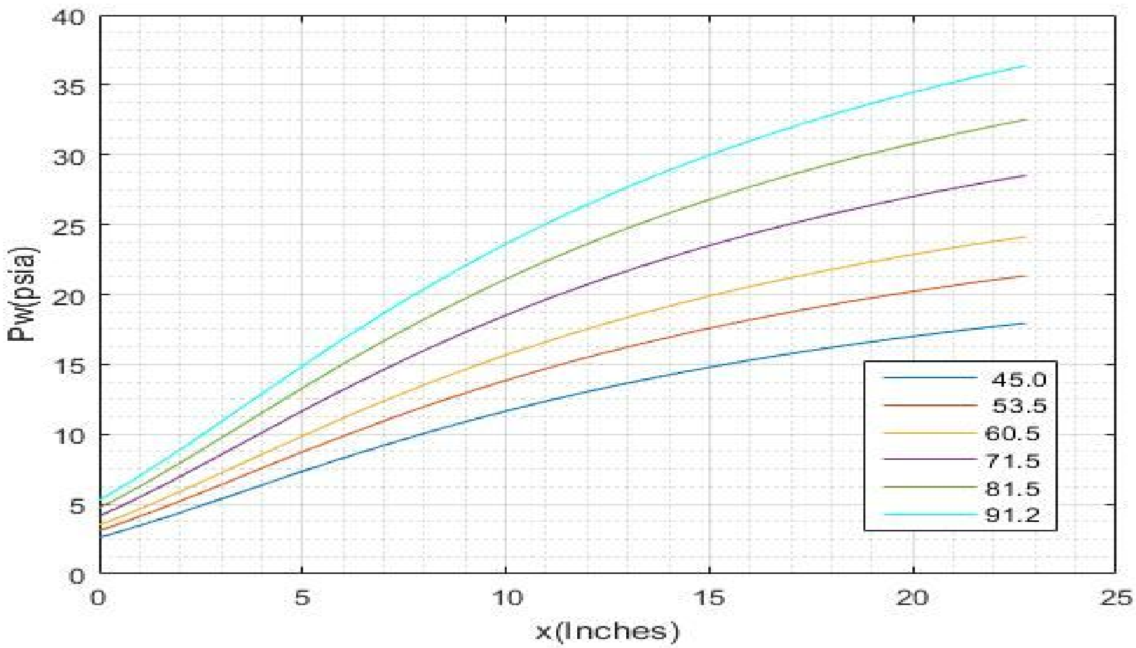
REPORT ON ISOLATOR
by Shashank Verma

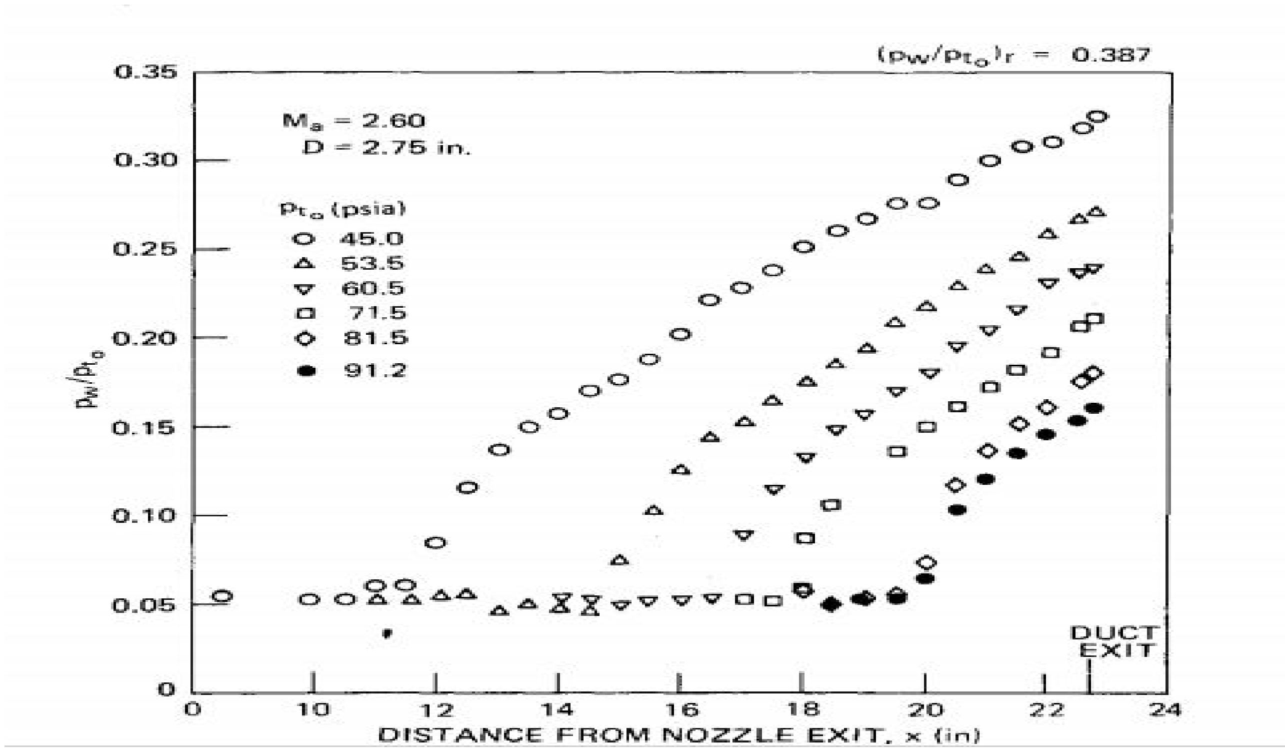


Pw stands for wall pressure, x is distance from starting point of isolator.

Above is obtained from solving the quasi 1-D flow equation which consists of mass conservation, energy conservation, Momentum Conservation differential equation along with diffusion equation which is determined by Ortwerth which empirically derived using experimental data, we have not taken the effect of shock due to formation of shock train which occur due to combustor flow separation due to adverse pressure gradient.

Above figure, is obtained by using initial conditions from Billig's Paper (Structure of Shock Wave in cylindrical Ducts)

Min = 2.60 (Billig's Paper)
Din = 2.75 inches (Billig's Paper)
L/D = 8.27 (Billig's Paper)
Gamma = 1.4 (assumed)
Cf = 0.002 (assumed)
Xmax = 22.7 (Billig's Paper) (Length of Isolator)
Ac/A = 1 = R(x)
From Bilig Experimental data,



It is seen that our obtained curve is very similar to experimental data for wall pressure.
It is seen that for different Total pressure value shock train start from different position.
In our calculation we couldn't able to include this factor of different location of shock train, so our pressure ratio(Pw/Pt0) is not constant for some duct length.
In Bilig paper they try to combine their results for different total pressure condition by shifting the curve to left so that they can coincide.

