

6 Supply and Installation of Mixture Gas Management System

MINIMUM TECHNICAL CHARACTERISTICS	
<p><i>1.4 mm RPCs</i></p> <p><i>working voltage at</i></p> <p>Description: <i>One of the characteristics?</i></p>	<p>Gas control and manipulation distribution system. These detectors, in order to become operational, need a mixture of different gases, a total of three are 94.7-95.2% freon (C₂, H₂, F₄), 4.5-5.0% isobutane (i-C₄H₁₀) and 0.3% sulphur hexafluoride (SF₆). This mixture is very efficient with relatively good results for detecting muons and other particles, and also the peak of work is relatively low, requiring only potential differentials of up to 6.8 KV.</p> <p>This entire system must meet either the classic studies (i.e. with the mixture cited above) or with innovative gas mixtures, which are defined as ECO-GASES (environmentally acceptable). The characteristic of these compounds is that they do not catch fire, and do not pollute the surrounding environment and also the natural environment. These types of studies are also a European priority for the protection and maintenance of the natural environment and public health in the workplace.</p> <p>These additional mixtures consist of 35-45% HFO and 50-60% CO₂, which can even replace the components of the classic mixture for RPC detectors.</p>
<p><i>stainless steel.</i></p> <p><i>Distribution panel.</i></p> <p>The gas distribution and monitoring system consists of: <i>Mixing</i></p>	<ul style="list-style-type: none"> • Six total gas distribution lines connected to their respective cylinders (14 liters - 20 liters) which will be mounted outside the main facility with the specific lines which will go to the Mixer structure, (<i>also outside the main facility</i>). The lines should be with strong metal material and not oxidizing from the inside. Preferably stainless steel or equivalent. <p>From the Mixer Structure, only one line will be introduced into the Laboratory which will be connected to the Digital Reading and Flow Control Unit which will be mounted inside the Laboratory.</p> <p><i>? gases.</i></p> <p>The newspapers are:</p> <ul style="list-style-type: none"> 1.1 CO₂ 1.2 HFO 1.3 Freon (C₂H₂F₄) 1.4 Isobutane C₄H₁₀ 1.5 SF₆ 1.6 Argon <p>The system consists of:</p> <ul style="list-style-type: none"> • Flow Controller • Mixer • Air humidifier • Digital Reading and Flow Control Unit • Portable Gas Leakage Meters • Dedicated Desktop Computer
<p><i>AND</i></p> <p><i>Actuators</i></p> <p><i>Safety Sensors & feed back</i></p> <p><i>AND ALARMS.</i></p> <p>Line Connection Mode:</p>	<p>1.1 These lines must have a control panel with valves and barometers and anti-CO₂ sensors, respectively indicating the pressure. These lines will be located in the structure of the cylinders.</p>

	1.2 These lines will be merged into a rack in the Mixer Structure, where each of them will have a flow controller.
MFC Flow Controller	
Type :	Gases
Quantity :	3 cups <i>3 channels</i>
Flow Range:	Max. 10 l/h for gases for SF6 Max.0.5l/h and C4H10 Max. 1.0 l/h. <i>~ for all other gases.</i>
Accuracy:	$\pm 0.5\%$ Rd plus $\pm 0.1\%$ FS
Repeatability:	$<\pm 0.2\%$ Rd (or $<\pm 0.04\%$ FS whichever is greater)
Decrease ratio:	1:150 (1:50 in analog mode)
Multi-fluid capability:	Maintaining the maximum of 8 calibration curves
Deployment time (in control, typical):	1 typical second above 5% FS; Option: Up to 600ms
Control stability:	$\leq \pm 0.1\%$ FS (typical for 1 ln/min N2)
Operating Temperature:	-10...+70°C
Temperature sensitivity:	zero: $< 0.05\%$ FS/°C; span: $< 0.05\%$ Rd/°C
Leak integrity, out:	tested $< 2 \times 10^{-9}$ mbar l/s He
Pressure Sensitivity:	0.1% Rd/typical N2 bar; 0.01% Rd/bar typical H2
Pressure Range Sensor:	0 to 64 bar
Leakage through closed valve:	$< 10^{-5}$ Pa.m3/s Ai
Assembly:	maximum error at 90° outside the horizontal 0.2% at 1 bar, Typical N2
Heating Time:	≤ 30 minutes
Storage/Shipping Conditions:	0...+50°C, max. 95% RH (non-condensing)
Mixer	
Materials:	316L stainless steel, passivated surface; for high chemical loads — PTFE-coated <i>of sheet?</i> — internals . Physical dimensions: dimensions for 19" industrial panel rack. Quantity 4 pieces
Tuba:	Stainless steel capillary tube 1/8" OD (ID ranges 24 mm for low-flow). Pressure rating ≥ 10 bar. Fittings: compression type (1/8" or 1/4") with FKM/FFKM O-ring. Quantity 1 piece.
Welding tee (stainless steel):	316L; male/female sizes 1/8"-1/4"; Orbital welding tolerance ± 0.1 mm to avoid dead-volume. Quantity 14 pieces.
Mixing tube:	ID: 2-4 mm; L: 150–300 mm (p.sh. 200 mm recommendation) for achieving homogenization at 0.1–10 l/h; Material: 316L stainless steel (or PTFE for butane/SE6 when inert required). Optional slope/spiral internals for better mixing. Quantity 1 cup
Material for orbital welding:	Spec of materials for TIG/orbital: e.g. tungsten, argon purity $\geq 99.998\%$, fixtures for 1/8"-1/4". Quality control: argon purge and leak test after welding. Quantity 1 set.
Rack panels:	19" rack mount panels, 2–3U per panel for MFC + valves + rotameter. Material: anodized alu or stainless steel . Includes cutouts for connectors and fields. Quantity 2 pieces.
Rotameter:	Range: 0–10 l/h (dual-scale for 0–1 l/h and 0–10 l/h). Nominal tube length 100–250 mm. Material tube: borosilicate; Float: stainless steel 316 / ceramic for aggressive gases. Typical accuracy: $\pm 2\text{--}5\%$ FS. Operating pressure up to 10–18 bar. Quantity 1 cup
Glass for flow meter:	Borosilicate glass; pressure rated; Protective Guard option. Quantity 1 piece.

