

GOMER – GEORGIA TECH ONLINE MASS ESTIMATION RESOURCE



USER MANUAL, v1.0

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1.1 INTRODUCTION

GOMER, or Georgia Tech Online Mass Estimation Relationship, is the product of a Master's project undertaken by Janssen Pimentel in the Spring of 2004. It is the extension of Reuben Rohrschneider's Master's project completed in 2002, where he compiled a listing of mass estimating relationships (MERs) used for the preliminary sizing of reusable launch vehicles (RLVs) gathered from various sources. His project resulted in a sizable .pdf document available for download from the Space Systems Design Lab website (<http://www.ssd1.gatech.edu>).

GOMER's objective is to take the information contained within this .pdf document and place it into a web-based application. By doing so, it allows any user to perform a simple search for any MER contained within the database. A user that accesses GOMER (<http://ssdl20.ae.gatech.edu/merdb>) first sees the *About* page (seen in the figure below).

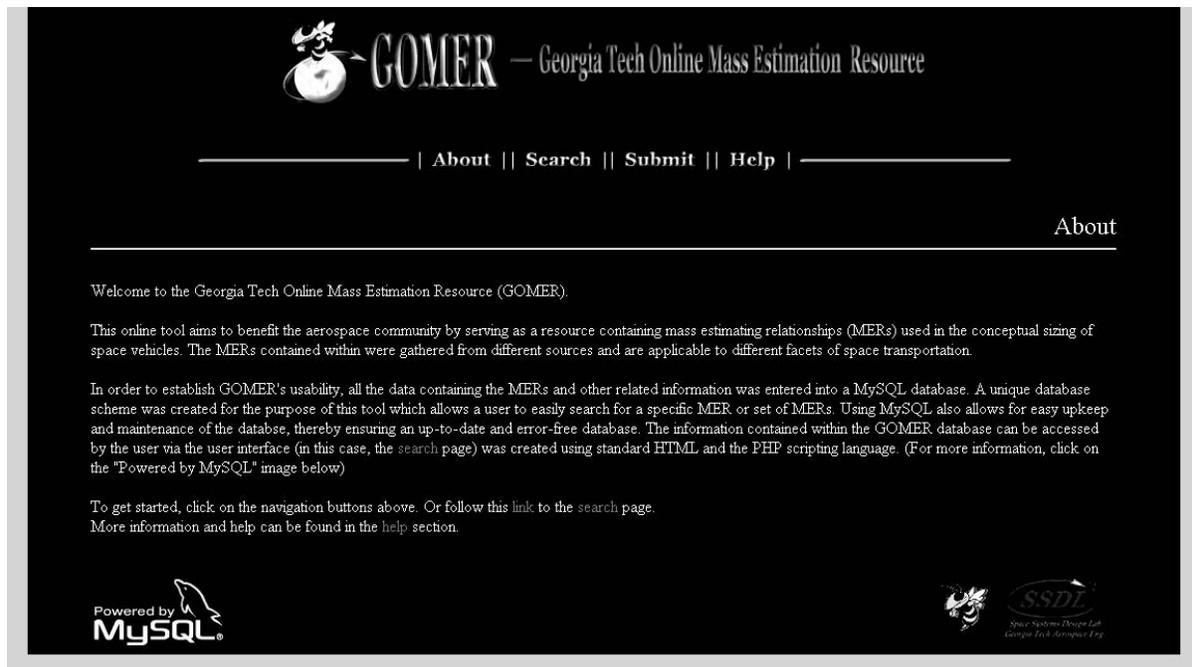


Figure 1-1: The *About* page greets the user when GOMER is first accessed.

A quick overview of the tool is given, and the user is then directed towards the navigation buttons to proceed through the site. From the navigation bar, it can be seen that there are four buttons: *About*, *Search*, *Submit*, and *Help*. The *About* button brings the user back to the main page.

The buttons for *Search*, *Submit*, and *Help* sends the user to the respective pages (these will be discussed in the following sections). Notice that below the overview text are graphics which are hot-linked to the MySQL, Georgia Tech, and SSDL websites (respectively, reading from left to right). Clicking on any of these graphics will open a new browser window directing the user to any of the three websites.

