

CRYOGENIC AIR SEPARATION PLANT

Industrial N₂ / O₂ / LAr Production System

- N₂ Purity $\leq$ 3 ppm O₂
- O₂ Purity $\geq$ 99.6%
- Capacity: 50 ~ 50,000 Nm³/h
- Energy $\leq$ 0.48 kWh/Nm³

XUZHOU HUAYAN GAS EQUIPMENT CO., LTD.

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About Huayan Gas Equipment

Xuzhou Huayan Gas Equipment Co., Ltd. is a specialized manufacturer of industrial gas equipment with over 15 years of experience in the design, engineering, and fabrication of air separation systems. Our product portfolio covers cryogenic air separation plants, PSA nitrogen/oxygen generators, hydrogen generation systems, and natural gas equipment. With a state-of-the-art manufacturing facility spanning 20,000 m² and a team of 120+ engineers and technicians, we serve more than 500 customers across 30+ countries worldwide.

20,000+ m² Manufacturing Facility	15+ Years of Industry Experience	500+ Global Customers	30+ Countries Served
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Our Product Portfolio

- Cryogenic Air Separation Plants (N2, O2, LAr, LIN, LOX)
- PSA / VPSA Nitrogen & Oxygen Generators
- PEM & Alkaline Hydrogen Generation Systems
- Natural Gas Compressors & Processing Equipment

Product Overview

Cryogenic air separation is the most mature and efficient technology for producing high-purity nitrogen, oxygen, and argon at industrial scale. Huayan offers a complete range of cryogenic air separation plants tailored to diverse industrial requirements, from small-scale units to large-scale liquid production facilities.



Small Cryogenic Air Separation Unit (KDON Series)

Produces both gaseous oxygen and nitrogen simultaneously. O₂ capacity from 50 to 550 Nm³/h with purity $\geq 99.6\%$, N₂ capacity from 50 to 1,000 Nm³/h. Ideal for small steel mills, glass manufacturing, and general industrial gas supply. Compact footprint from 145 to 420 m² with energy consumption as low as 0.65 kWh/Nm³ O₂.

High-Purity Nitrogen Unit (KDN Series)

Dedicated cryogenic nitrogen production with ultra-high purity ≤ 3 ppm O₂ (99.9997%). N₂ capacity from 200 to 1,600 Nm³/h. Select models also produce liquid nitrogen (10–60 L/h). Widely used in electronics, semiconductor, and pharmaceutical industries requiring ultra-pure nitrogen atmosphere.



Liquid Cryogenic / Liquefaction Unit

Produces liquid oxygen, liquid nitrogen, and liquid argon for storage and distribution. L_{O2} capacity up to 1,300 Nm³/h. Advanced models produce L_{O2} + L_{N2} + L_{Ar} simultaneously. Essential for medical L_{O2} supply, industrial gas distribution, and aerospace applications.

Large-Scale Air Separation Complex

Custom-engineered plants for capacity up to 50,000 Nm³/h. Designed for coal chemical, steel metallurgy, and petrochemical mega-projects. Features advanced process design with turbo-expander, structured packing columns, and DCS control system. Energy consumption as low as 0.48 kWh/Nm³ for nitrogen production.



Working Principle

Cryogenic air separation utilizes the boiling point differences of air components to separate nitrogen, oxygen, and argon through distillation at cryogenic temperatures. The process consists of five key stages:

① Compression & Pre-cooling

Feed air is compressed by a centrifugal compressor to 0.5–0.8 MPa, then pre-cooled to ~5° C in a direct-contact or shell-and-tube cooler for moisture removal.

② Molecular Sieve Purification

Pre-cooled air enters molecular sieve adsorbers filled with 13X zeolite, which removes residual H₂O, CO₂, and hydrocarbons to protect downstream cryogenic equipment.

③ Main Heat Exchange & Expansion

Purified air is cooled to ~-170° C in the main heat exchanger. A turbo-expander provides additional refrigeration to maintain the cryogenic temperature required for distillation.

④ Distillation Separation

Cooled air enters the distillation column. The lower column performs initial separation; the upper column refines the products via rectification, yielding high-purity N₂ (≥99.999%) and O₂ (≥99.6%). Argon is extracted from a side column.

⑤ Product Export

Gaseous products are re-warmed in the main heat exchanger and delivered to pipelines. A portion can be liquefied and stored in cryogenic tanks (LIN at -196° C, LO₂ at -183° C, LAr at -186° C).

Key Distillation Principle: $\alpha = (y_{N2}/x_{N2}) / (y_{O2}/x_{O2})$
Relative volatility of nitrogen/oxygen $\alpha \approx 3.5$ (at atmospheric pressure). This significant difference enables efficient separation through multi-stage rectification.

Technical Features & Core Advantages

Technical Features

● Cryogenic Distillation	Utilizes boiling point differences to separate N ₂ , O ₂ , and Ar
● High Capacity Range	Single unit N ₂ : 100 – 50,000 Nm ³ /h
● Ultra-High Purity	N ₂ ≤3 ppm O ₂ (99.9997%), O ₂ ≥99.6%
● Low Energy Consumption	≤0.48 kWh/Nm ³ (N ₂), 10 – 20% lower than conventional
● Flexible Load Control	30% – 110% load range via PLC/DCS
● Simultaneous Products	Gaseous + liquid (LIN, LOX, LAr) output
● Long Service Life	≥20 years design life, ≥2 years continuous operation
● Modular Design	Compact footprint, easy installation, on-site centralized supply

□ Low Energy Consumption

Advanced heat exchange network achieves ≤0.48 kWh/Nm³ (N₂), industry-leading.

