Worcester Controls
Rotary Switches
High Performance, Reliability and User Friendly
Flowserve Corporation’s Worcester Valve Automation Systems provides complete valve and damper automation to the worldwide processing industries. We provide maximum value to the end user through a broad offering of products, services, application engineering and our systematic approach to automation.

**Quality, Dependability and Productivity**

Recognized as the leaders in position indication and positioning control, Worcester limit switch and positioner products provide unparalleled performance combined with ease of calibration and maintenance.

Worcester rotary position indicators and positioners have a proven track record in industries such as chemical and petrochemical processing, oil and gas, pulp and paper, pharmaceutical, and energy-related industries. Hazardous location approvals and corrosion resistant materials make the Worcester rotary position indicators and positioners ideal for even the most hostile environments.

Our ISO 9001 certified manufacturing facilities, R&D department and engineering headquarters are located in Springville, Utah, and Cookeville, Tennessee.

Sales and service facilities are strategically located in industrial centers throughout the world.
**Featured Products**

**UltraSwitch™ WGL/WXCL/WPL Series Rotary Position Indicators**
The UltraSwitch series of position indicators provides a compact and economical package for both visual and remote electrical indication of valve position. Models are available in both die cast aluminum and engineered resin versions with UL and C-UL ratings suitable for NEMA 4, 4x and NEMA 4, 4x, 7 & 9 applications.

**Aviator™/BUSwitch™ Integrated Valve Controller**
The Aviator Integrated Valve Controller with internal pilot solenoid coil provides a truly integrated package for both visual and electrical position indication as well as control of supply air to rotary actuators. The Worcester BUSwitch provides all of the features of the Aviator but enables control and monitoring of automated on-off valves through digital fieldbus technology. Available in both aluminum and non-metallic enclosures, the Aviator/BUSwitch is suitable for NEMA 4, 4x and NEMA 4, 4x, 7 & 9 applications.

**Internal Switch Options**
An extensive range of both mechanical and proximity limit switches makes the UltraSwitch and Aviator the perfect choices for a wide range of applications.

**AutoBrakits**
Stainless steel NAMUR mounting kits provide consistent and reliable direct coupling to NAMUR compliant actuators.
The WGL Series rotary limit switch enclosure provides a compact, economical package for visual and remote electrical indication of valve position. The die cast aluminum housing is electrostatic powder coated and designed to meet NEMA 4x standards. The housing can also be configured for sanitary applications.

**Features:**
- **Pharos** visual indicator for high contrast, wide-angle viewing.
- **NAMUR** mounting compliance eliminates coupler and maximizes interchangeability.
- Captive stainless steel cover screws.
- **Sanitary** options include captive stainless steel hex head cover screws.

Standard housing offers a no “nooks and crannies” design to facilitate washdown.

**How To Order**
(Select **Bold Type Code** from each column that applies)

<table>
<thead>
<tr>
<th>Brand</th>
<th>Optional Prefix</th>
<th>Model</th>
<th>Cover</th>
<th>Switch*</th>
<th>Solenoid Options</th>
<th>Options</th>
<th>Extra Terminal Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>W - Worcester Controls</td>
<td>Blank - Double D Shaft (1/4” Flats)</td>
<td>GL</td>
<td>1 - Flat Top</td>
<td>0 - No Switches (Empty Housing)</td>
<td>0 - No Solenoid</td>
<td>Blank - No Option</td>
<td>Blank - 2 Open Terminal Locations (Standard)</td>
</tr>
<tr>
<td></td>
<td>N - NAMUR Shaft</td>
<td></td>
<td>2 - Pharos Indicator</td>
<td>1 - (2) SPDT Mechanical</td>
<td></td>
<td>T - Third Conduit Entry</td>
<td>4 - 4 Open Terminal Locations (2 SPST Switches)</td>
</tr>
<tr>
<td></td>
<td>E - Epoxy Coated</td>
<td></td>
<td>3 - Pharos 90° 3-way</td>
<td>4 - (2) SPST Proximity</td>
<td></td>
<td>H - Heavy-Duty Terminal Block</td>
<td>6 - 6 Open Terminal Locations (2 SPDT Switches)</td>
</tr>
<tr>
<td></td>
<td>B - Epoxy Coating/ NAMUR shaft</td>
<td></td>
<td>4 - Pharos 180° 3-way</td>
<td>5 - (2) SPDT Proximity</td>
<td></td>
<td></td>
<td>8 - 8 Open Terminal Locations (2 SPST Switches)</td>
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<tr>
<td></td>
<td>H - Hex Head Cover Screws</td>
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<td>5 - Pharos 180° 3-way Center Blocked</td>
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<td></td>
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<td></td>
<td>D - Hex Head Cover Screws/NAMUR Shaft</td>
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<td>T - Flat Indicator</td>
<td>E - (2) SPDT Sabre Proximity</td>
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<td>P - (2) Phazer II SPDT Proximity</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>T - (2) Phazer II BRS SPST Proximity</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Z - AS-i Communications Card</td>
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**Note:** Example: WGL210, WNGL32T
For Replacement Pharos Kit part numbers, see UltraSwitch Nomenclature
* Consult factory for additional switch options
**WPL-Series UltraSwitch™ Position Indicators**