2.0 SEARCHING FOR MERS

Accessing the MERs in the database requires that the user perform a search query. This is performed by using the search forms located on the *Search* page. These forms translate the user's search criteria into a form that is understood by the database structure through the use of PHP and MySQL. Specifically, PHP is used to carry the search request from the user to the MySQL command interpreter. MySQL then proceeds to run the search query and returns a listing of results, via PHP, back to the user in tabular format.

The *Search* page is shown in the following figure. Notice that there are two forms on this page: the first method searches the database via a keyword (or a set of keywords) provided by the user, while the second method allows the user to in effect “browse” through the database and returns a listing of results based on the user's search criteria.

 **GOMER** — Georgia Tech Online Mass Estimation Resource

| [About](#) || [Search](#) || [Submit](#) || [Help](#) |

Search

Use either search form below to browse through the database. The first form searches the equation or parameter descriptions for the provided keywords to return a set of MERs. The second method returns all the MERs in a certain weight group, derived from a typical weight breakdown structure, (*WBS*). It can also search for MERs from a specific source.

Enter search terms :

Search in :

Vehicle type :

Group :

Source :

A description of the sources can be found here.

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Space Systems Design Lab
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Figure 2-1: Screenshot of the GOMER mass estimating relationship search page.

2.1 BY KEYWORD

The first search method requires the user to input a keyword or set of keywords upon which to run the search query. Each MER that is included in the database is supplied with a short description. The keyword(s) supplied by the user are then placed in a search string, which MySQL uses to compare against the descriptions listed for each MER. Those MERs whose descriptions match, or partially match, the search string are returned in the result. For example, the equation shown below has the following description: “Vertical tail spar mass.”

$$M_{vert_spar} = \frac{c_{tip} b_{vert}}{2S_{vert}}$$

In this example, the user would be able to bring up this equation by typing in individual keywords such as “vertical,” “tail,” “spar,” or any combination of these words. Hence, if the user were aware of which equation he is interested in finding, they would only need to type in a few keywords to bring up the desired equation (or set of equations).

Additionally, there is an option on the search form which allows the user to search through the parameter descriptions. It works much the same way as searching through the equation descriptions, except that this method is particularly helpful in identifying the set of MERs that contain a certain parameter.

2.2 BY GROUP/SOURCE

The other method allows the user to return a set of equations that belong to a certain weight group. Clicking on the pull-down menu reveals a weight group statement similar to what one would normally find in a weight breakdown structure (albeit only the level 1 weights). A user would then simply select which weight group they want to view.

Browsing the MERs grouped by the reference source is also an option. As of this report, 11 different reference sources were used to complete the MER database, and each of these can be selected via the pull down menu. (Note: The current release does not support multiple selections).


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| About || Search || Submit || Help |

Search

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Enter search terms :

Search in : Equation description Show MERs

Vehicle type : All

Group : 2.0 Tail

Source : 6. Bobby Brothers Show MERs

All

1. I.O. MacConochie, P.J. Klich (1978)
2. Dr. John R. Olds (1993)
3. Dr. Ted Telay (1992)
- 4a. Marquardt Corporation (1966)
- 4b. General Dynamics/Convair
5. Aircraft Design: A Conceptual Approach (Raymer)
6. Bobby Brothers
7. Airlplane Design (Roskam)
8. Forbis, Kotker (Boeing)
9. Forbis, Woodhead (Boeing)
10. AC-Sizer (NASA MSFC)
11. Hawkins (1988)




Figure 2-2: Example search query using the “browse by group/source” method.

The above two search criteria can be combined, as shown in the figure above. In this example, the user is searching for MERs applicable to vehicle tail sizing; specifically, those that came from Bobby Brothers. The results of this search would then display the requested MERs, and is discussed in the following section.

3.0 RESULTS PAGE

After running a search query, the user is directed to the results page. A screenshot of the results produced from the previous example is provided in the figure below.

