# 5014i/5030i Diagnostics

For all Thermo i-series instruments we recommend setting the onboard datalogger to use 70% of the memory storage to collect 1-minute LRECs for Diagnostic purposes. This will allow the collection of at least 1 week of 1-minute data. The remaining 30% of memory can be used to collect 1 hour readings of the main parameters, such as Time, Date, PM, Sharp, Neph and status flags. This will allow the collection of at least 1 month of the main parameters for backup purposes and long-term Diagnostics.

For the 1-minute LREC readings we recommend adding a few parameters to the default selection to obtain the following list: Time, Date, Flags, pm, sharp, neph, baro, vac, pflow, ambrh, srh, ambtemp, ftemp, fvol, mcmp, ntmp, nrh, brdtemp, cflg and aflg. The 5014i would have the same list, but because it does not have the nephelometer it would not contain sharp, neph, ntmp and nrh.

For qa/qc purposes, we recommend downloading the data once a week with iPort and viewing it graphically in Excel. Once familiar with the procedure, downloading the data, importing it into Excel and graphing the main parameters should only take about 10 minutes. Below are some examples of useful graphs.

PM-Sharp-Neph:
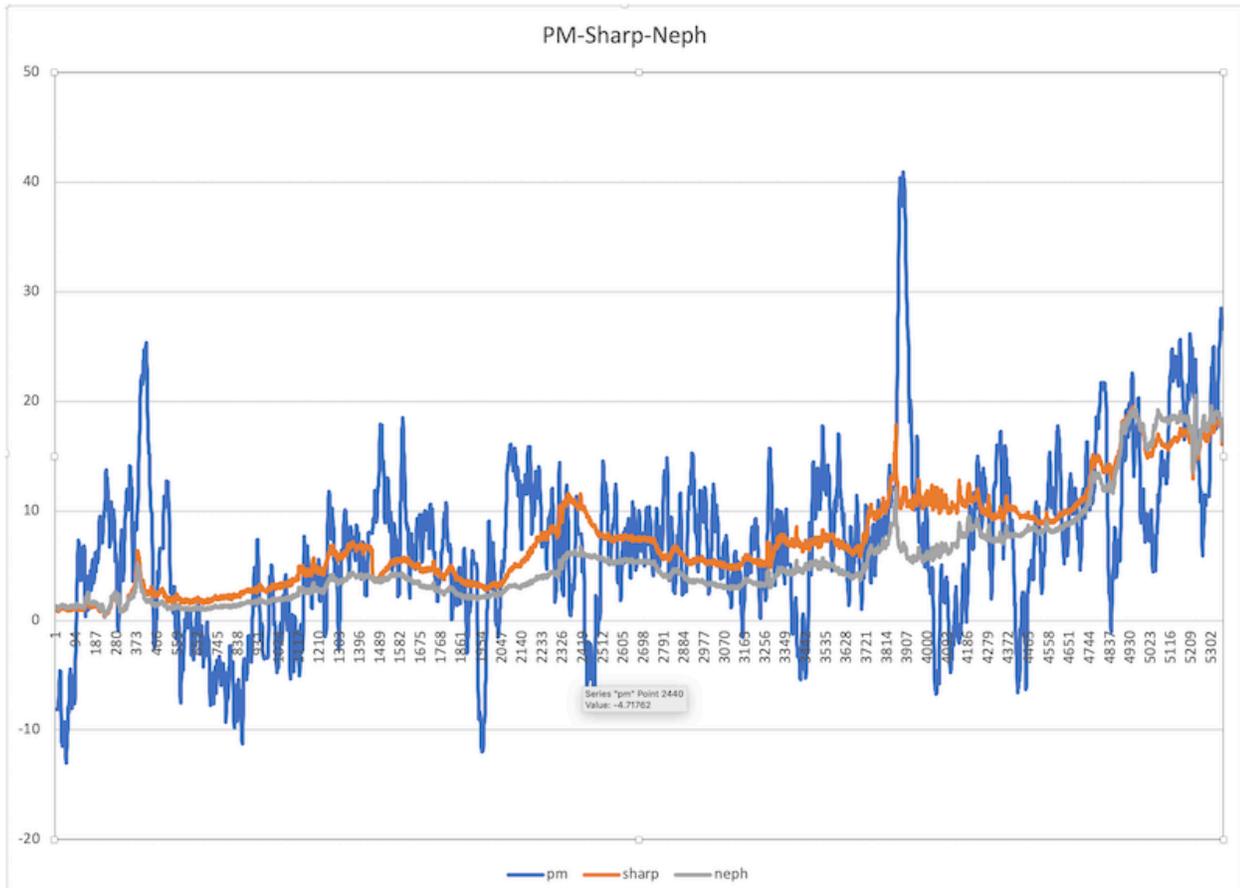
We always recommend graphing these 3 parameters together to get a true picture of operation. The Neph channel should always be positive and the most stable of the three. The Sharp channel should track with the Neph channel, but sometimes it will be higher and sometimes lower depending upon the correction factor supplied by the PM (beta) channel. The PM channel is inherently noisy with occasional spikes, usually caused by tape advance upsets. The example above we would consider only "acceptable". A really good PM trace would track with the Neph and have a +/- 5 ug/m3 noise with only an occasional spike of less than 20 ug/m3.

