

### 3.4 Water Hammer

Water hammer is a phenomenon which is very severe if it occurs in a hydraulic system, but is certainly not limited to hydraulic systems. In fact, the water system in your house will exhibit the water hammer phenomenon if the valve is closed fast enough. Water hammer is created when a valve is closed extremely fast. The flow passing through the valve is abruptly stopped. The momentum of the fluid will create a high pressure which can reverberate as a pressure wave through the system.

The schematic shows a typical cylinder control system developed using HyPneu. When the valve is closed rapidly, the water hammer performance occurs as shown in the curves. In this case, the cylinder is not at end of stroke and therefore cycles back and forth with the fluid wave. When the cylinder has a high cushion, the pressure wave will be damped out faster as shown in Fig. 3.4c.

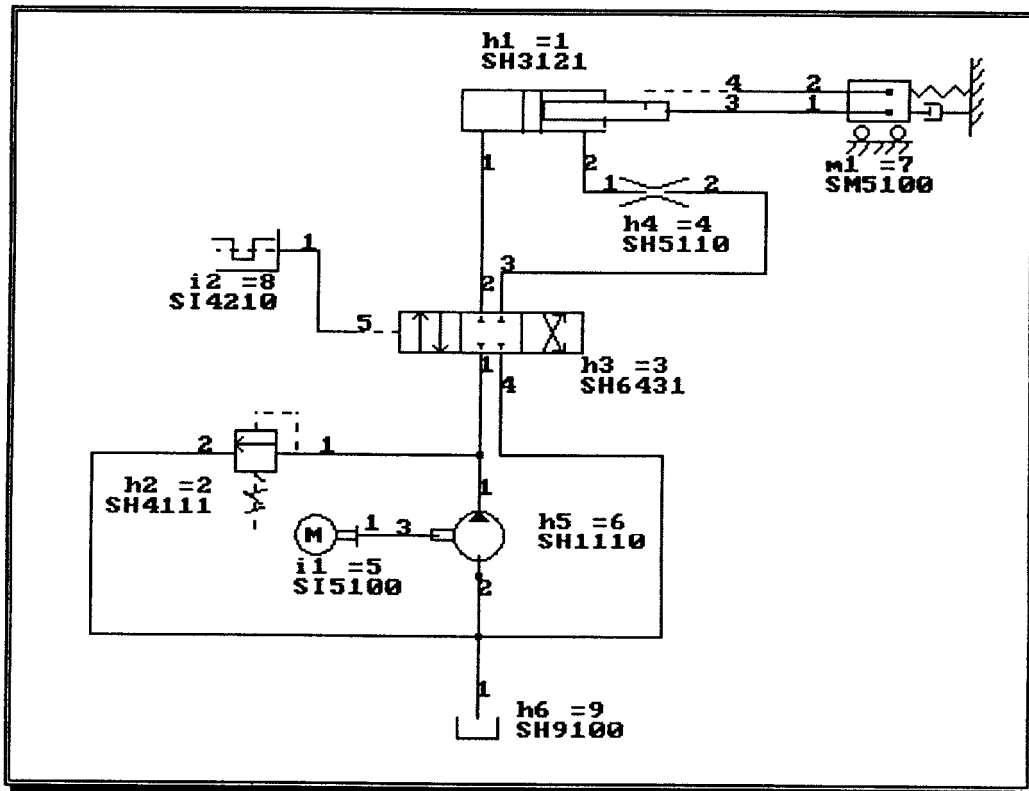


Figure 3.4a. Water Hammer Schematic.

