AIR CIRCUIT BREAKER

MAINTENANCE MANUAL

Susol / Metasol / Compact

LS ELECTRIC

Maintenance Manual of
Susol, Metasol, Compact ACB

- CONTENTS -

⚠ Caution for Installation Inspection

- ✓ Confirm all power sources are completely de-energized.
- ✓ Disconnect all connection from the operating part of circuit breaker. (Shunt trip coil, OCR, etc,.)
- ✓ Make the circuit breaker to the test position. (Basic inspection is available under test position.)
- ✓ Remove the circuit breaker from the cradle and place it on a safe place for inspection.

Thank you for purchasing LS ELECTRIC protection device.
The purpose of inspection for ACB is to prevent the accidents in advance and maintain the performance by changing the consumable and deteriorative parts in a timely manner. Please make sure the following guideline for appropriate inspection and check the usage cycles before using the equipment.

Product configuration

◈ Fixed type ACB

Terms

1. Trip relay
2. Counter
3. ON button
4. OFF button
5. Series name
6. Charge handle
7. Rated name plate
8. Charge/Discharge indicator
9. ON/OFF indicator
10. Corporation logo
11. Arc cover
12. Terminal cover
13. Cradle
14. Draw-out handle
15. Position indicator
16. Handle storage space
17. Pad lock button
18. Arc chute
19. Control cover
20. Fixed type bracket

◈ Draw-out ACB (Cradle)

Maintenance cycle

Please refer to following pages of section 1~3 for appropriate inspection

Operating environment	External environment	Site environment	Inspection guideline	Exchange cycle
General environment	Locations where the air is always clean and dry	Dust proof and air-conditioned electrical rooms, etc.	Once every two years. (Section 1) Once every three years or after 250 times mechanical operating. (Section 2) Once every five years. (Section 3)	Within 10 years
	Indoor locations with a little dust Locations without corrosive gases	Individual electrical rooms & Distribution panels without dust proof and air-conditioner	Once every year (Section 1) Once every two years or after 250 times mechanical operating. (Section 2) Once every five years. (Section 3)	Within 10 years

Note) For sites that mostly use no-load switching, please contact us for maintenance regulations.

Operating environment	External environment	Site environment	Inspection guideline	Exchange cycle
Harsh environment	Locations with salinity, high temperature and gases such as sulphur dioxide and hydrogen sulphide	Geothermal power plants, waste water treatment plants, steel mills, paper factories, pulp factories, etc.	Once every year. (Section 1) Once every year. or after 150 times mechanical operating. (Section 2) Once every three years. (Section 3)	Within 7 years
	Locations with especially severe gas and dust conditions and where humans cannot stay for a long period of time	Chemical factories, quarries, mining areas, etc.	Once every half a year. (Section 1) Once every year or after 150 times mechanical operating. (Section 2) Once every two years. (Section 3)	Within 5 years

Preventive maintenance by parts (Section 1)

Check list	Tool
Device	
Check the general condition of the device (control unit, case, chassis, connections)	None
Mechanism	
Open/Close operation by manually and electrically	None
Charging operation by manually and electrically	None
Check the closing operation of each pole	None
Number of operations	Operating counter
Breaking unit (arc chutes+contacts)	
Remove dust from the metal screen and check the fixing of the arc-chute	None
Control auxiliaries	
Check the auxiliary wiring	None
Control unit	
Check the correct operation of relay elements on LCD or LED of OCR. (Long time, short time, instantaneous time, grounding. Refer to page 11, 12, 13, 14.)	OCR tester
Check the Trip control unit and AL contacts operation by using tool	OCR tester
Device locking	
Open and close key locks installed on device	None
Open and close padlocking system installed on device	None
Chassis (optional)	
Remove device from chassis and put it back	None
Check the operation of position contacts (Option)	None
Check the operation of safety shutters (Option)	None
Chassis locking	
Open and close key locks installed on chassis	None
Operate padlocking system	None

Preventive maintenance by parts (Section 2)

Check	Tool
Mechanism	
Check the operating condition of gear-motor at 0.85~1.1 Vn (Charge time : Less than 5sec.)	Stop-watch+ external power supply
Check the damaged parts and alien substance of mechanism	None
Mechanism (optional)	
Remove dust and regrease chassis. (Page 16.) (Specification of grease : PLG-322, Company name : NEO)	Brush, Grease
Breaking unit (arc chutes+contacts)	
Check the breaking unit condition (Page 8, 9)	Screwdriver
Control auxiliaries	
Check the auxiliary contacts operation	Multimeter
Check the closing coil operation CC (0.85~1.1 Vn, check operation voltage for CC)	External power supply
Check the opening coil operation SHT1 (0.70~1.1 Vn, check operation voltage for SHT1)	External power supply
Check the under voltage coil operation (Pick up 0.65~0.85 Vn, Drop out 0.4~0.6 Vn)	External power supply
Check the UVT delay time when open the device or under the low voltage condition (0.4~0.6 Vn)	Stop-watch + External power supply
Terminal	
Measure the terminal temperature (Temperature rise shall be below 80K)	Thermal camera
Chassis (optional)	
Remove dust and regrease chassis. (Page 16.) (Specification of grease : PLG-322, Company name : NEO)	Brush, Grease
Regrease disconnecting-contact clusters. (Page 16.) (specific case of corrosive atmospheres) (Specification of grease : HITALUBE280GA, Company name : HITACHI)	Brush, Grease
Chassis (optional)	
Check and tighten loose connections (Page 15.)	Torque wrench

Check	Tool
Breaking unit (contacts)	
Measure the resistance of withdrawal ACB input/output contact. (Under 60μΩ)	Ohmmeter
Control auxiliaries	
Preventive replacement of control auxiliaries	None
Trip Relay(OCR)	
Save protection settings, log events (OCR-P/S)	OCR tester

Usage environment

Division	Normal	Good	Bad
Temperature	Annual average external temperature <35℃.	Annual average external temperature <25℃. Air conditioner installed or well ventilated environment.	Annual average external temperature 35~45℃.
Percent load	0.7 In <	0.5 In <	0.8 In >
Relative humidity	<70%	<50%	>80%
Salt environment	Salt-free environment.		Installed within 10 km from the seaside without special protection.
Current harmonics	Less than 30%	Less than 10%	30% or more
Dust	No dust / With filter / Ventilation structure		When device is not protected.
Corrosive atmospheres	Environment classification 3C1 or 3C2 installation. (Standard: IEC 60721-3-3)	Protection room installation (air conditioning and purification).	3C3 or 3C4 environment (Environment without special protection).
Vibration	Permanent vibration <0.2g	No vibration	Constant vibration 0.2~0.5g
Maintenance proposal	Exceeding the described criteria will accelerate the aging of the circuit breaker and may lead to malfunction. Regular inspections must be carried out. Special efforts are required to improve operational and environmental conditions.	The time interval between periodic checks can be doubled if all of the above conditions are met.	If any of the above conditions exist, the time interval between preventive maintenance should be reduced by half.