Vac-Pflow:
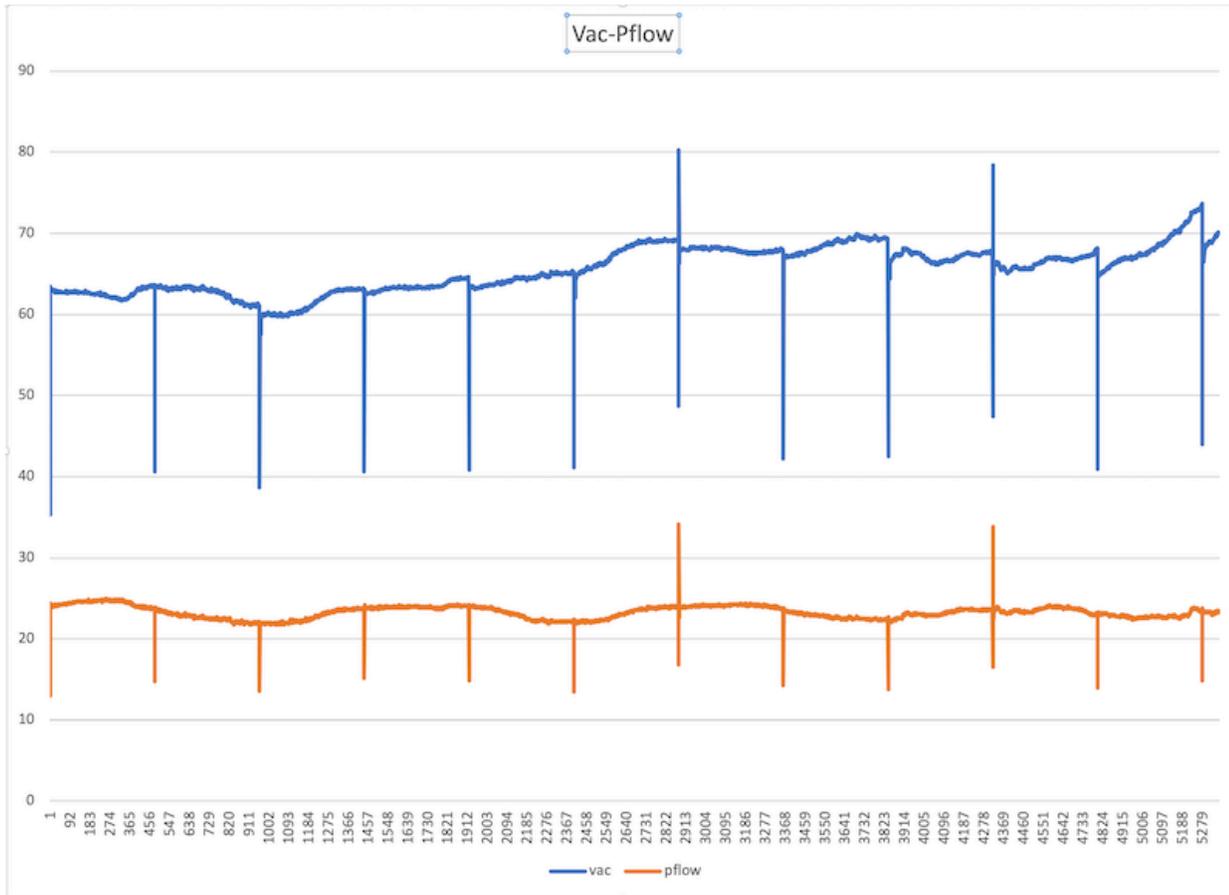
The Vac trace shows you the pressure drop across the filter tape and is generally 55 to 70 mmHg at the beginning of a new tape spot. When particulate readings are high you will see the pressure drop across the dirty filter ramp up until it advances to a new clean spot, and then start over again. A high Vac reading at the beginning of a new filter spot could indicate an incorrect (high) flow. A low Vac reading could indicate an incorrect (low) flow or a leak.

