

# TeSys F

## Maintenance Guide



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## Preface

Thank you for purchasing TeSys F range of contactors from Schneider Electric.

This guide provides a systematic, detailed and comprehensive procedure for the installation of contactors. This guide also functions to provide help to overcome some common difficulties faced during the installation and operation of the contactors.

These difficulties have been identified using customer feedback and thus the guide provides comprehensive explanations and solutions for the commonly faced difficulties during installation. This guide also helps in overcoming some common problems during operation. The guide intends to help authorized service centres, distributors and the end users.

Hoping that the guide encompasses solutions to all the problems that are most likely to be faced during installation and operation of contactors

Schneider Electric

## TeSys F Contactors - Applications

### Typical Applications:



Wind Power



Photo-Voltaic



Material handling

### Other applications:



## Selection of Contactors

Scope : TeSys F Contactors (115A-2600A)  
 Utilisation Category : AC-3 (115- 800A)  
 : AC-1 (200-2600A)

This document is useful for:

- Authorised Service centres, end-users & distributors

Objective of this document:

1. To explain the visual inspection methods
2. To trouble shoot the common problems faced in field.

Contactors have very high electrical life & normally don't need maintenance. But it's always better to have some periodical checking on the following parameters.

1. Over heating
2. Loose terminals
3. Loose connection on lugs
4. Color change of insulation on cables or bus bars, etc.,

Selection of right rating of contactor based on the full-load current and on utilisation category is very important. If you are at the performance limit select a bigger contactor.

|                    |          |          |          |          |          |          |          |          |          |          |          | New       | New        |           |           |           |           | New       |
|--------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|------------|-----------|-----------|-----------|-----------|-----------|
| Contactor type     | LC1 F115 | LC1 F150 | LC1 F185 | LC1 F225 | LC1 F265 | LC1 F330 | LC1 F400 | LC1 F500 | LC1 F630 | LC1 F780 | LC1 F800 | LC1 F1000 | LC1 SF1200 | LC1 F1250 | LC1 F1400 | LC1 F1700 | LC1 F2100 | LC1 F2600 |
| Ie AC3 @ ≤ 440V AC | 115A     | 150A     | 185A     | 225A     | 265A     | 330A     | 400A     | 500A     | 630A     | 780A     | 800A     | 1000A     | -          | -         | -         | -         | -         | -         |
| Ie AC1 @ ≤ 440V AC | 200A     | 250A     | 275A     | 315A     | 350A     | 400A     | 500A     | 700A     | 1000A    | 1600A    | 1000A    | 1250A     | 1200A      | 1260A     | 1400A     | 1700A     | 2100A     | 2600A     |
| Ue (up to)         | 1000V    |          |          |          |          |          |          |          |          |          |          |           | 690V       |           | 1000V     |           |           |           |
| 2P                 |          |          |          |          |          |          |          |          |          |          |          |           |            |           |           |           |           |           |
| 3P                 |          |          |          |          |          |          |          |          |          |          |          |           |            |           |           |           |           |           |
| 4P                 |          |          |          |          |          |          |          |          |          |          |          |           |            |           |           |           |           |           |
| Width 3P (mm)      |          |          | 168.5    | 201.5    | 213      | 233      | 309      | 702      | 309      | 438      | 233      | 309       |            | 438       |           |           | 519       |           |

## Contactor utilisation categories conforming to IEC 60947-1

The standard utilisation categories define the current values which the contactor must be able to make or break. These values depend on:

- the type of load being switched: squirrel cage or slip ring motor, resistors,
- the conditions under which making or breaking takes place: motor stalled, starting or running, reversing, plugging.

### Category AC-1

This category applies to all types of a.c. load with a power factor equal to or greater than 0.95 ( $\cos \Phi \geq 0.95$ ).

Application examples: heating, distribution.

### Category AC-2

This category applies to starting, plugging and inching of slip ring motors.

- On closing, the contactor makes the starting current, which is about 2.5 times the rated Current of the motor.
- On opening, it must break the starting current, at a voltage less than or equal to the mains supply voltage.

### Category AC-3

This category applies to squirrel cage motors with breaking during normal running of the motor.

- On closing, the contactor makes the starting current, which is about 5 to 7 times the rated Current of the motor.
- On opening, it breaks the rated current drawn by the motor; at this point, the voltage at the Contactor terminals are about 20 % of the mains supply voltage. Breaking is light.

Application examples: all standard squirrel cage motors: lifts, escalators, conveyor belts, bucket Elevators, compressors, pumps, mixers, air conditioning units, etc... .

### Category AC-4

This category covers applications with plugging and inching of squirrel cage and slip ring motors.

- The contactor closes at a current peak which may be as high as 5 or 7 times the rated motor current.
- On opening it breaks this same current at a voltage which is higher, the lower the motor speed. This voltage can be the same as the mains voltage. Breaking is severe.

Application examples: printing machines, wire drawing machines, cranes and hoists, metallurgy Industry.

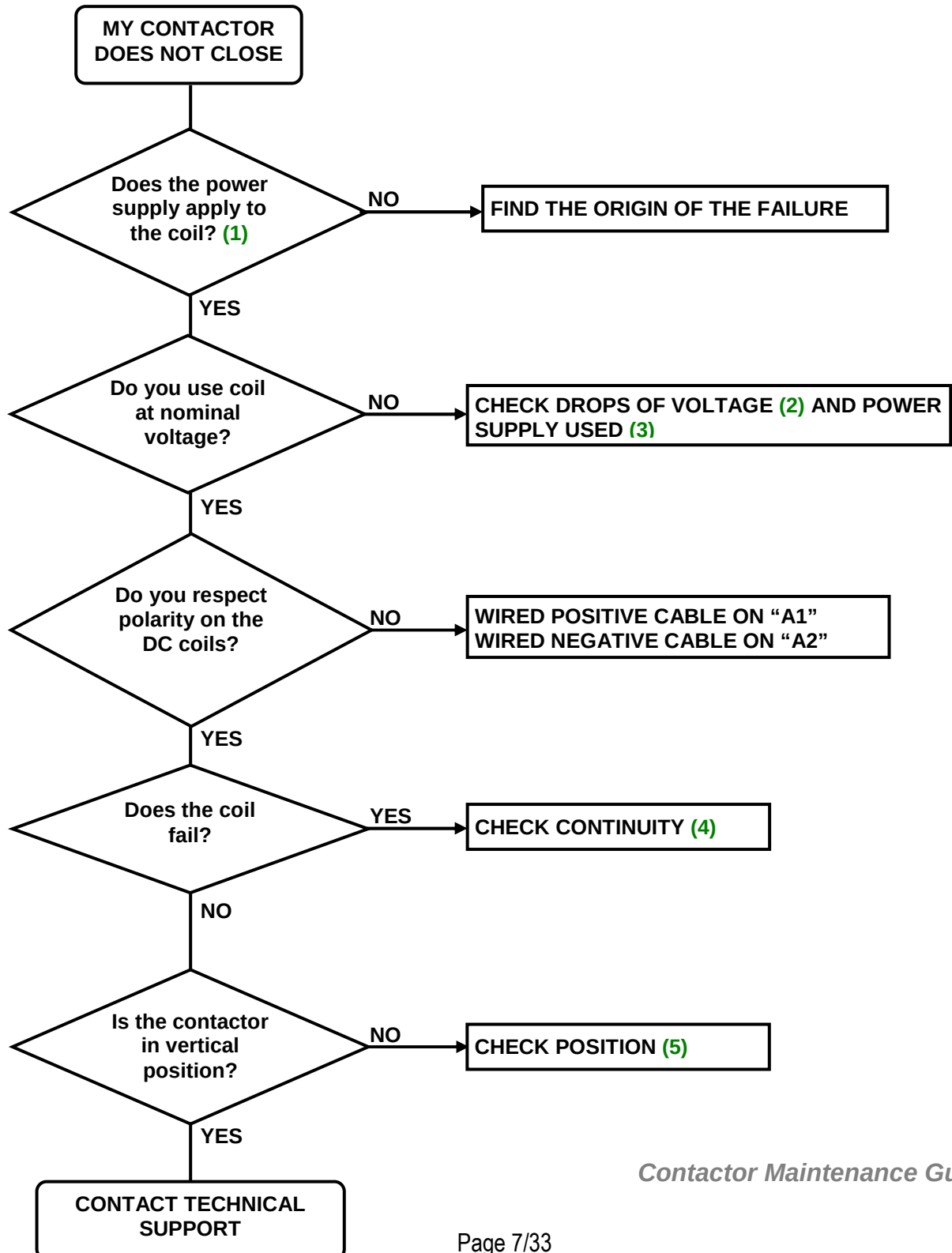
## Troubleshooting Contactors in Field

### How to troubleshoot my contactor if it does not close?

Use this troubleshooting guide if your power is not applied on your load after supplying your contactor's coil.

