

PATHWAY



**ENGINEERED SOLUTIONS
FOR DAMPERS & SOLIDS HANDLING**

PATHWAY CAPABILITIES

COMBINED FACILITIES

Manufacturing Floor Area	245,000 sq. feet (18580 sq. meters)
Total Land Area	31 acres (125,000 sq. meters)
Bridge Crane Capacity	40-ton max. (36,288 kg)
Maximum Hook Height	37 feet max. (11.28 meters)
Fork Lift Capacity	30,000 lbs. (13,608 kg)

FABRICATION

Welding	Sub Arc, Arc, Pulse Arc, TIG, MIG, Core Wire, Resistance, Electroslag, Tube Welding, Track Welding, Large Turn Tables, Rolls, and Positioners.
Plate Roll	1 1/2" Thickness (38.1 mm)
Angle Roll	5" x 5" x 1" (127 x 127 x 25 mm)
Press brakes	5 ton through 400 ton (4536 through 362,880 kg)
Radial Expanders	5 ton through 400 ton (4536 through 362,880 kg)
Shear	.003 through 1" (.08 through 2.5 mm)
Flame and Plasma Cutting	4-torch computer controlled water table
Abrasive Blasting	16' x 16' x 24', recirculating system (4.9 x 4.9 x 7.3 m)
Painting and finishing equipment	

QUALITY ASSURANCE

Senior Flexonics Quality Assurance System has been certified to ISO 9001 and is in compliance with ASME Section VII, Division 1, ASME B31.1, ASME B31.3, AWS D1.1, AISI, ASIC, Stoomwezen and T.U.V. and AMCA
Section VIII (U Stamp)
Section VIII (R Stamp)
Section III (N Stamp)
Section III (NPT Stamp)



TEST CAPABILITIES AND DESIGN VERIFICATION TESTS

X-ray 300KV – 10 MA and 5 MA Magnetic Particle,
Dye Penetrant, Zyglo, Ultrasonic and Eddy Current Testing
Mass Spectrometer and Halogen Leak Detection
Positive Material Identification (PMI)
Hydro Testing
Cycle Testing
Spring Rate Testing
Leakage Testing

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INTRODUCTION

Senior Flexonics Pathway, with origins dating to 1902, has manufactured heavy industrial equipment for the last 70 years. With the recent acquisition of the intellectual property of PEP (Precision Engineered Products), Senior Flexonics Pathway is again able to offer the highest standard of damper design and fabrication. The addition of dampers is a perfect complement to the highly engineered expansion joint products that have elevated us to a leadership position. Since those early days, we have stayed at the forefront of product design innovation and materials development technology. As a member of the Fluid Sealing Association (FSA) and the Expansion Joint Manufacturers Association (EJMA), Senior Flexonics Pathway has set the highest standards for furnishing engineered products to yield durability, reliability and extended service life. Pathway design standards conform to API 501, AISC, AISI and ASME.

This design manual has been developed to supply the reader with information necessary to make informed damper selection and application decisions. Useful design recommendations, installation instructions and engineering reference data have been included to assist the reader in selecting a damper that will provide the best overall value through increased operating efficiency, reduced maintenance and extended reliability.

Senior Flexonics Pathway provides the following services to meet your special needs; **On-Site Installation, Maintenance and Repair**. Senior Flexonics Pathway can mobilize an experienced field crew to perform turnkey installations, provide an experienced **Installation Specialist** to advise and support your plant personnel, or supply a trained **Maintenance and Repair Technician(s)**.

Emergency Hotline: We understand that emergencies usually don't happen during business hours. Our Emergency Hotline (830) 660-0337 is monitored 24/7 to provide immediate contact with responsible and knowledgeable personnel.

HOW TO SELECT A DAMPER

Isolation Applications

ROUND

- Sealing efficiencies for butterflies are 99.50% to 99.85% without seal air and 100% with seal air.
- Guillotines, although more costly, provide the least static pressure loss and assurance of 100% sealing efficiency or “man-safe” isolation with a solid plate blade.
- Sealing efficiency for a guillotine damper ranges from 99.75% to 100%.
- Closing times are faster with poppet valves (1/2 to 1 sec) versus butterflies (1 sec) and guillotines (10 sec min - size dependant)
- Poppets do not seal as well as butterfly or guillotine dampers with sealing efficiencies to 99.75%.
- Poppets do not survive system upsets and fires as well as butterfly and guillotine dampers.

Damper	Sealing Efficiency (Percent)	Pressure Loss (in WC)	Size & Weight	Operating Time (Seconds)	Cost
 Butterfly	99.75 to 100%	0.1 to 0.3	#	> 1	\$
 Guillotine	99.75 to 100%	0.0	###	> 10	\$\$\$
 Poppet	> 99.75	0.5 to 2.0	##	< 1	\$\$

RECTANGULAR

- Sealing efficiencies for rectangular butterfly dampers range from 99.00% to 99.75% and 100% with seal air.
- Multi-blade louver dampers offer sealing efficiencies from 98.00% to 99.50% and 100% in double louver configurations (w/seal air).
- Guillotine dampers provide sealing efficiencies from 99.75% without seal air and 100% with seal air.
- Operating times range from 1/2 to 1 sec. for louvers, 1 sec. for butterflies, and 10 sec min and are size dependant for guillotines.
- Louver dampers are more costly than butterflies but less than guillotines.
- Static pressure loss is minimal with guillotine dampers and greatest with louver dampers.
- Louver dampers are available in parallel or opposed blade configurations for improved flow control where sealing efficiency is important but improved control is also desired.