Valve for flow meter:	Needle/finely adjustable valve; CV approx 0.004 for very fine checks; material stainless steel 316L; leak rate $\leq 1 \times 10^{-6}$ mbar·L/s (for laboratory). Quantity 1 piece.
HV-2 Manual Valve (2-port):	Needle/ball valves with fine control; small CV (p.sh. 0.003–0.01); stainless steel body; torque ergonomic; seal FFKM for inert/reactive gases. Quantity 7 cope pieces.
HV-3 Manual Valve (3-port):	3-way switching valve, material inox, leak-tight. Quantity 1 piece.
MFC (Mass Flow Controller):	Flow ranges: gas configuration: 0–10 l/h (standard gas), 0–1.0 l/h (C_4H_{10}), 0–0.5 l/h (SF_6) — calibrated MFCs are recommended for the specific gas. Accuracy: typical $\pm(0.5\text{--}1\%)$ FS or by contraction; Repeatability: $< \pm 0.2\%$ FS; Resolution: 0.1% FS; Wetted materials: stainless steel 316L + seals FKM/FFKM/FFPM (or PTFE for butane), pressure rating: 1–5 bar in; interface: RS-232 / RS-485 / analogue 0–10 V or 4–20 mA; Response Time: 100–500 ms Typ. For hazardous areas, look for EX/ATEX versions (intrinsically safe EX-FLOW-type). Be calibrated for gas, ATEX/IECEx certification. Quantity 4 pieces.
Power Supply for MFC:	DC stabilized supply; galvanic insulation; output 24 V DC (or as required by MFC); ripple < 50 mV; over-voltage/current protection; for EX applications, preamplifier/safe-zone controller. Quantity 1 piece.
Mixer Composition:	<ul style="list-style-type: none"> Structural Mixing Material (NV) -4 Pieces Connectors / tubes for internal mixing connections – 1 piece Welding tees, stainless steel material for orbital / manual welding – 14 pieces Mixing tube, for mixing for laminar flow with stainless steel/PFA material -1 piece (Suitable for flows 2-4 mm ID) Cabinet Mounting Rack Panels – 2 Pieces Rotameter for Calibrated Scale Visual Flow Measurement – 1 piece (0–10 l/h for standard gases; 0–1 l/h (or less) for special gases) Glass for flow meters borosilicate material or inert material -1 piece Valve for Flow Meter Regulating Finish for Rotameter.-1pcs HV-2 manual valve (2 ports) manual flow closure – 7 pieces (Suitable for flows $< \approx 1$ l/h) HV-3 manual valve (3 ports) for flow change closure -1 piece (Suitable for flows $< \approx 1$ l/h) MFC (Mass Flow Controller), Automatic flow control; wetted materials: stainless steel 316L/seals FKM/FFKM; inlet pressure 1–5 bar.-4 pcs (0–10 l/h (usually inert gases) 0–0.5 l/h when used with SF_6, 0–1.0 l/h for C_4H_{10}) Power supply for MFC, Stable DC output power source.-1pcs
Humidifier (MFC auto-control)	
Manual valve (isolation):	Similar to HV-2: needle valves, Cv small, stainless steel. For humidifier, materials resistant to condensate (PTFE/316L). Quantity 6 cope
MFC (humidifier lines):	Flow ranges by humidification lines (0–10 l/h for gas, and 0–1 l/h for lines with C_4H_{10} and 0–0.5 l/h for

