



# ProcessPlugins Pump Condition Monitor



Partner Organizations:



Process  
Innovations  
Inc.



## PROCESS PLUGINS™ PUMP CONDITION MONITOR

The Pump Performance module monitors and presents a real time graphic display of your pump's key performance indicators. Pump head and efficiency are calculated and plotted against expected curves. Reference curves are scalable, dynamic, and adjust with pump speed as appropriate. Real time calculations include:

- Pump drive power consumption in kilowatts (kW) and horsepower (hp).
- Design efficiency corrected to actual pump speed, with a dynamic curve displayed graphically as function of flow.
- Design head corrected to actual pump speed, with a dynamic curve displayed graphically as function of flow.
- Actual efficiency plotted as function of flow.
- Actual head plotted as function of flow.
- Volumetric flow rate.
- Suction head, net positive suction head (NPSH), and total head.

Reference curves (see illustration below) are not static images, but are continually rendered real-time within the same object that renders the actual plot. This feature, which is unique to the Process Plugins™ solution, provides the following advantages:

1. Dynamic curves represent the expected performance at real time pump speed.
2. Since curves are not a background image, the curves and plots (dots) belong to the same object ensuring extremely high accuracy.
3. Real time actual values do not need to be corrected to test RPM since they are not plotted merely against static test curves.

The Process Plugins™ solution has the capability of monitoring an unlimited number of pumps, which could be added by the end user at any time in the future. All calculations are in accordance with ASME PTC 8.2 and utilize properties of water and steam calculated in accordance with the ASME 1997 formulations.

Using the "AF Relative" feature, one master display file may be used for an unlimited number of pumps. Corporate level summary "drill down" screens make navigation easy via PI Process Book, or Internet Explorer using PI Web Parts.

