

SECTION 23 09 13.43 - CONTROL DAMPERS

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Airfoil Dampers, Heavy Duty Galvanized Steel
- B. Thermally Insulated Dampers, Heavy Duty Galvanized Steel
- C. Airfoil Dampers, Aluminum - Ultra Low Leakage
- D. Thermally Insulated Dampers, Aluminum – Ultra Low Leakage
- E. Control Damper Actuators

1.2 RELATED SECTIONS

- A. *Section 23 73 23 – Custom Air Handling Units*
- B. *Section 23 31 00 – HVAC Ducts*
- C. *23 09 13 – Instrumentation and Control Devices for HVAC*
- D. *23 09 23 – Building Automation Systems*

1.3 REFERENCES

- A. *AMCA Standard 500*
- B. *Applicable SMACNA standards*
- C. *IMC – International Mechanical Code*

1.4 QUALITY ASSURANCE

- A. Products and execution shall be in compliance with applicable codes and standards including those referenced above in paragraph entitled *REFERENCES*.
- B. Installation shall be in compliance with Manufacturer's recommendations and installation instructions.

1.5 CERTIFICATION

- A. Dampers shall be licensed to receive the *AMCA* seal.

1.6 DAMPER CONFIGURATION

- A. Opposed Blade
 - 1. For modulating service
- B. Parallel Blade
 - 1. Primarily for isolation (open-close) service
 - 2. For modulating service when coordinated with opposed blade dampers to achieve linear control (i.e. return air damper in properly designed economizer)

1.7 DAMPER APPLICATIONS

- A. Mixed Air Economizer
 - 1. In traditional mixed air economizer applications the outdoor air and relief air dampers shall be of the opposed blade type. The return air damper shall typically be of the parallel blade type. As such, it is essential that it be properly sized (i.e. not oversized).

[Note to PSC: Although opposed blade dampers are typically used for modulating service, in the case of return air dampers parallel type are typically the better choice. The characteristic curves of the two damper types are different yet complimentary. When the two are properly combined in a mixed air economizer application nearly

linear performance can be achieved. Note: With this approach it is essential that dampers be properly sized. When used for modulating service parallel blade dampers must not be oversized. Careful engineering design is required.]

B. Minimum Outdoor Air Damper

1. If the minimum outdoor airflow rate required to satisfy ventilation requirements is relatively small as compared to the maximum design airflow rate a dedicated “minimum outdoor air” damper shall be provided to more accurately control ventilation airflow. Minimum OA dampers shall be provided as indicated in drawings, schedule or as otherwise indicated in project documents.

C. Isolation Damper

1. In many cases/conditions it is desired to isolate a ventilation system and/or space from an adjacent system or space. In many cases the “adjacent space” is the good old out-of-doors. It can be mighty hot, cold, humid or dry out there and we want to keep it out there. Otherwise it can damage things, make us uncomfortable and consume energy. Full-size parallel blade dampers shall typically be used for such applications. Isolation dampers can definitely be our friends.

1.8 DAMPER SIZING

A. Opposed Blade Damper

1. Unless otherwise scheduled or indicated in project documents, each modulating opposed blade control damper shall be sized for a full-open air pressure drop at design flow rate that is equal to 10% of the total pressure drop through the “controlled air path”. This approach yields a damper authority of 10%. This typically results in the damper being smaller than duct size. See schedule for damper size and/or discuss with PSC to confirm proper sizing.

[Note to PSC: The “controlled air path” is that portion of a system that is directly controlled by the associated control damper. For example, the controlled air path for an outdoor air economizer damper consists of the outdoor air louver, bird screen, plenum (if applicable), outdoor air duct as well as the control damper itself.]

B. Parallel Blade Damper

1. Isolation (open-close) dampers shall be full duct size and shall be selected to minimize pressure drop.
2. Modulating control dampers shall typically be opposed blade type although parallel control dampers is the better choice in some cases for managing damper authority relative to other control dampers in the same ventilation system. In such cases it is essential that the parallel blade damper be carefully sized and selected.
3. When used as a modulating return air damper in a properly designed economizer application, a parallel blade damper shall be sized with a damper authority of approx. 30%. This yields a full open pressure drop of 30% of the pressure drop through the controlled air path which in this case consists only of the path from the return air duct to the mixing box. This typically results in return dampers sized smaller than associated outdoor air and relief air dampers. Thus, a properly sized modulating parallel blade damper will likely be smaller than duct size. See schedule for damper size and/or discuss with PSC to confirm proper sizing.