Accelerating aging factors

① Ambient temperature (outside the switchboard)

Casue	Appearance	Result
The mechanical characteristics of plastic parts (insulation, case) gradually deteriorate with increasing temperature.	Change in color and appearance.	Breaking of parts and insulation leading to failure of functions.
Grease hardening at the primary contact finger where grease hardening has occurred.	Change in color and viscosity	Device cannot be operated. Increase of racking forces exerted on finger.
Deterioration of insulating varnishes on coils.	Change in color. Burning smell.	Failure of coils (CT, CC, SHT, UVT, RES) Trip operation caused by coil malfunction.
Hardening of glues on label.	Change in appearance.	Loss of labels.
Deterioration of electronic components.	Modified display of LCDs. Malfunction of electrolytic capacitors.	Damage of display. Trip operation.
Deterioration of opto-electronic devices and SCRs.	Not identifiable.	Possible transmission of erroneous orders.
Loss of battery backup power.	Not identifiable.	Fault indications not displayed.
Temperature thresholds in °C.		
< 25°C	26–35°C	36–45°C
Optimum operating conditions.	A 10 °C increase in the ambient temperature is equivalent to a 5 % increase in the percent load.	A 20 °C increase in the ambient temperature is equivalent to a 10 % increase in the percent load.
Recommendation		
Preventive maintenance		
Conduct periodic inspections.	Conduct periodic inspections.	Conduct periodic inspections.
Installation		
Particular preventive measures is not required.	Particular preventive measures is not required.	Installation of forced air ventilation in the switchboard or installation of air conditioners in the electrical room.

The ambient temperature affects the device temperature and is affected by the percentage load.
Changes in temperature (above 30°C) cause mechanical stress (thermal expansion) and condensation that can accelerate aging.

② Load factor (I/In)

Cause	Appearance	Result
Ageing of plastic insulation.	Change in color of insulation material.	Breaking of parts leading to function failure.
Ageing of grease.	Change in color and viscosity.	Increase in mechanical friction.
Ageing of electronic components.	Modified display of LCDs.	A 10 °C increase (an 90 percent load) reduce the life span of components by approximately half.
Deterioration of characteristics: • Steel spring (above 100 ° C) • Piano wire (above 120 ° C) • Stainless steel spring (above 250 ° C)	Rupture.	Non operation of mechanisms.

Thresholds				
< 80%, 24/24 hours	< 90%, 8/24 hours	< 90%, 24/24 hours	In, 8/24 hours	In, 24/24 hours
Maximum percent load generally taken into account in sizing the installation. At this percent load, temperature rise is reduced approximately 40 % with respect to a 100 percent load.	At this percent load, temperature rise is reduced only 20 %. Heating and cooling cycles impact on the mechanical junctions of the power circuit.	The thermal stress for continuous operation is three times higher than in the previous case, but the absence of thermal cycles slows ageing of the electromechanical components.	Between 90 and 100 %, temperature rise is close to its maximum value. Heating and cooling cycles impact on the mechanical junctions of the power circuit, with major impact on ageing.	Between 90 and 100 %, temperature rise is close to its maximum value. This situation has a major impact on ageing.
Recommendation				
Preventive maintenance				
Increase frequency of periodic inspection.	Increase frequency of periodic inspection.	Preventive maintenance is difficult due to the continuous process.	Increase frequency of periodic inspection.	Preventive maintenance is difficult due to the continuous process. Plan more frequent periodic checks.
Installation				
Applied ventilation structure for the switchboard. **※ The percent load affects the temperature of the device and is affected by the ambient temperature.**				Distributes the load to other circuit breakers. Install a higher rating device.

③ Relative humidity

Cause	Appearance	Result
Accelerated metal surface corrosion by contaminants. (corrosive gas, salt, chlorine, etc.).	• Red rust on iron • White rust on zinc • Blue sediment on copper • Black sediment on silver	Increase in friction. Risk of mechanical rupture resulting in non operation of mechanisms. Increase in contact resistance (clusters and main contacts).
Deterioration of dielectric qualities of plastics.	White traces on case.	Risk of a reduction in insulation.
Deterioration of electronic components, in particular SMCs and silver-coated components. This phenomenon is worsened by the presence of H2S corrosive gas.	Not visible. Appearance of dentrites on electronic boards.	Failure of control unit operation such as protection, measurement, display and communication functions due to a short circuit.
Deterioration of electronic components, in particular non-varnished copper circuits.	Not visible. Erosion of copper tracks. Oxidation of metal connectors and metal cases. Oxidation of integrated-circuit connectors mounted on supports.	Failure due to short-circuit or open circuit. Rupture of component connectors along case. Poor contact with integrated-circuit supports.
Degradation of opto-electronic components.	-	Failure of data transmission.
Thresholds (%)		
< 70%	70~85%	> 85%
General relative humidity level found in continental and temperate zones. The level is generally lower in switchboards due to the internal temperature rise. No significant deterioration is noted at this level.	General relative humidity level found in zones close to water. Possible appearance of condensation on cold parts and accelerated rusting.	General relative humidity level found in tropical zones and certain factories (e.g. paper mills). Increased risk of condensation and rust resulting in difficulties to disconnect devices, risk of non opening or non closing.
Recommendation		
Preventive maintenance		
Preventive maintenance	Implement periodic checks frequently. Insulation measurement is advised every 5 years.	Implement periodic checks frequently. Inspect rust on metal parts. Insulation measurement is necessary every 2 years.
Installation		
Particular preventive measures is not required.		Install dehumidifying equipment in the switchboard.

④ Salt environment

Cause	Appearance	Result
Corrosion of metal parts.	• White rust on zinc coatings • Red rust on steel • White rust on zinc-plated	Friction increase. Mechanism damage. Broken springs. CC/SHT/UVT non-operation or malfunction.
Risk of salt sediments on electronic circuits when thick salt mists occur.	Appearance of salt bridges on electronic boards.	Failure of electronic systems due to short-circuit or open circuit.
Risk of conducting salt sediments on the device when thick salt mists occur.	White sediment.	Deterioration of device dielectric withstand resulting in risk of phase-to-frame short-circuit and a phase-to-phase short-circuit if an overload occurs.
Thresholds		
No salt mist	Moderate salt mist < 10 km from seaside	Considerable salt mist < 1 km from seaside
No influence.	Accelerated aging of the circuit breaker.	Rapid ageing of exposed circuit breaker. On average, service life is divided by three for non-protected devices.
Recommendation		
Preventive maintenance		
Conduct periodic inspections.	Conduct periodic inspections.	Perform regular checks more often. Test the dielectric withstand every two years.
Installation		
Particular preventive measures is not required.	Particular preventive measures is not required.	Switchgear must be protected from salt mist. Increase the switchboard IP value (IP54 is advised / NEMA 3). Secure a protected room.

