



November of 2015 and March of 2016, analyzing the medium-voltage system at the VA Medical Center located in Dallas, Texas.

The oil sample report revealed the following issues.

USC-LV:

- Sample data shows Carbon Dioxide (CO₂) is above the normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in Condition 1. CO₂ gas is in Condition 3. It is recommended to resample in six months to monitor Carbon Monoxide (CO) / CO₂ gas generation.

USB-LV:

- Sample data shows CO₂ is above the normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in Condition 1. CO₂ gas is in Condition 3. It is recommended to resample in six months to monitor CO / CO₂ gas generation.

USR-LV:

- Sample data shows CO₂ is above the normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in Condition 1. CO₂ gas is in Condition 3. It is recommended to resample in six months to monitor CO / CO₂ gas generation.

USF-LV:

- Sample data shows CO₂ is above the normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in Condition 1. CO₂ gas is in Condition 3. It is recommended to resample in six months to monitor CO / CO₂ gas generation.

USD-LV:

- Sample data shows CO₂ is above the normal limit of <2500 ppm. Insulation degradation and overheating. Ethylene is above the normal limit of <50 ppm and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in Condition 2, due to single gas level of Ethylene. CO₂ gas is in Condition 2. It is recommended to resample in six months to monitor gas generation.

PT-1:

- Sample data shows CO₂ is above the normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in Condition 1. CO₂ gas is in Condition 2. It is recommended to resample in six months to monitor CO / CO₂ gas generation.

PT-2A:

- Sample data shows CO is above the normal limit of <350 ppm. CO₂ is above the normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in Condition 2 due to single gas level of CO. CO₂ is in Condition 3. Continue to monitor at normal sampling schedule.
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PT-2B:

- Sample data shows CO is above the normal limit of <350 ppm. CO2 is above the normal limit of <2500 ppm. Mild overheating. Check load and proper oil level in unit. Unit is in Condition 2 due to single gas level of CO. CO2 is in Condition 2. Continue to monitor at normal sampling schedule.

PT-2D:

- Sample data shows CO is above the normal limit of <350 ppm. CO2 is above the normal limit of <2500 ppm. Mild overheating. Check load and proper oil level in unit. Unit is in Condition 2 due to single gas level of CO. CO2 is in Condition 3. Continue to monitor at normal sampling schedule.

PT-7:

- Sample data shows CO2 is above the normal limit of <2500 ppm. Mild overheating. Check load and proper oil level in unit. Unit is in Condition 1. CO2 is in Condition 2. Continue to monitor at normal sampling schedule.

PT-13:

- Sample data shows Hydrogen nearing the normal limit of >100 ppm. Slight overheating. Methane is just above the normal limit of <25 ppm. Slight overheating. CO is above the normal limit of <350 ppm. CO2 is above the normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level. Unit is in Condition 2 due to CO and Hydrogen gas content. It is recommended to resample in six months to monitor gas generation.

PT-12:

- Sample data shows CO2 is above the normal limit of <2500 ppm. Mild overheating. Check load and proper oil level in unit. Unit is in Condition 1. CO2 is in Condition 2. Continue to monitor at normal sampling schedule.

PT-6-A-North:

- Sample data shows CO is above the normal limit of <350 ppm. CO2 is above the normal limit of <2500 ppm. Mild overheating. Check load for proper oil level in unit. Unit is in Condition 2 due to single gas level of CO. CO2 is in Condition 2. Continue to monitor at normal sampling schedule.

45:

- Sample data shows CO2 is above the normal limit of <2500 ppm. Mild overheating. Check load for proper oil level in unit. Unit is in Condition 1. CO2 is in Condition 3. Continue to monitor at normal sampling schedule.

44:

- Sample data shows CO2 is above the normal limit of <2500 ppm. Mild overheating. Check load for proper oil level in unit. Unit is in Condition 1. CO2 is in Condition 3. Continue to monitor at normal sampling schedule.

43:

- Sample data shows CO2 is above the normal limit of <2500 ppm. Mild overheating. Check load for proper oil level in unit. Unit is in Condition 1. CO2 is in Condition 2. Continue to monitor at normal sampling schedule.

PT-60:

- Sample data shows CO2 is above the normal limit of <2500 ppm. Mild overheating. Check load for proper oil level in unit. Unit is in Condition 1. CO2 is in Condition 2. Continue to monitor at normal sampling schedule.

PS-4B:

- Sample data shows CO is above the normal limit of <350 ppm. CO2 is above the normal limit of <2500 ppm. Mild overheating. Check load for proper oil level in unit. Unit is in Condition 2 due to single gas level of CO. CO2 is in Condition 3. Continue to monitor at normal sampling schedule.

PT-9:

- Sample data shows CO is above the normal limit of <350 ppm. CO2 is above the upper limit of >10,000 ppm. Mild overheating. Check load for proper oil level in unit. Unit is in Condition 3 due to single gas level of CO. CO2 is in Condition 4. It is recommended to resample in one month to monitor CO / CO2 gas generation.

SWGR 1 (Right):

- Sample data shows Hydrogen is above the normal limit of <100 ppm. Corona and or overheating. Ethylene is above the normal limit of <50 ppm. Overheating. CO2 is above the normal limit of <2500 ppm. Insulation

degradation and overheating. Check load and confirm proper oil level and flow through radiators. Unit is in Condition 2 due gas levels of Hydrogen and Ethylene. CO2 gas is in Condition 2. It is recommended to resample in six months to monitor gas generation.

SWGR 1 (Left):

- Sample data shows Ethylene is above the normal limit of <50 ppm but decreasing. Overheating. CO2 is above the normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through radiators. Unit is in Condition 3 due to single gas level of Ethylene. CO2 gas is in Condition 2. It is recommended to resample in three months to confirm gases are continuing to drop and become stable.

SWGR 2 (Right):

- Sample data shows Ethylene is above the normal limit of <50 ppm but decreasing. Overheating. CO2 is above the normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in Condition 1. CO2 gas is in Condition 2. Continue to monitor at normal sampling schedule.

SWGR 2 (Left):

- Sample data shows Methane is above the normal limit of <120 ppm. Slight overheating. Ethylene is above the upper limit of limit of >200 ppm. Ethane is above the normal limit of <65 ppm. Mild overheating. CO2 is above the normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in Condition 4 due to single gas level of Ethylene. It is recommended to resample in three months to monitor gas generation.

SCI:

- Sample data shows CO2 is above the normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in Condition 1. CO2 gas is in Condition 3. It is recommended to resample in six months to monitor gas generation.

A Visual Inspection of the Medium Voltage Transformers and Switches revealed the following issues:

PT-2A

The H3 bushing is leaking oil and the oil level is extremely low.

PT-2E

The H2 bushing and the drain valve are leaking oil.

PT-43

The H2 bushing and the drain valve are leaking oil.

PT-71

The unit has excessive exterior rust and is low on oil.

PT-7

The drain valve is leaking oil.

PT-45

Primary and Secondary bushings are leaking oil.

PT-44

The unit has excessive rust.

PS-2

The MV cables show signs of tracking at the terminations. The insulating red board needs to be replaced.

PS-2B

The MV cables show signs of tracking at the terminations. The insulating red board needs to be replaced.

PS-2A

The MV cables show signs of tracking at the terminations.

PS-2F

The unit has excessive exterior rust.

Oil sample test results, overall condition spreadsheets and technical information are enclosed for review.

	H= 480V L=208V M=4160	oil type	fused primary	manufac date	Level gauge	tap changer setting	Temp Gauge	MV connection	leaks	Exterior condition	remarks
Transformer ID	kVA										
PT-1	L750	Silicone	yes	1987	Yes/Sat.	4	Yes/Sat.	Load break	No	Fair	
PT-2a	H300	Silicone	yes	1987	Yes/Unsat.	3	Yes/Unsat.	Load break	Yes	Poor	H3 Bushing Leaking Oil. Oil Level Extremely Low
PT-2b	L750	Silicone	yes	1987	Yes/Sat.	3	Yes/Sat.	Load break	No	Fair	
PT-2c	L750	Silicone	yes	1987	Yes/Sat.	3	Yes/Sat.	Load break	No	Fair	
PT-2d	H1000	Silicone	yes	1987	Yes/Sat.	3	Yes/Sat.	Load break	No	Fair	
PT-2e	H500	Silicone	yes	1987	Yes/Sat.	2	Yes/Sat.	Load break	Yes	Poor	H2 Bushing and Drain Valve Leaking Oil
PT2-f	H500	Mineral	yes	1987	Yes/Sat.	3	Yes/Sat.	Load break	No	Fair	Exterior Rust
PT-2g	H2500		yes					Load break			
PT-3	L750	Mineral	yes	1987	Yes/Sat.	3	Yes/Sat.	Load break	No	Fair	
PT-4d	H750							Stress cone			
PT-6	L300	Silicone	yes	1986	Yes/Sat.	3	Yes/Sat.	Load break	No	Fair	
PT-6b	L225	Silicone	yes	1987	Yes/Sat.	3	Yes/Sat.	Load break	No	Fair	
PT-7	L225	Mineral	yes	1987	Yes/Sat.	3	Yes/Sat.	Load break	Yes	Fair	Oil Leak at Drain Valve
PT-9	L150	FR3	yes	2009	Yes/Sat.	3	Yes/Sat.	Load break	No	Good	
PT-12	H750	Mineral	yes	1994	Yes/Sat.	C	Yes/Sat.	Load break	No	Good	
PT-13	H750	Silicone	yes	2000	Yes/Sat.	C	Yes/Sat.	Load break	No	Fair	
PT-44	H300	Mineral	yes	1987	Yes/Sat.	3	Yes/Sat.	Load break	No	Poor	Excessive Rust
PT-45	L500	Mineral	yes	2005	Yes/Sat.	A	Yes/Sat.	Load break	Yes	Poor	Oil Leak on Primary and Secondary Bushings
PT-54	L150	Mineral						Load break			
PT-71	L300	Mineral	yes	1987	Yes/Sat.	3	Yes/Sat.	Load break	No	Poor	Excessive Rust
PT-79	L300	FR3	yes	2011	Yes/Sat.	C	Yes/Sat.	Load break	No	Good	
PT-43	H1500	Silicone						Load break			
PT-60	L500	Mineral						Stress cone			
70BP	H750	Mineral						Load break			
70CP	H2500	Mineral						Load break			
Swgr R	M3000	Mineral	yes	1994				Stress cone			
Swgr L	M3000	Mineral	yes	1994				Stress cone			
PT-78	L300							Load break			
PT-82	H500							Load break			
Unit Sub A	H2500	Mineral	yes	1994				Stress cone			
Unit Sub B	H2500	Mineral	yes	1994				Stress cone			
Unit Sub C	H2500	Mineral	yes	1994				Stress cone			
Unit Sub D	H2500	Mineral	yes	1994				Stress cone			
Unit Sub F	H2500	Mineral	yes	1994				Stress cone			
Unit Sub R	H2000	Mineral	yes	1994				Stress cone			
Unit Sub S	H2000	Mineral	yes	1994				Stress cone			

