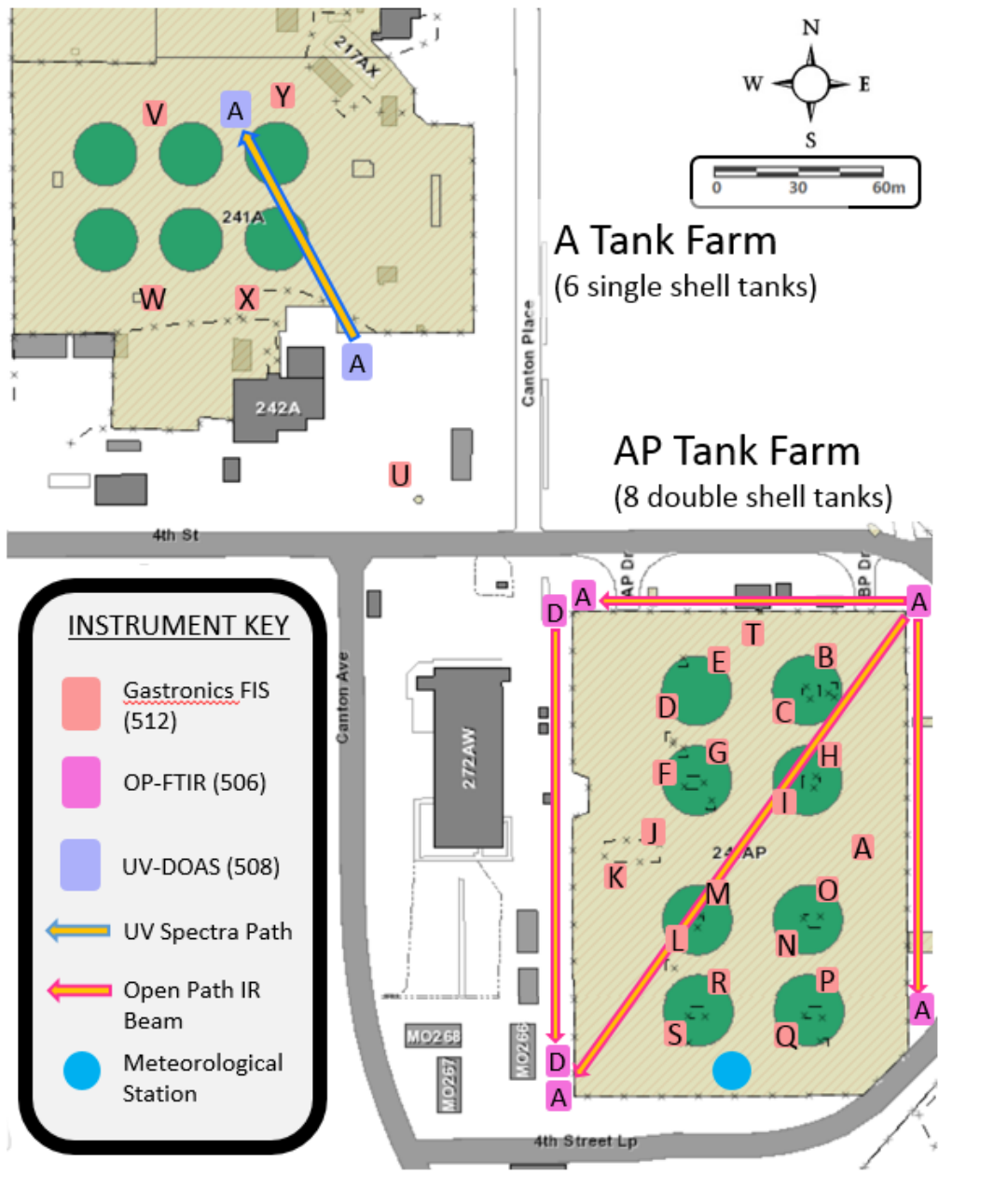


Vapor Monitoring and Detection System Weekly Report – A and AP Tank Farm Field Instrument Report

