Cape Cod Community College AMTS

Practical Project Guide for AMT 109 General Curriculum, Subject Item 15

Part 147, Appendix B, Subject E – Materials and Processes

Item 15. Perform dye penetrant, eddy current, ultrasonic, and magnetic particle inspection (Level 2)

Project 1

Purpose: To acquaint the student with the proper procedures for Nondestructive Dye Penetrant and Magnetic Particle inspections.

References:

(1) 14 CFR Federal Aviation Regulations for Aviation Maintenance Technicians, Aviation Maintenance Technician Handbook – General, Volume 1 (FAA-H-8083-30), Chapter 5
(2) AC 43.13-1B Chapter 5
(3) ZB-100F Zyglo Operating Manual
(4) Y-8 Battery Operated Magnetic Yoke Operating Manual

Equipment and Tools Needed:

(1) Cessna 402c
(2) Aircraft landing gear strut

Supplies and Materials Needed:

(1) PT-ATB Aluminum Test Block
(2) ZB-100F Zyglo Kit
(3) Y-8 Battery Operated Magnetic Yoke Kit

Procedure:

Complete following procedure on project 1

Project 1 Item 15. Perform dye penetrant, eddy current, ultrasonic, and magnetic particle inspection (Level 2)

(1) Inspect PT-ATB Aluminum test block for cracks in accordance with the AC 43.13-1B Chap 5, and ZB-100F Zyglo Operating Manual.
(2) Inspect Cessna Skymaster Engine bulkhead rivets for possible cracks in accordance with the AC 43.13B Chap 5, and ZB-100F Zyglo Operating Manual.
(3) Inspect aircraft landing gear strut using the Y-8 Yoke kit in accordance with AC 43.13-1B Chap 5, and Y-8 Magnetic Yoke Operating Manual

(4) Inspect 5 weld assemblies for flaws using Dye-penetrant and Magnetic particle inspection methods in accordance with AC 43.13-1B, Zyglo operating manual, and Y-8 Magnetic particle operating manual.

ZYGLO®

PENETRANT KIT OPERATING INSTRUCTIONS

HOW TO USE YOUR ZYGLO® KIT

Smooth surfaces such as those produced by clean cutting tools give best results. These include ground, machined, and sand blasted surfaces. Shot blasting, polishing, etc., which tend to smear over and close up surface openings, can give finishes that can cause poor results.

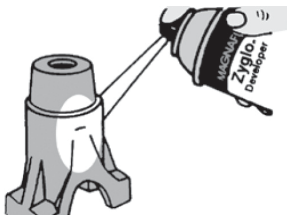
Surfaces should be free of foreign materials and paint that would prevent penetration of defects or hold unwanted penetrant. Grease, oils, etc. prevent penetration and should be removed by precleaning with cleaner. Scale, sand, dirt, etc. trap penetrant and hinder removal, therefore wire brushing or similar precleaning is necessary. Paint must be removed from areas to be tested.

Just before starting the test, plug the black light into a 115 Volt A.C. supply. Allow the light to warm up to maximum brilliance, in 5 or 10 minutes. Leave the light on throughout the tests. If turned off, it must cool before it will relight. **This Zyglo kit is not recommended for the inspection of plastic materials, as it may stain, soften, or even dissolve the plastic material under test.**

1. Cleaning

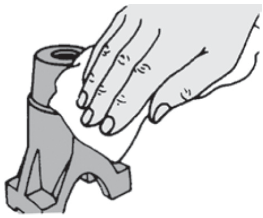
For precleaning, spray the part or section to be inspected with cleaner. Allow cleaner to remain on part long enough to dissolve dirt or film. Wipe dry with a clean rag. A check with black light will show any oils remaining, by their fluorescence. Repeat if necessary. After final clean wiping, allow time to dry before using penetrant.

2. Apply Penetrant



Spray the part or section to be inspected so that surface is covered with penetrant. Allow penetrant to remain on the part for a period of time. Generally a 10 minute dwell time is sufficient on new (clean) castings and welds, and most defects.