Tools Required:

- A controller to check voltage and resistance
- A screw driver



## (1) The power supply applies to the Coil

Check coil voltage:

a) Look after your coil range:

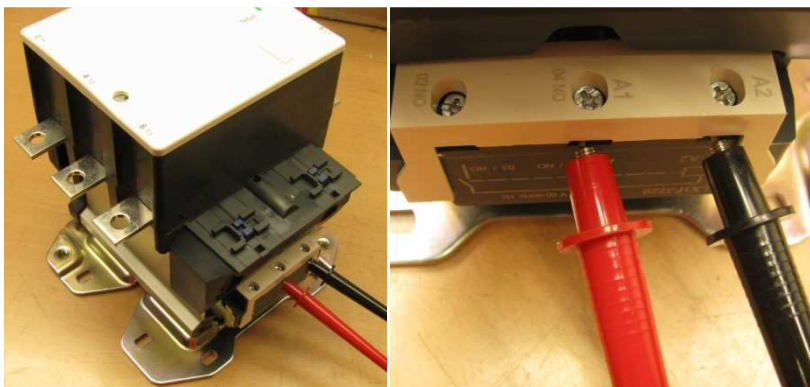


c) Measure:



When contactor is driven the coils voltage should be different than "0 Volts"

b) Put your probe on coil terminal A1 A2:



## (2) Drop of voltage

On power up sequence check if the voltage is stable. We can have different root cause for this issue:

- a) You drive simultaneously more than one contactor and your power supply is not correctly sized -see point (3)-
- b) You have a too long distance between supply and coil terminal. You will have to verify that your cable is correctly sized regarding the distance between the power supply and the contactor.



### (3) Power supply used

Your power supply should be able to support the sums of all contactors inrush current. Please, for the inrush current level of each individual contactor, you will have to refer to the technical data for each contactor you drive

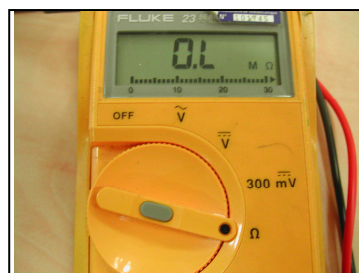
### (4) Continuity

For this point you will need to use a multi-meter to verify coils resistance. This resistance value should be between some Ohms to kOhms this depends of coils voltage and contactor models

a) If you found a value close less than 0.1 ohms you are facing a coil short circuit:



b) If you have an infinite value you are facing an open coils circuit

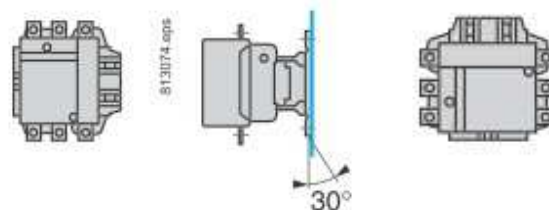


For both situations, you have to replace coil or the full contactor if you have no other possibility.

### (5) Contactor Position

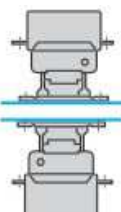
Operating positions  
Without de-rating

(Not to be used for LC1 F780, F1400  
F1700 F2100 & F2600)

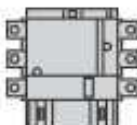


Operating positions  
With de-rating

(Not to be used for LC1 1250,  
F1400, F1700 F2100 & F2600)



Not to be used

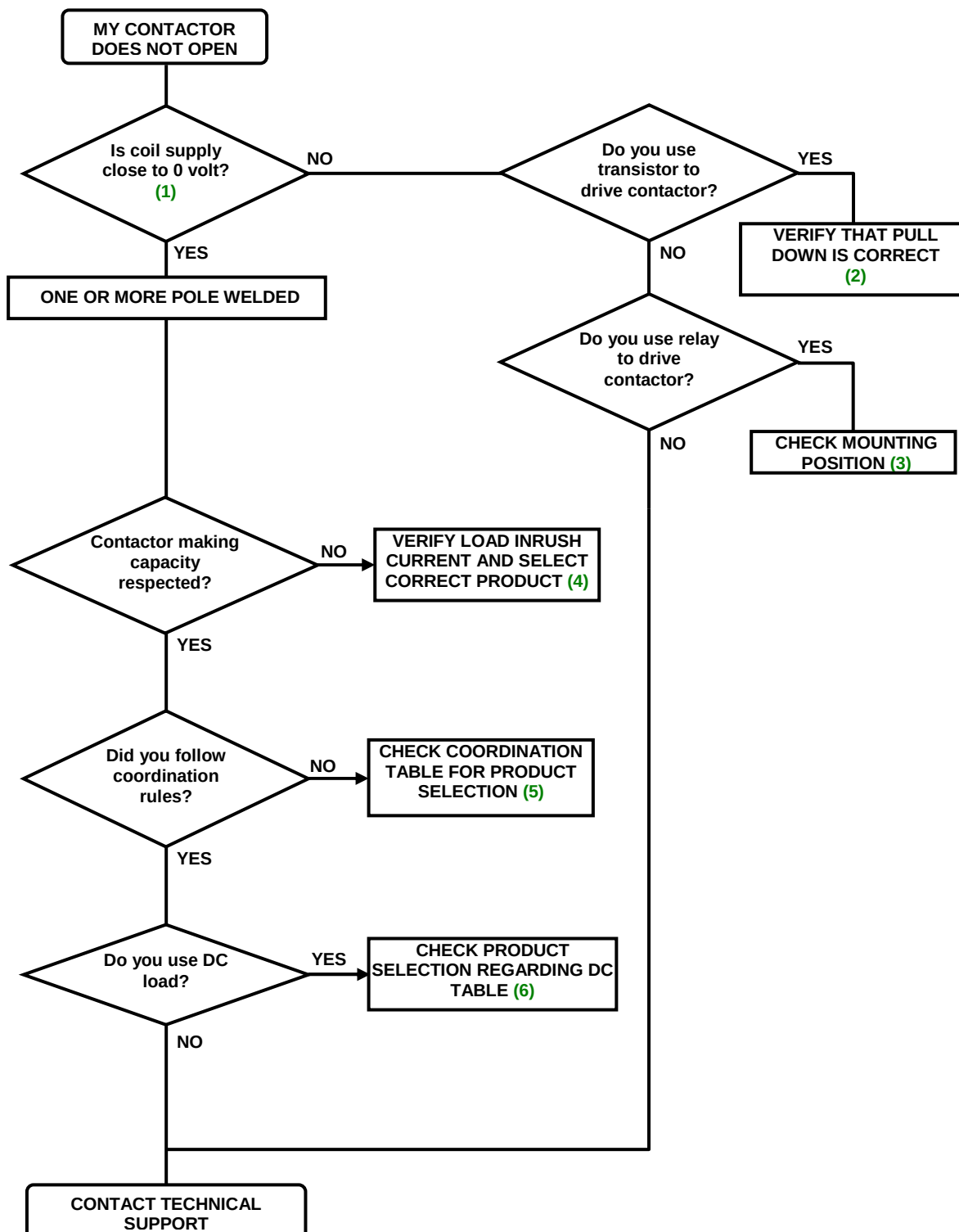


## How to troubleshoot my contactor if it does not open?

Use this troubleshooting guide in this case: contactor successfully closed but on stop order (remove voltage on coil) the power is still applied, even partially, to the load.

Tools Required:

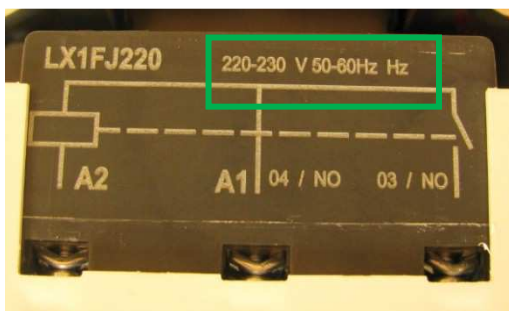
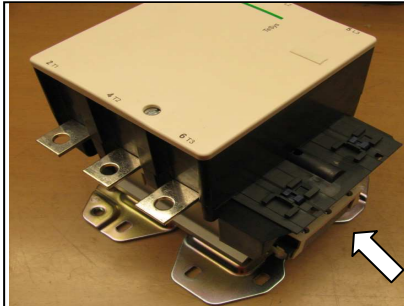
- A controller to check voltage
- A screw driver



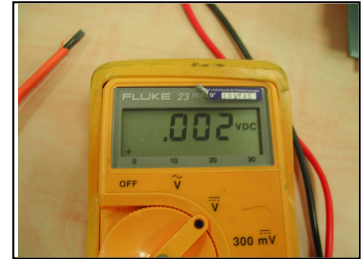
**(1) Coil supply is close to 0 volt**

Check coil voltage:

a) Look after your coil range:

