



Corrosion Test Instruments



According to reports, over four trillion yen is lost in damages annually in Japan from rust. To prevent such losses, testing for corrosion and rust is crucial. Many different researches are conducted in order to accurately determine the deterioration of metals and surface finishings.

As an expert maker of corrosion test instruments, Suga Test Instruments continues to evolve as a global enterprise by assimilating its knowledge and experiences it has cultivated over the years and responding to the needs of customers.

Representing Japan with determination since foundation, Suga will continue to be the enterprise that serves the society through its "Suga-only" products.

Only SUGA
Only SUGA

Achieving supremacy as the expert maker of corrosion test instruments.



CONTENTS

Purpose of Corrosion Test Instruments	3
Types of Corrosion Test Methods	4-5
Correlation between Outdoor Exposure and Corrosion Test Procedures	6
1. Salt Spray Test Instruments	7
2. Humidity Chamber	7
3. Combined Cyclic Corrosion Test Instruments	8
4. Corrosion Test Instrument with Light Test	9
5. Related Devices for Corrosion Test Instruments	9
6. Gas Corrosion Test Instruments	10
7. Heat Aging Chamber	10
Typical Standards for Corrosion Test Instruments	11

Purpose of Corrosion Test Instruments

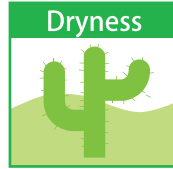
Products and materials all around us will ultimately deteriorate under their end use environment and end their service life. Corrosion test instruments are used to determine the service life span of products and materials by simulating and accelerating the natural corrosion process via incorporating various corrosion factors that exist in the natural environment.

Corrosion factors and their effects



Salt water

Chemical reaction with salt water deteriorates paint and plating, resulting in rust.



Dryness

Corrosion is accelerated by the chemical reactions in dry conditions. Reaction speed is dependent on the temperature: the higher the temperature, the faster it becomes. The differences in the thermal expansion coefficient between the coating and base metal cause fatigue in the material's physical structure.



Acid rain

Chemical reaction with acid rain forms corrosion pits (small holes from corrosion), causing stains etc. on the surfaces of paint and plating.



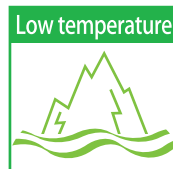
Humidity

Osmotic pressure from the swelling causes water to enter into the coating, accelerating corrosion by acting as an electrolyte.



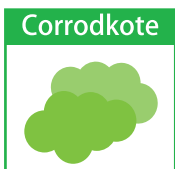
CASS

CASS is a highly reactive solution made by mixing neutral salt water, acetic acid and copper(II) chloride. Chemical reaction with this fluid generates rust from the corroded surface of the specimen.



Low temperature

The low temperature condition ruptures the coating through freezing of water, hardening and embrittlement of the plating, and peeling caused by the difference in the rate of expansion.



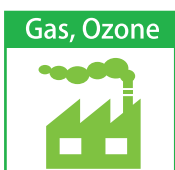
Corrodokote

Corrodokote is a paste made by mixing copper nitrate, iron(III) chloride hydrate and ammonium chloride with white clay, which is coated onto a specimen to generate corrosion.



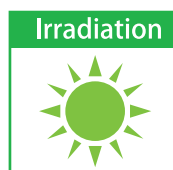
Chipping

Chipping is when pebbles and flinged-up rubbles hit running cars and damage their surfaces, causing corrosion on the damaged areas.



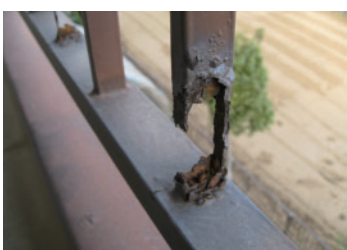
Gas, Ozone

Gases such as sulfur dioxide, nitrogen dioxide, hydrogen sulfide and chlorine cause corrosion in metals, while ozone primarily causes corrosion in rubber. Also, ozone and other gases cause discoloring in digital prints and fabrics.



Irradiation

Light energy deteriorates the anti-corrosion coating, leaving the base metal vulnerable to corrosion.