The WPL-Series UltraSwitch is provided with an engineered resin enclosure making it ideal for harsh corrosive environments. It is certified to UL/CSA/ATEX standards for nonincendive Class 1, Div. 2 hazardous locations. Designed to meet NEMA 4, 4x standards, the housing features a unique labyrinth cover seal.

**Features:**
- UltraDome™ visual indicator provides high contrast, wide-angle viewing of valve position. Also available with snap-on Pharos indicator or a low-profile flat indicator.
- Quick-Set™ spring loaded cams are extra wide and splined to allow tool free limit switch calibration.
- **Switches** available in a wide range of options.
- Terminal Strip is multipoint and prewired.
- Housing is an engineered resin suitable for corrosive environments.
- Dual ¾" conduit entries are standard.
- NAMUR mounting compliance eliminates coupling and maximizes interchangeability.
- Captive stainless steel cover screws.
- **Internal Potting Wells** within housing at the conduit entries available for factory sealed leads. They may be filled with conduit potting compound or RTV silicone sealant to prevent the ingress of corrosive vapors or liquids.

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**How To Order** *(Select Bold Type Code from each column that applies)*

<table>
<thead>
<tr>
<th>Brand</th>
<th>Optional Prefix</th>
<th>Model</th>
<th>Cover</th>
<th>Switch*</th>
<th>Analog Output</th>
<th>Solenoid Options</th>
<th>Options</th>
<th>Extra Terminal Locations</th>
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</thead>
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<tr>
<td>W</td>
<td>Blank</td>
<td>PL-</td>
<td>1 - Flat Cover</td>
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<td>0 - None</td>
<td>0 - No Option</td>
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<td>2 Open Terminal Locations (Standard)</td>
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<tr>
<td></td>
<td>DoEcket D</td>
<td>Zytel®</td>
<td>Flat Cover 2 - Pharo Indicator</td>
<td>0 - None</td>
<td>0 - No Option</td>
<td>Blank</td>
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</tr>
<tr>
<td></td>
<td>Hex Head</td>
<td>Engineered Resin Housing</td>
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<td>0 - No Option</td>
<td>Blank</td>
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<td></td>
<td>Head Cover Screws</td>
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<td>0 - None</td>
<td>0 - No Option</td>
<td>Blank</td>
<td>2 Open Terminal Locations (Standard)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Hex Head</td>
<td>3 - (2) SPDT Mechanical</td>
<td>0 - None</td>
<td>0 - No Option</td>
<td>Blank</td>
<td>2 Open Terminal Locations (Standard)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Head Cover Screws</td>
<td>4 - (2) SPDT Proximity</td>
<td>0 - None</td>
<td>0 - No Option</td>
<td>Blank</td>
<td>2 Open Terminal Locations (Standard)</td>
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<td></td>
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<tr>
<td></td>
<td>NAMUR Shaft</td>
<td>5 - (2) SPDT Proximity</td>
<td>0 - None</td>
<td>0 - No Option</td>
<td>Blank</td>
<td>2 Open Terminal Locations (Standard)</td>
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<td></td>
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<tr>
<td></td>
<td>Hex Head</td>
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<tr>
<td></td>
<td>Head Cover Screws</td>
<td>7 - (2) Phazer II SPDT Proximity</td>
<td>0 - None</td>
<td>0 - No Option</td>
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<tr>
<td></td>
<td>NAMUR Shaft</td>
<td>8 - (2) Phazer II BRS SPDT Proximity</td>
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<td>0 - No Option</td>
<td>Blank</td>
<td>2 Open Terminal Locations (Standard)</td>
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</tbody>
</table>

