marcogaz

NATURAL GAS ODORISATION PRACTICES IN EUROPE

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Contact

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ABOUT MARCOGAZ

Founded in 1968, MARCOGAZ represents 29 member organisations from 20 countries. Its mission encompasses monitoring and policy advisory activities related to the European technical regulation, standardization and certification with respect to safety and integrity of gas systems and equipment, rational use of energy as well as environment, health and safety issues. It is registered in Brussels under number BE0877 785 464.

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Executive summary

At early stages of the industry, manufactured gas (town gas) had a characteristic odour, which helped customers identify possible dangers such as leaks during distribution and transport, while improving safety during the entire process. As odorless natural gas replaced the town gas and its usage increased, odorisation practices become essential to prevent accidents.

With a view to tracking and monitoring operational data, MARCOGAZ periodically collects information from its members with respect of odorisation practices across Europe. As such, all the collected figures, numbers, and records, are summarized in tables and further categorized as follows: legal regulations, odorisation controls, odorisation plants, gas chromatographic analysis at odorisation plants, injection points at odorisation plants, biomethane injection, olfactory levels, and odorants concentrations.

With regards to legal national regulations, the information shows that each country has its own mandate for odorisation, including information on the points where odorisation is mandatory (transit, transport, or distribution). Due to the evolution of gas industry regulation, different approaches to odorisation (olfactory levels vs odorant concentration levels) exist. Depending on country-specific practices, three types of documents (standards, technical codes, and national laws) can specify odorisation requirements.

Olfactory tests, odorant concentration analysis (gas chromatography and chemical sensor), and control by odorant consumption are the three main methodologies used for the odorisation control. Each country performs at least one of these practices and, in some cases, several of them as obliged by their national regulations and legal requirements. It is important to observe that odorant consumption control is often used as a cross-check method.

Control can take place at different parts of the gas system: transit, transport, and distribution. In this document, the different frequency of controls (periodical or continuous) is described per country, and a list of the odorisation plants in each country is also provided. This information highlights the type of structure (centralized or decentralized) for odorisation processes, while the technology in use (type of pumps, use of bypass) shows that even though injection is mainly done at city gate, several countries also odorise on transport or transit. In some cases, several injection points exist at different levels.

Another important highlight is that the distribution of odorised gas across European countries follows unique and diversified pathways, which can lead to complex situations fully handled by the interoperability network codes.

Two basic groups are observed in most used odorising substances in Europe: sulphur-based (mainly used) and sulphur-free odorants. The document provides a list of odorants, their compositions (blends), and physical and chemical characteristics, all of which are some of the factors taken into consideration for choosing odorants. The level of odorant concentration accepted by each country is variable since too low or too high odorant concentration can cause safety or operational problems. The typical minimum and maximum odorant concentration [mg/m^3_N] information is listed in the document.

As a general conclusion, the document highlights that odorisation practices and methodologies often vary from country to country, although the same safety levels are pursued across Europe. This technical report provides operators with the opportunity to learn different methodologies and techniques for odorisation and exchange knowledge and expertise. Moreover, understanding various practices in gas odorisation across Europe, coupled with the peculiarity of the different gas chains, is important for a continuous improvement of the odorisation processes.

The present document is intended to be read by anyone with an interest of gas odorisation processes and practices.

1. Legal section

Country	Odorisation required on Transit	Transit Pressure (bar)	Odorisation required on Transport[1]?	Transport Pressure (bar)	Odorisation required on distribution	Distribution pressure (bar)	Is a Level of concentration/ olfactory sensation required? (Yes or Not)	If yes, please specify the requirement (minimum concentration or olfactory degree at 1% natural gas in air)	Control required	Requirements specified standards or codes
AT	No		No		Yes		Yes	Minimum concentration	Yes	ÖVGW-Guideline G B230, G B310 & G E530 EN ISO 13734
BE	No	-	No	14,7 to 80 bar	Yes	< 14,7 bar	No	-	Yes	Synergrid recommendation 2000.50.32
CH	No	> 5 bar	No	20 to 70 bar	Yes	< 5 bar	Yes	Minimum concentration	Yes	SVGW G 11
CZ	No	≥ 40 bar	No		Yes	See note[2]	Yes	See note[3]	Yes	Technical rule GAS TPG 918 01 and TPG 905 01
DE	No		No[4]	> 16 bar	Yes	< 16 bar	Yes	Minimum concentration	Yes	DVGW G 280 EN ISO 13734
DK	No	< 80 bar	No	< 80 bar	Yes	< 50 bar	Yes	Minimum concentration	Yes	DVGW G 280 BEK. 230 Order on gas quality
ES	Yes	80 bar	Yes	> 16 bar	Yes	< 16 bar	Yes	Minimum concentration	Yes	NGTS Code and R.D. 919/2006
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FR	Not defined	Not defined	No[5]	16 to 95 bars	Yes	< 25 bar	No	-	Yes	Arrêté 13 juillet 2000 (law), RSDG 10 (Industry requirement), Article R.555-10-1 du code de l'environnement (law)
GB	No	< 85 bar	No	< 85 bar	Yes	< 35 bar	Yes	Olfactory degree 2 on Sales Scale	Yes	Gas Safety (Management) Regulations 1996
GR	No	> 55 bar	Yes	> 16 to 80 bar	Yes	19 bar (DP) 16 bar (OP)	Yes	Minimum concentration	Yes	National Regulation 1712/06
IE	Yes	70	Yes	70	Yes	< 4 bar	Yes	Olfactory degree	Yes	Code of Operations

[1] For the purpose of this document, and although the terms may relate to different notion in EU countries, a distribution network is the network delivering gas to domestic customers, a transit network is the network transmitting gas (generally connected to other big network or infrastructure as storages), a transport network is the network transmitting gas to distribution network, sometime identified as regional transport.