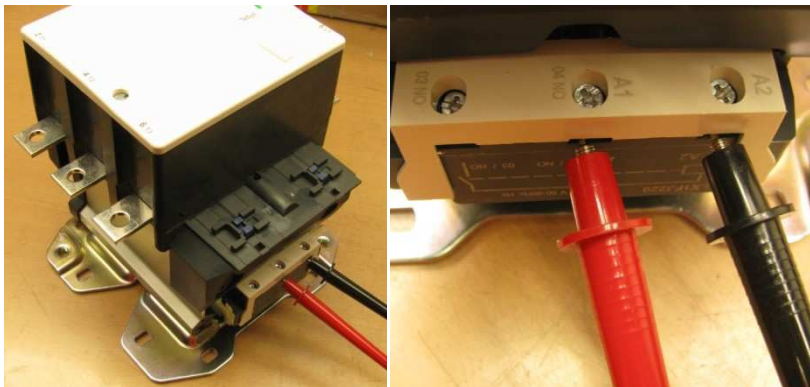


c) Measure:



b) Put your probe on coil terminal A1 A2:

:

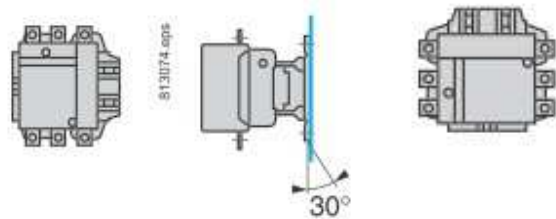
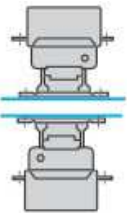
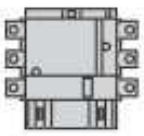


**(2) Verify that pull down is correct**

You should not have a residual voltage on your coil. In this case, you may not open completely the contactor even if the voltage is lower than the minimum “operating voltage” value.

### (3) Check mounting position

You should be in the correct position see pictures bellow

|                                                                                                                         |                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <p>Operating positions<br/>Without de-rating</p> <p>(Not to be used for LC1 F780,F1400<br/>F1700 F2100 &amp; F2600)</p> |   |
| <p>Operating positions<br/>With de-rating</p> <p>(Not to be used for LC1 1250,<br/>F1400, F1700 F2100 &amp; F2600)</p>  |    |
| <p>Not to be used</p>                                                                                                   |  |

### (4) Verify load inrush current and select correct product

You will have to verify that inrush current level does not exceed the making capacity of your contactor. For this you will have to refer to technical information of your contactor.

### (5) Check coordination table and product selection

You will have to verify that your contactor is correctly sized in regards of your application and coordination level you want. For this you will have to refer to technical information provided by coordination table.

### (6) Check product selection regarding DC table

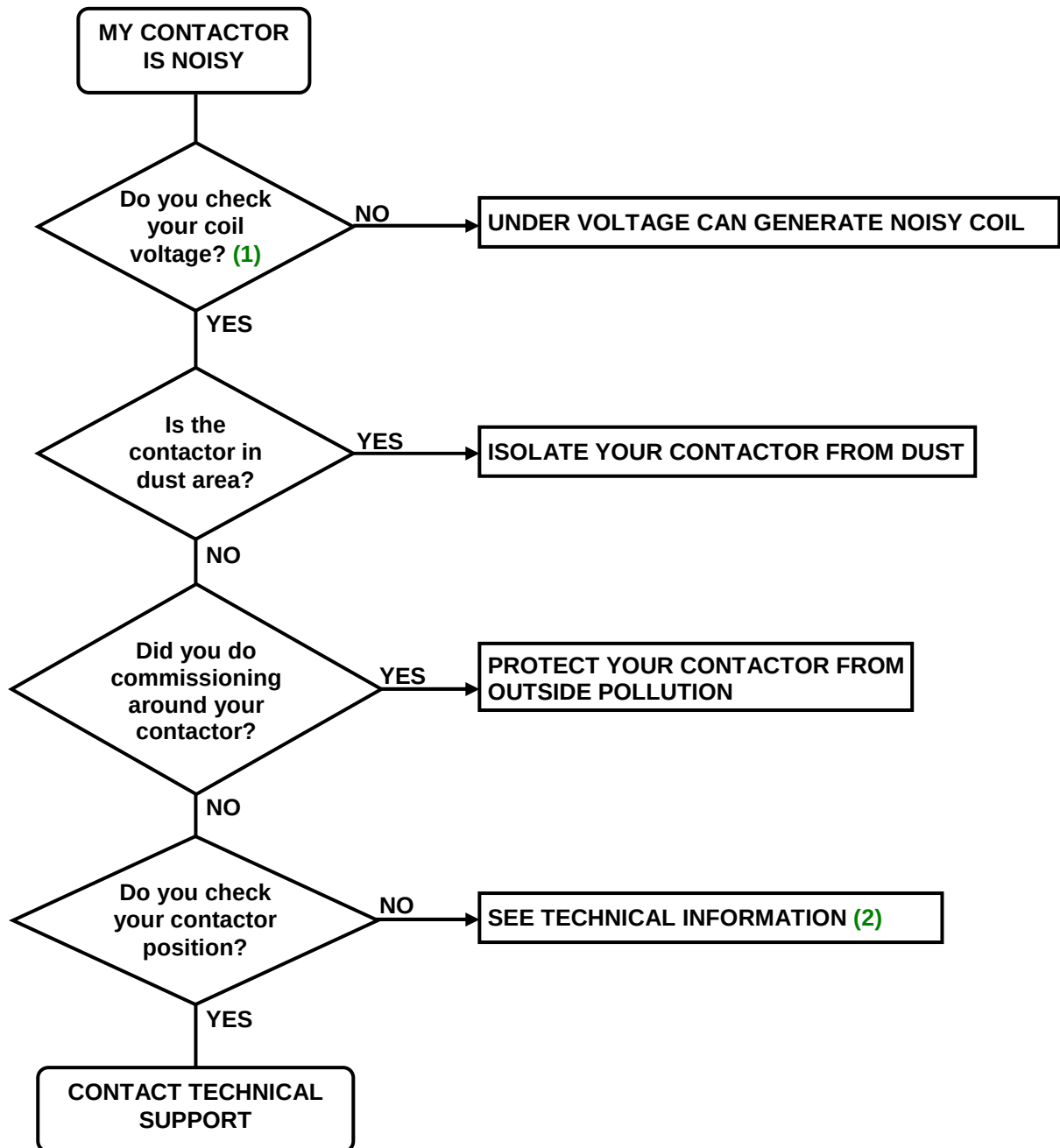
You will have to verify that current level does not exceed the breaking capacity of your contactor in DC application. For this you will have to refer to technical information provided in DC table.

## How to troubleshoot contactor if it is noisy?

Use this troubleshooting guide if your contactor is noisier than others contactors located in the same area.

Tools required:

- A controller to check voltage
- A screw driver



## (1) Coil voltage

Check coil voltage:

a) Look after your coil range:

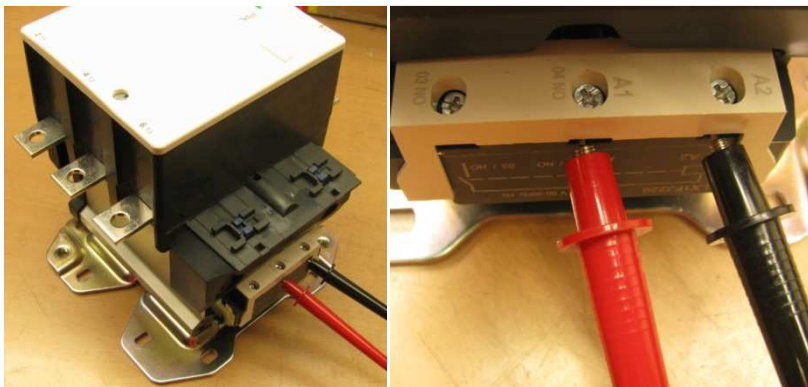


c) Measure:



When contactor is driven the coils voltage should be different than "0 Volts"

b) Put your probe on coil terminal A1 A2:

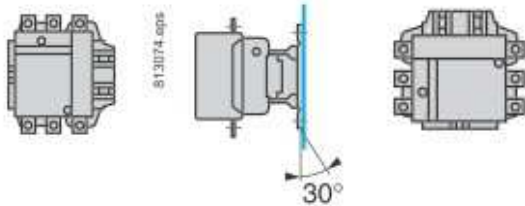


Verify the voltage you measure is in the allowed range of "operating voltage" for the contactor you use. See technical data concerning your contactor

(2) Contactor position

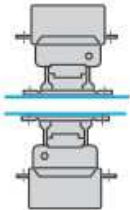
Operating positions  
Without de-rating

(Not to be used for LC1 F780,F1400  
F1700 F2100 & F2600)

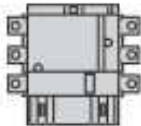


Operating positions  
With de-rating

(Not to be used for LC1 1250,  
F1400, F1700 F2100 & F2600)

