KC-46 Vertical Tail Panel Removal

Industry Sponsor: Jonathan Harkness – 76th Aircraft Maintenance Group
Faculty Advisor: Dr. David Baldwin

GALLOGLY COLLEGE OF ENGINEERING
SCHOOL OF AEROSPACE AND MECHANICAL ENGINEERING
The UNIVERSITY of OKLAHOMA

CAPSTONE TEAM 11

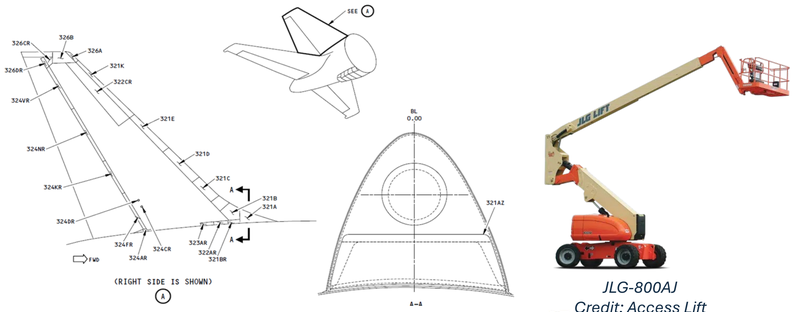


AME Capstone Team 11 Members (L-R):
- Brandon Agee
- Kyler Cagle
- Landon Hall
- Arash Amourpour

PROJECT BACKGROUND

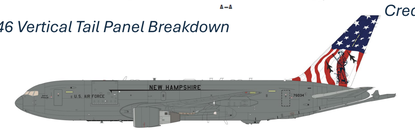
The 76th Aircraft Maintenance Group (AMXG) located at Tinker Air Force Base has partnered with AME Team 11 to design panel and ground support equipment with the purpose of aiding in the removal of the 4 leading-edge panels on the KC-46 Pegasus aircraft's vertical stabilizer.

The current method for panel removal requires repeated boom lift use, lowering panels to the ground one at a time. This project seeks to reduce these operational inefficiencies, the risk of panels falling, and develop ground support equipment which facilitates panel storage and transport.



KC-46 Vertical Tail Panel Breakdown

JLG-800AJ
Credit: Access Lift



KC-46 Pegasus
Credit: Wall Pilot

CONSTRAINTS AND REQUIREMENTS

- Design must be compatible with current 76 AMXG equipment
- Panels must be secured throughout lowering, preventing drops or damage to panel structure
- Structures must be able to support a minimum of 200 lbs
- Design must not inhibit other maintenance operations

CODES AND STANDARDS

ASTM Material Standards – Material selection and specifications

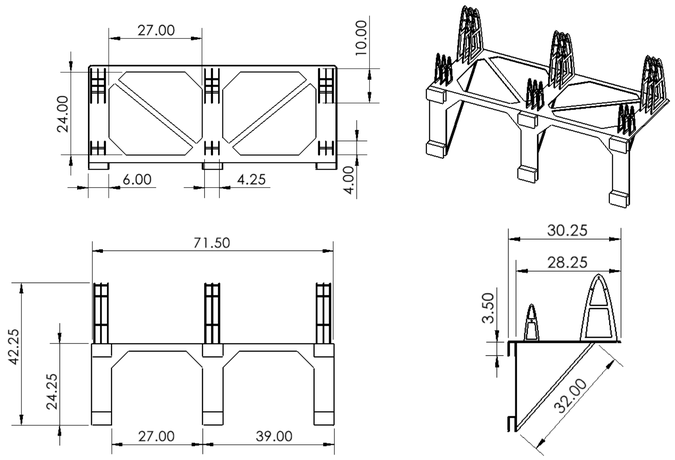
DAFMAN 91-203 – Department of the Air Force occupational safety standards

ASME Y14.5 – Engineering drawing and tolerance standards

SAE J249 – Steel fastener standards

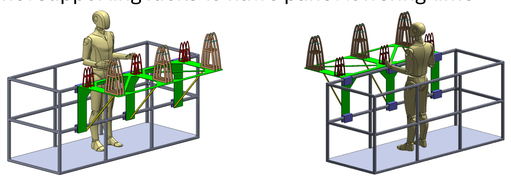
US Customary System – Dimension and unit standards

