Centrifugal Impeller Slip (Wiesner, Pfleiderer) and Euler Head

Outlet velocity triangle of a centrifugal pump impeller, slip by Wiesner and by Pfleiderer, and the theoretical Euler head with and without slip.

Input parameters

Unit system: SI

Parameter	Value	Unit
Impeller outlet diameter	0.30000	m
Inlet (eye) to outlet radius ratio	0.40000	
Outlet width	0.020000	m
Speed	1,480.0	rpm
Flow through the impeller	180.00	m^3/h
Outlet blade angle (from tangential)	20.000	°
Number of blades	7.0000	
Pfleiderer collector factor	Volute, 0.8	
Hydraulic efficiency	85.000	%

Calculated results

Parameter	Value	Unit
Tip speed	23.248	m/s
Meridional (radial) velocity	2.6526	m/s
Whirl without slip	15.960	m/s
Wiesner slip, V_s/U_2	0.14978	
Pfleiderer slip coefficient	0.36518	
Euler head without slip	37.835	m
Euler head with Wiesner slip	29.580	m
Euler head with Pfleiderer slip	27.714	m
Pump head (Wiesner × hydraulic efficiency)	25.143	m

Notes for this case

• No pre-swirl at the inlet. Blade blockage at the outlet is ignored, which slightly underestimates the meridional velocity. regards Pfleiderer's method as the more rational for real pumps; Wiesner's is a fit to Busemann's theory.

Formula and method

$$U_2 = \frac{\omega D_2}{2}, \quad V_{m2} = \frac{Q}{\pi D_2 b_2}, \quad V_{\theta 2,\infty} = U_2 - \frac{V_{m2}}{\tan \beta_{b2}}$$

$$\frac{V_s}{U_2} = \frac{\sqrt{\sin \beta_{b2}}}{n_b^{0.7}}, \quad p = \frac{a(1+\sin \beta_{b2})\, r_2^2}{n_b\,(r_2^2 - r_1^2)/2}, \quad H = \frac{U_2 V_{\theta 2}}{g}$$

Variables

D_2	Impeller outlet diameter	m
r_1/r_2	Inlet (eye) to outlet radius ratio	-
b_2	Outlet width	m

n	Speed	rad/s
Q	Flow through the impeller	m³/s
β_{b2}	Outlet blade angle (from tangential)	rad
n_b	Number of blades	-
a	Pfleiderer collector factor	-
η_h	Hydraulic efficiency	-
U_2	Tip speed	m/s
V_{m2}	Meridional (radial) velocity	m/s
$V_{\theta 2,\infty}$	Whirl without slip	m/s
σ_W	Wiesner slip, V_s/U_2	-
p	Pfleiderer slip coefficient	-
H_∞	Euler head without slip	m
$H_{th,W}$	Euler head with Wiesner slip	m
$H_{th,P}$	Euler head with Pfleiderer slip	m
H	Pump head (Wiesner × hydraulic efficiency)	m

Method and standards

Euler turbomachine equation with Wiesner and Pfleiderer slip.

Assumptions and limits

- Radial impeller, no inlet swirl, outlet blockage ignored.

Report details

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Reopens the calculator with the inputs of this report.