

Gas Turbine Exhaust Systems Noise & Emission Controls

Enabling Firm And Dispatchable Power For The Energy Transition

DELIVERING CONFIDENCE IN CLEAN, SAFE & EFFICIENT ENERGY TECHNOLOGIES

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Aarding, a CECO environmental brand, is focused on the design and manufacturing of equipment used in environmental and flue gas handling applications.

The Aarding brand is a global leader with over 65 years of experience in providing custom emissions management solutions for natural gas power and petrochemical processing plants.

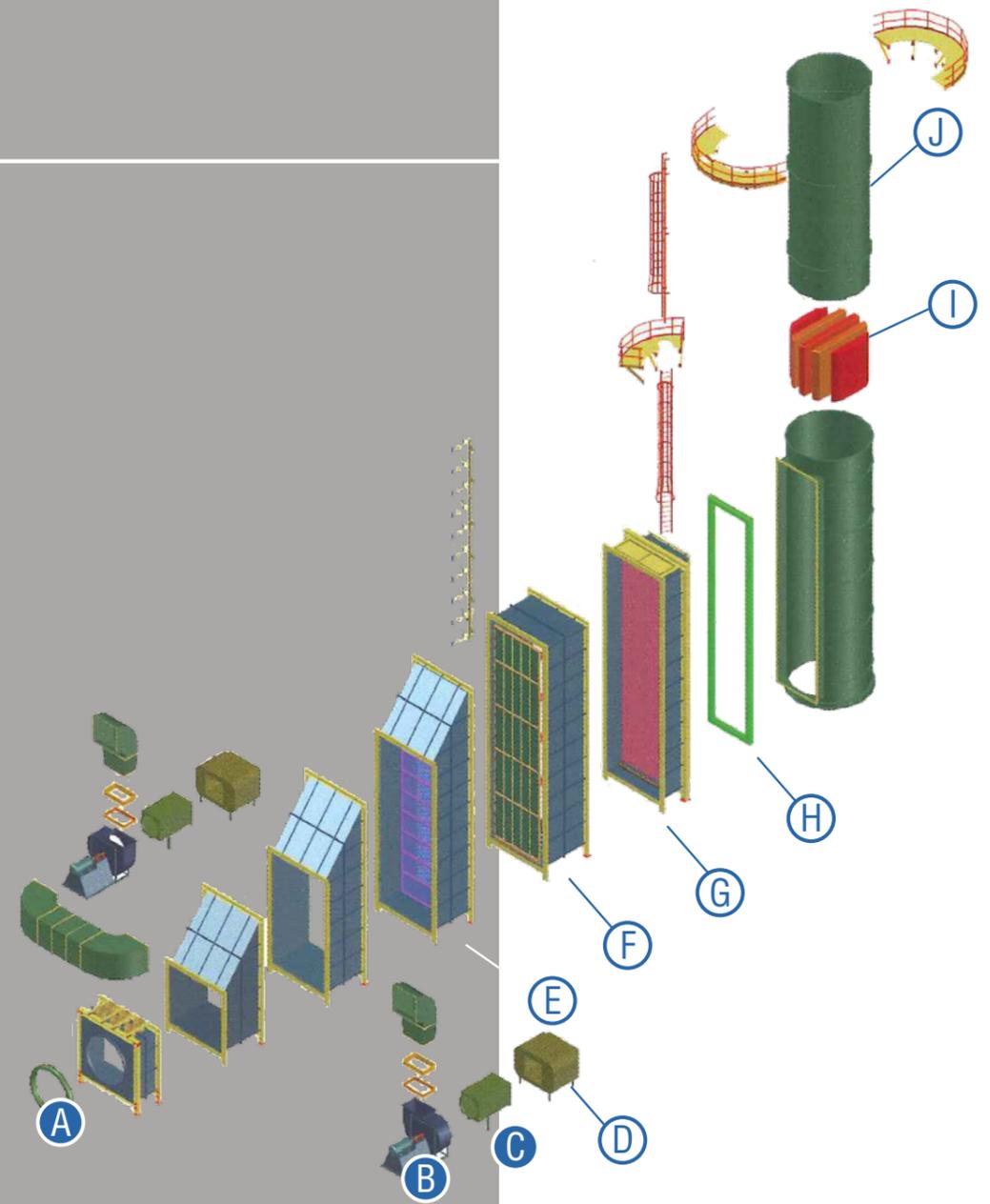
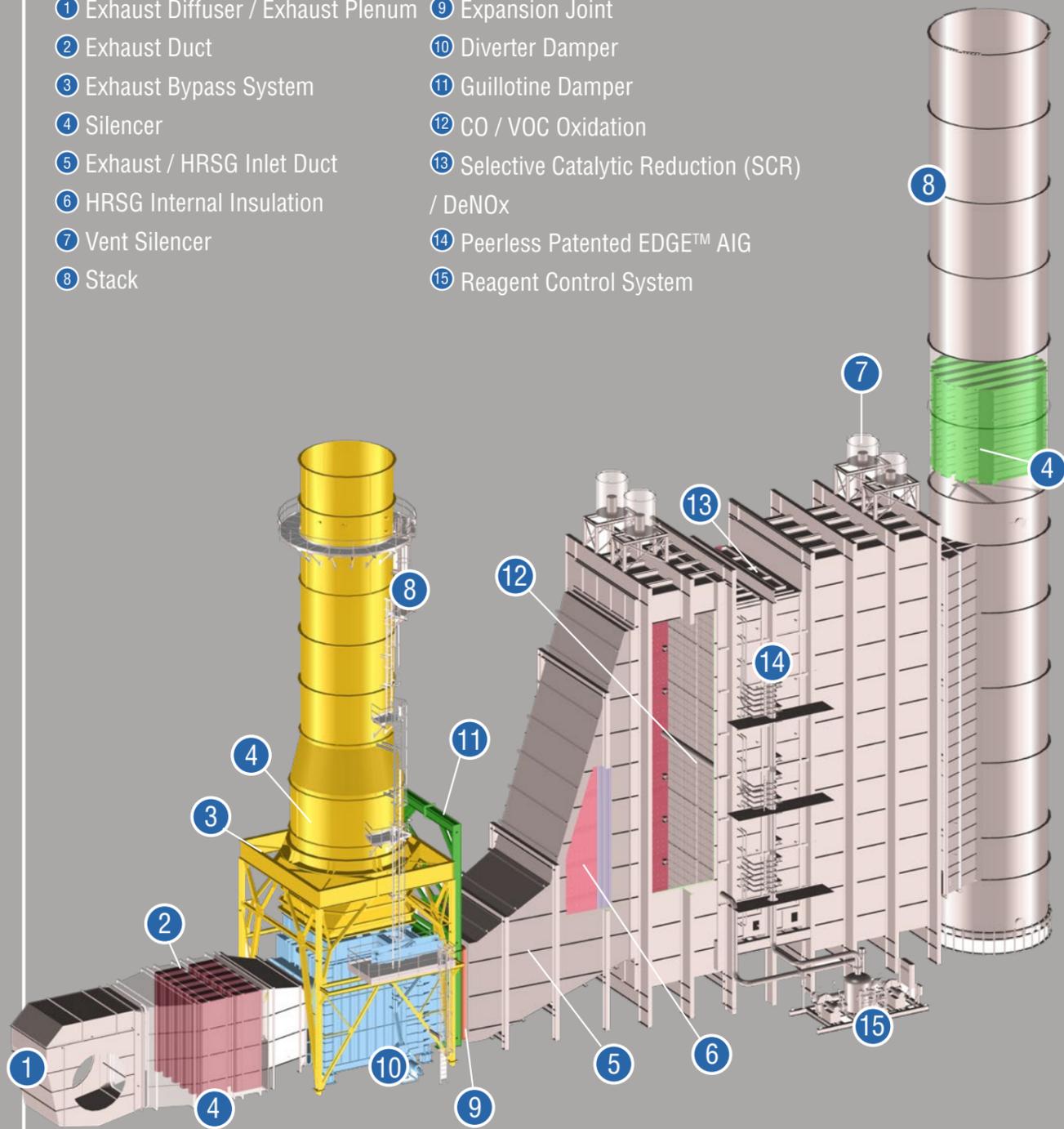
Our customers include gas turbine manufacturers (OEM), HRSG suppliers, power producers, EPC contractors, and end-users. Aarding takes charge of projects from design to installation, whether the solution involves our standard product line or requires a customized approach, including complex turnkey retrofit projects.

