Guidelines of Hermetically Sealed Relay

Ⅰ. Definition of Hermetically Sealed Relay and Function

1. Definition of hermetically sealed relay and classification

Relay is a kind of component, which can produce scheduled switching in one or several electric output circuits, when the input value (excitation value) meets certain prescribed conditions.

Electromagnetic relay is a kind of electric relay that operates by the magnetism produced by the input current put to the iron core and armature. Inside the relay, input part is an electromagnetic coil that can produce magnetism, output part is a group of switch contacts that control the controlled circuit " on " or " off ".
Classification of the common electromagnetic relays:

A. **Electromagnetic relay DC:** The control current is direct current.
B. **Electromagnetic relay AC:** The control current is alternating current.
C. **Magnetic latching relay:** Using permanent magnet to keep the output circuit "on" or "off " when the control current of the input circuit is off.
D. **High frequency relay:** The electromagnetic relay is used in switching the high frequency, radio-frequency circuit, which has a minimum loss of power.

In China military relay standard GJB1042 (MIL-R-5757) *Electromagnetic Relay general Criterion,* the sealing models of electromagnetic relay are divided into hermetical sealing and non-hermetical sealing.
Hermetical Sealing is to seal a relay into a metal cover by melt welding to ensure the small rate of gas leakage. Normally, it is the sealing between metal and metal, metal and pottery, metal and glass. Electromagnetic relay sealed in this method is the so-called Hermetically Sealed Relay.

2. Application of hermetically sealed relay

Relay is a kind of special controlling component, which is widely used in remote control, remote measuring, telecom, automatic control, integration of machinery and electrification, electric and electronic equipments. Generally, relay mainly has the following functions:

A. **To enlarge the range of control.** E.g., when the input value of a relay reaches a certain value, through the different forms of the contacts, it can synchronously change over, close or open several circuits.
B. **Enlargement.** E.g., sensitive relays and medium relays can control a high-power (tens or hundreds of input power) circuit with tiny controlling power.
C. **To integrate signals.** E.g., when several controlling signals are put into multi-winding relay in the stated form, the relay can realize the expectant controlling function by analyzing the different signals.
D. **Automatization, remote control and monitoring.** E.g., in automatic equipments, the relays and other components can constitute program-controlled circuit, realizing the automatic operation.

The relay organ is sealed in a metal cover of hermetic electromagnetic relay, so the relay is free of the impact of ambient conditions such as the harmful gas, humidity, dust etc; high pure N_2 gas filled in the relay can protect the contact effectively , improve the performance of arc extinguishing, heat dissipate and insulation, dielectric strength etc.; more over, the structure intensity obviously increases, shock resistance or vibration resistance improves.

Therefore, the reliability of the hermetic relay is higher than the non-hermetic relays, they can beused in hard climates and dynamic conditions.

Ⅱ. Main Technical Index of Hermetically Sealed Relay

1. Conditions of applicative ambient

1.1 Climate conditions

1.1.1 Temperature of applicative ambient

Application temperature has following influences upon the relay:

A. The coil resistance could be increased according with the ambient temperature, which leads to the input power decreased, so the pick-up voltage value increased a bit. In the same principle, the drop out voltage would be decreased a little in the low temperature. It under high temperature will have influence on the relay operation properly.

B. As the temperature rises, the arc extinction becomes difficult, the switching ability of the contact declines.

C. The temperature rising increases the aging of the insulation material and the oxidation of the metal parts; temperature rising speeds the release of organic gas, increases the forming of contact surface resistance, in particular, it affects the contact reliability directly under the low electric level and medium current; in low temperature, the contact surface frosts if the relay or the inner gas moisture exceeds the standard, then affects the of the contact; in low temperature, the of the Tin affects the hermetization of the Tin-sealing relay.

China military standard prescribes the operate temperature range grades. See Table 1:

Table 1: The operate temperature range grades

GJB1042 (MIL-R-5757)	Grade	A	B
	Temp. range	-55˚C to 85˚C	-65˚C to 125˚C
GJB65B (MIL-R39016)	Temp. range	-65˚C to 125˚C	

Our high-temperature type of HF9313 and HF9111 can meet the ambient temperature of -65˚C to180˚C.