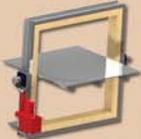
Damper	Sealing Efficiency (Percent)	Pressure Loss (in WC)	Size & Weight	Operating Time (Seconds)	Cost
 Butterfly	99% to 100%	0.1 to 0.3	#	> 1	\$
 Guillotine	99.75 to 100%	0.0	###	> 10	\$\$\$
 Louver	98% to 99.5%	0.5 to 1.0	##	> 1	\$\$

Control Applications

Damper	Control, Vol. & Press.	Pressure Loss (in W.C.)	Size & Weight	Cost
 Butterfly	Better	0.1 to 0.3	#	\$
 Multi-Blade Butterfly	Best	0.5 to 1.5	##	\$\$
 Radial Vane	Best	0.5 to 1.5	##	\$\$
 Flap Diverter	Good	0.2 to 2.0	###	\$\$\$

ROUND

- Flow Control of gas in round ducts is best accomplished with round opposed-blade and radial vane blades.
- Butterfly dampers provide excellent control of static pressure and volume in mid-range, but less than adequate low-flow control when compared to opposed-blade louvers.
- Radial vane dampers are preferred for control of gas entering centrifugal or radial fans.
- Flap diverter dampers are designed to control flow during startup of waste heat equipment.
- Positioning devices with analog or digital inputs are available to maintain reliable flow control on most damper configurations.
- Feedback instrumentation is available to provide exact positioning data.

Damper	Control, Vol & Press (in W.C.)	Pressure Loss (in W.C.)	Size & Weight	Cost
 Louver	0.5 to 1.0	0.5 to 1.0	##	\$\$
 Butterfly	0.1 to 0.3	0.1 to 0.3	#	\$
 Flap Diverter	0.2 to 2.0	0.2 to 2.0	###	\$\$\$

RECTANGULAR

- Opposed-blade louver dampers provide superior control of static pressure and volume for rectangular duct applications.
- Increasing the number of opposed-blades between 2 through 6 generally improves flow control characteristics.
- Parallel-blade dampers installed on centrifugal fan inlets divert gas thus reducing fan horse power and electrical power input.
- Flap diverter dampers are designed to control flow during startup of waste heat equipment.
- Positioning devices with analog or digital inputs are available to maintain reliable flow control on most damper configurations.
- Feedback instrumentation is available to provide exact positioning data.

— [OPTIONS & ACCESSORIES] —

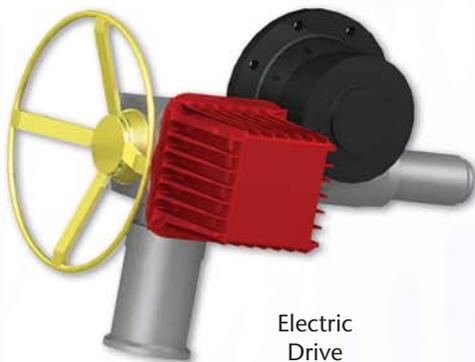
Dampers can be provided with a wide array of options and accessories designed to improve performance, automate operation, provide system feedback, increase safety or create redundancy for critical applications. The following is a sampling of devices to consider when specifying or purchasing equipment:

MATERIALS OF CONSTRUCTION

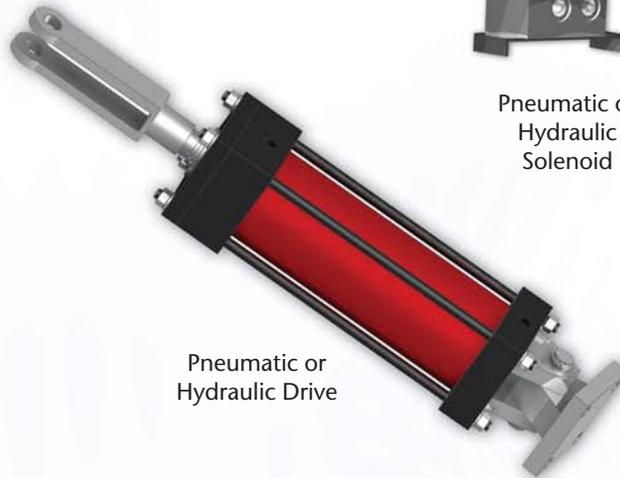
Dampers can be manufactured of many materials including carbon steel, stainless steel or nickel alloys such as Inconel, Hastelloy, Monel, fiberglass, etc. Matching the adjacent ductwork is the preferred approach. In some instances, internal refractory lining is incorporated in our scope of supply.

DRIVES

Dampers can be operated utilizing manual handwheels or actuator chain falls. Automated actuators include electric, pneumatic and hydraulic. Electric actuators can be supplied in all customary voltage requirements. Pneumatic and hydraulic actuators can be supplied with the necessary solenoids and accumulators. Damper control systems are designed to assume the closed, open or last position upon loss of source power or signal.



Electric Drive



Pneumatic or Hydraulic Drive



Pneumatic or Hydraulic Solenoid

POSITIONERS AND POSITIONER FEEDBACK

Control dampers require an input signal to position the blade(s) correctly. Signals are either electric (4-20 mA), pneumatic (3-15 psi or 3-30 psi) or digital. Positioners are a required accessory for controlling the location of the blades beyond full, open or close. Refer to the Engineering Design Data, Curves & Specifications on pages 15 & 16 for additional information on blade orientation versus flow or pressure drop.

LINKAGE

The styles of linkages are fixed and adjustable. Fixed linkage employs hardened steel pivots with thin-film PTFE (Teflon[®]) bushings. Linkage has lever arms pinned to the blade shafts. Adjustable linkages utilize turnbuckles to allow field re-adjustment of blades at operation temperature or over time.



