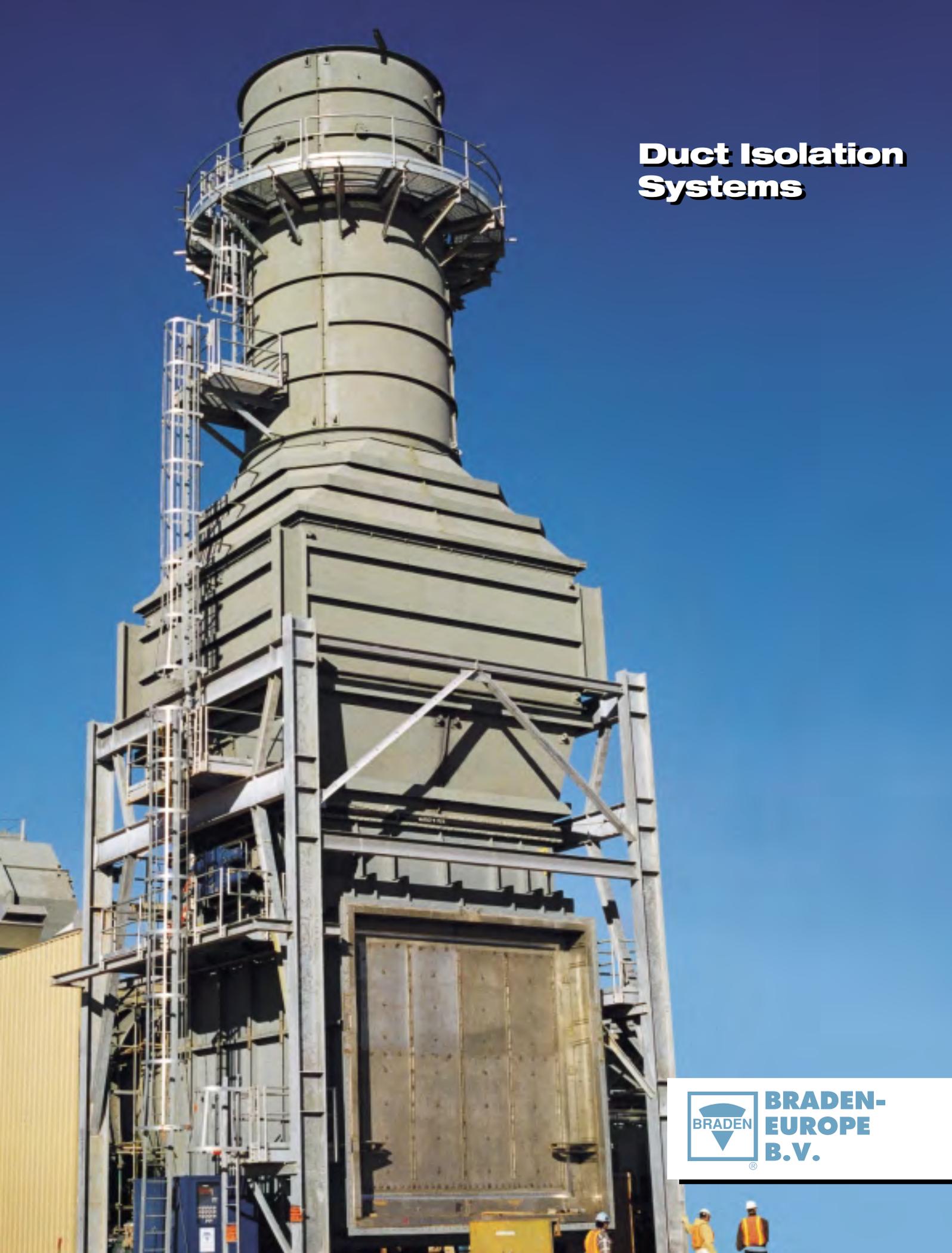


Duct Isolation Systems



**BRADEN-
EUROPE
B.V.**





Diverter Experience From The Extreme World Of Combined Cycle

Braden-Europe has designed and manufactured diverter isolators since 1985. The bulk of Braden-Europe's diverter experience is in combined-cycle gas turbine power plants, where extreme and sudden thermal changes necessitate thorough design foresight. Braden-Europe has also designed diverters for desulfurization (FGD) applications with several unique and patented features for improved flow distribution.

Single Blade Diverter Advantages

The diverter design has several inherent advantages, including the relative simplicity of having a single blade that does not have to move in conjunction with any other blade. The single blade design has a much smaller seal periphery than multiple blade dampers. The diverter "cube" is a modular design for ease of shipping and field assembly; extremely large diverters can be delivered as two or more modules that are designed for fast on-site erection.