The screenshot shows the GOMER website interface. At the top, there is a logo for GOMER (Georgia Tech Online Mass Estimation Resource) and a navigation menu with links for About, Search, Submit, and Help. The main content area is titled "Search Results" and indicates that 3 records were found. Each record is presented in a tabular format with a gray header row containing the equation description, weight group, and source. Below each header is a "View Details" link, followed by the equation itself, and a "Back to search" link at the bottom left. The footer includes logos for MySQL and SSDL (Space Systems Design Lab, Georgia Tech Aerospace Eng).

Search Results

3 records were found matching your query.

Tail mass - Group 2, Source 6
View Details
$M_{tail} = 26.06(S_{vert} (\mu_{c_{vert}})^{0.244} b_{vert}^{0.0364})^{0.8674}$

Vertical tail spar mass - Group 2, Source 6
View Details
$M_{vert_spar} = \frac{C_{up} b_{vert}}{2S_{vert}} M_{tail}$

Tail fairing mass - Group 2, Source 6
View Details
$M_{fairing} = S_{fairing} (0.02499q_{max} + 1.7008 + (0.003695q_{max} - 0.3252)b_{body})$

[Back to search](#)

Powered by MySQL

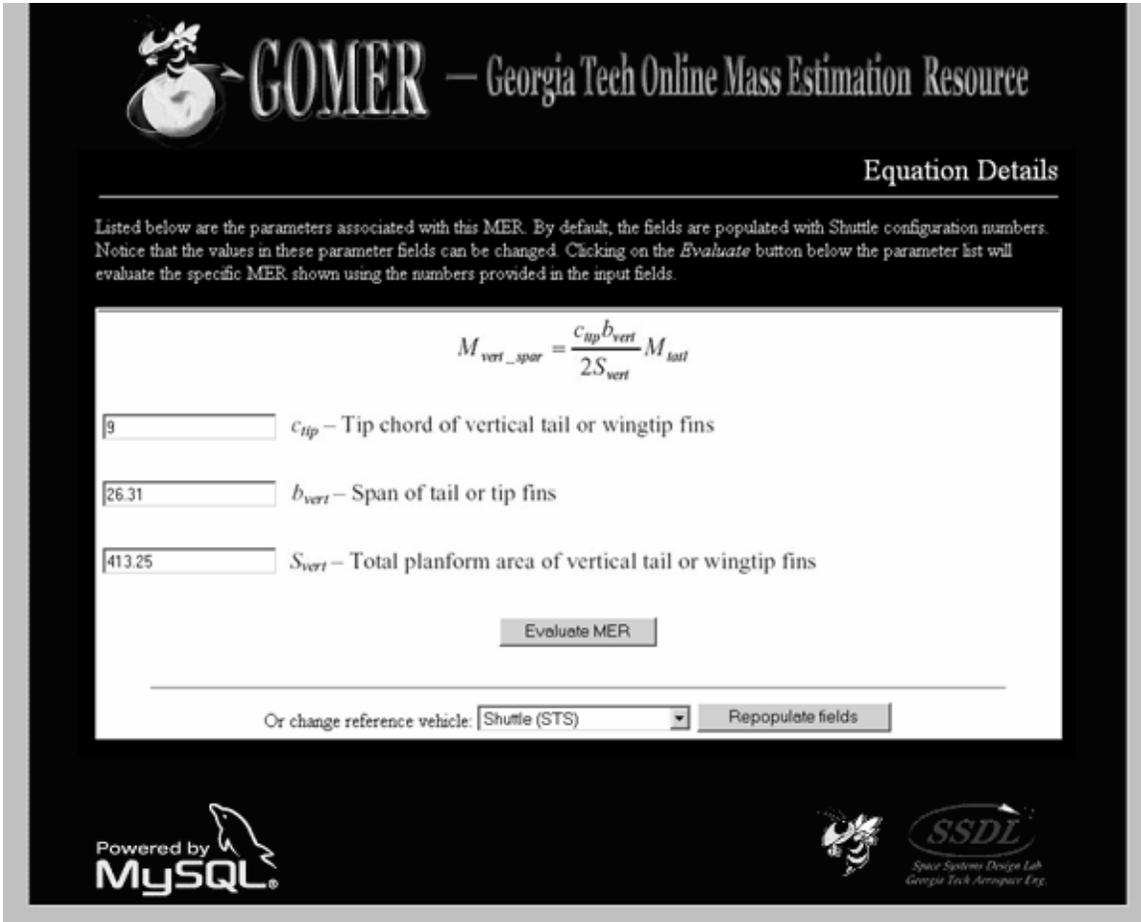
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Figure 3-1: Results obtained from the example search query performed.

