Populations, Activity and Emissions of Diesel Nonroad Equipment in EPA Region 7

PSU 1 PAMS Data Review Notes Appendix AF

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PSU 1 PAMS Data Review Notes

1688_1462, PAMS Test, Corsa datalogger installed 6/8/2007 on a 2006 Vermeer Navigator D16x20A Horizontal Boring Machine:

Review of raw data and plotted data shows operational voltage (with equipment running) generally over 13.8 V. Optical data is suspect throughout (much of the optical is zero when equipment is running). Capelec RPM appears invalid, all over the place throughout most of the dataset.

The on/off criteria (for equipment setup) at 13V was apparently not used correctly (confirmed by revisit notes), many instances where DL shuts down with voltage over 13 V. Probably due to the value of "12" seen in RPM settings in config file (when RPM goes to zero, DL shuts down). We applied the following on/off and RPM validity criteria: If V > = 13.5, equip is on. If equipment is "on" and optical RPM < 700, RPM is invalid (since the RPM "floor" we saw for the optical was around 1100.

All Capelec is invalid.

On 6/18/07, we see several 5-second drops in voltage (some under 13.5), but the RPM doesn't drop to zero (generally around 800 or so). Might be engine lugging during a boring or retraction operation, we didn't apply any algorithm modifications for this.

From 7/2 onward, all optical appears to be zero (invalid).

Review of data showed data between 6/8 and 6/12 is invalid, due to null RPM. Data collected between 6/8 and 6/12 will be excluded from import and analysis. Review of the plots indicates that on 6/12 at around 11:30 am the system starts acquiring what appears to be valid RPM. Files created prior to 6/12 will not be imported.

1/10/08: Review of data file showed we should use 13.1 as voltage on/off limit, since voltage drops below 13.5 with equipment on (which results in observations where the equipment is classified as ""off"" when it is actually running). Since we have many obs where the equipment is on, but no RPM (RPM sensor malfunction during testing), we will use voltage as the only on/off criteria. This will result in some trailing zeros in the "equipment on " file.

1/11/08 Review of file shows setting is OK. We have optical RPM values when equipment is off, but no optical rpm many times when the equipment is on, and voltage fluctuations during operation make voltage a weak indicator of equipment "active" vs "inactive". This is probably the best we can do here. Note that in this file we have multiple obs with very low and identical RPM, appears erroneous acquisition.

1688_0216, PAMS test, Corsa datalogger installed 6/8/2007 on a 2007 Vermeer Navigator D20x22 Horizontal Boring:

From review of data and plots we chose 13.1 V as the voltage criteria for "equipment on". All data appears valid and calibrated (we don't appear to have uncalibrated installation data). First data is on 6/8 (appears to be in the evening on Friday when they are moving the equipment onto the trailer).

1/10/08: Review of data suggests we should use 13.2 as voltage on/off limit. This leaves some observations at end of file with equipment is incorrectly classified as active (but it's not running) with rpm = zero. To eliminate these "trailing zero" observations, we'll apply logic of "if V < 13.2 AND RPM < 50 AND average of RPMs for next 5 obs is < 50 then equipment = off".

1/11/08: Review of datafile suggests we should go back to 13.1 V as the cutoff, and apply the "leading" and "trailing" zero cutoff algorithms.

1/15/08: We are going to apply the logic to eliminate "orphans" with one second of "active" (in the middle of inactive). Also, we are going to move the voltage cutoff to 13.0. Note in this file we are still seeing a few times where the RPM goes to zero, but equipment seems to stay running, and we have a non-sequential jump in time. It appears the equipment was running, but the Corsa is not collecting data for periods of time (or their date/time stamps are invalid)

2208_1918, PAMS test, installed 6/10/2007 on a 1983 John Deere 410B Turbo:

Datalogger was installed 6/10, but installation team had no key for the equipment when they installed the datalogger, so they were unable to verify operation or calibrate the datalogger. Returned on 6/12, and team did a pre-calibration check on 6/12 and a calibration. However, no valid RPM until 6/15, so data prior to 6/15 will not be imported.

Based on review of voltages and RPM (on/off) suggests we use 13.3 V as the equipment “on” voltage (if voltage >= 13.3 V, then equipment is on). After this logic is applied, we’ll review records where the equipment is listed as “off” yet we have RPM to ensure the RPM is not from operation (i.e., noise), or to determine if we need to change the voltage criteria or establish a secondary RPM criteria for proper overall on/off logic.