⑤ Harmonics

Cause	Appearance	Result
Increase in skin effect, proximity effect, iron losses, eddy currents.	Change in color of terminals, insulators and grease. Modified display of LCDs.	Greater temperature rise due to Harmonics.
Potential overload in neutral line when there are third harmonic or its multiples.	Distorted waveform.	Wrong current value. Trip error.
Thresholds in % of In		
THDi < 15%	THDi 15~30%	THDi > 30%
No notable influence on ageing.		At 40 % THDI, heat loss is approximately 10 % higher, corresponding to 5 % more current.
Recommendation		
Preventive maintenance		
Conduct periodic inspections.	Conduct periodic inspections.	Conduct periodic inspections.
Installation		
Particular preventive measures is not required.	Install filters to reduce harmonics	Install filters to reduce harmonics. If necessary, oversize the neutral.

⑥ Dust

Cause	Appearance	Result
Sediment deposition on grease of mechanisms (device and cradle).	Change in color and texture of greases.	Premature wear of mechanisms due to dust mixed with grease. Increase in mechanical friction and freezing of moving parts. Risk of device not moving on cradle. Risk of device non opening or non closing.
Deposit on grease of finger.	Change in color and texture of greases.	Increase in racking forces exerted. Increased contact resistance and temperature rise.
Deposit on displays.		Difficult to identify the screen value.
Deposit on insulation.		Reduced insulation resistance (depends on type of dust). This phenomenon is worsened by the presence of humidity.
Deposit on device contacts.		Increased contact resistance and temperature rise.
Deposit on opto-electronic communication system between devices.		Failure of communication-data transmission.
Dust deposit		
Low level	Moderate	High
Quantity of dust generally deposited on and around devices in commercial buildings and on standard industrial premises.	Quantity of dust found in protected switchboards installed in dusty environments such as cement works, grain mills, incineration installations, plastic and steel mills, mines, etc.	Quantity of dust deposited on and around devices inside non-protected switchboards installed in dusty environments such as cement works, grain mills, incineration installations, plastic and steel mills, mines, etc.
Recommendation		
Preventive maintenance		
Conduct periodic inspections.	Conduct periodic inspections frequently.	Conduct periodic inspections and cleaning frequently.
Installation		
Switchboard with standard IP (NEMA 1).	Make sure the switchboard maintains closed.	Special equipment to protect the switchboard from dust are essential.

⑦ Corrosive atmosphere

Corrosive Atmosphere	Cause	Appearance	Result	Thresholds(ppm) Average value(Refer to IEC 60721-3-3 for 3C1, 3C2, 3C3, 3C4)
SO_2 Sulphur dioxide	Corrosion of silver, aluminium and bare copper. Phenomenon accelerated by high temperature and relative humidity.	Blackening of exposed silver surfaces. Appearance of dendrites on electronic and power circuits.	Effect on silver alloy and silver plated products. Increase contact resistance exposed to air. Excessive device temperature rise. Short-circuits resulting in non operation of the control unit.	3C1: 0.037ppm 3C2: 0.11ppm 3C3: 1.85ppm 3C4: 4.8ppm
H_2S Hydrogen sulphide	Sulphuration of silver, this phenomenon is accelerated by high temperatures.	Blackening of exposed silver surfaces. Appearance of dendrites on electronic and power circuits.	Effect on silver alloy and silver plated products. Increase contact resistance exposed to air. Excessive device temperature rise. Short-circuits resulting in non operation of the control unit.	3C1: 0.0071 3C2: 0.071 3C3: 2.1 3C4: 9.9
Cl_2 Chlorine	Corrosion of metal parts.	Oxidation. Inter-granular corrosion of stainless steel.	Increase in friction. Risk of mechanical rupture. Breaking of stainless-steel springs.	3C1: 0.034 3C2: 0.034 3C3: 0.1 3C4: 0.2
NH_3 Ammoniac	Polycarbonates damage, corroision of copper.	Cracking of polycarbonates. Blackening of copper.	Risk of rupture. Temperature rise	3C1: 0.42 3C2: 1.4 3C3: 4 3C4: 49
NO_2 Nitrogen oxide	Corrosion of metal parts.	Oxidation.	Temperature rise.	3C1: 0.052 3C2: 0.26 3C3: 1.56 3C4: 5.2
Oily atmospheres	Polycarbonates damage.	Cracking of polycarbonates.	Risk of rupture. Temperature rise.	

Accelerating aging factors

#Note : Environment categories as per standard 721-3-3

Class			
3C1	**3C2**	**3C3**	**3C4**
Rural zones or urban zones with low industrial activity.	Urban zones with scattered industrial activity and heavy traffic.	Immediate vicinity of industrial pollution. Example, paper mills, water treatment, chemicals, synthetic fibres, smelting plants.	Inside polluting industrial premises. Example: paper mills, water treatment, chemicals, synthetic fibres, smelting plants.
Presence of corrosive gases			
Negligible	Low level	Significant level	High level
Impact on switchgear			
No impact on service life because concentrations are very low.	Moderate impact on service life.	Major impact, particularly concerning temperature rise. For electronic systems, no impact on varnished boards and gold-plated contacts.	Significantly reduced service life if no particular precautions are taken. For electronic systems, no impact on varnished boards and gold-plated contacts.
Recommendation			
Preventive maintenance			
Conduct periodic inspections.	Conduct periodic inspections.	Conduct periodic inspections. Change the grease on the disconnecting contacts.	Conduct periodic inspections. Change the grease on the disconnecting contacts.
Installation			
Particular preventive measures is not required.	Particular preventive measures is not required.	Use fixed instead of draw out devices.	Install the switchgear in a room protected from the pollution. Use fixed instead of draw out devices.

