STONE IN WAX SETTING:
GENERAL CASTING ADVICE ON STONE IN WAX CASTING

We hope that this section is a helpful tool and will help you to begin to cast stone in wax pieces. However much care and testing should precede the manufacture for full production runs, especially when using precious stones. Ensure your equipment is calibrated accurately and that you have taken the appropriate steps to fully educate yourself on the entire stone in place process.

WHICH STONES CAN I USE?
Many stones can be cast in place but not everything. Stone-in-wax casting always involves risk stones can break or have their appearances changed by any number of factors during this intricate process.

A word of caution when trying to use stones where the colour has been enhanced by heat-treating: the casting process may negatively affect the stones appearance and colour. Always test stones first for colourfastness and heat tolerance during casting before using them in your stone-in-wax designs.

If you are not sure whether your stones can be used we have a simple test as follows:
- We suggest taking two stones of the same kind, imbedding one in a paper or plastic drinking cup with investment and running through the burnout process. Compare the two after the burnout to see if the quality of the stone has changed.
- Do not use lab-created spinel doublets in stone-in-wax settings.
- Use good quality stones, which are of a consistent size for stone in wax setting. CLICKSET™ masters are engineered to close tolerances and will not always accept variation in stone sizes. Out of calibration over sized stones can be set in the wax however, heat and pressure from the casting process can crack or break the stones later in the process costing money in lost production and set up time. Choose to use quality-calibrated stones for the best results with stone in wax setting.
- It is safe to say that most soft stones cannot be used. It does not matter weather the stone is transparent or not the hardness is the key.
- Larger more expensive stones should not be attempted because there is always a risk of damage to the stone.
- Highly included or fractured stones should not be cast in place.
- Stones that have been found to be unsuitable for stone in casting include: amethyst, lapis, pearls, peridot, topaz, tourmaline, turquoise and black colour CZ™s.
- opal can be cast in place, but care has to be taken to heat and cool these stones very slowly.
When using CZ in the stone in wax models keep in mind that small stones (under 2mm) can withstand temperature shock and typically do not tend to crack easily. They however will dull more quickly than larger diameter CZ stones. CZ over 5mm diameter tends to be more susceptible to temperature shock stress cracking. Make temperature transitions as smooth as possible to reduce the opportunity for shock cracking of larger CZ material stones.

• The shape of the stone to be cast in place should also be considered. Stones with knife edge girdles, inclusions and sharp points are at higher risk for potential damage.

• Proper point voids should be built into the master to accommodate stone shapes like Marquise, Pear, Trillion, Trilliant or Princess cuts. Voids in the model where the points of the stone rest relieve any stone stress and reduce the opportunity for the tip to break when hot metal is cast around the stone later in the process.

MODEL MAKING
Master models must be adapted for stone in wax casting. The shrinkages that occur during the rubber moulding, waxing and casting process have a critical impact on the setting of the stone.

It is necessary to engineer the master pattern firstly to allow the stone to “click” into the wax easily and securely and secondly to ensure a good setting in spite of all the shrinkages during casting.

The master model requires very strict dimensional control to maintain stone integrity and quality results. All shrinkage factors must be accounted for when designing the stone in wax master model: metal shrinkage, moulding shrinkage and injection wax shrinkage. Not accounting for all of the shrinkage factors can cause stone breakage later in the process. Remember that the master is the benchmark for all processes to follow and the quality of the master directly affects the quality of the end result. Stone in wax casting can be a costly process if not thought through and controlled explicitly.

It is possible to adapt the master model yourself and many companies already do this. However it is a complicated process and requires precision engineering work and exhaustive testing to ensure the correctly functioning master pattern. SRS propose Clickset™ master settings or their own stone in place master model making service which will allow jewellery companies to bypass this most complicated stage and to start stone in wax setting immediately.

• Make sure that the master model for stone in wax is finished down to a 4/0 emery finish or polished to a high lustre for rhodium plating if desired.

• There should not be any tool marks in the master model; it should look like you expect a fine finished jewellery piece to look.
STONE IN WAX SETTING:
GENERAL CASTING ADVICE ON STONE IN WAX CASTING

• When using the Clickset products make sure to file and shape the components as desired, do not hammer or bend them to fit a contour as this will result in severe distortion of the master product and stones will not fit properly in the wax and give poor results.

RUBBER MOULDS
We recommend standard organic rubber like Castaldo white or Gold label as the preferred rubber for stone in wax setting.

