Application Note

On-Line NIR Analysis of Crude Distillation Unit

Introduction

Petroleum refining is the process of separating the many compounds present in crude petroleum. The principle which is used is that the longer the carbon chain, the higher the temperature at which the compounds will boil. The first processing step in a refinery operation is Crude Distillation, wherein crude oil is distilled into "rough" fractions. The crude petroleum is heated and changed into a gas. The gases are passed through a distillation column which becomes cooler as the height increases. When a compound in the gaseous state cools below its boiling point, it condenses into a liquid. Typically, crude oil distillation is performed at a pressure of 0 - 5 barg.

The temperature and pressure profile of the distillation column is selected to ensure the maximum separation efficiency to give the required products. The liquids may be drawn off the distilling column at various heights. The quality of fractions from the CDU (crude distillation unit) need to be continuously monitored, assuring the refinery that it is maintaining peak performance from the column while controlling the product quality. The resultant fractions or cuts are taken as products from the crude distillation section for further processing in downstream refinery units.

Process Analyzer

The WetSpec200 is an online, multi-channel wet process analysis system. It enables non-contact, real-time monitoring and closed-loop control of chemical composition in wet process applications. The WetSpec200 is ideal for monitoring petroleum and petrochemical products. Based on novel algorithm, the WetSpec200 measures the absorption spectrum in the near infrared (NIR) fast and accurately without labor and material waste. The system's versatile software models enable soft-switch between different chemistries.

The Main Analyzer is located in the Control Room, protected from the process environment. The Main Analyzer connects, via telecommunications fiber optics, to the Field Units, which are installed up to 3 km (2 miles) away, close to the process. Up to 8 Field Units can be connected to one Main Analyzer.

Features & Benefits

“All in One” - multiple streams, multiple properties analysis by a single central system housed in the central equipment room

- **Up to 3000 meters** distance between analyzer and measuring cell enables placement of the analyzer in a convenient location by using **standard communication fiber optic** cable.
- One analyzer can monitor **up to 8 measuring cells** with different chemistries.
- Short measurement time and **low operational costs**.
- **Online**, real-time measurement of chemical concentration of liquids for advanced process control purposes.
- Powerful Communication System.
- Automatic fine tuning of calibration Model.

Properties measured with the NIR analyzer

Naphtha	Kerosene	Diesel
RPV	Freeze Pt., Flash Pt.	Freeze Pt., Flash Pt., Cloud Pt., Pour Pt.
IBP, FBP	IBP, FBP	IBP, FBP
T10% - T90%	T10% - T90%	T10% - T90%
D(15)/D(20)/API	D(15)/D(20)/API	D(15)/D(20)/API
Benzene, Naphthenes, Paraffins, C-numbers		Cetane

Simple Solutions for Complex Requirements

Our Freetune Software calibration program allows automatically adjust the measurement results, in their periodic comparison with laboratory data. This greatly eliminates the need for adjustments to models and ensures maximum accuracy and reliability of work.

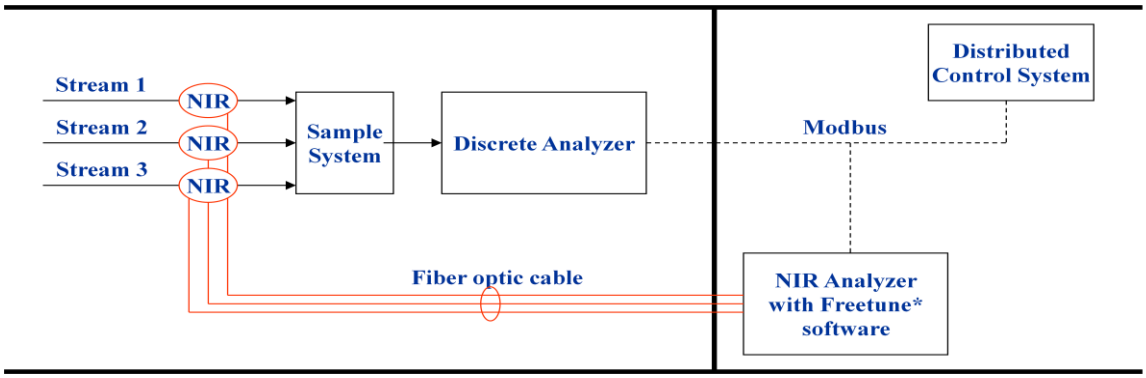
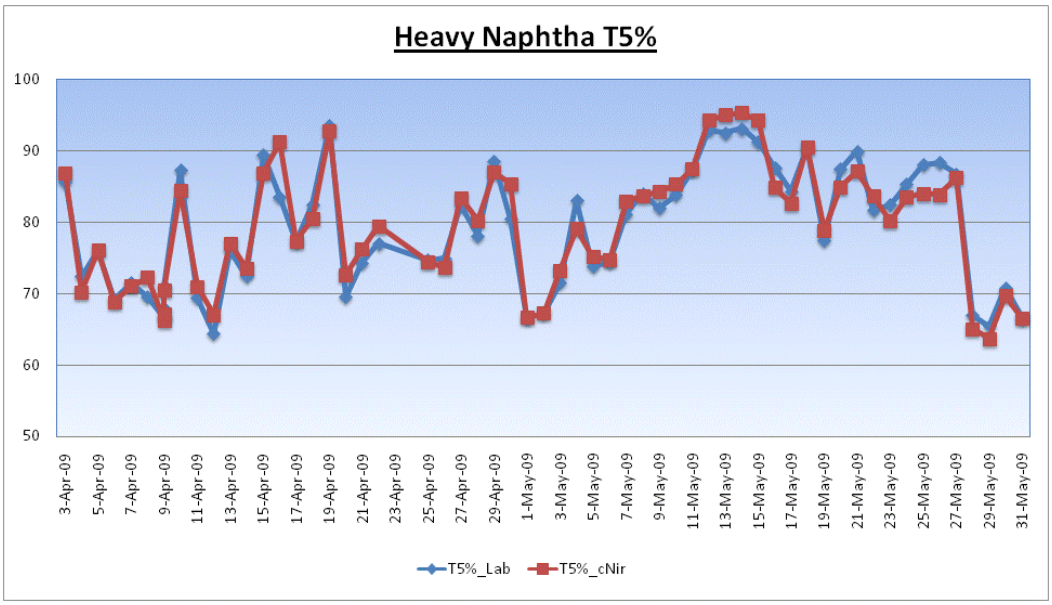
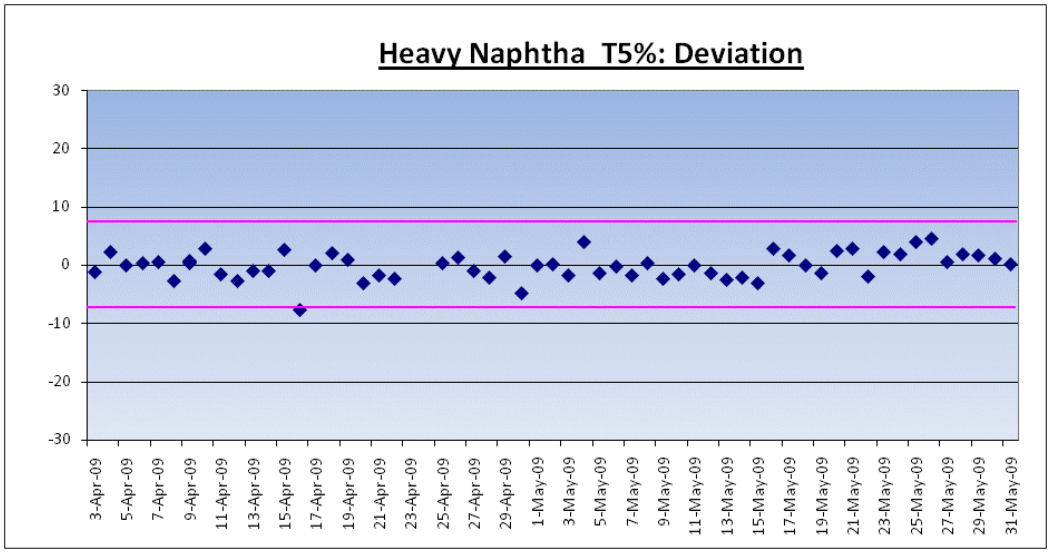


Figure: Schematic drawing of NIR Analyzer Unit which uses Discrete Analyzer for the independent measurement. These results are compared with those got by NIR Analyzer and by Freetune Software program are calculated to calibration curve. Such an arrangement on the one hand allows to decrease the expenditures spent on laboratory measurements and on the other one preserve high requirements like 98% audibility, 5-10 min sampling and standing with ASTM standards.

