MAN Energy Solutions
Future in the making

NAMAX

Turbomachinery for nitric acid production

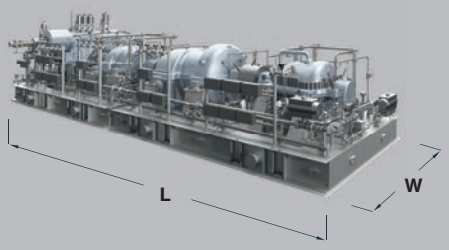
Benefits at a glance

- Modular train package for plant sizes from 400 to > 3,000 mtpd
- Notable low CAPEX and OPEX
- Unique robustness
- Remarkable small footprint
- Easy transportation and commissioning

The new modular nitric acid train package

Technical data

Plant size (mtpd)	Package L [mm]	Package W [mm]
400	15,600	4,500
500	15,800	4,500
750	16,200	4,500
1,000	16,600	4,500
1,250	17,100	4,500
1,500	17,600	4,500
1,750	18,100	5,000
2,000	18,600	5,000
2,250	19,100	5,000
2,500	19,700	5,000
2,750	20,300	5,000
3,000	20,900	5,500
3,250	21,500	5,500

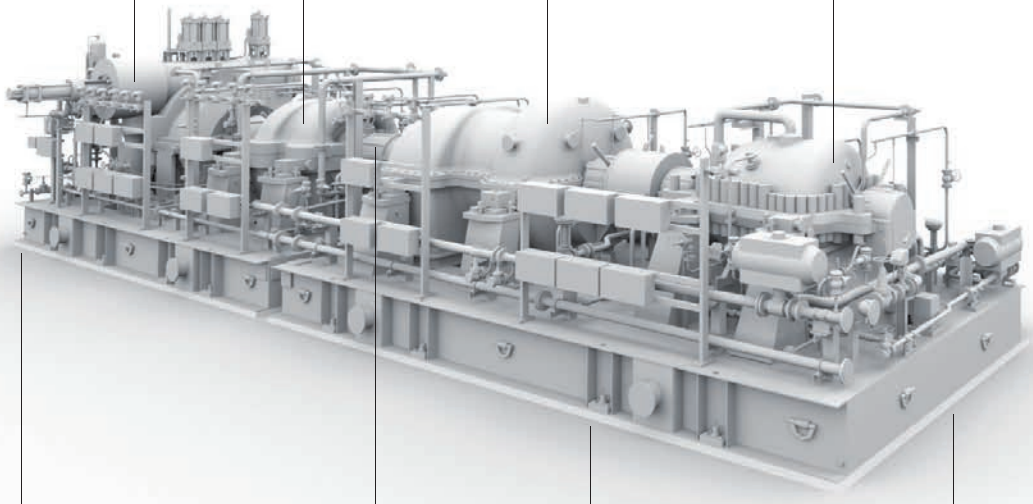


Steam turbine
- Modular system
- Reduced in axial length
- Improved steam consumption

NO_x gas compressor
- Fixed casing concept
- Optimized shaft sealing design

Axial air compressor
- Fixed casing concept
- Increased speed
- Reduced in size and weight
- Surge robust

Tail gas expander
- Fixed casing concept
- Reduced in size and weight



Train package
- Smaller footprint
- Reduced overall train package weight

Common train rotor speed
- No intermediate gearbox required
- Modular train configurations

Base frame configurations
- 4x single base frame
- 2x double base frames[1)]
- 1x single lift for small units[1)]

Various testing alternatives
- No shop test
- Mechanical running test (under vacuum conditions)[1)]
- Performance test[1)]

Design features

General

Nitric acid is a feedstock for the production of fertilizers, pharmaceuticals, mining explosives and various plastics. The demand for these commodities is expanding rapidly with the increasing urbanization and affluence of a growing world population.

The dual pressure process is the leading and efficient technology for processing ammonia to nitric acid.

MAN Energy Solutions (former GHH) has gained distinguished experience, since building and commissioning the first reference in 1963.

For over 50 years, our engineers have continuously improved the nitric acid train technology and advanced MAN Energy Solutions to the leading supplier for the dual pressure process:
- More than 500 turbomachinery casings
- Installed in about 180 nitric acid plants worldwide
- And in the world's largest 2,000 mtpd plant in Porsgrunn, Norway

MAN Energy Solutions has introduced a new comprehensively optimised, turbomachinery concept named NAMAX that provides an advanced level of flexibility and efficiency for nitric acid production.

NAMAX train package

- Designed for nitric acid production from 400 to more than 3,000 mtpd

- Significant smaller footprint
  - base frame area minus 35%

- Lower operating cost
  - Increased core machine efficiencies
  - Lower oil consumption (no intermediate gearbox, smaller bearings)

- Lower maintenance cost
  - No gearbox maintenance
  - Highest robustness of axial compressor blading

- Easier assembly, transport, erection and commissioning
  - Noticeably reduced overall train package weight
  - Assembly and testing of core machines on single base frames
  - Packaging of single turbo units and shipping to site in separate and easy to handle packages

- Various base frame configurations
  - Four single base frames as basic configuration, 2 x double base frames[1)] or one single base frame[1)]

- Various testing options
  - No shop test
  - Mechanical running test for single core machines (under vacuum conditions)[1)]
  - Performance test of single core machines or compressor train[1)]

- Faster delivery time
  - Highly standardized train moduls
  - Modular concept: basic configuration with pre-engineered options

Steam turbine

- Compact design with integrated bearing housing and pendulum support
- Inlet modul with single control valve
- Improved steam consumption

Axial air compressor

- Fixed casing concept
- MAX1 technology
- Unique surge robustness
- Increased power density reducing machine size and weight significantly
- Improved rotordynamics
- High efficiency
- Large operating range

NO_x gas compressor

- Fixed casing concept
- Optimized shaft sealing design
- Minimized consumption of external plant air

Tail gas expander

- Fixed casing concept
- Reduced in size and weight
- Optimized casing design

Installation and commissioning

- Train arrangement follows commissioning schedule:
  - Steam turbine → air compressor → NO_x compressor → expander
  - Reduction of commissioning costs
- Controller tailored to the nitric acid process
- MAN's digital CEON platform supports operating personal throughout the entire NAMAX train lifetime

[1)] pre-engineered option

MAN Energy Solutions
86224 Augsburg, Germany
P + 49 821 322-0
F + 49 821 322-3382
info@man-es.com
www.man-es.com

MAN Energy Solutions
Steinbrinkstr. 1
46145 Oberhausen, Germany
P + 49 208 692-2348
F + 49 208 692-021
turbomachinery@man-es.com
www.man-es.com