

Approved
ORNL WORK PLAN
Operations, Maintenance and Services



Work Plan Name / Rev: BL13 REPLACE BLEMCO / 1
Expiration Date: 12/26/2029

| WORK SCOPE/DESCRIPTION | | | | |
|-------------------------------------|--|-----------------|-----------------|---|
| Requester (Name/Badge/Division): | Sexton, Randall / 00712268 / X186 | | | |
| Location of work (Bldg/Rm/Other): | / / BL13 | | | |
| Work Plan Title: | Replace failed Blemco Controller on the Hot water side of 8713 main AHU | | | |
| Description of Service/Work Needed: | Replace failed Blemco Controller on the Hot water side of 8713 main AHU. | | | |
| Charge Number, if required: | | | | |
| Work Plan Grade/Worktype: | 3 / 0 | | | |
| Author (Name/Badge): | Sexton, Randall / 00712268 | | | |
| File Attachments: | Badge | Name | Attachment Desc | File Name |
| | 00712268 | Sexton, Randall | Instruction | belimo_LF_installation-instructions_en-us.pdf |
| | 00712268 | Sexton, Randall | Data Sheet | belimo_LF24-SR_US_datasheet_en-us.pdf |

INSTRUCTIONS

Prerequisites/Precautions:

1. Turn of unit.
2. Verify the power off
3. Verify the controller position it should read 0.

Directions:

1. Electrical research mechanic unwire controller
2. Research Mechanic remove old Bleimo controller and install new controller
3. ERM wire Controller
4. ERM turn on power
5. IHC turn on power

Post Work Testing:

Monitor controller on Epic

Closeout:

JOB HAZARD EVALUATION

| HAZARDS | PERMITS / CONTROLS |
|--|---|
| Deenergized Hazardous Energy Sources (LTV) | <ul style="list-style-type: none"> ORNL-213, ORNL Lock/Tag/Verify Permit form OR ORNL-214, ORNL Lock/Tag/Verify Permit Continuation form OR ORNL-215, ORNL Lock/Tag/Verify Permit Temporary Suspension form Perform Simple Lock/Tag/Verify - Work meets all criteria for Simple LTV <ul style="list-style-type: none"> No potential for stored, residual energy or re-accumulation of energy after shutdown For a single hazardous energy source that can be: Identified, isolated, and locked Isolation of single energy source completely de-energizes & deactivates equipment/system Energy source is isolated and locked out during service/maintenance Single lockout device will achieve a locked-out |

| | |
|---|---|
| | <p>condition.</p> <ul style="list-style-type: none"> i Lockout is under personal control for each staff performing work i Work creates no hazard for other staff i Equipment/system has no known history of unexpected activation or re-energization during maintenance or servicing <p>Otherwise: Perform Complex Lock/Tag/Verify</p> |
| Electrical Work | <ul style="list-style-type: none"> i Minimum level of electrical worker qualification for the task (i.e. EW, QEW 1, 2, 3, 4, or 5): Specify. |
| Ergonomic Conditions (Contact Stress, Vibration, Posture, Force, Repetitive Motion) | <ul style="list-style-type: none"> i Exposure Assessment: Enter or attach justification to classify exposure scenario as low risk, qualitative exposure assessment (QEA), or requirement to conduct quantitative exposure monitoring (QEM) |
| Manual Material Handling | <ul style="list-style-type: none"> i Establish Controls (Guideline) [apply 30-50-30 criteria for a non-repetitive lifting task] <ul style="list-style-type: none"> i Reduce weight i Decrease load i Design work area i Facilitate access to material i Optimum environment i Reduce distance /Provide proper storage facilities i Load storage i Eliminate manual lifting/lowering i Eliminate pushing/pulling – Use lifting aids i Other instructions to staff i Exposure Assessment: Enter or attach justification to classify exposure scenario as low risk, qualitative exposure assessment (QEA), or requirement to conduct quantitative exposure monitoring (QEM) |

DOCUMENTATION REVIEW AUTHORIZATION
(Approvals are certification of hazards assessment)

| | | |
|---|------------------|------------|
| Reviewer/Approver Roles | Signature | Date |
| Accountable Management (Service Provider, Line, Equipment Owner, or Facility Management) | Vasquez, Silbino | 12/26/2024 |
| IS/IH | Hostetler, Aaron | 8/22/2024 |
| Task Leader | Sexton, Randall | 8/21/2024 |
| Work Package Concurrence | | |
| Facility Manager | | |
| Operations Supervisor | | |
| Facility Manager Approval To Start Work | | |
| Facility Manager | | |
| Work Start Authorization | | |
| Task Leader | | |
| Work Acknowledged Complete | | |
| Task Leader | | |
| Worker Feedback: | | |

WORK DETAILS - Prerequisites/Precautions

| Hazards | Permits/Controls | Resources | Dur |
|---------|------------------|-----------|-----|
| (1) - | | | |

1. Turn off unit Epic's
2. Verify the power off
3. Verify the controller position it should read 0.

| | | | |
|--|--|------------------------------------|---|
| Deenergized Hazardous Energy Sources (LTV) | <ul style="list-style-type: none"> ORNL-213, ORNL Lock/Tag/Verify Permit form OR ORNL-214, ORNL Lock/Tag/Verify Permit Continuation form OR ORNL-215, ORNL Lock/Tag/Verify Permit Temporary Suspension form Perform Simple Lock/Tag/Verify - Work meets all criteria for Simple LTV <ul style="list-style-type: none"> No potential for stored, residual energy or re-accumulation of energy after shutdown For a single hazardous energy source that can be: Identified, isolated, and locked Isolation of single energy source completely de-energizes & deactivates equipment/system Energy source is isolated and locked out during service/maintenance Single lockout device will achieve a locked-out condition. Lockout is under personal control for each staff performing work Work creates no hazard for other staff Equipment/system has no known history of unexpected activation or re-energization during maintenance or servicing Otherwise: Perform Complex Lock/Tag/Verify | SNS Research Mechanic - Electrical | 1 |
| Electrical Work | <ul style="list-style-type: none"> Minimum level of electrical worker qualification for the task (i.e. EW, QEW 1, 2, 3, 4, or 5): Specify. | | |

2) -

1. Electrical research mechanic unwire controller

| | | | |
|-----------------|---|------------------------------------|---|
| Electrical Work | <ul style="list-style-type: none"> Minimum level of electrical worker qualification for the task (i.e. EW, QEW 1, 2, 3, 4, or 5): Specify. | SNS Research Mechanic - Electrical | 1 |
|-----------------|---|------------------------------------|---|

WORK DETAILS - Directions

| Hazards | Permits/Controls | Resources | Dur |
|---------|------------------|-----------|-----|
| 3) - | | | |