3. Remove Penetrant

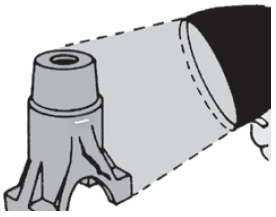


When sufficient penetration time has been allowed, wipe the surface clean with a clean towel or cloth. Repeat if necessary. Some surfaces will require only wiping. In general, however, remove excess surface penetrant with clean cloths premoistened with cleaner/remover. DO NOT flush surface with cleaner/remover because this will impair sensitivity. Repeat this procedure with additional wiping until residual surface penetrant has been removed.

4. Develop

Shake the can vigorously until the agitators rattle inside. Hold the can 8 to 12 inches above the part when spraying. Spray the part or section with developer, enough to wet the part thinly and evenly, no more. Proper thickness will dry to a thin white layer. Too much developer will mask indicationsv; too little will not develop the indication sufficiently. Apply to 6-8 inch sections at a time. Allow developer to dry. Large cracks show up immediately. Smaller cracks may take a few minutes to develop.

5. Inspect

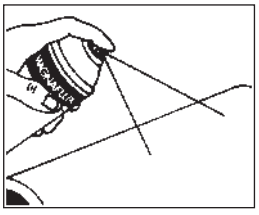


Defects will be marked by a bright indication when viewed with the portable black light. A glowing line marks a crack, lap, forging burst or cold shut. If wide and deep, the indication will grow and spread. Porosity, shrinkage, lack of bond, and leaks will appear as dots or bright areas under the black light. These, too, will grow and spread if the defect is large or extensive.

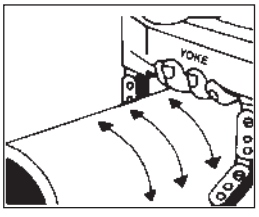
Y-8 Battery Powered Yoke

Technical Specifications

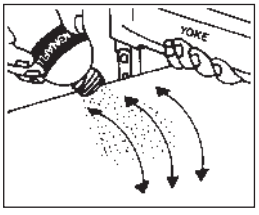
- Yoke Weight: 7 3/4 lbs.
- Leg Capacity: 0"-12" (0-30 cm) across poles
- Cord length: 12 ft., coiled
- Battery: 6 volt, 12 amp-hour
- Battery weight: 5 1/4 lbs.
- Battery Dimensions (in.): 4 1/4" x 2 3/4" x 5 1/2"
- Battery output voltage range: 6.84/7.35 V
- Battery output current: 1.6 amps maximum with Y-8 Yoke
- Battery operating temperature range: -40˚C to 60˚C (-40˚F to +140˚F)
- Yoke Kit includes: Battery charger, powder, powder bulb, padded battery pack with shoulder strap, carrying case and instructions (part #611710). Individual items also sold separately.
- Kit Weight: 23 1/2 lbs.
- Powder: 1 lb. (.45 kg) bottle of #1 Gray



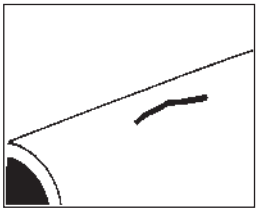
Step #1



Step #2



Step #3



Step #4

Features & Benefits

The Magnaflux® Y-8 Yoke is designed for reliable, one person magnetic particle inspection of ferrous parts when portability is essential. Ideal for in-plant structures and field work, the Y-8 is ready to go whenever the need arises. Complete with battery charger, powder, powder bulb, padded battery pack with shoulder strap and yoke carrying case – the Y-8 kit comes with everything you need to get the job done.

