ARO ® FDA Compliant AODD Pumps Overview / Training

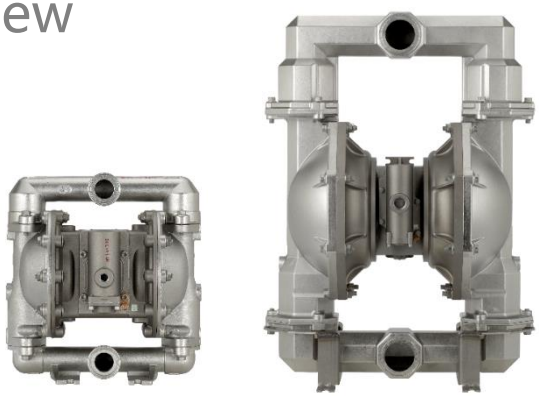
ARO® Fluid Product Management Team,

February 2019

Playbook Table of Contents

- ARO AOD Pumps
- EXP – Everything You Need
- ARO FDA Pump
  - Product Overview and Competitive Position
  - Where to Play - Market & Application Overview
  - How to Win
    - Target Applications

SD Series



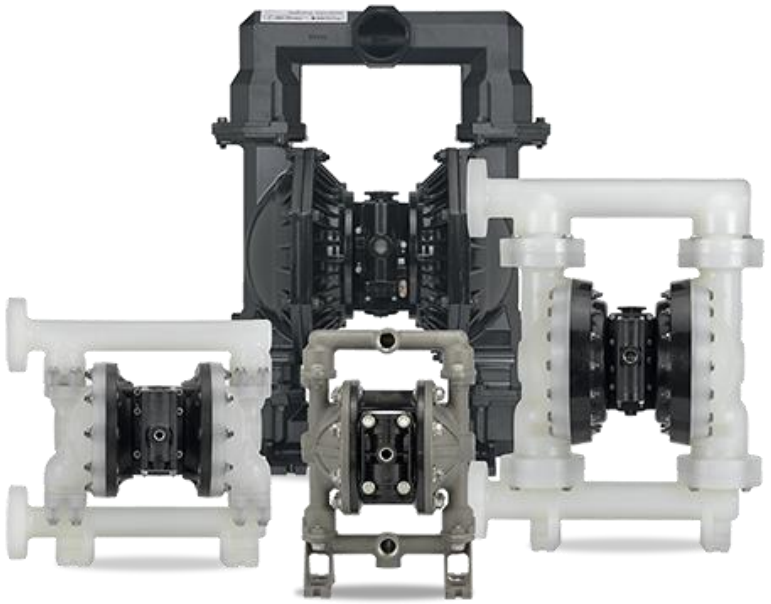
PM Series

AOD Pump Overview

ARO air-operated diaphragm pumps are expertly engineered to deliver superior performance and durability. But we provide more than just top-of-the-line products – we offer the ongoing service and support needed to optimize output.

ARO diaphragm pumps are everything you need, and nothing you don't.

The portfolio is divided into two main segments: EXP Series and Pro Series



ARO Pumps Make Success Flow

- ARO Quick Dump™ check valves divert cold exhaust air from ice-prone components, which prevents freezing and downtime
- Patented SimulShift™ "unstallable" air balanced valve design which avoids stalling issues associated with other pumps
- Backed by a five-year warranty, we have the most reliable pump line on the market today

ARO Air-Operated Diaphragm Pumps

EXP Series

Non-Metallic

Metallic

Compact Series

Non-Metallic

Metallic

Pro Series

Non-Metallic

Metallic

ARO AUTHENTIC ARO PARTS

Specialty Pumps

Powder

Flap Valve

Pit Boss

2:1 and 3:1

FDA Pump and Sanitary

Ingersoll Rand

EXP Series: Everything You Need

For “Automation Ready” and “Process Ready” fluid handling applications, ARO Compact and EXP Series pumps are everything you need. And because they feature our unique electronic interface technology, they help facilitate smarter facilities.

- **Companies already running automation:** Compact and EXP pumps are the most competitive and cost-effective solution. The Compact and EXP line is “**process ready”** to interface with your customer’s existing automated processes

- **Companies without automation:** Compact and EXP pumps provide the easiest, most productive, and economical pathway for helping companies become “**automation ready”** for conversion from manual to automated batch, or fully automated process operation

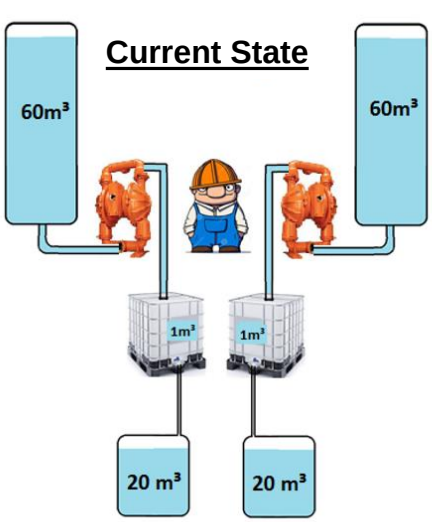
EXP Automation Ready- Upgrade processes easily

