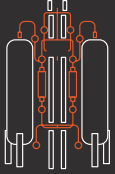




ARM PURIFICATION
BY APPLIED ENERGY SYSTEMS



Micro-Bulk Purifiers

Long-Lasting Gas Purifiers for Moderate Flow Rates

At ARM Purification, we know that longevity matters when it comes to your moderate flow rate applications. That's why we are committed to delivering a full suite of micro-bulk purifiers that meet your precise requirements and maximize life span.

ARM Purification's micro-bulk purifiers offer moderate flow rates, serving high purity and permanently installed gas delivery systems. Whether a micro-bulk gas purifier, pressure regulator station, or flow control panel, ARM Purification's cost-effective micro-bulk purifier solutions are designed to meet the specific requirements of any gas delivery system by allowing for customization of critical features.

Our Suite of Micro-Bulk Gas Purifiers

Vessels

Operate without requiring heat to remove impurities.

Advantage™ Micro-Series

Require a heated technology or automated regeneration.

- Heated Getter
- Heated Catalyst
- Dual Vessel



At-a-Glance

FEATURES

- Nominal flow rates from 100 to 1200 slpm
- Powder coated steel enclosure
- 316L stainless steel construction
- Pressure to 20.5 MPa
- Full integrated PLC control
- Touchscreen HMI

OPTIONS

- Flow indication
- Bypass valve
- Inlet/outlet connections
- Air-operated or manual valve options
- 100-120/220-240VAC 50/60Hz input power options

APPLICATIONS

- High production rate weld gas/purge gas
- Pharmaceutical production
- Glove box purge gas
- Additive manufacturing
- Annealing cover gas
- Moderate volume high and ultra high purity applications

Micro-Bulk purifiers typically offer a moderate flow rate serving a lab or production work cell through high purity, permanently installed plumbing to each point-of-use. This brochure outlines the features, benefits, and performance of ARM Purification's Micro-Bulk purifiers.

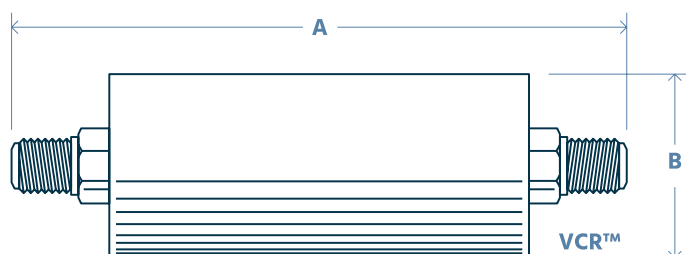
ARM Purification purifiers are categorized into three groups. The primary distinction is based on flow rate of the gas being purified. The following is offered as a general rule:

| Category | Flow Rate |
|--------------|------------------------------|
| Point-of-Use | 0.1-100 slpm |
| Micro-Bulk | 100-1200 slpm |
| Bulk | 60->5000 nm ³ /hr |

Vessels Only

Many gas/impurity combinations can be effectively purified with an ambient temperature purifier. In these applications, it can be very cost effective to simply have an ambient temperature purifier upstream of the use point.

Suitable vessel size is based on the anticipated flow rate of the gas being purified, input impurity load, and desired lifetime between regeneration or replacement. In some cases, it is desirable to oversize the vessel to enhance purity or lifetime performance. The chart at right lists nominal flow rates at 150 psi line pressures to achieve specified impurity removal to <100 PPT for a nominal one year service life. Max flow rates listed are based on filtration option specified, FP=0.003µm, CR=0.1µm.



| | | DIMENSIONS | | FLOW SLPM | | |
|-------|-------|------------|-------|-----------|--------|--------|
| MODEL | UNITS | A | B | NOMINAL | MAX FP | MAX CR |
| 975 | mm | 202.0 | 76.0 | 7.0 | 60.0 | 100.0 |
| | inch | 7.94 | 3.0 | | | |
| 977 | mm | 254.0 | 76.0 | 10.0 | 120.0 | 200.0 |
| | inch | 10.0 | 3.0 | | | |
| 05K | mm | 462.0 | 76.0 | 43.0 | 200.0 | 400.0 |
| | inch | 18.20 | 3.0 | | | |
| 07K | mm | 440.0 | 102.0 | 60.0 | 500.0 | 700.0 |
| | inch | 17.30 | 4.0 | | | |
| 08K | mm | 864.0 | 102.0 | 120.0 | 560.0 | 850.0 |
| | inch | 34.0 | 4.0 | | | |
| 50K | mm | 701.0 | 152.0 | 225.0 | 1000.0 | 1500.0 |
| | inch | 27.60 | 6.0 | | | |

- Nominal flow rates are based on providing 1-year service life at 5Ns inlet purity.
- Max flow rates are at 150 psig gas pressure.
- Weights range from 1 to 10 lbs based on size and fill material.