1.1.2 Low air pressure

The dielectric strength of the relay will drop obviously under low air pressure; the contact ability for the non-hermetic relay drops.

1.2 Dynamic conditions

The dynamic conditions of the relay are vibration, shock, and acceleration etc. The structure of contact & spring of electromagnetic relay is cantilever system, has a low inhere frequency. Resonance will occur under the influence of ambient vibration that is near or reaching the inhere frequency, then the contact pressure will drop and transient off-state will occur, that is the shake will occur. Movable armature will move due to the over-energizing of vibration, shock acceleration, and cause unfavorable contact or off on the contact. Periodical acting force will cause structure damage, fall, and then cause failure. The remaining loosing particles (burr drop-out, solder sediment, material crumbs) will drop into the contact gap or turning supporting under the influence of vibration and shock, and cause serious trouble. Vibration grades prescribed in China Military Standard refers to Table 2.

GJB65A (MIL-R-39016) prescribes that the relay should be able to endure the random vibration: acceleration density 40$(m/s^2)^2$/Hz acceleration value239.1m/s^2 .

Table 2: Relay sinusoidal vibration grades

GJB1042 (MIL-R-5757)			GJB65B (MIL-R39016)	
Symbol	Max. acceleration value	Frequency range Hz	Max. acceleration value	Frequency range Hz
1	1.5mm DA	10 to 55	294m/s^2(30g)	10 to 3000
2	98m/s^2 (10g)	10 to 500		
3	147m/s^2 (15g)	10 to 2000		
4	196m/s^2 (20g)	10 to 2000		
5	294m/s^2 (30g)	10 to 3000		

Shock grades prescribed in China Military Standard refers to Table 3. Under the influence of the vibration and shock, the off-state time of the close contact should be 10μs max, on-state time of open contact should be 10μs max according to GJB1042 (MIL-R-5757), and should be 1μs according to GJB65B (MIL-R-39016).

Table 3: Relay shock grades

Symbol	Shock grades (According to GJB360A (MIL-R-39016))
1	490m/s^2 (50g) (Test condition A)
2	735m/s^2 (75g) (Test condition B)
3	980m/s^2 (100g) (Test condition C)

2. Requests of physical parameters

Besides the general configuration physical requests such as configuration version, outline, dimension, mounting, termination, weight etc., the hermetical performance characterized by the gas leakage rate is one of the important technical indexes of hermetic relay. In addition to preventing the pollution of dust, harmful gas and moisture in the air, being suitable for long time storage, improving the adaptability and reliability of the relay in hard climate conditions, the hermetical performance of the relay has more important functions in high-vacuum conditions of the space area. If the hermetic failure or leakage is very serious, the relay radiating will become difficult, the temperature of the coil will rise high, leading to the change of operate and release parameters, even prevents the relay from working normally; radiating difficulty also causes the temperature rise of contact and the reduce of the contact breaking capacity; the drop of air pressure causes the drop of dielectric strength; it also makes the contact arc extinction difficult; under vacuum conditions, the evaporation and dispersion of organic substance lead to the contact contamination.

The common sealing methods are fusion welding and Tin-welding. The fusion welding can be divided into laser fusion welding, electron beam fusion welding, resistance fusion welding etc. fusion welding is the direct welding of two metal welded piece matrixes, while the Tin-welding uses Tin to seal the two metal welded pieces. Obviously, the fusion welding is better than the Tin-welding in terms of hermetic performance, welding intensity etc. The high-pure nitrogen larger than one atmospheric pressure is filled as the protective gas into the hermetic relay.

Hermetic requests of military electromagnetic relay prescribed in China military standard GJB1042 (MIL-R-5757) (MIL-R-5757). See Table 4:

Table 4: Relay hermetic requests

Cubage of hermetic cover	Max. leakage rate permitted
Larger than 33cm^3	10^{-1}Pa.cm^3/s (10^{-6}atm.cm^3/s)
Smaller than & equals 33cm^3	10^{-3}Pa.cm^3/s (10^{-8}atm.cm^3/s)

1/2 crystal cover series manufactured by our company use laser fusion welding, TO-5 series use resistance fusion welding, the leakage rate reaches 10^{-3}Pa.cm^3/s.

