

MODULE 07A

FOR B1 CERTIFICATION

MAINTENANCE PRACTICES

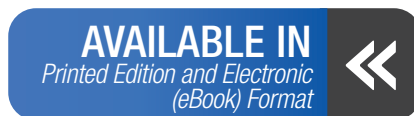
Aviation Maintenance Technician Certification Series



72413 U.S. Hwy 40
Tabernash, CO 80478-0270 USA

www.actechbooks.com

+1 970 726-5111



AVIATION MAINTENANCE TECHNICIAN CERTIFICATION SERIES

Contributor Tom Forenz
Layout/Design Michael Amrine

Version 003.1 - Effective Date 10.01.2021

Copyright © 2016, 2021 — Aircraft Technical Book Company. All Rights Reserved.

No part of this publication may be reproduced, stored in a retrieval system, transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of the publisher.

To order books or for Customer Service, please call +1 970 726-5111.

www.actechbooks.com

Printed in the United States of America



For comments or suggestions about this book, please call or write to:
1.970.726.5111 | comments@actechbooks.com

WELCOME

The publishers of this Aviation Maintenance Technician Certification Series welcome you to the world of aviation maintenance. As you move towards EASA certification, you are required to gain suitable knowledge and experience in your chosen area. Qualification on basic subjects for each aircraft maintenance license category or subcategory is accomplished in accordance with the following matrix. Where applicable, subjects are indicated by an "X" in the column below the license heading.

For other educational tools created to prepare candidates for licensure, contact Aircraft Technical Book Company.

We wish you good luck and success in your studies and in your aviation career!

REVISION LOG

VERSION	EFFECTIVE DATE	DESCRIPTION OF CHANGE
001	2016 01	Module Creation and Release
002	2016 08	Module Revisions
003	2019 10	Refined content sequencing to Appendix 1.
003.1	2021 10	Corrected description of file types (Sub-Module 07, Pages 3.15-3.16)

Version 003 - The following content was added for clarity:

Sub-Module 01	International Fire Classification
Sub-Module 02	Tool Care
Sub-Module 06	Accuracy of Drilled Holes; Formula for Determining Bow
Sub-Module 08	Cleco Fasteners
Sub-Module 11	Types of Lubricants
Sub-Module 13	Bowden Cables
Sub-Module 14	Composite Bonding; Ultrasonic Inspection
Sub-Module 16	Example Mass And Balance Computations
Sub-Module 17	Storage Methods
Sub-Module 18	Rewrite of Non-destructive Testing Methods
Sub-Module 19	Heavy Landing Inspection Checklist

MAINTENANCE PRACTICES

Welcome	iii
Revision Log.....	iii
Forward.....	iv
EASA License Category Chart	v
General Knowledge Requirements	v
Contents	ix

SUB-MODULE 01

SAFETY PRECAUTIONS - AIRCRAFT AND WORKSHOP

Knowledge Requirements	1.1
7.1 - Safety Precautions - Aircraft And Workshop	1.2
Safety Around Electricity	1.2
Fire Safety Around Electricity	1.2
Safety Around Compressed Gases	1.2
Oxygen Safety Considerations	1.3
Safety Around Hazardous Materials Such As Oils And Chemicals	1.4
Safety Around Machine Tools	1.5
Fire Safety	1.6
Requirements For A Fire To Occur	1.6
Classification Of Fires	1.6
European Standards	1.7
Fire Extinguishers	1.8
Identifying Fire Extinguishers	1.10
Inspection Of Fire Extinguishers.....	1.11
Using Fire Extinguishers	1.11
Flight Line Safety	1.11
Hearing Protection	1.11
Foreign Object Damage (FOD)	1.11
Safety Around Airplanes	1.12
Safety Around Helicopters	1.12
Questions	1.13
Answers	1.14

SUB-MODULE 02

WORKSHOP PRACTICES

Knowledge Requirements	2.1
7.2 - Workshop Practices	2.2
Care And Control Of Tools And Materials	2.2
Care Of Tools	2.2
Benches.....	2.2
Vices	2.2
Drilling Machines	2.2
Grinder.....	2.2
Motor Drives	2.3

Measuring Instruments	2.3
Drills And Reamers	2.3
Control Of Tools.....	2.3
Tool Control Procedures	2.3
Workshop Materials	2.4
Dimensions, Allowances, And Tolerances	2.5
Standards Of Workmanship	2.5
Tool Calibration.....	2.6
Questions	2.7
Answers	2.8

SUB-MODULE 03

TOOLS

Knowledge Requirements	3.1
7.3 - Tools	3.2
Common Hand Tools	3.2
Screwdrivers	3.2
Pliers And Plier-Type Cutting Tools	3.3
Clamps And Vises.....	3.4
C-Clamps.....	3.4
Vises	3.4
Hammers And Mallets.....	3.4
Punches	3.5
Wrenches.....	3.6
Open-End Wrenches	3.6
Box-End Wrenches	3.6
Socket Wrenches	3.7
Adjustable Wrenches	3.7
Special Wrenches	3.8
Strap Wrenches	3.8
Impact Wrenches	3.9
Torque Wrenches	3.9
Torque Tables	3.10
Cutting Tools.....	3.11
Hand Snips	3.12
Metal Shears.....	3.12
Hacksaws	3.12
Chisels	3.13
Files	3.14
Files And rasps are cataloged in three ways:.....	3.15
Care Of Files	3.17
Burring Tools	3.17
Reamers	3.17
Taps And Dies	3.18
Hand Power Tools	3.20
Saws.....	3.20
Circular-Cutting Saws.....	3.20

