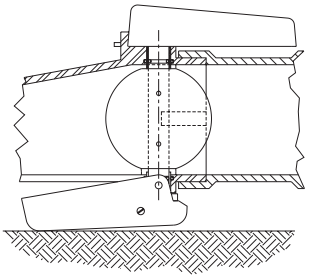
TASK FORCE TIPS
Technical Bulletin
March 18, 1993

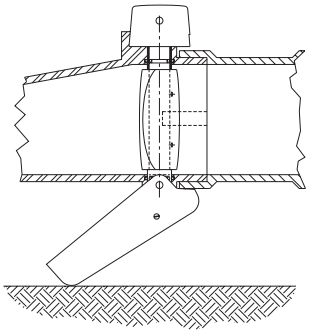
CROSSFIRE MONITOR SAFE-TAK VALVE OPERATING TEST

Task Force Tips' concern for firefighter's safety led to development of the Safe-Tak monitor base for the Crossfire monitor. Task Force Tips examined the pressure dynamics of the system to understand the effects of Safe-Tak valve actuation. When the Safe-Tak valve actuates, it reduces the flow area in the monitor by 90%. With this change in flow area there is an increase in hose line pressure and pump pressure. Task Force Tips wanted to be assured that any pressure spikes due to the valve actuation would not be likely to cause damage to the hose or fire apparatus which, in return, may cause injury to a firefighter.

SAFE-TAK valve
in open position



SAFE-TAK valve
in closed or tripped position



Task Force Tips tested the Crossfire monitor and Safe-Tak base with different hose lays of 2-1/2" and 5" hose. A pressure transducer was attached to the monitor directly upstream from the Safe-Tak valve to monitor the inlet pressure. Another pressure transducer was attached to a fitting located on the pump discharge to monitor pump pressure. Both pressure transducers were tested and calibrated to be within a maximum error of 1%, on an instrument that is directly traceable to the National Bureau of Standards. A potentiometer was attached to the shaft of the Safe-Tak valve to measure the rotation of the Safe-Tak valve. These devices were wired to an Analog to Digital Board, Manufactured by Labtech, to convert the signal and allow the data to be recorded by a computer.

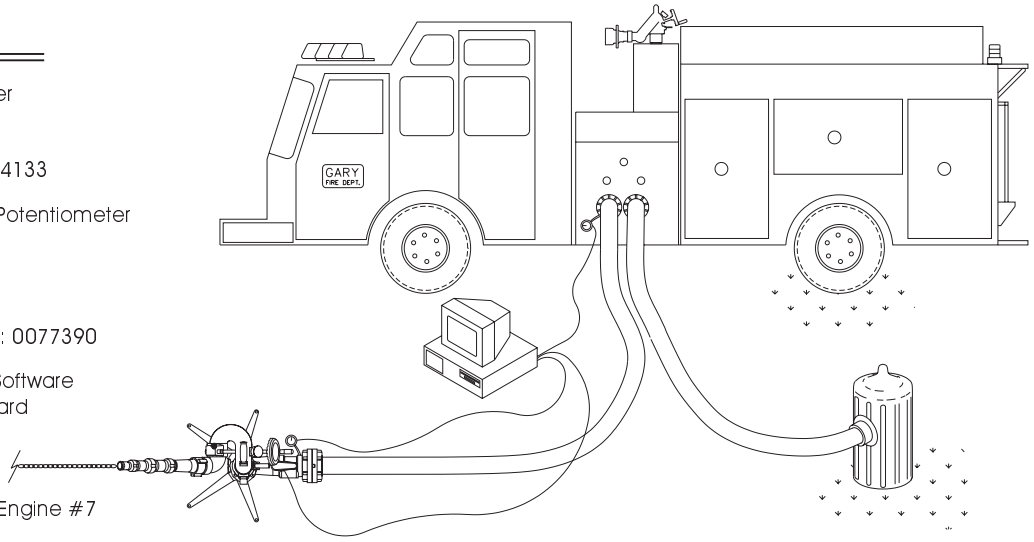
EQUIPMENT LIST

Viatron Corporation Pressure Transducer
Model: 3475AU2AAA20
Pressure Range: 0-500 psig
Serial #: 00263933 and Serial #: 00264133

Beckman Helipot Corporation 10-turn Potentiometer
Model: SA-05B
Linearity: .5%
Serial # B665-0

Swan 33 mghz 486 Computer Serial #: 0077390

Labtech Laboratory and Product Test Software
with a DAS 16 Junior Analog/Digital Board
Serial #: 27108



City of Gary, Indiana Fire Department Engine #7
Chief in Charge: Gordon Bradshaw.