Opposed Blade

BEARINGS

Bearings can be standard ball bearings, high-cycle ball bearings or adjustable UHMW (Ultra High Molecular Weight) and graphite sleeve bearings. Ball bearings are typically used when process temperatures do not exceed 500°F. Graphite sleeve bearings are ideal for 90 degree rotation and temperatures exceeding 500°F.



Bearings

PACKING

Packing glands are mounted separately from bearings to allow maintenance of shaft packings and eliminate improper loads on bearings or packing. The number of compressive bolts and packing gland material is dependant on the operating conditions.

Other accessories to consider:

- Limit or proximity switches
- Position transmitters
- Access doors
- Electric enclosures
- Conduit trim
- Personnel guards
- Lock-outs



Packing Gland

Seal Air System



Bird Screen

100 SERIES

Louver



Louver dampers employ fast acting single or dual rows of rectangular blades, mounted within a rigid frame for installation in round and rectangular flanged ducting. Louvers are particularly well suited for flow modulation, bypass, isolation and backflow prevention applications.

APPLICATIONS

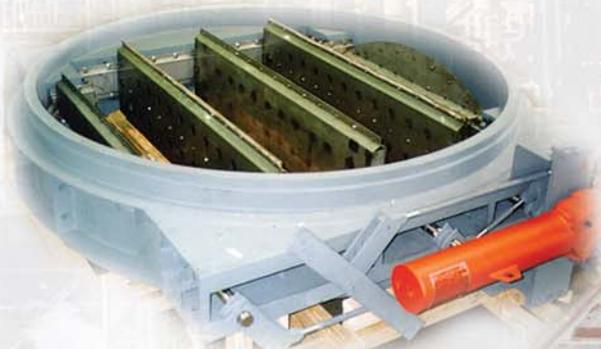
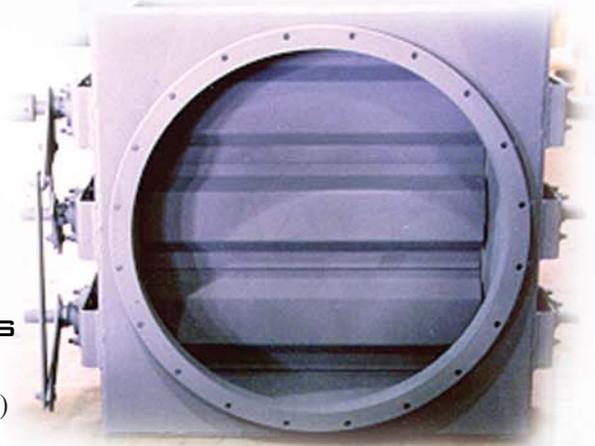
- Pressure control
- Fan isolation
- Combustion air control
- HRSG flow control
- Fan inlet spin control

PATHWAY PERFORMANCE ADVANTAGES

- 99% sealing efficiency with standard structural seal (99.5% with optional jamb seals and blade edge seals)
- Low pressure drop airfoil blade design
- Superior flow and pressure control with opposed blades
- Superior flow isolation and fan spin control with parallel blades
- High structural rigidity to eliminate frame distortion and blade jamming

STANDARD DESIGN FEATURES

- Welded monocoque airfoil blades
- Fixed linkage employs hardened steel pivots with thin-film PTFE (Teflon®) bushings
- Ball bearings on blade shafts
- Shaft seal gland consists of two compressible rings mounted separately from bearing
- Actuator is mounted directly to driving shaft, reducing frame flex and hysteresis





[200 SERIES]

Guillotine

Guillotines employ a sliding blade inserted into the duct from an external frame to block flow in rectangular and round ducting. Guillotines provide a mechanized means of inserting a duct blanking plate and offer superior isolation of flue gas applications containing heavy particulate loads and are ideal for tight shut off applications.

APPLICATIONS

- Scrubbers
- Incinerators
- Precipitators
- Boiler breaching
- Oxidizers
- Burner fuel lines
- Bag houses
- SCR's
- Heaters



Entry Seal

PATHWAY PERFORMANCE ADVANTAGES

- Low pressure drop due to full blade retraction from flow stream
- Dual chain or rack and pinion drive designed for actuator maximum stall output
- Reliable man safe isolation with optional seal air system

STANDARD DESIGN FEATURES

- Self cleaning blade seats for 99.75% sealing efficiency
- Self lubricated sleeve bearings
- Maintenance-free drive design
- Corrosion resistant drive and follower shafts
- Clean out access
- Actuator is directly coupled to the drive shaft

OPTIONS

- Push rod/chest style for high temperature or pressure
- Spectacle designs
- Enclosed bonnets
- Dual blade
- Seal air systems
- Position indicators
- Instrument ports



300 SERIES



Butterfly

Butterfly dampers have broad application versatility by employing a center mounted rotating disc that produces near equal flow characteristics on each side of the blade for modulating applications, while offering a simple and reliable means for on-off shutoff service.