[2] Distribution operated at 3 different pressure levels: Low pressure (2,1 – 5 kPa), Middle pressure (0,05 – 4 bar) and High pressure (4 – 40 bar).

[3] THT: minimum conc. 10 mg/m^3; Mercaptan mixtures: minimum conc. 3,6 mg/m^3; GASODOR S-free: minimum conc. 8,8 mg/m^3; 70% THT and 30% TBM mixture: minimum conc. 12 mg/m3. Olfactory degree for all kind of odorants is the same: 3 warn smell intensity (by 20 % of LEL NG in air).

[4] DE: The German law refers to DVGW codes or equivalent; odorisation in only a few transport systems, mostly based on sulphur free odorant.

[5] FR: The law requires that transmission companies deliver odorised gas to all customers (industrial and distributors), not to odorise network. However, the current practice is to odorise the transported gas (historical decision to simplify the management and the control of the odorisation).

Country	Odorisation required on Transit	Transit Pressure (bar)	Odorisation required on Transport[1]?	Transport Pressure (bar)	Odorisation required on distribution	Distribution pressure (bar)	Is a Level of concentration/ olfactory sensation required? (Yes or Not)	If yes, please specify the requirement (minimum concentration or olfactory degree at 1% natural gas in air)	Control required	Requirements specified standards or codes
IT	No		No[6]	> 5 > 24 from the fields 12-24 outside cities < 12 inside the cities	Yes	0,004 to 5 bar	Yes[7]	Both: olfactory control is the primary requirement and it is legally accepted, but ARERA (Regulatory Body), for economic incentives purpose, takes into account only determinations of the level of concentration by gas chromatography[8]	Yes	UNI CIG 7133 (6) UNI CIG 9463 Dir ARG/Gas569/2019
NL	No	> 40 bar	No	40-80 bar	Yes	< 8 bar	Yes	Minimum concentration	Yes	National Regulation Regeling gaskwaliteit (WJZ/13196684)
PL	No	-	No	5 to 84 bar (DSO < 84 bar)	Yes	< 5	Yes	Both: the olfactory control is a legal requirement, but the predetermined dependence of the odour perception on the odorant concentration allows for concentration control.	Yes	National Regulation Dz.U. 2018, No 1158, Polish technical standards.
PT	No	84 bar MAOP	No	84 bar MAOP	Yes but injection at the transport side	20 bar / 4 bar	Yes	Minimum ambient concentration 1/5th of the flammability limit detection (8mg/Nm^3)	No	National Law
RO	No	-	Yes	-	No	-	Yes	Olfactory degree	Yes	SR 13406 (Natural Gas Odorisation), SR 3317 (Natural Gas Quality Requirements) EN ISO 13734
SE	N/A	N/A	Yes	80 bar	Yes	4 or 10 bar	Yes, however not a quantitative requirement but a qualitative requirement	Gas shall be odorised so that a person with a normal sense of smell can perceive a gas mixture with air amounting to 20 percent of the lower explosion limit (LEL). In these concentrations, the odorant must not harm people or the pipeline system for natural gas.	No	Swedish Gas Distribution Code (EGN 2020) recommends at least 11 mg THT / Nm^3
SK	No	73,5 bar	No	25 to 63 bar	Yes	< 4 bar	Yes	Olfactory degree + Minimum concentration	Yes	TPP 918 01
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[6] IT: The gas transmission network is not odorised except for the gas delivered to the domestic customers and premises directly connected with them.
[7] IT: Directive ARG/Gas 569/2019 from ARERA (Regulatory Body) considers only “positive controls” referred to UNI 7133.
[8] IT: UNI 7133 states the odorant concentrations that assure level 4 of Odorisation on DecaSales scale in natural gas.

2. Odorisation control section

Country	Control on Transit	Control on Transport	Control on Distribution	Control location (end point of the pipe[9], entry point of the pipe, odorisation station,...)	Frequency: continuous (CI) or periodical inspection (P)	Who asks for the control (regulation, voluntary)	Who does work the control (third part or not)	What is controlled (odorant concentration, smell, etc.)	Controlled by Olfaction	Controlled by gas chromatography	Controlled by chemical sensor	Controlled by odorant consumption
AT	No	No	Yes	Representative points in the distribution grid	P: yearly	Legal requirement	Grid operator / third party	Odorant concentration	No	Yes	Yes	Yes
BE	No	No	Yes	Pressure station MP/LP & LP grid (End point of pipe)	P: min. 3 months	Legal requirement (Royal Decree 28.06.1971)	Third party	Odorant concentration	No	Yes	No	Yes: visual inspection and calculation of odorant concentration
CH	Yes	No	Yes	Before the entry in distribution system	P: min. 4 times/ year	Technical rules (SVGW G11)	Third party	Odorant concentration	No	Yes	No	No
CZ	No	-	Yes	All of the above.	Periodically, each 6th month. At some transit stations continuously.	Technical rule TPG 905 01. Voluntary too.	Partly by DSO staff and partly by metrological authority and other third parties.	Both	Yes	Yes	Yes	Yes, it is dependent on gas flow.
DE	No	No	Yes	End point of pipe / furthest point from injection	P: 2 times/year, one control must between May and September *Sometime CI near injection*	Legal requirement and technical rules (DVGW G 280)	Grid operator	Smell and odorant concentration	Yes	Yes (legal)	Yes	Yes
DK	No	No	Yes	At fixed strategic points. They are located far from the dosing plants	P: 2 times per year	Regulation (Danish Safety Technology Authority)	Grid Operator	Odorant concentration	No	Yes	No	Yes (odorant consumption continuously monitored)
ES	Yes	Yes	Yes	In Transport: downstream of injection point. In distribution: city gate and end point of the pipe	CI: near injection P: min. every 2/3 months	Legal requirement (Government)	Grid operator	Odorant concentration	No	Yes	Only for portable devices	Yes: visual inspection and calculation of odorant concentration
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[9] It means the furthest location from injection point.

