Research around the Vehicle Powertrain – The History of the Institute
Start in New Dimensions – Thermodynamics, Aerodynamics and Engine Research

The invention of the gasoline engine (1876) and the Diesel engine (1893) opened up completely new engineering research areas for propulsion concepts and their practical application.

The history of today’s Institute for Combustion Engines traces back to the appointment of the visionary and technician Hugo Junkers. He came to the Technical University Aachen in 1897 as professor for Thermodynamics and the new, innovative Machine Laboratory. Especially the optimization of combustion processes and their control under different operating conditions – whether stationary or mobile – were crucial for research.

Professor Junkers was fascinated with a just established approach, stating the unity of research and science as well as theory and practice, which he then taught his students to unconventionally inspire them with both aspects of the topic. Moreover, he represented the prototype of a science entrepreneur, since Junkers founded two private testing institutes as an entrepreneur, besides his academic work at the Technical University.

In addition, interdisciplinary research was important for him as well. After Junkers’ leave in 1912, a cooperation with the Professorship for Mechanics resulted amongst others in the construction of the legendary Junkers-aircrafts and the foundation of Lufthansa.
From Theory to Practice –
Power Supply, Automobiles
and Industrial Cooperation

In 1912, Paul Langer, Professor for Thermo-
dynamics, Combustion Engines and Turbo-
compressors, succeeded Hugo Junkers. In
this course, he took over the direction of the
Machine Laboratory and the Thermal Power
Plant, which then functioned as an organiza-
tional unit.

Langer realized early that with the establish-
ment of the combustion engine, there were
new possibilities in the mobility sector. Coher-
ently, he founded the Institute for Automotive
Engineering and Combustion Engines in 1923
and directed it additionally to the Machine
Laboratory and Thermal Power Plant.

As a consequence, research did not only
focus on Diesel engines and propulsion tech-
nology, but also on the interaction between
a vehicle and the roadway. A cooperation
project with Mannesmann-MULAG resulted in
a state-of-the-art truck test bench at that time.
Due to the use of moving belts instead of drums,
it was comfortably suitable for the increasingly
emerging, heavier trucks.

In 1939, Professor Langer’s field of work was
distributed. Professor Langer focused his
research on thermodynamics, the Machine
Laboratory and the Thermal Power Plant
from 1939 to 1943, while his former doctoral
candidate Professor Erich Marquard took over
the Institute for Automotive Engineering and
Combustion Engines.
Propulsion Research among the Shades of World War II

In April 1943, Professor Wilhelm Schultes took over the direction of the Machine Laboratory and the Thermal Power Plant as successor of Paul Langer. Moreover, Professor Schultes was head of the Institute for Steam-Boiler Construction, Heat and Power Economy.

However, bombardments and further consequences of the war did not only have a decisive impact on the urban, but also on the university life. Since teaching was not possible, research was all the more essential. Research was concentrated on the development of engines, materials and propulsion materials, especially steam-powered vehicles.

With the advancement of the allied troops in October 1944, the situation for the war-torn Aachen exacerbated. The Machine Laboratory, including its employees, was relocated to the company grounds of Sachsenberg in Dessau-Roßlau. However, with the Soviet occupation in 1945 and the accompanying dismounting, a large part of the equipment as well as the institute’s library were lost.

Furthermore, the US-American occupation force suspended Professor Schultes in 1945. Thus, the complete university operation in Aachen was severely limited from 1945 until fall 1947, since there were only few lectures and barely any research to take place.
Reconstruction and Reorientation of the Institute for Thermodynamics and Combustion Engines

At the end of the year 1947, the experienced engineer in the field of engine development and thermodynamics, Professor Fritz A. F. Schmidt, took over the Institute for Thermodynamics. In the course of restructuring, it emerged out of the former Institute for Steam-Boiler Construction, Heat and Power Economy, directed by Wilhelm Schultes, as well as the Combustion Laboratory. 1948, with the leaving of Erich Marquard, director of the Institute for Automotive Engineering and Combustion Engines, the subject Combustion Engines was integrated into the Institute for Thermodynamics, which was then called Institute for Thermodynamics and Combustion Engines.

