Aviation Fuel Contamination Monitoring

ACM20 Lab Unit

Global Filtration Technology
Aviation Fuel Contamination Monitoring

ACM20 Lab Unit

Features & Benefits

Test Time:
2 minutes

Repeat Test Time:
Every 2 minutes (Manual testing)

Principle of Operation:
Optical scanning analysis and measurement of actual particles and inference to water presence

Primary Output:
>4µ(c), >6µ(c), >14µ(c), >21µ(c), >25µ(c), >30µ(c) counts per ml

Secondary Diagnostic Output:
% Volume Distribution, via graphical display on handset and printout

International codes:
ISO 7-22 in accordance with ISO 4406-1999

Data entry:
32 character two line dot matrix LCD. Full alpha numeric entry facility on keypad

Data retrieval:
Memory access gives test search facility

Calibration:
In accordance with Parker Calibration Procedure CM20-N, which complies to ISO11171:1999, Clause 6 (Omitting Annex F)

Re-calibration:
Every 12 months by a dedicated Parker Service Centre (Consult Parker)

Max. working pressure:
420 bar

Operating Temperature:
+5°C to +80°C

Memory store:
300 test capacity

Computer compatibility:
Interface via RS 232 connection @ 9600 baud rate (USB serial cable to RS232 option available)

Laboratory sampling:
Oil delivery unit (ODU) - test portion sampling device

Portability:
Only 8 kg. ACM20 has its own battery pack and carry case with wheels

Power requirement:
12vDC input, 6 x 'D' Cell or rechargeable batteries

Printer facility:
Integral 16 column printer for hard copy data

Certification:
Complies with all relevant EC declarations of conformity


Development work carried out by the CMC engineers, in conjunction with ExxonMobil Aviation, highlighted the need for an alternative test method to determine the levels of dispersed contamination in Jet fuel.

5 years of field testing and development of the already established and successful LCM20 Hydraulic Laser Particle Counter saw the introduction of the Parker ACM20 with enhanced software providing the user with a better understanding of the contamination present in a sample.

As the benchmark particle counter for use in measuring the levels of contamination in fuels, the ACM20, as per the UK’s Energy Institute Test Method IP564, has now been included in the DEFSTAN 9191 Jet Fuel Specification as a report only test alongside the current Gravimetric test method (IP423 or ASTM D5452) and Clear & Bright Visual test method (IP216 or ASTM D2276).
**Specification**

**Construction:**
- Case-Lexan structural foam and ABS
- Hand-held display - ABS
- Keypad fluoro-silicone rubber

**Mechanical Components:**
- Brass, plated steel, stainless steel and aluminium

**Seals:**
- Fluorocarbon

**Hoses:**
- Nylon (Kevlar braided microbore), St. steel armoured ends

**Flow Rate:**
- 25 - 50ml/min (dictated by ODU)

**Fluid Compatability:**
- Hydrocarbon Fuel, Mineral Oil. For other fluids consult Parker

**Fuse:**
- 1.25 amp fast blow fuse included for overload protection (spare supplied)

**ACM20 Technology:**
- Patented flow cell, light obscuration

**Repeatability/Accuracy:**
- As per or better than ISO 11171

**Coincidence:**
- 40,000 particles per ml

**Viscosity Range:**
- 1 - 100 centistokes

**ACM20 Weight:**
- 8 kg

**Monitor Carrying Case:**
- Astra Board case

**Carrying Case Weight:**
- 5 kg

**Applications**

The Parker ACM20 Portable Particle Counter has been developed from existing technology for monitoring contamination in AvTur and other Hydrocarbon fuels, in accordance with the Energy Institute (EI) Method IP 564.

In addition, the ACM can also be used to monitor various fuels from existing sampling points in locations from refineries, pipelines, distribution terminals, airport fuel supply systems all the way through to the point of uplift into aircraft*.

* Hot works permit required for online sampling (ATEX Zone II unit available).

