Hydrodynamic Drives Terminology—SAE J641b

SAE Recommended Practice
Editorial change April 1978

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HYDRODYNAMIC DRIVES TERMINOLOGY—SAE J641b

SAE Recommended Practice

Report of Hydrodynamic Drive Committee approved January 1951 and last revised by Transmission and Drivetrain Technical Committee April 1978.

[Since the torque converter and fluid coupling have become a commonly ϕ used component 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.

ϕ The recommended usages represent the predominating 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.]

Hydrodynamic Drive—As contrasted with electrical or mechanical and so forth, is the type of drive that transmits power solely by dynamic fluid action in a closed recirculating path.

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

Torque Converter—A hydrodynamic drive which transmits power with ability to change torque. (Torque ratio is a function of speed ratio.) See Figs. ϕ 2 and 3.

Element—An element consists of a single row of flow directing blades. See ϕ Fig. 3.

Member—A member is an independent component of a hydrodynamic unit such as an impeller, reactor, or turbine. It may comprise one or more ele- ϕ ments. See Fig. 3.

Stage (Single- Two- Three- and so forth)—A stage is a turbine element interposed between elements of other members. The number of stages is the ϕ number of such elements of the turbine member. See Figs. 2 and 3.

Phase (Single- Two- Three- and so forth)—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 ϕ means such as a clutch or brake. See Figs. 2–5.

Impeller—Designates the power input member.

Turbine—Designates the output member.

Reactor—Designates the reaction member.

ϕ ***One-way Clutch***—See SAE J1087 (May, 1974).

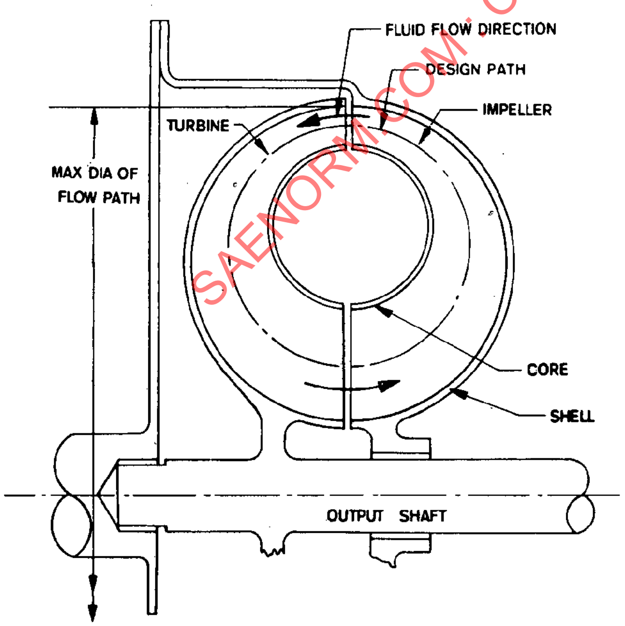

FIG. 1—FLUID COUPLING

The ϕ 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.

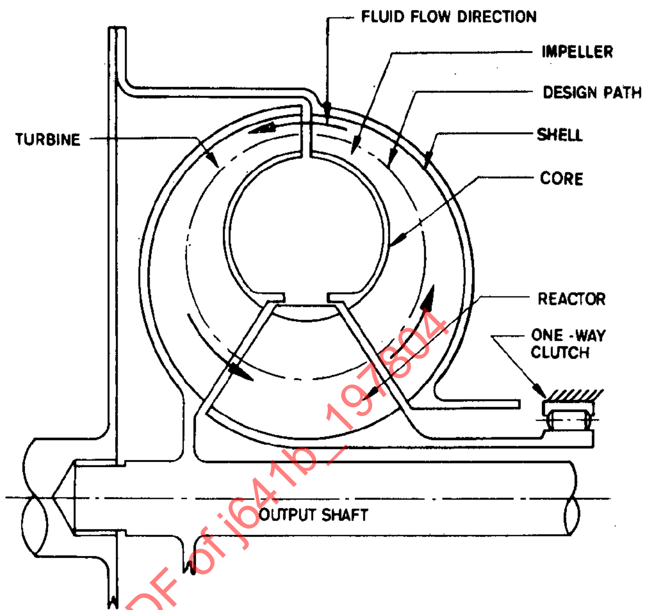

FIG. 2—TWO PHASE, SINGLE STAGE TORQUE CONVERTER (SINGLE PHASE, SINGLE STAGE IF ONE-WAY CLUTCH IS DELETED)

