

# DIN EN 16480:2017-07 (E)

## Pumps - Minimum required efficiency of rotodynamic water pumps

---

<b>Contents</b>		<b>Page</b>
European foreword .....		4
Introduction .....		5
<b>1</b>	<b>Scope .....</b>	<b>7</b>
<b>2</b>	<b>Normative references .....</b>	<b>8</b>
<b>3</b>	<b>Terms and definitions .....</b>	<b>8</b>
<b>3.1</b>	<b>General .....</b>	<b>8</b>
<b>3.2</b>	<b>List of quantities with definitions .....</b>	<b>8</b>
<b>3.3</b>	<b>Lists of basic letters and subscripts .....</b>	<b>10</b>
<b>3.4</b>	<b>General definitions .....</b>	<b>12</b>
<b>4</b>	<b>Minimum Required Efficiencies and Minimum Efficiency Index .....</b>	<b>14</b>
<b>4.1</b>	<b>The concept of "house of efficiency" .....</b>	<b>14</b>
<b>4.2</b>	<b>Mathematical representation of minimum required efficiency .....</b>	<b>15</b>
<b>4.3</b>	<b>Minimum efficiency at part load and overload .....</b>	<b>16</b>
<b>4.4</b>	<b>Minimum Efficiency Index .....</b>	<b>17</b>
<b>5</b>	<b>Determination of the Efficiency of a Test Pump .....</b>	<b>20</b>
<b>5.1</b>	<b>General .....</b>	<b>20</b>
<b>5.2</b>	<b>Test Procedures .....</b>	<b>20</b>
<b>5.3</b>	<b>Test conditions .....</b>	<b>21</b>
<b>5.4</b>	<b>Measuring uncertainties .....</b>	<b>22</b>
<b>5.5</b>	<b>Evaluation of test data .....</b>	<b>24</b>
<b>6</b>	<b>Proving the Minimum Efficiency Index of a pump size .....</b>	<b>29</b>
<b>6.1</b>	<b>General remarks .....</b>	<b>29</b>
<b>6.2</b>	<b>Determination of the Minimum Efficiency Index of a pump size .....</b>	<b>30</b>
<b>7</b>	<b>Verification of the Minimum Efficiency Index for a pump size .....</b>	<b>31</b>
<b>7.1</b>	<b>General remarks .....</b>	<b>31</b>
<b>7.2</b>	<b>Procedure and decision .....</b>	<b>31</b>
<b>Annex A (normative) Pump types in scope .....</b>		<b>35</b>
<b>Annex B (informative) General remarks on the efficiency of rotodynamic pumps .....</b>		<b>37</b>
<b>Annex C (informative) Mean Values of a Size Relevant for its Minimum Efficiency Index .....</b>		<b>39</b>
<b>Annex D (informative) Methods recommended for manufacturers to determine the mean values of hydraulic quantities of a size relevant for MEI .....</b>		<b>44</b>
<b>D.1</b>	<b>General remarks .....</b>	<b>44</b>
<b>D.2</b>	<b>Determination of the mean efficiency of a pump size from a test on one single test pump .....</b>	<b>44</b>
<b>D.3</b>	<b>Determination of the mean efficiency of a pump size from a sample of M test pumps .....</b>	<b>46</b>
<b>Annex E (informative) Numerical example .....</b>		<b>49</b>
<b>Annex F (informative) Application of mathematical statistics on tests .....</b>		<b>54</b>

<b>F.1</b>	<b>Purposes of applying statistics in the frame of qualification and verification .....</b>	<b>54</b>
<b>F.2</b>	<b>Confidence interval .....</b>	<b>55</b>
<b>F.3</b>	<b>Law of error propagation .....</b>	<b>57</b>
<b>F.4</b>	<b>Numerical example .....</b>	<b>57</b>
<b>Annex G (informative) Measurement uncertainties .....</b>		<b>64</b>
<b>G.1</b>	<b>General remarks .....</b>	<b>64</b>
<b>G.2</b>	<b>Determination of the overall measurement uncertainty of efficiency .....</b>	<b>66</b>
<b>Annex H (informative) Explanations concerning the methodology of the verification procedure and the probability of the results .....</b>		<b>68</b>
<b>Annex I (informative) Reporting of Test Results .....</b>		<b>71</b>
<b>I.1</b>	<b>Test Report Requirements .....</b>	<b>71</b>
<b>I.2</b>	<b>Pump test sheet .....</b>	<b>71</b>
<b>Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2009/125/EC, establishing a framework for the setting of ecodesign requirements of energy related products and implemented by the European Commission Regulation (EU) No. 547/2012 .....</b>		<b>73</b>
<b>Bibliography .....</b>		<b>74</b>