Diesel Particulate Filters' Feasibility Study Report

Report's Period:
2016/02/01-2016/02/29
Tehran - Iran

ASA
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شرکت کنترل کیفیت هوا
وابسته به شهرداری تهران

شهرداری تهران

معاونت حمل و نقل و ترافیک
شهرداری تهران
دفتر محیط زیست

FCE

هسته پژوهشی سوخت،
احتراق و آلایندگی

VERT certified for Health and Climate

Abstract

Iran's big cities air pollution is one of the major challenges to authorities in view of public health. Tehran City, with about 9 Million resident, has been facing more and more air quality problems over the last decade. The criteria pollutants in Tehran are PM2.5, PM10 and NO2. Particulates and especially ultrafine particles have been identified as the most toxic component of the polluting mixture. Considering diesel engine operation concepts, these types of engines are one of the main source emission of ultrafine particles in urban areas. So controlling particulates emitted from these sources, is one of the first steps to improve air quality. Diesel Particulate Filters (DPFs) are well-known and effective way to reduce particles number and mass. Lately, the Iranian government decided to legislate DPF installation for High Duty diesel Vehicles (HDV). Both, national and international engine industries and experts are now challenged to comply according to the new upcoming standards.

Tehran city bus Company with more than 3500 diesel engine buses is one of the organization that can play important role in improving air quality. In January 2014, the City Council of Tehran decided to order the retrofit of the public bus fleet of the capital. So DPFs' feasibility study project is organized by Tehran Air Quality Control Company (AQCC). The project consists of two phases. Phase 1 is particle filter tests on engine lab was provided in Tabriz for approval of DPFs in Iran. During this phase different types of DPFs from various companies were tested according to VTF1[1] test procedure, by FCE[2] under supervision of VERT association. Table 1 gives some information about phase 1.

Table 1. Phase 1 test procedures

Test Process	Evaluated data	Measurements devices
Engine baseline test – 4PTS[3]	• Exhaust Gas mixture. • emitted PM, PN during test points • Temperature and pressure analysis before and after DPF	• MRU (Gas Analyzer) • NM3 (Particle counter) • AVL sampling unit (particle mass collector) • Pressure and Temperature sensors
Engine Equipped with DPF		
Regeneration test		
PM and PN efficiency test		

[1] . VERT filtration test
[2] . Fuel ,Combustion and Emissions group
[3] . Stationary 4-points-test cycle

After analyzing phase 1 results, approved DPFs were sent to Tehran, for fieldwork tests. 18 BRT[4] from different lines with various working paths, were selected and equipped with data logger by ASA[5] Company. By the time, 9 DPFs were installed on these samples and their data have been collected and analyzed from installation date. Analyzed data were published as monthly reports, including separated reports for first and second half of the months, and specified DPFs' operation status. Table 2 shows summary information about installed DPFs until 29/F/2016.

Table 2. Installed DPFs

DPF Producer Company	Operation Report			Maintenance and Cleaning History
	Installation date	Working days	Bus mileage	
HJS_01 (Passive system with FBC) V. ID: 78514 (line 4)	10/Sep/2014	537 days	78620 km	DPF core was cleaned on Jun 13th after about 36000 km for the first time.
Dinex_01 (Passive system with FBC) V. ID: 78515 (line 4)	22/Oct/2014	403 days	49616 km	Filter core was changed on Feb 15th after 13253 km working. (High K-value and low additive dosage were reasons of the early cleaning.)
PURItech (Passive system with FBC) V. ID: 78524 (line 4)	28/Jan/2015	398 days	60575 km	DPF core was cleaned on Aug 12th after about 26500 km, for the first time. Considering system high backpressure, filter isolation defect, DPF core was removed on Sep 16th and installed on Nov 17th. The third cleaning was unavoidable after only 6 days working and was done on 29th Nov. System worked for two days and DPF was replaced by muffler on Nov 30 th . DPF was installed for the fourth time on Jan/19/2016 and was

[4] . Bus rapid transient
[5] . Azmoon Sanat Arvin

				replaced by muffler after only three days working because of high backpressure.
HJS _02 (Active system with FBC - Electrical Heater) V.ID: 85423 (line 4)	19/Feb/2015	389 days	58521 km	DPF was cleaned on 2016-02-03 for the first time.
HJS_03 (Active system with FBC - Electrical Heater) V.ID: 33572 (line 2)	19/Feb/2015	376 days	52160 km	DPF core was cleaned on Oct 5th after about 30801 km, for the first time. The second cleaning was done on Dec 19th.
HJS_04 (Passive system with FBC) V.ID:85476 (line 10)	23/Feb/2015	372 days	54116 km	DPF was cleaned on 22nd Jul for the first time and on 15th Dec for the second time after 44355 km mileage from installation date.
Dinex_02 (Passive system with FBC) V.ID: 33637 (line 2)	02/Jun/2015	This system works with DPF only for 21 days.	-	DPF had been removed after two weeks working on Jun 17th. After receiving cleaning machine, DPF was cleaned on Aug 10th and installed on Aug 22nd but worked only for ten days. The last cleaning was done on Sep 24th but cleaning issue was unavoidable after only three days working. Finally DPF was replaced by muffler on Sep 8th and system has been working from that date without DPF.

Tehag_01 (Catalyzed DPF) V.ID: 85182 (line 10)	24/Sep/2015	139 days	7989 km	DPF has been working from installation date until now without any cleaning.
Tehag_02 (Catalyzed DPF) V.ID: 33592 (line 2)	25/Jan/2016	35 days	3042	DPF has been working from installation date until now without any cleaning.

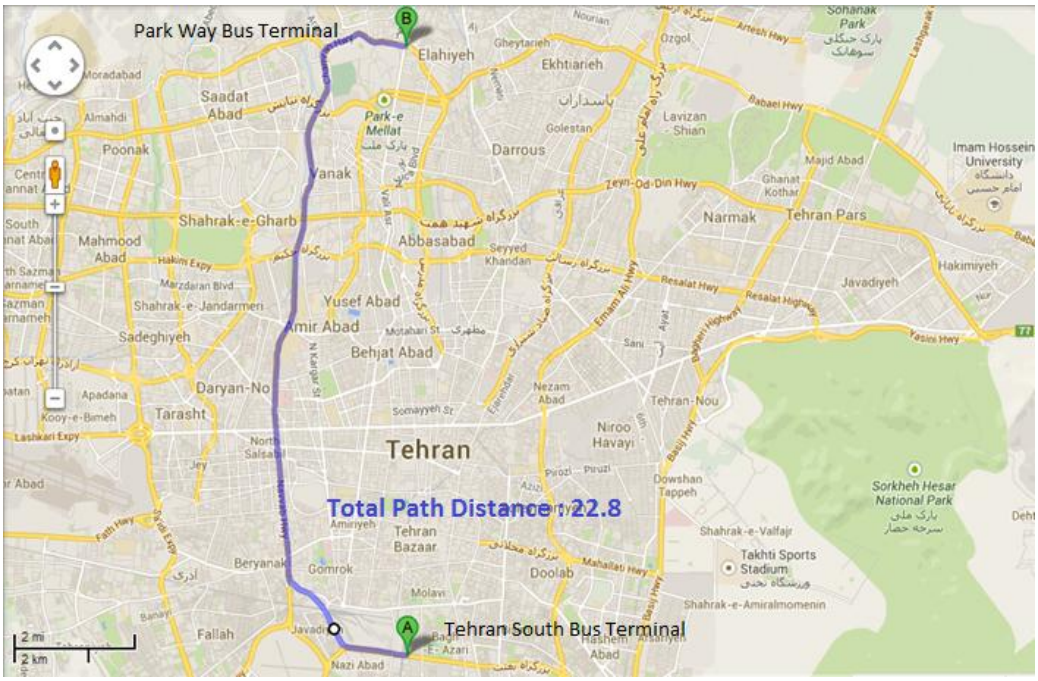
Table 3 represents DPFs' operation status during January. DPFs detailed information could be found in the next section.

Table 3. DPFs' operation status during Feb

Vehicle ID	DPF Producer Company	Operation Status Feb/01/2016 - Feb/15/2016	Operation Status Feb/16/2016 - Feb/29/2016
78514 (line 4)	HJS_01	1	6
85423 (line 4)	HJS _02	1	6
78515 (line 4)	Dinex_01	6	6
78524 (line 4)	PURItech	5	5
33572 (line 2)	HJS_03	2	2
33637 (line 2)	Dinex_02	5	5
85476 (line 10)	HJS_04	1	1
85182 (line 10)	Tehag_01	1	1
33592 (line 2)	Tehag_02	1	1

Status Number	Operation Status	Description
1	Excellent	Pressure above 200 mbar<0.1% ($P200 \sim 0$)
2	Good	$0.1\% \leq P200 \leq 3\%$
3	Maintenance required	$P200 > 3\%$ or DPF system blocking
4	Failed	DPF defect, black smoke, holes in the filter element
5	NO DPF	DPF was removed for cleaning or other issues
6	Bus was stationary	Bus related problems

Vehicle plate number	78514
Bus line	Number 4 (south to north bus line)
DPF producer company	HJS_01 (Passive system with FBC)



Overall Information

Table1- Overall Information

Vehicle plate number	78514
CPK data logger number	LN: 001496, DN: 1914, Sim +989218355923
Bus line	Number 4 (south to north bus line)
Bus Terminals	Tehran South Bus Terminal - Park Way Bus Terminal
Total path distance	22.8 km
DPF producer company	HJS_01 (Passive system with FBC)
Installation date	10/Sep/2014
Report period	01/Feb/2016 – 15/Feb/2016 (fifteen days)
K value - DPF upstream	1.80 [1/m]
K value – DPF downstream	0.02 [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	DPF core was cleaned on Jun 13th.
Dosing status	Dosing value has been kept constant from installation date until now.

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	78465 km
Bus mileage over the period	483 km
Working days over the period	8 days
Stop days	7 days
Data logger working days	8 days
Working hours over the period	52 hours 10 minutes
Average working hours per day (including stop days)	4 hours 0 minutes
Bus average speed	9.25 km/hr
idle speed time to all working time ration	67.79 %
Total Bus fuel consumption over the period	314 lit
Fuel consumption per hour	6 lit/hr
Average fuel consumption	0.65 lit/km
Total Bus additive consumption over the period	0.15 lit
Average additive consumption	310 cc/km
Additive consumption to fuel ration	477 cc/1000lit

Notice: Working hours and days were low due to bus technical problem.

Notice: Due to high idling ratio, average fuel consumption showed high value comparing with usual working period.

Temperature, Pressure and Engine Speed Overview

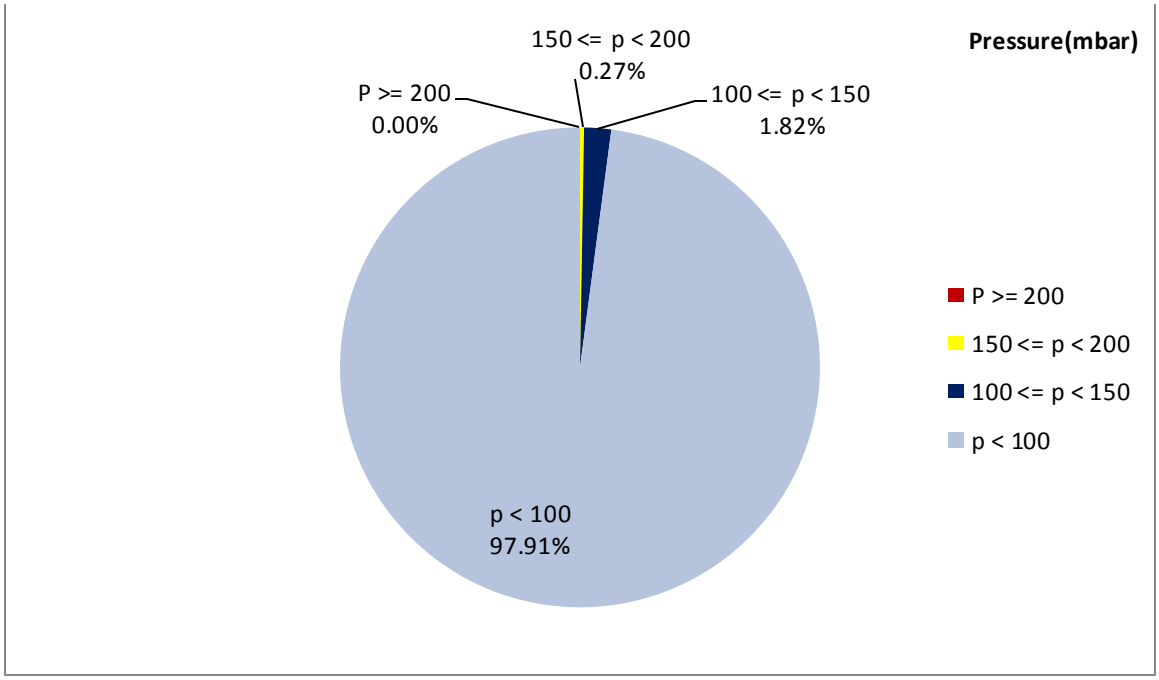


Figure 1- Pressure distribution over the working hours

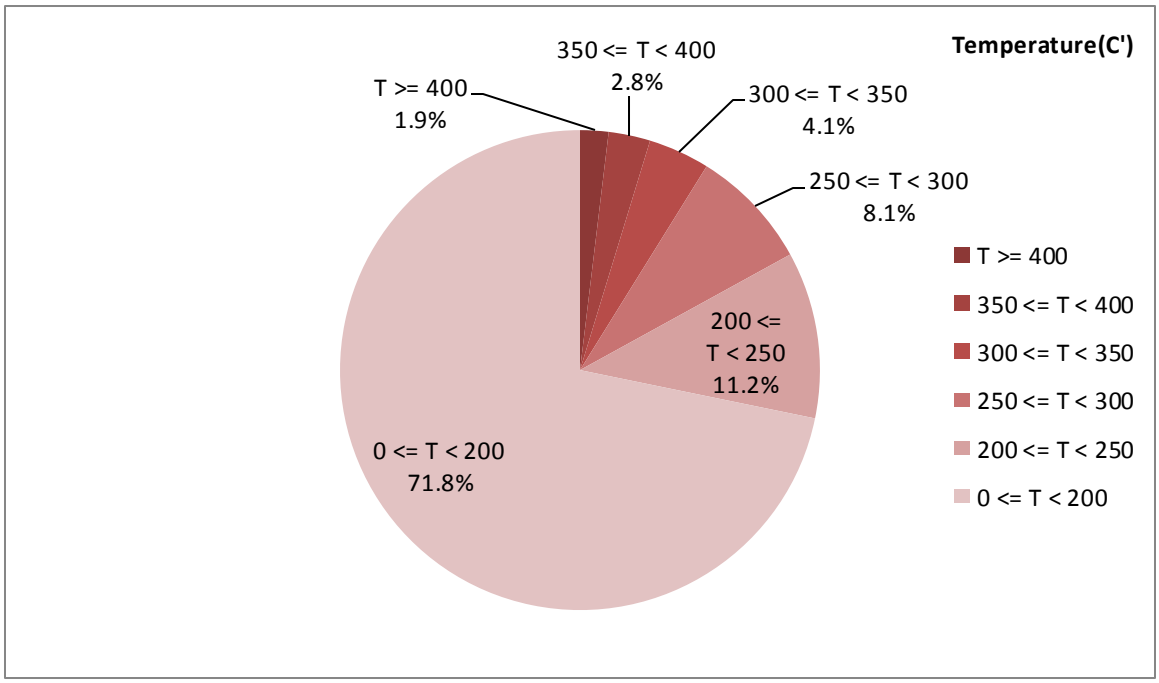


Figure 2-Temperature distribution over the working hours

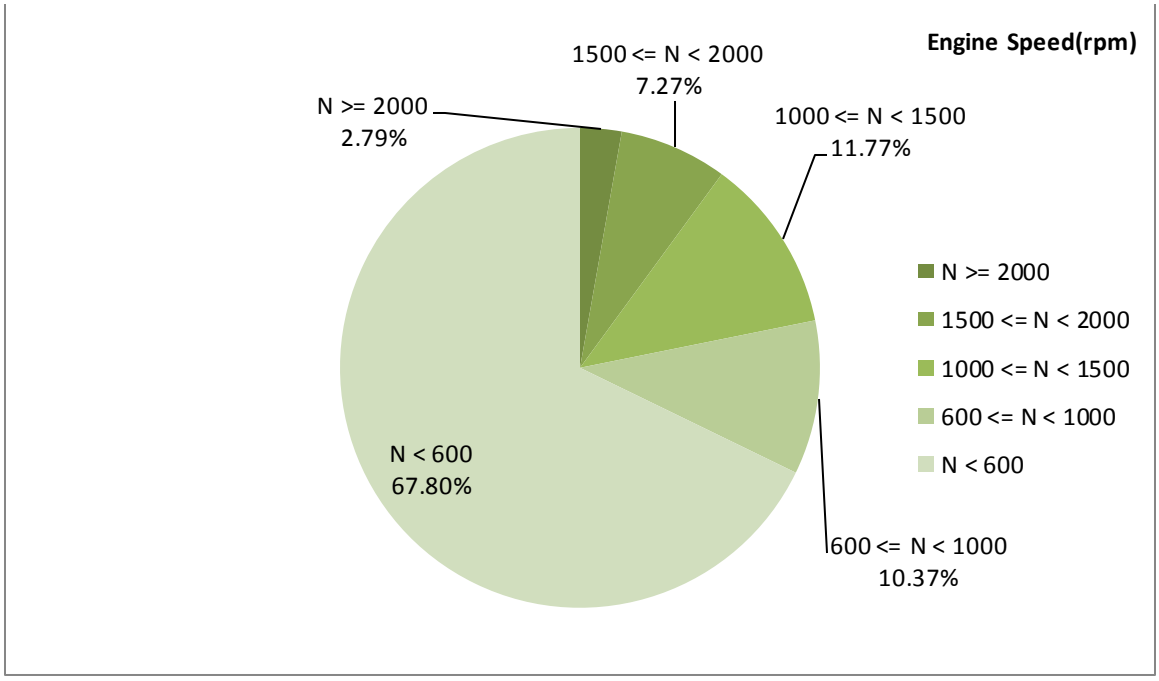


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
176.61	15.37	781

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
249.35	33.89	1277

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
470-50	189-0	2416-304

Detailed Pressure Analysis

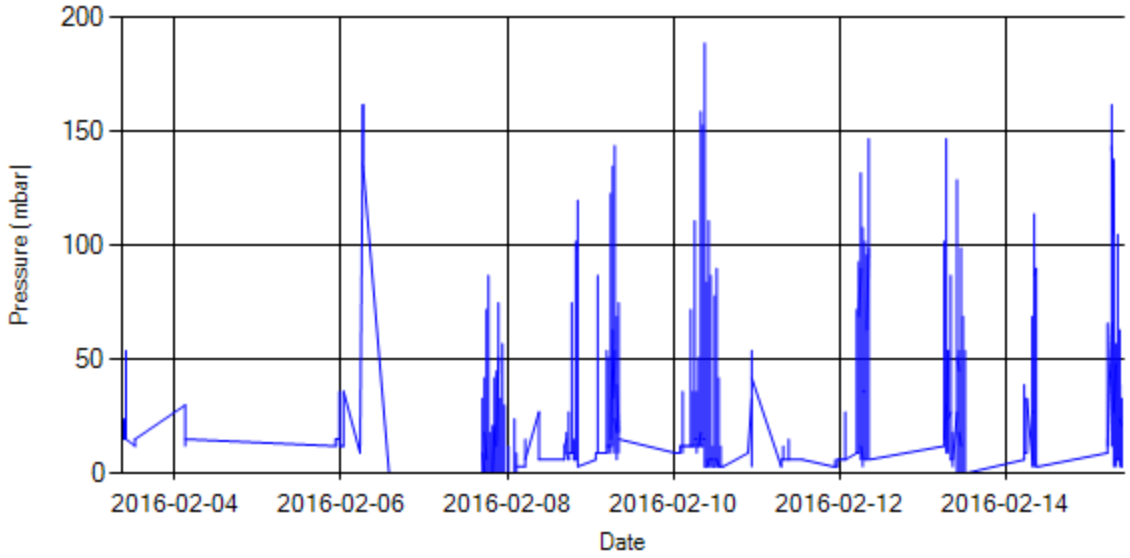


Figure 4- Pressure distribution over the period

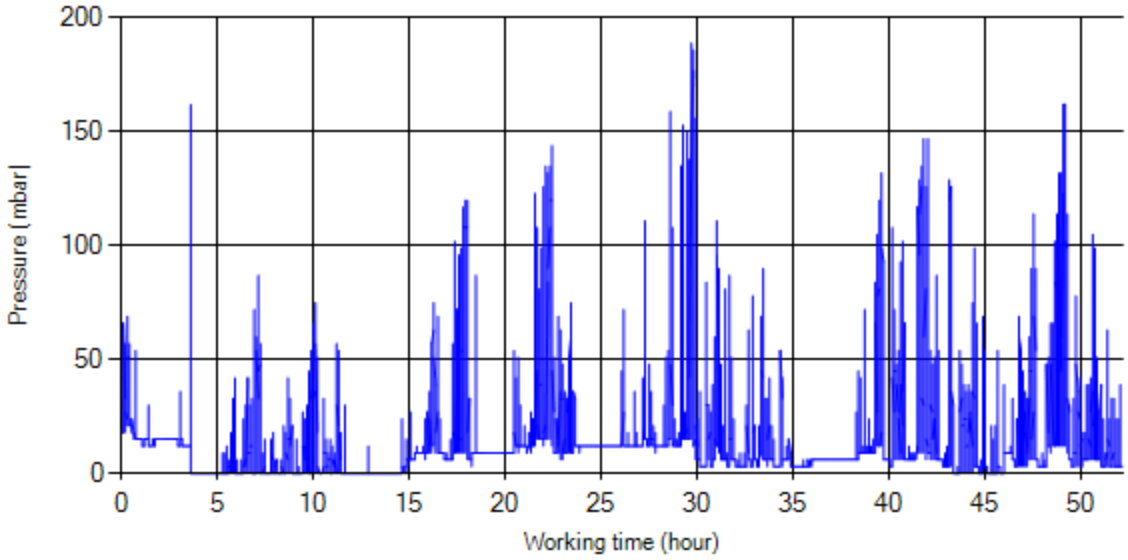


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

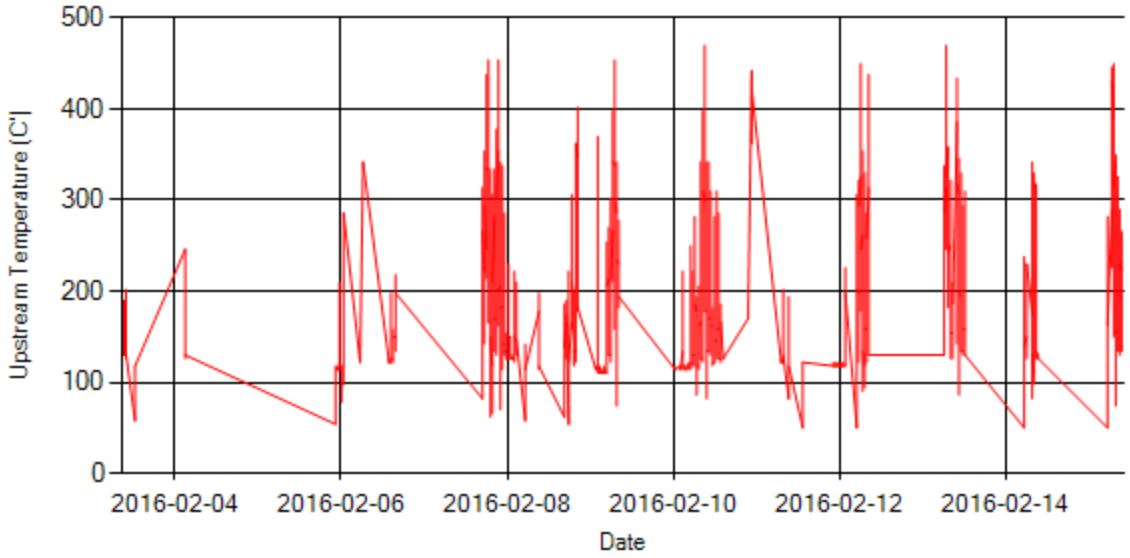


Figure 6- Temperature distribution over the period

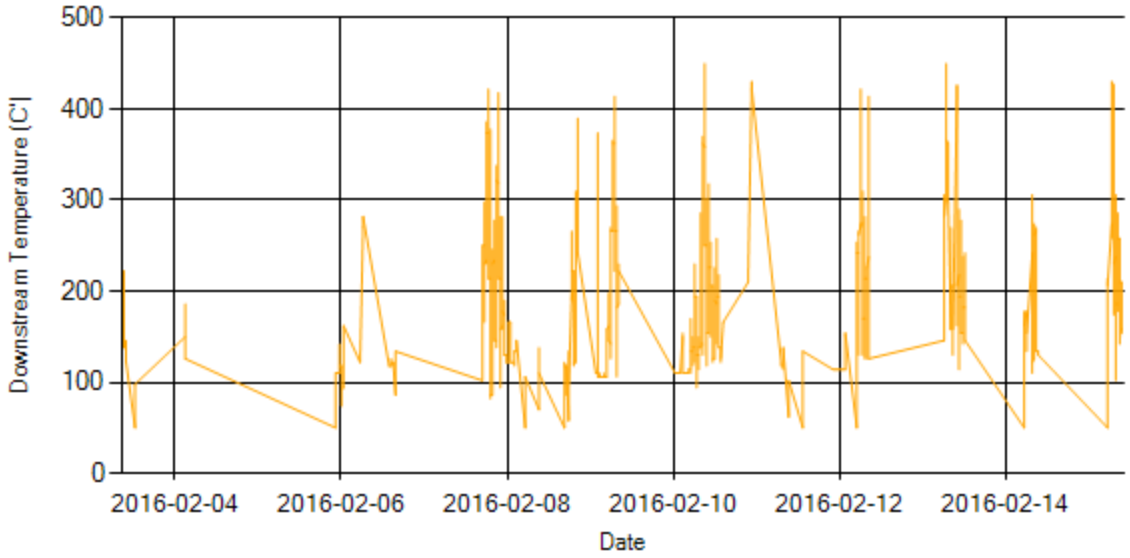


Figure 7- Temperature distribution over the period

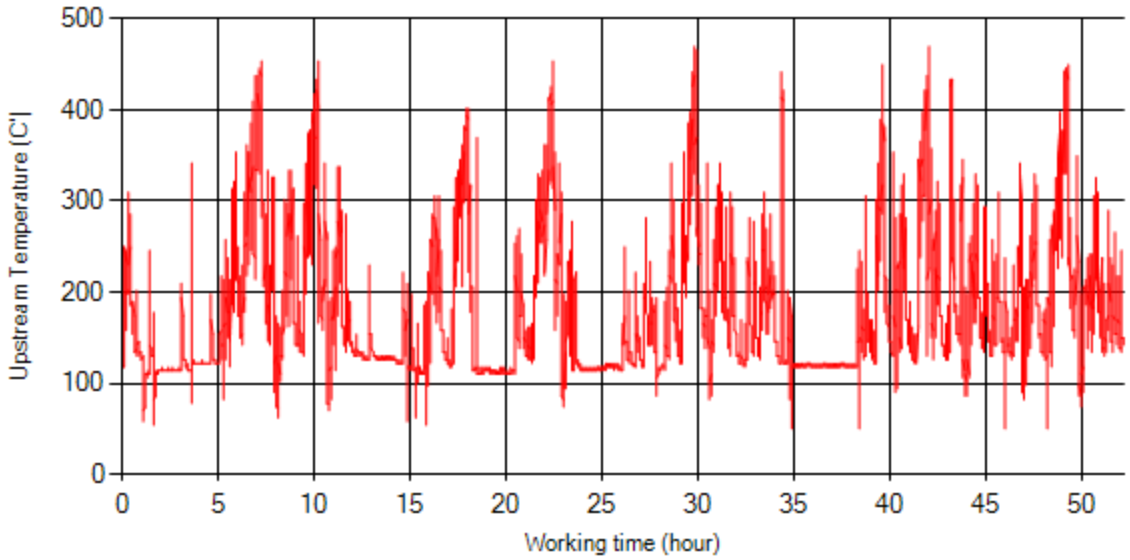


Figure 8- Temperature vs. working hours

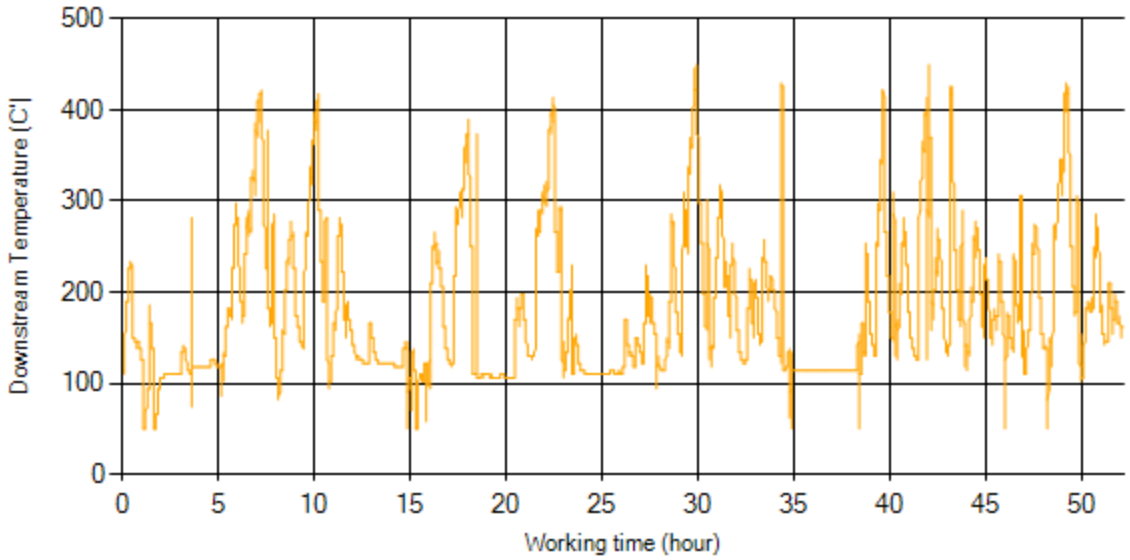


Figure 9- Temperature vs. working hours

Engine Speed Diagrams

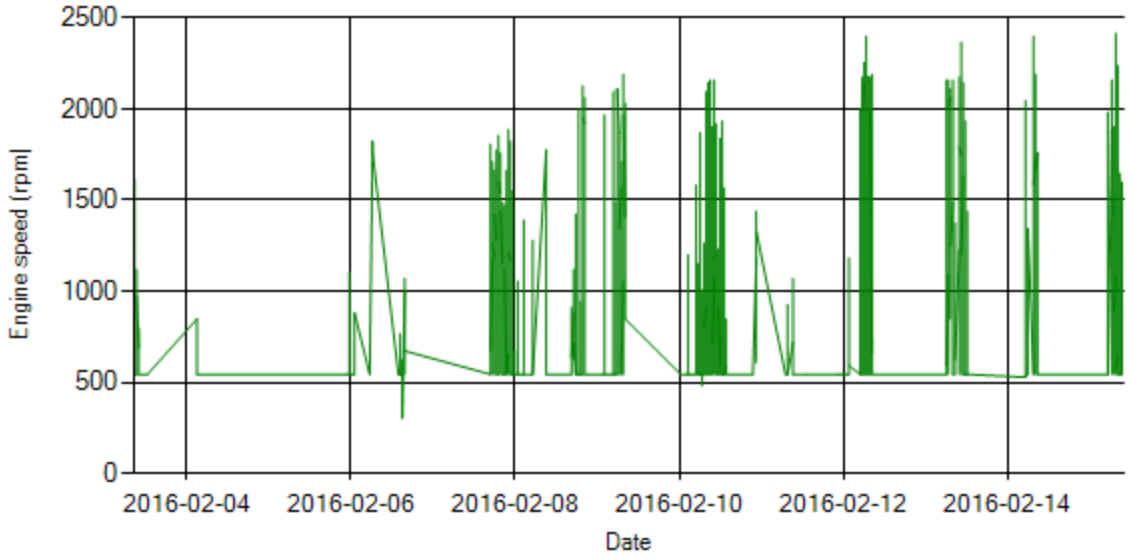


Figure 10- Engine speed distribution over the period

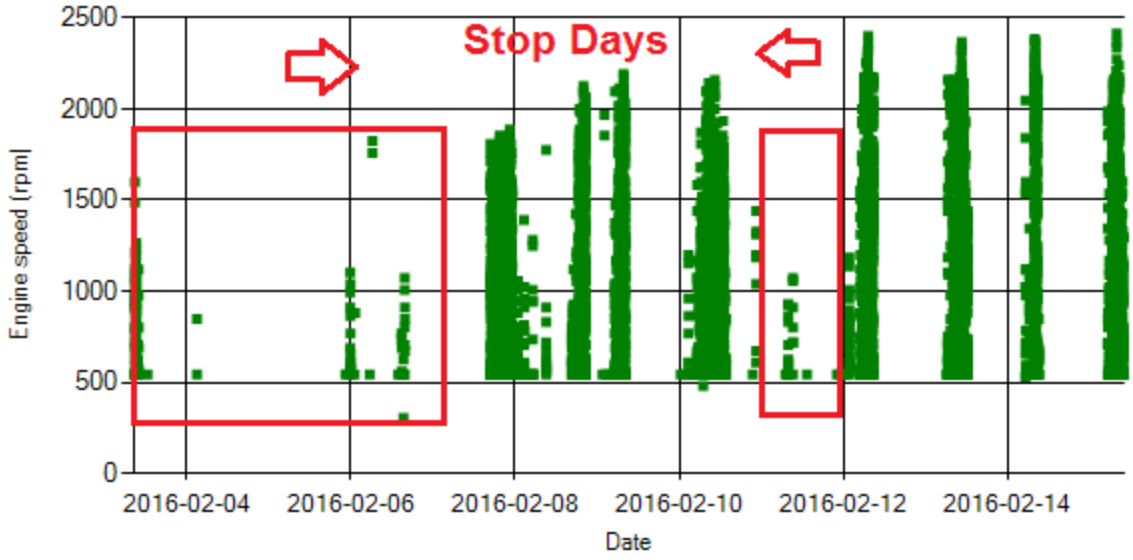


Figure 11- Engine speed diagram for calculating CPK's working days

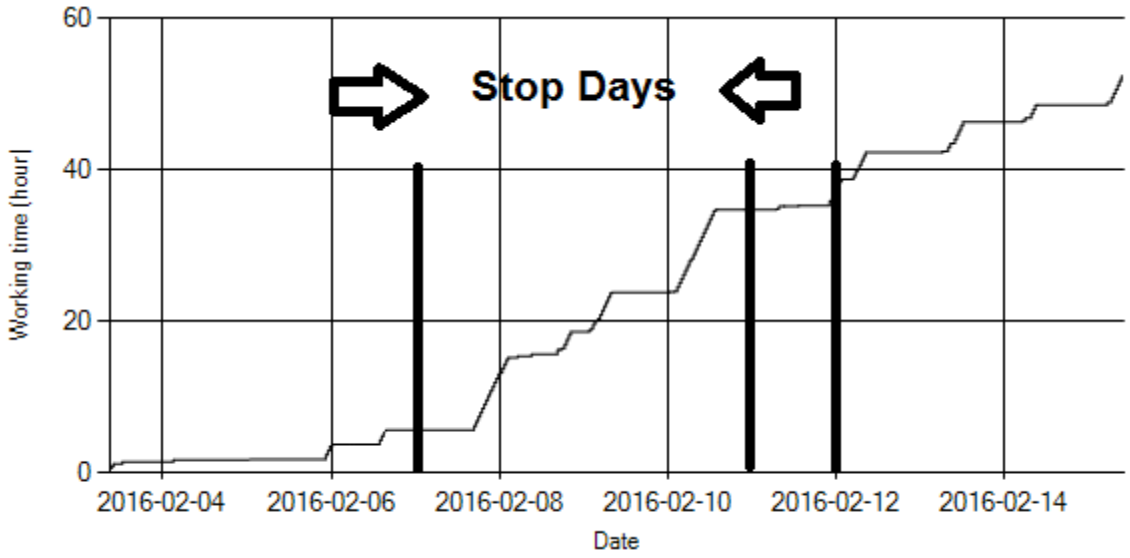


Figure 12- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data. As depicted in Figure 12, bus was stationary for 7 days during this period.

Pressure-Engine Speed diagrams

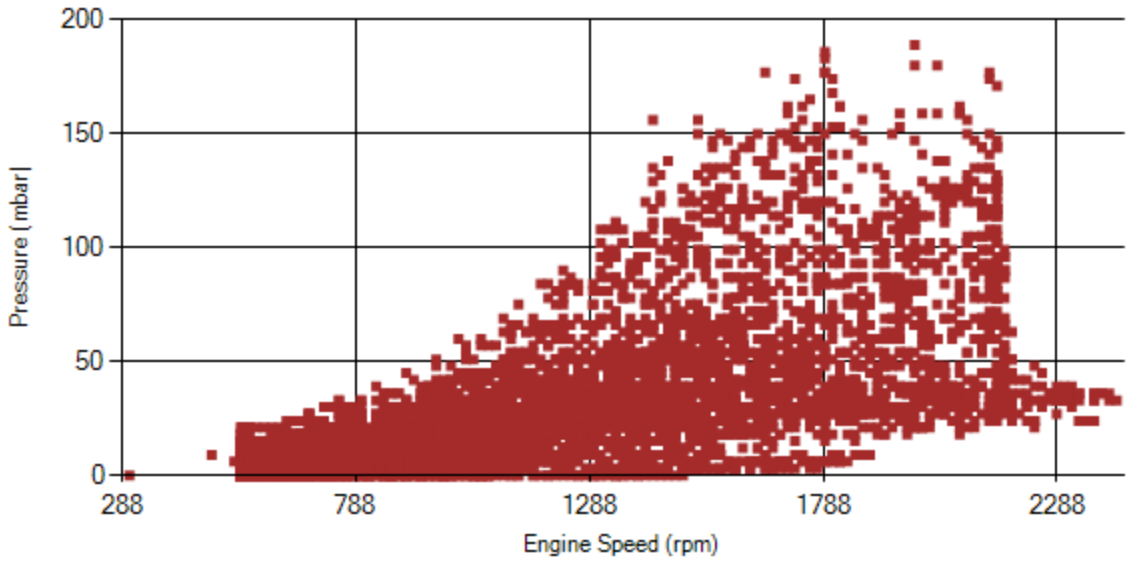


Figure 13- Pressure against engine speed

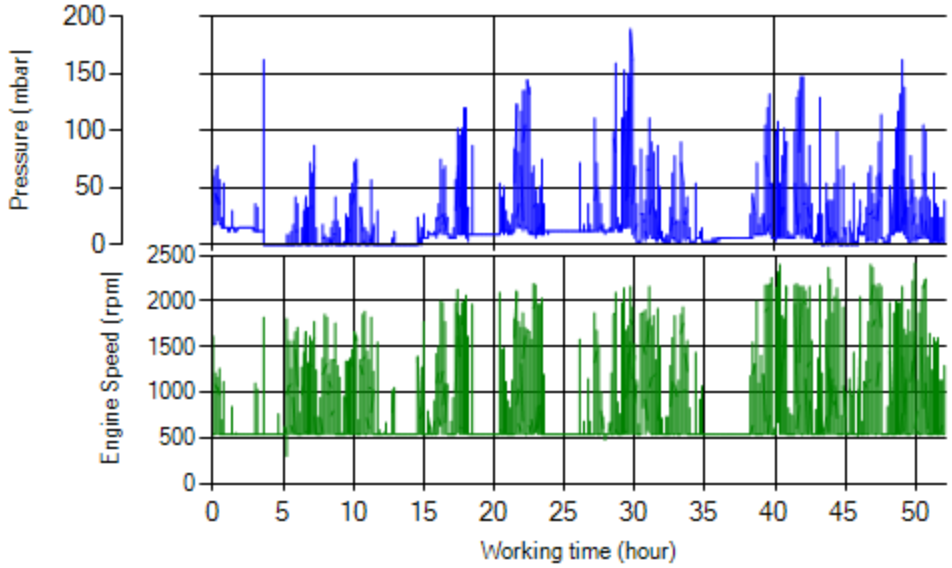


Figure 14- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

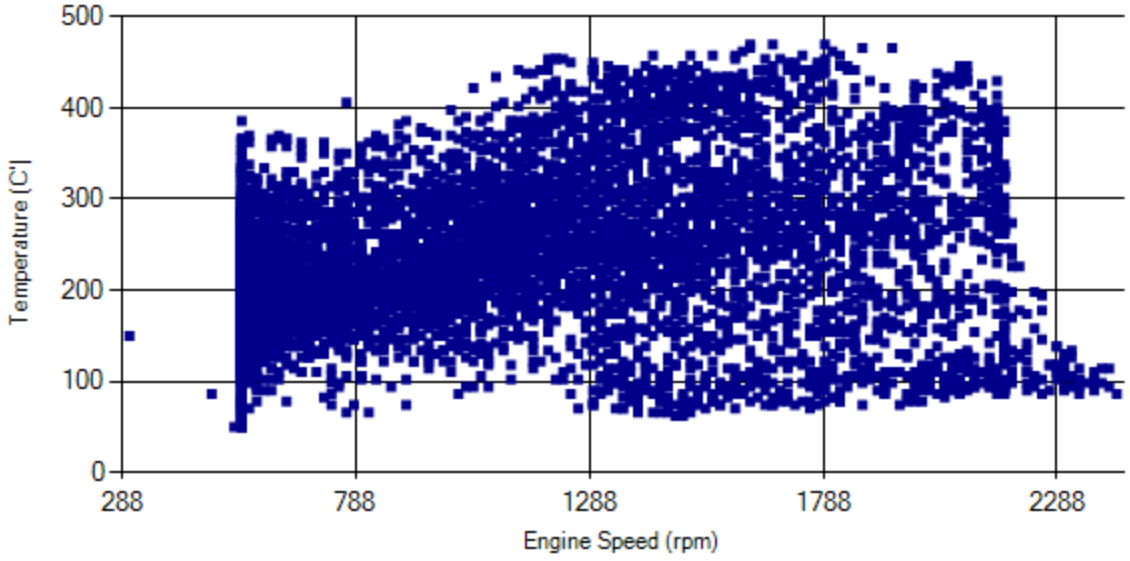


Figure 15- Temperature against engine speed

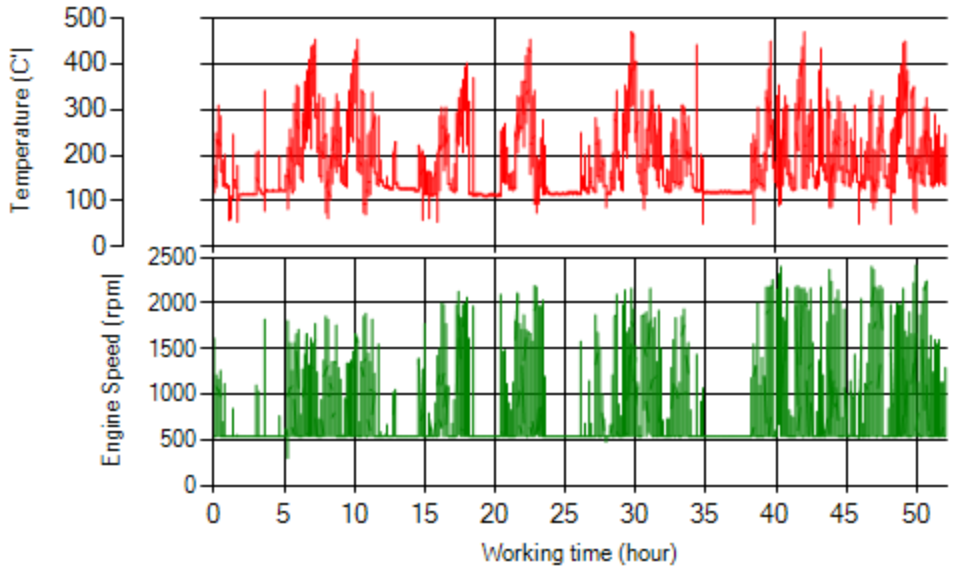


Figure 16- T, N distribution vs. working hours

Filter Operation Analysis

- As depicted in Figure 1, only 0.27% of working time, pressure was above 150 mbar.
- Figure 2 displays flow temperature before the DPF. It can be obviously observed that 1.9% of total working time temperature is above 400 ℃ and 4.7% above 350℃.
- Low pressure and temperature distribution was because of high idle working of the bus.
- Considering our adjusted parameters for evaluating DPF performance, this DPF was excellent during this period.

Filter operation status	Excellent ■	Good ☐
	Maintenance required ☐	Failed☐

Overall Information

Table1- Overall Information

Vehicle plate number	78514
CPK data logger number	LN: 001496, DN: 1914, Sim +989218355923
Bus line	Number 4 (south to north bus line)
Bus Terminals	Tehran South Bus Terminal - Park Way Bus Terminal
Total path distance	22.8 km
DPF producer company	HJS_01 (Passive system with FBC)
Installation date	10/Sep/2014
Report period	16/Feb/2016 – 29/Feb/2016 (fourteen days)
K value - DPF upstream	1.80 [1/m]
K value – DPF downstream	0.02 [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	DPF core was cleaned on Jun 13th.
Dosing status	Dosing value has been kept constant from installation date until now.

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	78620 km
Bus mileage over the period	155 km
Working days over the period	6 days
Stop days	8 days
Data logger working days	6 days
Working hours over the period	19 hours0 minutes
Average working hours per day (including stop days)	1 hours 21 minutes
Bus average speed	8.2 km/hr
idle speed time to all working time ration	70.99 %
Total Bus fuel consumption over the period	108 lit
Fuel consumption per hour	5.71 lit/hr
Average fuel consumption	0.7 lit/km
Total Bus additive consumption over the period	- lit
Average additive consumption	- cc/km
Additive consumption to fuel ration	- cc/1000lit

Notice: Working hours and days were low due to bus technical problem.

Notice: Due to high idling ratio, average fuel consumption showed high value comparing with usual working period.

Notice: due to low working hours, additive consumption was low and unmeasurable.

Temperature, Pressure and Engine Speed Overview

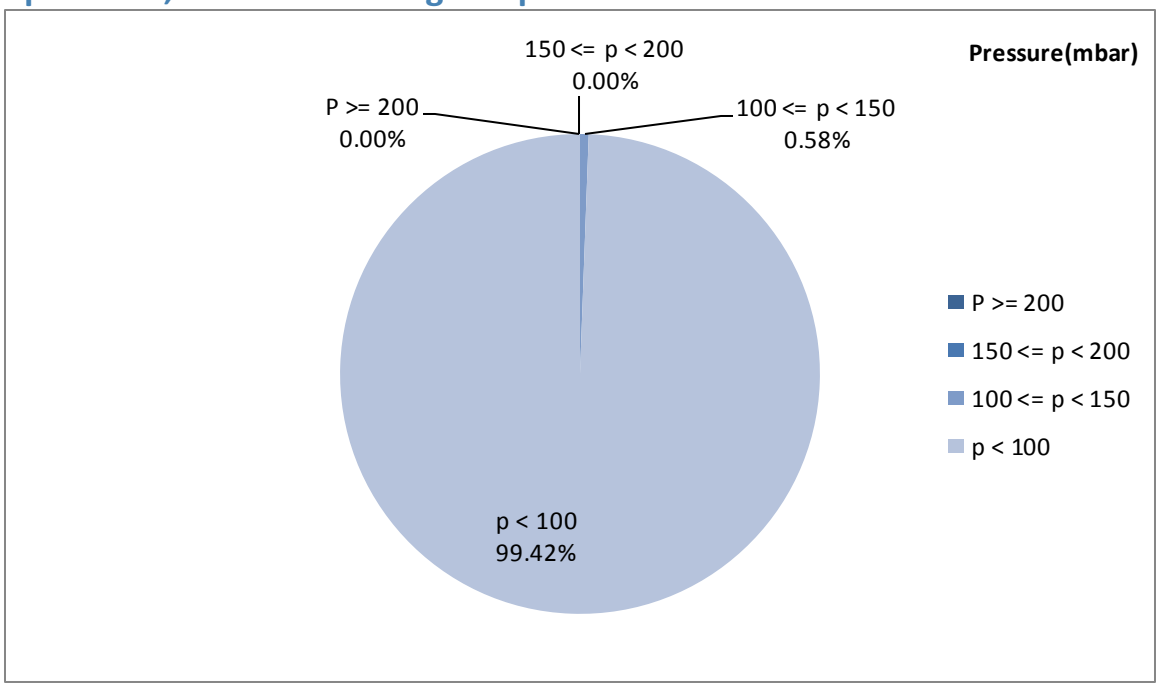


Figure 1- Pressure distribution over the working hours

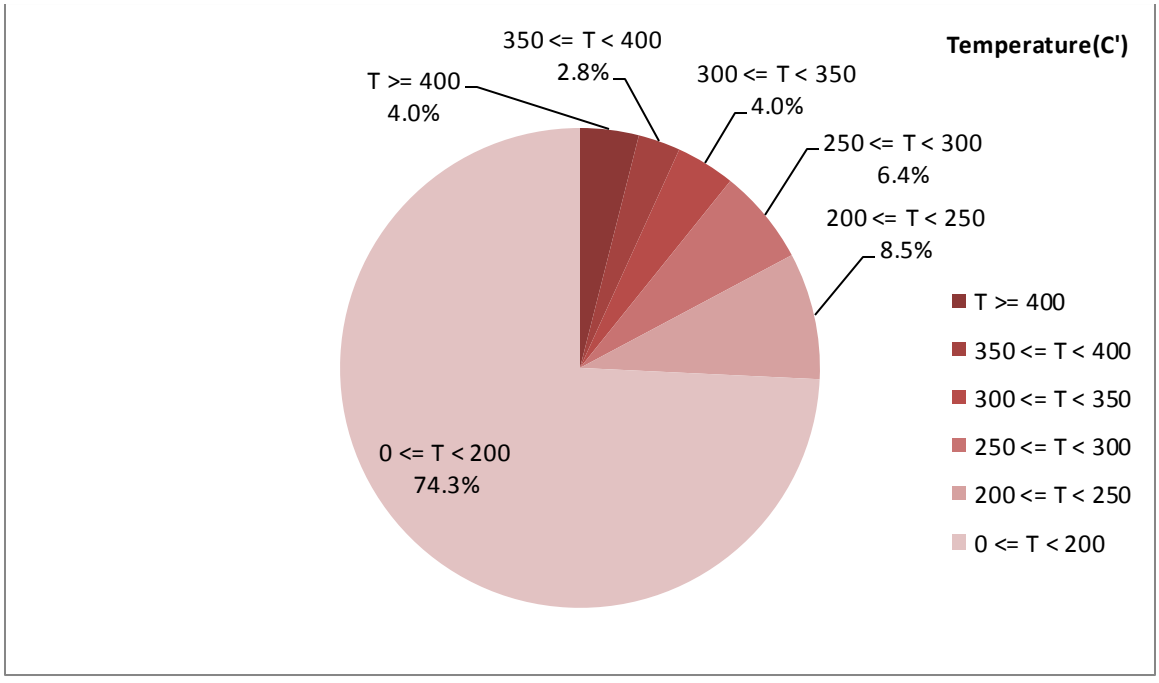


Figure 2-Temperature distribution over the working hours

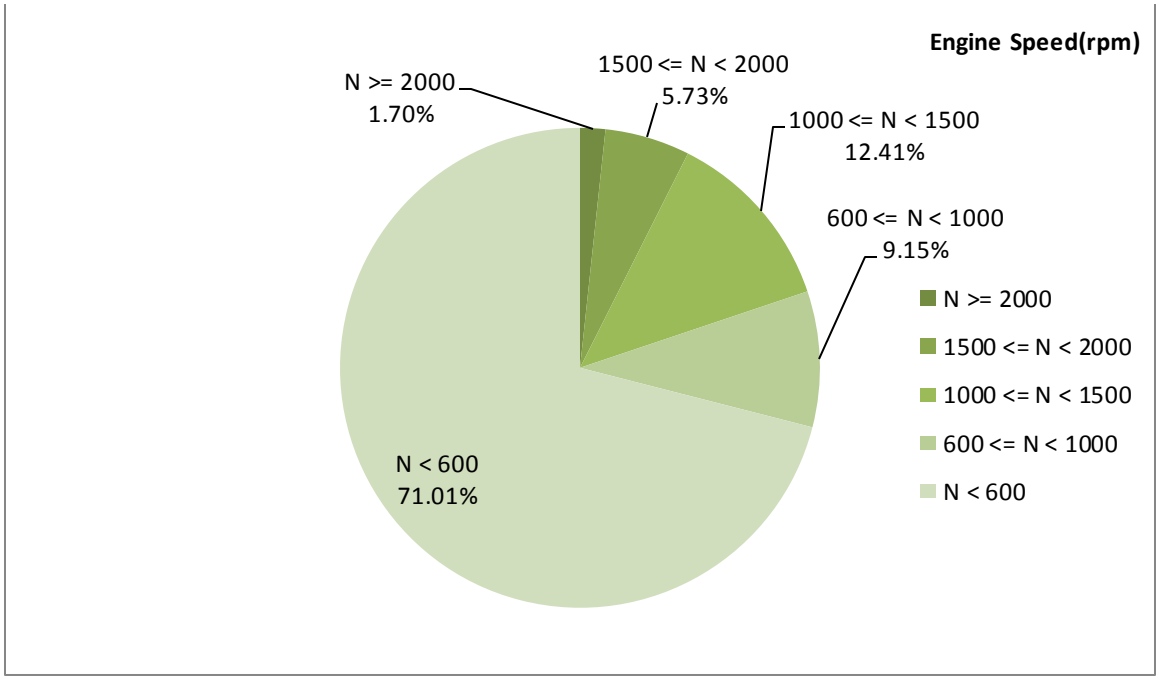


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
177.73	10.24	744

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
260.09	24.44	1231

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
502-50	123-0	2224-400

Detailed Pressure Analysis

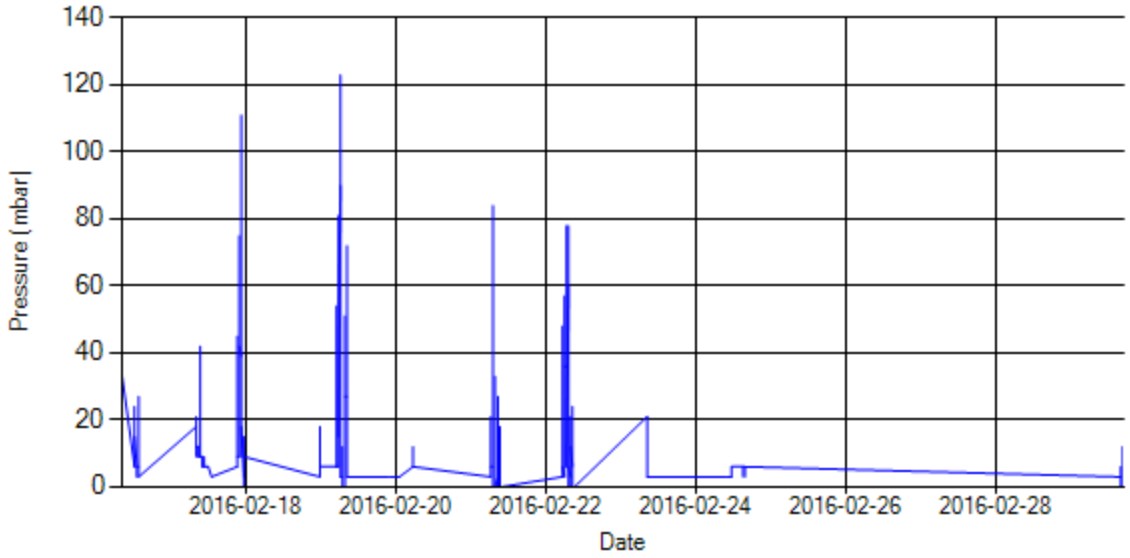


Figure 4- Pressure distribution over the period

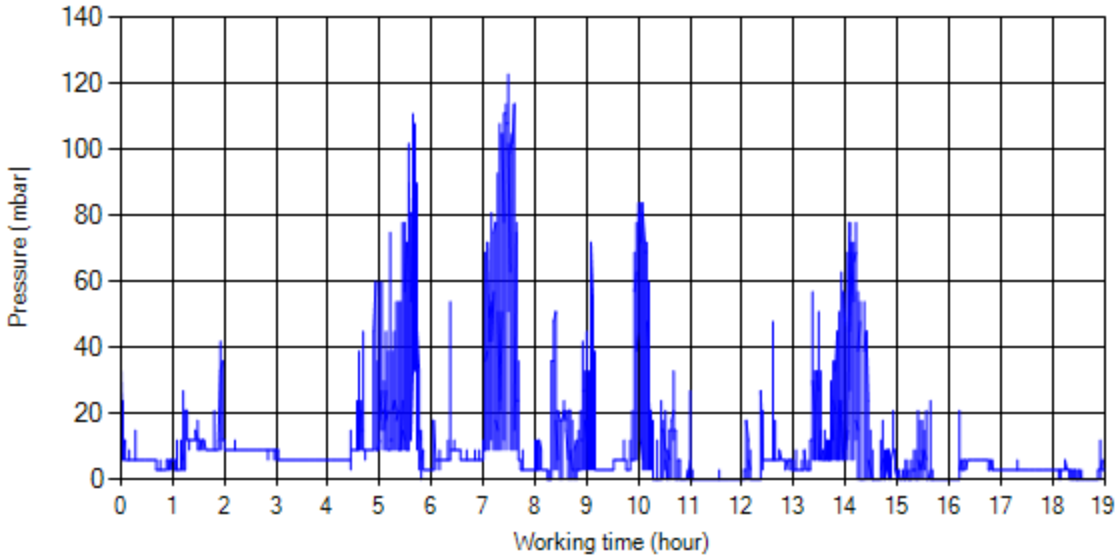


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

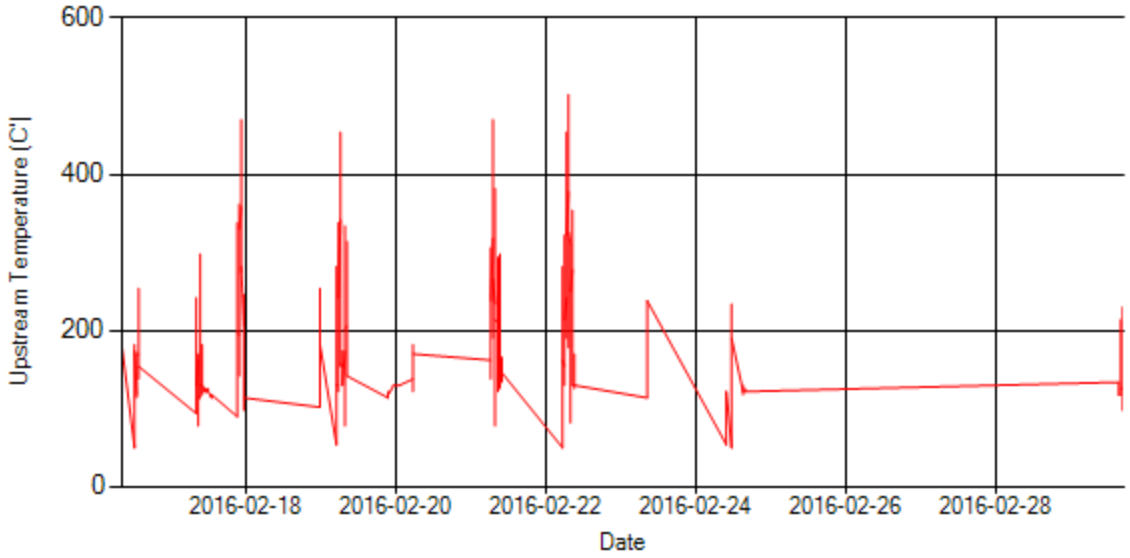


Figure 6- Temperature distribution over the period

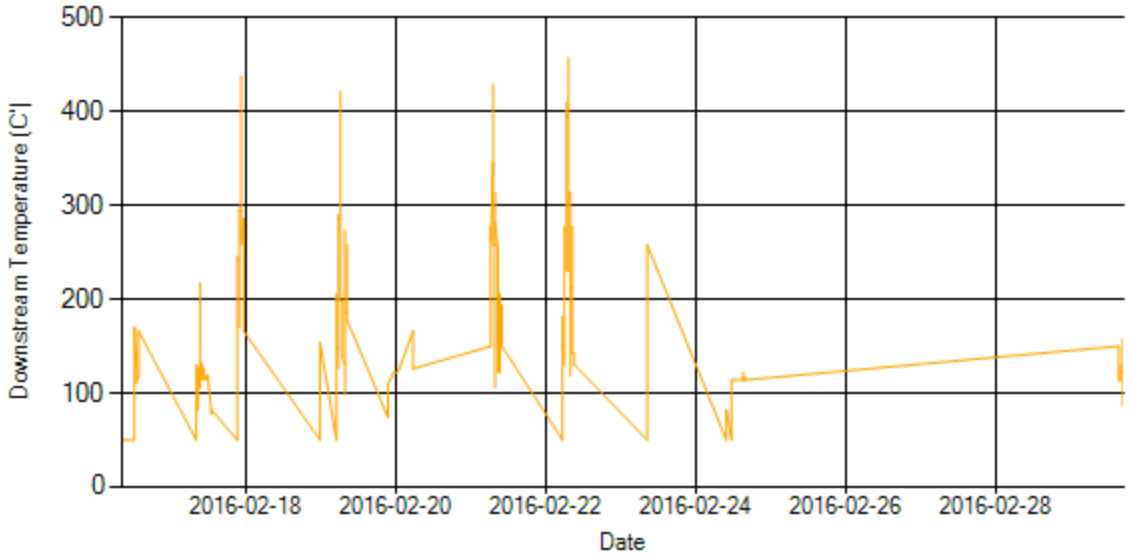


Figure 7- Temperature distribution over the period

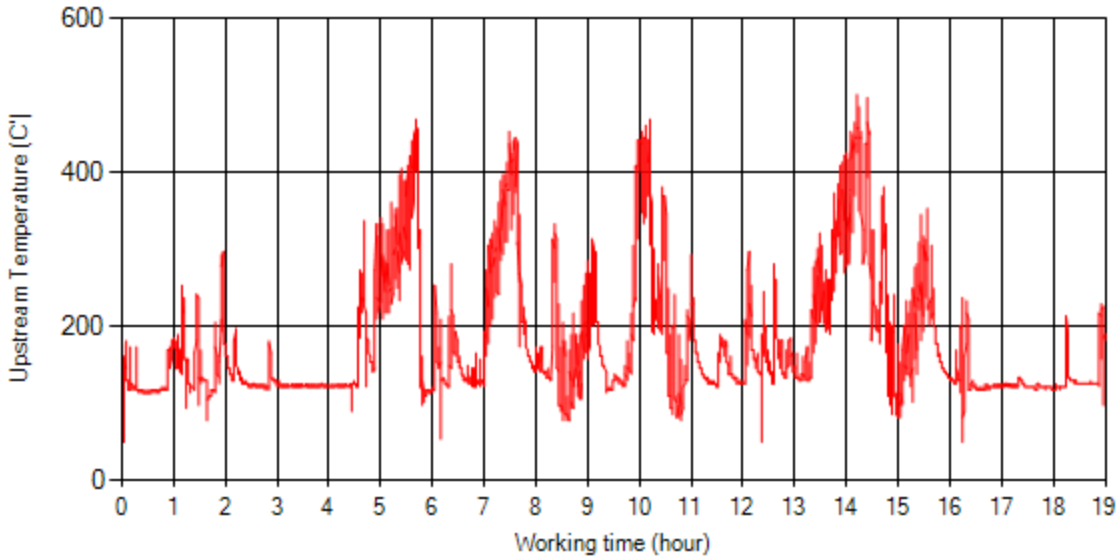


Figure 8- Temperature vs. working hours

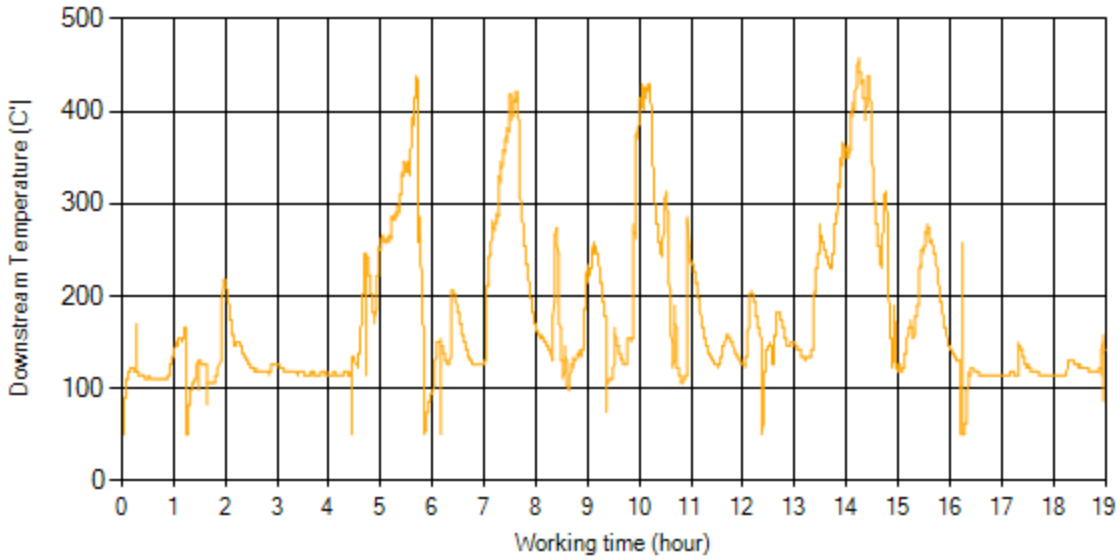


Figure 9- Temperature vs. working hours

Engine Speed Diagrams

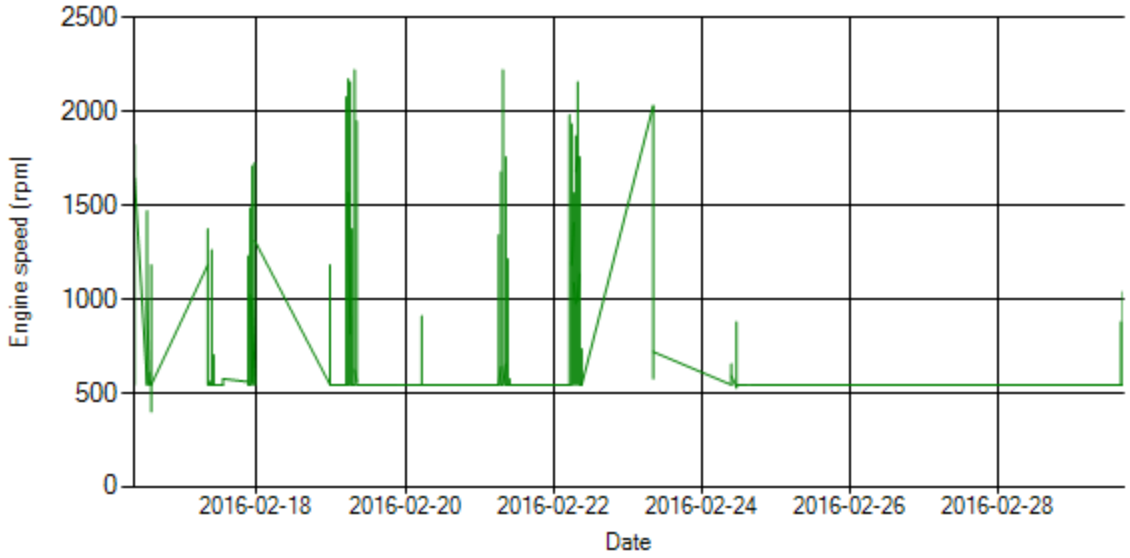


Figure 10- Engine speed distribution over the period

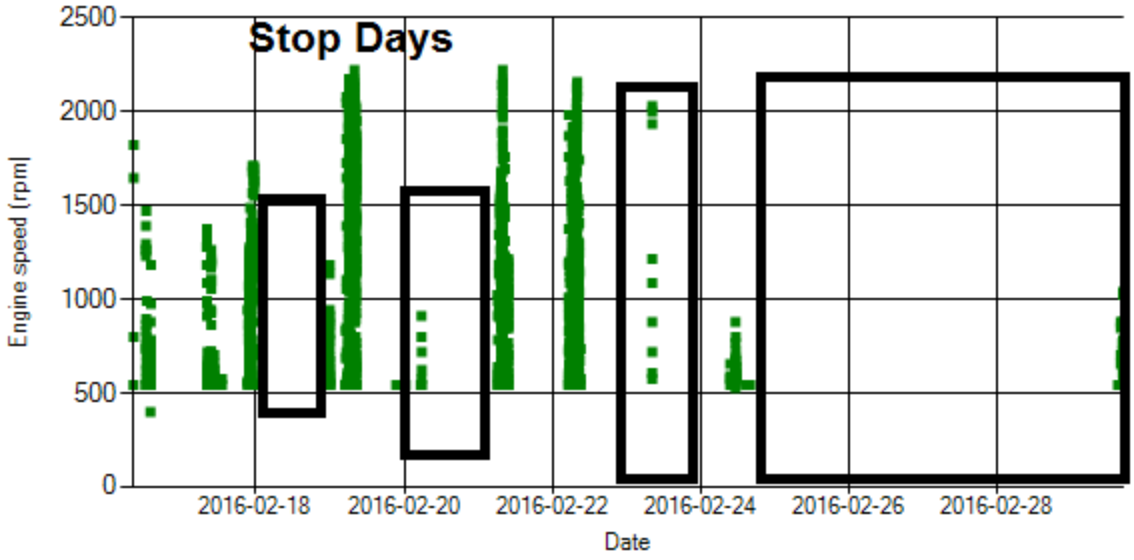


Figure 11- Engine speed diagram for calculating CPK's working days

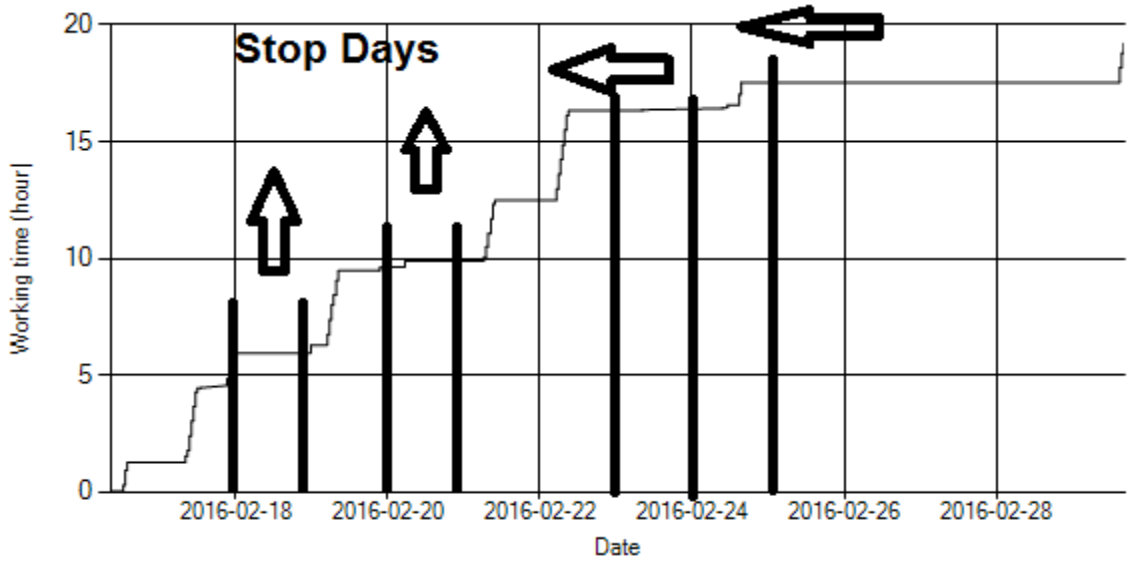


Figure 12- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data. As depicted in Figure 12

