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Introduction to JARI's Test and Research Facilities

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1. Introduction and conditions of using test and research facilities at JARI

2. Introduction to JARI's main test and research facilities

Exhaust gas and fuel efficiency tests/ noise tests/ hydrogen and fuel cell safety tests, fire tests/ collision tests/ impact and strength tests/ HMI tests/ new issues/ test courses

3. Cases for which industry utilizes JARI's test facilities

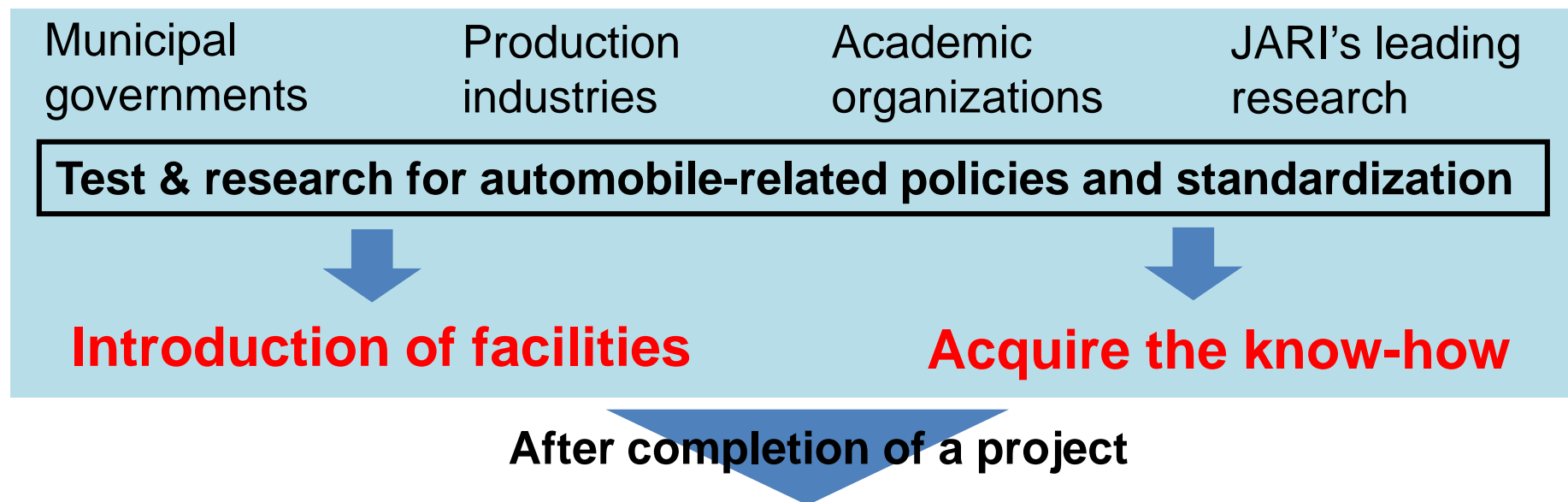
4. Cases for which overseas organizations utilize JARI's test facilities

5. Future direction of the utilizations of JARI's test facilities

1. Introduction and conditions of using JARI's test and research facilities



Projects as a third party organization



Projects of individual companies using JARI's resources



2. Introduction to JARI's main test and research facilities



Chronology of the introduction of the main evaluation test equipment

- 1960s A test course was built as a joint-use facility to help the Japanese industry catch up to Europe and North America.
- 1970s Installation of a collision test site for conducting ESV research.
Installation of a wind tunnel, tire test facility and large anechoic room for enhancing vehicle controllability.
Installation of CYD, engine dynamos.
- 1980s Installation of a HERP research facility for quickly investigating the effects of exhaust gases on human health.
- 1990s Introduction of a driving simulator to study driver traits, and a large CYD for improving air environments.
- 2000s New driving simulator for Human Machine Interface research.
New collision test site and test course.
- 2010s Introduction of [HYSEF](#), and facilities for evaluating fuel cells.
(HYSEF: Hydrogen and fuel cell vehicle Safety Evaluation Facility)
- 2020s Planned purchase of equipment for evaluating [robot safety](#).
Introduction of other types of equipment/facilities will be considered.

Exhaust gas and fuel efficiency tests

Chassis dynamometer for light duty vehicles

For 4WD vehicles (for dynamo 200 km/h, vehicle speed wind 160 km/h)

Temperature environments from -10 to 35°C. (2WD, uses RL-SHED)

- Full tunnel system for diesel vehicles.
- Diluted-air refinery for gasoline vehicles.
- Possible to measure regulated components, and unregulated components such as number of particles.



Chassis dynamometer for 4WD light duty vehicles

Appendix A
specifications

Chassis dynamometer for heavy duty vehicles

Compatible with temperature environments from -30 to 40°C.

- Full tunnel system for diesel vehicles (with diluted-air refinery).
- Possible to measure regulated components, and unregulated components such as number of particles.
- Possible to take time series measurements of gas before and after catalytic conversion, etc., at multiple sampling points.

Appendix B
specifications



Chassis dynamometer for heavy duty vehicles



Environmental chassis dynamometer
for heavy duty vehicles

Chassis dynamometer for motorcycles

Compatible up to 150 km/h (dynamo, vehicle speed wind)

- Possible to measure regulated components, and unregulated components such as number of particles
- Possible to evaluate particulates by full tunnel connection



Chassis dynamometer for motorcycles

Engine dynamometers

FREC (450 kW), FREC (370 kW), DCDY (370,150 kW) : For transient driving
ECDY (370,300kW) : For normal driving

- Full tunnel system for diesels (with diluted-air refinery)
- PM measurements in branch-dilution (micro) tunnel (before and after DPF)
- Possible to measure regulated components, and unregulated components such as number of particles
- Possible to take time series measurements of gas before and after catalytic conversion, etc., at multiple sampling points

Appendix C specifications



Engine dynamometer



Full-diluted tunnel



Diluted-air refinery

Equipment for testing vehicle vaporized gas

RL-SHED: Measures vaporized gas while vehicle is running.

DBL-SHED: Measures vaporized gas while vehicle is parked.

- Possible to measure regulated HCs, and unregulated components of hydrocarbons



RL-SHED test equipment
(with CYD for light duty vehicles)



DBL-SHED test equipment

Basic diesel combustion test and research facilities



- Single-cylinder engines: 1 L engine displacement, common rail injectors, superchargers
- Visible single-cylinder engines: 1 L engine displacement, accumulator injectors
- Spray observation chamber: can be used for non-combustion and combustion
- Lasers (YAG, He-Ne), high-speed video
- Combustion simulation: KIVAⅢ+CHEMKIN



Single-cylinder engines for research



Spray observation chamber

Noise tests

Road surface based on ISO standards for noise

Types and features of tests

- Measurements taken with testing methods of various countries (2- and 4-wheeled vehicles)
- Organization for confirming performance of aftermarket mufflers
- Involved with developing methods to harmonize domestic and international test methods, numerous test results



