Grundfos
Technical Institute

Dosing Basics
Jim Swetye
June 22, 2016

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WELCOME

- Participants are in a listen-only mode.

- To ask a question during the event, use the chat feature at the bottom left of your screen. Technical questions will be answered by ReadyTalk. Questions for our speakers can be asked at any time and will be answered during the Q&A at the end of the session.

- Visit pumpsandsystems.com in the coming days to view the answers to all of the questions asked during the Q&A session.

- Visit pumpsandsystems.com in the coming days to access the recording of the webinar.

Presenter: Jim Sweyte

Title: Senior Technical Trainer

Location: Grundfos Pumps Corporation, Ohio

Education: Bachelor of Arts from Hiram College, Ohio; Master of Science in Education/ Curriculum Leadership from Emporia State University, Kansas

Years in industry: 38

Specialties: Pumping systems for commercial HVAC, residential hydronics, industrial, and municipal; former Vice President of Knowledge and Education at the Hydraulic Institute and current certified trainer for Pump Systems Matter

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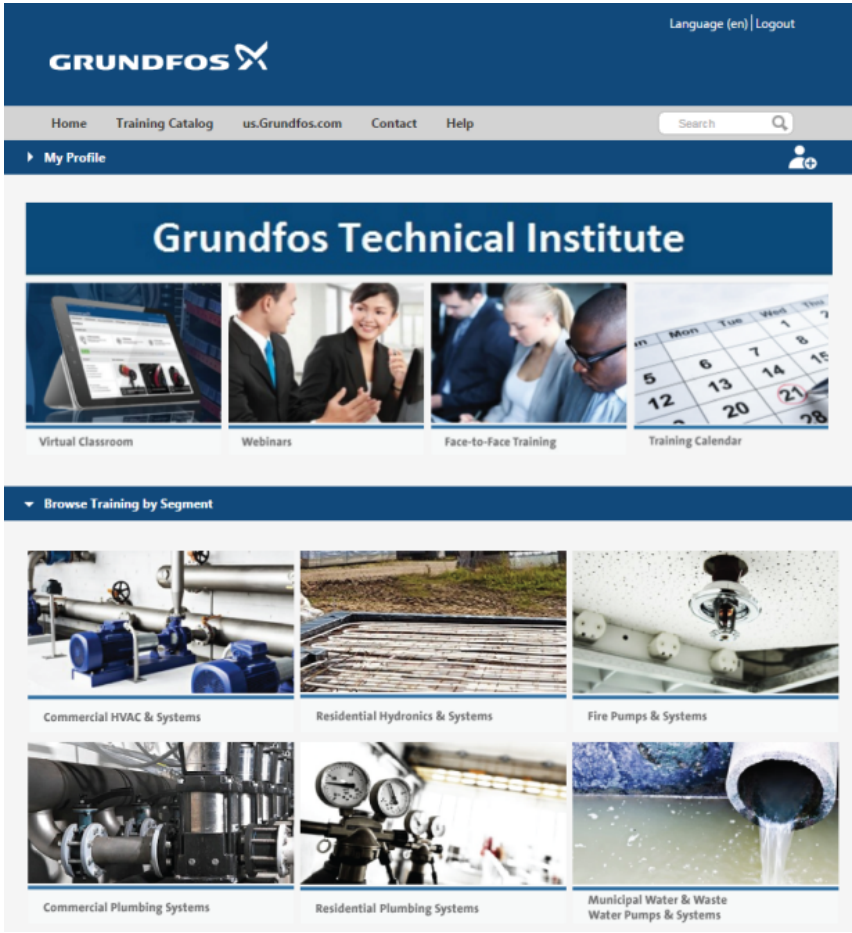


ASPE American Society of Plumbing Engineers CEU PROVIDER

Learning Objectives

By the end of this course you will be able to:

1. Provide a brief overview of dosing pumps and some of their applications
2. Describe the nature of liquids that are typically dosed
3. Explain the mechanics of dosing pumps
4. Demonstrate how to use the dosing pump performance chart
5. Describe typical control methods
6. Identify good installation and piping practices

A Variety of Names

- Dosing Pumps
- Metering Pumps
- Controlled Volume Metering Pumps
- Chemical Feed Pumps
- Injection Pumps

Hydraulic Institute Definition:

A Metering Pump is a reciprocating pump used to accurately displace a volume of liquid in a specified time period.

www.pumps.org

Benefits of Dosing Pumps

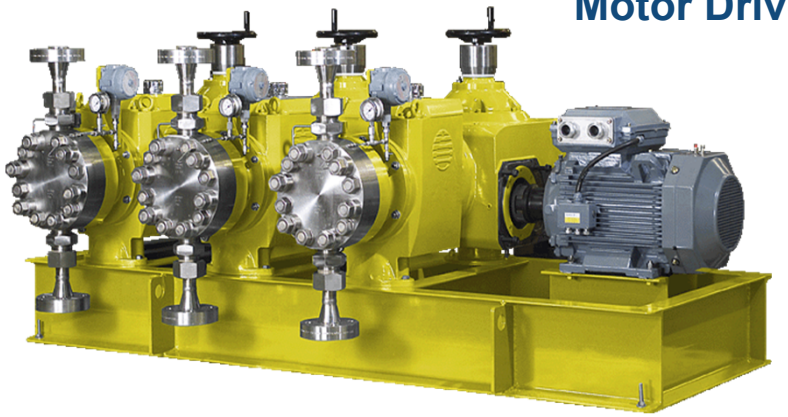
- High flow accuracy and improved process control
- Effective handling of hazardous and/or expensive chemicals

A variety of styles and configuration s

Hydraulic Diaphragm

Mechanical Diaphragm

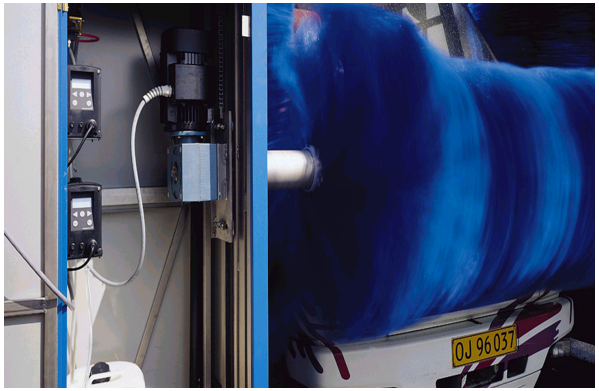
Motor Driven



Stepper Motor Driven

Solenoid Driven

Typical End Users and Applications



Typical Production Process Applications

- Petro-chemical
- Chemical
- Food
- Pharmaceutical
- Beverage
- Personal care
- Detergents
- Pulp & paper
- Textile
- Biotechnology plants
- Photo & Printing

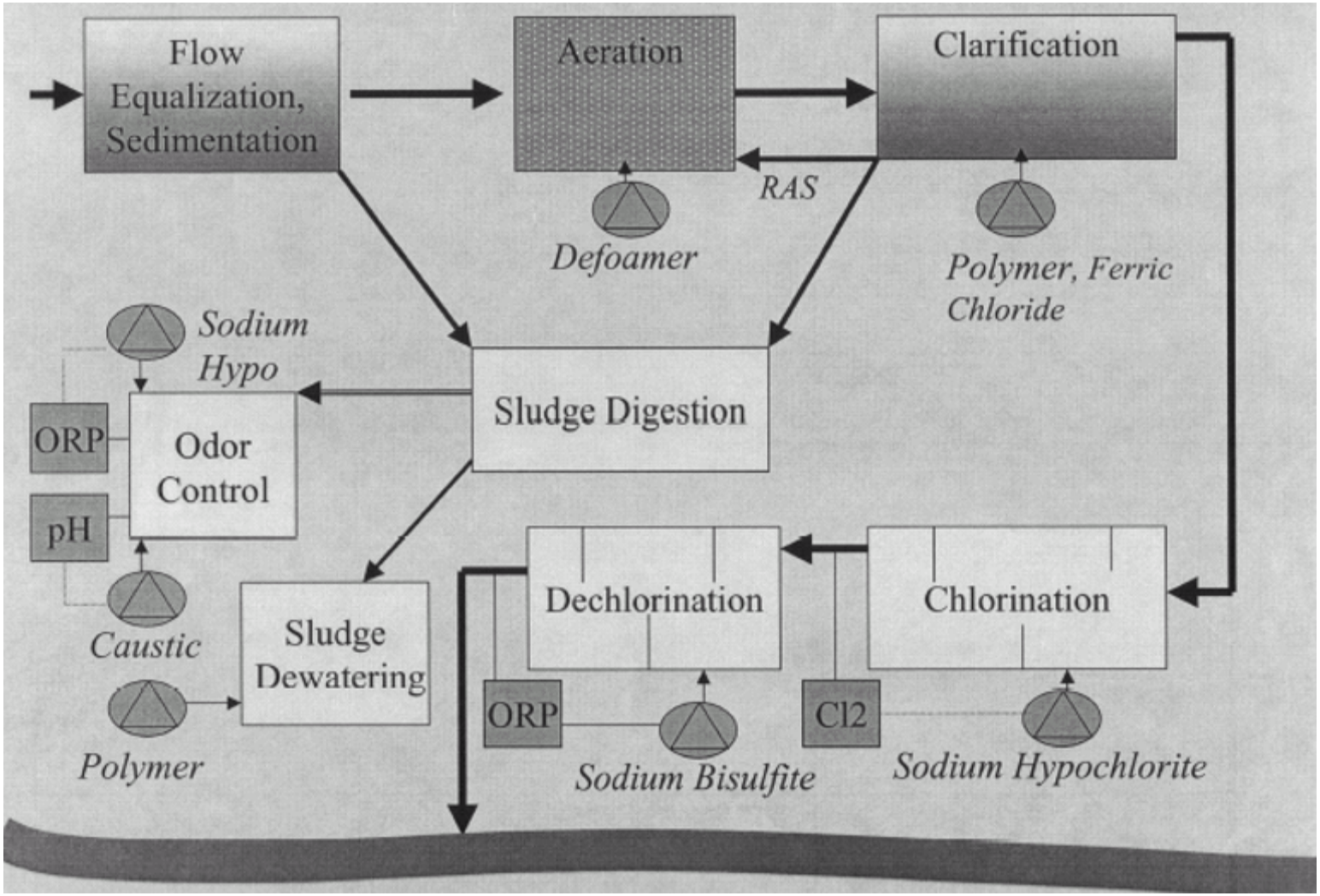
Typical Water Treatment Applications

- Public water supply
- Industrial, commercial and residential water supply
- Municipal waste water
- Industrial waste water
- Boiler feed water
- Heating system water
- Cooling water
- Industrial process water
- Public and private swimming pool, spa and baths
- Agriculture
- Cleaning systems
  - Car wash, laundries, dish wash

Why treat water?

- pH-control
- Anti-scaling, anti-fouling
- Oxygen scavenging
- Softening
- Disinfection (chlorination)
- Coagulation / flocculation
- Microbiological control
- Chemical precipitation
- Taste and smell control

Typical Wastewater Treatment Chemical Feed



Flow Range:

.00066 gph to 9000 gph

Flow Range:

.00066 gph to 9000 gph

or

1/100 of a teaspoon per minute to 150 gpm

How is injection flow rate determined?

- Flow rate in main line passing the injection nozzle
- Nature of and concentration of the treatment liquid
- Desired concentration in liquid to be treated

Why is dosing accuracy important?

The liquids can be:

- Toxic
- Corrosive
- Hazardous
- Expensive

Poor dosing can lead to mineral deposits

Proper dosing can help prevent disease

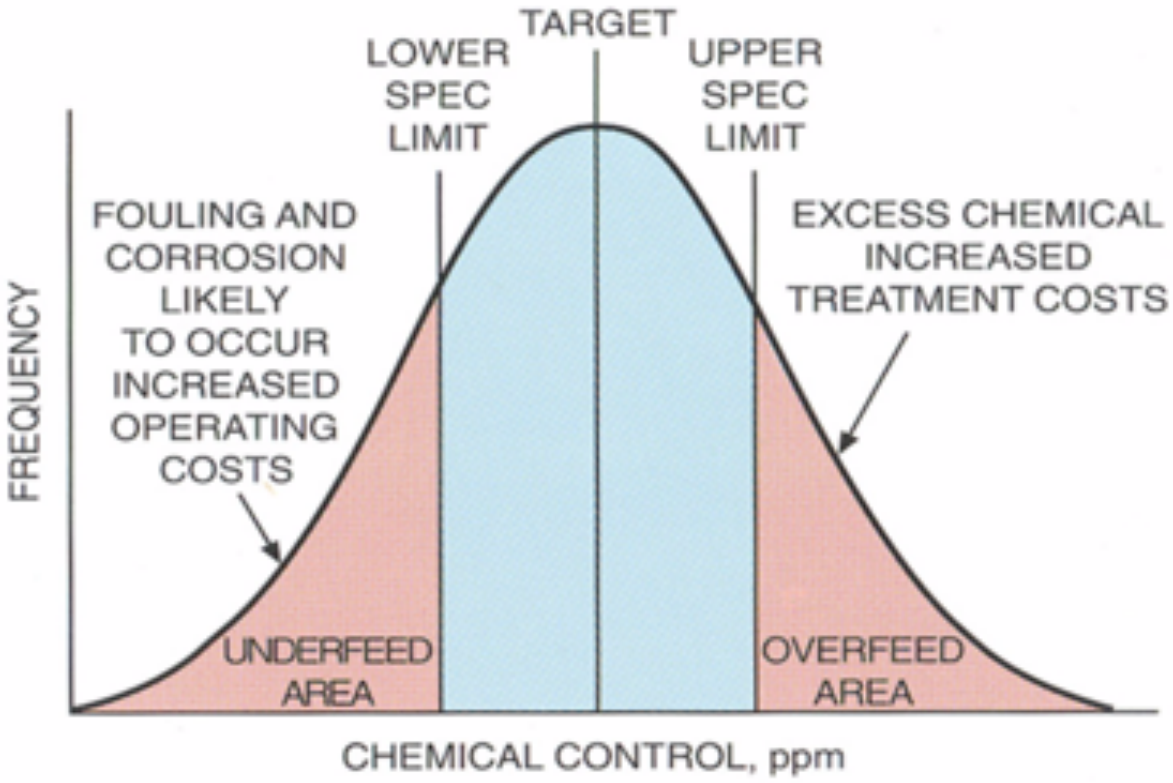
Disease – Legionnaire's

- Legionellosis is potentially fatal

- Symptoms include: cough, fever, chest pain, lethargy, and less commonly, gastrointestinal distress

