Power required to rotate a cylinder in a moving air

Notations : for more uniformed formulations and ease further comparison,
U is the upstream flow (= the apparent wind when a sailing ship is considered)
v is the tangential speed of rotation at the surface of the rotor (>> speed ratio = v/U)
D and H are the diameter and the height of the rotor.
Sw the "wetted" surface of the rotor is then : π D H
>>> Norwood uses rotor radius a , rotor height 1,5 a and the rotational speed w, so the correspondance are :
D = 2 a , H = 1,5 a and v = a*w
ρ is the air mass volumic of air (kg/m3)
Cf is the friction coefficient, computed using Re = U*D/v and Cf = 0,075 / (log10(Re) - 2)^2
v = air cinematic viscosity (m2:s)

« Norwood » formulation (rewritten with the above notations) :

Pm = Cf * (1/2 * ρ * Sw) * (2 * U^2 + v^2) * v

« **Norwood bis »** (when considering v for the integration in the 4th quadrant) :

Pm = Cf * (1/2 * ρ * Sw) * (3/2 * U^2 + 2/π * U * v + v^2) * v

>>> that presentation of the formulations highlights on the origin of the power computation (a friction force x a tangential speed of rotation) and especially on the quadratic function of (U,v) dimensioned as a squared speed and resulting from the integration on the cylinder perimeter.

Comparison with Reid Naca 1924 measurements :
<u>Data of the experiments</u> :
D = 0,1143 m ; H = 1,5232 m
v = 1,429 E-5 m2/s (estimated)
ρ = 1,23 kg/m3 (estimated)
Cf computed with Re = U D / v and Cf = 0,075 / (log10(Re) - 2)^2 >> Cf = 0,079
Measurements done with U = 15 m/s and for 14 values of v/U from 0,4 to 1,2