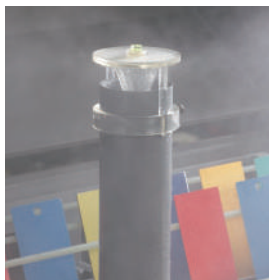
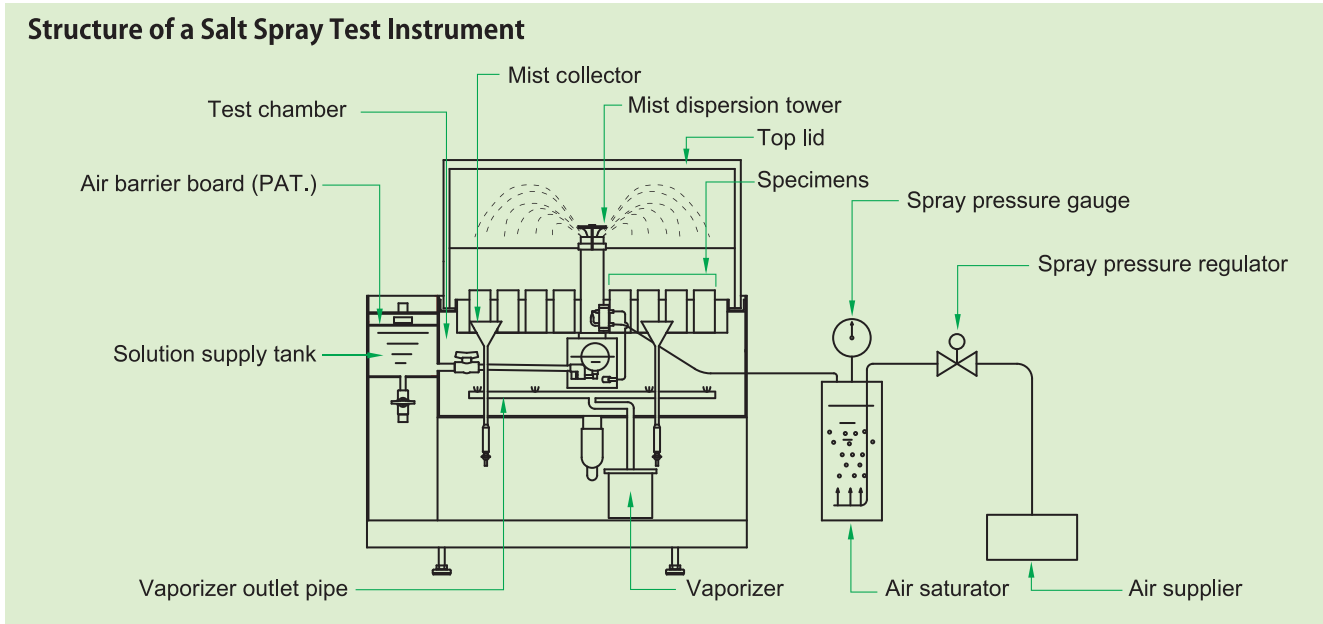


Types of Corrosion Test Methods

1 Salt spray test

The most well-known corrosion test methods that have been used around the world over a long period of time are (1) neutral salt spray tests, (2) acetic acid salt spray tests, and (3) CASS tests. They are specified in ISO and other standards around the world.

Salt spray tests are widely performed for purposes such as quality control and corrosion resistance comparison.



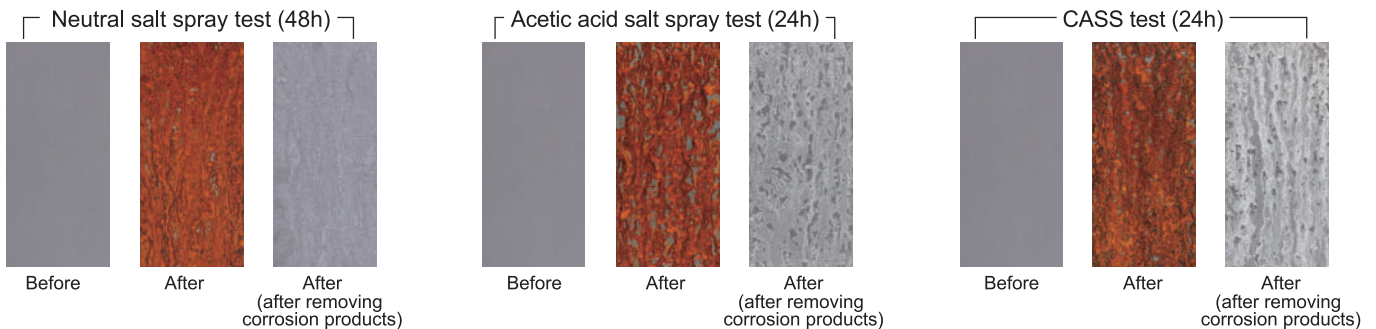
Mist dispersion tower during spray test

Air barrier board (PAT.) and the mist dispersion tower method: pillars of test reproducibility

Suga's STP-type salt spray test instrument isolates the solution and ambient air using the air barrier board (PAT.) inside the spray solution tank, and also controls the pH fluctuation by controlling the spray solution's temperature via direct steam heating method. Humidity is generated by the "mist dispersion tower method" as specified in ISO 9227, which allows for uniform distribution and collection of mist, preventing variation in the test results inside the chamber.

