Future From Fukushima.

Future from Fukushima.

Fukushima Innovation Coast Framework

FUKUSHIMA ROBOT TEST FIELD

Fukushima Robot Test Field

For Usage・Contact details

Public Interest Incorporated Foundation
Fukushima Innovation Coast Promotion Organization (Robot Group)
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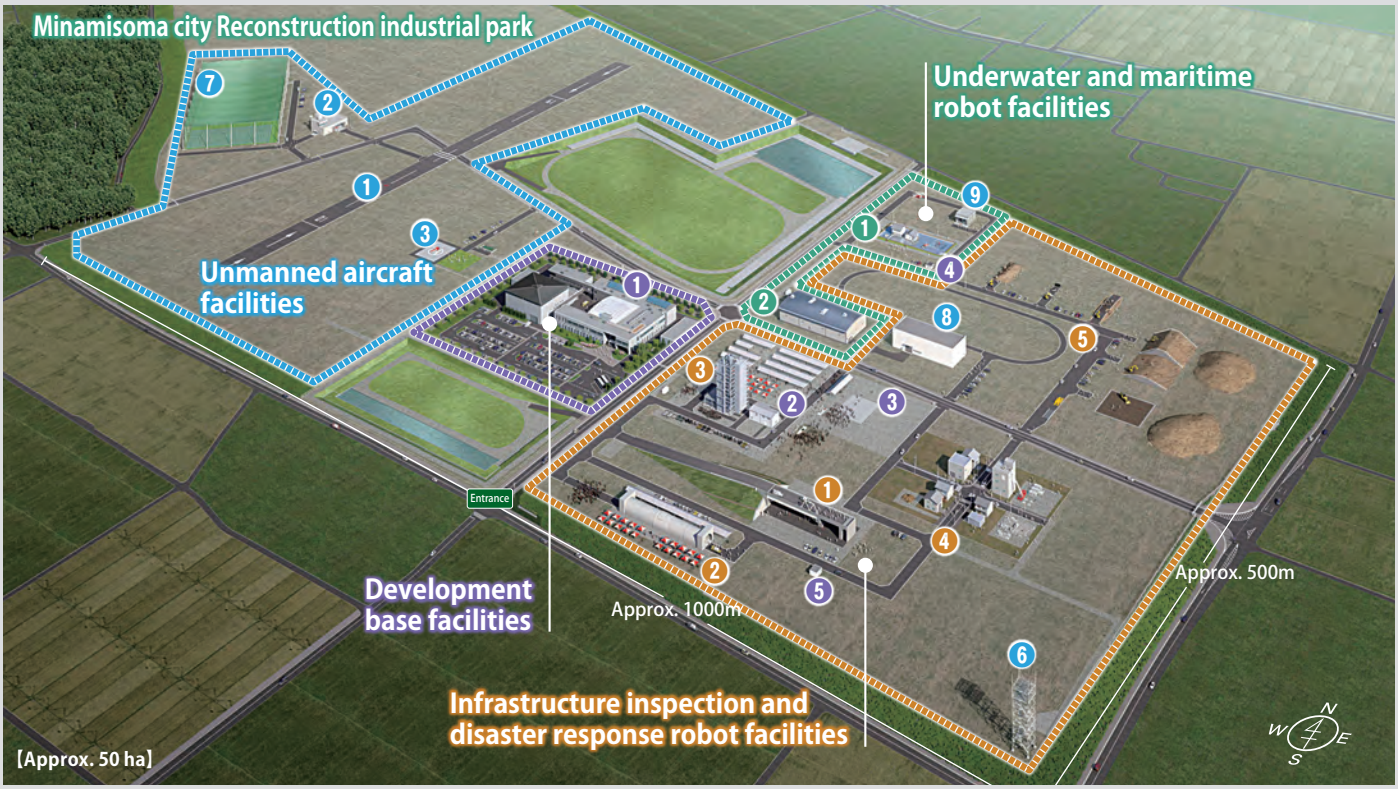
Fukushima Innovation Coast Promotion Organization

Fukushima Robot Test Field

Fukushima Robot Test Field, developed based on Fukushima Innovation Coast Framework, is one of the largest research and development bases in the world. At this reserach base, verification test, performance evaluation and operation training can be carried out while reproducing the actual operating conditions, mainly for ground, maritime, underwater and aerial robots that are expected to be utilized for logistic, infrastructure inspection and large-scale disaster.
The base is scheduled to open in spring 2020, and has unmanned aircraft facilities, infrastructure inspection and disaster response robot facilities, underwater and maritime robot facilities, and development base facilities, within the reconstruction industrial park in Minamisoma City.
The size of the site is approx. 1000 m from east to west and approx. 500 m from north to south.
The base also has Namie Town runway in Namie Town Tanashio industrial park to enable long distance flight test.

Fukushima Innovation Coast Framework

The Fukushima Innovation Coast Framework is aiming to restore industries in the coastal region of Fukushima which were lost due to the Great east Japan Earthquake and nuclear disaster. It also incorporates a national project which seeks to build a new industrial base in the region. Under the framework, we are working on industrial clustering, human resource development, and expansion of migrant population dynamics, as well as promoting the implementation of projects relating to nuclear reactor decommissioning, robotics, energy development, agriculture, forestry, and fisheries industries.

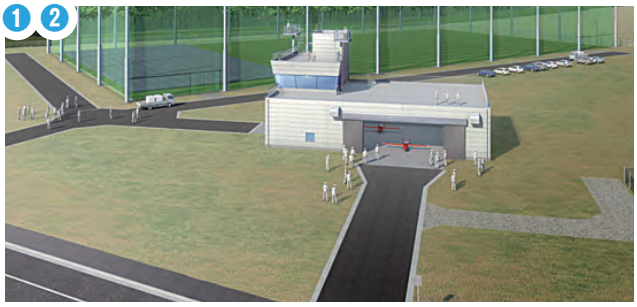


Unmanned aircraft facilities

Fukushima Robot Test Field has the largest flight airspace, runway, and airfield with impact absorption net in Japan for unmanned aircraft to provide an environment that enables basic flight test and other various tests such as collision avoidance, forced landing, falling, and long-distance flight, and promotes the practical application of unmanned aircraft.

❶ Minamisoma runway ❷ Hangar ❸ Heliport

These facilities are used for flight tests and operation training for unmanned aerial vehicles. Special flight test such as collision avoidance, forced landing, falling, or object dropping can be conducted in the buffer zone. The hangar has a measurement room that can overlook the entire area and an antenna mount are equipped. Heliport can be used for unmanned and manned VTOL type aircraft.



【❶Runway】
- Runway …… 500m×20m (Asphalt pavement)
- North-south direction
- Buffer zone …Width : 200m(including runway)
- Electric Power outlets, LAN ports near runway

【❷Hangar】
- Total floor space…Approx. 558 ㎡, Steel construction, and 2 stories
- Measurement chamber……66.5 ㎡ 2F
- Maintenance room……64.4 ㎡ 1F
- Hangar……314.1 ㎡ 1F
- Door size……W10m×H4.2m
- Antenna installation base……Roof
- Restroom

【❸Heliport】
- Heliport size…25m×20m (Concrete pavement)
- Apron……25m×23m (Lawn Ground)
- Fuel strage ……Concrete block construction 12m×6m×1.2m

❹ Namie runway　❺ Hangar

Scheduled to open in the 1st quarter of 2020

In contrast to the Minamisoma runway which runs north-south the Namie runway runs east-west allowing for takeoff directly over the sea.

