Intelligent Variable Speed Pumps with Cloud Based Active Performance Management
Armstrong Design Envelope Pumps are a complete solution for heating, cooling and plumbing systems. The integration of a perfectly matched pump, motor, intelligent variable speed controller and cloud based Active Performance Management creates the highest value pumping solution.

Whether driven by social, environmental or fiscal responsibility, forward-thinking organizations must embrace energy-saving technologies and practices.

Eliminate cost trade-offs
Through innovation, Armstrong’s Design Envelope offers the lowest installed cost and lowest life cost of any pumping solution on the market.
Demand-Based Operation

Design Envelope solutions reduce pumping costs through variable speed, demand-based operation — consuming only the energy required, based on current system demand.

Design Envelope Pumps use a combination of optimized impeller size and speed control for energy efficient operation within a given performance envelope. The performance envelopes are selected for the best pump efficiency where variable flow systems operate most often. This ensures a building’s pumping system consumes as little energy as possible. It also ensures that the installation meets or exceeds ASHRAE 90.1 guidelines requiring 70% energy savings at 50% of peak load.

Energy Savings

Armstrong Design Envelope variable speed technology fundamentally changes the operation of a pump within the larger HVAC system. The variable speed intelligence embedded in the Armstrong Design Envelope controller adjusts the pump operation to meet the immediate demand. The pump responds instantaneously and draws only the power required to meet that demand.
EVOLUTION OF PUMPING

**CONSTANT SPEED PUMP**
3-WAY VALVE

**VARIABLE SPEED PUMP**
WITH CONTROLS DISABLED (PUMP IN HAND)

- Constant speed operation
- Base case for pump energy usage
- Pump runs at design point, controlled by throttling

**AVERAGE 15% ENERGY SAVINGS**

**VARIABLE SPEED PUMP**
WALL-MOUNTED CONTROLLER/2-WAY VALVE

- Constant reduced speed
- Reduce motor speed in lieu of throttling flow

**UP TO 50% ENERGY SAVINGS**

**VARIABLE SPEED PUMP**
WALL-MOUNTED CONTROLLER/2-WAY VALVE

- Sensor in mechanical room
- Maintain constant design head
- No savings if sensor stops working

**UP TO 65% ENERGY SAVINGS**

**VARIABLE SPEED PUMP**
WALL-MOUNTED CONTROLLER/2-WAY VALVE

- Inefficient induction motor operation
- Pump selected to design point
- Sensor located at remote load
- Maintain pressure at remote zone
- No savings if sensor stops working

**UP TO 70% ENERGY SAVINGS**

**DESIGN ENVELOPE 3.1**

- Pump speed control through Sensorless technology
- Detailed mapping of performance curve
- Smaller motor selection on 25% of projects
- Integrated controller — higher motor efficiency
- Flow measurement accuracy of ±5%
- Optimized selection against load profile
SUPERIOR PERFORMANCE & ENERGY SAVINGS

40% SAVINGS WITH ACTIVE PERFORMANCE MANAGEMENT

ENERGY DRIFT OVER TIME

UP TO 80% ENERGY SAVINGS

DESIGN ENVELOPE GENERATION 5 (1-10 HP)

> Advanced digital controls
> Control tuned to specific motor
> DEPM motor: IE5 efficiency rating
> Advanced hydraulics

1-10 hp DEPM motor benefits:
> Higher efficiencies at full load and part loads for lower lifecycle costs
> Higher stable operating speeds for smaller pumps, lower installed costs
> Reduced noise and vibration for quiet and stable operation
> Reduced weight and size for easier, faster installation
> Less heat generated for longer equipment life

UP TO 90% ENERGY SAVINGS

DESIGN ENVELOPE GENERATION 5

> Multi-pump load sharing
> Best-efficiency staging (Parallel Sensorless Pump Control)
> Onboard diagnostics and trending
> Real-time performance management

ACTIVE PERFORMANCE MANAGEMENT SERVICES DELIVER:

Ongoing tracking, analysis and benchmarking of HVAC performance

Deeper insights into HVAC operation for informed decision-making

Data-driven optimization in response to system changes

Long-term mechanical system efficiency

Overall savings in HVAC energy and equipment maintenance costs
Using Sensorless technology, a Design Envelope Pump's performance data and operating curve are pre-programmed into the controller. During operation, the controller tracks the power draw and RPM of the pump and establishes the hydraulic performance and position of the pump's head-flow condition relative to the system requirements.

As the building's control valves open or close to regulate flow to the coils and maintain building occupant comfort, the Sensorless controller automatically adjusts the pump speed to match the required system pressure and flow.

