

Mark of respect

A NEW RANGE OF AC MOTOR CONTROLLERS OFFERS CE-COMPLIANT SAFETY FOR BATTERY-POWERED INDUSTRIAL TRUCKS AND ARE ALSO FUTURE-PROOFED TO MEET ANY CHANGING SAFETY REQUIREMENTS

Most of us are familiar with the CE mark and see it every day on a wide variety of consumer products – but fewer people are aware that it applies equally to complex industrial machinery, and even industrial vehicles such as forklift trucks. With that in mind, have you ever stopped to think what the mark really signifies?

The CE mark – originally standing for ‘Communauté Européenne’ – is the manufacturer’s declaration that the product bearing the mark meets all mandatory EU directives relevant to that product. It must be affixed to the product before it is placed on the market in the European Economic Area (EEA). In regard to a battery-powered industrial truck, such as a forklift truck, these directives include the Machinery Directive 2006/42/EC, among others.

Various EN harmonised standards exist that convert the requirements of the Machinery Directive into more easily understood, testable and measurable specifications. Yet, for a complex product such as a forklift truck, deciphering all the relevant individual standards for each aspect can still be a daunting task.

Thankfully, this problem was recognised and a hierarchy of harmonised standards developed (see Figure 3). Type C standards collect all the relevant requirements for a particular product from the various Type A and Type B standards, and list them all in a single document. For battery-powered industrial trucks, the Type C standard under the Machinery Directive is EN1175-1, Safety of Industrial Trucks.



Perplexed by the complexity of meeting the numerous mandatory safety regulations in your next forklift design? A future-proofed solution could be the answer

As an industrial truck manufacturer, once you can demonstrate that your truck meets the requirements of EN1175-1, then it is presumed to be in conformity with the electrical aspects of the Essential Safety Requirements of the Machinery Directive 2006/42/

EC. If you can similarly show conformance with all other applicable directives, then you can affix the CE logo to the truck and off to the (EEA) market you go...

Harmonised standards

However, there’s a catch. The world of conformance may not be the most dynamic, but the various normative and harmonised standards are regularly updated, amended or even replaced completely. Requirements evolve to accommodate changes in technology, higher demands for safety or tighter environmental restrictions. Usually, the changes are minor and evolutionary in nature, but occasionally a change to a standard comes along that requires a serious amount of time and effort to ensure a product complies with the new requirements. Such a change came along at the end of 2011.

For many years, there were no substantial changes to EN1175-1:1998. The very important subject of functional safety was addressed by requirements taken from the Type B standard, EN954-1:1996, Safety of Machinery. However, there had long been

	Voltage	1232E	1234E	1236E	1238E
2 min Arms Rating	24V	180–250A	200–350A	400–500A	650–800A
	36V	200A	275–350A	400–500A	650–800A
	48V	200A	275–350A	350–550A	450–650A
	80V	175A	200A	300–350A	550–650A
	96V	–	–	–	550–650A

FIGURE 2: Curtis E-Series controller model table

some concern that EN954-1 did not sufficiently address the use of software-dependent devices such as microprocessors when used in safety functions. After much debate within the machine-building industry, it was finally withdrawn at the end of 2011 and replaced by a newer Type B safety standard, EN ISO 13849-1:2008.

EN1175-1:1998 was hurriedly updated to reflect the adoption of EN ISO 13849-1 and an updated version, EN1175:1998+A1:2010, was released in 2012. All references to EN 954-1 were simply replaced with references to EN13849-1. But this posed quite a problem for the industrial truck industry, as EN ISO 13849-1 required a fundamentally different approach to assessing functional safety than EN954-1. This problem then propagated down to component manufacturers such as Curtis Instruments, a designer and manufacturer of safety-critical components such as the AC motor speed controllers used by many of these trucks.

The way that EN ISO 13849-1 was incorporated into the updated EN1175-1 also posed a problem in how to interpret the requirements. For example, there were several instances where the requirement in EN1175-1 was that “safety-related parts shall be in accordance with category 1 in EN ISO 13849-1” – in other words, a reference to a fairly simple designated architecture.

