Separation Connector

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Needs Identification

Document

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INTRODUCTION

Orbital Sciences Corporation is an engineering design company that contracts in space vehicles and missile defense systems. Our sponsor from Orbital Sciences Corporation is Mary Rogers. She is the current electronics packaging and actuator manager. She has requested, on behalf of Orbital Sciences Corporation, that our capstone group aid in redesigning their current separation connector. The separation connector is the device that allows the launch vehicle to de-mate from to the device being deployed. It is a mechanical device that detaches the communication wires of the launch vehicle and the deployed device. Ideally, this new separation connector will be easy to manufacture, light-weight, and more effective than its predecessor.

Figure 1: Current separator connector

NEEDS IDENTIFICATION

Mary Rogers approached us with this project in hopes of improving the current separation connector. She had some specific requests on what her company was looking for. Some of her requests included:

- The device being able to withstand military specification testing
    - including but not limited to thermal, shock, and vacuum tests
- The device should not de-mate prematurely
- The device should separate with a reasonable amount of force
    - For dynamic separation, reasonable is defined as 200 lbf
    - For static separation, reasonable is defined as 10-30 lbf
- The device must be reliable enough to mate and de-mate a minimum of 50 times without failure or damage

From these needs, we conclude that the customer needs a separation connecter that is perfectly reliable and can dynamically de-mate under smaller loads then currently available.

PROBLEM STATEMENT

The goal of the project is to design an improved separation connector. This separation connector must separate cleanly 100% of the time. Separation must be achieved under dynamic loads of less than 200 lbf or static loads of less than 30 lbf and must be tested at least 50 times with no signs of damage or failure.

OBJECTIVES

Our objectives are to create a smaller, inexpensive, more reliable, separation connector that is easy to manufacture. The original dimensions of the separator connector are based on the "crimp well data" which are set at: well diameter = 1.3583±0.03937 inches and nominal well depth = 5.5512 inches. We want the price to be less than $400 dollars which is the average price of a single separator connector. For reliability, we want the new separator connector to meet the client's requirement of passing 50 tests without failure or damage. Lastly, the part needs to be easier to manufacture. Our client currently purchases all of their separator connectors from other companies but would like to manufacture them in their own machine shop or on their 3-d printer. See below for the table of objectives.

Table 1: Table of objectives

Objectives	Basis	Units
Inexpensive	Material cost	$$
Ease of manufacturing	Time to manufacturing	$/hour
Reliability	percent of failure	%
Decrease in Size	diameter	inches

CONSTRAINTS

The constraints of this project include:

- Size must be no greater than 25% larger than current design
- Weight must be less than or equal to the current design's weight
- Material cannot out-gas in a vacuum
- After the de-mate process, the separator connector must stay behind the device
- The separator connector must not de-mate prematurely

CRITERIA AND CRITERIA TREE

This section contains our objectives converted into equivalent criteria and a diagram of the criteria tree. The criteria tree separates the newly transformed objectives into an easy to read diagram of the criteria.

Table 2: Objective and equivalent criteria

Objective	Criteria
Inexpensive	Cost
Ease of manufacturing	Manufacturability
Reliability	Failure rate
Decrease in Size	Size

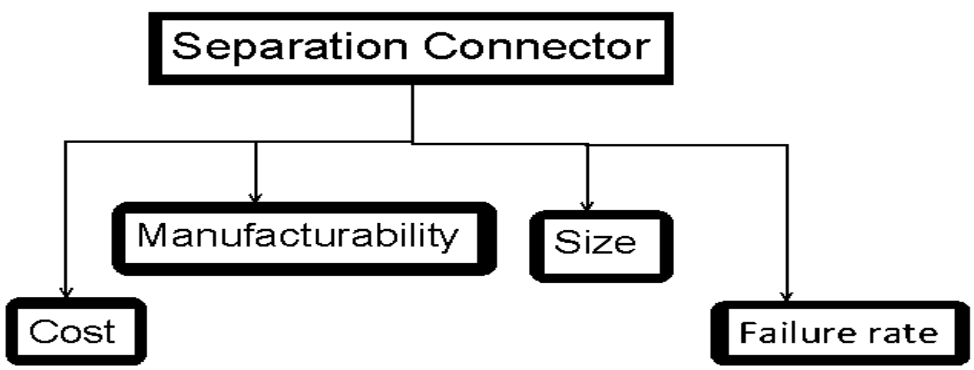

Figure 1: Criteria Tree

HOUSE OF QUALITY

This section contains our house of quality diagram. This diagram relates our engineering requirements to each other. The relationship between any two engineering requirements is positive if they are directly proportional, negative if they are inversely proportional or no relationship if they don't affect each other.