Reference specimen for corrosion

ISO 9227 specifies a calibration method using corrosion reference specimens for evaluating the repeatability and reproducibility of salt spray test instruments. A round robin test, which is a test procedure where identical reference specimens are tested by each country's test institutes followed by a comparison of the results, was performed by 18 institutions from 10 participating countries to determine the value of the mass loss*. We use these reference specimens to confirm the performance of our salt spray test instruments.



Provisional value for corrosion loss according to ISO 9227

	Test time (hours)	Mass loss (g/m ²)
Neutral salt spray test	48	70 ± 20
Acetic acid salt spray test	24	40 ± 10
CASS test	24	55 ± 15

* Mass loss (g/m²) = (weight before test) - (weight after test without corrosion products)

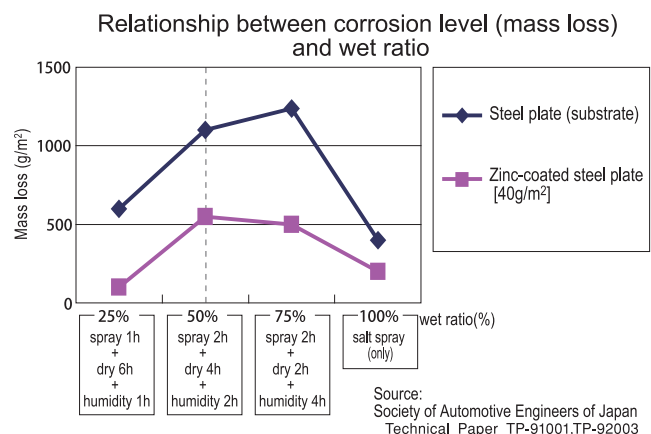
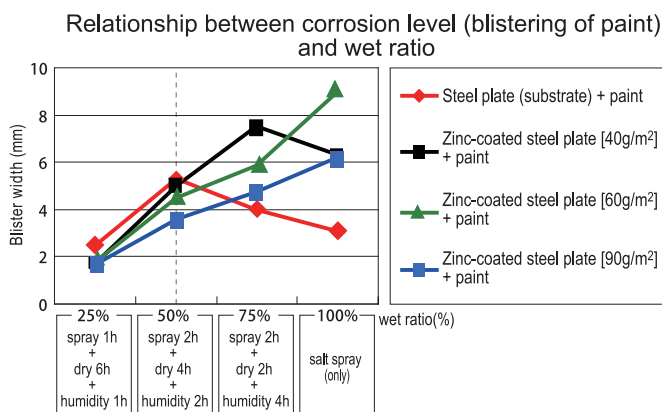
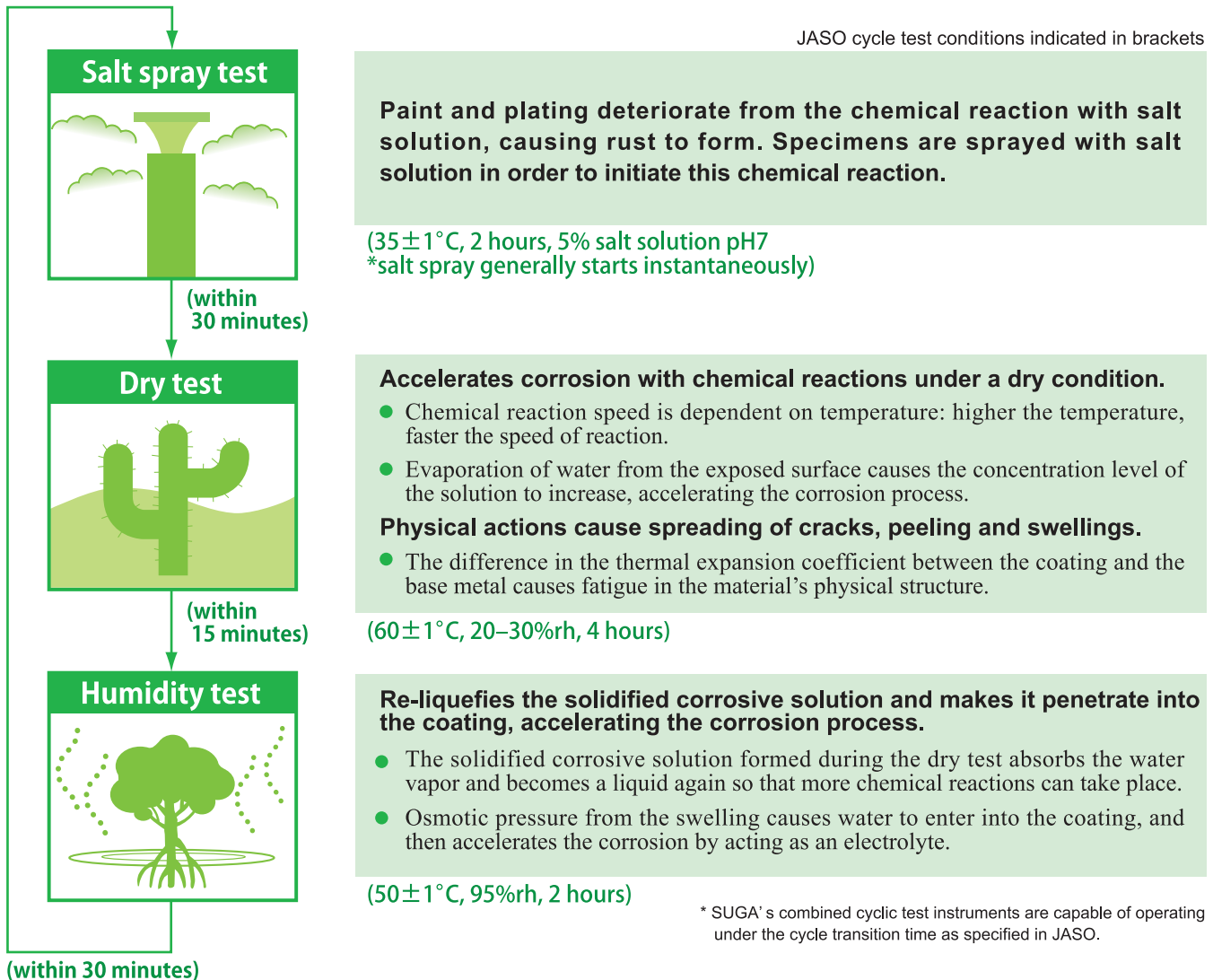
Types of Corrosion Test Methods

