# Anomalous Blow Mold Conditions

## A Paper on blow mold problems detected by WheelWatcher™

WheelWatcher is an integrated system used to gather critical blow mold parameters from production machinery in real time. WW executes several digital signal processing (DSP) algorithms to determine the quality of the every bottle produced. WW also makes this data available to interested personnel, statistical process control (SPC) programs and data archives. Depending on the activity involved these interested personnel can be from production, maintenance, research, development, engineering and quality control departments.

What follows is a summary of the critical blow mold parameters of interest and a discussion on the interpretation of various graphs provided by WheelWatcher™. The graphs presented were taken from actual production data.

These graphs are not intended to represent the WheelWatcher™ operator interface. These data are presented offline and in the context of analyzing the nature of stretch blow molding bottle formation. These graphs are, however, a subset of the views presented on the WW operator interface. Indeed, advanced WheelWatcher installations use more complicated regression, curve fitting and filters to provide other data valuable in research, development and quality control efforts.

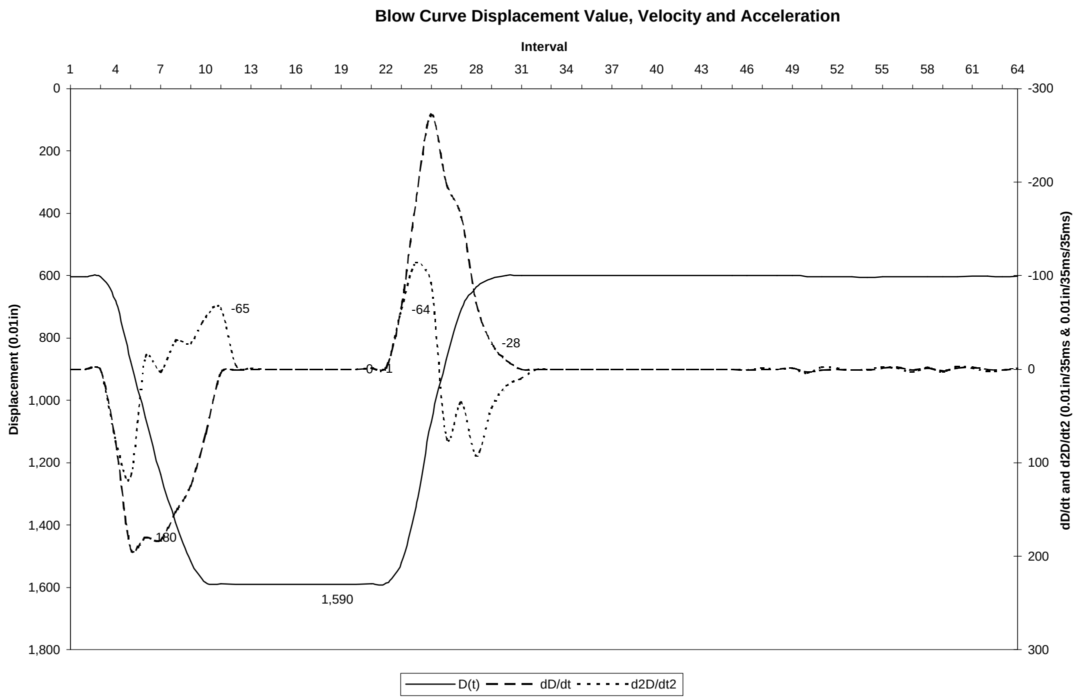
A typical blow curve is presented first for comparison purposes. Following these typical plots are several anomalous conditions observed by WW. These problem conditions are not exhaustive and represent only a few of the problems WW detects. These problems are some that were observed during the prototype implementation.

More information on WheelWatcher and data that it records and derives from the blow mold process is available from Keeva at 972.881.2349.

## Normal or typical plot

The plots below are provided for convenience and comparison. The anomalous plots can be compared to the normal ones below.

The first plot is one of the stretch rod displacement or axial orientation.