Test assembly of a hydraulically-operated diverter for a V94.3A turbine.



Pivot drives are available for diverters with inlet dimensions up to 16.4' x 27.8' (5m x 8.5m). The pivot design keeps the entire drive structure out of the gas flow at all times—also when in the boiler-closed position.

Adaptable Designs

Braden-Europe's diverter designs are highly adaptable. They can accommodate a variety of ductwork sizes and transition configurations. Vertical shaft designs allow for side discharge. When appropriate, diverters for gas turbine applications are internally insulated. Inclined blades for reduced flow turbulence are available, as well as integral retractable turning vanes (an exclusive Braden-Europe patented feature).

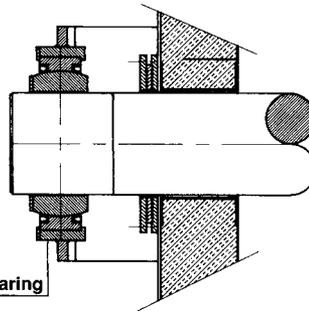


Toggle linkage mechanism installed on a FS-9E diverter damper.

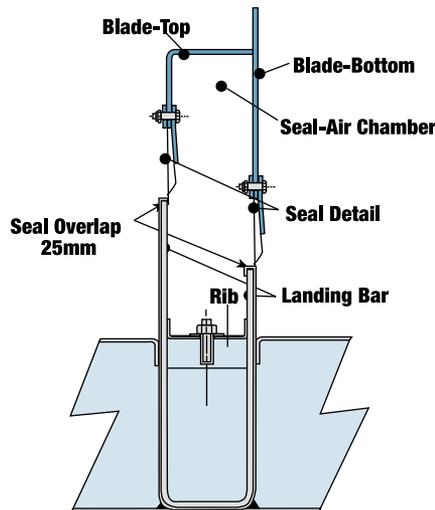
Blade & Shaft Seals

Based on media temperatures, dust-loading capacity, and corrosiveness, Braden-Europe can help you select the most appropriate seal designs. Braden-Europe's seals routinely achieve 99.98% gas tightness, with 100% sealing when seal air is applied. Seals are normally made from specially-treated high-nickel alloy materials and are resistant to wear, flutter, and fatigue-cracking.

The maintenance-free, flexible metallic seals for blade shafts are not subjected to radial loads, cannot be overtightened, and do not require readjusting.



Adjustable blade stops and seal cavity landing bars.





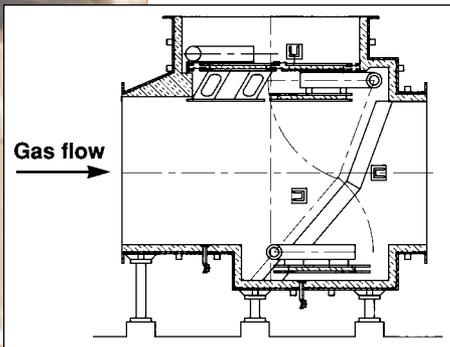
Triple Blade Diverters

Braden-Europe's triple blade diverters incorporate patent-pending designs for improved flow control in the world's largest gas turbines—those currently in use, as well as those under development. The three blade diverters can be shipped fully assembled or in modules to ease transportation and site erection.

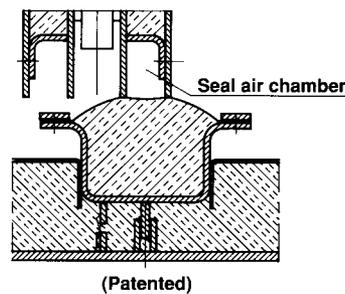
All BE diverters can connect to round diffusers without an additional transition duct.



Three blade diverter damper for power station in China.



Flow model tests at Nels Laboratory in Niagara, Canada have confirmed that Braden-Europe's diverter designs have the lowest pressure drop in both single and combined-cycle modes.



Another advanced seal design appropriate for specific applications is the Braden-Europe "pillow block" seal (S4), with excellent gas tightness and high resistance to fatigue failure. The patented "pillow block" reduces flow obstruction, increasing flow and turbine efficiency. The S4 seal is clamped on both sides to prevent flutter. Air injected into the blade's perimeter channel creates a positive pressure in the seal air chamber.

