Thermal Grease Test Report

Jiangsu Crystal River Electronic Technology Co., Ltd

Content

1. Product description

1.1 Overview

CR TM-SGrease series thermal grease product is a grease-like silicon material containing oxide thermal conductive composite filler. It has good wettability, which can effectively reduce the contact thermal resistance of the system. It is suitable for heat conduction and dissipation in electronic components. It has the characteristics of long-term operation under high temperature conditions and excellent hydrolysis within a certain temperature range. Stability, low toxicity and chemical inertness. This series of products are non-corrosive materials and have good adhesion. It can be dispensed on standard dispensing equipment or screen-printed through a stencil for high operational convenience and efficiency.

1.2 Product features

- ✓ Good thixotropy, suitable for dispensing and screen printing
- ✓ Non-toxic, odorless, non-corrosive
- ✓ Soft and extremely low stress during installation
- ✓ Suitable for use in standard occasions
- ✓ Meet the environmental protection requirements of EU Directive 2002/95/EC (RoHS)
- ✓ Room temperature storage, good stability

1.3 Product applications

- ✓ Chassis or related cooling modules
- ✓ Mainframe and small office network equipment
- ✓ Between the power resistor and the base
- ✓ Between CPU, GPU and radiator
- ✓ Automotive electronic equipment
- ✓ 5G communication equipment

1.4 Storage and use

CR TM-SGrease series thermal grease is a paste-like one-component thermal grease product with good consistency. It is packaged in a 300ml hose or canned for transportation. It is stored in a sealed and darkened condition at room temperature and has a shelf life of at least 6 months. This product can be dispensed directly with a dispenser or screen printed with a stencil.

2. Product Test Project

2.1 Product appearance

2.1.1 Purpose

Provide technical certification basis for the appearance status of three typical thermal grease products of CR TM-SGrease series.

2.1.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.1-1 CR TM-SGrease-1300 appearance

Fig. 2.1-2 CR TM-SGrease-1250N appearance

Fig. 2.1-3 CR TM-SGrease-1450N appearance

2.1.3 Test method

Visual inspection

2.1.4 Test result

- ✓ Thermal grease CR TM-SGrease-1300 product is white, the product is delicate, has continuous sag flow, no leveling phenomenon, no impurities on the surface, no agglomeration phenomenon.
- ✓ Thermal grease CR TM-SGrease-1250N product is gray, the product is fine, it has slow sag flow, no leveling phenomenon, no impurities on the surface, no agglomeration phenomenon.
- ✓ Thermal grease CR TM-SGrease-1450N is gray, the product is delicate, no leveling phenomenon, no impurities on the surface, no lump phenomenon.

2.2 Dispensing and screen-printing processing

2.2.1 Purpose

Provide technical certification basis for dispensing and screen-printing processing of three typical thermal grease products of CR TM-SGrease series.

2.2.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.2-1 CR TM-SGrease-1300

Fig. 2.2-2 CR TM-SGrease-1250N

Fig. 2.2-3 CR TM-SGrease-1450N

Dispensing and screen-printing samples

2.2.3 Test method

Visual inspection

2.2.4 Instruments or fixtures

Dispensing machine, Screen printing fixture

Fig. 2.2-4 Screen printing fixture

Fig. 2.2-5 Dispensing machine

2.2.5 Test method

1) Put the thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N into a 55CC needle tube respectively, and use a 13# needle for continuous dispensing on the stainless-steel wire mesh, place the stainless-steel wire mesh on the stainless-steel sheet, and

observe whether the thermal grease is smooth and whether there are bubbles.

2) Use a stainless-steel shovel to scrape the thermal grease on the sample after step 1), so that the thermal grease is printed on the stainless-steel sheet through the screen, then remove the screen to observe the screen-printing effect of the thermal grease on the stainless-steel sheet.

2.2.6 Test result

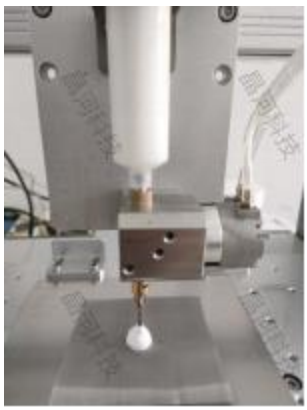

Fig. 2.2-6 CR TM-SGrease-1300

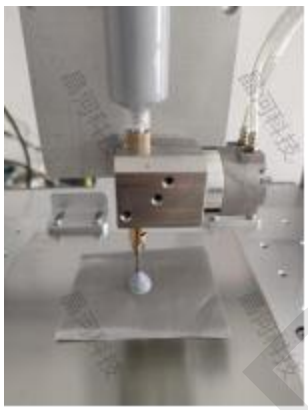

Fig. 2.2-7 CR TM-SGrease-1250N

Fig. 2.2-8 CR TM-SGrease-1450N

Dispensing status

Fig. 2.2-9 CR TM-SGrease-1300

Fig. 2.2-10 CR TM-SGrease-1250N

Fig. 2.2-11 CR TM-SGrease-1450N

Screen-printing status

- ✓ The thermal conductive silicone grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N can be continuously and smoothly dispensed during dispensing, and there is no bubble and leveling phenomenon in the process.
- ✓ Thermal grease CR TM-SGrease-1300 is screen-printed on stainless steel sheet after CR TM-SGrease-1300 is screen-printed with 500 mesh, CR TM-SGrease-1250N is screen-printed with 500 mesh and CR TM-SGrease-1450N is screen-printed with 400 mesh The printing thickness is uniform and full, and there is no overflow and no agglomeration.