As stated earlier, the results are presented in a tabular format. Above each equation is a gray row containing the equation description, the applicable weight group, and the reference source from which the equation was acquired. The equations themselves are image files in .jpg format to reduce load time on the user’s browser. Just above the equation images is the “*View Details*” link; clicking on this link opens up a new browser window which allows the user to see more the equation parameters in more detail.

3.1 VIEWING EQUATION DETAILS

In the *Details* window, the user is presented with a page dominated by a white area (see figure). Centered at the top is the equation itself, and below it is a listing of the parameters associated with that particular equation. Of note are the input boxes located directly to the left of each parameter—each box is filled with the values used to compare the equation to a reference vehicle. The default reference vehicle is the Shuttle.



The screenshot displays the GOMER (Georgia Tech Online Mass Estimation Resource) interface. At the top left is the GOMER logo, featuring a stylized bird-like figure. The main title is "GOMER — Georgia Tech Online Mass Estimation Resource". The page is titled "Equation Details". Below the title, a paragraph explains that the parameters are populated with Shuttle configuration numbers and can be changed. The equation shown is
$$M_{vert_spar} = \frac{c_{tip} b_{vert}}{2S_{vert}} M_{tail}$$
. Three input fields are provided: c_{tip} (9), b_{vert} (26.31), and S_{vert} (413.25). An "Evaluate MER" button is located below the fields. At the bottom, there is a dropdown menu for "Or change reference vehicle:" set to "Shuttle (STS)" and a "Repopulate fields" button. The page footer includes "Powered by MySQL" and the "SSDL" logo (Space System Design Lab, Georgia Tech Aerospace Eng.).

Figure 3-2: A screen showing the details of an equation selected from the results listing.