EXP combines a pump, interface, and controller together to give attainable, affordable automation:

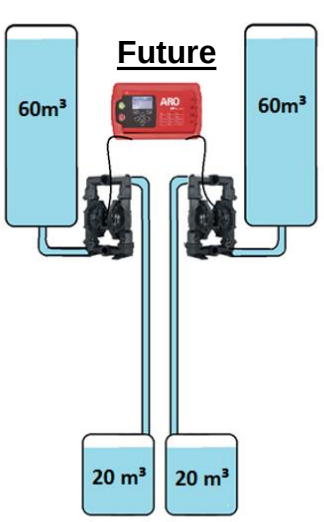
1) EXP + Interface + Controller - The EXP package comes with everything you need to switch from inaccurate, inefficient manual processes to cost-effective automated processes.

2) Don't Waste Materials or Man Hours - With EXP's advanced controller, you get touch-and-walk-away automation that ensures accuracy, saving you from having to station an employee to handle the process.

3) A Complete System That's Entirely Reliable - The EXP system is a combination of essential ARO components, each of which are expertly engineered to deliver leading service life, outstanding reliability, and increased productivity.



Frustrated Customer:
- Wasted time
- Volumetric errors



Controller / EI style pumps:
- Added productivity
- Accurate dispensing

Plug and play automation to replace wasteful manual processes

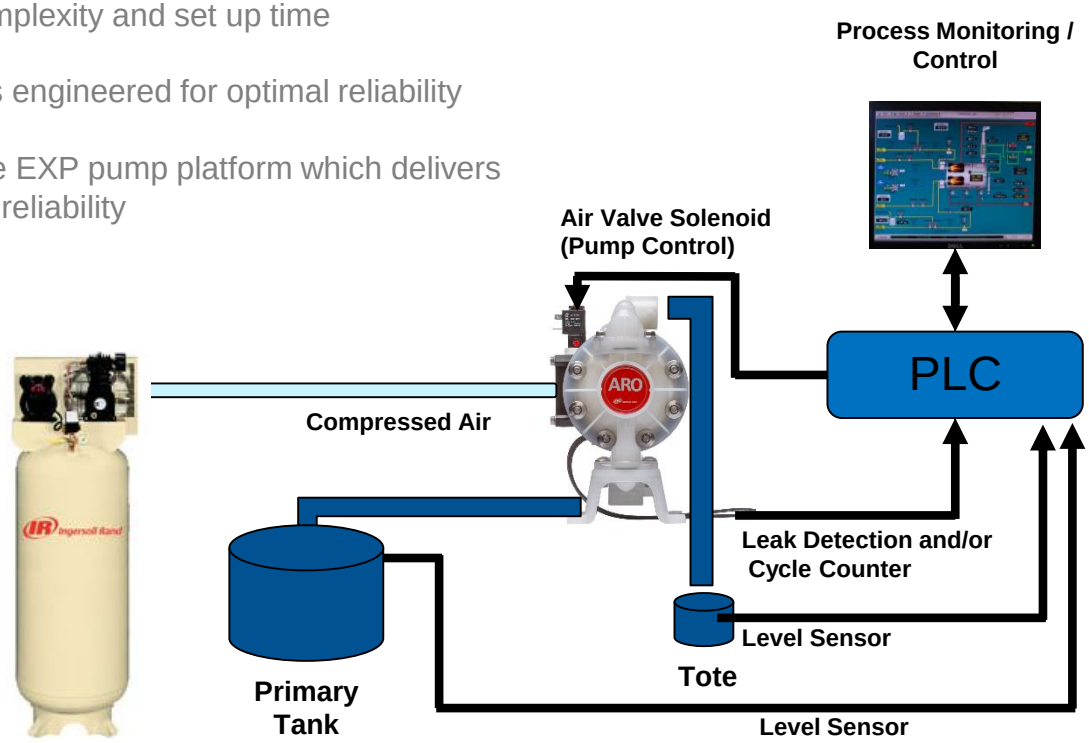
EXP Process Ready – Integrate Seamlessly

EXP electronic seamlessly integrates into existing control systems, creating a pump/interface that offers reliability only ARO products deliver

1) Compatible to the Core - EXP pump and interface are compatible with any automation system which minimizes system complexity and set up time

2) EXP + Interface – Pump electrical interface is engineered for optimal reliability

3) Built By ARO. Built To Last – Integrated to the EXP pump platform which delivers long service life, easy maintenance and greater reliability



Integrate to existing automation processes and assets

ARO Diaphragm Pumps:
Major Market Opportunities

FDA-Compliant Process Manufacturers
(Primarily Food and Beverage Market)

Chemical Processing

Wastewater Processing

Marine Processing

ARO FDA Compliant Pumps

Food and beverage manufacturers of all kinds require sanitary FDA-compliant diaphragm pumps for sanitary and safe processing and transfer of consumer products, and effective cleaning of food processing equipment

5 YEAR WARRANTY

Key FDA Pump Segments:

- Baked Goods
- Jams, Jellies and Sauces
- Beer / Spirits
- Other Beverages
- Other Industrial Segments (Cosmetic, General Industrial, Pharmaceutical)

Key FDA Pump Applications:

- **Process transfer**
- **Ingredient processing and batch application**
- **Mold cleaning**
- **Clean-in-place (CIP) applications**

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Pain Points within Baked Goods

ARO®

Common Pain Points to Address:

- Raw material cleaning and metering
- Need to transfer raw materials such as flavors, butter, syrup, etc.
- Need to spray a layer of lye on the surface of breads to improve color

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Pain Points within Jams, Jellies and Sauces

ARO®

Common Pain Points to Address:

- Need to transfer syrup, flavors and colloid with water from primary tank, to mixing tank
- Need to filter sauce elements as needed
- Need to transfer final product to filling machine

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Pain Points within Beer / Spirits

ARO®

Common Pain Points to Address:

- Need to transfer alcohol from one barrel to another
- Need to prevent foaming in beer dispensing applications
- Need to increase fill and turn around rates

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Pain Points within Beverage Applications

ARO®

Common Pain Points to Address:

- Need to transfer nitrite and calcium hypochlorite, etc. to purify water with carbonated beverages
- Blend syrup and transfer with pump
- Pump original juice from container to mixing tank (juices)
- Transfer concentrated tea from container to blending tank with pump

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Pain Points within Industrial Applications

Common Pain Points to Address:

- Process applications often require regular cleaning and frequent tear-down (typical in cosmetic, pharmaceuticals or other general industrial applications)
- Common to encounter hazardous locations and have sheer sensitive applications
- End users are frustrated by high installation/ maintenance costs involved with other electric equipment such as rotary lobe

ARO FDA Pumps – Making Success Flow

- Leverage EXP pump design - Industry leading total cost of ownership
  - Reliability
  - Safety
  - Ease of Maintenance
- Clamped Design – allows for quick maintenance for improved productivity
- 20% to 30% better flow than most competitors – quicker transfers when time counts
- Low material shear – for improved product quality
- 316L stainless steel **electro polished and passivated** – “rust-less” sanitary design which minimizes residual fluid or bacterial risk
- Fit for use in hazardous locations




ARO FDA Pump Compliance

The materials of construction used for fluid wetted STAINLESS STEEL components comply with established FDA regulation 21 CFR 174 and ANSI/NSF 51-1997 Stainless steel specifications for use in 3A and USDA applications. Those components can be made from 302, 303, 304, 316, CF8M per ASTM A743 or other grades of austenitic stainless steel.

Uncolored polypropylene fluid wetted components comply with established FDA regulation 21CFR 177.1520

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Ingersoll Rand
ARO Fluid Products
209 North Main Street
Bryan, Ohio 43506 USA

ingersollrandproducts.com

19 May 2016

Certificate of Conformance

RE: FDA Approved Materials for contact with Fluids:
Diaphragm Pumps 1/4" through 3"
PD, PF, PE & PM Series Diaphragm Pumps
SD Series Diaphragm Pumps
666xxx-xxx-C Series Diaphragm Pumps
SBxxx-xxx-x Pulsation Dampeners

To Whom It May Concern:

The materials of construction used for fluid wetted STAINLESS STEEL components comply with established FDA regulation 21 CFR 174 and ANSI/NSF 51-1997 Stainless steel specifications for use in 3A and USDA applications. Those components can be made from 302, 303, 304, 316, CF8M per ASTM A743 or other grades of austenitic stainless steel.

SD Series diaphragm pump housings have internal surface finish of 125 Ra and the housings are electro-polished per Ingersoll Rand specification S-1518 and ASTM B912-02-xxxx

Uncolored polypropylene fluid wetted components comply with established FDA regulation 21 CFR 177.1520

Elastomers:
Resins used (Santoprene, Hytrel, PVDF or PTFE) for ARO Diaphragms, Balls and Seats, meets one or more of the following FDA requirements in the Code of Federal Regulations:

Santoprene Balls/Seats/Diaphragms
21 CFR 177.1210
PTFE Balls/Seats/Diaphragms
21 CFR 177.1550
21 CFR 177.1520
21 CFR 177.2600
21 CFR 177.300
21 CFR 175.105
21 CFR 175.170
21 CFR 176.180

Best Regards,

Ingersoll Rand Company

Michael Conti
Principal Engineer – ARO Fluid Management
Ingersoll Rand Company

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ARO FDA Pump Compliance

- SD Series
  - Housings have internal surface finish of 125 Ra and are electro-polished per ASTM B912-02-xxxx

- PM Series
  - Comply with FDA regulation 21 CFR 174 and ANSI/NSF 51-1997 Stainless steel specifications for use in 3A and USDA applications.

