



### Hydraulic Cylinders Best Practices

A fatal accident involving a base lift jack on a longwall occurred when the cylinder was over-pressurized by an external force applied to the foot end of its piston rod.

See: [MSHA Fatalgram](#) & [Joy Service Bulletin](#).

The proper design, maintenance, and rebuild of hydraulic components and circuits is essential to the safe operation of hydraulic systems. This fatality involved a base lift jack on a longwall shield, however, the information in this Best Practices is meant to apply to hydraulic cylinders in a wide range of mining applications. Key in preventing the reoccurrence of similar accidents is the recognition of the forces that can act on the cylinders and the ways that these forces can be controlled.

First, the cylinder must be designed to withstand the operational forces over its life expectancy and the end user must understand the operating limits (working pressure) and life expectancy (number of cycles) of the cylinder. The following documents provide guidance for the design, manufacture, and examination/testing of hydraulic cylinders:

- American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC), Section VIII-Rules for Construction of Pressure Vessels, Divisions 1, 2, and 3.
- ASME BPVC Section IX-Welding and Brazing Qualifications
- ASME BPVC Section V-Nondestructive Examination
- SAE International, SAE J1334, Hydraulic Cylinder Integrity Test
- International Organization for Standardization (ISO), ISO 10771, Hydraulic fluid power
- National Fluid Power Association, T2.6.1, Fluid power components

Second, install a properly sized safety relief or yield valve as close as possible to the cylinder to prevent over-pressurization of the cylinder. Shutoff valves must not be installed between the cylinder and the relief or yield valve.

Third, when fully retracted/extended a means such as an external stop or cushioning should prevent the piston from impacting on either the cylinder's end cap or gland end where the end is not restrained.

Finally, rebuild of the cylinder must ensure the cylinder meets original design specifications. Rebuilders and maintenance personnel must consider the design and operating parameters of the cylinder when performing repair work. Nondestructive examination of cylinders and proof testing to 150% of the cylinder's design working pressure will help ensure that rebuilt cylinders are fit for further service. The mine operator is responsible for ensuring the safety of rebuilt cylinders.

Please contact Jim Angel at [angel.james@dol.gov](mailto:angel.james@dol.gov) or 304-547-2064 with any questions.