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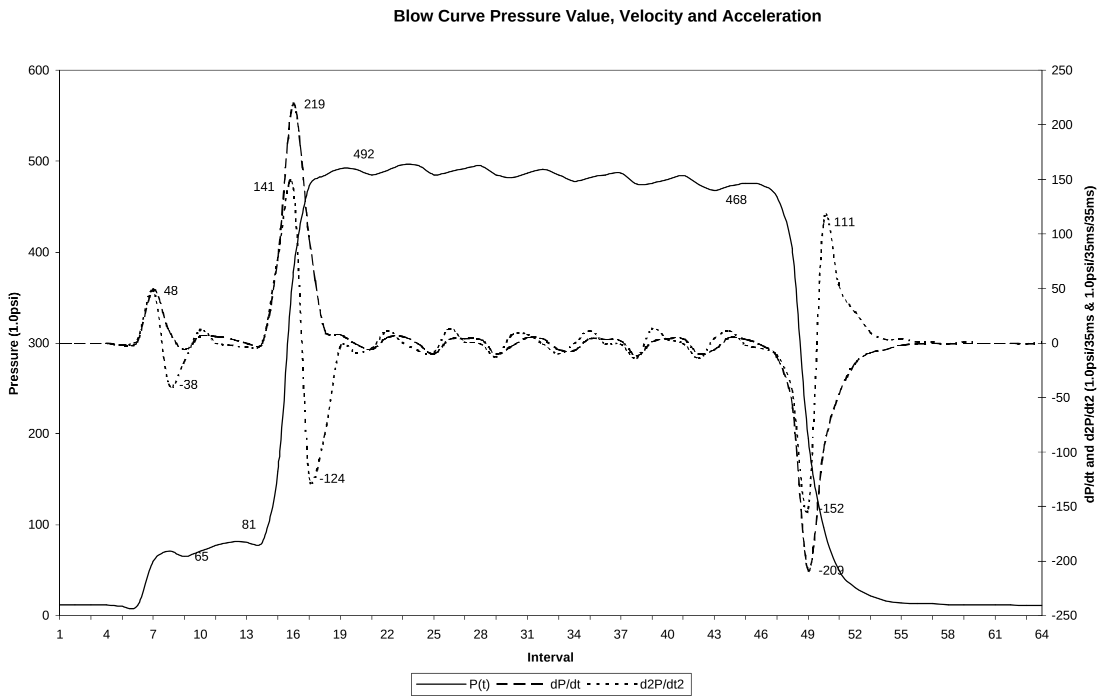
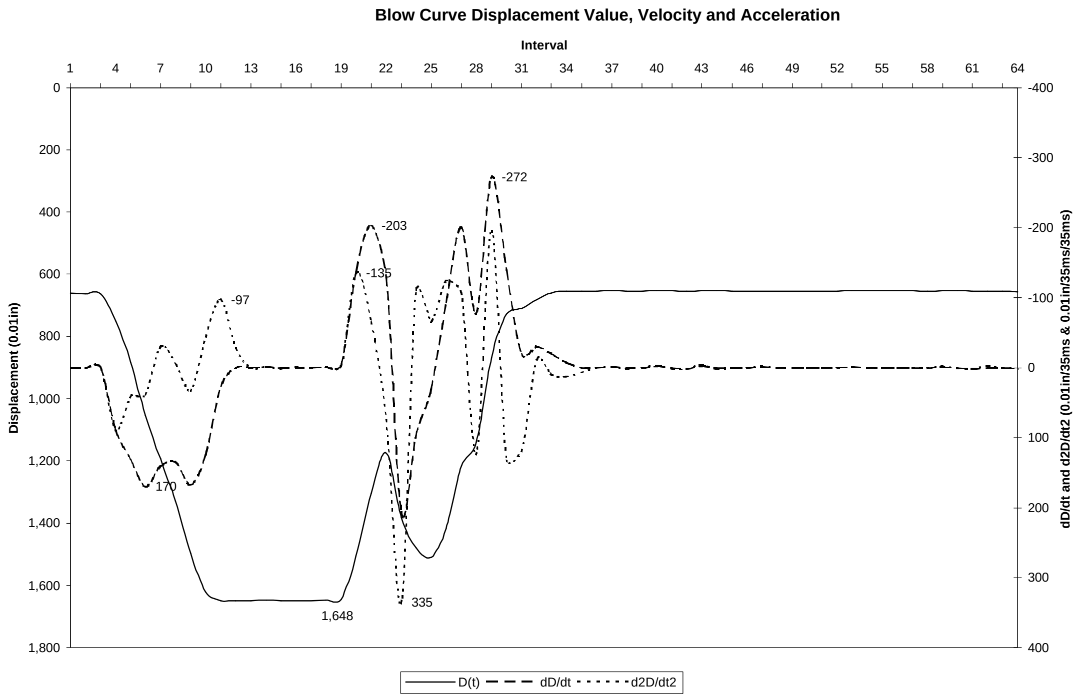
The plot below is of the blow pressure or radial orientation.



## Stretch rod lifted by high blow air

In this view the high blow air pressure actually lifts the stretch rod after it has reached full extension. At present, it is not known whether there was insufficient air pressure in the stretch rod cylinder or a leak had developed in the cylinder.



