ASME EA-2–2009

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Energy Assessment for Pumping Systems

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

ASME
SETTING THE STANDARD

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This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda issued to this edition.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Periodically certain actions of the ASME EA Committee may be published as Cases. Cases and interpretations are published on the ASME Web site under the Committee Pages at http://cstools.asme.org as they are issued.

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CONTENTS

FOREWORD

This document provides a standardized framework for conducting an energy assessment of pumping systems, hereafter referenced as an "assessment." A pumping system is defined as one or more pumps and those interacting or interrelating elements that together accomplish the desired work of moving fluid. A pumping system thus generally includes pump(s), driver, drives, distribution piping, valves, sealing systems, controls, instrumentation, and end-use equipment such as heat exchangers. Assessments involve collecting and analyzing system design, operation, energy use, and performance data and identifying energy performance improvement opportunities for system optimization. An assessment may also include additional information, such as recommendations for improving resource utilization, reducing per unit production cost, reducing life-cycle costs, and improving environmental performance related to the assessed system(s).

This Standard provides a common definition for what constitutes an assessment for both users and providers of assessment services. The objective is to provide clarity for these types of services which have been variously described as energy assessments, energy audits, energy surveys, and energy studies. In all cases, systems (energy-using logical groups of industrial equipment organized to perform a specific function) are analyzed through various techniques such as measurement, resulting in the identification, documentation, and prioritization of energy performance improvement opportunities.

This Standard sets the requirements for conducting and reporting the results of an assessment that considers the entire system, from energy inputs to the work performed as the result of these inputs. An assessment complying with this Standard need not address each individual system component or subsystem within an industrial facility with equal weight; however, it must be sufficiently comprehensive to identify the major energy efficiency opportunities for improving the overall energy performance of the system. This Standard is designed to be applied primarily at industrial facilities, but many of the concepts can be used in other facilities such as those in the institutional, commercial, and municipal sectors.

This Standard is part of a portfolio of documents and other efforts designed to improve the efficiency of industrial facilities. Initially, assessment standards are being developed for compressed air, process heating, pumping, and steam systems. Other related existing and planned efforts to improve the efficiency of industrial facilities include

(a) ASME guidance documents for the assessment standards, which provide technical background and application details to support understanding of the assessment standards. These guidance documents provide rationale for the technical requirements of the assessment standards and give technical guidance, application notes, alternate approaches, tips, techniques, and rules-of-thumb.

(b) a certification program for each ASME assessment standard that recognizes certified practitioners as individuals who have demonstrated, via a professional qualifying exam, that they have the necessary knowledge and skills to properly apply the assessment standard.

(c) an energy management standard, "Asset Management System for Energy, ANSI/MSE 2000:2008," which is a standardized approach to managing energy supply, demand, reliability, purchase, storage, use, and disposal, and is used to control and reduce an organization's energy costs and energy-related environmental impact. Note: This ANSI standard will eventually be superseded by ISO 50001, now under development.

(d) an ANSI-accredited measurement and verification protocol that includes methodologies for verifying the results of energy efficiency projects.

(e) a program, Superior Energy Performance, that will offer ANSI-accredited certification for energy efficiency through application of ANSI/MSE 2000:2008 and documentation of a specified improvement in energy performance using the ANSI measurement and verification protocol.

The complementary documents described above, when used together, will assist organizations seeking to establish and implement company-wide or site-wide energy plans.

ASME EA-2–2009 was approved by the EA Industrial System Energy Assessment Standards Committee on October 1, 2009 and approved by the American National Standards Institute (ANSI) on December 2, 2009.

EA INDUSTRIAL SYSTEM ENERGY ASSESSMENT STANDARDS COMMITTEE

(The following is the roster of the Committee at the time of approval of this Standard.)

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General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending Committee meetings. Correspondence should be addressed to:

Secretary, EA Committee
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New York, NY 10016-5990
http://go.asme.org/Inquiry

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Proposing a Case. Cases may be issued for the purpose of providing alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee Web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard, the paragraph, figure or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

Interpretations. Upon request, the EA Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the EA Committee.

