



## DESIGN ENVELOPE

Intelligent Variable Speed Pumps with Cloud Based Active Performance Management

### SOLUTION OUTLINE

FILE NO: 100.111IN  
DATE: APRIL 2020

SUPERSEDES: 100.111IN  
DATE: MARCH 2020

# DESIGN ENVELOPE

OPTIMUM  
PERFORMANCE  
ANY GIVEN TIME



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 organisations must embrace energy-saving technologies and practices.

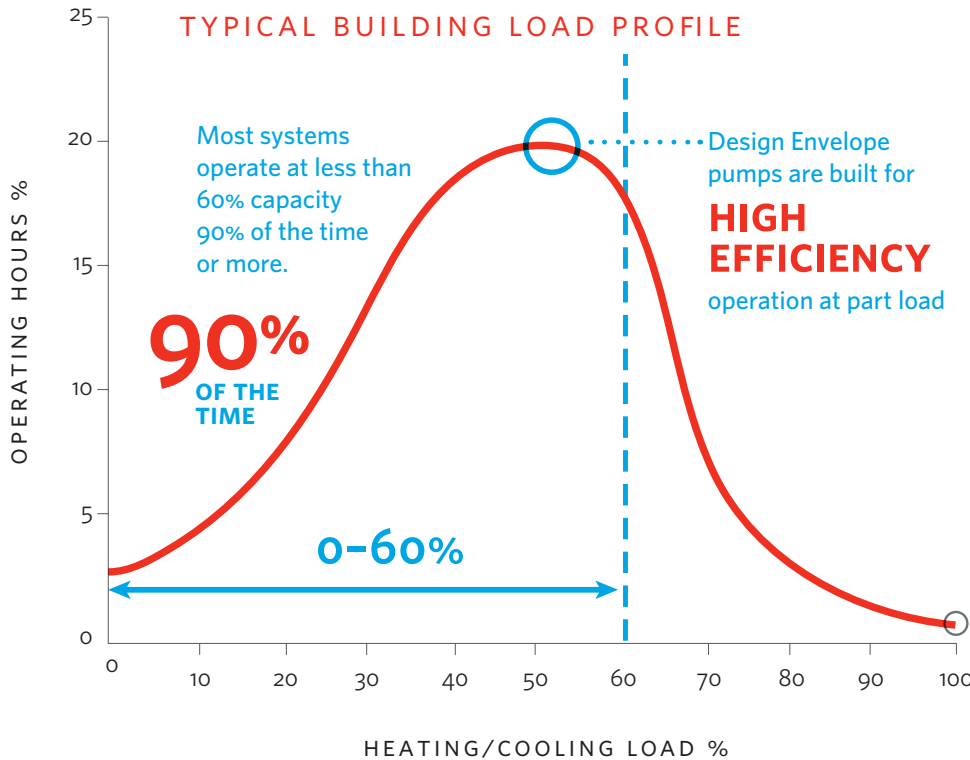
## Eliminate cost trade-offs

Through innovation, Armstrong's Design Envelope offers the lowest installed cost and lowest life cost of any pumping solution on the market.

# MAXIMUM ENERGY AND COST SAVINGS

UP TO  
**65%**

INSTALLED COST SAVINGS



UP TO  
**80%**  
ENERGY SAVINGS

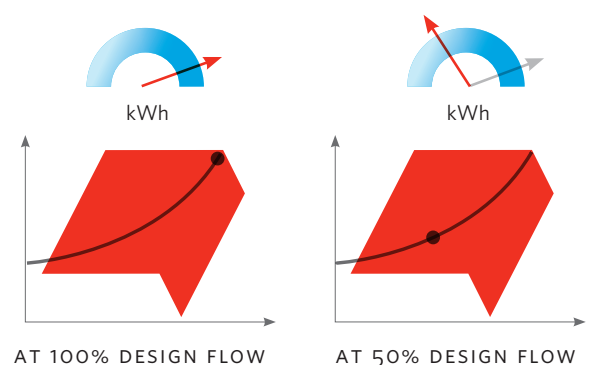
## Demand-Based Operation

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 optimised 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

- > 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  $\pm 5\%$
- > Optimised selection against load profile



# SUPERIOR PERFORMANCE

& ENERGY SAVINGS



UP TO  
**80%**  
ENERGY  
SAVINGS

DESIGN ENVELOPE  
GENERATION 5  
(0.75-7.5 kW)