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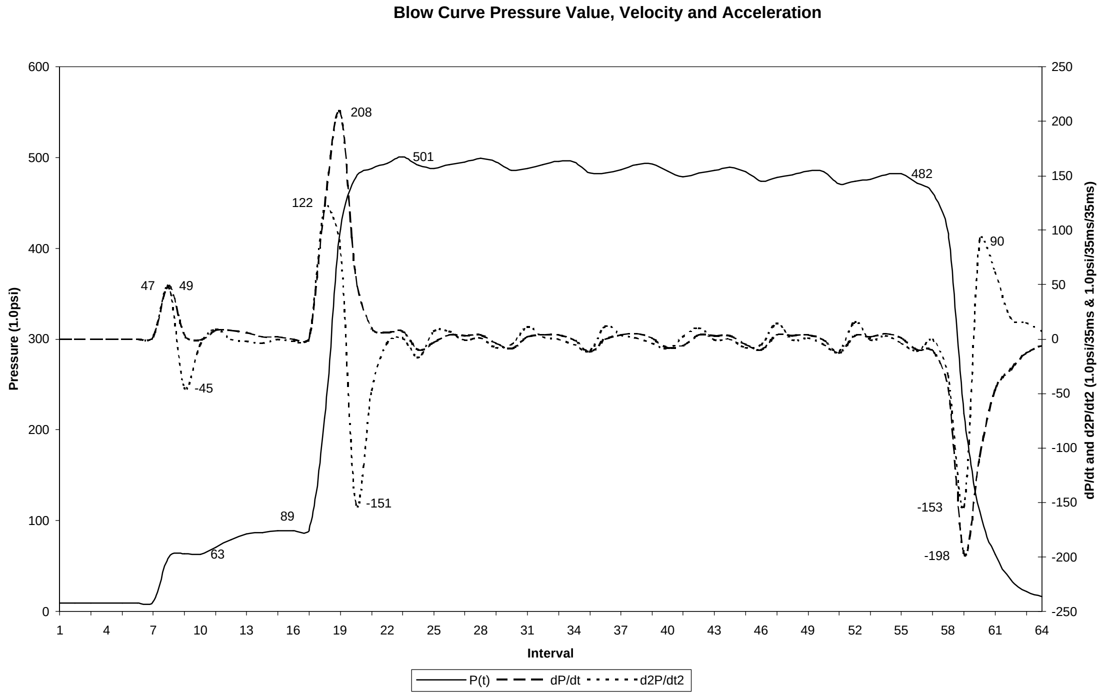
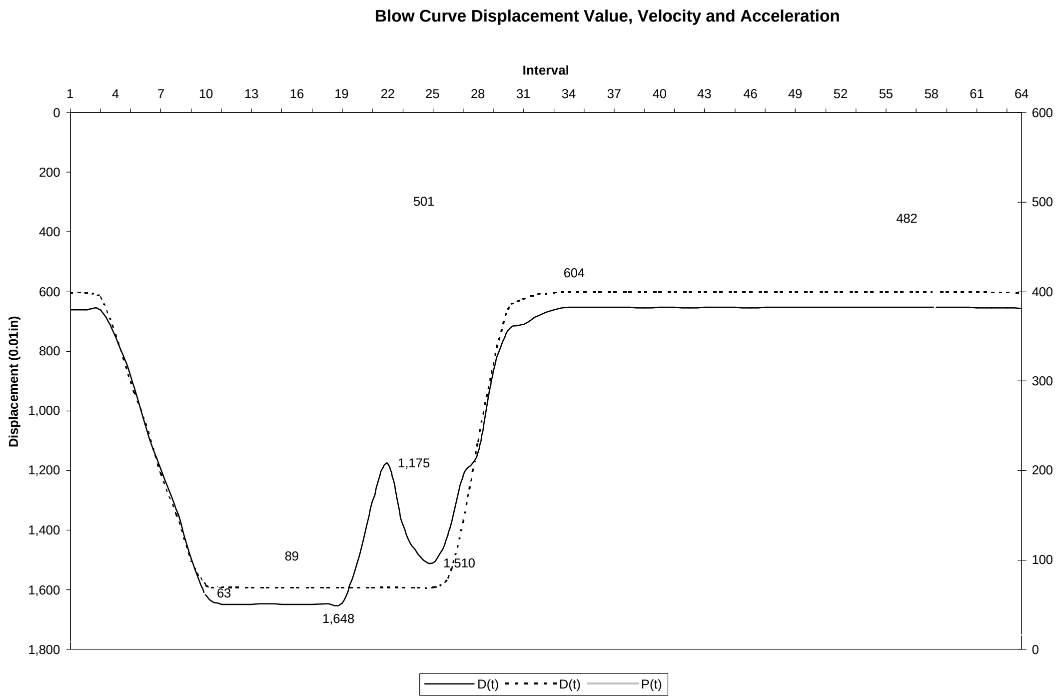
The pressure plot is relatively unaffected.



