

ASME EA-2-2009: An Energy Assessment Standard for Pumping Systems

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Abstract

During 2008 a draft assessment standard for pumping systems was produced for ANSI with support from U.S. Department of Energy. The standard was written by a core group of specialists. The work was continually reviewed by a reference group consisting of industry specialists and end-users. A long-term goal is that this assessment standard together with other standards will be a basis for an ISO standard.

The standard is accompanied by a guidance book that contains supplemental information related to applying the standard. It contains the following chapters:

Foreword

1. Scope

2. Definitions

3. References

4. Organizing the Assessment

5. Conducting the Assessment

6. Analysis of data from the assessment

7. Reporting and Documentation

Appendix A – Bibliography

Appendix B – Prescreening Worksheet

This paper gives a presentation of the standard and highlights the essential parts of the assessment procedures.

1. Introduction.

A number of initiatives in the area of energy conservation are presently underway in different parts of the world. In Europe, the European Union (EU) has launched the Directive 2006/32/EC on Energy End-Use and Energy Services. In U.S. a revision of the MSE 2000:2008 (Energy Management) is taking place. In connection with this work the American Society of Mechanical Engineers (ASME) was contacted in 2007 to serve as the oversight developer of a portfolio of American National Standards Institute (ANSI) standards and associated guidance regarding *energy efficiency assessments of*

compressed air, pumping, steam and process heating systems. The work is being undertaken in cooperation with a public/ private initiative, Superior Energy Performance (SEP), which includes: U.S. Department of Energy's Industrial Technologies Program (DOE/ITP), U.S. Environmental Protection Agency's ENERGY STAR Program for Industry (EPA Industry), National Institute of Standards and Technology (NIST) Manufacturing Extension Partnership (MEP), Texas Industries of the Future (TX IOF), ANSI, and U.S. Industry.

This work will initially include a set of four (4) ASME standards. If the initial work is successful, it is expected that the portfolio will expand in future years to include additional systems and selected industrial processes. The standards are accompanied by guidance documents that contain information about how to apply the standards. One of the goals was to make the standards as uniform as possible in order to minimize and facilitate the efforts needed by an end-user.

It is anticipated that these systems standards will be applied in industrial facilities to assist in the identification and development of energy saving projects. The U.S. Superior Energy Performance program (SEP) seeks to certify industrial facilities for energy efficiency. The use of these standards will offer an attractive path for plants seeking certification for energy efficiency to demonstrate the improvements in energy intensity required to qualify for certification.

The standards were written by experts under contract with U.S. DOE in cooperation with ASME Codes & Standards Project Teams, one for each standard, including volunteers from industry, utilities, equipment manufacturers, energy efficiency organizations, and government. The Project Teams report to the Energy Assessment Standards Committee with members representing a balanced interest of respective industries and end users. The contents were discussed and reviewed during frequent web-conferences and teleconferences while the standards were being developed.

The four draft standards went through an initial field testing beginning in the Fall of 2008 and continuing through January of 2009. Based on input from the field testing, the standards have been modified and are anticipated to be available for public review and comment by July 2009, with publication in late 2009.

Technical and financial assistance was made available through DOE/ITP in order to meet this aggressive timetable.

This paper gives a short presentation of the pump assessment standard, which is now also used as a reference document for an ISO new work item proposal (NWIP).

2. Outline of the content of ASME EA-2 – Energy Assessment for Pumping Systems

The draft ASME EA-2 – Energy Assessment for Pumping Systems, sets requirements for

- 1) organizing and conducting an assessment,
- 2) analyzing the data from an assessment
- 3) assessment reporting and documentation.

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.

The Standard consists of 7 Chapters:

1. Scope

2. Definitions
3. References
4. Organizing the Assessment
5. Conducting the Assessment
6. Analysis of data from the Assessment
7. Reporting and documentation

As mentioned above there is also a guidance document that provides supplemental information useful to those applying the standard.

