New myPLV Tool Provides Quick, Simple Option for Chiller Economic Comparisons

Today, businesses are more challenged than ever to manage energy consumption. Sustainable processes that result in reduced operational costs have become core values.

According to the U.S. Department of Energy, space heating, cooling and ventilation account for over 30 percent of energy used in a commercial building,[1] providing great cost-saving opportunities within a facility. At the same time, with customers anxious to lower utility bills, demand has grown for a quick way to assess heating, ventilation and air-conditioning (HVAC) equipment energy usage. This has led some in the industry to use single-number evaluation methods, such as the Integrated Part Load Value (IPLV), rather than a comprehensive and time-consuming full energy analysis. However, while the IPLV saves time comparing equipment, there are some issues to consider when using IPLV as a predictor of actual energy consumption costs.

IPLV can be valuable when used to compare a chiller's ability to unload at reduced loads and lifts, enabling a side-by-side comparison of like technologies. But it was not designed to predict the annualized energy consumption of a chiller in any specific application or location and therefore could lead to erroneous and costly purchasing decisions. New tools, such as the myPLV™ calculator, are now available to help quickly and more accurately predict chiller performance and chiller economics.

Understanding IPLV

The IPLV performance metric was developed by the Air-Conditioning, Heating and Refrigeration Institute (AHRI) as a way to determine whether a building meets the ASHRAE 90.1 requirements for operation and also helps compare the unloading characteristics of similar chillers.

IPLV uses four operating points with weighting factors to indicate the percentage of time a single chiller, following an averaged load profile, will operate at different loads and with assumed entering-condenser water temperature (Figure 1).

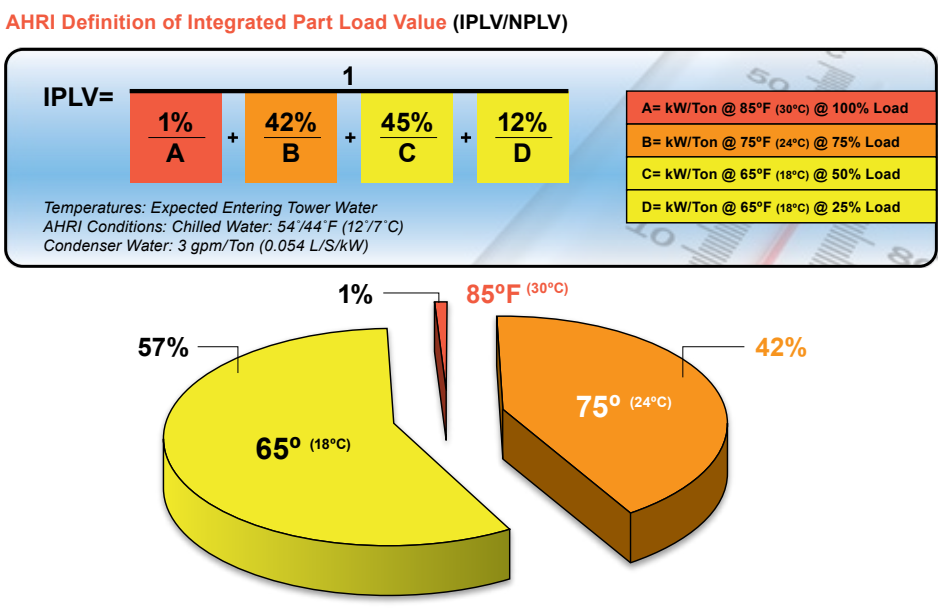


Figure 1: The metric is a weighted average of the full load (point A), and three part-load points (B, C and D) which represent 75, 50 and 25 percent loads, respectively. Each load is given a weighting criteria that is used to calculate the index. The industry-standard calculation assumes a full load (high load and high condenser water temperatures) is used 1 percent of the operating time, and a 75 percent load 42 percent of the operating time. The standard assumption for a 50 percent load is 45 percent of the operating time, while a 25 percent load is assumed 12 percent of the time.

In addition to part-load assumptions, the IPLV calculation uses weighted national averages of numerous factors that may or may not correspond to a specific building's profile. These factors include weather data from 29 cities across the United States and building types based on a Department of Energy study of buildings. Additional weighted average factors include operational hours (for operations with chiller plants only) and chiller plants both with and without an economizer.

Because all of these factors are weighted averages, IPLV is not representative of any specific building type or location. In addition, there are other limitations to the IPLV measurement when considering a single building:

- The metric does not include a calculation of a building's ton hours, which determines accurate energy estimations.
- IPLV is only valid for plants with a single chiller design, which contradicts the increasing trend to create redundancy in a building's system. Current estimates suggest that more than 90 percent of central chiller plants with water-cooled chillers are multiple-chiller installations, with the most common installation a two-chiller model.
- IPLV formula assumes that only 1 percent of chiller operation occurs at high loads and high condenser water temperatures. But in reality, the global average for this level is nearly 48 percent of a two-chiller plant's operating hours over the course of a year.[2]

