



Before replacing actuator, damper must be inspected and determined to be fully functional.

INSTRUCTION SHEET Replacement of Prefco McCabe Link Dampers with EMB2 MultiProducts Motor with Belimo FSxx Series

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Installer must be trained and experienced with repair of fire and smoke dampers and actuators.

www.belimo.us/firesmoke



UL®

In the "Marking & Application Guide, Dampers for Fire Barrier and Smoke Applications & Ceiling Dampers" April 2013 by Underwriters Laboratories Inc.®, page 6 they state:

DAMPER ACTUATORS

"... field mounting or substitution of actuators is not covered within the scope of the UL certification of the product. However, this does not necessarily preclude replacement of actuators in the field. Like any appliance, field servicing of these products is not covered under the scope of the UL certification and factory follow-up service program. As with any part of the damper, it is expected that replacement of actuators in the field be done in accordance with the damper manufacturer's normal field servicing program."

Code and Standard Issues

In general, the administrative section of codes state that all mechanical and electrical systems must be kept in working order and an individual section may state that all life safety devices and systems must be operable. NFPA 80 (Fire) & NFPA 105 (Smoke) require periodic testing and repair of dampers as soon as possible after any deficiency is uncovered.

Chapter 7 IBC & IFC "Containment" Dampers		
Commissioning		
End of first year		
Every 4 years except in hospitals every 6 years		
Chapter 9 IFC "Smoke Control System" Dampers		
Dedicated	Non-dedicated	
Commissioning	Commissioning	
Semi-annually	Annually	
Chapter 9 IBC & IFC		
Fire detection & Smoke control systems		
Dedicated	Non-dedicated	
Weekly self-test	Not required	

Fire & smoke dampers are appliances and field replacement of components is required when failure of any component occurs.

The Authority Having Jurisdiction (local Fire Marshal and/or Building Official) must be consulted if any blade or auxiliary switches are employed and are connected to the fire alarm system or to a Fire Fighters Smoke Control System (FSCS) panel. Retesting is required. A permit and inspection may be required since connections to an alarm system have been touched.

For the Air Movement and Control Association damper maintainance manual go to: http://www.amca.org/publications/damper_maintenance.aspx



NFPA 80 (Fire) & NFPA 105 (Smoke)

NFPA requires damper inspection and repair of dampers. See <u>www.nfpa.org</u>. for Standards. Details not covered here.

See NFPA 80 & NFPA 105 for details. The damper cleaning and examination check list here is based on them.

Damper installation shall meet code requirements. Fire stopping and drywall integrity shall be confirmed. Damper blades shall be in plane of wall. Duct shall be fall away with no fasteners connected to damper sleeve.

- a. Dampers and ducts shall be cleaned of all foreign debris and dust build-up.
- b. All exposed moving parts of the damper shall be dry lubricated as required by the manufacturer. Do not use oil as it draws dirt.
- c. Damper shall be examined without defective old motor or new actuator to determine:
 - i. The damper shall fully close from the open position.
 - ii. Damper shall fully open from the closed position.
 - iii. There are no obstructions to the operation of the damper. The damper shall not be blocked from closure in any way due to rusted, bent, misaligned, or damaged frame or blades. The damper shall not have defective hinges, side &/or blade seals, or other moving parts. The damper frame shall not be penetrated by any foreign objects that would affect operation.
- d. If the damper is equipped with a fusible link, the link shall be removed for testing to ensure full closure and lock-in-place if so equipped. If the link is damaged or painted, it shall be replaced with a link of the same size, temperature, and load rating.
- e. The fusible link shall be reinstalled after testing is complete.

After installation and wiring of new actuator it shall be tested.

- a. The checklist may be customized using material here and in NFPA Standards. Multiple geometric configurations of springs, fusible link, thermal sensor(s), and actuation are possible. Confirm with AHJ if any additional requirements exist.
- b. Electric thermal sensors, if present, must be tested and replaced if defective.
- c. The test shall be conducted with normal HVAC airflow.
- d. When equipped with smoke detection activation, the smoke detector shall be activated and damper operation observed.