6 volt, 12 amp-hour battery provides up to 8 hours of reliable inspection per charge Battery has a wide operating temperature range Articulating, double-jointed legs contour easily to any part shape to assure good contact Ergonomically designed for operator comfort Pull force complies with ASTM specifications for DC yokes 30 second ON/OFF duty cycle for fast, efficient inspections

Operating Instructions

When yoke is connected to the battery and energized, an intense longitudinal magnetic field is created in the area between the yoke legs. Any surface cracks will create flux leakage, which will attract magnetic particles that form indications and allow for detection. There are two testing methods:

MAGNAFLUX® Dry Non-Fluorescent Method does not require a black light and is more sensitive for finding subsurface defects on components with rough surfaces, such as castings and forgings.

MAGNAGLO® Wet Fluorescent Method, using the yoke and a black light, can find very fine surface flaws or slightly subsurface discontinuities.

Whichever method you use, the testing procedures are the same:

Step #1 – Cleaning
Apply cleaner on the area to be inspected, allow time for dirt/film to dissolve. Then, wipe with a clean cloth and allow to dry completely.

Step #2 – Energize Yoke
Position the yoke perpendicular to the direction of the suspected defects, then depress the switch to energize the yoke.

Step #3 – Apply Magnetic Particles
With the magnetic field continuously energized, apply magnetic particles between the legs of the yoke. Apply dry particles with powder bulb and wet particles with an aerosol can.

Step #4 – Inspect for Defects
Flaw indications will form immediately. With non-fluorescent particles, they are visible in normal light. With fluorescent particles, they can only be seen under a black light, model ZB-100 (part #600000) or model ZB-100F (part #600004).

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Part 147, Appendix B, Subject E – Materials and Processes

Item 17. Identify and select aircraft hardware and materials (Level 3)

Project 2

Purpose: To acquaint the student with the proper removal and installation of aircraft bolts on the Lycoming O-320.

References:

(1) AC 43.13-1B Chapter 7
(2) 14 CFR Federal Aviation Regulations for Aviation Maintenance Technicians, Aviation Maintenance Technician Handbook – General, Volume 1 (FAA-H-8083-30), Chapter 5
(3) Lycoming O-320 Direct Drive Overhaul Manual
(4) Lycoming O-320 Parts Catalog
(5) AVOTEK Aircraft hardware identification chart

Equipment and Tools Needed:

(1) Snap-on tool box

Supplies and Materials Needed:

(1) Lycoming O-320 Engine
(2) Pencil/Pen
(3) Paper

Procedure:

Complete following procedure on project 2

Project 2 Item 17. Identify and select aircraft hardware and materials (Level 3)

(1) On the Lycoming O-320, correctly identify ten different AN bolts, lengths, castle nuts, and self-locking nuts using above manuals. Correctly identify the proper torque for the ten bolts chosen as per the O-320 Direct Drive Overhaul Manual.

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Part 147, Appendix B, Subject E Materials and Processes

Item 17. Identify and select aircraft hardware and materials (Level 3)

Project 3

Purpose: To acquaint the student with the proper identification of sheet aluminum and aircraft steel alloy.

References:

(1) AC 43.13-1B Chapter 4
(2) 14 CFR Federal Aviation Regulations for Aviation Maintenance Technicians, Aviation Maintenance Technician Handbook – General, Volume 1 (FAA-H-8083-30), Chapter 5

Equipment and Tools Needed:

(1) None

Supplies and Materials Needed:

(1) 10 random pieces of Aluminum sheet metal
(2) Pencil/Pen
(3) Paper

Procedure:

Complete following procedure on project 3

Project 3 Item 17. Identify and select aircraft hardware and materials (Level 3)

(1) Identify alloys by visual recognition of code designators, and hardness using the following system. Where used, the temper designation follows the alloy designation and is separated from it by a dash: i.e., 7075-T6, 2024-T4, and so forth. The temper designation consists of a letter indicating the basic temper which maybe more specifically defined by the addition of one or more digits. These designations are as follows:

- F — as fabricated
- O − annealed, recrystallized (wrought products only)
- H − strain hardened
- H1 (plus one or more digits) − strain hardened only
- H2 (plus one or more digits) − strain hardened and partially annealed
- H3 (plus one or more digits) − strain hardened and stabilized