Pressure-Engine Speed diagrams

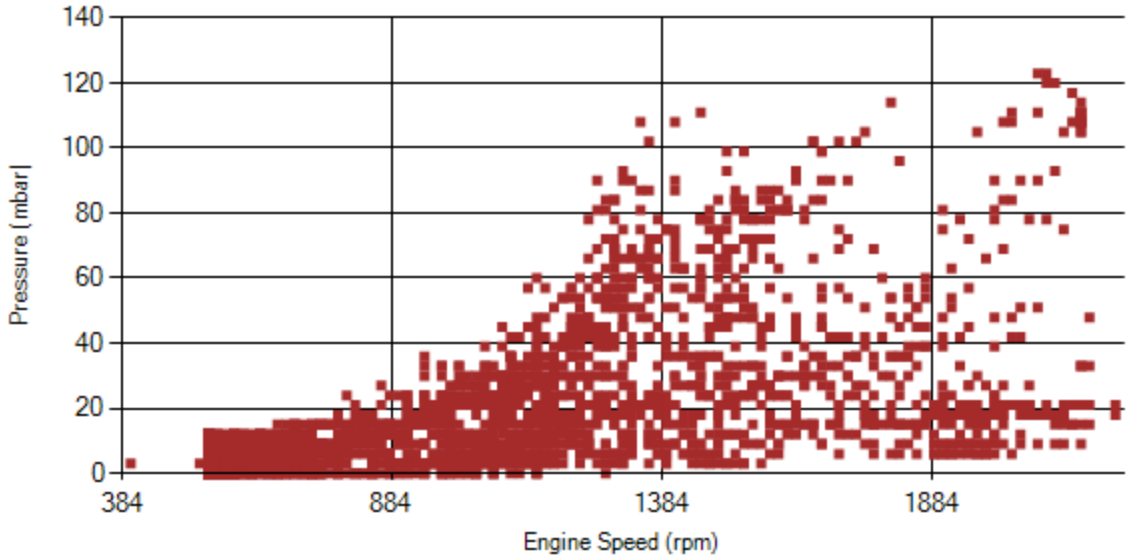


Figure 13- Pressure against engine speed

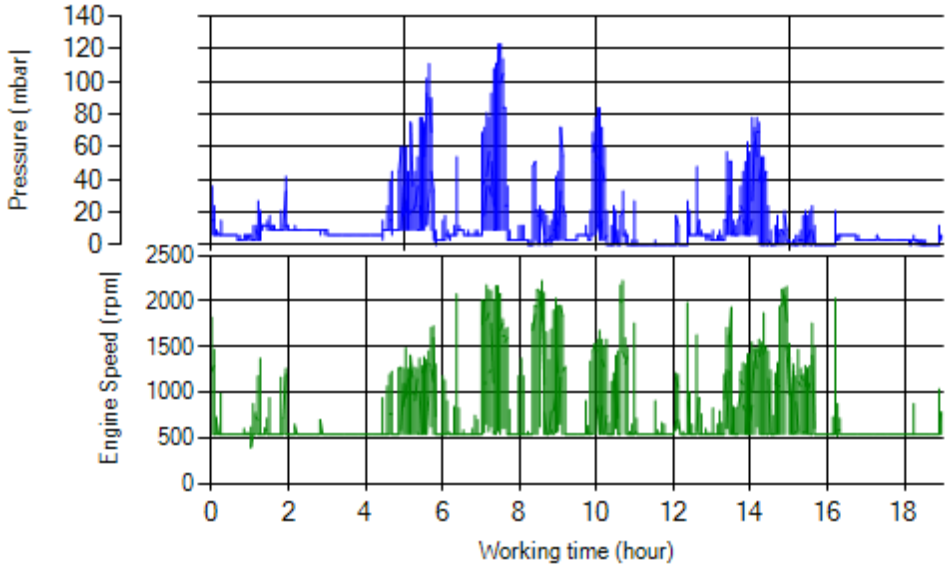


Figure 14- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

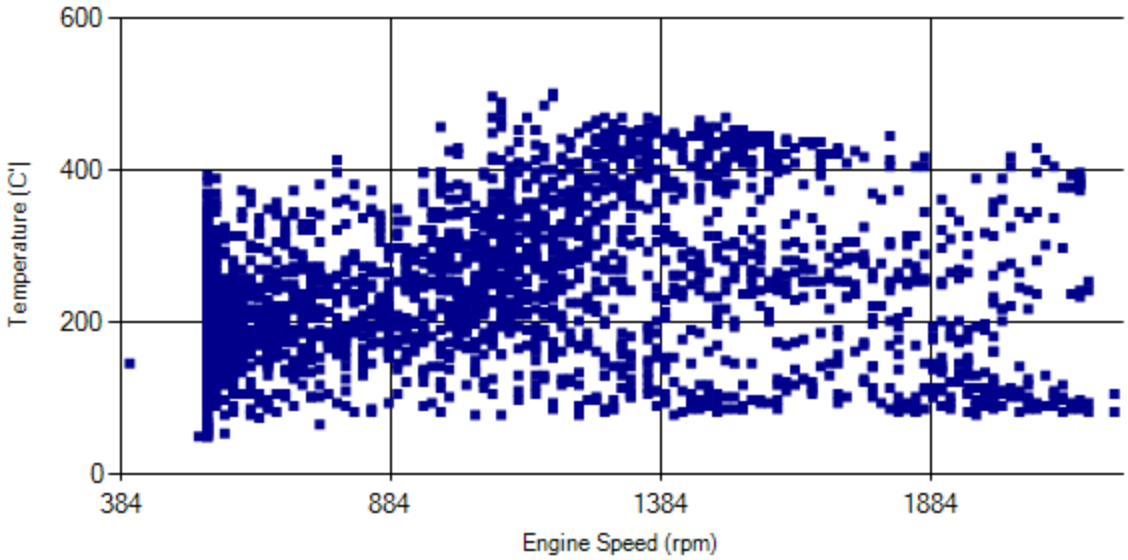


Figure 15- Temperature against engine speed

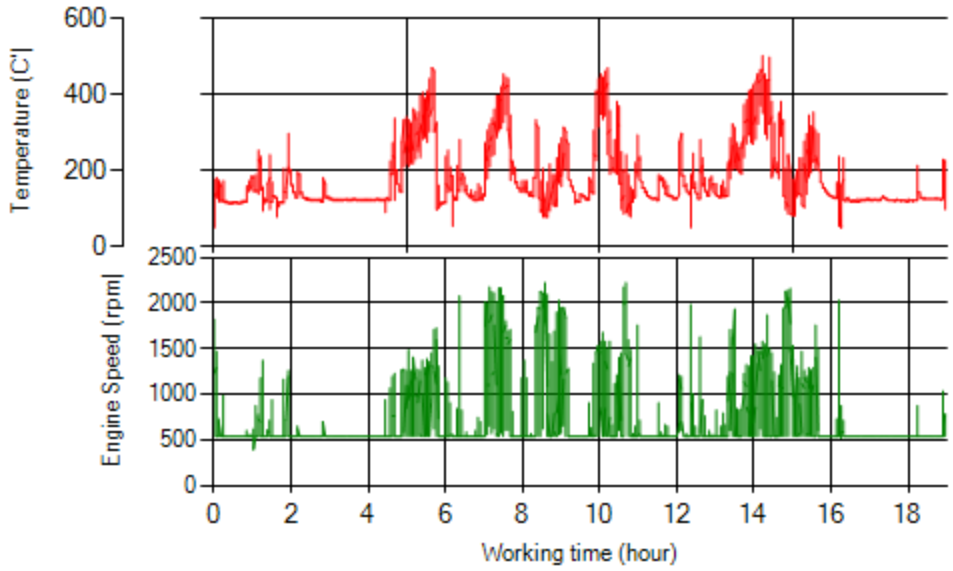
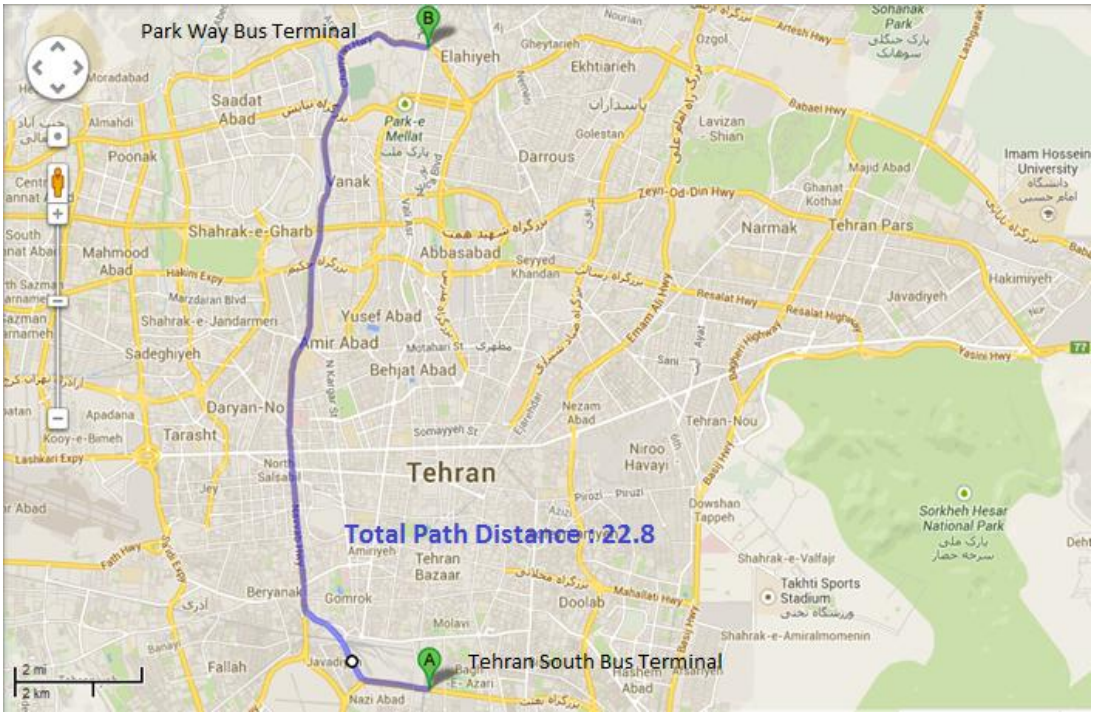


Figure 16- T, N distribution vs. working hours

Filter Operation Analysis

Bus was almost stationary and only worked 19 hours which 71% working time was idle operation. So at the results page, this month status for the DPF was declared as a "bus was stationary".

Vehicle plate number	85423
Bus line	Number 4 (south to north bus line)
DPF producer company	HJS_02 (active system with FBC – electrical heater)



Overall Information

Table1- Overall Information

Vehicle plate number	85423
CPK data logger number	LN: 001505, DN: 2001, Sim Number +989218469621
Bus line	Number 4 (south to north bus line)
Bus Terminals	South Bus Terminal - Park Way Bus Tehran Terminal
Total path distance	22.8 km
DPF producer company	HJS_02 (active system with FBC – electrical heater)
Installation date	19/Feb/2015
Report period	01/Feb/2016- 15/Feb/2016 (fifteen days)
K value - DPF upstream	1.80 [1/m]
K value – DPF downstream	0.02 [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	DPF was cleaned on 2016-02-03 for the first time.
Dosing status	Dosing value has been kept constant from installation date until now.

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	58521 km
Bus mileage over the period	1824 km
Working days over the period	15 days
Stop days	0
Data logger working days	15 days
Working hours over the period	119 hours 39 minutes
Average working hours per day (including stop days)	8 hours 33 minutes
Bus average speed	15.2 km/hr
idle speed time to all working time ration	- %
Total Bus fuel consumption over the period	1149 lit
Fuel consumption per hour	9.6 lit/hr
Average fuel consumption	0.63 lit/km
Total Bus additive consumption over the period	0.55 lit
Average additive consumption	302 cc/km
Additive consumption to fuel ration	478 cc/1000lit

Notice: RPM sensor had problem during this period and was fixed on 15th Feb.

Temperature, Pressure and Engine Speed Overview

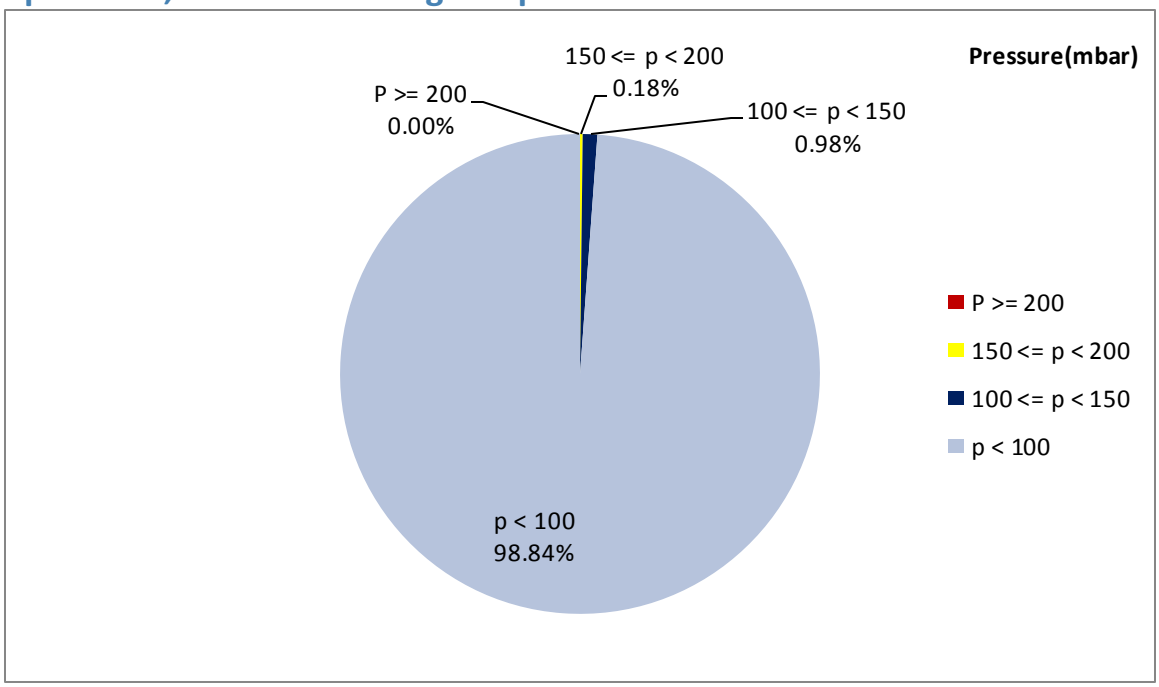


Figure 1- Pressure distribution over the working hours

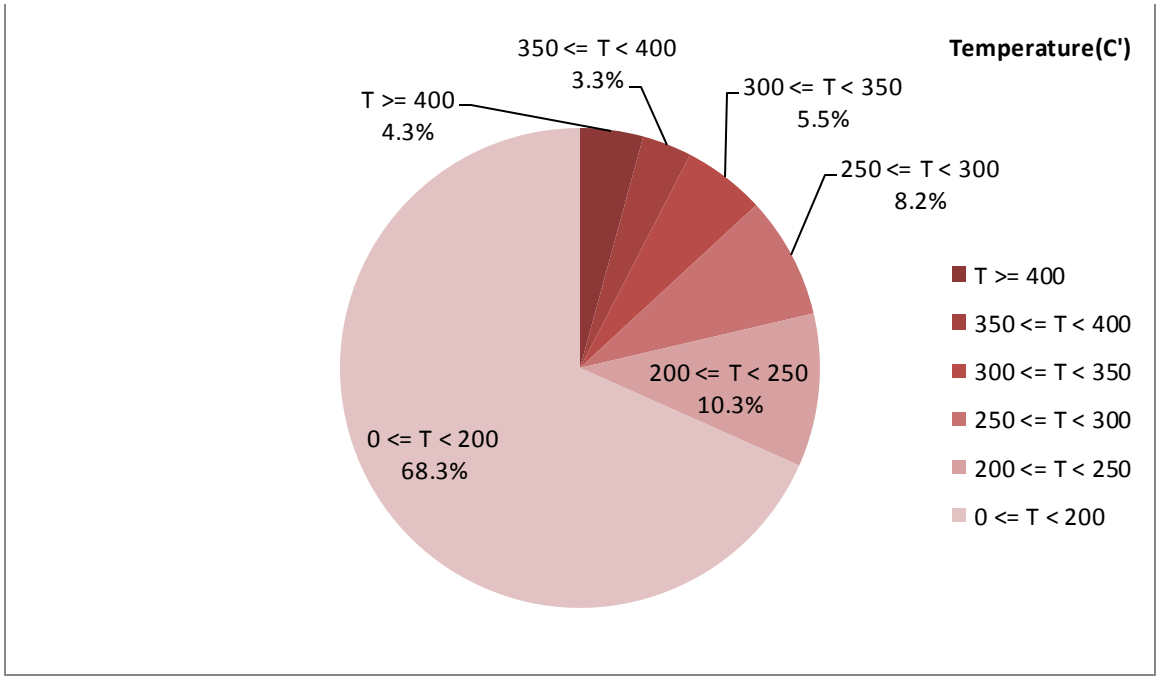


Figure 2-Temperature distribution over the working hours

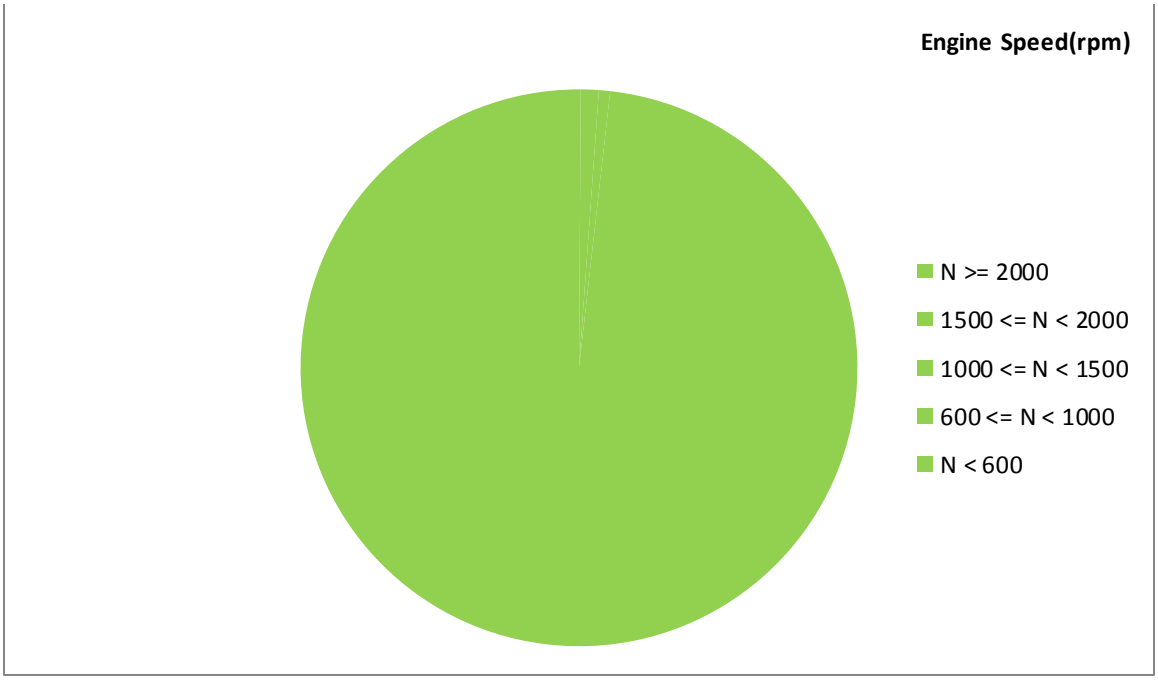


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
175.3	13.49	-

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
-	-	-

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
646-50	192-0	-

Notice: RPM sensor had problem during this period and was fixed on 15th Feb. So some parameters couldn't be calculated

Detailed Pressure Analysis

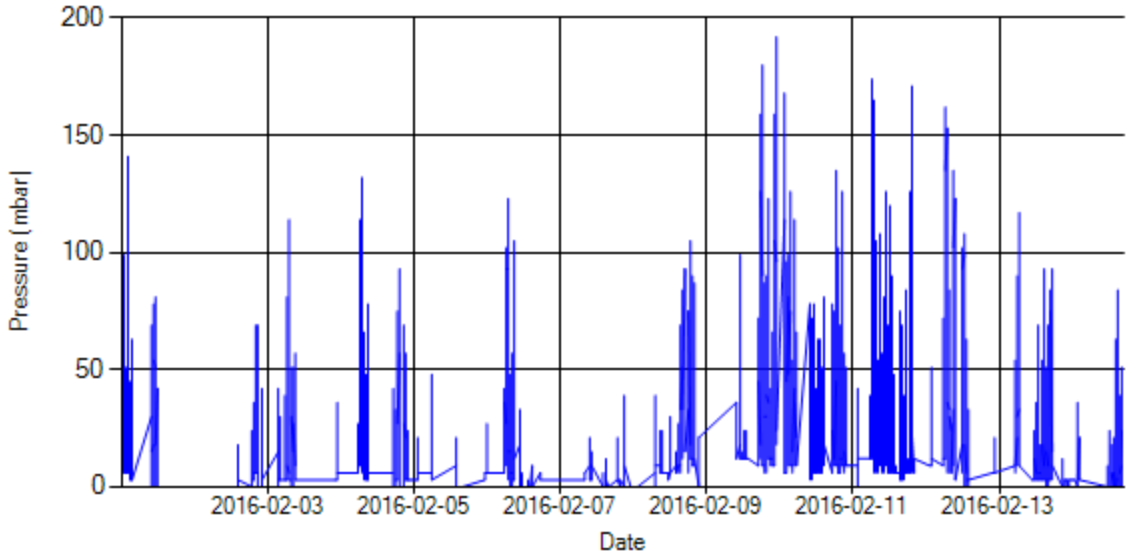


Figure 4- Pressure distribution over the period

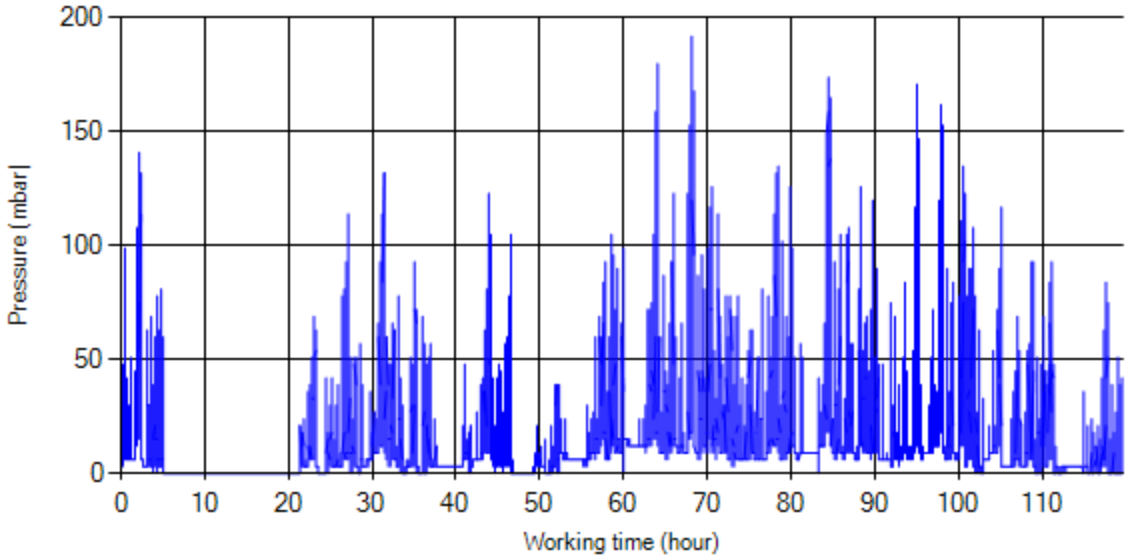


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

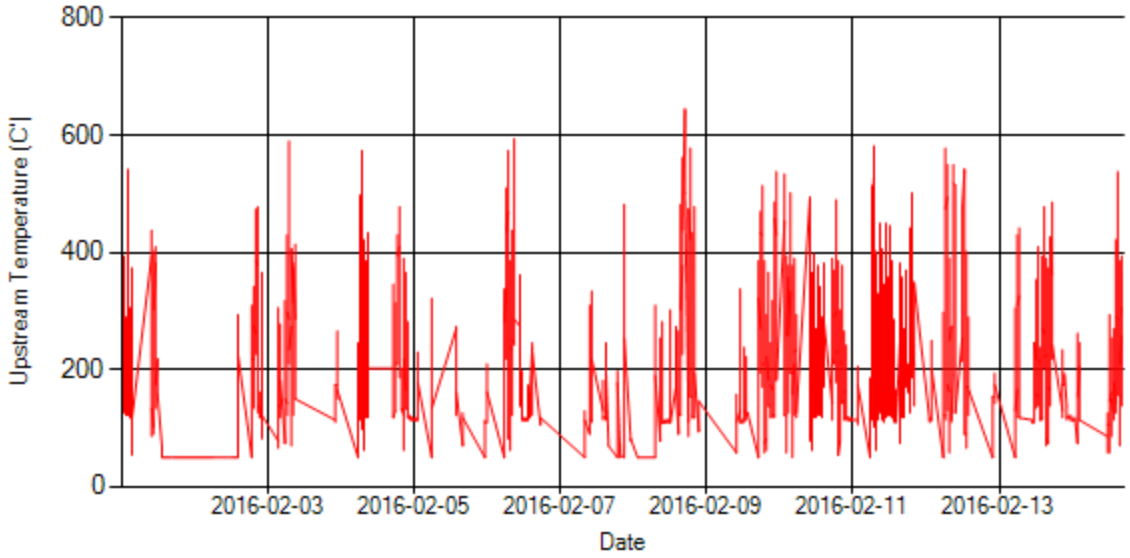


Figure 6- Temperature distribution over the period

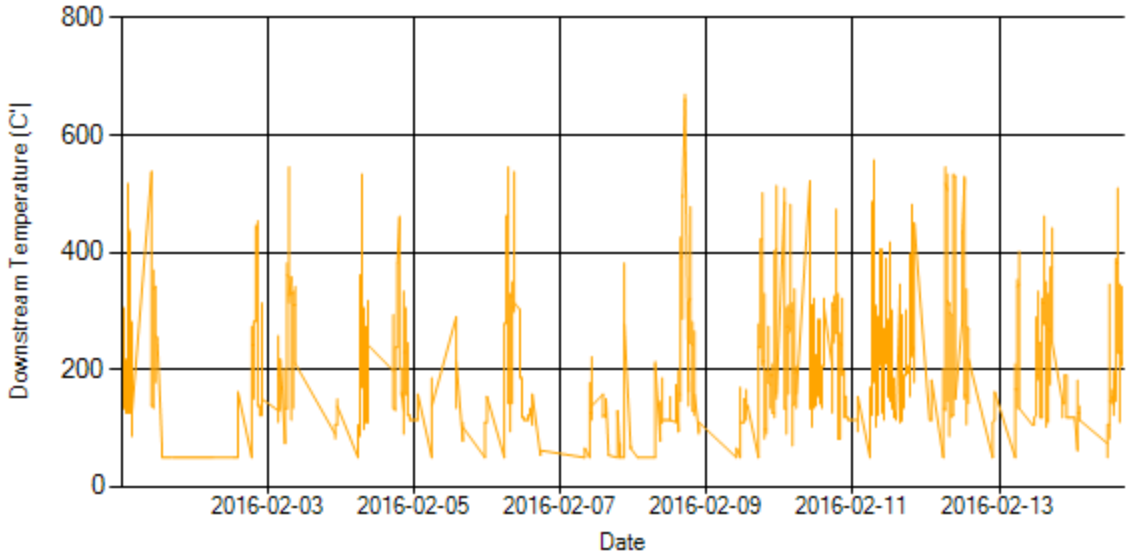


Figure 7- Temperature distribution over the period

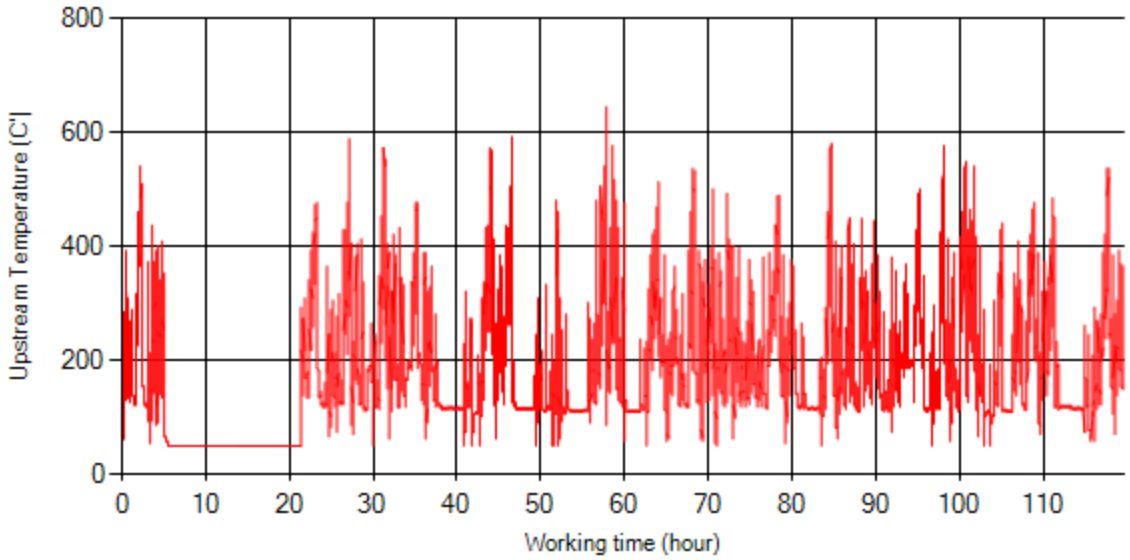


Figure 8- Temperature vs. working hours

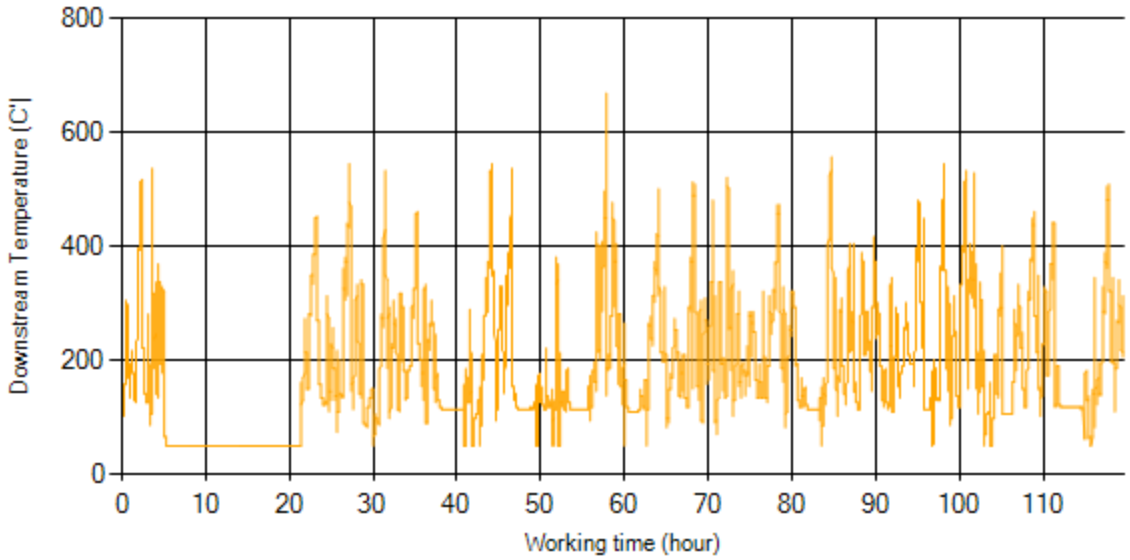


Figure 9- Temperature vs. working hours

Engine Speed Diagrams

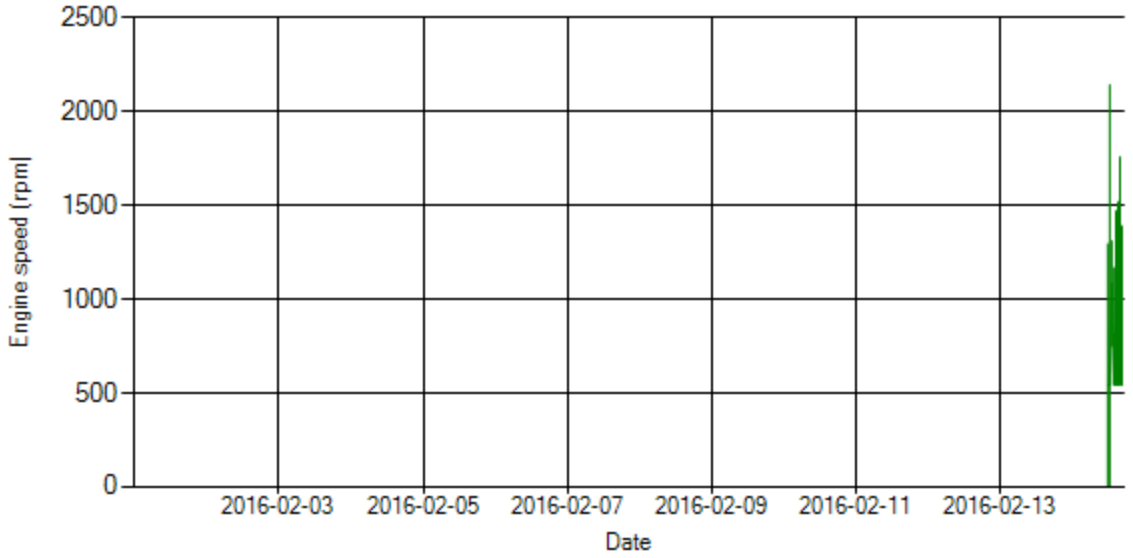


Figure 10- Engine speed distribution over the period

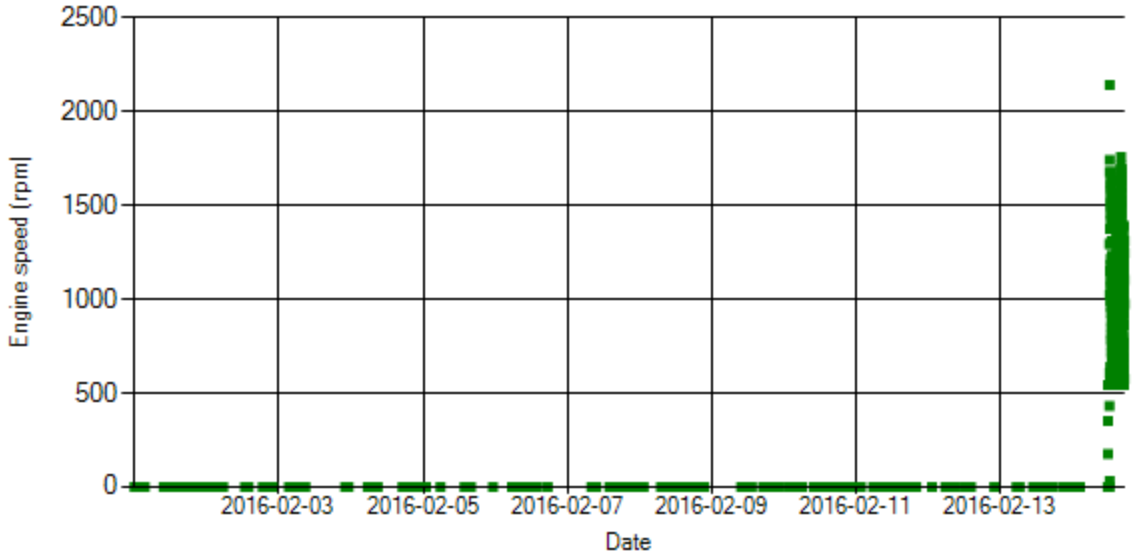


Figure 11- Engine speed diagram for calculating CPK's working days

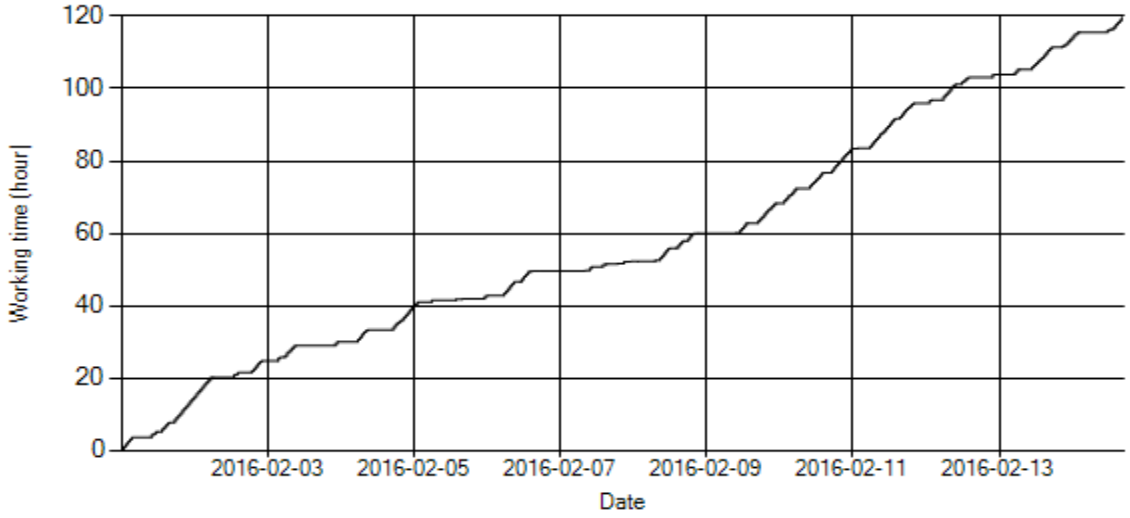


Figure 12- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data. System was working all days during the period.

Pressure-Engine Speed diagrams

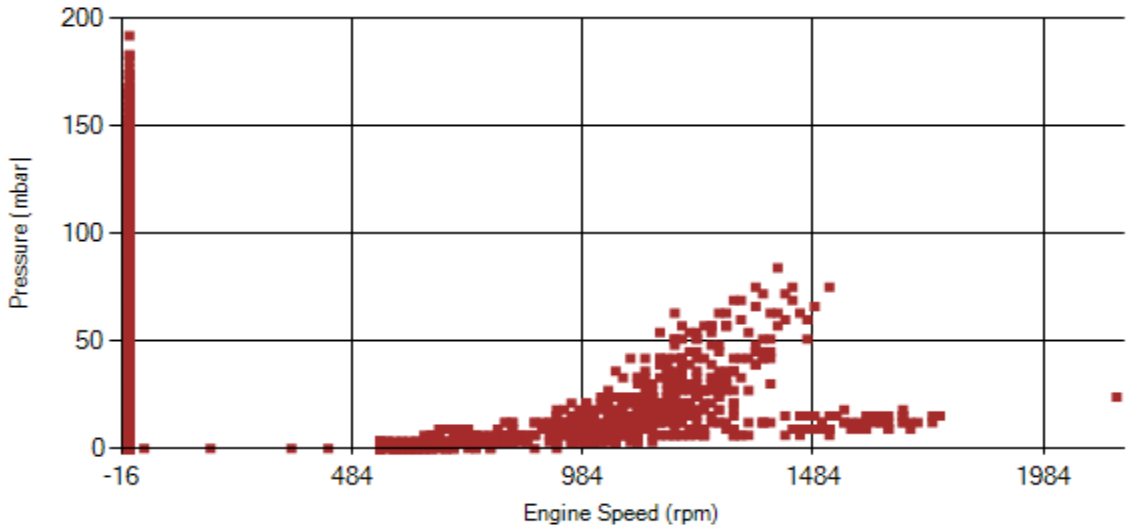


Figure 13- Pressure against engine speed

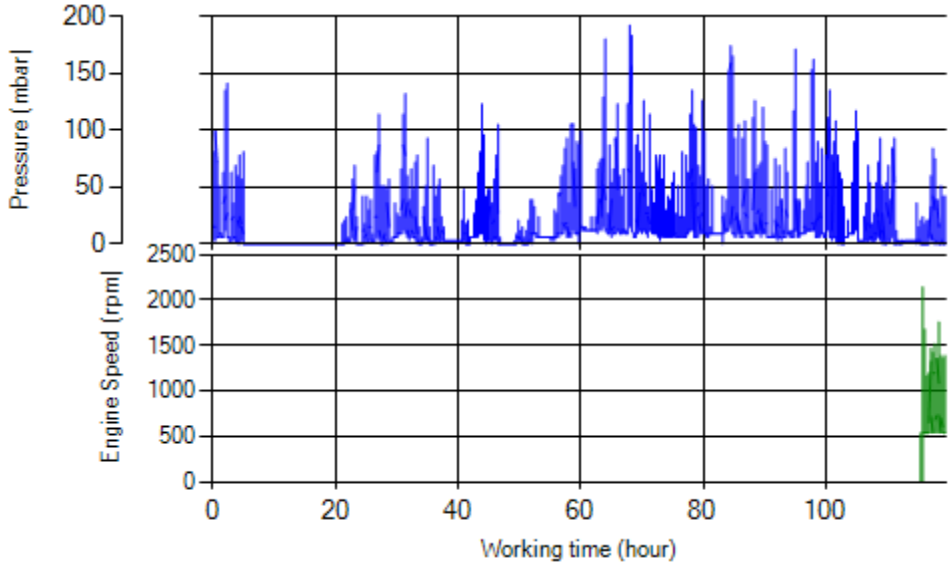


Figure 14- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

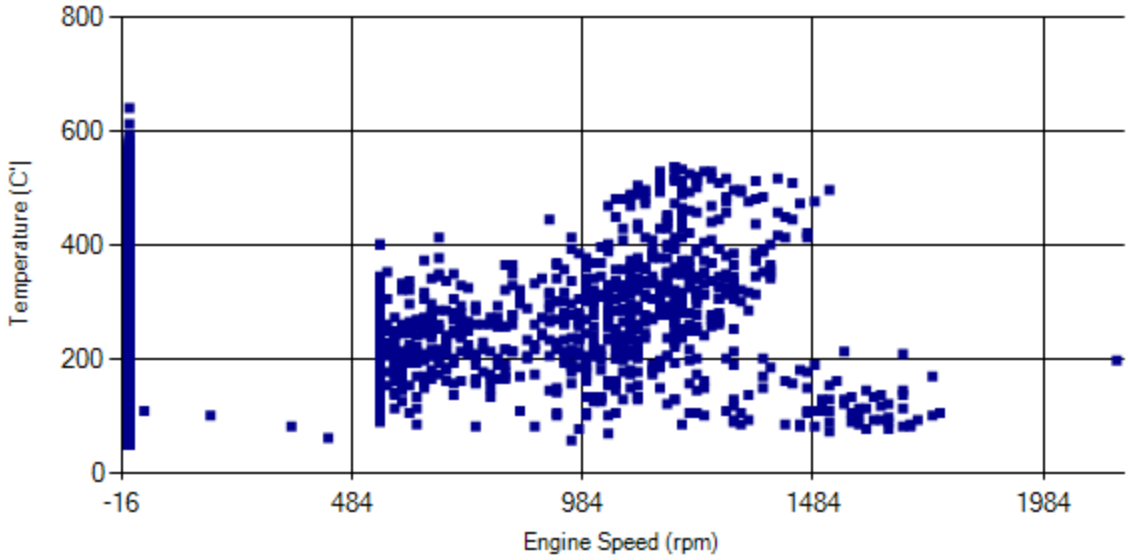


Figure 15- Temperature against engine speed

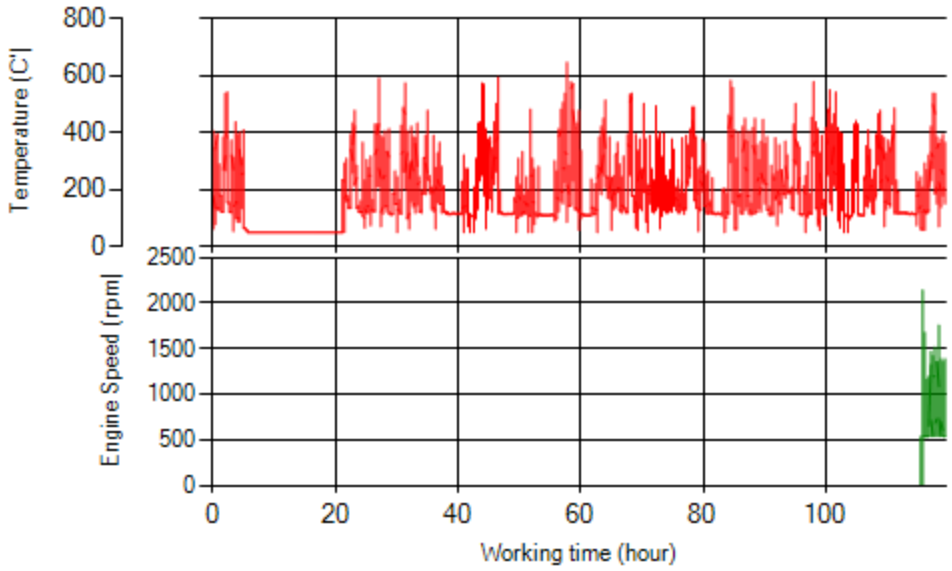


Figure 16- T, N distribution vs. working hours

Filter Operation Analysis

- As depicted in figure 1, only 0.18% of time pressure was above 150 mbar and pressure above 200 mbar was not observed.
- Figure 2 displays flow temperature distribution for DPF's upstream. It can be obviously observed that 4.3% of total working-time temperature is above 400 ℃ and 7.6% above 350℃.

Filter operation status	Excellent ■	Good ☐
	Maintenance required ☐	Failed ☐

ASA Azmoon Sanat Arvin	Document Number: DPF2016022/1 Date: 22/Mar/2016

Overall Information

Table1- Overall Information

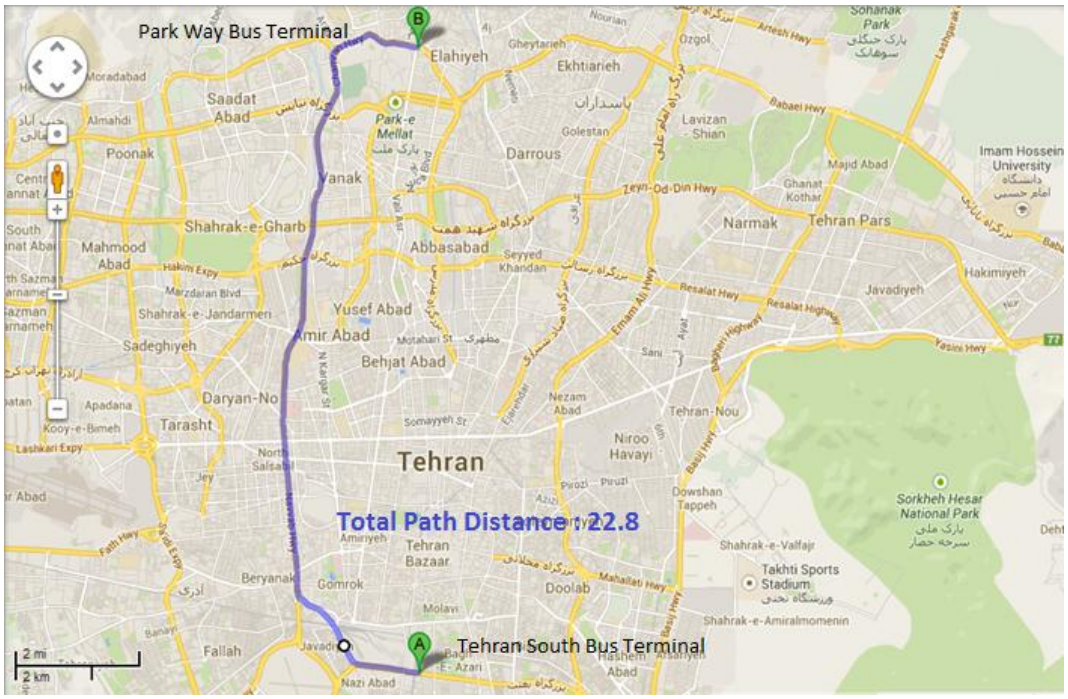
Vehicle plate number	85423
CPK data logger number	LN: 001505, DN: 2001, Sim Number +989218469621
Bus line	Number 4 (south to north bus line)
Bus Terminals	South Bus Terminal - Park Way Bus Tehran Terminal
Total path distance	22.8 km
DPF producer company	HJS_02 (active system with FBC – electrical heater)
Installation date	19/Feb/2015
Report period	16/Feb/2016- 29/Feb/2016 (fourteen days)
K value - DPF upstream	- [1/m]
K value – DPF downstream	- [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	DPF was cleaned on 2016-02-03 for the first time.
Dosing status	Dosing value has been kept constant from installation date until now.

Notice: Bus was stationary during this period.

Vehicle plate number	78515
Bus line	Number 4 (south to north bus line)
DPF producer company	Dinex_01 (Passive system with FBC)



Overall Information

Table1- Overall Information

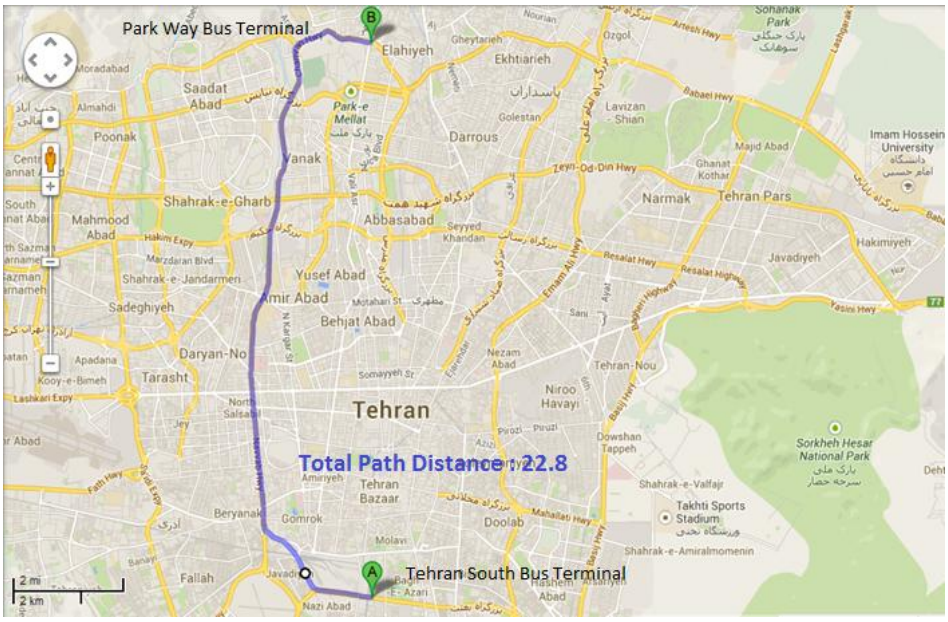
Vehicle plate number	78515
CPK data logger number	LN: 001490, DN: 1954, Sim Number +98000000000
Bus line	Number 4 (south to north bus line)
Bus Terminals	Tehran South Bus Terminal - Park Way Bus Terminal
Total path distance	22.8 km
DPF producer company	Dinex_01 (passive system with FBC)
Installation date	22/Oct/2014
Report period	01/Feb/2016 – 29/Feb/2016 (twenty nine days)
K value - DPF upstream	- [1/m]
K value – DPF downstream	- [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	Filter core was changed on 15/Feb/2015.
Dosing status	Dosing value was reduced by 70% on March February 15th. (Secondary value/Initial value=0.3)

Notice: Bus has been stopped from Sep 18th until now due to technical problems (related to Bus Company).

Vehicle plate number	78524
Bus line	Number 4 (south to north Bus line)
DPF producer company	PURItech (Passive system with FBC)



Overall Information

Table1- Overall Information

Vehicle plate number	78524
CPK data logger number	LN: 001443, DN: 1930,Sim +989218786219
Bus line	Number 4 (south to north Bus line)
Bus Terminals	Tehran South Bus Terminal - Park Way Bus Terminal
Total path distance	22.8 km
DPF producer company	PURItech (Passive system with FBC)
Installation date	28/Jan/2015
Report period	01/Feb/2016 – 15/Feb/2016 (Fifteen days)
K value	1.80
K value	1.80

Table 2- DPF Maintenance History

Filter maintenance date	DPF core was removed on Jul 22nd and was cleaned on Aug 12th for the first time. Considering system relatively high backpressure, filter isolation defect and air filter's deformation, DPF core was removed on Sep 16th and installed on Nov 17th. The third cleaning was unavoidable after only 6 days working and was done on 29th Nov. System only worked for two days and DPF was replaced by muffler on Nov 30th. DPF was installed for the fourth time on Jan/19/2016 and was replaced by muffler after only three days working because of high backpressure.
Dosing status	Dosing value has been kept constant from installation date until now.

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	58074 km
Bus mileage over the period	2826 km
Working days over the period	13 days
Stop days	2 days
Data logger working days	13 days
Working hours over the period	235 hours 25 minutes
Average working hours per day (including stop days)	15 hours 41 minutes
Bus average speed	12 km/hr
idle speed time to all working time ration	54.53 %
Total Bus fuel consumption over the period	1582 lit
Fuel consumption per hour	6.72 lit/hr
Average fuel consumption	0.56 lit/km
Total Bus additive consumption over the period	- lit
Average additive consumption	- cc/km
Additive consumption to fuel ration	- cc/1000lit

Temperature, Pressure and Engine Speed Overview

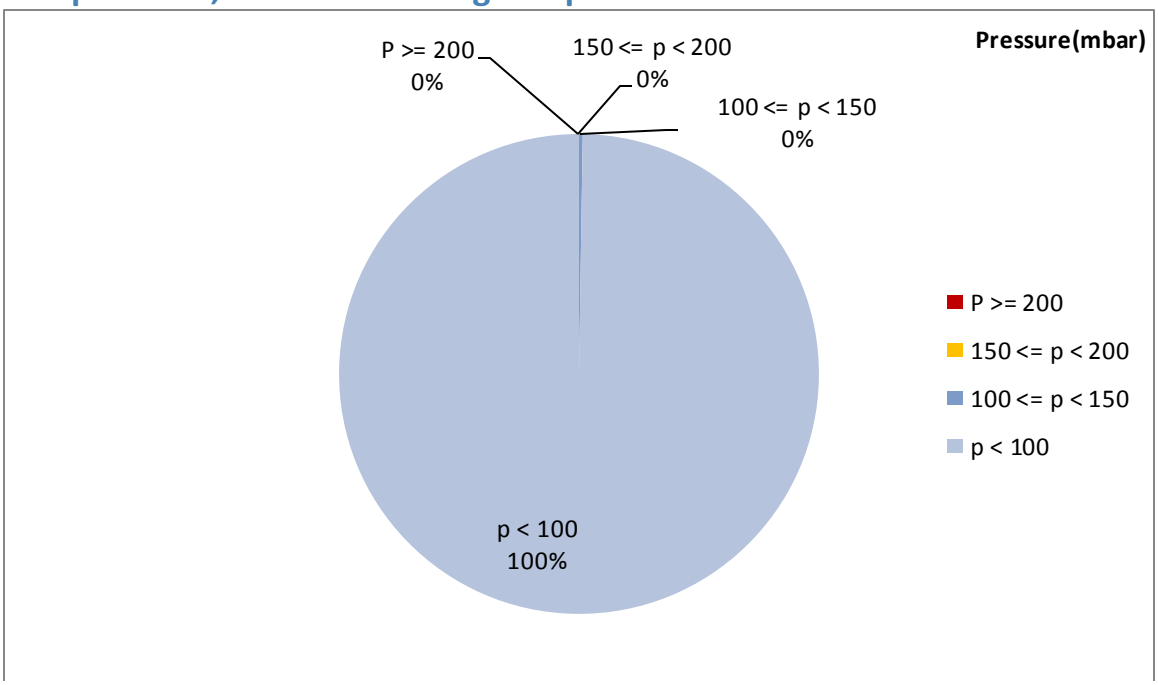


Figure 1- Pressure distribution over the working hours

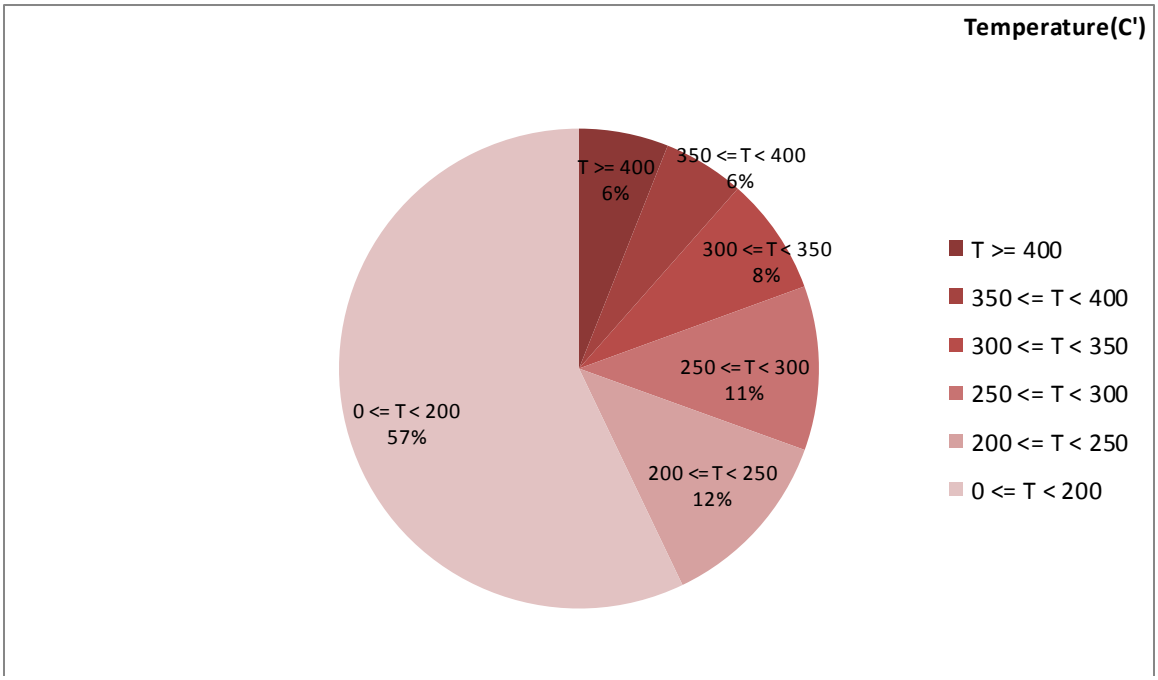


Figure 2-Temperature distribution over the working hours

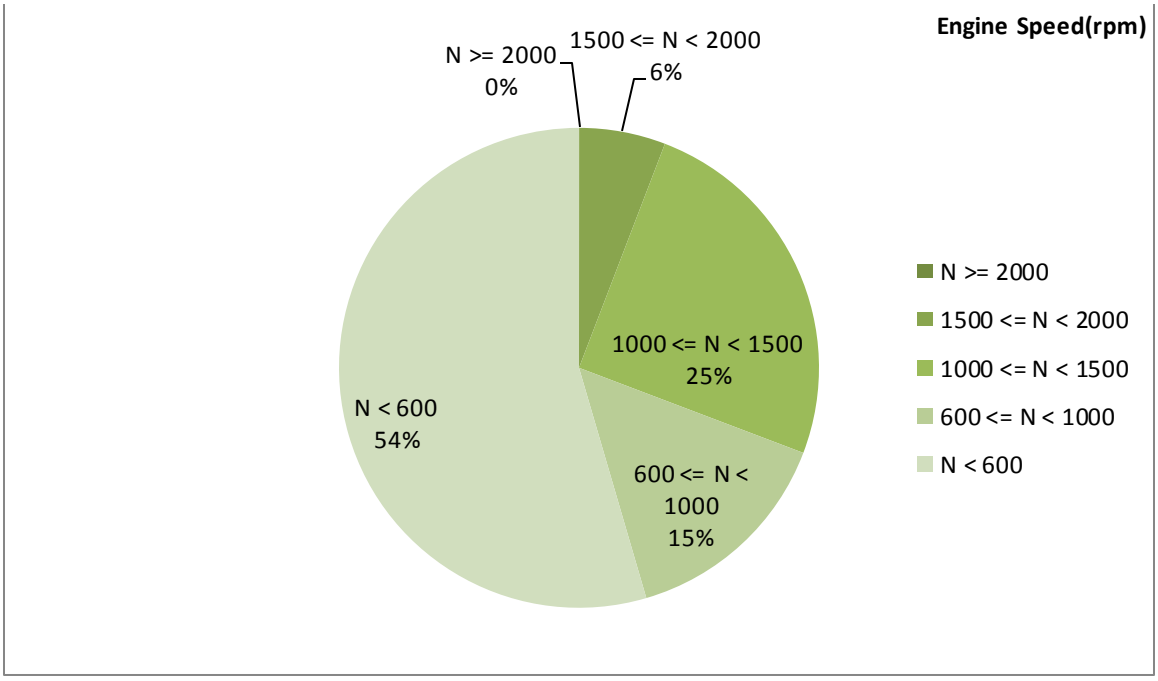


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
209.09	5.78	814

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
276.13	12.36	1135

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
530-50	126-0	2144-304

Detailed Pressure Analysis

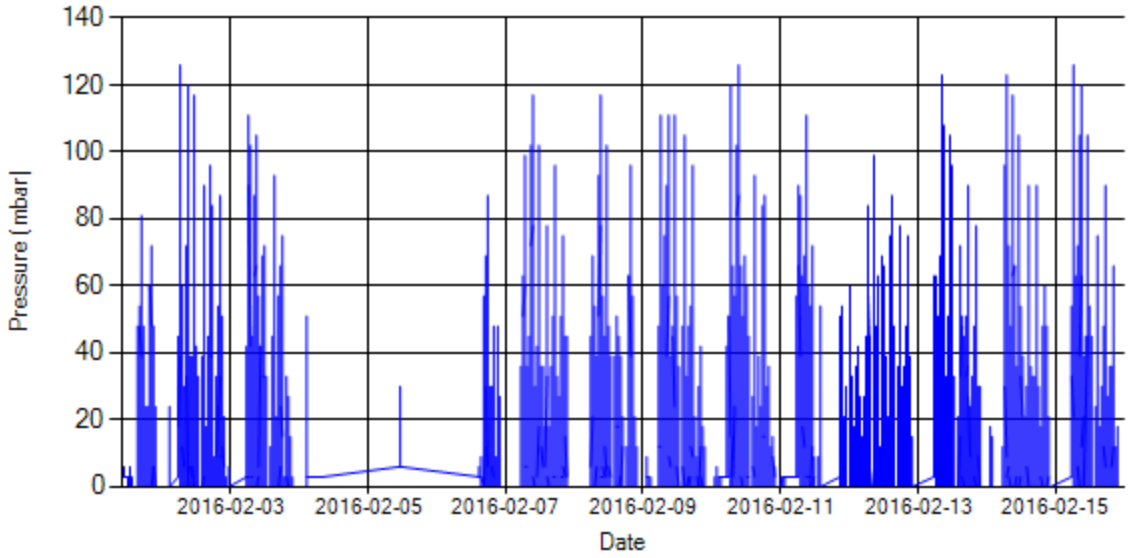


Figure 4- Pressure distribution over the period

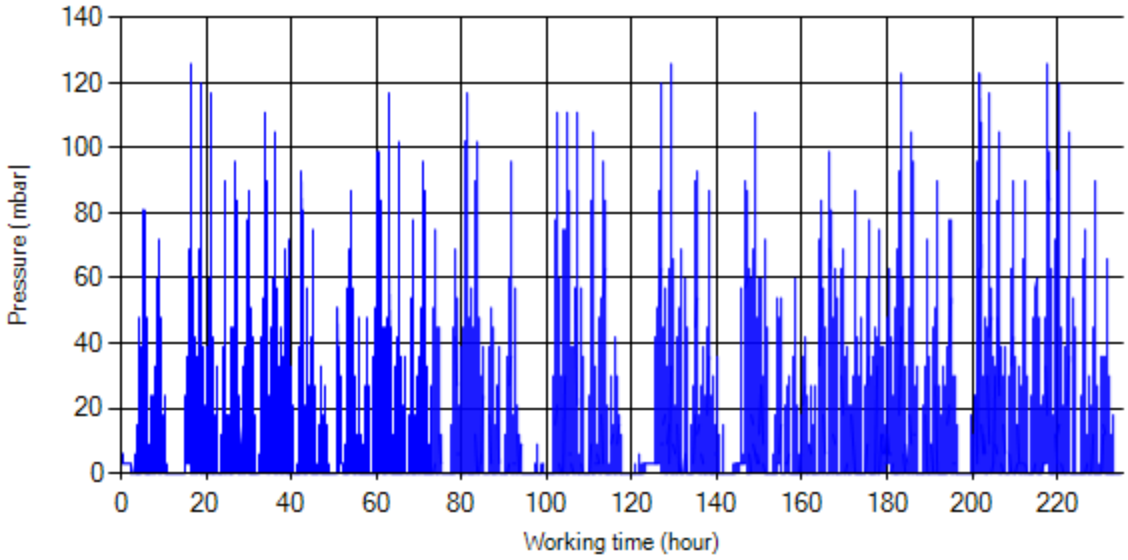


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

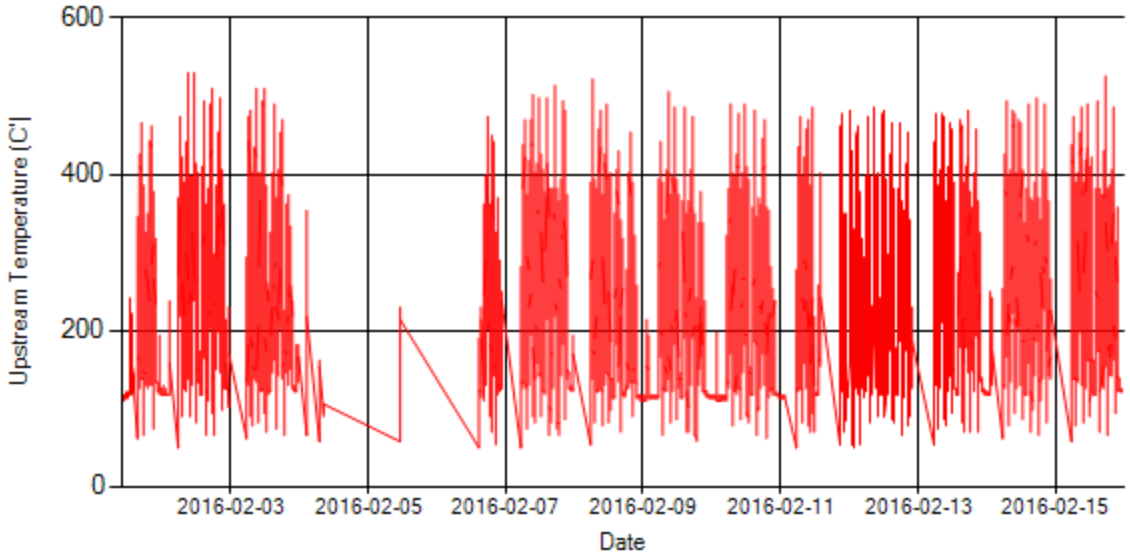


Figure 6- Temperature distribution over the period

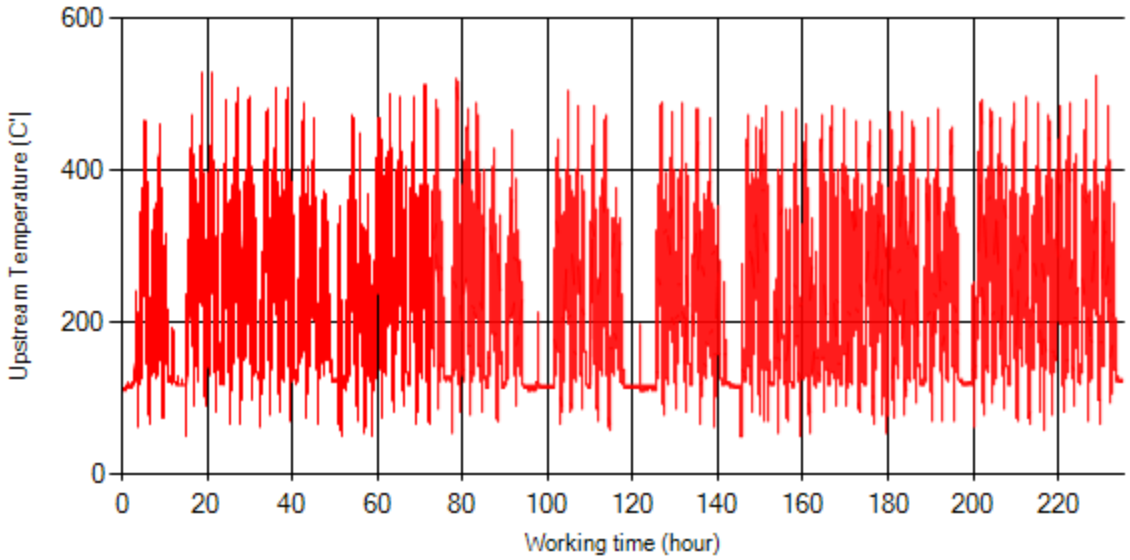


Figure 7- Temperature vs. working hours

Engine Speed Diagrams

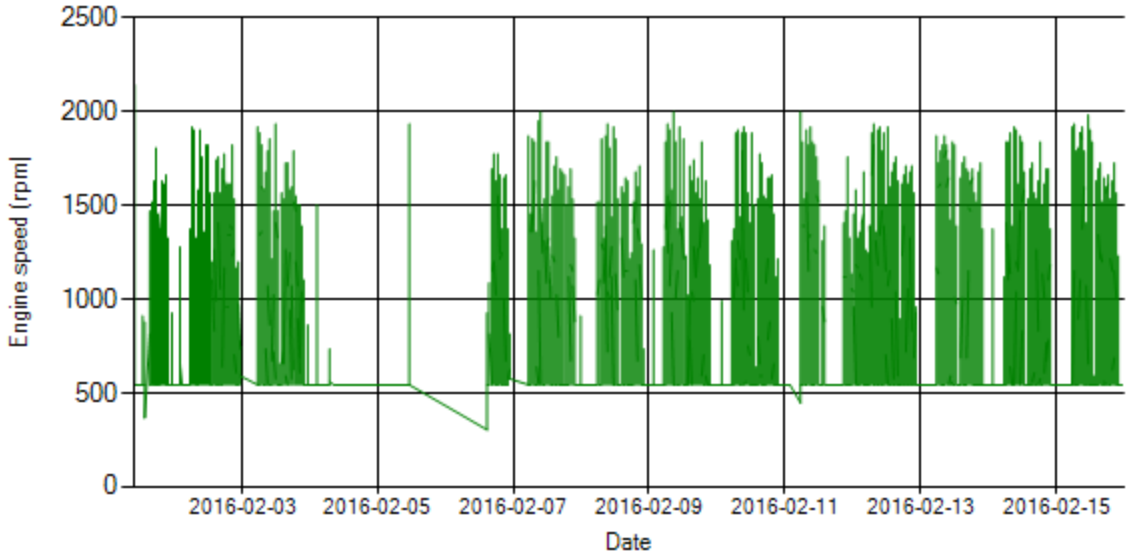


Figure 8- Engine speed distribution over the period

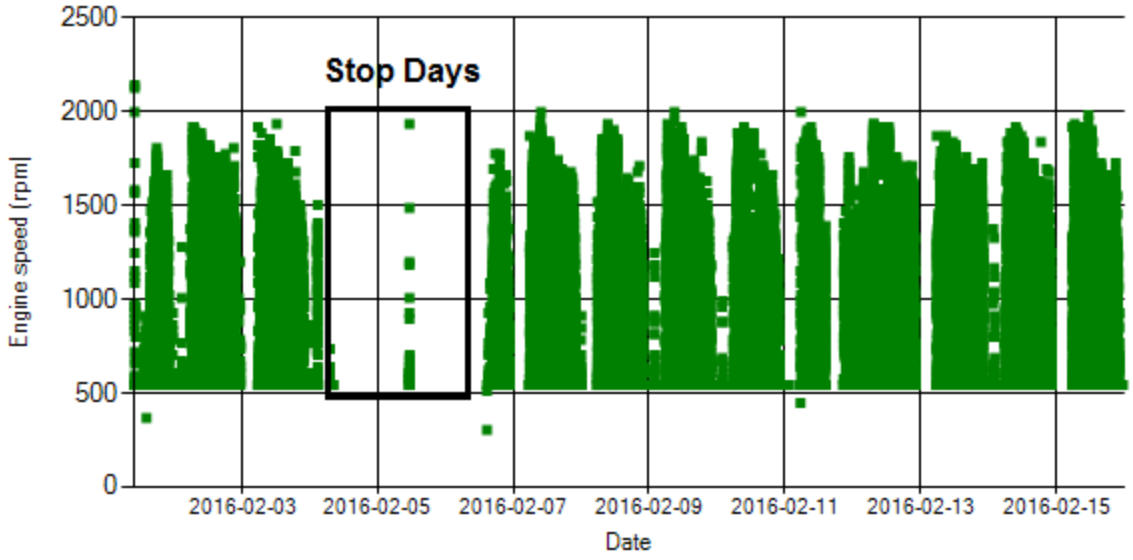


Figure 9- Engine speed diagram for calculating CPK's working days

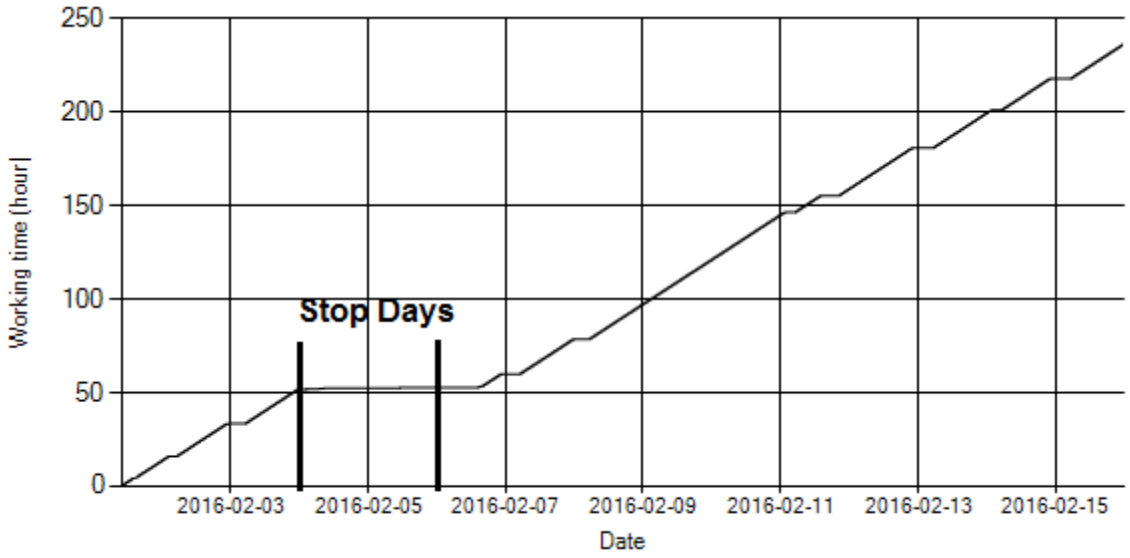


Figure 10- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data.