1. Remove old Bleimo controller and install new controller

| | | | |
|---|---|------------------------------------|---|
| Ergonomic Conditions (Contact Stress, Vibration, Posture, Force, Repetitive Motion) | <ul style="list-style-type: none"> <u>Exposure Assessment</u>: Enter or attach justification to classify exposure scenario as low risk, qualitative exposure assessment (QEA), or requirement to conduct quantitative exposure monitoring (QEM) | SNS Research Mechanic - Mechanical | 1 |
| Manual Material Handling | <ul style="list-style-type: none"> Establish Controls (<u>Guideline</u>) [apply 30-50-30 criteria for a non-repetitive lifting task] <ul style="list-style-type: none"> Reduce weight Decrease load Design work area Facilitate access to material Optimum environment Reduce distance /Provide proper storage facilities Load storage Eliminate manual lifting/lowering Eliminate pushing/pulling – Use lifting aids Other instructions to staff <u>Exposure Assessment</u>: Enter or attach justification to classify exposure scenario as low risk, qualitative exposure assessment (QEA), or requirement to conduct quantitative exposure monitoring (QEM) | | |
| 4) - Wire Controller | | | |
| Electrical Work | <ul style="list-style-type: none"> Minimum level of electrical worker qualification for the task (i.e. EW, QEW 1, 2, 3, 4, or 5): Specify. | SNS Research Mechanic - Electrical | 1 |
| 5) - Turn on power | | | |
| Deenergized Hazardous Energy Sources (LTV) | <ul style="list-style-type: none"> <u>Perform Simple Lock/Tag/Verify</u> - Work meets all criteria for Simple LTV <ul style="list-style-type: none"> No potential for stored, residual energy or re-accumulation of energy after shutdown For a single hazardous energy source that can be: Identified, isolated, and locked Isolation of single energy source completely de-energizes & deactivates equipment/system Energy source is isolated and locked out during service/maintenance Single lockout device will achieve a locked-out condition. Lockout is under personal control for each staff performing work | Research Mechanic Electrical | 1 |

- | | | |
|--|--|--|
| | <ul style="list-style-type: none">i Work creates no hazard for other staffi Equipment/system has no known history of unexpected activation or re-energization during maintenance or servicing <p>Otherwise: Perform Complex Lock/Tag/Verify</p> | |
|--|--|--|

6) - Turn on power on Epic's

| | | | |
|--|--|--|---|
| | | <input checked="" type="checkbox"/> Technician | 1 |
|--|--|--|---|

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PRE-JOB SAFETY REVIEW GUIDE

ID: 60229

Scope of Work: Review work package/plan to ensure all participants understand the work activity.

Hazards: Review the hazards identified in Job Hazard Evaluation (JHE) / work plan (IOP).

- ε Since the work package / plan was written: 1) Have conditions changed? 2) Are there new hazards? Refer to Field Notes and Focus Areas.

Hazard Controls / Permits: Review:

- ε Written permits for the work activity.
- ε Precautions, step warnings, Hold Points ...
- ε Personal Protective Equipment (PPE)

- ε Work instructions for information - e.g., steps where hazards are introduced.
- ε ORNL subject area requirements - e.g., non-permit hazard controls.

Performing Work:

- ε Discuss group/individual responsibilities for safe & effective work.
- ε Follow work instructions & safety procedures.
- ε Availability/location of materials, tools, etc.
- ε Any previous experiences / lessons learned?
- ε Response if work cannot be performed as planned.
- ε What is the worst thing that could happen?
- ε Are there Potential error traps with the job? → →
- ε Take a minute before: work start & leaving work area.
- ε Work Hand-off / Turnover - workers & Task Leader

→ **Potential Error Traps:**

- ε Time pressures
- ε Distractive environment
- ε High workload
- ε First time evolution
- ε First day back
- ε Vague guidance
- ε Over confidence
- ε Imprecise communications
- ε Work stress

Abnormal Situation Response:

- | Stop Work: Observe an unsafe act, activity or condition that creates an imminent danger.
- | Emergency Response: Discuss egress paths or other responses if problems are encountered.

Field Notes and Focus Areas: (Use this area as a work space to record notes related to new hazards identified in the field or changed conditions. Record feedback in work package/plan information systems.)

By signing below, I am indicating that I have been briefed on the potential hazards associated with completing this job.

| Signature / Badge | Date | Signature / Badge | Date |
|-------------------|------|-------------------|------|
| | | | |
| | | | |
| | | | |
| | | | |

Installation Instructions

Quick-Mount Visual Instructions for Mechanical Installation

BELIMO

Quick-Mount Visual Instructions

1. Rotate the damper to its failsafe position. If the shaft rotates counterclockwise, mount the "CCW" side of the actuator out. If it rotates clockwise, mount the actuator with the "CW" side out.
2. If the universal clamp is not on the correct side of the actuator, move it to the correct side.
3. Slide the actuator onto the shaft and tighten the nuts on the V-bolt with a 10mm wrench to 6-8 ft-lb of torque.
4. Slide the anti-rotation strap under the actuator so that it engages the slot at the base of the actuator. Secure the strap to the duct work with #8 self-tapping screws.

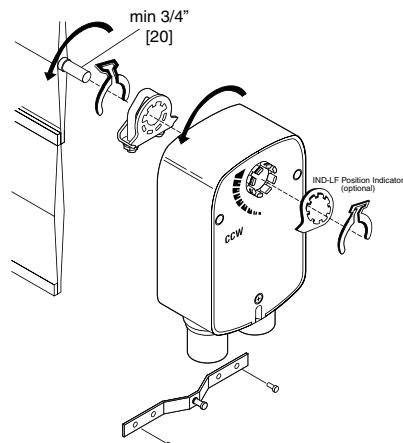
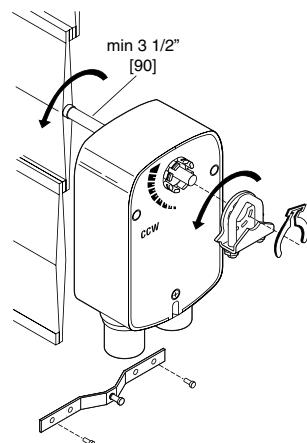
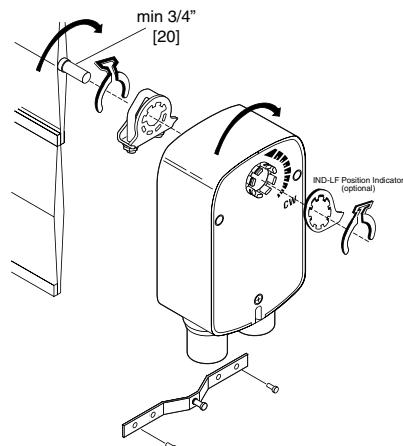
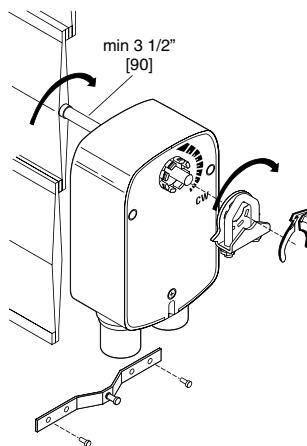
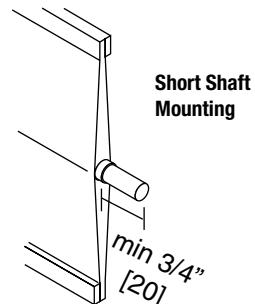
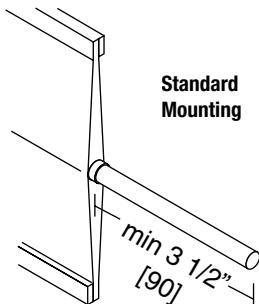
NOTE: Read the "Standard Mounting" instructions, on the next page, for more detailed information.

