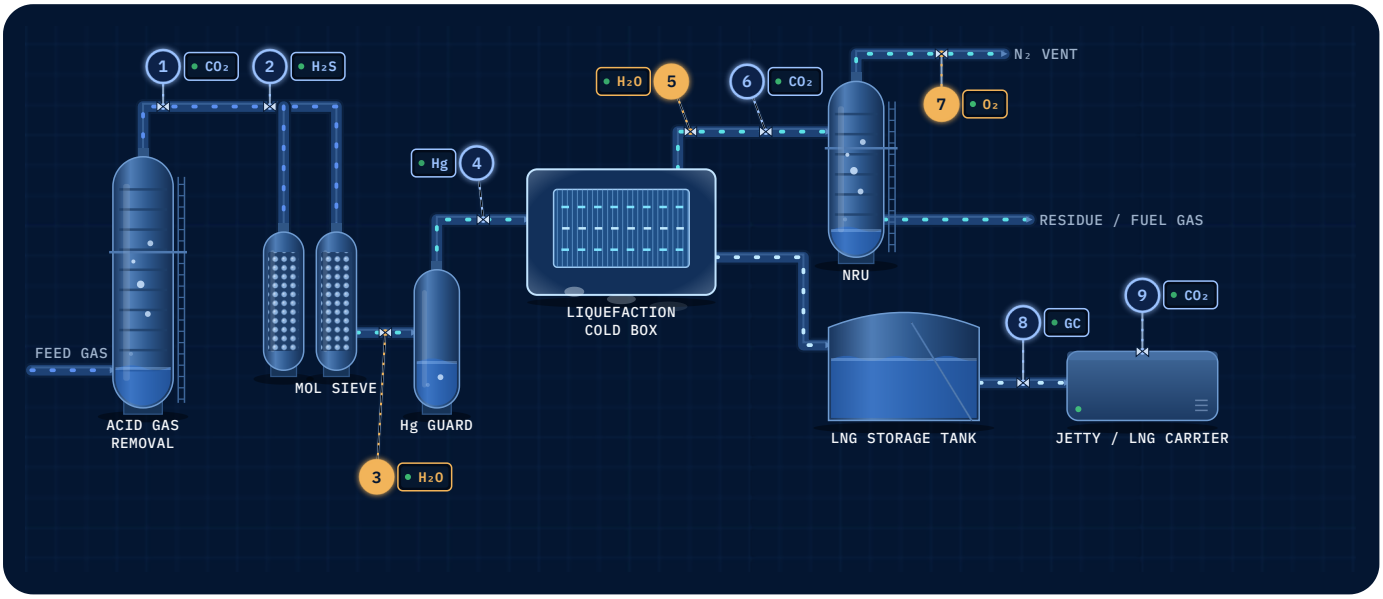
# LNG pretreatment and liquefaction: where to measure

Before gas reaches the cold box, water, $CO_2$, $H_2S$ and mercury must be taken down to ppm or lower. Each numbered point shows the limit, why it matters and the analyzer that fits.




● YORK instrument ○ Integrated system (supplied through YORK)

## How the process works

Liquefaction runs at about −160 °C. Anything that can freeze, such as water and $CO_2$, or attack aluminium exchangers, such as mercury, must be removed first. The analyzers prove each pretreatment step before the gas enters the cold box.

1. **Acid gas removal.** An amine unit takes $CO_2$ down to 50 ppmv or less and $H_2S$ below 4 ppmv, far deeper than pipeline gas needs.
2. **Dehydration.** Molecular-sieve beds dry the gas to about 0.1 ppmv water. One bed adsorbs while the other regenerates.
3. **Mercury removal.** A guard bed removes mercury to about 10 ng/Nm³ to protect brazed-aluminium exchangers.
4. **Liquefaction.** The main cryogenic heat exchanger condenses the gas to LNG, which runs down to the storage tanks.
5. **Nitrogen rejection.** Where the gas carries nitrogen, a cryogenic NRU removes it. Its feed needs the same deep drying and low $CO_2$.
6. **Loading.** LNG is sampled, vaporised and analysed by GC for custody transfer. Ship tanks are gassed up after inerting until $CO_2$ is low enough.

Interactive version with animation:
https://www.yorkinstrument.ae/guides/lng-pretreatment-measurement-points/

## Measurement points

| # | POINT | MEASURES | TYPICAL VALUE / LIMIT | RECOMMENDED SOLUTION |
|---|---|---|---|---|
| 1 | Acid gas removal outlet | Trace $CO_2$ | ≤ 50 ppmv | Integrated system: trace $CO_2$ analyzer (low-range NDIR or GC) |
| 2 | Acid gas removal outlet | $H_2S$ | < 4 ppmv | Integrated system: $H_2S$ analyzer (lead-acetate tape or UV) |
| 3 | Molecular-sieve dryer outlet / cold box inlet | Trace water (ppmv) | 0.1 ppmv or lower (≈ −90 °C frost point at 1 atm) | DPT830, DPT990-EX |
| 4 | Mercury guard bed outlet | Mercury | 10 ng/$Nm^3$ | Integrated system: mercury analyzer (cold-vapour atomic absorption or fluorescence) |
| 5 | Nitrogen rejection unit feed | Trace water | Dried by molecular sieves to trace levels; the exact limit is set by the process licensor | DPT830, DPT990-EX |
| 6 | Nitrogen rejection unit feed | Trace $CO_2$ | 50–100 ppmv in a conventional double-column NRU; about 0.3 mol% with a pre-separation column | Integrated system: trace $CO_2$ analyzer (low-range NDIR or GC) |
| 7 | NRU nitrogen vent | Oxygen | No published limit: measure when the vented nitrogen is reused as inert gas | PGA530, POA3500 |
| 8 | LNG rundown / loading line | Composition and gross calorific value | Per the sales contract; sampled, vaporised and analysed by GC | Integrated system: LNG sampling and vaporiser system with process GC |
| 9 | Ship tanks: gassing-up after inerting | $CO_2$ (%) | Cleared when $CO_2$ falls below a set value, for example 0.1 % | Integrated system: portable $CO_2$ analyzer certified for gas carriers |

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. The fundamentals of feed gas pretreatment — LNG Industry
2. Selecting technologies for onshore LNG production — Digital Refining
3. Santa Barbara Extraction Plant: mol-sieve dehydration and mercury removal — OSTI
4. Molecular sieve dehydration (webinar) — PetroSkills
5. Carbon dioxide-tolerant nitrogen rejection reduces costs — Gas Processing & LNG
6. LNG Custody Transfer Handbook, 5th edition — GIIGNL
7. PEH: Gas Treating and Processing — SPE PetroWiki