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

**0.75 - 7.5 kW 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



**40%**  
SAVINGS  
WITH ACTIVE  
PERFORMANCE  
MANAGEMENT

ENERGY DRIFT OVER TIME

**ACTIVE PERFORMANCE  
MANAGEMENT SERVICES DELIVER:**

Ongoing tracking, analysis and benchmarking of HVAC performance

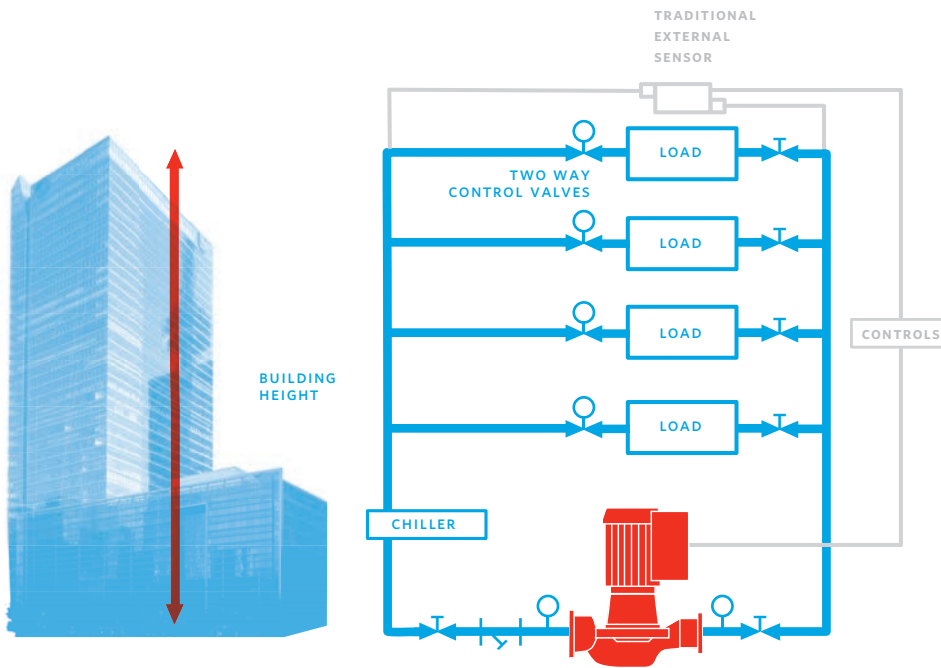
Deeper insights into HVAC operation for informed decision-making

Data-driven optimisation in response to system changes

Long-term mechanical system efficiency

Overall savings in HVAC energy and equipment maintenance costs

# SENSORLESS TECHNOLOGY



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.

## ACCURATELY TRACK POWER & SPEED

## CONTROL HEAD AND FLOW

TRACKING POWER & SPEED

PROGRAM MAP

CONTROLLING HEAD & FLOW

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.

# PARALLEL

# SENSORLESS



Parallel Sensorless Pump Control\* (PSPC) is a patented technology that improves the efficiency of a multi-pump installation through optimised load sharing.

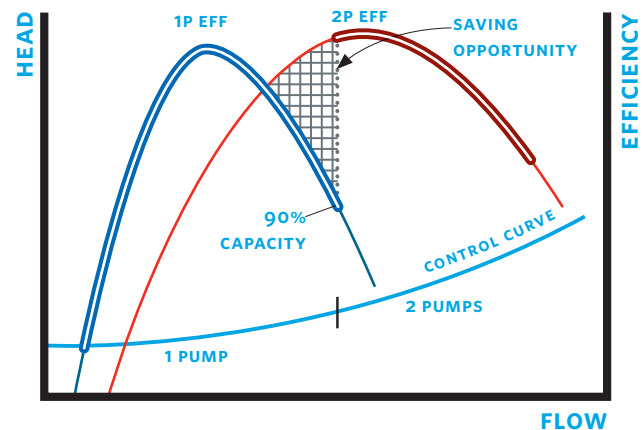
The traditional approach to control in a multi-pump installation involves staging pumps on the basis of motor speed. PSPC technology stages pumps based on operating efficiency rather than motor speed and improves the efficiency of the full pump array by up to 30% over traditional multi-pump installations.

