Miami University
Department of Engineering Technology
ENT 498 Senior Design
Universal Test Stand

Campus: Miami University Hamilton

Professor: Gary Drigel

Team Members: Tyler Gregory, Keith Kincaid

Date: March 2, 2020

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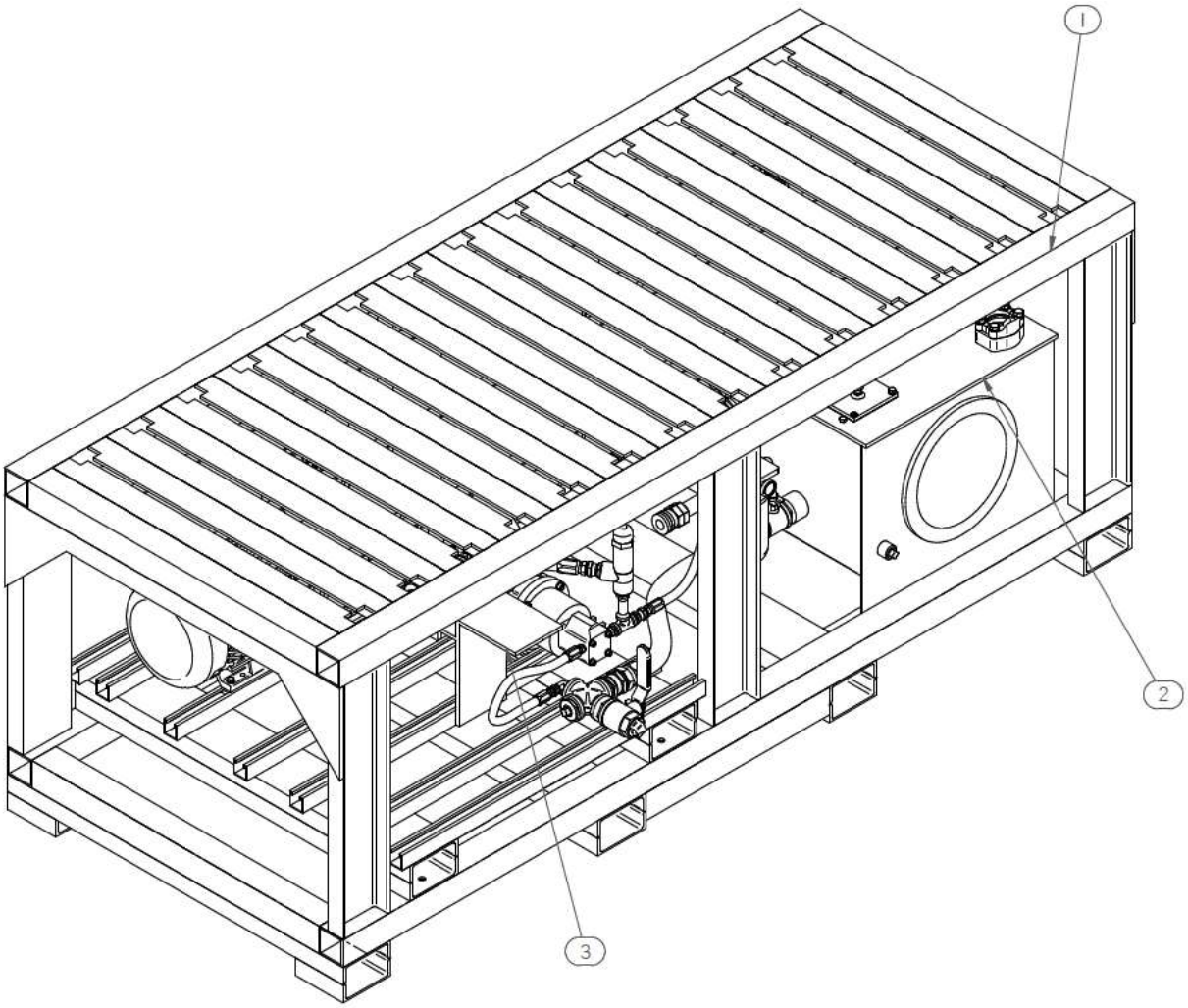
Universal Test Stand



Campus: Miami University Hamilton

Professor: Gary Drigel

Team Members: Tyler Gregory, Keith Kincaid

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Statement of Purpose•

The purpose of this project is to build a test stand for Force Control to be used in their Engineering test lab. It will be designed to test a variety of units in the way of a universal mounting feature in the top of the table, this will allow for multiple test setups to be run with one unit. The units that the test stand will be designed to test are the smaller oil shear clutch/brake units. These units normally consist of a pump motor group for hydraulic actuation to engage or stop the machinery attached to it via the oil shear clutch/brake. This test stand is being built so it can run a variety of different units with a range of horsepower and torque instead of just one set specific torque and horsepower rating.

The universal test stand will house its own actuation system to power a clutch/brake without setting it up as an independent actuation system. These oil shear units are being used to test all different sorts of applications by big companies all over the United States of America. John Deere uses these oil shear brake in their dynos to test the durability and strength of their drive train they build to put into their machines.

Force Control has specified a 40 Gallon capacity oil tank mounted under the table with low pressure actuation (0-100 PSI) and a cooling system with a pump at 33 GPM capacity. The actuation system and cooling system will share a common tank. The table needs to fit in a designated location of the lab, location yet to be determined, and size limitations need to be considered.

The purpose of building this type of test stand is to be a universal type test stand. One stand that can be used to test all different types of hydraulic clutch brake combinations that Force Control builds. Force Control currently has a test stand now, but this current stand can only run a couple different types of hydraulic clutch brake units, not universal for all the different combinations of

unit's Force Control builds. Building this test stand will require 3D modeling to develop the drawings for the stand, oil tank, complete unit assembly drawings as well as an installation drawing to show dimensions of completed unit and critical components. This unit will require FEA analysis to determine the stresses it can handle, and the design altered as required to meet Force Control needs. Thermal calculations can be easily found once Force Control determines the heat exchanger to be used, the heat exchanger will have a chart that will provide the amount of HP dissipated based on GPM from the cooling pump.

Table of Contents•

Scope and Methodology•

The scope and methodology for this universal test stand is listed below in order from start to finish of the project. Even though we have these steps listed in order, something can always go wrong and force a change or a setback in terms of the project completion. I think we have accounted for any foreseeable setbacks or bumps in the road to the best of our abilities and have been able to avoid any major problems. I think we made some great progress in the first half of senior design which is setting us up to complete the project early. We have created a topic proposal, had the proposal approved by Force Control, and Gary Drigel. Since Keith works for Force Control, he set up a meeting for Tyler to meet the engineering team at Force Control as well as the president who will oversee the design of this project. We had the test stand designed, the drawings for the stand had been approved, and budget had been created and approved before the winter break Once we had the budget approved, Keith collaborated with the purchasing department to order all of the parts for this test stand, at this point in the project all the parts were on order and supposed to arrive on time. Over the next couple of weeks, we were receiving parts in on a regular basis and were currently only missing a handful of the components to this system. Over the Winter Break, we were able to meet at Force Control and assemble all the subcomponents, in doing so we checked for fit and design issues. We found that the support for the return lines needed to be fabricated and welded to the stand and the supports for the drip trays were warped causing the trays not to fit properly. Force Control was able to assist by welding the return line support as well as the drip tray straps before paint. Keith was able to make time with the paint shop and he painted the test stand, tank and associated components blue per Force Controls request. Once the stand was painted, we were able to meet again to begin final assembly

and start making and attaching hoses as per the print. At this point the stand was fully assembled and awaiting Force Control to set up one of the units for functional testing and check for leaks.

Step by Step Plan:

1. Meet with group and Gary to see if the project is acceptable.
2. Tyler and Keith get together to get a full understanding of project, the purpose, and what the use is.
3. Setup a meeting with Force Control so Tyler can meet the CEO, head engineer, HR, and Keith's boss.
4. Create a presentation for the meeting with Force Control
5. Meet with Force Control to determine the scope of the work and add remove items as necessary. Work out details for location of test stand in the lab, make sure the company have a plan in place to connect power and controls to the system.
6. Have Keith get in contact with purchasing department to get an estimate on how long the lead time of some of the main components.
7. Determine tests and setup to be performed for the purposes of this project.
8. Design and create prints for the table/stand to be fabricated outside at a weld shop.
9. Order Stand after prints have been created and approved.
10. Design and create prints for oil tank for out fabrication.
11. Order tank after prints have been created and approved.
12. Review and revise budget and cut list as required to finalize budget.
13. Determine cut list for materials and supplies needed to complete the project.
14. Coordinate with Force Controls purchasing department to order required items.
15. Once items start arriving, start assembling components based off of what is available.
16. If stand arrives first, make any necessary changes to stand to accommodate the purpose of this project.
17. If the pumps and motors arrive at the same time then, assemble pumps and motors for actuation and cooling while waiting for other components.
18. Assemble the pump motor groups to the stand.
19. Once pump motor groups are assembled to the stand, look at prints to see which fittings go in which port.

20. Assemble filters, and any pressure relief valves to the system.
21. Fit Tank in stand and locate mounting holes, Weld items to stand as required/ make adjustments.
22. Fit pump motor groups, and filters to determine the plumbing for the hoses. Add additional support for items as required, i.e. weld, bolt on etc...
23. Disassemble any items that do not get painted.
24. Tape any items that cannot come off unit that does not receive paint.
25. Coordinate with Force Control to get the right color paint for the stand and unit.
26. If paint is not in stock, then order paint.
27. If waiting on paint, then we can assemble unit and start running some tests on the unit.
28. Once paint comes in, then prepare unit for paint then paint.
29. After paint is dry and approved with force control, remove any tape and assemble any parts that were removed prior to paint.
30. Coordinate with Force Control to install and hook up test stand with a test unit.
31. Test unit - check for leaks and proper operation.
32. If test fails, work out kinks in the unit and retest until proper operation.

Expected Findings•

Force Control specializes in Oil Shear Industrial Clutch and Brake systems. The principle behind the built-in oil pump and oil shear theory is displayed in Figure 1 (Force Control). These

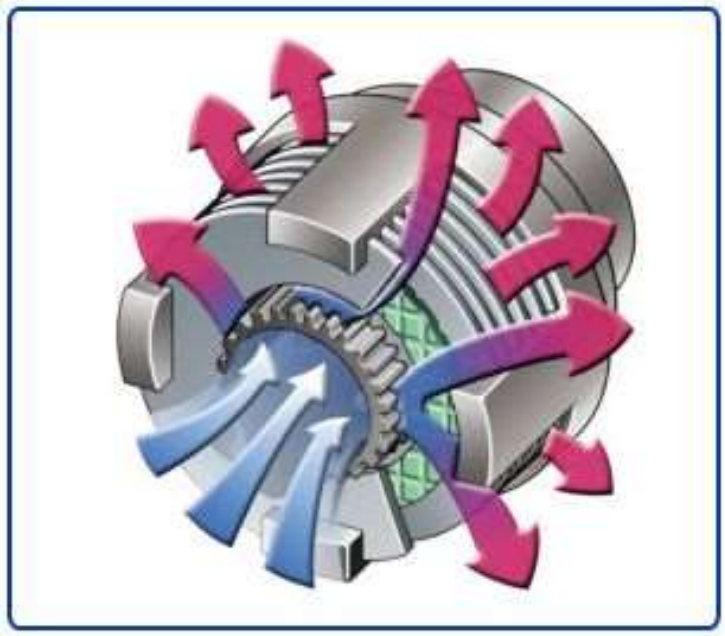

Figure 1

systems have many uses out in the industrial field from dyno applications, to motor brakes to Posidyne Clutch brakes. John Deere is one of Force Controls customers and they purchase these Oil Shear tension brake systems to test their drivetrain and transmission components installed on their products as a Dyno application. They take these units and run them at a certain desired horsepower and torque output on the drivetrain. They will usually run at 110% to see what component in their system breaks first. Once something breaks, they find out why it broke, and they redesign it and the whole system gets tested again and again until something does not break.

So, what is so important about this universal test stand that we have built? Force Control came to us and told us that they must be able to test as many as their products in house as possible before releasing these products to the customer. Before this test stand was completed Force Control was currently using multiple test stands to test certain size units before shipping. This universal test stand we have built is able to test multiple units up to a size 20, which is capable of a static torque rating of 3000 lb-ft. As previously mentioned, this test stand comes equipped with

a cooling system on board and is capable of handling the a 40HP motor that is planed to be installed on top of the stand to drive the units. With the Delta D49 hydraulic pump that we have installed on this stand, rated at 33.6 GPM with a 1800 RPM motor, the heat exchanger that will be installed and specified by Force Control is a API Heat Transfer model AOC-57, as referenced from API's AOC catalog, we can handle the 40 Thermal Horsepower. Due to the limited electrical power in the test lab at the time of our validation we currently have a 15HP motor with an AOC-37 installed which is limiting our THP capacity to 17HP max.

With the stand being open underneath, and the removable pump skid this stand is going to be a mechanic friendly unit to work on by having open spaces which will make assembly and dis-assembly of components very easy as illustrated as a 3D model in Figure 2. This stand features a quick disconnects for actuation, a removeable pump skid for quick pump motor group interchange and drip trays which eliminates having to worry about oil or fluid leaking on the floor, these drip trays will be very easy to slide in and out for drainage and positioning. On the bottom of the unit we have equipped lift points for the unit so it can be easily moved around the shop with a forklift without having to worry about damaging the unit itself. The feet also have holes drilled in them for the option of permeant mounting, this can be seen in figure 3, a picture of the stand as it has arrived from the fabrication shop back in December.

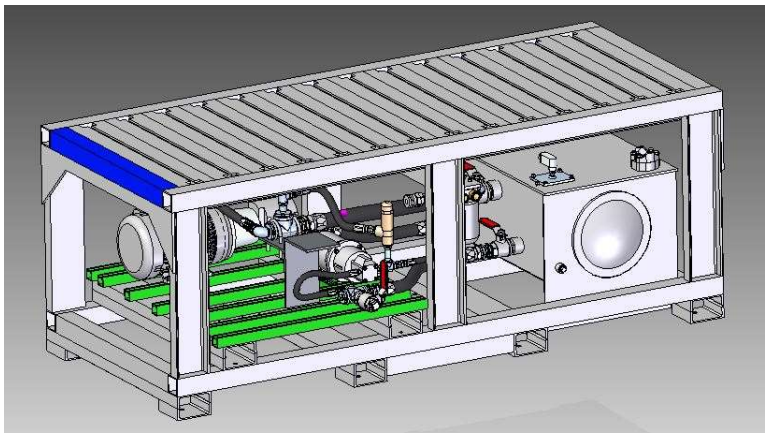

Figure 2

Figure 3

This unit is also big enough to house its own cooling system, which is something the other test stands do not allow. This stand has the capabilities to house a low-pressure system hydraulic actuation system and has the provisions to be able to run a high-pressure hydraulic actuation system. Figure 4 shows a 3D Model of the hydraulic skid with the cooling pump and low-pressure pump, Figure 5 shows a 3D model of the same skid but with the proposed future high-pressure pump. We have designed the tabletop of the stand to be made with a T- slot setup by putting angle iron back to back, this gives the ability of making the top into a universal design to handle multiple setups. The T-slots, skid, and area for the Tank can be seen in Figures 6, 7, and 8.