	SF6); outputs and interfaces as above. Quantity 3 pieces.
Mixing tubes (hum):	ID 2-4 mm, length 150-300 mm; poss. packed section (PTFE) for entropic transfer and lukewarm distribution. Quantity 2 pieces.
Connecting Pipes:	Compression fittings, purge points for deactivation. Quantity 1 piece.
Material for orbital welding:	Spec of materials for TIG/orbital: e.g. tungsten, argon purity \geq 99.998%, fixtures for 1/8"-1/4". Quality control: argon purge and leak test after welding. Quantity 1 set.
Welding Tees:	Stainless Steel 316L; minimize dead volume; see purge. Quantity 3 Pieces
Humidifier Composition:	<ul style="list-style-type: none"> Manual valves, (Fine-adjust valve for insulation/leakage.) -6 pieces MFC for humidity control with range according to quoted gases in flow controller-3 pcs Mixing tubes for mixing dry + humidified stream with inner diameter 2-4 mm ID-2 pieces Connecting pipes for curing gas elements -1 piece Orbital welding material, for welding pipelines for humidification.-1 set Welding tees for flow separation -3 pieces.
Moisture measurement	
Sensors:	Humidity sensor (Dew-point / RH sensor or equivalent), accurately according to the dew point specification ± 2 °C (or Equivalent). To support flow-independent measurements and to be suitable for low flows. Range dew point or equivalent: typical covering wide range Accuracy: ± 2 °C dew point for the specified sensor; Sensor technology: DRYCAP or equivalent polymer with auto-calibration; Output: analog 4-20 mA / 0-10 V + digital options (RS-485). Operating temp: -40...+60 °C . Wetted condensate tolerant materials; long-term good stability; Recommended periodic calibration interval: 12 months (or according to use). Quantity 1 cup
Sensor Power Supply:	Have a power supply for the sensor. 24 V DC nominal; ripple low; polarity protection; As for MFC, isolation is needed when in hazardous environments. Quantity 1 piece.
Reading panel for humidity measurement:	Parameter reading panel (RH, dew point, temperature). Panel-mounted display for dew point/RH/T; numeric readout + analogue output passthrough; Alarm relay outputs (2 levels) for setpoints. Quantity 1 cup
Portable Gas Leakage Meters <i>AND FIXED.</i>	
Description:	Portable Multi-Gas Detector with Integrated Pump
Detection Type:	4 gases simultaneously: O ₂ , LEL, CO, H ₂ S
Gases detected:	<ul style="list-style-type: none"> Oxygen (O₂) All Combustible Gases (LEL, Even Isobutane in this case) Carbon monoxide (CO) Hydrogen sulfide (H₂S)
Detection method:	Electro-chemicals for CO, H ₂ S and O ₂ ; catalytic for LEL
Built-in Pump:	Yes – electric pump for sampling up to 20 meters (flexible tube)
Response Time:	- O ₂ : \leq 15 seconds

