Reviewed

DataMaster DMT Explanation of Status Codes and Their Limits

Based on Vermont Software as of 3/30/2009

"PUMP ERROR"

If at anytime during the purge cycle or the running of a wet bath external standard, the flow rate drops below approximately 3 liters per minute (derived from a flow voltage limit of 1.35 Vdc), the message "PUMP ERROR" will be generated.

This voltage and the corresponding flow rate of approximately 3 l/m is also used as the MINIMUM FLOW RATE required when determining subject sample acceptance.

"FILTER (1, 2 or 3) WON'T ZERO"

In the event the DMT's D to A converter is unable to adjust the output detector signal prior to an analysis at any of the three wavelengths (3.44μ, 3.37μ and 3.50μ) to within 30 mV of 0.000 V, the message "FILTER (1, 2 or 3) WON'T ZERO" will be generated identifying which specific filter was unable to zero.

"AMBIENT FAIL"

During the initial purge cycle of a given test, the output signal of the detector is measured and quantified. The initial measurement is made 10 seconds after the pump comes on. A second measurement is made at the completion of the purge, 25 seconds from the start. When these 2 measurements are compared, if the difference is > .040 Vdc, the message "AMBIENT FAIL" will be generated.

"BLANK ERROR"

A Blank Test is performed subsequent to zeroing and prior to analysis when the primary, or 3.44μ filter is in the optical path. If this measurement produces a measurement ≥ 0.004 g/210 liters or equivalent, the message "BLANK ERROR" will be generated.

Additionally, if, after the allotted purge time after a sample has been delivered the displayed value ≥ 0.008 g/210 liters or equivalent, the message "BLANK ERROR" will be generated.

"STANDARD OUT OF RANGE"

If the simulator tolerance check is enabled, the value of an external standard must be within ±0.005 g/210 liters, or equivalent, of the target ethanol concentration for values of 0.080 g/210 liters or equivalent and above. For target concentrations below 0.080 g/210

When the DMT is powered-up, the 20 minute wait period to the time that a test can be conducted is 20 minutes after the sample chamber temperature reaches 45 degrees C.

BREATH TUBE TEMPERATURE CHECK

The temperature range for the breath tube is 40 ±10 degrees C inclusive. If the temperature is outside this limit, a message stating so will be displayed when a test is attempted. doesn't allow test, doesn't print

"RFI DETECTED"

An antenna wire in the breath tube monitors the environment around the DMT for elevated levels of radio frequency interference. If the set threshold for detection is exceeded due to elevated levels of RFI the message "RFI DETECTED" will be generated.

"INCOMPLETE ~~SAMPLE~~"

If the breath sample parameters are not met during the allotted 2 minute window for accepting a breath sample the message "INCOMPLETE SAMPLE" will be generated if it is determined that it is not a refusal.

"FILTER WHEEL ERROR"

2 optical sensors are used to validate proper positioning of the filters and quartz standard in the optical path. A stepper motor is used to move the filters and quartz standard into the proper position and a locking pin is actuated via a solenoid to secure in place. The software monitors the movement of these wheels and if there is misalignment during any of the movement sequences, the message "FILTER WHEEL ERROR" will be generated.

"SUCK BACK ERROR"

In addition to being able to determine the rate of airflow through the pathway, the mass airflow sensor can determine the direction of airflow. If the sensor detects airflow in the reverse direction during a breath test (sucking), the message "SUCK BACK ERROR" will be generated.

National Patent Analytical Systems, Inc.

Explanation of the INVALID SAMPLE message and the DataMaster DMT

12/14/07

Measurements of the alcohol concentration during breath sample delivery are taken every 250 milliseconds (4x per second).

A "positive slope" is defined as a comparison of a 2 consecutive point average to the previous where the trend is not in the negative direction. Both conditions of a positive change and no change are considered a positive slope.

The message "INVALID SAMPLE" will be produced while the instrument detects at least the minimum rate of airflow during sample delivery if:

There are three consecutive comparisons of two point averages where the trend is in the negative direction (values are decreasing) after seeing first a minimum of six positive comparisons of two point averages.

Or

Any final result $\geq$ 0.060 g/210 l is less than 95% of any previous high reading during that successfully delivered sample.

Or

Any final result $\geq$ 0.003 g/210 l but < 0.060 g/210 l is lower than any previous high reading during that successfully delivered sample by at least 0.003 g/210 l.

3.44μ x a21. The greater the concentration of the interference, or the less like ethanol (a21), the greater the discrepancy becomes.

As some allowance for variation between the values (3.44μ x a21 and 3.37μ) is necessary due to expected variability in any measurement (+/-0.002 for each measurement) the question arises as to at what level the discrepancy becomes significant and scientifically and legally of importance. The limit for the filter agreement threshold is 0.005. What this means is that once the discrepancy between the value at 3.37μ and the value at 3.44μ x a21 $\geq$ 0.005, the sample is said to contain an interfering substance. This threshold can, however, be adjusted.

The following is an explanation of what might happen if the sample were to contain acetone in addition to ethanol. Lets assume the ethanol concentration of the sample as measured at 3.44μ was 0.160. Knowing that ethanol absorbs approximately 20% more energy at 3.37μ, we would anticipate the result at 3.37μ to be 0.160 X 1.2 = 0.192. If acetone is also a component of the sample, it would be useful to know the characteristics of acetone at 3.44μ and 3.37μ. Test data has shown that acetone absorbs 2 to 3 times the amount of IR energy at 3.37μ than it does at 3.44μ (again, independent of the concentration). For this discussion we will use a 2:1 ratio. Assume a contribution of 0.010 at 3.44μ. Since we expect in this example 2X that concentration at 3.37μ, the value would be 0.020. If we add these concentrations of acetone to the ethanol portion we would see:

Reading at 3.44μ = 0.160 (etoh) + 0.010 (ace) = 0.170 total concentration

Reading at 3.37μ = 0.192 (etoh) + 0.020 (ace) = 0.212 total concentration

When multiplying the result at 3.44μ by a21 we see:

0.170 x 1.2 = 0.204

Comparing this to the result at 3.37μ we see:

0.204 – 0.212 = -0.008

This exceeds the "filter agreement threshold", (preset at 0.005) by 0.03. This test would result in the message of "interference detected" if the software were designed to handle the discrepancy in this manner.

If the contribution by acetone were 0.005 at 3.44μ in the above example, the amount at 3.37μ would be expected to be 2X or 0.010. This, added to our base ethanol concentration would yield:

Reading at 3.44 = 0.160 (etoh) + 0.005 (ace) = 0.165 total concentration

Reading at 3.37 = 0.192 (etoh) + 0.010 (ace) = 0.202 total concentration

See table below for example of thresholds with INT set to 5

Value @ Filt 1	Filter I1-2I Diff	Filter I1-3I Diff	Combined Diff I1-2I + I1-3I
0.025	0.0050	0.0050	0.0070
0.050	0.0050	0.0050	0.0070
0.075	0.0050	0.0050	0.0070
0.100	0.0050	0.0050	0.0070
0.150	0.0075	0.0075	0.0105
0.200	0.0100	0.0100	0.0140
0.250	0.0125	0.0125	0.0175
0.300	0.0150	0.0150	0.0210
0.350	0.0175	0.0175	0.0245
0.400	0.0200	0.0200	0.0280
0.450	0.0225	0.0225	0.0315
0.500	0.0250	0.0250	0.0350
0.550	0.0275	0.0275	0.0385
0.600	0.0300	0.0300	0.0420

Enter Int Thrshld
(2-10)
5

Separate worksheet allows changing Threshold setting to see limits.