A Comprehensive Handbook to the New Edition of ANSI B11.19 Standard

A SIX PART WHITE PAPER SERIES

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Sensor Intelligence.

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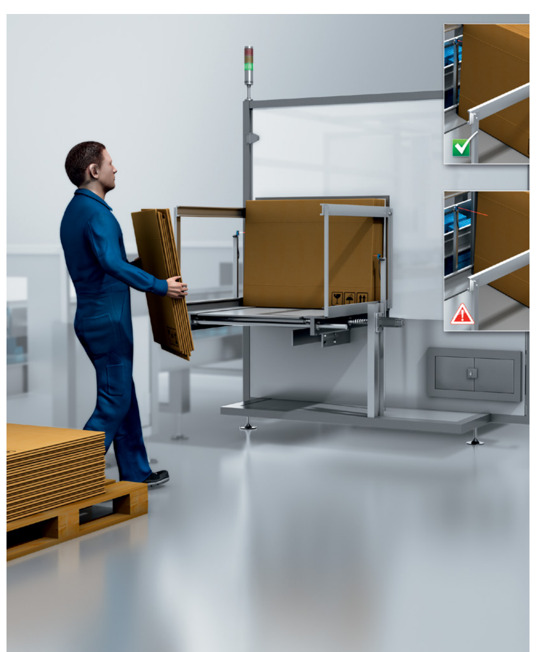
WHITE PAPER 1

An introduction to the updated ANSI B11.19 Standard

The American National Standards Institute (ANSI) is the United States' national member body to the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC). It coordinates the participation and input of the United States in the development of international standards (such as ISO/IEC). ANSI also accredits organizations to develop standards for use within the US, according to procedures called Essential Requirements.



More than 11,000 American National Standards (ANS) exist in the US, with many applying to the safety of people working with industrial equipment. Of these, one of the most essential, and broadly applicable, is **ANSI B11.19 – *Performance Requirements for Risk Reduction Measures.*** This standard is part of the B11 series of machinery safety standards, and applies to power driven industrial machinery which are not portable by hand while working.

This includes, "an assembly of linked parts or components (at least one of which moves) with the appropriate actuators, control, and power circuits, etc., that are joined together for a specific application such as, for the processing, treatment, marking, or moving of material." This standard is developed as a type-B standard applicable across a broad range of industries. (See the previous SICK white paper, Selecting Safety Standards for Machine Safeguarding Requirements, for further description of this stratification system.)

This white paper series is intended as an overview of the standard. True value can only be gained by obtaining and thoroughly reviewing its content. The standard is available now from various technical document providers, including directly from the ANSI webstore. While interpretation and application of the many standards may be cumbersome at times, qualified consultants are available to assist for each unique application, including SICK Services.

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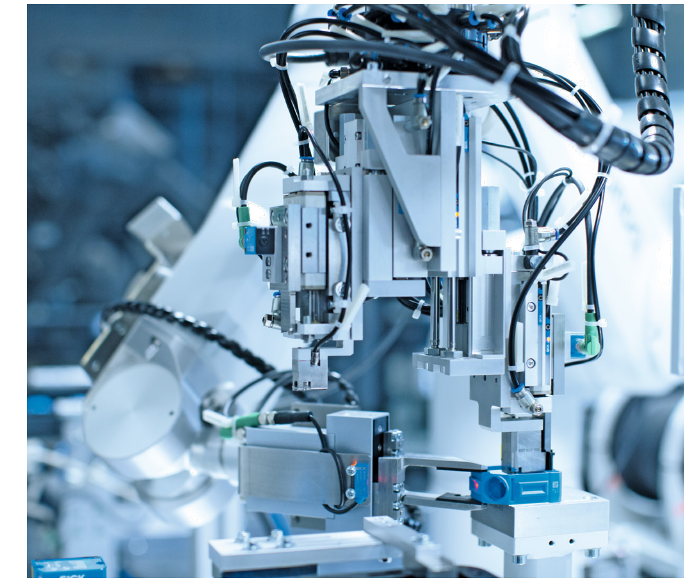

THE NEW STANDARD HAS MADE ATTEMPTS TO ALIGN WITH OTHER WIDELY USED STANDARDS, BOTH DOMESTICALLY AND INTERNATIONALLY, BY REDUCING CONFLICTS IN TERMINOLOGY AND TECHNICAL REQUIREMENTS.