Country	Control on Transit	Control on Transport	Control on Distribution	Control location (end point of the pipe[9], entry point of the pipe, odorisation station,...)	Frequency: continuous (CI) or periodical inspection (P)	Who asks for the control (regulation, voluntary)	Who does work the control (third part or not)	What is controlled (odorant concentration, smell, etc.)	Controlled by Olfaction	Controlled by gas chromatography	Controlled by chemical sensor	Controlled by odorant consumption
FR	Not defined	Yes	Yes	Transport: At odorisation station (entry points and some node of the network) Distribution: Random locations on network	CI (Transport): ≈ 70 locations on network P (Distribution): several controls per year	Regulation (Transport) Voluntary (Distribution)	Grid operator	Odorant concentration	No	Yes	Yes	No
GB	No	No	Yes	At entry to and across distribution network	P: Monthly and CI	Regulation	The relevant distribution network	Smell	Yes	No	No	Yes
GR	No	No	Yes	City gates and network points at random (especially the most remote ones from the odorant injection points)	P	Regulation	DSO	Odorant concentration	No	Yes	No	No
IE	Yes	Yes	Yes	Primary test point for each Entry point and secondary test-points across the distribution system	CI of odorant injection rate at each plant + P: Monthly samples at TX and DX points	Technical rules (Code of Operations) only require gas to be odorised	TSO/Third Party	Odorant concentration	No	No	No	Yes
IT	No	Yes (domestic uses)[10]	Yes	End point of the pipe, and odorisation station	P: 6 months	Legal requirement (Law 1083/71) Regulation (ARG/Gas 569/2019)	Grid operator	Odorant concentration (see notes[7] & [8]), smell	Yes (see note[7])	Yes	No[11]	No (only for odorisation plants check, as option)
NL	No	No	Yes	City gate station, Odorisation station	P: 3 weeks	Regulation	Grid operator	Odorant concentration	No	Yes	No	Yes
PL	No	No	Yes	Selected endpoints of the distribution system, pressure stations MP/LP	P: 2 weeks and CI	Technical rules (Dz.U. 2018, No 1158, Polish technical standards.)	Grid operator	Odorant concentration	No	Yes	Yes	No

[10] IT: The gas transmission network is not odorised except for the gas delivered to the domestic customers and premises directly connected with them.
[11] IT: Sensors sometimes are used as indicators.

Country	Control on Transit	Control on Transport	Control on Distribution	Control location (end point of the pipe[9], entry point of the pipe, odorisation station,...)	Frequency: continuous (CI) or periodical inspection (P)	Who asks for the control (regulation, voluntary)	Who does work the control (third part or not)	What is controlled (odorant concentration, smell, etc.)	Controlled by Olfaction	Controlled by gas chromatography	Controlled by chemical sensor	Controlled by odorant consumption
PT	Yes on custody transfer station	Yes	Yes by DSO	Odorisation station at the exit of transport pipe	Periodical (monthly)	Voluntary	Own operator personnel	Odorant concentration	no	Yes THT and sulphur content concentration measured on specific equipment	no	no
RO	No	Yes	Yes	-	P: 3 months	Technical rules (SR 13406 SR3317)	Grid operator	Smell and odorant concentration	Yes (olfactory is the primary method)	Yes	Yes	No
SE	N/A	Yes, according to industry practice	Yes, according to industry practice	Entry point of the pipe	Periodical inspection	Voluntary by the Swedish gas industry	The Swedish gas industry itself	Odorant vessel and injection pumps (concentration)	N/A	N/A	N/A	N/A
SK	No	Yes	Yes	Selected points of transport pipes and end point of the distribution system	P: 3 months (local odorisation) 6 months (central odorisation) + CI	Legal requirement (State legislation)	DSO	Smell and odorant concentration	Yes (olfactory is the primary method)	No	Yes	Yes
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3. Odorisation plants section

Country	Injection on transit	Injection on transport	Injection on city gate	Injection on other	Number of plants	Use of electronic pump	Use of Pneumatic pump	Use of bypass	Can odorised gas be received from outside the country?
AT	No	No	Yes	Yes	About 250	Yes	No	Yes	Yes
BE	No	No	Yes	Biomethane injection plant	~ 150	Yes	No	No	No
CH	No	No	No	No	Not communicated	Yes	Yes	Yes	Yes (from France)
CZ	No	No	Yes, odorisation plants are on other sites as well.	On inlet from transit into the distribution grid behind regulating station	109	Yes, electromagnetic also.	No	No	Yes, but small volumes only (regulated by contracts DSO x DSO)
DE	No	No	Yes	Yes (HP 16-70 bar pipelines)	Not communicated	Yes	No[12]	No[16]	Yes[13]
DK	No	No	Yes	No	45	Yes	No	No	No
ES	No	Yes	Yes	Yes (biomethane injection points, underground storages, LNG terminals)	Transport: 12 City Gates: 300	Yes	No	No	Yes
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FR	Yes[14]	No	No	Yes (biomethane, underground storage, operating only when emitting)	11 (Transit)[15] 10 (underground storage)	Yes	No	No	Yes (from Spain and Switzerland)
GB	No	No	Yes – on Leaving Transmission System	Yes – Direct connect Bio Sites into Distribution System	> 150	No	Yes	No	Not currently - there are interconnectors which are currently unodorised
GR	No	No	Yes	No	Not communicated	Yes	No	No	No
IE	Yes - Gas transiting to NI and IOM is also odorised	Yes at system Entry Points	No	At DX Bio-methane injection points	4 x plants, 3 x plants at 2 x Entry Points + 1 x plant at Bio-methane injection site	Yes (LEWA system)	Yes (Orbital system)	No	Yes (from UK), National Grid is contractually required to odorise gas entering GNI system (even though UK TX system is not odorised)
IT	No	Yes[10]	Yes	Bio-methane injection points	> 1250	Yes	Yes	Yes	Yes (from France)
NL	No	Yes (up to 40 bar transmission pipeline)	Yes	No	80 (Transport) 50 (City Gate)	Yes	No	No	No
PL	No	Yes	Yes	No	≈ 1500	Yes	Yes	Yes	No

