

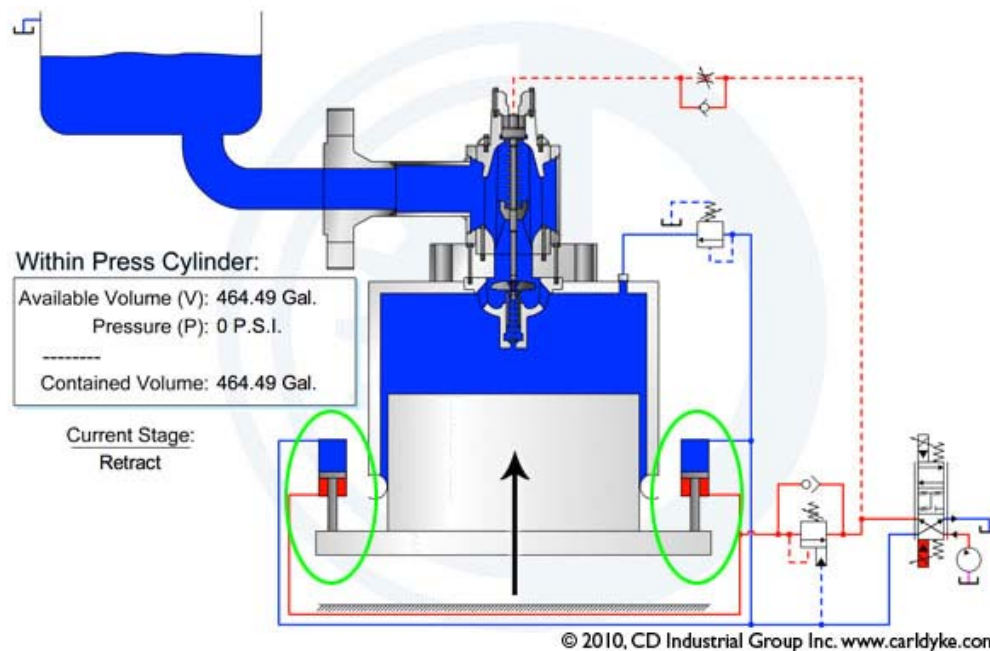
Newsletters That Teach.

Compression II

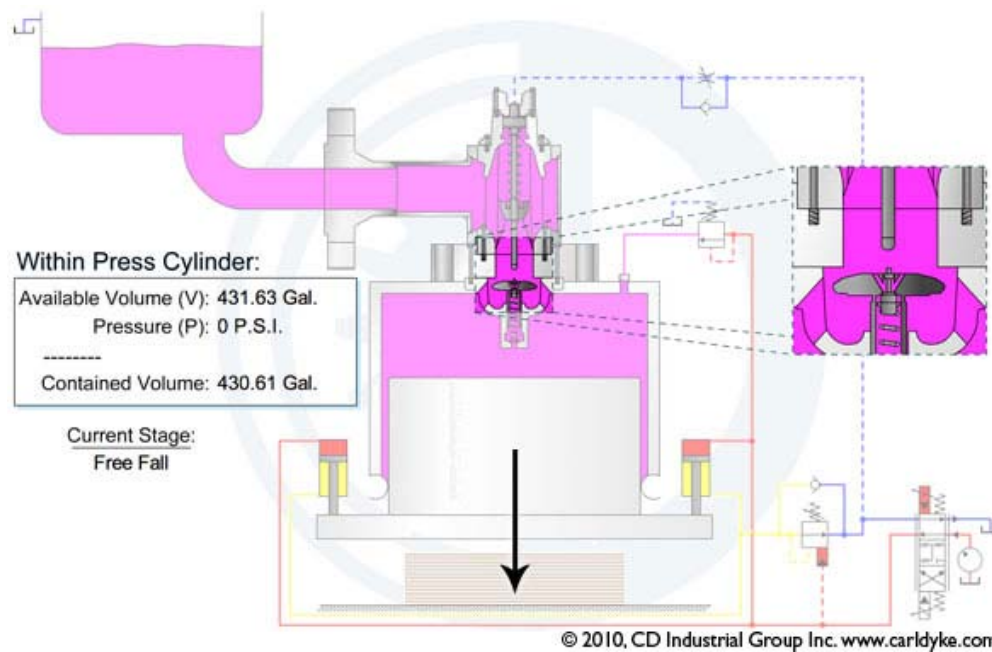
Mar 17, 2010
Posted in [Hydraulic](#)

Jack Cylinders and Prefill Valves

Jack cylinders are common to most large diameter press rams. They are used for the initial low pressure stage and are often critical for retracting the ram. During the main pressing stage, the jack cylinders will likely be used to contribute additional force. If the press ram is oriented vertically it may also have a prefill valve. This is especially true if the ram has a free fall stage. During free fall the prefill valve allows the natural partial vacuum that occurs as the ram drops to draw in the initial volume of fluid.