【❹Runway】
- Runway……400m×20m (Asphalt pavement)
- East-west direction
- Buffer zone……Width 100m (including runway)
- Electric Power outlets, LAN ports near runway

【❺Hangar】
- Same spec as Minamisoma Hangar

❻ Communication tower /The wide flight area

Through individual consultation, a flight course over land and sea can be approved for the approx. 13km distance between Minamisoma City and Namie Town. Long distance and wide area flights can also be carried out. Communication towers installed near both bases secure flight safety over a wide area by ensuring communication, measuring low wind direction and speed, and detecting objects such as manned aircraft and birds.

【Communication tower】
- Height:30m
- Wide area communication antenna (brought-in is allowed)
- Surveillance radar
- Meteorological Observation System (Measurement range 6km, direction wind speed of altitude 30m, 50m, 100m, wind 150m), wind speed of 5m above ground, temperature and humidity.

【Communication antenna】
High-gain antennas and rod antennas for 2.4 GHz and 920 MHz are installed in the Odaka and Haramachi areas.
By switching the antenna, the wide flight area radio communication is covered.

※As there are only a limited number of compatible radio equipment, settings will be needed.

【Surveillance radar】

■High-resolution type radar spec
- Monitoring range……360 degrees
- Azimuth resolution…Less than 0.45 degrees
- Distance resolution.……less than 25m
- Target speed resolution capacity ……0.001 m/s or less (Motion path, Traceability)

■Detection size and maximum detection distance by a radar
- An object to be detected……20 cm²: 3.5km *
  ……50 cm²: 5 km *
  ……500 cm²: 10 km *

* The maximum detectable distance is a calculated from a value in free space. This distance varies based on the conditions of the instruments and weather. Update time: 5 seconds.

【Meteorological Observation System (Lidar spec)】

■Measuring performance
- Altitude measurement……50 – 6,000m (Depends on the state of the atmosphere. It can measure up to 14,000 m.)
- Data measuring accuracy…0.5 – 10 seconds (Selectable)
- The number of measurement points…–320 points
- Measurement range and accuracy…±30m/s, 0.5m/s
- Distance resolution……25m/50m/75m/100m
- Scan azimuth angle……0 – 360 degrees (Accuracy 0.1 degree)
- Scan zenith angle…–10 – 190 degrees (Accuracy 0.1 degree)

■Screen display performance
- Wind direction・Wind speed data Horizontal resolution……200 – 500m
- Altitude Resolution……10 – 50m
- Data output format……CSV format
- Wind direction・Wind speed estimation method……VVP method
- Screen update frequency…3 – 5 minutes
- Other spec Display position of Doppler Lidar, mapping of past data on a map, zooming in and out of a map

※Please contact us for the actual range because it is described in the device spec.

❼ Airfield surrounded by net

This airfield is non-applicable to Civil Aeronautics Act, whose upper and surrounding parts are covered with net. Evaluation tests such as basic flight performance and autonomous control of unmanned aerial vehicles, flight training, and night flight and object dropping can be performed under an outdoor environment involving wind and rain or sunshine, without making any legal application in advance.

- 150m×80m×height 15m
- Long pile artificial grass
- Lighting, electric power outlets, LAN ports
- Net …… High strength and high weathering polyolefin gap ⌀2.4×120 ㎜

❽ Wind tunnel

Scheduled to open in the 1st quarter of 2020

The aerodynamics, flight performance, and stability of the aircraft against gusts and pulsating winds against unmanned aerial vehicles can be tested.

- Floor space……900 ㎡ Steel construction flat house
- Wind tunnel test device(including table and protective net)
- Overhead traveling crane (4.9 t)
- Cross sectional area……3m×3m
- Max wind speed……20m/s
- Wind speed distribution……less than ± 15% at more than 10m/s (air outlet)
- Turbulence value …… less than ± 10% at more than 10m/s (near the center of the air outlet)
- Windstorm performance……Within 3 seconds at 8m/s – 20m/s
- Pulsating performance……Within the cycle of 5 seconds at 10m/s – 20m/s
- Speed stratification performance……Velocity gradient to the vertical direction

❾ Durability test site

This facility is the test space covered with concrete,for the long-term continuous operation durability test for unmanned aircraft safely.

- Floor space……119 ㎡・ reinforced-concrete construction flat house
- Test space……10m×9.5m×Height 5m
- Door size……W5m×H4m

Underwater and maritime robot facilities

This is the only test site in Japan for the demonstration test by robot, regarding underwater infrastructure inspection and disaster response. These facilities can reproduce conditions occurring in the water such as dams, rivers, submerged urban areas, or harbors.

① Submerged urban field

This field can reproduce conditions of submerged city with flood damage. It can be used for information gathering, search/rescue training and etc. by water- surface and underwater robot and unmanned aerial vehicles. It can also be used for testing under conditions where objects and obstacles are sunk, rescue training with manned helicopters or boats.

- 50m×19m×water depth 0.7m Outdoor water tank (of which 10m x 10m:water depth 5m)
- Submerged house A ····· 53㎡ The partial 1st floor is submerged
- Submerged house B ····· 53㎡ The whole 1st floor is submerged
- Outdoor plug socket board

② Indoor water tank

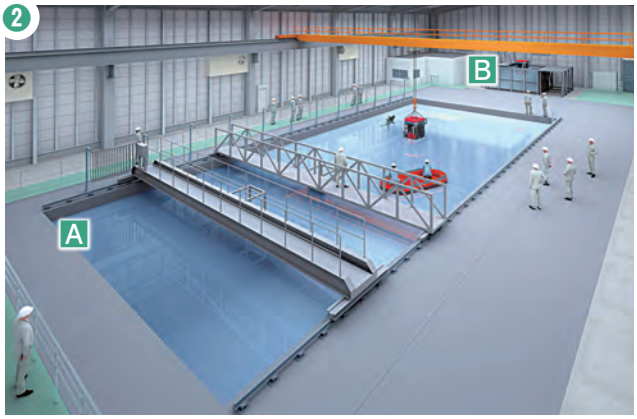
Scheduled to open in the 1st quarter of 2020

This facility reproduces conditions of dams, rivers, and harbors to perform tests and maneuver training on inspection and investigation with the underwater/ water-surface robot. The large water tank is equipped with a test piece simulated an aging underwater structure, and enables installation of inspection objects, generating water flow, reproducing the dark places. In a small water tank, the performance on observation instruments to be installed can be tested by controlling the turbidity.

- Floor space·····1,456㎡ • Steel construction, Flat house
- Carry-in entrance·····W3.5m×H3.4m

A Large water tank
- 30m×12m×water depth7m
- Water flow generation device (Point from device 1m: 3m/s, 5m: 1.4m/s)
- Brightness adjustable
- Restroom, changing room
- Movable observation stand
- 4.8t crane
- Water tank measurement room 12.2㎡

B Small water tank
- 5m×3m×water depth 1.7m
- Movable observation stand
- Turbidity adjustable



Infrastructure inspection and disaster response robot facilities

This is the only test site in Japan for the demonstration test on infrastructure inspection and disaster response by robot. It is possible to reproduce almost conceivable disaster environment and aging condition in structures such as tunnels, bridges, plants, urban areas and roads. In August 20 to 22, 2020, "World Robot Summit", the international robot competition will be held.

① Mockup bridge

Scheduled to open in the 1st quarter of 2020

This is a bridge of four different types made of steel and concrete that reproduces aging. It can be used for testing and maneuvering related to status check and inspection. It reproduces the objects to be inspected such as cracking/peeling/flaking on concrete, looseness/cracking on steel bolts, and dysfunction with bearings, and some variations can be replaced as test pieces. Also,objects of hindering on inspection, illumination posts , protective fences that may hinder inspection, trusses, or cable tubes can be installed.