Percentage of Alloying Elements
(aluminum and normal impurities constitute remainder)

Alloy	Copper	Silicon	Manganese	Magnesium	Zinc	Nickel	Chromium	Lead	Bismuth
1100	—	—	—	—	—	—	—	—	—
3003	—	—	1.2	—	—	—	—	—	—
2011	5.5	—	—	—	—	—	—	0.5	0.5
2014	4.4	0.8	0.8	0.4	—	—	—	—	—
2017	4.0	—	0.5	0.5	—	—	—	—	—
2117	2.5	—	—	0.3	—	—	—	—	—
2018	4.0	—	—	0.5	—	2.0	—	—	—
2024	4.5	—	0.6	1.5	—	—	—	—	—
2025	4.5	0.8	0.8	—	—	—	—	—	—
4032	0.9	12.5	—	1.0	—	0.9	—	—	—
6151	—	1.0	—	0.6	—	—	0.25	—	—
5052	—	—	—	2.5	—	—	0.25	—	—
6053	—	0.7	—	1.3	—	—	0.25	—	—
6061	0.25	0.6	—	1.0	—	—	0.25	—	—
7075	1.6	—	—	2.5	5.6	—	0.3	—	—

SERIES DESIGNATION	TYPES
100xx	Nonsulphurized carbon steels
11xx	Resulphurised carbon steels (free machining)
12xx	Rephosphorized and resulphurised carbon steels (free machining)
13xx	Manganese 1.75%
*23xx	Nickel 3.50%
*25xx	Nickel 5.00%
31xx	Nickel 1.25%, chromium 0.65%
33xx	Nickel 3.50%, chromium 1.55%
40xx	Molybdenum 0.20 or 0.25%
41xx	Chromium 0.50% or 0.95%, molybdenum 0.12 or 0.20%
43xx	Nickel 1.80%, chromium 0.5 or 0.80%, molybdenum 0.25%
44xx	Molybdenum 0.40%
45xx	Molybdenum 0.52%
46xx	Nickel 1.80%, molybdenum 0.25%
47xx	Nickel 1.05% chromium 0.45%, molybdenum 0.20 or 0.35%
48xx	Nickel 3.50%, molybdenum 0.25%
50xx	Chromium 0.25, or 0.40 or 0.50%
50xxx	Carbon 1.00%, chromium 0.50%
51xx	Chromium 0.80, 0.90, 0.95 or 1.00%
51xxx	Carbon 1.00%, chromium 1.05%
52xxx	Carbon 1.00%, chromium 1.45%
61xx	Chromium 0.60, 0.80, 0.95%, vanadium 0.12%, 0.10% min., or 0.15% min.
81xx	Nickel 0.30%, chromium 0.40%, molybdenum 0.12%
86xx	Nickel 0.55%, chromium 0.50%, molybdenum 0.20%
87xx	Nickel 0.55%, chromium 0.05%, molybdenum 0.25%
88xx	Nickel 0.55%, chromium 0.05%, molybdenum 0.35%
92xx	Manganese 0.85%, silicon 2.00%, chromium 0 or 0.35%
93xx	Nickel 3.25%, chromium 1.20%, molybdenum 0.12%
94xx	Nickel 0.45%, chromium 0.40%, molybdenum 0.12%
98xx	Nickel 1.00%, chromium 0.80%, molybdenum 0.25%

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Part 147, Appendix B, Subject E – Materials and Processes

Item 17. Identify and select aircraft hardware and materials (Level 3)

Project 4

Purpose: To acquaint the student with the proper rivet identification.

References:

(1) 14 CFR Federal Aviation Regulations for Aviation Maintenance Technicians, Aviation Maintenance Technician Handbook – General, Volume 1 (FAA-H-8083-30), Chapter 5
(2) AC 43.13-1B Chapter 7
(3) AVOTEK Rivet identification chart

Equipment and Tools Needed:

(1) Drill Gage from blue kits

Supplies and Materials Needed:

(1) Random, unlabeled and various size rivets
(2) Paper
(3) Pen or Pencil

Procedure:

Complete following procedure on project 4

Project 4 Item 17. Identify and select aircraft hardware and materials (Level 3)

(1) Identify and describe rivet length, diameter, type, alloy, where applicable, and type letter designating strength characteristics for 30 rivets using the AC 43.13-1B, Aviation Maintenance Technician Handbook, and AVOTEK Rivet Identification chart.

