SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J641

REAF. MAR2000

Issued 1951-01
Reaffirmed 2000-03

Superseding J641 AUG1993

Submitted for recognition as an American National Standard

Hydrodynamic Drives Terminology

1. ***Scope***—Since the torque converter and fluid coupling have become commonly used components of automatic transmissions in industry, the SAE appointed a committee to standardize terminology, test procedure, data recording, design symbols, and so forth, in this field. The following committee recommendations will facilitate a clear understanding for engineering discussions, comparisons, and the preparation of technical papers.

The recommended usages represent the predominant practice or the acceptable practice. Where agreement is not complete, alternates have been included for clarification.

EXAMPLE—Two systems of blade angle designations are described. Consequently when a blade angle is specified, the system should be designated.

This SAE Recommended Practice deals only with the physical parts and dimensions and does not attempt to standardize the design considerations, such as the actual fluid flow angle resulting from the physical blade shape.

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 version of SAE publications shall apply.

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

SAE J1087—One-Way Clutches—Nomenclature and Terminology

3. ***Definitions***

3.1 Hydrodynamic Drive—In contrast with electrical or mechanical drives, a hydrodynamic drive transmits power solely by dynamic fluid action in a closed recirculating path.

3.2 Fluid Coupling—A hydrodynamic drive which transmits power without ability to change torque. (Torque ratio is unity at all speed ratios.) See Figure 1.

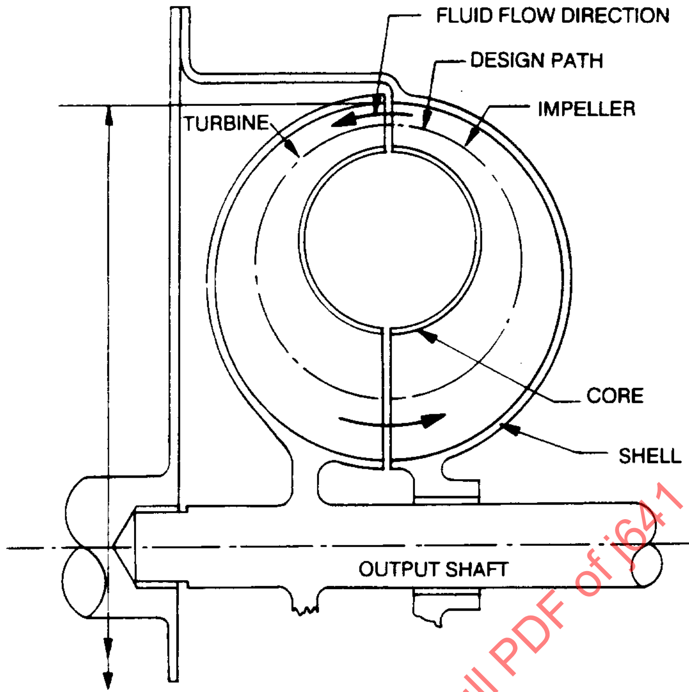

FIGURE 1—FLUID COUPLING

3.3 Torque Converter—A hydrodynamic drive which transmits power with ability to change torque. (Torque ratio changes as speed ratio changes.) See Figure 2.

