

ME 476

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## Preliminary Design Report

### Group 15

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## I. Introduction

The NAU Department of Dental Hygiene provides humanitarian services in some remote areas of the world. These remote areas sometimes have limited access to electricity. In December, a team of students and professors of the Department of Dental Hygiene will be travelling to Mainpat, India to work on teeth. To get the work done, they will need to use the Wig-L-Bug, a device that mixes dental filling material.

The Wig-L-Bug requires electricity to run. Because there will not be electric power available, the team will need to bring a portable power source with them. This power source must be able to power the Wig-L-Bug ten hours a day for two weeks, without any downtime. It needs to be a convenient size and weight, so that it can be easily transported.

## II. Need Identification

Currently, the Department of Dental Hygiene has no way to operate the Wig-L-Bug in areas with no electricity. In the past, they tried to use dental filling compounds that could be mixed by hand, but they were not satisfied with the results. The Department of Dental Hygiene wants to use the Wig-L-Bug to get consistent mixtures of the filler material.

There is no off-the-shelf substitute for the Wig-L-Bug that is capable of operating without electricity. Also, there is no off-the-shelf power supply that meets the needs of the Department of Dental Hygiene.

## III. Problem Statement

### a. Goal

The goal of the capstone design team is to build a fully functioning power source that meets the requirements of the Department of Dental Hygiene. The capstone team will not be designing a model that is to be produced on a commercial scale. The power supply will be designed for a production run of only one or two units.

### b. Objectives

The Design team will build a power supply capable of powering the Wig-L-Bug for an entire workday. The power supply will be small and light, so that it can be carried conveniently. It will be durable enough for rough transport. It will require no maintenance for the duration of the trip to Mainpat. While meeting all objectives and constraints, it will be as cheap as possible.

<b>Objective</b>	<b>Basis for Measurement</b>	<b>Units</b>
Powerful	Current output @ 110 volts	Watts
Portable (Size)	Disassembled minimum volume	Cubic cm
Portable (Weight)	Total weight	kilograms
Durable (Cyclical)	Repeated drops from height	centimeters
Long Life Span	Fully charge/discharge cycles	number
Low Cost	Cost per unit	Dollars

c. Constraints

- Must have stable output voltage of 110 volts at 60 hertz
- Maximum output of 1.2 amps
- Must be able to continuously power Wig-L-Bug for 10 hours
- Cannot weigh more than 12 Kg
- Must be able to fit in 56\*45\*25 centimeter container
- Must be able to charge on 220 volts at 50 hertz (If Applicable)
- Must be able to charge 0 – 100% in eight hours (If Applicable)

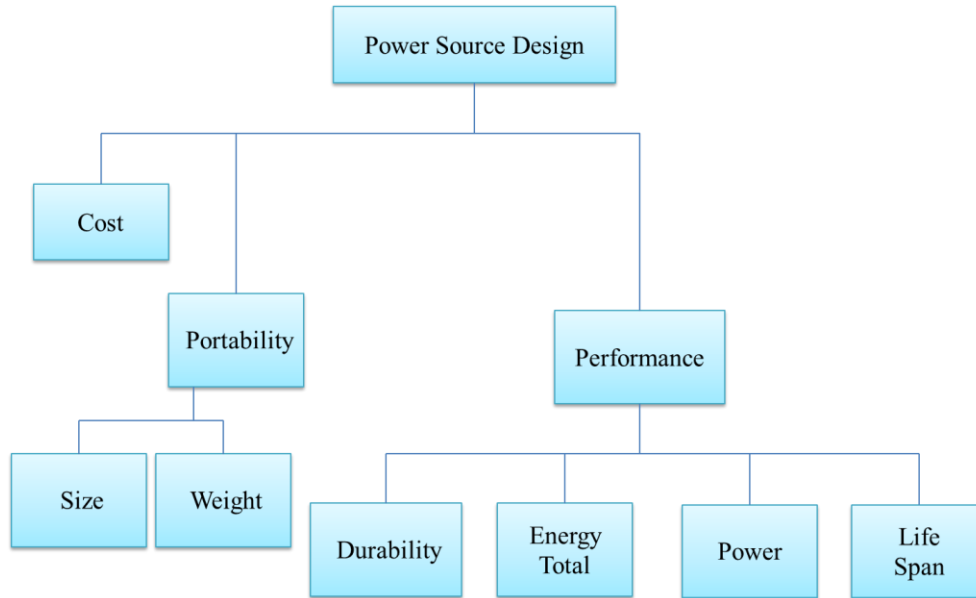
d. Test Environment

The test environments will be simulations of the real world working environments. The Wig-L-Bug will be run for 10 hours at 8 and 25 degrees Celsius. If the budget permits, destructive durability tests will be conducted by repeatedly dropping the power supply from a specified height onto a hard surface to simulate rough off-road transport and handling. If the budget does not allow for destructive testing, the weakest components of the system will be identified and tested individually. At this time, the design team does not have enough of a design to allow for more specific test plans.

e. Recapitulation

The ideal power supply will be as small and light as possible, while still being able to power the Wig-L-Bug for the specified duration. It will be durable and low cost.

