

# Plant Safety in the Mining Industry

## Safety of Machinery AS4024.1 2006



# Machine Safety in Australia



## ▶ Why safety on the machine?

- Nobody wants to see personnel getting injured
- Compliance with the standards and legislative framework

## ▶ Purpose of safety

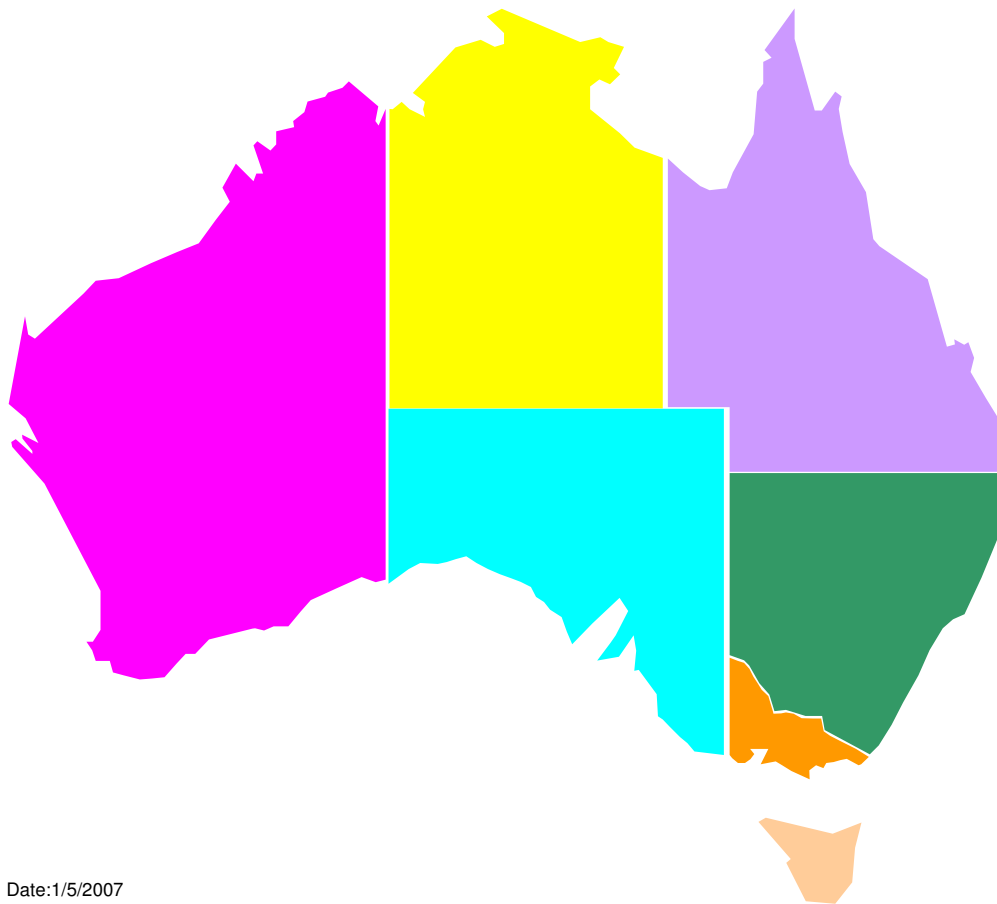
- Minimise the risks to health and safety of employees and others working with or otherwise near machinery

## ▶ What is the workplace benefit?

- Increased productivity
- Health and safety of plant and personnel
- Reduced direct and indirect costs

# Machine Safety in Australia

## ▶ Legislative Framework



OH&S  
ACT

OH&S  
Regulation

Standards  
&  
Codes of  
practice

# The Role of Australian Machinery Standards



- ▶ Provide practical guidance to designers, machinery users, importers and manufacturers
- ▶ Provide users, importers and manufacturers the same reference and guidance material as used by legislators and regulators



# The Role of Australian Machinery Standards



- ▶ Standards are developed through consultation with representatives from industry, workers and employers, special interest groups and government agencies.
- ▶ Standards are not necessarily law, but should be followed unless there is an alternative course of action that achieves the same or better standards.
- ▶ Evidence of failure to observe the standard may be used as evidence in proceedings for an offence under the Act. However, a person is not liable simply because of a failure to observe the standard.



# History of Machinery Safety Standards



- ▶ Prior to 1992 safety issues were incorporated in specific machinery standards (conveyors, cranes etc)
- ▶ BS 5304-1988 (Safety of Machinery) base for a new Australian standard
- ▶ In 1992 AS 4024.1 was released as an Interim standard (BS5304/EN954.1/BSEN954.1)
- ▶ In 1996 AS 4024.1 became a full fledged National Standard
- ▶ In 2006 AS 4024.1 rewritten with adoption of European standards



# History of Machinery Safety Standards



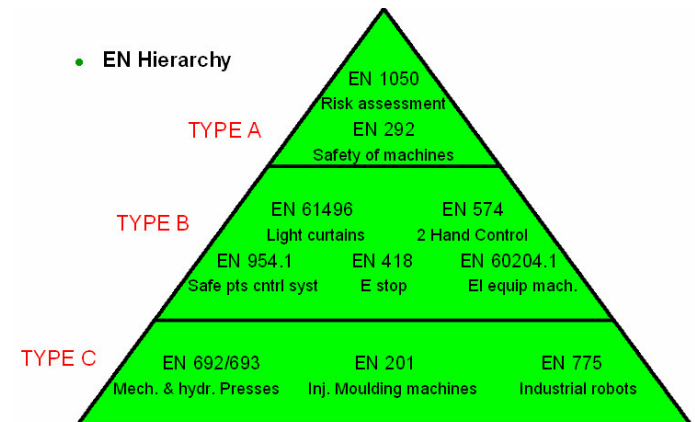
- ▶ Project committee (SF-041) to align AS 4024.1 1996 with International standards
- ▶ Project commenced November 2000
- ▶ Adopt the European 3 tiered Machinery standards model
- ▶ 26 European (EN) and International (ISO) safety and design standards



# Safety of Machinery AS4024.1 2006

## 3 tier Machinery standards model

- ▶ “Type A” - Basic standards
  - General aspects & design principles - relevant to all machines
- ▶ “Type B” - Group standards
  - B1 Specific to safety - Calculation of safety distances, Electrical safety, etc
  - B2 Safety Devices/Components - Two handed controls, e-stops, etc
- ▶ “Type C” - Machine family specific standards
  - Conveyors , wood working machines, power presses, etc



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## The New Layout



- ▶ Part One - compulsory:
  - Comprises Type A and some Type B standards
  - Safety Principles, Design Parameters, Ergonomics
- ▶ Part Two - only purchase as required:
  - 2 hand control devices, ESPE, integral lighting, laser etc
- ▶ Part Three - only purchase as required:
  - injection moulding machines, presses, packaging machines etc

# Safety of Machinery AS4024.1 2006

## Safety Principles



AS4024	AS Title	ISO No.	EN No.
-1101	Terminology – Terms and Definitions		1070
-1201	Principles - Basic Terminology and Methodology	12100-1	292-1
-1202	General Principles - Technical Principles	12100-2	292-2
-1301	Principles of Risk Assessment	14121	1050
-1302	Reduction of risks to health & safety from hazardous substances emitted by machinery...	14123-1	626-1
-1401	Ergonomic Principles – Design, Terminology, General		614.1