3. Contact parameters

Contact parameters include contact form, contact resistance, contact load and life (operate times), mechanical life, contact bounce time and etc.

Contact rating load is the load that the contact can switch under prescribed ambient conditions, within prescribed operate times, and under prescribed operate frequency. The contact load ability will change greatly, when the load nature changes.

Common relay load are as following:

A. **Resistance load:** the DC or AC load with the pure resistance nature.

B. **Lamp load:** the tungsten filament inside the incandescent lamp has a small resistance, the surge current at the time of “on” is 11 times higher than the steady current, it can cause the rapid melt of the contact, even the fusion welding failure.

C. **Motor load:** the impedance is very small when the motor doesn’t move, so the surge current will be very large when it starts, the current is about six times of the steady current. Besides, the relay contact works as the switch of the motor, it shall bear the arc effect produced by the shock of inductive counter electric potential of the motor winding, when it is cut off. Therefore, sufficient space shall be left for insulated anti-electricity level between the contacts and the load ability. A diode or a RC series component connected parallel on the both side of the contact can protect the contact well and improve the reliability of the relay.

D. **Capacitive load:** surge current will appear when the capacity circuit is on, contact may ablate or fusion welding may fail due to the large current. According to the capacity, connect a current limiting resistance in series connection properly can reduce this harm, when applied. Long transfer wire, anti-interference filter, and rectifier power source, etc are so-called high capacitive loads.

E. **Inductive load:** when the relay is off in inductive load circuit, the arc between the opening contacts releases the energy reserved by the inductive load, then it may cause contact ablation, fusion welding or insulation part failure. Inductor, solenoid, contactor coil, choke, electromagnetic iron coil and so on are inductive loads. A diode or a RC series component connected parallel on the both side of the contact also can protect the contact well.

F. **AC load:** relay contact AC load rating only applies in prescribed AC frequency. The switching ability of the relay is different under different frequencies.

G. **DC load:** the DC load is harder to cut than AC load. AC voltage may extinguish the arc automatically when it cross zero. Arc produced by the DC voltage doesn’t extinguish, until the arc is elongated and can not hold itself. Arc energy will cause contact damage such as serious corrosion, metal transfer and spray.

H. **Medium current load:** DC resistance load with an open-circuit voltage at 28VDC and a close-circuit current at 100mA. Spark discharge will appear between the contacts under this load which causes organic substance inside the relay to accumulate on the contact surface which results in contact resistance augment or instability, even the open-circuit failure.

I. **Low electric level load:** the load with an open-circuit voltage is at 10 to 50mV(DC or AC peak value) and a close-circuit current at 10 to 50μA. organic membrane accumulated on contact surface can’t be break on-down due to low load level which results in the contact resistance will become large or unstable, even causes a failure in the open-circuit.

User may change the contact current by percentage as per. See Table 5:

Table 5: Load current changing table under different load characteristics

Resistive current	Inductive stable current	Motor stable current	Lamp stable curren
100%	20%	17%	10%

4. Coil parameters

Coil parameters include coil rated operate voltage, operate voltage, hold voltage, release voltage, coil resistance, operate time, release time etc.

Insulation function includes insulation resistance and dielectric strength.

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Insulation function includes insulation resistance and dielectric strength.

6. Reliability index

Relay reliability refers to the ability of accomplishing the specific function under prescribed conditions and in prescribed time (or operate times). The relay reliability index prescribed in China military standard GJB65B (MIL-R-39016) *General Criterion of Electromagnetic Relay With Reliability Index* is mainly failure rate.

Failure rate is the percentage value of failure product sum within the unit time of t moment (operate time) to the normally operating product sum at that time. It shows the failure ratio in the unit time, when the products are operating until t moment. Its math representation formula is:

$$(t) = [n (t + t) - n (t)] / \{ [N - n (t)] \times t \}$$

In the formula:

N——product sum used in the test,

n(t)——failure sum at t moment,

t——time interval tested.