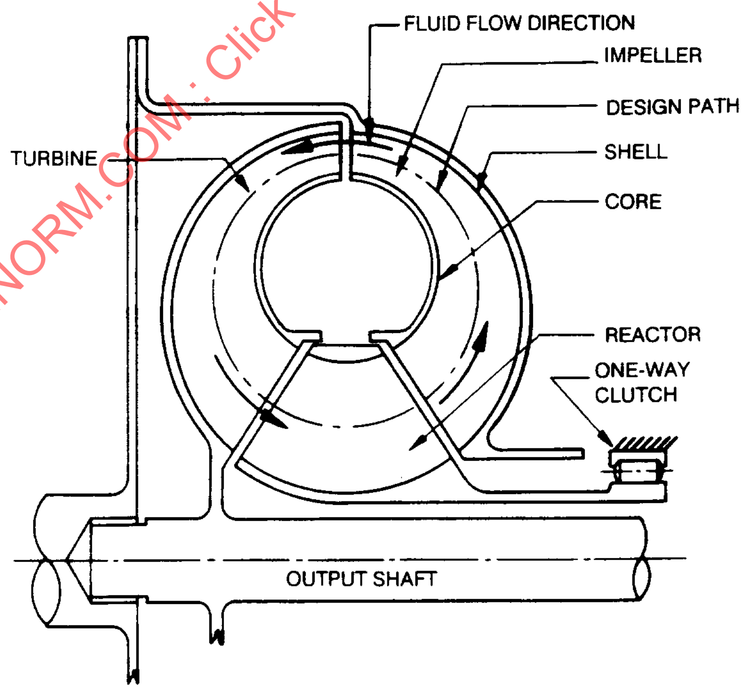

FIGURE 2—TWO-PHASE, SINGLE-STAGE TORQUE CONVERTER
(SINGLE-PHASE, SINGLE-STAGE IF ONE-WAY CLUTCH IS DELETED)

3.4 Element—An element consists of a single row of flow directing blades. See Figure 3.

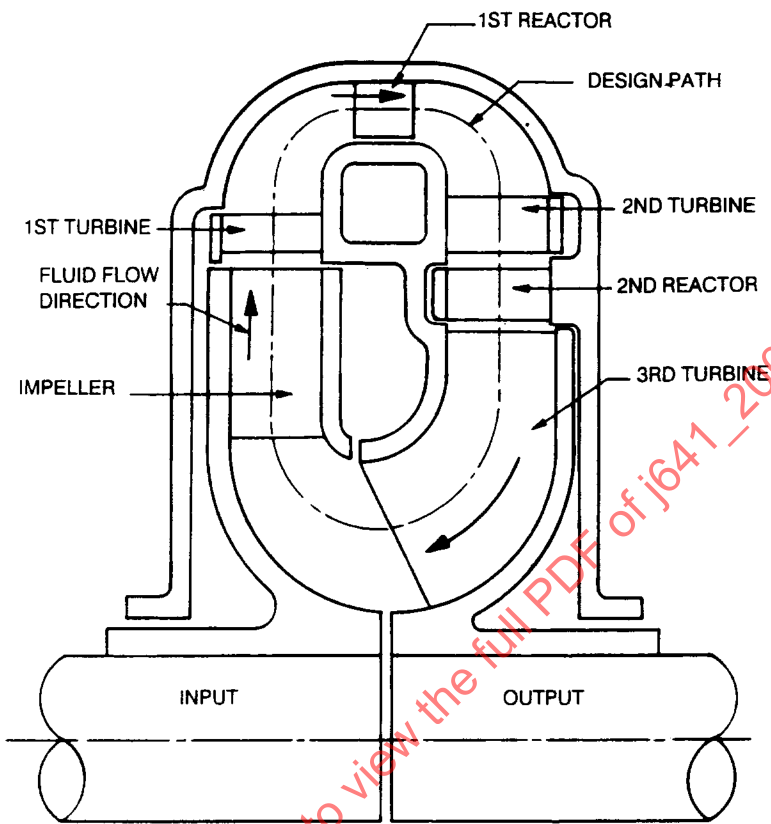

FIGURE 3—THREE-MEMBER, SIX-ELEMENT, SINGLE-PHASE, THREE-STAGE TORQUE CONVERTER

3.5 Member—A member is an independent component of a hydrodynamic unit such as an impeller, reactor, or turbine. It may comprise one or more elements. See Figure 3.

3.6 Stage (Single-, Two-, Three-, etc.)—A stage is a turbine element interposed between elements of other members. The number of stages is the number of such elements of the turbine member. See Figures 2 and 3.

3.7 Phase (Single-, Two-, Three-, etc.)—Applied to a torque converter, refers to the number of functional arrangements of the working elements when the functional change is produced by a one-way clutch or other mechanical means such as a clutch or brake. See Figures 2 and 3.

3.8 Impeller—Designates the power input member.

3.9 Turbine—Designates the output member.

3.10 Reactor (or Stator)—Designates the reaction member.

3.11 One-Way Clutch—See SAE J1087.

3.12 Clutch-Type Torque Converter—A hydrodynamic torque converter using a clutch to provide a direct mechanical drive. See Figure 4.