2 Combined cyclic tests

Combined cyclic tests are designed to achieve greater correlation with outdoor exposure.

After determining the corrosion factors of the product's end use condition, test with those factors incorporated are repeatedly performed. It is currently specified in JASO (Japanese Automotive Standards Organization), JIS (Japanese Industrial Standards) and ISO (International Organization of Standardization).

The most popular combined cyclic test method is the JASO cycle test, which is a combination of salt spray, dry and humidity tests. Their corrosion factors are the following:



Tests are conducted not only with specimens in the form of test pieces but also with full-scale models and products. With the above cycle test conditions as the bases, various test procedures are developed, such as using acid rain solution for spray tests.

Correlation between Outdoor Exposure and Corrosion Test Procedures

The photographs below are test results from various outdoor exposure tests, JASO cyclic test, and also the acid rain cyclic test that sprays artificial acid rain solution. It demonstrates that both the JASO cyclic test and the acid rain cyclic test show similar corrosion results to outdoor exposure.

For uncoated steel plates, 45 cycles (about two weeks) of JASO cyclic test were equal to one year of outdoor exposure in Okinawa, and for coated plates, 180 cycles (two months) were equal to a year and a half of outdoor exposure in Okinawa.

Comparison with various corrosion test results with outdoor exposure

Test type Specimen	Before test	Outdoor exposure		Acid rain cycle 15 days(45 cycles)	JASO cycle 15 days(45 cycles)	Outdoor exposure (Volvo test)	
		Tokyo 1yr	Okinawa 1yr			1yr (JIS salt)	1yr (halite)
Steel plate + chemical conversion coating film + 1 coat system (electrodeposition coating 20±2 μm)							
Zinc coated steel plate (40g/m ²) + chemical conversion coating film + 1 coat system (electrodeposition coating 20±2 μm)							
Zinc coated steel plate (60g/m ²) + chemical conversion coating film + 1 coat system (electrodeposition coating 20±2 μm)							
Steel plate + chemical conversion coating film + 3 coat system (electrodeposition coating 20±2 μm, primer surfacer 35±5 μm, white top coat 35±5 μm)							
Zinc coated steel plate (40g/m ²) + chemical conversion coating film + 3 coats (electrodeposition coating 20±2 μm, primer surfacer 35±5 μm, white top coat 35±5 μm)							

Acid rain cycle: Acid rain spray 35° C (2h) ⇒ Dry 60° C (4h) ⇒ Humidity 50° C (2h)
 JASO cycle: Salt spray 35° C (2h) ⇒ Dry 60° C (4h) ⇒ Humidity 50° C (2h)
 Volvo test: Spray salt solution once a week



Point 1

For example, as opposed to salt spray tests where corrosive solution is sprayed constantly, JASO cyclic tests only spray for two hours during a single eight-hour cycle, thus only using a quarter of spray solution compared to continuous salt spray tests.

Combined cyclic tests have the merit of reducing the amount of corrosive solution, the amount of water drainage, and the cost of production and management of corrosive solution. With its high acceleration and correlation with outdoor exposure, combined cyclic test is a great solution to today's energy conservation demands.

Point 2

Suga also offers devices that can save labor time during the solution supplying process, and also environmental protection devices that collect the solution fluid that has been sprayed.

Test type	Salt spray	JASO standard cycle
Test instrument model no.	STP-90	CYP-90
Amount of solution used (in 48hrs)	11.5L	3.0L

1. Salt Spray Test Instruments



STP-90V-4 Salt Spray Test Instrument

CAP-90V-4 CASS Test Instrument

Expert in metal corrosion

These are the most basic test instruments for determining the corrosion resistance of metals and surface treatment. The solution is sprayed from the mist dispersion tower, a method recommended by ISO for its uniform distribution capability. An air barrier board is set inside the solution tank, preventing the fluctuation of the solution's pH level (PAT.).

Model No.	STP-90V-4	CAP-90V-4
Test temperature	35±1 °C	50±1 °C
Spray solution	5% neutral salt solution	CASS solution
Internal dimension of chamber	Approx. width 90 cm, depth 60 cm, height 40 cm	
Number of specimens	64 (dimension of 150 × 70 × 1 mm)	
Specimen angle	15° or 20° from perpendicular position	
External dimension of the instrument	Approx. width 158 cm, depth 74 cm, height 114 cm [weight: approx.140 kg]	

STP-200 Large-sized Salt Spray Test Instrument

CAP-200 Large-sized CASS Test Instrument

Tests multiple / large-sized specimens at once

These instruments are capable of testing large number of specimens with its large-sized test chamber.

The increased floor load resistance option allows the instrument to test large-sized specimens and full-scale models and products.



Model No.	Internal dimension of chamber	Number of specimens (150 × 70 × 1 mm)
STP-110 (CAP-110)	Approx. width 110 cm, depth 60 cm, height 40 cm	76
STP-120 (CAP-120)	Approx. width 120 cm, depth 80 cm, height 50 cm	104
STP-160 (CAP-160)	Approx. width 160 cm, depth 100 cm, height 50 cm	224
STP-200 (CAP-200)	Approx. width 200 cm, depth 100 cm, height 50 cm	272

2. Humidity Chamber



CT-3 Humidity Cabinet

Our standard model acknowledged as the leader in humidity testing

This is a test instrument for evaluating the humidity resistance of paint (ISO 6270), rust preventive oil (JIS K 2246), and metal surface treatments such as coating and colorants. Its chamber lid designed so that water particles adhered on the ceiling will not fall onto the specimens, giving it outstanding test reproducibility.

Test temperature	49±1 °C*
Test humidity	Approx. 95 %rh or above
Internal dimension of the chamber	Approx. width 71 cm, depth 71 cm, height 73 cm
Number of specimens	36 (100 × 50 × 1 mm)
External dimension of the instrument	Approx. width 99 cm, depth 82 cm, height 155 cm [weight: approx.220 kg]

* There is also the high-temperature model CT-3H, capable of testing at 80°C

3. Combined Cyclic Corrosion Test Instruments

CYP-90 Combined Cyclic Corrosion Test Instrument: Salt Spray, Dry, Humidity World standard model for cyclic tests



This is a compact combined cyclic test instrument capable of either single or combination of salt spray, dry, humidity, and open air tests. It is widely used both in Japan and in overseas as a standard combined cyclic test instrument capable of performing JIS, JASO, and ISO cyclic tests.