We specialize in both new systems and upgrade/retrofit solutions. Our in-house design and engineering teams consist of experienced engineers who specialize in mechanical, thermal, and acoustical engineering, all dedicated to the power and petrochemical markets.

Manufacturing takes place worldwide, ensuring the most economical solutions and optimal logistical execution for projects. All systems are produced according to strict quality standards, with supervision and quality control conducted by experienced Aarding inspectors.

CAPABILITIES

- ① Exhaust Diffuser / Exhaust Plenum
- ② Exhaust Duct
- ③ Exhaust Bypass System
- ④ Silencer
- ⑤ Exhaust / HRSG Inlet Duct
- ⑥ HRSG Internal Insulation
- ⑦ Vent Silencer
- ⑧ Stack
- ⑨ Expansion Joint
- ⑩ Diverter Damper
- ⑪ Guillotine Damper
- ⑫ CO / VOC Oxidation
- ⑬ Selective Catalytic Reduction (SCR) / DeNO_x
- ⑭ Peerless Patented EDGE™ AIG
- ⑮ Reagent Control System



- Ⓐ Expansion Joint
- Ⓑ Tempering Air/Purge Fan
- Ⓒ Fan Silencer
- Ⓓ Fan Filter
- Ⓔ CO/VOC Reactor
- Ⓕ Peerless Patented EDGE™ AIG
- Ⓖ DeNO_x (SCR) Reactor
- Ⓗ Expansion Joint
- Ⓘ Stack Silencer
- Ⓝ Stack/CEMS

GAS TURBINE EXHAUST SYSTEMS

The current market needs is pushing the operational limits of industrial gas turbine systems. High cycling, characterized by frequent starts and stops, along with elevated local flue gas velocities and temperatures, places significant stress on the exhaust gas systems. Additionally, environmental regulations impose strict requirements regarding noise levels and emissions for gas and steam turbine-driven systems, as well as petrochemical applications, including environmentally friendly fuel applications such as HVO or Hydrogen firing.

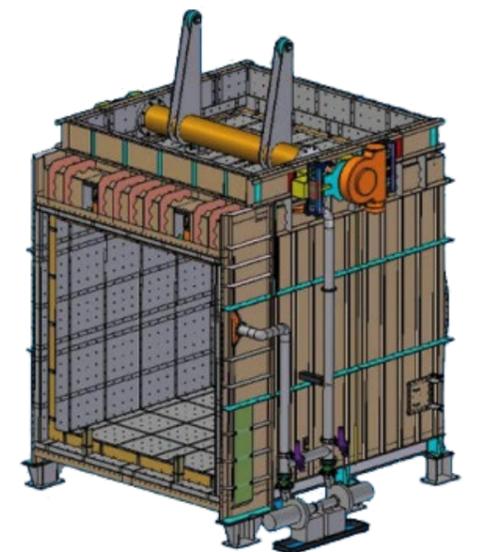
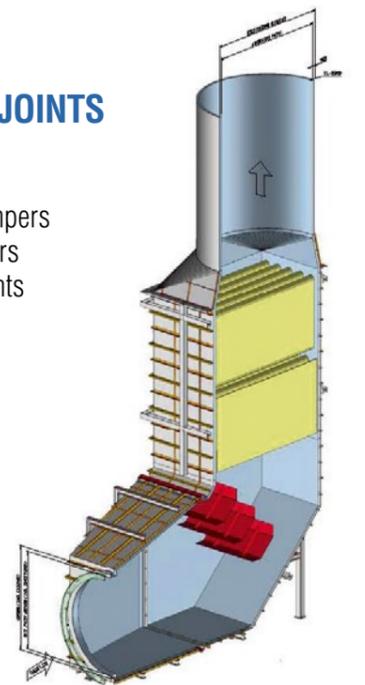


GAS TURBINE EXHAUST SYSTEMS

- + Diffusers, Plenum and Exhaust ducts
- + Single cycle exhaust systems
- + Bypass Exhaust systems
- + Exhaust Stacks
- + Thermal Insulation
- + Boiler Internals
- + CO & SCR Systems

DAMPERS & EXPANSION JOINTS

- + Diverters
- + Guillotine dampers
- + Louver dampers
- + Expansion joints



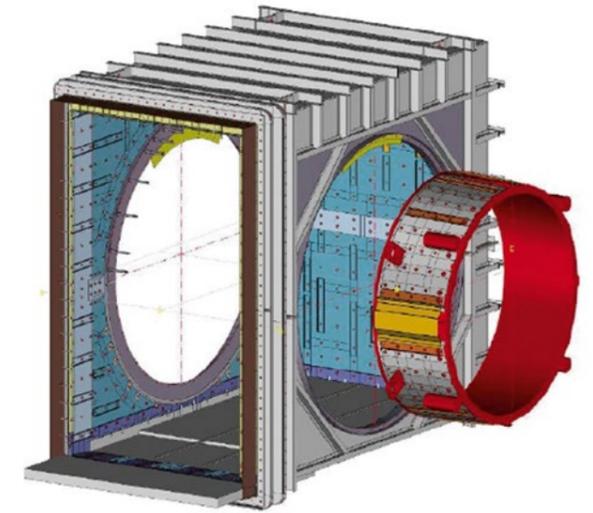


DIFFUSERS / PLENUMS (1)

One of the key transition areas between the gas turbine exhaust and the exhaust system is the diffuser duct, also known as the gas turbine exhaust plenum duct. In larger and newer gas turbines, the exhaust gas flows directly into the exhaust system through a straight diffuser duct. In certain specific gas turbine models, however, the exhaust gas is directed into the exhaust system through a plenum duct, which involves a 90-degree change in the direction of flow.

