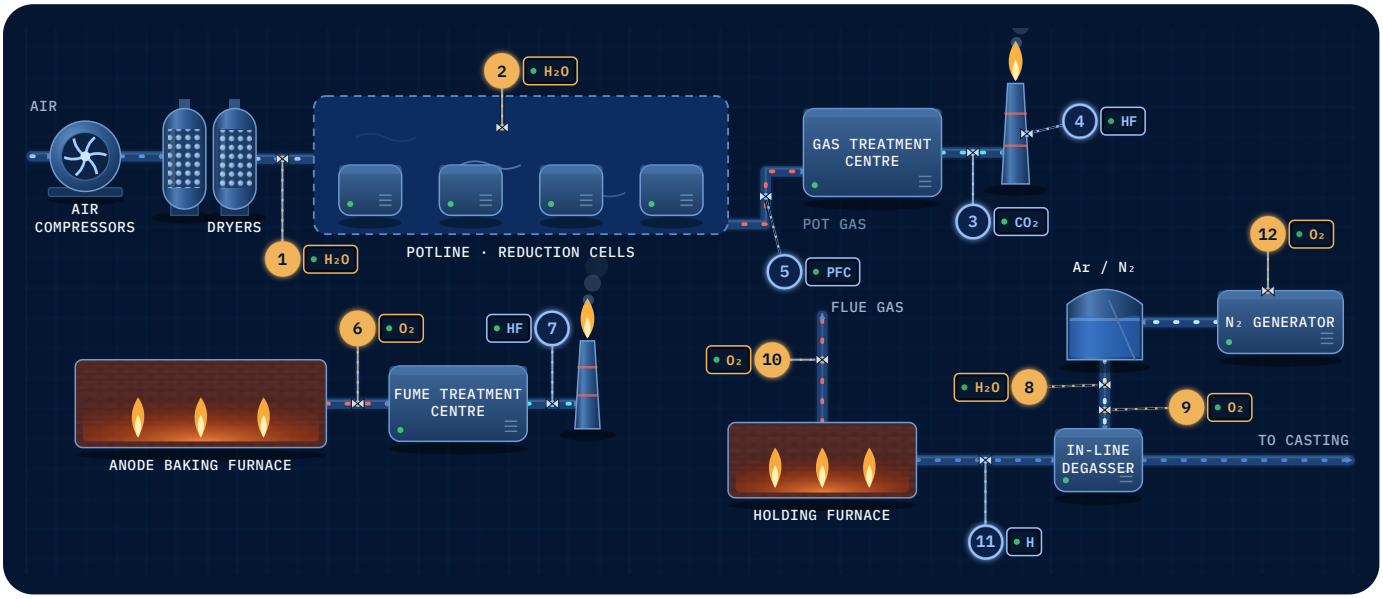
Aluminium smelters: where to measure moisture, O_2 and CO_2

Follow the air, gas and metal from the compressor house and potline to the gas treatment centre, anode baking furnace and cast house. Each numbered point shows what is measured, the typical value, why it matters and the analyzer that fits.



● YORK instrument ○ Integrated system (supplied through YORK)

How the process works

The GCC is home to some of the world's largest primary aluminium smelters. Gas measurement there is less about the electrolysis itself and more about the systems around it: dry compressed air for the potline, the fluoride and carbon balance at the gas treatment centre, combustion in the baking and holding furnaces, and dry, clean degassing gas in the cast house.

1. **Compressed air.** Compressors and dryers supply the point feeders, crust breakers and alumina conveying. Dry air keeps moisture out of the cells and the valves working.
2. **Potline.** Alumina is reduced in the cells. Hydrogen from moisture in the alumina and air reacts with the bath to form HF.
3. **Gas treatment centre.** Pot gas, diluted about a hundredfold with air, is scrubbed with fresh alumina and filtered. The stack is checked for HF, dust, SO_2 and PFCs.
4. **Carbon plant and anode baking.** Green anodes are baked in a ring furnace; the pitch volatiles burn as fuel and the fumes are treated before the stack.
5. **Cast house.** Metal from the holding furnace passes an in-line degasser, where argon or nitrogen strips hydrogen before casting.
6. **Nitrogen supply.** A nitrogen generator or bulk tank feeds degassing, dross cooling and purging.

Interactive version with animation:
https://www.yorkinstrument.ae/guides/aluminium-smelter-measurement-points/

Measurement points

#	POINT	MEASURES	TYPICAL VALUE / LIMIT	RECOMMENDED SOLUTION
1	Compressed air dryer outlet	Pressure dew point	Class chosen by the site under ISO 8573-1, e.g. Class 2 ≤ −40 °C or Class 1 ≤ −70 °C	DPT810, DPT830
2	Potline air header (point feeders)	Pressure dew point at the point of use	As specified by the site	DPT810, DPT-600 Plus
3	Gas treatment centre stack / main duct	CO_2 (vol %)	0.6–1.2 vol % in pot exhaust gas	Integrated system: NDIR CO_2 analyzer with a 0–2 vol % range
4	Gas treatment centre stack	HF and total fluoride	EU BAT-AEL: HF ≤ 1.0 mg/Nm³ (daily average), total F ≤ 1.5 mg/Nm³; GCC permits set their own limits	Integrated system: in-situ or extractive laser (TDL) HF analyzer
5	Pot gas duct / gas treatment centre	CF_4 and C_2F_6 (perfluorocarbons)	Low-voltage CF_4 about 0.01–1 ppmv; up to 0.5–10 ppmv during anode effects; detection limit needed ≤ 0.01 ppmv	Integrated system: extractive FTIR or quantum-cascade laser analyzer
6	Anode baking furnace flue (exhaust ramp)	O_2 (%)	Set by the furnace operator; high O_2 in the preheat zone signals air ingress	POA3500, DPSS-61XX
7	Fume treatment centre outlet	HF, dust, PAH	EU BAT-AEL (integrated plant): HF 0.3–0.5 mg/Nm³ (daily average)	Integrated system: laser (TDL) HF analyzer, dust monitor and periodic PAH sampling
8	Argon / nitrogen to the degasser	Dew point	As dry as possible; no neutral published limit at the point of use	DPT830, DPT-600 Plus, DM9600, DM9700
9	Argon / nitrogen to the degasser	Trace O_2 (ppm)	Point-of-use limit set by the cast house	POA200, PGA500
10	Holding / melting furnace flue	Excess O_2 (%)	General guidance for gas-fired furnaces: 2–3 % O_2 (10 % excess air ≈ 2.1 % O_2)	POA3500, POA300, PGA530
11	Molten metal before casting	Dissolved hydrogen (mL/100 g)	Target < 0.15 mL/100 g in one plant study; porosity thresholds 0.1–0.2 mL/100 g	Integrated system: in-melt hydrogen probe or reduced-pressure test
12	Nitrogen generator outlet	Residual O_2 (ppm or %)	Purity set by the use: degassing, dross cooling or purging	POA200, PGA500, POA300, PGA530

Typical values from published standards, regulations and technical literature. Your contract, licensor or plant specification always governs. Integrated systems are supplied by YORK through its partner integration factory.

Key references

1. Commission Implementing Decision (EU) 2016/1032: BAT conclusions for non-ferrous metals, aluminium — EU (legislation.gov.uk mirror)
2. Same Decision, BAT 10 monitoring — EU (legislation.gov.uk mirror)
3. Good Practice Guidance: Measuring Perfluorocarbons — International Aluminium Institute
4. D1.3 Recycling of the flue gas from aluminium electrolysis cells (HighEFF) — SINTEF