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What is PLEV?

Centrifugal Pumps installed in HVAC systems typically operate in variable load applications that see a variation of flow requirements based on the heating or cooling load in a building.

Part Load Efficiency Value, or “PLEV” for short, is Bell & Gossett’s term for the weighted average pump efficiency. **This number is determined based on the standard system load profile developed in AHRI 550/590-1998 also known as IPLV or Integrated Part Load Value.**

The $PLEV_V$ equation is as follows:

$$PLEV = \frac{1}{\frac{1\%}{A} + \frac{42\%}{B} + \frac{45\%}{C} + \frac{12\%}{D}}$$

A, B, C and D are the pump efficiency values at 100%, 75%, 50% and 25% of flow rate and at the corresponding head value on the control curve. Based on the above equation, during any given year the Pump will operate at 100% flow (Duty Point) - only 1% of the year, 75% flow - 42% of the year, 50% flow - 45% of the year and 25% flow - 12% of the year.

The Subscript "v" denotes variable speed operation with the control or fixed head calculated within a systems critical circuit. Bell & Gossett’s ESP-PLUS software defaults to 30% of pump TDH (Total Design Head) to represent the minimum control head within a system. ASHRAE 90.1- 2013 requires that the total head loss in a system be calculated making it natural to calculate the critical zone’s fixed head should too. The actual calculated number should be used as it represents a more accurate calculation which will be reflective in the cost analysis.

The actual load and flow characteristic for any building or system will change based on location, system type, and system usage. The PLEV is simply a term that represents the efficiency of the pump at partial flow rates and may be used to gauge true pump performance within a hydronic system which can be used to accurately compare pump manufactures for an overall operational efficiency.

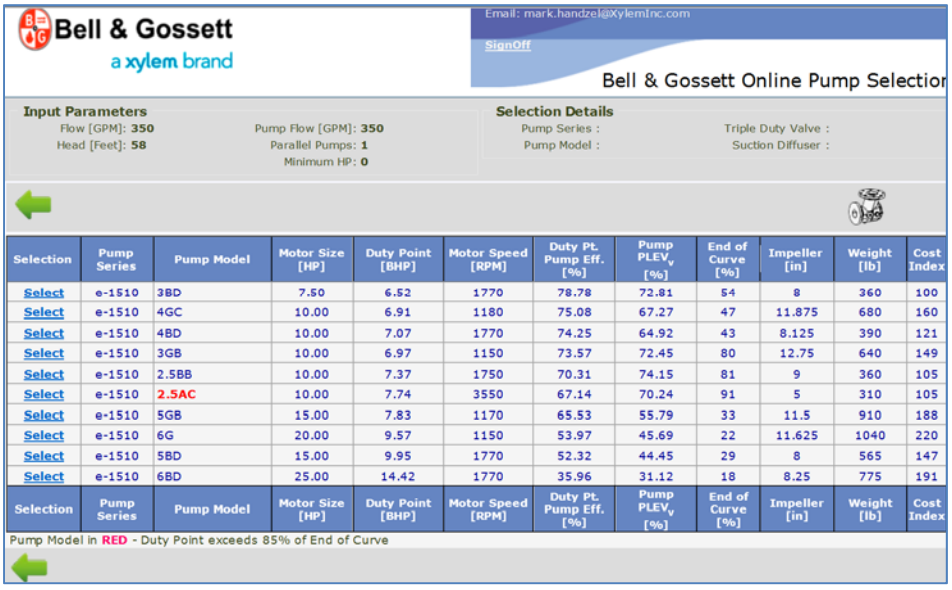
PLEASE NOTE: Bell & Gossett suggests listing the 30% TDH or calculated minimum control head within the equipment schedule as well as specifications to keep a fair comparison between manufacturers.

Please contact your local Bell & Gossett Representative for additional information on PLEV.

Additional information on PLEV

Does ESP-PLUS still default to rank pumps with the highest efficiency at full load?

Yes, ESP-PLUS still defaults to rank pump selections by the highest efficiency at full design load. As you've always been able to do with other selection criteria, you can click on the selection summary screen individual headers to change the ranking by PLEV if you wish.



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SignOff
Bell & Gossett Online Pump Selection

Input Parameters
Flow [GPM]: **350**
Head [Feet]: **58**
Pump Flow [GPM]: **350**
Parallel Pumps: **1**
Minimum HP: **0**

Selection Details
Pump Series :
Pump Model :
Triple Duty Valve :
Suction Diffuser :

Selection	Pump Series	Pump Model	Motor Size [HP]	Duty Point [BHP]	Motor Speed [RPM]	Duty Pt. Pump Eff. [%]	Pump PLEV$_v$ [%]	End of Curve [%]	Impeller [in]	Weight [lb]	Cost Index
Select	e-1510	3BD	7.50	6.52	1770	78.78	72.81	54	8	360	100
Select	e-1510	4GC	10.00	6.91	1180	75.08	67.27	47	11.875	680	160
Select	e-1510	4BD	10.00	7.07	1770	74.25	64.92	43	8.125	390	121
Select	e-1510	3GB	10.00	6.97	1150	73.57	72.45	80	12.75	640	149
Select	e-1510	2.5BB	10.00	7.37	1750	70.31	74.15	81	9	360	105
Select	e-1510	2.5AC	10.00	7.74	3550	67.14	70.24	91	5	310	105
Select	e-1510	5GB	15.00	7.83	1170	65.53	55.79	33	11.5	910	188
Select	e-1510	6G	20.00	9.57	1150	53.97	45.69	22	11.625	1040	220
Select	e-1510	5BD	15.00	9.95	1770	52.32	44.45	29	8	565	147
Select	e-1510	6BD	25.00	14.42	1770	35.96	31.12	18	8.25	775	191