Revision 0 – Initial Release of Report

5/3/2017 6:00 – 5/10/2017 6:00

Instrument/Sampling Locations – A and AP Tank Farms



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Abbreviations and Units

CH ₄	=	methane
COPC	=	chemicals of potential concern
DRI	=	direct reading instrument
FIS	=	fixed instrument skid
IR	=	infrared
ND	=	not detected
NH ₃	=	ammonia
NO	=	nitric oxide
N ₂ O	=	nitrous oxide
NO ₂	=	nitrogen dioxide
OEL	=	occupational exposure limit
OP-FTIR	=	open path Fourier transform infrared spectrometer ¹
OSHA	=	Occupational Safety and Health Administration
PEL	=	permissible exposure limit
ppb	=	parts per billion
ppm	=	parts per million
UV	=	ultraviolet
UV-DOAS	=	ultraviolet differential optical absorption spectrometer ²
VMDS	=	vapor monitoring and detection system
VOC	=	volatile organic compounds, which include both volatile and semi-volatile compounds

VMDS Instruments

506A	=	OP-FTIR Multi-Path
506D ³	=	OP-FTIR Single-Path
508A	=	UV-DOAS
512	=	FIS Gastronics Direct Reading Instrument

¹ OP-FTIR Fact Sheet: <http://hanfordvapors.com/wp-content/uploads/2016/10/OP-FTIR-fact-sheet.pdf>

² UV-DOAS Quick Sheet: <http://hanfordvapors.com/wp-content/uploads/2016/10/UV-DOAS-Fact-Sheet.pdf>

³ The OP-FTIR single-path instrument identification number was changed from 506B to 506D in the OSI PI System in September 2017. The instrument identification number was changed to be consistent with the Tank Farm Monitoring and Control Systems number.

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Introduction

This summary contains Vapor Monitoring and Detection System (VMDS) pilot-scale data collected over one week (5/3/2017 at 06:00 through 5/10/2017 at 06:00) using direct reading vapor detection instruments, the open path Fourier transform infrared spectrometer (OP-FTIR), and the ultraviolet differential optical absorption spectrometer (UV-DOAS).

Pilot-scale testing is focused on evaluating component integration and functionality. Data shown may include results for calibration and calibration check (bump test) tests performed to verify sensors are functioning; these tests are visible in the data as spikes. Raw spectra (data) may need to be reprocessed and reviewed as understanding of the particular instruments being used as part of the VMDS pilot test are deployed and the company's ability to align the instruments with the overall objectives of the pilot test improves.

The spectroscopic instruments—OP-FTIR and UV-DOAS—provide real-time multi-gas measurement (qualitative and quantitative) of gases. Even though the instrument is very accurate regarding the quantification of chemical compounds, reported results cannot be directly calculated into a concentration for a specific location, this is due to its sample size – an open path between two points. The sample path is defined by the location of the emitter and the reflector which may be tens to hundreds of meters apart. Therefore data from these instrument types will not be directly compared to the Occupational Exposure Limits (OELs) and Action Levels, but used to determine concentrations of compounds along the path of the instrument's beam.

Each analyte measured by the OP-FTIR and the UV-DOAS has a specific reference spectrum, which represents the absorption characteristics for that chemical in the IR or UV spectral regions. Reference spectra for each analyte are stored in an instrument software library (library) that specifies which absorption features are analyzed, how analysis is performed, and reporting criteria. Revisions to the library are periodically performed to improve accuracy of analysis for analytes; the optimization of the library is iterative and periodic changes to the library are being performed. Revisions to the library may result in the identification of a compound not previously thought to be present, or conversely determine that a previously reported analyte was not actually present. Identification of an analyte depends on the analytical method (UV or IR), the library used, analyte concentration, other chemical compounds present, and other factors. The compounds present can interfere/overlap with the analyte spectral signature, especially for compounds having the same functional groups (e.g., methyl or ketone groups). Work is ongoing to optimize the library and minimize these interferences.