2.3 Density test

2.3.1 Purpose

Provide technical certification basis for density performance of three typical thermal grease products of CR TM-SGrease series.

2.3.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.3-1 CR TM-SGrease-1300

Fig. 2.3-2 CR TM-SGrease-1250N

Fig. 2.3-3 CR TM-SGrease-1450N

Density test samples

2.3.3 Test standards

ASTM D1475

2.3.4 Instruments or fixtures

Balance, Vacuum box, Vibrating fixture, Vernier caliper

Fig. 2.3-4 Balance

Fig. 2.3-5 Vacuum box

Fig. 2.3-6 Vibrating fixture

Fig. 2.3-7 Vernier caliper

2.3.5 Test method

1) Scrub the vibrating fixture with a clean cloth, measure the inner diameter D and the inner depth H with a vernier caliper, and record.
2) Carry out the tare operation on the balance of the vibrating jig after step 1).

3) Put 200 grams of thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N into the vibrating jig respectively, the samples are in overflow state.
4) Put the vibrating jig after step 3) into the vacuum box and vacuumize for 3 minutes, and then carry out the sturdy operation for about 2 minutes after taking it out.
5) Use a spatula to scrape off the sample overflowing from the tap jig in step 4), to ensure that the sample is completely filled with the tap jig, and to ensure that there is no additional sample adhesion on the outer surface of the tap jig.
6) Put the vibrating jig after step 5) on the balance that has been peeled, weigh the net weight M of the three samples, and record.
7) Calculate its density according to the following formula.

   ρ=4*M/(3.14*D^2*H)

   Where:

   ρ: Density, g/cm^3

   M: Net weight of thermal grease, g

   D: Inner diameter of the vibrating fixture, cm

   H: Depth of tapped fixture, cm

2.3.6 Test result

Tab. 2.3-1 Density test results for thermal grease

Part number	No.	Vibration fixture dimension		Sample weight M, g	Density, g/cm^3	
		Inner diameter D, cm	Depth H, cm		Calculated value	Mean
CR TM-SGrease-1300	1	3.0	3.5	83.31	3.37	3.37
	2	3.0	3.5	82.80	3.35	
	3	3.0	3.5	83.63	3.38	
CR TM-SGrease-1250N	1	3.0	3.5	72.04	2.91	2.91
	2	3.0	3.5	72.16	2.92	
	3	3.0	3.5	71.96	2.91	
CR TM-SGrease-1450N	1	3.0	3.5	67.70	2.74	2.75
	2	3.0	3.5	67.91	2.75	
	3	3.0	3.5	68.28	2.76	

2.4 Extrusion rate test

2.4.1 Purpose

Provide technical certification basis for extrusion rate performance of three typical thermal grease products of CR TM-SGrease series.

2.4.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.4-1 CR TM-SGrease-1300

Fig. 2.4-2 CR TM-SGrease-1250N

Fig. 2.4-3 CR TM-SGrease-1450N

60psi&13# Needle/90psi&No Needle Extrusion Rate Test Sample

2.4.3 Test standards

JH-WI-20/Product Extrusion Rate Test Operation Instructions

2.4.4 Instruments or fixtures

Electronic balance, Dispensing machine, Vacuum box, Glass plate

Fig.2.2-4 Electronic balance

Fig.2.2-5 Dispensing machine

Fig.2.2-6 Vacuum box

2.4.5 Test method

1) Put the thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N into the 30CC needle tube respectively, the quantity is about two-thirds of the 30CC needle tube, each with two pieces. One with a 13# needle, the other without a needle.
2) Put the three groups of samples in step 1) into the vacuum box and vacuumize for 5 minutes, take out the pier and push the bottom plug to ensure that the bottom plug is in complete contact with the rubber compound.
3) Wipe the blank glass plate clean, weigh it on the electronic balance and peel it.
4) Manually dispense the two samples from step 2) on the peeled glass plate from step 3). Dispensing conditions: The dispensing conditions with 13# needles are 60psi&1min, and the dispensing conditions without needles are 90psi&1min. During the dispensing process, the needle should be perpendicular to the glass plate, and the pressure should be turned off at the end of the time. Then the weights of the thermal greases were respectively weighed and recorded.

2.4.6 Test result

Tab.2.4-1 Extrusion rate test table for thermal greases

Part number	Test times	30CC extrusion, g/min	
		13# needle (Inside diameter: 1.9mm)//60psi	No needle (Inside diameter: 2.4mm)/90psi
CR TM-SGrease-1300	1	13.12	73.03
	2	13.20	72.03
	3	13.49	74.03
	Average extrusion rate	13.27	73.03
CR TM-SGrease-1250N	1	31.22	223.40
	2	31.94	222.03
	3	31.74	225.75
	Average extrusion rate	31.63	223.73
CR TM-SGrease-1450N	1	6.97	37.09
	2	7.01	38.08
	3	7.21	37.27
	Average extrusion rate	7.06	37.48

2.5 Thermal conductivity test

2.5.1 Purpose

Provide technical certification basis for thermal conductivity performance of three typical thermal grease products of CR TM-SGrease series.

