Protect the Heart of the Irrigation System - The Pump

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PRESIDENT
EPIPHENE, INC
“What gets us into trouble is not what we don't know. It's what we know for sure that just ain't so.”

— Mark Twain
Outline

• Downhole Pumps - Sand Protection
• Self-Cleaning Suction Screens
• Strainers
• Flow Control Solutions
Car Analogy

• Fuel Filter
• Oil Filter
• Air Filter
• Fuel Injection Nozzles
Downhole Pumps – Why Sand Protection?

- Declining well water levels
- Decreased well production
- Silt and Sand intrusion
- Damage to bowls and impellers

**MAIN BENEFITS**

INCREASES LIFE OF PUMP UP TO **FIVE TIMES**
MAINTAINS FLOW AND HEAD FOR LONGER
Downhole Pumps – Solutions for Submersibles
Downhole Pumps – Solutions for Turbines
Downhole Pumps – Solutions for both Submersible and Turbine

• Important Factors to consider:
  • Casing Inside Diameter
  • Water Level
  • Pump level
  • Depth to bottom of well

• Typical Requirements to consider:
  • Correct Connections & Approach
  • Does the pump have minimum head requirement to operate the downhole separator?
  • Does it change during season?
  • Does it have minimum of 30 ft to bottom?
Why Self-Cleaning Suction Screens?

• Protect Centrifugal or Close Coupled Turbines from
  • debris,
  • aquatic beasties,
  • and algae
What Are Self-Cleaning Suction Screens?

- Centrifugal
- Close Coupled Turbines
- Video Example
Self-Cleaning Suction – Solutions for both Submersible and Turbine

**Important Factors:**
- Flow Rates
- Debris Expected
- Inlet Velocities
- Protecting Screen Collapsing & Pump From Cavitating
- Drive Type

**Typical Requirements:**
- Always Oversize
- Algae, Fish & Frogs, other debris
- Maximum Inlet velocity .4 fps
- Vacuum Gauge with Switch
- Diesel or Electric
Why Strainers?

• Protects the Pump
• But also protects downstream components
  • Check Valves
  • Control Valves
  • Filters
• Bottomline:
  • Safety Screen
  • Rather clean a strainer than chase down issues in downstream components
Types of Strainers

Y STRAINERS

BASKET STRAINERS
Design Consideration

Y STRAINERS
• More Flexible Installation
• Flushable
• More turbulence
• Higher Friction Loss

BASKET STRAINERS
• Only installed one way
• Not Flushable
• Less turbulence
• Lower Friction Loss
Types of Strainers

**Y STRAINER**

![Y Strainer Diagram](image1)

**Y STRAINER**

![Y Strainer Image](image2)
Types of Strainers

**BASKET STRAINER**

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Strainer - “Saving Energy”

Smaller screen has less surface, reducing flow. Less surface area means screen clogs more quickly.

Up to 30% larger screen has more surface area. Flow travels smoothly through more holes. Clogs less.

Conventional Old Y Strainer
Same design since 1908

New LPD Y Strainer
 Designed 2016
Strainer - “Saving Energy”

Bridge wall restricts flow, increases velocity and increases pressure drop.

No bridge wall. Flow is smooth with very low pressure drop.

Conventional Old Y Strainer
Same design since 1908

New LPD Y Strainer
Designed 2016
Strainer - “Saving Energy”

**Conventional Old Y Strainer**
Same design since 1908

**New LPD Y Strainer**
Designed 2016

- Orange and red bubbles show increased velocity as flow is squeezed into cavity.
- Flow is straighter. Velocity remains almost unchanged, pressure drop is low, maximizing NPSH.
Strainer - “Saving Energy”

- LPD Strainer
- Low Pressure Differential “Y” Strainer
- Differential Pressure Ports
- Access Port for Injection Or Flow Sensor
- Installation Option Vertical & Horizontal 4 to 8 O’Clock Allowed – Less Clearance than most Basket Strainer Sizes
- More Open Area to Pipe – Less Clogging
- Significantly Larger Screen – Less Clogging & More Storage
- Manual or Automatic Flushing Port – Minimizes Service
- Flow Through Design – No Obstructions & Lower Pressure Loss
- Flow Capacity often exceeds Basket Strainers of the same size – No need to upsize
- Detachable Bottom 4 Bolts – Easy Access
Strainer – Design Flows

Flow vs. Pressure Drop

<table>
<thead>
<tr>
<th>Size</th>
<th>Cv</th>
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<tbody>
<tr>
<td>2</td>
<td>113.8</td>
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<tr>
<td>2.5</td>
<td>165.1</td>
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<tr>
<td>3</td>
<td>236.1</td>
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<tr>
<td>4</td>
<td>460</td>
</tr>
<tr>
<td>5</td>
<td>641.9</td>
</tr>
<tr>
<td>6</td>
<td>952</td>
</tr>
<tr>
<td>8</td>
<td>1579.5</td>
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<tr>
<td>10</td>
<td>2423.5</td>
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<tr>
<td>12</td>
<td>3576.5</td>
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</table>
Strainer – Design Flow Comparison

Area Comparison LPD vs Basket Strainer

NPS PIPE SIZE

INCHES

Basket Strainer Area (in²)  LPD Strainer Area (in²)

<table>
<thead>
<tr>
<th>2</th>
<th>2.5</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
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<tbody>
<tr>
<td>27.5</td>
<td>52</td>
<td>33.6</td>
<td>54.6</td>
<td>99</td>
<td>94</td>
<td>147.3</td>
<td>118.6</td>
<td>226.5</td>
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Price Comparison LPD vs Basket Strainer

- **Basket Strainer Cost**
- **LPD Strainer Cost**

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Strainer - “Saving Energy”

LPD Y Strainer
Energy Savings Calculator

Enter your pipe size
8 in.

