Raptor Arm Specifications

- **Manipulator Type**: Force Feedback Manipulator
- **Degrees Freedom-Of-Motion**: 7
- **Grip Closure Force (controllable)**: 0-300 lbf (1334 N)
- **Wrist Rotate Torque**: 1200 in-lbs (135 Nm)
- **Lift Capacity at Full Extension**: 200 lbs (91 kg)
- **Maximum Lift Capacity**: 500 lbs (227 kg)
- **Stowed Height**: 35.75" (908 mm)
- **Vertical Reach**: 65.15" (1655 mm)
- **Horizontal Reach**: 68.40" (1737 mm)
- **Construction**: Anodized aluminum & stainless steel

**Hydraulically Powered 7-function**

- **Operating Pressure**: 1500-3000 psi (104-207 bar)
- **Flow Rate**: 5 gpm (19 lpm)
- **Operating Depth, Extended**: 21,000 fsw (6500 msw)
- **Operating Depth, Standard**: 10,000 fsw (3000 msw)
- **Weight In Seawater**: 165 lbs (75 kg)
- **Weight In Air**: 35 lbs (16 kg)

**Jaw Opening**

- **Jaw Opening (intermeshing)**: 8.75" (220 mm)
- **Jaw Opening (parallel acting)**: 4" (100 mm)

**Motion**

- **Wrist Rotate (slaved mode)**: 340 degrees
- **Wrist Rotate (continuous)**: 0-40 rpm
- **Wrist Yaw**: 200 degrees
- **Shoulder Azimuth**: 270 degrees
- **Shoulder Elevation**: 120 degrees

**Filtration**

- **Filtration**: 25 micron absolute

**Operating and Storage Temperatures**

- **Ambient Temperature**
  - Operating: -20°C to +70°C
  - Storage: -20°C to +85°C
  - Storage: -40°C to +85°C

**Humidity**

- **Humidity**:
  - Operating: 95%RH max (non condensing)
  - Storage: 95%RH max (non condensing)

**Power Requirements**

- **Power Requirements**
  - KMC 770 Servo Driver: 6-40VDC 30 Watts
  - OCU Power Chassis: 24VDC 265W max, 130W typical
  - Operator Control Unit (OCU): Auto select 110/220VAC 50/60Hz
  - Portable console: 110/220VAC 50/60Hz

**Dimensions**

- **Dimensions (LxWxH)**
  - OCU Power Chassis: 5"x4.25"x2.46" (127x108x62 mm)
  - Operator Control Unit (OCU): 15.87"x12.25"x5.62" (403x311x143 mm)
  - Aluminum enclosure with On/Off switch: 11.5 lbs (5.2 kg)

**Features**

- **Strong – Rugged heavy duty construction**
- **Powerful – 500 lbs of maximum lift, 200 lbs at full extension**
- **Compact – Less than 36" x 19" x 8" in stowed configuration**
- **High Dexterity – 200 degrees of wrist pitch & yaw motion**
- **Integral control valves – No separate valve package and hose bundle**
- **Intuitive master/slave control with high fidelity force feedback**

**Contact Information**

- Kraft TeleRobotics Inc.
- 11667 West 90th Street
- Overland Park, KS 66214 U.S.A.
- Telephone 913-894-9022 • FAX 913-894-1363
- Email info@KraftTeleRobotics.com
- www.KraftTeleRobotics.com

**Performance in Motion™**
Raptor is a 7-function, hydraulically powered manipulator for use in both deep ocean and hazardous inland environments. With 64 inches of reach and a 500 lbs lift capacity, Raptor delivers powerful manipulator performance in a compact package.

Raptor is capable of completing a wide variety of complex tasks in subsea environments. Raptor's close-coupled wrist with 200 degrees of pitch and yaw motion provides high dexterity where its needed most. A high efficiency piston valve delivers “smooth” oil flow, minimizing system noise and vibration. Kraft's unique method of controlling the pressure allows the operator to proportionally vary the rate of jaw closure and the amount of grip force.

Raptor's manipulator arm, based on extensive experience in the field, is designed to minimize overall cost of ownership. Kraft manipulator arms incorporate fewer components and are less complicated than any other manipulator in its class. By design Kraft manipulator arms minimize overall cost of ownership. Kraft force feedback manipulator arms have achieved a remarkable track record by demonstrating exceptional performance and reliability in demanding underwater, nuclear, aerospace, electric utility, and military applications worldwide.