**Fuel Testing Laboratories – DefStan 9191**

In order to better understand dispersed contamination in jet fuel, particle counting is now included alongside existing laboratory techniques

- **Bottle Sampling - Energy Institute (EI) - IP 564**
  Laboratory determination of the level of dispersed contamination in aviation kerosine using an Automatic Particle Counter (APC)

- **Replace Clear & Bright and Gravimetric**
  With the introduction of the ACM20, all subjectivity surrounding Clear & Bright and Gravimetric methods can be removed

- **Also for use on petroleum based hydraulic applications (Skydrol compatible available)**
  Suitable for use with mineral oil and petroleum based fluid as per standard hydraulic particle counter, reporting fluid cleanliness to ISO 4406:1999
Defence Standard 91-91 is the specification for aviation turbine fuel, which the United Kingdom Civil Aviation Authority (CAA) has agreed is under the technical authority of the Director of the Defence Fuels Group.

Laboratory determination of the level of dispersed contamination in aviation kerosene using an Automatic Particle Counter (APC).

This standard describes a method for determining the level of dispersed contamination in aviation kerosene fuels, specifically dirt particles and water droplets in the range from >4µ(c) to >30µ(c). This method relates specifically to Aviation fuels but the equipment can be used on all fuels, petroleum and mineral based fluids.
**Aviation Fuel Contamination Monitoring**

**ACM20 Lab Unit**

**IP 564 Procedure**

1. **Apparatus:**
   The apparatus shall be set up in accordance with manufacturers’ operating instructions.

2. **Test Portion Preparation:**
   Decant a minimum of 450ml of the field sample into a clean test portion container.

3. Prior to starting a test, tumble the test portion end over end for 60 seconds to ensure any settled particles are redistributed.

4. Flush the equipment with the new test sample for 60 seconds prior to starting the test.

5. Following the flush, start a test by turning the blue valve in the direction indicated. Repeat a further 3 times.

**Note:**
The implementation date for IP 564 test method “Determination of the level of cleanliness of aviation turbine fuel - laboratory automatic particle counter” will be June 2009. It is the specification authorities intention to replace current test methods with particle counting at the earliest opportunity.
Field Monitoring - ACM202022

For use in non-hazardous areas, the ACM2022 is designed for online sampling of hydrocarbon fuels and hydraulic systems, utilising existing "quick connect" sampling points such as the Millipore Adaptor.

Field Monitoring - ACM202032 (Z2)

The ACM202032 (Z2) is the world’s only ATEX approved portable particle counter for sampling directly from the process line in hazardous areas:

- Assembled in an approved and certified stainless steel enclosure to comply with ATEX Directive 94/9/EC and EN50 021 requirements
- Certified to CE Ex 11 3 G Ex nR/nI 11C T6
- “A” Class product defined for the Aviation market
- ATEX approved handset and keypad
## Ordering Information

### Standard products table - ACM20

<table>
<thead>
<tr>
<th>Product number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACM202022UK</td>
<td>Particle counter UK*</td>
</tr>
<tr>
<td>ACM202022US</td>
<td>Particle counter US*</td>
</tr>
<tr>
<td>ACM202022EUR</td>
<td>Particle counter Euro*</td>
</tr>
<tr>
<td>ACM202024UK</td>
<td>Particle counter with lab kit UK (DefStan 9191)</td>
</tr>
<tr>
<td>ACM202024US</td>
<td>Particle counter with lab kit US (DefStan 9191)</td>
</tr>
<tr>
<td>ACM202024EUR</td>
<td>Particle counter with lab kit Euro (DefStan 9191)</td>
</tr>
<tr>
<td>B84794</td>
<td>1m process cable assembly</td>
</tr>
<tr>
<td>B84816</td>
<td>Parsmart downloader software</td>
</tr>
<tr>
<td>B84855</td>
<td>Carry case</td>
</tr>
<tr>
<td>B84746</td>
<td>Bottle assembly</td>
</tr>
<tr>
<td>B84745</td>
<td>Throttle kit</td>
</tr>
<tr>
<td>B84645</td>
<td>Millipore adaptorassy</td>
</tr>
<tr>
<td>B84609</td>
<td>Re-chargeable battery pack</td>
</tr>
<tr>
<td>B84617</td>
<td>UK power supply</td>
</tr>
<tr>
<td>B84630</td>
<td>US power supply</td>
</tr>
<tr>
<td>B84631</td>
<td>Euro power supply</td>
</tr>
<tr>
<td>B84632</td>
<td>Laboratory kit</td>
</tr>
</tbody>
</table>

