

**100**  
**BETRIEBE**  
mit  
**RESSOURCEN-  
EFFIZIENZ**  
BADEN-WÜRTTEMBERG

CRONIMET Ferroleg.  
GmbH  
Karlsruhe

# 100 Pioneers for Efficient Resource Management

Examples of excellence in Baden-Württemberg from all parts of industry

**Best practice case of  
CRONIMET Ferroleg. GmbH**



**CRONIMET**

# Development of systems and technology for aircraft engine and landing gear recycling in Baden-Württemberg

**CRONIMET Ferroleg. GmbH, Karlsruhe**

Technology/Process Technology:

Aircraft recycling

Measure:

Secondary raw material extraction of economically critical raw materials

## Background and objectives

Decommissioned aircraft are a source of high quality components and materials. Some of these engine and landing gear components have a limited service life and must be replaced after a defined number of revolutions, operating hours and landings in aircraft maintenance hangars. Before the materials can be introduced into the secondary raw material cycle, the components must be rendered unusable through a documented process. The reason for this process is to prevent suspected unapproved parts and inferior imitations (bogus parts) from appearing on the world market. The materials in question accumulate continuously at aircraft maintenance hangars, so their documented dismantling and ultimate recycling can be scheduled.

More than half of all commercial aircraft ever produced are still in operation. There are also large aircraft cemeteries in the arid regions of the USA. The recovery of material from old aircraft is all-in-all a promising field of activity. Engine recycling is a very interesting niche for the extraction of secondary raw materials such as technology metals, super alloys, titanium alloys and stainless steel alloys. However, the environmental standards and recycling quotas in this field vary widely on a global basis. As yet, only recommendations for the high-quality recycling and recirculation of aircraft materials exist on a global level, but no laws, such as the German End-of-Life Vehicles Act. Beyond the rules of waste and aviation law, only the guidelines of the Aircraft Fleet Recycling Association (AFRA) are available as legal guidelines. CRONIMET is also a member of this association and works according to best management practice.

The recycling (urban mining) of engines and landing gear from old aircraft extracts numerous relevant technology metals and thus serves particularly to ensure the availability of raw materials. In the study analysing critical raw materials for Baden-Württemberg's state strategy for resource efficiency, titanium, for example, was classified as critical. Strategically important raw materials are to be recycled through the interventions. In concrete terms, high-temperature super alloys, titanium and high-quality aluminium and stainless steel super alloys are to be recovered from engines and used to secure Baden-Württemberg's raw materials supply.

## Challenge

The greatest challenges lie in the procurement of the primary materials from the aircraft and engine maintenance hangars and in creating an adequate, documented process for rendering the serialised aircraft components (they are individually identified with serial numbers up to that point) unusable. The aircraft recycling project for the recycling of aircraft engines and landing gear is currently being carried out by CRONIMET Ferroleg. GmbH at its Karlsruhe site.

When serialised aircraft components are rendered unusable, it is important to pay attention to ensure that the destruction of the materials is verifiably documented. This is necessary because these components have only been designed for a certain running time or number of revolutions or landings and must therefore be taken out of circulation after the specified running time.



Discs from the fan intake of an engine

Picture on the right: Rolls Royce RB 211 engine



White plastic bags covering parts of the machinery.

21535-38

HERE

WARNING  
PULLING FORCE EXCEEDS  
MAXIMUM ALLOWABLE FORCE  
OF 1000 LBS



Delivery of an engine

### Idea

For the first time in Germany, CRONIMET is offering a combination of service and technology for the recovery and recirculation of the highest quality alloys from safety-related applications in aviation. This service includes securing a supply of secondary raw materials through their worldwide business at the accumulation sites of aircraft maintenance hangars and engine recycling with plants in America, Europe and Asia. A safe, documented and service-oriented process for rendering sensitive secondary raw materials from the aviation industry unusable and for recovering the raw materials by recycling and upcycling can thus be guaranteed worldwide.

### Implementation

During implementation of the measures, strict compliance with procedures is vital to ensure the quality and safety of recycling. The task of the aircraft maintenance hangars is the collection of parts and the corresponding documentation for further processing, then at CRONIMET the delivered parts are checked, sorted and dismantled. Finally, CRONIMET recycles the remaining materials. In order to meet the safety requirements of the aviation industry, all process steps must be verifiably documented. In addition, all CRONIMET employees involved are checked for reliability in accordance with §7 of the German Aviation Security Act.

After the process had been developed, suitable machines were purchased, employees were explicitly trained and instructed in their use and storage and handling facilities were

created. A laboratory for the analysis of the secondary raw materials was set up in Karlsruhe, allowing comprehensive material analyses to be conducted. A nitrogen/oxygen analyser and a carbon/sulphur analyser from LECO Instrumente GmbH are among the devices used. An X-ray fluorescence spectrometer and optical emission spectrometer are used to detect main-group and transition elements of the periodic table of elements and trace elements can be detected by glow discharge mass spectrometry.