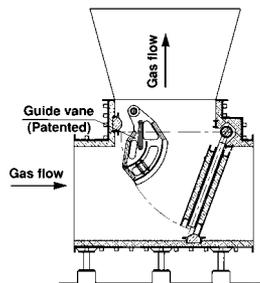
Flap & Diverter Design Features

Improved Flow Via Guide Vanes & Inclined Blades

Flow around the 90° bend of the by-pass produces back pressure, which robs the system of efficiency. Computer simulation and modeling proves that Braden-Europe's patented, retractable guide vanes significantly reduce turbulence and back pressure. An inclined blade design is typically used to further improve gas flow. The blade is inclined when in the by-pass position (closed to the heat recovery steam generator—HRSG). The incline reduces turbulence along the blade, consequently reducing back pressure.



Fixed guide vanes, to be used during simple cycle, were designed to be easily removed during conversion to combined cycle service. The internally-insulated diverter shown above is for a Middle East power station.



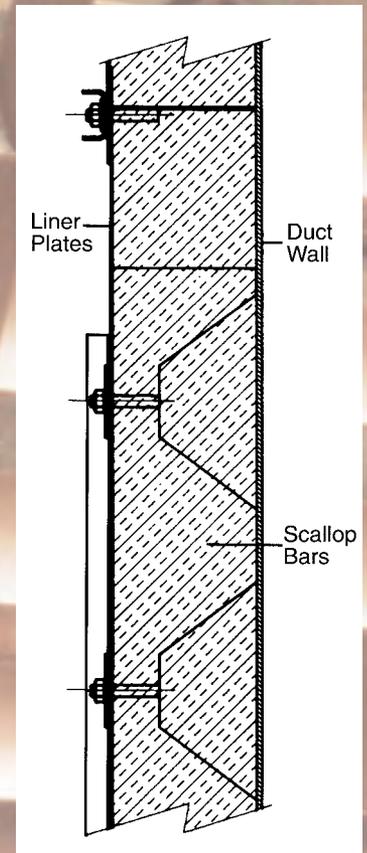
Patented retractable guide vanes are combined with an inclined blade for reduced back pressure and improved by-pass flow. This feature is often used in conjunction with a rounded inlet corner.

Temperature-Compensating Blade (Flex Tight) Designs

The blade assembly is designed to allow all components to expand freely during start-up transients and shutdowns. To reduce heat transmission, blades are fully insulated under their stainless steel cover sheets.



"Sandwich" blade construction. One single blade consists of seven independent modules, all designed to accommodate sharply rising and falling gas temperatures.





Damper Design Features

Actuators/Drives

Drives are a critical component of isolation systems. If the drive is not correctly sized, it can jeopardize the entire operation. Braden-Europe will specify a drive that closely matches the application requirements for reliability, size, speed and media flow. Braden-Europe's blade and drive assemblies are typically designed to withstand all specified operating conditions with safety margins.

Drives are either electric, pneumatic, or hydraulic, with adequate torque power to overcome anticipated freeze-up after long periods without movement. Manual emergency overrides can be added to most designs.

For high temperature applications, drives are designed to compensate for differences in temperature between the damper frame and drive linkage so as not to inadvertently change the position of damper blades. All of the drive linkages are adjustable.

Blade position indicators are mounted directly on the blade shaft for absolute verification. Typically the drive system components are external to the duct, accessible at all times for inspection and maintenance. The blade shaft has a mechanical lock for the "boiler-closed" position, externally accessible for inspection and removal.



Quick-acting hydraulic actuators for fast cycling times. Hydraulic drive systems can have one or two hydraulic rams actuated by an electrically-driven motor. The motor powerpack assembly includes all of the required blade controllers.



Electric actuator for a toggle linkage drive, spring mounted for temperature compensation. Electric drive systems use an actuator to drive a self-locking gearbox.

Louvre Dampers For Fast Isolation & Control

Louvre Advantages

Louvre dampers are widely used in industrial and utility plants for the fast isolation, by-pass, and/or modulation of gas flows. In addition to having short opening and closing times, louvre drives have low power requirements. Louvre dampers can be used in round or rectangular ducts. Modular designs can be developed for very large ducts.

Louvre dampers are fairly lightweight and compact, and can fit anywhere in ducting, at any altitude. To minimize gas flow interference, Braden-Europe typically designs dampers without intermediate blade landing bars. Combination louvre/guillotine dampers are also available from Braden-Europe.