1/10/08: Reviewing file, we'll use the voltage on/off setpoint of 13.1. In addition, to eliminate "trailing zero" observations when equipment is turned off, we'll apply the logic of "if V < 13.1 AND RPM < 50 AND average of RPMs for next 5 obs is < 50 then equipment = “off”.

1/11/08: We're going to 12.7, apply leading and trailing zero scrubbing algorithm. No noise seen during equipment off, so we probably won't inadvertently get "active" status (good). Sometimes we did see optical rpm =0 when equipment appeared to be "active".

1/15/08: Again, we have areas in the data where RPM goes to zero, but we have high voltage so we indicate the equipment is "active". These correspond to a gap (non-sequential time stamps) in data, 2 minutes up to 15 minutes. These are apparently missing observations through the raw data set, perhaps a datalogger or installation Issue, 2 to 15 minutes in duration. The RPM readings before, and after this gap in time are zero. For future data processing and analysis, may want to consider looking at the gaps in time as an additional check on equipment "active" status. At this point, we left e;quipment as "active", because we never saw a drop in voltage below the cutoff, so this seems more like missing observations than the equipment turning off. We are going to say disregard the leading/trailing zero logic if there is a jump in time (missing data) and rely solely on voltage for equipment on/off since we don't know what's happening with RPM prior to or after the zero observations (due to missing data) Note that we appear to have segments where the rpm drops (but not to zero), the equipment active status is set to "N" because the voltage drops below cutoff, but engine really does appear to keep running.

1437_0399, PAMS test, Corsa datalogger installed 6/9/2007 on a 1999 Bobcat (Melroe-Ingersol Rand) 873 G-Series Skidsteer loader:

Based on review of voltages and RPM (on/off) again we are going to start with 13.3 V as the initial equipment on/off limit. Then we’ll revise if needed after looking at the data. Looking at raw data, it appears voltage jumps up above here really quickly (within a couple seconds).

Data appeared to be calibrated from initial install, but let’s double check that it’s not necessary to eliminate any data that was collected after the initial installation but prior to calibration.

We reviewed data, all data prior to 14:55 on 6/9/07 was suspect (day of install and apparently prior to calibration), so those records were excluded from the SAS readin program.
1/10/08: Review of file showed voltage setting was 13.5, we will drop to 13.3 to refine (this will help us ensure we get startup points). Again, we'll have some trailing zeros (where the equipment is listed as "active" but is turned off. To eliminate these "trailing zero" observations when equipment is turned off, we'll apply the logic of "if V < 13.3 AND RPM < 50 AND average of RPMs for next 5 obs is < 50 then equipment = off".
1/11/08: Using 13.3, we do still lose a 2 to 3 seconds of observations at start of some run events (at startup). We will drop voltage limit to 13.0 . Also, we are going to look at RPM for prior 5 observations, if the equipment is classified as "inactive", and the RPM of the current observation is < 50, and the average of the RPMs of the preceding 5 obs is < 50, then equipment will stay inactive, even if voltage rises above our cutoff.
1/15/08: Occasionally voltage is > 13.0 for 1 ob, but equipment off, we will scrub these incorrect "orphans" using logic that if only 1 or 2 seconds active, then make it "inactive". Also noted, several points where time stamps are not sequential (XX.000, XX.001, then skip 30 seconds), on these the RPM is zero but equipment is active. This appears to be a datalogger issue where the equipment is on but the DL lost signal and sequential acquisition (original raw data acquisition problem). Data analysis algorithm appears fine here.

