

REV 2
PRELIMINARY_ AWAITING OIL RESULT

KAN 19008-900

**LTC BACK BOARD INSPECTION
RADIATOR REGASKET + NEW PACKING
VACUUM OIL FILL**



REPORT SUBMITTED BY: POLLARO 4/16/19

REPORT REVIEWED BY: MK 4/16/19

EQUIPMENT:

McGraw Edison (1)

60/67.2/80/89.6/100/112 MVA

161/92.9 - 69 KV

Three phase transformer w/LTC

10,600 gallons of oil Main

455 gallons of oil LTC

SCOPE OF WORK SUMMARY:

PHASE 1:

- **As Found oil sample** of transformer LTC:
 - Oil analysis for standard screen, water content, and Dissolved Gas Analysis (DGA)
 - **Perform** transformer LTC inspection of back board. Estimated to include the following:
 - Transformer to be de-energized, grounded and isolated by others
 - Drain approx. 455 gallons of oil into storage tank provided by EPS.
 - Open LTC and clean internally for inspection
 - Pressurize transformer and Inspect the LTC back board and report finding to customer (no repair will be performed at this time).
 - Replace LTC door gasket (gasket provided by EPS)
 - Fill LTC with oil previously drained using a filter press with 0.5 micron filters
 - **As left oil sample** of transformer LTC:
 - Oil analysis for standard screen, water content, and Dissolved Gas Analysis (DGA)
-

PHASE 2:

- **As found oil sample** of transformer:
 - Oil analysis for standard screen, water content, and Dissolved Gas Analysis (DGA)
 - **Re-gasket** transformer radiators shut-off valves. Estimated to include the following:
 - o Transformer to be de-energized, grounded and isolated by others
 - o Customer to disconnect and reconnect all bushings leads
 - o Drain approx. 10600 gallons of oil into storage tank provided by EPS followed with dry,
 - o Breathable air or nitrogen
 - o Close all upper and lower radiators shut-off valves
 - o Disconnect, remove and re-gasket radiators shut-off valves + PACKING
 - o re-install radiators
 - o Pressurize and check for leaks
 - **Vacuum fill** the transformer with oil after the re-gasketing is completed. Estimated to include the following:
 - o 24 hour vacuum, at 1.0 Torr or less, prior to filling
 - o Fill the transf with oil previously drained under vacuum @ 1 torr or below and the oil
 - o Heated to 50°C during filling.
 - o Establish nitrogen blanket on the transformer
 - o Circulate the oil 0 passes
 - **Testing** after re-gasketing and vacuum filling is completed. Estimated to include the following:
 - o Transformer power factor test (DOBLE 10KV)
 - o Power Factor testing, bushings (C1 & C2)
 - o Transformer Turns ratio – TTR (as found tap on both DETC and LTC)
 - o Core Ground Megger Test
 - o Winding Resistance test – (as found tap on both DETC and LTC)
 - o Insulation Resistance Test
 - o Sweep Frequency (SFRA) test
 - o Impedance test
 - **As left oil sample** of transformer:
 - Oil analysis for standard screen, water content, and Dissolved Gas Analysis (DGA)
-

DAILY ACTIVITY STATUS UPDATES

STATUS UPDATE: DAY 1

- 24 MAN HOURS
- RECEIVED FRAK TANK & INSPECTED FOR CLEANLINESS
- DRAINED TRANSFORMER & FOLLOWED DOWN WITH DRY AIR
- REMOVED FANS + RADIATOR BRACING IN PREP FOR DISASSEMBLY
- CRANE TO ARRIVE 11 AM TODAY 4/3

STATUS UPDATE: DAY 2

- ON SCHEDULE
- + 36 MANHOURS
- ALL (18) VALVE PACKING COMPLETE
- ALL (9) RADIATORS REGASKETED
- CRANE COMPLETE AND SENT AWAY
- UNIT PRESSURE CHECKED – NO IMMEDIATE LEAKS
- PRESSURE CHECK WILL CONTINUE OVERNIGHT
- VACUUM TOMORROW

STATUS UPDATE: DAY 3 END

- + 36 MANHOURS
- STARTED VACUUM
- PRESSURE DROP TEST _ PASS
- OIL FILL TODAY

STATUS UPDATE: TESTING

- TRANSFORMER POWER FACTOR TEST (DOBLE 10KV)
 - POWER FACTOR TESTING, BUSHINGS (C1 & C2)
 - TRANSFORMER TURNS RATIO – TTR (AS FOUND TAP ON BOTH DETC AND LTC)
 - CORE GROUND MEGGER TEST
 - WINDING RESISTANCE TEST – (AS FOUND TAP ON BOTH DETC AND LTC)
 - INSULATION RESISTANCE TEST
 - SWEEP FREQUENCY (SFRA) TEST + IMPEDANCE TEST
-

RESULTS AND RECOMMENDATIONS:

- LEAKAGE OF LTC BOARD COULD NOT BE OBSERVED
- BOTH PACKING + O-RING REPLACED ON EACH RADIATOR HEADER
- UNIT TIGHT AND FREE OF LEAKS
- TEST RESULTS SATISFACTORY
- AS LEFT CONDITIONS NOTED IN PICTURES BELOW: DETC, GAUGES, OIL LEVELS, PRESSURE
- LEAKAGE REACTANCE & SFRA PROVIDED AS BASELINE ONLY
- C2 POWER FACTOR + CAP VALUES SATISFACTORY DESPITE LACKING C2 NP INFORMATION

NEXT PAGES:

- VACUUM + OIL LOGS
- TEST RESULTS
- REMAINING PICS

Best Regards,

DOMINIC POLLARO

Dominic Pollaro

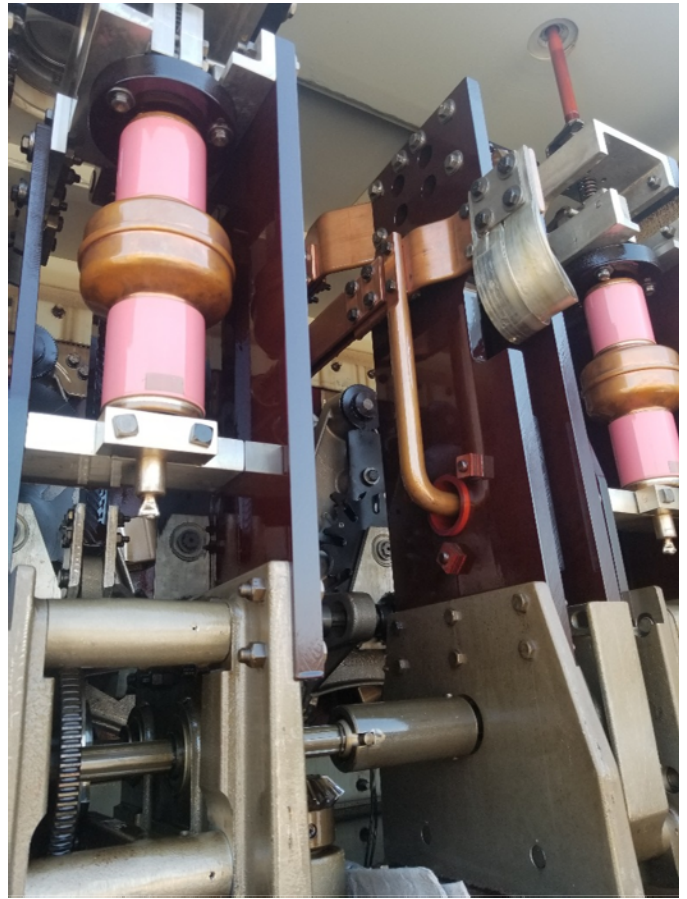
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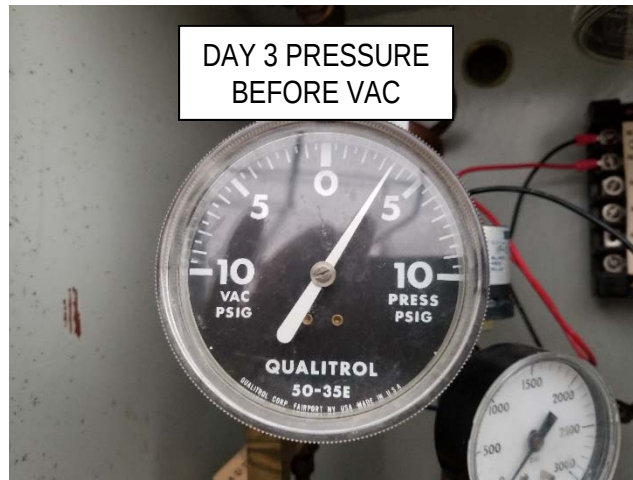
LTC

BEFORE BACKBOARD INSPECTION



LTC
AFTER INSPECTION
NO SIGN OF LEAKAGE





ELECTRIC POWER SYSTEMS TESTING & ENGINEERING SERVICES

Date: 4-4-19 Transformer: C-01835-5-1 Job #: KAN 17002-700

Pressure drop test:
A small variation up to 1 PSI in pressure may occur in the first 12 to 24 hours due to temperature variations. The unit must hold pressure for a 24 hour period.

Start PSI = 4 Date/Time: 4/4/19 End PSI = 3.5 Date/Time: 4/4/19 Tech: JD
2:00 PM 9:00 AM

Vacuum leak drop test:
To verify no leaks are present in vacuum piping system.

A. "Blank-out" the pump by closing its valve (3), the transformer valve (1) and maintain the vacuum pump running. Verify the vacuum level in the vacuum meter installed on the pump. The pressure should drop drastically reaching 50 μ Hg or below within 3 to 10 minutes.

B. Open the valve (3) and verify the sealing within the hose. The pressure should maintain at least 50 μ Hg, otherwise a leak is suspected.

C. Open the transformer valve (1) wait 5 minutes for the pressure to stabilize in the transformer. Record the vacuum level reached.

D. Wait exactly 15 minutes after the pressure has stabilized and re-check the vacuum level in the transformer.

F. The difference between the 5 and 15 minutes readings is used to calculate the leak rate. If the leak rate exceeds 10 torr-gallons per second, then a leak on the transformer is present. Break the vacuum and identify/repair the leak.

L = $(P \times V) / 900$
L = Leak rate (torr-gallons per second)
P = Pressure change (torr) between the 5 and 15 minute readings
V = Total volume of oil in transformer

Start Vac 2345
5 min 1.650
15 min 1.03

Leak rate value should be less than 10 torr-gallons per second.

P (acceptable calculated torr change) $< 9000/V$ (volume oil in transformer)

P (acceptable calculated torr change) $< .949$

Torr (Actual at 5 minutes) = 1.650 EPS Tech: JD

Torr (Actual at 15 minutes) = 1.03 EPS Tech: JD

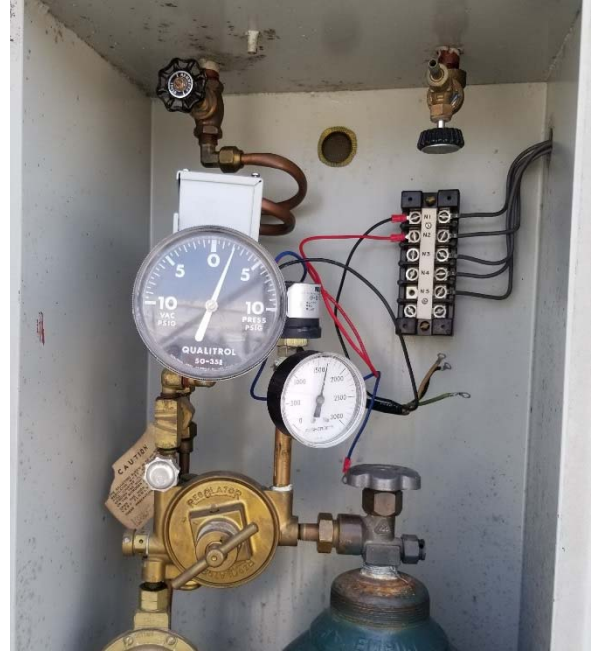
(Actual 15 minute-5 minute torr change) = .380 Acceptable? YES (< P calculated)

Revised 9/28/2015



VACUUM LEAK CHECK
RESULTS

AS LEFT CONDITIONS



LTC OIL LEVEL GAUGE





MAIN TANK OIL LEVEL GAUGE



ELECTRIC POWER SYSTEMS

VACUUM PROCESSING LOG

Sheet: 1

CUSTOMER DATA													
CLIENT: IPL				LOCATION: INDEPENDENCE, MO				DATE: 4/4/2019					
TYPE: OA-FA-FA		MVA: 67.2-89.6-112		VOLTAGE: 161-69KV		MFG:		JOB #: KAN19008-900					
TRANSFORMER SN#: C-06835-5-1				QUANTITY OF OIL: 10600				OPERATOR: RL, JM, SA					
TEST DATA													
TIME	OUTSIDE TEMP (C)	TRANSFORMER			OIL PROCESSING								
		VACUUM TORR (mm)	OIL TEMP (C)	WINDING TEMP (C)	OIL IN TEMP (C)	OIL OUT TEMP (C)	VACUUM TORR (mm)	GALLONS	OIL - PPM IN	WATER OUT	OUTSIDE HUMIDITY	DIELECTRIC D877 D1816	
12:01 AM	---	---	---	---	---	---	---	---	---	---	---	---	---
1:00 AM	---	---	---	---	---	---	---	---	---	---	---	---	---
2:00 AM	---	---	---	---	---	---	---	---	---	---	---	---	---
3:00 AM	---	---	---	---	---	---	---	---	---	---	---	---	---
4:00 AM	---	---	---	---	---	---	---	---	---	---	---	---	---
5:00 AM	---	---	---	---	---	---	---	---	---	---	---	---	---
6:00 AM	---	---	---	---	---	---	---	---	---	---	---	---	---
7:00 AM	---	---	---	---	---	---	---	---	---	---	---	---	---
8:00 AM	---	---	---	---	---	---	---	---	---	---	---	---	---
9:00 AM	---	---	---	---	---	---	---	---	---	---	---	---	---
10:00 AM	---	---	---	---	---	---	---	---	---	---	---	---	---
11:00 AM	9.0°C	0.438	---	---	---	---	0.189	---	---	---	57	---	---
12:00 PM	10.0°C	0.268	---	---	---	---	0.104	---	---	---	73	---	---
1:00 PM	11.0°C	0.208	---	---	---	---	0.840	---	---	---	58	---	---
2:00 PM	11.0°C	0.184	---	---	---	---	0.730	---	---	---	62	---	---
3:00 PM	11.0°C	0.172	---	---	---	---	0.610	---	---	---	66	---	---
4:00 PM	12.0°C	0.168	---	---	---	---	0.580	---	---	---	69	---	---
5:00 PM	11.0°C	0.166	---	---	---	---	0.560	---	---	---	68	---	---
6:00 PM	13.0°C	0.164	---	---	---	---	0.550	---	---	---	70	---	---
7:00 PM	13.0°C	0.163	---	---	---	---	0.540	---	---	---	69	---	---
8:00 PM	11.0°C	0.163	---	---	---	---	0.540	---	---	---	71	---	---
9:00 PM	11.0°C	0.167	---	---	---	---	0.550	---	---	---	70	---	---
10:00 PM	11.0°C	0.169	---	---	---	---	0.550	---	---	---	70	---	---
11:00 PM	11.0°C	0.171	---	---	---	---	0.550	---	---	---	70	---	---
11:59 PM	10.0°C	0.171	---	---	---	---	0.550	---	---	---	71	---	---
COMMENTS:													

