Introduction:

For many years, the UL 508 "Standard for Industrial Control Equipment" has been the U.S. standard for control products, such as contactors, self-protected combination motor controllers and overload relays.

Due to the market requirements in North America for more harmonization, UL collaborated with members of industry and the standard UL 508 for Industrial Control Equipment has been harmonized with selected sections of the IEC 60947 series, standard for Low-Voltage Switchgear and Controlgear.

In 2007, UL published the new harmonized standards for North America:
- UL 60947-4-1 Low Voltage Switchgear and Controlgear - Part 1: General Rules
- UL 60947-4-1 for Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters

This standard is harmonized to the greatest extent possible with the IEC 60947-4-1 standard Contactors and Motor-Starters - Electromechanical Contactors and Motor Starters with deviations for the US, Canada, and Mexico stated in the UL 60947-4-1 standard. It is a tri-national standard for North America (U.S., Canada and Mexico).

The UL 60947-4-1 standard addresses coordination between the branch circuit protective device and the motor starter. It also provides a method to measure performance of these devices if a short circuit occurs.

This standard defines two levels of component protection in the event of a short circuit:
- Type “1” co-ordination
- Type “2” co-ordination

What's behind Type “1” and Type “2” co-ordinated equipment?

Type of coordination “1” or “2”

When selecting the component combinations, either coordination Type “1” or “2” can be selected in most cases. According to UL 60947-4-1, the coordination type defines the permissible degree of damage for a device following a short-circuit.

Type of coordination “1”:

Definition as per UL 60947-4-1: Type “1” coordination requires that under short-circuit conditions the contactor or starter shall cause no danger to persons or installation and may not be suitable for further service without repair and replacement of parts.

Consequence: After a short-circuit, it is permissible for the starter to be inoperative. In particular, damage to the contactor, solid-state switching devices and overload relay is permissible.

Type of coordination “2”:

Definition as per UL 60947-4-1: Type “2” co-ordination requires that under short-circuit conditions the contactor or starter shall cause no danger to persons or installation and shall be suitable for further use. The risk of contact welding is recognized, in which case the manufacturer shall indicate the measures to be taken in regards to the maintenance of the equipment. The starter is still operative. There must be no signs of damage to the devices with the exception of slightly welded contactor contacts that can be easily separated again without any noticeable deformation.

Consequence: After a short-circuit, the starter must remain suitable for further operation. The risk of contact welding (such as on a contactor) is acceptable. In that case, the
manufacturer instructions need to be applied to easily break apart the welded contacts.

In general, a short circuit will be reliably and safely cleared and disconnected regardless of which type of coordination is applied. Assemblies of coordination Type “2” can therefore be considered as being more qualitative. In addition, they are often instantly available for further operation after a short circuit.

Combinations of coordination Type “1” are usually the more favorably priced combinations. Combinations of coordination Type “2” automatically fulfill the requirements of coordination Type “1”.

Tests

All of the specified combinations in the available tables are tested in compliance with UL 60947-4-1 by the original manufacturer Siemens. Official UL certificates of Compliance (CoC) can be downloaded from the Siemens U.S. support website:

http://support.automation.siemens.com/US

Origin and background of Type “1” and “2” coordinated equipment:

The concept of Type “1” and “2” coordinated equipment originally came from Europe. Users of industrial control equipment wanted the manufacturer to specify the short circuit protection device to be used for the individual starter. And they wanted to know how a short circuit would affect the use of industrial control equipment. Thus, the manufacturer carried out short circuit tests with specific short circuit protective devices. The test results were the basis to determine the level of damage to a specific starter with a specified short circuit protective device at a certain voltage level.

The associated short circuit protective device needed to be specified since equipment based on IEC standards are usually designed very close to the maximum capacities. This leads to different electrical ratings between manufacturers. Whereas, the NEMA standards used in North America specify NEMA sizes for controllers and starters which are usually larger than similarly rated IEC components. The ratings from different NEMA manufacturers are more likely to be similar.

These variations in product and performance form the basis of why each manufacturer specifies the starter and the associated short circuit protective device.

What are the benefits of Type “2” coordinated equipment?

a.) Increased productivity:

High reliability and availability along with continuous motor operation play major roles in many manufacturing processes.

b.) Reduction of costs:

Components affected by a short circuit current need to be replaced in most cases. Starters, such as contactors and overload relays which comply with Type “2” coordination requirements, remain fully functional after the short circuit current occurred and can thus be used for further operation without repair or renewal of parts. And this may significantly reduce the labor and material costs compared to repairing or replacing parts.