2.5.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.5-1 CR TM-SGrease-1300

Fig. 2.5-2 CR TM-SGrease-1250N

Fig. 2.5-3 CR TM-SGrease-1450N

Thermal conductivity test samples

2.5.3 Test standards

ASTM D5470

2.5.4 Instruments or fixtures

Thermal conductivity tester

Fig. 2.5-4 Thermal conductivity tester

Fig. 2.5-5 Quartz glass fixture

2.5.5 Test method

1) Take about 20 grams of each of the three thermal grease samples for use, and keep them clean during the sampling process.
2) Turn on the L9389 thermal conductivity tester and select the fourth "Grease Thermal Conductivity" thermal grease thermal conductivity test mode.
3) Wipe the hot and cold electrodes of the thermal conductivity tester, and place the quartz glass fixture.
4) Set the test conditions: pressure 20psi, hot end temperature 80℃, test time 10min.
5) Take the test sample after step 1) and use a spatula to take the thickness of 0.1mm, 0.2mm, and 0.3mm, so that the sample is filled with the hot electrode and avoid the introduction of air bubbles.
6) Start the thermal conductivity test, scrape off the sample on the hot electrode after each end, put the sample again, repeat the test 3 times according to the thickness of 0.1mm, 0.2mm and 0.3mm, and the system will automatically calculate the thermal conductivity.

2.5.6 Test result

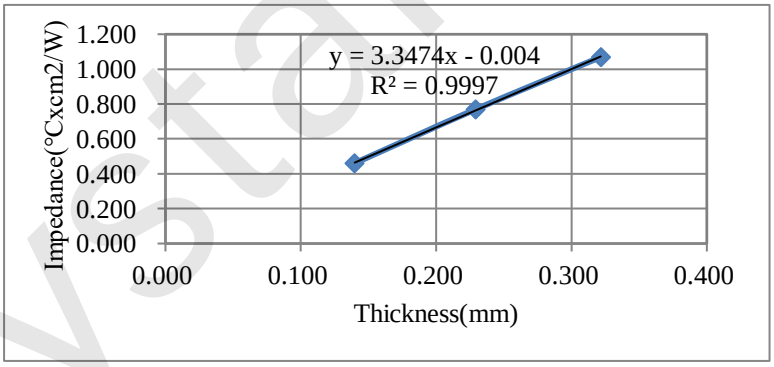

Fig. 2.5-6 Thermal conductivity test results for CR TM-SGrease-1300

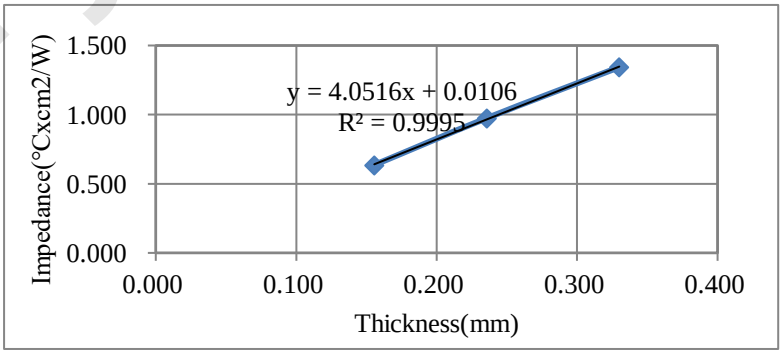

Fig. 2.5-7 Thermal conductivity test results for CR TM-SGrease-1250N

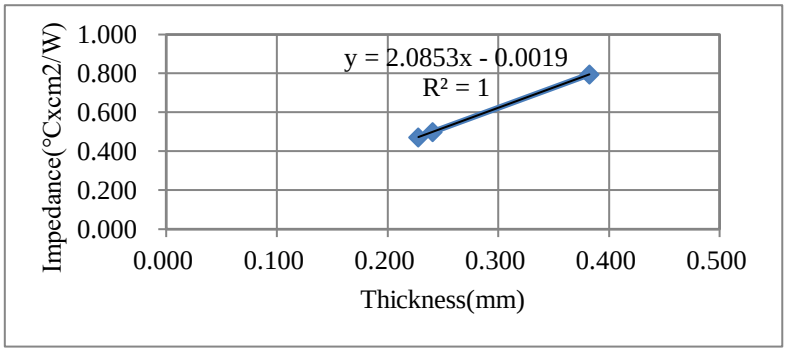

Fig. 2.5-8 Thermal conductivity test results for CR TM-SGrease-1450N

Tab. 2.5-1 Thermal conductivity test results for thermal greases

Part number	Thickness	Thermal impedance		Thermal	R^2	Fitted thermal
	mm	℃·cm²/W	℃·in²/W	conductivity, W/m·℃		conductivity, W/m·℃
CR TM-SGrease-1300	0.140	0.461	0.071	3.03	0.9997	2.99
	0.229	0.769	0.119	2.98		
	0.322	1.069	0.166	3.01		
CR TM-SGrease-1250N	0.156	0.636	0.099	2.45	0.9995	2.47
	0.236	0.975	0.151	2.42		
	0.330	1.344	0.208	2.46		
CR TM-SGrease-1450N	0.228	0.474	0.073	4.81	1	4.80
	0.241	0.500	0.077	4.82		
	0.382	0.795	0.123	4.81		

2.6 Thermal impedance test

2.6.1 Purpose

Provide technical certification basis for thermal impedance performance of three typical thermal grease products of CR TM-SGrease series.