Field selector	Selector Type	Manufacture	Kirk Key	manufacture date	Red board condition	Exterior condition	Comments
PS-1	PMH-13	S&C	no	1986	Sat.	Sat.	
PS-2	PMH-13	S&C	no	1987	Unsat.	Sat.	Cables Show Signs of Tracking
PS-2a	PMH-3	S&C	no	1987	Unsat.	Sat.	Cables Show Signs of Tracking
PS-2b	PMH-3	S&C	no	1987	Unsat.	Sat.	Cables Show Signs of Tracking
PS-2c	PMH-3	S&C	no	1987	Unsat.	Sat.	
PS-2d	PMH-3	S&C	no	1987	Unsat.	Sat.	
PS-2f	PMH-3	S&C	no	Jul-94	Unsat.	Unsat.	Exterior Rust
PS- 2g	PMH-13						
PS-3	PMH-13	S&C	no	1986	Sat.	Sat.	
PS-4B	PMH-13	S&C	yes		Sat.	Sat.	
PS-6	PMH-10		yes	2005	Sat.	Sat.	
PS-43	PMH-13	S&C	no	1987	Sat.	Sat.	
PS-60	PMH-13		yes				
PS-70a	PMH-13		no				
PS-70b	PMH-13		no				
PS-78	PMH-13		yes				
PS-82	PMH-13						
PS-83	PMH-13						
USA	Dual HVL		yes				
USB	Dual HVL		yes				
USC	Dual HVL		yes				
USD	Dual HVL		yes				
USF	Dual HVL		yes				
USR	Dual HVL		yes				
USS	Dual HVL		yes				

Oil Samples



OIL SAMPLE REPORT

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CUSTOMER DATAShop Order#: 1-0683-05Equip ID PT-2ASerial# P176225Received Date: 11/10/2015Reported Date: 11/19/2015Phase 3 PhaseTank TransformerBreathing SealedLocation Dallas, TxImp. (% Z) 3.11Gallons 220Primary Voltage kV 13.2/.48KVA: 300Mfg. GEFluid Silicon OilVoltage Class <69kV

Contact:

Phone:

EXT

SAMPLE DATA

Date Sampled: 11/8/2015 12/15/2012 2/12/2011

Oil Temp (C): 22 30 20

Hydrogen (H2): 25 45 19

Methane (CH4): 27 59 43

Ethane (C2H6): 1 5 0

Ethylene (C2H4): 1 1 0

Acetylene (C2H2): 0 0 0

Carbon Monoxide (CO): 768 368 1145

Carbon Dioxide (CO2): 17067 3265 24348

Nitrogen (N2): 164747 90873 137661

Oxygen (O2): 8664 2971 19498

Tot Dissolved Gas: 191303 97589 182713

Tot Dissolved Combustible Gas: 822 478 1206

Equivalent TCG %: 0.35 0.38 0.11

Moisture PPM: 19.6 20.3 18.3

Interfacial Tension (dynes/cm): 24.6 24.3 21.4

Acid Number (mg KH/g): .02 .05 .05

Color Number (Relative): .5 .5 .5

Visual Exam (Relative): CLR CLR CLR

Sediment Exam (Relative): ND ND Part. Vis.

Dielectric Breakdown (kV): 45.6 47.8 49.6

Dielectric Breakdown 1 mm (kV mm-C):

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .004 .003 .003

Power Factor @ 100C (%):

Specific Gravity (Relative): .961 .961 .962

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID PT-2A

Serial# P176225

Location Dallas, Tx

N2 Diagnosis - Pad gas Total Combustible Gas - OK, Continue routine operation Relative Saturation - 1.30%

Recommendations

Sample data shows CO above normal limit of <350 ppm. CO2 above normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 2, due to single gas level of CO. CO2 is in condition 3. Continue to monitor at normal sampling schedule.

OIL SAMPLE REPORT

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CUSTOMER DATA

	Shop Order#:	<u>1-0683-05</u>	Equip ID	<u>PT-2B</u>
	Customer PO#:		Location	<u>Dallas, Tx</u>
	Serial#	<u>P176039</u>	Imp. (% Z)	<u>5.86</u>
	Received Date:	<u>11/10/2015</u>	Gallons	<u>275</u>
	Reported Date:	<u>11/19/2015</u>	Primary Voltage kV	<u>13.2/.48</u>
	Phase	<u>3 Phase</u>	KVA:	<u>750</u>
EXT	Tank	<u>Transformer</u>	Mfg.	<u>GE</u>
	Breathing	<u>Sealed</u>	Fluid	<u>Silicon Oil</u>
			Voltage Class	<u><69kV</u>

SAMPLE DATA

Date Sampled:	11/8/2015	12/15/2012	2/12/2011
Oil Temp (C):	22	24	14
Hydrogen (H2):	18	20	25
Methane (CH4):	19	44	14
Ethane (C2H6):	1	5	0
Ethylene (C2H4):	1	0	0
Acetylene (C2H2):	0	0	0
Carbon Monoxide (CO):	788	547	2235
Carbon Dioxide (CO2):	9269	1731	11891
Nitrogen (N2):	152671	93888	127233
Oxygen (O2):	16360	2672	15226
Tot Dissolved Gas:	179128	98910	156623
Tot Dissolved Combustible Gas:	827	616	2273
Equivalent TCG %:	0.37	0.46	0.22
Moisture PPM:	13.8	14.5	15.3
Interfacial Tension (dynes/cm):	24.7	24.8	25.1
Acid Number (mg KH/g):	.02	.07	.10
Color Number (Relative):	.5	.5	.5
Visual Exam (Relative):	CLR	CLR	Clear
Sediment Exam (Relative):	ND	ND	Part. Vis.
Dielectric Breakdown (kV):	45.2	48.2	53.2
Dielectric Breakdown 1 mm (kV mm-C):			
Dielectric Breakdown 2 mm (kV mm-C):			
Power Factor @ 25C (%):	.003	.002	.002
Power Factor @ 100C (%):			
Specific Gravity (Relative):	.961	.961	.960
Passivator (ppm):			
Oxidation Inhibitor (wt. %):			

Customer PO#: s **Shop Order#:** 1-0683-05 **Equip ID** PT-2B
Serial# P176039 **Location** Dallas, Tx

N2 Diagnosis - Pad gas Total Combustible Gas - OK. Continue routine operation Relative Saturation - 0.91%

Recommendations

Sample data shows CO above normal limit of <350 ppm. CO2 above normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 2, due to single gas level of CO. CO2 is in condition 2. Continue to monitor at normal sampling schedule.

OIL SAMPLE REPORT

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CUSTOMER DATAShop Order#: 1-0683-05Equip ID PT-2C

Customer PO#:

Location Dallas, TxSerial# P176290Imp. (% Z) 5.97Received Date: 11/10/2015Gallons 275Reported Date: 11/19/2015Primary Voltage kV 13.2/.48Phase 3 PhaseKVA: 75Tank TransformerMfg. GEBreathing SealedFluid Silicon OilVoltage Class <69kV**SAMPLE DATA**

Date Sampled: 11/8/2015 12/15/2012 2/12/2011

Oil Temp (C): 22 24 12

Hydrogen (H2): 0 25 33

Methane (CH4): 12 40 21

Ethane (C2H6): 1 6 0

Ethylene (C2H4): 1 1 0

Acetylene (C2H2): 0 0 0

Carbon Monoxide (CO): 131 364 1726

Carbon Dioxide (CO2): 5883 2365 17960

Nitrogen (N2): 147992 85229 145358

Oxygen (O2): 31876 11014 29416

Tot Dissolved Gas: 185899 99047 194513

Tot Dissolved Combustible Gas: 145 436 1780

Equivalent TCG %: 0.05 0.34 0.15

Moisture PPM: 18.6 20.4 14.2

Interfacial Tension (dynes/cm): 24.4 24.1 24.2

Acid Number (mg KH/g): .02 .07 .10

Color Number (Relative): .5 .5 .5

Visual Exam (Relative): CLR CLR Clear

Sediment Exam (Relative): ND ND Part. Vis.

Dielectric Breakdown (kV): 46.3 46.7 50.7

Dielectric Breakdown 1 mm (kV mm-C):

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .013 .002 .002

Power Factor @ 100C (%):

Specific Gravity (Relative): .961 .962 .963

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID PT-2C

Serial# P176290

Location Dallas, Tx

N2 Diagnosis - Pad gas Total Combustible Gas - OK, Continue routine operation Relative Saturation - 1.23%

Recommendations

Sample data ok. Unit is in condition 1. No action required. Continue to monitor at normal sampling schedule.
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OIL SAMPLE REPORT

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CUSTOMER DATAShop Order#: 1-0683-05Equip ID PT-2D

Customer PO#:

Location Dallas, TxSerial# P176060Imp. (% Z) 5.54Received Date: 11/10/2015Gallons 280Reported Date: 11/19/2015Primary Voltage kV 13.2/.48Phase 3 PhaseKVA: 1000Tank TransformerMfg. GEBreathing SealedFluid Silicon OilVoltage Class <69kV**SAMPLE DATA**

Date Sampled: 11/8/2015 12/15/2012 2/12/2011

Oil Temp (C): 27 30 20

Hydrogen (H2): 23 8 6

Methane (CH4): 40 19 19

Ethane (C2H6): 4 4 0

Ethylene (C2H4): 1 0 0

Acetylene (C2H2): 0 0 0

Carbon Monoxide (CO): 605 117 609

Carbon Dioxide (CO2): 14033 1310 11885

Nitrogen (N2): 162734 86899 127928

Oxygen (O2): 21349 9418 46000

Tot Dissolved Gas: 198793 97779 186447

Tot Dissolved Combustible Gas: 673 148 634

Equivalent TCG %: 0.27 0.11 0.06

Moisture PPM: 14.2 15.0 17.7

Interfacial Tension (dynes/cm): 25.4 25.3 25.6

Acid Number (mg KH/g): .03 .07 .09

Color Number (Relative): .5 .5 .5

Visual Exam (Relative): CLR CLR Clear

Sediment Exam (Relative): ND ND Part. Vis.