[Note to PSC: Damper authority is not well understood by most designers. It is similar in concept to control valve authority. If the authority of the control device (valve or damper) is too low (due to oversizing) the control system will be unstable and will be inclined to hunt. In order to achieve adequate damper authority an air velocity of 1,500 FPM or greater is typically required. For this reason, modulating economizer dampers shall not be located at outdoor air or relief air louvers. The air velocity is far too low at these locations. Outdoor air and relief air control dampers shall be located within the respective ducts or at the AHU mixing chamber. In designing to achieve good control as described herein, one should be mindful that increased air pressure drop across dampers typically results in increased fan energy consumption. So, a balanced approach is prudent.]

[Note to PSC: For an excellent resource addressing application and sizing of control dampers see *Belimo Damper Applications Guide* at URL: http://www.belimo.us/media/downloads/Instructions/Application_Guides/Damper_Applications_Guide.pdf]

[Note to PSC: Provide control damper schedule. This is non-optional. It is essential that a complete and detailed control damper schedule be provided directly on the project drawings. This schedule shall include all of the following information:

- Damper tag (Each control damper shall be identified with a unique tag)
- Application (e.g. AHU-xx OA damper, AHU-xx-RA damper, AHU-xx-EA damper, EF-xx-ISO damper)
- Function (e.g. Modulating, Isolation)
- Damper type (e.g. heavy duty steel, ultra-low leakage aluminum)
- Blade pattern (parallel, opposed, single)
- Frame style (in-duct, flanged)
- Insulated (yes, no)
- Design air flow rate (CFM)
- Design velocity (FPM)
- Pressure drop (in.w.c.)
- Damper size (w"xh")
- Opening/duct size (w"xh")
- Actuator type (electronic, pneumatic)
- Positioner requirement
- Fail position (open, closed, last position)
- Other pertinent information]

1.9 FAIL POSITION

- A. Control dampers shall fail to "safe" position
 1. Outdoor air economizer damper – Fail closed
 2. "Minimum outdoor air" damper – Fail closed
 3. Relief air economizer damper – Fail closed
 4. Return air economizer damper – Fail open
 5. Exhaust fan dampers – Typically fail closed
 6. Associated makeup air dampers – Typically fail closed
 7. VAV terminal unit dampers – Typically fail open
 8. Face and bypass dampers – Typically fail open to face, closed to bypass

PART 2 – PRODUCTS

[Note to PSC: FYI – Basis of design for specified dampers are as follows:

- *Heavy Duty Galvanized Steel Damper: Ruskin CD30AF*
- *Thermally Insulated Heavy Duty Insulated Galvanized Steel Damper: None*
- *Ultra-Low Leakage Aluminum Damper: Tamco Series 1500*
- *Thermally Insulated Ultra Low Leakage Damper: Tamco Series 9000]*

2.1 AIRFOIL DAMPERS, HEAVY DUTY GALVANIZED STEEL

- A. Frame
 1. Galvanized steel channel
 2. 12 gauge minimum
 3. Reinforced corners for increased rigidity
- B. Blades

1. Galvanized steel
 2. 16 gauge minimum
 3. Airfoil shape
 4. 8" maximum individual blade height
- C. Axles (Pins)
1. Stainless steel
 2. Non-cylindrical drive pin to prevent slippage of actuator drive mechanism (e.g. hexagonal shape, with set screw "flat", or similar) [Note to PSC: Cylindrical (round) stainless steel drive shafts tend to be too hard and slick to sustain proper engagement with actuator drive mechanisms]
 3. Drive pin length adequate for mounting direct-coupled actuator
 4. Drive pin extension and outboard bearing support bracket as required
- D. Bearings
1. Stainless steel
 2. Thrust bearings as required for vertical blade orientation
- E. Blade Edge Seals
1. Mechanically attached to blade, adhesives and clips not allowed
 2. Neoprene, EPDM or Silicone as scheduled and or/as appropriate for application
- F. Jamb Seals
1. Compressible stainless steel
- G. Linkage
1. Stainless steel
 2. Face linkage, exposed in airstream *[Note to PSC: Exposed or easily accessible linkage is essential. It allows repair/replaced in the future without removal of damper from duct/frame.]*
- H. Jack Shafts
1. Jack shafts shall be pre-manufactured and mounted at the factory
 2. Jack shaft assemblies, including shaft, bearings, bearing supports and linkage shall be of comparable construction and quality as damper components specified above.
- I. Ratings
1. Temperature
 - a. Conservatively rated for specific application
 - b. 400 degrees F rating for steam heating applications
 - c. Rating applied to all components including blade edge seals, jamb seals and bearings
 2. Pressure
 - a. Rated for 1.25 x system design static pressure, 4" w.c. minimum
 3. Velocity
 - a. Rated for 1.25 x system design velocity, 2000 FPM minimum
 4. Leakage
 - a. Allowable leakage: AMCA Class 1
 - b. 4 CFM / SF at 1" w.c. differential pressure