- Primarily effects susceptible individuals such as: elderly, immune-suppressed, and those with chronic lung problems

Dosing quality and process results



Typical Dosed Fluids

- Sodium Hydroxide
- Aluminum Chloride
- Calcium Hypochlorite
- Sodium Hypochlorite
- Ferrous Sulfate
- Sulfuric Acid

Liquid Properties

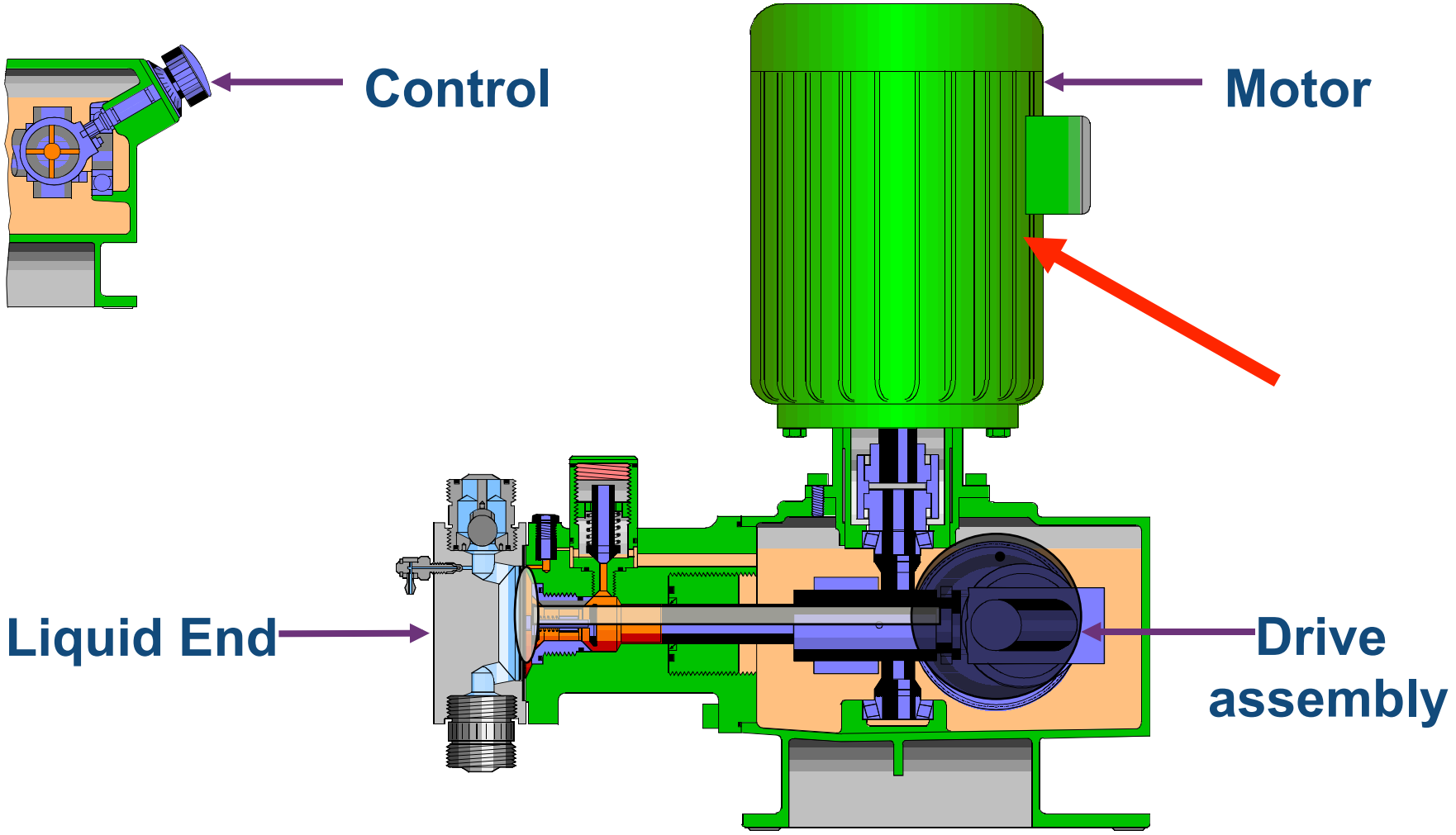
1. Corrosive
2. Abrasive
3. Temperature
4. Viscosity
5. Specific Gravity
6. Entrained gas
7. Vapor Pressure
8. Concentration

Pump Materials and Liquids

Pumped liquid 20°C		Concentration %	Materials										
			Pump housing				Gasket					Ball	
			PP	PVDF	316 SS	PVC	FKM	EPDM	CSM	PTFE	Centelken C	Ceramic	Glass
Acetic acid	CH_3COOH	25	●	●	●	●	–	●	○	●	●	●	●
		60	●	●	●	●	–	○	–	●	○	●	●
		85	●	●	●	–	–	–	–	●	○	●	●
Aluminium chloride	$AlCl_3$	40	●	●	–	●	●	●	●	●	●	●	●
Aluminium sulphate	$Al_2(SO_4)_3$	60	●	●	●	●	●	●	●	●	●	●	●
Ammonia, aqueous	NH_4OH	28	●	●	●	●	–	●	●	●	○	●	–

Most manufacturers do not recommend any material for any particular application. Field experience can be the best guide.

Metering Pump Basic Components



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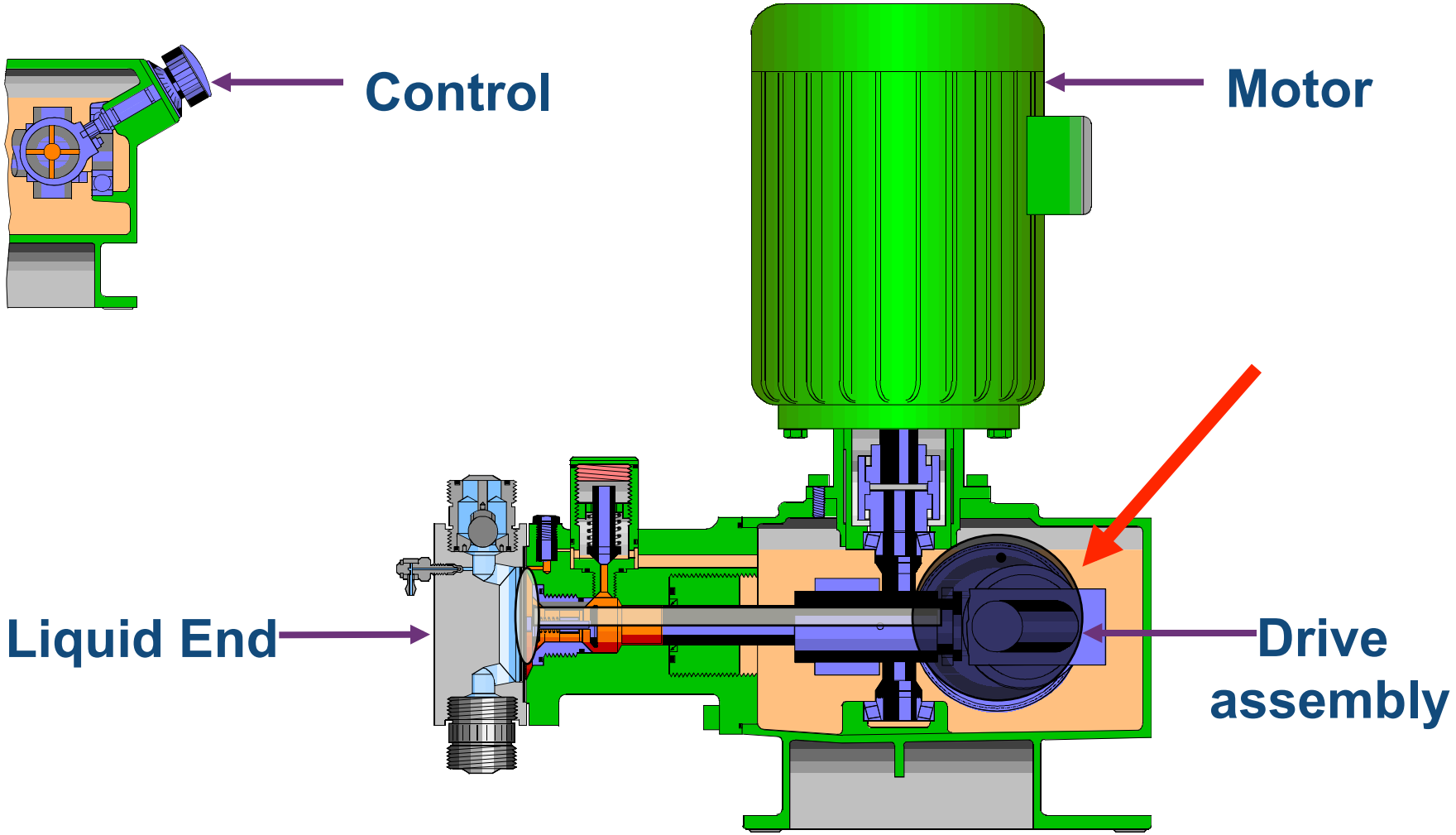

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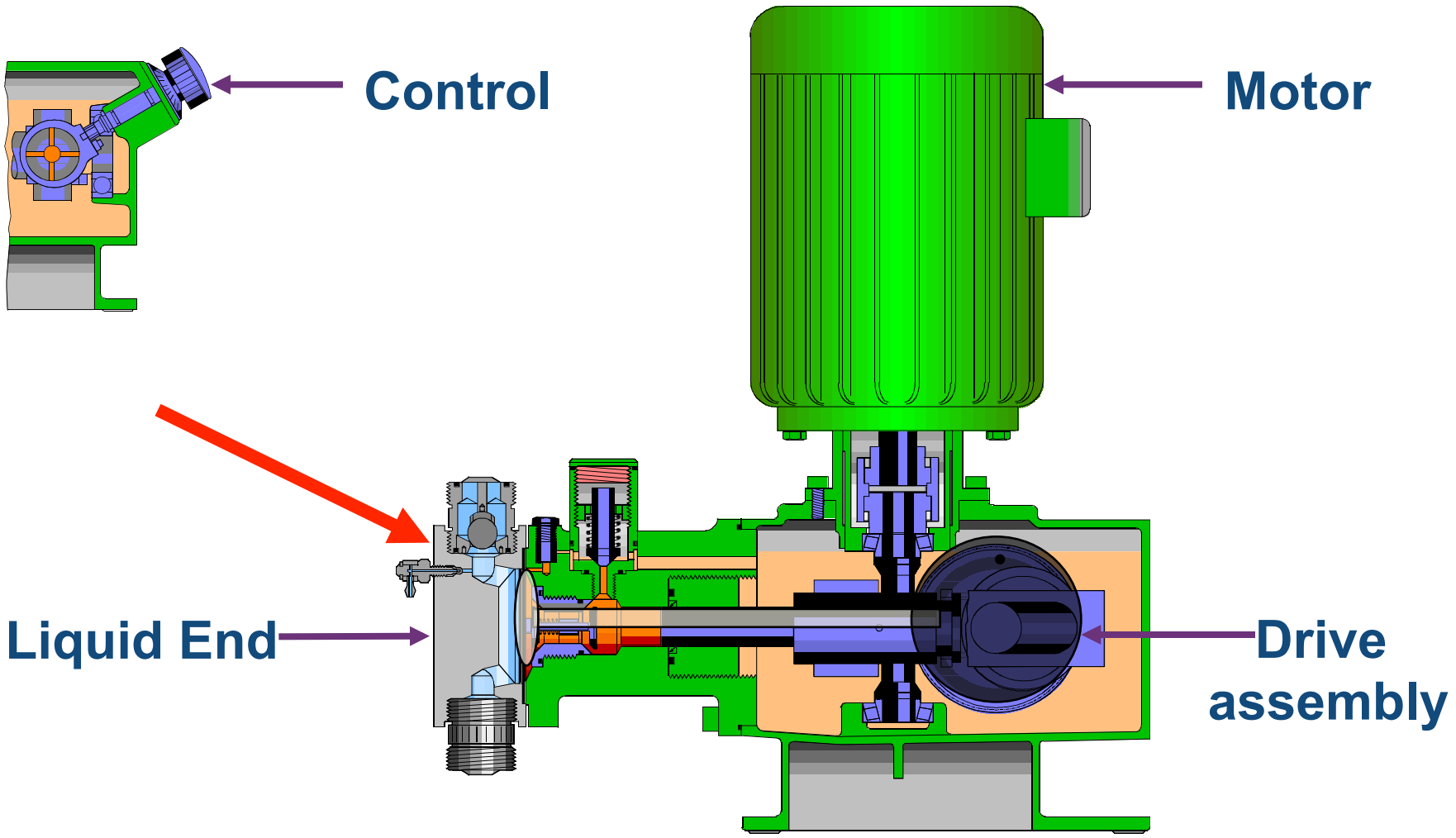