STC (with confidence) at SHIROSATO

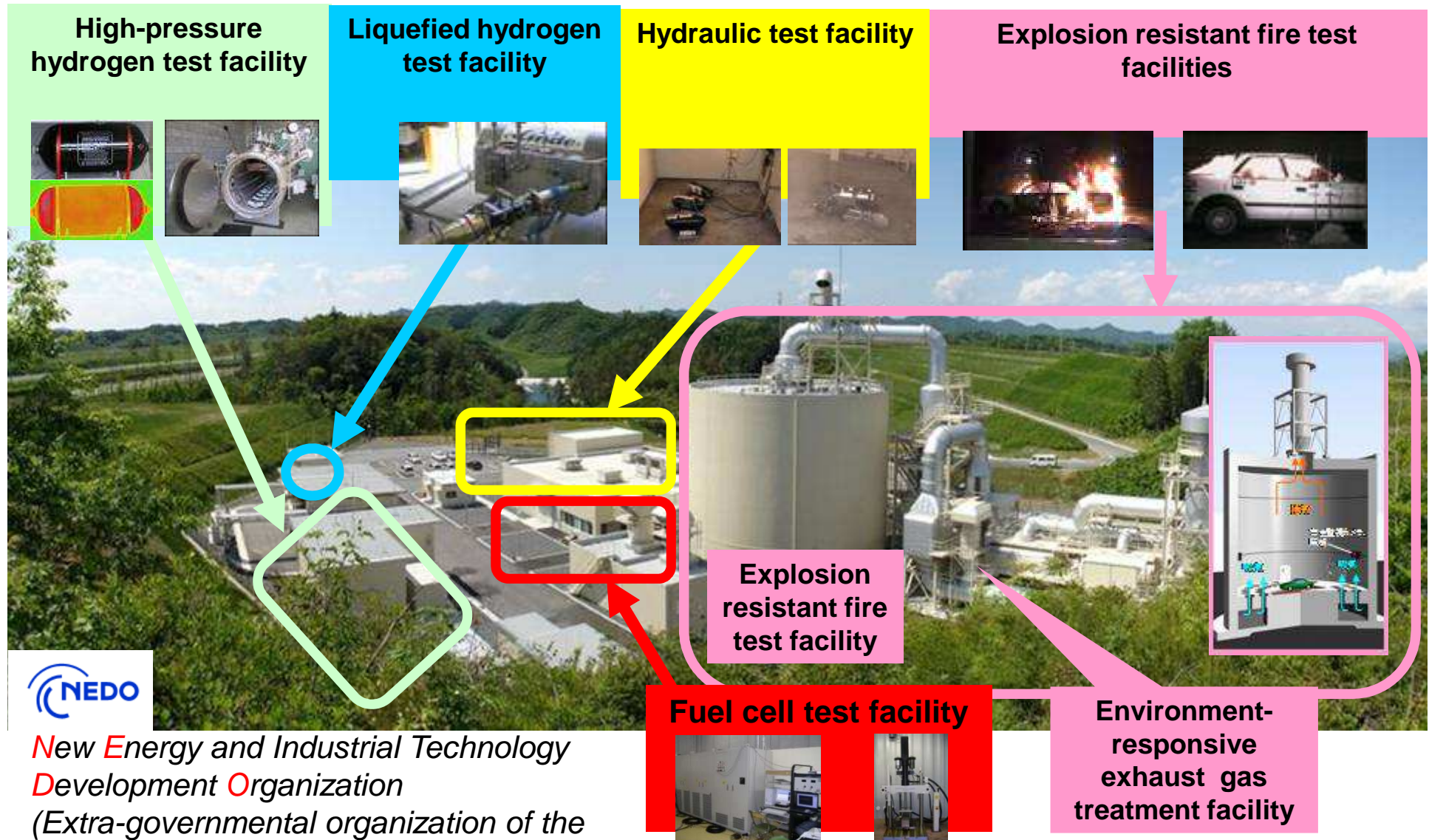


Simulated test fields at TSUKUBA

Hydrogen and fuel cell safety tests, fire tests

Hy-SEF

(Hydrogen and Fuel Cell Vehicle Safety Evaluation Facility)



New Energy and Industrial Technology Development Organization
(Extra-governmental organization of the Ministry of Economy, Trade and Industry)

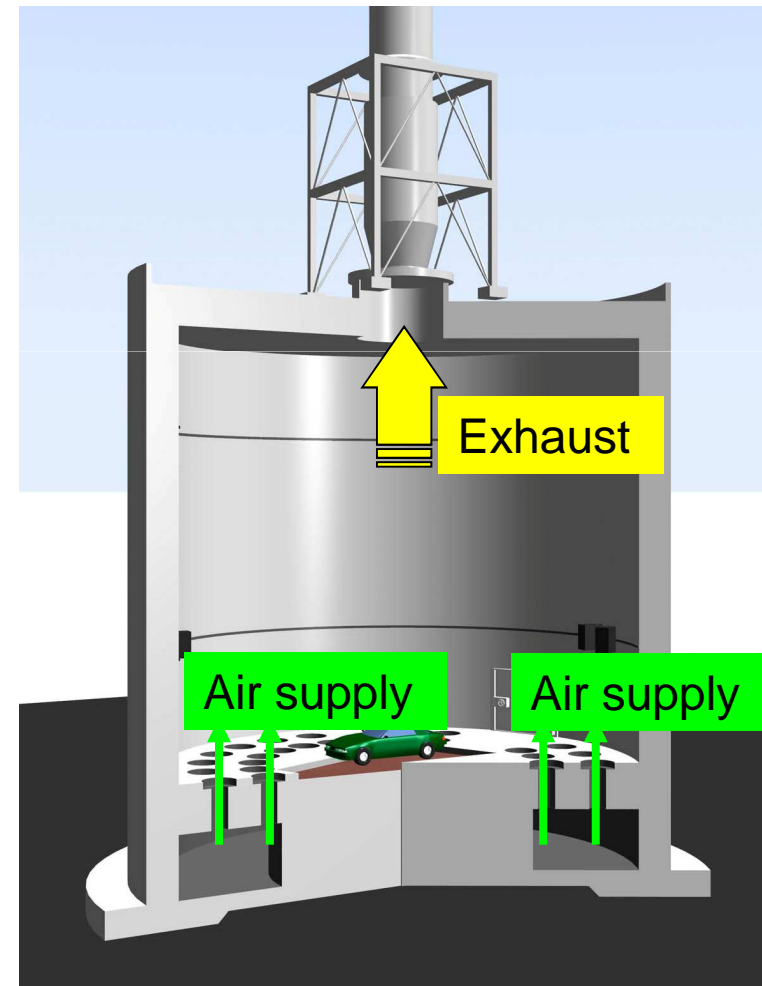
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Explosion resistant fire test facilities

Fire exposure tests for hydrogen tanks and fuel cells, vehicle fire tests
Safe 70 MPa filling pressure, 260 L capacity fuel tank structure that will not rupture (designed to withstand 50 kg TNT gunpowder)