2.6.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.6-1 CR TM-SGrease-1300

Fig. 2.6-2 CR TM-SGrease-1250N

Fig. 2.6-3 CR TM-SGrease-1450N

Thermal impedance test samples

2.6.3 Test standards

ASTM D5470

2.6.4 Instruments or fixtures

Thermal conductivity tester

Fig. 2.6-4 Thermal conductivity tester

2.6.5 Test method

1) Turn on the L9389 thermal conductivity tester and select the "Pad/Grease Thermal Impedance Test" thermal grease thermal resistance test mode.
2) Wipe the hot and cold electrodes of the thermal conductivity tester.
3) Take 10 grams of each of the three samples, and use a tongue depressor

to spread the thermal conductive silicone grease evenly and thinly on the hot end to fill the hot electrode with the sample, and smooth the surface to avoid the introduction of air bubbles.

4) Set the test conditions: pressure 40psi, hot end temperature 80℃, test time 30min.
5) Start the test and record the experimental data.

2.6.6 Test result

Tab. 2.6-1 Thermal impedance test results for thermal greases

Part number	Times	Th ℃	Tc ℃	Tave ℃	P psi	Q W	R ℃/W	Icm ℃·cm²/W	Iin ℃·in²/W	Thickness mm	K W/m·℃
CR TM-SGrease-1300	1	79.64	78.14	78.89	39.91	91.46	0.016	0.106	0.016	0.028	2.68
	2	80.00	78.55	79.28	39.95	91.84	0.016	0.101	0.016	0.020	1.97
	3	80.01	78.62	79.31	39.95	91.94	0.015	0.097	0.015	0.015	1.56
CR TM-SGrease-1250N	1	79.91	79.18	79.54	39.98	85.86	0.009	0.055	0.009	0.018	3.17
	2	80.02	79.35	79.68	40.00	85.52	0.008	0.050	0.008	0.012	2.45
	3	80.03	79.40	79.71	39.98	85.00	0.007	0.048	0.007	0.008	1.72
CR TM-SGrease-1450N	1	79.70	78.98	79.34	39.93	93.34	0.008	0.050	0.008	0.027	5.39
	2	79.99	79.30	79.64	39.93	93.05	0.007	0.048	0.007	0.021	4.33
	3	80.00	79.31	79.65	39.98	93.12	0.007	0.048	0.007	0.017	3.51

2.7 Viscosity test

2.7.1 Purpose

Provide technical certification basis for viscosity performance of three typical thermal grease products of CR TM-SGrease series.

2.7.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.7-1 CR TM-SGrease-1300

Fig. 2.7-2 CR TM-SGrease-1250N

Fig. 2.7-3 CR TM-SGrease-1450N

Viscosity test samples

2.7.3 Test standards

ASTM D2196

2.7.4 Instruments or fixtures

Brookfield viscometer, Vacuum box

Fig. 2.7-4 Brookfield viscometer

2.7.5 Test method

1) Take three kinds of thermal conductive silicone grease to be tested, each about 200 grams, and try to reduce the air in the cylinder by tapping the side wall of the packaging cylinder, and seal the front end with a rubber cylinder head plug. The whole process should be completed within 2 minutes.

2) Level the viscometer and turn on the viscometer, at this time the viscometer has been automatically calibrated.
3) Select the 93# rotor and screw it on the viscometer.
4) Set the speed of 6, 10, and 60 respectively to test the viscosity of the sample in step 1).
5) Record the test results.

2.7.6 Test result

Tab. 2.7-1 Viscosity test results for thermal greases

Part Number	Viscosity& 23℃/93# rotor, cps			Thixotropic Index
	6rpm	10rpm	60rpm	
CR TM-SGrease-1300	253300	197600	113100	0.447
CR TM-SGrease-1250N	166700	123200	56270	0.338
CR TM-SGrease-1450N	674700	502400	226900	0.336

Note: Thixotropic Index = 60 RPM Viscosity/6 RPM Viscosity

2.8 Penetration test

2.8.1 Purpose

Provide technical certification basis for penetration performance of three typical thermal grease products of CR TM-SGrease series.

2.8.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.8-1 CR TM-SGrease-1300

Fig. 2.8-2 CR TM-SGrease-1250N

Fig. 2.8-3 CR TM-SGrease-1450N

Penetration test samples

2.8.3 Test standards

GB/T 269-91

2.8.4 Instruments or fixtures

Penetration tester

Fig. 2.8-4 Penetration tester

2.8.5 Test method

1) Take about 1 kg of the sample to be tested into the container, and try to reduce the air in the container by solidifying the sample in the container, so as not to affect the reliability of the data, and press the sample with a scraper. Prepare 3 copies of the same sample within 6 mm from the edge of the

container.