The direct read instruments located within AP and A Tank Farms include the Fixed Instrument Skid (FIS) Gastronics (512) units with sensors for detecting NH₃ and VOCs. At times, communications between the Gastronics radio and the Wi-Fi receiver were frequently and randomly interrupted resulting in loss of the Wi-Fi signal and data drops.

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Summary for 5/3/2017 through 5/10/2017

The following sections summarize data reporting for vapor monitoring and detection instruments at AP and A Tank Farms for the 5/3/2017 through 5/10/2017 period. Instruments at AP Tank Farm include open path FTIR instruments (multi-path and single-path) and the FIS Gastronics direct reading instruments. Instruments at A Tank Farm include a UV-DOAS spectroscopy instrument and Gastronics direct reading instruments.

AP TANK FARM

AP Tank Farm OP-FTIR Instruments

Instruments 506A and 506D were not in service this week due to the AP Tank farm electrical outage. No data from these instruments were reported to OSI PI⁴ this week (Table 1).

Table 1. Chemical Species Detected^a by Open Path FTIRs at AP Tank Farm

Chemical Compound	506A: OP-FTIR Multi-Path (ppm)	506D: OP-FTIR Single-Path (ppm)
Nitrous Oxide*	NR	NR
Ammonia*	NR	NR
Methane	NR	NR
1,3-Butadiene*	NR	NR
1-Butanol*	NR	NR
2-Hexanone*	NR	NR
3-Buten-2-one*	NR	NR
Acetaldehyde*	NR	NR
Acetonitrile*	NR	NR
Benzene*	NR	NR
Butanal*	NR	NR
Butyl Nitrite*	NR	NR
Ethylamine*	NR	NR
Formaldehyde*	NR	NR
Furan*	NR	NR
Methanol*	NR	NR
Methyl Isocyanate*	NR	NR
Methyl Nitrite*	NR	NR
N-Nitrosodiethylamine*	NR	NR
N-Nitrosodimethylamine*	NR	NR
N-Nitrosomorpholine*	NR	NR
Propanenitrile*	NR	NR
Pyridine*	NR	NR
Tributyl Phosphate*	NR	NR

Notes: (a) Based on data retrieved from OSI PI; OSI PI System is a data visualization software package from OSIsoft.

*Chemical is on Chemical of Potential Concern (COPC) list

NR – Not reported

⁴ OSI PI System is a data visualization software package from [OSIsoft](http://www.osisoft.com).

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AP Tank Farm Direct Reading Instruments

Instruments 512U, located between A and AP Tank Farm, are included.

FIS Gastronics (512 - NH₃, VOCs, N₂O): Units located in AP Tank Farm include: 512A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, and T. All of these 512 instruments were calibrated successfully for NH₃ except for 512H, L, Q, P, and R in early May (5/1/2017 through 5/3/2017). The 512 instruments that passed calibration for VOC were 512A, B, C, D, E, F, H, I, J, L, O, P, and T.

No ammonia was detected by Gastronics instruments that were in calibration and reporting this week. Instruments 512H, L, Q, and R reported NH₃ values as high as 2 ppm through the reporting period immediately following the calibration for each of these instruments (Figure 1). Based on review of the data and the calibration process, the zero reset was performed too early on these instruments, before they reached the minimum ammonia reading for the zero calibration gas portion of the test. Therefore these 2 ppm ammonia readings are not considered valid.

Regarding the calibrated VOC sensors, three instruments (512E, O, and S) did not report to OSI PI, two reported non-detects of VOCs, and seven units reported VOCs at <2 ppm. A total VOC limit of 2 ppm currently is prescribed by Fact Sheet EH-09-001⁵. The N₂O sensors do not hold calibration and are not reported on. Only instruments that are reporting to OSI PI and pass calibration for NH₃ and VOCs are reported on here.