The request for interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his request in the following format:

Subject: Cite the applicable paragraph number(s) and a concise description.

Edition: Cite the applicable edition of the Standard for which the interpretation is being requested.

Question: Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in this format will be rewritten in this format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The EA Committee holds meetings or telephone conferences, which are open to the public. Persons wishing to attend any meeting or telephone conference should contact the Secretary of the EA Standards Committee.

ENERGY ASSESSMENT FOR PUMPING SYSTEMS

1 SCOPE AND INTRODUCTION

1.1 Scope

This Standard covers pumping systems, which are defined as one or more pumps and those interacting or interrelating elements that together accomplish the desired work of moving a fluid. A pumping system thus generally includes pump(s), driver, drives, distribution piping, valves, sealing systems, controls, instrumentation, and end-use equipment such as heat exchangers. This Standard addresses open and closed-loop pumping systems typically used in industry, and is also applicable to other applications.

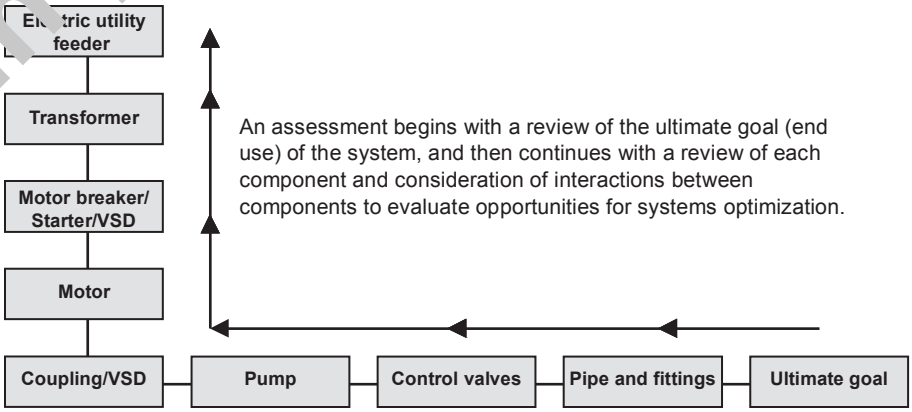
This Standard sets the requirements for conducting and reporting the results of a pumping system assessment (hereafter referenced as an "assessment") that considers the entire pumping system, from energy inputs to the work performed as the result of these inputs. An assessment complying with this Standard need not address each individual system component or subsystem within an industrial facility with equal weight; however, it must be sufficiently comprehensive to identify the major efficiency improvement opportunities for improving the overall energy performance of the system. This Standard is designed to be applied primarily at industrial facilities, but many of the concepts can be used in other facilities such as institutional, commercial, and water and wastewater facilities.

Assessments involve collecting and analyzing system design, operation, energy use, and performance data, and identifying energy performance improvement opportunities for system optimization. An assessment may also include other information, such as recommendations for improving resource utilization, reducing per unit production cost, reducing life-cycle costs, and improving environmental performance related to the assessed system(s). Assessment activities may include, but are not limited to, engaging facility personnel and providing information about the assessment process; collecting and analyzing data on system design, operation, energy use, and performance; identifying energy performance improvement opportunities and making recommendations for system improvement and implementation in a written report. The report should document system design; quantify energy consumption and performance data; document the assessment process; show results, recommendations and savings projections; and improve facility personnel's understanding of system energy use and operation.

All system assessments start with identifying the ultimate goal of the system. When the ultimate goal of the system has been established, the assessment continues to investigate how well-suited the existing system is to deliver the needed output from the perspective of both component selection and energy efficiency. See Fig. 1. An assessment thus encompasses more than just looking at input and output of energy.

This Standard sets requirements for: organizing and conducting a pumping system assessment; analyzing the data from the assessment; and reporting

Fig. 1 System Assessment Approach



and documentation of assessment findings. When contracting for assessment services, plant personnel may use the Standard to define and communicate their desired scope of assessment activity to third party contractors or consultants.