[12] DE: Generally not, but exceptions, e.g. LNG stations, may exist.
[13] DE: Possible only, if gas odorisation is guaranteed by contract to be contained in accordance with DVGW-G 280, gas to comply with DVGW-G 260
[14] FR: Except in the North of France where a 30 km pipeline is not odorised.
[15] FR: At the entry points of transmission network (including LNG terminals), operating continuously.

Country	Injection on transit	Injection on transport	Injection on city gate	Injection on other	Number of plants	Use of electronic pump	Use of Pneumatic pump	Use of bypass	Can odorised gas be received from outside the country?
PT	Yes	No	yes	Industrial clients but not on some CCGTs	84	All	None	yes	Yes
RO	No	No	No	Yes (0 – 10 bar pipeline)	Not communicated	Yes	No	Yes	No
SE	N/A	Yes	No, already odorised for transport	Yes, all injection point for biomethane – both for transport and for distribution	10 +	Yes	No	No	Yes, but will almost never be.
SK	No	Yes	Yes	No	1400	Yes	Yes	Yes	No
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4. Gas chromatographic analysis at odorisation plants

Countries/ Questions	Are odorisation control measurements performed in your country?	Are they requested by laws or standards? (Please give references)	Continuous or spot analysis?	Type of gas chromatographs/ detectors	Prescriptions on location of the sampling point and instrumentation (distance from the injection point, grid layout between injection and measurement, etc.)	Any other point of concern
AT	Yes	No	Both	All types of detectors	No	-
BE	No	No	-	-	-	Continuous control between odorant consumption and amount of odorised gas by Lewa controller and ODO-check program
CH	No stationary GCs at the odorisation plants. However, DSOs make analyses of the odorised gas with them.	No	-	-	-	-
CZ	No	No	-	-	-	The relationship between odorant consumption (kg) and the amount of odorised gas (m^3) is compared to the working setting value of the injection pump.
DE	Yes	Gas chromatographic methods are not mandatory according to DVGW G 260 but common practice	Uusually spot, continuous is possible (see Table: ODORISATION CONTROL SECTION)	No special design is compulsory, (micro-)gc equipped with ECD, AED or SCD are common practice. As reference method for calibration gas chromatographic methods (i.e. DIN 51855) are mandated For S-Free control measurements a FID or TCD are suitable	End point of pipe / furthest point from injection (see Table: ODORISATION CONTROL SECTION) Sampling point must be representative for the grid in question	Before sampling an adequate amount of gas shall be blown off. The rinsing volume shall exceed three times the dead volumes of the sampling facility
DK	Yes	No	Spot	Portable MicroGC type Agilent 490 CP to onsite analysis	End point of pipe	-
ES	Yes	Spanish Technical Management of the Gas System Regulations establish the requirements of minimum concentration of odorant in the gas, but not the method of measuring it.	Continuous, spot analysis in order to contrast with laboratory or when required	Instruments: Varian CP 2002; Varian CP 4900; Agilent 490 CP Detector: MicroTCD On site gas chromatographic analysis.	Enough distance to ensure odorant is mixed within the gas for a representative sample	-
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FR	Yes	No standard or law. Technical specification	Continuous	Micro chromatography	The sampling point is usually at 80-100D to the injection point (Natural Gas). For biomethane the distance is shorter, a static mixer is added to improve the odorant blending	-

Countries/ Questions	Are odorisation control measurements performed in your country?	Are they requested by laws or standards? (Please give references)	Continuous or spot analysis?	Type of gas chromatographs/ detectors	Prescriptions on location of the sampling point and instrumentation (distance from the injection point, grid layout between injection and measurement, etc.)	Any other point of concern
GB	No	No	-	-	-	-
GR						
IE	Yes as back-up control at some entry points	No	Continuous	Chromatograph (Encal 3000)	Must be at least 60D downstream of injection point	-
IT	Yes, at least two times per year	Standard: UNI 9463	Spot (usually)	Portable micro GC	No particular prescriptions: the sampling point must be as close as possible to the odorisation plant	Periodical check can be done by comparison between odorant consumption and gas volume
NL	Yes, once every 3 weeks	Yes (Meet-code gas LNB)	Spot	Portable	In case of odorisation on transport: at the first City gate station; In case of odorisation on City Gate station: in the grid of the DSO or industry	-
PL	Yes	Yes, National Regulation Dz.U. 2018, No 1158, Polish technical standards.	Usually spot, continuous is possible in selected places	Laboratory gas chromatographs with FPD or PFPD detector, process and portable devices with electrochemical sensors	End point of pipe. Sampling point must be representative for the grid in question	-
PT	Yes	No	Continuous	Specific odorant and sulphur	Sampling 10 m downstream the injection point	No
RO						
SE	Only by manual supervision of odorisation unit, e.g. operation of odorisation pumps etcetera	Industry practice	Industry practice (SPOT)	N/A	N/A	N/A
SK	Yes	Yes, standard TPP 918 01	Spot and selected places continuous	Electrochemical sensors	Grid representative points, the length of the respective network.	-
UA						

