

# ISO 22166-1:2021 (E)

## Robotics — Modularity for service robots — Part 1: General requirements

---

### Contents

	Foreword
	Introduction
1	Scope
2	Normative references
3	Terms and definitions
3.1	General terms
3.2	Terms related to component
3.3	Terms related to module
3.4	Terms for classification of modules
3.5	Characterization of modules regarding principal function
4	General provisions
4.1	General
4.2	Generic principles of modularity
4.2.1	General
4.2.2	Composability
4.2.3	Integrability
4.2.4	Interoperability
4.2.5	Module granularity
4.2.6	Platform independence
4.2.7	Openness
4.2.8	Reusability
4.2.9	Safety
4.2.10	Security
4.3	Abstraction
4.4	Electrical interfaces and communication protocols
4.5	Interchangeability
4.6	Module properties
4.6.1	General
4.6.2	Module identification
4.7	Simulation
4.8	Data types for interoperability
5	Provisions for safety and security
5.1	General
5.2	Robot system level safety
5.3	Module level safety
5.4	General aspects of security
5.5	Steps to design security into a module
5.6	Physical security of modules
5.7	Cyber security of modules
6	Hardware aspects in module design
6.1	General
6.2	Requirements and guidance for hardware aspects of modules
6.2.1	Mechanical interfaces
6.2.1.1	General
6.2.1.2	Connection accuracy and reliability
6.2.1.3	Connection stiffness
6.2.1.4	Mechanical connectors and connections
6.2.2	Interfacing for power supply

- 6.2.3 Other aspects for module description
- 7 Software aspects in module design
  - 7.1 General
  - 7.2 Information model
    - 7.2.1 General
    - 7.2.2 Model for exchange of information among modules
    - 7.2.3 Model for access to properties and its access
    - 7.2.4 Model for error handling and recovering
    - 7.2.5 Interoperation of software modules
  - 7.3 Architectural model for software modules
    - 7.3.1 General
    - 7.3.2 Requirements for software modules
  - 7.4 Safety/Security-related requirements for modules with software aspects
    - 7.4.1 General
    - 7.4.2 Interaction with safety/security manager modules
- 8 Information for use
  - 8.1 General
  - 8.2 Markings or Indications
  - 8.3 Information for users
  - 8.4 Information for service
- Annex A (informative) Robot module template
  - A.1 General template
  - A.2 Hardware-specific extensions to the robot module template
- Annex B (informative) Robot module examples
  - B.1 Examples of modules with hardware aspects
    - B.1.1 Actuated rotating joint
    - B.1.2 Power supply
  - B.2 Examples of modules with software aspects
    - B.2.1 Recognition
    - B.2.2 Localisation
  - B.3 Examples of commonly used composite modules
    - B.3.1 General
    - B.3.2 Manipulator module
    - B.3.3 Mobile platform module
    - B.3.4 Human robot interaction module
- Annex C (informative) Use case examples of modularity for service robots
  - C.1 General
  - C.2 Modularity for mobile robot systems
  - C.3 Modularity for exoskeleton robot systems
- Annex D (informative) Guidance for testing robot modules
  - D.1 General
  - D.2 Identify required tests
  - D.3 Tests for compliance of safety and security
    - D.3.1 General
    - D.3.2 Mechanical safety tests
    - D.3.3 Electrical safety and electromagnetic compatibility tests
    - D.3.4 Safety-related software tests
    - D.3.5 Security tests
    - D.3.6 Bio and chemical safety tests
  - D.4 Tests for compliance of performance
    - D.4.1 General
    - D.4.2 Mechanical performance tests
    - D.4.3 Electrical and electromagnetic performance tests
    - D.4.4 Artificial intelligence software performance tests
    - D.4.5 Environment tests
    - D.4.6 Human factors and usability tests
    - D.4.7 Verification and validation