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**Minimum allowable values of energy efficiency and
energy efficiency grades for petrochemical centrifugal
pumps**

石油化工离心泵能效限定值及能效等级

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Minimum allowable values of energy efficiency and energy efficiency grades for petrochemical centrifugal pumps

1 Scope

This Standard specifies the basic requirements for petrochemical centrifugal pumps (hereinafter referred to as “pumps”), efficiency calculation methods for pumps, energy efficiency grades for pumps, minimum allowable values of energy efficiency for pumps, target minimum allowable values of energy efficiency for pumps, and evaluating values of energy conservation for pumps.

This Standard applies to single-stage single-suction pumps and single-stage double-suction pumps with closed (maximum) impellers installed which deliver clean liquids.

This Standard does not apply to clean-water centrifugal pumps, non-metallic centrifugal pumps, and seal-less rotodynamic pumps.

2 Normative references

The following documents are indispensable for the application of this document. For the dated references, only the editions with the dates indicated are applicable to this document. For the undated references, the latest edition (including all the amendments) are applicable to this document.

GB/T 3215 Centrifugal pumps for petroleum petrochemical and natural gas industries

GB/T 3216 Rotodynamic pumps - Hydraulic performance acceptance tests - Grades 1, 2 and 3

GB/T 5656 Technical specification for centrifugal pumps - Class II

GB/T 7021 Glossary of terms for centrifugal pump

GB/T 13006 NPSH for centrifugal, mixed flow and axial flow pump

3 Terms and definitions

The terms and definitions as defined in GB/T 7021 and the following ones apply to this document.

3.1 Specified point

The point on the pump performance curve determined by the specified flow and the specified head.

3.2 Minimum allowable values of energy efficiency for pumps

The minimum efficiency of the specified point allowed under the test conditions specified by the standard.

3.3 Target minimum allowable values of energy efficiency for pumps

The minimum efficiency of the specified point allowed after the implementation of this Standard for a certain period of time.

3.4 Evaluating values of energy conservation for pumps

The minimum efficiency of the specified point which shall be achieved to meet the energy conservation certification requirements under the test conditions specified by the standard.

4 Technical requirements

4.1 Basic requirements

4.1.1 The design and manufacture of the pumps should meet the requirements of GB/T 3215 or GB/T 5656.

4.1.2 Unless otherwise agreed with the user, the required NPSH (NPSHR) of the pump's specified point shall comply with the provisions of GB/T 13006.

4.1.3 The test methods of the pumps shall comply with the provisions of GB/T 3216. The allowable tolerance coefficient of the flow (Q), head (H), efficiency (η), and NPSHR of the pump shall comply with Grade 2 regulations of GB/T 3216.

4.2 Calculation methods of pump efficiency and specific speed

4.2.1 Calculation of pump efficiency

Pump efficiency is a percentage of the ratio of pump output power (effective

n - Speed, in revolutions per minute (r/min).

4.3 Energy efficiency grades for pumps

The energy efficiency grades for pumps are divided into 3 grades, of which 1 is the highest and 3 is the lowest. The energy efficiency grades for pumps are determined according to Table 1. When the flow is greater than 3000 m³/h, the energy efficiency grade for pump is determined according to the flow $Q=3000$ m³/h. For an example of calculation method of energy efficiency grades for pumps, see Appendix A.

4.4 Minimum allowable values of energy efficiency for pumps

The minimum allowable values of energy efficiency for pumps shall not be lower than the energy efficiency grade 3 η_3 of Table 1.

4.5 Target minimum allowable values of energy efficiency for pumps

When the flow is in the range of 5 m³/h~3000 m³/h, the target minimum allowable value η_{T0} of energy efficiency for pumps is determined as follows:

- a) When $120 \leq n_s \leq 210$, any target minimum allowable value (η_{T0}) of energy efficiency in the specific speed range shall be found in Figure 1 (or Table 2);
- b) When $20 \leq n_s < 120$ and $210 < n_s \leq 300$, for any target minimum allowable value (η_T) of energy efficiency in the specific speed range, η_{T0} shall be found in Figure 1 (or Table 2); then according to Figure 2 (or Table 3) and Figure 3 (or Table 3) respectively, FIND $\Delta\eta$. Then according to formula (4), calculate η_T .

$$\eta_T = \eta_{T0} - \Delta\eta \quad \dots\dots\dots (4)$$

Where:

η_T - Target minimum allowable value of energy efficiency for pump when $20 \leq n_s < 120$ and $210 < n_s \leq 300$;

η_{T0} - Target minimum allowable value of energy efficiency for pump when $120 \leq n_s \leq 210$;

$\Delta\eta$ - Pump efficiency correction value when $20 \leq n_s < 120$ and $210 < n_s \leq 300$.

For an example of calculation method of target minimum allowable values of energy efficiency for pumps, see Appendix B.

Appendix A

(Informative)

Calculation method of energy efficiency grades for pumps

A.1 Example

The performance of the specified point of a single-stage double-suction petrochemical centrifugal pump is: $Q=800 \text{ m}^3/\text{h}$, $H=12 \text{ m}$, $n=1470 \text{ r/min}$. Calculate the efficiency value η_1 of energy efficiency grade 1, the efficiency value η_2 of energy efficiency grade 2, and the efficiency value η_3 of energy efficiency grade 3.

A.2 Calculate the specific speed n_s of pump

Substitute the above example data into formula (3) to calculate:

$$n_s = \frac{n \times 3.65 \times \sqrt{\frac{Q}{2}}}{H^{3/4}} = \frac{1\,470 \times 3.65 \times \sqrt{\frac{800}{2 \times 3\,600}}}{12^{3/4}} = 277.4$$

A.3 Calculate the efficiency values of energy efficiency grades for pumps

A.3.1 Calculate the efficiency value η_1 of energy efficiency grade 1 for pump

The efficiency value η_1 of energy efficiency grade 1 for pump may be calculated as follows:

- a) FIND the reference value η ;

According to Figure 1 (or Table 2), when $Q=800 \text{ m}^3/\text{h}$, $\eta=81.9\%$.

- b) Determine the efficiency correction value $\Delta\eta$;

According to Figure 3 (or Table 3), when $n_s=277.4$, $\Delta\eta=2.1\%$.

- c) Calculate the efficiency value η_0 of specified point of pump;

$$\eta_0 = \eta - \Delta\eta = 81.9\% - 2.1\% = 79.8\%$$

- d) Calculate the efficiency value η_1 of grade 1 for pump;

According to Table 1, when $Q=800 \text{ m}^3/\text{h}$, the efficiency value of energy efficiency grade 1 is:

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