5. Injection points at odorisation plants

Countries	Company/ Association	Type (DSO/TSO/ Other)	Type of odorant used (THT, TBM, Gasodor S-Free, ect.)	Description of the injection system used (design, size (length, height and width), material used, compatibility with gas odorant, pictures) and how to be sure that the exchange surface between gas and odorant is optimum. Any standard/regulation and/or requirement/technical specification to follow	Location of the injection point, any recommendations about the location and/or the position (vertical, tilted (45°) etc.) in the pipeline (at the top of the pipeline, at the bottom of the pipeline, in the middle of the pipeline), possible difference between natural gas and biomethane. Any standard/regulation and/or requirement/technical specification to follow	Choice of the injection system (injection nozzle): based on the size of the pipeline, the speed of gas, the pressure, the flow rate, any other considerations, etc.
AT	General	DSO	THT, TBM, S-Free	ÖVGW Guideline G 530	ÖVGW Guideline G E530	ÖVGW Guideline G E530
BE	Fluxys - Synergrid	TSO	TSO uses only THT (to odorise the distributed gas as instructed by the DSO)	One injection point in outgoing station collector. See standard P&ID. Internal Fluxys technical specification. See standard piping assembly plan.	Check valve position: As Is: Check valve situated above ground – two meters upstream of injection nozzle in gaspipe To Be: Check valve situated at the extremity of the injection point (just before nozzle) in gas pipe	Purpose: make sure that every injected THT drop is directly in contact with the gas stream. Modified injector with larger exposure area.
	Sibelga-Synergrid	DSO	THT	LEWA injector, made of stainless steel, consisting of a perforated pipe ("vaporiser") at the injection point. A 3/4" NPT connection is welded onto the pipe and the injector is fixed in it. Upstream of the injection, two valves are separated by a non-return valve. The length of the "valves" part is about 20 cm, the length of the connection and vaporizer side varies according to the pipe diameter (between 85 and 450 mm for diameters from DN 50 to DN 700).	Injection is always done after the meter; vertical or 45° positioning depending on the location on our network (two different backgrounds); the end of the injector arrives about halfway up the pipe. Note that the vaporization is done over the whole injection height (not a single point).	Injection is done through a pump adapted by line (not globalized for the station, each line has its injection according to its metering); a line giving ideally between 20 000 and 30 000 m³/h. The design remains valid up to 100 bar, so we do not have different designs per pressure level (we only operate up to 14.7 bar)
	Fluvius-Synergrid	DSO	THT and Scentinel E	Two different injection methods. The sieve has a larger exchange surface. However, there is no noticeable difference in the odour level checks at the end of the gas network.		Based on the size of the pipeline
CH						
CZ	GasNet	DSO	TBM/DMS THT GASODOR S-free	Specific designed plants, based on pressure less stationary Odor-tank and high-pressure electric pump. Details can be seen on: Odorisation stations | GasNet	Injection point is located on horizontal oriented pipeline. The orientation of injection nozzle is vertical only. Size of injection nozzle depends on power of odorisation plant.	Based on the flow rate of gas.
	EG.D.		Mixture containing 70% of THT and 30% TBM.	Stainless steel injection system. Design and size are dependent on the projected flow of gas of the device.	Position of the injection nozzles is horizontal to the evaporating element. No biomethane in our DSO.	

Countries	Company/ Association	Type (DSO/TSO/ Other)	Type of odorant used (THT, TBM, Gasodor S-Free, ect.)	Description of the injection system used (design, size (length, height and width), material used, compatibility with gas odorant, pictures) and how to be sure that the exchange surface between gas and odorant is optimum. Any standard/regulation and/or requirement/technical specification to follow	Location of the injection point, any recommendations about the location and/or the position (vertical, tilted (45°) etc.) in the pipeline (at the top of the pipeline, at the bottom of the pipeline, in the middle of the pipeline), possible difference between natural gas and biomethane. Any standard/regulation and/or requirement/technical specification to follow	Choice of the injection system (injection nozzle): based on the size of the pipeline, the speed of gas, the pressure, the flow rate, any other considerations, etc.
	PPD		THT	Stainless steel.	Injection point is located on horizontal oriented pipeline. The orientation of injection nozzle is vertical only.	
DE						
DK	Energinet-Evida	TSO / DSO	THT	Odorising systems from Lewa (metering pumps)	The odorant injection point is at M/R stations outlet.	The injection nozzle can be in vertical (most common) or horizontal position. The injection muzzle can be extracted when the section for injection is depressurized.
ES	Enagas	TSO	THT	• Enagas Technical Specification for the supply of odorisation systems (EV-204). • Only injection systems are approved. • No specific dimensions of the injection point. Design is based on the installation and the volume of odorant to be injected. • Materials: stainless steel or copper-free alloys for components in contact with the odorant. • Types and sizing of the odorant supply tank according to the size of the entry/delivery station. • Control Unit is in charge of the correct operation of the odorisation system, controlling the dosing pumps and ensuring correct dosing. • Odorant injector must be a stainless-steel nozzle retractable in operation. Injection of odorant is done by nebulisation or impregnation.	• Although it is not defined in the Technical Specification, injection point is normally installed in a vertical position. The insertion length is determined by the provider, in order to ensure the required odorant concentration. • Complex systems for Interconnection Points, LNG terminals or Underground Storages are studied in detail by the Engineering Department.	• The choice of the injection point is done according to the size of the station, maximum flow of natural gas and operating pressure. • Consumption of odorant is determined based on the above, and the injection system designed accordingly. It is very important to define: 1. Type and volume of the odorant supply tank according to the odorant consumption. 2. Signal alarms in case of odorisation fault or maintenance notification. 3. All the fittings of the odorisation system, which shall include: - Odorant filters in suction of dosing pumps. - Insulating valves of the auxiliary tank. - Retention and/or safety valves. - Vent and active carbon filter of venting and fill connection. - Flow meter in the injection line.
FI						
FR	GRTgaz Teréga	TSO	THT	Use of injection probe. THT is normally injected at the top of the pipeline. No standard or regulation in France.	The injection probe is vertical in the pipeline normally located at the top of the pipeline for maintenance facilities, but some construction can lead to a location at the bottom. No standard or regulation in France	Use of spray or impregnator. The choice is mainly based on the flow rate and the speed of gas, and on the THT concentration upstream of the injection.
GB	Company	TSO (Direct Connect) / DSO	TBM + DMS	IGEM/SR/16 Edition 2	-	-
GR						
IE	GNI	TSO & DSO	NB (TBM/DMS)	Determined by OEM (Original Equipment Manufacturer)	Determined by OEM	DETERMINED BY OEM

