FAMU/FSU College of Engineering
Department of Mechanical Engineering

Project Plans and Product Specifications

Marine Keel Cooler Optimization Tool

EML 4551C Senior Design

Project Sponsor: Frank Ruggiero - Cummins Inc.

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Team 3

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Abstract

This report defines the project plans and product specifications for the Marine Keel Cooler Optimization Tool. Cummins Marine is in need of a better tool which would enable the Marine Application Engineers to ensure proper validation of the marine keel cooler. The current tool was developed in the early 1980's and is limited to only steel keel coolers and only provides a pass/fail output to the user. The team is then faced with the creation of a new tool which will not only test the pass/fail cooling capability of the keel cooler but the tool will also be able to calculate box channel, half round and full pipe sections in steel or aluminum. It will evaluate an existing keel cooler system and be able to recommend other sizes which would optimize the cooling per vessel/engine installation. Such tool will allow the Marine Application Engineer to validate the keel cooler not only in extreme conditions but in different climates as well since most commercial vessels will navigate across international waters.

To ensure tool accuracy, research is currently being conducted to obtain adequate knowledge with regards to keel cooled systems and the design parameters needed to keep in mind. The following project plan includes an overview of the steps to be followed to complete the project. The overall plan, methodology and project approach decided upon by the team will ensure deliverables are met on time and timely product delivery to the sponsor.

1. Problem Statement

The Senior Design Project for Group 3 for the Marine Keel Cooler Optimization Tool is sponsored by Cummins Marine. The tool currently utilized by the Marine Application Engineers is severely outdated and only returns whether or not the user inputted parameters will result in a passing or failing keel cooler design. The program does not provide any feedback to the designer or operator. This limits the overall design process and does not validate the keel cooler design on the vessel for other nautical water climates.

"The current Cummins keel cooler design tool provides no feedback on a particular design and is limited in its capability"

2. Project Scope and Goal

The project should cover all marine engines offered by Cummins, both current production and out of production which will/are installed in keel cooled vessels. The tool is to be used not only to validate the keel cooler system but also suggest the optimal keel cooler design to the boat builder. The tool must be able to calculate and predict how the cooling system will behave under different engine loads and water ambient temperatures. This tool will then be validated through testing on a sea channel constructed by the team and depending on boat builder availability, it will be tested on a current installation.

"Design a more versatile design tool which generates feedback and provides a more user friendly interface"

3. Project Objectives

Objectives:

- Successfully predicts the heat dissipation, efficiency, as well as the optimal operation temperatures for a particular design
- Suggests useful design alterations that would increase the efficiency of the design
- Validate the keel cooler system in scenarios where the vessel is at low idle or relocated to a different body of water (different ambient water temperature)
- Must be user friendly and intuitive

4. Methodology

4.1 Marine Keel Cooler Optimization Development

To ensure accuracy and Cummins industry standards are met, extensive research is being conducted in the design and science behind marine keel coolers. It is important to properly define the input design parameters since they will need to be able to be utilized cross engine models and performance ratings and provide the user accurate results.

Once the proper parameters have been defined, the program will be written to utilize the proper equations, constants and provide proper feedback to the user. Ultimately, not only provide a pass/fail result, but allow the option of the material used as well as a recommendation for the adequate sizing of the keel cooler per engine/vessel installation.

4.2 Analysis

As the optimization tool is being written, part of the team will utilize the resources available to construct a rudimentary sea channel. This sea channel will allow the team to conduct flow analysis testing in order to fine tune the program. The program will be tested for validation against the sea channel. Once accuracy from the tool has been obtained, the team plans to enter the parameters for a QSK 19 MCRS engine and construct an adequately sized keel cooler based on the programs suggestion or depending on the availability of the boat builder, test the program against a current engine installation.

4.3 Schedule

To ensure deliverables are achieved on schedule, a Gantt Chart was created through the use of Microsoft Project, *Image* _____

5. Project Constraints

This project will need to be able to take parameters from the different marine engine models both current production and out of production and be able to calculate the adequate size and cooling needed dependent on the vessel application. With over 15 engines models and each different performance rating available, it is going to be important to find the common variables which can serve as inputs for the tool.

The most restrictive constraint for the project is budget. For this project, the sponsor agreed to an amount of $6000 which will be used to design a sea channel for the testing/validation of the tool to possibly creating a keel cooler based on the tools recommendation. A time constraint has also been placed on this project for completion by Spring 2016. The team is also faced with the challenge of finding a keel cooled boat under construction by a boat builder within the Tallahassee area in order to validate the tool on an actual installation.

6. Deliverables

7. Assigned Resources

Specific roles are charged to each team member based on experience, skill set and preference. Team members are responsible for the role assigned to them throughout the duration of the project. The description of each role is delineated therein.

Project Leader *Stanko Gutalj*

The project leader advances the project along with the support of the team. The project leader oversees and ensures that the established plan and timeline is kept. The project leader is also responsible for promoting a positive work environment, maintaining team cohesiveness and always act in the best interest of the project. Project tasks will be delegated by the project leader to the team members based on experience and skill set. Works alongside team members towards the advancement and ultimate completion of the project.

Technical Liaison *Melissa Allende*

The technical liaison is the link of communications between the two entities involved in this project, Cummins Marine and FAMU-FSU College of Engineering. Ensures the specific goals of the project are successfully translated to meet end-user tool requirements and is executed upon throughout the development of the project. The technical liaison defines and often will execute appropriate tests to the program to ensure a first-time product acceptance in the marine market. The technical liaison provides real-time feedback and assistance in answering any questions presented by the team members.

Web Based Technician *Grady Beasley*

The web based technician strives to maintain a cohesive professional design for the team's website. The web based technician will ensure information on the website is kept up to date and ensure all data is accurate. Will uphold the responsibility to properly represent the team's sponsor and university with professionalism and dignity.

Financial Advisor *Jacob Ross*

The financial advisor will be responsible for the administration of the budget for the project. The financial advisor will retain all records of credits and debits charged to the account. Requests for the use of the budget will be submitted to the financial advisor and then the financial advisor will forward the request to the team advisor/sponsor. It is the financial advisors responsibility to maintain proper analysis of the budget and communicate balances and any adjustments to the team.

Administrative Assistant ***James Haga***

The administrative assistant will be responsible for storing, organizing and managing team files. All deliverables will be submitted to the administrative assistant for final review to ensure accuracy and clarity. The administrative assistant is also in charge of planning and scheduling; this includes scheduling team meeting times and dates, staff meetings, tracking deliverable due dates, and key presentation dates. The administrative assistant ensures team members are aware of these dates to ensure the timely progress for the project.

8. Product Specification

8.1 Design Specification

8.2 Performance Specification

References

1. Shaw, Courtney. "Cummins Marine Propulsion." *Cummins Marine*. Web. 23 Sept. 2015. <http://marine.cummins.com/>.
2. "Marine Keel Coolers for Heat Dissipation." *Marine Keel Coolers for Heat Dissipation*. Web. 23 Sept. 2015.
3. *Cummins Keel Cooler Sizing Tool*. Computer software. Vers. 2.0. Cummins, n.d. Private Web. 23 Sept. 2015.