Preliminary Steps

1. Belimo actuators should be mounted indoors in dry, relatively clean environment free from corrosive fumes. If the actuator is to be mounted outdoors, a protective enclosure must be used to shield the actuator (See *Belimo Mechanical Accessories*).
2. For new construction work, **order dampers with extended shafts**. Instruct the installing contractor to allow space for mounting and service of the Belimo actuator on the shaft.
3. For standard mounting, the damper shaft must extend at least 3 1/2" from the duct. If the shaft extends less than 3 1/2", the actuator may be mounted in its short shaft configuration. If an obstruction blocks access, the shaft can be extended with the AV 10-18 shaft extension. (K6-1 is required)



Dimensions (Inches [mm])



Mechanical Operation

The actuator is mounted directly to a damper shaft up to 1/2" in diameter by means of its universal clamp, or up to a 3/4" shaft with the optional K6-1 clamp. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft.

The LF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator.

The LF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°.

The LF...-S versions are provided with 1 built-in auxiliary switch. This SPDT switch is provided for safety interfacing or signaling, for example, for fan start-up. The switching function is adjustable between 0° and 95°.

Standard Mounting / Airtight Damper Procedure

- See **Figure B**. Manually move the damper to the fail-safe position (a) (usually closed). If the shaft rotated counterclockwise (↖), this is a CCW installation. If the shaft rotated clockwise (↗), this is a CW installation. In a Left Hand installation, the actuator side marked "CW" faces out, while in a CW installation, the side marked "CCW" faces out. All other steps are identical.
- The actuator is usually shipped with the universal clamp mounted to the "CW" side of the actuator. To test for adequate shaft length, slide the actuator over the shaft with the side marked "CW" (or the "CCW" side if this is the side with the clamp). If the shaft extends at least 1/8" through the clamp, mount the actuator as follows. If not, go to the *Short Shaft Installation* section.
- If the clamp is not on the correct side as determined in step #1, re-mount the clamp as follows. If it is on the correct side, proceed to step #5. Look at the universal clamp. If you are mounting the actuator with the "CCW" side out, position the clamp so that the pointer section of the tab is pointing to 0° (see **Figure C**) and the spline pattern of the clamp mates with spline of the actuator. Slip the clamp over the spline. (Use the same procedure if the "CW" side is out.)
- Lock the clamp to the actuator using the retaining clip.
- Verify that the damper is still in its full fail-safe position (a).
- Mount the spring return actuator to the shaft. Tighten the universal clamp, finger tight only.
- Mount the anti-rotation strap at the base of the actuator. Do not tighten the screws.
- Remove the screw from one end of the mounting bracket and pivot it away from the actuator.
- Loosen the universal clamp and, making sure not to move the damper shaft, rotate the actuator approximately 5° in the direction which would open the damper.
- Tighten the universal clamp to the shaft.
- Rotate the actuator to apply pressure to the damper seals (b) and re-engage the anti-rotation strap (c).
- Tighten all fasteners.

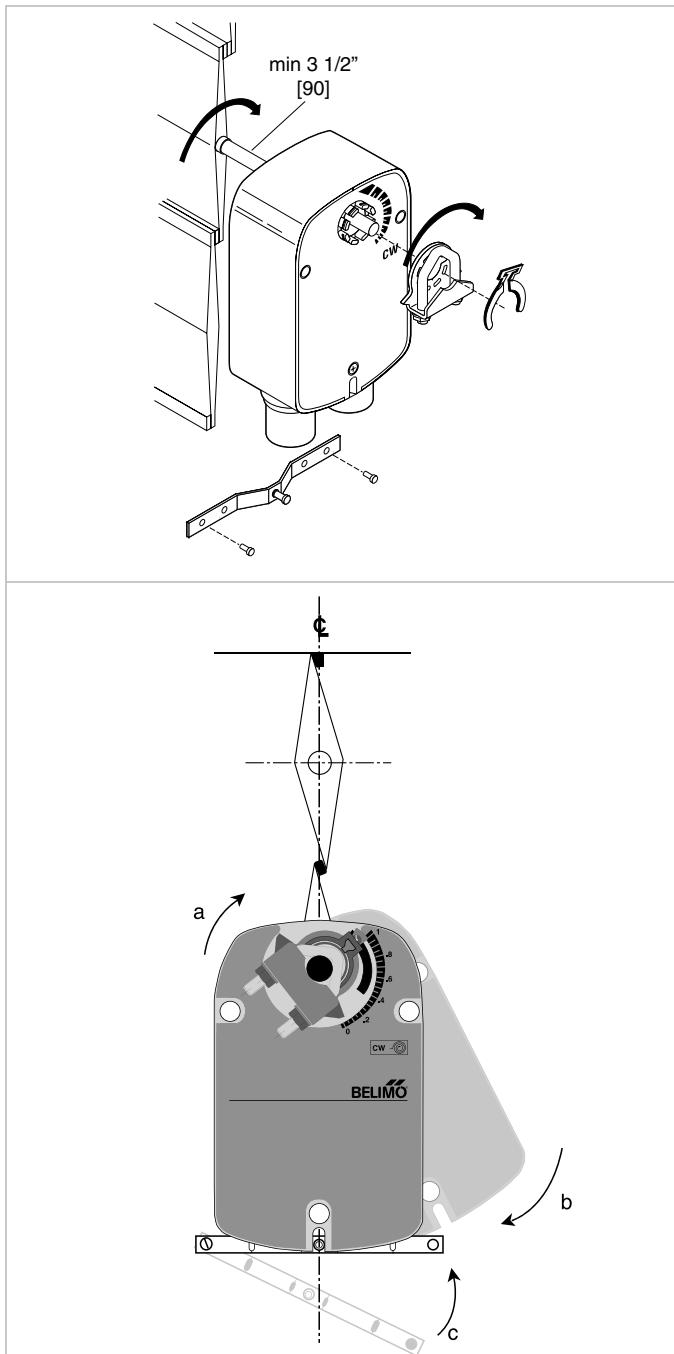


FIGURE B – Standard Mounting (Dimensions in Inches [mm])