Temperature and humidity range for each tests	[Salt spray]	35, 50 ± 1 °C 5 % neutral salt spray solution
	[Dry]	(ambient temp. + 10 °C) to 70 ± 1 °C, 25 ± 5 %rh humidity (at 60 °C)
	[Humidity]	(ambient temp. + 10 °C) to 50 ± 1 °C, 60 to 95 ± 5 %rh humidity (at 50 °C)
	[Open air]	Ambient temperature (no temperature and humidity control)
Internal dimension of the chamber	Approx. width 90 cm, depth 60 cm, height 50cm	
Number of specimens	58 (150 × 70 × 1 mm)	
Specimen angle	15° or 20° from perpendicular position	
External dimension of the instrument	Approx. width 183 cm, depth 101 cm, height 149 cm (174 cm when lid opened) [weight: 270 kg]	

This product is also available as CE model upon request.

CYP-200 Large-sized Combined Cyclic Corrosion Test Instrument

Tests multiple / large-sized specimens at once



This is a large-sized combined cyclic test instrument capable of either single or combination of salt spray, dry, humidity, and open air tests. It is capable of testing large number of specimens at once. With the increased floor load capacity option, large-sized specimens and full-scale models and products can also be tested.

Model No.	Internal dimension of the chamber	Number of specimens (150 × 70 × 1 mm)
CYP-120	Approx. width 120 cm, depth 80 cm, height 50 cm	104
CYP-160	Approx. width 160 cm, depth 100 cm, height 50 cm	224
CYP-160D	Approx. width 160 cm, depth 100 cm, height 100 cm	224
CYP-200	Approx. width 200 cm, depth 100 cm, height 50 cm	272
CYP-200D	Approx. width 200 cm, depth 100 cm, height 100 cm	272

CCT-1(L) Combined Cyclic Corrosion Test Instrument; Salt, Dry, Humidity, Immersion, (Low temp.)

Suga's challenge to correlation with outdoor exposure and accelerated degradation



This is a combined cyclic test instrument capable of either single or combination of salt spray, dry, humidity, salt solution immersion, and open air tests (also low temperature tests for CCT-1L). Capable of performing highly precise and diverse cycles, it is applied in various fields where high corrosion resistance is demanded, such as exteriors, suspension parts and steel for automobiles.

Temperature and humidity range for each tests	[Salt spray]	35, 50 ± 1 °C
	[Dry]	20 to 70 ± 1 °C, 25 ± 5 %rh humidity (at 60 °C)
	[Humidity]	50 to 70 ± 1 °C, 60 to 95 ± 5 %rh humidity (at 50 °C)
	[Salt immersion]	(ambient temp. + 10 °C) to 60 ± 1 °C (solution temperature)
	[Open air]	Ambient temperature (no temperature and humidity control)
	[Low temp.]	-20 to 20°C (CCT-1L low temperature model only) -40°C *optional
Internal dimension of the chamber	Approx. width 96cm, depth 61cm, height 86cm	
Number of specimens	112 (150 × 70 × 1 mm)	
Specimen angle	15° or 20° from perpendicular position	
External dimension of the instrument	Approx. width 171 cm, depth 177 cm, height 217 cm [weight: 1,150 kg]	

Other models available are: CCT-2 with wider chamber dimension (120×90×100cm) and CCT-3 (200×100×120cm).

4. Corrosion Test Instrument with Light Test



CCT-RX Weather Test Chamber

Determines the outdoor resistance of large full-scale products

This combined cyclic test chamber simulates various harsh outdoor conditions (light, acid rain spray, dry, humidity, dew and low temperature) in combination of the user's choice. It is capable of testing large-sized materials and full-scale products such as automobiles and motorcycles.

Light source	Three xenon-arc lamps* WX7.5 (7.5 kW water-cooled type)
Test types	Light, acid rain, dry, humidity, dew, low temperature (single or cyclic)
Irradiance	60 W/m ² (wavelength at 300 to 400 nm)
Temperature range	-20 to 80°C, depending on test type (example: 40 to 70°C during light test)
Internal dimension of the chamber	Approx. width 350 cm, depth 302 cm, height 176 cm
External dimension of the instrument	Approx. width 540 cm, depth 377 cm, height 279 cm [weight: approx. 5,000 kg]

* Models using other light sources such as metal halide lamps are also available.