- PDXXP / PEXXP
  - Uncolored polypropylene pump wetted components comply with FDA regulation 21CFR 177.1520

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Best Regards,

Ingersoll Rand Company

Michael Conti
Principal Engineer – ARO Fluid Management
Ingersoll Rand Company

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ARO Unique Engineering (SD Series)

Band Clamp Design - *QKD (quick-knockdown)* - *No Dead Angle, Easy Cleaning & Maintenance*

Single Piece PTFE Diaphragm – reduces cleaning fluids needed during CIP and cleaning time

All 316L Stainless steel electronic polished construction- *No Rust, Residual Fluid, or Bacteria Risks*

- Retainer geometry redesigned to allow more contacting surfaces between clamp and caps
  a) Less stress loaded into v-clamp
  b) More efficient clamp
  c) More safety
- Self-locking nuts prevent loosening of v-clamp in pressurized application

What it means to the end user

Reliability & Efficiency

Low failure cost

- No air leakage and fluid leakage
- No icing and stalling
- Stable flow rate performance
- Long life
- Able to work in high temperature during CIP

Safety

Meets Special FDA Requirements in Target Markets

- No rust in air and fluid section ensures sanitary conditions
- Fluid section material all meet FDA standards to ensure sanitary conditions
- Diaphragm & ball material: PTFE, Hytrel, Medical Grade Santoprene®, and 316 SST (Balls only)

Easy Maintenance

Reduced Service and Maintenance Cost

- Clamp construction for easy service/maintenance and CIP (Clean In Place) application
- Single-piece PTFE diaphragm

Automation/Process Ready

Ease of installation

- EI Interface allows for quick integration with existing control systems or with an ARO controller

Latest Offering Includes

Polypropylene Center Bodies

- Improved weight design
- Lower cost
- Increased chemically compatibility

Single Piece PTFE Diaphragms

- Minimizes the number of collection points for fluid being pumped
- Speeds cleaning & reassembly
- Minimizes leakage potential through (no center hole)
- Extends time between cleanings

Electric Interface (Solenoid operation, Leak Detection, Cycle Count)

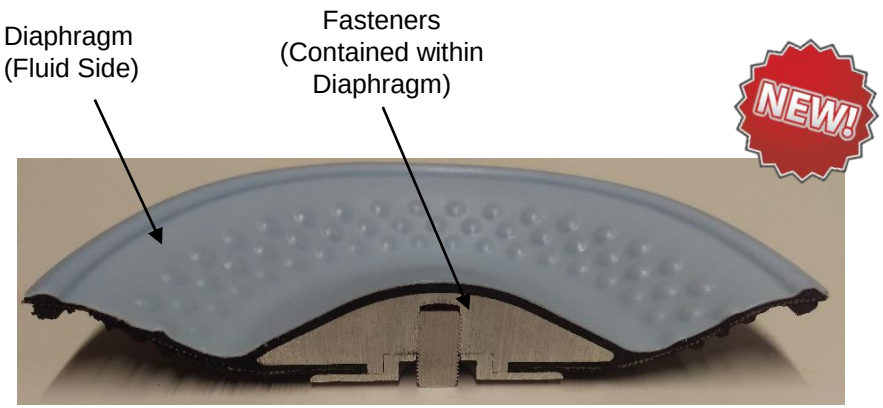
- Improved controllability (use with PLC or ARO Controller)
- Leak detection capability - improved response time to diaphragm failures
- Cycle Counting – Better preventative maintenance awareness

Single Piece Diaphragm

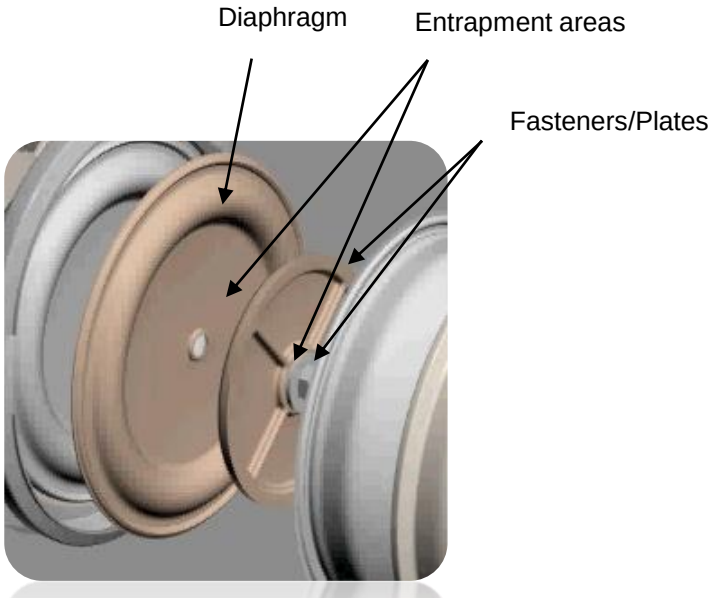
ARO

ARO's single piece composite PTFE diaphragms offer safe, clean and reliable fluid transfer with no fluid entrapment areas to minimize fluid contamination and risk liabilities. These diaphragms reduce labor with their clean-in-place (CIP) capabilities provided by its smooth contoured shape and no outer diaphragm washer.