Louvre Blades

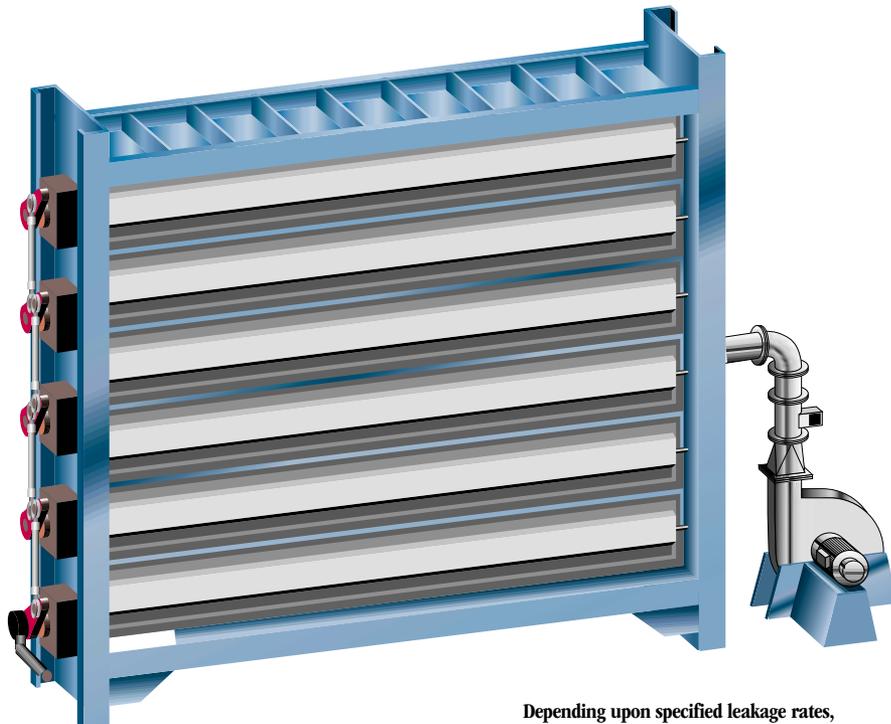
Blade shape is determined by the amount of pressure drop that can be tolerated. A flat blade is simplest, but can be used for low pressure applications only.

“Open profile” blades can be used in applications with very high temperature changes, with the one-sided blade design providing quick response to thermal transients. “Closed profile” designs are appropriate for media that is corrosive, erosive, or loaded with heavy, stick deposits. Braden-Europe typically uses “airfoil” designs to minimize pressure drops.

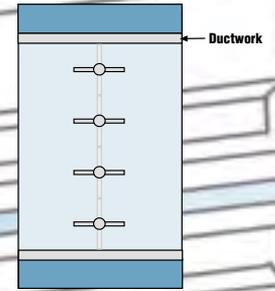
Designs For Unique Applications

Braden-Europe designs custom louvre dampers for special purpose applications, including demanding flue gas desulfurization (FGD), gas turbine, and other critical installations. Our highly efficient designs are a comprehensive solution to your detailed technical requirements. Custom louvres incorporate our specialized knowledge of damper technology, including proprietary designs for blades, shafts, seals, bearings and actuators.

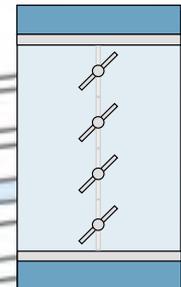
Braden-Europe louvre dampers can be designed to fit circular, as well as rectangular ductwork.



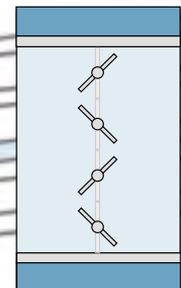
Depending upon specified leakage rates, dampers may be provided with or without flexible seals.



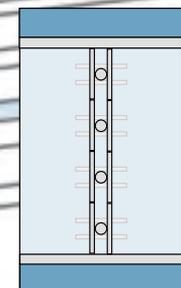
Single Louvre



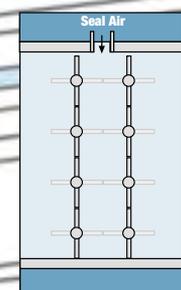
Parallel Louvre



Opposed Louvre



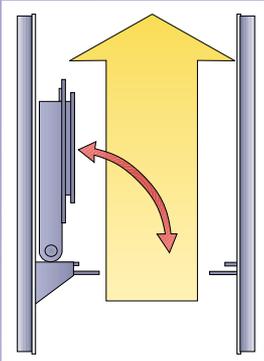
Bi-Plane Design



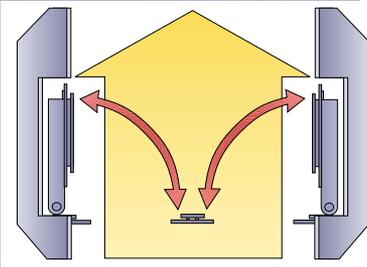
Double Louvre



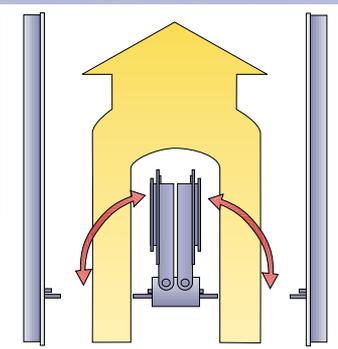
Flap Damper Configurations



Single blade damper. This configuration is designed to fit into the existing duct.