However, according to EN ISO 13849-1, “category 1 shall be designed and constructed using well-tryed components ... complex electronic components such as microprocessors cannot be considered as equivalent to well tried”. In other words, any safety-related part using software really needs to meet more complex category 2 designated architecture requirements.

Furthermore, a key goal of the EN ISO EN13849-1 methodology was to derive the performance level (PL) needed by a safety-related part to sufficiently mitigate the risk of injury or death – but there was no mention of PL anywhere in EN1175:1998+A1:2010. It seemed this lack of a required PL, and the apparent

confusion over category 1, meant that a further amendment to EN1175-1 was highly likely.

Curtis Instruments therefore had a decision to make: take the easy route, and simply re-certify the existing controllers as satisfying category 1 as per EN1175:1998+A1:2010, or do the job properly. If Curtis developed products that met all the relevant requirements of the Type B standard EN ISO 13849-1 in its entirety, it could offer the forklift truck manufacturers AC motor controllers that provided a far superior level of functional safety that exceeded the present requirements and were ‘future-proofed’ against possible changes to EN1175-1.

The E-Series launch

Several months later, Curtis launched Model 1232E, the first in the new E-series family of AC motor controllers designed to offer enhanced functional safety capabilities (Figure 1). The E-series features an advanced dual microprocessor logic core that meets EN ISO 13849-1 requirements for a Category 2

designated architecture and provides a performance level of up to PL=d, easily surpassing the requirements of today’s EN1175-1:1998+A1:2010.

The E-Series controllers were developed following processes that fully comply with the product lifecycle management aspects of EN ISO 13849-1:2008. The design and functional safety of the E-series controllers has been independently assessed and found to be fully compliant with all relevant requirements of EN ISO 13849-1:2008, rather than just the few referenced by EN1175-1:1998+A1:2010.

As a result, these controllers are CE marked as safety components and are provided with a Declaration of Conformity that references EN12895:2000 (EMC), EN ISO 13849-1:2008 and EN1175-1:1998+A1:2010. A comprehensive Technical Construction File is available as required. The Curtis E-Series AC motor speed controllers for electric vehicle traction and hydraulic pump applications are available in a wide range of voltage and current ratings, as shown in Figure 2.

When designing materials handling equipment such as a reach truck, the vehicle designer has many choices and decisions to make. An ICE truck designer may choose to future-proof the design by selecting a diesel engine that fully meets Tier 4 Final/Stage IV emissions standards – in fact, many would think it foolish not to. The same also goes for battery-powered vehicles. Safety legislation will continue to be tightened – and rightly so. By selecting a range of electric vehicle AC motor controllers that can be shown to meet current and projected future safety requirements, that are CE marked and provided with all necessary compliance documentation, vehicle designers have one less concern and can proceed with their designs in confidence.

Application support

In recent years, Curtis Instruments has further strengthened its global team of application and customer support engineers. Based across its 14 wholly owned sales and technical support centres worldwide, Curtis engineers work closely with the customers to design, develop and test optimum solutions that achieve the project specification and performance criteria required by the vehicle designer.

Given the high functionality of the Curtis E-Series AC controllers, plus the versatility achieved with Curtis Vehicle Control Language (VCL) application layer software, design engineers are able to quickly build proof-of-concept prototypes, reduce the overall parts count and optimise system performance, with a proficiency that would be difficult to achieve purely on their own. **ALT**

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Model	Safety Function	Performance Level (PL)	Designated Architecture	MTTFd	DC
1232E	Uncommanded Powered Movement	d	Category 2	≥ 40 years	≥ 90
	Motor Braking Torque	c		≥ 16 years	≥ 90
1234E	Uncommanded Powered Movement	d		≥ 40 years	≥ 90
	Motor Braking Torque	c		≥ 16 years	≥ 90
1236E	Uncommanded Powered Movement	d		≥ 36 years	≥ 90
	Motor Braking Torque	c		≥ 12 years	≥ 90
1238E	Uncommanded Powered Movement	d		≥ 36 years	≥ 90
	Motor Braking Torque	c		≥ 12 years	≥ 90

MTTFd = Mean Time To Failure (Dangerous)
DC = Diagnostic Coverage

FIGURE 1: Curtis E-Series AC motor controllers EN ISO 13849-1 data



FIGURE 3: Hierarchy of EN harmonised standards