A Tradition of Technological Achievement

Kraft is the beneficiary of over 25 years of manipulator system development and manufacturing experience. Raptor is a mature product combining field proven technology with simplicity of design. With an emphasis on overall system reliability and field serviceability, the Raptor manipulator arm incorporates fewer components and is less complicated than any other manipulator in its class. By design Kraft manipulator arms minimize overall cost of ownership.

Kraft force feedback manipulator arms have achieved a remarkable track record by demonstrating exceptional performance and reliability in demanding underwater, nuclear, aerospace, electric utility, and military applications worldwide. Raptor, as shown on the Red Zone, allows marine scientists to complete a wide variety of tasks in undersea and terrestrial environments. In applications where dexterity and physical strength are important, Raptor delivers. When work must be completed in a timely manner and with little risk of damage to the work site, the advantages provided by a high dexterity force feedback manipulator arm are significant.

Meeting The Challenge

Raptor force feedback manipulator arms are used to perform wide variety of tasks (ranging from subsea and industrial environments. In applications where dexterity and physical strength are important Raptor delivers. When work must be completed in a timely manner, and with little risk of damage to the work site, the advantages provided by a high dexterity force feedback manipulator arm are significant.

KMC 770 Advanced Operating System

The KMC 770 control system offers many standard features which enhance system performance and ease of operation. These features include:

- One button indexing — the ability to offset master position relative to the manipulator for operator comfort.
- Power alignment — allows the operator to realign the master with the manipulator after indexing. When selected, the master controller will move into alignment with the manipulator under its own power.
- Joint lock — the ability to select lock one or more axes of the manipulator so that motion at the master has no effect on the locked axis.
- Joint scaling — the ability to alter the ratio of master arm movement to manipulator arm movement. Scaling can be established for each joint individually.
- Joint limits — the ability to establish individual joint motion limits to prevent arm impact with peripheral equipment.
- Proportional control of grip force — greatly enhances manipulator performance and is far superior to conventional on-off position control.
- Auto-stabilizer — allows the operator to automatically slow or stop the manipulator using a previously programmed routine.
- Robotic operation — provides the ability to touch the manipulator or sequence and permanently save it for execution at a later time.
- System diagnostics — provides comprehensive tools for evaluating and troubleshooting the system.

As the vital link between the remote manipulator and the human operator, the Kraft force feedback mini-master® allows the operator to control complex manipulator-end effectors in a comfortable and intuitive manner. Electric actuators on the individual joints of the master respond to the forces acting upon the manipulator arm, providing force feedback to the operator. Conveniently located switches on the master handgrips provide the operator with direct access to core manipulator functions for latching arm operation. The mini-master® is designed for comfortable left-hand or right-hand operation.

In its standard configuration the mini-master® is mounted to a compact, portable, operator control unit that can be placed on nearly any surface for operator. A color liquid crystal display allows the operator to view system information and menus. Pushbutton keys surrounding the display allow the operator to select various operating options.
Raptor is a 7-function, hydraulically powered manipulator for use in both deep ocean and hazardous inland environments.

Raptor is the beneficiary of over 25 years of manipulator system development and manufacturing experience. Raptor is a modular product combining field proven technology with simplicity of design. With an emphasis on overall system reliability and field serviceability, the Raptor manipulator arm incorporates fewer components and is less complicated than any other manipulator in its class. By design, Kraft manipulator arms minimize overall cost of ownership. Kraft force feedback manipulator arms have achieved a remarkable track record by demonstrating exceptional performance and reliability in demanding undersea, nuclear, aerospace, electric utility, and military applications worldwide.

As the vital link between the remote manipulator and the human operator, the Kraft force feedback mini-master® allows the operator to control complex manipulator motions in a comfortable and intuitive manner. Electric actuators on the individual joints of the master respond to the forces acting upon the manipulator arm, providing force feedback to the operator. Conveniently located switches on the master arm allow the operator to quickly select between primary, secondary, and tertiary operating options.

In its standard configuration the mini-master® is mounted to a compact, portable, liquid crystal display allows the operator to view system information and menus. Pushbutton keys surrounding the display allow the operator to select various operating options.

Meeting The Challenge

Raptor force feedback manipulator arms are used to perform a wide variety of tasks in underwater and terrestrial environments. In applications where dexterity and physical strength are important, Raptor delivers. When work must be completed in a timely manner, and with little risk of damage to the work site, the advantages provided by a high dexterity force feedback manipulator are significant.