APPLICATIONS

- Thermal oxidizers
- Fan inlet flow control
- Stack isolation
- System isolation
- Boiler breaching
- Incinerators
- Combustion air
- Pressure relief



PATHWAY PERFORMANCE ADVANTAGES

- Solid disc resists thermal and mechanical deformation
- Precision aligned stub shafts welded to blade
- Frame is externally seal welded to prevent crevice corrosion
- A variety of seal designs



STANDARD DESIGN FEATURES

- Four bolt ball bearings on blade stub shafts
- Shaft seal gland consists of two compressible rings mounted separately from bearing
- Swing through blade design with 98% isolation efficiency



99.75% sealing efficiency high-cycle application

Step Seat



99.85% sealing efficiency high-cycle application

Metal-to-Metal Seal



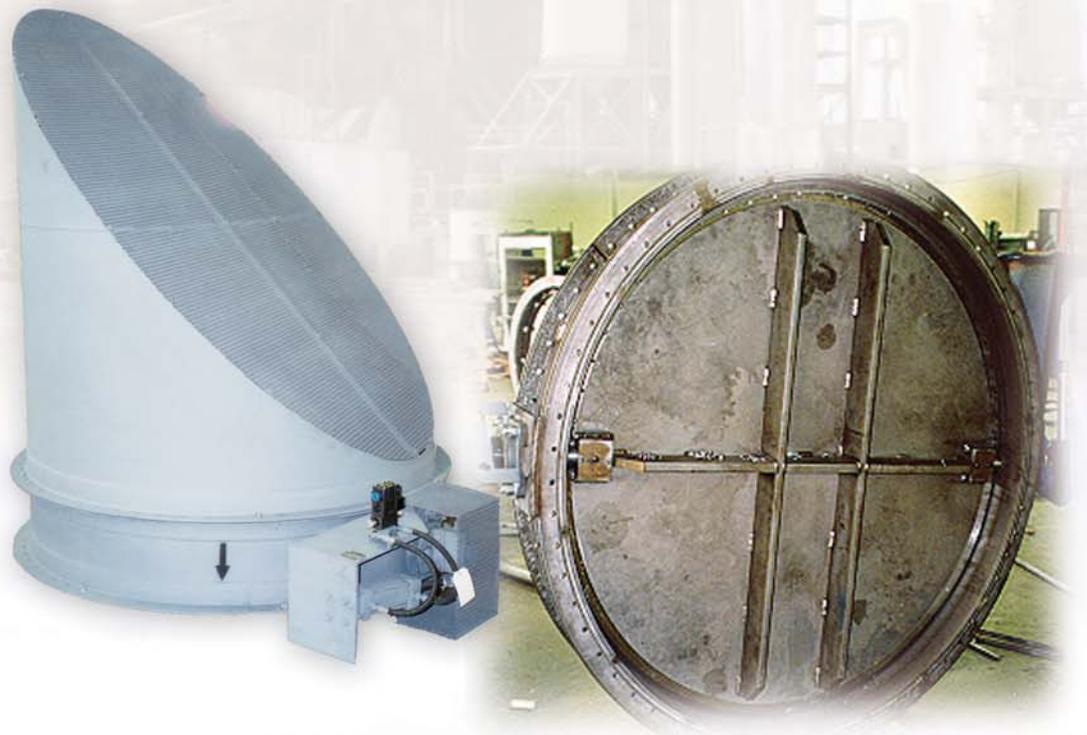
99.75% sealing efficiency

Tadpole Seat



100% sealing efficiency Patented and adjustable machined seal seat

Double Seat



[400 SERIES]



Diverter

Diverter dampers are available in three configurations: butterfly tee, multi-louver and flap diverter. Tee diverter dampers extend the capabilities of the butterfly damper design by combining two butterfly dampers into a common wye or tee fitting, primarily for isolation/bypass applications. In a wye configuration, diverters can allow synchronized actuation of each blade for the purpose of splitting and modulating flow.

Flap diverters are designed to provide up to 100% sealing efficiency while minimizing heat loss and pressure drop. They are ideally suited to isolate waste heat recovery units on gas turbines.

APPLICATIONS

- Flow bypass
- Diesel exhaust
- Gas turbine
- Stack diversion
- HRSG bypass
- Tempering air

PATHWAY PERFORMANCE ADVANTAGES

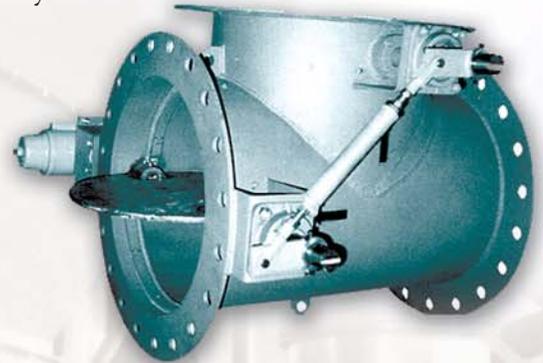
- Solid discs resist thermal and mechanical deformation
- Precision aligned stub shafts welded to blade
- Frame is externally seal welded to prevent crevice corrosion
- A variety of sealing designs to meet specified isolation efficiencies

STANDARD DESIGN FEATURES

- Maintenance free high temperature bearings
- Shaft seal gland consists of two compressible rings mounted separately from bearing

OPTIONS

- Bulb on step seat for 99.75% isolation efficiency (butterflies)
- Patented and adjustable machined seal seat for 99.85% isolation efficiency (butterflies)
- Stack damper designs
- Flap style with vent/purge for 100% isolation efficiency





[500 SERIES]

Poppet Valve

Poppet valves employ a seal disc that is capable of extremely rapid actuation and used in critical gas ducting applications that require rapid diversion or isolation of gasses.

