



Gas & Chemical Industry – AI ERP TicketingOS

Cylinder Operations: Empty → Fill → Stock → Logistics | Bulk Storage | Custom Gas Mixtures

⚡ ECNR empty cylinder tracking · Filling process · Filled stock · Logistics (empty/filled) · Gas blending



Key ERP Requirements (Gas & Chemical – Cylinder Focus)

- **Empty cylinder inward & stock management** – ECNR (Empty Cylinder Not Returned) tracking, cylinder lifecycle (serial#, last hydrotest date), location tracking
- **Bulk gas storage** – Large storage tanks (liquid oxygen, nitrogen, argon, CO₂), level monitoring, auto reorder
- **Filling process** – Manifold connected cylinders, filling pressure/temperature logging, QC (purity, moisture)
- **Filled cylinder stock management** – By gas type, pressure, batch, expiry (if specialty gas), quarantine for QC
- **Custom gas mixtures** – Partial pressure blending for specific orders (e.g., 5% H₂ + 95% N₂), recipe management, calibration certificate
- **Logistics – empty & filled cylinders** – Dispatch filled, receive empties, exchange billing, route optimisation for cylinder delivery



Gas Cylinder Order to Delivery – Master Execution Flow (ID + Progress)

ID	Process	Activity	Details / Systems	Progress %
7001	Customer Order	Sales order for gas cylinders (type, quantity, pressure, mixture spec)	CRM / OMS	5
7002	Inventory Check – Filled	Check filled cylinder stock availability (by gas & batch)	WMS (filled)	10
7003	Production Planning	If stock not available: schedule filling or custom blending	Production scheduler	15
7004	Bulk Gas Withdrawal	Draw from bulk storage tanks (cryogenic / tube trailers) to manifold	SCADA / tank telemetry	20
7005	Empty Cylinder Preparation	Select ECNR-tracked empty cylinders, inspect, vacuum / purge if needed	Empty cylinder mgmt	25
7006	Filling Process	Connect to manifold, fill to target pressure/temp, auto log	Filling machine + ERP	40
7007	In-process QC	Sample analysis: purity, moisture, oxygen content (for inert), mixture ratio (GC)	LIMS / QC module	50
7008	Custom Blending (if required)	Partial pressure blending of 2+ gases, certificate generation	Blending skid + recipe mgmt	55
7009	Filled Cylinder Stock Entry	Assign barcode/serial, move to filled warehouse (quarantine until QC pass)	WMS (filled)	60
7010	QC Release	Certificate of analysis (COA) generated, batch released for dispatch	QA/QC	70

ID	Process	Activity	Details / Systems	Progress %
7011	Dispatch Planning	Load cylinders onto truck (filled), generate delivery note, empty cylinder return order	TMS	75
7012	Logistics – Filled Delivery	Transport to customer site, GPS tracking, temperature monitoring (if cryo)	Fleet / telematics	85
7013	Customer Delivery & Empty Return	Customer signs POD for filled; collects empties (ECNR count)	Mobile POD	90
7014	Empty Cylinder Inward (Return)	Scanned empties back to empty yard, update ECNR, check damage/hydrotest	Empty cylinder mgmt	95
7015	Invoicing & Settlement	Based on gas filled + cylinder rental (if any) + empty cylinder deposit	Finance / billing	100



Bulk Gas Storage & Filling Plant (Large Cylinder Banks)

Bulk Storage Tanks

- Liquid O₂, N₂, Ar, CO₂, H₂, He (cryogenic at -183°C to -269°C)
- Level sensors (radar/ultrasonic) → auto reorder when low

Filling Manifold (Cylinder bank)

- 10-100 cylinders connected simultaneously
- Automatic pressure / temperature control

Custom Gas Blending Skid


- For mixtures (e.g., 2% H₂ + 98% N₂, or 10% CO₂ + 90% Air)
- Partial pressure / mass flow control
- Certificate of Calibration per batch

- Vaporisers convert liquid to gas for filling manifolds

- Digital weight scale for CO₂ / other liquefied gases

Empty Cylinder Management (ECNR, Stock, Tracking)

Field	Description
Cylinder Serial # (Barcode/RFID)	Unique ID, stamped on cylinder, barcode label
Last Hydrotest Date	Mandatory periodic testing (5/10 years) – auto block if expired
Current Status	Empty / Filled / In-QC / Out for hydrotest / Scrap
Location	Empty yard bay, filling line queue, customer site (ECNR), transit
ECNR (Empty Cylinder Not Returned)	Track cylinders with customer: overdue flag, deposit billing
Gas Type Compatibility	Dedicated cylinders for O ₂ , fuel gases, inert – prevents cross-contamination

 ECNR tracking: if customer does not return empties within agreed period, system auto-invoices cylinder deposit or rental.

