

11471 Deerfield Rd., Cincinnati, OH 45242 Phone: 513-235-5131 Fax: 513-469-7212 E-Mail: rbowen@moldersworld.com www.MoldersWorld.com



Porcerax II



Custom & Standard Inserts



Porcerax II Stock Sizes, 7 & 20 Micron

Porcerax II Rectangles

1-1/8 square x 8" 1-5/8 square x 8" 2-1/8 square x 8" 3-1/8 square x 8" 1-1/8 x 1-5/8 x 8" 1-5/8 x 2-1/8 x 8" 2-1/8 x 3-1/8 x 8" 3-1/8 x 4-1/8 x 8" 1-1/8 x 2-1/8 x 8" 1-5/8 x 3-1/8 x 8" 2-1/8 x 4-1/8 x 8" 3-1/8 x 5-1/8 x 8" 1-1/8 x 3-1/8 x 8 1-5/8 x 4-1/8 x 8" 2-1/8 x 5-1/8 x 8" 3-1/8 x 6-1/8 x 8" 1-1/8 x 4-1/8 x 8" 1-5/8 x 5-1/8 x 8" 2-1/8 x 6-1/8 x 8" 1-1/8 x 5-1/8 x 8" 1-5/8 x 6-1/8 x 8" 1-1/8 x 6-1/8 x 8"

Porcerax II Rounds; OD is .020-.040" over

1/4" rd. x 4"	1-1/2" rd. x 8"
3/8" rd. x 7"	2" rd. x 4" & 8"
1/2" rd. x 8"	3" rd. x 4" & 8"
3/4" rd. x 8"	6-3/8" rd. x 2-1/4" speaker grill blanks
1" rd. x 8"	7-3/8" rd. x 2-1/4" speaker grill blanks
Other Diameters Availa	able Upon Request.

Porcerax II Vent Pins & Venting Ejector Pins Headed Style Blanks; Customer or Molder's World can machine to finished Pin.



.250" shaft OD +/- .001 x 2-1/4" .375" shaft OD +/- .001 x 3-1/2" & 7" .500" shaft OD +/- .001 x 3-1/2" & 7"

Precision Ground Press Fit Vent Pins

(.0002 - .0004 over on OD, +/- .001 on length)



.375" OD x 3/8", 1/2", & 1" long .250" OD x 1/4, 3/8" & 1/2" long .1875" OD x 1/4" **Custom sizes available upon request.**

Venting Ejector Pins, Standard & With Removable Head



3/8" & 1/2" shaft OD x custom made lengths



10 & 12 mm x 9" long cut to length Porcerax pin & snap on head

Manufactured Inserts Made to your Data





Professional Cleaning for Porcerax II inserts



We are the experienced Porcerax II mold insert Manufacturer! We machine & clean Porcerax II inserts for molders & mold builders every day!

Nano Coating for Mold Release

Nanotechnology and Plastics

With current demands to maintain a competitive advantage, moldmakers and molders alike are challenged with highly complicated design requirements, expedited manufacturing expectations, coupled with high raw material prices for molds and resins.

Many parts require tight tolerances with little draft and high level cosmetic finishes. Some require designs that are not ideal for part cooling or part removal. Others require the use of various resin compounds that by their very nature may be prone to sticking and filling issues, as well as part surface imperfections.



Figure 1: The coating is created by forming a nanoscale barrier from nano-formulated molecules.

A mold coating created using nanotechnology can address these issues, thereby solving significant problems for today's moldmakers and processors—a semi-permanent coating, designed to reduce cycle times, rejects and maintenance, while improving part quality in injection molding, blow molding and rubber molding applications. The coating is created by forming a nanoscale barrier from nano-formulated molecules (see Figure 1).

The coating can facilitate a part release for up to and in many cases exceeding 300,000 cycles per coat—depending on the molded material, fillers, mold design, material flow rates and pressures.

