

Hydraulic Institute Program Guideline for

Circulator Pump Energy Rating Program



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Hydraulic Institute Program Guideline

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Foreword (Not part of program guideline)

Purpose and Aims of the Hydraulic Institute

The purpose and aims of the Hydraulic Institute are to promote the advancement of the pump manufacturing industry and further the interests of the public and to this end, among other things:

- a) Develop and publish standards
- b) Address pump systems
- c) Expand knowledge and resources
- d) Educate the marketplace
- e) Advocate for the industry

Purpose of Program Guidelines

- a) Hydraulic Institute Program Guidelines are offered in the public interest to benefit the manufacturer and end user.
- b) Use of Hydraulic Institute Program Guidelines is voluntary. The existence of Hydraulic Institute Program Guideline does not in any respect preclude a Participant from manufacturing or selling products not conforming to the Program Guideline.

Definition of a Hydraulic Institute Program Guideline

A Hydraulic Institute Program Guideline outlines a normative process that must be followed to Participate in the Program.

Comments From Users

Comments from users of this Program Guideline will be appreciated to help the Hydraulic Institute prepare even more useful future editions. Questions arising from the content of this program guideline may be directed to the Technical Director of the Hydraulic Institute. If appropriate, the inquiry will then be directed to the appropriate technical committee for provision of a suitable answer.

Revisions

Hydraulic Institute Program Guidelines are subject to constant review, and revisions take place whenever it is found necessary because of new developments and progress in the art.

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This document does not contain a complete statement of all requirements, analyses, and procedures necessary to ensure safe or appropriate selection, installation, testing, inspection, and operation of any pump or associated products. Each application, service, and selection is unique with process requirements that shall be determined by the owner, operator, or its designated representative.

Units of Measurement

U.S. Customary units are specified in this document because the program is based on the U.S. Department of Energy (DOE) Appliance Standards Federal Rulemaking Advisory Committee (ASRAC) working group's recommend term sheets, which requires U.S. Customary units.

Committee Roster

A committee met on a regular basis to develop this document. At the time it was developed, the committee had the following members:

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Special Acknowledgements – Peer Review

Several independent experts in the industry review and evaluate committee drafts. They conducted a thorough review of the material, ensuring the document met the intended goal established by the committee chairs, and provided accurate, coordinated, and relevant information to the reader. Their work is extremely valuable, and the committee thanks all of them for their time and efforts.

41.5 Program Guideline for Circulator Pump Energy Rating Program (normative)

41.5.1 Introduction

HI 41.5-2021 was updated from the 2018 edition to improve representation, accuracy and clarity in following ways:

- For pressure control testing and manual speed control testing, allowance has been made to correct for test data below the reference curve. This change eliminates the need for all control curves to exist above reference curve and allows for a better representation of control curves used in the market and allows for circulator pump CEI values to better represent a pump's capabilities.
- The testing flow tolerance has been reduced from $\pm 10\%$ to $\pm 5\%$ of the reference load point flow rate. This change limits the pump efficiency ranges allowed for a given test point and minimizes unnecessary variation in CEI values for a given test.
- Correction of power to the reference curve above the reference curve has been removed. This change eliminates a discontinuity in CEI values when transitioning between corrected, and un-corrected values and allows for better representation of pump CEI.
- A correction was made to the $Z_{\max}$ and Z_{reduced} coefficients in the external input signal controls. This was done to correct the transposition of the coefficients in the previous edition.
- Some prescriptive testing requirements were removed from HI 41.5 and instead references to HI 40.6-2021 Methods for Rotodynamic Pump Efficiency Testing are included.
- Terminology changes from the prior edition were made so that Circulator Energy Index (CEI) and Circulator Energy Rating (CER) are distinguishable from the DOE regulatory required Pump Energy Index (PEI) and Pump Energy Rating (PER) for commercial and industrial pumps.

41.5.1.1 Purpose

The purpose of the Hydraulic Institute Circulator Pump Energy Rating Program Guideline (hereinafter referred to as the "Program Guideline") is to define the requirements to participate in and list circulator pumps in the Hydraulic Institute Energy Rating Program (hereinafter referred to as the "ER Program"). The Program Guideline establishes the method for testing circulator pumps to determine an Energy Rating value, and requirements for listing circulator pumps in the ER Program.

41.5.1.2 Scope

The scope of pumps included in the ER Program are limited to clean water circulator pump types CP1 (wet rotor), CP2 (dry rotor two-piece), and CP3 (dry rotor three-piece) as defined in Section 41.5.1.5.1 of this document. Clean water circulator pump means a circulator pump that is designed for use in pumping water with a maximum non-absorbent free solid content of 0.016 pounds per cubic foot (0.25 kilograms per cubic meter), and with a maximum dissolved solid content of 3.1 pounds per cubic foot (50 kilograms per cubic meter), provided that the total gas content of the water does not exceed the saturation volume, and disregarding any additives necessary to prevent the water from freezing at a minimum of 14 °F (-10 °C).

41.5.1.3 Proper Use of the HI Energy Rating

The Energy Rating (ER) provides a method to estimate energy savings, but realized energy consumption will depend on the individual installation, operation, and control mode chosen. The ER metric can be used

by utilities and energy program administrators as part of a program to provide incentives for selection of circulator pumps that, when properly applied, should result in lower overall energy use. Proper sizing and selection of circulator pumps is vital to achieving the most efficient pumping system, but is outside the scope of this prescriptive program. The ER as outlined in this program should only be used when comparing circulator pumps that have been properly sized for the application and load type. Refer to ANSI/HI 14.3 *Rotodynamic Pumps for Design & Application and Optimizing Pumping System Guidebook*, for selection considerations of a rotodynamic pump.

