Internship Report

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Executive Summary

This report outlines my sixteen-week internship experience at Piper Aircraft, Inc., located at Vero Beach Regional Airport (KVRB), during the Fall of 2025. This earns me not just an additional 1 internship credit hour that I need for graduation but also an expansion to my skills and experience. With this internship rotation, I underwent essential training. I helped with two Engineering Work Order (EWO)'s: one for the fatigue testing that I started during Summer but could not finish back then, and the other one pertaining to the pitot-static system of the Piper Aircraft (PA)28's.

Moreover, I worked on an independent project to improvise the current system capturing the rudder force applied by the pilots, calibrate the new system, and do data acquisition. Besides, I learnt how to use many more tools like fish scale, safety cables, ferrules, crimp guns, Hi-locs, dry-wall anchors, sheet metal cutters, electrical pins, air tools etc. I got training to do processes like drilling and installing rivets, Tungsten Inert Gas (TIG) welding, nut plate installation, and Hi-loc installation and removal. I learnt how to navigate internal Piper database for a multitude of things, like looking up parts, fasteners, and components using internal Piper numbers or codes, look up industry standard hardware like Military Standard (MS), National Aerospace Standard (NAS), Army-Navy (AN).

There were various learning opportunities. I attended the Art of Aircraft Design Luncheon every Tuesday for a good number of sessions. The presenter is a senior engineer who went over so many foundational calculations and design considerations that one should account for if setting on making an airplane from scratch. This reinforced my knowledge from the Airplane Dynamic Stability class. Regular conversations with a few aerodynamicists that I could meet taught me more.

I got to do some outreach in the community. I, along with my supervisor, did a STEM outreach at the Osceola Elementary School for about a 100 students. Overall, this internship is a worthy enhancement to my master's degree and no matter where I go, I can apply all the knowledge. Plus, I made some great connections and memories for life.

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List of Abbreviations

A&P Airframe and Powerplant. 1

AN Army-Navy.

EWO Engineering Work Order. , 1, 2

LT Low Torque. 3

MPE Multi Purpose Elite. 3

MS Military Standard.

NAS National Aerospace Standard.

PA Piper Aircraft.

SH Servo Hydraulic. 3

TD HT Type Design High Torque. 3

TIG Tungsten Inert Gas.

TWE TestWare Elite. 3

Introduction

Piper Aircraft Inc., recently celebrating its 88th anniversary, stands as one of the oldest and a few leading trainer aircraft manufacturers fully based in the United States. With a portfolio of approximately 11 distinct aircraft models categorized into Business, Personal, and Trainer segments, Piper has honed its craft over nearly nine decades. The company is headquartered in Vero Beach, Florida, occupying an expansive 80-acre campus adjacent to the airport. This site functions as a self-contained community, encompassing 21 buildings that house manufacturing, production, fabrication, medical and wellness facilities, fitness centers, human resources, engineering departments, service and experimental hangars, and a private Piper ramp.

During this internship rotation, I continued in the same department as in the summer term, working as a Test Engineer within the Test Operations wing. This division includes both ground and flight test operations and is composed of Airframe and Powerplant (A&P) mechanics, test engineers, and flight test pilots. The team conducts a wide range of test setups—from structural and pressure testing to control systems and electrical configurations—designed to capture real-world data that reflects aircraft performance in operational environments.

My primary responsibilities involved taking care of two Engineering Work Orders (EWOs). This entailed designing and executing test setups to acquire data requested by engineers from other departments for further analysis. Once a test setup was complete, it underwent verification by the supervisor, the initiating engineer, and a quality assurance representative. If any issues arose, we resolved them in real time before proceeding with data collection. Upon successful completion, all documentation was submitted to the Data Release team to formally close the work order.

One of the most rewarding aspects of working in this team was the diversity of tasks and the flexibility to explore different areas of interest. Between EWOs, I had the opportunity to collaborate on one independent project with a colleague in the team.

