CO-OP WORK REPORT

SCHOOL OF AERONAUTICAL AND ASTRONAUTICAL ENGINEERING

PURDUE UNIVERSITY

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During my third work session at Ball Aerospace & Technologies, I worked in the Materials and Processes Engineering Group. The Materials and Processes Engineering Group (M&P) defines and monitors all the materials and products that are used in the processing of flight hardware and writes many of the documents defining the processes involved with flight hardware.

During my four months in M&P, I was involved in redefining the documents used to define the expendable products that are used in the processing of flight hardware. These documents are called Expendable Material Standards (EMS). Although there are many EMS's, I focused on five of them. The first two EMS's I worked on were revisions of current documents, but for the last three I created new documents. The first EMS I revised was for general use cleanroom gloves. The previous version of the EMS specified the use of latex gloves, which are significantly dirty compared to the Nitrile gloves the revised EMS specifies. The other EMS I revised was for low-lint, low-residue wipers. I significantly tightened the requirements for both the EMS's that I revised. The three new EMS's I wrote were for swabs, cleanroom paper, and cleanroom notebooks.

The process of writing an EMS starts by ordering sample products from vendors and performing analytical tests on them. Although the nine test methods I used were based on industry standards, I modified them to suit M&P's needs. The most common test I performed is called a non-volatile residue test which is a common way of quantifying how dirty a product is. The basic theory is to use a solvent to extract residue (which commonly includes hydrocarbons, soaps or silicone) from a product. After being extracted, the residue is weighed and reported with respect to the surface area of the sample tested. An infrared spectrum of the residue is also taken to help identify its composition. A particle count, which quantifies how many particles are released from a product, is another standard test I used. I also performed tests on solvent resistance and absorbency. After meeting with vendors and testing many product samples, I wrote drafts for the EMS's I worked on. Although two of the EMS's were technically revisions of previous versions, they had to be entirely rewritten because of a change in the document content and format. The documents have not been release into circulation as of the end of my work session, but they will be released in a short matter of time.

Along with the work I did on the EMS's, I also spent time on a project to measure the coefficient of thermal expansion (CTE) for 7 different optical substrates. The temperature range for the test was 20 → -150 → 20 °C at a ramp rate of 1°C/min. The low ramp rate was used to ensure that the optics did not fracture due to thermal shock. The CTE tests were performed using a thermal mechanical analyzer (TMA). This instrument has a stage that the sample sits on and a probe that rests on top of the sample and measures very small dimensional variation as the temperature of the sample and its environment change. The entire sample and probe are encapsulated in a furnace. The low ramp rate for this test had never been achieved at Ball before and was done by surrounding the furnace with a constant level of liquid nitrogen and using the furnace to control the ramp rate to 1°C/min.