The ER is suitable to be used as a comparison tool under the following conditions:

- A selected circulator pump compared to its baseline performance
 - Selected circulator pumps that have been properly selected for the duty point(s)
 - Selected circulator pumps that have controls and do not have controls
- This assumes:
- Both will be used in a variable flow system
 - The system curve(s) are generally represented by the control curve outlined in Section 41.5.3.4
 - The actual load profile is generally represented by the load profile outlined in Section 41.5.3.4

The ER is NOT a suitable tool for:

- Selection of circulator pump for a specific application
- To compare the energy performance of circulator pumps selected for different duty points
- To compare the energy performance of circulator pumps with controls and without controls that will operate in a constant flow system

41.5.1.4 Benefits of HI Energy Rating Program

The ER Program benefits circulator pump end-users, specifiers, and purchasers worldwide by establishing a consistent approach to enable the comparison of properly selected circulator pumps based on the average power consumption. This accelerates the adoption of efficient products into the market, reducing the operating cost, saving energy and reducing carbon emissions.

To maximize the benefits, any corporation, domestic or foreign, that manufactures, sells, packages, or distributes circulator pump(s) within scope of the Program is eligible to participate in the Program to generate and display an ER label in accordance with the requirements described in this document.

41.5.1.5 Definitions and Nomenclature

Nomenclature and definitions related to testing are provided in the normative reference HI 40.6-2021 *Methods for Rotodynamic Pump Efficiency Testing*. Supplemental industry recognized nomenclature and definitions can be found in ANSI/HI 14.1-14.2 *Rotodynamic Pumps for Nomenclature and Definitions*.

41.5.1.5.1 Program Definitions and Nomenclature

Adaptive pressure control – means a pressure control that adjusts the control curve automatically based on the conditions of use.

Bare pump – means a pump excluding mechanical equipment, driver, and controls.

Basic model – means all units of a given class of pump manufactured by the Participant rating the pump, having the same primary energy source, and having essentially identical electrical, physical, and functional (or hydraulic) characteristics that affect energy consumption.

Circulator Energy Index (CEI) – means the ratio of the Circulator Energy Rating (CER), for the rated circulator pump model, divided by the CER_{REF} for a pump serving the same hydraulic load. See Equation 41.5.3.2.

Circulator Energy Index Baseline ($CEI_{Baseline}$) – means the ratio of the baseline Circulator Energy Rating ($CER_{Baseline}$), for the rated circulator pump model, divided by the CER_{REF} for a pump serving the same hydraulic load. See Equation 41.5.4.1a.

Circulator Energy Rating (CER) – means the weighted average electric input power expressed in horsepower to the driver or control, over a specific load profile for each equipment class and control when the basic model is distributed in commerce. See Equations 41.5.3.4.1, 41.5.3.4.2c, 41.5.3.4.3c, 41.5.3.4.4.1c, 41.5.3.4.4.2c, and 41.5.3.4.5c.

Circulator Energy Rating Baseline ($CER_{Baseline}$) – means the weighted average electric input power expressed in horsepower to the driver of a baseline circulator pump, over a specific load profile for each equipment class. See Equation 41.5.4.1b.

Circulator Energy Rating Reference (CER_{REF}) – means the weighted average electric input power (WAIP) expressed in horsepower to the driver of a reference circulator pump, over a specific load profile for each equipment class. See Equation 41.5.3.3c.

Circulator pump – means a wet rotor circulator pump (CP1); a dry rotor, two-piece circulator pump (CP2); or a dry rotor three-piece circulator pump (CP3).

Control – means any device that can be used to operate the driver. Examples include, but are not limited to, continuous or non-continuous controls, schedule-based controls, on/off switches, and float switches.

Dry rotor, two-piece circulator pump – means a single stage, rotodynamic, single-axis flow, close-coupled, dry rotor pump that: (1) has a hydraulic power less than or equal to 5 horsepower at best efficiency point at full impeller diameter, (2) is distributed in commerce with a horizontal motor, and (3) discharges the pumped liquid through a volute in a plane perpendicular to the shaft. Examples include, but are not limited to, pumps generally referred to in industry as CP2.

Dry rotor, three-piece circulator pump – means a single stage, rotodynamic, single-axis flow, mechanically coupled, dry rotor pump that: (1) has a hydraulic power less than or equal to 5 horsepower at best efficiency point at full impeller diameter, (2) is distributed in commerce with a horizontal motor, and (3) discharges the pumped liquid through a volute in a plane perpendicular to the shaft. Examples include, but are not limited to, pumps generally referred to in industry as CP3.

Energy Rating (ER) – is a value which communicates the relative energy usage of a basic model compared to other basic models in its equipment class. It provides an easy method to calculate comparative energy savings and the energy cost savings. Refer to Section 41.5.4.2 for the calculation.

ER Program – The Hydraulic Institute Energy Rating Program.

External input signal control – means a variable speed drive that adjusts the speed of the driver in response to an input signal from an external logic and/or user interface.

HI Approved Pump Test Laboratory – Laboratory that has been audited and maintains approval status per the requirements of HI 40.7 *Program Guide for Pump Test Laboratory Approval*. For more information on HI's Pump Test Lab Approval Program and approved laboratories, visit www.pumps.org/40.7.

Horizontal motor – means a motor that requires the motor shaft to be in a horizontal position to function as designed under typical operating conditions, as specified in manufacturer literature.