⑧ Vibration

Cause	Appearance	Result	
Premature deterioration of contact surfaces (fingers and main contacts).	Not identifiable.	Increased device temperature rise.	
Untightening of bolted assemblies.	Not identifiable.	Temperature rise and durability decrease due to increased mechanical gap.	
Wear of mechanical parts.	Not identifiable.	Spring breakage Increase in mechanical play between parts, decrease in durability	
Appearance of fretting corrosion on auxiliary connections.	Not identifiable.	Erroneous information or loss of continuity in data or supply, excessive temperature rise.	
Breaking of connectors on large electronic components (e.g. large capacitors)	Not identifiable..	Failure of protection function.	
Wear of adjustable switch on the control unit.	Not identifiable.	Nuisance tripping or no tripping.	
Thresholds			
< 0.2g	0.2~0.5g	0.5~0.7g	> 0.7g
Normal condition, no impact on service life.	Reduced service life.	Significant increase in incidents.	Forbidden for standard devices.
Recommendation			
Preventive maintenance			
Conduct periodic inspections.	Conduct periodic inspections.	Conduct more frequent periodic inspections. Check in particular the tightness of connections.	
Installation			
Particular preventive measures is not required.	Particular preventive measures is not required. Install switchgear on a rubber mounting bush.	Install switchgear on a rubber mounting bush.	Use special devices.

⑨ Operating cycle

Cause		Result
The number of operating cycles depends directly on the electrical and mechanical endurance of the device.		Device service life depends on the daily number of operating cycles.
Device service life depends on the daily number of operating cycles.		
< 30 cycles per month	< 60 cycles per month	<120 cycles per month
Corresponds to one cycle per day. For an endurance of 10,000 cycles and an interrupted current of less than 0.4 In, the service life is 30 years.	Corresponds to two cycles per day. For an endurance of 10,000 cycles and an interrupted current of less than 0.4 In, the service life is 15 years.	Corresponds to four cycles per day. For an endurance of 10000 cycles and an interrupted current of less than 0.4 In, the service life is 10 years.

⑩ Breaking current

Cause	Appearance	Result
Wear of fixed and moving contacts.	Deterioration of contacts.	Beyond the electrical-endurance limit, device temperature rise increases due to the greater contact resistance and a reduction in the contact pressure.
Wear of the arc chutes (insulating materials, separators).	Deterioration of insulation.	If the arc chute wear limit is exceeded, the arc extinguishing performance is deteriorated and there is a risk of an accident.
Thresholds		
< 1 In (Sensor ratio)	1~ 4 In (Sensor ratio)	4~ 8 In (Sensor ratio)
This breaking current level corresponds to the mechanical durability (see Mechanical endurance).	This breaking current level corresponds to the expected level of a short-circuit current event.	This breaking current level corresponds to a severe short circuit event. Breaker contact and arc chute need to be inspected.

Inspection method
After trip operation

1. Figure out what cause the trip operation

   - Do not perform the closing operation before figuring out the cause of trip and removing it completely.
   - The trip event will be indicated with LED of OCR in advance and be reported to the circuit breaker by output signal of Trip Alarm Contact(AL).
   - There can be various possible causes for trip operation of circuit breaker. The trip operation can be done due to the function test of facilities or the warning for accident.

2. If short-circuit occurred, check the condition of circuit breaker with the following inspection items suggested below. (all power source should be disconnected from circuit breakers for the inspection)

   - Check the Arc chamber. (Refer to Inspection method of Arc chamber)
   - Check the Contacts. (Refer to Inspection method of Arc chamber)
   - Check the Connection parts. (ex. Bolt tightened parts, Busbars connected parts, etc,.)
   - Check the Cluster. (Refer to page 9.)

3. Perform closing operation again, after removing the cause for trip operation described above.

1. Remove the mounting screws of the arc chamber.
2. Separate the arc chamber by lifting it up using two screw drivers as shown in fig. 7 below.
3. Check the condition of the disassembled arc chamber.
   - Check if there is any damage on grid assembly of arc chamber or parts and replace them if necessary.
   - Please contact our company if you check whether arc chamber has to be changed or not.

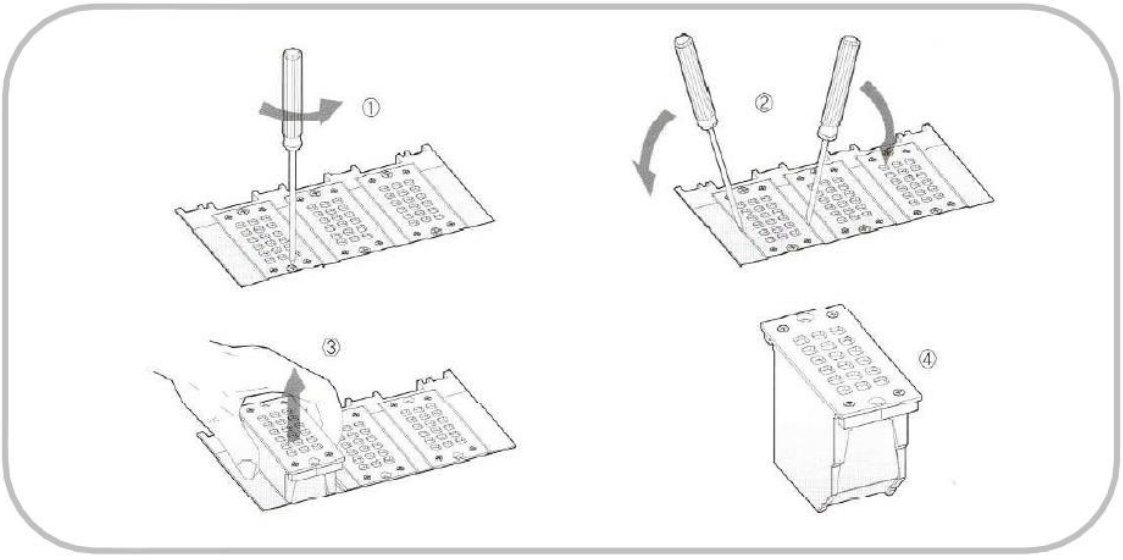


Fig. 7. Separate procedure of Arc chamber

Moving contact Inspection method

1. The contact damage can be checked upon following inspection method periodically.
2. Separate arc-chamber.
3. Close the circuit breaker and compare the condition of the moving contact as below Fig. 8.