Countries	Company/ Association	Type (DSO/TSO/ Other)	Type of odorant used (THT, TBM, Gasodor S-Free, ect.)	Description of the injection system used (design, size (length, height and width), material used, compatibility with gas odorant, pictures) and how to be sure that the exchange surface between gas and odorant is optimum. Any standard/regulation and/or requirement/technical specification to follow	Location of the injection point, any recommendations about the location and/or the position (vertical, tilted (45°) etc.) in the pipeline (at the top of the pipeline, at the bottom of the pipeline, in the middle of the pipeline), possible difference between natural gas and biomethane. Any standard/regulation and/or requirement/technical specification to follow	Choice of the injection system (injection nozzle): based on the size of the pipeline, the speed of gas, the pressure, the flow rate, any other considerations, etc.
IT	Italian Gas Committee	Italian National Technical Committee	THT TBM + IPM + NPM	Requirements are listed in the relevant effective Italian technical standards series UNI CIG 9463 "Odorisation plants and odorant depots for combustible gases employed in domestic or similar uses": • Part 1: "Terms and definitions" • Part 2: "Design, construction, testing and surveillance" • Part 3: "Odorant storages - Design, construction and operating criteria" • Part 4: "Odorant storages - Odorant supply conditions" Injection points characteristics are decided by Manufacturers and are part of their know-how.	Position of the injection points in the pipeline is decided by Manufacturers according to their technology and it is part of their know-how.	• When injection odorising system is associated at a gas pressure control/measuring station, injection points are generally located downstream control and measurement systems. • When injection odorising system is located in the grid, injection points are installed directly on the pipework. Gas velocity in the downstream pipelines is fixed by Italian technical standards and it shall be not higher than 25 m/sec. Size of the pipeline is the key parameter to be considered for injection nozzle sizing. Pressure is generally not relevant for injection nozzle sizing.
NL	Gasunie	TSO	THT	Use of Interchangeable injection probe. THT is normally injected at the top of the pipeline. Length of the probe depends on the pipe diameter (between 80 and 240 mm) No standard or regulation in the Netherlands.	THT is normally vertical injected at the top of the pipeline. No standard or regulation in the Netherlands.	Length of the probe depends on the pipe diameter: DN100 -80 mm injection probe DN150 – 130 mm injection probe DN200 – 190 mm injection probe DN250-500 – 240 mm injection probe no difference in injection point between high pressure odorisation (40 bar) or low pressure odorisation (8-4 bar)
PL	PSG	DSO	THT	Injection point on outgoing gas pipeline. Polish technical standards.	Manufacturers technical requirements.	Manufacturers technical requirements.
PT	Company	TSO	THT	Detail not available in this format	Detail not available in this format	Flow rate
RO						
SE	Swedegas	TSO	THT	According to manufacturer's instructions	According to manufacturer's instructions	According to manufacturer's instructions
SK	SPP-distribúcia	DSO	THT, TBM (80%) + MES (20%)	Injection points are usually on outgoing gas pipeline (there are exceptions) and on top.		From our experience no nozzle is needed.
UA						

6. Odorisation plants section (biomethane injection)

Country	Biomethane injection on Transport?	Number of biomethane injections on Transport (if known)	Number of Odorisation plants on Transport (if known)	Biomethane injection on Distribution?	Number of biomethane injections on Distribution (if known)	Number of Odorisation plants on Distribution (if known)	Specific requirement for biomethane Odorisation?	Standards for biomethane Odorisation
AT	No	-	-	Yes	About 15	About 13	No	ÖVGW-Guideline G B230, G B310 & G E530 EN ISO 13734
BE	No	0	0	Yes	6	6	Synergrid G8/01 (Odorants and odorant concentrations are the same as in natural gas.)	No
CH	No			No				No
CZ	No	0	0	Yes	1	1	Same technical rules: TPG 918 01, TPG 905 01	TPG 918 01, TPG 905 01
DE	Yes	~ 20[16]	0[17]	Yes	~ 185	185	No	DVGW G 280[18]
DK	Yes	1	1	Yes	55	55	No	DVGW G 280
ES	Yes	2	2	Yes	4	4	No (the same requirement for Odorisation in natural gas)	Same as for natural gas
FI								
FR	Yes	~ 70	~ 70	Yes	~ 450	~ 450	The requirements for Odorisation are the same as for natural gas. No specific requirements. Injection of THT and control of Odorisation by gas chromatography	No
GB	Yes	1	0	Yes		Matches number of sites	NTS is unodorised and so any biomethane plant connected to NTS would not require odorisation. For local transmission distribution systems there are no specific requirements.	IGEM/SR/16 Edition 2
GR	No			No				No
IE	No but planned for future	0	0	Yes	1	1	Requirements are very similar to Natural Gas specification except for modification to permit higher oxygen content	IGEM/SR/16 & IGEM/TD/16
IT	Yes	10	If injected in TSO grid, biomethane is not odorised	Yes	3	If injected in DSO grid, biomethane must be odorised	Before injection, both on TSO and DSO grids, biomethane must be proven to be odorisable giving, after odorant addition, the same warning as odorised natural gas. Only when injected in DSO grid it must be odorised. Odorants and odorant concentrations are the same as for natural gas.	UNI TS 11537/2019 UNI 7133-2/20
NL	No	3 (Transport < 40 bar)	3 (Transport < 40 bar)	Yes	~ 40	~ 40	Before injection, both on odorised TSO (< 40 bar) and DSO grids, biomethane must be proven to be odorised giving the same warning as odorised natural gas. Odorants and odorant concentrations are the same as for natural gas.	Same as natural gas
PL	No	-	-	No	-	-	-	No
PT	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
RO	No			No				No