2) Put the sample after step 1) in a constant temperature room with a temperature of 23±2 degrees for 4 hours.
3) Place the sample after step 2) on the penetrometer platform that has been adjusted to a completely horizontal level, adjust the instrument so that the cone is in the "zero position", and carefully adjust the instrument so that the cone tip just touches the center of the sample on the surface, observing the shadow of the cone tip is helpful for precise adjustment, press to start the test, let the cone drop for 5s, and record the experimental data.
4) Perform three tests on the sample and take the median value.

2.8.6 Test result

Tab. 2.8-1 Penetration test results for thermal greases

Penetration, 0.1mm / Part number	Test value			
	Sample 1	Sample 2	Sample 3	Median
CR TM-SGrease-1300	300.9	306.2	303.5	303.5
CR TM-SGrease-1250N	311.8	316.5	314.8	314.8
CR TM-SGrease-1450N	222.8	245.1	230.4	230.4

2.9 Oil separation test

2.9.1 Purpose

Provide technical certification basis for oil separation performance of three typical thermal grease products of CR TM-SGrease series.

2.9.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.9-1 CR TM-SGrease-1300

Fig. 2.9-2 CR TM-SGrease-1250N

Fig. 2.9-3 CR TM-SGrease-1450N

Oil separation test samples

2.9.3 Test standards

HG/T 2502-1993 5201

2.9.4 Instruments or fixtures

Blast drying oven, Electronic balance, Dryer, Steel mesh oil separator

Fig. 2.9-4 Blast drying oven

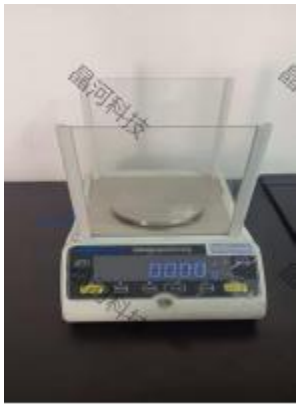

Fig. 2.9-5 Electronic balance

Fig. 2.9-6 Dryer

Fig. 2.9-7 Steel mesh oil separator

2.9.5 Test method

1) Scrub the beaker with a clean cloth and absolute ethanol, and place it in a desiccator for 30 minutes before use.
2) Weigh the beaker weight M_0 after step 1), accurate to 0.01g, and hang it on the hanging rod.
3) Weigh three samples each with a weight of 50g sample M, accurate to 0.01g, and place it in the cone mesh. The bottom of the cone should be filled. Air pockets and voids.
4) Hang the cone net with the sample on the hanging rod after step 2) to ensure that it rests in the middle of the hanging rod on the beaker mouth.
5) Bake the steel mesh oil separator after step 4) in a constant temperature drying oven at 200±2℃ for 24 hours.
6) Take out the stencil oil separator after step 5), put it in a desiccator and cool it to room temperature.
7) Take out the hanging rod and cone mesh in the steel mesh oil separator after step 6), and weigh the total weight M_1 of the beaker and oil.
8) Calculation formula of oil separation:

   Where:

   $X_1=(M_1-M_0)/M*100\%$

   X_1 - Oil separation, %

   M - Sample weight, g

   M_0 - Beaker weight, g

   M_1 - The sum of the mass of the beaker and the oil, g

   Remarks: The oil separation is greater than 5%, and the difference between the two parallel determination results should not be greater than 1%. If the oil separation is less than or equal to 5%, the difference between the two parallel determination results should not be greater than 0.7%. Take the arithmetic mean as the test result.

2.9.6 Test result

Tab. 2.9-1 Oil separation test result for thermal greases

Part number	Experimental conditions	No.	M_0, g	M, g	M_1, g	Oil separation X_1, %	CR standard	Result
CR TM-SGrease-1300	200℃&24h	1#	101.660	50	101.666	0.012	<0.05%	Ok
		2#	102.984	50	102.991	0.014		
		3#	102.801	50	102.811	0.020		
CR TM-SGrease-1250N	200℃&24h	1#	101.668	50	101.681	0.026	<0.05%	Ok
		2#	102.803	50	102.826	0.046		
		3#	102.988	50	103.009	0.042		
CR TM-SGrease-1450N	200℃&24h	1#	102.805	50	102.813	0.016	<0.05%	Ok
		2#	102.992	50	102.999	0.014		
		3#	101.673	50	101.679	0.012		

2.10 Volatile content test

2.10.1 Purpose

Provide technical certification basis for Volatile content performance of three typical thermal grease products of CR TM-SGrease series.