Pump Model in RED - Duty Point exceeds 85% of End of Curve

Figure #A – example pump selection table with rankings by Duty Point Efficiency

Why does PLEV default to 30% of pump discharge head for Control Head?

A majority of heating and cooling systems are generally closed loops and require a constant head differential at all times. The constant head differential is necessary for system control and to insure that the necessary differential head across any controlled sub-circuits is maintained during operation (See Figure #X below). The PLEV calculation requires a minimum control head be used so B&G has selected "30% of pump total design head (TDH)" as the value for Minimum Control Head

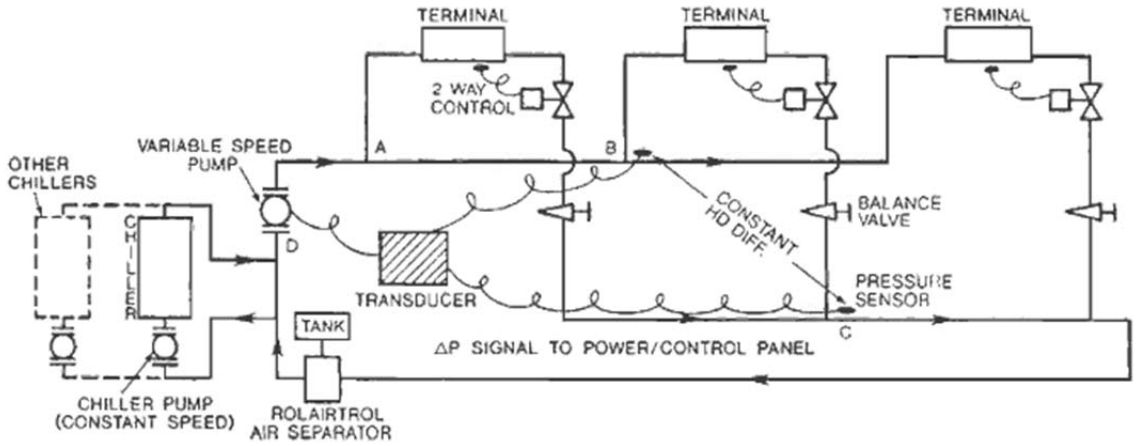

Figure #B: Typical Closed Loop HVAC System: Constant Head Difference must be maintained at all times.

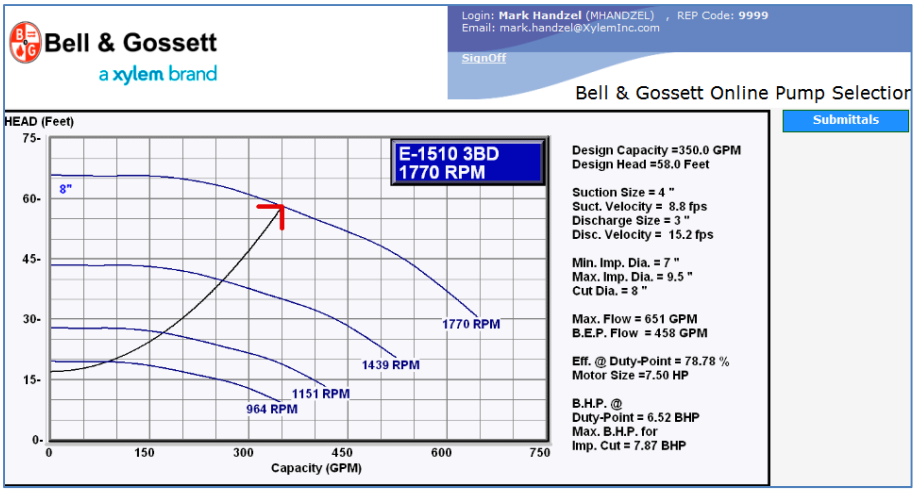

Figure #C: Typical Closed Loop HVAC System: Constant Head of 17' TDH

Is it acceptable to select pumps to the right of Best Efficiency Point?

Pump selections to the right of Best Efficiency Point (BEP) may have a higher PLEV than other selections. This is because the PLEV Load Profile is heavily weighted on operating hours at 75% and 50% operation (these load profile points account for 87% of operating hours). Selecting a pump at full load with a selection point to the right of BEP is an allowable design practice as long as the system head loss has been calculated accurately. If system head loss has been estimated and a selection is made to the right of BEP, there is a risk that the pump will run outside the acceptable range of operation. In a worst case scenario, the pump may run off the end of the pump curve. The American Society of Heating, Refrigerations and Air Conditioning Engineers' (ASHRAE) guidelines prefer pump selections between 85% and 105% of BEP.