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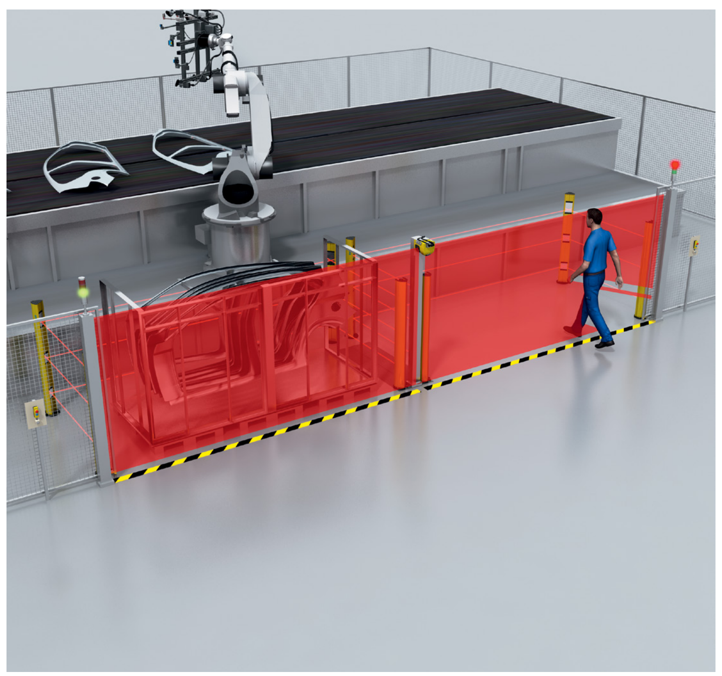
Structure of the new ANSI B11.19 standard follows the hierarchy of controls (all subclauses not listed)

WHITE PAPER 2

Newly added risk reduction measures

As mentioned in the previous SICK white paper Reducing Risk on Industrial Machinery: An Introduction to the Updated ANSI B11.19 Standard, the newest edition of ANSI B11.19 includes a number of risk reduction measures not addressed in previous editions. Furthermore, the new standard has reorganized the concepts of risk reduction into a systematic structure following the hierarchy of controls, also known as the three-step method. This white paper is aimed to briefly introduce the new topics presented in ANSI B11.19. A thorough understanding of the technical requirements can only be achieved by acquiring and reviewing the standard in its entirety.



Step 1: Inherently Safe by Design

Risk reduction measures which are inherently safe by design, are defined by ANSI B11 as “a design measure that reduces risk, which is not susceptible to a malfunction that will increase the risk of harm.” Both ANSI B11.0 and ANSI B11.19 discuss these measures in detail in the new editions.

Of particular interest, it is important to clarify a misnomer that has existed in industry for some time. ISO 12100 refers to Step 1 as “inherently safe design measures,” and defines it as a “protective measure which either eliminates hazards or reduces the risks associated with hazards by changing the design or operating characteristics of the machine without the use of guards or protective devices.”

The ISO definition, in use since at least 2003, is not aligned with the technology of today. As written, any measure that is not a guard or device (e.g., interlock, light curtain, etc.) and built into the equipment qualifies as “inherently safe design.” The confusion this has introduced is an assumption that anything integrated into a machine is, therefore, “inherently safe.“

However, another definition important to consider in light of this discussion is that of a safety function, described as a “function of a machine whose failure can result in an immediate increase of the risk(s).”

It is widely accepted that safety functions are impl mented by Step 2 of the hierarchy of controls. With equipment such as power and force limited (PFL) robots, commonly referred to as ‘collaborative robots,’ the power and force limiting feature used to reduce risk is indeed inherently built into the equipment. However, almost all PFL robots on the market today utilize monitoring of speed and/or force to implement the limiting features. This monitoring function is indeed susceptible to failures, in which case risk will immediately increase. It is imperative to consider the measure itself and how it functions, rather than simply considering if it is built into the equipment by the designer.