Refer to Table 6 for failure rate grades prescribed in China military standard GJB65B (MIL-R-39016):

Table 6: Relay failure rate grades

Grade	Symbol	Max. failure rate (1/10 times)
sub-fifth grade	L	3×10^{-5}
fifth grade	M	1×10^{-5}
sixth grade	P	1×10^{-6}
seventh grade	R	1×10^{-7}

HF9310, HF9110 and other relays manufactured by our company accord with GJB65B (MIL-R-39016) with reliability index.

Ⅲ. Guidelines of Choosing Hermetically Sealed Relay

1. On coil

1.1 Choosing coil energizing value

A. When the relay operates, the coil should be energized by rated operate voltage rather than operate voltage, so the coil voltage can fluctuate within power source voltage, or a safety space for reliable operating is reserved when there are mechanical vibration, shock or high ambient temperature in applicative ambient. On the other hand, when the coil voltage is too high, the coil heat will become serious, and the coil life will be shortened.

B. Magnetic latching relay is very suitable for energy-saving occasions, but its coil cannot be electrified for a long period because the coil is designed according to the applied pulse current, long-time electrifying will cause overheating on the coil. It is wrong to electrify the coil for a long time in order to ensure its reliability.

C. For relay of the same specification, it is not correct to think that the relay will become more sensitive if the operate voltage is smaller. When the operate voltage reduces, the mechanical parameters such as electromagnetic suction, elastic counterforce, contact clearance will reduce too which will affect the performance such as anti-vibration, reliability, load ability, electric strength between contacts and life. Just as the same, it may not be better to have a higher release voltage.

1.2 Coil transient suppression

At the moment when the relay coil voltage breaks off, there will be an inverse peak voltage that is much greater than the energizing voltage (usually more than 8 times), which will do a significant damage to the circuit and should be suppressed. Many kinds of methods can be used to suppress it. The general way is to connect a diode parallel with both coil terminals. However, the diode may prolong the drop-out time which consequently affects the operational life of relay. Attention should be paid on this point during the application. The relay that possesses transient suppression ability already contains the suppression components. Please take care of the polarity of the terminals of coil for such kind of a relay: the incorrect polarity connection may damage the diode and results in the relay failure.

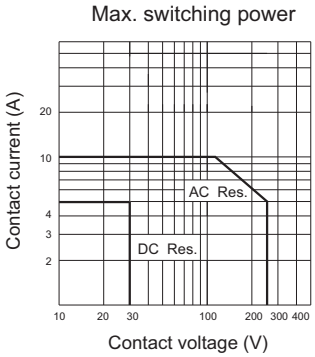
Meanwhile, it should be short connected when the parameters of insulation resistance and dielectric strength are tested to avoid damaging the suppression components inside.

2. On contact

2.1 Relation between voltage and current in contact load

Generally, a reduction in load voltage will cause an increase in the load current while a reduction in load current may cause an increase in load voltage; however, there is not a general corresponding relationship between load voltage and current. Furthermore, current or voltage will not increase unlimitedly even if voltage or current reduces unlimitedly: there is an upper limit. On the other hand, relay may not be able to switch to any load as low as zero or lower than zero; a relay that can switch a big load may not be able to switch a small load, in particular the low electric level load or medium current load. For example, it is not reliable to use a product with a rated load 10A to switch a 50μA load because the mechanism of contact failure is different in various loads. Different relays possess different relating curves between load voltage and load current, that is called load curve. The actual applied load should be limited below this curve.

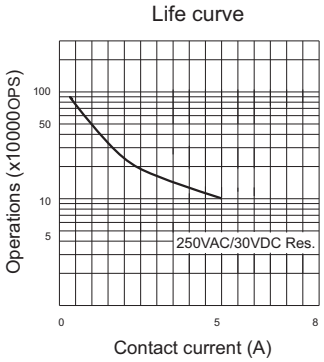
Figure 1: Load curve demenstration



2.2 Relation between load and life cycles

Life cycles of the relay are compared to the prescribed rated loads. Obviously, if the load is bigger, the life will be shorter. However, there is not a general relationship between load and life. Different relays possess different relating curves between load and life, that is called life curve.