ELECTRIC POWER SYSTEMS

VACUUM PROCESSING LOG

Sheet: 1

CUSTOMER DATA													
CLIENT: IPL				LOCATION: INDEPENDENCE, MO				DATE: 4/5/2019					
TYPE: OA-FA-FA		MVA: 67.2-89.6-112		VOLTAGE: 161-69KV		MFG:		JOB #: KAN19008-900					
TRANSFORMER SN#: C-06835-5-1				QUANTITY OF OIL: 10600				OPERATOR: RL, JM, JA					
TEST DATA													
TIME	OUTSIDE TEMP (C)	TRANSFORMER			OIL PROCESSING								
		VACUUM TORR (mm)	OIL TEMP (C)	WINDING TEMP (C)	OIL IN TEMP (C)	OIL OUT TEMP (C)	VACUUM .55	GALLONS	OIL - PPM IN	WATER OUT	OUTSIDE HUMIDITY	DIELECTRIC D877	DIELECTRIC D1816
12:01 AM	10.0°C	0.171	---	---	---	---	0.550	---	---	---	71	---	---
1:00 AM	10.0°C	0.171	---	---	---	---	0.540	---	---	---	71	---	---
2:00 AM	9.0°C	0.173	---	---	---	---	0.540	---	---	---	72	---	---
3:00 AM	8.0°C	0.178	---	---	---	---	0.560	---	---	---	73	---	---
4:00 AM	7.0°C	0.179	---	---	---	---	0.560	---	---	---	73	---	---
5:00 AM	7.0°C	0.179	---	---	---	---	0.540	---	---	---	73	---	---
6:00 AM	8.0°C	0.178	---	---	---	---	0.540	---	---	---	73	---	---
7:00 AM	8.0°C	0.178	---	---	---	---	0.540	---	---	---	73	---	---
8:00 AM	8.0°C	0.179	---	---	---	---	0.600	---	---	---	73	---	---
9:00 AM	7.0°C	0.177	---	---	---	---	0.600	---	---	---	61	---	---
10:00 AM	8.0°C	0.170	---	---	---	---	0.680	---	---	---	61	---	---
11:00 AM	8.0°C	0.170					0.670				60	---	---
12:00 PM	10.0°C	0.399			14.0°C	49.0°C	0.311				60	---	---
1:00 PM	12.0°C	0.237			15.5°C	53.1°C	0.369	1789	7	1	56	---	---
2:00 PM	13.0°C	0.239			18.0°C	56.0°C	0.383	2921	7	1	54	---	---
3:00 PM	15.0°C	0.245			18.0°C	54.0°C	0.385	5260	7	1	54	---	---
4:00 PM	17.0°C	0.246			19.0°C	54.0°C	0.386	6690	7	1	54	---	---
5:00 PM	17.0°C	0.251			21.0°C	54.0°C	0.387	8100	7	1	54	---	---
6:00 PM	17.0°C	0.260			25.0°C	57.0°C	0.392	9874	7	1	52	---	---
7:00 PM	15.0°C	0.296			26.0°C	56.0°C	0.416	10342	7	1	50	---	---
8:00 PM												---	---
9:00 PM												---	---
10:00 PM												---	---
11:00 PM												---	---
11:59 PM												---	---
COMMENTS:													

C-06835-5-1_X2



Report Source TwoWindingTransformer

Session Test Date 4/5/2019 7:30:02 AM

Nameplate - Two-winding Transformer

Company	IPL	Serial Number	C-06835-5-1
Location	Independence, Mo.	Special ID	
Division		Circuit Designation	
Manufacturer	McGraw-Edison	Configuration	Y-Δ
Year Manufactured		Tank Type	N2 Blanket
Mfr Location	Canonsburg, PA	Coolant	Oil
Phases	Three	Class	OA/FA/FA
Oil Volume	10600 UG	BIL	550 kV
Weight	285100 LB		
kV	161, 69	VA Rating	60, 80, 100, *, MVA

Administration

Test Date	4/5/2019	Test Time:	7:30 AM	Weather	Partly Cloudy
Air Temperature	15°C	Apparatus Temperature	18°C	Humidity	54 %
Tester	Robin Lafflin	Work Order	KAN19008-900	Date Last Tested	
Verified		Test Set Type		Date Retested	
Verification Date		Set Top Serial #		Reason	ROUTINE
Last Sheet #		Set Bottom Serial #		Travel Time	
Purchase Order		Ins. Book #		Duration	
Copies		Sheet #		Crew Size	2

Session Notes

Megger Test @ 5000 VDC

H-L		H-G	L-G
15 Sec	2.90 G	1 Min 3.75 G	1 Min 1.79 G
30 Sec	3.33 G		
45 Sec	3.50 G		
1 Min	3.67 G		
2 Min	4.01 G		
3 Min	4.18 G		
4 Min	4.60 G		
5 Min	4.86 G		
6 Min	4.98 G		
7 Min	5.22 G		
8 Min	5.47 G		
9 Min	5.56 G		
10 Min	5.80 G		
PI	1.58		

Bushing Nameplate

Designation	Serial #	Manufacturer	Type	C1 %PF	C1 Cap	C2 %PF	C2 Cap	Rated kV	Amps
H0	2173029	General Electric	U	0.32	471	*	*	25	1200
H1	G74959	McGraw-Edison	OTHER	0.48	330	*	5170	161	800
H2	G74961	McGraw-Edison		0.47	331	*	5169	161	800
H3	G74960	McGraw-Edison		0.45	325	*	4995	161	800
X1	A74925	McGraw-Edison		0.49	322	*	*	69	1200
X2	A74924	McGraw-Edison		0.5	315	*	*	69	1200
X3	A74933	McGraw-Edison		0.5	298	*	*	69	1200

Overall Tests

	Insulation	Test kV	mA	Watts	% PF Corr.	Corr Fctr	Cap (pF)	Manual
1	CH+CHL	10.000	50.288	1.267	0.252	0.998	13339.750	
2	CH	10.000	30.048	0.869	0.289	0.998	7970.885	
3	CHL(UST)	10.000	20.186	0.380	0.188	0.998	5354.655	
4	CHL	0	20.240	0.398	0.197	0.998	5368.865	
5	CL+CHL	10.000	52.358	1.475	0.281	0.998	13888.300	
6	CL	10.000	32.130	1.108	0.344	0.998	8522.660	
7	CHL(UST)	9.981	20.186	0.360	0.178	0.998	5354.875	
8	CHL	0	20.228	0.367	0.181	0.998	5365.640	

Bushing C1

ID	Serial #	NP %PF	NP Cap	Test kV	mA	Watts	% PF Corr.	Corr Fctr	Cap(pF)	Manual
H0	2173029	0.32	471	10	1.776	0.059	0.334	1.005	471.154	
H1	G74959	0.48	330	10	1.221	0.067	0.550	1	323.982	
H2	G74961	0.47	331	10	1.241	0.067	0.536	1	329.204	
H3	G74960	0.45	325	10	1.218	0.060	0.491	1	323.172	
X1	A74925	0.49	322	10	1.193	0.060	0.504	1	316.540	
X2	A74924	0.5	315	10	1.168	0.061	0.524	1	309.847	
X3	A74933	0.5	298	10	1.103	0.057	0.515	1	292.715	

Bushing C2

ID	Serial #	NP %PF	NP Cap	Test kV	mA	Watts	% PF Corr.	Corr Fctr	Cap(pF)	Manual
H0	2173029	*	*	0.5	2.605	0.058	0.223	1	690.938	
H1	G74959	*	5170	2	19.361	1.033	0.534	1	5135.675	
H2	G74961	*	5169	2	19.363	1.135	0.586	1	5136.280	
H3	G74960	*	4995	2	18.608	0.742	0.399	1	4935.905	
X1	A74925	*	*	2	1.158	0.039	0.338	1	307.109	
X2	A74924	*	*	2.000	1.211	0.036	0.297	1	321.312	
X3	A74933	*	*	2	1.415	0.041	0.293	1	375.398	

Exciting Current Tests

Manufacturer			Type	Steps	Boost %	Buck %	Position Found	Position Left	Oil Volume			
DETC							4	4	*			
On-line (LTC)									*			
DETC	LTC	Test kV	H1 H0			H2 H0			H3 H0			Manual
			mA	Watts	X	mA	Watts	X	mA	Watts	X	
4	3R	5	458.112	419.493	L	416.566	321.783	L	448.834	418.841	L	

Leakage Reactance Tests (3-Phase Equivalent) [H-L]

Test Results											Ratings
DETC/LTC	Phase	Voltage	Current	Watts	PF meas	Ind.	Res. (Ohms)	Imp. (Ohms)	Reac. (Ohms)		Manual
4/3R	Phase A	190.264 V	3.082 A	13.529 W	2.307	0.164 H	1.424	61.761	61.745		Unrated
4/3R	Phase B	190.292 V	3.072 A	13.446 W	2.3	0.164 H	1.424	61.944	61.928		Unrated
4/3R	Phase C	190.344 V	3.084 A	13.835 W	2.357	0.164 H	1.455	61.78	61.762		Unrated
DETC/LTC		Phase	% Impedance			% Reactance					
			% Imped.	Benchmark	Delta Bench.	% Reac.	Benchmark	Delta Bench.	D Average (%)		
4/3R			7.156	7.3	-1.976	7.154	7.3	-2.002			

Leakage Reactance Tests (Per Phase) [H-L]

Test Results										Ratings
DETC/LTC	Phase	Voltage	Current	Watts	PF meas	Ind.	Res. (Ohms)	Imp. (Ohms)	Reac. (Ohms)	Manual
4/3R	Phase A	240.038 V	8.253 A	71.174 W	3.593	0.077 H	1.045	29.082	29.063	Unrated
4/3R	Phase B	240.119 V	8.296 A	69.87 W	3.507	0.077 H	1.015	28.95	28.932	Unrated
4/3R	Phase C	239.992 V	8.19 A	66.513 W	3.384	0.078 H	0.992	29.291	29.274	Unrated
		% Impedance				% Reactance				
DETC/LTC	Phase	% Imped.	Benchmark	Delta Bench.		% React.	Benchmark	Delta Bench.	D Average (%)	
4/3R	Phase A	6.732	7.3	-7.786		6.727	7.3	-7.846	0.094	
4/3R	Phase B	6.701	7.3	-8.204		6.697	7.3	-8.261	0.540	
4/3R	Phase C	6.78	7.3	-7.123		6.776	7.3	-7.177	0.634	

Turns Ratio Tests

Serial Number					HV Winding			LV Winding		
					Wye			Delta		
Connections					-	-	-	-	-	
					-	-	-	-	-	
Tap	NP Volt	Tap	NP Volt	Cal	Ratio 1	Ratio 2	Ratio 3	Min. Lim	Max. Lim	Manual
3R/D	156975	none	69000	1.313	1.316	1.316	1.316	1.307	1.320	

KAN 19008-900
INDIANAPOLIS POWER AND LIGHT
PHASE 2 WORK
WINDING RESISTANCE RESULTS
4/6/19

H1-H2	759.35 m Ohm	H1-H0	381.32 m Ohm
H2-H3	759.50 m Ohm	H2-H0	379.54 m Ohm
H3-H1	761.05 m Ohm	H3-H0	381.58 m Ohm

X3-X1	116.57 m Ohms
X1-X2	116.44 m Ohms
X2-X3	111.25 m Ohms

DSP 4.16.19



Transformer Count: 1
Total Test Count: 9

1. Manufacturer: McGraw-Edison, Serial Number: C-06835-5-1, Special ID: M-T1

TestDate: 4/6/2019 1:04 PM, Trace Name: H1-H0_2019-04-06_13-04-03
TestDate: 4/6/2019 1:08 PM, Trace Name: H2-H0_2019-04-06_13-08-13
TestDate: 4/6/2019 1:12 PM, Trace Name: H3-H0_2019-04-06_13-12-33
TestDate: 4/6/2019 1:17 PM, Trace Name: H3-H0_2019-04-06_13-17-23
TestDate: 4/6/2019 1:20 PM, Trace Name: H2-H0_2019-04-06_13-20-18
TestDate: 4/6/2019 1:23 PM, Trace Name: H1-H0_2019-04-06_13-23-10
TestDate: 4/6/2019 1:27 PM, Trace Name: X1-X3_2019-04-06_13-27-19
TestDate: 4/6/2019 1:30 PM, Trace Name: X2-X1_2019-04-06_13-30-18
TestDate: 4/6/2019 1:33 PM, Trace Name: X3-X2_2019-04-06_13-33-53