MATERIAL & HEAD MARKING	UNIVERSAL HEAD	100° COUNTERSUNK	ROUND HEAD	FLAT HEAD	BRAZIER HEAD	MODIFIED BRAZIER HEAD
1100-F ALUMINUM No Head Mark	MS20470A	MS20426A	AN430A	AN442A	AN455A	AN456A
2117-T4 ALUMINUM Dimple	MS20470AD	MS20426AD	AN430AD	AN442AD	AN455AD	AN456AD
5056-H32 ALUMINUM Raised Cross	MS20470B	MS20426B	AN430B	AN442B	AN455B	AN456B
2017-T4 ALUMINUM Raised Dot	MS20470D	MS20426D	AN430D	AN442D	AN455D	AN456D
2024-T4 ALUMINUM Raised Double Dash	MS20470DD	MS20426DD	AN430DD	AN442DD	AN455DD	AN456DD
2219-T81 ALUMINUM Indented Square	MS20470K	MS20426K				
7050-T73 ALUMINUM Indented Ring	MS20470E	MS20426E				
45Cb TITANIUM Indented Diamond	MS20470T	MS20426T				
2219-T62 ALUMINUM Indented Triangle	MS20470J	MS20426J				
CARBON STEEL Head Mark Varies	MS20613_P AN125551 to AN125700	MS20427	MS20435	AN441		
COPPER No Head Mark	MS20615_CU	MS20427C	MS20435C	AN441C		
BRASS No Head Mark	MS20615_B	MS20427B	MS20435B	AN441B		
300 SERIES STAINLESS Head Mark Varies	MS20613_C AN125401 to AN125550	MS20427F AN124951 to AN125100	MS20435F	AN441F		
MONEL Head Mark Varies	MS20615_M NAS508	MS20427M	MS20435M	AN441M		
INCONEL No Head Mark	AN123301 to AN123450	AN123601 to AN123750				
347 STAINLESS No Head Mark	AN123151 to AN123300	AN123451 to AN123600				
A286 HIGH TEMP STAINLESS Raised Dot	NAS1198	NAS1199				

Material	Head Marking	AN Material Code	AN425 78° Counter-sunk Head	AN426 100° Counter-sunk Head MS20426*	AN427 100° Counter-sunk Head MS20427*	AN430 Round Head MS20470*	AN435 Round Head MS20613* MS20615*	AN441 Flat Head	AN442 Flat Head MS20470*	AN455 Brazier Head MS20470*	AN456 Brazier Head MS20470*	AN470 Universal Head MS20470*	Heat Treat Before Use	Shear Strength psi	Bearing Strength psi
1100	Plain	A	X	X		X			X	X	X	X	No	10 000	25 000
2117T	Recessed Dot	AD	X	X		X			X	X	X	X	No	30 000	100 000
2017T	Raised Dot	D	X	X		X			X	X	X	X	Yes	34 000	113 000
2017T-HD	Raised Dot	D	X	X		X			X	X	X	X	No	38 000	126 000
2024T	Raised Double Dash	DD	X	X		X			X	X	X	X	Yes	41 000	136 000
5056T	Raised Cross	B		X		X			X	X	X	X	No	27 000	90 000
7075-T73	Three Raised Dashes		X	X		X			X	X	X	X	No		
Carbon Steel	Recessed Triangle				X		X MS20613*	X					No	35 000	90 000
Corrosion Resistant Steel	Recessed Dash	F			X		X MS20613*						No	65 000	90 000
Copper	Plain	C			X		X	X					No	23 000	
Monel	Plain	M			X			X					No	49 000	
Monel (Nickel-Copper Alloy)	Recessed Double Dots	C					X MS20615*						No	49 000	
Brass	Plain						X MS20615*						No		
Titanium	Recessed Large and Small Dot			MS20426									No	95 000	

*New specifications are for design purposes.