2.10.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.10-1 CR TM-SGrease-1300

Fig. 2.10-2 CR TM-SGrease-1250N

Fig. 2.10-3 CR TM-SGrease-1450N

Volatile content test samples

2.10.3 Test standards

HG/T 2502-1993 5201

2.10.4 Instruments or fixtures

Blast drying oven, Electronic balance, Dryer, Steel mesh oil separator

Fig. 2.10-4 Blast drying oven

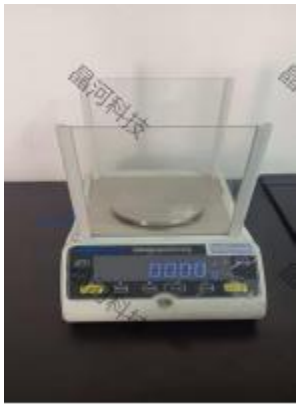

Fig. 2.10-5 Electronic balance

Fig. 2.10-6 Dryer

Fig. 2.10-7 Steel mesh oil separator

2.10.5 Test method

1) Scrub the beaker with a clean cloth and absolute ethanol, and place it in a desiccator for 30 minutes before use.
2) Weigh the beaker weight M_0 after step 1), accurate to 0.01g, and hang it on the hanging rod.
3) Weigh three samples each with a weight of 50g sample M, accurate to 0.01g, and place it in the cone mesh. The bottom of the cone should be filled. Air pockets and voids.
4) Hang the cone net with the sample on the hanging rod after step 2), make sure it is placed in the middle of the hanging rod on the beaker mouth, and weigh its total weight M_2.
5) Bake the steel mesh oil separator after step 4) in a constant temperature drying oven at 150±2°C, 200±2°C for 24 hours.
6) Take out the stencil oil separator after step 5) and put it in a desiccator to cool to room temperature.
7) Weigh the total weight M_3 of the stencil oil separator after step 6).
8) Volatility calculation formula: $X_2=(M_2-M_3)/M*100\%$

   Where:

   X_2 - Volatile matter content, %

   M - Sample weight, g

   M_2 - The sum of the weight of the sample before baking and the stencil oil separator, g

   M_3 - The sum of the weight of the sample after baking and the stencil oil separator, g

   Remarks: The difference between the two results of parallel determination should not be greater than 0.5%. Take the arithmetic mean as the test result and take two significant figures.

2.10.6 Test result

Tab. 2.10-1 Volatile content test result for thermal greases

Part number	Experimental conditions	No.	M_2, g	M, g	M_3, g	Oil separation X_2, %	CR standard	Result
CR TM-SGrease-1300	150℃&24	1#	204.137	50	204.007	0.260	<0.5%	Ok
		2#	204.736	50	204.614	0.244		
		3#	204.581	50	204.463	0.236		
	200℃&24h	1#	202.998	50	202.825	0.346		
		2#	206.056	50	205.887	0.338		
		3#	204.435	50	204.262	0.346		
CR TM-SGrease-1250N	150℃&24h	1#	204.133	50	203.948	0.370	<1%	Ok
		2#	204.748	50	204.570	0.356		
		3#	204.559	50	204.370	0.378		
	200℃&24h	1#	203.288	50	203.044	0.488		
		2#	204.068	50	203.800	0.536		
		3#	206.130	50	205.880	0.500		
CR TM-SGrease-1450N	150℃&24h	1#	204.049	50	203.746	0.606	<1%	Ok
		2#	206.135	50	205.811	0.648		
		3#	203.254	50	202.941	0.626		
	200℃&24h	1#	204.112	50	203.652	0.920		
		2#	206.140	50	205.685	0.910		
		3#	203.240	50	202.793	0.894		

2.11 Metal corrosion test

2.11.1 Purpose

Provide technical certification basis for metal corrosion performance of three typical thermal grease products of CR TM-SGrease series.

2.11.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.11-1 CR TM-SGrease-1300

Fig. 2.11-2 CR TM-SGrease-1250N

Fig. 2.11-3 CR TM-SGrease-1450N

Metal corrosion test samples

2.11.3 Test standards

HG/T 2502-1993 5201&SH/T0331-92

2.11.4 Instruments or fixtures

45# steel (50*25*5 mm), 20 times microscope, HAST chamber

Fig. 2.11-4 45# steel sheet

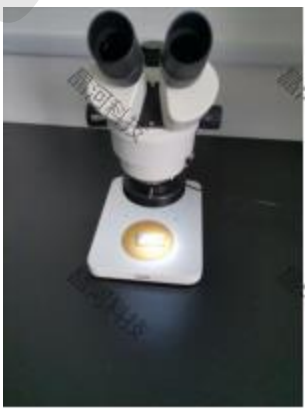

Fig. 2.11-5 20times microscope

Fig. 2.11-6 HAST chamber

2.11.5 Test method

1) Use sandpaper to remove the oxidized surface of No. 45 steel sheet. The surface of No. 45 steel sheet should always be free of dirt, dust and fingerprints.
2) Smear 5mm*5mm*1mm thin-layer sample on No. 45 steel sheet.

