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Enhancing Aviation Maintenance Training Using Scenario-based Education

Raymond Thompson
Western Michigan University, raymond.thompson@wmich.edu

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Dr. Raymond Thompson – Western Michigan University

Why Develop an MRO Simulation?

- Medium to large aircraft maintenance is structured differently than small general aviation aircraft maintenance

- Most Part 147 training is done on GA aircraft

Goals of the MRO Simulation

- Expose students to large aircraft inspection and maintenance methodology
- Develop the communication and team skills required
- Develop the documents to train, perform, and document large aircraft maintenance

AVS 4630 Professional Maintenance Operations

- Capstone course for the Aviation Technical Operations program
- Students have completed a traditional inspection course
- Primary course focus is on the maintenance process with hands-on skill building a secondary function

AVS 4630 Learning Outcomes

- Apply industry standards and practices for enabling airworthy medium to large transport category aircraft maintenance, including inspection and operation of large aircraft components and powered systems. (AABI 3.3.1-h, AABI 3.3.2-2)

AVS 4630 Learning Outcomes

- Create, validate and deploy a functional aircraft maintenance program an assigned section of WMU's corporate or transport category aircraft, using process problem solving and risk assessment techniques (including Process Mapping and Risk Hazard Analysis diagramming techniques and manufacturer technical manual data). (AABI 3.3.1-c, 3.3.1-h, AABI 3.3.2-2)

AVS 4630 Learning Outcomes

- Plan and develop checklists for safe operation of aircraft systems relevant to medium or large transport aircraft, using technical writing principles, job hazard assessment and process mapping techniques covered in lectures and labs. Demonstrate safe operation of same. (AABI 3.3.1-h, AABI 3.3.2-3).

Project-based Learning

- Students are assigned a system and an inspection task
  - Create a GenFam module on that system for all to use
  - Process map the task
  - Perform a hazard analysis
  - Create a task card for the task
  - Perform the maintenance with role play

Selected Course Resources

- B727-200F
- Aircraft Maintenance Manuals
- Aircraft Illustrated Parts Catalog
- Aircraft Wiring Manuals
- FAA Dirty Dozen
- NASA Foundations of Mission Control
- ASQ Flowchart Tool

Federal Aviation Administration

Avoid the Dirty Dozen

12 Common Causes of Human Factors Errors

About 80 Percent of Maintenance Mistakes Involve Human Factors . . . and if Not Detected. . . Would Lead to Accidents.

Put Safety First and Minimize the 12 Common Causes of Mistakes in the Aviation Workplace

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Improve your communication—

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Avoid the tendency to see what you expect to see—

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Don't guess, know—

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Distractions are the #1 cause of forgetting things, including what has or has not been done in a maintenance task.

Get back in the groove after a distraction—

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Build solid teamwork—

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Improve supply and support—

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See the whole picture—

- Make sure there are no conflicts with an existing repair or modifications.
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Norms

Expected, yet unwritten, rules of behavior.

Help maintain a positive environment with your good attitude and work habits—

- Existing norms don't make procedures right.
- Follow good safety procedures.
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FOUNDATIONS OF MISSION CONTROL

To instill within ourselves these qualities essential for professional excellence:

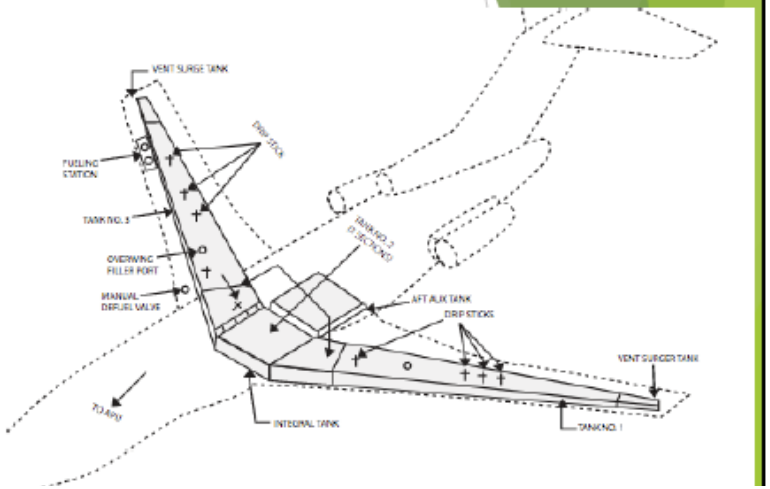
Discipline	Being able to follow as well as lead, knowing that we must master ourselves before we can master our task.
Competence	There being no substitute for total preparation and complete dedication, for space will not tolerate the careless or indifferent.
Confidence	Believing in ourselves as well as others, knowing that we must master fear and hesitation before we can succeed.
Responsibility	Realizing that is cannot be shifted to others, for it belongs to each of us; we must answer for what we do, or fail to do.
Toughness	Taking a stand when we must; to try again, and again, even if it means following a more difficult path.
Teamwork	Respecting and utilizing the ability of others, realizing that we work toward a common goal, for success depends on the efforts of all.

