

# GAS CHARGED VALVE ACTUATORS

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## The safest choice for safety critical applications in nuclear power plants

**Meets multiple internationally recognized** qualification standards

**Designed to meet the requirements of Gen3/3+ reactor designs**, as well as the existing nuclear reactors

**Highly Customizable design** for adaptability to all customer applications

**Symmetrical layout** to allow for 360° mounting to customer valves

**Variable speed** control adjustments

**Manufactured in accordance with** some of the most stringent QA requirements in the world

R.A. Hiller can offer a wide range of configurations specifically designed for harsh plant environmental conditions.

Our actuators feature a rugged, compact and efficient design that benefits the user with reduced size, weight, cost and a simple mounting interface that easily integrates with any application requiring linear output.

R.A. Hiller can design and manufacture a variety of other products qualified for safety related applications within a commercial nuclear power plant.

These include our Linear hydraulic / Linear pneumatic actuators (typically used for Main Steam Isolation and Main Feedwater Isolation Valves) our Gas pneumatic / Gas hydraulic ranges of quarter-turn pneumatic and hydraulic actuators, our ranges of qualified gearboxes for multi-turn applications, our range of qualified gearboxes for quarter-turn and multi-turn applications, and our ranges of electric actuators.

Pneumatic and hydraulically operated valves featured prominently in the systems of nuclear power generating stations make a major contribution to the economy, efficiency, reliability and safety of the station in which they operate. The emphasis on safety has raised the level of technology required for a wide range of equipment associated with these systems.

R.A. Hiller has been involved in the supply of valve actuators for installation in nuclear power plants since the late 1960s and has been a participant member of the subcommittees of the US Standards Committee responsible for drafting various standard Institute of Electrical and Industrial Engineers (IEEE) 382 since the 1970s. Generally, the categories of safety related duty valve applications are as designated as Class 1E in standard IEEE 323 and defined as equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling and containment and reactor heat removal, or otherwise essential in preventing significant release of radioactive material to the environment:

- Inside containment – active
- Inside containment – passive
- Outside containment – active
- Outside containment – passive

**Central nitrogen spring pressure vessel** allows for compact, lightweight design

**Designed for ease of maintenance** with no special tool requirements

**Redundant emergency fast close trains** for increased reliability

**Optional dual motor design** for reduced retract times and increased operability

**Qualified modular construction** allows production of qualification by similarity document, needed to demonstrate the suitability of final product configuration for the safety related application



Where ‘active’ refers to valves which have to operate during and after reactor emergency and ‘passive’ refers to valves which do not have to operate, but must maintain their structural integrity during and immediately after an emergency. Conditions associated with outside containment valves are far less severe than for the inside containment active units. R.A. Hiller has developed solutions to cover all of these types of applications.

**R.A. Hiller actuators are certified for use inside and outside containment areas. Our products meet and exceed the stringent safety standards set by nuclear authorities around the world.**

**NUCLEAR QUALIFIED**

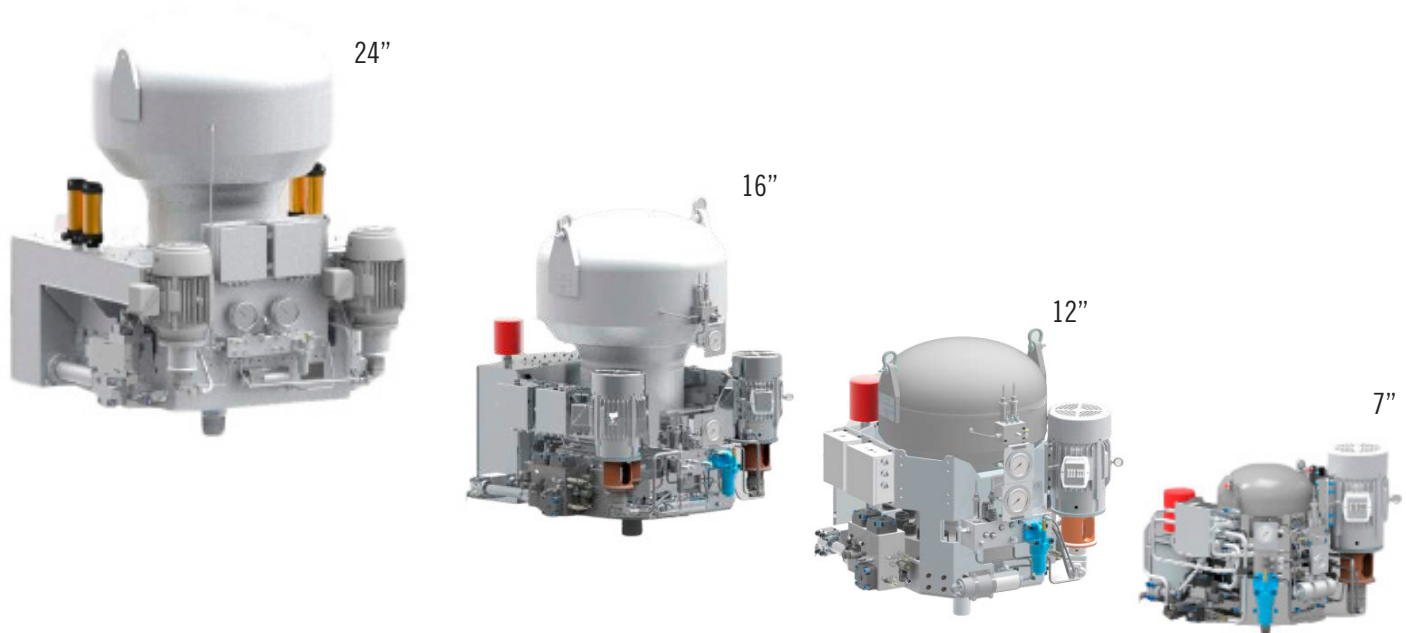
This designation is only applied by R.A. Hiller to an actuator design which has been qualified for safety related duties in nuclear power plants, and is manufactured under strict quality control conditions which ensure that:

- The design standard qualified generically by type test is maintained during manufacture
- The specific requirements of the application are met

The basis of qualification of R.A. Hiller actuators is the IEEE 382 “IEEE Standard for Qualification of Safety-Related Actuators for Nuclear Power Generating Stations and Other Nuclear Facilities” which specifies procedures and test methods for the environmental qualification of valve actuators. The levels of qualification for gas charged actuators are given in the qualification summary section of this document (page 5). Analysis can also be performed to demonstrate suitability for RCC-E applications (European standard).

**COMPLETE RANGE OF SIZES AVAILABLE**

- Actuator piston sizes available from 2” to 24” to meet all customer needs
- Additional sizes and configurations available from the graphics below





## TYPICAL MATERIALS OF CONSTRUCTION

Component	Material
Cylinder Bore	Chrome Plated Honed Steel
Pressure Vessel	Carbon Steel
Piston Shaft	Chrome Plated Steel
Piston	Carbon Steel
Seals	Viton
O-rings	Viton
Bushing	Bronze

## PRODUCT VARIATIONS

R.A. Hiller can supply control solutions that are configured to best suit the application specific requirements. These fully qualified accessories can be locally or remotely mounted:

### 1. NITROGEN CHARGED PRESSURE VESSEL

The centrally mounted nitrogen vessel stores potential energy in the form of compressed gas above the piston, while in the retracted position. This provides a safe and reliable closing force during slow-close and fast-close operations, as well as a passive device to assure a fail-safe closed position

### 2. NITROGEN MANIFOLD AND VISUAL PRESSURE DIAL

For regulation and local indication of nitrogen pressure

### 3. HYDRAULIC SYSTEM PUMP MOTOR

Dual or single motor configurations available to best conform to customer needs

### 4. PUMP SIDE HYDRAULIC MANIFOLD AND SYSTEM ACCUMULATOR

Regulates system hydraulic pressure and provides both local and remote indication

### 5. FORGED BASEPLATE

Allows for 360° valve mounting configurations to conform to any plant layout

### 6. HYDRAULIC CYLINDER

Hydraulic force is applied beneath the piston to retract the valve rod and compress the nitrogen spring

## INDICATION ACCESSORIES

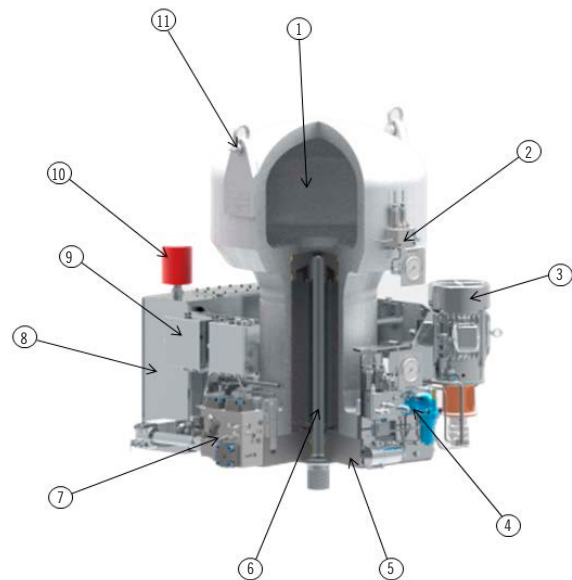
- Pressure dial gauges
- Pressure transducers
- Visual local sight glass

## PROTECTION ACCESSORIES

- Filtration
- Pressure regulation
- Pressure relief

\*Partial listing.