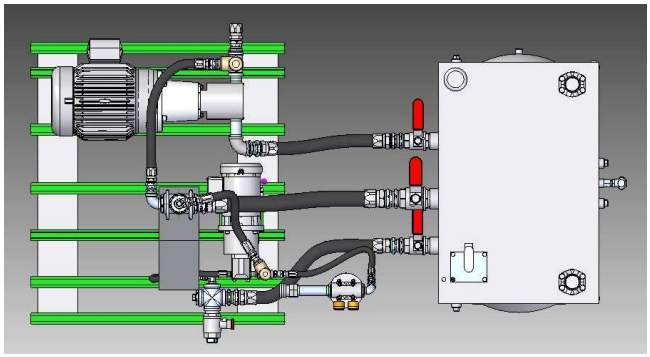

Figure 4

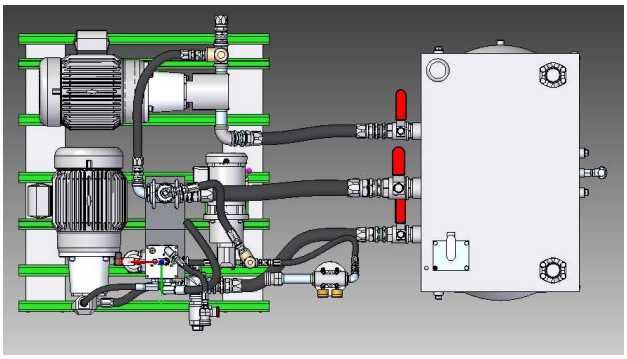

Figure 5

Figure 6

Figure 7

Figure 8

The materials we have ordered for the stand arrived in late November, early December. During winter break we were able to get a jump of things by installing the pump motor groups, the motor mounts, filter bracket mounts, hose fittings, and ball valves. The hydraulic tank arrived in early December after the stand itself had been delivered. Once all those items were delivered, we had started pulling the items from Force Controls stock that was not ordered, these can be seen in Figures 9, 10, 11, 12, 13, 14, 15.

Figure 9

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14

Figure 15

When we received all the materials and the tank arrives we were able to get started with paint and assembly. After several meetings we were able complete the assembly of the test stand, but this did not come without some problems. Some of the obstacles we had to overcome in the building process of the test stand were parts being on backorder. Once all the ordered components of the stand arrived, we thought we had received everything we needed to complete this project, but after further evaluation we realized we were missing a black iron nipple and a couple hose fittings.

Another problem we ran into was once we received the stand, we noticed the supports that hold up the drip pan were severely bowed. We were able to cut those supports off and then have them rewelded to keep them flat. The next problem we had ran into was the stand did not come with the tank return line support attached. Even though we had called this bracket out in the drawing, it was not attached. We had to coordinate with the weld shop to have them weld on the tank return line support in the correct position.

Force Control decided they wanted the Universal Test Stand Painted Force Control blue as seen in Figures 16,17. Figure 16 is the quick removable skid for the pump motor groups, the filter bracket, and the tank. Figure 17 is 40 Gallon Tank with the modification specified on the drawing.

Figure 16

Figure 17

Once we had all the main components that required paint, painted we gave the unit a couple days for the paint to cure and dry and then we started the final re-assembly. We had to carefully re-install all the pump motor groups onto the removeable skid and then place the removeable skid in its correct position which is underneath the t slotted table top which can see be seen in Figures 18, and 19. This skid was obviously too heavy for Keith and I to pick up so we had to use the forklift to pick up from designated fork slots we had designed to be built in underneath the skid.

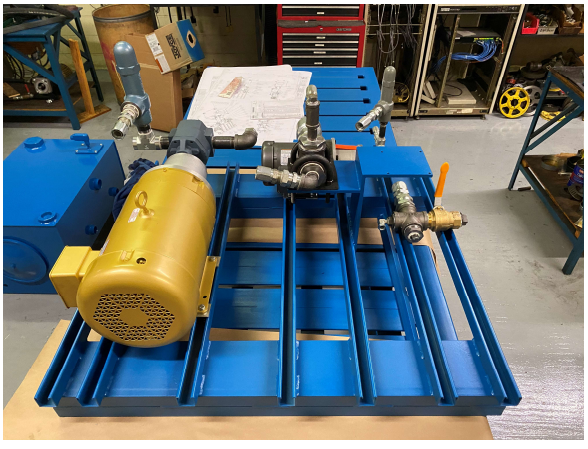

Figure 18

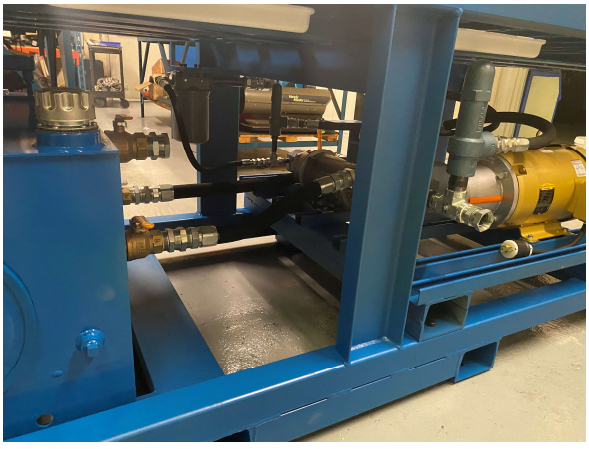

Figure 19

Once the skid was installed, we bolted down the skid into place and then started adding the hose fittings that go on the filter housing, the side of the tank, and the fittings that go on the top of the pump motor groups.

The next order of business was making the hoses for this unit. We took a measurement for each hose, cut that hose to exact length, cleaned the inside of the hose out so no debris would get logged in the filter, then assemble the field assembled hose fittings onto the ends of each hose. Every hose except for one hose is using the field assembled hose fittings, the main return hose back to the tank needed to be sized and crimped with Parker dies and crimping tool. Force Control does not have the Parker hose crimping equipment in house, Tyler had to take the 422-32 hose and the 10143-32-32 hose fittings and get them crimped by Hydrotech Incorporated. Tyler is a former employee of Hydrotech and keeps in touch with his former colleagues, so Tyler called and asked for a favor. This route was much quicker and easier than the normal route Force Control takes which is shipping this hose out to get crimped and that could take weeks.

The crimped hose was returned and installed on to the unit three days later which left nothing else to do but test the unit and check for proper installation and leaks. Keith had the electrical engineer at Force Control install electrical plugs on the motors for easy connection and disconnection for testing purposes. After all the electrical cords were installed a Force Control test unit from the lab was temporarily installed and mounted down on top of the Universal Test Stand. Force Control also setup a load cell and pressure control actuation system, so the unit could be controlled.

For the test a 03 Tension Brake test unit from the lab at Force Control is being used to test for any leaks and proper installation and operation of the Universal Test Stand. This unit and setup were picked so we can test both the hydraulic actuation and cooling at one time. Once the initial

test was running, a few fittings were found to be leaking some fluid, those fittings were taken off, cleaned and more pipe dope was installed then re-installed. The last problem that we encountered was the filter on the filter housing was leaking as we came up to pressure. After further investigation we determined it was due to a bad filter housing. Due to some unforeseen circumstances in getting a new housing and retesting at a later date, we bi-passed the filter housing for this test and sent in an order for a new filter housing. Once the Filter housing was bi passed, we noticed the unit was running up to full potential and no other issues presented themselves. The completed Universal Test stand with the 03 Tension Brake test unit can be seen in Figures 20 and 21.

Figure 20

Figure 21

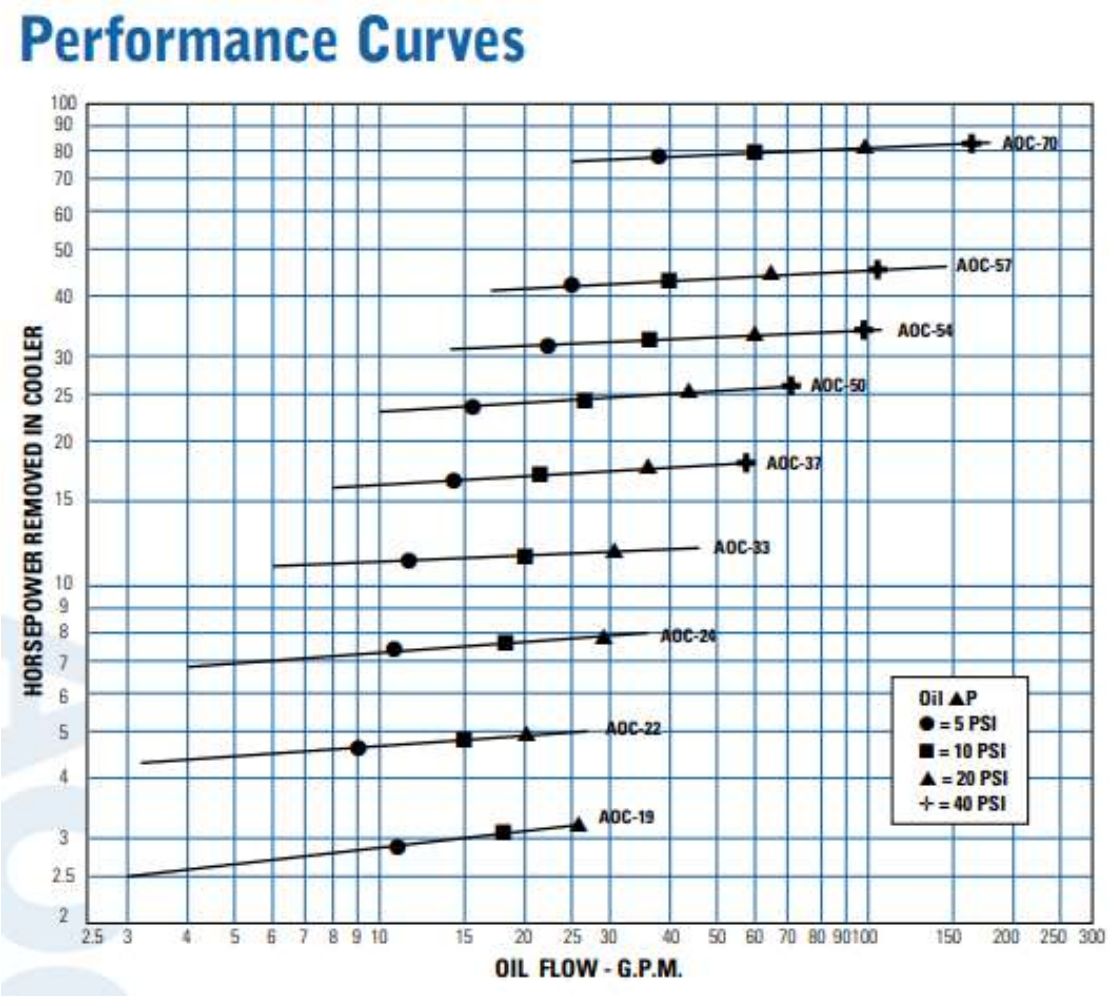

Chart 1

We ran two different tests on the TB03 with the cooling pump at 30 Hz suppling approximately 15 GPM to the unit, from the AOC-37 performance curve chart 1, this will dissipate approximately 16 THP (the full 33 GPM the system is rated for was not needed). The first of the two runs with the 15 HP motor on a 1:1 pully setup at 10 Hz from the VFD (Variable frequency drive, to control the speed of the motor). With this input from the VFD we were capable of 2.5HP at 300 RPM. The second run used the same setup but the VFD was changed to 30 Hz, this changed our capabilities to 7.5HP at 900 RPM. The data recorded from these tests can be seen in Table 1 and Chart 2. The max torque we were able to record was at 50 ft-lbs due to the motor stalling in the first test and the motor slipping the belt in the second test.

Force Control TB3 Test Results			
Motor @ 10Hzs (300 RPM 2.5 HP)		Motor @ 30Hzs (900 RPM 7.5 HP)	
PSI	Ft-lbs (from load cell)	PSI	Ft-lbs (from load cell)
5	10	5	10
6	20	7	20
11	30	10	30
17	40	18	40
25	50	25	50

Table 1

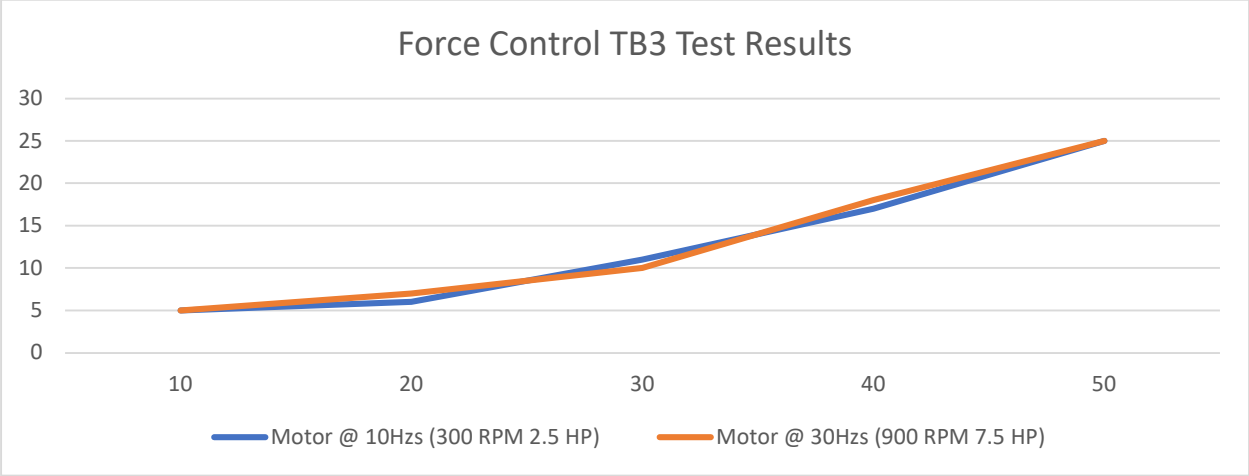

Chart 2

Conclusions•

Overall Senior Design was a huge success and a foundation for us to build on in the years to come. We set goals and milestones for this project and achieved those goals and crushed those milestones. We set our own personal deadlines and due dates by the Gantt Chart and hit each one of those deadlines. Senior Design was not just a course in the Engineering Program at Miami University, it was just not another project along the way to your degree; instead it was a feel for a project managed type of build that we managed. You learn a lot about yourself throughout this process of Senior Design, learning how to work well with others during a team project, learning that without communication the chances that you can succeed are very slim. One of the most valuable of the experiences is learning time management, since that plays a major role in this project due to the eight-month deadline, and juggling how to be able to multitask, with different aspects of this project, life outside of class and the other courses taken in conjunction with senior design

We designed, created, built, and tested a Universal Test Stand for Force Control to utilized in the years to follow. Force Control put their trust in us, financed this project and worked to meet our needs in order to complete this project. We had run into a couple issues along the way but that did not stop us from achieving our overall goal which was designing and building a Universal Test for Force Control Industries.