At Aarding, diffusers and plenums are engineered using Computational Fluid Dynamics (CFD) studies to evaluate the flow profile and swirl characteristics of the GT exhaust. This ensures an optimized design that reduces turbulence, minimizes pressure drop, and provides stable downstream conditions. Our cold casing solutions are specifically designed for start-stop operations and elevated temperatures, combining validated CFD-driven designs with proven operational performance in both simple cycle and combined cycle applications. designs are currently the standard, engineered specifically for the relevant operational conditions.

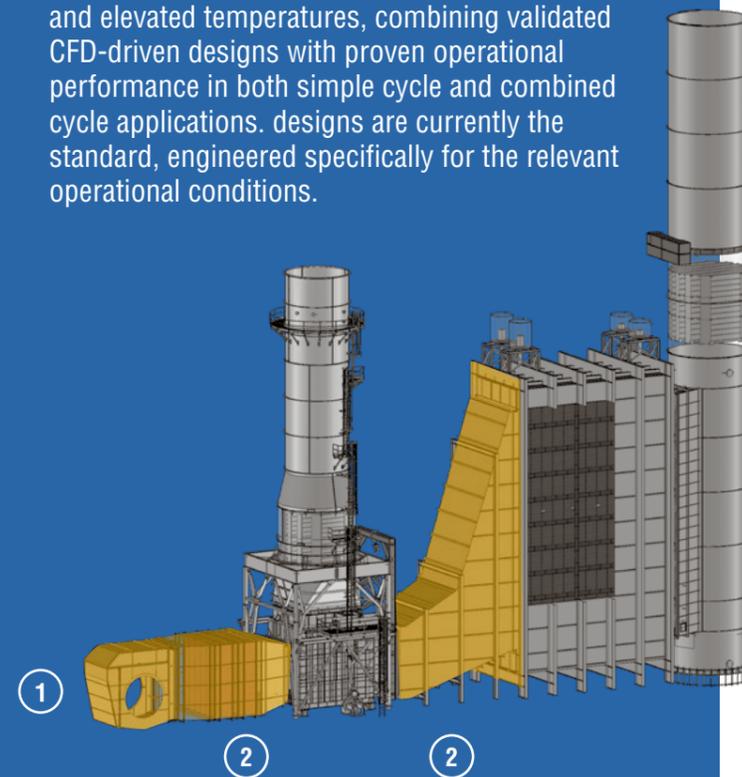
“Aarding specializes in designing, manufacturing, and supplying complete gas turbine exhaust systems, from the inlet expansion joint to the stack exit.”



GT EXHAUST DUCTS (2)

Exhaust ducts are primarily used as a transition between diffuser and diverter systems, or between the diverter system and the Heat Recovery Steam Generator (HRSG) inlet duct. The main design considerations focus on managing high swirl rates, exhaust gas velocities, and elevated temperatures.

Aarding uses advanced CFD modeling to analyze and refine exhaust duct flow dynamics, ensuring smooth gas distribution and reduced losses. This approach allows us to deliver state-of-the-art cold casing solutions that not only meet stringent thermal and acoustic requirements but also improve overall performance by lowering pressure drop and enhancing flow uniformity. Typical designs may incorporate silencers to dampen noise, turning vanes optimized through CFD studies, and fast-opening access doors with compensator flanges. These performance-oriented designs are proven to support reliable operation in simple cycle projects where efficiency and responsiveness are critical.



SINGLE CYCLE EXHAUST SYSTEMS

In today's energy market, there is an increasing demand for peaking power. Single-cycle operation is a fast and reliable method to meet flexible power demands at short notice. Aarding offers a variety of alternatives for single-cycle exhaust systems, designed to support effective cyclic operations and manage the thermal load changes associated with frequent start-stop cycles.

Each design is customized, taking into account internal stud spacing, stud size, and liner plate thickness to ensure optimal operational conditions and extend the unit's lifespan.

In addition to the growing trend of faster start-up and cycling operations, we are also witnessing the increased use of sustainable fuels such as hydrogen, hydrotreated vegetable oil (HVO), and ammonia. Each of these fuels presents unique challenges, and our systems are specifically designed to address them. For instance, our exhaust systems are hydrogen-ready, and emissions control systems can be integrated to help minimize emissions.

Aarding handles the design, manufacturing, and supply of the complete system, from the inlet expansion joint to the stack exit. Our in-house acoustical capabilities are backed by extensive laboratory and field measurements, enabling us to develop state-of-the-art solutions for your noise control needs.

With extensive experience in supplying single-cycle exhaust systems, Aarding can provide everything from sections of the system to the complete exhaust solution, including on-site erection and commissioning, enabling our customers to generate firm and dispatchable power when it matters most.



