

Manufacturing environmentally friendly aero engines

# Requested by the airlines

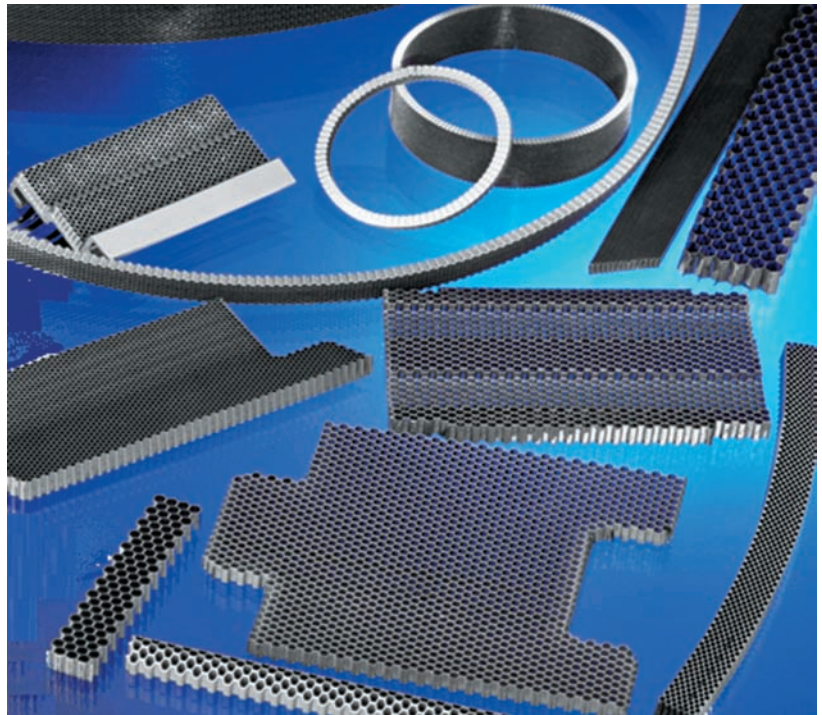
In the last few decades, airlines have started demanding more efficient engines for their fleet. The future of air traffic is highly dependent on environmental and economic factors, such as fuel consumption, fuel prices, alternative fuels, airport noise limitations, and CO<sub>2</sub> emissions. Sulzer Metco offers solutions that meet the needs of the aero industry.

All original equipment manufacturing (OEM) companies like GE, Rolls Royce, Snecma, and Pratt & Whitney are responding to this challenge by developing state-of-the-art engines. They are employing advanced light materials and coatings, thin wall castings, and other complex technologies in order to improve thermal efficiency, increase propulsive efficiency, and reduce weight and noise.

**A supplier to most OEMs**

As a supplier to almost all engine OEMs, Sulzer Metco contributes to this challenge by offering and adapting its expertise and manufacturing capabilities. Currently, Sulzer Metco is involved in several high-tech civil aero engine programs, such as the Trent 900, GP7000, Trent 1000, Trent XWB, BR725, PW1200, PW1500, and SaM146/TP400. These engines power different classes of civil airplanes<sup>1</sup>.

Sulzer Eldim, part of the Sulzer Metco division, consists of three entities located in three European countries. Sulzer



<sup>2</sup> Neomet products: typical honeycombs.

**<sup>1</sup> Engine and corresponding airplane**

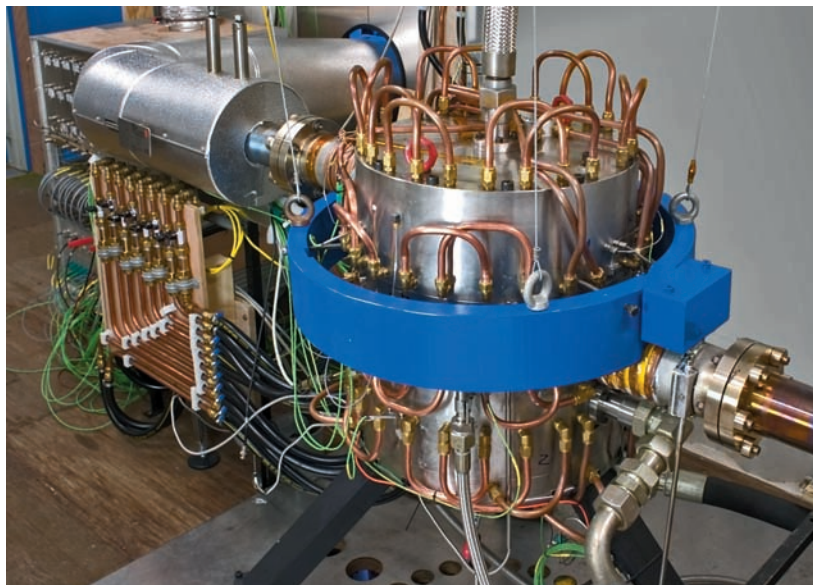
Trent 900, GP7000	Airbus 380
Trent 1000	Boeing 787
Trent XWB	Airbus 350
BR725	Gulfstream G650
PW1200	Mitsubishi Regional Jet
PW1500	Bombardier C series
SaM146	Sukhoi Superjet 100
V2500	Airbus 320 series
CFM56 (upgrade)	Boeing 737

Eldim (NL), in Lomm, Netherlands, is specialized in the manufacturing of labyrinth air seals and industrial gas turbine (IGT) airfoil drilling; Neomet Ltd, in Stockport, United Kingdom, is specialized in the manufacturing of honeycombs <sup>2</sup>, an essential component of a labyrinth air seal; and Sulzer Eldim (HU), in Debrecen, Hungary, is specialized in manufacturing sheet metal details, nozzle guide vane inserts, and baffles and offers a best-cost supplier option to our

customers. Currently, Sulzer Eldim (HU) is involved in the production of the V2500 nozzle guide vane inserts.