Equipped with Sensorless technology, Design Envelope solutions do not require an external sensor to monitor and control the HVAC load.

In a chilled or heating water system, a building's temperature controls influence the local flow of control valves that modulate the flow to the coils (load). As the control valves open for more water flow, the differential pressure across the valve decreases.

The controller reacts to this change by increasing the pump speed. If the control valves close to reduce the water flow, the differential pressure across the valve increases and the controller reduces the pump speed.
Parallel Sensorless Pump Control (PSPC) is a patented technology that improves the efficiency of a multi-pump installation through optimized load sharing.

The traditional approach to control in a multi-pump installation involves staging pumps on the basis of motor speed. PSPC technology stages pumps based on operating efficiency rather than motor speed and improves the efficiency of the full pump array by up to 30% over traditional multi-pump installations.

HVAC loads and flow requirements change throughout the day. In the graph, the point where the dotted vertical line intersects the system efficiency curves represents the flow level at which one pump in the array should be staged on or off.

Staging pumps at any other point forces the pump array to operate at efficiency levels that are less than optimal. In a multi-pump installation, Parallel Sensorless Pump Control monitors pump speed and stages pumps at the correct flow levels to optimize efficiency.

*PSPC can control and stage up to 4 pumps*  
The Armstrong iPS 4000w is available to control more than 4 pumps.
Because HVAC pumping systems mostly operate at part load, a design using 2 or more smaller pumps is more efficient than one larger pump. In a 2-pump system, if one pump fails, the remaining pump can serve the system requirements with about 70% flow redundancy. The capacity split can be adjusted based on the building type and duty requirement.

<table>
<thead>
<tr>
<th>CAPACITY SPLIT</th>
<th>FLOW REDUNDANCY</th>
<th>DUTY REQUIREMENT</th>
<th>TYPICAL APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 × 50%</td>
<td>![Flow Diagram]</td>
<td>70%</td>
<td>GENERIC DUTY</td>
</tr>
<tr>
<td></td>
<td>50%</td>
<td></td>
<td>SCHOOLS, APARTMENTS,</td>
</tr>
<tr>
<td></td>
<td>50%</td>
<td></td>
<td>CONDOS</td>
</tr>
<tr>
<td>2 × 70%</td>
<td>![Flow Diagram]</td>
<td>85%</td>
<td>HIGH SENSIVITY</td>
</tr>
<tr>
<td></td>
<td>70%</td>
<td></td>
<td>HOTELS, OFFICES, OUT</td>
</tr>
<tr>
<td></td>
<td>70%</td>
<td></td>
<td>PATIENT CLINICS</td>
</tr>
<tr>
<td>2 × 100%</td>
<td>![Flow Diagram]</td>
<td>100%</td>
<td>MISSION CRITICAL</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td></td>
<td>BLOOD BANKS,</td>
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<td></td>
<td></td>
<td></td>
<td>HOSPITALS, DATA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CENTERS</td>
</tr>
</tbody>
</table>
Design Envelope Pumps monitor flow so accurately they function as a flow meter. Industry standards recommend balancing system flows to ±10% accuracy. Design Envelope Pumps ≥ 2 hp (1.5 kw) deliver accuracy of ±5%.

- **Highly accurate and reliable** - no issues with fouling, so no need to service or re-calibrate
- **Low installation cost** - easy installation for retrofits
- **Integral to pump** - no additional space or wiring required
- **Energy savings** - accurate flow data informs optimization of an entire HVAC system

For evaluating an HVAC system, just two flow values and four temperature points provide all the data needed to understand flow rates, heat loads and operating efficiency.
Active Performance Management is a systems management approach that optimizes HVAC systems at any stage of a building’s life-cycle by continually learning from a broad network of installations and responding to changing HVAC requirements. The combination of smart commissioning with real-time alerts and system transparency addresses performance drift and maintains occupant comfort.

With Active Performance Management at the plant level, you can save up to 40% annual operating cost.
Pump Manager is a cloud-based subscription service that tracks pump performance and provides early diagnostic warnings, trends, analysis and automated reports. With Pump Manager, customers can make informed decisions based on real-time data and take action as needed.

Through connections to existing BAS, CMMS and EMS systems, Pump Manager enables Active Performance Management, leveraging deep analytics to provide greater predictive accuracy and even greater HVAC efficiency.