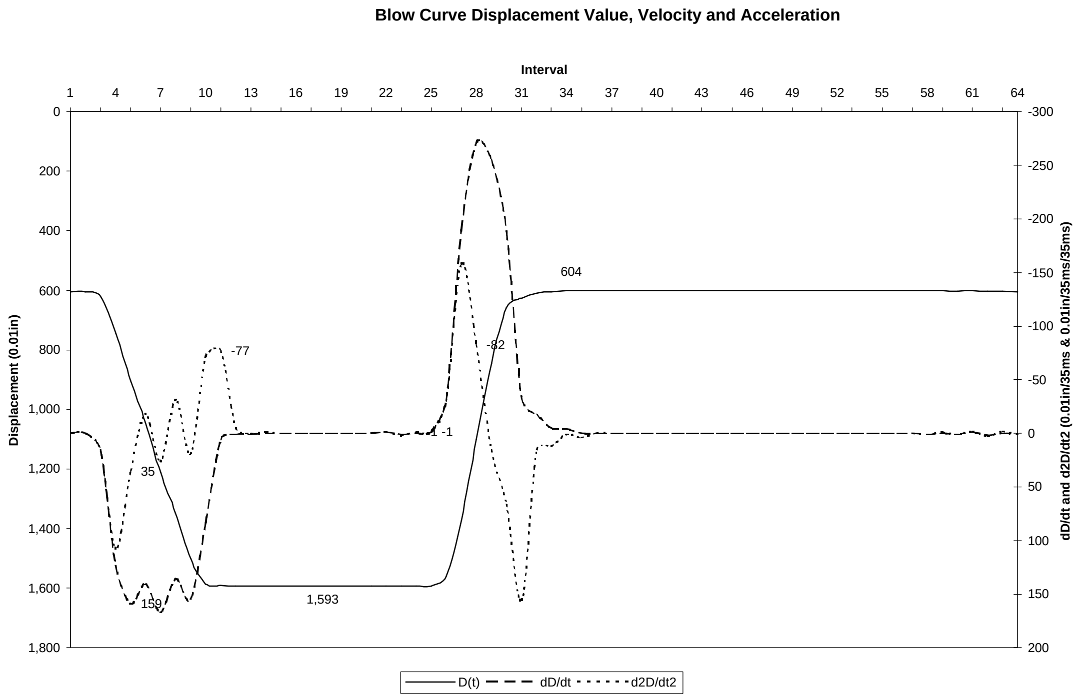
Perhaps the result can best be viewed by overlaying the pressure and displacement graph as shown below.




From this view, it can be seen the air pressure rose to a point where the stretch rod could not be held down by the air pressure in the stretch rod cylinder. The stretch rod can be seen to rise 4.73in. The stretch rod then moves back down 3.35in before finally being retracted. A typical displacement trace is overlaid to show the relative timing of the retraction. From this overlay it can be seen the rod was not retracted until it had started to move down the second time.

## Three-way valve drop out

On some blow mold machines, the three-way valve is switched in such a manner that the switch lever can move in the opposite direction it should. This is often called "dropping out". The axial plot is unaffected by this phenomenon.