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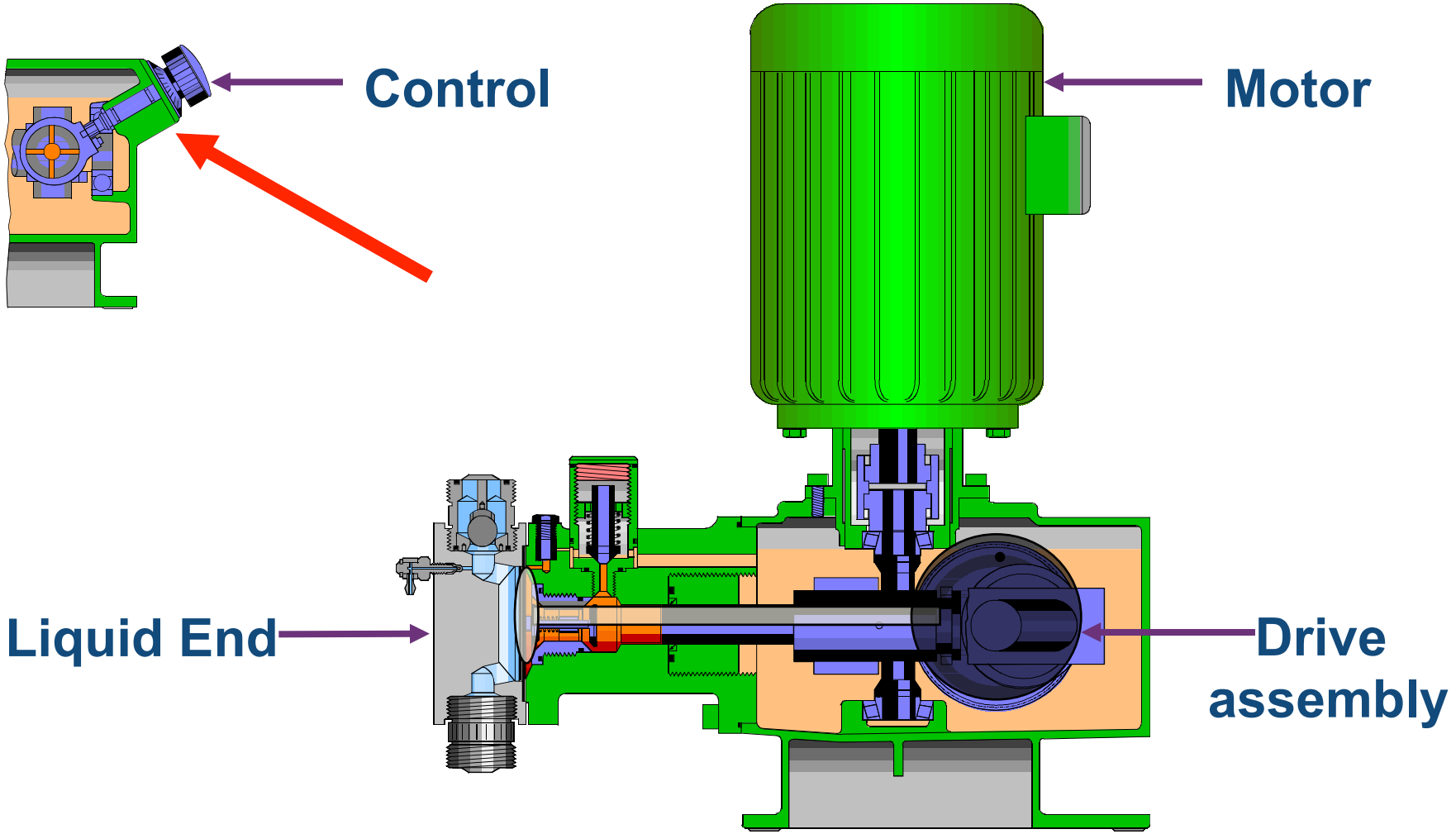

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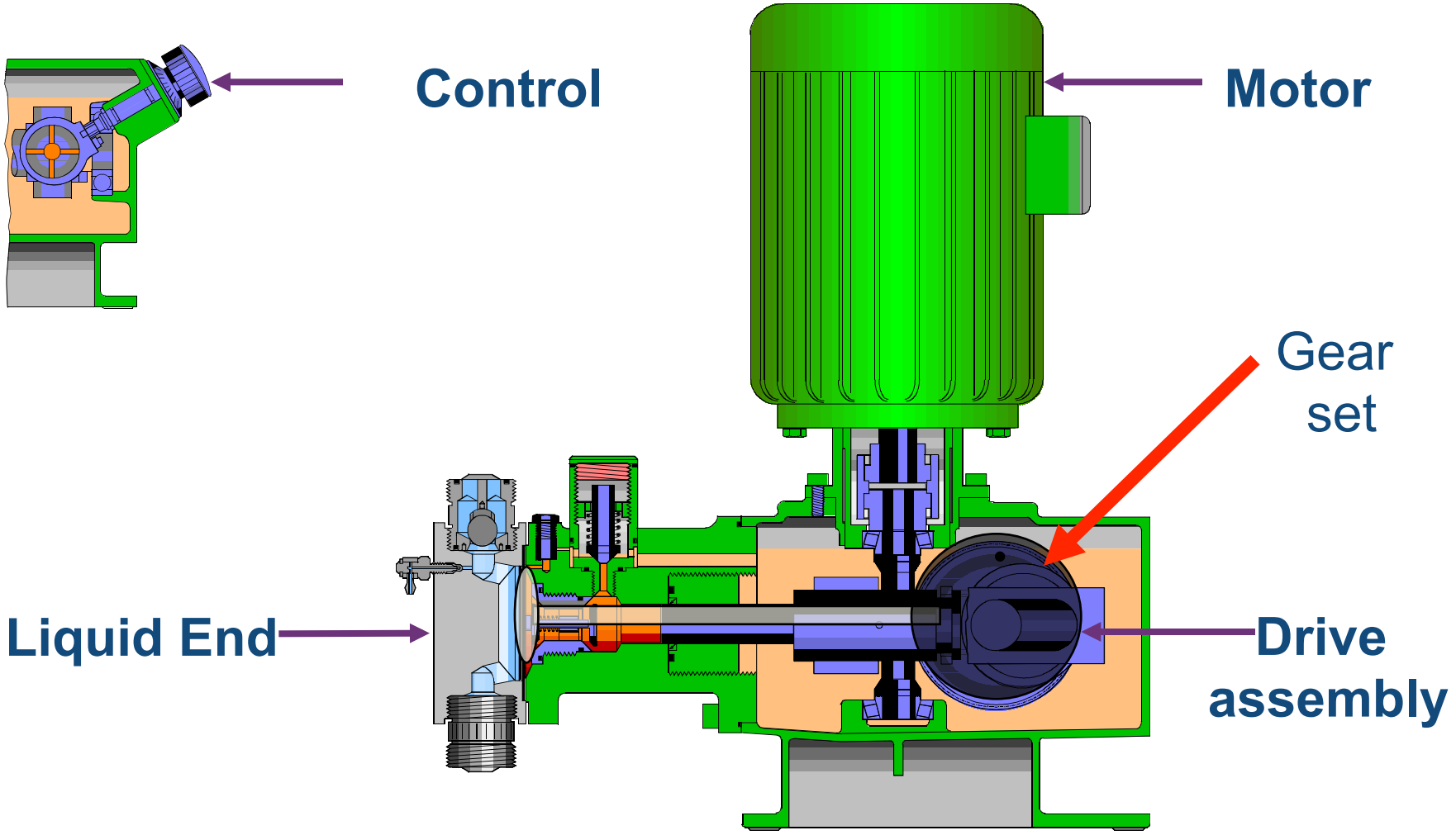

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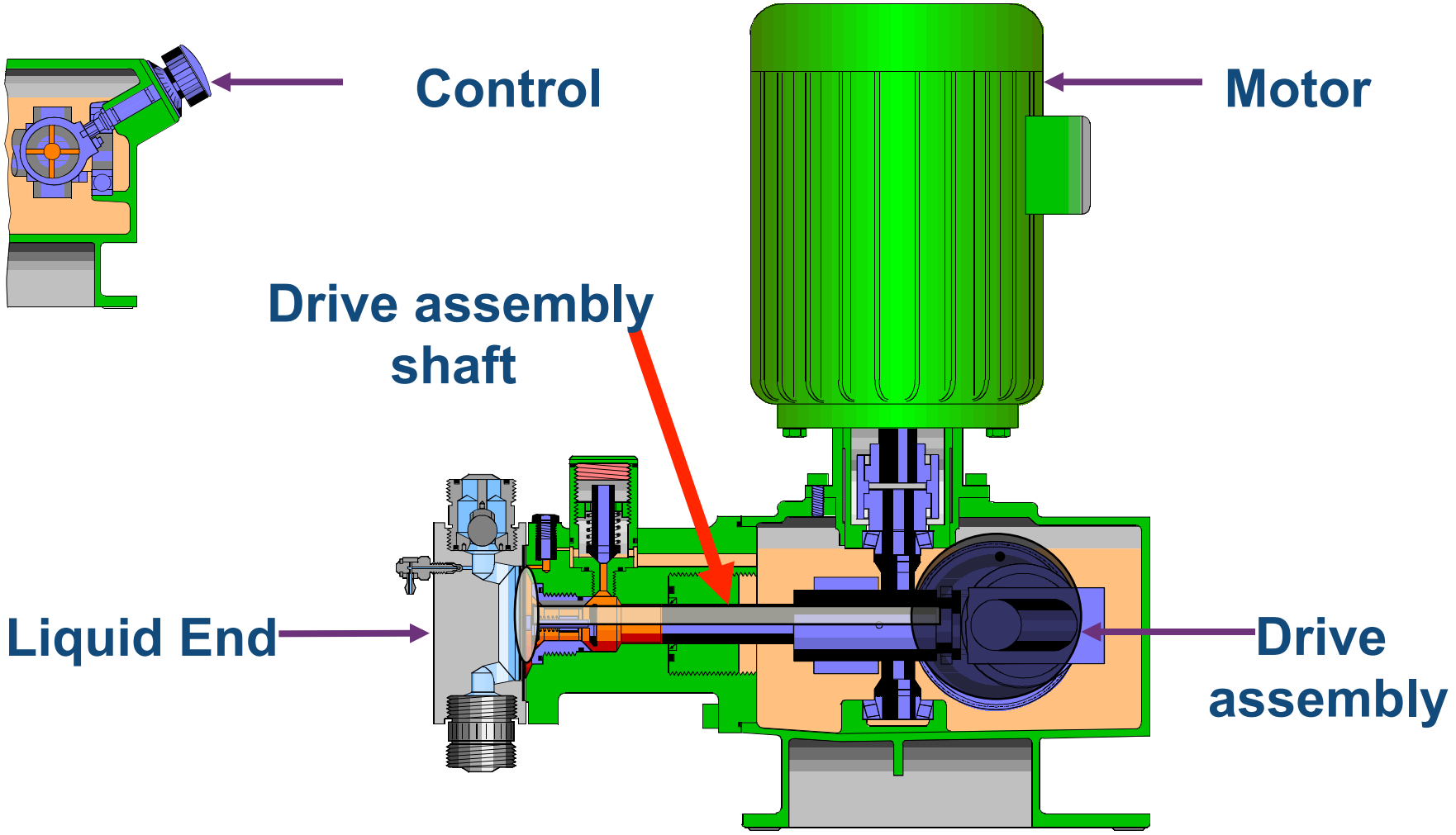

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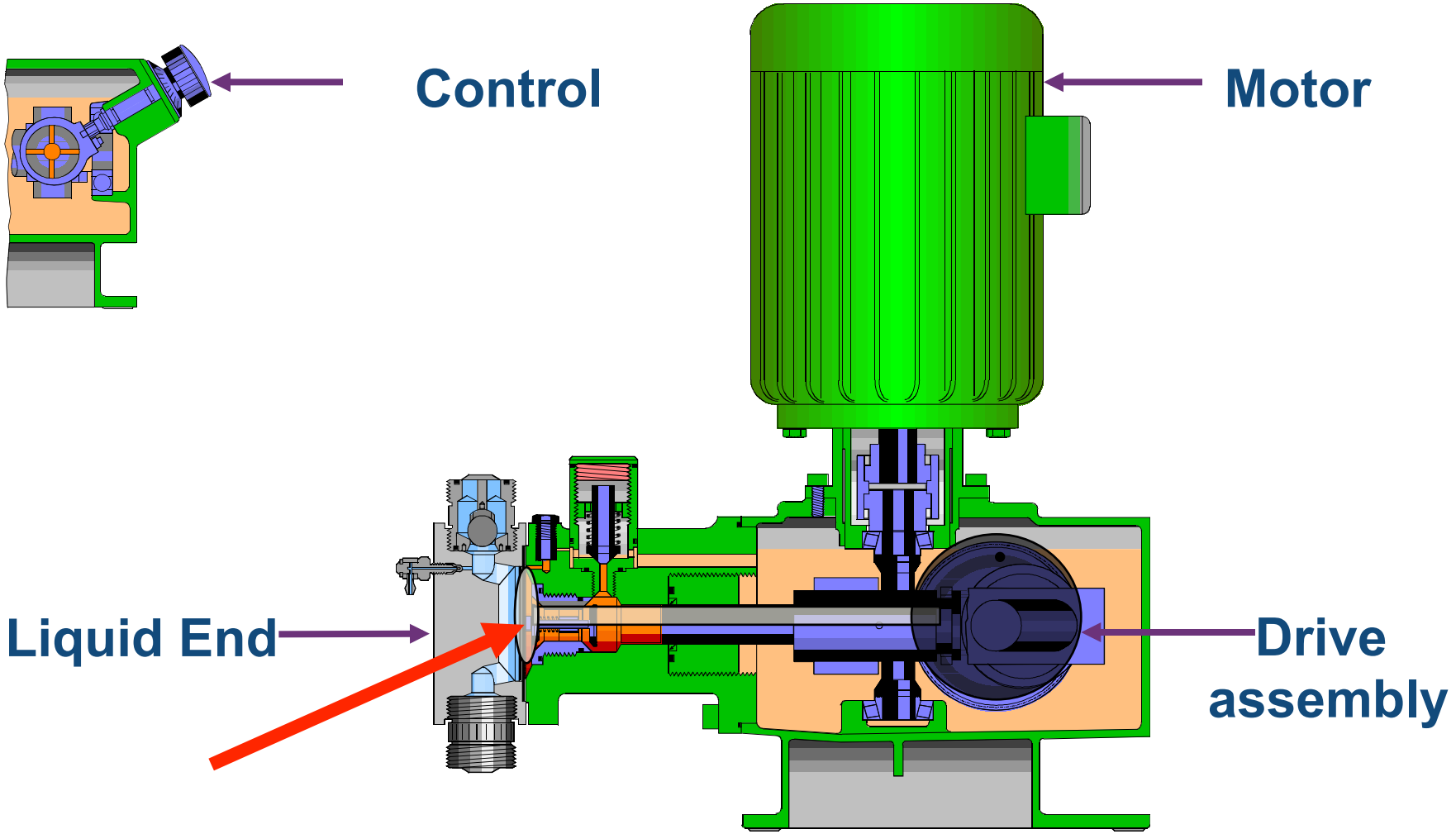

