DATASHEET:
Casting with stones already set into waxes by Ajit Menon

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Stone-in-place casting can offer dramatic savings in stone setting labour costs, once a few common questions are answered.

Stone-in-place casting has been done in the United States for more than 10 years. In the beginning, though, this process was used very discreetly, since it conveyed tremendous economic benefits and an edge over competitors. In recent years, interest in the process has grown and information has become more readily available. In this article, we answer some of the most frequently asked questions about stone-in-place casting.

How does setting stones in wax differ from setting stones in metal?

The most obvious answer is that it takes much less strength to set the stones in the wax than to bur and move metal around a stone. Because great pressure is not applied to the stones while they are set, there is much less stone breakage.

In addition, when stones are set in wax, the metal remains unworked. In traditional channel setting, for example, the metal of the channel is burnished or pounded with a hammer, which can cause the metal to become brittle or cracked.

Are special materials and/or special equipment needed for casting stones in place?

No. Gemstone casting can be done using conventional casting equipment, although it is important that the equipment be capable of accurate temperature control. In addition, vendors do offer investments, casting metals, and even casting equipment specially designed for the gemstone casting process. Alloys have been formulated to give a better casting efficiency at low temperatures, and additives can be added to the investment to protect the gemstones, allowing flasks to be burnt out at a higher temperature. When using centrifugal casting techniques, there may be some flashing of metal over the stones if the force of the metal going into the flask is very high. This usually can be corrected by changing the orientation of the wax pattern in the tree. The pressure of the incoming metal can be reduced by increasing the angle of the wax pattern toward the horizontal plane of the center sprue.

What stones can be set this way?

The stones most commonly set in wax for casting are diamond, sapphire, ruby, and garnet. (Ruby and sapphire are second only to diamond in hardness.) Cubic zirconia and laboratory grown coloured stones can also be used.

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Gemstones should be flawless and of high quality, since those with inclusions tend to become milky or frosty during the casting process. There are many stones that can be cast in place, but success is determined by the type of setting and the care taken in investment removal and in monitoring temperature controls during casting.

What types of settings can be used for casting stones in place?
Numerous types of settings can be used for casting stones in wax. In flush mountings, prong settings, or bead settings, the model is made so that the setting's dimensions are fractionally smaller than the stone's girdle diameter. The modelmaker must also calculate the shrinkage factor. If the setting dimensions are not correct, the stone may be lost or dislodged during casting. Gemstones are often set by gently pressing a heated wax pen tip on the top of the stone. The gemstone is heated and slips easily into the setting. The process works great for most settings.

In prong settings, the prongs must be pre-notched in the model so the waxes have the appropriate notches. In flush mount settings, if the seat is too small, the wax may bulge when the stone is set, and excess wax may be pushed onto the top of the stone. In this type of setting, the seat must be cleaned all the way through the wax to create a brilliance hole. A brilliance hole will also hold the stone in place during investment and casting.

For channel settings, the model should have a notch or edge cut for the stones in the channel wall. As with other types of settings, the channel wall must have dimensions slightly smaller than the stone to be set. The stones are slipped into the channel, where the notch will hold the girdle securely. Slight adjustments to the way the gems sit in the channel may be made with a heated wax pen. The stone setter must be careful to keep the stones from overlapping or touching each other, since this may cause them to chip or crack.

Channel setting can be simplified even further. Instead of being installed into the wax patterns, the gemstones may be set directly into the rubber mold, and the wax injected around them. In this method, sometimes referred to as the "gemstone in mold" technique, the gemstones will be automatically placed in the wax.

Sorting gemstones into the rubber mold is beneficial for channel setting styles that have a lot of closely arranged stones. The process takes less time and is excellent for high volume production.

For this process, gemstones must be properly set in the metal model and a rubber mold made from that model. Gemstones are then set in their proper seats in the rubber mold, and the wax injected into the mold. Once the wax pattern is removed from the rubber mold, minor adjustments, such as aligning the gemstones, may be made with a heated wax pen tip.

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Strict measurements must be taken by the modelmaker for this procedure to be successful, and smaller stones of a carat group must be used to ensure there are no large voids around the stone in the rubber mold. Stones must also be set with a slight space between them so they are held securely by the rubber when the wax is injected.

In addition, the modelmaker must also take care with the gate location. Parting lines should not occur over stones, and the stone setter must be able to place stones in one side of the rubber mold. The gate should be thick and located on the side of a ring to prevent non-fills and shrinkage porosity. Other types of settings can also be used as long as the modelmaker keeps in mind stone size and shrinkage, and carefully determines the gate size and location.