# Safety of Machinery AS4024.1 2006

## Design Parameters



AS4024	AS Title	ISO No.	EN No.
-1501	Design of Safety Related Parts of Control Systems – General Principles	13849-1	954-1
-1502	Design of Safety Related Parts of Control Systems – Validation	13849-2	954-2
-1601	Design of Controls, interlocking and guarding – fixed / moveable guards	14120	953
-1602	Interlocking devices associated with guards – Principles for selection	14119	1088
-1603	Design of controls, interlocks and guards – Prevention of unexpected start-up	14118	1037
-1604	Design of controls, interlocks and guards – Emergency Stop	13850	418

# Safety of Machinery AS4024.1 2006

## Ergonomics



AS4024	AS Title	ISO No.	EN No.
-1701	Human Body measurements – Basic measurements for techn. design	7250	
-1702	Human Body measurements – dimensions for whole body access		547-1
-1703	Principles for determining the dimensions required for access openings		547-2
-1704	Human Body measurements – Anthropometric data		547-3
-1801	Safe distance to prevent danger zones being reached by the upper limbs	13852	294
-1802	Safe distance to prevent danger zones being reached by the lower limbs	13853	811

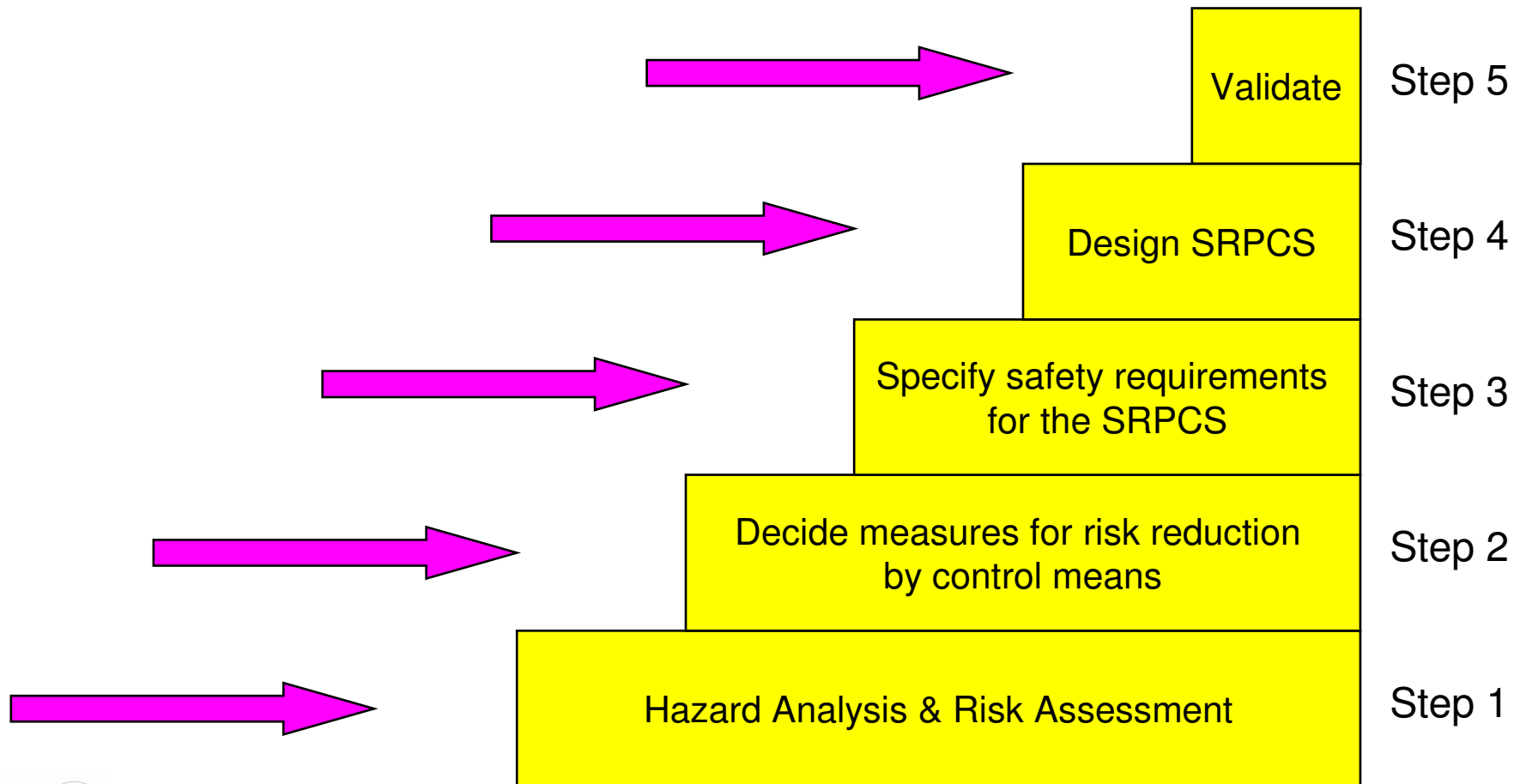
# Safety of Machinery AS4024.1 2006



## Ergonomics cont.

AS4024	AS Title	ISO No.	EN No.
-1803	Minimum gaps to prevent crushing of parts of the human body	13854	
-1901	Ergonomic requirements for the design of control actuators – Principles		894-1
-1902	Ergonomic requirements for the design of displays	9355-2	894-2
-1903	Ergonomic requirements for the design of control actuators		894-3
-1904	Requirements for visual, auditory and tactile signals	13852	61310-1
-1905 -1906 -1907	Displays controls, actuators and signals – Requirements for Marking Displays controls, actuators and signals – Requirements for Location System of auditory and visual danger and information signals	IEC1310/2 IEC1310/3 11429	61310-2 61310-3 981