**Performance Packages**

- **Sensorless Bundle** (standard)
  - Sensorless control
  - Flow meter
  - Constant flow
  - Constant pressure

- **Parallel Sensorless** (standard on Tango and dualArm)
  - Parallel Sensorless control

- **Energy Performance Bundle**
  - Auto-flow balancing
  - Maximum flow control

**Functions Included**

- Minimum flow control
- Bypass valve control
- Pre-set heating and cooling parameters for two-pipe systems

**Design Envelope Pump Control Functions**
# Choose Your Configuration

**Installation Cost Comparison**

<table>
<thead>
<tr>
<th></th>
<th>2 End-Suction pumps with drives on wall &amp; remote pressure sensor 100% duty/standby</th>
<th>1 Tango pump with sensorless and parallel sensorless control 2 × 50% capacity split, parallel operation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total pump weight</strong></td>
<td>682 lbs</td>
<td>91 lbs (87% savings)</td>
</tr>
<tr>
<td><strong>Installation weight</strong></td>
<td>2,221 lbs</td>
<td>521 lbs (76% savings)</td>
</tr>
<tr>
<td><strong>Installation footprint</strong></td>
<td>26.6 sf</td>
<td>5.8 sf (78% savings)</td>
</tr>
<tr>
<td><strong>Installation cost</strong></td>
<td>$9,004</td>
<td>$1,829 (80% savings)</td>
</tr>
</tbody>
</table>

- Legacy design
- Base case for comparison
- Time intensive seal change

- Managed redundancy and parallel operation replaces duty/standby
- Smaller units are easier to handle
- Two rotating devices sharing one casing
- Reporting and proactive management
- Optimized lifetime performance

* Eliminates the need for: housekeeping pads, inertia base, flex connections, grouting and alignment
* Reduced installation labor costs
* Smaller mechanical room footprint (50–75%)

* Eliminates the need for: inertia base and alignment
* Reduced installation labor costs
* Smaller mechanical room footprint (30–50%)
Complete integrated solutions offer the lowest installed cost and add value in lifetime energy and maintenance savings

### DESIGN ENVELOPE CONFIGURATION OPTIONS

<table>
<thead>
<tr>
<th>2 × Design Envelope Vertical in-lines with sensorless control 100% duty/standby*</th>
<th>2 × Design Envelope End-Suction with sensorless control 100% duty/standby*</th>
</tr>
</thead>
<tbody>
<tr>
<td>216 lbs (68% savings)</td>
<td>198 lbs (71% savings)</td>
</tr>
<tr>
<td>748 lbs (66% savings)</td>
<td>961 lbs (57% savings)</td>
</tr>
<tr>
<td>12.3 sf (54% savings)</td>
<td>18.1 sf (32% savings)</td>
</tr>
<tr>
<td>$ 4,163 (54% savings)</td>
<td>$ 4,906 (46% savings)</td>
</tr>
</tbody>
</table>

**Eliminates the need for:**
- Housekeeping pads, inertia base, flex connections, grouting and alignment
  - Reduced installation labor costs
  - Smaller mechanical room footprint (50–75%)

**Eliminates the need for:**
- Inertia base and alignment
  - Reduced installation labor costs
  - Smaller mechanical room footprint (30–50%)

* Could also be sized 2×50% parallel
UNMATCHED ENERGY EFFICIENCY

Advanced hydraulic design supports industry-leading flow efficiency

Built-in Parallel Sensorless pump control saves up to 30% more energy

Armstrong DEPM motor technology delivers an additional 6-20% efficiency, meeting IE5 efficiency standards

Control algorithm constantly reviews operating conditions and adjusts output to meet immediate flow requirements at minimum energy consumption

ALWAYS AVAILABLE

Most building HVAC systems operate at the design point (100% load) less than 1% of the time. Traditional system design applies 100% redundancy and duplication of components to ensure that the design point can always be met. This creates huge over capacity and higher costs.

The traditional duty/standby approach to redundancy in HVAC systems inflates the installed costs for equipment and labor, and adds to the carbon footprint of the building. Tango's dual-pumping configuration modernizes the approach to redundancy. Pumps and motors are selected from a range of sizes to achieve a level of redundancy that matches the requirements of the application.

With the proper approach to redundancy, HVAC requirements can be met for all but the most extreme days of the year; and for those few days, variation in temperature will be minimal.

For pumps larger than 10 hp use dualArms for lowest installed cost, lowest lifecycle operating cost achieved with Parallel Sensorless, and increased serviceability with built-in isolation valves.
**BENEFITS**

**Easy maintenance**
Less than 30 minutes to replace the mechanical seal. No need for realignment.

**Mechanical room space savings**
Pumps require minimal floor space or can be installed overhead.

**Reduced vibration**
Dynamically balanced impeller and shaft assembly operates with minimum vibration.

**Lowest installed cost**
Component, material and labor savings - fewer fittings and no housekeeping pad required.

**Reliable operation**
Vertical in-line design requires less maintenance, at a lower cost, than any other pump configuration.