Nameplate Details

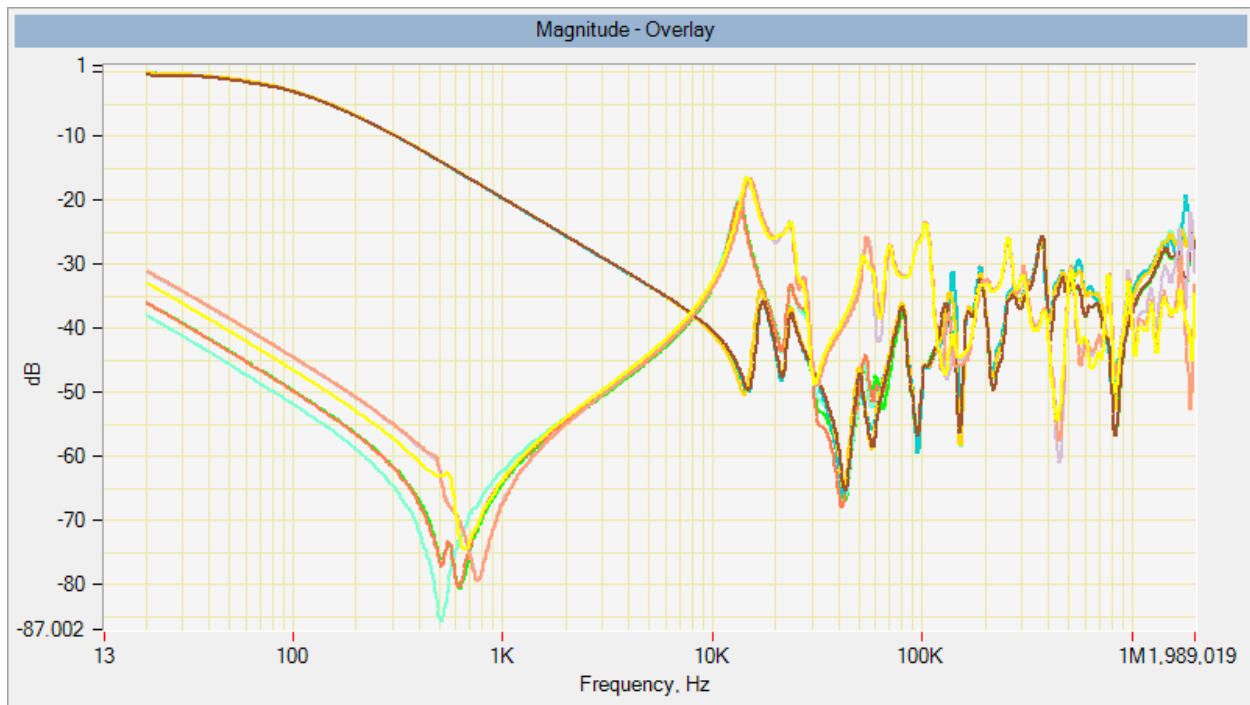
1. Manufacturer: McGraw-Edison, Serial Number: C-06835-5-1, Special ID: M-T1

TestTemplate: 3-Ph 2-Wind Y-D

Serial Number: C-06835-5-1
Manufacturer: McGraw-Edison
Year of Manufacture: 1985
Special ID: M-T1
Current: 0
Phases: 3
Windings: 2
Type: DIST
HV: 161
LV1: 69
LV2: 0
Tertiary: 0
Impedance HV-LV1: 0
Impedance HV-LV2: 0
Impedance HV-Tertiary: 0
Impedance LV-Tertiary: 7.3

MVA Maximum: 100
MVA1: 60
MVA2: 80
MVA3: 100
Notes:
Template: 3-Ph 2-Wind Y-D
LTC Serial Number:
LTC Manufacturer:
LTC Year of Mfr: 0
LTC Range: 16L-16R
LTC Notes:
DETC Serial Number:
DETC Manufacturer:
DETC Year of Mfr: 0
DETC Range: 1-5 (A - D)
DETC Notes:

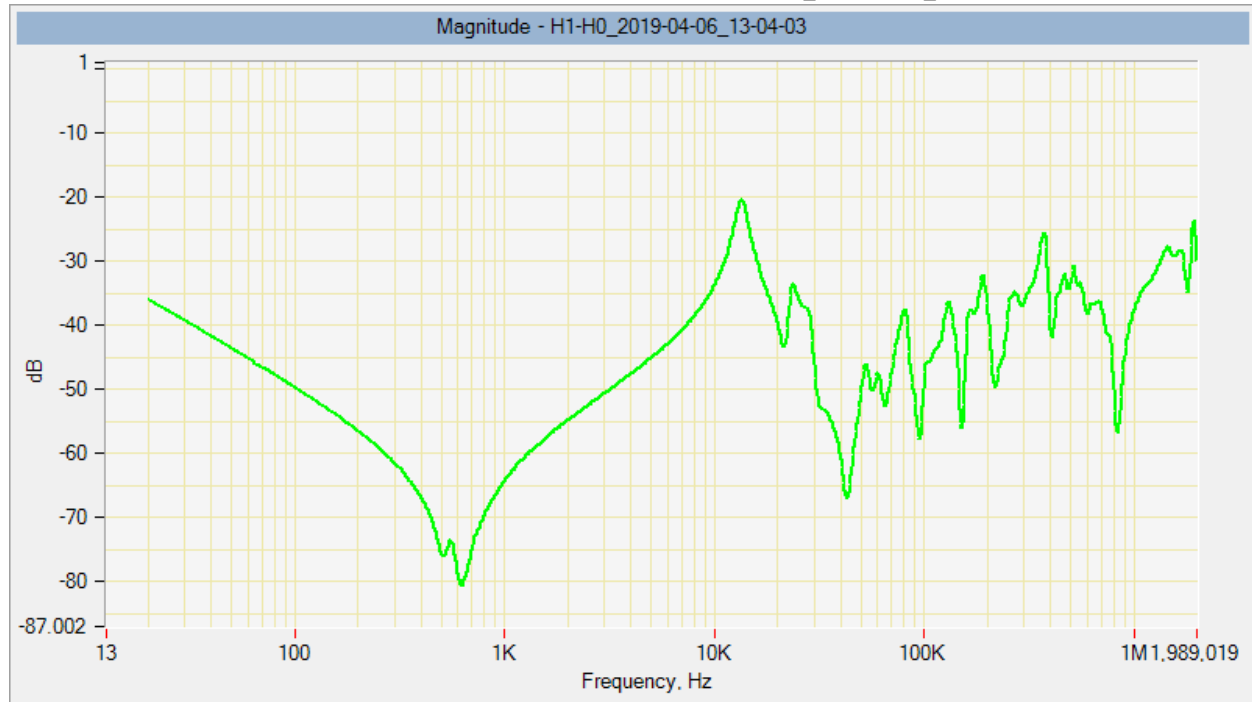
Sweep Frequency Response Analyzer Test Report



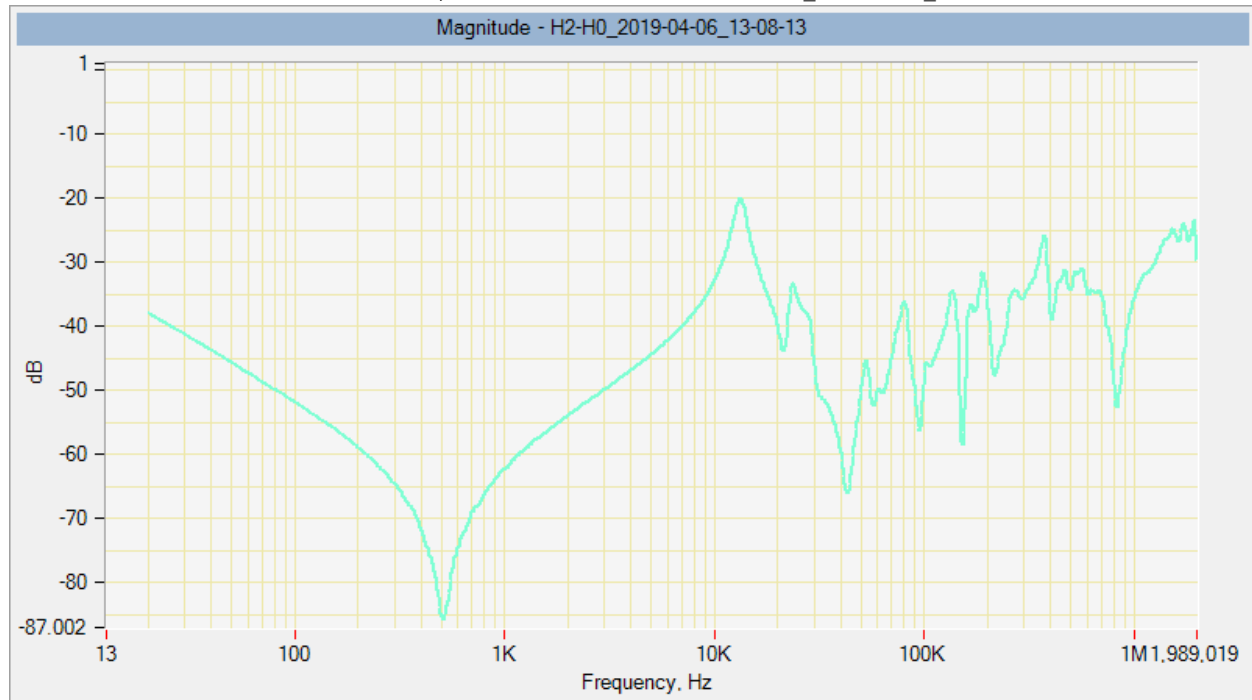
	H1-H0_2019-04-06_13-04-03 - Manufacturer: McGraw-EdisonSerial Number: C-06835-5-1Date: 4/6/2019 1:04:03 PM LTC: 3RDETC: DMVA Maximum: 100KV: 161/69
	H2-H0_2019-04-06_13-08-13 - Manufacturer: McGraw-EdisonSerial Number: C-06835-5-1Date: 4/6/2019 1:08:13 PM LTC: 3RDETC: DMVA Maximum: 100KV: 161/69
	H3-H0_2019-04-06_13-12-33 - Manufacturer: McGraw-EdisonSerial Number: C-06835-5-1Date: 4/6/2019 1:12:33 PM LTC: 3RDETC: DMVA Maximum: 100KV: 161/69
	H3-H0_2019-04-06_13-17-23 - Manufacturer: McGraw-EdisonSerial Number: C-06835-5-1Date: 4/6/2019 1:17:23 PM LTC: 3RDETC: DMVA Maximum: 100KV: 161/69
	H2-H0_2019-04-06_13-20-18 - Manufacturer: McGraw-EdisonSerial Number: C-06835-5-1Date: 4/6/2019 1:20:18 PM LTC: 3RDETC: DMVA Maximum: 100KV: 161/69
	H1-H0_2019-04-06_13-23-10 - Manufacturer: McGraw-EdisonSerial Number: C-06835-5-1Date: 4/6/2019 1:23:10 PM LTC: 3RDETC: DMVA Maximum: 100KV: 161/69
	X1-X3_2019-04-06_13-27-19 - Manufacturer: McGraw-EdisonSerial Number: C-06835-5-1Date: 4/6/2019 1:27:19 PM LTC: 3RDETC: DMVA Maximum: 100KV: 161/69
	X2-X1_2019-04-06_13-30-18 - Manufacturer: McGraw-EdisonSerial Number: C-06835-5-1Date: 4/6/2019 1:30:18 PM LTC: 3RDETC: DMVA Maximum: 100KV: 161/69
	X3-X2_2019-04-06_13-33-53 - Manufacturer: McGraw-EdisonSerial Number: C-06835-5-1Date: 4/6/2019 1:33:53 PM LTC: 3RDETC: DMVA Maximum: 100KV: 161/69

Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: McGraw-Edison, Serial Number: C-06835-5-1 - H1-H0_2019-04-06_13-04-03

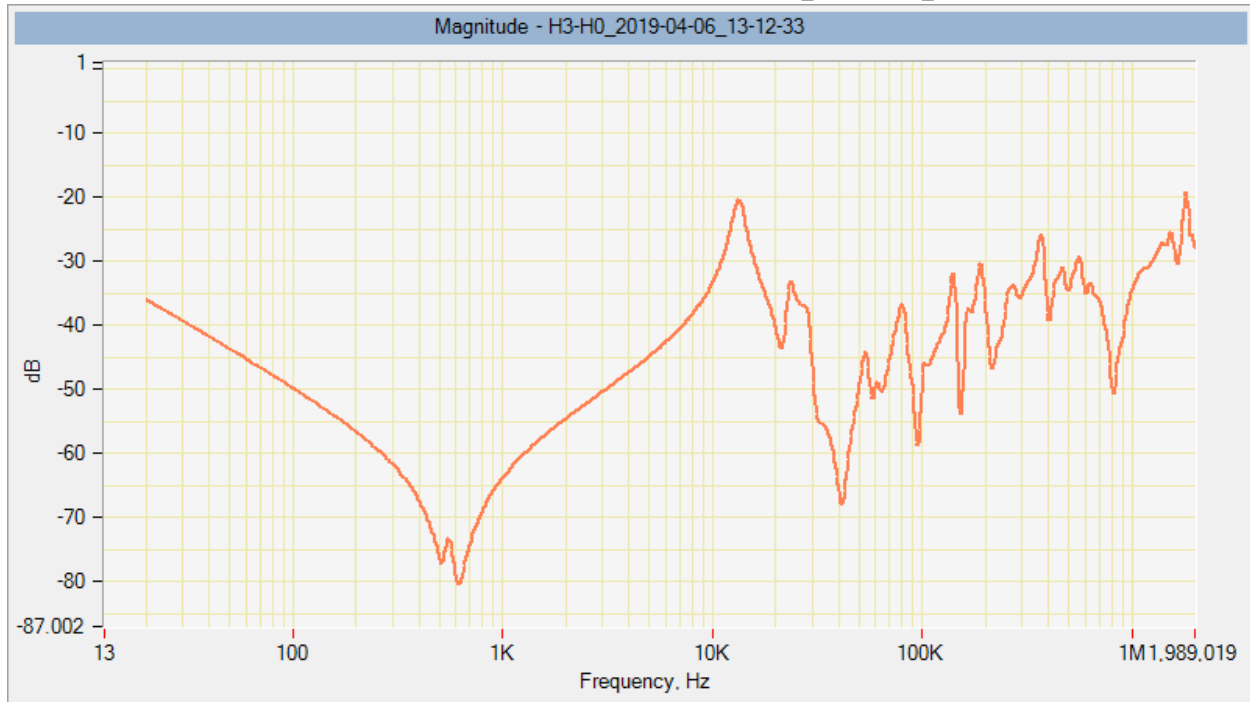


Transformer: Manufacturer: McGraw-Edison, Serial Number: C-06835-5-1 - H2-H0_2019-04-06_13-08-13

