

# **Weather Terms and Definitions**

## **Air Density Ratio**

Air density ratio (ADR) is the ratio produced by dividing the calculated density of the air being sampled by the Standard Day air density. Standard Day air is defined as a temperature of 60°F, a relative humidity of 0%, and an absolute barometric pressure of 29.92 In. Hg. The ADR for those conditions is 1.00. The RaceAir system expresses this ratio as a percent, Standard Day = 100%, as an aid to understanding the performance increases and decreases that air density causes. Air Density Ratio is used to determine engine fuel tuning changes. If the ADR goes down 2%, then fuel must be reduced 2% to stay at the same air/fuel ratio.

## **Absolute Barometric Pressure**

Absolute barometric pressure, measured in inches of mercury (In. Hg.), is the pressure that is present at the location of the sensor from the atmosphere only. The term 'barometric' comes from the weather instrument, the mercury barometer, which is used as a laboratory precision measuring device. The term 'absolute' refers to absolute zero, where without the earth's atmosphere, the measured pressure would be 0 In. Hg. Normal pressure gages have a scale that sets the atmospheric pressure of 14.7 psi (29.92 In. Hg.) as the zero point. This is referred to as gage pressure. The RaceAir system provides the absolute baro pressure that is used in the calculations for ADR, Density Altitude, and the Correction Factor. It has the biggest influence on air quality. Absolute baro pressure normally varies between 25 and 31 In. Hg. depending on the elevation above seal level where the sensor is. The atmospheric pressure defined as Standard Day at sea level is 29.92 In. Hg. and decreases about 1 In. Hg. per 1000 ft. of elevation.

## **Altitude**

Altitude equals the elevation above mean sea level (MSL) in feet.

## **Altitude – Density**

See 'Density Altitude'.

## **Altitude – Pressure**

See 'Pressure Altitude'.

## **Barometric Pressure - Absolute**

See 'Absolute Barometric Pressure'.

## **Barometric Pressure - Corrected to Sea Level**

In order to provide a standard method of stating barometric pressure, the National Weather Service (NWS) adjusts the absolute barometric pressure observations to sea level elevation (0 feet). Without this standard the barometer readings would be meaningless at different geographic elevations around the world. The correction adds about .001 In. Hg. per foot of elevation to the absolute baro number. Corrected barometric pressure cannot be used for

performance calculations without subtracting the local elevation from the NWS value. Even then it would be an approximation because the barometer is at another location.

### **Barometric Pressure - Dry**

See 'Dry Barometric Pressure'.

### **Correction Factor**

The correction factor is a Society of Automotive Engineers (SAE) equation that uses the calculated dry barometric pressure (In. Hg.) and the measured local temperature (°F) to compensate for changes in dynamometer observed horsepower readings due to air density differences. The correction factor is utilized in the following Computech calculations: Standard Dial In, Throttle Stop, Test and Tune, and Estimated Performance.

### **Density Altitude**

Density altitude is a value in feet that relates the local measured atmospheric conditions (absolute barometric pressure or pressure altitude, temperature, and relative humidity) to the aeronautical industry defined standard day atmosphere. The density altitude for an absolute barometric pressure of 29.92 In. Hg. or a pressure altitude of 0 ft., a temperature of 60°F, and a humidity of 0% is 0 ft. A good air day in the spring or fall might be below 0 ft. (i.e. -831 ft.). Conversely, a hot summer day might have a density altitude of 4500 ft. (equivalent to 4500 ft. of altitude on a standard day). Density Altitude is used in the Computech Density Altitude Dial-In calculation.

### **Dew Point**

The dew point temperature is the calculated temperature at which the measured partial saturation of water vapor in the air will turn to liquid and form dew. Moisture can cause inconsistent traction and, in certain circumstances, effect engine performance. The warmer the air is the more water vapor it can hold. See 'Relative Humidity' for more information. An air sample has a specific amount of water vapor present. As the temperature drops and reaches the dew point, the air can no longer hold the water vapor suspended so it condenses and turns to water. This condensation will occur on cooler surfaces first.

### **Dry Barometric Pressure**

The dry barometric pressure (In. Hg.) is the absolute barometric pressure with the partial saturation water vapor pressure subtracted from it. The measured absolute barometric pressure is from a combination of oxygen, nitrogen, argon, and some other trace gases plus water vapor. The portion that is water vapor will not contribute to combustion of the fuel and therefore must be factored out. Dry baro pressure is used to calculate ADR, Density Altitude, and the Correction Factor.

### **Pressure Altitude**

Pressure altitude is a term from the aeronautical industry. It is the aircraft altimeter indicated value in feet that results from setting the pressure adjustment window to 29.92 In. Hg. This number relates to the industry defined Standard Day altitudes. An indication of 0 ft. is equal to an absolute barometric pressure of 29.92 In. Hg. Lower or negative values (i.e. -180 ft.)

indicate better air pressure. Higher values (i.e. 2500 ft.) show poorer air pressure. An altimeter will also show absolute barometric pressure (In. Hg.) in the pressure window when the altitude pointer is rotated to indicate 0 ft. Note that this number is pressure only. Until it is adjusted for temperature and humidity via the density altitude process it is not an indication of total air quality. The RaceAir system calculates and displays this information as additional air data but does not use it for other calculations.

### **Relative Humidity**

Relative humidity (% RH) is a value to indicate how much water vapor is present in an air sample. Air has the ability to hold more water vapor as temperature increases. This phenomenon makes thinking of water vapor content difficult. By always relating the amount of water vapor present to the maximum amount that air could hold at that temperature, the relationship is easier to understand (i.e. 50% RH is always 50% of the possible saturated water vapor content for air at any temperature). The RaceAir system senses the relative humidity of the air sample.

### **Temperature**

Also known as dry bulb temperature (°F). There is nothing special about how the RaceAir system measures the temperature. But it does matter where the sample is taken. In order for the Computech Systems to correctly calculate atmospheric effects, the sensor measured temperature needs to be similar to the engine intake air temperature.

### **Vapor Pressure**

Vapor pressure is a value (In. Hg.) calculated from the sensed temperature and relative humidity. The RaceAir system uses numbers derived from mechanical engineering steam tables to calculate the partial saturation vapor pressure of the moisture in the sampled air. That value is displayed and used in the 'Dry Barometric Pressure' computation. This is one of the more complex but very necessary operations the RaceAir does. The vapor pressure number indicates the portion of the available air pressure that is actually water vapor, which could alter the air/fuel ratio in the engine.

### **Water Vapor**

Water vapor (Gr.) is the same information as 'Vapor Pressure' expressed in different units. The reason for this is some race teams use 100 Gr. as a threshold for making tuning changes. Above 100 Gr. additional fuel and timing changes are added.

### **Wet Bulb Temperature**

Wet bulb temperature refers to using a mercury thermometer with a water soaked cotton wick over the sensing bulb. This technique produces a lower temperature indication for lower humidity conditions due to evaporation. The wet bulb temperature and the dry bulb temperature can be used to calculate 'Relative Humidity'. The RaceAir system does not use this method to determine RH % but does display the data as information.