*Consult factory for additional switch options.
Zytel® is a registered trademark of DuPont.*
**WXCL-Series UltraSwitch™ Position Indicators**

The WXCL-Series UltraSwitch is a globally-certified explosionproof/flameproof position indicator for use throughout the world. The rugged die cast aluminum enclosure has a dichromate undercoat and electrostatic powder topcoat for superior corrosion resistance. The housing is certified to UL/CSA/ATEX standards and is available with optional position transmitter and a wide range of switches.

**Features:**
- **UltraDome™** visual indicator provides high contrast, wide-angle viewing of valve position.
- **Quick-Set™** spring loaded cams are extra wide and splined to allow tool free limit switch calibration.
- **Switches** available in a wide range of options.
- **Terminal Strip** is multipoint and prewired.
- **Housing** is die cast aluminum with dichromate undercoat and electrostatic powder topcoat, UL/CSA/ATEX approved for hazardous locations.
- **Dual ¾” conduit entries** are standard.
- **NAMUR** mounting compliance eliminates coupling and maximizes interchangeability.
- **Captive** stainless steel cover screws.
- **Potting** compartments available for factory sealed leads.

**How To Order** (Select *Bold Type Code* from each column that applies)

<table>
<thead>
<tr>
<th>Brand</th>
<th>Shaft Option</th>
<th>Model</th>
<th>Indicator Option</th>
<th>No. Switches</th>
<th>Switch Type*</th>
</tr>
</thead>
<tbody>
<tr>
<td>W - Worcester Controls</td>
<td>D - Double D Shaft (¼” Flats)</td>
<td>XCL - (2) ¾” NPT Conduit</td>
<td>1 - Flat Top (no indicator) U - Red/Green (std) C - 90° 3-way D - 180° 3-way E - 180° 3-way Blocked Center K - Ektar Red/Green H - Black/Gray/Yellow R - Reverse (Red - Open, Green - Closed)</td>
<td>0 - No Switches 1 - 1 Switch 2 - 2 Switches 4 - 4 Switches</td>
<td>00 - No Switches M1 - SPDT Mechanical MG - SPDT Mechanical - Gold Plated M3 - DPDT Mechanical MA - 3-Position Control MD - DA 3-Position Control w/Indication MS - SR 3-Position Control w/Indication P4 - SPST Proximity PS - SPDT Proximity PE - SPDT Sabre PP - SPDT Phazer PT - SPST BRS N8 - P+F NJ2-V3-N FZ - AS-i Communications Card</td>
</tr>
<tr>
<td>N - NAMUR Shaft</td>
<td>XML - (2) M25 Conduit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Certifications**
- 14 - General Purpose
- 18 - UL/CSA/ATEX Explosionproof
- 19 - ATEX Explosionproof
- M1 - Metal Nameplate UL/CSA/ATEX Explosionproof (Mechanical Switch)
- M2 - Metal Nameplate UL/CSA/ATEX Explosionproof (Proximity Switch)
- M3 - Metal Nameplate ATEX Explosionproof

**Analog Output Options**
- 0 - None (std)
- T - 4-20 mA Transmitter
- D - 180° 4-20 mA Transmitter
- A - 0-1 Ohm Potentiometer
- B - 0-5k Ohm Potentiometer
- C - 0-10k Ohm Potentiometer

**Wiring Options**
- 0 - None (std)
- H - Heavy-Duty Terminal Strip

**Open Terminals (Minimum)**
- 2 - 2 open (std)
- 4 - 4 open
- 6 - 6 open

**Special Options**
- 0 - None (std)
- P - 180° Potentiometer Gearing
- V - Viton O-rings

**Coating Options**
- 0 - Black Polyester Powdercoat (std)
- E - White Epoxy

**Example**
NWXCLU2M1-18-00200 = Worcester WXCL UltraSwitch, NAMUR Shaft, UltraDome indicator, (2) SPDT Mechanical switches, FM/CSA and ATEX certifications.