To always be aware that suddenly and unexpectedly we may find ourselves in a role where our performance has ultimate consequences.

To recognize that the greatest error is not to have tried and failed, but that in trying, we did not give it our best effort.

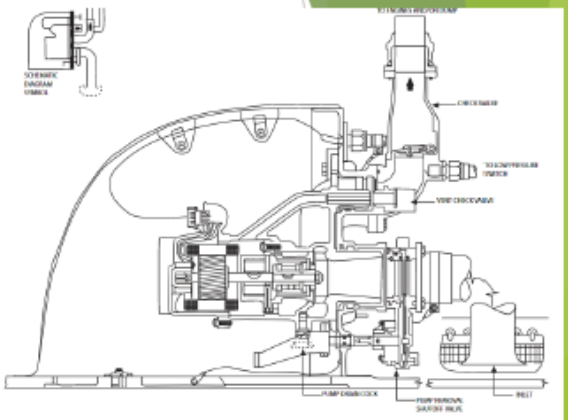
Tanks

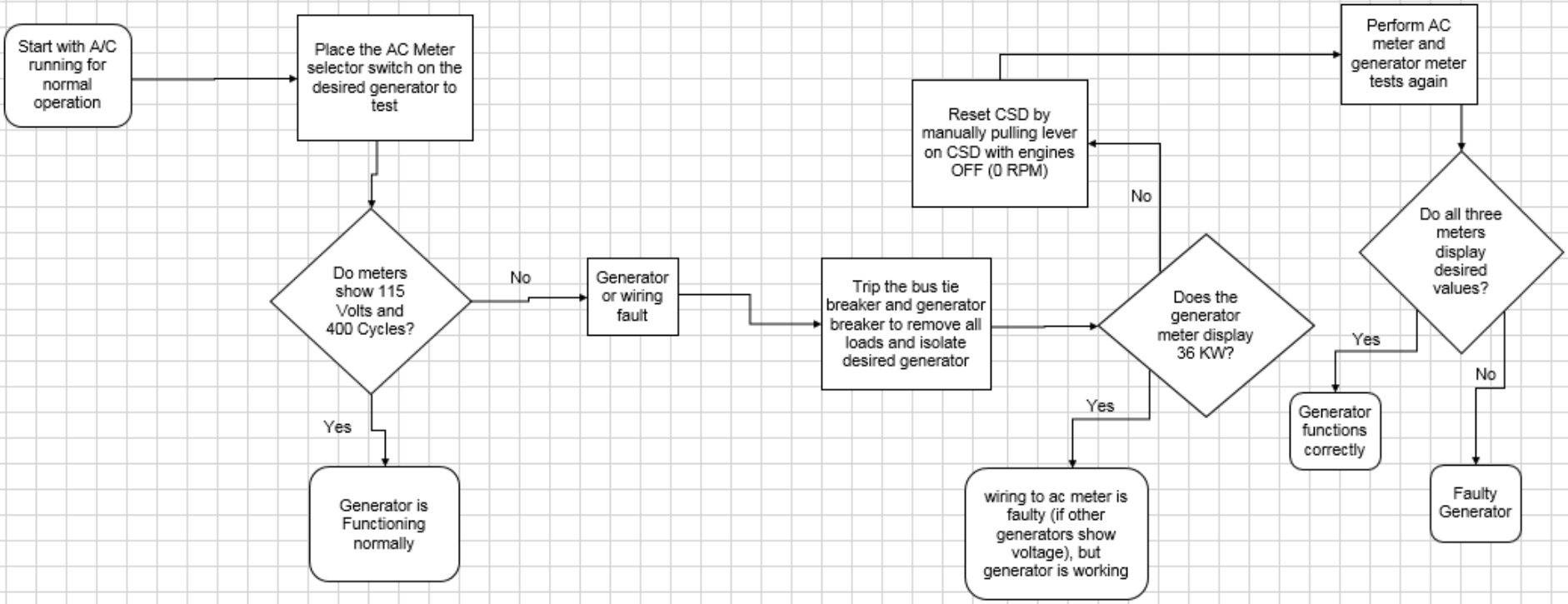
- 3 main tanks
  - 1 in each wing
  - 1 in center of wing under fuselage
- Tank type: integral
- 8000 lb total fuel capacity
- Capacitance type quantity measurement
- Drip sticks for manual measurement