APPLICATIONS

- Isolation of a single duct (two-way)
- Control flow from one gas path to either of two new paths (three-way)
- Control flow from two gas paths to either of two new paths (four-way)

PATHWAY PERFORMANCE ADVANTAGES

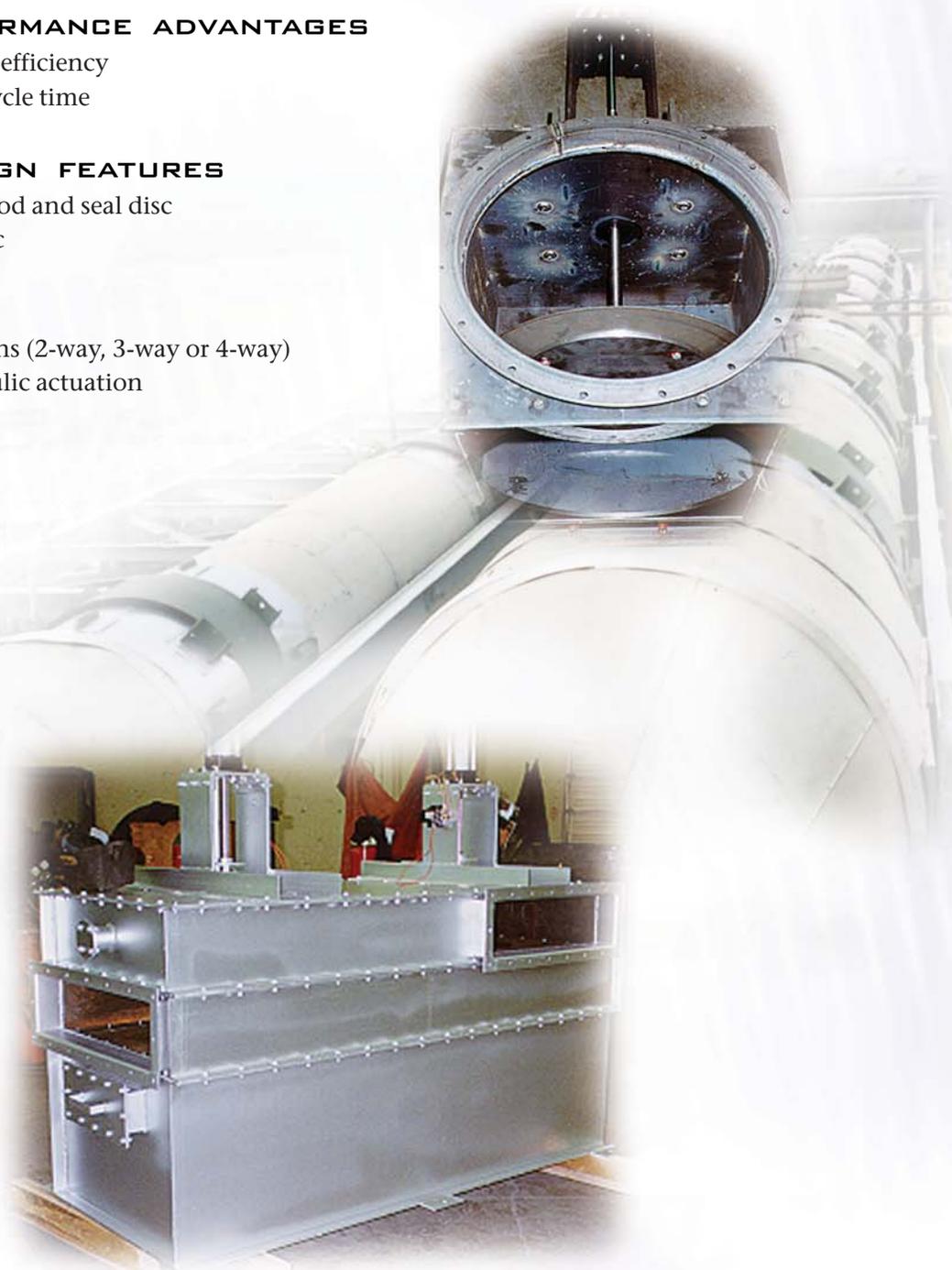
- 99.9 to 100% sealing efficiency
- One second or less cycle time

STANDARD DESIGN FEATURES

- Stainless steel push rod and seal disc
- Self aligning seal disc

OPTIONS

- Configuration options (2-way, 3-way or 4-way)
- Pneumatic or hydraulic actuation
- Controls



600 SERIES

Solids Handling



Fabricated gate valves are used in solids material handling applications with erosion and high head pressures.

APPLICATIONS

- Coal valves
- Fly ash
- Cement
- Pneumatic conveying
- Material silo piping
- Metering applications
- Food service/manufacturing

PATHWAY PERFORMANCE ADVANTAGES

- High abrasion resistance
- Heavy duty, shielded blade seat
- Low blade friction
- Large seal contact area
- Fabricated construction eliminates costly castings and casting size restrictions

STANDARD DESIGN FEATURES

- Maintenance-free seat
- Full port throat design

OPTIONS

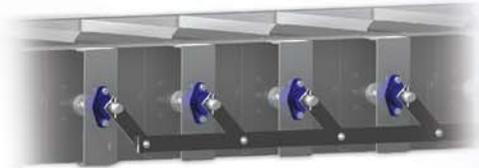
- Actuators
- Controllers



[PARTS & SERVICE]

Dampers include wear parts which will occasionally need replacement or refurbishment to continue proper operation. Components which should be inspected on a regular basis include:

- Bearings
- Packing
- Actuators
- Controls, hoses, fittings



Parallel Blade

Senior Flexonics Pathway can supply replacement components and service for other brands of dampers.

Factory field installation & service are an ideal way to guarantee proper fit-up and installation of dampers. This service assures you of problem free operation. Many times due to accessibility or cost, refurbishment either on-site or in our shop is a viable alternative to new replacement. Original drawings and/or a site inspection is the first step to assessing the potential.



