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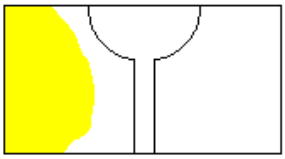
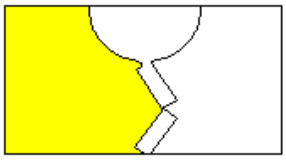
Advice for CAD designers - how to avoid the most common pitfalls when designing models for lost wax casting.

Many of the 3D designs and Rapid Prototyped waxes/resins we receive from customers, unfortunately have in-build design flaws that will result in a failed casting. Then people look at the castings and think there is porosity when in fact the fault is due to small bits of investment material breaking off in the cast and coming to rest on the surface of the casting. This results in pits in the surface. The majority of these faults center around three main areas; 1, Small diameter pilot holes going through a thick metal section. 2, Very sharp crevices between adjacent collets and sometimes between claws. 3, Thin and sharp crevices also between split shoulders of rings.

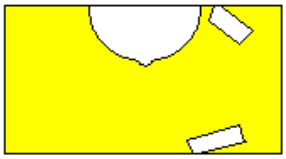
Problems with stone holes and pilot holes.



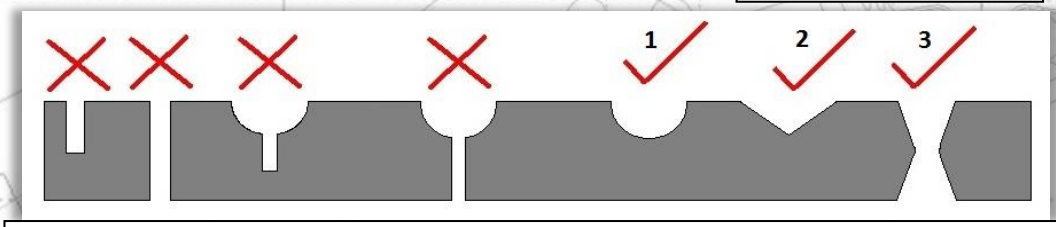
Metal flows into the casting. The metal is travelling quite fast and is dense.



When metal hits this very thin column of investment material (which is the tiny hole you have created for drilling of stone seat) it breaks!



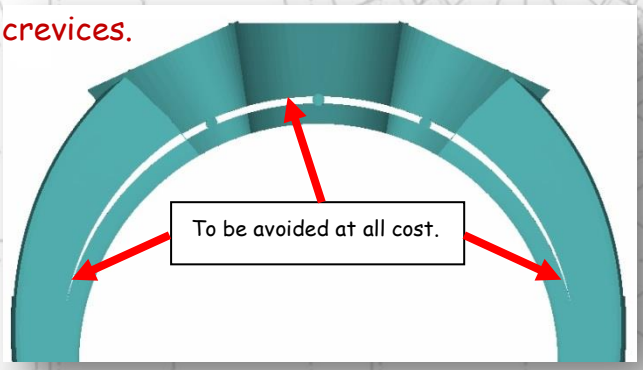
As the metal continues to flow the broken pieces of investment material from the hole travel around the casting leaving holes, or 'pits' in the metal where they are not wanted - usually on the surface of the casting!

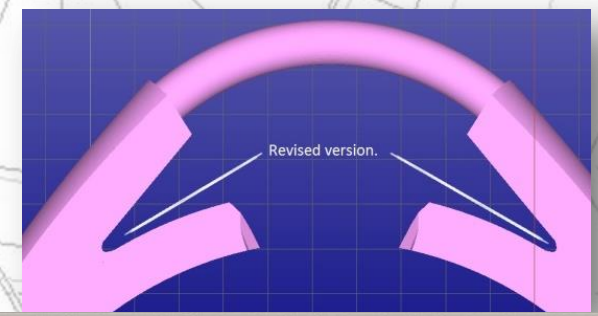


For small size stones please adopt one of the hole profiles shown above as OK. The profile of the hole to the far right may not be suitable for very small holes. For very small stones please use either styles 1 or 2.

Problems with sharp inner walls, sharp edges and tiny crevices.

