

## **NEN Webmeeting**

# **ISO 13482 – Safety Requirements for Personal Care Robots**

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# ISO 13482: Personal Care Robot Safety: WHY??



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- **Personal care robots:**
  - newly emerging robots and robotic devices
  - new applications in non-industrial environments for providing services rather than manufacturing applications
  - require close human-robot interaction and collaborations, as well as physical human-robot contact
  - used by/with **lay persons** and **vulnerable users** (children, elderly)
- **ISO 13482:**
  - Protect vulnerable users
  - Facilitate robot industry & accelerate robot introduction by providing means to prove safety (liability claims)

# Contents



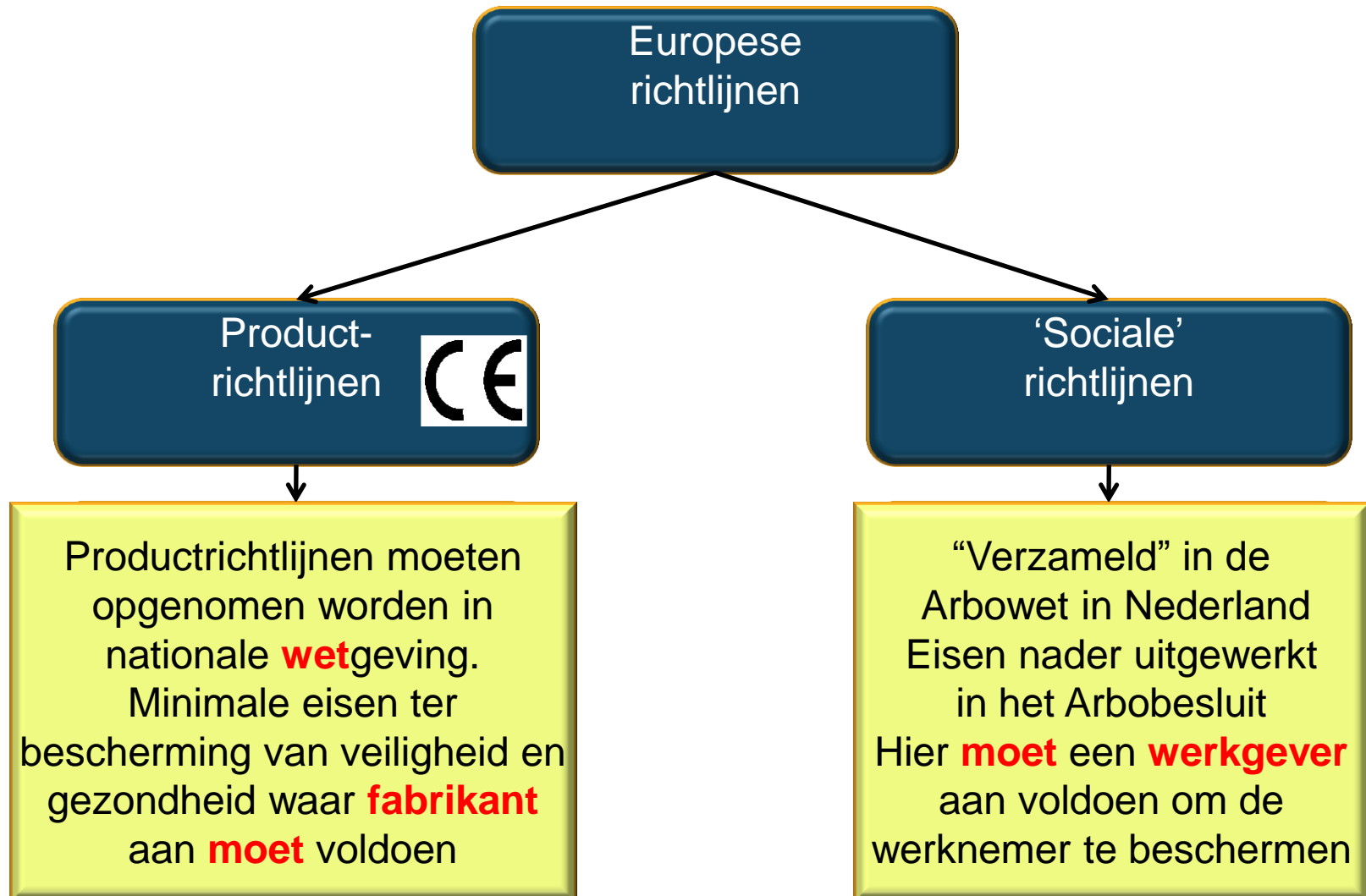
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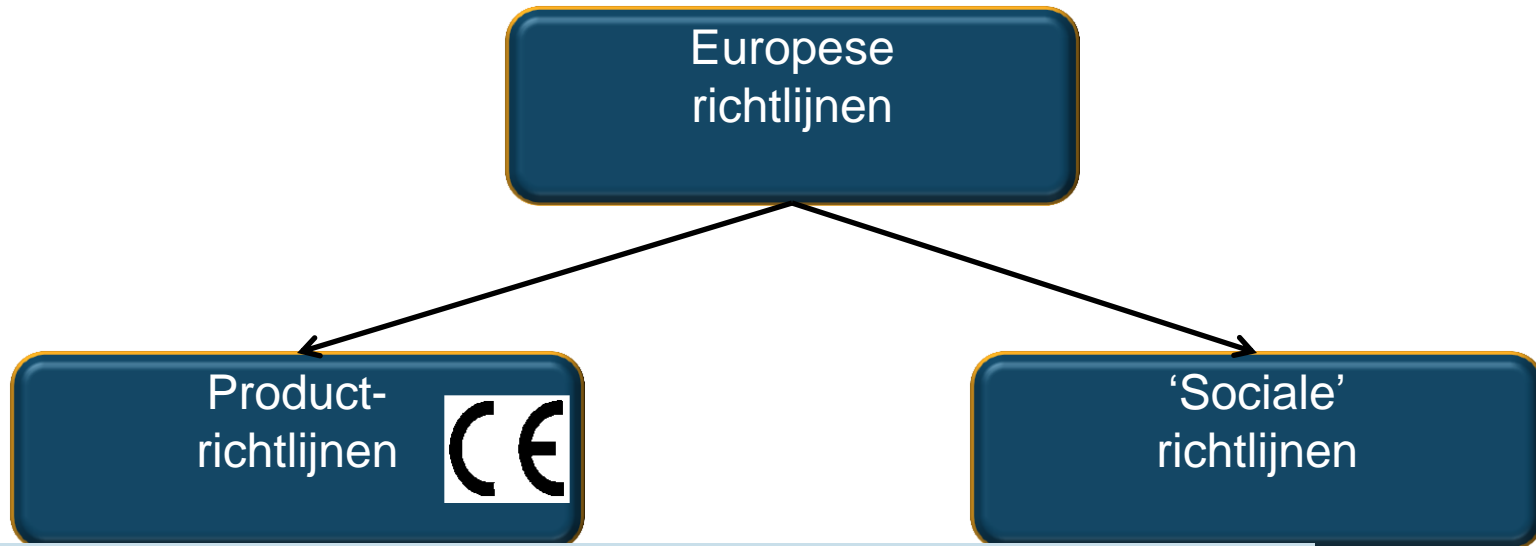
- Information on standard ISO 13482:  
Safety of Personal Care Robots
- **Your** experience with and opinion on  
update of ISO 13482