Properly designed master models for stone in wax casting will have the built in tolerance for standard organic rubber moulding procedures. When using the CLICKSET master components do not mould the master model using any RTV or 0-1% shrinkage mould materials, the tolerance for organic rubber moulding is built into the master on the front end, using zero percent moulding materials may result in stones being loose in the metal pattern after casting. Please be aware that not all models will shrink by the same amount.

When cutting the mould to remove a stone in wax master model be sure to hide the parting lines as much as possible. In the case of the CLICKSET master, place the internal parting line on the seat nibs not where the stone will seat. Parting lines can translate into flash or an edge that could possibly cause a stone to break later in the process. Also, carefully place any external parting lines on edges of the master pattern for ease of clean up and aesthetics. As with all mould making procedures, ensure that the wax model is properly vented to reduce any defects when shooting the wax into the mould. It is extremely critical that the quality of the injected wax pattern for stone in wax setting be of the highest quality without any defects in the wax or on the wax pattern surface. Cut moulds so that wax patterns pull easily without distortion to the overall design.
STONE IN WAX SETTING:
GENERAL CASTING ADVICE ON STONE IN WAX CASTING

WAX INJECTION
It should be possible to use most types of wax for stone in wax setting. Much is dependent on ambient temperature inside the work shop.

It is however necessary for the wax to have a certain elasticity to allow the stones to really "click" into place. SRS recommends the SRS 003 Pink wax.

- Inspect all wax patterns for signs of defects or blemishes that will translate into the metal in the final product.
- With the time that is invested into making a master for stone in work it is well worth additional time on the front end of the process to insure that the end cast result is of the highest quality.
- Clean and smooth all wax patterns in preparation for the stone setting into the wax.
- As a general practice, all waxes that are injected in a day should be used the same day.
- Wax patterns that set over night can become brittle and break when the stone is clicked into the stone seat.
- Freshly injected wax patterns should be allowed to set and normalize for several hours, if a stone is set into a warm newly injected wax this could result in distortion of the wax pattern and a poorly fitting seat for the stone in the wax. * When setting stones into wax patterns do not set stones over wax flashing or any defects, when eventually replaced by metal this can result in stone breakage or damage.
- CLICKSET™ masters are designed to not need any special tools for imbedding the stones to be set into the wax patterns. Stones should click into place on the back set models and snap down evenly on the prong style models and channel sets.
- If for some reason a hot wax tools is needed to repair the wax be careful not cause a wax film on the back of the stone.
- Stones that look dark after casting are usually the result of a thin film of metal on the back of the stone where wax was inadvertently deposited.
- Prong set CLICKSET™ masters should have all of the prongs smoothed and finished in the master model portion of the process so that when a stone is clicked into the prong seats in the wax pattern it should fit snugly and there should be no need for any additional work to the prongs or prong tips.
- Back set CLICKSET™ masters should have sufficient metal on the bezel top to hold the overall stone table and girdle in place. Stones back set into place in the wax pattern should fit snugly and the table portion of the stones should be evenly displayed from the top of the wax pattern. The small specially engineered nibs inside of the wax pattern on Clickset mountings should hold the stone level and securely.
SETTING STONES INTO THE CLICKSET MASTER WAX PATTERNS:
Once the wax pattern has normalized to room temperature and passed a quality check, place the right size stone into the pattern and using a flat smooth surface for prong set stones, press the stone into the wax prongs. It should snap into place and seat level in the wax.

For setting the back set CLICKSET™ wax patterns, turn the pattern so that the backside of the mounting is facing toward you and rest the top of the mounting on a smooth even surface, place the stone in the back of the wax pattern and using a pointed tool gently press on the pavilion of the stone till it clicks into the wax seat. It may be necessary to press on several locations on the back of the stone to insure that it is seated under each of the wax nibs inside of the back set CLICKSET™ model.

Cold setting of stones is the preferred method of setting for CLICKSET™ patterns; hot wax pens are not needed for this process. When setting channel set stones into CLICKSET™ models be sure that stones do not touch at the girdle or overlap in the channel, as either of these problems can cause stone breakage when they are cast except as noted before.

SPRUING AND GATING STONE IN WAX PATTERNS
It is recommended that larger than a normal feed sprue or gate be used for stone in place wax models since they will typically be cast at a lower than usual flask temperature and the additional sprue diameter will aide in the metal filling process.