Only fuses need to be replaced, in cases where they are applied in the branch circuit as short circuit protective device instead of a resettable circuit breaker. Downtime of the equipment is reduced, since replacing of the components is not required. This is especially important in process industries like automotive, food and beverage or chemical where downtimes have a major impact on the overall costs and need to be reduced as much as possible.

Notes:

1.) Example for Type “2” coordination equipment in IEC standards for machines: Some standards require that power contactors and the associated short circuit protection devices shall be selected in a way which satisfies the requirements according to IEC 60947-4-1 for Type “2” coordination, for instance the IEC/EN 60204-32 Electrical Equipment of Machines – Part 32: Requirements for Hoisting Machines.

2.) Marking requirements for UL 508A listed industrial control panels: The current edition of the UL 508A (issued Dec. 2013) requires a specific marking for industrial control panels with a high fault Short Circuit Current Rating (SCCR above the default SCCR of the single components):

WARNING

Risk of Fire or Electric Shock – The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. All current-carrying parts and other components protected by this device should be examined and replaced if damaged. If burnout of a current element of an overload relay occurs, the complete overload relay must be replaced.

These Markings are addressed to the service and maintenance personnel. With Type “2” coordinated equipment, the starter can be examined to determine whether it is damaged and if it can be used
for further operation. Type “1” coordinated equipment however should be replaced, as recommended in the standard, since a detailed examination of the components is usually not possible.

Siemens Type “2” coordination rated equipment:
Siemens has conducted a significant amount of UL60947-4-1 tested combinations acc. Type “2” coordination. Since this is an ongoing process and there are constantly new ratings available, please visit our website to get the latest ratings: www.usa.siemens.com/sscr

Can IEC 60947-4-1 based ratings be used instead of UL 60947-4-1 based ratings for Type “1” and Type “2”?

The test results vary so this is not recommended for several reasons.

1.) Type coordination ratings based on IEC standards are sometimes very different in comparison to UL 60947-4-1 ratings. For instance, the achieved Short Circuit Current rating Iq for the individual combinations varies significantly.

2.) In cases where fuses are applied, the characteristics of the short circuit protection devices are different in regards to the interrupting rating Icu, the peak-let through current Ip and the peak-let through energy I2t. IEC 60269 certified fuses are different in design, size and electrical ratings in comparison to UL 248 certified fuses e.g. Class CC, J, G, T, RK1 or RK5 fuses.

3.) The tests according to IEC and UL are conducted at different voltage levels. IEC test are usually conducted at 400 V, 500V and 690V. UL standards usually require tests at 480V and 600V.

Is there a transition time between the UL 508 and UL 60947-4-1 standards for industrial control equipment?

Yes, there is a transition time between UL 508 and UL 60947-4-1 certified equipment.

Manufacturers of industrial control equipment designed according to UL 508 have until Nov. 2017 to transpose the relevant UL 508 certificates to the new UL 60947-4-1 standard. After Nov. 2017, existing UL 508 certifications may be retained, only if there are no changes to the products which would require re-evaluation by UL. If any changes are made that would require re-evaluation, the products will be subject to UL 60947-4-1.

Even after the transitional period, UL 508 and UL 60947-4-1 certified equipment can be applied and will be accepted according to the latest North American standards and codes.

How can users of contactors and motor-starters figure out whether the components already comply with the UL 60947-4-1 standard?

The distinction between UL 508 and UL 60947-4-1 approved products is possible with the “guide card” for that specific product. The guide card, belonging to the individual CCN’s was revised and also contains references to the new standard UL 60947-4-1. Within the individual UL listings of a manufacturer, UL 508 approved products are segregated from those which already comply with the new UL 60947-4-1.

The following CCNs are affected by the transition: NLDX, NRNT, NLRV, NKJH, and NKCR (overload relays only).

Further information on individual listings can be found in UL’s database at www.ul.com/database.

References:
www.ul.com
www.ul.com/database
UL 60947-1 Low Voltage Switchgear and Controlgear – Part 1: General Rules
UL 60947-4-1 Low-Voltage Switchgear and Controlgear – Part 4-1: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Staters
UL 508A Standard for Industrial Control Panels

Further information and support:
www.usa.siemens.com/controls
www.usa.siemens.com/controlpaneldesign
www.usa.siemens.com/planning-efficiency
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