#### IV. Criteria



#### V. Functional Diagram

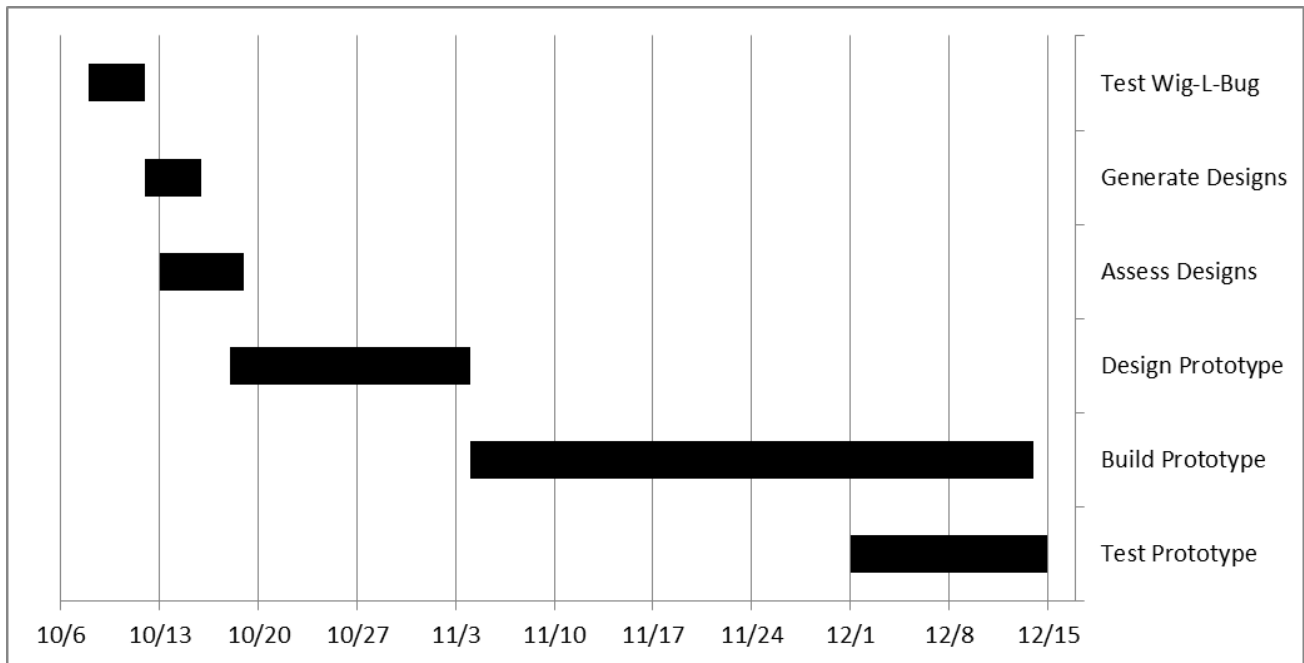
The team is not far along enough in the design to have a functional diagram. The team will build a power supply that the Wig-L-Bug plugs into. That is all that is known so far.

VI. Quality Function Deployment/ House of Quality

		Engineering Requirements								
		Output Voltage	Output Current	Dimensions	Energy Density	Charging Current	Charging Voltage	Cost	Weight	Life Time of Battery
Customer Requirement	Powerful	X	X							
	Durable							X	X	
	Long Life Span							X		X
	Portable			X	X					
	Fast charged				X	X	X			
	Has Large Energy Capacity			X	X			X	X	
	Low Cost			X	X			X	X	X
	Safe	X	X	X		X	X		X	
	Units	V	A	cm*cm*cm	Wh/kg	A	V	\$	kg	Cycles
		110	1.2	56*45*25	150	6	220	500	12	150

	Output Voltage	Output Current	Output Power	Volume	Energy Density	Cost	Weight	Lifetime	Total Energy
Output Voltage									
Output Current	-								
Output Power									
Volume			+						
Energy Density									
Cost			+	+	+				
Weight			+	+		-			
Lifetime						+	+		
Total Energy				+	+	+	+	+	

VII. Gantt Chart



The Department of Dental Hygiene wants a working prototype by December 15. The first task of the design team is to test the Wig-L-Bug and analyze the power draw. After that, multiple designs will be evaluated. By October 17, a final design will be chosen and worked out. The team will begin building the power supply by November 4. Testing will start by December 1<sup>st</sup>. Two weeks will be sufficient time to complete the power supply.