These projects offered greater creative freedom and fewer constraints, allowing me to broaden my understanding of the department's capabilities. This time, I chose to diversify my experience rather than focus solely on EWOs, which helped me better appreciate the full scope of operations within the Test Ops group. Rather than just focusing on learning the MTS machine, I did something different. I tried to make a model airplane using the newly learned riveting skill and knowledge from the Art of Aircraft Design Luncheon. Designed completely out of sheet metal, that was a surreal personal growth and confidence boost. I am so glad I did that. With the time constraint that I had due to the nature of this internship, I decided on making a scaled down static model and just get it 'down and dirty'. However, that comes with its own set of challenges and struggling through those and figuring out solutions was good learning.

Duties and Lessons Learned

I. Fatigue Testing of Representative Vertical Stabilizer Spar Low Torque Bolted Joints

This project started during the Summer where the MTS load frame and software had to be configured to run a high cycle fatigue test on six specimens of the vertical spar of PA28's to detect the development of any possible cracks, especially around the torqued bolts. The three specimens were Type Design High Torque (TD HT) at 90 in-lbs and the other three were Low Torque (LT) at 30 in-lbs.

This test was done entirely on the MTS load frame as shown in **Figure 1**. Each sample had to be loaded on to the MTS machine and run for 20 million cycles at intervals of 5 million cycles and inspections. At the end of each interval, the nuts had to be un-torqued using a torque wrench, dial type with memory pointer, holes had to be measured, Surface Eddy Currents inspection had to be done, and then the bolts had to be torqued back at the rated torque value to go for the next 5 million cycles and so on. One cycle was defined as going from 122.5 +/− 6.2 lbf to 1225 +/− 62 lbf and back to 122.5 +/− 6.2 lbf at a frequency of 20-25 Hz.

I took this opportunity to get familiar with the Multi Purpose Elite (MPE) software. I designed the same test on this software using a company template. This solved many problems that were arising on the old TestWare Elite (TWE) program during Summer. These are proprietary software from MTS, used heavily for these testings in the industry. Therefore, I had to write a new MATLAB script to process the data files coming out of MPE instead of TWE. MPE is mainly designed for servo hydraulic tests and can run a large set of data without crashing and the data files are in a much better user friendly format. It is not that TWE cannot handle servo hydraulic tests because otherwise the company would not provide Servo Hydraulic (SH) templates inside of it. However, there are some caveats to it.

With the machine running continuously, it took about four months to finish the test,

collect all the data and sort them. The final stamps were collected from a quality person and the work order was closed.

II. Pitot Mast/ Hose Pull Test

The pitot and static mast has two pipes or cables attached to them. Tension was required to be applied to each hose in line with the connector and that tension had to be recorded. The test setup is shown in **Figure 2** . This test gave me the opportunity to see how revisions are made to work orders. Also, that not all tests requested on work orders are involving. Some of these tests are quick and easy grabs. You can just take what's around and get them done. After the work order was revised, instead of using the entire pitot mast, the pipe was connected to a flat aluminum stock via a 7/16" threaded hole. I applied recently learned welding skills to weld an aluminum tube with a flat base to get a base support frame to hold on to. However, while testing, the hose clamp would slip away. Later I realized that the reason of slippage was that there was no shaft inside the hose clamp to grip onto. So, we moved the hose clamp to the other end of the pipe and inserted a screw so the clamp could grip to that. Finally, a little loop with a safety cable did the job. The fish scale gave the numbers in lbs. Five tests were run with the pitot pipe and five with the static pipe. The values ranged between 15 - 21 lbs.

III. Rudder Pedal Force Capture Assy

III.I. Design Considerations

Pilots apply forces on the rudder to yaw the airplanes. That force needs to be captured for testing and analysis purpose in flight test environment. A load cell can be used to measure that force. However, the key issues with the old design were:
1. There was a small cylindrical block sitting on top of a button load cell. The surface area of the top of the cylinder was too small and pilots had to consciously make sure to press-on to that small area. During flight, when a pilot is task saturated, adding this to the checklist and making a pilot bend over to look at the foot is risky.

2. The location of the load cell was not quite right. It was tricky for pilots with bigger feet to get to the load cell mark.
3. The rudder pads and brake pads were at the same height which was not helping in placing the foot comfortably to press on the brakes when needed.
4. There was no way to look inside the cylindrical flange to make sure the contact is well established between the metal block and the load cell.