5. Related Devices for Corrosion Test Instruments



EF-1R • EF-2R Exhaust Treatment Unit (Water circulation system)



Completely processes the salt spray test exhaust

This instrument processes all exhausts from salt spray tests by passing the exhaust through sprayed water. Processing water is recycled to keep consumption minimal. EF-2R is for larger corrosion test instruments.

Composition	Rigid PVC
Water amount	20 L in circulation
External dimension	Approx. width 64 cm, depth 30 cm, height 154 cm [weight: approx. 50 kg] (EF-2R is 198 cm high and weight 53 kg)



SS-2 Automatic Solution Supplying Unit

Contributes to reducing energy consumption in the solution supplying process

This unit automatically detects the water level in the corrosion test instrument's solution tank, and supplies water when necessary. This is best suited for tests that take long period of time. It includes an air barrier board (PAT.), which prevents the pH level of the solution from changing. SS-2's water tank can hold up to 100 liters. Models with more solution capacity and capability of generating solutions are also available.

Composition	Rigid PVC
Air barrier board	Rigid PVC
Water amount	Approx. 100 L
External dimension	Approx. width 46 cm, depth 46 cm, height 114 cm [weight: approx. 130 kg]

6. Gas Corrosion Test Instruments

Ozone



OMS-HN•OMS-LN Ozone Weather Meter

True ozone control made possible with pursuit of accuracy

This instrument performs accelerated ozone degradation testing for organic materials (such as rubber) used in automobiles and electronic materials. Its fully closed system allows for true ozone concentration tests.

Applicable to ISO 1431-1 standard.

Model no.	OMS-HN	OMS-LN
Ozone concentration range	20 to 250 pphm (200 to 2,500 ppb) / 1 to 200 ppm	20 to 250 pphm (200 to 2,500 ppb)
Internal dimension of chamber	Width 50 cm, depth 50 cm, height 50 cm (volume: 0.125 m ³)	
Temperature range	(ambient temperature + 10 °C) to 60 ± 1 °C	
Dynamic test (vertical tension test)	(specimen dimension & number) (25 × 120 × 3mm) 12 pieces (or 24 as an option)	
	(frequency) 0.5 Hz (specimen rotation) 2 rpm	
Static test	(specimen rotation) 2 rpm (extending holder) FW-H, 16 pieces	
External dimension of the instrument	Approx. width 140 cm, depth 77 cm, height 191 cm [weight: 430 kg]	Approx. width 140 cm, depth 77cm, height 191 cm [weight: 390 kg]

Gas



GT-100 Gas Corrosion Test Instrument

Instrument capable of accommodating tests with and without Cl₂

GT-100 is used to evaluate the corrosion resistance of electronic components and plated products against pure or mixed gases of SO₂, H₂S, NO₂ and Cl₂. Exchangeable test Chamber for both conducting tests using chlorine as well as tests not using chlorine (PAT.). More stable control of the gas density, temperature, and humidity by preventing condensation system (PAT.).

Gas concentration range	SO ₂	0.1~200ppm (100~200,000ppb)
	H ₂ S	0.01~200ppm (10~200,000ppb)
	NO ₂	0.1~ 20ppm (100~20,000ppb)
	Cl ₂	0.01~ 20ppm (10~20,000ppb)
Temperature range	20 to 65 ± 1°C	
Humidity range	65 to 95 ± 3%rh at 20°C, 45 to 95 ± 3%rh at 40°C, 30 to 95 ± 3%rh at 65°C	
Internal dimension of the chamber	Width 50 cm, depth 50 cm, height 40 cm	
External dimension of the instrument	Approx. width 130 cm, depth 144 cm, height 194 cm [weight: approx. 570 kg]	

7. Heat Aging Chamber



TG100 Gear Oven Aging Tester

Heat aging test complying with ISO 188

TG100 is a heat aging test instrument that conforms to the new ISO 188-2007, an important standard for determining the lifespan of rubber and plastic materials. The air replacement rate is set by the easy-to-operate flow rate meter as recommended by ISO. Accurate testing can be performed with minimal limitations on installation location.

Model no.	TG100	TG216
Temperature range	(ambient temp. + 10 °C) to 300 °C ±1 °C (less than 100 °C), ± 1 % (over 100 °C)	
Air replacement range	3 to 10 times per hour	
Introduced air temperature	40 ± 1 °C	
Internal dimension of the chamber	Width 45 cm, depth 45 cm, height 50 cm (volume approx. 100 L)	Width 60 cm, depth 60 cm, height 60 cm (volume approx. 216 L)
External dimension of the instrument	Approx. width 115 cm, depth 69 cm, height 146 cm [weight: approx. 200 kg]	Approx. width 130 cm, depth 84 cm, height 153 cm [weight: approx.230 kg]
Standards	JIS K 6257, K 7212, ISO 188, etc.	