Pressure-Engine Speed diagrams

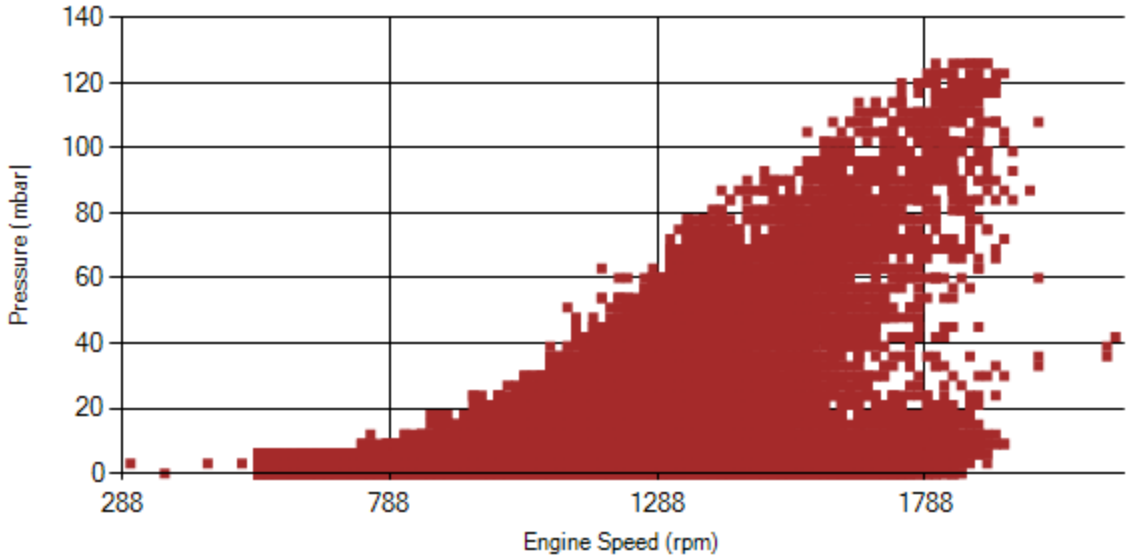


Figure 11- Pressure against engine speed

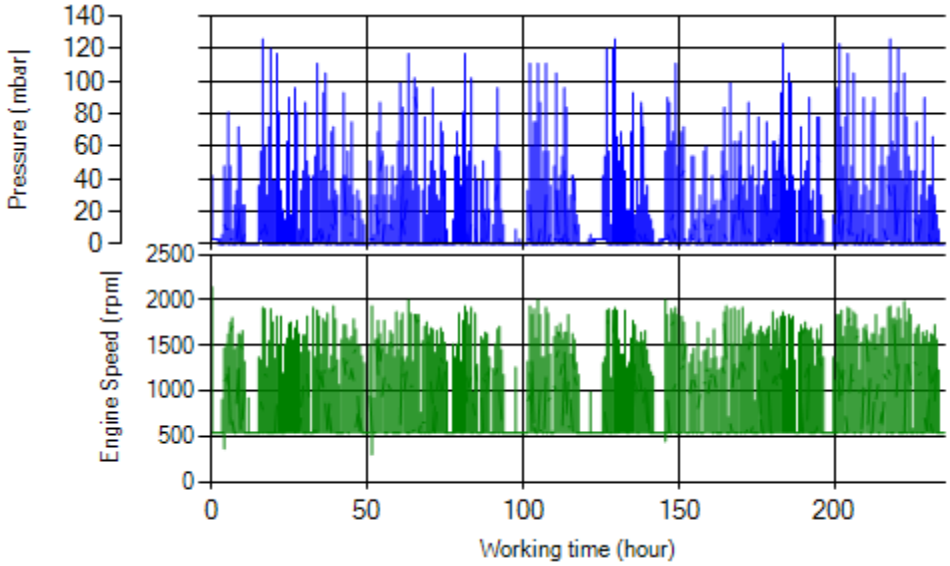


Figure 12- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

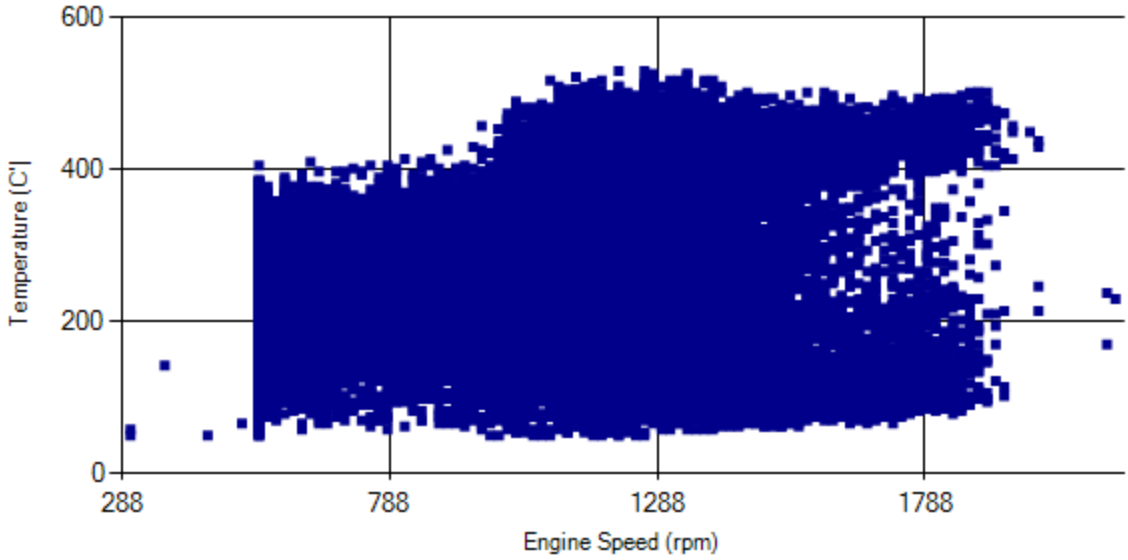


Figure 13- Temperature against engine speed

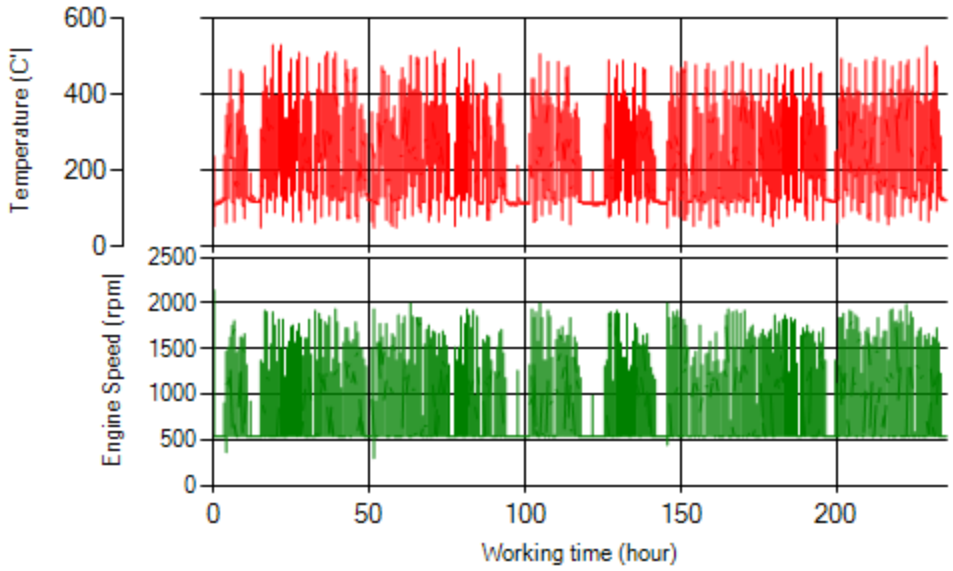


Figure 14- T, N distribution vs. working hours

Filter Operation Analysis

Notice: System was working without DPF during this period.

Overall Information

Table1- Overall Information

Vehicle plate number	78524
CPK data logger number	LN: 001443, DN: 1930,Sim +989218786219
Bus line	Number 4 (south to north Bus line)
Bus Terminals	Tehran South Bus Terminal - Park Way Bus Terminal
Total path distance	22.8 km
DPF producer company	PURItech (Passive system with FBC)
Installation date	28/Jan/2015
Report period	16/Feb/2016 – 29/Feb/2016 (Fourteen days)
K value	1.80
K value	1.80

Table 2- DPF Maintenance History

Filter maintenance date	DPF core was removed on Jul 22nd and was cleaned on Aug 12th for the first time. Considering system relatively high backpressure, filter isolation defect and air filter's deformation, DPF core was removed on Sep 16th and installed on Nov 17th. The third cleaning was unavoidable after only 6 days working and was done on 29th Nov. System only worked for two days and DPF was replaced by muffler on Nov 30th. DPF was installed for the fourth time on Jan/19/2016 and was replaced by muffler after only three days working because of high backpressure.
Dosing status	Dosing value has been kept constant from installation date until now.

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	60575 km
Bus mileage over the period	2501 km
Working days over the period	12 days
Stop days	2 days
Data logger working days	12 days
Working hours over the period	204 hours 47 minutes
Average working hours per day (including stop days)	14 hours 37 minutes
Bus average speed	12.2 km/hr
idle speed time to all working time ration	53.47 %
Total Bus fuel consumption over the period	1426 lit
Fuel consumption per hour	6.95 lit/hr
Average fuel consumption	0.57 lit/km
Total Bus additive consumption over the period	- lit
Average additive consumption	- cc/km
Additive consumption to fuel ration	- cc/1000lit

Temperature, Pressure and Engine Speed Overview

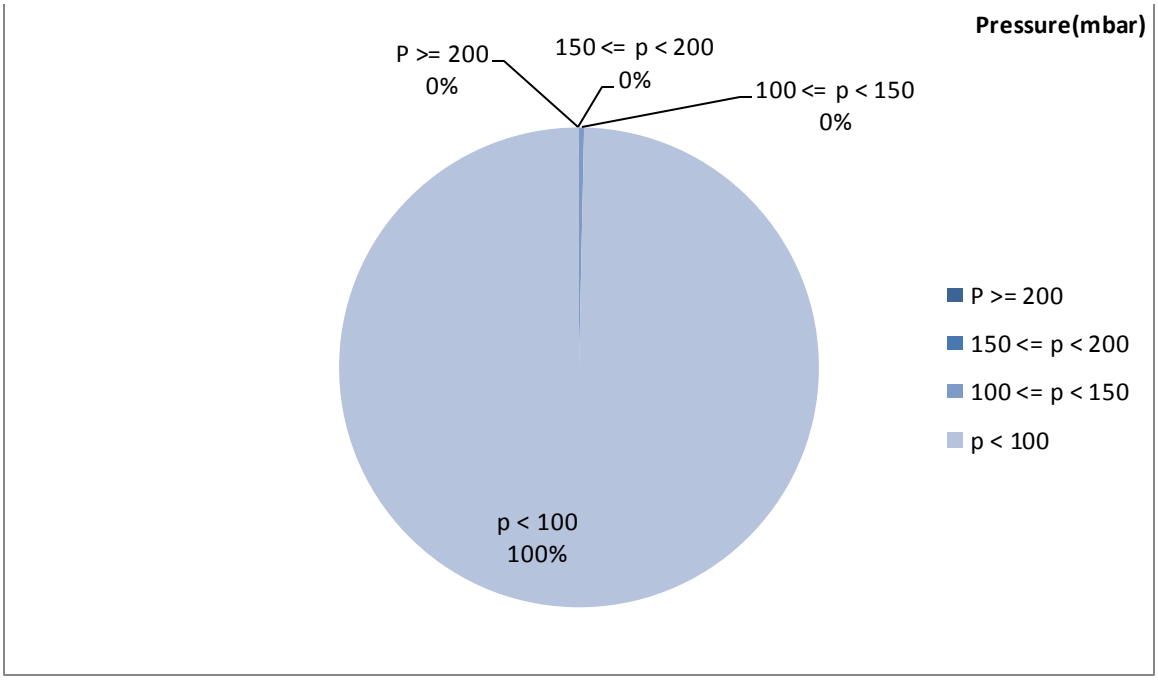


Figure 1- Pressure distribution over the working hours

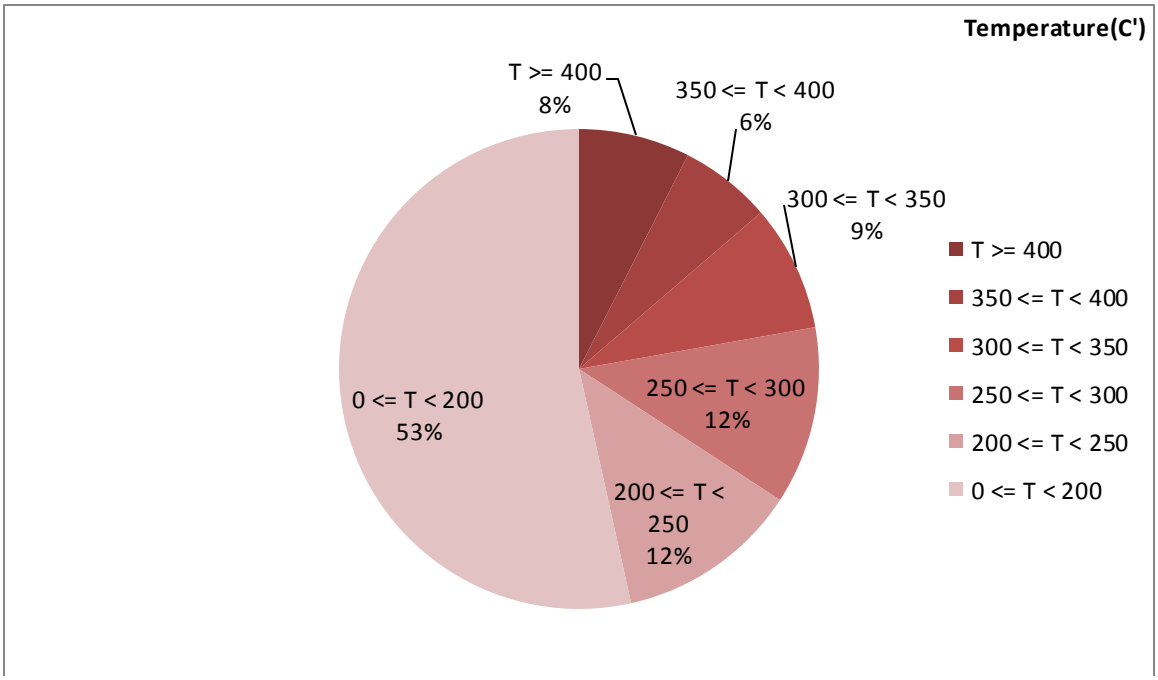


Figure 2-Temperature distribution over the working hours

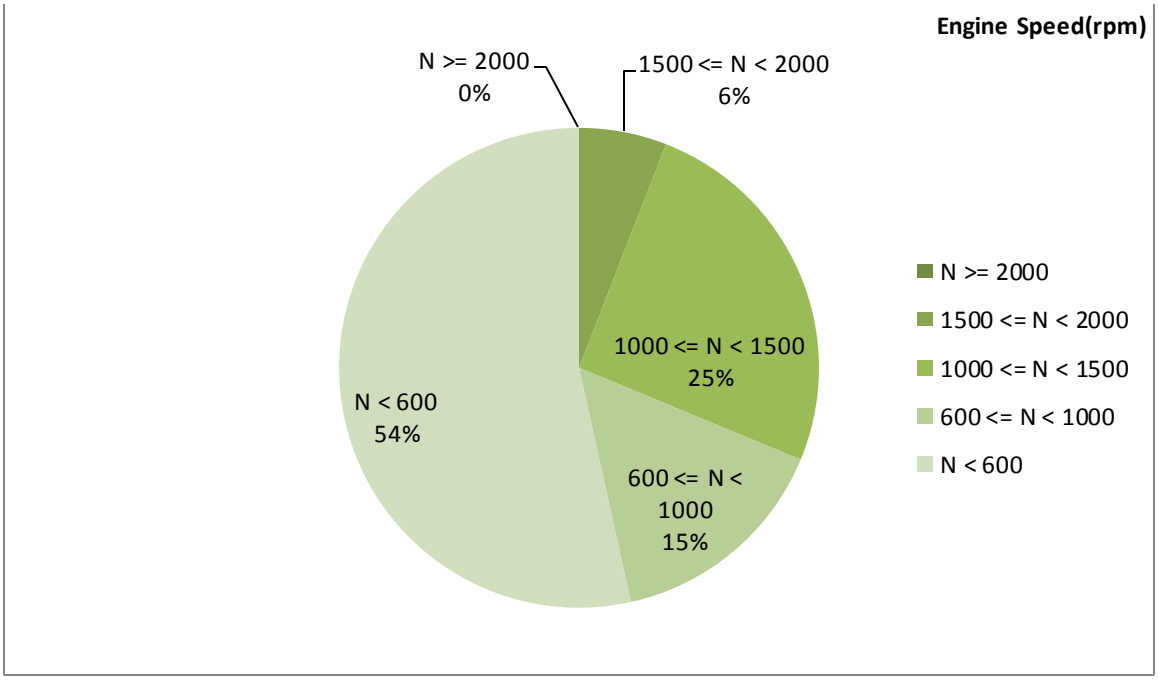


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
220.3	5.32	818

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
288.91	11.37	1131

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
558-50	120-0	2032-432

Detailed Pressure Analysis

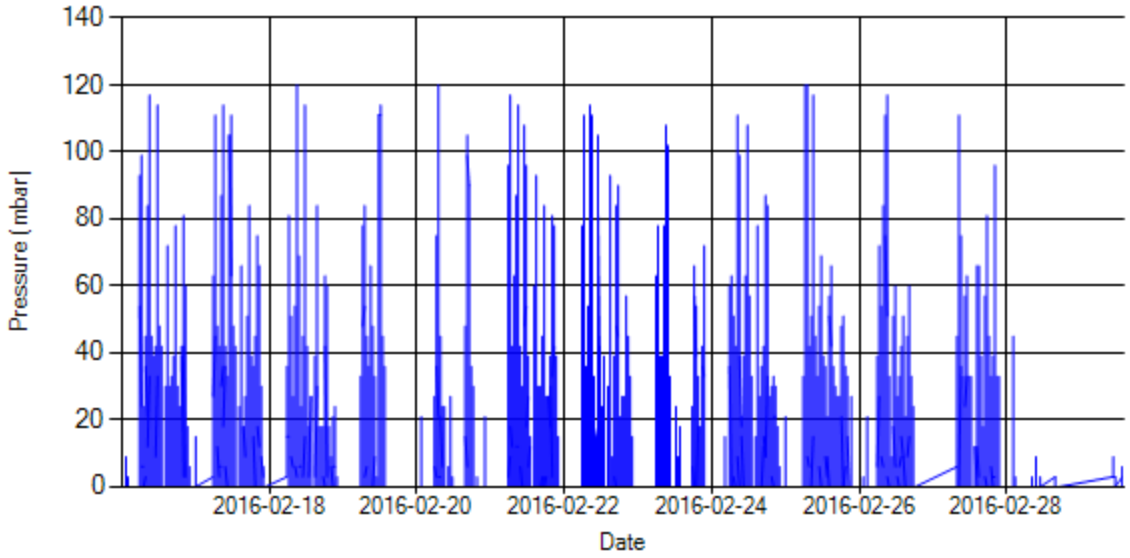


Figure 4- Pressure distribution over the period

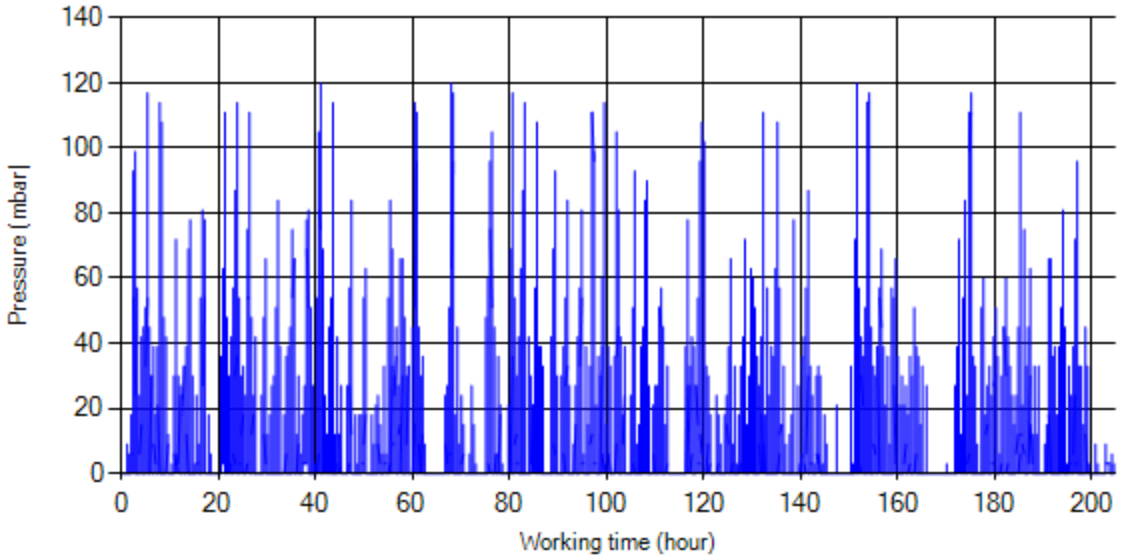


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

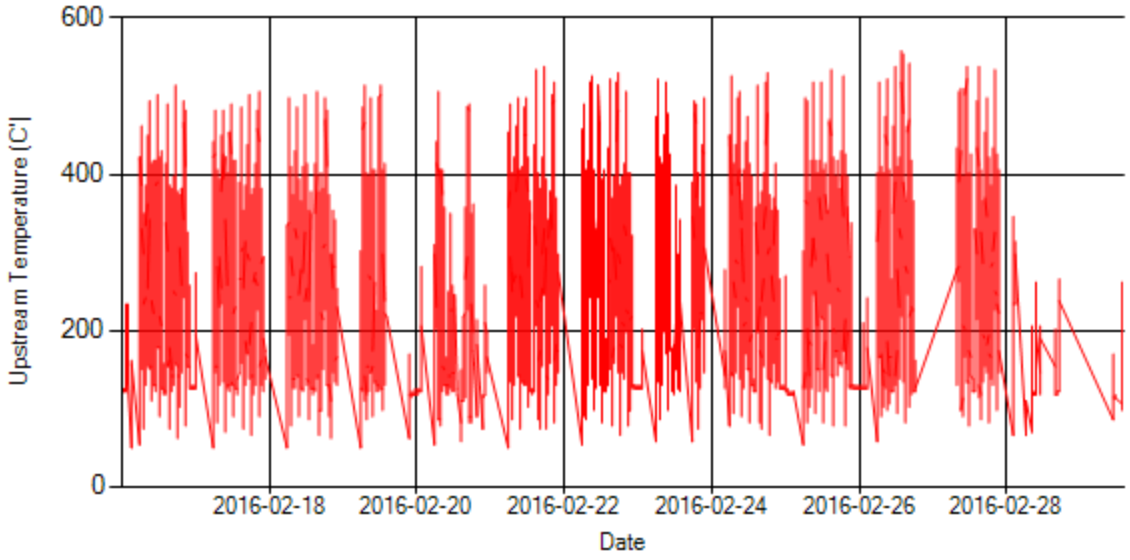


Figure 6- Temperature distribution over the period

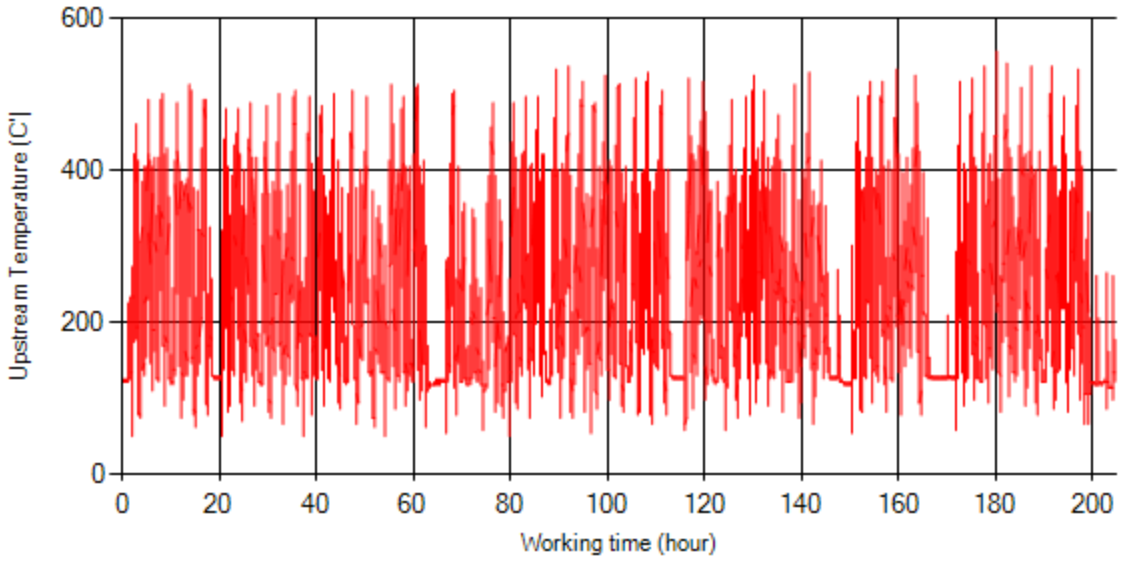


Figure 7- Temperature vs. working hours

Engine Speed Diagrams

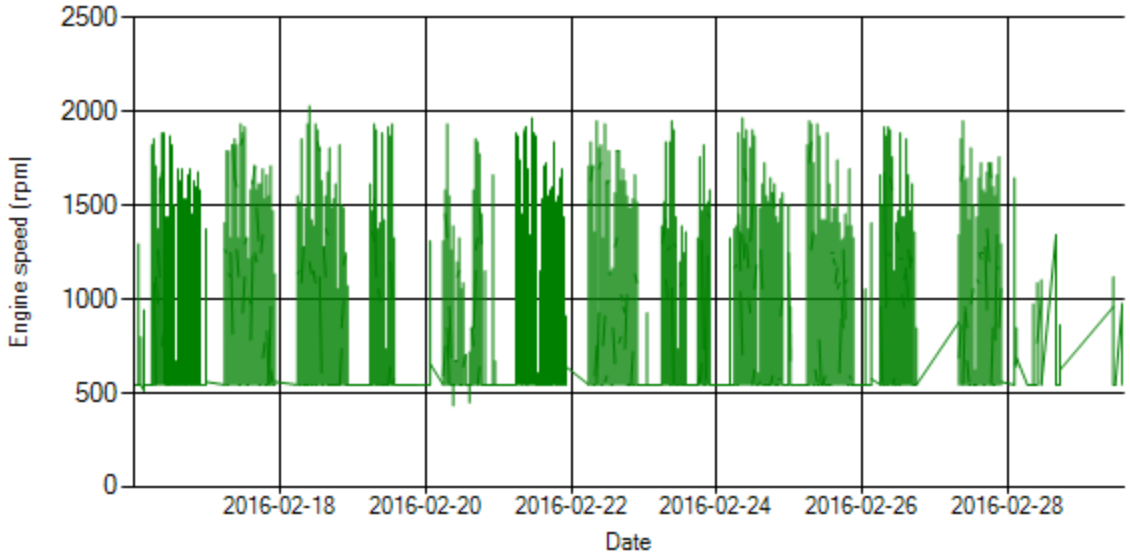


Figure 8- Engine speed distribution over the period

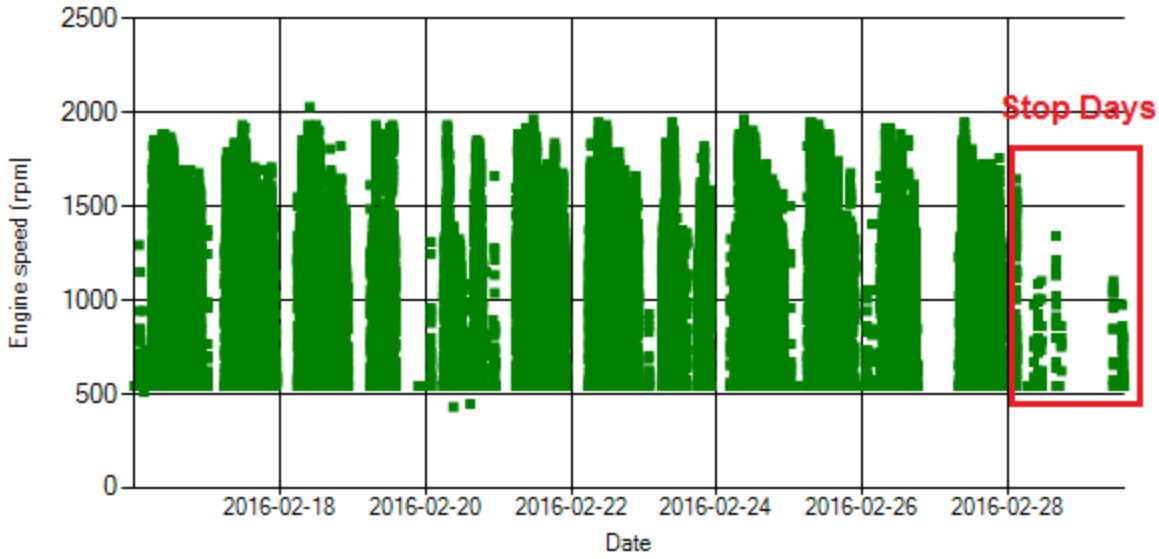


Figure 9- Engine speed diagram for calculating CPK's working days

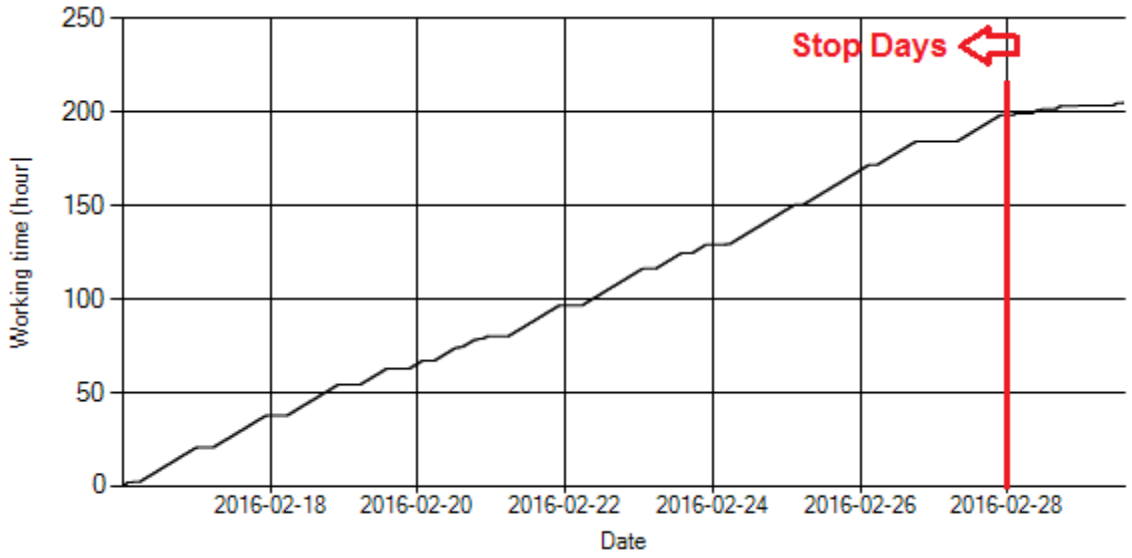


Figure 10- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data.

Pressure-Engine Speed diagrams

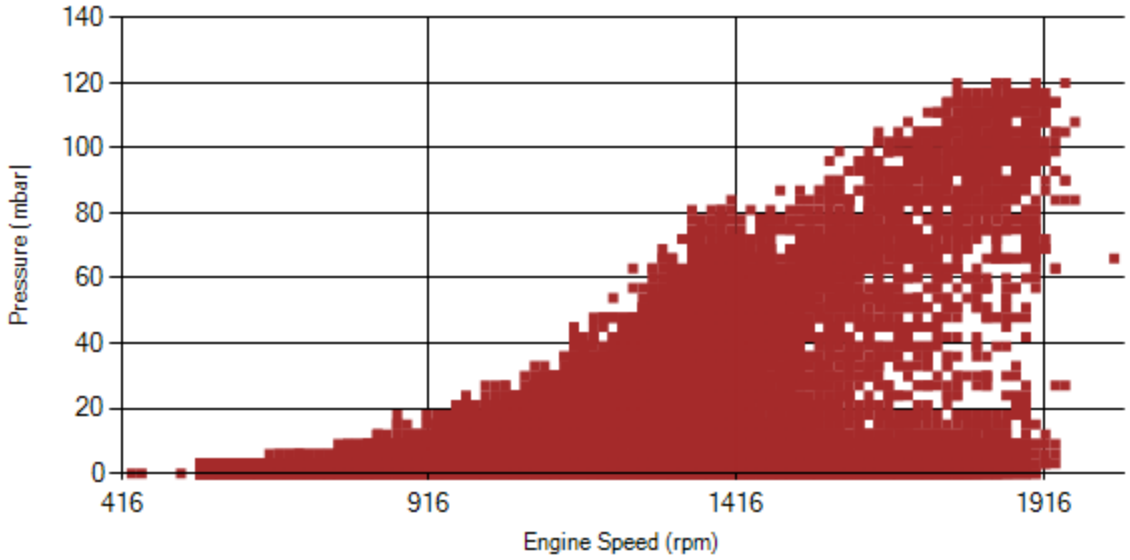


Figure 11- Pressure against engine speed

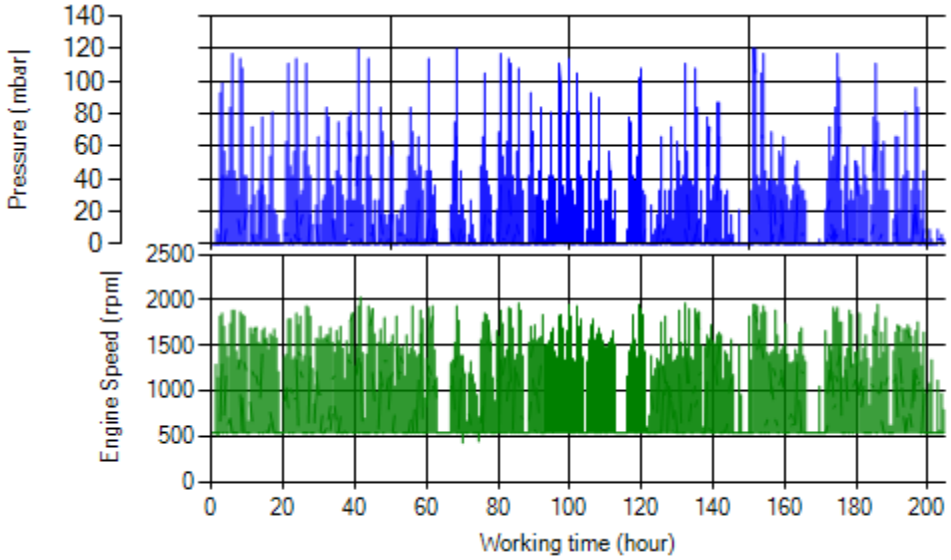


Figure 12- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

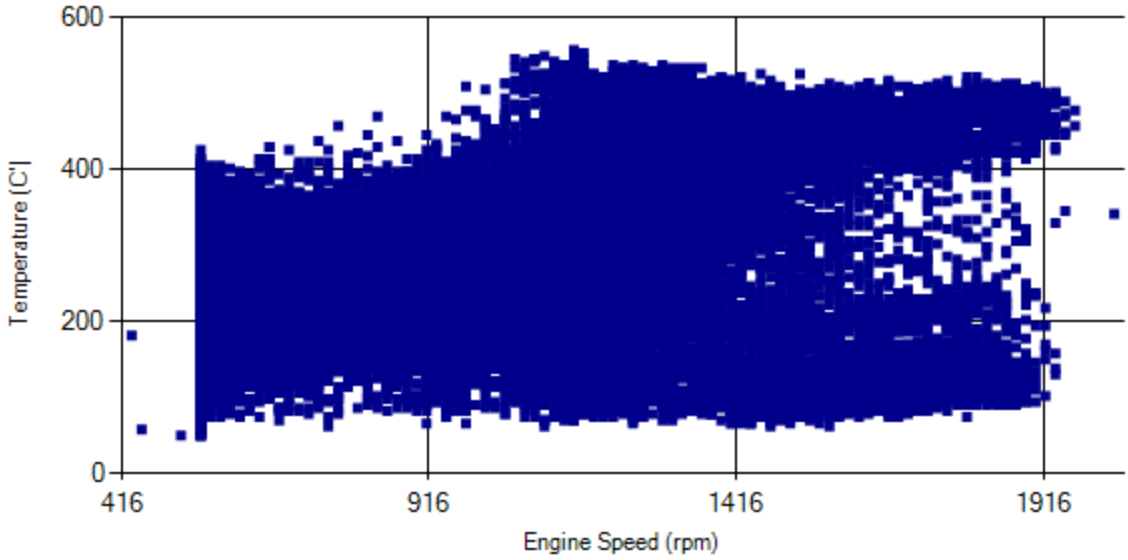


Figure 13- Temperature against engine speed

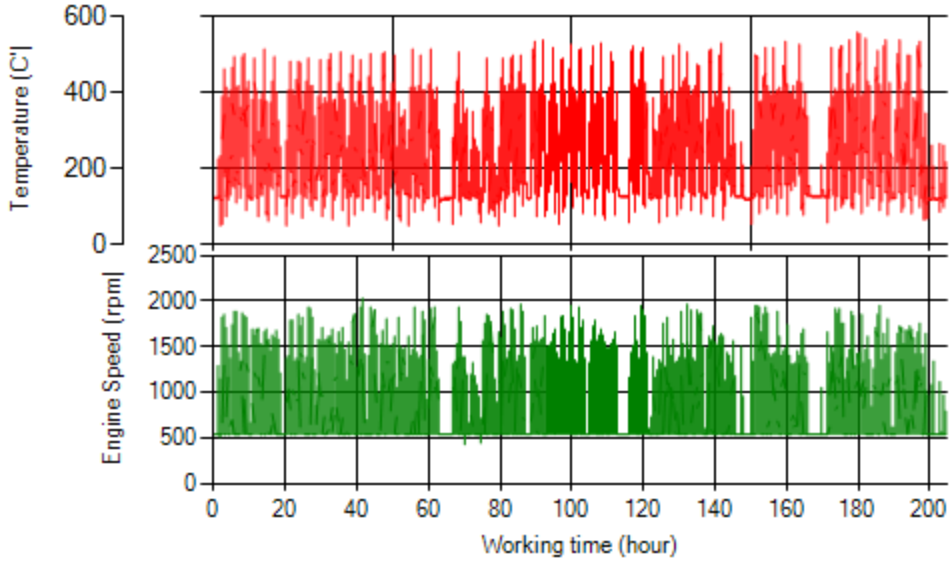
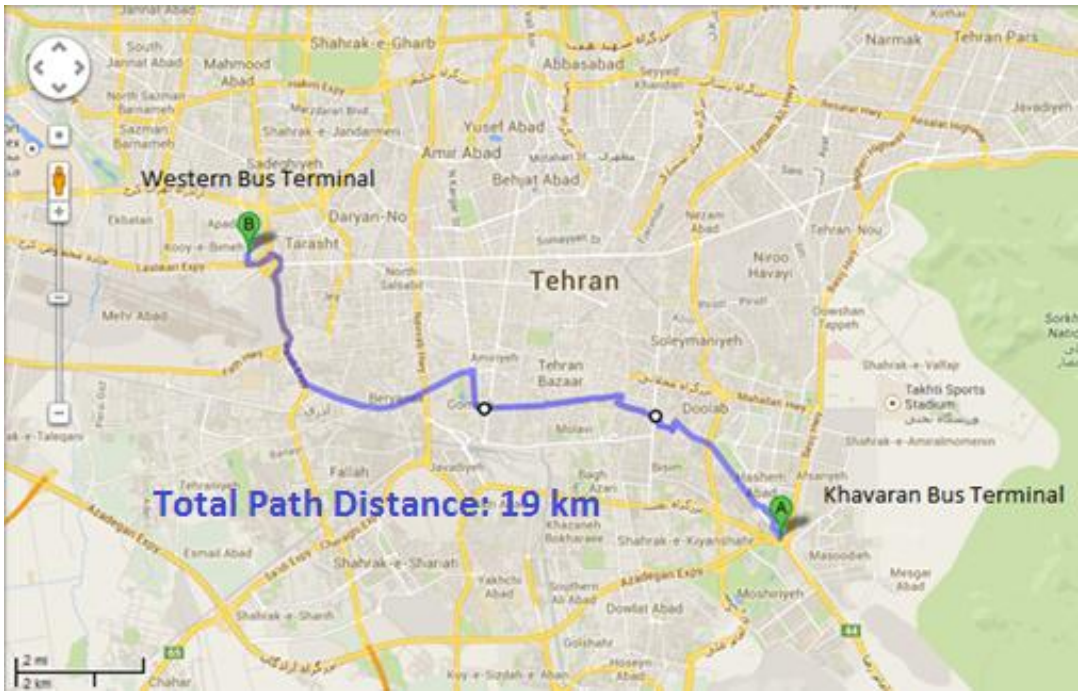


Figure 14- T, N distribution vs. working hours

Filter Operation Analysis

Notice: System was working without DPF during this period.

Vehicle plate number	33572 (28958)
Bus line	Number 2 (west to east bus line)
DPF producer company	HJS_03 (active system with FBC – electrical heater)



Overall Information

Table1- Overall Information

Vehicle plate number	33572 (28958)
CPK data logger number	LN: 001521, DN: 1995, Sim Number +989218469643
Bus line	Number 2 (west to east bus line)
Bus Terminals	Khavaran Bus Terminal - Western Bus Terminal
Total path distance	19 km
DPF producer company	HJS_03 (active system with FBC – electrical heater)
Installation date	19/Feb/2015
Report period	01/Feb/2016 – 15/Feb/2016 (fifteen days)
K value - DPF upstream	1.85 [1/m]
K value – DPF downstream	0.02 [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	DPF was cleaned on Oct 5th for the first time. The second cleaning was done on Dec 19th.
Dosing status	Dosing value has been kept constant from installation date until now.

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	49888 km
Bus mileage over the period	2205 km
Working days over the period	13 days
Stop days	2 days
Data logger working days	13 days
Working hours over the period	169 hours 28 minutes
Average working hours per day (including stop days)	11 hours 18 minutes
Bus average speed	13.01 km/hr
idle speed time to all working time ration	47.92 %
Total Bus fuel consumption over the period	1389 lit
Fuel consumption per hour	8.2 lit/hr
Average fuel consumption	0.63 lit/km
Total Bus additive consumption over the period	0.65 lit
Average additive consumption	295 cc/km
Additive consumption to fuel ration	468 cc/1000lit