CONTENTS

Kett Saw	3.20	Two Hole Drill Motors	3.34
Pneumatic Circular-Cutting Saw	3.20	Drill Extension And Adapters	3.34
Reciprocating Saw	3.20	Extension Drill Bits	3.34
Die Grinders	3.21	Angle Adapters	3.35
Cut-Off Wheels	3.21	Snake Attachment	3.35
Nibblers	3.21	Drill Press	3.35
Table Top, And Bench Tools.....	3.22	Types Of Drill Bits	3.36
Notchers	3.22	Twist Drill Bits.....	3.36
Band Saws	3.22	Step Drill Bits	3.36
Throatless Shears.....	3.22	Twist Drill Construction And Sizes	3.36
Scroll Shears	3.22	Drill Bit Sizes.....	3.38
Rotary Punch Press.....	3.23	Hole Drilling Techniques.....	3.38
Foot Operated Shear.....	3.23	Drilling Large Holes	3.39
Squaring Shear	3.23	Drill Lubrication	3.42
Sanders	3.24	Drill Accessories	3.42
Disk Sander	3.24	Drill Stops	3.42
Belt Sander	3.24	Drill Bushings	3.42
Grinders	3.24	Drill Bushing Holder.....	3.42
Grinding Wheels	3.25	Precision Measuring Tools	3.43
Bending And Forming Tools	3.25	Rules	3.43
Bar Folding Machine	3.26	Combination Sets	3.43
Cornice Brake	3.26	Scriber	3.44
Box And Pan Brake	3.27	Dividers And Pencil Compasses	3.44
Press Brake	3.27	Calipers	3.45
Slip Roll Former	3.28	Micrometer Calipers	3.45
Rotary Machine	3.29	Micrometer Parts	3.46
Shrinking, Stretching Tools And Procedures	3.29	Reading A Micrometer	3.46
Shrinking Tools	3.29	Vernier Scale.....	3.47
Stretching Tools	3.30	Using A Micrometer	3.48
Stretch Forming	3.30	Dial Indicator.....	3.48
Drop Hammer	3.30	Slide Calipers	3.48
Hydropress Forming	3.30	Lubrication Equipment	3.48
Spin Forming	3.31	Electrical Test Equipment.....	3.50
Forming With An English Wheel	3.31	DC Measuring Equipment.....	3.50
Piccolo Former	3.31	D'Arsonval Meter Movement.....	3.50
Manual Sheet Metal Shrinker	3.32	Dampening.....	3.51
Hand-Operated Shrinker And Stretcher	3.32	Basic Multirange Ammeter	3.51
Dollies And Stakes.....	3.32	Precautions	3.52
Hardwood Form Blocks.....	3.32	The Voltmeter	3.52
V-Blocks	3.32	Voltmeter Sensitivity	3.53
Shrinking Blocks	3.33	MultiRange Voltmeters	3.53
Sandbags.....	3.33	Voltmeter Circuit Connections	3.53
Sheet Metal Hammers And Mallets	3.33	Influence Of the Voltmeter in the Circuit	3.53
Drilling	3.33	The Ohmmeter	3.53
Portable Power Drills	3.34	Zero Adjustment	3.53
Pneumatic Drill Motors.....	3.34	Ohmmeter Scale.....	3.53
Angled Drill Motors	3.34	Multirange Ohmmeter.....	3.55

Megger (Megohmmeter)	3.55
AC Measuring Equipment	3.56
Electrodynamometer Meter Movement	3.57
Moving Iron Vane Meter	3.57
Inclined Coil Iron Vane Meter	3.58
Varmeters	3.58
Wattmeter	3.58
Frequency Measuring Oscilloscope	3.59
Horizontal Deflection	3.60
Vertical Deflection	3.61
Tracing a Sine Wave	3.61
Control Features on an Oscilloscope.....	3.61
Flat Panel Color Displays For Oscilloscopes	3.62
Digital Multimeter	3.62
Basic Circuit Analysis And Troubleshooting.....	3.63
Voltage Measurement.....	3.63
Current Measurement	3.64
Checking Resistance In A Circuit.....	3.64
Continuity Checks	3.65
Capacitance Measurement	3.65
Inductance Measurement.....	3.66
Troubleshooting The Open Faults In Series	
Circuits.....	3.66
Troubleshooting The Shorting Faults In Series	
Circuits.....	3.67
Troubleshooting The Open Faults In Parallel	
Circuits.....	3.68
Troubleshooting The Shorting Faults In	
Parallel Circuits	3.69
Troubleshooting The Shorting Faults In	
Series-Parallel Circuits.....	3.70
Tracing Opens With The Voltmeter	3.70
Questions	3.73
Answers	3.74

SUB-MODULE 04

AVIONIC GENERAL TEST EQUIPMENT

Knowledge Requirements	4.1
7.4 - Avionic General Test Equipment	4.2
Built-In Test Equipment	4.2
Classification Of Avionics Test Equipment	4.3
Avionics Test Equipment	4.4
Oscilloscope	4.4
Time Domain Reflectometer (TDR)	4.4
Spread Spectrum Time Domain Refectometer	
(SSTDR)	4.4
Pitot-Static Test Equipment	4.4

Specialized Test Equipment	4.5
Automatic Test Equipment	4.5
VME/VXI	4.6
Data Bus Analyzers	4.6
SS Test Equipment Calibration Standards	4.6
Functional Checks	4.7
Questions	4.9
Answers	4.10

SUB-MODULE 05

ENGINEERING DRAWINGS, DIAGRAMS AND STANDARDS

Knowledge Requirements	5.1
7.5 - Engineering Drawings, Diagrams, And Standards	5.2
Purpose And Function Of Aircraft Drawings	5.2
Care And Use Of Drawings	5.2
Drawing And Diagram Types: Symbols, Dimensions,	
Tolerances And Projections	5.2
Drawing Types	5.2
Detail Drawings.....	5.2
Assembly Drawings	5.2
Installation Drawings	5.5
Sectional View Drawings.....	5.5
Universal Numbering System	5.5
Drawing Standards	5.5
Bill Of Material	5.5
Other Drawing Data	5.7
Revision Block	5.7
Notes.....	5.8
Zone Numbers	5.8
Station Numbers And Location Identification	
On Aircraft.....	5.8
Allowances And Tolerances.....	5.8
Finish Marks	5.10
Application	5.10
Methods Of Illustration	5.10
Applied Geometry	5.10
Orthographic Projection	5.10
Pictorial Drawings	5.11
Lines And Their Meanings.....	5.13
Centerlines	5.13
Dimension Lines	5.13
Extension Lines	5.15
Sectioning Lines.....	5.15
Phantom Lines	5.15
Break Lines	5.15
Leader Lines.....	5.15

CONTENTS

Hidden Lines	5.16
Outline Or Visible Lines	5.16
Stitch Lines	5.16
Cutting Plane And Viewing Plane Lines	5.16
Drawing Symbols	5.16
Material Symbols	5.16
Shape Symbols	5.16
Electrical Symbols	5.16
Reading And Interpreting Drawings	5.16
Drawing Sketches	5.19
Sketching Techniques	5.19
Basic Shapes	5.19
Repair Sketches	5.19
Care Of Drafting	5.20
Title Blocks	5.20
Drawing Or Print Numbers	5.20
Reference And Dash Numbers	5.20
Computer Graphics	5.20
Microfilm And Microfiche	5.21
Digital Images	5.21
Specification 100 Of the Air Transport Association (ATA)	5.22
ATA 100 And iSpec 2200	5.22
Aeronautical Standards	5.23
ISO	5.23
AN (Army/Navy)	5.24
MS (Military Standard)	5.24
NAS (National Aerospace Standard)	5.24
BS (British Standards)	5.24
Wiring And Schematic Diagrams	5.24
Diagrams	5.24
Installation Diagrams	5.24
Schematic Diagrams	5.24
Block Diagrams	5.25
Wiring Diagrams (Schematics)	5.25
Flowcharts	5.26
Troubleshooting Flowchart	5.26
Logic Flowchart	5.26
Graphs And Charts	5.28
Reading And Interpreting Graphs And Charts	5.28
Nomograms	5.28
Questions	5.31
Answers	5.32