3.2 THE COMPARISON FEATURE

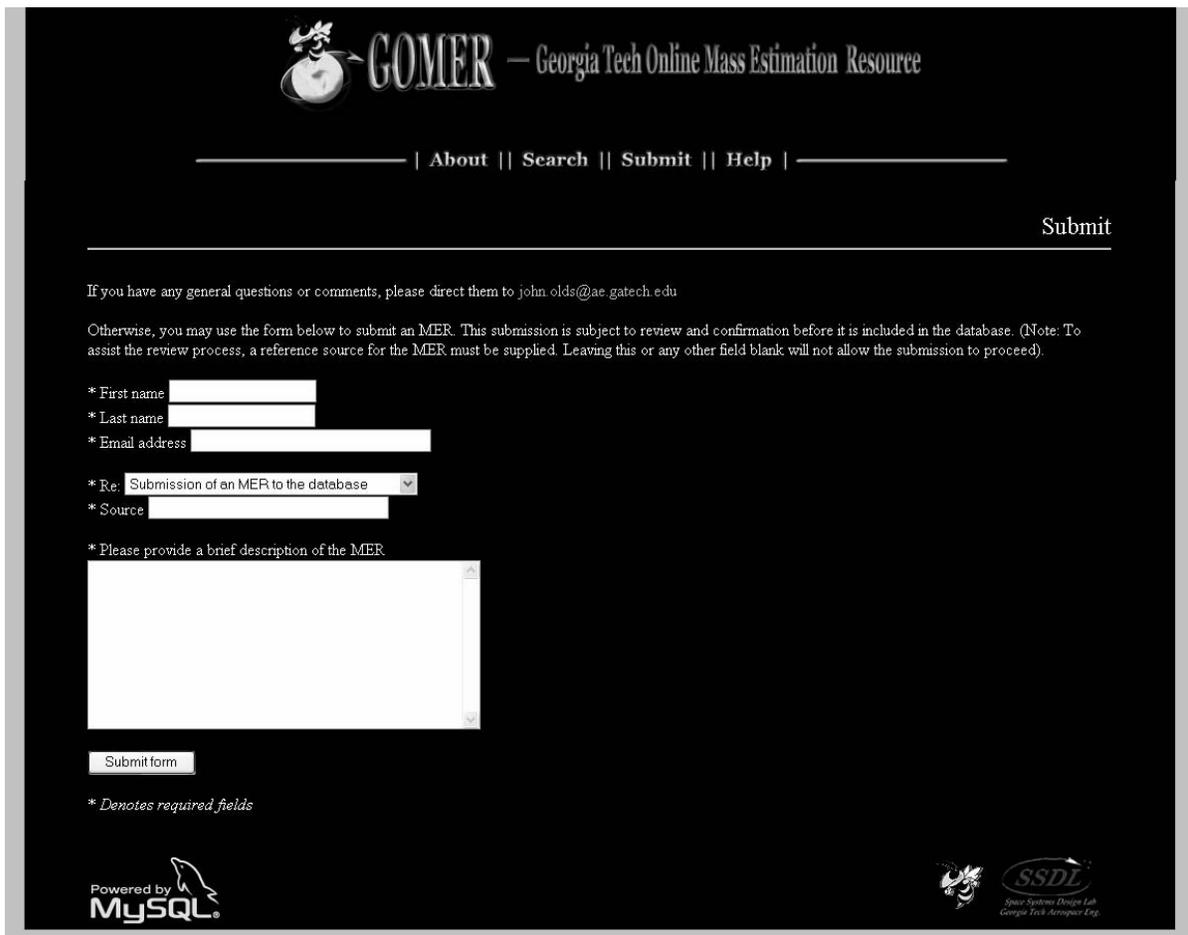
One useful feature of GOMER is the ability to compare an equation's evaluated result to a reference value. This is accomplished through the parameter value input fields seen in the *Details* window. By default, these boxes are filled with numbers defining Shuttle's vehicle characteristics. For example, in the figure shown, the number "9" in the first field refers to the Shuttle's vertical tail tip chord (in feet). (Note: These numbers are in standard ft/lb/sec units).

When the "Evaluate" button is pressed, GOMER then evaluates the equation using the given values in the input fields. The equation result is shown below the parameter listing. A percent error between the equation result and a reference value is also provided.

However, the user is not limited in his comparison options. A pull down menu showing a listing of vehicles available for comparison allows the equation result to be compared against reference values of different vehicles. Selecting a different vehicle will populate the parameter input fields with numbers associated with the desired reference vehicle. Furthermore, the user also has the option to replace any of the parameter inputs with user-defined values—in effect "creating" a user-defined vehicle. This allows the user to be able to get a first-order look at how their custom vehicle compares to various reference vehicles.

4.0 SUBMITTING AN MER

One particular advantage in having MERs located in a dynamic database is the ability to add new MERs. At the time of this writing, currently only MERs applicable to RLVs—and in some instances, expendable launch vehicles (ELVs)—are included in GOMER’s database. However, due to the nature of this tool, the task of adding more MERs is more or less easily accomplished. Thus, it is not so far-fetched in imagining that the GOMER database will grow and eventually come to include MERs for RLVs, ELVs, space transportation vehicles (STVs), and more.



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| About || Search || Submit || Help |

Submit

If you have any general questions or comments, please direct them to john.olds@ae.gatech.edu

Otherwise, you may use the form below to submit an MER. This submission is subject to review and confirmation before it is included in the database. (Note: To assist the review process, a reference source for the MER must be supplied. Leaving this or any other field blank will not allow the submission to proceed).

* First name

* Last name

* Email address

* Re:

* Source

* Please provide a brief description of the MER

** Denotes required fields*

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Figure 4-1: GOMER form used to submit an MER for inclusion into the database.