Temperature, Pressure and Engine Speed Overview

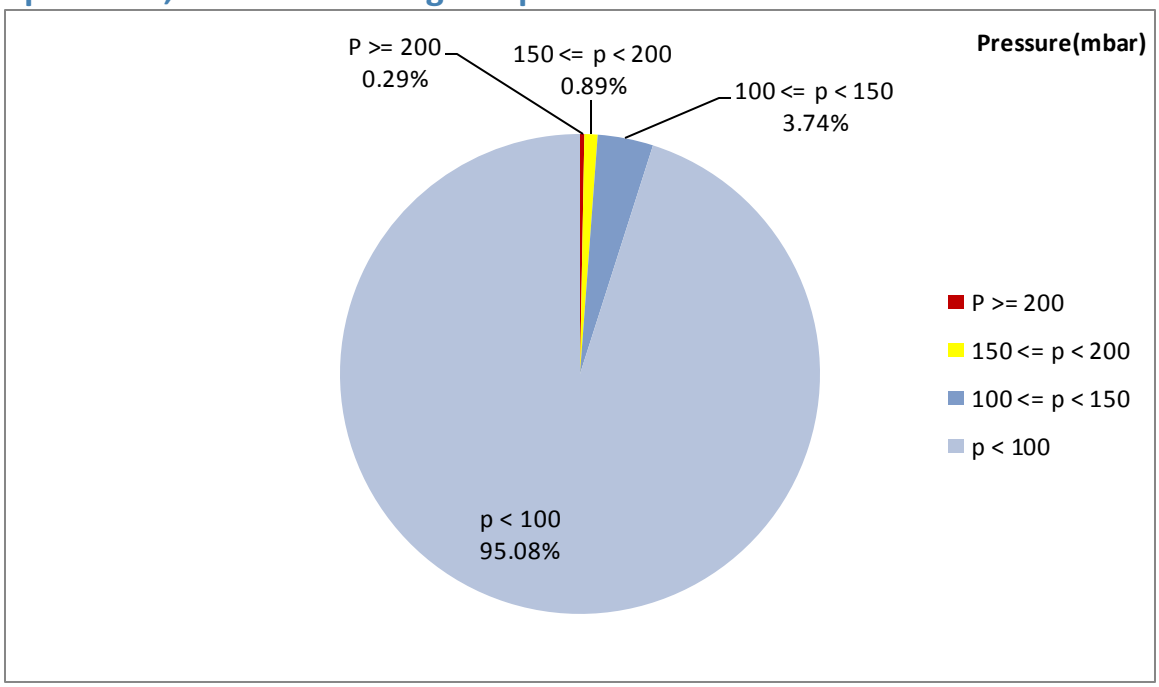


Figure 1- Pressure distribution over the working hours

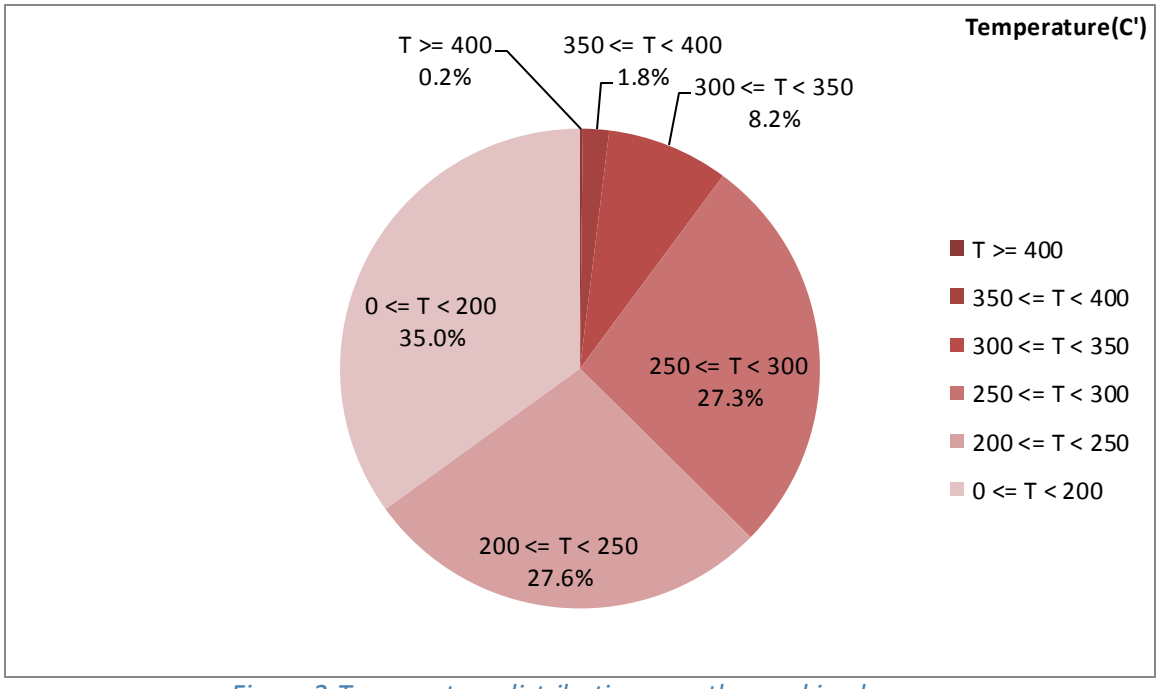


Figure 2-Temperature distribution over the working hours

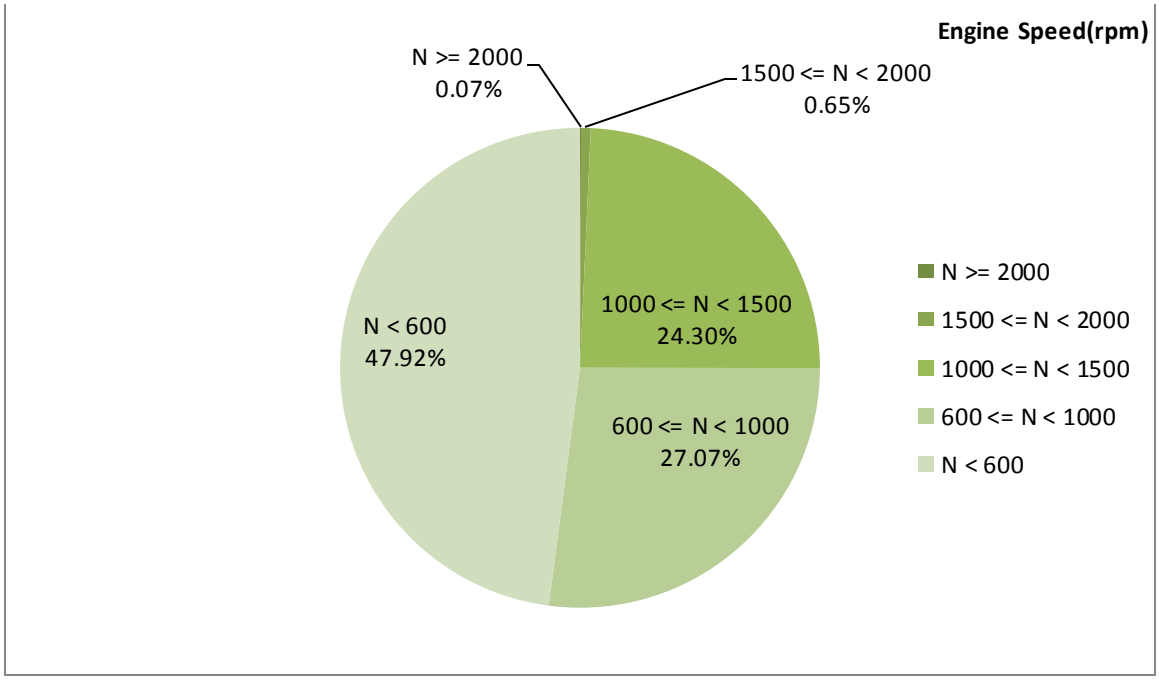


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
223.29	31.62	767

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
264.33	53.77	969

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
450-50	342-0	2128-464

Detailed Pressure Analysis

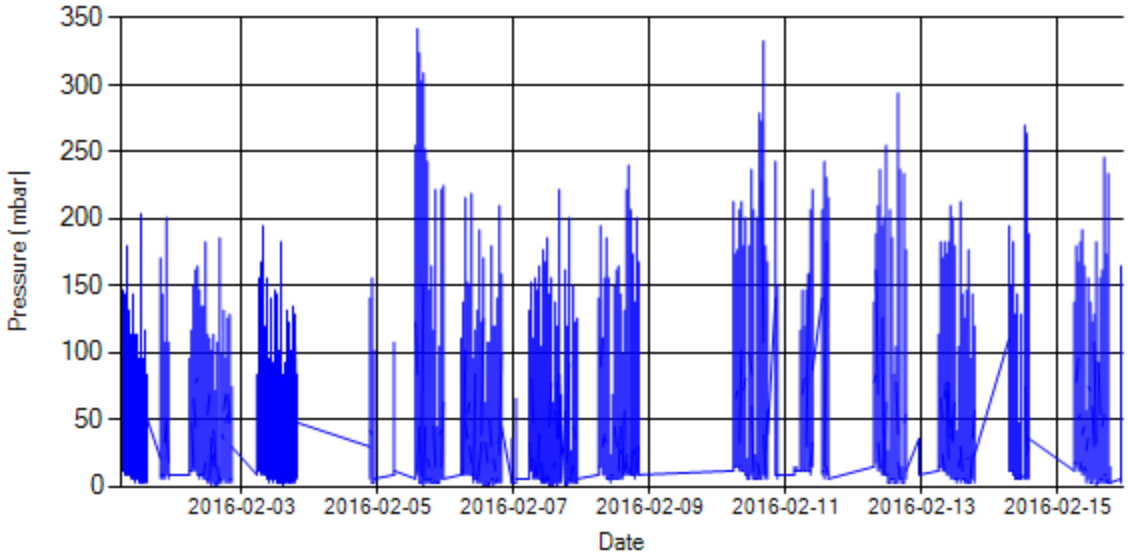


Figure 4- Pressure distribution over the period

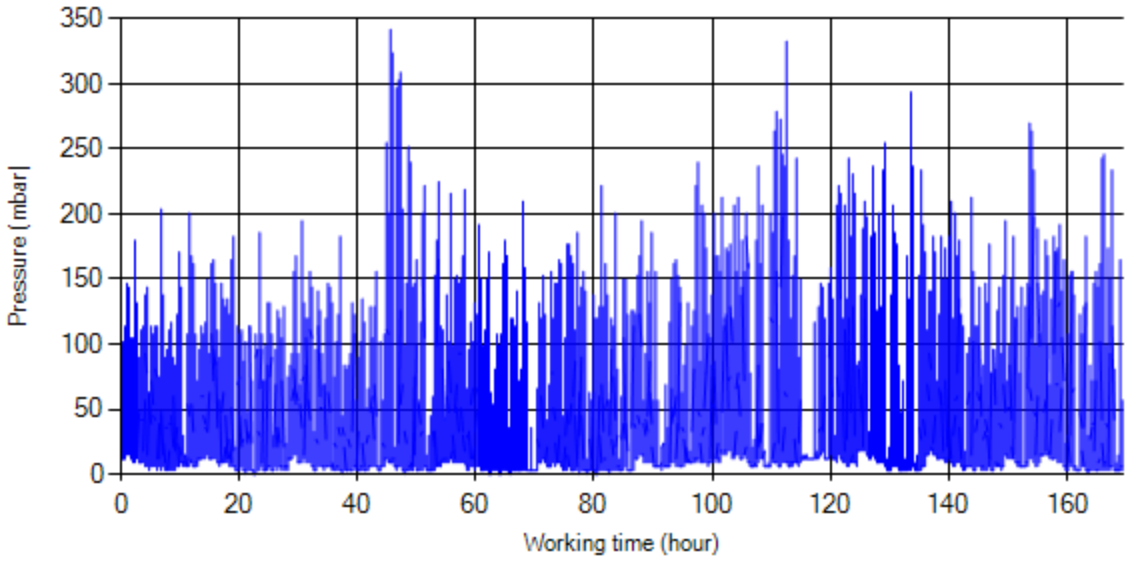


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

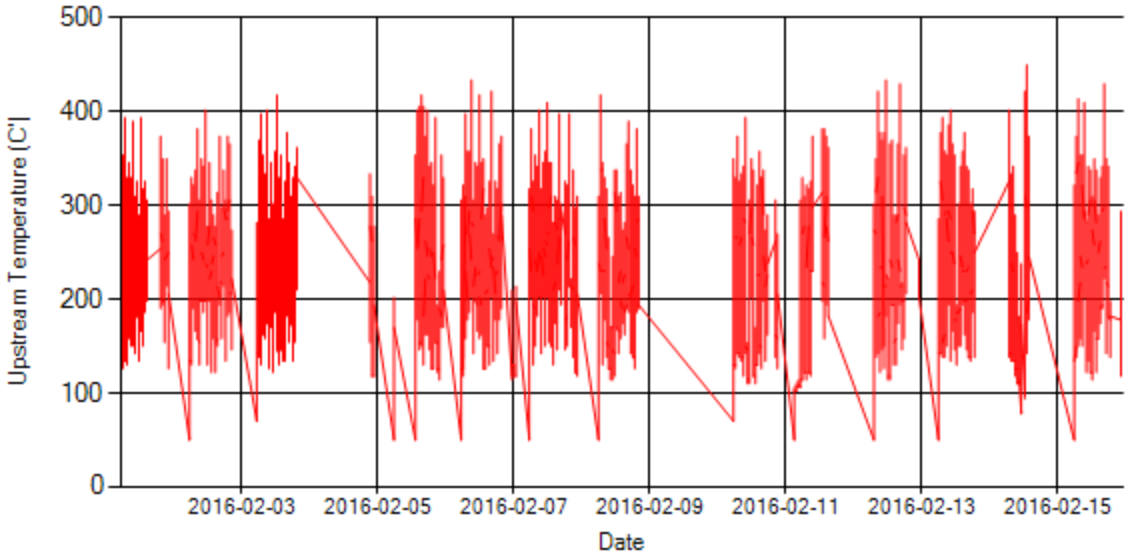


Figure 6- Temperature distribution over the period

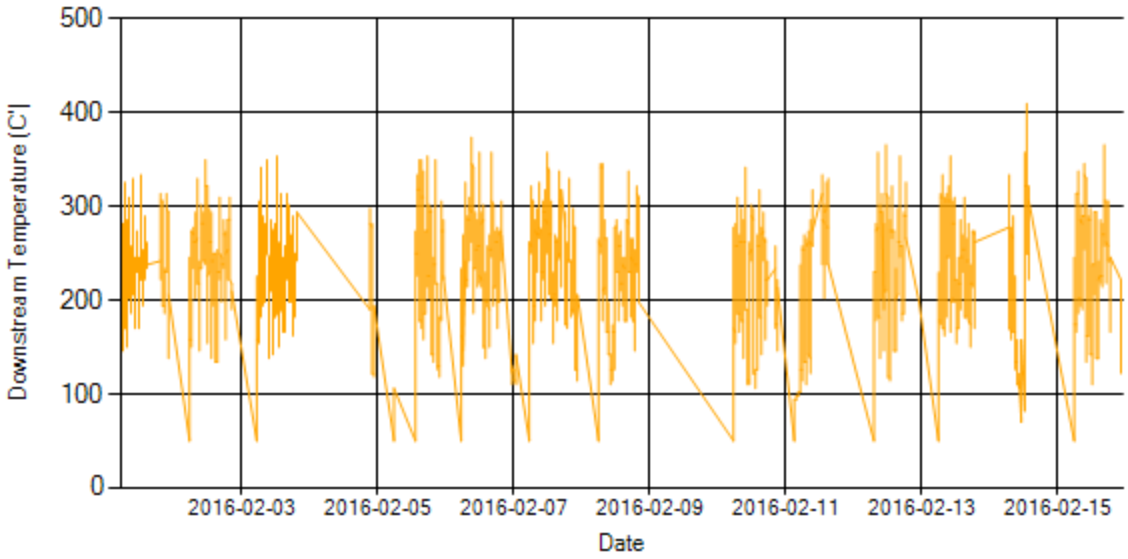


Figure 7- Temperature distribution over the period

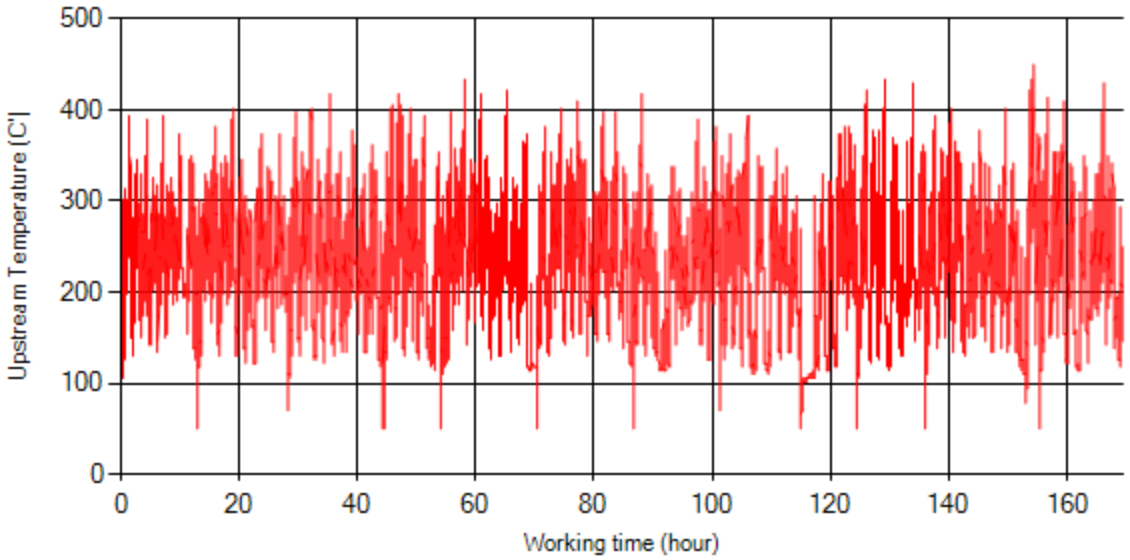


Figure 8- Temperature vs. working hours

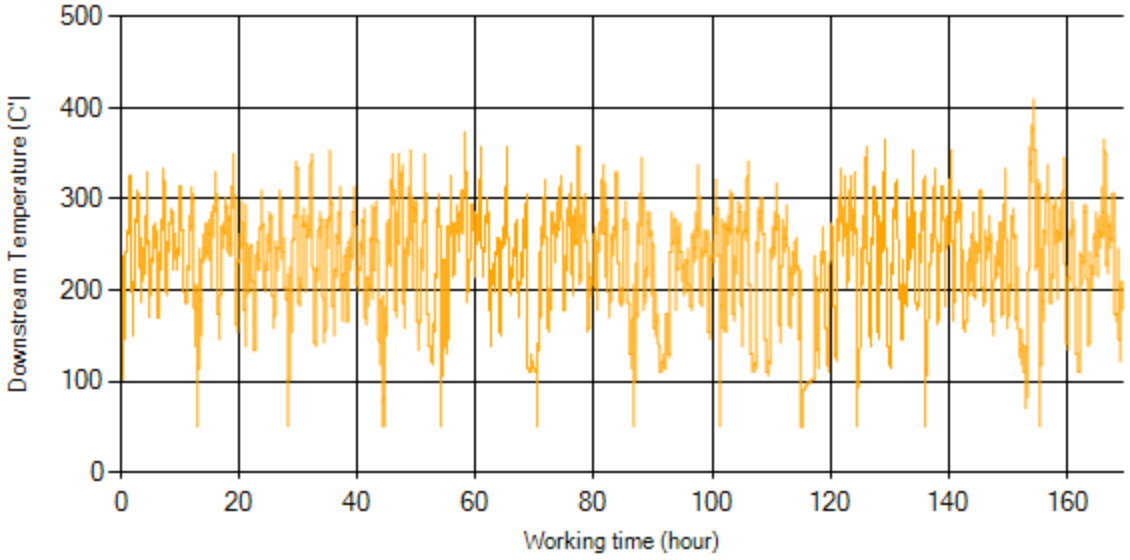


Figure 9- Temperature vs. working hours

Engine Speed Diagrams

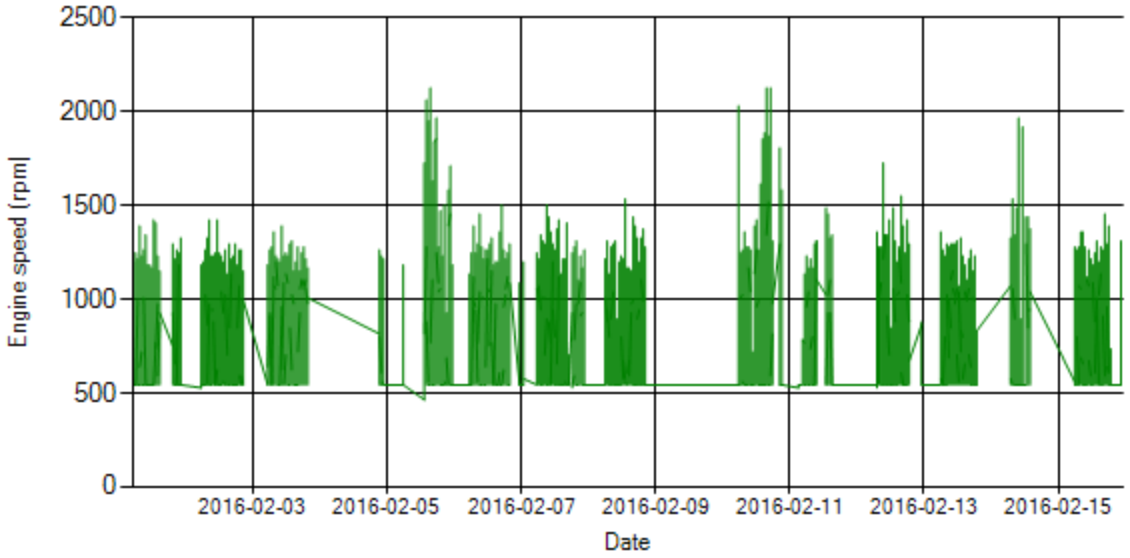


Figure 10- Engine speed distribution over the period

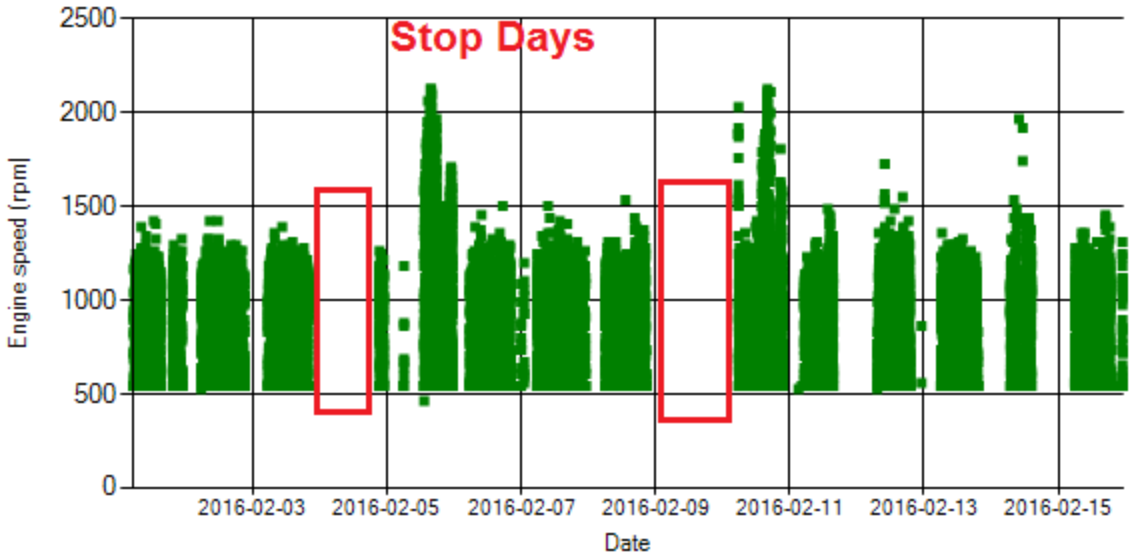


Figure 11- Engine speed diagram for calculating CPK's working days

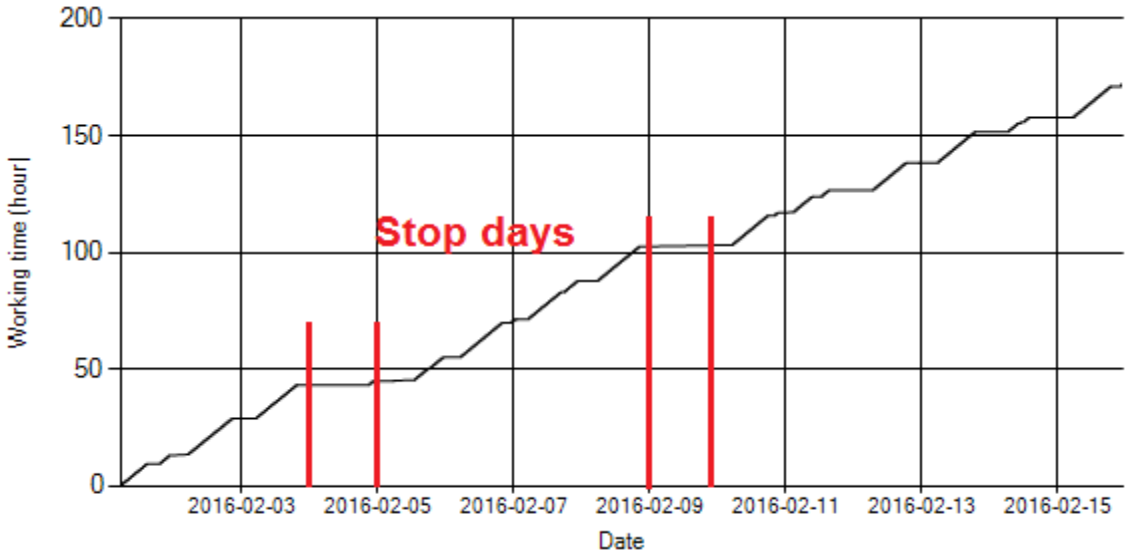


Figure 12- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data. As depicted in Figure 12, bus was stationary on 4th and 9th of Feb.

Pressure-Engine Speed diagrams

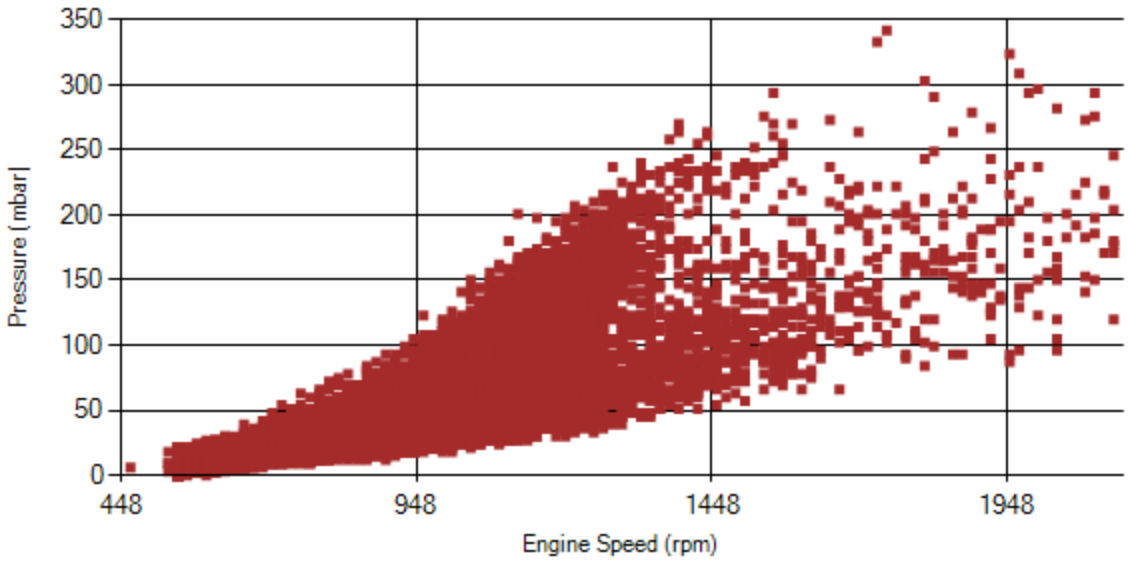


Figure 13- Pressure against engine speed

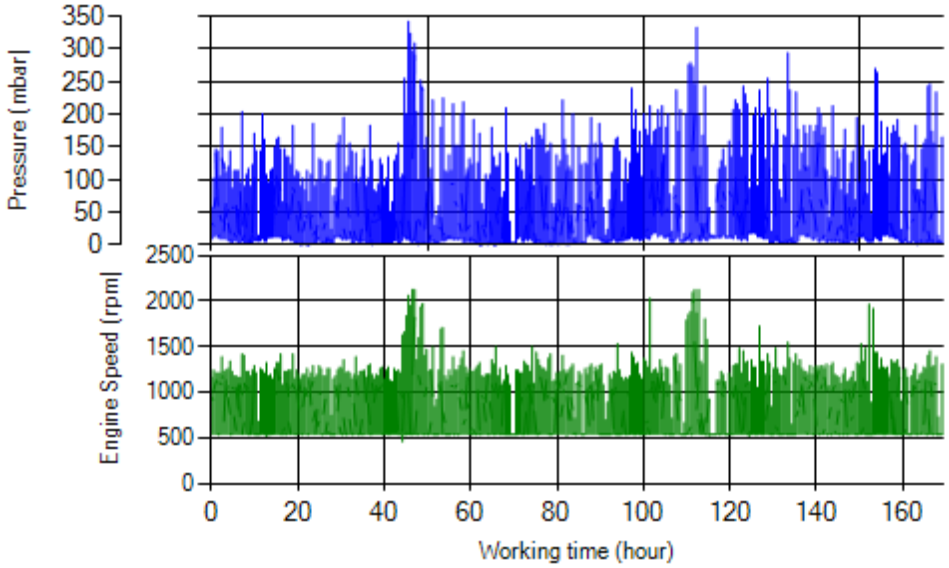


Figure 14- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

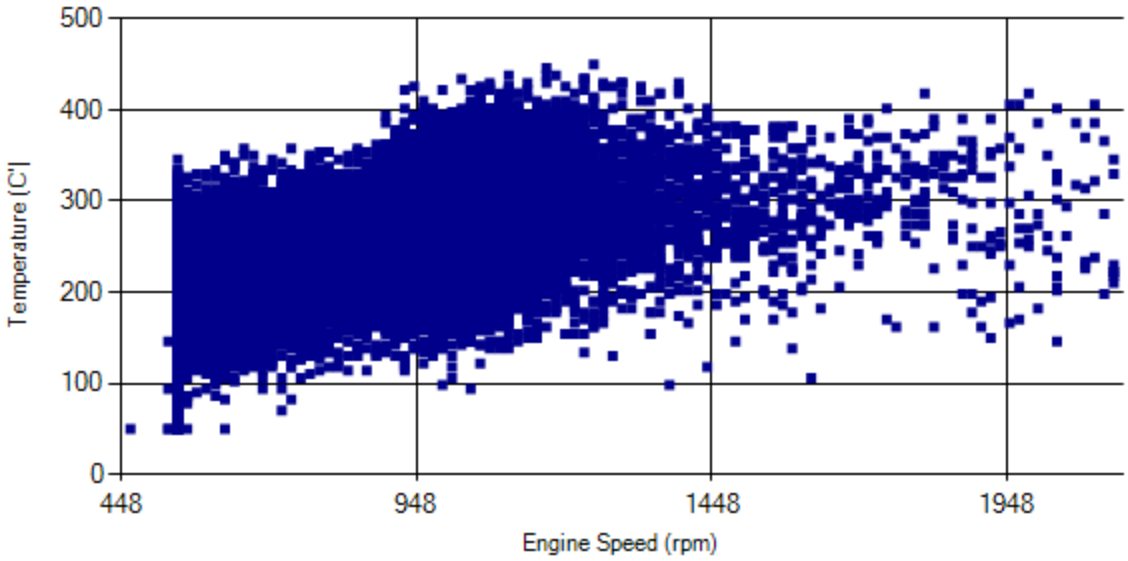


Figure 15- Temperature against engine speed

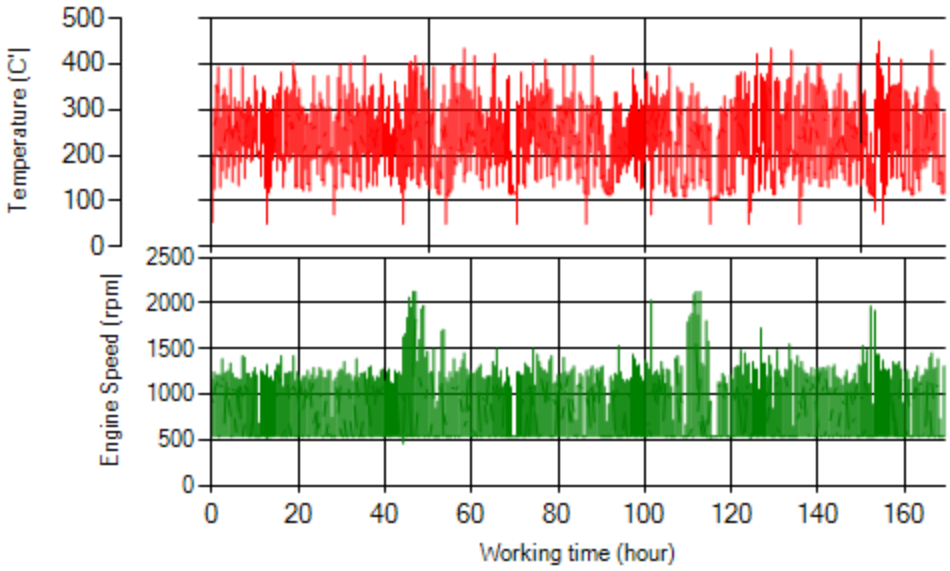


Figure 16- T, N distribution vs. working hours

Filter Operation Analysis

- As depicted in figure 1, 0.29% of total working time pressure is above 200 mbar and 1.18% above 150 mbar during this period.

- Figure 2 displays flow temperature distribution for DPF's upstream. It can be obviously observed only 2% of total working time temperature is above 350°C, so it could be concluded that active regeneration plays important role on working this DPF.

- Pressures above 300 mbar, which were seen on 5th and 11th of Feb, were because of engine full load working. RPM distribution confirmed this claim (pictures 13 and 14).

Filter operation status	Excellent ☐	Good ■
	Maintenance required ☐	Failed ☐

Overall Information

Table1- Overall Information

Vehicle plate number	33572 (28958)
CPK data logger number	LN: 001521, DN: 1995, Sim Number +989218469643
Bus line	Number 2 (west to east bus line)
Bus Terminals	Khavaran Bus Terminal - Western Bus Terminal
Total path distance	19 km
DPF producer company	HJS_03 (active system with FBC – electrical heater)
Installation date	19/Feb/2015
Report period	16/Feb/2016 – 29/Feb/2016 (fourteen days)
K value - DPF upstream	1.85 [1/m]
K value – DPF downstream	0.02 [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	DPF was cleaned on Oct 5th for the first time. The second cleaning was done on Dec 19th.
Dosing status	Dosing value has been kept constant from installation date until now.

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	52160 km
Bus mileage over the period	2272 km
Working days over the period	13 days
Stop days	1 day
Data logger working days	13 days
Working hours over the period	181 hours 43 minutes
Average working hours per day (including stop days)	12 hours 58 minutes
Bus average speed	12.5 km/hr
idle speed time to all working time ration	49.59 %
Total Bus fuel consumption over the period	1454 lit
Fuel consumption per hour	8.00 lit/hr
Average fuel consumption	0.64 lit/km
Total Bus additive consumption over the period	0.700 lit
Average additive consumption	308 cc/km
Additive consumption to fuel ration	481 cc/1000lit

Temperature, Pressure and Engine Speed Overview

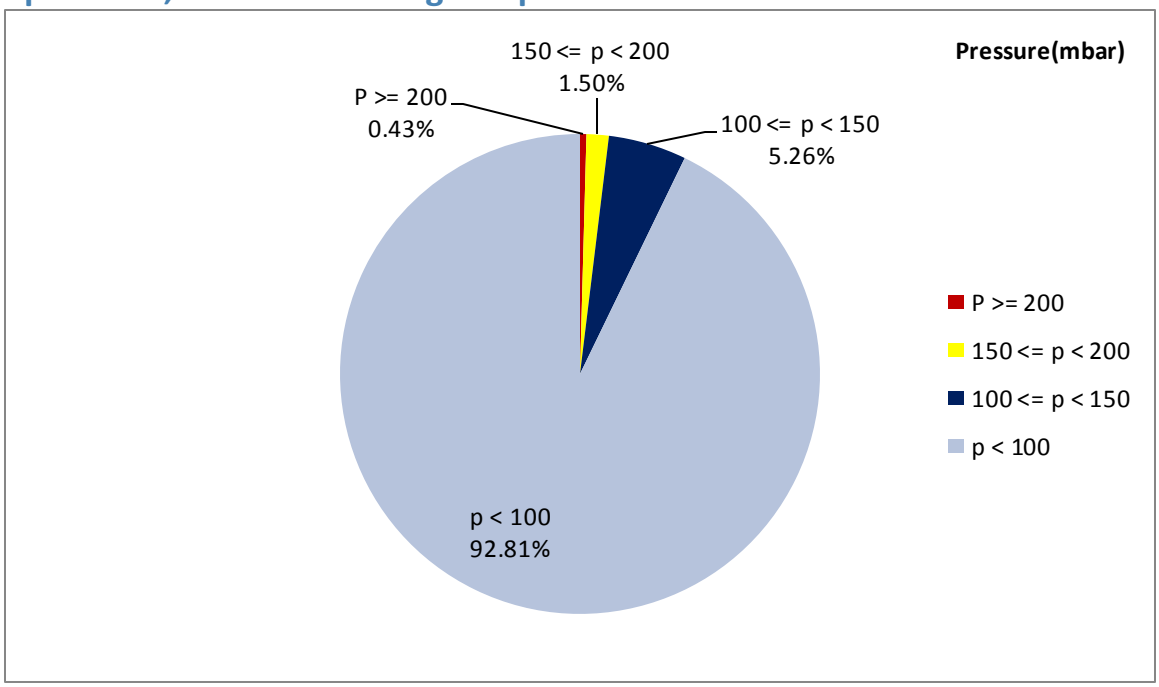


Figure 1- Pressure distribution over the working hours

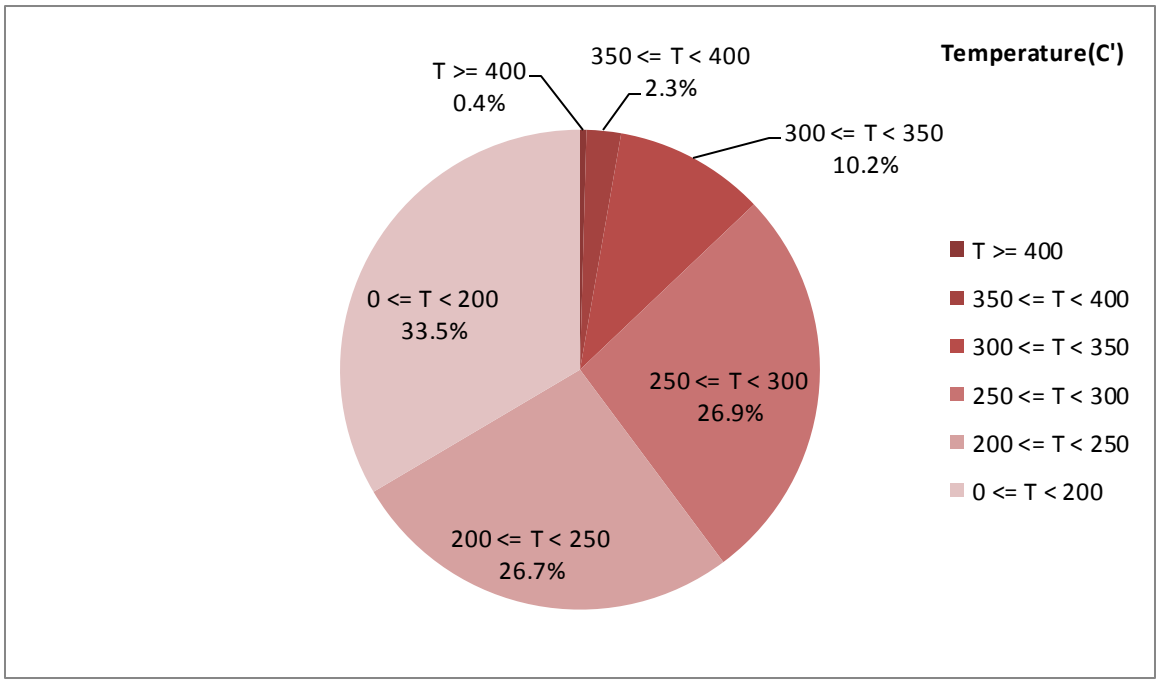


Figure 2-Temperature distribution over the working hours

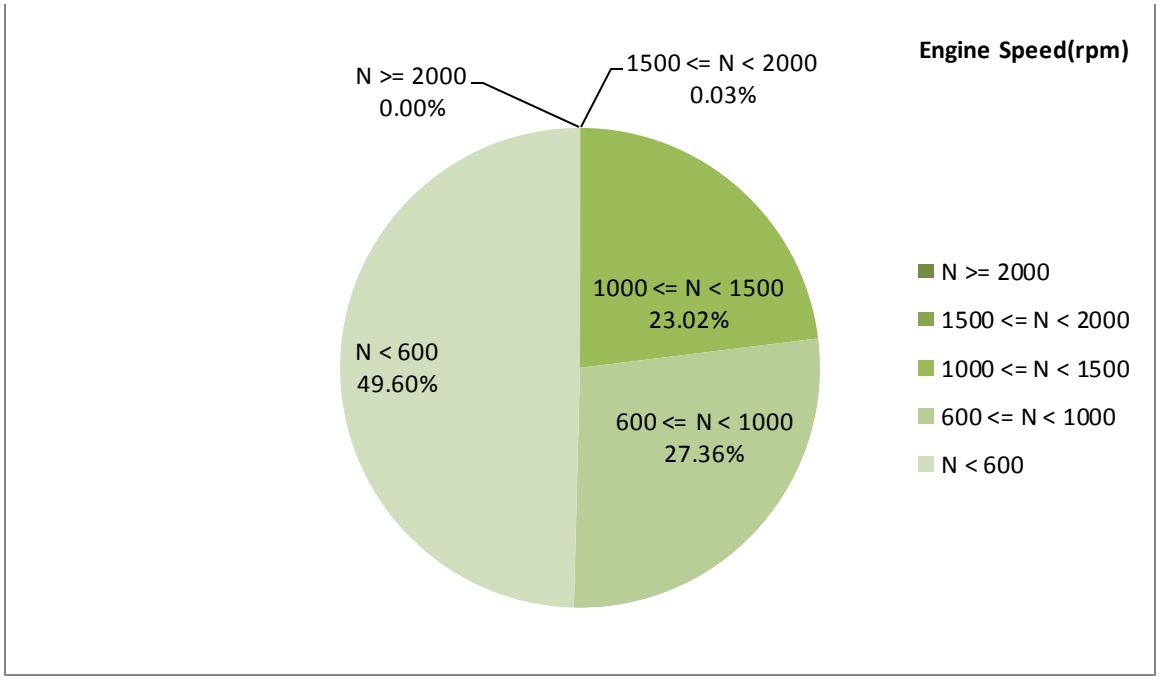


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
227.26	35.27	752

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
271	62.39	953

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
470-50	330-0	1696-416

Detailed Pressure Analysis

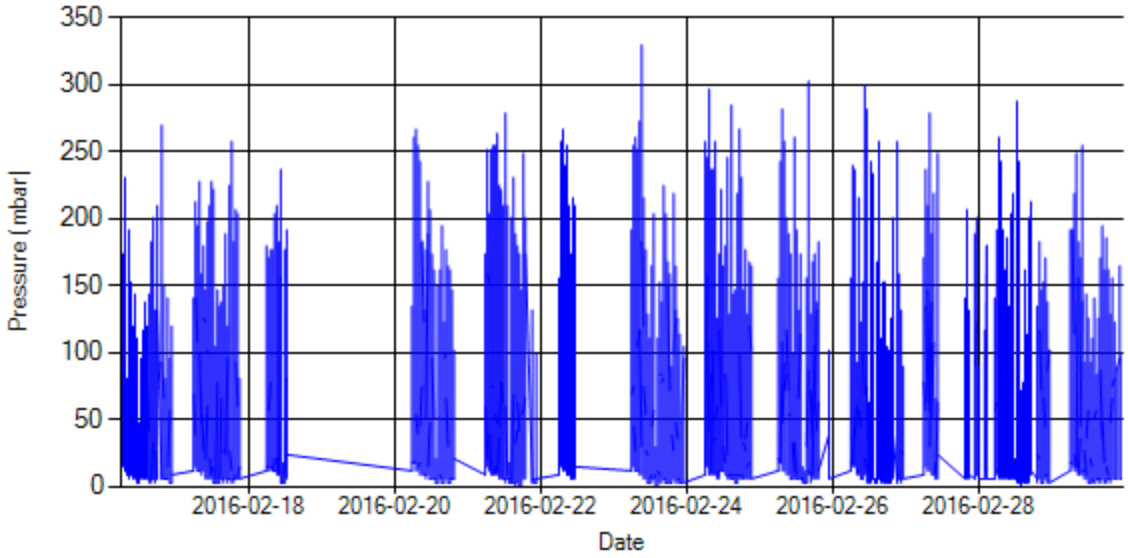


Figure 4- Pressure distribution over the period

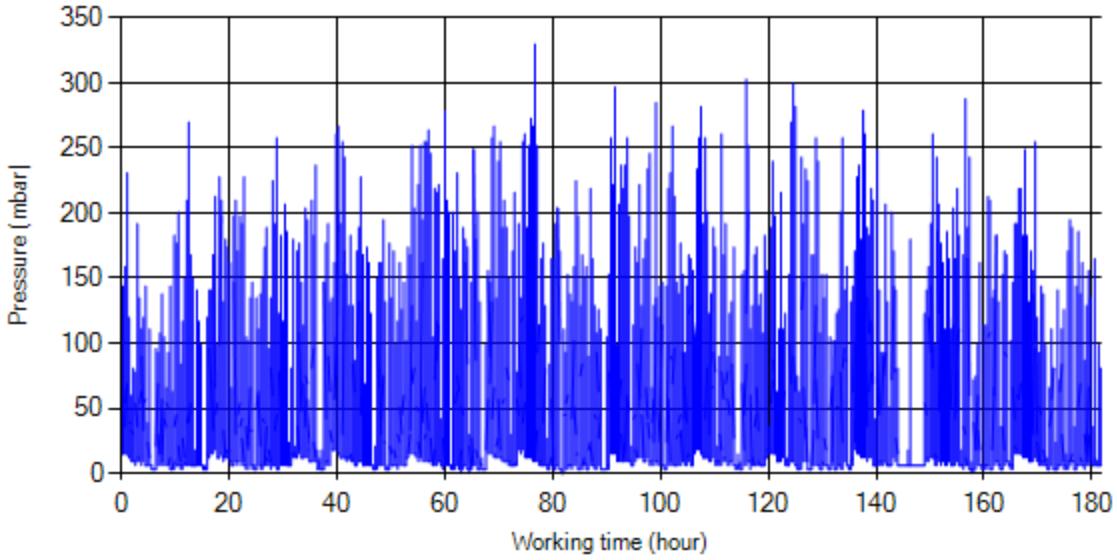


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

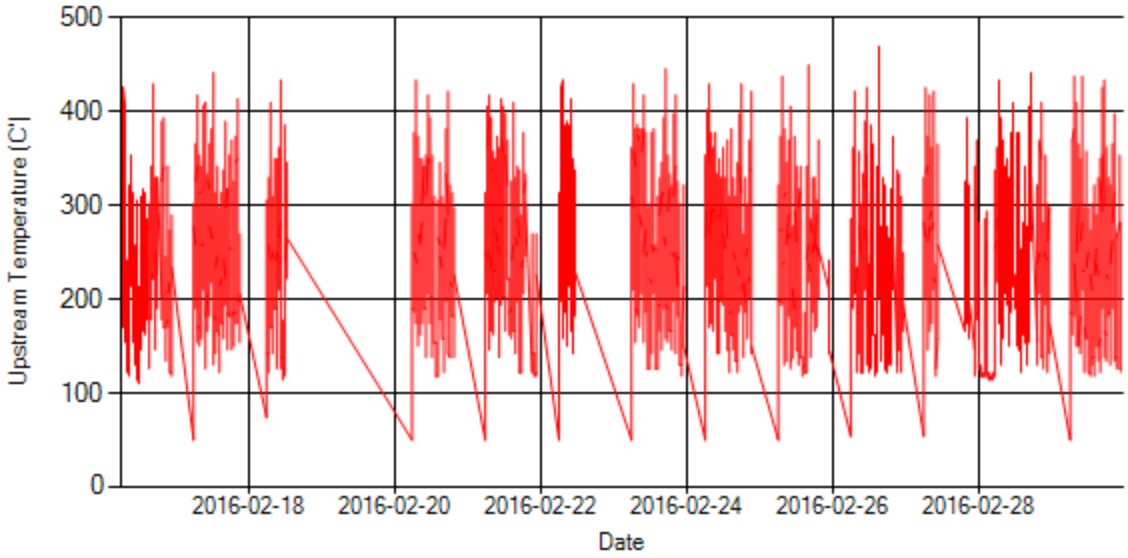


Figure 6- Temperature distribution over the period

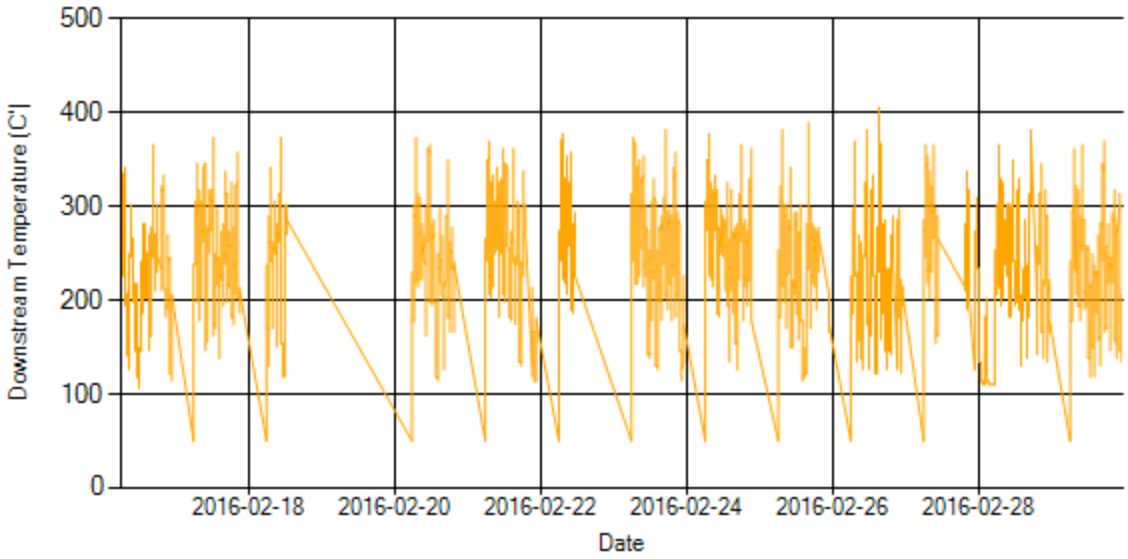


Figure 7- Temperature distribution over the period

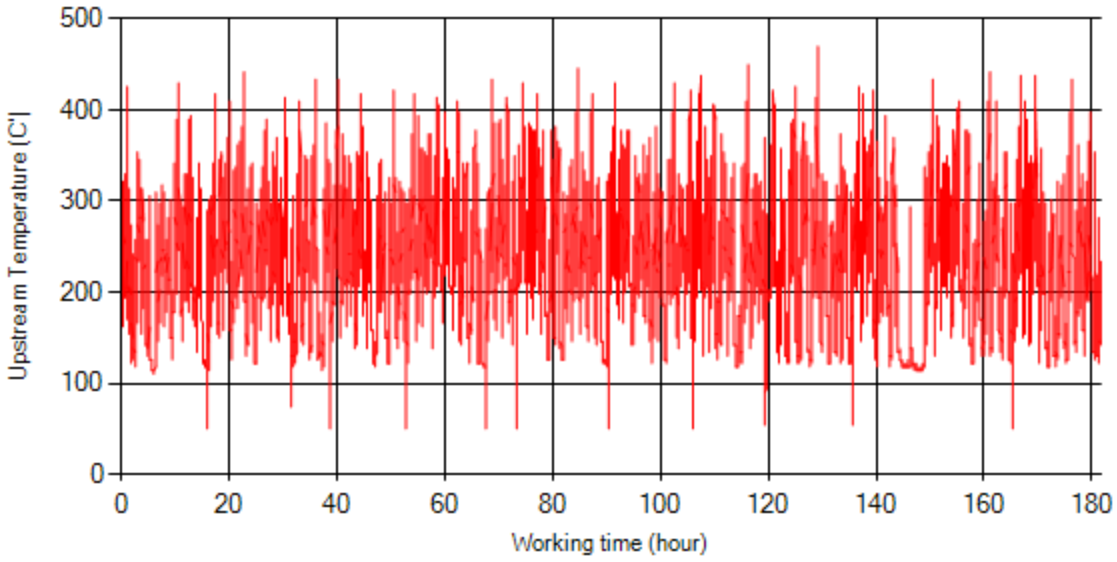


Figure 8- Temperature vs. working hours

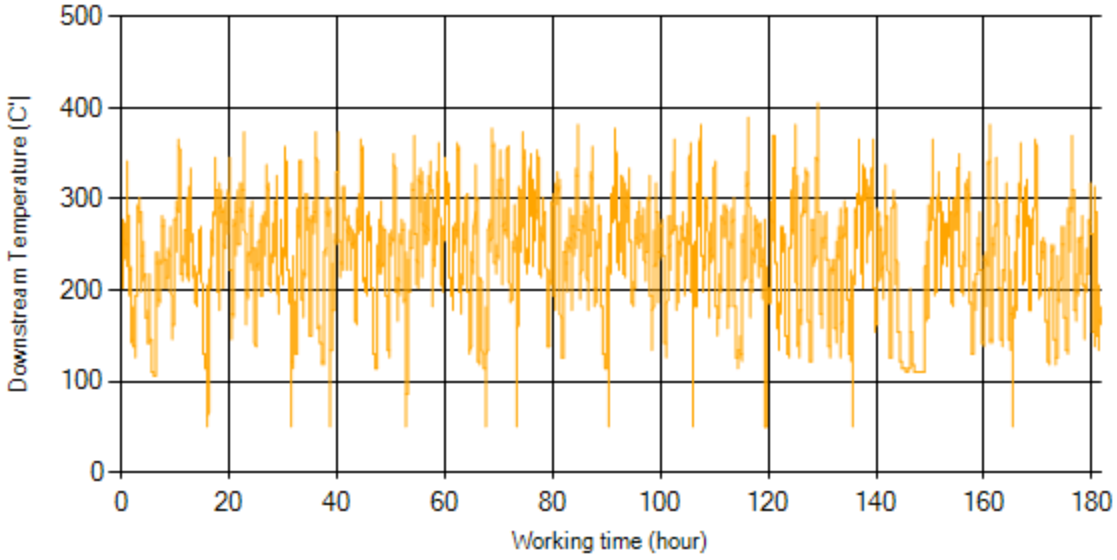


Figure 9- Temperature vs. working hours

Engine Speed Diagrams

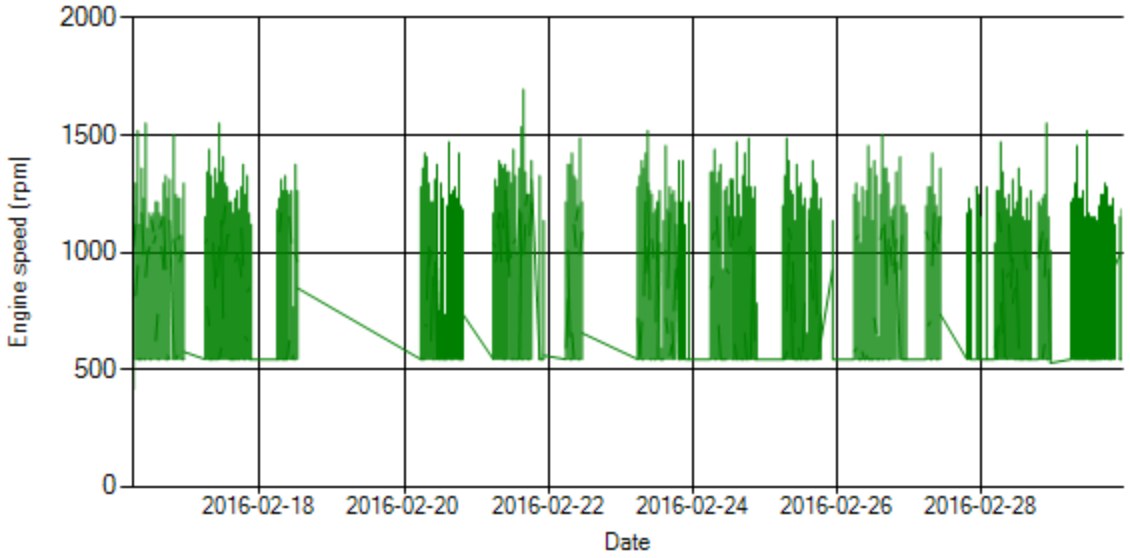


Figure 10- Engine speed distribution over the period

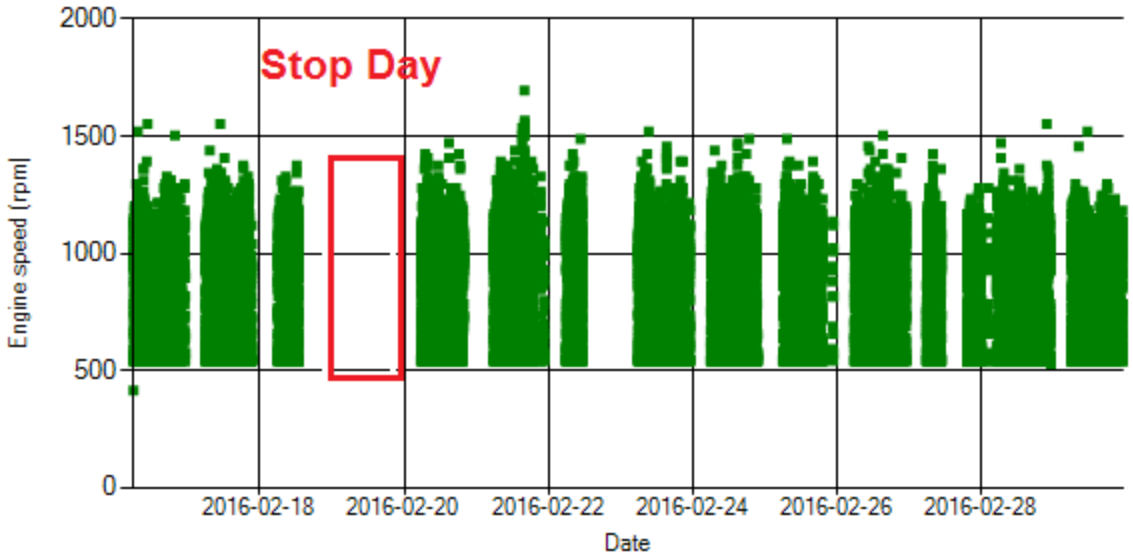


Figure 11- Engine speed diagram for calculating CPK's working days

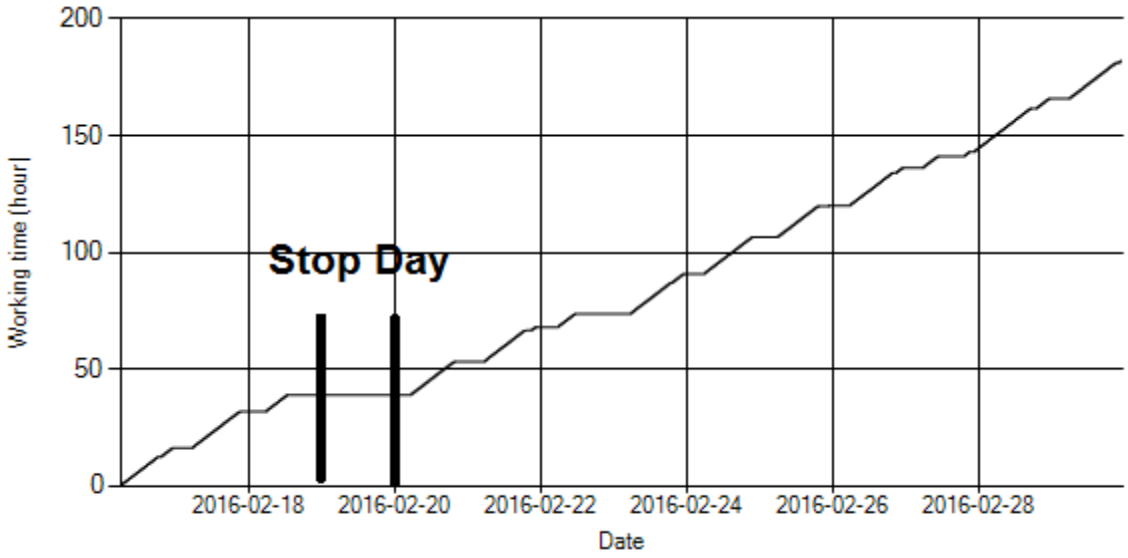


Figure 12- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data. As depicted in Figure 12, bus was stationary on 19th Feb.

Pressure-Engine Speed diagrams

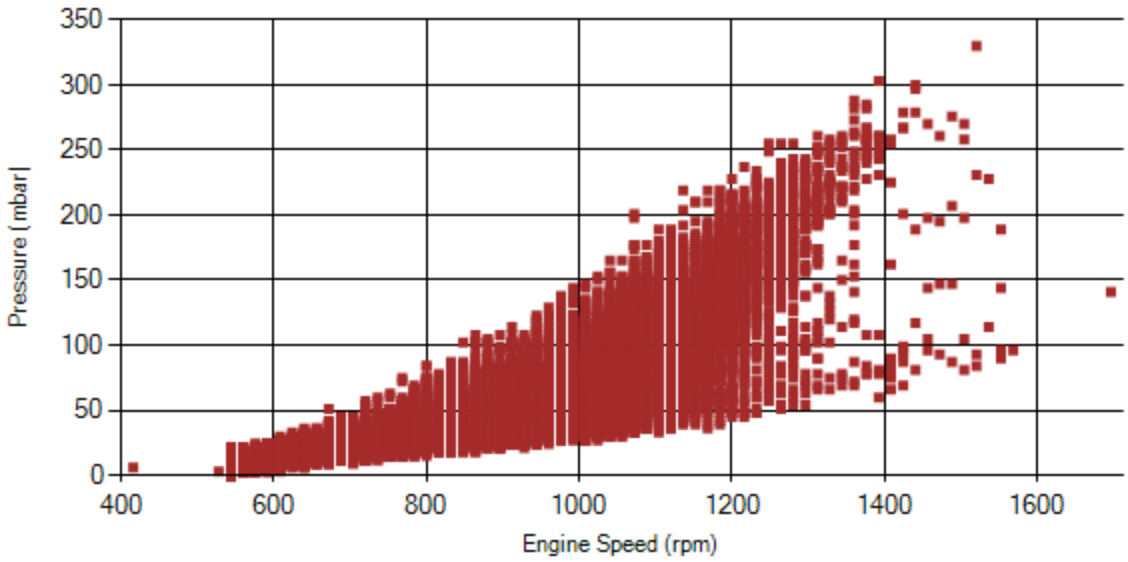


Figure 13- Pressure against engine speed

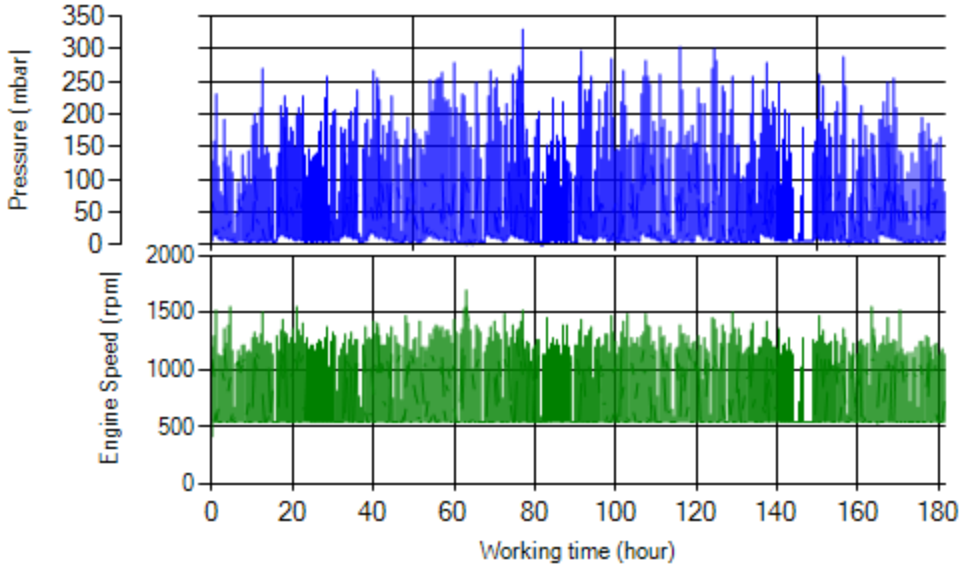


Figure 14- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

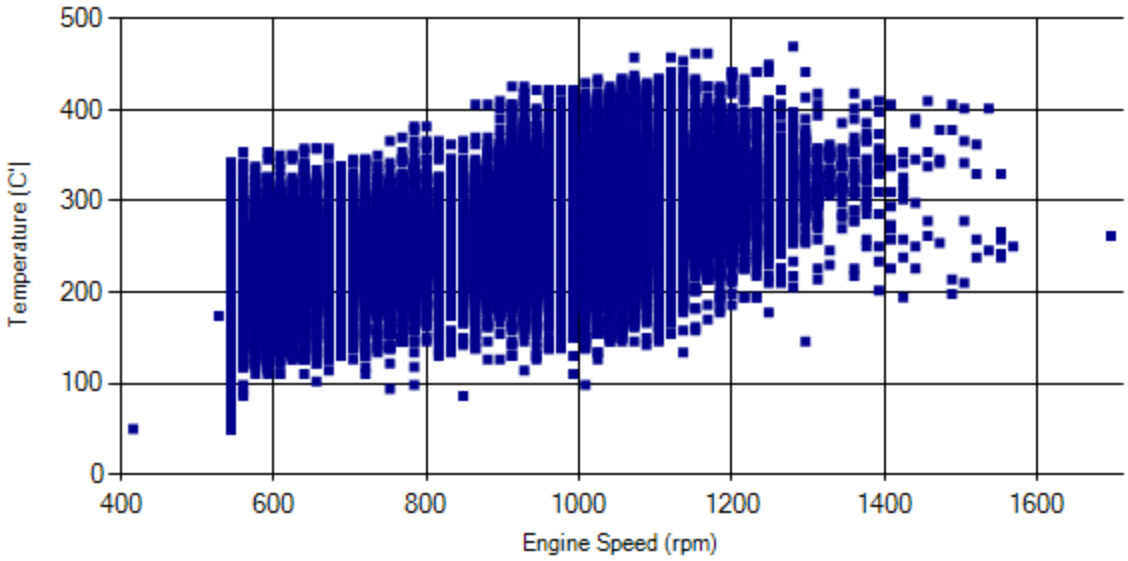


Figure 15- Temperature against engine speed

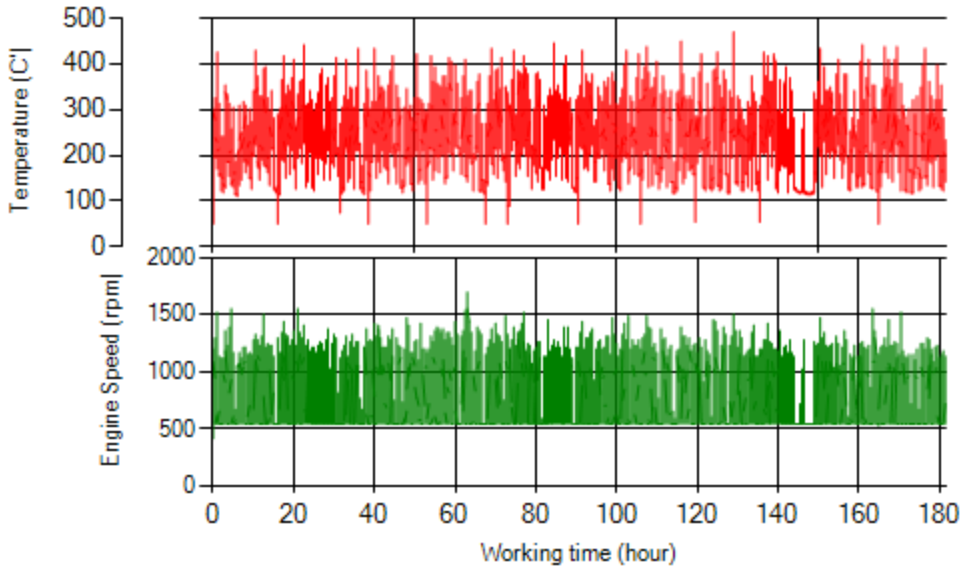


Figure 16- T, N distribution vs. working hours

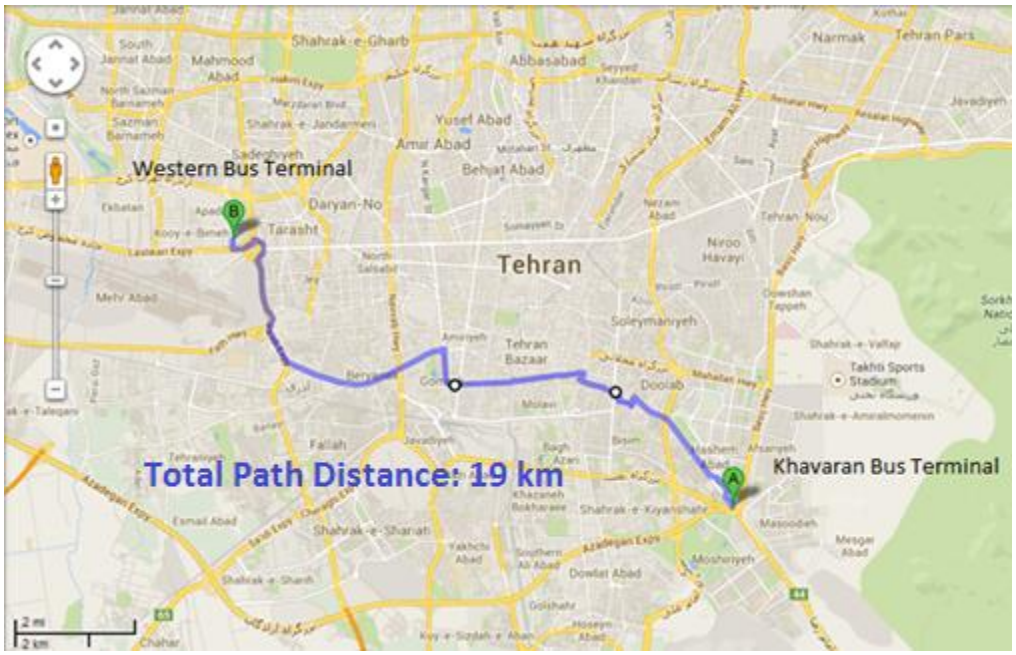
Filter Operation Analysis

- As depicted in figure 1, 0.43% of total working time pressure is above 200 mbar and 1.93% above 150 mbar during this period.

- Figure 2 displays flow temperature distribution for DPF's upstream. It can be obviously observed only 2.7% of total working time temperature is above 350°C, so it could be concluded that active regeneration plays important role on working this DPF.

Filter operation status	Excellent ☐	Good ■
	Maintenance required ☐	Failed ☐

Vehicle plate number	33637 (34119)
Bus line	Number 2 (west to east bus line)
DPF producer company	Dinex_02 (Passive system with FBC)



Notice: System was working over this period without DPF.

Overall Information

Table1- Overall Information

Vehicle plate number	33637 (34119)
CPK data logger number	LN: 001492, DN: 1933, Sim +989210000000
Bus line	Number 2 (west to east bus line)
Bus Terminals	Khavaran Bus Terminal - Western Bus Terminal
Total path distance	19 km
DPF company producer	Dinex_02 (Passive system with FBC)
Installation date	02/Jun/2015
Report period	01/Feb/2016 – 15/Feb/2016 (fifteen days)
K value - DPF upstream	- [1/m]
K value – DPF downstream	- [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	DPF has been removed after two weeks working on Jun 17th. After receiving cleaning machine DPF was cleaned on Aug 10th and was installed on Aug 22nd but worked only for ten days. The last cleaning was done on Sep 24th but cleaning issue was unavoidable after only three days working. Finally DPF was replaced by muffler on Sep 8th and system have been working from that date without DPF.
Dosing status	Additive dosing was increased 60% of its initial value for tests two and three.

Table 3- Fuel and Additive Consumption Information

Bus mileage over the period	2467 km
Working days over the period	14 days
Stop days	1 day
Data logger working days	14 days
Working hours over the period	238 hours 51 minutes
Average working hours per day (including stop days)	15 hours 55 minutes
Bus average speed	0 km/hr
idle speed time to all working time ration	57.8 %
Total Bus fuel consumption over the period	1653 lit
Fuel consumption per hour	6.91 lit/hr
Average fuel consumption	0.67 lit/km