During its first years, the Institute for Thermodynamics and Combustion Engines was located in “Kruppstraße”, before moving to a new building in “Schinkelstraße” in 1956. Initially, especially theoretical works were conducted, due to a general scarcity of resources in the post-war period. Later on, the conduction of experimental research increased. The research focused on gas turbines, combustion and ignition processes in Diesel and gasoline engines as well as the reduction of fuel consumption by increasing efficiency. The research’s emphasis was also visible in teaching, and the lecture offer concerning the combustion engine was expanded continuously.

Professor Schmidt’s official retirement took place in 1968. Afterwards, the Institute for Thermodynamics and Combustion Engines was renamed as Institute for Thermodynamics. It was divided into the Chair of Technical Thermodynamics and the Institute for Applied Thermodynamics. The latter was still being directed by Professor Schmidt as a temporary replacement in 1969.
Milestones in Engine Research – Fundamentals, Optimization, New Ways

In 1970, Professor Dr. techn. Franz Pischinger took over the direction of the Institute for Applied Thermodynamics (German abbreviation: LAT). He came to Aachen with the understanding that the combustion engine still had great potential.

His research activities targeted the improvement of gasoline and Diesel engines of all scales as well as their exhaust gas quality, the lowering of noise emissions as well as the application of alternative and sustainable fuels.

To achieve this goal, Professor Franz Pischinger reorganized the research operation and rebuilt the engine laboratory at the location “Schinkelstraße” from 1971 to 1974. As a result, the simultaneous examination of several engines in separate test bench cells was possible with the help of state-of-the-art sensor technology and simulation models.

Important research successes include:

**Three-way-catalyst for gasoline engines**
distinct improvement by operating with a stoichiometric mixture and catalytic exhaust gas aftertreatment

**Diesel direct injection for passenger cars**
breakthrough with the help of turbocharging in combination with sophisticated combustion-chamber geometries and a secondary exhaust gas control

**Particulate filter for Diesel engines**
series application is based on Professor Franz Pischinger’s research

**Gasoline engine with Direct Injection**
application in a city bus demonstrator vehicle with lean-burn stratified-charge process

**Downsizing**
series application is based on Professor Franz Pischinger’s research

**Alternative fuels**
use of methanol and ethanol in passenger car and truck engines

Professor Franz Pischinger and his team
Moreover, he founded the Collaborative Research Center “Engine Combustion”, which examined the energy conversion in combustion engines in an interdisciplinary approach from 1984 to 1995. The Collaborative Research Center was funded by the German Research Foundation (German abbreviation: DFG).

To enable joint discussions of high-quality specialists, Professor Franz Pischinger founded the “Aachen Colloquium Automobile and Engine Technology” in cooperation with Professor Jürgen Helling from the Institute for Automotive Engineering (German abbreviation: ika) in 1987. The connection of theory and practice in research and teaching was given a high priority at the Institute for Applied Thermodynamics: Professor Franz Pischinger moved research closer to industry needs and achieved a faster implementation of the results.

In 1997, Franz Pischinger was succeeded by his son Professor Stefan Pischinger. His passion for engine research and pleasure for teaching brought the former RWTH Aachen University student back to the location of his mechanical engineering studies.

In 1998, the new dynamics resulted in renaming the Institute for Applied Thermodynamics to Institute for Combustion Engines (German abbreviation: VKA) – according to the idea of a label matching the content.

Research on Diesel injection and combustion (Collaborative Research Center “Engine Combustion”)
The research focus of the Institute for Combustion Engines was expanded by the increasing complexity of technical development without disregarding traditional competencies like thermodynamics, exhaust gas aftertreatment, mechanics or design. To take account of this expansion, the Institute for Combustion Engines relocated to today’s area at Campus Melaten in 2013.

The Institute for Combustion Engines still conducts intense and continuous research on efficiency increase as well as emission reduction for gasoline and Diesel engines. Driven by challenges in society as a whole, alternative propulsions like hybrid, electro or fuel cell drives increasingly gain a center stage within the institute’s research.

The early realization that the future needs interdisciplinary concepts in propulsion research more than ever resulted in the inauguration of the state-of-the-art research center “Center for Mobile Propulsion” (CMP), under direction of the Institute for Combustion Engines in 2013. The Cluster of Excellence “Tailor-Made Fuels from Biomass” (TMFB), raised in 2007, complements and strengthens the interdisciplinary, future-oriented networking of the Institute for Combustion Engines.