Fill Class

Designations for the fill material required to remove specific impurities from specific gas streams are listed in the chart below. This is not a comprehensive list of every possible impurity that can be removed from every possible gas. If the gas to be purified, or impurities are not listed, contact ARM Purification for assistance.

| Class | Gases Purified | Impurities Removed ¹ | Removal Efficiency ¹ | Regen Capable |
|-------|---|---|---------------------------------|---------------|
| C | Ar, He, Kr, Ne, Xe, N ₂ , H ₂ | CO, CO ₂ , H ₂ , H ₂ O, NMHC, O ₂ | <100 PPT | Yes |
| CA | Ar, He, Kr, Ne, Xe, N ₂ , H ₂ | CO, CO ₂ , H ₂ , H ₂ O, NMHC, O ₂ | <100 PPT | Yes |
| F | C ₂ F ₆ , C ₃ F ₈ , C ₄ F ₈ , CClF ₃ , CCl ₂ F ₂ , CCl ₄ , CF ₄ , CHClF ₂ , CHF ₃ , CH ₃ F | CO, CO ₂ , H ₂ , H ₂ O, NMHC, O ₂ | <100 PPT | No |
| OX | CDA, O ₂ | CO ₂ , H ₂ O, NMHC, Amines, NOx | <100 PPT | Yes |
| T | BCl ₃ , BF ₃ , Cl ₂ , ClF ₃ , F ₂ , HBr, HCl, HF, NF ₃ , SF ₆ , WF ₆ | H ₂ O | <100 PPT | No |
| W | Ar, He, Kr, Ne, Xe, H ₂ , N ₂ | H ₂ O | <100 PPT | Yes |
| Y | AsH ₃ , B ₂ H ₆ , CH ₄ , D.C.S.(SiH ₂ Cl ₂), Ge ₂ H ₆ , GeH ₄ , H ₂ Se, NH ₃ , PH ₃ , SF ₆ , SiH ₂ , SiH ₄ , Si ₂ H ₆ , DMHZ, Hydride/Carrier Gas Mix | CO ₂ , H ₂ O, O ₂ | <100 PPT | Yes |

¹ <100 PPT removal efficiency is based on 5N5 (99.9995%) inlet gas purity at nominal flow and rated pressure.

Inlet/Outlet Connections

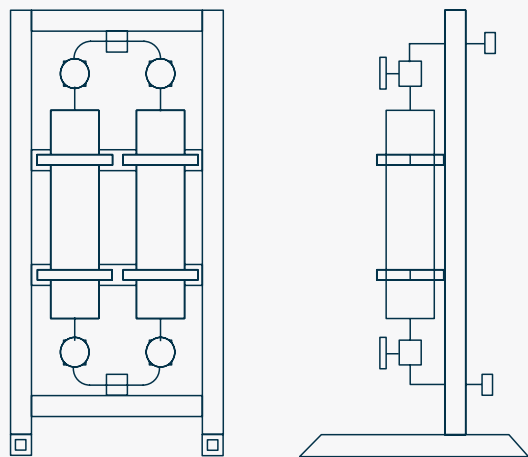
The standard inlet/outlet connections are 1/2" VCR™ face seal fittings. Other connection types are optional. Contact ARM Purification for a quote.

Open Frames

When only vessels that operate at ambient temperature are required, typical installation is on a structural square tube frame that can hold just a vessel. In some cases, a pair of vessels and plumbing are used to allow for removal of a vessel for factory regeneration, and will include isolation valves with appropriate purge ports to ensure a clean installation of the regenerated vessel.

Open frame plumbing can include pressure gauges, sample ports, flow meters, or any other additional indication or features required.

Frames are typically constructed of 2" square stainless steel structural tubing.