The Pflow is the pressure drop across the flow orifice and is usually between 15 and 30 mmHg. It is normally quite flat but can change due to changes in the ambient temperature and pressure. Again, an incorrect flow could make this reading high or low. A high reading could also indicate that the flow orifice is plugging up.

Extremely high or low readings in either parameter could indicate faulty pressure sensors.

RH:
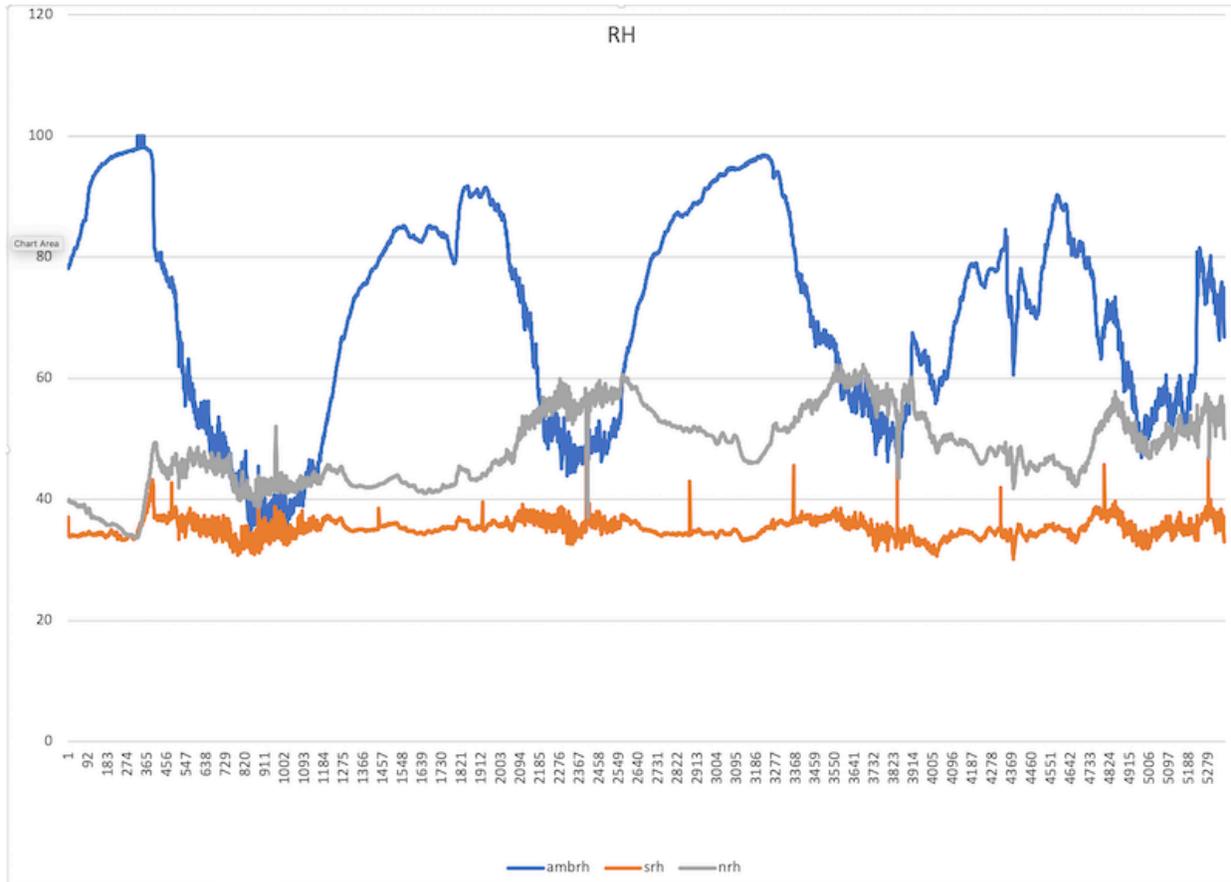
The ambient RH reading varies greatly depending upon the location and conditions. Generally, it increases at night as the temperature drops and declines during the day as it warms up.