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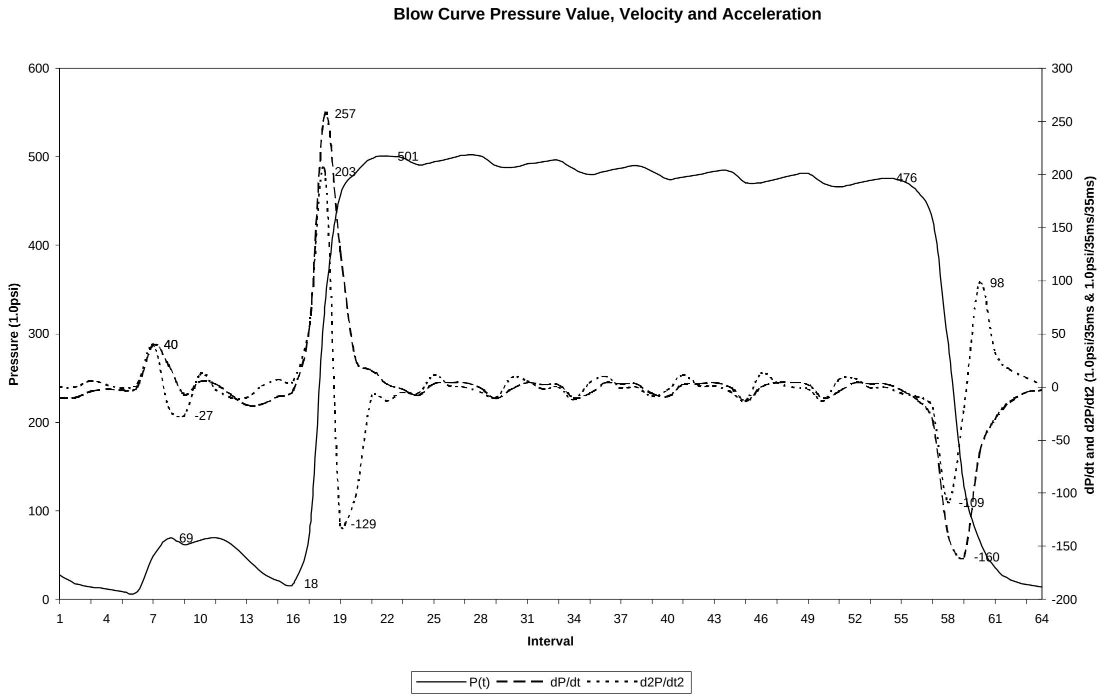
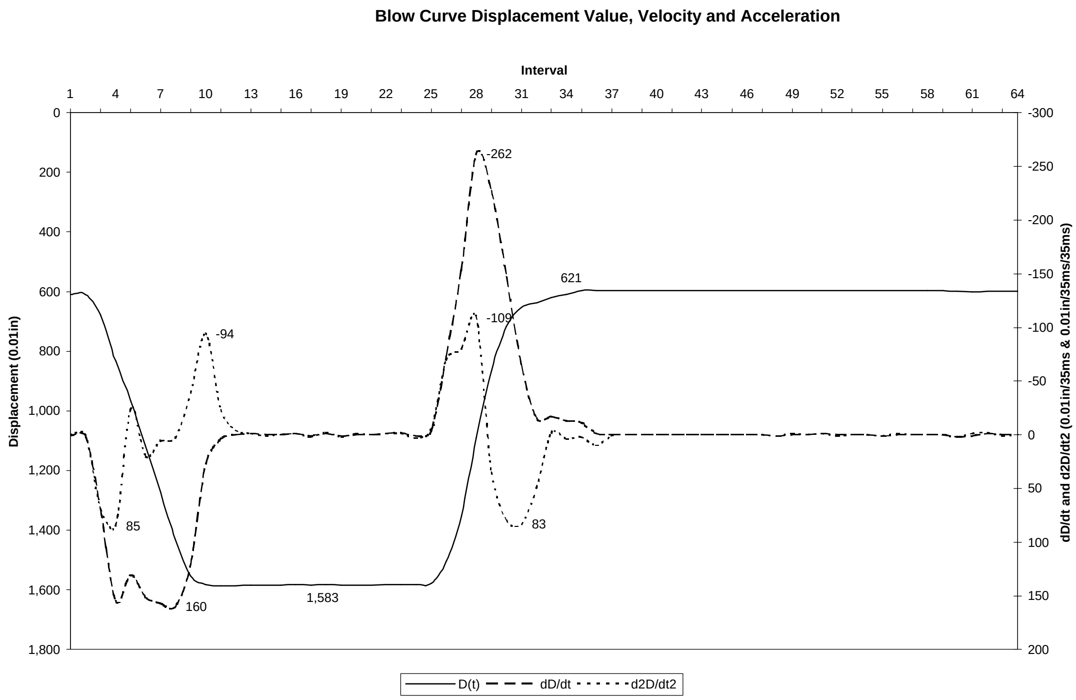
The radial plot shows the dramatic pressure change from low blow to almost ambient and abruptly to high blow.



## Neck seal leak

If a neck fold or neck o-ring seal failure were to occur, high blow air pressure could be observed to detect this condition. The stretch rod plot would not reflect the change.



