CGA
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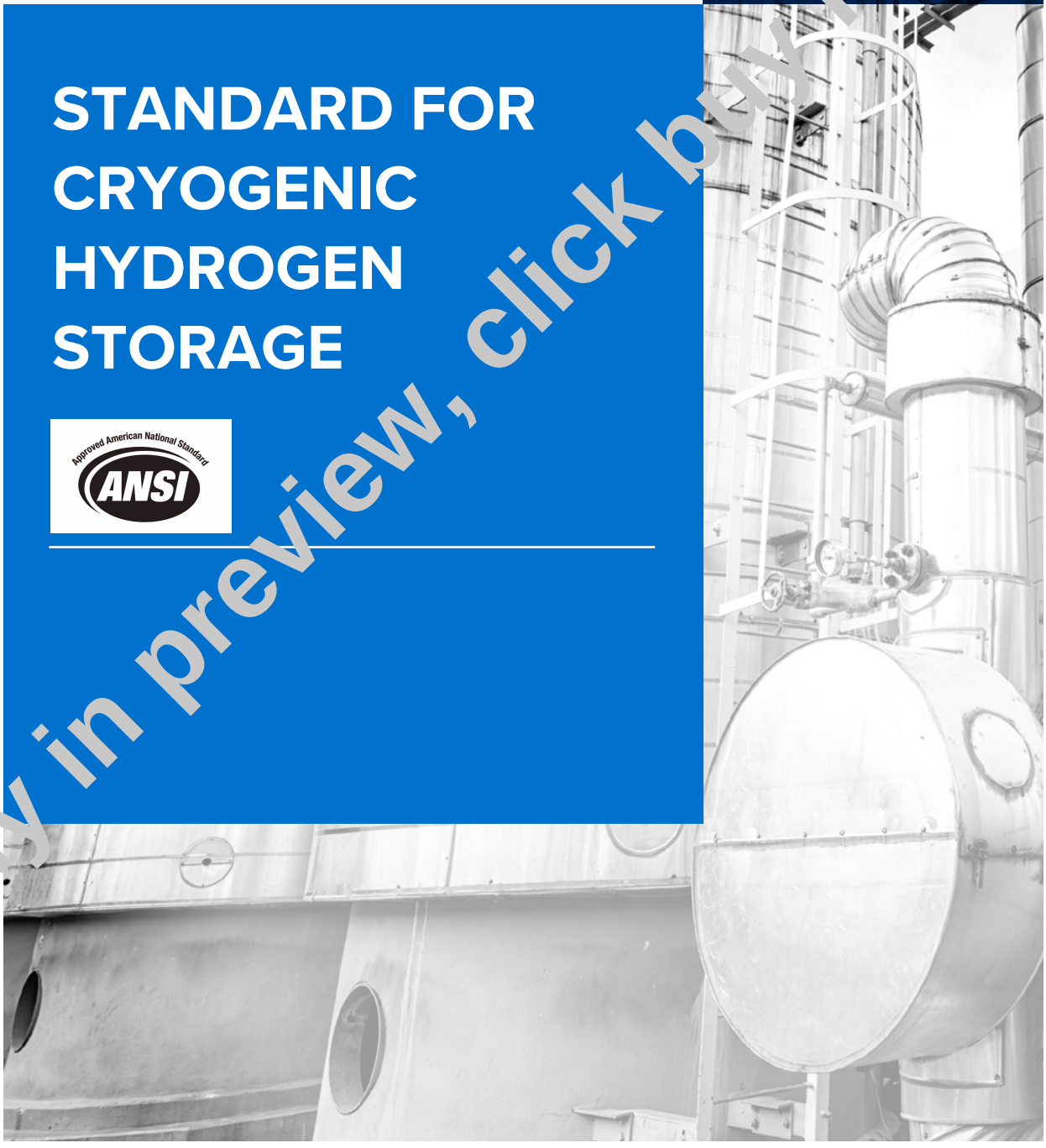
4TH EDITION

ANSI/CGA H-3 — 2024

STANDARD FOR CRYOGENIC HYDROGEN STORAGE

Approved American National Standard
ANSI



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Work Item 23-036
Hydrogen Technology Committee

NOTE—Technical changes from the previous edition are underlined.

NOTE—Appendices A and B (Informative) are for information only.

FOURTH EDITION: 2024
THIRD EDITION: 2019
SECOND EDITION: 2013
FIRST EDITION: 2006

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Approved as an American National Standard on June 12, 2024.