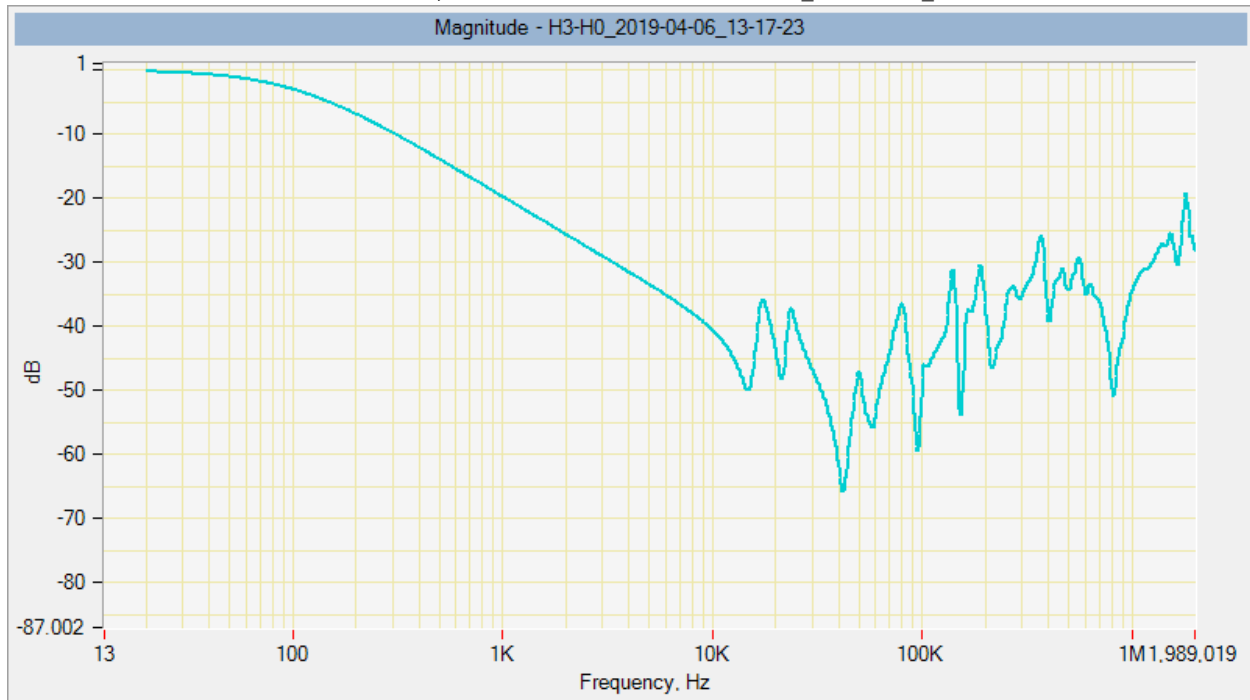


Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: McGraw-Edison, Serial Number: C-06835-5-1 - H3-H0_2019-04-06_13-12-33

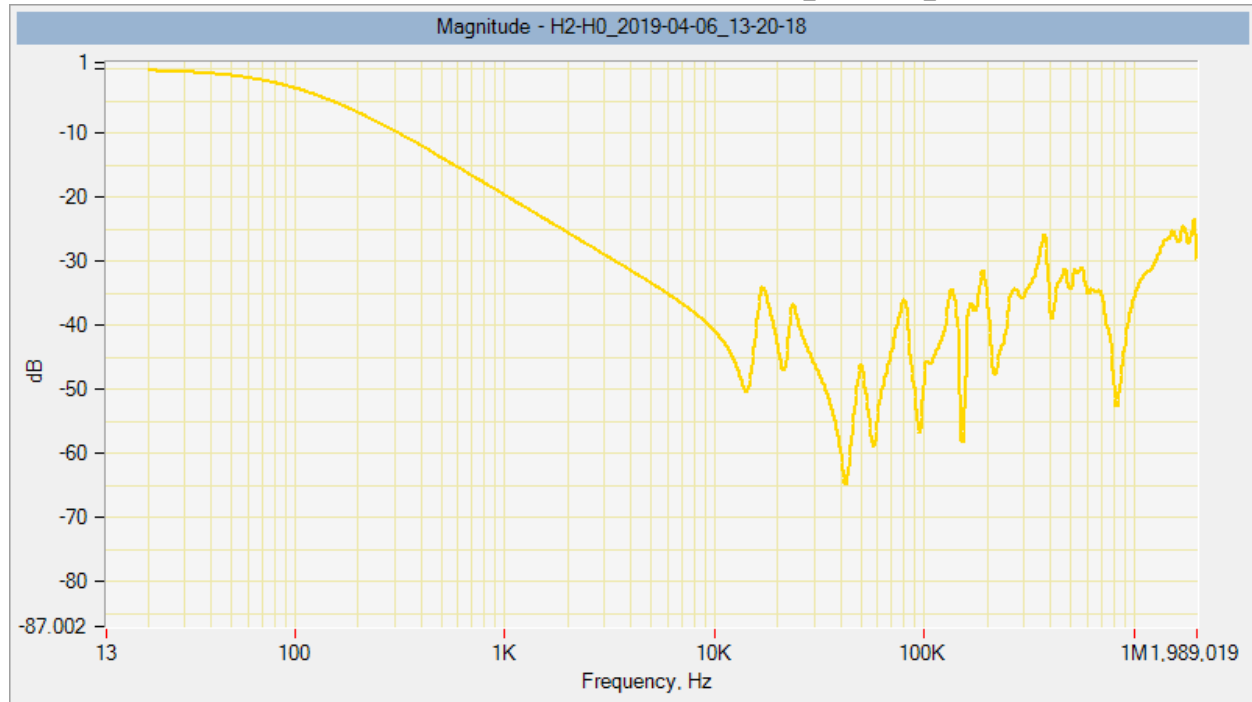


Transformer: Manufacturer: McGraw-Edison, Serial Number: C-06835-5-1 - H3-H0_2019-04-06_13-17-23

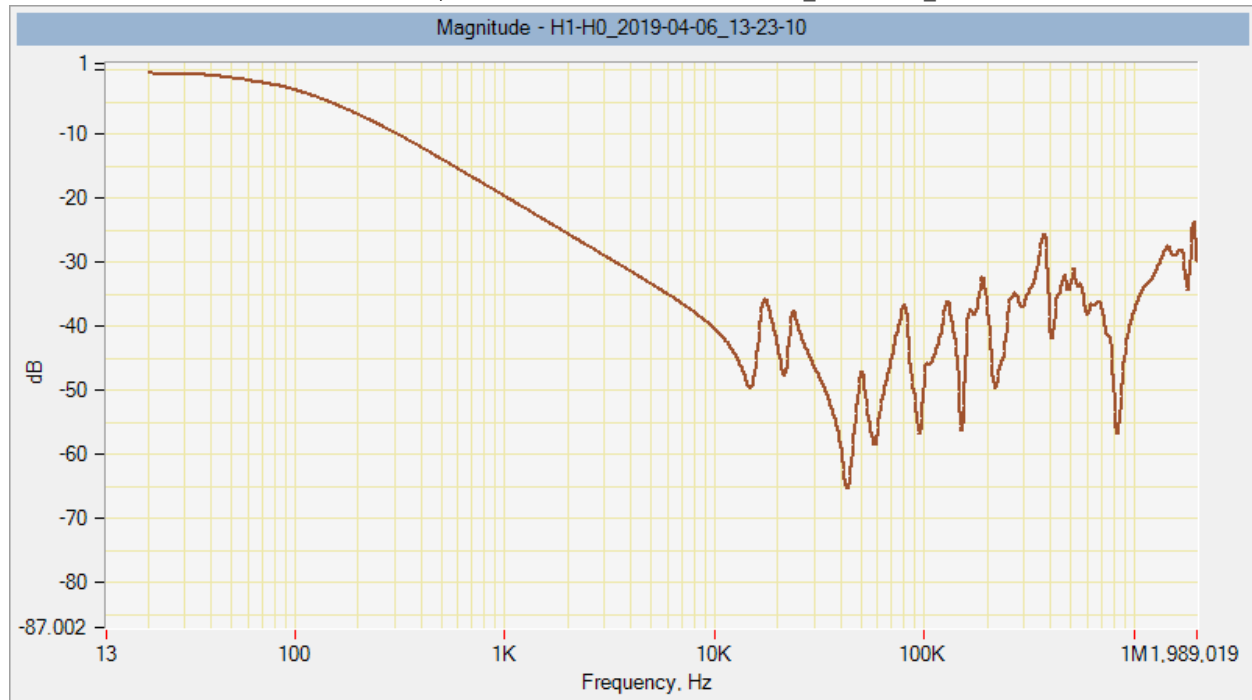


Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: McGraw-Edison, Serial Number: C-06835-5-1 - H2-H0_2019-04-06_13-20-18

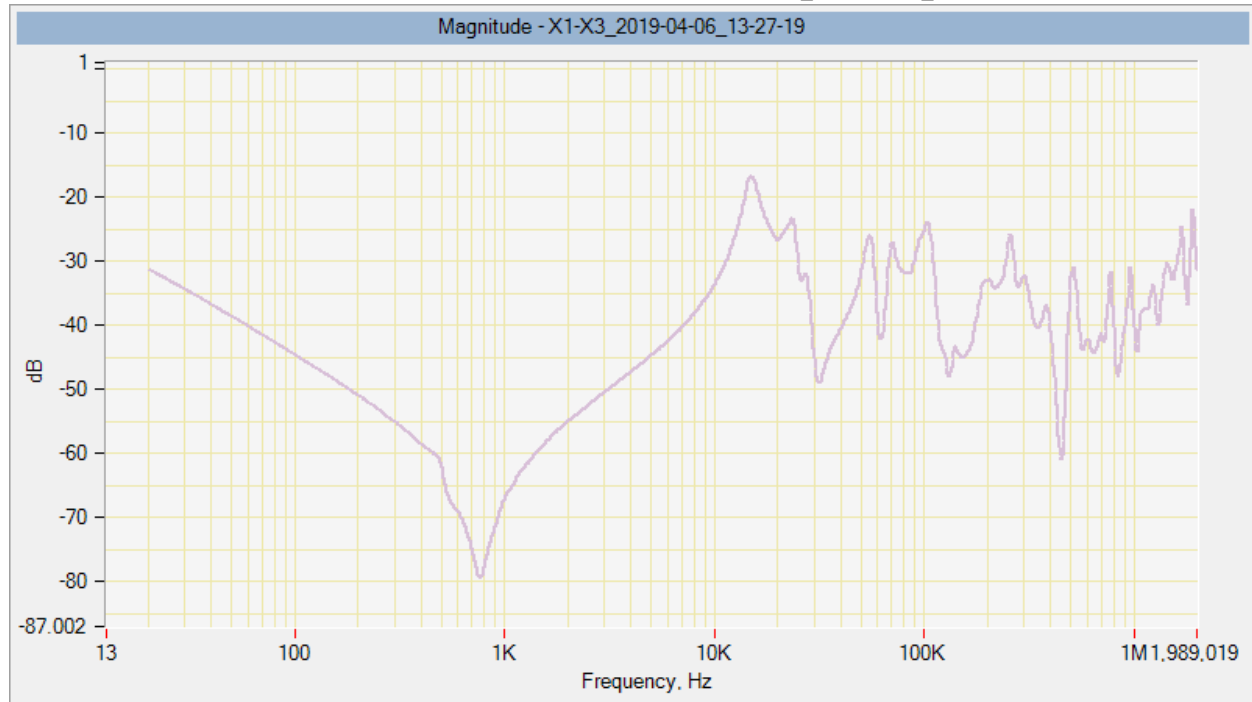


Transformer: Manufacturer: McGraw-Edison, Serial Number: C-06835-5-1 - H1-H0_2019-04-06_13-23-10