For the designer, it is important to know the process you are designing for, so for lost wax casting please avoid sharp corners and moving from thick to thin profiles on the same piece. Bear in mind the material flows quickly and avoid any unnecessary obstructions or restrictions. For successful casting results, the design of the piece is as important as the material it's printed with and cast into.

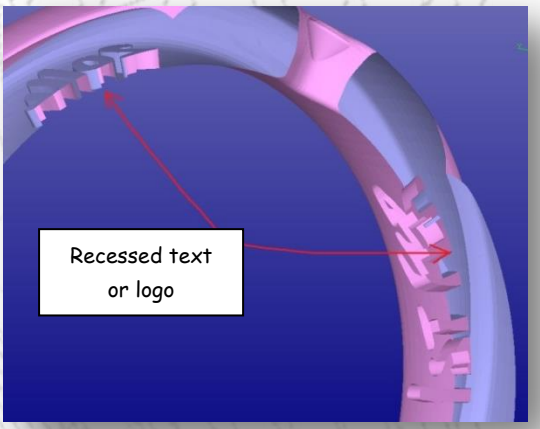


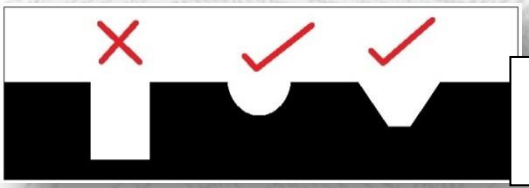


The design above is a classic and shows the problems we're faced with, again investment material is certain to break off during casting. Adding a radius or a fillet to a sharp edge really helps combat this. Also in the case above, the gap for the gallery, even at the top of the ring is far too small, again causing problems.

Recessed and engraved text/logo issues.

Recessed text is regularly causing a problem as the design is usually too small, too deep and perpendicular with sharp edges - as in this example, looking inside a cut away of a ring model. Please try to taper the recesses, as if you were using an engraving tool and avoid going deeper than 0.3mm to 0.4mm. Again, imagine the molten metal smashing into these tiny walls of investment material (at this scale, almost like chalk columns) – they will want to break off!

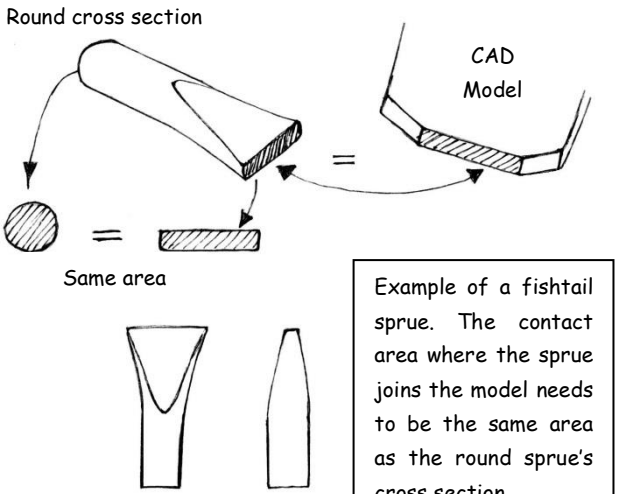




Suggested profile design for small recesses and engraved text.

Tips for sprueing intricate CAD models.

Another key area that is regularly misinterpreted is the design, size and placement of sprues in the CAD model. Ideally the feeds should be round in section and be attached to the thickest part of the design for the best possible cast. A small sprue trying to feed a ring for example at the thinnest part of the shank will result in the metal being throttled and either the furthest heavier sections can get shrinkage porosity or shrinkage holes can be formed close to the sprue, as it cools down sooner than the heavier area.



Example of a fishtail sprue. The contact area where the sprue joins the model needs to be the same area as the round sprue's cross section.

Full eternity rings can be a problem to sprue, as there is an automatic restriction of the casting flow between each round setting. Creating an internal cartwheel feed system can sometimes work but does involve cutting off many chunky feeds after casting. This can lead to awkward trimming and cleaning up of parts of the ring that are difficult to get to. What we suggest is a system where you elongate all the claws on one side of the ring and create a rail around the outside which attaches to the longer claws. The model is built and cast with this rail attached. It is then easier to pierce through the longer claws near to the rail, ready for trimming to length and final setting.