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STEP 1

Inherently Safe by Design
Risk reduction measures which are inherently safe by design, are defined by ANSI B11 as “a design measure that reduces risk, which is not susceptible to a malfunction that will increase the risk of harm.”

STEP 2

Engineering Controls
As mentioned in Part 1 of this white paper series, the second step of risk reduction includes a broad variety of risk reduction techniques.

STEP 2a

Engineering Controls – Guards
When preventing exposure of individuals to hazards cannot be accomplished using Step 1, the next best option is to apply barriers that provide a physical boundary to a hazard.

STEP 2b

Engineering Controls – Control Functions
By separating the control features from the actual hardware, the specific requirements common to all control functions are consolidated into a single cause.

STEP 2c

Engineering Controls – Devices
A handful of new safety devices were added to the 4th edition of ANSI B11.19. The additions are in response to established risk reduction measures already in use or quickly entering the market.

STEP 3

Administrative Controls
When used in conjunction with other measures and applied iteratively according to the risk assessment process, administrative controls assist further reduction to a level considered As Low As Reasonably Practical (ALARP).

WHITE PAPER 3

Solutions for whole body access

The concept of "whole body access" – as well as the associated risks to employees – is by no means new to industry. However, the latest edition of ANSI B11.19 is the first general industrial safety standard to address this concern directly. Not only does the new standard introduce a definition of this application condition, it also provides a holistic approach to reducing the related risks. To no surprise, the general methodology presented is based upon the two most important tenets of industrial safety: risk assessment and the hierarchy of controls.

As explained in the first White Paper of this series, Reducing Risk on Industrial Machinery: An Introduction to the Updated ANSI B11.19 Standard, the hierarchy of controls is the fundamental basis for ANSI B11.19. Fu thermore, the standard is applicable across a broad range of industries. (See the previous SICK White Paper, Selecting Safety Standards for Machine Safeguarding Requirements, for more information.)

Two key parameters must be met in order for whole body access to exist:

one **1** physical access permitting the entire body to enter the area

two **2** a space within the area that permits a person to remain undetected

What is Whole Body Access?

ANSI B11.19 defines *whole body access* as "a situation where an individual(s) can be completely inside the risk reduction measures defining a perimeter or safeguarded space." Other terms used in industry to represent this situation include 'full body access,' 'perimeter safeguarding,' 'perimeterguarding,' and 'pass-through.' Efforts are currently underway to further harmonize both the terminology and the definition of this important concept in other international standardization activities.

As introduced in Part 2 of this White Paper series, Newly Added Risk Reduction Measures in the Updated ANSI B11.19 Standard, these situations most often occur in applications where a defined perimeter is established with safeguarding devices. Examples include integrated machinery systems, industrial robot systems, and packaging equipment, where all or part of the automation equipment is contained within an area defined by safeguards (typically fencing). Access points are often provided to allow necessary intervention with the equipment using interlocked doors or presence-sensing devices.

However, whole body access can also occur in applications where safeguarding is applied to protect the point-of-operation (the location in the machine where the material or workpiece is positioned and work is performed on the material or workpiece). For instance, a light curtain mounted at the appropriate safety distance on a press may also present whole body access if sufficient space exists between the sensing field and the press bed for a person to safely access the space and remain undetected. The maximum distance between a light curtain and the machine structure to prevent an individual from stepping behind a sensing field is established as 75mm (3 inches) in many safety standards for industrial power presses, including the following:

- ANSI B11.1-2009, clause 8.6.3.17
- ANSI B11.2-2013, clause 8.6.3.16
- ISO 16092-1:2018, clause 5.3.2.11(c)