Filtration

All purifiers include an integral filter. Two standard options are available: CR-0.1 micron and FP-0.003 micron. These filter particles down to the size specified to less than 1 particle per cubic foot of gas.

| Specification Common to All | |
|--|--|
| Max Operating Pressure | 200 PSIG (17.24 BAR) |
| Max Operating Temperature ¹ | 400°C |
| Nominal Flow Rate ² | 0.3 slpm to 20.0 slpm |
| Maximum Flow Rate ² | 4.5 slpm to 300.0 slpm |
| Pressure Drop ² | <1 ATM typical |
| Filtration | 0.1 µm standard, optional 0.003 µm |
| Wetted Surfaces | Electro-polished, <10Ra, 316L stainless steel |
| Typical Inlet Gas Purity | 99.999% ⁴ |
| Outlet Purity | <100 PPT |
| Input Power | 100VAC, 120VAC, 230VAC, 50/60Hz, 600W (max) |
| Inlet/Outlet Fittings | VCR™ standard, optional Swagelok™ or tube stub |
| Operating Air Supply ³ | 60-90 psig CDA |

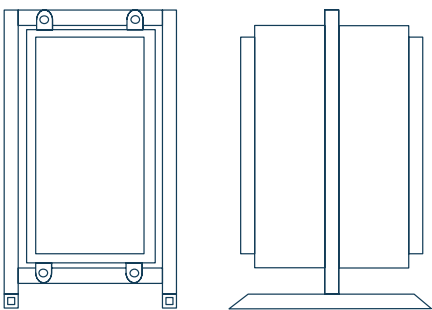
¹ Applicable to heated vessels in Nova™ Series and Pro-Panel™ Series only.
² Dependent on vessel size.
³ Only applicable with air operated valve option.
⁴ 50 PPM maximum

With Enclosures

When removal for factory regeneration is not desirable, regeneration heaters and controls can be added to facilitate in-situ regeneration with a level of automation from simple timers with manual valves, to a completely automated regen schedule with electro-pneumatic valve operation.

These enclosed designs can include pressure gauges, sample ports, flow meters, or any other additional indication or features required.

Frames are typically constructed of 2" square stainless steel structural tubing.



| Features | Vessel Only | Pro-Panel™ Series |
|--|-------------|-------------------|
| Heated Operation | No | Yes |
| Optional Inlet/Outlet/Bypass Valves | Yes | Yes |
| Optional Pneumatic Inlet/Outlet Valves | N/A | Yes |
| Power Status Indication | N/A | Yes |
| Ready (for Operation) Indication | N/A | Yes |
| Thermocouple Fault Indication | N/A | Yes |
| Process Indication | N/A | Yes |
| Alarm Indication | N/A | Yes |
| Valves Open Indication | No | Yes |

Advantage™ Micro Series

When a heated technology is required or automated regeneration for uninterrupted gas flow is required, ARM Purification's Advantage™ Micro Series purifier is the answer.

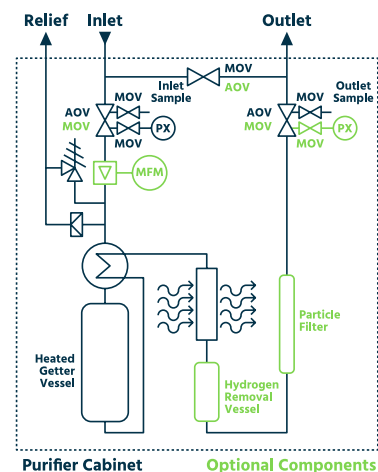
The Advantage™ Micro Series is a modular design, with fully automated control, and configurable to meet your specific requirements. The three basic technologies used are described below, which are selected based on the gas to be purified and the impurities to be removed.

Getter

Getter purifiers use getter material, sometimes at elevated temperatures, to remove impurities that react with the getter and chemically bond to it. This chemical bond, once made, survives for the life of the purifier.

For overall thermal efficiency, a gas-to-gas heat exchanger is incorporated to use the cold gas entering the getter vessel to cool the gas leaving the getter vessel. For added protection of downstream components, additional air or optional water cooling of the outlet gas stream is incorporated into the design.