Innovation In Control Technology

KMC 770 Advanced Operating System

The KMC 770 control system offers many standard features which enhance system performance and ease of operation. These features include:

- Arm position – allows the operator to display the manipulator in either real-time or stored memory.
- Real-time position – allows the operator to view the manipulator in real-time.
- Arm status – allows the operator to view the manipulator in real-time.
- Joint limits – allows the operator to view the manipulator in real-time.
- Arm control – allows the operator to view the manipulator in real-time.
- Arm diagnostic – allows the operator to view the manipulator in real-time.
- Arm load – allows the operator to view the manipulator in real-time.
- Arm speed – allows the operator to view the manipulator in real-time.
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Raptor is a 7-function, hydraulically powered manipulator for use in both deep ocean and hazardous inland environments. With 64 inches of reach and a 1 foot diameter, Raptor delivers powerful manipulator performance in a compact package.

Raptor is capable of completing a wide variety of complex tasks in unstructured environments.

Raptor is the beneficiary of over 25 years of manipulator system development and manufacturing experience. Raptor is a modern product combining field proven technology with simplicity of design. With an emphasis on overall system reliability and field serviceability, the Raptor manipulator arm incorporates fewer components and is less complicated than any other manipulator in its class. By design Kraft manipulator arms minimize overall cost of ownership.

Kraft force feedback manipulator arms have achieved a remarkable track record by demonstrating exceptional performance and reliability in demanding environments, nuclear facilities, aerospace, utility, and military applications worldwide. Efforts of ease of operation and productivity at the work site are important, Raptor excels.

Raptor's close-coupled wrist with 200 degrees of pitch and yaw motion provides high dexterity where its needed most. A high efficiency piston motor delivers “smooth” oil-free, maintenance free operation. Kraft’s unique method of controlling the project allows the operator to proportionally vary the rate of jaw closure and the amount of grip force.

Raptor force feedback manipulator arms are used to perform core tasks in a variety of environments. In applications where dexterity and physical strength are important, Raptor delivers. When work must be completed in a timely manner, and with little risk of damage to the work site, the advantages provided by a high dexterity force feedback manipulator are significant.

Raptor requires only one electrical connection and a proven 4-bolt hydraulic connection. All valves are packaged as an integral part of the manipulator arm, eliminating the cumbersome hydraulic lines that would be necessary with a remote valve package. A square, four-bolt flange makes mounting the arm simple.

Raptor manipulator arms are used in the decommissioning of nuclear vessels worldwide. Raptor as shown in the figure below with a “WRC” work platform is used in the downrating of commercial equipment.

As the vital link between the remote manipulator and the human operator, the Kraft force feedback mini-master® allows the operator to control complex manipulator functions in a comfortable and intuitive manner. Electric actuators in the individual joints of the master respond to the forces acting upon the manipulator arm, providing force feedback to the operator. Conveniently located switches on the master handle grip provide the operator with direct access to core manipulator functions for faster arm operation. The mini-master® is designed for comfortable left-hand or right-hand operation.

In its standard configuration the mini-master® is mounted to a compact, portable, operator control unit that can be placed on nearly any surface for operator use. A color liquid crystal display allows the operator to view system information and menus. Pushbutton keys surrounding the display allow the operator to select various operating options.

As the vital link between the remote manipulator and the human operator, the Kraft force feedback mini-master® allows the operator to control complex manipulator functions in a comfortable and intuitive manner. Electric actuators in the individual joints of the master respond to the forces acting upon the manipulator arm, providing force feedback to the operator. Conveniently located switches on the master handle grip provide the operator with direct access to core manipulator functions for faster arm operation. The mini-master® is designed for comfortable left-hand or right-hand operation.

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Raptor Arm Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manipulator Type</td>
<td>Hydraulically powered 7-function</td>
</tr>
<tr>
<td>Degrees Freedom-Of-Motion</td>
<td>0-200°</td>
</tr>
<tr>
<td>Grip Closure Force (controllable)</td>
<td>0-300 lbf (1334 N)</td>
</tr>
<tr>
<td>Wrist Rotate Torque</td>
<td>1200 in-lbs (135 Nm)</td>
</tr>
<tr>
<td>Lift Capacity at Full Extension</td>
<td>200 lbs (91 kg)</td>
</tr>
<tr>
<td>Maximum Lift Capacity</td>
<td>500 lbs (227 kg)</td>
</tr>
<tr>
<td>Stowed Height</td>
<td>35.75” (908 mm)</td>
</tr>
<tr>
<td>Vertical Reach</td>
<td>64.52” (1655 mm)</td>
</tr>
<tr>
<td>Horizontal Reach</td>
<td>64.52” (1639 mm)</td>
</tr>
<tr>
<td>Construction</td>
<td>Fire resistant</td>
</tr>
<tr>
<td>Hydraulic Fluid Type</td>
<td>Fire resistant</td>
</tr>
<tr>
<td>Filtration</td>
<td>25 micron absolute</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>5 gpm (19 lpm)</td>
</tr>
<tr>
<td>Operating Pressure</td>
<td>1500-3000 psi (104-207 bar)</td>
</tr>
<tr>
<td>Operating Depth, Extended</td>
<td>21,000 fsw (6500 msw)</td>
</tr>
<tr>
<td>Weight In Seawater</td>
<td>98 lbs (44 kg)</td>
</tr>
<tr>
<td>Weight In Air</td>
<td>165 lbs (75 kg)</td>
</tr>
</tbody>
</table>