Case Study: Naphtha

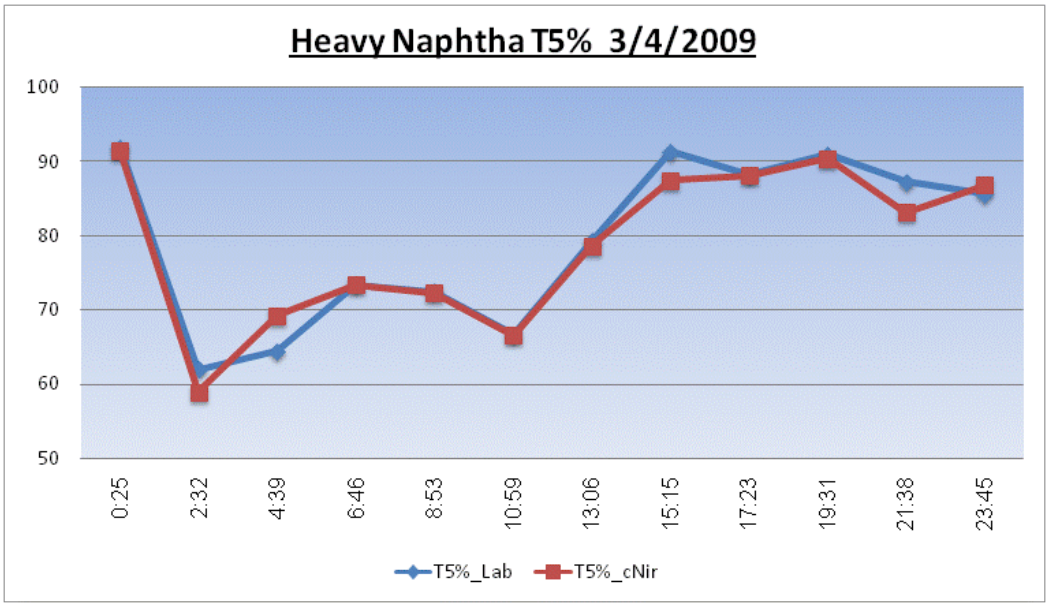


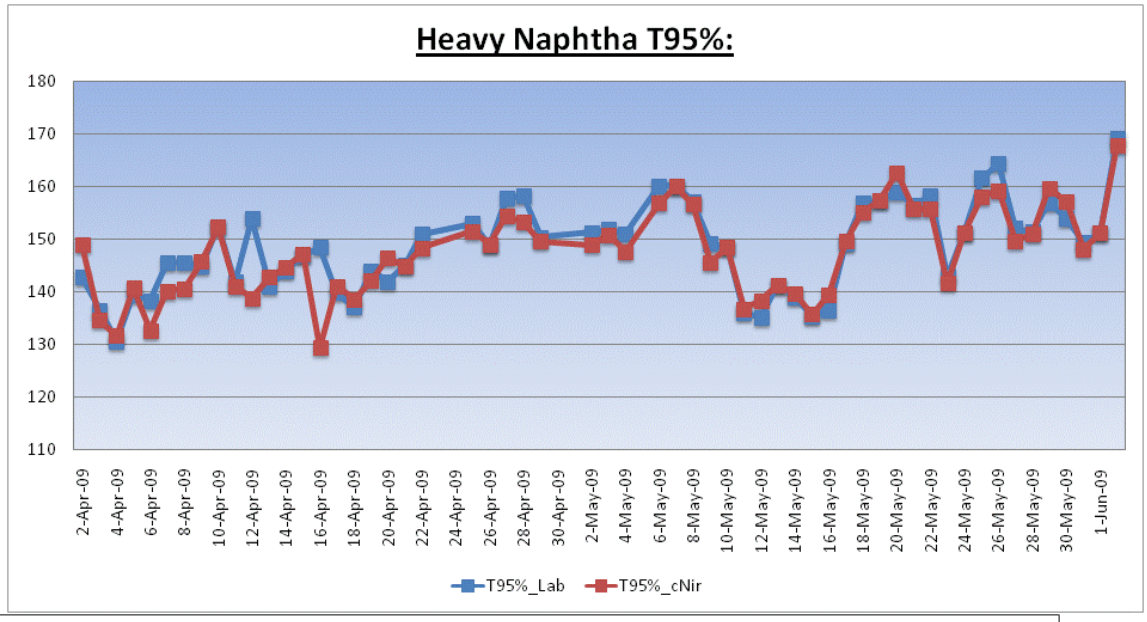


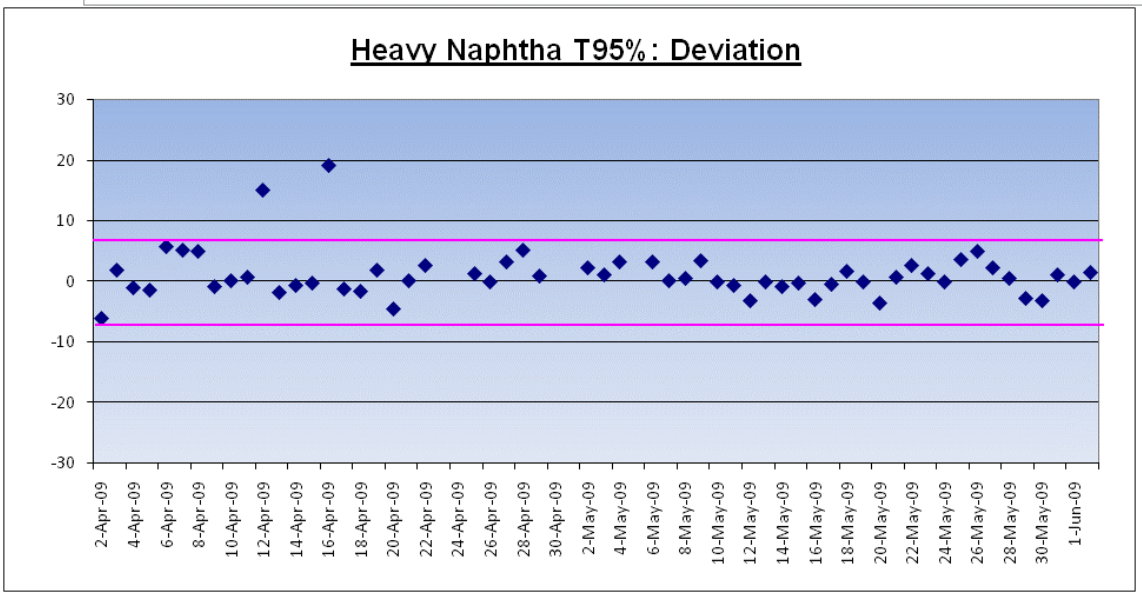
ASTM D86 - 4.8

Guarantied – 7.2

NIR – 4.8







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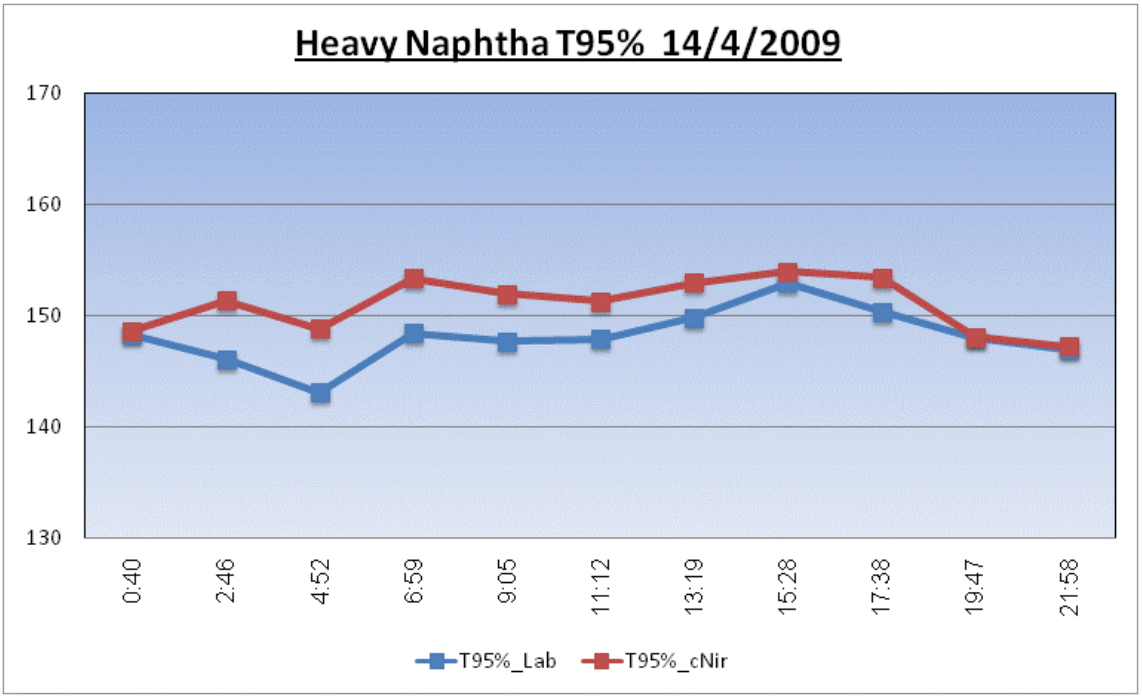
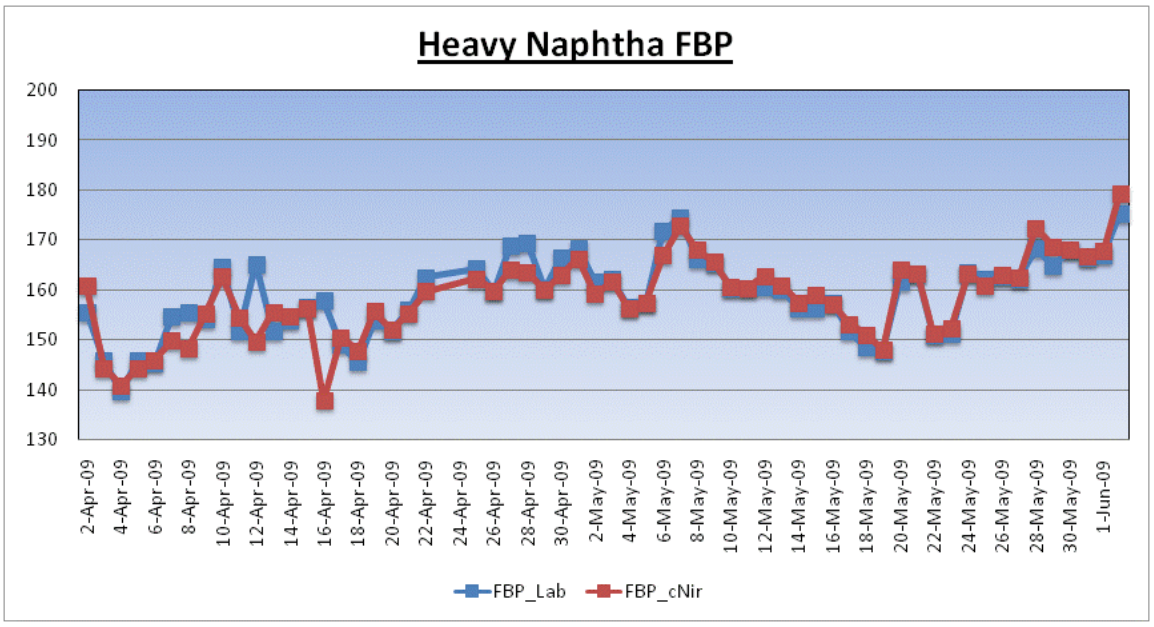
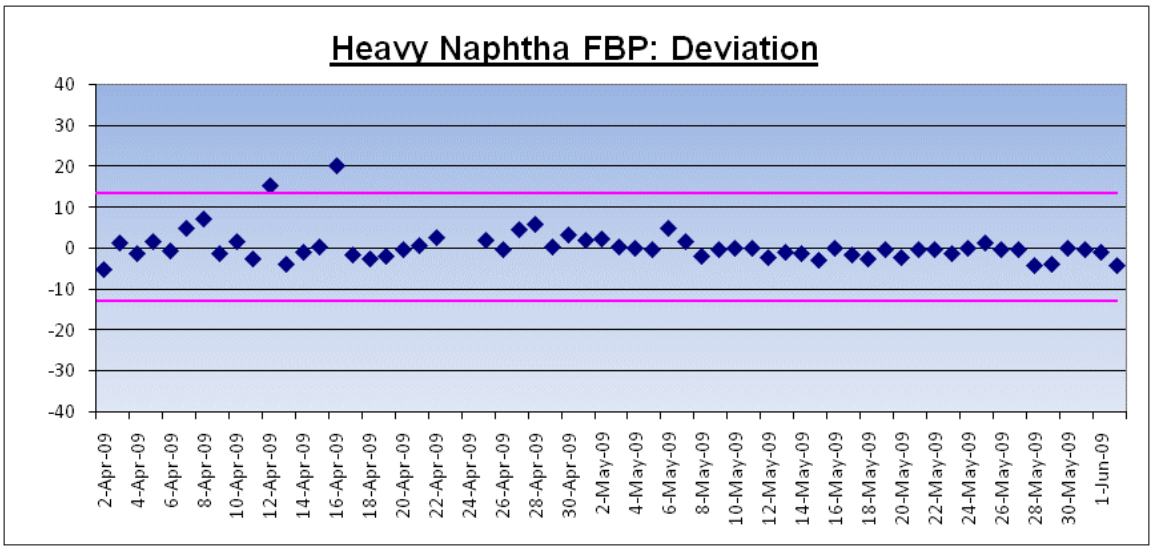


