ISO 17757:2017-09 (E)

Earth-moving machinery and mining - Autonomous and semi-autonomous machine system safety

Contents

Page

Foreword v

Introduction vi

1 Scope 1

2 Normative references 1

3 Terms,definitionsandabbreviatedterms 2

4 Safety requirements and/or protective/risk reduction measures 6
4.1 General 6
4.2 Stop systems 6
4.2.1 General 6
4.2.2 All-stop system 6
4.2.3 Remote stop system 6
4.3 Warning devices and safety signs 6
4.3.1 Visual indicators 6
4.3.2 Audible alarms 7
4.3.3 Safety signs 7
4.4 Fire protection 7
4.5 Machine access systems 7
4.6 Braking and steering 7
4.6.1 General 7
4.6.2 Braking 8
4.6.3 Steering 8
4.7 Adaptation to environmental conditions 9
4.8 On-board electrical power 9
4.8.1 General 9
4.8.2 Requirements 9

5 Positioning and orientation (POSE) 10
5.1 General 10
5.2 Risk and failure modes 10
5.3 Requirements 10

6 Digital terrain map (DTM) 10
6.1 General 10
6.2 Requirements 11

7 Perception 11
7.1 General 11
7.2 Risk and failure modes 11
7.2.1 Failure to detect or late detection of an object 11
7.2.2 False detection of non-existent object 12
7.2.3 Erroneous location of a detected object 12
7.2.4 Misclassification of an object 12
7.3 Requirements 12

8 Navigation system 12
8.1 General 12

8.2 Risks ... 13
8.3 Requirements ... 13

9 Task planner ... 13
9.1 General ... 13
9.2 Risks ... 13
9.3 Requirements ... 13

10 Communications and networks ... 14
10.1 General ... 14

10.2 Risk and failure modes ... 14
10.2.1 Risks ... 14
10.2.2 Failure modes ... 14
10.2.3 Potential causes ... 15
10.3 Communication systems requirements ... 15
10.3.1 Communication security ... 15
10.3.2 Communication security ... 15
10.4 Safety messages ... 15

11 ASAM supervisor system ... 16
11.1 General ... 16
11.2 Requirements ... 16

12 AOZ access, permissions and security ... 17
12.1 Permissions and security ... 17
12.2 AOZ access and warnings ... 17
12.3 Operational risks ... 17
12.4 Mode changes ... 18

13 ASAMS site operating procedures ... 18
13.1 General ... 18
13.2 Incident recording ... 18
13.3 Commissioning ... 18
13.4 Documentation and training ... 18
13.4.1 Documentation ... 18
13.4.2 Training ... 19

14 Operational hazard controls ... 19

15 Verificationofsafetyrequirementsand/orprotective/riskreductionmeasures ... 19

16 Information for use ... 20
16.1 Safety labels and machine markings ... 20
16.2 User manual ... 20

Annex A (informative)Listofsignificanthazards ... 21

Annex B (informative) Safety and the risk management process ... 23

Annex C (informative) Integration of ASAMS into the site planning process ... 26

Annex D (informative) Access control systems ... 28

Annex E (informative) Change management -- Example for mining ... 30

Annex F (informative) Supervision ... 32

Annex G (informative) Commissioning ... 33

Annex H (informative) Operational hazard controls ... 35

Bibliography ... 36