SINGLE CYCLE EXHAUST SYSTEMS

Aarding engineers, manufactures and supplies complete exhaust emission control packages optimized for the lowest life cycles cost:

- + Tempering air systems for low life-cycle cost
- + Purge air systems to meet NFPA
- + Noise abatement to meet the most stringent near-field and far-field criteria
- + Stack and Continuous Emission Monitoring System (CEMS)
- + Reagent storage and handling
- + Reagent control and vaporization systems distribution
- + Controls integration
- + Selective Catalytic Reduction (SCR) catalyst
- + CO/VOC catalyst
- + Peerless EDGE™ AIG for superior performance
- + Rapid Advantage SCR - RASCR (Fast Start SCR)

Aarding provides pre-assembled modular SCR and CO exhaust system packages, ranging from smaller units to large-scale gas turbine systems that currently exceed 570 MW.

- + Modular construction for reduced erection time and smaller system footprint
- + Designs optimized for lowest life-cycle cost
- + Turnkey construction, construction management and field service support
- + Optimized performance for the lowest achievable emissions



“With optional seal air systems, leakage is significantly minimized to support a man-safe maintenance environment”

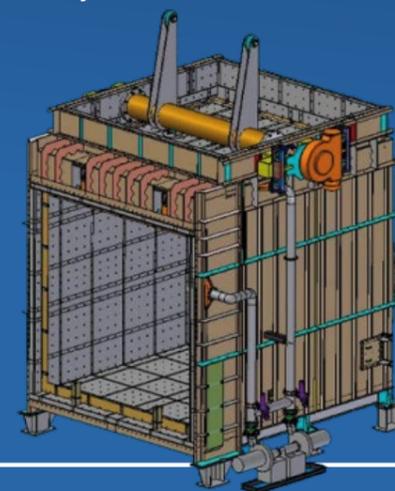


BYPASS EXHAUST SYSTEMS

To achieve higher efficiency levels in gas turbines, waste heat is utilized to generate process steam or operate steam turbines. Aarding offers Bypass Exhaust Systems that connect the gas turbine to the Heat Recovery Steam Generator (HRSG). These Bypass Systems enable flexible operation of the power plant, allowing the gas turbine to start rapidly while the HRSG gradually comes online.

This method provides the advantage of quick power generation and extends the lifespan of the HRSG. In today’s business environment, Bypass Exhaust Systems present a solution for balancing between baseload and peaking/modulating operations.

Aarding’s Bypass Exhaust Systems are equipped with advanced diverter systems. The diverter valves can be designed as pivot or toggle types and can accommodate both hydraulic and electric drives. Additionally, by adding a seal air system, we can provide a safe working environment downstream, allowing maintenance on the HRSG.



“ Burgess-Manning, a sister company of Aarding, is a global leader in noise control solutions, dedicated to shaping the future of acoustic excellence.”

BURGESS-MANNING NOISE BARRIER

Acoustic walls are engineered to reduce noise transmission by up to 50dB, providing reliable noise control in industrial and commercial environments. Constructed using high-performance acoustic panels, the walls ensure effective and high sound attenuation while maintaining structural integrity.

The absorptive panels are available in multiple thicknesses. In general, a panel thickness can be 50mm up to 150mm (2 to 6 inches) to meet the project-specific noise requirements, ensuring optimal performance for each application.

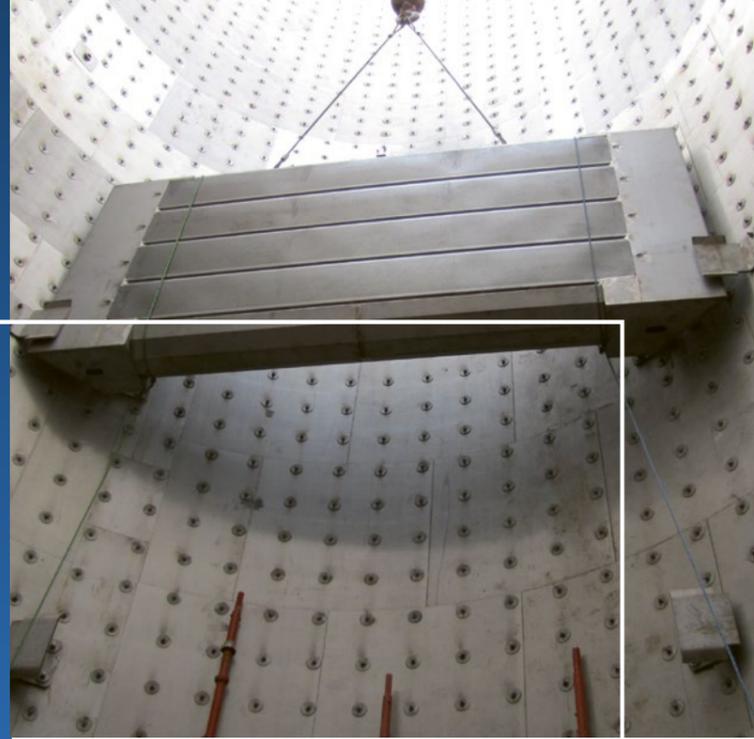
The outer panel casing is built from durable materials such as galvanized steel or stainless steel, enclosing layers of sound-absorbing mineral wool. This design effectively reduces noise while preventing issues like rot, mold, and bacterial growth.

