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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

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Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

English Version

Gas infrastructure - Underground gas storage - Part 1: Functional recommendations for storage in aquifers

Infrastructures gazières - Stockage souterrain de gaz -
Partie 1 : Recommandations fonctionnelles pour le
stockage en nappe aquifère

Gasinfrastruktur - Untertagespeicherung von Gas - Teil
1: Funktionale Empfehlungen für die Speicherung in
Aquiferen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 234.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Page

European foreword.....	4
Introduction	5
1 Scope	6
2 Normative references	6
3 Terms and definitions	7
3.1 Terms and definitions common to EN 1918 (all parts)	7
3.2 Terms and definitions specific to this document	11
4 Requirements for underground gas storage	13
4.1 General	13
4.2 Underground gas storage	13
4.2.1 Overview and functionality	13
4.2.2 Types	14
4.2.3 General characterization	15
4.2.4 Storage in aquifers	15
4.3 Long-term containment of stored gas	17
4.4 Environmental conservation	17
4.4.1 General	17
4.4.2 Methane emissions	17
4.4.3 Other gas emissions	18
4.5 Safety	19
4.6 Monitoring	19
5 Design	19
5.1 Design principles	19
5.2 Geological description	20
5.2.1 General	20
5.2.2 Geological description and modelling	20
5.2.3 Evidence of the existence and the continuity of a tight caprock	21
5.3 Determination of the maximum operating pressure	22
5.3.1 General	22
5.3.2 Limit for avoidance of mechanical failures	23
5.3.3 Limit for avoidance of the gas migration through the caprock	23
5.3.4 Maximum operating pressure	24
5.4 Wells	24
5.4.1 General	24
5.4.2 Location	26
5.4.3 Equipment	27
5.5 Monitoring systems	29
5.5.1 General	29
5.5.2 Vertical confinement	30
5.5.3 Lateral confinement	30
5.6 Neighbouring subsurface activities	31
6 Construction	31
6.1 General	31

6.2	Wells.....	32
6.3	Completions.....	32
6.4	Wellheads.....	32
7	Testing and commissioning.....	32
8	Operation, monitoring and maintenance	33
8.1	Operating principles.....	33
8.2	Monitoring of the storage reservoir	33
8.2.1	Pressure monitoring	33
8.2.2	Monitoring of the gas zone	34
8.2.3	Monitoring of gas operation	34
8.3	Monitoring of indicator horizon.....	34
8.3.1	General	34
8.3.2	Pressure measurements	35
8.3.3	Water analyses	35
8.3.4	Gas logging	35
8.4	Monitoring of connected aquifers	35
8.5	Monitoring of wells	35
8.6	Injection and withdrawal operations.....	35
8.7	Maintenance of wells.....	36
8.8	Health, safety and environment.....	36
8.8.1	Safety management and health and environment.....	36
8.8.2	Emergency procedures.....	36
8.9	Adaptation to climate change.....	37
8.9.1	Climate change effects	37
8.9.2	Climate change impacts.....	37
9	Abandonment.....	39
9.1	General	39
9.2	Withdrawal of the gas and pressure monitoring	39
9.3	Plugging and abandonment of wells.....	39
9.4	Surface facilities	40
Annex A (informative)	Significant technical changes between this document and EN 1918-1:2016.....	41
Bibliography		42

European foreword

This document (prEN 1918-1:2025) has been prepared by Technical Committee CEN/TC 234 “Gas infrastructure”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 1918-1:2016.

For a list of significant technical changes with respect to EN 1918-1:2016, see Annex A.

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

This document is Part 1 of a European Standard on “Gas infrastructure - Underground gas storage”, which includes the following five parts:

- *Part 1: Functional recommendations for storage in aquifers;*
- *Part 2: Functional recommendations for storage in oil and gas fields;*
- *Part 3: Functional recommendations for storage in solution-mined salt caverns;*
- *Part 4: Functional recommendations for storage in rock caverns;*
- *Part 5: Functional recommendations for surface facilities.*

Introduction

This document specifies common basic principles for underground gas storage facilities. Users of this document should be aware that more detailed standards and/or codes of practice exist. This document is intended to be applied in association with relevant national standards and/or codes of practice and does not replace them. Furthermore, a non-exhaustive list of related European and international standards can be found in the Bibliography.

NOTE Directive 2009/73/EC concerning common rules for the internal market in natural gas and the related Regulation (EC) No 715/2009 on conditions for access to the natural gas transmission networks also aim at technical safety including technical reliability of the European gas system. These aspects are also in the scope of CEN/TC 234 standardization. In this respect, CEN/TC 234 evaluated the indicated EU legislation and amended this technical standard accordingly, where required and appropriate.

1 Scope

This document covers the functional recommendations for design, construction, testing, commissioning, operation, maintenance and abandonment of underground gas storage (UGS) facilities in aquifers up to and including the wellhead.

It specifies practices, which are safe and environmentally acceptable.