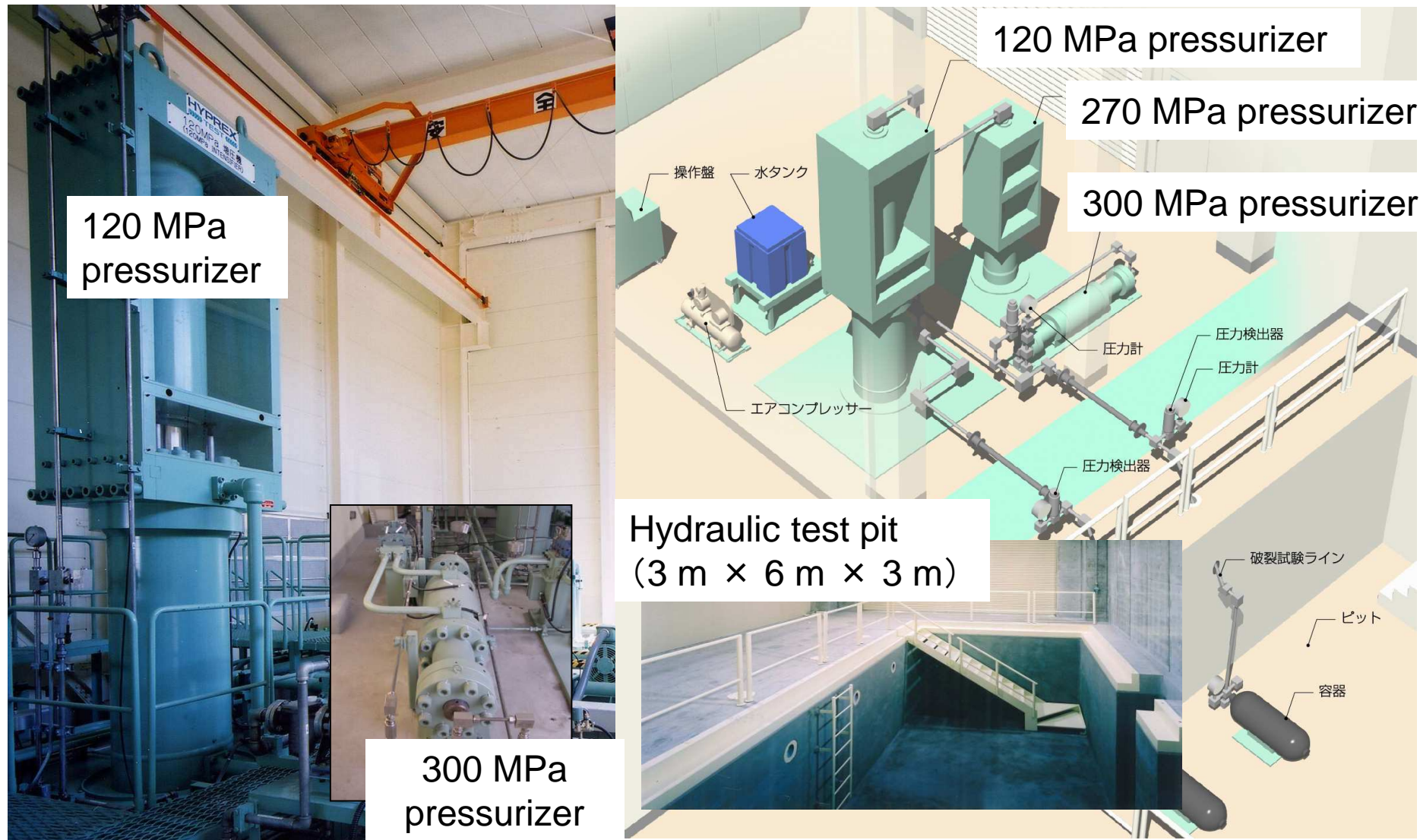


Shape: 18 m inner diameter, 16 m high
Wall structure: Reinforced concrete (1.2 m thick)
Inner wall: sheet metal finish
Noise reduction: -80 dB



Hydraulic test facilities

Tests on compressed hydrogen tanks for cars, etc., pressure cycles of high-pressure tanks (durability evaluation), rupture (pressure resistance) tests, etc.



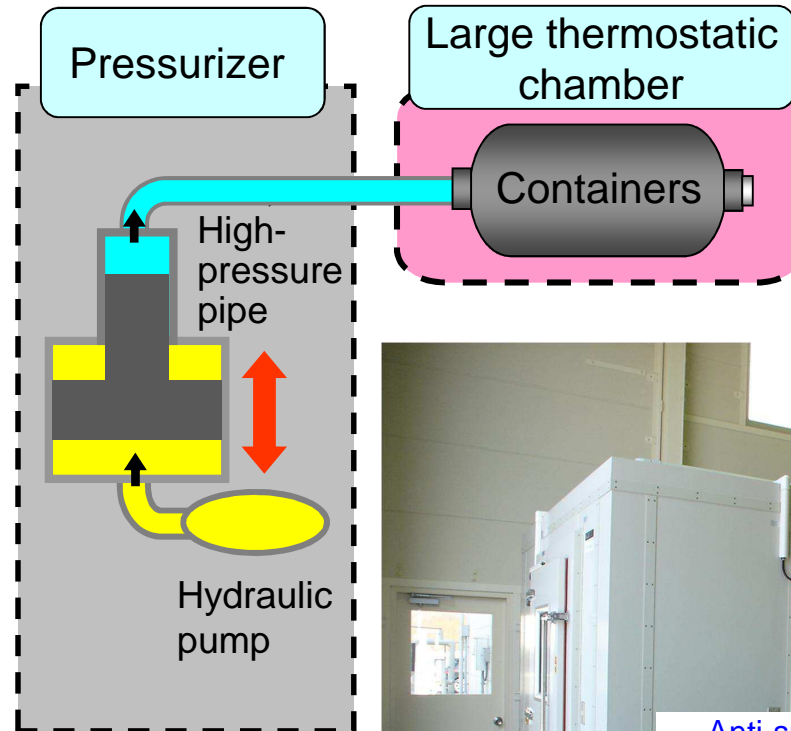
Environment cycle test using hydraulic test facilities



Pressurizer

Maximum pressure used: 120 MPa

Tank size: 20 - 260 L



Large thermostatic chamber
(-40°C to 150°C, 60% to 98%RH)

Gas test pit

Hydrogen filling and release tests, gas permeability tests, etc.

Gas test pits: 2 units
(3 m × 6 m × 3 m)



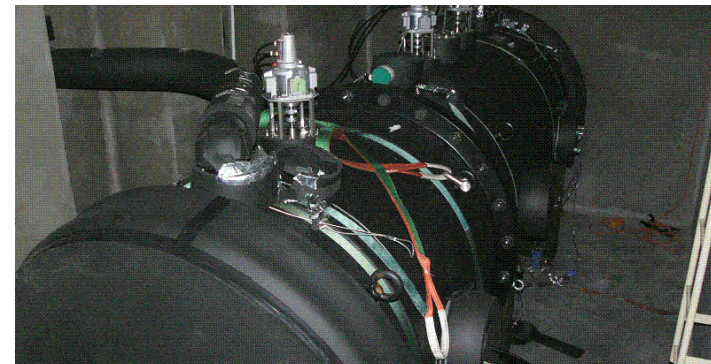
Gas permeability test chamber



Tank size: up to 260 L

Temperature control range: from -40 to 85°C

Explosion resistant chamber



Tank size: up to 130 L

Temperature control range: from -40 to 50°C

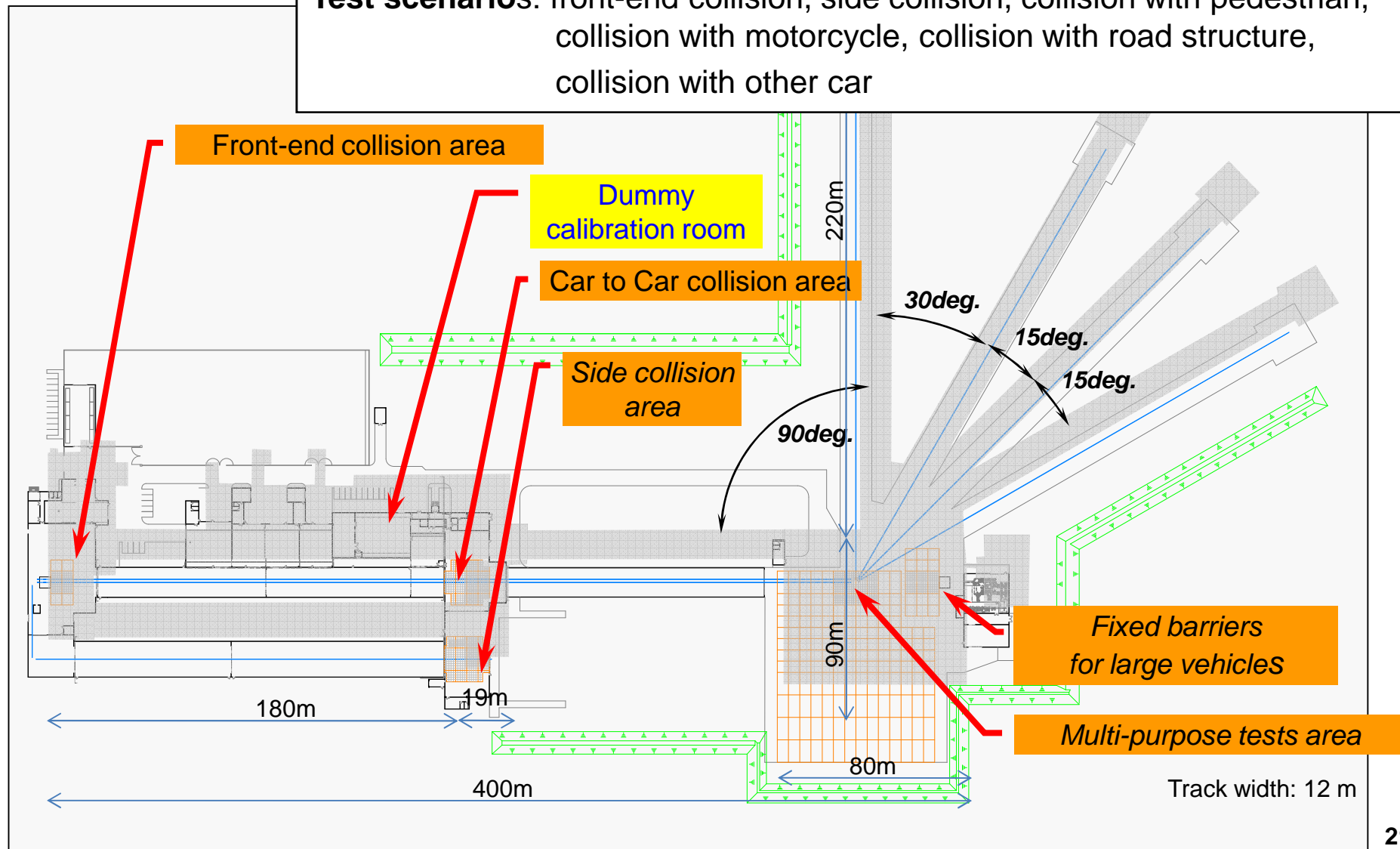
Collision tests

Collision test site

Maximum traction speed: 150 km/h (up to 2.8 ton test vehicle weight)