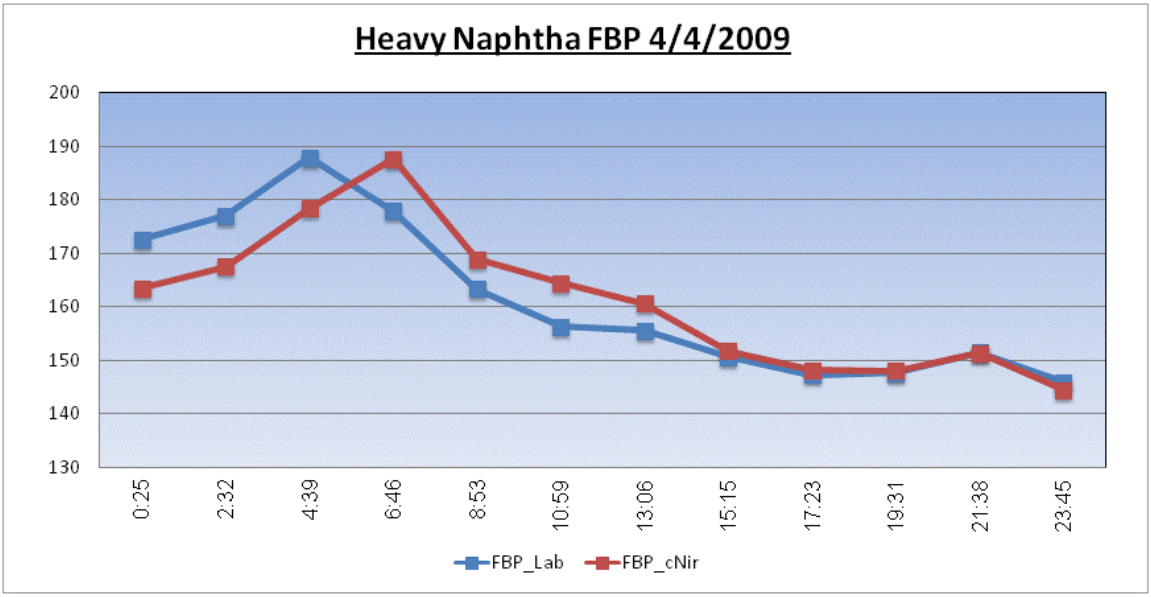


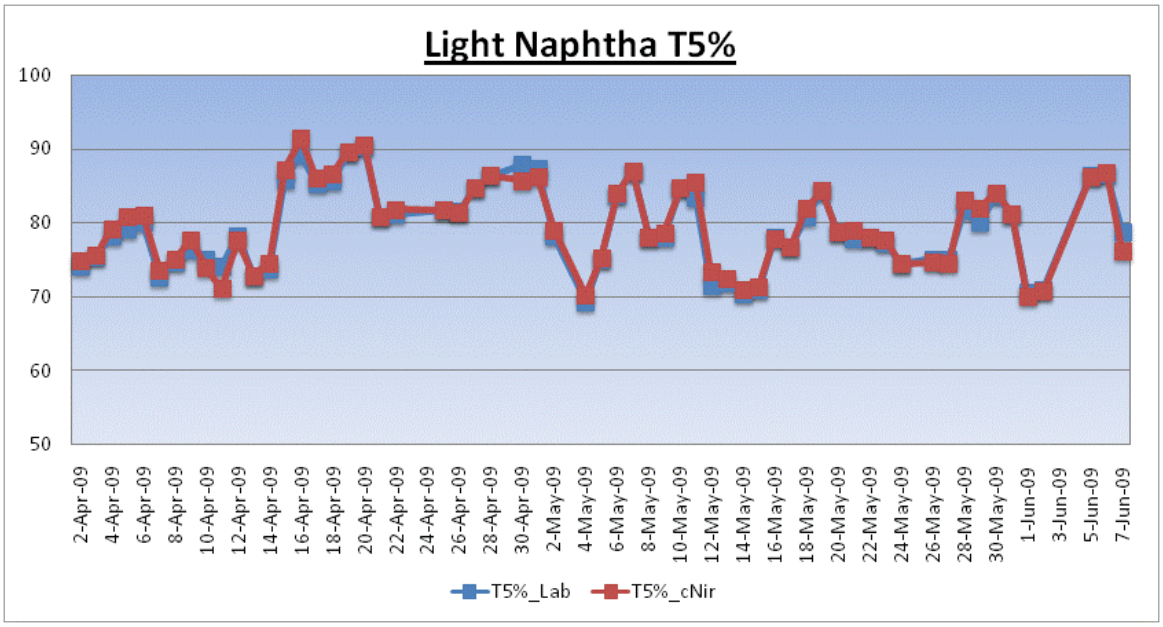


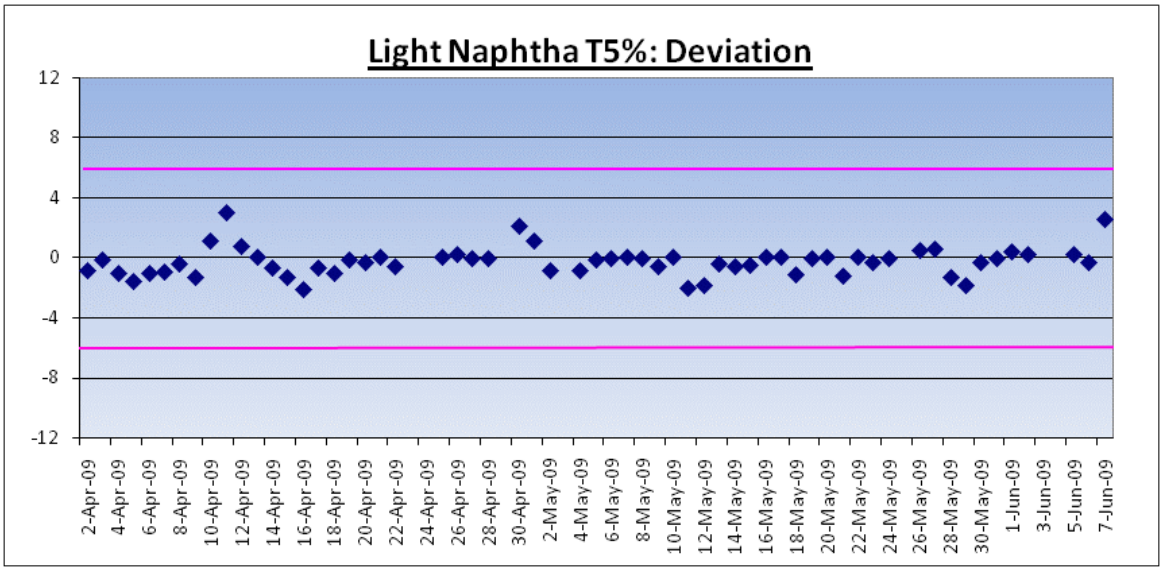
ASTM D86 – 10.5

Guarantied – 15.8

NIR – 9.4







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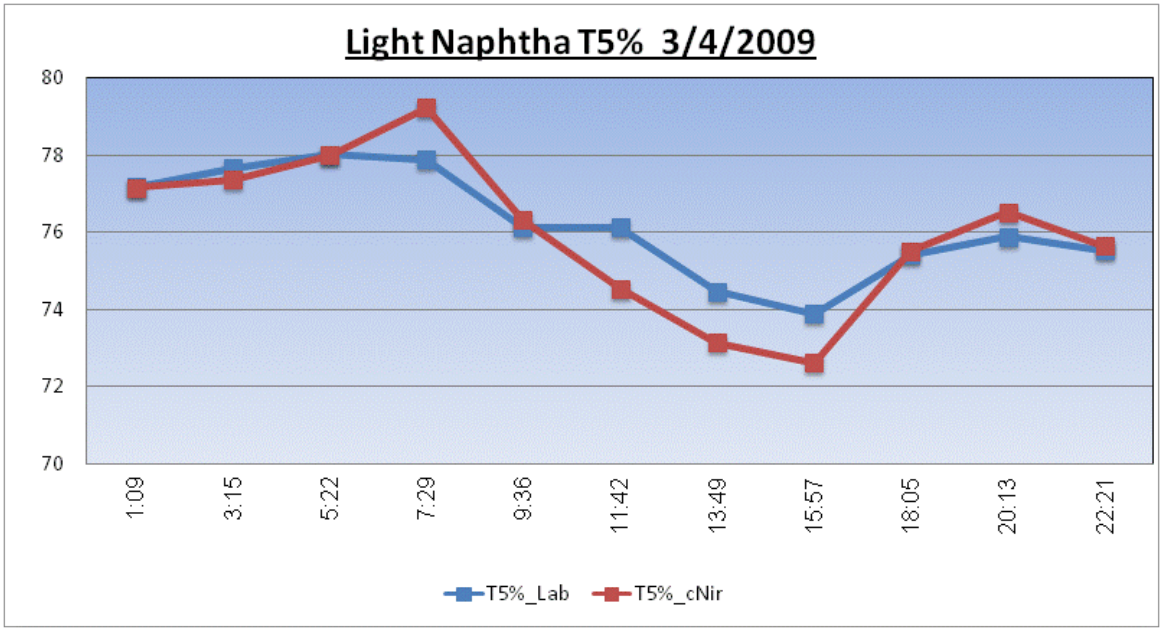