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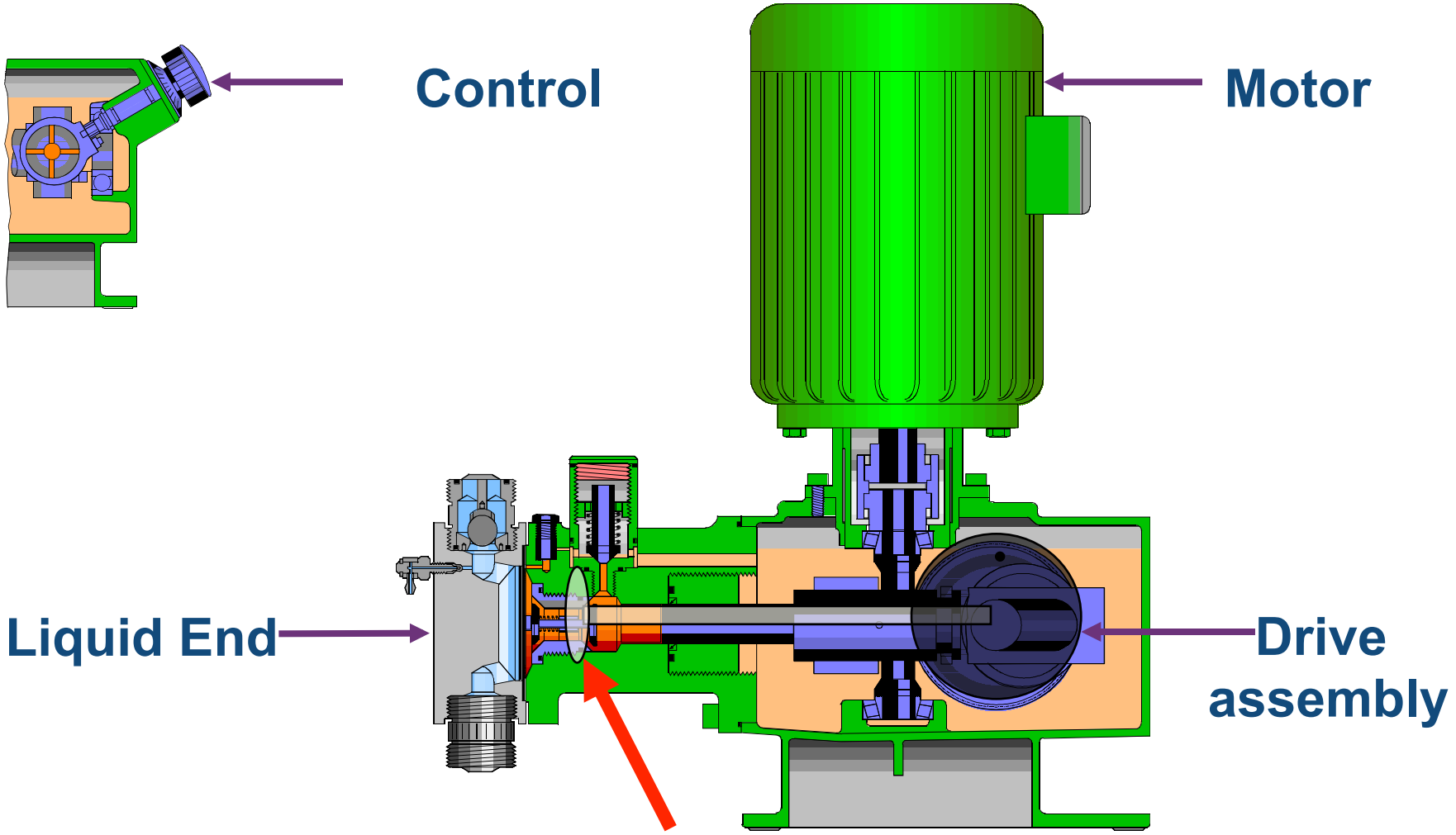

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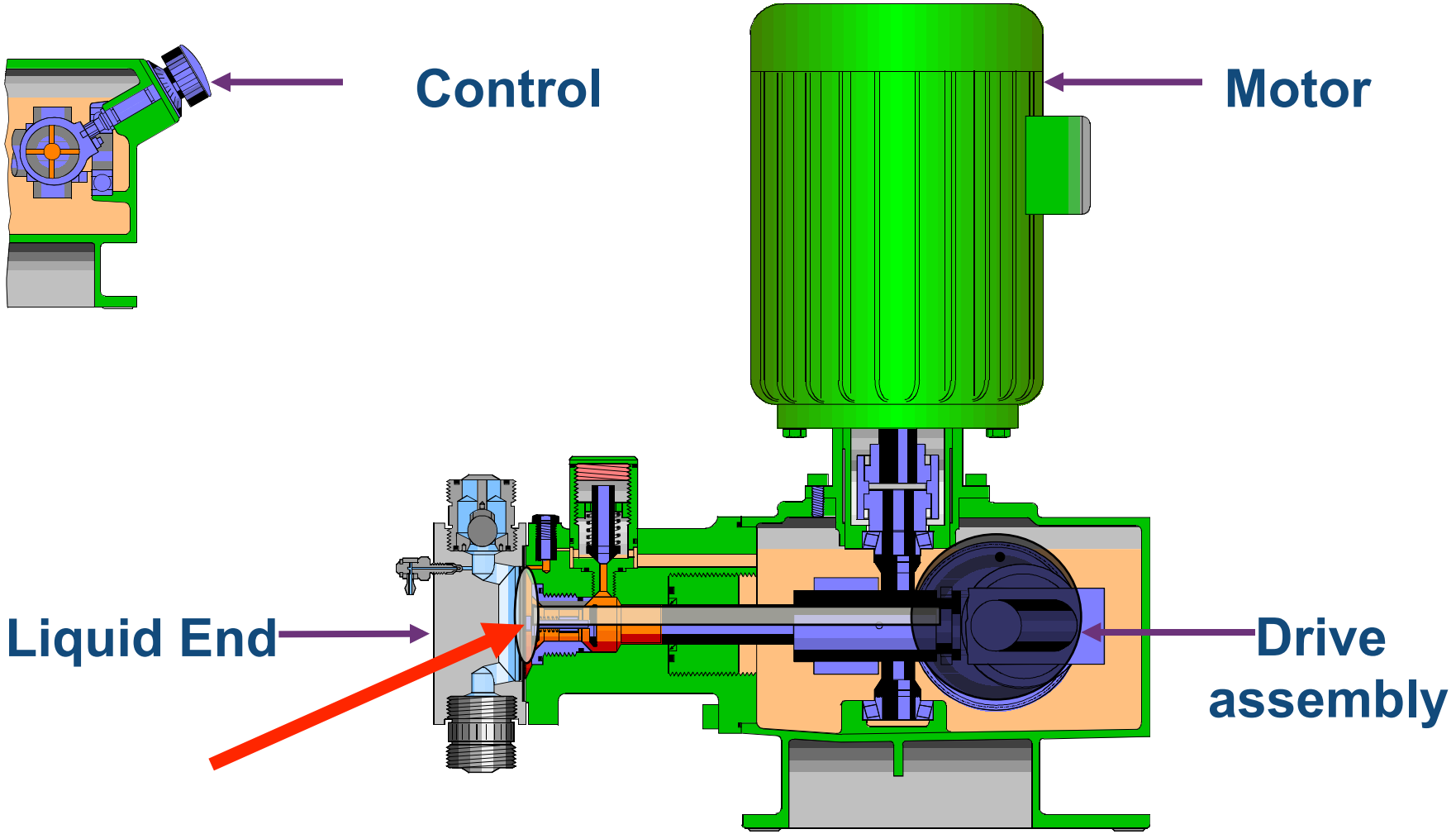

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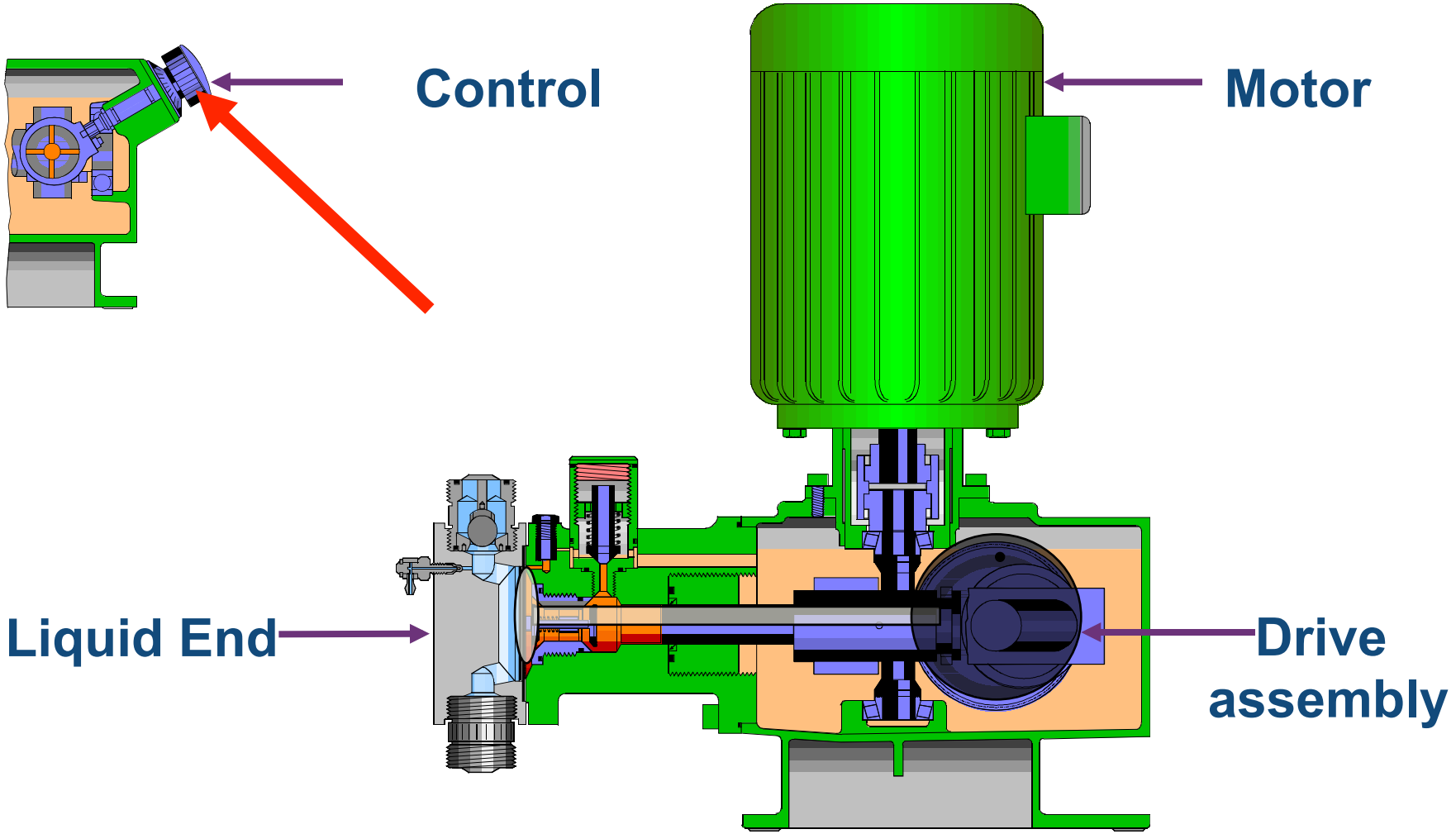
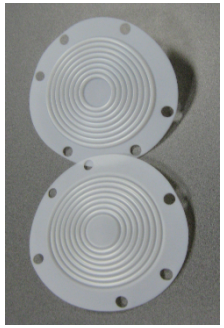


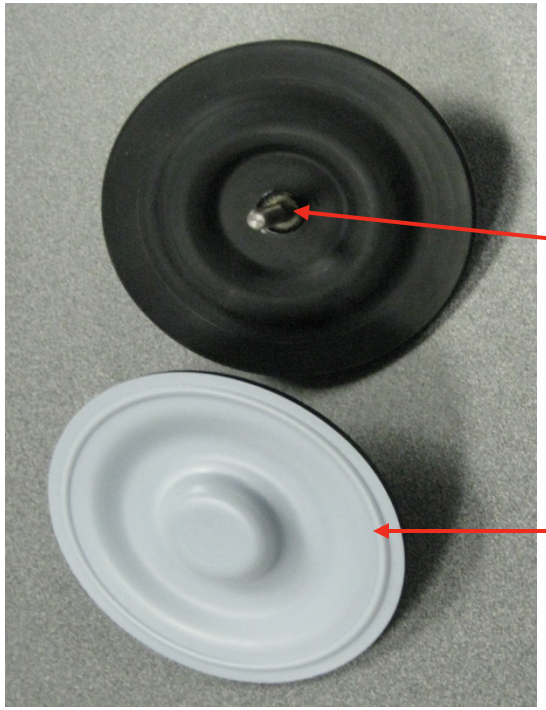
Controlled Volume Metering Pumps: Two Basic Types