TASK FORCE TIPS, INC.
www.tft.com
2800 East Evans Avenue, Valparaiso, IN 46383-6940
800-348-2686 219-462-6161 FAX 219-464-7155

For each test, the pump pressure was set at 200 PSI. The nozzle pressure was measured with a blade pitot. This pressure was used to determine the flow through the nozzle with the Safe-Tak valve opened (Initial Flow). The monitor was then intentionally tipped to cause the Safe-Tak valve to actuate. When the monitor was tipped, a micro-switch, located on the monitor, activated the analog to digital board in the computer which recorded pressures and valve rotation 200 times per second. The data was recorded until the engine pressure reached a steady state condition. The nozzle pressure was measured with a blade pitot to determine the flow through the nozzle with the Safe-Tak valve closed (Ending Flow).

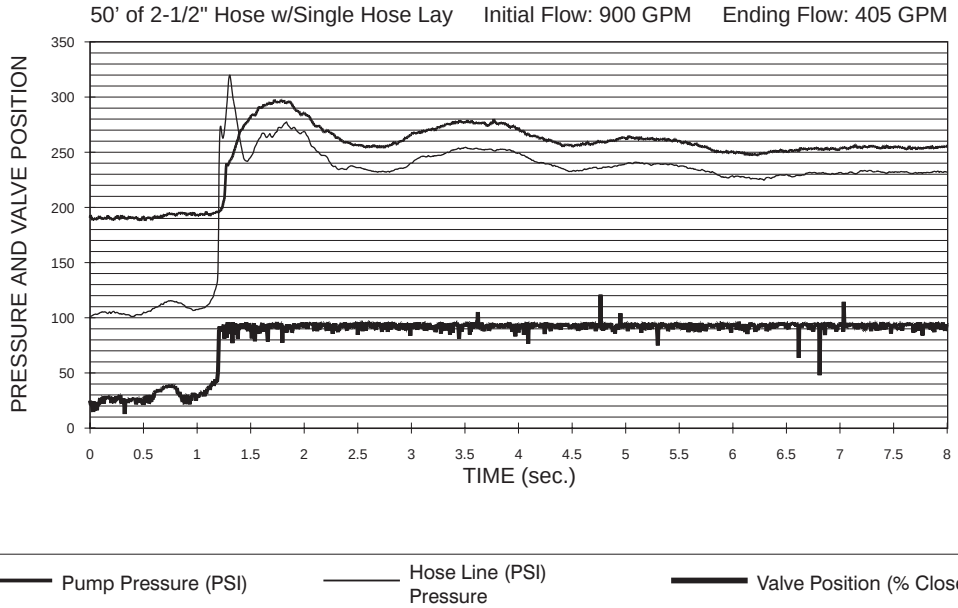
The tests were done using various lengths of 2-1/2" Service Master Attack Hose, single and dual, and 5" Flowmaster Supply Hose. The test results are given below.

					PUMP PRESSURE			MONITOR INLET PRESSURE		
GRAPH	**Hose Diameter** (inches)	**Hose Length** (feet)	**Initial Flow** (GPM)	**Ending Flow** (GPM)	**Initial** (PSI)	**Max.** (PSI)	**Ending** (PSI)	**Initial** (PSI)	**Max.** (PSI)	**Ending** (PSI)
A	2-1/2 (1)	50	900	405	190	297	253	100	320	241
B	2-1/2 (2)	200	940	405	203	290	268	122	272	242
C	2-1/2 (1)	400	450	315	203	225	214	63	153	138
D	5	200	1050	460	203	228	226	112	201	193
E	5	500	950	420	205	247	240	125	189	182
F	5	1000	830	350	208	235	235	111	170	159

Pump and hose line pressure rises can be calculated by taking the difference between the maximum and the ending pressure values. The highest pressure rise of 79 PSI, which was less than expected, occurred behind the Safe-Tak valve in a 50 foot length of 2-1/2" hose. The maximum pressure recorded was 320 PSI.

