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Shock-Tunnel Waveform Analysis

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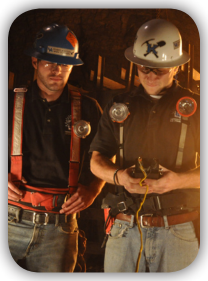

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Overview

The dynamics of explosive detonations are understood, however recreating a real-world, to-scale scenario is costly. The use of a shock-tunnel allows explosives testing to be done on a smaller scale, with the simulated effect of a large explosion.

A shock-tunnel is an arbitrary geometric shape (typically round or rectangular), which is open at both ends. An explosive charge is detonated within the tunnel to produce a shock front which travels down opposite ends. It is known that a shockwave propagates radially outward from the center, so when the wave is confined in a shock-tunnel, the waves will reflect off all surfaces resulting in a more directed wave. This focuses the energy of the wave as well as extends the duration of the positive phase impulse.

The data obtained from this project will enhance the knowledge and understanding of shock tunnel dynamics thereby increasing the ability of this tunnel to be used more effectively in the testing of blast resistant products. The objective is to observe the influence the tunnel has on the shockwave so the retrieved data can be more accurately applied to a real-world situation.

Figure 1

Experimental Set-up

To conduct the experiment, stands were constructed to hold the Free-Field Piezoelectric Pressure Sensors within the shock-tunnel at the desired dimensions, as seen in Figure 1. Seven sensors were placed in the geometric center of the tunnel at a two-foot spacing with four feet between each pair as seen in Figure 2.

Figure 2

All the experimental data was recorded with a 16-channel PCB Signal Conditioner fixed to a Data Trap II Acquisition System and was accessed by a Panasonic Toughbook laptop as seen in Figure 3. Once the set-up was completed, the explosive charges were weighed and placed in the tunnel at the desired distance to the sensors, as seen in Figure 4.

Figure 3

Figure 4

Data Collection

Using the above set-up, data was collected and stored for later analysis utilizing D-Plot Graphing Software. The data pulled from the Data Trap was converted from millivolts to pressure (PSI) using the sensitivityscaleapplied to each individual sensor. Figure 5 is a representation of raw data pulled from the Data Trap; after being transferred to D-Plot, the data is converted and recorded in Microsoft Excel as seen in Figures 6 & 7.

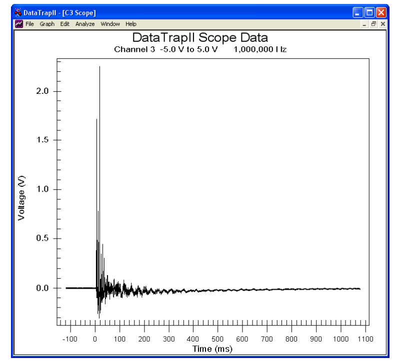

Figure 5

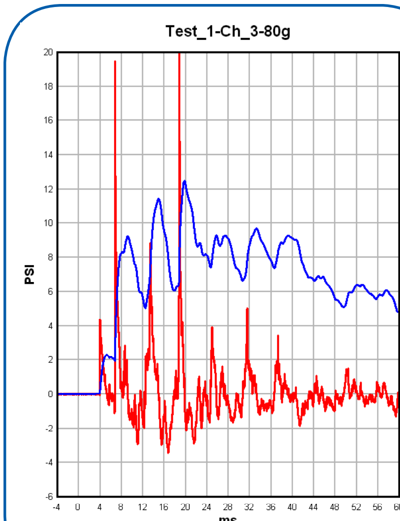

Figure 6

Project Progress

Over the course of the summer, all the field testing has been completed and the data is currently being analyzed for final comparison between the open-air arena and shock-tunnel tests. Due to out-of-state internships (June through July) in the explosives industry, research and analysis is currently being conducted whenever possible on the weekends. As of July, the progress made is on par with the time-line and will be completed and ready for presentation in August.

	Channel 1			Channel 2
Pressure (PSI)	Impulse (PSI-ms)	Time of Arrival (ms)	Pressure (PSI)	Impulse (PSI-ms)
74.73273	5.567732	0.014	21.30537	11.00042
80.04729	5.530628	0.006	22.09327	21.02468
99.32155	5.781826	0.011	17.32325	10.51331
84.70052333	5.626728667	0.010333333	20.24063	14.17947
	Velosity (ft/ms):	1.975633849		

Figure 7