80 km/h (up to 25 ton test vehicle weight)

Test scenarios: front-end collision, side collision, collision with pedestrian, collision with motorcycle, collision with road structure, collision with other car



Examples of collision tests

Car-to-car (head-on collision)



Moving barrier-to-car (side collision)



Car-to-pedestrian



Car-to-motorcycle



Front-end collision
(no belts in rear seats)



Car-to-bicycle



Offset front-end collision



Impact and strength tests

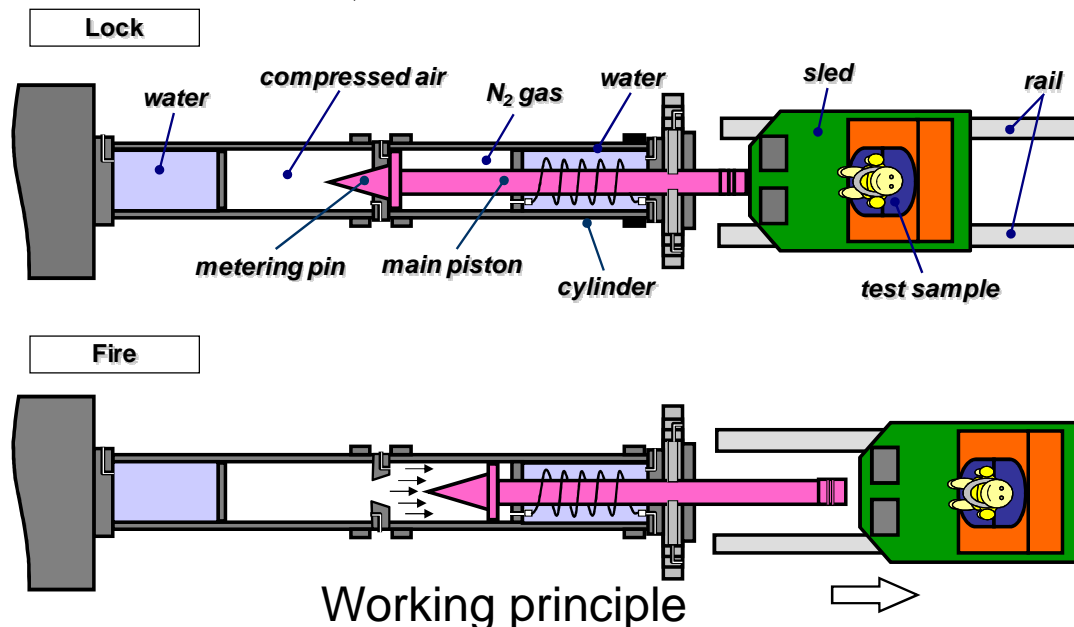
HYGE sled test equipment

Specifications

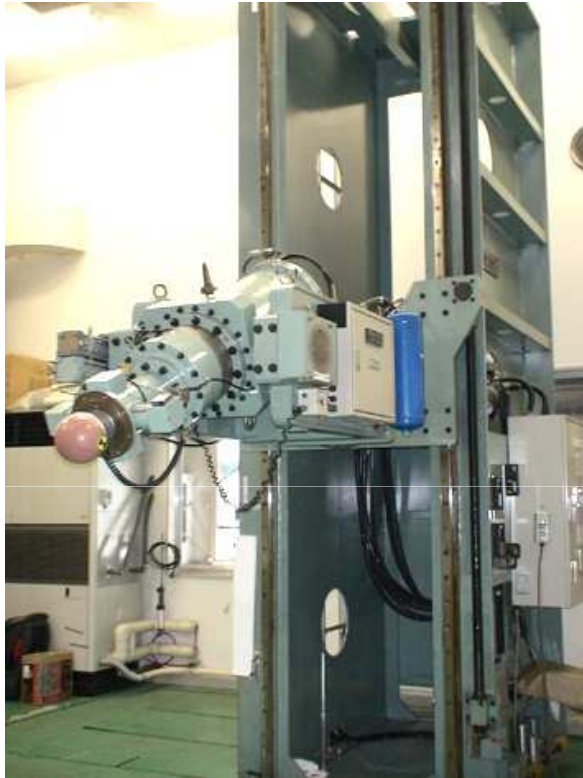
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|------------------------|---|
| (1) Cylinders | Inner: ca. 300 mm (12 inch); Length: 7,314 mm |
| (2) Sleds | Width: 1,219 mm; Length: 3,657 mm; Mass: 996 kgf |
| (3) Rails | Length: 36 m |
| (4) Lighting equipment | Lamps: 28 × 2kw metal halide lamps (both sides)
Illuminated area: 1.7 m × 7.0 m (11.9m ²);
Average illuminance: 54,000 lx |



HYGE sled test equipment



Injection system collision test equipment



Head impactor tests

Leg impactor tests

Free flight and guidance systems

Main specifications

- Acceleration system: Pneumatic acceleration cylinders
- Impactor mass: 2.5 - 20 kg
- Collision speed: 10 - 50 km/h



Example: Pedestrian protection evaluation test (head)

Drop weight test equipment



Energy absorbed by specimen materials is measured when a weight (spindle) is freely dropped on them.

Specifically, this involves axial compression features of the front side member, bending properties of side sills, shearing of bolts, etc. Basic properties of each member can be obtained by these tests.

Main specifications

- Effective dropping height: 7 m
(Max 60 km/h using acceleration equipment)
- Maximum load: 100 tons
- Weight mass: 50 - 2000 kg
(4000 kg under some conditions)

Compression test equipment on a plate (CTP)

- Quasi-static evaluation of the compression properties of large parts (bumpers, white body, etc.)
- Can also be used for strength tests for anchor bolts, etc.

Main specifications

- Compression load: Max 50 tons (load cell: 10 tons × 4)
- Movable amount: 0 - 999 mm
- Load acceleration: 5 - 500 mm/min

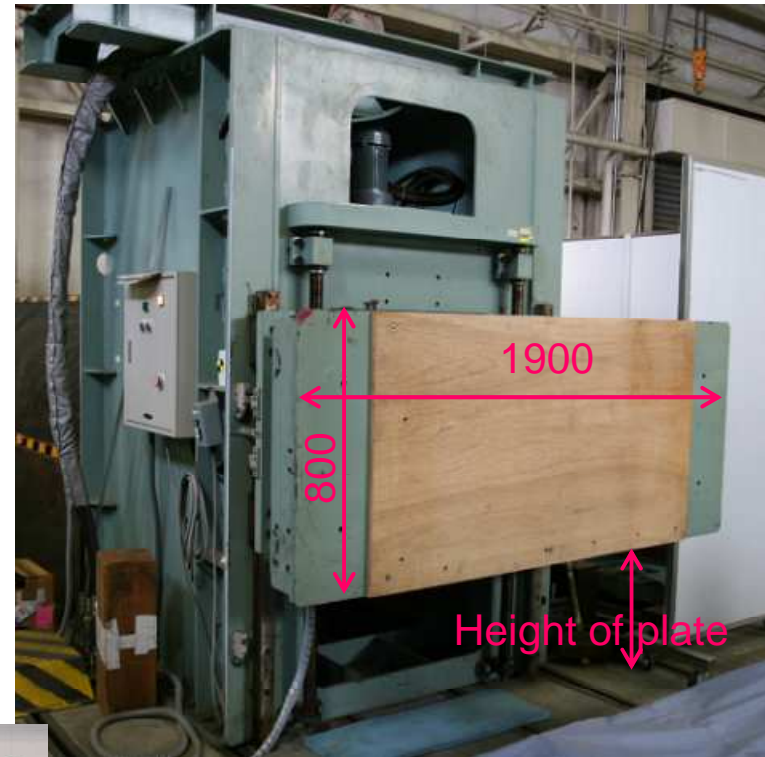
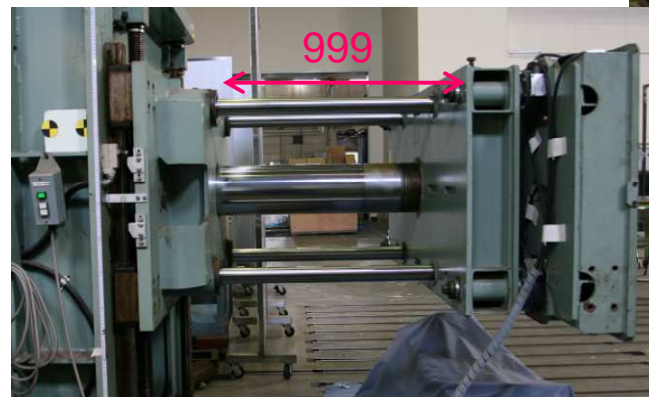