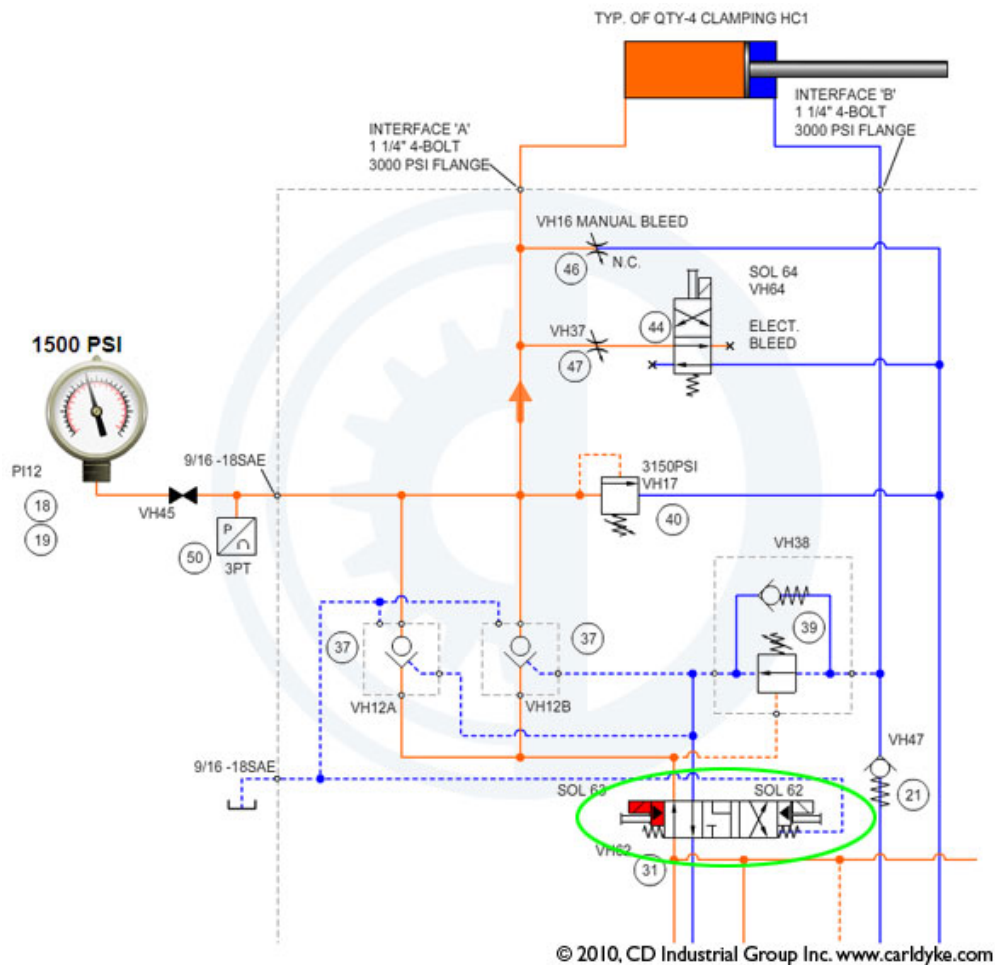
Jack cylinders (circled in green) are used to retract the large ram.



During free fall, a partial vacuum is created because of the huge volume of the ram cylinder. The prefill valve (magnified at the right of the image) allows fluid into the blind end of the cylinder to reduce the partial vacuum that is being created. If fluid were not allowed into the cylinder, the vacuum created would overpower the combined forces of gravity and the jack cylinders, and the ram would not drop.

While the jack cylinders are extending the ram, or while the ram is dropping under the force of gravity, fluid must be allowed to flow into the ram on the blind end port. A simple check valve arrangement is typical here to allow the ram to draw in fluid directly from the reservoir. These large diameter check valves are specifically made for a press prefill function and will also feature a pilot port to force the valve open later during the return stroke stage. In our example the prefill valve also has a built-in decompression poppet.