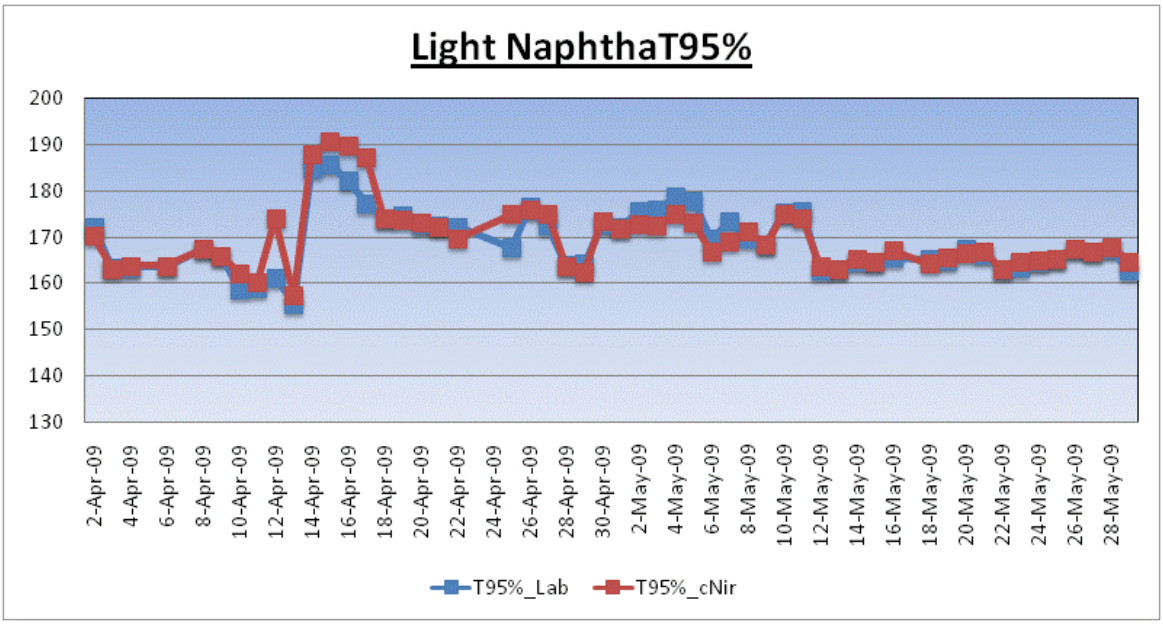

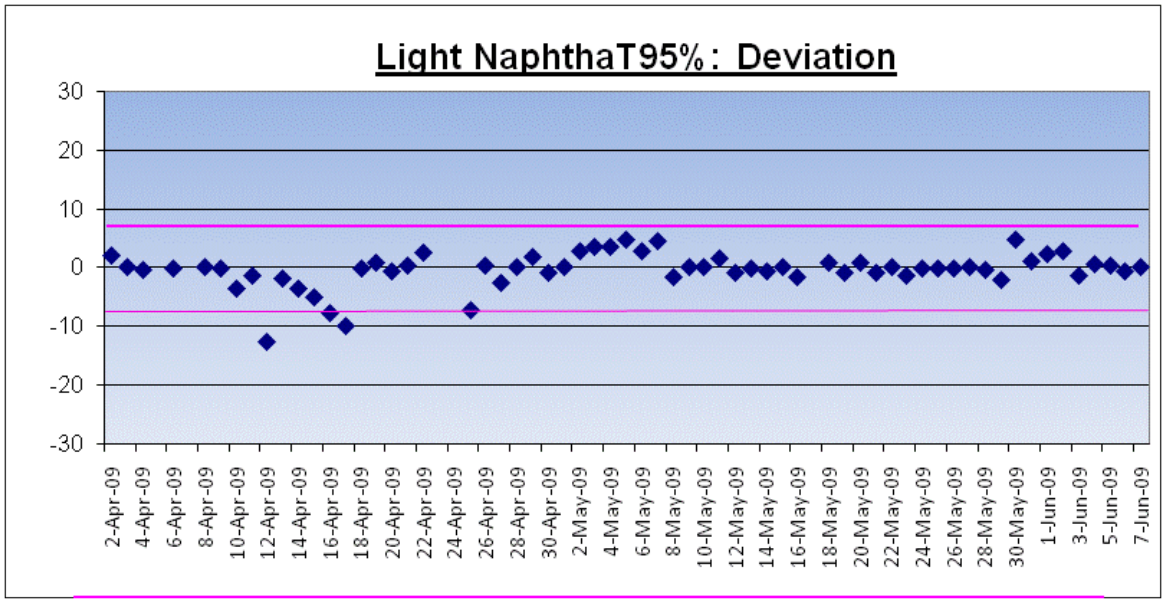

ASTM D86 - 4.8

Guarantied – 7.2

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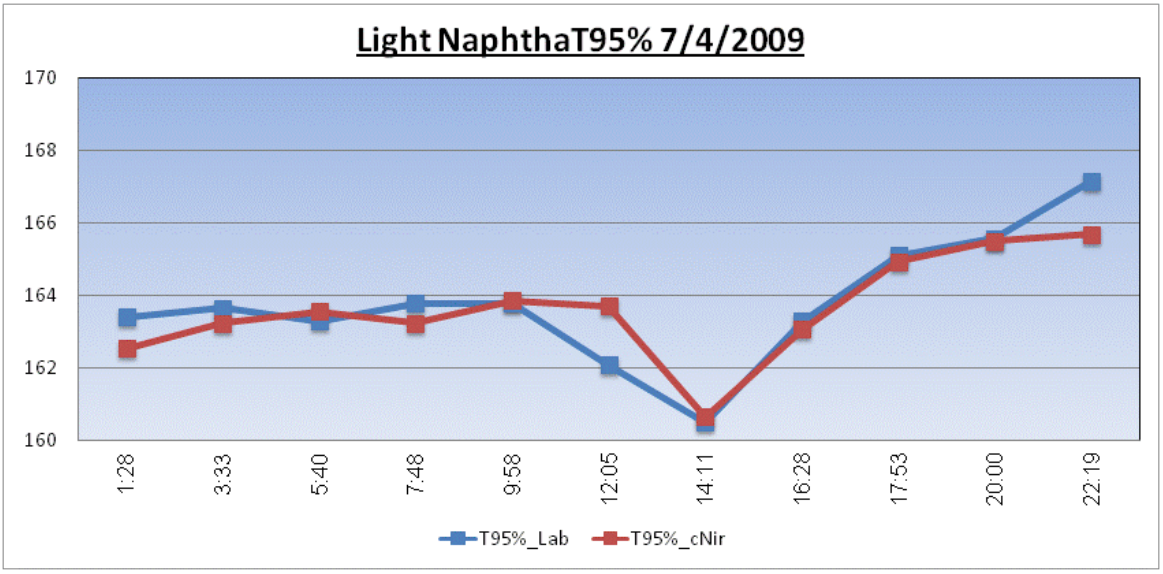
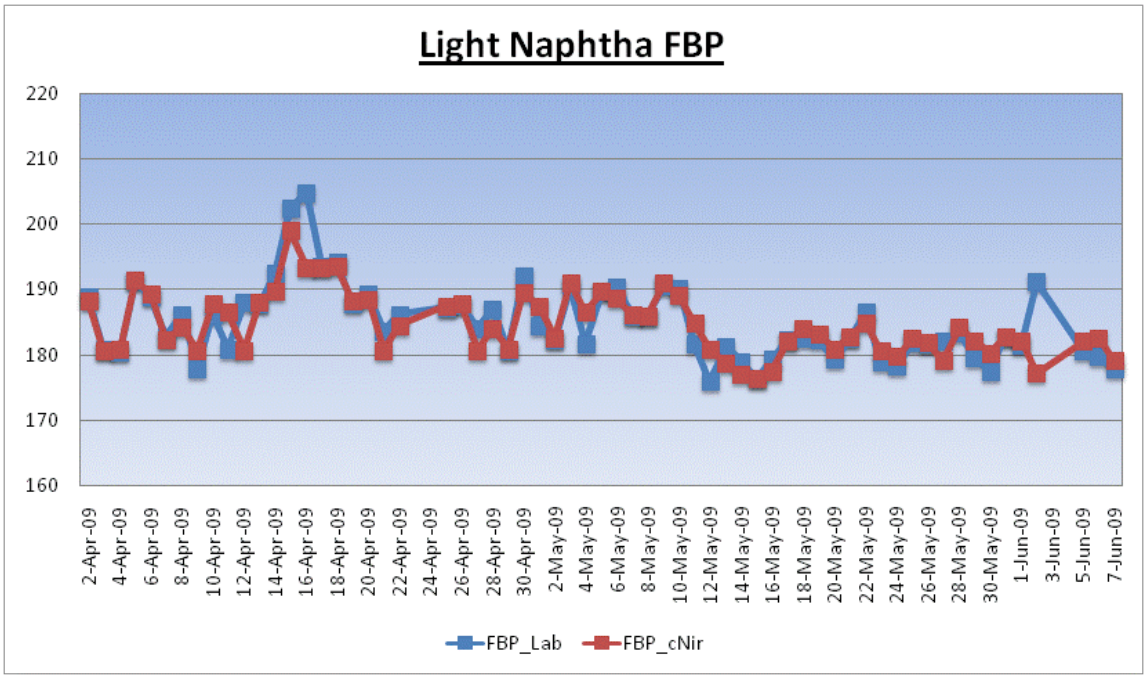
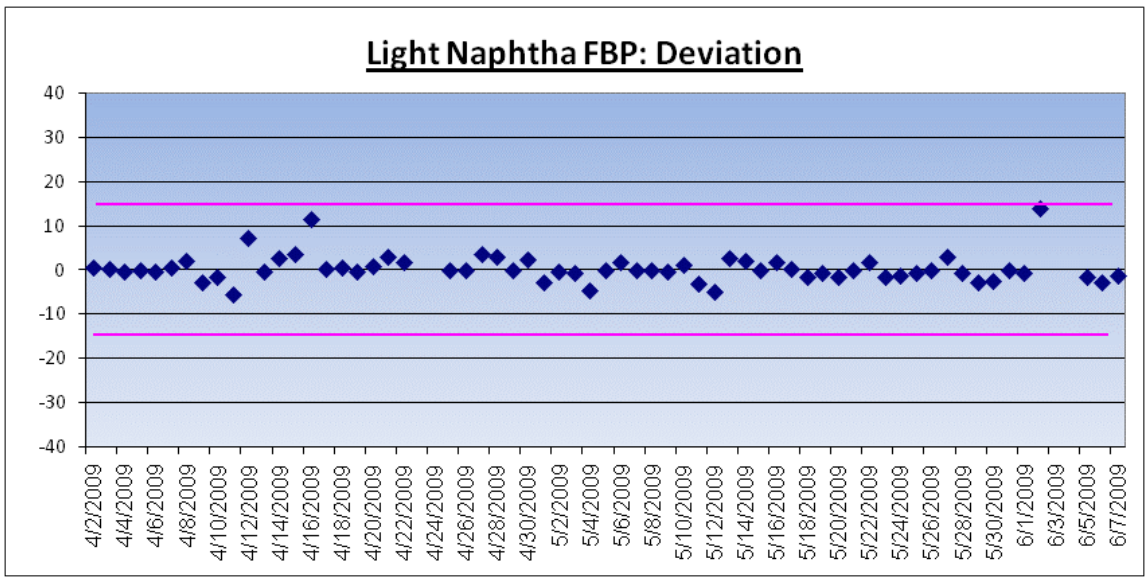