**15 minute seal change: saves up to $700**

For a 10 hp/7.5 kw pump, save an additional $2,000 with pipe mounting and no inertia base.
HVAC pumping systems are expected to operate smoothly and quietly while delivering comfort heating and cooling.

Although it’s practical to mount pumps on the floor, this practice can also transmit noise or vibration to the rest of the building. Mechanical vibrations are most apparent close to the source, but can also be transmitted through the structure of a building, sometimes resurfacing hundreds of feet away.

Concrete and inertia bases have traditionally been used to mitigate vibration, but this adds excess weight and cost to the installation.

Advances traditional design

- Lowest possible installed costs and operating cost
- More added value than any other horizontal pump

No inertia base

EQUIPMENT AND MATERIAL SAVINGS

- No inertia base required
- Rigid pump design needs no steel baseplate
- No differential pressure sensors required
- Reduced use of concrete for lowest carbon footprint
- Split coupled option ensures quick seal changes

up to $2,000 in savings without the inertia base
Integral vibration isolation eliminates the need for inertia bases or baseplates.

The following features minimize the transmission of vibration:

- Balance rotor design
- Soft start controls
- Direct coupling to motor
- Reduced overall weight

**ASHRAE Handbook recommends the use of inertia bases even for pump installations on grade**

The vibration isolators are standard and pre-sized for the pumping unit.

The springs and flex connectors act to dampen vibration.

With flex connectors separating the pump from the piping, and vibration isolators between the pump and the ground, the pump floats in an isolated spring system.

Inertia base, concrete and curing time not required.

In pumps over 10 hp the integrated design with baseplate has a lower installed cost than a traditional pump with a wall-mounted drive.
## DESIGN ENVELOPE PUMP RANGE

Available for 200-230 V, 380-480 V and 575 V

### Indoor vs. Outdoor

<table>
<thead>
<tr>
<th>Indoor</th>
<th>Outdoor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.33–10 hp</td>
<td>1–10 hp</td>
</tr>
<tr>
<td>15–100 hp</td>
<td>1–100 hp</td>
</tr>
<tr>
<td>15–40 hp</td>
<td>1–40 hp</td>
</tr>
<tr>
<td>0.33–450 hp</td>
<td>1–125 hp</td>
</tr>
<tr>
<td>1–10 hp with integrated vibration isolators</td>
<td>N/A</td>
</tr>
<tr>
<td>15–125 hp</td>
<td>N/A</td>
</tr>
<tr>
<td>1–10 hp with integrated vibration isolators</td>
<td>N/A</td>
</tr>
</tbody>
</table>

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**Indoor models available**

**Express models available**

**Stainless steel**

1–10 hp

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**Available for** 200-230 V, 380-480 V and 575 V

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*Single phase available to 7½ hp / 5½ kW*

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### Design Envelope Pump Range

- **4322/4372 Split and close-coupled Tango**
- **4302 Split-coupled dualArm**
- **4312 Split-coupled Twin**
- **4300 Split-coupled vertical in-line**
- **4380 Close-coupled vertical in-line**
- **4200H Split-coupled end-suction**
- **4280 Close-coupled end-suction**

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**SELECT & CONFIGURE**

Use ADEPT Select to quickly and easily select Armstrong products that are right for your projects. Visit adept.armstrongfluidtechnology.com to learn more.
Through our Planet Proposition charter, Armstrong has committed to minimizing our impact on the environment. Around the world, Armstrong’s Planet Proposition teams have taken on projects that are helping us meet our targets. Two examples of ongoing projects are:

2 BY 22

Armstrong is committed to helping existing customers reduce GHG emissions of installed equipment by 2 million tons by the year 2022. Under this initiative, Armstrong works with customers to upgrade existing installations and continues to develop new energy-savings solutions.

NET ZERO CARBON BUILDINGS COMMITMENT

The Net Zero Commitment positions energy efficiency as a central component to achieving decarbonization globally. In signing the Net Zero Carbon Buildings Commitment, Armstrong has pledged to ensure our entire portfolio of buildings operates at net zero carbon by the year 2030.
0.33 hp

Up to 1250 hp available

SELECT & CONFIGURE
Use ADEPT Select to quickly and easily select Armstrong products that are right for your projects. Visit adept.armstrongfluidtechnology.com to learn more