Chain Drive



Limit Switch



Blade-to-Blade Seal



Jamb Seal

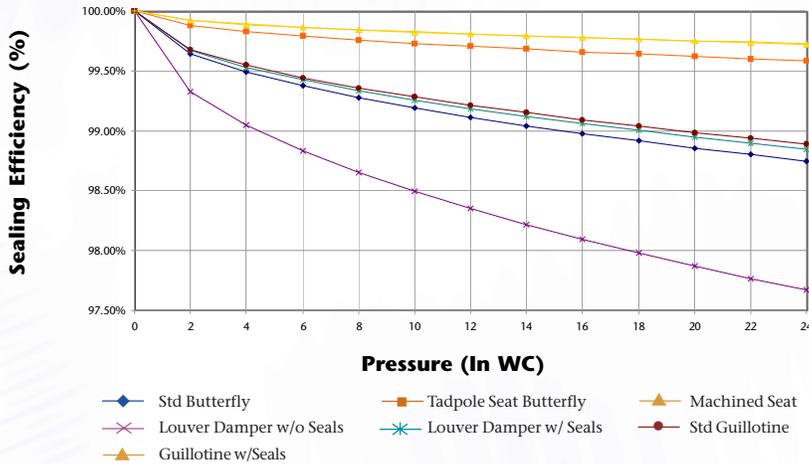
HOW TO ORDER PARTS & SERVICE

- for PEP dampers, locate the metal name tag, copy the reference drawing number shown on the tag, and contact Pathway Customer Service at (800) 847-5746, info@myej.com or www.myej.com
- for all other dampers, fax the damper drawing to Pathway Customer Service at (830) 629-6899

Selecting a damper for control of static pressure and flow control

Flow Curves: Based on a 48"ID Butterfly and 42.5"w x 42.5"h parallel blade and opposed blade louver handling 37,630 ACFM (3,000 FPM), 0.040 Lb/Ft³ gas density, 3-blades in each louver damper.

DAMPER SEALING EFFICIENCY



This curve provides a sealing efficiency comparison between various types of dampers with different seal options. A sealing efficiency of 100% generally requires a pressure-assisted sealing system. Pathway manufactures several designs including the Patented model 362 and 365 butterfly dampers, Pathway model 150C double-louver damper, and model 222, 230, and 266 guillotine dampers. Sealing efficiency for all damper styles can be improved with available options.

CONCLUSION

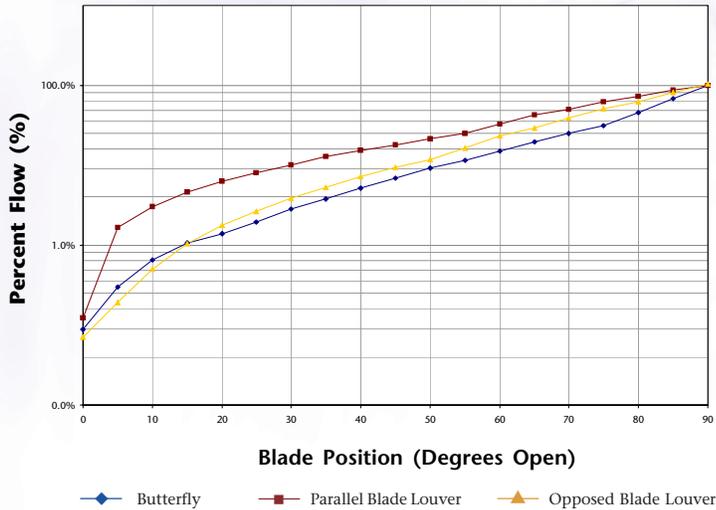
Use butterfly dampers when cost is the primary consideration. Selecting seal options is a very inexpensive way to achieve better isolation. Select guillotine dampers in cases where pressure loss is a major consideration. Should 100% isolation be required, select one of Pathway's many models with the help of a factory-trained application engineer.

PRESSURE LOSS VERSUS BLADE POSITION



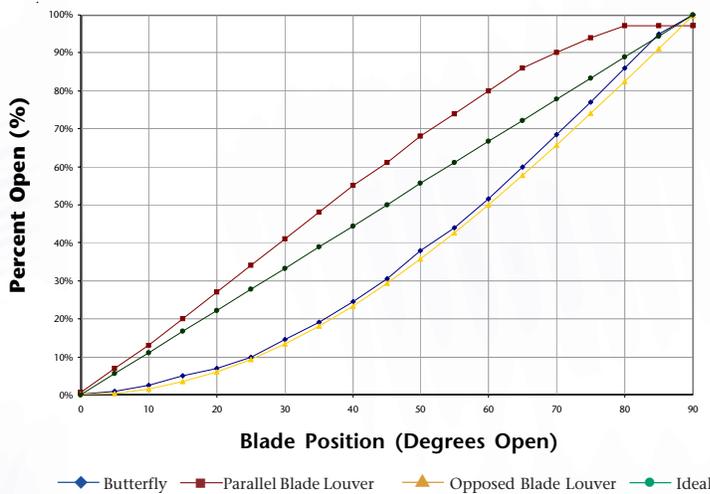
This curve illustrates the advantages and disadvantages of each damper type for static pressure control. Butterfly dampers for round ducts and opposed blade dampers for rectangular ducts provide excellent static pressure control. At mid-range blade positions, static pressure can be effectively controlled. This is not the case with parallel blade dampers where pressure control can only effectively occur approaching closed position. Parallel blade dampers are better suited for pre-spin of gas entering centrifugal fan inlets where gas flow direction favors fan efficiency improvement.

