MITSUBISHI

MAGNETIC MOTOR STARTERS
AND MAGNETIC CONTACTORS

TECHNICAL NOTES

MS-N Series

MAGNETIC STARTERS,
CONTACTORS AND RELAYS

INSTRUCTION MANUAL

MS-N Series
SR-N Series
SD-M Series

Contents

Safety Precautions

Please read this instruction manual and enclosed documents before starting mounting, operation, maintenance and inspections to ensure correct usage. Thoroughly understand the equipment and device, safety information and precautions before starting operation.
The safety precautions are ranked as "WARNING" and "CAUTION" in this instruction manual.

⚠WARNING	When a dangerous situation may occur if handling is mistaken leading to fatal or major injuries.
⚠CAUTION	When a dangerous situation may occur if handling is mistaken leading to medium or minor injuries, or physical damage.

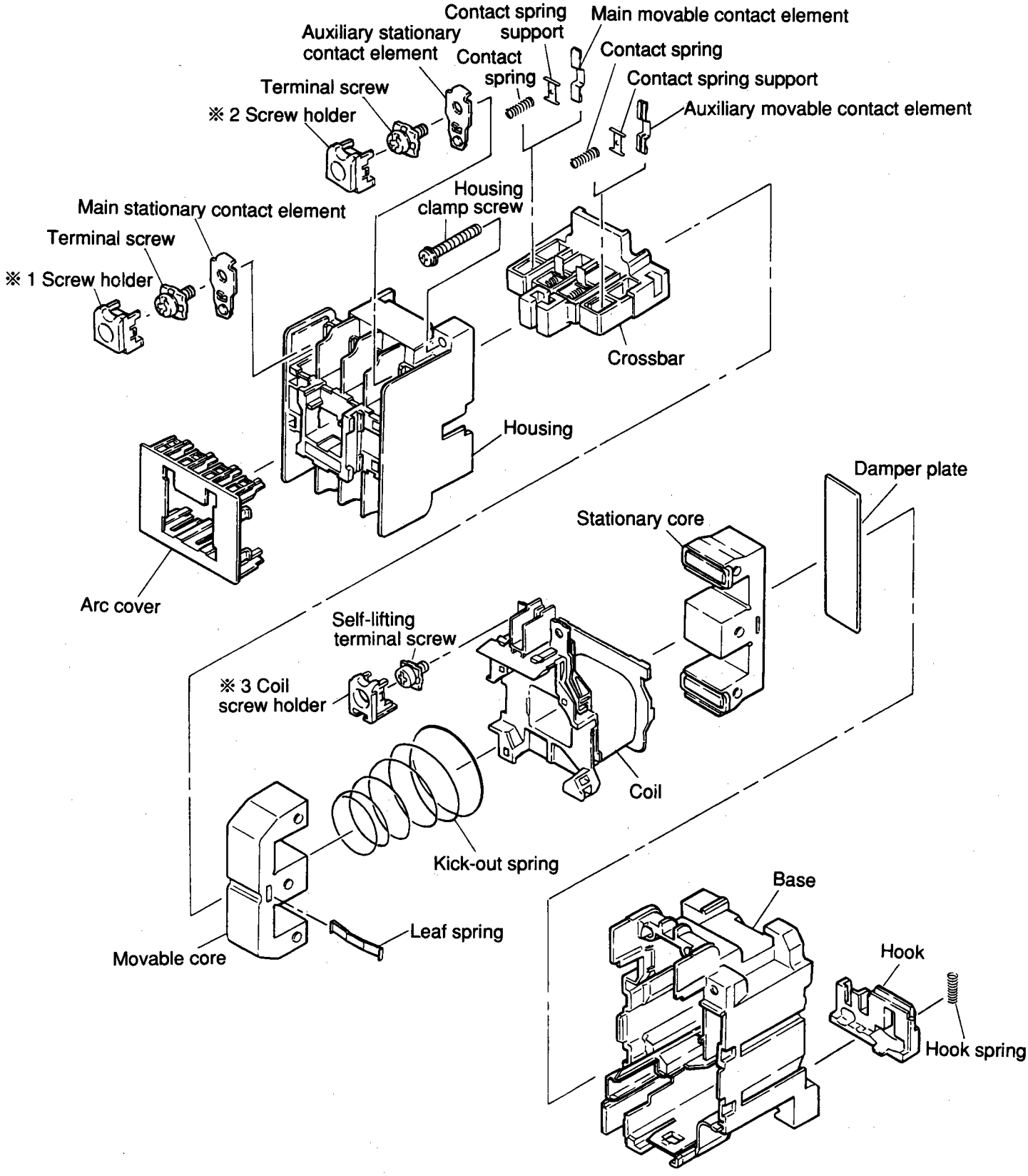
Note that some items described as ⚠CAUTION may lead to serious results depending on the situation. In any case, important information that must be observed is described.

- ○ The contents of this instruction manual are subject to change without notice.
- ○ Mitsubishi Electric will not be held responsible for any damage caused by repairs, disassembly or modifications by a party other than Mitsubishi or a Mitsubishi Electric Service Center.
- ○ An effort has been made to improve the quality and reliability of the product, but the product may fail. Take care to prevent secondary damage, such as personal injuries or fires because of this product's failure.
- ○ Store the "Precautions for Use" enclosed with the product in a place that is easily accessible.

⚠WARNING	Reference page in this manual
• Do not touch or go near the product while the power is ON. Failure to observe this could lead to electric shocks or burns.	8
• Turn the power off before starting maintenance or inspections. Failure to do so could lead to electric shocks.	15 ,29,55

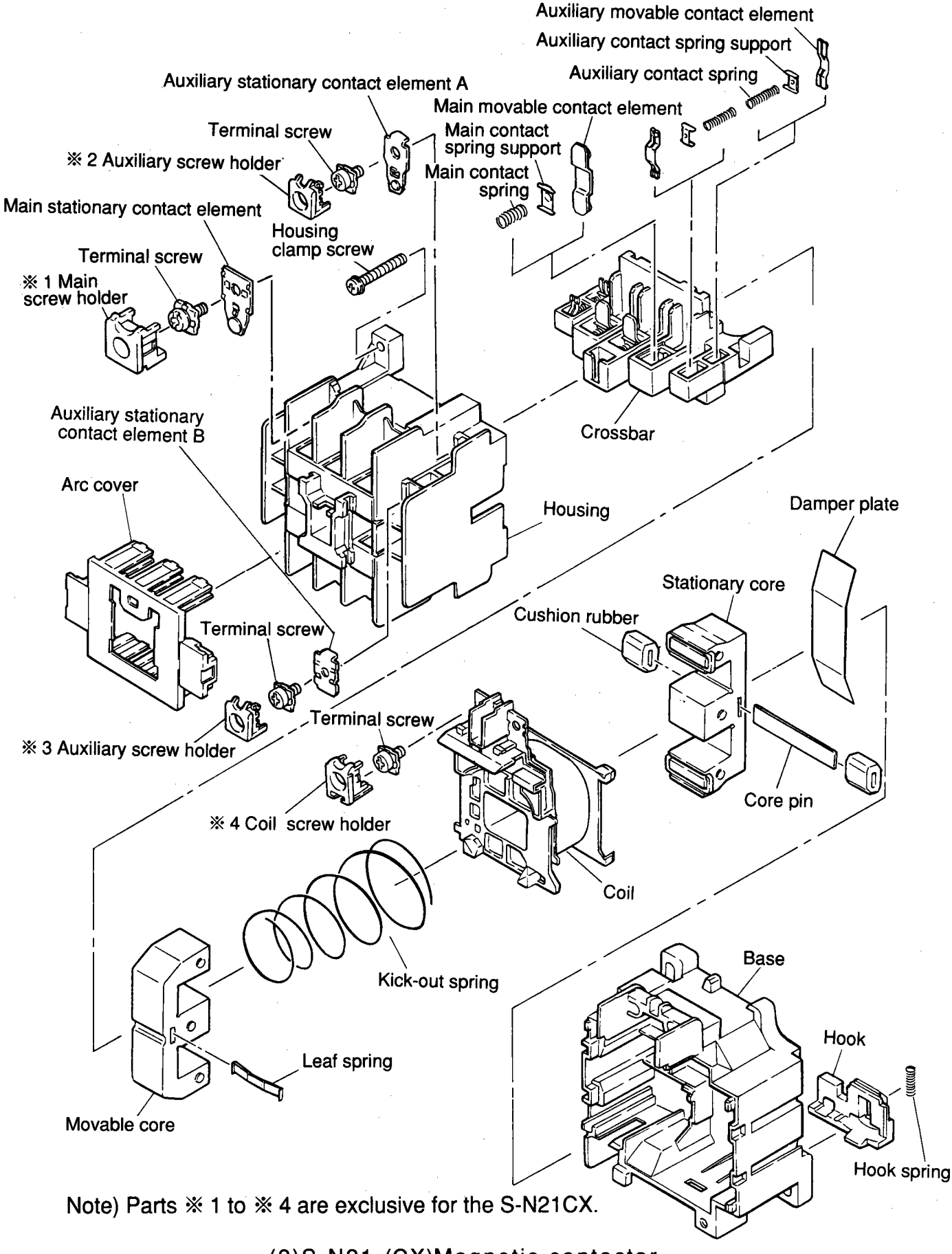
⚠CAUTION	Reference page in this manual
• Secure a space larger than that specified in the Instruction Manual when mounting the product. Failure to do so could lead to burns or fires.	9
• Use wires that meet the applied voltage and continuity current, and tighten with the tightening torque specified in the Instruction Manual.	10
• Always confirm the ratings and specifications, and use the product within the specified ratings and specifications. Use in an environment that exceeds the ratings or specifications could lead to ground faults or short circuit accidents due to destruction of the insulation, to fires due to overheating, and damage due to incorrect shut off.	5,15,29

1. Names of each part



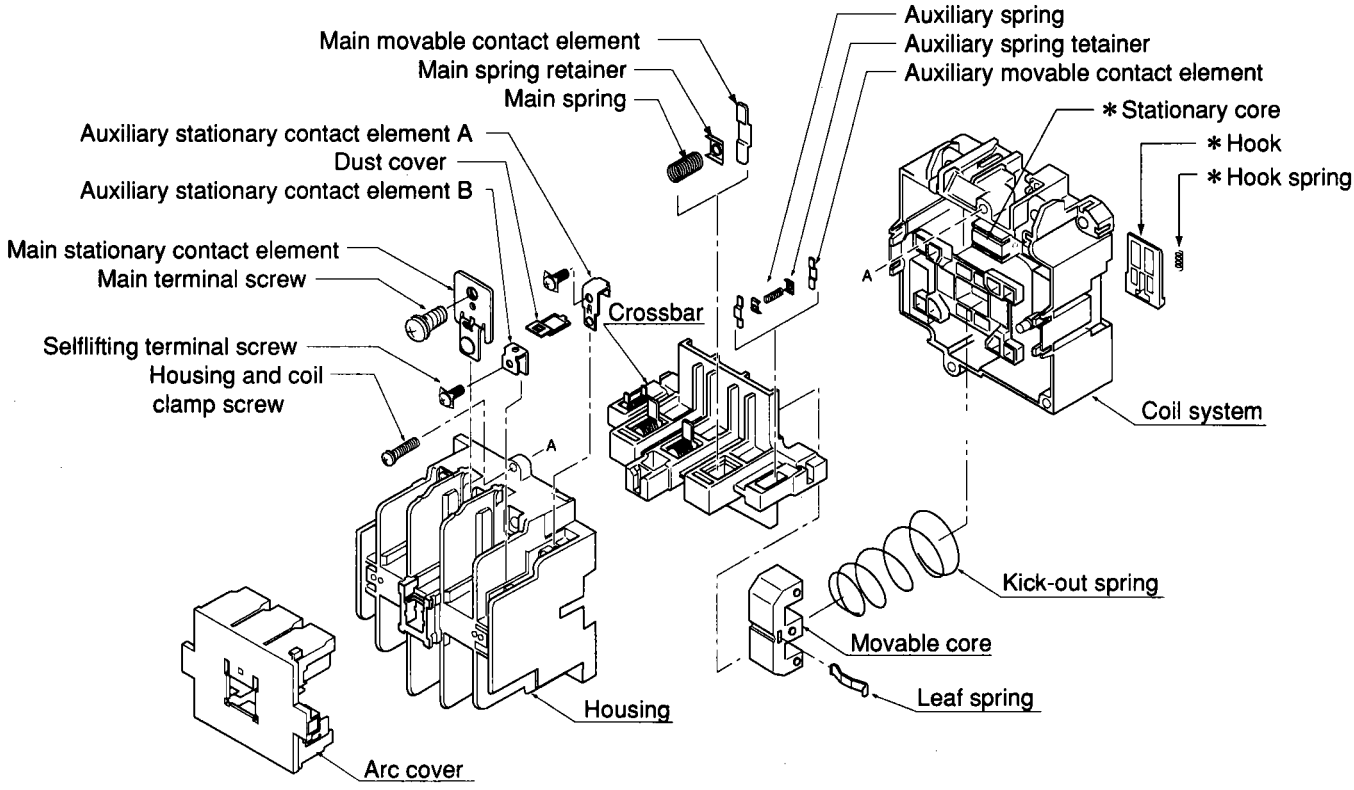
Note) Parts ※ 1 to ※ 3 are exclusive for the S-N11CX(SR-N4CX).

(1) S-N10/N11(CX)Magnetic contactor
(SR-N4(CX)Magnetic relay)



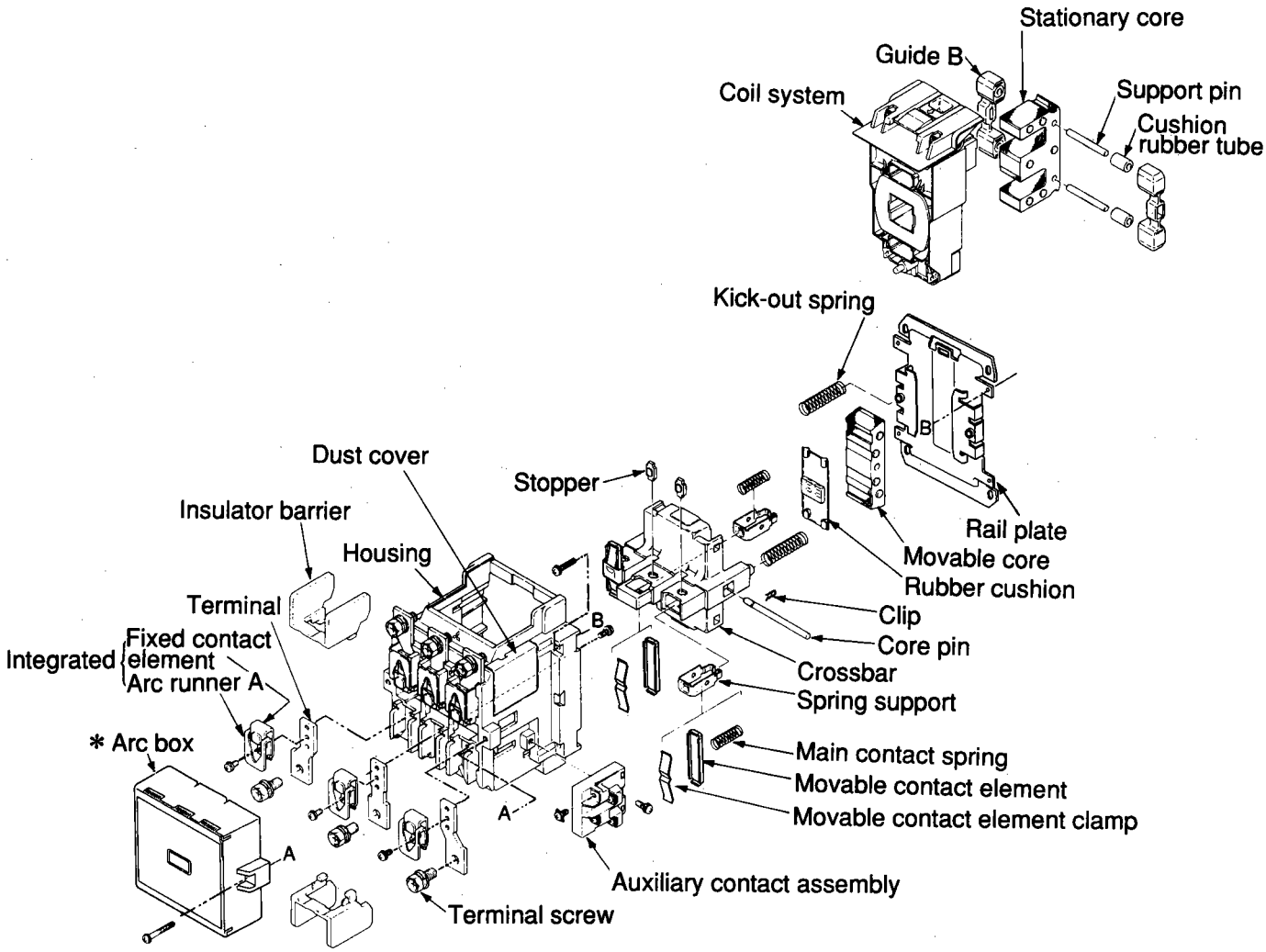
Note) Parts ※ 1 to ※ 4 are exclusive for the S-N21CX.

(2)S-N21 (CX)Magnetic contactor



Note) * Parts marked with are included in coil system.

(3) S-N50 Magnetic contactor



Note) * Grid, etc., are assembled in the arc box.

(4) S-N150 Magnetic contactor

2. Working Environment

⚠CAUTION	Using this product in an environment or atmosphere other than the normal working conditions could lead to failure. Always use the product under the normal working conditions.

The working environment varies as the controller is used in a wide range of applications. However, the product has been manufactured under the following normal working conditions. Measures such as those given in section (2) are required when using the controller in an environment differing from the following conditions.

Mitsubishi manufactures the product with the designated special environment while taking the following points into consideration.

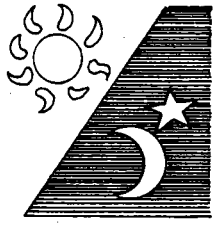
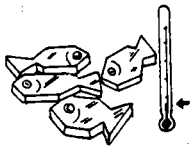
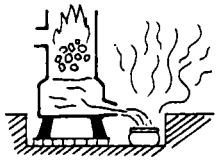
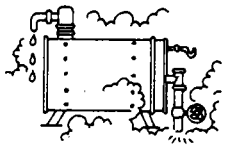
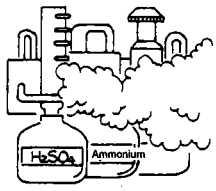
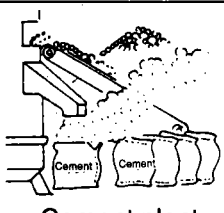
(1) Normal working conditions

• In-panel temperature:	Reference 20℃, -10℃ to 40℃ (max. daily average temperature 35℃, max. annual average temperature 25 ℃) The maximum temperature in the panel 55℃. Note that in either case, there must be no dew condensation or freezing.
• Relative humidity:	45 to 85%RH
• Altitude:	2,000 m or less
• Vibration:	10 to 55 Hz 19.6m/s^2 (Max.)
• Impact:	49m/s^2 (Max.)
• Atmosphere:	Low levels of dust, smoke, corrosive gas, flammable gas, water or sodium. When used in the sealed state for a long time, contact defect, etc., could occur.

(2) Special environment measures

The main measures for when using the controller under conditions that differ from the normal working conditions are shown on the following page for reference.

Basically, there is a limit to how far the environment resistance of the product can be improved. Thus, an appropriate structure for the outer box (panel) storing the product must be used, such as by using an outdoor type, dust-proof type or corrosion-proof type, to prevent damage.

Special environment		Problem points	General measures	For special environment	
				Name	Type
Sudden temperature changes		• Rusting or malfunctioning due to dew condensation (freezing).	• Install a space heater to lower the relative humidity. • Move the product to a place with little temperature change.		
Low temperature	 Freezer storage Low temperature room	• Freezing • Malfunctioning or rust due to dew condensation.	• Install a space heater, etc., to increase the temperature. • Dry the area.		Consult Mitsubishi when the temperature is -10℃ or less.
High temperature	 Steel mill Molding forming plant	• Malfunctioning • Heat resistance of connected wires • Overheating of insulator	• Lower load current • Use heat resistant wires • Use in places where the in-panel temperature exceeds 55℃ is not possible		
High humidity level	 Chemical plants Pump room	• Drop of insulation resistance • Corrosion, rusting	• Place in a waterproof type box, etc. • Inspect well	• Corrosion-proof treatment	MSO-□□YS S-□□YS
				• Boxed	MS-□□ S-□□CZ
Corrosive gas, sodium	 Petrol refining plant Chemical plant, coastline City water pump room (Chlorine disinfectant)	• Corrosion, rusting	• Place corrosion proof type in corrosion-proof box	• Corrosion-proof treatment	Place MSO-□□YS S-□□YS in corrosion-proof box
				• Corrosion-proof treatment • DC operated type	For DC operated type, place MSOD-□□YS SD-□□YS in corrosion-proof box
Dust, water	 Cement plant Textile plant	• Defect in contact continuity • Defect in mechanism operation • Deterioration of insulation	• Place in a dust-proof box, etc.		

3. Storage and Transportation

⚠CAUTION	• Take care to injuries from the edges or the packaging material (paper, wood, nails) or the product, or from dropping the product. • Confirm that no parts have fallen off or been damaged due to accidents during transportation. • Confirm that the ratchet (S-N125 to S-N400) on the coil section is locked. Do not hold the ratchet during transportation. • After unpacking the product, do not leave it in a humid or dusty place. • Do not get on or place objects on the product.

(1) Storage and transportation

The ambient temperature when storing or transporting the product must be between -40℃ and 65℃. The normal working conditions must be established before starting use.

• Unpacking and storing

Do not place the product directly on a concrete floor, etc. Always place it on slats or a shelf.

Do not store the product without a cover after unpacking.

• Avoid humidity

Do not leave the product for a long time in a place with a high humidity level.

• Avoid corrosive gases

Do not leave the product in an atmosphere containing sulfuric gas, ammonium gas or chloric gas.

(2) Precautions for transportation

• Carefully pack and transport

Do not drop the product during transportation.

When transporting the product after mounting and wiring it to a panel, pack it carefully. The movable parts do not need to be locked in particular during transportation.

• Do not hold terminals or wires when transporting

Holding the terminals, thermal relays, latched mechanism or wires, etc., when transporting the product could lead to damage or dropping.

(3) Long-term storage between mounting and usage

After completing the product as a panel, the power might not be turned on for a long time. If the product is delivered during construction work, cement, concrete and water, etc., can enter the product easily.

In this case, always protect the product until it is to be used.

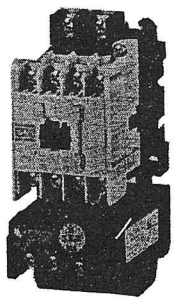
4. Mounting and Connection

⚠WARNING • Do not touch or go near the product while the power is ON. Failure to observe this could lead to electric shocks or burns.

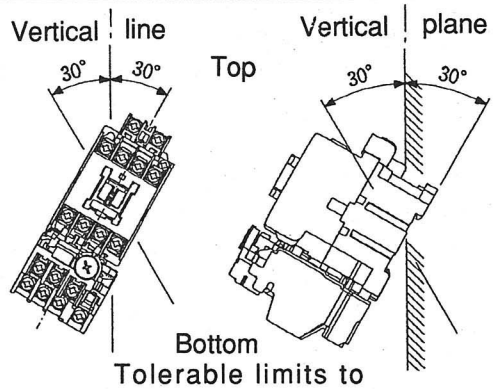
⚠CAUTION

- Make sure that foreign matter does not enter the product during mounting or wiring.
- Do not apply an excessive shock during transportation or mounting, and do not use a damaged product.
- If the mount screw size is changed or an insufficient number is used, or if the mounting onto the DIN rail is incomplete, the product may fall off.
- If the product is damaged during mounting or wiring, the product may overheat or short circuit. Do not use a damaged product.
- If the control circuit wiring is long, the circuit may not open even when the exciting is released due to a floating capacity.
- Never manually operate the product in the live state.
- If the product is stored in a box, always close the cover when the power is ON. Failure to do so could lead to electric shocks.
- Do not mount the product on the floor or ceiling.