Typical Standards for Corrosion Test Instruments

Field	Test type	Standards: year when issued or revised			
Metals	Neutral salt spray	ISO 9227	ASTM B117	JIS Z 2371	
	Acetic acid salt spray		ASTM G85		
	CASS				
	Combined cyclic	ISO 11130	ISO 16539	ASTM G60	
		ISO 14993 ISO 16151	ISO 16701 ISO 21207**	ASTM G85**	
Gas	ISO 10062	EIA-364-65A			
Steel plate with inorganic coating	Combined cyclic	ISO 16151		JIS G 0594	
Plating	Neutral salt spray	ISO 9227		JIS H 8502	
	Acetic acid salt spray				
	CASS				
	Corrodkote	ISO 4541			
	Combined cyclic	ISO 14993	ISO 16151		
Aluminum anodic oxide film	CASS	ISO 9227	ISO 28340*	JIS H 8602*	
	Acetic acid salt spray	ISO 9227		JIS H 8681-2	
Paints / Varnishes	Neutral salt spray	ISO 9227		JIS K 5600-7-1	
	Combined cyclic	ISO 11997-1 ISO 11997-2*	ISO 15110 ISO 20340*	JIS K 5600-7-9 JIS K 5621* JIS K 5981	
Automotive	Neutral salt spray			JIS D 0201 JIS D 0202	JASO M 104
	CASS		ASTM B368	JIS D 0201	
	Corrodkote		ASTM B380		
	Combined cyclic		SAE J2334		JASO M 609 JASO M 610
	Ozone		FMVSS 106	JIS D 0205 JIS D 2601 JIS D 2602	JASO M 104
Electric / Electronics	Neutral salt spray	IEC 60068-2-11		JIS C 60068-2-11	
	Combined cyclic	IEC 60068-2-52		JIS C 60068-2-52	
	Gas	IEC 60068-2-42		JIS C 60068-2-42	
		IEC 60068-2-43 IEC 60068-2-60		JIS C 60068-2-43 JIS C 60068-2-60	
Plastic	Neutral salt spray	ISO 4611			
Rubber	Ozone	ISO 1431-1 ISO 1431-3	ASTM D1149 ASTM D1171 ASTM D4575	JIS C 3005 JIS K 6259 JIS K 6330-7 JIS K 6385 JIS K 6411	
Building materials	Ozone			JIS A 6008	JSTM G 7202
Wires / cables	Ozone		ASTM D470 ASTM D2802	JIS C 3005	
Photography	Ozone	ISO 18941			JEITA CP-3901A

* Specifies the test conditions for combined cyclic tests with light test

** Specifies the test conditions for combined cyclic tests with gas

I S O : International Organization of Standardization
I E C : International Electrotechnical Commission
A S T M : American Society for Testing and Materials

S A E : Society of Automotive Engineers
F M V S S : Federal Motor Vehicle Safety Standards
J I S : Japanese Industrial Standards

J A S O : Japanese Automotive Standards Organization
J E I T A : Japan Electronics and Information Technology Industries Association



Suga Test Instruments Co., Ltd.
www.suga-global.com

Head Office	5 - 4 - 14 Shinjuku, Shinjuku-ku, Tokyo, 160-0022, Japan	phone +81-3-3354-5241	fax +81-3-3354-5275
Hidaka / Kawagoe Factory	1973 - 1 Takahagi, Hidaka-shi, Saitama, 350-1213, Japan	phone +81-42-985-1661	fax +81-42-989-6626
Suga Europe	11 Lovelace Road, North Oxford, Oxfordshire, OX2 8LP, UK	E-mail i_sales@sugatest.co.jp	
Nagoya branch	1 - 605 Yashirogaoka, Meito-ku, Nagoya-shi, Aichi, 465-0051, Japan	phone +81-52-701-8375	fax +81-52-701-8513
Osaka branch	3 - 23 Enokicho, Suita-shi, Osaka, 564-0053, Japan	phone +81-6-6386-2691	fax +81-6-6386-5156
Hiroshima branch	2-12-11 Kannonhonmachi, Nishi-ku, Hiroshima-shi, Hiroshima, 733-0033, Japan	phone +81-82-296-1501	fax +81-82-296-1503