Hydraulically Actuated Diaphragm



Mechanically Actuated Diaphragm

Mechanical Diaphragm Liquid End



Diaphragm

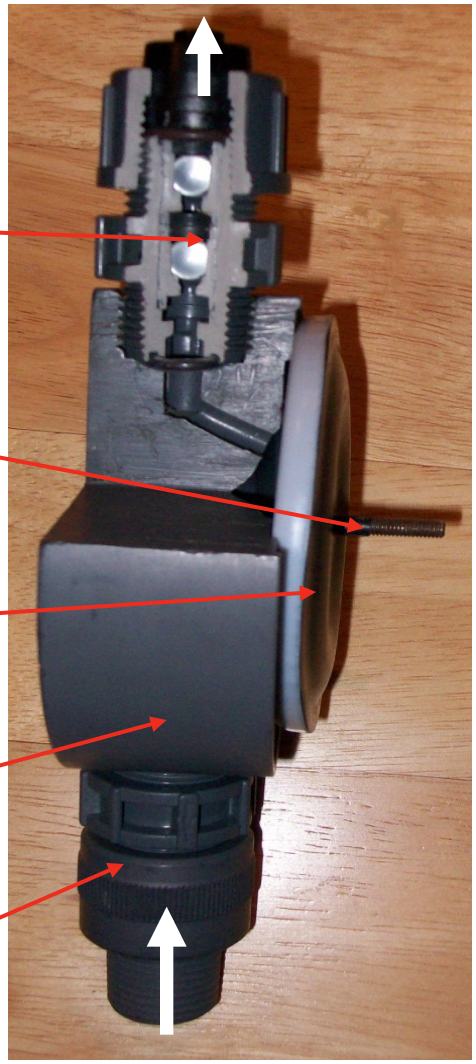
Discharge Check Valve

Threaded Diaphragm Shaft

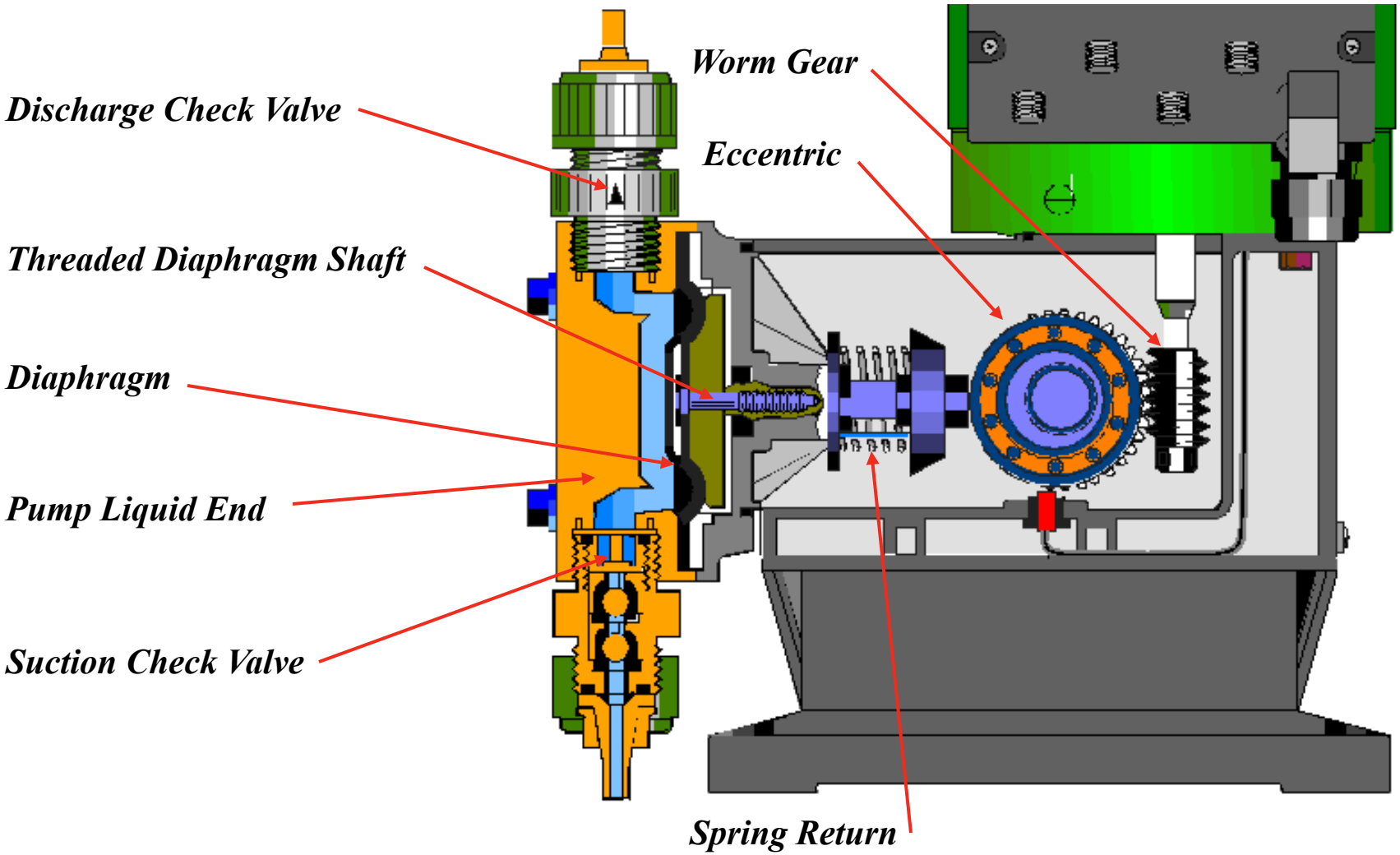
Diaphragm

Pump Liquid End

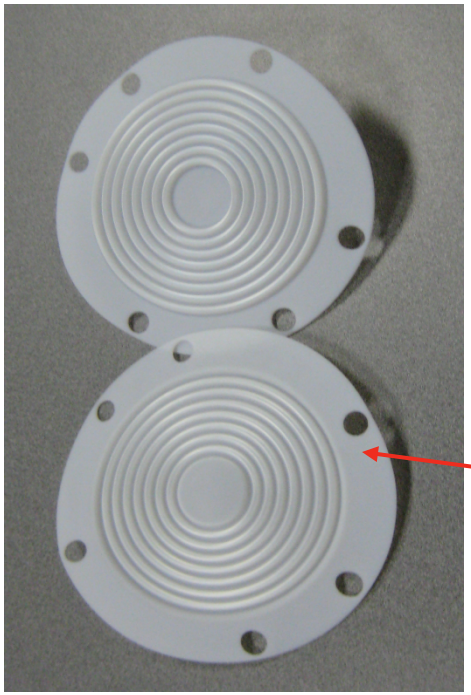
Suction Check Valve



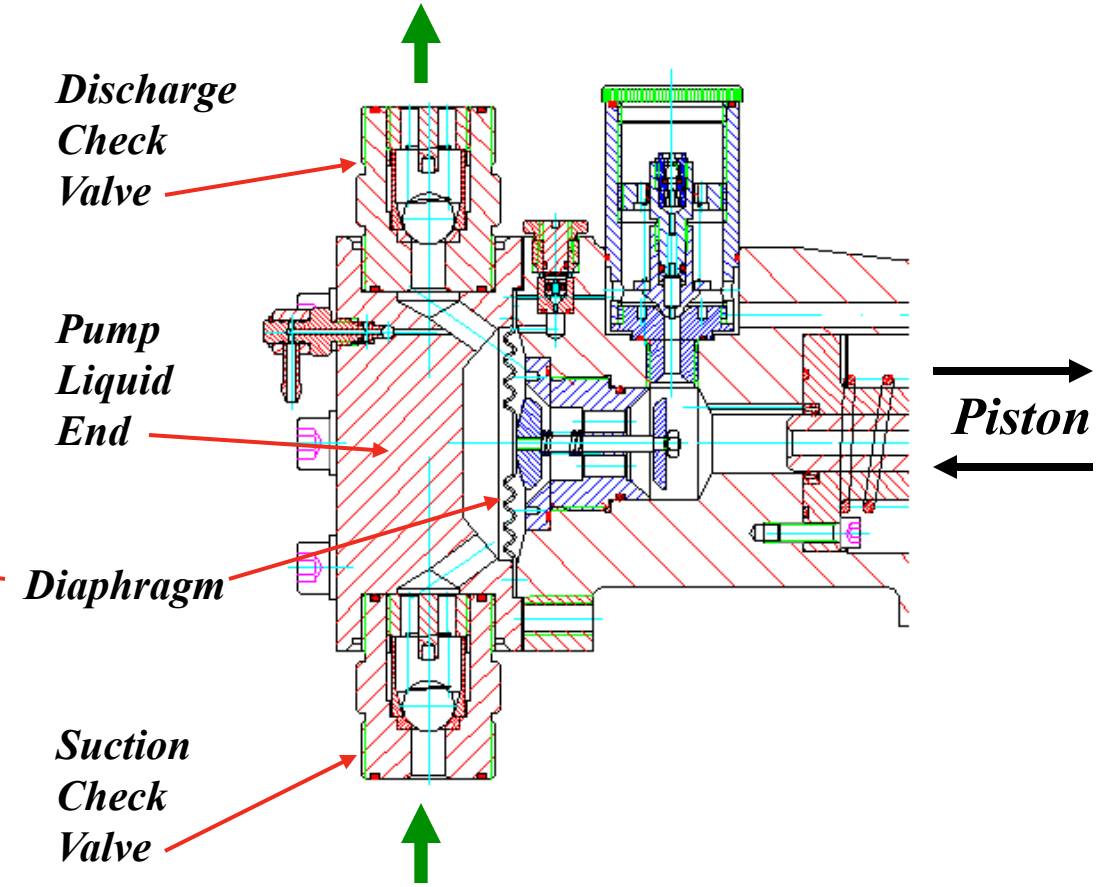
Mechanical Diaphragm Pump



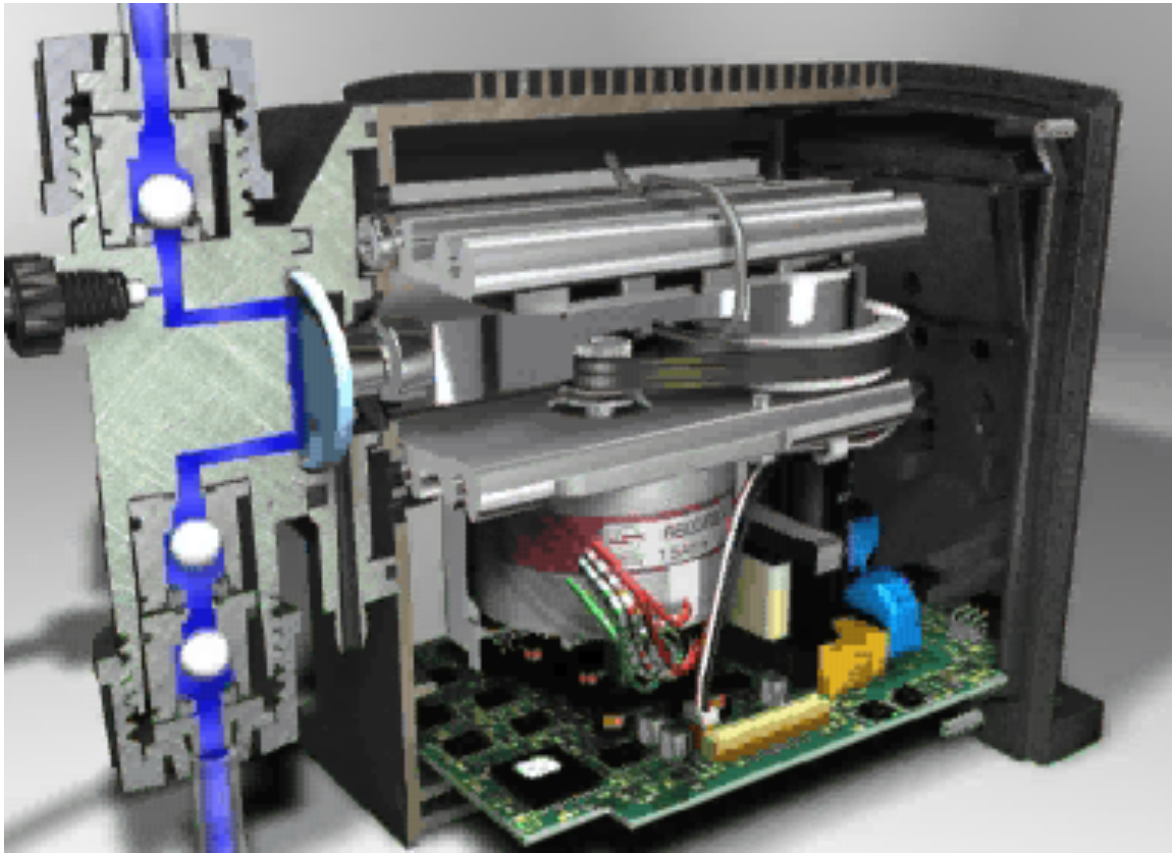
Hydraulic Diaphragm Liquid End



Diaphragm



Mechanically Actuated Diaphragm



What Types of Drivers Are Available?

Conventional motor

Stepper motor

Solenoid

Controlled Volume Metering Pumps: Control Options

- Stroke length Adjustment
  - Manual
  - Electric Actuator
  - Pneumatic Actuator
- Frequency Adjustment
  - Manual
  - External Signal
- Variable Frequency Drive

Setting Dose Rate

Stroke Frequency Control

Stroke Length Control

Example:

- 50% stroke length
- 50% frequency
- Total dose rate equal to 25% of the maximum rated capacity of the pump.

How Does the Pump Achieve Flow Control?