References•

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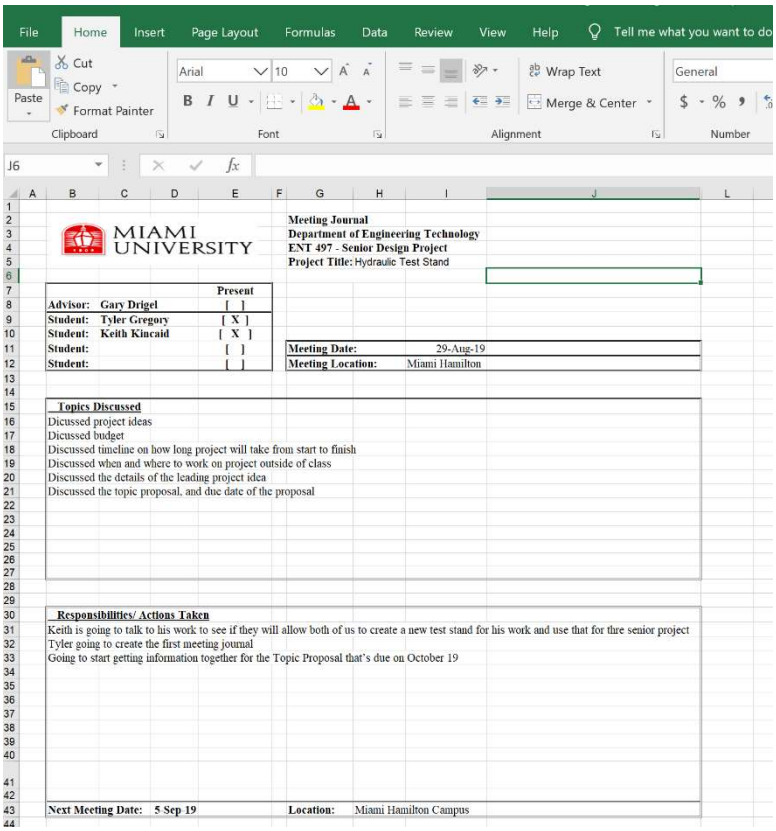
Appendices•

Appendix A - Meeting Journal's



MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Hydraulic Test Stand

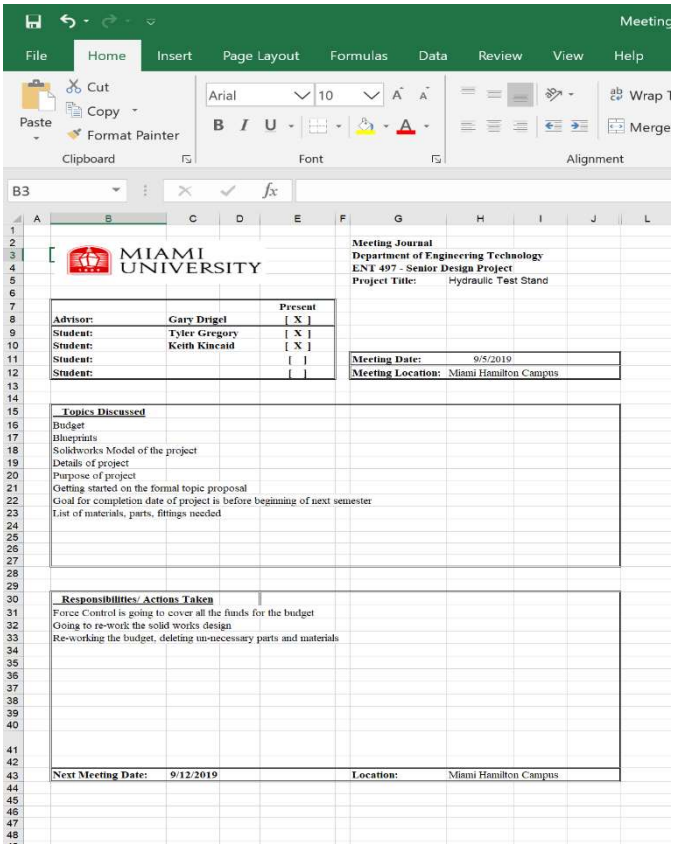
		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	29-Aug-19
Meeting Location:	Miami Hamilton

Topics Discussed
Dicussed project ideas
Dicussed budget
Discussed timeline on how long project will take from start to finish
Discussed when and where to work on project outside of class
Discussed the details of the leading project idea
Discussed the topic proposal, and due date of the proposal

Responsibilities/ Actions Taken
Keith is going to talk to his work to see if they will allow both of us to create a new test stand for his work and use that for thre senior project
Tyler going to create the first meeting journal
Going to start getting information together for the Topic Proposal that's due on October 19

Next Meeting Date:	**5 Sep 19**	**Location:**	Miami Hamilton Campus



MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
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Project Title: Hydraulic Test Stand

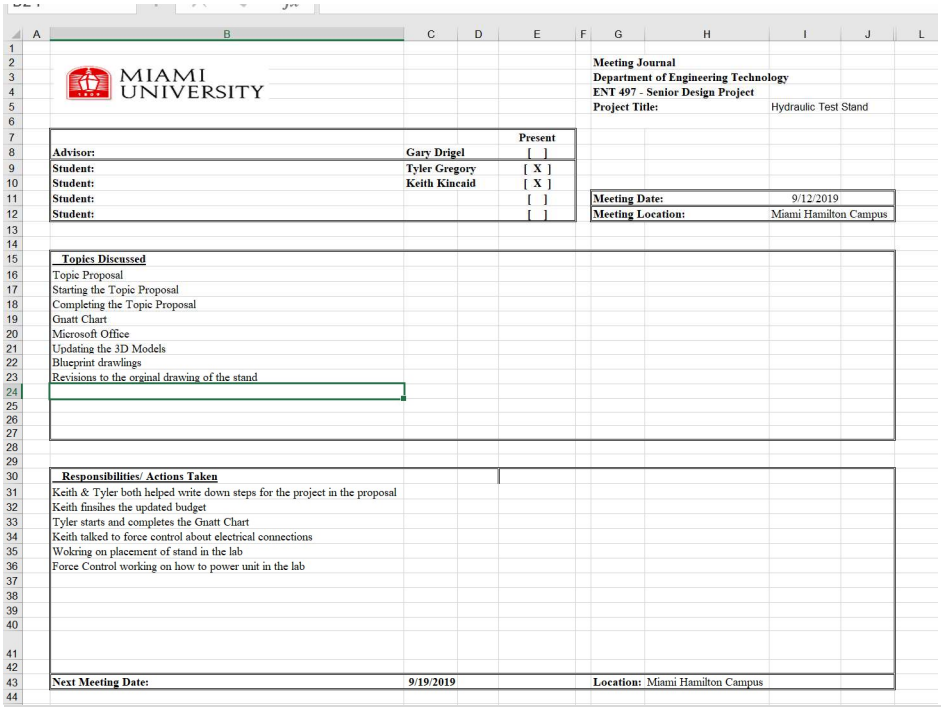
		Present
Advisor:	**Gary Drigel**	[X]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	9/5/2019
Meeting Location:	Miami Hamilton Campus

Topics Discussed
Budget
Blueprints
Solidworks Model of the project
Details of project
Purpose of project
Getting started on the formal topic proposal
Goal for completion date of project is before beginning of next semester
List of materials, parts, fittings needed

Responsibilities/ Actions Taken
Force Control is going to cover all the funds for the budget
Going to re-work the solid works design
Re-working the budget, deleting un-necessary parts and materials

Next Meeting Date:	**9/12/2019**	**Location:**	Miami Hamilton Campus



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Project Title: Hydraulic Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	9/12/2019
Meeting Location:	Miami Hamilton Campus

Topics Discussed
Topic Proposal
Starting the Topic Proposal
Completing the Topic Proposal
Gnatt Chart
Microsoft Office
Updating the 3D Models
Blueprint drawlings
Revisions to the orginal drawing of the stand

Responsibilities/ Actions Taken
Keith & Tyler both helped write down steps for the project in the proposal
Keith finsihes the updated budget
Tyler starts and completes the Gnatt Chart
Keith talked to force control about electrical connections
Wokring on placement of stand in the lab
Force Control working on how to power unit in the lab

Next Meeting Date:	**9/19/2019**	**Location:**	Miami Hamilton Campus

MIAMI UNIVERSITY

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Department of Engineering Technology
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		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	9/19/2019
Meeting Location:	Miami Hamilton Campus

Topics Discussed

Meet with Force Control
Assembly drawing
changes made to stand
Stand and tank drawings
Topic Proposal
Gnatt Chart

Responsibilities/ Actions Taken

Meeting tentivly set with Force Control for Friday 9/27 at 4:00PM
Assembly drawing of complete stand finished, discussed the approach Force Control would like to take with ordering and tracking purchased items
Updated stand to make "T" slots to current standard, added additional structure as determined from FEA, changed tank mounting frame.
Completed tank and stand drawings, sent to the purchacing department for qoutes.
Completed Topic Proposal, sent to Gary and waiting for feedback.
Completetd Gnatt Chart, steps laid out in chart in a timely manner
Researched different types of steel that should be used to make the stand

Next Meeting Date: 9/19/2019 **Location** Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
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		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	9/26/2019
Meeting Location:	Miami Hamilton Campus

Topics Discussed

Meeting with Force Control tomrrow 9/27 at 4
Powerpoint presentation for meeting at Force Control
Topic Proposal
Updated/finalized budget for stand and tank
Received quote -- Stand takes 5 weeks to come in from order date
Received quote -- Tank takes 8 weeks to come in from order date

Responsibilities/ Actions Taken

Tyler and Keith put together a Powerpoint Presentation for the meeting tomorrow
Keith talked to Force Control about ordering the tank and stand within the next couple days
Got the updated/ finalized budget back from the tank and stand, numbers are pretty close from our orginal amount
Waiting for feedback from Gary about possible changes needed on the Topic Proposal

Next Meeting Date: 10/3/2019 **Location:** Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[x]
Student:	**Keith Kincaid**	[x]
Student:	**Tyler Gregory**	[ ]
Student:		[ ]
Student:		[ ]

Meeting Date:	3-Oct
Meeting Location:	Miami Hamilton campus

Topics Discussed

Force Control meeting results from 9/27 with Keith and Tyler
Drawings Finalized
Material list
Build location

Responsibilities/ Actions Taken

Meeting went well, Force Control satified with design and presentation
Stand and tank drawing finalized, placed order for fabricated parts
Submited complete Bill of Materials to Force Control for part ordering
Reviewed lab space with Force Control engineering department and decided on a location for the test stand

Next Meeting Date: 10/10/2019 **Location:** Miami Hamilton Campus

MIAMI UNIVERSITY

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Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	10/10/2019
Meeting Location:	Miami Hamilton Campus

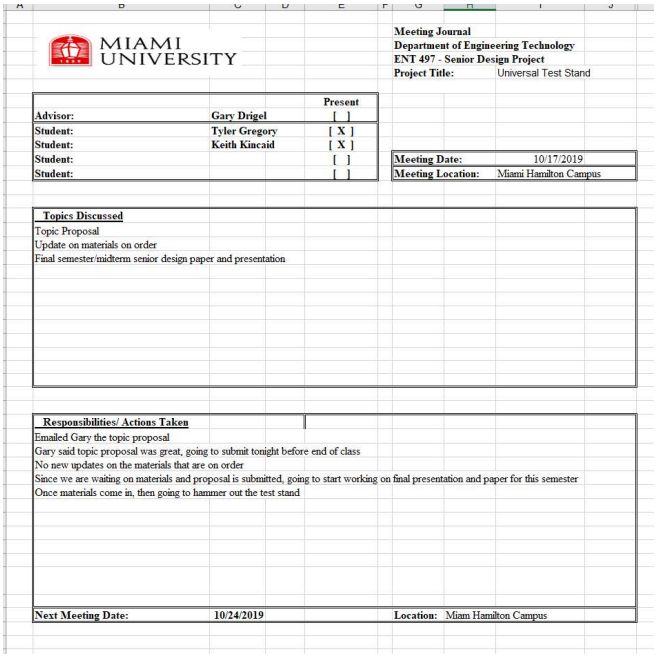
Topics Discussed

Topic Proposal
Purchasing items
Fianl Presentation for Fall Semester
No new updates

Responsibilities/ Actions Taken

Looked at topic propsal, made a bunch of new changes, updates, going to re-send to gary for further evaluation
Keith talked to Purchasing Department, all parts have been order/ on order. No new updates on materials that are on order.
Talked about starting on final presentation for the fall semester once topic proposal has been approved by gary
No new updates at the moment, playing the waiting game.

Next Meeting Date 10/17/2019 **Location:** Miami Hamilton Campus



MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date: 10/17/2019
Meeting Location: Miami Hamilton Campus

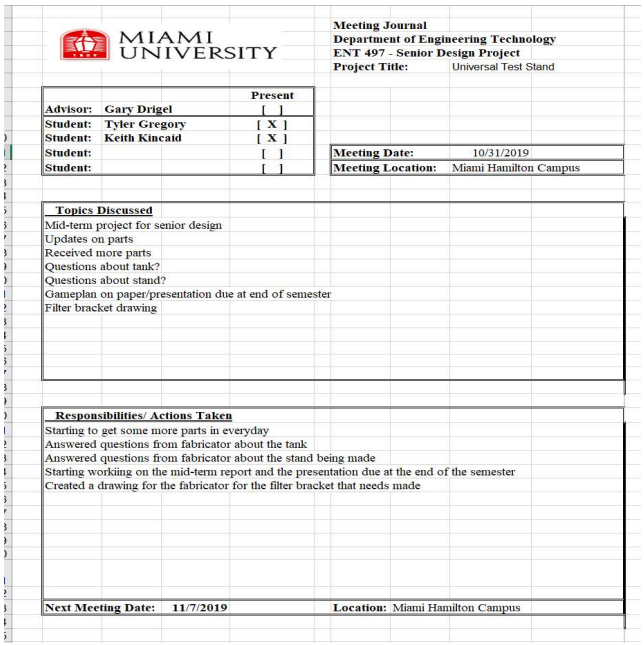
Topics Discussed

Topic Proposal
Update on materials on order
Final semester/midterm senior design paper and presentation

Responsibilities/ Actions Taken

Emailed Gary the topic proposal
Gary said topic proposal was great, going to submit tonight before end of class
No new updates on the materials that are on order
Since we are waiting on materials and proposal is submitted, going to start working on final presentation and paper for this semester
Once materials come in, then going to hammer out the test stand

Next Meeting Date: 10/24/2019 **Location:** Miam Hamilton Campus



MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date: 10/31/2019
Meeting Location: Miami Hamilton Campus

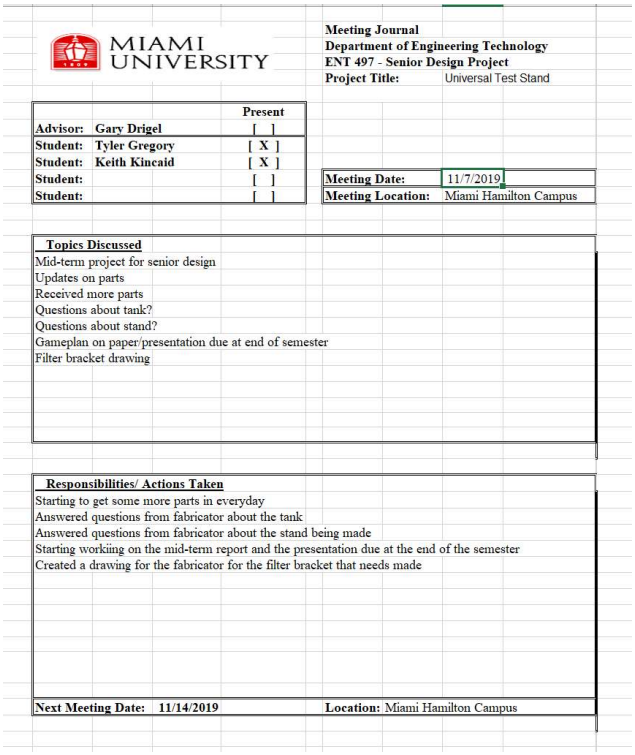
Topics Discussed

Mid-term project for senior design
Updates on parts
Received more parts
Questions about tank?
Questions about stand?
Gameplan on paper/presentation due at end of semester
Filter bracket drawing

Responsibilities/ Actions Taken

Starting to get some more parts in everyday
Answered questions from fabricator about the tank
Answered questions from fabricator about the stand being made
Starting workiing on the mid-term report and the presentation due at the end of the semester
Created a drawing for the fabricator for the filter bracket that needs made

Next Meeting Date: 11/7/2019 **Location:** Miami Hamilton Campus



MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date: 11/7/2019
Meeting Location: Miami Hamilton Campus

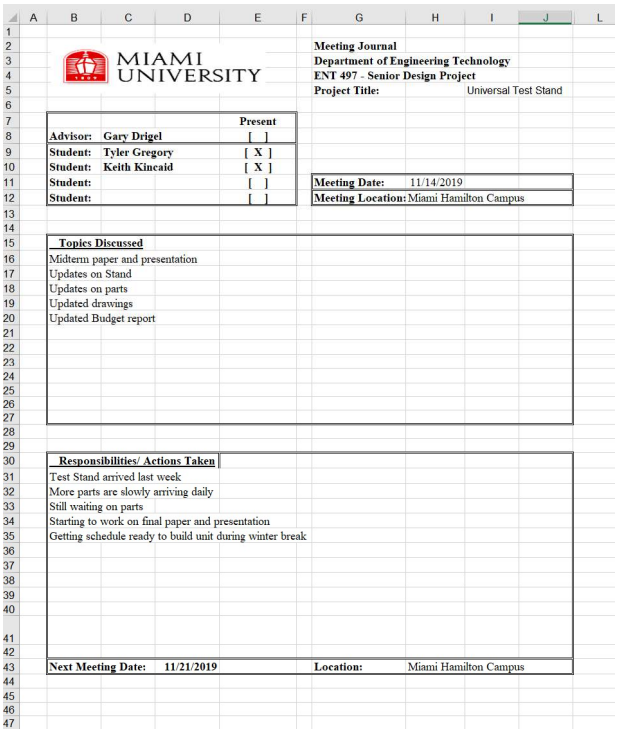
Topics Discussed

Mid-term project for senior design
Updates on parts
Received more parts
Questions about tank?
Questions about stand?
Gameplan on paper/presentation due at end of semester
Filter bracket drawing

Responsibilities/ Actions Taken

Starting to get some more parts in everyday
Answered questions from fabricator about the tank
Answered questions from fabricator about the stand being made
Starting workiing on the mid-term report and the presentation due at the end of the semester
Created a drawing for the fabricator for the filter bracket that needs made

Next Meeting Date: 11/14/2019 **Location:** Miami Hamilton Campus



MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date: 11/14/2019
Meeting Location: Miami Hamilton Campus

Topics Discussed

Midterm paper and presentation
Updates on Stand
Updates on parts
Updated drawings
Updated Budget report

Responsibilities/ Actions Taken

Test Stand arrived last week
More parts are slowly arriving daily
Still waiting on parts
Starting to work on final paper and presentation
Getting schedule ready to build unit during winter break

Next Meeting Date: 11/21/2019 **Location:** Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	Winter Break, 1/30/2020
Meeting Location:	Force Control

Topics Discussed
Got together during winter break
Started Assembly
Final Assmebly

Responsibilities/ Actions Taken
Tyler and Keith met at Force Control on December 26
Started Assembly, got eyes on the unit
Put pump motor groups together
Put Mis fittings on stand

Next Meeting Date: 2/6/2020 **Location:** Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	2/6/2020
Meeting Location:	Miami Hamilton Campus

Topics Discussed
End of year report
Senoir design day
Stand progress

Responsibilities/ Actions Taken
Planning the actions for putting the report and display board together for design day
Keith is working with Force Control to get the stand paint and ready for final assy.