1437_1396, PAMS test, installed 6/6/2007 on a 2004 Bobcat S300 Skidsteer loader:
Review of consolidated instrumentation log, data and plots suggests that RPM was calibrated on 6/9 at 2:30 PM. Review of data and plots indicates 13.6 is a good starting point for initial voltage “on” setting.
1/10/08: Review of data shows quite a few where voltage drops to just over 13.5 but equipment stays on, so we'll drop voltage limit to 13.5 in order to ensure we capture those observations. Note that we have several observations where RPMs go to zero but equipment stays on, and also trailing zeros. To eliminate "trailing zero" observations when equipment is turned off but listed as active and we have "0" for RPM, we'll apply the logic of "if V < 13.3 AND RPM < 50 AND average of RPMs for next 5 obs is < 50 then equipment = off". This will eliminate trailing zeros, but will retain the observations where RPMs drop to zero for only a few seconds (due to faulty RPM sensor or load/voltage drop on engine). Also note that file had some observations where the voltage dropped to mid 12s but equipment kept running (appeared to be bogging down). We'll lose these either way with our existing logic.
1/11/08 - Review of data suggests dropping V to 13.2 and applying the "leading zero" logic (to eliminate inadvertent "active" classifications. Review shows several observations within datafile where voltage dropped below 13.0, but still had RPM (these will still be lost) and also when equipment is off (and voltage is below 13.0), the optical output includes contiguous observations with nonzero values (which the algorithm correctly classifies as "inactive"). The optical output has a lot of noise when the equipment is off.
1/15/08: Occasionally voltage is > 13.0 for 1 ob, but equipment off, we will scrub these incorrect "orphans" using logic that if only 1 or 2 seconds active, then make it "inactive". Also noted, several points where time stamps are not sequential (XX.000, XX.001, then skip 30 seconds), on these the RPM is zero but equipment is active. This appears to be a datalogger issue where the equipment is on but the DL lost signal and sequential acquisition (original raw data acquisition problem). Data analysis algorithm appears fine here.
NOTE: this dataset (among others) shows duplicate records for the same second (different subsecond values), where one RPM appears valid and nonzero and the other RPM is zero. The corsa is storing some erroneous RPM values for some obs. These all appear to be located around obs with the subsecond value of *.001. These have been scrubbed out.

1911_9540, PAMS test, Corsa datalogger installed 6/19/2007 on a 2006 or 2007 Core Cut CC6560 XLS Concrete Saw:

Two RPMs for this were equipment RPM and optical RPM, both seem to provide a reliable and reasonable signal. We used equipment RPM > 40 RPM to indicate equipment on (rather than voltage). Raw files "A2450034" through "A2450040" were all from the installation and calibration procedures from around noon on 6/19 and were excluded from the data set (were not read in).

1911_1916, PAMS test, Isaac datalogger installed 6/11/2007 on a 2003 Ingersoll Rand Bobcat T300 Turbo Tracked Loader:

This was the Isaac datalogger, the configuration file was set with rpm >300 as on/off criteria. No additional processing necessary (logger only operated when equipment was on). May have some observations at start or end of file that were missed due to RPM <300, but this is expected to be minimal and cannot be corrected.

PSU 2 PAMS Data Review Notes

2535-9216, PAMS test, Isaac datalogger installed 9/17/2007 on a 1999 Case 580 Super L Backhoe:

All data on install date is excluded. Much data on 10/29, but datalogger was removed in AM, and team was not able to properly retrieve data, so this data appears to be after removal during data retrieval.

Data from 10/29 and afterward is invalid (not on equipment) and has been removed from final dataset.

File does appear to show equip ran with very low voltage (< 12 volts) but we were getting RPM, & equipment also operated with high voltages, so voltage is unreliable indicator of operation. Perhaps key on/engine off (KOEO) warming of glow plug or accessories.

We see many instances of equipment in apparent koeo (no rpm but slow voltage drop over time). Mid-file, rpm begins to be sporadic/unreliable/intermittent and not a reliable indicator of engine operation. Equip has optical but no Capelec, and logger is on if power is on.

If data is collected, we'll assign "key on" = yes. RPM and/or voltage are needed to assign engine on (equipment active) but due to intermittent rpm signal and varying voltage values this is as close as we can get. No "equipment active" field will be assigned (equipment active was only used when we used battery voltage for on/off decisions).

ERG RPM = Optical. No RPM validity flag will be assigned (RPM validity was only used when we used battery voltage for on/off decisions). Use new flag (such as "RPM too high") to identify observations with RPM > threshold (such as 6000 rpm). Review of instrumentation file shows no RPM calibration needed.

3702_9726, PAMS test, Isaac datalogger Installed 9/15/2007 on a 2005 Skytrak 6042 Fork Truck:

Again, we see a number of “key on, engine off” (KOEO) instances (appears to be glow plug warming). This datalogger only collects data when key is on, so if data is collected, we'll assign "key on" = "yes". No "equipment active" field will be assigned (equipment active was only used when we used battery voltage for on/off decisions).

Use Optical RPM for ERG RPM.