SUB-MODULE 06 FITS AND CLEARANCES

Knowledge Requirements	6.1
7.6 - Fits And Clearances	6.2
Drill Sizes For Holes	6.2
Accuracy Of Drilled Holes	6.2
Classes Of Fit	6.2
Standards Of Fits And Clearances	6.3
Newall System	6.3
British Standards BS 4500 System	6.3
BS 4500 Definitions:	6.3
BS 4500 Basic Hole System	6.5
BS 4500 Basic Shaft System	6.5
Basic Hole Method - Metric	6.5
Dimensions, Allowances And Tolerances	6.6
Dimensions	6.6
Allowances	6.6
Tolerances	6.6
Schedule Of Fits And Clearances	6.7
Limits For Bow, Twist And Wear	6.7
Limits For Bow	6.7
Limits For Twist	6.8
Limits For Wear	6.8
Limits For Ovality	6.8
Methods For Checking Shafts, Bearings And Other Parts	6.8
Checking For Bow	6.8
Clearance Measured By Feeler Gauges	6.8
Checking For Twist	6.9
Piston Engine Connecting Rod Twist	6.9
Checking For Ovality	6.9
Questions	6.11
Answers	6.12

SUB-MODULE 07 ELECTRICAL WIRING INTERCONNECTION SYSTEM (EWIS)

Knowledge Requirements	7.1
7.7 - Electrical Wiring Interconnect System (EWIS) ..	7.2
Continuity, Insulation, Bonding, And Testing	7.2
Continuity	7.2
Insulation	7.2
Bonding And Grounding	7.3
Grounding	7.3
Bonding	7.4
Stripping And Crimping Tools; Hand And Hydraulic	7.5
Stripping Wire	7.5

Module 07A B1 - Maintenance Practices

 **AIRCRAFT**
TECHNICAL
BOOK COMPANY

xiii

CONTENTS

Method Of Double Flush Riveting	8.18
Questions	8.19
Answers	8.20

SUB-MODULE 09

PIPES AND HOSES

Knowledge Requirements	9.1
7.9 - Pipes And Hoses	9.2
Tubing Sizes	9.2
Fabrication, Bending And Flaring Of Metal	
Tube Lines	9.2
Tube Cutting	9.2
Tube Bending	9.3
Alternative Bending Methods	9.4
Tube Flaring	9.5
Rolling-Type Flaring Tools	9.5
Double Flaring	9.6
Beading	9.6
Inspection And Testing Of Pipes And Hoses	9.7
Rigid Tubing Inspection And Inspection	9.7
Flexible Hose Inspection	9.7
Flexible hose Size Designations	9.7
Fabrication And Replacement Of Flexible Hose	9.8
Flexible Hose Testing	9.8
Installation And Clamping Of Pipes	9.8
Rigid Tube Installation And Inspection	9.8
Connection And Torque	9.10
Flareless Tube Installation	9.10
Installation Of Flexible Hose Assemblies	9.12
Hose Clamps	9.12
Questions	9.15
Answers	9.16

SUB-MODULE 10

SPRINGS

Knowledge Requirements	10.1
7.10 - Springs	10.2
Inspection And Testing Of Springs	10.2
Corrosion	10.2
Overheating	10.2
Fatigue	10.2
Static Measurement	10.2
Load Deflection	10.2
Questions	10.5
Answers	10.6

SUB-MODULE 11

BEARINGS

Knowledge Requirements	11.1
7.11 - Bearings	11.2
Testing, Cleaning, And Inspection Of Bearings	11.2
Testing Bearings	11.2
Cleaning the Wheel Bearings	11.2
Wheel Bearing Inspection	11.2
Lubrication Requirement Of Bearing	11.4
Bearing Handling And Lubrication	11.4
Lubricants	11.4
Types Of Lubrication	11.5
Hydrodynamic Lubrication	11.5
Boundary Lubrication	11.5
Hydrostatic Lubrication	11.5
Solid Film	11.5
Storage	11.5
Defects in BEarings And Their Causes	11.5
Contamination And Corrosion	11.5
Electric Current Damage	11.6
Questions	11.7
Answers	11.8

SUB-MODULE 12

TRANSMISSIONS

Knowledge Requirements	12.1
7.12 - Transmissions	12.2
Inspection Of Gears, Backlash	12.2
Gears	12.2
Lash And Pattern	12.2
Inspection Of Belts And Pulleys, Chains And Sprockets	
12.3	
Belts And Pulleys	12.3
Chains And Sprockets	12.4
Inspection Of Jackscrews, Lever Devices, Push-pull	
Rod Systems	12.4
Jack Screws	12.4
Levers	12.4
Push-pull Rod Systems	12.5
Questions	12.7
Answers	12.8

SUB-MODULE 13

CONTROL CABLES

Knowledge Requirements	13.1
7.13 - Control Cables	13.2
Swaging Of End Fittings	13.2

Terminals	13.2
Splicing	13.3
Swaged Ball Terminals	13.3
Cable Slippage In Terminal	13.3
Nicopress® Swaged End Fittings	13.3
Inspection And Testing Of Cables	13.6
Manufacturer Wire Splices.....	13.8
Testing Cable Tension	13.8
Aircraft Flexible Control Systems.....	13.9
Bowden Cable Systems	13.9
Teleflex Cable Systems	13.9
Attachment Of Teleflex End Fittings	13.9
Questions	13.11
Answers	13.12

SUB-MODULE 14 MATERIAL HANDLING

Knowledge Requirements	14.1
7.14 - Material Handling	14.2
Sheet Metal.....	14.2
Marking Out And Calculations Of Bend Allowance	14.2
Terminologies	14.2
Layout Or Flat Pattern Development	14.3
Making Straight Line Bends	14.3
Bending A U-Channel	14.4
Using A Formula To Calculate The Setback..	14.5
Using A Setback Chart To Find The Setback	14.6
Formula 1: Bend Allowance For A 90° Bend	14.7
Formula 2: Bend Allowance For A 90° Bend	14.8
Using A Bend Allowance Chart For A 90° Bend	14.8
Using A Chart For Other Than A 90° Bend..	14.8
Using A J-Chart To Calculate Total Developed	
Width	14.10
How To Find The Total Developed Width	
Using A J-Chart.....	14.11
Sheet Metal Working (Bending And Forming).....	14.12
Sheet Metal Forming Process.....	14.12
Forming Operations And Terms	14.13
Stretching	14.13
Shrinking	14.13
Bumping.....	14.14
Crimping	14.14
Folding Sheet Metal.....	14.14
Using A Sheet Metal Brake To Fold Metal	14.14
Folding A Box.....	14.16
Relief Hole Location	14.17
Layout Method	14.18