4.1 Mounting

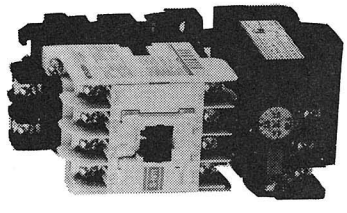


Correct mounting



Tolerable limits to vertical surface

- Mount the product in a dry place that has little dust, corrosive gas or vibration.
- Tighten the mount screw with the mounting torque corresponding to the screw size shown in Table 2 on page 14.
- The correct mounting position is a vertical surface. However, the product can be mounted vertically up to 30 ° in each direction.
- Horizontal mounting



Horizontal mounting (Excluding S-N600, 800 and reversing type)

If horizontal mounting is unavoidable, turn the product 90 ° in the counterclockwise direction from the correct vertical mounting state, and mount.

The characteristics will not change much when the product is mounted horizontally but the mechanical life may drop somewhat.

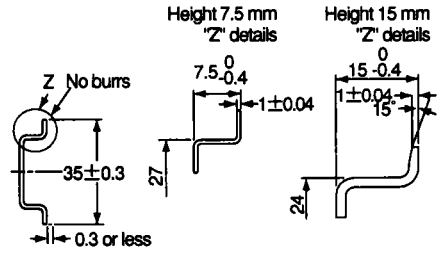
Note that the reversing type and S-N600 and N800 link operating frames cannot be mounted horizontally.

When mount onto DIN rail also cannot be mounted horizontally.

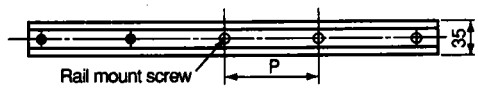
• DIN rail mounting

The N10 to N35, N18 to N48, N50 andN65 frames and SD-M series can be mounted on a 35-mm wide DIN rail. The rail height is either 7.5 or 15 mm. The rail dimensions are as shown on the right. For the reversing type, remove the mount plate, and mount the rail.

For the 7.5 mm high rail, keep an interval between the rail mount screws as shown below to secure strength. For the parallel mounting, the temperature rise and life will be affected, so always secure the dimensions shown on age 12.



DIN rail dimension

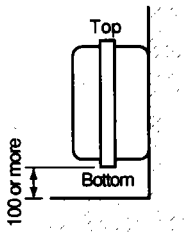


For S-N10,N11,N12,N18,N28,SR types (magnetic relays), P = 300mm or less
For S-N20 to N35, N38, N48, N50,N65, P = 200mm or less
For each, the dimensions show the case when the device is mounted on a 7.5 mm high DIN rail with the clearances shown in Table 1 on page 12.

DIN rail mount screw interval

• Mounting of enclosed MS type

Secure as much space as possible below the enclosed MS type for wiring purposes. For the MS-N10 to N35, at least 100 mm or more is required in terms of maintenance and inspection. (Refer to drawing on right.)

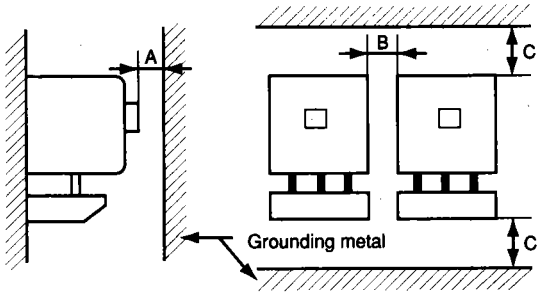


Space below boxed type

• Minimum mounting clearance

⚠ CAUTION Always observe the specified minimum mounting space and arc space. Hot ionized gas will be discharged when the current switches.

Refer to Table1.



[Note] The arc clearance (A) is 10mm for the MSOL(D)/SL(D)-N50 and N65.

Table 1. Minimum mouning clearance (Unit:mm)

Type	A	B	C	Other magnetic contactors
SR-N4	5	1	15	
MSO/S-N10, N11, N12	5	5	15	SD-M11,M12,MR12
MSO/S-N20, N21	5	5	15	SD-M19, MR19 S-U12, UR12
MSO/S-N18	5	5	15	S-N28
MSO/S-N25, N35	5	5	15	S-N38, N48
MSO/S-N50, N65	5[Note]	10	25	
MSO/S-N80, N95	10	10	25	
MSO/S-N125	10	12	25	
MSO/S-N150	10	12	30	
MSO/S-N180, N220	10	12	50	
MSO/S-N300, N400	10	12	90	
S-N600, N800	10	15	90	
—	20	10	25	B(D)-A65 DU(D)-A30, A60
—	30	12	25	B(D)-A100
—	30	12	50	DU(D)-K180
—	50	12	90	DU(D)-K260

4.2 Connection

⚠CAUTION

- If the terminal screws become loose, overheating or fires may occur. Always tighten with the specified tightening torque(refer Table 2 on Page 13), and periodically tighten the screws.
- If the tightening torque is excessive, the terminal screw or the terminal could be damaged.
- A sufficient insulation distance must be secured for the crimp terminal and connection conductor connected to the terminal, or else short circuits could occur.
- If the wire size is insufficient, overheating or fires could occur. Use a wire that meets the working conditions.
- If lock paint or a thermo-label, etc., contacts the wire connection section or contact, overheating or fires could occur due to continuity defects.
- If the terminal screws have been loosened, securely tighten them with the specified tightening torque. Failure to do so could lead to overheating or fires.

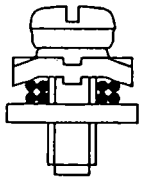
(1) Coil voltage and frequency

The voltage and frequency of the control source and the rated indicated voltage and frequency of the coil must match.

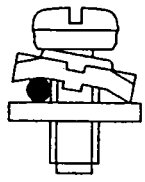
(2) Connection to wire retainer type terminal screw

The wire retainer(self-lifting terminal screw) can be used even when a crimp terminal is provided at the end of the wire.

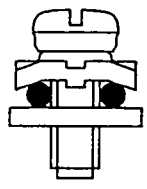
The wire retainer can also be used when the insulation sheath of the wire is peeled and the line is connected to the terminal. If the wire is a thick stranded wire, separate the wires into two and connect.



(Thick stranded wire)



(One wire)



(Two wires)

(3) Connection to terminal with screw holder (For N10 to N35 and N18 to N48 frames and SR-N Series)

Bare wire, single wire, Y-type crimp terminal

1. Press the wire and Y-type crimp terminal into the terminal. (Fig. 1)
   At this type, make sure not to catch the insulator such as the wire's sheath.
2. Tighten the terminal screw with the specified tightening torque.
3. To remove the wire, loosen the terminal screw. (Note 4)

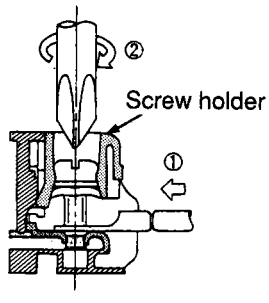


Fig. 1

Round crimp terminal

1. Confirm that the terminal screw has been loosened.
2. Lift the screw holder for each pole. (Fig. 2, Fig. 8)(Note 2)

(a) Wiring procedure for one crimp terminal

3. Insert the crimp terminal. (Fig. 2)
4. Lower the screw holder. (Insert the end of the screw, and temporarily fix.)(Fig. 3)
5. Tighten the screw.(Note 3)
6. To remove the wire, follow the tightening procedure in reverse.(Note 4)

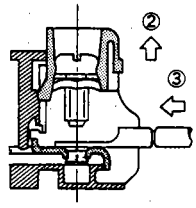


Fig. 2

(b) Wiring procedure for two crimp terminals.

3. Insert the upper crimp terminal, and pass the crimp terminal through a screw. (Figs. 4, 5)
4. Insert the lower crimp terminal, and pass the crimp terminal through a screw. (Fig. 6)
5. Lower the screw holder. (Temporarily fix the crimp terminal.) (Fig. 7)
6. Tighten the screw.(Note 3)

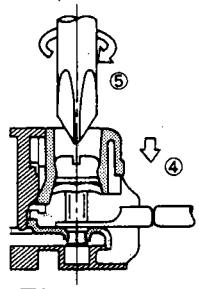


Fig. 3

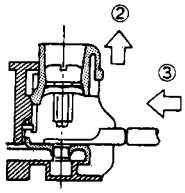


Fig. 4

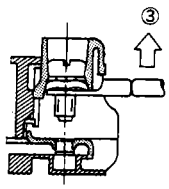


Fig. 5

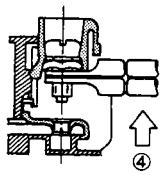


Fig. 6

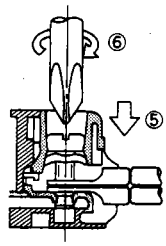


Fig. 7

7. To remove the wire, completely loosen the screw, lift the screw holder, and lower the crimp terminal toward the terminal and remove it. (Fig. 8)(Note 4)

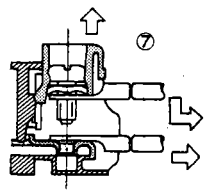


Fig. 8

Note 1. The terminal screw differs from the MS-K Series, so make sure that differing types of screws are not used.

Note 2. If the screw holder cannot be lifted, completely loosen the terminal screw and then lift it up.

Note 3. When tightening the screw, slightly press down on the screwdriver while rotating it, so that the screw completely fits in.

Note 4. If the screw returns causing the screw holder to be pressed and lifted up by the terminal screw, press down the screw holder and insert the screw.

Note 5. Tighten even the terminal screws to which wires have not been connected.

Note 6. If the terminal screw comes off the screw holder, set the terminal screw in the crimp terminal, press in the screw head and hold it.

(4) Application to circuits exceeding 380 V
When using the following types of magnetic contactors or magnetic relays in circuits where the voltage exceeds 380 V and wiring the crimp terminal, use of a crimp terminal with insulation tube is recommended.

Recommended	Not recommended
Crimp terminal with insulation tube	Bare crimp terminal
	

MS, MSO, S-N10 ~ N12
MSO, S-2 × N10, N11
SD-M11, M12, MR12
S-U12, UR12
TH-N12 thermal relay
TH-N18,N20 thermal relay auxiliary
SR-N4 magnetic relay

(5) Applicable wire size and terminal screw tightening torque
Refer to Table 2.

(6) Always ground the metal enclosure.

Table 2 Wire size and tightening torque

Type		Terminal dimensions			Applicable wire size (mm^2)		Terminal screw tightening torque Upper line: N • m (Lower line: standard value)	
Standard magnetic relay, magnetic contactor, thermal overload relay	Other magnetic contactor	Main circuit		Control circuit				
		Screw size	Screw type	Cross-slot screw	Main circuit	Control circuit	Main circuit	Control circuit
SR-N4		—	—	M3.5	—		—	0.94~1.51 (1.17)
S-N10, N11, N12	SD-M11, M12, MR12	M3.5		M3.5	ϕ1.6 1.25~2		0.94~1.51 (1.17)	0.94~1.51 (1.17)
S-N20, N21	SD-M19, MR19 B(D)-N20	M4		M3.5	ϕ1.6 1.25~5.5		1.18~1.86 (1.47)	0.94~1.51 (1.17)
S-N18, N28		M4	Cross-slot screw	M3.5	ϕ1.6 1.25~5.5		1.18~1.86 (1.47)	0.94~1.51 (1.17)
S-N25, N35 S-N38, N48		M5		M3.5	(2~14) 1.25~14		2.06~3.33 (2.54)	0.94~1.51 (1.17)
S-N50, N65	B(D)-A65 DU(D)-A30, A60	M6		M4	(8~22) 1.25~38	ϕ1.6 1.25~2	3.53~5.78 (4.41)	1.18~1.86 (1.47)
S-N80, N95		M6		M4	(8~38) 1.25~60		3.53~5.78 (4.41)	1.18~1.86 (1.47)
S-N125	B(D)-A100	M8		M4	5.5~60		6.28~10.24 (7.84)	1.18~1.86 (1.47)
S-N150		M8	Hexa-gon bolt	M4	8~100		6.28~10.24 (7.84)	1.18~1.86 (1.47)
S-N180, N220	DU(D)-A120 DU(D)-K180	M10		M4	14~150		11.8~19.1 (14.7)	1.18~1.86 (1.47)
S-N300, N400	DU(D)-K260	M12		M4	22~200		19.6~31.3 (24.5)	1.18~1.86 (1.47)
S-N600, N800	—	M16		M4	80~325		62.8~98 (78.4)	1.18~1.86 (1.47)
TH-N12	—	M3.5		M3.5	ϕ1.6 1.25~2		0.94~1.51 (1.17)	0.94~1.51 (1.17)
TH-N18, N20	—	M4	Cross-slot screw	M3.5	ϕ1.6 1.25~5.5		1.18~1.86 (1.47)	0.94~1.51 (1.17)
TH-N20TA	—	M5		M3.5	(2~14) 2~14		2.06~3.33 (2.54)	0.94~1.51 (1.17)
TH-N600	—	—		M4	—		—	1.18~1.86 (1.47)
TH-N60, N60TA	—	M6		M4	(8~22) 8~22		3.53~5.78 (4.41)	1.18~1.86 (1.47)
TH-N120, N120TA	—	M8		M4	8~38		6.28~10.29 (7.84)	1.18~1.86 (1.47)
TH-N220RH/HZ	—	M10	Hexa-gon bolt	M4	22~150		11.8~19.1 (14.7)	1.18~1.86 (1.47)
TH-N400RH/HZ	—	M12		M4	22~200		19.6~31.3 (24.5)	1.18~1.86 (1.47)

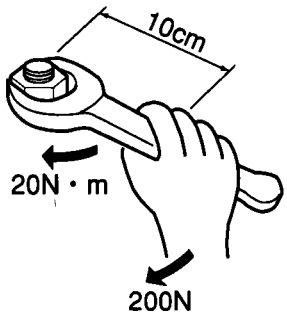
Note 1. The SRT-NN and NF type time delay relays are the same as SR-N.

2. When wiring a wire to the terminal with the insulation sheath peeled, use the designated wire retainer. At this time, the wires sizes shown in parentheses can be used. MS-N25 to N95 have a main circuit wire retainer enclosed in the box. However, this is not enclosed with the MSO, S-N50 to N95, so purchase it separately.

3. The control circuit refers to the terminals of magnetic contactor's auxiliary contact , coil and control of thermal overload relay.

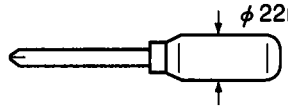
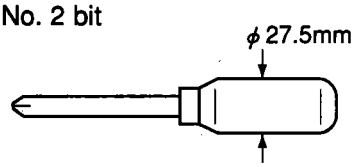
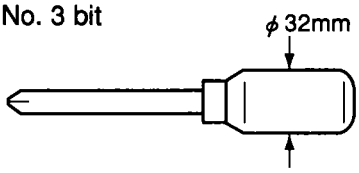
4. Either two wires or two round crimp terminals can be connected to each terminal.

Examples of general tightening torque



Generally, a man has an arm strength of 200N, so if the tightening tool handle's length is 10 cm, the torque will be 20N•m.

Maximum tightening torque of screwdriver [N • m]

Phillips screwdriver (made by VESSEL)	Right hand only	Left hand only	Both hands
No. 1 bit 	2.5	2.3	2.8
No. 2 bit 	3.6	3.0	3.9
No. 3 bit 	4.2	3.9	5.7

1. Hold the screwdriver horizontally, and rotate in the tightening direction.
2. Example for man having a right arm strength of 500N and left arm strength of 450N.

5. Maintenance and Inspection of Contacts

⚠WARNING	• Turn the power off before starting maintenance or inspections. Failure to do so could lead to electric shocks.

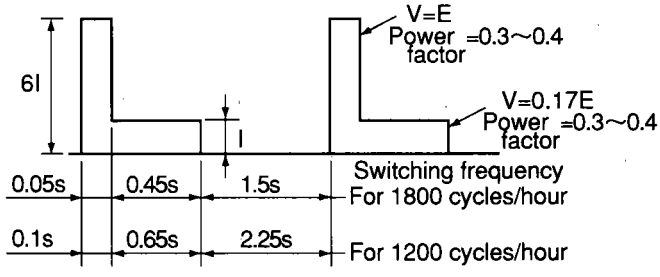
⚠CAUTION	• The contact and mechanism parts have a switching life, so periodically inspect the wear. • If the contact is welded and does not open due to switching of an excessive current, abnormal wear or deterioration of the contact, or due to the life, the machine device may run away. Estimate the inhibited closing and releasing due to mechanical constraints or contact welding, and secure the safety. • Do not use to remove, disassemble or modify the parts such as the arc cover. Doing so could lead to a drop in performance. • If chattering occurs in the operation command contact, a contact weld could occur leading to malfunction or fires. • If smoke is generated due to a short circuit accident, etc., toxic gas may be generated. Make sure not to inhale the toxic gas. • After inspecting the contacts, they may be replaced as an emergency procedure. The replacement method is described in this manual, but short circuits or fires could occur due to a drop in insulation. Replace the product. • If parts have been removed or replaced during the inspection or repairs, accurately set them in the original positions, and tighten them. • SD-M series shall not be disassembled. They are not allowed to be maintained.

5.1 Mechanism of Contact Wear

There is electrical wear of contacts in which the contact material scatters in fine particle form due to the current switching, and mechanical wear of contacts in which the contact deformed due to hitting or friction. Most contact wear, however, is electrical wear.

(1) Normal usage Category AC-3

Normal usage is that in which the starting current of the 3-phase squirrel-cage motor is turned ON, and the current decreases after the full-speed state is reached and then the contact opens. This is called Category AC-3 in IEC standard terminology. In detail, this is the operation in which a current that is six-fold the rated usage current closes the circuit, and a current that is one-fold opens the circuit. The electrical switching endurance of the MS-N Series is 1,000,000 cycles. However, this of S-N400, S-N600, S-N800 is 500,000 cycles.



Category AC-3 electrical switching endurance test operation

I : Rated operational current

E : Rated operational voltage

The unevenness of the contact surface in this case is relatively low and the wear deformation is also low. In a silver alloy contact, the surface is as though it is covered with fine black particles, and there are marks on part of the contact.

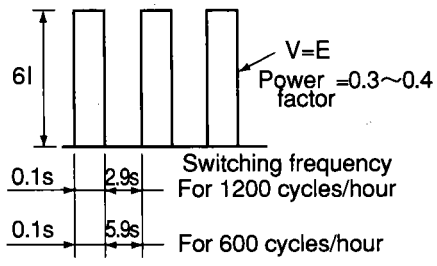
In this case, the contact does not need to be serviced generally.

Normally the wear of each of the 3-phase pole contacts is not even in each of the three-phase, and is only seen in two of the poles. This is because the 3-pole contacts do not simultaneously switch and that there is a 120 ° phase difference in the current.

(2) Inching and Plugging Category AC-4

Inching operation refers to shutting off the starting current before the motor reaches the full speed by frequently repeating the motor's start and stop operation.

Plugging is a method to generate a reverse run torque when braking the motor, and switches the large current to which the reverse phase current is added to the starting current.

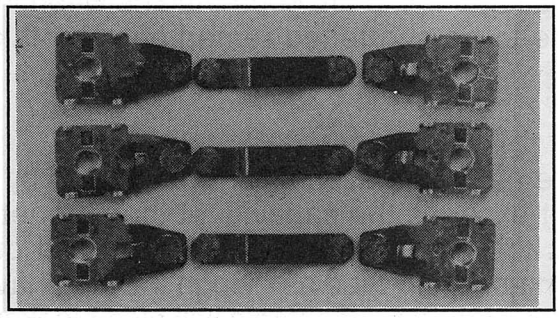


Category AC4 electrical switching endurance test operation

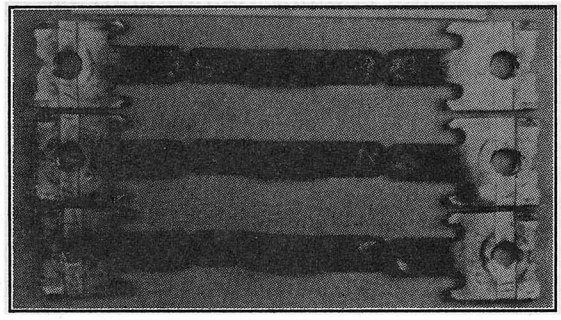
In IEC standard terminology, this usage method is called Category AC-4, and is specified by testing with the type of operations shown on the left. This operation switches the motor's starting current, and is a severe operation on the magnetic contactor. The Category AC-4 electrical switching endurance of the MS-N Series is 30,000 cycles. 15,000 cycles for ratings more than 380V of N35 to N800. During inching, a current that is six times the rated operational current is shut off, causing the contact wear to be extremely large. The unevenness of the contact surface is remarkable, and the contact material scatters in a particle form.

In the silver alloy contact, the black section extends to the surface and peripheral alloy, and large white marks appear on the contact surface.

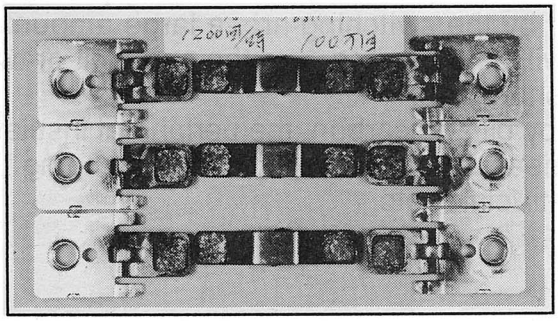
Contact after electrical life test



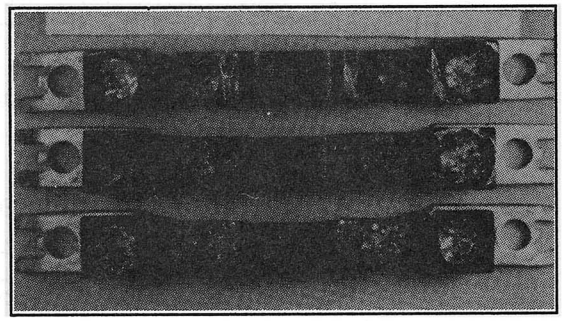
S-N21 type, 3 phase 440 V
Category AC-3, After 1,000,000 cycles
of closing at 120 A and shut off at 20 A



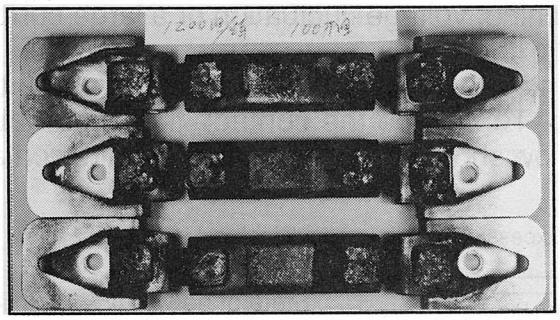
S-N35 type, 3 phase 440 V
Category AC-3, After 1,000,000 cycles
of closing at 192 A and shut off at 32 A



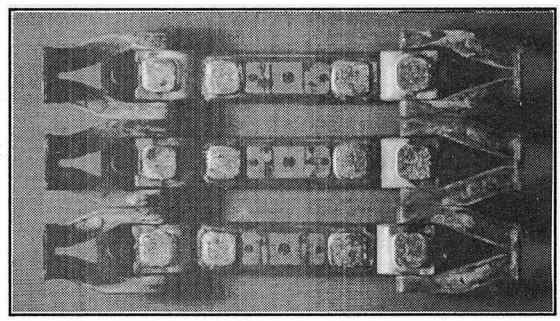
S-N65 type, 3 phase 440 V
Category AC-3, After 1,000,000 cycles
of closing at 372 A and shut off at 62 A



S-N95 type, 3 phase 440 V
Category AC-3, After 1,000,000 cycles
of closing at 558 A and shut off at 93 A



S-N150 type, 3 phase 440 V
Category AC-3, After 1,000,000 cycles
of closing at 900 A and shut off at 150 A



S-N220 type, 3 phase 440 V
Category AC-3, After 1,000,000 cycles
of closing at 1320 A and shut off at 220 A

(3) Abnormal switching caused by chattering

The phenomenon in which switching is repeated at an extremely high frequency due to a drop in the circuit voltage or bouncing of the operation contact is called chattering. During chattering, the motor's starting current will repeatedly switch, and the contact temperature will rapidly rise due to the arc generated between the contacts. This will cause the contact life to be shortened remarkably, so take measures immediately.