⁵ Fact Sheet for Action Limit for Volatile Organic Compounds, Washington River Protection Solutions, Richland, Washington: <https://hanfordvapors.com/wp-content/uploads/2017/12/EH-09-001-Turnback-value-for-VOCs.pdf>

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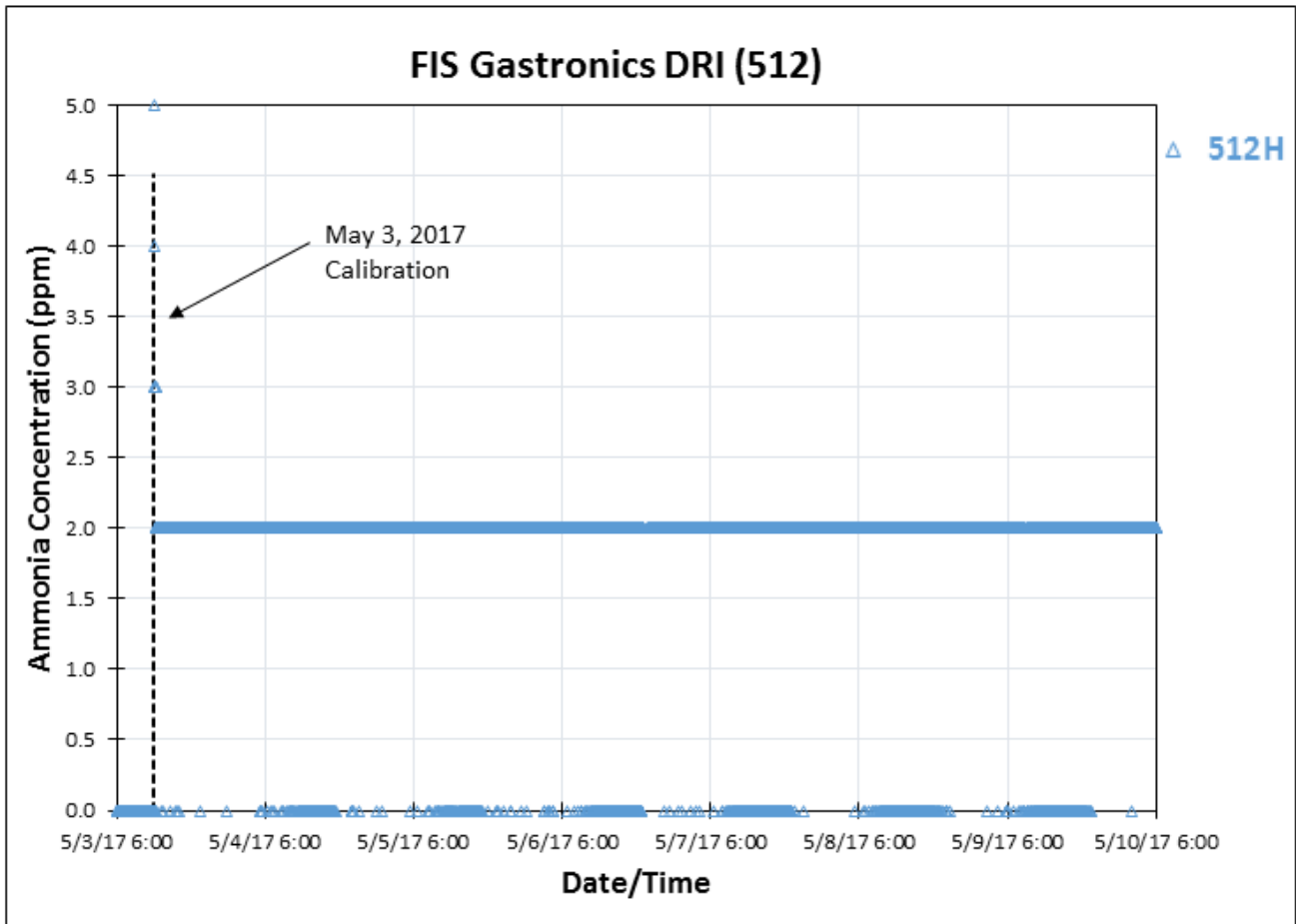


Figure 1. Example Showing Ammonia Readings Following Calibration.

