# Bumper Gun (Chalk Gun)
# Electro-Mechanical Delay Time

**Timothy J. Reust**

**Accident Science**
**27811 Avenue Hopkins, Suite #1**
**Valencia, California 91355**
**(661) 254-8084**
**www.accidentscience.com**
**treust@accidentscience.com**

**Prepared for:**

**The Southwestern Association of Technical Accident Investigators**
**SATAI**
**SUMMER 2000 CONFERENCE**

**JULY 14-15, 2000**
**Phoenix, Arizona**

## INTRODUCTION

Tests were performed to determine the elecro-mechanical delay time for several bumper guns. A data acquisition system logging at 500 Hertz (500 samples per second) was used to record the time duration between when power was first sent to the bumper gun, up to when the chalk marker hit a surface below. The surface below the bumper gun was instrumented with a micro-switch that would activate upon impact of the chalk marker. The distance between the bumper gun's exit port and the surface below was measured for each test.

This paper answers the following questions:

1. Does a bumper gun have an electro-mechanical delay time?
2. Should the delay time be considered when used during a test?
3. What is the best power source for the bumper gun?
4. What bumper guns are available today?

## TEST RESULTS

When the Pacific Institute bumper gun was tested, it was found that the time durations did not follow a logical order. That gun had previously experienced many mis-fires, so it was suspected that the cartridges might have influenced the time durations. The next set of tests with that gun measured the time duration between when power was first sent to the bumper gun, up to when the hammer struck the cartridge. That set of tests indicated that the electro-magnet was influencing the time durations. It is suspected that electro-magnet coils were heated during a test and influenced the next test because the resistance of the coil would be slightly different.

**Pacific Institute of Traffic Safety Inc.**
(eletro-magnet with swing arm hammer, 38 caliber)
The results are as follows:

| | |
|---|---|
| Exit height 20 inches | Time duration 0.168 seconds |
| Exit height 16 inches | Time duration 0.292 seconds |
| Exit height 16 inches | Time duration 0.190 seconds |
| Exit height 10 inches | Time duration 0.150 seconds |
| | |
| Power to hammer strike | Time duration 0.130 seconds |
| Power to hammer strike | Time duration 0.124 seconds |
| Power to hammer strike | Time duration 0.122 seconds |
| Power to hammer strike | Time duration 0.120 seconds |
| Power to hammer strike | Time duration 0.118 seconds |
| Power to hammer strike | Time duration 0.146 seconds |
| Power to hammer strike | Time duration 0.148 seconds |

**AAA Bumper Gun**
(eletro-magnet with swing arm hammer, 22 caliber)
The results are as follows:
Power to hammer strike Time duration 0.10 to 0.105 seconds

These results were indicated by Jerry Eubanks and based on high speed video.
The author intends to test this gun and post the results in the future.

**Braker Box Shot Marker**
(electric actuator with spring loaded ram)
The results are as follows:

| | |
|---|---|
| Exit height 20 inches | Time duration 0.054 seconds |
| Exit height 18 inches | Time duration 0.054 seconds |
| Exit height 16 inches | Time duration 0.052 seconds |
| Exit height 14 inches | Time duration 0.052 seconds |
| Exit height 12 inches | Time duration 0.050 seconds |
| Exit height 10 inches | Time duration 0.052 seconds |

## CONCLUSIONS AND RECOMMENDATIONS

A review of the test results indicates that the delay time is primarily due to the electrical and mechanical components of the guns. The travel time of the chalk is minimal, once it leaves the barrel.

The delay time of the bumper gun is a factor that should be considered. As an example, if a test were conducted at 60 mph (88fps), with a delay time of 0.052 seconds, the switch would first activate 4.6 feet before the chalk hits the road surface. If a test were conducted at 60 mph (88fps), with a delay time of 0.190 seconds, the switch would first activate 16.7 feet before the chalk hits the road surface.

In the past, some bumper guns have been powered by the brake lights of the test vehicle. Recent testing has indicated that this is not a good power source. After reviewing the results of skid testing conducted with CAARS (Stockton, California, 4-19-2000), it was found that the brake light power source increased the bumper gun delay time. The Braker Box Shot Marker was powered by the brake light circuit of a 1999 Ford Crown Victoria with both brake light bulbs removed to reduce the power consumption. With that power source, the electro-mechanical delay time was increased from 0.052, to approximately 0.130 seconds. The recommended power source would be the cigarette lighter outlet of the test vehicle or a rechargeable heavy-duty 12 volt battery. The recommended activation switch would be the one sold with the Braker Box Shot Marker, or to construct one using a tape switch and a relay. The use of the relay is necessary because the tape switch is rated for 2 amps. The power requirement for the actuator of the Braker Box Shot Marker is approximately 5 amps at 12 volts.

The Braker Box Shot Marker uses a spring-loaded ram with an offset firing pin that is released by a 12 volt electric actuator (the actuator is similar to what is used in the electric door lock mechanism of a car). The gun uses the same 22-caliber cartridge used by contractors to shoot nails into concrete (cartridge is readily available at hardware stores). The chalk is typical blackboard chalk. The barrel of the gun is manufactured to use 10mm diameter chalk. The author has found that 10mm chalk is difficult to obtain as most chalk sold in the U.S. is 3/8 inch diameter (9.5mm).

As of the time that this paper was written, the only chalk gun manufactured and sold currently is the Braker Box Shot Marker.

Shot marker. $150.00
Brake pedal switch. $60.00
Braker Box
318 Quarry Road
Comox, BC V9M 3C4
Canada
Fax (250) 339-4850
fentiman@island.net