Dielectric Breakdown (kV): 46.6 47.3 51.4

Dielectric Breakdown 1 mm (kV mm-C):

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .002 .002 .002

Power Factor @ 100C (%):

Specific Gravity (Relative): .961 .961 .962

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Customer PO#:
Shop Order#: 1-0683-05
Serial# P176060
Equip ID PT-2D
Location Dallas, Tx

N2 Diagnosis - Pad gas Total Combustible Gas - OK, Continue routine operation Relative Saturation - 0.78%

Recommendations

Sample data shows CO above normal limit of <350 ppm. CO2 above normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 2, due to single gas level of CO. CO2 is in condition 3. Continue to monitor at normal sampling schedule.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATAShop Order#: 1-0683-05Equip ID PT-7Serial# P175945Received Date: 11/10/2015Reported Date: 11/19/2015Phase 3 PhaseTank TransformerBreathing SealedLocation VA HospitalImp. (% Z) 3.41Gallons 270Primary Voltage kV 13.2KVA: 225Mfg. GEFluid Mineral OilVoltage Class <69kV

Contact:

Phone:

EXT

SAMPLE DATA

Date Sampled: 11/8/2015 2/12/2011

Oil Temp (C): 27 28

Hydrogen (H2): 44 114

Methane (CH4): 68 59

Ethane (C2H6): 3 10

Ethylene (C2H4): 17 31

Acetylene (C2H2): 0 0

Carbon Monoxide (CO): 224 1169

Carbon Dioxide (CO2): 2753 4304

Nitrogen (N2): 108352 76607

Oxygen (O2): 857 821

Tot Dissolved Gas: 112321 83118

Tot Dissolved Combustible Gas: 356 1383

Equivalent TCG %: 0.23 1.35

Moisture PPM: 9.3 8.2

Interfacial Tension (dynes/cm): 32.8 25.9

Acid Number (mg KH/g): .02 0.08

Color Number (Relative): .5 1.0

Visual Exam (Relative): CLR Yellow

Sediment Exam (Relative): ND Part. Vis.

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 48.4 55.8

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .047 .046

Power Factor @ 100C (%):

Specific Gravity (Relative): .871 .872

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID PT-7

Serial# P175945

Location VA Hospital

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, Overheating Total Combustible Gas - Re-sample with-in 6 mos. Level indicates need for further investigation Relative Saturation - 5.12%

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 1. CO2 is in condition 2. Continue to monitor at normal sampling schedule.

OIL SAMPLE REPORT

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CUSTOMER DATAShop Order#: 1-0683-05Equip ID PT-71Serial# P175972Received Date: 11/10/2015Reported Date: 11/19/2015Phase 3 PhaseTank TransformerBreathing SealedLocation VA HospitalImp. (% Z) 3.36Gallons 290Primary Voltage kV 13.2KVA: 300Mfg. GEFluid Mineral OilVoltage Class <69kV

Contact:

Phone:

EXT

SAMPLE DATA

Date Sampled: 11/8/2015 2/12/2011

Oil Temp (C): 26 26

Hydrogen (H2): 0 113

Methane (CH4): 23 28

Ethane (C2H6): 7 5

Ethylene (C2H4): 38 79

Acetylene (C2H2): 0 0

Carbon Monoxide (CO): 225 518

Carbon Dioxide (CO2): 2083 4014

Nitrogen (N2): 89775 83698

Oxygen (O2): 125911 174

Tot Dissolved Gas: 104745 88631

Tot Dissolved Combustible Gas: 293 743

Equivalent TCG %: 0.17 0.68

Moisture PPM: 7.4 9.8

Interfacial Tension (dynes/cm): 32.4 25.3

Acid Number (mg KH/g): .03 0.08

Color Number (Relative): 1.5 1.5

Visual Exam (Relative): Amber Yellow

Sediment Exam (Relative): ND Part. Vis.

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 48.9 58.3

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .046 .103

Power Factor @ 100C (%):

Specific Gravity (Relative): .870 .870

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID PT-71

Serial# P175972

Location VA Hospital

N2 Diagnosis - Pad gas Total Combustible Gas - OK. Continue normal operation Relative Saturation - 4.23%
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Recommendations

Sample data ok. Unit is in condition 1. No action required. Continue to monitor at normal sampling schedule.
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OIL SAMPLE REPORT

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CUSTOMER DATAShop Order#: 1-0683-05Equip ID PT-13

Customer PO#:

Location VA HospitalImp. (% Z) 5.57Received Date: 11/10/2015Gallons 350Reported Date: 11/19/2015Primary Voltage kV 13.2Phase 3 PhaseKVA: 500Tank TransformerMfg. GEBreathing SealedFluid Silicon OilVoltage Class <69kV**SAMPLE DATA**

Date Sampled: 11/8/2015 2/12/2011

Oil Temp (C): Not Listed 22

Hydrogen (H2): 123 97

Methane (CH4): 42 30

Ethane (C2H6): 5 0

Ethylene (C2H4): 5 0

Acetylene (C2H2): 0 0

Carbon Monoxide (CO): 583 1042

Carbon Dioxide (CO2): 5321 6415

Nitrogen (N2): 161878 132087

Oxygen (O2): 18311 25096

Tot Dissolved Gas: 186271 164767

Tot Dissolved Combustible Gas: 758 1169

Equivalent TCG %: 0.37 0.11

Moisture PPM: 12.4 16.1

Interfacial Tension (dynes/cm): 25.6 21.8

Acid Number (mg KH/g): .02 0.08

Color Number (Relative): .5 .5

Visual Exam (Relative): CLR Clear

Sediment Exam (Relative): ND ND

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 40.2 35.6

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .002 .001

Power Factor @ 100C (%):

Specific Gravity (Relative): .960 .960

Passivator (ppm):

Oxidation Inhibitor (wt. %):

	Shop Order#: <u>1-0683-05</u>	Equip ID <u>PT-13</u>
Customer PO#: Results	Serial# <u>Q554517-T0R</u>	Location <u>VA Hospital</u>

N2 Diagnosis - Pad gas CO Diagnosis - Insulation degradation, Overheating CO2 Diagnosis - Insulation degradation, Overheating Total Combustible Gas - Re-sample with-in 6 mos. Level indicates need for further investigation Relative Saturation - Can't calculate due to no temp listed

Recommendations

Sample data shows Hydrogen nearing normal limit of >100 ppm. Slight overheating. Methane just above normal limit of <25 ppm. Slight overheating. CO above normal limit of <350 ppm. CO2 above normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level. Unit is in condition 2, due to CO and Hydrogen gas content. Recommend a resample in 6 months to monitor gas generation.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0683-05Equip ID PT-12Serial# 949000902Location VA HospitalReceived Date: 11/10/2015Imp. (% Z) 5.7Reported Date: 11/19/2015Gallons 389Primary Voltage kV 13.2/480Phase 3 PhaseKVA: 1000

Contact:

Phone:

EXT

Tank TransformerMfg. CooperBreathing SealedFluid Mineral OilVoltage Class <69kV

SAMPLE DATA

Date Sampled: 11/8/2015 2/12/2011

Oil Temp (C): 27 35

Hydrogen (H2): 22 29

Methane (CH4): 13 6

Ethane (C2H6): 2 1

Ethylene (C2H4): 58 44

Acetylene (C2H2): 0 0

Carbon Monoxide (CO): 208 276

Carbon Dioxide (CO2): 2904 3199

Nitrogen (N2): 93494 77379

Oxygen (O2): 12584 24589

Tot Dissolved Gas: 109290 105528

Tot Dissolved Combustible Gas: 303 356

Equivalent TCG %: 0.19 0.27

Moisture PPM: 7.4 10.3

Interfacial Tension (dynes/cm): 31.8 25

Acid Number (mg KH/g): .02 0.07

Color Number (Relative): 1.0 1.0

Visual Exam (Relative): Light Amber Yellow

Sediment Exam (Relative): ND Part. Vis.

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 50.1 53.8

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .017 .011

Power Factor @ 100C (%):

Specific Gravity (Relative): .872 .872

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID PT-12

Serial# 949000902

Location VA Hospital

N2 Diagnosis - Pad gas CO2 Diagnosis - insulation degradation, Overheating Total Combustible Gas - OK, Continue routine operation Relative Saturation - 4.07%
--

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 1. CO2 is in condition 2. Continue to monitor at normal sampling schedule.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0683-05Equip ID PT-6-A-NorthSerial# P175971Received Date: 11/10/2015Reported Date: 11/19/2015Phase 3 PhaseTank TransformerBreathing SealedLocation VA HospitalImp. (% Z) 3.30Gallons 215Primary Voltage kV 13.2/208KVA: 300Mfg. GEFluid Silicon OilVoltage Class <69kV

Contact:

Phone:

EXT

SAMPLE DATA

Date Sampled: 11/8/2015 2/12/2011

Oil Temp (C): 32 30

Hydrogen (H2): 37 18

Methane (CH4): 66 56

Ethane (C2H6): 5 0

Ethylene (C2H4): 2 0

Acetylene (C2H2): 0 0

Carbon Monoxide (CO): 738 1456

Carbon Dioxide (CO2): 10417 14557

Nitrogen (N2): 160681 139519

Oxygen (O2): 4587 19279

Tot Dissolved Gas: 176535 174885

Tot Dissolved Combustible Gas: 848 1530

Equivalent TCG %: 0.37 0.13

Moisture PPM: 19.7 18.7

Interfacial Tension (dynes/cm): 24.8 24.3

Acid Number (mg KH/g): .02 0.09

Color Number (Relative): .5 .5

Visual Exam (Relative): CLR Clear

Sediment Exam (Relative): ND Part. Vis.

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 48.9 57.3

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .001 .001

Power Factor @ 100C (%):

Specific Gravity (Relative): .961 .961

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Customer PO#: Results

Shop Order#: 1-0683-05

Equip ID PT-6-A-North

Serial# P175971

Location VA Hospital

N2 Diagnosis - Pad gas
CO Diagnosis - Insulation degradation, Overheating
CO2 Diagnosis - Insulation degradation, Overheating
Total Combustible Gas - Re-sample with-in 6 mos. A situation deserving serious attention
Relative Saturation - 0.91%

Recommendations

Sample data shows CO above normal limit of <350 ppm. CO2 above normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 2, due to single gas level of CO. CO2 is in condition 2. Continue to monitor at normal sampling schedule.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0683-05Equip ID 43Location VA MedicalImp. (% Z) 5.66Gallons 355Primary Voltage kV 13.2/480KVA: 15000Mfg. GEFluid Mineral OilVoltage Class <69kVSerial# P176079Received Date: 11/10/2015Reported Date: 11/19/2015Phase 3 PhaseTank TransformerBreathing Sealed

E-Mail:

Contact:

Phone: EXT

Cell:

FAX:

SAMPLE DATA

Date Sampled: 11/8/2015

Oil Temp (C): 26

Hydrogen (H2): 12

Methane (CH4): 39

Ethane (C2H6): 11

Ethylene (C2H4): 30

Acetylene (C2H2): 0

Carbon Monoxide (CO): 343

Carbon Dioxide (CO2): 3533

Nitrogen (N2): 110263

Oxygen (O2): 333

Tot Dissolved Gas: 114565

Tot Dissolved Combustible Gas: 435

Equivalent TCG %: 0.25

Moisture PPM: 12.4

Interfacial Tension (dynes/cm): 32.7

Acid Number (mg KH/g): .02

Color Number (Relative): 1.5

Visual Exam (Relative): Amber

Sediment Exam (Relative): ND

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 43.9

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .061

Power Factor @ 100C (%):