### Savings

The sustainability aspects of the process encompass the securing of high-quality technological alloys as raw materials for the state of Baden-Württemberg, environmental relief through substitution of primary sources with secondary sources of high-temperature alloys and other critical metals, securing the location by creating new jobs and increasing the quality and security of existing jobs at the Karlsruhe site. Of the 21,000 commercial aircraft with jet engines put into service worldwide to date, around two thirds are still in use, since the typical period of use before they are decommissioned is around 26 years. A commercially used engine has an average mass of around 3 t, so that a total of 126,000 t of high-quality secondary raw materials is potentially available. The potential within the 15 largest airlines in Europe was examined and 7,265 engines with a combined weight of 22,000 t were found to be available.

The total potential of 126,000 t of high-quality secondary raw materials from the engine sector can be divided up in terms of time and geographic location. Assuming a market penetration of 10%, a potential of approx. 600 t of material per year can be expected, which can be used to close the cycle for the first time at the site in Karlsruhe, Germany.

### Learning objective

Initial experience has already been gained even during the implementation of the process for engine and landing gear recycling at CRONIMET. Reliable information was compiled on the range of commercial and military engines available. This study was divided into Europe (Karlsruhe collection point), North America and Asia. In addition, many tests were carried out on the dismantling, analysis, destruction and recycling of various engine



Combustion chambers in a military engine

types. On the basis of these different dismantling studies, recycling technologies were also tested for currently unusable substances or products, e.g. coatings in the high-temperature range.

### Company

CRONIMET has been a specialist in stainless steel scrap, ferroalloys and primary metals for four decades and is established on four continents with over 60 subsidiaries, shareholdings and representative offices. The CRONIMET Group is a global leader in stainless steel raw materials, mining and recycling and has over 5,600 employees. The company combines many years of experience and expert knowledge with reliability, competence and cooperative partnership. CRONIMET responds to the needs of its suppliers and customers through daily, personal contact.

The company has four foundational pillars: Trade & Sales, Recycling, Production and Services. Based on these, they have a comprehensive offering, which ranges from pure metals and ferroalloys for primary raw materials, to processed stainless steel and metal scrap, to special and super alloys. CRONIMET guarantees its customers exact percentage analyses of all its raw materials, whether pure or in new, precise combinations. As required, all components can be supplied ready for charging into the smelting process.



High-temperature combustion area of a commercial engine



Technical dismantling discussion on a commercial engine



**CRONIMET**  
metals are our passion

### CRONIMET Ferroleg. GmbH

Südbeckenstraße 22

D-76189 Karlsruhe

[www.cronimet.de](http://www.cronimet.de)

Gregor Zenkner

[zenkner.gregor@cronimet.de](mailto:zenkner.gregor@cronimet.de)

The project "100 Companies for Resource Efficiency" was initiated by the Alliance for Greater Resource Efficiency between the leading trade associations of the state of Baden-Württemberg and the state government. The alliance includes the Ministry for the Environment, Climate and the Energy Sector Baden-Württemberg, the State Association of the Baden-Württemberg Industry (LVI), the Baden-Württemberg Chamber of Industry and Commerce (BWIHK), the Chemical Industry Association of Baden-Württemberg (VCI), the Mechanical Engineering Industry Association (VDMA) for Baden-Württemberg and the Electrical and Electronic Manufacturers' Association (ZVEI), Regional Office of Baden-Württemberg.

The project was carried out jointly by the Institute for Industrial Ecology (INEC) at Pforzheim University and the Baden-Württemberg State Agency for Environmental Technology. The examples presented were carefully examined and selected by a jury of members of the participating alliance partners.

The initiative shows how resource efficiency can be implemented and the benefits associated with it. It supports the previous activities on resource efficiency in the country with concrete, presentable results and brings them to the operational level. This motivates other companies to participate.

The 100 examples of excellence have a strong impact beyond Baden-Württemberg and underline the efficiency of the local economy. The aim is to highlight and present the examples of excellence in a representative, high-profile and exemplary way.

**Further information about the project:**

[www.100betriebe.pure-bw.de](http://www.100betriebe.pure-bw.de)

**Contact to the project team:**

Prof. Dr. Mario Schmidt,  
E-Mail: [mario.schmidt@hs-pforzheim.de](mailto:mario.schmidt@hs-pforzheim.de)

Dr.-Ing. Hannes Spieth,  
E-Mail: [hannes.spieth@umwelttechnik-bw.de](mailto:hannes.spieth@umwelttechnik-bw.de)

**The pages are an extract from the book**

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**Baden-Württemberg**

MINISTERIUM FÜR UMWELT, KLIMA UND ENERGIEWIRTSCHAFT