• It is advisable to sprue to the side of the patterns near to where stones are set, multiple sprues may be needed for feeding hot metal into some channel set styles of stone in wax patterns. * Be aware that metal hitting the stones directly could and can move and dislodge the stones from the investment holding them
• Make sure that there is a good full contact where the sprue meets the pattern; do not restrict the connection and use the full diameter of the sprue to make good contact with the surface of the wax model, restricted flow contact between the sprue and the pattern will prohibit the flow of metal to fill the pattern properly and cause time and labour to be lost.
• Stone in wax pattern trees can be made in any size/height to match flask capacities.
• Keep in mind that sometimes on trees larger than 6â€“tall, the metal force at the top of the tree may cause some flashing around the stone in place patterns. One way to avoid this problem is to tree standard patterns that are non stone in place on the first two levels of the tree then start your stone in pattern treeing on the third row.
STONE IN WAX SETTING:
GENERAL CASTING ADVICE ON STONE IN WAX CASTING

- Conversely, try not to tree down too far on the bottom of the tree close to the button as the pressure for metal fill is lesser here and no fills are most likely to be experienced on the last row closest to the button, try to leave 10-20mm from the top of the button to the first row of wax patterns when treeing.
- Angle wax patterns outward at about a 45-degree angle as done for most other standard treeing procedures in order to assist in the smooth transition of metal entering the mould areas.
- When using a hot wax tool for sprueing be careful not to touch the wax patterns or to flood any wax over the stone in wax settings as this will result in metal being cast over the stone in the end product.
- Quality control all aspects of this process for the optimum quality results.
- Make sure that any pre-setting holes are open and not closed with wax.
- Remove any surface tension on the wax patterns by using an anti-static bath or spray on the whole tree.
- Make certain the tree is completely dry prior to investing.
- It may be necessary for some multi-stone type settings to position the set stones downward so that bubbles will not form under the stone in wax patterns when investing the tree.

INVESTING AND INVESTMENTS PRECIOUS STONES
For Precious stones you will need a special investment powder (SRS STONECAST) designed for stone in place casting or to make a chemical addition to protect the stones. In addition you will need to adjust your burnout cycle to a lower temperature and to a longer dwell at top temperature.

SRS recommends SRS STONECAST™ [link to SRS web site here] which is a pre-blended investment powder already containing the special additive to protect the stones.

NON PRECIOUS STONES
For non precious stones you can use a normal investment powder “NO SPECIAL ADDITIVES ARE REQUIRED. SRS recommends SRS CLASSIC™ or SRS GLOBAL™. Once the choice of investment powder has been made mix and pour your flask as normal taking care not to dislodge any stones. Allow to stand for 2 hours prior to starting the dewax or burnout cycle.

DEWAX AND BURNOUT CYCLES
SRS do not recommend steam dewaxing for stone in wax casting of diamonds or precious stones where a special investment or additive has been used. There is a danger that the steam will wash away the additive protecting the diamonds. If you do steam dewax take great care that the steam is not too aggressive.
There are however good reasons for using steam dewaxing.
- Wax carbons must be removed as much as possible at the beginning of the cycle end since the burnout temperatures are lower in the stone in wax process.
- Residual carbon left in the mould can result in metal casting defects and affect the quality of the metal in the final product.
- Load flasks into a pre-heated steam de-waxing unit and de-wax for one hour then transfer the flasks immediately into a pre-heated oven set at 150°C (302°F).
- Do not allow the flasks to cool down below the boiling point of water, (220°F). This will help reduce the chance of any rapid heat changes that can stress some stones set in wax, facilitating and speeding up the wax elimination process.
GENERAL COMMENTS ON BURNOUT CYCLE

- Maintaining a sustained time period at the top of the burnout schedule will aide in the removal of much of the residual carbon in the mould.
- It will not however eliminate all of the carbon from standard investments at this lower casting range.
- For investments that do not have any additives this may result in some slight gas porosity from the residual carbon which will combine with the free oxygen that can be liberated from the decomposition of the gypsum bonded investment forming CO2 gas.
- Additives in the investment help to protect the stones and also aide in eliminating carbon in the mould.
- Reused metal for stone in wax trees will eventually experience some degree of contamination from the low burnout temperatures resulting in SO2 gas exposure, which leads to gas porosity in the metal.
- Most metal used in the stone in wax process will require complete replacement more frequently than the more standard casting processes, where the metal being used can be refreshed with a percentage of new and continue to be used to a high quality of performance.