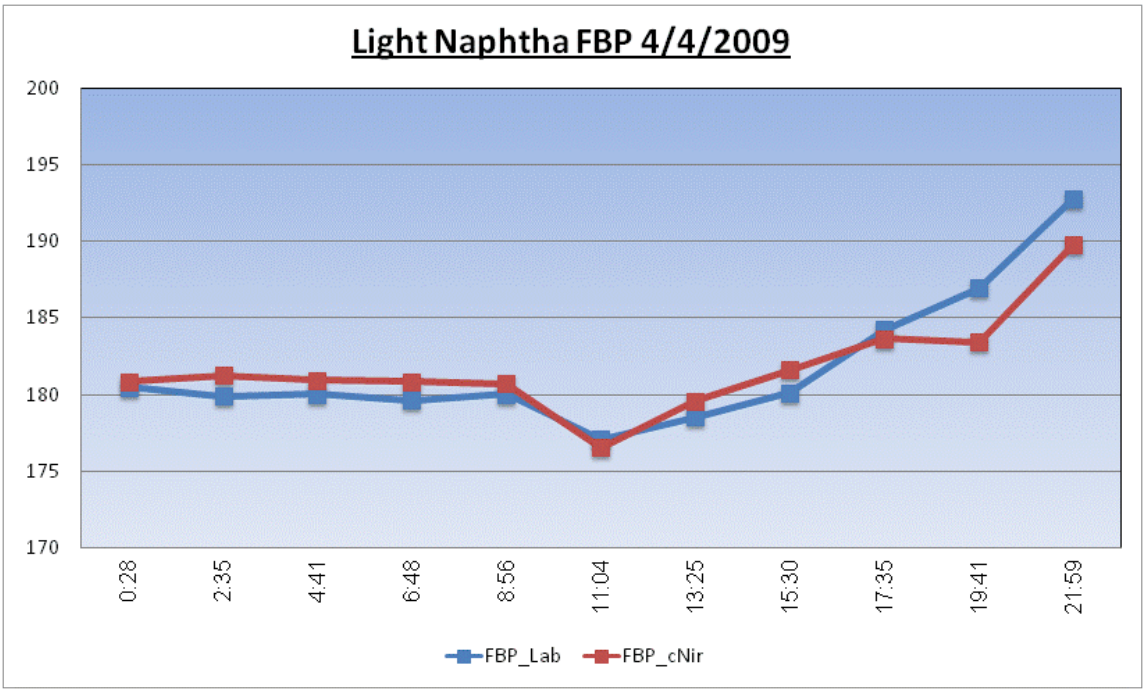




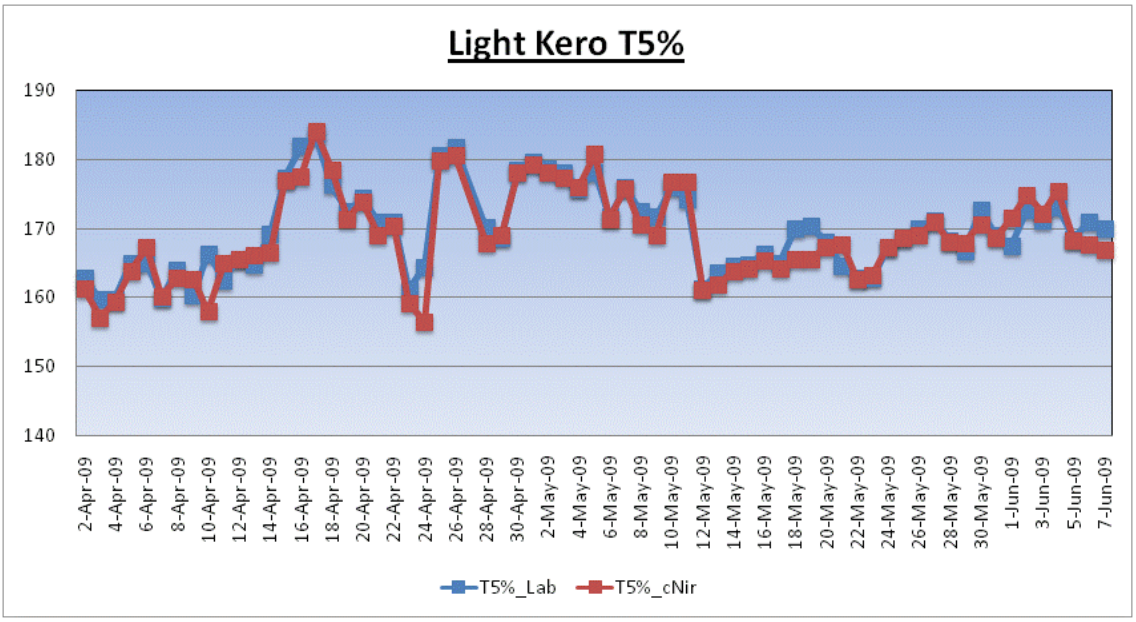
ASTM D86 – 10.5

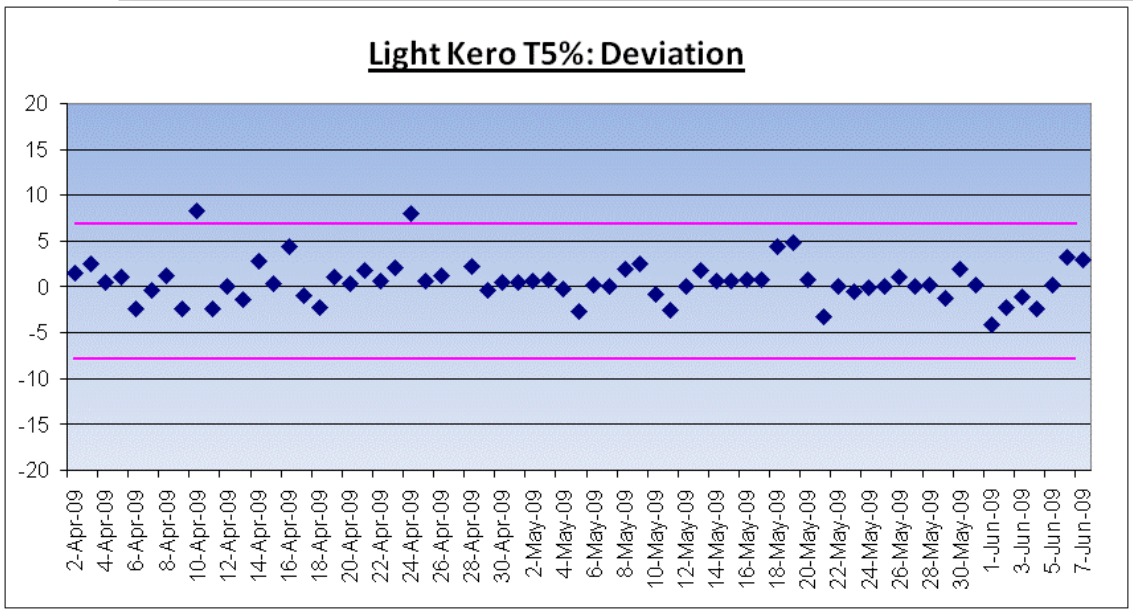
Guarantied – 15.8

NIR – 5.8



Case Study: Kerosene





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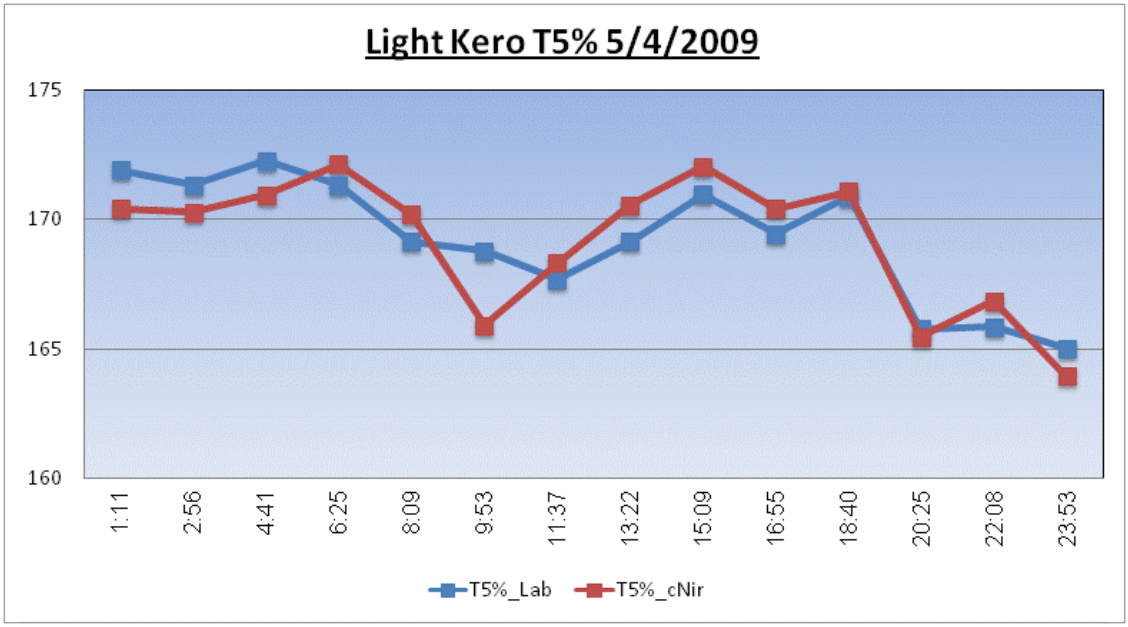
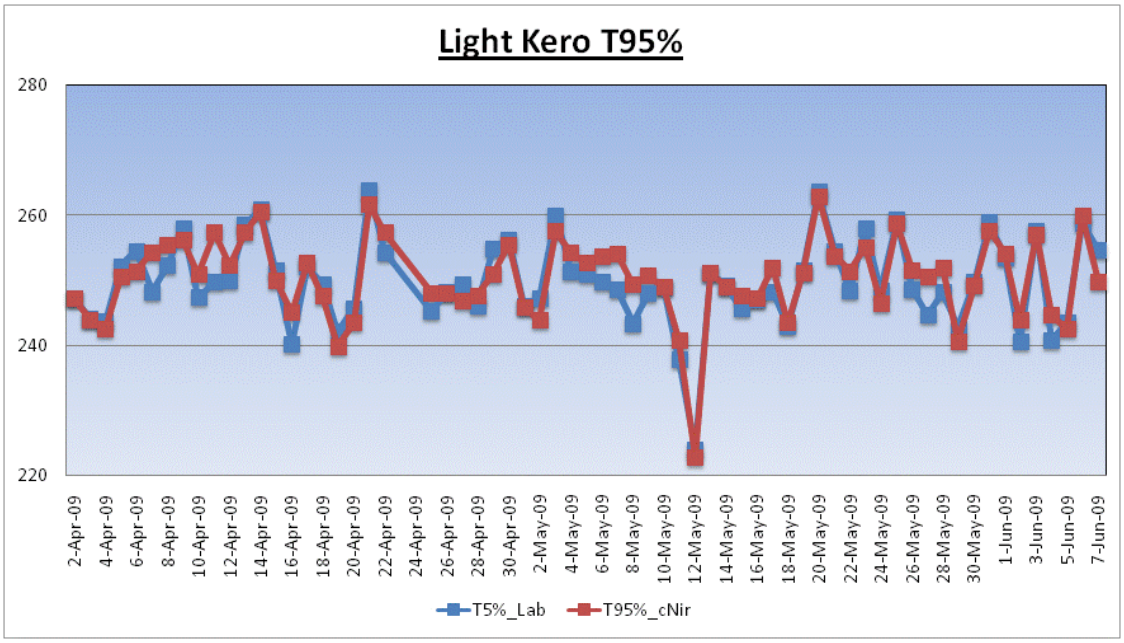
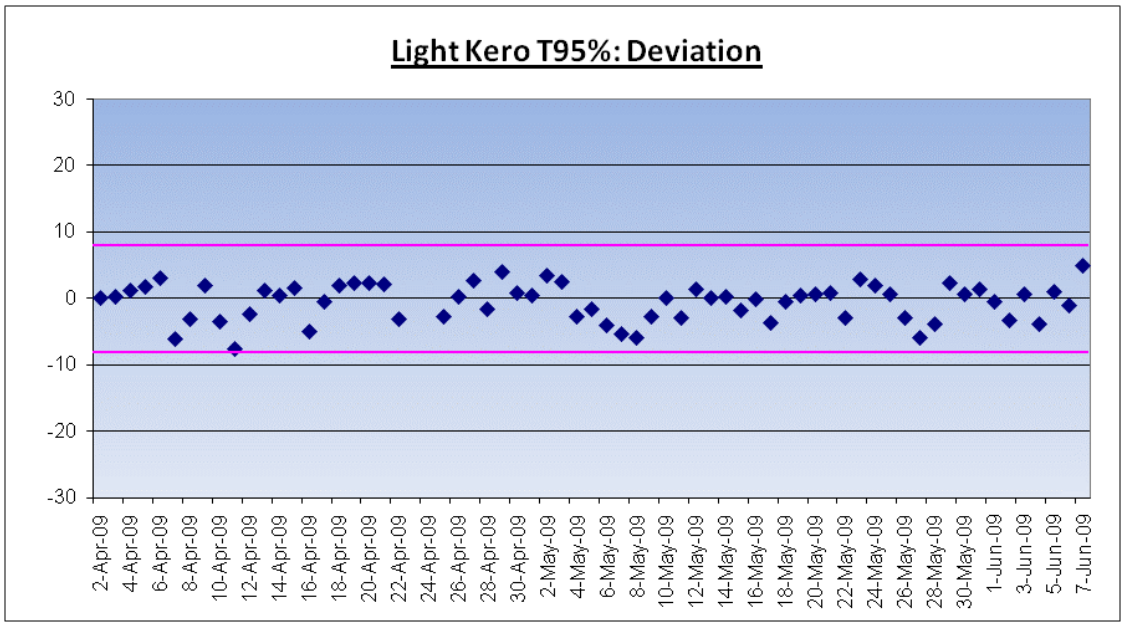
NIR – 5.0