With the improvisation, the changes that were made were:

1. Instead of a small, about an inch diameter cylindrical block, a rectangular plate that tapers down to a small sphere was built. The sphere is about the size of the button load cell. This is in an attempt to reuse the button load cell. This would increase the surface area.
2. The load cell was moved up to account for the location. This could introduce flexing and also mean that now the load cell is not directly on top of the rudder hump on the pedal. To make sure that maximum load is exerted on the rudder hump and to avoid flexing, a block was added underneath at the center to fill in the cavity between this fixture and the concave pedal shape.
3. The rectangular pad is at a higher level than the brake pads. This offset in the height solves this issue.
4. A peep-hole is added on the existing flange. This would facilitate visibility to make sure everything inside the flange looks good and the contact is not lost over time or there are no ruptures or wear and tear over time.

Lessons learned from the design phase:

1. Not every design project needs to be redesigned from scratch. For improvisations, keep what is working, just focus on what is not working. This is easier said than done but try your best to not get into the 'redesign-from-scratch' cycle.
2. Taking reviews from the end user should be the first step while generating a product development sheet. This helps in pin-pointing the pain areas. If things get too overwhelming, take the three top most pressing issues and focus on resolving those.

Remember, design work is a dynamic process. You do not have to solve everything all at once.

3. 3D printing is good for proof of concept but 3D printing is not fabrication. For instance, tap drills may not resolve properly or show up during 3D printing. The thickness for plates may not be accurate, as while the extruder lays a layer, because of the heat, the plastic can develop local deformities. One can pry a little harder to make fasteners fit when it is plastic but with metal, the hole depths, threads etc. must be accurate to the tolerances. It is important to be wary of these little things.

III.II. Calibration of the load cells

The calibration process is straight forward. A 5000 lbf or 22 kN load cell is used in line with the button load cell using a C-clamp. The button load cell is connected to the proprietary application and the bigger load cell to its own respective software for calibration. The calibration gives a relation between the lbf and Volts.

Later, the button load cell which is attached to the rudder force capture assy is put inside the airplane to test. The app shows the measured reading in Volts (V). Then the simple linear equation generated from the calibration (shown below) can be used to go from Volts to load in lbf:

$$y = (m + b)x$$

where;

y is in lbf,

m is the multiplication factor or gain value,

b is the offset, if any,

x is in Volts (V).

IV. Rivet Training

Piper has its own Harry Brubaker Training Center where it trains employees before they start on the production floor. On a need basis, engineers too can get approval from supervisor and go through the same training to get a better understanding of the riveting process or to learn from scratch. Airplanes are held together using rivets and there are thousands of them that go on making one airplane. Piper uses some types of rivets than others and maintains internal specs or documentation on the installation process. As part of this internship, I successfully completed the three-days long training. **Figures 4 and 5** show the drilling and prepping work done on a provided training coupon.

Results

I. Fatigue Testing of Representative Vertical Stabilizer Spar Low Torque Bolted Joints

The deliverables were six different .txt data files containing raw data. The peak and valley load numbers in lbf and the cycle count. Switching from TWE to MPE made the file sizes go from about 2 GB to 200 MB, which made the post processing significantly easier. A sample data file from the MPE software is shown in **Figure 3.** The other items stored were the regular checks pictures, back off torque videos, Test logs, notes, MATLAB scripts etc.

II. Pitot Mast/ Hose Pull Test

The force numbers were recorded on the table attached to the work order itself and a picture of the setup was also attached.

III. Rudder Pedal Force Capture Assy

The outcome of this project was a fixture or product. This is to be used by the test ops team inside the experimental airplanes for data collection. No picture or data can be provided due to the confidentiality nature of this project.

Conclusion/ Summary

- How ERAU education helped in this internship?

  A lot of the things that I did here throughout my time at Piper had to do with structures which is a lot of what I have done during my time in the mechanical industry. One thing that I can say for sure is that all of that new knowledge of Dynamics and Control from ERAU and the skills with it, complimented things a lot. Mainly, the conceptual and software skills.