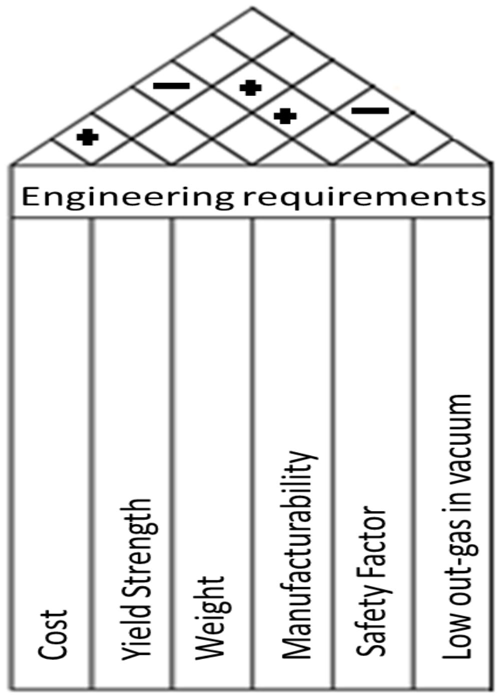

Figure 2: House of Quality

FUNCTIONAL DIAGRAM

This section contains our functional diagram. The functional diagram relates the customer's requirements to equivalent engineering requirements. It also helps choose which requirement of the project is most important. The most important engineering requirement according to our functional diagram is having a low out-gas material if/when the separator connector is in a vacuum. However, the most important customer requirement is reliability.

Table 3: Functional diagram/table

		Engineering Requirements					
		Yield Strength	Manufacturability	Safety Factor	Weight	Cost	Low out-gas in vacuum
Customer Requirements	Materials	x	x		x	x	x
	Contact Size				x	x	
	Resist Damaging	x		x			
	Inexpensive					x	
	Reliability	x		x			
	Easy to manufacture		x				
	Robust design				x		x
	Units	psi	$/hr		lb	$	
	Engineering Targets			1.5			

GANTT CHART

This section contains our Gantt chart. The Gantt chart shows our projected dates to have certain aspects of the project completed and when we actually completed them. This schedule is tentative and is subject to change.

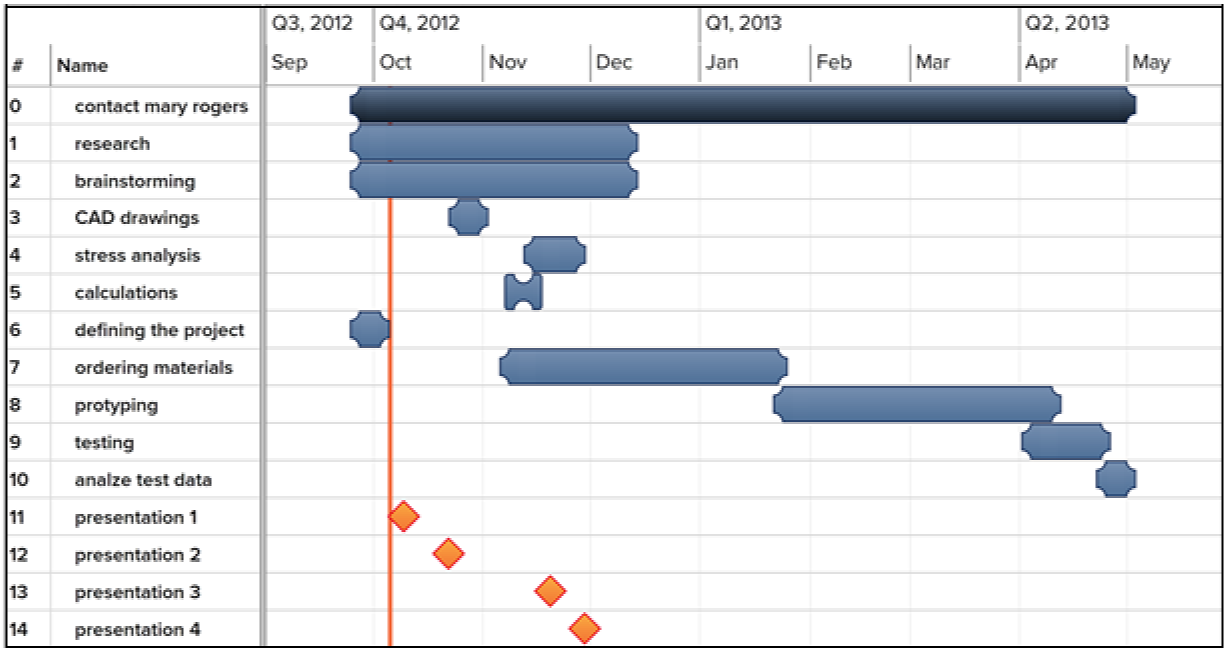

Figure 3: Gantt Chart

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