Next Meeting Date: 2/13/2020 **Location:** Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	2/13/2020
Meeting Location:	Miami Hamilton Campus

Topics Discussed
End of year report
Senoir design day
Stand progress

Responsibilities/ Actions Taken
still planning the actions for putting the report and display board together for design day
We were able to get the extra items welded to the stand and fix the straps under the top that support the drip trays. The stand has been relocated to the paint shop and we are awaiting availablity for Force Control to paint.

Next Meeting Date: 2/20/2020 **Location:** Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	2/20/2020
Meeting Location:	Miami Hamilton Campus

Topics Discussed
End of year report
Senoir design day
Stand progress

Responsibilities/ Actions Taken
still planning the actions for putting the report and display board together for design day
We were able to get the extra items welded to the stand and fix the straps under the top that support the drip trays. The stand has been relocated to the paint shop and we are awaiting availablity for Force Control to paint.
Stand has been painted and returned from the paint shop.
We are getting together tomorrow to start working on final assembly.

Next Meeting Date: 2/27/2020 **Location:** Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	2/27/2020
Meeting Location:	Miami Hamilton Campus

Topics Discussed
End of year report
Senoir design day
Stand progress
Final Assembly

Responsibilities/ Actions Taken
Still planning the actions for putting the report and display board together for design day
We were able to get the extra items welded to the stand and fix the straps under the top that support the drip trays. The stand has been relocated to the paint shop and we are awaiting availablity for Force Control to paint.
Stand has been painted and returned from the paint shop.
We are getting together tomorrow to finish working on final assembly.
Tri-fold poster board has been purchased

Next Meeting Date:	**3/5/2020**	**Location:**	Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	3/5/2020
Meeting Location:	Miami Hamilton Campus

Topics Discussed
End of year presentation
Senoir design day
Final Paper
Final Assembly, testing

Responsibilities/ Actions Taken
Tyler got a real good jump on the report this week, added in tons of new stuff, took out old stuff that applied to the midterm
Tylerr got last hose crimped and is returned
Plan on getting together March 13 to do do testing, and take video for senior design day.
Planning on having report mostly finished by next week.

Next Meeting Date:	**3/12/2020**	**Location:**	Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	3/12/2020
Meeting Location:	Miami Hamilton Campus

Topics Discussed
End of year presentation
Senoir design day
Final Paper
Final Assembly, testing

Responsibilities/ Actions Taken
Tyler almost finished with rouhg draft of report
Keith moved over test unit from lab
Plan on getting together tomorrow to do do testing, and take video for senior design day.
Planning on having report mostly finished by next week.

Next Meeting Date:	**3/19/2020**	**Location:**	Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	3/19/2020
Meeting Location:	Miami Hamilton Campus

Topics Discussed
End of year presentation
Senoir design day
Final Paper
Final Assembly, testing

Responsibilities/ Actions Taken
Tyler almost finished with rouhg draft of report
Testing went very well, no leaks or unexpected errors
Planning on sending Gary rough draft of report this weekend
Figuring out what else is needed on for the report with classes being canceled.

Next Meeting Date:	**4/2/2020**	**Location:**	Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	4/2/2020
Meeting Location:	Miami Hamilton Campus

Topics Discussed
End of year presentation
Senoir design day
Final Paper
Google Meets

Responsibilities/ Actions Taken
Sent rough draft to Gary, said it was excellent
Working on cleaning up the powerpoint and the testing video
Planning on doing a test/final google meets presentation on Tuesday 4/7/2020
Figuring out what else is needed on for the report with classes being canceled.

Next Meeting Date: 4/9/2020 **Location:** Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	4/9/2020
Meeting Location:	Miami Hamilton Campus

Topics Discussed
End of year presentation
Senoir design day
Final Paper
Google Meets

Responsibilities/ Actions Taken
Paper was excellent, minor corrections
Working on cleaning up the powerpoint
Planning on doing another practice final presentation this weekend
Figuring out what else is needed on for the report with classes being canceled.

Next Meeting Date: 4/16/2020 **Location:** Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	4/16/2020
Meeting Location:	Miami Hamilton Campus

Topics Discussed
End of year presentation
Senoir design day
Final Paper
Google Meets

Responsibilities/ Actions Taken
Paper was excellent, minor corrections
Working on cleaning up the powerpoint
Planning on doing another practice final presentation this weekend
Figuring out what else is needed on for the report with classes being canceled.

Next Meeting Date: 4/23/2020 **Location:** Miami Hamilton Campus

MIAMI UNIVERSITY

Meeting Journal
Department of Engineering Technology
ENT 497 - Senior Design Project
Project Title: Universal Test Stand

		Present
Advisor:	**Gary Drigel**	[ ]
Student:	**Tyler Gregory**	[X]
Student:	**Keith Kincaid**	[X]
Student:		[ ]
Student:		[ ]

Meeting Date:	4/23/2020
Meeting Location:	Miami Hamilton Campus

Topics Discussed
End of year presentation
Senoir design day
Final Paper
Google Meets

Responsibilities/ Actions Taken
Paper was excellent, minor corrections
Working on cleaning up the powerpoint
Planning on doing another practice final presentation this weekend
Figuring out what else is needed on for the report with classes being canceled.
Final paper/presentation and everything due next Friday.

Next Meeting Date: 4/30/2020 **Location:** Miami Hamilton Campus

Topic Proposal –

Miami University
School of Engineering & Applied Science
Department of Engineering Technology

ENT 497/498
Senior Project

Title: **Universal Test Stand**

Team Members: **Keith Kincaid and Tyler Gregory**

Advisors Name: **Gary Driegel**

Advisor's Signature ***Date***

Supporting Company:
Force Control

Objective:
The purpose of this project is to build a test stand for Force Control to be used in their Engineering test lab. It will be designed to test a variety of units in the way of a universal mounting feature in the top of the table, this will allow for multiple test setups to be run with one unit. The units that the test stand will be designed to test are the smaller oil shear clutch/brake units. These units normally consist of a pump motor group for hydraulic actuation to engage or stop the machinery attached to it via the oil shear clutch/brake. This test stand is being built so it can run a variety of different horsepower and torque units instead of just one set specific torque and horsepower rating. It will also house its own actuation system to power a clutch/brake without setting it up as an independent actuation system. These oil shear units are being used to test all different sorts of applications by big companies all over the United States of America. John Deere uses these oil shear brake in their dynos to test the durability and strength of their drive train they build to put into their machines. Force control has specified a 40 Gallon oil tank capacity mounted under the table with low pressure actuation (0-100 PSI) and a cooling system with a pump at 33GPM capacity. The actuation system and cooling system will share a common tank. The table needs to fit in a designated location of the lab, location yet to be determined, and size limitations need to be considered.

Justification or Applicability:

9/5/2019
Keith Kincaid, Tyler Gregory

The purpose of building this type of test stand is to be a universal type test stand. One stand that can be used to test all different types of hydraulic clutch brake combinations that force control builds. Force Control currently has a test stand now, but this current stand can only run a couple different types of hydraulic clutch brake units, not universal for all the different combinations of units force control builds. Building this test stand will require 3D modeling to develop the drawings for the stand, oil tank, complete unit assembly drawings as well as an installation drawing to show dimensions of completed unit and critical components.
This unit will require FEA analysis to determine the stresses it can handle and the design altered as required to meet force Control needs.
Thermal calculations will be supplied with the completed stand based on the heat exchanger used to show the cooling limits of the unit.

Miami University
School of Engineering & Applied Science
Department of Engineering Technology
9/5/2019
Keith Kincaid, Tyler Gregory

ENT 497/498
Senior Project

Materials list

User: kkincaid — Bill of Material Report — Force Control Industries, Inc. — Single Level — Page: 1 — Date: 10/3/2019 — Time: 3:38:26PM

Lvl	Typ	Seq	Part Number	Bin	Description	Qty/Parent	Required Qty	Remarks
			01-T5053		**TEST STAND, UNIVERSAL**	1.00 EA	1.00 EA	
1	Mtl	1	TST101	NEWPART	TEST STAND WELDMENT, UNIVERSAL	1.00 EA	1.00 EA	
1	Mtl	2	TST102	NEWPART	40 GALLON VESOR TANK, TEST STA	1.00 EA	1.00 EA	
1	Asm	3	TST103	NEWPART	FILTER MOUNT PLATE, LAB TEST S	1.00 EA	1.00 EA	
1	Mtl	4	174-01-067-GE	BL-15C	HHCS 3/8-16 X 1 GRADE 5	8.00 EA	8.00 EA	
1	Mtl	5	195-04-011	BL-53B	LOCKWASHER 3/8", MED WT	8.00 EA	8.00 EA	
1	Mtl	6	175-01-079	BL-N/S	SHCS 1/2-13 X 1-1/2	4.00 EA	4.00 EA	
1	Mtl	7	195-04-013	BL-53B	LOCKWASHER 1/2", MED WT	4.00 EA	4.00 EA	
1	Mtl	8	184-8-007	BL-53F	90 DEG ELBOW 1-1/4	1.00 EA	1.00 EA	
1	Mtl	9	184-35-067	BL-53E	PIPE NIPPLE 1-1/4 X 4	1.00 EA	1.00 EA	
1	Mtl	10	129-20120320	BL-59B	HOSE FITTING 20120-20-20	1.00 EA	1.00 EA	
1	Mtl	11	134-0107-2020	BL-59E	SWIVEL ADAPTER 0107-20-20	1.00 EA	1.00 EA	
1	Mtl	12	184-36-001	STK	PIPE PLUG, square head, 1/8" n	1.00 EA	1.00 EA	
1	Mtl	13	160-35-U-4RHSXS	NEWPART	RELIEF VALV,1-1/4NPT,80-175PSI	1.00 EA	1.00 EA	
1	Mtl	14	184-16-020	BL-46E	REDUCING BUSHING 1-1/4X1 SS	1.00 EA	1.00 EA	
1	Asm	15	184-100-5311	NEWPART	1-1/4" PIPE TEE WITH 1/8" NPT	1.00 EA	1.00 EA	
1	Mtl	16	184-35-031	BL-N/S	PIPE NIPPLE 1-1/4 X 2-1/2	2.00 EA	2.00 EA	
1	Mtl	17	287-8034	BL-49B	PUMP ADAPTER, STYLE T	1.00 EA	1.00 EA	
1	Mtl	18	184-16-008	BL-61C	PARKER TEE, 1/2" NPT, STEEL	1.00 EA	1.00 EA	
1	Mtl	19	184-35-040	STK	PIPE NIPPLE 1/2 X 3	1.00 EA	1.00 EA	
1	Mtl	20	184-16-013	BL-N/S	RED BUSH 3/4" X 1/2" nptsteel	1.00 EA	1.00 EA	
1	Mtl	21	160-35-U-4RHSXS	BL-05C	RELIEF VALVE,3/4NPT,80-175 PSI	1.00 EA	1.00 EA	
1	Mtl	22	184-35-003	BL-N/S	PIPE NIPPLE, 3/8" npt X 1-1/2"	1.00 EA	1.00 EA	
1	Mtl	23	184-16-039	STK	REDUCING BUSHING 1/2X3/8 STEEL	1.00 EA	1.00 EA	
1	Mtl	24	129-20120808	BL-59B	HOSE FITTING 20120-8-8	2.00 EA	2.00 EA	
1	Mtl	25	129-2107-0808	BL-61C	PH SWIVEL PIPE ELBOW 2107-8-8	1.00 EA	1.00 EA	
1	Mtl	26	129-20120212	BL-59B	Parker 20120-12-12 hose fitth	2.00 EA	2.00 EA	
1	Mtl	27	134-0107-1212	BL-59E	SWIVEL ADAPTER 0107-12-12	2.00 EA	2.00 EA	
1	Mtl	28	184-16-028	BL-N/S	REDUCING BUSHING 1-1/4X1/2 STL	1.00 EA	1.00 EA	
1	Mtl	29	184-41-004	BL-53B	STREET ELBOW 1/2NPT 90 DEG IRO	1.00 EA	1.00 EA	
1	Mtl	30	134-0107-0808	BL-59E	SWIVEL ADAPTER 0107-8-8	2.00 EA	2.00 EA	
1	Mtl	31	129-20120808	BL-59B	HOSE FITTING 20120-8-8	2.00 EA	2.00 EA	
1	Mtl	32	195-04-010	STK	LOCKWASHER 5/16", MED WT	8.00 EA	8.00 EA	
1	Mtl	33	175-01-167-GE	BL-N/S	SHCS 5/16 - 18 X 4-1/4 GRADE 5	4.00 EA	4.00 EA	
1	Mtl	34	175-01-077	BL-N/S	SHCS 3/8-16 X 1-1/2 (1250)	4.00 EA	4.00 EA	
1	Mtl	35	103-07-099	BL-27F	ROTEX CPLG, 19-01-AL	1.00 EA	1.00 EA	
1	Mtl	36	195-03-010	STK	LOCKWASHER 5/16", LIGHT WT.	4.00 EA	4.00 EA	
1	Mtl	39	182-P-1007	BL-40D	UNISTRUT NUT 5/16-18	4.00 EA	4.00 EA	
1	Mtl	40	174-01-056	BL-N/S	HHCS 5/16-18 X 1"	4.00 EA	4.00 EA	
1	Mtl	41	126-08-001	BL-43F	FILTER SPIN-ON 10 MICRON	1.00 EA	1.00 EA	
1	Mtl	42	327-760L-9F	BL-46C	PRESSURE GAUGE,0-100PSI,LIQUID	2.00 EA	2.00 EA	
1	Mtl	43	175-01-032	BL-N/S	SHCS 5/16-18 X 3/4 (2500)	4.00 EA	4.00 EA	
1	Mtl	44	184-16-022	BL-53D	REDUCING BUSHING 1-1/4X1 STEEL	1.00 EA	1.00 EA	
1	Mtl	45	3-PK313A2AZF1	NEWPART	BALDOR MOTOR,NORM EFF,7-1/2 HP	1.00 EA	1.00 EA	
1	Mtl	46	103-07-059	BL-N/S	COUPLING 28-03 (ROTEX)	1.00 EA	1.00 EA	
1	Mtl	47	146-D-49	BL-29F	PUMP,DELTA D-49	1.00 EA	1.00 EA	
1	Mtl	61	174-01-089-F	BL-N/S	HHCS, 3/8-16 X 1.5 FULL THRD	4.00 EA	4.00 EA	
1	Mtl	62	195-03-011	STK	LOCKWASHER 3/8", LIGHT WT	8.00 EA	8.00 EA	
1	Mtl	63	182-P-1008J	BL-26E	UNISTRUT NUT 3/8-16, SS	4.00 EA	4.00 EA	
1	Mtl	67	184-41-006	STK	STREET ELBOW 1NPT 90 DEG IRON	1.00 EA	1.00 EA	
1	Mtl	68	129-20120816	BL-61C	Parker 20120-16-16 hose fitth	2.00 EA	2.00 EA	
1	Mtl	69	134-0107-1616	BL-61C	SWIVEL ADAPTER 0107-16-16	2.00 EA	2.00 EA	
1	Mtl	70	3-PD3434HAZF1	BL-N/S	BALDOR 5HHP, 56C FRAME	1.00 EA	1.00 EA	
1	Mtl	71	182-M0994ZAF	BL-29F	MAGNALOY PUMP/MOTOR MOUNT	1.00 EA	1.00 EA	
1	Mtl	72	146-D-6	BL-29E	Delta D-6 pump	1.00 EA	1.00 EA	
1	Mtl	73	134-0107-2424	BL-61C	SWIVEL ADAPTER 0107-24-24	3.00 EA	3.00 EA	
1	Mtl	74	134-0107-3232	BL-61C	SWIVEL ADAPTER 0107-32-32	2.00 EA	2.00 EA	