How It Works

After the coating has been applied, the nanomesh has become a uniform and cross-linked microstructure on the substrate surface. The upper region of the microstructure, by virtue of its hybrid material base, is chemically inert and exudes hydrophobic properties. It repels materials that come in contact with it.

The miniscule size of this nanomesh denies access to molecular structures that are too large to pass. Only entities at nano particle size can pass through the nanomesh; therefore, molded material cannot adhere directly to the substrate, yet the substrate is vapor permeable.



PC/ABS parts with complex detail.

Usage, Applications and Benefits

It is currently in use primarily by molders in every market around the world. It is widely used in extended production runs and new tool launches. For example, non abrasive materials like polyolefins and elastomers that might be used for molding caps or closures typically experience a number of cycles in the 300,000 plus range. Highly abrasive materials can experience a wide range from low thousands for example in complex pump housing to hundreds of thousands in connector molding, depending on the application. Even in the event of the lower number of cycles, the ROI becomes evident because these applications in many cases are highly labor intensive, require significant amounts of mold release, and can have very expensive scrap rates.

A nano-formulated mold coating can be used for virtually any molded material—including heavy glass- and mineralfilled resins, rubber and silicones, and can be applied to any steel or aluminum substrates, as well as other materials such as beryllium, copper, etc. It has been successfully used on tool steels. For example, H13, P20, S-7, which are very popular molds for the majority of general-purpose moldmaking, as well as 420 stainless steel molds with diamond finish for molding of caps and closures. In addition, it has been applied over beryllium copper inserts with successful results.

At between 100 nm (0.0001mm) to 200nm (0.0002mm) in thickness, a nano-formulated coating has no effect on dimensional integrity and exudes hydrophobic (water repelling) anti-stick, anti-static and anti-corrosion properties with an extremely low-friction coefficient, which ranges from .050 to .130 per ASTM 1894.



ABS parts with 160 pin holes.

The reduction in surface tension assists in filling and decreasing scrap due to the elimination of material dragging upon fill. In many applications, lower molding pressures and temperatures also can be achieved.

Faster cycle applications coupled with lowered fill and pack pressures can equate to lower part weights and substantial material savings. Some molded parts such as caps and closures may realize a combination of benefits including a reduction in fill time, reduction in molding pressure, overall cycle time reduction and reduced scrap due to the elimination of ejector pin push through.

The coating can withstand temperatures of up to 1200°F. Due to its nanomesh structure the coating stretches along with the expansion and contraction of the mold, rather than chipping or flaking.

This type of coating is non-toxic and does not migrate to the part surface, so it has no effect on post molding operations—such as painting, plating or decorating. It can be used in cleanroom applications and in paint booth environments where aerosol and silicone mold release products are prohibited.

It offers the flexibility of in-house application contrary to other coatings that require the molder to send the tool or components out to be coated by third-party coating companies. The coating is easily applied by wiping or brushing and allowing it to cure. Cure times can be from eight to 16 hours depending on the formulation. Depending on the application, a nano-formulated mold coating can completely eliminate the use of traditional mold release products.

By using a nano-formulated mold coating a machine can often be run in fully automatic mode, greatly reducing cycle times, and eliminating the aerosol mold release for each shot. It is designed to be resistant to most common cleaners and degreasers so molds can be cleaned without removing the coating.

Nanotechnology Benefits to the Moldmaker and Molder

Moldmakers and molders should consider nano-formulated mold coatings to address many of the challenges they face. By facilitating the release of parts and reducing drag upon material fill, these coatings can overcome many obstacles inherent to complicated designs and sticky materials. The ability to apply the coatings in house is largely beneficial in terms of time and material savings, and in both existing molds and the commissioning of new molds.



Porcerax II is a sintered, porous metal with porosity in the range of 20 to 30% by volume. A system of interconnected pores with an average diameter of 7 (.0003"), or 20 (.0008") micron is dispersed throughout the Porcerax II material. Using Porcerax II in appropriate areas, eliminates gas buildup, reduces injection pressure, lowers cycle times, gloss levels and substantially reduces scrap and reject rates.