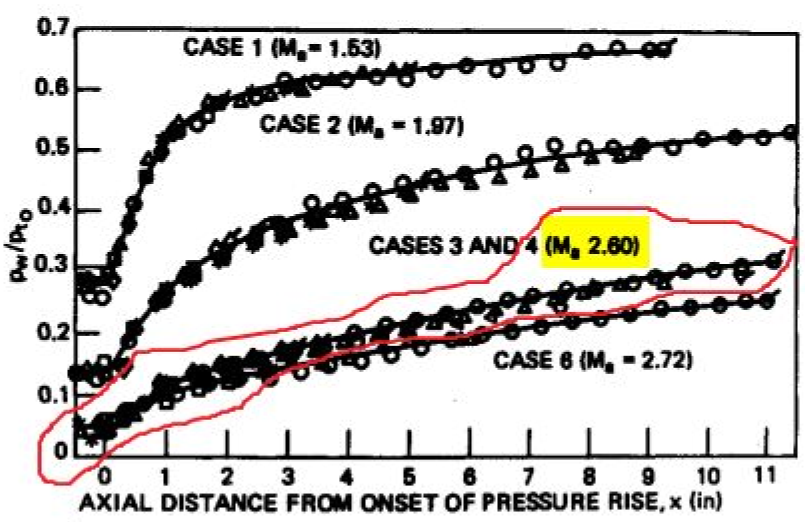
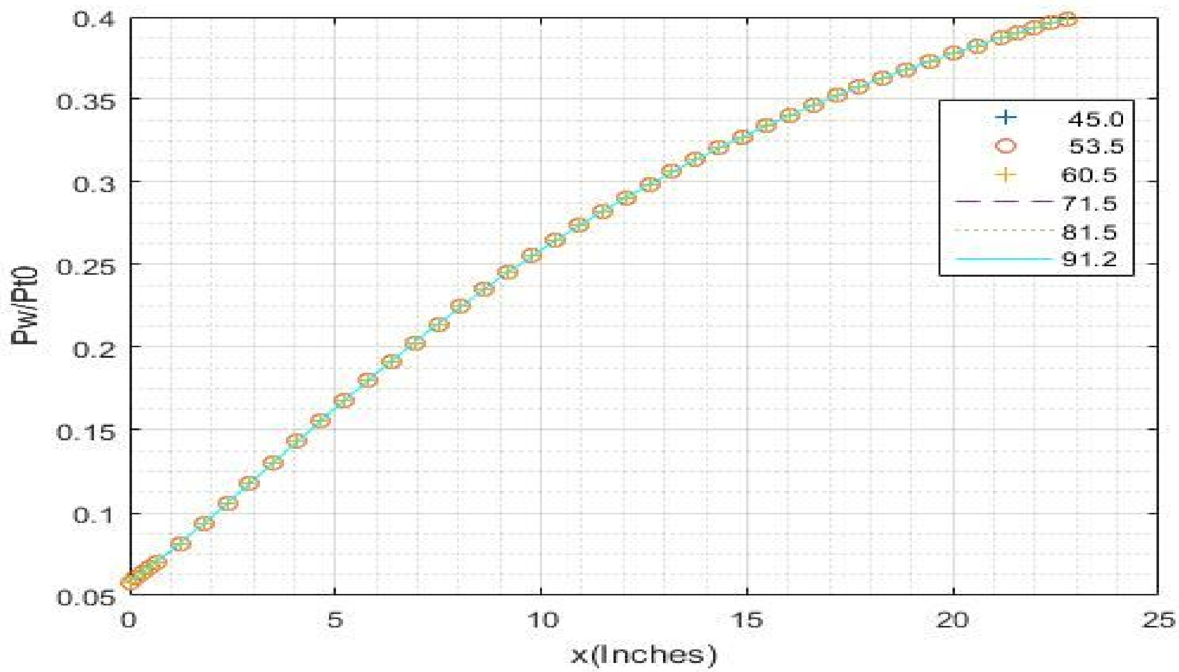


Fig. 4 Collapsed wall pressure distributions.



Above figure is our calculated ratio of Wall pressure by total pressure.

We can see that all the six curve coincides perfectly.

But our values do not perfectly match there is some slight difference which may be possible due to our assumption of gamma = 1.4, Cf = 0.0002, shock train didn't start right from the start of duct and we also didn't account Shocks in our calculation.

But these results are promising.

Reference:

1. All the calculations are inspired by two papers
   A: Analysis of a Dual-Mode Scramjet Engine Isolator Operating From Mach 3.5 to 6.
   B: Scramjet Isolators by Professor Michael K. Smart (NATO)
2. Results were compared with Paper on "Structure of Shock Waves in Cylindrical Ducts" by P. J. Waltrup and F. S. Billig