□ High Reliability

Oil-free turbomachinery, automatic molecular sieve regeneration, ≥2 years continuous run.

☐ **Flexible Load Adjustment**

30% - 110% regulation, ideal for variable-load industries like coal chemical & steel.

☐ **Safety & Environmental**

Low-temp atmospheric operation, no hazardous chemicals, compliant waste gas discharge.

☐ **Smart Control**

DCS remote diagnostics + fault pre-warning, minimal operating personnel required.

Technical Specifications

I. Small Cryogenic Air Separation Unit (KDON Series)

Model	KDON-50/50	KDON-80/160	KDON-180/300	KDON-260/500	KDON-350/700	KDON-550/1000
O2 Output (Nm ³ /h)	50	80	180	260	350	550
O2 Purity (%O2)	≥99.6	≥99.6	≥99.6	≥99.6	≥99.6	≥99.6
N2 Output (Nm ³ /h)	50	160	300	500	700	1,000
N2 Purity (ppm O2)	≤10	≤10	≤10	≤10	≤10	≤10
Unit Energy (kWh/Nm ³ O2)	≤1.3	<0.85	≤0.68	≤0.65	≤0.65	≤0.65
Footprint (m ²)	145	150	160	180	250	420

II. High-Purity Nitrogen Unit (KDN Series)

Model	KDN-200	KDN-300	KDN-400	KDN-700	KDN-1000	KDN-1600
N2 Output (Nm ³ /h)	200	300	400	700	1,000	1,600
N2 Purity (ppm O2)	≤3	≤3	≤3	≤3	≤3	≤3
LN2 Output (L/h)	—	10	10	20	40	60
N2 Pressure (MPa)	0.34~1	0.34~1	0.34~1	0.34~1	0.34~1	0.34~1
Footprint (m ²)	95	150	220	260	300	320

Liquid Unit Specifications

III. Liquid Cryogenic / Liquefaction Unit

Model	KD0-180y	KD0-250y	KD0-400y	KDON-1200y/300y	KDONAr-1300y/200y/40y
L02 Output (Nm ³ /h)	180	400	400	1,200	1,300
L02 Purity (%)	≥99.6	≥99.6	≥99.6	≥99.6	≥99.6
L02 Pressure (MPa)	0.2	0.2	0.2	0.2	0.2
LN2 Output (Nm ³ /h)	—	—	—	300	200
LN2 Purity (ppm O2)	—	—	—	≤5	≤5
LN2 Pressure (MPa)	—	—	—	0.5	0.5
LAr Output (Nm ³ /h)	—	—	—	—	40
LAr Purity	—	—	—	—	≤1.5ppm O2+4ppm N2
LAr Pressure (MPa)	—	—	—	—	0.2
Footprint (m ²)	250	300	350	850	4,000

IV. Air Composition (Physical Properties)

Component	Symbol	Volume %	Weight %
Nitrogen	N2	78.084	75.5
Oxygen	O2	20.95	23.1
Argon	Ar	0.932	1.29
Carbon Dioxide	CO2	0.035	0.05
Helium	He	0.00046	0.00006
Neon	Ne	0.0016	0.0011
Krypton	Kr	0.00011	0.00032
Xenon	Xe	0.000008	0.00004

Application Scenarios

Nitrogen (N₂) Applications

- ☐ Steel & Metallurgy: O₂ for blast furnace coal injection & BOF steelmaking; N₂ for tuyere sealing, instrument purging, and furnace atmosphere control.
- ☐ Coal Chemical Industry: Large-scale N₂ for coal gasification, ammonia synthesis, and methanol production as protective atmosphere.
- ☐ Electronics & Semiconductor: Ultra-high purity N₂ ($\geq 99.9999\%$) for wafer manufacturing, chip packaging, and cleanroom atmosphere.
- ☐ Food & Beverage: Liquid nitrogen for rapid freezing; nitrogen flushing for modified atmosphere packaging (MAP).
- ☐ Metal Heat Treatment: High-purity N₂ for annealing, quenching, and sintering to prevent oxidation.
- ☐ Pharmaceutical: Nitrogen as inert protective gas in API production, packaging, and storage.

Oxygen (O₂) & Argon (Ar) Applications

- ☐ Medical & Healthcare: Medical liquid oxygen for hospital centralized O₂ supply systems; liquid nitrogen for cryopreservation of biological samples.
- ☐ Aerospace: Liquid oxygen as rocket propellant oxidizer; high-purity nitrogen for system purging.
- ☐ Metallurgy & Combustion Support: Industrial O₂ for enhanced combustion in furnaces, kilns, and incinerators; argon for argon-oxygen decarburization (AOD) in stainless steel production.
- ☐ Environmental Protection: Oxygen-enriched combustion for wastewater treatment and flue gas treatment.

Quality Assurance & Service

Certifications

- ☐ ISO 9001:2015 — Quality Management System
- ☐ ISO 45001:2018 — Occupational Health & Safety
- ☐ ISO 14001:2015 — Environmental Management
- ☐ CE Certified — European Conformity
- ☐ ATEX Certified — Explosion Protection (Zone 1/2)
- ☐ ASME U Stamp — Pressure Vessel Design
- ☐ GB 50030 — Chinese Air Separation Plant Standard

After-Sales Service

- ☐ 12-month warranty from date of commissioning
- ☐ Lifetime technical support and spare parts supply
- ☐ On-site installation supervision and commissioning
- ☐ Operator training program included
- ☐ 24/7 remote technical diagnosis available
- ☐ Annual maintenance and performance optimization

Contact Us

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Thank you for choosing Huayan Gas Equipment.
We look forward to building a long-term partnership with you.