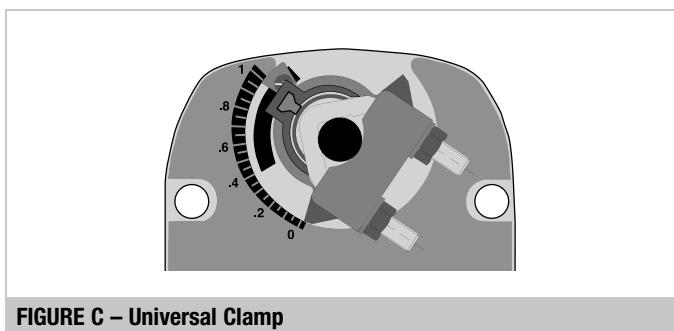


FIGURE C – Universal Clamp

Installation Instructions

Mechanical Installation

BELIMO

Short Shaft Mounting with IND-LF Position Indicator / Airtight Damper Procedure

If the shaft extends at least 3/4" from the duct, follow these steps:

1. (See **Figure D**) Move damper blades to the fail-safe position (a).
2. Determine the best orientation for the universal clamp on the back of the actuator. The best location would be where you have the easiest access to the V bolt nuts on the clamp.
3. Engage the clamp to the actuator as close as possible to the determined location.
4. Lock the clamp to the actuator using the retainer clip.
5. Mount the spring return actuator to the shaft. Tighten the universal clamp, finger tight only.
6. Mount the anti-rotation strap at the base of the actuator. Do not tighten the screws.
7. Remove the screw from one end of the mounting bracket and pivot it away from the actuator.
8. Loosen the universal clamp and, making sure not to move the damper shaft, rotate the actuator approximately 5° in the direction which would open the damper.
9. Verify that the damper is still in its full fail-safe position.
10. Tighten the universal clamp to the shaft.
11. Rotate the actuator to apply pressure to the damper seals (b) and re-engage the anti-rotation strap (c).
12. Tighten all fasteners.
13. Use IND-LF accessory if position indication is needed.

Operational Information for LF24-SR US and LF24-MFT... US Actuators

Initialization of the LF24-SR US and LF24-MFT... US

When power is applied, the internal microprocessor recognizes that the actuator is at its full fail-safe position and uses this position as the base for all of its position calculations. This procedure takes approximately 15 seconds. During this time you will see no response at the actuator. The microprocessor will retain the initialized zero during short power failures of up to 25 seconds. When power is applied during this period, the actuator will return to normal operation and proceed to the position corresponding to the input signal provided. For power failures over 25 seconds, the actuator will be at its fail-safe position and will go through the start up initialization again.

Motor position detection

Belimo brushless DC motors eliminate the need for potentiometers for positioning. Inside the motor are three "Hall Effect" sensors. These sensors detect the spinning rotor and send pulses to the microprocessor which counts the pulses and calculates the position to within 1/3 of a revolution of the motor.

Overload protection

The LF, On/Off actuators are electronically protected against overload. The LF, On/Off actuators have an internal current limiter which maintains the current at a safe level which will not damage the actuator while providing adequate holding torque.

The LF24, modulating actuators (LF24-SR US, LF24-3 US, LF24-MFT US) are protected against overload by digital technology located in the ASIC. The ASIC circuitry constantly monitors the rotation of the brushless DC motor inside the actuator and stops the pulsing to the motor when it senses a stall condition. The motor remains energized and produces full rated torque during stall conditions. The actuator will try to move in the direction of the stall every 2 minutes, for a period of 32 minutes. After this, the actuator will try again every 2 hours.

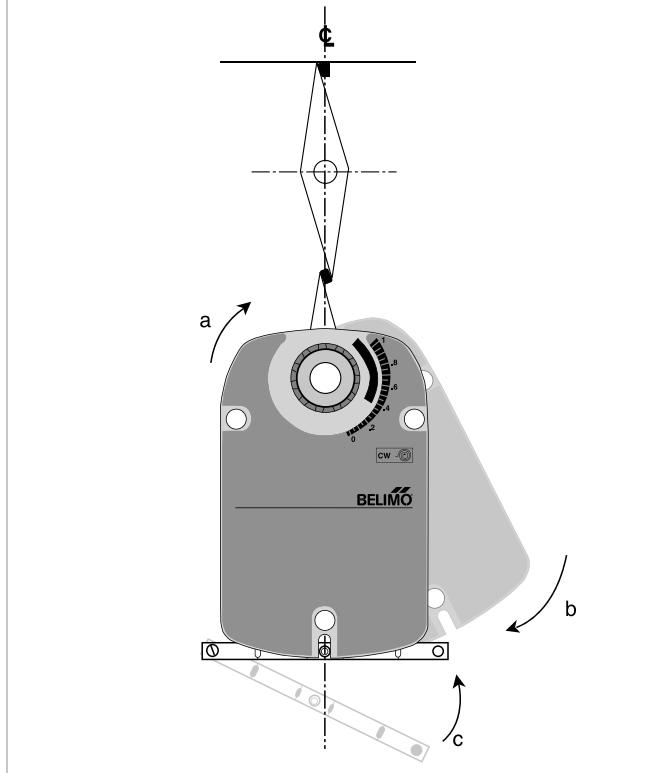
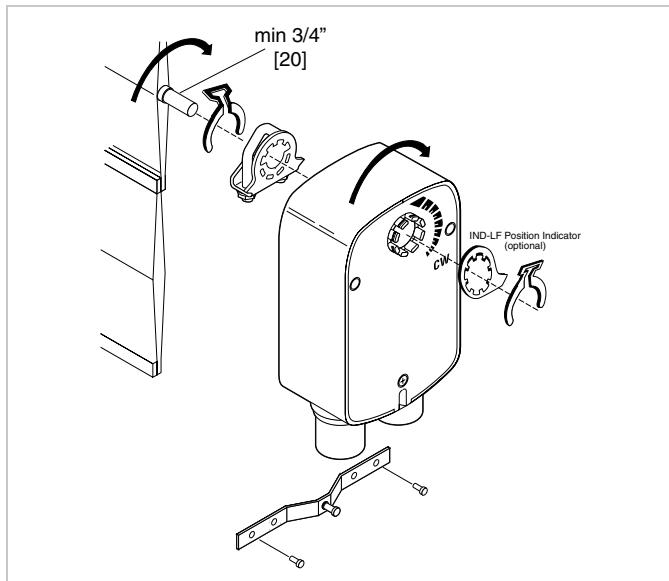


