Mechanical press safety standards and good practices require that in case of a failure within the valve that controls a pneumatic clutch and brake, air must be exhausted quickly to ensure fast stopping time, a monitor must take action to prevent further operation of the press and a method to alert personnel should be incorporated. Double valves, or dual valves, meet these requirements and have become the press industry’s safety standard for clutch and brake control.

Double valves incorporate two valve elements independently controlled by two solenoid pilots within one valve body. The two valve elements share common inlet, outlet and exhaust ports. When the pilots are simultaneously energized, the elements operate so that the valve functions as a 3/2 normally closed valve.

Double valves such as the ROSS DM® Series D have built-in self monitoring and can send a signal back to the press controls in case of a valve failure. Each independent valve element monitors and cross-checks the operation of the other on each cycle, so that if one side fails to operate properly the valve immediately exhausts the downstream volume. The built-in monitor places the internal elements into a “locked-out” condition, which prevents further operation of the valve or the press. A momentary reset signal is required to clear the valve fault and continue operation. An optional status indicator switch can provide “go” or “faulted” signals.

Incorporating double valves into all mechanical press clutch/brake circuits will eliminate the inherent problems with single element valves and external monitoring systems. Control Reliability is defined as “the capability of a device or system to stop or prevent initiation of hazardous motion in the event of a single component failure within the device or system”. Control Reliable devices can be applied anywhere there could be exposure to catastrophic injury. Standardizing on double valves such as the ROSS DM® Series D will simplify circuits and add a significant measure of safety.
Overview of DM® Series D Double Valve Function

Valve de-actuated:
The flow of inlet air pressure into the crossover passages is restricted by the size of the passage between the stem and the valve body opening. Flow is sufficient to quickly pressurize pilot supply/timing chambers A and B. The inlet poppets prevent air flow from crossover passages into the outlet chamber. Air pressure acting on the inlet poppets and return pistons securely hold the valve elements in the closed position. (Air passages shown out of position and reset adapter omitted for clarity.)

Valve actuated:
Energizing the pilot valves simultaneously applies pressure to both pistons, forcing the internal parts to move to their actuated (open) position, where inlet air flow to crossover passages is fully open, inlet poppets are fully open and exhaust poppets are fully closed. The outlet is then quickly pressurized, and pressure in the inlet, crossovers, outlet, and timing chambers are quickly equalized. De-energizing the pilots quickly causes the valve elements to return to the ready-to-run position.

Valve locked-out:
Whenever the valve elements operate in a sufficiently asynchronous manner, either on actuation or de-actuation, the valve will move to a locked-out position. In the locked-out position, one crossover and its related timing chamber will be exhausted, and the other crossover and its related timing chamber will be fully pressurized. The valve element (side B) that is partially actuated has pilot air available to fully actuate it, but no air pressure on the return piston to fully de-actuate the valve element. Air pressure in the crossover acts on the differential of side B stem diameters creating a latching force. Side A is in a fully closed position, and has no pilot air available to actuate, but has full pressure on the inlet poppet and return piston to hold the element in the fully closed position.

Inlet air flow on side A into its crossover is restricted, and flows through the open inlet poppet on side B, through the outlet into the exhaust port, and from the exhaust port to atmosphere. Residual pressure in the outlet is less than 1% of inlet pressure. The return springs are limited in travel, and can only return the valve elements to the intermediate (locked-out) position. Sufficient air pressure acting on the return pistons is needed to return the valve elements to a fully closed position.

Resetting the valve:
The valve will remain in the locked-out position, even if the inlet air supply is removed and re-applied. A remote reset signal (air or electric), or a manual push button actuation must be applied to reset the valve. Reset is accomplished by momentarily pressurizing the reset port. Actuation of the reset piston physically pushes the main valve elements to their closed position. Inlet air fully pressurizes the crossovers and holds the inlet poppets on seat. Actuation of the reset piston opens the reset poppet, thereby, immediately exhausting pilot supply air, thus, preventing valve operation during reset. (Reset adapter added to illustration.)

De-actuation of reset pistons causes the reset poppets to close and pilot supply to fully pressurize. Reset air pressure can be applied by a remote 3/2 normally closed valve, or from an optional 3/2 normally closed solenoid, or a manual push button mounted on the reset adapter.

Status indicator:
The status indicator pressure switch will actuate when the main valve is operating normally, and will de-actuate when the main valve is in the locked-out position or inlet pressure is removed. This device is not part of the valve lockout function, but, rather, only reports the status of the main valve.

Size 12 and 30 valves require relatively large pilots to actuate and de-actuate the main valve elements. In order to achieve extremely quick valve response for such large pilots, a 2-stage solenoid pilot system is incorporated into the design. This keeps the electrical current required to operate the pilots, to a minimum.