



### Company Information

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|----------------------|--|----------------------------------|-------------|
| <b>Company Name</b>  | 3M Scott Safety  | <b>Date Submitted</b>            | 21-APR-2022 |
| <b>Project Title</b> | Design of a Smart cylinder fill and test station (3M_TEST) | <b>Planned Starting Semester</b> | Fall 2022   |

### Senior Design Project Description

#### Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

| <b>Discipline</b> | <b>Number</b> | <b>Discipline</b> | <b>Number</b> |
|-------------------|---------------|-------------------|---------------|
| Mechanical        | 2             | Electrical        | 1             |
| Computer          | 1             | Systems           | 1             |

#### Company and Project Overview:

3M|Scott Fire and Safety is a premier manufacturer of innovative respiratory and personal protective equipment and safety devices for firefighters, industrial workers, police squads, militaries, homeland security forces and rescue teams around the world. 3M|Scott products protect thousands of individuals each day from environmental hazards including smoke, toxic fumes, combustible gasses, falling objects and contaminants. The 3M|Scott product line includes self-contained breathing apparatus' (SCBA), supplied air and air-purifying respirators, thermal imaging cameras and firefighter communication and accountability devices.

Headquartered in Monroe, North Carolina with corporate offices in St. Paul, Minnesota, 3M|Scott Fire and Safety generates >\$500M in revenue and employs about 500 people in Monroe.

3M|Scott Fire and Safety offers a complete assortment of compressed breathing air cylinders to meet the needs and demands of all SCBA users, from aluminum cylinders for infrequently-used SCBA, to carbon-wrapped cylinders for daily use, including a higher-pressure 5500 psi. The assortment of compressed breathing air cylinders are available in multiple operating pressures including 2216, 4500, and 5500 psi. An example of a 3M|Scott Fire and Safety cylinder is shown below.



### **Project Overview**

The project will focus on the delivery and presentation of a complete working prototype for the current cylinder fill and testing process at the 3M|Scott Fire and Safety Monroe, NC manufacturing plant to a “smart” filling process.

The current cylinder filling process utilizes a GCA rail connection which connects up to 6 cylinders in order to fill. The cylinders are placed in a rack which is then set into the machine. The rail connection is connected via supply lines into the filling machine which supplies pressure and gauge readouts. The cylinders are filled for a set amount of time and allowed to cool for a set amount of time. Under the current process, the production team’s historic data suggest that the first pass yield (FPY) of the work cell is around only 97%, signaling that around 3% of cylinders are overpressurized or under pressurized during the normal production process. There is a significant opportunity to increase the FPY to avoid rework and scrapping of the cylinder assemblies by creating a “smart” filling process, once which indicates fill pressure and temperature to the operator for each cylinder. In addition, there is also no traceability in the current process which shows where the over/under pressurization occurred within the machine.

### **Project Requirements:**

Submit a completed working prototype of a smart air filling rail for 3M|Scott Fire and Safety compressed breathing cylinders in order to gain more process control/detection and reduce variability in fill levels. The working prototype will be required to work with the 2216, 4500 and 5500 psi cylinder/valve assemblies, and will encompass the fill and test process and process traceability during fill and test. The proposal scope will not include the 3000 psi cylinder/valve assemblies fill and test, valve to cylinder assembly, product labeling, or packaging processes.



**Expected Deliverables/Results:**

Complete a working prototype of an air filling rail for 3M|Scott Fire and Safety compressed breathing cylinders, which accurately display pressure and temperature for up to six cylinders that can be used on the existing fill station racking and CGA coupling interface. The working prototype is required to work safely with pressures up to 5500 psi. In addition, students shall also determine how to store the test information for each of the fill fittings to ensure traceability.

**Disposition of Deliverables at the End of the Project:**

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

**List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):**

- Thermodynamics
- Physics
- High Pressure Pneumatics
- Heat Transfer
- Fluid Dynamics
- Industrial Engineering
- PLC knowledge
- SEGR student to have SEGR 4141 as a pre or corequisite.
- Students are required to travel to the 3M Scott Facility in Monroe, NC and will be reimbursed for travel according to ISL procedures.