Double blade damper. This configuration is for very low pressure drop applications, with the blades recessed into duct pockets when in the open position.



For circular ducts, a twin blade damper can be used in a back-to-back ("butterfly") configuration.

Flap Isolators

Flap Damper Advantages Blade Designs (Flex Tight)

Flap dampers are widely used in FGD and NO_x removal and other flow isolation applications. There are many advantages for using the Braden-Europe flap design:

- 100% Gas Tight: With seal air system.
- Reduced Corrosion: Only the drive shaft extends outside of the duct, so hot/cold interfaces that generate corrosion-producing condensation are minimal.
- Compact: Can be installed in confined areas, such as stacked duct systems. Modular designs are available for fast and accurate installation, reducing erection costs.
- Lightweight: Flap dampers weigh less than double louvre dampers. And, unlike guillotine dampers with bonnets, flap dampers have no "wind load" or dust "pockets."
- Versatile: Can be configured for virtually all duct shapes and sizes, including round ducts.

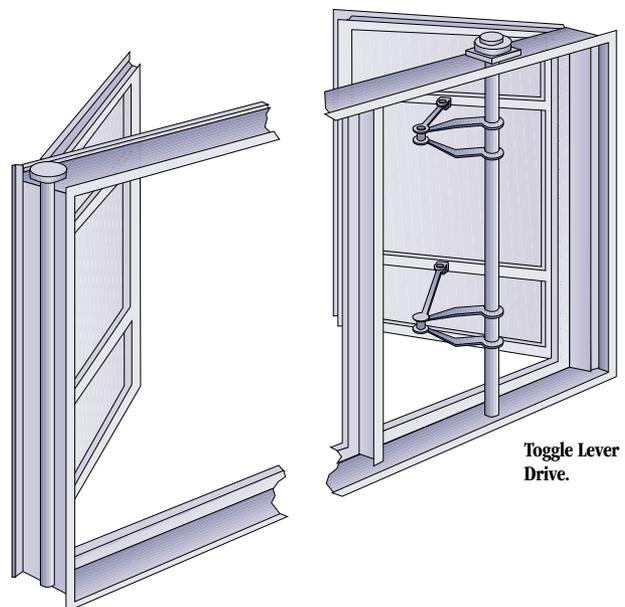
For both toggle lever and pivot drive designs, Braden-Europe offers dampers incorporating the "sandwich" blade design. Braden-Europe's special S3 lateral spring seals, made from stainless Inconel® 625 steel, are used with seal air to create 100% gas-tight isolation at a very competitive cost.

Toggle Lever Drives For Large Dimensions

Braden-Europe's toggle drive flap dampers are ideal for large duct dimensions. The toggle drive has a greater mechanical advantage, so less torque is required from the drive's actuator. The toggle lever drive delivers its highest mechanical force when it's needed, at the open/closed sealing positions, and it reduces the operating speed when it approaches the seating. To reduce flow restriction, the blade can nest into duct pockets when in the open position.

Pivot Drive For Fast Operation

Braden-Europe's pivot drive flap damper offers fast opening and closing operation. With the pivot drive structure recessed into duct pockets, there is minimal gas flow interference/pressure loss. No internal bearings reduce the need for maintenance within the duct.



Pivot Drive.

Toggle Lever Drive.

Guillotine Isolation Dampers (Duct Tight)

Excellent Isolation With A High Degree Of Safety

Guillotine isolators are typically specified for heavy-duty, gas tight shut-off of ducts. Their design permits them to be installed into a short length of ductwork. Pressure drop is low across the wide-open damper. Guillotine blades are also better able to withstand furnace puffs and mild overpressure conditions than some other damper designs. Guillotine performance needs can vary from a simple chainfall blanking plate design to fully-automated 100% gas-tight isolators.

The Leader in Guillotine Fabrication

Braden-Europe custom designs guillotines to meet the special performance requirements of FGDs, gas-turbine installations, and additional gas-tight isolation applications. Braden-Europe builds guillotines for all applications—from cold, wet, high-corrosive media to dry, high-temperature conditions. Guillotine blades can enter from either the bottom or the top, for either round or rectangular ducts.