Specific Gravity (Relative): .871

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID 43

Serial# P176079

Location VA Medical

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, Overheating Total Combustible Gas - OK, Continue routine operation Relative Saturation - 7.08%
--

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 1. CO2 is in condition 2. Continue to monitor at normal sampling schedule.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0683-05Equip ID 45Location VA MedicalImp. (% Z) 5.0Gallons 330Primary Voltage kV 4.16/2400KVA: 500Mfg. VTFluid Mineral OilVoltage Class <69kV

Contact:

Phone:

EXT

Serial# 83V2003Received Date: 11/10/2015Reported Date: 11/19/2015Phase 3 PhaseTank TransformerBreathing Sealed

SAMPLE DATA

Date Sampled: 11/8/2015Oil Temp (C): 55Hydrogen (H2): 18Methane (CH4): 13Ethane (C2H6): 5Ethylene (C2H4): 17Acetylene (C2H2): 0Carbon Monoxide (CO): 294Carbon Dioxide (CO2): 4931Nitrogen (N2): 98065Oxygen (O2): 10023Tot Dissolved Gas: 113370Tot Dissolved Combustible Gas: 347Equivalent TCG %: 0.23Moisture PPM: 8.6Interfacial Tension (dynes/cm): 34.8Acid Number (mg KH/g): .02Color Number (Relative): 1.5Visual Exam (Relative): Light AmberSediment Exam (Relative): ND

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 42.4

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .067Power Factor @ 100C (%): .067Specific Gravity (Relative): .880Passivator (ppm): .880Oxidation Inhibitor (wt. %): .880

Shop Order#: 1-0683-05

Equip ID 45

Serial# 83V2003

Location VA Medical

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, Overheating Total Combustible Gas - OK, Continue routine operation Relative Saturation - 1.81%
--

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 1. CO2 is in condition 3. Continue to monitor at normal sampling schedule.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0683-05Equip ID 44Location VA MedicalImp. (% Z) 3.14Gallons 290Primary Voltage kV 13.2/480KVA: 300Mfg. GEFluid Mineral OilVoltage Class <69kV

Contact:

Phone:

EXT

Serial# P175973Received Date: 11/10/2015Reported Date: 11/19/2015Phase 3 PhaseTank TransformerBreathing Sealed

Date Sampled: 11/8/2015

Oil Temp (C): 28

Hydrogen (H2): 48

Methane (CH4): 34

Ethane (C2H6): 11

Ethylene (C2H4): 29

Acetylene (C2H2): 0

Carbon Monoxide (CO): 306

Carbon Dioxide (CO2): 6363

Nitrogen (N2): 106181

Oxygen (O2): 395

Tot Dissolved Gas: 113371

Tot Dissolved Combustible Gas: 428

Equivalent TCG %: 0.29

Moisture PPM: 9.3

Interfacial Tension (dynes/cm): 33.8

Acid Number (mg KH/g): .02

Color Number (Relative): 1.5

Visual Exam (Relative): Amber

Sediment Exam (Relative): ND

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 42.7

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .065

Power Factor @ 100C (%):

Specific Gravity (Relative): .870

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID 44

Serial# P175973

Location VA Medical

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, Overheating Total Combustible Gas - OK, Continue routine operation Relative Saturation - 4.93%
--

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 1.CO2 is in condition 3. Continue to monitor at normal sampling schedule.
--

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0683-05Equip ID PT-3Serial# P176292Location VA MedicalReceived Date: 11/10/2015Imp. (% Z) 5.70Reported Date: 11/19/2015Gallons 335Primary Voltage kV 13.2/208Phase 3 PhaseKVA: 750Tank TransformerMfg. GEBreathing SealedFluid Mineral OilVoltage Class <69kV

SAMPLE DATA

Date Sampled: 11/8/2015

Oil Temp (C): 20

Hydrogen (H2): 27

Methane (CH4): 35

Ethane (C2H6): 18

Ethylene (C2H4): 30

Acetylene (C2H2): 0

Carbon Monoxide (CO): 274

Carbon Dioxide (CO2): 3285

Nitrogen (N2): 109609

Oxygen (O2): 265

Tot Dissolved Gas: 113546

Tot Dissolved Combustible Gas: 384

Equivalent TCG %: 0.23

Moisture PPM: 7.4

Interfacial Tension (dynes/cm): 34.8

Acid Number (mg KH/g): .01

Color Number (Relative): 1.0

Visual Exam (Relative): CLR

Sediment Exam (Relative): ND

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 45.7

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .010

Power Factor @ 100C (%):

Specific Gravity (Relative): .870

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID PT-3

Serial# P176292

Location VA Medical

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, Overheating Total Combustible Gas - OK, Continue routine operation Relative Saturation - 5.33%
--

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 1. CO2 is in condition 2. Continue to monitor at normal sampling schedule.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0683-05Equip ID PT-60Location VA MedicalImp. (% Z) 4.80Gallons 259Primary Voltage kV 13.2/208KVA: 500Mfg. GEFluid R TempVoltage Class <69kV

Contact:

Phone:

EXT

Received Date: 11/10/2015Reported Date: 11/19/2015Phase 3 PhaseTank TransformerBreathing Sealed

SAMPLE DATA

Date Sampled: 11/8/2015

Oil Temp (C): 35

Hydrogen (H2): 5

Methane (CH4): 19

Ethane (C2H6): 19

Ethylene (C2H4): 1

Acetylene (C2H2): 0

Carbon Monoxide (CO): 307

Carbon Dioxide (CO2): 2952

Nitrogen (N2): 70084

Oxygen (O2): 1772

Tot Dissolved Gas: 75162

Tot Dissolved Combustible Gas: 351

Equivalent TCG %: 0.33

Moisture PPM: 4.3

Interfacial Tension (dynes/cm): 46.8

Acid Number (mg KH/g): .01

Color Number (Relative): .5

Visual Exam (Relative): CLR

Sediment Exam (Relative): ND

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 47.8

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .002

Power Factor @ 100C (%):

Specific Gravity (Relative): .867

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID PT-60

Serial# M08012971

Location VA Medical

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, Overheating Total Combustible Gas - OK, Continue routine operation Relative Saturation - 1.77%
--

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 1. CO2 is in condition 2. Continue to monitor at normal sampling schedule.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0683-05Equip ID PS-4BSerial# 93J444061Location VA MedicalReceived Date: 11/10/2015Imp. (% Z) 5.75Reported Date: 11/19/2015Gallons 167Primary Voltage kV 13.2/480Phase 3 PhaseKVA: 500Tank TransformerMfg. ABBBreathing SealedFluid Mineral OilVoltage Class <69kV

SAMPLE DATA

Date Sampled: 11/8/2015

Oil Temp (C): 29

Hydrogen (H2): 47

Methane (CH4): 37

Ethane (C2H6): 1

Ethylene (C2H4): 1

Acetylene (C2H2): 0

Carbon Monoxide (CO): 482

Carbon Dioxide (CO2): 4168

Nitrogen (N2): 103411

Oxygen (O2): 431

Tot Dissolved Gas: 108583

Tot Dissolved Combustible Gas: 568

Equivalent TCG %: 0.42

Moisture PPM: 6.8

Interfacial Tension (dynes/cm): 35.7

Acid Number (mg KH/g): .01

Color Number (Relative): 1.0

Visual Exam (Relative): CLR

Sediment Exam (Relative): ND

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 44.6

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .006

Power Factor @ 100C (%):

Specific Gravity (Relative): .885

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID PS-4B

Serial# 93J444061

Location VA Medical

N2 Diagnosis - Pad gas
CO Diagnosis - Insulation degradation, Overheating
CO2 Diagnosis - Insulation degradation, Overheating
Total Combustible Gas - Re-sample with-in 1 year. Acceptable, but deserving of continued attention
Relative Saturation - 3.47%

Recommendations

Sample data shows CO above normal limit of <350 ppm. CO2 above normal limit of <2500 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 2, due to single gas level of CO. CO2 is in condition 3. Continue to monitor at normal sampling schedule.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0683-05Equip ID PT-79Serial# 1150012045Location VA MedicalReceived Date: 11/10/2015Imp. (% Z) 4.7Reported Date: 11/19/2015Gallons 144Primary Voltage kV 13.2/480Phase 3 PhaseKVA: 150Tank TransformerMfg. CooperBreathing SealedFluid FR3Voltage Class <69kV

SAMPLE DATA

Date Sampled: 11/8/2015

Oil Temp (C): 32

Hydrogen (H2): 15

Methane (CH4): 3

Ethane (C2H6): 179

Ethylene (C2H4): 9

Acetylene (C2H2): 0

Carbon Monoxide (CO): 14

Carbon Dioxide (CO2): 641

Nitrogen (N2): 85686

Oxygen (O2): 354

Tot Dissolved Gas: 86903

Tot Dissolved Combustible Gas: 220

Equivalent TCG %: 0.05

Moisture PPM: 24.3

Interfacial Tension (dynes/cm): 24.8

Acid Number (mg KH/g): .02

Color Number (Relative): .5

Visual Exam (Relative): Green

Sediment Exam (Relative): ND

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 40.1

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .212

Power Factor @ 100C (%):

Specific Gravity (Relative): .920

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID PT-79

Serial# 1150012045

Location VA Medical

N2 Diagnosis - Pad gas Total Combustible Gas - OK, Continue routine operation Relative Saturation - 1.11%

Recommendations

Sample data shows elevated level of Ethane, this is common in Natural Ester fluid filled equipment. Unit is in condition 1. No action required. Continue to monitor at normal sampling schedule.
--

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0683-05Equip ID PT-9Serial# 25966401-007-01Location VA MedicalReceived Date: 11/10/2015Imp. (% Z) 3.75Reported Date: 11/19/2015Gallons 118Primary Voltage kV 13.2/480Phase 3 PhaseKVA: 150

Contact:

Phone:

EXT

Tank TransformerMfg. CopperBreathing SealedFluid FR3Voltage Class <69kV

SAMPLE DATA

Date Sampled: 11/8/2015

Oil Temp (C): 29

Hydrogen (H2): 35

Methane (CH4): 143

Ethane (C2H6): 0

Ethylene (C2H4): 1

Acetylene (C2H2): 0

Carbon Monoxide (CO): 588

Carbon Dioxide (CO2): 12136

Nitrogen (N2): 163813

Oxygen (O2): 7797

Tot Dissolved Gas: 184515

Tot Dissolved Combustible Gas: 767

Equivalent TCG %: 0.30

Moisture PPM: 18.6

Interfacial Tension (dynes/cm): 24.8

Acid Number (mg KH/g): .02

Color Number (Relative): .5

Visual Exam (Relative): Green

Sediment Exam (Relative): ND

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 42.8

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .002

Power Factor @ 100C (%):