Plate area: 800 × 1900 mm
Plate height: 110 - 700mm



Min.dis. (0 mm)



Max. dis. (999 mm)

HMI tests and research

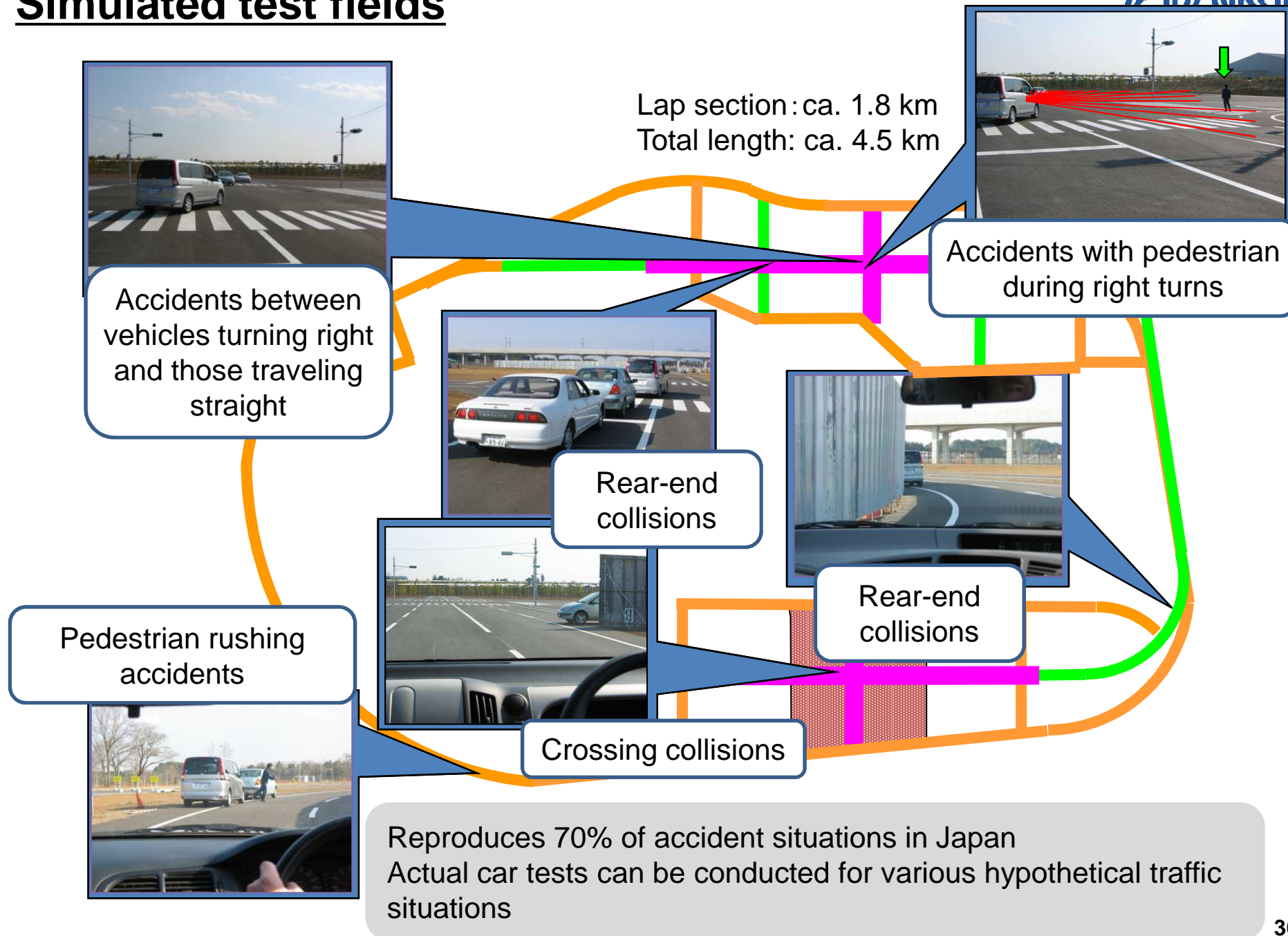
Driving simulator (DS)

All-direction
field of view



Dangerous scenarios
are tested safely in
the DS.

