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## **GAS CARRIER FUNDAMENTALS TRAINING**

Delivered in a phased approach to facilitate learning comprehension, this comprehensive hybrid training program has 28 hours of interactive web-based courses and 28 hours of instructor-led workshops that cover a variety of topics, including theoretical explanations about natural gas liquids, gas carrier ship design and arrangement, containment systems, cargo handling equipment and preparing for ABS surveys and inspections.

## AUDIENCE

Shipowners and operators, facility operators, vessel crews, port regulators, shipyard personnel and other maritime industry stakeholders interested in gaining knowledge and increasing competencies in gas carriers.

## TRAINING OBJECTIVES

1. Explain the properties of gases and how they behave based on gas laws.
2. Describe gas carrier types, design criteria and cargo hazards.
3. Demonstrate an understanding of natural gas components and properties.
4. Summarize characteristics, support systems, materials and insulation of cargo containment systems on gas carriers.
5. Review the applicability of the cargo containment systems using real-world examples.
6. Practice verifying the compliance of the provided scenarios in accordance with ABS Rules and the IGC Code.
7. Use critical thinking to answer strategic questions to avoid or reduce potential findings from classification societies.
8. Recognize applicable verification points that are examined by class surveyors during surveys after construction.

## COURSE STRUCTURE

### Phase I: Introduction to Natural Gas Liquids and Gas Carriers

Phase I covers the science of natural gas, ship types and hazards and provides the foundation to learn about gas carrier systems, operations and survey requirements in the other phases. The curriculum includes two assessments and a workshop.

1. **Welcome**
  - a. Introduction
  - b. Program overview
  - c. Resources and references
2. **Terms and Definitions Flip Card Activity**
  - a. Activity
  - b. Gas carrier terms and definitions
3. **Introduction to Natural Gas**
  - a. Energy demand
  - b. Introduction to natural gas production
  - c. Differences: NGL, LPG and LNG
4. **Science Behind Natural Gas**
  - a. States of matter
  - b. Gas laws
  - c. Components: Percentages and molecular weight
5. **Natural Gas Value Chains and Supporting Technologies**
  - a. Value chains: Dry and wet gases
  - b. Gas processing and fractionation
  - c. Liquefaction
  - d. Reliquefaction
  - e. Regasification
6. **Ships Carrying Liquefied Gases**
  - a. IGC Code and ABS Rules
  - b. Ships carrying liquefied gases
7. **Cargo Hazards**
  - a. Dangers of liquefied gases
  - b. Gas dangerous spaces
  - c. Gas zones in hazardous areas
  - d. Liquefied gas: Safety measures
8. **Ship Survival Capabilities**
  - a. Carriage requirements for gases considered dangerous
  - b. Surviving damage standards
  - c. Special requirements for Type 1G ships
9. **Surveys and Certificate of Fitness**
  - a. Gas carrier surveys
  - b. Survey requirements
  - c. Certificate of fitness for the carriage of liquefied gases in bulk
10. **Phase I: Workshop**
  - a. Review of Phase I lessons
  - b. Feedback activity
  - c. Gas carrier design overview
  - d. Transportation method activity
  - e. Closing and wrap up of Phase I

### Phase II: Cargo Containment Systems and Design Requirements

Phase II covers the science of natural gas, ship types and hazards and provides the foundation to learn about gas carrier systems, operations and survey requirements in the other phases. The curriculum includes two assessments and a workshop.

1. **Cargo Containment Systems Overview**
  - a. Fundamentals
  - b. Cargo tank classification
  - c. Tank materials and insulation
  - d. Advantages and disadvantages of each containment system
2. **Type A Cargo Containment System**
  - a. Characteristics
  - b. Support systems
  - c. Materials and insulation
3. **Type B Cargo Containment System**
  - a. Characteristics
  - b. Spherical support systems
  - c. Tank materials and insulation
  - d. Prismatic Type B tanks
4. **Type C Cargo Containment System**
  - a. Characteristics
  - b. Support systems
  - c. Materials and insulation
5. **Design Requirements**
  - a. Containment system:
    - Rules and regulations
    - Design considerations
    - Ship arrangements
  - b. Hull construction
6. **Safety Systems**
  - a. Gas detection system
  - b. Emergency shutdown (ESD) system
  - c. Fire extinguishing systems
7. **Phase II: Workshop**
  - a. Independent cargo containment systems activity
  - b. Design requirements review
  - c. Safety systems review
  - d. Containment systems review
  - e. Real-world examples

## COURSE STRUCTURE

### Phase III: System/Subsystems and Cargo Handling Equipment

Phase III comprises systems and subsystems of gas carriers and cargo handling equipment and operations. The curriculum includes two assessments and two workshops.