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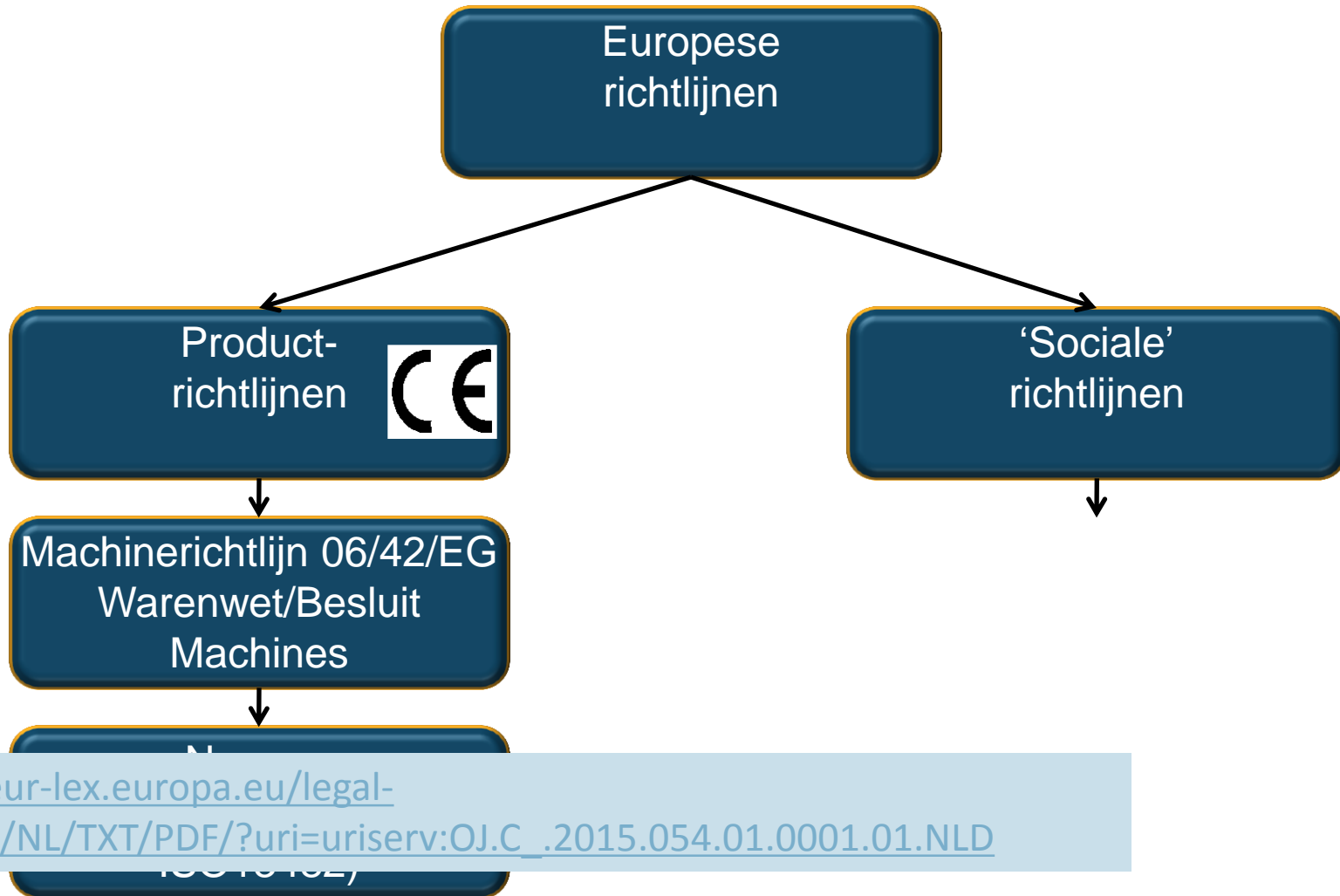
“This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association **to provide one means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC *Machinery safety.***”