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Table 2. AP Tank Farm Gastronics (512) Comments

Chemical Compound (units)	Comment	OEL	Action Level	Detection Range
NH ₃ (ppm)	No ammonia detected on any instrument	25	12	1 – 100
VOC (ppm)	<ul style="list-style-type: none"> Out of Calibration: 512C^a, G, K, M, N, Q, R, T, and U Instruments that reported no VOCs detected: 512F and H Instruments that reported a maximum value of <2 ppm: 512A, B, D, I, J, L, and P Instruments that reported maximum values ≥ 2 ppm: None 	N/A	2	0.005 – 50 ⁶

VOC: Only instruments reading within 10% of the calibration gas concentration during their most recent bump/calibration test are reported here⁷.

^a Instrument 512C passed its previous VOC calibration, however it exhibited a zero drift and was out of calibration during most of the time it reported to OSI PI.

A TANK FARM

A Tank Farm UV-DOAS Instrument

Ammonia and nitric oxide (NO) were detected by the UV-DOAS instrument during this week (Table 3). These compounds are typically found in detectable quantities in air⁸ at the same levels as reported here. The instrument UV lamp failed at 07:27 on 5/4/2017 and was replaced at 09:33 on 5/8/2017 (Figure 3). All data reported by the UV-DOAS instrument when the UV lamp failed is not considered representative. A value of 0.026 ppm toluene was reported to OSI Pi, but this value is associated with re-starting the instrument after the UV lamp was replaced. Therefore, this toluene concentration value is not considered representative. Analyte concentrations are reported in Table 3 and Figure 3 below.

⁶ Gastronics FIS Overview: <https://hanfordvapors.com/wp-content/uploads/2016/11/Gastronics-FIS-Fact-Sheet.pdf>

⁷ Calibrating and Testing Direct-Reading Portable Gas Monitors: <https://www.osha.gov/dts/shib/shib093013.html>

⁸ Air Composition from "The Engineering ToolBox": http://www.engineeringtoolbox.com/air-composition-d_212.html

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Table 3. Chemical Species Detected^a by UV-DOAS at A Tank Farm

Chemical Compound	508A: UV-DOAS (ppm)	Chemical Compound	508A: UV-DOAS (ppm)
Ammonia*	ND – 0.13	Methyl Nitrite*	ND
Nitric Oxide	ND – 0.13	Pyridine*	ND
1,3-Butadiene*	ND	1,2,4-Trimethylbenzene	ND
2-Methyl-2-butenal*	ND	1,3,5-Trimethylbenzene	ND
2-Methylfuran*	ND	Ethylbenzene	ND
Acetaldehyde*	ND	m-Xylene	ND
Benzene*	ND	Nitrogen Dioxide	ND
Butanal*	ND	o-Xylene	ND
Ethylamine*	ND	p-Xylene	ND
Formaldehyde*	ND	Styrene	ND
Furan*	ND	Sulfur Dioxide	ND
Mercury*	ND	Toluene	ND ^b

Notes: (a) Based on data retrieved from OSI PI; OSI PI System is a data visualization software package from OSIsoft.

(b) Reported concentration for toluene was due to re-starting the instrument following UV lamp replacement and is not considered representative, therefore is not included in the table.

