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 APPLICATIONS

A. Isolation
   1. For on-off or isolation applications parallel blade dampers shall be used.
B. Modulating Control
   1. For modulating control applications opposed blade dampers shall typically be used.
   2. Given that parallel and opposed blade dampers have different flow characteristic (performance curve) in some cases a parallel blade damper may be a better selection for modulating service than an opposed blade damper.
C. Mixed Air Economizer
   1. There is no “one size fits all” approach to damper selection and sizing for mixed air applications. A system approach shall be taken that selects damper type based upon characteristic and damper size based upon authority. More often than not optimal design yields opposed blade outside air and relief dampers and “smaller” (in relative terms) parallel blade return dampers. Percent minimum outdoor airflow and relative pressure drops through air paths are key inputs into proper damper sizing.
D. Minimum Outdoor Air
1. Minimum outdoor airflow dampers shall typically be opposed blade type.

E. Face and Bypass

1. For two-position bypass or two position face and bypass applications parallel blade dampers shall be used.

2. For modulating face and bypass applications opposed blade dampers shall typically be used.

1.7 DAMPER SIZING

A. Opposed Blade Damper

1. Modulating opposed blade control dampers 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%. For duct mounted applications opposed blade dampers shall typically be 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.

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 increase damper authority velocity through the damper and associated pressure drop must be increased. Velocities of, say, 1500 FPM or 2000 FPM are often used by engineers as ballpark numbers for control damper sizing. This approach may work generally speaking but it will not yield optimized control.

In designing to optimize 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: Modulating economizer dampers shall not be located at outdoor air or relief air louvers. Outdoor air and relief air control dampers shall be located within the respective ducts or at the AHU mixing chamber.]

B. Parallel Blade Damper

1. When used for isolation (open-close, parallel blade dampers shall be sized for minimal pressure drop. For duct mounted applications parallel blade dampers shall typically be full duct size. See schedule for damper size and/or discuss with PSC to confirm proper sizing.

2. When used for modulating control, parallel blade dampers shall be sized for a full-open air pressure drop at design flow rate that is equal to 30% of the total pressure drop through the controlled air path yielding a damper authority of 30%. For duct mounted applications parallel blade control dampers shall typically be substantially smaller than duct size. See schedule for damper size and/or discuss with PSC to confirm proper sizing.

[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)
1.8 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 INSULATED 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 LEAKAGE

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


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.