- Length 50m Road width 10m Bridge girder height 5m
- Steel bridge part
  Steel simple girder length 35m
- Concrete bridge part
  PC simple pretension system T girder bridge and the same floor slab bridge length15m

【Appendage】
- Mockup light column, flexible guard fence, rigid guard fence
- Mockup trusses, mockup failure prevention devices, mockup inspection paths, mockup mounting pipes
- Outdoor plug socket board

【Inspection object】
- Cracking・Peeling・flaking of the concrete, loose bolt・crack of Steel material, Dysfunction of bearing part

② Mockup tunnel

This tunnel reproduces the wall peeling and aging. It can be used for testing and maneuvering on situation confirmation, search, debris removal, aging inspections. On its wall, it is equipped with lighting equipment on expressways and ordinary roads (LED light, sodium lamp) and jet fans to reproduce cracking/peeling to be inspected. Some variations can be replaced as test pieces. Inside the tunnel, obstacles such as vehicle, rubble, rock, or gravel can be placed, and the shutters on both sides can be closed to reproduce the central part of a long tunnel.

- Length of 50m（Barbed concrete section 40m,Plain concrete section 10m）,road width of 6m
- Inner section
  ····· W8.8m×H6.36m

【Appendage】
- LED light, sodium lamp
- Mockup jet fan
- Mockup fire-hydrant
- Water supply port
- Induction display board
- Water drain
- Plug socket board

【Inspection object】
- Cracking of the concrete
- Flaking
- Collapse
- Deficiency of thickness of tunnel wall

❸ Mockup plant

This facility reproduces plants at normal/disaster situation to perform tests and maneuvering training on inspections, information gathering and equipment operation. This facility has been installed plumbs, valves, ducts, stairs, spiral stairs, catwalks, vertical ladders, tanks and chimneys in various shapes. Abnormal environments can be reproduced, by changing/blinking instruments and indicators, filling smoke or gas, and arranging heat sources and debris.

- Steel construction 6 stories (height 30m)
  Each floor approx.130 ㎡
  Elevator for cargo(H2.0m×W4.5m weight upper limit 2.1t)
- 5th and 6th floor
  3 chimneys(⌀ 3m, ⌀ 2m, ⌀ 1m) and vertical ladder are installed.
  The 5th and 6th floor total space 197.08 ㎡
- 3rd and 4th floor
  Mockup tank (3rd floor r 2.8m, 4th floor r 1.8m) and vertical ladders and spiral stairs are installed.
  3rd and 4th floor each space127.82 ㎡
- 2nd floor
  Piping (SGP500A,300A,200A, 100A,50A,PVC200A,50A)Gate Valve, pressure gauge, View station, duct
- 1st floor (2 sections)
  Piping (SGP200A,150A, 100A,80A,50A)
  A Mock up boiler B Pump
  C Tank
  Slope, ball valve, gate valve, butterfly valve, pressure gauge, water level gauge


3rd floor


5th and 6th floor


1st floor C


2nd floor


1st floor A


1st floor B

❸

❹ Urban field

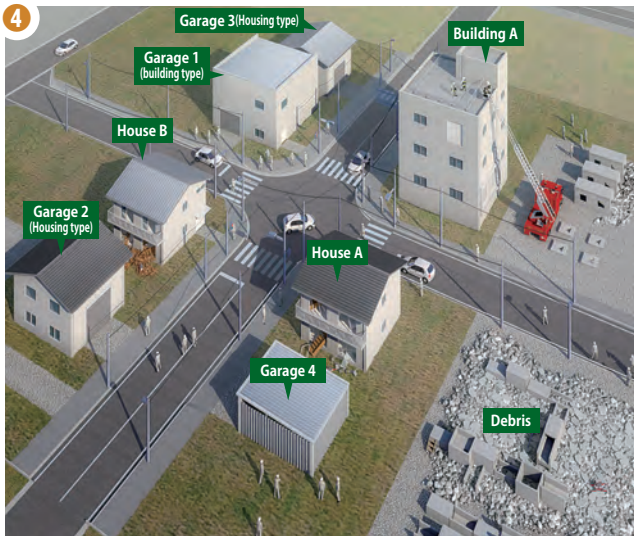
In this field, houses, buildings and intersections with traffic light/road sign are arranged to reproduce the condition of city area. Vehicles, debris, and objects to be inspected are placed inside/outside the buildings to perform information gathering, investigation, obstacle removal, search and rescue of personnel, and inspection testing and maneuvering training. It can also be used for running tests using concrete and wood debris, bleaching training on building walls and floors, and automatic driving tests using road parts.

- Building A ····· Reinforced concrete construction, 3 stories, each floor 100㎡
- House A ····· Wooden construction, 2 stories, each floor space 53㎡(Simulate the inside house and simulate damage)
- House B ····· Wooden construction, 2 stories, each floor 53 ㎡ (simulates the inside house)
- Garage 1 (building type) ····· Steel construction, 1 story, 110㎡ Inside can be used as a warehouse
- Garage 2 (Housing type) ····· Steel construction, 1 story,56㎡ inside can be used as a warehouse
- Garage 3 (Housing type) ····· Steel construction, 1 story,56㎡ inside can be used as a warehouse
- Garage 4 ··· Light gauge steel construction, 1 story, 47 ㎡ Inside can be used as a warehouse

【Road】
- North-south direction
  Length 75m Width 12m (including sidewalks)
- North-east direction
  Length 96m, width 7.5m (including the sidewalk)
- Telegraph poles, road signs, lights, traffic lights, etc.

【Debris】
- Concrete culvert (32 Pieces)
- Bleaching panel (9 pieces)
- Concrete Debris
- Wood Debris

❹



❺ Debris/landslide field

This facility reproduces the road interception site at the time of disaster and the landslide site. It can be used for testing and operation training on unmanned construction heavy equipment and robot status confirmation, search and rescue, and restoration work. It has a soil slope reproducible at 15 or 30 degree, muddy grounds with adjustable softness, and a circuit for running durability test, as well as various obstacles that can be placed on the road.

【Circuit】
- Length 400m, width 4m, (asphalt pavement)

【Soil slope】
- Inclination 30° ···30m×30m, height approx. 7m
- Inclination 15° ···30m×30m, height approx. 3m

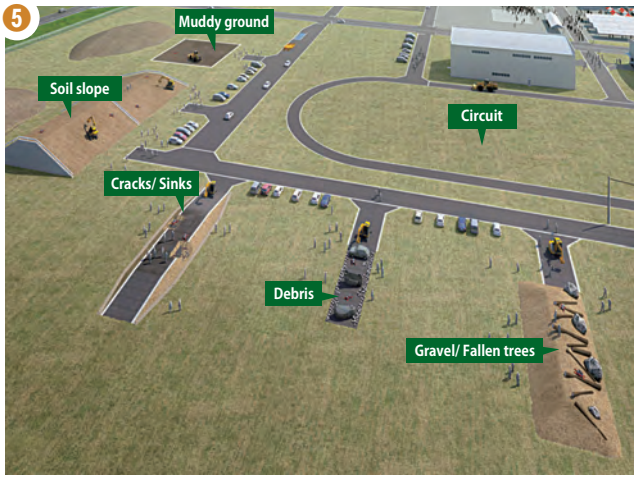
【Cracks/ Sinks】
- Length 20m , width 7.6m, (asphalt pavement)
- Road collapse/Road crack

【Muddy ground】
- 30m×30m depth 0.3m

【Debris】
- Length 20m, width 6m, (asphalt pavement)
- Concrete block/ Vehicles/Telegraph poles

【Gravel/ Fallen trees】
- Length 30m, width 6m, (concrete pavement)
- Soil, rock, approx.10 fallen trees

❺



Development base facilities

① Research building

This facility is the main building of Fukushima Robot Test Field, where can use for various tests against wind, rain, waterproof, dustproof, fog, water pressure, temperature, humidity, vibration, and radio wave about performance evaluation of robot. It also can use for preparation,processing and measurement for each test.
This facility can be used as a short/long term base for researchers, an office, and hold a large-scale conference or an exhibition.
In addition, Fukushima Technology Centre Minamisoma Technical Support Centre, installed in the ward, will provide equipment support,technical consultations and development support.