# Using AS4024.1 – 2006 And the Machine Safety Process

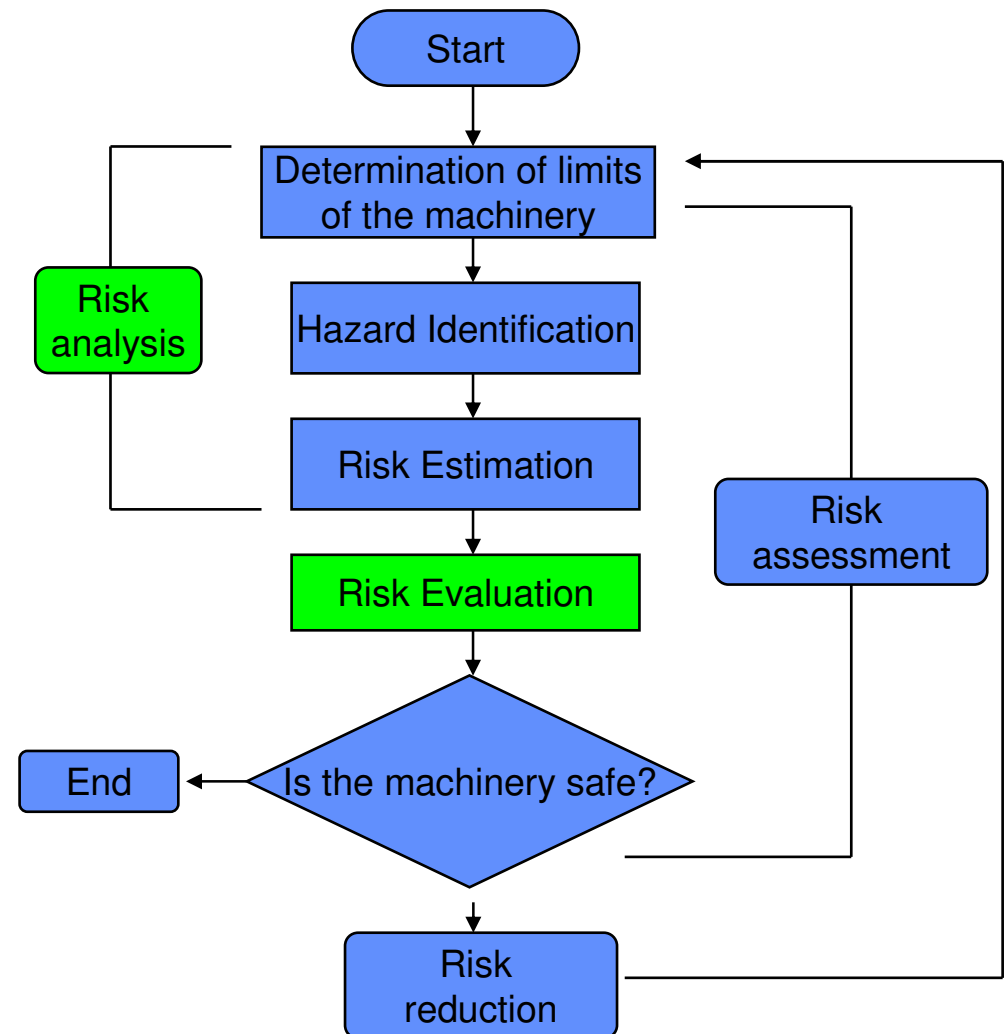


# AS4024.1301 2006

## Principles of Risk Assessment

### ► Risk assessment:

- Is a series of logical steps to enable the examination of hazards associated with machinery
- Consists of
  - Risk analysis and
  - Risk evaluation
- Relies on judgemental decisions which are supported by qualitative methods and complemented, where possible, with quantitative methods.

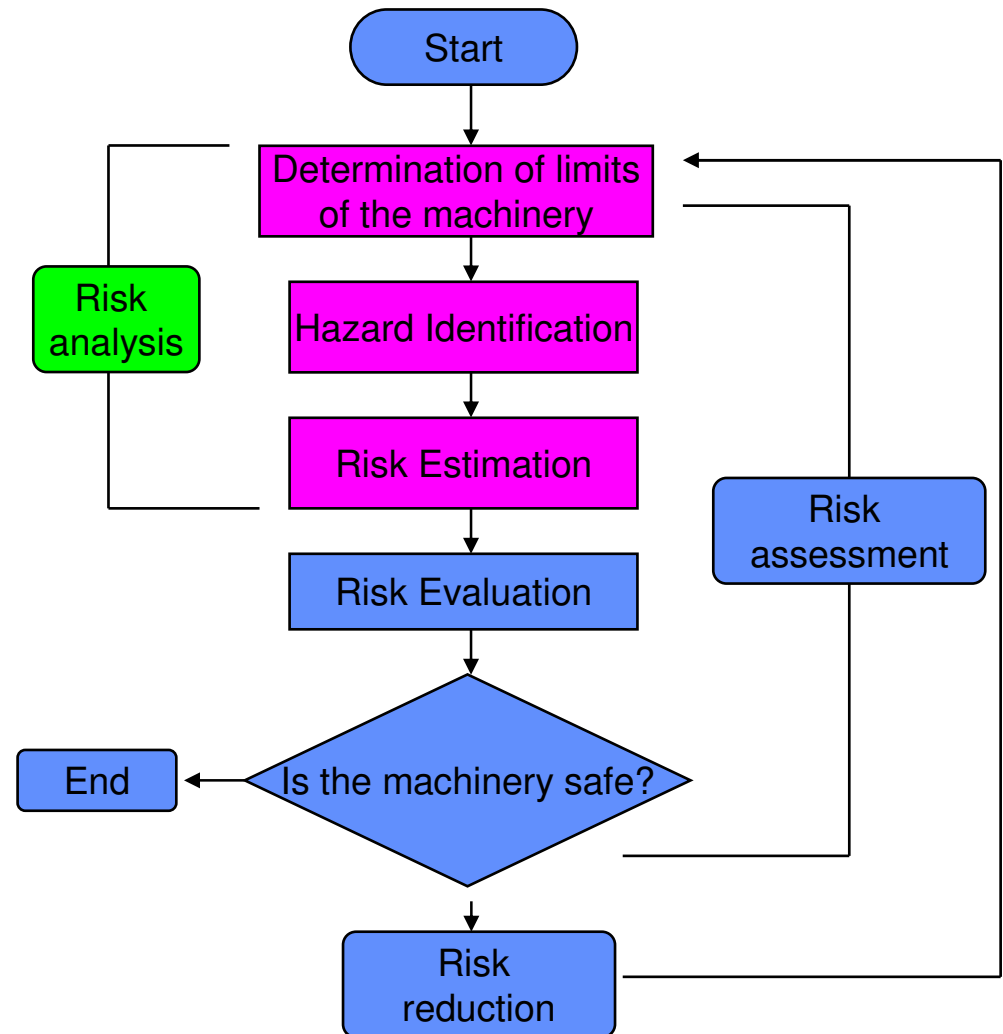


# AS4024.1301 2006

## Principles of Risk Assessment

► Risk analysis includes :

- Determination of limits of the machinery
- Hazard identification
- Risk estimation