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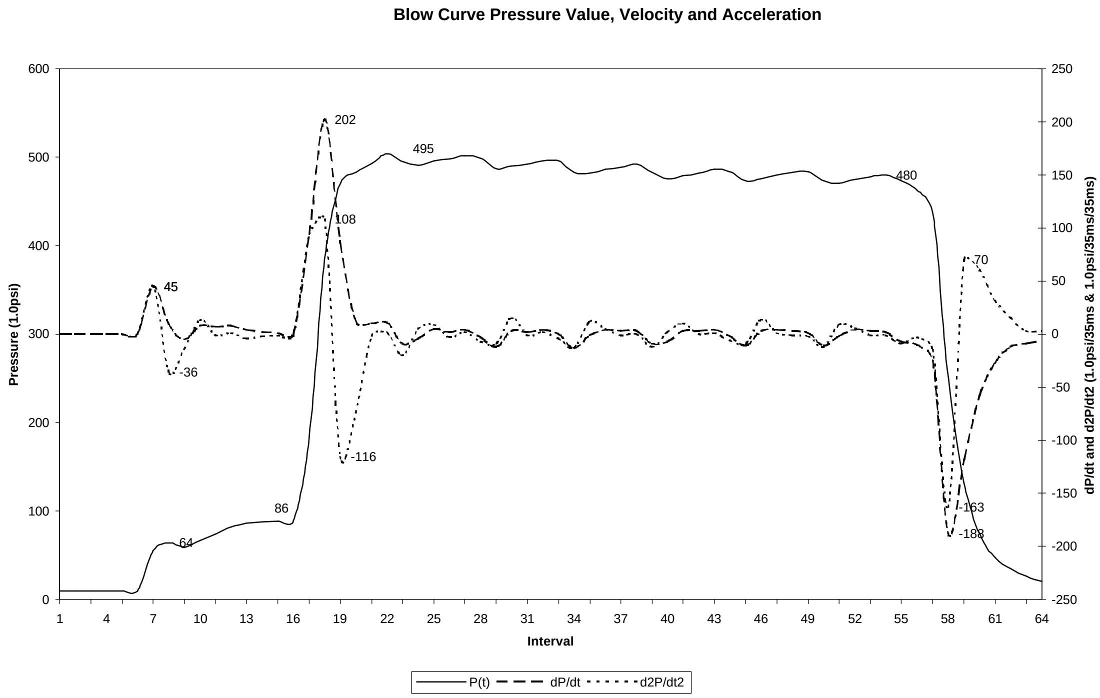
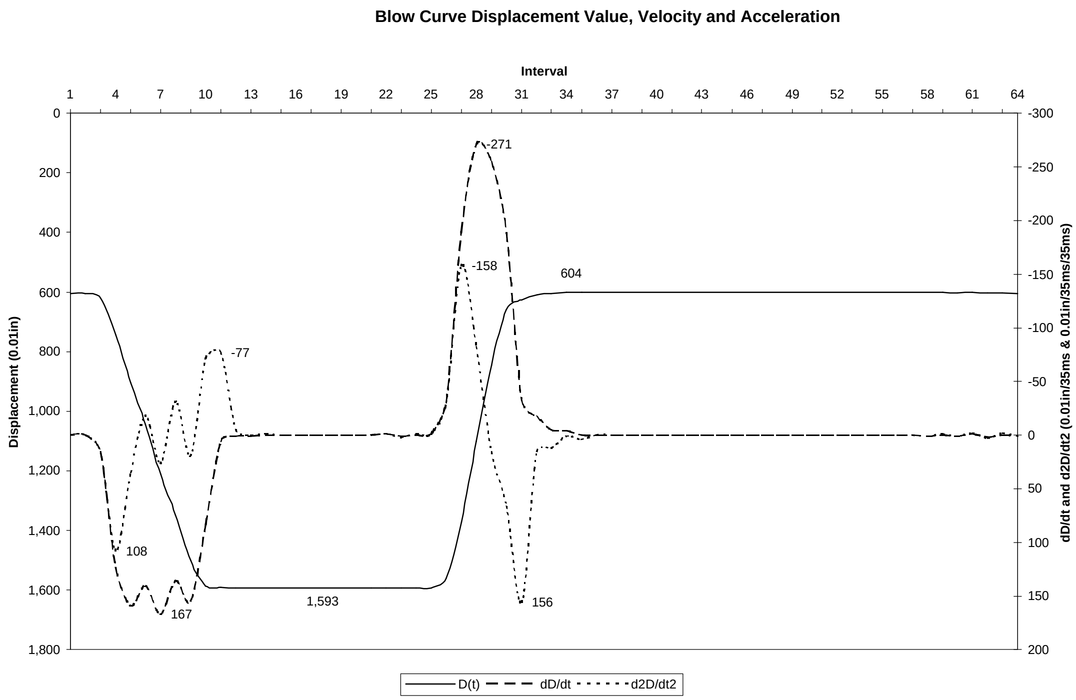
However, the high blow air pressure should evidence some sort of anomaly or general decline. The plot below does not necessarily reflect such a condition. However, by observing at the high blow interval and concentrating on the relative, downward trend its manifestation is visualized.



## Low blow interval bypass

This anomaly occurs when a faulty three-way valve connects high blow pressure to the bottle cavity during the low blow interval. It can also occur when high pressure air is present in the low blow manifold because of a neighboring station's faulty three-way valve has ported the high pressure air to the manifold. As one would expect, the displacement plot is unaffected.