Test voltage input to actuators and repair as necessary if voltage is not correct. Old breakers often deliver below 115V and failed actuators may be due to power supply problems.

A record of all repairs must be kept and made available to AHJ.



Local Code Approval

While it is not detailed in codes, the following rules should be followed for selecting Belimo actuators for replacement:

Check the technical specifications to ensure an "equal or better" actuator is used.

- Temperature the replacement actuator shall have been UL555S tested at the same or better temperature as the original actuator. 250°F or 350°F are standard. (Code is 250°F. However, in engineered smoke control systems the consulting engineer may have required 350°F. Tunnels and some other applications require higher temperatures.)
- **Time** the replacement actuator shall drive open and spring closed at a speed equal or faster than presently required by codes. (<75 seconds is UL 555S and most codes. Las Vegas is 60 seconds. Consult the AHJ with any questions.)
- **Torque** replacement actuator shall have equal or greater torque than the failed actuator.
- Voltage replacement actuator shall have the same voltage rating as the original.
- Amperage the replacement actuator(s) shall not draw more amperage than the original(s) and cause the total connected amp draw on a circuit breaker to be greater than allowed by electrical code. (This is not a problem as Belimo actuators draw very low current.)
- Final **Testing** actuated damper and associated devices shall be tested for proper operation. See Acceptance testing details below.

(Mnemonic device: TTT-VAT)



In all cases, installation must comply with any and all local electrical and life safety codes. Operation of the system after installation must be performed to verify proper damper cycling. Final checkout requires verifying correct function.



Note that where any fire alarm wiring is touched, the fire department must be informed.



Cross Reference

For greater detail see <u>www.belimo.us/firesmoke</u> RETROFIT or download from <u>https://www.belimo.us/mam/americas/technical_documents/pdf-</u> web/fire and smoke doc/fire smoke competitive replacement data reference.pdf

The EMB2 and other motors were used on these dampers.

Multiproducts and Siebe motors do not cross reference directly to any Belimo as they did not have internal springs. Linkages or direct coupling of the Belimo will replace the <u>application</u>, not the <u>motor</u>. In general this brings the assembly up to present UL standards.

All Belimo Fire & Smoke actuators **(FSTF, FSLF, FSNF, FSAF_A, FSAFB)** are UL555S Listed The FSLF, FSNF, & FSAF_A meet requirements for 350°F operation and the others were tested at 250°F which is the minimum per codes.

All are also UL2043 listed for low smoke generation and may be installed in plenums per the International Mechanical Code Section 602 And the NEC 300.22 (C).

As the old Prefco dampers are no longer manufactured, the torque to area of damper is not clear.

Assuming the damper is in good condition and not binding or corroded, Belimo conservatively recommends:

The **FSTF** should be used for up to 1.5 sq. ft. at 2000fpm on the Prefco cable-pulley dampers. Testing one sample of a large number to ensure proper operation is necessary. This actuator passes 2 sq.ft. in the UL555S test on modern dampers. It should NOT be used on McCabe® Link dampers without special Belimo review.

The **FSLF** should be used for McCabe[®] Link dampers up to $18" \times 18"$ – direct coupled only where damper shafts are available. Since the actuator must drive against the shaft spring the first time it operates to set the link, de-rating is recommended.

The **FSNF** should be used for larger dampers. It can be direct coupled or linkage connected. It is recommended that it be used for a maximum 36" x 45" section on retrofits.

The **FSAF** actuators have special features (modulation, balancing, manual override, 24VDC capability) that may be employed, but normally an FSNF is sufficient.



MultiProducts

Prefco 5800 EMB

In all cases disconnect external motor spring without	FSTF if less than	
compromising fusible link and internal spring ability to close	1.5 sq.ft.	
the blades. These are quite old and changes may have been		Use -S models if
made over the years. Investigate operation. Confirm voltage.	FSLF from 1.5 to 4	auxiliary switches
Check fusible links or McCabe © Link. Verify damper	sq.ft.	are required.
functions after replacement by testing damper open and		
spring closed.	FSNF up to 10	
	sq.ft.	
Use of FSLF is recommended for dampers less than 4 sq.ft.		
For linkage applications all FSTF & FSNF parts can be used.		