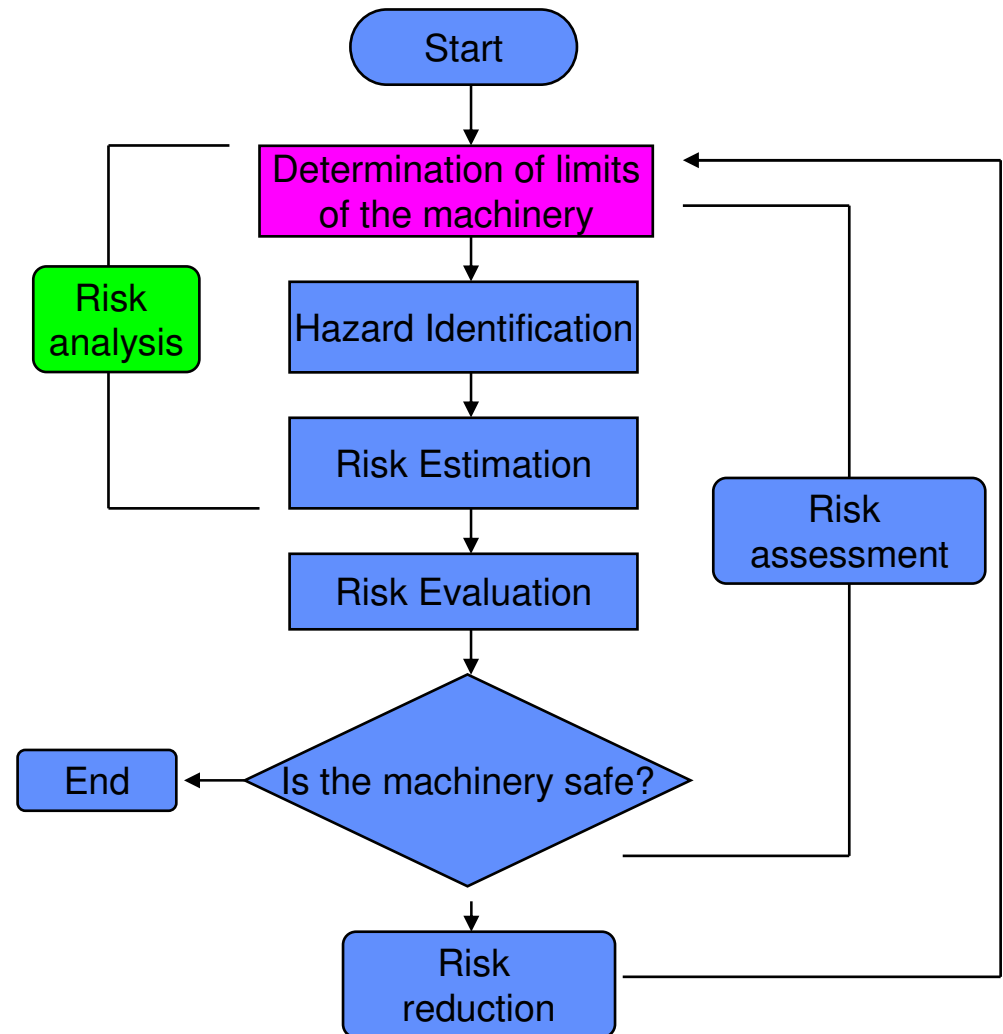


# AS4024.1301 2006

## Principles of Risk Assessment

### ► Determination of limits of the machinery :

- Intended use of the machine, operating modes
- Space requirements, range of movement
- 'Life limit' of the machine

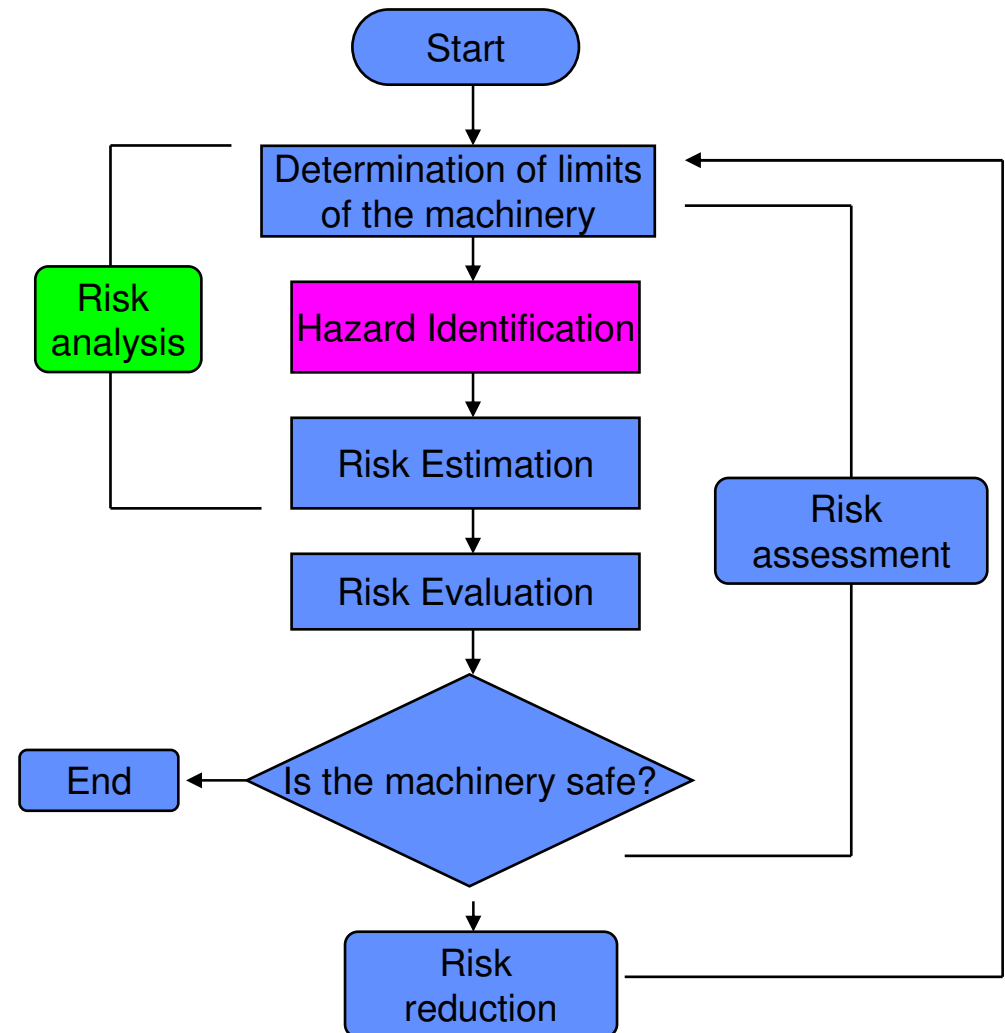


# AS4024.1301 2006

## Principles of Risk Assessment

► Hazard ID – a hazard is a potential source of harm and includes:

- Mechanical hazards
- Electrical hazards
- Thermal hazards
- Noise hazards
- Vibration hazards
- Radiation hazards
- Ergonomic hazards
- Slipping, tripping and falling



# AS4024.1301 2006

## Principles of Risk Assessment

### ▶ Typical mechanical hazards -

- Crushing
- Shearing
- Cutting/severing
- Entanglement
- Drawing-in/trapping
- Impact
- Stabbing/puncture
- Friction/abrasion