<http://www.rvo.nl/onderwerpen/tools/wet-en-regelgeving/eu-wetgeving/ce-markering/overzicht-ce-richtlijnen/machines-en-aanverwante-producten>

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:157:0024:0086:NL:PDF>



- **Verplicht voor (bijna) alle (niet-voltooid) machines die een fabrikant op de Europese markt brengt.**
  - Ook in zijn eigen bedrijf. Ook bij import van buiten EU.
- **Fabrikant moet:**
  - **Voldoen aan vermelde essentiële gezondheids- en veiligheidseisen**
  - Technisch dossier en andere info zoals gebruiksaanwijzing leveren
  - EG verklaring van overeenstemming opstellen
  - CE markering aanbrengen
- **Geldt voor hele levenscyclus** van het product (dus ook fabricage, onderhoud en storing) en voor redelijkerwijs voorzienbaar **verkeerd gebruik**



▶ **Machinerichtlijn: essentiële gezondheids- en veiligheidseisen**

- Risicobeoordeling uitvoeren (ISO 12100)
- Geïntegreerde veiligheid
  1. Risico's uitsluiten of verminderen: aanpak van de bron
  2. Beveiligingsmaatregelen
  3. Informeren over restrisico's
- Machine met CE-markering: **vermoeden** van conformiteit aan normen en dus veilig
- **Géén keurmerk of kwaliteitscertificaat!**  
(in meeste gevallen mag fabrikant dit zelf doen)

“This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association **to provide one means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC Machinery safety.**”

“This International Standard includes **additional information in line with ISO 12100** and adopts the approach proposed in ISO 13849 and IEC 62061 to formulate a safety standard for robots and robotic devices in personal care to specify the conditions for physical human robot contact ...”

“This **type-C** International Standard **complements ISO 10218-1**, which covers the safety requirements for robots in **industrial environments only**

“**Not all of the hazards identified by this International Standard apply to every personal care robot, ....** Consequently, the safety requirements, and/or protective measures can vary... In such a case, a risk assessment is conducted to determine the protective measures needed,...”

“**Future editions** might include more specific requirements on particular types of personal care robots, as well as more complete numeric data for different categories of people (e.g. children, elderly, pregnant women).

