

ISO/PAS 8800:2024-12 (E)

Road vehicles - Safety and artificial intelligence

Contents

Page

Foreword.....	vi
Introduction.....	vii
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	2
3.1 General AI-related definitions.....	2
3.2 Data-related definitions.....	7
3.3 General safety-related definitions.....	9
3.4 Safety: Root cause-, error-and failure-related definitions.....	11
3.5 Miscellaneous definitions.....	12
4 Abbreviated terms.....	14
5 Requirements for conformity.....	15
5.1 Purpose.....	15
5.2 General requirements.....	15
6 AI within the context of road vehicles system safety engineering and basic concepts.....	16
6.1 Application of the ISO 26262 series for the development of AI systems.....	16
6.2 Interactions with encompassing system-level safety activities.....	17
6.3 Mapping of abstraction layers between the ISO 26262 series, ISO/IEC 22989 and this document.....	20
6.4 Example architecture for an AI system.....	22
6.5 Types of AI models.....	23
6.6 AI technologies of a ML model.....	23
6.7 Error concepts, fault models and causal models.....	24
6.7.1 Cause-and-effect chain.....	24
6.7.2 Root cause classes.....	26
6.7.3 Error classification based on the safety impact.....	27
7 AI safety management.....	28
7.1 Objectives.....	28
7.2 Prerequisites and supporting information.....	28
7.3 General requirements.....	28
7.4 Reference AI safety life cycle.....	31
7.5 Iterative development paradigms for AI systems.....	33
7.6 Work products.....	34
8 Assurance arguments for AI systems.....	35
8.1 Objectives.....	35
8.2 Prerequisites and supporting information.....	35
8.3 General requirements.....	36
8.4 AI system-specific considerations in assurance arguments.....	36
8.5 Structuring assurance arguments for AI systems.....	37
8.5.1 Context of the assurance argument.....	37
8.5.2 Categories of evidence.....	38
8.6 The role of quantitative targets and qualitative arguments.....	39
8.7 Evaluation of the assurance argument.....	40
8.8 Work products.....	41
9 Derivation of AI safety requirements.....	41

9.1	Objectives.....	41
9.2	Prerequisites and supporting information.....	42
9.3	General requirements.....	42
9.4	General workflow for deriving safety requirements.....	43
9.5	Deriving AI safety requirements on supervised machine learning.....	46
9.5.1	The need for refined AI safety requirements.....	46
9.5.2	Derivation of refined AI safety requirements to manage uncertainty.....	47
9.5.3	Refinement of the input space definition for AI safety lifecycle.....	50
9.5.4	Restricting the occurrence of AI output insufficiencies.....	50
9.5.5	Metrics, measurements and threshold design.....	54
9.5.6	Considerations for deriving safety requirements.....	55
9.6	Work products.....	56
10	Selection of AI technologies, architectural and development measures.....	56
10.1	Objectives.....	56
10.2	Prerequisites.....	56
10.3	General requirements.....	56
10.4	Architecture and development process design or refinement.....	57
10.5	Examples of architectural and development measures for AI systems.....	58
10.6	Work products.....	62
11	Data-related considerations.....	62
11.1	Objectives.....	62
11.2	Prerequisites and supporting information.....	62
11.3	General requirements.....	62
11.4	Dataset life cycle.....	63
11.4.1	Datasets and the AI safety lifecycle.....	63
11.4.2	Reference dataset lifecycle.....	64
11.4.3	Dataset safety analysis.....	65
11.4.4	Dataset requirements development.....	71
11.4.5	Dataset design.....	74
11.4.6	Dataset implementation.....	75
11.4.7	Dataset verification.....	75
11.4.8	Dataset validation.....	76
11.4.9	Dataset maintenance.....	77
11.5	Work products.....	77
12	Verification and validation of the AI system.....	78
12.1	Objectives.....	78
12.2	Prerequisites and supporting information.....	78
12.3	General requirements.....	78
12.4	AI/ML specific challenges to verification and validation.....	80
12.5	Verification and validation of the AI system.....	81
12.5.1	Scope of verification and validation of the AI system.....	81
12.5.2	AI component testing.....	84
12.5.3	Methods for testing the AI component.....	86
12.5.4	AI system integration and verification.....	88
12.5.5	Virtual testing vs physical testing.....	88
12.5.6	Evaluation of the safety-related performance of the AI system.....	89
12.5.7	AI system safety validation.....	90
12.6	Work products.....	91
13	Safety analysis of AI systems.....	91
13.1	Objectives.....	91
13.2	Prerequisites and supporting information.....	92
13.3	General requirements.....	92
13.4	Safety analysis of the AI system.....	93
13.4.1	Scope of the AI safety analysis.....	93
13.4.2	Safety analysis based on the results of testing.....	95
13.4.3	Safety analysis techniques.....	95
13.5	Work products.....	97

14	Measures during operation	97
14.1	Objectives	97
14.2	Prerequisites and supporting information	98
14.3	General requirements	98
14.4	Planning for operation and continuous assurance	99
	14.4.1 Safety risk of the AI system during operation phase	99
	14.4.2 Safety activities during the operation phase	99
14.5	Continual, periodic re-evaluation of the assurance argument	100
14.6	Measures to assure safety of the AI system during operation	101
	14.6.1 General	101
	14.6.2 Technical safety measures	101
	14.6.3 Safe operation guidance and misuse prevention in the field	102
14.7	Field data collection	103
14.8	Evaluation and continuous development	104
	14.8.1 Field risk evaluation	104
	14.8.2 Countermeasures addressing field risk	105
	14.8.3 AI re-training, re-validation, re-approval and re-deployment	105
14.9	Work products	106
15	Confidence in use of AI development frameworks and software tools used for AI model development	106
15.1	Objectives	106
15.2	Prerequisites and supporting information	107
15.3	General requirements	107
15.4	Confidence in the use of AI development frameworks	107
15.5	Confidence in the use of tools used to support the AI-safety lifecycle	109
15.6	Principles for data-driven AI model training and evaluation	110
15.7	Work products	110
Annex A	(informative) Overview and workflow of this document	111
Annex B	(informative) Example assurance argument structure for an AI system	116
Annex C	(informative) ISO 26262 gap analysis for ML	130
Annex D	(informative) Detailed considerations on safety-related properties of AI systems	137
Annex E	(informative) STAMP/STPA example	139
Annex F	(informative) Identification of software units within NN-based systems	144
Annex G	(informative) Architectural and development measures for AI systems	147
Annex H	(informative) Typical performance metrics for machine learning	162
	Bibliography	167