Additional accessories available.



### 7. HYDRAULIC TRAIN MANIFOLD

Redundant manifolds provide indication and control of hydraulic systems (Pictured Train 1 of 2)

### 8. COMPACT HYDRAULIC RESERVOIR

Hydraulic oil is stored in a compact, lightweight reservoir

### 9. ELECTRICAL ENCLOSURES

Configurable design for applicability with any plant Instrumentation and Control (I&C) systems

### 10. DESICCANT BREATHER

Provides protection of hydraulic oil in often harsh plant environments

### 11. INTEGRATED LIFTING LUGS

For ease of rigging and maintenance



## SUMMARY OF QUALIFIED ENVIRONMENTAL LEVELS

Environmental Parameters	Qualification Test Unit
Design Life (yrs)	60
Number of Cycles	2,200
Normal Maximum Ambient Temperature (°F)	135
Normal Pressure (psig)	Atmospheric
Relative Humidity %	100
Total Radiation Exposure (Normal+DRA TID) (Mrads+air)	1.09

## SUMMARY OF QUALIFIED SEISMIC LEVELS

Seismic Test	Qualification Test Unit
Resonance Search	0.2 g.1 – 500 – 1 Hz, 1 octave/min
Vibration Aging	2g.10 – 100 -10 Hz, 2 octave/min
Operating Basis Earthquake (OBE)	4.4g.2 – 64 -2 Hz 1 octave/min
Safe Shutdown Earthquake (SSE)	6.6g.2 – 64 -2 Hz, 1 octave/min

## TEST SUMMARY FOR MOTOR

Test Type	Test Standard	Test Level	Application	Criterion	Test Result
Low Frequency Conducted Susceptibility	MIL - STD 461E CS101	> 28 V	Power Leads	A	Complies
High Frequency Conducted Susceptibility	MIL - STD 461E CS114	Figure 8.2-6 <sup>1</sup> (Medium Exposure)	Power & Signal Leads	A	Complies
Conducted Susceptibility	MIL - STD 461E CS115	4 Amps	Signal Leads	A	Complies
Conducted Susceptibility	MIL - STD 461E CS116	10 Amps	Signal Leads	A	Complies
Radiated Susceptibility Magnetic Field	MIL - STD 461E RS101	Figure 8.2-7 <sup>1</sup>	Equip under test & Leads	A	Complies
Radiated Susceptibility Electric Field	MIL - STD 461E RS103	10 V/m	Equip under test & Leads	A	Complies
Surge Combination Wave	CEI 61000-4-5	Level 4:4 kV	Power Leads	A	Complies
		Level 3:2 kV	Signal Leads	A	Complies
Electrical Fast Transient	CEI 61000-4-4	Level 4:4 kV	Power Leads	A	Complies
		Level 4:2 kV	Signal Leads	A	Complies
Electrostatic Discharge	CEI 61000-4-2	Level 4:8 kV contact, 15 kV air	Equip under test	A	Complies
Surge Ring Wave	CEI 61000-4-12	Level 4:4 kV	Power Leads	A	Complies
		Level 3:2 kV	Signal Leads	A	Complies
Conducted Emissions	MIL - STD 461E CE101	Figure 8.2-1 <sup>1</sup>	Power Leads	Limit Line	Complies
	MIL - STD 461E CE102	Figure 8.2-2 <sup>1</sup>	Power Leads	Limit Line	Complies
Radiated Emissions	MIL - STD 461E RE101	Figure 8.2-3 <sup>1</sup>	Enclosure	Limit Line	Complies
	MIL - STD 461E RE102	Figure 8.2-4 <sup>1</sup>	Enclosure	Limit Line	Complies



