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7. GLOSSARY OF TERMS

7.1 Experimental Terms

Absolute pressure: the sum of the indicated gage pressure plus the atmospheric pressure.

ACH (air changes per hour): the complete replacement of air inside an area; an office or space that has its total air volume replaced in the time period of one hour experiences one air change per hour.

Anemometer: an instrument used to measure air velocities.

Atmospheric pressure: the pressure exerted upon the earth's surface by the air because of the gravitational attraction of the earth, measured with a barometer. Standard atmospheric pressure at sea level is 14.7 pounds per square inch (psi).

Barometer: an instrument for measuring atmospheric pressure.

BTU (British thermal unit): the amount of heat required to raise or lower the temperature of one pound of water 1 °F. 1 BTU = 1,055 Joules.

Calibration: determining or correcting the error of an existing scale.

Calorie: the amount of heat needed to raise the temperature of 1 g of water by 1 °C, from 14.5 to 15.5 °C. A kilocalorie (kilogram-calorie or large calorie) is 1,000 calories.

Calorimeter: the measurement of heat. Heat is one of the most conveniently handled forms of energy. Calorimetry is used to estimate nutritional requirements of humans and farm livestock and to evaluate different foods. It is also a powerful research tool used to study fundamental nutritional and physiological life processes, and to evaluate stresses imposed by abnormal environments. It is used in clinics as a diagnostic tool for the investigation of metabolic disorders.

Capture hood: an instrument that takes the air of a supply, return, or exhaust terminal and guides it over a flow-measuring device. It measures airflow in cubic feet per minute.

Chromatography: a separation method that relies on differences in partitioning behavior between a flowing mobile phase and a stationary phase to separate the components in a mixture.

CFM (cubic feet per minute): a unit of measurement representing the volume or rate of airflow.

Deflecting vane anemometer: a device that gives instantaneous, direct readings in feet per minute, used most often for determining air velocity through supply, return, and exhaust air grilles, registers or diffusers. Attachments are used to measure low velocities in an open space or at the face of a fume hood.

Differential pressure gage: an instrument that reads the difference between two pressures simultaneously, eliminating the need to take two separate pressures and calculate the difference.

Electronic Instruments: most of the mechanical analog instruments now have electronic digital counterparts. All instruments, analog or digital, should be checked against a sheltered set before each balancing project. Pressure measuring instruments should be checked against a standard liquid-filled manometer.

Endotherm: a species that maintains an appreciable difference between body temperature and ambient temperature by virtue of internal (metabolic) production of heat.

FPM (feet per minute): a unit of measurement used for velocity.

Gage: an instrument for measuring pressure.

Gage pressure: the pressure that is indicated on the gage.

Gas chromatography: a chromatographic technique that can be used to separate volatile organic compounds. A gas chromatograph consists of a flowing mobile phase, an injection port, a separation column containing the stationary phase, and a detector. The organic compounds are separated due to differences in their partitioning behavior between the mobile gas phase and the stationary phase in the column.

Homeotherm: species such as mammals and birds that regulate their body temperature physiologically.

Hot wire anemometer: an instrument that measures instantaneous air velocity in feet per minute using an electrically heated wire. As air passes over the wire, the wire's resistance is changed and this change is shown as velocity on the instrument's scale.

Inches of water gage or column: a unit of air pressure using as a reference the pressure exerted by a column of water that is one inch high.

Latent heat: the amount of heat required to convert a quantity of a solid at its melting point into a liquid at the same temperature.

Manometer: an instrument that is the industry standard for reading air pressure. Types of

manometers commonly used to measure air pressure are the inclined manometer, the inclined-vertical manometer, the U-tube manometer, and the micromanometer.

Meniscus: the curved surface of the liquid column in a manometer. In manometers that measure air pressure, the liquid is either water or a light oil. In manometers that measure water pressure, the liquid is mercury.

Metabolic Rate: in comparative physiology, the rate of an animal's energy consumption, that is, the rate at which it converts chemical energy to heat and external work.

Micromanometer: an instrument used to measure very low pressure, accurate down to plus or minus one-thousandth (0.001) inch of water gage.

Operating load point: the actual system operating capacity when an instrument reading is taken.

Parallax: a false reading that occurs when the eye of the reader is not exactly perpendicular to the lines on an instrument scale.

Pitot tube: a sensing device used to measure total pressure in a fluid stream, invented by a French physicist, Henri Pitot, in the 1700's. The standard Pitot tube has a double tube construction with a 90-degree radius bend near the tip and measures both total and static pressures.

Relative humidity: the ratio of the partial pressure of water vapor in moist air to the saturation vapor pressure at the same temperature.