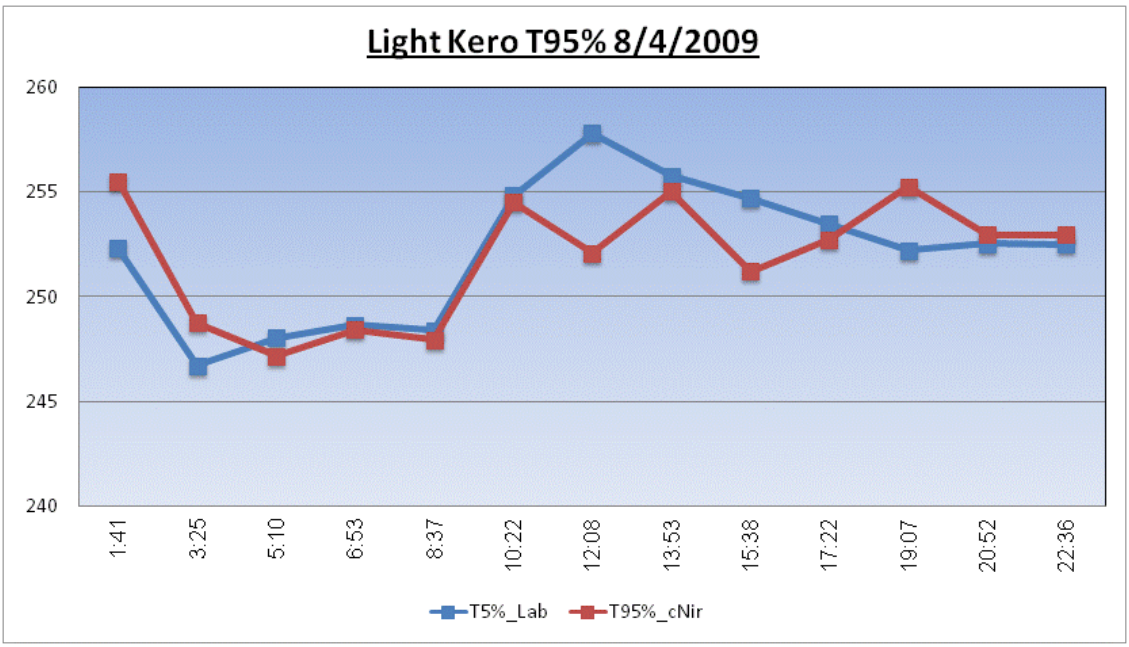


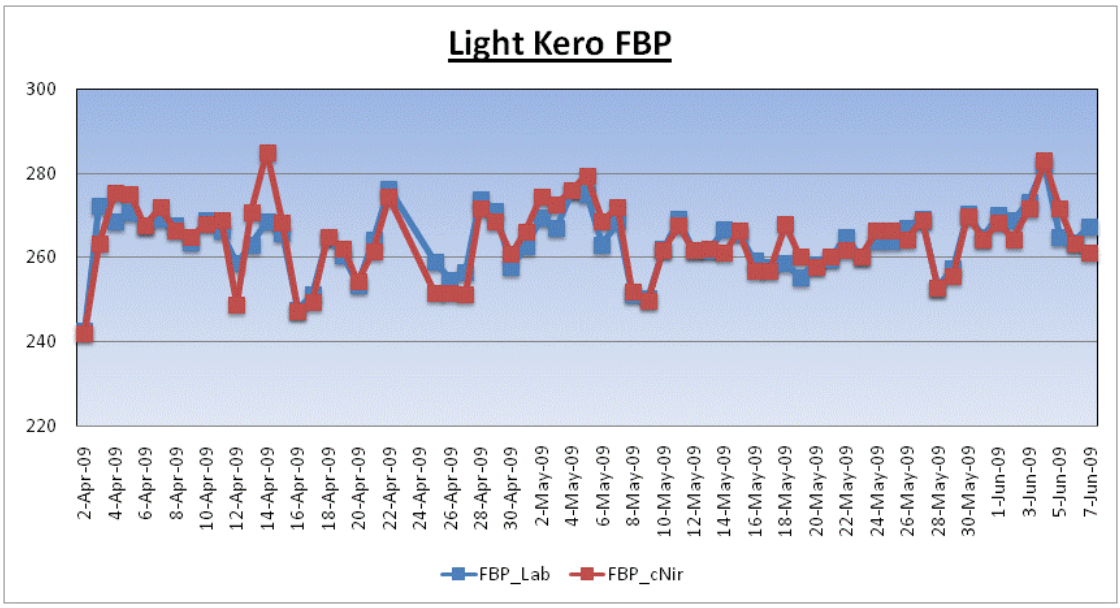


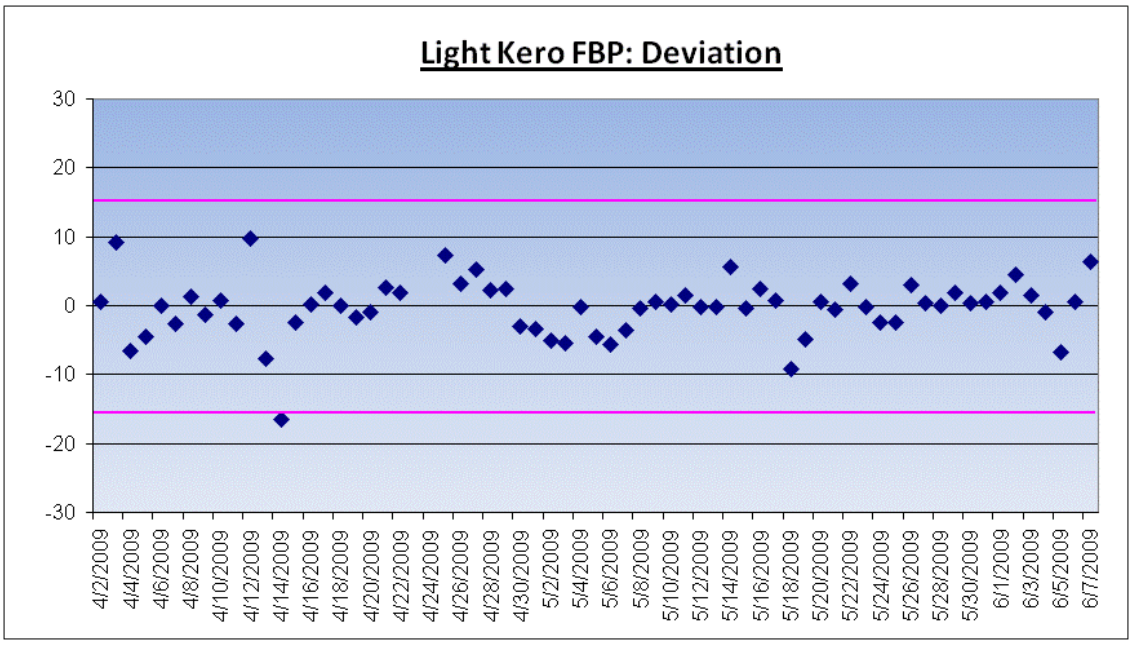
ASTM D86 - 4.8

Guarantied – 7.2

NIR – 7.2







ASTM D86 – 10.5

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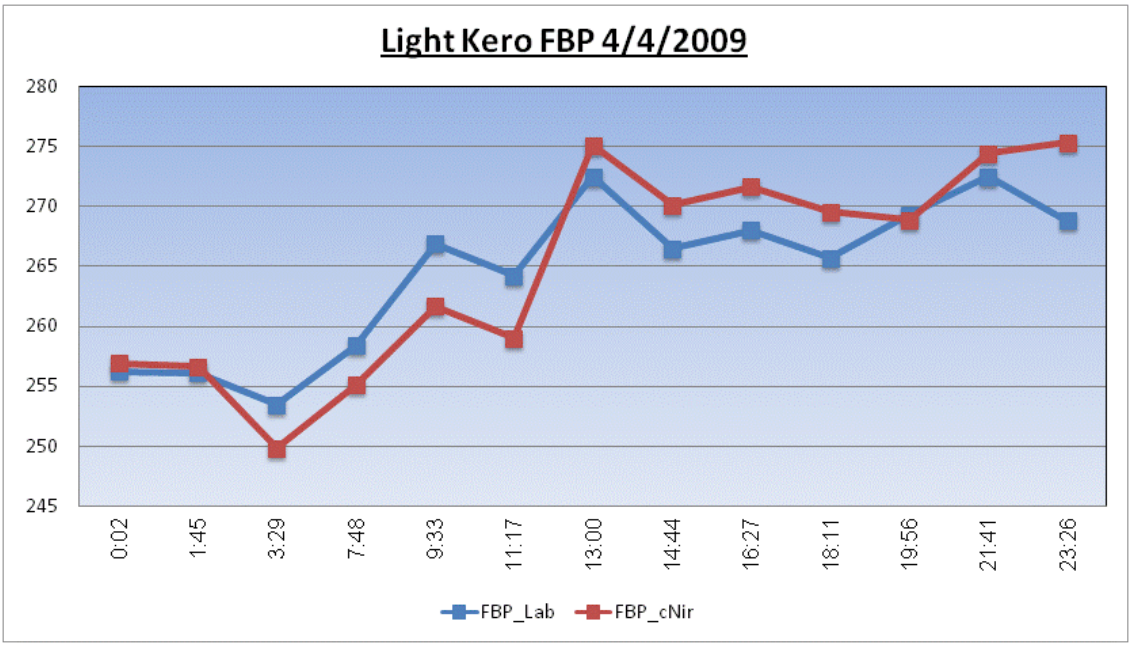