Specific Gravity (Relative): .920

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID PT-9

Serial# 25966401-007-01

Location VA Medical

N2 Diagnosis - Pad gas
CO Diagnosis - Insulation degradation, Overheating
CO2 Diagnosis - Insulation degradation, Overheating
Total Combustible Gas - Re-sample with-in 1 month. Level indicates a need for further investigation
Relative Saturation - 0.95%

Recommendations

Sample data shows CO above normal limit of <350 ppm. CO2 above upper limit of >10,000 ppm. Mild overheating. Check load and for proper oil level in unit. Unit is in condition 3, due to single gas level of CO. CO2 is in condition 4. Recommend a resample in 1 month to monitor CO/CO2 gas generation.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATAShop Order#: 1-0683-05Equip ID PT-6-B-SouthSerial# P175944Received Date: 11/10/2015Reported Date: 11/19/2015Phase 3 PhaseTank TransformerBreathing SealedLocation VA HospitalImp. (% Z) 3.36Gallons 200Primary Voltage kV 13.2/208KVA: 225Mfg. GEFluid Silicon OilVoltage Class <69kV

Contact:

Phone:

EXT

SAMPLE DATA

Date Sampled: 11/8/2015 2/12/2011

Oil Temp (C): 30 30

Hydrogen (H2): 0 17

Methane (CH4): 1 24

Ethane (C2H6): 0 0

Ethylene (C2H4): 1 0

Acetylene (C2H2): 0 0

Carbon Monoxide (CO): 12 862

Carbon Dioxide (CO2): 533 12848

Nitrogen (N2): 152173 125533

Oxygen (O2): 22798 35915

Tot Dissolved Gas: 175541 175200

Tot Dissolved Combustible Gas: 14 904

Equivalent TCG %: 0.00 0.09

Moisture PPM: 17.4 16.9

Interfacial Tension (dynes/cm): 24.7 24.5

Acid Number (mg KH/g): .02 0.09

Color Number (Relative): .5 .5

Visual Exam (Relative): Green Clear

Sediment Exam (Relative): ND Part. Vis.

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 48.1 51.6

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .014 .001

Power Factor @ 100C (%):

Specific Gravity (Relative): .961 .961

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Customer PO#: 2015.146.000 **Shop Order#:** 1-0683-05 **Equip ID** PT-6-B-South
Serial# P175944 **Location** VA Hospital

Results

N2 Diagnosis - Pad gas Total Combustible Gas - OK. Continue normal operation Relative Saturation - 0.85%
--

Recommendations

Sample data ok. Unit is in condition 1. No action required. Continue to monitor at normal sampling schedule.
--

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATAShop Order#: 1-0851-05Equip ID SWGR 1 (Right)Serial# 930269-B1Received Date: 11/25/2015Reported Date: 11/25/2015Phase 3 PhaseTank TransformerBreathing SealedLocation VA - Dallas, TxImp. (% Z) 5.62Gallons 225Primary Voltage kV 13.2/.480KVA: 750Mfg. SQ DFluid Mineral OilVoltage Class <69kV

Contact:

Phone: EXT

SAMPLE DATA

Date Sampled: 11/24/2015 4/11/2011

Oil Temp (C): 35 25

Hydrogen (H2): 129 124

Methane (CH4): 7 15

Ethane (C2H6): 3 3

Ethylene (C2H4): 80 105

Acetylene (C2H2): 0 0

Carbon Monoxide (CO): 234 625

Carbon Dioxide (CO2): 2910 1717

Nitrogen (N2): 101539 78615

Oxygen (O2): 11849 17141

Tot Dissolved Gas: 116754 98348

Tot Dissolved Combustible Gas: 453 872

Equivalent TCG %: 0.36 0.76

Moisture PPM: 6.3 5.7

Interfacial Tension (dynes/cm): 31.4 31.0

Acid Number (mg KH/g): .02 .01

Color Number (Relative): 1.5 1.0

Visual Exam (Relative): Amber Yellow

Sediment Exam (Relative): ND Part. Vis.

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 46.3 54.8

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .036 .040

Power Factor @ 100C (%):

Specific Gravity (Relative): .878 .877

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Customer PO#: 2015.146.000 **Shop Order#:** 1-0851-05 **Equip ID** SWGR 1 (Right)
Serial# 930269-B1 **Location** VA - Dallas, Tx

Results

O2 Diagnosis - Leak to atmosphere, air vented
H2 Diagnosis - Corona and or overheating
CO2 Diagnosis - Insulation degradation, Overheating
C2H4 Diagnosis - Overheating
N2 Diagnosis - Pad gas and/or atmospheric air intrusion
Total Combustible Gas - Re-sample with-in 6 months. Acceptable, but deserving of continued attention
Relative Saturation - 2.59%

Recommendations

Sample data shows Hydrogen above normal limit of <100 ppm. Corona and or overheating. Ethylene above normal limit of <50 ppm. Overheating. CO2 above normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through radiators. Unit is in condition 2, due gas levels of Hydrogen and Ethylene. CO2 gas is in condition 2. Recommend a resample in 6 months to monitor gas generation.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATAShop Order#: 1-0851-05Equip ID SWGR 1 (Left)Location VA - Dallas, TxSerial# 930269-A1Imp. (% Z) 5.92Received Date: 11/25/2015Gallons 465Reported Date: 11/25/2015Primary Voltage kV 13.2/.480

Contact:

Phase 3 PhaseKVA: 2500

Phone:

EXT

Tank TransformerMfg. SQ DBreathing SealedFluid Mineral OilVoltage Class <69kV**SAMPLE DATA**

Date Sampled: 11/24/2015 4/11/2011

Oil Temp (C): 35 32

Hydrogen (H2): 36 25

Methane (CH4): 62 45

Ethane (C2H6): 15 12

Ethylene (C2H4): 104 166

Acetylene (C2H2): 0 0

Carbon Monoxide (CO): 170 681

Carbon Dioxide (CO2): 2653 1755

Nitrogen (N2): 107180 82263

Oxygen (O2): 1755 1815

Tot Dissolved Gas: 111978 86766

Tot Dissolved Combustible Gas: 387 929

Equivalent TCG %: 0.18 0.66

Moisture PPM: 6.1 5.9

Interfacial Tension (dynes/cm): 34.2 34.5

Acid Number (mg KH/g): .05 0.09

Color Number (Relative): 1.5 1.0

Visual Exam (Relative): Amber Yellow

Sediment Exam (Relative): ND ND

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 39.9 49.2

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .008 .011

Power Factor @ 100C (%):

Specific Gravity (Relative): .876 .876

Passivator (ppm):

Oxidation Inhibitor (wt. %):

	Shop Order#: <u>1-0851-05</u>	Equip ID <u>SWGR 1 (Left)</u>
Customer PO#Results	Serial# <u>930269-A1</u>	Location <u>VA - Dallas, Tx</u>

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, Overheating C2H4 Diagnosis - Overheating Total Combustible Gas - Re-sample with-in 3 months. Acceptable, but deserving of continued attention Relative Saturation - 2.50%
--

Recommendations

Sample data shows Ethylene above normal limit of <50 ppm but decreasing. Overheating. CO2 above normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through radiators. Unit is in condition 3, due to single gas level of Ethylene. CO2 gas is in condition 2. Recommend a resample in 3 months to confirm gases are continuing to drop and become stable.
--

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

	Shop Order#: <u>1-0851-05</u>	Equip ID <u>SWGR 2 (Right)</u>
Contact:	Customer PO#: <u>2015.146.000</u>	Location <u>VA - Dallas, Tx</u>
Phone:	Serial# <u>930269-D1</u>	Imp. (% Z) <u>5.60</u>
	Received Date: <u>11/25/2015</u>	Gallons <u>650</u>
	Reported Date: <u>11/25/2015</u>	Primary Voltage kV <u>13.2/4.16</u>
	Phase <u>3 Phase</u>	KVA: <u>3000</u>
	Tank <u>Transformer</u>	Mfg. <u>SQ D</u>
	Breathing <u>Sealed</u>	Fluid <u>Mineral Oil</u>
		Voltage Class <u><69kV</u>

SAMPLE DATA

Date Sampled:	11/24/2015	4/11/2011
Oil Temp (C):	38	35
Hydrogen (H2):	39	30
Methane (CH4):	49	39
Ethane (C2H6):	15	8
Ethylene (C2H4):	52	91
Acetylene (C2H2):	0	0
Carbon Monoxide (CO):	152	691
Carbon Dioxide (CO2):	3039	2037
Nitrogen (N2):	107979	80344
Oxygen (O2):	2445	1448
Tot Dissolved Gas:	113773	84690
Tot Dissolved Combustible Gas:	307	859
Equivalent TCG %:	0.17	0.69
Moisture PPM:	3.8	1.0
Interfacial Tension (dynes/cm):	36.4	36.0
Acid Number (mg KH/g):	.05	0.09
Color Number (Relative):	1.0	1.0
Visual Exam (Relative):	Yellow	Yellow
Sediment Exam (Relative):	ND	Part. Vis.
Dielectric Breakdown (kV):		
Dielectric Breakdown 1 mm (kV mm-C):	44.7	63.7
Dielectric Breakdown 2 mm (kV mm-C):		
Power Factor @ 25C (%):	.009	.006
Power Factor @ 100C (%):		
Specific Gravity (Relative):	.879	.879
Passivator (ppm):		
Oxidation Inhibitor (wt. %):		

Shop Order#: 1-0851-05

Equip ID SWGR 2 (Right)

Serial# 930269-D1

Location VA - Dallas, Tx

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, Overheating Total Combustible Gas - Re-sample with-in 1 year. Acceptable, but deserving of continued attention Relative Saturation - 1.40%
--

Recommendations

Sample data shows Ethylene above normal limit of <50 ppm but decreasing. Overheating. CO2 above normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in condition 1. CO2 gas is in condition 2. Continue to monitor at normal sampling schedule.
--

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0851-05Equip ID SWGR 2 (Left)Location VA - Dallas, TxImp. (% Z) 5.60Gallons 650Primary Voltage kV 13.2/4.16KVA: 3000Mfg. SQ DFluid Mineral OilVoltage Class <69kV

Contact:

Phone:

EXT

Serial# 930269-C1Received Date: 11/25/2015Reported Date: 11/25/2015Phase 3 PhaseTank TransformerBreathing Sealed

SAMPLE DATA

Date Sampled: 11/24/2015 4/11/2011

Oil Temp (C): 37 35

Hydrogen (H2): 72 53

Methane (CH4): 206 185

Ethane (C2H6): 76 96

Ethylene (C2H4): 216 248

Acetylene (C2H2): 0 0

Carbon Monoxide (CO): 156 778

Carbon Dioxide (CO2): 3078 2037

Nitrogen (N2): 106610 75698

Oxygen (O2): 3164 2520

Tot Dissolved Gas: 113582 81616

Tot Dissolved Combustible Gas: 726 1360

Equivalent TCG %: 0.27 0.91

Moisture PPM: 4.9 4.6

Interfacial Tension (dynes/cm): 37.3 37.4

Acid Number (mg KH/g): .05 0.09

Color Number (Relative): 1.0 .5

Visual Exam (Relative): CLR Clear

Sediment Exam (Relative): ND ND

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 45.8 50.9

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .002 .002

Power Factor @ 100C (%):