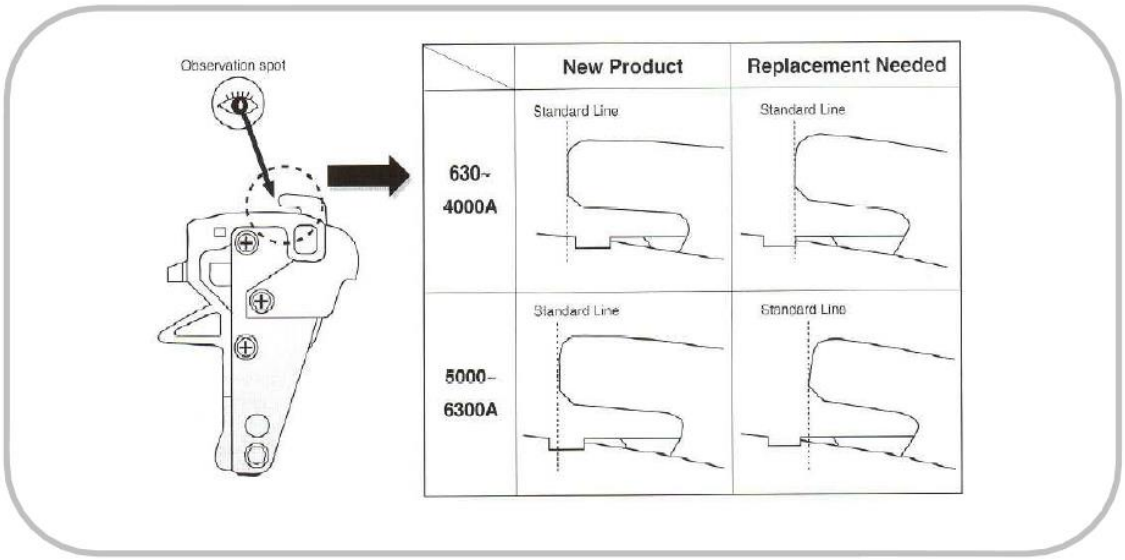


Fig. 8. The standard figure for contact replacement

1. Inspect the external appearance and check for following possible damages.
   - Check for discolored parts.
   - Check for peel-off coating.
   - Check for damages on the plate spring.
   - Check for assembly condition of cluster.
   - Check for other possible damages on the cluster.

2. Inspect the contact part of the cluster and terminal block as follows.
   - Check if there is enough conducting grease on the contacting part.
   - Check if conducting grease has hardened.

3. Remove the cluster by hand and replace it if necessary. (Refer to Fig. 9.)

4. If the cluster has been used because there is no problem, please clean it and new grease applies.
   (Specification of grease : Mobiltemp SHC32, Company name : Mobil**)**

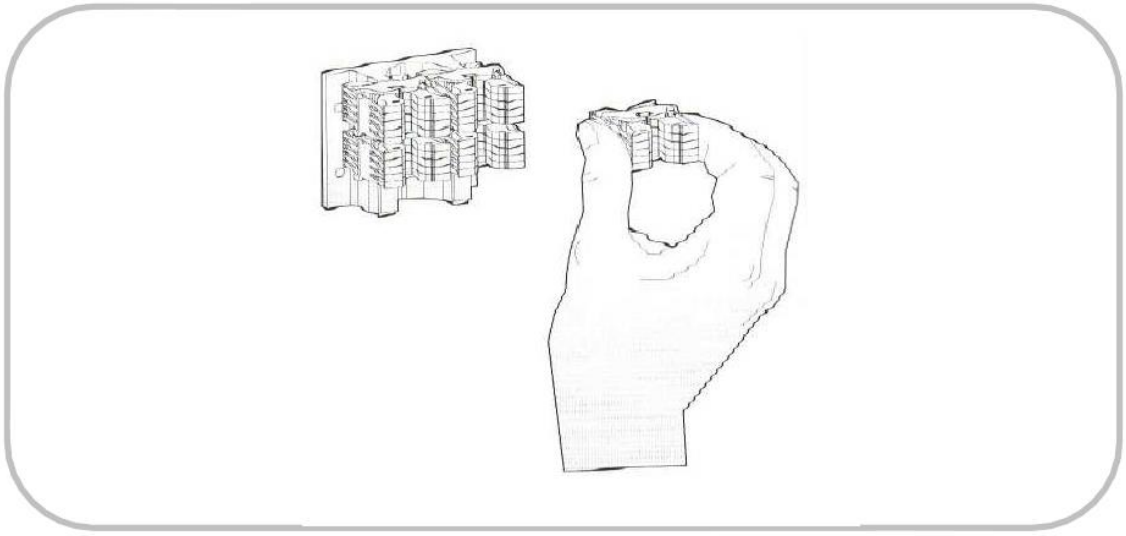


Fig. 9. The cluster by hand and replace

1. Long Time Delay

1) Changing OCR knob setting
   : Refer to Table 1 "Test table for Long Time Delay trip" before setting.
   Set other protection function (Isd/Ii/Ig) to OFF.
2) Changing Tester setting
   : Refer to Table 1 "Test table for Long Time Delay trip" before setting.
3) Press START button
4) Time count will begin and be displayed on LCD screen of tester.
   After a certain period of time, a trip operation is performed.
   Check if trip progresses within standard time.
5) Check operation of correct protection function on LCD or LED of OCR
6) After the test is complete, press STOP button of tester to return to main screen.

Table 1

Test table for Long Time Delay trip						
No.	Setting Condition					Standard Operation Time (Sec)
	OCR knob				TESTER (Current Base: Ir)	
	N/A Type		P/S Type			
	Iu	Ir	Ir	tr	R/S/T	
1	0.5	0.8	0.4	0.5	2.0	4.214~6.322
2				0.5	6.0	0.4~0.6
3				20.0	6.0	16.0~24.0
4	1.0	1.0	1.0	0.5	2.0	4.214~6.322
5				0.5	6.0	0.4~0.6
6				20.0	6.0	16.0~24.0

Note) For how to use the OCR Tester, refer to the user manual enclosed with the tester.

2. Short Time Delay

1) Changing OCR knob setting
   : Refer to Table 2 "Test table for Short Time Delay trip" before setting.
   Set other protection function (Ir/Ii/Ig) to OFF.
2) Changing Tester setting
   : Refer to Table 2 "Test table for Short Time Delay trip" before setting.
3) Press START button
4) Repeat steps 4) ~ 6) on page 22.

Table 2

Test table for Short Time Delay trip							
No.	Setting Condition						Standard Operation Time (Sec)
	OCR knob					TESTER (Current Base: Ir)	
	N/A Type		P/S Type				
	Iu	Ir	Ir	Isd	tsd(I^2 t)	R/S/T	
1	0.5	0.8	0.4	1.5	0.1(off)	1.65	0.08~0.14
2	0.5	0.8	0.4	1.5	0.1(on)	1.65	2.938~4.407
3	0.5	0.8	0.4	1.5	0.4(off)	1.65	0.36~0.44
4	0.5	0.8	0.4	1.5	0.4(on)	1.65	11.753~17.630
5	1.0	1.0	1.0	10.0	0.1(off)	11.0	0.08~0.14
6	1.0	1.0	1.0	10.0	0.4(off)	11.0	0.36~0.44

Note) For how to use the OCR Tester, refer to the user manual enclosed with the tester.