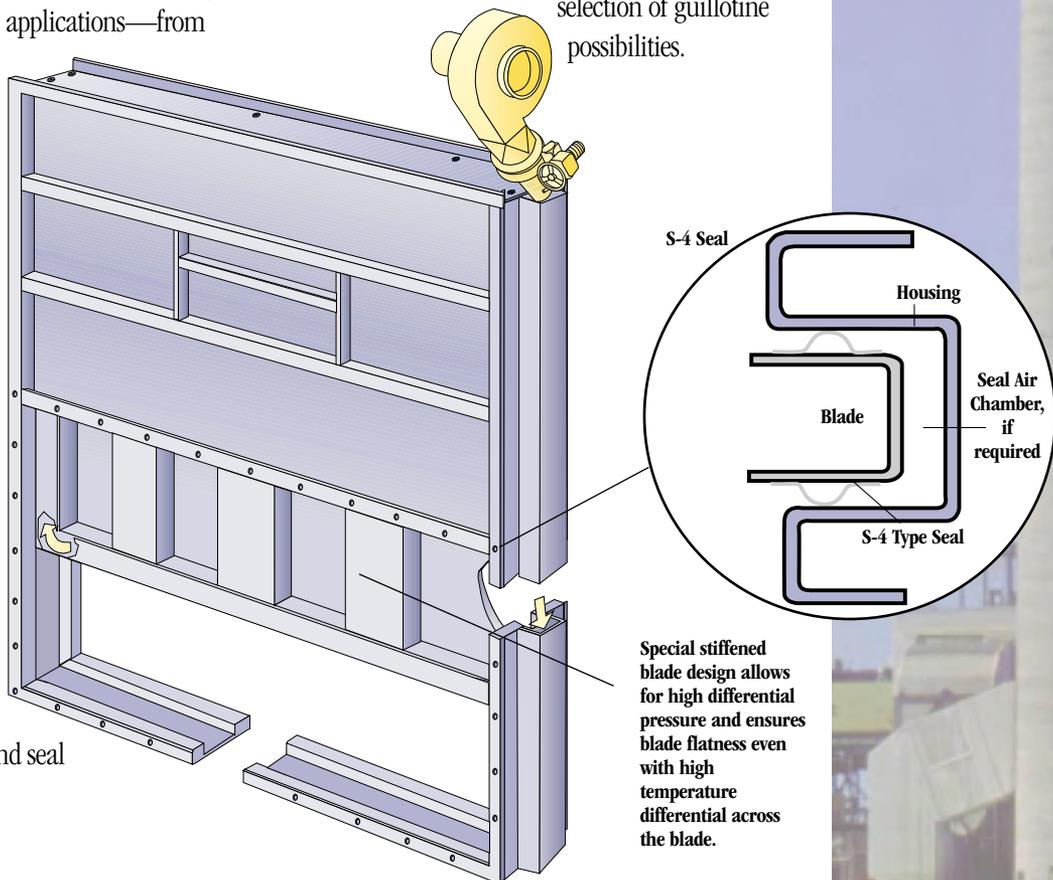
Guillotines can be supplied with a simple tadpole seal for 99%+ sealing efficiency on the cross section. For applications needing 100% sealing efficiency, Braden-Europe's patented S4 type seals and seal air is used.

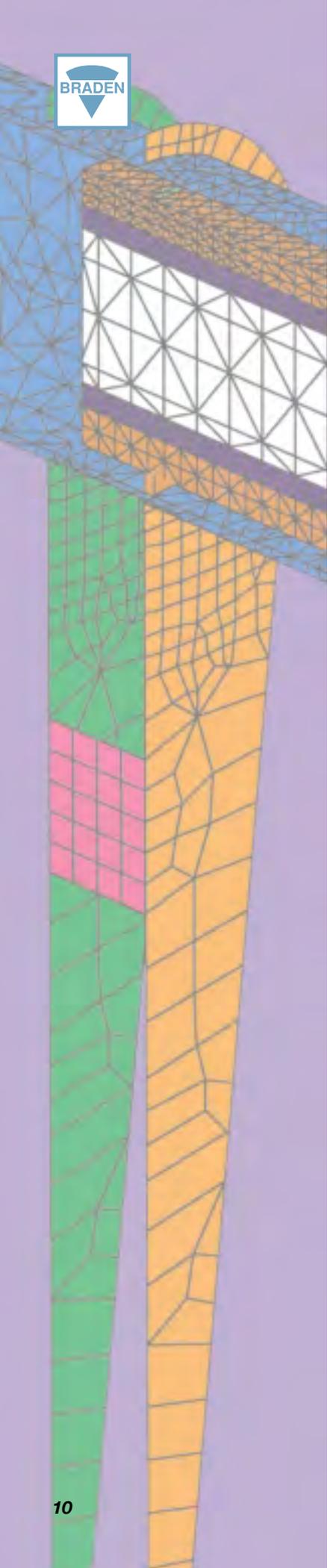
Special High Performance Construction

Guillotines can have internal or external fiber insulation or, when conditions require, with internal concrete insulation. A large variety of metals are used in construction, including A36, SS304, SS321, steels and high-nickel alloys.