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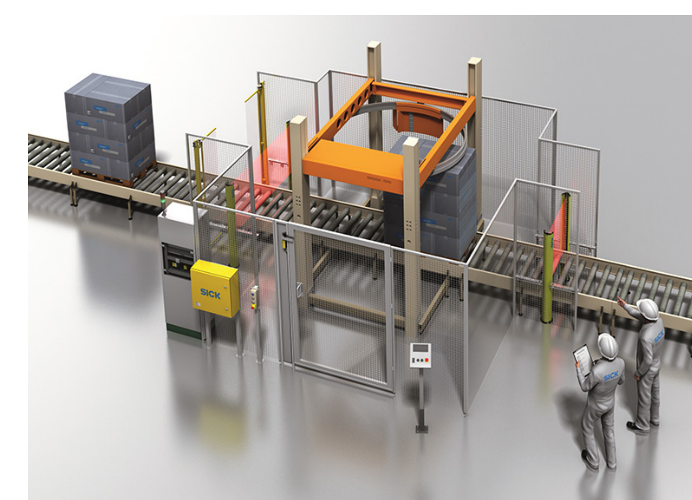

WHITE PAPER 4

Physical barriers as addressed in ANSI B11.19

The use of physical barriers to separate individuals from one or more danger zones is quite possibly the oldest – and most reliable – means of reducing risk in the workplace. As discussed in the previous white paper, Newly Added Risk Reduction Measures in the Updated ANSI B11.19 Standard, the conceptual approach of using guards to create physical boundaries to a hazard is the most common approach to reducing risk, given their relative simplicity and proven effectiveness. As such, the guidance in the new ANSI B11.19 standard is somewhat short and succinct in comparison to other general topics addressed in the new edition. However, the many nuances associated with the various types of physical barriers warrants a deeper look at this seemingly simple topic.

	GUARD	SHIELD	AWARENESS BARRIER
GENERAL PURPOSE	'keep people out'	'keep hazards in'	'provide a warning'
DEFINITION	A barrier that prevents exposure to a hazard	A barrier to keep chips/ coolant within the confines of the machine, or to reduce the potential of parts from being ejected	An awareness device that warns individuals by means of physical contact

As used in ANSI B11.19-2019, the term *barrier* is used to represent "a device or object that provides a physical boundary to a hazard." Examples of physical barriers used to reduce risk are barrier guards. These can be secured in place or movable. Many types of barriers can be used for the purpose of risk reduction, including framework components of the machinery or nearby equipment, or even the facility structure itself.

As discussed in Part 2 of this white paper series, the newest edition of ANSI B11.19 has added five new types of guards. When combined with the six existing types of barriers carried over from the previous edition, both the thoroughness and the complexity of the document grow. This was done in an effort to help industry better understand the purposes, requirements – and in some cases, limitations – of various physical barriers that can be used to effectively reduce risk to individuals.

The most important differentiation is that not all barriers are created equally. At the highest conceptual level, there are three primary classifications of physical barriers: *guards*, *shields*, and *awareness barriers*.

FIXED GUARD

A guard affixed in such a manner (for example, by screws, nuts, or welding) that can only be opened or removed by:

- the use of a tool (such as a key or wrench) designed to open and close a fastener; or
- destruction of the means which the guard is affixed

MOVEABLE GUARD

A guard which can be opened without the use of tools

NOTE: An improvised element, such as a coin or nail file, is not be considered a tool

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WHITE PAPER 5

Safety distance considerations for devices

When applying engineering control devices to reduce risk to individuals in the workplace, there are many topics to consider. A basic understanding of the performance and design requirements for individual components used for risk reduction is crucial to ensure the proper devices are selected for safety applications. In recent years, much attention has been given to the concept of functional safety, with great concentration on Performance Levels (PL) according to ISO 13849-1 and Safety Integrity Levels (SIL) as defined in IEC 62061. The five core pillars of functional safety have been the subject of many standards, articles, and training courses in recent years.