The sample RH is a calculated value that uses the ambient RH, as well as the difference between the ambient temperature and the filter temperature. The inlet heater is used to control the chamber temperature to maintain a theoretical maximum of 35% RH.

The 5030i has a nephelometer with an internal RH sensor. To avoid getting dirty, the RH sensor is not in the direct flow path, so it is slightly buffered by the enclosure temperature. However, it should be close and is therefore useful as a "double-check" to the sample RH. In the example graph above, the nephelometer RH is reading at least 10% too high, or the ambient RH is reading 10% low. This indicates a need for an RH/temperature calibration as soon as possible.
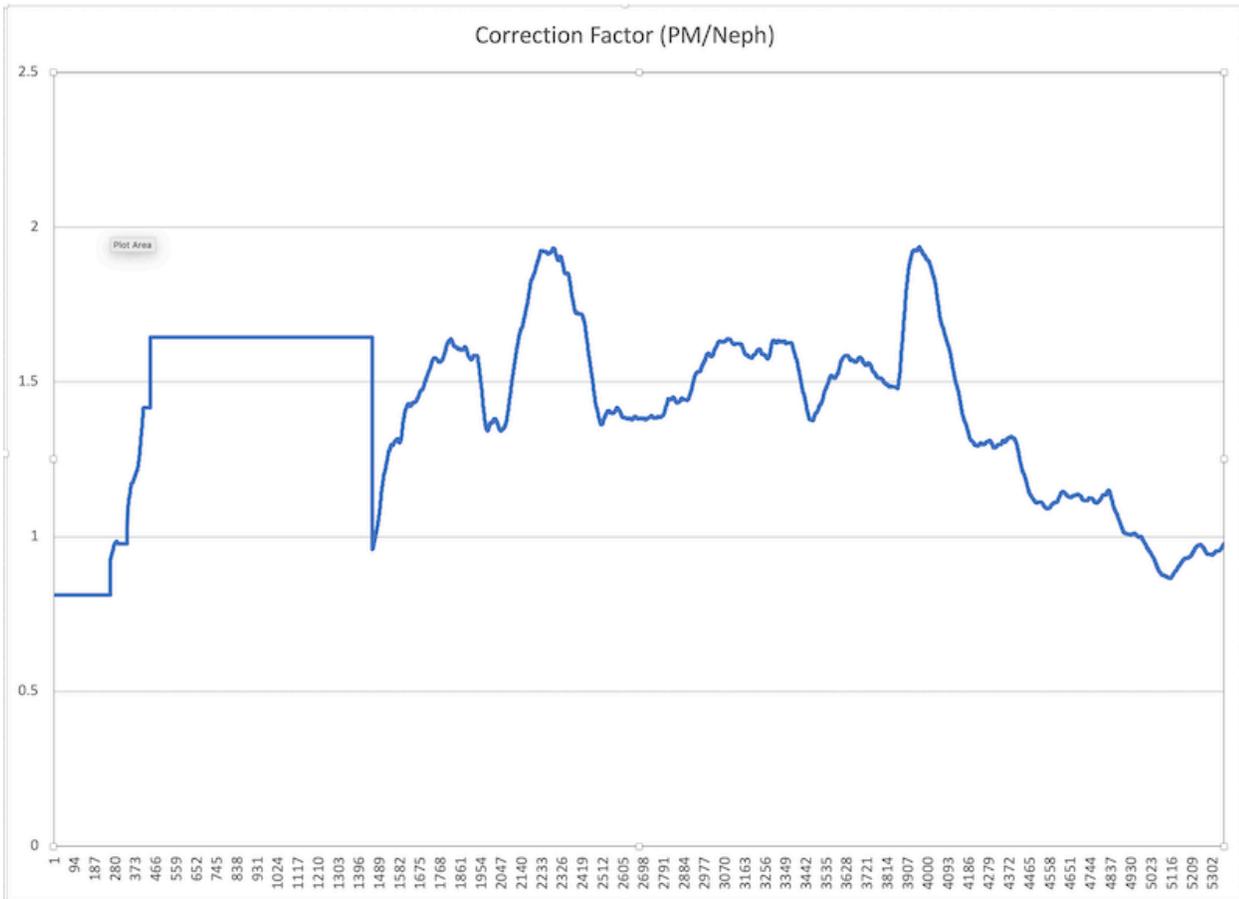
Temperatures:
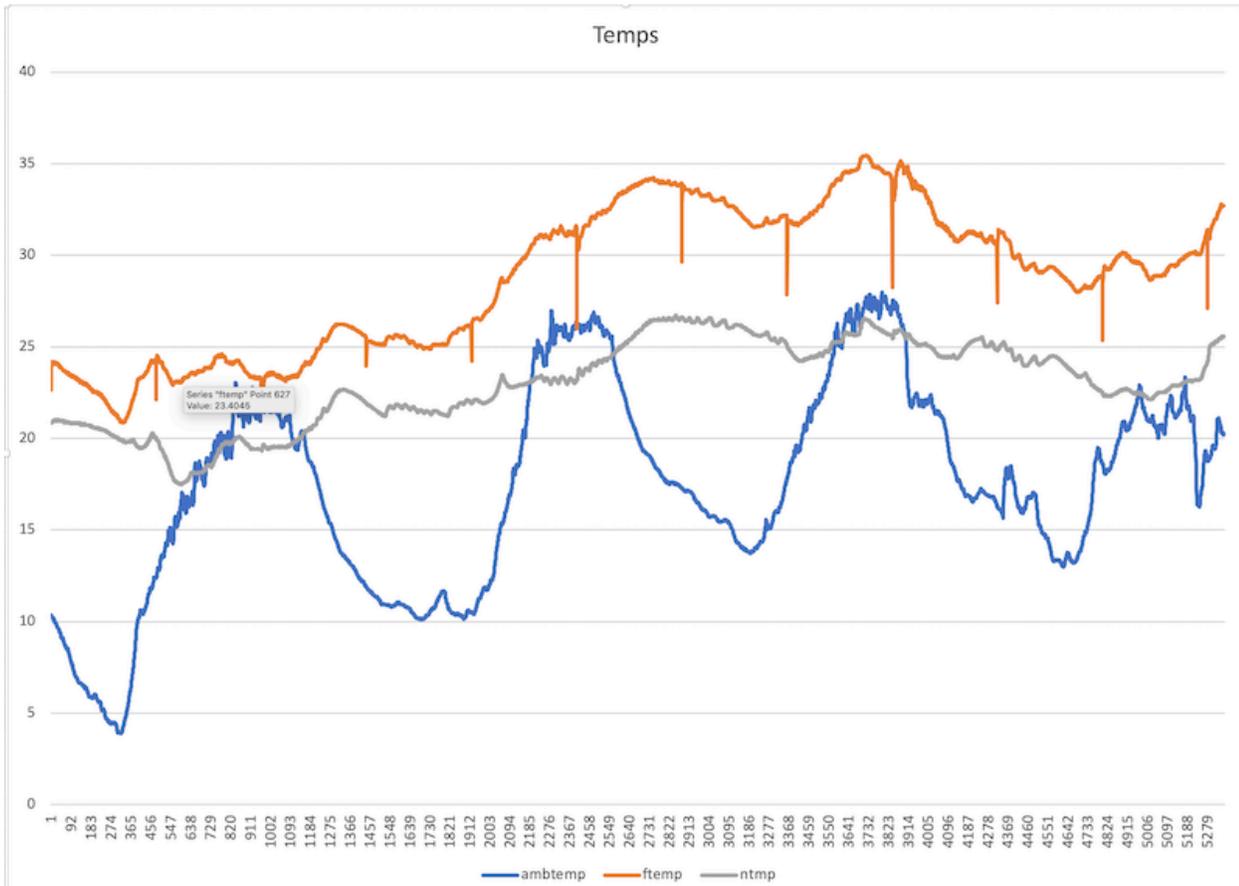
The ambient temperature sensor is important as it is used to adjust the volumetric flow through the inlet head. It is also used to calculate what the flow temperature needs to be to have a sample RH of 35%.