9/5/2019
Keith Kincaid, Tyler Gregory

User: kkincaid — Bill of Material Report — Force Control Industries, Inc. — Single Level — Page: 2 — Date: 10/3/2019 — Time: 3:38:26PM

Lvl	Typ	Seq	Part Number	Bin	Description	Qty/Parent	Required Qty	Remarks
1	Mtl	75	156-47695V480	NEWPART	2" NPT BALL VALVE	1.00 EA	1.00 EA	
1	Mtl	76	156-47695V470	NEWPART	1.5" BALL VALVE	3.00 EA	3.00 EA	
1	Mtl	77	184-18-029	BL-53D	MUST BE ANVIL BRAND	1.00 EA	1.00 EA	
1	Mtl	78	184-03-009	NEWPART	1-1/2" NPT IRON CROSS	1.00 EA	1.00 EA	
1	Mtl	79	184-18-031	BL-N/S	reducer bushing, 1-1/2" npt X	1.00 EA	1.00 EA	
1	Mtl	80	129-201202424	BL-N/S	HOSE FITTING 20120-24-24	4.00 EA	4.00 EA	
1	Mtl	81	129-225-8	STK	225 HYDRAULIC HOSE, 13/32 ID	2.00 FT	2.00 FT	
1	Mtl	83	129-225-24	BL-N/S	225 HYDRAULIC HOSE, 1-3/8 ID	2.00 EA	2.00 EA	
1	Mtl	84	184-38-009	BL-53F	TEE 2 IRON	1.00 EA	1.00 EA	
1	Mtl	85	184-18-043	BL-N/S	REDUCING BUSHING 2X1 STEEL	1.00 EA	1.00 EA	
1	Mtl	86	184-18-035	BL-N/S	REDUCING BUSHING 2X3/4 STEEL	1.00 EA	1.00 EA	
1	Mtl	87	129-10143-32-32	STK	RIGID MALE FITT 2NPT,2ID	2.00 EA	2.00 EA	
1	Mtl	88	129-422-32	BL-N/S	422 HYDRAULIC HOSE, 2 ID	2.00 FT	2.00 FT	
1	Mtl	89	184-35-029	STK	PIPE NIPPLE 3/4 X 2-1/2	1.00 EA	1.00 EA	
1	Mtl	90	184-38-005	BL-N/S	TEE 3/4 IRON	1.00 EA	1.00 EA	
1	Mtl	91	129-225-12	STK	225 HYDRAULIC HOSE, 5/8 ID	1.00 FT	1.00 FT	
1	Mtl	92	129-225-16	BL-N/S	225 HYDRAULIC HOSE, 7/8 ID	2.00 FT	2.00 FT	
1	Mtl	93	129-53179430	NEWPART	STEEL SNAP-TITE HOSE COUPLING	1.00 EA	1.00 EA	
1	Mtl	95	198-50-010	BL-N/S	PIPE CLAMP 3"	2.00 EA	2.00 EA	
1	Mtl	96	129-5315K160	NEWPART	STEEL SNAP-TITE HOSE COUPLING	1.00 EA	1.00 EA	
1	Mtl	97	184-35-114	BL-46C	PIPE NIPPLE 1 X 6	1.00 EA	1.00 EA	
1	Mtl	98	184-06-001	STK	PIPE PLUG, square head, 1/8" n	2.00 EA	2.00 EA	
1	Mtl	99	129-225-8	STK	225 HYDRAULIC HOSE, 13/32 ID	2.00 FT	2.00 FT	
1	Mtl	101	084-100-2747	BL-03E	GASKET, FLOAT ACCESS COVER	1.00 EA	1.00 EA	
1	Asm	102	086-100-2746	BL-07B	COVER, FLOAT ACCESS	1.00 EA	1.00 EA	
1	Mtl	103	184-35-086	BL-N/S	PIPE NIPPLE 1/4 X 5	1.00 EA	1.00 EA	
1	Mtl	104	184-34-001	BL-53B	MERCH CPLG 1/4	1.00 EA	1.00 EA	
1	Mtl	105	349-LS1950	BL-07D	LEVEL SWITCH	1.00 EA	1.00 EA	
1	Mtl	106	279-21100375	BL-32C	DYNA-SEAL 3/8"	4.00 EA	4.00 EA	
1	Mtl	107	184-35-002	BL-53B	PIPE NIPPLE 1/4 X 1-1/2	1.00 EA	1.00 EA	
1	Mtl	108	184-18-038	BL-53C	REDUCING BUSHING 1/2X1/4 STEEL	1.00 EA	1.00 EA	
1	Mtl	109	302-LB-50-CG	BL-05B	LB CONDUIT BODY, 1/2", WITH	1.00 EA	1.00 EA	
1	Mtl	110	126-5151HK-32	BL-N/S	SPLIT FLANGE KIT 2"	2.00 EA	2.00 EA	
1	Mtl	111	174-01-063-GE	BL-53B	HHCS 5/8-11 X 1-1/2 GRADE 5	4.00 EA	4.00 EA	
1	Mtl	112	195-03-015	STK	LOCKWASHER 5/8", LIGHT WT	4.00 EA	4.00 EA	
1	Mtl	113	134-0107-2420	NEWPART	P.H. FITTING 1-1/2" NPT MALE T	1.00 EA	1.00 EA	
1	Mtl	114	129-225-24	BL-N/S	225 HYDRAULIC HOSE, 1-3/8 ID	2.00 EA	2.00 EA	
1	Mtl	115	307-100-3823	BL-46C	THERMOWELL, 6", 304 SS	1.00 DZ	12.00 EA	
1	Mtl	116	E6500-TRP-4/26-6"	BL-N/S	TEMP PROBE,RTD 100 OHM, 0-20mA	1.00 EA	1.00 EA	
1	Mtl	117	184-26-005	STK	PIPE PLUG SQ HD 3/4	8.00 EA	8.00 EA	
1	Mtl	118	184-06-008	BL-53C	PIPE PLUG SQ HD 1-1/2	1.00 EA	1.00 EA	
1	Mtl	119	160-03-006	BL-53B	HEX NUT 5/8-11 UNC	4.00 EA	4.00 EA	
1	Mtl	120	129-32-16S21	NEWPART	HOSE FITTING, CODE 61, 2" ELBO	2.00 EA	2.00 EA	
1	Mtl	121	129-32-06X	NEWPART	FITTING 37 DEG JIC TO FEMALE N	2.00 EA	2.00 EA	

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Step by Step Plan:

1. **Meet with group and Gary to see if the project is acceptable.**
2. **Tyler and Keith get together to get a full understanding of project, the purpose, and what the use is.**
3. **Setup a meeting with Force Control so tyler can meet the CEO, head engineer, HR, and Keith's boss.**
4. **Create a presentation for the meeting with Force Control**
5. **Meet with force control to determine the scope of the work and add remove items as necessary. Work out details for location of test stand in the lab, make sure the company have a plan in place to connect power and controls to the system.**
6. **Have Keith get in contact with purchasing department to get an estimate on how long the lead time of some of the main components.**
7. **Determine tests and setup to be performed for the purposes of this project.**
8. **Design and create prints for the table/stand to be fabricated outside at a weld shop.**
9. **Order Stand after prints have been created and approved.**
10. **Design and create prints for oil tank for out fabrication.**
11. **Order tank after prints have been created and approved.**
12. **Review and revise budget and cut list as required to finalize budget.**
13. **Determine cut list for materials and supplies needed to complete the project.**
14. **Coordinate with Force Controls purchasing department to order required items.**
15. **Once items start arriving, start assembling components based off of what is available.**
16. **If stand arrives first, make any necessary changes to stand to accommodate the purpose of this project.**
17. **If the pumps and motors arrive at the same time then, assemble pumps and motors for actuation and cooling while waiting for other components.**
18. **Assemble the pump motor groups to the stand.**
19. **Once pump motor groups are assembled to the stand, look at prints to see which fittings go in which port.**

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20. **Assemble filters, and any pressure relief valves to the system.**
21. **Fit Tank in stand and locate mounting holes, Weld items to stand as required/ make adjustments.**
22. **Fit pump motor groups, and filters to determine the plumbing for the hoses . Add additional support for items as required, i.e. weld, bolt on ect..**
23. **Disassemble any items that do not get painted.**
24. **Tape any items that cannot come off unit that does not receive paint.**
25. **Coordinate with Force Control to get the right color paint for the stand and unit.**
26. **If paint is not in stock, then order paint.**
27. **If waiting on paint, then we can assemble unit and start running some tests on the unit.**
28. **Once paint comes in, then prepare unit for paint then paint.**
29. **After paint is dry and approved with force control, remove any tape and assemble any parts that were removed prior to paint.**
30. **Coordinate with Force Control to install and hook up test stand with a test unit.**
31. **Test unit, check for leaks and proper operation.**
32. **If test fails, work out kinks in the unit and retest until proper operation.**

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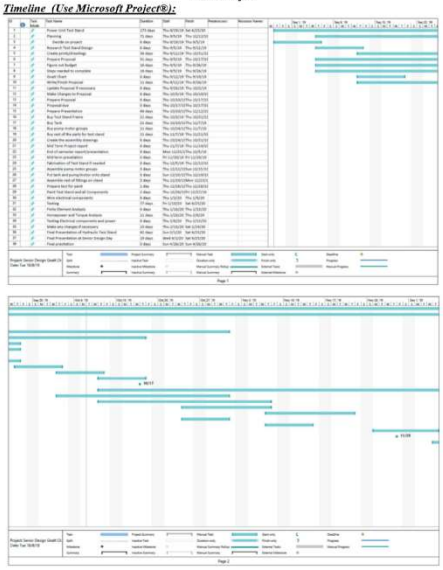
Timeline (Use Microsoft Project®):



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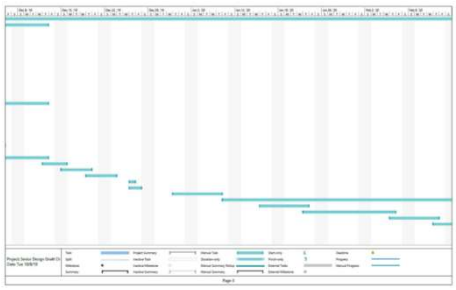

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Cost :
Force Control is to cover the cost of test stand and will retain the final product for their use in the Engineering Lab.

Universal test stand				
Description	**Manufacture**	**Part number**	**Budget**	**Actual cost**
40HP motor		supplied by Force Control	$ -	$ -
Force Contol test unit	Force Control	supplied by Force Control	$ -	$ -
7.5HP motor (Cooling pump)	Baldor	CEM3770T	$ 900.00	
Pump adaptor	Vescor	267-6034	$ 67.00	
Pump (cooling)	Delta	146-d-49	$ 410.00	
Relief valve	Fulflo	190-05-VJ-5R/HS/WS	$ 120.00	
.75HP motor (Low press act)	Baldor	3-PD3A3A1A2B1	$ 150.00	
Pump adaptor	Magnaloy	182-M056424F	$ 25.00	
Pump (low press)	Delta	146-D-8	$ 184.00	
Relief valve	Fulflo	190-05-VJ-5R/HS/WS	$ 120.00	
Filter assy	Parker	126-08-001	$ 60.00	
40Gal tank	Vescor	189-94-571	$ 1,200.00	
Heat exchanger	Thermo xfer	supplied by Force Control	$ -	$ -
2 Plastic trays	US Plastics	P-263	$ 144.00	
Dyno frame	Weldment's Inc		$ 5,000.00	
6 Gauges	Mcdaniel	327-T6DL-GF	$ 120.00	
Hose	Parker		$ 500.00	
SAE tank fittings	Parker		$ 200.00	
3 couplings	Parker		$ 100.00	
SAE split flange	Parker		$ 60.00	
Shut-off valves			$ 250.00	
40 Gallons of Oil		supplied by Force Control	$ -	$ -
additional hoses, fitting, etc...			$ 2,000.00	
		Total	$ 11,610.00	$ -

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Final Comments

Provisions will be added to the stand for a future high pressure actuation pump systems to be added. In the tank design we have added extra NPT ports to reduce the risks of limitations for unseen uses at this time.

Presentation for Force Control

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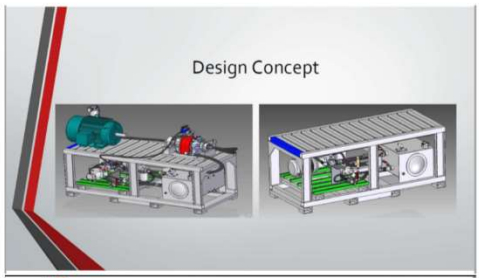

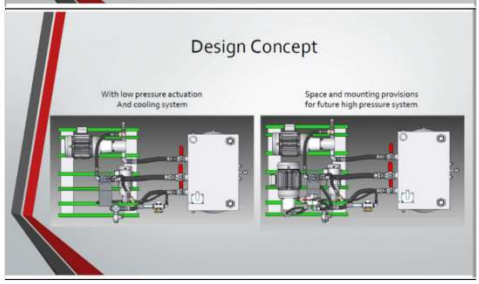

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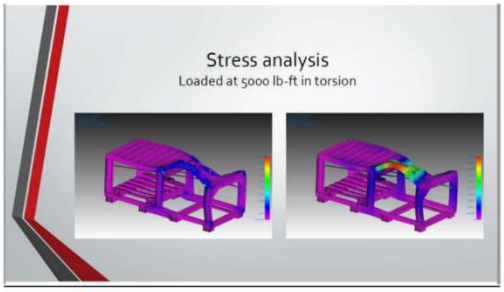

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Budget Cont.

