

PRODUCTS

1. Acceptable Manufacturers

Subject to compliance with requirements, provide electric and electronic control system products by one of the following:

- Honeywell, Inc.
- Johnson Controls, Inc.
- Invensys Building Systems, Inc. (Siebe Environmental Controls Co., Barber-Colman Co., Robertshaw Controls, Inc.)
- Siemens Building Technologies, Inc. (Landis & Staefa, Inc., Landis & Gyr, Inc., Landis & Gyr Powers, Inc., Powers Regulator Co.)

A. Materials and Equipment

1. General

Provide electric and electronic control system products in sizes and capacities indicated, consisting of automatic control valves, automatic control dampers, thermostats, clocks, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer. Provide electric control systems with the following functional and construction features as indicated.

DELETE FROM ABOVE AND BELOW THOSE ELECTRIC AND ELECTRONIC CONTROL COMPONENTS NOT REQUIRED FOR PROJECT. ADD OTHER FEATURES AND CAPABILITIES AS DESIRED.

2. Automatic Control Valves

Provide automatic control valves suitable for the specified controlled media of the type and general construction indicated. Where type or general construction is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on controlled media, maximum pressure and temperature rating of piping system, and other pertinent application requirements. Unless otherwise indicated, provide valves which mate and match material of connecting piping. Provide equipment control valves with control valve actuators of required input power type and control signal type that will

accurately position the flow control element and provide sufficient force to achieve required leakage specification.

a) Distribution Valves

(1) Flanged Valves, line size 2 ½” to 6”

(a) Controlled Media Specific Items

SELECT ONE OR MORE OF THE FOLLOWING CONTROLLED MEDIA

(i) Steam

The control valve shall be suitable for saturated steam to a maximum temperature of 337°F (170°C) and a maximum pressure of 100 psig (690 kPa). A Linear flow characteristic and stainless steel trim is recommended.

(ii) Water

The control valve shall be suitable for chilled water to a minimum of 32°F (0°C) and hot water to a maximum temperature of 250°F (120°C). A modified equal percentage flow characteristic is recommended. Bronze trim is recommended for operating differential pressures up to 25psi. Stainless steel trim is recommended for operating differential pressures up to 50psi.

(iii) Glycol Solutions

The control valve shall be suitable for 50% ethylene or propylene glycol solutions, chilled glycol/water solutions to a minimum of 20°F (-7°C) and hot glycol/water solutions to a maximum temperature of 250°F (120°C). A modified equal percentage flow characteristic is recommended. Bronze trim is recommended for operating differential pressures up to 25psi. Stainless steel trim is recommended for operating differential pressures up to 50psi.

(b) General Construction Materials/Applicable Standards

SELECT ONE OR BOTH OF THE FOLLOWING PRESSURE CLASSES

(i) Pressure Class 125

Control valve bodies shall be constructed of gray cast iron according to ASTM A126B, and shall meet requirements of ANSI B16.1, pressure class ANSI 125.

(ii) Pressure Class 250

Control valve bodies shall be constructed of gray cast iron according to ASTM A126B, and shall meet requirements of ANSI B16.1, pressure class ANSI 250.

(iii) Flange Connection Dimensions

For Class 125 and Class 250 valve assemblies, flange dimensions shall be according to ANSI B16.1, and valve body flange-to-flange dimensions shall be according to ANSI/ISA S75.03.

(iv) Flow Rate (Cv)

The control valve flow rate (Cv) shall meet the requirements of ANSI/ISA S75.02.

SELECT ONE OR BOTH OF THE FOLLOWING FLOW CHARACTERISTIC TYPES

(v) Linear Flow Characteristic

The control valve shall have a linear flow characteristic, according to ANSI/ISA S75.11.

(vi) Equal Percentage Flow Characteristic

The control valve shall have a modified equal percentage flow characteristic.

(vii) Rangeability

The control valve shall have a minimum rangeability of 100:1.