3. Three Assessment Levels

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

- 1) The 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 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 3 assessment is required, the assessment process for that pumping system is considered complete.
- 2) The 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.
- 3) The 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.

Table 1. Assessment Levels

Activities	Level 1 Assessment	Level 2 Assessment	Level 3 Assessment
Prescreening opportunities	Required	n/a	n/a

Walk through	Optional	Required	Required
Identify systems with potential saving opportunities	Required	Required	Required
Evaluate systems with potential saving opportunities	Optional	Required	Required
Snapshot type measurement of flow, head and power data	Optional	Required	n/a
Measurement / data logging of systems with flow conditions that vary over time *	n/a	n/a	Required

* Verify and use data from plant historical information where applicable

3.1 Assessment Levels 1 and 2

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 (if any) require a Level 2 or 3 assessment based on the criteria presented in the standard.

In general, the steps taken during the prescreening shall include:

- Sort by system size, annual operating hours, and estimated energy cost,
- Focus on *centrifugal pumps* operating at fixed speed,
- Focus on pump systems that *throttle, recirculate or by-pass* for flow control,
- Look for energy-waste symptoms such as large difference in supply and demand, commonly achieved through valve throttling and by-pass flows (reference section 5.4),
- Identify bad actors via maintenance and operational staff interviews and review of maintenance records
- Select for assessment those systems that appear most likely to exhibit savings potential.

From this information the assessment team makes estimates regarding the potential for energy savings in each system and prioritizes the continuing work. To some degree it might be possible at this stage to determine if a system should be assessed according to level 2 or 3. Systems with a size smaller than an agreed limit are usually excluded.

An overview of the assessment levels and related activities is shown in Table 1. The standard discusses the different assessment levels in detail. It sets demands on what should be measured at the different levels.

There are also flowcharts to help the user navigate through the different phases of an assessment. See figures 1 and 2.