5800EMB2XPO	FSLF120	
5800EMB2XPC	FSLF120	
5800EMB1	FSLF120	5800EMB1 - Outside the duct, top mount, power open
5800EMB7	FSLF120	5800EMB7 - Inside the duct, bottom mount, power closed
5800EMB10	FSLF120	5800EMB10 - Outside the duct, bottom mount, power closed
5800EMB5	FSLF120	5800EMB5 - Inside the duct, top mount, power open
5800EMB8	FSLF24	
5800EMB9	FSLF120	

While direct coupling is preferable, some applications require linkages. See **Linkages** below for an example of a FSTF linkaged to a Prefco internally.

Model	Voltage	Notes
2430	120VAC	
2553A	120VAC	1
2585	120VAC	2
2659	120VAC	3
2724	120VAC	4
2781	24/120 VAC	5
2814A-SQ	120VAC	6
2814-SQ	120VAC	7
2920	120VAC	8
2985	120VAC	9
2986	120VAC	10
3158	120VAC	11
3159	120VAC	12
5983	120VAC	13
6247	120VAC	14
MZRHM	120VAC	15
TB2000/1	120VAC	16

All 120V, FSLF120		
	Nailor	
	5953	
	5949	
	M12, MZRHM	
	6247	
	5186	



Square shaft inserted into damper sleeve with special crankarm. If a smoke damper, 1 replacement may be possible and requires a new shaft and other linkage parts. If a combination fire and smoke damper, Belimo may not be capable of being used. See Air Balance with MP2553. 2 Typically these were linkaged using a crank arm on the square motor shaft and the spring was on the round shaft. Remove all linkage parts and direct couple to damper shaft. 3 Safe-Air / Imperial. Typically linkaged. There was an internal spring and fusible link for the fire function. 4 Except in rare occasions where space constraints exist, simply remove all linkage parts and direct couple on damper shaft. Use old motor as a mounting platform for anti-rotation strap 5 Usually on a Negator Spring damper. For pneumatic, the FSLF120 will usually work. For electric, the Ruskin kit FSLF120/MP must be ordered from a Ruskin rep. 6 10 in-lb. "A" model = CW rotation; plain = CCW. Check voltage. FSLF replaces both in most cases. Use FSTF when linkages necessary 7 10 in-lb. "A" model = CW rotation; plain = CCW. Check voltage. FSLF replaces both in most cases. Use FSTF when linkages necessary. 8 Inside clamp mounting or a shaft extension required. 9 See Greenheck Installation Instructions. Typically these were linkaged using a crank arm on the square shaft and the spring was on the round shaft. Remove all linkage parts and direct couple to damper shaft. 10 See Greenheck Installation Instructions. Typically these were linkaged using a crank arm on the square shaft and the spring was on the round shaft. Remove all linkage parts and direct couple to damper shaft 11 Some were direct coupled to the damper shaft with an external spring. Some were linkaged using a crank arm on the square motor shaft and the spring was on the round shaft. Remove all linkage parts and direct couple. 12 Some were direct coupled to the damper shaft with an external spring. Some were linkaged using a crank arm on the square motor shaft and the spring was on the round shaft. Remove all linkage parts and direct couple. 13 https://www.belimo.us/mam/americas/technical_documents/pdfweb/fire_and_smoke_doc/nailor_multiproducts_to_belimo_fs_instructions.pdf 14 Nailor. Remove linkage parts and mount to damper shaft. FSLF for dampers < 4 sq.ft. and FSNF for dameprs > 4 sq.ft. 15 Nailor. Remove linkage parts and mount to damper shaft. FSLF for dampers < 4 sq.ft. and FSNF for dameprs > 4 sq.ft. 16 Typically these were linkaged using a crank arm on the square motor shaft and the spring was on the round shaft. Remove spring and all linkage parts and direct couple to damper shaft.