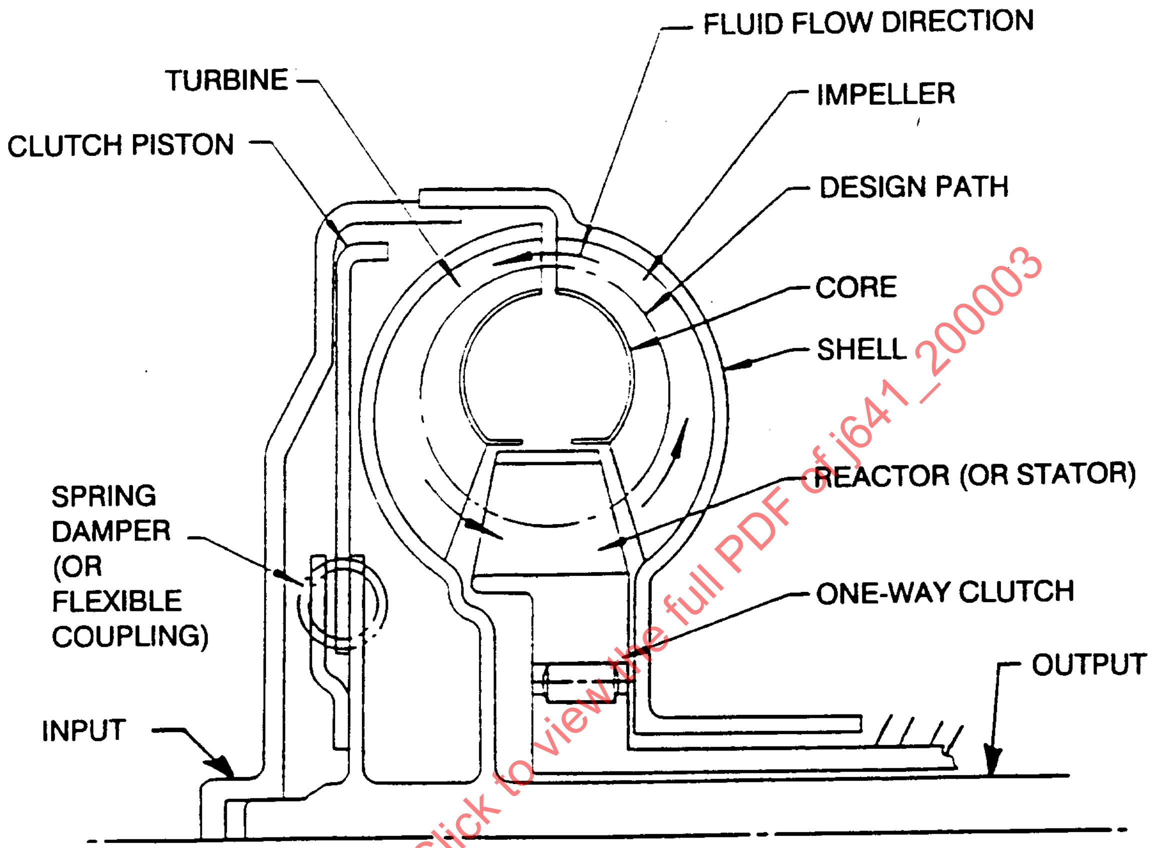

FIGURE 4—CLUTCH-TYPE TORQUE CONVERTER

3.13 Clutch Piston—A friction element device which can mechanically couple the impeller to the output. See Figure 4.

3.14 Spring Damper (or Flexible Coupling)—A device that reduces the amplitude of torsional vibration to the output. See Figure 4.

3.15 Naming of Multiple Members—Multiple members that perform basically the same function in both polyphase and multistage torque converters are named in the order of fluid circulation in normal operation:

a. First impeller, second impeller, etc.
b. First turbine, second turbine, etc.
c. First reactor, second reactor, etc.

3.16 Blade—Within an element, designates the means of directing fluid flow.

3.17 Variable Blade—Designates a blade provided with control means to vary the angular position and thus vary the direction of fluid flow.

3.18 Torus Section—Designates the confines of a flow circuit in a radial plane of a torque converter or fluid coupling.

3.19 Shell—Designates the outside wall of the torus section in any member. See Figures 1 and 2.

3.20 Core—Designates the inside wall of the torus section in any member. See Figures 1 and 2.

3.21 Design Path—The path of the assumed mean effective flow, used for definition of blade angles, entrance and exit radii, etc. See Figures 1 and 2.