3) Place the No. 45 steel sheet in step 2) horizontally in a dust-free constant temperature and humidity box with a temperature of 23±2°C& 100±2℃ and a relative humidity of 45% to 55% for 24 hours.
4) Immerse the No. 45 steel sheet in step 3) in absolute ethanol to remove the sample.
5) Use a 20x microscope to observe whether the No. 45 steel sheet is corroded.
   L: No penetration corrosion
   M: The penetration corrosion area is not more than 50%
   H: The penetration corrosion area is greater than 50%

2.11.6 Test result

Non-corrosive

Fig. 2.11-7 Initial state of the sample

Fig. 2.11-8 23℃&50%RH/24h

Fig. 2.11-9 State after cleaning

Fig.2.11-10 45# Initial state of the sample

Fig. 2.11-11 100℃&50%RH/24h

Fig. 2.11-12 45# State after cleaning

CR TM-SGrease-1300 Metal corrosion test results

Fig. 2.11-13 Initial state of the sample

Fig. 2.11-14 23℃&50%RH/24h

Fig. 2.11-15 State after cleaning

Fig.2.11-16 45# Initial state of the sample

Fig. 2.11-17 100℃&50%RH/24h

Fig. 2.11-18 45# State after cleaning

CR TM-SGrease-1250N Metal corrosion test results

Fig. 2.11-19 Initial state of the sample

Fig. 2.11-20 23℃&50%RH/24h

Fig. 2.11-21 State after cleaning

Fig.2.11-22 45# Initial state of the sample

Fig. 2.11-23 100℃&50%RH/24h

Fig. 2.11-24 45# State after cleaning

CR TM-SGrease-1450N Metal corrosion test results

2.12 Volume resistivity test

2.12.1 Purpose

Provide technical certification basis for volume resistivity performance of three typical thermal grease products of CR TM-SGrease series.

2.12.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.12-1 CR TM-SGrease-1300

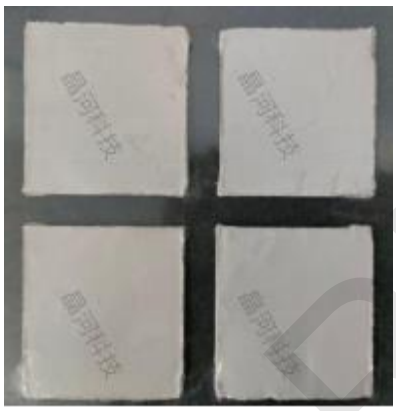

Fig. 2.12-2 CR TM-SGrease-1250N

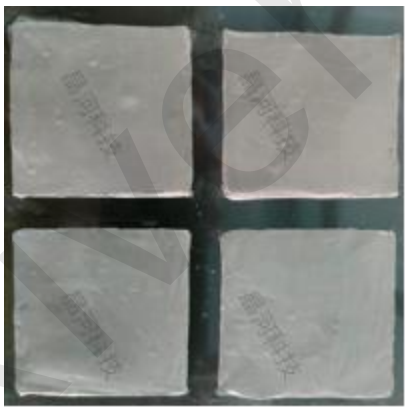

Fig. 2.12-3 CR TM-SGrease-1450N

Volume resistivity test sample

2.12.3 Test standards

GB/T1410-2006

2.12.4 Instruments or fixtures

Insulation resistance tester, Gold-plated electrodes, Blast drying oven, Thickness gauge

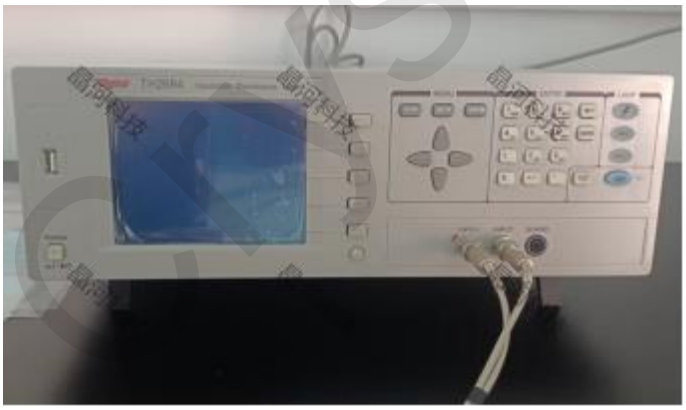

Fig. 2.12-4 Insulation resistance tester

Fig. 2.12-5 Thickness gauge

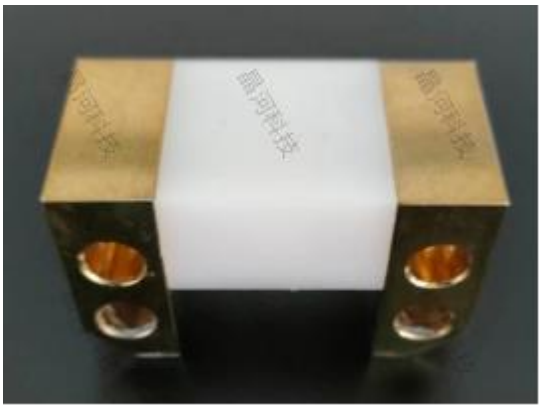

Fig. 2.12-6 Gold-plated electrodes

Fig. 2.12-7 Blast drying oven

2.12.5 Test method

1) Using a square jig, each of the three samples is made into a 4pcs sample with a size of 5cm*5cm and a smooth surface.
2) The sample passed through step 1) was put into the blast drying oven, the baking condition was 150℃/20 min, and the samples were taken out and cooled at room temperature for 1 hour.
3) Measure the thickness D of the sample with a thickness gauge, measure 3 points for each sample, and record and take the median value.
4) Use an insulation resistance tester to test the resistance of the sample, select 500v power supply, and record the data.
5) Calculate its volume resistivity according to the following formula.