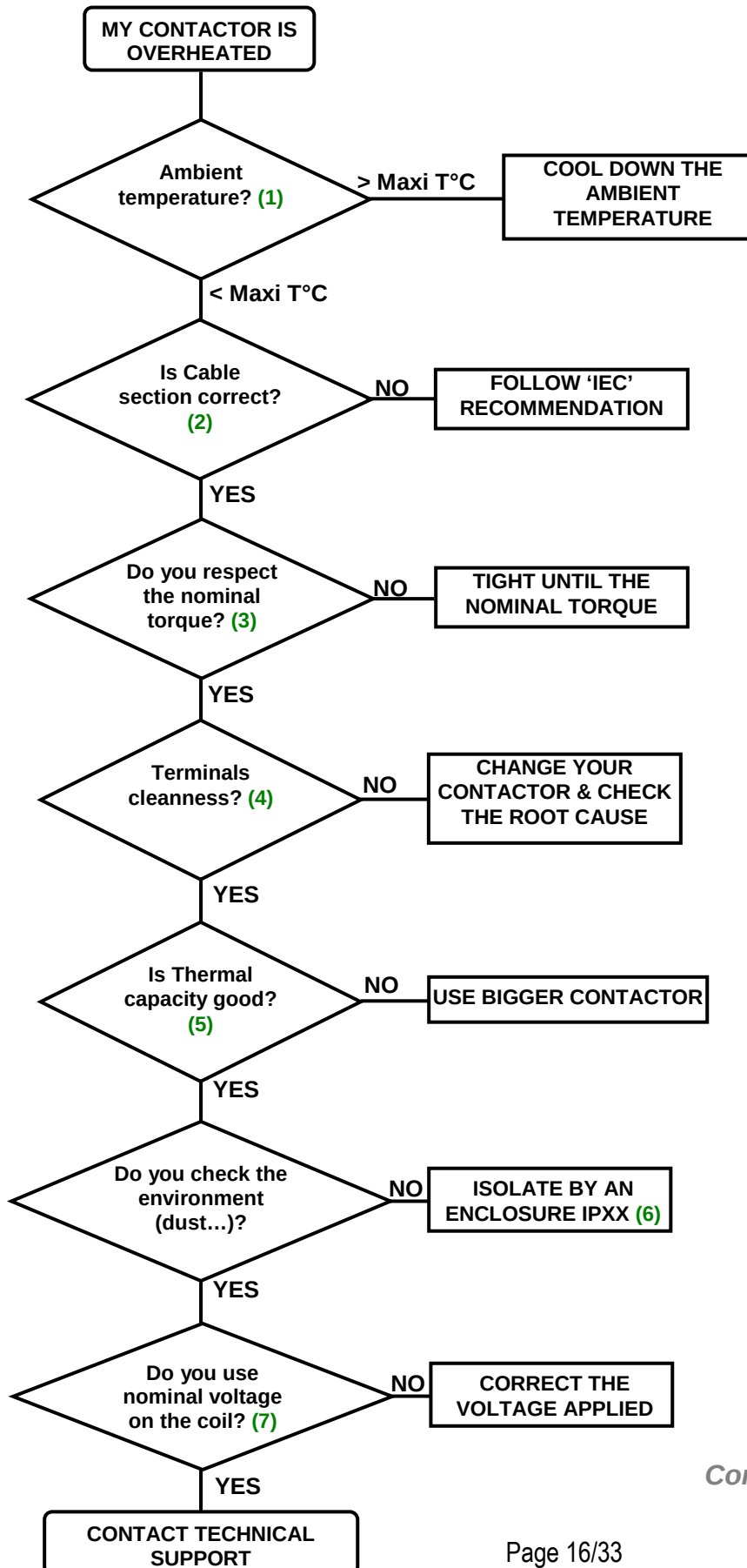


Not to be used



## Why does the contactor over heat?

Use this troubleshooting guide in this case: contactor is overheated. The flow chart will describe you different possible root cause for this behaviour in order to understand why the contactor is overheated into your application.





## (1) Ambient Temperature

The IEC standard 60947 defines temperature raise regarding the ambient temperature.

The maximum ambient temperatures allowed for our contactors are:

For K range + 50°C

For D range + 60°C

For F range + 55°C

For Bar contactor (LC1B\*\* or CV1/3\*) + 55°C

In case the contactor is overheating, you will have to sum the ambient temperature and the temperature raise allowed (See table below for temperature raise allowed on our contactor).

*Example for terminals connections:*

Ambient temperature: + 35°C

Terminals temperature raise allowed + 65K

=> If your terminal temperature is less than  $35 + 65K = 100^{\circ}C$  your contactor is not overheating.

**Table 2 – Temperature-rise limits of terminals**  
(see 7.2.2.1 and 8.3.3.3.4)

| Terminal material                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Temperature-rise limits <sup>1) 3)</sup><br>K |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Bare copper                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 60                                            |
| Bare brass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 65                                            |
| Tin plated copper or brass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 65                                            |
| Silver plated or nickel plated copper or brass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 70                                            |
| Other metals                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <sup>2)</sup>                                 |
| <sup>1)</sup> The use in service of connected conductors significantly smaller than those listed in tables 9 and 10 could result in higher terminals and internal part temperatures and such conductors should not be used without the manufacturer's consent since higher temperatures could lead to equipment failure.<br><sup>2)</sup> Temperature-rise limits to be based on service experience or life tests but not to exceed 65 K.<br><sup>3)</sup> Different values may be prescribed by product standards for different test conditions and for devices of small dimensions, but not exceeding by more than 10 K the values of this table. |                                               |

**Table 3 – Temperature-rise limits of accessible parts**  
(see 7.2.2.2 and 8.3.3.3.4)

| Accessible parts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Temperature-rise limits <sup>1)</sup><br>K |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
| <b>Manual operating means:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                            |
| Metallic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 15                                         |
| Non-metallic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 25                                         |
| <b>Parts intended to be touched but not hand-held:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                            |
| Metallic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 30                                         |
| Non-metallic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 40                                         |
| <b>Parts which need not be touched during normal operation<sup>2)</sup>:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                            |
| Exteriors of enclosures adjacent to cable entries:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                            |
| Metallic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 40                                         |
| Non-metallic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 50                                         |
| Exterior of enclosures for resistors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 200 <sup>2)</sup>                          |
| Air issuing from ventilation openings of enclosures for resistors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 200 <sup>2)</sup>                          |
| <sup>1)</sup> Different values may be prescribed by product standards for different test conditions and for devices of small dimensions but not exceeding by more than 10 K the values of this table.<br><sup>2)</sup> The equipment shall be protected against contact with combustible materials or accidental contact with personnel. The limit of 200 K may be exceeded if so stated by the manufacturer. Guarding and location to prevent danger is the responsibility of the installer. The manufacturer shall provide appropriate information, in accordance with 5.3. |                                            |

## (2) Cable Section

An incorrect cable section choice in regards of current level creates cable overheating. The consequence is contactor overheated. You can find recommendation regarding IEC standard for cable section regarding current level.

**Table 9 – Test copper conductors for test currents up to 400 A inclusive\***  
(see 8.3.3.3.4)

| Range of test current <sup>1)</sup> |     | Conductor size <sup>2), 3), 4)</sup> |         |
|-------------------------------------|-----|--------------------------------------|---------|
| A                                   |     | mm <sup>2</sup>                      | AWG/MCM |
| 0                                   | 8   | 1,0                                  | 18      |
| 8                                   | 12  | 1,5                                  | 16      |
| 12                                  | 15  | 2,5                                  | 14      |
| 15                                  | 20  | 2,5                                  | 12      |
| 20                                  | 25  | 4,0                                  | 10      |
| 25                                  | 32  | 6,0                                  | 10      |
| 32                                  | 50  | 10                                   | 8       |
| 50                                  | 65  | 16                                   | 6       |
| 65                                  | 85  | 25                                   | 4       |
| 85                                  | 100 | 35                                   | 3       |
| 100                                 | 115 | 35                                   | 2       |
| 115                                 | 130 | 50                                   | 1       |
| 130                                 | 150 | 50                                   | 0       |
| 150                                 | 175 | 70                                   | 00      |
| 175                                 | 200 | 95                                   | 000     |
| 200                                 | 225 | 95                                   | 0000    |
| 225                                 | 250 | 120                                  | 250     |
| 250                                 | 275 | 150                                  | 300     |
| 275                                 | 300 | 185                                  | 350     |
| 300                                 | 350 | 185                                  | 400     |
| 350                                 | 400 | 240                                  | 500     |

\* See notes following table 11.