3. Instantaneous trip

1) Changing OCR knob setting
   : Refer to Table 3 "Test table for Instantaneous trip" before setting.
   Set other protection function (Ir/Isd/Ig) to OFF.
2) Changing Tester setting
   : Refer to Table 3 "Test table for Instantaneous trip" before setting.
3) Press START button
4) Repeat steps 4) ~ 6) on page 22.
5) Current can be applied on all phase or single phase for trip operation.

Table 3

Test table for Instantaneous trip						
No.	Setting Condition					Standard Operation Time (Sec)
	OCR knob				TESTER (Current Base: In)	
	N/A Type		P/S Type			
	Iu	Ir	Ir	Ii	R/S/T	
1	In stantard does not influence operating time with any value setting.			2	2.2	Within 0.05 sec
2				6	6.6	
3				15	16.5	

Note) For how to use the OCR Tester, refer to the user manual enclosed with the tester.

4. Ground Fault Delay

1) Changing OCR knob setting
   : Refer to Table 4 "Test table for Ground fault trip" before setting.
   Set other protection function (Ir/Isd/Ii) to OFF.
2) Changing Tester setting
   : Refer to Table 4 "Test table for Ground fault trip" before setting.
3) Press START button
4) Repeat steps 4) ~ 6) on page 22.
5) Ground fault trip test only apply current to single phase.

Table 4

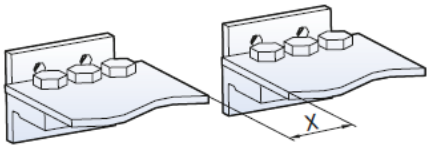
Test table for Ground Fault trip

No.	Setting Condition					TESTER (Current Base: In)	Standard Operation Time (Sec)
	OCR knob						
	N/A Type		P/S Type				
	Iu	Ir	Ir	Ig	tg(I^2 t)	R/S/T	
1	In stantard does not influence operating time with any value setting.			0.2	0.05(off)	0.24	0.02~0.08
2					0.1(off)	0.24	0.08~0.14
3					0.4(off)	0.24	0.36~0.44
4				1.0	0.05(off)	1.1	0.02~0.08
5					0.1(off)	1.1	0.08~0.14
6					0.4(off)	1.1	0.36~0.44

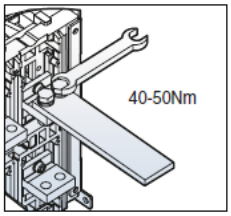
Note) For how to use the OCR Tester, refer to the user manual enclosed with the tester.

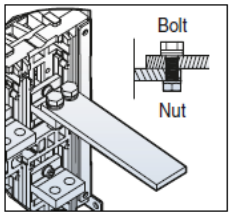
Minimum isolation distance

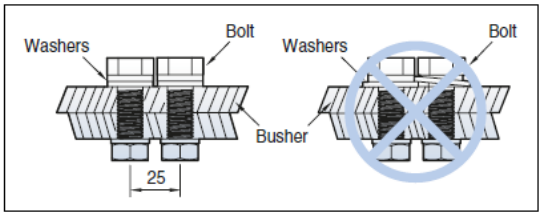
For the safety, all the electric charging parts need to be installed over minimum isolation distance.



Insulating voltage(Ui)	Minimum isolation distance(X min)
600V	8mm
1000V	14mm
1150V	16mm



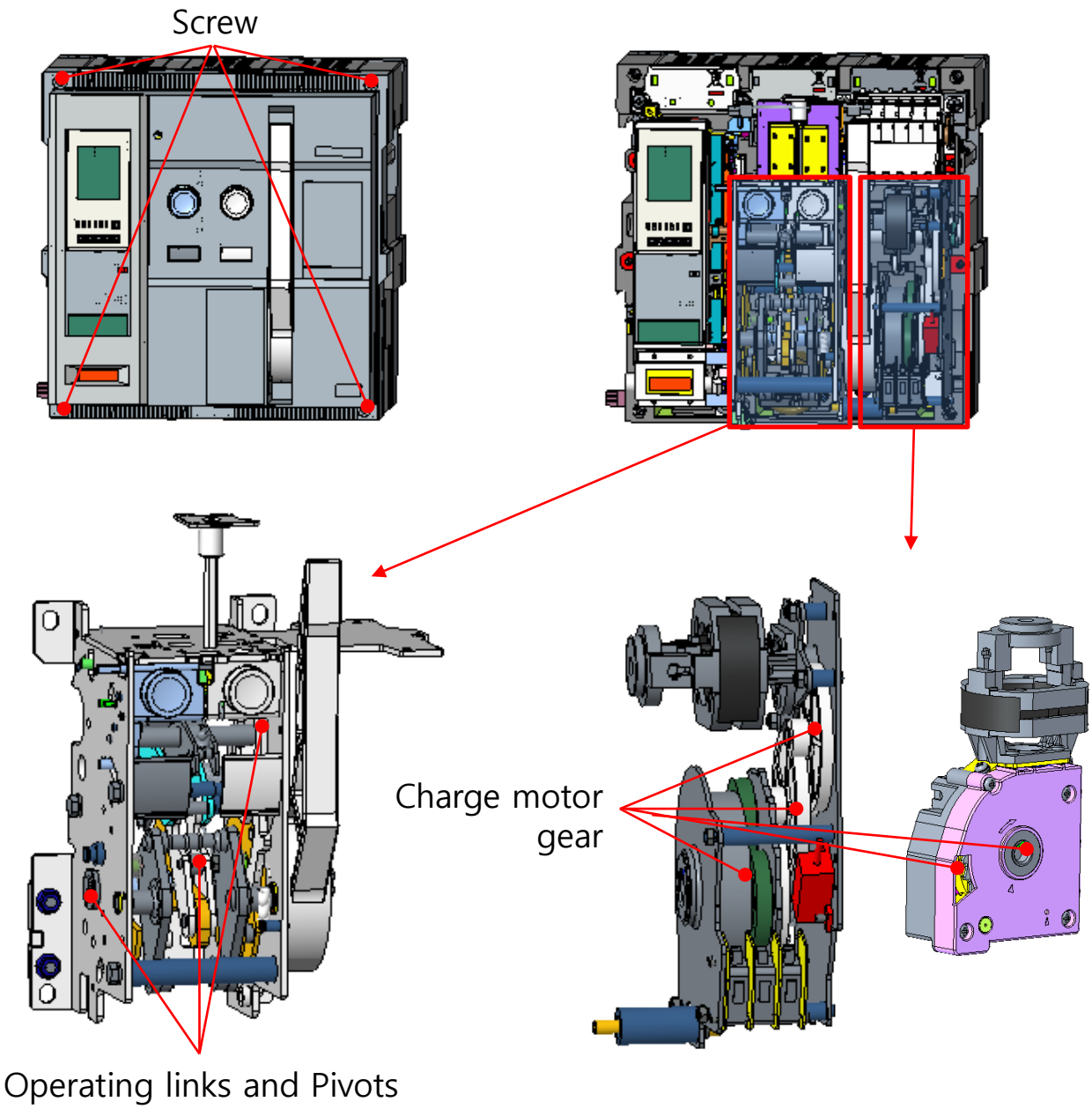




Screw type	Tightening torque			
	Standard(kgf · cm)	Tolerance	Standard(N.m)	Tolerance
M8	135	±16	13.3	±1.6
M10	270	±32	26.5	±3.2
M12	480	±57	46.6	±5.6