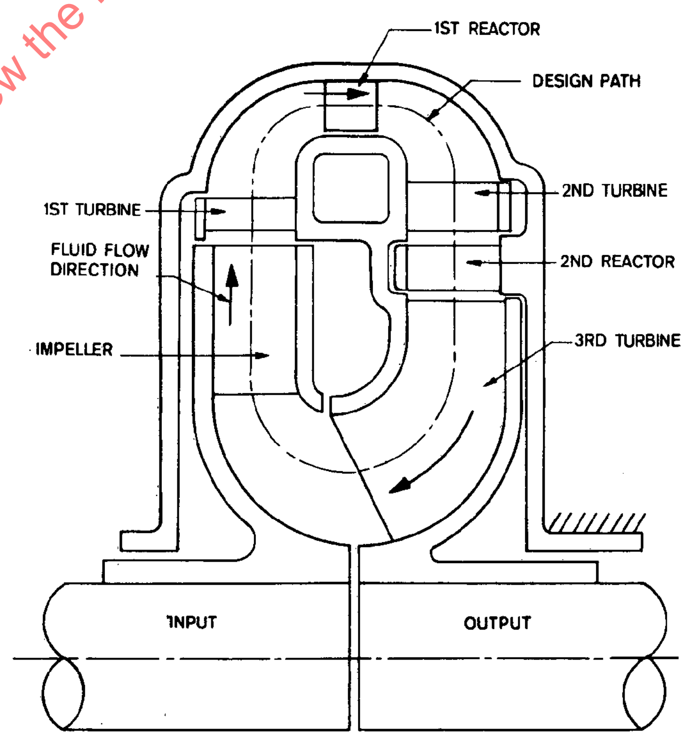

FIG. 3—THREE MEMBER, SIX ELEMENT, SINGLE PHASE, THREE STAGE TORQUE CONVERTER

Nomenclature of Multiple Members—Nomenclature of multiple members of basically the same function in both polyphase and multistage torque converters should be named in the order of fluid circulation in normal operation:

first impeller	first turbine	first reactor
second impeller	second turbine	second reactor
and so forth	and so forth	and so forth

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

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

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

Shell—Designates the outside wall of the torus section in any member. See Figs. 1–4.

Core—Designates the inside wall of the torus section in any member. See Figs. 1–4.

Design Path—The path of the assumed mean effective flow and is used for definition of blade angles, entrance and exit radii, and so forth. See Figs. 1–4.

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 Fig. 4.

Scroll—The angle between the two planes containing the intersection of the design path and the entering and leaving edges of the blade when that blade does not lie in one axial plane. See Fig. 4.

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

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 Fig. 4.