CALCULATING SAFETY DISTANCE

$$D = (K \times T) + d_{ds} + Z$$

Where:

D = safety distance of a device

K = maximum speed that an individual can approach the hazard

T = total time to achieve a safe condition

d_{ds} = reaching distance associated with devices

Z = supplemental distance factor(s)

However, one of the key topics which should not be forgotten or overlooked is the concept of safety distance. Safety distance is defined as "the minimum distance an engineered control (guard or device) is installed from a hazard such that individuals are not exposed to the hazard." Safety distance considerations addressed in the newest edition of ANSI B11.19 specific to guards and other protective structures was examined in Part 4 of this white paper series. This included discussion of the basic machine safeguarding tenet described with the acronym *AUTO* – a person should not be able to reach *Around*, *Under*, *Through* or *Over* a guard to reach the hazard.

As it turns out, the *AUTO* principles also apply to protective devices to provide effective risk reduction for individuals. Furthermore, other related considerations must also be considered, such as angle of the sensing field (detection zone), depth of field, and minimum / maximum height requirements. This white paper is intended as a basic introduction to these concepts, with added focus given to the additions and modifications made in the recent revision to ANSI B11.19.

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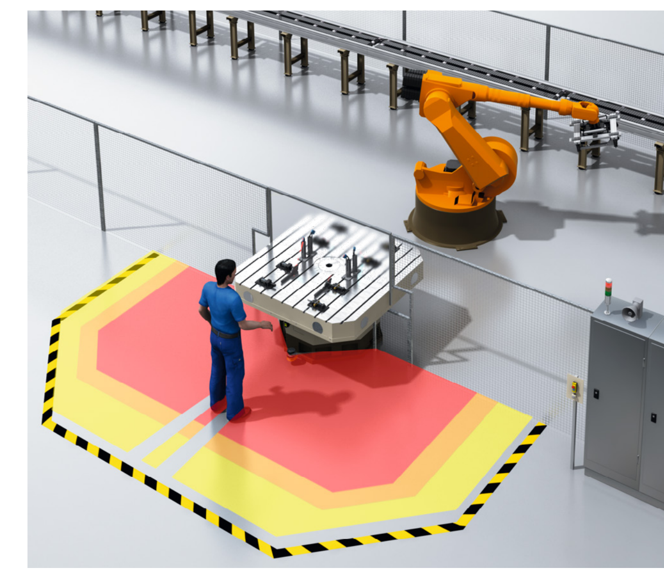
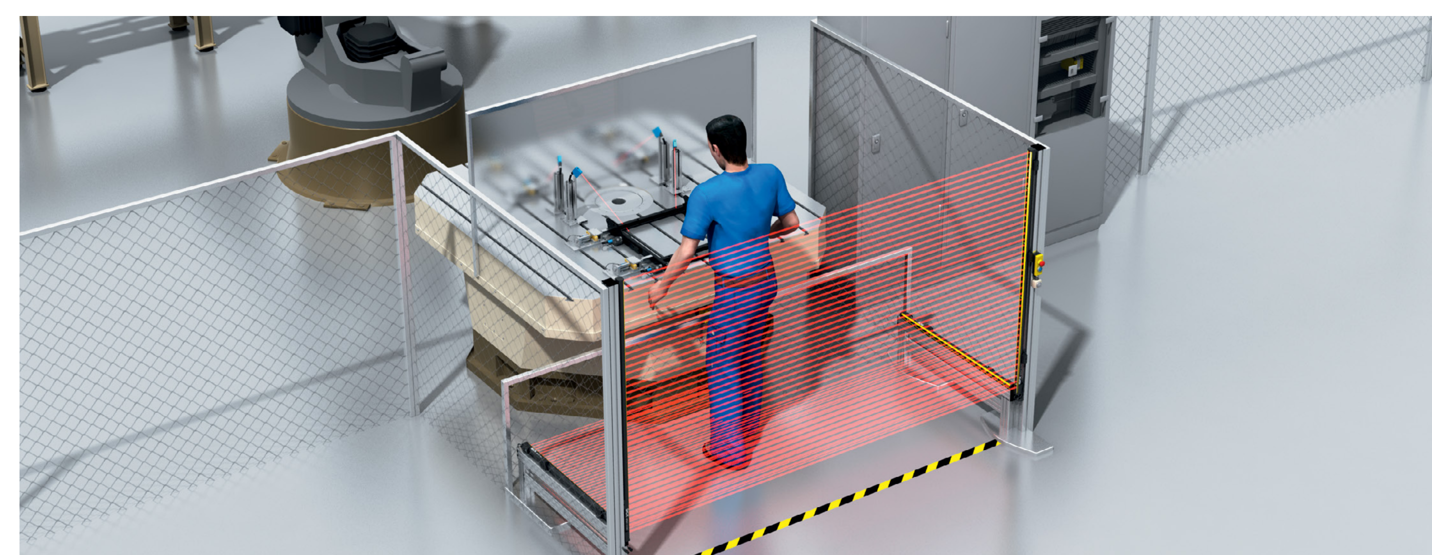
Effective risk reduction requires more than selecting the appropriate device technology and applying the concepts of functional safety to the control system. The basic principle of *safety distance* must be considered to ensure the machine has achieved a safe condition before an individual can access the hazard(s).

