# Unipower®

# HPL110, HPL420

## Programming Suggestions for **Centrifugal Pumps**

## *General Principles*

Centrifugal pumps are constant head - variable flow systems with a power consumption which basically tracks flow rate as shown in Fig. 1.

Since power consumption tracks flow, power monitoring is an effective basis for monitoring and protection.

For seal-less centrifugal pumps, it is particularly important to protect against dry-running since without fluid, the rotor rubs directly against the stator housing. When dry running occurs, the power consumed by the pump immediately drops to a very low level - well below the zero flow power and approaching the idle power of the motor. This characteristic makes power monitoring particularly useful for protecting seal-less pumps from dry-running.

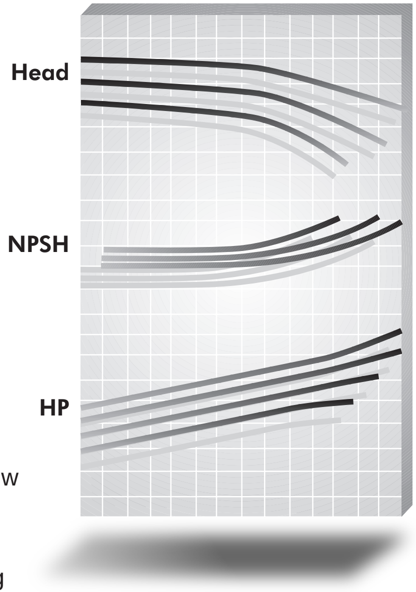


**Figure 1**

*Alarm functions required for centrifugal pump protection are:*

**Low Power:**

- Dry-running due to lack of fluid, blocked inlet, air induction,
- Operation below Min. Safe Flow leading to over-heating and fluid vaporization,

**High Power:**

- Operation above Max. Safe Flow leading to cavitation and unstable operation,
- Jammed impeller.

The Unipower HPL110 and HPL420 models both incorporate high/low power alarm functions suitable for pump protection applications. Please refer to the relevant data sheet for overall information and instructions; this guide is solely intended to provide suggestions on limit setting for centrifugal pumps.

# Unipower Alarm Objectives for Centrifugal Pumps

Once the Unipower system has been installed and basic set-up completed, there are five parameters which must be set for effective pump protection:

**Ts -** **Start Delay Timer:** Delays active monitoring until the pump/motor have reached normal operating speed (or in the case of self-priming pumps, until prime is established).

**L1 -** **Max. Limit Alarm:** Alarm when Max. Safe Flow is exceeded.

**L2 -** **Min. Limit Alarm:** Alarm when Min. Safe Flow is not met.

**Tr1 -** **Trip Delay for L1:** Time duration for which an alarm condition must exist before alarm is declared; avoids nuisance tripping due to normal process fluctuations.

**Tr2-** **Trip Delay for L2:** As above for the L2 Min. Alarm.

# Setting Ts Start Delay

While Ts is active, monitoring is disabled so this parameter should be set as short as possible.

For normal primed applications, a typical power vs. time plot is shown in Fig. 2. The motor is started at time 1 and the system settles to a running normal value at time 4. In this case, Ts is set at 3.5 seconds resulting in normal monitoring becoming active at time 4.5.

Typical Ts values for primed centrifugal pump applications are in the range 1 to 5 seconds; default of 2 seconds is a good starting point.

For self-priming applications, the pump starts by running dry until prime is established. This results in a period on start-up where the power is below the normal L2 Min. Power alarm level and an extended Ts period must be used. In these cases, set Ts to the value suggested by the pump manufacturer (contact WEN Technology if extended Ts options are required).

# Setting L1 - L2 Max. and Min. Alarm Limits

The objective is to set these values to the Max. and Min. Safe Flow power values for the pump system. Unipower models HPL110 and HPL420, however, are programmed in units of %kW; programming L1 - L2 in %kW for these models is achieved as follows:

# Empirical Peak Detect Method

First disable the L1 & L2 alarms by setting them to 101% and 0% respectively.
Run the pump and first open the outlet valve to normal full flow setting then close the outlet valve to the normal minimum flow setting. Return the valve setting to normal flow.

Depress the Δ key and note the max. power experienced by the pump in %kW - set L1 appropriately above (slightly) this value.