This Standard differentiates between and has requirements for three levels of assessments:

(a) Level 1 (prescreening) assessment is a qualitative investigation that is intended to determine the magnitude of energy optimization potential and therefore determine the necessity for a Level 2 or Level 3 assessment. The Level 1 assessment is used to identify specific systems for further analysis. A Level 1 study may be performed prior to beginning the Level 2 or Level 3 study. Alternately, a Level 1 assessment may be performed in concert with the Level 2 or 3 assessments. In this case, if a given pumping system does not pass the prescreening criteria indicating a Level 2 or Level 3 assessment is required, the assessment process for that pumping system is considered complete.

(b) Level 2 assessment is a quantitative (measurement-based) investigation meant to determine the energy savings potential for at least one operating condition. This assessment is performed using data taken from the plant information systems or by using portable measuring devices. The measurements usually cover a limited amount of time, thus giving a snapshot of the operating conditions at the time of measurement. In systems with little or no variability, a Level 2 assessment shall be used to determine the savings potential.

(c) Level 3 assessment is also a quantitative investigation, requiring measurements taken over an extended period of time sufficient to develop a system load profile. This activity is usually associated with more extensive use of in-situ monitoring to ensure that the operating conditions can be accurately determined at the various duty points. The data analysis is also more complex.

All pumping system assessments should start with a Level 1 assessment. During this prescreening, the pumping systems that will undergo further investigation are identified and selected. The outcome of the prescreening process shall be the selection of the best candidates, typically those with significant energy savings potential, for more in depth analysis (Level 2 or Level 3 assessment). The assessment team shall determine which systems require a Level 2 or Level 3 assessment based on the criteria presented in section 5. An overview of the decision making process for each of the levels are provided in Fig. 2 (see para. 5.2).

1.2 Limitations

This Standard does not provide guidance on how to perform a pumping system assessment, but sets the requirements that need to be performed during the system assessment. For additional assistance, see the companion *ASME Guide for ASME EA-2-2009 Energy Assessment for Pumping Systems* on how to apply this Standard.

(a) This Standard does not specify how to design a pumping system.

(b) This Standard does not specify the qualifications and expertise required of the person using the Standard.

(c) This Standard does not specify how to implement the recommendations developed during the assessment, but does include requirements for an implementation action plan.

(d) This Standard does not specify how to measure and validate the energy savings that result from implementing assessment recommendations.

(e) This Standard does not specify how to calibrate test equipment used during the assessment.

(f) This Standard does not specify how to estimate the implementation cost or conduct financial analysis for recommendations developed during the assessment.

(g) This Standard does not specify specific steps required for safe operation of equipment during the assessment. The plant personnel in charge of normal operation of the equipment are responsible for ensuring that it is operated safely during the data-collection phase of the assessment.

(h) For outside individuals working in a private or publicly owned company facility, issues of intellectual property, security, confidentiality, and safety shall be addressed before beginning an assessment. While the importance of satisfying these requirements and related issues is acknowledged, they are not addressed in this Standard.

2 DEFINITIONS

assessment: activities undertaken to identify energy performance improvement opportunities in a system which consider all components and functions, from energy inputs to the work performed as the result of these inputs. Individual components or subsystems may not be addressed with equal weight, but system assessments must be sufficiently comprehensive to identify the major energy efficiency opportunities for improving overall system energy performance. System impact versus individual component characteristics should be discussed.

best efficiency point (BEP): the rate of flow and head at which the pump efficiency is at its maximum for a given operating speed.

bypass control: bypassing flow from the discharge to the suction side of the pump through a special conduit.

cavitation: a phenomenon in which the local pressure drops below the vapor pressure of the fluid, resulting in the liquid flashing to vapor, but with subsequent pressure recovery, resulting in the vapor pockets violently collapsing back to the liquid state. This can occur within the pump or at other locations in the system.

centrifugal pump: the most common type of rotodynamic pump. Rotodynamic pumps are kinetic machines in