

# ISO/TS 12901-1:2024-08 (E)

## Nanotechnologies - Occupational risk management applied to engineered nanomaterials - Part 1: Principles and approaches

---

<b>Contents</b>		<b>Page</b>
	<b>Foreword</b> .....	<b>v</b>
	<b>Introduction</b> .....	<b>vii</b>
<b>1</b>	<b>Scope</b> .....	<b>1</b>
<b>2</b>	<b>Normative references</b> .....	<b>1</b>
<b>3</b>	<b>Terms and definitions</b> .....	<b>1</b>
<b>4</b>	<b>Abbreviated terms</b> .....	<b>3</b>
<b>5</b>	<b>Nanomaterial types and characteristics</b> .....	<b>5</b>
5.1	General.....	5
5.2	Fullerenes.....	5
5.3	Carbon nanotubes.....	5
5.4	Graphene.....	5
5.5	Nanowires.....	6
5.6	Quantum dots.....	6
5.7	Metals and metal oxides, ceramics.....	6
5.8	Carbon black.....	6
5.9	Organic nanoparticles.....	6
5.10	Dendrimers.....	6
5.11	Nanoclays.....	6
<b>6</b>	<b>Nanomaterial hazard, exposure and risk</b> .....	<b>7</b>
6.1	General.....	7
6.2	Risk to health.....	7
6.2.1	Hazard information.....	7
6.2.2	Exposure.....	8
6.3	Risks to safety.....	10
6.3.1	Hazard information.....	10
6.3.2	Risk of fire and explosion from NOAA.....	10
<b>7</b>	<b>General approach to managing risks from NOAA</b> .....	<b>11</b>
<b>8</b>	<b>Identification and competence of person conducting risk assessment</b> .....	<b>12</b>
<b>9</b>	<b>Information collection</b> .....	<b>12</b>
<b>10</b>	<b>Health risk evaluation</b> .....	<b>13</b>
10.1	General.....	13
10.2	Hazard assessment.....	14
10.3	Exposure assessment.....	14
10.4	Health risk assessment and prioritization.....	15
10.5	Document and review.....	15
<b>11</b>	<b>Control of risk</b> .....	<b>15</b>
11.1	Hierarchy of control.....	15
11.2	Control measures.....	16
11.2.1	General.....	16
11.2.2	Elimination.....	16
11.2.3	Substitution/modification.....	16
11.2.4	Enclosures/isolation.....	16
11.2.5	Engineering controls.....	16
11.2.6	Administrative controls.....	17
11.2.7	Personal protective equipment.....	17

11.3	Selection of controls .....	18
11.3.1	General .....	18
11.3.2	Hazard-based control.....	18
11.3.3	Control banding and other qualitative approaches.....	19
11.3.4	Safety-by-design approach.....	19
11.3.5	“State of the art” approaches.....	19
11.4	Evaluation of the effectiveness of control measures.....	19
11.5	Information, instruction and training.....	20
<b>12</b>	<b>Measurement methods.....</b>	<b>21</b>
12.1	Need for measurement.....	21
12.2	Selection of instruments.....	21
12.3	Sampling strategy.....	24
12.3.1	Air sampling.....	24
12.3.2	Surface sampling.....	25
12.4	Limitations.....	26
<b>13</b>	<b>Health surveillance.....</b>	<b>27</b>
<b>14</b>	<b>Spillages and accidental releases.....</b>	<b>27</b>
<b>15</b>	<b>Disposal procedures.....</b>	<b>28</b>
15.1	General.....	28
15.2	Planification of storage and disposal of nanomaterials .....	28
15.3	Storage of nanomaterial waste prior to disposal .....	30
15.3.1	General.....	30
15.3.2	Storage in waste containers.....	30
15.3.3	Storage in plastic bags.....	30
15.4	Disposal of nanomaterial waste.....	30
<b>16</b>	<b>Prevention of fire and explosion.....</b>	<b>31</b>
<b>Annex A (informative) NOAA categories.....</b>		<b>33</b>
<b>Annex B (informative) Additional information on dermal and ocular exposure.....</b>		<b>34</b>
<b>Annex C (informative) Guidance and articles on “State of the art” approaches to control measures.....</b>		<b>35</b>
<b>Bibliography.....</b>		<b>36</b>