Open And Closed Bends	14.18
Open End Bend (Less Than 90°).....	14.18
Closed End Bend (More Than 90°).....	14.19
Hand Forming	14.19
Straight Line Bends	14.19
Formed Or Extruded Angles.....	14.20
Stretching With V-Blocks	14.20
Shrinking With The V-Blocks And Shrinking	
Blocks	14.20
Flanged Angles	14.21
Curved Flanged Parts	14.22
Forming By Bumping	14.24
Form Blocks Or Dies	14.25
Sandbag Bumping	14.25
Joggling	14.26
Lightening Holes	14.27
Flanging Lightening Holes	14.28
Working Stainless Steel	14.28
Inconel® Alloys 625 And 718.....	14.28
Working Magnesium	14.29
Working Titanium	14.30
Description Of Titanium.....	14.30
Inspection Of Sheet Metal Work	14.32
Inspection Of Riveted Joints	14.32
Inspection For Corrosion	14.33
Composite And Non-Metallic.....	14.33
Bonding Practices	14.33
Bonding Methods	14.34
Thermoplastic Adhesives	14.34
Thermosetting Adhesives.....	14.34
Environmental Conditions	14.34
Inspection Methods.....	14.35
Visual Inspection.....	14.35
Tap Testing	14.35
Ultrasonic Inspection	14.35
Electrical Conductivity.....	14.36
Questions	14.37
Answers	14.38

SUB-MODULE 15 WELDING, BRAZING, SOLDERING AND BONDING

Knowledge Requirements	15.1
7.15 - Welding, Brazing, Soldering And Bonding	15.2
Soldering Methods; Inspection Of Soldered Joints	15.2
Soldering	15.2
Aluminum Soldering	15.2

CONTENTS

Silver Soldering	15.2	Techniques Of Position Welding	15.28
Inspection Of Soldered And Brazed Joints	15.3	Flat Position Welding	15.28
Welding And Brazing Methods	15.3	Vertical Position Welding	15.29
Types Of Welding.....	15.3	Overhead Position Welding.....	15.29
Gas Welding.....	15.3	Expansion And Contraction Of Metals.....	15.30
Electric Resistance Welding	15.7	Welded Joints Using Oxy-Acetylene Torch	15.31
Plasma Arc Welding	15.7	Butt Joints.....	15.31
Gas Welding And Cutting Equipment	15.9	Tee Joints	15.31
Welding Gases	15.9	Edge Joints	15.31
Pressure Regulators	15.9	Corner Joints	15.32
Welding Hose	15.10	Lap Joints	15.32
Check Valves And Flashback Arrestors	15.10	Repair Of Steel Tubing Structure By Welding ..	15.32
Torches	15.10	Dents At A Cluster Weld	15.32
Torch Tips	15.11	Dents Between Clusters.....	15.32
Welding Eyewear	15.11	Tube Splicing With Inside Sleeve	
Torch Lighters	15.12	Reinforcement	15.33
Filler Rod	15.12	Tube Splicing With Outer Split Sleeve	
Equipment setup.....	15.12	Reinforcement	15.34
Gas Cylinders.....	15.12	Landing Gear Repairs	15.35
Regulators.....	15.12	Engine Mount Repair	15.36
Hoses	15.12	Rosette Welding.....	15.36
Torch Connection	15.13	Brazing	15.37
Tip Size Selection	15.13	Torch Brazing Of Steel	15.37
Regulator Working Pressure Adjustment	15.13	Torch Brazing Of Aluminum	15.38
Lighting And Adjusting The Torch.....	15.14	Inspection Of Welded Joints	15.38
Flame Types	15.14	Bonding Methods And Inspection Of Bonded Joints	15.39
Torch Handling	15.15	Inspection Of Bonded Joints	15.40
Oxy-acetylene Cutting.....	15.16	Questions	15.41
Shutting Down The Gas Welding Equipment	15.16	Answers	15.42
Gas Welding Procedures	15.17		
Puddle.....	15.17		
Correct Forming Of A Weld.....	15.17		
Oxy-Acetylene Welding Of Ferrous Metals	15.18		
Steel (Including SAE 4130).....	15.18		
Chrome Molybdenum	15.19		
Stainless Steel.....	15.19		
Oxy-Acetylene Welding Of Non-Ferrous Metals	15.19		
Aluminum Welding.....	15.20		
Magnesium Welding	15.21		
Gas Metal Arc Welding (TIG)	15.22		
TIG Welding 4130 Steel Tubing.....	15.22		
TIG Welding Stainless Steel.....	15.23		
TIG Welding Aluminum	15.24		
TIG Welding Magnesium.....	15.24		
TIG Welding Titanium.....	15.24		
Arc Welding Procedures.....	15.25		
Multiple Pass Welding.....	15.27		

SUB-MODULE 16

AIRCRAFT WEIGHT AND BALANCE

Knowledge Requirements	16.1
7.16 - Aircraft Weight And Balance	16.2
Center Of Gravity/Balance Limits Calculations	
And Relevant Documents	16.2
Aircraft Weight And Balance.....	16.2
Need And Requirements For Aircraft Weighing	16.2
Weight And Balance Terminology.....	16.3
Datum	16.3
Arm	16.3
Moment	16.4
Center Of Gravity	16.4
Maximum Weight	16.4
Empty Weight	16.5
Empty Weight Center Of Gravity.....	16.5
Useful Load	16.5