TEST SUMMARY FOR SOLENOID VALVES

Test Type	Test Standard	Test Level	Application	Criterion	Test Result
Radiated Emissions	MIL-STD-461F RE101	30 Hz - 100 KHz NRC guide 1.180,figure 3.3	Enclosure and Power Leads	Below Limit Line	Complies
Radiated Emissions	MIL-STD-461F RE102	2 MHz - 1 GHZ NRC Guide 1.180, figure 3.4	Enclosure and Power Leads	Below Limit Line	Complies
Conducted Emissions	MIL-STD-461F CE101	<b>DC powered Equip under test</b> 30 Hz - 10 kHz DC Power Curve NRC Guide 1.180, Figure 3.1  <b>AC powered Equip under test</b> 50 Hz - 10 kHz AC Power ≤ 1 kVA Curve NRC Guide 1.180, Figure 3.1	Power leads	Below Limit Line	Complies
Conducted Emissions	MIL-STD-461F CE102	10 kHz-2 MHz Curve matching rated voltage NRC Guide 1.180, Figure 3.2	Power leads	Below Limit Line	Complies
Radiated susceptibility Electric Field	MIL-STD-461F RS103	30 MHz – 10 GHz 10 V/m	Enclosure and Power Leads	A	Complies
Electrostatic Discharge Immunity	IEC 61000-4-2	Contact Discharge +/- 8 kV Air Discharge +/- 15 kV	Enclosure	A	Complies
Radiated Immunity (E-field)	IEC 61000-4-3	26 MHz – 1GHz 10 V/m	Enclosure and Power Leads	A	Complies
Electrical Fast Transients/ Burst Immunity	IEC 61000-4-4	Power Lines +/- 4 kV Control/Signal Lines +/-2 kV	Power and input / output Leads	A	Complies
Surge Immunity	IEC 61000-4-5	Power Lines +/- 4 kV Control/Signal Lines +/-2 kV	Power and input / output Leads	A	Complies
RF Conducted Immunity	IEC 61000-4-6	150 kHz – 80 MHz 140 dBµV	Power and input / output Leads	A	Complies
Magnetic Field Immunity	IEC 61000-4-8	50 & 60 Hz 30 A/m /152 dBpT	Enclosure and Power Leads	A	Complies
Pulse Magnetic Field Immunity	IEC 61000-4-9	50 Hz, 60 Hz, 50 kHz 300 A/m /172 dBpT	Enclosure and Power Leads	A	Complies
Damped Oscillatory Magnetic Field Immunity	IEC 61000-4-10	100 kHz & 1 MHz 30 A/m /152 dBpT	Enclosure and Power Leads	A	Complies
Ring Wave Immunity	IEC 61000-4-12	Power Lines +/- 4 kV Control/Signal Lines +/- 2 kV	Power and I/O Leads	A	Complies
Conducted Susceptibility Low Frequency	IEC 61000-4-13	NRC Guide 1.180 Table 10	Power Leads	A	Complies
Conducted Susceptibility Low Frequency	IEC 61000-4-16	IEC 61000-4-16 Sec 5.1 & 5.2 Level 3	Power Leads	A	Complies
Damped Oscillatory Wave Immunity Wave Immunity	IEC 61000-4-18	+/- 2 kV Ground Mode +/- 1 kV Differential Mode	Power leads	A	Complies

## QUALITY ASSURANCE

The R.A. Hiller quality system details all the procedures and documentation utilized for both standard and nuclear actuators. The program for gas charged actuators has been evolved in co-operation with utilities and architect-engineers responsible for construction and operation of nuclear power stations.

The R.A. Hiller quality assurance program is designed to meet the requirements of 10CFR50 Appendix B, ASME NQA-1, and ANSI N45.2 to ensure that:

1. Hiller actuator components are only supplied by vendors whose own quality systems and performance are under the surveillance of and approved by the R.A. Hiller quality manager.
2. Safety related components are manufactured from certified materials.
3. Safety related components are kept in a separate bonded store.
4. Design qualification is maintained during manufacture and unqualified modification is forbidden.
5. Specific application requirements and sizing data for each actuator are recorded.
6. Assembly of each actuator is carried out under specific procedures and the work is traceable.
7. Specific actuator performance is tested and recorded.
8. Safety related components are traceable through the supply chain and to installed actuators.
9. A certificate of compliance is signed by the quality manager or designer only when auditable evidence of these requirements have been satisfied.

## LOT CONTROL AND MATERIAL TRACEABILITY OF SAFETY RELATED COMPONENTS

All safety related components are lot controlled and are traceable to the actuators to which they are fitted.

Records are maintained and are available for the life of the plant.

All safety related components are stored in a bonded store ensuring that material traceability is maintained.

## PRODUCT MAINTENANCE

R.A. Hiller is responsible for the generic and specific qualification of safety related actuators up to the expiration of the warranty period.

Any modifications required as a result of changes in customer specification may necessitate retesting of the actuators by qualified personnel and test equipment for the qualification documentation to be maintained. Similarly, repairs arising from transit or site damage to components likely to affect performance may also involve retesting to enable qualification to be maintained.



Any repairs under warranty will be carried out by R.A. Hiller using only qualified personnel with the appropriate documentation and certificate of compliance; where retesting is required to maintain this qualification, R.A. Hiller will undertake this.

From expiration of the warranty period, responsibility for the equipment, including maintenance of the qualification if required, passes to the owner. R.A. Hiller can provide qualified service engineers for site work, and can also provide training courses for customer personnel.

## QUOTE REQUEST AND ORDERING INFORMATION

To request a quotation, we require:

1. Actuator type needed
2. Project / plant name
3. Country of installation
4. Design conditions
5. Application information



## Trillium Valve Actuators

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