

## Counterbalance for Mechanical Stamping Presses

A pneumatic counterbalance system compensates for the weight of the slide and upper die on a press. The system also reduces gear and drive component damage that occurs from high force loadings when the slide reverses direction. The standard OEM system includes two or more air cylinders attached between the slide and main frame, a pressure control regulator, a check valve, a surge tank and a manual bleed-off valve. Surge tanks store the air displaced from the cylinders, since it would be cost prohibitive to refill the system with every stroke of the press. The regulator is used to set the correct pressure for the combined weight of the slide plus the die. The OEM provides a chart for the proper pressure setting of any given die weight. A check valve keeps pressure within the system, while a bleed-off valve allows for manual removal of system pressure for maintenance or repair.

During the downward stroke of the press, gravity acts upon the slide and die, pulling them away from the press drive and opening up many small tolerances. When the upper and lower dies meet, the upper die decelerates until these openings close and the drive begins to “push” through the work. After this initial “shock-loading”, the die forms the part and is then immediately reversed to “pull” the die back up, which opens up all of the tolerances once again. This shock-loading occurs twice on every stroke of the press, causing additional wear and damage to drive components and dies.

An “underbalanced” counterbalance system allows for tremendous shock loads to occur and increases operating costs because of the heavier load that must be picked up by the motor. An “overbalanced” counterbalance system consumes a great deal of flywheel energy, reducing tonnage available at the part as well as the possibility of the press becoming “stuck on bottom” ... where there is not enough flywheel energy available to overcome the die separation, loading and reversal forces of the press.

The ROSS automatic counterbalance system integrates modern air valve technology with electrical controls to monitor and maintain appropriate counterbalance pressures.

**Is there anything wrong with the equipment that came on the press?** No, but it is a system with minimal performance characteristics. It is desirable to correct pressures as quickly as possible and to maintain them. The standard OEM system does not do this.

The recovery time to increase pressure is long with the regulator and it has no way of decreasing pressure. Because the regulator set pressure is the same as the counterbalance setting, flow through the regulator is very slow and even minor pressure changes take much time.

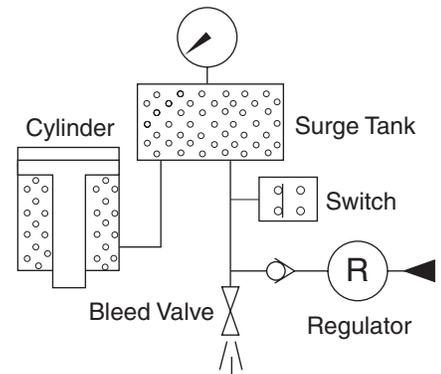
The ROSS automatic counterbalance system allows for the maximum amount of “fill” air per cycle because valves are adjusting pressures. A unique check valve design feature eliminates the need to de-energize the fill valve during a press cycle and eliminates “back flushing” of air into the plant air system.

**So what is the correct counterbalance pressure?** A slightly overbalanced pressure maintains mechanical tolerances of the press drive components in a closed state. This improves ram parallelism, minimizes wear, reduces strain on the press, reduces operating costs, enhances safety and most importantly ... improves parts quality. Integrating the valve requires simultaneous dualchannel outputs from the GuardLogix® safety controller to power the two main solenoids that shift the valve and provide downstream pressure for normal machine operation.

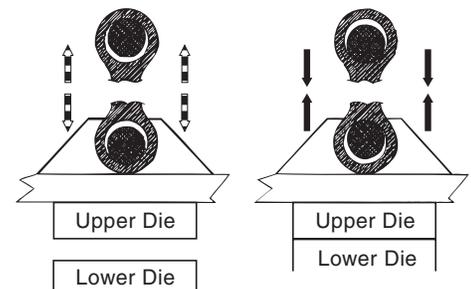
When a safety event occurs, the GuardLogix® safety controller removes power from the main solenoid coils.

This removes pneumatic energy that’s creating motion during operation. The safety events can be pre planned, such as putting the machine in a safe condition to clear a jam, or unplanned, such as when a person trips a light curtain or scanner that’s controlling access to the potentially hazardous area.

The valve also provides feedback to the control system about the valve’s condition via a pressure switch. The switch isn’t part of the safety system inherent in the valve; it’s used for diagnostics. An abnormal valve operation, or fault, occurs when the two internal elements don’t synchronously shift within 100ms of each other. This helps monitor for a sticky or sluggish valve, meeting “diminished performance” requirements of the ANSI/PMMA B15.1 standard.