Universal test stand				
Description	Manufacture	Part number	Budget	Actual cost
40HP motor		supplied by Force Control	$ -	$ -
Force Control test unit	Force Control	supplied by Force Control	$ -	$ -
7.5HP motor (Cooling pump)	Baldor	CEM3770T	$ 900.00	
Pump adaptor	Vescor	267-6034	$ 67.00	
Pump (cooling)	Delta	146-E-49	$ 410.00	
Relief valve	Fulflo	190-05-V1-38/HS/WS	$ 120.00	
.75HP motor (Low press act)	Baldor	3-PDIA3A1A2B1	$ 150.00	
Pump adaptor	Magnaloy	182-M[illegible]24F	$ 25.00	
Pump (low press)	Delta	146-D-8	$ 184.00	
Relief valve	Fulflo	190-05-V1-38/HS/WS	$ 120.00	
Filter assy	Parker	128-08-001	$ 60.00	
40Gal tank	Vescor	189-94-571	$ 1,200.00	
Heat exchanger	Thermo [illegible]	supplied by Force Control	$ -	$ -
2 Plastic trays	US Plastics	P-283	$ 144.00	
Dyno frame	Weldment's Inc		$ 5,000.00	
6 Gauges	Mcdaniel	327-T60L-GF	$ 120.00	
Hose	Parker		$ 500.00	
SAE tank fittings	Parker		$ 200.00	
3 couplings	Parker		$ 100.00	
SAE split flange	Parker		$ 80.00	
Shut-off valves			$ 230.00	
40 Gallons of Oil		supplied by Force Control	$ -	$ -
additional hoses, fitting, etc...			$ 2,000.00	
		Total	$ 11,610.00	$ -

Timeline

- Senior Design Day is April 25th, so the project has to be completed, painted, tested and properly working by at least April 25th.
- We have already sent in our Topic Proposal to our professor Gary Drigel, once he gets back with us on our proposal we would like to be able to start ordering parts for the test stand. The parts that will take the longest to get here; stand, tank, pumps, motors.
- Once those come in we can start working on those parts while we wait for the rest of the fittings, hoses, and filters to come in.
- Would like to have the parts on order by the end of October/ early November.
- Target date for completion would be before the Spring Semester starts, which is the end of January.
- Going to try and get as much done with the stand during the holiday break since there will be no class and people are off work.

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Thank you Force Control

- We would personally like to thank each and every single one of you for allowing Keith and I to be able to build this test stand and use it as our Senior Design project.
- I personally would like to say thank you for allowing me to be apart of this project and allowing me to be able to work on the project on company property.

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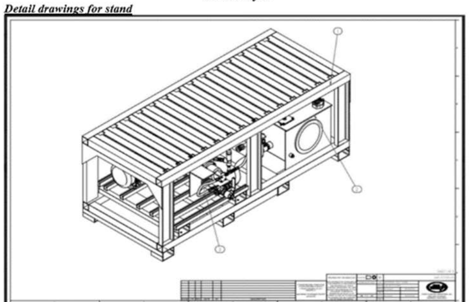
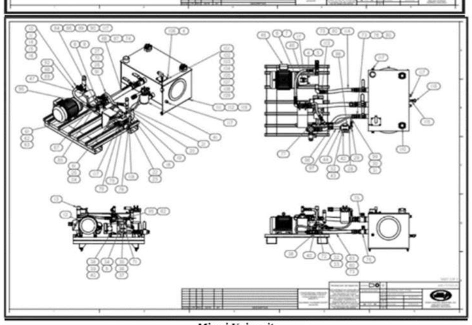
Detail drawings for stand





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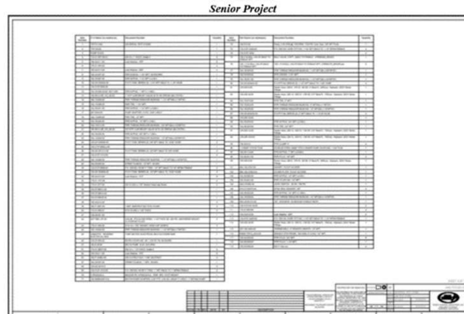

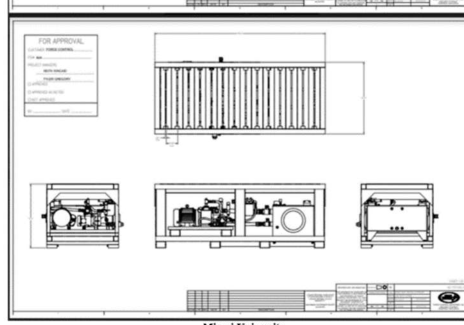

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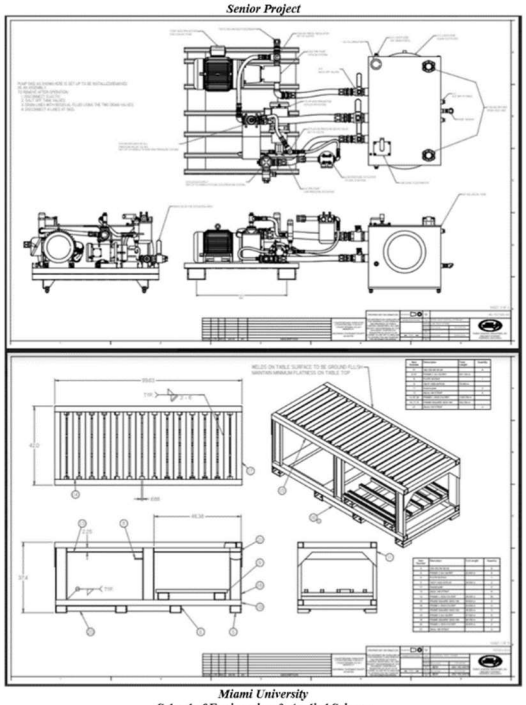

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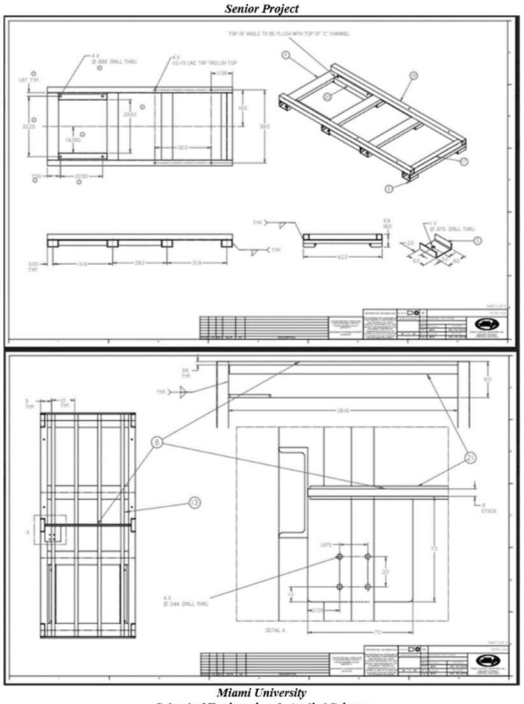

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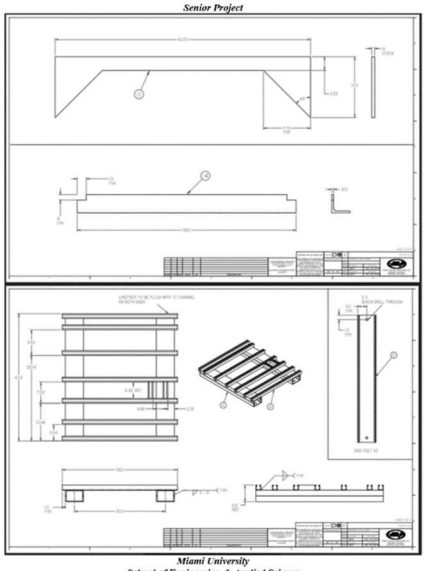

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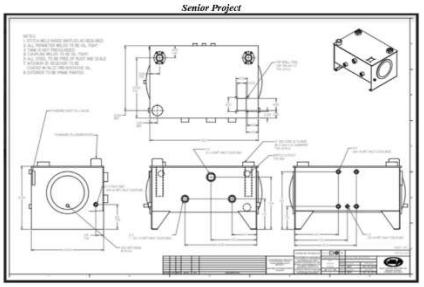

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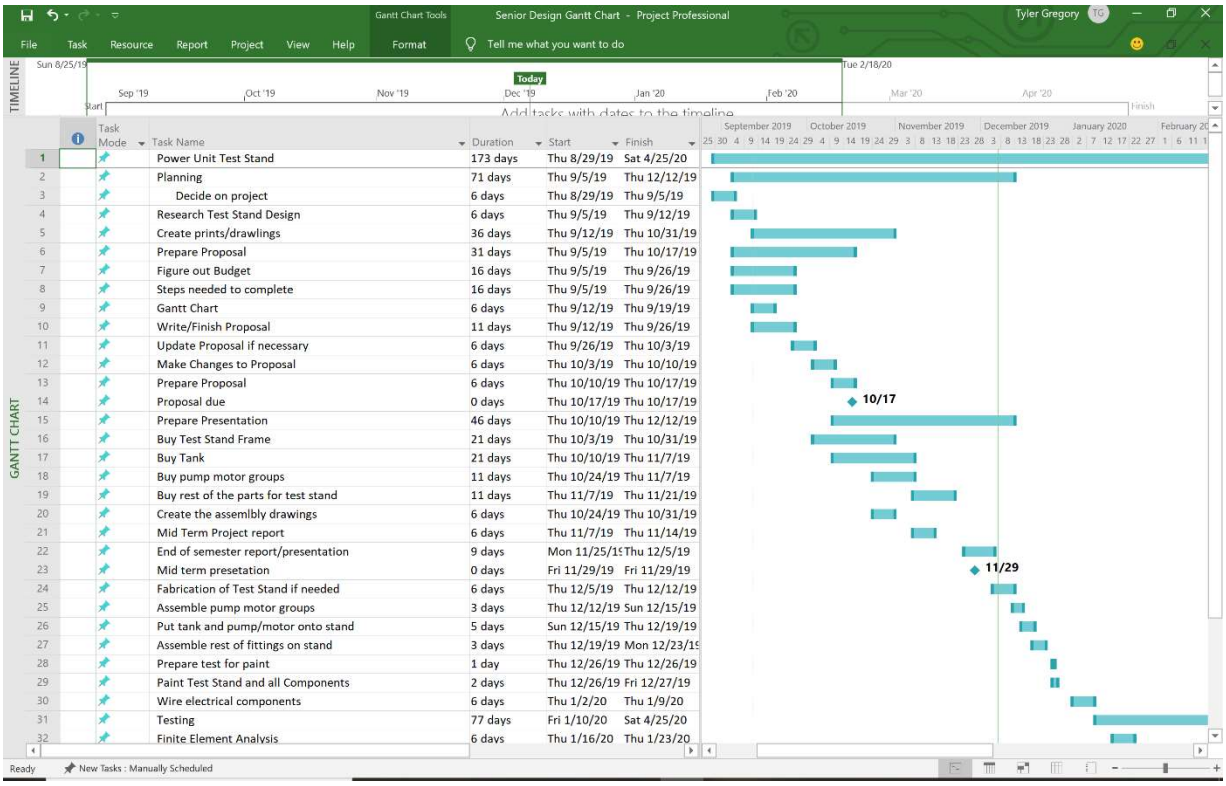
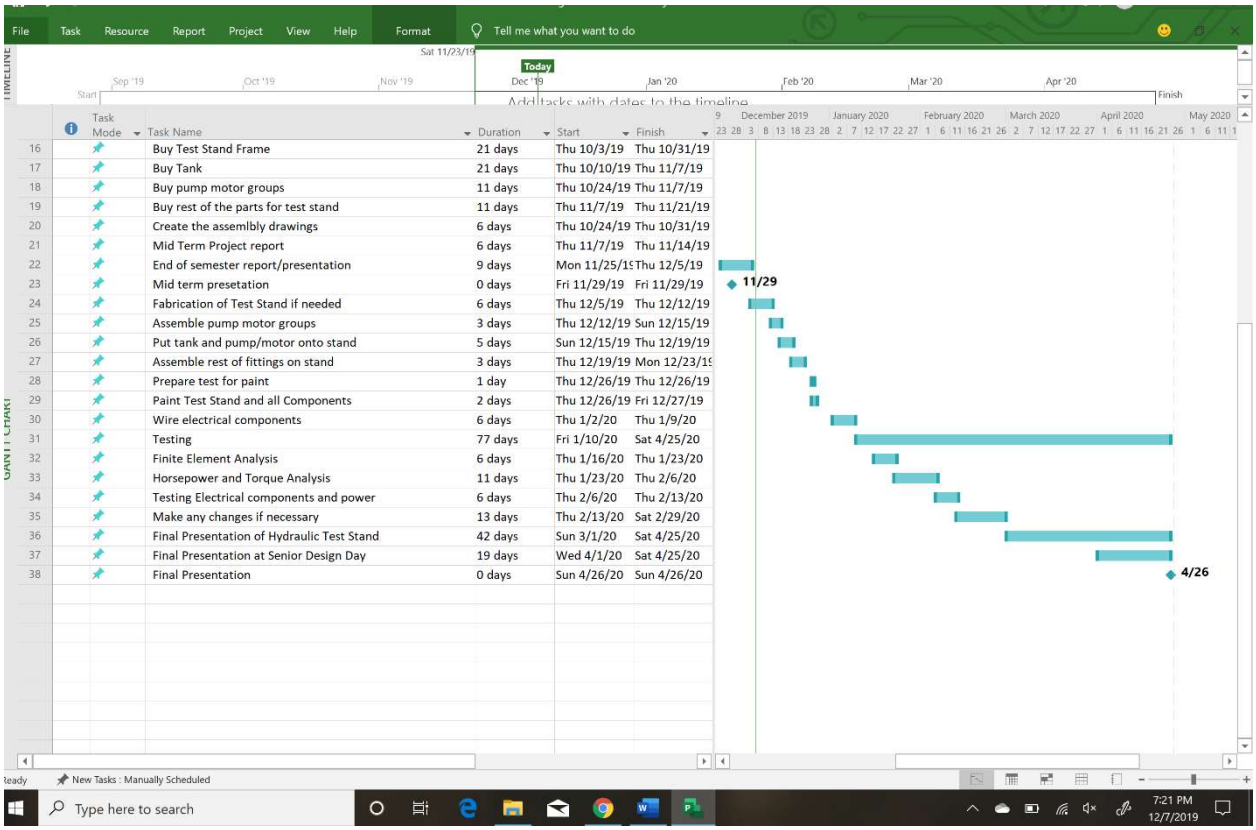
Gant Chart –



	Task Mode	Task Name	Duration	Start	Finish
1		Power Unit Test Stand	173 days	Thu 8/29/19	Sat 4/25/20
2		Planning	71 days	Thu 9/5/19	Thu 12/12/19
3		Decide on project	6 days	Thu 8/29/19	Thu 9/5/19
4		Research Test Stand Design	6 days	Thu 9/5/19	Thu 9/12/19
5		Create prints/drawlings	36 days	Thu 9/12/19	Thu 10/31/19
6		Prepare Proposal	31 days	Thu 9/5/19	Thu 10/17/19
7		Figure out Budget	16 days	Thu 9/5/19	Thu 9/26/19
8		Steps needed to complete	16 days	Thu 9/5/19	Thu 9/26/19
9		Gantt Chart	6 days	Thu 9/12/19	Thu 9/19/19
10		Write/Finish Proposal	11 days	Thu 9/12/19	Thu 9/26/19
11		Update Proposal if necessary	6 days	Thu 9/26/19	Thu 10/3/19
12		Make Changes to Proposal	6 days	Thu 10/3/19	Thu 10/10/19
13		Prepare Proposal	6 days	Thu 10/10/19	Thu 10/17/19
14		Proposal due	0 days	Thu 10/17/19	Thu 10/17/19
15		Prepare Presentation	46 days	Thu 10/10/19	Thu 12/12/19
16		Buy Test Stand Frame	21 days	Thu 10/3/19	Thu 10/31/19
17		Buy Tank	21 days	Thu 10/10/19	Thu 11/7/19
18		Buy pump motor groups	11 days	Thu 10/24/19	Thu 11/7/19
19		Buy rest of the parts for test stand	11 days	Thu 11/7/19	Thu 11/21/19
20		Create the assemlbly drawings	6 days	Thu 10/24/19	Thu 10/31/19
21		Mid Term Project report	6 days	Thu 11/7/19	Thu 11/14/19
22		End of semester report/presentation	9 days	Mon 11/25/19	Thu 12/5/19
23		Mid term presetation	0 days	Fri 11/29/19	Fri 11/29/19
24		Fabrication of Test Stand if needed	6 days	Thu 12/5/19	Thu 12/12/19
25		Assemble pump motor groups	3 days	Thu 12/12/19	Sun 12/15/19
26		Put tank and pump/motor onto stand	5 days	Sun 12/15/19	Thu 12/19/19
27		Assemble rest of fittings on stand	3 days	Thu 12/19/19	Mon 12/23/19
28		Prepare test for paint	1 day	Thu 12/26/19	Thu 12/26/19
29		Paint Test Stand and all Components	2 days	Thu 12/26/19	Fri 12/27/19
30		Wire electrical components	6 days	Thu 1/2/20	Thu 1/9/20
31		Testing	77 days	Fri 1/10/20	Sat 4/25/20
32		Finite Element Analysis	6 days	Thu 1/16/20	Thu 1/23/20