*Consult factory for additional switch options.*
Aviator™ Integrated Valve Controller

WXV Series
The Aviator integrated valve controller enclosure and solenoid valve provides an integrated package for position indication and control of supply air to rotary actuators. The WXV Series housing is designed for hazardous locations for NEMA 4, 4x, 7 & 9 and CENELEC EEx d IIB.

WWR Series
The WWR Series offers many features of the WXV Series in an engineered resin housing. The WWR Series housing is a non-metallic engineered resin and provides an excellent enclosure for harsh corrosive environments. The WWR Series Aviator is designed for easy upgrading to fieldbus communication protocols.

Features
• **Captive** stainless steel cover screws.
• **UltraDome** visual position indicator provides high contrast, wide-angle viewing of valve position.

Fieldbus Upgradeability. The Aviator has been designed to accommodate the circuitry required to interface with various fieldbus protocols.

NAMUR mounting compliance eliminates coupler and maximizes interchangeability.

Internal Pilot Solenoid Coil offers the advantage of having the solenoid coil contained and protected within the Aviator housing. This provides a high degree of protection in hazardous environments and washdown applications.

Quick-Set™ spring loaded cams are extra wide and splined to allow tool free limit switch calibration.

Switches are available in a wide range of options.

Corrosion Resistant Materials all exposed parts are either stainless steel, anodized aluminum, or aluminum treated with dichromate undercoat and polyester electrostatic powder top coat. The WWR Series provides further protection with an engineered resin enclosure.

Three ½” conduit entries are standard (WXV Series).
The BUSwitch™ integrated valve controller provides all of the features of the Aviator but enables control and monitoring of automated on-off valves through fieldbus technology. The BUSwitch communication cards provide a gateway to fieldbus networks allowing seamless integration of the limit switches and solenoid valves. The integral BUSwitch functions assist the user with predictive and preventative maintenance. The intelligent valve automation package features AS-i, FOUNDATION Fieldbus, DeviceNet, and PROFIBUS DP protocols. The BUSwitch is available in both explosionproof aluminum or corrosion resistant engineered resin housings.

Protocol-Specific Features:
- **FOUNDATION Fieldbus** BUSwitch controls include cycle counter and timer functions. User-selectable failure modes permit valves to move to desired position on loss of communications.
- **PROFIBUS DP** BUSwitch features cycle counter, timer and alarm functions. User-selectable failure modes permit valves to move to desired position on loss of communications. Dry-contact external input enables integration of emission-detecting pressure switch or other simple device.
- **DeviceNet** BUSwitch offers basic on-off valve control with limited diagnostic capabilities. Solenoid coil continuity, stroke timer, and stroke counter provide important information for effective valve and actuator maintenance. A dry-contact external input enables integration of emission-detecting pressure switch or other simple device.
- **AS-i** BUSwitch provides simple on-off valve control in a very economical package. It is available in all limit switch enclosures, including the WGL, WPL and WXCL UltraSwitches.

**How To Order**

(Select Bold Type Code from each column that applies)