### - FW PUMP 1A

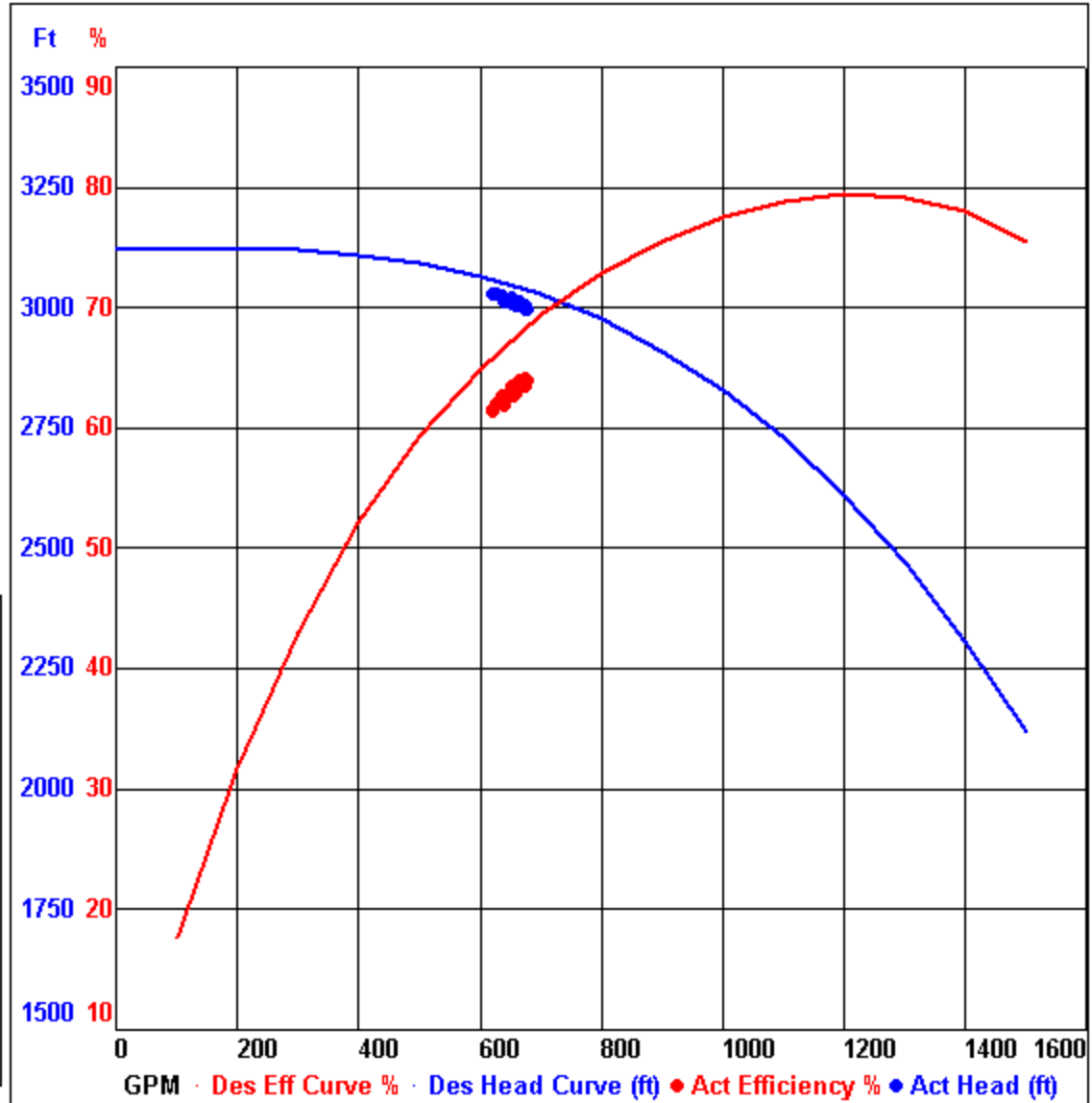
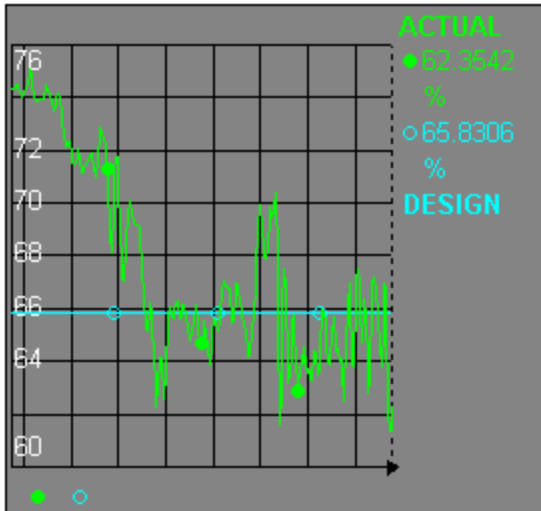
**FIELD INPUTS:**

Temperature: 248.0 °F  
 Suction Press: 14.1 PSIG  
 Discharge Press: 1,291.2 PSIG  
 Mass Flow: 296.8 KPPH

**CALCULATED RESULTS:**

Pump Flow: 628.5 GPM  
 Motor Power: 602.4 kW  
 Fluid Power: 338.1 kW  
 Suction Head: 134.5 ft 55.0 psi  
 NPSH: 124.1 ft 50.7 psi  
 Discharge Head: 3,158.6 ft 1,291.5 psi

	ACTUAL	DESIGN
Total Head:	3,024.0 ft	3,059.6 ft
	1,236.5 psi	1,251.0 psi
Efficiency:	62.4 %	65.8 %



## MORE ABOUT PROCESS PLUGINS™

OSIsoft's PI System continues to be the industry standard in data historians, which has been the core of its 21<sup>st</sup> century real-time infrastructure platform. And now this platform comes fully loaded with every feature necessary to support all of your needs for monitoring, modeling, diagnostics, or forecasting without the need for any 3<sup>rd</sup> party software. That's where the Process Plugins™ package comes in.