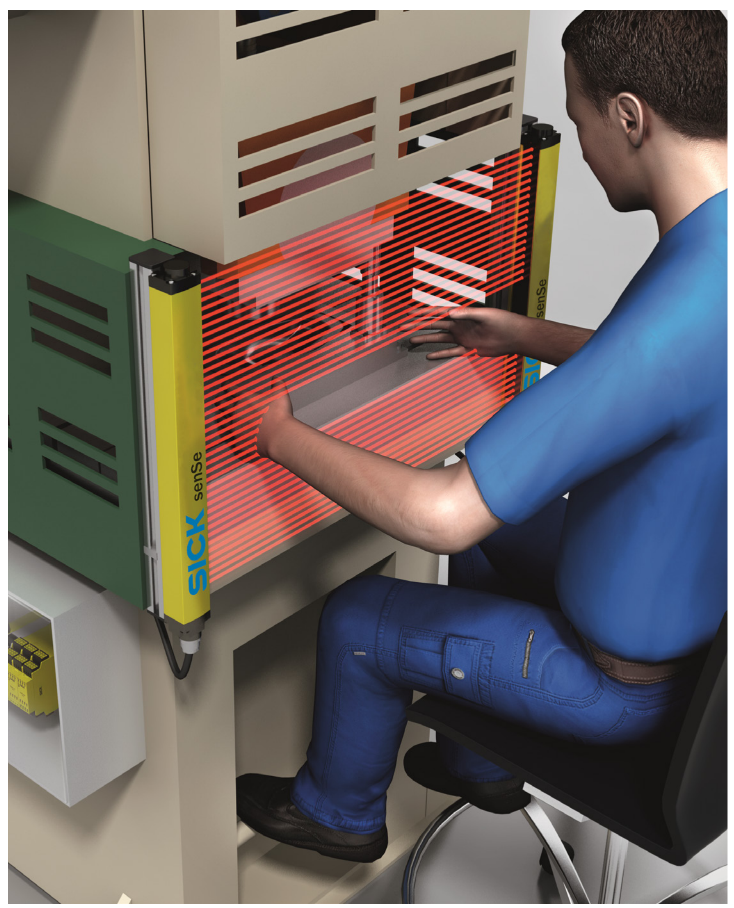




WHITE PAPER 6

Informative annexes in the updated ANSI B11.19 Standard

This series of white papers addressing the new edition of ANSI B11.19 has highlighted many modifications and improvements made to the fourth edition of the standard. Many of these enhancements were made with the intention that ANSI B11.19 become an effective complement to the risk assessment process by providing a more holistic list of risk reduction measures and associated requirements. In addition to the nearly 200 pages of mandatory and informative content of the standard, nearly 100 pages of informative annexes are also included to aid the reader and help provide a better depth of understanding. Approximately sixty percent of this informative content was updated from the 2010 edition of the standard – either in small or large parts. Close to twenty five percent of the explanatory information is new to the standard, but highly aligned with best practice guidance from other industry standards and published research. The remainder of the material is intended to provide useful support to help the reader better understand complex relationships established within the normative content of the standard itself.