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
<th>Indicator</th>
<th>Switch</th>
<th>Number of Coils</th>
<th>Solenoid Coil</th>
<th>Spool Valve</th>
<th>Shafts and Coatings</th>
<th>Spool Valve Options</th>
</tr>
</thead>
</table>
| W      | - Worcester Controls | XV - Aluminum NEMA 4, 4x, 7 & 9<br>CV - Aluminum<br>WR - Resin NEMA 4, 4x<br>FR - Resin I.S. Class 1, Div. 1 Groups A-D (F2 FOUNDATION Fieldbus protocol only) | U - UltraDome Indicator<br>C - 90° 3-way<br>D - 180° 3-way<br>E - 180° 3-way Center Blocked | M1 - (2) SPDT Mechanical Gold Contacts<br>MG - (2) SPDT Mechanical Gold Contacts<br>R4 - (2) SPST Proximity<br>P1 - (2) Sabre SPST Proximity<br>PP - (2) Phazer II SPST Proximity<br>B4 - (2) BRS SPST Proximity<br>S4 - (2) P&F NJ2-V3-N (NAMUR)<br>SE - (2) Effector Type IN-2002-ABOA Communication Protocol<br>F2 - 2-wire FOUNDATION Fieldbus<br>F4 - 4-wire FOUNDATION Fieldbus<br>FD - PROFIBUS DP<br>FA - AS-i<br>FN - DeviceNet | 0 - Single Coil<br>1 - Dual Coil (WWR Series only)<br>2 - External Solenoid Coil (BUSwitch only F4 option) | A - 110 VAC 50/60 Hz<br>B - 220 VAC 50/60 Hz<br>C - 12 VDC<br>D - 24 VDC<br>E - 12 VDC Low Power<br>G - 24 VDC Low Power<br>H - 24 VDC Low Power<br>K - 24 VDC Intrinsically Safe BUSwitch Only<br>G - 24 VDC<br>J - 24 VDC Low Power<br>P - 24 VDC Piezo Ultra-Low Power (F2 Protocol only)<br>0 - None | N - NAMUR Shaft<br>B - Epoxy Coating/NAMUR Shaft (WXV Series only)<br>P - 24 VDC Piezo Ultra-Low Power (F2 Protocol only)<br>N - NAMUR Shaft<br>B - Epoxy Coating/NAMUR Shaft (WXV Series only)<br>P - 24 VDC Piezo Ultra-Low Power (F2 Protocol only) | R - Thermoplastic Rain Caps (Standard)<br>M - Thermoplastic Rain Caps/Momentary Manual Override<br>L - Thermoplastic Rain Caps/Locking Manual Override<br>X - Sintered Bronze Exhaust Mufflers<br>Y - Sintered Bronze Exhaust Mufflers/Momentary Manual Override<br>Z - Sintered Bronze Exhaust Mufflers/Locking Manual Override<br>S - Stainless Steel Exhaust Mufflers<br>T - Stainless Steel Exhaust Mufflers/Momentary Manual Override<br>U - Stainless Steel Exhaust Mufflers/Locking Manual Override
Fieldbusses for Process Control

**AS-i**
- WGL, WPL and WXCL Series UltraSwitch (requires external 24 VDC solenoid valve)
- WWR and WXV Series BUSwitch with integral coil and spool valve
- Series 75 electric actuator

**DeviceNet**
- WGL, WPL and WXCL Series UltraSwitch (requires external 24 VDC solenoid valve)
- WWR and WXV Series BUSwitch with integral coil and spool valve
- Series 75 electric actuator

**PROFIBUS DP**
- WWR and WXV Series BUSwitch with integral coil and spool valve
- Series 75 electric actuator

**FOUNDATION Fieldbus**
- WWR, WFR and WXV Series BUSwitch with integral coil and spool valve
- Series 75 electric actuator

**HART, Profibus PA, FOUNDATION Fieldbus**
- L93 “Pulsair” positioner

<table>
<thead>
<tr>
<th></th>
<th>AS-i(2.1)</th>
<th>PROFIBUS DP</th>
<th>FOUNDATION Fieldbus</th>
<th>DeviceNet</th>
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<td>32</td>
<td>32</td>
<td>64</td>
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<tr>
<td>Cable Length (ft)</td>
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<td>328 to 3937</td>
<td>2953</td>
<td>328 to 1640</td>
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<tr>
<td>Data Speed (Kbps)</td>
<td>167</td>
<td>9.6 to 12,000</td>
<td>31.25</td>
<td>125 to 500</td>
</tr>
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</table>
UltraSwitch™/Aviator™ Internal Switch Options

**Mechanical Switches**

- **Type 1 / M1**
  - (2) SPDT Mechanical
  - 15 amp @ 125 VAC,
  - ½ amp @ 125 VDC
  - Minimum 50 mA

- **Type G / MG**
  - (2) SPDT Mechanical
  - Gold-Plated Contacts
  - 1 amp @ 125 VAC
  - 1 amp @ 24 VDC
  - Minimum 1 mA

- **Type 3**
  - (2) DPDT Mechanical
  - 15 amp @ 125 VAC
  - Minimum 50 mA
  - Consult factory for DC voltages

**Proximity Switches**

hermetically sealed for long life.