Figure 2: Life curve demenstration



2.3 Relation between life cycles and operate frequency

Relay load and life has obvious relation with the contact switching frequency. As for higer current load, the increase in contact switching frequency will make the heat produced by contact arc discharge not disperse within sufficient time, which will result in the contact temperature, quicker arc discharge and short contact life.

Table 7: Relay contact switching frequency

Contact switching current load	Switching frequency
Larger than 3A	3s On, 3s Off
Smaller than 3A	1s On, 1s Off
Max. switching frequency under small load	0.1cycle/(max. pick-up time + max. drop-out time)

2.4 Relation between life cycles and the ambient temperature

When the temper ature rises and the arc discharge speeds up, the load and life will be reduced dramatically.

2.5 Contact series-parallel connection

Because the operating time of every set of contact is different, Therefore, the contact parallel connection can not improve the contact load current and electric life. Just the same, the contact series connection cannot improve the load voltage.

2.6 Protection of relay contact

When the contact cuts off the inductive load circuit, the energy stored in contact should be consumed by contact arc ignition. Generally, in order to eliminate and lighten the harm of arc, to expand the contact life, to eliminate or lighten the interference and damage of relay to relative sensitive circuit, generally arc is used to restrain contact to protect the circuit. Common contact protection circuits are: to parallel-connect a resistive or capacitive circuit on the inductive load, or parallel-connect a diode.

Try to avoid the collinearity or anastomosis of the input part and output part, because when the coil is energized, the counter electric potential on the coil will add to the contact, the off voltage of the contact will increase, and interfere other circuits.

3. On reliability

3.1 Methods to improve reliability

3.1.1 Derating application

Proper derating application of relay load can reduce the failure in rated load current, improve the contact life and reliability, but users should be careful when the current is reduced to 100mA or μA grade.

3.1.2 Parallel and series connection of contacts

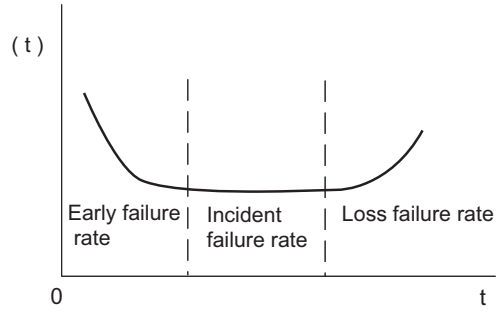
The contact parallel connection doesn't increase the load current, but it can increase the reliability of the circuit switch-on and decrease the failure rate of the circuit switch-on; however, the parallel connection may affect the reliability of circuit switch-off. Just as the same, series connection may improve the reliability of the circuit switch-off, but affect that of the circuit switch-on.

3.2 Relay screening

3.2.1 Typical curve of relay failure rate

According to lots of statistics and analysis done on relay failure, the failure rate has a changing rule shown as below. Usually it is called a *tub* curve, because it looks like a tub. As the *tub* curve shows, failure has three phases: early failure period, incident failure period and loss failure period. Therefore, screening is a common method to remove the early failure relays and improve the relay reliability.

Figure 3: Typical curve of relay failure rate



3.2.2 Screening items

The screening of relay usually includes vibration (non-destructive), high-low temperature run, inner humidity inspection, particle impact noise detect (PIND), sealing inspection, etc. Relative standards are prescribed on those items, but relays can be screened according to users' requirements.

- Purpose of vibration screening is to remove the products that have structure defects.
- Purpose of high-low temperature run is to remove the products that have failure in parameter adjustments.
- Purpose of inner humidity inspection is to remove the products that exceeds the standard of water content of inner protective gas.
- Purpose of particle impact noise detect (PIND) is to remove the products that have redundant substance inside the relay.
- Purpose of sealing inspection is to remove the products that don't reach the leakage rate requirement.