- Student experience at ERAU compared to professional internship experience:
  Student experience at ERAU gives limited exposure to real world work. Internships help with that. It is here that I learnt that what I have been loving to do since day one actually has a name to it - a test engineer and a test pilot. School is a small space for people who have exceptional kinesthetic-engineering skills. My strength lies in actually seeing machines, tools, etc., touching them, sensing them, playing with them. School makes me limited.

- Coping strategies about life both inside and outside the workplace:
  Inside:
  1. Stay away from any and all kinds of gossips. Do not participate in trivial discussions not pertaining to work. Like they say, "Great minds discuss ideas.". Cheap people talk about other people. Do not get clogged up in meaningless talks. This way, it keeps your mental health happy.
  2. Just because others are doing things fast, does not mean you have to rush. Half of them are moving fast but missing tens of minute and key things. I have seen this first hand. Go at your own pace. Going slower than others never means you are slow or bad at what you do. It actually means you are vigilant. I get this a lot that I have good eyes and I catch things others miss and that is exactly because I go at my speed.
  3. Peer pressure can be a big one. Stay away from it even if that means standing alone. This is a crucial stage in your life and the four or five people you spend

time with, you will become like them and your life's trajectory and growth will be about the same. There is a difference between work colleagues and real life friends.

4. Find out about events happening around the industry or factory and go to those. It is always fun to put yourself out there and show up.

Outside:

1. All the non-work related mess that your head gets in accidentally, forget about all of that the minute you step out or you can always share it with someone and get it out of your system. Goes a long way.

2. When you are tired, take a break. Go on road trips. Weekends are best for short road trips.

3. Do something to stay active. That can be going for fun meetups like water aerobics, hot yoga, swimming, etc. or simple walking to put steps in.

4. Stay in touch with family. Super important to keep you grounded and anchored. So no bad company can sway you away.

- How did the internship improve your technical knowledge level? Big time. This has to be my favorite part of the entire time here. I have gathered good stuff to last a lifetime. I had just learned a lot of fabrication at the University of Michigan during my job there but had to leave and I was fearing that I may get rusty. This internship helped in sharpening all of that. On top of that, I learned how to weld, a lot of invaluable things about rivets, airplane building, structural knowledge, fracture and fatigue concepts, and many more. Piper is definitely going to have a special place in life for training me with all of that. Overall, good memories for life.

- Will this internship help in being a better student? Yes. Any internship you do helps open your mind up. When more neurons are activated, no matter where you use them, they give you good harvest. What I learn in flying helps me in engineering, what i learn in both helps me in school, what i learn from all of them helps me in life. It is all cascaded.

- Did this internship contribute to your preparation as a potential future employee? Yes. With actual skills in my hand, I can do any and many things. I can use them in future jobs, I can use them in business. Possibilities are many. Skills never go wasted. Any time spent gaining those is worth it.

- The most important thing I learned both technically and as a new professional: Always have a birds eye view about all of this. When you are diving into the details, it is equally important to have the big picture all the time. You are bound to make mistakes, some days you may feel hopeless or a complete loser, things are going to go wrong but if you know where the end goal is, you will bounce back in no time. Learning is a process and do not expect it to happen overnight. The big picture will give you the motivation to keep going and never give up.