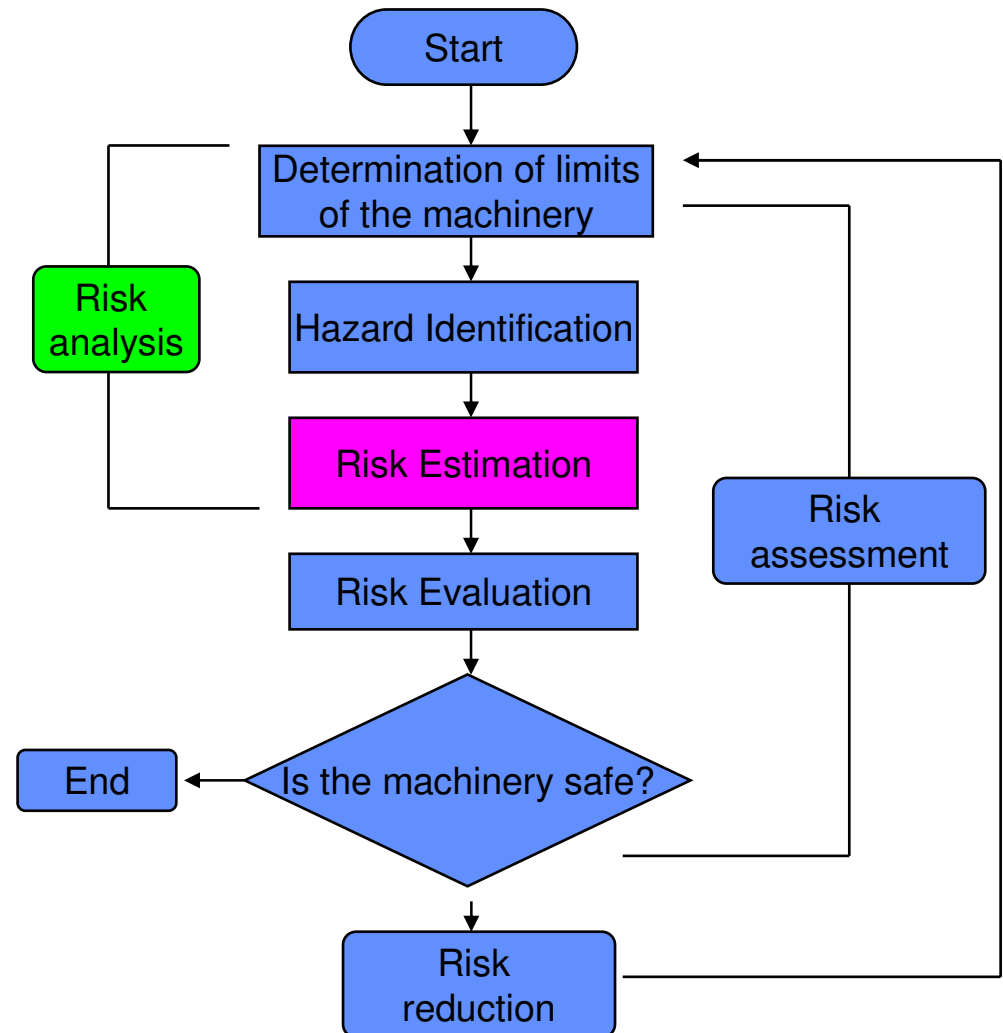


# AS4024.1301 2006

## Principles of Risk Assessment

### ► Risk Estimation :

- Severity – (degree of harm)
  - Slight (reversible)
  - Serious (irreversible)
- Probability
  - Frequency
  - Duration

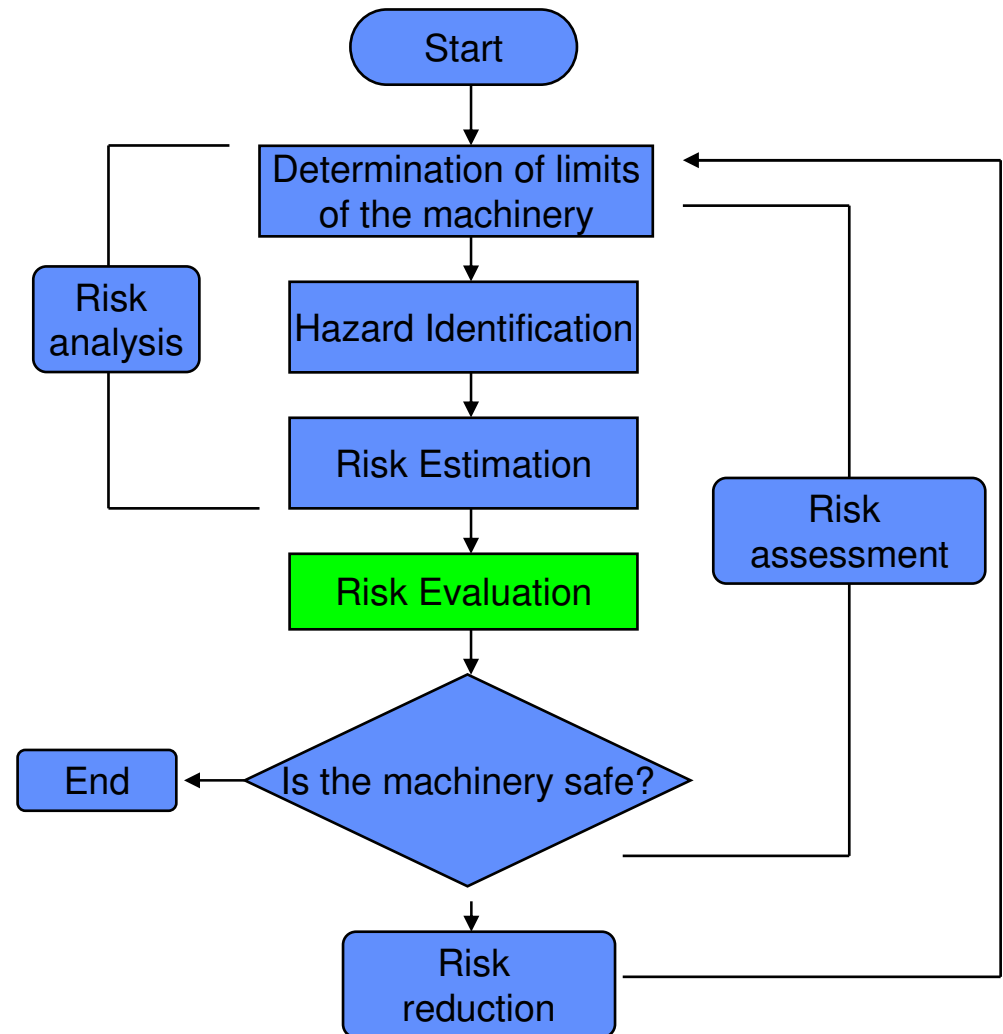


# AS4024.1301 2006

## Principles of Risk Assessment

### ► Risk Evaluation :

- After risk analysis is complete, risk evaluation is carried out to determine if risk reduction is required or whether safety has been achieved.

