The Engineering Society
For Advancing Mobility
Land Sea Air and Space®

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# SAE J640 JUN88

# Symbols for Hydrodynamic Drives

**SAE Recommended Practice**
**Revised June 1988**





**Submitted for Recognition as an American National Standard**

The Engineering Society For Advancing Mobility Land Sea Air and Space®
400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

HIGHWAY VEHICLE PRACTICE

Submitted for recognition as an American National Standard

SAE J640

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# SYMBOLS FOR HYDRODYNAMIC DRIVES



## 1. SCOPE:

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

## 2. HYDRODYNAMIC SYMBOLS:

Where possible, the symbols consist of the first letter of the name of the quantity as given in SAE J641 FEB83; 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, $a^1$ is blade entrance angle and $a^2$ is blade exit angle. No Greek letters are used so that all symbols can be written on standard typewriters.

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 established engineering symbols have been retained, such as E for efficiency, H for head in feet (meters), and N for rpm. Where no standardization exists at present, the most suitable letters have been chosen as symbols.

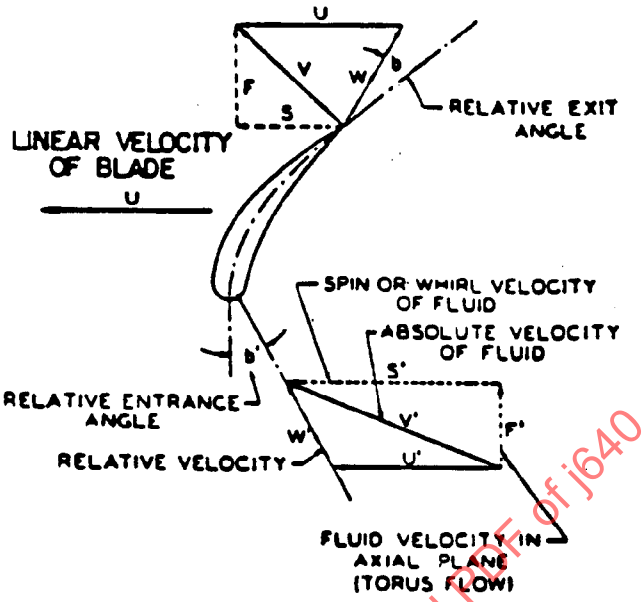


FIGURE 1 - Vector Diagram Showing Use of Hydrodynamic Drive Symbols

3. LIST OF COMMON SYMBOLS:

A = area, net normal to axial plane, $ft^2$ ($m^2$)
$A_Q$ = area, gross, between shell and core normal to axial plane, $ft^2$($m^2$)
a = angle, blade exit, degree (°)
a' = angle, blade entrance, degree (°)
B = width of channel, projected width of blade, in (mm)
b = angle, relative blade exit, degree (°)
b' = angle, relative blade entrance, degree (°)
C = coefficient
D = diameter, ft (mm)
d = density, $lb/ft^3$ ($kg/m^3$)
E = efficiency
F = fluid velocity in axial plane, torus flow, ft/s (mm/s) (Refer to Fig. 1)
g = gravity constant, 32.2 $ft/x^2$ (9.806 $m/s^2$)
H = head, ft (m)
h = thickness of blade, in (mm)
K = capacity factor, $rpm/(lb/ft)^{1/2}$ $[rpm/(N-m)^{1.2}]$
M = mass flow, slugs/s (kg/s)
L = moment of momentum, slugs $ft^2/s$ (kg · $m^2/s$)
N = speed (rev/min)
n = speed ratio
P = power, hp (watts)
Q = volumetric flow rate, $ft^3/s$ ($m^3/s$)
R = radius, ft (m)
S = tangential component of absolute velocity, ft/s (m/s) (Refer to Fig. 1)

3. (Continued)

T = torque, lb-ft (N · m)
t = torque ratio
U = linear velocity of a point on a blade, ft/s (m/s)
V = absolute velocity, ft/s (m/s) (Refer to Fig. 1)
W = relative velocity, ft/s (m/s) (Refer to Fig. 1)
w = angular velocity, rad/s
% = number of blades