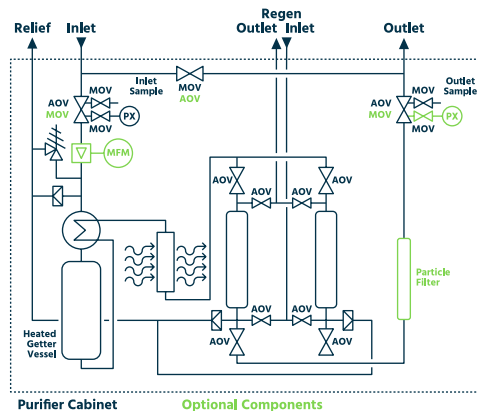
| Gases Purified | Impurities Removed to <100 PPT |
|--|---|
| N ₂ , N ₂ /Noble gas mix | CH ₄ , CO, CO ₂ , H ₂ , H ₂ O, O ₂ |
| H ₂ | CO, CO ₂ , H ₂ O, N ₂ , O ₂ |
| Hydrides | CO ₂ , H ₂ O, O ₂ |



Catalyst

Catalyst purifiers use true catalytic materials that react with hydrocarbons and other impurities, converting them to gas molecules that are then removed by an downstream adsorber stage. The adsorber stage is actually a parallel dual column arrangement allowing for regeneration without interrupting purified gas flow.

| Gases Purified | Impurities Removed to <100 PPT |
|----------------------|---|
| O ₂ , CDA | CH ₄ , CO, CO ₂ , H ₂ , H ₂ O, THC |
| N ₂ | CH ₄ , CO, CO ₂ , H ₂ , H ₂ O, O ₂ , THC |
| X | |

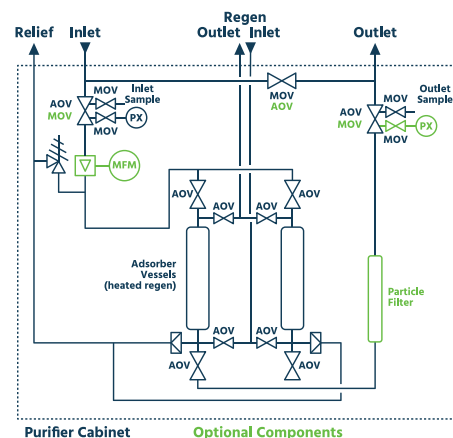


Adsorber-Reactive Catalyst

Adsorber-Reactive Catalyst purifiers use adsorber material, or in certain instances a reactive catalyst, to remove impurities from a wide variety of gases.

The impurities are either absorbed into the material, adsorbed to the surface of the material, or reactive catalysts, form compounds on the surface of the material. To ensure uninterrupted purified gas flow, dual columns are arranged in parallel with the PLC control system performing the automatic switching and regeneration.

| Gases Purified | Impurities Removed to <100 PPT |
|--|---|
| Ar, He, Kr, Ne, Xe, N ₂ , H ₂ | CO, CO ₂ , H ₂ , H ₂ O, NMHC, O ₂ |
| CDA, CO ₂ , N ₂ O, O ₂ | CO ₂ , H ₂ O, NMHC, Amines, NOx |
| Ar, CO, H ₂ , He, Kr, N ₂ , Ne, Xe | H ₂ O |



Standard Features/Options

There are a variety of options with the Advantage™ Micro Series micro-bulk purifiers. The table below lists most of the common standard and optional features with the Advantage™ Micro Series purifiers.

| Instrumentation & Controls | Standard | Optional |
|---|----------|----------|
| Inlet Pressure Transducer | ✓ | |
| Outlet Pressure Transducer | | ✓ |
| Captured Overpressure Exhaust | ✓ | |
| Emergency Shutdown | ✓ | |
| PLC Control of Automatic Functions | ✓ | |
| Microprocessor Control of Automatic Functions | | ✓ |
| Remote Internet Access for Control, Upgrades | | ✓ |
| Touchscreen HMI | ✓ | |
| Remote Internet Access for Troubleshooting | | ✓ |

| Hardware | Standard | Optional |
|---|----------|----------|
| 316L Stainless Steel Tubing, Fittings, Components | ✓ | |
| Wetted Surfaces Electro-Polished | ✓ | |
| Steel and Aluminum Enclosures, Powder Coated | ✓ | |
| Manually Operated Bypass Valves | | ✓ |
| Pneumatic/Electric Operated Valves | ✓ | |
| Industry Standard Inlet/Outlet Connections | ✓ | |
| Gas-to-Gas Heat Exchangers | ✓ | |
| Air Cooled Heat Exchangers | ✓ | |
| Water Cooled Heat Exchanges | | ✓ |
| Flow Meter/Flow Totalizer | | ✓ |
| Overpressure Relief Protection | ✓ | |
| Particle Filtration | | ✓ |