Burgess-Manning Acoustical barriers are free-standing and shall consist of a series of vertical steel posts fixed to a suitable concrete foundation. A series of horizontal bars/rails are attached to the front of the posts to allow for mounting the acoustic panels.



FAST START-UP

When transitioning from a base load combined cycle operation to an intermittent and fast start-up operation, many Heat Recovery Steam Generators (HRSG) units struggle to meet the necessary start-up times for connecting to the power grid. Aarding offers fast start-up modification systems, including high-volume air injection systems, which facilitate acceptable warm-up cycles for HRSG units that must be operational on short notice.



FLUE GAS SILENCER

Aarding flue gas silencers are custom designed to keep noise emissions within acceptable levels. Current gas turbine operation requires the latest design, engineering and advanced material selections.

FOCUS ON:

- + Sound power level/noise output of gas turbine
- + Noise requirement of power plant
- + Dynamic insertion losses
- + Pressure drop requirements
- + Dimensions of duct/stack
- + Other noise sources, e.g burners
- + Other noise reducing parts of the system, e.g. boiler & elbow
- + Maximum flow velocity

THE AARDING FLUE GAS SILENCER OFFER THE FOLLOWING ADVANTAGES;

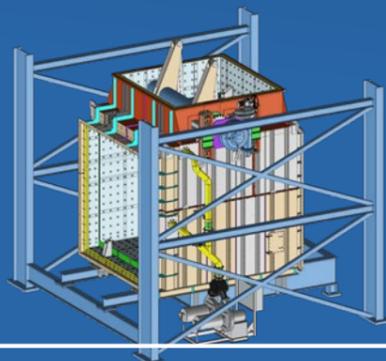
- + In-house design by our team of acoustical engineers & experts
- + Most effective and economical design
- + Patented design
- + Fabrication based upon a welded construction
- + 730°C design temperatures for the exhaust and Flue Gas Silencers

DAMPERS & EXPANSION JOINTS

DIVERTER DAMPER

The diverter is an isolation device specifically designed for applications involving HRSG exhaust ducts. Aarding manufactures two types of diverters: low-leak and zero-leak models. The low-leak design is suitable for situations where a minimal amount of flue gas leakage across the closed diverter blade can be accepted.

Aarding has extensive experience in designing and supplying both toggle-type and pivot-type diverter dampers for HRSG waste heat recovery and other systems that require the diversion of gas streams. We have successfully designed and installed diverter dampers for a range of systems, from small turbine units to some of the largest turbines globally.



LOUVER DAMPERS

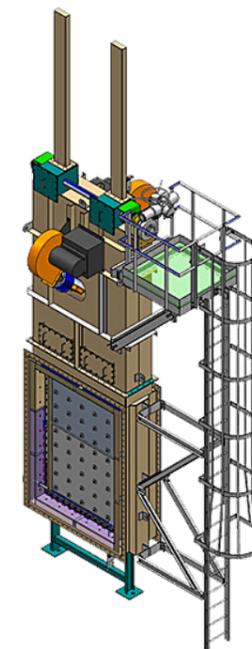
Where precise flow control is essential, Aarding provides a comprehensive range of heavy-duty louver dampers. We offer Single Louvers for low-leak applications and Double Louvers for complete exhaust gas flow isolation. Our designs are proven to be effective across a wide variety of applications. If we don't have a solution that meets your needs, we will design one just for you!



"With the experience of more than 2000 references worldwide, Aarding provides support for both the supply of new systems and retrofits for existing power plants. Even when significant changes to the plant are needed, Aarding can deliver dedicated engineering, supply, and installation packages."

GUILLOTINE DAMPERS

Guillotine dampers are utilized when a shut-off is necessary. Aarding offers designs that include open-bonnet or enclosed-bonnet options, and there is an optional feature for 100% isolation with seal air fans. Aarding has provided guillotine dampers for the largest duct sizes available in the industry.



EXPANSION JOINTS

The main purpose of an expansion joint is to allow for flexibility in exhaust ducts, helping to relieve stress caused by thermal expansion or movement within the system. Our non-metallic expansion joints, made from composite and elastomeric materials, incorporate the latest advancements in engineering and material technology. These joints are designed for applications that require a wide operational temperature range.