Enter your flow rate
1255.22 GPM
or
8.05 FPS

Enter your pump efficiency
0.7%

Enter your motor efficiency
0.9%

Enter your hours of operation / year
1600 hours

Your cost per kWh
0.17 $

How much debris?
Two (2) $1 bills = 32.05 sq in.

To help visualize the amount of debris, we use a size equivalent to a US $1 bill: 16.00254 sq in.
(103.39 sq. cm.)

Here’s how they compare

<table>
<thead>
<tr>
<th></th>
<th>OLD Y Strainer</th>
<th>LPD Y Strainer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cv*</td>
<td>920</td>
<td>1500</td>
</tr>
<tr>
<td>Pressure drop ( psi  )</td>
<td>2</td>
<td>0.7</td>
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<tr>
<td>Screen area ( sq. in )</td>
<td>387</td>
<td>515</td>
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<tr>
<td>% of clogged area</td>
<td>8.3</td>
<td>6.2</td>
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<tr>
<td>HP required</td>
<td>2.31</td>
<td>0.77</td>
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<tr>
<td>kW required</td>
<td>1.73</td>
<td>0.57</td>
</tr>
<tr>
<td>Total kWh</td>
<td>15120.26</td>
<td>5023.71</td>
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<tr>
<td>Annual electricity cost</td>
<td>$ 2.570.44</td>
<td>$ 854.03</td>
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An LPD Y Strainer saves
$1,716.41 per year

* Cv is the number of U.S. gallons/minute of 60 degF water that will flow through a strainer with 1 psi pressure drop across the strainer.
Why Flow Control Solutions?

• Minimizes Turbulence
• Minimized Friction Loss
• Improves Asset Life
  • Pump
  • Motor
  • Control Valves
  • Check Valves
  • Pressure Sensors
  • Flow Meters
• Pump & Devices Operate at Design
Why Flexible Connector Solutions?

• Minimizes Vibration
• Mitigates Thermal Expansion Issues
• Easier Connections In the Field
• Strain Relief
• Offers some seismic protection
SUCTION DIFFUSER

FLOW CONDITIONER

Removing Turbulence
Flow Conditioning
“Saving Energy & Assets”

**BEFORE**
- Turbulence from pump can damage valve and make balancing impossible.
- Suction diffuser causes significant pressure drop as it converts turbulent flow prior to entering pump.
- Rarely cleaned, screen is not designed for debris collection. When cleaned it requires complete system shutdown.
- Balancing valve manufacturer requires length of pipe equal to 5 to 10 pipe diameters from pump to valve.

**AFTER**
- "Y" strainer with large screen designed for debris collection.
- Significantly smoother flow. Flow enters valve with even less turbulence than using long length of pipe. Balancing is easier and more accurate.
- Suction Diffuser Flex isolates vibration and "turns" flow to create a smooth entry and exit from elbow.
- Vane Flex isolates vibration and smooths turbulent flow in a fraction of the space.
- Blow down permits in-service cleaning.
- Standard Long or Short Radius elbow.
BEFORE ELBOW FLOW CONDITIONING
REMOVING TURBULENCE

SUCTION DIFFUSER – 2” THRU 16”
Flow Conditioning

4.5% Flow Increase

7% HP Reduction

8.6% Discharge Head Increase
Flow Conditioning

Standard Suction Diffuser Flex Configurations

Long Radius Elbow

- Suction Diffuser Flex with 150# plate flanges for connecting to a long radius elbow
- Suction Diffuser Flex with 150# plate flange x groove end for connecting to a long radius elbow
- Suction Diffuser Flex with 150# plate flanges with concentric reducer for connecting to a long radius elbow
- Suction Diffuser Flex with 150# plate flange x groove end with concentric reducer for connecting to a long radius elbow

Short Radius Elbow

- Suction Diffuser Flex with 150# plate flanges for connecting to a short radius elbow
- Suction Diffuser Flex with 150# plate flange x groove end for connecting to a short radius elbow
- Suction Diffuser Flex with 150# plate flanges with long radius 90° elbow
- Suction Diffuser Flex with 150# plate flange x groove end with concentric reducer for connecting to a short radius elbow

90° Reducing Elbow

- Suction Diffuser Flex with 150# plate flange with 90° reducing elbow
- Suction Diffuser Flex with 150# plate flange x groove end with 90° reducing elbow
- Suction Diffuser Flex with 150# plate flange x groove end with concentric reducer for connecting to a short radius elbow
Flow Conditioning

10 pipe diameters

Vane Flex
Flow Conditioning

Standard Vane Flex Configurations

- Vane Flex with 150# plate flanges
- Vane Flex with 150# plate flange x grooved
- Vane Flex with 150# plate flanges with concentric reducer
- Vane Flex with 150# plate flange x grooved with concentric reducer
- Vane Flex with 150# plate flanges with 90° reducing elbow
- Vane Flex with 150# plate flange x groove with 90° elbow
- Vane Flex with 150# plate flange x groove with 90° reducing elbow
- Vane Flex with 150# plate flange with 90° elbow
Flow Conditioning
Rigid Configurations

2” thru 12”
Summary

• Design of Pump Station Impacts System Performance
• Minimization of Turbulence
• Minimization of Friction Loss
• Increased Design Flexibility
• Increased Reliability
• Improved Asset Life
• New Tools exist to address issues
• Economically Viable with Quick Paybacks