MINI DRONE CAST WITH HELP OF 3D-PRINTED PATTERNS

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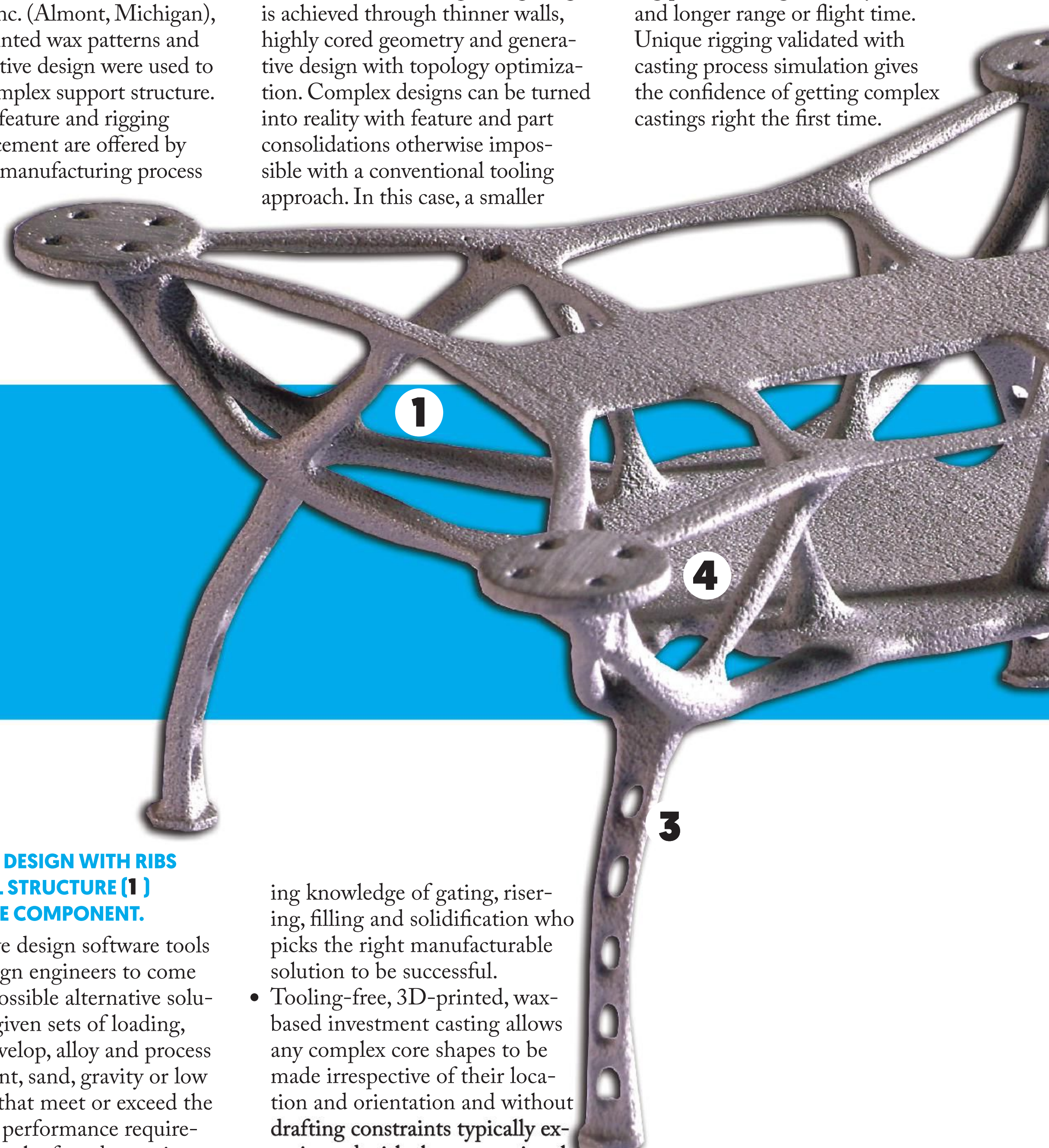
In a mini drone cast by AFS Corporate Member Aristo Cast Inc. (Almont, Michigan), 3D printed wax patterns and generative design were used to achieve a complex support structure. Freedom of feature and rigging element placement are offered by the additive manufacturing process because it doesn't have tooling-related constraints. Lightweighting is achieved through thinner walls, highly cored geometry and generative design with topology optimization. Complex designs can be turned into reality with feature and part consolidations otherwise impossible with a conventional tooling approach. In this case, a smaller and lighter mini drone housing provides longer battery life and longer range or flight time. Unique rigging validated with casting process simulation gives the confidence of getting complex castings right the first time.