**SAVE UP TO  
30% ON  
OPERATING  
COSTS**

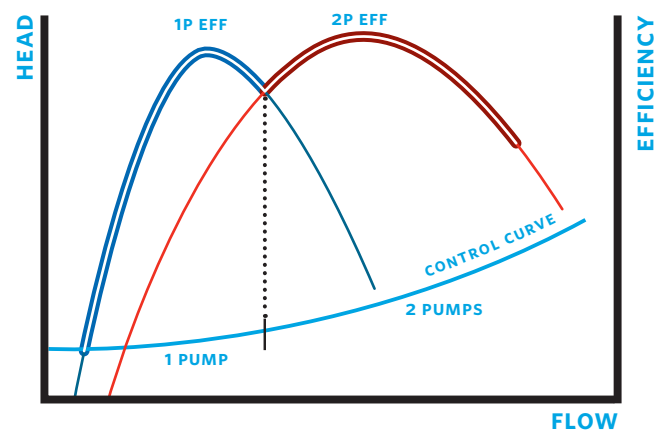
HVAC loads and flow requirements change throughout the day. In the graph, the point where the dotted vertical line intersects the system efficiency curves represents the flow level at which one pump in the array should be staged on or off.

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 optimise efficiency.

## TRADITIONAL SPEED-BASED STAGING



## PARALLEL SENSORLESS PUMP CONTROL BEST EFFICIENCY STAGING

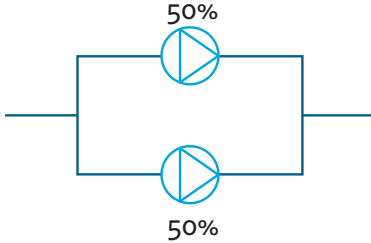
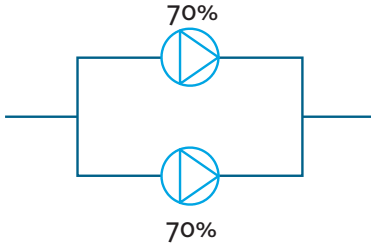
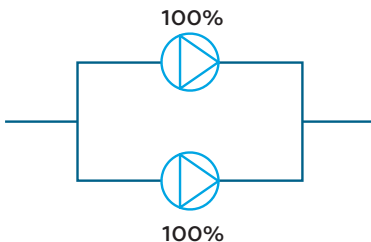


\*PSPC CAN CONTROL AND STAGE UP TO 4 PUMPS  
The Armstrong IPS 4000w is available to control more than 4 pumps.

# REDUNDANCY AND SAVINGS WITH PARALLEL PUMPING

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.

CAPACITY SPLIT	FLOW REDUNDANCY	DUTY REQUIREMENT	TYPICAL APPLICATIONS
2 × 50%	 <p>70% Flow Redundancy</p>	GENERIC DUTY	SCHOOLS, APARTMENTS
2 × 70%	 <p>85% Flow Redundancy</p>	HIGH SENSITIVITY	HOTELS, OFFICES, HEALTH CENTRES
2 × 100%	 <p>100% Flow Redundancy</p>	MISSION CRITICAL	HOSPITALS, DATA CENTRES

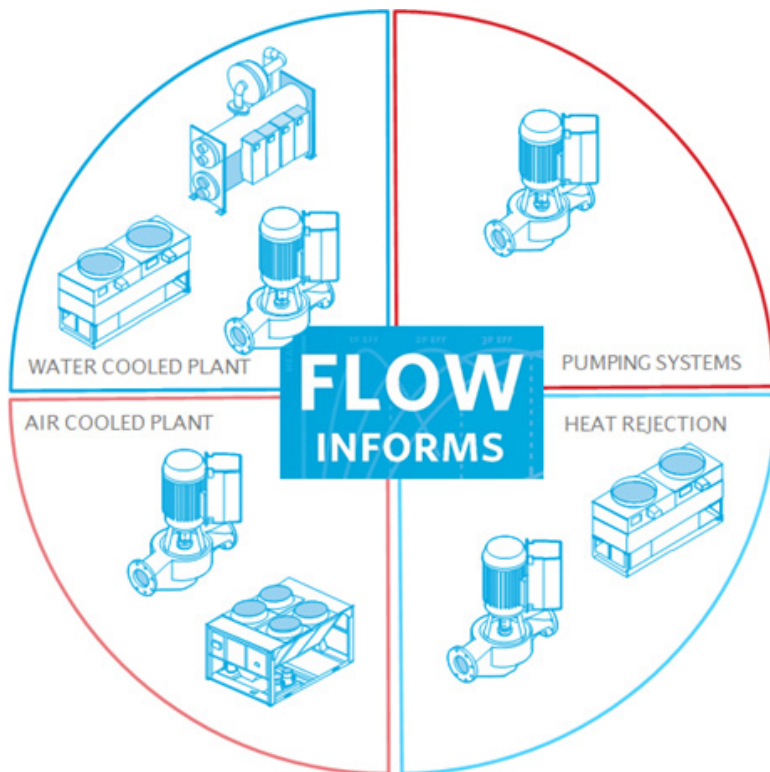


# FLOW INFORMS

Design Envelope Pumps monitor flow so accurately they function as a flow metre. Industry standards recommend balancing system flows to  $\pm 10\%$  accuracy. Design Envelope Pumps  $\geq 1.5$  kW deliver accuracy of  $\pm 5\%$ .