*Hot works permit required for online sampling.*

Note 1: Part numbers featured with bold highlighted codes will ensure a 'standard' product selection.
Note 2: Alternate displayed part number selection will require you to contact Parker Filtration for availability.
ATEX Approved Portable Particle Counter

ACM20 Z2
ATEX Approved Portable Particle Counter

ACM20 Z2

Features & Benefits

Test Time:
2 minutes.
Repeat Test Time:
Every 2 minutes (Manual testing) Every 6 minutes (Automatic).
Principle of Operation:
Optical scanning analysis and measurement of actual particles and inference to water presence.
Primary Output:
>4µ(c), >6µ(c), >14µ(c), >21µ(c), >25µ(c), >30µ(c) counts per ml.
Secondary Diagnostic Output:
% Volume Distribution, via graphical display on handset.
International codes:
ISO 7-22 in accordance with ISO 4406-1999
Data entry:
32 character two line dot matrix LCD, Full alpha numeric entry facility on keypad.
Data retrieval:
Memory access gives test search facility.
Calibration:
In accordance with Parker Calibration Procedure CM20-N, which complies to ISO11171:1999, Clause 6 (Omitting Annex F).
Re-calibration:
Every 12 months by a dedicated Parker Service Centre (Consult Parker).
Max. working pressure:
420 bar.
Operating Temperature:
+5°C to +80°C
Memory store:
300 test (scrolling memory) capacity.
Computer compatibility:
Interface via RS 232 connection @ 9600 baud rate.
Portability:
15 kg. ACM20 has its own battery pack and carry case with wheels.
Power requirement:
Rechargeable battery powered or via the 12vDC input.
System connection:
Via Millipore adaptor with flow restriction through supplied needle valve.
Certification:
Complies with all relevant EC declarations of conformity

- Assembled in an approved and certified stainless steel enclosure to comply with ATEX Directive 94/9/EC and EN50 021 requirements.
- Can be used in explosive and hazardous areas, including Offshore and Mining.
- Certified to CE Ex II 3 G Eex nA/nL IIB T *(as tested)
- “A” Class product defined for the Aviation market.
- ATEX approved Handset and keypad.
- Suitable for use with mineral oil and petroleum based fluid as per LCM20 particle counter.
## Specification

**Construction:**
- **Unit:** stainless steel
- **Carrying case:** ABS
- **Hand-held display:** ABS
- **Keypad:** polyester membrane
- **Mechanical components:** Brass, plated steel, stainless steel and aluminium
- **Seals:** Viton
- **Hoses:** Nylon (Kevlar braided microbore)

**Fluid compatibility:**
- All fuels. For other fluids consult Parker
- Internal rechargeable battery:
  - Note: ONLY to be charged outside of the hazardous area, with the unit switched off
- **Fuse:**
  - 1.25A fast blow fuse included for overload protection
  - Return to Parker Hannifin if fuse is blown
- **ACM20.2032 technology:**
  - Unique optical scanning system
- **Repeatability/Accuracy:**
  - Better than 5% (typical)

## Using ACM20 Z2

ACM20Z2 is designed to be used to monitor various fuels from existing sampling points in hazardous locations from refineries, pipelines, distribution terminals, airport fuel supply systems all the way through to the point of uplift into aircraft. With Zone 2 classification, the ACM20Z2 is the world’s only ATEX approved particle counter.

## Applications in Fuels

- **Oil Refinery**
  - To count and verify the levels of dispersed contamination in accordance with specification limits.
- **Distribution Terminals/Hubs**
  - For use on receipt and outbound supply. Also to provide filtration performance, tank cleanliness and product quality checks.
- **Storage**
  - Settling times can be reduced by monitoring with the ACM by ensuring that levels of dispersed contamination are below acceptable levels.
- **Airport Fuel Farm**
  - Monitoring of the fuels into storage, through the fuel farm, hydrant system and uplift into wing.
- **Pipeline Commissioning**
  - Fast real time monitoring of pipelines following pigging and cleaning processes.
- **Oil and Gas Platforms**
  - Used to monitor the filtration performance, system cleanliness and quality of delivered product.
ATEX Approved Portable Particle Counter

ACM20 Z2

Applications in hydraulics

Solutions in the offshore industry.

In addition, the ACM20 Z2 can be used in many hydraulic system applications as detailed below.