Enhanced Guidance

Another large portion of the informative material in the new edition of ANSI B11.19 is heavily based on content from previous editions. As state-of-the-art and best practices continue to evolve, so too must the guidance provided in each edition of the standard.

ANNEX C: PERFORMANCE OF THE SAFETY FUNCTIONS

When applying risk reduction measures to machinery, engineering controls are often used. The overall performance of the safety function(s) must be identified and accounted for in the design strategy when devices and/or control functions are integrated into the machinery control system. The level of performance depends on the level of risk associated with each task/hazard pair, and the realization to achieve (or exceed) that level is associated with the concepts of functional safety (or "control reliability" using phrasing from the past).

The basic content of Annex C is included in each ANSI B11 type-C standard. However, the 2019 edition of ANSI B11.19 has been further enhanced to address more specific concerns associated with the application of engineering control devices. Such enhancements include discussion on the consideration, analysis and exclusion of faults.

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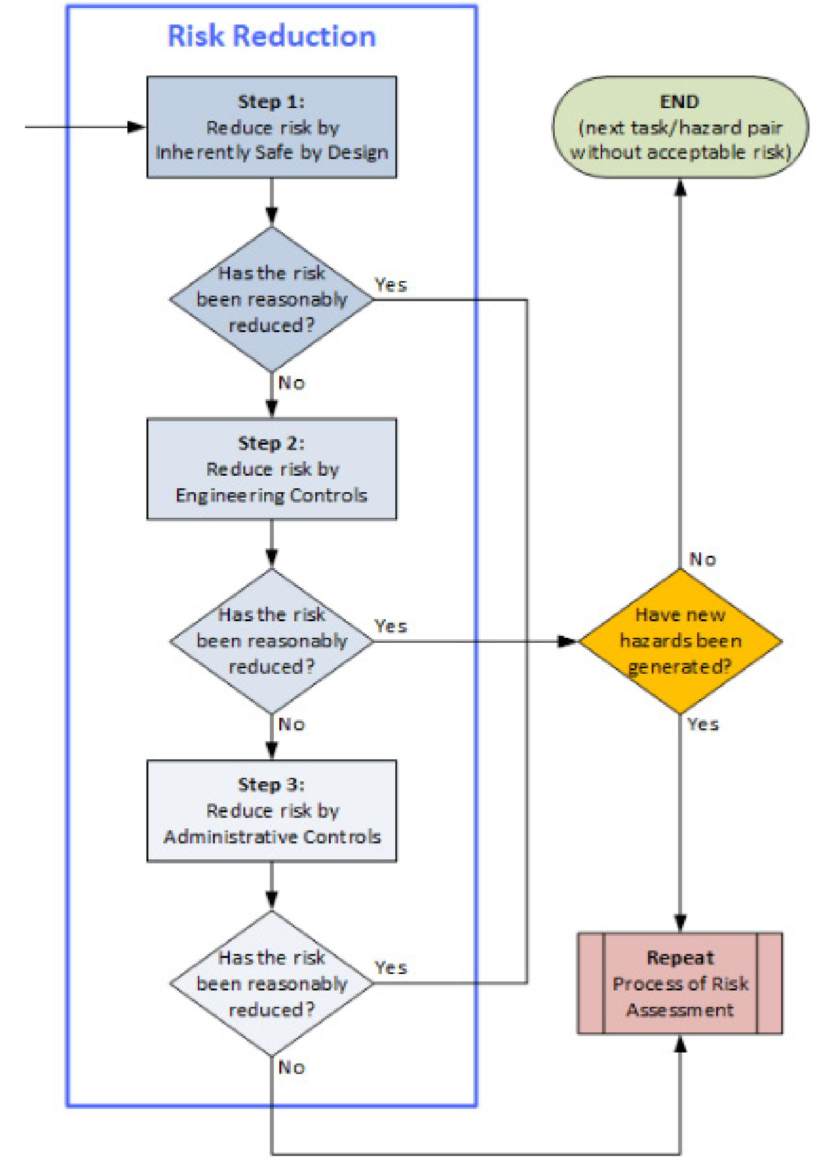

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