*Chemical is on COPC list

ND – Not detected

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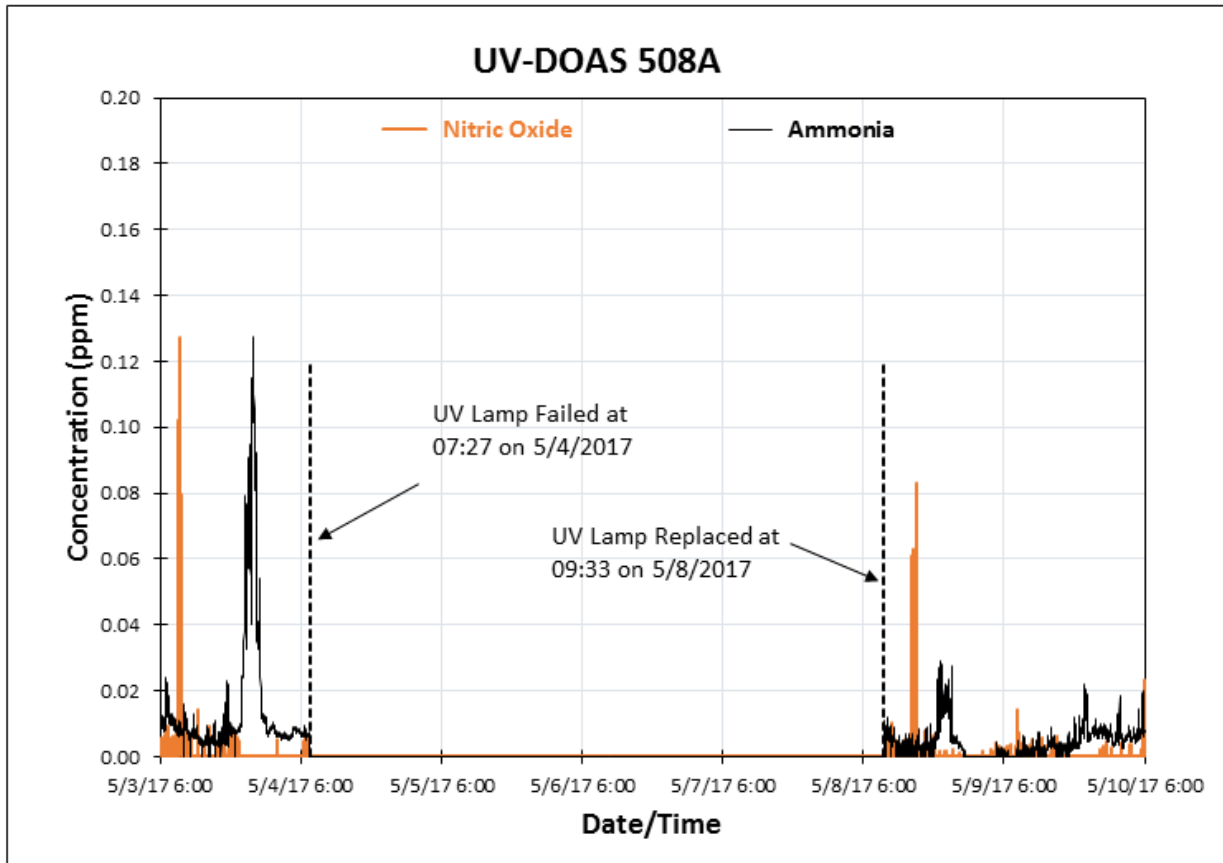


Figure 2. Chemical Compounds Detected by UV-DOAS Instrument 508A

A Tank Farm Direct Reading Instruments

FIS Gastronics (512 - NH₃, VOCs, N₂O): Units located in A Tank Farm include: 512V, W, X, and Y. None of these instruments reported data during the week. All of these instruments were last calibrated on 5/2/2017. All of these instruments passed calibration for NH₃ on 5/2/2017. None of these instruments passed calibrated for VOC on 5/2/2017.

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5/3/2017 – 5/10/2017 Instrument Operational Status:

Time reporting is calculated using the time sensors that report to OSI PI System for each instrument (Tables 4 and 5).

Table 4. Gastronics Direct Reading Instruments (512) % Time Reporting^a

Instrument	% Time Reporting	Instrument	% Time Reporting
512A	87	512N	0
512B	95	512O	0
512C	97	512P	55
512D	90	512Q	75
512E	0	512R	59
512F	95	512S	0
512G	0	512T	10
512H	97	512U	>99
512I	97	512V	0
512J	1	512W	0
512K	86	512X	0
512L	97	512Y	0
512M	0		

(a) % time reporting based on NH₃.

Table 5. Spectrometer Instruments Time Reporting

Instrument	% Time Reporting
506A	0
506D	0
508A	>99