Multidisciplinary Senior Design
Project Readiness Package

Project Title:	Adjustable Aircraft Brake Simulator
Project Number: (assigned by MSD)	**P18371**
Primary Customer: (provide name, phone number, and email)	**Kyle Berkowitz** MABS: Akron
Sponsor(s): (provide name, phone number, email, and amount of support)	**Mark Maydew** MABS: Great Britain
Preferred Start Term:	Spring 2018
Faculty Champion: (provide name and email)	TBD
Other Support:	As Needed
Project Guide: (assigned by MSD)	

Ankit Prasad

Prepared By Signature Date

Received By Date

Items marked with a * are required, and items marked with a † are preferred if available, but we can work with the proposer on these.

Project Information

*** Overview:**
Please provide a brief (2-3 paragraphs) overview of the background on the problem to be solved, the motivation for solving it, the short-term goals for the proposed project, and the long-term goals for any program the project may support.

Meggitt Aircraft Braking Systems engineers and manufactures aircraft brakes for multiple aircraft manufacturers. Currently, the brake engineering team is looking for an apparatus to hydraulically simulate multiple brake systems and various size levels. One of the key attributes is to eliminate the need to use an actual aircraft brake assembly in the simulator device.

The goal is to develop hydro-mechanical apparatus to simulate an aircraft brake assembly. The assembly is intended to be used for connection into a hydraulic simulator rig, where the rest of the aircraft control system is incorporated for performance analysis or testing purposes. The apparatus is intended to replicate both the brake assembly hydraulic compliance and mechanical stiffness. The apparatus will be used dynamically during the simulation runs to generate hydraulic load in the control system as generated from the brake assembly.

The apparatus must be highly adjustable and will likely be made from both mechanical and hydraulic components. Based upon the compliance curve, the user needs to have the ability to rapidly implement modifications to both the mechanical, hydraulic, and any control logic used in the apparatus's setup. The volumetric displacement vs. pressure curve requirements is confirmed and duplicated by the apparatus.

Set up modification should be adjustable within an eight hour period with defined procedures and parameters such that they can be duplicated whenever desired. Output performance of the apparatus should be easily recorded, plotted and confirmed against requirements.

*** Preliminary Customer Requirements (CR):**
What attributes does the customer seek in the final project? Each CR should map to one or more ER (see below).

Please see table below.

*** Preliminary Engineering Requirements (ER)**:
Include both metrics and specifications. Each ER should map to one or more CRs (see above).
Metrics: what quantities will be measured in order to verify success?
Specifications: what is the target value of the metric that the team should design to?

Please see table below.

Table 1: Customer & Engineering Requirement

Category	Customer Requirement	Engineering Requirement
User	Transportable	Capable of being moved by 1 Person
	Compact	Fit though a standard 32" man door
	Installation Time	Within 30 minutes
	To change between specific desired pressure-displacement settings.	8 hours MAX
	Safe for user	Reduce pinch points
		Utilize shields to protect operators for both mechanical and electrical
		NEMA & CE compliant; if using electrical components
		Apparatus must be in an Enclosure with sight window
		Secure any subcomponents of the apparatus which may be at risk for becoming displaced during operation
Configurability	Easily Configurable	Specific setup activities are readily known
		Parameters are easily replicated
		Common set-up parameters result in consistent output
Hydraulics	Pistons & Rod Seals Specs	AS4716
	Face Seals Specs (Not Preferred)	AS6235
	Configure to existing hydraulic lines	The fitting ends must be to AS4375 Style-E (Tube Size: OD: 0.375")
Fluid	Compatible to simulate aircraft brake fluids	Red Oil (Recommended for Development): MIL-PRF-5606
		Phosphate Ester: AS1241
	Easily free the system	Must bleed the system of air within x minutes
DISP vs. Pressure	Design to any Displacement vs. Pressure curve	See attached file: (Appendix A)
	Range of Displacement	Appendix A
	Range of Pressure	Min (0psi) Max(5000psi)
	Ability to tune fill rate	Hydraulic inlet must have 0.052'' restrictor for prototype
Maintainability & Repairability	Reliable	1 million max pressure cycles
	Ability to maintain and repair	Commercially available parts or specialized parts shall be made from high quality aerospace materials.
		Easily dissemble, modify, & rebuild

Material	Resistance to indoor environment and exposed hydraulic fluids	Corrosion Resistant Material
Software	If required, should be readily available software	Please contact customer during design phase for software use.