Delivery

- Any tank to any engine
- Normal operation
  - Tank 1= engine 1
  - Tank 2 = engine 2
  - Tank 3 = engine 3
- Tank to tank transfer on ground only
- Electric boost bumps
  - Higher pressure boost pump in center tank to override wing tanks
  - Centrifugal type using 115 volt, 3-phase AC power
  - Pumps have small housings which isolate them from the fuel tanks
- Crossfeed system
  - All tanks sumped to one location, then directly to a specific engine




Start with A/C running for normal operation
Place the AC Meter selector switch on the desired generator to test
Do meters show 115 Volts and 400 Cycles?
No
Generator or wiring fault
Yes
Generator is Functioning normally
Trip the bus tie breaker and generator breaker to remove all loads and isolate desired generator
Does the generator meter display 36 KW?
No
Reset CSD by manually pulling lever on CSD with engines OFF (0 RPM)
Yes
wiring to ac meter is faulty (if other generators show voltage), but generator is working
Perform AC meter and generator meter tests again
Do all three meters display desired values?
Yes
Generator functions correctly
No
Faulty Generator

Category: Choose an item. N258FE (ship -258)		B727-200F Series Job Card Issued: 9/20/2017 Revision Date: 9/20/2017 Revision #: 1

Job Card Number: 27-50-00-Flap Control Travel

Job Card Title: Inspect flap control travel

Zones: 2-22, 2-23, 5-82, 5-84, 6-85, 6-87

Access Panels: Not applicable

ATA Sections: 27

Consumables:	**Specialized Tooling and Equipment**:
None	Ladder Safety glasses Digital protractor

Work Instructions:	**Tech.**	**Insp.**
1. Prepare aircraft for maintenance		
2. Using a power cart, apply 28 VDC and 115 VAC to the aircraft		
3. Turn on battery switch on flight engineers panel		
4. Ensure all three bus ties are in the open position on flight engineers panel		
5. Close all three electrical bus ties		
6. Check current flap position and verify it matches current flap handle position		
7. Engage system B hydraulic pumps 1 and 2. Switches located on flight engineers panel		
8. Open hydraulic ground interconnect valve on flight engineers panel.		
9. Move flap handle to 0° (see figure 1)		
10. Establish 0° starting point on flap using digital protractor		
11. Move flap handle to 2°		
12. Measure flap angle with protractor a. Record measured angle i. RH inboard_____ ii. RH Outboard_____ iii. LH inboard _____ iv. LH outboard _____ b. If recorded angle differs from flap handle, investigate rigging of flaps, check proper operation of flap transmission and other flap hydraulic components		
13. Move flap handle to 5° (see figure 1)		
14. Measure flap angle with protractor a. Record measured angle i. RH inboard_____ ii. RH Outboard_____ iii. LH inboard _____		

Category: Choose an item.

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iv. LH outboard _____ b. If recorded angle differs from flap handle, investigate rigging of flaps, check proper operation of flap transmission and other flap hydraulic components		
15. Move flap handle to 20° (see figure 1)		
16. Measure flap angle with protractor a. Record measured angle i. RH inboard_____ ii. RH Outboard_____ iii. LH inboard _____ iv. LH outboard _____ b. If recorded angle differs from flap handle, investigate rigging of flaps, check proper operation of flap transmission and other flap hydraulic components		
17. Move flap handle to 25° (see figure 1)		
18. Measure flap angle with protractor a. Record measured angle i. RH inboard_____ ii. RH Outboard_____ iii. LH inboard _____ iv. LH outboard _____ b. If recorded angle differs from flap handle, investigate rigging of flaps, check proper operation of flap transmission and other flap hydraulic components		
19. Move flap handle to 30° (see figure 1)		
20. Measure flap angle with protractor a. Record measured angle i. RH inboard_____ ii. RH Outboard_____ iii. LH inboard _____ iv. LH outboard _____ b. If recorded angle differs from flap handle, investigate rigging of flaps, check proper operation of flap transmission and other flap hydraulic components		

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21. Move flap handle to 40° (see figure 1)		
22. Measure flap angle with protractor a. Record measured angle i. RH inboard_____ ii. RH Outboard_____ iii. LH inboard _____ iv. LH outboard _____ b. If recorded angle differs from flap handle, investigate rigging of flaps, check proper operation of flap transmission and other flap hydraulic components		
23. Move flap handle to 0°		
24. Disengage system B pumps 1 and 2		
25. Open 3 busses and turn off battery switch		
26. Power down power cart and remove AC and DC power from aircraft		