[16] DE: 204 biomethane plants (+6 injections of hydrogen or syngas) end of 2017. Thereof around 20 biomethane plants inject in transmission grids.
[17] DE: no odorisation of natural gas/biomethane on transport grid.
[18] DE: German technical rule for odorisation of natural gas, no specific requirements or a separate standard for odorisation of biomethane.

Country	Biomethane injection on Transport?	Number of biomethane injections on Transport (if known)	Number of Odorisation plants on Transport (if known)	Biomethane injection on Distribution?	Number of biomethane injections on Distribution (if known)	Number of Odorisation plants on Distribution (if known)	Specific requirement for biomethane Odorisation?	Standards for biomethane Odorisation
SE	Yes	2	3 (in total)	Yes	~ 10	~ 10	Same as for natural gas	Same as for natural gas
SK	Yes	1	32	No	0	0	No	No
UA								

7. Olfactory level section

Country	Minimum required olfactory degree	Control required	Requirements specified standards or codes
AT	Not required	No	-
BE	Not required	No	-
CH	Not required	No	-
CZ	3 (warn intensity smell) DVGW scale (Table 1, A 3, TPG 918 01)	Yes	Technical rule TPG 918 01
DE	Not required	No	-
DK	Not required	No	-
ES	Not required	No	-
FI			
FR	Not required	No	-
GB	2 (Sales scale)	Yes	Gas Safety Management Regulations, GS(M)R1996
GR	Not required	No	-
IE	2 (Sales scale)	Yes	Code of Operations
IT	4 (DecaSales scale[19])	No: National Authority take into account only gas chromatographic analyses.	UNI CIG 7133 Dir ARG/Gas 569/2019
NL	Not required	Yes	-
PL	2 degrees	Yes	National Regulation Dz.U. 2018, No 1158 Polish technical standards.
PT	Capable to detect 1/5th of the lower flammability limit	no	National Law
RO	2 (Sales scale)	Yes	SR 13406 (Natural Gas Odorisation), SR 3317 (Natural Gas. Quality Requirements),
SE	N/A	N/A	N/A
SK	2 degrees	Yes	TPP 918 01
UA			

[19] The new DecaSales scale was introduced in UNI 7133-1: 2019, doubling the Sales Scale and using only integer from 0 to 10 olfactory degrees.

8. Odorants concentrations section

Country	Odorant	Percent consumption	Minimum concentration (mg/m³)	Maximum concentration (mg/m³)	Typical concentration (mg/m³)	Unit reference (Standard or Normal)	Customers receiving non-odorised gas: specify what type of industry is receiving non odorised gas	Odorised gas in Salt cavern?	Odorised gas in lined cavern?	Odorised gas in aquifer storage?	Odorised gas in depleted field?
AT	THT Other odorants Sulphur Free Odorant	94% 5% <1%	9,0 - 8,0	As required at representative points in the distribution grid	12 - 14 - 10	Normal	Industry: glass, ceramics, chemical, power plants	No	No	No	No
BE	THT TBM + IPM + NPM	-	17 5,4	34 7,1	20 6	Normal	Chemical Industry & power plants	No	No	No	No
CH	THT S-Free Acrylate	100% -	10 8,8	30 -	15 - 30 12 - 14	Normal	Some Industry	No	No	No	No
CZ	TBM + DMS THT GASODOR S-free (not as a mixture)	60% 37% 3% (Of GasNet amount of distributed natural gas)	3,6 10 8,8	8 12 8,8	5 10 8,8	Standard	Chemical and petrochemical industry	No	No	No	No
	Mixture contains 70% of THT and 30% TBM.	100% (Of EG.D. amount of distributed natural gas)	12	40	20						
	THT	100% (Of PPD amount of distributed natural gas)	12	24	12						
DE	THT Other odorants mixt THT + EA Sulphur Free Odorant TBM + IPM + NPM	59 – 74% 2% - 21% 15 - 17%	10 Not specified 6 8 3	According to DVGW G 260 the total sulphur concentration shall not exceed 10 mg/m³	15 - 18 - 11 - 15 11 - 15 5 - 8	Normal	Industries: glass, ceramics, chemical	No	No	No	No
DK	THT	100%	10,0 (at consumer location)	Not specified	11 - 17	Normal	Not allowed in Denmark. All gas is odorised	No	No	No	No
ES	THT	100%	15 (TSO) 18 (DSO)	-	22	Normal	None	Not apply: there is not any salt cavern	Not apply: there is not any lined cavern	Yes	Yes
FI											
FR	THT	100%	15	40	25	Normal	None	Yes	No	Yes	Yes

