Kakuda Space Center

Kakuda Space Center is located in Kakuda City, some 40 kilometers south of Sendai, the capital of Miyagi Prefecture, northern Japan. It has several test facilities each surrounded by mounds on three sides, over land measuring 1.7 million square meters.

The history of Kakuda Space Center started in 1965 when the National Aerospace Laboratory (NAL), the predecessor of JAXA, set up a research center for rocket engines in the west area of the center. In 1978, the National Space Development Agency of Japan (NASDA), also the predecessor of JAXA, set up a test center for rocket engine in the east area of the site. The two organizations were merged in October 2003, and Kakuda Space Center became the research and development (R&D) hub for JAXA's space propulsion technology. The center is used for various tasks from research of fundamental technologies to development and tests of rocket engines.

The center had engaged in R&D and test work on LE-5 engine, Japan's first LOX/LH_2 engine which settled the basis of Japan's large-sized liquid oxygen/liquid hydrogen (LOX/LH_2) rocket engines, and the turbopump system of LE-7 engine of H-II Launch Vehicle. Those technologies have been inherited to produce the current LE-5B and LE-7A engines for the H-IIA/H-IIB Launch Vehicle. The center is now developing the upgraded LE-5B-3 engine, and the most-advanced LE-9 engine for Japan's Next Generation Launch Vehicle H3. The research of fully reusable launch systems and its rocket-based combined-cycle (RBCC) engine which has already been confirmed to operate at a speed of Mach 8 are also carried out at the center. Kakuda Space Center's test facilities are open to private businesses, universities, and foreign space agencies such as NASA. The center is JAXA's R&D hub for space propulsion technologies and a world-leading institute that continues to strive to develop technological innovation.

Kakuda Space Center is also contributing to industry and education as the regional base of JAXA's outreach activities in Hokkaido and Tohoku areas.

The panorama view of Kakuda Space Center

Space Development Exhibition Room

The Space Development Exhibition Room shows Kakuda Space Center's history, and displays a real-sized rocket engine and RBCC engine models with posters explaining R&D project backgrounds. The most impressive display is the wreckage of LE-7 engine which was salvaged from the seabed after the failure of H-II Launch Vehicle No. 8 in 1999, teaching us a lesson of "Learn from Failure." There are also real-size LOX/LH_2 engines of LE-5 and LE-7 and a fuel tank of H-II Launch Vehicle displayed outside of the Exhibition Room and visitors can enjoy a closer look at all of them freely.

The Exhibition Room for studying about rocket engines with posters and models.

Outdoor displays of real rocket engines.

Open: 10:00 – 17:00
Closed: Weekends and national holidays from Nov. to March and New Year holidays
Admission: Free

Public Open Day:
The center holds an annual Open Day in September, celebrating Space Day in Japan. See the website for details and the event schedule.

Group tour
Please call us in advance for group tour reservations if you would like to visit us with 20 or more people.

Inquiries about exhibition and group tours
Tel. 050-3362-7500 (within Japan, or +81-50-3362-7500 from overseas)
From 9:30 a.m. to 12:00 p.m. and 1:00 p.m. to 5:45 p.m. on weekdays.

Location

Access

By train from Tokyo

1. From Tokyo Station, take the JR Tohoku Shinkansen ("Hayabusa" or "Komachi") to Sendai Station (90 min.). Change to the JR Tohoku Line. Get off at Funaoka Station (30 min.) to take a taxi to the center (10 min.).
2. From Tokyo Station, take the JR Tohoku Shinkansen ("Yamabiko" or "Tsubasa") to Fukushima Station (100 min.) and change to the JR Tohoku Line. Get off at Funaoka Station (60 min.) and take a taxi to the center (10 min.).
3. From Tokyo Station, take the JR Tohoku Shinkansen ("Yamabiko") to Shiroishi-Zao Station (110 min.) and take a taxi to the center (30 min.).

By Car

1. From the Tohoku Expressway
   About a 30-minute drive from "SHIROISHI" Interchange or "MURATA" Interchange
2. From the Joban Expressway
   About a 30-minute drive from "YAMAMOTO" Interchange

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JAXA Website https://global.jaxa.jp

Front page images: The moon taken by Super Low Altitude Test Satellite "TSUBAME", the Earth by JAXA/NASA

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JAXA Explore to Realize

Kakuda Space Center

Uncovering new values For people, nations and the Earth

The environment surrounding the use and development of space is now dramatically changing. JAXA is expected to play a far greater role, not only in pioneering the frontiers of space science, but also in contributing to national security, disaster prevention, and industrial development.
The agency has committed to enhancing its existing efforts centering on technology development and tests for broadening the range of the aerospace industry by collaborating with private companies and universities. Our mission is to respond to ever-changing social needs with technologies to open up a new era.

Activities of Japan Aerospace Exploration Agency (JAXA)

Space Utilization Through Satellites
Enhancing our life through global environment observations, disaster monitoring, and the development of communication and positioning technologies.