* **Constraints:**
List any external factors that limit the selection of alternatives, e.g., allowable footprint, budget, required use of legacy hardware/software.

See Eng. Requirements
Easily Moveable
No legacy software is being used currently hence the team has complete software freedom
Apparatus works in conjunction with Hydraulic System (Per AS4375 Requirements)
Industrial grade equipment is acceptable *upon approval*.
Design with a budget of $10,000 on hardware

† **Potential Concepts:** (will not be given to the students, but will be provided to the team's guide for reference):

Meggitt would like to advise the student to not see any of the previous designs as Meggitt Aircraft Braking Systems wants an unbiased design solely based on the CRs & ERs and the students' expertise and imagination.

* **Project Deliverables:**
Minimum requirements:

- All design documents
    - Concepts
        - Layouts, Method of Tuning
    - Analysis
        - Must: Theoretical Pressure Displacement Curve
        - Structural Analysis
        - Component Evaluation for operational pressures and loads
        - Overall safety evaluation
        - If electrical design is incorporated, NEMA & CE (European) compliant
    - Detailed drawings/schematics
        - Material Fluid Compatibility
    - BOM
        - Follow EHS guidelines.
            - Non-toxic materials and coatings
            - ROHS compliant

        - Environmentally friendly
        - No fumes
        - Must be able to operate in an open environment.
    - Test results
    - Working prototype
    - Manual Included
    - Technical paper
    - Poster
    - All teams finishing during the spring term are expected to participate in ImagineRIT

† **Budget Information:**
Include total budget, any major cost items anticipated, and any special purchasing requirements from the sponsor(s).

Total Budget: $10,000

* **Intellectual Property:**
Describe any IP concerns or limitations. According to RIT policy, students have the right to retain any IP they generate during a course, but some students voluntarily agree to be placed on projects where they will be asked to assign their IP. If a sponsor wishes to have a team assign their IP, we need to know ahead of time so that we can place appropriate students on the team.

In order to ensure that students can discuss their projects openly during presentations and job interviews, we ask that no more than ~20% of the project is considered confidential.

Project Resources

† **Required Resources (besides student staffing):**
Describe the resources necessary for successful project completion. When the resource is secured, the responsible person should initial and date to acknowledge that they have agreed to provide this support. We assume that all teams with ME/ISE students will have access to the ME Machine Shop and all teams with EE students will have access to the EE Senior Design Lab, so it is not necessary to list these. Limit this list to specialized expertise, space, equipment, and materials.

Faculty list individuals and their area of expertise (people who can provide specialized knowledge unique to your project, e.g., faculty you will need to consult for more than a basic technical question during office hours)	**AP / 11-7-17**
Hydraulics, Safety analysis, Component stress analysis, electrical (if required)	
Environment (e.g., a specific lab with specialized equipment/facilities, space for very large or oily/greasy projects, space for projects that generate airborne debris or hazardous gases, specific electrical requirements such as 3-phase power)	**AP / 11-7-17**
Machine Lab, ability to work w/ hydraulic fluids – discussed with Jan Maneti and Rob Kraynik – team can use space in shop area. BD 12/2017	
Equipment (specific computing, test, measurement, or construction equipment that the team will need to borrow, e.g., CMM, SEM,)	**AP / 11-7-17**
CNC, Hydraulic pressure source, data collection, machining, hand tools	
Materials (materials that will be consumed during the course of the project, e.g., test samples from customer, specialized raw material for construction, chemicals that must be purchased and stored)	**AP / 11-7-17**
Hydraulic fluids, aerospace metals, hydraulic components.	
Other	