To meet various performance needs, Braden-Europe selects from a wide range of drive designs, including rack and pinion drives, chain drives, and spindle drives. Single or double drives are used, depending upon guillotine size.

To protect the guillotine blade from weather and to prevent gas from leaking into the atmosphere, gas-tight enclosures ("bonnets") are available. "Bonnetless" designs are also common. The pictures shown here indicate only a very limited selection of guillotine possibilities.



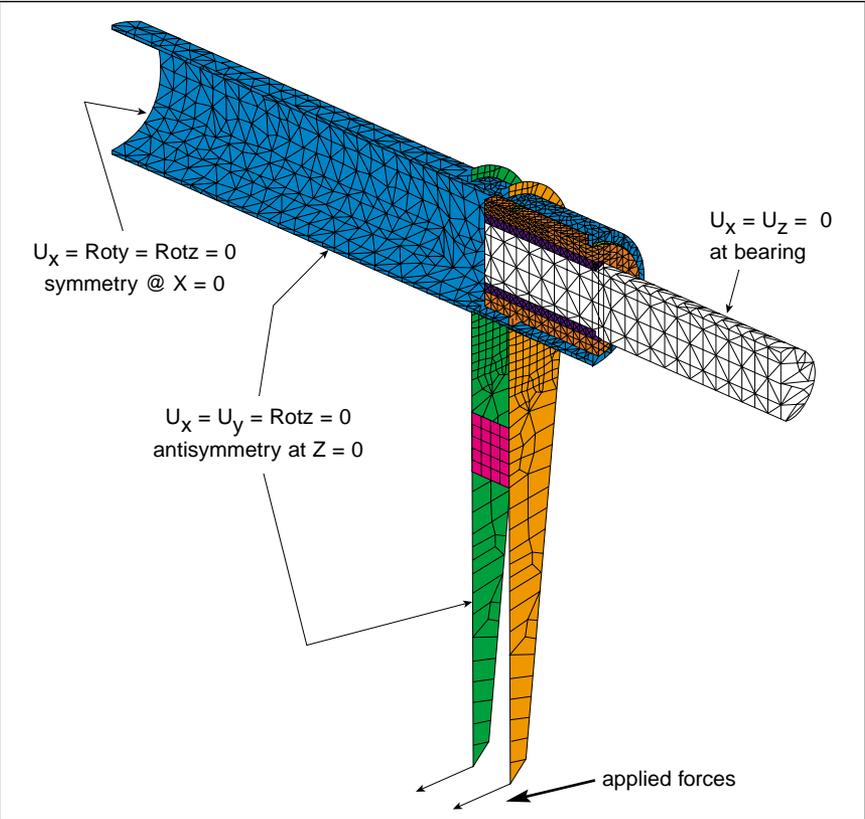


Comprehensive Design & Engineering Capabilities

Braden's technical capabilities are extensive. Our experienced engineering staff uses the most modern data processing equipment and software to provide accurate and immediate solutions to duct isolation applications.

Braden has the following design engineering capabilities:

- 3-D Solid Modeling of Complex Shapes
- Computational Fluid Dynamics (CFD)
- Structural Design Analysis
- Thermal, Buckling, and Vibration Frequency Analysis
- Finite Element Analysis (FEA)
- Acoustical Testing and Analysis



Finite Element Model of Toggle Linkage.

World Class Manufacturing Quality

With ISO 9001 certification as the baseline for our quality programs, every manufacturing process is strictly monitored to insure our customers' expectations are exceeded. Six Sigma Process Improvement Methodology is the core of our Continuous Improvement Program.