Capelec scaling factor varies (3.7, 4.43, 4.43, and 8.88), so we'll use the median (4.43) and multiply all Capelec RPM by 4.43 for a new field entitled "corrected Capelec" rpm. Note that due to variability in Capelec scaling factor, “corrected Capelec” RPM is not believed to be highly accurate.

Use new flag (such as "RPM too high") to flag observations with RPM > threshold (such as 6000 rpm).

No RPM validity flag will be assigned (RPM validity was only used when we used battery voltage for on/off decisions).

3858_5754, PAMS test, Isaac datalogger installed 9/15/2007 on a 1992 Case 480F LL Backhoe:

The start of many segments have no RPM but we see the battery voltage drop rather quickly, then sharp drop, after which we get RPM and a sharp jump in voltage. These appear to be KOEOs, probably to warm the glow plugs, followed by the operator cranking and starting the engine.

Datalogger power was taken from the fuel solenoid, so if data is collected, we'll assign "key on" = "yes".

No "equipment active" field will be assigned (equipment active was only used when we used battery voltage for on/off decisions).

After 9/20, multiply all optical RPM by 1.06 (for a "corrected optical" rpm).

We will use "corrected optical RPM" for "ERG RPM". No Capelec RPM on this installation.

Some of the data around 8:00 am on 9/20 appears to be invalid (V = 12.8 but no RPM), this could be due to

the ERG visit (adjusting the optical sensor bracket) or running the equipment without getting RPM. This appears isolated, so I'm reluctant to apply broad screening to the RPM data on ERG visits. Generally, our visits should not significantly affect RPM data.

3858_1482, PAMS test, Isaac datalogger installed 9/16/2007 on a 1996 Caterpillar D4C Crawler Dozer :

Optical seems unreliable and intermittent, and when Capelec is working, Capelec seems to be more reliable than optical. I have little confidence in the optical data for this installation.
Data file has many observations where V > 14V but optical = 0 or erratic (optical is malfunctioning).
If data is collected, we'll assign "key on" = "yes". No "equipment active" field will be assigned (since this would require interpreting voltages and RPM validity, which is risky here). If RPM > 6000, ERG RPM = "." (null), for all tests. Capelec scaling factor is 2.06, so multiply all Capelec values by 2.06 for a new field entitled "corrected Capelec" rpm. If Capelec > 0, ERG RPM = Corrected Capelec. If Capelec = 0, ERG RPM = optical (switch optical and corrected Capelec as primary RPM field for this dataset only).
Use “rpm too high” flag to identify observations with RPM > threshold (use 6000 rpm).
No RPM validity flag will be assigned (RPM validity was only used when we used battery voltage for on/off decisions).

3597_0265, PAMS test, Isaac datalogger installed 9/14/2007 on a 1999 Caterpillar 962 G Wheeled Loader

No data for this installation (equipment was 24V and we didn't have a power transducer to step it down to 12 V).

3854_9162, PAMS test, Corsa datalogger, installed 9/12/2007 on a 1985 Case 586D Forklift

Installed 9/12, but no data until 9/21. First download was 9/25, which confirms no data files are missing. From recollection of facility operations, I recall equipment was used infrequently. Data on 9/21 looks reasonable, voltages are low which causes SAS to set flags for review, but RPM data appears to be valid. Datalogger is on switched power, so no power is provided to logger when key is off.
Noted observations 226491 and 226968, these are trip starts w/ the same voltages and RPMs as the prior trips). (which is not possible). Further investigation shows that this appears to be on all trip starts, and is in the raw Corsa data. RPM and voltage values for the first observation of a trip are the same as the RPM and voltages of the last observation in the prior trip for this and other Corsa datafiles. This appears to be a Corsa data acquisition anomaly.
Quite a bit of operation w/ apparent KOEO, (low voltage, no RPM). Occasional drops into the 9V range appear correspond to operator moving key into start position (accessory and glow plug voltage drains). Some RPMs seen on 10/9 > 6000 (these have been screened from "ERG RPM" field).
Use new flag (such as RPM upper bound) to identify observations with RPM > threshold (such as 6000 rpm).
No RPM validity flag will be assigned (RPM validity was only used when we used battery voltage for on/off decisions). No RPM scaling factor is necessary. If data is collected, we'll assign "key on" = "yes". No "equipment active" field will be assigned (this only used when RPM and battery voltage was used for on/off decisions during Phase 1). Operational voltage frequently below 12V. Voltage flag will be dropped to 10V on this test only.
For several observations (such as 231628 – 231630), we are in the middle of the trip, no RPM, big voltage drop, dup records. We’re seeing some dropouts of the optical RPM with a low supply voltage. There is no other RPM signal. Review of voltage patterns suggest that the observations with RPM = 0 are indeed KOEO episodes.