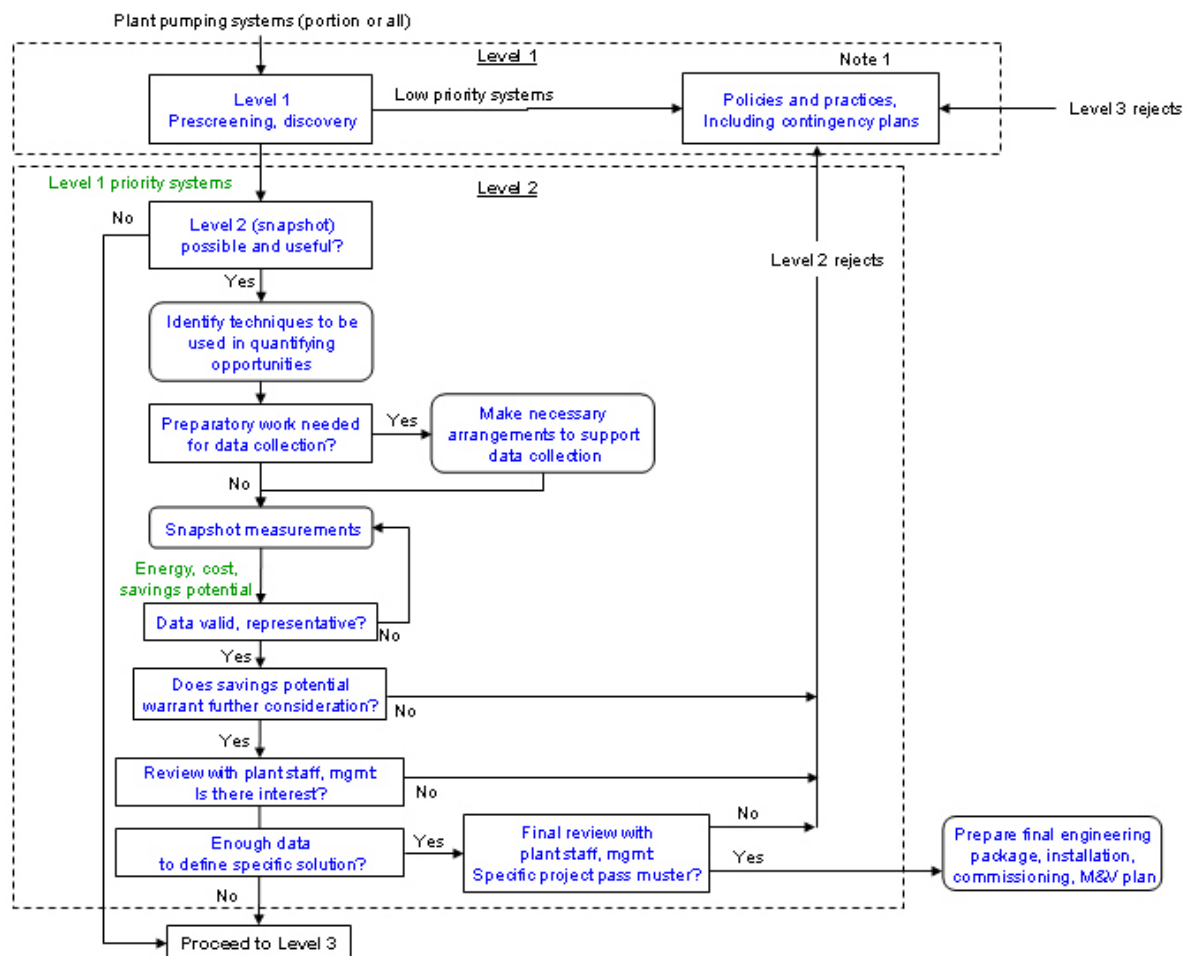


Figure 1. Flow chart for assessment levels 1 and 2.

3.2 Assessment Level 3

A Level 3 assessment is similar to a level 2 assessment but it is understood that it is more complicated since a “snapshot” of the system is not enough to assess the system. System conditions have to be measured during a period long enough to capture all operating conditions. The data reduction therefore also becomes more complicated.

