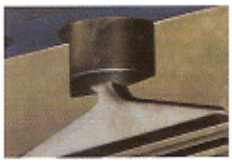

Correctly Applying Vacuum Technology

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The business of producing die cast parts has become increasingly competitive, and there is now much less of a tolerance for downtime or high scrap rates. All too often, the source of production headaches comes from porosity present within the part.

To address this, it should be first recognized that in die casting, everything needs evacuation.

Today, with advances that have occurred, a strong case can be made for using vacuum technology over a conventional vent system. And, with vacuum approaches, two basic styles exist: valve and valve-less. Therefore it is necessary to further evaluate the benefits derived from not only a vacuum approach, but from the use of valve-less vacuum technology as well.

Upon evaluating these advances, more and more die casters are moving from traditional venting to the correct application of vacuum technology. Why? Because vacuum is an assistive approach that ultimately helps to create better quality parts.

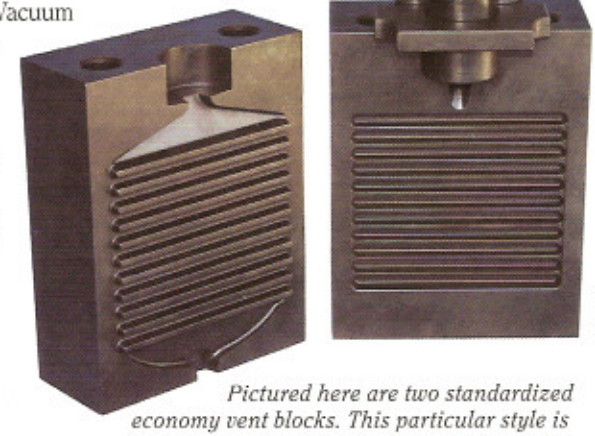
Benefits of Vacuum Technology

Die casters will often say the choice between conventional venting and vacuum is based on part requirement and customer preference. However, it's fair to consider making a cost comparison before deciding. The customer might be pleasantly surprised. Consider the following benefits.

Conventional venting is less effective than vacuum because there's not enough total vent area for the cavity to evacuate efficiently. In venting, the press alone does all of the work, whereas a vacuum system assists the press in evacuating the cavity. It's more efficient and there's less wear and tear on the machine and tool, saving maintenance time and costs, not to mention part fallout.

Vacuum systems reduce the amount of gas porosity in the casting. This is a major benefit because although all porosity cannot be eliminated, most of it can be with vacuum assistance. There are three different types of porosity created during the die casting process. One is simply air in the metal feed system and die cavity. The second type is a gas that is created when the hot metal that is being injected hits the lubricant that is being used; and the third is shrinkage. Vacuum technology helps reduce the first two types of porosity, but in the latter, process control is a more critical factor in minimizing the problem, and vacuum technology has little influence.

"Vacuum vents have helped us reduce poor fill and porosity scrap rate and produce a better quality part," reports Rod Dunn, Inverness Casting Group, Dowagiac, MI. As for technical assistance with selecting the proper technology? "It's been appreciated!"



Pictured here are two standardized economy vent blocks. This particular style is made of pre-hardened H13 tool steel and salt bath nitrided. They are ideal for short runs or prototyping.

Other benefits of vacuum technology include improved surface finish and improved mechanical properties of the metal being cast. Vacuum technology reduces out gassing, thereby improving painting and plating quality as it reduces the out gassing. Additionally, the higher the density of the casting, the better the weldability and leakage factors will be.

It may be useful to note that with powder coating, painting or plating, the use of vacuum blocks means there will be less scrap because the porosity can be buried inside the part. Location of porosity is critical. If air is near the surface when the parts heat up, the air will expand and could cause holes or blisters on the surface during powder coating or plating. Vacuum assist will help prevent this problem, along with problems that can arrive downstream during machining.

"We had a four-cavity aluminum disk mold, where the part was simple and the initial inspection was positive," describes Denny Schlager, Twin City Die Castings, Minneapolis, MN. "But during the machining process, grooves were cut across the face of the casting and we were experiencing a high rate of porosity at the deepest machined sections. This caused an 80% rejection rate!"

Twin City had to do something: "We installed two valve-less vacuum blocks. One block serviced two cavities and with the help of technicians from the blocks supplier, a proper runner was engineered. They also advised Twin City in the set-up and operation of the system. This improved our acceptance rate to over 95%."

In today's competitive marketplace, where die casting is taking on more and more complexity, it's hard to justify the rationale of not considering the use of vacuum technology to increase up-time and lower costs.

Valve vs. Valve-less

There are two types of vacuum block systems available today: valve and valve-less. Following are some notable comparisons.

- Valve style blocks require moving parts; valve-less blocks have no moving parts.

A valve type system uses a valve of some design to shut off the metal flow during the shot cycle and prevent the metal from plugging the vacuum system. There are moving parts in the valve type system that will wear and require routine maintenance prior to, during or after the system's use. When maintenance will be required is not fully predictable, and component parts must be inventoried to ensure the continued operation of the system. One has only to talk to a current user of valve type blocks to find out they are fairly high maintenance.

