



Tool Steel Recommendations for Injection Molds Designed For Processing Geon[®] Vinyl Compounds

INTRODUCTION

Over the past several years questions have existed regarding what type of tool steels can be used for molds designed for injection molding Geon vinyl. This brochure hopes to clarify some misunderstandings and questions on this subject. Molds will be broken down into three basic categories - prototypes, short run production and long term production. The information is based on real life experience throughout the global marketplace. No matter what material is used to build the mold certain basic guidelines pertain.

MOLD CORROSION

Most flame retardant materials can decompose and give off corrosive gases under improper processing conditions. Flame retardant rigid vinyl compounds are no exception. This decomposition occurs mainly when equipment malfunction or human error allows the processing temperature to reach temperatures in excess of 30 to 50 degrees Fahrenheit over normal processing temperatures.

Mold design can also play a role in corrosion. Undersized sprues, gates and runners, lack of venting and sharp outside corners can all cause decomposition of the vinyl compound in the mold resulting in localized corrosion.

TYPE OF VINYL MATERIAL

In the world of injection molding there are three basic types of vinyl materials-flexible, rigid and glass-filled. The information given in this article is based on non glass-filled rigid vinyls. In general flexible vinyls will be much less severe and therefore tool life will be significantly better. On the other hand glass-filled vinyls, like all glass filled materials, are highly abrasive. All tooling should be made in steel, even prototype tools.

PROPER TOOL CARE

All tools processing rigid vinyl materials need to be neutralized on a regular basis. Aluminum and non stainless steels which are not plated need to be neutralized against corrosion with an acid neutralizer¹ every eight hours when the tool is in production. For tools made from stainless steel or plated steels a light neutralization process is recommended every 24 hours. No matter what the material of construction is, a thorough neutralization and

subsequent rust preventative is required when the tool is stored at the end of the production run.

PROTOTYPE MOLDS

Generally three materials are used. They are Kirksite, aluminum and soft steel. All three are used successfully. Kirksite being the softest has the shortest life. We have molded anywhere (from 5 to 100 pieces from Kirksite molds. Normally corrosion is not a problem. The soft nature of the Kirksite often requires more careful molding procedures. Cracking of the mold and galling at the parting line are Kirksite tools major problems. Quick tooling delivery time (6 to 10 weeks) is the major advantage.

Aluminum remains an excellent material of construction for prototype molds. We have run hundreds of aluminum prototype molds with very good success. Many of the prototype tools were able to give us several hundred to a few thousand pieces and are still in good shape to mold additional parts. The aluminum prototype molds need to be neutralized at the end of molding to prevent minor corrosion and pitting.

In many non appearance parts aluminum prototype molds end up being production molds for many years. This is especially true of many custom molded valves and fittings. Annual volume in these cases are low: 1,500 to 25,000 units.

SHORT RUN PRODUCTION MOLDS

For purposes of this discussion short run production are tools whose life expectancy with normal maintenance is 150,000 to 200,000 units. For Geon vinyl compounds there are two basic alternatives. The first is a P20 steel tool with either electroless nickel plate or chrome plating. Many of the new specialty plating systems using Teflon (examples being Poly Ond Coatings² and Nicklon³) are also acceptable. The life of these tools should easily exceed the 200,000 shots with good tool maintenance.

The second choice is a P20 steel tool with no plating. While we have always recommended not to use this method in the past, real experience has proven it can be done using properly trained, experienced shop personnel. However it does require a well designed mold, properly gated and vented. In addition it requires very careful mold neutralization on a DAILY basis. A disadvantage

however is in the unlikely event of an equipment malfunction or human error where degraded vinyl compound is inadvertently shot into the mold, accelerated corrosion and pitting may occur if immediate neutralization steps are not taken.

Experience has shown the P20 tools can last in excess of 500,000 shots. However in addition to good mold maintenance it is very possible minor repair and retexturing may be necessary every 50,000 to 150,000 shots. The part design and gating system will most likely dictate the frequency.

HIGH VOLUME PRODUCTION

For high volume production (tool life expectancy greater than 500,000 shots) the tool steel of choice is stainless steel. 420SS or CSM21⁴ are very acceptable grades of stainless steel. Other acceptable options are electroless nickel plated or chrome plated P20 steel. These plated tools will require more maintenance including replating than stainless steel tools. On most high volume

jobs the economics favor stainless steel over plated P20. Major reasons for this is tool revisions and plating wear.

All plating processes eventual wear away requiring stripping and replating. Also any tool revisions which require machining the core or cavity will also require a stripping and replating process. This process can range from \$750 to \$7,000 depending on size and complexity of mold.

SPECIALTY MATERIALS

Often times customers will want to insert area of their tools with specialty materials to expedite heat removal. Materials such as beryllium copper and alloy materials such as Ampco 940⁵ are used. Experience with these types of materials present no unusual problems. Corrosion resistance and wear resistance with vinyl is excellent.

COMPARISON OF TOOL STEELS GUIDELINE FOR PROCESSING GEON VINYL				
	Good Quality Tool Steel P-20/4140 or Equivalent	Stainless Steel 420/CSM-21 or Equivalent	Aluminum 6061-T6/QC7 or Equivalent	Ampco Metals Nickel-Silicone-Chromium
Corrosion Resistant	P-w/o plating G-w/plating	E	G	VG
Polishability	E	VG	VG/E	VG
Texturability Acid etching	VG	VG	VG	VG
Machinability	G	G	E	G
Heat Transfer	VG	G	VG	E
Wear Durability				
Rigid vinyl	VG	E	G	VG
Glass/hi/filler	G	VG	P	G
* - Only used in either core or cavity to help transfer heat out thick walls, long flow, or deep rib areas. NOTE: All tool steel should be double chrome plated or electroless nickel plated to mold vinyl production parts, on a smooth and reliable base. P=Poor G=Good VG=Very Good E=Excellent				

¹An excellent acid neutralizing agent (Spray N816) is available from IMS, Chagrin Falls, OH

²Poly Ond is a trademark of Poly-Plating Inc., Chicopee, MA 01020

³Nicklon is a registered trademark of Bales Mold Service Inc., Downers Grove, IL 60515

⁴Crucible Steel Corp., Camillus, NY 13031

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