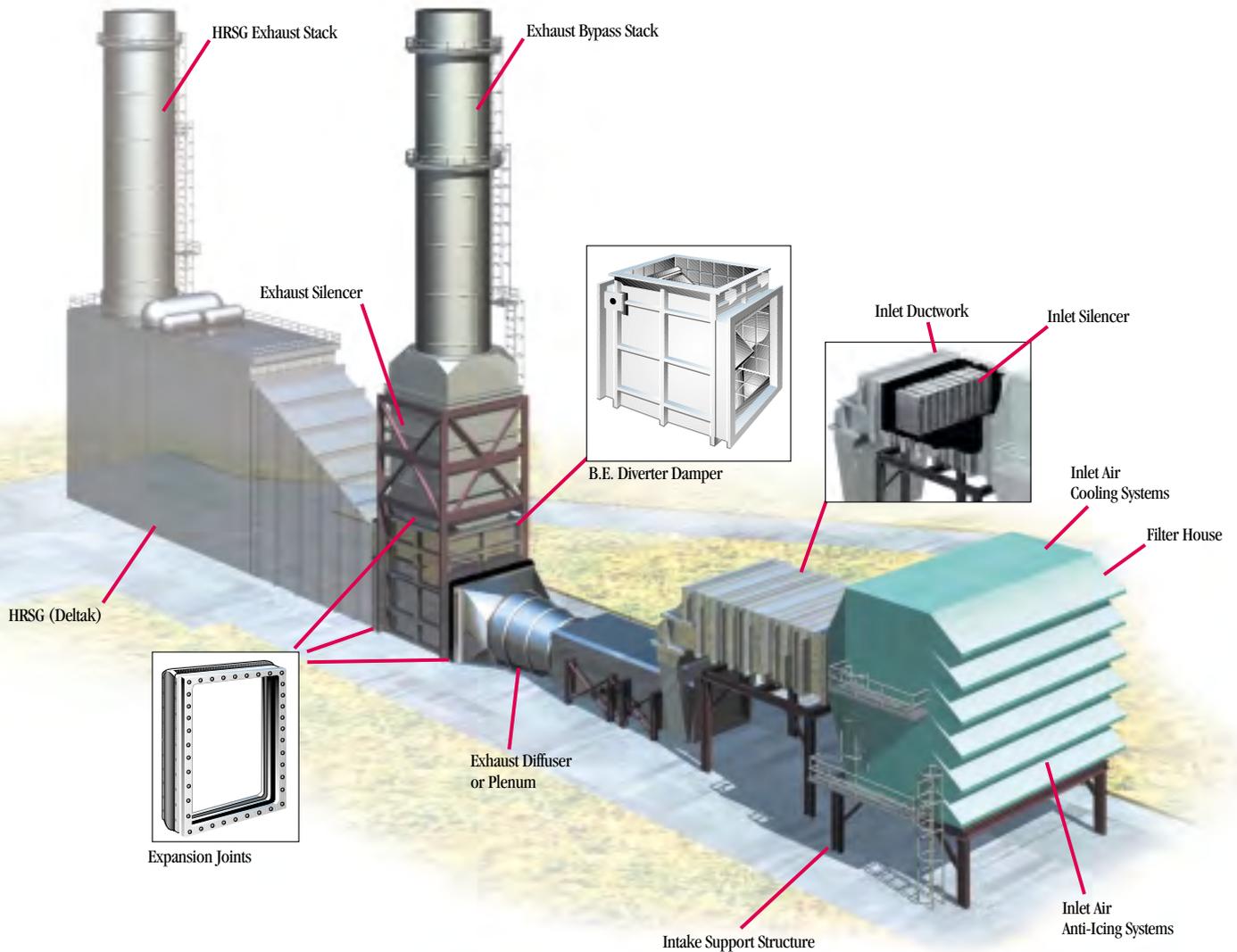
Material preparation bay.



Shop pre-assembly of V94.3A diverter for functional testing.



Braden Systems For Gas Turbines



Braden Manufacturing, LLC

5199 North Mingo Road
Tulsa, Oklahoma 74117 USA

Tel: 918-272-5371
Fax: 918-272-7414

E-mail: Sales@braden.com
Website: www.braden.com

Braden-Europe B.V.

Grasbroekerweg 114
6412 BH Heerlen
The Netherlands

Tel: 31-(0) 45-5615-420
Fax: 31-(0) 45-5726-161

E-mail: BradenEurope@BradenEurope.com

Other Global Energy Equipment Group Companies:

Deltak - Heat Recovery Steam Generators

2905 Northwest Boulevard
Suite 150
Minneapolis, MN 55441 USA

Tel: 612-557-7440
Fax: 612-557-4700

E-mail: boilers@deltak.com
Website: www.deltak.com

Deltak Asia

Representative Office
10 Anson Road
#25-12 International Plaza
Singapore 079903

Tel: 65-227-6823
Fax: 65-227-8375