(4) Switching of abnormal current

Switching that is 13 times or more of the rated operational current, caused by a short circuit accident, etc., is usage that exceeds the capacity of the magnetic contactor. The contact will become as though inching has been carried out excessively, and the surface will be remarkably deformed as though the arcs have whipped the contact surface. The insulator around the contacts will also blacken, the insulation deterioration will be promoted, and if switching is carried out several times, reuse will not be possible.

The contact will be welded if the current is 20 times or more of the rated operational current. This type of welding is often seen when the current is abnormal.

(5) When oil gets on contact

If switching is carried out when there is oil on the contact surface, such as when using the contact in a machine tool, the contact wear will be remarkably promoted. At this time, the oil will be decomposed by the switching arc, a large amount of hydrogen gas will be discharged, wear will be promoted, and the one-digit or two-digit life in a normal atmosphere will be shortened.

The contact surface will be blackened by oil and carbon, the peripheral insulator will become remarkably dirty, so take measures to prevent this by changing the mounting position or using a protective structure, etc.

5.2 Maintenance of Contacts

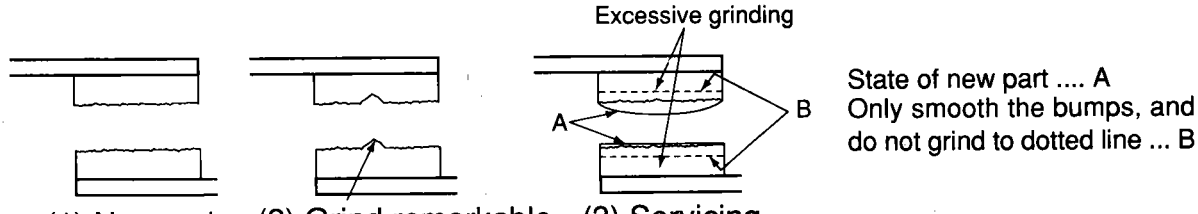
(1) Contact maintenance period and method

When the contact discolors or becomes uneven, the contact surface is filed and polished. This is a method used to service contacts that use easily oxidized copper or silver tungsten, etc. For the S-N magnetic contactors that use a silver alloy contact, grinding the contact with a file can shorten the life.

Blackening of the contact and slight unevenness of the contact surface caused by normal switching operation does not required servicing, and instead not servicing the contact can lead to a favorable wear state and a longer life.

However, if the partial unevenness is remarkable or if burrs appear due to abnormal switching such as extremely severe switching, voltage fluctuation or a large current shut off, the contact should be serviced.

When the contact has reached is life and the wear limit (refer to section 5.3), the contacts for all poles must be replaced. To service the contact, the remarkable unevenness as shown in the drawings below should be smoothed. The entire contact does not need to be ground or polished.



Servicing of contacts

(2) Discoloration of contacts

Black discoloration of the electrical contact is caused by sulfurization and the adherence of foreign matter. The sulfurization of the contact is the silver sulfide caused by gas in the air. The color will change from brown to brownish to black depending on the film thickness. Sulfurization is caused mainly on silver alloys by hydrogen sulfide generated from sewage, contaminated canals and rivers, humans and waste gas. Silver sulfide is used on the film for semiconductors, and does not cause a problem in normal atmospheres or a normal switching frequency. However, it can cause a contact defect when the current is small or the voltage is low, and the switching frequency is low.

The adherence of foreign matter causes discoloration through contact switching, and is caused by a complicated reaction. It cannot be determined which compound causes what color, but the black color is carbon generated when carbides in the formed part or air is decomposed by arcs.

A yellowish band is the color of oxidants and will be dispersed partially.
Silver oxidants do not have a strong insulation film such as copper oxide, and easily decompose at approximately 250℃ due to the thermal and mechanical weaknesses. These oxidants breakdown with a low voltage, so the contact resistance in a 24 V or higher circuit does not pose a major problem.

(3) Rise of contact temperature

The temperature rise of the magnetic contactor's contacts is specified as "a degree that does not impose usage", but a general guideline for the contact temperature rise is 100℃ [K] or less. The temperature rise at the terminal section is specified as 70℃ [K] or less (ambient temperature 40℃).

(4) Cause of abnormal wear and measures

(a) During inching and Plugging

The amount of contact wear will differ according to the percent of inching and Plugging that is carried out within the entire operation times. However, this is basically a severe usage method, so refer to the catalog, etc., and select a magnetic contactor with a large rated capacity.

(b) During chattering

The causes of wear are largely divided into the following two causes.

(i) Excessive voltage drop

If the circuit voltage drop is excessive (level that exceeds 35%) when the magnetic contactor is closed and the motor's starting current flows, the magnetic contact will repeat closing, voltage drop, opening, voltage recovery, closing again, voltage drop. Thus, chattering will occur at a high frequency of approximately once every 20 to 50 msec. The following causes can be considered, so make modifications. This type of voltage drop cannot be measured with a tester, so record the drop with an oscilloscope.

- Insufficient power capacity. • Insufficient wire size.
- Mounting too far from power source.
- Incorrect starting method. (During simultaneous starting of multiple motor, etc.)

(ii) Bouncing of control circuit system

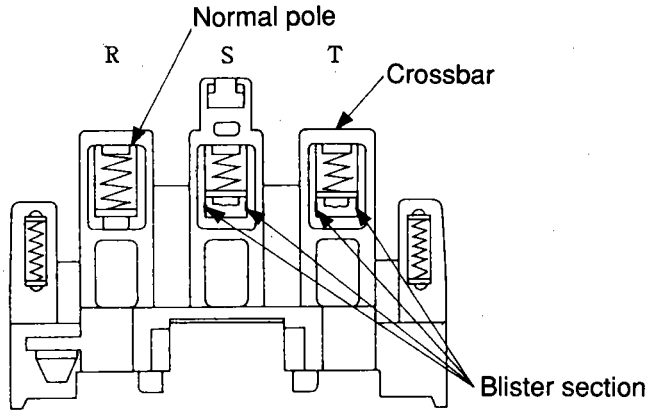
If the contact in the control circuit bounces due to a mechanical or electrical shock, or vibration from an external source, the exciting of the magnetic contactor's operating coil will be cut off, and chattering will occur. The following causes can be considered, so investigate the cause and make modifications.

- Relay is mounted near magnetic contactor, and the relay contact bounces due to the impact of the contactor closing.
- The contact of the pressure switch, float switch or limit switch, etc., bounces. The relay operates intermittently due to unstable fluctuation of the switches.
- The contact bounces due to an incorrect control panel structure or insulation.
- The terminal connection is insufficient. (The screw tightening or soldering is incorrect.)
- The coil voltage is too high causing a large impact when closed.

(5) Judgment of cause looking from burned state

The current is turned on and shut off at a high frequency due to chattering, so the amount of arc heat accumulated will be higher than that dispersed. This will cause the contact section to reach a high temperature of approximately 800℃ in a short time (3 to 20 seconds with starting current, 20 to 120 seconds with rated current.) In this case, the contact could burn with the following process.

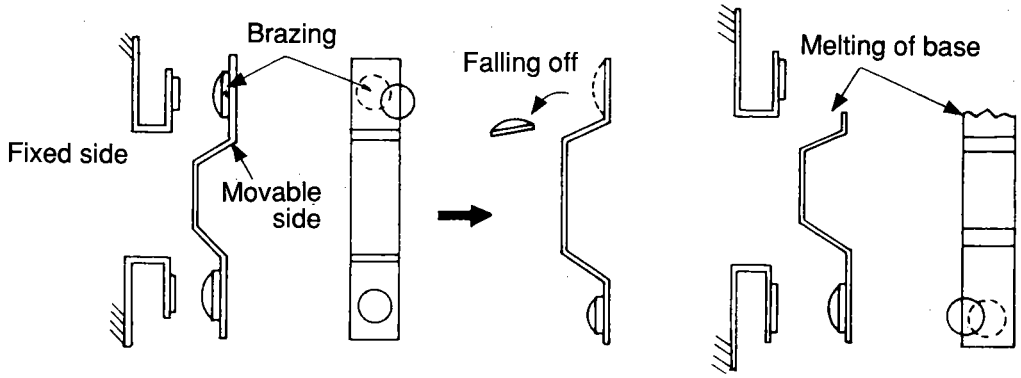
1. There are cases where blistering deformation occurs in the sliding section of the crossbar that supports the movable contact element, causing the poor movement of the movable contact element.



As shown with the S and T poles in the drawing, the spring retainer catches on this section because of the blistering, causing the movable contact element to not be pushed completely.
(Note) The R pole shows the normal pole.

1. Blistering of mold (sliding section) during early stage of chattering

2. Next, the brazed section of the contact melts causing the brazed section to deviate or the contact to fall off.



2-1 2-2 3

3. If chattering continues, the current will be switched at the base section where the contact has fallen off, and the base will melt. The sliding section of the crossbar will blister due to the heat causing carbonization to advance.
   In some cases, the heat will be conveyed to the connected wire, causing the insulator sheath to discolor or melt.
4. In most cases, if the two-pole contact element welds, the current will be shut off, and the accident will be terminated. In some cases, the carbonization of the insulator parts around the contact element will advance due to arc heat, and can cause a short circuit between poles.

The burning state of the contact caused by chattering is as described above.

- However, burning caused by an abnormal current is somewhat different.
  Judgment of state of contact burning caused by abnormal current
  If an excessive current is turned on due to a short circuit, etc., the contact will weld in most cases. However, if the protective coordination in respect to short circuit accidents in the circuit is insufficient, the contact element may fuse.

5.3 Contact Replacement Reference and Method

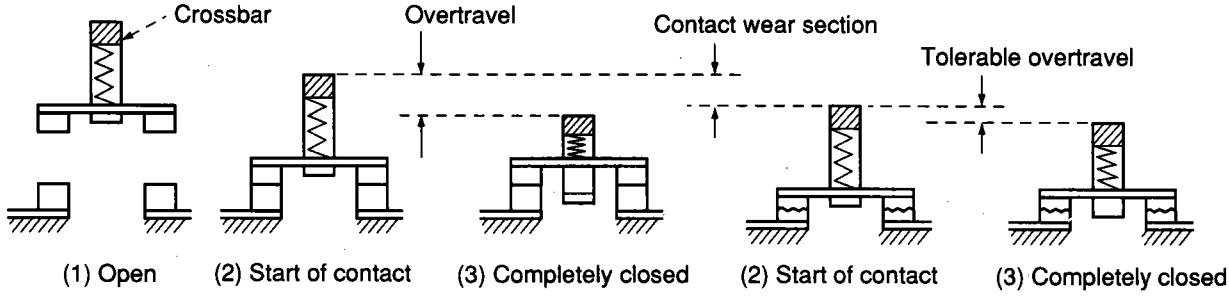
⚠CAUTION	• After inspecting the contacts, they may be replaced as an emergency procedure. The replacement method is described in this manual, but short circuits or fires could occur due to a drop in insulation. Replace the whole product.

Generally, with normal operation, the replacement period can be determined by the rated capacity, the number of switches obtained from the number of usages and by the number of days used. However, with the actual motor operation, various conditions such as inching operation and the abnormal wear explained earlier must also be considered. Thus, the contact replacement period must be judged by the drop in contact overtravel (drop in contact force) and the degree of wear deformation.

(1) Limits to electrical life
- (a) When the contact thickness wears to 50% of new part, or when overtravel drops 60%. (Refer to Table 3)
- (b) When contact is remarkably deformed, peeled or the insulator is burned and deteriorated.
- (c) When the insulation resistance between each pole, between the ground or between the power load drops to 1M-ohm or less.
- (d) If a withstand voltage test can be done, when 2,500 V for one minute cannot be withstood at the same places listed in (c).

(2) Judgment with overtravel and contact force measurement

The thickness of the contact decreases due to the scattering of arcs when the current is switched, by that causing the overtravel and contact force to drop. Measure the overtravel, and use the measured value as a guideline for the contact force.



New contact element Worn contact element

Drop of overtravel and contact force

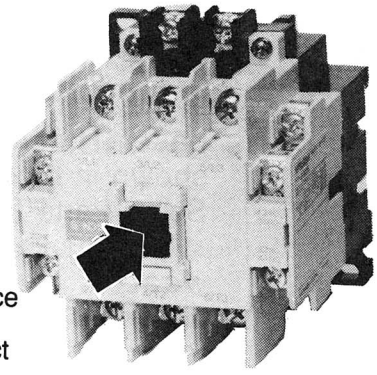
● Measurement of overtravel

Measure the crossbar movement from the start of contact to the point where the contact is fully pressed for the three poles on the top of the crossbar. If the tolerable overtravel is lower than values given in Table 3 for even one pole, the contact life has been reached, so replace the contacts for all three poles. The difference in the contact of the three poles (difference of whether simultaneous contact is achieved or not), is approximately 0.5 mm or less.

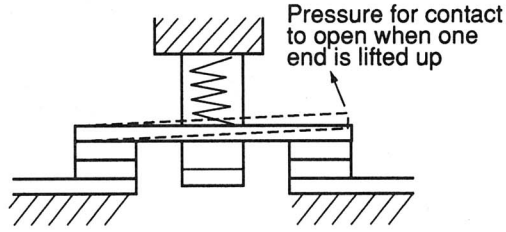
● Measurement of contact force - Reference measurement

To measure the contact pressure, use a fan-type balance or spring balance, and lift one end of the movable contact element in the contact closed state (the power should be on to the operating coil).

The reference values for the minimum tolerable contact force are given in Table 3.



Measurement of overtravel



Measurement of contact force

Table 3 Tolerable contact force and overtravel at magnetic contactor contact replacement interval

Type	Tolerable overtravel (mm)	Minimum contact force (g)	Type	Tolerable overtravel (mm)	Minimum contact force (g)
S-N10, N11, N12	0.5	—	S-N125	1.5	620
S-N20, N21, N18, N28	0.7	—	S-N150	1.5	840
S-N25, N35, N38, N48	0.8	110	S-N180, N220	1.7	1170
S-N50, N65	0.8	265	S-N300, N400	2.0	2250
S-N80, N95	1.2	425	S-N600, N800	2.0	11000

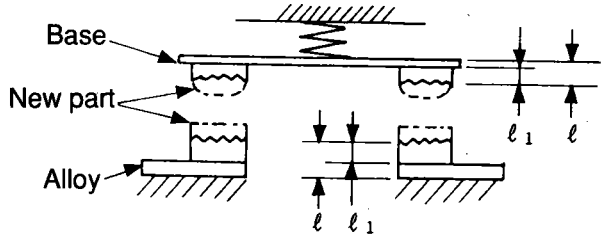
Note 1. The contact force values are reference values.

(3) Judgment with changes in contact shape

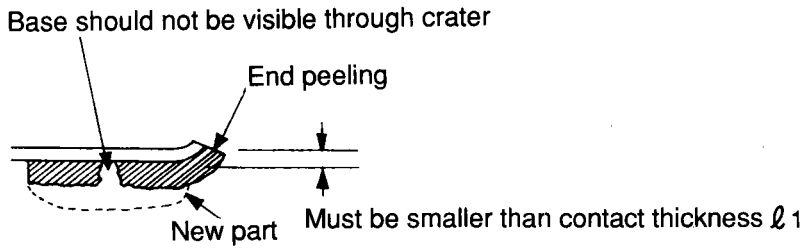
The change in the contact shape caused by wear is often not even, and so to make a judgment, the average of the contact surface is looked at.

When the thickness ℓ_1 of the contact having the most wear reaches 50% or less of a new part, replace the parts for all three poles. When actually looking at the thickness, it is easier to look at the ℓ dimension including the base. These dimensions are shown in boxes in Appendix 1 Spare Parts Table.

For remarkable unevenness or wear of the tip caused by abnormal wear, the guideline for replacement is when the degree of end peeling or unevenness reaches near the contact thickness.

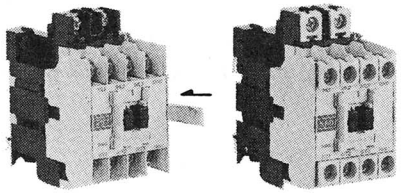
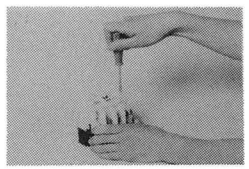
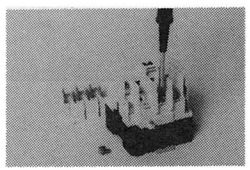
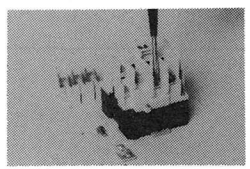
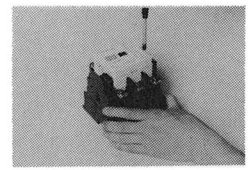
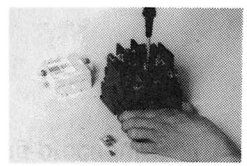
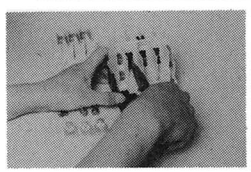
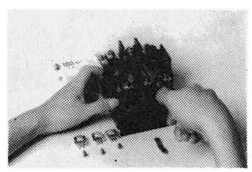


Contact wear dimensions



During abnormal usage

SR-N Magnetic relay, S-N Magnetic contactor

<table>
<tr><th colspan="2"></th><th>SR-N4 S-N10 to N35 N18 to N48</th><th>S-N50, N65</th><th>S-N80～N800</th></tr>
<tr><td rowspan="2">Contact</td><td>Main stationary contact element</td><td>S-N10～N21,SR-N4
1. Insert a flat-tip screwdriver into the end of the arc cover as shown in Fig. 1, and remove the arc cover.
 
Fig. 1 Fig. 2
S-N10～N20CX,SR-N4CX
1. Lift up the screw holder for each pole on the top as shown in Fig. 2.
2. Insert a flat-tip screwdriver into the end of the arc cover as shown in Fig. 1, and remove the arc cover.
S-N21～N48CX
1. Lift up the screw holder for each pole of the upper main circuit.
2. Insert a flat-tip screwdriver into the end of the arc cover as shown in Fig. 1, and remove the arc cover.
(Note 1) After inspections, make sure to securely mount the arc cover on the unit, and confirm that the stationary contact element (terminal) has not dropped off.
Insert the screw holder to a position where it does not protrude from the unit.</td><td>1. Insert a flat-tip screwdriver into the end of the arc cover as shown in Fig. 1, and remove the arc cover.
 
2. Remove the terminal screw on the stationary contact element.
 
3. Catch a Phillips screwdriver on the hole for the screw terminal tightening, and remove the stationary contact element.
  </td><td>1. Loosen the screws on both ends of the arc box, and remove the arc box.
 
2. Loosen the screw tightening the fixed contact element, and remove the fixed contact element.
  </td></tr>
<tr><td>Main movable contact element</td><td>3. Pull out with a pair of tweezers.</td><td>4. Pull out the movable contact element with a pair of radio pliers or tweezers.
  </td><td>3. Pull out the movable contact element with a pair of radio pliers.
  </td></tr>
</table>

		SR-N4, S-N10～N35,N18～N48,N50,N65	S-N80～N125	S-N150～N400	S-N600, N800
Contact	Auxiliary contact built in	1. Remove the terminal screw, and pull out the fixed contact element with a screwdriver. 2. Pull out the movable contact element with a pair of tweezers. 3. Mount the new movable contact element onto the crossbar. 4. Insert the new stationary contact element into the housing. (Refer to the next page for the insertion procedures.)	[Excluding N18 to N48 frames.]	———	———
	Auxiliary contact mounted on unit	1. Slide the unit to the power supply side while lifting up the unit mounting stopper. 2. Mount a new unit. (Refer to pages 46 and 47 for the mounting procedures.) (Refer to page 45 and the catalog for the combination possibilities.)	1. Remove the unit mount screw, and remove the unit. 2. Mount a new unit. (Refer to page 47 for the mounting procedures.)		1. Remove the unit mount screw, and remove the unit. 2. Mount a new unit. (Refer to page 47 for the mounting procedures.)

S-N10 to N35 and S-N50 to N125 Magnetic contactor, auxiliary stationary contact element
SR-N Magnetic relay, stationary contact element

Insertion procedures

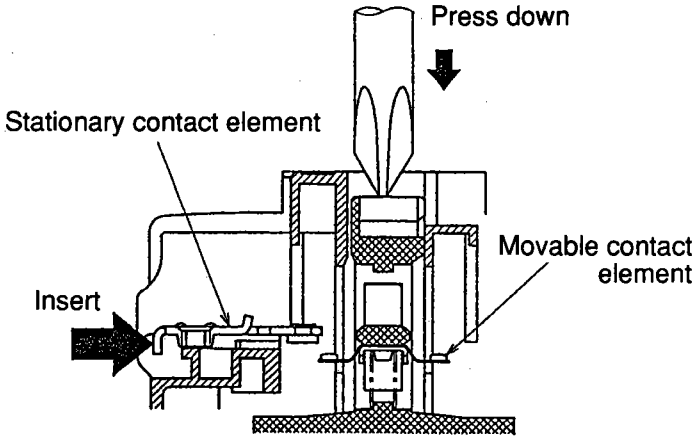
● Application

If the stationary contact element is pulled out for replacement or experiments, etc., and is reinserted carelessly, the movable contact element may be pushed out by the end of the fixed contact element. The insertion procedures to avoid this are described in this section.

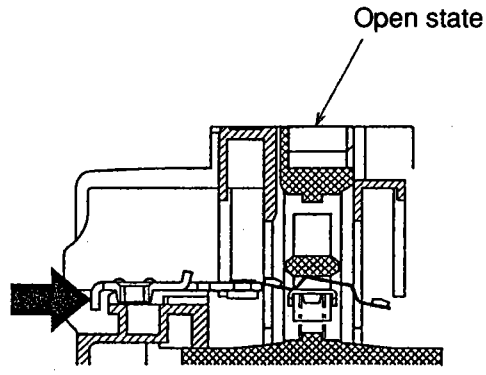
● Insertion procedures

(1) For b(NC) contact

Press the protruding end of the movable section with a finger to enter the closed state, or for the mechanically latched type, enter the latched state, and then insert the fixed contact element. If the element is inserted in the open state, the movable contact element will be pressed down, and will fall off.



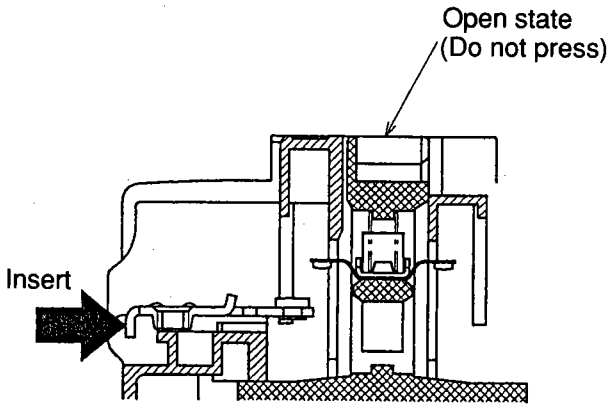
Correct



Incorrect

(2) For a(NO) contact

Insert the a contact in the state that the movable contact is opened. If the a contact is inserted while the movable section is pressed with a finger in the same manner as the b contact, the movable contact element will be pressed out and will fall off.