Valve-less vacuum blocks offer improved casting integrity, reduced porosity, reduced scrap and they improve surface finish. Pictured here are standardized units.

The valve-less vacuum system uses no moving parts in the metal flow path. The valve-less method instead utilizes resistance to metal flow and the solidification of the metal to shut off the vacuum and metal flow. In addition, the blocks are heat-treated using H13 material and cooling lines can be incorporated in the block to aid in the solidification of the metal.

- Valve styles use both the metal flow via a secondary valve or electrical switches plus a cylinder to shut off the vacuum with the valve; whereas valve-less styles pull vacuum during the complete shot cycle until the metal solidifies.

Commonly, valve style systems use the metal flow to shut a secondary valve and close off the vacuum flow. This system has many moving parts and can become costly to purchase and maintain. Experience has shown a great deal of down time associated with these systems, which further adds to the overall cost of the vacuum. The stories about the high cost of utilizing a vacuum system have prevented many die casters from adopting vacuum assistance as a way to improve casting quality. The simplicity of the valve-less vacuum technology is changing that mindset.

- Those moving components in a valve style block must be maintained and replaced on a routine basis; valve-less style blocks require no maintenance.

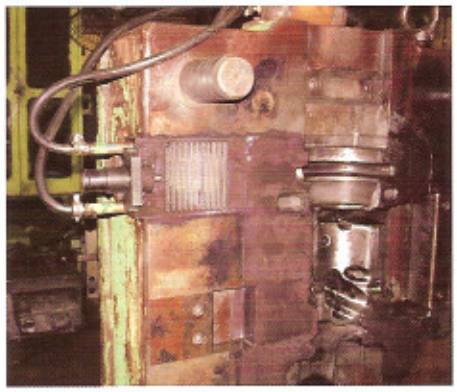
Whether limit switches, timers and/or plc is used to control the vacuum valve open-close, they are expensive to install, maintain and are subject to failure. The more complicated the system, the more likely the system will not perform in a die casting environment. This fact can be confirmed when considering the filters used on most systems. Filters are required to prevent the flow of gases, residue and metal from damaging the vacuum pump, secondary valves and gauges. Due to the nature of the vacuum assist, a build-up of particles will occur. Of course you want this to happen – better in the filter than in one of the components. However, if routine maintenance is not performed regularly, in many cases the filters plug up and the effectiveness of the vacuum system will be reduced. A filter is available that is free flowing and does not require the amount of maintenance required in the conventional type.

The valve-less vacuum blocks are designated by size, which relates to the area available to pull the necessary evacuation. The user must determine the vacuum area size required prior to ordering the specific model of block. The calculations for determining the block size are provided by the supplier or there are computer software products available that can provide this data. Generally, the formula for determining the necessary area computes the total volume of the metal feed system including part and fill time. There are safety factors built into the formula to assure the area is adequate to accomplish the evacuation of the cavity.

Valve-less vacuum blocks can be used in aluminum, zinc and magnesium die casting, and many have lasted more than 100,000 shots without repair. Complete systems including tank, pump, controls, filter and gauges are available as is design assistance.

Standardization Saves Money

To stay competitive in a global market, it makes sense now more than ever to have standardized valve-less technology available off the shelf to help keep costs down and maintain consistency in performance.



Valve-less vacuum blocks are pictured here installed in a die cast die. These standardized blocks work for aluminum, magnesium and zinc casting projects.

Vent and vacuum technology has been around since the 1950s. Even valve-less vacuum systems are not new to die casting, but the systems had to be custom manufactured for each project. Only in 1995 did valve-less vacuum and vent blocks begin to become truly standardized. Now complete systems are available off the shelf and the benefits are clear. In most cases, these standardized systems are 4 to 5 times less expensive than custom varieties; and add to that a significant savings in valuable production time.

With customer quality expectations running high, and costing pressures like never before, die casters can benefit from evaluating these technological advances. Vacuum technology, properly applied, dramatically increases productivity and decreases scrap. Advances in die cast components such as valve-less vacuum blocks would reduce porosity and slash scrap rates, even if applied as a custom solution, on a case-by-case basis.

However, standard component supplier Progressive Components (Wauconda, IL) works with developers such as Rick Dubay and Larry Winkler, co-authors of this article, as well as with an in-house engineering team to make innovations standard and widely available.

"Die casters have long been looked over for standardized solutions, as opposed to their 'siblings' in the injection mold industry," states Progressive's president Glenn Starkey. "That strikes us as strange, since the harsher conditions of the die casting process seem to dictate even more of a need for proven, pre-engineered components in new tooling, along with replacement products available downstream off-the-shelf."

Progressive Components was the first company to publish a catalog offering a full line of standardized components exclusively for the die cast industry in 2002.

Starkey adds, "We're getting pushed more and more by tooling engineers and buyers to stock these items globally."