3.22 Bias (Entrance and Exit)—At the entering and exit blade edges, designates the angular variance with respect to an axial plane at the design path. The angle is measured as viewed in an axial direction. See Figure 5.

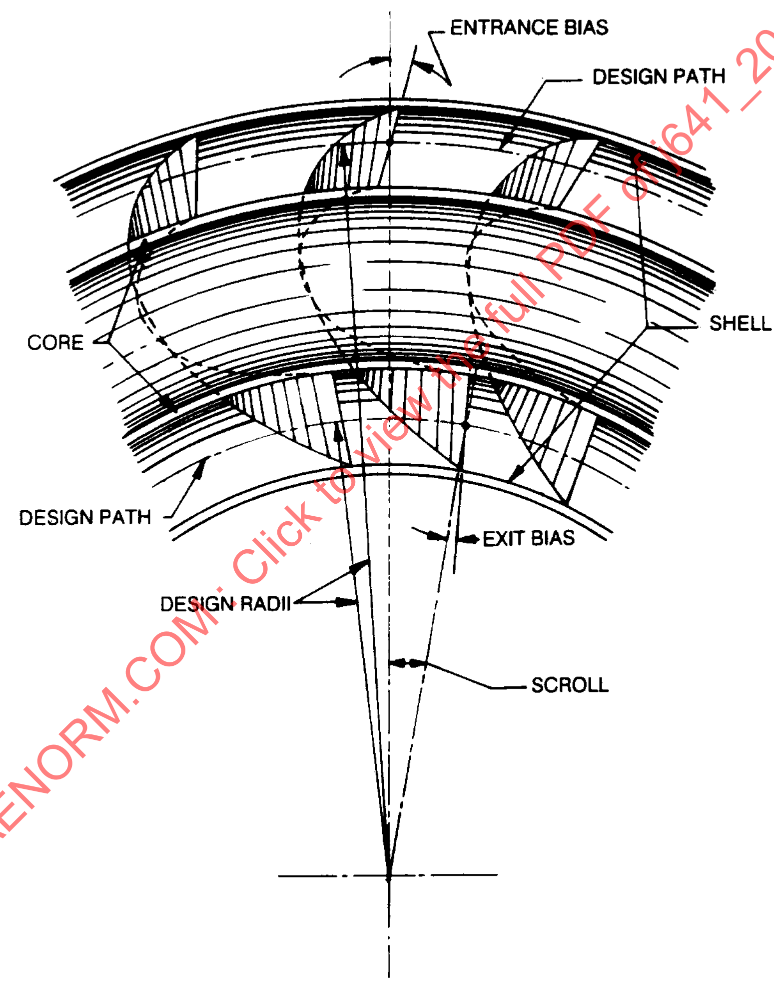

FIGURE 5—BLADE TERMINOLOGY (TURBINE)

3.23 Scroll—The angle between the two planes containing the intersection of the design path and the entering and leaving edges of the blade when the blade does not lie in one axial plane. See Figure 5.

3.24 Torque Converter Size—In general terms, is designated by the maximum diameter of the flow path. See Figure 1.

3.25 Design Radii (Entrance or Exit)—Design radii of any member are taken at the point of intersection of the design path with the theoretical blade edges. See Figure 5.

3.26 Slip—Designates the difference between input speed (N_i) and output speed (N_o). It may also be expressed as a percent of input speed.

3.27 Speed Ratio—Designates the output speed divided by the input speed (N_o/N_i).

3.28 Torque Ratio—Designates the output torque divided by the input torque (T_o/T_i).

3.29 Capacity Factor for a Hydrodynamic Drive—The input speed in rpm (N_i) divided by the square root of the input torque (T_i) (see Equation 1).

$$K = \frac{N_i}{\sqrt{T_i}} \qquad \text{(Eq. 1)}$$

3.30 Stall Torque Ratio—Designates the torque ratio when the turbine is restrained from rotating.

3.31 Stall Start—Accomplished by restraining the vehicle with the brakes, opening the throttle fully, and subsequently releasing the brakes after the engine has attained maximum stall speed.

3.32 Stall Speed—Designates the input speed in rpm at a specified input torque when the turbine is restrained from rotating.

3.33 Racing Speed—Designates the input speed in rpm at a specified input torque when the turbine is not restrained from rotating.