Process Plugins™ is not 3<sup>rd</sup> party software. The Process Plugins™ package customizes your OSIsoft platform for your plant. This is the only existing solution if you want:

1. No unnecessarily redundant PI tags
2. No 3<sup>rd</sup> party software
3. One Microsoft certified package with seamless integration of calculations and models
4. Web browser interface capability
5. Ability to drill down into calculations to see (or edit) exactly what they're doing

## PI Analysis Framework (PI-AF)

The screenshot displays the PPI - PI System Explorer interface. The main window shows the 'Suction' element selected, with its attributes listed in a table. The 'Head' attribute is highlighted, and its configuration details are shown on the right. The configuration includes a name, description, configuration item, categories, UOM, value type, value, and data reference. A formula is also visible at the bottom of the configuration pane.

Name	Value
Area	0.7853982 ft2
Head	7.85393 ft
InnerDiameter	12 in
MassFlow	649.7575 kpph
NPSH	-172.0822 ft
PressureAbs	17.66299 psi
PressureGage	2.995549 psi
Temperature	316.741 °F
Velocity	4.048453 ft/s
VolumeFlow	1427.125 GPM

Configuration for 'Head':

- Name: Head
- Description:
- Configuration Item:
- Categories:
- UOM: ft
- Value Type: Single
- Value: 7.85393 ft
- Data Reference: Formula

Formula: A=PressureGage;B=Velocity;C=\PPIStmEng\_VTL OutputV;UOM=ft3/lbm;[144°C\*A + ((B^2)/(2\*32.174))]

The Process Plugins™ package resides primarily within OSIsoft's PI Analysis Framework (PI-AF). Your plant customization exists in the form of *elements* which handle most of your basic performance calculations. Using PI System Explorer, system administrators can view, modify, or enhance elements as desired.

## Element Formulas

**Formula Configuration: (Head)**

**Parameters**

- A=PressureGage
- B=Velocity
- C=\PPISmEng\_VTLIOutputV;UOM=ft3/lbm

**Equations**

$$144 * C * A + ((B^2) / (2 * 32.174))$$

Default Values Allowed

**Result**

Unit of Measure:  Minimum:  Maximum:

Fundamental performance calculations exist as formulas within elements. Some routines utilize OSIsoft's PI Advanced Computing Engine (PI ACE), which delivers results back to an element.

## Element Templates

The screenshot displays the PPI - PI System Explorer application. The main window is titled "PPI - PI System Explorer" and features a menu bar (File, Edit, View, Go, Help) and a toolbar with options like Database, Query Date, Back, Check In, New Element Template, and New Attribute Template. A search bar is located in the top right corner.

The interface is divided into several panes:

- Library:** A list of element templates, with "PPIstmSI\_VTL" selected and highlighted in blue.
- Elements, Transfers, Library, Unit of Measure:** A vertical sidebar on the left with icons and labels for these categories.
- PPISmSI\_VTL:** The main configuration area, showing tabs for "General", "Attribute Templates", and "Ports". The "General" tab is active, displaying a search bar and a table of attributes.
- Attribute Configuration:** A panel on the right for configuring the selected attribute, "InputT".
- Search:** A search bar on the far right with a list of search criteria: Formula, PI Point, PI Point Array, and Table Lookup.

The "Attribute Configuration" panel for "InputT" includes the following fields:

- Name: InputT
- Description: Temperature
- Configuration Item:
- Categories: [Empty field]
- UOM: °C
- Value Type: Single
- Default Value: 0 °C
- Data Reference: Formula
- Settings... button
- Formula text area: A=.\|Temperature;UOM=°C;[A]

The status bar at the bottom indicates: "PPIstmSI\_VTL Modified:2/14/2009 5:04:04 PM."

The Process Plugins™ package comes with a complete set of “Drag & Drop” Element Templates for use in PI-AF.

