Schroefkeuze

Instructiecollege Hydromechanica 3
door Pepijn Pennings

Motor

Maximaal asvermogen

$$P_D = 790\ kW$$

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$$n = \frac{108}{60} = 1.8\ \ omw/s$$

Romp

Weerstand

$$R = cV_s{}^2$$

$$R = 50.0\ kN$$

@

$$V_s = 12\frac{1852}{3600} = 6.2\ m/s$$

Volgstroom $w = 0.30$

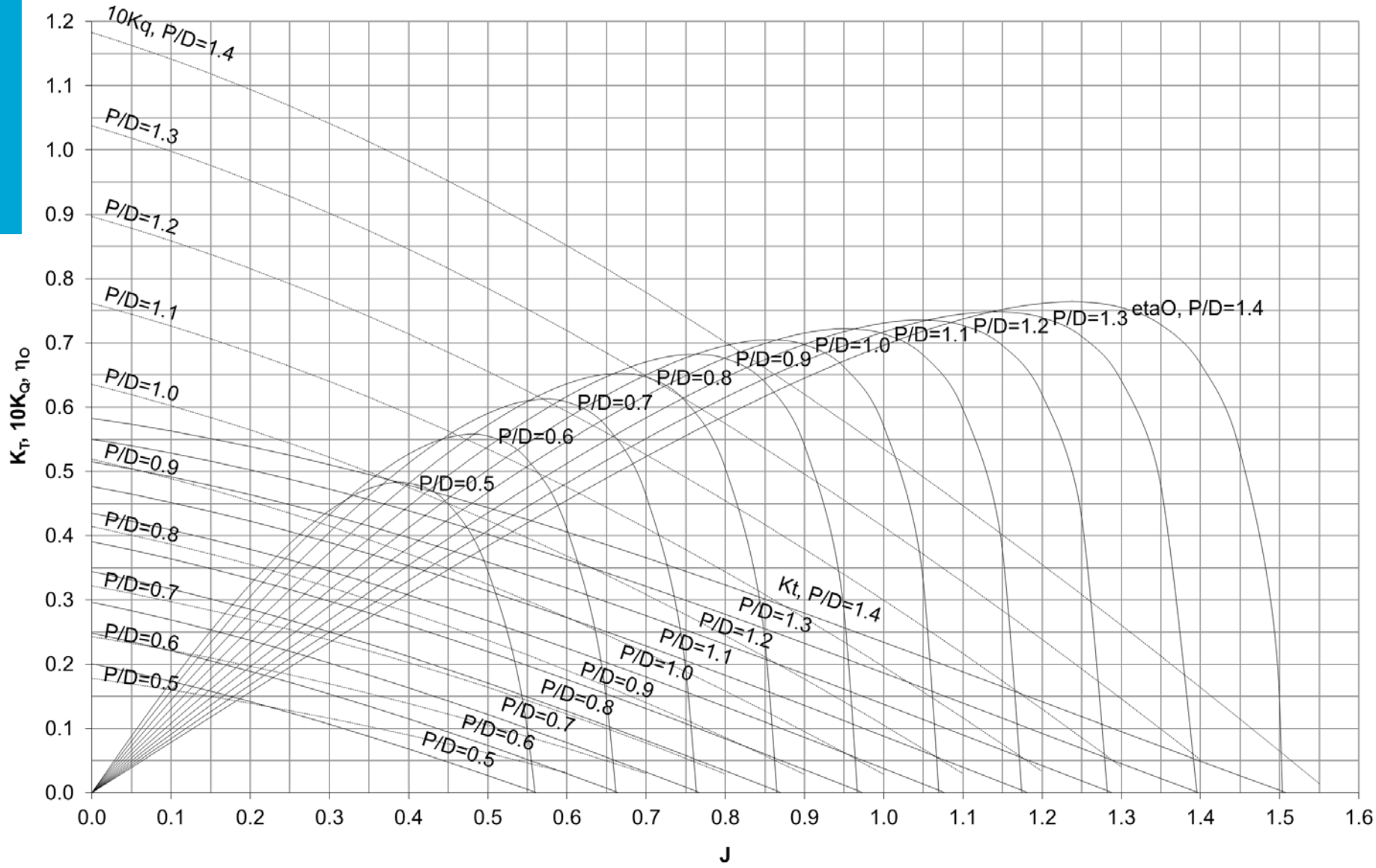
Zoggetal $t = 0.15$

Schroef

Schroefserie B4.70

Maximale diameter $3.5\ m$

B4.70 series diagram



Maximaal Vermogen

$$P_D = 2\pi n Q$$

$$\downarrow$$

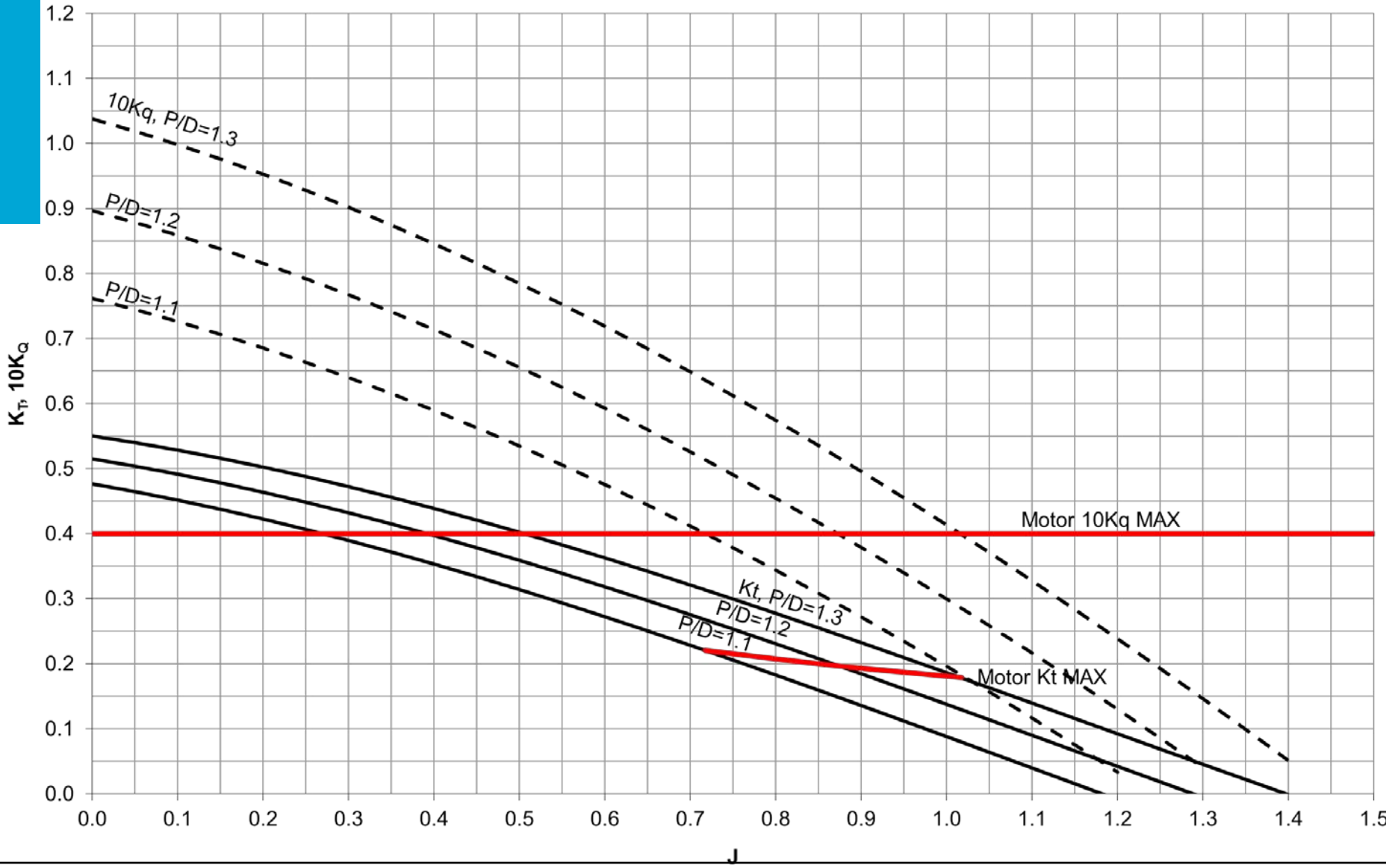
$$K_{Q(max)} = \frac{Q}{\rho n^2 D^5} = \frac{P_D}{2\pi\rho n^3 D^5} = 0.04$$