Supplemental Information

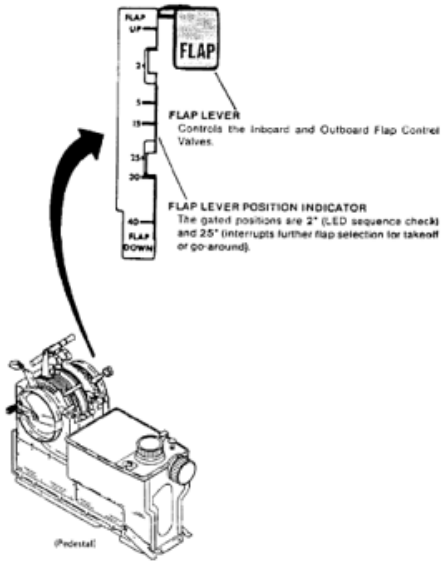

Figure 1

Maintenance Process - Process

- 1 Shift manager
    - 2 -3 Lead technicians
        - 2 – 3 individuals / teams per lead
- Students receive team building and communication training

29-Sep	6-Oct	13-Oct	20-Oct	27-Oct	27-Oct	3-Nov	10-Nov	17-Nov
Lab 4	Lab 5	Lab 6	Lab 7	Lab 8A	Lab 8B	Lab 9	Lab 10	Lab 11
SM	TECH	TECH	LEAD	TECH	TECH	LEAD	TECH	TECH
TECH	SM	TECH	TECH	LEAD	TECH	TECH	LEAD	TECH
TECH	TECH	SM	TECH	TECH	LEAD	TECH	TECH	LEAD
TECH	LEAD	TECH	TECH	TECH	SM	TECH	LEAD	TECH
Interview 1	TECH	LEAD	TECH	SM	TECH	TECH	TECH	LEAD
LEAD	TECH	TECH	LEAD	TECH	TECH	SM	TECH	TECH
TECH	LEAD	TECH	TECH	LEAD	TECH	TECH	SM	TECH
LEAD	TECH	TECH	SM	TECH	TECH	LEAD	TECH	TECH
TECH	TECH	LEAD	TECH	TECH	LEAD	TECH	TECH	SM
TECH	LEAD	TECH	TECH	LEAD	TECH	TECH	SM	TECH
LEAD	TECH	TECH	LEAD	TECH	TECH	SM	TECH	TECH
TECH	TECH	LEAD	TECH	SM	TECH	TECH	LEAD	TECH
TECH	LEAD	TECH	TECH	TECH	SM	TECH	LEAD	TECH
LEAD	TECH	TECH	SM	TECH	TECH	LEAD	TECH	TECH
TECH	TECH	SM	TECH	TECH	LEAD	TECH	TECH	LEAD
TECH	SM	TECH	TECH	LEAD	TECH	TECH	TECH	LEAD
SM	TECH	TECH	LEAD	TECH	TECH	LEAD	TECH	TECH

Maintenance Process - Personnel

Shift manager

- Review the status of all tasks
  - Complete / in-progress / not started
  - Determine work assignments for leads
- Brief leads at beginning of lab on work and other items of note (visitors, etc.)
- Supervise shift

Maintenance Process - Personnel

Lead Technicians

- Receive briefing form shift manager on work and other items of note (visitors, etc.)
- Coordinate resources and operations with other leads to avoid conflicts
- Brief technicians
- Supervise work

Maintenance Process - Personnel

Technicians

- Receive briefing form lead on work and other items of note (visitors, etc.)
- Perform task card items with inspection from QA as required
- Document work on task card

Maintenance Process – End of Shift

- Techs and leads interface to determine the status of the work
- Leads summarize information and meet with shift manager and update the turnover communication tool
- The next shift manager and lead group participate in out shift briefing

Landing Gear & Wheel Wells

Wings

Fuselage

Empennage

Control & Passenger Cabins

Auxilary Power Plant

Power Plant and Nacelles

AVS 4630
Shift Turnover Log

Projects and Non-Routines

Safety Briefing Items

Tooling-Parts

Ramp Manager

Base Manager

Card Tracking

Issues & Follow Up

MCC - ACARS

Ordering

Federal Aviation Administration

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Summation

- Does this process create experts? No

- Exposure to the development and implementation of large aircraft maintenance lays a foundation of understanding that prepares them for the air carrier and MRO workplace

There Is More……

- Research maintenance related NTSB reports
- Learn airline maintenance management
- Maintenance economics
- Quality assurance

- They stay busy!

For More Information

Raymond Thompson
Associate Dean, College of Aviation
Western Michigan University

raymond.thompson@wmich.edu