Item 18. Inspect and check welds (Level 3)

Project 5

Purpose: To acquaint the student with the proper inspection of aircraft welded assemblies of acceptable and unacceptable quality.

References:

(1) AC 43.13-1B Chapter 4
(2) 14 CFR Federal Aviation Regulations for Aviation Maintenance Technicians, Aviation Maintenance Technician Handbook –General, Volume 1 (FAA-H-8083-30), Chapter 5
(3) Olympus Ultrasonic Epoch 650 software

Equipment and Tools Needed:

(1) Olympus Ultrasonic Epoch 650 Machine
(2) Snap-on tool box
(3) Magnifying glass
(4) Comanche PA 24-250
(5) Cessna 402C

Supplies and Materials Needed:

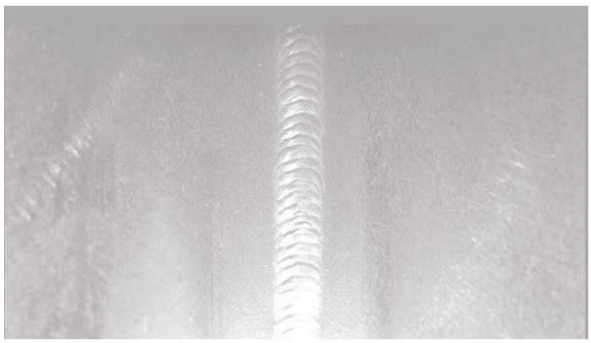
(1) Rags
(2) Pencil or Pen
(3) Paper

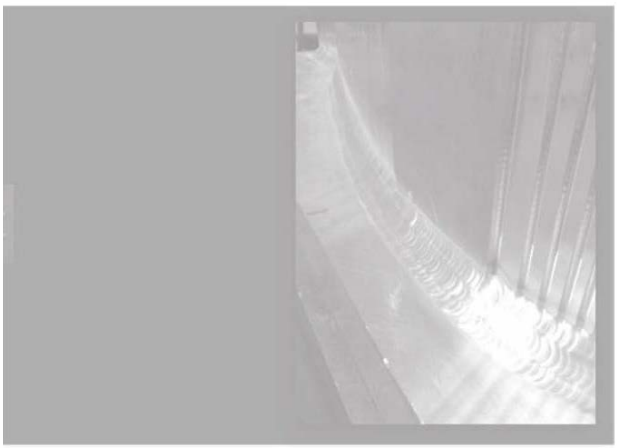
Procedure: **Complete the following procedure on project 5**

Project 5 Item 18. Inspect and check welds (Level 3)

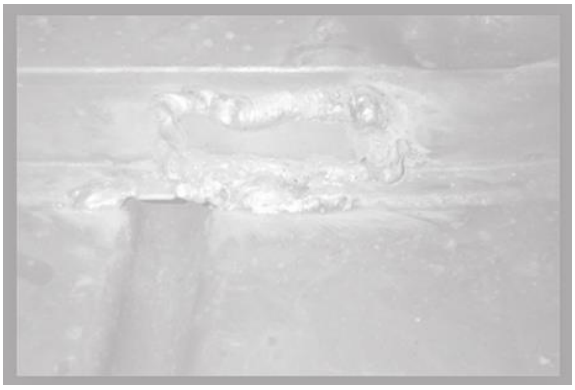
(1) Inspect and evaluate the quality of the weld in ten welded aircraft assemblies. Use the Olympus Epoch 650 Ultrasonic machine, AC 43.13-1B, and Aviation Maintenance Technician Handbook to decide what is acceptable or should be rejected for welds. If using the Olympus Ultrasonic machine, follow the software procedures depending on the type of metal.