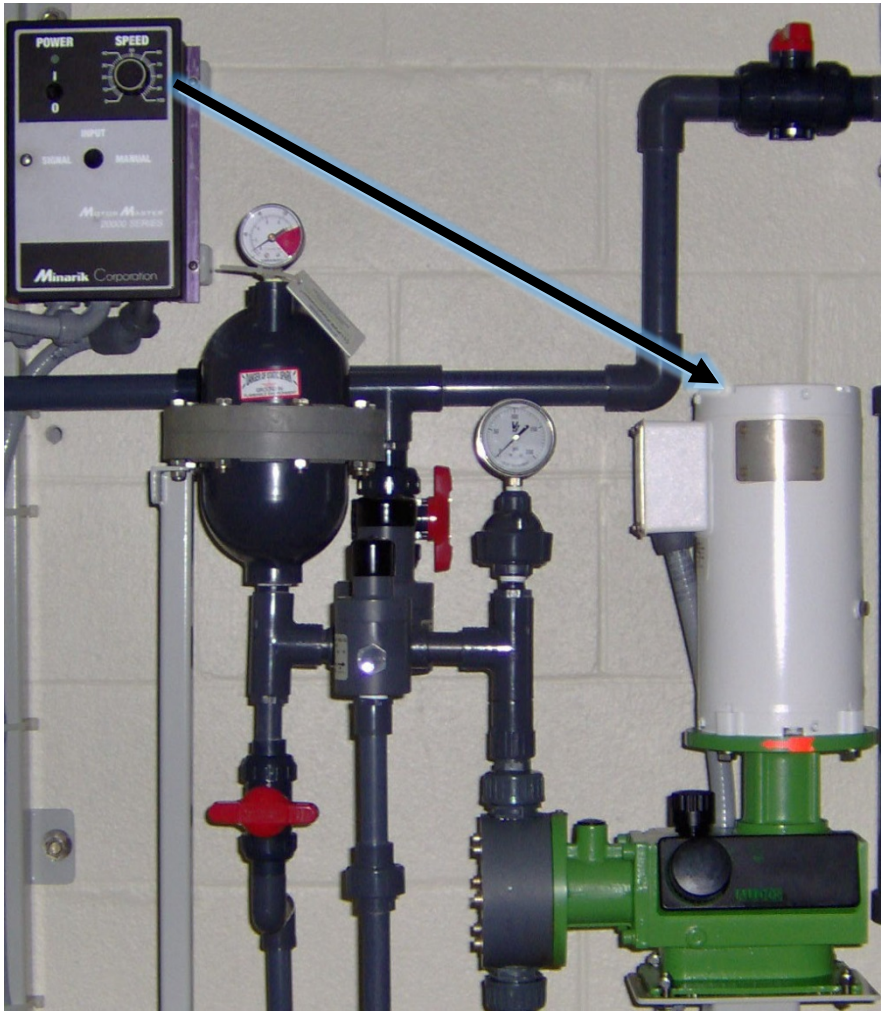
Three ways to do it:

1. Control stroke length (how far)
2. Control stroke frequency (how often)

and also

3. Control stroke speed (how fast)

Variable Speed Drive

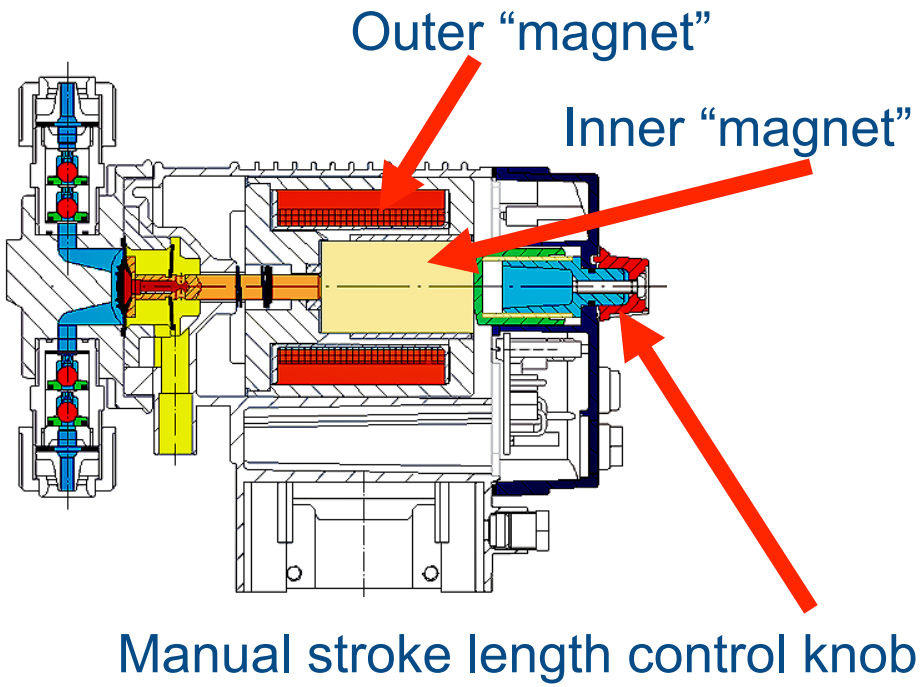


Pump with Variable Speed Drive for Automatic Motor Speed Control.

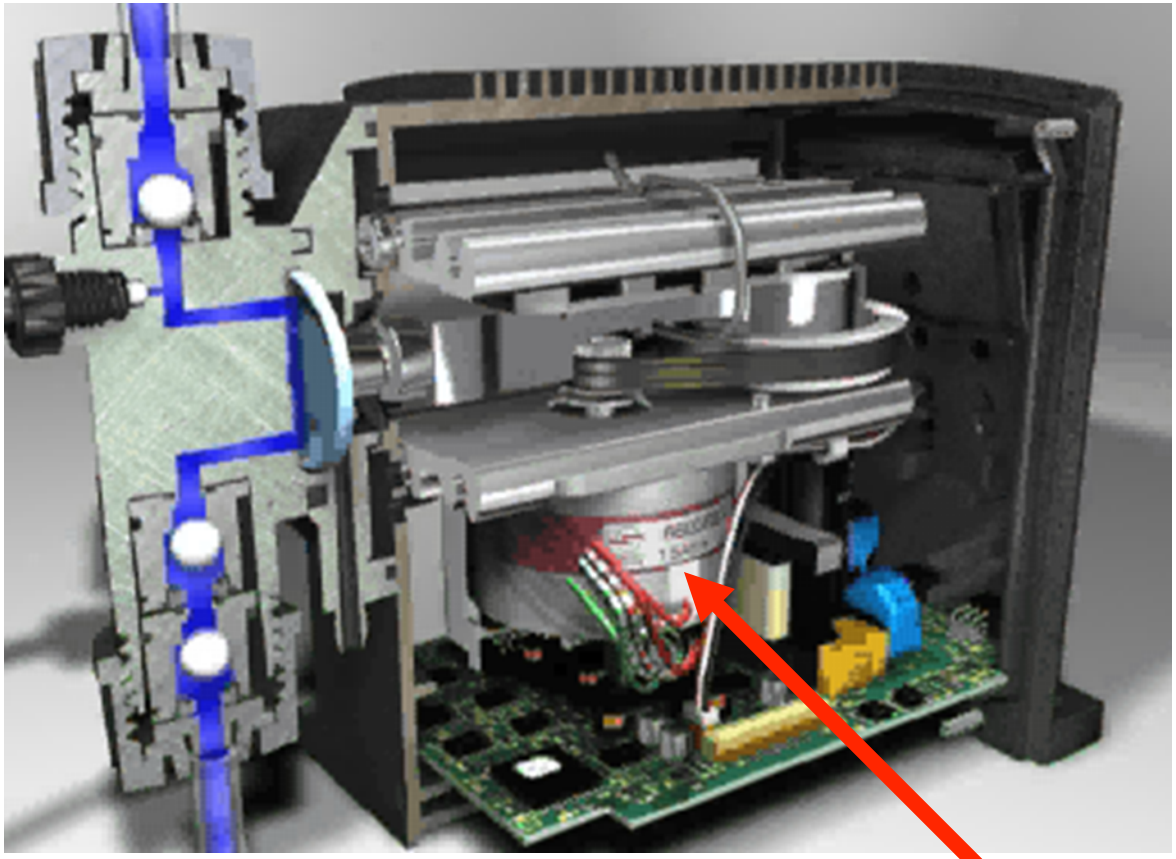
Limited turndown depending on drive and motor characteristics.

Metering pumps require constant torque.

Solenoid driven pump control



Stepper



Wiring Considerations

120V / 1Ph USA / Canada power plug most common

Ports (varies by model) for:

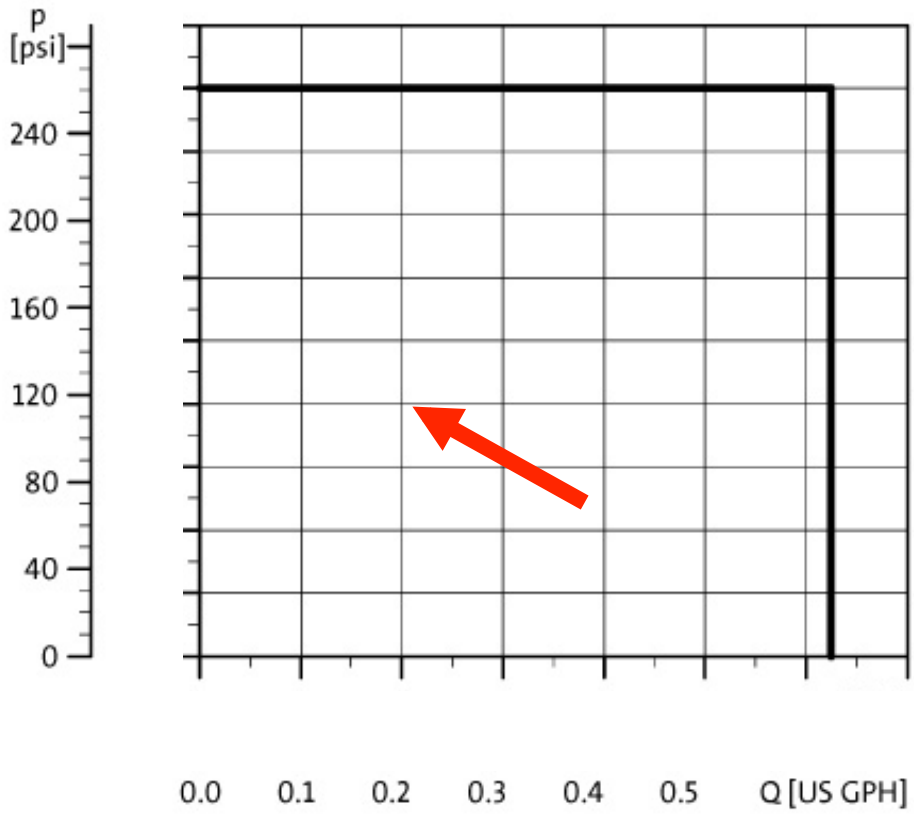
Input:

- Control
- Level
- Analog
- Pulse
- Leakage
- Stop dosing
- Dosing monitor

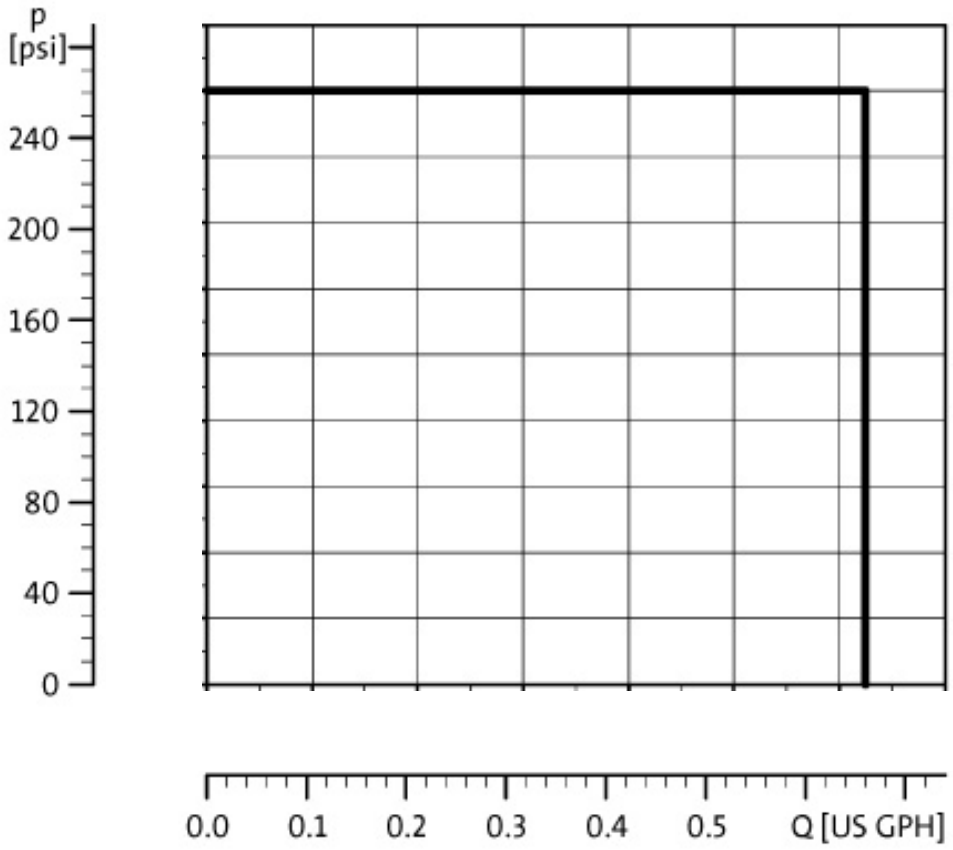
Output:

- Alarm relay
- Dosing is occurring
- Notice of liquid level
- Analog outputs

Typical Dosing Pump Performance Chart



Typical Dosing Pump Performance Chart



Definition of “Turndown”

- A statement of relationship between the maximum flow indicated on a pump’s chart and the minimum flow that the same unit can dose with accuracy

Chart Interpretation and “Turndown”

- For above chart with a maximum flow of 0.66 gph:
  - Minimum flow at maximum turndown of 1000:1 is gph

Chart Interpretation and “Turndown”

- For above chart with a maximum flow of .66 gph:
  - Minimum flow at maximum turndown of 1000:1 is 0.00066 gph

Chart Interpretation and “Turndown”

- For above chart with a maximum flow of .66 gph:
  - Minimum flow at maximum turndown of 1000:1 is 0.00066 gph

- For a pump with 10:1 ratio and maximum flow of 10 gph, minimum accurate flow is gph