In many industries, worker awareness needs to be maintained at a high level to ensure the safety of their operation. This is particularly relevant to offshore oil-drilling and gas-drilling crews, given the interactive and hazardous nature of their work. The Zone 2 ACM20 portable particle analyser is a tried and tested technology designed, proven and approved as a fluid contamination monitor that crews are using and trusting in such hazardous and demanding environments.

- Certified to CE Ex II 3 G ExnA/nL IIB T* (*as tested).
- Can be used in explosive and hazardous areas, including Offshore and Mining.
- Primary Output. Six cumulative particle size channels ranging from >4µm(c) to >30µm(c) and numbers per ml in accordance with ISO4406-1999.

ACM20Z2 – operational in oil refineries and fuel fields.

Already operational in oil refineries and designed to be used inside commercial airfield fuel locations and at the point of upload of fuel into the aircraft, ACM20Z2 has an impressive success record in this approvals sensitive area of operation.

With a number of safety features designed in as operational standards, the ACM20Z2 can be taken to the point of use, connected in moments and reporting in little more than 2 minutes to ISO approved standards.

- Assembled in an approved and certified stainless steel enclosure to comply with ATEX Directive 94/9/EC and EN50 021 requirements.
- ‘A’ Class product defined for the aviation market.
- Designed for on-line operation, connecting to the process line via existing Millipore™ fittings, already in use for other industry equipment.

Applications in other hazardous environments.

- Railroad equipment manufacturer - Warranty protection.
- Power generation stations - Preventative maintenance.
- Mobile equipment - Roll-off cleanliness testing.
- Mining operations - Service tool.
- Steel mills - Preventative maintenance.
Online Commission Kit

a – ACM20 Zone 2 Particle Counter
b – Battery Charger
c – Process Cable
d – User Manual
e – Downloader Software
f – Throttle Kit
g – Millipore Adaptor Assembly
h – Aluminium Case
i – Bottle Assembly

Installation Details
Alternative Fuel Monitoring

In addition to the Z2, Parker also have the ACM20 laboratory Particle Counter which has been designed in accordance with the Energy Institute (EI) Method IP PM DK.

The ACM20 with additional laboratory kit is proposed as an alternative method for use within DefStan 9191 – the standard for aviation turbine fuel, which the United Kingdom Civil Aviation Authority (CAA) has agreed is under the technical authority of the Director Defence Fuels Group.

The ACM can also be used to monitor various fuels from existing sampling points in the same way as the Z2*.

*Hot works permit required for online sampling.

Laboratory Kit
The Oil Delivery Unit (ODU) laboratory kit is a peristaltic pump unit that allows fuel to be pumped through the ACM20 for testing purposes offline.

Specification
Height: 150mm wide x 150mm deep x 170mm
Weight: 1.7 kg
Power Requirement:
Can be run from the 12-volt ACM20 power supply or from another suitable supply via the connecting lead supplied.
Fuse: 0.5 amp fast blow fuse included for overload protection.
Minimum Flow Rate: 15ml/min.

Average Particle Counts in AV System

The table below gives estimated counts found in a typical aviation fuel distribution system, and is given as guidance, in which APR/EI filtration equipment is installed.