- Floor space : approx. 5,200 ㎡
- Reinforced concrete construction(2stories)
- Parking area for approx. 165 cars

A Laboratory
- 30 – 60 ㎡ 16 rooms
- office desk 2, office chair 2, Bookshelf 1 (laboratories 1 – 13 are equipped a mini kitchen.)

B Conference room
- 7 rooms for 20 – 40 people

C General control room
- For operation management while looking at the unmanned aircraft facilities

D Indoor examination-place
- Floor space 32×30m
- Ceiling height 11 m
- Overhead travelling crane 2t
- Epoxy resin type floor covering on floor concrete
- Carry in entrance W7m×H4.1m
- Robot driving performance test course (NIST standard)

E Courtyard
- Courtyard with half roof(36×18m) can use for test preparation

F Conference hall
- For 180 people (theater type)

G Development laboratory
- 2 room(For short-term stay, 40 ㎡)
- single phase 100V,single phase 200V

H Instrument Analysis Room/Precision Measurement Room/Dust test room

I Processing room

J Environmental measurement room

K Anechoic chamber

L Vibration test room

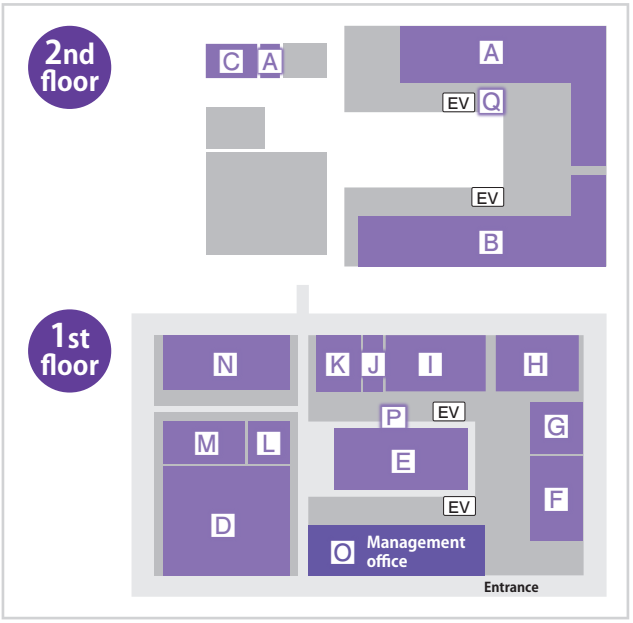
M Test room for wind resistance･rainfall/Waterproof test room

N Rental warehouse/Depository
- 30 – 100㎡ 7 rooms
- 2ton overhead travelling crane (only in Depository)
- Carry in entrance W2, 690 mm/3, 790 mm/ 4, 300 mm x H4, 100 mm
- Epoxy resin type floor covering on floor concrete

O Management office

P Shower room

Q Mini workshop, electronic control room



② Test Preparation Building　③ Outdoor test preparation place
④ Simple measurement room A　⑤ Simple measurement room B

For Preparation of test and maintenance of robot

【❷Test Preparation building】
- Steel framed structure 2 stories,approx.220㎡
- maintenance room … 70.7㎡
- Preparatory office 1 … 45.0㎡
- Preparatory office 2 … 74.6㎡
- Restroom

【❸Outdoor test preparation place】
- 20m×25m (Concrete pavement)

【❹Simple measurement room A ❺Simple measurement room B】
- Light gauge steel construction, Flat house, Floor space 24.3 ㎡
- Office space 16.8 ㎡, restroom , kitchen

Period of use

1) 【AM】9:00 – 13:00　【PM】13:00 – 17:00
【Nighttime】17:00 – 21:00　【All day】0:00 – 24:00
【Extratime】0:00 – 9:00 and 21:00 – 24:00

2) It will be added the same amount as the fee if any of the following applies.
①Holding event with collecting admission fee,tuition,membership fee for the purpose of profit
②Using for profit-making such as commodity sales, commercial advertising

3) In the case of using for preparation, it will be reduced the fee to 70%.

4) In the case of continued use of more than 2 days, if it is for storage of exhibits or equipment, Nighttime ~ Morning fee will not be collected.

Flow of use

1 Pre-consultation <by 1 month before the test day>	■Please inquire availability for test,by E-mail. ■Please contact us as soon as possible if you want to use any facilities.
2 Application for use <by 2 weeks before the test day>	■In pronciple, please submit required documents by the day 2weeks before the test day.
3 Approved for use <by 10 days before the test day>	■If the use is approved after confirming the content, we will send a usage approval and payment form.
4 Test plan meeting, payment of fee < by the day before the test day>	■The meeting for the test will be held by the day before the test day. ■Please pay the fee before use.
5 The test day	■Please use according to the user guide. ■After use, please restore to original state and be checked by the staff.

Equipment list

※ In this list, robot test field staff is in charge of the items marked with ●. Fukushima Technology Centre, Minamisoma Technical Support Centre staff is in charge of the other items.

Machining equipment	Type	Spec
I Machining center	VARIAXIS j-600/5X AM Wire arc metal lamination	Movement : 850mm (X axis), 550mm (Y axis), 510mm (Z axis), -120 – 90° (B axis), 360° (C axis) Lamination method : Wire arc metal lamination Laminatable metal : Aluminum, Stainless steel, Mold steel, Heat resistant alloy, etc.
I NC milling cutter	KE55	General purpose operation, Machining guidance operation and NC program operation are available Movement : 550mm (X) ×320mm (Y) ×350mm (Z) Table size (work space) : 800mm×375mm Spindle rotational speed : 40 – 4,000rpm
I Semi-automatic lathe	TAC-360	General purpose operation, Interactive input operation, Machining by CNC programming are available Distance between both centers : 770mm Spindle speed range : 60 – 2,000rpm
I Drilling machine	B 23S	Maximum processing capacity : ⌀23mm Spindle rotations : 2,400rpm, 1,320rpm, 830rpm, 400rpm
I Contour machine	VZ-300SA	Cutting ability : 200mm (H) × 300mm (D) Table stroke : 250mm
I High-speed cut-off machine	HS-100G2	Standard cutting ability : 45mm (Pipe material), 40mm(Solid material), Plate material (20mm×75mm)
I Shearing machine	AST-1313	Cutting thickness : 13mm (approx. SS400 equivalent) Cutting length : 1,280mm
I Cutting dynamometer	9139AA	Measuring range (when loaded on a plate) : ±30kN (Fx,Fy,Fz), ±3,000N・m (Mx,My,Mz) Top plate : 140mm×190mm
I Double-headed grinder	FG255T	Grinding wheel outer diameter : ⌀255mm × 25 mm (thickness) rotational speed : 1,500 rpm
I Belt grinder	FS-2N	Belt width : 100 mm Belt speed : 17.2 m / s (50 Hz)
Q 3D printer (1)	L-DEVO F300TP	Fabrication method : Fused deposition method Fabrication size (mm) : 310(W)×310(D)×450(H) Fabrication material (example) : H-PLA、ABS
Q 3D printer (2)	F170	Fabrication method : Fused deposition method Fabrication size (mm) : 254(W)×254(D)×254(H) Fabrication material (example) : PLA、ABS Support material : WaterWorks soluble support method

Material processing equipment	Type	Spec
I Sputtering device	MC1000	Film forming material : Pt, Pt-Pd, Au, Carbon
I Sample polishing system	Ecomet300 pro / Automet300	Polishing plate size : 10 inch Polishing plate rotation speed : 50 – 400rpm

