SAE International

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J640 JUL2011

Issued 1953-12
Stabilized 2011-07

Superseding J640 MAR2011

Symbols for Hydrodynamic Drives

RATIONALE

The technical report covers technology, products, or processes which are mature and not likely to change in the foreseeable future.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE Automatic Transmission Transaxle Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

1. ***Scope***—The following system of symbols is recommended for use in technical papers and engineering reports dealing with hydrodynamic drives.

2. ***References***

2.1 Applicable Publication—The following publication forms a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J641—Hydrodynamic Drives Terminology

3. ***Hydrodynamic Symbols***—Where possible, the symbols consist of the first letter of the name of the quantity as given in SAE J641; for example: R for radius, A for area, a for angle, d for density. Subscripts, where needed, are also based on the standardized nomenclature; for example: R_R for radius of reactor or R_{R1} for radius of first reactor when more than one reactor is in question. Only one superscript is used for a given element; for example: in the difference between entrance and exit angles, a′ is blade entrance angle and a is blade exit angle.

These symbols were selected so that when used with the standard nomenclature, they are easy to remember, are as simple as practical to write and read without danger of confusion, and require no special type to print. Several already-established engineering symbols have been retained, such as E for efficiency, H for head in m (ft), and N for rpm. Where no standardization exists at present, the most suitable letters have been chosen as symbols.

4. ***List of Common Symbols***

A = area, net, normal to axial plane, m^2 (ft^2)
A_Q = area, gross, between shell and core normal to axial plane, m^2 (ft^2)
a = angle, blade exit, degree (°)
a′ = angle, blade entrance, degree (°)
B = width of channel, projected width of blade, mm (in)
b = angle, relative blade exit, degree (°)
b′ = angle, relative blade entrance, degree (°)
C = coefficient
D = diameter, m (ft)

d = density, kg/m^3 (lb/ft^3)
E = efficiency
F = fluid velocity in axial plane, torus flow, m/s (ft/s) (Refer to Figure 1)
g = gravity constant, 9.806 m/s^2 (32.2 ft/s^2)
H = head, m (ft)
h = thickness of blade, mm (in)
K = capacity factor, rpm/(N·m)$^{1/2}$ [rpm/(lb-ft)$^{1/2}$]
M = mass flow, kg/s (slugs/s)
L = moment of momentum, kg·m^2/s (slugs ft^2/s)
N = speed (rev/min)
n = speed ratio
P = power, watts (hp)
Q = volumetric flow rate, m^3/s (ft^3/s)
R = radius, m (ft)
S = tangential component of absolute velocity, m/s (ft/s) (Refer to Figure 1)
T = torque, N·m (lb-ft)
t = torque ratio
U = linear velocity of a point on a blade, m/s (ft/s)
V = absolute velocity, m/s (ft/s) (Refer to Figure 1)
W = relative velocity, m/s (ft/s) (Refer to Figure 1)
w = angular velocity, rad/s
% = number of blades

5. *Examples*

5.1 Examples of Use of Symbols

Capacity Factor: $K = N/T^{1/2}$
Torque Exerted on Impeller: $T_1 = M (S_1 \times R_1 - S'_1 \times R'_1$

$$\text{Efficiency: } E = \frac{T_T}{T_1} \times \frac{N_T}{N_1} = t \times n \qquad \text{(Eq. 1)}$$

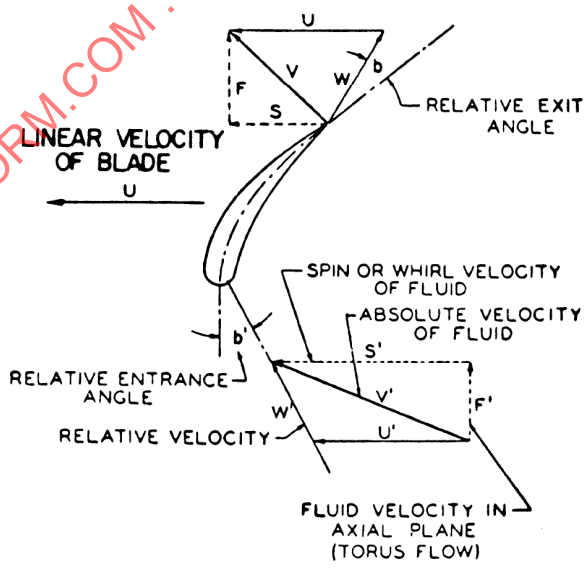

FIGURE 1—VECTOR DIAGRAM SHOWING USE OF HYDRODYNAMIC DRIVE SYMBOLS

TABLE 1—SUMMARY OF HYDRODYNAMIC DRIVE SYMBOLS

	First Impeller	Second Impeller	First Turbine	Second Turbine	First Reactor	Second Reactor
Radius, blade entrance, m (ft)	R'_{11}	R'_{12}	R'_{T1}	R'_{T2}	R'_{R1}	R'_{R2}
Radius, blade exit, m (ft)	R_{11}	R_{12}	R_{T1}	R_{T2}	R_{R1}	R_{R2}
Torque, N·m (lb-ft)	T_{11}	T_{12}	T_{T1}	T_{T2}	T_{R1}	T_{R2}
Angle, blade entrance(1)	a'_{11}	a'_{12}	a'_{T1}	a'_{T2}	a'_{R1}	a'_{R2}
Angle, blade exit(1)	a_{11}	a_{12}	a_{T1}	a_{T2}	a_{R1}	a_{R2}
Tan, blade entrance angle	tan a'_{11}	tan a'_{12}	tan a'_{T1}	tan a'_{T2}	tan a'_{R1}	tan a'_{R2}
Angle, relative blade entrance(1)	b'_{11}	b'_{12}	b'_{T1}	b'_{T2}	b'_{R1}	b'_{R2}
Cot, blade exit angle	cot a_{11}	cot a_{12}	cot a_{T1}	cot a_{T2}	cot a_{R1}	cot a_{R2}
Head, m (ft)	H_{11}	H_{12}	H_{T1}	H_{T2}	H_{R1}	H_{R2}
Speed, rpm	N_{11}	N_{12}	N_{T1}	N_{T2}	N_{R1}	N_{R2}
S, Entrance, m/s (ft/s)	S'_{11}	S'_{12}	S'_{T1}	S'_{T2}	S'_{R1}	S'_{R2}
V, Exit, m/s (ft/s)	V_{11}	V_{12}	V_{T1}	V_{T2}	V_{R1}	V_{R2}
U, Entrance, m/s (ft/s)	U'_{11}	U'_{12}	U'_{T1}	U'_{T2}	U'_{R1}	U'_{R2}
W, Exit, m/s (ft/s)	W_{11}	W_{12}	W_{T1}	W_{T2}	W_{R1}	W_{R2}
F, Entrance, m/s (ft/s)	F'_{11}	F'_{12}	F'_{T1}	F'_{T2}	F'_{R1}	F'_{T2}

1. degree (°)