Common Specifications

The Advantage™ Micro Series micro-bulk purifiers have been designed to be modular to meet the specific needs of the application. When quoted, the exact specifications will be defined and can include:

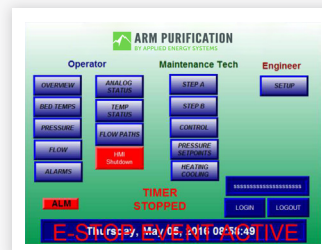
| Specifications | Range | Specifications | Range |
|------------------------------------|------------------|----------------|----------------------------|
| Maximum Allowable Working Pressure | 150 to 250 PSI | Pressure Drop | 1 ATM or less |
| Inlet/Outlet Tube Diameters | 1/2" to 1" | Outlet Purity | Down to <100 PPT |
| Flow Rate | 100 to 1200 slpm | Input Power | 100 to 240 VAC 50/60 Hz |

Control & Instrumentation

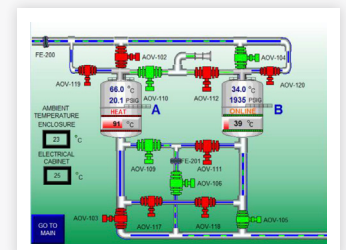
The Advantage™ Micro Series micro-bulk purifiers come standard with PLC controls and touchscreen HMI. For process flow and any automated routines, such as regeneration, electropneumatic valves are controlled by the PLC. Manual valves are used for isolation of instruments, such as pressure transducers and for sample or test ports as required.

The Advantage™ Micro Series indication and control software provides three separate password controlled access levels:

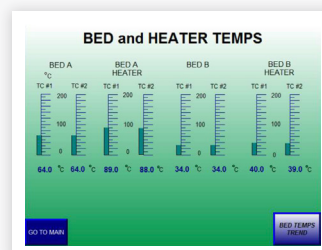
- **Operator** level allows access to all indications necessary to verify proper operation.
- **Maintenance Tech** level allows access to control a number of subroutines designed for care and maintenance of the purifier.
- **Engineer** level allows access to all operator and maintenance tech screens as well as the ability to set up all parameters, limits, alarms, etc.
- **REMOTE ACCESS** options allows ARM Purification remote access to the purifier control program for both updates and factory assistance with operation or troubleshooting, should that become necessary.



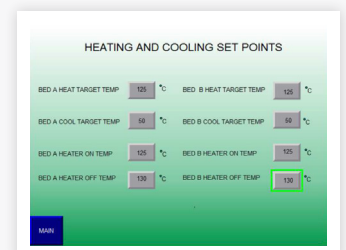
Main entry screen, with options for three levels of password protected operation.



Main status screen, with valve condition, pressures, and temperatures displayed.



Typical indication screen, with graphic display of bed temperatures.



Typical set point input screen (Engineer level access).

Enclosures

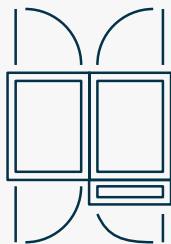
- There are three common enclosure sizes for protected area installation, which are shown below. The door clearance required is 20.0" (508 mm) and is typical for all doors shown.
- Hinge locations are as shown unless otherwise specified. Opposite hinge locations are optional (specify when ordering).
- Enclosures are constructed of steel and are powder coated standard ARM Purification colors.
- All metal enclosure components are properly grounded and access to electrical control and instrumentation is protected with EMO interlocks.
- All user control and indication displays/interfaces are accessible without removing panels or opening doors.
- Locking casters are standard, leveling pads and seismic tie-downs are optional.
- Contact ARM Purification for detail on optional weatherproof enclosures for unprotected gas pad type installations.



SF Enclosure

Dimensions are:

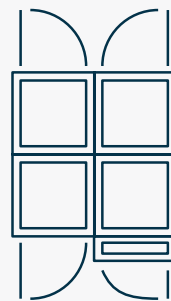
21.0" (533 mm) wide
42.0" (1066 mm) deep
42.0" (1066 mm) tall



MF Enclosure

Dimensions are:

42.0" (1066 mm) wide
42.0" (1066 mm) deep
42.0" (1066 mm) tall



LF Enclosure

Dimensions are:

42.0" (1066 mm) wide
58.0" (1473 mm) deep
42.0" (1066 mm) tall



NEMA Enclosures

When the installation has to be outside a protected area, exposed to the elements, ARM Purification can furnish the micro-bulk purifiers in a suitable NEMA rated cabinet. For specific details, contact ARM Purification.