Specific Gravity (Relative): .879 .880

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0851-05

Equip ID SWGR 2 (Left)

Serial# 930269-C1

Location VA - Dallas, Tx

N2 Diagnosis - Pad gas
CO2 Diagnosis- Insulation degradation, Overheating
CH4 Diagnosis - Slight overheating
C2H6 Diagnosis - Mild overheating
C2H4 Diagnosis - Overheating
Total Combustible Gas - Re-sample with-in 3 mos. Level indicates need for further investigation
Relative Saturation - 1.87%

Recommendations

Sample data shows Methane above normal limit of <120 ppm. Slight overheating. Ethylene above upper limit of limit of >200 ppm. Ethane above normal limit of <65 ppm. Mild overheating. CO2 above normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in condition 4, due to single gas level of Ethylene. Recommend a resample in 3 months to monitor gas generation.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATAShop Order#: 1-0683-05Equip ID SCILocation VA - Dallas, TxSerial# 940230-A1Imp. (% Z) 5.65Received Date: 11/25/2015Gallons 595Reported Date: 11/25/2015Primary Voltage kV 13.2/480Phase 3 PhaseKVA: 2500Tank TransformerMfg. SQ DBreathing SealedFluid Mineral OilVoltage Class <69kV**SAMPLE DATA**

Date Sampled:	11/24/2015	12/15/2012	2/12/2011
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Oil Temp (C):	40	45	30
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Hydrogen (H2):	16	14	27
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Methane (CH4):	25	50	50
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Ethane (C2H6):	10	14	14
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Ethylene (C2H4):	50	76	203
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Acetylene (C2H2):	0	0	0
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Carbon Monoxide (CO):	216	192	1213
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Carbon Dioxide (CO2):	6229	1413	11027
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Nitrogen (N2):	106031	66865	70936
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Oxygen (O2):	6854	2686	2159
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Tot Dissolved Gas:	119434	71312	85632
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Tot Dissolved Combustible Gas:	317	346	1507
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Equivalent TCG %:	0.17	0.26	1.28
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Moisture PPM:	3.6	4.4	10.9
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Interfacial Tension (dynes/cm):	31.8	30.2	27.4
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Acid Number (mg KH/g):	.06	.07	.08
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Color Number (Relative):	2.5	2.0	2.0
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Visual Exam (Relative):	Amber	Amber	Amber
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Sediment Exam (Relative):	ND	ND	ND
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Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C):	40.2	44.1	35.8
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Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%):	.026	.024	.026
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Power Factor @ 100C (%):

Specific Gravity (Relative):	.886	.886	.886
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Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID SCI

Serial# 940230-A1

Location VA - Dallas, Tx

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, Overheating Total Combustible Gas - OK, Continue routine operation Relative Saturation - 1.24%
--

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in condition 1. CO2 gas is in condition 3. Recommend a resample in 6 months to monitor gas generation.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATAShop Order#: 1-0683-05Equip ID USC-LVLocation VA DallasImp. (% Z) 5.59Gallons 595Primary Voltage kV 13.2/480KVA: 2500Mfg. SQ DFluid Mineral OilVoltage Class <69kV

Serial# 940204-A2
Received Date: 11/3/2015
Reported Date: 11/4/2015
Phase 3 Phase
Tank Transformer
Breathing Sealed

Contact:
Phone: EXT

SAMPLE DATA

Date Sampled:	10/15/2015	12/16/2012	2/13/2011
Oil Temp (C):	41	41	40
Hydrogen (H2):	11	5	49
Methane (CH4):	43	26	17
Ethane (C2H6):	3	5	4
Ethylene (C2H4):	26	22	23
Acetylene (C2H2):	0	0	0
Carbon Monoxide (CO):	105	156	1040
Carbon Dioxide (CO2):	4143	874	4381
Nitrogen (N2):	107272	72575	89018
Oxygen (O2):	3932	1392	1092
Tot Dissolved Gas:	115538	75057	95628
Tot Dissolved Combustible Gas:	188	214	1133
Equivalent TCG %:	0.09	0.17	0.93
Moisture PPM:	4.3	4.0	9.4
Interfacial Tension (dynes/cm):	34.7	29.7	27.9
Acid Number (mg KH/g):	.02	.06	.07
Color Number (Relative):	1.0	1.0	1.0
Visual Exam (Relative):	Yellow	Yellow	Yellow
Sediment Exam (Relative):	ND	ND	ND
Dielectric Breakdown (kV):			
Dielectric Breakdown 1 mm (kV mm-C):	46.2	48.3	41.2
Dielectric Breakdown 2 mm (kV mm-C):			
Power Factor @ 25C (%):	.012	.007	.007
Power Factor @ 100C (%):			
Specific Gravity (Relative):	.886	.884	.885
Passivator (ppm):			
Oxidation Inhibitor (wt. %):			

Shop Order#: 1-0683-05

Equip ID USC-LV

Serial# 940204-A2

Location VA Dallas

N2 Diagnosis - Pad gas CO2 Diagnosis - insulation degradation, overheating Total Combustible Gas - OK, Continue routine operation Relative Saturation - 1.43%
--

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in condition 1. CO2 gas is in condition 3. Recommend a resample in 6 months to monitor CO/CO2 gas generation.
--

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATAShop Order#: 1-0683-05Equip ID USB-LVLocation VA DallasSerial# 940204-B1Imp. (% Z) 5.53Received Date: 11/3/2015Gallons 520Reported Date: 11/4/2015Primary Voltage kV 13.2/480Phase 3 PhaseKVA: 2000Tank TransformerMfg. Sq DBreathing SealedFluid Mineral OilVoltage Class <69kV**SAMPLE DATA**

Date Sampled:	10/15/2015	12/16/2012	2/13/2011
Oil Temp (C):	44	37	42
Hydrogen (H2):	13	5	26
Methane (CH4):	56	29	18
Ethane (C2H6):	6	5	4
Ethylene (C2H4):	13	9	9
Acetylene (C2H2):	0	0	0
Carbon Monoxide (CO):	190	159	965
Carbon Dioxide (CO2):	4172	819	3955
Nitrogen (N2):	112758	68110	89998
Oxygen (O2):	5733	1946	3027
Tot Dissolved Gas:	122942	71084	98004
Tot Dissolved Combustible Gas:	278	207	1022
Equivalent TCG %:	0.14	0.18	0.81
Moisture PPM:	6.2	4.0	9.1
Interfacial Tension (dynes/cm):	32.6	29.6	28.6
Acid Number (mg KH/g):	.03	.06	.08
Color Number (Relative):	1.0	1.0	1.0
Visual Exam (Relative):	Yellow	Yellow	Yellow
Sediment Exam (Relative):	ND	ND	ND
Dielectric Breakdown (kV):			
Dielectric Breakdown 1 mm (kV mm-C):	47.2	55.8	65.4
Dielectric Breakdown 2 mm (kV mm-C):			
Power Factor @ 25C (%):	.017	.009	.008
Power Factor @ 100C (%):			
Specific Gravity (Relative):	.885	.885	.885
Passivator (ppm):			
Oxidation Inhibitor (wt. %):			

Shop Order#: 1-0683-05

Equip ID USB-LV

Serial# 940204-B1

Location VA Dallas

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, Overheating Total Combustible Gas - OK, Continue routine operation Relative Saturation - 1.86%
--

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in condition 1. CO2 gas is in condition 3. Recommend a resample in 6 months to monitor CO/CO2 gas generation.
--

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATAShop Order#: 1-0683-05Equip ID USA-LVLocation VA DallasImp. (% Z) 5.65Gallons 595Primary Voltage kV 13.2/480KVA: 2500Mfg. Sq DFluid Mineral OilVoltage Class <69kV

Serial# 940204-A1
Received Date: 11/3/2015
Reported Date: 11/4/2015
Phase 3 Phase
Tank Transformer
Breathing Sealed

Contact:
Phone: EXT

SAMPLE DATA

Date Sampled:	10/15/2015	12/16/2012	2/13/2011
Oil Temp (C):	45	44	42
Hydrogen (H2):	11	8	13
Methane (CH4):	9	6	2
Ethane (C2H6):	1	1	1
Ethylene (C2H4):	5	7	9
Acetylene (C2H2):	0	0	0
Carbon Monoxide (CO):	20	21	64
Carbon Dioxide (CO2):	1165	232	2290
Nitrogen (N2):	89115	59232	33910
Oxygen (O2):	424	7333	15942
Tot Dissolved Gas:	945573	66844	52234
Tot Dissolved Combustible Gas:	46	43	89
Equivalent TCG %:	0.03	0.05	0.16
Moisture PPM:	5.4	5.2	11.0
Interfacial Tension (dynes/cm):	32.7	29.7	27.0
Acid Number (mg KH/g):	.03	.07	.08
Color Number (Relative):	1.0	1.0	1.0
Visual Exam (Relative):	Yellow	Yellow	Yellow
Sediment Exam (Relative):	ND	ND	ND
Dielectric Breakdown (kV):			
Dielectric Breakdown 1 mm (kV mm-C):	46.4	48.3	47.1
Dielectric Breakdown 2 mm (kV mm-C):			
Power Factor @ 25C (%):	.033	.026	.025
Power Factor @ 100C (%):			
Specific Gravity (Relative):	.885	.885	.885
Passivator (ppm):			
Oxidation Inhibitor (wt. %):			

Shop Order#: 1-0683-05

Equip ID USA-LV

Serial# 940204-A1

Location VA Dallas

N2 Diagnosis - Pad gas Total Combustible Gas - OK, Continue routine operation Relative Saturation - 1.57%

Recommendations

Sample data ok. Unit is in condition 1. No action required. Continue to monitor at normal sampling schedule.
--

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATAShop Order#: 1-0683-05Equip ID USR-LVLocation VA DallasImp. (% Z) 5.52Gallons 520Primary Voltage kV 13.2/480KVA: 2000Mfg. Sq DFluid Mineral OilVoltage Class <69kV

Serial# 940204-B2
Received Date: 11/3/2015
Reported Date: 11/4/2015
Phase 3 Phase
Tank Transformer
Breathing Sealed