Temperature, Pressure and Engine Speed Overview

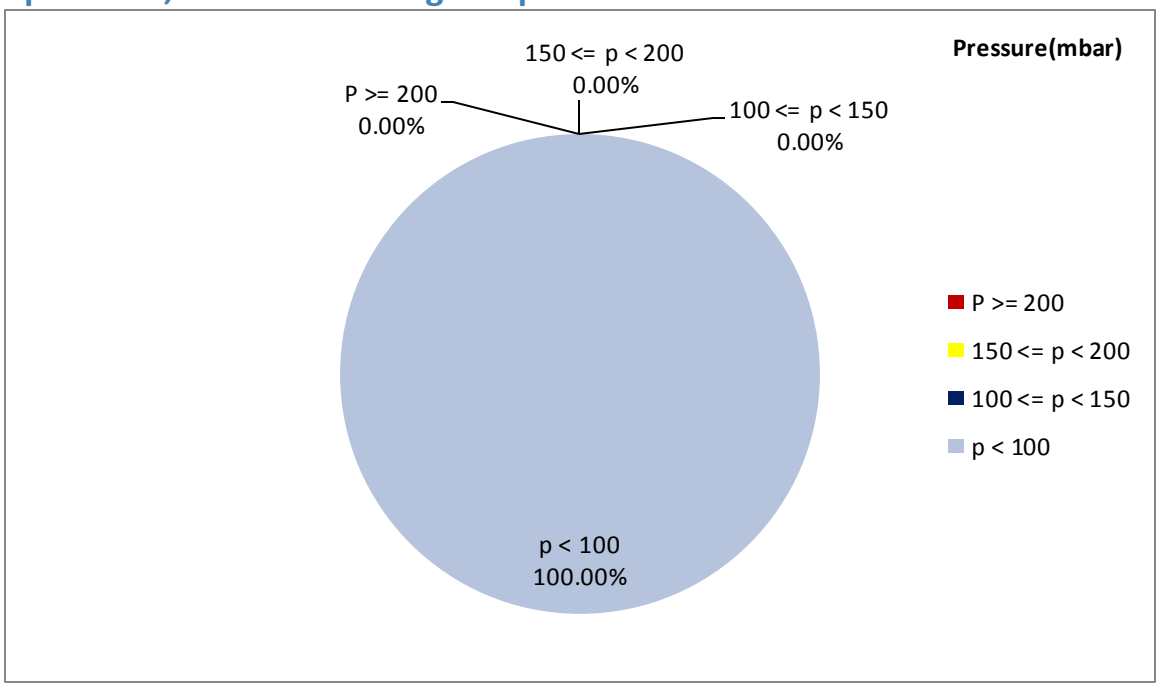


Figure 1- Pressure distribution over the working hours

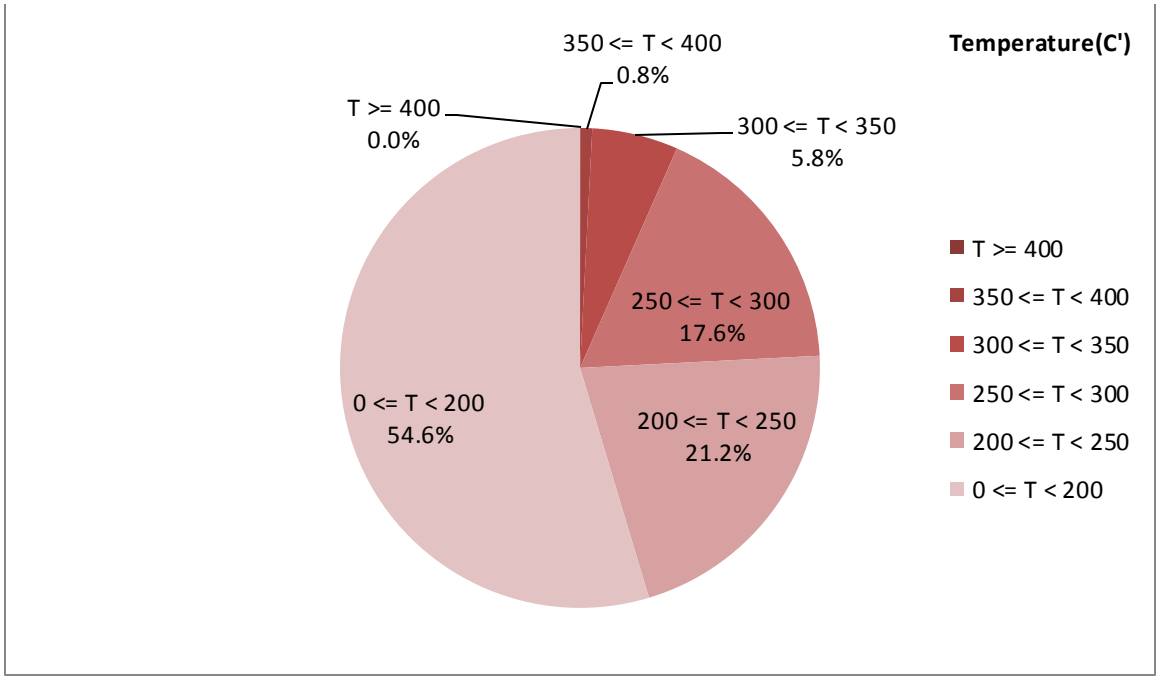


Figure 2-Temperature distribution over the working hours

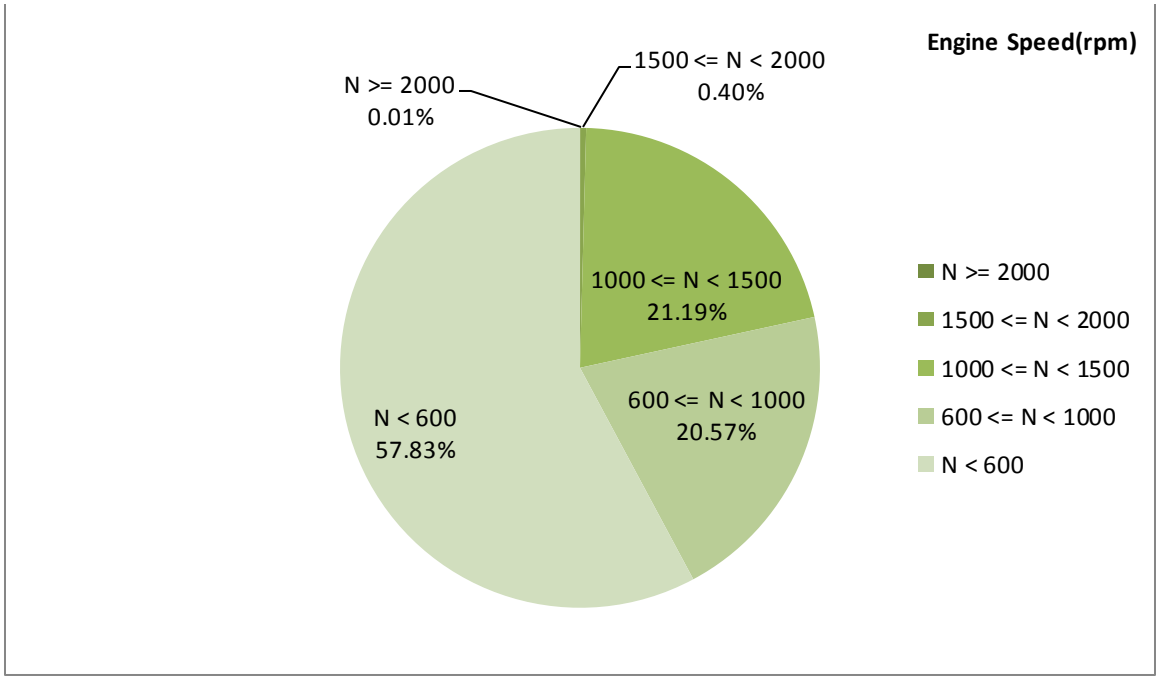


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
192.65	0.94	729

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
253.16	2.22	981

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
414-50	84-0	2080-272

Detailed Pressure Analysis

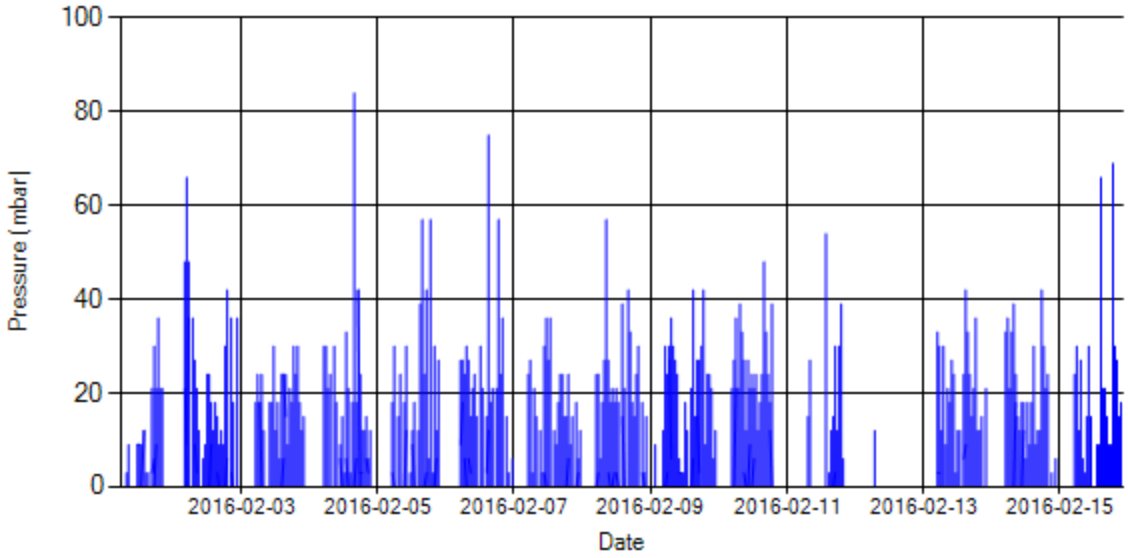


Figure 4- Pressure distribution over the period

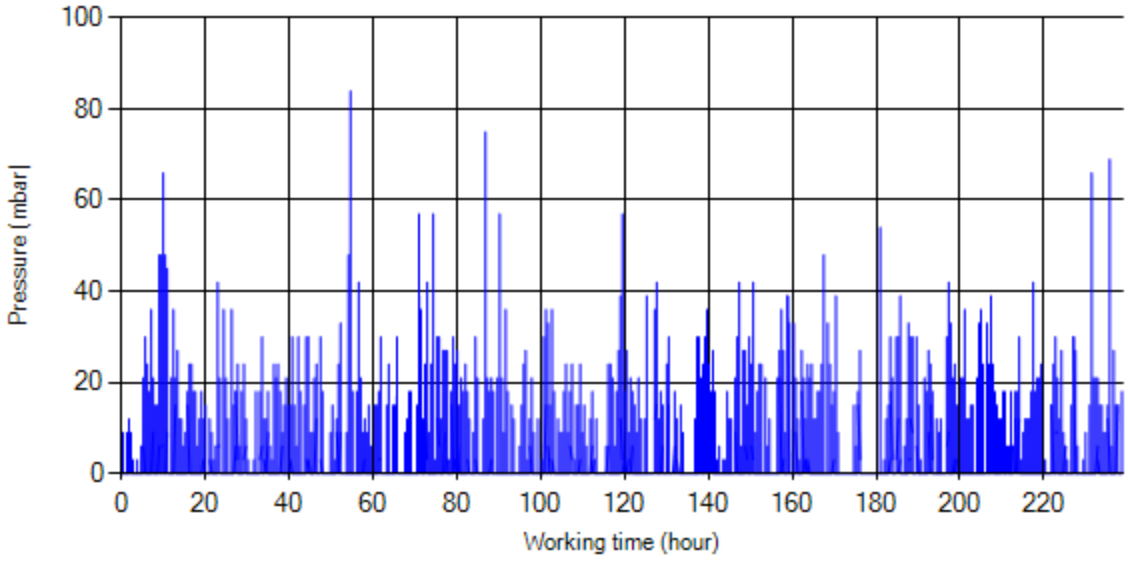


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

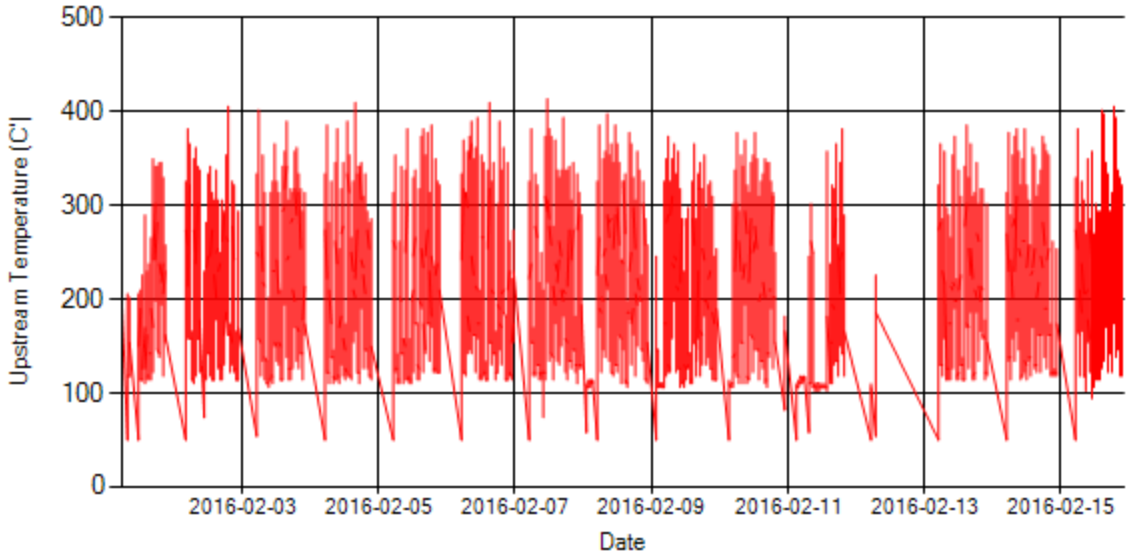


Figure 6- Temperature distribution over the period

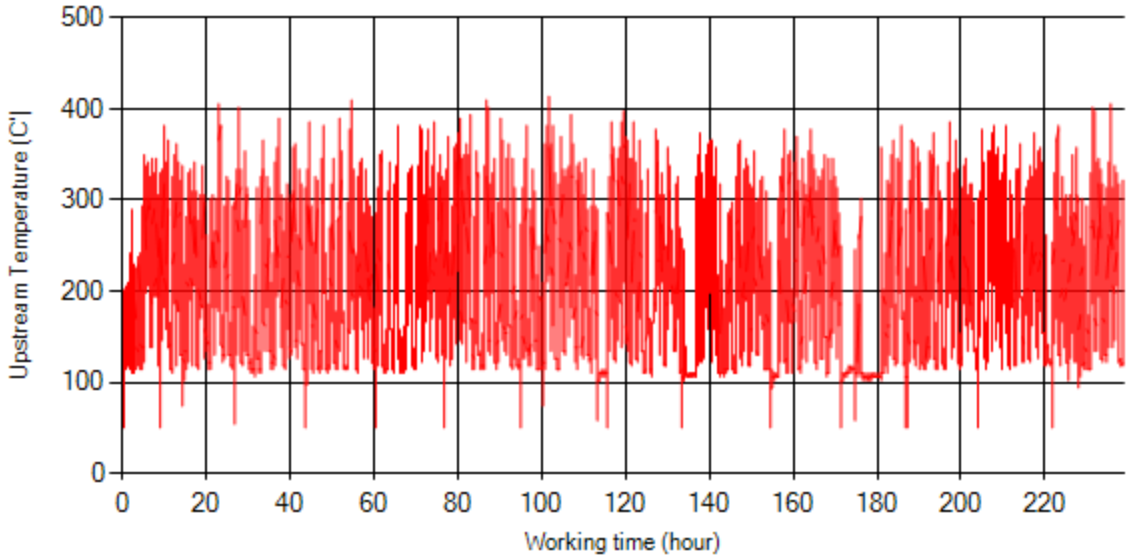


Figure 7- Temperature vs. working hours

Engine Speed Diagrams

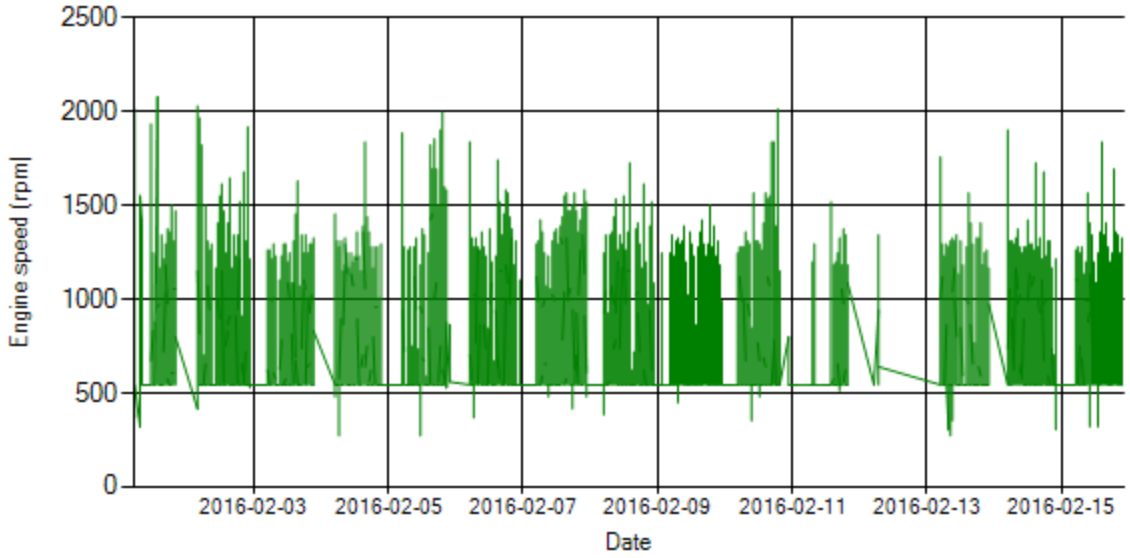


Figure 8- Engine speed distribution over the period

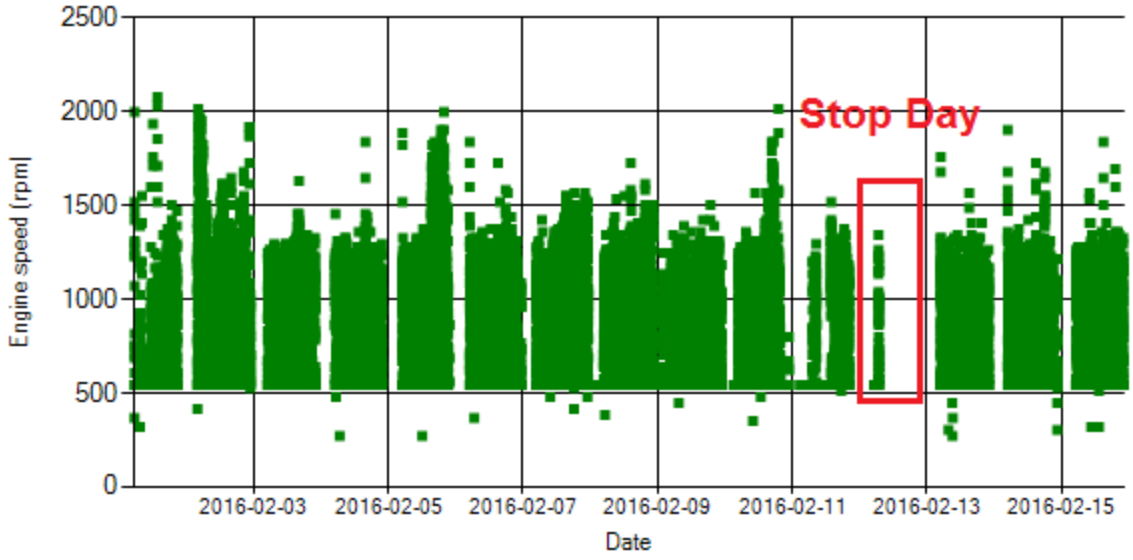


Figure 9- Engine speed diagram for calculating CPK's working days

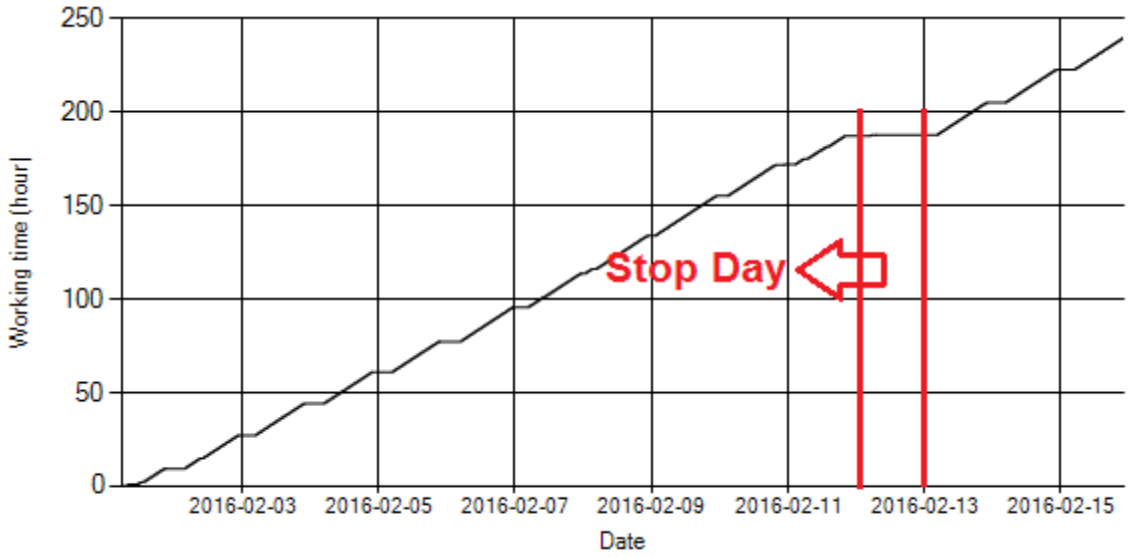


Figure 10- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data.

Pressure-Engine Speed diagrams

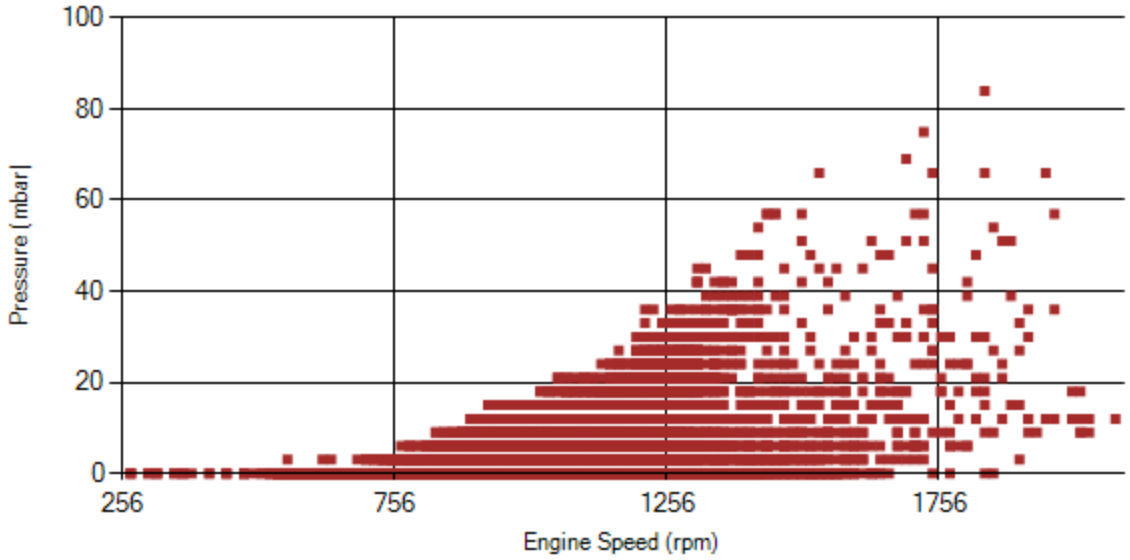


Figure 11- Pressure against engine speed

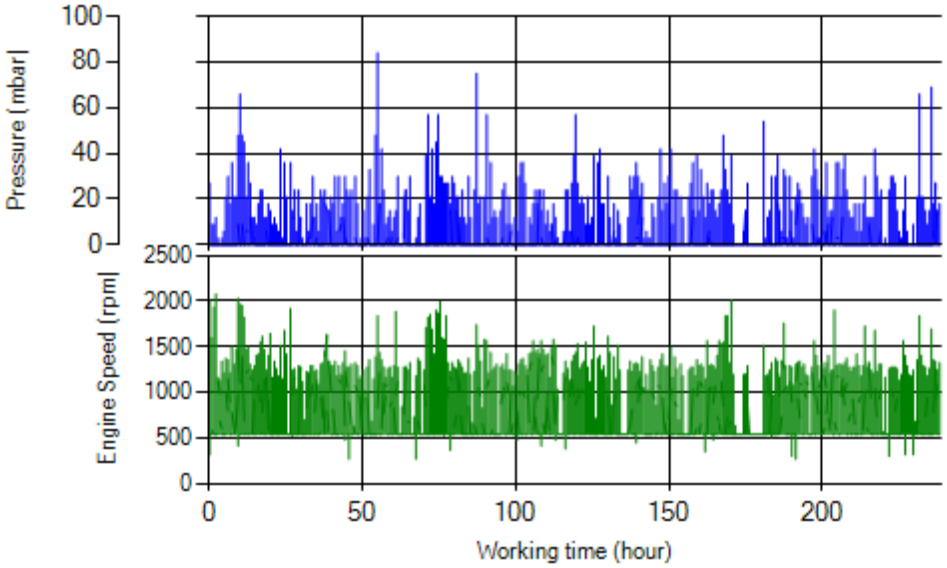


Figure 12- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

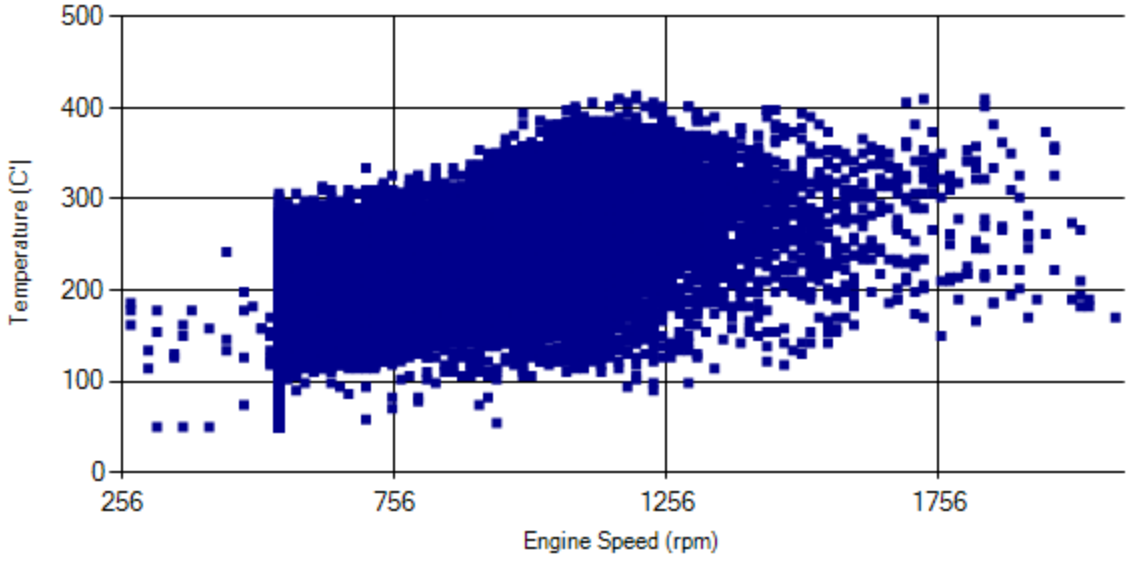


Figure 13- Temperature against engine speed

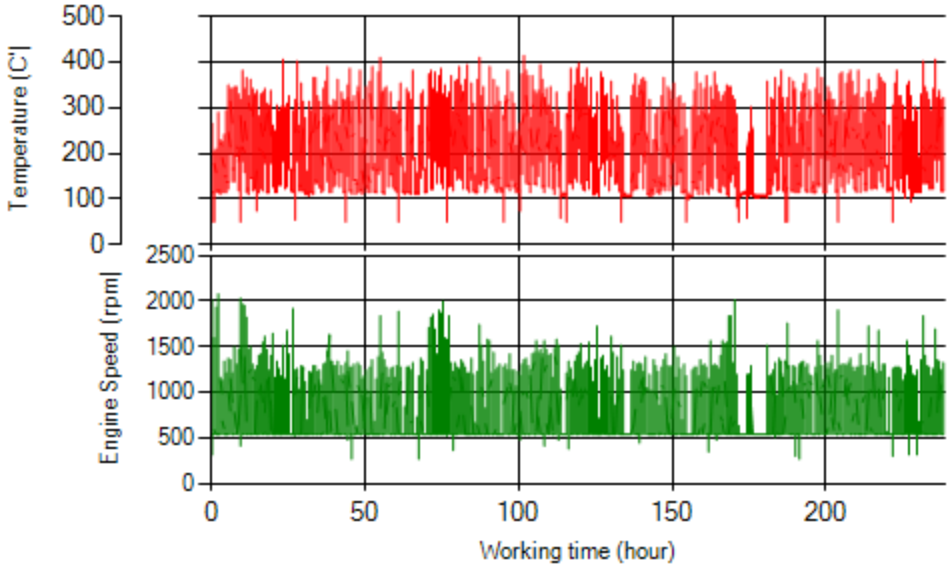


Figure 14- T, N distribution vs. working hours

Filter Operation Analysis

Notice: System was working over this period without DPF.

ASA Azmoon Sanat Arvin	Document Number: DPF2016022/1 Date: 21/Mar/2016

Notice: System was working over this period without DPF.

Overall Information

Table1- Overall Information

Vehicle plate number	33637 (34119)
CPK data logger number	LN: 001492, DN: 1933, Sim +989210000000
Bus line	Number 2 (west to east bus line)
Bus Terminals	Khavaran Bus Terminal - Western Bus Terminal
Total path distance	19 km
DPF company producer	Dinex_02 (Passive system with FBC)
Installation date	02/Jun/2015
Report period	16/Feb/2016 – 29/Feb/2016 (fourteen days)
K value - DPF upstream	- [1/m]
K value – DPF downstream	- [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	DPF has been removed after two weeks working on Jun 17th. After receiving cleaning machine DPF was cleaned on Aug 10th and was installed on Aug 22nd but worked only for ten days. The last cleaning was done on Sep 24th but cleaning issue was unavoidable after only three days working. Finally DPF was replaced by muffler on Sep 8th and system have been working from that date without DPF.
Dosing status	Additive dosing was increased 60% of its initial value for tests two and three.

Table 3- Fuel and Additive Consumption Information

Bus mileage over the period	2818 km
Working days over the period	13 days
Stop days	1 day
Data logger working days	13 days
Working hours over the period	208 hours 48 minutes
Average working hours per day (including stop days)	14 hours 54 minutes
Bus average speed	13.5 km/hr
idle speed time to all working time ration	53.75 %
Total Bus fuel consumption over the period	1832 lit
Fuel consumption per hour	8.8 lit/hr
Average fuel consumption	0.65 lit/km

Temperature, Pressure and Engine Speed Overview

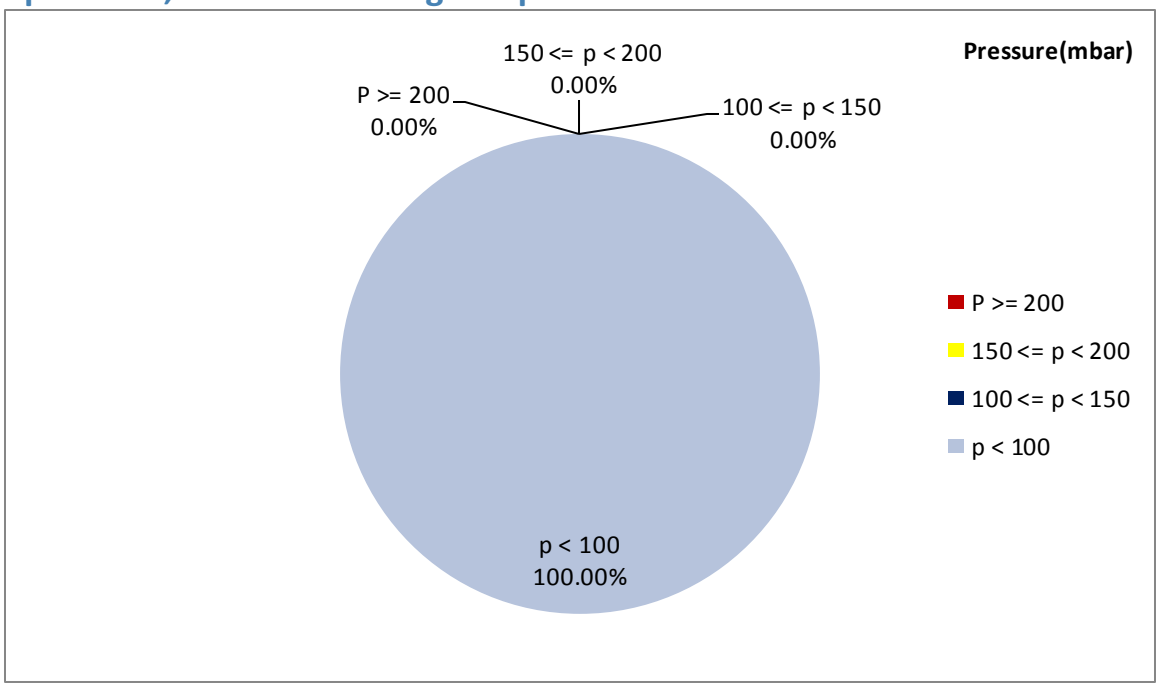


Figure 1- Pressure distribution over the working hours

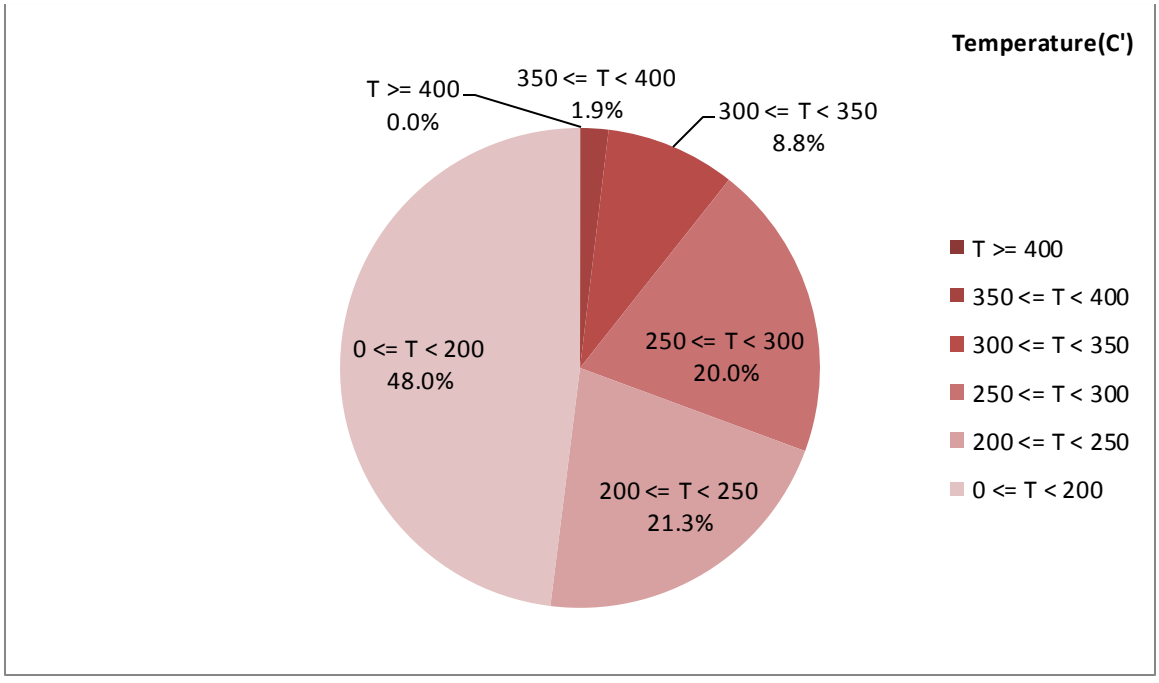


Figure 2-Temperature distribution over the working hours

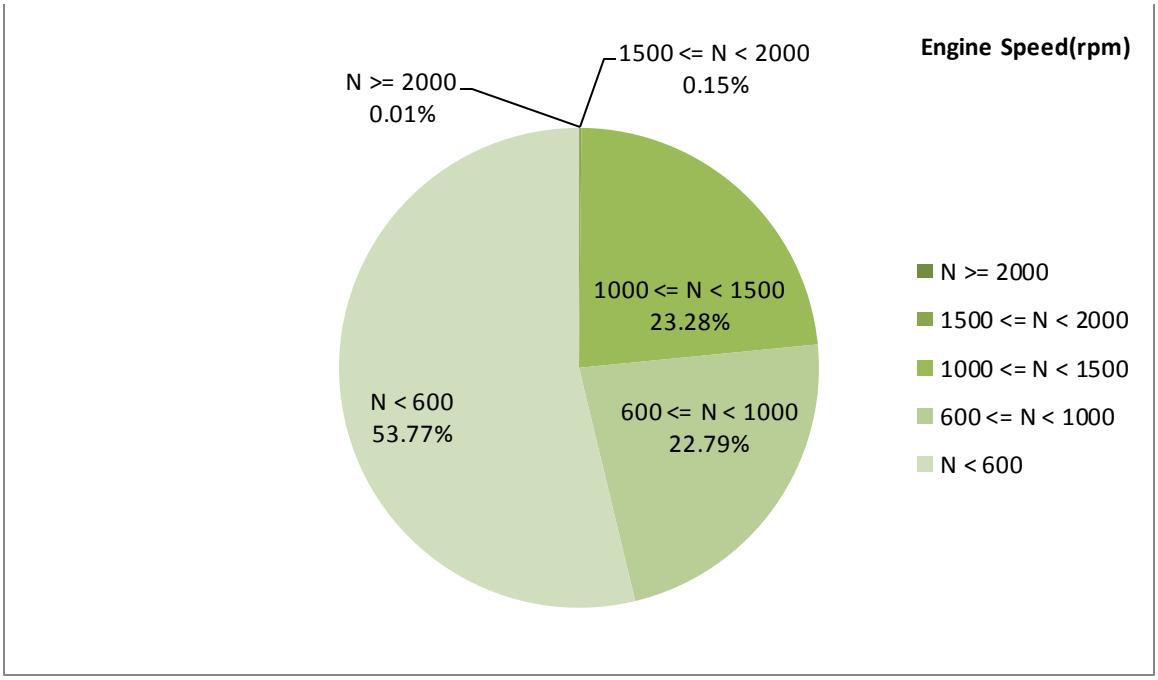


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
207.57	0.91	743

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
262.56	1.97	972

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
426-50	60-0	2112-288

Detailed Pressure Analysis

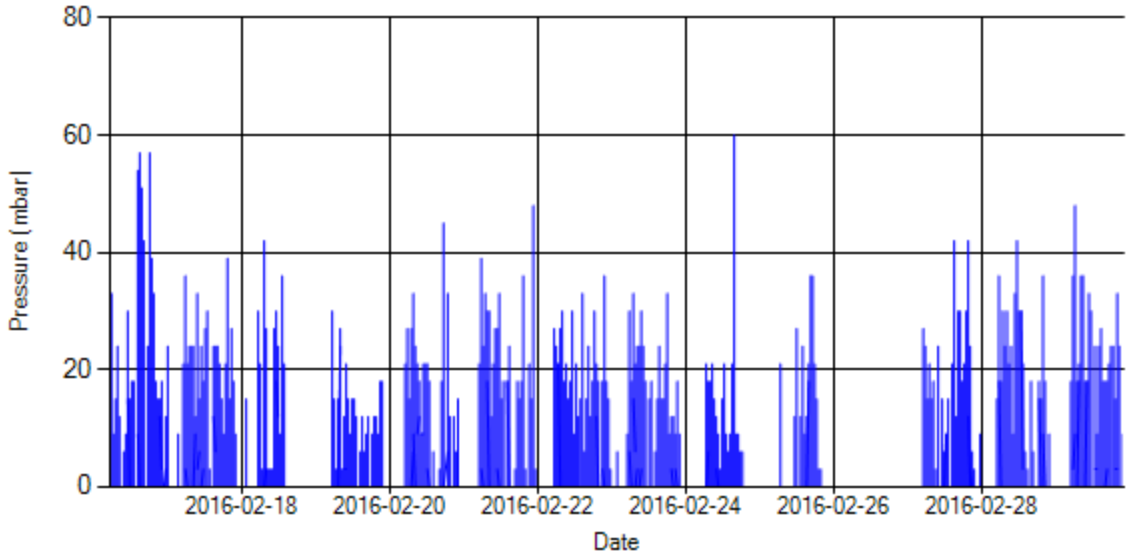


Figure 4- Pressure distribution over the period

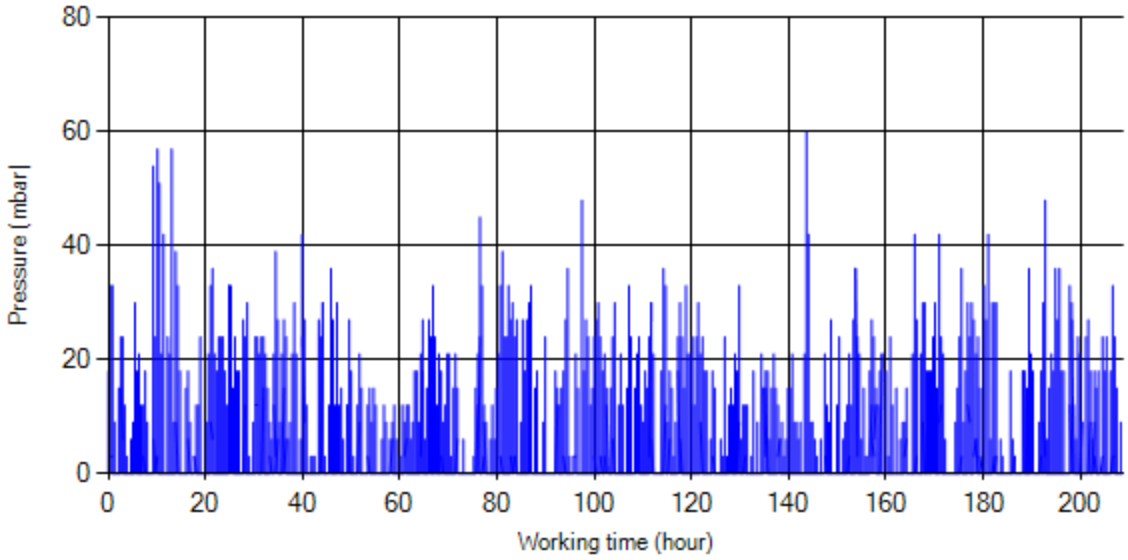


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

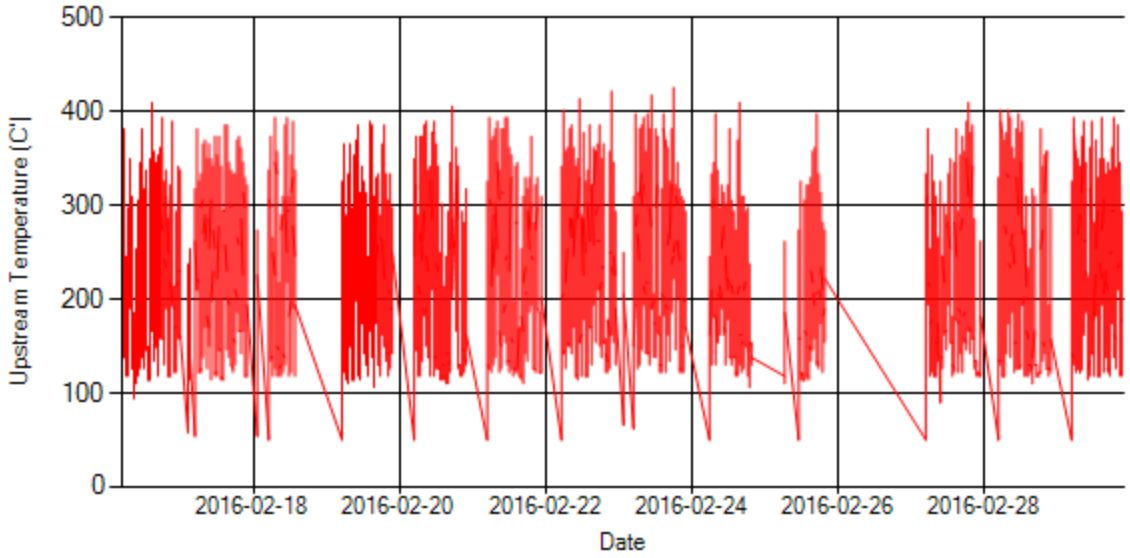


Figure 6- Temperature distribution over the period

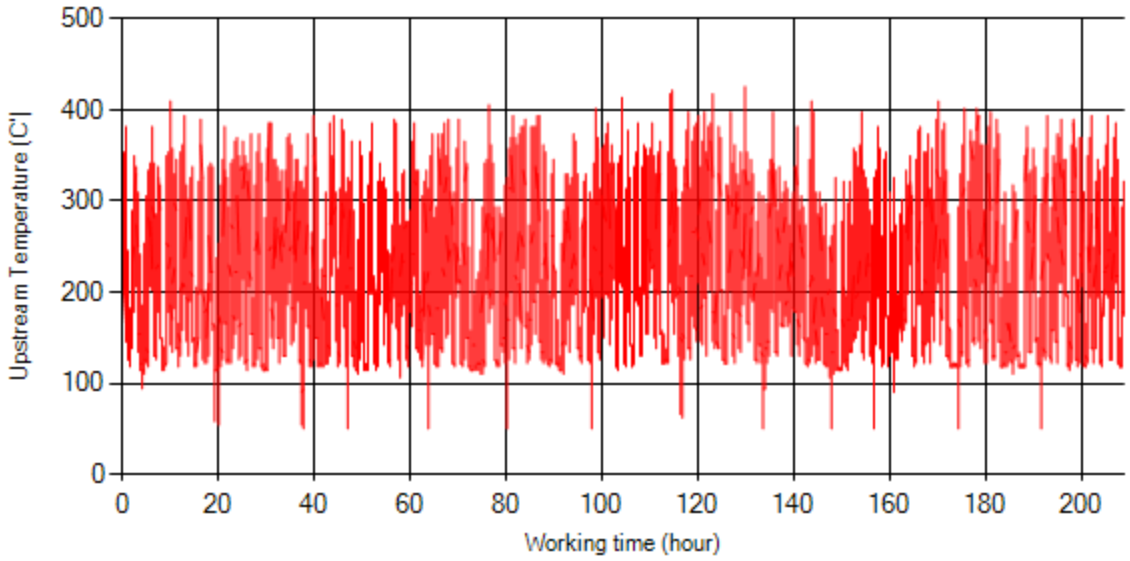


Figure7- Temperature vs. working hours

Engine Speed Diagrams

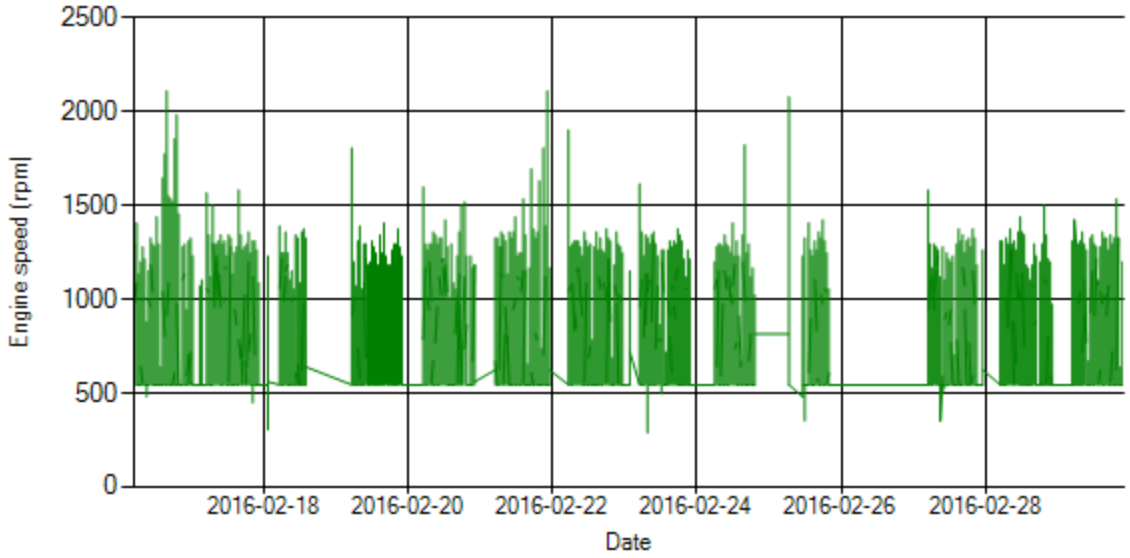


Figure 8- Engine speed distribution over the period

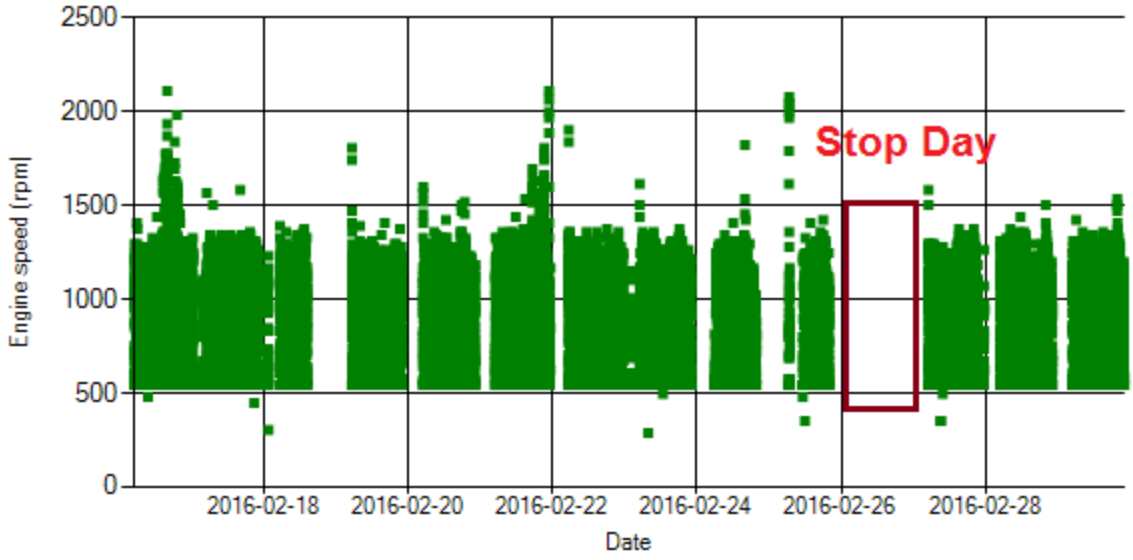


Figure 9- Engine speed diagram for calculating CPK's working days

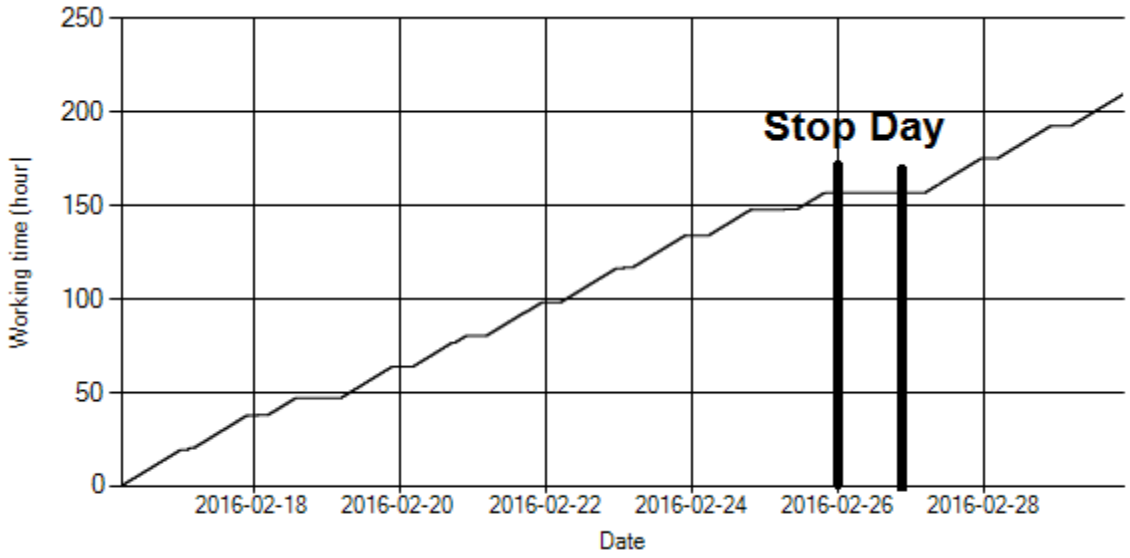


Figure 10- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data.

Pressure-Engine Speed diagrams

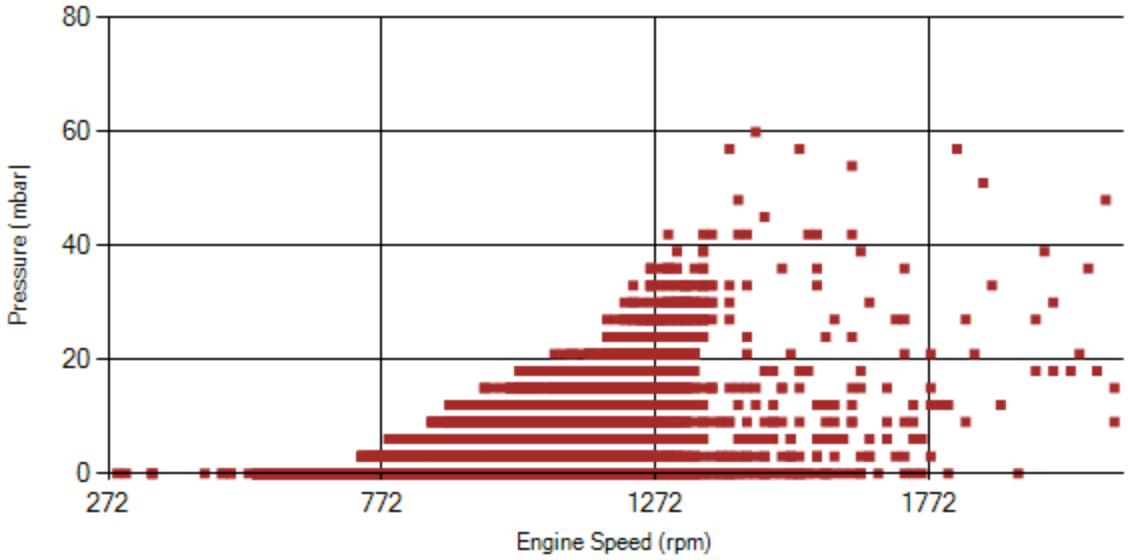


Figure 11- Pressure against engine speed

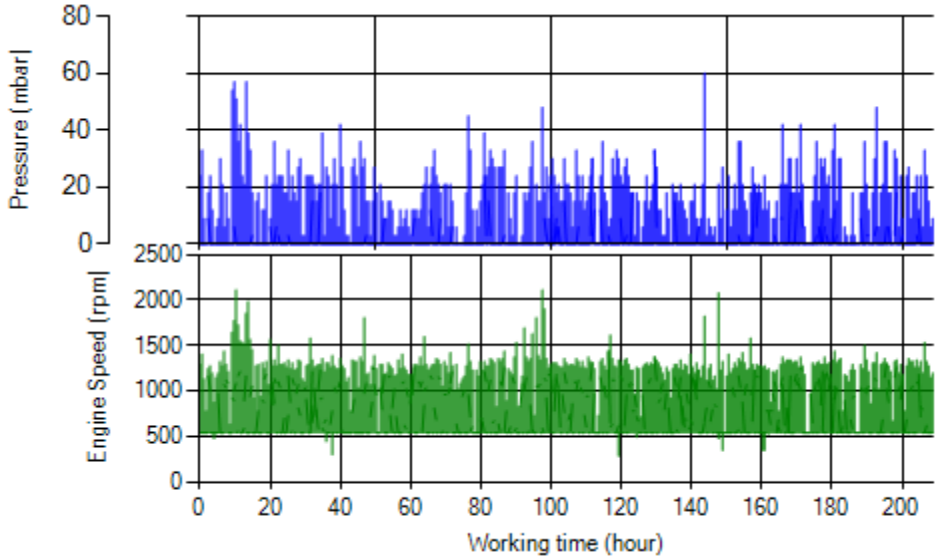


Figure 12- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

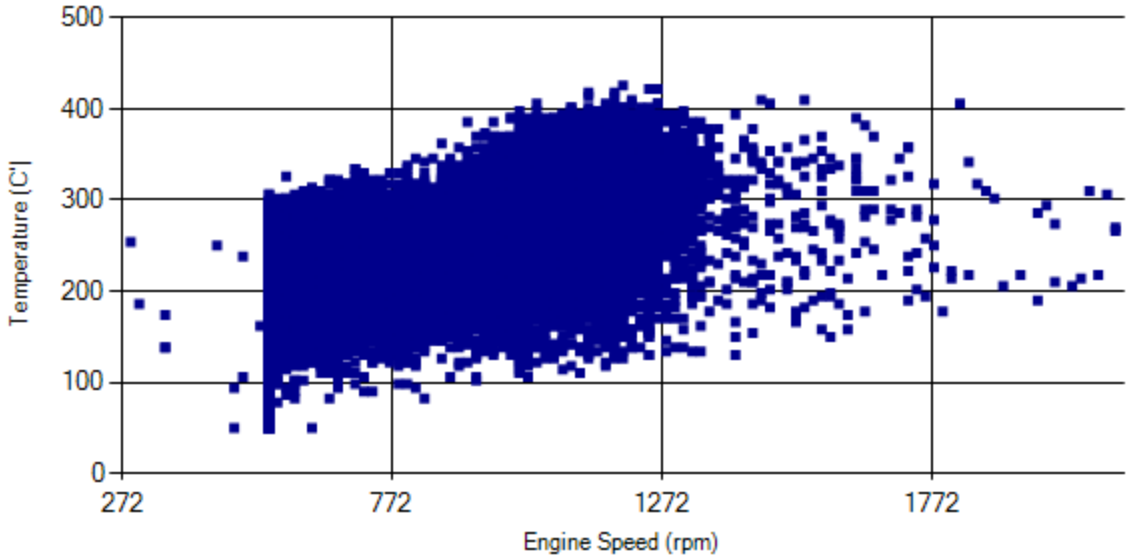


Figure 13- Temperature against engine speed

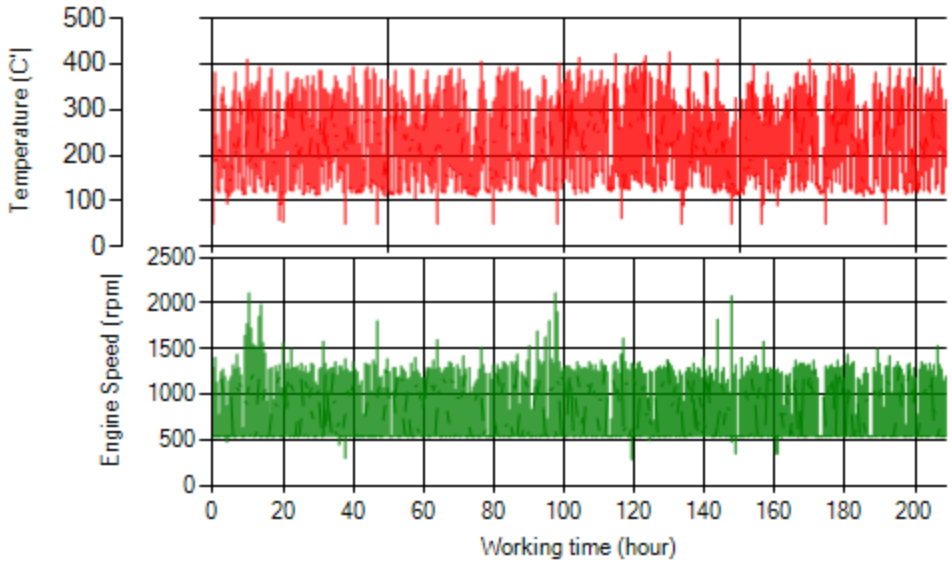
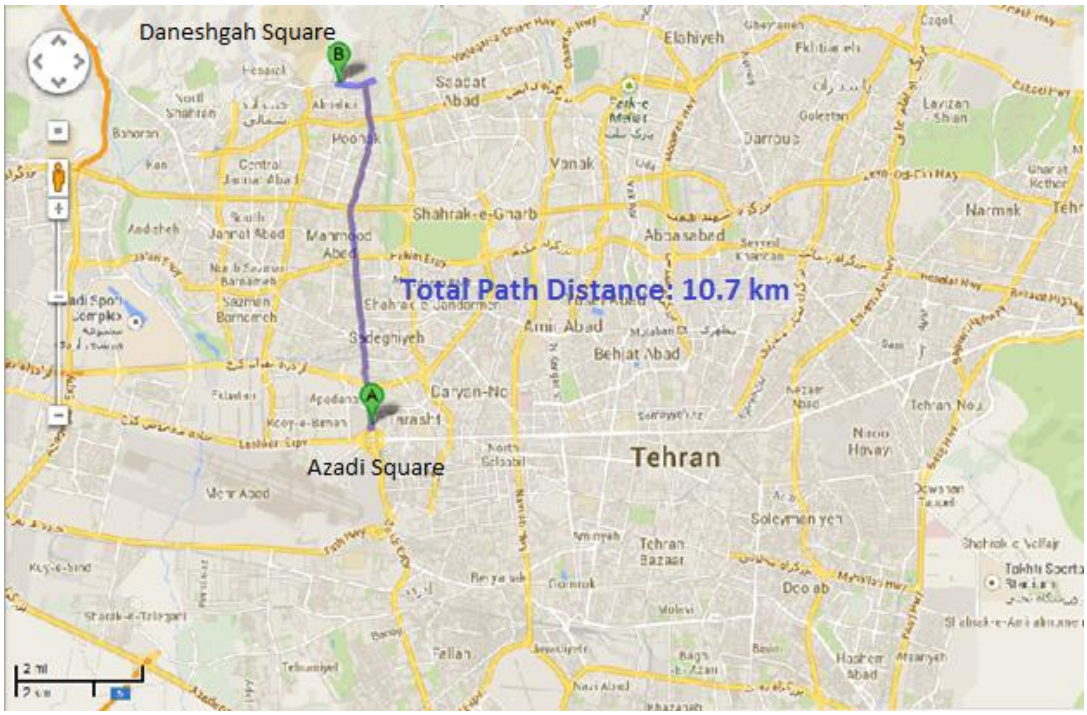


Figure 14- T, N distribution vs. working hours

Filter Operation Analysis

Notice: System was working over this period without DPF.

Vehicle plate number	85476
Bus line	Number 10 (south to north Bus line)
DPF producer company	HJS_04 (Passive system with FBC)



Overall Information

Table1- Overall Information

Vehicle plate number	85476
CPK data logger number	LN: 001508, DN: 2003, Sim +989218469624
Bus line	Number 10 (south to north Bus line)
Bus Terminals	Azadi square - Daneshgah square
Total path distance	10.7 km
DPF producer company	HJS_04 (Passive system with FBC)
Installation date	23/Feb/2015
Report period	01/Feb/2016 – 15/Feb/2016 (fifteen days)
K value - DPF upstream	2.00 [1/m]
K value – DPF downstream	0.04 [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	DPF was cleaned on 22nd Jul for the first time and on 15th Dec for the second time after 44355 km mileage from installation date.
Dosing status	Dosing value has been kept constant from installation date until now.

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	52751 km
Bus mileage over the period	2193 km
Working days over the period	1 day
Stop days	14 days
Data logger working days	14 days
Working hours over the period	215 hours 4 minutes
Average working hours per day (including stop days)	14 hours 20 minutes
Bus average speed	10.2 km/hr
idle speed time to all working time ration	64.22 %
Total Bus fuel consumption over the period	1315 lit
Fuel consumption per hour	6.12 lit/hr
Average fuel consumption	0.6 lit/km
Total Bus additive consumption over the period	0.65 lit
Average additive consumption	300 cc/km
Additive consumption to fuel ration	500 cc/1000lit

