ASRAC Pumps Working Group
DOE Regulation and Metric Proposal

Lucas Adin
BUILDING TECHNOLOGIES PROGRAM
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Pump Configurations

• A ‘pump’ is typically sold one of three ways:

  1. Bare pump
  2. Pump + motor
  3. Pump + motor + controls

• DOE does not expect to consider:
  – Drivers other than electric motors, e.g., engines, steam turbines
    • Only applies to estimated ~1-2% of clean water pumps
  – Mechanical equipment, e.g., belts, gears
    • Not typically relevant to clean water pumps
Proposed Definitions

• ‘Pump’ is a device, inclusive of mechanical equipment, driver, and -- when present -- controls, that moves fluids by physical or mechanical action.

- ‘Bare pump’ will be defined as inclusive of the various pump types/equipment classes considered for coverage.
- ‘Mechanical equipment’ may include belts, gears, or other equipment.
- ‘Driver’ may include an electric motor, natural gas or diesel engine, or steam-driven turbine.
- ‘Controls’ means any device that automatically adjusts the speed of the motor in response to system feedback, including, but not limited to, Variable Frequency Drives (VFDs).
## Metric Applicability to Pump Configurations

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Bare Pump</th>
<th>Pump+Motor</th>
<th>Pump+Motor+Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump Efficiency</td>
<td>✔</td>
<td>Does not capture motor efficiency</td>
<td>Does not capture control losses or benefits</td>
</tr>
<tr>
<td>Overall Efficiency (w/ std. motor)</td>
<td>✔</td>
<td>✔</td>
<td>Does not capture power reduction</td>
</tr>
<tr>
<td>Weighted Avg. Electric Input Power (w/ std. motor)</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

The only metric that captures efficiency implications of all components of a ‘pump’ and therefore works for all configurations is an electric input power based metric.

- By using a single metric, each pump configuration may have its own equipment class set with a unique standard or equipment could be combined into one set with higher efficiency motors and controls as design options.
## Testing Overview

<table>
<thead>
<tr>
<th></th>
<th>Bare Pump</th>
<th>Pump +Motor</th>
<th>Pump+Motor+Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment tested</td>
<td>Test bare pump alone</td>
<td>Option A: Test bare pump alone and combine with motor performance data</td>
<td>Option A: Test bare pump alone and combine with motor+controls performance data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Option B: Test pump+motor</td>
<td>Option B: Test pump+motor+controls</td>
</tr>
<tr>
<td>Variable load profile device</td>
<td>Throttling</td>
<td>Throttling</td>
<td>Speed reduction</td>
</tr>
<tr>
<td>Covered equipment</td>
<td><a href="#">Diagram</a></td>
<td><a href="#">Diagram</a></td>
<td><a href="#">Diagram</a></td>
</tr>
</tbody>
</table>

**Diagram:**
- **Std. Motor**
- **Motor**
- **Control**
- **Pump**
Bare Pump

- Standard motor will be AC Induction, NEMA Design B, open enclosure.
  - HP used will be next HP above brake horsepower at 120% BEP.
  - Poles will be based on speed at which pump is being rated.
- Standard full load motor efficiency based on Federal standards.
- Standard motor part-load curves based on DOE Motor Masters database.
Pump Motor

A

- Pump performance data from pump test at rated speed
- Manufacturer motor efficiency at full and part load

B

- Manufacturer can pair its pump data with manufacturer motor data tested in accordance with DOE motor TP.
- Manufacturer can measure power of pump + motor combo.

- ‘A’ will be required except for submersible pumps or in certain other cases – e.g., when shaft input power cannot be measured, or potentially when motor is not covered by DOE standard and cannot be rated with DOE motor TP.
Pump+Motor+Controls

A

- Pump performance from pump test at rated and reduced speed
- Manufacturer can pair its pump data with tested motor+VFD data.

B

- Pumps with ECMs or other motor technologies with multiple or variable speeds may be tested as pump+motor+controls.
- Quadratic system curve will be specified for part-load points.
- ‘A’ will be required except for submersible pumps or in certain other cases – e.g., when shaft input power cannot be measured or controls cannot be rated with AHRI 1210.
- Because AHRI 1210 is a voluntary standard, manufacturer burden will be taken into account for both approaches.

VFD MOTOR

manufacturer motor/VFD performance map from AHRI 1210 or similar – certified or test data

Controls MOTOR PUMP

Manufacturer can measure power of pump+motor+controls combo.