APPARATUS
TESTING & ENGINEERING

NETA
Accredited Firm

May 1, 2025

UC-Davis
1 Shields Ave
Davis, CA 95616

Attention:	Brent Gesell	bggesell@ucdavis.edu
Subject:	Electrical Maintenance Testing Performed at University of California, Davis, Davis, CA.	
A.T.E. Reference:	S-25001 Rev. 1	

We wish to thank you for giving Apparatus Testing and Engineering, Inc. the opportunity to serve your testing needs on the above referenced project. This letter and the attached Field Test Report constitute the Report for the Project.

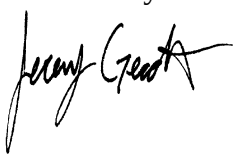
Please review the Results and Recommendations section of this report for items requiring further action.

We appreciate your business and look forward to meeting your testing needs again in the future. Please do not hesitate to contact us if you require further information.

Sincerely,

APPARATUS TESTING AND ENGINEERING, INC.

Submitted by:



Jeremy Gerdts
Field Technician
NETA Certification #: 19-4-9345440

Certified by:

Lee Madsen
NETA Certification #: 17-4-7547

JG:ns

PROJECT REPORT

I. SUMMARY:

UC Davis engaged the services of Apparatus Testing and Engineering, Inc. to provide maintenance testing and inspection of the electrical equipment at UC-Davis for the Raptor Area Enhancement Project. Testing was performed by Jeremy Gerdts, NETA Certification #: 19-4-9345440, of Apparatus Testing and Engineering.

II. TEST EQUIPMENT USED:

A. AEMC Megger
B. AEMC TTR
C. Megger DRLO

III. EQUIPMENT INSPECTED AND TESTED:

A. One (1) Oil Filled Transformer.

IV. TEST PROCEDURES:

A. TRANSFORMERS - LIQUID FILLED

1. Visual and Mechanical Inspection
   a. Inspect for physical damage, cracked insulators, leaks, tightness of connections and general mechanical and electrical conditions.
   b. Verify proper auxiliary device operation.
   c. Verify proper liquid level in all tanks.
   d. Perform specific inspections and mechanical tests as recommended by manufacturer.

2. Electrical Tests
   a. Perform insulation-resistance tests, winding-to-winding, and windings-to-ground. Test duration shall be for 10 minutes with resistance tabulated at 30 seconds, 1 minute and 10 minutes. Calculate dielectric absorption ratio and polarization index.
   b. Perform a turns-ratio test between windings at all tap positions. The final tap setting is to be determined by the owner/user's electrical engineer and set by the testing firm.
   c. Sample insulating liquid in accordance with ASTM D-923. Sample shall be laboratory tested for:
      1. Dielectric strength – ASTM D1816
      2. Acid Neutralization – ASTM D974
      3. Visual condition – ASTM D1524
      4. Interfacial tension – ASTM D971
      5. Dissolved gas analysis – ASTM D3612
      6. Water content – ASTM D1533B
      7. Specific gravity – ASTM D1298

8. Power factor: ASTM D-924

d. Perform dissolved gas analysis (DGA) in accordance with ANSI/IEEE c57.104 or ASTM D-3612.

e. Measure total combustible gas (TCG) content in accordance with ANSI/IEEE C.57.104 or ASTM D-3284.

h. Perform winding-resistance tests on each winding at all tap positions.

V. RESULTS AND RECOMMENDATIONS:

A. Transformer was not installed at time of test. Client to verify grounding, anchoring, and conductor connections before energization.

B. There may be a loose connection or improper torque on the well inserts affecting the resistance between well inserts H2A and H2B. It is recommended to verify proper torque on all well inserts before energization.

C. A sample of the transformer's insulating fluid was taken and submitted to a lab for analysis.

1. Oil lab results found elevated levels of acetylene, suggesting that arcing is possibly occurring within the transformer. This info, coupled with the higher internal resistance on H2 inserts, indicate a possible loose connection.

D. This is a service-aged transformer and the acetylene may have been from previous use. A.T.E. has the following recommendations:

1. If the application is low load and low priority, A.T.E. simply recommends a follow-up oil sample 6 months after energization to trend the oil results and decide if follow up work is required.

2. If the application is considered vital or the load is expected to be high, the transformer should be repaired or replaced. It is unknown if this transformer is a totally welded tank or if it can be opened for inspection or repair.