Temperature, Pressure and Engine Speed Overview

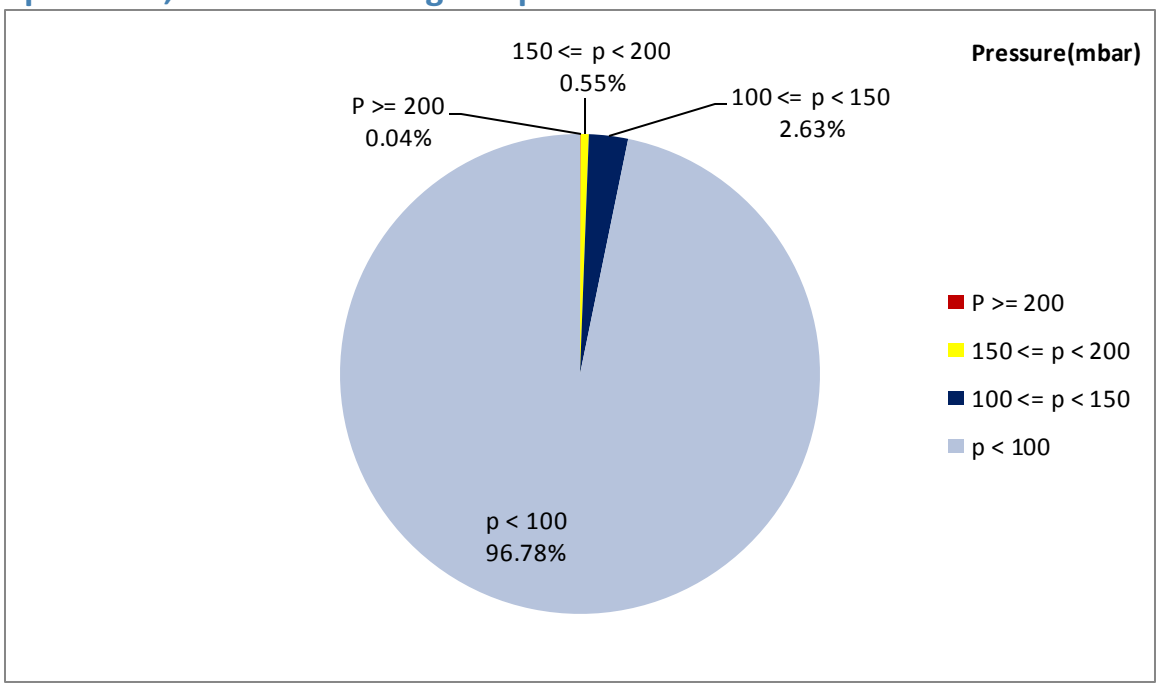


Figure 1- Pressure distribution over the working hours

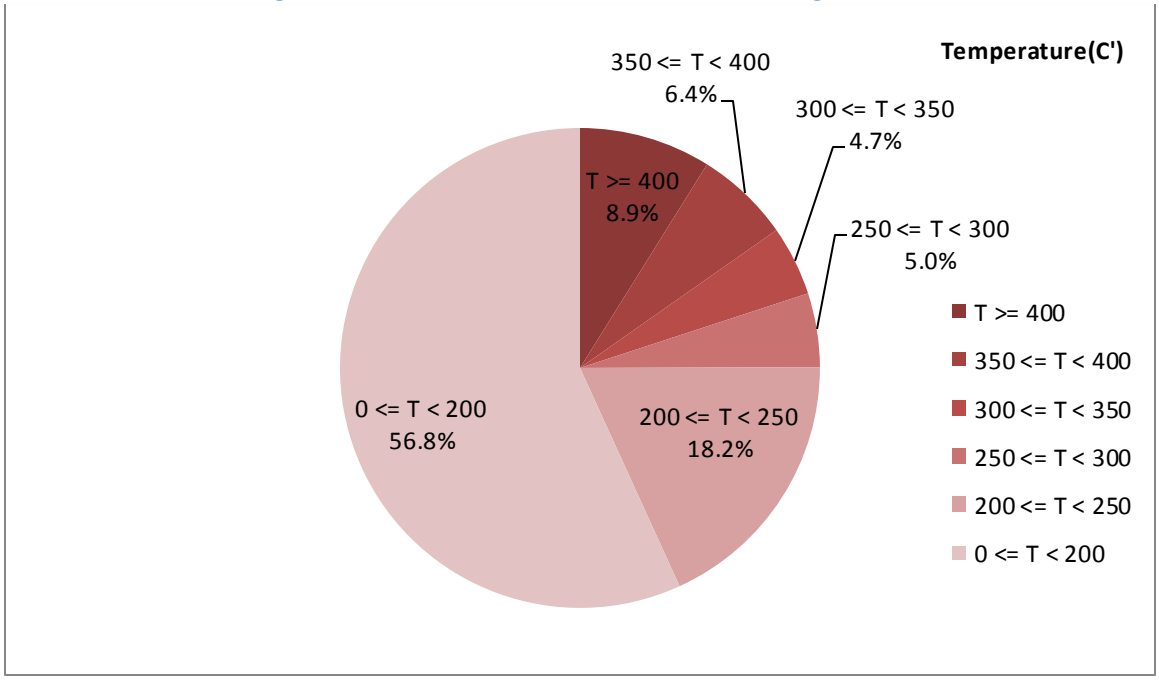


Figure 2-Temperature distribution over the working hours

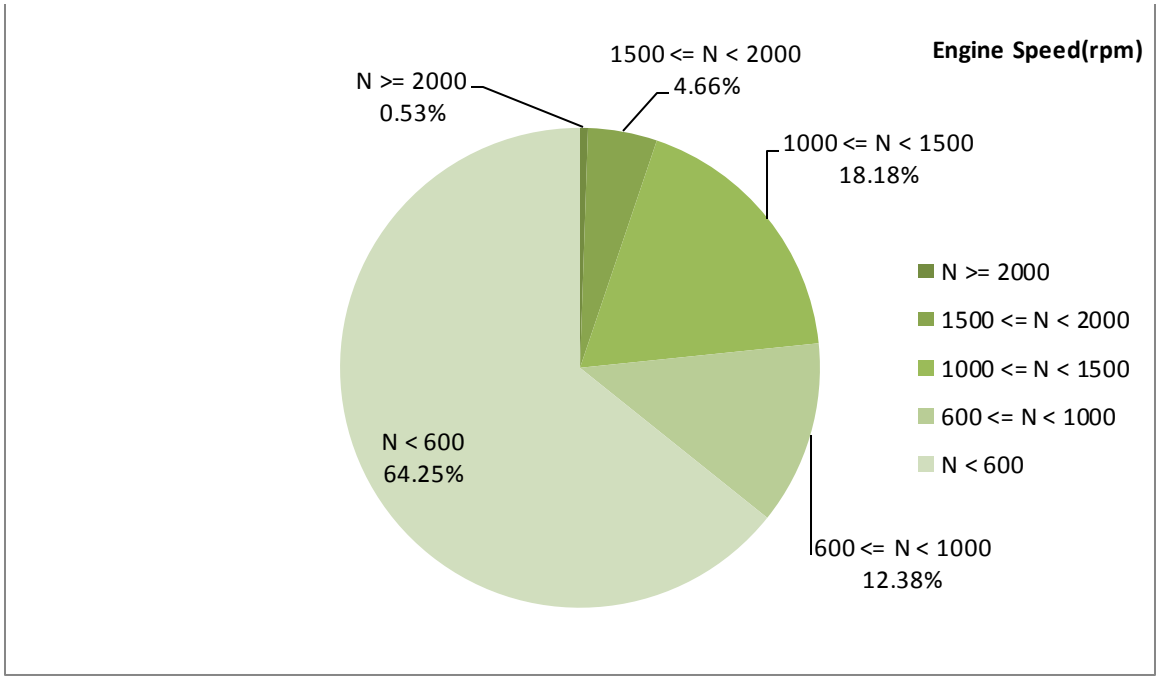


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
216.3	19.75	770

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
285.46	41.94	1144

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
602-50	228-0	2624-256

Detailed Pressure Analysis

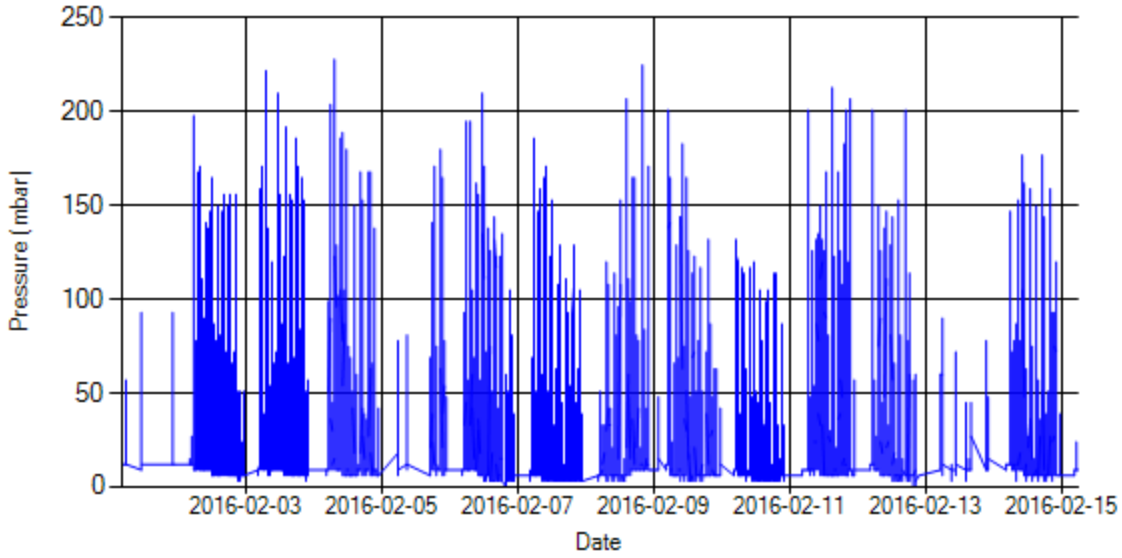


Figure 4- Pressure distribution over the period

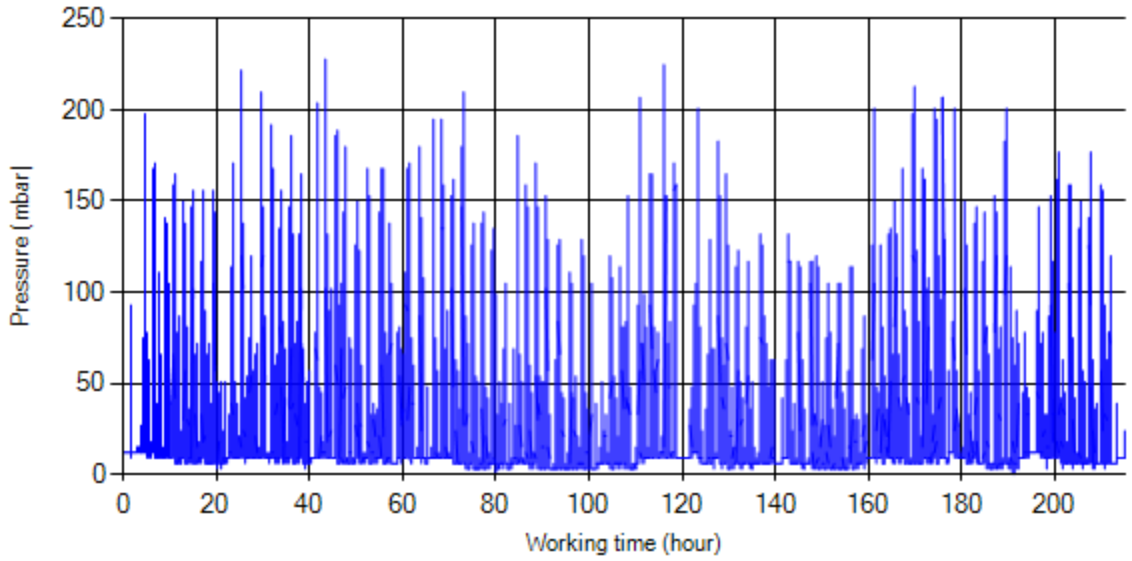


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

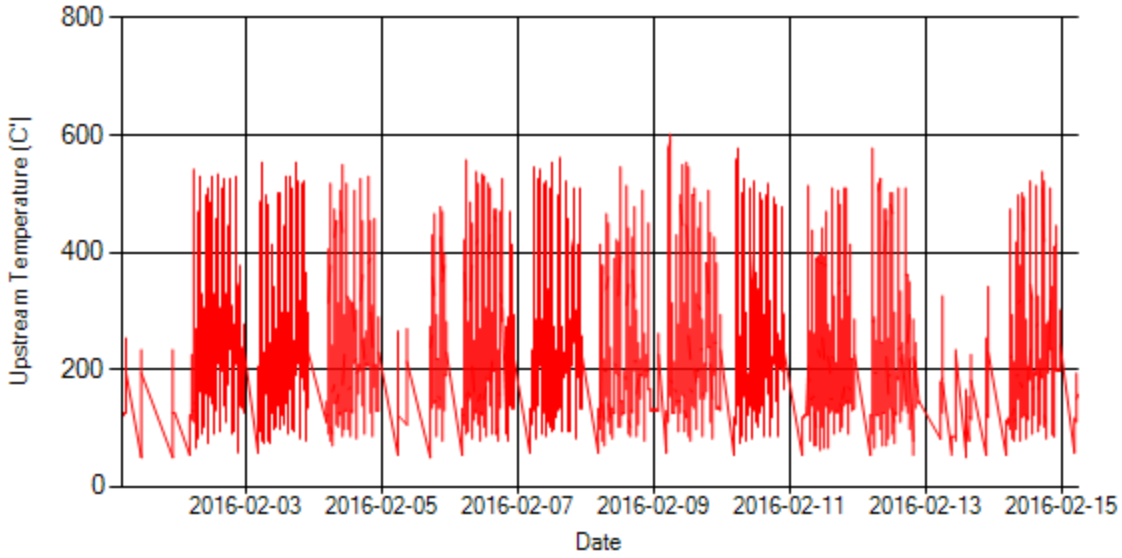


Figure 6- Temperature distribution over the period

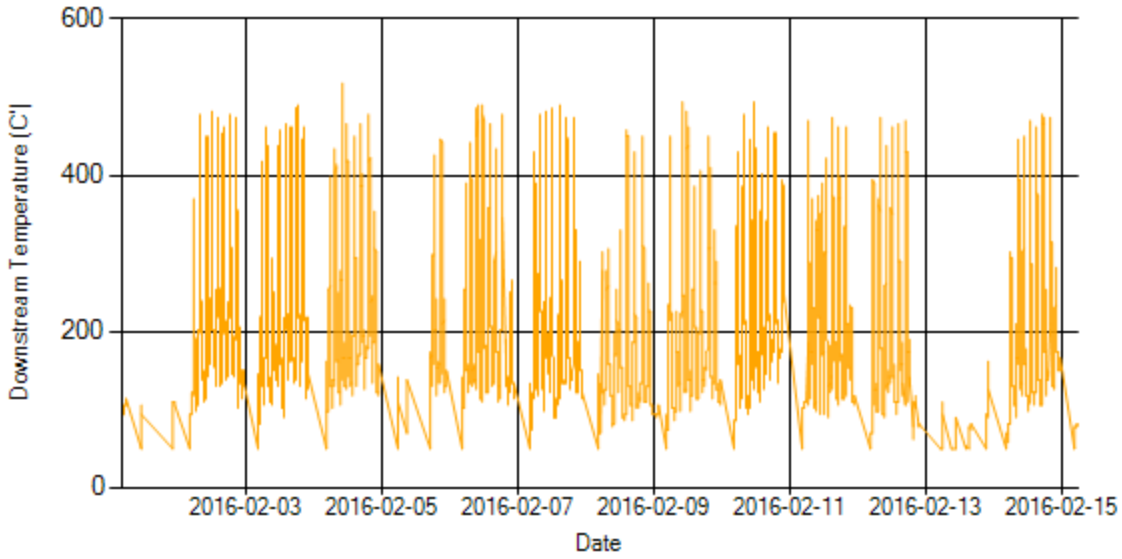


Figure 7- Temperature distribution over the period

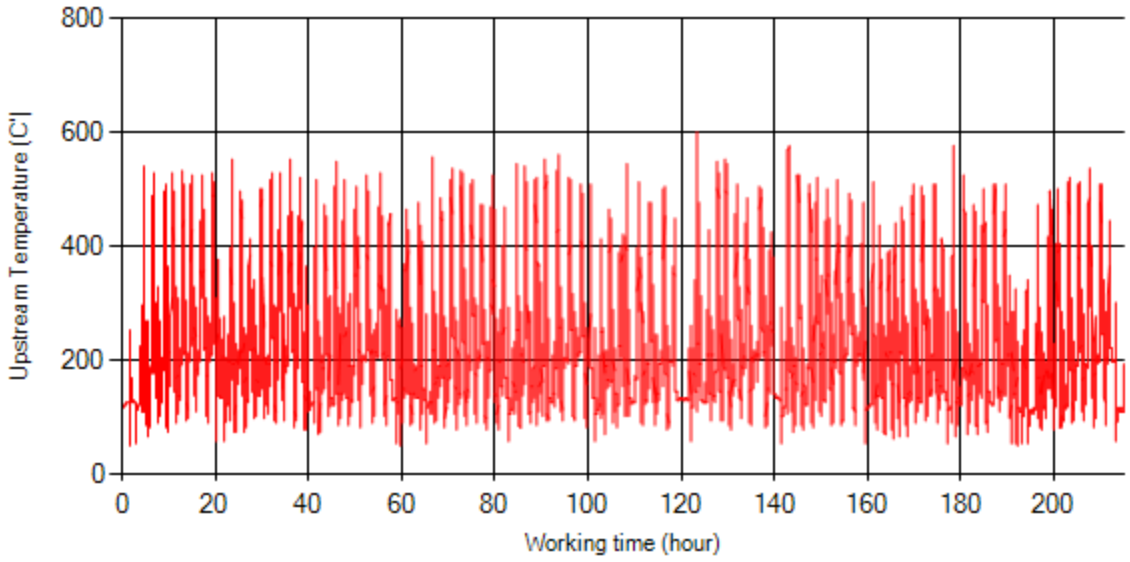


Figure 8- Temperature vs. working hours

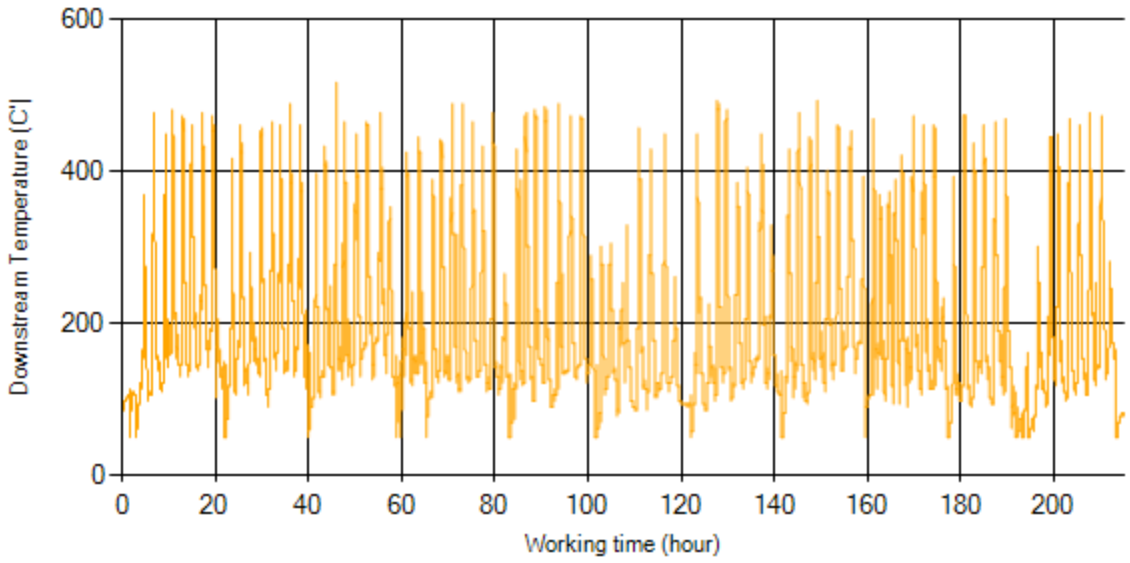


Figure 9- Temperature vs. working hours

Engine Speed Diagrams

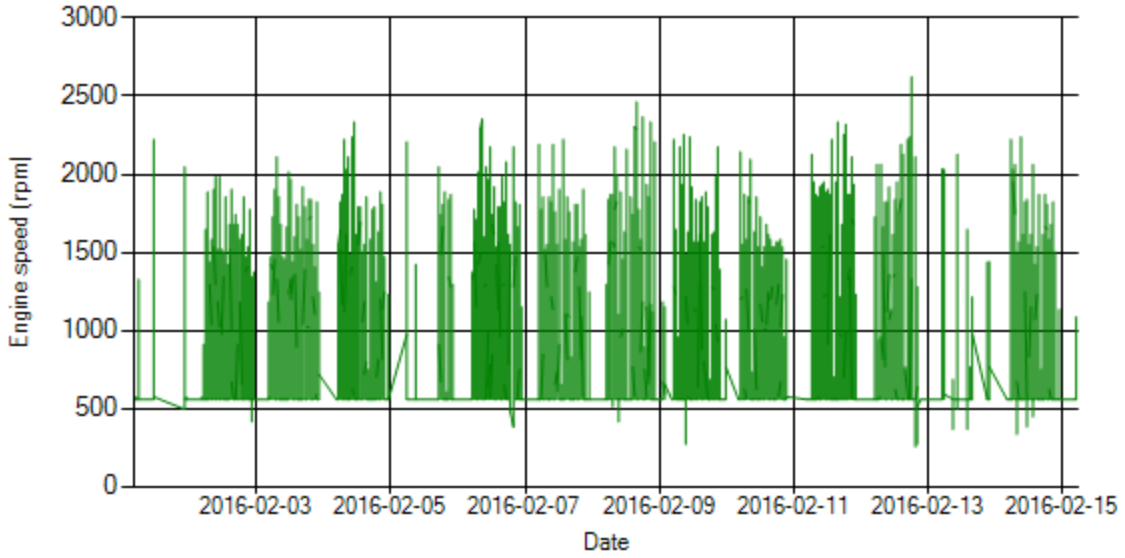


Figure 10- Engine speed distribution over the period

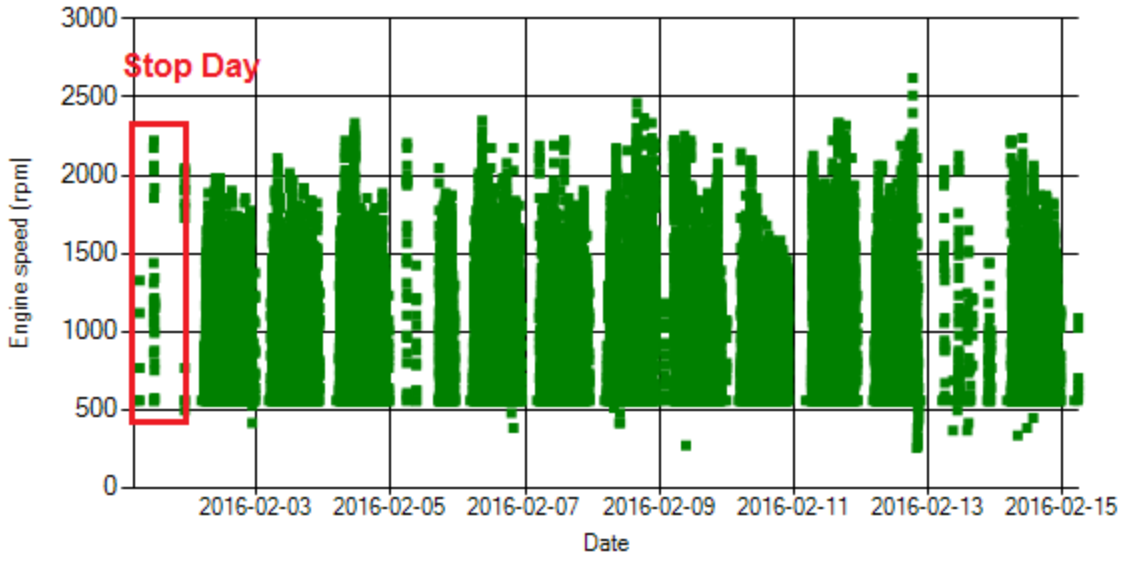


Figure 11- Engine speed diagram for calculating CPK's working days

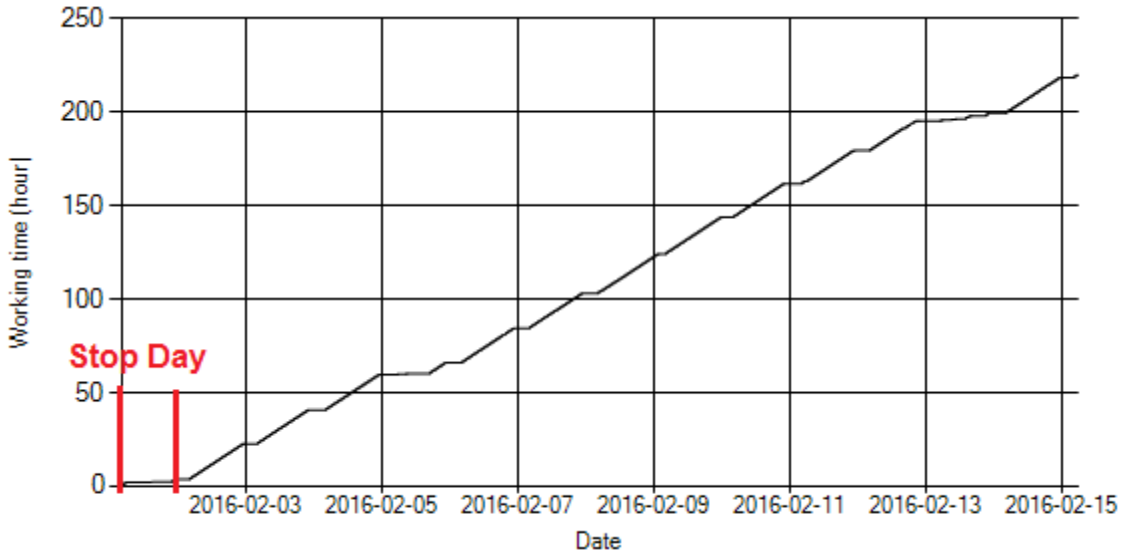


Figure 12- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data. As depicted in Figure 12, first of Feb bus was stationary.

Pressure-Engine Speed diagrams

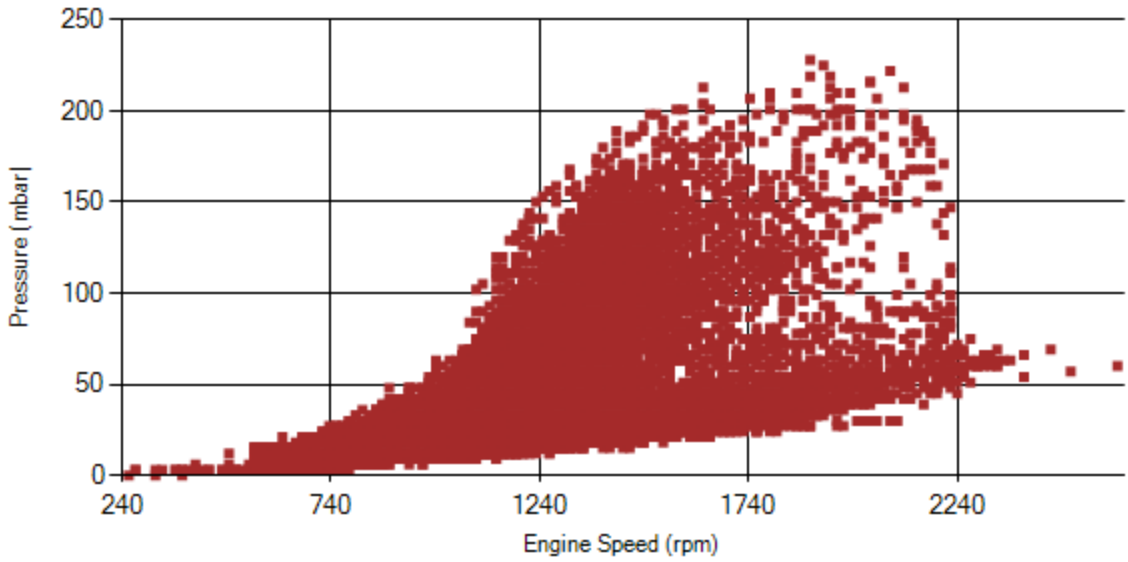


Figure 13- Pressure against engine speed

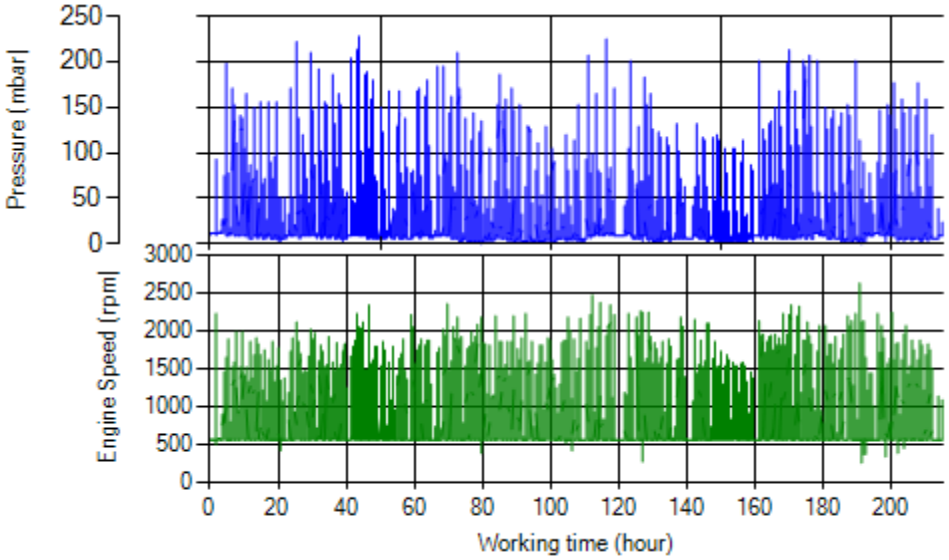


Figure 14- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

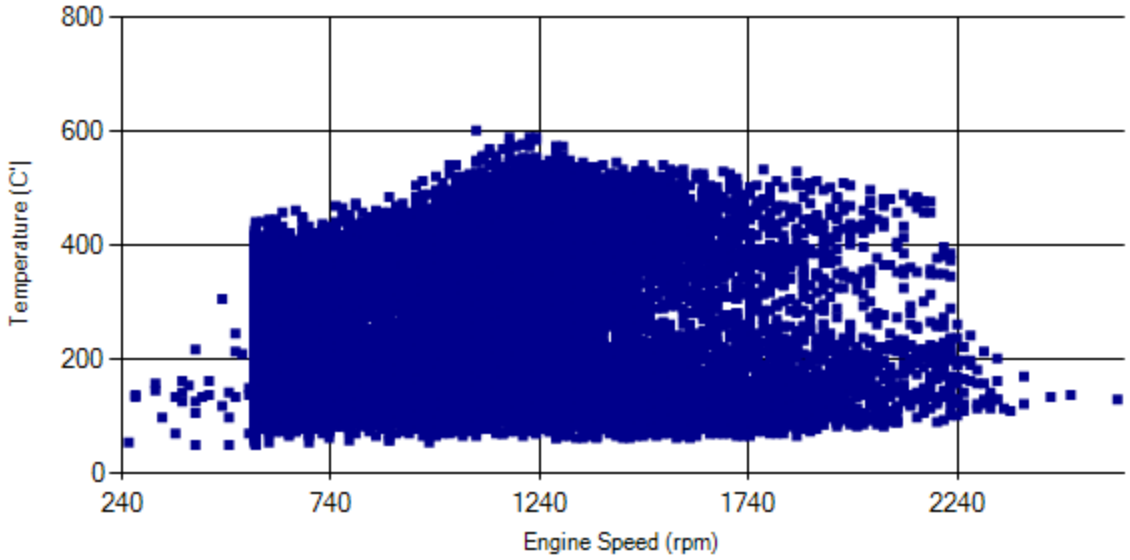


Figure 15- Temperature against engine speed

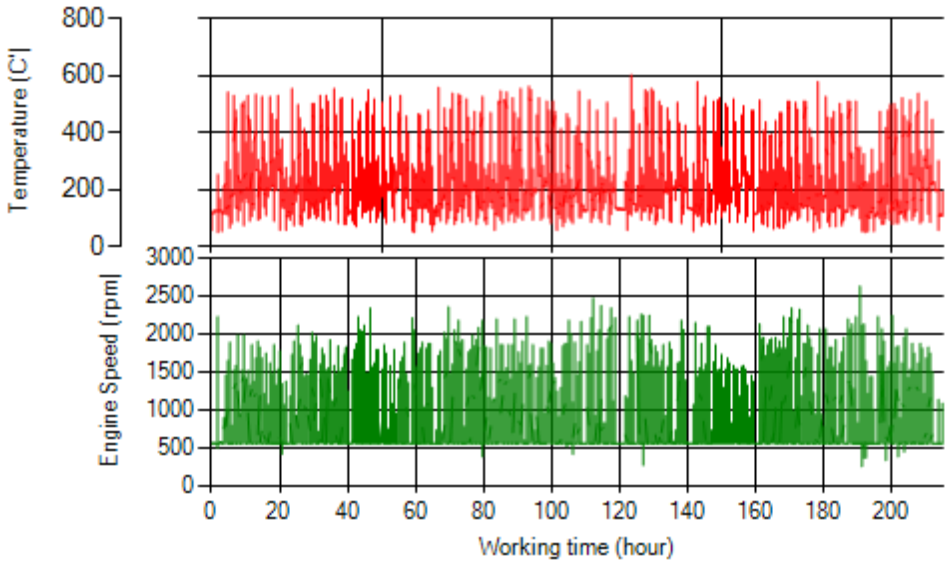


Figure 16- T, N distribution vs. working hours

Filter Operation Analysis

- As depicted in figure 1, only 0.04% of working time pressure was above 200 mbar and 0.59% above 150 mbar.
- It can be obviously observed that 8.9% of total working-time temperature is above 400 °C and 15.3% above 350°C.

Filter operation status	Excellent ■	Good ☐
	Maintenance required ☐	Failed☐

Overall Information

Table1- Overall Information

Vehicle plate number	85476
CPK data logger number	LN: 001508, DN: 2003, Sim +989218469624
Bus line	Number 10 (south to north Bus line)
Bus Terminals	Azadi square - Daneshgah square
Total path distance	10.7 km
DPF producer company	HJS_04 (Passive system with FBC)
Installation date	23/Feb/2015
Report period	16/Feb/2016 – 29/Feb/2016 (fourteen days)
K value - DPF upstream	2.00 [1/m]
K value – DPF downstream	0.04 [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	DPF was cleaned on 22nd Jul for the first time and on 15th Dec for the second time after 44355 km mileage from installation date.
Dosing status	Dosing value has been kept constant from installation date until now.

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	54116 km
Bus mileage over the period	1365 km
Working days over the period	11 days
Stop days	3 days
Data logger working days	11 days
Working hours over the period	149 hours 59 minutes
Average working hours per day (including stop days)	10 hours 42 minutes
Bus average speed	9.1 km/hr
idle speed time to all working time ration	69.91 %
Total Bus fuel consumption over the period	846 lit
Fuel consumption per hour	5.64 lit/hr
Average fuel consumption	0.62 lit/km
Total Bus additive consumption over the period	0.4 lit
Average additive consumption	297 cc/km
Additive consumption to fuel ration	480 cc/1000lit

Temperature, Pressure and Engine Speed Overview

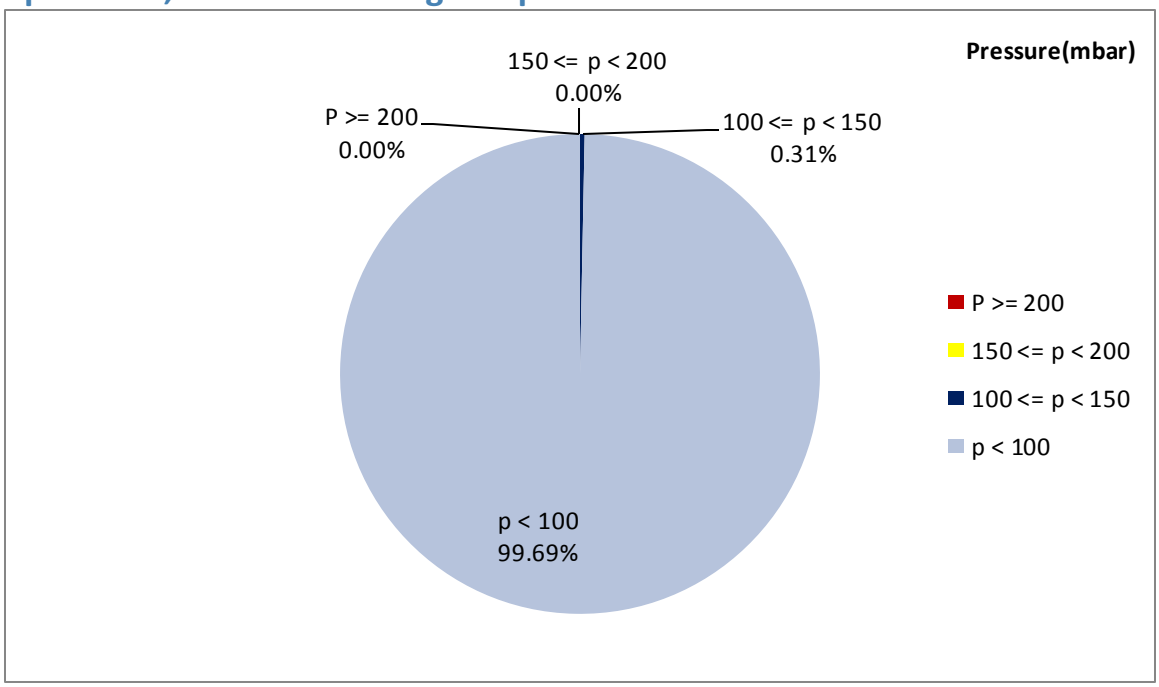


Figure 1- Pressure distribution over the working hours

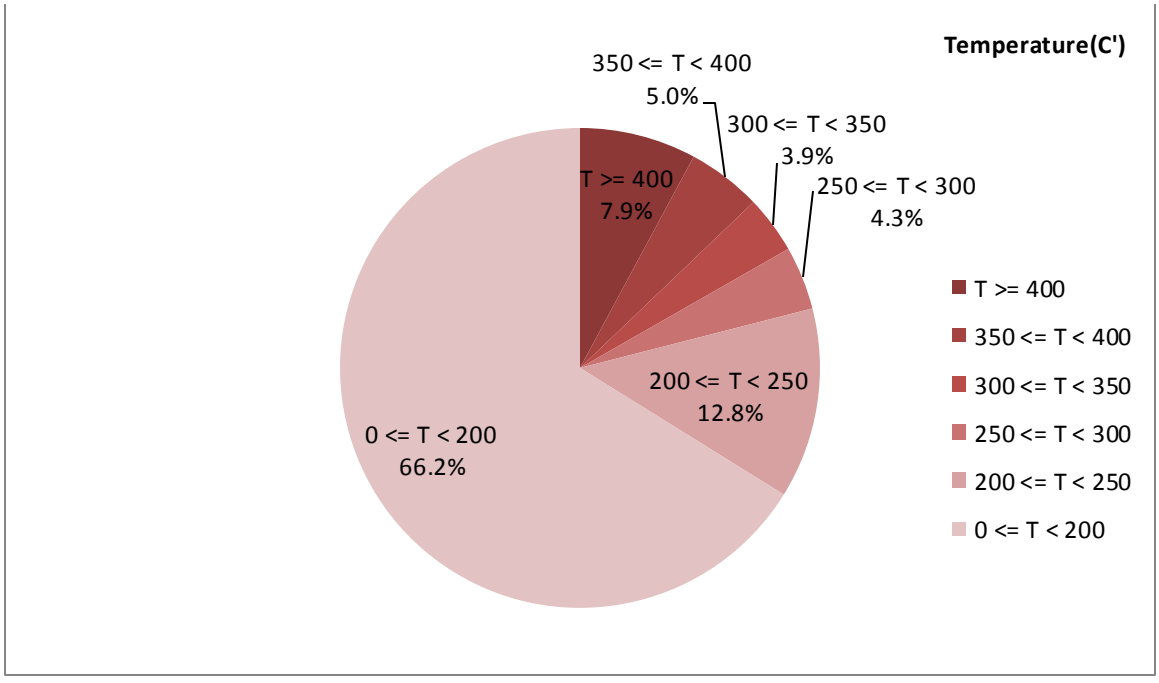


Figure 2-Temperature distribution over the working hours

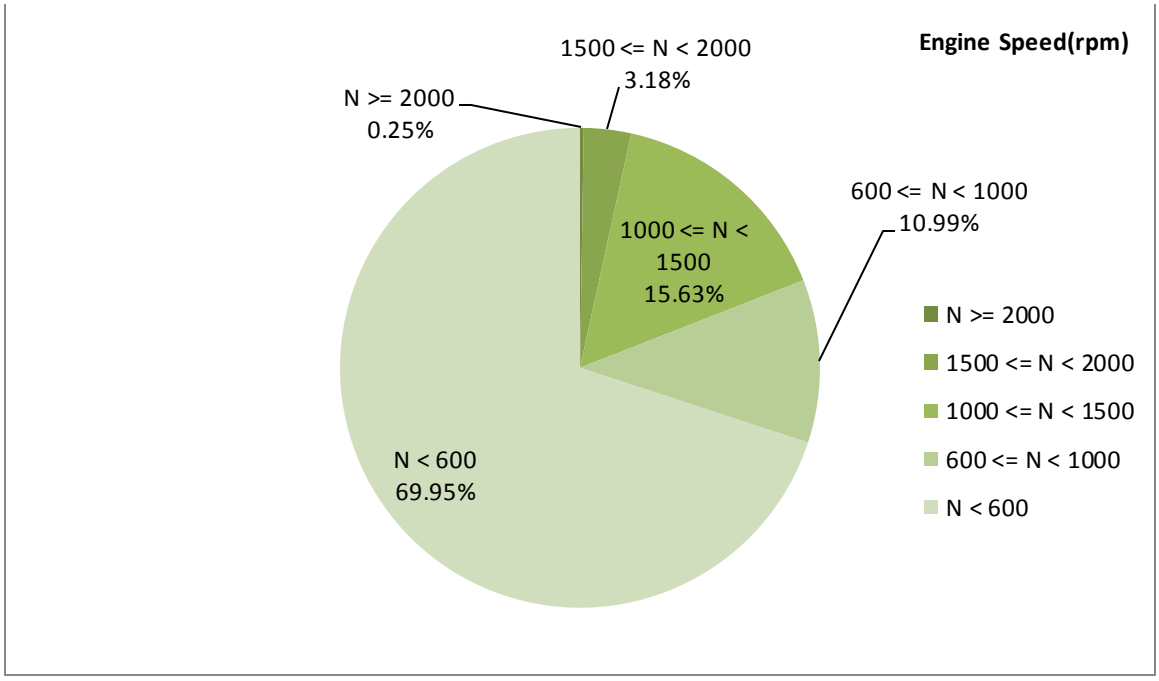


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
198.4	10.87	726

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
284.85	23.66	1111

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
574-50	150-0	2464-272

Detailed Pressure Analysis

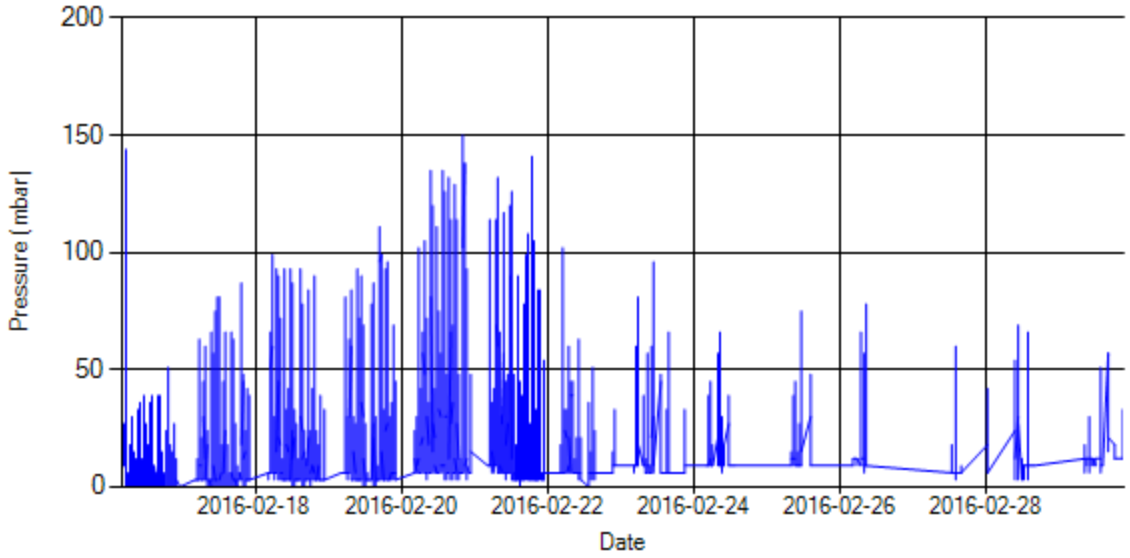


Figure 4- Pressure distribution over the period

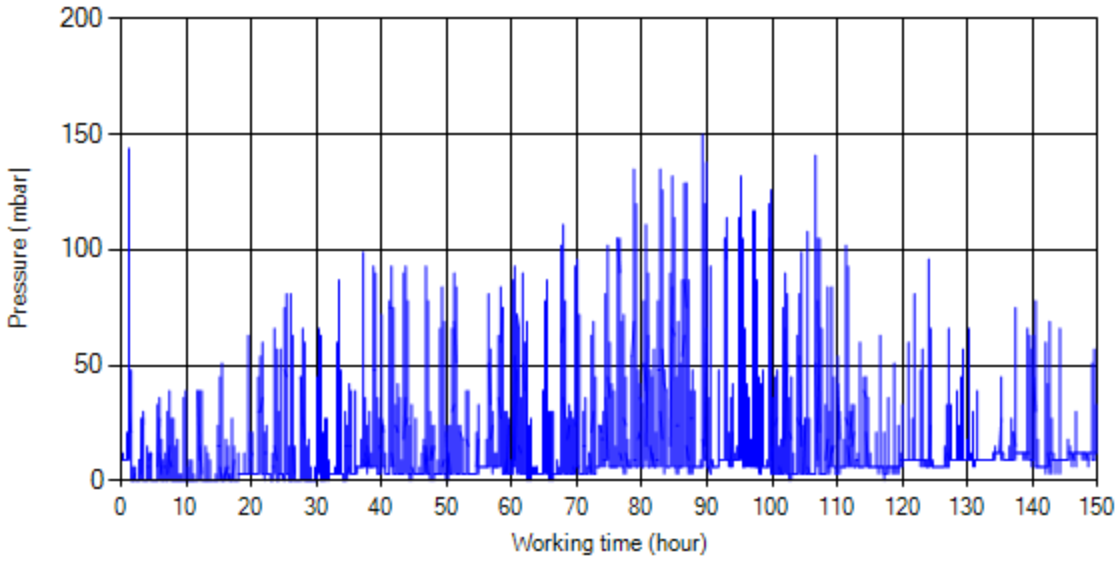


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

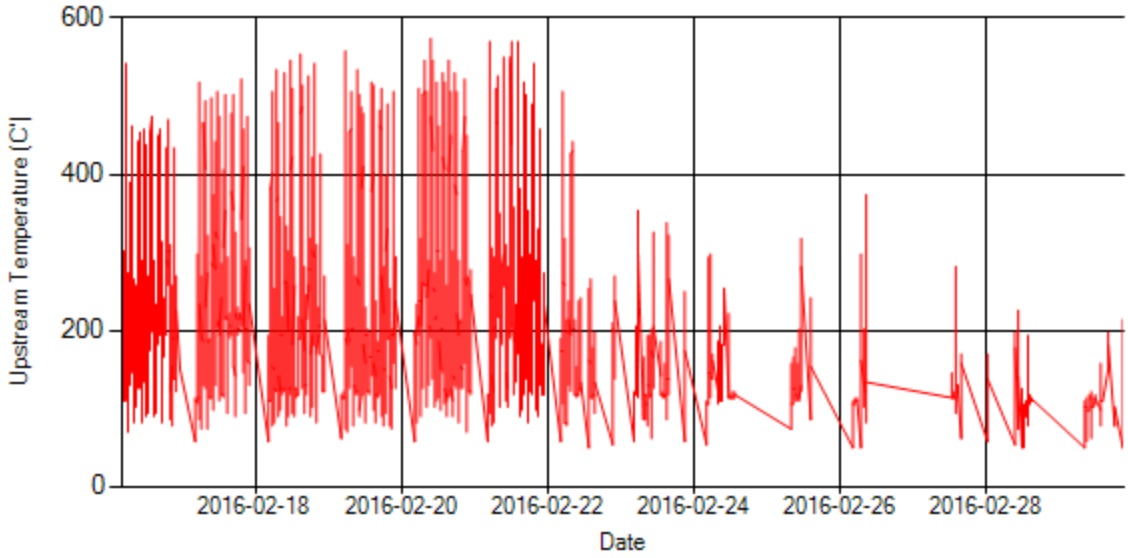


Figure 6- Temperature distribution over the period

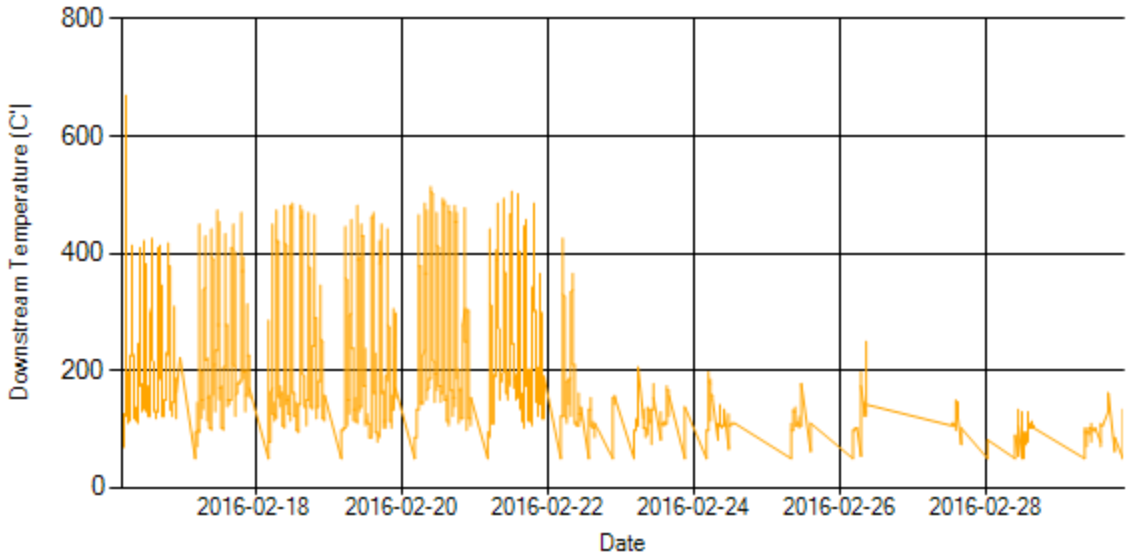


Figure 7- Temperature distribution over the period

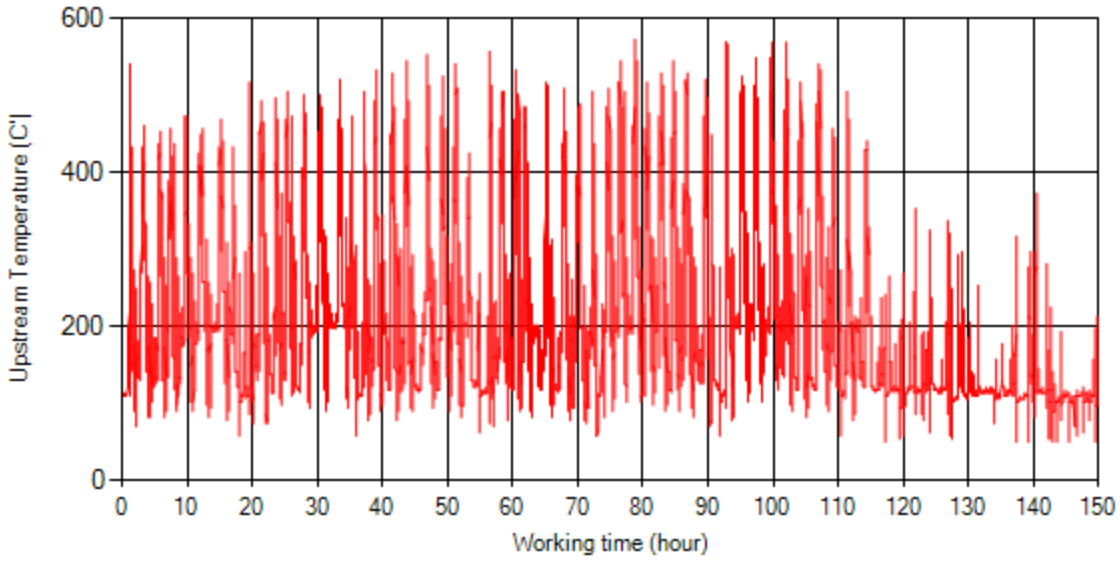


Figure 8- Temperature vs. working hours

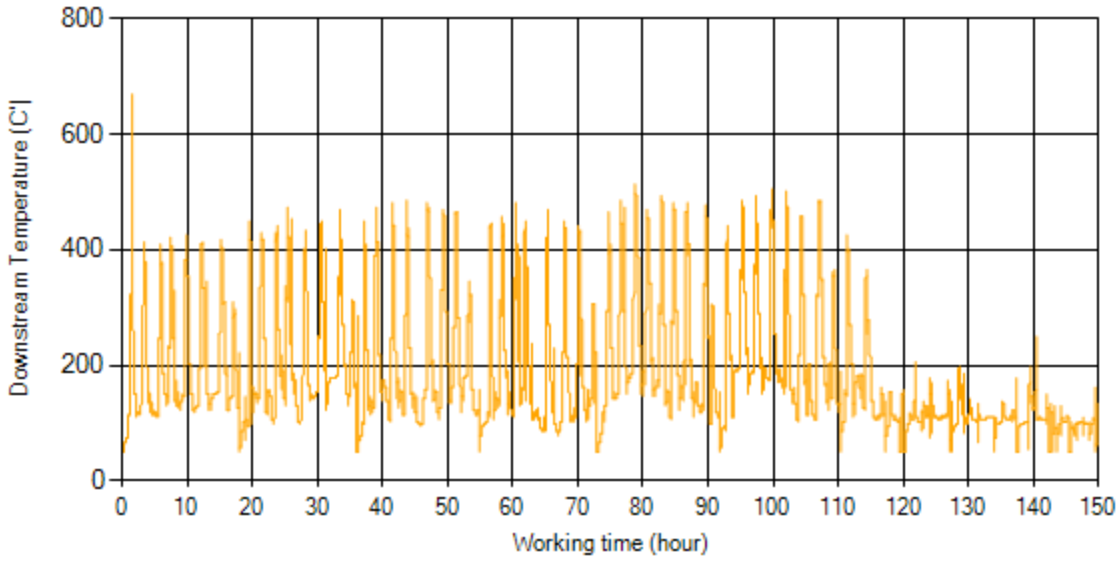


Figure 9- Temperature vs. working hours

Engine Speed Diagrams

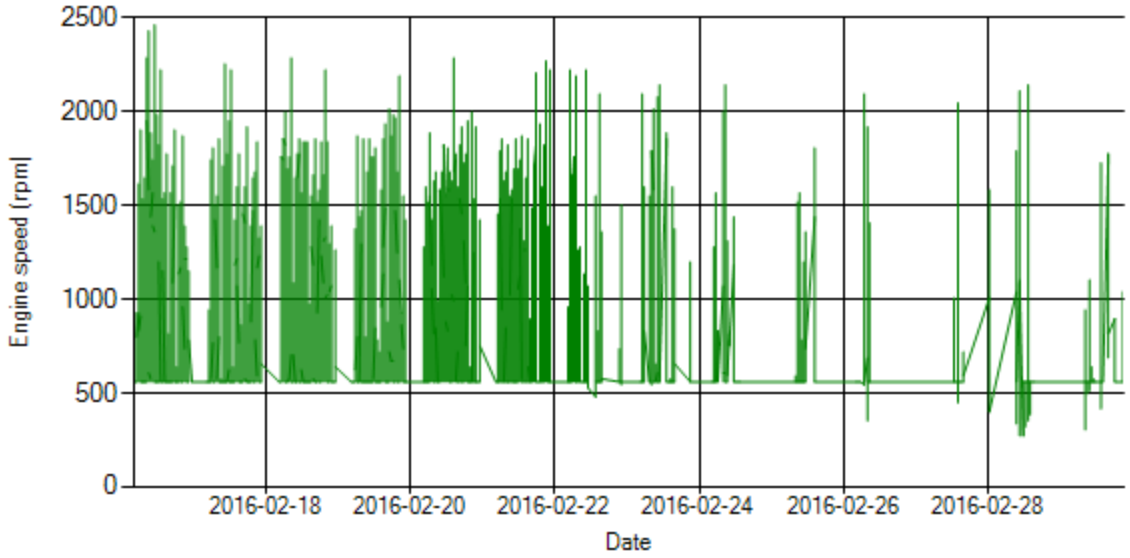


Figure 10- Engine speed distribution over the period

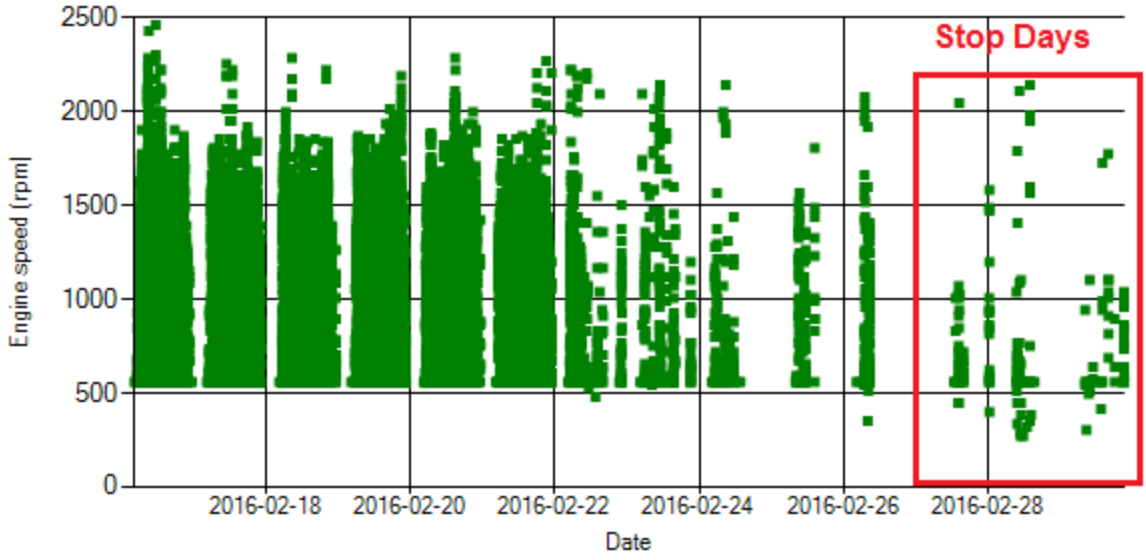


Figure 11- Engine speed diagram for calculating CPK's working days

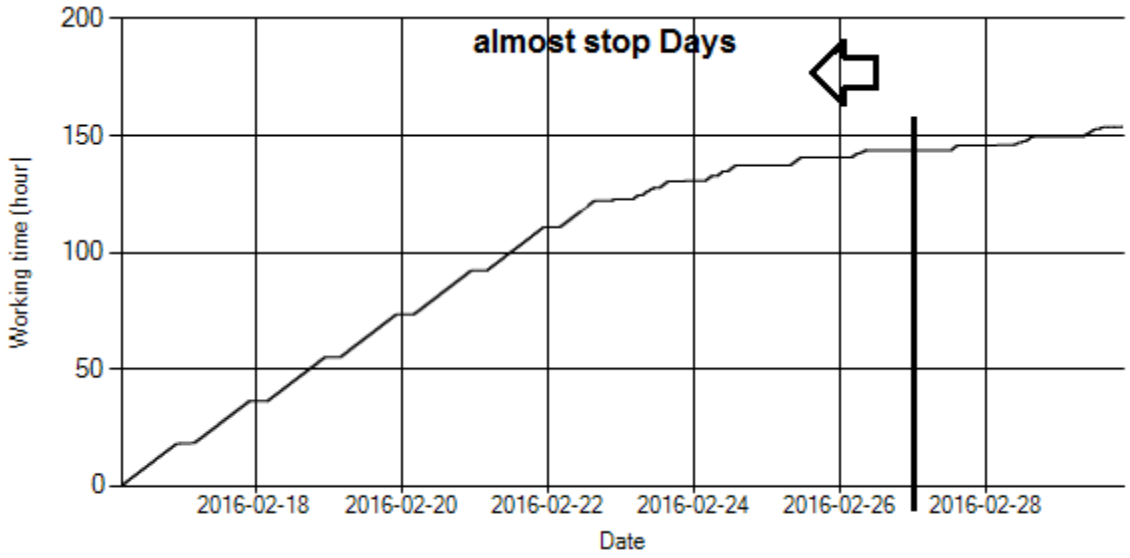


Figure 12- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data.

Pressure-Engine Speed diagrams

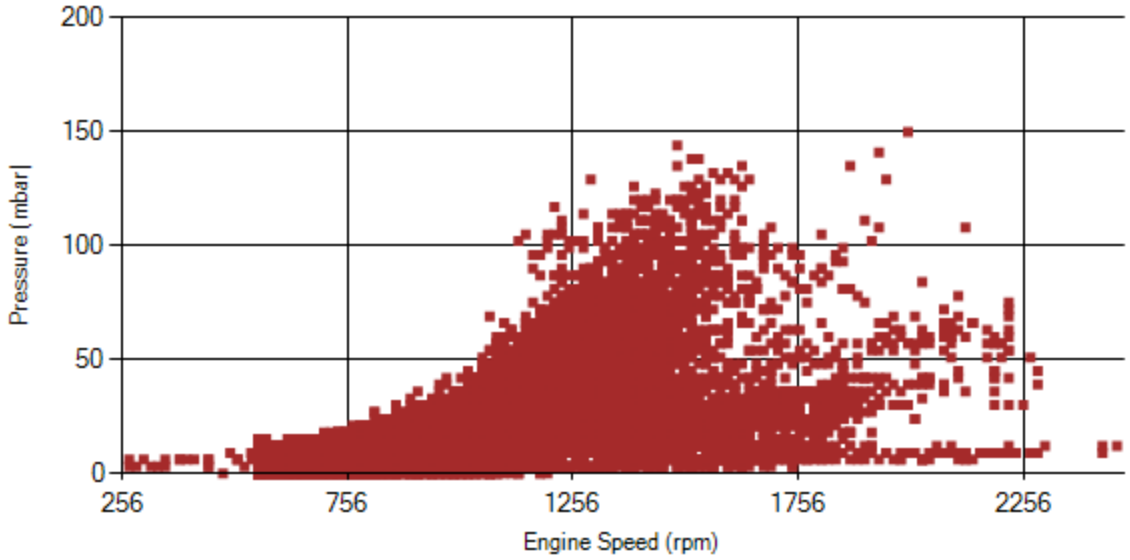


Figure 13- Pressure against engine speed

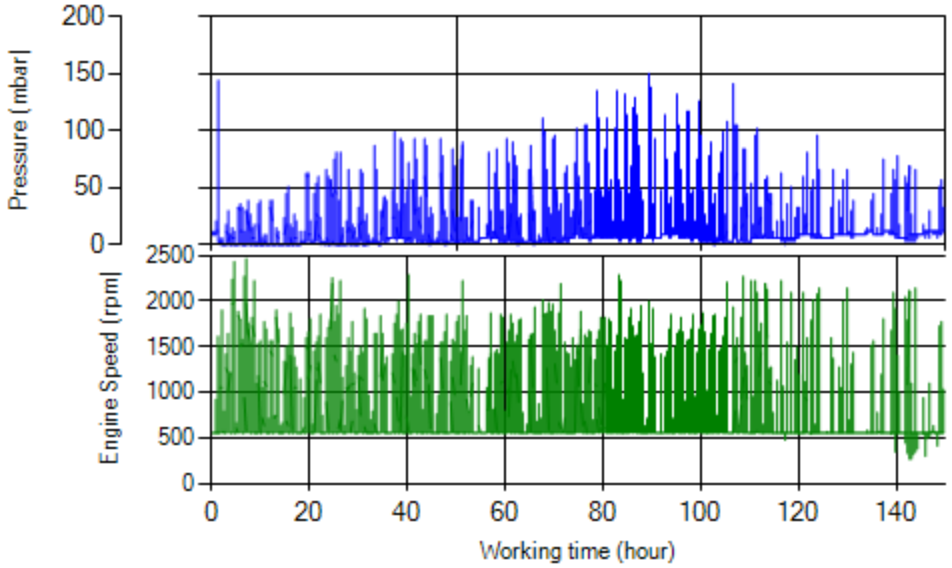


Figure 14- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

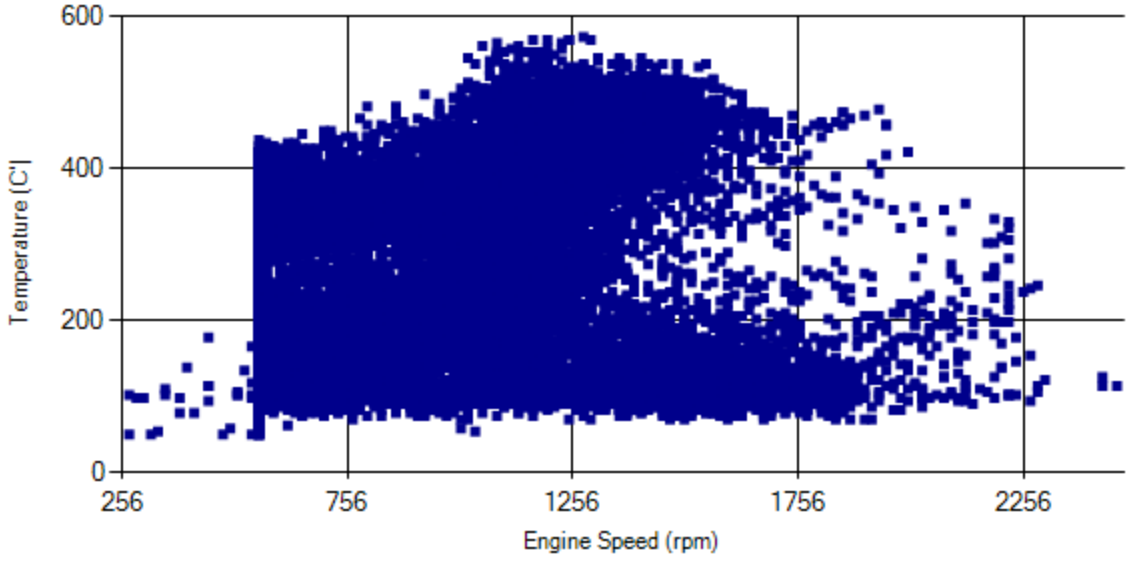


Figure 15- Temperature against engine speed

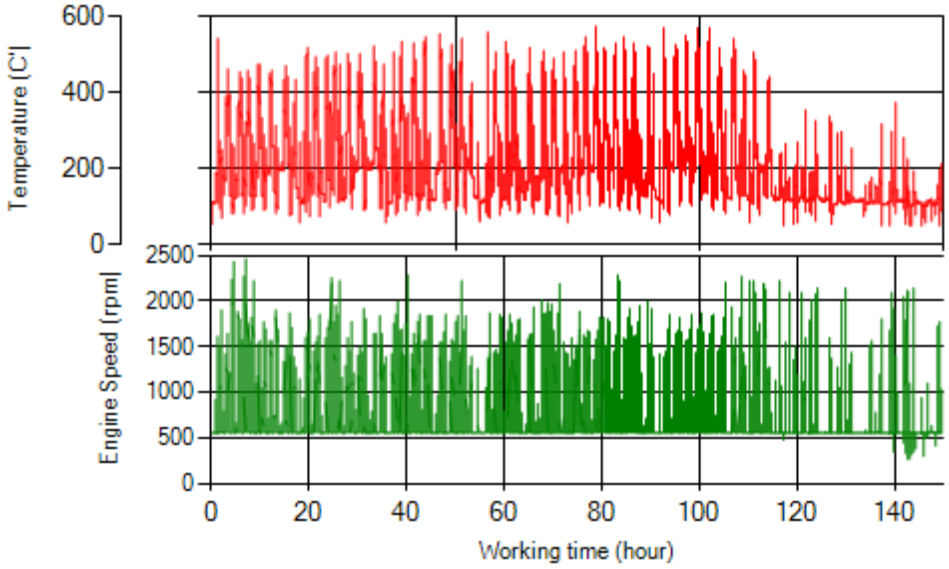


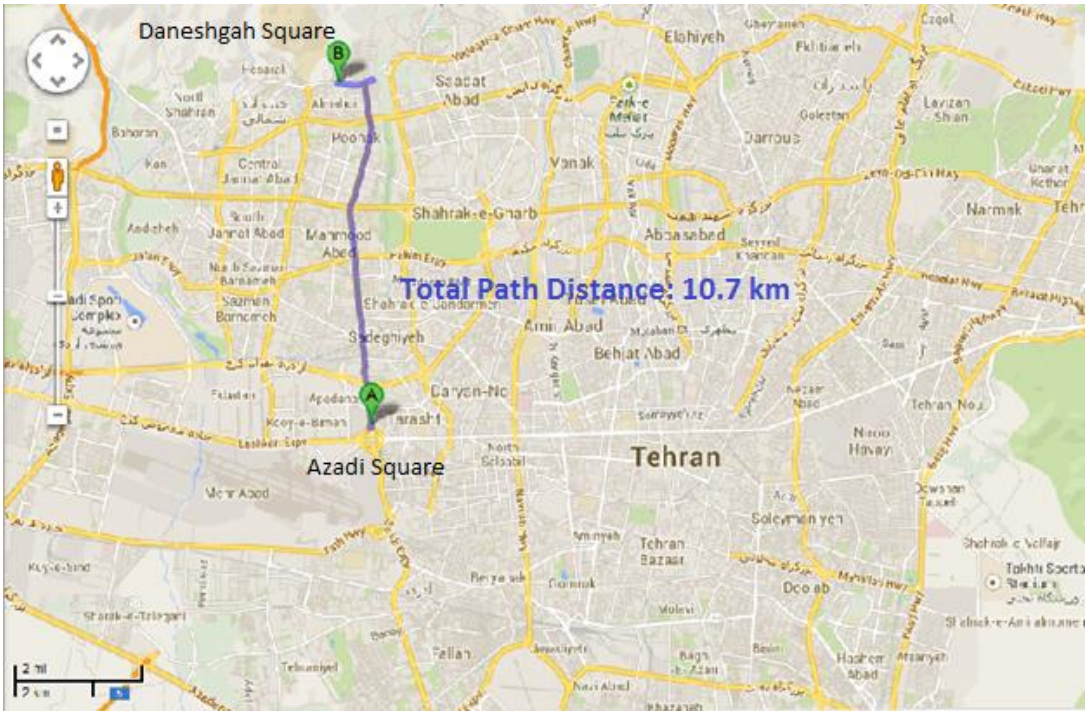
Figure 16- T, N distribution vs. working hours

Filter Operation Analysis

- As depicted in figure 1, pressure above 150 mbar was not observed during this period.
- It can be obviously observed that 7.9% of total working-time temperature is above 400 ℃ and 12.9% above 350℃.

Filter operation status	Excellent ■ Good ☐ Maintenance required ☐ Failed☐

Vehicle plate number	85182
Bus line	Number 10 (south to north Bus line)
DPF producer company	Tehag_01 (Catalyzed DPF)



Overall Information

Table1- Overall Information

Vehicle plate number	85182
CPK data logger number	LN: 001502, DN: 1999
Bus line	Number 10 (south to north Bus line)
Bus Terminals	Azadi square - Daneshgah square
Total path distance	10.7 km
DPF producer company	Tehag_01 (Catalyzed DPF)
Installation date	24/Sep/2015
Report period	01/Feb/2016 – 15/Feb/2016 (fifteen days)
K value - DPF upstream	1.85 [1/m]
K value – DPF downstream	0.04 [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	Filter have been working from installation date without any cleaning.
Dosing status	This system doesn't use additive.