CASTING MACHINERY

Casting of a stone in wax jewellery can be done with either vacuum or centrifugal casting methods, however vacuum assist is generally preferred.

- Remember to keep the metal temperature as low as possible to avoid heat shocks.
- Excessive metal pressure sometimes can lead to flashing of metal around the stones; this flash can usually be removed with a metal brush or wheel.
- The best choice of casting equipment is the machine that will offer the most accurate control of the metal temperature allowing for consistency and assisting in a quality end result in casting.
STONE IN WAX SETTING:
GENERAL CASTING ADVICE ON STONE IN WAX CASTING

ALLOY SELECTION
A wide variety of silver and gold alloys work well for stone in wax casting, some casters prefer alloys that contain de-oxidizing agents and alloys with low shrinkage rates which are most suitable for this process.

- Do not overheat the alloy as this will add to the total system temperature applied to the mould and stones and can cause burning
- It is generally acceptable to slightly superheat an alloy by 100-150°C over the liquidus range of the alloy.
- Always consider that the stone in the mould is experiencing a total system temperature, which is the combination of the flask, and the metal temperatures and this combined temperature affects the ambient temperature experience within the core of the mould. * The flask should be cast at the lowest possible temperature to still fill the patterns with out burning the embedded stones.
- Sterling, yellow gold’s of various karats, white gold including Palladium white gold, have all been cast successfully using the stone in wax process.

Flask cooling and investment removal:
It is important that the cast stone in flask be allowed to properly cool prior to performing any devesting processes. Quenching a hot flask of stone in patterns can shock the stones and result in extensive damage to the patterns. An appropriately cooled flask should be cool enough to be held in the hand and depending upon the size of the flask, will take two hours or longer. Waiting this long for a flask makes the investment more difficult to remove and will make the metal very soft however this waiting period will prevent the gemstones from experiencing thermal shock and cracking.

- Never quench the stone-in flask in water while it is still hot as the thermal shock will certainly break the stones!
- A simple dry process is as follows:
  - Wait 45 minutes after casting
  - Do not quench in water but tap bottom of tree and sides of flask with small hammer.
  - At this point the casting normally falls out of flask. The powder falls off the stones easily but is caked onto the metal.
  - Wait for the tree to be hand hot i.e. so that you can pick it up without gloves.
  - Holding the tree gently in your hand tap the bottom of the tree so that it vibrates gently.
  - Most of the powder will fall off.
  - To clean finally use water jet under pressure.
  - Thoroughly check the tree for any loose or missing stones and account for these before continuing with any further finishing processes.
FINISHING PROCESS
- Clip the stone in cast patterns from the tree and carefully quality inspect them for any defects.
- Hand polishing is always a method of finishing for stone in castings however if careful quality control was performed on the front end of the process most castings should be suitable for mass finishing using mechanical tumbling or magnetic pin finishing.
- It is important to choose polishing media that is non aggressive and do not attach the stone facets and surfaces.
- Certain types of ceramic and steel shots are considered dangerous for softer stones while materials like plastic medias and organic wood based medias are more appropriate.
- Steel shot can also work harden your pieces so it is best to watch the times closely if this process is used. Diamonds are not damaged by steel medias and suitable finishing options are by magnetic finisher.
- SRS recommend OTEC, Germany as a suitable supplier of mass finishing machinery for stone in wax cast pieces.
- Consult your supplier for recommended medias for finishing stone in castings.

SOLDERING ON STONE IN CASTINGS
Most gemstones that can withstand the heat of a torch can be soldered on after stone in wax casting.

Stones like CZ will likely stress and break from the concentrated heat of soldering so castings with CZ should not be worked on with a torch after casting.

Some stone in wax casters have begun to use laser welding units to repair minor issues in stone in castings
Poorly cast or damaged stone in castings should be scrapped and lessons learned for future preparation of master models and wax patterns.

Direct technical help
If you need any direct technical help please feel free to contact the following SRS personnel:

Stone in wax setting enquiries:
Mr Peter Croton, peterc@srs-ltd.co.uk
Ms Bryony Kirk, bryonk@srs-ltd.co.uk
Mr Martin Cookson, martinc@srs-ltd.co.uk

General casting enquiries:
Mr Peter Croton, peterc@srs-ltd.co.uk
Mr Martin Cookson, martinc@srs-ltd.co.uk