3.34 Torque Conversion Range—Designates the range of operation where torque multiplication exists.

3.35 Coupling Range—Designates the range of operation at which torque ratio is unity.

3.36 Coupling Point—Designates the point where the torque conversion range ends and the coupling range begins.

3.37 Hydrodynamic Unit Charge Pressure—Designates the externally applied hydraulic fluid pressure under which the hydrodynamic unit operates.

3.38 Mean Camberline—Mean camberline is the locus of the centers of the series of circles which are tangent to both surfaces of the blade profile. See Figure 6.

This method of mean camberline determination is shown for a continuously varying double surface type of hydrofoil. The same system applies to all other types of blade profiles, including cases where discontinuities arise, because of edge modifications, as with sheet metal blades.

3.39 Blade Angles—Unless otherwise specified, a blade angle is measured from a zero reference to the line tangent to the mean camberline extended in the direction of flow from the point of interest on the design path. The variation of angle at points other than on the design path must be specified. A blade is generally identified by the angles at its entrance and exit edges.

3.40 Blade Angle Systems—See Figure 7.

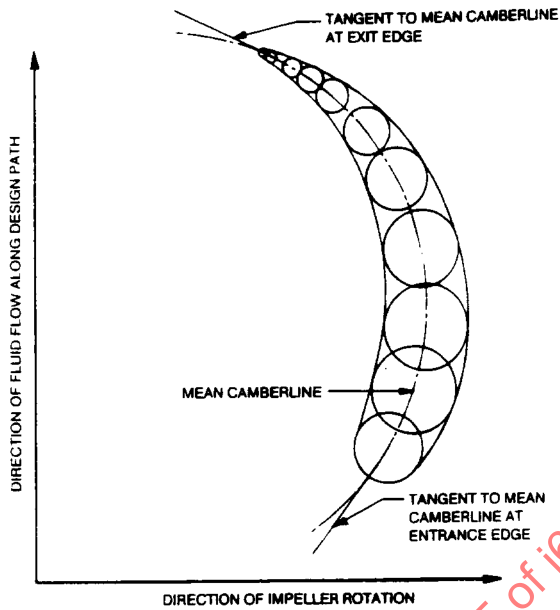

FIGURE 6—DEVELOPED SECTION OF BLADE AT INTERSECTION WITH DESIGN PATH SURFACE

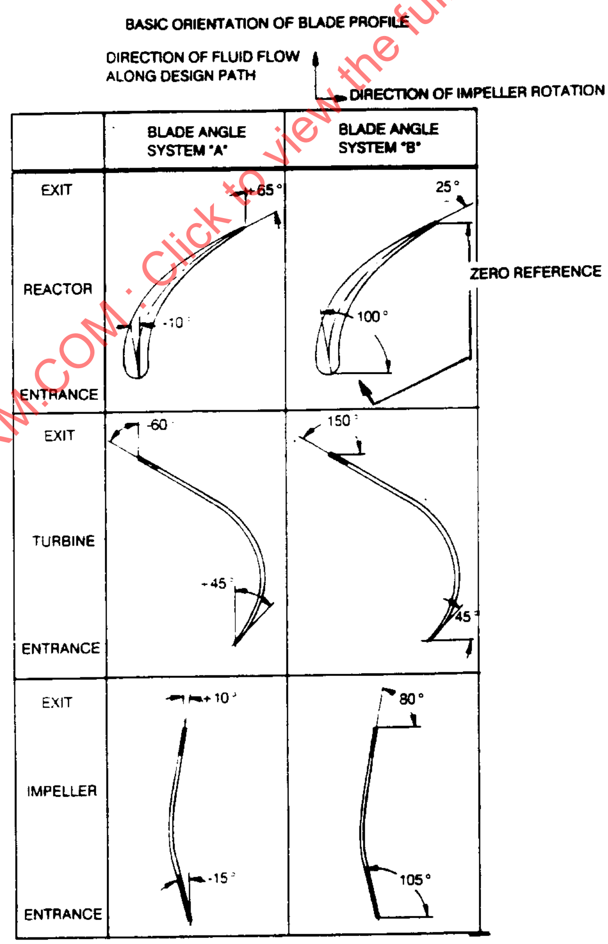

FIGURE 7—BLADE ANGLE SYSTEMS