LEL = Lower Explosive Limit

	<ul style="list-style-type: none"> - LEL: ≤15 seconds - CO/H₂S: ≤20 seconds
Measurement range:	<ul style="list-style-type: none"> - O₂: 0–30% - LEL: 0–100% LEL - CO: 0–1000 ppm - H₂S: 0–200 ppm
Alarms:	<ul style="list-style-type: none"> - Visual - Acoustic - Vibration
Display:	LCD with automatic illumination; shows gas concentrations, pump and battery status
Memory & Login:	Stores the history of alarms and events
Powering the pump:	Automatic and blocked suction protected (displays blockage alarm)
Power Supply:	Rechargeable lithium-ion battery
Battery life:	Up to 13 hours of continuous operation with active pump
Charging Time:	Approximately 5 hours
Weight:	No more than 350 Grams with the built-in Pump
Working Conditions:	Temperature: -20 °C to +50 °C Humidity: 10 – 95% RH
Certifications:	ATEX, IECEx, UL, CSA – for use in hazardous environments
Note:	CE product, Total 2 of them needed.
Warranty Coverage Period:	Min. 2 years (24 months)
Dedicated Desktop Computer	
Min. Points for Processor As: cpubenchmark.net	Min. 49000 Dots with Min 20 Core
Min Proc. Rating According to: cpubenchmark.net:	
"RAM":	Min. 32 GB, min. DDR5 5600 ECC
Hard Disk Size "HDD Size":	Min. (1) x 1T SSD M.2
Raid:	Raid 0, 1 Support
Graphics card:	Integrated graphic Card.
"Media Device":	DVD+/-RW RW (External DVD+/-RW can also be used, not necessarily of the same brand as the computer)
"Slots":	Min (3) M.2 PCIe, Min(4) PCIe where (1) be x16 slot. Min(3) SATA 3.5 inch
Communication & Management	
Communication Ports "Ports":	<ul style="list-style-type: none"> Min(9) USB, where Min (7) is USB 3.2. Min (4) USB to be Money. (1) RJ-45, Min (2) Display Port. Min (1) Headset jack Min (1) Thunderbolt Port
"Networking" Network:	1 RJ45 (1GbE) Ethernet port Wi-Fi 7 802.11be, Bluetooth Min5.4
"Sound":	Integrated Sound Card
"Speakers":	Internal speakers or Built-in Monitor
Security Management:	Embedded Security TPM 2.0
"Preinstalled Licensed O. S." Operating System:	Ubuntu 24.04 LTS
Keyboard:	Standard Keyboard QWERTY
"Mouse":	Minimum 3 Button scroll Optical
"Power Supply" Food:	220 V AC , 50 Hz
Energy Efficiency:	Energy Star
Accessories	
Power Cord Cable:	Yes, European

"Recover":	Recover Partition
MONITORS	
"Type" types:	LCD or LED of the same brand as the Computer
Size:	$\geq 23"$
Rezolucioni "Native Resolution":	1920 x 1080 @ 60 Hz
Contrast Report "Contrast Ratio Static":	3000:1
Response Time:	≤ 6 ms
"Display Port":	(1) VGA or DVI and (1) from DP/DVI/HDMI Ports
Energy Efficiency:	Energy Star
"Power Supply" Food:	220 V AC, 50 Hz
Warranty	
Warranty Coverage Period:	Min. 3 Years (36 Months)

- Clarification on Gas Management System Installation Structure (OK)

Gas Management System Installation Structure	
<p>Description:</p> <p><i>need space for space for cylinders and empty ones outside</i></p>	<ul style="list-style-type: none"> - The first structure which is the cylinder cage should be constructed of stainless steel or 50x50mm galvanized steel profiles, with galvanized metal mesh panels (30x30mm mesh) for full natural ventilation. The roof should be sloping, covered with coated steel/aluminum foil for weather protection. <p>The base should be made of metal beams reinforced with metal gratings (grating) for resistance and ventilation from below. The door must have stainless steel hinges and a safety lock. Inside there should be holders for fixing the cylinders.</p> <p><i>12</i></p> <p>The minimum capacity should be 6 canisters (14–20 l), diameter \leq 230 mm, height \leq 1700 mm, located vertically. The structure must be modular for future expansion and meet European safety standards for the storage of technical gases.</p> <ul style="list-style-type: none"> • The second structure will serve for the installation of the Mixer, Flow Controller and Air Humidifier. This structure will be placed next to the first structure of the cylinders and represents an external technical booth (Gas Mixing Shelter) dedicated to hazardous equipment operating with technical, flammable or toxic gases (<i>it should be noted that only one of the gases which is isobutane is flammable, but at the required limit there is no high risk. However, safety is required to be protected in any case.</i>). It is built to guarantee high explosion safety, atmospheric protection, controlled ventilation, gas leak monitoring, explosion-proof wiring, as well as safe access for authorized personnel. <p><i>extra space for future or contaminated lines.</i></p> <p>Six individual lines of metal piping (stainless steel or equivalent material, corrosion-resistant, and non-oxidizing from the inside) must emerge from the cylinder cage, each connected to the corresponding cylinder. The cage will be positioned outdoors, in front of the laboratory. The lines will be inserted into the second structure in which the mixer will be positioned</p>