The flow temperature, for much of the year, is quite often elevated to reduce the sample RH to 35%. For example, if the ambient conditions are 25C and 80%, then the flow temperature would have to be 38.3C to obtain 35% RH. In the winter, when the temperature is colder, the heater may not come on at all. For example, with an ambient temperature of -10C and an RH of 80%, the flow temperature only needs to be 3.3C to obtain 35%. In this case, with the instrument inside a heated trailer at 21C, the sample temperature would probably be 16-17C, even without the heater coming on. This would give an RH of around 15%.

The nephelometer temperature (5030i only) is not a critical temperature but can be useful in verifying proper operation. Because it is not in the direct flow path, it is somewhat moderated by the enclosure temperature. It should track with the flow temperature, but not get as hot in the summer, or as cold in the winter.

Mass (mcmp):

MCMP (mass) is a default LREC setting that is quite useful as a quick check on the instrument operation. Due to the erratic nature of the Beta signal, there will be occasional glitches in the data trace, but, in most cases, the mass will zero at the beginning of a new tape spot and increase over time until the tape advances again. The rate of change is relative to the particulate concentration.

Correction Factor (PM/Neph):

Although the Correction Factor (CF) cannot be chosen as an LREC parameter, it can easily be estimated in Excel by dividing the PM column by the Neph column. The CF can be anywhere from 0.1 to 10, but under normal operation it is usually between 0.5 and 2.0. As you can see from the graph, the CF factor is frozen when the long-term average of either the PM or Neph is low. It is also frozen for 8 hours when first turned on, or after a power failure.

Over the long-term, if the CF is significantly higher, or lower, than 1.0, then it is recommended to adjust the Nephelometer span coefficient to bring it close to a 1:1 relationship.