Development of Transport Systems including Rockets
Advancing Japan's rocket technologies to maintain a technology base while pursuing higher skills and cost efficiency to respond to the needs of space development.

Research on Space Science
Exploring the mysteries of cosmic origins and evolution, as well as the birth of life. Conducting space experiments and advanced engineering research to pave the way for the future of humans.

Use of the Space Environment
Operating the "Kibo" experiment module and "KOUNOTORI" cargo spaceship safely and steadily to contribute to the international community.

Aeronautical Technology Research
Contributing to the growth of the aviation industry and the creation of a secure society through research and development focused on the environment and safety.

Fundamental Technology Research
Strengthening base and advanced technologies in the aerospace sector to enhance Japan's industrial competitiveness.

Kakuda Space Center is a Hub in Research and Development to Innovate Future Space Transportation

H3 Launch Vehicle (H3-22S)

Engine Development for Japan's Flagship Rockets

Japan's flagship H-IIA/H-IIB two-staged Launch Vehicle are powered by LOX/LH_2 propulsion engines; LE-7A for the first stage and LE-5B for the second. Fundamental technologies for critical components of those engines, such as turbopumps, bearings, and shaft seals, have been developed and tested at Kakuda Space Center.
The center is also playing a key role in developing both the first stage LE-9 engine and the second stage LE-5B-3 engine of Japan's Next Generation Launch Vehicle H3.

The high altitude firing test of the second stage engine LE-5B

The running test of a hydrogen turbopump

Research for Improving Reliability and Performance of Rocket Engines

LOX/LH_2 rocket engines are exposed to a wide range of temperatures from extreme-low (under -250°C) to extreme-high (over 3,000°C).
The turbopump pressurizes a large amount of liquid oxygen and liquid hydrogen to several hundred atmospheric pressures with an inducer and impeller rotating at tens of thousands rpm. Both fluids are chemically highly reactive and require careful handlings. Rocket engines must work precisely in such extreme environments to produce high propulsion power.
At the center, the researchers are studying the evaluation and design methodology for the most important components of liquid rocket engines, such as turbopumps and combustors for improving the reliability and performance. The center is also working on engine development and combustion tests to realize reusable launch systems for the future.

The combustion test of a reusable rocket engine (for a reusable sounding rocket)

Bearings and shaft seals developed at the center

Research on Fully Reusable Systems in the Future

About 80% of the weight of the current rockets is oxidant such as liquid oxygen. Reducing the amount of oxidant onboard will allow vehicles to carry more payloads to the space and consequently cost reduction can be achieved. JAXA is developing a combined-cycle engine incorporating the benefits of an air-breathing engine that uses oxygen in the atmosphere super/hypersonic flight.
The center's research team has succeeded in operating an air-breathing engine by using hydrogen fuel under the flight conditions of Mach 4 to 8. The next step is to research and develop a demonstration engine fueled by hydrocarbon which is safer and suitable for practical use than hydrogen.

An image of a combined-cycle engine

An combustion test of a combined-cycle engine in the ejector jet mode

Research on Atmospheric Re-entry

Reusable space vehicles and return capsules are exposed to the gas with temperatures of over 10,000°C when re-entering the atmosphere from orbit. The phenomena during the re-entry phase still remains uncertain because there had been no such thing as this test facility that could make it possible to simulate atmospheric re-entry with high accuracy.
The center's High Enthalpy Shock Tunnel (HIEST) can reproduce an environment with the maximum temperatures of 10,000 °C and the maximum pressure of 150 MPa for a few milliseconds. By dropping a scale model into the airflow at the right moment when hypersonic gas comes into the test section, aerodynamic forces, heat, and pressure on a model can be obtained in the similar condition to an actual free flight, without interference from the supporting systems which occurs with conventional measuring systems. The tunnel is also available for conducting combustion tests at hypersonic speeds of over Mach 8. HIEST is one of the world's biggest shock tunnel which allows versatility and the most advanced functionality with sophisticated test methods, attracting researchers from across the world.

High Enthalpy Shock Tunnel (HIEST)

Re-entry test using a return capsule model

Facilities at Kakuda Space Center

In the east area there are crucial facilities for developing rocket engines such as the High Altitude Test Stand (HATS), in which combustion tests of the second stage engine for a large liquid rocket under the high altitude environment, are conducted. The other facility is the Integrated Feed System Test Stand (FETS) which is used for testing of LH_2 turbopumps and LOX turbopumps of the first stage engine.
In the west area, there are research facilities for fundamental technologies such as the High Altitude Test Stand for research use, the Cryogenic Advanced Turbopump Test Stand and JAXA Rotor-dynamics Test Stand (JARTS). There are also the Ramjet Engine Test Facilities that offer firing tests under the hypersonic environment at speeds of more than Mach 4, the High Enthalpy Shock Tunnel (HIEST) that simulates atmospheric re-entry, and the Laser Energy Transmission Experimental Facility for the Space Solar Power System.