Minimum Fuel.....	16.6	Jacking the Aircraft	16.28
Tare Weight	16.6	Leveling the Aircraft	16.29
Standard Weights Used For Aircraft Weight And Balance	16.6	Safety Considerations	16.29
Procedures For DEtermining Weight And Balance	16.6	Built-In Electronic Weighing.....	16.29
Weight And Balance Data	16.8	Helicopter Weighing	16.29
Center Of Gravity Range	16.9	Questions	16.33
Empty Weight Center Of Gravity Range	16.9	Answers	16.34
Operating Center Of Gravity Range	16.11		
Example Weight And Balance Computations	16.11	SUB-MODULE 17	
EWCG Formulas.....	16.12	AIRCRAFT HANDLING AND STORAGE	
Datum Forward Of The Airplane–Nosewheel		Knowledge Requirements	17.1
Landing Gear.....	16.13	7.17 - Aircraft Handling And Storage.....	17.2
Datum Aft Of The Main Wheels–Nosewheel		Aircraft Taxiing And Towing.....	17.2
Landing Gear.....	16.13	Engine Starting And Operation.....	17.2
Location Of Datum	16.14	Reciprocating Engines	17.2
Datum Forward Of The Main Wheels–Tail		Hand Cranking Engines	17.3
Wheel Landing Gear.....	16.14	Turboprop Engines	17.4
Datum Aft Of The Main Wheels–Tail Wheel		Turbofan Engines.....	17.6
Landing Gear.....	16.14	Auxiliary Power Units (APUs)	17.8
Loading An Airplane For Flight	16.15	Unsatisfactory Turbine Engine Starts	17.8
Example Loading Of An Airplane For Flight	16.15	Extinguishing Engine Fires.....	17.8
Adverse-Loaded CG Checks.....	16.15	Taxiing Aircraft	17.9
Weight And Balance Extreme Conditions	16.16	Taxi Signals	17.9
Equipment Change And Aircraft Alteration.....	16.16	Towing Aircraft	17.11
Example Calculations After An Equipment		Aircraft Jacking, Chocking And Securing	17.13
Change	16.17	Aircraft Jacking.....	17.13
The Use Of Ballast	16.17	Tiedown, Chocking And Securing	17.14
Loading Graphs And CG Envelopes.....	16.19	Securing Light Aircraft	17.14
Large Airplanes – Mean Aerodynamic Chord ..	16.21	Securing Heavy Aircraft	17.15
Helicopter Weight And Balance	16.23	Tiedown Procedures For Seaplanes.....	17.16
Weight And Balance Records.....	16.23	Tiedown Procedures For Skiplanes	17.16
Preparation Of Aircraft For Weighing	16.24	Tiedown Procedures For Helicopters	17.16
Weight And Balance Equipment	16.24	Aircraft Storage Methods	17.17
Scales	16.24	Hangars.....	17.17
Spirit Level.....	16.25	Fire Precautions	17.17
Plumb Bob	16.26	Storage Processes	17.18
Hydrometer	16.26	Phase 1 – Preparation	17.18
Preparing An Aircraft For Weighing.....	16.26	Phase 2 – Routine Servicing	17.18
Fuel System	16.27	Phase 3 – Repreparation In Storage	17.18
Oil System	16.27	Phase 4 – Return To Service	17.18
Miscellaneous Fluids	16.27	Fuel Servicing Of Aircraft	17.18
Flight Controls.....	16.27	Fuel Types And Identification	17.18
Other Considerations.....	16.27	Contamination Control	17.19
Weighing Points.....	16.28	Fueling Hazards	17.19
Weight And Balance For Large Airplanes.....	16.28	Grounding And Bonding	17.19
Weighing An Aircraft	16.28	Fueling Procedures	17.20
		Over The Wing Refueling	17.20

CONTENTS

Pressure Refueling	17.20
Defueling	17.21
Ground De-icing And Anti-Icing Of Aircraft.....	17.22
De-icing And Anti-icing Of Transport Aircraft	17.22
Deicing Fluid	17.22
Holdover Time (HOT)	17.22
Critical Surfaces	17.22
Frost Removal	17.24
Ice And Snow Removal	17.24
Ground Power Supplies; Electric, Hydraulic And Pneumatic	17.24
Electric Ground Power Units	17.24
Hydraulic Ground Power Units	17.25
Ground Support Air Units	17.26
Ground Air Heating And Air Conditioning.....	17.26
Oxygen Servicing Equipment	17.26
Oxygen Hazards	17.26
Air/Nitrogen, Oil, And Fluid Servicing	17.27
Effect Of Environmental Conditions on Aircraft Handling And Operation	17.27
Questions	17.29
Answers	17.30

SUB-MODULE 18

DISASSEMBLY, INSPECTION, REPAIR AND ASSEMBLY TECHNIQUES

Knowledge Requirements	18.1
7.18 - Disassembly, Inspection, Repair And Assembly Techniques	18.2
Types Of Defects And Visual Inspection; Corrosion Removal, Assesment, And Reprotection	18.2
Basic Inspection Techniques And Practices	18.2
Preparation	18.2
Aircraft Logs.....	18.3
Checklists	18.3
Publications	18.4
Manufacturers' Service Bulletins/Instructions	18.4
Maintenance Manuals	18.5
Visual Inspection Techniques	18.5
Types Of Defects	18.5
External Damage	18.6
Inlets And Exhausts.....	18.6
Liquid Systems	18.6
Gaseous Systems	18.6
Landing Gear.....	18.7
System Indicators And Gauges	18.7
Probes	18.7

Handles, Latches, Panels And Doors	18.7
Other Inspection Items	18.8
Life Limited Items	18.8
Corrosion Removal, Assessment And Reprotection	18.8
Preventive Maintenance	18.8
Corrosion Removal	18.9
Surface Cleaning And Paint Removal.....	18.9
Corrosion Of Ferrous Metals	18.10
Mechanical Removal Of Iron Rust	18.10
Chemical Removal Of Rust.....	18.11
Chemical Surface Treatment Of Steel.....	18.11
Removal Of Corrosion From Highly Stressed Steel Parts.....	18.11
Corrosion Of Aluminum And Aluminum Alloys	18.11
Treatment Of Unpainted Aluminum Surfaces	18.12
Treatment Of Anodized Surfaces	18.12
Treatment Of Intergranular Corrosion In Heat-Treated Aluminum Alloy Surfaces.....	18.13
Corrosion Of Magnesium Alloys	18.13
Treatment Of Wrought Magnesium Sheet And Forgings	18.13
Treatment Of Installed Magnesium Castings	18.14
Corrosion Of Titanium And Titanium Alloys ..	18.14
Protection Of Dissimilar Metal Contacts	18.14
Contacts Not Involving Magnesium	18.14
Contacts Involving Magnesium.....	18.14
Corrosion Limits.....	18.15
Processes And Materials Used In Corrosion Control Metal Finishing.....	18.15
Surface Preparation.....	18.15
Chemical Treatments	18.16
Anodizing.....	18.16
Alodizing	18.16
Chemical Surface Treatment And Inhibitors	18.16
Protective Paint Finishes	18.17
General Repair Methods, Structural Repair Manual; Aging; Fatigue And Corrosion Control Programs	18.17
General Repair Methods.....	18.17
Inspection	18.17
Classification Of Damage.....	18.18
Negligible Damage	18.18
Damage Repairable By Patching	18.19
Damage Repairable By Insertion.....	18.19
Damage Necessitating Replacement Of Parts	18.19
Repairability Of Sheet Metal Structure.....	18.19
Structural Support During Repair	18.19
Assessment Of Damage	18.20

