Cast in Steel 2022 Celtic Leaf Sword

Tips and Tricks…

Cast in Steel 2022 challenges teams to use steel casting technology to create a winning Celtic Leaf Sword. This year's competition should be in person with a member of the team testing their entry in the final performance tests. The competition this year includes more categories for awards and a Grand Prize for the best entry.

If you have competed in the past, this year is different. The event will be in person and Ben Abbot and Phillip Harrison are both planning to be judges and teams will be able to meet them and talk about their project.

This year we are changing the awards to better recognize the teams that excelled at the requirements for the competition. We will also aggregate the scores and pick a grand prize, best sword award. In the past we asked teams to include a design description that authenticated that their entry was the item we required. This was included in the report, but no recognition was attached to the most authentic. This year a separate recognition will be made for the best authentic Celtic sword. We also required innovative use of the steel casting process to produce the item, this was in the report but was not recognized in our awards. This year, the best use of casting for production of the Celtic leaf sword will be selected. There will continue to be recognitions for the best technical report, video and of course for the best performance based on testing and expert evaluation. The scores for each of these recognitions will be combined to allow us to recognize the winner of the Cast in Steel 2022 competition.

The Celtic Leaf sword is a challenge for using casting technology. It is almost ideal for forging. But the original sword made in bronze were cast and then processed. Using casting is both a challenge and an opportunity.

Making things that are thin and complex is easier using investment casting, but this year's item may be larger than the normal investment casting process accommodates. Some teams may be able to accommodate a longer cast item, but it may be difficult.

The challenge is to actually use castings that would allow better sword performance than forging. But, however, forging the original cast blade is a useable option. While casting a

blade and forging the shape is possible, it would not demonstrate the innovative use of casting to add value. But casting to near net shape would require grinding and sharpening the edge. Forging the edge of a cast blade would allow the use of forging as a processing step like heat treatment and would be appropriate.

If we consider traditional sand-casting technologies, there are interesting opportunities. If we are able to cast a near net shape edge, the solidification structure would align with the edge to provide the potential for superior performance. The challenge is the blade would be thin and difficult to fill and might have non-uniform sections. If a commercial product had a long thin section, two common tricks are used. One would be to put a thick section "U" gate around the blade to assure filling. This would allow production but might not give optimal properties. An alternative would be to have a heavy gate down the length of the blade to get filling that would force solidification patterns to optimize the properties near the edge. Ideally, the solidification pattern would be rapid and directional solidification from the edge into the center to align the dendrites from the edge to the center. One could even chill the edge with specialty sands or hard chills to get the finest structure and desired alignment of the microstructure for performance.

Investment casting is still attractive if the shell making, and casting operation can accommodate the size. Using a fan during solidification can enhance the directional solidification which may be desired. There is a commercial brand that is now using cast blades as a benefit for their production. Check out their cast blades here: https://www.cutleryusa.com/M48-3757

Other innovative ideas are possible. Casting allows a wide range of alloy choices. Using highly alloyed steels or wear resistant alloys could be beneficial. Casting a strip of higher carbon alloy into an investment or sand-casting blade down the center could get some hybrid or Damascus blade type structures.

There are no restrictions in post processing. Heat treatment is expected. This could be zoned to get a hard edge with a tough center. So is grinding or machining to get the edge and geometry required. Forging as a finishing technique could be used but the starting casting would need to be designed to add value. Forging like heat treatment can be considered as a post processing operation to meet the final sword requirements.

Any questions on allowable or alternative processes or approaches are welcome!

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