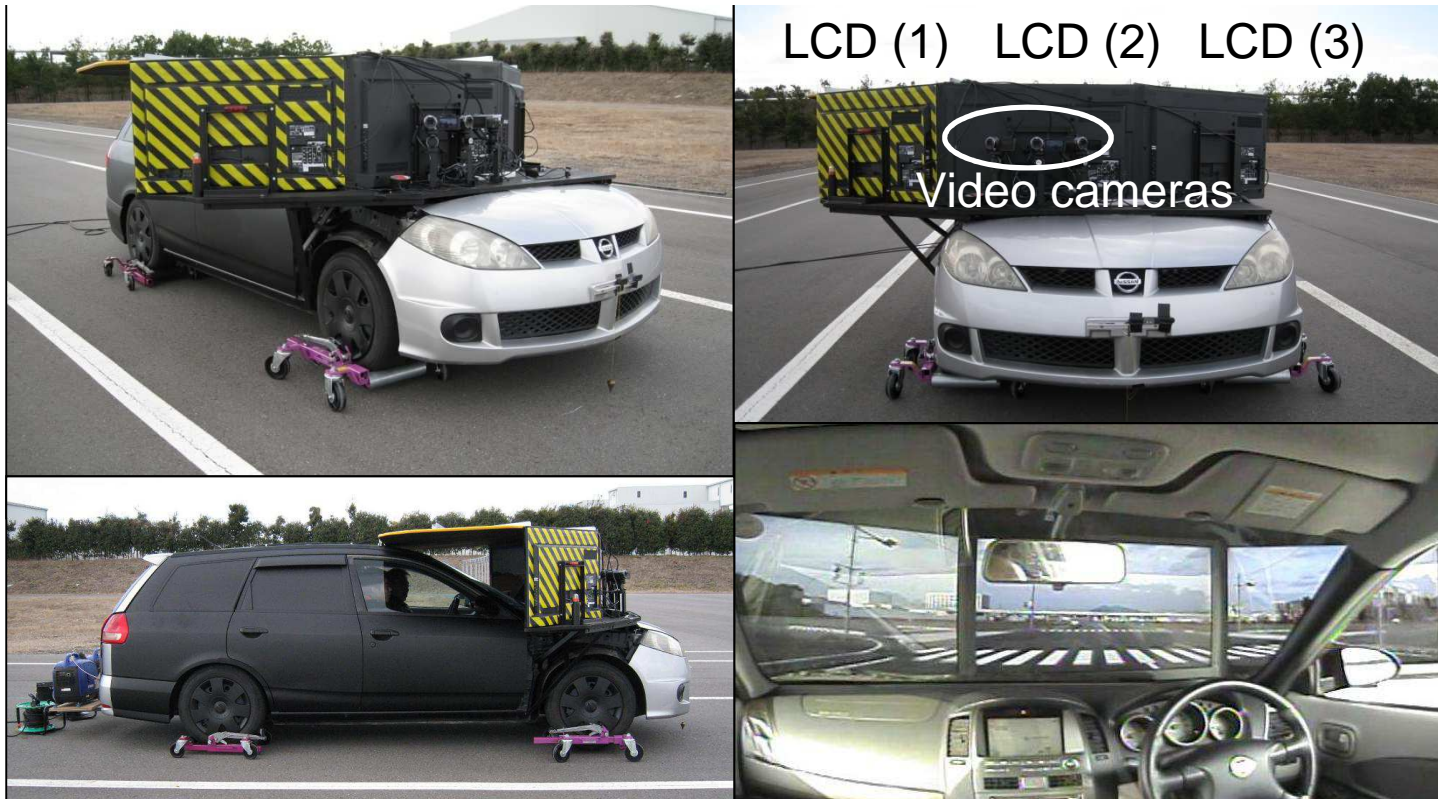
Simulated test fields



New projects

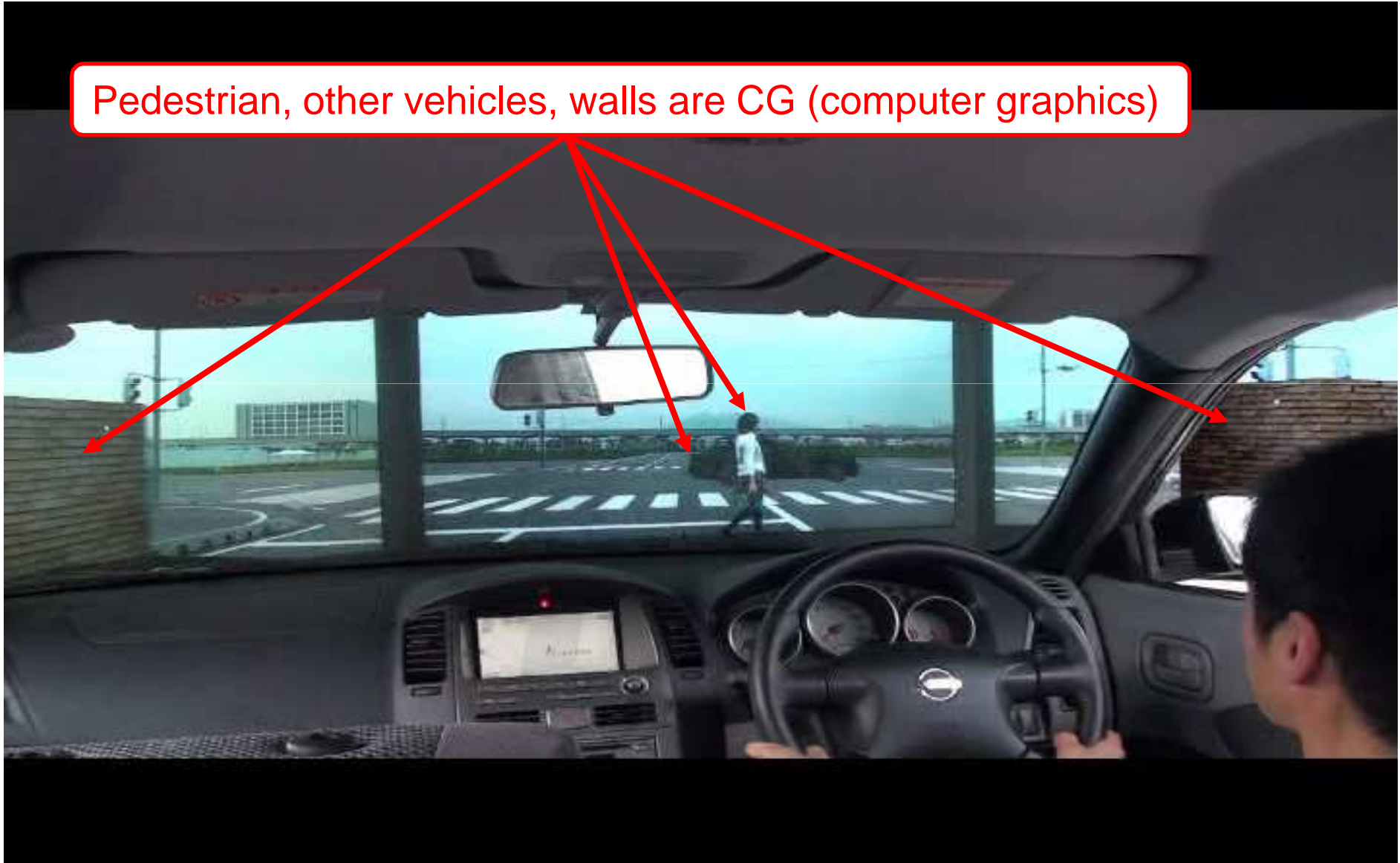
Test car with a monitor screen (for reproducing dangerous scenarios)

- Three **LCDs** and three **video cameras** are mounted on the hood.
- The scenes in front of vehicles are given composite displays of virtual objects (CG vehicles/pedestrians)
- Running tests with real cars can enable **reproduction of highly realistic dangerous scenarios**.



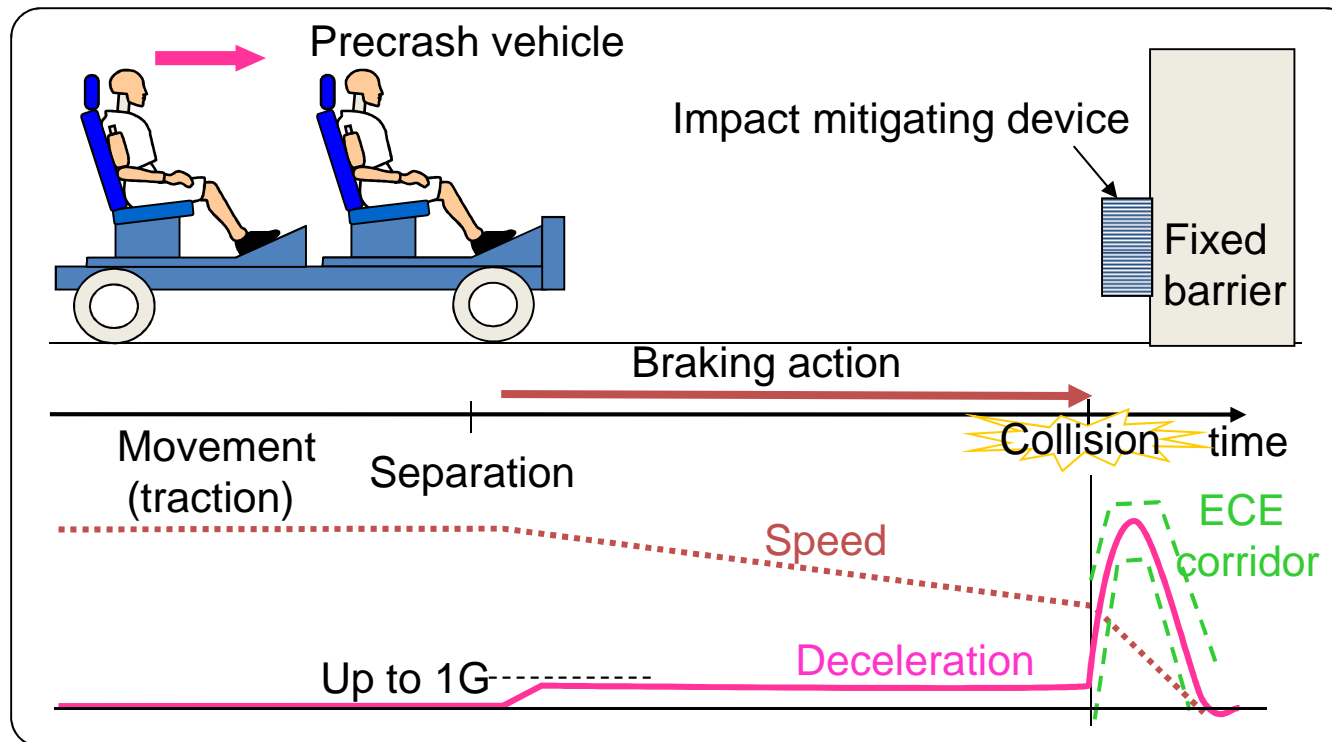
Composite examples of virtual objects (pedestrians, other vehicles, walls) made with CG

Pedestrian, other vehicles, walls are CG (computer graphics)



Pre-crash sled test equipment

60% of drivers who cause accidents take evasive actions (maneuvers).
⇒ Pre-crash sled test equipment is developed that can reproduce **braking action** just before a collision



- Brakes: Deceleration can be freely set to a maximum of 1G
- Collisions: With a target deceleration corridor of ECE-16 or 44, collisions can be made at up to 55 km/h.

