A Tour of Turbine Engine Parts Facility

Chromalloy Castings unveils new facility in Tampa, FL

By Ronald Donner
Editor

A new state-of-the-art facility for casting turbine engine parts and components was unveiled last December in Tampa, FL, and members of the aviation maintenance media were there.

Chromalloy is a worldwide supplier of large gas turbine engine critical gas path (hot section) blade and vane repairs and coatings, and also a manufacturer of replacement hot section components approved by the FAA under a Parts Manufacturer Approval. In addition to aircraft turbine engine parts, the facility also produces the same types of parts for industrial gas turbines found in the power generation industry, marine, and other heavy industrial applications. Both the aircraft and commercial industrial parts are all subject to the same high-standards and follow the same manufacturing processes.

The company invested $30 million into this 115,000-square-foot facility. Tom Trotter, vice president and general manager of Chromalloy Castings, says, “This was a clean-sheet design and throughout the facility process flow was designed into the floor plan and lean manufacturing techniques were considered with every process. This facility is designed to pour up to 1 million pounds of nickel and cobalt super alloys per year in a process known as “investment casting.”

According to Trotter, approximately 250 are employed at Chromalloy Castings, 30 in engineering or other technical specialty roles, and the company has 12 Six-Sigma Black Belt individuals on staff. The new facility is within a 20-minute drive of the old facility which has been established in the Tampa area for 20 years. Approximately 90 percent of the existing work force was retained after moving to the new location. Trotter shares, “All of the employees are excited to be part of the clean-sheet design and everyone embraces the culture of continuous improvement. This is all part of how we are re-defining World Class.”

Courtesy of Chromalloy.
Wax patterns for turbine engine blade casting.

Courtesy of Chromalloy.
Chromalloy Casting’s new facility in Tampa, FL.

Courtesy of Chromalloy.
Chromalloy Casting’s furnace. Photo courtesy of Chromalloy.

Courtesy of Chromalloy.
Automation used in the casting process.

Investment casting

Investment casting as it was explained is an old process in which molten metal is poured into a ceramic mold. The mold is made by using a wax pattern in the shape of the desired part. This wax pattern is covered or “invested” in a slurry made from ceramic materials which hardens into the mold. Investment casting is sometimes referred to as “lost-wax casting” because the wax pattern is eventually melted out of the mold.

The investment casting process is typically used for casting metal parts having complex shapes with high melting temperatures such as turbine engine blades and is very precise. The most common metals used are aluminum alloys, bronze alloys, magnesium alloys, cast iron, stainless steel, and tool steel. Investment casting of turbine engine parts requires many types of equipment and technical processes, such as wax mold creation, ceramic slurry application, pouring molten metal, furnaces, autoclaves, cutting, grinding, sandblasting, inspection, measuring, and more.

The new facility

Our facility tour started near the Wax Department, which has a staff of 37 people all having more than 10 years experience in their jobs. Marilyn Breckley proudly says, “It all begins with the wax input. Cleanliness and housekeeping are most important and audits of the area are regularly accomplished to ensure we continually meet the standards set for this type of operation.” She went on to show some of the first steps involved with producing a wax pattern and the mold assembly for a first stage high-pressure turbine blade for a CFM56-3 series engine. The result forms the pattern used to cast a new blade.

The next stop on our tour was the Shell Building area. The Shell Team is comprised of 24 people; again all with many years of related experience. This is the “investment” stage. The shell is typically made of six to 10 layers of the ceramic slurry which has been applied around an assembly of wax molds on what is termed a mold tree. The shell is then cured in an autoclave under high temperature and high pressure.

The Casting Department is comprised of 11 casting furnaces, and is considered the most critical step. This is where the new part is formed. A high-level review of the process steps at this location are: shell inspection, preheating, wax melting, metal pouring, and cooling. It was explained that four key disciplines are employed in the Casting Department: safety, 6S, quality, and flow. Their 6S program further defined consists of Sorting, Set-in-order, Shine, Standardize, Sustain, and again Safety. Turbine engine blades cast here can include single-crystal, directionally solidified, or conventional equiaxed crystal material processes.

The Rough Finishing Department is where shell removal and initial cleanup occurs, and traceability for each individual part is introduced. Chemical processes are used so additional strict safety standards are followed and data analysis is employed in order to minimize process variation. A high safety conciseness was apparent throughout the facility.

The last stop on our tour and the most impressive area was the PHOENIX Room, which is a combination of several departments and process steps combined together in one location. PHOENIX was the name decided upon by the group because of the numerous processes that are accomplished in this one area such as, sandblasting, bench check, visual inspection, dimensional inspection, florescent penetrant inspection, additional part marking, X-ray, final inspection, and eventually preparations for shipping to the customer.

The name PHOENIX stands for finishing (PH), operational (O), excellence (E), nondestructive testing (N), inspection (I), and X-ray (X). This area was where process flow design and lean manufacturing techniques paid huge dividends. It was explained that at the old facility a casting would travel up to 6,000 feet for accomplishment of these processes. In the PHOENIX Room that same casting travels 185 feet to complete the same process steps. Numerous inspection steps take place here as the parts are near completion. One of the inspection steps is an advanced topographic optical scanner (ATOS). The ATOS laser scanner takes a complete scan of the exterior contour of a casting, and makes a comparison to the electronic modal in its nominal condition. Through these processes, deviations from the nominal modal can be identified. These processes evaluate in great detail the dimensional quality, and are performed on every high-pressure turbine blade cast.

The next steps

Trotter says, “We are now able to offer the industry a single source for engine component design, engineering, tooling, machining, repairs, coatings and now castings.”

Chromalloy announced its plan to already expand this new facility by adding another 40,000 square feet to it in order to develop complex ceramic cores on-site. A ceramic core is used in the investment casting process to form complex features internal to a casting such as cooling passages and holes within turbine engine components. The complex core area is planned to be fully operational by January 2012. Trotter feels the new facility allows them full control of all manufacturing functions using state-of-the-art process control.

Not yet 100 percent, the facility is on its way to becoming totally green. Work is underway to become a zero-discharge facility, which includes the reclamation of waste water. As an example the shell materials are being considered for highway applications and most of the metal alloy materials are retainable.

It appears the clean-sheet approach is working as evidenced by the cleanliness of the organization of the facility, and how engaged and proud all the employees appeared. Located in all work areas were large poster-size photo standards describing at a glance how the work area should appear. Everyone spoke about safety, process, continuous improvement, and customer service.

For more information you can visit **www.chromalloy.com**.