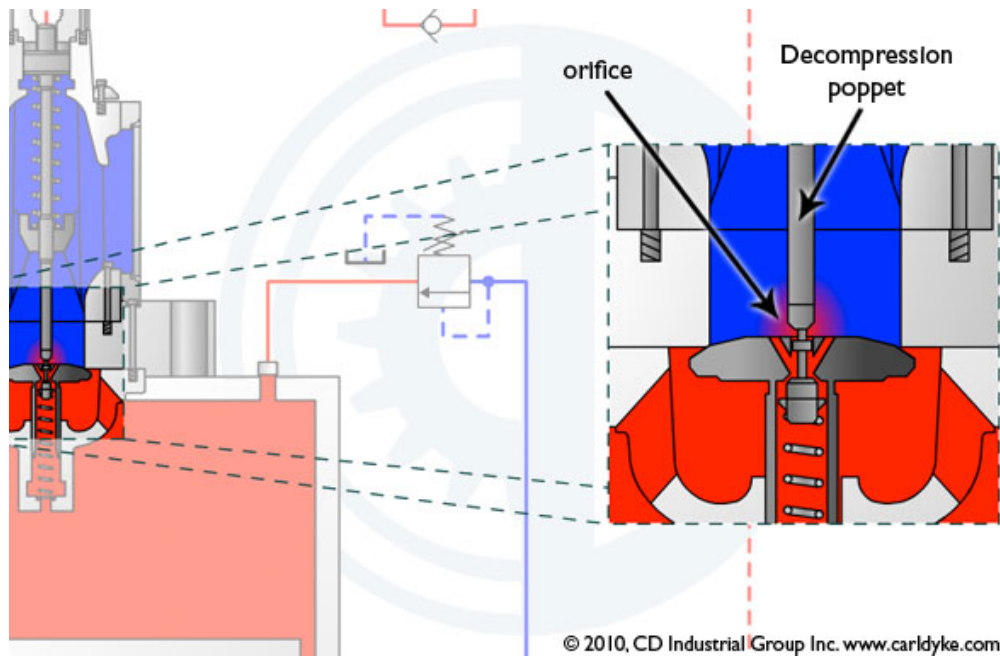
On some press rams that move very slowly in a horizontal orientation, the large and specialized prefill valve is replaced by a smaller, basic hydraulic directional valve. Decompression, however, must still be handled very carefully through a control valve of some sort at the end of ram stroke.



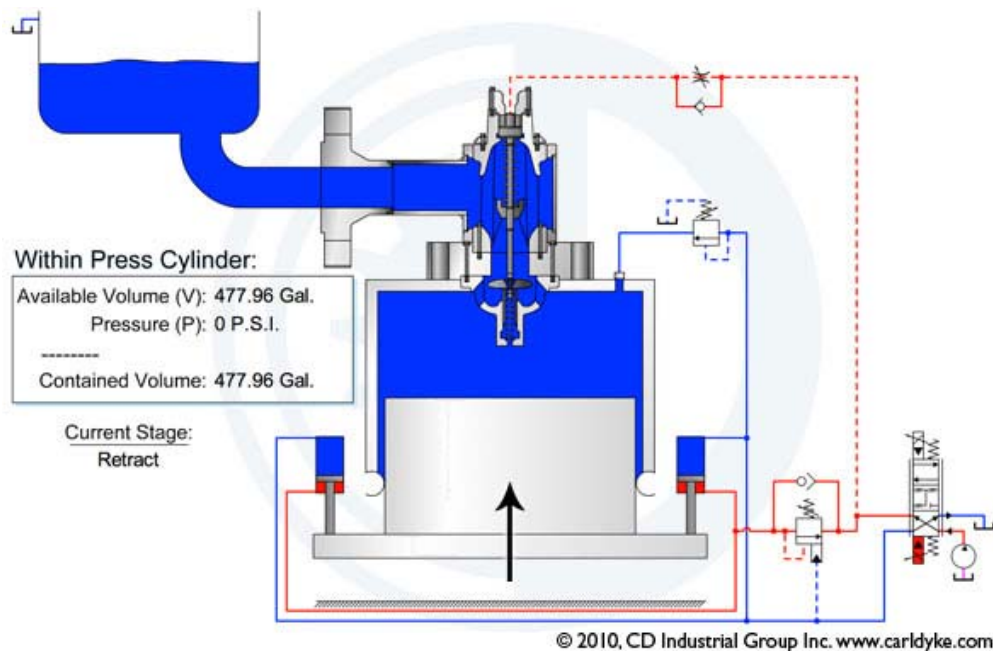
A basic directional valve handles the cylinder prefill for a slow horizontal press application.

In our main vertical press example, the ram moves through free fall first. Then, as pressure builds in the jack rams, the sequence valve opens and the pump's flow is directed into the main ram. The prefill valve, which is essentially a check valve, will now be closed.