The wax stone setter should not begin setting stones until waxes are inspected, defects mended, and parting lines cleaned. This will help ensure that stones will remain clean of any excess wax that could cause the stones to become loose.

Stones should also be inspected once they have been set in the wax. The stone should be straight and secure in the seat. If minor adjustments are made with a heated wax pen tip, be sure to check the bottom or culet of the setting. Heated wax can surround or cover this area, and the investment will not hold the stone in place.

How do you keep stones from falling out of place once the waxes have been burnt out?
If the stone is not secure in its seat, the stone will move during casting and become embedded in another area of the item. To keep stones in place, stones should be exposed at both the top and the bottom. Remember, the wax areas will be replaced by metal, while all the areas exposed to you will be filled with investment. When the wax is burnt out, the gemstones are held securely in place by the investment.

What special wax burnout procedures are needed?
Any conventional burnout procedure may be used. Care must be taken, however, that the peak temperature does not exceed a safe level. Although other authorities recommend that the casting flask temperature be limited to 850°F, we have successfully cast diamonds at flask temperatures up to 1,1 50°F, and CZs and other synthetic gemstones at regular flask temperatures in the range of 1,250°F to 1,300°F. We recommend 1,050°F for diamonds, 950°F for labcreated opals, and 1,000°F for other gemstones. A longer burnout time is used to compensate for the low peak burnout temperature. I recommend that flasks be held at the peak temperature for a minimum of six to eight hours prior to casting. In addition, steam

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dewaxing for waxes with gemstones is highly recommended. Although my own practical experience suggests that steam dewaxing is not necessary, as a metallurgist I would personally recommend the steam dewaxing process, since it can help produce a more complete burnout.

How large can casting trees be?
Casting trees can be as large as 10 inches long. Flasks can be as large as 1 foot long. Our experiments have shown that casting efficiency starts to decrease when trees are longer than 10 inches.

What special precautions must be taken during the actual casting process?
Care must be taken that the flasks are not handled roughly when moving from the oven to the casting equipment. Do not overheat the metal, and make sure the metal is clean and free from dross. Pour the metal as soon as possible if it is hand poured. Let the flask sit for at least two hours at room temperature prior to removing the investment. The flask must not be quenched in water. Doesn't the lower temperature lead to non-fills and shrinkage porosity? It can. Even though other factors contribute to such defects, lower flask temperatures are largely responsible for nonfills and shrinkage porosity. Proper spruing techniques, including location and thickness of the gates, should diminish the chances of shrinkage porosity. Proper casting technique should eliminate non-fills. In addition, there are alloys specially formulated for this process that have higher fluidity and long-range freezing parameters.

If flasks can't be quenched, how should investment be removed from around the tree?
One of the most important and difficult aspects of the gemstone casting process is removal of the investment. Flasks should never be quenched in water. Quenching causes sudden contraction of the stones and metal, which leads to shattering or cracking of gemstones.

Once cast, flasks should be allowed to cool for two hours. With a rubber mallet, gently tap around the flask to loosen the investment. With more tapping on the flask, the bottom will release the cast trees. The button of the newly released tree should be immersed in cold water for five to 10 minutes. When the casting is cool enough to be handled, it may be sprayed as usual, or soaked in any commercial investment removing chemical solution.

High pressure washing can be used to remove investment, although the technique can sometimes damage or crack synthetic opals, bend prongs, or knock diamonds from their channels. However, when stones are knocked from their channels, I usually find that the stones were not properly set in the first place. Extra care must be taken to protect opals and prongs while using high pressure spraying.

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Some gemstones may be sensitive to certain acids, so test a sample stone prior to pickling the castings. Tumbling equipment with very small media, such as a magnetic tumbler with fine steel media, can be used to shine the castings. Most gemstones are not affected by this process, but they should be tested to be certain the media will not scratch them.

I tried casting diamonds in place, and the diamonds turned milky. Is there any way to correct the problem? Can the diamonds be re-cut?
Diamonds will lose their crystal structure and turn milky if they are heated above 1,200°F in an oxidizing environment, such as that found during burnout. The diamonds become amorphous (non-crystalline) and lose their optical properties.

As far as I know, these diamonds cannot be re-cut since the milky appearance is not a surface phenomenon only. The entire crystal structure of the carbon atoms is lost—theoretically it is not even a diamond anymore. I do not know of any process that will change the milky diamonds back to their original state.