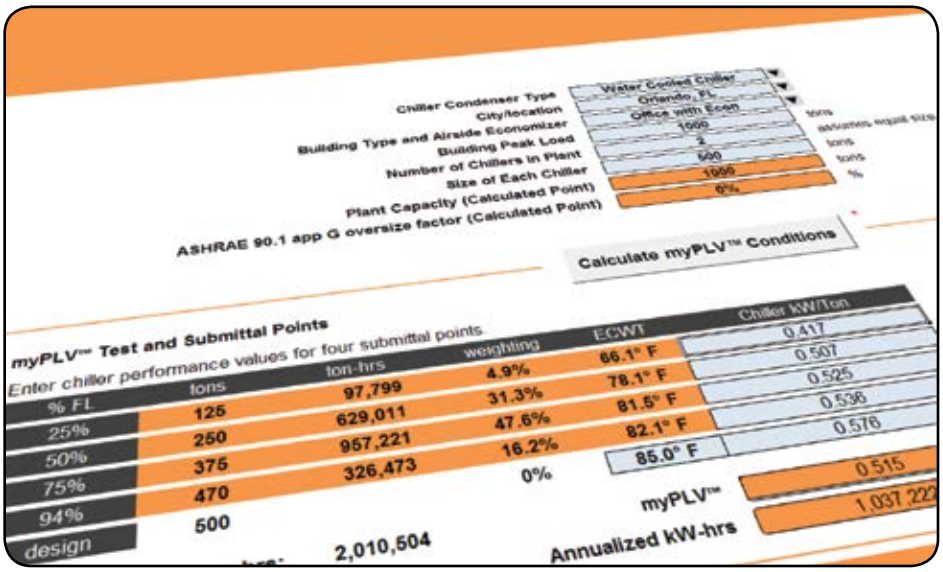
Missing important considerations

Because of the way IPLV is calculated, even AHRI, the agency that developed the metric, cautions that it was not intended to be used to predict energy consumption in specific operations or conditions, since the metric presents a very high level estimate based on national averages.

Appendix D of the AHRI Standard 550/590 states: "The IPLV value was not intended to be used to predict the annualized energy consumption of a chiller in any specific application or operating conditions. There are many issues to consider when estimating the efficiency of chillers in actual use. Neither IPLV nor design rating metrics on their own can predict a building's energy use.

Additionally, chiller efficiency is only a single component of many which contribute to the total energy consumption of a chiller plant. It is for this reason that AHRI recommends the use of building energy analysis programs, compliant with ASHRAE Standard 140, that are capable of modeling not only the building construction and weather data but also reflect how the building and chiller plant operate."

A chiller in Phoenix will operate at different hours than one installed in Boston. Similarly, the requirements from a hospital cooling plant may vary from those of a university or an office building. Therefore, design decisions for specific buildings based on incomplete data can lead to poor economic and environmental outcomes.



A new option for evaluating energy costs

Because every project is unique, myPLV — a free, manufacturer-agnostic tool — was designed to help engineers, businesses and building owners quickly and accurately estimate chiller energy usage and costs for specific buildings, locations and chiller plants while avoiding a full building energy simulation model.

To estimate chiller performance with myPLV, users select their location and building type; building peak load; number and size of the chillers in the plant; and chiller condenser control strategy. The myPLV calculator then uses industry standard building model data in combination with the user-specific information to accurately estimate applied chiller operating conditions.

myPLV background

The building load profiles included in myPLV were generated from public domain EnergyPlus™ files developed at the Pacific Northwest National Labs (PNNL) for energy analysis work in conjunction with ASHRAE.

The myPLV building profiles result from the EnergyPlus simulation program for various building types in 17 climate zones. User information entered into the calculator is mapped to one of these climate zones, with the building load profile generalized to the zone rather than the city. In addition, the building load profile provided by the publicly available PNNL database is scaled to the Building Peak Load entry as specified by the user in the myPLV calculator.

The program determines four weighted performance points to compute a myPLV value. The test and submittal points are developed by grouping data from the 8760 hour EnergyPlus analysis into four chiller plant load ranges. These ranges are zero to 37.5 percent; 37.5 to 62.5 percent; 62.5 to 87.5 percent and 87.5 to 100 percent. The groupings correspond to center-weighted test points at 25, 50, 75 and 94 percent.

The 100 percent design point is not included in the myPLV performance weighting criteria, since the highest level of the 94 percent grouping includes performance at the 100 percent load point. However, the 100 percent design point is shown in the submittal entry, where the user specifies the entering condenser water temperature. It is critical to specify this point as the selected chiller provides operation at the design point.

Selecting the design performance and anticipated tower control method for the condensed water system helps to estimate the economic impact of peak demand charges attributable to the chillers.

Taking the industry standard load profiles and recreating those four performance points for the specific building type, location and plant design provides accurate weighting points and condenser temperatures, as well as the ton-hours at each of those points.

Making the right decisions with the right tools

The HVAC industry has been looking for a process to easily predict a building's energy usage and the myPLV calculation tool is designed to fill that void. The goal of myPLV is to help users make the right purchasing decisions based on a more accurate analysis of life cycle costs, which can result in better energy payback and savings for building owners.

myPLV offers a quick and accurate energy economic comparison among chiller performance alternatives when time constraints are limited. Using industry standard data in combination with user-provided information generates information specific to a region and building type.

Accuracy is critical when making decisions for your new or existing facility and even small improvements in efficiency performance as a result of a better comparison metric can add up to significant energy savings.

To learn more and to download a free copy of myPLV, please visit **trane.com/myPLV.**

[1, 2] W. Ryan Geister and Mike Thompson, "A Closer Look at Chiller Ratings," *ASHRAE Journal* (December 2009): 22–32.

Ingersoll Rand (NYSE:IR) advances the quality of life by creating comfortable, sustainable and efficient environments. Our people and our family of brands — including Club Car®, Ingersoll Rand®, Thermo King® and Trane® — work together to enhance the quality and comfort of air in homes and buildings; transport and protect food and perishables; and increase industrial productivity and efficiency. We are a global business committed to a world of sustainable progress and enduring results.

ingersollrand.com

We are commited to using environmentally conscious print practices.

 CTV-PRB019-EN
February 26, 2014