4. EXAMPLES:

4.1 Examples of Use of Symbols:

Capacity Factor: $K = N/T^{1/2}$

Torque Exerted on Impeller: $T_1 = M(S_1 \times R_1 - S'_1 \times R'_1)$

Torque Exerted on Turbine: $T_1 = M(S'_T \times R'_T - S_T \times R_T)$

Efficiency: $E = \frac{T_T}{T_1} \times \frac{N_T}{N_1} = t \times n$

The phi (Ø) symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

4.2 Example Table of Symbol Usage:

TABLE 1 -- SUMMARY OF HYDRODYNAMIC DRIVE SYMBOLS

| | First Impeller | Second Impeller | First Turbine | Second Turbine | First Reactor | Second Reactor |
|---|---|---|---|---|---|---|
| Radius, blade entrance, ft (m) | $R'_{I1}$ | $R'_{I2}$ | $R'_{T1}$ | $R'_{T2}$ | $R'_{R1}$ | $R'_{R2}$ |
| Radius, blade exit, ft(m) | $R_{I1}$ | $R_{I2}$ | $R_{T1}$ | $R_{T2}$ | $R_{R1}$ | $R_{R2}$ |
| Torque, lb-ft (N . m) | $T_{I1}$ | $T_{I2}$ | $T_{T1}$ | $T_{T2}$ | $T_{R1}$ | $T_{R2}$ |
| Angle, blade entrance[a] | $a'_{I1}$ | $a'_{I2}$ | $a'_{T1}$ | $a'_{T2}$ | $a'_{R1}$ | $a'_{R2}$ |
| Angle, blade exit[a] | $a_{I1}$ | $a_{I2}$ | $a_{T1}$ | $a_{T2}$ | $a_{R1}$ | $a_{R2}$ |
| Tan, blade entrance angle | $\tan a'_{I1}$ | $\tan a'_{I2}$ | $\tan a'_{T1}$ | $\tan a'_{T2}$ | $\tan a'_{R1}$ | $\tan a'_{R2}$ |
| Angle, relative blade entrance[a] | $b'_{I1}$ | $b'_{I2}$ | $b'_{T1}$ | $b'_{T2}$ | $b'_{R1}$ | $b'_{R2}$ |
| Cot, blade exit angle | $\cot a_{I1}$ | $\cot a_{I2}$ | $\cot a_{T1}$ | $\cot a_{T2}$ | $\cot a_{R1}$ | $\cot a_{R2}$ |
| Head, ft (m) | $H_{I1}$ | $H_{I2}$ | $H_{T1}$ | $H_{T2}$ | $H_{R1}$ | $H_{R2}$ |
| Speed, rpm (rpm) | $N_{I1}$ | $N_{I2}$ | $N_{T1}$ | $N_{T2}$ | $N_{R1}$ | $N_{R2}$ |
| S, Entrance, ft/s (m/s) | $S'_{I1}$ | $S'_{I2}$ | $S'_{T1}$ | $S'_{T2}$ | $S'_{R1}$ | $S'_{R2}$ |
| V, Exit, ft/s (m/s) | $V_{I1}$ | $V_{I2}$ | $V_{T1}$ | $V_{T2}$ | $V_{R1}$ | $V_{R2}$ |
| U, Entrance, ft/s (m/s) | $U'_{I1}$ | $U'_{I2}$ | $U'_{T1}$ | $U'_{T2}$ | $U'_{R1}$ | $U'_{R2}$ |
| W, Exit, ft/s (m/s) | $W_{I1}$ | $W_{I2}$ | $W_{T1}$ | $W_{T2}$ | $W_{R1}$ | $W_{R2}$ |
| F, Entrance, ft/s (m/s) | $F'_{I1}$ | $F'_{I2}$ | $F'_{T1}$ | $F'_{T2}$ | $F'_{R1}$ | $F'_{R2}$ |

[a] degree(°)

RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

SAE J641 FEB83, Hydrodynamic Drives Terminology

APPLICATION:

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

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