

ISO/TR 27929:2024-10 (E)

Transportation of CO₂ by ship

Contents

Page

Foreword.....	v
Introduction.....	vi
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	1
4 Abbreviations.....	3
5 Regulatory regime for maritime and inland waterways for CO₂ transportation.....	3
5.1 General.....	3
5.2 Maritime governance.....	4
5.3 Technical safety regime for maritime transportation of liquid CO ₂	5
5.4 Greenhouse gas emissions.....	6
5.5 Trading and cross-border transportation.....	6
6 Ship transport of CO₂.....	7
6.1 General.....	7
6.2 CO ₂ cargo transport conditions.....	7
6.2.1 General.....	7
6.2.2 Low pressure.....	8
6.2.3 Medium pressure.....	8
6.2.4 Elevated pressure.....	8
6.2.5 Density effects.....	9
6.2.6 Solid state CO ₂ (dry ice).....	9
6.3 Cargo tank design.....	9
6.3.1 Cargo tank design considerations.....	9
6.3.2 Tank material.....	10
6.3.3 Novel materials.....	10
6.3.4 Design pressure.....	11
6.3.5 Insulation.....	11
6.4 CCS ship transport concepts.....	11
6.4.1 General.....	11
6.4.2 Ship terminal to terminal.....	12
6.4.3 Barge terminal to terminal (inland waterways).....	12
6.4.4 Offshore floating storage and injection unit (FSIU).....	12
6.4.5 Offshore injection unit.....	12
6.4.6 Offshore direct injection.....	13
6.5 Multi Gas and dedicated carriers.....	13
6.5.1 General.....	13
6.5.2 Existing ship conversion.....	13
6.6 Ship design.....	13
7 Properties of CO₂, CO₂ streams and mixing of CO₂ streams influencing the ship transportation.....	13
7.1 Thermodynamic properties of CO ₂ and CO ₂ composition.....	13
7.2 CO ₂ impurities and trace components.....	15
7.2.1 Common impurities.....	15
7.3 Flexibility and mixing of CO ₂ streams from different sources.....	16
8 Ship operation.....	17
8.1 Ship and terminal modes of operation.....	17

8.2	Compatibility and interface	17
8.3	Cargo operations.....	18
8.3.1	Responsibilities.....	18
8.3.2	Manifold operations	18
8.3.3	Loading operations	18
8.3.4	Offloading operations.....	19
8.4	Cargo management.....	19
8.4.1	General.....	19
8.4.2	Cargo tank preparation.....	19
8.4.3	Cargo voyage management.....	19
8.4.4	Cargo losses.....	20
9	Technical gaps and development.....	20
9.1	Applicability and precision of existing requirements.....	20
9.2	Identification of additional relevant requirements such as practices onshore.....	20
9.3	Qualification and process for new technology.....	21
9.4	Gaps and need for development.....	21
10	Safety and risks.....	21
10.1	Health, safety and environment (HSE).....	21
10.1.1	Toxicity and asphyxiation.....	21
10.1.2	Hazards of liquid CO ₂	22
10.2	Measures to mitigate risks.....	22
10.2.1	Gas detection.....	22
10.2.2	Emergency shut down.....	22
10.2.3	Emergency release system.....	22
10.3	Special risks with liquid CO ₂ as ship cargo.....	22
10.3.1	Solid formation.....	22
10.3.2	Material integrity.....	22
10.3.3	Electrostatic charge.....	23
11	Quantification and verification of CO₂ cargo.....	23
11.1	General.....	23
11.2	Quantification and measurement.....	23
11.2.1	General.....	23
11.2.2	Cargo measurement.....	23
11.2.3	CO ₂ quality.....	24
11.2.4	Co-mingling.....	24
11.2.5	Onboard carbon capture.....	24
11.3	Verification.....	24
12	Summary status and development needs for CO₂ ship transportation for CCS value chains.....	24
	Bibliography.....	26