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1 Introduction

This publication contains the suggested minimum design and performance requirements for shop-fabricated, vacuum-insulated cryogenic tanks (vertical and horizontal) intended for above ground storage of liquid hydrogen.

2 Scope

This publication applies to liquid hydrogen storage tanks with maximum allowable working pressures (MAWP) up to and including 175 psi (1210 kPa).[1,2] Tanks less than 1000 gal (3785 L) gross volume or greater than 25 000 gal (94 600 L) gross volume and all transportable containers are excluded. Tanks outside these pressure and volume constraints may also meet the requirements of this standard when agreed upon by the purchaser/manufacturer and the authority having jurisdiction (AHJ). This standard does not include operation and installation requirements or emergency response information.

3 Definitions

For the purpose of this publication, the following definitions apply.

3.1 Publication terminology

3.1.1 Shall
Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

3.1.2 Should
Indicates that a procedure is recommended.

3.1.3 May
Indicates that the procedure is optional.

3.1.4 Will
Is used only to indicate the future, not a degree of requirement.

3.1.5 Can
Indicates a possibility or ability.

3.2 Technical definitions

3.2.1 Ancillary equipment
Group of components used for operation of the tank including valves, gauges, fittings, telemetry systems, etc.

3.2.2 Annular space
Volumetric space between the inner vessel and outer jacket that contains insulation materials and is evacuated to lessen heat flux.

3.2.3 Annular space piping
Interconnected piping between the inner vessel and outer jacket.

3.2.4 Cold net volume
Net capacity of the inner vessel at –423 °F (–253 °C) in liters or gallons.

NOTE—This value is also referred to as the full trycock volume or the net liquid capacity of the inner vessel. It may be expressed as the cold gross volume minus the ullage (vapor space) of the inner vessel.

[1] psi, bar, and kPa shall indicate gauge pressure unless otherwise noted as (psia; bar, abs; and kPa, abs) for absolute pressure or (psid; bar, dif; and kPa, dif) for differential pressure. All kPa values are rounded off per CGA P-11, *Guideline for Metric Practice in the Compressed Gas Industry* [1].

[2] References are shown by bracketed numbers and are listed in order of appearance in the reference section.

3.2.5 Cold spot
Surface temperature that is 10 °F (5 °C) or more below ambient in-the-shade air temperature.

3.2.6 Gross volume
Total internal volume of the inner vessel in liters or gallons.

3.2.6.1 Cold gross volume
Total internal volume at –423 °F (–253 °C).

NOTE—Cold gross volume is the warm gross volume adjusted for the thermal contraction of the inner vessel. It may be expressed as the cold net volume plus the ullage (vapor space) of the inner vessel.

3.2.6.2 Warm gross volume
Total internal volume at 68 °F (20 °C).

NOTE—Warm gross volume is frequently referred to as water volume.

3.2.7 Inner vessel
Internally pressurized envelope (including nozzle penetrations) that contains the liquid hydrogen.

3.2.8 Insulation
Material surrounding the inner vessel that reduces the flow of heat into the inner vessel.

NOTE—Typically, the insulation is perlite (expanded siliceous volcanic rock) or super insulation (alternating layers of reflective surfaces and nonconducting spacers).

3.2.9 Maximum allowable working pressure (MAWP)
Maximum vapor space gauge pressure permitted at the top of the inner vessel.

3.2.10 Outer jacket
External vessel that contains the inner vessel, annular space piping, and insulation. The outer jacket is externally pressurized by atmospheric pressure on the outside and low absolute pressure (high vacuum) on the inside.

3.2.11 Tank
Inner vessel, annular-space piping, insulation, outer jacket, and external control piping and instrumentation system.

3.2.12 Ullage
Minimum vapor volume in a cryogenic liquid storage tank that is the difference between the gross volume of the tank and the maximum fill point of the tank at operating conditions. This volume is required to accommodate liquid expansion.

4 Properties of hydrogen

For properties of hydrogen, see CGA G-5, *Hydrogen* [2].

5 General requirements

5.1 Certification and approvals

The supplier and the supplier's facilities, personnel, equipment, and procedures shall be currently qualified (certified, approved, authorized) as required by any of the applicable ASME codes and/or by this standard. All welding and brazing performed on the tank or pipework shall be performed by qualified welders according to qualified welding procedures contained in the applicable ASME codes. Documentation of each welder's qualification test for range of line size shall be maintained.

5.2 Quality control

The purchaser and/or a designated inspector shall be permitted to inspect the tank fabrication and testing to ensure that this standard is being followed. The purchaser shall be permitted reasonable access for inspection