<table>
<thead>
<tr>
<th>Stage</th>
<th>ISO Code - 4406 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF</td>
<td>High Count Code</td>
</tr>
<tr>
<td>&gt;4µ(c)</td>
<td>2,500 18</td>
</tr>
<tr>
<td>&gt;6µ(c)</td>
<td>100 15</td>
</tr>
<tr>
<td>&gt;14µ(c)</td>
<td>10 10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage</th>
<th>ISO Code - 4406 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>FWS</td>
<td>High Count Code</td>
</tr>
<tr>
<td>&gt;4µ(c)</td>
<td>500 16</td>
</tr>
<tr>
<td>&gt;6µ(c)</td>
<td>50 13</td>
</tr>
<tr>
<td>&gt;14µ(c)</td>
<td>5 9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage</th>
<th>ISO Code - 4406 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airport storage</td>
<td>High Count Code</td>
</tr>
<tr>
<td>&gt;4µ(c)</td>
<td>100 14</td>
</tr>
<tr>
<td>&gt;6µ(c)</td>
<td>10 10</td>
</tr>
<tr>
<td>&gt;14µ(c)</td>
<td>1 7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage</th>
<th>ISO Code - 4406 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>FWS Out of Storage</td>
<td>High Count Code</td>
</tr>
<tr>
<td>&gt;4µ(c)</td>
<td>500 16</td>
</tr>
<tr>
<td>&gt;6µ(c)</td>
<td>50 13</td>
</tr>
<tr>
<td>&gt;14µ(c)</td>
<td>5 9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage</th>
<th>ISO Code - 4406 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>After FWS into Hydrant</td>
<td>High Count Code</td>
</tr>
<tr>
<td>&gt;4µ(c)</td>
<td>100 14</td>
</tr>
<tr>
<td>&gt;6µ(c)</td>
<td>10 10</td>
</tr>
<tr>
<td>&gt;14µ(c)</td>
<td>1 7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage</th>
<th>ISO Code - 4406 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>After Monitor Into Plane</td>
<td>High Count Code</td>
</tr>
<tr>
<td>&gt;4µ(c)</td>
<td>100 14</td>
</tr>
<tr>
<td>&gt;6µ(c)</td>
<td>10 10</td>
</tr>
<tr>
<td>&gt;14µ(c)</td>
<td>1 7</td>
</tr>
</tbody>
</table>

Note: Figures will vary from location to location.
### Ordering Information

#### Standard products table - ACM20 Z2

<table>
<thead>
<tr>
<th>Product number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACM202032UK</td>
<td>Particle counter with online kit &amp; UK power supply</td>
</tr>
<tr>
<td>ACM202032US</td>
<td>Particle counter with online kit &amp; US power supply</td>
</tr>
<tr>
<td>ACM202032EUR</td>
<td>Particle counter with online kit &amp; Euro power supply</td>
</tr>
<tr>
<td>ACM202034UK</td>
<td>Particle counter with online &amp; lab kit + UK power supply</td>
</tr>
<tr>
<td>ACM202034US</td>
<td>Particle counter with online &amp; lab kit + US power supply</td>
</tr>
<tr>
<td>ACM202034EUR</td>
<td>Particle counter with online &amp; lab kit + Euro power supply</td>
</tr>
<tr>
<td>B84647</td>
<td>UK battery charger</td>
</tr>
<tr>
<td>B84652</td>
<td>US battery charger</td>
</tr>
<tr>
<td>B84653</td>
<td>Euro battery charger</td>
</tr>
<tr>
<td>B84650</td>
<td>2m process cable assembly</td>
</tr>
<tr>
<td>B84616</td>
<td>Parsmart downloader software</td>
</tr>
<tr>
<td>B84656</td>
<td>Carry case</td>
</tr>
<tr>
<td>B84746</td>
<td>Bottle assembly</td>
</tr>
<tr>
<td>B84745</td>
<td>Throttle kit</td>
</tr>
<tr>
<td>B84645</td>
<td>Millipore adaptor assy</td>
</tr>
</tbody>
</table>
Important Information

WARNING — USER RESPONSIBILITY

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

• This document and other information from Parker-Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise.

• The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met.

The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

• To the extent that Parker or its subsidiaries or authorized distributors provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

Sales conditions

The items described in this document are available for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. Any sale contract entered into by Parker will be governed by the provisions stated in Parker’s standard terms and conditions of sale (copy available upon request)
At Parker, we're guided by a relentless drive to help our customers become more productive and achieve higher levels of profitability by engineering the best systems for their requirements. It means looking at customer applications from many angles to find new ways to create value. Whatever the motion or control technology need, Parker has the experience, breadth of product and global reach to consistently deliver. No company knows more about motion and control technology than Parker.