- **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 optimisation 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.



**+/- 5% FLOW MEASUREMENT ACCURACY**

The interface features a vertical sidebar on the left with icons for user profile, pump status, trends, settings, information, and notifications. The main display area shows the following data:

ARMSTRONG	
Flow	550 GPM
Head	100 FT
Speed	1778 RPM
Power	13.05 kW
Voltage	575 V
Current	13 A

Below the data is a blue button with a circular refresh icon and the text 'Auto'. At the bottom, it displays 'Pump Tag: CHW P12'.



OPTIMISED EFFICIENCY  
AND PERFORMANCE

# ACTIVE PERFORMANCE MANAGEMENT™

LEARNS

PREDICTS

OPTIMISES

With Active Performance  
Management at the plant  
level, you can save up to

**40%**

annual operating cost

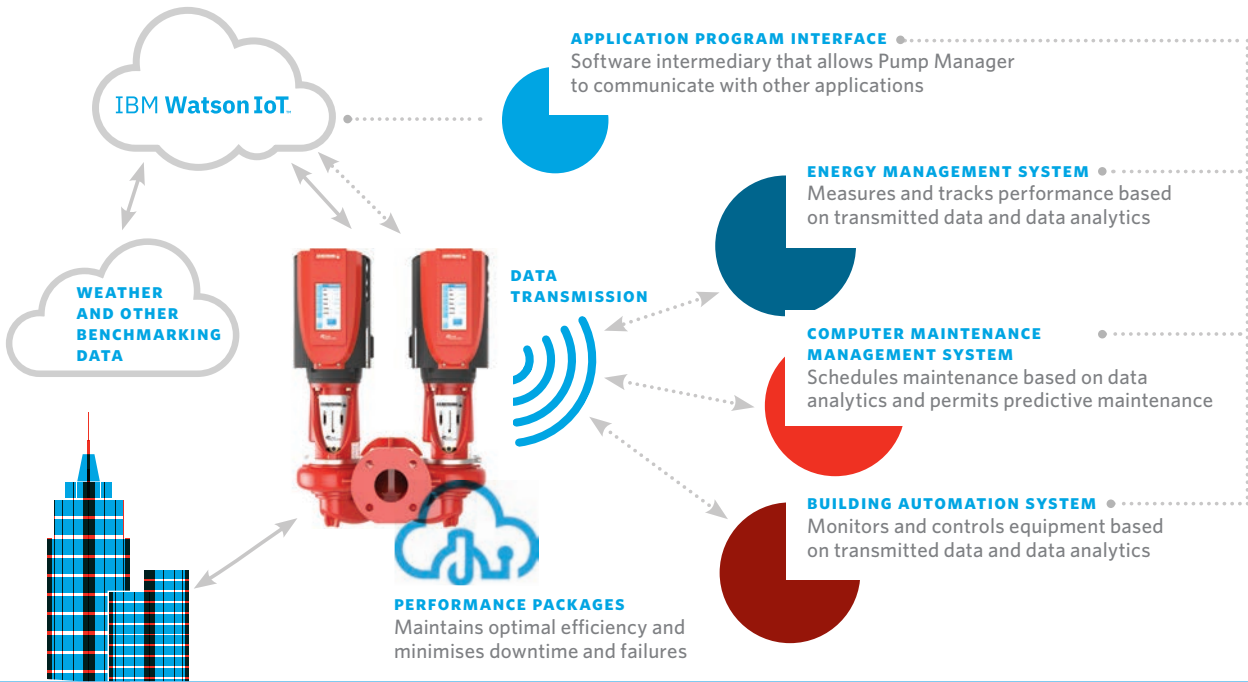
Active Performance Management is a systems management approach that optimises HVAC systems at any stage of a building's life-cycle by continually learning from a broad network of installations and responding to changing HVAC requirements. The combination of smart commissioning with real-time alerts and system transparency addresses performance drift and maintains occupant comfort.



# PUMP MANAGER

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.