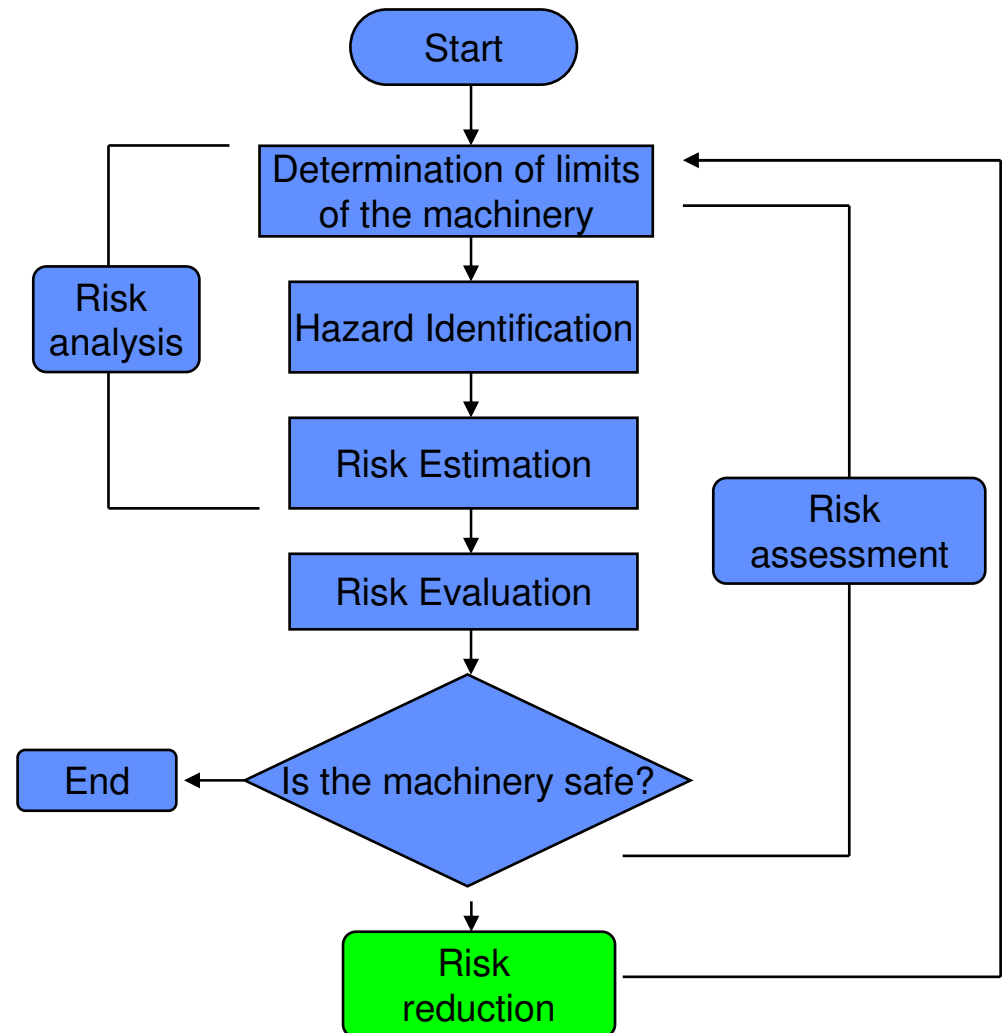


# AS4024.1301 2006

## Principles of Risk Assessment

- ▶ Risk Reduction – 3 steps of reduction need to be applied until an acceptable level of safety is achieved

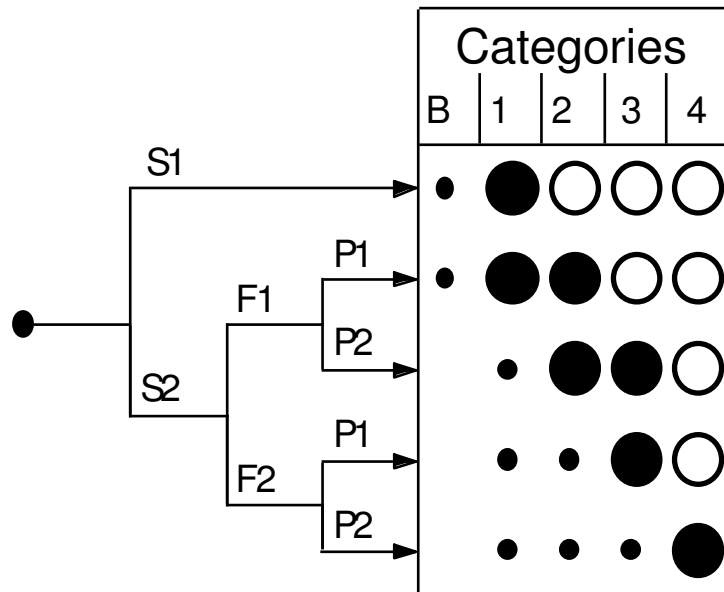
- Risk reduction by inherently safe design measures (removal of risk)
- Risk reduction by safeguarding and complimentary measures
- Risk reduction by information of use



# AS4024.1501 2006

## Design of S R P C S

- ▶ The key objective is that the designer ensure that the safety related parts of a control system produce outputs which achieve the risk reduction objective
- ▶ Selection of Categories of SRPCS is used for this purpose

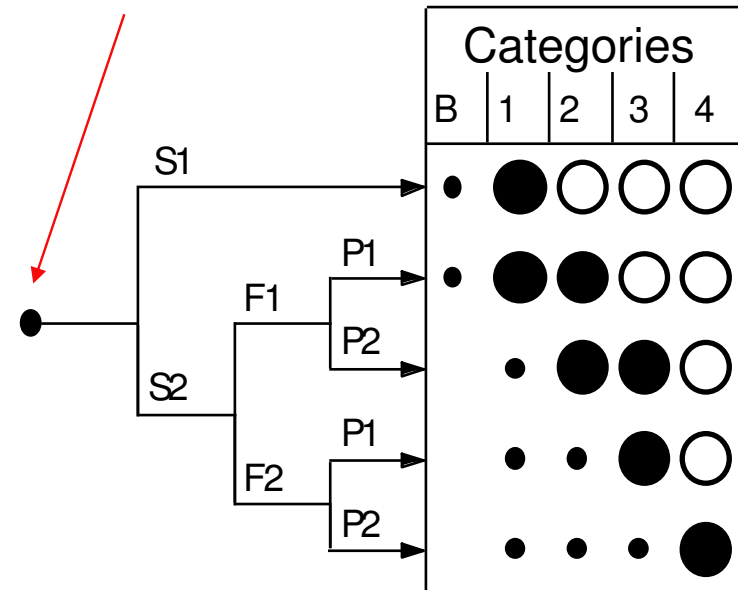


# AS4024.1501 2006

## Design of S R P C S

- ▶ **S\_Severity of injury:**
  - 1 = Slight (reversible)
  - 2 = Serious (non-reversible) including fatal injuries
  
- ▶ **F Frequency and exposure times**
  - 1 = Seldom and/or short exposure
  - 2 = Frequent to continuous and/or long exposure
  
- ▶ **P\_Possibility of avoiding the hazard**
  - 1 = Possible under specific conditions
  - 2 = Nearly impossible