E. All other items tested passed NETA and/or Manufacturer's specifications.

DATA

TEST

SHEETS

APPARATUS
TESTING & ENGINEERING

SACRAMENTO (916) 853-6280 • SF BAY AREA (925) 454-1363

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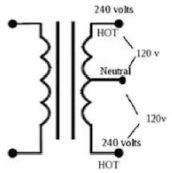
TRANSFORMER TEST REPORT

CUSTOMER:	LOCATION:	JOB NO.: S-25001
UNIVERSITY OF CALIFORNIA	RAPTOR CENTER	DATE: 3/6/25
DAVIS, CA		TESTED BY: JG
IDENTIFICATION: RAPTOR TRANSFORMER	TEST EQUIPMENT USED: AEMC MEGGER, AEMC TTR,	
	MEGGER DRLO	

NAMEPLATE INFORMATION

MFG.	COOPER	X	OIL
KVA	100		DRY
IMPEDANCE	2.5%		
SERIAL NO.	0852020790		
OIL SAMPLE TAKEN	X YES		NO
OIL CAPACITY	69 GAL	DGA#	S-103415
PRIMARY VOLTAGE	12470V		
SECONDARY VOLTAGE	240V / 120V		
AS LEFT TAP	C (12470V)		

DIAGRAM:



MEGGER TEST AT 5KVDC

H-L (G)	25.5K MΩ				
H-G (L)	21.1K MΩ				
L-G (H)	6.90K MΩ @ 1KV				
DURATION: 1 MIN					
TEMP ºC	13	AIR	13	OIL	
WINDING RESISTANCE (1)					
H_{1A}-H_{2A}	11.53 Ω	X_1-X_2	1904 µΩ		
		X_2-X_3	1110 µΩ		
		X_1-X_3	2825 µΩ		

ELECTRICAL TEST DATA

TURNS RATIO TEST			CONNECTIONS		
TAP	PRI. VOLTS	CALC.RATIO	$H_{1A}H_{2A}$-X_1X_2	$H_{1A}H_{2A}$-X_2X_3	$H_{1A}H_{2A}$-X_1X_3
A	13094	54.56 / 109.11	109.09	109.10	54.55
B	12782	53.26 / 106.51	106.50	106.51	53.26
C	12470	51.96 / 103.92	103.92	103.93	51.96
D	12158	50.66 / 101.32	101.34	101.34	50.67
E	11847	49.36 / 98.72	98.76	98.76	49.38

HIGH SIDE BUSING RESISTANCE (µΩ) (1,3)	H1A – H1B	H2A – H2B	
	615	9712	

VISUAL INSPECTION

BUSHINGS	OK	FANS	N/A	TEMP. GAUGE	OK
INSULATORS	OK	CONTROL WIRING	N/A	LIQ. LEVEL GAUGE	OK
CONNECTIONS	(2)	GROUNDING	(2)	PRESS. GAUGE	N/A
ANCHORING	(2)	PRES. RELIEF DEV.	OK		

REMARKS:

(1) WINDING RESISTANCE TESTS PERFORMED AT NOMINAL TAP 12470V (C). VALUES CORRECTED TO 75ºC FOR ALUMINUM WINDINGS, CORRECTION FACTOR 1.261.

(2) XFMR NOT INSTALLED AT TIME OF TEST.

(3) THE BUS RESISTANCE FROM H2A TO H2B IS SIGNIFICANTLY HIGHER THAN H1A TO H2A. IT IS RECOMMENDED TO VERIFY TORQUE ON ALL WELL INSERTS BEFORE ENERGIZATION.

DAR / PI DATA:	30S	60S	10M	DAR	PI
H – L (G)	19.1K	25.5K	65.9K	1.34	2.58
H – G (L)	19.9K	21.1K	23.25K	1.06	1.10
L – G (H)	5.20K	6.90K	10.58K	1.33	1.53

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TRANSFORMER WINDING RESISTANCE TEST REPORT

CUSTOMER:	LOCATION:	JOB NO.: S-25001
UNIVERSITY OF CALIFORNIA	RAPTOR CENTER	DATE: 3/6/25
DAVIS, CA		TESTED BY: JG

TRANSFORMER IDENTIFICATION: RAPTOR CENTER	TEST EQUIPMENT USED: MEGGER DRLO

TEST DATA

HIGH VOLTAGE WINDING	MEASURED WINDING RESISTANCE (Ω)			RESISTANCE CORRECTED TO 75°C (mΩ)			TEST SET SCALE	DURATION	REMARKS
	H_{1A}-H_{2A}		H_{1B}-H_{2B}	H_{1A}-H_{2A}		H_{1B}-H_{2B}			
A (13094V)	9.144		9.153	11.531		11.542	2.5 Ω	1 MIN	(1)
B (12782V)	8.919		8.925	11.247		11.254	2.5 Ω	1 MIN	(1)
C (12470V)	8.702		8.709	10.973		10.982	2.5 Ω	1 MIN	(1)
D (12158V)	8.495		8.490	10.712		10.706	2.5 Ω	1 MIN	(1)
E (11847V)	8.354		8.361	10.534		10.543	2.5 Ω	1 MIN	(1)

LOW VOLTAGE WINDING	MEASURED WINDING RESISTANCE (μΩ)			RESISTANCE CORRECTED TO 75°C (μΩ)			TEST SET SCALE	DURATION	REMARKS
	X_1-X_2	X_2-X_3	X_1-X_3	X_1-X_2	X_2-X_3	X_1-X_3			
240V / 120V	1510	880	2240	1904	1110	2825	25 mΩ	1 MIN	(1)

REMARKS:

(1) TEMPS CORRECTED TO 75°C FOR ALUMINUM WINDINGS. WINDING TEMP AT TIME OF TEST 13C, 68% HUMIDITY, CORRECTION FACTOR 1.261.