(viii) Leakage Class IV (0.01%)

Valve shall meet the requirements of seat leakage Class IV according to ANSI/FCI 70.2, with no more than 125% of nominal force necessary to balance fluid forces applied to valve stem.

SELECT ONE OR BOTH OF THE FOLLOWING STEM PACKING TYPES

(ix) Chilled and Hot water Packing

Valve stem packing shall be of a cartridge type and shall contain at least two EPDM o-rings.

(x) Steam Packing

Valve stem packing shall be of a spring-loaded cartridge type and shall contain at least seven Teflon v-rings and one EPDM o-ring.

SELECT ONE OR BOTH OF THE FOLLOWING TRIM MATERIAL TYPES. STAINLESS STEEL IS RECOMMENDED FOR STEAM APPLICATIONS AND HIGH DIFFERENTIAL PRESSURE APPLICATIONS. BRONZE TRIM IS RECOMMENDED FOR NORMAL DUTY WATER SERVICE.

(xi) Bronze Trim

Control valve seat shall be made of stainless steel according to UNS S30300 or ASTM A582 Type 303, and plug shall be made of bronze according to UNS C84400.

(xii) Stainless Trim

Control valve seat and plug shall be made of stainless steel according to UNS S30300, or ASTM A582 Type 303.

(xiii) Stem Materials

Valve stem shall be made of polished stainless steel according to ASTM A581/A or ASTM A582/A.

(c) Service Parts

(i) Packings

SELECT ONE OR BOTH OF THE FOLLOWING STEM PACKING TYPES

(a) Chilled and Hot water Packing

Valve stem packing shall be of a cartridge type and shall contain at least two EPDM o-rings. The cartridge type packing shall be replaceable as a unit.

(b) Steam Packing

Valve stem packing shall be of a spring-loaded cartridge type and shall contain at least three

Teflon v-rings and one EPDM o-ring.

(ii) Trim

(a) Plug and stem

The control plug and stem shall be replaceable as a unit.

(2) Threaded Valves, line size ½” to 2”

(a) Controlled Media Specific Items

SELECT ONE OR MORE OF THE FOLLOWING CONTROLLED MEDIA

(i) Steam

The control valve shall be suitable for saturated steam to a maximum temperature of 337°F (170°C) and a maximum pressure of 100 psig (690 kPa). A Linear flow characteristic and stainless steel trim is recommended.

(ii) Water

The control valve shall be suitable for chilled water to a minimum of 32°F (0°C) and hot water to a maximum temperature of 250°F (120°C). A modified equal percentage flow characteristic is recommended. Bronze or brass trim is recommended for operating differential pressures up to 25psi. Stainless steel trim is recommended for operating differential pressures up to 50psi.

(iii) Glycol Solutions

The control valve shall be suitable for 50% ethylene or propylene glycol solutions, chilled glycol/water solutions to a minimum of 20°F (-7°C) and hot glycol/water solutions to a maximum temperature of 250°F (120°C). A modified equal percentage flow characteristic is recommended. Bronze or brass trim is recommended for operating differential pressures up to 25psi. Stainless steel trim is recommended for operating differential pressures up to 50psi.

(b) General Construction Materials/Applicable Standards

(i) Pressure Class 250

Control valve bodies shall be constructed of cast bronze according to UNS C84400 or

forged brass according to UNS C37700, and shall meet requirements of ANSI B16.1, pressure class ANSI 250.

(ii) Threaded Connection Dimensions

Threaded connection specifications shall be according to ANSI B2.1.

(iii) Flow Rate (Cv)

The control valve flow rate (Cv) shall meet the requirements of ANSI/ISA S75.02.

SELECT ONE OR BOTH OF THE FOLLOWING FLOW CHARACTERISTIC TYPES

(iv) Linear Flow Characteristic

The control valve shall have a linear flow characteristic, according to ANSI/ISA S75.11.