Analytical equipment	Type	Spec
H Scanning electron microscope	S-3700N	Elements can be analyzed : B – U Magnification : 15 x – 300,000 x Maximum sample size : ⌀300mm
H Measuring microscope	MF-UK4020D	Measurement range : 400 mm × 200 mm, Maximum height of test object 220 mm Observation mode : bright field, dark field, differential interference, simplified polarization Measurement accuracy : (2.2+0.002L) μm
H Fourier transform infrared spectroscopy system	Spotlight200i-DTGS SpectrumTWO	Measurement wave number range : 8,300 – 350cm-1、7,800 – 400cm-1 (Microscopic) Detector : LiTaO3、DTGS (Microscopic)
H Energy dispersive X-ray fluorescence analyzer	EA6000VX	Measurement element：Na(11) – U(92) Tube voltage and current：50kV (Variable) /20 – 1,000 μA Irradiation type : Top vertical irradiation
H Stereomicroscope	S9i	Magnification range : 6.1x – 55x Built-in camera : 10 million pixel color
L FFT analyzer	CF-9400	Number of channels : 4 Frequency range : DC – 100kHz A / D converter : 24 bit ΔΣ type
Q Oscilloscope	Wave Runner 8254-MS	Analog band width : 2.5 GHz Channel : 4 ch (analog), 16 ch (digital) Waveform analysis tool : Serial trigger, decode, measurement/graph, eye pattern
Q Data logger	GL980	Sampling interval : 1 μs – 1 min Possessed probe : K type thermocouple, temperature sensor Channel : 8 ch Recordable time : 4 seconds (1 μs) – 1 year or more (1 s)
Q Radar evaluation equipment	DSO5804A	Measurable frequency : 75 GHz – 83 GHz (using block down converter) Analysis function : Digital modulation analysis, FMCW Radar analysis, pulse radar analysis
Q DC stabilized power supply (18V specification)	DC30-36	Output rating (Voltage : 30V Current : 36A Power : 360W)
Q DC stabilized power supply (60V specification)	DC80-27	Output rating (Voltage : 80V Current : 27A Power : 720W)
Q AC stabilized power supply (single-phase specification)	DP015S	Power capacity : 1.5kVA Rated Output Voltage : 100V/200V Maximum Current : 15A/7.5A Frequency Setting Range : 40Hz – 550Hz
Q Digital multimeter	34470A	Resolution : 7 1/2digit, DC voltage (range : 100mV – 1,000V, minimum resolution : 10nV), AC voltage (range : 100mV – 750V, minimum resolution : 10nV, frequency band : 3Hz – 300kHz) , Resistance (range : 100Ω – 1GΩ, minimum resolution : 10 μΩ) , DC current (range : 1 μA – 10A, minimum resolution : 100fA), AC current (range : 100 μA – 10A, minimum resolution : 10pA, frequency band : 3Hz – 10kHz)
Q Impedance analyzer	65120B	Measurement frequency range : 20Hz – 120MHz Measurement range : 0.01mΩ – 2GΩ, measurement parameters : Z, θ, C, D, L, Q, R, X, G, B, Y fixture : for lead parts, for chip parts, for thin films

Physical properties equipment	Type	Spec
H Vickers hardness tester	HMV-G21DT	Sample stage space : 100mm×100mm Maximum sample height capacity : 100mm Ability : 98.07mN – 19.61N
H Rockwell hardness tester	RMT-1	Maximum sample height capacity : 200mm Maximum sample depth capacity : 165mm Ability : 588.4N, 980.7N, 1471N
I Universal material testing machine	AG-100KNXPlus	Maximum load capacity : 100kN Effective test width : 930mm Crosshead movement : 1,330mm (Without jig)

Dimensions・shape measurement equipment	Type	Spec
H X-ray CT scanner	TOSCANER-24500AVFD	X-ray tube output : Maximum 450kV / 3.3mA Line detector /flat panel detector switchable Scan area : ⌀600 mm × H 1,000 mm
H CNC 3-D measuring machine	STRATO-Apex9166	Measurement range : 900mm (X axis) 1,600mm (Y axis) 600mm (Z axis) Measurement error range : E0,MPE=0.9 +2.5L/1,000 (μm)
H Measuring machine for Surface coarseness and Outline shape	SV-C4500L8	Measurement range : 200mm (X axis (drive unit)) 60mm (Z1 axis (detection unit))
H Non-contact 3-D digitizer	ATOS Compact Scan 12M	CCD camera pixel number : 12 million pixels × 2 Measurement range : 170mm×130mm×110mm, 390mm×290mm×250mm, 700mm×500mm×500mm

Environmental equipment	Type	Spec
● D Pressureproof test equipment	—	Pressurize by water. Maximum pressure : 2.2 MPa Container size : ⌀1.5 m , 1.5 m(H)
● H Earthly affairs test device	DTS-2019-SP5	Can test based on IP5X, IP6X Tank size：1,500(W)×1,500(D)×1,000(H) mm Maximum sample weight：150kg
J Temperature and humidity testing chamber	EC-16MHHP	Tank size : 500mm (W) ×380mm (D) ×630mm (H) Temperature range : -40 – 150℃ Humidity range : 20 – 98%RH
J Decompression Temperature and humidity testing chamber	ALT-7018-3400-HW	Tank size : 1,500mm (W) ×1,500mm (D) ×1,500mm (H) Temperature range : -70 – 180℃ (Atmospheric pressure) -70 – 140℃ (Below atmospheric pressure – 33.4kPa) Humidity range : 20 – 95%RH (Atmospheric pressure) 20 – 85%RH (69.7kPa) Pressure control range : 10.7 – 101kPa (Absolute pressure)
J Thermal shock testing equipment	ES-77LH	Tank size : 410mm (W) ×360mm (D) ×490mm (H) Temperature range : -70 – 0℃ (Low temperature exposure), 60 – 200℃ (High temperature exposure)
J High acceleration life testing equipment	PC-422R8	Tank size : 420mm (⌀) ×485mm (D) Temperature range : 105.0 – 133.3℃ (100%RH) 110.0 – 140.0℃ (85%RH) 118.0 – 150.0℃ (65%RH) Humidity range : 65 – 100%RH Pressure range : 0.019 – 0.208MPa
J Drying furnace	VTEC-216-H	Tank size : 600mm (W) ×600mm (D) ×600mm (H) Temperature range : 60 – 300℃
L Two axes reshuffling vibration testing equipment	VTS-60ES-2 ／ 150 Type	Testable waveform : Sine wave (Steady, Sweep : linear/logarithm), Random wave Test frequency range : 3Hz – 200Hz Maximum acceleration : 49m/s² Maximum loading : 500kg Table size : 1,500mm×1,500mm
L Single axis vibration testing equipment	FC-080K ／ 60 Type	Testable waveform : Sine wave (35kN), Random wave (35kNrms), Shock wave (87.5kN) Test frequency range : DC – 2,000Hz Maximum acceleration : 889m/s² (Sine wave no load), Maximum loading : 500kg Available for combined test
L Tempurature and humidity testing chamber (Compound test)	VC-102DWMX (32) P3G-H/V	Tank size : 1,000mm (W) ×1,000mm (D) ×1,000mm (H) Temperature range : -40 – 150℃ Humidity range : 30 – 98%RH
● M Waterproof test equipment	IPX-3456-TBSP	Can test based on IPX3, IPX4, IPX5, and IPX6
● M The rain・drizzle test device	FRTF-HRS200V-180	Precipitation : 10 – 180mm approx 3mm/h (Drizzle) Particle size (raindrop diameter) : approx. ⌀1mm, approx. ⌀3mm Rainfall range : 4m×4m×Height 4m
● M Wind-resistant test device	Jet GYM GRL-8041	Fan diameter : ⌀800mm Wind speed and reach distance : 5m/s(20m) 1.5m/s(70m)