FIGURE D – Standard Mounting (Dimensions in Inches [mm])

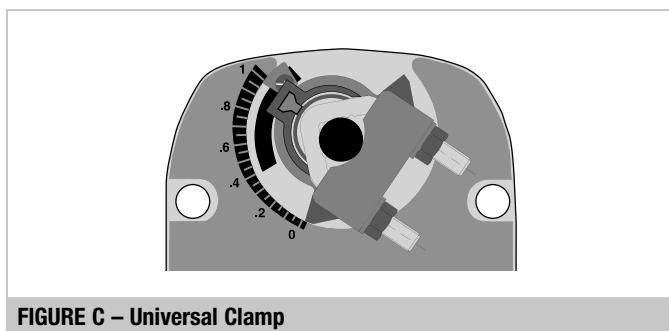
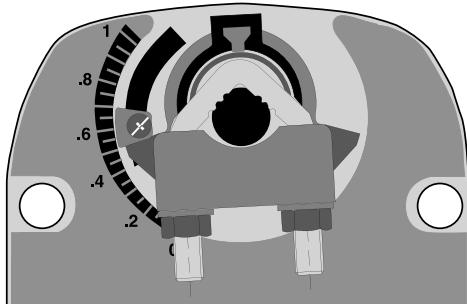


FIGURE C – Universal Clamp

Mechanical Angle of Rotation Limiting

The LF actuators are provided with an adjustable stop to limit the rotation of the actuator. This function works in conjunction with the universal clamp or the optional position indicator. The adjustable stop is needed when rotation of less than 95° is required. The LF actuator can be indefinitely stalled, in any position, without harming the actuator.

**Using the Universal Clamp**

1. Loosen the end stop fastening screw using a #2 Phillips screwdriver.
2. Move the stop block so the bottom edge of the block lines up with the number corresponding to the desired degrees of rotation. (example: 45 degrees of rotation = .5)
3. Lock the block in place with the fastening screw.
4. Check the actuator for proper rotation.

Using the IND-LF Position Indicator with Adjustable Stop

NOTE: preferred method if short shaft mounting is used.

1. With the actuator in its fail-safe position, place the IND-LF Position Indicator so that it points to the 0 degree position.
2. Loosen the end stop fastening screw using a #2 Phillips screwdriver.
3. Move the stop block so the bottom edge of the block lines up with the number corresponding to the desired degrees of rotation (example: 45 degrees of rotation = .5).
4. Lock the block in place with the fastening screw.
5. Check the actuator for proper rotation.

Direction of Rotation Switch

LF24-3(-S) US and LF24-SR(-S) US actuators have a direction of rotation switch on the cover labeled "CW-CCW". Switch position indicates start point. For the LF24-SR, with the switch in position "CW", the actuator rotates clockwise with a decrease in voltage or current. With the switch in position "CCW", the actuator rotates counter-clockwise with a decrease in voltage or current.

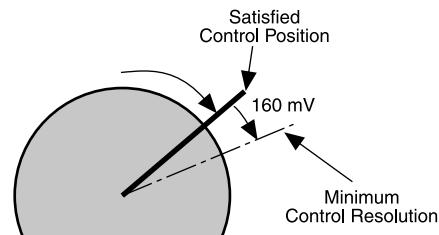
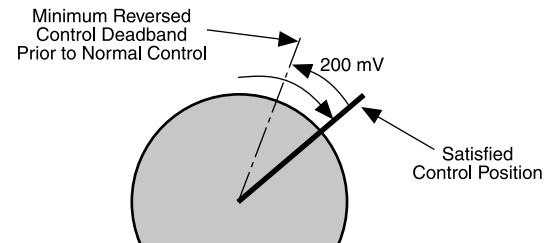
The LF24-3(-S) US and LF24-SR(-S) US actuators rotate clockwise when the switch is in the "CW" position and power is applied to wire #3. When power is applied to wire #4 the actuator rotates counter clockwise.

Rotating the direction of rotation switch to "CCW" reverses the control logic. During checkout, the switch position can be temporarily reversed and the actuator will reverse its direction. This allows the technician a fast and easy way to check the actuator operation without having to switch wires or change settings on the controller. When the check-out is complete, make sure the switch is placed back to its original position.

Control Accuracy and Stability

LF24-SR US actuators have built-in brushless DC motors which provide better accuracy and longer service life.

The LF24-SR US actuators are designed with a unique non-symmetrical deadband. The actuator follows an increasing or decreasing control signal with a 160 mV resolution. If the signal changes in the opposite direction, the actuator will not respond until the control signal changes by 200 mV. This allows these actuators to track even the slightest deviation very accurately, yet allowing the actuator to "wait" for a much larger change in control signal due to control signal instability.

LF Actuator responds to a 160 mV signal when not changing direction from stop position.**LF Actuator responds to a 200 mV signal when reversing direction from stop position.**

The LF24-MFT(-S) US control accuracy and stability can be found in the MFT technical documentation.

Installation Instructions

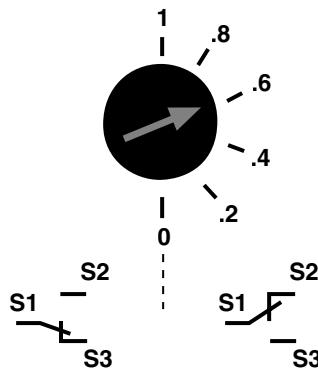
Auxiliary Switches and Non-Direct Mounting Methods

BELIMO®

Auxiliary Switches

The ...-S model actuators are equipped with an adjustable auxiliary switch used to indicate damper position or to interface additional controls or equipment. Switching positions can be set over the full 0 to 95° rotation simply by setting a switch on the actuator.

1. Set desired switch position.
(Example 60%)
2. As the actuator rotates, the switch indicator moves from .6 (60%) toward 0 (0%). When the indicator passes 0 the switch contact between S1 and S2 is broken and the contact between S1 and S3 is made.