(v) Equal Percentage Flow Characteristic

The control valve shall have a modified equal percentage flow characteristic.

(vi) Rangeability

The control valve shall have a minimum rangeability of 100:1.

(vii) Leakage Class IV (0.01%)

Valve shall meet the requirements of seat leakage Class IV according to ANSI/FCI 70.2, with no more than 125% of nominal force necessary to balance fluid forces applied to valve stem.

SELECT ONE OR BOTH OF THE FOLLOWING STEM PACKING TYPES

(viii) Chilled and Hot water Packing

Valve stem packing shall be of a cartridge type and shall contain at least two EPDM o-rings.

(ix) Steam Packing

Valve stem packing shall be of a spring-loaded cartridge type and shall contain at least three Teflon v-rings and one EPDM o-ring.

SELECT ONE OR BOTH OF THE FOLLOWING TRIM MATERIAL TYPES. STAINLESS

STEEL IS RECOMMENDED FOR STEAM APPLICATIONS AND HIGH DIFFERENTIAL PRESSURE APPLICATIONS. BRONZE/BRASS TRIM IS RECOMMENDED FOR NORMAL DUTY WATER SERVICE.

(x) Bronze/Brass Trim

Control valve seat shall be made of stainless steel according to UNS S30300 or ASTM A582 Type 303, and plug shall be made of bronze according to UNS C84400 and/or brass according to UNS C36000 or C37700.

(xi) Stainless Trim

Control valve seat and plug shall be made of stainless steel according to UNS S30300, or ASTM A582 Type 303.

(xii) Stem Materials

Valve stem shall be made of polished stainless steel according to ASTM A581/A or ASTM A582/A.

(c) Service Parts

(i) Packings

SELECT ONE OR BOTH OF THE FOLLOWING STEM PACKING TYPES

(a) Chilled and Hot water Packing

Valve stem packing shall be of a cartridge type and shall contain at least two EPDM o-rings. The cartridge type packing shall be replaceable as a unit.

(b) Steam Packing

Valve stem packing shall be of a spring-loaded cartridge type and shall contain at least three Teflon v-rings and one EPDM o-ring.

(ii) Trim

(a) Plug and stem

The control plug and stem shall be replaceable as a unit.

b) Terminal Unit Valves

(1) Threaded Valves, line size ½” to 1 ½”

(a) Controlled Media Specific Items

SELECT ONE OR MORE OF THE FOLLOWING CONTROLLED MEDIA

(i) Steam

The control valve shall be suitable for saturated steam to a maximum temperature of 250°F (120°C) and a maximum pressure of 15 psig (103.5 kPa). A linear flow characteristic and stainless steel trim is recommended.

(ii) Water

The control valve shall be suitable for chilled water to a minimum of 32°F (0°C) and hot water to a maximum temperature of 250°F (120°C). Bronze or brass trim is recommended for operating differential pressures up to 25psi. Stainless steel trim is recommended for operating differential pressures up to 50psi.

(iii) Glycol Solutions

The control valve shall be suitable for 50% ethylene or propylene glycol solutions, chilled glycol/water solutions to a minimum of 32°F (0°C) and hot glycol/water solutions to a maximum temperature of 250°F (120°C). Bronze or brass trim is recommended for operating differential pressures up to 25psi. Stainless steel trim is recommended for operating differential pressures up to 50psi.

(b) General Construction Materials/Applicable Standards

(i) Pressure Class 250

Control valve bodies shall be constructed of cast bronze according to UNS C84400 or forged brass according to UNS C37700, and shall meet requirements of ANSI B16.1,

pressure class ANSI 250.

(ii) Threaded Connection Dimensions

Threaded connection specifications shall be according to ANSI B2.1.

(iii) Flow Rate (Cv)

The control valve flow rate (Cv) shall meet the requirements of ANSI/ISA S75.02.