Anechoic chamber	Type	Spec
K Anechoic chamber	3m Radio anechoic chamber	Space : 8.5m (L) ×5.0m (W) ×5.6m (H) Turntable : ⌀2.0m Antenna lift range : 1 – 4m Measurable frequency band : 30MHz – 18GHz
K 3-D radiation pattern measurement system	—	Measurement frequency range : 700 MHz – 6 GHz Rotation range : Measurement by gantry (horizontal; 360°, vertical : ±165°) Measurement coordinate system : Spherical coordinates
K TRP/TIS measurement system	—	Communication method : LTE (FDD), TD-LTE, IEEE802.11 b/g/a/n/ac, etc.
K GNSS receiving system sensitivity evaluation system	—	Supported satellite : GPS, QZSS, Galileo, etc.
K Multipath phasing evaluation system	—	Test frequency range : 380 MHz – 6 GHz Phasing pattern : Rayleigh phasing
K Radiation EMI measurement system	—	Measuring frequency range : 30 MHz – 6 GHz Applicable standard : CISPR32, VCCI
K Radiation immunity test system	—	Test frequency range : 80MHz – 4GHz(Max30V/m), 4GHz – 6GHz(Max10V/m) Applicable standard : IEC61000-4-3

Other equipment	Type	Spec
● Fume simulator	PS-2006	Smoke ability : 10 – 31m³/min (Variable) Smoke reach distance : 3m (Windless time)
● Victim simulator	WRR-25	Material : PVC plastic resin Body weight : 24.9kg±4% Height : 160cm±5cm
● Outdoor large monitor system	LEDVISION	Monitor size : 4,000mm×2,000mm Viewing angle : 150 (°Horizontal) 120 (°Vertical) Contrast ratio : 5,000:1 Maximum brightness : 5,000NITS (cd/m²)
● Light projector	LS304D	LED energy consumption : 300W × 4 light Power Generator : 2kVA (50Hz)
● Generator	DGM600MK	Can output simultaneous Three-phase・single-phase three line Rated output : Three-phase four-line 50 / 60kVA, single-phase three-line 30 / 36kVA Outlet:6 pieces
● High-speed camera	SA-Z type RX-HK	Color photographing Pixel number : 1,024×1,024 pixel Maximum shooting speed (full frame) : 20,000fps Maximum shooting speed (Dividedframe) : 2,100,000fps
● Picture record system	—	Network camera：4K fixed type and HD image quality fixed type・movable type Portable camera：4K Handy Type and Small Type Image recording apparatus : Image of network camera and a portable camera can be edited simultaneously
● 3D motion capture	OQUS7+	Sampling : 300fps (12 million pixels), 1,100fps (3 million pixels) Maximum sampling : 10,000fps Can measure in outdoor

Transport Access

From Tokyo (Approx. 3 hours)

Car
- **Misato IC**
- Approx. 250km , and 3 hours via Joban Expressway
- **Minamisoma IC**
- Approx. 9km, 17 minutes via Prefectural Route 12 by car
- **Fukushima Robot Test Field**

Shinkansen
- **JR Tokyo Station**
- Approx. 1 hour 30 minutes by Tohoku Shinkansen
- **JR Fukushima Station**
- Direct bus runs roundtrip approx. 1 hour 45 minutes 12 times per a day
- **JR Haranomachi Station**

Shinkansen
- **JR Tokyo Station**
- Tohoku Shinkansen The fastest approx.1 hour 30 minutes
- **JR Sendai Station**
- JR Joban Line runs per an hour approx. 1hour 20 minutes
- **JR Haranomachi Station**

Train
- **JR Ueno Station**
- Approx.2 hours 10 minutes by JR Joban Line Limited Express Hitachi
- **JR Iwaki Station**
- Train runs round trip 5 times per a day, approx.1hour 40minutes (JR Joban Line)
- **JR Haranomachi Station**

Bus
- **JR Tokyo Station**
- The direct bus Tohoku Access takes 1–2times (round trip) per a day (approx. 5 hour)
- **JR Haranomachi Station**

From Fukushima City (Approx. 90 min.)

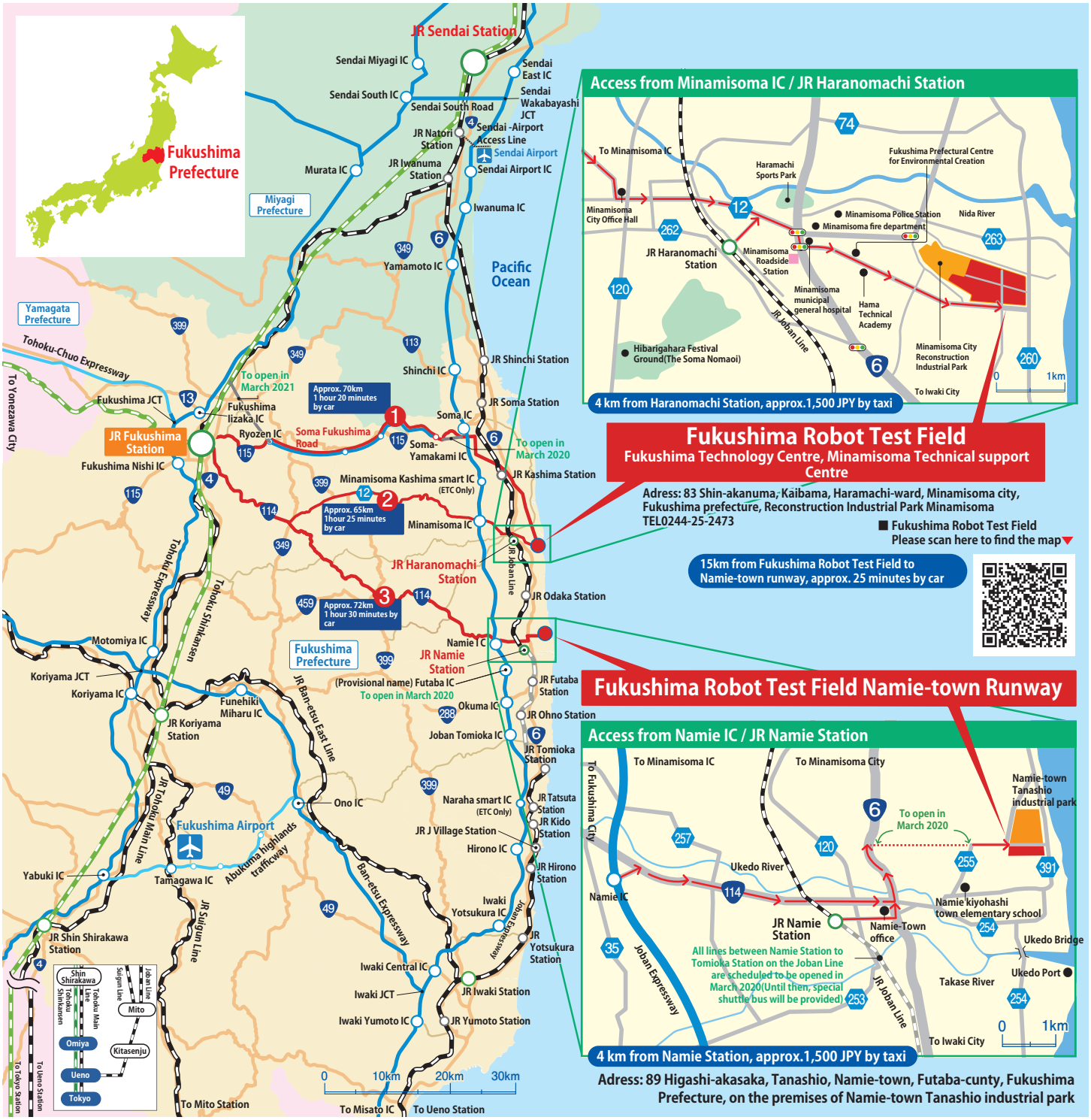
Car
- **JR Fukushima Station**
- ❶Approx. 1 hour 20 minutes , 70km via National Route 115・Soma Fukushima road
- ❷Approx.1 hour 25 minutes, 65km via National Route 114 and Prefectural Route 12
- **Fukushima Robot Test Field**

Bus
- **JR Fukushima Station**
- The direct bus Fukushima traffic・Tohoku Access takes 12times(round trip) per a day(approx. 1 hour 45 minutes)
- **JR Haranomachi Station**

From Sendai Airport (Approx. 70 min.)