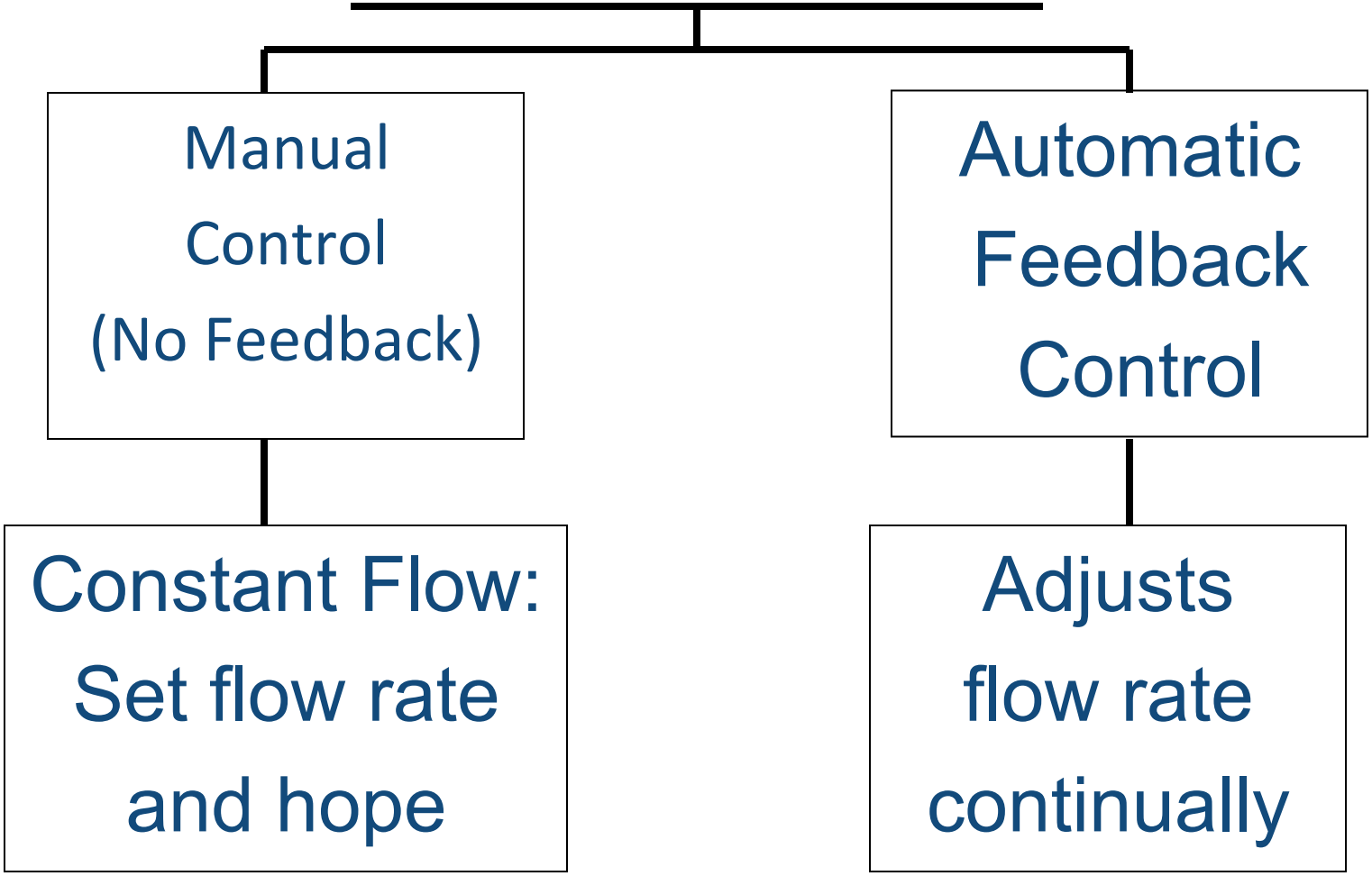
Chart Interpretation and “Turndown”

- For above chart with a maximum flow of .66 gph:
  - Minimum flow at maximum turndown of 1000:1 is 0.00066 gph

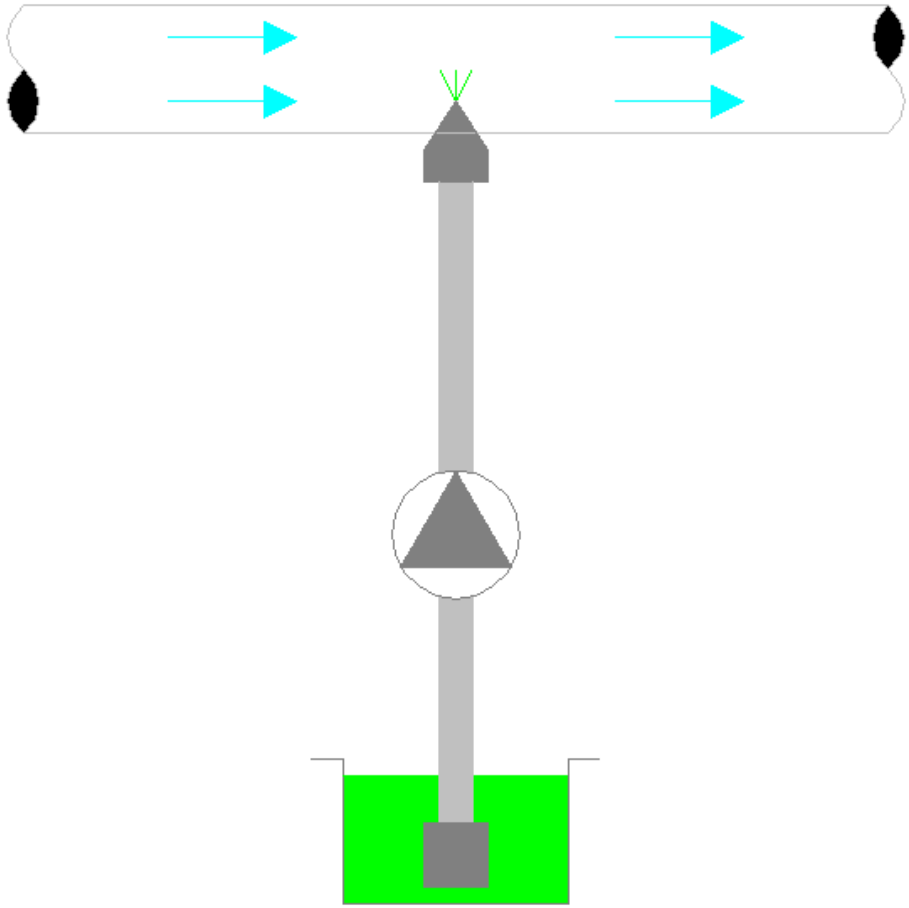
- For a pump with 10:1 ratio and maximum flow of 10 gph, minimum accurate flow is 1 gph

- Many pumps can operate at lower flows than turndown indicates, but rate flow will not be reliable

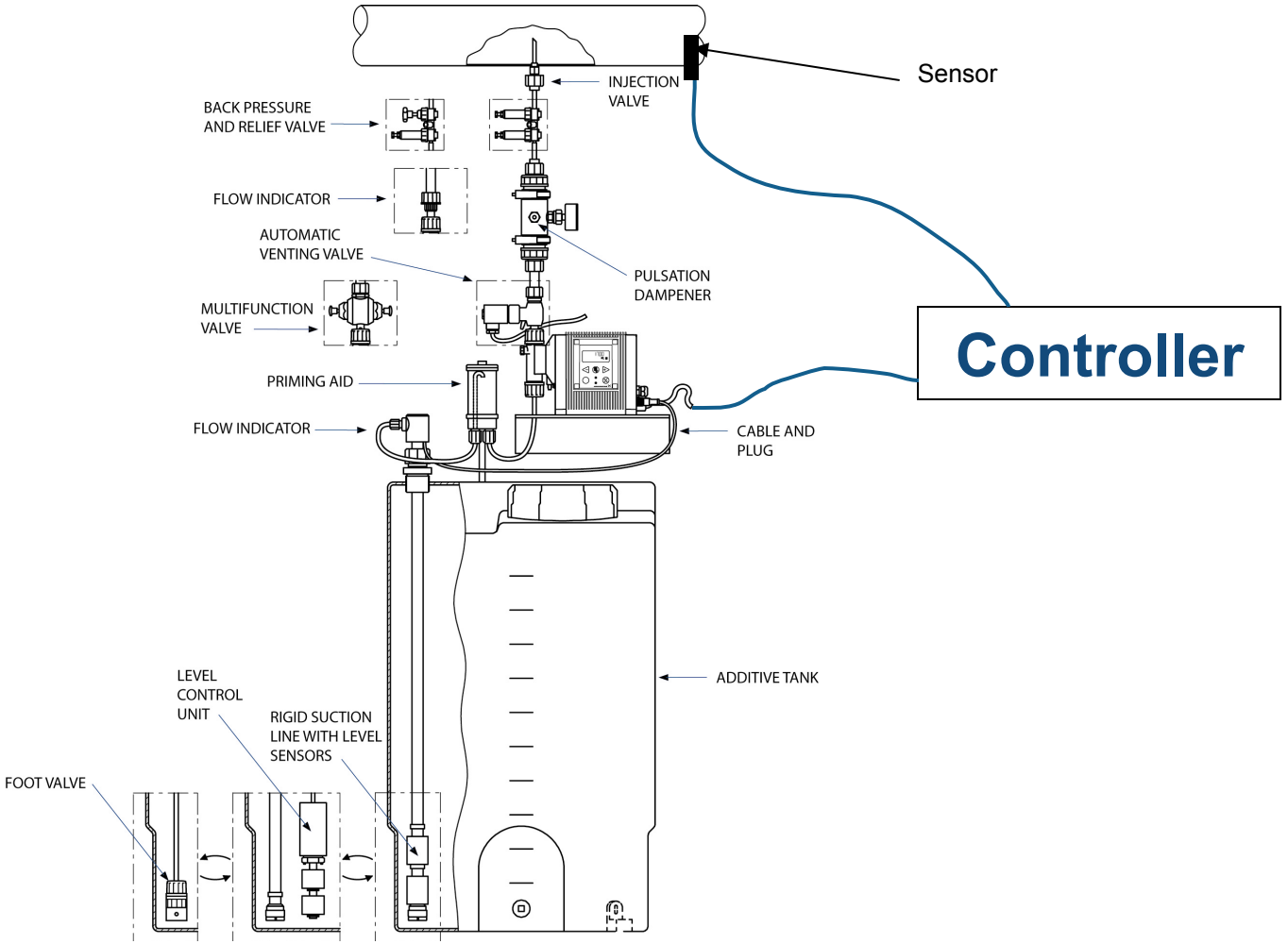
Control Of Driver



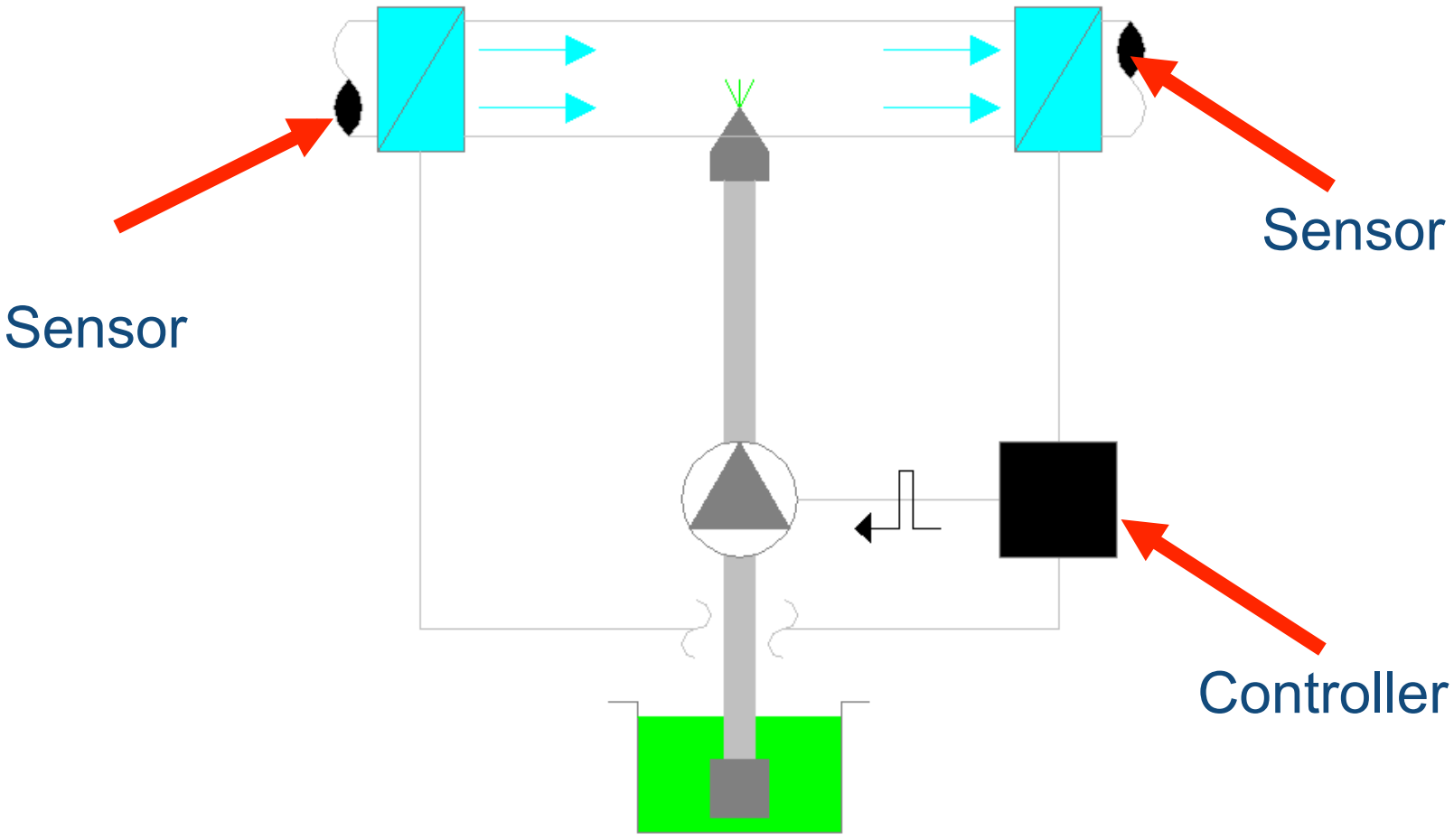
Manual Constant Flow System: No Feedback