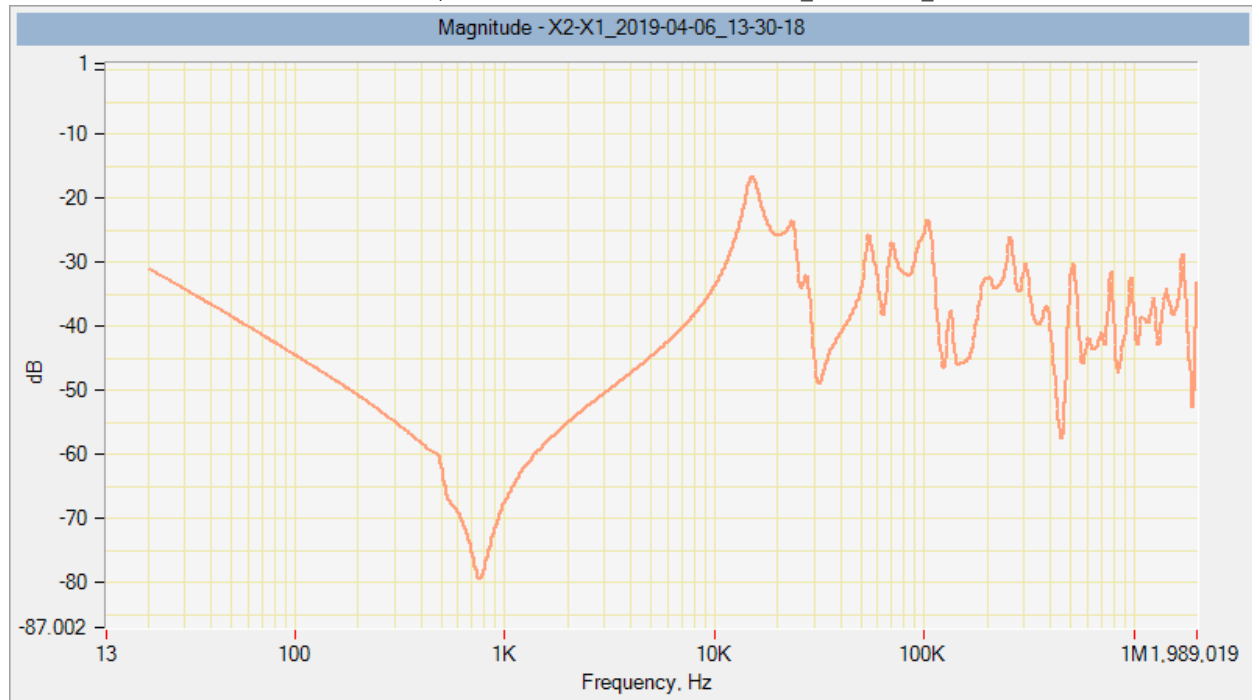


Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: McGraw-Edison, Serial Number: C-06835-5-1 - X1-X3_2019-04-06_13-27-19

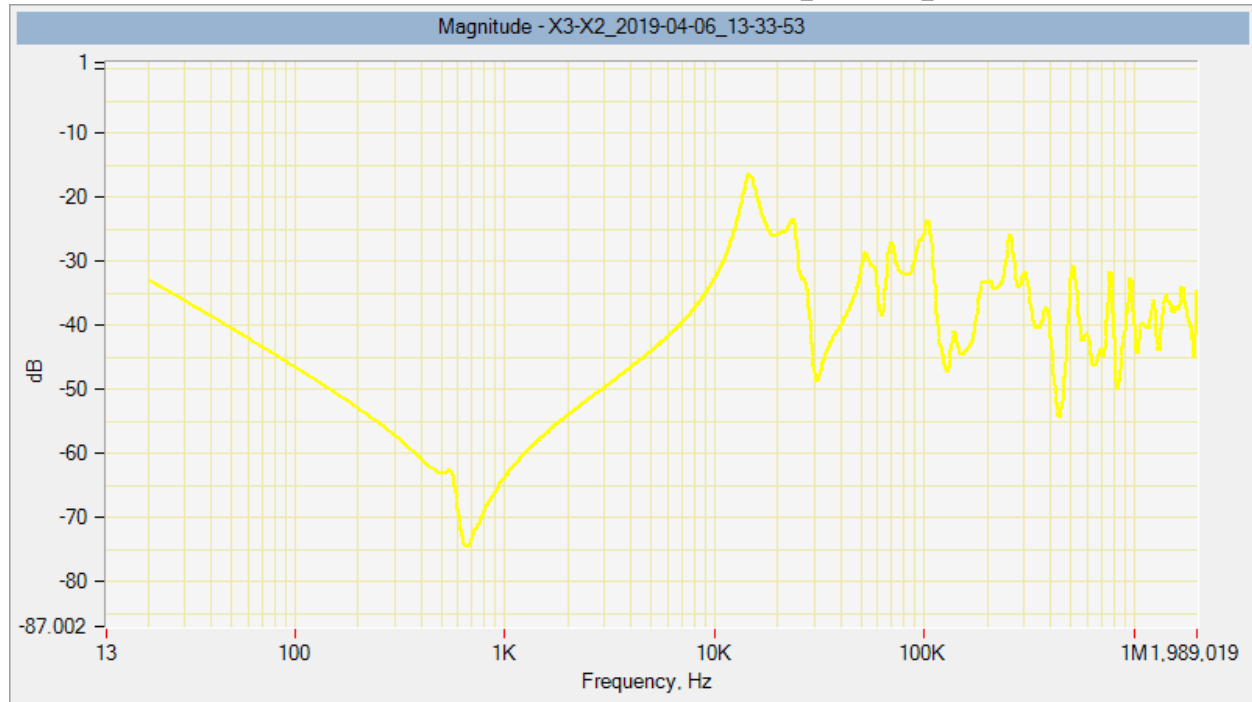


Transformer: Manufacturer: McGraw-Edison, Serial Number: C-06835-5-1 - X2-X1_2019-04-06_13-30-18



Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: McGraw-Edison, Serial Number: C-06835-5-1 - X3-X2_2019-04-06_13-33-53



Equipment	C0683551	Manufacturer	MCGE
Serial No.	C0683551	Fluid volume	455
Apparatus type	LTC	Tank	MAIN
Group name	EPS	Norms used	DUKE_MW_LTC_MCGRAW_OIL
Owner	IPL	DGA result	1/1
Substation	INDEPENDENCE, MO	FQ result	2/2
Designation	M-T1	Moisture result	1/1
Norms	DUKE_MW_LTC_MCGRAW_OIL	PCB result	0/0
Fluid type	OIL	Oil test status	REVIEWED
Description	LOAD TAP CHANGER		

Gas Analysis

Sample date	2019-03-28	2019-03-26
Fluid temp	32	32 °C
Hydrogen (H2)	0	0 µL/L
Methane (CH4)	2	1 µL/L
Ethane (C2H6)	0.0	0.0 µL/L
Ethylene (C2H4)	0.0	0.0 µL/L
Acetylene (C2H2)	0.0	0.0 µL/L
Carbon Monoxide (CO)	39	13 µL/L
Carbon Dioxide (CO2)	483	461 µL/L
Total heat gas	2	1 µL/L
TDCG	41	14 µL/L
Est. safe handling limit	12.2	12.1 %
Predicted composite fault gas	7	2 µL/L
CO2/CO	12.385	35.462
NEI-HC	0.01	0.00 kJ/kL
NEI-CO	0.83	0.68 kJ/kL
DGA retest days	182	182 days
DGA retest date	2019-09-26	2019-09-24
DGA reference days	2.0	0.0 days
DGA result	1	1
DGA diagnosis	X1	X1

Gas Analysis Remarks

No anomalies. Results before and after inspection by EPS.

Fluid Quality

Sample date	2019-03-28	2019-03-26
Fluid temp	32	32 °C
Diel breakdown D877	35.6	36.7 kV
PF at 25 C	0.055	0.049 %
Acid number	0.030	0.030 mg KOH/g
Interfacial tension	37.6	38.1 mN/m
Specific Gravity	0.873	0.876
Color	2.0*	2.0*
Oil quality index	0.8	0.8
Visual	CLEAR	CLEAR
FQ result	2	2

Symbol legend: *: abnormal level

Fluid Quality Summary

Variable name	Value	Units	Description
Color	2.0*		Level alert (high 2.0).

color*

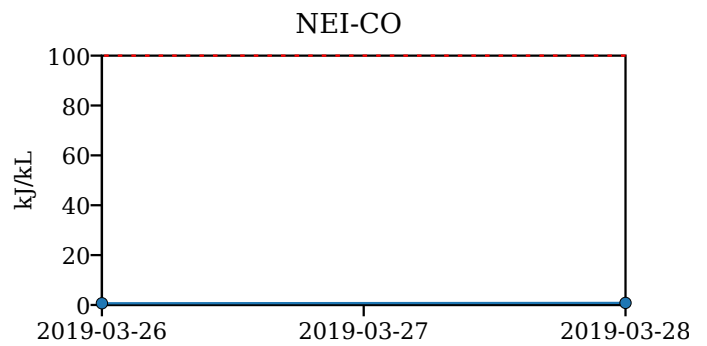
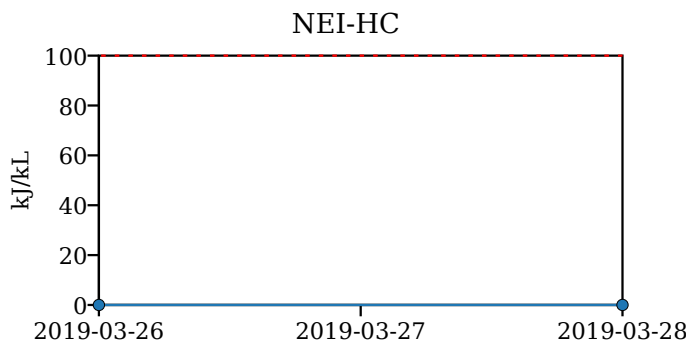
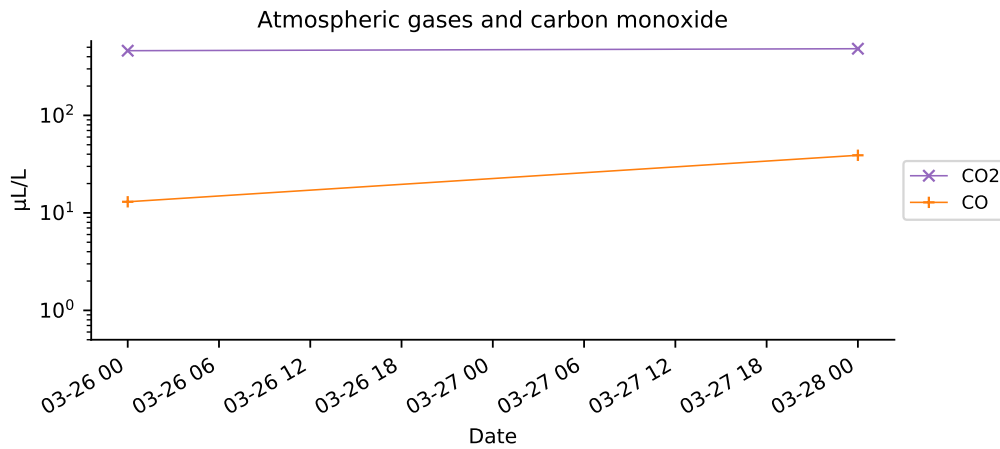
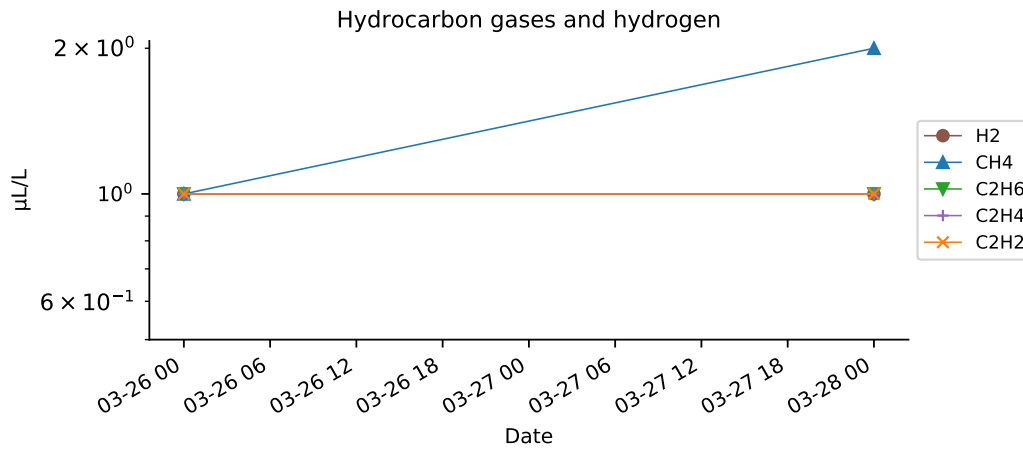
Moisture Analysis