Siebe/Barber			Aux		
Coleman	Power	Torque	Switches	Belimo	Notes
MA220	120 VAC	30		FSLF120 US	1, 2, 4
MA221	240 VAC	30		FSLF230 US	1, 2, 4
MA223	24 VAC	30		FSLF24 US	1, 2, 4
MA230	120 VAC	50		FSNF120 US	1, 2, 3
MA231	240 VAC	50		FSNF230 US	1, 2, 3
MA233	24 VAC	50		FSNF24 US	1, 2, 3
MA240	120 VAC	50			5,6
MA250	120 VAC	50		FSNF120 US	1, 2, 3, 4
MA251	230 VAC	50		FSNF230 US	1, 2, 3, 4
MA253	24 VAC	50		FSNF24 US	1, 2, 3, 4
MA-318	24 VAC	60		FSNF24 US	1, 3
MA-318-500	24 VAC	60	1	FSNF24 -S US	1, 3
MA-418	120 VAC	60		FSNF120 US	1, 3
MA-418-500	120 VAC	60	1	FSNF120-S US	1, 3
1	Direct couple the Belimo where shaft is available.				
	FSTF <1.5 sq.ft. FSLF <4				
2	sq.ft.				
3	FSNF <12 sq.ft. FSAF*A <18 sq.ft.				
4	For Pottorff with shaft spring see: <u>https://www.belimo.us/mam/americas/technical_documents/pdf-web/fire_and_smoke_doc/pottorff-ma2xx_to_belimo.pdf</u>				
5	Motor was not 90 degree and pulley and cable were usually used. Some geometric changes are necessary to simplify.				
6	Provide photos. Motor, linkage, blades, fusible link, McCabe © Link, Typically direct couple to damper shaft if available. Otherwise, investigation necessary.				



Applications

MultiProducts motors were used in a variety of ways. Two examples are shown below.



While the Belimo FSNF can replace the motor here, the damper should be replaced. The broken drywall ruins the fire protection. CODE VIOLATION.



EMB2X MultiProducts type motor. A number of variations were made.

REPLACE DAMPER.

Some internal mounts are very difficult to modify. See example to the right.

The Belimo jackshaft adaptor may be considered.





Motors were non-spring and many used a "screen door" spring was tensioned when the motor drove the damper open.





The essential point about replacing old Prefco or PHL motors is that one removes all the linkage components, not simply the motor.

Then the Belimo actuator is direct coupled to the damper shaft like modern fire and smoke dampers.

Note the damper shaft here is quite adequate for direct coupled mounting.



Replacement Actuator Installation Instructions For Field Maintenance Of UL Classified Factory Mounted Actuators

5800 EMB2X - Power Open Or Power Closed (On Extended Shaft, Multiblade Style Dampers



Remove motor, spring, all linkage components





McCabe Link and shaft spring.

These are not to be modified as they perform the fire damper closing function.

External spring and bracket parts that will be removed.

Note that the short ½" shaft is available for mounting Belimo. When too short for direct coupling, see linkages below.

Regardless of what motor was used, this application can be replaced with a Belimo by removing the linkage parts and <u>mounting the</u> <u>Belimo on the damper shaft</u>. The spring must be removed unless it is part of the fire closing function. The bracket may be used in some cases to mount the Belimo anti-rotation strap.



USE CAUTION!

Spring is under high torsion and may cause serious injury! If any external springs are present, exercise caution – wear face and hand protection.



Prefco McCabe[®] Link Operation with Belimo FSxx Series



CAUTION !!!

The shaft spring closes the damper in < 1 second.

Do not put hands inside damper due to risk of injury.



The motor arm is not engaged in the McCabe® Link above.



The motor arm is engaged in the McCabe® Link above.

Alternate view

When the actuator turns (here clockwise from the shaft side of damper), it moves the motor arm down and tensions the jackshaft spring. The arm catches in the Link and holds.