(iv) Modified Equal Percentage Flow Characteristic

The control valve shall have a modified equal percentage flow characteristic, according to ANSI/ISA S75.11.

(v) Rangeability

The control valve shall have a minimum rangeability of 100:1 on valves with a Cv value greater than or equal to 1.0 and a minimum rangeability of 50:1 on valves with a Cv value less than 1.0.

(vi) Leakage Class IV (0.01%)

Valve shall meet the requirements of seat leakage Class IV according to ANSI/FCI 70.2, with no more than 125% of nominal force necessary to balance fluid forces applied to valve stem.

(vii) Chilled water, Hot water, and Steam Packing

Valve stem packing shall contain at least two EPDM o-rings.

SELECT ONE OR BOTH OF THE FOLLOWING TRIM MATERIAL TYPES. STAINLESS STEEL IS RECOMMENDED FOR STEAM APPLICATIONS AND HIGH DIFFERENTIAL PRESSURE APPLICATIONS. BRONZE/BRASS TRIM IS RECOMMENDED FOR NORMAL DUTY WATER SERVICE.

(viii) Bronze/Brass Trim

Control valve seat and plug shall be made of bronze according to UNS C84400 and/or brass according to UNS C36000 or C37700.

(ix) Stainless Trim

Control valve seat and plug shall be made of stainless steel according to UNS S30300, or ASTM A582 Type 303.

(x) Stem Materials

Valve stem shall be made of polished stainless steel according to ASTM A581/A or ASTM A582/A

c) Zone Valves

(1) Threaded or Sweat Connection Valves, line size ½” to 1”

(a) Controlled Media Specific Items

SELECT ONE OR MORE OF THE FOLLOWING CONTROLLED MEDIA

(i) Water

The control valve shall be suitable for chilled water to a minimum of 34°F (1°C) and hot water to a maximum temperature of 230°F (110°C).

(ii) Glycol Solutions

The control valve shall be suitable for 50% ethylene or propylene glycol solutions, chilled glycol/water solutions to a minimum of 34°F (1°C) and hot glycol/water solutions to a maximum temperature of 230°F (110°C).

(b) General Construction Materials/Applicable Standards

(i) Pressure Class 125

Control valve bodies shall be constructed of forged brass and shall meet requirements of ANSI B16.1, pressure class ANSI 125.

SELECT ONE OR MORE OF THE FOLLOWING CONNECTION TYPES

(ii) Threaded Connection Dimensions

Threaded connection specifications shall be according to ANSI B2.1.

(iii) Sweat Connection Dimensions

Sweat connection specifications shall be according to ANSI B16.22.

(iv) Flow Rate (Cv)

The control valve flow rate (Cv) shall meet the requirements of ANSI/ISA S75.02.

(v) Linear Flow Characteristic

The control valve shall have a linear flow characteristic, according to ANSI/ISA S75.11.

(vi) Leakage Class III (0.1%)

Valve shall meet the requirements of seat leakage Class III according to ANSI/FCI 70.2, with no more than 125% of nominal force necessary to balance fluid forces applied to valve stem.

(vii) Chilled and Hot water Packing

Valve stem packing shall contain at least two EPDM o-rings.

(viii) Brass Trim

Control valve seat and plug shall be made of brass according UNS C36000.

(ix) Stem Materials

Valve stem shall be made of polished stainless steel according to ASTM A581/A or ASTM A582/A.

d) Ball Valves

(1) Threaded Valves, line size ½” to 2”

(a) Controlled Media Specific Items

SELECT ONE OR MORE OF THE FOLLOWING CONTROLLED MEDIA

(i) Water

The control valve shall be suitable for chilled water to a minimum of 32°F (0°C) and hot water to a maximum temperature of 250°F (120°C).

(ii) Glycol Solutions

The control valve shall be suitable for 50% ethylene or propylene glycol solutions, chilled glycol/water solutions to a minimum of 32°F (0°C) and hot glycol/water solutions to a maximum temperature of 250°F (120°C).