A COMPLEX DESIGN WITH RIBS AND NODAL STRUCTURE (1) LIGHTEN THE COMPONENT.

- Generative design software tools allow design engineers to come up with possible alternative solutions for given sets of loading, overall envelop, alloy and process (investment, sand, gravity or low pressure) that meet or exceed the structural performance requirements; it is the foundry engineer with sound casting manufacturing knowledge of gating, risering, filling and solidification who picks the right manufacturable solution to be successful.
- Tooling-free, 3D-printed, wax-based investment casting allows any complex core shapes to be made irrespective of their location and orientation and without drafting constraints typically experienced with the conventional investment casting process.

CASTING PROFILE

Cast Component:
Mini drone housing.

Process:
Investment casting.

Material:
Magnesium AZ91E -T6.

Dimensions:
3.9 x 3.9 x 2 in.

Weight:
24 g.

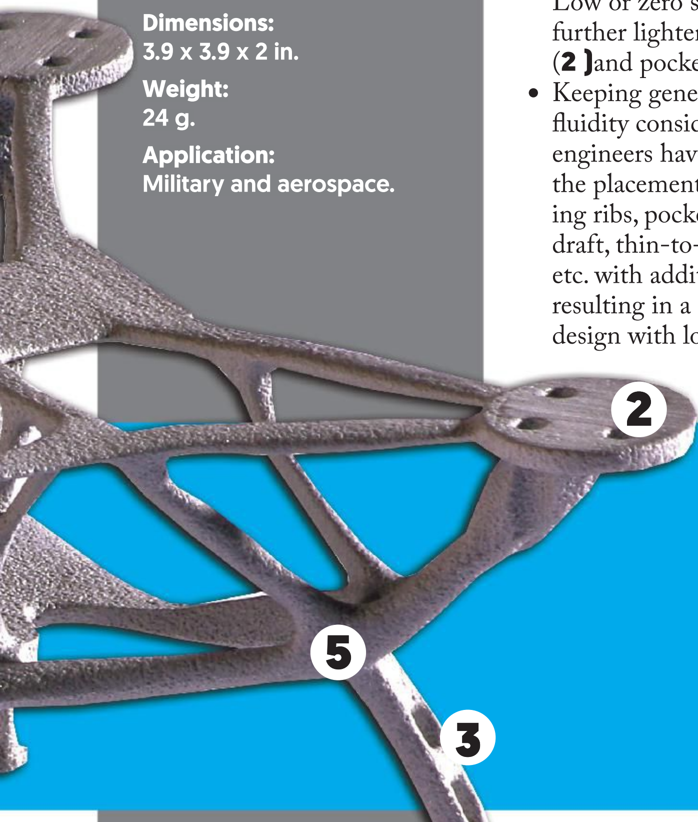
Application:
Military and aerospace.

PROCESS PARAMETERS AND THE GATING AND RISERING DESIGN FOR THESE INTERCONNECTED STRUCTURAL BEAMS NEED TO BE VALIDATED TO ENSURE THE LIQUID METAL FILLS PROPERLY AND SOLIDIFIES TO GET THE DESIRED SOUNDNESS, PROPERTIES AND QUALITY.

- With design optimization, imagine the solid walls being replaced with load bearing beam structure, leading to light weight solution. Low or zero stress areas can be further lighten up by cored holes (**2**)and pockets (**3**).
- Keeping generic castability and fluidity considerations, design engineers have full freedom with the placement of features including ribs, pockets, cored holes, draft, thin-to-thick transition, etc. with additive manufacturing, resulting in a robust optimum design with lower weights.

COMPLEX INVESTMENT CASTINGS REQUIRE GENEROUS FILLET (4), RADII (5) FOR SMOOTHER TRANSITIONS.

- When it comes to filling and solidification behavior, 3D-printed patterns are no different than wax patterns in conventional investment casting, except the patternmaking method (shelling, melting, pouring, cleaning and post processing) remain identical to the conventional investment casting process.
- Complex casting shapes make the rigging design challenging when producing 3D-printed, tooling-free investment castings with the desired quality. However, casting process modeling is found to be very valuable to validate various rigging scenarios and process conditions and predict the casting quality before printing the wax pattern or ceramic shell. **CS**



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