UNIQUE CHARACTERISTICS

- Sintered, porous mold steel that is 25% air by volume.
- Interconnected pore structure allows trapped gasses to escape directly through the steel.
- Pre-hardened to 35-38 HRc for wear resistance

BENEFITS

The benefits molders derive from using Porcerax II are primarily, but not limited to, the elimination of trapped gas problems that occur in inadequately vented areas within the mold. Frequently, it is difficult, if not impossible, to provide adequate venting in these hard to mold areas. Traditional methods of venting, such as parting line vents, vent plugs, and pins often do not provide sufficient surface area to accommodate the large volumes of gases that can be generated. Porcerax II provides a location-specific method of venting gas in a targeted area. Since it is 25% air by volume, one-fourth of the surface area becomes a vent. The larger the surface area of the piece installed, the greater the venting capacity.

Prevention of Burning

Burning is a condition caused by compressed gasses trapped by the flow of molten resin in a cavity pocket. Using Porcerax II venting steel, gasses are permitted to evacuate through the steel to the outside atmosphere, thus eliminating the burning condition, as seen below.





Before Porcerax II

After Porcerax II

The enhanced venting capabilities of Porcerax II are illustrated below. The illustration is taken from a current production application:



Vent Line to Atmosphere

Typical Installation Technique

In a typical automotive console application, gasses have a tendency to settle in areas such as the cup holder recess area or the CD/cassette storage compartment. This causes short shots and/or material burning. The illustration above shows Porcerax II inserted in the problem area and properly vented to the atmosphere. The scrap rate on this part prior to installation of the Porcerax II insert was over 45%. Upon completion of the installation, the documented scrap rate dropped to 9% and was unrelated to the previous burning problem.

Prevention of Knit Lines

Minimizing or eliminating flow and knit lines is an additional benefit for using Porcerax II. Knit lines occur at points where resin flows converge after molding around an obstruction, or protrusion within the mold, usually away from the gate area. There are two primary reasons for this occurrence:

1) The failure of resin to sufficiently fuse due to the drop in temperature after flowing over long distances.

2) The presence of residual air at the resin flow convergence point at the cavity obstruction, prohibiting the proper fusion of the flows.

The permeability of Porcerax II prevents defects arising from residual gases normally trapped inside the mold cavity. Also, using Porcerax II reduces back pressure and improves the flow rate, allowing the resin flows to merge while still hot.

Reduction in Cycle Time

Because of the reduction in backpressure within the mold, the plastic fills the cavity faster, thus allowing for reductions in temperatures which shortens cooling and cycle times.

Eliminates Shrink

Trapped air bubbles between the resin and mold steel surface can cause shrinkage or sink that shows as a ripple in the otherwise straight plastic surface. Using Porcerax II on the trapped air side of the cavity will eliminate shrink in most cases.



Eliminates Short Shots

Short shot is another condition caused by too low of an injection pressure, or trapped gasses, in pocket areas of the cavity. This results in the part not being completely filled out. Porcerax II reduces back pressure, therefore, less injection pressure is needed, and because it vents trapped gasses, both causes of short shots are eliminated.



Illustration of Trapped Gasses in the Mold

Illustration of Trapped Gasses in the Mold

Enhances Part Appearance

Webbed, ribbed, and other difficult to fill thin-walled designs are greatly enhanced and cosmetically defined using Porcerax II in the mold. Molding these high-detailed, thin-walled, and aesthetic parts, like this automotive speaker grill, is easily accomplished with the reduced back pressure and added venting of Porcerax II.



Gloss Reduction

When using Porcerax II as a cavity in an injection mold, the air typically trapped between the cavity and the resin (causing a gloss to show on the part) is allowed to escape through the pores, thus leaving a dull matte finish. This often eliminates the need for costly secondary spray painting operations.