(b) General Construction Materials/Applicable Standards

(i) Body Material

Control valve bodies shall be constructed of forged brass according to ASTM B283, and shall meet requirements of no less than 360 PSI at 250°F.

(ii) Ball Material

Valve ball shall consist of chemically nickel-plated brass. Manufacturer shall provide a glass filled polymer ball insert, as an integral part of the ball, for modulating flow applications.

(iii) Threaded Connection Dimensions

Threaded connection specifications shall be according to ANSI B2.1.

(iv) Flow Rate (Cv)

The control valve flow rate (Cv) shall meet the requirements of ANSI/ISA S75.02.

(v) Equal Percentage Flow Characteristic

The control valve shall have an equal percentage flow characteristic, according to ANSI/ISA S75.11.

(vi) Leakage Class IV (0.01%)

Valve shall meet the requirements of seat leakage Class IV according to ANSI/FCI 70.2, with no more than 125% of nominal force necessary to balance fluid forces applied to valve stem.

(vii) Chilled and Hot water Packing and Stem

Valve shall have a blow-out proof stem with two EPDM O-rings.

(viii) Stem Materials

Valve stem shall be made of brass.

(ix) Manual Operation

Valve shall have the ability to be manually operated in the event of a power failure.

3. Control Valve Actuators

a) Pneumatic Valve Actuators

(1) General Requirements

(a) Operating pressure

Valve actuator shall operate with supply pressure up to a maximum of 35psi (240kPa).

(b) Safety pressure

Valve actuator shall withstand a maximum supply overpressure of 50psi (345kPa) then resume normal operation when control pressure is applied.

(c) Pressure vessel integrity

Valve actuator shall be tested for pressure vessel integrity at a level of triple maximum operating pressure.

(2) Distribution Valve Actuators

(a) Mounting locations

The control valve actuator shall be suitable for mounting in plenum spaces as defined by NEC, Article 100

-Definitions.

(b) Direct Coupled

The control valve actuator shall be directly coupled to the valve, with no intermediary linkage kit required, to facilitate repair and/or replacement.

(c) Control signal

The actuator control signal shall be 5 psi nominal, and shall have a fully adjustable start point over the nominal range of 3 to 10 psi, to facilitate operational sequencing.

(d) Control signal accuracy

Valve actuator position resolution shall be >100:1, with a hysteresis <5% of nominal control signal span.

SELECT ONE OF THE FOLLOWING OPERATING AMBIENT SPECIFICATIONS

(e) Normal duty operating ambient conditions

The control valve actuator shall be suitable for operation to a minimum temperature of -40°F (-40°C), and a maximum temperature of 150°F (65°C), with 0-95% non-condensing ambient humidity, and dry air supply.

(f) Heavy duty operating ambient conditions

The control valve actuator shall be suitable for operation to a minimum temperature of -40°F (-40°C), and a maximum temperature of 180°F (82°C), with 0-95% non-condensing ambient humidity, and dry air supply.

(g) Accessories

FOR 8" AND 12" PNEUMATIC ACTUATORS ONLY

The valve actuator shall have provisions to field or factory mount a pilot positioner.

(3) Terminal Unit Valve Actuators

(a) Mounting locations

The control valve actuator shall be suitable for mounting in plenum spaces as defined by NEC, Article 100
– Definitions.

(b) Direct Coupled

The control valve actuator shall be directly coupled to the valve, with no intermediary linkage kit required, to facilitate repair and/or replacement.

(c) Control signal

The actuator control signal shall be 5 psi nominal, and shall have a fixed, selectable start point over the nominal range of 3 to 10 psi, to facilitate operational sequencing.

(d) Control signal accuracy

Valve actuator position resolution shall be >100:1, with a hysteresis <5% of nominal control signal span.