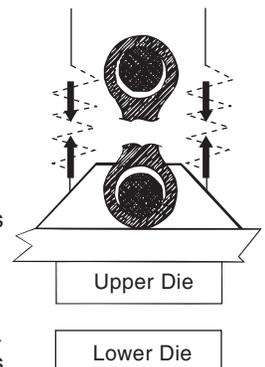
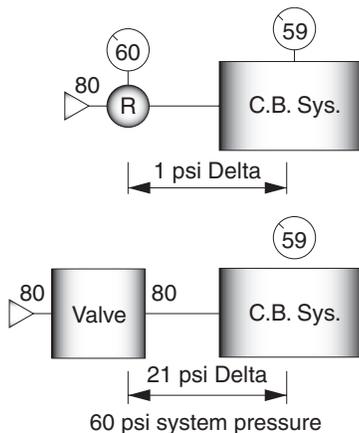


Standard Counterbalance System



Shock at die strike without counterbalances

*Regulator effect*  
Fill rate depends on pressure difference



Proper Counterbalance (pre-compression effect)

Should the valve operate abnormally, the status indicator switch provides a signal that the valve isn't ready to run. The valve then can be reset through a dedicated reset solenoid. This dedicated reset requires that a system fault is acknowledged and cleared. Like an electrical safety module, when the valve faults, internal monitoring causes the valve to go into its safety mode, which exhausts downstream pneumatic energy and inhibits further operation.

The status indicator drives a message on the operator control station, alerting the operator of a problem within the pneumatic safety circuit. The message also provides the operator with the next steps needed to clear the fault.

## Press Counterbalance Cycles

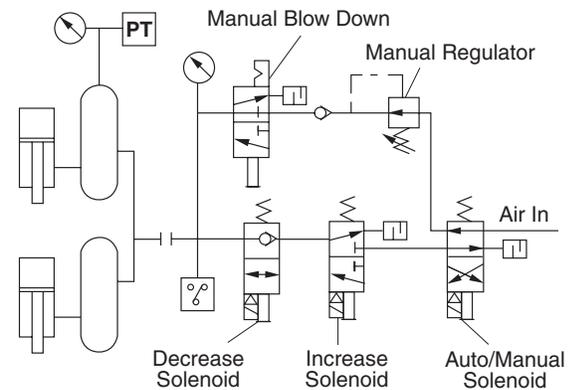
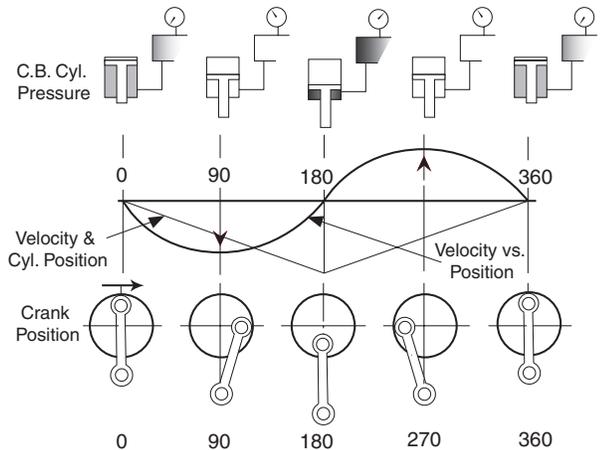
During a press cycle the counterbalance system increases in pressure during the downstroke when the cylinder pistons are driven down by the slide. Press manufacturers have allowed for this in their calculations and have provided a chart of proper counterbalance pressure, per die weights, on the press. Heavier die sets require more counterbalance pressure to run efficiently and reduce motor loads.

All counterbalance pressures are referenced and set at TDC (top dead center).

## ROSS Automatic Counterbalance Systems

The ROSS automatic counterbalance system contains both an automatic as well as manual pressure circuit running in parallel. A manual/automatic select valve determines which circuit is used, with the default condition (de-energized) being the manual mode.

For automatic operation, the auto select valve is energized which allows the fill and dump valves to be operated by the press controls, keeping counterbalance pressures optimal. During each cycle the press controls check the pressure transducer reading at TDC on the accumulator, compare it to the pre-set optimal pressure setting, and make appropriate pressure adjustments. Adjustment and fault windows can be set up around the desired set pressure to within +/- 1 psi (0.068 bar).



## Press Counterbalance Systems

### *Why not dump the C.B. air to atmosphere on each stroke and eliminate the surge tanks?*

A 1,000 ton double acting press contains an average of 180 cu. ft. of air. The horsepower (H.P.) to produce air is 5 scfm per H.P. To refill the system of the 1,000 ton press in one minute would take **45 H.P.** At 40 strokes per minute (spm), there is 1/80 minute to fill the system, so the required H.P. is: **2,880 H.P.!!**

## Cost justification for Automatic Counterbalance Systems

- *Conserved electric costs (to run the flywheel)*
- *Conserved air costs (to run the compressor)*
- *Cost of die repair*
- *Reduced scrap savings*
- *Savings of die repairs*
- *Cost reductions of labor due to higher part yield*
- *Profit from added production*
- *Total savings= JUSTIFIED*

### Additional resources

For extended information related to press metalforming, press safety products, please contact your local ROSS distributor.

Also, please visit the press metalforming page at [www.rosscontrols.com](http://www.rosscontrols.com).