- Superior fluid containment and chemical resistance
- Fewer parts to minimize containment points
- Prevents fluid containment with its smooth contoured shape
- Saves time and labor with faster cleaning



FDA Single Piece Composite Diaphragm



Conventional Diaphragm Configuration

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Faster cleaning, service and maintenance

Sanitary Flange Connection:

Quick knock down (QKD) design facilitates rapid disassembly (and re-assembly) of components for inspection and maintenance—in place or out of place—and right back into service.

Leak Free Diaphragm / Flange Design:

Diaphragm bead design is tailored for leak free operation

SD Series is well suited in applications where <u>downtime</u> matters!

FDA SD Series - Pump Model Performance

Operating Data	SD10X-CSS-SXX-A 1“ Pump	SD20X-CSS-SXX-A 2" Pump
Startup Pressure PSI (bar)	25 (1.723)	25 (1.723)
Dry suction lift ft. H20 (m)	16.49 (5.02)	18.25 (5.56)
Wet suction lift ft. H20 (m)	31.4 (9.57)	31.4 (9.57)
Flow Rate GPM (lpm)	54 (204.4)	195 (738)
Displacement per/cycle @ 100 PSI GAL (liters)	0.258 (0.976)	1.3 (4.9)
Max. Solids Passage in. (mm)	0.125 (3.175)	0.25 (6.35)
Fluid Inlet/Outlet	1-1/2” Tri-Clamp	2-1/2” Tri-Clamp

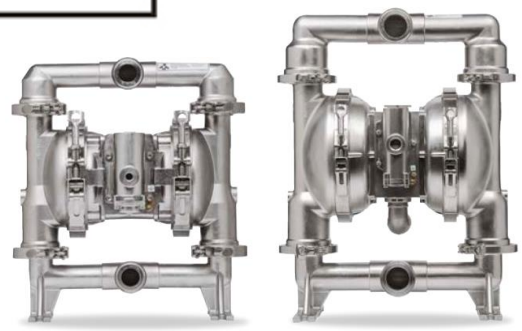
SD Series QKD Pumps – Materials of construction

- Electro-polished stainless-steel 316L construction. FDA compliant materials and high temperature capability.
- Diaphragms available in a variety of materials
- Center bodies available in Polypropylene or Stainless Steel
    - Stainless center bodies: Provide durable / reliable construction compliant with FDA environments.
    - Polypropylene Center Bodies: Lighter and chemically compatible for the most caustic environments.

Service Kits for SD Series Pumps

	SD10S Stainless Steel Center	SD10R Polypropylene Center	SD20S Stainless Steel Center	SD20R Polypropylene Center
Fluid Kit	637493-XX		637494-XX	
Air Section Kit	637495		637497	637497-1
Valve Block Kit	637496	637496-1	637498	637498-1

ARO® AUTHENTIC ARO PARTS



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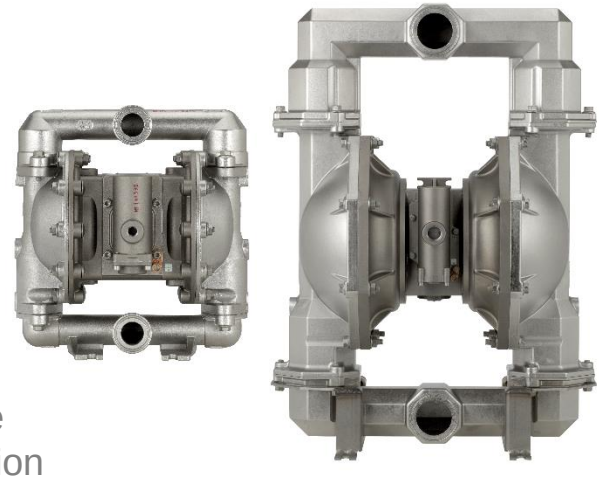
FDA PM Series - Pump Model Performance

Operating Data	PM05X 1/2” Pump	PM10X 1” Pump	PM15X 1-1/2” Pump	PM20X 2” Pump	PM30X 3” Pump
Startup Pressure PSI (bar)	25 (1.723)	25 (1.723)	25 (1.723)	25 (1.723)	25 (1.723)
Dry suction lift ft. H20 (m)	16.49 (5.02)	16.49 (5.02)	16.49 (5.02)	16.49 (5.02)	18.25 (5.56)
Wet suction lift ft. H20 (m)	31.4 (9.57)	31.4 (9.57)	31.4 (9.57)	31.4 (9.57)	31.4 (9.57)
Flow Rate GPM (lpm)	54 (204.4)	54 (204.4)	54 (204.4)	54 (204.4)	195 (738)
Displacement per/cycle @ 100 PSI GAL (liters)	0.258 (0.976)	0.258 (0.976)	0.258 (0.976)	0.258 (0.976)	1.3 (4.9)
Max. Solids Passage in. (mm)	0.125 (3.175)	0.125 (3.175)	0.125 (3.175)	0.125 (3.175)	0.25 (6.35)
Fluid Inlet/Outlet	1-1/2” Tri-Clamp	1-1/2” Tri-Clamp	2” Tri-Clamp	2-1/2” Tri-Clamp	3” Tri-Clamp