Tape Counts:
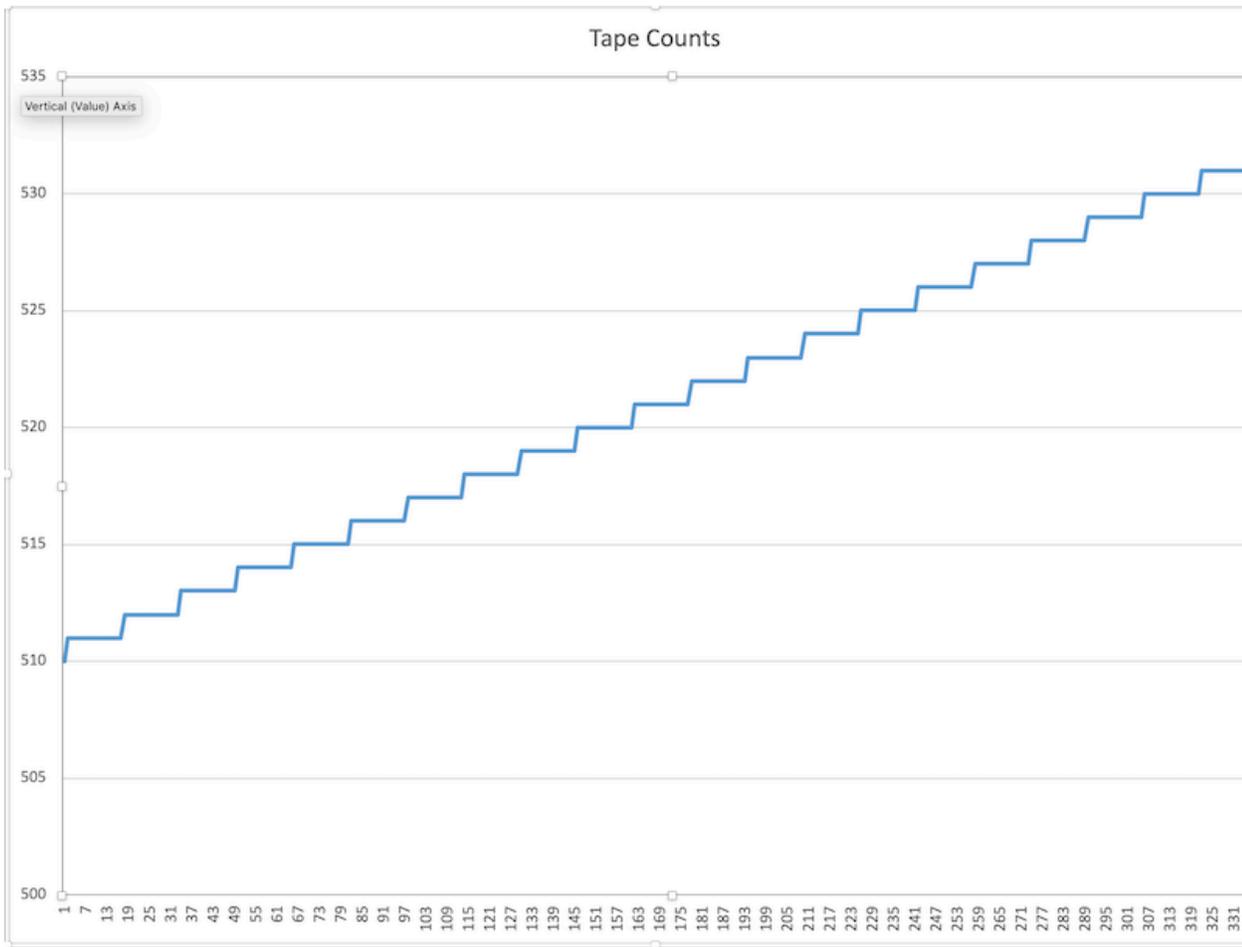
Another useful Diagnostic is the Tape Counts. A quick glance at the graph shows you if there have been any upsets or changes. This is another parameter that is not polled by the internal logger but can be collected if using Envidas, or an external logger.