ME/MET 191

PROJECT TESTING

An important part of product design is testing of the prototype. This testing is more than simply operating the device to see if it works. The testing procedure must follow set procedures which include the following:

Objectives:

The first required item is a clear statement of the testing objectives. These objectives are established by going back to the original identification of a need, definition of the problem and the criteria for the design. The purpose of the testing is to see if the final design really does what was envisioned at the beginning of the design process. The objective should include both numerical quantities such as weight, performance figures and expected life, and qualitative items such as ease of use.

Apparatus:

In addition to the actual device, most testing will require some form of instrumentation. In addition, some testing may require test fixtures, dynamometers, wind tunnels, etc. The test procedure must include a clear listing of these items.

Test Procedure:

The first step is to check the non-operational aspects of the final design such as the desired maximum weight, size, and cost. Have these objectives been met? If not, by how much were they missed?

The operational testing procedure is more than simply operating the device in its normal mode. In most cases the device is operated over a range of carefully controlled conditions. While these conditions simulate the actual operation, in many cases—for data gathering purposes--the duration of operation at a fixed point is longer than that encountered in normal operation. It is important to make sure this mode of operation doesn’t introduce errors in the results.

The first step is to determine the independent and dependent variables. What do you control? What are the outcomes? Each of the independent variables should, if possible, be set to a minimum of three values not including zero. The advantages of three values is the ability to get the shape of the resulting curve. In general instrumentation errors close to zero make the origin an unreliable data point.

A cardinal rule of testing is changing one independent variable at a time. If more than one thing is changed it is impossible to determine what caused the change in the results.

The last step in the procedure is to define how the dependent variables will be measured. The quantitative values are usually measured with some form of instrumentation such as thermocouples, strain gages, pressure gages, etc. In the case of qualitative outcomes the method may be such things as developing a questionnaire to be answered by a user of the device.

Results:

Once the test procedure has been completed the data must be reduced and presented in an easily understandable form. When looking at the non-operational aspects and some other cases the results may be a simple comparison; e. g. is the final weight within the limit set in the definition of the problem? In many cases the quantitative results will be in tabular or graphical form. Given a choice, a graphical presentation is usually easier to interpret quickly. Computer programs such as Excel make generation of graphical presentation very easy. In the case of qualitative results the results may be in text or tabular form but in some cases even these can be put into a bar or pie chart.

Conclusions:

The next step in the evaluation process is comparing the results with the objectives. What you want to know is: how well did the design meet the original objectives? Did it achieve all of the objectives? some of the objectives? none of the objectives? In some cases this will be a yes/no answer; in other cases it will be less clear. For example, the conclusion might be the weight is five percent over the original design specification.

Recommendations:

The last step is to determine if the design meets enough of the objectives to proceed to further development or production. In most cases some compromises will have taken place in the design process but these may not be enough to prevent going ahead. If the design fails to meet original expectation in many categories it probably should be redesigned or abandoned.

Data Collection:

A data collection scheme needs to be established prior to the actual start of testing. The two most common methods of data collection are pencil and paper or a laptop computer. In either case a format for data collection must be established. In the case of numerical data blanks or columns of blanks need to be established. In general, place the independent variables to the left and the dependent variables to the right. The first column should always be an identification number and the second column should be the time, preferably in 24 hour format. Where possible, two sets of data separated by a short time period should be recorded. If any values are significantly different additional sets should be taken until two sets are identical within reasonable limits. In the case of qualitative data the data sheet might include multiple choice answers or blanks for comments.

In addition to the actual data some other information must be included as follows:

Who is collecting the data? Provide a place for initials or signatures.

When and where is the data being taken? Include the date, building name, street address, city and state, and any other information which will pinpoint the location In the case of field testing you might include longitude and latitude.

If they have any possible influence on the results the ambient condition including temperature, humidity (or wet bulb temperature) barometric pressure, wind velocity and direction, and weather conditions should be recorded.

All equipment and instrumentation must be identified completely. Particularly in the case of instrumentation, manufacturers' names, model numbers, serial numbers and any other identifying marks such as University property numbers should be recorded. Even in cases when only one device exists the information should be recorded. In addition the information on instrumentation should include the full range of the instrument and any other information available on its accuracy down to such things as the width of divisions on the dial. If the instrument has been calibrated the calibration data including the date, who did the calibrating and by what standard should be recorded. Any strange behavior of instrumentation should be noted. In the case of such things as strain gages, the manufacturer's name batch number and calibration should be recorded.

*Lastly, never erase a value on a data sheet. If an incorrect value is recorded draw a single line through **it** and record the proper value. When recording data in a computer insert the proper value and place the original value in a foot note.*