## DESIGN ENVELOPE PUMP CONTROL FUNCTIONS

### PERFORMANCE PACKAGES



**Sensorless Bundle (standard)**

### FUNCTIONS INCLUDED

- Sensorless control
- Flow metre
- Constant flow
- Constant pressure



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

- Parallel Sensorless control



**Energy Performance Bundle**

- Auto-flow balancing
- Maximum flow control

### PERFORMANCE PACKAGES



**Protection Bundle**

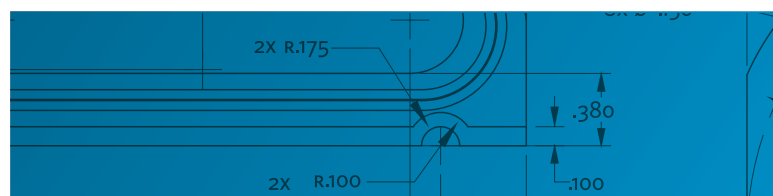
### FUNCTIONS INCLUDED

- Minimum flow control
- Bypass valve control



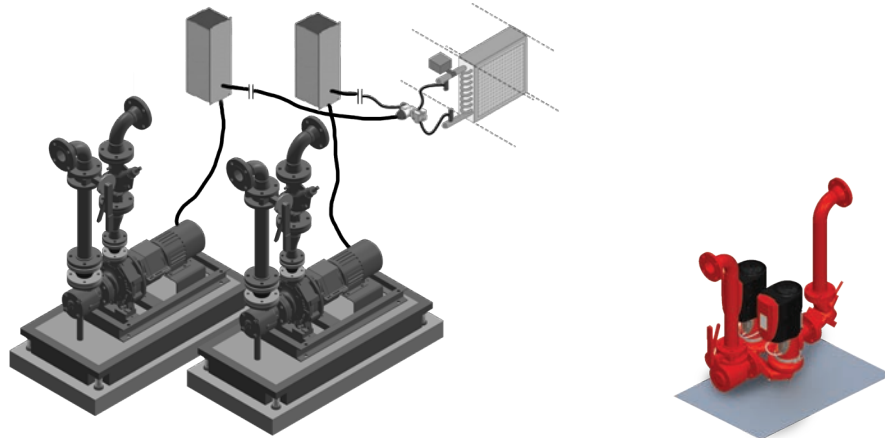
**Dual-season setup**





- Pre-set heating and cooling parameters for two-pipe systems



# CHOOSE YOUR CONFIGURATION

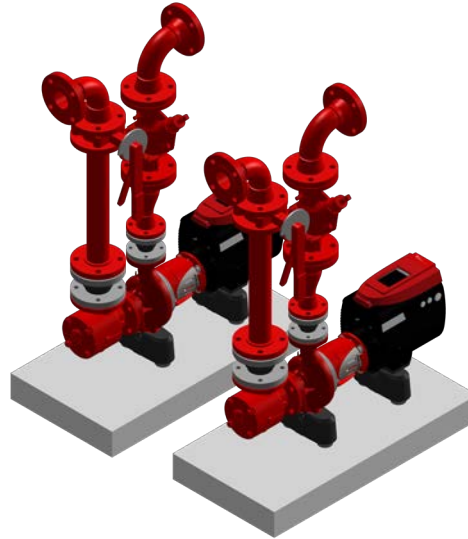
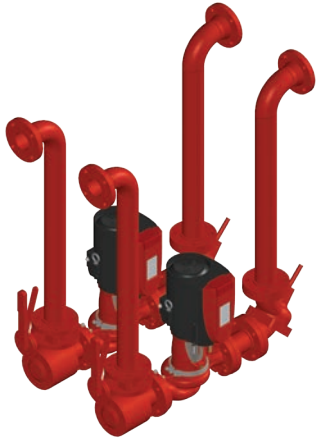
## INSTALLATION COST COMPARISON



	2 End-Suction pumps with drives on wall & remote pressure sensor 100% duty/standby	1 Tango pump with sensorless and parallel sensorless control 2 × 50% capacity split, parallel operation
 <b>Total pump weight</b>	309.3 kg	41.3 kg (87% savings)
 <b>Installation weight</b>	1007.4 kg	236.3 kg (76% savings)
 <b>Installation footprint</b>	2.47 sm	0.54 sm (78% savings)
 <b>Installation cost</b>	₹ 4,82,800	₹ 98,000 (80% savings)
	<ul style="list-style-type: none"> <li>▪ Legacy design</li> <li>▪ Base case for comparison</li> <li>▪ Time intensive seal change</li> </ul>	<ul style="list-style-type: none"> <li>▪ Managed redundancy and parallel operation replaces duty/standby</li> <li>▪ Smaller units are easier to handle</li> <li>▪ Two rotating devices sharing one casing</li> <li>▪ Reporting and proactive management</li> <li>▪ Optimised lifetime performance</li> </ul>