PM Series Bolted Fluid Section Pumps – Materials of construction

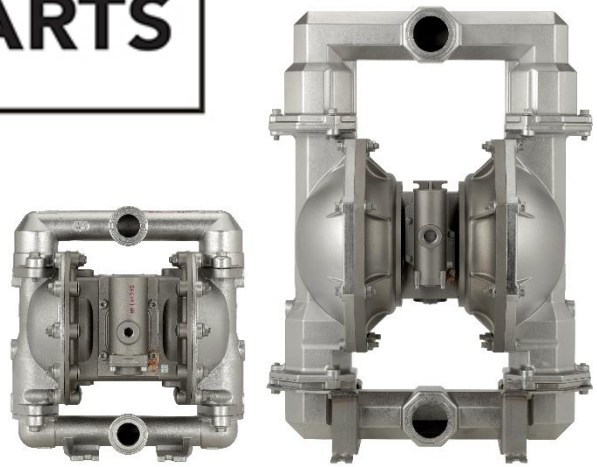
- Electro-polished stainless-steel 316L construction. FDA compliant materials and high temperature capability.
- Diaphragms available in a variety of material
- Center bodies available in Aluminum, Polypropylene or Stainless Steel
    - Aluminum center bodies: Light weight / reliable performance
    - Stainless center bodies: Provide durable / reliable construction compliant with FDA environments.
    - Polypropylene Center Bodies: Lighter and chemically compatible for the most caustic environments.



Service Kits for SD Series Pumps

	PM05 1/2” Pump	PM10 1” Pump	PM15 1-1/2” Pump	PM20 2” Pump	PM30 3” Pump
Fluid Kit	637427-XX	637401-XX	637375-XX	637309-XX	637303-XX
Air Section Kit	637428	637397	637389	637421	637421
Valve Block Kit					

ARO® AUTHENTIC ARO PARTS



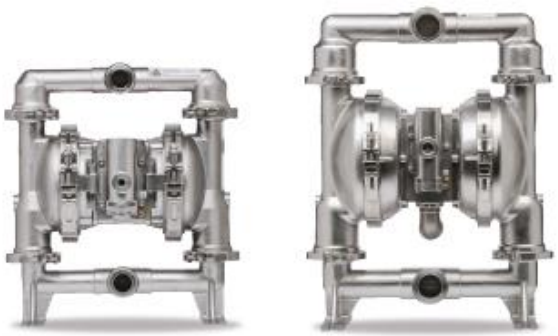
Competitive Performance Comparison

Competitor	1"	2"
Brand W 	45.5 gpm (172 lpm)	156 gpm (591 lpm)
Brand G 	40 gpm (151 lpm)	150 gpm (568 lpm)
ARO- FDA 	54 gpm (204.4 lpm)	195 gpm (738 lpm)

Note: Other brands do not publish FDA performance

Competitors won't tell you about their flow performance for a reason

Comparison vs. Competitors



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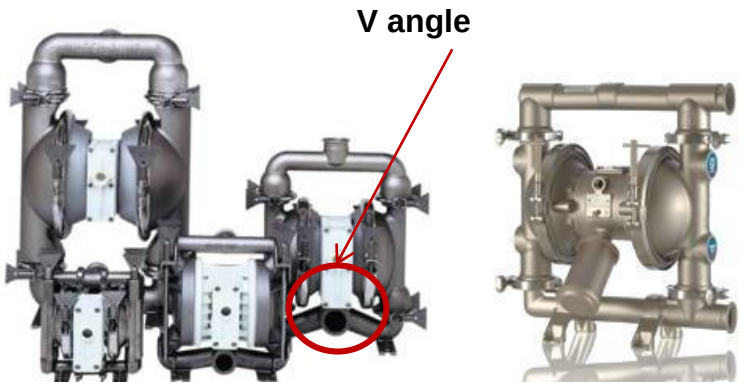
Construction Materials-
No impurities and bacteria risk

- Wetted parts **316L** stainless steel
- Center body **316** stainless steel and Poly center
- **Electronic Polish** surface treatment

Pump design minimize remain material, less clean time and easy to clean

- **Right angle** inlet manifold



Others

Construction Materials-

- Wetted parts **316** stainless steel
- Center body **propylene, aluminum,** stainless steel

Pump Design

- **Thread** inlet/outlet design
- **V angle** inlet manifold permits remain materials and potential bacteria risk

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Built to your Requirements

SD10S

SD10R

ARO®

Customize ARO® FDA pumps to application needs for cost-effective, factory control and worry-free integration:

Ordering

Position	1	2		3	4	5		6	7	8			9	10
Example:	SDXX	X	-	C	S	S	-	X	X	X	-	B	X	X

Position 1 Model Series	Position 2 Center Section	Position 3 Port	Position 4 Fluid Caps & Manifold Mat.	Position 5 Hardware	Position 6 Seat Material	Position 7 Ball Material	Position 8 Diaphragm Material
SD10 - 1" Pump SD20 - 2" Pump	R - White Polypropylene S - 316 SS	C - Sanitary Flange	S - 316L Stainless Steel*	S - Stainless Steel	C –Hytrel® K - PVDF S - 316L Stainless Steel	C - Hytrel® M - Medical Grade Santoprene® S - 316L SS T - PTFE	C - Hytrel® M - Medical.Grade Santoprene® T - PTFE/Santoprene® K - Single Piece PTFE Composite