**Know-how and manufacturing experience**

Labyrinth air seals are used in aero gas turbines to reduce airflow leakage at stator/rotor tips. The ability to design and manufacture seals with less weight and tighter tolerances will significantly contribute to the overall performance of



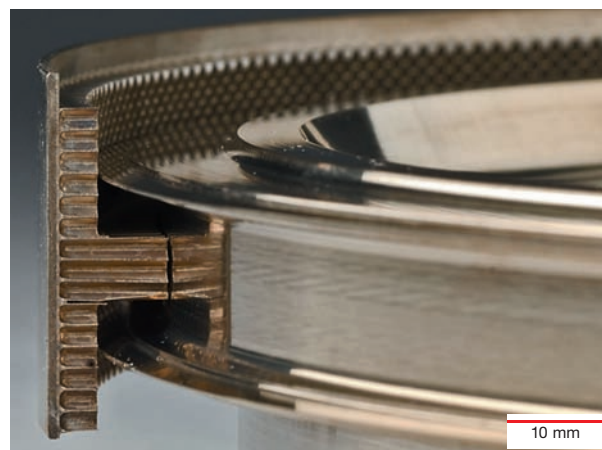
3 Seal test rig.

the engine. Weight restrictions and tighter tolerance schemes are driving the manufacturability of a part to its limits. For example, machining a thin wall casting cost-effectively without deforming the shape of the component is a challenge for any supplier and, consequently, also for the customer. For that reason, the OEMs frequently use Sulzer Eldim's accumulated know-how and manufacturing experience in the pre-design phase of their products. In this co-design phase, customers can still adjust their final definition of the labyrinth seal to favor any of the above-mentioned requirements. During any development and engineering phase, it may become evident that the first design does not meet the required performance targets, and thus, changes may be needed to overcome this deficiency. Sulzer Eldim has often proven that know-how and manufacturing experience contributes to a more favorable approach in the design phase and therefore, ultimately, to a more successful solution.

NLR, and VGT. Different seal concepts were evaluated against the following criteria: interface, performance, weight, manufacturability, costs, reliability and maintenance, design life, assembly, safety, technical risks, intellectual property, regulatory, tool development, and standard work. During the evaluation process, a staggered labyrinth seal was selected. The selected concept was optimized for seal performance using detailed computational fluid dynamics (CFD) analysis. The performance improvement was demonstrated experimentally against a base line stepped labyrinth seal in a specially designed seal test rig at the National Aerospace Laboratory 3. The results were above expectations. A 42% performance improvement with a two-knife-edge staggered labyrinth seal 4 5 could be measured against a two-knife-edge stepped base line labyrinth seal 6. Based on these

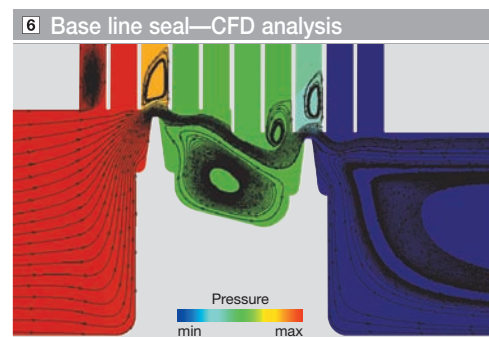
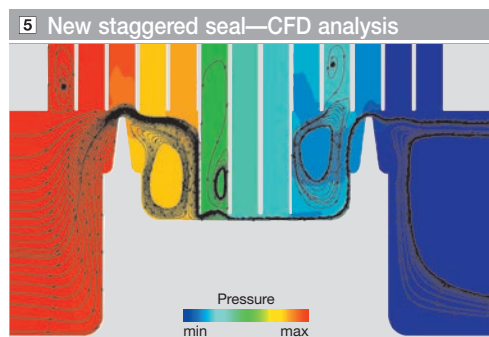
results, the DAEC is currently in the process of defining a new development program with the goal of joining Snecma's green engine platform. Sulzer's contribution to this program will be its manufacturing know-how and experience of seal components.

Sulzer Metco, through its Sulzer Eldim facilities, produces critical components for aero engines, using expert design and conventional and non-conventional machining capabilities. Through its collaborations, Sulzer Eldim contributes in the development of environmentally friendly aero engines for the global market.



4 Rotor concept: Staggered honeycomb seal.

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### Developing a new labyrinth seal

In addition to its direct work with OEMs, Sulzer Eldim has participated in a joint collaboration and initiative of the Dutch Aero Engine Cluster (DAEC) to develop a new labyrinth seal concept that will improve gas turbine efficiency. This development was undertaken in cooperation with DutchAero, Atkins Nedtech,