## Scope:

- Requirements and guidelines for inherently safe design, protective measures, and information for use of personal care robots, in particular
  - mobile servant robot
  - physical assistant robot
  - person carrier robot

These robots typically perform tasks to improve the quality of life of intended users, irrespective of age or capability.
- Describes hazards associated with the use of these robots, and provides requirements to eliminate, or reduce, the risks associated with these hazards to an acceptable level.
- Covers human-robot physical contact applications
- Not for medical & military devices

# ISO 13482: Definition of Service Robots

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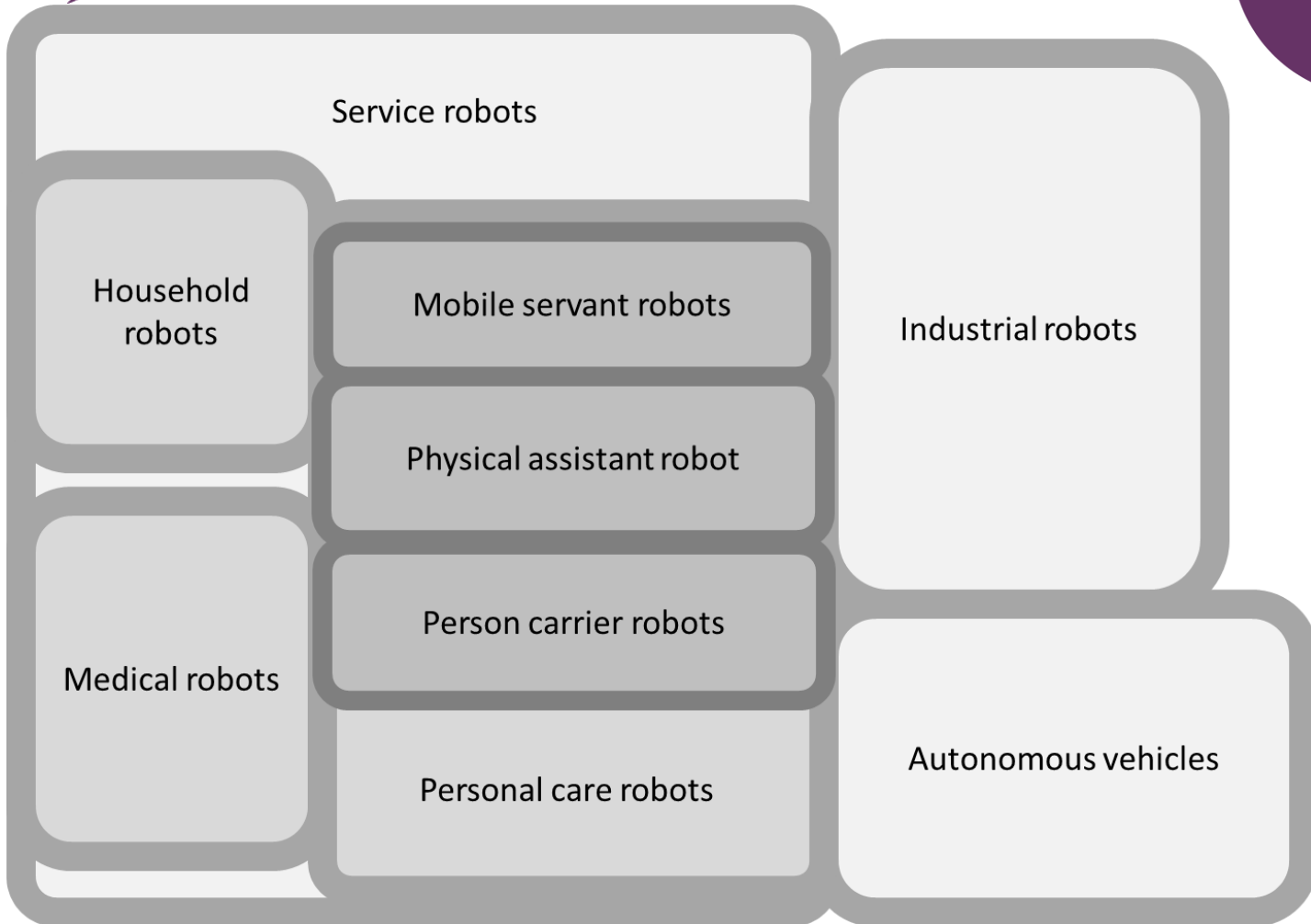