Switch Rating

| Voltage | Resistive load | Inductive load |
|---------|----------------|----------------|
| 120 VAC | 3 A | 1.03 A |
| 250 VAC | 3 A | 0.5 A |

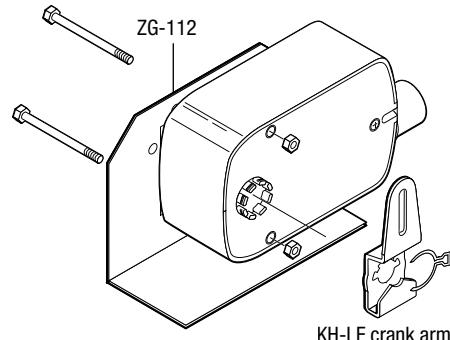
Non-Direct Mounting Methods

KH-LF Crank arm Including Retaining Ring



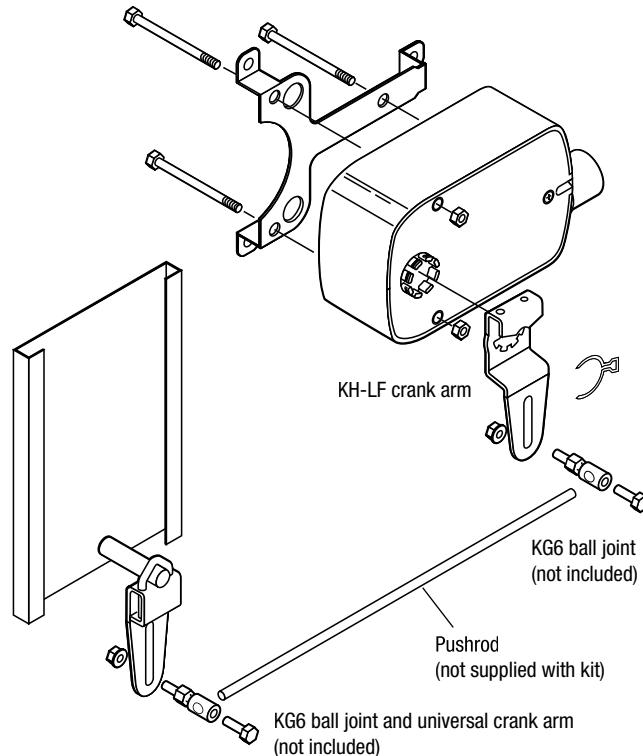
KH-LF
For round shafts up to 1/2"

ZG-LF112 Crank arm Adaptor Kit



KH-LF crank arm

ZG-LF2 Crank arm Adaptor Kit



WARNING The wiring technician must be trained and experienced with electronic circuits. Disconnect power supply before attempting any wiring connections or changes. Make all connections in accordance with wiring diagrams and follow all applicable local and national codes. Provide disconnect and overload protection as required. Use copper, twisted pair, conductors only. If using electrical conduit, the attachment to the actuator must be made with flexible conduit.

Always read the controller manufacturer's installation literature carefully before making any connections. Follow all instructions in this literature. If you have any questions, contact the controller manufacturer and/or Belimo.

Transformers

The LF24 . . actuator requires a 24 VAC class 2 transformer and draws a maximum of 7 VA per actuator. The actuator enclosure cannot be opened in the field, there are no parts or components to be replaced or repaired.

- EMC directive: 89/336/EEC
- Software class A: Mode of operation type 1
- Low voltage directive: 73/23/EEC

CAUTION It is good practice to power electronic or digital controllers from a separate power transformer than that used for actuators or other end devices. The power supply design in our actuators and other end devices use half wave rectification. Some controllers use full wave rectification. When these two different types of power supplies are connected to the same power transformer and the DC commons are connected together, a short circuit is created across one of the diodes in the full wave power supply, damaging the controller. Only use a single power transformer to power the controller and actuator if you know the controller power supply uses half wave rectification.

Multiple Actuators, One Transformer

Multiple actuators may be powered from one transformer provided the following rules are followed:

1. The TOTAL current draw of the actuators (VA rating) is less than or equal to the rating of the transformer.
2. Polarity on the secondary of the transformer is strictly followed. This means that all No. 1 wires from all actuators are connected to the common leg on the transformer and all No. 2 wires from all actuators are connected to the hotleg. Mixing wire No. 1 & 2 on one leg of the transformer will result in erratic operation or failure of the actuator and/or controls.

Multiple Actuators, Multiple Transformers

Multiple actuators positioned by the same control signal may be powered from multiple transformers provided the following rules are followed:

1. The transformers are properly sized.
2. All No. 1 wires from all actuators are tied together and tied to the negative leg of the control signal. See wiring diagram.

Wire Length for LF... Actuators

Keep power wire runs below the lengths listed in the table in **Figure A**. If more than one actuator is powered from the same wire run, divide the allowable wire length by the number of actuators to determine the maximum run to any single actuator.

Example for LF24-SR US: 3 actuators, 16 Ga wire
 $550 \text{ Ft} \div 3 \text{ Actuators} = 183 \text{ Ft. Maximum wire run}$

LF24(-S) US Maximum Wire Length

| Wire Size | Max. Feet. | Wire Size | Max. Feet |
|-----------|------------|-----------|-----------|
| 12 Ga | 1100 Ft. | 18 Ga | 260 Ft. |
| 14 Ga | 700 Ft. | 20 Ga | 140 Ft. |
| 16 Ga | 440 Ft. | 22 Ga | 75 Ft. |

LF120(-S) US / LF230(-S) Maximum Wire Length

| Wire Size | Max. Feet. | Wire Size | Max. Feet |
|-----------|------------|-----------|-----------|
| 12 Ga | 1250 Ft. | 18 Ga | 320 Ft. |
| 14 Ga | 800 Ft. | 20 Ga | 160 Ft. |
| 16 Ga | 500 Ft. | 22 Ga | 85 Ft. |

LF24-SR(-S) US / LF24-3(-S) US

LFC24-3-R(-S) US / LF24-MFT... US

Maximum Wire Length

| Wire Size | Max. Feet. | Wire Size | Max. Feet |
|-----------|------------|-----------|-----------|
| 12 Ga | 1500 Ft. | 18 Ga | 375 Ft. |
| 14 Ga | 925 Ft. | 20 Ga | 200 Ft. |
| 16 Ga | 550 Ft. | 22 Ga | 100 Ft. |

FIGURE A

Wire Type and Wire Installation Tips

For most installations, 18 or 16 Ga. cable works well with the LF24... actuators. Use code-approved wire nuts, terminal strips or solderless connectors where wires are joined. It is good practice to run control wires unspliced from the actuator to the controller. If splices are unavoidable, make sure the splice can be reached for possible maintenance. Tape and/or wire-tie the splice to reduce the possibility of the splice being inadvertently pulled apart.

The LF24... proportional actuators have a digital circuit that is designed to ignore most unwanted input signals (pickup). In some situations the pickup may be severe enough to cause erratic running of the actuator. For example, a large inductive load (high voltage AC wires, motors, etc.) running near the power or control wiring may cause excessive pickup. To solve this problem, make one or more of the following changes:

1. Run the wire in metallic conduit.
2. Re-route the wiring away from the source of pickup.
3. Use shielded wire (Belden 8760 or equal). Ground the shield to an earth ground. Do not connect it to the actuator common.

Brushless DC Motor Operation

Belimo's brushless DC motor spins by reversing the poles of stationary electromagnets housed inside rotating permanent magnets. The electromagnetic poles are switched by a microprocessor and a special ASIC (Application Specific Integrated Circuit) developed by Belimo. Unlike the conventional DC motor, there are no brushes to wear or commutators to foul.