MARKETS

Aarding provides products and services to the following markets:

POWER GENERATION MARKET

Within the Power Generation Market, the products of Aarding can be placed within:

- + Simple Cycle
- + Combined Cycle
- + Waste Heat Recovery Plant

PETROCHEMICAL MARKET AND REFINERIES

Aarding provides customized design fully in accordance with stringent design requirements applicable in refineries or at petrochemical plants.

GAS TURBINE TEST CELL MARKET

Aarding provides new as well as retrofit silencer and exhaust systems for Aero Engine test cells and hush houses as well as for land based gas turbine engine test cells.

NATURAL GAS TRANSMISSION MARKET

With proven expertise in managing high pressures, extreme temperatures, and stringent acoustic requirements, Aarding helps operators maintain compliance and minimize environmental impact while supporting the critical flow of energy worldwide.

LNG & DATA CENTERS MARKETS

Aarding also supports the growing LNG & data center markets with engineered exhaust solutions that address rising power demand, strict emissions standards, and challenging noise requirements.

AARDING AND PEERLESS EMISSION CONTROL SYSTEMS

Aarding, in collaboration with its sister company, Peerless specializes in NOx and CO/VOC Emission control systems for new and retrofit applications:

Power Generation Market

- + Simple Cycle Combustion Turbines
- + Heat Recovery Steam Generators (HRSG)
- + Utility Boilers
- + IC Engines

Petrochemical Market and Refineries

- + Refinery Heaters
- + Reformers
- + Petrochemical and Process Heaters

Industrial Market

- + Industrial Boilers
- + Process Units





SERVICE & RETROFIT MARKET

Aarding offers products and services for both new projects and the service and retrofit market.

In today's changing market, the growing and aging fleet of heavy industrial equipment, along with the need for greater flexibility and higher output, is putting pressure on component life. Aarding provides a variety of services aimed at extending the lifespan, upgrading, or retrofitting existing exhaust gas systems and acoustic systems.

Many older gas turbine units experience substantial wear and tear in their exhaust systems. Even minor defects in the insulation can lead to extensive damage, resulting in increased trips and reduced availability.

Aarding delivers engineering solutions that include upgraded materials, improved insulation packages, and advanced engineering simulation techniques to ensure effective thermal and acoustic design for exhaust systems.

We also provide noise and emission measurements, spare parts and field services for a wide range of systems, regardless of the equipment's make or model.

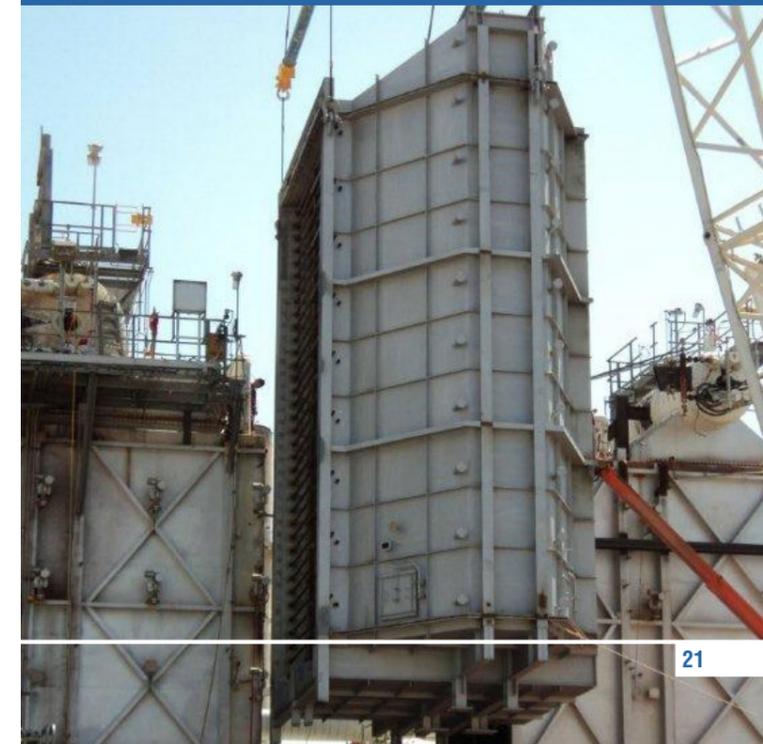
Aarding has extensive experience to support power plant changes and upgrades including the latest designs for emission control retrofits.

AARDING AND PEERLESS EMISSION CONTROL RETROFIT

As environmental regulations tighten, retrofitting existing plants with SCR technology is often the most economical way to achieve full compliance with NOx emissions standards. Aarding, in collaboration with its sister company, Peerless, has extensive experience and innovative engineers who can help you attain strict emission reductions in your facility's existing space with minimal disruption.

