AMENDMENT NO. 1 FEBRUARY 2023

TO

IS 14220 : 2018 OPENWELL SUBMERSIBLE PUMPSETS — SPECIFICATION

(*Page* 4, *clause* **9**) — Substitute the following *for* existing:

'**9 EFFICIENCY**

The pump efficiency of open well submersible pumps at duty point as declared by the manufacturer for 4 and 2-poles shall not be less than calculated as in **16.4.1**.'

(*Page* 8, *clause* **16.1.2,** *line* 4) — Delete 'However, after applying the tolerance, overall efficiency value shall not be less than that calculated from Fig. 5, Fig. 6 and Fig. 7.'

[*Page* 9, *clause* **16.4.1**(a)] — Substitute the following *for* existing:

'a) Pump Efficiency, Horizontal Single Stage Openwell Submersible Pumpset (Fig. 2).

$$\eta_P = 88.59\,x + 13.46\,y - 11.48\,x^2 - 0.85\,y^2 - 0.38\,xy - C \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

where

ln = Natural logarithm;
$x = \ln(n_s)$;
$y = \ln(Q)$;
n_s = Specific speed;
Q = 'Discharge Rate' in m^3/h at BEP; and
η_P= Minimum pump efficiency.

$$n_s = n \cdot \frac{\sqrt{Q_{BEP}/3\,600}}{(H_{BEP})^{0.75}}$$

where

H_{BEP} = 'Head' per stage in meters (m) at best efficiency point;
n = 'Rotational Speed' in revolutions per minute (rpm);
Q_{BEP} = 'Discharge Rate' at best efficiency point in m^3/h; and
BEP = Best efficiency point.

C - Values for Horizontal Single Stage Openwell Submersible Pumpset and Pump Efficiency Levels

Minimum Efficiency Level, MEL		**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**
C - Values for different pump efficiency levels	2 Pole, speed	133.82	132.23	130.77	129.86	128.8	127.75
	4 Pole, speed	131.2	129.77	128.46	127.38	126.57	125.46

NOTES
1 Efficiency corresponding to MEL 0.2 is taken as the minimum pump efficiency and other MEL values are for the guidance of the manufacturer and to upgrade to higher values of pump efficiency.
2 An illustrative example for calculating pump efficiency using above equation is given at Annex B.

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b) Pump efficiency, vertical/horizontal multistage open well submersible pumpsets, 2 pole and 4 pole speed (Fig. 3).

$$\eta_P = 0.657\,1\,x + 0.085\,1\,y - 0.005\,34\,x^2 - 0.000\,565\,y^2 + 0.001\,06\,xy + C \quad \ldots\ldots(2)$$

where

$x = n_s$;
$y = Q$;
n_s = Specific speed;
Q = 'Discharge Rate' in m^3/h at BEP; and
η_P = Minimum pump efficiency.

Minimum Efficiency Level, MEL	**0.20**	**0.30**	**0.40**	**0.50**	**0.60**	**0.70**
C - Values for different pump efficiency levels	42.0	44.0	45.9	47.7	49.4	51.0

NOTES

1 Efficiency corresponding to MEL 0.2 is taken as the minimum pump efficiency and other MEL values are for the guidance of the manufacturer and to upgrade to higher values of pump efficiency.
2 An illustrative example for calculating pump efficiency using above equation is given at Annex C.

$$n_s = n\,.\frac{\sqrt{Q_{BEP}/3\,600}}{(H_{BEP})^{0.75}}$$

where

H_{BEP} = 'Head' per stage in meters (m) at best efficiency point;
Q_{BEP} = 'Discharge rate' at best efficiency point in m^3/h;
n = 'Rotational speed' in revolutions per minute (rpm); and
BEP = Best efficiency point.'

(*Page* 9, *clause* **16.4.1**) — At the end, insert the following new clause:

'**16.4.2** The efficiency calculated as per **16.4.1** (b) represents three or more stages of vertical and horizontal multistage open well submersible pumpsets, 2 Pole speed.

a) For two stage pump, multiply efficiency calculated by a factor 0.98; and
b) For single stage pump, multiply efficiency calculated by a factor 0.97.'

(*Page* 9, *clause* **16.5.1**) — Substitute the following *for* existing:

'**16.5.1** For arriving overall efficiency percentage (minimum) of the pumpset, multiply pump efficiency (minimum) value calculated as per **16.4.1** (a) or **16.4.1** (b) by motor efficiency factor.'