Complete integrated solutions offer the lowest installed cost and add value in lifetime energy and maintenance savings

## DESIGN ENVELOPE CONFIGURATION OPTIONS



2 × Design Envelope Vertical in-lines with sensorless control 100% duty/standby\*

2 × Design Envelope End-Suction with sensorless control 100% duty/standby\*

98.0 kg (68% savings)

89.8 kg (71% savings)

339.3 kg (66% savings)

435.9 kg (57% savings)

1.14 sm (54% savings)

1.68 sm (32% savings)

₹ 2,23,204 (54% savings)

₹ 2,63,086 (46% savings)

**Eliminates the need for:** housekeeping pads, inertia base, flex connections, grouting and alignment

- Reduced installation labour costs
- Smaller mechanical room footprint (50-75%)

**Eliminates the need for:** inertia base and alignment

- Reduced installation labour costs
- Smaller mechanical room footprint (30-50%)

\* Could also be sized 2×50% parallel



# TANGO

DESIGN  
ENVELOPE

## 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 labour, and adds to the carbon footprint of the building. Tango's dual-pumping configuration modernises 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 7.5 kW use dualArms for lowest installed cost, lowest lifecycle operating cost achieved with Parallel Sensorless, and increased serviceability with built-in isolation valves

# VERTICAL IN-LINE

## 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

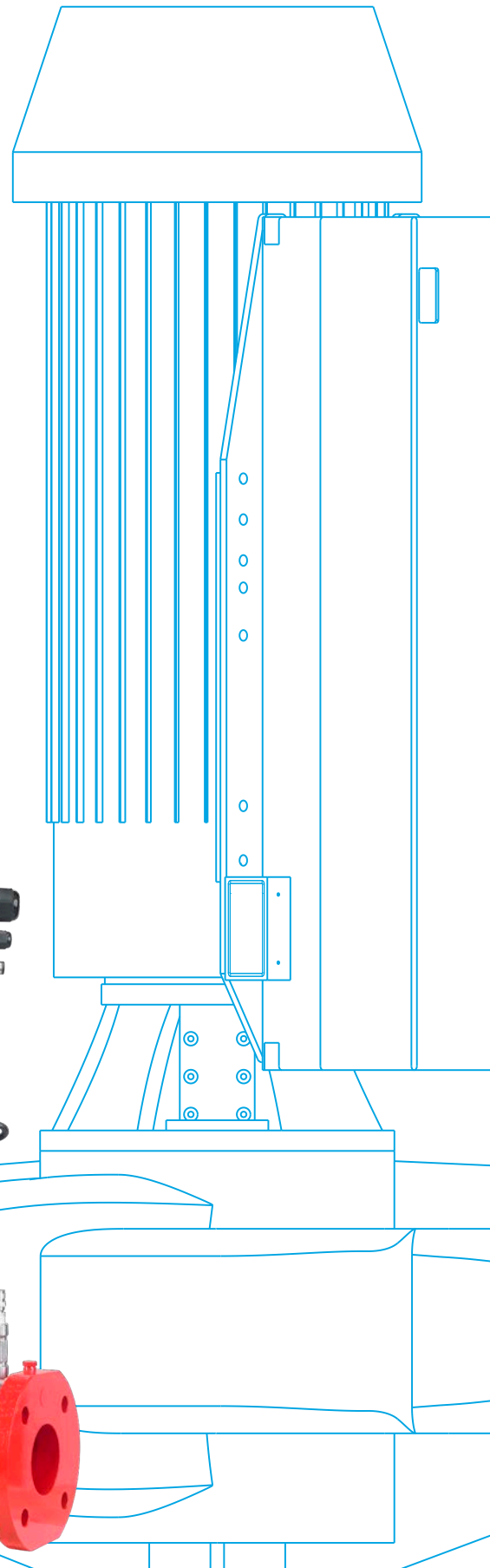
Component, material and labour savings - fewer fittings and no housekeeping pad required.