Dissolved Gas Analysis

ASTM D3612-C

TJ | H2b ANALYTICAL SERVICES

Date : 03-19-2025
Report Number : 1415667
P.O. Number: S-25001

Lee Madsen
Apparatus Testing & Engineering

11300 Sanders Drive Ste 29
Rancho Cordova, CA 95742

Location :	UCD-RAPTOR
Bank & Phase :	
Serial Number :	0852020790
Manufacturer :	Cooper
Equipment Type :	Transformer
Model :	

Year of Mfg. :	
kV Rating :	12.47
Breathing :	
Cooling :	
Fluid type :	Natural Ester
Fluid Volume :	

Sample Date :	3/6/2025
Laboratory No. :	1415667
Container No. :	S-103415
Temperature :	13
Hydrogen (ppm) :	24
Methane (ppm) :	5
Ethane (ppm) :	102
Ethylene (ppm) :	14
Acetylene (ppm) :	4
Carbon monoxide (ppm) :	43
Carbon dioxide (ppm) :	1695
Nitrogen (ppm) :	30512
Oxygen (ppm) :	379
Total (ppm) :	32778
Total (%) :	3.28
TDCG (ppm) :	192
TDCG Rate (ppm/day) :	0.0
ETCG (% in blanket) :	0.23
CH4 / H2 :	0.19
C2H2 / C2H4 :	0.30
C2H2 / CH4 :	0.88
C2H6 / C2H2 :	24.39
C2H4 / C2H6 :	0.13
CO2 / CO :	39.09
O2 /N2 :	0.01

Dissolved Gas Diagnostics

Key Gas Method : Arcing is indicated.

Ethane is being produced as a byproduct of oxidation.

Dissolved Gas Analysis

ASTM D3612-C

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Serial Number : 0852020790
Manufacturer : Cooper
Equipment Type : Transformer
Model :

Year of Mfg. :
kV Rating : 12.47
Breathing :
Cooling :
Fluid type : Natural Ester
Fluid Volume :

Approved by:

Tyler Harris-Krull
Laboratory Manager

Insulating Fluid Evaluation

TJ | H2b ANALYTICAL SERVICES

Lee Madsen
Apparatus Testing & Engineering

11300 Sanders Drive Ste 29
Rancho Cordova, CA 95742

Location :	UCD-RAPTOR	Date :	03-19-2025
Bank & Phase :		Report Number :	1415667
Serial Number :	0852020790	P.O. Number :	S-25001
Manufacturer :	Cooper	kV Rating :	12.47
Equipment Type :	Transformer	Breathing :	
Model :		Cooling :	
Year of Mfg. :		Fluid type :	Natural Ester
		Fluid Volume :	

Sample Date :	3/6/2025
Laboratory Number :	1415667
Container Number :	S-103415
Temperature :	13
D1533 Moisture (ppm) :	49
D971 Interfacial Tension (mN/m) :	29.0
D974 Acid Number (mg KOH/g) :	0.04
D1500 Color Number (ASTM) :	<1.0
D1524 Visual Examination :	Clear w/ part.
D877 Dielectric BV (kV) :	
D1816 Dielectric BV (kV) :	24
D924 Power Factor (% at 25 C) :	0.221
D924 Power Factor (% at 100 C) :	
D2668 Oxidation Inhibitor (%) :	
D1298 Specific Gravity :	0.919
D445 Viscosity (SUS) :	
D97 Pour Point (C) :	
D92 Flash Point (C) :	
D92 Fire Point (C) :	
D1807 Refractive Index :	
D1275 Corrosive Sulfur :	

Insulating Fluid Diagnostics

	ASTM D6871	IEEE Group I	
Moisture :	200 max	Acceptable	35 max
Interfacial Tension :		Acceptable	24 min
Acid Number :		Acceptable	0.2 max
Color Number :	10. max		
Visual Examination :	clear & bright		
Dielectric BV D877 :		Acceptable	26 min
Dielectric BV D1816 :	20 min		23 min
Power Factor @ 25 C :	0.20 max		
Power Factor @ 100 C :	4.0 max		
Oxidation Inhibitor :			
Specific Gravity :	0.96 max		
Viscosity @ 40 C :	230 max		
Pour Point :	10 max		
Flash Point :	275 min		
Fire Point :	145 min		
Refractive Index :			
Corrosive Sulfur :	noncorrosive		

Comments :

Insulating Fluid Evaluation

TJ | H2b
ANALYTICAL SERVICES

Lee Madsen
Apparatus Testing & Engineering

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Location :	UCD-RAPTOR
Bank & Phase :	
Serial Number :	0852020790
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kV Rating :	12.47
Breathing :	
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Fluid type :	Natural Ester
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Approved by:

Tyler Harris-Krull
Laboratory Manager