Maintaining Original Strength	18.20	Ultrasonic Inspection.....	18.47
Shear Strength And Bearing Strength	18.22	Pulse Echo	18.49
Maintaining Original Contour	18.22	Through Transmission	18.51
Keeping Weight To A Minimum.....	18.22	Resonance	18.51
Flutter And Vibration Precautions	18.23	Ultrasonic Instruments	18.52
Damage Removal	18.23	Reference Standards	18.53
Repair Material Selection.....	18.23	Couplants	18.53
Repair Parts Layout	18.23	Inspection Of Bonded Structures	18.53
Rivet Selection	18.23	Types Of Defects	18.53
Rivet Spacing And Edge Distance.....	18.23	Acoustic Emission Inspection	18.53
Corrosion Treatment.....	18.23	Magnetic Particle Inspection	18.53
Sheet Metal Repair Methods	18.23	Development Of Indications	18.54
Repair Of Stressed Skin Structure.....	18.23	Types Of Discontinuities Disclosed	18.54
Patches	18.24	Preparation Of Parts For Testing	18.54
Open And Closed Skin Area Repair.....	18.24	Effects Of Flux Direction	18.55
Design Of A Patch For A Non-Pressurized		Effects Of Flux Density.....	18.56
Area	18.25	Magnetizing Methods	18.56
Typical Repairs For Aircraft Structures.....	18.26	Identification Of Indications	18.56
Floats	18.26	Magnaglo Inspection	18.57
Corrugated Skin Repair.....	18.26	Magnetizing Equipment	18.57
Replacement Of a Panel.....	18.26	Indicating Mediums.....	18.59
Repair Of Lightening Holes	18.28	Demagnetizing.....	18.59
Repairs To A Pressurized Area	18.28	Radiographic	18.60
Stringer Repair.....	18.30	Radiographic Inspection.....	18.60
Former Or Bulkhead Repair	18.31	Preparation And Exposure	18.60
Longeron Repair	18.33	Radiation Hazards	18.60
Spar Repair.....	18.33	inspection Of Composites	18.61
Rib And Web Repair	18.33	Tap Testing	18.61
Leading Edge Repair.....	18.35	Electrical Conductivity.....	18.61
Trailing Edge Repair	18.36	Thermography	18.61
Specialized Repairs	18.36	Disassembly And Re-Assembly Techniques	18.62
Inspection Openings	18.36	Replacement Of Major Components And	
Aging, Fatigue, And Corrosion Control Programs	18.36	Modules.....	18.63
Non-destructive Inspection Techniques	18.42	Disassembly And Re-assembly Of	
Advantages And Disadvantages Of NDI Methods	18.42	Major Components.....	18.63
Visual Inspection	18.42	Disassembly And Re-assembly Of	
Surface Cracks	18.42	Minor Components	18.63
Borescope.....	18.42	Basic Disassembly And Re-assembly Techniques ..	18.63
Liquid Penetrant Inspection	18.42	Discarding Of Parts	18.64
Surface Drying	18.44	Freeing Seized Components.....	18.64
Interpretation Of Penetrant Results.....	18.44	Assembly	18.64
False Indications	18.44	Trouble Shooting Techniques	18.65
Penetrant Precautions	18.45	Questions	18.67
Eddy Current Inspection.....	18.45	Answers	18.68
Basic Principles	18.45		
Principles Of Operations	18.46		
Eddy Current Instruments	18.47		

CONTENTS

SUB-MODULE 19

ABNORMAL EVENTS

Knowledge Requirements	19.1
7.19 - Abnormal Events	19.2
Special Inspections	19.2
Electrical Related Damage	19.2
Lightning Strikes	19.2
High Intensity Radiated Fields (HIRF) Penetration	19.3
Specific Testing - HIRF	19.4
Structural Related Damage	19.4
Hard Or Overweight Landings	19.4
Post Heavy Landing Inspection	19.4
Severe Turbulence Inspection	19.5
Other Types Of Damage	19.5
Fire Damage	19.5
Flood Damage	19.6
Seaplanes	19.6
Aerial Application Aircraft	19.6
Questions	19.7
Answers	19.8

SUB-MODULE 20

MAINTENANCE PROCEDURES

Knowledge Requirements	20.1
7.20 - Maintenance Procedures	20.2
Maintenance Planning	20.2
Modification Procedures	20.3
Stores Procedures	20.4
Certification And Release Procedures	20.6
Interface with Aircraft Operation	20.7
Maintenance Inspection; Quality Control And Assurance	20.7
Additional Maintenance Procedures	20.8
Control Of Life Limited Components	20.9
Questions	20.11
Answers	20.12
Acronym Index	A.1
Index	I.1

FIRE EXTINGUISHERS

Water extinguishers are the best type to use on Class A fires. Water has two effects on fire: it deprives fire of oxygen and cools the material being burned.

Since most petroleum products float on water, water-type fire extinguishers are not recommended for Class B fires.

Extreme caution must be used when fighting electrical fires with water-type extinguishers. Not only must all electrical power be removed or shut off to the burning area, but residual electricity in capacitors, coils, and so forth must be considered to prevent severe injury and possibly death from electrical shock.

Never use water-type fire extinguishers on Class D fires. Because metals burn at extremely high temperatures, the cooling effect of water causes an explosive expansion of the metal. Water fire extinguishers are operated in a variety of ways. Some are hand pumped, while some are pressurized.

The pressurized types of extinguishers may have a gas charge stored in the container with the water, or it may contain a "soda-acid" container where acid is spilled into a container of soda inside the extinguisher. The chemical reaction of the soda and the acid causes pressure to build inside the fire extinguisher, forcing the water out.

Carbon dioxide (CO₂) extinguishers are used for Class A, B, C electrical fires, by extinguishing the fire by depriving it of oxygen. (*Figure 1-5*) Additionally, like water-type extinguishers, CO₂ cools the burning material.



Figure 1-5. Carbon dioxide fire extinguisher.

Never use CO₂ on Class D fires. As with water extinguishers, the cooling effect of CO₂ on the hot metal can cause explosive expansion of the metal.

When using CO₂ fire extinguishers, all parts of the extinguisher can become extremely cold, and remain so for a short time after operation. Wear protective equipment or take other precautions to prevent cold injury (such as frostbite) from occurring.

Extreme caution must be used when operating CO₂ fire extinguishers in closed or confined areas. Not only can the fire be deprived of oxygen, but so too can the operator.

CO₂ fire extinguishers generally use the self-expelling method of operation. This means that the CO₂ has sufficient pressure at normal operating pressure to expel itself. This pressure is held inside the container by some type of seal or frangible disk, which is broken or punctured by a firing mechanism, usually a pin. This means that once the seal or disk is broken, pressure in the container is released, and the fire extinguisher is spent, requiring replacement. (*Figure 1-6*)

Halogenated hydrocarbon extinguishers are most effective on Class B and C electrical fires. They can be used on Class A and D fires but they are less effective. Halogenated hydrocarbon, (commonly called Freon™ by the industry), are numbered according to chemical formulas with Halon™ numbers.

Carbon tetrachloride (Halon 104), chemical formula CCl₄, has a toxicity rating of 3. As such, it is extremely toxic. (*Figure 1-7*)

Hydrochloric acid vapor, chlorine and phosgene gas are produced whenever carbon tetrachloride is used on ordinary fires. The amount of phosgene gas is increased whenever carbon tetrachloride is brought in direct contact with hot metal, certain chemicals, or continuing electrical arcs. It is not approved for any fire extinguishing use. Old containers of Halon 104 found in or around shops or hangars should be disposed of in accordance with regulations and local laws and ordinances.