Contact:
Phone: EXT

SAMPLE DATA

Date Sampled:	10/15/2015	12/15/2012	2/13/2011
Oil Temp (C):	41	39	32
Hydrogen (H2):	23	20	81
Methane (CH4):	84	25	39
Ethane (C2H6):	7	6	8
Ethylene (C2H4):	20	24	20
Acetylene (C2H2):	0	0	0
Carbon Monoxide (CO):	248	155	1418
Carbon Dioxide (CO2):	4107	1019	5385
Nitrogen (N2):	105989	67853	72371
Oxygen (O2):	5565	2351	3112
Tot Dissolved Gas:	116047	71455	82437
Tot Dissolved Combustible Gas:	382	230	1566
Equivalent TCG %:	0.21	0.22	1.56
Moisture PPM:	5.2	4.0	8.6
Interfacial Tension (dynes/cm):	31.8	30.3	29.3
Acid Number (mg KH/g):	.03	.06	.07
Color Number (Relative):	1.0	1.0	1.0
Visual Exam (Relative):	Yellow	Yellow	Yellow
Sediment Exam (Relative):	ND	ND	ND
Dielectric Breakdown (kV):			
Dielectric Breakdown 1 mm (kV mm-C):	45.1	45.7	51.3
Dielectric Breakdown 2 mm (kV mm-C):			
Power Factor @ 25C (%):	.011	.009	.011
Power Factor @ 100C (%):			
Specific Gravity (Relative):	.886	.887	.887
Passivator (ppm):			
Oxidation Inhibitor (wt. %):			

Shop Order#: 1-0683-05

Equip ID USR-LV

Serial# 940204-B2

Location VA Dallas

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, overheating Total Combustible Gas - OK, Continue routine operation Relative Saturation - 1.73%
--

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in condition 1. CO2 gas is in condition 3. Recommend a resample in 6 months to monitor CO/CO2 gas generation.
--

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATAShop Order#: 1-0683-05Equip ID USF-LVLocation VA DallasImp. (% Z) 5.51Gallons 595Primary Voltage kV 13.2/480KVA: 2500Mfg. Sq DFluid Mineral OilVoltage Class <69kV

Serial# 940204-A4
Received Date: 11/3/2015
Reported Date: 11/4/2015
Phase 3 Phase
Tank Transformer
Breathing Sealed

Contact:
Phone: EXT

SAMPLE DATA

Date Sampled:	10/15/2015	12/16/2012	2/13/2011
Oil Temp (C):	40	40	38
Hydrogen (H2):	21	17	81
Methane (CH4):	164	50	60
Ethane (C2H6):	12	16	9
Ethylene (C2H4):	23	31	13
Acetylene (C2H2):	0	0	0
Carbon Monoxide (CO):	299	138	1321
Carbon Dioxide (CO2):	4701	971	5919
Nitrogen (N2):	105523	70194	72744
Oxygen (O2):	1189	1967	1381
Tot Dissolved Gas:	111935	73387	81528
Tot Dissolved Combustible Gas:	519	252	1484
Equivalent TCG %:	0.27	0.20	1.48
Moisture PPM:	4.3	4.9	9.0
Interfacial Tension (dynes/cm):	31.6	30.4	29.4
Acid Number (mg KH/g):	.04	.07	.08
Color Number (Relative):	1.0	1.0	1.0
Visual Exam (Relative):	Yellow	Yellow	Yellow
Sediment Exam (Relative):	ND	ND	Part. Vis.
Dielectric Breakdown (kV):			
Dielectric Breakdown 1 mm (kV mm-C):	44.4	44.2	28.3
Dielectric Breakdown 2 mm (kV mm-C):			
Power Factor @ 25C (%):	.020	.017	.016
Power Factor @ 100C (%):			
Specific Gravity (Relative):	.886	.886	.886
Passivator (ppm):			
Oxidation Inhibitor (wt. %):			

Shop Order#: 1-0683-05

Equip ID USF-LV

Serial# 940204-A4

Location VA Dallas

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, Oveheating Total Combustible Gas - OK, Continue routine operation Relative Saturation - 1.48%

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in condition 1. CO2 gas is in condition 3. Recommend a resample in 6 months to monitor CO/CO2 gas generation.
--

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0683-05Equip ID USD-LVLocation VA DallasImp. (% Z) 5.54Gallons 595Primary Voltage kV 13.2/480KVA: 2500Mfg. SQ DFluid Mineral OilVoltage Class <69kV

Serial# 940204-A3
Received Date: 11/3/2015
Reported Date: 11/4/2015
Phase 3 Phase
Tank Transformer
Breathing Sealed

Contact:
Phone: EXT

SAMPLE DATA

Date Sampled:	10/15/2015	12/16/2012	2/13/2011
Oil Temp (C):	43	45	42
Hydrogen (H2):	10	11	59
Methane (CH4):	4	6	27
Ethane (C2H6):	5	4	19
Ethylene (C2H4):	69	124	30
Acetylene (C2H2):	0	0	0
Carbon Monoxide (CO):	70	35	471
Carbon Dioxide (CO2):	3322	779	5055
Nitrogen (N2):	91365	67519	62307
Oxygen (O2):	3903	8657	30460
Tot Dissolved Gas:	98750	77139	98431
Tot Dissolved Combustible Gas:	158	180	606
Equivalent TCG %:	0.07	0.07	0.56
Moisture PPM:	6.7	7.2	13.0
Interfacial Tension (dynes/cm):	31.7	29.6	25.3
Acid Number (mg KH/g):	.05	.07	.08
Color Number (Relative):	1.5	1.5	1.5
Visual Exam (Relative):	Amber	Amber	Amber
Sediment Exam (Relative):	ND	ND	ND
Dielectric Breakdown (kV):			
Dielectric Breakdown 1 mm (kV mm-C):	46.8	53.4	50.4
Dielectric Breakdown 2 mm (kV mm-C):			
Power Factor @ 25C (%):	.050	.044	.050
Power Factor @ 100C (%):			
Specific Gravity (Relative):	.886	.886	.886
Passivator (ppm):			
Oxidation Inhibitor (wt. %):			

Shop Order#: 1-0683-05

Equip ID USD-LV

Serial# 940204-A3

Location VA Dallas

N2 Diagnosis - Pad gas
C2H4 Diagnosis - Overheating
CO2 Diagnosis - Insulation degradation, Overheating
Total Combustible Gas - OK, Continue routine operation
Relative Saturation - 2.08%

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Insulation degradation and overheating. Ethylene above normal limit of <50 ppm. OverheatingCheck load and confirm proper oil level and flow through all radiators. Unit is in condition 2, due to single gas level of Ethylene. CO2 gas is in condition 2. Recommend a resample in 6 months to monitor gas generation.

OIL SAMPLE REPORT

Page 1 of 2

CUSTOMER DATA

Shop Order#: 1-0683-05Equip ID PT-1Serial# P176054Received Date: 11/3/2015Reported Date: 11/4/2015Phase 3 PhaseTank TransformerBreathing SealedLocation VA DallasImp. (% Z) 5.77Gallons 335Primary Voltage kV 13.2/.208KVA: 750Mfg. GEFluid Mineral OilVoltage Class <69kV

Contact:

Phone:

EXT

SAMPLE DATA

Date Sampled: 11/1/2015

Oil Temp (C): 30

Hydrogen (H2): 16

Methane (CH4): 78

Ethane (C2H6): 8

Ethylene (C2H4): 17

Acetylene (C2H2): 0

Carbon Monoxide (CO): 283

Carbon Dioxide (CO2): 3713

Nitrogen (N2): 107862

Oxygen (O2): 408

Tot Dissolved Gas: 112388

Tot Dissolved Combustible Gas: 402

Equivalent TCG %: 0.23

Moisture PPM: 4.4

Interfacial Tension (dynes/cm): 33.6

Acid Number (mg KH/g): .03

Color Number (Relative): 1.5

Visual Exam (Relative): Amber

Sediment Exam (Relative): ND

Dielectric Breakdown (kV):

Dielectric Breakdown 1 mm (kV mm-C): 39.7

Dielectric Breakdown 2 mm (kV mm-C):

Power Factor @ 25C (%): .067

Power Factor @ 100C (%):

Specific Gravity (Relative): .870

Passivator (ppm):

Oxidation Inhibitor (wt. %):

Shop Order#: 1-0683-05

Equip ID PT-1

Serial# P176054

Location VA Dallas

N2 Diagnosis - Pad gas CO2 Diagnosis - Insulation degradation, Overheating Total Combustible Gas - OK, Continue routine operation Relative Saturation - 2.16%
--

Recommendations

Sample data shows CO2 above normal limit of <2500 ppm. Insulation degradation and overheating. Check load and confirm proper oil level and flow through all radiators. Unit is in condition 1. CO2 gas is in condition 2. Recommend a resample in 6 months to monitor CO/CO2 gas generation.
--

Descriptions of Tests



Oil Tests and Their Significance

Physical Tests

1.	Aniline Point	D611-82 (1998)
2.	Color	D1500-98
3.	Flash and Fire Points	D92-98a
4.	Interfacial Tension	D971-99
		D2285-99
5.	Pour Point	D97-96a
6.	Relative Density (Specific Gravity)	D1298-85 (1990)
7.	Viscosity	D88-94
		D445-97
		D2161-93

Electrical Tests

		ASTM Method Number
1.	Dielectric Breakdown Voltage	D877-87 (1995)
		D1816-97
2.	Dielectric Breakdown Impulse Voltage	D3300-94
3.	Dissipation Factor (Power Factor)	D924-92
4.	Gassing of Insulating Oils Under Electrical Stress and Ionization	D2300-98

Chemical Tests

		ASTM Method Number
1.	Gas Content	D2945-90 (1998)
		D3284-99
		D3612-96
2.	Polychlorinated Biphenyls	D4059-96
3.	Corrosive Sulfur	D1275-96a
4.	Neutralization Number (Acidity)	D664-95
		D974-97
5.	Oxidation Inhibitor Content	D2668-96
		D4768-96
6.	Oxidation Stability (Inhibited oil only, Oxidation Stability)	D2112-95 (BOMB)
		D2440-99
7.	Water in Insulating Liquids	D1533-96
8.	Furans in Insulating Liquids	D5837-95

Description Of Physical Tests

Aniline Point -ASTM D611-82- (1998)

The aniline point (temperature) of a mineral insulating oil indicates the solvency of the oil for some materials that are in contact with the oil. A high aniline point indicates a lower degree of aromaticity and a lower solvency for some material (rubber, for example).

Color - ASTM D1500-98

Insulating oil should have a light color and be optically clear so that it permits visual inspection of the assembled apparatus inside the equipment tank. Any change in the color of an oil over time is an indication of deterioration or contamination of the oil.

Flash and Fire Points - ASTM D92-98a

The flash point of an oil is the temperature to which the material must be heated (under prescribed conditions of test) in order to give off sufficient vapor to form a flammable mixture with air. The fire point is the temperature that provides sufficient oil vapors to ignite and sustain a fire for 3 seconds (under the same test conditions). A low flash point indicates the presence of volatile combustible contaminants in the insulating oil.

Interfacial Tension - ASTM D971-99a, ASTM D2285-99

This method covers the measurement, under nonequilibrium conditions, of the surface tension that an insulating fluid maintains against water. Interfacial tension is a measurement of the forces of attraction between molecules of the two fluids. It is expressed in millinewtons per meter (mN/m). The test is an excellent means of detecting oil-soluble polar contaminants and oxidation products in insulating oils.