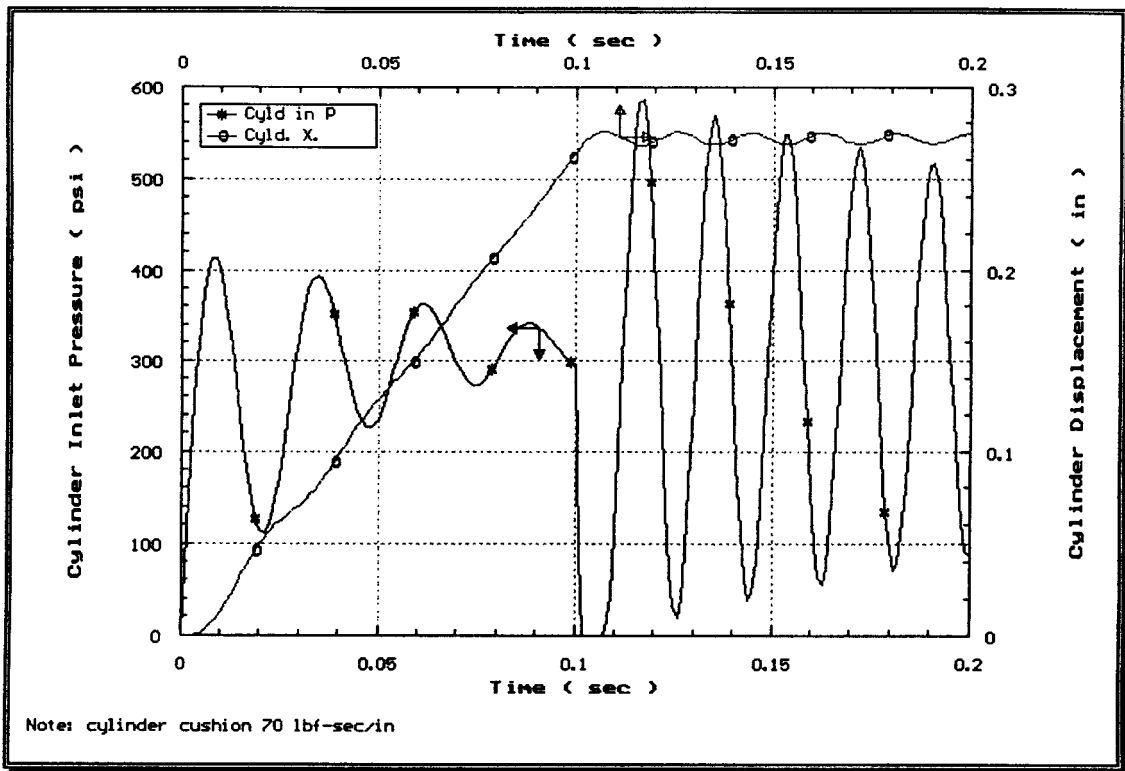


Figure 3.4b. Water Hammer Analysis with Low Cylinder Cushion.

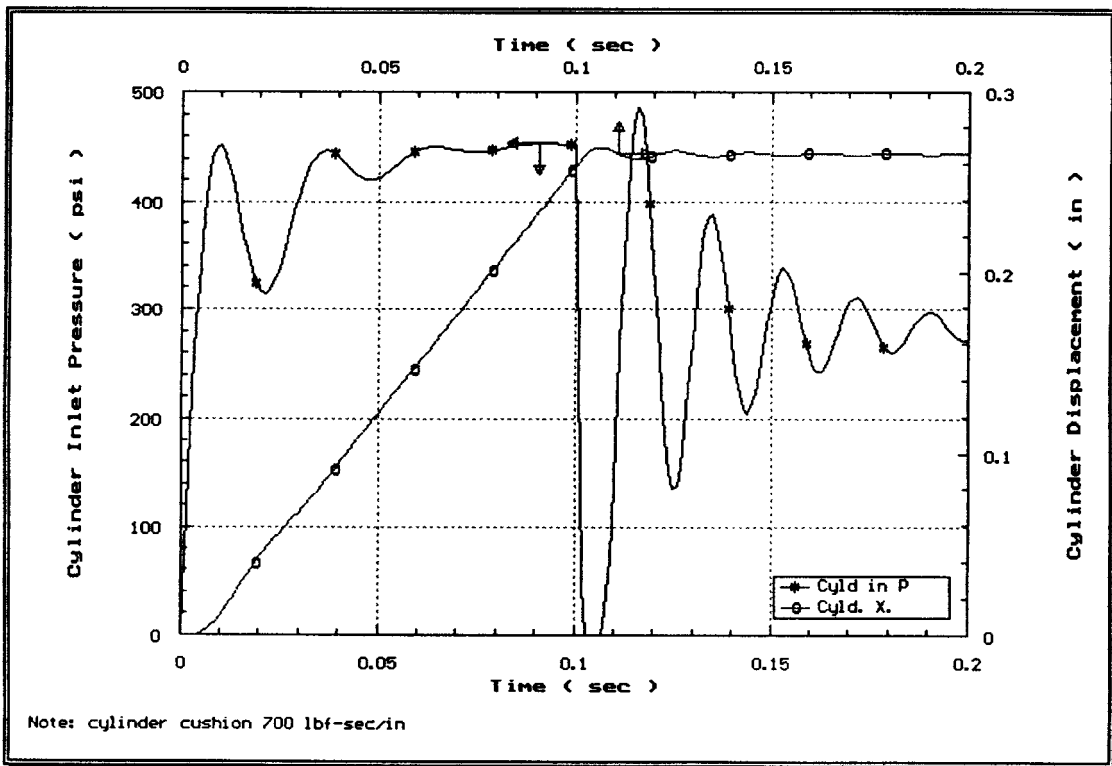


Figure 3.4c. Water Hammer Analysis with High Cylinder Cushion