

Executive Summary

The European project ADMAP-GAS succeeded in presenting alternatives to the critical broaching process for the manufacturing of fir tree structures in gas turbine discs by the alternative processes of Abrasive Water Jet Cutting (AWJC) and High-Speed Wire-EDM (HS-WEDM). Eight partners effectually combined their efforts to develop robust manufacturing processes for the European engine manufacturing industry with the objective to drastically decrease failure risks and machining costs as well as preserve energy and environment through the project.

Until the last project month research and development work was carried out and successfully finished. Both developed manufacturing processes (AWJC and HS-WEDM) are able to enter into competition with the broaching process. This showed the evaluation process which was done during the last project months. It can be stated, that both manufacturing technologies underwent an improvement through the project. Especially cutting rates, surface integrity aspects and process monitoring systems have been increased or even completely new developed. The developed AWJC process for cutting fir tree structures was proven to be a manufacturing process for roughing operations which requires a very economic technology to process hard to machine alloys. Through a process monitoring system, a multi axis cutting head, increased accuracy and a new developed nozzle geometry (all objects have been developed within ADMAP-GAS) the manufacturing technology is on a very good way to be able to machine fir tree geometry profiles. With further effort and development this technology will be an alternative to broaching.

In terms of HS-WEDM several developments improved the standard manufacturing process to a competitive manufacturing technology to the state of the art broaching process. Improved cutting rates which have been achieved through technology optimisation, nozzle development and generator tuning together with very good surface integrities (minimal surface layer and contamination as well as no crack occurrences) indicates that the developed process is a serious alternative to broaching. On the one hand this was shown regarding economic aspects and on the other hand this was shown regarding functionality through fatigue tests.

To summarize the technical work done within ADMAP-GAS and to critically assess the project regarding the objectives of the complete project it can be stated, that the failure risks of engine discs have been decreased through the developed process monitoring systems. Additionally, the machining costs to produce a fir tree with the challenging requirements have been decreased by 25%. This was shown through a Life Cycle Cost analysis. Concerning the energy consumption and the environmental impact a Life Cycle Assessment showed an enormous decrease (up to 60%) by using one of the two developed processes. Furthermore it was shown, that the developed processes are able to be implemented into other industries like the motorsport sector.

Regarding the work concerning public relation dissemination and exploitation activities have been done. For the future a dissemination and exploitation plan has been set up to spread the very good project results after the project end. During the project end phase several turbine manufacturers like MTU, Rolls Royce and Pratt & Whitney contacted the consortium to receive detailed project results. All of them are very interested in the research which has been done during the project and they asked the partners for cooperation to evaluate the processes with their own standards.

Overall it can be summarized, that the project ADMAP-GAS has come to a very good end. Two special manufacturing processes to machine fir tree geometry profiles have been developed which are able to substitute the critical broaching process in the future.