3.2.3 Principle of confirming screening items and conditions

A. Screening should be directed against the product defects and important failure modes. It is not right to believe that more screening items can make products more reliable.

B. Stress imposed should not destroy good products, but discover and remove the most potential defects. Improper screening may leave hidden troubles, and decrease the reliability. As for products that have a rated current not higher than 5A, load should be low level: 10 to 50μA ,10 to 50mV, when doing high-low temperature run screening; As for products that have a rated current larger than 5A, load should be medium current: 0.1A 28Vd.c.; as for products that have a rated current larger than 25A, load should be 1A 28Vd.c. Sine scan vibration screening should be carried in most dangerous direction, according to various products.

C. The choosing of the screening time should be based on the principle of excluding the potential defects and increase product reliability. Because there is no screening scheme to expose all potential defects, screening time should be confirmed according to prescribed confidence and defect rate allowed.

3.3 Relay failure analysis

3.3.1 Preparation before analysis

Before analysis of failure relays, the failure mode, application conditions when failure should be recorded, inclusive of climatic conditions such as ambient temperature, humidity, air pressure etc., dynamic conditions such as shock, vibration, acceleration, etc; electric stress conditions such as contact load type, voltage, current, coil voltage, current and circuit voltage, current, etc; the product related data, mounting and wire connection should be fully noted. If necessary, making the failure re-occurrence.

3.3.2 Failure analysis procedure

Try to carry out failure analysis according to following procedures.

Table 8: Relay failure analysis procedure

	Analysis item	Analysis content	Analysis tools
1	Appearance visual inspection	physical damage, contamination, Appearance defect, sealing defec	magnifier, microscope
2	X-ray perspective analysis	inner contamination, inner short circuit or open circuit , leakage at sealing area, inner mechanical defect, part damage, assembly defect etc	X-ray machine or monitor display
3	particle collision inspection	inner loose particle	particle collision instrument
4	Electric parameter's inspection	wire, connection condition of socket, coil resistance, contact resistance, operating characteristics, insulation withstanding voltage etc.	regular testing instrumentation, memory oscillograph,etc.
5	Sealability inspection	glass insulator sintering status, leakage hole, pore at welding area, crack, etc.	helium spectrometer or pressure gas leakage detecting equipment
6	Gas analysis	gas components and organic gas contamination components inside the relay	gas mass spectrometer or chromatic spectrum spectrometer
7	Remove cover	try to not bring contaminant into relay or destroy inner state	specific tool
8	Internal visual inspection	inner structure, whether the parts are deformed, discolored; other redundant substance or contaminant	magnifier, microscope
9	Inner mechanical inspection	contact gap, pressure, tracking, returning force, armature stroke, armature flexibility, parts matching etc.	ergometer, gauge, microscope
10	Inner electric parameters' inspection	electromagnetic absorptive force, electric parameters, etc.	regular testing instrumentation, memory oscillograph,etc.
11	surface and material analysis of contacts and other key parts	the analysis of the chemical component change, impurity statue and crystal structure change of material, minim contamination analysis, physical and mechanical performance analysis of material	electron microscope, infrared spectroscope physics & chemistry analysis equipment, mechanical performance analysis equipment for material
12	Further analysis	To carry out the special analysis if necessary	

Ⅳ. Test of Main Parameters

1. Test conditions

A. All the tests are under normal climatic conditions, unless specified:

Temperature: 15°C to 35°C,
Relative humidity: 45% to 75%,
Atmospheric pressure: 86 to 106Kpa;
The following is the climate condition of relay arbitration test, in case of dispute:
Temperature: 25^{+0}_{-2} °C
Relative humidity: 50% ± 2%
Atmospheric pressure: 86 to 106Kpa;

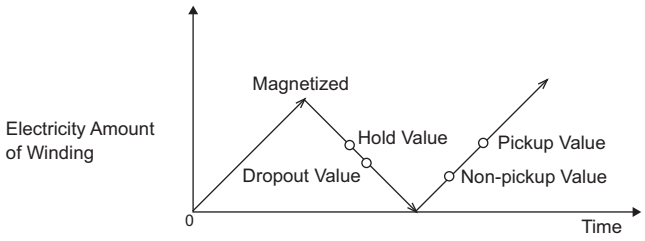
B. Checking instruments should accord with the standard, test precision should be in the prescribed range and the same with the relay manufacturer if possible.