**Table 10 – Test copper conductors for test currents above 400 A and up to 800 A inclusive\***  
(see 8.3.3.3.4)

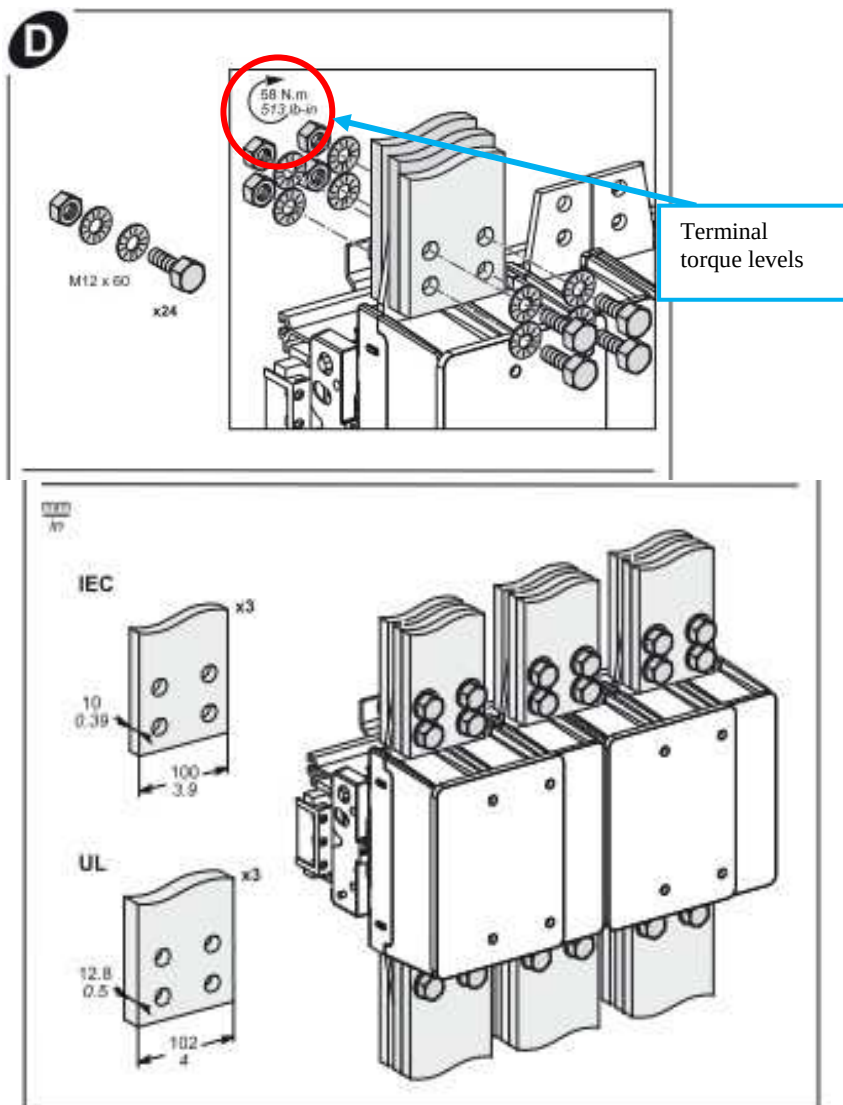
| Range of test current <sup>1)</sup><br>A |     | Conductors <sup>2), 3), 4)</sup> |                      |        |          |
|------------------------------------------|-----|----------------------------------|----------------------|--------|----------|
|                                          |     | Metric                           |                      | MCM    |          |
|                                          |     | Number                           | Size mm <sup>2</sup> | Number | Size MCM |
| 400                                      | 500 | 2                                | 150                  | 2      | 250      |
| 500                                      | 630 | 2                                | 185                  | 2      | 350      |
| 630                                      | 800 | 2                                | 240                  | 3      | 300      |

\* See notes following table 11.

### (3) Nominal Torque

Loose connection on terminal creates overheating condition (check torque level on terminals). You can find these values on the product's sticker.

Example:



### (4) Terminals cleanliness

Unclean terminals (dust, pollution...) increases connection resistance and in this case creates overheating effect.

## (5) Thermal capacity

Please choose your contactor correctly based on full load current and on utilisation category. If you are at the performance limit select a bigger contactor.

(From Catalogue 2016 Motor control and protection components):

### Characteristics

## TeSys contactors

### TeSys F contactors

Utilisation category AC-3 (115 to 1000 A),

AC-1 (200 to 2600 A)

Control circuit: a.c. or d.c. supply

### TeSys F

| Pole characteristics                                                                       |                                           |    |                                                              |                          |                          |                          |
|--------------------------------------------------------------------------------------------|-------------------------------------------|----|--------------------------------------------------------------|--------------------------|--------------------------|--------------------------|
| Contactor type                                                                             |                                           |    | LC1 F115                                                     | LC1 F150                 | LC1 F185                 | LC1 F225                 |
| Number of poles                                                                            |                                           |    | 3 or 4                                                       | 3 or 4                   | 3 or 4                   | 3 or 4                   |
| Rated operational current (Ie)<br>(Ue ≤ 440 V)                                             | In AC-3, θ ≤ 55 °C                        | A  | 115                                                          | 150                      | 185                      | 225                      |
|                                                                                            | In AC-1, θ ≤ 40 °C                        | A  | 200                                                          | 250                      | 275                      | 315                      |
| Rated operational voltage<br>(Ue)                                                          | Up to                                     | V  | 1000                                                         | 1000                     | 1000                     | 1000                     |
| Frequency limits                                                                           | Of the operational current <sup>(1)</sup> | Hz | 16 <sup>2/3</sup> ...200                                     | 16 <sup>2/3</sup> ...200 | 16 <sup>2/3</sup> ...200 | 16 <sup>2/3</sup> ...200 |
| Conventional thermal current                                                               | θ ≤ 40 °C                                 | A  | 200                                                          | 250                      | 275                      | 315                      |
| Rated making capacity                                                                      | I rms conforming to IEC 60947-4-1         | A  | Making current: 10 x I in AC-3 or 12 x I in AC-4             |                          |                          |                          |
| Rated breaking capacity                                                                    | I rms conforming to IEC 60947-4-1         | A  | Making and breaking current: 8 x I in AC-3 or 10 x I in AC-4 |                          |                          |                          |
| Maximum permissible current<br>No current flowing for previous<br>60 minutes, at θ ≤ 40 °C | For 10 s                                  | A  | 1100                                                         | 1200                     | 1500                     | 1800                     |
|                                                                                            | For 30 s                                  | A  | 640                                                          | 700                      | 920                      | 1000                     |
|                                                                                            | For 1 min                                 | A  | 520                                                          | 600                      | 740                      | 850                      |
|                                                                                            | For 3 min                                 | A  | 400                                                          | 450                      | 500                      | 560                      |
|                                                                                            | For 10 min                                | A  | 320                                                          | 350                      | 400                      | 440                      |

## (6) IPxx of enclosure

Dust or other pollution can increase contact resistance and create an overheating situation. We recommend to use IP6\* enclosure (sealed) or for alternative solution IP5\* enclosure in association with pressurization system, this will not allow pollution to enter in the enclosure. In order to understand what IP code means, we put below the description (*From Catalogue 2016 Motor control and protection components*):

| IP ●●● code                                                                                                                                                                                                                                                                                                                                         |                                                                                   |  |                                                                                                                                                                               |  |                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--------------------------------------------------------------------------------|
| The IP code comprises <b>2 characteristic numerals</b> (e.g. IP 55) and may include an <b>additional letter</b> when the actual protection of personnel against direct contact with live parts is better than that indicated by the first numeral (e.g. IP 20C). Any characteristic numeral which is unspecified is replaced by an X (e.g. IP XXB). |                                                                                   |  |                                                                                                                                                                               |  |                                                                                |
| 1 <sup>st</sup> characteristic numeral                                                                                                                                                                                                                                                                                                              |                                                                                   |  | 2 <sup>nd</sup> characteristic numeral                                                                                                                                        |  | Additional letter                                                              |
| corresponds to protection of the equipment against penetration of solid objects and protection of personnel against direct contact with live parts.                                                                                                                                                                                                 |                                                                                   |  | corresponds to protection of the equipment against penetration of water with harmful effects.                                                                                 |  | corresponds to protection of personnel against direct contact with live parts. |
| Protection of the equipment                                                                                                                                                                                                                                                                                                                         | Protection of personnel                                                           |  |                                                                                                                                                                               |  |                                                                                |
| <b>0</b> Non-protected                                                                                                                                                                                                                                                                                                                              | Non-protected                                                                     |  | <b>0</b> Non-protected                                                                                                                                                        |  | <b>A</b> With the back of the hand.                                            |
| <b>1</b>  Protected against the penetration of solid objects having a diameter greater than or equal to 50 mm                                                                                                                                                      | Protected against direct contact with the back of the hand (accidental contacts). |  | <b>1</b>  Protected against vertical dripping water, (condensation).                         |  | <b>B</b> With the finger.                                                      |
| <b>2</b>  Protected against the penetration of solid objects having a diameter greater than or equal to 12.5 mm.                                                                                                                                                  | Protected against direct finger contact.                                          |  | <b>2</b>  Protected against dripping water at an angle of up to 15°.                        |  | <b>C</b> With a Ø2.5 mm tool.                                                  |
| <b>3</b>  Protected against the penetration of solid objects having a diameter greater than or equal to 2.5 mm.                                                                                                                                                  | Protected against direct contact with a Ø2.5 mm tool.                             |  | <b>3</b>  Protected against rain at an angle of up to 60°.                                 |  | <b>D</b> With a Ø1 mm wire.                                                    |
| <b>4</b>  Protected against the penetration of solid objects having a diameter greater than or equal to 1 mm.                                                                                                                                                    | Protected against direct contact with a Ø1 mm wire.                               |  | <b>4</b>  Protected against splashing water in all directions.                             |  |                                                                                |
| <b>5</b>  Dust protected (no harmful deposits).                                                                                                                                                                                                                  | Protected against direct contact with a Ø1 mm wire.                               |  | <b>5</b>  Protected against water jets in all directions.                                  |  |                                                                                |
| <b>6</b>  Dust tight.                                                                                                                                                                                                                                            | Protected against direct contact with a Ø1 mm wire.                               |  | <b>6</b>  Protected against powerful jets of water and waves.                              |  |                                                                                |
|                                                                                                                                                                                                                                                                                                                                                     |                                                                                   |  | <b>7</b>  Protected against the effects of temporary immersion.                            |  |                                                                                |
|                                                                                                                                                                                                                                                                                                                                                     |                                                                                   |  | <b>8</b>  Protected against the effects of prolonged immersion under specified conditions. |  |                                                                                |