Startup and Checkout

Instructions For LF24-SR (-S) US and LF24-MFT...US + P100



LF24-SR (-S) US and LF24-MFT...US + P100 Electrical Check-Out Procedure

| STEP | Procedure | Expected Response | Gives Expected Response Go To Step... | Does Not Give Expected Response Go To Step... |
|------|---|--|--|---|
| 1. | Remove power to reset actuator. Re-apply power. Apply control signal to actuator. | Actuator will move to its "Control Signal" position. | Actuator operates properly Step 8. | No response at all Step 2. Operation is reversed Step 3. Does not drive toward "Control Signal Position" Step 4. |
| 2. | Check power wiring. Correct any problems. See Note 1. | Power supply rating should be the total power requirement of the actuator(s). Minimum voltage of 19.2 VAC or 21.6 VDC. | Power wiring corrected, actuator begins to drive Step 1. | Power wiring corrected, actuator still does not drive Step 4. |
| 3. | Turn reversing switch to the correct position. Make sure the switch is turned all the way left or right. | Actuator will move to its "Control Signal" position. | Actuator operates properly Step 8. | Does not drive toward "Control Signal Position" Step 4. |
| 4. | Make sure the control signal positive (+) is connected to Wire No 3 and control signal negative (-) is connected to wire No. 1. Most control problems are caused by reversing these two wires. Verify that the reversing switch is all the way CCW or CW. | Drives to "Control Signal" position | Actuator operates properly Step 8. | Step 5. |
| 5. | Check input signal with a digital voltmeter (DVM). Make sure the input is within the range of the actuator. For LF24-SR US this is 2 to 10 VDC or 4 to 20 mA. Note: The input signal must be above the 2 VDC or 4 mA to have the actuator move. | Input voltage or current should be $\pm 1\%$ of what controller's adjustment or programming indicate. | Controller output (actuator input) is correct. Input Polarity Correct Step 6. | Reprogram, adjust repair or replace controller as needed Step 1. |
| 6. | Loosen the nuts on the V-bolt and move the damper by hand from fully closed to fully open. | Damper will go from fully closed to fully open. | Damper moves properly Step 7. | Find cause of damper jam and repair. Move damper back to the fully closed position and tighten the nuts Step 1. |
| 7. | Check damper torque requirement. | Torque requirement is actuator's minimum torque. | Defective Actuator. Replace Actuator. - See Note 2. | Recalculate actuator requirement and correct installation. |
| 8. | Actuator works properly. Test controller by following controller manufacturer's instructions. | | | |

NOTE 1 Check that the transformer(s) are sized properly.

- If a common transformer is used, make sure that polarity is observed on the secondary. This means connect all No. 1 wires to one leg of the transformer and all No. 2 wires to the other leg of the transformer.
- If multiple transformers are used with one control signal, make sure all No. 1 wires are tied together and tied to control signal negative (-).
- Controllers and actuators must have separate 24 VAC/VDC power sources.

NOTE 2 If failure occurs within 5 years from original installation date, notify Belimo and give details of the application.

Basic Fail-Safe modulating actuator for controlling dampers in typical commercial HVAC applications.

- Torque motor 35 in-lb [4 Nm]
- Nominal voltage AC/DC 24 V
- Control modulating
- Position feedback 2...10 V



5-year warranty



Technical data

| Electrical data | Nominal voltage | AC/DC 24 V |
|------------------------------------|---|------------|
| Nominal voltage frequency | 50/60 Hz | |
| Nominal voltage range | AC 19.2...28.8 V / DC 21.6...28.8 V | |
| Power consumption in operation | 2.5 W | |
| Power consumption in rest position | 1 W | |
| Transformer sizing | 5 VA | |
| Electrical Connection | 18 GA plenum cable, 1 m, with 1/2" conduit connector | |
| Overload Protection | electronic throughout 0...95° rotation | |
| Electrical Protection | actuators are double insulated | |
| Functional data | | |
| Torque motor | 35 in-lb [4 Nm] | |
| Operating range Y | 2...10 V | |
| Operating range Y note | 4...20 mA w/ ZG-R01 (500 Ω, 1/4 W resistor) | |
| Input impedance | 100 kΩ for 2...10 V (0.1 mA), 500 Ω for 4...20 mA | |
| Position feedback U | 2...10 V | |
| Position feedback U note | Max. 0.7 mA | |
| Direction of motion motor | selectable with switch 0/1 | |
| Direction of motion fail-safe | reversible with cw/ccw mounting | |
| Angle of rotation | Max. 95° | |
| Running Time (Motor) | 150 s / 90° | |
| Running time motor note | constant, independent of load | |
| Running time fail-safe | <25 s @ -4...122°F [-20...50°C], <60 s @ -22°F [-30°C] | |
| Noise level, motor | 30 dB(A) | |
| Noise level, fail-safe | 62 dB(A) | |
| Position indication | Mechanical | |
| Safety data | | |
| Power source UL | Class 2 Supply | |
| Degree of protection IEC/EN | IP54 | |
| Degree of protection NEMA/UL | NEMA 2 | |
| Enclosure | UL Enclosure Type 2 | |
| Agency Listing | cULus acc. To UL 873 and CAN/CSA C22.2 No. 24-93 | |
| Quality Standard | ISO 9001 | |
| UL 2043 Compliant | Suitable for use in air plenums per Section 300.22(C) of the NEC and Section 602 of the IMC | |
| Ambient humidity | Max. 95% RH, non-condensing | |
| Ambient temperature | -22...122°F [-30...50°C] | |
| Storage temperature | -40...176°F [-40...80°C] | |
| Servicing | maintenance-free | |

| | | |
|------------------|------------------|------------------|
| Weight | Weight | 3.4 lb [1.5 kg] |
| Materials | Housing material | galvanized steel |

Footnotes †Rated Impulse Voltage 800V, Type of action 1.AA, Control Pollution Degree 3