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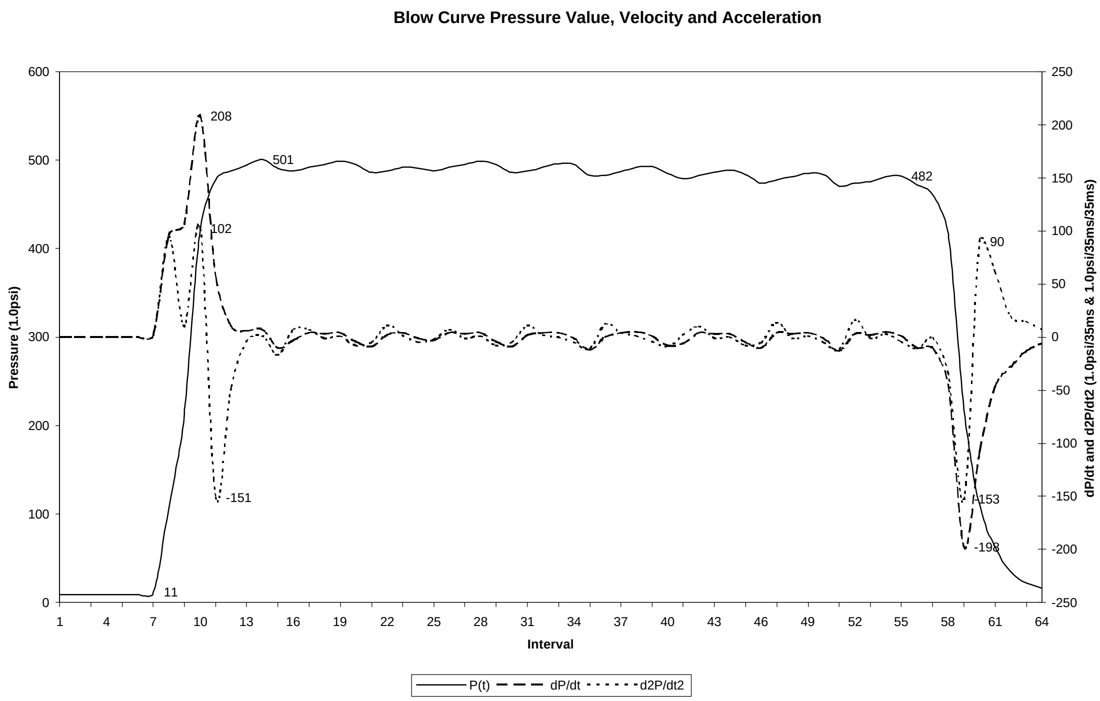
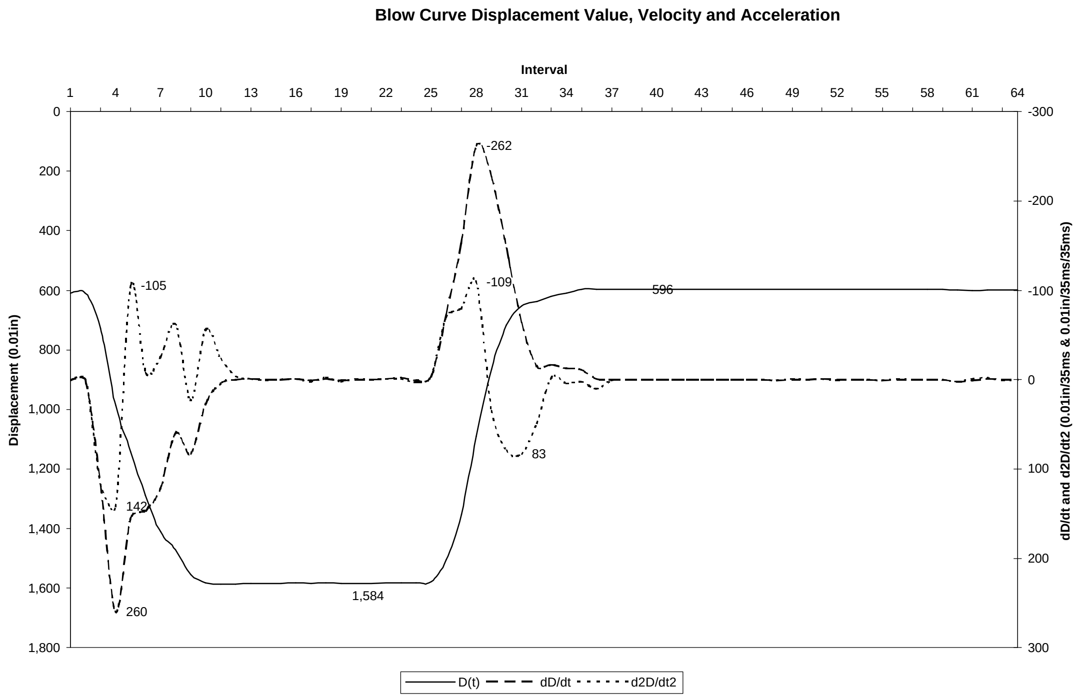
The pressure plot shows the move from ambient conditions straight to high blow pressure.