Car
- **Sendai Airport IC**
- Approx. 55 km , 50 minutes via Sendai Eastern Road and Joban Expressway
- **Minamisoma IC**
- Approx. 17 minutes , 9km via Prefectural Route 12
- **Fukushima Robot Test Field**

Train
- **Sendai Airport Station**
- Train runs approx. 10 minutes and 2-3 times per hour (Sendai Airport Line)
- **JR Natori Station**
- Train runs aprrox.1 hour 10 minutes per hour (JR Joban Line)
- **JR Haranomachi Station**



Fukushima Robot Test Field Facility & Equipment Use Fee List

Unmanned aircraft facilities

Facility / Equipment	Per hour	All day	AM / PM	Nighttime	Extratime (per hour)
1 Minamisoma runway	6,100 JPY	—	24,200 JPY	29,100 JPY	7,900 JPY
2 Hangar attached to Minamisoma runway (measurement chamber)	—	—	6,400 JPY	7,600 JPY	2,100 JPY
2 Hangar attached to Minamisoma runway (maintenance room)	—	—	6,400 JPY	7,700 JPY	2,100 JPY
2 Hangar attached to Minamisoma runway (hangar)	—	—	18,500 JPY	22,200 JPY	6,000 JPY
2 Hangar attached to Minamisoma runway (hangar (when using half space))	—	—	10,500 JPY	12,600 JPY	3,400 JPY
3 Heliport	—	—	6,300 JPY	7,500 JPY	2,100 JPY
4 Namie runway	4,600 JPY	—	18,300 JPY	22,000 JPY	6,000 JPY
5 Hangar attached to Namie runway (measurement chamber)	—	—	6,500 JPY	7,800 JPY	2,200 JPY
5 Hangar attached to Namie runway (maintenance room)	—	—	6,600 JPY	7,900 JPY	2,200 JPY
5 Hangar attached to Namie runway (hangar)	—	—	19,500 JPY	23,400 JPY	6,400 JPY
5 Hangar attached to Namie runway (hangar (when using half space))	—	—	11,000 JPY	13,200 JPY	3,600 JPY
6 Communication tower (communication antenna)	—	—	21,900 JPY	26,300 JPY	7,100 JPY
6 Communication tower (installation of carrying-in equipment)	—	—	3,300 JPY	3,900 JPY	1,100 JPY
6 Equipment attached to communication tower (Surveillance rader)	—	—	9,000 JPY	9,000 JPY	2,260 JPY
6 Equipment attached to communication tower (meteorological observation system)	—	—	14,900 JPY	14,900 JPY	3,730 JPY
7 Airfield surrounded by net	—	—	55,600 JPY	66,700 JPY	18,100 JPY
7 Airfield surrounded by net (when using half space)	—	—	29,100 JPY	34,900 JPY	9,500 JPY
7 Airfield surrounded by net (when using 1/3 space)	—	—	20,200 JPY	24,200 JPY	6,600 JPY
8 Wind tunnel	—	—	185,000 JPY	222,000 JPY	60,200 JPY
9 Durability test site	—	—	13,100 JPY	15,700 JPY	4,300 JPY

Underwater and maritime robot facilities

Facility / Equipment	Per hour	All day	AM / PM	Nighttime	Extratime (per hour)
1 Submerged urban field	—	—	14,900 JPY	17,800 JPY	4,900 JPY
1 Submerged urban field (Excluding building)	—	—	11,000 JPY	13,200 JPY	3,600 JPY
A Indoor water tank (large water tank)	—	—	72,100 JPY	86,500 JPY	23,500 JPY
B Indoor water tank (small water tank)	—	—	11,000 JPY	13,200 JPY	3,600 JPY
B Indoor water tank (small water tank (when performing a turbidity test))	—	—	28,000 JPY	33,600 JPY	9,100 JPY
A Indoor water tank (crane)	1,300 JPY	—	—	—	—
A Indoor water tank (measurement room)	—	—	3,000 JPY	3,500 JPY	1,000 JPY

Infrastructure inspection and disaster response robot facilities

Facility / Equipment	Per month	All day	AM / PM	Nighttime	Extratime (per hour)
1 Mockup bridge	—	—	29,700 JPY	35,600 JPY	9,700 JPY
2 Mockup tunnel	—	—	26,400 JPY	31,700 JPY	8,600 JPY
3 Mockup plant, 1F (when using half space)	—	—	14,100 JPY	16,900 JPY	4,600 JPY
3 Mockup plant, 2F	—	—	13,900 JPY	16,700 JPY	4,600 JPY
3 Mockup plant, 3F	—	—	10,900 JPY	13,100 JPY	3,600 JPY
3 Mockup plant, 4F	—	—	10,200 JPY	12,300 JPY	3,400 JPY
3 Mockup plant, 5F / 6F	—	—	16,800 JPY	20,200 JPY	5,500 JPY
4 Urban field	—	—	30,500 JPY	36,500 JPY	9,900 JPY
4 Urban field (Building A)	—	—	9,500 JPY	11,400 JPY	3,100 JPY
4 Urban field (House A)	—	—	5,800 JPY	7,000 JPY	1,900 JPY
4 Urban field (House B)	—	—	6,000 JPY	7,200 JPY	2,000 JPY
4 Urban field Garage 1 (Building type)	224,700 JPY	9,900 JPY	—	—	—
4 Urban field Garage 2 (Housing type)	160,800 JPY	7,800 JPY	—	—	—
4 Urban field Garage 3 (Housing type)	142,700 JPY	7,200 JPY	—	—	—
4 Urban field Garage 4	99,200 JPY	5,700 JPY	—	—	—
4 Urban field (Road)	—	—	15,800 JPY	18,900 JPY	5,200 JPY
4 Urban field (Debris)	—	—	3,500 JPY	4,200 JPY	1,200 JPY
5 Debris / landslide field	—	—	21,000 JPY	25,100 JPY	6,800 JPY
5 Debris / landslide field (Gravel / fallen trees)	—	—	3,600 JPY	4,300 JPY	1,200 JPY
5 Debris / landslide field (Debris)	—	—	3,000 JPY	3,600 JPY	1,000 JPY
5 Debris / landslide field (Crocks / Sinks)	—	—	3,900 JPY	4,700 JPY	1,300 JPY
5 Debris / landslide field (Soil slope)	—	—	13,900 JPY	16,700 JPY	4,600 JPY
5 Debris / landslide field (muddy ground)	—	—	3,700 JPY	4,400 JPY	1,200 JPY
5 Debris / landslide field (Circuit)	—	—	5,100 JPY	6,200 JPY	1,700 JPY