	Task Mode	Task Name	Duration	Start	Finish
16		Buy Test Stand Frame	21 days	Thu 10/3/19	Thu 10/31/19
17		Buy Tank	21 days	Thu 10/10/19	Thu 11/7/19
18		Buy pump motor groups	11 days	Thu 10/24/19	Thu 11/7/19
19		Buy rest of the parts for test stand	11 days	Thu 11/7/19	Thu 11/21/19
20		Create the assemlbly drawings	6 days	Thu 10/24/19	Thu 10/31/19
21		Mid Term Project report	6 days	Thu 11/7/19	Thu 11/14/19
22		End of semester report/presentation	9 days	Mon 11/25/19	Thu 12/5/19
23		Mid term presetation	0 days	Fri 11/29/19	Fri 11/29/19
24		Fabrication of Test Stand if needed	6 days	Thu 12/5/19	Thu 12/12/19
25		Assemble pump motor groups	3 days	Thu 12/12/19	Sun 12/15/19
26		Put tank and pump/motor onto stand	5 days	Sun 12/15/19	Thu 12/19/19
27		Assemble rest of fittings on stand	3 days	Thu 12/19/19	Mon 12/23/19
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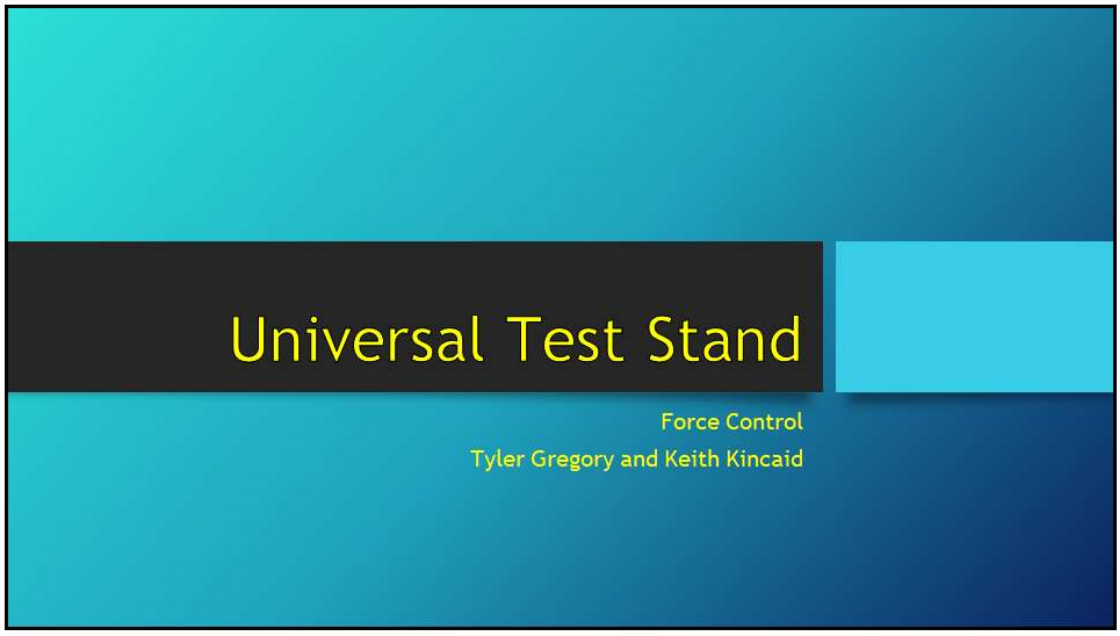
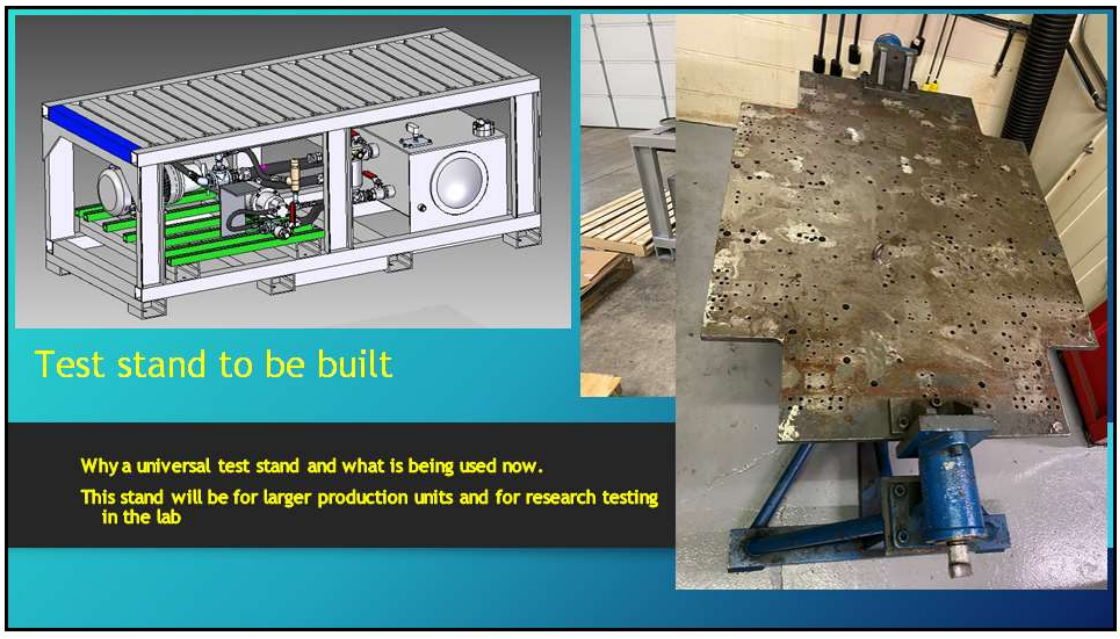
29		Paint Test Stand and all Components	2 days	Thu 12/26/19	Fri 12/27/19
30		Wire electrical components	6 days	Thu 1/2/20	Thu 1/9/20
31		Testing	77 days	Fri 1/10/20	Sat 4/25/20
32		Finite Element Analysis	6 days	Thu 1/16/20	Thu 1/23/20
33		Horsepower and Torque Analysis	11 days	Thu 1/23/20	Thu 2/6/20
34		Testing Electrical components and power	6 days	Thu 2/6/20	Thu 2/13/20
35		Make any changes if necessary	13 days	Thu 2/13/20	Sat 2/29/20
36		Final Presentation of Hydraulic Test Stand	42 days	Sun 3/1/20	Sat 4/25/20
37		Final Presentation at Senior Design Day	19 days	Wed 4/1/20	Sat 4/25/20
38		Final Presentation	0 days	Sun 4/26/20	Sun 4/26/20

Final Presentation –





1

Who is Force Control

- Founded in 1969
- Oil Shear Industrial Clutch and Brakes
- Where does the Universal test stand fit in?
  - Dyno applications
  - Motor Brakes
  - Posidyne Clutch brakes

HIGH SPEED REVERSING DRIVES *(HSRvD)*

MULTI-SPEED DRIVES *(MSDr)*

Force Control expectations

- Universal test stand to test multiple units up to a size 20 (300 lb-ft Static torque)
- Be able to easily work on components in test stand.
- House a cooling system with a 7HP Motor and a 33.6 GPM pump
- House a low pressure hydraulic actuation system with a 3/4HP motor and a 3.5 GPM pump
- Provisions for a high pressure hydraulic actuation system.
- Universal mounting on table top
- Size limitations

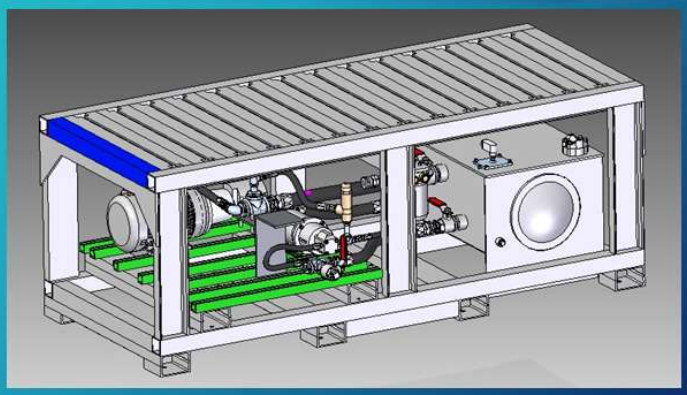
Budget

- Budget has been approved by Force Control.
- There has been no surprises in regards to the budget, everything has been on budget since the beginning of the project.
- As seen in the "Actual vs Cost" we ended up a little over budget, but within reason.

Universal test stand				
Description	Manufacture	Part number	Budget	Actual cost
40HP motor		supplied by Force Control	$ -	$ -
Force Contol test unit	Force Control	supplied by Force Control	$ -	$ -
7.5HP motor (Cooling pump)	Baldor	CEM3770T	$ 900.00	$ 908.70
Pump adaptor	Vescor	267-6034	$ 67.00	$ 70.33
Pump (cooling)	Delta	146-d-49	$ 410.00	$ 456.76
Relief valve	Fulflo	190-05-VJ-5R/HS/WS	$ 120.00	$ 173.85
.75HP motor (Low press act)	Baldor	3-PD3A3A1A2B1	$ 150.00	$ 184.73
Pump adaptor	Magnaloy	182-M056424F	$ 25.00	$ 32.00
Pump (low press)	Delta	146-D-8	$ 184.00	$ 183.90
Relief valve	Fulflo	190-05-VJ-5R/HS/WS	$ 120.00	$ 105.45
Filter assy	Parker	126-08-001	$ 60.00	$ 67.42
40Gal tank	Vescor	189-94-571	$ 1,200.00	$ 1,200.00
Heat exchanger	Thermo xfer	supplied by Force Control	$ -	$ -
2 Plastic trays	US Plastics	P-263	$ 144.00	$ 150.00
Dyno frame	Weldment's Inc		$ 5,000.00	$ 5,500.00
2 Gauges	Mcdaniel	327-T6DL-GF	$ 120.00	$ 40.24
SAE tank fittings	Parker		$ 200.00	$ 513.00
Shut-off valves			$ 250.00	$ 225.00
40 Gallons of Oil		supplied by Force Control	$ -	$ -
additional hoses, fitting, etc...			$ 2,660.00	$ 2,083.20
		Total	$ 11,610.00	$ 11,894.58

Design and planning

- Size and features
  - Top slots
- FEA @ 5000 lb-ft in torsion
  - Results
  - Improvements
- Items arriving
- Sub assembly build-up and fit
- Paint
- Final assembly
- Operation of test stand
- Testing and results
- Timeline used for the project

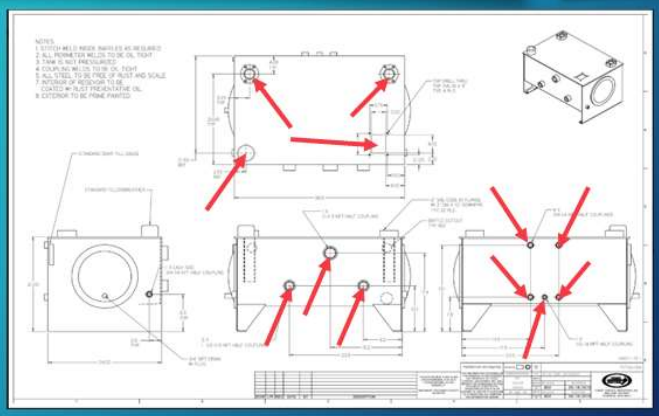


Size and features

We started with a Vescor 40 Gallon tank

36" x 24" Tank, Stand built around tank

- Sides
  - Two - 1 ½" NPT suction ports.
  - One - 2" NPT return.
  - One - ½" NPT for a thermo coupler.
  - Four - ¾" NPT ports for future needs.
- Top
  - Two - 2" SAE code 61 return ports.
  - One - cutout for low level float.
  - One - Filler/breather.

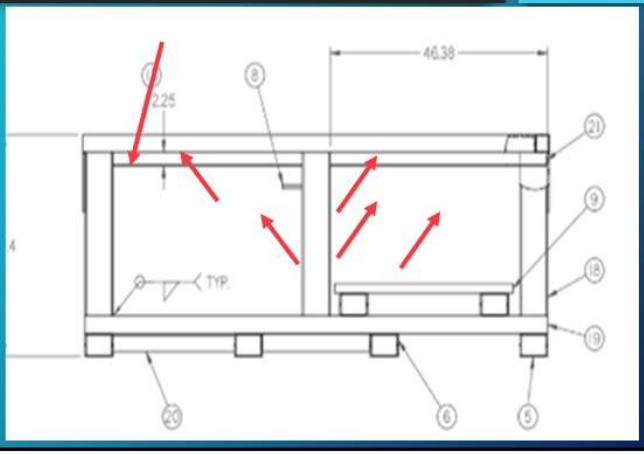


Size and features cont.

Fabricated stand

100" x 42" x 37" tall

- Top
  - 5/8" T-slot spaced to industry standard.
  - Angle iron back-to-back for strength.
  - Slats under top to support drip tray.
- Bottom
  - Removable skid setup for pump groups.
  - "C" channel to make feet for fork lift truck.
  - Designed to house tank on opposite side of skid.



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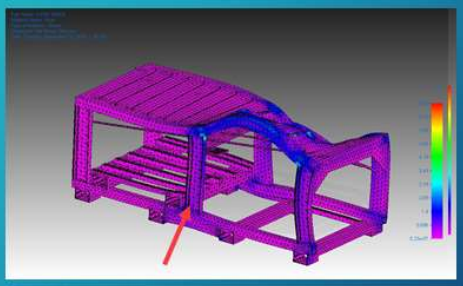
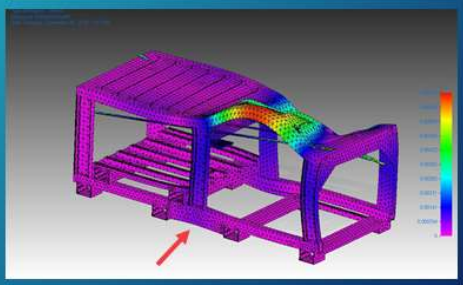
FEA

- Stress analysis 5000 lb-ft in torsion
  - Displacement
    - Extreme movement is .007 in
    - First image shows a weak spot at the center leg
    - Second image has an added angle to reduce stress.
  - Stress
    - The Highest points of stress are at the corners and showing approx. 3 ksi.
    - A-36 Hot roll steel has a Yield strength of 36 ksi





Items arriving

- All materials have on time.
- Pulled stock items for the project.

5

Sub assembles and fit

- Assembled pump motor groups and fit them to the stand.
- Fit the tank in the stand to ensure proper alignment.
- Built up subassemblies to identify and missing parts or fittings.