Figure 1
MTS Load Frame

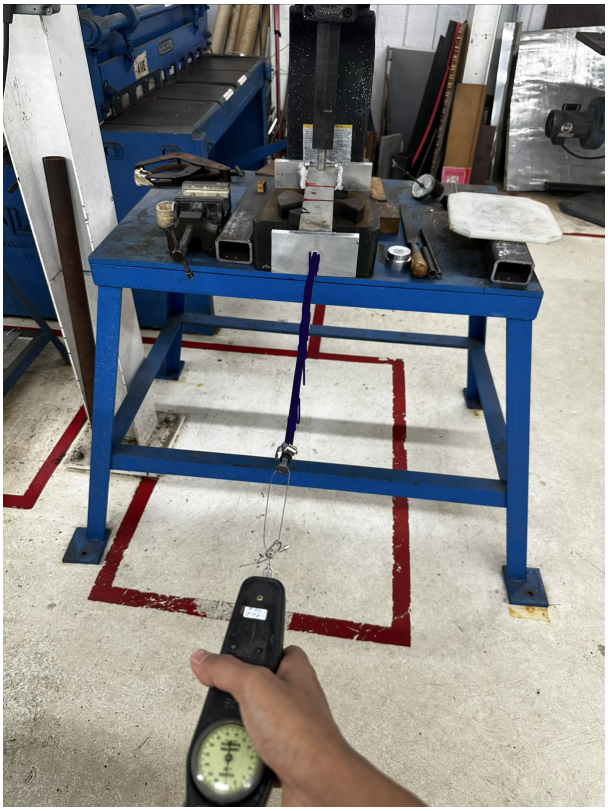

Figure 2
Pitot Mast/ Hose Pull Test Setup

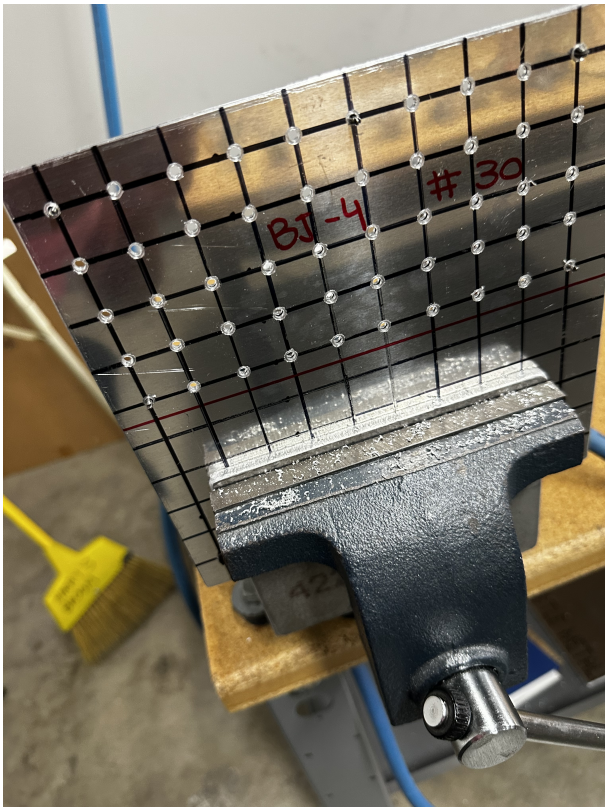

Figure 3
Rivet Training: Drilling #30 holes for a BJ-4 rivet install.



Figure 4

Rivet Training: Installing BJ rivets and getting them ready to be riveted using a rivet gun and bucking bar.

File Path: C:\MTS TestSuite\Data Files\EWO28074D Fatigue Testing\Test Run 1 09-22-25 7 43 33 AM\Cycle 0 Data - Data Acquisition 1 - (Peak-Valley).txt
Test: MTS SH Fatigue Test 28074D
Test Run: Test Run 1
Date: 9/18/2025 9:10:09 AM

CycleCount	Axial Load Valley	Axial Load Peak
CycleCount	lbf	lbf
1	120.862839427737	120.97400898688
1	120.913072920211	121.053729443387
1	120.930224481421	120.990954729356
1	120.98917096699	121.19800837629
1	121.194180147828	121.20519831075
1	120.934862263573	121.288486291988
1	120.952370577256	121.029511438957
1	120.909697492964	121.368000929761
1	121.038540020779	121.425863436661
1	121.320964488297	121.54599297138
1	121.364447126278	121.464282933773
1	0	121.300766809815
2	427.923631092813	483.696693642505
3	537.334043790251	647.006943980455
4	581.207517827008	715.426634721921
5	605.017836507038	751.115328863979
6	613.271112876588	768.757232627727
7	612.613206431047	774.824823806588
8	608.513407009254	774.685306147077
9	604.324145044187	772.999952578775
10	600.830769941806	772.523550814589

Figure 5
Sample MPE Data file