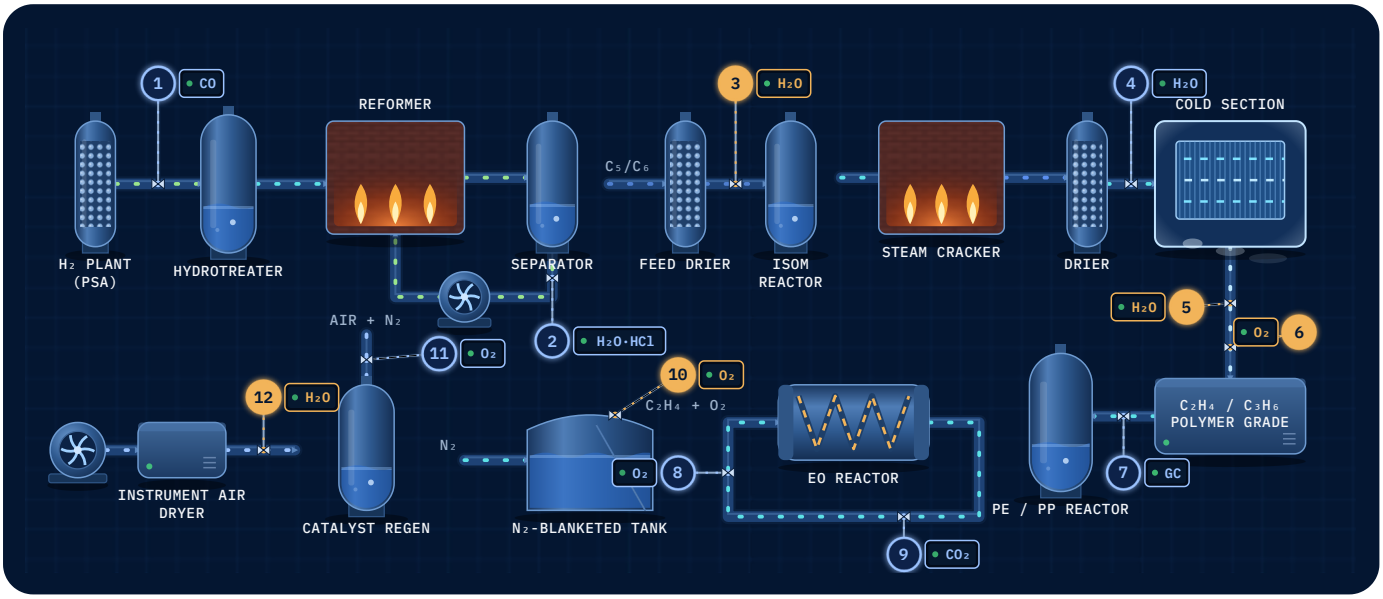
Refining and petrochemicals: where to measure moisture, O_2 and CO_2

Twelve points across hydrogen, reforming, isomerization, olefins, polymers, ethylene oxide and utilities. Each shows the typical limit, why it matters and the analyzer that fits.



● YORK instrument ○ Integrated system (supplied through YORK)

How the process works

A refinery or petrochemical complex is a set of units, not one line. The map groups the units where gas analysis protects a catalyst, a product specification or plant safety.

1. **Hydrogen and hydrotreating.** A PSA unit supplies make-up hydrogen. Trace CO and CO_2 in it inhibit hydrotreating catalysts.
2. **Catalytic reforming.** The recycle hydrogen loop needs a tight water–chloride balance. Its HCl content rules out conventional metal-oxide moisture sensors.
3. **Isomerization.** Feed driers protect a catalyst that water destroys permanently, so the drier outlet is alarmed.
4. **Steam cracking and olefins.** Cracked gas is dried before the cold section. Polymer-grade ethylene and propylene are checked for water, oxygen, CO, CO_2 and acetylene before the PE/PP reactors.
5. **Ethylene oxide.** The reactor cycle gas runs close to its flammable limit, so oxygen is part of the safety system and CO_2 is controlled for selectivity.
6. **Utilities and safety.** Nitrogen blanketing keeps tanks below the limiting oxygen concentration, catalyst regeneration burns coke under controlled oxygen, and instrument air stays dry.

Interactive version with animation:
https://www.yorkinstrument.ae/guides/refinery-petrochemical-measurement-points/

Measurement points

#	POINT	MEASURES	TYPICAL VALUE / LIMIT	RECOMMENDED SOLUTION
1	Make-up hydrogen from the PSA unit	CO + CO_2 (ppm)	Typically < 10 ppmv; 10–50 ppmv slip is common; catalyst limits range from < 20 to 100 ppm	Integrated system: process GC with methanizer-FID
2	Catalytic reformer recycle hydrogen	Water and HCl	Water: semi-regen target 20 ± 5 ppmv; CCR 15–20 ppmv, max 30 ppmv. HCl: < 3 vol ppm	Integrated system: laser (TDLAS) moisture and HCl analyzer
3	Isomerization feed drier outlet	Trace water	Sub-ppm water: chlorided-alumina catalyst is irreversibly deactivated by water	DPT830, DPT990-EX
4	Cracked-gas molecular-sieve drier outlet	Trace water	Below 1 ppmv	Integrated system: laser (TDLAS) moisture analyzer
5	Polymer-grade ethylene / propylene	Water	Ethylene ≤ 7.8 ppm mol (5 ppmw), or ≤ 10 ppm v/v in another specification; propylene ≤ 5 ppm	DPT830, DPT990-EX, DM9900
6	Polymer-grade ethylene / propylene	Oxygen	Ethylene ≤ 0.5 ppm mol; propylene ≤ 2–5 ppm	PGA500, PGA500-EX, POA200
7	PE / PP reactor feed	CO, CO_2, acetylene	Ethylene: CO ≤ 1, CO_2 ≤ 3, C_2H_2 ≤ 3 ppm mol; propylene: CO ≤ 0.07–0.3 ppm	Integrated system: process GC with methanizer-FID
8	Ethylene oxide reactor cycle gas	Oxygen (%)	5–10 mol % (8 % in a patent example); the shutdown trip is set from the flammability limit	POA3500; Integrated system: redundant paramagnetic oxygen analyzers (SIL-rated)
9	Ethylene oxide reactor cycle gas	CO_2 (%)	1–15 mol % (another design 0.5–10 %)	Integrated system: NDIR CO_2 analyzer, explosion-proof or in a purged shelter
10	Tank and reactor nitrogen blanketing	Oxygen (%)	NFPA 69 margin, for example ≤ about 10 % O_2 for methane service and ≤ about 3 % for hydrogen	PGA500-EX
11	Catalyst regeneration gas	Oxygen (%)	0.1–2.0 vol %; CCR burn zone usually 0.5–1.5 vol %	POA3500; Integrated system: paramagnetic or zirconia oxygen analyzer for acid-gas service
12	Instrument air header	Pressure dew point	At least 10 °C below the lowest ambient temperature, and never above 4 °C at line pressure (ISA-7.0.01)	DPT810, DM9200, DPT-600 Plus-EX

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. Q&A 17: water content of reformer feed and recycle gas — AFPM
2. Q&A 44: CCR operating parameters including water — AFPM
3. Q&A 53: typical CO/CO_2 in hydrotreating make-up hydrogen — AFPM
4. US 5053371: catalyst regeneration with three-zone combustion gas addition — USPTO