Correct

For the mechanically latched type, release the latch (turn latch OFF) before inserting.

5.5 Contact Welding

If the contact is welded due to a short circuit current or chattering, take the following measures.

(a) Light welding

If the welding is light and can be opened easily, the contact surface can be ground with a file and reused. Grind as far as the surface is still slightly uneven, and make sure not to grind too far.

(b) Heavy welding

If the welding is heavy and the contact cannot be opened even when pulled, replace the contactor with a new part. In this case, there may be a large arc heat, so inspect the insulator around the contact. The contact cannot be reused.

5.6 Maintenance of Arc Box

- Highly heat resistant and arc resistant material is used for the MS-N Series arc box insulator material, so even if the material discolors or peels, the breaking performance and contact life will not be affected.
- The arc runner, and grid may melt, scatter and thin out due to the arcs, but these parts do not need to be replaced. (This is not wear that will affect the performance during normal use including inching operation).
- Remove any foreign matter (metal chips that have scattered, etc.), accumulation friction dust and dust during inspections.
- In the following cases, damage may occur during abnormal use such as an excessive current shut off, so replace the magnetic contactor. (Use a magnetic contactor with a large rated current.)
  1. When arc runner, etc., is abnormally worn and breaks.
  2. When a hole opens in the arc box partition wall.

5.7 Precautions after Inspections

(a) Mount the arc box.

Always mount the removed arc box at its original position. If operating with an operation coil, mount the arc box even if the current is not switched with a contact.

(b) Do not press the protrusions of the operation display on the surface to switch the current.

During inspections and sequence checks, the current is switched by pressing the operation displays protruding on the surface of the arc box. This operation can be used only for checking, and must never be done to operate while flowing a current to the main contact.

This will cause welding of the contact.

(c) Cleaning

When replacing the contact, clean the dirt in the inside of the arc box and the around the insulation barrier, etc., with a soft cloth.

6. Maintenance and Inspection of Core and Coil

⚠WARNING	•Turn the power off before starting maintenance or inspections.

⚠CAUTION	•The terminal and coil areas will become hot through switching. Do not touch these carelessly. •The coil has a thermal life, so periodically inspect for discoloration. •Never manually operate the product in the live state. •If parts have been removed or replaced during inspections or repairs, always set the parts in the original positions and tighten them. •SD-M series shall not be disassembled. They are not allowed to be maintained.

6.1 AC Magnet

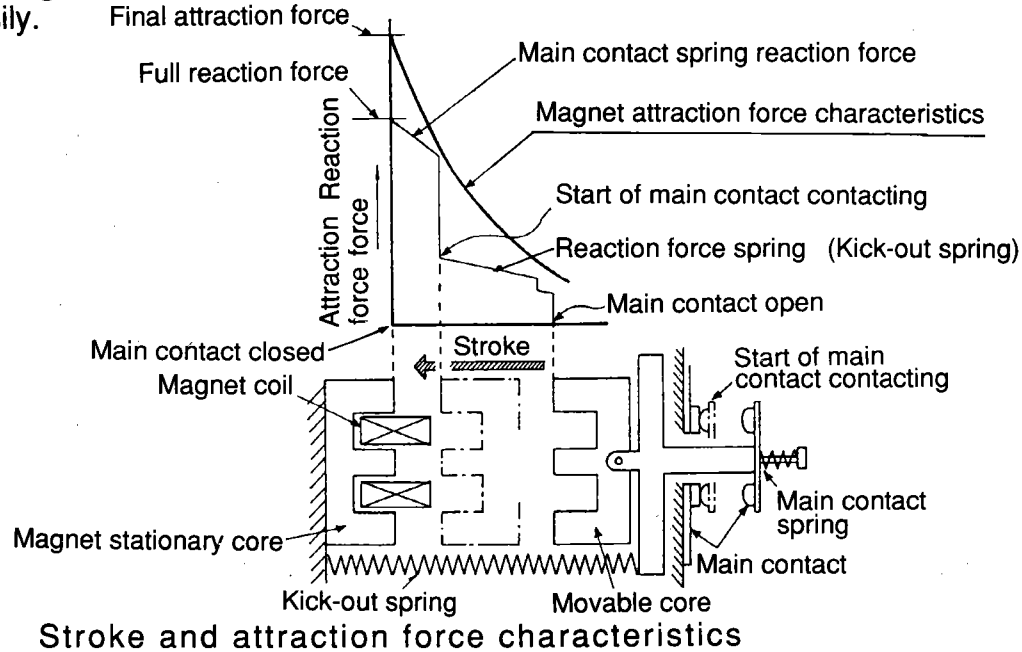
(1) Magnet stroke and reaction force

The magnetic contactor and magnetic relay operate the contacts with the attraction force of a magnet.

When the movable core is open, the coil's exciting current is large, and the attraction force is the weakest. The force becomes the strongest after attraction. The main contact begins to contact during that stroke, and the reaction force increases rapidly. The reaction force becomes the largest after the attraction, and the coil's exciting current becomes constant. Full continuity is achieved for the first time at this point.

During this interim process and during the full stroke, the attraction force beats the reaction force and operates. If this relation is not continued even after attraction, various problems will occur.

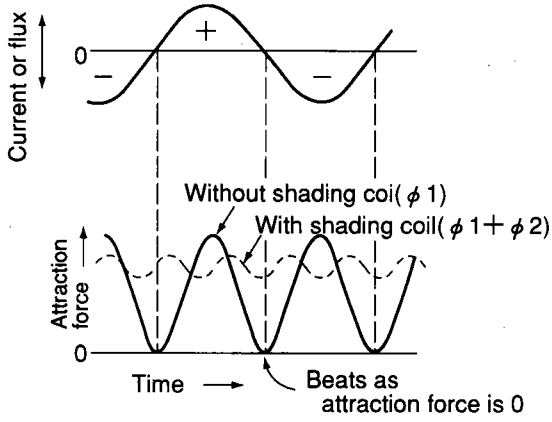
A rush current flows to the current the instant that the main contact contacts, and thus the voltage drop occurs easily. As the contact force is weak, contact welding occurs easily.



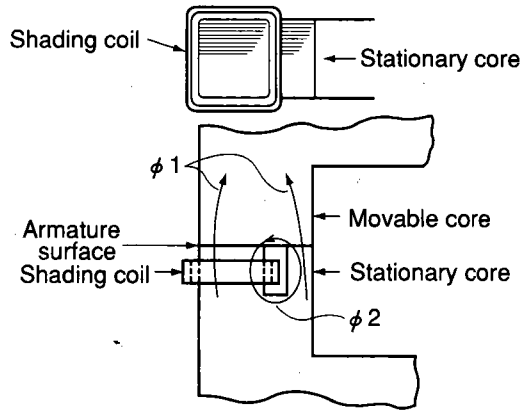
Stroke and attraction force characteristics

(2) Shading coil

The attraction force created by the alternating current will change over time together with the circuit's frequency. Thus, the force will lose to the contact's reaction force, causing beating and inhibiting use. To reduce this beating, a shading coil is provided on the core.



Attraction force of AC magnet



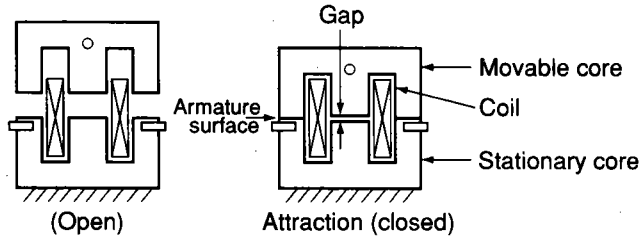
Shading coil

By using a shading coil, the flux ϕ 2 created by the shading coil is compounded on the original flux ϕ 1, so the beating is decreased remarkably. Even if the beating is decreased in this manner, the AC magnet cannot prevent the beating completely. To completely reduce the beating, the contactor must be replaced with a DC operated type or mechanically latched type.

(3) Rust and dirt on core armature surface

The AC magnet prevents beating by using a shading coil, but if there is a gap between this movable core and the stationary core's armature surface, the effect of the shading coil will drop in half. Thus, the armature surface is finished to be smooth, and is treated for rust prevention.

Depending on the type of dirt, such as that containing water or oil or that is gummy and adhesive, the core dropping may be inhibited (the motor may runaway), and cause a hazardous state.



SR-N, S-N10 to N35, S-N18 to N48
(E-E type core)

(4) Gap for residual magnetism prevention

An electric steel plate is used for the AC magnet, but a gap is provided to prevent the movable core from not separating and falling due to residual magnetism even when the coil current is turned off after attraction. The size of the gap is approximately 0.15 mm for the N10 to N35 and N18 to N48 types.

When the number of magnetic contactor switching reaches several times 1,000,000 cycles, this gap will decrease and may cause the core not to drop or beating to occur. This is the mechanical switching endurance limit of the magnetic contactor.

6.1.1 Maintenance of Core

(1) Guideline to beating size

● Non-obstructing beating

Beating that can be heard slightly when a magnetic contactor is placed in a quiet room and is listened to from approximately 60 cm away is normal.

Even if the beating is larger, the coil's exciting current is not increasing much, so the coil will not burn.

● Beating requiring caution

If beating that is as loud as a buzzer is sound and vibration is felt, the coil's exciting current is increasing, so measures must be taken.

(2) Prevention of beating

During normal use, beating that will cause a problem will rarely occur. However, depending on the working environment and conditions, such as the existence of high humidity levels, dust or corrosive gases, beating may occur.

If beating occurs easily, use of a DC operated type or mechanically latched contactor can be effective, so consider changing or replacing the contactor.

Cause of beating	Measures
• Intervening of foreign matter on core attraction surface Foreign matter such as dust from external source, rust	• Use an outer box to prevent foreign matter and humidity from external sources. • Heat with a heater when operation is halted if the temperature fluctuation is large.
• Drop in attraction force Drop in power voltage Incorrect coil rating	• Use a coil that matches the voltage, and lower the voltage fluctuation. (85 to 110% of rated voltage)
• Breakage of shading coil • Decrease in gap between core center poles • Roughening or uneven wear or core attraction surface	The mechanical switching endurance limit of the magnetic contactor has been reached. Replace.
• Resonance of devices mounted in same panel.	Review the panel structure.

6.1.2 Repair and Servicing of Core

The procedures to be taken if matter such as rust or dust adheres on the magnet core are explained below.

(1) Removal of rust

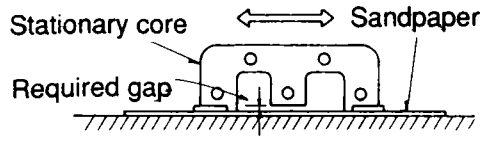
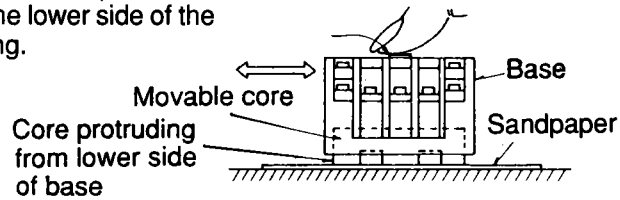
● Light rust and foreign matter (adhesive) on armature surface

Wipe the armature surface with a dry rag or with a rag soaked in solvent such as lacquer thinner. The rust can be removed easily.

● Heavy rust or adhesive matter on entire armature surface

Brush off the rust with a soft wire brush (brass brush), or place #140 to #300 sandpaper on a flat surface, and rub the core surface against this to polish it. The armature surface is finished to a high flatness precision, so take care not to lose the flatness. After removing the rust or adhesive matter, use a rag soaked in lacquer thinner to clean the surface. Take measure to prevent rust from forming and adhesive matter from entering.

If appropriate measures are not taken, these problems will recur repeatedly.

Cate-g-ory	Work procedure drawing	Judgment
Stationary core	《SR-N, S-N10 to N35, S-N18 to N48》  Table	Degree that traces of paper are left on core's armature surface.
Movable core	《SR-N, S-N10 to N35, S-N18 to N48》 Press down on crossbar with a finger so that the movable core protrudes from the lower side of the housing.  Table	Finish to the degree that traces of paper are left on entire surface.

(2) Rust prevention treatment

- If the part forms light rust and is constantly used or if there is adhesive, do not apply rust preventing oil on the armature surface. Instead, polish the surface. Rust will rarely form during operation.
- If the part forms light rust and is used intermittently with a long halt period, soak a rag in solvent, wring it out, and wipe the armature several times with the rag.
- If the part forms heavy rust and is used constantly (part having temporary adverse conditions such as a long halt), use the same treatment as above.
- If the part forms heavy rust and is used in an environment where rust forms easily, shield the part from the environment by placing it in a structure such as a moisture proof box.
- If appropriate measures are not taken to prevent rust, these problems will recur repeatedly.

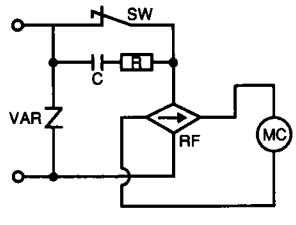
(3) Precautions

There are many types of commercial rust preventing oils available, but some of these when applied on the core surface can cause the nominal adhesion of the foreign matter on the core to extend and make opening impossible.

6.2 AC Operated DC Exciting Magnet

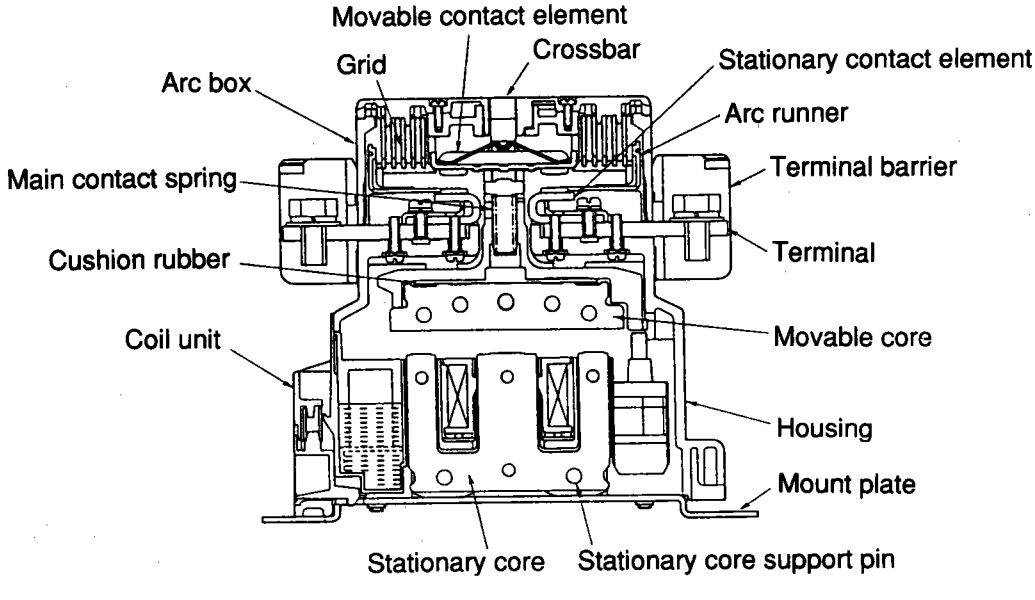
In the S-N50 to N800 models, a voltage drop method using the capacitor shown below is incorporated. The AC operated power is converted into DC internally.

When the magnetic contactor is closing, the switchover switch (SW) still ON, and the current is flowed and attracted to the coil (MC). During constant operation, the switchover switch turns OFF, and the current that flows to the operating coil (MC) is limited by the capacitor (C), allowing the holding state to be maintained with a small power consumption. The magnet is a DC magnet so there is no beating sound from the magnet, and as opposed to the AC magnet that uses a shading coil, there is no hysteresis loss or shading coil loss, so the power consumption can be lowered remarkably.



C : Capacitor
R : Resistor
SW : Changeover switch
RF : Full wave rectifier
VAR : Surge absorber
MC : Operating coil

DC holding type coil circuit diagram



Structure of S-N220 magnetic contactor

6.3 Maintenance of Coil

⚠ CAUTION

- The coil's voltage fluctuation range is 85 to 110%, but if a voltage not in that range is applied for a long time, burning or fires could occur due to an increase in current and drop in insulation. Use at 95 to 100% of the rated voltage in consideration of the endurance life.
- When a low voltage is applied so that the magnetic contactor does not operate, a current higher than the rating flows to the coil, and could lead to coil burning or fires within a short time.
- If the coil is used in a circuit having a high harmonics or surge, the coil may burn or fires may occur.
- If smoke is emitted due to a short circuit accident, etc., toxic gas could be generated. Make sure not to inhale the toxic gas.

(1) Classification of coil voltage
The rated voltage and frequency of the coil are indicated with numerals and colors.

<SR-N, S-N10~N35, N18~N48>

100V 50Hz, 100~110V 60Hz	Yellow
200V 50Hz, 200~220V 60Hz	Red
Other AC voltages	White
For DC (SRD-□, SD-□)	Blue

<S-N50~S-N800>

100V~127V 50Hz/60Hz	Yellow
200V~240V 50Hz/60Hz	Red
Other AC voltages	White
For DC (SD-□)	Blue

(2) Coil voltage fluctuation range
The operating range in respect to the voltage fluctuation is 85 to 110%.
However, using at a voltage of 95 to 100% is recommended. If the voltage exceeds 100%, the coil's insulation endurance may drop.

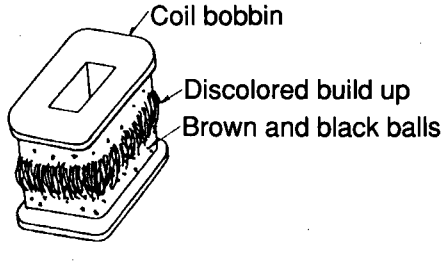
(3) Rise of coil temperature
Class E insulation is used for the coil insulation, but if rated voltage is applied, the temperature rise is suppressed to approximately Class A.

Temperature rise standards IEC 947
Class E 100℃[K] Class A 85℃[K]
(According to ambient temperature 40℃, resistance method)

Thus the coil will seem to be hot when touched, but if the temperature is within the above temperature rise, there will be no problem.
The temperature rise according to the Class E thermometer method is 80℃ [K] (reference value).

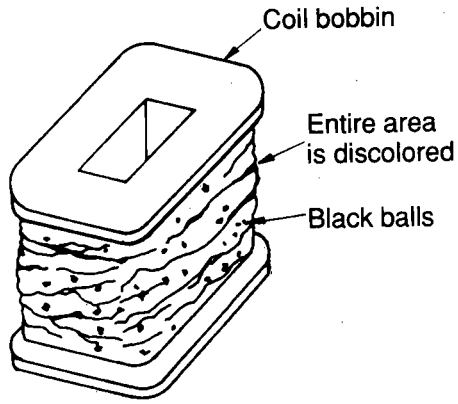
(4) Judgment according to coil burning
In addition to simple coil burning causes, there are cases when various causes are overlapped. Thus, judging the coil after it has burned is difficult. Often the actual status records and site need to be investigated. However, the following explanation is a guideline.

● Coil that has burned in a short time (under several minutes)



The center area of the coil is built up, and small brown and black balls have formed on the surface.
Part of the insulation tape on the surface has burned, and the edges are normal.
A layer short circuit in the coil generally does not cause discoloration to the outside.

● Coil that has burned over a long time (over 20 minutes)



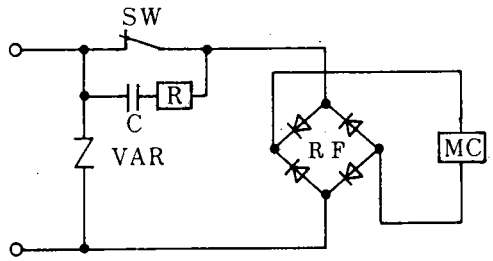
The entire surface of the coil is swollen and black. All of the insulation tape has burned and has shrunk.
Many of the small balls on the surface are black.
The coil that has burned over a long time has a surface that is entirely swollen and is discolored. Since the coil that has burned in a short time is partially discolored, the state can be judged with this.

●The mechanically latched magnetic contactor and magnetic relay coils have short-time ratings.
The magnetic contactor coil and magnetic relay coil both have a rating of 15 seconds. Thus, if these have a continuous continuity, they will burn in a short time. Note that the coil's continuity time tends to increase when the voltage drop is large and the operation is inhibited.

● S-N50 to N800 coil electronic part failure

⚠ CAUTION

- The varistor (used in the coil, surge absorber, etc.) may emit smoke due to deterioration.
Make sure not to near the product during operation, and always use a short-circuit protection device such as a fuse on the operating circuit.



■ Coil (MC) burning
As explained above, the short-time and long-time burned states are the same.

■ Varistor (VAR) damage
The varistor may be damaged due to application of a voltage double the rating or an extremely large surge voltage.
Cracks will form on the epoxy filler and varistor surface, and often, the resistance between the coil terminals will be zero.

■ Full wave rectifier (RF) damage
The rectifier may be damaged due to the external lightning surge or thermal stress after the surge absorber (varistor) is damaged.

■ Switchover switch (SW) contact defect
Contact defects rarely occur because of the cleaning function of C and R, however, a defect may cause when foreign matter enters the contact surface of when sulfur gas enters.
The resistance value between the coil terminals will be 1k Ω or more, so detection is possible.

Table 4 Causes of and measures for coil burning

Cause	State	Measures
• Excessive voltage A 100V coil was used for 200V circuit	《SR-N, S-N10 to N35, and S-N18 to N48 types》 Burns in short time	Replace
	《S-N50 to N800 types》 Varistor burns in several seconds	Replace
• Attraction not possible due to voltage drop The voltage is 85% or less, or a 200V coil was used for 100V circuit	Burns in short time Beating is great	• Voltage should be 100% • Use a DC operated type (the DC coil has no rush current, and does not burn easily)
• Chattering Insufficient power capacity, bouncing of operating contact	• Burns in short time (Differs according to state) • Occurrence of contact burning	• Increase the power capacity • Prevent bouncing
• Entry of large foreign matter to core armature surface	• Beating is large (The burning time will differ according to the size of the foreign matter.)	Prevent foreign matter by using an outer box
• Layer short circuit caused by entry of machine oil, etc.	Use of alkaline machine oil	Prevent entry of machine oil

Note 1. For the type of SL and SRL mechanically latched magnetic contactor and magnetic relay, do not replace the coil or disassembly the latched section.

6.4 S-N Magnetic Contactor, SR-N Magnetic Relay Coil Replacement Procedures

6.4.1 For the S-N10 to N12, N18 to N48 and SR-N4

1. Remove the screws tightening the housing and mounting frame.
   For the S-N10 to N12(CX), N18(CX), N28(CX) and SR-N4(CX), N38(CX) and N48(CX) load sides, disengage the housing and mounting frame with a flat-tip screwdriver. (Fig. 1)
   For the S-N12(CX), N38(CX) and N48(CX), disengage the load side with a flat-tip screwdriver. (Fig. 2)
2. Separate these, and remove the coil. For the finger protection models(CX), lift the coil terminal screw holder, and then remove the coil.
3. Place the coil to be replaced in the center of the stationary core.
   For the coil built in the surge absorber, check for removal and inclination of the surge absorber.
4. While setting the conical spring on the housing side onto the coil spool, assemble the housing and mounting frame. (The side of the conical spring that contacts the coil spool is the side with the larger diameter.)
5. Tighten the housing and mounting frame with the screws. Make sure that the sections of the S-N10 to N12 (CX), N18(CX), N28(CX) and SR-N4 (CX) load side and the S-N12 (CX), N38(CX) and N48(CX) power supply sides, disengaged in step 1, are completely engaged.