1. Parts of mechanism

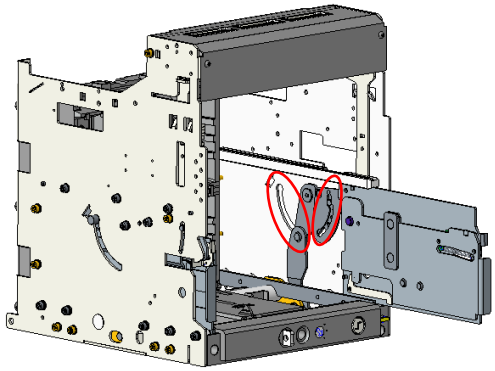
1) Loosen 4 screws for removing Front cover.
2) Regrease parts as below.
(Specification of grease : Mobiltemp SHC32 or NEO PLG-322)

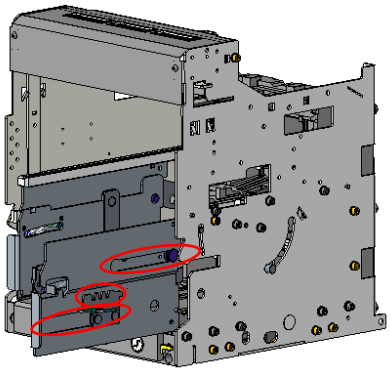


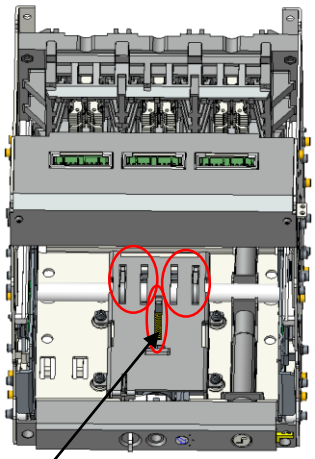
1. Cradle

Regrease parts as below. (Left and Right side)

(Specification of grease : Mobiltemp SHC32 or NEO PLG-322)



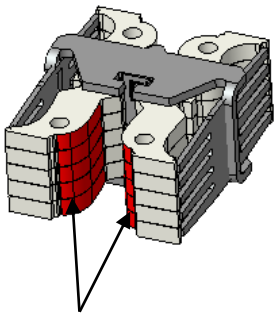


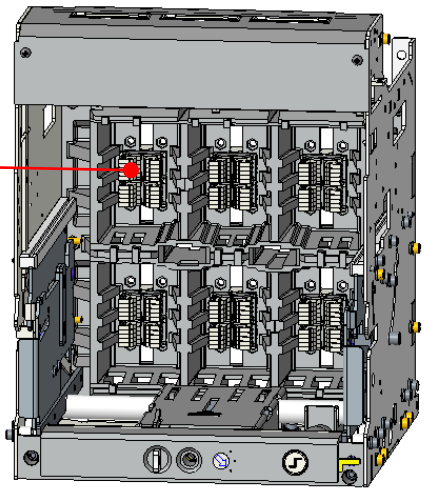


2. Cluster

Regrease all disconnecting-contact clusters. (Refer as below)

(Specification of grease : Mobiltemp SHC32)





Defects and Troubleshooting

Types of Defect	Cause	Countermeasure
The circuit breaker opens without giving an OPEN signal to the circuit breaker, and the F ault trip Reset button does not pop out.	No voltage or UVT is damaged.	Check the voltage. Replace the damaged UVT.
	Voltage disturbance occurred to the trip device.	Check the voltage supply part.
The circuit breaker opens at the same time as the closing operation and the reset button pops out.	Short circuit.	Check the condition of the breaker before re-closing.
	Transient current is too high at closing operation.	Revise the network or change the trip device setting.
The open operation can be performed manually but not for electrically.	Voltage supply to the trip device is too low. V<0.7Vn	Check the voltage supply. (0.7~1.1Vn)
	Defect on the trip device.	Replace the trip device.
Open operation does not work manually.	Damage on the mechanism.	Contact LSELECTRIC service center.
	Welding of main circuit.	Contact LSELECTRIC service center.
Breaker does not close manually or electrically or both.	Closing operation at short circuit state.	Check the moving contacts, if it is damaged or not.
	Fault trip reset button does not reset.	Reset fault trip reset button.
	Imperfect draw-in/out.	Check the position of the chassis.
	Anti-pumping function.	Re-operate manually after removing power of the closing coil.
	Spring charge of the breaker is not worked.	Check the power supply of the charging motor. If the manual charging does not work, contact LSELECTRIC service center.
	Power supply problem of the closing coil.	Check the manual operation after removing the power supply of the closing coil. When the manual closing operation is possible, apply the power again and check the electrical operation. If the manual operation is not possible, contact LSELECTRIC service center.

	Power supply problem of the trip coil	Remove the power supply of the trip coil
	Insufficient power supply of the UVT or defect.	Apply the voltage (V>0.85Vn) to UVT coil and check the closing operating using closing coil.
	Locked state of the breaker under open position.	Contact LSELECTRIC service center.
The breaker closes manually but does not close electrically.	Inappropriate voltage supply of the closing coil.	Check the voltage supply of the closing coil. (0.85~1.1Vn)
	Defective closing coil.	Replace the closing coil.
Motor charging malfunction.	Inappropriate voltage supply to the charging motor.	Check the voltage supply of the motor.
		Check the connections for the motor.
Draw-out handle cannot be inserted.	The handle insertion hole is closed.	Insert the handle while pressing the open button.
	Panel door is opened. (When Racking Interlock is used)	Panel handle can be inserted only when panel door is closed.
The breaker cannot be drawn -out	When the handle is inserted.	Remove Draw-out handle.
	The breaker is not in Disconnected position.	Draw out to the Disconnected position completely.
Breaker cannot be drawn in completely. (It is not in the connected position)	Inappropriate position of the clusters.	Relocate clusters to the right position.
	Safety shutter is locked.	Remove the lock.