Appearance of pre-crash sled test equipment



- Base stage: 1800 × 3500 mm
- Weight of vehicle: 2 tons (total weight: 2.5 tons)

- Using guide rollers beneath the vehicle, the forward movement stability and pitching of the vehicle after separation can be controlled.
- Braking deceleration and timing are controlled using dual-system braking equipment (rail brakes, tire brakes).



Braking using guide rails



Reproduces impact deceleration by having the vehicle collide with impact mitigating devices (pipes).

Safety evaluation of life-supporting robots

Creating and proposing methods for testing life-supporting robots
Establishing testing and certification organizations



Anechoic chamber



Vibration testing device



In the future

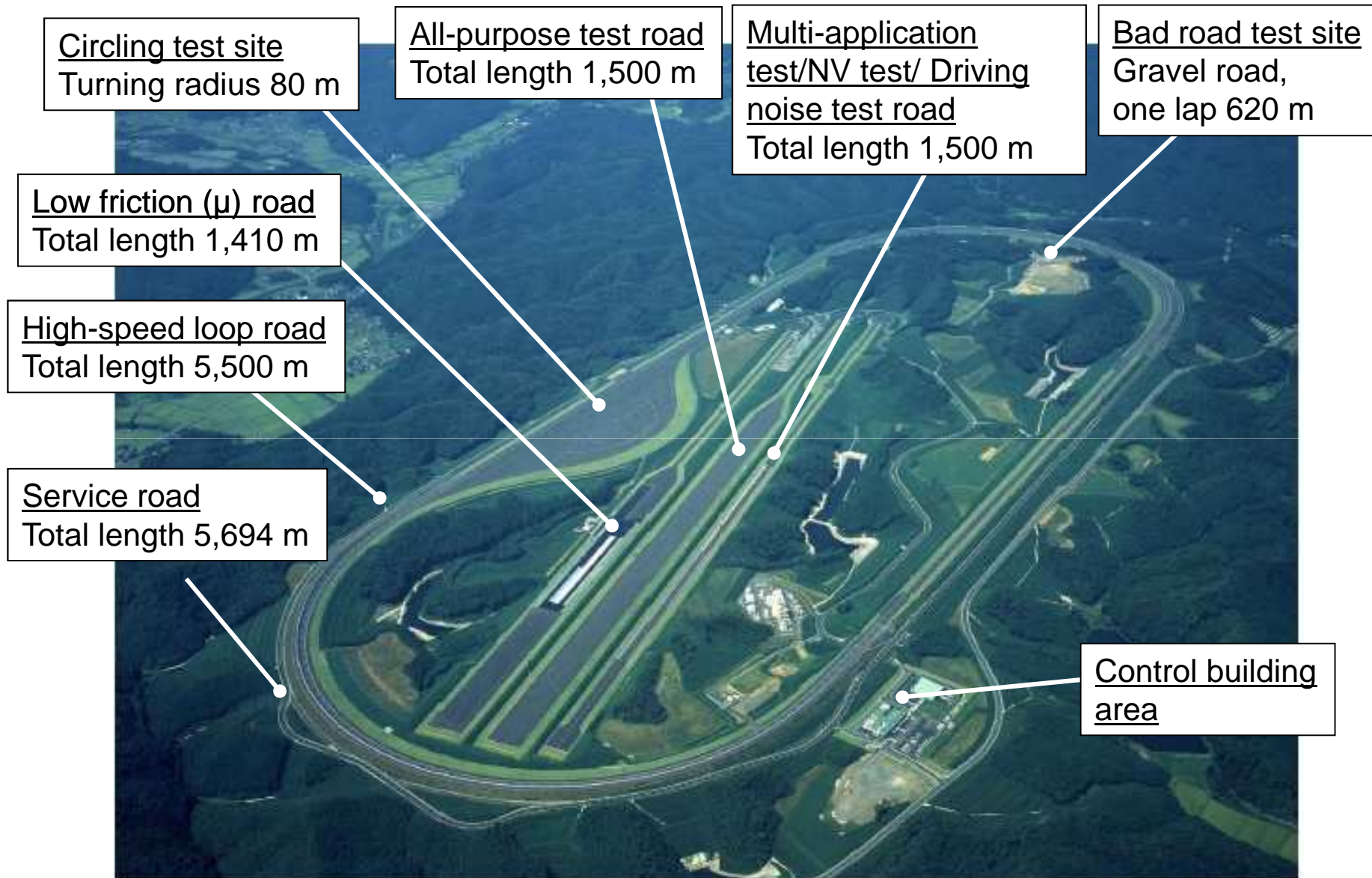
- Projects for evaluating robot safety
- Use of various devices for various evaluation tests



*Advanced Industrial Science
Technology Research Institute
(Extra-governmental organization of the
Ministry of Economy, Trade and Industry)*

Test Course

SHIROSATO Test Center



Total area: 302ha

Appendix D specifications

3. Cases for which industry utilizes JARI's test facilities

Automobile manufactures

- Only JARI has the facility
- Company's facilities are insufficient
- As a 3rd party organization (certification test data)
- FS before the formulation of regulations

(Examples)

Hysef, etc.
Collision test site
ANCAP

Use of World SID dummies

Parts and electrical equipment makers

- Without investing in equipment
- No experience in conducting tests

CYD and sled tests
Fuel cell safety tests

Venture companies and parallel importers

- To register a small-number of vehicles (model certification)

Braking and noise tests
Belt anchor tests

4. Cases for which overseas organizations utilize JARI's test facilities

Consulting

- Support and training for construction of collision test sites
- Visiting test courses (many visitors)

Provision of information

- EV data provision
- FC data provision

Contracted projects

- Muffler tests
- Effects of engine oil on exhaust gas
- Benchmark exhaust gas tests
- ANCAP collision experiments
- Leg collision tests

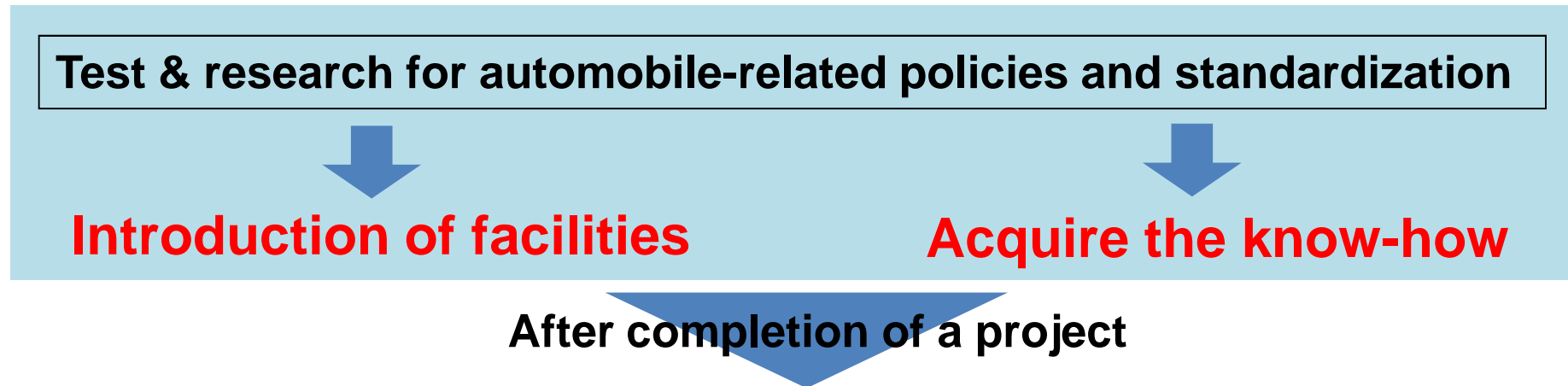
Overseas manufactures and research organizations, especially Asian research institutes, can benefit from the advanced knowledge and extensive experience of JARI

5. Future direction for the utilization of JARI's test and research facilities



Projects as a third party organization

the same activities as before



Projects of individual companies

for future activities



Thank you for your attention.

**If you have any comments and questions,
please feel free to contact me: Tamotsu NAKATANI.**

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Appendix A Specification of chassis dynamometer for light duty vehicles,etc.