- c. 8 CFM / SF at 4" w.c. differential pressure
- 5. Pressure Drop
 - a. Allowable pressure drop for 24"x24" damper
 - b. 0.15" w.c. at 2,000 FPM
- J. Size
 - 1. 48" maximum blade length
 - 2. 16 sq. ft. maximum overall damper area
 - 3. Exceptions may be considered on a case by case basis
- K. Basis of Design
 - 1. Ruskin CD30AF
- 2.2 THERMALLY INSULATED AIRFOIL DAMPERS, HEAVY DUTY GALVANIZED STEEL
 - A. Thermally insulated heavy duty galvanized steel airfoil dampers shall satisfy all requirements specified above in paragraph entitled *AIRFOIL DAMPERS – HEAVY DUTY GALVANIZED STEEL*.
 - B. Exceptions:
 - 1. Frame and blades shall be insulated, filled with high density foam
 - 2. Basis of Design: None
- 2.3 AIRFOIL DAMPERS, HEAVY DUTY STAINLESS STEEL
 - A. Heavy duty stainless steel airfoil dampers shall satisfy all requirements specified above in paragraph entitled *AIRFOIL DAMPERS, HEAVY DUTY GALVANIZED STEEL*.
 - B. Exceptions
 - 1. Frame and blades shall be type 304 or type 316 stainless steel. *[Note to PSC: Indicate which material is to be used.]*
 - 2. Blade edge seals shall be silicone.
- 2.4 THERMALLY INSULATED AIRFOIL DAMPERS, HEAVY DUTY STAINLESS STEEL
 - A. Thermally insulated heavy duty stainless steel airfoil dampers shall satisfy all requirements specified above in paragraph entitled *THERMALLY INSULTATED AIRFOIL DAMPERS, HEAVY DUTY GALVANIZED STEEL*.
 - B. Exceptions:
 - 1. Frame and blades shall be type 304 stainless steel.
 - 2. Blade edge seals shall be silicone.
- 2.5 AIRFOIL DAMPERS, ALUMINUM – ULTRA LOW LEAKGE
 - A. Frame
 - 1. Extruded aluminum channel
 - 2. 12 gauge minimum
 - B. Blades
 - 1. Extruded aluminum
 - 2. Airfoil shape
 - 3. Double overlap design
 - 4. End caps or equivalent to minimized jamb seal abrasion
 - 5. 8" maximum individual blade height

- C. Axles (Pins)
 - 1. Solid aluminum or zinc plated steel
 - 2. Geometric shape (e.g. hexagonal) to match blade opening
 - 3. Drive pin length adequate for mounting direct-coupled actuator
 - 4. Drive pin extension and outboard bearing support bracket as required
- D. Bearings
 - 1. Celron inner bearing rotating within a polycarbonate outer bearing or equivalent synthetic bearing elements with no metal-to-metal or metal-to-plastic contact
 - 2. Thrust bearings as required for vertical blade orientation
- E. Blade Edge Seals
 - 1. Secured in integral slot
 - 2. Double overlap design
 - 3. Extruded silicone
- F. Jamb Seals
 - 1. Secured in integral slot
 - 2. Extruded silicone or equivalent low-friction synthetic material
- G. Linkage
 - 1. Aluminum and/or corrosion-resistant zinc plated steel
 - 2. Accessible in airstream. Exception: Linkage may be located within frame if dampers are flanged and are easily removable from duct or have full exterior access
- H. Jack Shafts
 - 1. Jack shafts shall be pre-manufactured and mounted at the factory
 - 2. Jack shaft assemblies, including shaft, bearings, bearing supports and linkage shall be of comparable construction and quality as damper components specified above.
- I. Ratings
 - 1. Temperature
 - a. Conservatively rated for specific application
 - b. 400 degrees F rating for steam heating applications
 - c. Rating applied to all components including blade edge seals, jamb seals and bearings
 - 2. Pressure
 - a. Rated for 1.25 x system design static pressure, 4" w.c. minimum
 - 3. Velocity
 - a. Rated for 1.25 x system design velocity, 2000 FPM minimum
 - 4. Leakage
 - a. Allowable leakage: AMCA Class 1
 - 1) 3 CFM / SF at 1" w.c. differential pressure
 - 2) 8 CFM / SF at 4" w.c. differential pressure
 - 5. Pressure Drop
 - a. Allowable pressure drop for 24"x24" damper
 - b. 0.15" w.c. at 2,000 FPM

J. Size

1. 48" maximum blade length
2. 16 sq. ft. maximum overall damper area
3. Exceptions may be considered on a case by case basis.