### 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 ₹ 25,000

For a 7.5 kw pump, save an additional ₹ 50,000 with pipe mounting and no inertia base



**DESIGN  
ENVELOPE**

# END-SUCTION

**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.



up to ₹ 50,000 in savings without the inertia base

**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**

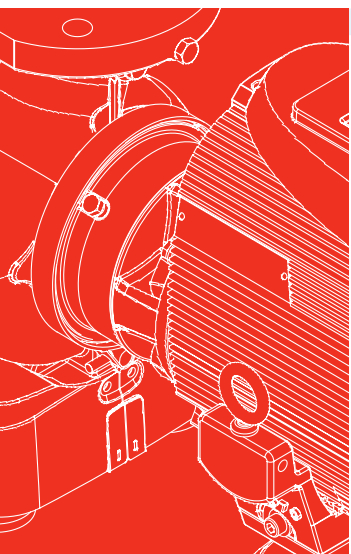
**No inertia base required**

**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**



Integral vibration isolation eliminates the need for inertia bases or baseplates.

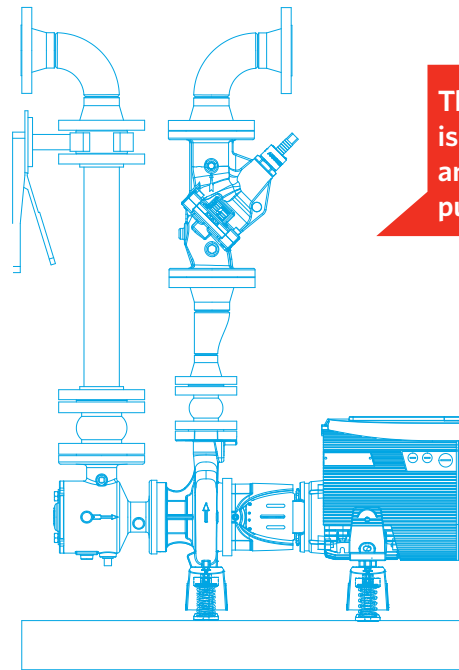
The following features minimise the transmission of vibration:

**Balance rotor design**

**Soft start controls**

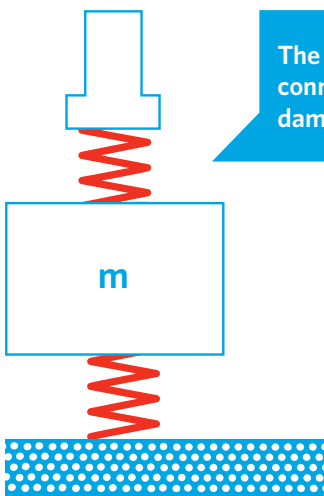
**Direct coupling to motor**

**Reduced overall weight**



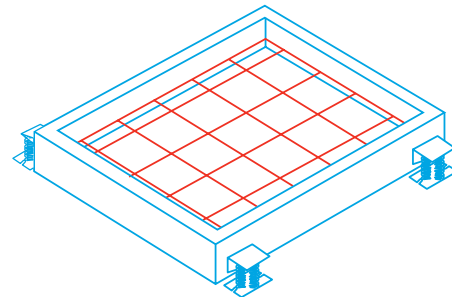
The vibration isolators are standard and pre-sized for the pumping unit

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



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



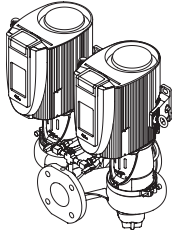

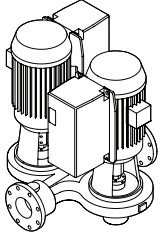
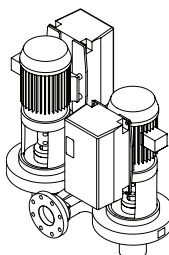
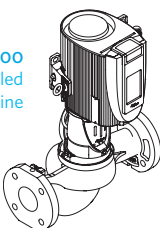

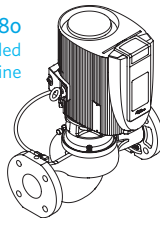

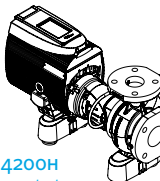
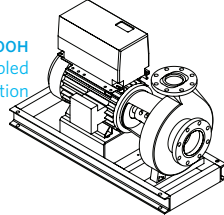