Starting point for the risk estimation of the safety-related control section



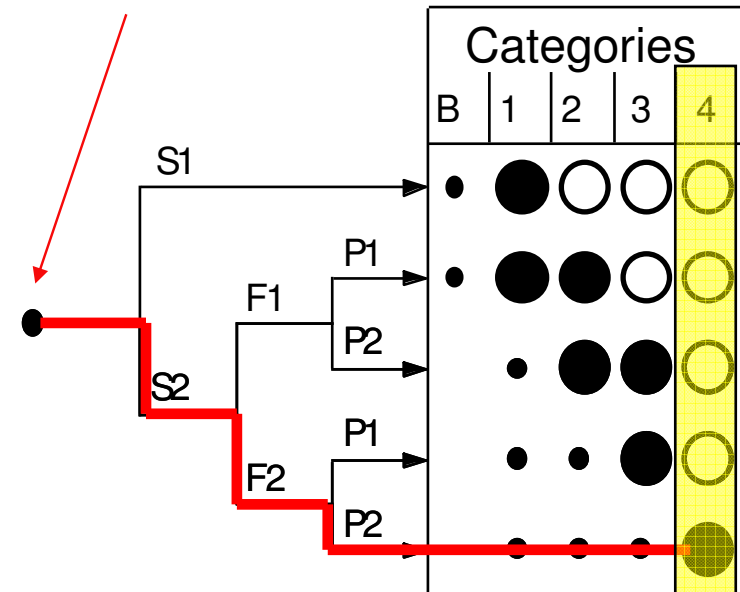
# AS4024.1501 2006

## Design of S R P C S



Starting point for the risk estimation of the safety-related control section

- ▶ S2 Serious (non-reversible)
- ▶ F2 Frequent to continuous and/or long exposure
- ▶ P2 Nearly impossible



# AS4024.1501 2006

## Design of S R P C S – category B



Cat	Summary Requirements	System Behaviour
B	SRPCS &/or their protective equipment, as well as their components, shall be designed, constructed, selected, assembled and combined in accordance with relevant standards so that they can withstand the expected influence.	The occurrence of a fault can lead to loss of the safety function

# AS4024.1501 2006

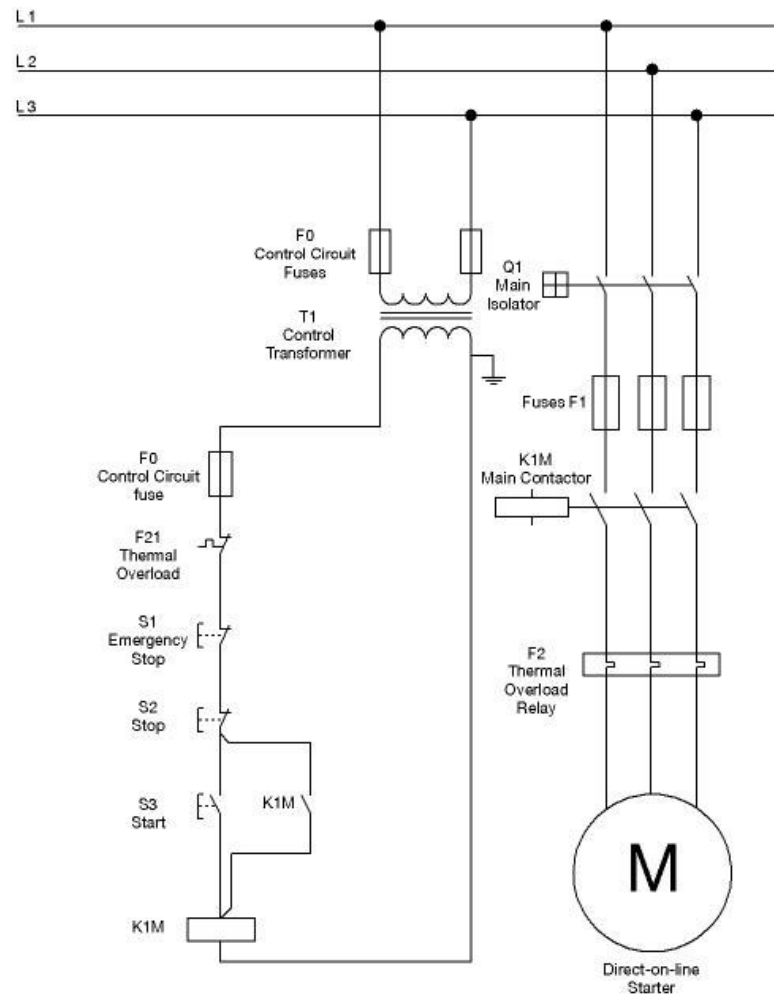
## Design of S R P C S – category 1



Cat	Summary Requirements	System Behaviour
1	Requirements of B. Well tried components and well tried safety principles shall be used.	The occurrence of a fault can lead to loss of the safety function but the probability of occurrence is lower than B.

# AS4024.1501 2006

## Design of S R P C S – category 1



# AS4024.1501 2006

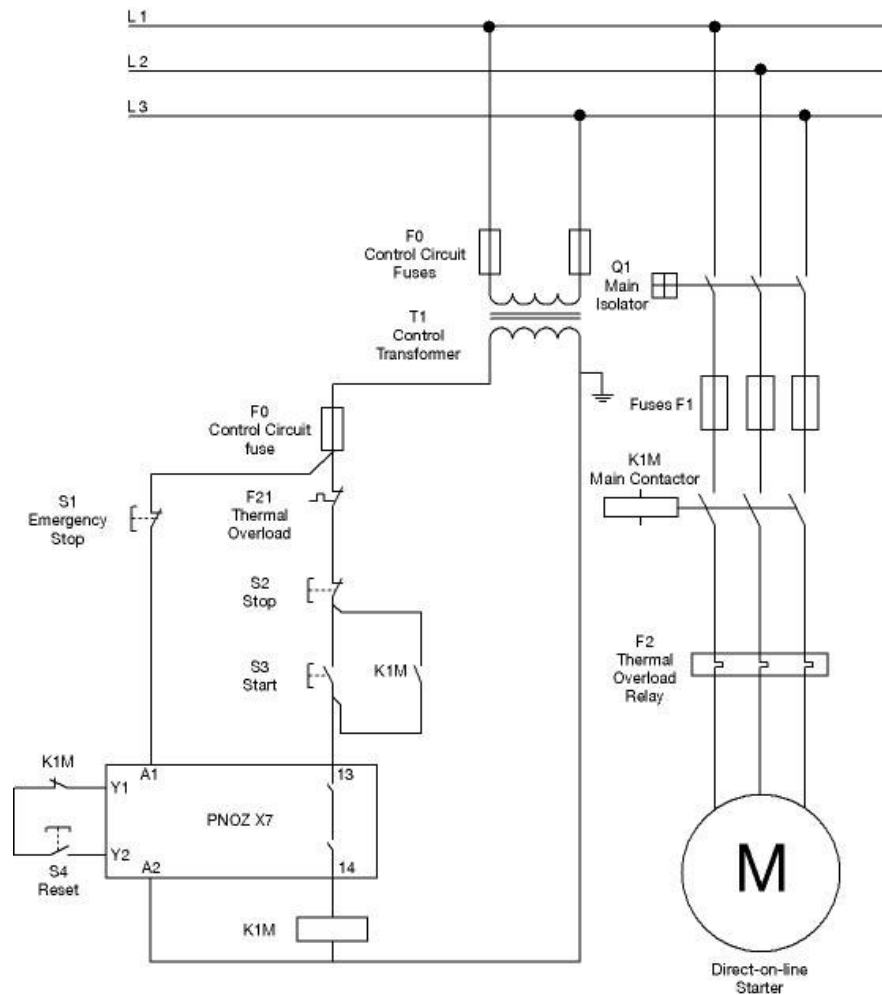
## Design of S R P C S – category 2



Cat	Summary Requirements	System Behaviour
2	Requirements of B and 1. Safety function shall be checked at suitable intervals by the machine control system.	The occurrence of a fault can lead to loss of the safety function between checks. The loss of the safety function is detected.