$$\downarrow$$

Schroefdiagram

$$\downarrow$$

$$K_{T(max)} = \frac{T}{\rho n^2 D^4}$$


1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
K_T, $10K_Q$
10Kq, P/D=1.3
P/D=1.2
P/D=1.1
Motor 10Kq MAX
Kt, P/D=1.3
P/D=1.2
P/D=1.1
Motor Kt MAX
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
J

Weerstand

$$R = cV_s{}^2$$

$$\downarrow$$

$$K_T = f(J) = f\left(\frac{V_e}{nD}\right)$$

$$c = \frac{R}{V_s{}^2} = \frac{50 \cdot 10^3}{6.2^2} = 1.3\,\frac{kN}{m^2/s^2}$$

$$R \rightarrow T \rightarrow K_T$$

$$V_s \rightarrow V_e \rightarrow J$$

$$R = cV_s{}^2$$

$$t = \frac{T - R}{T} \quad \rightarrow \quad R = T(1 - t)$$

$$K_T = \frac{T}{\rho n^2 D^4} \quad \rightarrow \quad T = K_T \rho n^2 D^4$$

$$R = K_T \rho n^2 D^4 (1 - t)$$

$$R = cV_s{}^2$$

$$V_e = V_s(1-w) \rightarrow \quad V_s = \frac{V_e}{1-w}$$

$$J = \frac{V_e}{nD} \qquad \rightarrow \quad V_e = nDJ$$

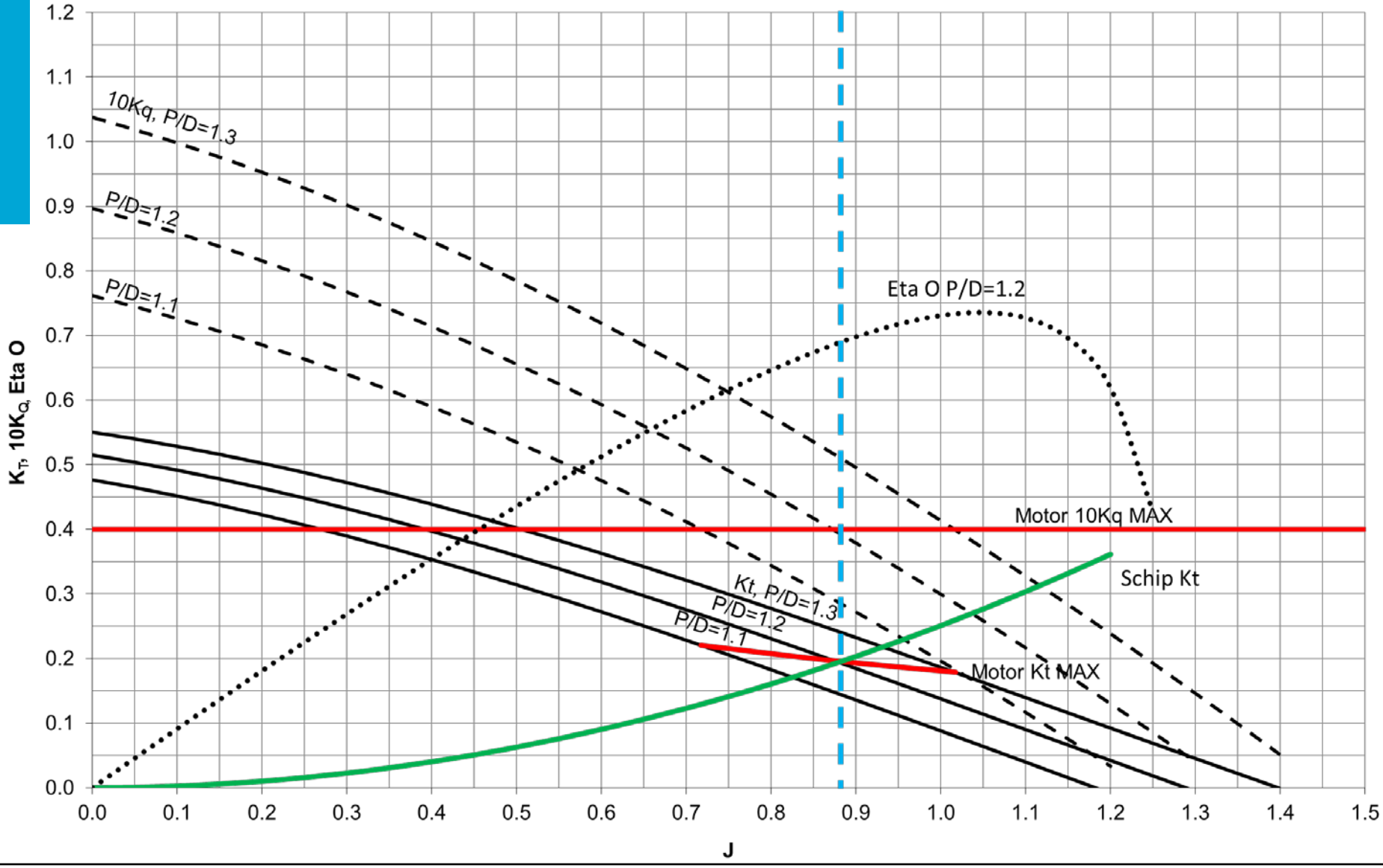
$$V_s{}^2 = \left(\frac{nDJ}{1-w}\right)^2 = \frac{n^2D^2}{(1-w)^2}J^2$$