Conventional Molding

Porcerax II

Tool Simplification and Cost Reduction

When back pressures, injection pressures and cycle times are lowered, fewer drops are needed to assure proper filling of the cavity. Lowering the number of drops needed to fill a cavity simplifies design while saving tool costs. In some cases the entire hot runner manifold is eliminated.

Aiding in Part Ejection

In many situations, an air poppet is needed to help eject the molded part from the cavity. Inserting Porcerax II in the cavity with an air blow setup helps break the vacuum seal and aids the ejector pins in doing their job.

GENERAL PROPERTIES

Average pore size: 7 or 20 microns Porosity: 25% air by volume Linear Expansion: (@20 - 150°C) 6.67 - 6.94 in./in F

Heat transfer co-efficient (at room temperature): 16.93 - 19.35 BTU/ft. hr. F Tensile strength: 64,000 - 71,000 lbs./in.2 Hardness: HMV 350 - 400 HSS Machinability: Good

Machining and Polishing

Porcerax II can be machined by conventional methods using cutoff saws, end mills, grinders, EDM methods, stoning, etc. It is important to remember that this material is honeycombed with thousands of microscopic holes which are affected by metal removal. Oil coolant is recommended.

Grinding and milling closes the pores of this porous steel.

Stoning and polishing, up to about a number 800 stone/paper finish, is possible after EDM. During the stoning and polishing process, it is important to occasionally flush the pores at the

surface to prevent packing the pores with debris.

Electric Discharge Machining is the best way to re-establish permeability. This method will burn away the metal fragments that are crushed over the pores by milling and/or grinding. Because of its powdered metal origin, when using a wire EDM machine. It is important to increase the wire speed about 10 % to prevent arcing from the particles produced. Because a wire EDM machine uses water, the insert must be dried in an oven after EDM, or rust and pore closer will ensue.

POST- MACHINING TREATMENTS

Heat Treatment

Heat treating of Porcerax II should be done in a vacuum furnace. As supplied, Porcerax II has a hardness of 35 HRc. It can be heat treated to 50-52 HRc; however, Porcerax II carries a fairly high potential for movement. Strict guidelines are supplied by Molder's World, Inc. and should be followed.

Hardness

Porcerax II is 20-30% porosity by volume and will give false or misleading readings if tested with either a Rockwell or Brinell hardness tester. As the load of either of these testers is applied, the pores beneath the surface will collapse and render a false reading. It is recommended that a micro Vickers hardness tester (50 or 30g load) be used to test the hardness of Porcerax II.

Texturing

Porcerax II can be textured. In order to prevent the possibility of destroying the internal vent structure of the material, certain procedures must be strictly adhered to. It is imperative that the chosen texture source know they are working with Porcerax II. If they don't, the likelihood for permanent, irreparable damage to the piece is virtually assured. The pores of the material must be thoroughly cleaned and properly sealed prior to texturing. Failure to do so results in the etchants used in the texturing process leaching into the pore structure and rusting the venting closed. This rust is permanent and cannot be removed once it has occurred. The piece will be useless and must be replaced.

Thousands of molds worldwide have been successfully textured. However, it is imperative that the molder and/or mold maker's texture source come supplied with the information needed to properly process the piece. We strongly advise against inserting Porcerax II into an already textured surface. The perfect venting of Porcerax II results in much higher resolution of the grain at the inserted area and a dramatic reduction in gloss. It is recommended that the entire textured surface be Porcerax II. Please consult your graining source for more information.

Surface Reproduction

Porcerax II provides perfect venting of all gases from the mold. While this is desirable in most cases, the venting of the Porcerax produces a perfect "marriage" between the resin and the molding surface, thus producing a dull, matte finish. If Porcerax II is used as an insert on the cavity side, the result will be two dissimilar appearances due to differences in gloss and texture definition. This may be acceptable if the parts are painted after molding.