PERCENT FLOW VERSUS BLADE POSITION



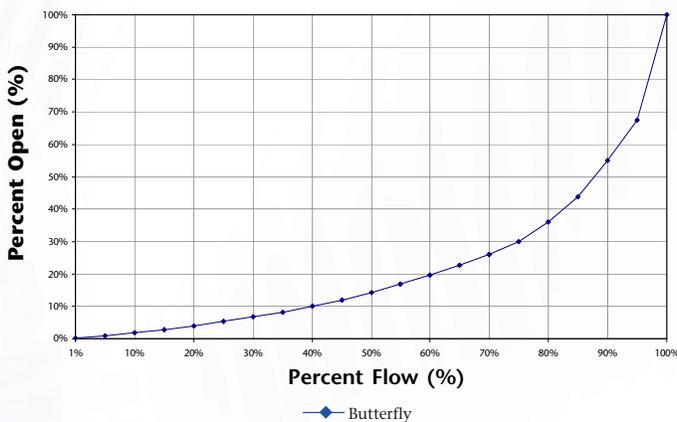
This curve illustrates the advantages of opposed blade dampers and butterflies for fine flow control. These produce near-linear flow control characteristics as a function of blade position making them ideal for use with positioning devices. Parallel blade dampers provide acceptable flow control exceeding 20-30% full flow. Turbulence produced by parallel blade dampers must be accounted for in the design of duct systems

PERCENT OPEN VERSUS BLADE POSITION

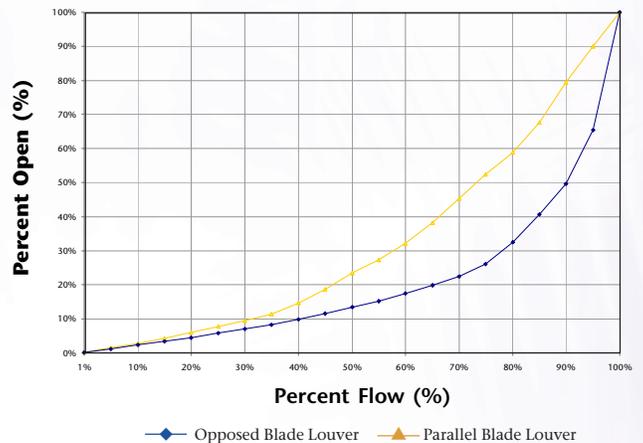


This curve illustrates the differences in open flow area percentage as a function of blade position. From 0 to 30 degrees, butterflies and opposed blade louvers change very little in open area compared with parallel blade louvers. Small changes in open area equate to more precise low-flow control during startup of process systems. From 65 degrees to 90 degrees, parallel blade louvers exhibit better high-flow control since rate of change in open area is less as a function of blade position.

PERCENT FLOW VS. PERCENT OPEN



PERCENT FLOW VS. PERCENT OPEN



CONCLUSION

Use opposed blade dampers for control of static pressure or flow in rectangular ducts. Parallel blade dampers should be used for isolation and flow diversion such as for the inlets of centrifugal fans. Butterflies can be used for control as well as isolation where they are especially adept. Specialized applications for flow control include radial vane fan inlet dampers and diverter dampers.

INSTALLATION & TESTING

Senior Flexonics Pathway is a full service damper company incorporating design, manufacture, inspection, installation, refurbishment and testing services. The installation and start-up of a damper is crucial to the reliability of the equipment. We recommend whenever possible and particularly on critical equipment, that a site installation and start-up commission be considered. This service includes the following items:

FACTORY SUPERVISED INSTALLATION

- Duct squareness
- Flange flatness
- Internal obstructions
- Rigging/installation procedure

FACTORY COMMISSIONING/RE-COMMISSIONING

This service can also incorporate the following:

- Operator training
- On-site consulting
- Damper evaluations
 - Field
 - In-house

MAINTENANCE

- Actuator calibration
- Seal, seat adjustment or replacement
- Repair
- Inspection