   ρ = R*W*D/L

   Where:

   ρ - Volume resistivity, Ohm-cm

   R – Resistance, Ohm

   W - The width of the specimen through which the current passes, cm

   D - Specimen thickness, cm

   L - The length of the sample through which the current passes, cm

   Remark: Since the width and length of the gold-plated copper electrodes are both 2.54cm, the volume resistivity can be simplified as: ρ = R * D

   The unit is: Ohm-cm

2.12.6 Test result

Tab. 2.12-1 Dielectric strength test table of thermal grease

Part Number	No.	Thickness D cm	Resistance R Ohm	Volume Resistivity, Ohm-cm		Result
				Test value	CR standard	
CR TM-SGrease-1300	1#	0.220	1.558*1013	$3.43*10^{12}$	$>1.0*10^{12}$	Ok
	2#	0.215	1.847*1013	$3.97*10^{12}$		
	3#	0.211	2.080*1013	$4.39*10^{12}$		
	4#	0.225	1.918*1013	$4.32*10^{12}$		
CR TM-SGrease-1250N	1#	0.210	2.490*1013	$5.22*10^{12}$	$>1.0*10^{12}$	Ok
	2#	0.210	1.996*1013	$4.19*10^{12}$		
	3#	0.210	1.720*1013	$3.61*10^{12}$		
	4#	0.210	1.848*1013	$3.88*10^{12}$		
CR TM-SGrease-1450N	1#	0.389	2.370*1013	$9.21*10^{12}$	$>1.0*10^{12}$	Ok
	2#	0.445	2.490*1013	$1.11*10^{13}$		
	3#	0.345	2.080*1013	$7.17*10^{12}$		
	4#	0.406	2.270*1013	$9.21*10^{12}$		

2.13 Dielectric Strength test

2.13.1 Purpose

Provide technical certification basis for dielectric strength performance of three typical thermal grease products of CR TM-SGrease series.

2.13.2 Test product

Thermal grease CR TM-SGrease-1300, CR TM-SGrease-1250N and CR TM-SGrease-1450N.

Fig. 2.12-1 CR TM-SGrease-1300

Fig. 2.12-2 CR TM-SGrease-1250N

Fig. 2.12-3 CR TM-SGrease-1450N

Dielectric strength test sample

2.13.3 Test standards

ASTM D149

2.13.4 Instruments or fixtures

Thickness gauge, Breakdown voltage tester, Blast drying oven

Fig. 2.12-4 Thickness gauge

Fig. 2.12-5 Breakdown voltage tester

Fig. 2.12-6 Blast drying oven

2.13.5 Test method

1) Using a square jig, cut out a 5pcs sample with a size of 5cm*5cm with a flat and smooth surface.
2) Put the sample under step 1) into blast drying oven under the baking condition of 150℃/20min, and take it out and cool it at room temperature for 1h.
3) Use a thickness gauge to measure the sample thickness D of the sample in step 2), measure 3 points for each sample, record and take the median value.
4) Open the glass mask of the machine, clamp the sample with tweezers and place it between the two electrode pads, keep the edge of the product at a distance of 1cm from the electrode pads, put down the upper electrode pad, and clamp the sample.
5) Click on the top of the screen on the right side of the machine, select continuous boost, fill in the thickness of the sample, keep the initial voltage at 2kv, the initial rate at 0.5kv/s, and the holding time at 20s.
6) After the parameters are set, open the test software on the computer

desktop and create the test code.

7) Press the green start button of the machine to start the breakdown experiment, and it is forbidden to touch the machine at this time.
8) When you hear a "bang", it means that the sample has been broken down, record the breakdown voltage, breakdown current, breakdown strength, breakdown time and other data at this time.
9) Repeat the above test procedure, test 5 consecutively.

2.13.6 Test result

Tab. 2.13-1 Dielectric Strength Test Result for thermal greases

Part Number	No.	Thickness mm	Breakdown voltage, KV	Breakdown time, s	Dielectric strength, KV/mm		Result
					Test value	CR standard	
CR TM-SGrease-1300	1#	3.23	16.936	30	5.243	>5.000	Ok
	2#	3.34	15.697	30	5.312		
	3#	3.31	18.210	30	5.501		
	4#	3.30	16.900	30	5.121		
	5#	3.28	15.802	30	6.930		
CR TM-SGrease-1250N	1#	6.12	0.127	6	0.020	>0.020	Ok
	2#	4.97	0.213	6	0.042		
	3#	4.03	0.121	6	0.030		
	4#	4.53	0.114	6	0.025		
	5#	4.53	0.185	6	0.041		
CR TM-SGrease-1450N	1#	4.06	0.059	4	0.034	>0.020	Ok
	2#	4.64	0.170	3	0.036		
	3#	3.89	0.240	2	0.061		
	4#	4.45	0.237	3	0.053		
	5#	3.45	0.220	2	0.063		