Extinguishing Materials	Class of Fire				Self-Generating	Self-Expelling	Cartridge of N ₂ Cylinder	Stored Pressure
	Combustibles	Liquids/Gas	Electrical	Metals				
Water and Anti-Freeze	X						X	X
Soda-Acid (water)	X				X			
Wetting Agent	X						X	
Foam	X	X			X			
Loaded Stream	X	X+					X	X
Multipurpose Dry Chemical	X+	X	X				X	X
Carbon Dioxide		X+	X			X		
Dry Chemical		X	X				X	X
Bromotrifluoromethane—Halon 1301		X	X			X		
Bromochlorodifluoromethane—Halon 1211		X	X					X
Dry Powder (Metal Fires)				X			X	

+ Smaller sizes of these extinguishers are not recognized for use on these classes of fires.

Figure 1-6. Extinguisher operation and methods of expelling.

Group	Definition	Examples
6 (Least toxic)	Gases or vapors which in concentrations up to 20% by volume for durations of exposure of up to approximately 2 hours do not appear to produce injury.	Bromotrifluoromethane (Halon 1301)
5a	Gases or vapors much less toxic than Group 4 but more toxic than Group 6.	Carbon Dioxide
4	Gases or vapors which in concentrations of the order of 2 to 2½% for durations of exposure of up to approximately 2 hours are lethal or produce serious injury.	Dibromodifluoromethane (Halon 1202)
3	Gases or vapors which in concentrations of the order of 2 to 2½% for durations of exposure of the order of 1 hour are lethal or produce serious injury.	Bromochloromethane (Halon 1011) Carbon Tetrachloride (Halon 104)
2	Gases or vapors which in concentrations of approximately ½ to 1% for durations of exposure of up to approximately ½ hour are lethal or produce serious injury.	Methyl Bromide (Halon 1001)

Figure 1-7. Toxicity table.

Methyl bromide (Halon 1001), chemical formula CH₃Br, is a liquefied gas with a UL toxicity rating of 2. This chemical is very toxic, it is corrosive to aluminum alloys, magnesium, and zinc. Halon 1001 is not recommended for aircraft use.

Chlorobromomethane (Halon 1011), chemical formula CH₂ClBr, is a liquefied gas with a UL toxicity rating of 3. Like methyl bromide, Halon 1011 is not recommended for aircraft use. Dibromodifluoromethane (Halon 1202), chemical formula CBr₂F₂, has a UL toxicity rating of 4. Halon 1202 is not recommended for aircraft use.

Bromochlorodifluoromethane (Halon 1211), chemical formula CBrClF_2 , is a liquefied gas with a UL toxicity rating of 5. It is colorless, noncorrosive and evaporates rapidly, leaving no residue. It does not freeze or cause cold burns, and will not harm fabrics, metals or other materials it contacts. It acts rapidly on fires by producing a heavy blanketing mist that eliminates oxygen from the fire source. But more importantly, it interferes chemically with the combustion process of the fire. It has outstanding properties in preventing reflash after the fire has been extinguished.

Bromotrifluoromethane (Halon 1301), chemical formula CF_3Br , is also a liquefied gas with a UL toxicity rating of 6. It has all the characteristics of Halon 1211. A significant difference between the two is that Halon 1211 forms a spray similar to CO_2 , while Halon 1301 has a vapor spray that is more difficult to direct.

Note: Environmental Agencies have restricted Halon to its 1986 production level due to its effect on the ozone layer. Dry powder extinguishers, while effective on Class B, C electrical fires, are the best for use on Class D fires.

The method of operation of dry powder fire extinguishers varies from gas cartridge charges, or stored pressure within the container which forces the powder charge out of the container, to tossing the powder on the fire by hand, by scooping pails or buckets of the powder from large containers or barrels.

Dry powder is not recommended for aircraft use (except on metal fires as a fire extinguisher) because the leftover chemical residues and dust often make cleanup difficult, and can damage electronic or other delicate equipment.

IDENTIFYING FIRE EXTINGUISHERS

Fire extinguishers should be marked to indicate suitability for a particular class of fire. The markings on **Figure 1-8** should be placed on the fire extinguisher and in a conspicuous place in the vicinity of the fire extinguisher. When the location is marked, however extreme care must be taken to ensure that the fire extinguisher kept at that location is in fact the type depicted by the marking. In other words, if a location is marked for a Class B fire extinguisher, ensure that the fire extinguisher in that location is in fact suitable for Class B fires. Markings should be applied by

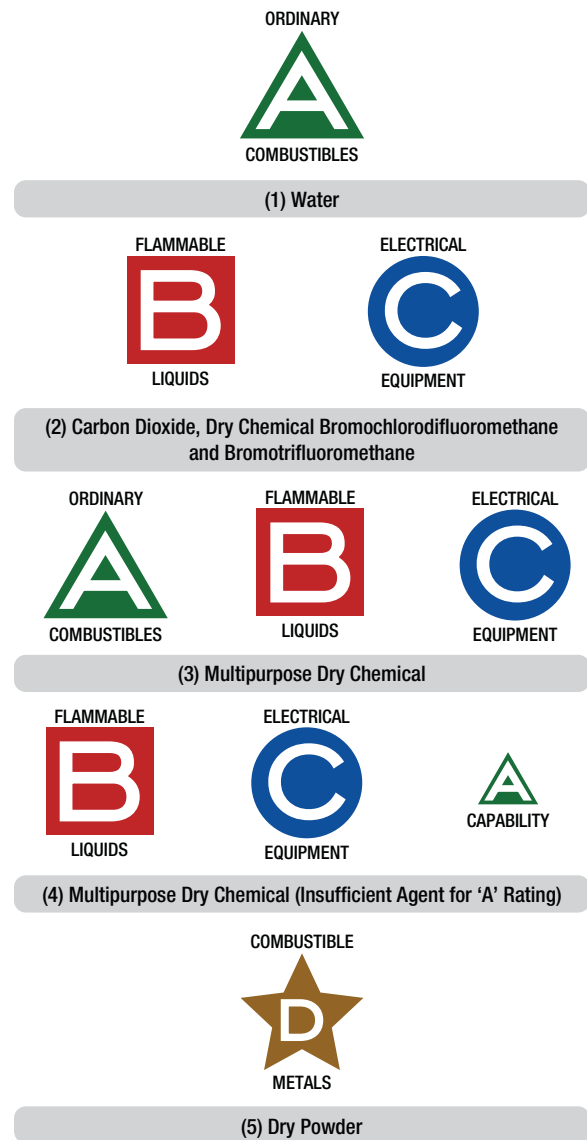


Figure 1-8. Typical extinguisher markings.

decalcomanias (decals), painting, or similar methods. They should be legible and as durable as necessary for the location. For example, markings used outside need to be more durable than those in the hangar or office spaces.