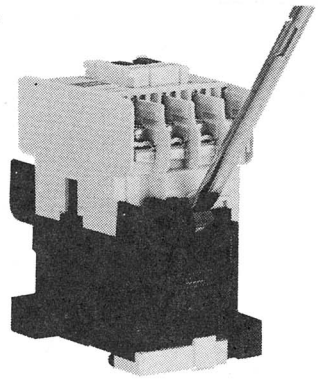


Fig. 1

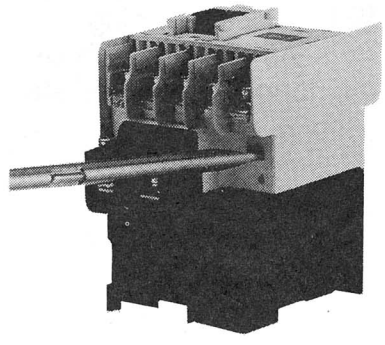
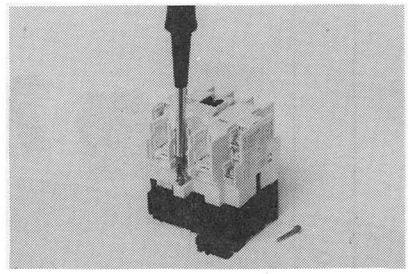


Fig. 2

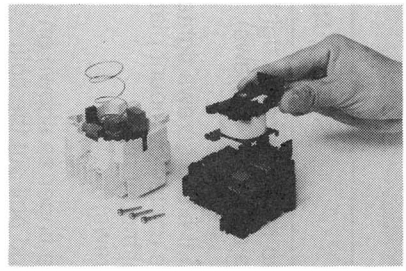
6.4.2 For the S-N20 to N35

1. Remove the screws tightening the housing and mounting frame.

   S-N20(CX), N21(CX) : 2 pcs.
   S-N25(CX), N35(CX) : 3 pcs.

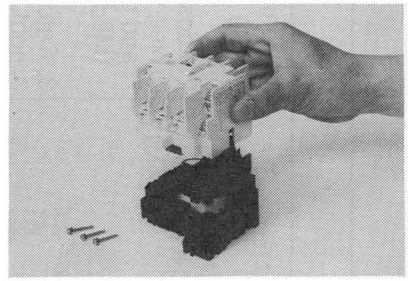


2. Separate these, and remove the coil. For the finger protection models(CX), lift the coil terminal screw holder, and then remove the coil.



3. Place the coil to be replaced in the center of the stationary core.
   For the coil built in the surge absorber, check for removal and inclination of the surge absorber.

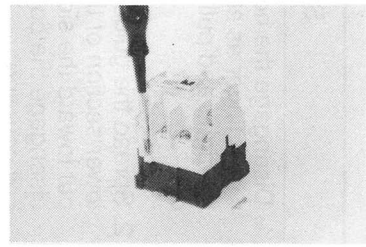
4. While setting the conical spring on the housing side onto the coil spool, assemble the housing and mounting frame. (The side of the conical spring that contacts the coil spool is the side with the larger diameter.)



5. Tighten the housing and mounting frame with the screws.

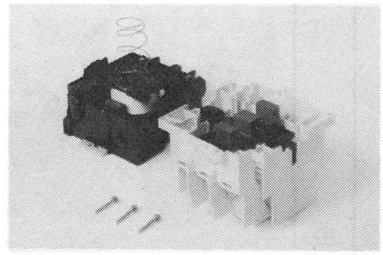
6.4.3 For the S-N50 and N65

1. Remove the three screws tightening the housing and coil as shown on the right.

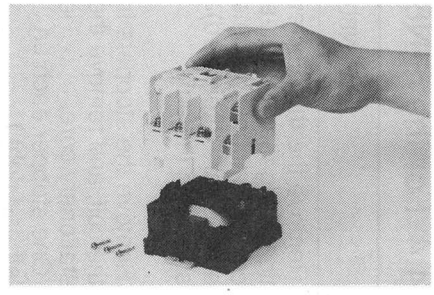


2. Replace the coil (the mounting frame, coil and stationary core are integrated).

3. While setting the conical spring on the housing side onto the coil spool, assemble the housing and coil. (The side of the conical spring that contacts the coil spool is the side with the larger diameter.)



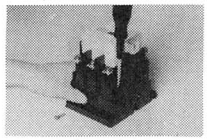
4. Tighten the housing and coil with the screws.



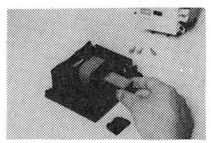
6.4.4 For the S-N80 to N800

S-N80, N95

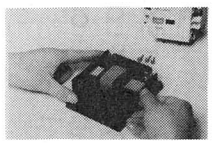
1. Remove the three screws tightening the housing and coil (the mounting frame and coil are integrated)as shown on the right.



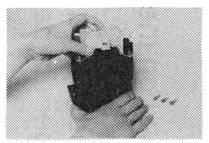
2. Remove the stoppers from the coil, and remove the stationary core. (One stopper each on the left and right.)



3. Place the stationary core into the coil to be replaced, and fit the stoppers. (Both sides)

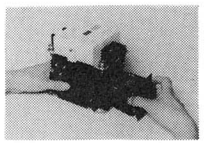


4. Fit the spring on the housing side into the spring retainer, assemble the housing and coil, and tighten the screws.

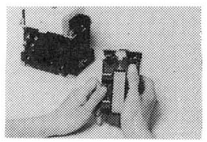


S-N125~N400

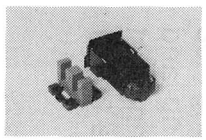
1. Disengage the housing with a finger as shown on the right, and pull out the coil.



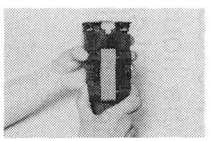
2. Spread the guides on the lower section of the coil out toward the sides, and disengage the core and coil coupling.



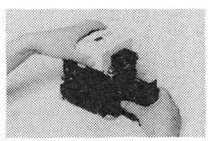
3. Replace the coil.



4. Press the guides inward, and couple the core and coil.
   The guides of S-N125 to N220 have an orientation, so take care when coupling the parts.



5. Completely fit the ratchet. (Press in the coil until a "click" is heard.)

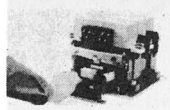


S-N600, N800

1. Remove the two screws tightening the cover. (M4 screws)

2. Loosen the two screws tightening the contactor mount plate and coil mount plate. (M6 screws)

3. Catch a finger as shown on the right, and pull out the coil.

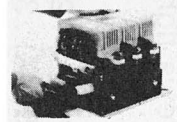


4. Spread the guides on the lower section of the coil out toward the sides, and disengage the core and coil coupling.

5. Replace the coil.

6. Press the guides inward, and couple the core and coil. (The guides have an orientation, so take care when coupling the parts.)

7. Press the coil in the unit.



8. Tighten the two screws tightening the contactor mount plate and coil mount plate. (M6 screws)

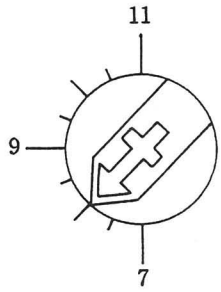
9. Assemble the cover onto the contactor, and tighten with two screws. (M4 screws)

7. Maintenance and Inspection of Thermal Overload Relay

(1) Heater rating and adjustment

For the settling current of the thermal relay, select one that matches the motor's full load current. Make fine adjustments by rotating the knob. For example, if the motor's full load current is 8A, use a 9A thermal overload relay, and turn the knob as shown below to set it to the 8A scale position.

Note that a mistaken trip could occur due to the ambient temperature, wire size, set value error, and time transition changes, etc. Turn the knob to adjust the set position.



Knob adjustment (for 8A)

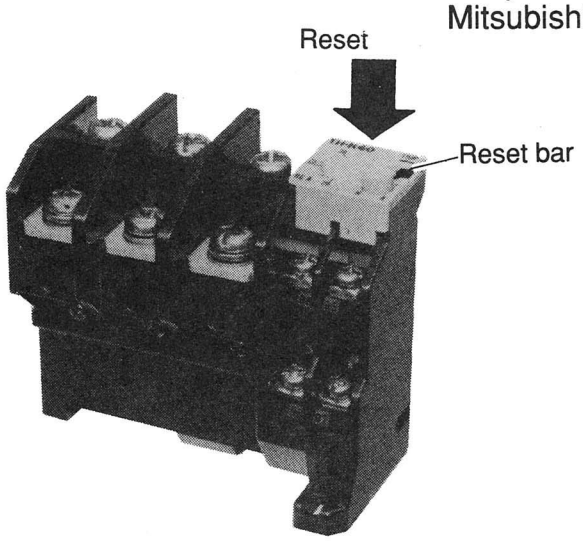
[Reset]

If an overcurrent flows to the motor, the thermal overload relay will trip.

Check the cause of the overcurrent, take measures, and then press the reset bar to reset the relay. There may be cases when the relay cannot be reset immediately after a trip, but resetting will be possible after the bimetal cools. For the automatically reset type, the relay will be reset automatically after a short time. (This will differ according to the temperature that the bimetal is heated to, but will be approximately several 10 seconds to 10 minutes.)

[Do not disassemble]

Never touch the inside of the thermal relay. The thermal relay has been precisely adjusted and shipped from Mitsubishi.



(2) Fusing of thermal overload relay

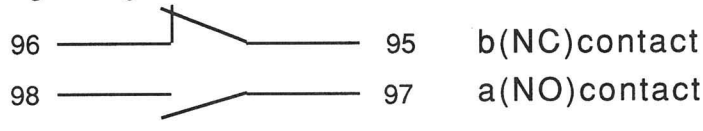
The thermal overload relay is used to protect the motor from burning. It cannot be used as protection against short circuits, so if a short circuit occurs, replace the thermal overload relay.

The thermal overload relay heater will fuse if a large current passes more than the heater's fuse I^2t due to a short circuit, etc. To prevent fusing of the heater, use the correct capacity for the M.C.C.B. connected on the power side of the magnetic starter, or use a saturable reactor on the thermal overload relay to coordinate the protection.

If the heater fuses, the bimetal in the thermal overload relay may curve in the opposite of the correct direction. This is because the bimetal is abnormally heated and the internal stress is exceeded due to a large heating amount caused by the heater fusing, and is a permanent deformation.

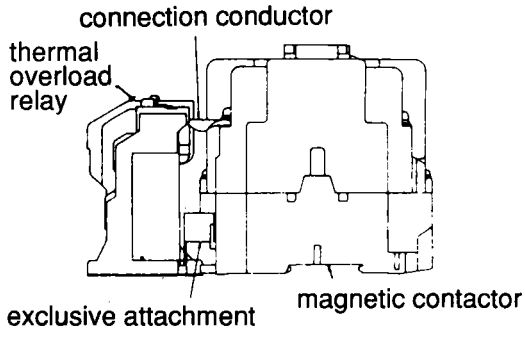
(3) Contact configuration

TH-N Series thermal overload relay contact configuration is a 1a1b (1NO 1NC) as shown below. The a (NO) contact and b (NC) contact can be used as independent contacts, and differing voltages can also be used.



(4) Mounting of thermal overload relay

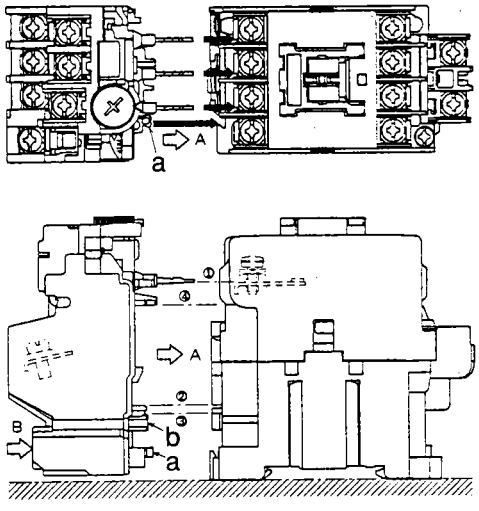
When assembling a TH-N thermal overload relay to the S-N magnetic contactor(to create an MSO-N magnetic starter), fix the thermal overload relay to the contactor with the exclusive attachment shown on the right. Purchase this attachment and the connection conductor as separate parts. (The attachment is not required for the MSO-N10 to N35 and N180 to N400.)



● Combination of S-N10 to N18

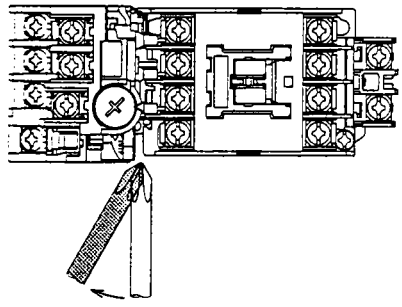
【Assembly procedure】

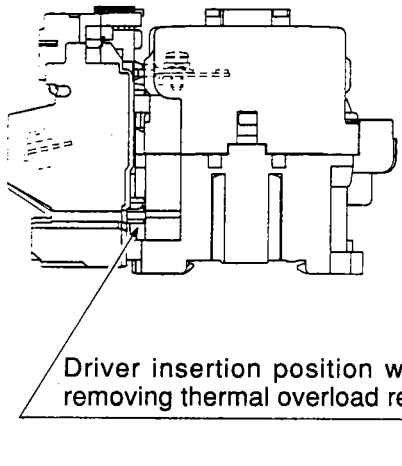
1. Loosen the three main terminal screws (2/T1, 4/T2, 6/T3) on the magnetic contactor, and open the wire retainer and terminal by approximately 3 mm.
2. Insert the thermal relay in the direction of View A, and pass the connection conductor along 1 in the drawing to the right of the main terminal in the contactor.
3. Set the thermal overload relay on the lower side of the mounting frame on the surface 2 and 3 shown below, and make the protrusions a and b visible from the mounting frame.
4. Press the thermal overload relay View B position to insert the protrusion a, and then insert protrusion b to fit the relay. (The thermal overload relay is guided by the surface 1, 2 and 3 shown in the drawing, and finally surface 4 is set on the housing.)
5. Tighten the main terminal screws.



☐ Removal of thermal overload relay

1. Loosen the three main terminal screws (2/T1, 4/T2, 6/T3) on the magnetic contactor.
2. Insert a screwdriver between the thermal overload relay protrusions a and b.
3. Rotate the screwdriver in the direction of the thermal relay, and disengage the protrusions a and b.

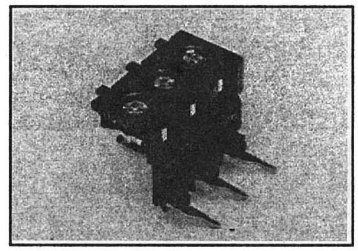




● Combination of S-N20 and N21

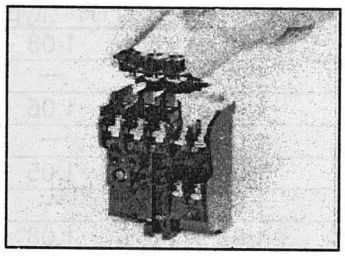
The optional UN-TH20 kit(connecting parts is)required for assembly.

Appearance of UN-TH20 kit

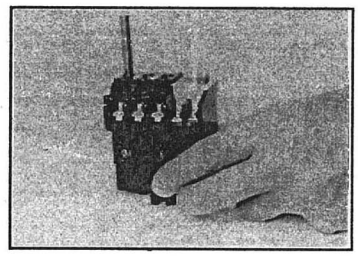


【Assembly procedure】

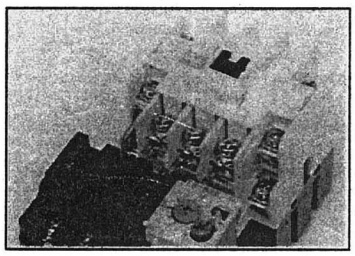
1. Mount the UN-TH20 kit onto the thermal overload relay (TH-N20).



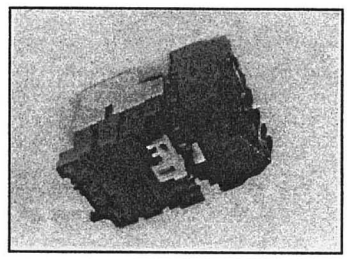
2. Tighten the screws.



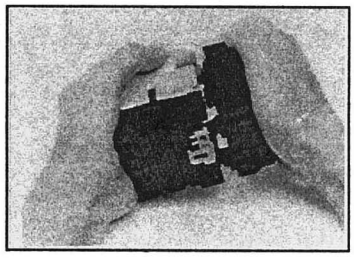
3. Loosen the terminal screws on the magnetic contactor, and insert a conductor through the left of the terminal screws.



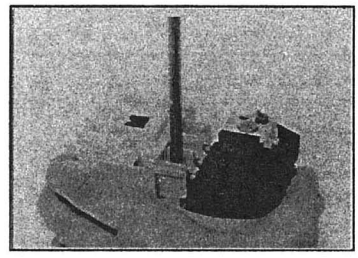
4. Align the two engagement sections.



5. Press and engage the sections until two clicks are heard.



6. Tighten the terminal screws while pressing the magnetic contactor and thermal overload relay.



● Combination of S-N25 and N35

The optional UN-TH25(CX)kit(connecting parts) is required for assembly.

Combina the overload relay TH-N20(TA) and contactor same as "4" and "5" above, then using UN-TH25(CX), connect them by terminal screws as "6" above.

(5) Ambient temperature and settling current

The TH-N Series thermal overload relays are adjusted with enclosed in standard box as magnetic starters, and with a reference ambient temperature of 20℃. These have an ambient temperature compensation device, so the fluctuation of operating characteristics in respect to the effect of the ambient temperature is low. The characteristics of the ultimate operating current's fluctuation based on an ambient temperature of 20℃ are shown in Fig. 1.

If the ambient temperature of where the magnetic starter is mounted greatly differs from 20℃, the settling current of the thermal overload relay must be compensated according to Fig. 1.

If the reference adjustment conditions differ such as when using the thermal overload relay as a single unit, compensate the settling current according to Table 1.

Table 1 Compensation rate according to thermal overload relay usage format

Type	Standard enclosed (MS-□type)	In control panel [Note2] (MSO-□type)	Open usage (MSO-□type)	Single thermal relay unit (TH-□type)
TH-N12 (CX)(KP)	1.00	1.02	1.06	1.08
TH-N18 (CX)(KP)	—	1.02	1.06	—
TH-N20 (CX)(KP)	1.00	1.02	1.05	1.06
TH-N20 (CX) TA (KP)	1.00	1.02	1.05	—
TH-N60 (KP)	1.00	1.01	1.03	1.05
TH-N60TA (KP)	1.00	1.01	1.03	—
TH-N120 (KP)	1.00	1.02	1.06	1.08
TH-N120TA (KP)	1.00	1.02	1.06	—
TH-N220 (KP)	1.00	1.00	1.01	1.01
TH-N400 (KP)	1.00	1.00	1.01	1.01
TH-N600 (KP)	—	1.00 [Note3]	—	1.02

[Note 1] The compensate rate for when the ambient temperature is 20℃ is shown.
[Note 2] The compensation rate in the control panel is calculated using the in-panel temperature rise as 15℃[K].
[Note 3] The compensation rate for independent mounting in the control panel is shown.
(For independent mounting only.)

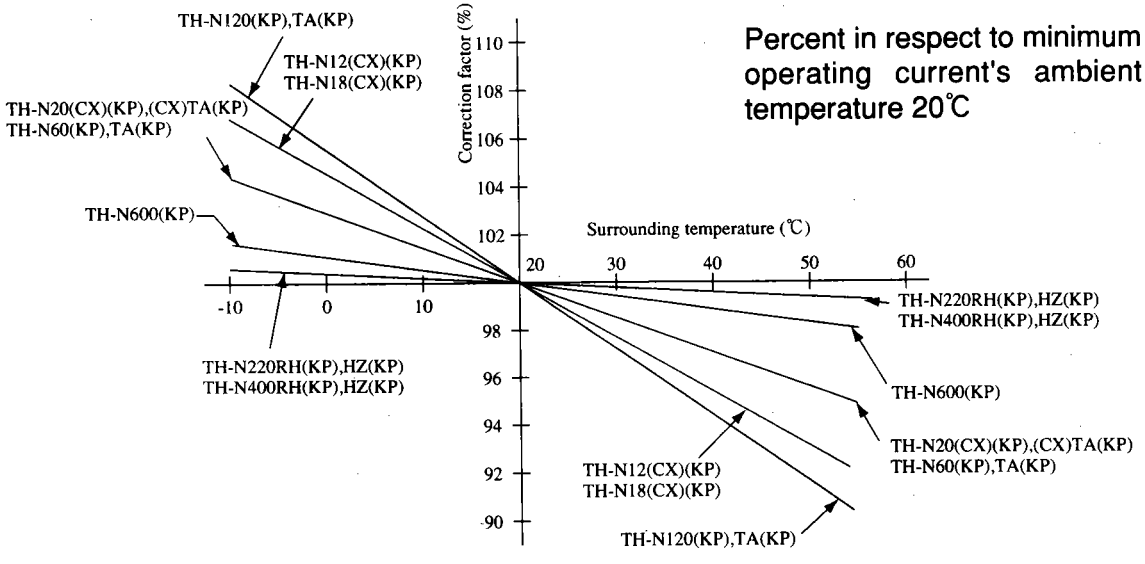


Fig. 1 TH-N Series thermal overload relay ambient temperature compensation curve

《Setting current compensation method》

Obtain the compensation rate in respect to the working ambient temperature from Table 1 and Fig. 1, and set a value from which the motor's full load current is divided by the compensation rate as the settling value.

(6) Connection wire size

The heat generated from the thermal relay differs according to the connected wire size, and thus the characteristics can be affected. The ultimate operating current for the TH type is adjusted with the standard connected wire sizes shown in Table 2, so if a wire thinner than this size is connected, the heat generated will be higher, and the ultimate operating current will be smaller. On the other hand, if a thick wire is used, the ultimate operating current will increase.

Thus, when using a size that differs from the standard connection wire size, strictly speaking, the setting current must be compensated. For example, if the TH-N20 type is used with the heater nominal and settling current of 15 A connected with a 5.5 mm ^{2}wire, the scale must be compensated to the 15 x 1/1.04 ≒ 14.4 (A) position according to the ultimate operating current fluctuation rate 104% given in Table 2.

Table 2 TH type thermal overload relay connection wire size and Ultimate operating current

Type	Heater nominal (A)	Standard connection wire size (mm^2)	Connection wire size (mm^2)	Ultimate operating current fluctuation rate Average (%)
TH-N12(CX)(KP)	0.12~11	2	1.25	98
TH-N20(CX)(KP)	0.24~11		3.5	103
TH-N18(CX)(KP) TH-N20(CX)(KP)	15	3.5	2 5.5	97 104
TH-N20(CX)TA(KP)	22	5.5	3.5 8	97 104
	29, 35	8	5.5 14	96 104
TH-N60(KP)	15	3.5	2 5.5	95 105
	22	5.5	3.5 8	96 105
	29, 35	8	5.5 14	95 105
	42	14	8 22	95 104
	54	22	14 —	96 —
TH-N60TA(KP)	67	22	14 38	97 105
TH-N120(KP)	42	14	8 22	95 104
	54, 67	22	14 38	96 106
	82	38	22 60	95 104
TH-N120TA(KP)	105	60	38 100	95 105
	125	60	38 100	95 105

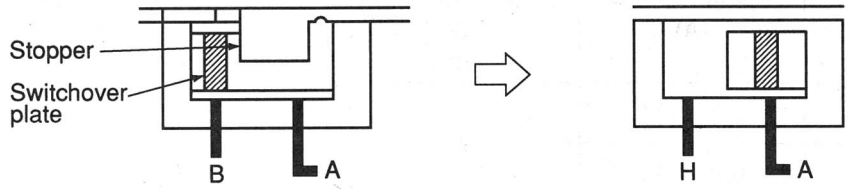
(7) Prevention of foreign matter entering display window
Note that the relay may not trip if foreign matter such as wire scraps enter from the display window.

(8) Automatic resetting method

> **⚠ CAUTION**
>
> • Secure the surrounding safety assuming that accidents may occur due to automatic restarting of the machine device, etc., when the output contact is recovered when the thermal overload relay is automatically reset, or when the power is recovered after a power failure.