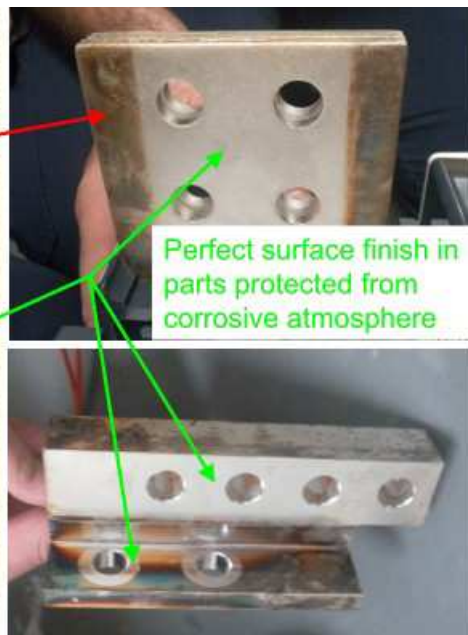
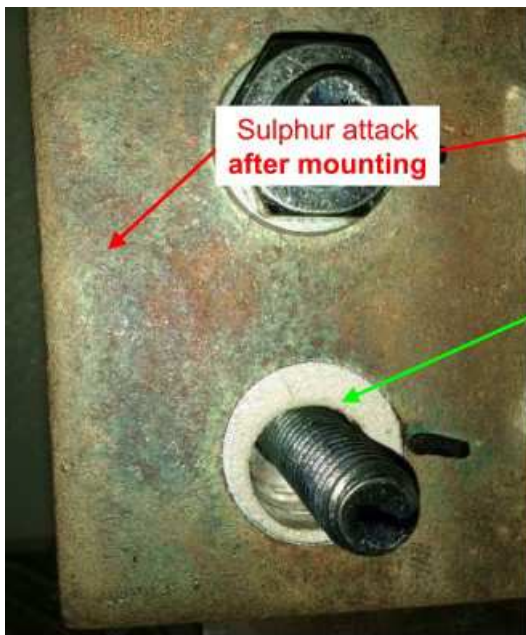
## (7) Coil Nominal Voltage

Incorrect voltage applied on coil can increase coil temperature and create contactor overheating. Check the nominal coil voltage (Uc) on your contactor and your power supply should have a level between 0.85 and 1.1 x Uc.



## Sulphuration on contact terminals and bus bars

Abnormal colors observed are “yellow, blue or dark black” on F-range higher ratings above 1400A.



New Products received by customer are without any defect.



### Root cause

- Sulphuration on pieces (with silver coating) appears only after mounting (protected areas of pieces are not sulphured).
- It means that silver reacts with sulphur
- Sulphur could be present in atmosphere either in assembly of panels or in the area of installation.
- It seems that something creates this corrosive atmosphere in customer environment
- It could come from vapours from diesel motors, forklifts, incinerator, etc.,...

### What is sulphuration and how it can appear?

| Corrosive atmosphere                  |                                                                                                                   |                                                                                                           |                                                                                                                                                                                      |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Corrosive atmosphere                  | Influence                                                                                                         | Appearance                                                                                                | Consequences                                                                                                                                                                         |
| SO <sub>2</sub><br>Sulphur dioxide    | Corrosion of silver, aluminium and bare copper. Phenomenon accelerated by high temperature and relative humidity. | Blackening of exposed silver surfaces.<br>Appearance of dendrites on electronic and power circuits.       | Increased resistance of disconnecting contacts exposed to air.<br>Excessive device temperature rise.<br>Short-circuiting of circuits resulting in non operation of the control unit. |
| H <sub>2</sub> S<br>Hydrogen sulphide | Sulphuration of silver, this phenomenon is accelerated by high temperatures.                                      | Major blackening of exposed silver surfaces.<br>Appearance of dendrites on electronic and power circuits. | Increased resistance of disconnecting contacts exposed to air.<br>Excessive device temperature rise.<br>Short-circuiting of circuits resulting in non operation of the control unit. |

### Probable causes:

- Use of forklifts or diesel motors in area
- Petrochemical industry in area
- Incinerator in area
- Remark : when the chemical reaction begins, it is impossible to stop it

### Our recommendations

The best solution is to remove root of sulphur production but it can be difficult to detect or to remove it so here are some recommendations:

- In sulphurous (corrosive) atmospheres (H<sub>2</sub>S / SO<sub>2</sub>), it is necessary to implement the cleaning procedure using the Thiourea solution, with mandatory regreasing using the specified fluorinated grease.
- This type of grease protects the silver and copper coated contacts against sulphuration.
- Because silver or copper sulphide being insulating it provokes an increase in the contact resistance and thus greater temperature rise.
- The grease breaks down over time and it is therefore necessary to replace it regularly.
- Be careful for all products you use with silver parts, a sulphuration could appear too.

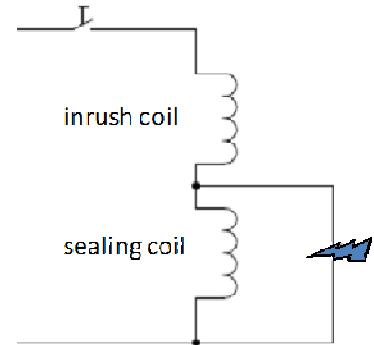
### Conclusion

- After analysis of our metallic material experts detect sulphuration on our products.
- Sulphuration appeared after mounting in panels, issue comes from corrosive atmosphere and not from products.
- These conclusions will probably be confirmed thanks to expertise realized in our expertise centre and we engage to obtain fast results.

- In the same time, we recommend to search the root cause of sulphur production in or around installation.
- There's no risk of overheating due to bad connections because this is no sulphuration in this area.
- It is only an issue of material aspect due to environment, and the problem of the product.

## Spark when contactor is opening

- Spark appears when contact opens
- This flash is completely normal
- From inrush to sealed, power goes from around 1650VA to around 22VA in a very short time.
- The contact of commutation coil inrush / coil sealed has to break a huge energy. It is normal to see an electric arc during opening of this contact
- The reason to have this electrical arc visible by customer is due to coils construction because the switch used in the coils is covered by a transparent plastic cover (industrial reason for controls).



## Arcing into coil/contactor

*It is normal to see an electric arc in coil when the contact close.  
During our testing we observed such behavior (see next pictures & Video).*



8. No arc (contactor is switched on or off).



9. Electric arc is visible just when switching ON.



## Common problems in contactors & possible causes

### (1) Noisy magnet and or noisy + rusty

#### Root cause

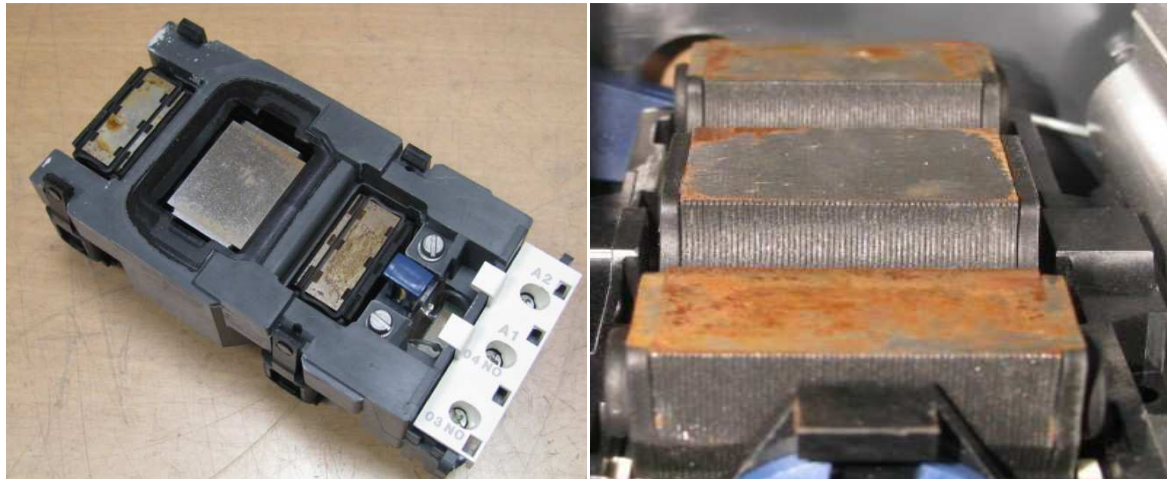
- The main reason for noisy contactor is due to an airgap between fixed and mobile electromagnet. This distance can be due to :
  - Pollution, dust
  - Rust created with humidity and high temperature.