PANEL SUPPORT DESIGN

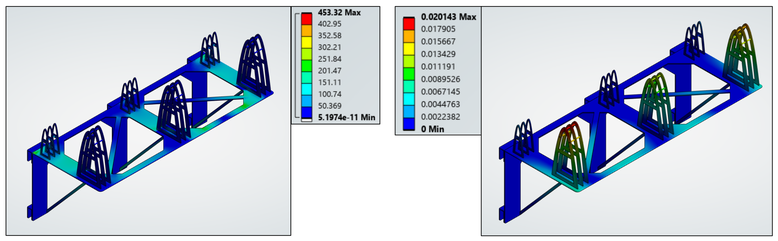


PANEL SUPPORT SPECIFICATIONS

- 0.25 in. ASTM 6061 Aluminum provides 40,000 psi of maximum yield strength at a total design weight of 61.37 lbs
- 28.25 in. overhanging platform length allows for easy access to both panel mounts for technicians
- Buna-N nitrile rubber allows for high friction, surface safe contact between panels and mounts
- U-hook mounting system to attach to JLG-800AJ boom lift basket
- Two panel supporting racks to halve panel lowering time



FINITE ELEMENT ANALYSIS



Equivalent Stress (psi)
Anticipated Loading

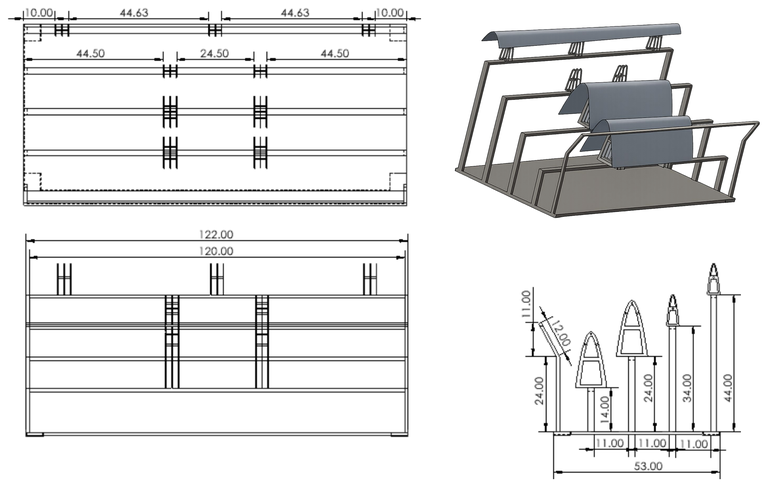
Total Deformation (in.)
Anticipated Loading

- Rigid design minimizes total deformation and evenly distributes stress
- Maximum loading of 1500 lbs. while maintaining a safety factor above 3
- Low deformation and stress under anticipated maximum load of 50 lbs

GROUND SUPPORT SPECIFICATIONS

- Staggered compact design
- ASTM A36 Steel provides 36,000 psi of maximum yield strength
  - 1 x 2 in. square tube railing with 1/8 in. thickness
  - 1/8 in. thick base
- 41 and 5/8 in. handle height
- 4 in. diameter 1000 lb. load rated locking swivel casters

GROUND SUPPORT DESIGN



COST ESTIMATES

Material Cost Estimates				
Equipment	Material	Desc.	Quantity	Est. Price (USD)
Panel Support	6061 Aluminum Alloy	0.25 in. sheet	18 sqft	781
	6061 Aluminum Alloy	3/8 in. diameter rod (6 in.)	12	11
	Buna-N Nitrile Rubber	1/16 in. sheet	36 in. x 36 in.	48
Total Panel Support Cost Estimate:				**840**
Ground Support	ASTM A36 Steel	1/8 in. sheet	54 sqft	442
	ASTM A36 Steel	1/8 in. thick 1 x 2 in. square tube	77 ft	339
	Buna-N Nitrile Rubber	1/16 in. sheet	36 in. x 36 in.	48
	Steel	caster wheel w/ brake	4	133
	6061 Aluminum Alloy	3/8 in. diameter rod	17	16
Total Ground Support Cost Estimate:				**978**

Developing working prototypes for each design would cost a total of approx. **$1,818**.

CONCLUDING REMARKS

The panel support equipment, costing approx. **$840**, provides a **100% increase in operational efficiency** while mitigating falling object hazards.

The ground support equipment, costing approx. **$978**, simplifies storage and transport of the panels.