## Lookup Tables

The screenshot displays the PPI - PI System Explorer interface. The main window is titled "PumpEfficiency" and shows a table with two columns, X and Y. The table contains 11 rows of data. The first row is highlighted in blue. The status bar at the bottom indicates the table was modified on 2/14/2009 at 5:09:47 PM and is version 1/1/1970 12:00:00 AM, Revision 1.

X	Y
0	3.52384
80	13.82063
160	23.01308
240	31.19163
320	38.442
400	44.84508
480	50.47703
560	55.40922
640	59.70823
720	63.43588
800	66.64922
880	69.40051
960	71.73725
1040	73.70216

The Process Plugins™ package comes with both industry standard and site specific tables which are used by elements for lookup functions as well as interpolation.

## Data Storage

The screenshot displays the 'PPI - PI System Explorer' application window. The interface is divided into several panes:

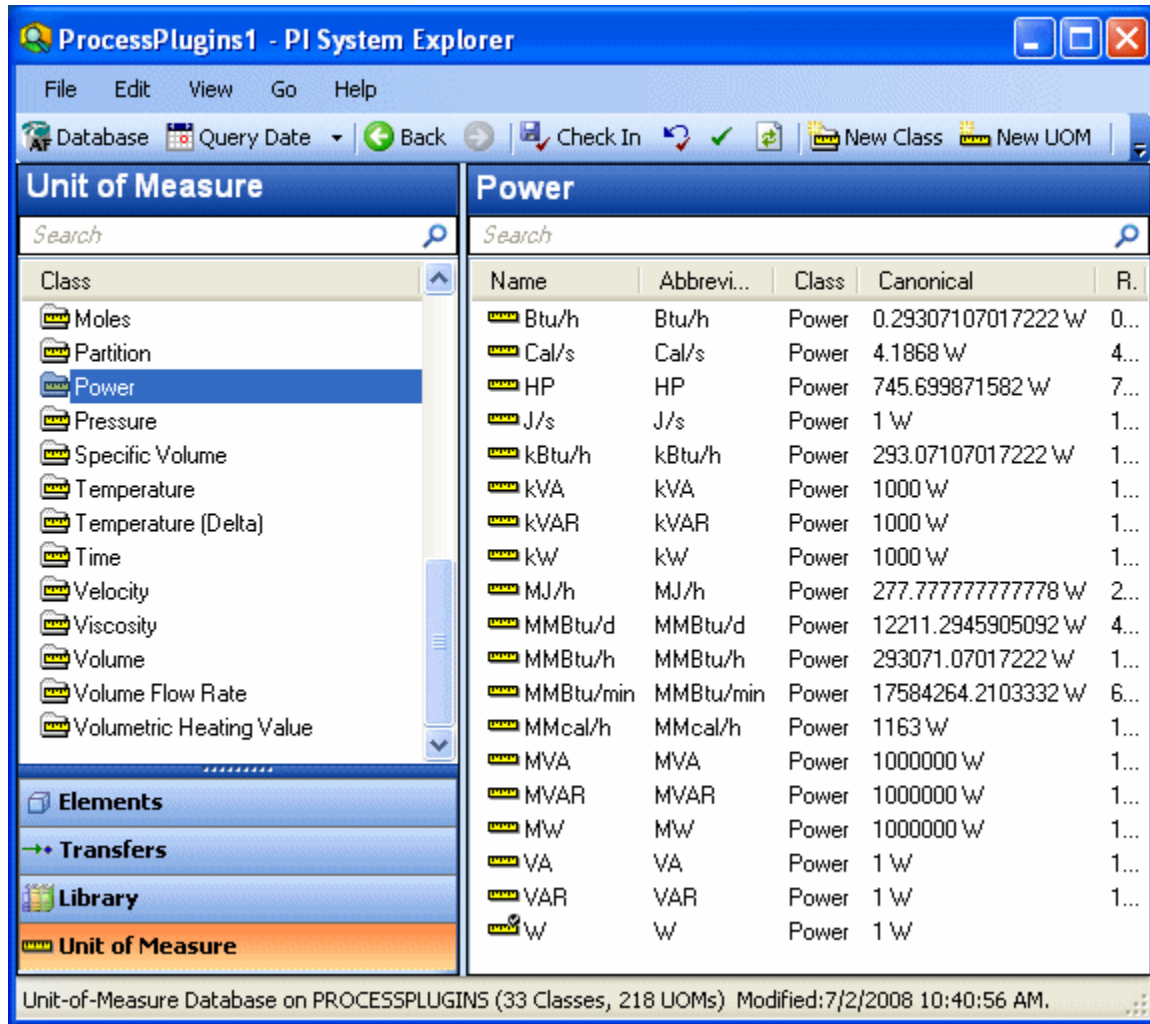
- Elements:** A tree view on the left showing a hierarchy of elements. Under 'Performance', 'PPI\_WriteToPI' is selected.
- Attributes:** A central pane showing a table of attributes for the selected 'PPI\_WriteToPI' element. The table has columns for 'Name' and 'Value'.