Raptor Arm Features
- Strong – Rugged heavy duty construction
- Powerful – 500 lbs of maximum lift, 200 lbs at full extension
- Compact – Less than 36” x 19” x 8” in stowed configuration
- High Dexterity – 200 degrees of wrist pitch & yaw motion
- Integral control valves – No separate valve package and hose bundle
- Intuitive master/slave control with high fidelity force feedback

KMC 770 Control System Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode of Operation</td>
<td>Position control with force feedback</td>
</tr>
<tr>
<td>Control Power Chassis</td>
<td>24VDC 265W max, 130W typical</td>
</tr>
<tr>
<td>Storage</td>
<td>-25°C to +70°C</td>
</tr>
<tr>
<td>Dimensions (LxWxH)</td>
<td>15.75” x 8” x 3.75” (400 x 203 x 95 mm)</td>
</tr>
<tr>
<td>Operator Control Unit (OCU)</td>
<td>6-40VDC 30 Watts</td>
</tr>
<tr>
<td>Storage</td>
<td>-20°C to +55°C</td>
</tr>
<tr>
<td>Dimensions (LxWxH)</td>
<td>15.87” x 12.25” x 5.62” (403 x 311 x 143 mm)</td>
</tr>
<tr>
<td>OCU Power Chassis</td>
<td>110/220VAC 50/60Hz</td>
</tr>
<tr>
<td>Storage</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Dimensions (LxWxH)</td>
<td>5”x4.25”x2.46” (127x108x62 mm)</td>
</tr>
</tbody>
</table>

KMC 770 Control System Features
- Optional: Fiber Optic, (single mode / multimode)
- Optional: RS-232, RS-422/485, Ethernet
- Optional: Command and telemetry for the arm
- Standard: 50-500 Hz, 1000 Hz available
- Standard: Auto select 110/220VAC 50/60Hz
- Standard: 180W typical
- Standard: 355W max
- Standard: 1100 W continuous
- Standard: 10% duty cycle
- Standard: Powered by OCU power chassis
- Standard: 178°F (81°C) max
- Standard: 95%RH max (non condensing)
- Standard: Operating -20°C to +55°C
- Standard: Storage -25°C to +70°C
- Intuitive master/slave control with high fidelity force feedback

Performance in Motion™

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# Raptor Arm Specifications

## General Information
- **Manipulator Type**: Force Feedback Manipulator
- **Mode of Operation**: Position control with force feedback
- **Features**:
  - Intuitive master/slave control with high fidelity force feedback
  - Integral control valves – No separate valve package and hose bundle
  - High Dexterity – 200 degrees of wrist pitch & yaw motion
  - Compact – Less than 36" x 19" x 8" in stowed configuration
  - Powerful – 500 lbs of maximum lift, 200 lbs at full extension