However, the overall system voltages are pretty low (generally). The charging system appears to be in need of some TLC. For this test, we'll leave as-is and assign key on and rpm too high as usual.

3597_095K, PAMS test, Corsa datalogger installed 9/10/2007 on a 1997 Hyster C340C Asphalt Roller

Manual review of several miscellaneous records in the datafile shows the following: Trip 3 appears to be key on, engine off (KOEO), no optical RPM, and Capelec is bogus noise. Actually, Trips 3 thru 15 all look like KOEO.
On trip 17, (and all the other trips I've seen), the first ob of some data (voltage and RPMs) appear same as ending observation from prior trip (as we've seen with the raw Corsa data).
Trips 17 thru 23 all seem to be KOEO. The operational voltage after that is a lot higher (13.5 volts or more) and we then have optical RPM. Trip 28 looks like KOEO, as does trip 38 (on an ERG visit day).
For trip 92, it looks like KOEO for about the 1st 10 seconds, then the engine started cranking (optical RPM value jumps up and voltage increases too). For trip 141, looks like we have KOEO for about the first 19 seconds, then the engine starts. Then, I moved down in file to trip 204, which looks like KOEO.
Then, on trip 207, the voltage seems relatively high (12.9), but moving down a bit I can see a fairly rapid decay in voltage (we're down to around 12.1 volts after about 160 seconds), so I'm fairly confident this is KOEO too. The engine is finally started at observation 689 in trip 207. On trip 209, looks like KOEO until 499 seconds in the file. Then check out observation 654 and onward in Trip 209. Looks like we lose optical (it goes to zero but voltage is high). But look at voltage decay for the rest of that trip, it drops quickly, so it's KOEO again. This file has a number of long KOEO episodes, which could be use of accessory or electrical power take off.
For the Capelec calibration, we have data that could be used to apply an RPM correction, except the two pre-test scale factors are 5.73 and 9.23, and the 3 post-test factors are 2.10, 2.12, 2.14. Looking in the data, I see that the ratio between Capelec and optical ranges from 1 to 4. We see too much variability in Capelec RPM calibration information to be able to correct the Capelec RPM, so we cannot correct the Capelec RPM data. As with others, we've assigned "key_on" and "RPM too high" flags.

3868_8720, PAMS test, Corsa datalogger installed 09/19/07 on a 1997 Ingersoll-Rand VR-90B Forklift Truck

All dates are erroneous (each trip resets to 1/1/1970), but the SAS code does correctly increment the trips. RPM drops out on Trip 8, then re-established on trip 46 (perhaps this is the 10/1 visit when the optical sensor was repaired). Then we seem to have RPM until around Trip 241, at which time it seems to start dropping out again. After Trip 241, RPM is sporadic. Voltages suggest to me that the equipment is running when RPM is zero (not KOEO). As with other Phase 2 tests, we'll have "key_on" (yes for all obs), "RPM_too_high" (yes if > 6000)

2535_2754, PAMS test, Corsa datalogger, installed 10/6/2007 on a 2002 Case 580 Super M Backhoe

All the data thru 10/16 looks OK (spot check) and in places where RPM drops off, the voltage is low, so it appears those are KOEO. On 10/17 (obs 44041), we start to see RPM too high, (as usual, we'll flag RPM > 6000 as "RPM_too_high"). Our data shows RPM is correctly calibrated, so this isn't something we can scale. We don't see this again until 10/23. I suspect these high RPMs could either be optical sensors mis-alignment, or sunlight streaming into engine compartment and reflecting off reflective indicator.
Oddly, on observation 88835, we see RPM go to zero for several obs, but voltage stays high. Seems fairly isolated. I don't think there is anything we can do about this. Assign "Key_on" when we have data and "RPM too high"

flags when RPM > 6000. In general for this test, it should be noted that some RPM readings appear erroneous during certain periods (10/16, 10/23, etc). Unknown cause, cannot correct because RPM was properly calibrated.