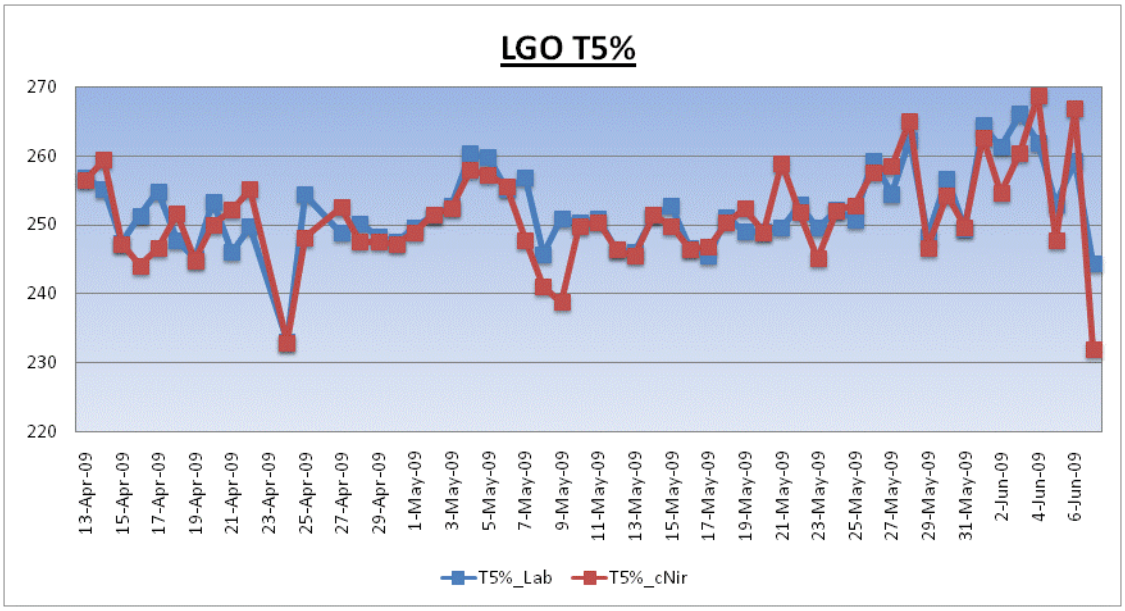
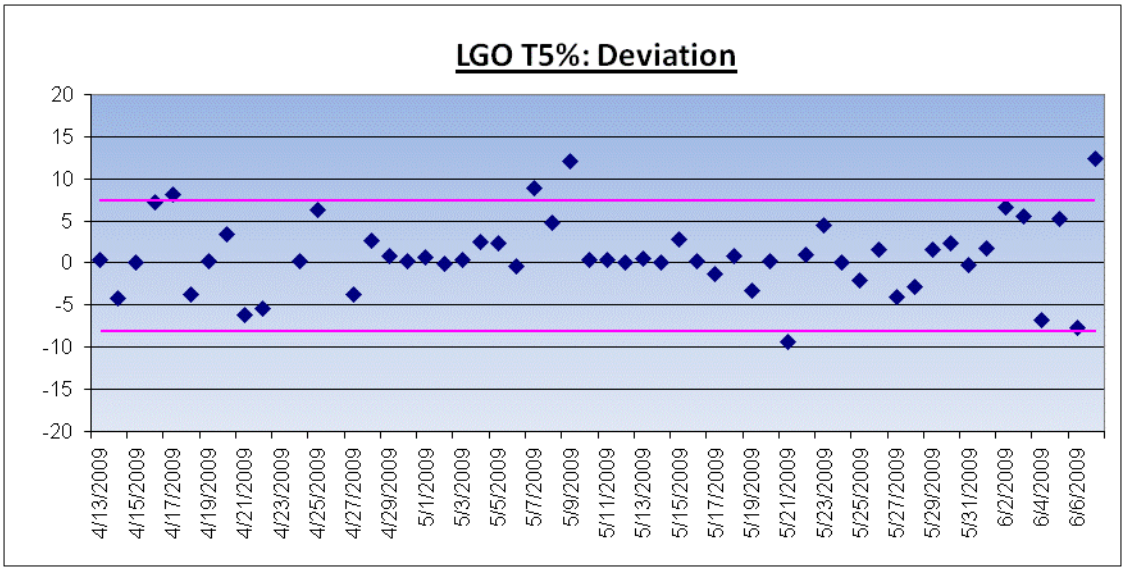
NIR – 8.6



Case Study: Diesel





ASTM D86 - 4.8

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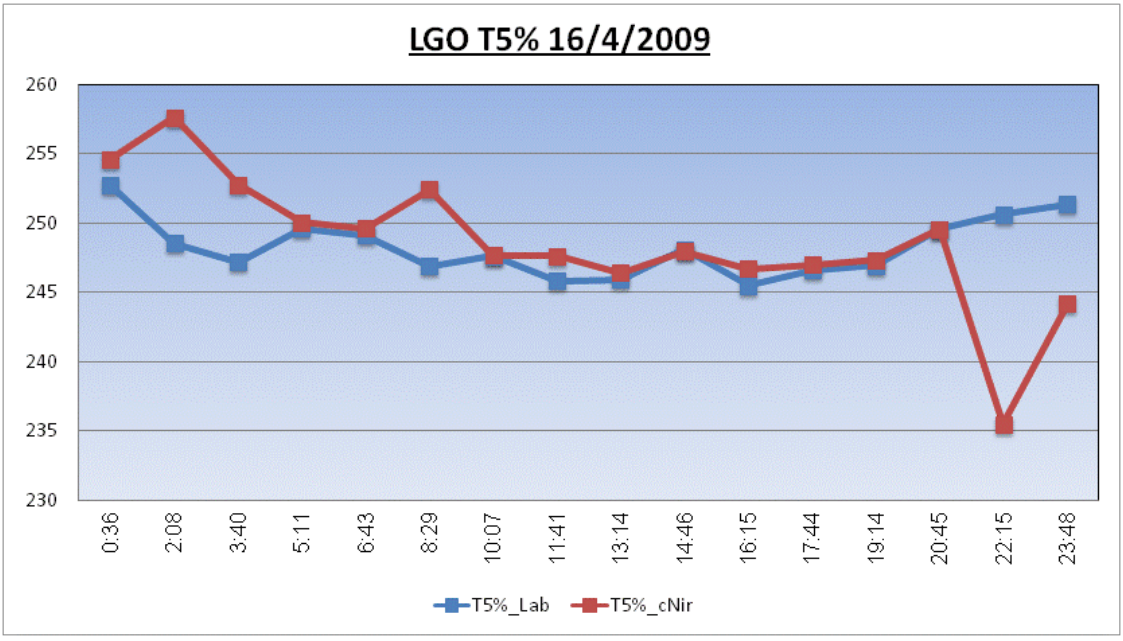
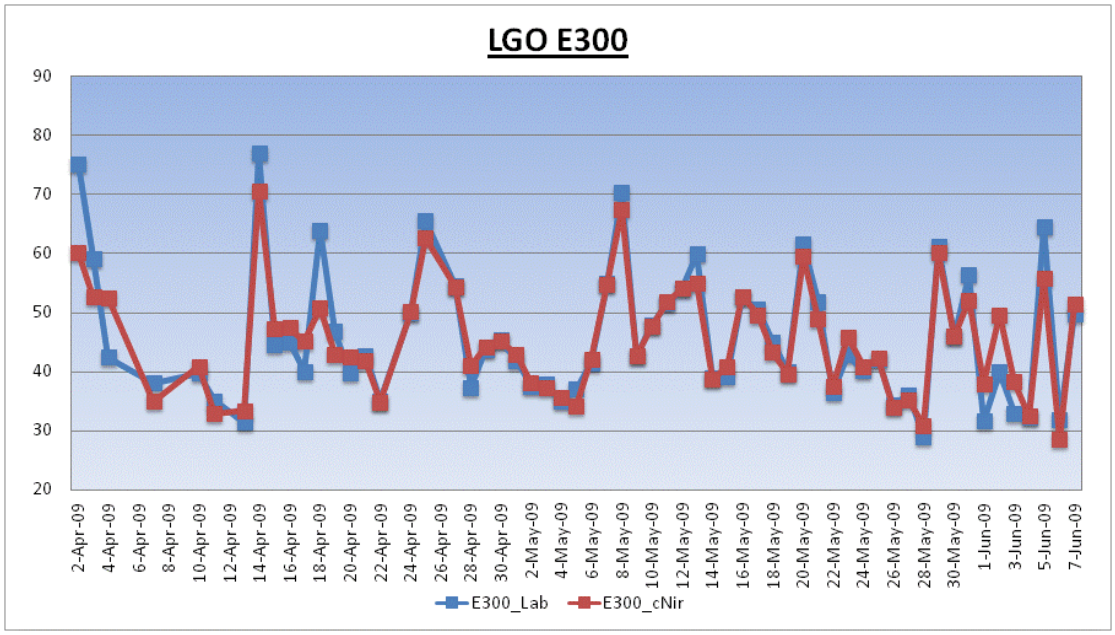
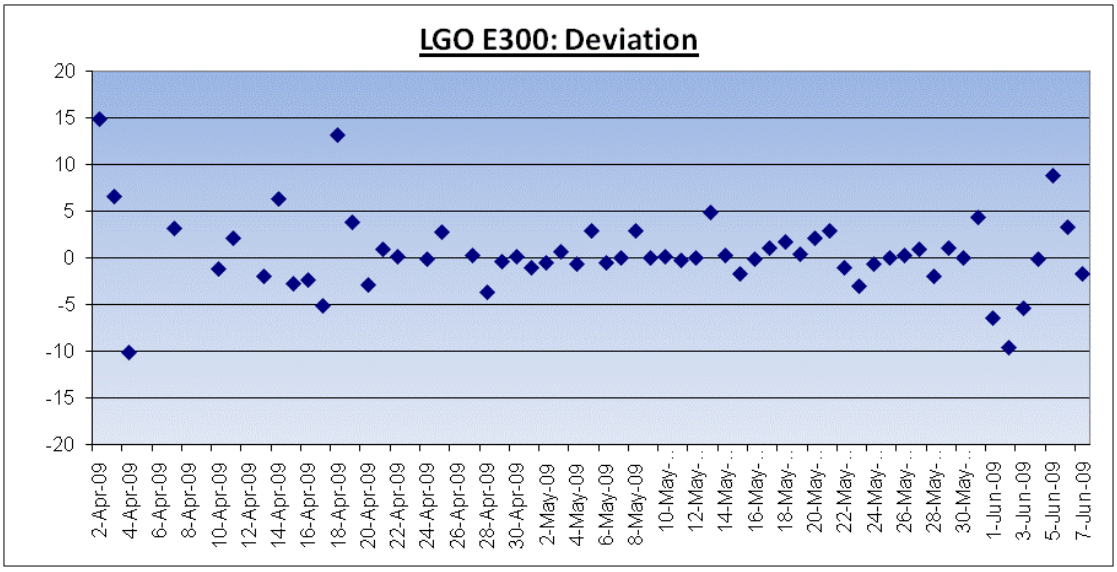