For necessary surface facilities for underground gas storage, EN 1918-5 applies.

In this context “gas” refers to flammable gas:

- which is in a gaseous state at a temperature of 15 °C and under a pressure of 0,1 MPa (the stored product is also named fluid);
- which meets specific quality requirements in order to maintain underground storage integrity, performance, environmental compatibility and fulfils contractual requirements.

This comprises:

- gas not in liquid phase under subsurface conditions;
 - methane-rich gases;
 - natural gas;
 - biomethane;
 - synthetic methane;
 - hydrogen of various purities;
 - any mixtures of the gases above;
- hydrocarbon gas in liquid phase under subsurface conditions such as;
 - ethylene;
 - liquified petroleum gas (LPG).

NOTE 1 Correspondingly the EN 1918 series can be considered where applicable for underground storage of any other fluid e.g. helium, carbon dioxide, compressed air, rDME (renewable dimethyl ether) and hydrogen transport fluids (such as ammonia and LOHC).

This document is not intended to be applied retrospectively to existing facilities.

NOTE 2 Correspondingly this document can be considered for major conversions in case of significant change of gas composition.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1918-5, *Gas infrastructure - Underground gas storage - Part 5: Functional recommendations for surface facilities*

ISO 1663, *Rigid cellular plastics - Determination of water vapour transmission properties*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. The definitions common with parts 1 to 4 of EN 1918 are listed in 3.1; those specific for this document are listed in 3.2.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org>

3.1 Terms and definitions common to EN 1918 (all parts)

3.1.1

abandoned well

well permanently out of operation and permanently plugged including removed surface facilities

3.1.2

annulus

space between two strings of pipes or between the casing and the borehole

3.1.3

aquifer

reservoir, group of reservoirs, or a part thereof that is fully water-bearing and displaying differing permeability/porosity

3.1.4

auxiliary well

well completed for other purposes than gas injection/withdrawal, e.g. water disposal

3.1.5

casing

pipe or set of pipes that are screwed or welded together to form a string, which is placed in the borehole for the purpose of supporting the borehole and to act as a barrier preventing subsurface migration of fluids when the annulus between it and the borehole has been cemented and to connect the storage reservoir respectively cavern to surface

3.1.6

casing shoe

bottom end of a casing

3.1.7

cementing

operation whereby usually a cement slurry is pumped and circulated down a cementation string within the casing and then upwards into the annulus between the casing and the open or cased hole

3.1.8

completion

technical equipment inside the last cemented casing of a well

3.1.9

containment

capability of the storage reservoir or cavern and the storage wells to resist leakage or migration of the fluids contained therein

Note 1 to entry: This is also known as the integrity of a storage facility.

3.1.10

core sample

sample of rock taken during coring operation in order, e.g. to determine various parameters by laboratory testing and/or for a geological description

3.1.11

cushion gas volume

gas volume required in a storage for reservoir management purpose and to maintain an adequate minimum storage pressure for meeting working gas volume delivery with a required withdrawal profile and in addition in caverns also for stability reasons

Note 1 to entry: The cushion gas volume of storages in oil and gas fields can consist of recoverable and non-recoverable *in situ* gas volumes and/or injected gas volumes.

3.1.12

drilling

all technical activities connected with the construction of a well

3.1.13

exploration

all technical activities connected with the investigation of potential storage locations for the assessment of storage feasibility and derivation of design parameters

3.1.14

formation (horizon)

body of rock mass characterized by a degree of homogeneous lithology, which forms an identifiable geologic unit

3.1.15

gas injection

gas delivery from gas transport system into the reservoir/cavern through surface facilities and wells

3.1.16

gas inventory

total of working and cushion gas volumes contained in UGS

3.1.17

gas withdrawal

gas delivery from the reservoir or cavern through wells and surface facilities to a gas transport system

3.1.18

geological modelling

generating the image of a structure from the information gathered

3.1.19**hydrogen****H**

lightest and most represented chemical element, found in nature as a diatomic molecule (H₂, or dihydrogen), gaseous under standard conditions, colorless, odorless and highly flammable

3.1.20**indicator horizon**

horizon overlying the caprock in the storage area and used for monitoring

3.1.21**landing nipple**

device in a tubing string with an internal profile to provide for latching and sealing various types of plugs or valves

3.1.22**liner**

casing installed within last cemented casing in the lowermost section of the well without extension to surface

3.1.23**lithology**

characteristics of rocks based on description of colour, rock fabrics, mineral composition, grain characteristics and crystallization

3.1.24**logging**

measurement of physical parameters versus depth in a well

3.1.25**master valve**

valve at the wellhead designed to close off the well for operational reasons and in case of emergency or maintenance

3.1.26**maximum operating pressure****MOP**

maximum pressure of the storage reservoir or cavern, normally at maximum inventory of gas in storage, which has not to be exceeded in order to ensure the integrity of the UGS and is based on the outcome of geological/technical engineering and is approved by authorities

Note 1 to entry: The maximum operating pressure is related to a datum depth and in caverns usually to the casing shoe of the last cemented casing.