Pour Point - ASTM D97-96a

The pour point is the temperature at which oil ceases to flow under prescribed testing conditions. The pour point has little significance as a test for contamination or deterioration of the oil. It may be useful for oil identification and determination of suitability for a particular climate.

Relative Density (Specific Gravity) - ASTM D1298-85

The relative density of an oil is the ratio of the weights of equal volumes of the oil and water, tested at 15 °C. The relative density is significant in determining the suitability for use in certain applications, in cold climates, ice may form in equipment exposed to temperatures below freezing. When considered along with other oil properties, relative density can be an indicator of the quality of the oil.

Viscosity - ASTM D88-94, ASTM D445-97, ASTM D2161-93 (1999)

The viscosity of an insulating oil is measured by timing the flow of a known volume of oil through a calibrated tube. Viscosity is not significantly affected by oil contamination or deterioration, but may be useful for identifying certain types of service-aged insulating oils. Viscosity has an important influence on the heat transfer characteristics of an oil. High viscosity decreases the cooling efficiency of the oil. High viscosity will also affect the movement of parts in electrical equipment, such as circuit breakers, switchgear, tap changers, pumps, and regulators. Viscosity is a factor in determining the conditions for oil processing and cellulose impregnation time.

Visual Examination - ASTM D1524-94 (1999)

This test indicates the color and degree of turbidity of an oil, which may indicate the presence of free water or contaminating solid particles. The source of insoluble solid contaminants may be determined by filtrating the particles and examining them. This test may be used to suggest the need for additional laboratory tests, as it may permit a determination of whether the sample should be sent to a central laboratory for a full evaluation.

Description Of Electrical Tests

Dielectric Breakdown Voltage - ASTM D877-87 (1995), ASTM D1816-97

The dielectric breakdown voltage of insulating oil is a measure of its ability to withstand voltage stress without failure. It is the voltage at which breakdown occurs between two electrodes under prescribed test conditions. The test serves primarily to indicate the presence of electrically conductive contaminants in the oil, such as water, dirt, moist cellulosic fibers, or particulate matter. A high dielectric breakdown voltage does not indicate the absence of all contaminants, however.

The electrodes in D877 are thin flat disks, which are not representative of the electrodes in transformers. Although the rounded electrodes in D1816 do not duplicate the characteristics of insulated electrodes in transformers, they more closely approximate transformer applications. However, the D1816 electrodes are more responsive to particles and dissolved water in oil, both of which are detrimental to the electrical strength of oil in transformers. Therefore, D1816 test results furnish a better evaluation of changes that may occur in the oil from transformers.

Two methods are recognized for measuring the dielectric breakdown voltage of insulating oils:

1. ASTM D877-87 (1995) is recommended for the routine acceptance of new, unprocessed oil from a supplier for use in circuit breakers. This test method uses thin flat-faced cylindrical electrodes with a 2.5 mm gap. The sensitivity of this method, to the general population of contaminants present in a liquid sample, decreases as applied test voltages used in this method become greater than 25 kV rms.
2. ASTM D1816-97 is recommended for testing fluid that is being processed into transformers or contained in transformers and load tap changers. This method uses spherically shaped electrodes. The fluid sample is circulated continuously in the test cell throughout the test. The gap distance standard settings are 1 mm and 2 mm (alt. 0.04 in and 0.08 in).

Dielectric Breakdown Impulse Voltage - ASTM D3300-94

This test method is most commonly performed using a negative polarity point opposing a grounded sphere (NPS). The NPS breakdown voltage of fresh unused oils measured in the highly divergent field in this configuration depends on oil composition; decreasing with increasing concentration of aromatic, particularly polyaromatic, hydrocarbon molecules.

This test method may be used to evaluate the continuity of composition of oil from shipment to shipment. The NPS impulse breakdown voltage of oil can also be substantially lowered by

contact with materials of construction, by service aging, and by other impurities. Test results lower than those expected for a given fresh oil may also indicate use or contamination of that oil.

Although polarity of the voltage wave has little or no effect on the breakdown strength of oil in uniform fields, polarity does have a marked effect on the breakdown voltage of oil in non-uniform electric fields.

Transient voltages may also vary over a wide range in both the time to reach crest value and the time to decay to half crest or to zero magnitude. The IEEE standard lightning impulse test specifies a 1.2 by 50-us negative polarity wave.

Dissipation Factor (Power Factor) - ASTM D924-92

The dissipation factor is a measure of the power lost when an electrical insulating liquid is subjected to an ac field. The power is dissipated as heat within the fluid. A low-value dissipation factor means that the fluid will cause little of the applied power to be lost. The test is used as a check on the deterioration and contamination of an insulating oil because of its sensitivity to ionic contaminants.

Gassing of Insulating Oils Under Electrical Stress and Ionization - ASTM D2300-98

This test measures whether insulating oils are gas absorbing or gas evolving when subjected to electrical voltage. For certain applications, when insulating oils are stressed at high voltage gradients, it is desirable to know the rate at which gas is absorbed or evolved from the oil. The absorption or evolution of gas by a liquid under electrical stress is a function of the aromatic character of the liquid molecules. Liquids that are significantly aromatic in character will absorb gas as they are electrically stressed. Liquids that have little or no aromatic character will evolve hydrogen gas upon application of an electrical voltage. At the present time, however, correlation of these test results with equipment performance is limited. Numerical results obtained in different laboratories or by using two different procedures may differ significantly in magnitude, and the results of this method should be considered qualitative in nature.

Description Of Chemical Tests

Gas Content ASTM D2945-90 (1998), ASTM D3284-99, ASTM D3612-96

The gas content of an insulating fluid may be defined as the volume of dissolved gas per 100 volumes of oil, at standard pressure and temperature. Some types of equipment require the use of electrical insulating liquids of low gas content. In filling electrical apparatus, a low gas content reduces foaming and also reduces the available oxygen, thereby increasing the service life of the insulating oil.

The amount and kind of gases dissolved in oil can be used as a tool to aid in detecting and diagnosing faults and abnormal operating conditions in equipment.

The test is not intended for use in purchase specifications because the oil is customarily degassed immediately prior to use. The test can be used, however, as a factory control test and is more useful in evaluating the health of the transformer equipment. Overheating or arcing within the transformer will generate combustible and noncombustible gasses that will be dissolved in the oil. For Dissolved Gas Analysis, reference IEEE C57.104-1991 for further recommendations.

Polychlorinated Biphenyls (PCBs) - ASTM D4059-96

United States regulations require that electrical apparatus and electrical insulating fluids containing PCBs be handled and disposed of through the use of specific procedures. The procedure to be used for a particular apparatus or quantity of insulating fluid is determined by the PCB content of the fluid. The results of this analytical technique can be useful in selecting the appropriate handling and disposal procedures, refer to Title 40 Code of Federal Regulations Part 761.

Corrosive Sulfur-ASTM D1275-96a

This test is designed to detect the presence of free sulfur and combined corrosive sulfur by how the liquid affects polished copper strips in prescribed conditions. The test indicates the possibility of corrosion inside of electrical equipment resulting from the presence of sulfur-containing compounds. The source of sulfur present in insulating oil is usually the crude oil from which it is refined. The sulfur may come from rubber hoses used for oil processing or from replacement gasket materials.

Neutralization Number (Acidity) - ASTM D664-95, ASTM D974-97

The neutralization number of an electrical insulating liquid is a measure of the acidic components of that material. In a new oil, any acid present is likely residual from the refining process. In a service-aged liquid, the neutralization number is a measure of the acidic byproducts of the oxidation of an oil. The neutralization number may be used as a general guide for determining when an oil should be reprocessed or replaced. ASTM D974-97 is the traditional color-change indicator method of titrating the acids with a mild (0.1 N) KOH solution. ASTM D664-95 is a potentiometric titration method. On some service-aged liquids, the color may be so dark as to impair the ability of the technician to determine the indicator color change in ASTM D974-97, so ASTM D664-95 is used instead. The correlation between these two methods, however, has not been established.

Oxidation Inhibitor Content - ASTM D2668-96 by infrared spectrophotometry, ASTM D4768-96 by gas chromatography

There are two synthetic oxidation inhibitors commonly used in dielectric fluids. They are 2-6 ditertiary-butyl phenol (DBP) and 2-6 ditertiary-butyl para-cresol (DBPC). Their use provides added resistance to oxidation in systems that are partially or wholly exposed to air. The effectiveness of the oxidation inhibitor depends a great deal on the type of crude oil from which the insulating oil came. Certain new oils may contain naturally occurring antioxidant substances that may yield a false-positive indication in this test.

Oxidation Stability, Inhibited only, (BOMB) - ASTM D2112-95, ASTM D2440-97

This method is a rapid test for evaluating the oxidation stability of a new mineral insulating oil that contains the synthetic oxidation inhibitor 2-6 DBPC or 2-6 DBP. The test measures the length of time required for the oil sample to react with a given volume of oxygen when a sample of oil is heated and oxidized under test conditions.

Oxidation Stability - ASTM D2440-99. This test method determines the resistance of mineral insulating oils to oxidation under prescribed accelerated aging conditions. Oxidation stability is measured by the propensity of oils to form sludge and acid products during oxidation. This test method is applicable to new oils, both inhibited and uninhibited.

Water in Insulating Liquids: Karl Fischer Method - ASTM D1533-96

Water may be present in insulating liquids in several forms. The presence of free water may be indicated by visual examination. The oil will appear cloudy or separated water drops will be seen, probably on the bottom surface. The presence of free water can be remedied by filtration or other means. Dissolved water cannot be detected visually and is normally quantified by physical or chemical means. Dissolved water may affect the dielectric breakdown of an insulating oil, however, its significance is determined by several factors including the percent of moisture saturation, and the amount and type of contaminants. The method cited is suitable for the determination of water in insulating oil, and, depending upon conditions of sample handling and methods of analysis, can be used to estimate total water as well as dissolved water in insulating oil. The units of measure of water are mg/Kg (parts per million) (ppm). New insulating oil received from the manufacturer normally contains less than 25mg/kg (ppm) moisture. New insulating oil should be tested for moisture content. If necessary, applicable measures should be taken to avoid introducing high moisture-content oil into electrical equipment.

Furans in Insulating Liquids - ASTM D5837-95

Furanic compounds are generated by the degradation of cellulosic materials used in the solid insulation systems of electrical equipment. Furanic compounds which are oil soluble to an appreciable degree will migrate into the insulating liquid. The presence of high concentrations of furanic compounds is significant in that this may be an indication of cellulose degradation from aging or incipient fault conditions. Testing for furanic compounds by High-Performance Liquid Chromatography (HPLC) may be used to complement dissolved gas in oil analysis as performed in accordance with ASTM D3612-90 test method.