**Parker’s Motion & Control Technologies**

**AEROSPACE**

**Key Markets**
- Aerospace
- Agriculture
- Bulk chemical handling
- Construction machinery
- Food & beverage
- Fuel & gas delivery
- Industrial machinery
- Mobile
- Oil & gas
- Transportation
- Welding

**Key Products**
- Brass fittings & valves
- Diagnostic equipment
- Fluid conveyance systems
- Industrial hose
- PTFE & PFA hose, tubing & plastic fittings
- Rubber & thermoplastic hose & couplings
- Tube fittings & adapters
- Quick disconnects

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**CLIMATE CONTROL**

**Key Markets**
- Agriculture
- Air conditioning
- Food, beverage & dairy
- Life sciences & medical
- Precision cooling
- Refrigeration systems
- Transportation

**Key Products**
- CDX controls
- Electronic controllers
- Filter drivers
- Hand shut-off valves
- Hose & fittings
- Pressure regulating valves
- Refrigerant distributors
- Safety relief valves
- Solenoid valves
- Thermostatic expansion valves

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**ELECTROMECHANICAL**

**Key Markets**
- Aerospace
- Factory automation
- Life science & medical
- Machine tools
- Packaging machinery
- Paper machinery
- Plastics machinery & converting
- Primary metals
- Semiconductor & electronics
- Textile
- Wire & cable

**Key Products**
- AGV drives & systems
- Electric actuators, pony robots & slides
- Electrohydraulic actuation systems
- Electromechanical actuation systems
- Human machine interface
- Linear motors
- Slapper motors, servo motors, drives & controls
- Structural excitations

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**FLUID & GAS HANDLING**

**Key Markets**
- Aerospace
- Agriculture
- Bulk chemical handling
- Construction machinery
- Food & beverage
- Fuel & gas delivery
- Industrial machinery
- Mobile
- Oil & gas
- Transportation
- Welding

**Key Products**
- Brass fittings & valves
- Diagnostic equipment
- Fluid conveyance systems
- Industrial hose
- PTFE & PFA hose, tubing & plastic fittings
- Rubber & thermoplastic hose & couplings
- Tube fittings & adapters
- Quick disconnects

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**HYDRAULICS**

**Key Markets**
- Aerospace
- Aerial VT
- Agriculture
- Construction machinery
- Forestry
- Industrial machinery
- Mining
- Oil & gas
- Power generation & energy
- Truck & hydraulics

**Key Products**
- Diagnostic equipment
- Hydraulic cylinders & accumulators
- Hydraulic motors & pumps
- Hydraulic systems
- Hydraulic valves & controls
- Power take-offs
- Rubber & thermoplastic hose & couplings
- Tube fittings & adapters
- Quick disconnects

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**PNEUMATICS**

**Key Markets**
- Aerospace
- Conveyor & material handling
- Factory automation
- Life science & medical
- Machine tools
- Packaging machinery
- Transportation & automotive

**Key Products**
- Air preparation
- Brass fittings & valves
- Manifolds
- Pneumatic accessories
- Pneumatic actuators & grippers
- Pneumatic valves & controls
- Quick disconnects
- Rotary actuators
- Rubber & thermoplastic hose & couplings
- Structural excitations
- Thermostatic tubing & fittings
- Vacuum generators, cups & sensors

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**PROCESS CONTROL**

**Key Markets**
- Chemical & refining
- Food, beverage & dairy
- Medical & dental
- Microelectronics
- Oil & gas
- Power generation

**Key Products**
- Analytical sample conditioning products & systems
- Fluoropolymer chemical delivery fittings, valves & pumps
- High purity gas delivery fittings, valves & regulators
- Instrumentation fittings, valves & regulators
- Medium pressure fittings & valves
- Process control manifolds

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**FILTRATION**

**Key Markets**
- Food & beverage
- Industrial machinery
- Life sciences
- Marine
- Mobile equipment
- Oil & gas
- Power generation
- Process
- Transportation

**Key Products**
- Analytical gas generators
- Compressed air & gas filters
- Condition monitoring
- Engine air, fuel & oil filtration systems
- Hydraulic, lubrication & coolant filters
- Process, chemical, water & microfiltration filters
- Nitrogen, hydrogen & zero air generators

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**SEALING & SHIELDING**

**Key Markets**
- Aerospace
- Chemical processing
- Consumer
- Energy, oil & gas
- Fluid power
- General industrial information technology
- Life sciences
- Military
- Semiconductor
- Telecommunications
- Transportation

**Key Products**
- Dynamic seals
- Elasticometric o-rings
- EMI shielding
- Extruded & precision cut, fabricated elastomeric seals
- Homogeneous & inserted elastomeric shapes
- High temperature metal seals
- Metal & plastic retained composite seals
- Thermal management

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**ENGINEERING YOUR SUCCESS.**