STANDARD TESTING

- Temperature test
- Leak test
- Cycle testing



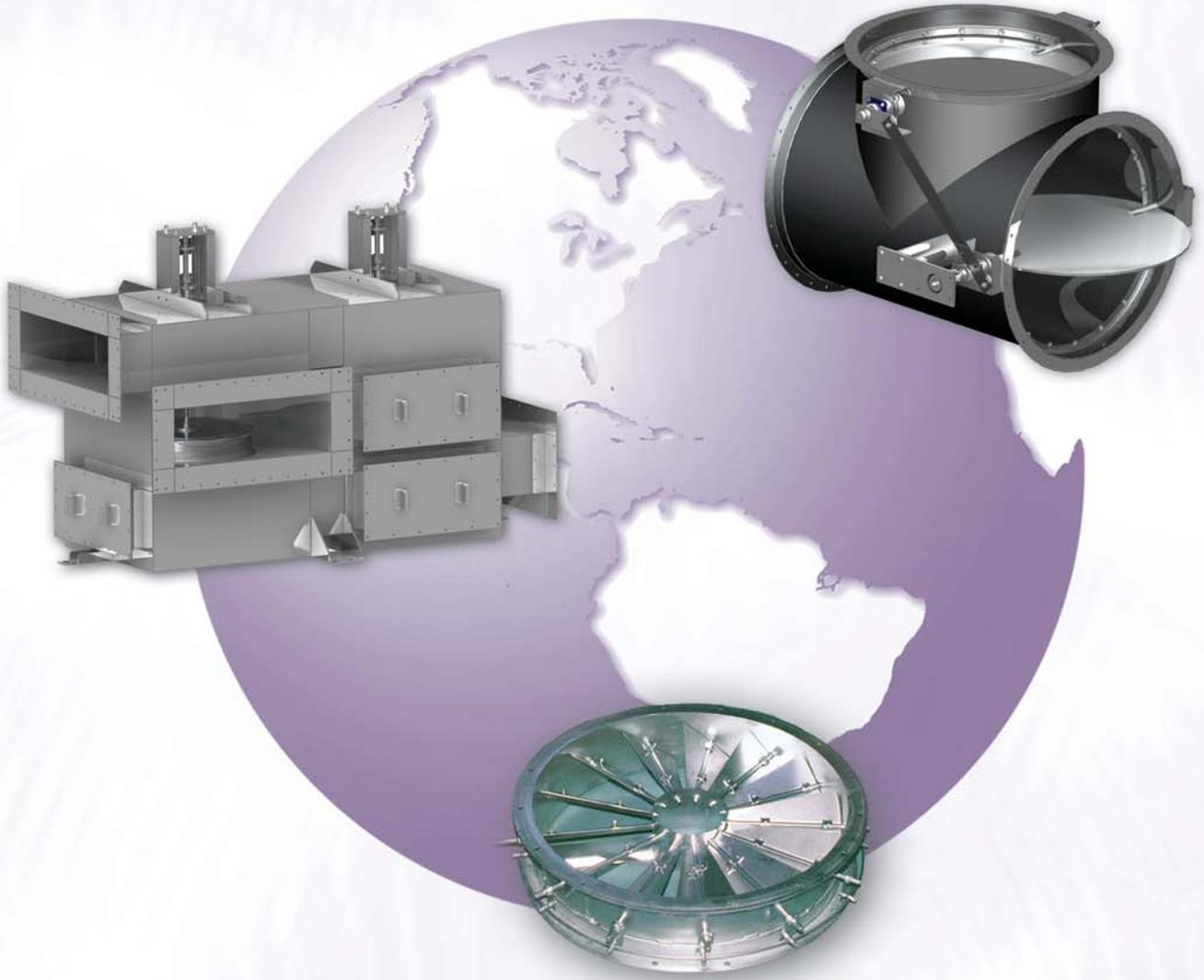
DAMPER SPECIFICATION SHEET

CUSTOMER NAME			DELIVERY REQUIRED BY	DATE
MAILING ADDRESS			PROJECT NAME	
NAME OF PERSON SUBMITTING DATA	PHONE	FAX NO.	INQUIRY NO.	SPEC. NO.
APPLICATIONS OR PROCESS DESCRIPTION - MEDIA COMPOSITION:				

DAMPER CONFIGURATIONS



DESIGN CONDITIONS	FLOW RATE	NORMAL		ACFM	AM ³ /S
		DESIGN		ACFM	AM ³ /S
	STATIC PRESSURE	NORMAL		IN WC	MMH ₂ O
		DESIGN		IN WC	MMH ₂ O
	GAS DENSITY	NORMAL		LBS/CU FT	KGS/M ³
		DESIGN		LBS/CU FT	KGS/M ³
	TEMPERATURE	NORMAL		°F	°C
		DESIGN		°F	°C
	DIFFERENTIAL PRESSURE	NORMAL		IN WC	MMH ₂ O
		DESIGN		IN WC	MMH ₂ O
ALLOWABLE LEAKAGE ACROSS DAMPER	FLOW		ACFM	AM ³ /S	
	DIFF. PRESSURE		IN WC	MMH ₂ O	
	TEMPERATURE		°F	°C	
SITE CONDITIONS	DESIGN AMBIENT TEMP		°F	°C	
	SITE ELEVATION		FT SL	M SL	
	OTHER				
STYLE REQUIRED	100 LOUVER / 200 GUILLOTINE / 300 BUTTERFLY / 400 DIVERTER / 500 POPPET VALVE / 600 SOLIDS HANDLING				
FRAME / BLADE	FRAME ORIENTATION	HORIZONTAL / VERTICAL / OTHER			
	BLADE POSITION	HORIZONTAL / VERTICAL / MULTI-BLADE (FOR FAIL SAFE ON OVER PRESSURIZATION)			
	BLADE ORIENTATION	HORIZONTAL / VERTICAL / OTHER			
	GUILLOTINE ENTRY	TOP / BOTTOM / SIDE / DIVERTER / ISOLATION ONLY			
	UPSTREAM/DOWNSTREAM	OPPOSED BLADE / PARALLEL BLADE	OPPOSED BLADE / PARALLEL BLADE		
	MATERIAL	BLADE			
FRAME					
STUB SHAFTS / THROUGH SHAFTS					
SEAL					
DRIVE SYSTEM	ACTUATOR	MANUAL / MANUAL W CHAIN WHEEL / HANDWHEEL / ELECTRIC / PNEUMATIC / HYDRAULIC / ELECTRO-HYDRAULIC			
	POWER SOURCE	VOLTAGE			
		PRESSURE			
	CONTROL	2 POSITION (ON/OFF) / MODULATING			
	CONTROL POWER	4-20 MA / 3-15 PSI / 3-27 PSI			
DRIVE COMPONENTS	CHAIN & SPROCKET / RACK & PINION / JACK SCREW / PNEUMATIC CYLINDER				
SIZE	WIDTH				
	HEIGHT				
	DIAMETER				
	F - F				
QUANTITY					



PATHWAY

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 Fax Int: 1 972 623 1990