- **Type 4 / R4**
  - (2) SPST Proximity
  - 0.35 amp @ 140 VAC,
  - 1 amp @ 50 VDC, 50 Watt Max.
  - Minimum 1 mA

- **Type 5**
  - (2) SPDT Proximity
  - ¼ amp @ 120 VAC,
  - ¼ amp @ 28 VDC, 3 Watt Max.
  - Minimum 5 mA

- **Type 8**
  - (2) Solid State Pepperl & Fuchs
  - Proximity
  - 2-wire NAMUR per DIN 19234

**High Performance Proximity Switches**

hermetically sealed for severe service and long life.

- **Type E / P1 Sabre Switch**
  - (2) SPDT Proximity
  - 1 amp @ 120 VAC,
  - 1 amp @ 24 VDC, 25 Watt Max.
  - Minimum 1 mA

- **Type P / PP Phazer II**
  - (2) SPDT Proximity
  - 3 amp @ 120 VAC,
  - 2 amp @ 24 VDC, 100 Watt Max.
  - Minimum 50 mA

- **Type T / B4 BRS**
  - (2) SPST Proximity
  - 3 amp VAC,
  - ½ amp @ 24 VDC, 100 Watt Max.
  - Minimum 1 mA

**AutoBrakits**

NAMUR mounting kits and NAMUR shaft options permit direct coupling of Automax limit switches or positioners to NAMUR actuators. Our NAMUR shaft options include an integral alignment pin to ensure accurate fit between accessory and actuator. The kits feature stainless steel construction at an economical price.
Material Guide for Harsh Environments

Worcester limit switch products are designed with harsh chemical environments in mind. Although users do not normally expose valve automation accessories directly to concentrated chemicals, mild concentrations do exist in plant atmospheres. This guide provides chemical compatibility for materials used in exposed parts, i.e., housings, covers and visual indicators.

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<th>Chemical</th>
<th>Concentration</th>
<th>Noryl®</th>
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<td>U</td>
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<td>C (D)</td>
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<td>Sulfuric</td>
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<td>U</td>
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<td>Sulfuric</td>
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<td>E</td>
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<td>Ammonium Hydroxide</td>
<td>10%</td>
<td>—</td>
<td>C (L)</td>
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<td>U</td>
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<tr>
<td>Potassium Hydroxide</td>
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</tr>
<tr>
<td>Sodium Hydroxide</td>
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<td>E</td>
<td>C (L)</td>
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<td>Methylene Chloride</td>
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<tr>
<td>Sodium Chloride</td>
<td>10%</td>
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<td>C (L)</td>
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<td>Mineral Oil</td>
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E = Excellent (chemical has no effect)
C = Compatible, but material slightly affected by chemical:
L = greater than 1% dimensional change
D = discoloration
U = Unsatisfactory (chemical attacked material)
— = No test data or experience available

WWR Series Aviator™/BUSwitch™ – General Electric Noryl®
Noryl®, a modified PPO resin, features high hydrolytic stability, meaning that it does not absorb moisture readily, making it well suited for high humidity and steam environments. Noryl offers good resistance to most acids, bases, detergents and aqueous solutions. Halogenated and aromatic solvents may soften or dissolve this material.

WPL Series UltraSwitch™ – DuPont Zytel®
Zytel®, a polyamide resin, features resistance to low concentrations of bases, solvents and salts. This high-strength engineered resin provides an excellent enclosure for harsh corrosive environments.

UltraDome™ & Pharos™ Visual Indicators – General Electric Lexan®
Lexan®, a polycarbonate resin, is extremely tough and generally is not affected by low concentrations of acids, alcohols and alkalis. High concentrations should be avoided. Mild detergents, pure petroleum greases and pure silicone greases are generally compatible. Avoid solvents.

WGL & WXCL Series UltraSwitch™,
WXV Series Aviator™/BUSwitch™ - Dichromate Conversion Undercoat with Polyester Powder Top Coat
The dichromate conversion coating provides improved adhesion of the top-coat, retards mildew formation, and provides extra protection against oxidation, particularly on unpainted surfaces such as the interior. Polyester provides general protection against low concentrations of some acids and alkalis. Avoid bases. Optional epoxy coating provides better chemical resistance, but has a tendency to chalk under direct exposure to ultraviolet light.
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