# AS4024.1501 2006

## Design of S R P C S – category 2



# AS4024.1501 2006

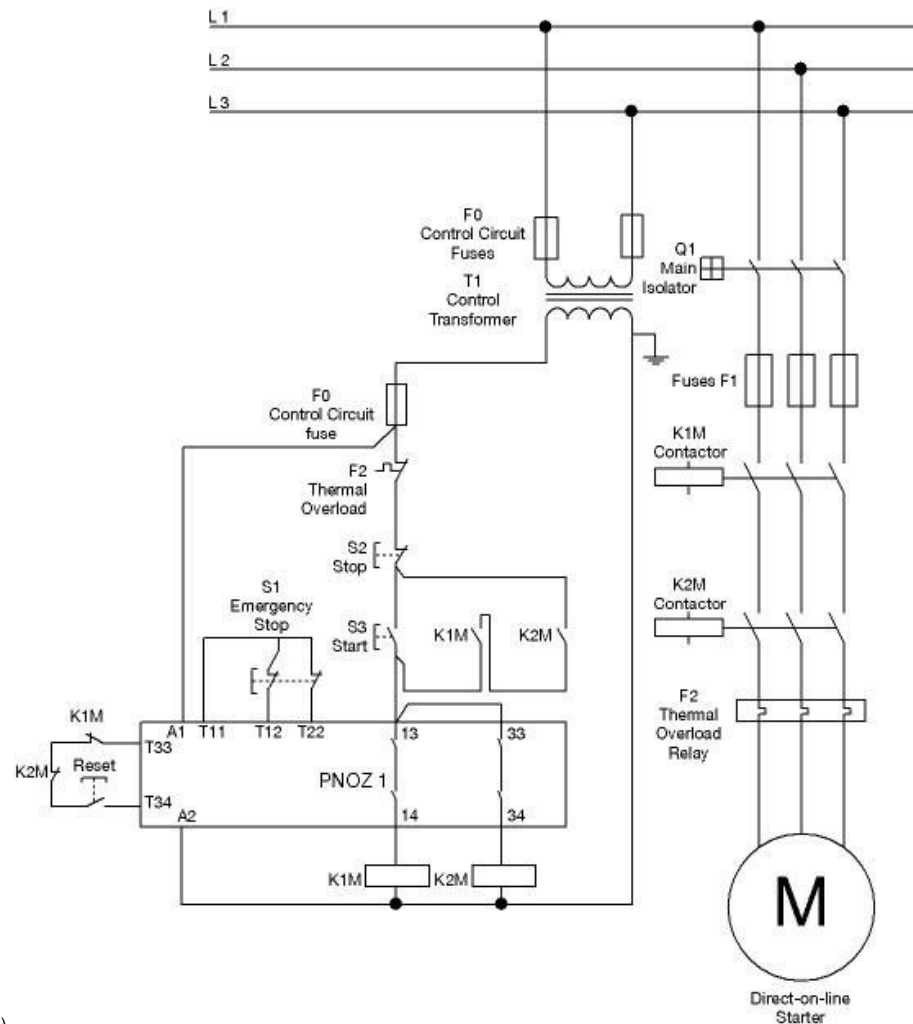
## Design of S R P C S – category 3



Cat	Summary Requirements	System Behaviour
3	<p>Requirements of B and 1.</p> <p>Safety related parts shall be designed so that –</p> <p>A single fault in any of these parts does not lead to loss of the safety function; and</p> <p>Whenever reasonably practicable the single fault is detected.</p>	<p>When a single fault occurs, the safety function is always performed.</p> <p>Some but not all faults will be detected.</p> <p>Accummulation of undetected faults can lead to loss of the safety function.</p>

# AS4024.1501 2006

## Design of S R P C S – category 3



# AS4024.1501 2006

## Design of S R P C S – category 4



Cat	Summary Requirements	System Behaviour
4	<p>Requirements of B and 1.</p> <p>Safety related parts shall be designed so that –</p> <p>A single fault in any of these parts does not lead to loss of the safety function; and</p> <p>The single fault is detected at or before the next demand upon the safety function.</p>	<p>When faults occurs, the safety function is always performed.</p> <p>The faults will be detected in time to prevent loss of the safety function.</p>

# AS4024.1501 2006

## Design of S R P C S – category 4

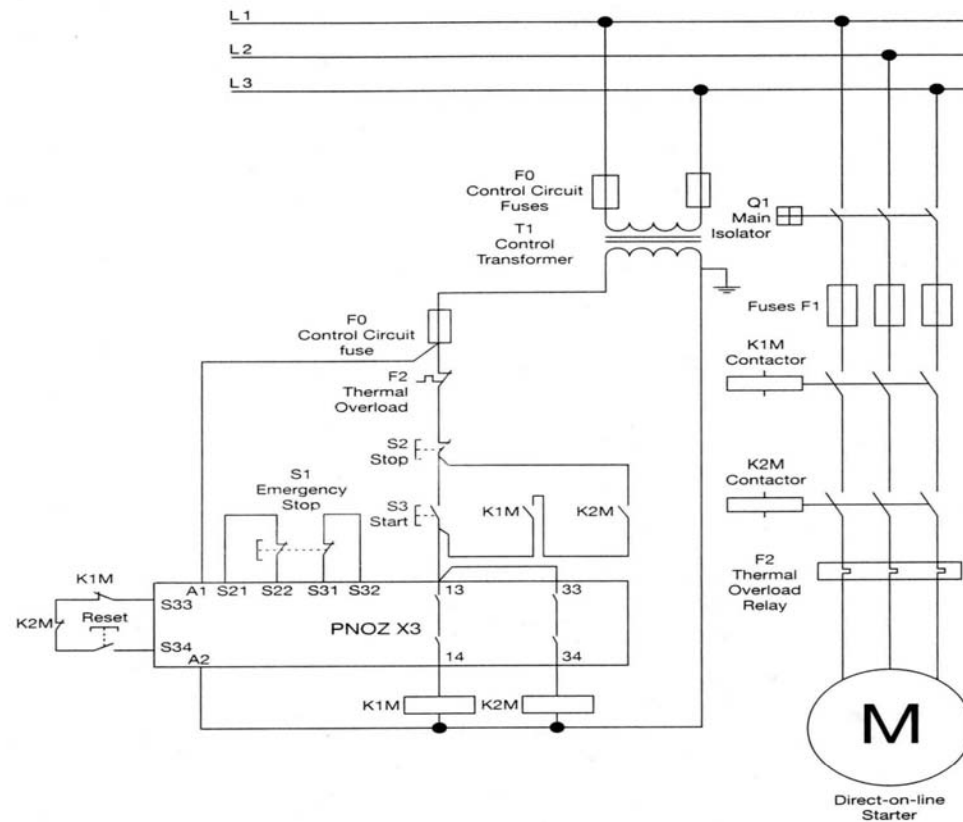


Fig. 45: Simplified E-Stop circuit for category 4 (Pilz PNOZ X3)

**THANK YOU**



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