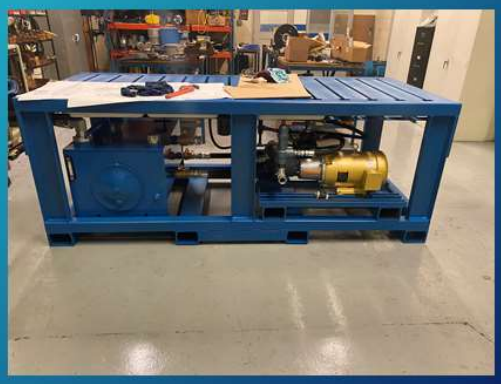
Paint

- Prepped and painted the stand, tank and associated parts blue.

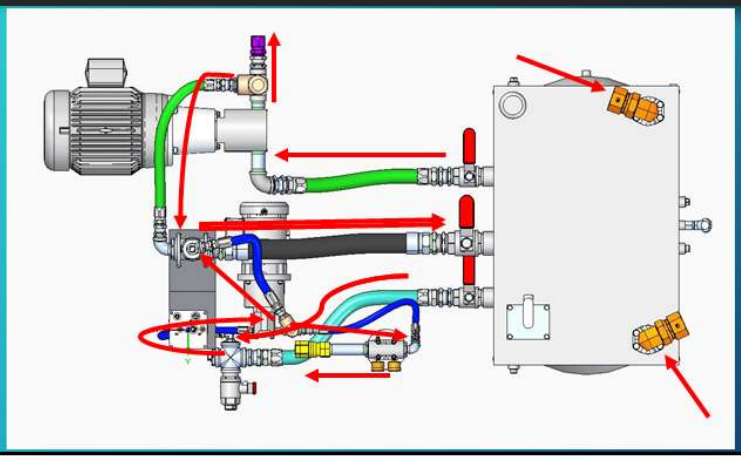

6

Final assembly

- Pump motor groups were installed on the skid, hoses were made up and connected.
- Tank components were installed and the tank mounted in frame.
- Skid assembly was installed on the stand and hose connection to the tank were made up and installed.
- Final review of all installations and connections were made.



Operation of test stand



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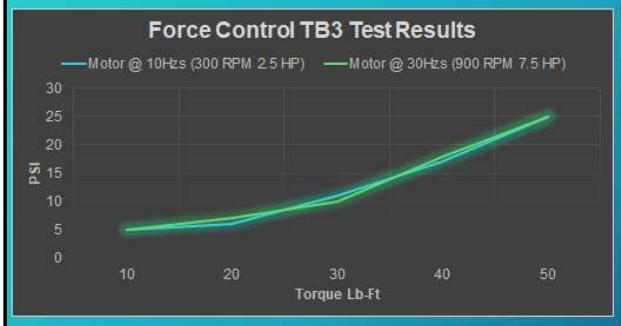
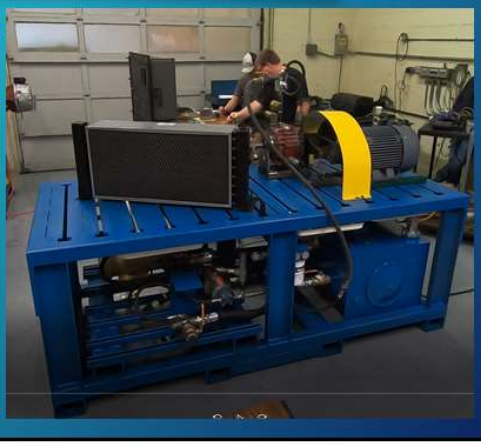
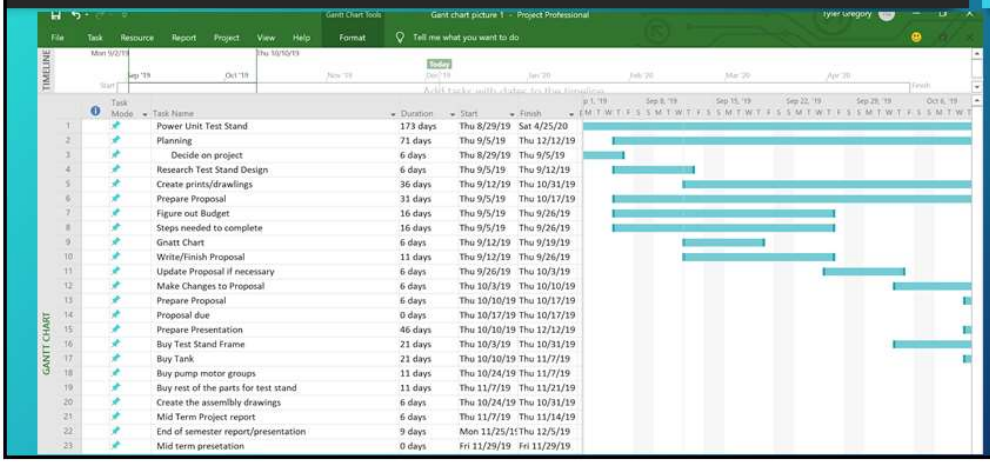
Testing and results

- We used a TB03 (Force Control Tension Brake) with a 15 HP motor on a 1:1 belt drive at 10 Hz and 30 Hz to get a pressure vs torque chart.
- Leak checks and functional checks are satisfactory.





Timeline



	Task Mode	Task Name	Duration	Start	Finish
1		Power Unit Test Stand	173 days	Thu 8/29/19	Sat 4/25/20
2		Planning	71 days	Thu 9/5/19	Thu 12/12/19
3		Decide on project	6 days	Thu 8/29/19	Thu 9/5/19
4		Research Test Stand Design	6 days	Thu 9/5/19	Thu 9/12/19
5		Create prints/drawlings	36 days	Thu 9/12/19	Thu 10/31/19
6		Prepare Proposal	31 days	Thu 9/5/19	Thu 10/17/19
7		Figure out Budget	16 days	Thu 9/5/19	Thu 9/26/19
8		Steps needed to complete	16 days	Thu 9/5/19	Thu 9/26/19
9		Gnatt Chart	6 days	Thu 9/12/19	Thu 9/19/19
10		Write/Finish Proposal	11 days	Thu 9/12/19	Thu 9/26/19
11		Update Proposal if necessary	6 days	Thu 9/26/19	Thu 10/3/19
12		Make Changes to Proposal	6 days	Thu 10/3/19	Thu 10/10/19
13		Prepare Proposal	6 days	Thu 10/10/19	Thu 10/17/19
14		Proposal due	0 days	Thu 10/17/19	Thu 10/17/19
15		Prepare Presentation	46 days	Thu 10/10/19	Thu 12/12/19
16		Buy Test Stand Frame	21 days	Thu 10/3/19	Thu 10/31/19
17		Buy Tank	21 days	Thu 10/10/19	Thu 11/7/19
18		Buy pump motor groups	11 days	Thu 10/24/19	Thu 11/7/19
19		Buy rest of the parts for test stand	11 days	Thu 11/7/19	Thu 11/21/19
20		Create the assemlbly drawings	6 days	Thu 10/24/19	Thu 10/31/19
21		Mid Term Project report	6 days	Thu 11/7/19	Thu 11/14/19
22		End of semester report/presentation	9 days	Mon 11/25/19	Thu 12/5/19
23		Mid term presetation	0 days	Fri 11/29/19	Fri 11/29/19

Timeline (Cont.)

GANTT CHA

		Task Name	Duration	Start	Finish
24		Fabrication of Test Stand if needed	6 days	Thu 12/5/19	Thu 12/12/19
25		Assemble pump motor groups	3 days	Thu 12/12/19	Sun 12/15/19
26		Put tank and pump/motor onto stand	5 days	Sun 12/15/19	Thu 12/19/19
27		Assemble rest of fittings on stand	3 days	Thu 12/19/19	Mon 12/23/19
28		Prepare test for paint	1 day	Thu 12/26/19	Thu 12/26/19
29		Paint Test Stand and all Components	2 days	Thu 12/26/19	Fri 12/27/19
30		Wire electrical components	6 days	Thu 1/2/20	Thu 1/9/20
31		Testing	77 days	Fri 1/10/20	Sat 4/25/20
32		Finite Element Analysis	6 days	Thu 1/16/20	Thu 1/23/20
33		Horsepower and Torque Analysis	11 days	Thu 1/23/20	Thu 2/6/20
34		Testing Electrical components and power	6 days	Thu 2/6/20	Thu 2/13/20
35		Make any changes if necessary	13 days	Thu 2/13/20	Sat 2/29/20
36		Final Presentation of Hydraulic Test Stand	42 days	Sun 3/1/20	Sat 4/25/20
37		Final Presentation at Senior Design Day	19 days	Wed 4/1/20	Sat 4/25/20
38		Final presentation	0 days	Sun 4/26/20	Sun 4/26/20

Ready | New Tasks : Manually Scheduled

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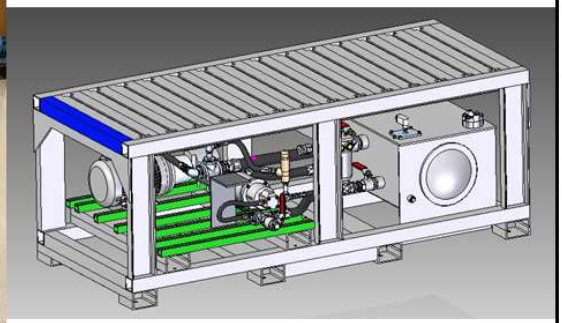

Questions

- Keith Kincaid -- kincaik2@miamioh.edu
- Tyler Gregory -- gregortc@miamioh.edu
- Miami Regionals Campus contacts:
  - Hamilton -- 513-785-3000
  - Middletown -- 513-727-3200

9

Reflective Essay- Tyler Gregory

This senior design project has been very different from anything that I have ever done before in school or in my career field. In my time here at Miami I have grown accustom to going into a class and the professor having everything already planned out throughout the semester, the assignments already made, tests from the previous semester, and the lectures already completed. Well Senior Design has been the complete opposite from every class I have ever taken at Miami. With the overwhelming amount of self-responsibility senior design puts on every single person's shoulders, this class single handedly gets people ready for the career field you about to embark in. Overall, I'd say this project has been nothing short of a headache sometimes, but it marks a bitter sweet ending to a chapter in my life that's going on eight years. Keith has blessed me with this partnership from day one of senior design back in the fall. The same day that, heading into that class I was very unsure if I was even going to make it to senior design day in April. Heading into the fall semester I did not know exactly what I was going to do with senior design or really had any clue about how much this course requires. The partner who I had verbally committed to take senior design with had changed his mind last minute, so therefore I had no partner and no ideas for a topic. But, none of that really matters because it all worked out in the long run, and now here we are finishing up our college careers with senior design.

When Keith came up to me in the fall about possibly working together, I had a glimmer of hope that I might make it out of senior design alive. When Keith told me he already had a topic idea planned out, all I wanted to do was say thank you. The opportunity that Keith and everybody over at Force Control has presented me with this project is unbelievable. This project was not easy at all times, it definitely has presented its fair share of challenges.

A project of this magnitude really relies solely on communication and how well you can work with other people. Keith and I did a very good job regarding communicating with each other throughout the week and during the weekends. It presents a challenge for yourself when you are doing a project through your teammates work. Keith is at Force Control every single day, knows the ins and outs of the company, knows the purpose of this project, and has eyes on the project on a daily basis. For me on the other hand, I did not even know Force Control existed until the first day of Senior Design this year. I was unaware of what Force Control did, and the different ins and outs of this universal Test stand. It was a little more difficult for me to try and setup a time where I can go to Force Control to actually get my eyes and hands on this Universal test stand. But I think I did a good enough job in staying active in this project, showing Keith and showing Force Control that I was motivated and willing to work when it came down to this project.

I also think Keith and I did an excellent job of managing our time when working on this project because a challenge presents itself when you both work full time outside of taking courses at night. One of the best things we have done was to exchange each other's phone numbers so we would always be able to contact each other. Keith was always reachable by his phone and would always get right back with you if you had a question. I tried my best to make it to Force Control when they would setup a date and time after work for me to come into their facility and work on this unit. There was one Friday in February that me and Keith had scheduled to get together after work and I had to cancel last minute due to being stuck at work.

Keith took a project manager role, while I took more of a hands on/ laborer role. I wanted to try and do as much of the project, paper and presentation as I could to make up with my lack of attendance at Force Control on a daily basis. I was always trying to ask Keith if there was

anything else he needed me to do or work on so he didn't have to do any more than he was already doing. I tried my best to get involved in the senior design class updates every Thursday, tried to complete every Meeting Journal for the project during both semesters. I feel there is always some room for improvement in anything you do. I will take the lessons learned during my time in Senior Design and make sure I apply them in my future life endeavors.

Reflective Essay- Keith Kincaid

I have found the senior capstone class to be different and challenging from the start. Being an unconventional student at Miami has presented many challenges and the one that showed up day one of this class was not knowing many students. Since I usually take two classes a term, I have seen students come and go and was a little apprehensive about finding a partner for this class. I was also wrong in thinking that there would be a list of projects to choose from when we showed up. I suppose we get use to the "leading by the hand" type of treatment throughout the 4-year degree program as most of the classes have a predetermined path throughout the term. Even with these obstacles, having to find a project and a partner wasn't a difficult task as I had a potential project in mind and recognized Tyler from a prior class.

I have had no problem in jumping into this project as it is like being in the role of a project manager. I have led many projects throughout my career, but I also understand that the coursework at Miami has helped prepare me for this type of project involving design and engineering. Being in the Engineering field has played a part in the understanding of the processes that go into a successful project. I have learned through experience, and if I remember correctly it was discussed in project management, that to get things done you have to been willing to work with people. This includes working with a partner, a company and a University as we are doing with this project.

Tyler and I partnered up with each other the first day of class, I was able to present a project to Miami University that had previously been shelved by Force Control. I initially set up a meeting with Force Control and Tyler to introduce every and figure out logistics of getting the work done with Tyler not being an employee. Force Control has been great in allowing us to do this project for them as well as financing it with little oversite.

Tyler has been a great partner to work with on this project, he is very willing to take on his share of the work and was open to working with me on this project with Force Control. I feel Tyler has done a great job in staying involved wherever possible, even if not onsite Tyler jumped in on working through the reports and weekly journals. I have done my best to keep Tyler up to date and informed on the parts of this project that are note visible to him such as the scope laid out by Force Control and materials arriving at the plant.

Working with the Force Controls materials department has been a pleasure, my frequent checkups on purchased parts have been address in a professional manor and not treated like a nuisance project. I met with Jerry, the materials manager, at the beginning of the project and made him aware of the timeline and set the tone for how the project would be handled. He has responded with every enquiry I have sent his way with quick precise answers. When I discovered ordered items were missed on my part, Jerry was very willing to help and quick to place additional orders. Communications from outside vendors on the fabricated items have went smoothly and without incident.

I have enjoyed working on the design for the Universal Test stand and feel confident that we have designed a stand that meets the needs of Force Control. I think this design will give the versatility in testing the many units that Force Control manufactures and stand up to the torques the #20 Posidyne can put on it. I enjoyed getting my hands dirty in the assembly and testing of this stand, seeing a project through from concept to reality was rewarding.

Tyler and I have set out from day one to hit this project head on and shoot for an early completion date to give plenty of time for testing and proof of concept. We were successful in staying on pace to get the stand fully assembled and ready to test. Tyler took time out of his work schedule to meet at Force Control at critical points to keep us on pass for early completion.

Force Control had an important project that was underway in November that looked like it may slow some progress, but we were able to adjust what we were doing and work through it to stay on track.

To my own surprise, as mentioned earlier, we had very little oversite in this project. I feel this was very intentional on Force Controls part to allow Tyler and I to get the most from the experience. As a team Tyler and I were able to be very successful in bring the project from concept to reality in under our allotted time. I would welcome the opportunity to work with Tyler on another project in the future.