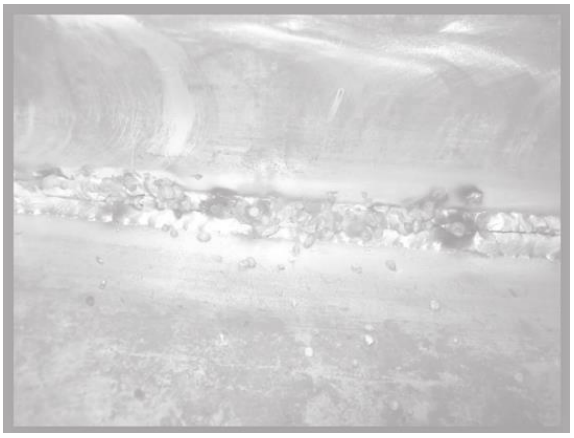
Examples of good aircraft welds:

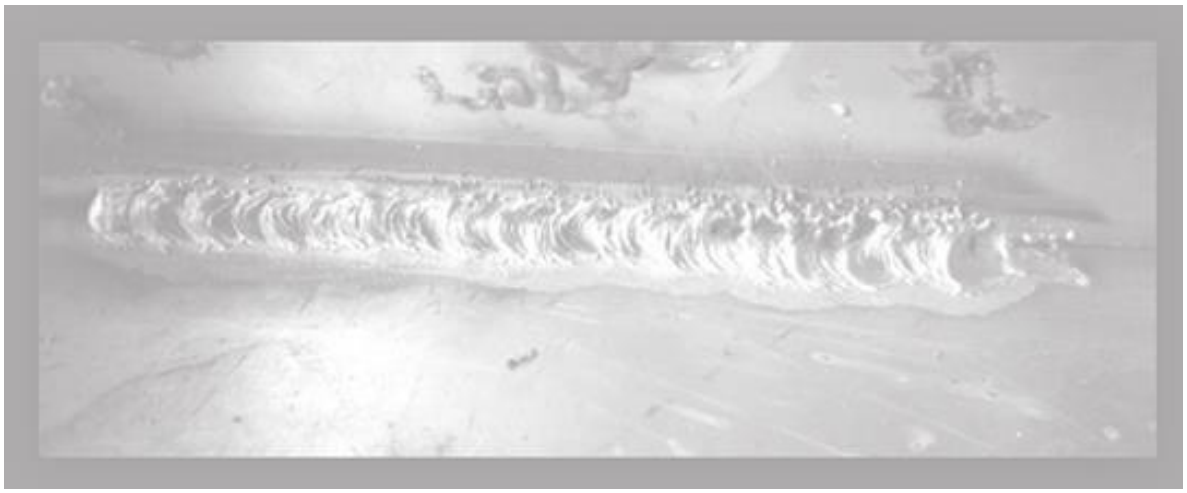




Examples of bad welds:







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Part 147, Appendix B, Subject E Materials and Processes Item

15. Perform eddy current inspections (Level 2)

Project 6

Purpose: To acquaint the student with the proper inspection techniques using Eddy Current.

References:

(1) AC 43.13-1B Chapter 5
(2) 14 CFR Federal Aviation Regulations for Aviation Maintenance Technicians, Aviation Maintenance Technician Handbook – General, Volume 1 (FAA-H-8083-30), Chapter 5
(3) Olympus Nortec 600 Eddy Current Software

Equipment and Tools Needed:

(1) Olympus Nortec 600 Eddy Current Machine
(2) Snap-on tool box
(3) Magnifying glass
(4) Skymaster
(5) Comanche PA 24-250
(6) Cessna 402C

Supplies and Materials Needed:

(1) Rags
(2) Paper
(3) Pen or Pencil
(4) Isopropyl Alcohol

Procedure:

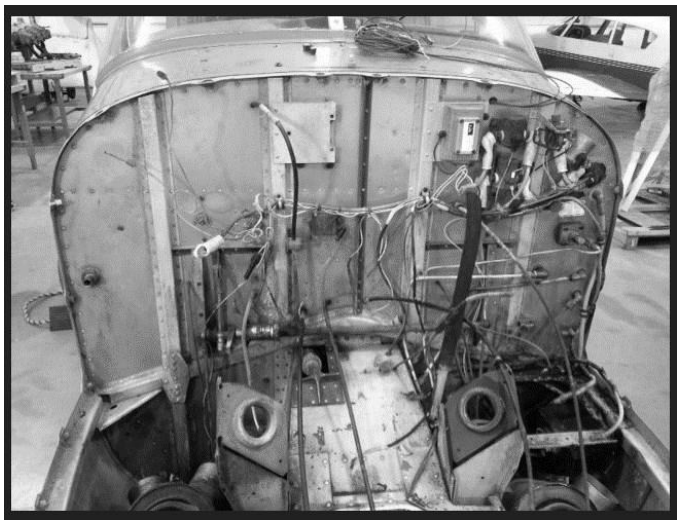
Complete following procedure on project 6

Project 6 Item 15. Perform dye penetrant, eddy current, ultrasonic, and magnetic particle inspection (Level 2)

(1) Inspect and evaluate Skymaster forward bulkhead rivets for any cracks or corrosion as per the Olympus Nortec 600 Eddy current software to verify the correct set-up, and AC 43.131B.
(2) Inspect Cessna 402C seat rails for any cracks or corrosion as per the Olympus Nortec 600 Eddy current software and AC 43.13-1B.


OLYMPUS
Vpp 9.8
Vpp 49.1
FULL NEXT
A
B
C
D
E
ZERO NULL
GAIN
ERASE
ANGLE
FREEZE
REF SAVE
MAIN FILTER
DISP
ALARM
MEM
ADV SETUP
MOBITEC 800

1



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Part 147, Appendix B, Subject E Materials and Processes

Item 17. Identify and select aircraft hardware and materials (Level 3)

Project 7

Purpose: To acquaint the student with the proper principals of safety wire installation.

References:

(1) AC 43.13-1B Chapter 7
(2) 14 CFR Federal Aviation Regulations for Aviation Maintenance Technicians, Aviation Maintenance Technician Handbook – General, Volume 1 (FAA-H-8083-30), Chapter 5

Equipment and Tools Needed:

(1) Safety Wire Trainer
(2) Duck bill pliers
(3) Diagonal cutting pliers

Supplies and Materials Needed:

(1) Safety Wire (.032 and .040)

Procedure:

Complete following procedure on project 7

Project 7 Item 17. Identify and select aircraft hardware and materials (Level 3)

(1) Correctly safety wire all bolts and turn buckle on the safety wire trainer as per the AC 43.131B, Chap 7 and the Aviation Maintenance Technician Handbook.


AM3

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Part 147, Appendix B, Subject E Materials and Processes Item

19. Perform precision measurements (Level 3)

Project 8

Purpose: To acquaint the student with the proper way to conduct precision measurement.

References:

(1) 14 CFR Federal Aviation Regulations for Aviation Maintenance Technicians, Aviation Maintenance Technician Handbook – General, Volume 1 (FAA-H-8083-30), Chapter 5
(2) Starrett Precision Measurement Instrument Certification Manual
(3) Principles of Fasteners Manual

Equipment and Tools Needed:

(1) Starrett and Snap-on Precision Measurement Tool Box
(2) Snap-on TTP-1 precision measurement block

Supplies and Materials Needed:

(1) Aircraft Bearings
(2) Cylinders
(3) Sheet Metal
(4) Pistons
(5) Crankshaft
(6) Blank Report Forms

Procedure:

Complete following procedure on project 8

Project 8 Item 19. Perform precision measurements (Level 3)

(1) Preform inspections on aircraft bearings, cylinders, sheet metal, pistons, and crankshaft using the appropriate inspection tools as per the Starrett Measurement Certification Manual. Complete report forms or status tags indicating acceptance or rejection of the inspected components.

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