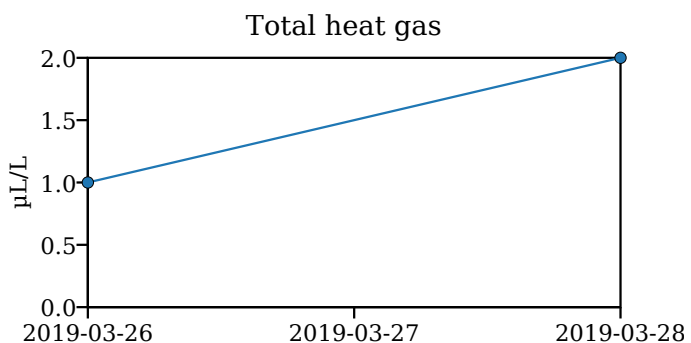
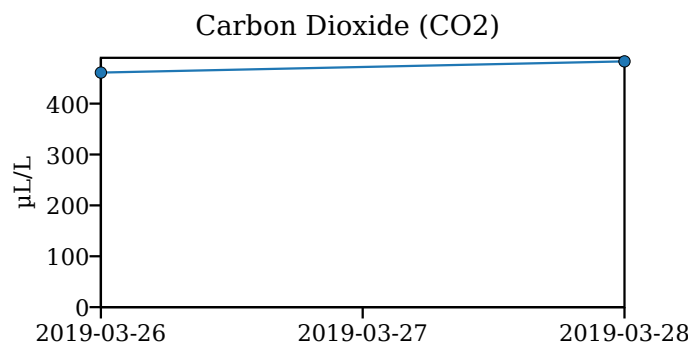
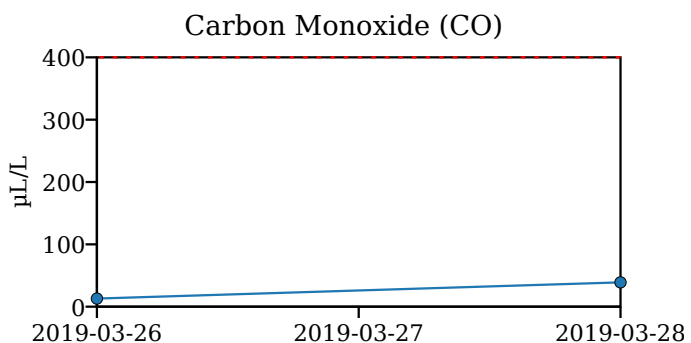
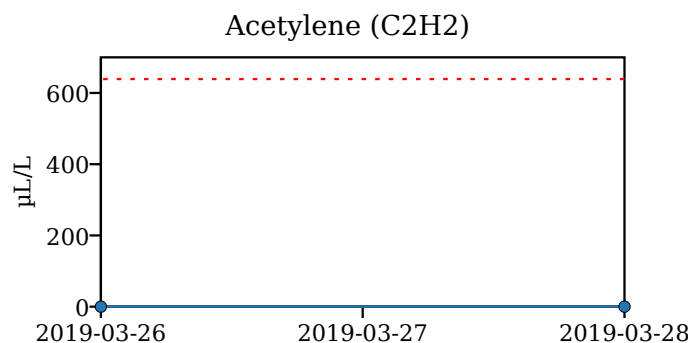
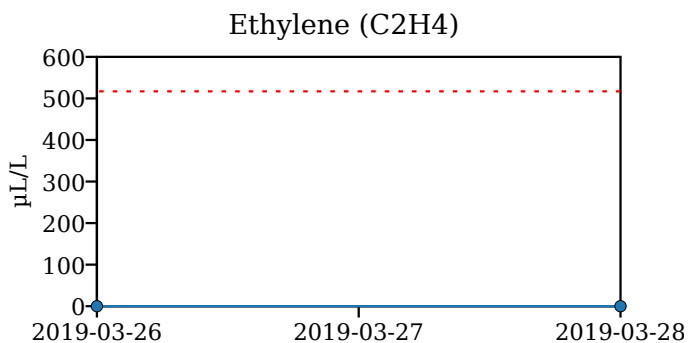
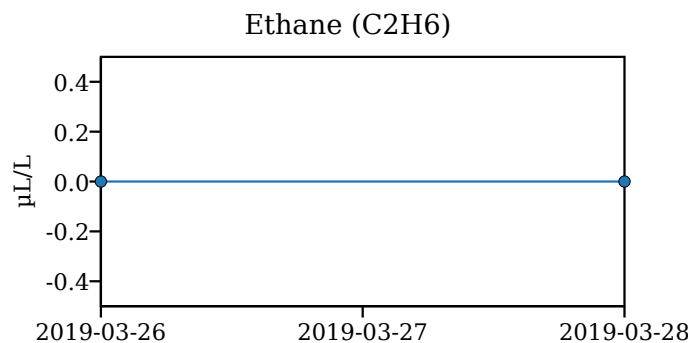
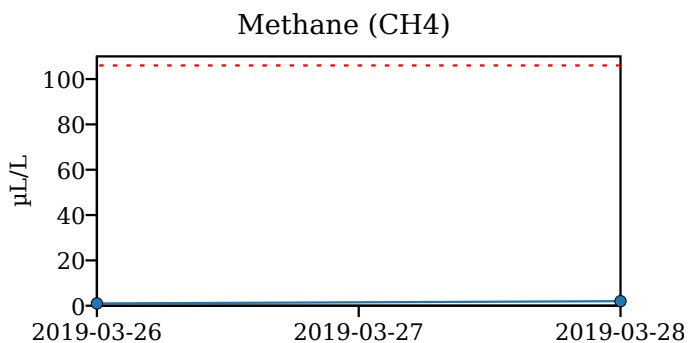
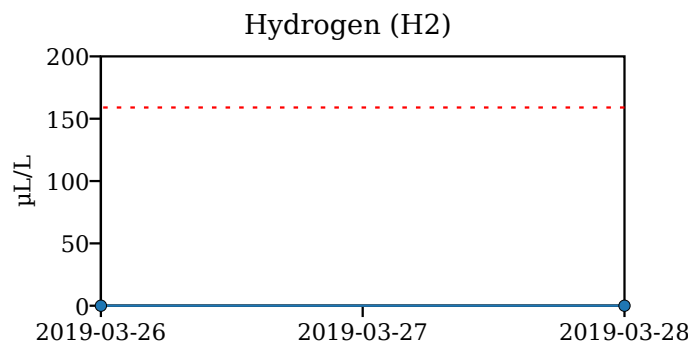
Sample date	2019-03-28	2019-03-26
Fluid temp	32	32 °C
Moisture	17	17 mg/kg
Relative saturation	19	19 %
Dew point	-5	-5 °C
Moisture result	1	1

Moisture Remarks

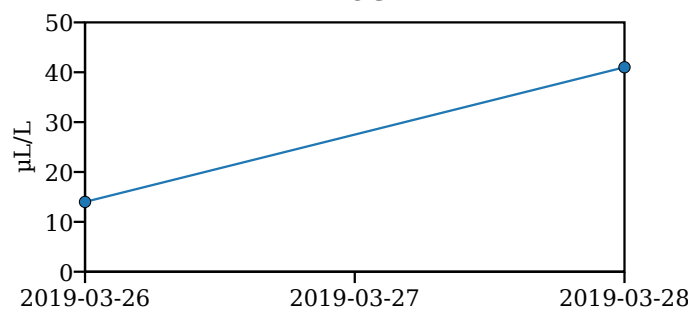
The water content of the oil is acceptable.