Water Lines

<u>Molder's World, Inc. does not recommend running water through Porcerax II, if at all</u> <u>possible</u>. However, occasionally the need will arise, due to size or application considerations, to water-cool Porcerax II. There are a number of ways to accomplish this. In designs that involve a straight-through water line pattern, a simple, effective way to seal the line and prevent leakage is electrolysis-nickel plate the water lines. In complex circuit-type patterns, it is advisable to use an acceptable sealant such as Dichtol. Electrolysis nickel has a tendency to pull away from sharp corners such as those at intersections of crossing water lines. However minutely this pulling away from corners may be, it will eventually cause some leakage into the material and reduce permeability through oxidation. Improper use of the Dichtol sealant will produce the same results. Regardless of which sealing process is used, be absolutely certain the material has been thoroughly cleaned of any residual machining fluids or other contaminants.

DESIGN GUIDELINES

When designing for Porcerax II venting steel, the following guidelines should be considered:

Resins Used

Depending on the emissions or gas residue given off during the molding process, the molder will have to evaluate whether to use 7 or 20-micron pore size. Resins such as ABS, polypropylene, soft type PVC, polyethylene, acrylic, polyurethane, and styrene work very well with a 7-micron (.0003") pore size. For low viscosity or talc-filled resins, it may be necessary to have an automated system reverse the airflow after each shot to purge the impurities from the pores. Rigid PVC resins will work, but only until the corrosive gasses close the pores. This can still be a feasible method if disposable inserts are used. The 20-micron pore size (.0008") will vent about 25% more gas than the 7 micron pore size.

Size of Area to be Vented

The producing mill recommends that at least 10% of the cavity area be Porcerax II to insure proper venting. While this is not always possible, it is important to remember that the more square inches used in the cavity area, the lower the back pressure will be in the cavity. Due to the larger surface area, the insert will not require cleaning quite as often as a smaller piece. If Porcerax II is used as a core or cavity half, instead of as an insert, there may not be a need for parting line vents.

Note: The thinner the Porcerax or the shorter the distance air has to <u>travel</u> to the exhaust line the better the venting will be. Keep in mind the physical properties of Porcerax II.

Surface Finish Requirements

Since most applications can be addressed using inserted pieces on the core side, an EDM finish is acceptable and will vent better than any other surface finish. Should an EDM finish be unacceptable, a stoned or polished surface will provide the next best venting surface, however the piece must be edm burned first. The 7 micron pore size provides the best polished finish (up to 600 paper). It is important to remember that if the venting steel is used on the cavity side of a mold, the gloss level will be severely reduced (from #9 to #3 with PP), so matching should be considered. If a low gloss level on a textured part is desired, it can be accomplished with the 7-micron Porcerax II.

Slide/Lifter Applications

Porcerax II can be used in slide or lifter applications. However, it is important to consider lubrication requirements on such a design. Lubricants will, in all likelihood, reduce or eliminate permeability in areas that coming into contact with Porcerax II.

CLEANING, MAINTENANCE AND RESIN REMOVAL

There are two times cleaning must to be performed to Porcerax II:

The first time is when the tool shop has prepared the insert or cavity. The material is 25% air by volume and the cutting fluids will displace the air, thus filling and clogging the pores. After the permeability has been restored by EDM machining the venting surface, the steel should be sent to Molder's World, Inc for professional cleaning.

The second time cleaning is needed is after the insert or cavity has been in operation and film, a thin layer of mold release agent, resin residue, shop oil or any other contaminate has partially or totally blocked the air flow. For cleaning send inserts to: Molder's World, Inc., 11471 Deerfield Rd., Cincinnati, OH 45242, 513-235-5131

Porcerax 2 insert Installation



Various designs for the bottom of a Porcerax insert pocket.



Typical Porcerax II Insert With Vent Hole Pattern



Ribs & other plastic molding surfaces must be EDM burned



PORCERAX II PIN INSTALLATION

Best results can be achieved by drilling a vent hole into the bottom of the pin (Figure #1). This procedure considerably shortens the "escape route" for gas.



Since highest permeability can be achieved with an EDM finish, it is desirable to EDM the bottom and sides of the drilled hole for better efficiency (Figure #2). Be sure all EDM fluids are cleaned out before installing the pin into the tool.