Name	Value
Formula	6508.577
PIPoint	6508.572
- Configuration:** A right-hand pane with tabs for 'General', 'Child Elements', 'Attributes', 'Ports', and 'Version'. The 'General' tab is active, showing fields for 'Name' (PIPoint), 'Description', 'Configuration Item', 'Categories', 'UOM' (<None>), 'Value Type' (Single), 'Value' (6508.572), and 'Data Reference' (PI Point). A 'Settings...' button is also present.
- Search:** A search pane on the far right listing various elements like PPIStmEng\_HPS, PPIStmEng\_HPT, etc.

At the bottom of the window, the text 'PIPoint' is visible.

Key resultant data generated by Process Plugins™ modules are stored in the OSIsoft PI historian. Process Plugins™ modules do NOT store redundant or unnecessary data, but only a handful of PI tags for key results.

## Units of Measure



ProcessPlugins1 - PI System Explorer

File Edit View Go Help

Database Query Date Back Check In New Class New UOM

### Unit of Measure

Search

- Class
- Moles
- Partition
- Power**
- Pressure
- Specific Volume
- Temperature
- Temperature (Delta)
- Time
- Velocity
- Viscosity
- Volume
- Volume Flow Rate
- Volumetric Heating Value

### Power

Search

Name	Abbrevi...	Class	Canonical	R.
Btu/h	Btu/h	Power	0.29307107017222 W	0...
Cal/s	Cal/s	Power	4.1868 W	4...
HP	HP	Power	745.699871582 W	7...
J/s	J/s	Power	1 W	1...
kBtu/h	kBtu/h	Power	293.07107017222 W	1...
kVA	kVA	Power	1000 W	1...
kVAR	kVAR	Power	1000 W	1...
kW	kW	Power	1000 W	1...
MJ/h	MJ/h	Power	277.777777777778 W	2...
MMBtu/d	MMBtu/d	Power	12211.2945905092 W	4...
MMBtu/h	MMBtu/h	Power	293071.07017222 W	1...
MMBtu/min	MMBtu/min	Power	17584264.2103332 W	6...
MMcal/h	MMcal/h	Power	1163 W	1...
MVA	MVA	Power	1000000 W	1...
MVAR	MVAR	Power	1000000 W	1...
MW	MW	Power	1000000 W	1...
VA	VA	Power	1 W	1...
VAR	VAR	Power	1 W	1...
W	W	Power	1 W	1...

Unit-of-Measure Database on PROCESSPLUGINS (33 Classes, 218 UOMs) Modified:7/2/2008 10:40:56 AM.

The Process Plugins™ package includes a complete set of engineering units utilized by the utility industry for use with the PI AF Unit of Measure (UOM) system. PI-AF automatically performs unit conversions on demand and delivers results in either the U.S. English or S.I. engineering unit systems.



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