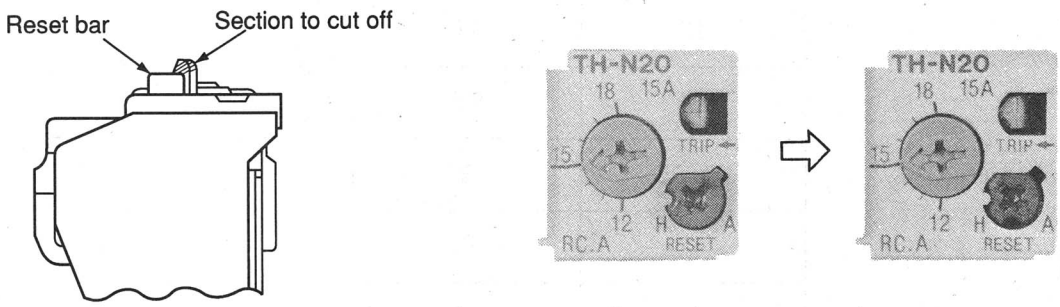
TH-N12, N18

A stopper is provided on the switchover plate section so that the setting cannot be easily changed from manual reset to automatic reset. When changing to automatic reset, cut off this stopper, press in the reset bar, and slide the switchover plate to the right (to the A position). Then fix the reset bar.



TH-N20 ~ N600

A stopper is provided on the head of the reset bar so that the setting cannot be easily changed from manual reset to automatic reset. When changing to automatic reset, use a pair of nippers to cut off this stopper at the shaded section shown below, press in the bar with a Phillips screwdriver, and rotate it 90 ° in the counterclockwise direction (to the A position).



(9) Special thermal overload relay
A thermal overload relay that matches the characteristics of the motor to be protected must be selected. Mitsubishi will manufacture thermal overload relays for special applications when designated.

Motor application	Thermal overload relay type
• General overload, locked rotar protection	Standard TH type (with two elements)
• 3-phase 4-wire type wiring overload, locked rotar protection	TH-KP type with three elements
• When starting time is long (25 seconds or less)	TH-SR type with saturable reactor
• When starting current is excessive	
• When inching or intermittent operation frequency is high	
• When tolerable locked rotar time is short such as for submerged motor	TH-KF type quick acting 2E characteristics type or TH-FS type quick acting characteristics type
• General overload, locked rotar or open phase protection	TH-KP type with phase failure protection

8. Types of Accessory Units and Installation Procedures

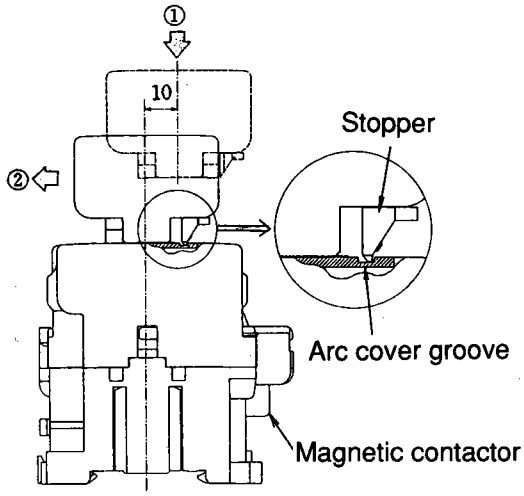
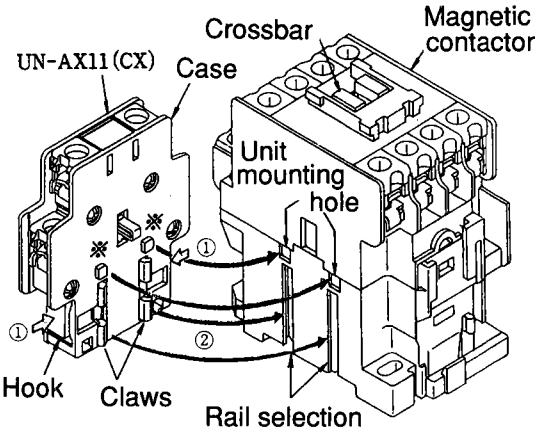
Various types of cassette-type option units including additional auxiliary contact units, mechanical interlock units, surge absorber unit and thermal reset release units can be mounted on the MS-N Series magnetic starters. These options can be used effectively to change circuits, improve handling and as spare parts.

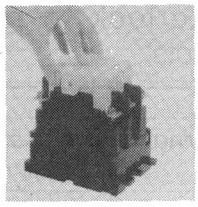
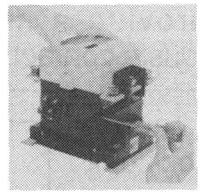
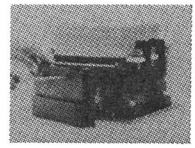
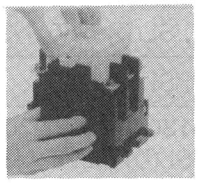
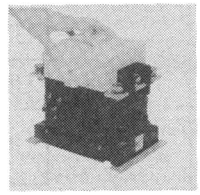
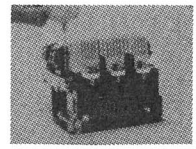
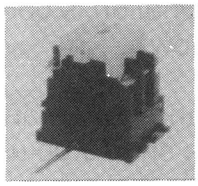
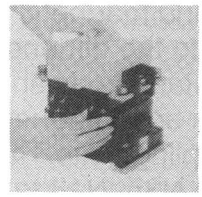
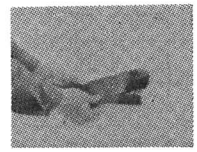
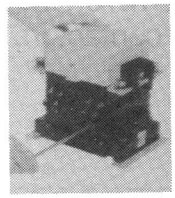
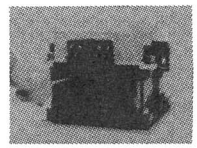
8.1 Additional auxiliary contact unit

Unit type	Contact arrangement per unit	Unit mounting method	Applicable magnetic contactor, magnetic relay type			No. of units mountable on non-reversing type
			AC operated	DC operated	Mechanically latched	
UN-AX2 UN-AX2CX	2a (2NO)	Front clip- on	S-N10～N35(CX) S-N18～N48(CX) S-N50/N65 SR-N4(CX)	SD-N11～N12/N21/N35(CX) SD-N50/N65 SRD-N4(CX)	—	1
	1a1b (1NO1NC)					
	2b (2NC)					
UN-AX4 UN-AX4CX	4a (4NO)	Front clip- on			—	1
	3a1b (3NO1NC)					
	2a2b (2NO2NC)					
UN-AX11 UN-AX11CX	1a1b (1NO1NC)	Side clip- on	S-N10/N11/N20/N21/N25/N35(CX) S-N50/N65 SR-N4(CX)	SD-N11/N21/N35(CX) SD-N50/N65 SRD-N4(CX)	SL(D)-N21/N35(CX) SL(D)-N50/N65 SRL(D)-N4(CX)	2 [Note2]
UN-AX80	1a1b (1NO1NC)	Side clip-on	S-N80～N125	SD-N80～N125	SL(D)-N80～N125	2 [Note4]
UN-AX150	1a1b (1NO1NC)	Side clip-on	S-N150～N400	SD-N150～N400	SL(D)-N150～N400	2 [Note4]
UN-AX600	2a2b (2NO2NC)	Side clip-on	S-N600/N800	SD-N600/N800	SL(D)-N600/N800	1 [Note4]

[Note 1] The front clip-on and side clip-on types cannot be mounted on the same unit.
[Note 2] For the reversing type, one unit can be mounted each on the left and right outer sides.
[Note 3] UN-AX□CX is the type with CAN (finger protection) terminal.
[Note 4] Refer to the catalog for the number of unit that can be mounted on the reversing type. (UN-AX80, UN-AX150, UN-AX600)
[Note 5] The side clip-on type cannot be mounted on S(D)-N12(CX),S-N18～N48(CX).

● Auxiliary contact unit mounting procedures

UN-AX2(CX), UN-AX4(CX)	UN-AX11(CX)
1. Place the auxiliary contact unit at a position shifted approximately 10 mm to the power supply side from the center of the magnetic contactor head. 2. Slide the unit toward the load side, and engage the unit's stopper with the groove on the arc cover.  	1. Hold the two hooks, and insert into the UN-AX11 case. 2. While aligning the protrusion (marked with ※) on the UN-AX11 case with the unit mounting hole on the side of the magnetic contactor, engage the hook claws into the rail on the lower side of the magnetic contactor. Note. Confirm the following items after mounting. 1. Lightly tug on the UN-AX11 unit, and confirm that it is securely installed. 2. Confirm that the crossbar on the front of the magnetic contactor is pressed in. 

UN-AX80	UN-AX150	UN-AX600
1. Press the head of the crossbar. 	1. Remove the dust cover on the position where the unit is to be mounted. 	1. Remove the two screws tightening the right cover of the contactor. (M4 screws) 
2. Fit the auxiliary contact unit into the window on the side of the contactor, and slide it to the right. 	2. Press the head of the crossbar. (Press until the main contact touches.) 	2. Tighten auxiliary contact block (UN-AX600) with the two enclosed screws. (M4 screws) 
3. Tighten the enclosed screws. 	3. Press the auxiliary contact block (UN-AX150). 	3. Remove the dust plate (127 x 28 x 1) fit on the cover. (The dust plate is not used.) 
	4. Tighten the enclosed screws. 	4. Assemble the cover onto the contactor, and tighten with the two screws. (M4 screws) 

8.2 Mechanical interlock unit

> **⚠ CAUTION** • When two or more magnetic contactors are used, and a short circuit might occur if they turn ON simultaneously, always provide a mechanical interlock to prevent simultaneously contacting of the contacts.

A reversing magnetic contactor can be created by using a mechanical interlock unit and two magnetic contactors.

The magnetic contactor types that can be used in combination with the mechanical interlock unit types are as shown on the right.

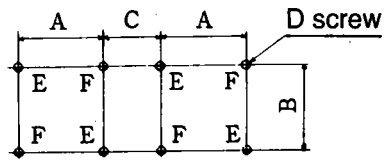
The UN-ML11 (CX) has a 2b contact for an electrical interlock.

Unit type	Magnetic contactor type combinations
UN-ML11 (CX)	S-N10(CX), S(D)-N11(CX)
UN-ML21	S-N20(CX), N21(CX), N25(CX), N35(CX) S-N50,N65 SD/SL(D)-N21(CX),N35(CX) SD/SL(D)-N50, N65
UN-ML80	S(D)/SL(D)-N80, N95, N125
UN-ML150	S(D)/SL(D)-N150
UN-ML220	S-N180, N220, N300, N400 SD/SL(D)-N220, N300, N400

8.2.1 Combination of Mechanical Interlock Units

(1) Confirm that the interlock unit and magnetic contactor combination is correct.
(2) Drill mounting holes according to the dimensions shown below.
(3) Fit the interlock unit in both contactors as shown below.
(4) Sandwich the interlock unit with both magnetic contactors, and couple and fix both magnetic contactors with a coupling plate.The coupling plate should be used when mounting on a DIN rail. (N10 to N35, N18 to N48, N50, N65)
(5) Fix the magnetic contactors onto mounting surface with screws.
(6) Always provide a direct electrical interlock mutual to the magnetic contactors as shown in the center below for the reversing type. Use the auxiliary contact on the inner side between the magnetic contactors for the electrical interlock.

Mounting hole dimensions



Frame	A±0.2	B±0.2	C±0.3	D	Hole drilling position
N10, N11	35	50	21	M4	E
N20, N21	54	60	19	M4	E
N18, N28	30	60	23	M4	E
N25, N35	65	70	20	M4	E
N38, N48	40	80	24	M4	E
N50, N65	70	75	28	M4	F
N80, N95	80	110	57	M5	F
N125	90	125	49	M4	E, F
N150	100	125	39.5	M5	E, F
N180, N220	120	190	40	M6	E, F
N300, N400	145	225	37	M8	E, F

●UN-ML11(CX)···N10 (CX), N11 (CX)

(1) Fit the interlock unit lever 1 into the lever fitting hole 2 on the side of the magnetic contactor, fit the protrusion 3 into the unit mounting hole 4, and sandwich the interlock unit with the left and right magnetic contactors so that there is no gap.

Confirmation point

Confirm that movement is smooth when one of the crossbar heads 5 is pressed in this state. Confirm the other side magnetic contactor in the same manner. If the crossbar head 5 is constrained and cannot move, reassemble the parts.

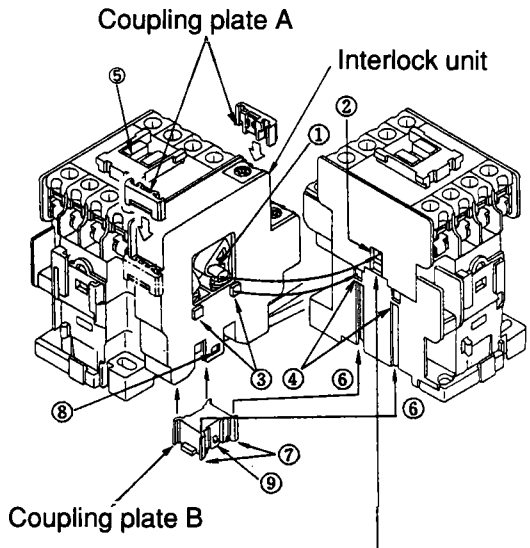
(2) Fit the coupling plate A so that the left and right magnetic contactor barriers are sandwiched. Fit in until a "click" is heard. (Two places)

(3) Align the rail section 7 of the coupling plate B to the groove 6 at the bottom of the left and right magnetic contactors, and press in the protrusion 9 of the coupling plate B into the interlock unit hook 8 until a "click" is heard.

(4) Connect the interlock unit lead wire to the coil terminal A1.

Lead wire R02(red)to right magnetic contactor

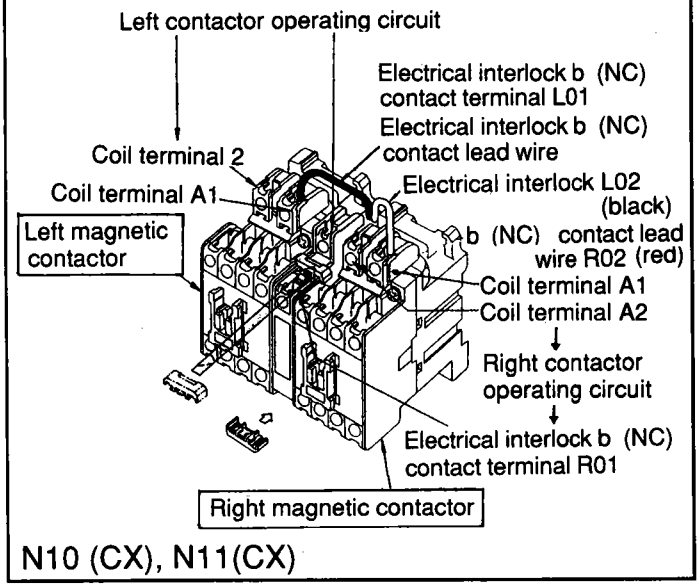
Lead wire L02 (black)to left magnetic contactor



N10 (CX), N11 (CX)

Precautions

Do not fit the lever 1 into this clearance. Always insert the lever into the fitting hole 2 on the upper side.

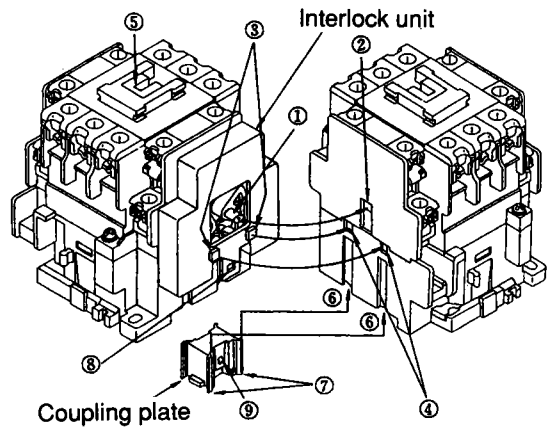


N10 (CX), N11(CX)

●UN-ML21 ... N20 to N35(CX), N18 to N48(CX), N50, N65

(1) Fit the interlock unit lever 1 into the lever fitting hole 2 on the side of the magnetic contactor, fit the protrusion 3 into the unit mounting hole 4, and sandwich the interlock unit with the left and right magnetic contactors so that there is no gap.

(2) Align the rail section 7 of the coupling plate B to the rail section 6 at the bottom of the left and right magnetic contactors. Press the coupling plate until the protrusions 9 fit in to the interlock unit hook 8 and a "click" is heard.



N20 toN35(CX), N18 to N48(CX), N50, N65

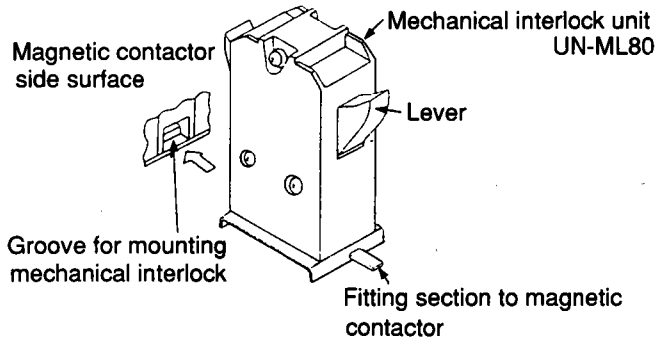
● UN-ML80 ~ ML220

(1) Drill the magnetic contact installation screw hole in the panel.

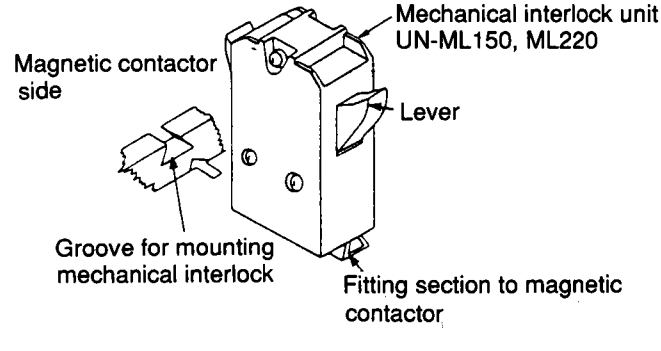
(2) Install one of the magnetic contactors on the panel.

(3) Insert the lever of the mechanical interlock unit into the square hole on the side of the magnetic contactor. Insert the fitting section on the bottom into the installation groove on the side of the magnetic contactor.

(4) Install the other magnetic contactor on the panel so as to sandwich the mechanical interlock unit. At this time, make sure that the mechanical interlock unit is fit in with the left and right magnetic contactors without a clearance.



N80, N95, N150



N150, N180, N220, N300, N400

Confirmation point

After assembling the mechanical interlock unit, press the crossbar head of one of the magnetic contactors, and confirm that the movement is smooth. Also confirm that when one of the crossbars is pressed in, the other one cannot be pressed in.

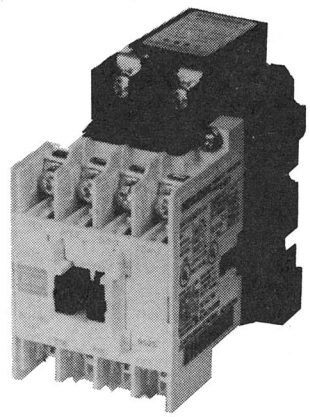
8.3 Surge Absorber Unit

⚠ CAUTION

- The varistor (used in the coil, surge absorber, etc.) may emit smoke due to deterioration.
  Make sure not to near the product during operation, and always use a short-circuit protection device such as a fuse on the operating circuit.
- A surge will be generated from the contact and coil during switching. Avoid danger by connecting a surge absorber, etc.
- Destruction or fires may occur if the surge absorber is used exceeding the rated voltage.

A surge absorber can be additionally mounted on the compact magnetic contactor with N35 and lower frame and the SR magnetic relay.

For N10 to N35(CX), N18 to N48(CX), a type with a varistor type surge absorber built in (S(D)-N □(CX)SA, SR(D)-N4(CX)SA)can be manufactured. (Coil nominal 12 to 230 VAC)



SR-N4, S-N10 to N35(CX), S-N18 to N48(CX)

8.3.1 Types and applicable models

Table 1 Surge absorber types and applicable models

Application / Surge absorber	AC operated	DC operated	Mechanically latched (AC operated)	Mechanically latched (DC operated)
	S-N10～N35(CX) S-N18～N48(CX) SR-N4(CX)	SD-N11(CX), N12(CX), N21(CX), N35(CX) SRD-N4(CX)	SL-N21(CX), N35(CX) SRL-N4(CX)	SLD-N21(CX), N35(CX) SRLD-N4(CX)
UN-SA21	○	○	○	○
UN-SA22	○	○	○	○
UN-SA13	—	○	—	○
UN-SA23	○	—	○	—
UN-SA25	○	○	○	○

Note 1. Mounting on the mechanically latched tripping coil is not possible.
(UN-SA7□□ can be used for the tripping coil.)

Application / Surge absorber	DC operated	Mechanically latched	
	SD-N50 SD-N65	SRL(D)-N4(CX) (Tripping coil)	SL(D)-N21(CX), N35(CX) SL(D)-N50, N65
UN-SA721	○	○	○
UN-SA712	—	○	—
UN-SA722	○	—	○
UN-SA713	○	○ (SRLD)	○ (SLD)
UN-SA723	—	○ (SRL)	○ (SL)
UN-SA725	○	○	○

8.3.2 Applicable voltage in respect to voltage nominal

Table 2 Applicable voltage range in respect to voltage nominal of surge absorber

Voltage nominal	Recommended applicable voltage range	Minimum applicable voltage	Remarks
AC 48V	AC24~50V, DC24~60V	—	UN-SA25, SA721, SA725
AC 100V	AC100~127V, DC100~125V	AC, DC24V	There are no target parts for UN-SA21, SA22, SA25
AC 200V	AC100~240V, DC100~250V	AC50V, DC60V	CR type UN-SA23, SA723 is exclusive for AC
AC 400V	AC346~480V	AC24V	UN-SA21, SA721
DC 200V	DC100~220V	DC24V	CR type UN-SA13, SA713 is exclusire for DC.

8.3.3 Order indication method

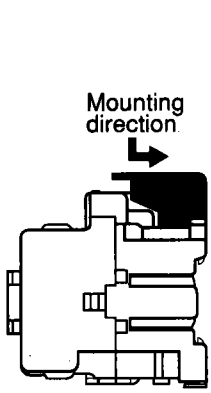
UN-SA □ △ Voltage nominal

△ indicates a space

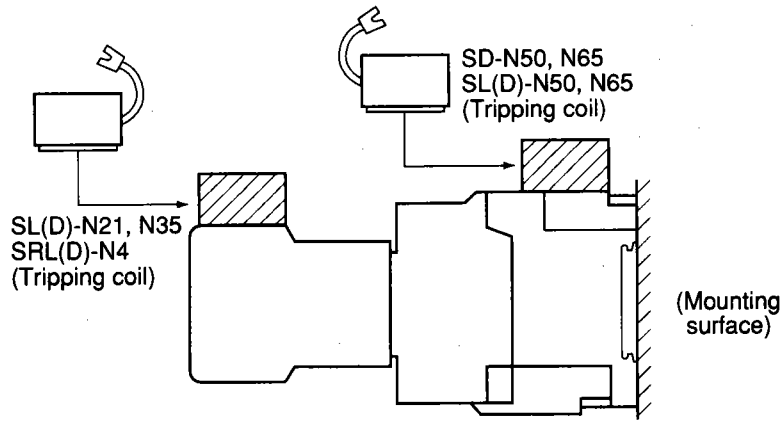
Type	Built-in Element	Voltage nominal (type)
21	With varistor	AC200V, AC400V
721		AC48V, AC100V, AC200V, AC400V
22	With varistor and indicator lamp	AC200V
712,722		AC100V, AC200V
13,713	With CR	AC200V
23,723		DC200V
25	With varistor and CR	AC48V, AC200V
725		AC48, AC100V, AC200V

8.3.4 Mounting method

1. Tighten the surge absorber terminal together with the operating coil terminal.
2. Fit the surge absorber unit into the groove provided on the top of the magnetic contactor.
3. Mount the magnetic contactor in a panel.
   The S-N50 to N800 operating coils are DC held and have a built-in surge absorber, so an external unit is not required. (Reference: Page 30, section 6.2.)