Depress the ∇ key and note the min. power experienced by the pump in %kW - set L2 appropriately below (slightly) this value.

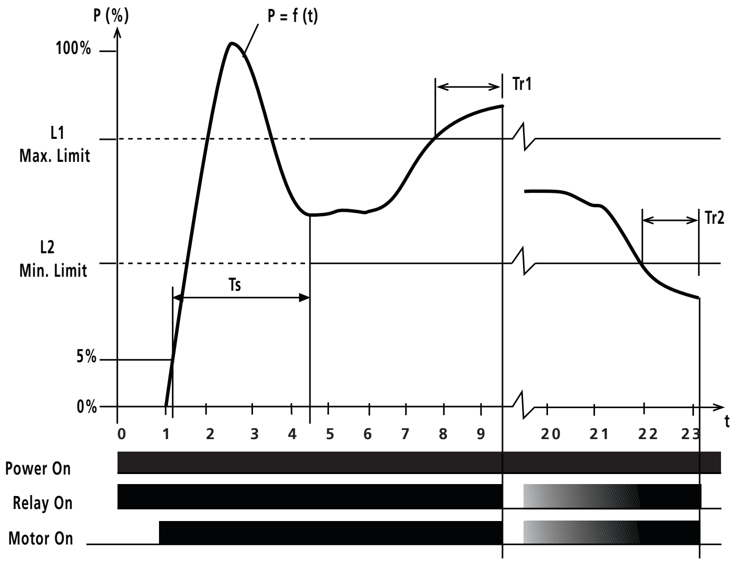


Figure 2

# Empirical Min. Safe Flow Setting

An accurate setting of the critical Min. Safe Flow trip point in %kW can be achieved with a slight variation on the above procedure.

Instead of running the pump with the outlet valve set at normal minimum flow, close the outlet valve completely and record the power value in %kW with the valve closed - Zero Flow %kW (ZF%kW). (Be sure to re-open the outlet valve immediately)

From the pump curve, note the power consumption at Zero Flow (ZFP) and at Min. Safe Flow (MinP). Use this data to establish the Min. Safe Flow setting for the Unipower unit as follows:

**Min. Safe Flow (%kW) = ZF%kW x MinP / ZFP (%kW)**

Set L2 to this calculated Min. Safe Flow value in %kW.

***Note:*** *This method is quite accurate for setting Min. Safe Flow. However, for basic protection from dry-running, any L2 setting which is equal to or above the zero flow - dead-headed - power of the pump will be effective.*

# Setting Tr1 - Tr2 Trip Delays

The Tr1 - Tr2 Trip Delay timers ensure that the measured power remains above or below the respective L1 - L2 Limits continuously for the time set by the Tr timer; see Fig. 2. As such, they reduce sensitivity to short duration process fluctuations and are used to reduce nuisance tripping of the system.

Setting these parameters is empirical. The default values for the Unipower systems are 0.1 seconds. For pumping applications, it is usual to use a longer Tr time and values in the range 1 to 5 seconds are typical.

## Setting Protection

Once the settings have been determined and set, protect the program by setting DIP Switch 1 to the "ON" position.

## FAQ

***Q: Why are the HPL110 and 420 models not programmed in units of HP?***

**A:** The Unipower motor load monitors measure the input power to the motor whereas pump curve data is related to motor output power. And quite a bit more data must be entered and processed in order to display and function in engineering units. Programming based on observed %kW values is an easy and safe method without requiring a detailed knowledge of the motor efficiency curve.

Two options exist for programming from the pump curve in real units of power. The first option is Unipower model PCU4123 which is programmable in units of kW and includes a scaling function which can be used for motor efficiency correction.

The second option is to convert %kW into kW using the equation:

$$P\,[100\%kW] = \sqrt{3}\ .\ U\ .\ I$$

where U is the rated voltage of the unit (e.g. for HPL110/460, V is 460V) and I is the effective primary current (see System Configuration section in Installation Manual). Remember that this is the input power to the motor; to convert to output power, adjust these values based on the efficiency curve for the motor.

A conversion chart for your application can be supplied based on receiving all the information listed in the set-up log sheet found on the back of the Installation Manual; for Limits L1 and L2, give the desired Max. and Min. Safe Flow ratings in units of HP or kW (please denote which are being given).

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