3.1.27**minimum operating pressure**

minimum pressure of the storage reservoir or cavern, normally reached at the end of the decline phase of the withdrawal profile and is for caverns based on geomechanical investigations to ensure stability and to limit the effect of subsidence

Note 1 to entry: The minimum pressure is related to a datum depth.

3.1.28

**monitoring well
observation well**

well for purposes of monitoring the storage horizon and/or overlying or underlying horizons for subsurface phenomena such as pressure fluctuation, fluid flow and qualities, temperature, etc

3.1.29

operating well

well used for gas withdrawal and/or injection

3.1.30

overburden

all sediments or rock that overlie a geological formation

3.1.31

permeability

capacity of a rock to allow fluids to flow through its pores

Note 1 to entry: Permeability is usually expressed in Darcy. In the SI Unit system permeability is measured in m^2 .

3.1.32

plug

tool designed to isolate different zones within a well, usually set to prevent fluid migration, especially for well abandonment operations

3.1.33

porosity

volume of the pore space (voids) within a rock formation expressed as a percentage of its total volume

3.1.34

reservoir

porous and permeable (in some cases naturally fractured) formation having area- and depth-related boundaries based on physical and geological factors

Note 1 to entry: It contains fluids which are internally in pressure communication.

3.1.35

saturation

percentages of pore space occupied by fluids

3.1.36

seismic technology

technology to characterize the subsurface image with respect to extent, geometry, fault pattern and fluid content applying acoustic waves, impressed by sources near to surface in the subsurface strata, which pass through strata with different seismic responses and filtering effects back to surface, where they are recorded and analysed

3.1.37

string

entity of casing or tubing plus additional equipment, screwed or welded together as parts of a well respectively completion

3.1.38**subsurface safety valve**

valve installed in casing and/or tubing beneath the wellhead or the lower end of the tubing for the purpose of stopping the flow of gas in case of emergency

3.1.39**tubing**

pipe or set of pipes that are screwed or welded together to form a string, through which fluids are injected or withdrawn or which can be used for monitoring

3.1.40**well**

borehole and its technical equipment including the wellhead

3.1.41**well integrity**

well condition without uncontrolled release of fluids throughout the life cycle

3.1.42**well integrity management**

complete system necessary to ensure well integrity at all times throughout the life cycle of the well, which comprises dedicated personnel, assets including subsurface and surface installations, and processes provided by the operator to monitor and assess well integrity

3.1.43**wellhead**

equipment supported by the top of the casing including tubing hanger, shut off and flow valves, flanges and auxiliary equipment, which provides the control and closing-off of the well at the upper end of the well at the surface

3.1.44**working gas volume**

volume of gas in the storage above the designed level of cushion gas volume, which can be withdrawn/injected with installed subsurface and surface facilities (wells, flow lines, etc.) subject to legal and technical limitations (pressures, gas velocities, flow rates, etc.)

Note 1 to entry: Depending on local site conditions (injection/withdrawal rates, utilization hours, etc.) the working gas volume can be cycled more than once a year.

3.1.45**workover**

well intervention to restore or increase production, repair or change the completion of a well or the leaching equipment of a cavern

3.2 Terms and definitions specific to this document**3.2.1****capillary pressure**

pressure difference between the non-wetting phase and the wetting phase in porous rock

3.2.2**capillary threshold pressure**

pressure needed to overcome the property of a porous rock saturated with a wetting phase (water) to block the flow of a non-wetting phase (gas)

3.2.3

caprock

sealing barrier for fluids overlying the pore storage reservoir

3.2.4

closure

vertical distance between the top of the structure and the spill point

3.2.5

connected aquifer

aquifers, which are connected to the storage and thereby subject to changes of pressure caused by the storage operations (hydraulic communication)

3.2.6

gas water contact

interface between the gas and the water in a reservoir

3.2.7

hanger

device for supporting the weight of pipes and to assure the pressure tightness of the annulus

3.2.8

initial reservoir pressure

pressure existing in a reservoir before any change due to operation of the reservoir or due to operation in the surrounding area

Note 1 to entry: The initial reservoir pressure is related to a datum depth.

3.2.9

reservoir simulation

numerical modelling of a reservoir to predict or to monitor the behaviour and movement of the fluids in the formation and in general the reservoir behaviour with respect to rates, pressures and saturation distribution

3.2.10

sand screen

filters placed at the level of the storage formation in order to avoid the entrainment of sand particles and fines during withdrawal

3.2.11

spill point

structural point within a reservoir, where hydrocarbons could leak and migrate out of the storage structure

3.2.12

well testing

taking pressure and flow rate measurements during flowing and shut-in periods of operating wells to provide information about the characteristics of the storage reservoir and the capacity of the wells