Product features

| | |
|------------------------------|---|
| Application | For fail-safe, modulating control of dampers in HVAC systems. Actuator sizing should be done in accordance with the damper manufacturer's specifications. The actuator is mounted directly to a damper shaft from 3/8" up to 1/2" in diameter by means of its universal clamp, 1/2" shaft centered at delivery. For shafts up to 3/4" use K6-1 accessory. A crank arm and several mounting brackets are available for applications where the actuator cannot be direct coupled to the damper shaft. The actuator operates in response to a 2...10 V, or with the addition of a 500Ω resistor, a 4...20 mA control input from an electronic controller or positioner. A 2...10 V feedback signal is provided for position indication. |
| Operation | The LF series actuators provide true spring return operation for reliable fail-safe application and positive close-off on air tight dampers. The spring return system provides consistent torque to the damper with, and without, power applied to the actuator. The LF series provides 95° of rotation and is provided with a graduated position indicator showing 0 to 95°. The LF24-SR US uses a brushless DC motor which is controlled by an Application Specific Integrated Circuit (ASIC) and a microprocessor. The microprocessor provides the intelligence to the ASIC to provide a constant rotation rate and to know the actuator's exact fail-safe position. The ASIC monitors and controls the brushless DC motor's rotation and provides a digital rotation sensing function to prevent damage to the actuator in a stall condition. The actuator may be stalled anywhere in its normal rotation without the need of mechanical end switches. Power consumption is reduced in holding mode. |
| Typical specification | Spring return control damper actuators shall be direct coupled type which require no crank arm and linkage and be capable of direct mounting to a shaft up to a 3/4" diameter and center on a 1/2" shaft (default). Actuator shall deliver a minimum output torque of 35 in-lbs. The actuator must provide modulating damper control in response to a 2 to 10 VDC or, with the addition of a 500Ω resistor, a 4 to 20 mA control input from an electronic controller. Actuators shall use a brushless DC motor controlled by a microprocessor and be protected from overload at all angles of rotation. Run time shall be constant, and independent of torque. A 2 to 10 feedback signal shall be provided for position feedback. The actuator must be designed so that they may be used for either clockwise or counter clockwise failsafe operation. Actuators shall be cULus listed, have a 5 year warranty, and be manufactured under ISO 9001 International Quality Control Standards. Actuators shall be as manufactured by Belimo. |

Accessories

| Electrical accessories | Description | Type |
|---|-------------|---------|
| DC Voltage Input Rescaling Module | | IRM-100 |
| Auxiliary switch, mercury-free | | P475 |
| Auxiliary switch, mercury-free | | P475-1 |
| Signal simulator, Power supply AC 120 V | | PS-100 |
| Convert Pulse Width Modulated Signal to a 2...10 V Signal for Belimo Proportional Actuators | | PTA-250 |
| Positioner for wall mounting | | SGA24 |
| Positioner for front-panel mounting | | SGF24 |
| Resistor, 500 Ω, 1/4" wire resistor with 6" pigtail wires | | ZG-R01 |
| Resistor kit, 50% voltage divider | | ZG-R02 |
| Transformer, AC 120 V to AC 24 V, 40 VA | | ZG-X40 |

| Mechanical accessories | Description | Type |
|---|---------------|------|
| Shaft extension 170 mm ø10 mm for damper shaft ø6...16 mm | AV6-20 | |
| End stop indicator | IND-LF | |
| Shaft clamp for LF.. | K6 US | |
| Shaft clamp reversible, clamping range ø16...20 mm | K6-1 | |
| Ball joint suitable for damper crank arm KH8 / KH10, Multipack 10 pcs. | KG10A | |
| Ball joint suitable for damper crank arm KH8, Multipack 10 pcs. | KG6 | |
| Ball joint suitable for damper crank arm KH8, Multipack 10 pcs. | KG8 | |
| Damper crank arm Slot width 8.2 mm, for ø1.05" | KH12 | |
| Damper crank arm Slot width 6.2 mm, clamping range ø10...18 mm | KH6 | |
| Damper crank arm Slot width 8.2 mm, clamping range ø10...18 mm | KH8 | |
| Actuator arm, clamping range ø8...16 mm, Slot width 8.2 mm | KH-LF | |
| V-bolt Kit for KH-LF. | KH-LFV | |
| Anti-rotation bracket LF. | LF-P | |
| Push rod for KG10A ball joint 36" L, 3/8" diameter | SH10 | |
| Push rod for KG6 & KG8 ball joints (36" L, 5/16" diameter). | SH8 | |
| Wrench 0.32 in and 0.39 in [8 mm and 10 mm] | TOOL-06 | |
| Angle of rotation limiter, with end stop | ZDB-LF | |
| Form fit adapter 8x8 mm | ZF8-LF | |
| Mounting bracket | ZG-109 | |
| Linkage kit | ZG-110 | |
| Mounting bracket for LF.. | ZG-112 | |
| Damper clip for damper blade, 3.5" width. | ZG-DC1 | |
| Damper clip for damper blade, 6" width. | ZG-DC2 | |
| LF crankarm adaptor kit (includes ZG-112). | ZG-LF112 | |
| LF crankarm adaptor kit (T bracket included). | ZG-LF2 | |
| Shaft extension for 3/8" diameter shafts (4" L). | ZG-LMSA-1 | |
| Shaft extension for 1/2" diameter shafts (5" L). | ZG-LMSA-1/2-5 | |
| Weather shield 13x8x6" [330x203x152 mm] (LxWxH) | ZS-100 | |
| Base plate, for ZS-100 | ZS-101 | |
| Weather shield 406x213x102 mm [16x8-3/8x4"] (LxWxH) | ZS-150 | |
| Explosion proof housing 16x10x6.435" [406x254x164 mm] (LxWxH), UL and CSA, Class I, Zone 1&2, Groups B, C, D, (NEMA 7), Class III, Hazardous (classified) Locations | ZS-260 | |
| Weather shield 17-1/4x8-3/4x5-1/2" [438x222x140 mm] (LxWxH), NEMA 4X, with mounting brackets | ZS-300 | |
| Weather shield 17-1/4x8-3/4x5-1/2" [438x222x140 mm] (LxWxH), NEMA 4X, with mounting brackets | ZS-300-5 | |
| Shaft extension 1/2" | ZS-300-C1 | |
| Shaft extension 3/4" | ZS-300-C2 | |
| Shaft extension 1" | ZS-300-C3 | |
| Linkage kit | ZG-JSL | |
| Jackshaft Retrofit Linkage with Belimo Rotary Actuators | | |

Electrical installation



Warning! Live electrical components!

During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.



Meets cULus requirements without the need of an electrical ground connection.



Provide overload protection and disconnect as required.



Actuators may also be powered by DC 24 V.



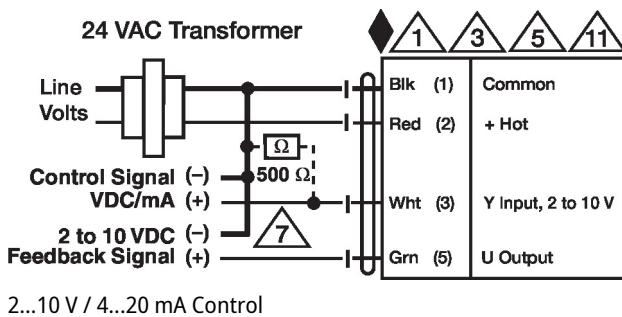
Only connect common to negative (-) leg of control circuits.



A 500 Ω resistor (ZG-R01) converts the 4...20 mA control signal to 2...10 V.



Actuators may be connected in parallel if not mechanically linked. Power consumption and input impedance must be observed.



Dimensions