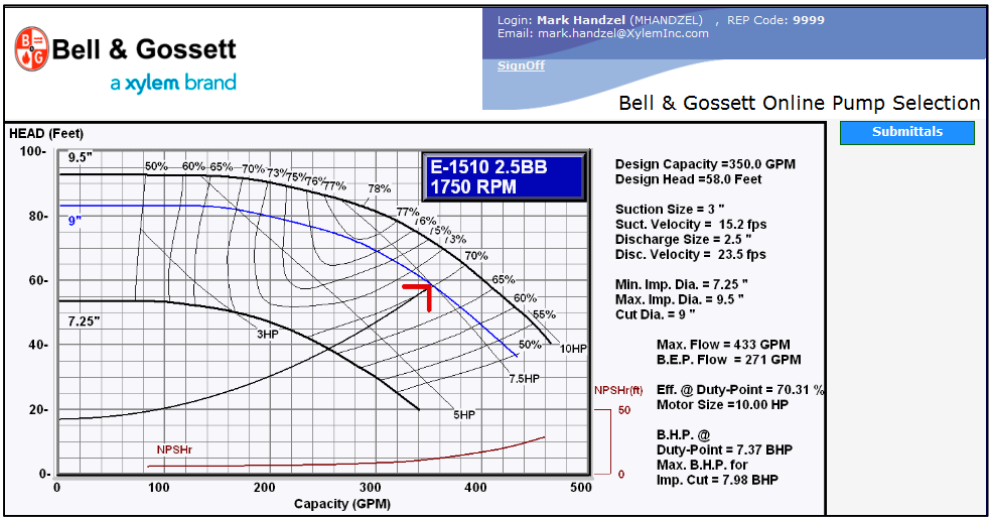

Figure #D: Example of a higher PLEV pump selection to the right of BEP at full load

Is 3500 RPM an acceptable speed for selections?

Bell & Gossett makes pumps that operate across a wide-range of speeds (1200, 1800 and 3600 RPM). For HVAC Closed Loop Systems, the common design practice is to utilize 1800 RPM pump selections. While pumps at other speeds are also acceptable, 1800 RPM selections offer a number of advantages: increased mass to absorb system harmonics that could lead to unwanted vibration, as well as higher efficiencies to left of Best Efficiency Point. There are significant advantages for pump selections at higher speeds too: smaller pumps and motors which yield lower first cost, less mechanical room space requirements,smaller pipe diameters and higher PLEV efficiencies.

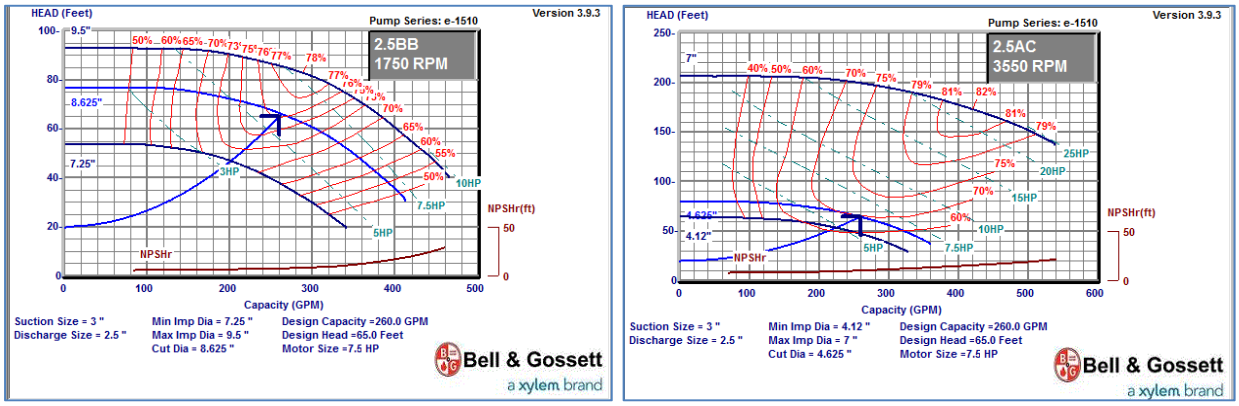

Figure #E and #F: Examples of Pump Selections at same flow and head at 1800 and 3600 RPM

What is the impact of PLEV on parallel pump selections?

PLEV may be considered as a factor in two-pump parallel pump selections but Bell & Gossett strongly recommends that users carefully evaluate the requirement for a point of intersection between the single pump curve and the system curve. The risk of selecting a pump with a higher PLEV or right of BEP will increase the likelihood that the single pump curve will not have a point of intersection. In general, selecting pumps to the left of BEP in multiple parallel pump systems continues to be a recommended practice to minimize operating costs as a whole.

What is the impact of PLEV on pumps selected for Open Systems?

If you are selecting a pump for an open system (Cooling Towers) you need to be aware of NPSHr and picking right of BEP generally increases NPSHr so PLEV may not be a key selection criteria.