#### Proposed solution

- Protect contactor from dust (enclosure with minimum IP5X)
- Protect contactor from humidity :

#### Comment

- Noise is a nuisance and rust is a visual aspect issue but contactor functions and life time are still compliant with our specifications



### (2) Black traces on power poles/outlet

#### Root cause

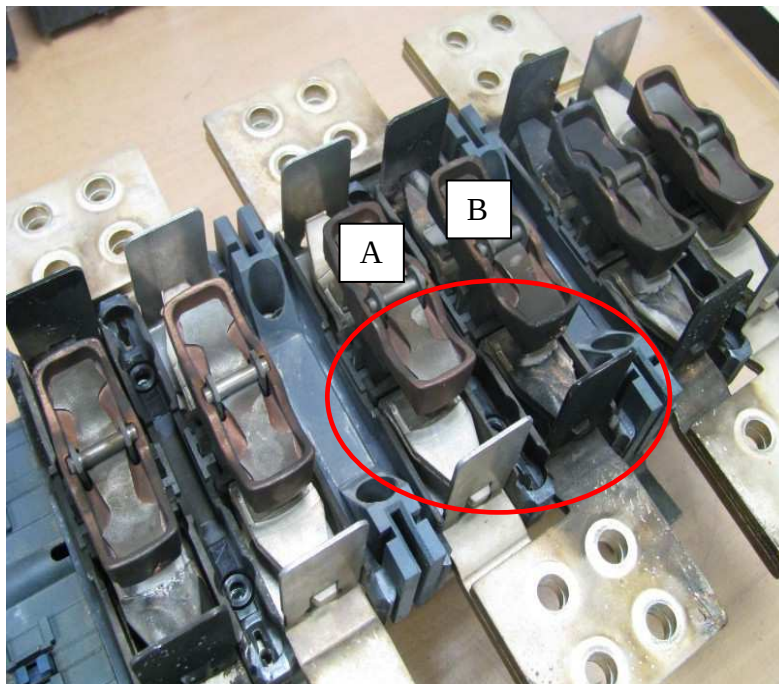
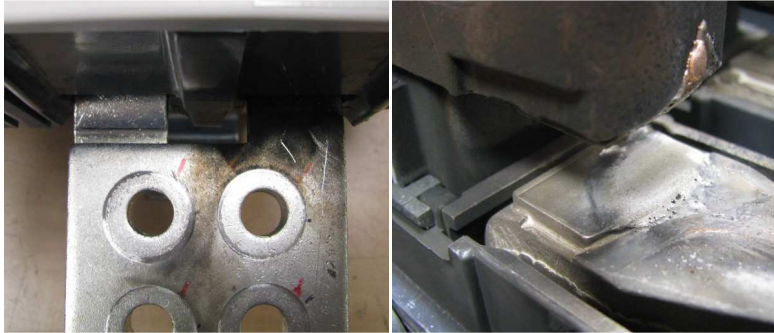
- Black traces observed on products are a normal consequence of contactor breaking function during opening of power poles on a load.
- An electrical arc is generated during this breaking action and as this arc is very energetic, a gas with some particles of silver, copper and plastic is generated and creates black traces when it is ejected from arc chamber of the contactor. The gas is released and going by the gap between arc shield and power outlet. That is why the arc shield chamber has an open space to be able to release the gas close to the power outlet.

### Proposed solution

- This phenomenon could be avoided if a design change is done or a new product is launched in the future

### Comment

- Black traces are a visual aspect issue but contactor functions and life time are still compliant with our specifications



- For the LC1F1400 and above contactors, 2 poles are in parallel for each power phase (pole A and B).
- Two poles are used for the heat dissipation during nominal current is going into each phase (when contactor is closed).
- During the making and breaking current (= when mobile poles are closing & when mobile poles are opening) mainly one pole per phase is used (poles are not exactly opening at the same time, which is normal). It is visible on the returned contactor, the power poles "B" are the poles used for the making and the breaking current.

### (3) Mobile magnet broken

#### Root cause

- Switching frequency over and above the allowed limits as specified in catalogue (see catalogue MKTED210011EN)

#### Proposed solution

- Take care about maximal switching frequency really encountered by contactor in application



6 – Damaged mobile magnet.

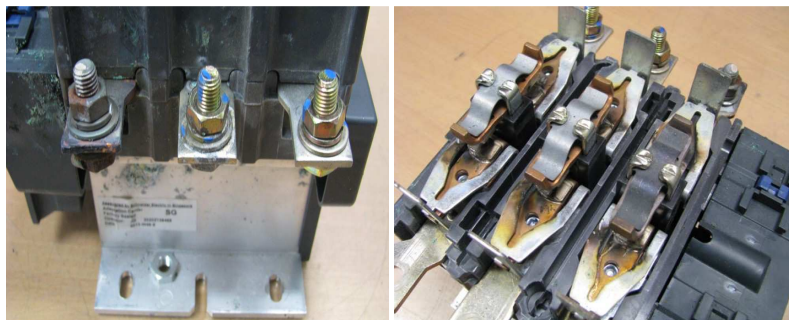
### (4) Overheated outlet

#### Root cause

- Cable/busbar is not maintained in connector with the specified tightening torque
- Cable / busbar size is not according to IEC 61439
- Ambient temperature in switchboard is  $>40$  degrees

#### Proposed solution

- Follow data given in instruction sheets
- Choose correct cable/busbar according to IEC 61439
- Manage ambient temperature in switchboard







**C**

| LC1 F             | a (mm) | C (N.m) |
|-------------------|--------|---------|
| 115/1154          | 10     | 10      |
| 150/1504/185/1854 | 13     | 18      |
| 225 ... 5004      | 16     | 35      |
| 630/6304/800/1250 | 18     | 58      |

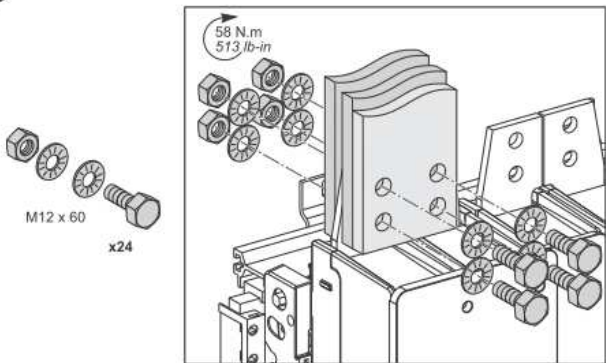
lb-in = N.m x 8.85

|           | 115  | 150  | 185  | 225  | 265  | 330  | 400   | 500   | 630  | 800  | 1250 |
|-----------|------|------|------|------|------|------|-------|-------|------|------|------|
| A (mm)    | ≤ 20 | ≤ 25 | ≤ 25 | ≤ 30 | ≤ 30 | ≤ 30 | ≤ 30  | ≤ 40  | ≤ 60 | ≤ 60 | ≤ 60 |
| B (mm)    | 10   | 12,5 | 12,5 | 15   | 15   | 15   | 15    | 20    | 25   | 25   | 25   |
| Ø (mm)    | 6,6  | 9    | 9    | 11   | 11   | 11   | 11    | 11    | 13   | 13   | 13   |
| S (mm²)   | 95   | 120  | 150  | 185  | 240  | 240  | 2x150 | 2x240 | -    | -    | -    |
| C (N.m)   | 10   | 18   | 18   | 35   | 35   | 35   | 35    | 35    | 58   | 58   | 58   |
| C (N.m) ↓ | 6    | 6    | 6    | 6    | 10   | 10   | 35    | 35    | 58   | 58   | 58   |

inches = mm x 0.0394  
lb-in = N.m x 8.85

W9 1355817 0191 A17

**D**



Guide

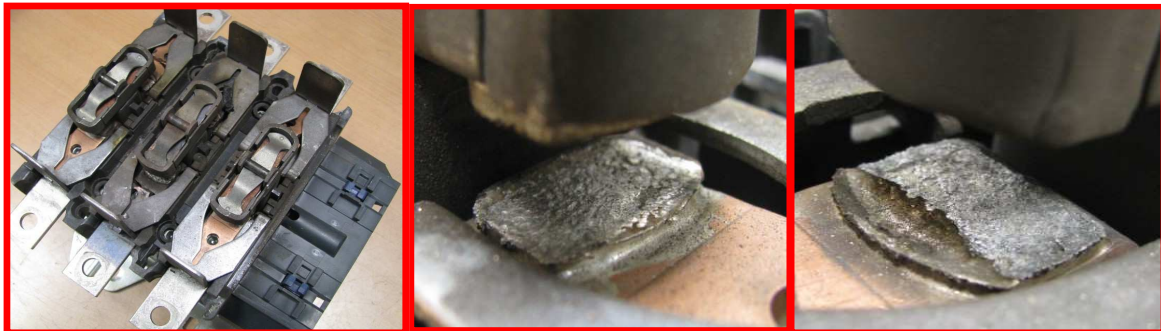
## (5) Power pole wear

### Root cause

- Pole wear is normal during contactor's life time. Contacts can be changed with set of spare contact kits (ex. LA5Fxxxx specified in page. B9/15 of Catalogue) when end of life is reached.
- But if this wear appears very early after commissioning, it could be due to a non-adequation between contactor's selection and application (making or breaking exceeded, ...)

