

LIQUID PROPULSION GUIDE

PoliTo Rocket Team



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1. Mission

The Mission of the Liquid Propulsion subteam is to design and build a Liquid Rocket Engine (LRE) for research purposes. This is a long-term project that will most likely last for the next couple of years, covering every aspect of the design of a cryogenic liquid-propelled engine, with precise mathematical models and simulations, and the integration between each involved system.

2. Structure

The Chief Engineer of this project is Matteo Crachi, who is responsible for the design and will direct and organize the work, alongside Pier Luigi Mercadante and Cristian Manfredi, the Project Coordinators. The Chief Engineer and the Coordinators make up the Project Management.

This Subteam is divided into five divisions, which are:

- Test Bench
- Liquid System Architecture
- Engine Cycle
- Thrust Chamber Assembly
- Engine Control Strategy

Each division has its own Lead, who is responsible for the technical work of each member and the organization of its division.

For the complete list of members, please refer to the Excel file “organisational_structure.xlsx”, located in the “DOCUMENTS” folder of the Team’s google drive.



3. Communication

The official communication channel of the PoliTo Rocket Team is the official Discord server. Each division has its text channel, which is visible only to the division members, leads and project management. In these channels, technical topics can be discussed between colleagues, leads can be contacted, and issues reported.

The division leads and project management has their private text channel, in which general topics related to the whole project will be discussed.

External messaging apps are not official communication channels but can be used for informal communication or if some of the members cannot be contacted via Discord. Privately messaging the leads should be avoided in most cases, since any information regarding the subteam is preferably shared between leads and management, to better organize the project.

It is also important that no file is shared via email since it would be hard to keep track of each one and some important documents might be missed. More information about file sharing can be found in the relative section.

In case a lead would need to report a technical or organizational issue to the project management, a weekly slot of 15 minutes per lead will be available. The booking will be done by filling in a shared Google Sheets file. If the problem involves other members of the division, they can attend the meeting too. In case the problem would require more time to be solved, a specific meeting will be organized.

4. Gantt

The project management makes use of a Gantt chart to keep track of the workload of each member, task timelines and deadlines, milestones achieved, issues and changes to the base plan.

Each lead will have reading access to the chart, while only the project coordinators can edit it, and they will do so after receiving instructions from the Chief and insight into the progress by the division leads.

Both deadlines and timelines will be thoroughly discussed between the project management and the project leads.

The workload is divided into Stages, Tasks and Milestones. A stage is a general activity that is assigned to a division and is made of different tasks, each entrusted to a specific member of the division. Both stages and tasks can be dependent on another stage or task, they can be subsequent or contemporaneous. A milestone is a precise occurrence that concludes an activity.

5. Meetings

To keep track of progress, each division is required to have a weekly meeting of the duration of 30 minutes, during which each member will update its lead on the work done during the week and if any issues have come up, as well as discuss future actions. Each lead is required to plan their meetings independently, making sure that each member can participate, in person or by video conference.

The division lead will then produce a Meeting Minute (about 1 page), which is a report that summarizes the topics discussed during the meeting and the number and names of the participants.

The format for this document will be: "LRE_DIV_W_YYYY-MM-DD", where LRE stands for "Liquid Rocket Engine", DIV is the code for each division, W stands for "Weekly" and "YYYY-MM-DD" is the meeting date in that specific format. The blue text is what distinguishes different meeting reports.

The leads will also participate in another 30-minute bi-weekly meeting with the project management, to report what they have learned from the meeting with their division, receive further instructions, discuss important issues and plan any future tasks accordingly.

Moreover, the whole Subteam will have a monthly meeting of the duration of 1 hour, in which relevant information, such as important milestones achieved, blocking points and general future planning will be shared among all the members. Each person will talk for a couple of minutes about his work and achievements. The week before this meeting, the project management group will share a document that each member will fill with synthetic information about their work progress.

The date for this meeting will be decided sufficiently in advance, to allow every member to take part in it.

6. Report

6.1. File name

For each task and stage to be considered complete, a report must be submitted. The format for the files is: "LRE_DIV_S###_T###_REV###".

"S" stands for "Stage", while "T" stands for "Task". The three-digit number is directly related to the stage or task number found in the Gantt chart. The "REV" number is the Review iteration number, that allows keeping track of the changes made to a report and can be updated only by the leads and the project management.

6.2. Stages

The project Efesto is organized into different stages. As of May 20th, 2023, the stages are the following:

- **Stage 1:** part of the project in which the state-of-the-art of various components, materials and processes that form a Liquid Rocket Engine are studied
- **Stage 2:** part of the project in which the limitations, constraints and competition rules are examined. Masses are estimated and some components are chosen
- **Stage 3:** start the actual design of the engine. Simulations through specific software(s) to optimize the parameters of the engine, first iterations of the CAD model of the engine

6.3. Format and Template

Every report must be written in LaTeX and follow the official PoliTo Rocket Team template. The Overleaf link with the template will be provided to each team member.

A Liquid Propulsion technical report must be structured as follows:

- Title, containing the main topic
- Introduction
- Materials and Methods
- Results
- Discussion
- Conclusion

In the introduction will be specified what the report is about and will present a general overview of the content. The Materials and Methods section will contain in detail how the experimental test was set up and conducted, specifying software and study methodology; any assumed hypothesis must be explicated and justified. The results of the experimental test will be presented in the Results section and discussed in the Discussion section. The Conclusion section will give a summary of the results and how they have been interpreted.

Every report should be named according to the guidelines and it should have a brief but explanatory title on its first page.

6.4. Sources

Scientific articles, papers and books that were used must be mentioned in the specific part of the report, using the symbol [#], which refers to the material in the References page at the end of the report. All the material must be uploaded together with the report to make the review process easier. The source file name format is: "YYYY_NAME_TITLE", where "YYYY" is the publication year, and "NAME" is the family name of the first author.

6.5. File management

The Team keeps its files organized in a Google Drive, in which there is the Liquid Propulsion folder. The content of this folder is divided into a separate folders for each division, to which only the members of the division, the leads and the project management have access. Each division folder contains two different folders for reports and Meeting Minutes. To upload a report, a new folder must be created,

using the same name as the report file, except for the “REV##” part, in which the report, its reviewed versions and all the sources have to be uploaded.

When changes are made to the report, the original file should NOT be deleted, but a new file should be uploaded, with the Review number incremented by 1.

Every report is contained in a Google Sheets file, “Reports Register”, which can be found in the “DOCUMENTS” folder in the Efesto Drive, and can be consulted and updated by the members of the Efesto Project.

In the “DOCUMENTS” folder you can also find an Excel named “Purchases Request”, where every lead must write every purchase needed by their division, filling all the columns. Obviously, before adding the purchase to the document, the lead must discuss it with the Project Management.

7. Members removal procedure

Team managers reserve the right to assess the work of the members and, in case of insufficient work, remove them from their duties before the start of the new recruitment. The decision will be taken after appropriate discussion with the lead of the division of the member in question. The lead is also required to solicit members during the year if their work is insufficient, inviting them to get involved more. The final decision is unappealable.

Managers also reserve the right to delete positions that are no longer useful to the team, obviously trying to reassign the corresponding members to new positions. However, the possible removal from the team cannot be excluded in case of absence of available positions.