Fig 4.1 Application Guide

# ISO 13482: Definition of Service Robots

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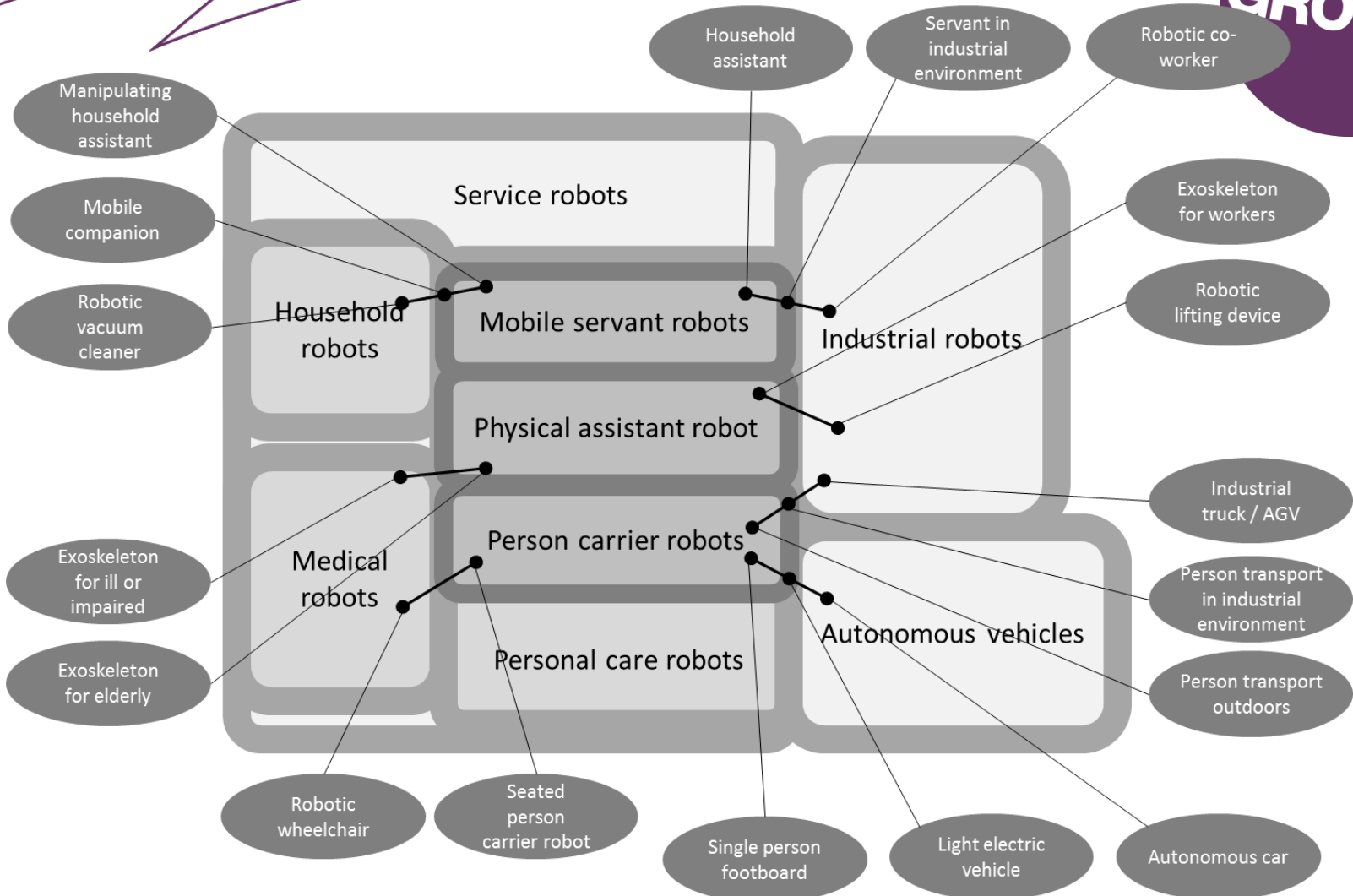