### Proposed solution

- Follow contactor's selection tables in catalogue, especially maximum making and breaking capacities.
- Select the contactor based on the utilisation category (AC-1, AC-3 or AC-4) and the required electrical durability



## (6) Power pole welded

Power poles get welded due to multiple reasons. The possible solution can be provided by verifying various points regarding installations, type of application, quality of power, power source, type of starting, etc.,

### Root causes :

- Pole welding can appear when making current is over and above contactor's specification
- Switching frequency is too high
- Contactor reaches end of life
- Contactor making capacity was exceeded
- Contactor is flickering due to unstable coil supply
- Unbalance load: The possibility due to load characteristic connect to this contactor and harmonic from controller devices.
- No suitable short-circuit protection

### Proposed solution

- We recommend to verify the following
  1. Check the coil supply: How coil is energized (power source specification, voltage drop during inrush phase ...).
  2. Inrush current: current during the inrush phase.

- Further details/ question about application:
  - Type of load, power, current, voltage,  $\cos \phi$ , time constant L/R ...
  - Was the contactor used as single device or in pair as reversing contactors, or in star-delta type starting application?
  - Wiring diagram of the installation
  - Voltage source: how was the coil energized (power source specification)? How many contactors are supplied with same power supply in same time?
  - Stability of power supply (mainly for coil control circuit during inrush phase).
  - Switching frequency (how often switched the contactor per hour/day/year).
  - Measurement of the voltage at coil terminals.
  - Pictures of the installation.
  - Do harmonics occur in the circuit (power pole)
  - Ambient temperature where the contactor is installed.
  - Confirm us which type of contactor utilization categories (AC-1, AC-3, AC-4, DC-1 ...):



## (7) No proper short-circuit protection

### Root causes :

- Short circuit upstream/downstream contactor

### Proposed Solution:

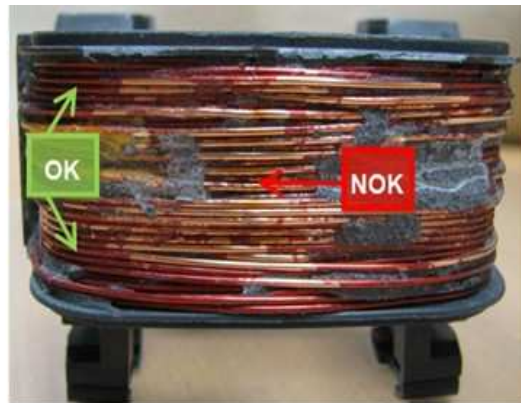
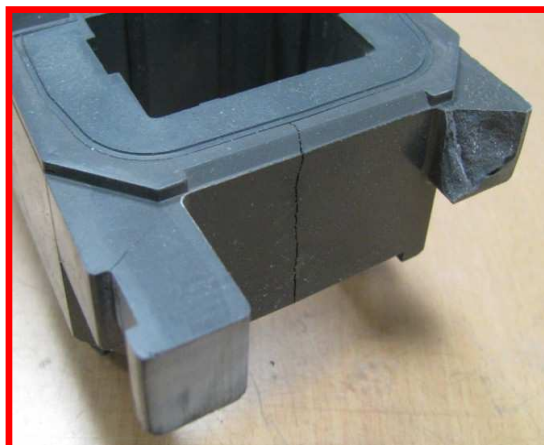
- Protect line by proper rating of fuses or circuit breaker
- Respect distances between bus-bars
- Follow the guidelines as specified in the catalogue







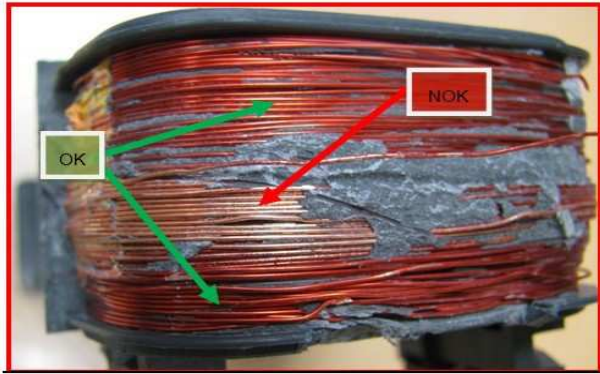
## (8) Coil winding overheated and failed in open circuit



9. Uncovered coil #1 - Burned winding (varnish insulator is melted down).

### Burnt inrush winding

- There are four frequent reasons why the inrush winding could be overheated:
  1. Mechanical problem of the contactor – if the mobile parts of the contactor could not move freely the coil gets overloaded. Such overloading will led to inrush winding burning.
  2. Voltage drops – coil is energized by the inrush current but due to low input voltage contactor is not able to switch-on:
    - a) Long cable of the coil energizing can cause voltage decreasing.
    - b) Insufficient power source – the power source cannot provide enough energy to close the contactor (weak power source, too many contactors switched at the same time).
  3. Inrush winding might be overloaded by too frequent switching. For example, maximal allowable switching frequency for the coils LX4FH220 is 40 cycles per minute (at temperature  $\leq 55^{\circ}\text{C}$ ).
  4. Residual voltage. If a voltage of few volts is left on opened contactor the inrush winding is under permanent load. Therefore it will not get cool down and can be burned easily. Residual voltage appears typically when electronic device are used to drive the coil.



7. Uncovered coil #3 - Burned winding (varnish insulator is melted down).

### Proposed Solution:

- Make sure that there is no broken mechanism or any other external material which stops free movement of the mobile contacts.
- Refer to product catalogue or contact our service staff/ front office to check proper length and cross section of cables for control circuit are used
- Verify whether the capacity of the power source is enough to provide sufficient energy to close the contactor(s).
- The number of switching per minute/ per hour should be within the allowed limits and also check the ambient temperature.
- Check for residual voltage at the coil inputs (A1-A2)

## (9) Damaged PCB card – diodes

### Root causes :

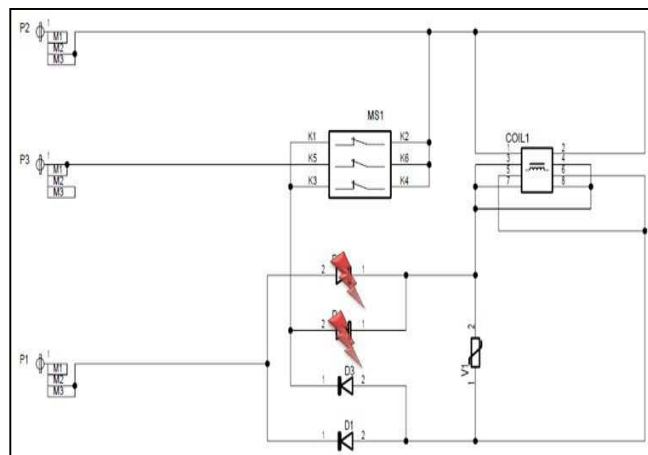
- Overvoltage from the network can damage input of PCB card in contactors
- Switching frequency is over contactor's specifications

### Proposed Solution:

- Better manage coil power supply to avoid over voltage (for example insert a filter between power supply and coil ≠ surge suppressor to protect external devices from overvoltage created by contactor when opening)



6 - PCB card after removing over molding material



## Conclusion

We hope that you find this guide is quite useful to understand the F-range of contactors, their selection and different utilisation categories, trouble shooting, understand common problems and possible solutions.

If you need further support please contact your local service teams, or your nearest sales office to provide you required support.

Users of this guide are welcome to provide suggestions for further improvement of this guide via e-mail at [nagarajan.mani@schneider-electric.com](mailto:nagarajan.mani@schneider-electric.com)