Custom Gas Mixture (2+ Gases) – Specific Order Workflow

- **Step 1 – Recipe definition** – Customer specifies gas components and target concentrations (e.g., 5% H₂, 10% CO₂, balance N₂).
- **Step 2 – Partial pressure calculation** – ERP calculates required pressure of each component based on cylinder volume.
- **Step 3 – Sequential filling** – Fill highest pressure component first (e.g., N₂), then intermediate, then balance.
- **Step 4 – Analysis** – Gas chromatograph (GC) verifies final mixture; certificate of analysis generated.
- **Step 5 – Labelling & dispatch** – Special label with mixture composition, hazard class, batch number.

📄 Certificate of Calibration / Analysis is mandatory – printed and attached to each cylinder.


Logistics – Empty & Filled Cylinder Management

Movement Type	ERP Process	Tracking
Filled cylinder dispatch	Pick from filled warehouse → load truck → generate e-way bill → GPS tracking → POD with customer signature	Consignment status, ETA to customer
Empty cylinder return from customer	Scan cylinders at customer site via mobile app → truck loading → receive at empty yard	ECNR status updated, cylinder condition check
Empty cylinder to third-party hydrotest	Issue to external vendor → track due date → receive back with test certificate	Block from filling until test passed
Bulk gas delivery to plant	Purchase order to gas supplier → tanker arrival → weighbridge → transfer to storage tanks	Inventory level update, cost allocation



Billing & Payment Milestones (Gas by Cylinder)

Milestone	Basis	Payment % / Terms
Gas filled (content)	Per cylinder (e.g., \$20 per m ³ of O ₂ , \$5 per kg CO ₂)	80% on delivery, 20% after cylinder return (if deposit not applicable)
Cylinder rental / deposit	Refundable deposit per cylinder + monthly rental if kept beyond free days	Collected upfront with first order
Custom mixture premium	+30% to 50% over standard gas price (blending + analysis)	100% with order (non-refundable)
Empty cylinder overdue (ECNR)	Daily / monthly charge after grace period (e.g., \$1/day per cylinder)	Auto-invoiced monthly
Bulk gas purchase (plant)	Per ton / per m ³ from supplier	LC / 30-60 days credit

 Example: Customer orders 10 cylinders of 5% H₂+95% N₂ – pays gas + mixture premium + refundable cylinder deposit.



AI-Based Automation for Gas & Chemical (Cylinder Ops)

**ECNR
Auto-escalation**
– AI tracks

**Filling
optimisation –**
ML predicts

**Custom
mixture
recipe**

**Bulk tank
level
forecasting –**

**Route
optimisation
for cylinder**

cylinder return overdue → auto sends reminder SMS to customer → after grace, raises deposit invoice

filling pressure to minimise gas waste based on ambient temperature

assistant – AI suggests blending order and pressure steps to achieve target composition with minimum passes

Historical usage + upcoming orders → predicts when tanker refill needed, auto-generates PO

delivery – Considers empty pickup + filled dropoff, vehicle capacity, delivery windows

Hydrotest expiry alert – AI scans cylinder hydrotest dates weekly, blocks filling, schedules external testing

ERP Module Mapping (Gas & Chemical)

Empty Cylinder Management
– ECNR, hydrotest scheduling,

Bulk Storage & Telemetry – Tank levels, vaporiser status, auto reorder

Filling Production – Manifold job card, pressure/temp log, QC sampling

Blending Recipe & GC – Partial pressure calculation, certificate generation

Filled Stock WMS – By gas type, batch, QC hold/release, barcode

location tracking

Logistics TMS (Empty/Filled)

– Route planning, POD with cylinder scan, ECNR update

Billing & Deposit Management

– Gas content, rental, overdue charges, refundable deposit

AI Analytics – Forecast demand, cylinder utilisation, ECNR recovery rate



Final Gas & Chemical ERP + TicketingOS Architecture

Customer Order



Check Filled Stock



Production (Bulk Draw → Fill → QC / Blend)



Filled Stock Entry



QC Release



Dispatch (Filled) + Empty Return Order



POD & Empty Scan



Invoicing (Gas + Deposit/Rental)



AI TicketingOS: ECNR alerts, filling optimisation, blend assistant, tank replenishment, route planning, hydrotest scheduler

AI ERP TicketingOS – Gas & Chemical Industry (Cylinder Operations). Covers ECNR empty mgmt, bulk storage, filling, custom blends, empty/filled logistics.

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