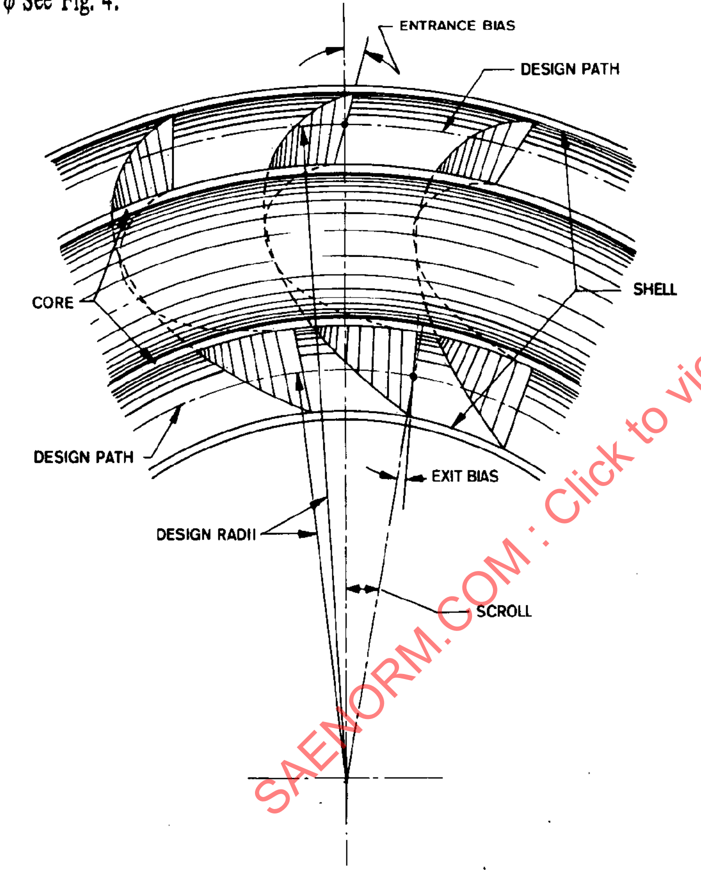

FIG. 4–BLADE TERMINOLOGY (TURBINE)

Slip—Designates the difference between input and output rpm. It may also be expressed as a percent of input.

Speed Ratio—Designates the output speed divided by the input speed.

Torque Ratio—Designates the output torque divided by the input torque.

Capacity Factor for a member is the rpm divided by the square root of the torque.

$$K = \frac{N}{\sqrt{T}}$$

Stall Torque Ratio—Designates the torque ratio with a stalled turbine.

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

Stall Speed—Designates the input speed in revolutions per minute with a stalled turbine at a specified input torque.

Racing Speed—Designates the input speed in revolutions per minute with a free turbine at a specified input torque.

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

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

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

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

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 Fig. 5.

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.

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.

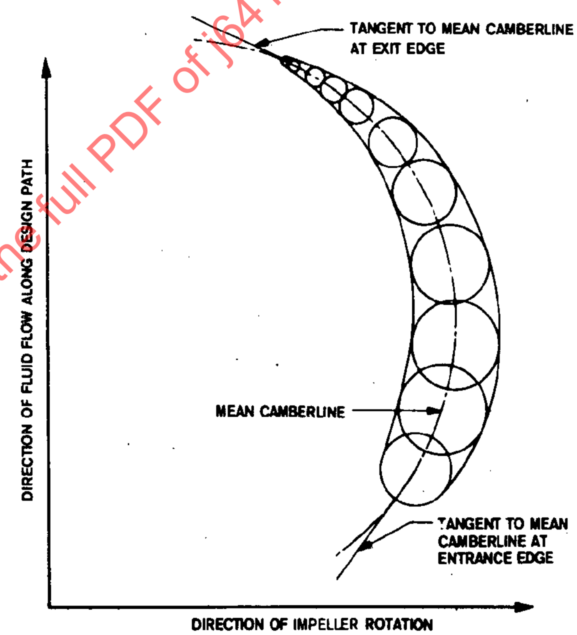

FIG. 5–DEVELOPED SECTION OF BLADE AT INTERSECTION WITH DESIGN PATH SURFACE

Blade Angle Systems—(See Fig. 6.)

System A—In this system, the zero reference is the plane containing the axis of rotation and the point of tangency on the blade mean camberline.

Angle limits are −90 and +90 deg. A positive angle is one whose side tangent to the mean camberline extends in the direction of impeller rotation. A negative angle is one whose tangent side extends opposite to the direction of impeller rotation. In this system the sine and tangent functions of the blade angle, as used in torque converter design, have the same sign as the angle, and the cosine function is always positive.

System B—In this system the zero reference is the line extended from the point of tangency in the direction of impeller rotation and normal to the plane containing the axis of rotation and the point of tangency.

Angle limits are 0 and 180 deg. The angle is less than 90 deg when the side tangent to the mean camberline extends in the direction of impeller rotation. It is more than 90 deg when the tangent side extends opposite to the direction of impeller rotation. In this system, a trigonometric function of a blade angle, as used in torque converter design, derives its plus or minus sign from the appropriate table for the corresponding quadrant.