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	7499 km
Bus mileage over the period	405 km
Working days over the period	7 days
Stop days	8 days
Data logger working days	7 days
Working hours over the period	86 hours 0 minutes
Average working hours per day (including stop days)	5 hours 43 minutes
Bus average speed	4.7 km/hr
idle speed time to all working time ration	74.97 %
Total Bus fuel consumption over the period	284 lit
Fuel consumption per hour	3.3 lit/hr
Average fuel consumption	0.7 lit/km

Temperature, Pressure and Engine Speed Overview

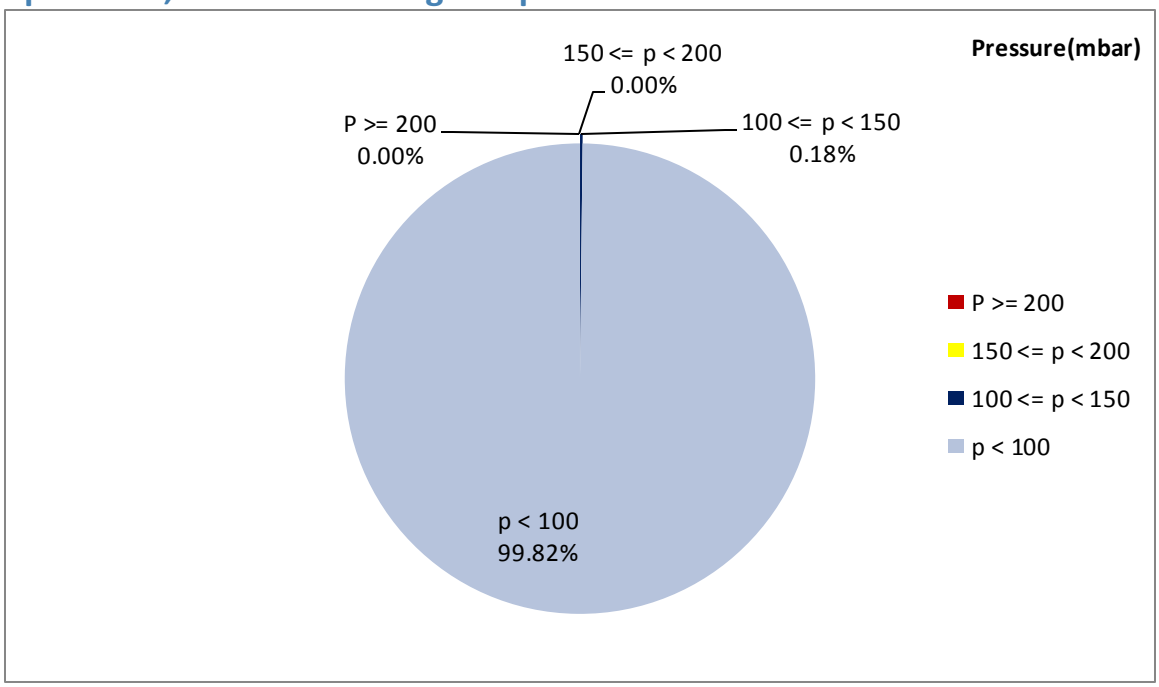


Figure 1- Pressure distribution over the working hours

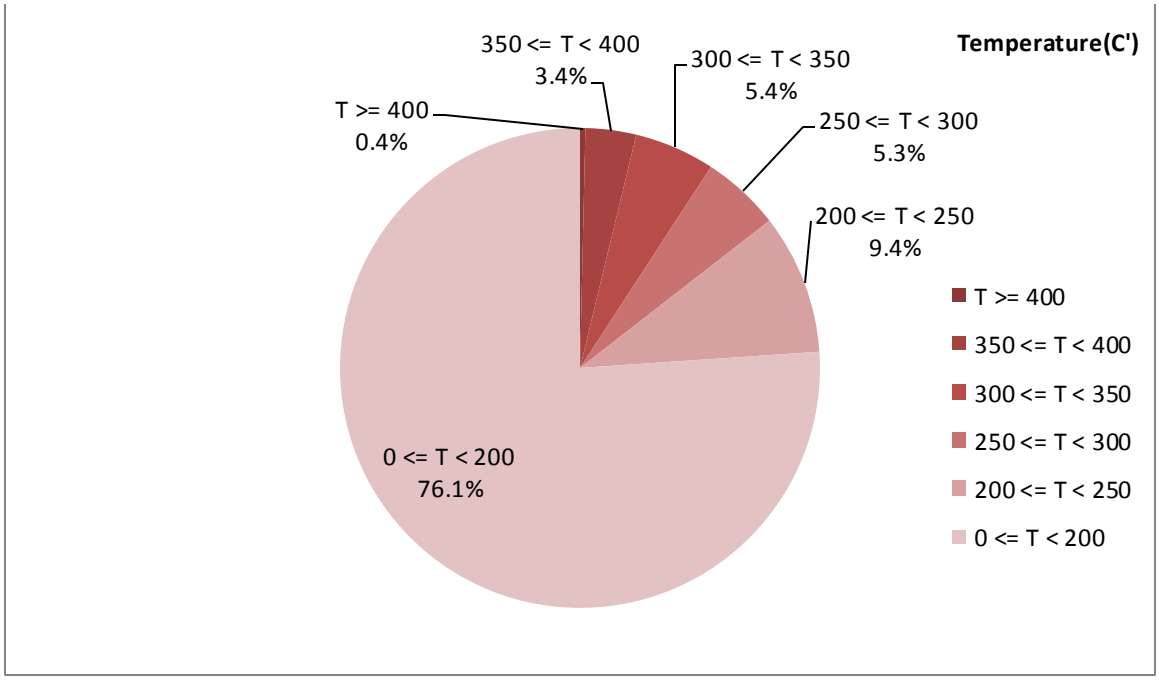


Figure 2-Temperature distribution over the working hours

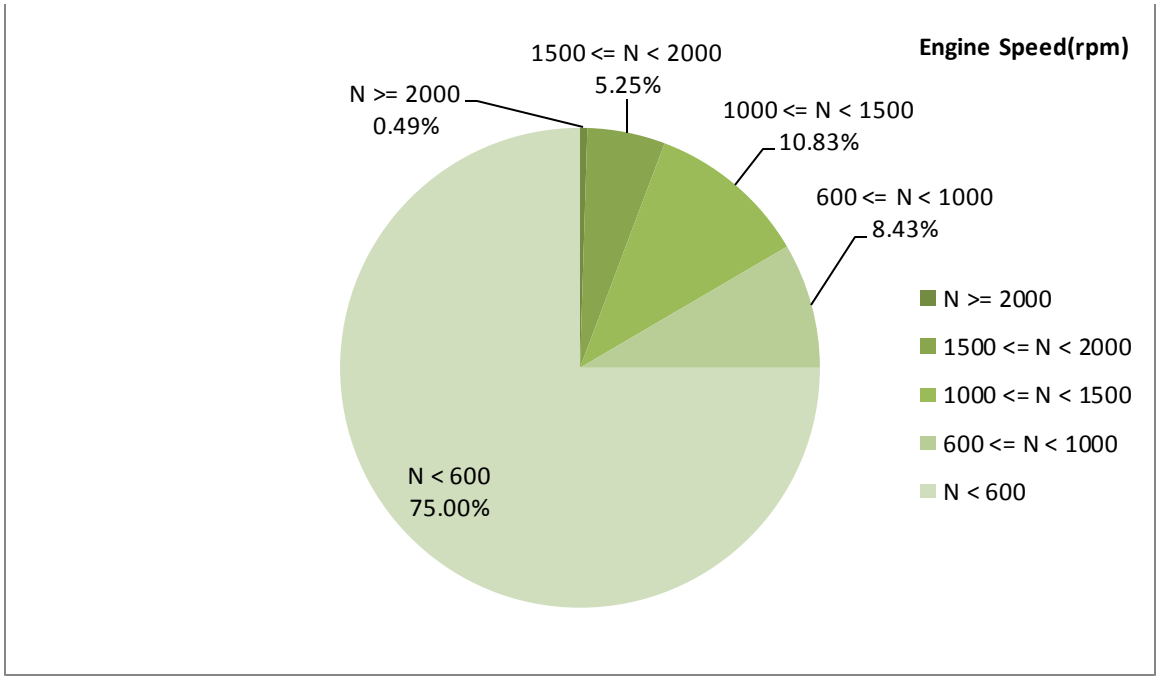


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
167.82	6.48	716

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
242.29	20.63	1197

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
438-50	138-0	2192-272

Detailed Pressure Analysis

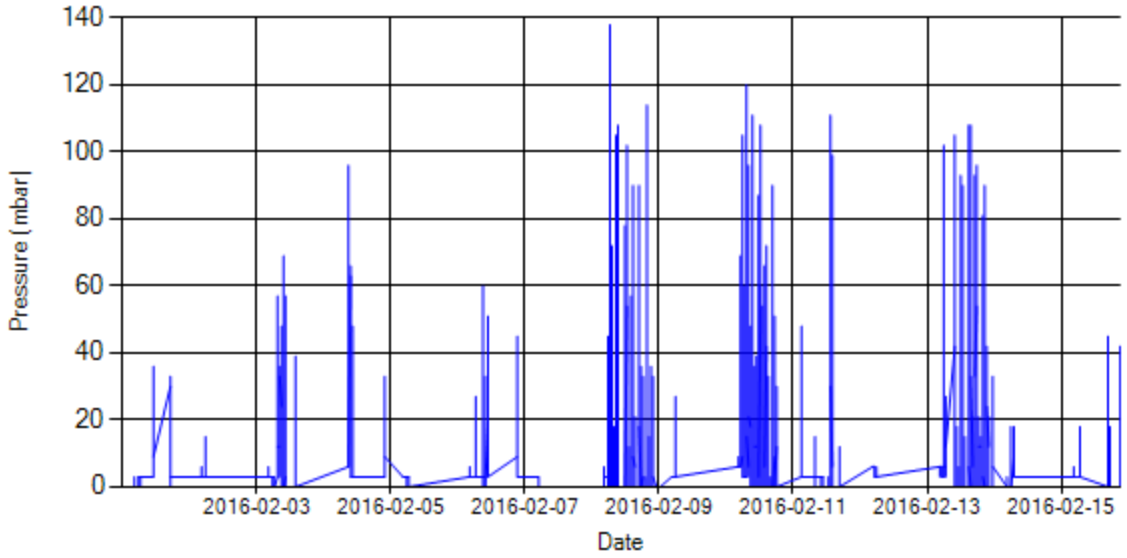


Figure 4- Pressure distribution over the period

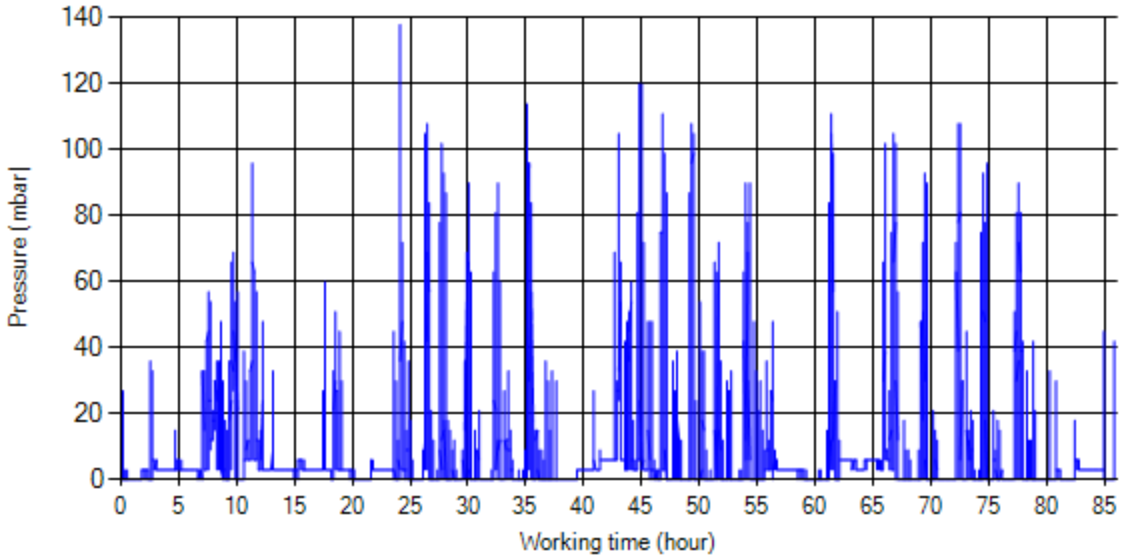


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

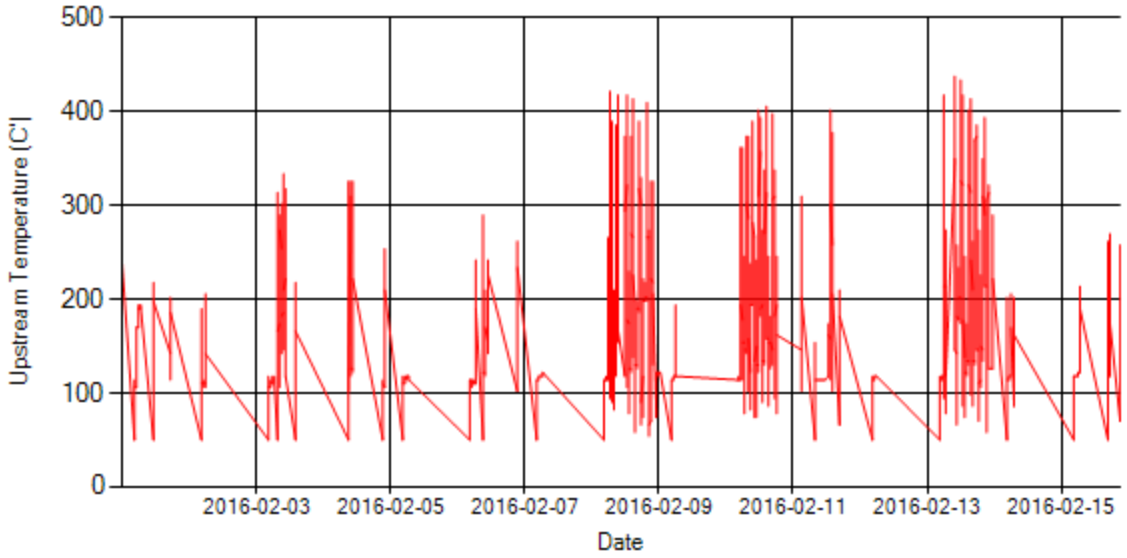


Figure 6- Temperature distribution over the period

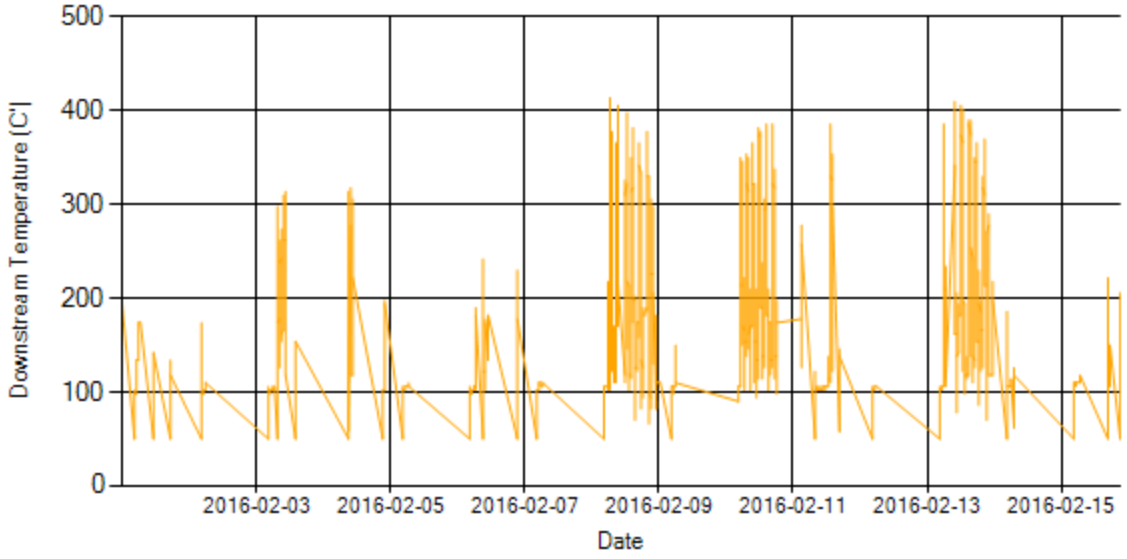


Figure 7- Temperature distribution over the period

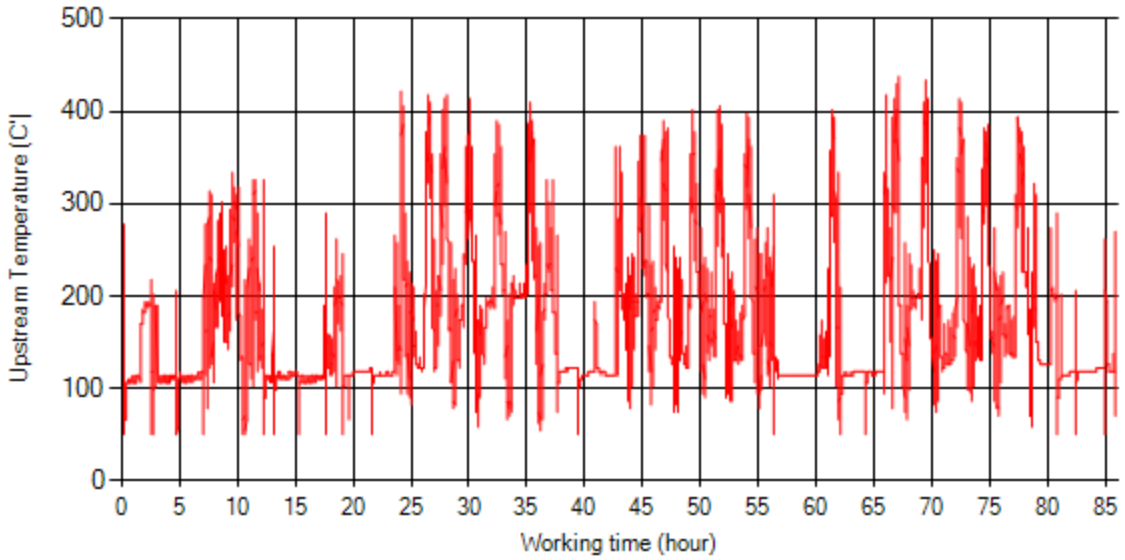


Figure 8- Temperature vs. working hours

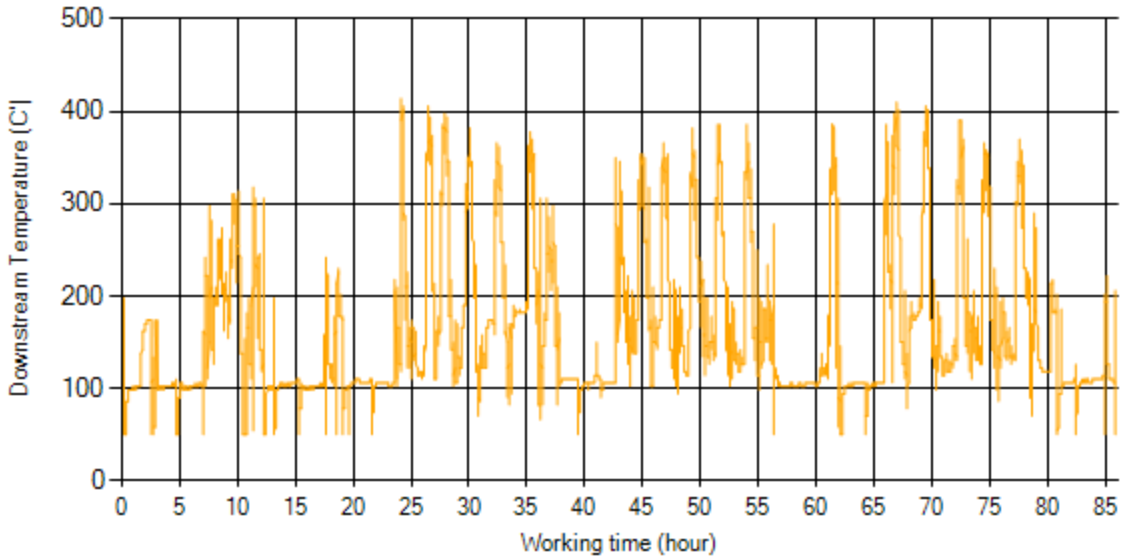


Figure 9- Temperature vs. working hours

Engine Speed Diagrams

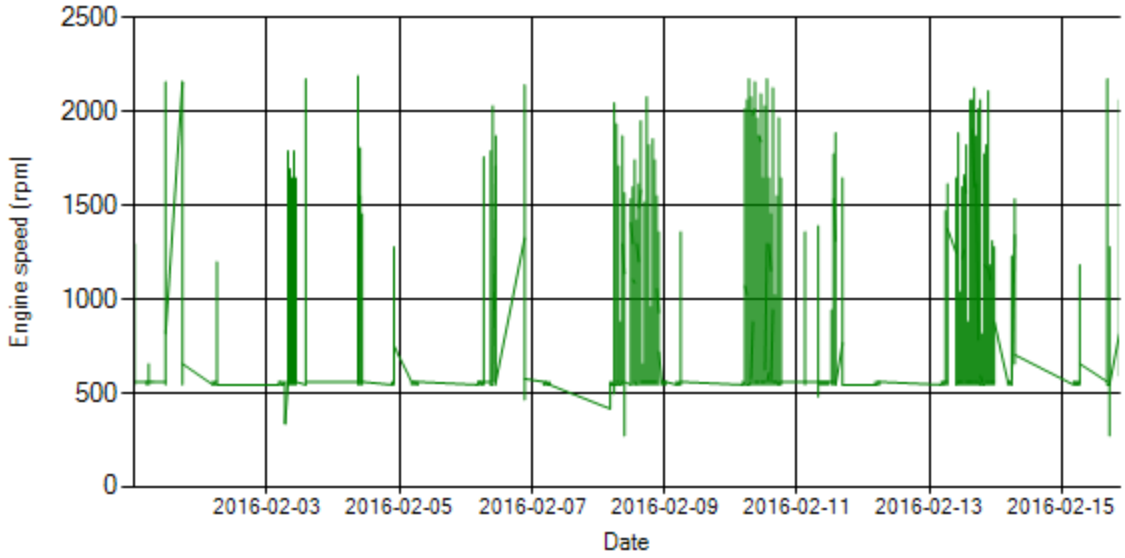


Figure 10- Engine speed distribution over the period

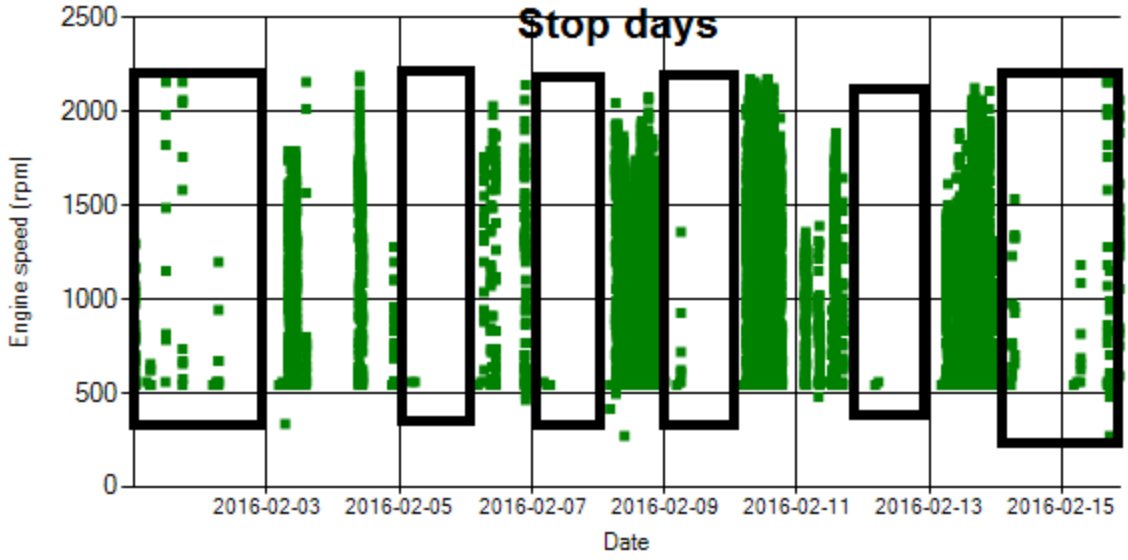


Figure 11- Engine speed diagram for calculating CPK's working days

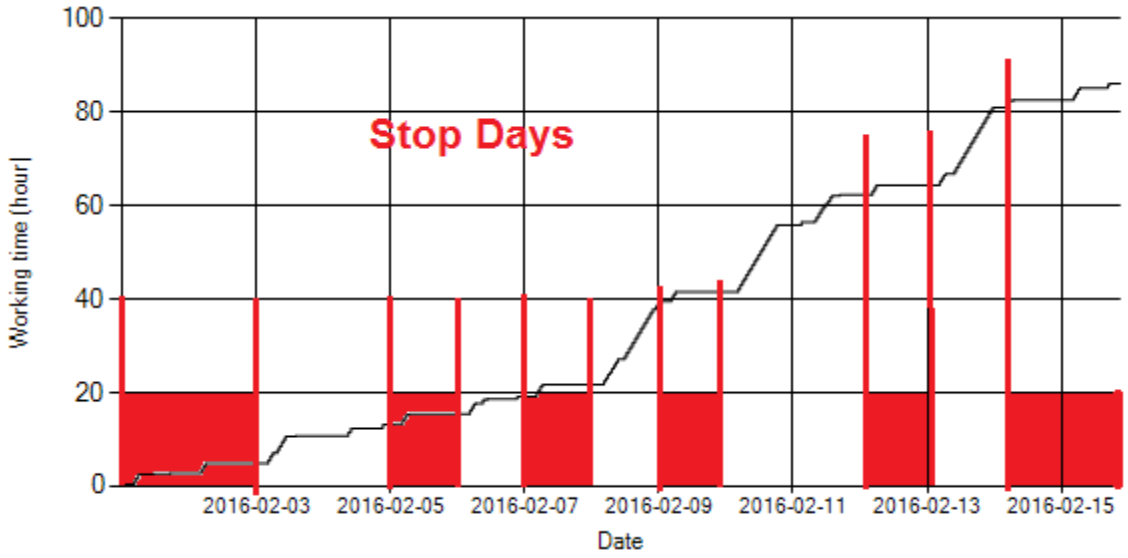


Figure 12- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data.

Pressure-Engine Speed diagrams

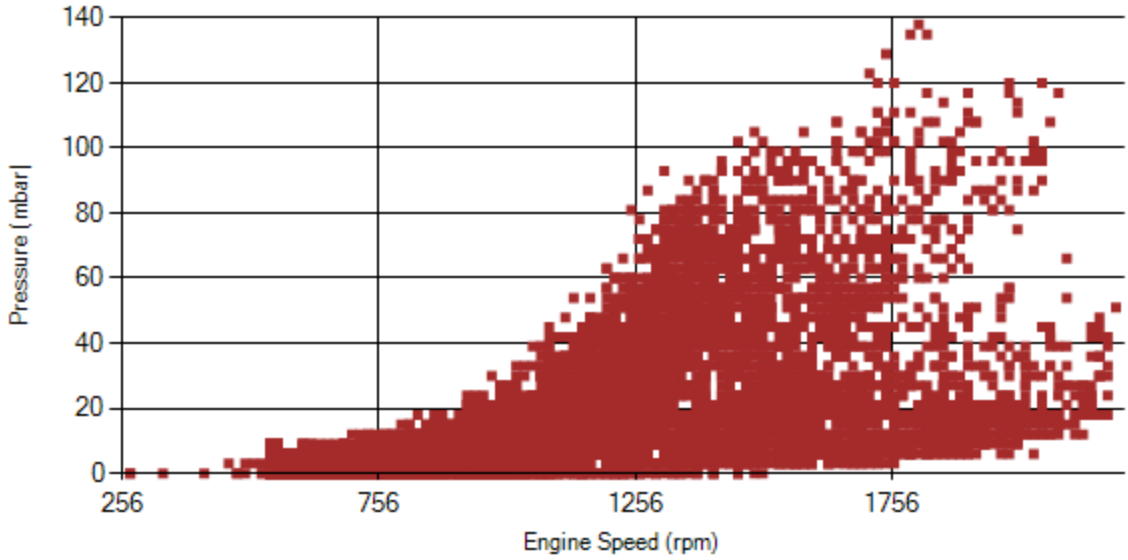


Figure 13- Pressure against engine speed

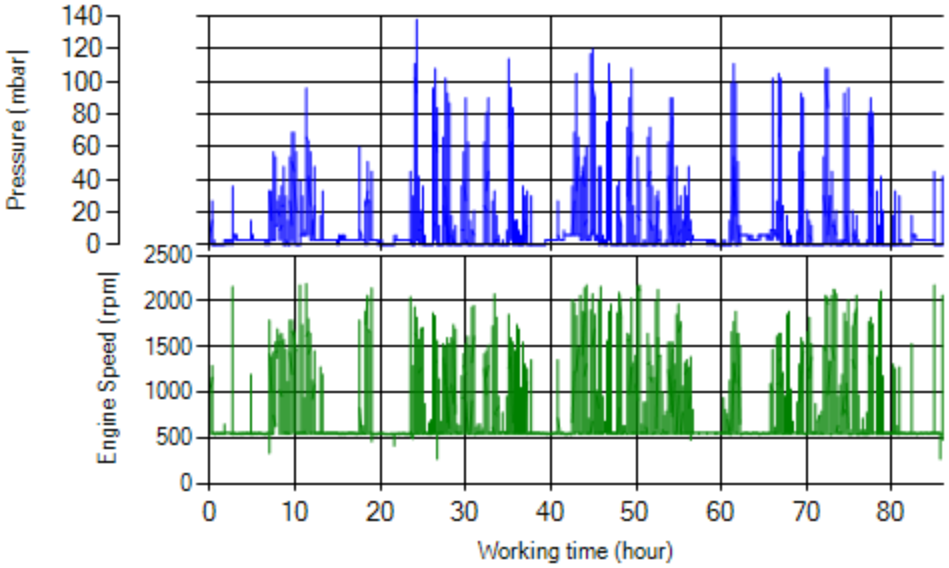


Figure 14- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

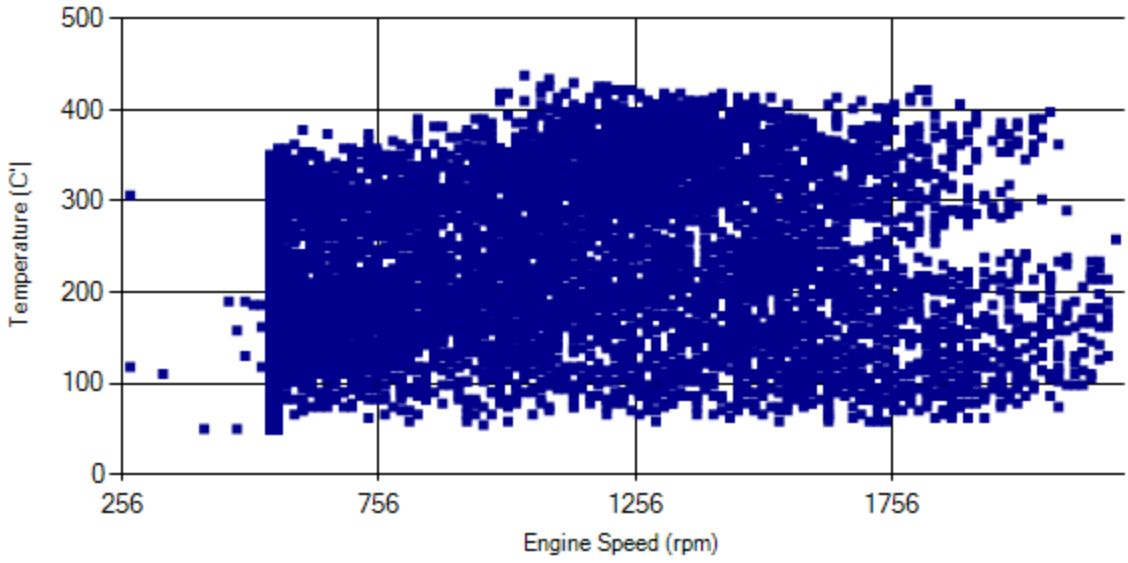


Figure 15- Temperature against engine speed

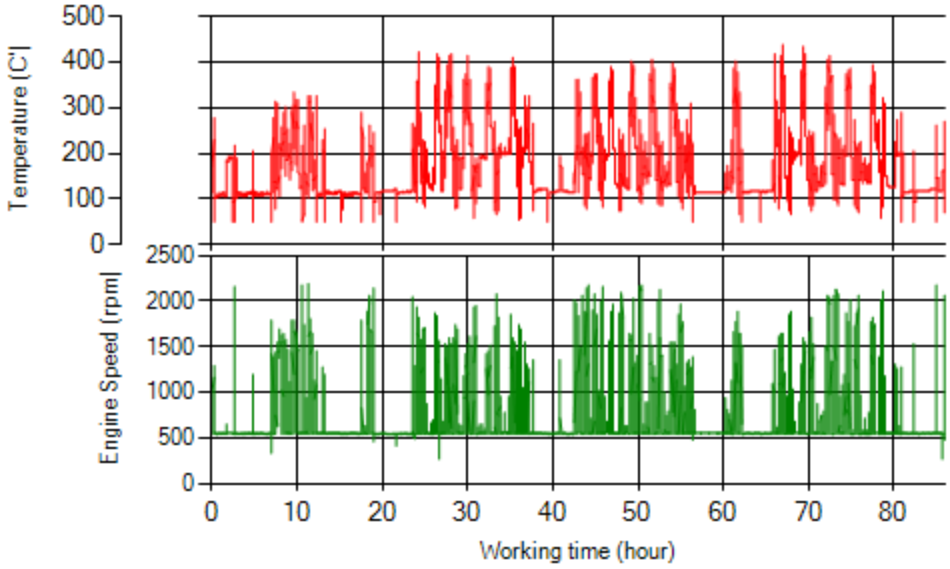


Figure 16- T, N distribution vs. working hours

Filter Operation Analysis

- As depicted in figure 1, only 0.18% of working time pressure was above 100 mbar during this period.
- Figure 2, 17 display flow temperature distribution for DPF's upstream. It can be obviously observed that 3.8% of total working-time temperature is above 350 °C and 14.1% above 250°C.

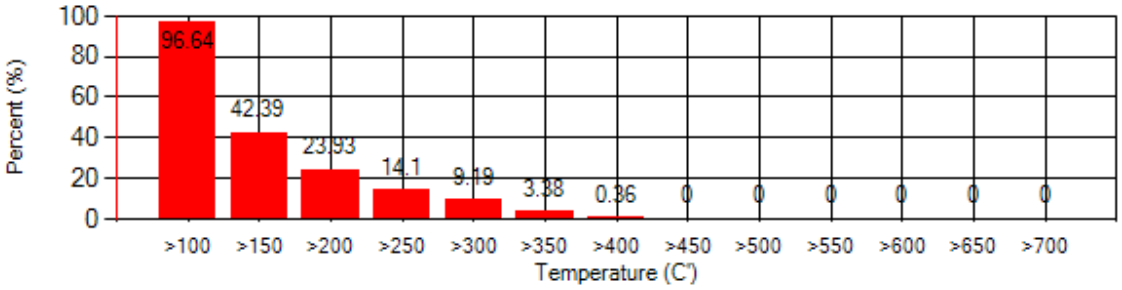


Figure 17. Cumulative diagram of exhaust gas temperature

Filter operation status	Excellent ■	Good ☐
	Maintenance required ☐	Failed☐

Overall Information

Table1- Overall Information

Vehicle plate number	85182
CPK data logger number	LN: 001502, DN: 1999
Bus line	Number 10 (south to north Bus line)
Bus Terminals	Azadi square - Daneshgah square
Total path distance	10.7 km
DPF producer company	Tehag_01 (Catalyzed DPF)
Installation date	24/Sep/2015
Report period	16/Feb/2016 – 29/Feb/2016 (fourteen days)
K value - DPF upstream	1.85 [1/m]
K value – DPF downstream	0.04 [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	Filter have been working from installation date without any cleaning.
Dosing status	This system doesn't use additive.

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	7989 km
Bus mileage over the period	490 km
Working days over the period	5 days
Stop days	9 days
Data logger working days	5 days
Working hours over the period	80 hours 17 minutes
Average working hours per day (including stop days)	5 hours 43 minutes
Bus average speed	6.13 km/hr
idle speed time to all working time ration	76.42 %
Total Bus fuel consumption over the period	338 lit
Fuel consumption per hour	4.21 lit/hr
Average fuel consumption	0.69 lit/km

Temperature, Pressure and Engine Speed Overview

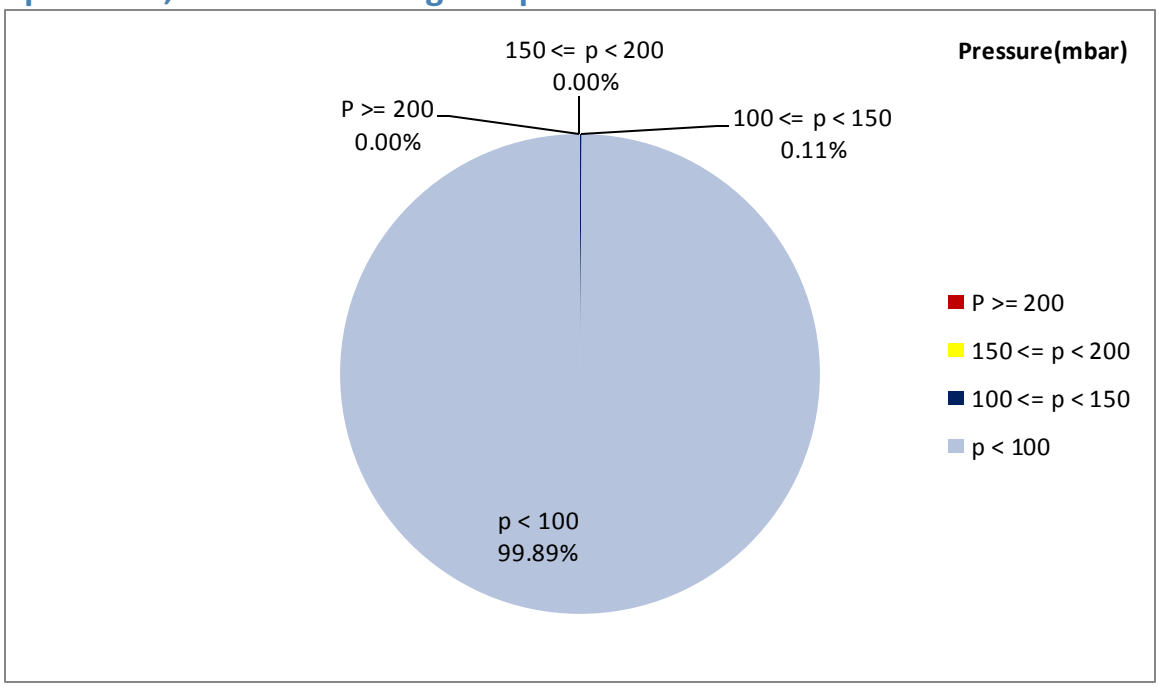


Figure 1- Pressure distribution over the working hours

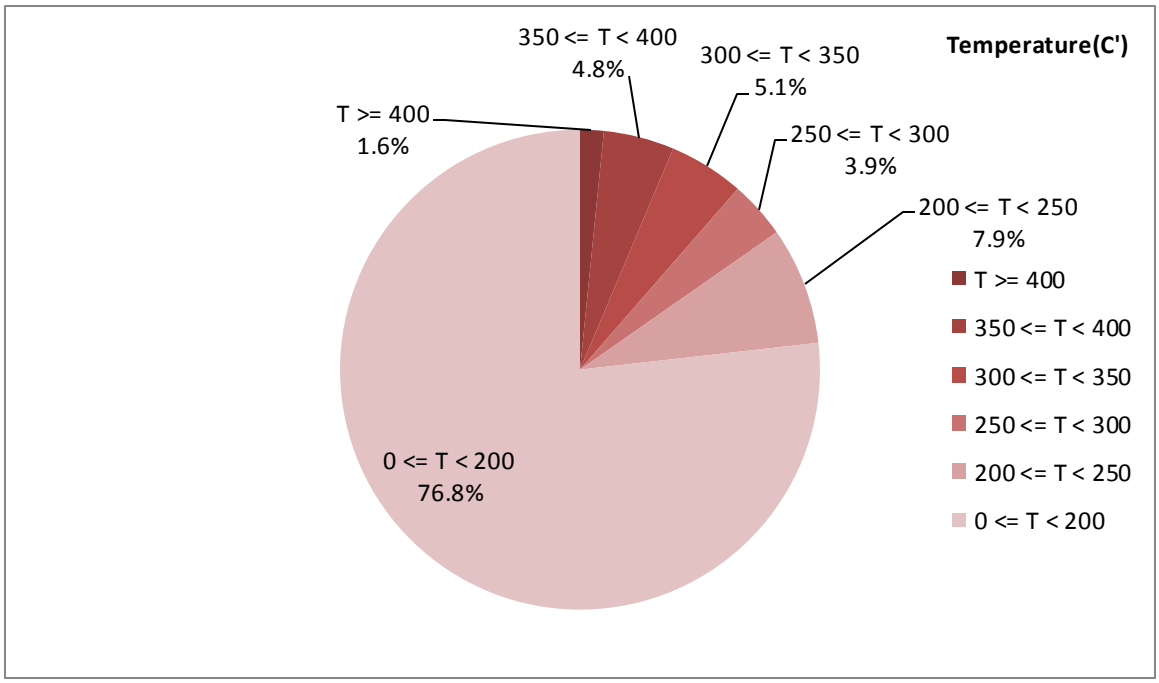


Figure 2-Temperature distribution over the working hours

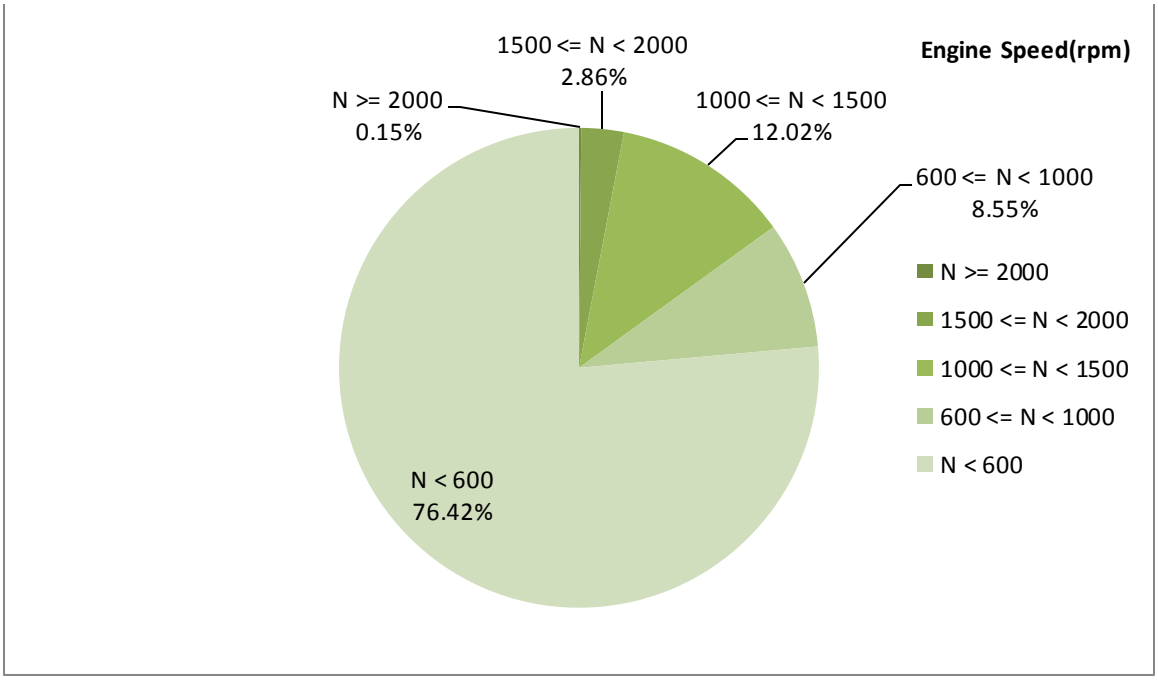


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
170.32	4.25	691

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
255.44	15.66	1123

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
470-50	126-0	2208-528

Detailed Pressure Analysis

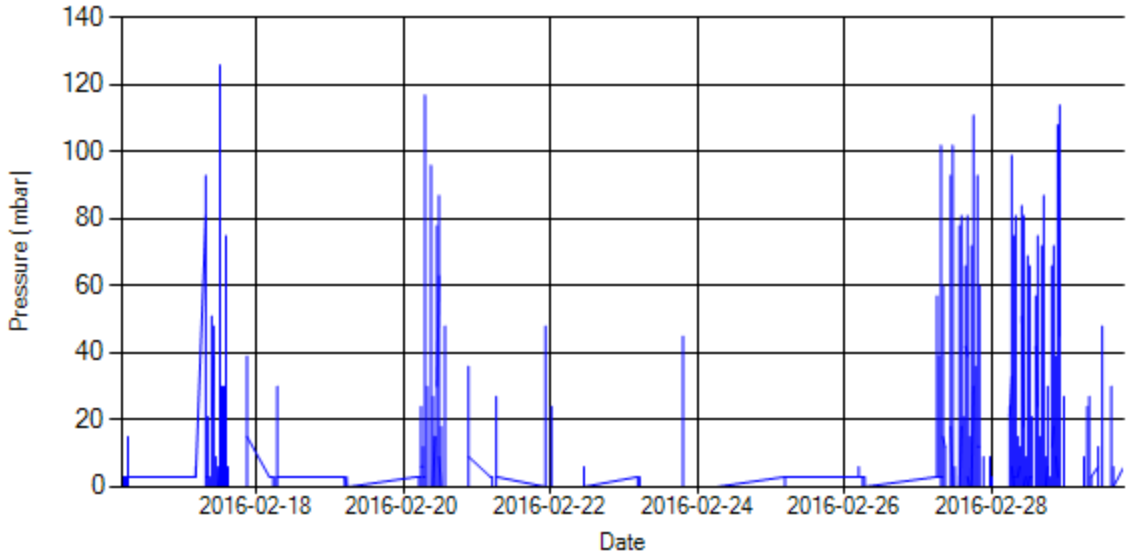


Figure 4- Pressure distribution over the period

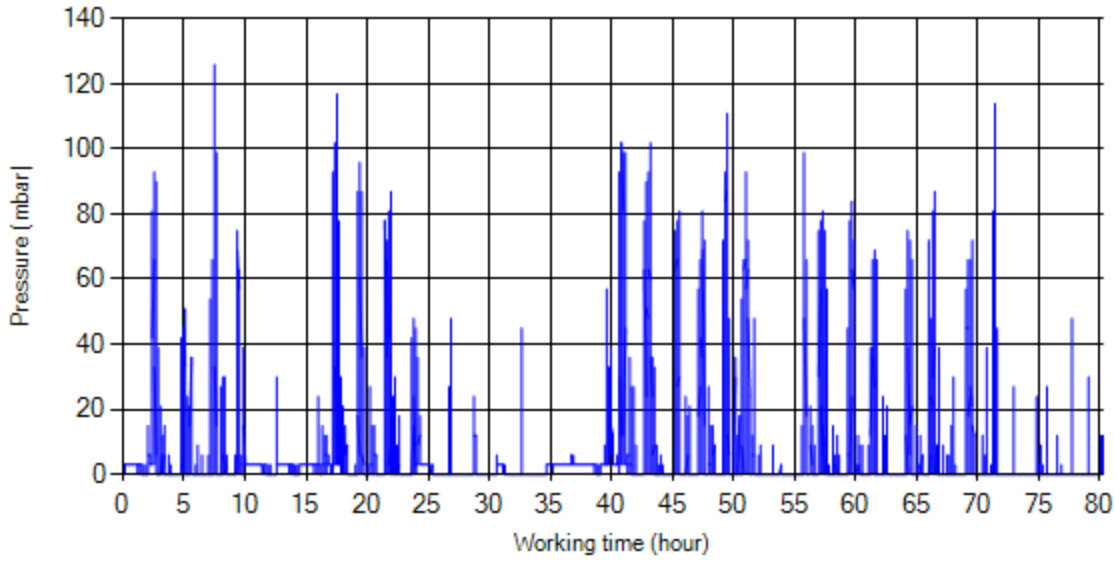


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

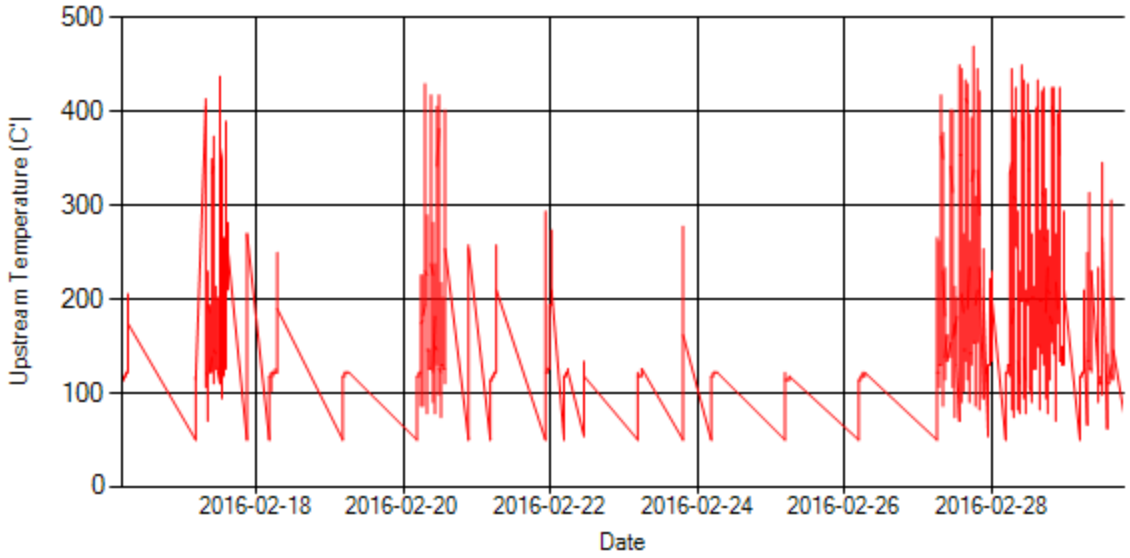


Figure 6- Temperature distribution over the period

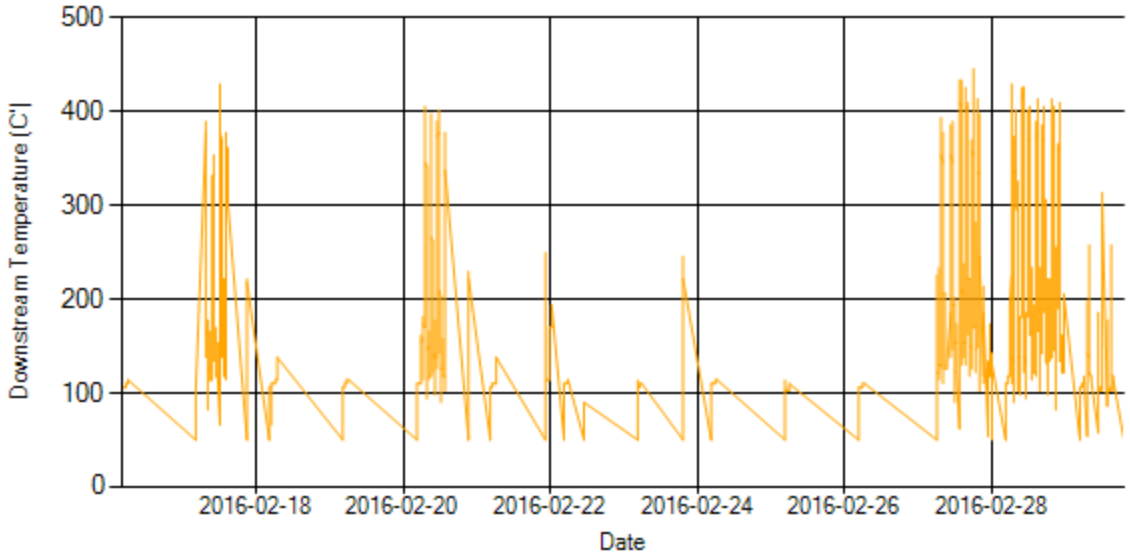


Figure 7- Temperature distribution over the period

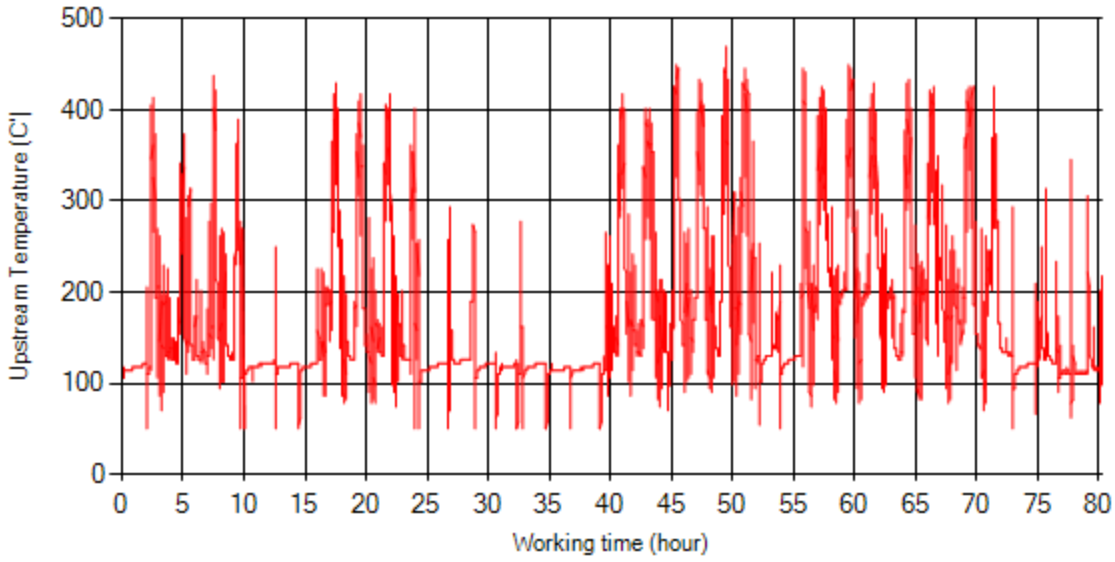


Figure 8- Temperature vs. working hours

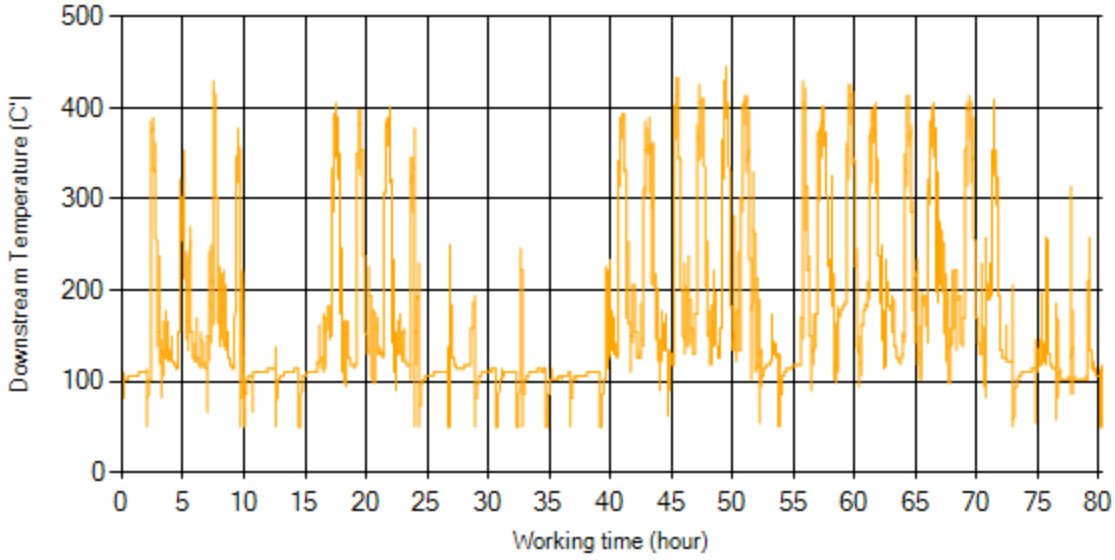


Figure 9- Temperature vs. working hours

Engine Speed Diagrams

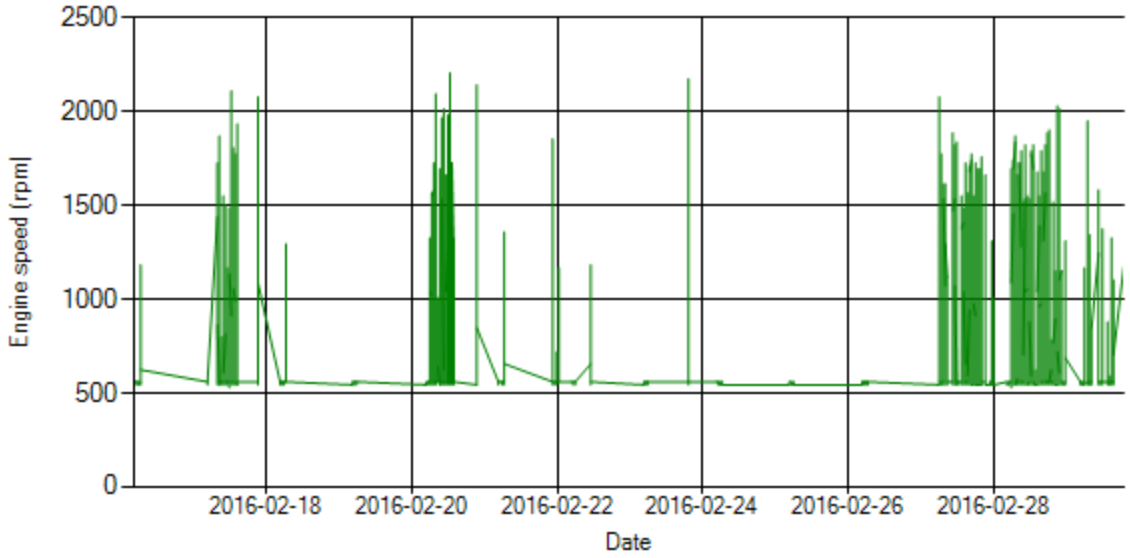


Figure 10- Engine speed distribution over the period

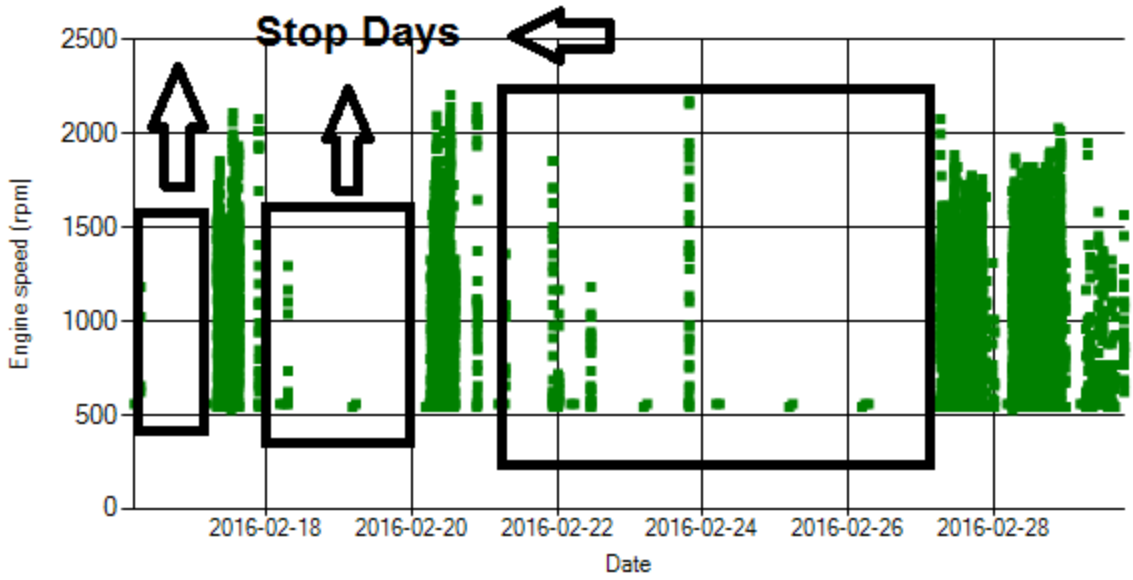


Figure 11- Engine speed diagram for calculating CPK's working days

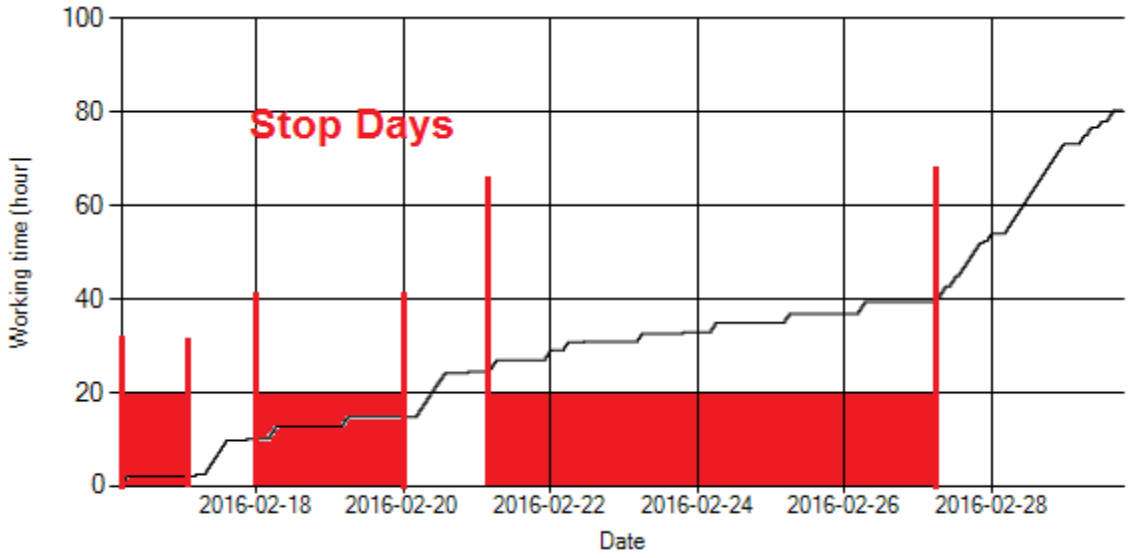


Figure 12- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data. As depicted in Figure 12, bus was approximately stationary for 9 days.

Pressure-Engine Speed diagrams

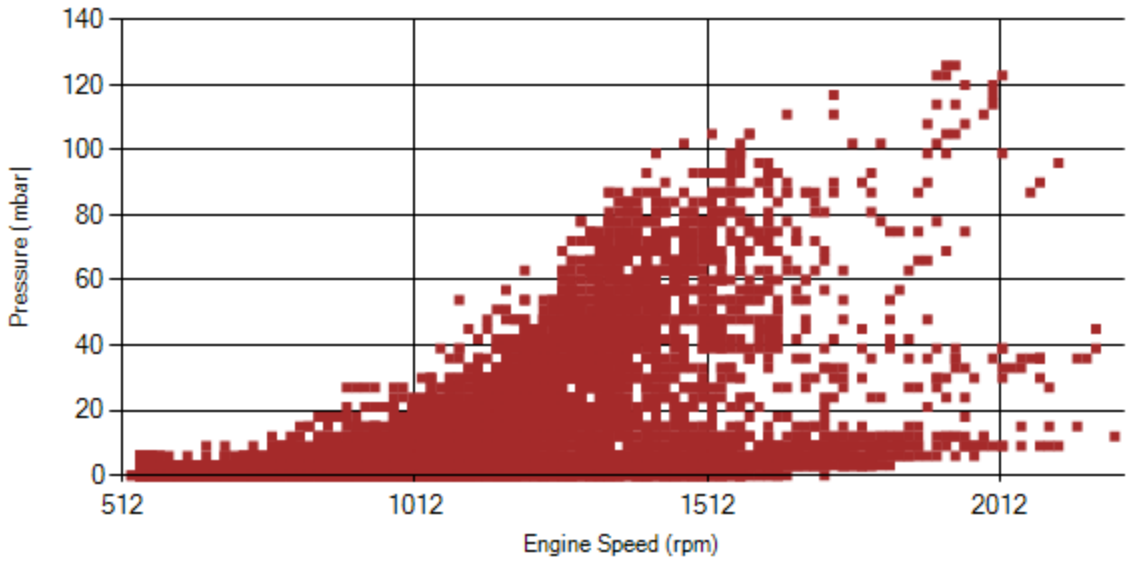


Figure 13- Pressure against engine speed

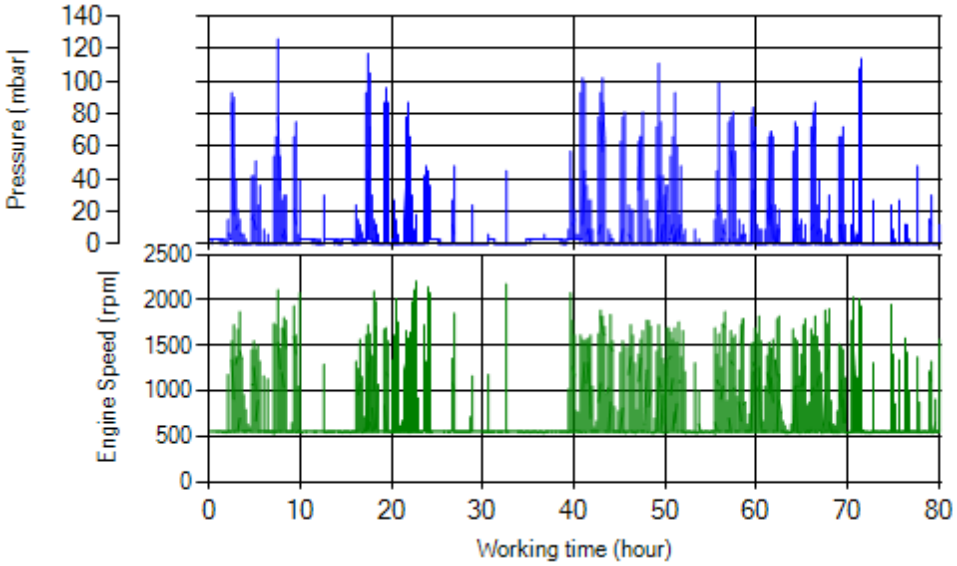


Figure 14- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

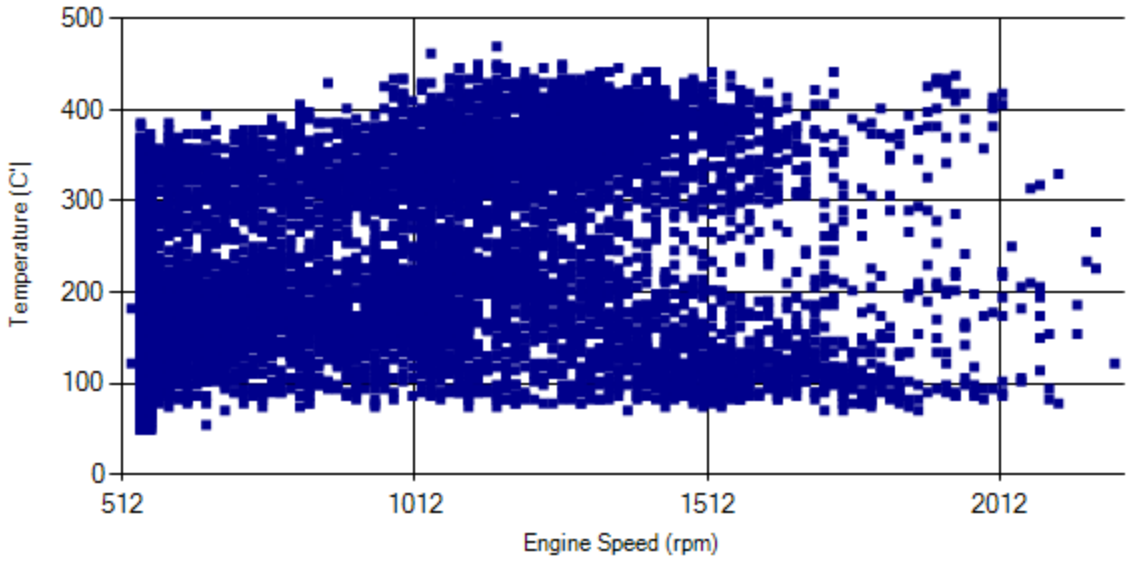


Figure 15- Temperature against engine speed

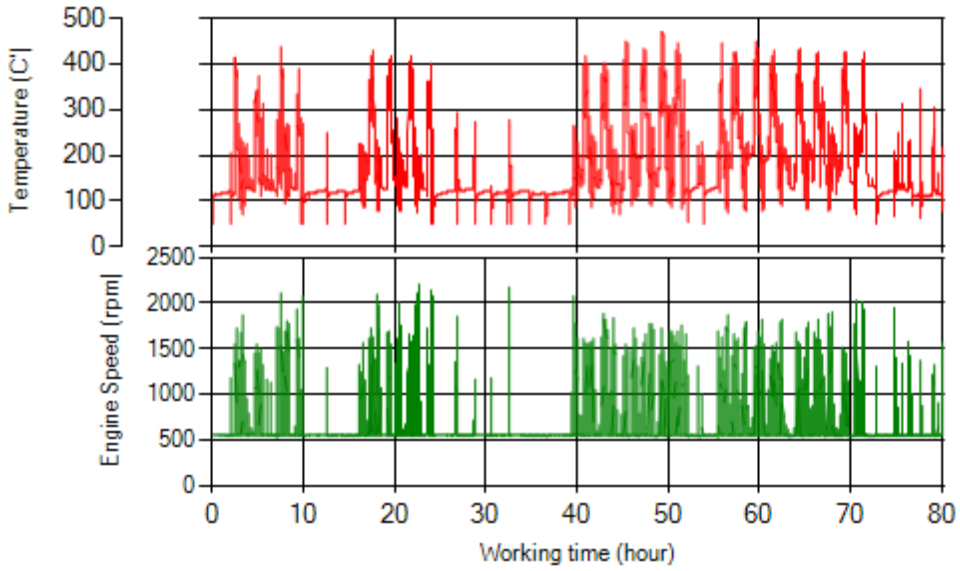


Figure 16- T, N distribution vs. working hours

Filter Operation Analysis

- As depicted in figure 1, only 0.11% of working time pressure was above 100 mbar during this period.
- Figure 2, 17 display flow temperature distribution for DPF's upstream. It can be obviously observed that 5.33% of total working-time temperature is above 350 ℃ and 15.03% above 250℃.

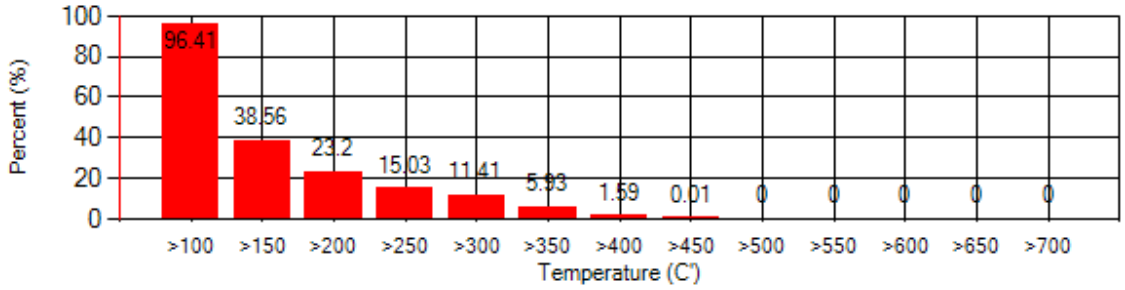
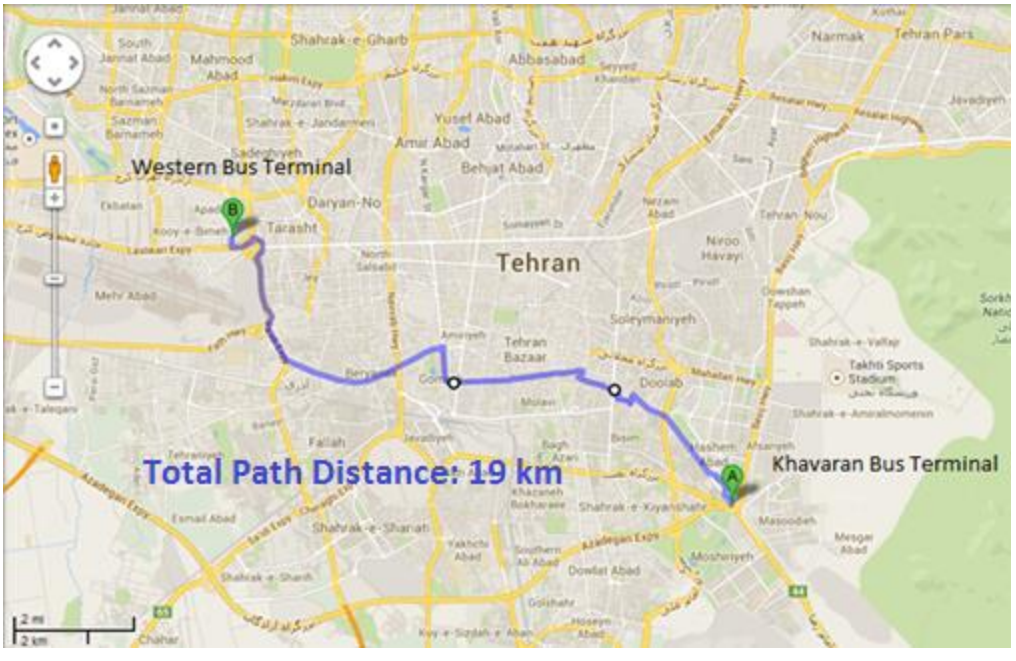


Figure 17. Cumulative diagram of exhaust gas temperature

Filter operation status	Excellent ■	Good ☐
	Maintenance required ☐	Failed☐

Vehicle plate number	33592 (32441)
Bus line	Number 2 (west to east bus line)
DPF producer company	Tehag_02 (CDPF)



Overall Information

Table1- Overall Information

Vehicle plate number	33592 (32441)
CPK data logger number	LN: 001506, DN: 1927
Bus line	Number 2 (west to east bus line)
Bus Terminals	Khavaran Bus Terminal - Western Bus Terminal
Total path distance	19 km
DPF producer company	Tehag_02 (Catalyzed DPF)
Installation date	25/Jan/2016
Report period	01/Feb/2016- 15/Feb/2016 (fifteen days)
K value - DPF upstream	1.62 [1/m]
K value – DPF downstream	0.02 [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	Filter have been working from installation date without any cleaning.
Dosing status	This system doesn't use additive.

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	2025 km
Bus mileage over the period	1690 km
Working days over the period	12 days
Stop days	3 days
Data logger working days	7 days
Working hours over the period	-
Average working hours per day (including stop days)	-
Bus average speed	-
idle speed time to all working time ration	65.58 %
Total Bus fuel consumption over the period	1014 lit
Fuel consumption per hour	-
Average fuel consumption	0.6 lit/km

Notice: Data logger had problem during this period and was fixed on Feb 6th. So working hours and their relative parameters were left blank.