Fig 4.2 Application Guide

# ISO 13482: Definition of Service Robots

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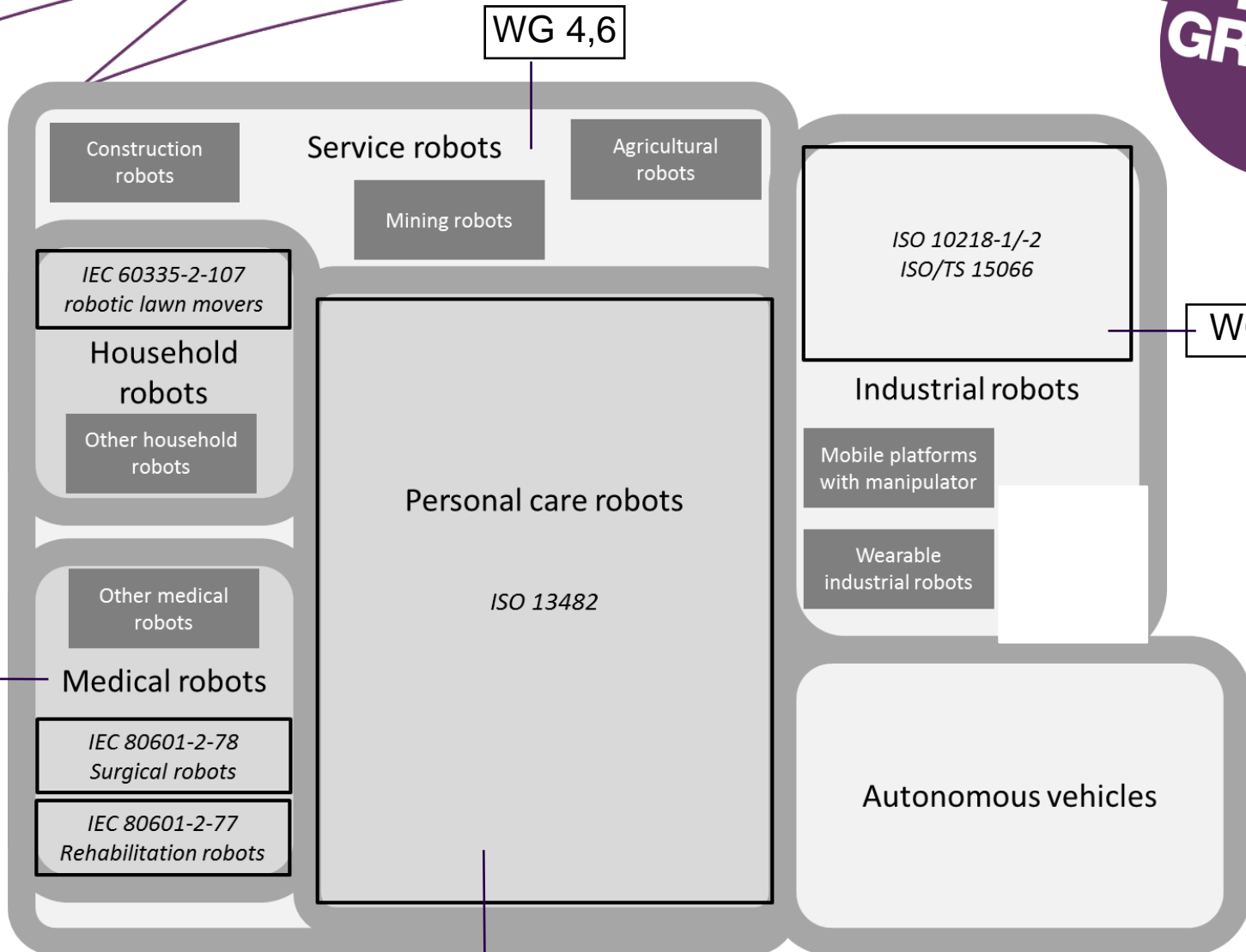


Fig 4.3 Application Guide

# ISO 13482: Contents

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5.16 Hazards due to localization and navigation errors

**Step 1: Identify issues that should be taken  
in consideration to identify all possible hazards.  
Annex A shows examples.**

**Step 2: Carry out risk estimation for  
all hazards in section 4.2**

**Step 3a: Adopt inherently safe design and  
protective measures according to CH5**

## Introduction

### 1. Scope

### 2. Normative references

### 3 Terms and definitions

### 4 Risk assessment

#### 4.1 General

#### 4.2 Hazard identification

#### 4.3 Risk estimation

### 5 Safety requirements and protective measures

#### 5.1 General

#### 5.2 Hazards related to charging battery

#### 5.3 Hazards due to energy storage and supply

#### 5.4 Robot start-up and restart of regular operation

#### 5.5 Electrostatic potential

#### 5.6 Hazards due to robot shape

#### 5.7 Hazards due to emissions

#### 5.8 Hazards due to electromagnetic interference

#### 5.9 Hazards due to stress, posture and usage.

#### 5.10 Hazards due to robot motion

#### 5.11 Hazards due to insufficient durability

#### 5.12 Hazards due to incorrect autonomous decisions and actions

#### 5.13 Hazards due to contact with moving components

#### 5.14 Hazards due to lack of awareness of robots by humans

#### 5.15 Hazardous environmental conditions



# ISO 13482: Contents

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## Introduction

- 1. Scope
- 2. Normative references
- 3. Terms, definitions and abbreviations

**Step 3b: If protective measures are implemented through a control system, apply the requirements of CH6**

## 4 Risk assessment

### 4.1 General

**The required performance level (PL) or safety integrity level (SIL) of the control system is determined conform ISO 13849-1 or IEC 62061. Table 1 shows PLr's for several personal care robots**