Where markings are applied to the extinguisher, they should be located on the front of the shell (if one is installed) above or below the extinguisher nameplate. Markings should be large enough and in a form that is easily seen and identifiable by the average person with average eyesight at a distance of at least 3 feet.

Where markings are applied to wall panels, and so forth, in the vicinity of extinguishers, they should be large enough and in a form that is easily seen and identifiable by the average person with average eyesight, at a distance of at least 25 feet. (**Figure 1-9** and **Figure 1-10**)

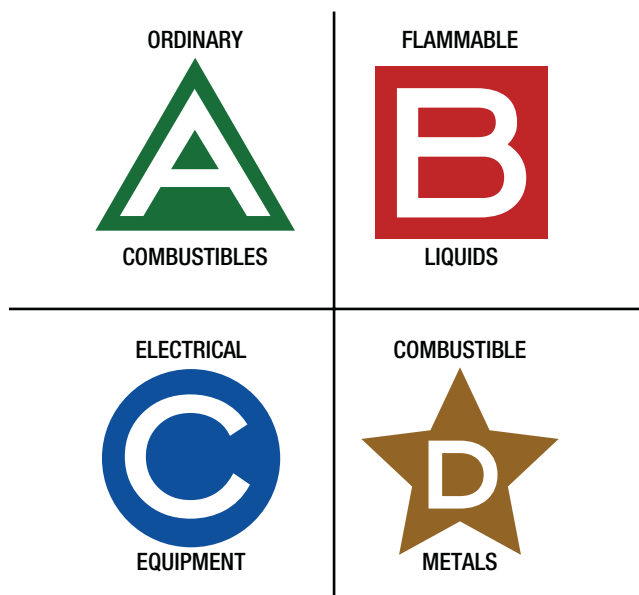


Figure 1-9. United States identification codes of fire extinguishers.

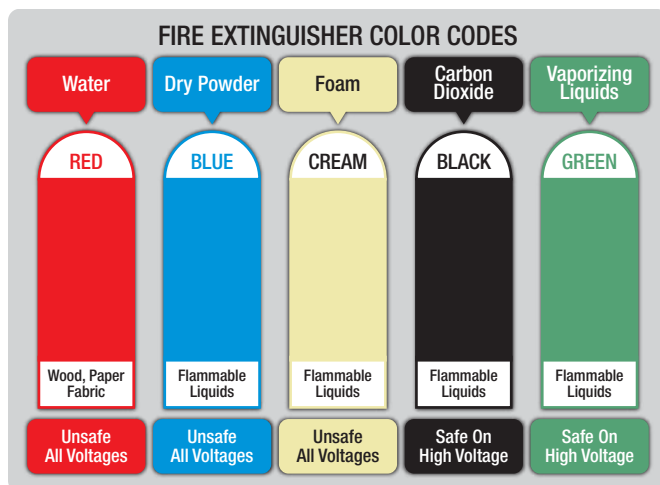


Figure 1-10. European and Australian identification codes of fire extinguishers.

INSPECTION OF FIRE EXTINGUISHERS

Fire extinguishers should be checked periodically utilizing a checklist. If a checklist is unavailable, check the following as a minimum:

- Proper location of appropriate extinguisher
- Safety seals unbroken
- All external dirt and rust removed
- Gauge or indicator in operable range
- Proper weight
- No nozzle obstruction
- No obvious damage

Airport or other local fire departments can usually help in preparing and often can provide extinguisher checklists. In addition, these fire departments can be helpful in answering questions and assisting in obtaining repairs to or replacement of fire extinguishers.

USING FIRE EXTINGUISHERS

When using a fire extinguisher, make sure you have the correct type for the fire. Most extinguishers have a pin to pull that will allow the handle to activate the agent. Stand back and aim at the base of the fire or flames. Squeeze the lever and sweep side to side until the fire is extinguished.

FLIGHT LINE SAFETY

HEARING PROTECTION

The flight line is a place of dangerous activity. Technicians who perform maintenance on the flight line must constantly be aware of what is going on around them. The noise on a flight line comes from many places. Aircraft are only one source of noise. There are auxiliary power units (APUs), fuel trucks, baggage handling equipment, and so forth. Each has its own frequency of sound. Combined all together, noises on the ramp or flight line can cause hearing loss.

There are many types of hearing protection available. Hearing protection can be external or internal. The external protection is the earmuff/headphone type. The internal type fit into the auditory canal. Both types will reduce the sound level reaching the eardrum and reduce the chances of hearing loss. Hearing protection should also be used when working with pneumatic drills, rivet guns, or other loud or noisy tools or machinery. Because of their high frequency, even short duration exposure to these sounds can cause a hearing loss. Continued exposure will cause permanent hearing loss.

FOREIGN OBJECT DAMAGE (FOD)

FOD is any damage caused by any loose object to aircraft, personnel, or equipment. These loose objects can be anything from broken runway concrete to shop towels to safety wire.

To control FOD, keep ramp and operation areas clean, have a tool control program, and provide convenient receptacles for trash, used hardware, shop towels, and other consumables.

The modern gas turbine engine will create a low pressure area in front of the engine that will cause any loose object to be drawn into the engine. The exhaust of these engines can propel loose objects great distances with enough force to damage anything that is hit. The importance of an FOD program cannot be overstressed when a technician considers the cost of engines, components, or the cost of a human life. Never leave tools or other items around the intake of a turbine engine.

SAFETY AROUND AIRPLANES

As with the previously mentioned items, it is important to be aware of propellers. Do not assume the pilot of a taxiing aircraft can see you. Technicians must stay where the pilot can see them while on the ramp area. Turbine engine intakes and exhaust can also be very hazardous areas. There should be no smoking or open flames anywhere near an aircraft in operation. Be aware of aircraft fluids that can be detrimental to skin. When operating support equipment around aircraft, be sure to allow space between it and the aircraft and secure it so it cannot roll into the aircraft. All items in the area of operating aircraft must be stowed properly.

SAFETY AROUND HELICOPTERS

Every type of helicopter has its own differences. These differences must be learned to avoid damage to the helicopter or injury to the technician. When approaching a helicopter while the blades are turning, observe the rotor head and blades to see if they are level. This will allow maximum clearance as you approach the helicopter. Observe the following:

- Approach the helicopter in view of the pilot.
- Never approach a helicopter carrying anything with a vertical height that blades could hit. This could cause blade damage and personal injury.
- Never approach a single main rotor helicopter from the rear. The tail rotor is invisible when operating.
- Never go from one side of the helicopter to the other by going around the tail. Always go around the nose of the helicopter.

When securing the rotor on helicopters with elastometric bearings, check the maintenance manual for the proper method. Using the wrong method could damage the bearings.