C. Test methods including test times should accord withrelay test method standard.

2. Operate and release value test

Test of no-operate value, operate value, hold value, release value should be carried out according to Figure 4 in the test procedure. The strongest point of this test is that the test parameters have good repetition, but it doesn't mean that the relay should be magnetized before working in actual application.

Figure 4: Test procedure



3. Coil resistance

Coil resistance can be measured by voltage method, current method, and electric bridge method. When using the voltage method, current method, try to avoid or reduce the influence of small voltmeter, ammeter inner resistance, and also shorten test time, so as to prevent the coil temperature from rising too high and affecting the measurement veracity. Coil resistance is very sensitive to the ambient temperature, so put the products under test conditions within 1 to 2 hours before testing (not energizing coil). Teat value should be converted into value under benchmark temperature (usually 25°C), conversion formula is :

$$Ra = R_0 [1 + a (Ta-25)]$$

In the formula: **Ta** refers to the ambient temperature(°C)

a is the resistance temperature coefficient (resistance temperature coefficient of copper wire is 0.004 / °C)

4. Contact resistance

Relay is not energized when testing contact resistance of NC contact and movable contact; relay is energized when testing contact resistance of NO contact and movable contact. Contact resistance can be measured by voltammeter method. When measuring, the load added to contact should accord with the China Military Standard, usually 6V 10mA (resistance). Test position is within 4mm to the root of the terminal. Load should be added after the contact is stably closed and removed before the contact is cut off.

5. Insulation performance

Usually use megohmmeter to test the relay insulation resistance, the tested relay should be put on high-quality insulation board, test voltage should accord with the China Military Standard (usually 500Vd.c.), the min. value tested becomes the tested value.

When doing the dielectric strength test, usually use the 1.1 times of the prescribed test voltage, max leakage current allowed is 1mA, hold time is 1s. Hold time under prescribed voltage is 1 min under if any dispute rises.

6. Time parameters

The measurement circuit of the time parameters is shown in Figure 5 and Figure 6, other proper electron apparatus or instruments can be used, contact load is resistance, load is 10mA 6V (resistance load) when testing operate time, release time and bounce time; load is 50μA 50mV (resistive load), when testing the stable time of the relay that has a failure rate grade M, P, R. the resolution of the instrument is 1μs.

Figure 5: Measuring circuit of time data

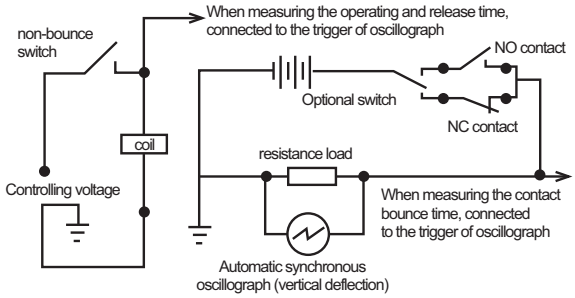
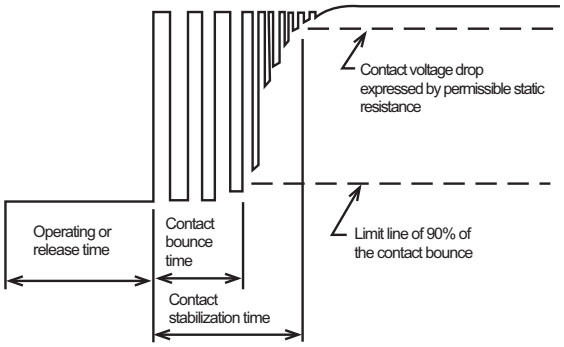


Figure 6: Typical waveform figure when measuring the operating, release, and contact bounce time



Ⅴ. Transportation, Storage, Mounting and Application of Hermetically Sealed Relay