Temperature-rise limit

The temperature-rise limit of the IEC 60947-2 is 80K based on the external connection terminal.

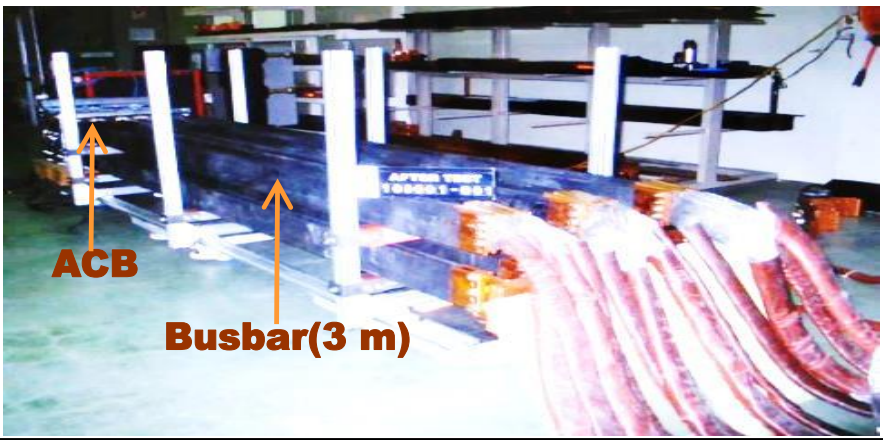
Table 7 – Temperature-rise limits for terminals and accessible parts

Description of part [a]	Temperature-rise limits [b] K
– Terminals for external connections	80
– Manual operating means:	
Metallic	25
non-metallic	35
– Parts intended to be touched but not hand-held:	
Metallic	40
non-metallic	50
– Parts which need not be touched for normal operation:	
Metallic	50
non-metallic	60

☐ **IEC standard & test conditions**

- **Temperature standard: 80 K** (External connection)
- **Test condition:** Free Air
  (Without Panel Enclosed Switchgear)

Temperature-rise test



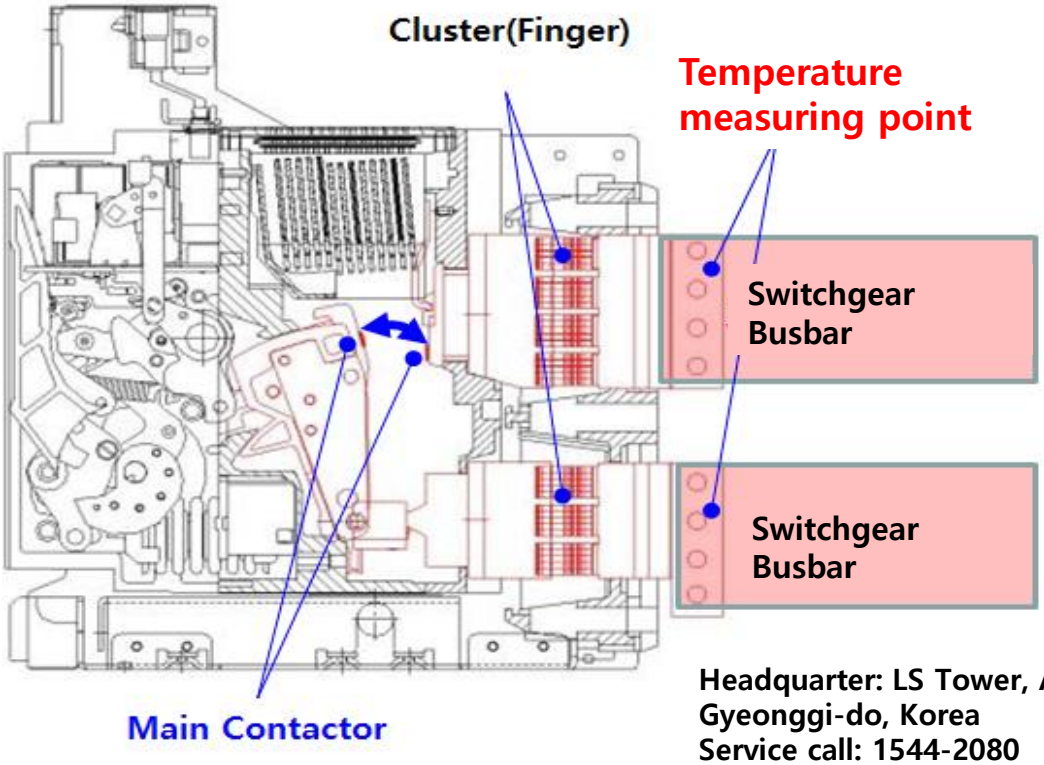
Temperature measuring

1. Use thermal camera to measure the temperature of the contact parts between the cradle and the busbar; Manage temperature rise below 80K compared to internal panel temperature.
   (If the temperature inside the panel is 30 degrees, up to 110 degrees is allowed)

2. If exceeded, please contact LSELECTRIC service center.

3. For temporary measure, opening the panel door would help to lower the temperature.

4. Possible defects when overheated.
   1) Decrease product life.
   2) Abnormal ACB Trip. (CT burnt, molding material melting)
   3) Increasing contact resistance of cradle finger.
   4) Both ACB Adapter and Cradle Finger carbonized and discolored.



Headquarter: LS Tower, Anyang-si, Gyeonggi-do, Korea
Service call: 1544-2080

http://www.lselectric.co.kr

Operation life cycle

Susol/Metasol /Compact ACB		Life Cycle (MAX)		Guarantee Life Cycle*		
		Mechanical	Electrical	Mechanical	Short Circuit Breaking	Electrical
1600AF 2000AF	AN-D AS-D AH-D	20000	5000	2500	O-CO-CO	500
3200AF 4000AF	AN-E AS-E AH-E	15000	5000	1500		
5000AF	AS-F AS-G AH-G	10000	2000			
6300AF	AS-G AH-G	10000	2000			
1600AF	AN-C AH-C	12500	6000	2500		
1000AF	AR-C	5000	3000			
2000AF	AV-D AV-E AW-D	20000	1000	2500		
2500AF	AW-E	15000	1000	2500		
2500AF	AV-E	20000	1000	2500		
3200AF 4000AF	AW-E	15000	1000	1500		
3200AF 4000AF	AV-E	20000	1000	1500		

Notes)
1. DC product and Disconnector product have the same mechanical life cycle. For electrical life cycle, refer to the catalog registered on the website.
2. * Guarantee Life Cycle is according to IEC60947-2.

LSELECTRIC always appreciates your consideration and support for our products.

**Headquarter: LS Tower, Anyang-si,
Gyeonggi-do, Korea
Service call: 1544-2080**

http://www.lselectric.co.kr

2022.07.28