With decades of experience, our engineers specialize in providing emission-reduction technologies for combustion sources in power plants, refineries, and chemical plants. Our expertise in engineering, designing, procuring, and constructing SCR systems allows us to offer flexible solutions tailored to your facility's specific needs and timelines.

Beyond new emission-reduction projects, our engineers possess the knowledge and skills to upgrade existing emission-control systems. This includes enhancing current SCR systems with catalyst improvements and additions, ammonia system upgrades, and burner modifications.



-  Aarding office
-  Projects

AARDING PROJECTS

"Our strength comes from our extensive know-how on a wide variety of acoustical products."

NORTH AMERICA

- + Greenfield, Canada
Supply of steam vent silencers
- + Brazos Valley, USA
Supply of exhaust gas systems and flue gas silencers
- + Cane Run, USA
Supply of stack dampers
- + El Segundo, USA
Supply of internal insulation and boiler internals
- + Hines II, USA
Supply of internal insulation and boiler internals
- + Richmond County, USA
Supply of steam vent silencers
- + Sutton, USA
Supply of steam vent silencers
- + Temple & Sherman, USA
Supply of internal insulation and boiler internals
- + Wayne County, USA
Supply of steam vent silencers

LATIN & SOUTH AMERICA

- + Belgrano & San Martín, Argentina
Supply of steam vent silencers
- + Pilar, Argentina
Supply of steam vent and flue gas silencers
- + Termoflores II & III, Colombia
Supply of steam vent silencers
- + EPM, Colombia
Supply of exhaust bypass systems
- + Rio Bravo, Mexico
Supply of exhaust systems
- + Pemex Nuevo, Mexico
Supply of exhaust gas systems
- + Pemex Tabasco, Mexico
Supply of exhaust gas systems
- + Manzanillo, Mexico
Supply of steam vent and flue gas silencers
- + Tamare & Bachaquero, Venezuela
Supply of internal insulation and boiler internals

EUROPE

- + Ivago Gent, Belgium
Supply of exhaust gas systems
- + AES ELSTA
Supply of exhaust ducts
- + Te-to Zagreb, Croatia
Supply of internal insulation system and flue gas silencers
- + Megalopolis, Greece
Supply of steam vent silencers
- + Schiphol, the Netherlands
Supply of aircraft engine and testcell retrofit & upgrade
- + Hemweg & Diemen, the Netherlands
Supply of internal insulation and boiler internals
- + Magnum, the Netherlands
Supply of internal insulation and boiler internals
- + Tuapse, Russia
Supply of steam vent and flue gas silencers
- + Baglan, UK
Supply of intern insulation system

- + Corby, UK
Supply of exhaust ducts

AFRICA

- + Arzew, Algeria
Supply of internal insulation and boiler internals / Supply of bypass flue gas silencers
- + Sidikrir & El Af, Egypt
Supply of internal insulation and boiler internals / Supply of internal insulation for bypass stacks

MIDDLE EAST

- + Al Rasheed, Iraq
Supply of simple cycle exhaust systems
- + Mukhaizna, Oman
Supply of internal insulation and boiler internals
- + PP12, Saudi Arabia
Stack dampers, vent silencers and flue gas silencers
- + Rafha, Saudi Arabia
Supply of simple cycle exhaust systems

- + Rabigh 6, Saudi Arabia
Supply of steam vent silencers
- + Tabuk, Saudi Arabia
Supply of simple cycle exhaust systems
- + Qatargas, Qatar
Supply of exhaust gas systems
- + Fujairah, UAE
Supply of steam vent silencers

ASIA

- + BLNG Shell, Brunei
Supply of exhaust ducts
- + Samalkot, India
Supply of steam vent and flue gas silencers
- + Sengkang, Indonesia
Supply of steam vent silencers
- + Keppel, Singapore
Supply of steam vent and flue gas silencers
- + BangPa, Thailand
Supply of steam vent silencers
- + Mapta Phut, Thailand
Supply of exhaust plenum ducts

AUSTRALIA & NEW ZEALAND

- + Pinjarra I & II, Australia
Supply of exhaust gas systems and flue gas silencers
- + Wheatstone, Australia
Supply of bypass stack, louver dampers, guillotine dampers and expansion joints
- + Yarwun, Australia
Supply of steam vent silencers
- + Huntly, New Zealand
Supply of exhaust gas systems



CECO ENVIRONMENTAL is a leading environmentally focused, diversified industrial company whose solutions protect people, the environment, and industrial equipment across the globe, serving a broad landscape of industrial air, industrial water and energy transition markets. It is listed in NASDAQ (ticker symbol: CECO).

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