#### 1. Cargo Handling Operations

- a. Cargo operations manual
- b. Tank inspection
- c. Drying
- d. Inerting
- e. Gassing up
- f. Cooling down
- g. Loading
- h. Loaded voyage
- i. Cargo discharge
- j. Ballast voyage
- k. Gas freeing
- l. New construction surveys
- m. Surveys after construction

#### 2. Cargo Control Room

- a. Location requirements
- b. Monitoring and controls
- c. High-level monitoring and control tasks
- d. Cargo control room console
- e. Ship-to-shore link
- f. Cargo control room alarms

#### 3. Automation for Gas Carriers

- a. Safe and proper operations
- b. Integrated automation system
- c. Subsystems

#### 4. Cargo Piping and Valves

- a. Piping system differences: Gas carriers vs. tankers
- b. LNG cargo piping systems
- c. Cargo piping and components
- d. Fabrication and testing requirements

#### 5. Cargo Pumps and Compressors

- a. Cargo pumps
- b. Pump types and their characteristics
- c. Compressor types

#### 6. Heat Exchangers

- a. Certification and test requirements
- b. Characteristics
- c. Cargo heaters
- d. Cargo vaporizers
- e. Cargo condensers or coolers

#### 7. Pressure Control

- a. Gas management
- b. Reliquefaction
- c. Thermal oxidation
- d. Other methods

#### 8. Pressure and Temperature Monitoring

- a. Sensors
- b. Pressure monitoring
- c. Temperature monitoring

#### 9. Inert Gas and Nitrogen Systems

- a. Overview
- b. Inert gas generating system
- c. Nitrogen system

#### 10. Liquid Level Measurements

- a. Importance of liquid level measurements
- b. Liquid level measurements gauges
- c. Capacitance, radar and laser level gauges
- d. Ultrasonic level gauge
- e. Mechanical level or float gauges

#### 11. Gas Detection Systems

- a. Importance of gas detection systems
- b. Types and requirements
- c. Installed sampling gas detection system
- d. Installed continuous gas detection system
- e. Portable gas detection system
- f. Gas detection system calibration
- g. Gas detection system analyzers (detection heads):
  - Type 1: Catalytic combustion analyzer
  - Type 2: Infrared gas detector (point) analyzer
  - Type 3: Infrared gas detector (open path) analyzer
  - Type 4: Electrochemical analyzer

#### 12. Electrical Equipment in Gas Dangerous Spaces

- a. Certifications
- b. Conformity assessment body
- c. Booklet of electrical equipment in hazardous zones
- d. Electrical equipment: Name plates

#### 13. Phase III: New Construction Workshop

- a. Shipyard scenarios:
  - Cofferdam transverse bulkhead and inner bottom plate connection
  - Dry chemical powder hose boxes
  - Guard rails in stringer areas
- b. Sea trial and gas trial requirements
- c. Gas trial preparations
- d. Gas trial day 1: Scenarios
- e. Gas trial days 2 and 3: Scenarios
- f. Gas trial day 4: Activities

#### 14. Phase III: Surveys After Construction Workshop

- a. Verification points activity:
  - Logbooks
  - Records
  - Documentation
  - Cargo machinery surveys
- b. Annual survey activity:
  - Replacing equipment in hazardous areas
  - Cargo piping scenario
- c. Special survey activity:
  - High-duty compressors
  - BOG compressors
  - Submerged cargo pumps
  - Submerged stripping cargo pumps
  - Temperature indicating device (sensor)
  - Pressure indicating device (sensor)
  - Cargo vaporizers
  - Cargo heaters
- d. Cargo handling machinery scenario
- e. Special survey: Engine room video
- f. Special survey: Cargo handling machinery video
- g. Special survey: Cargo containment system video