TYL 1: Visionary Engineering

Electrical & Mechanical Engineering

Trane Gas Lab Equipment Automation

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Sponsor: Trane Technologies
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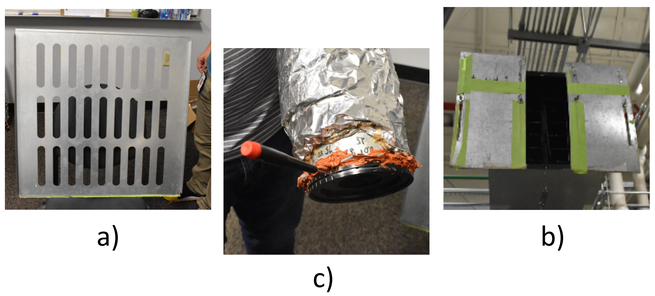
Abstract

Mechatronic automation can eliminate many of the errors induced by manual, technician-operated controls, improving experiment quality. As such, automation of the Trane Gas Lab's furnace testing devices will improve the quality of experiment data and reduce the time needed to complete a test, increasing productivity. To achieve this, the existing air shutters used in furnace testing were retrofitted using mechatronic equipment and computer controls to increase the efficiency of testing operations and remove the error introduced by human technicians. Compared to technician operated tests, the control devices developed have reduced the time required to perform the tests while significantly increasing data quality.

Objective

The furnace testing equipment consists of Inlet Shutter (Fig.1a), Outlet Shutter (Fig.1b), and Iris Shutter (Fig.1c).



a) b) c)

Fig.1 Furnace test equipment parts: a) Inlet Shutter, b) Outlet Shutter, and c) Iris Shutter

Our main objective from this project is to automate the furnace test equipment for the Trane Gas Lab located in Tyler, TX, with a goal of reducing cycle time to conduct allowable air and blocked vent testing.

Design

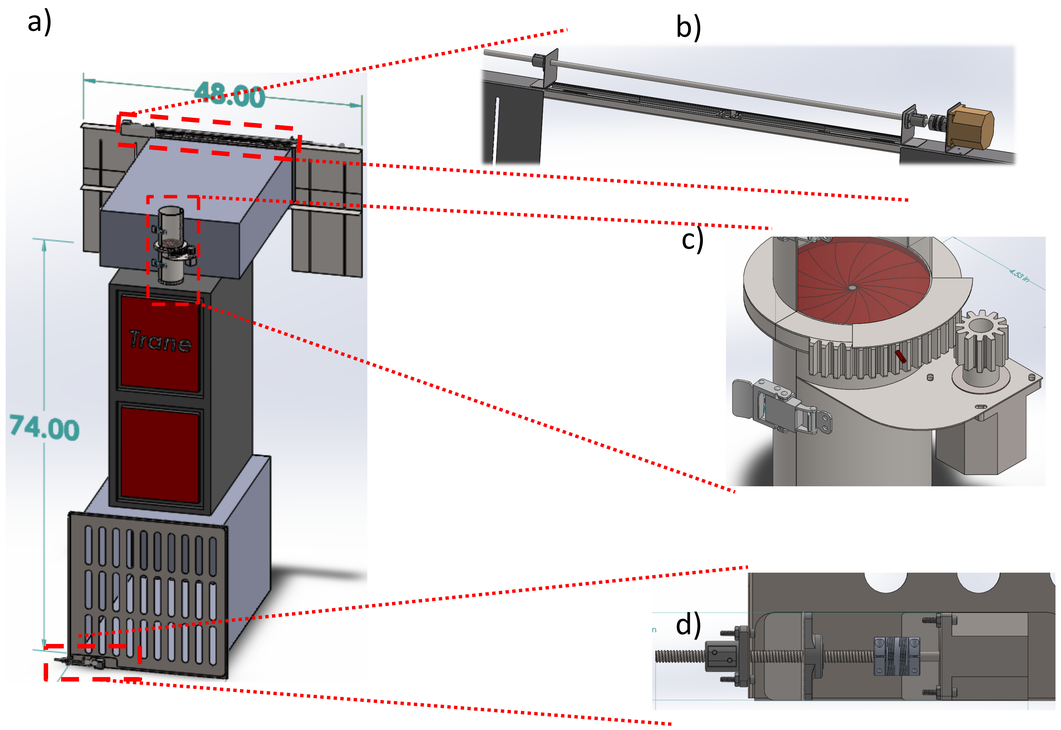


Fig.2 a) Automated furnace test equipment design: b) Inlet Shutter, c) Outlet Shutter, and d) Iris Shutter.

Inlet Shutter:

Automated by using stepper motor and feedback control to closes incrementally to restrict the flow of air coming into the furnace, thus increasing the temperature of the air leaving it. The feedback control will consist of a proportional controller that intakes the position error of the system and outputs the right position.

Outlet Shutter:

A similar mechanism will be used to incrementally closes and restrict the airflow of conditioned air leaving the furnace to maintain a given static pressure. To give the outlet shutter its motion a dual threaded lead screw system will be used in conjunction with a stepper.

Iris Shutter:

A direct connection will be used between the stepper motor and Trane facilities to control the shutter which operates by closing the opening of the flue exhaust port incrementally to build back pressure in the system.

Testing Results

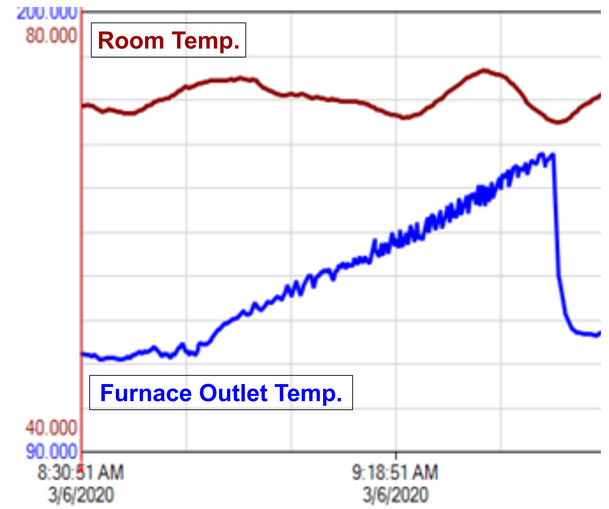


Fig.3. Results from testing inlet shutter taken from Trane's WonderWare® application; Test conducted: Allowable Air.

The results shown in Fig. 3 display the best of 8 test runs conducted by the team at Trane's Gas Lab on the Inlet Shutter. This image shows the achievement of one of the main operating goals for this shutter, namely, the linear nature of the furnace outlet temperature.

Conclusions

As shown Visionary Engineering (TYL 1) has validated the automation of test apparatuses for the Trane Gas Lab located in Tyler, TX. Further testing would seek to refine current results to eliminate variation in results. Additionally, team would seek to test the two remaining apparatuses.

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