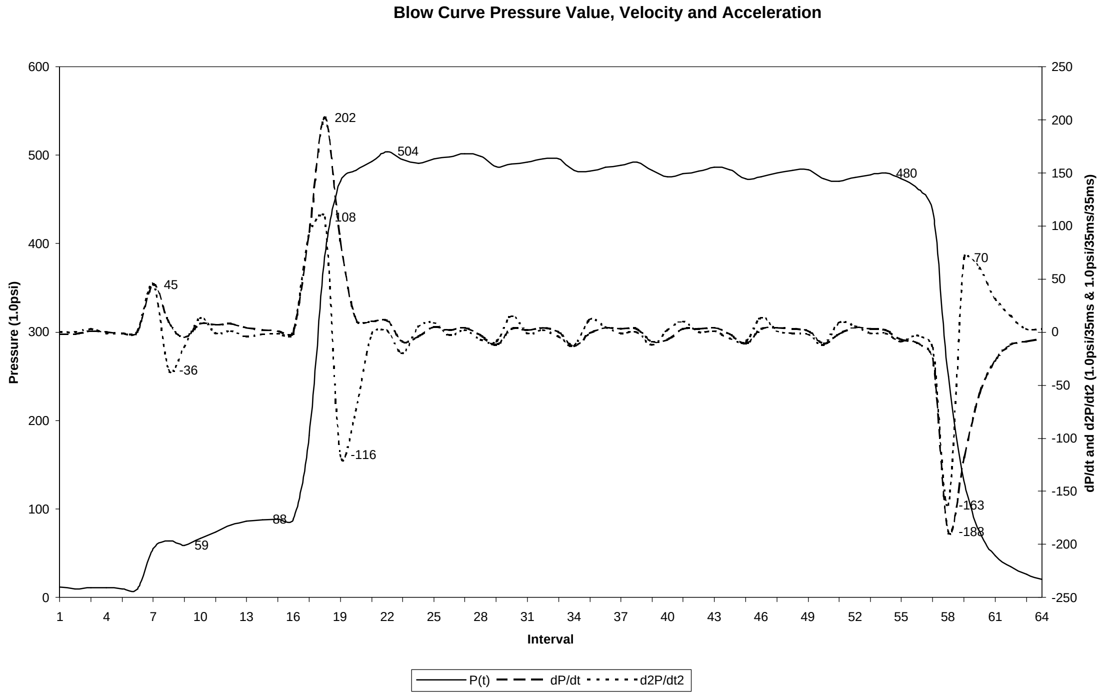


## Stretch rod extension plugging

The stretch rod can bind, jerk or plug during extension or retraction. This condition is most often seen during extension because the stretch rod has resistance to its motion due to elongating preform. The plot below shows one such manifestation.

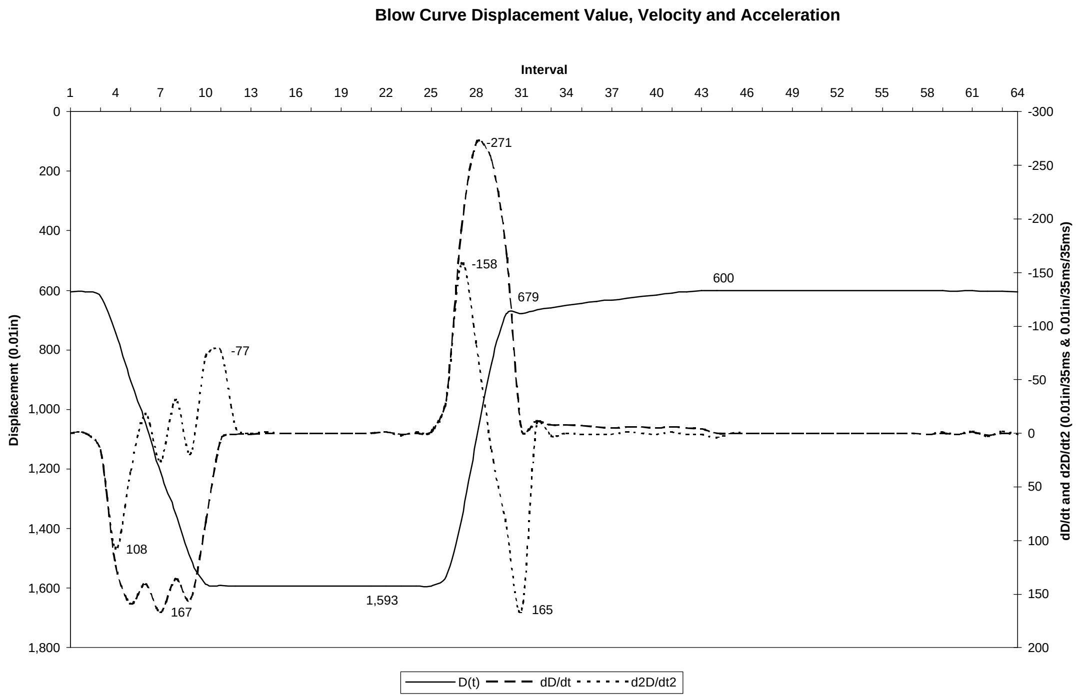


The pressure plot is unaffected.



## Stretch rod retraction cushion preset too high

The exhaust port on the stretch rod air cylinder has an adjustable valve that can constrict the exhaust air so as to cushion the stretch rod as it retracts to its home position. This is to prevent slamming the stretch rod into the cylinder seat or block. The motion should be crisp and definite. In the plot below, the stretch rod is seen slowly creeping back to the home position at the end of the retraction interval. By opening this exhaust port slightly, the air can escape faster and the stretch rod action will return to normal.



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As one would expect, the pressure plot is unaffected.