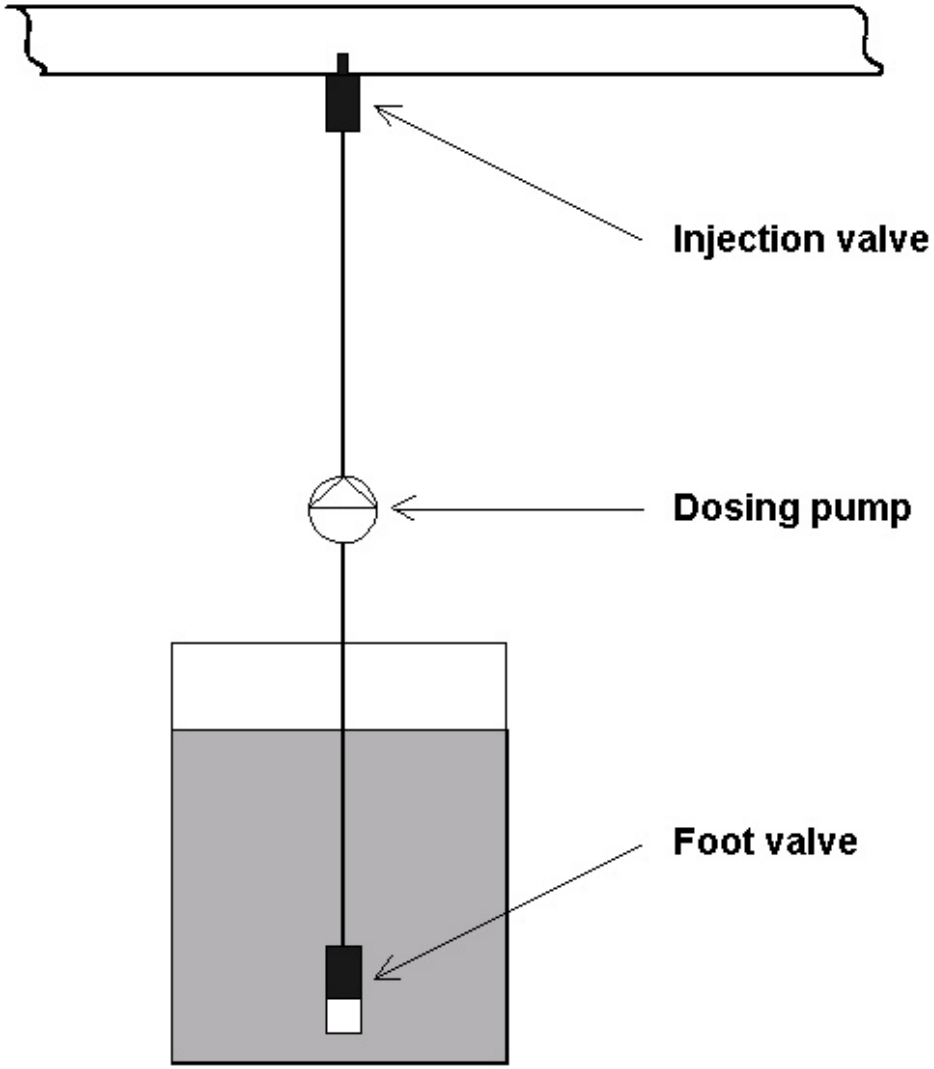
Typical Feedback System



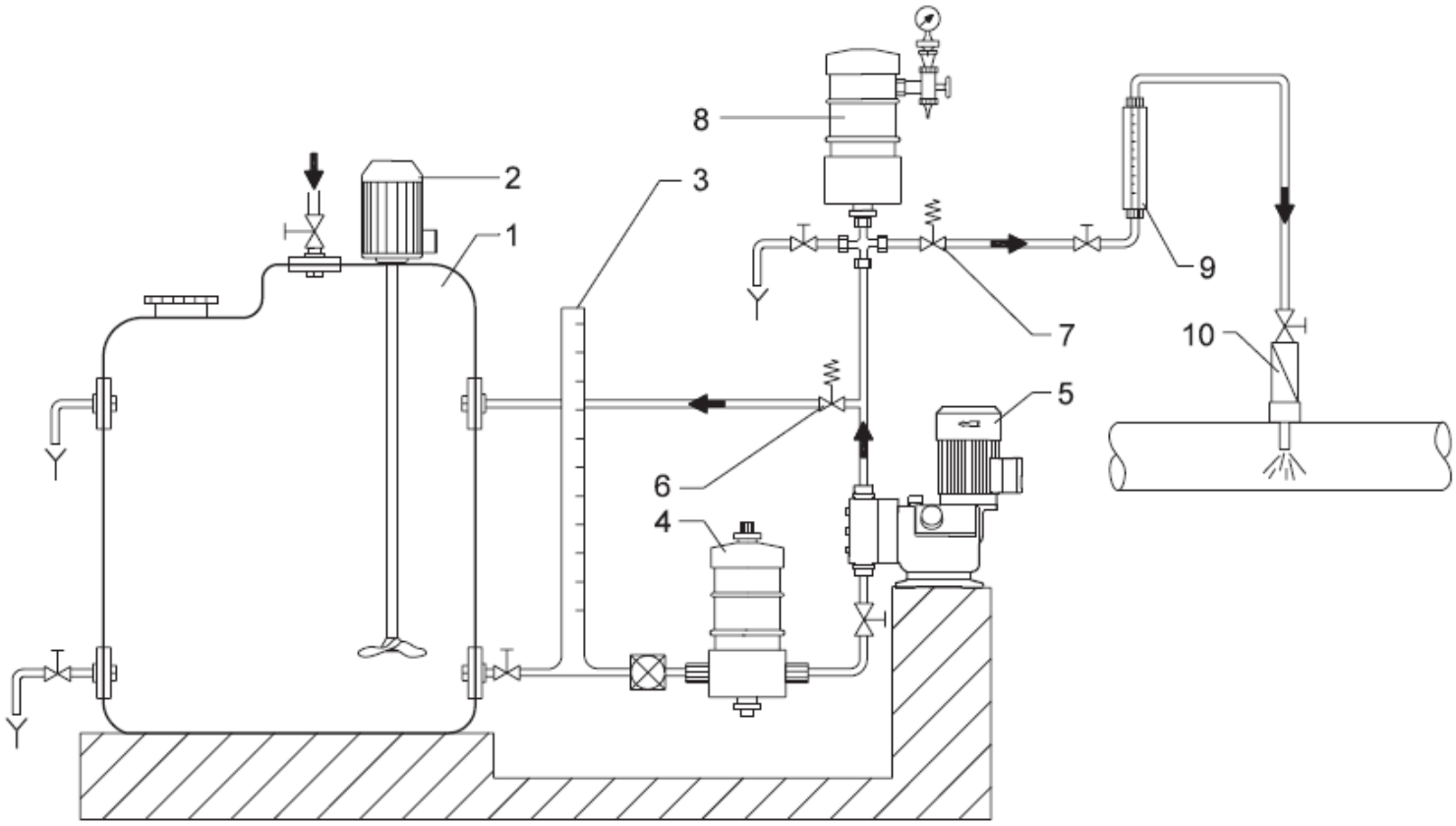
Combined Feed Forward and Feed Back



“Standard” Installation

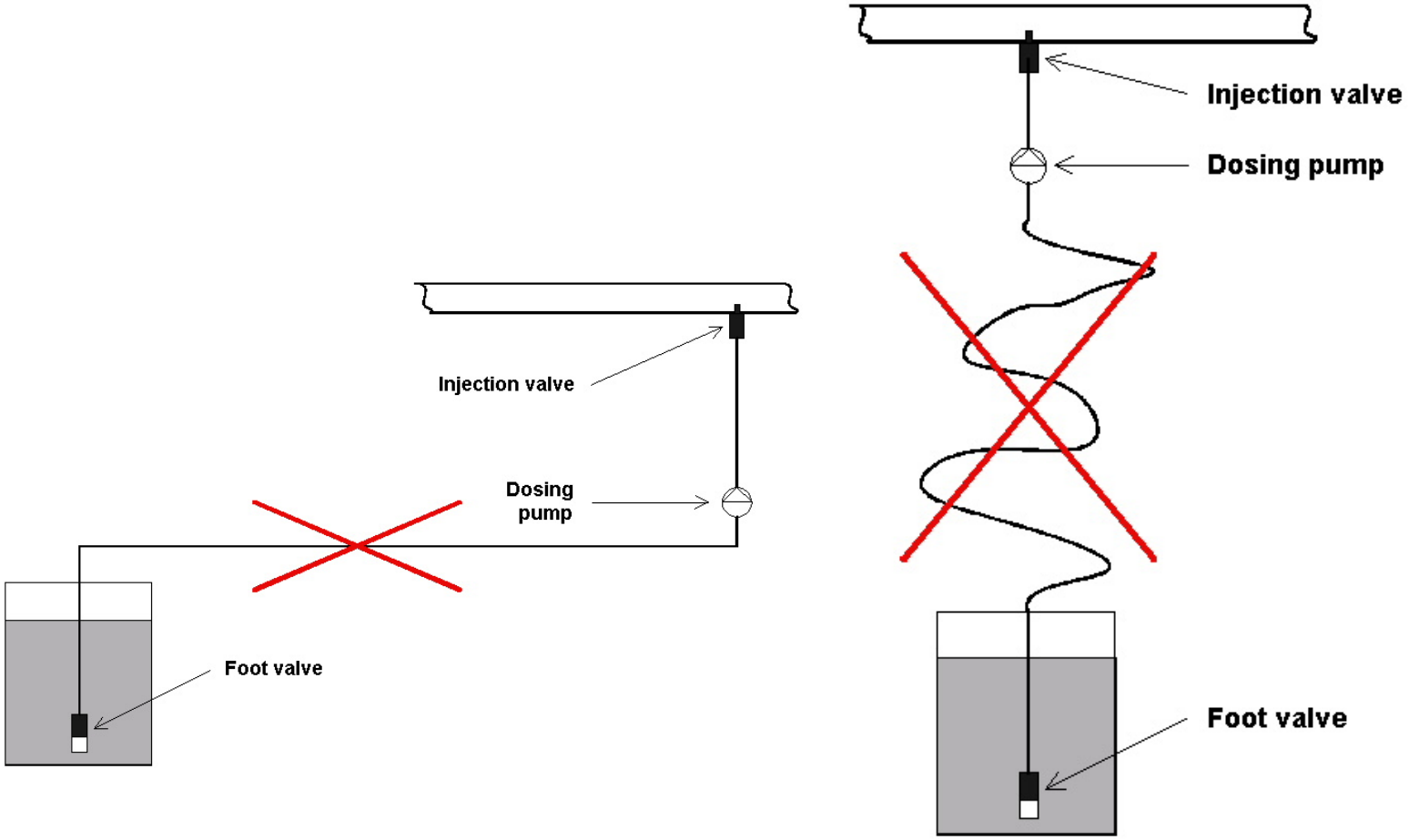


Typical System Components



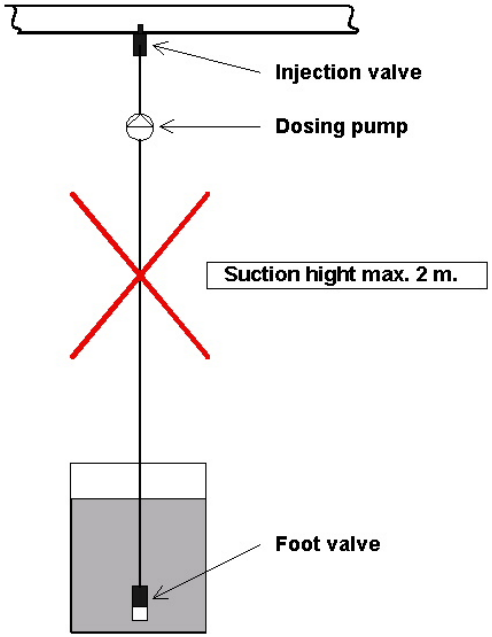
Good Installation Practices:

Avoid long or complex suction lines

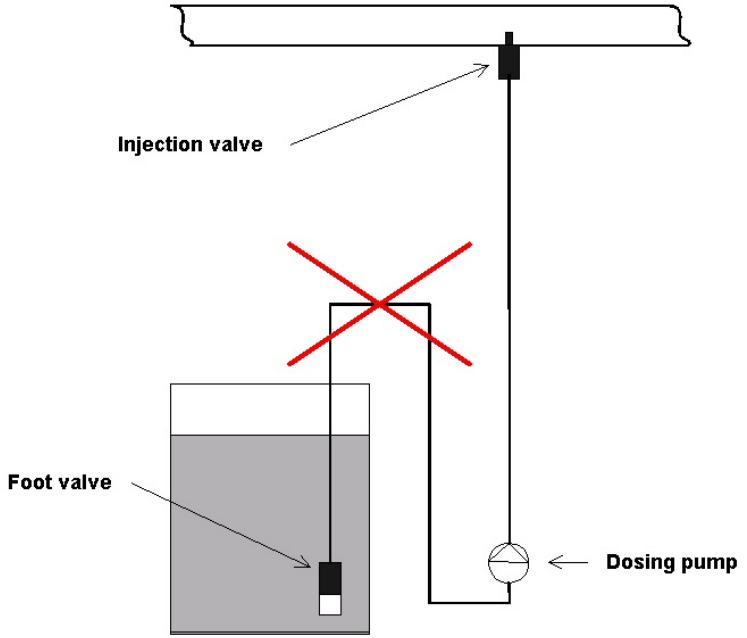


More Installation Tips

Avoid large suction heights



Avoid gas traps in suction lines



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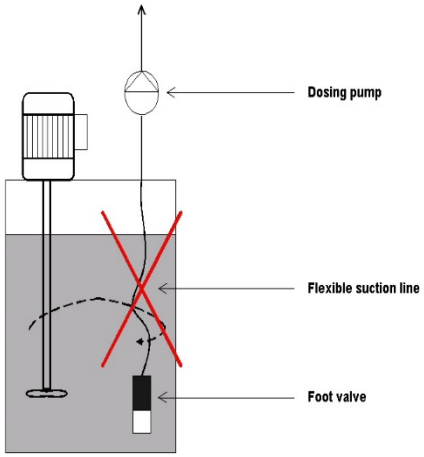
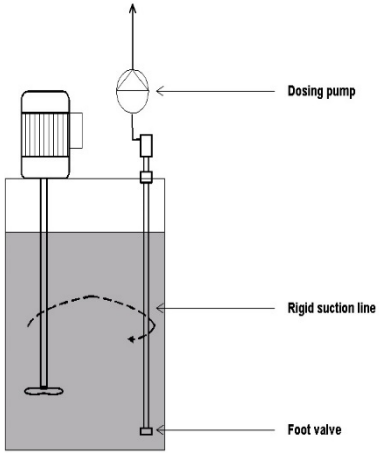
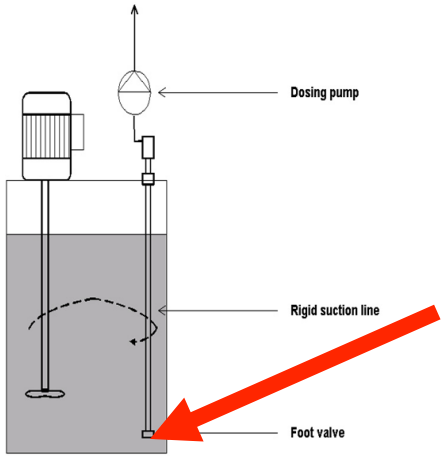


Flexible suction line



Rigid suction line



Keep foot valve 3” to 6” off bottom of tank to keep debris out.

Summary Slide of Learning Objectives:

At the conclusion of this webinar you should be able to:

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2. Describe the nature of liquids that are typically dosed
3. Explain the mechanics of dosing pumps
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Thank you!

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Questions & Answers

Use the chat feature to submit questions