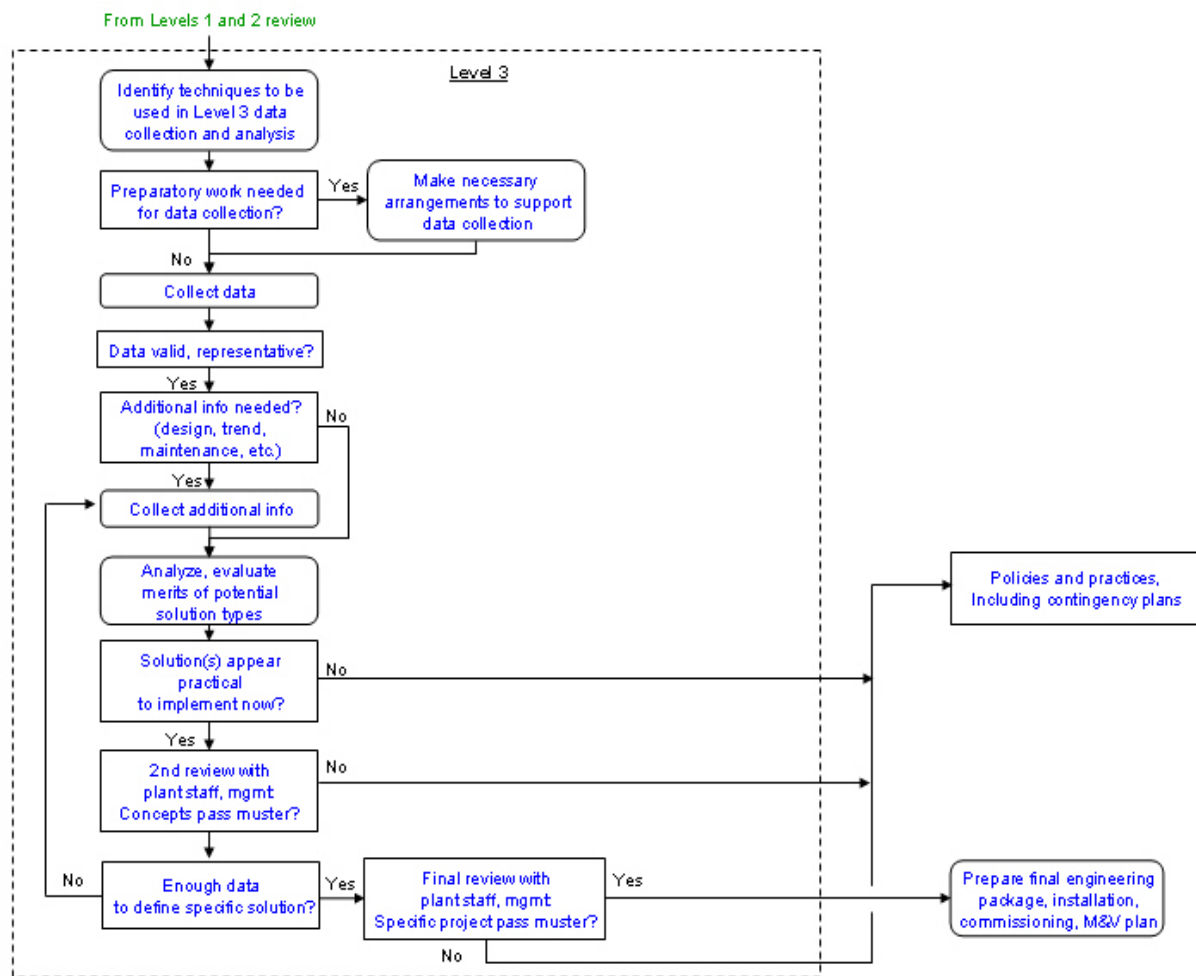


Figure 2. Assessment flow chart for a level 3 assessment

4. System requirements, system boundaries and data needed

It is of utmost importance that the system requirements are understood before starting an assessment. In some complex systems it might not be possible to assess a pump system without knowledge and understanding about other types of systems that are connected to or served by the pump system.

The standard stresses the importance of determining system boundaries and system demand.

It further lists and details the information that is needed to assess a pump system such as:

- 1) Driver information
- 2) Motor information
- 3) Pump information
- 4) Fluid properties
- 5) System data
- 6) Operational information

It differentiates between information that can be collected from data associated with the equipment and system and operating data that has to be measured. The measured data being:

1. Pressure
2. Flow
3. Power

5. Analysis of data gathered during the assessment

The standard discusses common causes and remedies for excessive energy use. Remedies discussed include:

- Reduction of system head
- Reduction of flow rate
- Ensuring that components operate close to best efficiency
- Change of run time

The standard is “tool neutral”. It does not prescribe that any specific tool has to be used in the assessment, since that could hamper development of new tools. There is, however, a requirement that the tools used should be transparent so that any person that looks at the assessment report should be able to understand how the results are obtained.

The basic energy reduction opportunity calculations are listed and it is shown how to compare existing and optimal energy use and how to calculate excessive system energy use.

6. Reporting and documentation

The last chapter of the standard defines how the assessment will be reported and documented. It lists the information to be included:

- General information about the facility
- A summary table that identifies potential improvements with preliminary energy and cost savings estimates
- General description of systems reviewed
- Assessment methods
- Facility energy use data
- Analysis and recommended improvements
- General comments and observations

7. Conclusion

Europump and the Hydraulic Institute (HI) have decided to move forward with an ISO standard for Pump System Assessments.

A NWIP (New Work Item Proposal) on Pump system energy assessment - **ISO/TC115 WG7-** was sent out for vote in June 2009. The U.S. Technical Advisory Group (TAG) as well as a number of European organizations have voted to move forward with an ISO standard for Pump System Assessments and nominated participants.

A working group ISO PC242 has been created. It is anticipated that the **ASME EA-2-2009** standard will serve as a reference document together with other international documents for a new ISO standard. The first working meeting will take place in October 2009 in Paris.