1. The terminal of the hermetic relay is supported by glass insulator, and cannot move freely, otherwise, the glass insulator would split, the relay hermetization would be damaged, the application performance would be affected, even the terminal would loose, break, then failure would occur. If the terminal (refer to terminal with a smaller diameter) needs to be moved, the terminal should be fixed at the place 3mm away from the base before moved. The terminal with a large diameter is prohibited to be moved. Just as the same, the stress on terminal should be proper when mounting and applying.
2. The terminal should be soldered with neutral flux in order to avoid polluting the glass insulator, which would decrease the insulation capability. At the same time, the soldering time should not be too long, the temperature usually be 260°C max., continuous soldering time be 3s max., if soldering should be repeated, the next soldering should be made after the solder is fully cooled. After soldering, the solder on the relay surface should be removed.
3. Check the insertion & pull intensity of the relay socket carefully before using, and keep the socket clean. The unfavorable contact between the relay and socket is one of the important reasons that affect the relay reliability.

4. Relay mounted directly on PCB should not only be supported by the terminal. But combination of the terminal, cover and PCB embedding should be used to reinforce. Or the relay with mounting parts like mounting bolt should be used. Or the ring bracket is used to support the relay. So the terminal and relay will not be damaged under the influence of powerful shock and vibration.

5. To avoid mount relay on cantilever frame or parts with unfavorable rigidity that can easily cause resonance, lest resonance will occur on the frame or parts under the influence of powerful vibration and shock, and the heat produced from the frame or parts will pass to the relay and cause relay defect or failure. It should be pointed that PCB is very easy to cause resonance under strong dynamic conditions, as its rigidity is not good, relay mounted on PCB is affected by the vibration and shock, failure occurs. As a result, the rigidity of PCB should be enhanced. When the relay is mounted, the contact moving direction and the armature pick-up direction should be different with the vibration and shock direction. The stress at the two sides of the relay mounting support should balance.

6. To avoid mounting the relay near strong magnetic fields and strong heat source in order to avoid affecting the relay performance by magnetic and heat effect., use magnetic shield or heat spacer if necessary. Relays should be mounted away each other in certain distance, to avoid the magnetic interference or heat influence.

7. Well-packaged relay should be stored in place: ambient temperature -10°C to 40°C, relative humidity not greater than 80%, no acidic or corrosive gas in the air.

8. Collision, drop, beat during the relay packaging, transporting and using would cause the obvious change in electric parameters. Hence should be careful, specific box should be used. If the relay drops by accident, its inner part may be damaged due to the powerful shock, it should be isolated, tested and confirmed to be OK before using.

Ⅵ. Ordering

1. After choosing the relay, please refer to the ordering mark and fill in the ordering contract correctly, indicate the product model, specification number, mounting form, termination, grade and others in the contract in order to avoid any mistake.

2. The special requirements on termination, mounting form, electric performance, insulation performance and relay appearance or products that need to be checked according to the prescribed technical agreement, and also prescribed clearly in the contract.

3. Contact requirement on low level and non-resistive load or load voltage higher than 28Vdc, should be prescribed, then relative measures can be taken in design and manufacture.

Ordering information:

	HF9310	-012	L	0	1	Ⅰ
Type						
Coil Voltage	5, 6, 9, 12, 24, 27Vd.c.					
Failure Rate	**L:** Failure rate level L (level Ⅲ products available) **M:** Failure rate level M (level Ⅲ products available) **Nil:** Without failure rate requirement(level Ⅰ, Ⅱ products available)					
Mounting Styles	0, 1, 2, 3 (See " Mounting styles " below)					
Terminals	1, 3, 4 (See " Terminal styles " below)					
Ambient Grade	**Ⅰ:** level Ⅰ **Ⅱ:** level Ⅱ **Nil:** level Ⅲ (with failure rate requirement)					

HF9310/027-01-Ⅰ — refers to the relay: model is HF9310, coil rated voltage is 027Vd.c., mounting form is 0, termination is 1, ambient grade is Grade Ⅰ.