### 5.3 Hazards due to energy storage and supply

**Step 4. Evaluate the residual risk and prove that it is reduced to an acceptable level. All safety requirements shall be verified wrt their associated verification standard. The V&V document will provide guidance.**

### 5.9 Hazards due to stress, posture and usage.

### 5.10 Hazards due to robot motion

**5. Provide information of remaining risks for the user**

### 5.13 Hazards due to contact with moving components

### 5.14 Hazards due to lack of awareness of robots by humans

### 5.15 Hazardous environmental conditions

### 5.16 Hazards due to localization and navigation errors

## 6 Safety-related control system requirements

- 6.1 Required safety performance
- 6.2 Robot stopping
- 6.3 Limits to operational spaces
- 6.4 Safety-related speed control
- 6.5 Safety-related environmental sensing
- 6.6 Stability control
- 6.7 Safety-related force control
- 6.8 Singularity protection
- 6.9 Design of user interface
- 6.10 Operational modes
- 6.11 Manual control devices

## 7 Verification and validation

## 8 Information for use

- 8.1 General
- 8.2 Markings or indications
- 8.3 User manual
- 8.4 Service manual

### Annex A List of significant hazards for personal care robots

### Annex B Examples of operational spaces for personal care robots

### Annex C Example of the implementation of a safeguarded space

### Annex D Examples of functional tasks of personal care robots

### Annex E Examples of markings for personal care robots

# ISO 13482: Annex A

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No	Hazard item	Hazard analysis		Associated safety requirement clause	Remarks
		Hazard	Potential consequence		
18.	Hazards due to robot start-up	Unintended/ unexpected start-up	Other hazards	<a href="#">5.4</a>	
19.		Hazardous actions taken during start-up or restart	Other hazards	<a href="#">5.4</a>	
56.	Hazards due to robot motion	Mechanical instability (overturning, falling, excessive leaning)	Crushing, trapping, dropped loads	<a href="#">5.10.2</a>	
57.		Mechanical instability – overturning while handling loads	Crushing, trapping, dropped loads	<a href="#">5.10.2</a>	
72.		Collision with fragile safety-related objects	Damage to the environment, dropped loads, release of harmful substances, burning (for hot fluids), cutting/severing (for sharp safety-related objects)	<a href="#">5.10.8</a>	Not applicable to restraint-type physical assistant robots.
80.	Hazards due to localization and navigation errors	Localization errors causing unexpected movement of the personal care robot	Crushing, trapping, impact injury, dropped loads	<a href="#">5.16</a>	



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- Under construction
- Goal: facilitate in application of ISO 13482
- Contents:
  - **Guidance on overlaps or gaps in scope of ISO 13482**
  - **Methodology**
  - **Worked examples of the main personal care robots (in high risk and low risk variations)**



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- Under construction: close to ballot
- Goal: Specify methods to test personal care robots in terms of safety requirements ISO 13482
- Contents:
  - **Definition of testing conditions**
  - **Test for physical hazards (e.g. voltage, acoustic noise, high temperature, injury by collision or friction on skin)**
  - **Endurance tests**
  - **Stability tests**
  - **Tests of safety-related control systems**
  - **Test of reliability of autonomous decisions and actions**

## Your ....



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- Experience with ISO 13482?
- Opinion on update of ISO 13482?
- Contribution to ISO TC299?