3928_1649, PAMS test, Corsa datalogger installed 9/11/2007 on a 1998 Lull 644B-42 Forklift

There are very few zero optical RPM values for this installation (indicating there are few, if any, RPM dropouts and few KOEO episodes). There are several records with an RPM value that is too high (over 6000), and the RPMs seem to jump around a lot when we see those high values (likely erroneous). We've flagged RPM > 6000 as RPM too high. The relatively few zero RPM values I saw appeared to be at the start of a trip. These appear to be fine, assign a Key_on flag (all observations are key on = yes).

3868_0304, PAMS test, Corsa datalogger installed 9/13/2007 on a 1999 Grove RT640C Crane

The data for this file looks good - very few non-zero optical RPM values. The datalogger seemed to acquire good RPM data while the key was turned on. No data after 9/21/2007, tho. Field records indicate that at the site visit on 10/1/2007, the datalogger was soaked with water and was removed for repairs (and not reinstalled), so for this file we will have data from 9/13/07 through 9/21/07. We can go ahead and assign "key_on" and "rpm too high" variables.

PSU 3 PAMS Data Review Notes

0062_0394, PAMS Test, Corsa datalogger installed 8/11/2008 on a 2001 Caterpillar D4C Crawler Dozer :

20AUG08:16:25:49, equip appears to turn off for 4 seconds, but logger stayed on, so in our SAS we classify this as a single trip since the logger stayed on (we don't use RPM or voltage as determinant in trip identification, but rather jump in time). Equipment appears to have been shut off and right back on.

We appear to have occasional erroneously high RPM on a few days (8/20, 8/27, 9/15)

Beginning on 8/18, optical goes to zero during engine operation (key on, engine on), as revealed by voltage (high voltage, steady or increasing). Removal note from 9/16 indicates sporadic RPM until the optical sensor was wiped clean, so optical may incorrectly go to zero during the remainder of this test.

We are going to apply the following logic:

If voltage is in the 12s, and RPM = 0, RPM is probably OK. If voltage is in the 13s and RPM = 0, RPM is probably invalid. If RPM = 0 and voltage is < 13.0, then RPM is OK (key on, engine off). If RPM = 0 and voltage is > = 13.0, then RPM is invalid.

2nd review (after new logic was applied):

We are now seeing RPM < 600 with engine running, appears to be invalid RPM signal due to faulty RPM optical sensor, so we will now change logic to indicate that if voltage is in the 13s and RPM < 600 (rather than zero), RPM is probably invalid. If voltage is in the 12s and RPM <600 but > 0, RPM is probably invalid, but if voltage is in the 12s and RPM = 0, RPM is probably OK.

3rd review

This last fix (voltage in the 12s and RPM between 0 and 600) leads a lot of start-up and shut-down events to be classified as invalid. We'll modify it to be:

if voltage is in the 13s and RPM < 600 (rather than zero), RPM is classified as invalid

If voltage is in the 12s, RPM is probably OK (unless it's over 6000) (no screening in the 12s since this contains start up and shut down episodes).

8597_0194, PAMS Test, Corsa datalogger installed 7/10/2008 on a 2008 Bobcat T250 Compact Track Loader:

This installation had OEM (RPM equipment tap) and optical RPM acquisition, OEM used for 'ERG RPM", all looked good. Zero RPMs appeared to correspond to Key on engine off, no apparent problems.

8555_2757, PAMS Test, Corsa datalogger installed 7/7/2008 on a 2002 Bobcat S185 Turbo compact skid steer loader:

Installed 7/7, oddly 7/18 is first day of acquisition, confirmed in raw file. Data looked good, timestamp correction of subtracting 6 hours applied, looks good. No evidence of erroneous RPM or key on, engine running (without RPM).

0229_3781, PAMS Test, Corsa datalogger installed 7/8/2008 on a 1985 Case 1085B Wheeled Excavator

Supply voltage is based on 24V to 12V transducer output, so voltage cannot be used to indicate activity. RPM and operation and timestamp correction (subtract 6 hours) all looked fine, no concerns. No evidence of erroneous RPM or key on, engine running (without RPM).

0229_0045, PAMS Test, Corsa datalogger installed 7/11/2008 on a 1995 John Deere 410D Turbo 4X4 backhoe loader

RPM appears to become intermittent from 8/1 onward for this test (voltages are in the "operating" range, but RPM is intermittent and often zero). Key on / engine off voltage appears to be in the 11-12 v range, and idle RPM is > 800, so we are going to apply the following for this test: If voltage is > 12 and RPM < 600, ERG RPM is null (observation is suspect).