Replacement Instructions McCabe[™] link damper models

Mounting actuators on dampers less than 10" in height (U10)

If the damper is less than 10" in height (U-10), the drive rod requires less than 90° of rotation (varies from 43-48°). As the drive mode delivers substantially more torque than the spring return it is preferred to have the actuator at full open when the damper is open. Therefore, for U-10 dampers the suggested method of installation is to power the actuator open, hold the damper open and then tighten the actuator to the shaft. Installing the actuator when de-energized on a closed damper could cause damage to the damper linkage as the actuator continues to attempt to drive the damper open after rotation has ceased.

- 1. Disconnect incoming power and wiring at junction box or actuator. Tag all wires.
- 2. Remove old actuator and mounting bracket. Attach shaft extension if required.
- 3. Mount Belimo FSLF or FSNF.
- 4. Reconnect wiring per original drawing. Typical wiring shown below.
- 5. Restore incoming power.
- 6. Test all functions.
 - a. Open smoke detector or relay contacts. Actuator springs damper <u>fully</u> closed.
 - b. Re-close contacts. Actuator drives damper open.
 - c. Trip McCabe[™] link with long screwdriver. Actuator is disconnected and the damper spring engages to <u>fully</u> close damper. CAUTION <1 SECOND CLOSING.</p>
 - d. After link release on a McCabe link operated damper, the best method of reset is to open the electrical circuit and allow the return spring of the actuator to unwind to the closed position – this resets the McCabe link. Then restore power and the actuator/damper assembly should wind back to open.

Replacement of old motors.

- 1. Remove old motor and external spring. A number of different discontinued motors were used.
- 2. Clean damper. Test McCabe® Link, open and close blades to ensure operation. Engage motor arm in McCabe® Link.
- 3. Close damper and place Belimo on shaft in sprung closed direction. (See , 10" note above.)
- 4. Mark holes and install anti-rotation strap.
- 5. If damper requires, install Belimo on jackshaft with 5° preload. Set anti-rotation strap with one screw and rotate out of way of U-slot in actuator.
- 6. Close tight. Then insert anti-rotation stud and second screw.



Test functions after installation of Belimo.

1. Power actuator. Damper opens. McCabe® Link is engaged in order to operate.



Actuator has opened the damper. McCabe® Link must be engaged for actuator to move damper.

2. Cut power to actuator. Actuator spring closes damper. McCabe® Link is engaged.



Actuator has sprung damper closed.



Another view of actuator sprung closed.



The actuator must wind up the spring the first time it drives. That one time requires extra torque. For that reason the actuators cannot operate as much damper area and require derating:

McCabe® Link dampers:

Up to 18" x 18"	FSLF (30 in-lb)
Up to 36" x 45"	FSNF (70 in-lb)

Notes:



Direct Coupled Mounting

Anti-rotation strap



Belimo anti-rotation strap may be bent to adjust to fit.

Where necessary the



Short shaft mounting



For short shaft mounting, the ZG-LMSA-1/2-5 can be used. Alternately, the clamp can be installed between the actuator and sheet metal.











FSLF mounted on the damper shaft. Two sheet metal screws hold the anti-rotation strap. Two nuts secure coldweld clamp onto shaft.



FSNF mounted on the damper shaft. Two screws hold the antirotation strap. Two nuts secure cold-weld clamp onto shaft.

FSAF mounts the same.





Actuator anti-rotation strap may not be screwed to the duct. It must attach to either the sleeve or to the mounting bracket. The duct must be able to fall away from the damper in case of ceiling collapse in a fire.

Note that actuator floats freely. The anti-rotation strap stud allows the actuator to move if shaft is not perfectly concentric. Rigid mounting by jamming the stud into the U-slot of actuator is NOT usually best.



Read Data Sheet provided in box with each actuator for specific wiring details.



Linkage applications



One linkage method that can be helpful is to use the FSTF actuator with its linkage parts. Shown at left.