# Take Home Message



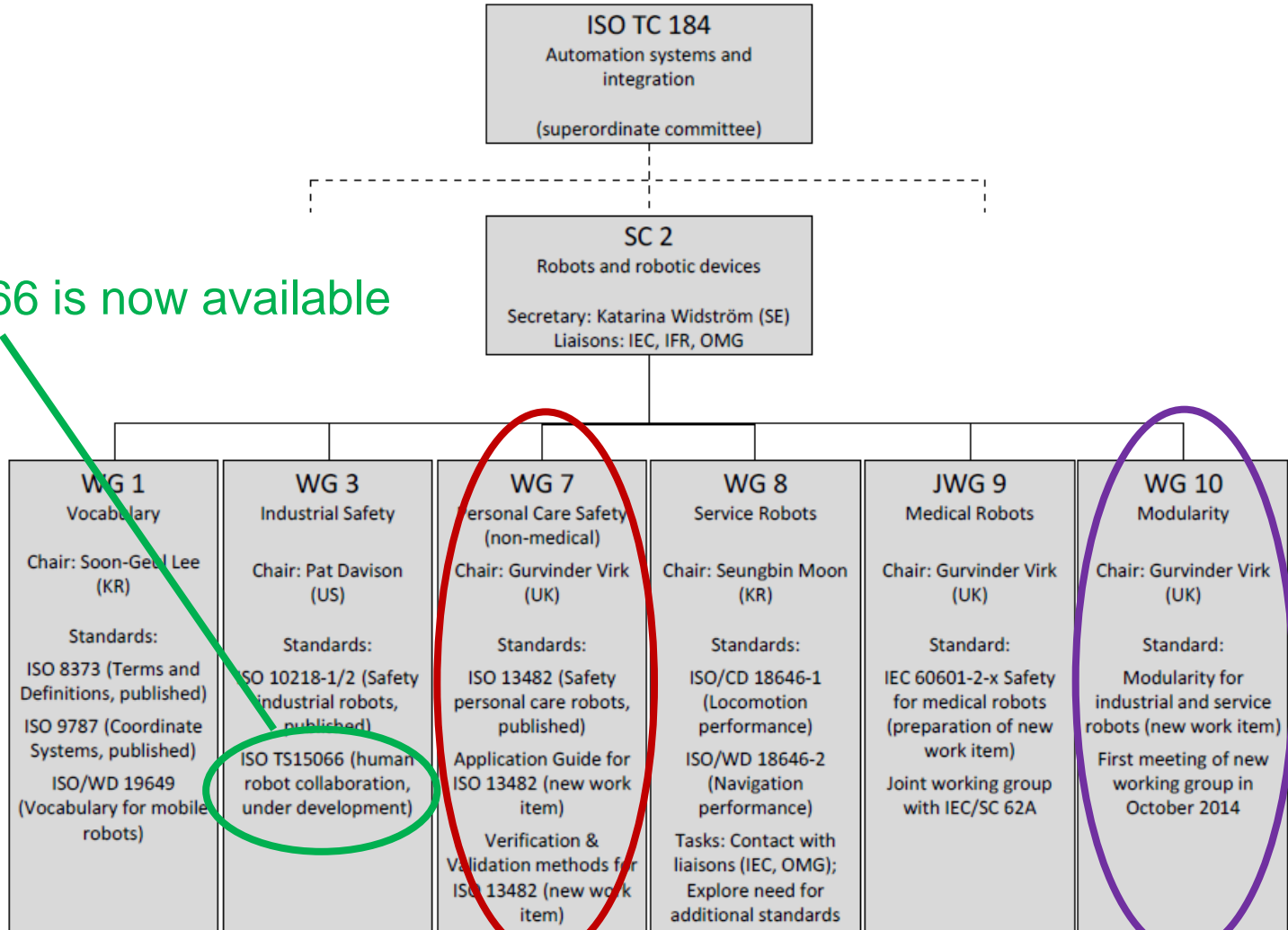
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- If your robot falls within the scope of ISO 13482, this standard can be applied to show that the robot is conform the essential requirements of the EU directive Machinery Safety (and thus CE marked)
- More Dutch delegates are needed to increase our influence on international robot standards

# Until 1/1/2016: ISO TC 184 / SC2

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TS15066 is now available



# Starting from 1/1/16: ISO TC299

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ISO TC 299  
Robots and  
Robotic Devices

**WG 1**  
Vocabulary and  
characteristics

(former SC2/WG1)

Chair: Soon-Geul Lee  
(KR)

**WG 2**  
Personal care  
robot safety

(former SC2/WG7)

Chair: Gurvinder Virk  
(UK)

**WG 3**  
Industrial  
Safety

(former SC2/WG3)

Chair: Roberta  
Nelson Shea

**WG 4**  
Service  
Robots

(former SC2/WG8)

Chair: Seungbin Moon  
(KR)

**JWG 5**  
Medical Robot  
Safety

(former SC2/WG9)

Chair: Gurvinder Virk  
(UK)

(joint with IEC/SC 62A  
and 62D)

**WG 6**  
Modularity for  
Service Robots

(former SC2/WG3)

Chair: Gurvinder Virk  
Shuping Yang (CN)  
Hongseong Park (KR)