(e) Normal duty operating ambient conditions

The control valve actuator shall be suitable for operation to a minimum temperature of 32°F (0°C), and a maximum temperature of 150°F (65°C), with 0-95% non-condensing ambient humidity, and dry air supply.

b) Electronic Valve Actuators 24Vac Powered

(1) General Requirements

(a) Applicable Standards

The valve actuator shall be identified as a Class 2 operating device, according to NEC, Article 725.

The valve actuator shall be tested and listed by Underwriters Laboratories according to UL873, and shall bear the UL and cUL approval symbols.

The valve actuator shall be designed and tested to NEMA 1 standards, according to NEMA 250.

FOR PRODUCT LIKELY TO BE EXPORTED TO OR USED IN EUROPE OR A

EUROPEAN TERRITORY OR COMMONWEALTH,

The valve actuator shall bear the CE mark, and shall be designed and tested according to EU directives 89/336/EEG and 72/23/EEG.

(2) Distribution Valve Actuators

OMIT THE FOLLOWING FOR LINKAGE COUPLED ACTUATORS

(a) *Direct Coupled*

The control valve actuator shall be directly coupled to the valve, with no intermediary linkage kit required, to facilitate repair and/or replacement.

The control valve actuator shall be equipped with a manual override feature, allowing operation of the control valve upon loss of control power or signal, without the aid of a separate tool or auxiliary power supply.

(b) *Fail Safe operation*

SELECT ONE OR MORE OF THE FOLLOWING FAIL SAFE OPERATION OPTIONS

•(i) Upon power failure or loss of control signal, the valve actuator shall return to a fail-safe operating position by means of a mechanical spring.

•(ii) Upon power failure, the valve actuator shall maintain its last controlled position (fail in place).

(c) *Visual position indication*

The valve actuator shall provide indication of valve stem position, clearly visible from a distance of 15ft. (4.5m).

(3) Terminal Unit Valve Actuators

OMIT THE FOLLOWING FOR LINKAGE COUPLED ACTUATORS

(a) Direct Coupled

The control valve actuator shall be directly coupled to the valve, with no intermediary linkage kit required, to facilitate repair and/or replacement.

The control valve actuator shall be equipped with a manual override feature, allowing operation of the control valve upon loss of control power or signal, without the aid of a separate tool or auxiliary power supply.

(b) Fail Safe operation

SELECT ONE OR MORE OF THE FOLLOWING FAIL SAFE OPERATION OPTIONS

•(i) Upon power failure or loss of control signal, the valve actuator shall return to a fail-safe operating position by means of a mechanical spring.

•(ii) Upon power failure or loss of control signal, the valve actuator shall return to a fail-safe operating position by self-contained electronic means.

(iii) Upon power failure, the valve actuator shall maintain its last controlled position (fail in place).

(c) Visual position indication

The valve actuator shall provide indication of valve stem position, clearly visible from a distance of 15ft. (4.5m).

(4) Zone Valve Actuators

(a) Direct Coupled

The control valve actuator shall be directly coupled to the valve, with no intermediary linkage kit required, to facilitate repair and/or replacement.

The control valve actuator shall be equipped with a manual override feature, allowing operation of the control valve upon loss of control power or signal, without the aid of a separate tool or auxiliary power supply.

(b) Fail Safe operation

SELECT ONE OR MORE OF THE FOLLOWING FAIL SAFE OPERATION OPTIONS

•(i) Upon power failure or loss of control signal, the valve actuator shall return to a fail-safe operating position by means of a mechanical spring.

•(ii) Upon power failure, the valve actuator shall maintain its last controlled position (fail in place).

(c) Visual position indication

The valve actuator shall provide indication of valve stem position, clearly visible from a distance of 15ft. (4.5m).

(5) Ball Valve Actuators

(a) Direct Coupled

The control valve actuator shall be directly coupled to the ball valve stem to facilitate repair and/or replacement.

The control valve actuator shall be equipped with a manual override feature, allowing operation of the control valve upon loss of control power or signal.