For UN-SA□□



For UN-SA7□□

8.4 Reset release for thermal overload relay

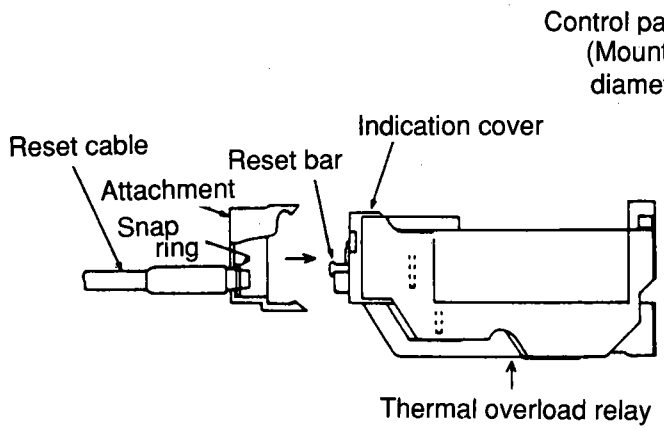
The thermal overload relay can be reset from a remote position using the additional reset release.

The release length indicates the length from the surface such as a door to the mounting fixture, so select a unit with the types shown on the right.

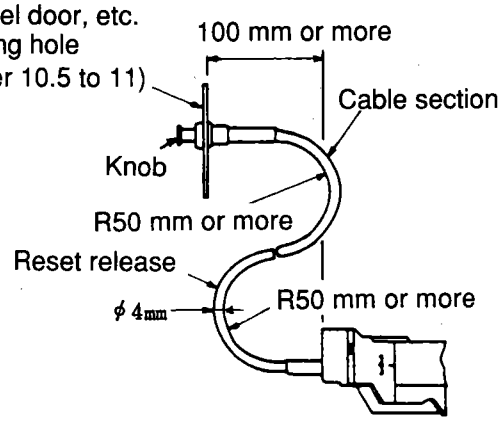
Release length (mm)	Unit type		
	TH-N12	TH-N20(TA)	TH-N60 ~N600
200	UN-RR205	UN-RR200	UN-RR206
400	UN-RR405	UN-RR400	UN-RR406
550	UN-RR555	UN-RR550	UN-RR556
700	UN-RR705	UN-RR700	UN-RR706

8.4.1 Mounting

(1) Align the end of the reset cable with the center of the thermal overload relay's reset bar (blue), and securely fit in the attachment. (Fig. 1)
(2) Mount the reset knob side of the reset cable at a random position such as a panel door.
(3) Mount the reset release as shown in Fig. 2.
(4) Use the cable section as straight as possible. If the cable must be bent, use less than two bends, and keep the bend radius at 50 mm or larger.
(5) Press the knob in the working state, and confirm that the thermal overload relay is accurately reset.
(6) The cable section is coated with insulator, but do not touch the bare live parts.



(Fig. 1)



(Fig. 2)

8.4.2 Operation of thermal overload relay

Knockout holes are provided on the cover at the current adjusting knob and trip display lever positions. Use a screwdriver, etc., and open the holes before installation when required.

For the TH-N12 thermal overload relays, the current adjusting knob and trip display levers can be operated without opening the holes.

9. Maintenance and Inspection of SL and SRL mechanically latched magnetic contactors and magnetic relays

⚠WARNING • Turn the power off before starting maintenance or inspections.

⚠CAUTION
- Do not remove, disassemble or modify the parts such as the arc cover. Doing so could lead to a drop in performance.
- Never manually operate the product in the live state.
- Do not touch the sections other than the manual operation section for the mechanically latched type units. Failure to observe this could lead to entanglement accidents.

9.1 Coil

(1) Operating circuit voltage
Use an operating circuit voltage within the coil's rated voltage range.

AC operated circuit rating

Nominal	Rating
AC100V	100—127V 50/60Hz
AC200V	200—240V 50/60Hz
AC300V	260—350V 50/60Hz
AC400V	380—440V 50/60Hz
AC500V	460—550V 50/60Hz

DC operated circuit rating

Nominal	Rating
DC100V	100—110V
DC125V	120—125V
DC200V	200—220V

(2) Coil replacement
If the closing coil or tripping coil must be replaced, please contact the Mitsubishi. (Do not replace the coils.)

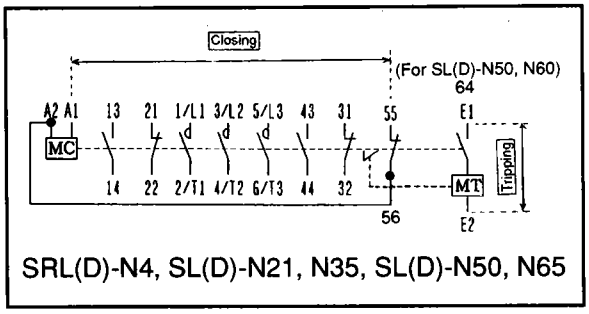
(3) Operating coil
The closing coil and tripping coil both have a short time rating of 15 seconds, so never remove the self-deenergizing circuit (contact 1a1b (INO INC) built in unit connected in series to coil).

(4) Control command time
The command time of the external switch that issues commands to the closing coil and tripping coil must be set to be 0.3 seconds or more for the SRL(D)-N4 and SL (D)-N21 to N220, and 0.5 seconds or more for the SL(D)-N300 to N800.

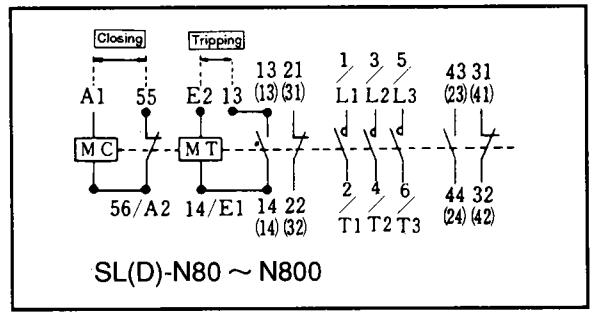
(5) Close command and trip command
Set the external switch for closing and the external switch for tripping so that the commands from each do not overlap (simultaneously contact).

(6) Wiring of operating circuit
Connect the operating circuit for closing to A1-55 the terminal and the operating circuit for tripping to the E1-E2 (SRL(D)-N4, SL(D)-N21, N35), 64-E2(SL(D)-N50/ N65) or E2-13 (SL(D)-N80 ~ N800) terminals.

Connection



SRL(D)-N4, SL(D)-N21, N35, SL(D)-N50, N65

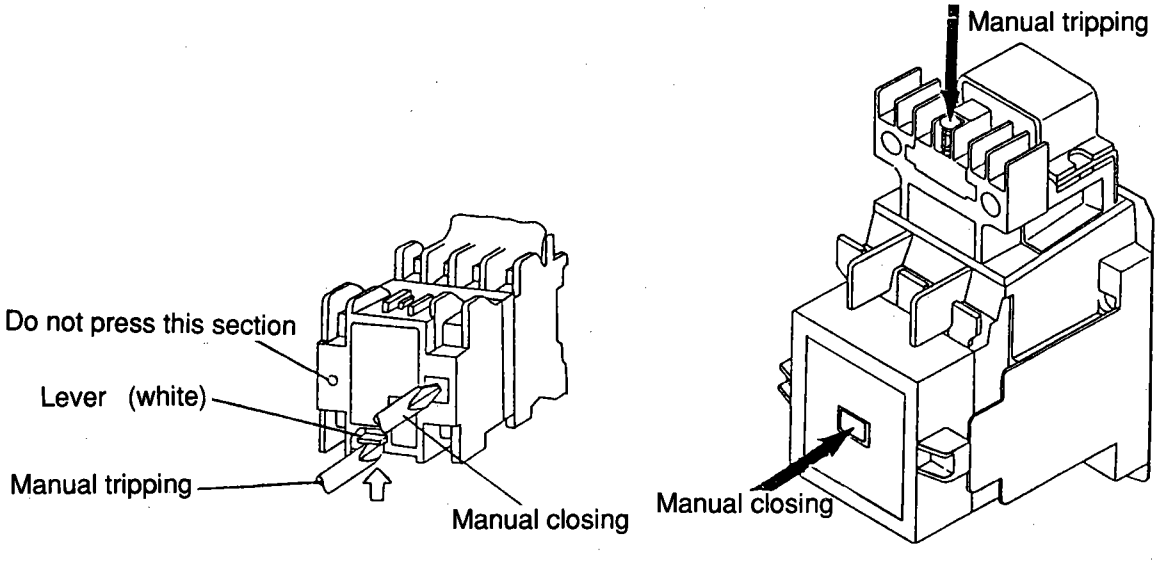


SL(D)-N80 ~ N800

9.2 Manual Closing and Manual Tripping Methods

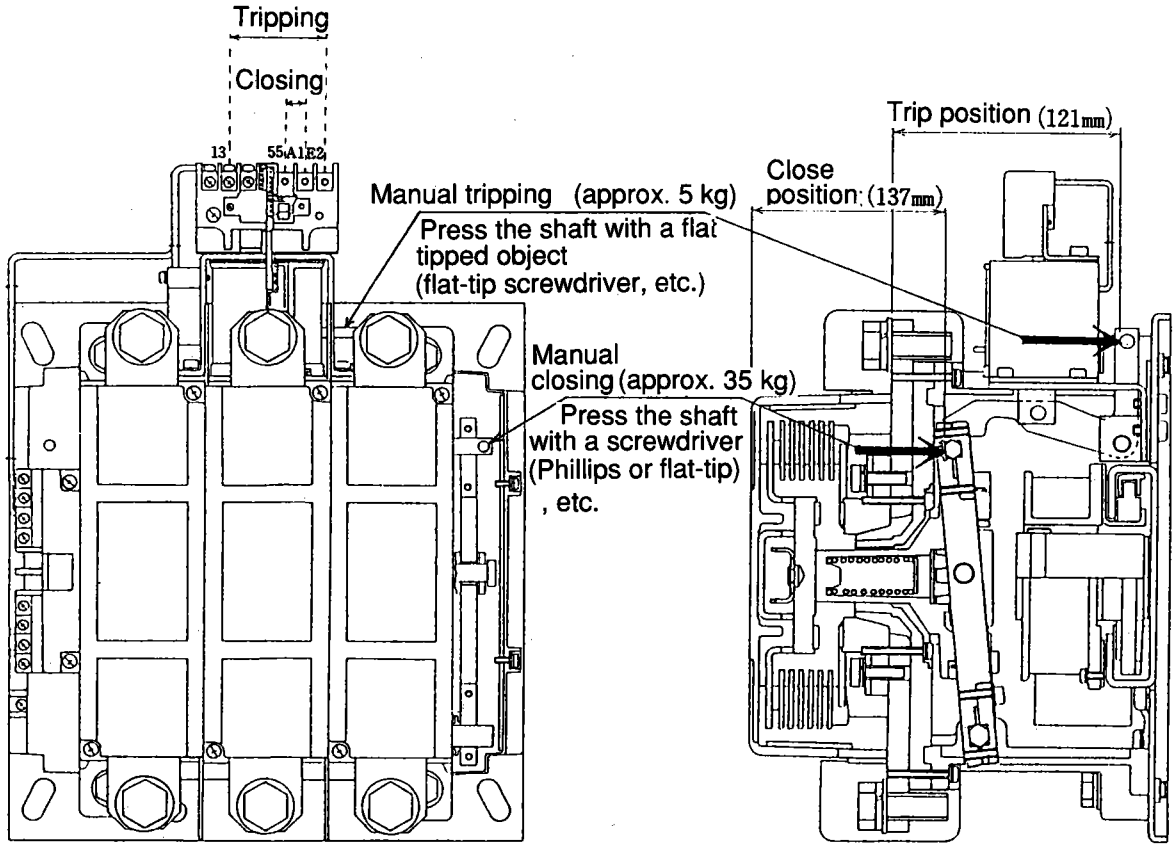
Carry out manual closing and manual tripping by pressing with a screwdriver as shown below.

Note that carrying out manual closing or manual tripping must never be done while a voltage is applied to the main circuit or operating circuit, as it can be extremely hazardous.



SRL(D), SL(D)-N21～N65

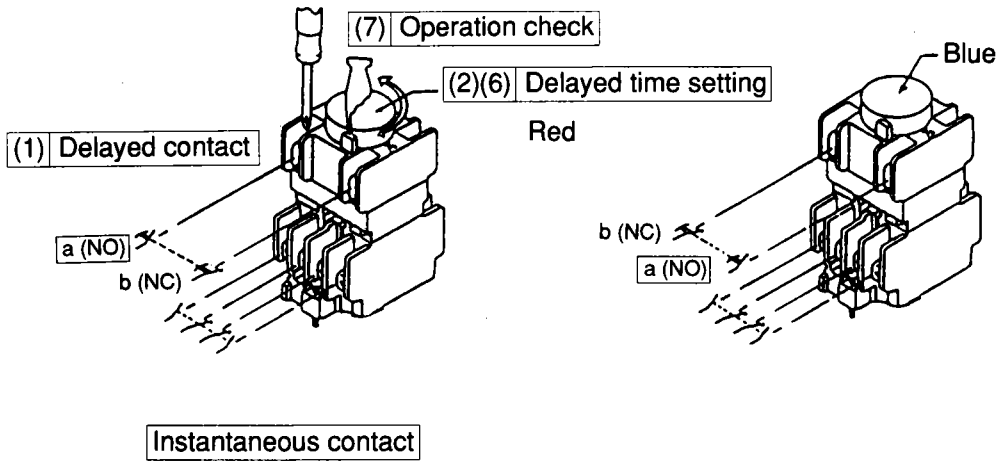
SL(D)-N80～N400



Note. The drawing shows the state with the right cover removed, and as a cross-section for some parts.

SL(D)-N600, N800

10. Maintenance and Inspection of Pneumatic Timer



On-delay timer
SRT-NN, SRTD-NN

Off-delay timer
SRT-NF, SRTD-NF

(1) Layout of time limit contacts
The layouts (left/right directions) of the a (NO) contact and b (NC) contact differ between the on-delay and off-delay, so take care not to mistake the wiring.

(2) Time delay setting
The numerals on the adjusting knob are a guideline for the delayed time seconds. Measure the delayed time that the coil is excited and electrically operated, instead of manual operation.

(3) Coil replacement
See catalog.

(4) Working environment
Use this timer in a place with low levels of dust and corrosive gas, and where there is no dew condensation.

(5) Periodic inspection
The delayed time may fluctuate greatly due to the ambient temperature and time passage, etc. Thus, periodically confirming the deleyed time with the actual working conditions is recommended.

(6) Removal of adjusting screw
Do not remove the adjusting knob for the time limit setting as trouble will occur in the adjusting knob coupling.

(7) Manual time delay confirmation
The deleyed time may not function if the unit is placed on the floor, so manually operate the unit when placed on a level place.

11. Recommended Update Interval

The recommended update interval for each device is either 10 years, or the number of switches specified according to the category, class and type in the standards.

This recommended update interval is not a value guaranteed in respect to the functions or performance. Instead, it is an interval generally believed to be effective for replacing the part with a new part including economic feasibility terms, due to deterioration of the device configuration materials when the part is used under normal working conditions and the following maintenance and inspections are carried out.

12. Maintenance and Inspection Check List

Magnetic starter, magnetic relay

Date:
Write after inspecting

Class		Inspection item		Purpose	Details of inspections	Remarks	Results
Periodic inspection (reference: every six months)	Daily inspection	Abnormal noise	Listen	Abnor-mality	Generation of abnormal noise (Abnormal noise caused by magnet fault or damage, etc.)	Per panel (all parts)	
		Abnormal odor	Smell	Abnor-m-ality	Generation of abnormal odor	Per panel (all parts)	
		Appeara-n-ce	Visual	Conta-m-ination	Existence of water or oil adherence or fault caused by dust	Per panel (all parts)	
				Break-a-ge	Existence of mold breakage, discoloration or deformation	Per panel (all parts)	
		Coil	Visual	Discol-o-ration	Is there any discoloration?	All parts	
		Clamp screw	Visual	Loosen-i-ng	Are any of the clamp screws loose?	All parts	
		Metal sections	Visual	Rusting, corro-sio-n	Is there any rust or corrosion?	All parts	
		Movement of movable sections	Manual or electric	Move-m-ent fault	Do movable sections move smoothly when operated manually or magnetically?	All parts	
		Latch mechani-s-m	Manual or electric	Move-m-ent fault	Does the latch section (plunger and movable core) move smoothly when operated manually or magnetically?	All parts with latch	
Detailed inspection		Life and function deteriora-t-ion	Test (Test at Mitsu-bi-shi)	The outline details of the sampling investigation carried out when detailed investigations are required during the life margin estimate, daily inspection or periodic inspection are as follow.			
				Contact contami--nation	(1) Contact resistivity measurement - Existence of contact resistivity fault		
				Mecha-n-ism friction	(2) Operation test ? Existence of ating voltage fault		
				Layer short circuit	(3) Coil characteristics test ? Eistence of fault in resistivity value, current value	Sampling	
				Contact wear	(4) Main dimension (overtravel) measurement ? Is value within tolerable value?		
				Contact opera-ti-on	(5) Contact reliability test ? Is value within tolerable value? (Reliabilitytest following JIS C4531)	Sampling	
				Life margin	(6) Coil Life margin test (High temperature continuity, surge test, BDV pin hole test)	Sampling	

11. Recommended Update Interval

The recommended update interval for each device is either 10 years, or the number of switches specified according to the category, class and type in the standards.

This recommended update interval is not a value guaranteed in respect to the functions or performance. Instead, it is an interval generally believed to be effective for replacing the part with a new part including economic feasibility terms, due to deterioration of the device configuration materials when the part is used under normal working conditions and the following maintenance and inspections are carried out.

12. Maintenance and Inspection Check List

Magnetic starter, magnetic relay

Date:
Write after inspecting

Class		Inspection item		Purpose	Details of inspections	Remarks	Results
Periodic inspection (reference: every six months)	Daily inspection	Abnormal noise	Listen	Abnor-mality	Generation of abnormal noise (Abnormal noise caused by magnet fault or damage, etc.)	Per panel (all parts)	
		Abnormal odor	Smell	Abnor-m-ality	Generation of abnormal odor	Per panel (all parts)	
		Appeara-n-ce	Visual	Conta-m-ination	Existence of water or oil adherence or fault caused by dust	Per panel (all parts)	
				Break-a-ge	Existence of mold breakage, discoloration or deformation	Per panel (all parts)	
		Coil	Visual	Discol-o-ration	Is there any discoloration?	All parts	
		Clamp screw	Visual	Loosen-i-ng	Are any of the clamp screws loose?	All parts	
		Metal sections	Visual	Rusting, corro-sio-n	Is there any rust or corrosion?	All parts	
		Movement of movable sections	Manual or electric	Move-m-ent fault	Do movable sections move smoothly when operated manually or magnetically?	All parts	
		Latch mechani-s-m	Manual or electric	Move-m-ent fault	Does the latch section (plunger and movable core) move smoothly when operated manually or magnetically?	All parts with latch	
Detailed inspection		Life and function deteriora-t-ion	Test (Test at Mitsu-bi-shi)	The outline details of the sampling investigation carried out when detailed investigations are required during the life margin estimate, daily inspection or periodic inspection are as follow.			
				Contact contami--nation	(1) Contact resistivity measurement - Existence of contact resistivity fault		
				Mecha-n-ism friction	(2) Operation test ? Existence of ating voltage fault		
				Layer short circuit	(3) Coil characteristics test ? Eistence of fault in resistivity value, current value	Sampling	
				Contact wear	(4) Main dimension (overtravel) measurement ? Is value within tolerable value?		
				Contact opera-ti-on	(5) Contact reliability test ? Is value within tolerable value? (Reliabilitytest following JIS C4531)	Sampling	
				Life margin	(6) Coil Life margin test (High temperature continuity, surge test, BDV pin hole test)	Sampling	

13. Troubleshooting List

Trouble	State	Cause	Measures	Reference section in this manual
Contact does not close	A beating sound (loud and quiet) is heard, and contact does not close	The coil rating voltage is incorrect.	Replace with correct rating.	6.3 Maintenance of Coil (page 34)
		The terminal voltage is low (85% or less).	Modify to the specified voltage.	
		The voltage drop is large. { Power capacity is insufficient / Wiring capacity is insufficient }	Increase the power capacity. Use thicker wires.	
		Foreign matter has entered movable sections.	Disassemble and clean.	6.4 Coil Replacement Procedures (page 36)
		Layer short circuit in coil.	Replace the coil.	
		The unit is damaged.	Replace the entire unit.	
	There is no sound.	The wiring is defective.	Repair the defective place.	
		Fault in operating switch.	Replace the switch.	
		The fuse is blown.	Replace the fuse.	
		Wire breakage in operating coil or short circuit in operating circuit.	Replace the coil.	
Contact does not open. (Does not return)	The exciting has not turned off.	A voltage is applied on the coil.	Check and modify the circuit.	
		Capacity between wires for long-distance wiring.	Use a DC operated type or insent breeder resistor.	
		Induction voltage from other wires.	Separate from the other wires.	
		Fault in operating switch: Welding / Breakage	Check that the capacity is correct, and replace if necessary. Replace the switch (relay).	
	There is no excitation.	The contact is welded.	Replace the contact, check the cause, and take measures.	5.5 Contact Welding (page 28)
		Oil or dust is adhered on core surface.	Disassemble, clean and take adherence prevention measures.	6. Maintenance and Inspection of Core and Coil (page 29)
		Dew has condensed on core surface.	Decrease the temperature difference.	
		Attraction due to residual magnetism.	The life is worn, so replace the entire unit.	
		Foreign matter has entered movable sections.	Disassemble and clean.	
		Main unit has deformed due to heat or mounting stress.	Replace the entire unit.	
		The unit is damaged.	Replace the entire unit.	
Coil burning	Burned in short time	The coil rating voltage is incorrect.	Replace with correct rating.	6. Maintenance and Inspection of Core and Coil (page 29)
		The applied voltage is incorrect (high).	Replace the coil, and modify the voltage.	
		Operating voltage is low, thereby inhibiting attraction.	Replace the coil, and modify the voltage.	
		Layer short circuit		

Continued

Trouble	State	Cause	Measures	Reference section in this manual
Coil burning	Burns after a while	Attraction is not possible sometimes (When voltage is 85% or less, etc.)	Replace the coil, check the cause, and take measures.	6. Maintenance and Inspection of Core and Coil (page 29)
		Layer short circuit caused by environmental deterioration.	Replace the coil, check the cause of deterioration, and take measures.	
		The applied voltage is too high.	Replace the coil, and modify the voltage.	
		The in-panel temperature is too high. (55℃ or more)	Replace the coil, and set the coil temperature to 140℃ or less.(Lower the in-panel temperature)	
Contact welding	The no-fuse breaker or fuse blew	Short circuit on load side ┌ Insulation deterioration ├ Wiring defect └ Handling mistake Simultaneously closing when using reversing or star delta starter .	Check the cause and make modifications. If there is no fault in the main unit, replace the contacts. If there is a fault, replace the entire unit.	
	Light welding occurred during use	Pumping occurs.	Check the cause and make modifications.	5.2 Maintenance of Contacts (page 18)
		The switching frequency is too high.	Lower the frequency and increase the capacity.	
		A semi-attraction state is caused by a drop in voltage.	Check and remove the cause of the voltage drop.	
		Electrical life	If there is no fault in the main unit, replace the contacts.	
		The load is too large.	Replace with a contactor and motor having the correct capacity.	
Abnormal wear of contact	Arc during switching is large.	The load is too large.	Replace with a contactor having a large capacity.	5.2 Maintenance of Contacts (page 18)
		The switching frequency is high.	Select a capacity that matches the frequency.	
		The bounce at closing is large.	Check the cause and make modifications.	
	The contact's brazed section has fallen off.	The contact chattering is large.	Check the cause and make modifications.	
		The switching frequency is too high.	Lower the frequency, or replace with a part having a large capacity.	
	The wear is fast.	Oil, etc., is adhered on contact surface.	Clean, and take measures to prevent adherence.	
		There is corrosive gas.	Modify the case or installation position.	
		Simultaneous contact does not take place.	Set to approx. 0.5 mm.	
Contact defect	Occurs some-times	The dust level is high.	Clean, and take measures to prevent dust.	5.1 Mechanism of Contact Wear (page 15)
		The contact surface is sulfurized.	Polish the contact surface, and take measures to prevent sulfurization.	
		Foreign matter has entered the contact surface.	Clean the contact surface.	
		Foreign matter has entered the movable section.	Disassemble and clean.	