## Specification Details

<table>
<thead>
<tr>
<th>Specification</th>
<th>Maximum</th>
<th>Standard</th>
<th>Weight In Seawater</th>
<th>Weight In Air</th>
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<tbody>
<tr>
<td>Jaw Opening (intermeshing)</td>
<td>8.75&quot; (220 mm)</td>
<td>4&quot; (100 mm)</td>
<td>165 lbs (75 kg)</td>
<td>11.5 lbs (5.2 kg)</td>
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<tr>
<td>Jaw Opening (parallel acting)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motion</td>
<td>250 degrees</td>
<td>200 degrees</td>
<td></td>
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<tr>
<td>Shoulder Elevation</td>
<td>120 degrees</td>
<td>120 degrees</td>
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<tr>
<td>Elbow Pivot</td>
<td>120 degrees</td>
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<tr>
<td>Wrist Yaw</td>
<td>200 degrees</td>
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</tr>
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<td>Wrist Rotate (continuous)</td>
<td>0-40 rpm</td>
<td></td>
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<tr>
<td>Wrist Rotate (slaved mode)</td>
<td>340 degrees</td>
<td></td>
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</tr>
<tr>
<td>Lift Capacity at Full Extension</td>
<td>200 lbs</td>
<td>200 lbs</td>
<td></td>
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</tr>
<tr>
<td>Maximum Lift Capacity</td>
<td>500 lbs</td>
<td>500 lbs</td>
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<td>Lift Capacity at Full Extension</td>
<td>200 lbs</td>
<td>200 lbs</td>
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<tr>
<td>Stowed Height</td>
<td>35.75&quot; (908 mm)</td>
<td>35.75&quot; (908 mm)</td>
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<tr>
<td>Vertical Reach</td>
<td>65.15&quot; (1655 mm)</td>
<td>65.15&quot; (1655 mm)</td>
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<tr>
<td>Horizontal Reach</td>
<td>64.52&quot; (1639 mm)</td>
<td>64.52&quot; (1639 mm)</td>
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<tr>
<td>Construction</td>
<td>Anodized aluminum &amp; stainless steel</td>
<td>Hydraulically powered 7-function</td>
<td></td>
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<tr>
<td>Fire resistant</td>
<td>Quaker Quintolubric® 822</td>
<td>MIL-H-5606 NATO Code H-515</td>
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<tr>
<td>Hydraulic Fluid Type</td>
<td>Shell Tellus® 32 (or equivalent)</td>
<td>Petroleum / Mineral based oils</td>
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<tr>
<td>Hydraulic Power Requirements:</td>
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</tr>
<tr>
<td>Operating Depth, Extended</td>
<td>21,000 fsw (6500 msw)</td>
<td>10,000 fsw (3000 msw)</td>
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<tr>
<td>Operating Depth, Standard</td>
<td></td>
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</tr>
<tr>
<td>Weight In Seawater</td>
<td>98 lbs (44 kg)</td>
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<tr>
<td>Weight In Air</td>
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<tr>
<td>Jaw Opening</td>
<td>8.75&quot; (220 mm)</td>
<td>4&quot; (100 mm)</td>
<td>165 lbs (75 kg)</td>
<td>11.5 lbs (5.2 kg)</td>
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<tr>
<td>Jaw Opening (parallel acting)</td>
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<td>Motion</td>
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<td>Shoulder Elevation</td>
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<td>Elbow Pivot</td>
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<tr>
<td>Wrist Yaw</td>
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</table>

## Raptor Arm Specifications

### Key Specifications
- **Hose Specifications**
  - Material: Anodized aluminum & stainless steel
  - Connection: Hydraulically powered 7-function
- **Fire Resistant Fluids**
  - Quaker Quintolubric® 822
  - Shell Tellus® 32 (or equivalent)
- **Operating Temperature**
  - Seawater: -40°C to +85°C
  - Air: 0°C to +55°C
- **Humidity**
  - Seawater: 95% RH max (non condensing)
  - Air: 95% RH max (non condensing)
- **Power Requirements**
  - Seawater: KMC 770 Servo Driver
  - Air: OCU Power Chassis
- **Dimensions (LxWxH)**
  - Seawater: 5"x4.25"x2.46" (127x108x62 mm)
  - Air: 15.87"x12.25"x5.62" (403x311x143 mm)

## KMC 770 Control System Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Standard</th>
<th>Optional</th>
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<tbody>
<tr>
<td>Model of Operation</td>
<td>Position</td>
<td>Force feedback</td>
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<tr>
<td>Interface</td>
<td>Multi-function</td>
<td>Key-press</td>
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<tr>
<td>Communication (pneumatic)</td>
<td>RS-232</td>
<td>Fiber Optic</td>
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<td>Communication (digital)</td>
<td>RS-422/485</td>
<td>Single Mode</td>
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<td>Communication (electrical)</td>
<td>Ethernet</td>
<td>Multimode</td>
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<td>Communication (analog)</td>
<td>Voltage signal</td>
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<td>Communication (telemetry)</td>
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<td>Operating Pressure</td>
<td>1500-3000 psi</td>
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<td>Flow Rate</td>
<td>5 gpm</td>
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<td>Flow Rate (max)</td>
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<td>25 micron absolute</td>
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<tr>
<td>Storage Temperature</td>
<td>-20°C to +70°C</td>
<td>-25°C to +70°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-40°C to +85°C</td>
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</tr>
</tbody>
</table>

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**Performance in Motion™**

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