$$cV_s{}^2 = c\frac{n^2D^2}{(1-w)^2}J^2$$

$$R = cV_s{}^2$$

$$K_T \rho n^2 D^4 (1-t) = c \frac{n^2 D^2}{(1-w)^2} J^2$$

$$K_T = \frac{c}{\rho D^2} \frac{1}{1-t} \frac{1}{(1-w)^2} J^2 = 0.251 J^2$$


10Kq, P/D=1.3
P/D=1.2
P/D=1.1
Eta O P/D=1.2
Motor 10Kq MAX
Schip Kt
Kt, P/D=1.3
P/D=1.2
P/D=1.1
Motor Kt MAX
K_T, $10K_Q$, Eta O
J
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5

Snelste combinatie Motor + Romp + Schroef

B4.70 P/D=1.2

@

$J = 0.88$

$\eta_O = 0.69$

$$V_{s(max)} = \frac{nDJ}{1-w} = 7.9\ m/s = 15.4\ knopen$$

$$K_T = 0.251\, J^2 = 0.194$$

$$K_Q = 0.04$$

$$T = \rho n^2 D^4 K_T = 96.8\ kN$$

$$Q = \rho n^2 D^5 K_Q = 69.8\ kNm$$

Totaal rendement

$$\eta_D = \eta_O \eta_H \eta_R = \frac{P_E}{P_D} = \frac{RV_s}{P_D} = \frac{cV_s{}^3}{P_D} = 0.825$$

Open water rendement

$$\eta_O = \frac{JK_T}{2\pi K_Q} = 0.69$$

Romp rendement

$$\eta_H = \frac{1-t}{1-w} = 1.21$$

Relatieve rotatie rendement

$$\eta_R = \frac{\eta_D}{\eta_O \eta_H} = 0.985$$