(b) Fail Safe operation

SELECT ONE OR MORE OF THE FOLLOWING FAIL SAFE OPERATION OPTIONS

•(i) Upon power failure or loss of control signal, the valve actuator shall return to a fail-safe operating position by means of a mechanical spring.

•(ii) Upon power failure, the valve actuator shall maintain its last controlled position (fail in place).

(c) Torque Requirement

The control valve actuator shall provide minimum torque required for full valve shutoff position.

c) Electric Valve Actuators 115Vac/230Vac Powered

(1) General Requirements

(a) Applicable Standards

The valve actuator shall be identified as a Class 1 operating device, according to NEC Article 725.

The valve actuator shall be tested and listed by Underwriters Laboratories according to UL873, and shall bear the UL and cUL approval symbols.

The valve actuator shall be designed and tested to NEMA 1 standards, according to NEMA 250.

FOR PRODUCT LIKELY TO BE EXPORTED TO OR USED IN EUROPE OR A EUROPEAN TERRITORY OR COMMONWEALTH,

The valve actuator shall bear the CE mark, and shall be designed and tested according to EU directives 89/336/EEG and 72/23/EEG.

(2) Distribution Valve Actuators

OMIT THE FOLLOWING FOR LINKAGE COUPLED ACTUATORS

(a) Direct Coupled

The control valve actuator shall be directly coupled to the valve, with no intermediary linkage kit required, to facilitate repair and/or replacement.

The control valve actuator shall be equipped with a manual override feature, allowing operation of the control valve upon loss of control power or signal, without the aid of a separate tool.

SELECT ONE OR MORE OF THE FOLLOWING FAIL SAFE OPERATION OPTIONS

;(b) Fail Safe operation

;(i) Upon power failure or loss of control signal, the valve actuator shall return to a fail-safe operating position by means of a mechanical spring.

•(ii) Upon power failure, the valve actuator shall maintain its last controlled position (fail in place).

•(c) *Visual position indication*

The valve actuator shall provide indication of valve stem position, clearly visible from a distance of 15ft. (4.5m).

(3) Terminal Unit Valve Actuators

OMIT THE FOLLOWING FOR LINKAGE COUPLED ACTUATORS

(a) *Direct Coupled*

The control valve actuator shall be directly coupled to the valve, with no intermediary linkage kit required, to facilitate repair and/or replacement.

The control valve actuator shall be equipped with a manual override feature, allowing operation of the control valve upon loss of control power or signal, without the aid of a separate tool.

(b) *Fail Safe operation*

SELECT ONE OR MORE OF THE FOLLOWING FAIL SAFE OPERATION OPTIONS

•(i) Upon power failure or loss of control signal, the valve actuator shall return to a fail-safe operating position by means of a mechanical spring.

•(ii) Upon power failure, the valve actuator shall maintain its last controlled position (fail in place).

(c) *Visual position indication*

The valve actuator shall provide indication of valve stem position, clearly visible from a distance of 15ft. (4.5m).

(4) Zone Valve Actuators

OMIT THE FOLLOWING FOR LINKAGE COUPLED ACTUATORS

(a) Direct Coupled

The control valve actuator shall be directly coupled to the valve, with no intermediary linkage kit required, to facilitate repair and/or replacement.

The control valve actuator shall be equipped with a manual override feature, allowing operation of the control valve upon loss of control power or signal, without the aid of a separate tool.

(b) Fail Safe operation

SELECT ONE OR MORE OF THE FOLLOWING FAIL SAFE OPERATION OPTIONS

•(i) Upon power failure or loss of control signal, the valve actuator shall return to a fail-safe operating position by means of a mechanical spring.

•(ii) Upon power failure, the valve actuator shall maintain its last controlled position (fail in place).

(c) Visual position indication

The valve actuator shall provide indication of valve stem position, clearly visible from a distance of 15ft. (4.5m).