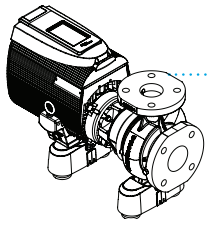

✓ Inertia base, concrete and curing time not required



In pumps over 7.5 kW 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

 <p>4322/4372 Split and close-coupled Tango</p>	INDOOR	0.25-7.5 kW	OUTDOOR	0.75-7.5 kW
	Express models available 			
 <p>4302 Split-coupled dualArm</p>	INDOOR	0.55-37 kW	OUTDOOR	0.55-37 kW
 <p>4312 Split-coupled Twin</p>	INDOOR	0.55-22 kW	OUTDOOR	0.55-22 kW
 <p>4300 Split-coupled vertical in-line</p>	INDOOR	0.25-250 kW	OUTDOOR	0.55-90 kW
	Standalone 315 kW - 1000 kW			
Express models available 				
 <p>4380 Close-coupled vertical in-line</p>	INDOOR	0.25-7.5 kW	OUTDOOR	0.75-7.5 kW
	Express models available 			
 <p>4200H Split-coupled end-suction</p>	INDOOR	0.75-7.5 kW with integrated vibration isolators	OUTDOOR	N/A
 <p>4200H Split-coupled end-suction</p>	INDOOR	11-90 kW	OUTDOOR	N/A
	Express models available 			
 <p>4280 Close-coupled end-suction</p>	INDOOR	0.55-5.5 kW with integrated vibration isolators	OUTDOOR	N/A
	Express models available 			

\* Single phase available to 5.5 kW



## SELECT & CONFIGURE

Use ADEPT Select to quickly and easily select Armstrong products that are right for your projects. Visit [adept.armstrongfluidtechnology.com](http://adept.armstrongfluidtechnology.com) to learn more



# OUR SERVICE TO THE PLANET



## PLANET PROPOSITION

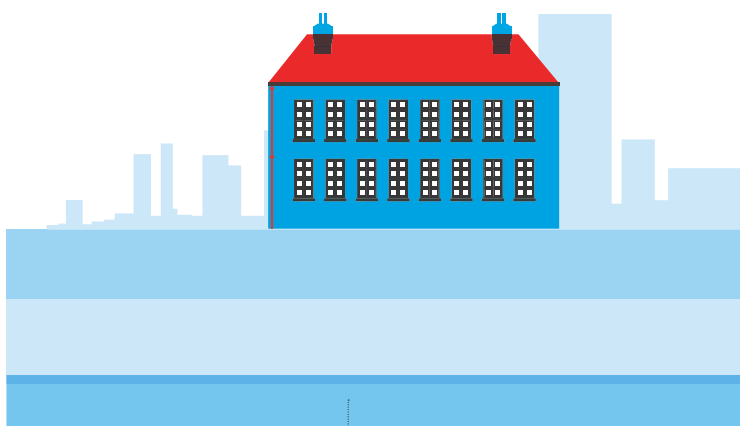
**T**hrough our Planet Proposition charter, Armstrong has committed to minimising our impact on the environment. Around the world, Armstrong's Planet Proposition teams have taken on projects that are helping us meet our targets. Two examples of ongoing projects are:

### 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 decarbonisation 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.



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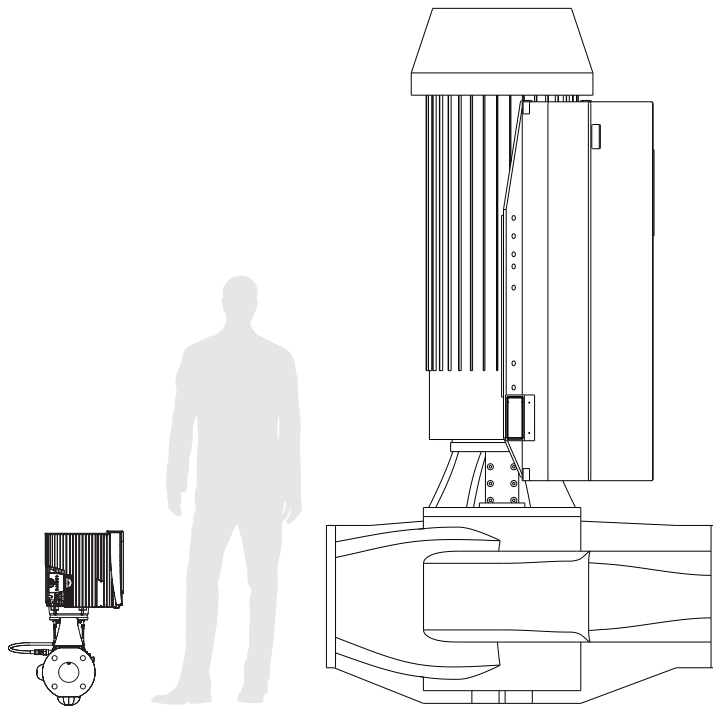
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**ARMSTRONG FLUID TECHNOLOGY**  
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**0.25 kW**

**Up to 932 kW available**



**SELECT & CONFIGURE**

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