Conclusion

The age-old venting problems that have faced molders for years have been solved using Porcerax II venting steel. Better mold cavity venting adds many benefits, from reduction of scrap to better cycle times. Whether it is a retrofit or engineered into the tool from the start, Porcerax II adds value to all molds.

Porcerax II Success Tips

- 1. Porcerax II can be machined, but it should be machined wet with carbide cutters to prevent work hardening. Because Porcerax II is porous and will corrode, an oil-based coolant should be used if possible.
- 2. Finish machining should be done at a slower feed rate than other mold steels due to its tendency to chip or splinter as the tool exits the work piece. "Picture framing" or machining the parameter of the insert first will also help in this matter.
- 3. Welding Porcerax II is not recommended by the manufacturer of Porcerax II due to its tendency to crack. It is best to re-machine the Porcerax II insert and weld or shim in the core pocket. Silver soldering or brazing is acceptable, however it is important to realize that where the material is soldered it will lose permeability.
- 4. The machining process will smear the pores closed on the surface of Porcerax II. After machining the pores must be reopened by EDM machining or texturing.
- 5. Wire EDM re-opens the Porcerax II pores as well, but the wired surface should be "skimmed" with a finish pass to remove the recast layer. A 10% higher feed rate is also recommended to prevent the wire from breaking due to arcing particles. After wire EDM process be sure to blow the insert out with dried, filtered, compressed air & place in an oven @ 200 degrees F for 2 hrs to prevent rusting.
- Be aware of your resins flash points. Seven (7) micron Porcerax II has pores that average .0003" in diameter; twenty (20) micron has pores that average .0008" in diameter. Nylon 6 for instance will flow into the pores that are .0008" but polypropylene and ABS will not.
- 7. 7 micron Porcerax II will provide a better finish than 20 micron thus release is better & should be considered over 20 micron for side wall applications such as deep ribs.
- 8. Texturing the 7 micron Porcerax II is possible, however your texture house must be aware that they are working with Porcerax II and if not familiar with the material they should contact Molder's World immediately.
- 9. Mold releases such as silicon mold release will clog the surface pores of Porcerax II if sprayed onto the surface of the material. Therefore positive air pressure should be

blown back through the exhaust line while the tool is being sprayed. Inserts protected with mold saver must be cleaned before use.

- 10. Strategically placed high- pressure cleanout or back flush/exhaust holes drilled & EDM machined into the backside of the Porcerax II insert are necessary to allow the insert to vent. They also relieve pressure as well as provide a method for proper cleaning.
- 11. The more square inches of Porcerax II used in the cavity area the better the venting will be. The thinner the Porcerax II or the shorter the distance air has to travel to the exhaust line the better the venting will be. Keep in mind the physical limitations of Porcerax II.
- 12. An exhaust line through the core block must be adjacent to an EDM machined area on the side or back of the Porcerax II insert. The cavity side of the Porcerax II must also be EDM machined.
- 13. Porcerax II must be cleaned both before it goes into production for the first time to remove EDM cutting fluids and periodically (after 20,000 30,000 shots) during production to remove resin gas buildup.
- 14. Because of health, safety and fire risks it is recommended that Porcerax II be professionally cleaned by Molder's World, Inc. We have the proper equipment with the proper frequencies to insure safety with renewed life for your Porcerax II inserts.
- 15. Avoid running water lines through Porcerax II, since they are difficult to seal and Porcerax 2 will rust.

For more information Call: **Molder's World, Inc. / 513-235-5131** <u>www.Moldersworld.com</u>

All technical and engineering data and suggested procedures, specifications and applications contained in this publication are for general information only. Sinto Steel, Molder's World, Inc., International Mold Steel and/or their distributors disclaim any and all express or implied warranties of merchantability, suitability for any particular purpose or use, or freedom from infringement of any patent, trademark or copyright. Porcerax II® is a registered trademark of International Mold Steel, Inc. and SintoSteel.