The FSTF cannot be purchased without Product Management approval. It is limited in torque and the application must be reviewed and field tested before use. The actuator has 18 in-lb of torque; it will tolerate only 250°F for a half-hour. This makes it a 2 sq.ft. actuator. Linkage geometry can modify the torque translation and must be examined.

The Belimo ZG-AF and brackets are useful in some cases for larger dampers where linkages are needed.

FSAF_A and FSNF may be mounted as shown to the right.



Belimo linkage kits:

https://www.belimo.com/pim/mam /americas/technical_documents/d ata_sheets/man-airacc/Mechanical_Accessories.pdf

Mounting Methods Guide: https://www.belimo.us/mam/americ as/technical_documents/pdfweb/guides/mounting_methods.pdf



Miscellaneous parts

Should they be needed, Belimo carries a range of parts. Ball joints and 5/16" rods are available from most distributors.



SH8 (not shown – see picture page 9). Push-rod for KG6 & KG8 ball joints. 5/16" 36" long Use SH10 3/8" rods for GMB and dual FSAF or FSNF linkages. 5/16" can bend under heavy loads.



Thermal sensor replacements – BAE165 US



Belimo BAE165 US

Where existing sensor is defective or one must be added, the 165°F primary sensor may be used. Original equipment is recommended although not strictly required by code. UL does not regulate replacement or repair. See NFPA 80 or NFPA 105.



Wiring



Disconnect and lock out power before starting to disconnect old motor.



here is no electrical thermal sensor used where the McCabe Link was used. Wiring is shown in the drawing below.



This is the most common wiring method used.





Regardless of the wiring routes used, this drawing shows the wiring necessary for a UL555S damper and actuator. Use it as a basis for any of the other wiring schematics. Note that the alarm connections are not touched when replacing an actuator. This is a major concern for Fire Marshals.

Call with questions or if there are field modifications requiring more investigation.



Blade Position Indication Switches

Dampers under 10" in height do not use a full 90° of rotation. If using the Belimo –S actuator and installed as noted on "U-10" dampers above, only the full open switch would be functional.

Use of Prefco blade indicator switches is recommended in that case.



BLADE POSITION INDICATOR SWITCHES

Top Mounted, to Indicate Full Closed (2 wires)

Bottom Mounted, to Indicate Full Open (2 Wires)



On larger than 10" dampers, the Belimo FSxx -S models provide auxiliary switches that can replace existing switches as well as the actuator. See Belimo data sheets for information.

Where the original switches for signaling position to a Fire Fighters' Smoke Control Panel or to local indicator lights must be replaced or are inoperative the Belimo –S model actuators may be used or a S2A-F may be installed.

Belimo S2A-F

FSLF (mid 2014ff), FSNF, and FSAF actuators can use the add on switch package.







Building Official / Fire Marshal Notification Form

Retain this portion of checklist at premises for Fire Marshal inspection. See local AHJ or Fire Marshal for more is in turn on them when they are other information and requirements regarding conformance with NFPA 80 & NFPA 105.

1. Single Sensor Combination Damper

Test Checklist (Smoke dampers do not have sensors. Only steps a & b apply.)

- a. Dopen smoke detector or relay wire or contact to cut power. Damper springs closed.
- b. □ Reconnect power. Damper drives open.
- c.
 □ Release McCabe Link using heat gun. Damper springs closed.
- e.
 □ Restore power and drive damper open.

Repeat 3 times to ensure operation. This imitates UL555S test.

When completed, ensure sensors are reset and smoke detector is in normal state. Damper is normally Open; check sequence of operation.

2. Reopenable Two Sensor Fire-Smoke Combination Damper (Since this system involves the Firefighters' Smoke Control System, inform fire department.)

Fire fighter light indicators and override switch must be checked per fire department instructions.

☐ When completed, ensure sensors are reset and smoke detector is in normal state and FSCS switch is in Auto. Damper is normally Open; check sequence of operation.

Damper Numbers or Location Identifying Numbers
Date
Contractor
Service Technician (Print)
Service Technician (Signed)
Phone Number ()
Notes

Call Belimo with any testing requirements for other applications.