A Different Approach from Inquiry to Commissioning

The typical purifier manufacturer will present a number of standard systems with available options and specifications for flow rate, output purity, etc. via its website or printed brochure. It is up to the customer to sift through the specs and determine which model is best suited for their application. Customers must then call to verify the suitability of their choice, define desired options, and request a quote. Many times flexibility is limited to specific model/size/option selections that the manufacturer's marketing group has determined are the most popular.

At ARM Purification, we are the experts when it comes to our products, and we understand the customer may not be intimately familiar with the technologies and configuration flexibility that ARM Purification offers. Your time is valuable, and we have proven over the years that the shortest time between RFQ and quotation, with the least amount of customer time required, is via verbal communication. At ARM Purification, we approach micro-bulk purifier inquiries with a level of customer service that leads little doubt regarding performance, price, and total cost of ownership.



Confirm Spec

Depending on the customer's preference, this can be as simple as a call or as involved as an in-person visit to relay the critical requirements: gas, impurities, flow, pressure, and desired features. Regardless, our objective is to review the pure gas needs and work together to develop a detailed statement of work, hardware descriptions, and performance specs.



Generate a Quote

If the need matches an existing Advantage™ Micro Series configuration, a firm fixed price quote referencing a specific model number is generated. Alternately, we will generate a statement of work with a listing of specific configuration data. The quote can include ARM Purification performing the installation and startup, or managing the installation and startup using local contractors.



Receive the Order

Any order resulting from a quote is reviewed to make sure it matches the proper specifications. An order acknowledgment is then sent. This begins the process that results in your pure gas requirements being met.



First Deliverables

The first deliverables include a detailed P&ID drawing for the specific Pro-Panel™ Series configuration purchased, along with a fully documented facilities drawing so you can begin to prep the location to receive the purifier.



Acceptance Testing

Acceptance testing is conducted at the ARM Purification factory. If quoted, we can accommodate the customer witnessing final assembly testing, including Helium leak checking, pressure decay testing, particle testing, and purity testing.



Delivery, Installation & Startup

All ARM Purification micro-bulk purifiers come with a detailed user manual defining installation, startup, operation, and service procedures to support the customer or contractor completing the installation and startup of the purifier. If purchased, ARM Purification personnel will perform installation and startup or manage the project using local contractors.

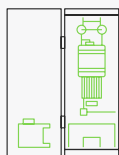
How to Begin

It's as easy as a phone call. We will discuss your specifics: gas, flow, pressure, duty cycle, etc. To the right is a document that will help you collect the information we need in order to define the type of technology, level of automation, and any recommended options to meet your particular gas purification requirements.

Each Advantage™ Micro Series purifier built is assigned a model number that identifies the basics about the purifier. For example, it is determined that the system will be purifying Argon gas at an 85 nm³/hr. When quoted, the model number would be **A-50KC-30-Ar**. A indicates an Advantage™ Micro Series purifier, 50KC indicates the vessel size and media used, 30 indicates the rated flow, and Ar indicates Argon gas.

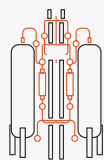
This is not the only way we identify a particular purifier. Each system is serialized with documentation tying that particular unit back to engineering drawings, test records, control software, and unique qualities of that particular purifier, which helps us support our customers following a sale.

ARM Purification delivers a full range of point-of-use, micro-bulk and bulk purifier solutions for high and ultra high purity applications. Our proven purifiers have been trusted by the world's innovators to uphold the most stringent purity requirements for more than two decades.



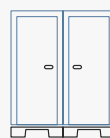
Point-of-Use

0.1-100 slpm



Micro-Bulk

100-1200 slpm



Bulk

60- >5000 nm³/hr

Contact ARM Purification, or your local representative for assistance, or for gases and options not listed.

For more information on how we can meet your gas purification needs, visit www.armpurification.com.



ARM PURIFICATION
BY APPLIED ENERGY SYSTEMS

BROUGHT TO YOU BY

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