		Type A	Type B	Type C	Type D
Chassis Dynamometer		Light-duty vehicle・Passenger car (@MEIDEN)			Motor cycle (@MEIDEN)
		4WD_CHDY (Normal temperature type)	2WD_CHDY (Normal temperature type)	2WD_CHDY+VT_SHED (Environmental type)	Normal temperature type
Objective	Air-conditioner	Temperature 25°C±5°C	Temperature 25°C±5°C	Temperature -10°C~40°C	Temperature 25°C±5°C
	Driving Wheeis	4WD	2WD	2WD	-
	Total vehicle weight	800~3500kg	454~5443kg	500~3000kg	100~550kg
	wheelbase	2100-4100mm	2032-3302mm	2032-3302mm	-
	tread	770-2370mm	800-2750mm	900-2160mm	-
Dynamometer	Absorption Power	220kW -FCDY	←	95kW -DCDY	37kW-DCDY
	Motoring Power	200kW -FCDY	←	70kW -DCDY	30kW-DCDY
	Max vehicle speed	200km/h	200km/h	160km/h	150km/h
	Rollers	φ 1219.2,smooth iron-made	←	←	φ 530.5,smooth iron-made
	Max cooling fan speed	160km/h	120km/h	120km/h	150km/h
CVS System	CVS volume rate	5 , 10 , 15 , 20 , 25 , 30 m ³ /min	4.5 , 9 , 12 m ³ /min	4.5 , 6 , 9 , 12 , 15 , 18 m ³ /min	3 , 4.5 , 6 , 9 m ³ /min
	Model	CVS-7400T (@HORIBA)	CVS-9400S DAR-1400 (@HORIBA)	CVS-7200S DAR-1400 (@HORIBA)	CVS-9400S (@HORIBA)
Emissions Analyzers	Analyzer type	NOx: Chemiluminescence detector CO, CO2: Non-dispersive infrared detector THC: Heated flame inoization detector CH4: Gas chromatograph	NOx: Chemiluminescence detector CO, CO2: Non-dispersive infrared detector THC: Flame inoization detector CH4: Gas chromatograph	← ← ← ←	NOx: Chemiluminescence detector CO, CO2: Non-dispersive infrared detector THC: Flame inoization detector
	Model	MEXA-7100D (for direct) MEXA-7200D(for dilute,bag) (@HORIBA)	MEXA-9100D (for STD dilute,bag) MEXA-9200LE-S (for LEV dilute,bag) (@HORIBA)	MEXA-7200LE (for dilute,bag) (@HORIBA)	MEXA-9400D (for direct,dilute,bag) (@HORIBA)

Appendix B Specification of chassis dynamometer for heavy duty vehicles



			Type A	Type B	Type C
Chassis Dynamometer			Heavy-duty vehicle (@MEIDEN)		
			Enviromental type	Normal temperature type	Normal temperature type
Objective	Air-conditioner	Laboratory	Temperrature -30℃～40℃	Temperrature 25℃±5℃	Temperrature 25℃±5℃
		engine suction air	Temperrature 25℃±5℃(4℃＜) relative humidity 55%±2%(4℃＜)	Temperrature 25℃±5℃ relative humidity 55%±2%	Temperrature 25℃±5℃ relative humidity 55%±5%
	Driving Wheels		Rearaxle 1 or Rearaxle 2 of truck or bus	Rearaxle 1 or Rearaxle 2 of truck or bus	Rearaxle 1 or Rearaxle 2 of truck or bus
	Total vehicle weight		3500～25000kg	2000～25000kg	2000～25000kg
Dynamometer	Absorption Power		370kW -FCDY	←	370kW -DCDY
	Motoring Power		300kW -FCDY	←	300kW -DCDY
	Max vehicle speed		150km/h	←	←
	Rollers		2-shaft type, φ 1061,smooth iron-made	←	←
	Flywheel System		Mechanical + electrical inertia compensation	←	←
			Axle1:3500～20000kg	←	Axle1:2000～20000kg
			Axle2:5000～25000kg	←	Axle2:5000～25000kg
Dilution Sampling System	Primary tunnel	Diameter	457.2mm	←	605.6mm
		Length	4622mm	←	6191.5mm
	Secondary tunnel	Diameter	≥ 76.2mm	←	83.1mm
		Length	≥ 1000mm	←	1076.5mm
	CVS volume rate		30,40,50,60,70,80,90 m³/min	←	150,120,90,50 m³/min
	Sample gas flow rate for PM		50～200L/min	←	75～150L/min
	Clean air Supply system	Flow rate	100 m³/min	←	180 m³/min
		temperayure	25±5℃	←	25±2℃
		Humidithi	50±8%RH	←	50±8%RH
	Model		CVS-7400T DLS-7200 DLT-1890W (@HORIBA)	← ← ← ←	CVS-9400T DLS-150 DLT-24150W (@HORIBA)
Emissions Analyzers	Analyzer type		NOx: Chemiluminescence detector CO, CO2: Non-dispersive infrared detector THC: Heated flame inoization detector CH4: NonMethane Cutter	← ← ← ←	← ← ← ←
	Model		MEXA-7100D (for direct) MEXA-7100DEGR(for direct) MEXA-7200F(for dilute,bag) (@HORIBA)	← ← ← ←	MEXA-9100DEGR(for direct) MEXA-7200D(for dilute,bag) (@HORIBA)

Appendix C Specifications of engine test bench



			Test bench A (HERP building)	Test bench B (4No. building)	Test bench C (Diesel Center Building)
Engine Dynamometer	Dynamometer type		DC Dynamometer (@MEIDEN)	AC Dynamometer (@MEIDEN)	AC Dynamometer (@MEIDEN)
	Absorption Power		370kW	370kW	450kW
	Motoring Power		300kW	300kW	400kW
	Torque		1961Nm	2000Nm	2100Nm
	Max. speed		4000min ^{^-1}	5000min ^{^-1}	6000min ^{^-1}
	Center height		750mm	750mm	750mm
Dilution Sampling System	Primary tunnel	Diameter	605.6mm	609.6mm	457.2mm
		Length	6191.5mm	6521.5mm	4622mm
	Secondary tunne	Diameter	83.1mm	83mm	83mm
		Length	1076.5mm	1076.5mm	1076.5mm
	CVS volume rate		20,40,60 m ³ /min	50,90,120,150 m ³ /min	10,20,30,40,50,60,70,80,90 m ³ /min with dilution air refinery(DAR)
	Sample gas flow rate for PM		50~200L/min	75~150L/min	50~200L/min
	Secondary dilution air flow rate		15~75L/min	75~150L/min	50~200L/min
	Model		CVS-9300T DLS-200 DLT-2470W (@HORIBA)	CVS-9400T DLS-150 DLT-24150W (@HORIBA)	CVS-7400T DLS-7200 DLT-18900W DAR-5000 (@HORIBA)
Emissions Analyzers	Analyzer type		NOx : Chemiluminescence detector CO, CO2 : Non-dispersive infrared detector THC : Heated flame inoization detector CH4 : Gas chromatograph	NOx : Chemiluminescence detector CO, CO2 : Non-dispersive infrared detector THC : Heated flame inoization detector CH4 : Non methane cutter	NOx : Chemiluminescence detector CO, CO2 : Non-dispersive infrared detector THC : Heated flame inoization detector CH4 : Non methane cutter
	Model		MEXA-9100DEGR(for direct) MEXA-9200F(for dilute,bag) (@HORIBA)	MEXA-9100DEGR(for direct) MEXA-7200D(for dilute,bag) (@HORIBA)	MEXA-7100DEGR(for direct) MEXA-7100D(for direct) MEXA-7200D(for dilute,bag) (@HORIBA)
Application of test cycles			Steady state test cycle : WHSC,ESC,NRSC,etc. Transient test cycle : WHTC,ETC,NRTC,FTP,etc.		

- **Ideal for large-scale tests**

(high-speed driving, wide turning area, long straight roads)

- **High-quality standard road surfaces** (flat, μ -values , ISO road, etc.)

- **Road surface specs and course design with high degree of freedom and convenience**

(Simple, flat, and diversified road surfaces, equipment loan, having common area)

- **Locational conditions with high confidentiality, partitioned independent test courses**

- Locations, natural scenery, serenity suited for filming, etc.

- Fully-equipped test and repair facilities (weather, repair shop, apparatuses)

- Facilities that can be used for events

(large meeting rooms, overnight lodging, cafeteria, plaza)

⇒ Consultations can be made for nighttime/long-term use

⇒ Course can be visited beforehand