K. Basis of Design

1. Tamco Series 1500

2.6 THERMALLY INSULATED DAMPERS, ALUMINUM – ULTRA LOW LEAKAGE

A. Aluminum thermally insulated dampers shall satisfy all requirements specified above in paragraph *entitled THERMALLY INSULATED AIRFOIL DAMPERS – HEAVY DUTY GALVANIZED STEEL* Frame

1. Insulated, filled with closed cell foam

B. Blades

1. Insulated, filled with high density foam

C. Basis of Design

1. Tamco Series 9000

2.7 CONTROL DAMPER ACTUATORS

A. Electronic Actuator, Spring Return

1. Direct mount type with V bolt clamp and matching cradle. Single bolt or setscrew fasteners not acceptable.
2. NEMA rated as appropriate for application/location. Actuators for outdoor applications shall be NEMA 4 rated.
3. Brushless DC motor
4. 24 VAC or 24 VDC power supply
5. 0-10, 2-10 VDC or 4-20 mA control input
6. Signal inverter switch
7. Fully modulating/proportional or two position as scheduled or indicated in control schematic/sequence.
8. Automatic stroke calibration
9. Spring return for fail-safe operation.
10. 60,000 cycle rated
11. 50% duty cycle rated
12. Sized for 150% of maximum damper torque requirement
13. Rated for 120 degree F ambient temperature
14. Motor overload/stall protection throughout rotation
15. Visual position indicator
16. Manual mechanical override
17. 3' (minimum) prewired cable or ½" conduit connection as appropriate for application
18. Approved for plenum application as required
19. Two adjustable SPDT auxiliary switches (end switches) for position indication as scheduled or indicated in control schematic/sequence
20. Electric analog feedback. Provide only if scheduled or otherwise indicated in documents

21. Adequate mounting height to accommodate 2" thick duct insulation
 22. Multiple tandem-mounted actuators not allowed
 23. Two-year unconditional warranty
 24. Approved manufacturers: Belimo, Siemens, Schneider/TAC
- B. Pneumatic Actuator, Spring Return
1. Aluminum or steel housing with swivel connection
 2. Spring-loaded piston with replaceable rolling molded synthetic rubber diaphragm
 3. Chrome plated or stainless steel shaft with swivel ball joint and crank arm connector
 4. Sized for 150% of maximum damper torque requirement at 15 PSIG control air pressure
 5. Relay type pneumatic positioner
 6. Two adjustable SPDT auxiliary switches (end switches) for position indication as scheduled or indicated in control schematic/sequence
 7. Rated for 25 PSIG control air pressure
 8. Rated for -20 to 150 degree F ambient temperature

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Dampers shall be provided as shown on drawings, scheduled and/or otherwise indicated in project documents.
2. Dampers shall be automated via electronic or pneumatic actuation unless clearly indicated in design documents as manually operated.

B. Control Damper

1. Damper frame as well as associated duct opening shall be completely square (i.e. not "racked") to prevent binding.
2. Metal angle shall be provided all around (all four sides) within duct/frame and rigidly attached. Damper frame shall be attached to angle rather than duct, thus providing free-play for adjustment of damper within duct prior to permanent attachment.
3. Damper shall be installed with blades horizontal unless other orientations (e.g. vertical) are approved by manufacturer.
4. Each damper shall be installed such that blades and any face linkage are fully accessible from within duct, plenum, air handling unit, etc. If damper linkage is located within frame, flange mounting shall be provided. Flange mounting shall allow full exterior access to linkage or easy removal of damper from duct. Adequate clearance shall be provided relative to adjacent ductwork, piping, etc.
5. Sizable access door(s) shall be provided such that dampers are easily accessible for inspection, repair or replacement.
6. After installation, each damper shall be opened and closed manually prior to actuator mounting to ensure smooth operation.
7. Structural bracing shall be provided for multiple section assemblies to support assembly weight and hold against system pressure. Bracing shall be provided at every horizontal and vertical mullion.

C. Control Damper Actuator, Electronic

1. Actuator shall be direct mounted on associated damper drive shaft.

2. One actuator shall be provided for each damper section. No actuator shall serve more than one damper section. Multiple tandem-mounted actuators are not allowed.
 3. Actuators shall be installed outside of airstream if possible, especially outdoor airstream.
- D. Control Damper Actuator, Pneumatic
1. One actuator may be used to power multiple damper sections.
 2. Blade-to-blade “jumper” brackets not allowed. Jack shaft must be used to drive multiple sections.
 3. Actuator shall be installed outside of airstream to prevent exposure to freezing temperatures.
- E. Control Damper Operator, Manual
1. Manual operator shall be factory manufactured for such application and damper design and shall include positive locking mechanism.

END OF SECTION **23** 09 13.43

This section of the *U of I Facilities Standards* establishes minimum requirements only.
It should not be used as a complete specification.