Development base facilities

Facility / Equipment	One month	AM / PM	Nighttime	Extratime (per hour)
F Conference hall	—	14,100 JPY	17,000 JPY	4,600 JPY
F Conference hall (including foyer)	—	19,000 JPY	22,700 JPY	6,200 JPY
B Conference room 1	—	5,600 JPY	6,700 JPY	1,800 JPY
B Conference room 2	—	5,400 JPY	6,500 JPY	1,800 JPY
B Conference room 3	—	5,400 JPY	6,500 JPY	1,800 JPY
B Room 201 (conference room)	91,300 JPY	5,500 JPY	6,600 JPY	1,800 JPY
B Room 202 (conference room)	93,300 JPY	5,500 JPY	6,600 JPY	1,800 JPY
B Room 203 (conference room)	94,600 JPY	5,300 JPY	6,400 JPY	1,800 JPY
B Room 204 (conference room)	91,400 JPY	5,200 JPY	6,200 JPY	1,700 JPY
G Room 101 (development laboratory)	78,700 JPY	4,800 JPY	5,700 JPY	1,600 JPY
G Room 102 (development laboratory)	77,900 JPY	4,700 JPY	5,700 JPY	1,600 JPY
D Indoor examination place	—	50,300 JPY	60,400 JPY	16,400 JPY
D Indoor examination place (when using half space)	—	26,400 JPY	31,700 JPY	8,600 JPY
② Test preparation building (Maintenance room)	—	7,000 JPY	8,400 JPY	2,300 JPY
② Test preparation building (Preparatory Office 1)	—	5,700 JPY	6,800 JPY	1,900 JPY
② Test preparation building (Preparatory Office 2)	—	7,500 JPY	9,000 JPY	2,500 JPY
③ Outdoor test preparation place	—	4,300 JPY	5,200 JPY	1,400 JPY
④ Simple measurement room A	—	6,100 JPY	7,300 JPY	2,000 JPY
⑤ Simple measurement room B	—	6,900 JPY	8,300 JPY	2,300 JPY

Facility / Equipment	Period of use	Fee
A Laboratory 1	One month	109,100 JPY
A Laboratory 2	One month	105,700 JPY
A Laboratory 3	One month	108,700 JPY
A Laboratory 4	One month	108,600 JPY
A Laboratory 5	One month	108,700 JPY
A Laboratory 6	One month	111,500 JPY
A Laboratory 7	One month	105,900 JPY
A Laboratory 8	One month	108,600 JPY
A Laboratory 9	One month	108,700 JPY
A Laboratory 10	One month	110,500 JPY
A Laboratory 11	One month	72,500 JPY
A Laboratory 12	One month	62,300 JPY
A Laboratory 13	One month	62,300 JPY
A Laboratory 14	One month	62,300 JPY
A Laboratory 15	One month	62,300 JPY
A Laboratory 16	One month	74,800 JPY
N Depository	All day	9,300 JPY
N Depository (when using half space)	All day	5,900 JPY
N Rental warehouse 1	One month	59,500 JPY
N Rental warehouse 2	One month	59,900 JPY
N Rental warehouse 3	One month	58,300 JPY
N Rental warehouse 4	One month	59,500 JPY
N Rental warehouse 5	One month	59,900 JPY
N Rental warehouse 6	One month	58,300 JPY
P Shower room	One time	200 JPY

Equipment list

Machining equipment	Fee
I Machining center	12,960 JPY per hour
I NC milling cutter	2,130 JPY per hour
I Semi-automatic lathe	1,110 JPY per hour
I Drilling machine	140 JPY per hour
I Contour machine	180 JPY per hour
I High-speed cut-off machine	420 JPY per hour
I Shearing machine	1,850 JPY per hour
I Cutting dynamometer	1,510 JPY per hour
I Double-headed grinder	110 JPY per hour
I Belt grinder	110 JPY per hour
Q 3D printer (1)	920 JPY per hour
Q 3D printer (2)	1,780 JPY per hour
Q 3D printer (1) (FDM type) Molding resin	60 JPY per 10g
Q 3D printer (2) (FDM type) Molding resin	830 JPY per 10g

Analytical equipment	Fee
H Scanning electron microscope	4,460 JPY per hour
H Measuring microscope	980 JPY per hour
H Fourier transform infrared spectroscopy system	1,190 JPY per hour
H Energy dispersive X-ray fluorescence analyzer	1,960 JPY per hour
H Stereo microscope	140 JPY per hour
L FFT analyzer	770 JPY per hour
Q Oscilloscope	1,040 JPY per hour
Q Data logger	200 JPY per hour
Q Radar evaluation equipment	4,140 JPY per hour
Q DC stabilized power supply (18V specification)	130 JPY per hour
Q DC stabilized power supply (60V specification)	140 JPY per hour
Q AC stabilized power supply (single-phase specification)	190 JPY per hour
Q Digital multimeter	260 JPY per hour
Q Impedance analyzer	850 JPY per hour

Dimension · shape measurement equipment	Fee
H X-ray CT scanner	14,450 JPY per hour
H CNC 3-D measuring machine	7,680 JPY per hour
H Measuring machine for Surface coarseness and Outline shape	1,070 JPY per hour
H Non-contact 3-D digitizer	2,690 JPY per hour

Material processing equipment	Fee
I Sputtering device	400 JPY per hour
I Sample polishing system	940 JPY per hour

Physical properties equipment	Fee
H Vickers hardness tester	530 JPY per hour
H Rockwell hardness tester	420 JPY per hour
I Universal material testing machine	2,320 JPY per hour

Anechoic chamber	Fee
K Anechoic chamber	9,040 JPY per hour ※1
K 3-D radiation pattern measurement system	7,270 JPY per hour
K TRP/TIS measurement system	8,940 JPY per hour
K GNSS receiving system sensitivity evaluation system	2,750 JPY per hour
K Multipath phasing evaluation system	5,370 JPY per hour
K Radiation EMI measurement system	4,170 JPY per hour
K Radiation immunity test system	8,800 JPY per hour

Environment test equipment	Fee
D Pressure test equipment	4,490 JPY per hour
H Dust test equipment	3,280 JPY per hour
J Constant temperature and humidity chamber	380 JPY per hour
J Decompression constant temperature and humidity chamber	2,180 JPY per hour
J Thermal shock test machine	770 JPY per hour
J Advanced accelerated life test machine	300 JPY per hour
J Drying furnace	140 JPY per hour
L 2-axis switching vibration test machine	4,450 JPY per hour
L Single axis vibration test machine	4,310 JPY per hour
L Constant temperature and humidity chamber (for combined testing)	1,690 JPY per hour
M Waterproof test equipment	2,520 JPY per hour
M Rain and spray test equipment	2,780 JPY per hour
M Wind resistance test equipment	240 JPY per hour

Other equipment	Fee	Extratime (per hour)
② Fume simulation	100 JPY ※2 ※3	20 JPY
② Victim simulation	400 JPY ※3	90 JPY
② Outdoor large monitor system	7,400 JPY ※3	1,840 JPY
② Light projector	400 JPY ※2 ※3	90 JPY
② Generator	400 JPY ※2 ※3	90 JPY
② High-speed camera	4,700 JPY ※3	1,170 JPY
② Picture record system	5,000 JPY ※3	1,230 JPY
② 3D motion capture	5,900 JPY ※3	1,480 JPY

※1 Separate fee for each test equipment is added. ※2 Fuel cost (or smoke agent cost) is not included.
※3 Fee will occur in A.M. P.M. and Nighttime.

Remarks (1) A.M.: 9:00 a.m. to 1:00 p.m., P.M.: 1:00 p.m. to 5:00 p.m., Nighttime: 5:00 p.m. to 9:00 p.m., All day: 12:00 a.m. to 12:00 a.m., Extratime : 1 hour during 12:00 a.m. to 9:00 a.m. and 9:00 p.m. to 12:00 a.m.

(2) The same amount as fee is added when it falls under any of the following.
1. When holding an event by collecting admission fee, attendance fee, or membership fee for a profit. 2. When using for any profit-making activities, such as selling goods, commercial advertisement, etc.

(3) Fee is reduced to 70%, when using for preparation.

(4) When using continuously for two days or more, fee is not occured from the night to early morning, as far as it is used for storage of display items and equipment.

December, 2019