Position 9 Specialty Code 1 (blank if no specialty code)	Position 10 Specialty Code 2 (blank if no specialty code)
A - Solenoid 120VAC, 110VAC + 60VDC C - Solenoid 240VAC, 220VAC + 120VDC D - Solenoid 24VDC, 48VAC + 44VACA E - Solenoid 12VDC NEC/CEC* F - Solenoid 24VDC NEC/CEC* G - Solenoid 12VDC ATEX/IECex* H - Solenoid 24VDC ATEX/IECex* J - Solenoid 120VDC NEC/CEC* K - Solenoid 220VDC N - Solenoid with no coil 0 - Standard Valve Block (No Solenoid) P -	E - End of stroke feedback + Leak Detection F - End of stroke feedback G - End of Stroke ATEX/IECex* H - End of Stroke feedback + Leak Detection ATEX / IECex* L - Leak Detection M - Leak Detection ATEX/IECex/NEC/CEC* O - No Option R - End of Stroke Feedback NEC / CEC* T - End of Stroke Feedback + Leak Detection NEC / CEC

* Acceptable for use in hazardous locations. - NEC / CEC: Class I&II, Div 1&2 , Group A-D - ATEX: Zone 1&2, 21&22

Ingersoll Rand®

Built to your Requirements

PM15S

PM30S

ARO®

Customize ARO® FDA pumps to application needs for cost-effective, factory control and worry-free integration:

Ordering

Position	1	2		3	4	5		6	7	8		9		
Example:	PMXX	X	-	C	S	S	-	X	X	X	-	X	0	2

Position 1 Model Series	**Position 2** Center Section	**Position 3** Port	**Position 4** Fluid Caps & Manifold Mat.	**Position 5** Hardware	**Position 6** Seat Material	**Position 7** Ball Material	**Position 8** Diaphragm Material	**Position 9** Revision Level
SD10 - 1" Pump SD20 - 2" Pump	R - White Polypropylene S - 316 SS	C - Sanitary Flange	S - 316L Stainless Steel*	S - Stainless Steel	C –Hytrel® K - PVDF S - 316L Stainless Steel	C - Hytrel® M - Medical Grade Santoprene® S - 316L SS T - PTFE	C - Hytrel® M - Medical.Grade Santoprene® T - PTFE/Santoprene® K - Single Piece PTFE Composite	A02 -1", 1-1/2" Ported Pumps B02 -1/2", 2" Ported Pumps C02 -3" Ported Pumps

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Santoprene® is a registered trademark of Monsanto Company, licensed to Advanced Elastomer Systems, L.P.

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CIP Cleaning System

- CIP cleaning: **CLEAN IN PLACE**
- A cleaning fluid is used to clean the production line safely & automatically with simple operation. This eliminates the need to move equipment or disassemble it.
- CIP process is used in most food, beverage, Pharma manufacturers. CIP not only cleans machines but also controls the bacterial content.
- CIP cleaning technique is widely used in advanced food industries such as Coca Cola, who uses a CIP System to clean pipes, equipment and tanks.
- Cleaning Medium: 40°C water & 2% alkali; 40°C water & 0.8% acid; >90°C hot water

Application Examples

Personal Care Application

Opportunities:

1. Semi-finished Material Filling: Almost 50% of products in the Personal care market are filled by a third party.
2. Raw Material transportation: To mixing tank/emulsification vessels
3. Mobile Pump

Popular Model: 2” FDA

Why use SST Pump Center: CIP with hot water (60 ^{O}C~90^{O}C)

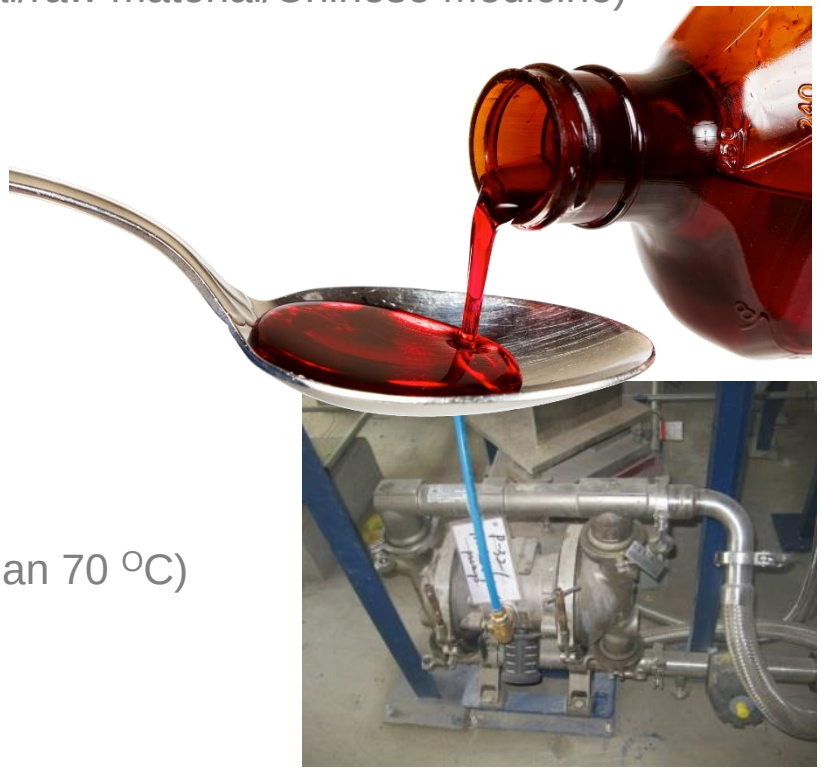
Benefit:

1. Wetted part made of 316L, no impurity exude in to the liquid
2. Suction capability, easy for feeding

Pharmaceutical Application

Typical Opportunities：

1. Serous Fluid/Mother Liquid (Blood Product, Vaccine Manufacture)
2. Solvent transportation (e.g. alcohol)
3. Liquid Medicine (Semi-finished material/raw material/Chinese Medicine)
4. Pump Upgraded Opportunities
5. CIP return pump (Suction Pump)



Why choose FDA AODD?

1. Sterile process of manufacture
2. Risk of Microbe/impurity
3. Clean Requirement

Why use SST Pump Center?

1. Liquid with high temperature (higher than 70 ^{O}C)
2. Install in the sterile area

Advantage of ARO：

1. Wetted Parts made of SST 316L
2. Suitable for hazardous location environments

Emulsion Applications

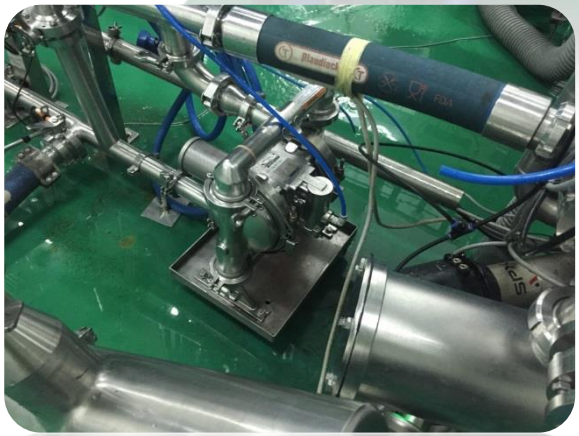
- Industry: Personal Care
- Model: SD10S-CSS-STT-A
- Material: Emulsion
- Application: Pump emulsion out of the emulsification vessels
- Process Description:
  1. Emulsion transfer from emulsification vessels to storage tank (distance less than 10m)
  2. Viscosity>15000 cps, but the dynamic viscosity is 5000~8000 cps
  3. Clean process: CIP+ strip and clean by hands
- Feedback:
  1. Easy to disassembly, easy to clean
  2. Comparing with the rotary lobe pump, flow rate is smaller, will choose 2 inch pump

Food Mixture Applications

- Industry: Food / Jelly
- Model: SD10S-CSS-SMM-A×12unit
- Material: Thickener, flavor spices, sour agent, syrup, colorings, liquid glue (80 ^{O}C)
- Application: Mixture
- Process Description:
  1. Pumping the raw material/additive from the storage tank/55 Gal drum to the mixing tank
  2. Sharing sensitive material with viscosity about 5000cps
  3. CIP Clean (hot water)
- Background:
  1. FDA AODD often used in JELLY production, 10 units~12units for one product line
  2. Replace WILDEN FDA AODD

Beverage Mixture Applications

- Segment: Beverage
- Pump Model: SD10S-CSS-STT-A
- Liquid: Concentrated Juice (Raw material)
- Application: Mixture
- Process:
  1. Pumping the raw material/additive from the storage tank/55 Gal drum to the mixing tank
  2. Viscosity of concentrated juice: 2000~5000 cps
  3. CIP clean
- Background:
  1. Typical application for AODD
  2. Replace WILDEN



Shampoo Transfer

- Industry: Personal Care
- Customer background: Production of personal care products
- Model: SD20S-CSS-SMM-A
- Material: Silicon 1788
- Application:
  1. Transfer the silicon 1788 from storage tank to mixing tank
  2. Silicon is widely used for shampoo and cleaner to make the material soft and smooth
- Competition:
  1. FDA AODD: Wilden
  2. FDA Rotary Lobe pump

Transfer into Bioreactor

- Industry: Pharmaceutical
- Model: SD10S-CSS-STT-A
- Material: Distilled water/ Liquid protein
- Application: Feeder pump for Bioreactor
- Background:
  1. Integrator for sanitary market, provide Bioreactor, CIP system, Liquid distribution system
  2. AODD preferred as feeder pump due to ATEX requirements and hygienic level
  3. The original typical feeder pump is sanitary centrifugal pump
- Disadvantage for centrifugal pump:
  1. High Shearing force
  2. High cost of hazardous rated motor and high installation costs