2nd review

Our changes looked good, the RPM readings which look invalid (appear to be key on engine running but low or no RPM) are correctly identified as invalid.

0349_0567, PAMS Test, Corsa datalogger installed 8/14/2008 on a 2006 Caterpillar 330D track excavator

We saw a number of "zero" RPMs on 9/3 and 9/4 for long segments (i.e., 10 minutes), the voltage doesn't fluctuate enough to indicate whether the engine was on or off, so it appears to be a transduced (stepped-down) 24V system. No other indications that this RPM is invalid, so this appears to be key on, engine off. The remainder of the data looked valid. However, removal notes indicated power supply problems, so we could be missing data, not able to tell.

9429_7232, PAMS Test, Corsa datalogger installed 8/12/2008 on a 2008 Caterpillar 420E backhoe loader

All looks fine, episodes of zero RPM appear to be key on engine off (based on system voltage). RPM values seem reasonable during periods of operation.

0062_6976, PAMS Test, Isaac datalogger installed 8/11/2008 on a 2006 John Deere 310G backhoe loader
These notes apply to Isaac data acquisition in general

Isaac file – this test looked fine, RPM looked solid throughout (except one zero with high voltage, appears to be engine bogging, potentially erroneous signal due to transient voltage supply). One anomaly appears to be 3 to 4 second orphan trips (zero RPM with low voltage) either prior to or immediately after a trip as the key is moved from the "on" position to "off" (or from "start" to "on"). Between these orphans and the adjacent trip is about a 4 second delay (either preceding or following the orphan). This could artificially inflate the total trip count for each installation (and reduce the average trip length). This may be result of voltage drop when engine is started. The algorithm we're using classifies trips as individual segments (these segments are broken out by the Isaac). This may differ from our Corsa trip classification, since the corsa data is provided in one long data file (rather than segments broken out by the datalogger during acquisition).

8542_1271, PAMS Test, Isaac datalogger installed 7/10/2008 on a 2007 Bobcat 329G compact track excavator

No problems with this file, same issue with trip identification as 0062-6976 (which applies to all Isaacs).

9429_0323, PAMS Test, Isaac datalogger installed 8/12/2008 on a 2006 Ditch Witch directional drill

Time stamp issue identified that affects this and prior (all other possibly) Isaac files in which times starting around 1 PM might be classified as midnight (this is a SAS issue, not a problem in the raw data, since timestamps are not provided in the raw data on a second-by-second basis). We will go back and correct. Revisit after correction of timestamp issue: has been corrected.

9679_6459, PAMS Test, Isaac datalogger installed 8/13/2008 on a 1998 New Holland LX665 Turbo skid steer forklift:

8/13 (install) thru 8/22, rpm may be invalid, optical sensor was replaced on 8/22 visit.
All RPM data between 8/13 and 8/22 is suspect, 8/22 onward is good.
We will retain 8/13 thru 8/22 data, RPM will be null (dot) throughout that range, but since PAMS was on switched power, the data will provide info on whether the key was on or off (provide general info on amount of usage over that time period).

8597_1096, PAMS Test, Isaac datalogger installed 7/9/2008 on a 2008 Bobcat T190 compact track loader

This was the Isaac that was installed and left continually running. We have RPM on the first (install) day, looks like most of the RPM on that first day is due to our installation. On the next day, we have intermittent RPM through part of the day (but RPM is missing during time when the engine is operating, as indicated by voltages). Then, review of voltage/rpm plots and data for the remainder of the test period 7/20 through 8/9 shows that we did not get RPM when the engine was turned on. Removal notes indicated RPM was inconsistent and erratic.
All RPM for this file is invalid. We'll use voltage to indicate whether or not the engine is running. From review of RPM vs. voltage plots and data (esp on install day), KOER voltage appears to be > 13.5 when running, and < 13.5 when engine is off (although upon key-off the battery voltage appears to hover around 13.5, then slowly start to decay). When engine is started, voltage appears to jump above 13.6 pretty quickly, so this is what we'll use for engine on (≥ 13.6) vs engine off (< 13.6). This will provide info on general amount of usage over the period of installation (# of hours/day, times of day used, hours/week, etc.)