(*Page* 11, *Annex* A) — Insert the following at the end:

'**ANNEX B**
(*Clause* 16.4.1)

EXAMPLE OF MINIMUM PUMP EFFICIENCY CALCULATION FOR HORIZONTAL SINGLE STAGE END SUCTION VOLUTE TYPE OPENWELL SUBMERSIBLE PUMPSET (2 POLE) DUTY POINT

B-1 INPUT DATA

Head = 32 m
Discharge rate = 6.5 lps
Speed = 2 900 rpm

B-2 CALCULATIONS

B-2.1 To Find Out Discharge Rate, Q_{BEP} in m^3/h

Discharge rate = 6.5 lps × 3.6 = 23.4 m^3/h

B-2.2 To Find Out Specific Speed, n_s

$$n_s = n \cdot \frac{\sqrt{Q_{BEP}/3\,600}}{(H_{BEP})^{0.75}}$$

$$n_s = 2\,900 \times \frac{\sqrt{23.4/3\,600}}{(32)^{0.75}} = 17.37$$

NOTE — For specific speed calculation we have to use discharge (Q) in m^3/h and head per stage (H) in m.

B-2.3 To Find Out Minimum Pump Efficiency, η_P

$$\eta_P = 88.59\,x + 13.46\,y - 11.48\,x^2 - 0.85\,y^2 - 0.38\,xy - C \quad \ldots\ldots\ldots\ldots (1)$$

$$x = \ln(n_s) = \ln(17.37) = 2.85$$

$$y = \ln(Q), = \ln(23.4) = 3.15$$

NOTE — For minimum pump efficiency calculation we have to use discharge (Q) in m^3/h.

C = 133.82 (C - value for MEL 0.2 to be taken from the table for minimum efficiency calculation for 2 pole)

$$\eta_P = 88.59 \times 2.85 + 13.46 \times 3.15 - 11.48 \times 2.85^2 - 0.85 \times 3.15^2 - 0.38 \times 2.85 \times 3.15 - 133.82$$

η_P = 55.97 % (Minimum pump efficiency)

ANNEX C
(*Clause* 16.4.2)

EXAMPLE OF MINIMUM PUMP EFFICIENCY CALCULATION FOR VERTICAL AND HORIZONTAL MULTISTAGE DIFFUSER TYPE OPENWELL SUBMERSIBLE PUMPSET (2 POLE) DUTY POINT

C-1 INPUT DATA

Head = 32 m
Discharge = 6.5 lps
Speed = 2 900 rpm
Stages = 02

C-2 CALCULATIONS

Head per stage = 32/2 = 16 m

C-2.1 To find Out Discharge Rate, Q in m^3/h

Discharge = 6.5 lps × 3.6 = 23.4 m^3/h

$$n_s = n \cdot \frac{\sqrt{Q_{BEP}/3\,600}}{(H_{BEP})^{0.75}}$$

$$n_s = 2\,900 \times \frac{\sqrt{23.4/3\,600}}{(16)^{0.75}} = 29.22$$

NOTE — For specific speed calculation we have to use discharge (Q) in m^3/h and head per stage (H) in m.

$$\eta_P = 0.657\,1\,x + 0.085\,1\,y - 0.005\,34\,x^2 - 0.000\,565\,y^2 + 0.001\,06\,xy + C \quad \text{.....(2)}$$

$$x = n_s = 29.22$$

$$y = Q = 23.40$$

NOTE — For minimum pump efficiency calculation we have to use discharge (Q) in m^3/h.

C = 42 (C - value for BIS-MEL 0.2 to be taken from the table for minimum pump efficiency calculation)

$$\eta_P = 0.657\,1 \times 29.22 + 0.085\,1 \times 23.4 - 0.005\,34 \times 29.22^2 - 0.000\,565 \times 23.4^2 + 0.001\,06 \times 29.22 \times 23.4 + 42$$

η_P= 59.05 % × 0.98 (Factor for 2 stage)

η_P= 57.86 % (Minimum pump efficiency)'

(*Page* 14, *Fig.* 5) — Delete.

(*Page* 15, *Fig.* 6) — Delete.

(*Page* 16, *Fig.* 7) — Delete.

(MED 20)

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