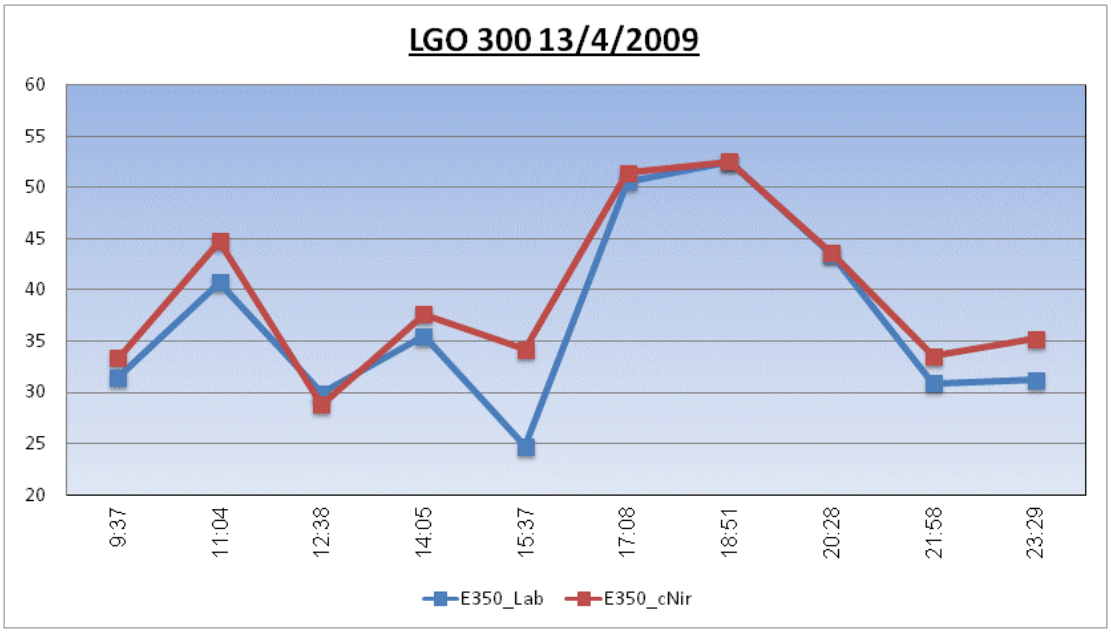


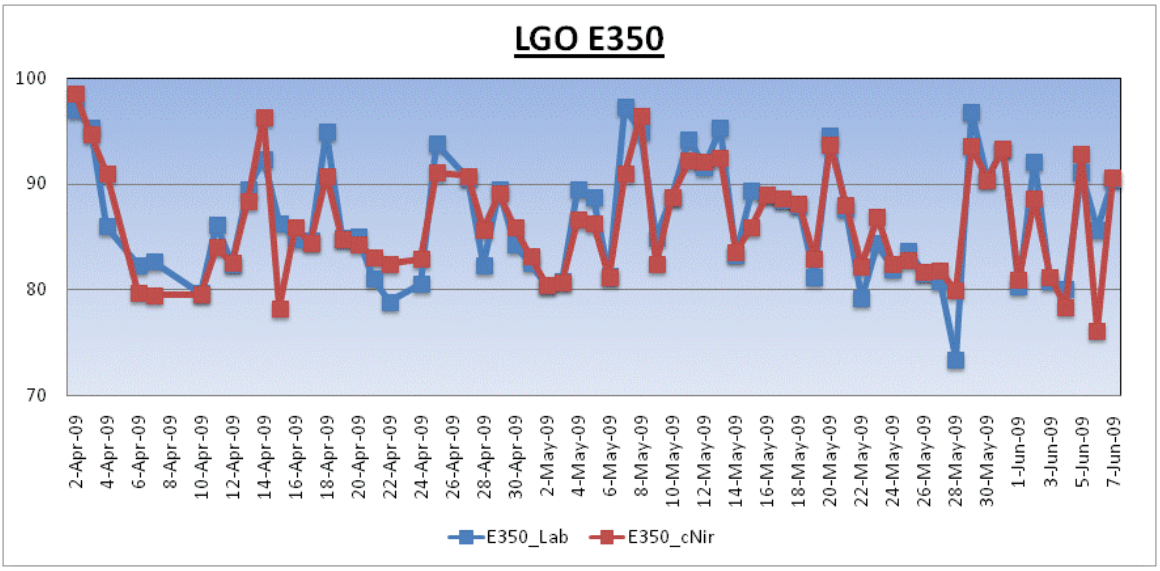


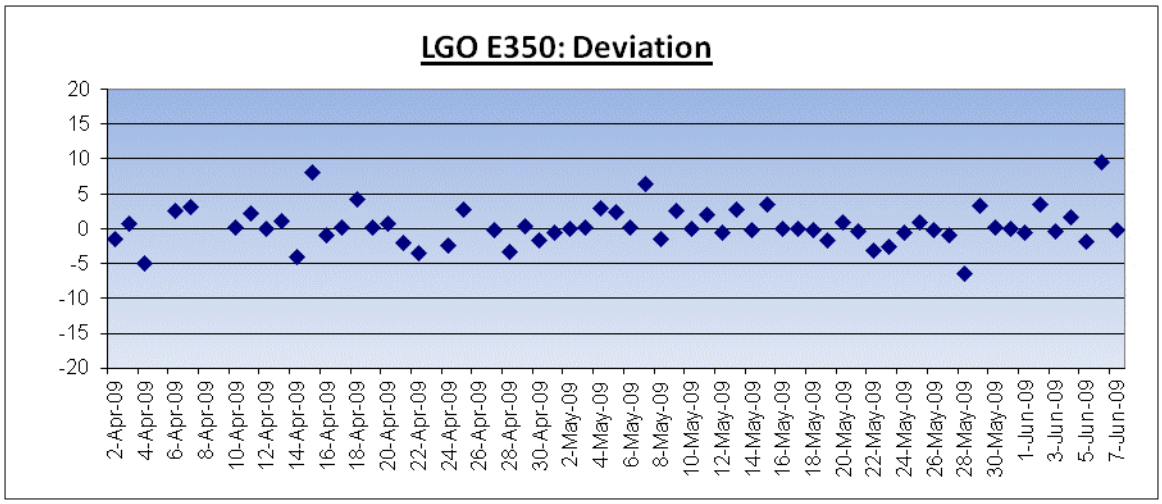
ASTM D86 -

Guarantied –

NIR – 7.3







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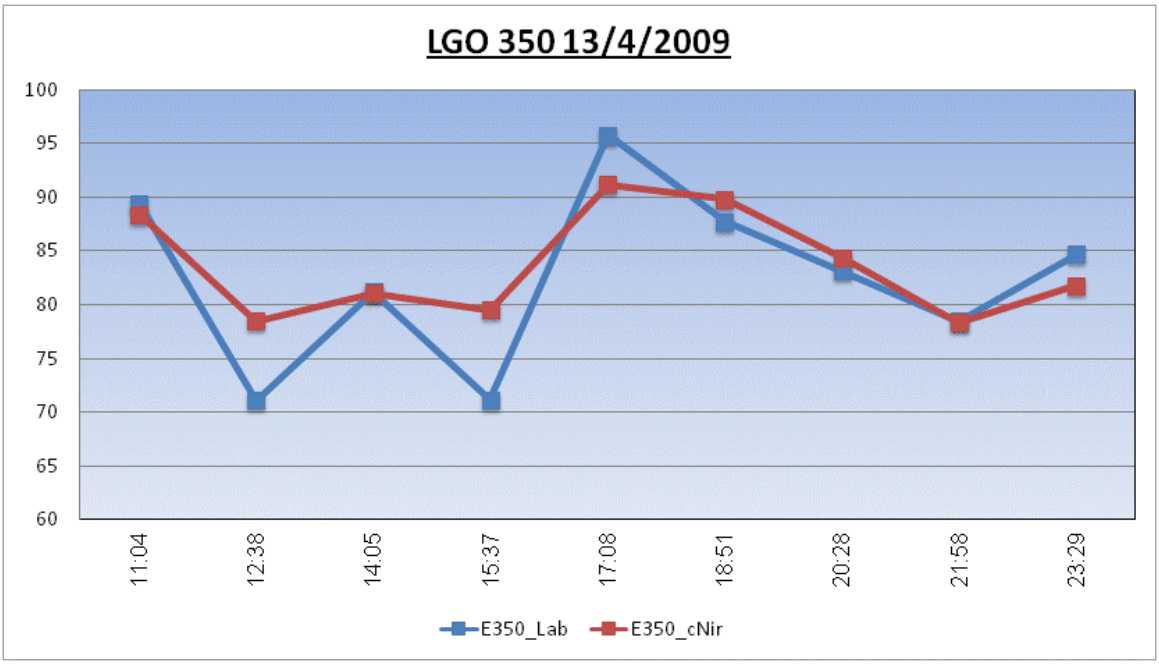

MODCON

To Whom It May Concern

Subject: Modcon NIR Analyzer Beacon-2000

We hereby confirm that Modcon Systems Ltd. has successfully designed, engineered, manufactured, assembled, tested, integrated, supplied and commissioned their Beacon-2000 Process NIR Analyzer for crude distillation unit (CDU) applications at Petrbrazi Petrom OMV Oil Refinery (Romania).

The analyzer has been used for process control of seven CDU process streams since June 2008. The measured properties includes distillation curve points 5%, 95%, 300^{0}C, 350^{0}C, FBP. All measured values show good correlation with Lab results, and same or better reproducibility as required by ASTM methods used in plant laboratory.

Sincerely Yours,

Bolim Marian

Project Manager for Online analyzers

MODCON SYSTEMS LTD.

Leaders in Analysis, Measurement and Automation

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Azerbaijan: (99412)4189859 **UK:** (44207)5043626 **USA:** (1917) 5916880 **Russia:**(7095)2349908