Sensible heat: the amount of heat required to raise the temperature of a solid.

Sensitivity: a measure of the smallest incremental change to which an instrument can respond.

Sheltered set: a set of instruments used only to check the calibration of field instruments.

SCFM (standard cubic feet per minute): the volumetric rate of air flow at standard air conditions.

Thermoneutral zone: a range of environmental temperatures within which the metabolic rate is independent of ambient temperature and is lower in range than any other ambient temperature.

U-tube manometer: a manometer with a U-shaped glass or plastic tube partly filled with oil or tinted water.

7.2 CFD Glossary

Advection: the process by which a quantity of fluid is transferred from one point to another due

to the movement of the fluid.

Boundary condition(s): a term that means either a set of conditions that define a physical problem, or a plane at which a known solution is applied to governing equations.

Boundary layer: a very narrow region next to a solid object in a moving fluid, containing high gradients in velocity.

CFD (computational fluid dynamics): the study of the behavior of fluids using computers to solve the equations that govern fluid flow.

Clustering: increasing the number of grid points in a region to better resolve a geometric or flow feature; increasing the local grid resolution.

Continuum: having properties that vary continuously with position. The air in a room can be thought of as a continuum because any cube of air will behave much like any other cube of air.

Convection: a more generic description of the advection process.

Convergence: a state that is achieved when the imbalances in governing equations fall below an acceptably low level during the solution process.

Diffusion: the process by which a quantity spreads from one point to another due to the existence of a gradient in that variable.

Diffusion, molecular: spreading of a quantity due to molecular interactions within the fluid.

Diffusion, turbulent: spreading of a quantity due to increased mixing rates exhibited by turbulent flows. In the majority of situations, turbulent diffusion far exceeds molecular diffusion.

Divergence: a situation that occurs when the imbalances in governing equations reach unacceptably high levels during the solution process

Eddy viscosity: an additional viscosity that is produced due to the effects of fluid turbulence.

Eddy diffusivity: an additional diffusivity that is produced due to the effects of fluid turbulence.

Far-field distance: the approximate distance from the surface of the body to the farthest point in the Computational Domain. For example, "The wing simulation had a far-field distance of 15 wing chords."

Gauss Siedel equation solve: a method by which linear equations are solved on a cell-by-cell basis.

Gradient: the amount by which a variable changes in space or time.

Grid resolution: the amount of grid points located in a physical area, for example, “The grid uses 20 grid points to resolve the boundary layer.”

Near-wall spacing: the distance of the closest point to the surface of a body, an especially important parameter in viscous flow simulations.

Normal stress: the force/unit area that results from one body directly striking another. For instance, slamming your fist down upon a table will cause pain due to normal stress on your hand and the table. Pressure is always a normal stress.

Reynolds number: a nondimensional number that is used to indicate how turbulent the flow of a fluid.

Reynolds stress: the averaged product of two velocity components in turbulence modeling, in which an instantaneous velocity is broken down into mean and fluctuating components.

Reynolds flux: a Reynolds flux, as in a Reynolds stress, is the average product of two fluctuating variable components, one of which is a fluctuating velocity component.

Shear stress: the force/unit area that results from one body sliding relative to another. For example, sliding a book along a table top will cause a shearing stress on both the book and the table top.

Solution domain: the computational volume in which the governing equations, together with the boundary conditions, are solved.

Turbulence: a type of flow that occurs when a fluid is moving quickly and/or within an unconfined space, characterized by a marked increase in mixing where, superimposed on the principle motion, there are countless irregular fluctuations.

Viscosity: a description of thick or heavy flow in the movement of one layer of fluid over another. For example, a viscous fluid like maple syrup will take a long time to pour from a bottle, while beer, which is not as viscous, can be poured quite readily. Viscosity is usually given the Greek symbol “ η ”. Water is approximately 100 times as viscous as air, while most oils are approximately 1,000 times as viscous as water. The effects of viscosity are most easily related to a concept like friction. The viscosity of fluids will cause a resistance to motion, such as a drag that must be overcome by providing more power. If the drag caused by viscosity is small compared to other forces, or if it is important only in a small region like in boundary layer theory, then the effects of viscosity can be ignored. Such a case is called inviscid flow. It is a point of confusion, even for practicing aeronautical engineers, that an inviscid flow is not the flow of a

fluid with zero viscosity, rather an inviscid flow contains negligibly small viscous stresses.

Vorticity: the swirling motion of a fluid. Satellite photographs on the TV news weather forecasts often show large rotating masses of fluid, which are special cases of vortices.