PRESSURE AND VALVE POSITION VS. TIME

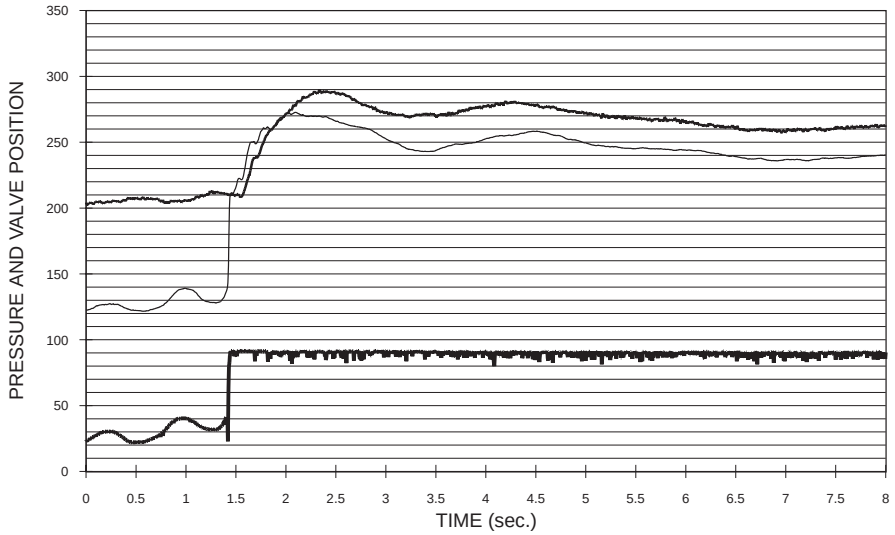
A



PRESSURE AND VALVE POSITION VS. TIME

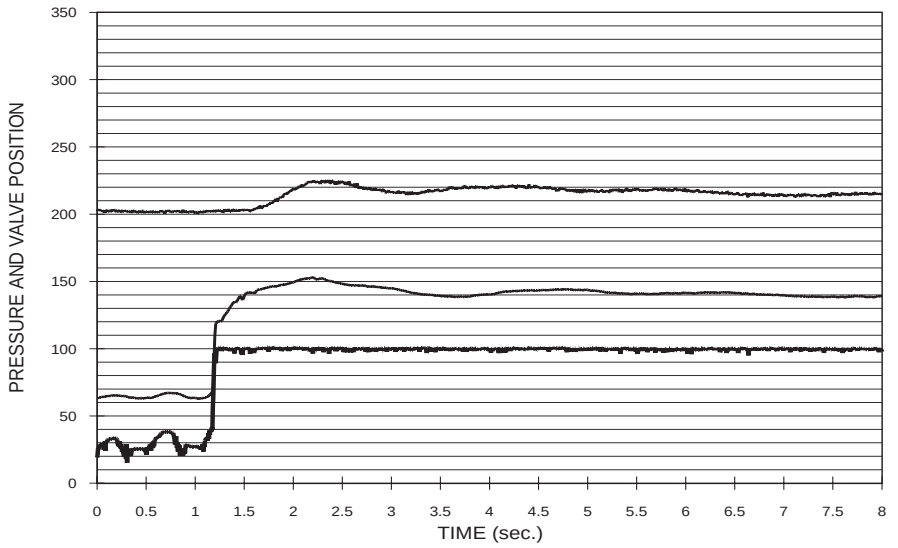
B

200’ of 2-1/2 Hose w/Dual Hose Lay Initial Flow: 940 GPM Ending Flow: 405 GPM



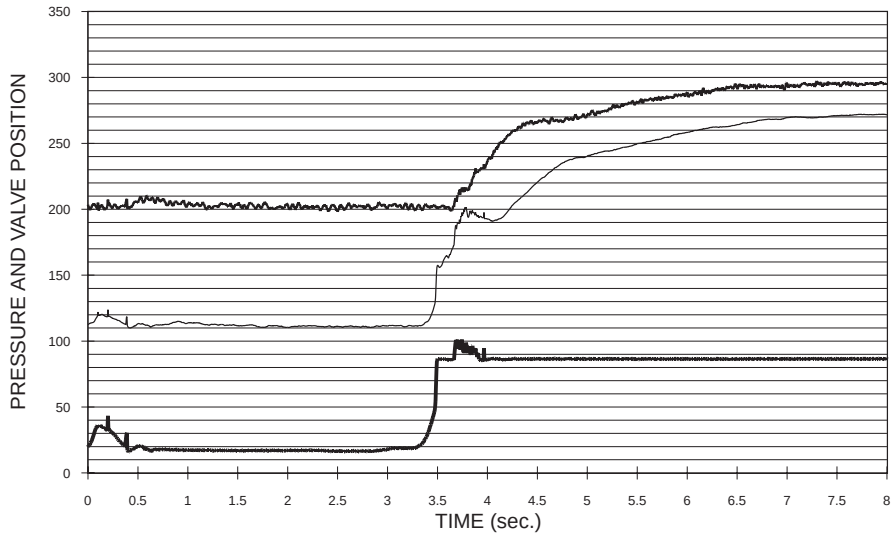
C

400’ of 2-1/2" Hose w/Single Hose Lay Initial Flow: 450 GPM Ending Flow: 315 GPM



D

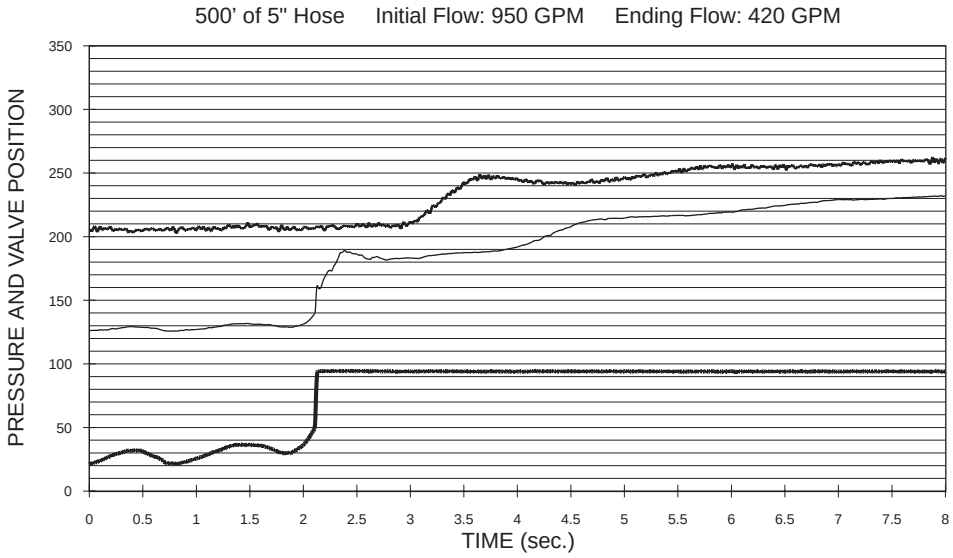
200’ of 5’ Hose Intial Flow: 1050 GPM Ending Flow: 460 GPM



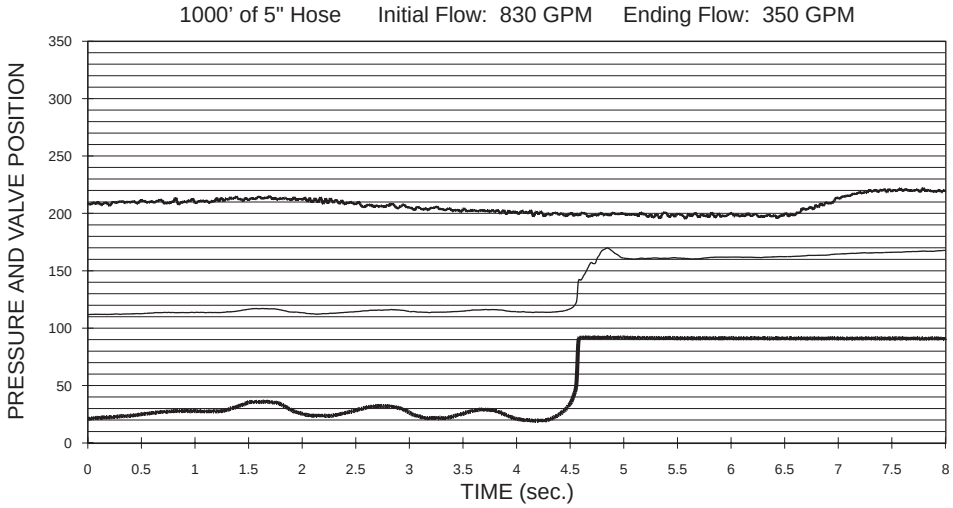
Pump Pressure (PSI) Hose Line (PSI) Pressure Valve Position (% Closed)

PRESSURE AND VALVE POSITION VS. TIME

E



F



(NOTE: The dial pointer on the mechanical pressure gage located on Engine #7 would instantaneously reach higher readings than what was recorded by the pressure transducer throughout the testing. A mechanical gage has a bourdon tube which is a flattened tube that deflects under pressure. The bourdon tube is attached to a linkage which is geared to the dial pointer. The impact of the water during these tests caused the bourdon tube to quickly deflect from equilibrium, causing the inertia of the gage components to overshoot the actual pressure reading. [Inertia is defined as the tendency of a body to remain at rest or stay in motion unless acted on by an external force.] Pressure transducers are designed for dynamic pressure responses because they do not contain any mechanical linkages and therefore inertia has no effect on the pressure transducer.)

Task Force Tips has concluded that a pressure rise can occur in the hose when the Safe-Tak valve is actuated. The pressure rise will travel backward through the hose line and cause a smaller pressure rise at the pump. When a pressure rise occurs the hose acts like a shock absorber. The larger diameter hose has more material to absorb the impact of the water. For this reason, the pressure rises are higher with the shorter hose lays and the smaller diameter hose. All pressure rises fell below the recommended burst pressure of attack hose (900 PSI) and supply hose (600 PSI) specified in the NFPA 1961 Fire Hose Specification. Therefore, Task Force Tips feels there is a very low risk of hose damage, engine damage or personal injury due to the actuation of the Safe-Tak valve, and there is a far greater risk of personal injury with a monitor that lifts off the ground and gets out of the firefighter's control.