Country	Odorant	Percent consumption	Minimum concentration (mg/m³)	Maximum concentration (mg/m³)	Typical concentration (mg/m³)	Unit reference (Standard or Normal)	Customers receiving non-odorised gas: specify what type of industry is receiving non odorised gas	Odorised gas in Salt cavern?	Odorised gas in lined cavern?	Odorised gas in aquifer storage?	Odorised gas in depleted field?
GB	TBM + DMS	100%	Not specified	As required, but must not exceed total sulphur limit of GS(M)R regulation	6	Standard	Industrial but typically Power Stations	No	No	No	No
GR	THT	100%	15	35	20	Normal					
IE	TBM + DMS	100%	3	10	6	Standard	Every customer receives odorised gas	No	No	No	Yes
IT	THT TBM + IPM + NPM ([20])	40% 60%	32 9,3[21]	80 27	-	Standard	Industry	No	No	No	Yes
NL	THT	100%	10	40	18	Normal	Industry; Power plant; dedicated Pipe	No	No	No	No
PL	THT	100%	Not specified	Not specified	15 - 25	Normal	Industry	No	No	No	No
PT	THT		Required to ensure the detection anywhere after the city gate	Not defined	24	Normal	Some CCGTs only and some feedstock users	Yes	Not applicable	Not applicable	Not applicable
RO	EM	100%	3	30	8	Not known	Some Industry	No	No	No	No
SE	THT (Mercaptans for LPG)	N/A	11	N/A	> 11	Normal	None that are attached to a transport or distribution gas grid	N/A	Yes	N/A	N/A
SK	THT TBM(80%) + MES(20%)	59 % 41 %	8 5	40 15	18 10	Normal	Chemical industry and some technological customers	No	No	No	No
UA											

NOTE: The unit can be expressed in reference to normal or standard conditions: the difference is related to the temperature to which the volume is expressed; the following definitions are taken from the EN ISO 14532:

- **Normal reference conditions**: reference conditions of pressure, temperature and humidity (state of saturation) equal to: 101,325 kPa and 273,15 K for a dry, real gas.
- **Standard reference conditions**: reference conditions of pressure, temperature and humidity (state of saturation) equal to: 101,325 kPa and 288,15 K for a dry, real gas.

[20] IT: The 2019 revision of UNI 7133 – Part 2, has an annex in which a concentration of 24,1 mg/m³ is given as basis for further studies for usage of odorant without sulphur with a composition of 32% of methyl acrylate, 66% of ethyl acrylate and 2% of 2-ethyl-3-methylpyrazin.

[21] IT: the concentration is expressed as TBM, because it is the only compound of the mixture that can be analysed on the field at the lower concentration. This concentration of TBM alone reach 4 olfactory degrees at 1% of natural gas in air even in absence of the other two mercaptans of the odorant mixture (IPM and NPM are more reactive, and can be easily lost in the grid).

ODORANTS TABLE															
Odorant	**Composition %**										**%S**	**Density at 273K (kg/m3)**	**Vapour Pressure at 273K (mbar)**	**Density (kg/m³ at 15°C)**	**Vapour Pressure bara at 15°C**
	THT Tetrahydro thiophene	**TBM Tertiary Butyl Mercaptan**	**IPM Isopropyl Mercaptan**	**NPM Normal Propyl Mercaptan**	**MES Methyl Ethyl sulphide**	**DMS DiMethyl sulphide**	**EM Ethyl Mercaptan**	**Ethyl Acrylate**	**Methyl Acrylate**	**2-Ethyl-3-Methylpyrazin**					
Formula	C_4H_8S	$C_4H_{10}S$	C_3H_8S	C_3H_8S	C_3H_8S	C_2H_6S	C_2H_6S	$C_5H_8O_2$	$C_4H_6O_2$	$C_7H_{10}N_2$					
Molecular weight	88,2	90,2	76,2	76,2	76,2	62,1	62,1	100,1	86,1	122,2					
Sulphur Free								66%	32%	2%	0,0%	Note[22]	Note[23]		
THT + EA (Ethyl Acrylate)	12%							88%			4,4%	950	11		
THT + TBM	70%	30%									36,1%			893,1	0,084
THT	100%										36,4%	1016	5,8	1002,8	0,014
TBM + IPM + NPM		76%	16%	8%							37,1%	825	82	810,8	0,17
TBM + MES		80%			20%						36,9%	828	71		
TBM + DMS (UK+IE)		80%				20%					38,8%	830	114	814,4	0,23
TBM + DMS (CZ)		65%				35%					41,2%	837	140		
EM							100%				51,6%	861	246	844,3	0,474

NOTE: The information and data included in this document have been compiled by MARCOGAZ from a variety of sources from its Members. MARCOGAZ will not accept any liability for the data accuracy and completeness.

[22] From the Safety Data Sheet: 0,9300 - 0,9400 at 20 °C (relative density).
[23] From the Safety Data Sheet: 83 mbar (at 25 °C).

9. Updating references

Country	Data of updating	Comments
AT	08/09/2022	From Marcostat member
BE	06/10/2022	From Marcostat member
CH	02/10/2012	
CZ	27/09/2022	From Marcostat member
DE	16/05/2023	DVGW code of practice G 280 is under revision, new version expected 2023-2024
DK	30/05/2022	From Marcostat member
ES	10/01/2023	From Marcostat member
FI		
FR	06/02/2023	From WG member (Update of the number of odorisation plants (TSO & DSO) including biomethane)
GB	15/06/2022	Data supplied by company's Engineering Manager – Gas Quality, Metering, Telemetry & Policy.
GR	02/10/2012	
IE	16/01/2023	From WG member
IT	25/11/2023	From CIG (Italian National Gas Committee)
NL	09/01/2020	From MARCOSTAT member
PL	18/08/2022	From WG member
PT	30/09/2022	From MARCOSTAT member
RO	02/10/2012	
SE	29/09/2022	From MARCOSTAT member
SK	12/09/2022	From MARCOSTAT member
UA		

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