- heated
to $\geq 10^\circ\text{C}$

19

<p>gas Bottles ?</p> <p>See previous section</p>		<p>without the need for long horizontal alignment. And from the second structure in which the mixer is positioned, a line will be inserted inside the laboratory, short distance. Entry into the indoor environment must be carried out through a dedicated panel with hermetic passages, guaranteeing maximum safety and isolation from external factors.</p> <p>In the interior of the laboratory, in front of the cylinder cage and the structure of the Mixer, a dedicated metal rack unit will be mounted, which will contain all the main components of the gas management system. These include control panels and pressure gauges, as well as other auxiliary equipment necessary for accurately measuring and distributing gases to detectors. The rack should be of industry standard, with sufficient ventilation and easy access for maintenance. The connection of the equipment to the gas inlet lines from the cylinder cage in the mixer structure must be carried out with piping and hermetic connections certified for use with technical gases, guaranteeing maximum safety and stable operation of the system.</p>
Structure of Bombula		
Cylinder Frame Material:	Stainless steel or galvanized steel, 50×50 mm profiles	
Side panels for cylinder structure:	Galvanized metal mesh (mesh), opening 30×30 mm	
Canister Structure Roof:	Sloping, with coated steel/aluminum foil for weather protection	
Basis of the structure of the canisters:	Metal beams reinforced with metal grating (grating) for ventilation and resistance	
Cylinder Structure Door:	Reinforced with stainless steel hinges and key safety lock	
Capacity of the cylinders:	Up to 6 vertical canisters, 14–20 liters, minimum diameter ≤ 230 mm, height ≤ 1700 mm	
Modularity for cylinder structure:	Structure designed for future expansion with additional modules	
Gas Line Outlets for Cylinder Structure:	6 stainless steel or equivalent metal piping lines, corrosion resistant and non-oxidizing	
Line connections in the Mixer structure:	Direct insertion into the second structure through the panel with hermetic passages, no long distance	
Position of the Cylinder Cage:	Outdoors, in front of the laboratory	
Balloon Structure Ventilation:	Natural ventilation through side meshes and grilled bases	
Safety of Cylinder Structure:	Limited lock access, cylinder drop protection, warning inscriptions	
Dimensions of the structure of the canisters:	Minimum 1200 mm x 1000 mm x 2300 mm (Width/ Depth/ Height)	
Mixer Structure		
Mixer Structure:	<ul style="list-style-type: none"> • Metal sandwich panels with 60–80 mm insulation, of fire-resistant polyurethane / stone wool material. • Galvanized steel metal frame or INOX AISI 304 or equivalent • Raised floor with antistatic metal top, connected to the grounding. 	
Dera:	<ul style="list-style-type: none"> • Metal door with insulation, with anti-corrosion treatment. 	

Inside

	<ul style="list-style-type: none"> Industrial/EX Locking Devices. Opening from the outside with emergency handle. Warning Plates: EX, Flammable Gas, Authorized Personnel Only.
Dimensions:	<ul style="list-style-type: none"> Length: 2.2 – 2.6 m Width: 1.8 – 2.2 m Interior height: 2.1 – 2.3 m <p>These dimensions are sufficient for:</p> <ul style="list-style-type: none"> Mixer Internal Distribution Panels EM Valves / Shut-off Ducted ventilation Service space (min. 80 cm in front of the equipment)
Wiring (EX-zone):	All electrical equipment within the structure must be ATEX according to Directive 2014/34/EU.
Electrical elements to include:	<ul style="list-style-type: none"> ATEX IP66 Lighting Emergency wrench / stop emergency EX ATEX Electric Distribution Box Installation of grounding ($\leq 1 \Omega$) and equalization of potentials Sheathed, anti-static and low/high temperature resistant EX cable Fire detectors.
Ventilation:	<ul style="list-style-type: none"> Natural + mechanical ventilation Ventilation grilles with stainless steel mesh (min. 150–200 cm² each) An ATEX mechanical fan for extraction (mandatory as working with HFO, Freon, C4H10, SF6) Sensor that activates the fan in case of leakage.
Gas Detection:	<ul style="list-style-type: none"> 2–3 EX gas detectors (depending on the type of gases) Sensors for: CO₂, SF₆, C₄H₁₀, Freon, HFO, Isobutane <u>same</u> Alarm panel inside lab + EX siren outside
Clarification on the works to be carried out:	<p>The Economic Operator undertakes the supply of the gas management system along with all relevant components and accessories. Also, it must provide as part of the offered solution all the necessary technical installations to ensure the full and optimal operation of the system, in accordance with the defined technical specifications.</p> <p>In addition to the supply and installation of the main system, the Economic Operator is responsible for the realization of all the works for the extension and connection of the six gas pipeline lines that connect the gas cylinders in the metal cage with the gas management equipment within the second structure and the line that goes to the Laboratory to be connected to the Digital Reading and Flow Control Unit. These works must be carried out with certified, corrosion-resistant materials and suitable for use with technical</p>

gases, guaranteeing insulation, safety and stable operation of the system.

Also, the hermetic connection and installation of pipeline passage panels on the laboratory wall must be ensured, respecting technical requirements and international standards for safety and environmental protection. All works should include functional testing and quality control before the final acceptance of the system.

- Pressure Test
- Leak Tested.