History Graphs and Diagnostic Charts

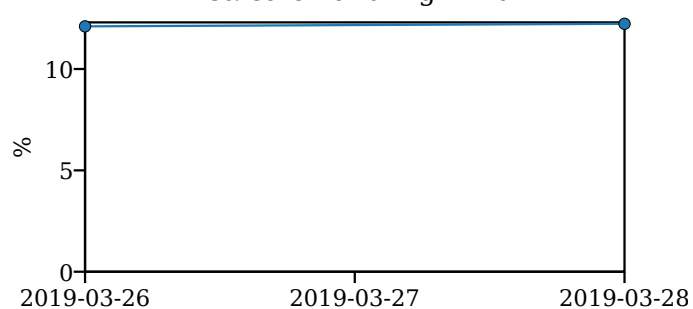




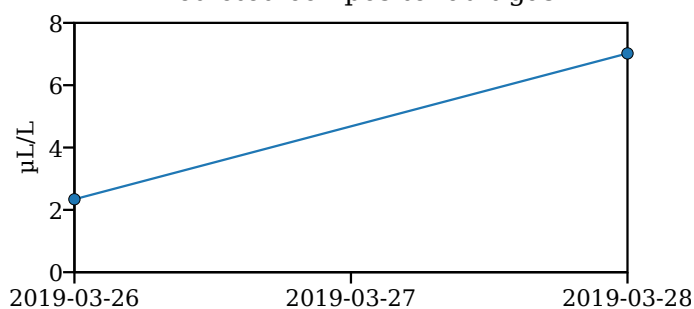
TDCG



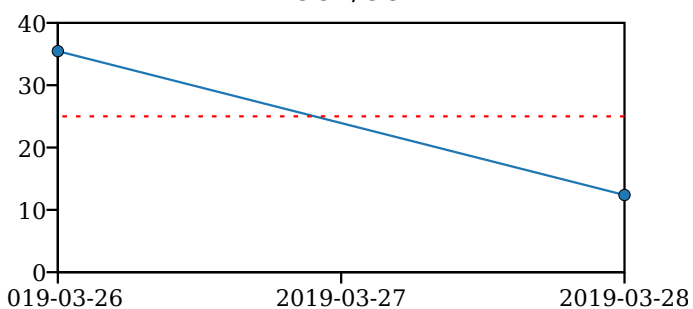
Est. safe handling limit



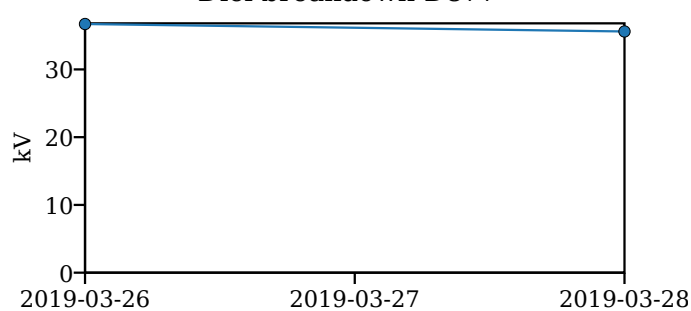
Predicted composite fault gas



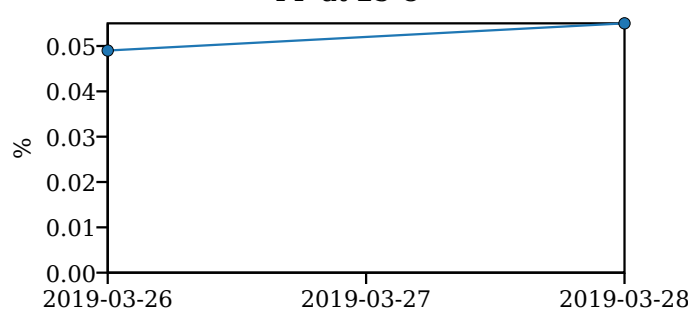
CO2/CO



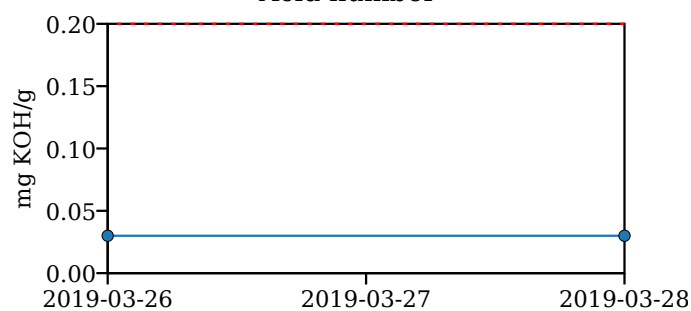
Diel breakdown D877



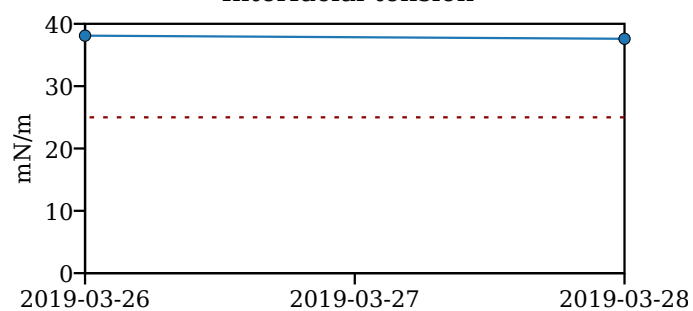
PF at 25 C



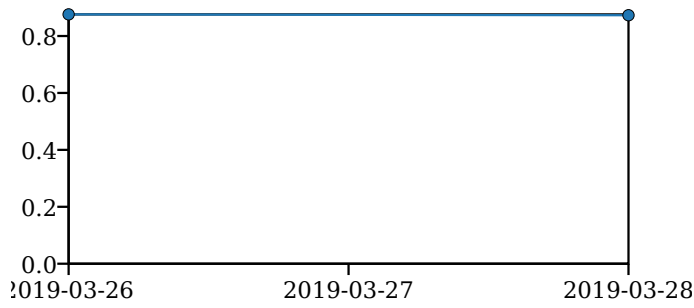
Acid number



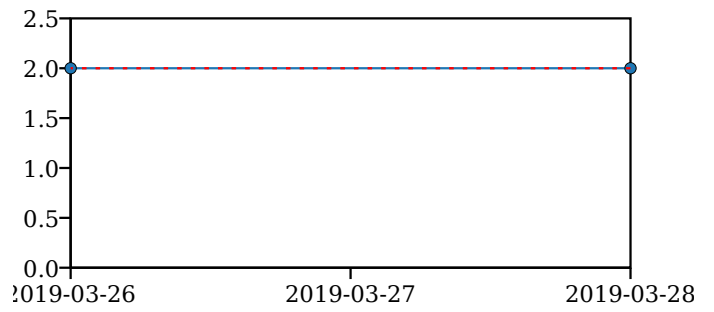
Interfacial tension



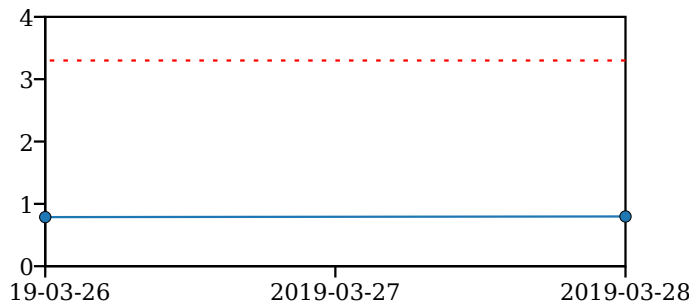
Specific Gravity



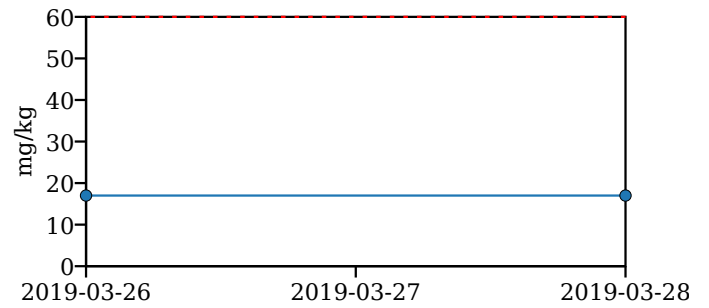
Color



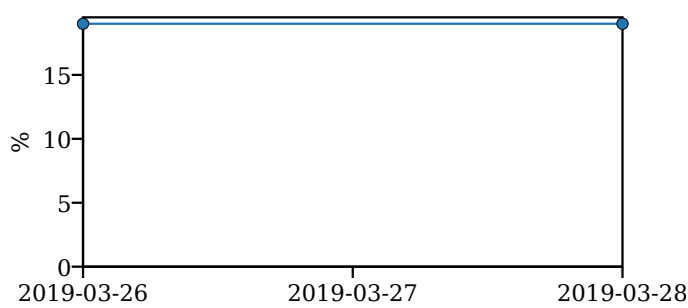
Oil quality index



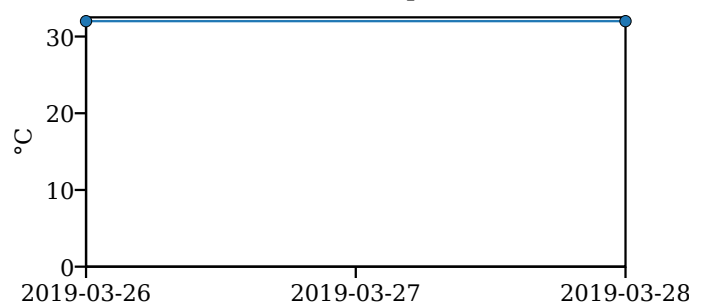
Moisture



Relative saturation



Fluid temp



Equipment	C0683551	kV ratings	161
Serial No.	C0683551	MVA ratings	60
Apparatus type	TRN	Oil preservation type	INERT GAS-PRESSURE
Group name	EPS	Fluid volume	10600
Owner	IPL	Tank	MAIN
Substation	INDEPENDENCE, MO	Norms used	TRN_IEEE_INC_69_288KV
Designation	M-T1	Gassing status	1
Norms	TRN_IEEE_INC_69_288KV	DGA result	1/1
Fluid type	OIL	FQ result	1/1
Description	POWER TRANSFORMER	Moisture result	1/1
Manufacturer	MCGE	PCB result	0/0
Year manufactured	1985	Oil test status	REVIEWED

Gas Analysis

Sample date	2019-04-06	2019-04-03
Fluid temp	18	22 °C
Hydrogen (H2)	0	0 µL/L
Methane (CH4)	0	0 µL/L
Ethane (C2H6)	0.0	1.0 µL/L
Ethylene (C2H4)	0.0	0.0 µL/L
Acetylene (C2H2)	0.0	0.0 µL/L
Carbon Monoxide (CO)	5	4 µL/L
Carbon Dioxide (CO2)	99	261 µL/L
Total heat gas	0	1 µL/L
TDCG	5	5 µL/L
Est. safe handling limit	12.5	12.0 %
Predicted composite fault gas	1	1 µL/L
CO2/CO	19.800	65.250
CO/CO2	0.051	0.015
NEI-HC	0.00	0.00 kJ/kL
NEI-CO	0.16	0.37 kJ/kL
DGA retest days	365	365 days
DGA retest date	2020-04-05	2020-04-02
DGA reference days	3.0	0.0 days
DGA result	1	1

Gas Analysis Remarks

(Surveillance). No recent significant abnormalities. EPS re-gasketed radiator, vacuum filled and tested.

Fluid Quality

Sample date	2019-04-06	2019-04-03	
Fluid temp	18	22	°C
Diel breakdown D877	44.7	38.8	kV
PF at 25 C	0.155	0.091	%
PF at 100 C	7.092	1.796	%
Acid number	0.020	0.020	mg KOH/g
Interfacial tension	39.8	41.6	mN/m
Specific Gravity	0.870	0.870	
Color	1.0	1.0	
Oil quality index	0.5	0.5	
PF100/PF25	45.755	19.736	
Visual	CLEAR	CLEAR	
Fluid quality retest days	365	365	days
Fluid quality retest date	2020-04-05	2020-04-02	
FQ result	1	1	

Fluid Quality Analysis Remarks

No oil quality problems were detected.

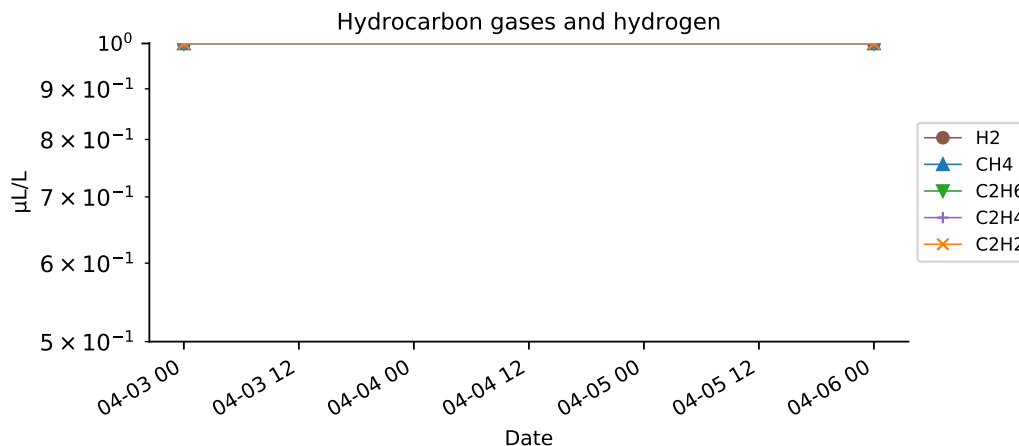
Moisture Analysis

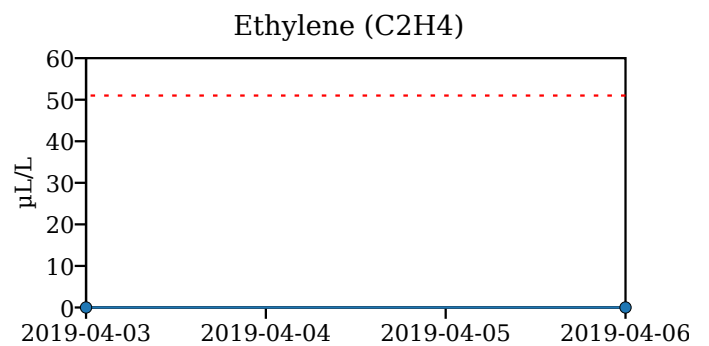
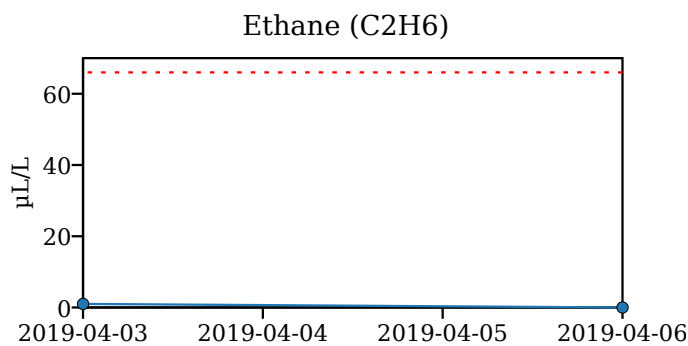
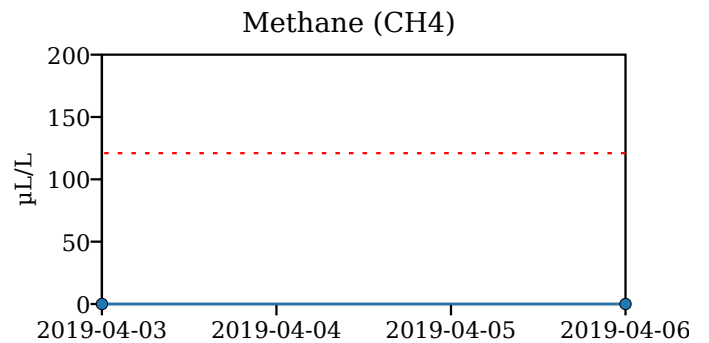
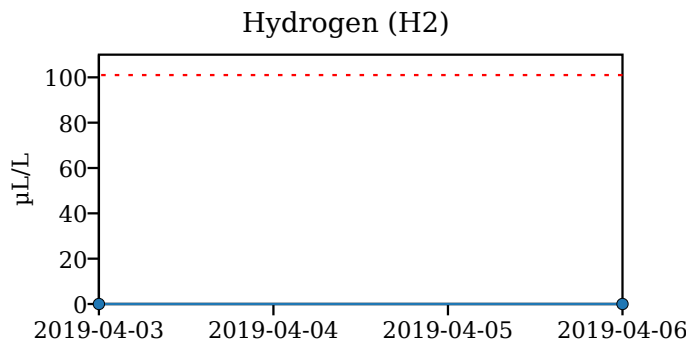
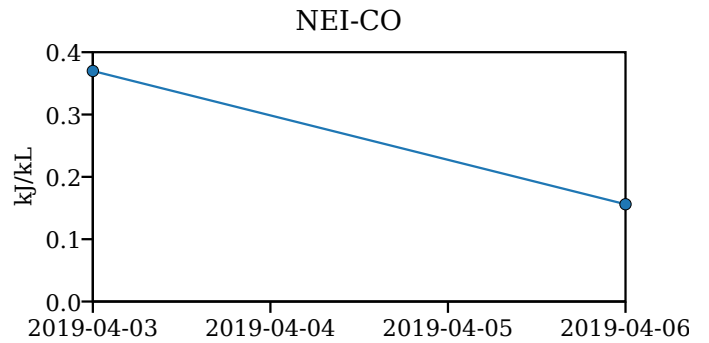
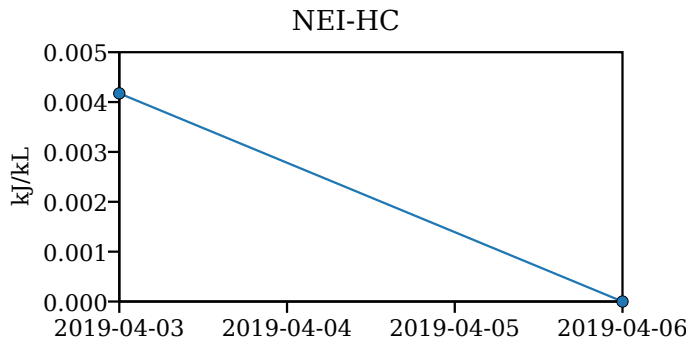
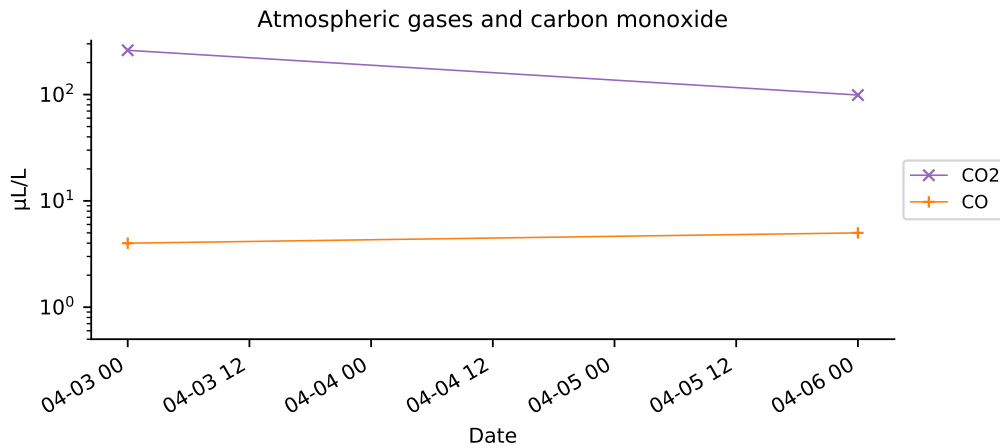
Sample date	2019-04-06	2019-04-03	
Fluid temp	18	22	°C
Moisture	8	11	mg/kg
Relative saturation	16	18	%
Dew point	-18	-13	°C
Moisture result	1	1	