Temperature, Pressure and Engine Speed Overview

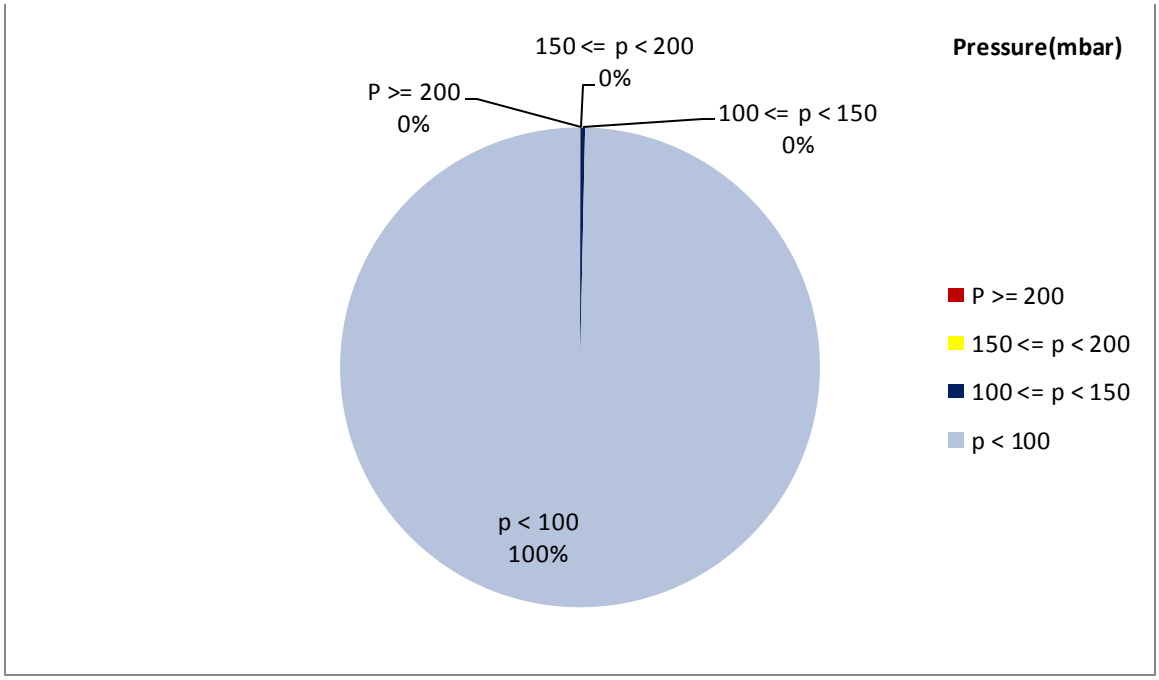


Figure 1- Pressure distribution over the working hours

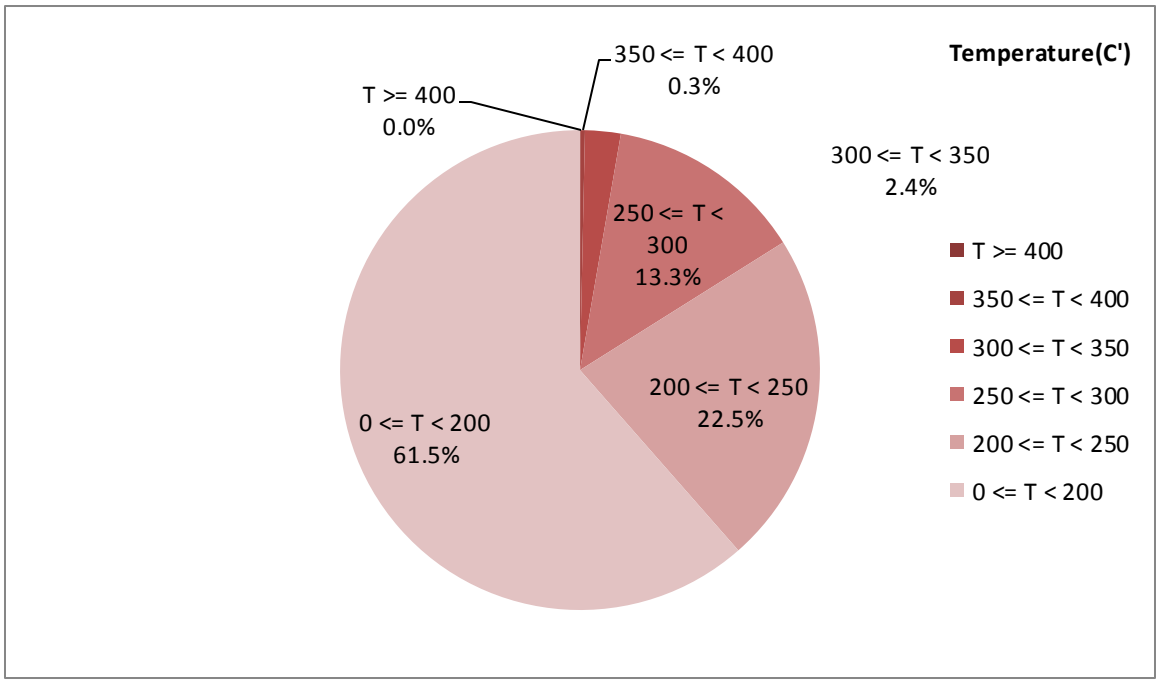


Figure 2-Temperature distribution over the working hours

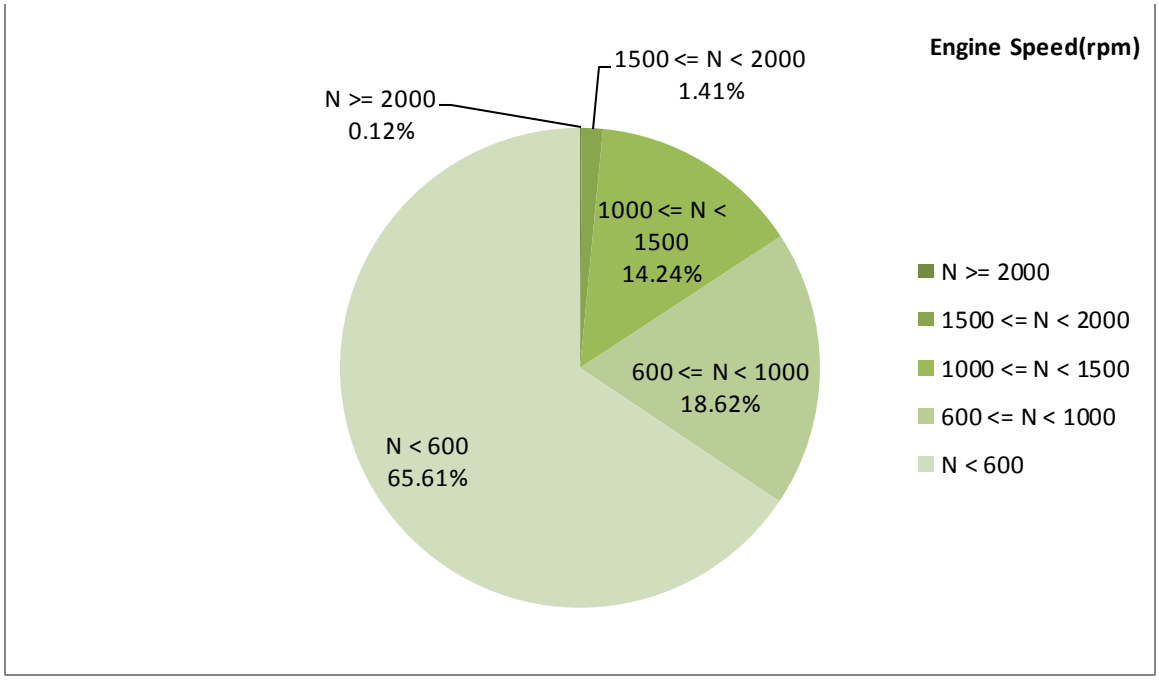


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
176.73	-	688

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
242.62	-	989

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
418-50	222-0	2096-256

Notice: pressure sensor had problem during this period and was fixed on Feb 9th. So pressure data was unreliable.

Detailed Pressure Analysis

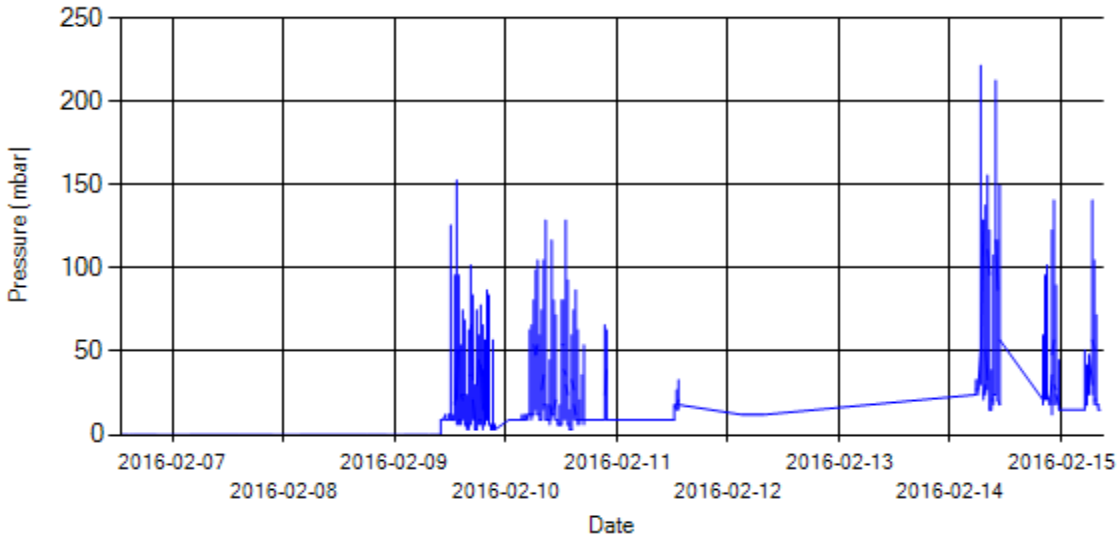


Figure 4- Pressure distribution over the period

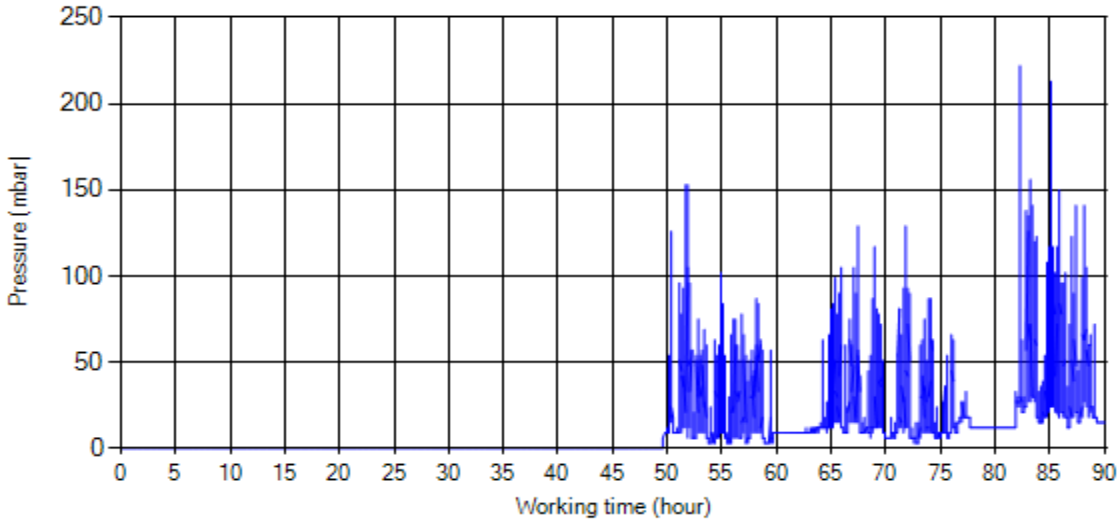


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Notice: System was stationary from 1st to 5th of the Feb. Also pressure sensor had problem during this period and was fixed on Feb 9th.

Detailed Temperature Analysis

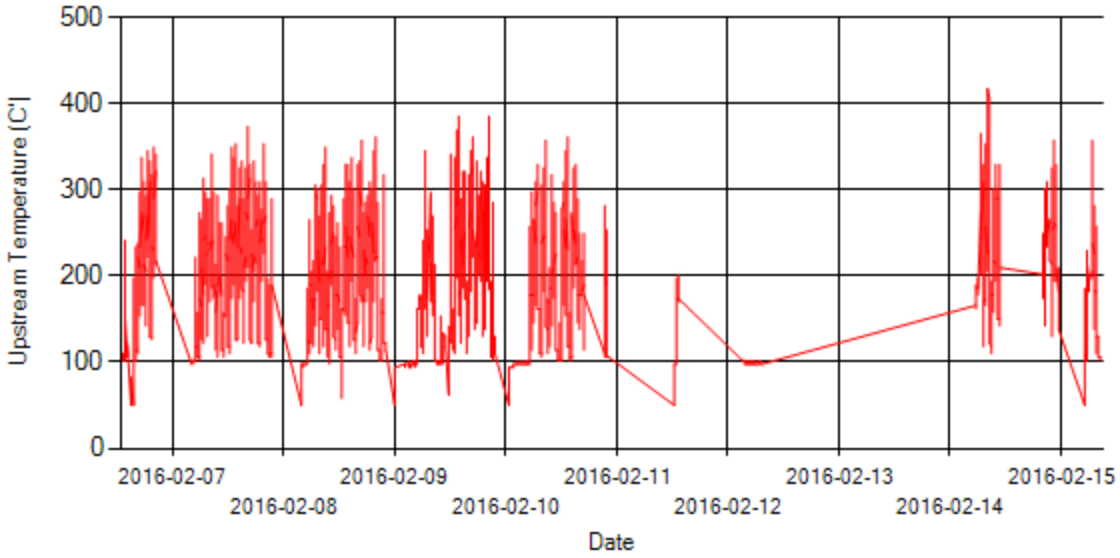


Figure 6- Temperature distribution over the period

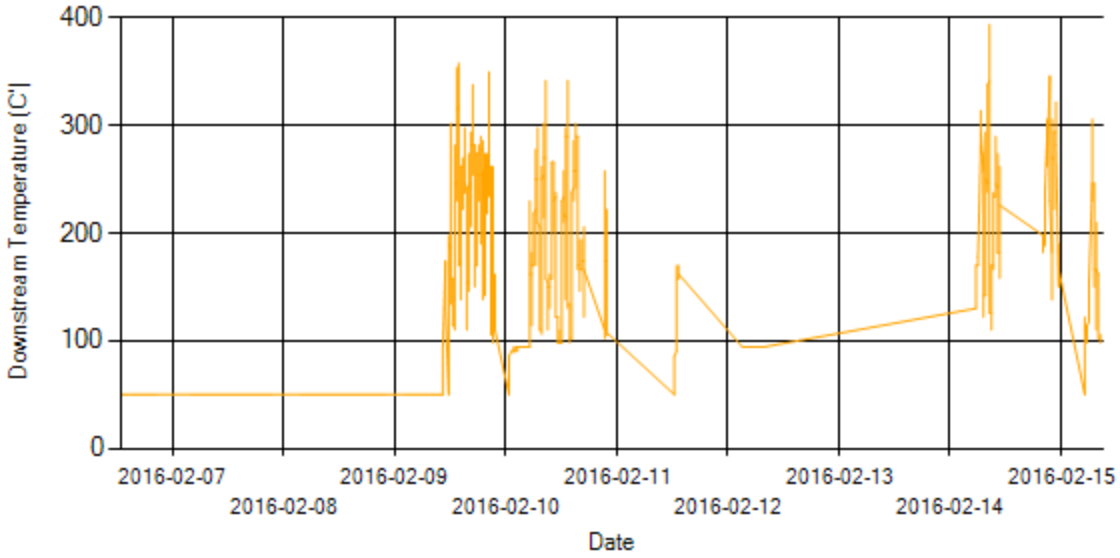


Figure 7- Temperature distribution over the period

Notice: Downstream temperature sensor had problem during this period and was fixed on Feb 9th.

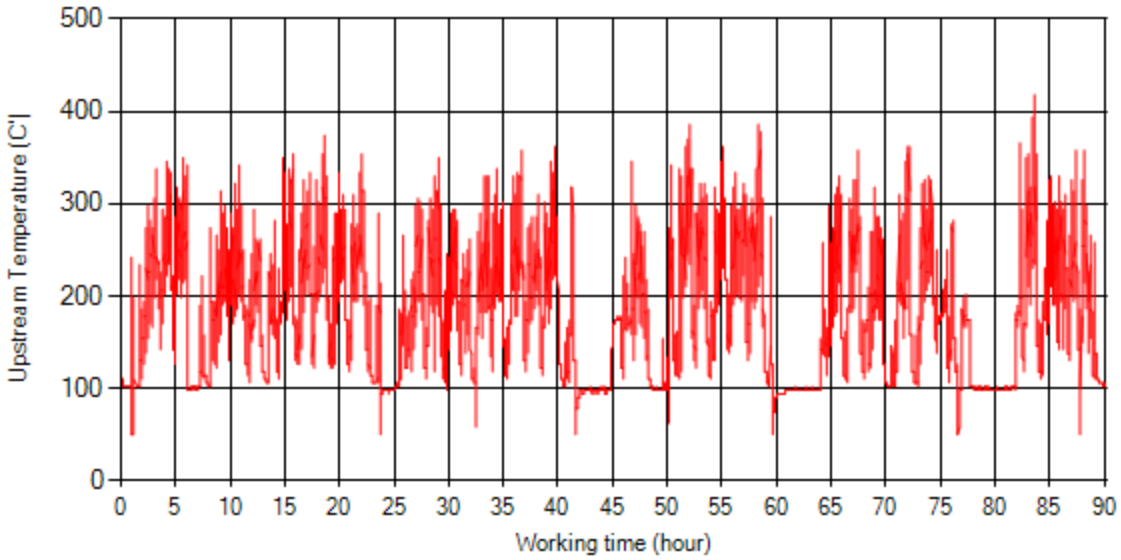


Figure 8- Temperature vs. working hours

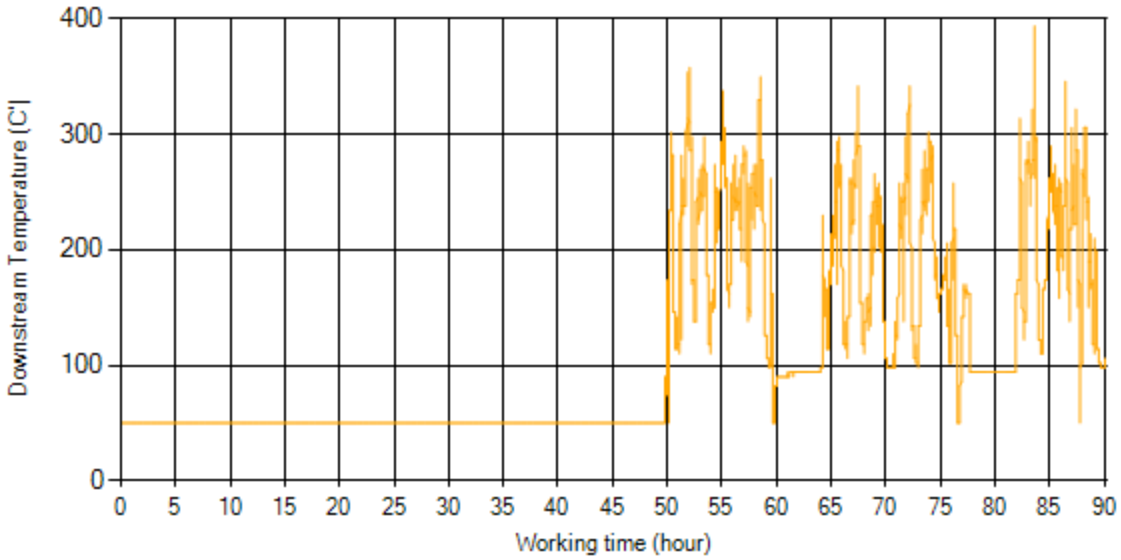


Figure 9- Temperature vs. working hours

Engine Speed Diagrams

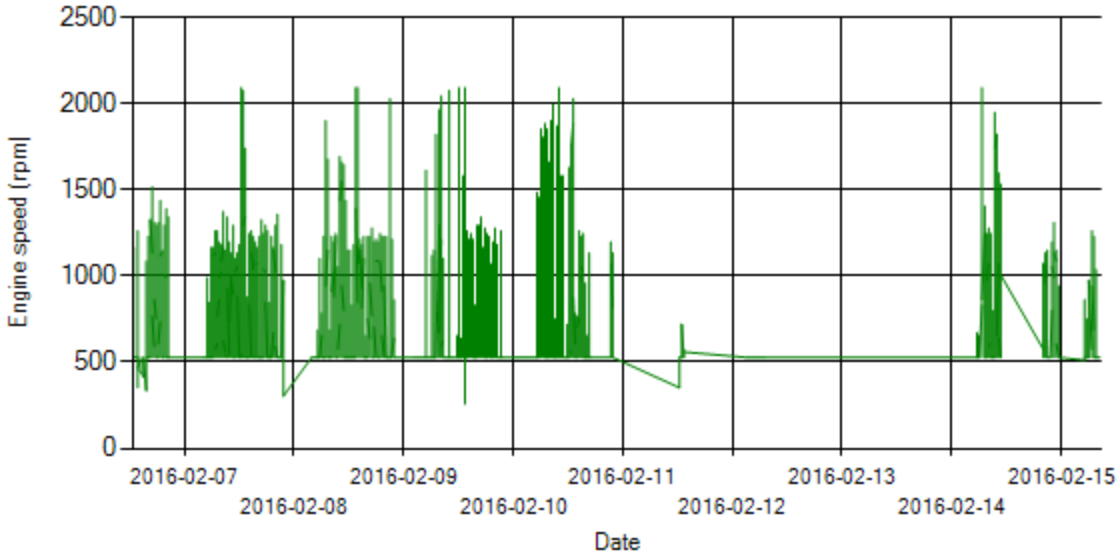


Figure 10- Engine speed distribution over the period

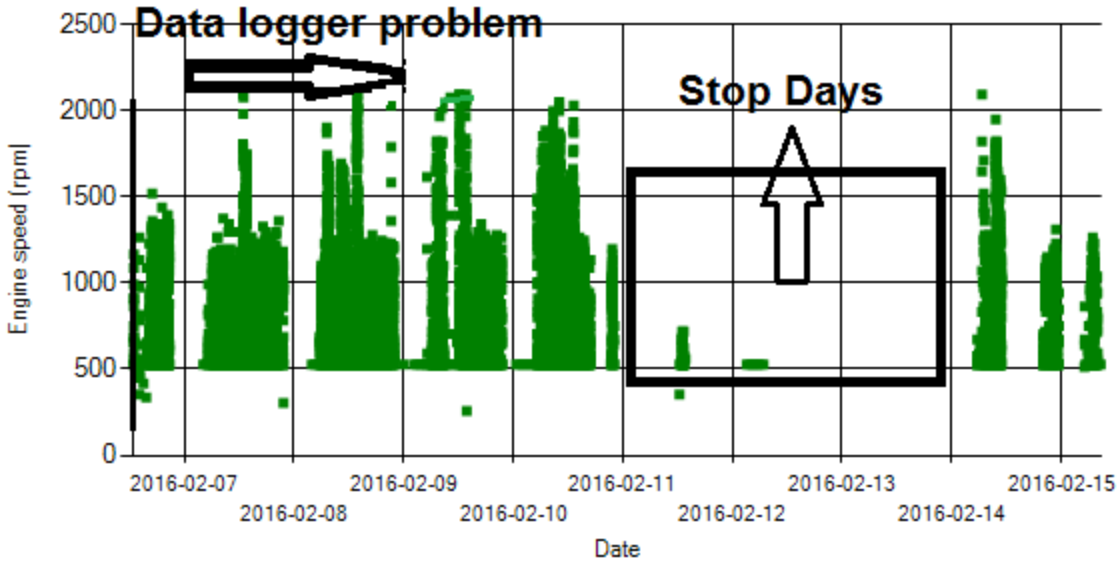


Figure 11- Engine speed diagram for calculating CPK's working days

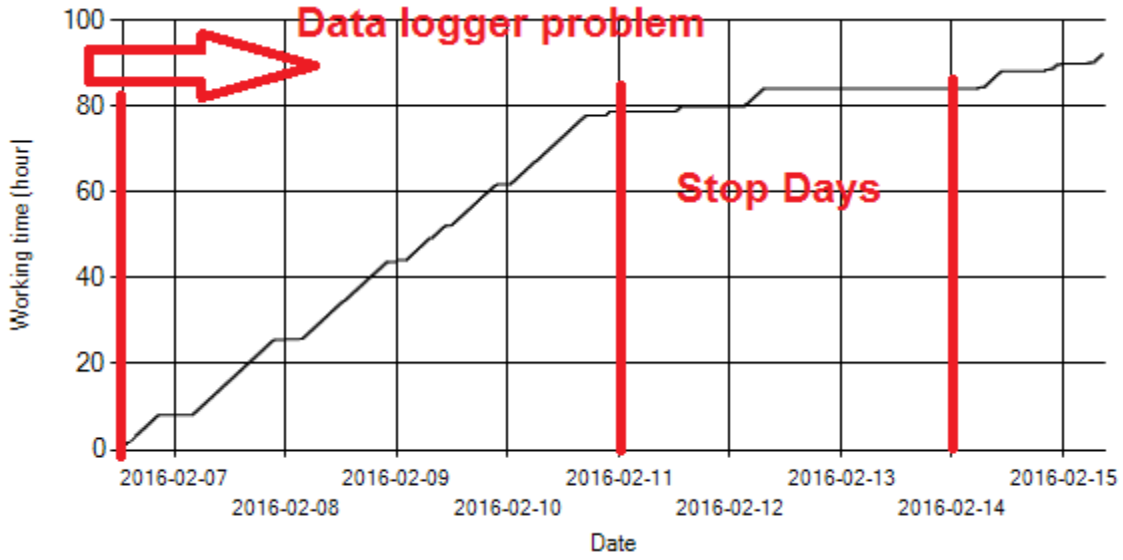


Figure 12- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data. As depicted in Figure 12, data logger only sampled data for 7 days.

Pressure-Engine Speed diagrams

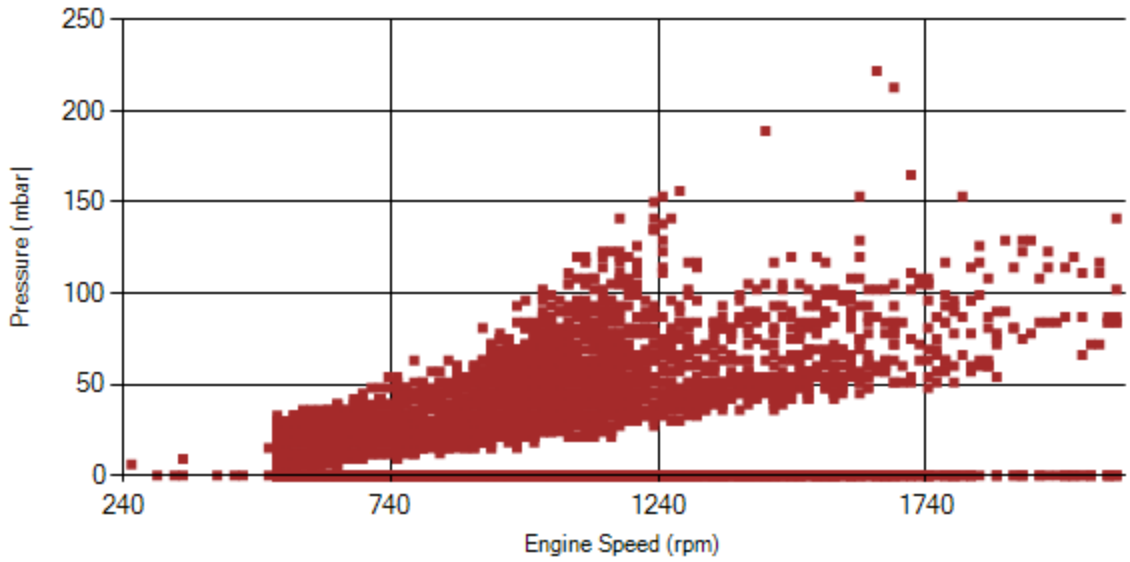


Figure 13- Pressure against engine speed

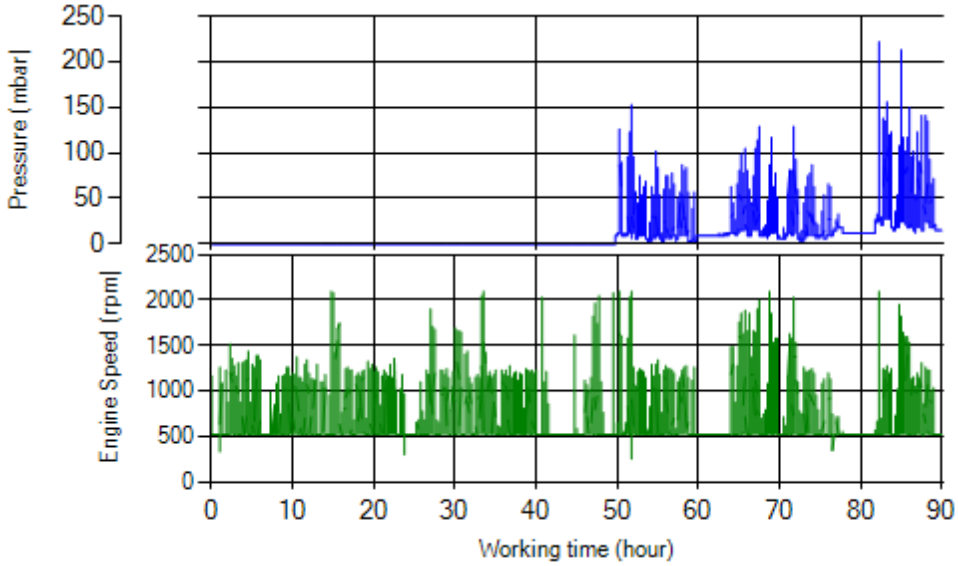


Figure 14- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

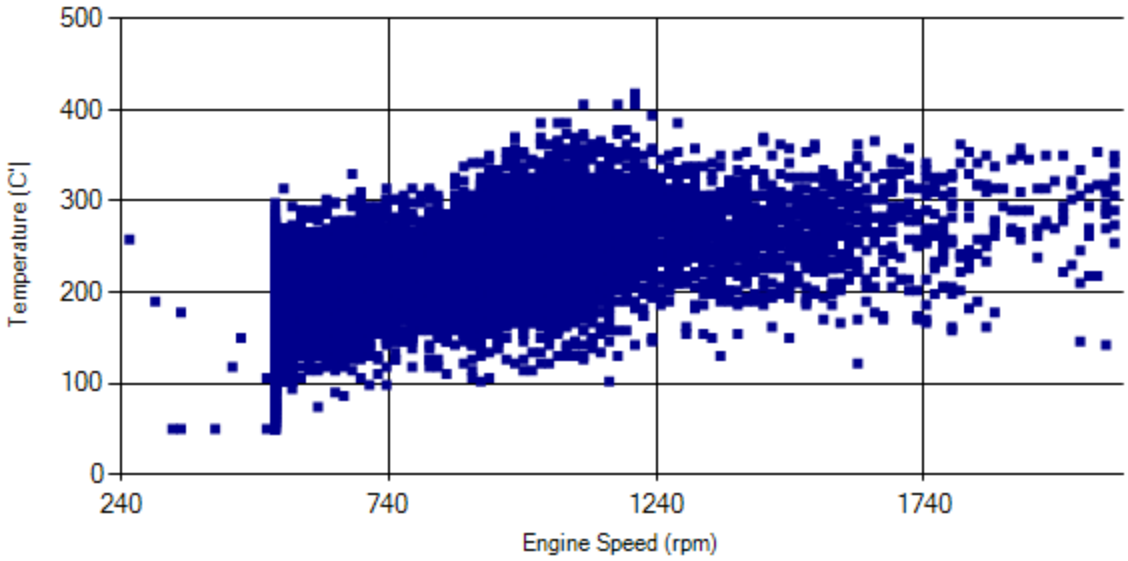


Figure 15- Temperature against engine speed

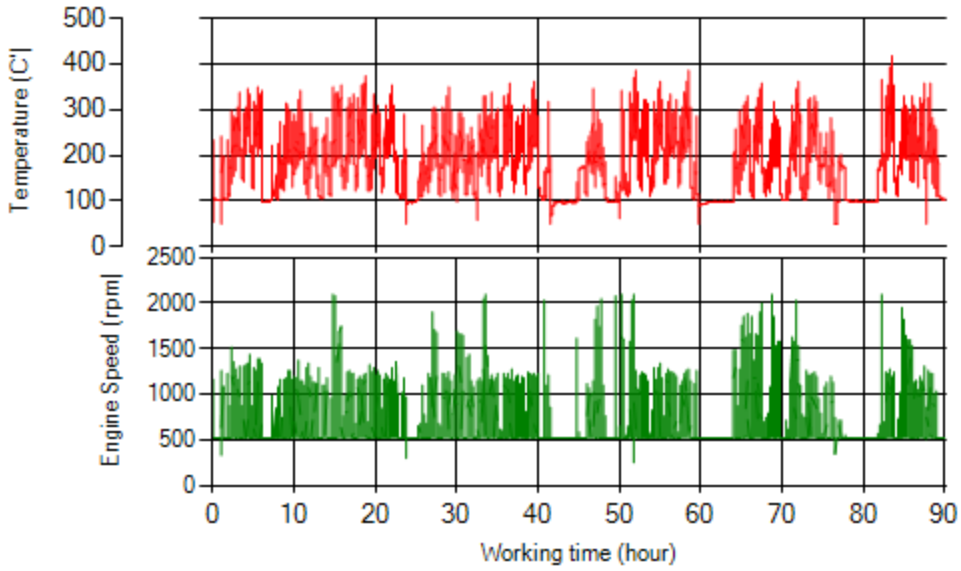


Figure 16- T, N distribution vs. working hours

Filter Operation Analysis

Considering data logger and sensors problem, the system exact operation evaluation is not possible. But considering data logger working days and back-pressure distribution it can be guessed, DPF operation status was excellent during the period.

Filter operation status	Excellent ■	Good ☐
	Maintenance required ☐	Failed☐

Overall Information

Table1- Overall Information

Vehicle plate number	33592 (32441)
CPK data logger number	LN: 001506, DN: 1927
Bus line	Number 2 (west to east bus line)
Bus Terminals	Khavaran Bus Terminal - Western Bus Terminal
Total path distance	19 km
DPF producer company	Tehag_02 (Catalyzed DPF)
Installation date	25/Jan/2016
Report period	-
K value - DPF upstream	1.60 [1/m]
K value – DPF downstream	0 [1/m]

Table 2- DPF Maintenance History

Filter maintenance date	
Dosing status	

Table 3- Fuel and Additive Consumption Information

Bus mileage (from DPF installation date)	3042 km
Bus mileage over the period	1017 km
Working days over the period	9 days
Stop days	5 days
Data logger working days	9 days
Working hours over the period	92 hours 37 minutes
Average working hours per day (including stop days)	6 hours 37 minutes
Bus average speed	11 km/hr
idle speed time to all working time ration	68.29 %
Total Bus fuel consumption over the period	641 lit
Fuel consumption per hour	6.93 lit/hr
Average fuel consumption	0.63 lit/km

Temperature, Pressure and Engine Speed Overview

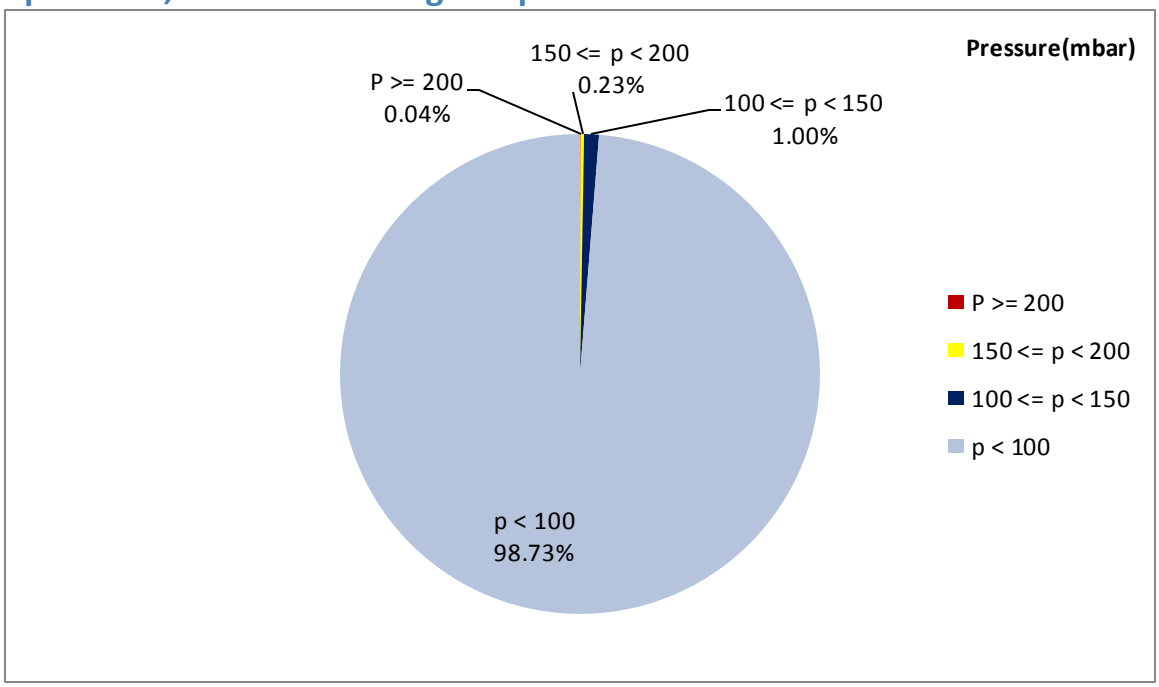


Figure 1- Pressure distribution over the working hours

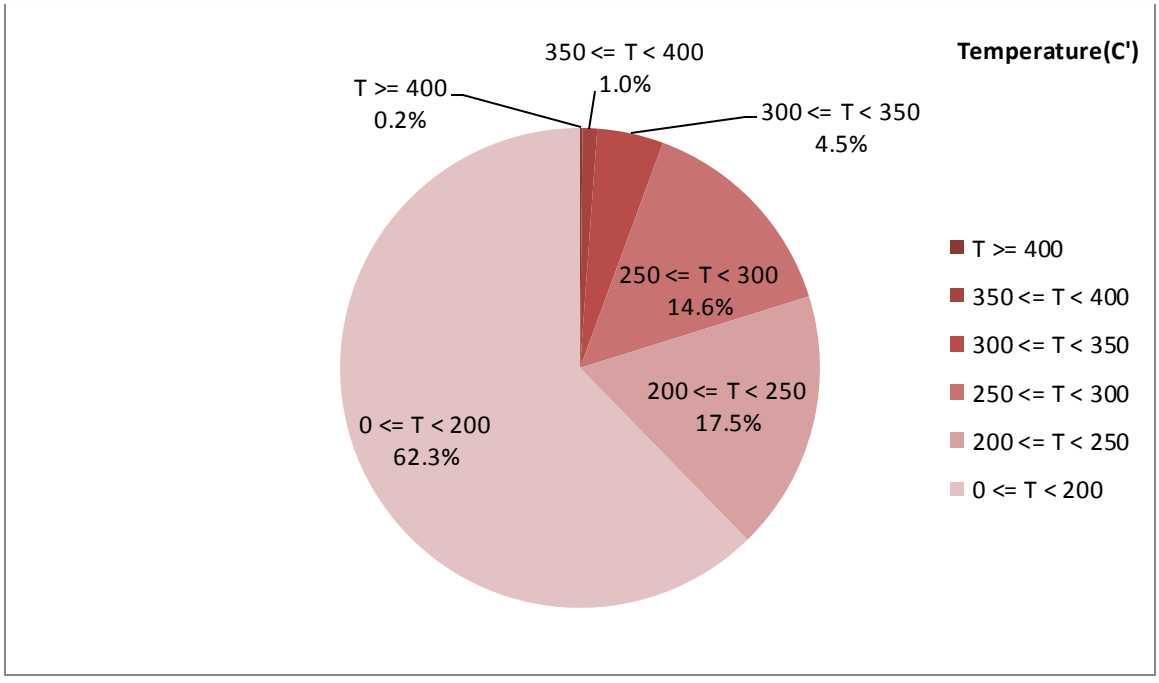


Figure 2-Temperature distribution over the working hours

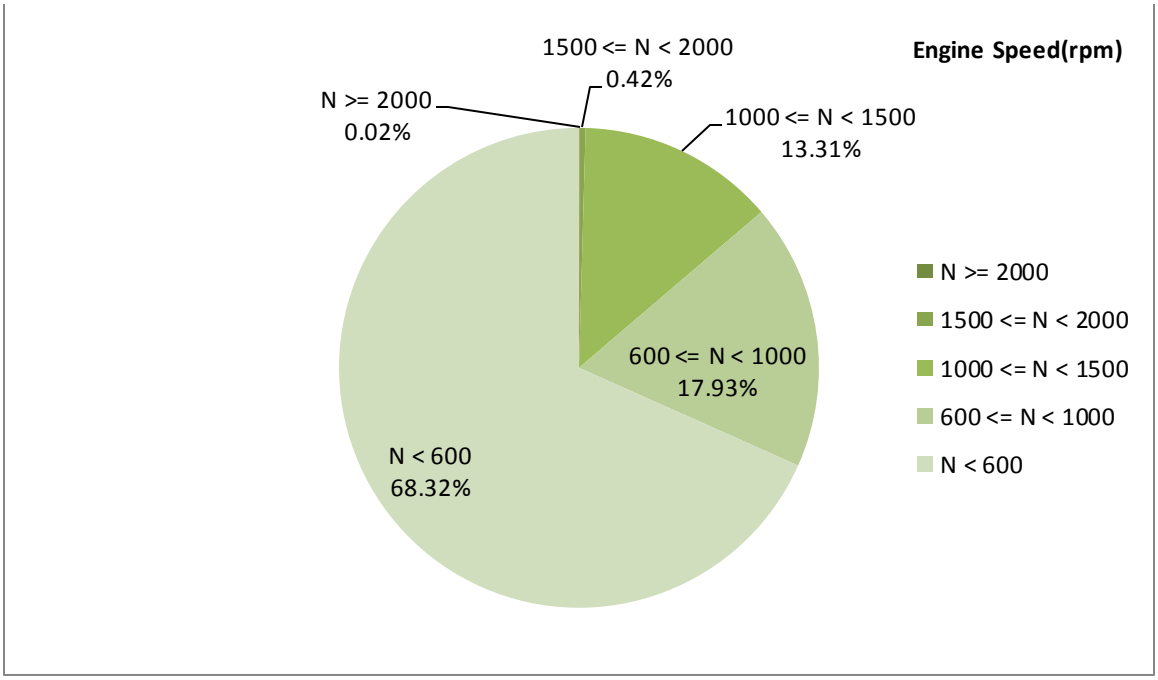


Figure 3- Engine speed distribution over the working hours

Table 4- Mean values

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
178.4	15.94	666

Table 5- Mean values without idling

Mean temperature (C)	Mean pressure(mbar)	Mean engine speed(rpm)
254.92	35.8	958

Table 6- Max-min values

Max-min temperature(C)	Max-min pressure(mbar)	Max-min engine speed(rpm)
486-50	270-0	2096-256

Detailed Pressure Analysis

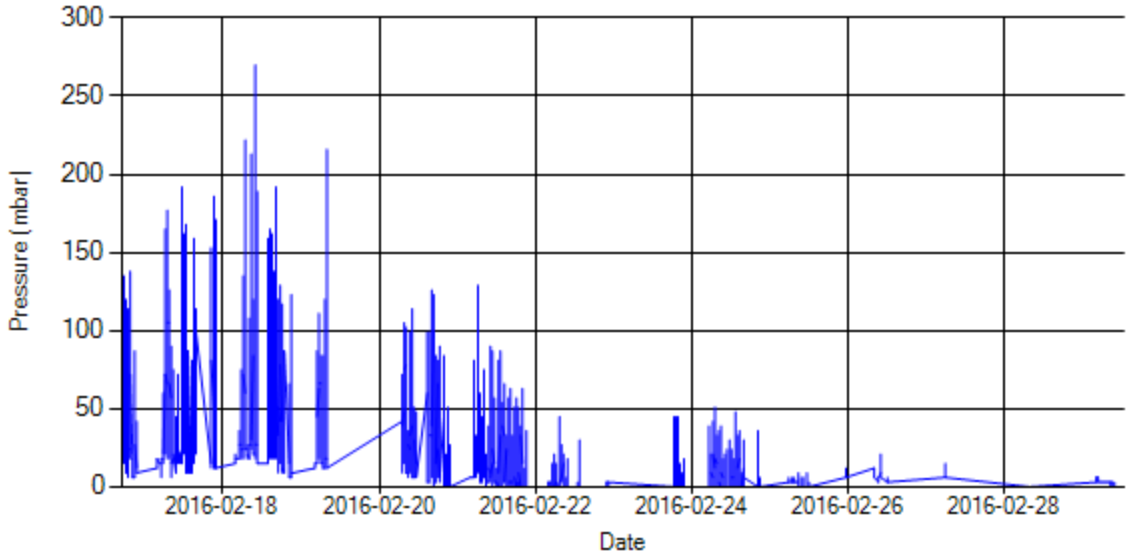


Figure 4- Pressure distribution over the period

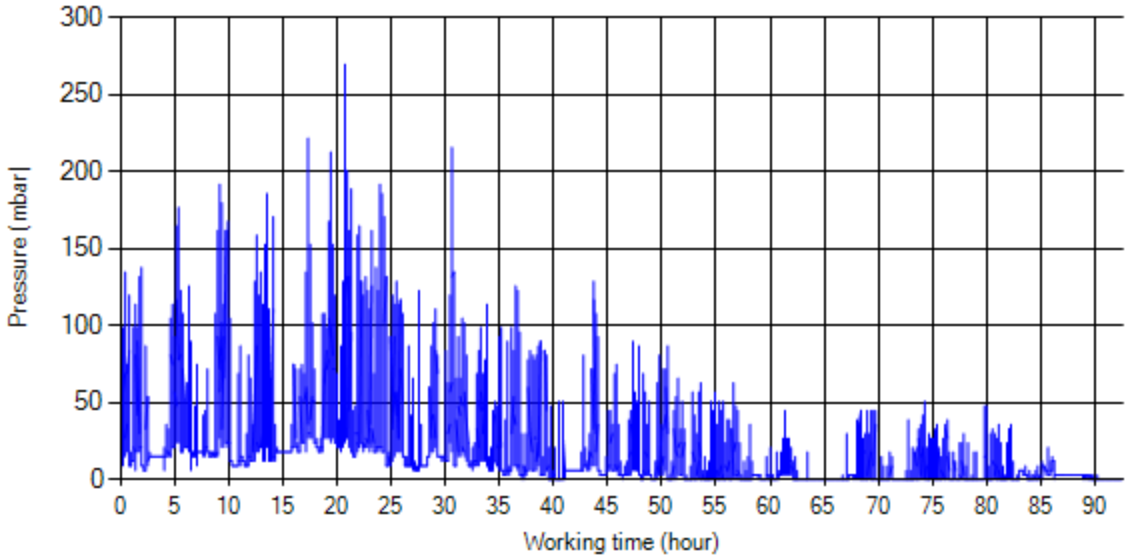


Figure 5- Pressure vs. working hours

Notice: backpressure distribution was shown into two diagrams. As obvious in figure 5, stop-working periods were eliminated and pressure was displayed along working hours.

Detailed Temperature Analysis

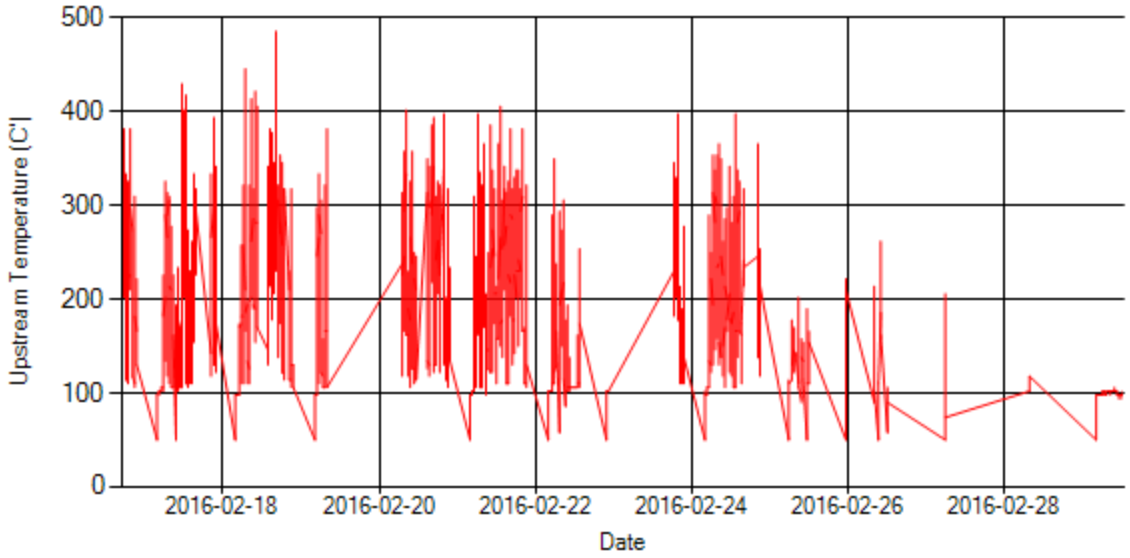


Figure 6- Temperature distribution over the period

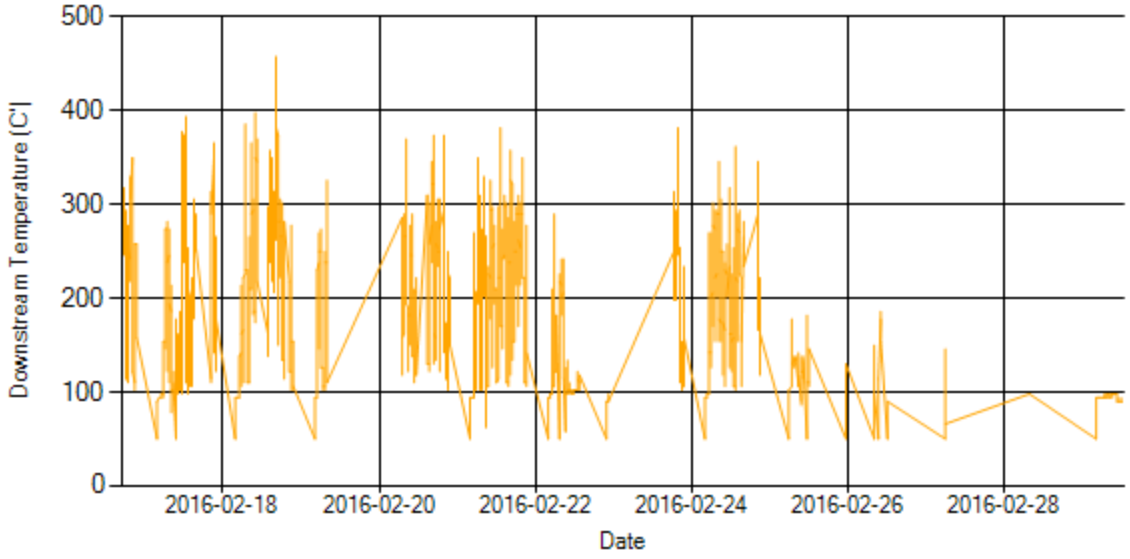


Figure 7- Temperature distribution over the period

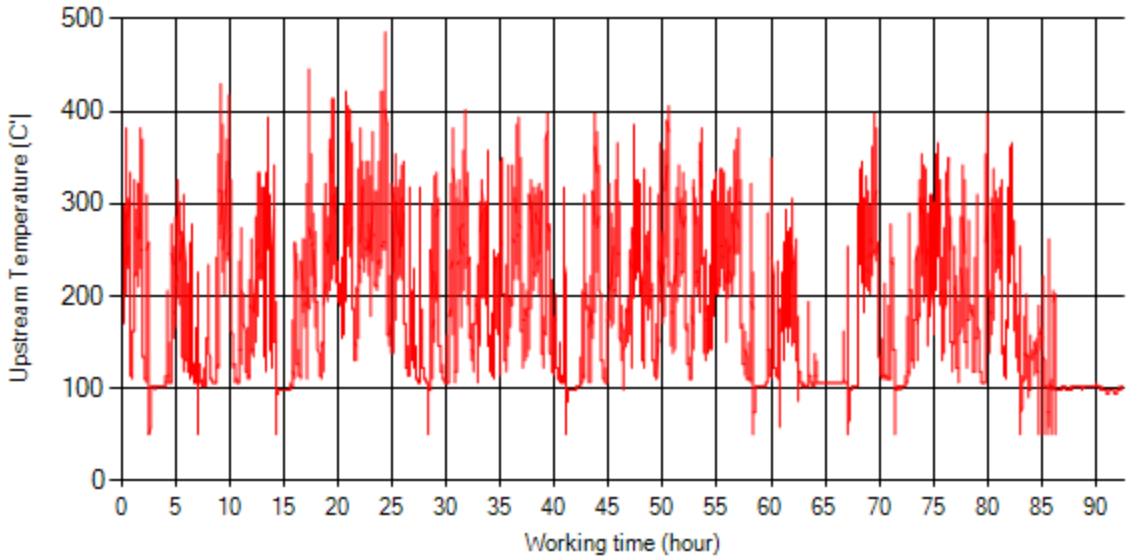


Figure 8- Temperature vs. working hours

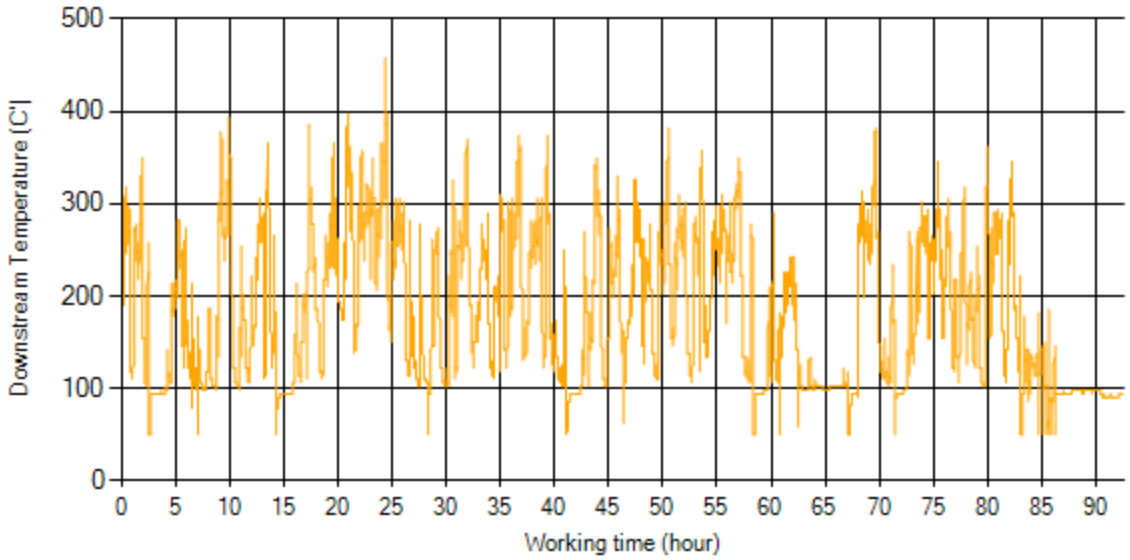


Figure 9- Temperature vs. working hours

Engine Speed Diagrams

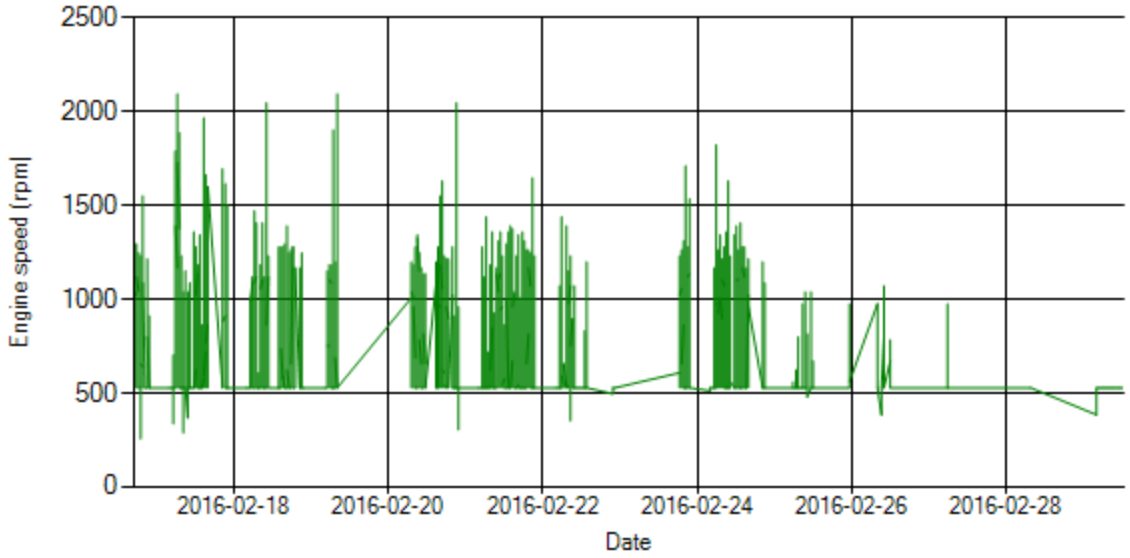


Figure 10- Engine speed distribution over the period

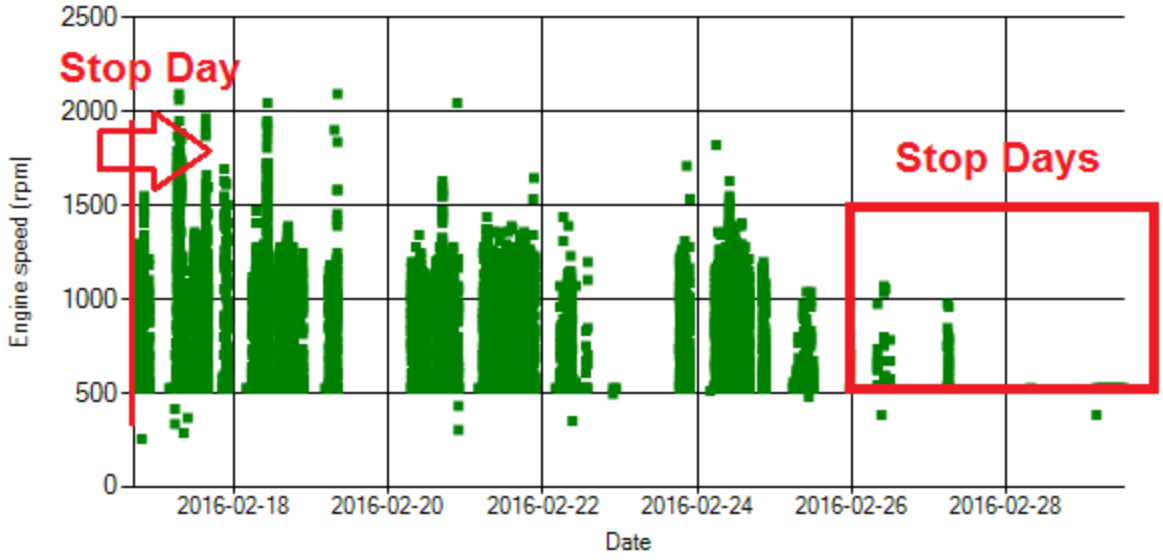


Figure 11- Engine speed diagram for calculating CPK's working days

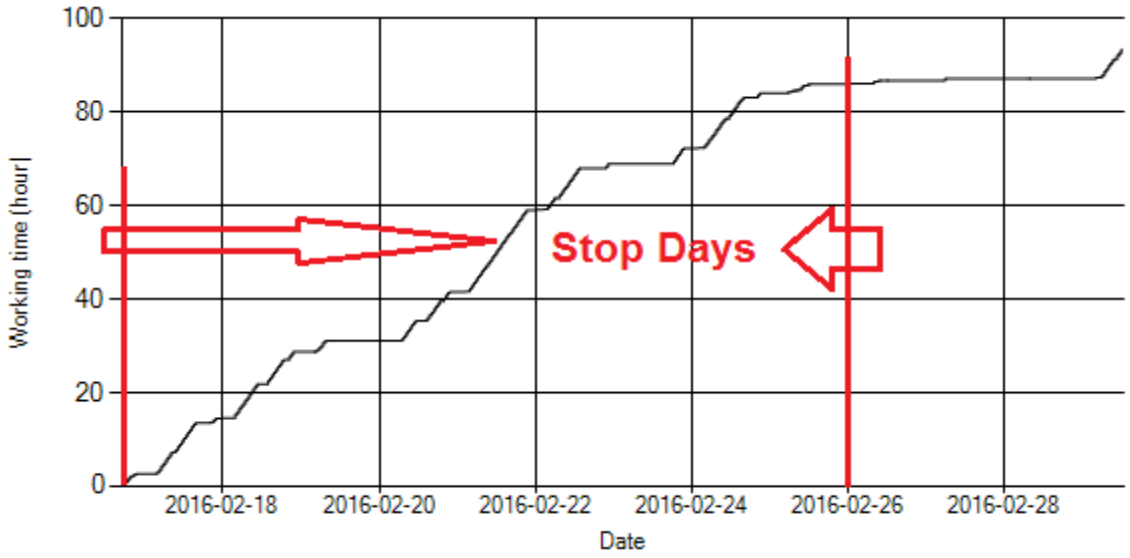


Figure 12- Time diagram for calculating CPK's working days

Notice: Data logger sampling time can be calculated from Figure 12. The lines parallel with Date axis show days without data logger data. As depicted in Figure 12, bus was stationary for 5 days during this period.

Pressure-Engine Speed diagrams

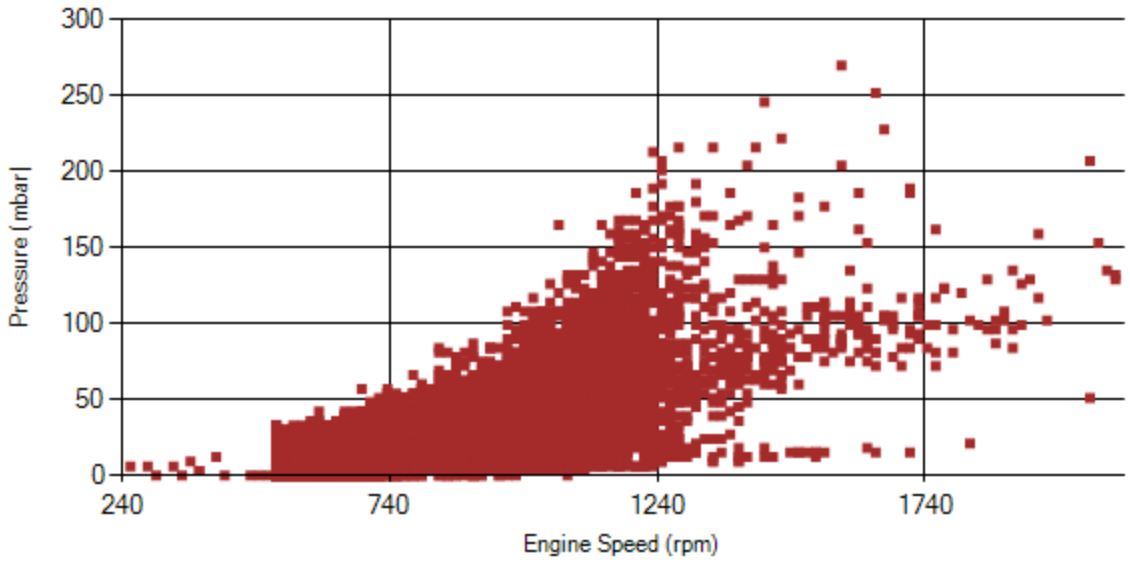


Figure 13- Pressure against engine speed

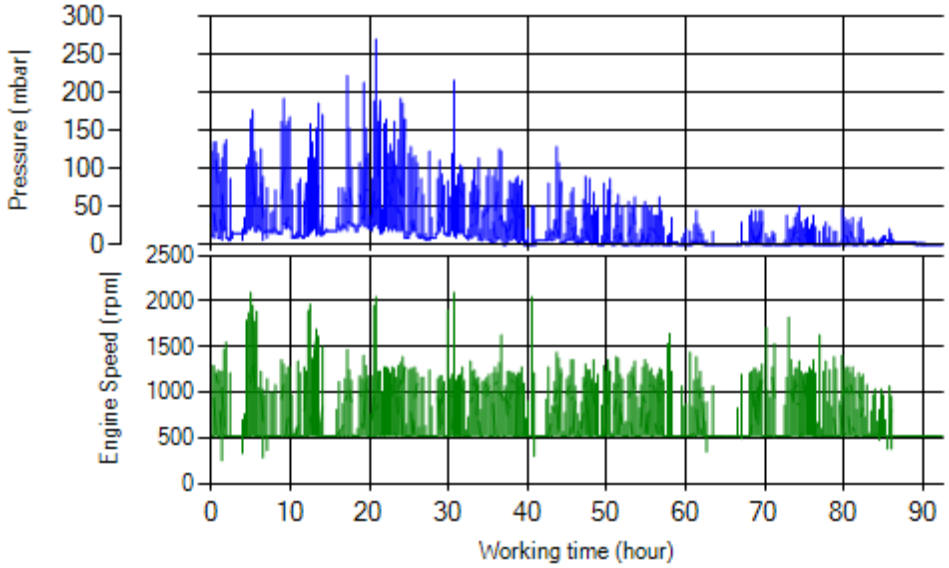


Figure 14- P, N distribution vs. working hours

Temperature-Engine Speed diagrams

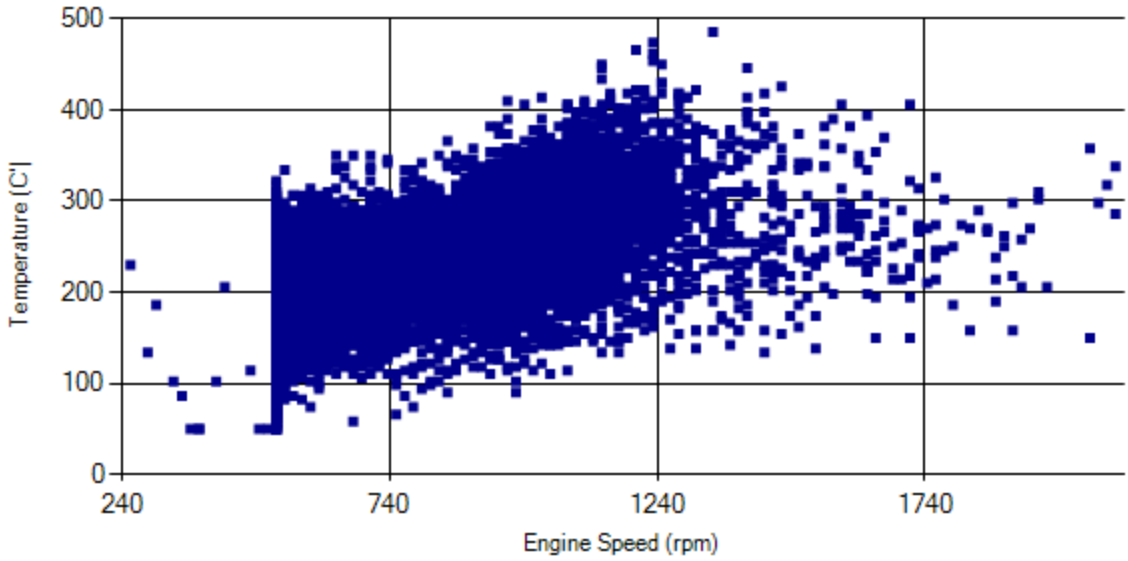


Figure 15- Temperature against engine speed

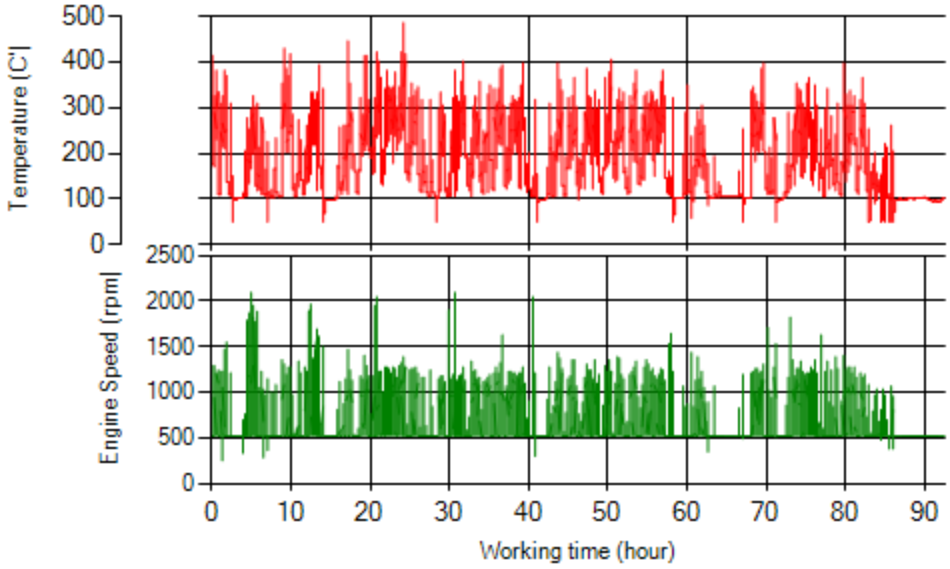


Figure 16- T, N distribution vs. working hours

Filter Operation Analysis

- As depicted in figure 1, only 0.04% of working time pressure was above 200 mbar and 0.27% above 150 mbar during this period.
- Figure 2, 17 display flow temperature distribution for DPF's upstream. It can be obviously observed that 1.01% of total working-time temperature is above 350 °C and 18.67 % above 250°C.

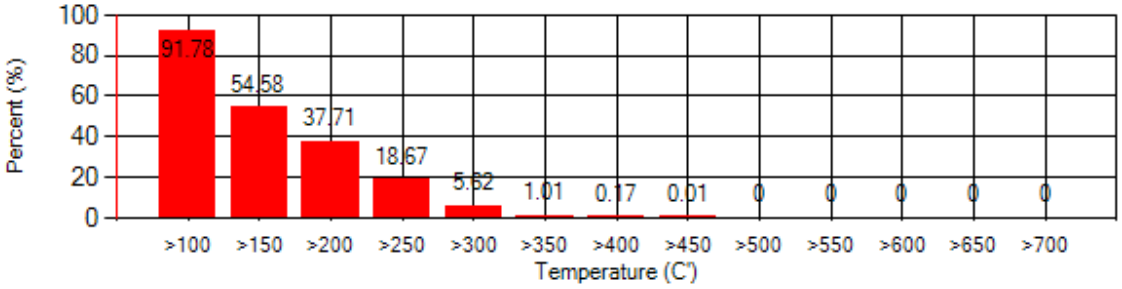


Figure 17. Cumulative diagram of exhaust gas temperature

Filter operation status	Excellent ■	Good ☐
	Maintenance required ☐	Failed☐

Diesel Particulate Filter

an effective way to control solid particulate

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