One way this can be accomplished is through the involvement of the aerospace community. GOMER users can submit MERs for inclusion into the database through the *Submit* page, as shown above.

The form itself is fairly self-explanatory. It is important to note that all fields must be filled prior to submission. That is, all fields are required and the form will not be sent if any of them are left empty. When submitting an MER for consideration, it is recommended that the description include at least the following:

- Brief description of equations
- List of associated parameters
- Applicability to which vehicles (RLV, ELV, STV)?
- Weight group

The more information that is provided will facilitate the review of the submitted MER and its inclusion into the GOMER database. Clicking on the “Submit” button sends the completed form via email to the GOMER administrator for review. A copy of the email will also be sent to the user.

Also, this form can be used to submit a correction to an already existing MER. In order to do so, the user should simply select “Correction to a current MER” in the pull-down menu and then describe the correction in the text box provided.

5.0 HELP

The final page is the *Help* page. This page contains some helpful documentation as well as a short glossary of terms that are used on the GOMER website. Users looking for more information on the tool itself should look to this page (figure below).

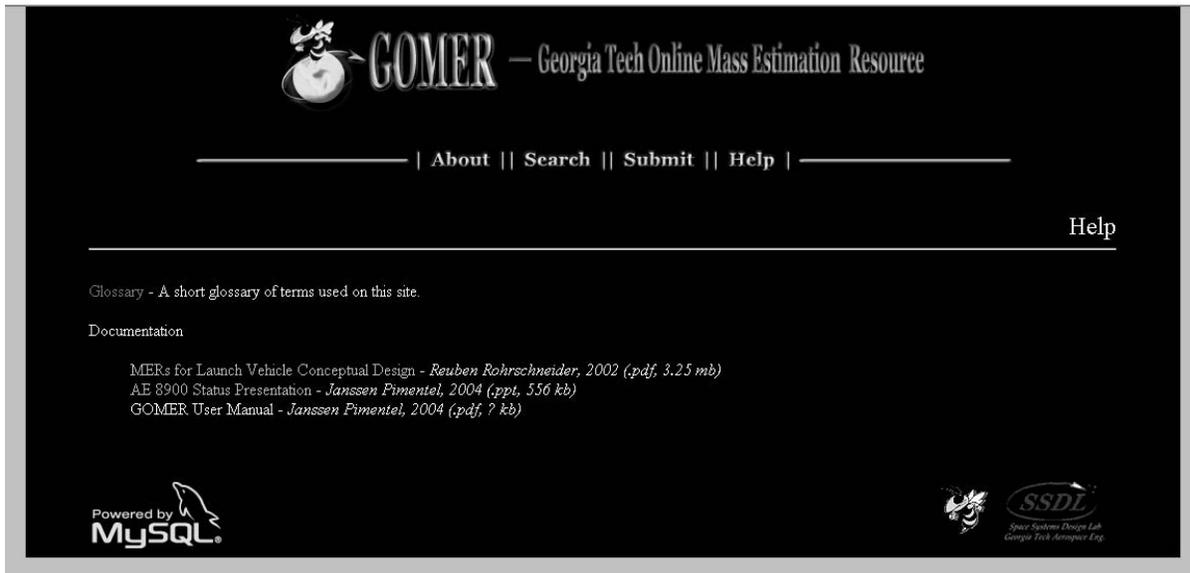


Figure 5-1: The GOMER help page contains a short glossary as well as useful documentation.

Clicking on the “Glossary” link will lead to the glossary page. This page contains a short set of terms that are used throughout the GOMER site and provides brief definitions. Users should make a note that this glossary does not include terms that may show up in the equation or parameter descriptions.

Lastly, the *Help* page also provides some documentation which may answer any questions that still remain. Included in the list is this particular document, as well as Reuben Rohrschneider’s .pdf document containing the RLV MERs upon which this database was initially populated. It is recommended that users having any specific questions regarding MERs which have not been directly addressed by the *Results* or *Details* page look through this volume.