When the press cycle is complete and the directional valve is reversed, the ram is not immediately set into a retract motion. The ram cannot retract even with the jack cylinders powered into their retract mode. The reason for this delay in retract motion is the fact that the prefill valve is not open. If the prefill valve could be opened at full pressure, the explosive force of the compressed fluid would cause serious damage. Decompression of the main ram must occur before opening a large flow valve. In our example, a small decompression poppet is slowly opened via a small flow control orifice. The ram pressure is bled down safely through the small poppet. Only when the ram is sufficiently depressurized does the pilot piston develop enough force to open the large diameter prefill valve. At this point main ram retraction can occur.

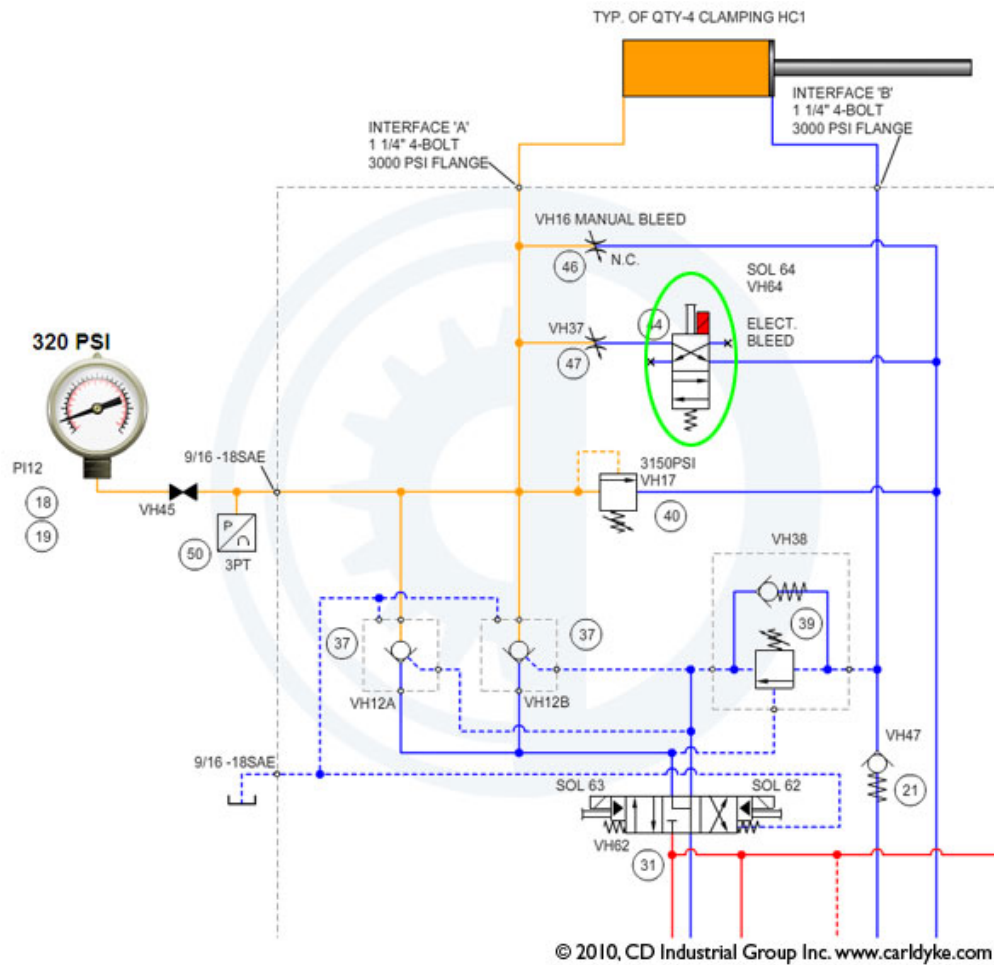


The decompression poppet opens...



...and the jack cylinders can retract the ram safely after decompression is complete.

Going back to our horizontal press schematic we see that the main ram is extended and retracted by a standard solenoid controlled, pilot operated valve. The decompression function is handled by a separate solenoid operated valve with a flow control acting as a bleed down control orifice. Can you imagine what negative effects will occur if that bleed down orifice is maladjusted to an opening that is too large? The circuit also requires that the press sequence controller (a PLC of some sort) continue to read pressures correctly from the pressure transducer, and to operate valve solenoids in the correct order.



In our slow horizontal press application, decompression is occurring via the valve circled in green.

Fluid Science Feature



Bulk Modulus

The bulk modulus (K) of a substance measures the substance's resistance to uniform compression. *(source: Wikipedia, Bulk Modulus)*

Of course in a hydraulic press we're actually dealing with inverse bulk modulus and the fact that the fluid can be compressed as opposed to stretched.