College of Engineering
Department of Mechanical & Industrial Engineering

College of Engineering
School of Electrical Engineering & Computer Science

To Predict ▶ To Design ▶ To Perform

ME, ECE Capstone Design Programs

Team 2: Pleated Filter Frame Technology

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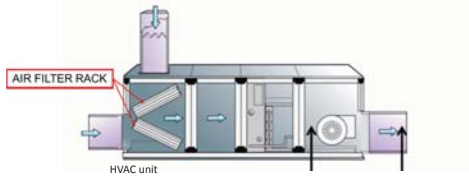
Air-Nu
FILTRATION - OUR ONLY BUSINESS

Objective

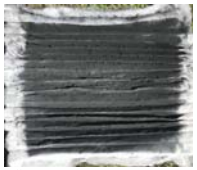
The goal is to reduce maintenance costs by providing the contractor with a permanent filter frame with interchangeable pleated filtration media that is easily serviceable by one technician.



HVAC unit

Testing

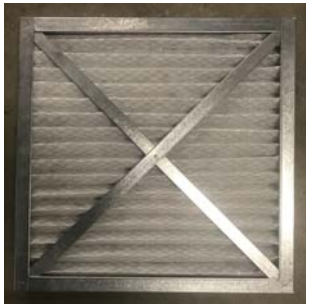
- Filter Change Time Trial
- Service Time Study
- Impact Test
- Air Filter Efficiency
- Air Flow Velocity
- Differential Pressure


Efficiency Test proved no visible blow through the side of the frame


Differential Pressure test stand

Background

- Provides filtration sales and service for all commercial and industrial accounts
- The current issue that they are facing is cost control
- Air-Nu wants to redesign the air filter frame so that it can be permanent and would only require the filter media to be changed


Front of frame with cross brace – supports media from air flow


Back of frame – collects dust particles

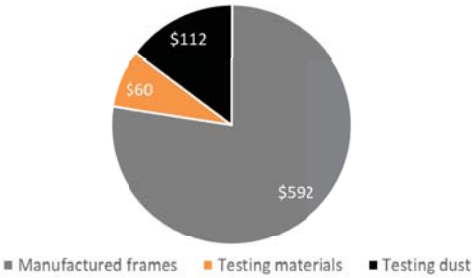
Engineering Specifications

Specification	Desired Value	Tested Values
Dimensions	23.375" x 23.375" x 1.75"	23.375" x 23.375" x 1.75"
Weight	< 5 pounds	5.90 pounds
Time to Change Filter Media	< 180 seconds	45 seconds
Return on Investment	< 36 months	26.75 months
Frame Durability	10 drops	10 drops
Minimum Efficiency Reporting Value	8	8
Maximum Air Flow Velocity	575 FPM	> 749 FPM
Maximum Differential Pressure	≥ 1" w.g.	20" w.g.

Manufacturing Plan

Manufactured by B&C Sheetmetal
Shearing: Sheet metal cut into flat layout
Roll-Forming: Sheet metal rolled creating safety edges
Bending: Sheet metal bent into square shape with a 0.06 in internal radius

Budget



Engineering Analysis

- Support Members Analysis

$$\begin{bmatrix} \Sigma Fy = 0 \\ F(normal) - W = 0 \\ F(normal) = W \end{bmatrix} \begin{bmatrix} \Sigma Fz = 0 \\ F(air\ flow) - R(reactive\ force) = 0 \\ F(air\ flow) = R(reactive\ force) \end{bmatrix}$$

- Maximum Bending Stress

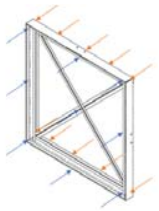
$$\left[\sigma_{max} = \frac{Mc}{I} \right]$$

- Rivets

$$\left[\tau = \frac{F}{A} \right]$$

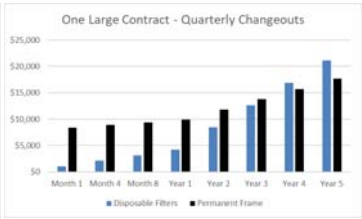
F = Force of air flow

R = Reactive force



Cost Analysis

The charts show the cost difference between the use of disposable filters and the use of the designed product over a five year period.



September

- Preliminary Meetings
- Research

October

- Concept Generation

November

- Finalized Design
- Engineering Analysis

December

- Sent drawings to Manufacturer

January

- Generated Testing Plan

February

- Received First Iteration

March

- Created Second Iteration
- Started Testing

April

- Finished Testing and Analyzing

Sponsor: Robert Darbonne

Advisers: Clifford Gillio, AJ McPhate