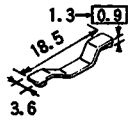
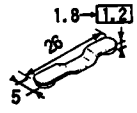
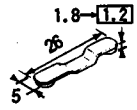
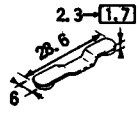
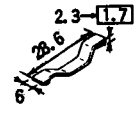
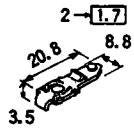
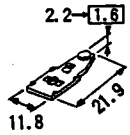
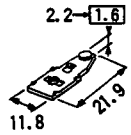
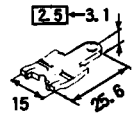
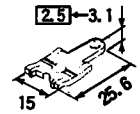
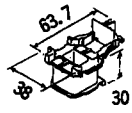
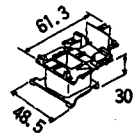
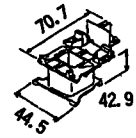
Trouble	State	Cause	Measures	Reference section in this manual
Contact defect	Occurs continuously.	Oil or dust is adhered on contact surface.	Disassemble, clean and take adherence prevention measures.	5.1 Mechanism of Contact Wear (page 15)
		The contact surface is extremely sulfurized.	Replace the contact, and modify the enclosure and installation place.	
		Low voltage, low current	Set to 100 V 50 mA or more if possible.	
		Foreign matter has entered the contact surface.	Disassemble and clean.	
		The contact has fallen off.	Repair the contact, remove the cause of the falling off, take measures to prevent adherence, and confirm the main unit.	
		The mechanism section is damaged.	Replace the entire unit.	
Terminal burning	Burning of terminals or wires	The terminals were not tightened.	Replace the entire unit. Correctly tighten the screws.	4.2 Connection (page 10)
		The terminal screws were not tightened sufficiently.		
		The screws were loosened by vibration or impact.	Prevent vibration and impact.	
		The wires are thin.	Replace the wires and main unit.	
		Contact welding or wear (life)	Replace the entire unit.	
A beating sound is heard	The sound is heard some-times	Foreign matter has entered between the cores.	Disassemble and clean.	6.1.1 Maintenance of Core (page 31)
		Light rust has formed on the core.	Disassemble and polish the core surface.	
		The core is worn (The life is up)	Replace the entire unit.	
		The power voltage is low.	Clean the contact surface.	6.3 Maintenance of Coil (page 34)
		There are high levels of corrosive gas or humidity.	Use a DC operated or mechanical latch types that prevent entry from external sources.	
	The sound is always heard	Foreign matter has entered between the cores.	Disassemble and clean.	6.1.1 Maintenance of Core (page 31)
		The core is rusty.	Disassemble and polish the core on a flat plate.	
		The shading coil is broken. (Life)	Clean the contact surface.	
		Incorrect mounting or distortion of mounting surface.	Change to correct mounting.	
Beating occurs	Beating always occurs	The coil voltage is incorrect. (Low voltage)	Replace with a correct coil.	6.1.1 Maintenance of Core (page 31)
		The core is worn. (The life has been reached.)	Replace the entire unit.	
		Resonance during panel mounting.	Change the mounting structure.	
		Mechanical interlock	Readjust or replace the mechanical interlock.	

Continued

Trouble	State	Cause	Measures	Reference section in this manual
Beating occurs	Beating occurs at main circuit section	A large current is flowing.	Measure the current and remove the cause.	6.1.1 Maintenance of Core (page 31)
		The wiring in the enclosure has separated.	Pass the input and output wiring through the same hole when wiring.	
The thermal overload relay trip	Trip frequently	The load is large.	Use a correct load.	
		The switching frequency is too high.	Re-select according to the frequency.	
		The vibration and impact during use is large.	Change the mounting method or place.	
		The relay scale setting is incorrect.	Set to the correct scale.	
		The relay current capacity selection is incorrect.	Replace with the correct current capacity.	
	Occurs when starting.	The starting time is long. (10 sec. or more)	Re-select the relay, or mount a saturable reactor.	
		The starting current is large.		
		The application is incorrect. (Y-△, pole change, etc.)	Re-select for the correct application.	
		The ambient temperature has risen.	Compensate the temperature, or change the mounting position.	
		The load is inconsistent.	Correct the load or re-select the motor.	
The thermal overload relay does not function.	—	The relay rating selection is incorrect.	Re-select the correct rating.	7. Maintenance and Inspection of Thermal overload Relay (page 39)
		The relay scale setting is incorrect.	Set correctly.	
		The relay is damaged.	Replace the relay.	
		The motor has a special structure.	Replace with a special thermal overload relay.	
		The resetting is repeated in a short time.	Review the motor capacity.	
		Contact welding (short circuit in the circuit)	Replace the relay.	
		Fault in the magnetic contactor.	Replace the magnetic contactor.	
		The wiring is incorrect or defective.	Repair the defective section.	
	Heater wire breakage	A short circuit current flowed.	Replace the relay and improve the protection balance.	
		The wiring is incorrect or defective.	Replace the relay and repair the defective section.	
The thermal overload relay cannot be reset	—	The relay is reset too early.	Wait for the relay to cool before resetting.	
		The contact contacting is defective.	Replace the relay.	
		The wiring is defective.	Repair the defective section.	

Appendix 1 Spare Parts List

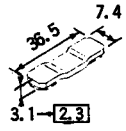
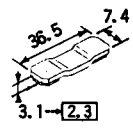
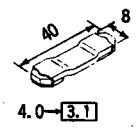
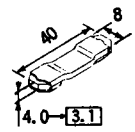
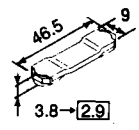
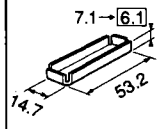
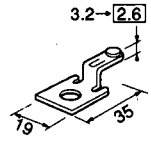
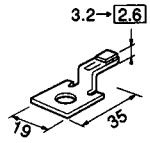
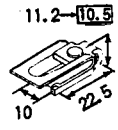
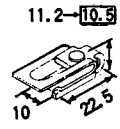
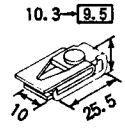
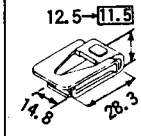
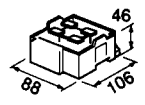
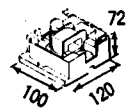
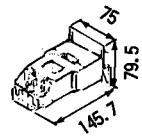
Table 5-(1) Magnetic Contactor Main Contact Element, Spring and Coil List (Unit:mm) (Continued)

Type		S-(N10), N11, N12	S-N18	S-N20, N21	S-N25	S-N35
Main movable contact element		Copper alloy t0.4  Not plated	Copper alloy t0.8  Not plated	Copper alloy t0.8  Not plated	Copper alloy t1  Not plated	Copper alloy t1  Not plated
Main fixed contact element		Iron t1  Nickel plated	Copper alloy t1.2  Silver plated	Copper alloy t1.2  Silver plated	Copper alloy t2  Silver plated	Copper alloy t2  Silver plated
Main contact spring		SUS ϕ 0.29  Free length 9.2 Total No. of windings: 10	SUS ϕ 0.4  Free length 12.6 Total No. of windings: 8	SUS ϕ 0.4  Free length 8.7 Total No. of windings: 6	SUS ϕ 0.45  Free length 14.9 Total No. of windings: 9	Same as S-N25
Main contact kit No.		BH719N300	BH729N300	BH739N300	BH749N300	BH749N301
Qty. in kit	Movable contact element	3	3	3	3	3
	Fixed contact element	6	6	6	6	6
	Contact spring	3	3	3	3	3
Coil		 	Same as S-N10	 	 	Same as S-N25

Note 1. The dimensions given in → □ for the main movable contact element and fixed contact element are the life limit dimensions for when the contact is worn evenly.
2. S-N10 uses the one of the same externals for S-N11 and N12.

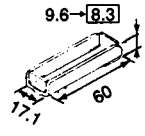
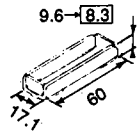
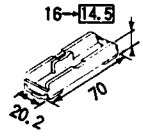
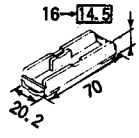
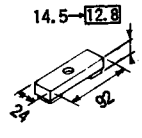
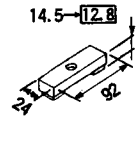
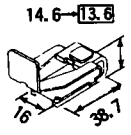
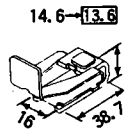
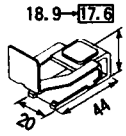
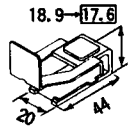
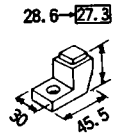
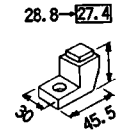
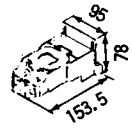
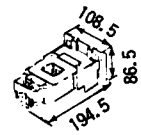
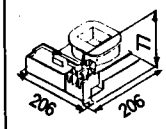
Table 5-(1) (Continued)

(Unit:mm)

Type		S-N50	S-N65	S-N80	S-N95	S-N125	S-N150
Main movable contact element		Copper alloy t1.6  Not plated	Copper alloy t1.6  Not plated	Copper alloy t2.3  Not plated	Copper alloy t2.3  Not plated	Copper alloy t2.0  Not plated	Copper alloy t2.0  Not plated
Main fixed contact element		Copper alloy t2  Silver plated	Copper alloy t2  Silver plated	Copper alloy t2.6  Silver plated	Copper alloy t2.6  Silver plated	Copper alloy t2  Silver plated	Copper alloy t2.3  Silver plated
Main contact spring		SUS ϕ 0.8  Free length 14.2 Total No. of windings: 9	Same as S-N50	SUS ϕ 0.9  Free length 15.4 Total No. of windings: 9	Same as S-N80	SUS ϕ 0.9  Free length 18.9 Total No. of windings: 9	— (Relacement by user not possible)
Main contact kit No.		BH759N300	BH759N301	BH769N300	BH769N301	BH779N300	BH789N300
Qty. in kit	Movable contact element	3	3	3	3	3	3
	Fixed contact element	6	6	6	6	6	6
	Contact spring	3	3	3	3	3	—
Coil		 	Same as S-N50	 	Same as S-N80	 	Same as S-N125

Note 1. The dimensions given in →□ for the main movable contact element and fixed contact element are the life limit dimensions for when the contact is worn evenly.

(Unit:mm)

Type		S-N180	S-N220	S-N300	S-N400	S-N600	S-N800
Main movable contact element		Copper alloy t2  Not plated	Copper alloy t2  Not plated	Copper alloy t2.3  Not plated	Copper alloy t2.3  Not plated	Copper alloy t12  Not plated	Copper alloy t12  Not plated
Main fixed contact element		Copper alloy t3.2  Silver plated	Copper alloy t3.2  Silver plated	Copper alloy t4.5  Silver plated	Copper alloy t4.5  Silver plated	Copper profile bar  Silver plated	Copper profile bar  Silver plated
Main contact spring		— (Relacement by user not possible)	— (Relacement by user not possible)	— (Relacement by user not possible)	— (Relacement by user not possible)	— (Relacement by user not possible)	— (Relacement by user not possible)
Main contact kit No.		BH799N300	BH799N301	BH609N300	BH609N301	BH619N300	BH619N301
Qty. in kit	Movable contact element	3	3	3	3	3	3
	Fixed contact element	6	6	6	6	6	6
	Contact spring	—	—	—	—	—	—
Coil			Same as S-N180		Same as S-N300		Same as S-N600

Note 1. The dimensions given in →□ for the main movable contact element and fixed contact element are the life limit dimensions for when the contact is worn evenly.

Note 2. The main contact kit No. for SD-N50 to N125 differs from S-N as shown below.

Type	Main contact No.	Type	Main contact No.
SD-N50	BH759N302	SD-N95	BH769B303
SD-N65	BH759N303	SD-N125	BH779N301
SD-N80	BH769N302		

Table 5-(2) S-N Magnetic Contactor Auxiliary Contact Element

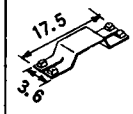
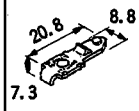
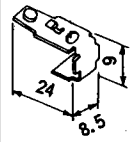
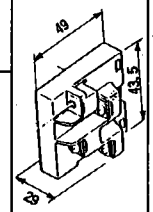
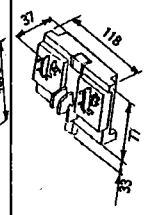
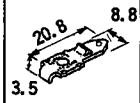
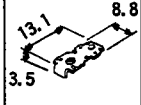
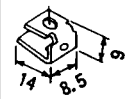
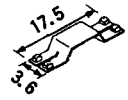
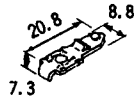
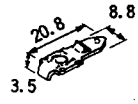
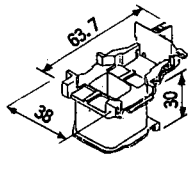
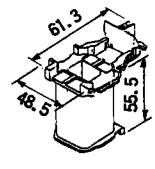
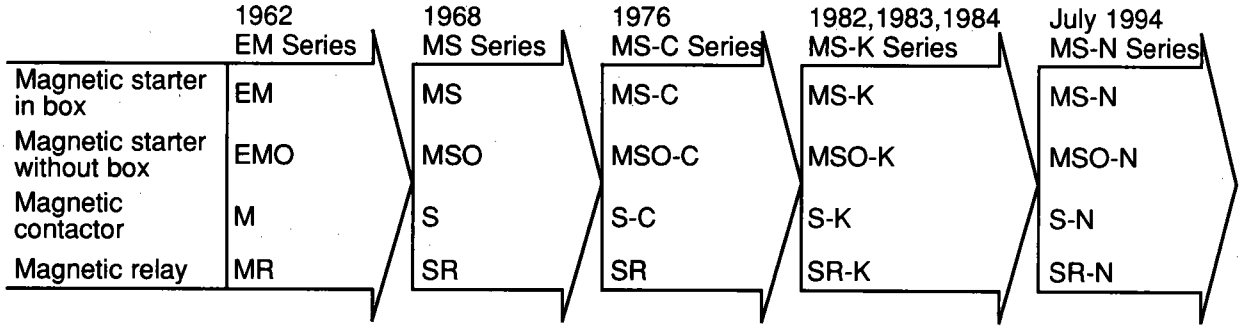
Type		S-N10,N11	S-N12	S-N20	S-N21,N35	S-N50～N95	S-N125	S-N150 ～N400	S-N600,N8-00
Auxiliary movable contact element		Copper alloy t0.2 (twin-shape)  Not plated	Same as S-N10	Same as S-N10	Same as S-N10	Same as S-N10	Same as S-N10		
Auxiliary a fixed contact element		Iron t1  Nickel plated	Same as S-N10	Same as S-N10	Same as S-N10	Iron t1.0  Nickel plated	Same as S-N50	 	
Auxiliary b fixed contact element		Iron t1  Nickel plate	Same as S-N10	Same as S-N10	Iron t1  Nickel plate	Iron t1.0  Nickel plated	Same as S-N50		
Auxiliary presser spring		SUS ϕ 0.29  Free length 9.2 Total No. of windings: 10	Same as S-N10	SUS ϕ 0.29  Free length 11.7 Total No. of windings: 15	Same as S-N20	SUS ϕ 0.29  Free length 13.5 Total No. of windings: 13	SUS ϕ 0.29  Free length 13.5 Total No. of windings: 14		Two mounting screws Cross-slot screw with SW-PW
Auxiliary contact kit No.		BH719N310	BH729N301	BH739N310	BH739N311	BH539N315	BH579N312	UN-AX150	UN-AX600
Qty. in kit	Movable contact element	1	2	2	4	4	4	Auxiliary contact unit with 1a1b (1NO1NC)	Auxiliary contact unit with 2a2b (2NO2NC)
	a fixed contact element	2	2	2	4	4	4		
	b fixed contact element	—	2	2	4	4	4		
	Presser spring	1	2	2	4	2	2		

Table 6 SR-N, SRD-N Magnetic Relay Contact Element, Spring and Coil List (Unit:mm)

Type		SR-N4(CX)	SRD-N4(CX)
Presser spring		SUS ϕ 0.29  Free length 9.2 Total No. of windings: 10	
Movable contact element		 Copper alloy t0.2, Not plated (twin-shaped)	
Fixed contact element	a(NO)	 Steel t1 Nickel plated	
	b(NC)	 Steel t1 Nickel plated	
Kickout spring	4a(NO)	 Free length 39 Total No. of windings: 3 SUS ϕ 0.8	
	3a1b (3NO1NC)	 Free length 55.5 Total No. of windings: 3 SUS ϕ 0.9	
	2a2b (2NO2NC)	 Free length 53 Total No. of windings: 3 SUS ϕ 0.9	 Free length 53 Total No. of windings: 6 SUS ϕ 0.9
Coil		 	

Appendix 2. Transition of Types and Compatibility

The names of Mitsubishi's main controllers have changed as shown below. The compatibility of each type is explained below.



● Using the mounting compatibility table

1. The symbols used in the table have the following meanings.
   "○": Directly compatible.
   "●": Standard type has not compatibility, but S-N□XA (special spec.) can be supplied.
   "△": Compatible when exclusive adaptor (optional accessory) is added.
   "None": Equivalent part that is not compatible in terms of mounting dimensions.

2. The coils and contact elements are not compatible.
   (1) Magnetic contactor
   The magnetic contactor has contacts that wear and a coil that generates heat, and thus, it is replaced the most often. The comparison of the new and old magnetic contactors in terms of mounting dimensions, rated capacity and number of auxiliary contacts is shown in Tables 7 and 8.
   The new type is compact, so according to these tables, the rated capacity is equivalent or there is an allowance.

Note 1. The dimension are equal or smaller.
2. For the reversing type, replace both units. Replacement of only one unit is not possible.

Table 7 Mounting compatibility with current non-reversing magnetic contactor
Table 8 Mounting compatibility with current reversing magnetic contactor

Table7 Mounting compatibility with carrent non-reversing magnetic contactor

Old type						Current type
S type		S-C type		S-K type		S-N type
Type	Compatibility	Type	Compatibility	Type	Compatibility	Type
S-8	○	S-C10 (RM)	○	S-K10	○	S-N10
S-10	○	S-C11 (RM)	○	S-K11	○	S-N11
S-11	○	S-C12 (RM)	○	S-K12	○	S-N12
S-20	○	S-C20	○	S-K20	○	S-N20
S-18	○	S-C21	○	S-K21	○	S-N21
		S-C25	△	S-K25	△	S-N25
S-25	○	S-C35	△	S-K35	△	S-N35
S-35	△	S-C50	△	S-K50	○	S-N50
S-50	None	S-C60	△	S-K65	○	S-N65
S-65	△	S-C80	△	S-K80	○	S-N80
S-80	None	S-C100	None	S-K95	○	S-N95
S-100	None	S-C120	●	S-K125	○	S-N125
	●	S-C150	●	S-K150	○	S-N150
S-150				S-K180	○	S-N180
S-200	●	S-C220	●	S-K220	○	S-N220
S-300	None	S-C300	●	S-K300	○	S-N300
S-400	None	S-C401	●	S-K400	○	S-N400
S-600	○	S-C600	○	S-K600	○	S-N600

Table8 Mounting compatibility with carrent reversing magnetic contactor

Old type						Current type
S type		S-C type		S-K type		S-N type
Type	Compatibility	Type	Compatibility	Type	Compatibility	Type
S-2×11M1	None	S-CR11	None			S-2×N10
	None		None			S-2×N11
	None		○	S-KR11		
S-2×20	None	S-2×C20	None	S-2×K20	None	S-2×N20
S-2×18	None	S-2×C21	None	S-2×K21	None	S-2×N21
		S-2×C25	None	S-2×K25	○	S-2×N25
S-2×25	None	S-2×C35	None	S-2×K35	○	S-2×N35
S-2×35	None	S-2×C50	None	S-2×K50	○	S-2×N50
S-2×50	None	S-2×C60	None	S-2×K65	○	S-2×N65
S-2×65	None	S-2×C80	None	S-2×K80	○	S-2×N80
S-2×80	None	S-2×C100	None	S-2×K95	○	S-2×N95
S-2×100	None	S-2×C120	None	S-2×K125	○	S-2×N125
	None	S-2×C150	None	S-2×K150	○	S-2×N150
S-2×150	None			S-2×K180	○	S-2×N180
S-2×200	None	S-2×C220	None	S-2×K220	○	S-2×N220
S-2×300	None	S-2×C300	None	S-2×K300	○	S-2×N300
S-2×400	None	S-2×C401	None	S-2×K400	○	S-2×N400
S-2×600	None	S-2×C600	None	S-2×K600	○	S-2×N600

(2) Magnetic relay

The mounting dimensions of the magnetic relay have not been changed so all models are compatible. The contact configuration has not been changed from the SR-K type. The main differences are shown in Table 9.

Table 9 Mounting compatibility with current magnetic relay and main differences

<table>
<tr><th colspan="9">Old type</th><th>Current type</th></tr>
<tr><th colspan="3">SR type</th><th colspan="3">SR (RM) type</th><th colspan="3">SR-K/SR-N type</th><th></th></tr>
<tr><th>Type</th><th>Comp atibility</th><th>Differences</th><th>Type</th><th>Comp atibility</th><th>Differences</th><th>Type</th><th>Comp atibility</th><th>Differences</th><th>Type</th></tr>
<tr><td>SR-4</td><td>○</td><td rowspan="5">• Coil terminal position
• Nos. of all terminals
• Elimi-nation of 1a1b, 5b (5 poles)
• Layout of 5a3b, 4a4b contacts (8 poles)</td><td>SR-40 (RM)</td><td>○</td><td rowspan="4">• Coil terminal position
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• Layout of 5a3b, 4a4b contacts (8 poles)</td><td>SR-K4</td><td>○</td><td rowspan="4">• Coil terminal position
• Coil and b contact terminal Nos.
• 5-pole terminal Nos.</td><td>SR-N4</td></tr>
<tr><td>SR-5</td><td>○</td><td>SR-50 (RM)</td><td>○</td><td>SR-K5</td><td>○</td><td>(SR-N5)</td></tr>
<tr><td>SR-8</td><td>○</td><td>SR-80 (RM)</td><td>○</td><td>SR-K8</td><td>○</td><td>(SR-N8)</td></tr>
<tr><td>SR-33, 633F</td><td>○</td><td>SR-63, 60 (RM)</td><td>○</td><td>SR-K63 -K6</td><td></td><td></td><td></td></tr>
<tr><td>S-10</td><td>○</td><td>SR-100</td><td>○</td><td></td><td>SR-K10</td><td>○</td><td></td><td>(SR-K100)</td></tr>
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Note * In parentheses show Japanese domespic type.

Appendix 3. Measures when unit has been submerged

If the controller has been submerged due to floods or fires, etc., in most cases, the controller cannot be reused. If the controller must be used due to unavoidable circumstances, the characteristics and performance will not be guaranteed. Replace the unit with a new part as soon as possible.

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