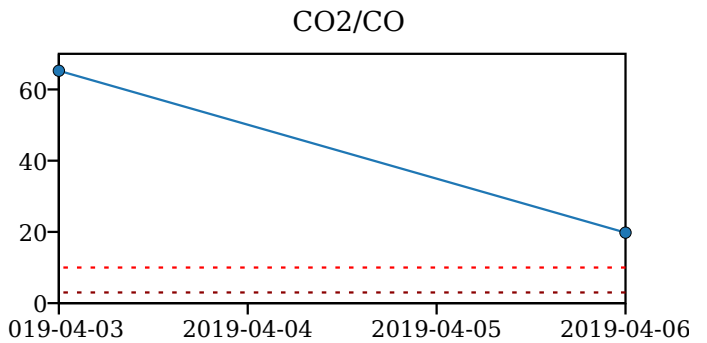
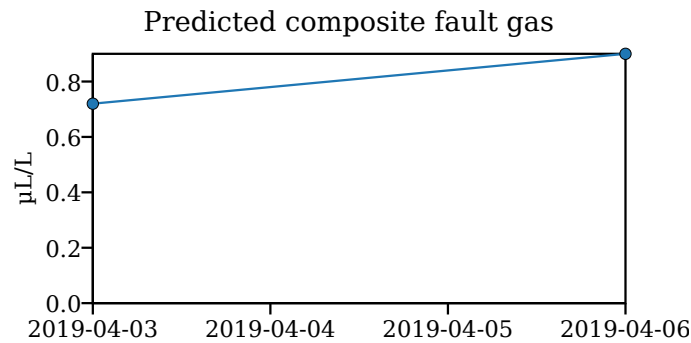
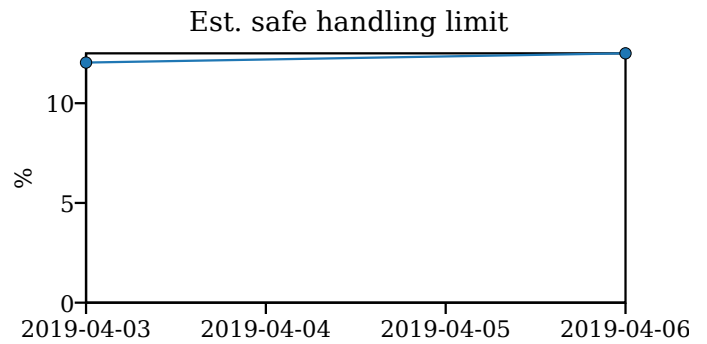
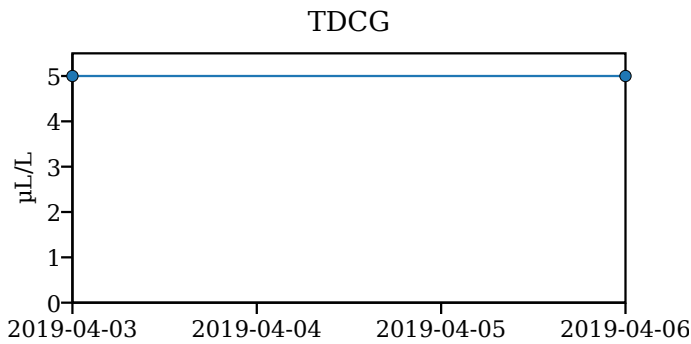
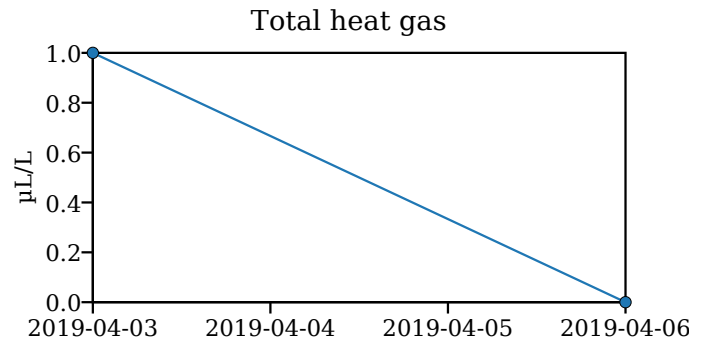
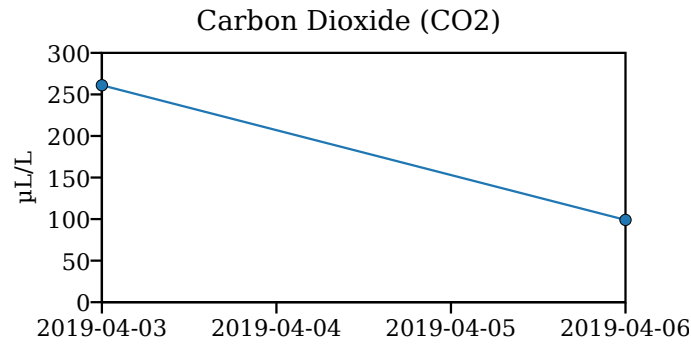
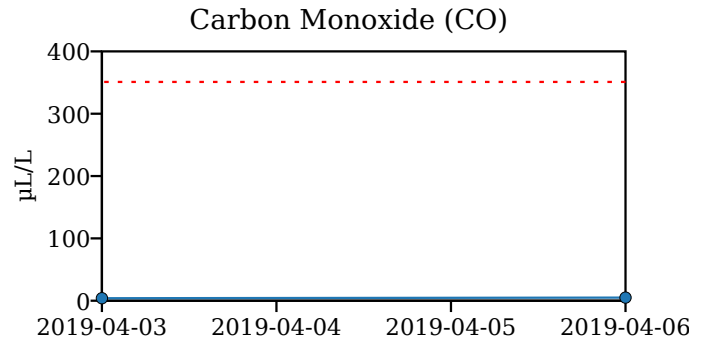
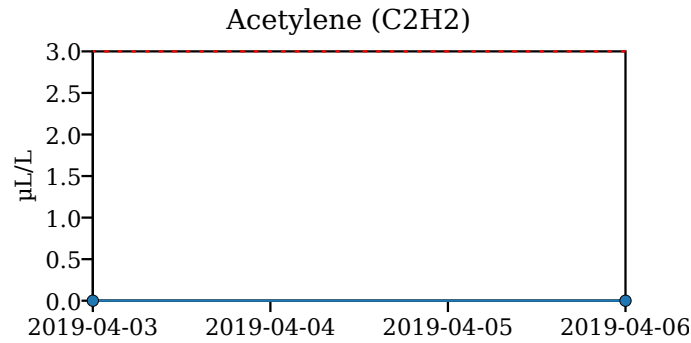
Moisture Remarks

The water content of the oil is acceptable.

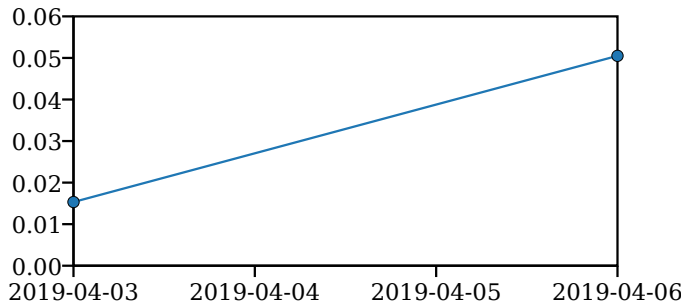
History Graphs and Diagnostic Charts



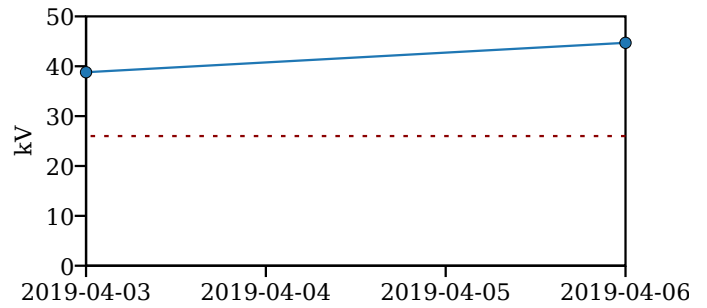




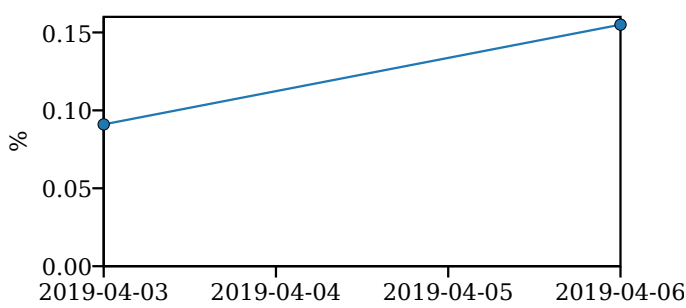
CO/CO2



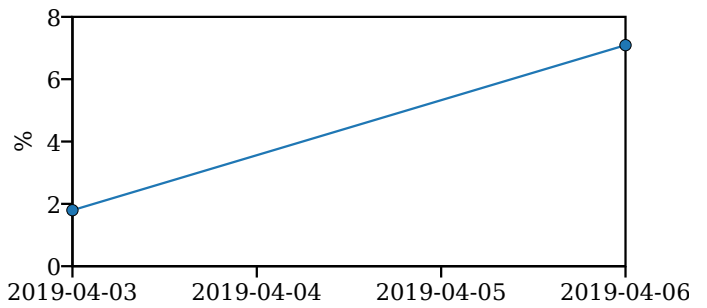
Diel breakdown D877



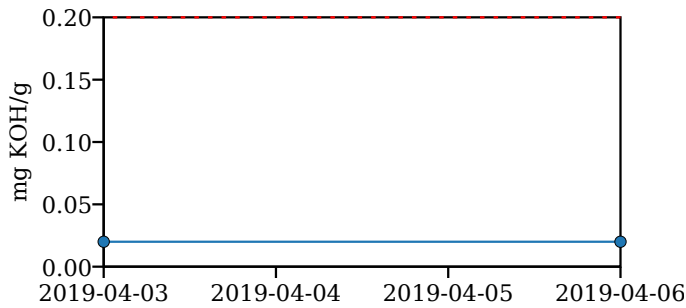
PF at 25 C



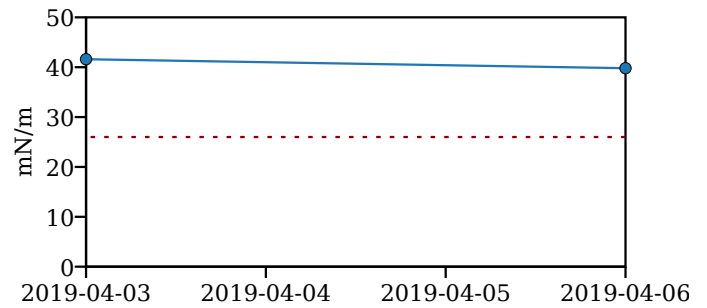
PF at 100 C



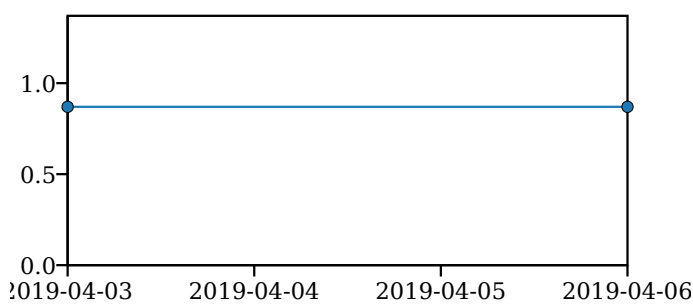
Acid number



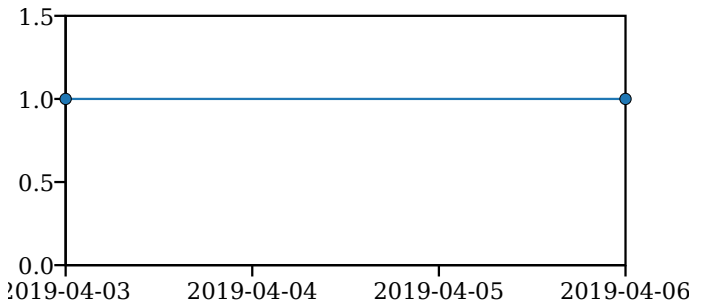
Interfacial tension



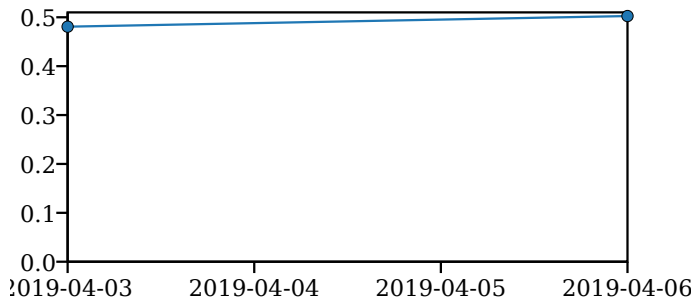
Specific Gravity



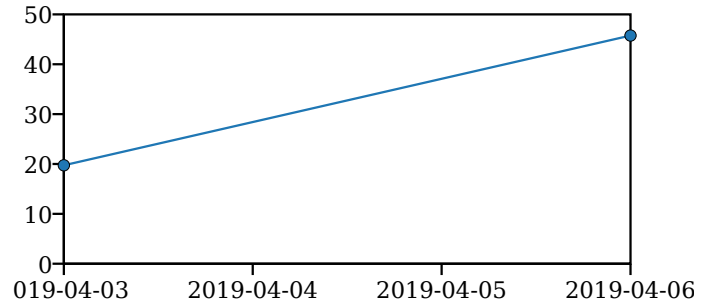
Color



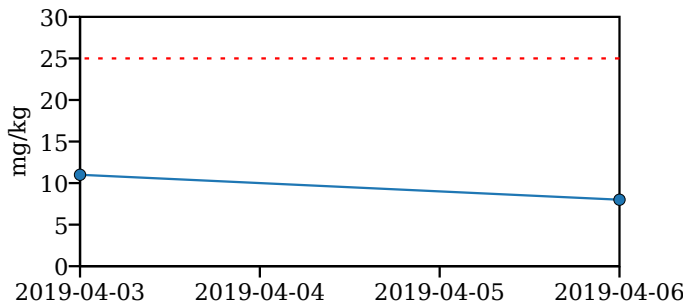
Oil quality index



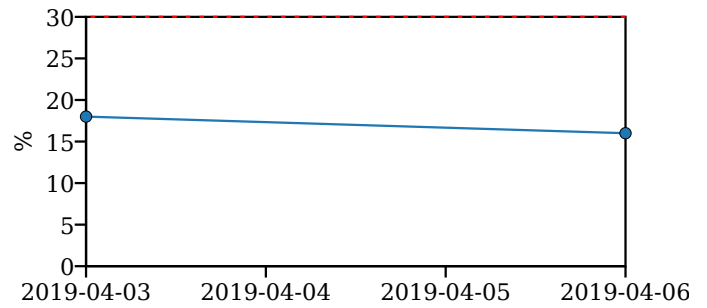
PF100/PF25



Moisture



Relative saturation



Fluid temp

