Soil Resistivity Worksheet

Location	Spacing (Test Depth)				
	1.52 m(5 ft.)	3 m(10 ft.)	6.1 m(20 ft.)	9.1 m(30 ft.)	12.2 m(40 ft.)
Meter Readings (steps 2 through 5)					
1 of 5					
2 of 5					
3 of 5					
4 of 5					
5 of 5					
Soil Resistivity Calculations (step 10)					
$\rho = 191.5 \times A \times R$ ρ = soil resistivity in Ω-cm A = Distance between test rods (in feet) R = Resistance obtained from tester		OR	$\rho = 628 \times A \times R$ ρ = soil resistivity in Ω-cm A = Distance between test rods (in metres) R = Resistance obtained from tester		
1 of 5	ρ=	ρ=	ρ=	ρ=	ρ=
2 of 5	ρ=	ρ=	ρ=	ρ=	ρ=
3 of 5	ρ=	ρ=	ρ=	ρ=	ρ=
4 of 5	ρ=	ρ=	ρ=	ρ=	ρ=
5 of 5	ρ=	ρ=	ρ=	ρ=	ρ=
Test completed by:			**Notes:**		
Date:					
Client / Project:					
Site Location/ID:					
Ground Resistance Tester **Model:**_____ **S/N:**_____ **Calibration date:**_____					
Soil Description:					
Ambient Conditions **Temperature:**_____ **Present conditions (dry, rain, snow):**_____ **Date of last precipitation:**_____					

SITE NAME: _____

4 POINT WENNER METHOD
TESTING LAYOUT

- Test Direction 1
- Test Direction 2
- Test Direction 3
- Test Direction 4
- Test Direction 5

Technical Evaluation and Development Services, LLC
(T.E.D.S)
tsumners@tedswireless.com
(303) 903-6347

ORGANIZATION NAME
SITE NAME
State

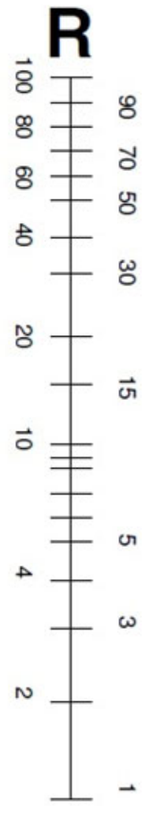
PROJECT NO:
DESIGN OFFICE:
DESIGNED BY: Ted Sumners
DRAWN BY: Ted Sumners
CHK'D BY:
APPROVED BY:
DATE: 03/07/2020

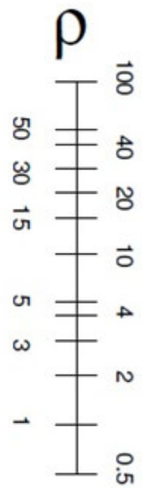
E1 - 1

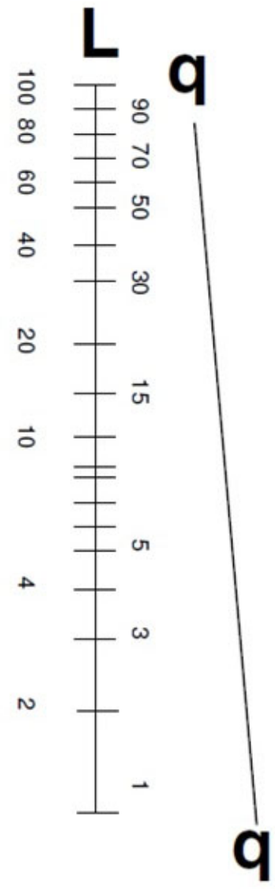
SITE NAME: _____

SOIL RESISTIVITY NOMOGRAPH

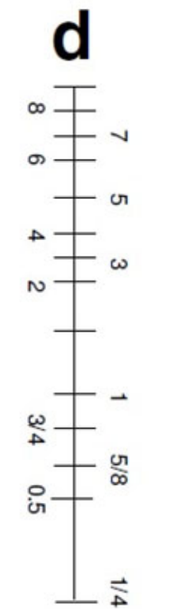
Single Electrode Ground Resistance (R)	Value From Worksheet p= (Ω-cm)	Depth of Grounding Electrode	Grounding Electrode Diameter
___Ω	_____ Ω-cm	___ feet	____- Inches

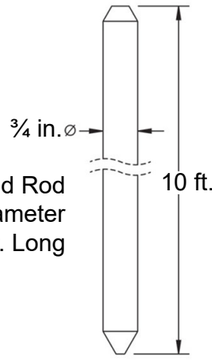






Typical 10 ft Ground Rod
in 30-in. Deep Trench =
12.5 ft.





Typical Ground Rod
¾ in. Diameter
10 ft. Long

Technical Evaluation and Development Services, LLC (T.E.D.S.)
tsumners@tedswireless.com
(303) 903-6347

ORGANIZATION NAME
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PROJECT NO:
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DESIGNED BY: Ted Sumners
DRAWN BY: Ted Sumners
CH'CD BY:
APPROVED BY:
DATE: 03/07/2020

MARK | DESCRIPTION | DATE | APPROVED

SITE NAME

GROUNDING ELECTRODE SYSTEM RESISTANCE

GROUNDING ELECTRODE SYSTEM DESIGN

Single Rod Ground Resistance (from Nomograph) = (R) 37 Ω

Depth of Ground Rods (from Nomograph) = (D) 20 ft.

Diameter of Ground Rods (from Nomograph) 3/4 in.

Ground Rod Qty (X) 8 ea.

Ground Rod Length <Rod Length> = (L) 10 ft.

Distance Between Rods (*d*) 20 ft.

Ground Rod Spacing (S) 2L

Combined Resistance Percentage = (Y)
Y = The point on the graph where X intersects L (Horizontal Line) 17 %

Combined Resistance of Proposed Grounding Electrode System = CR

(CR = R x Y)

37 Ω x 0.17 = 6.29 Ω

Instructions:

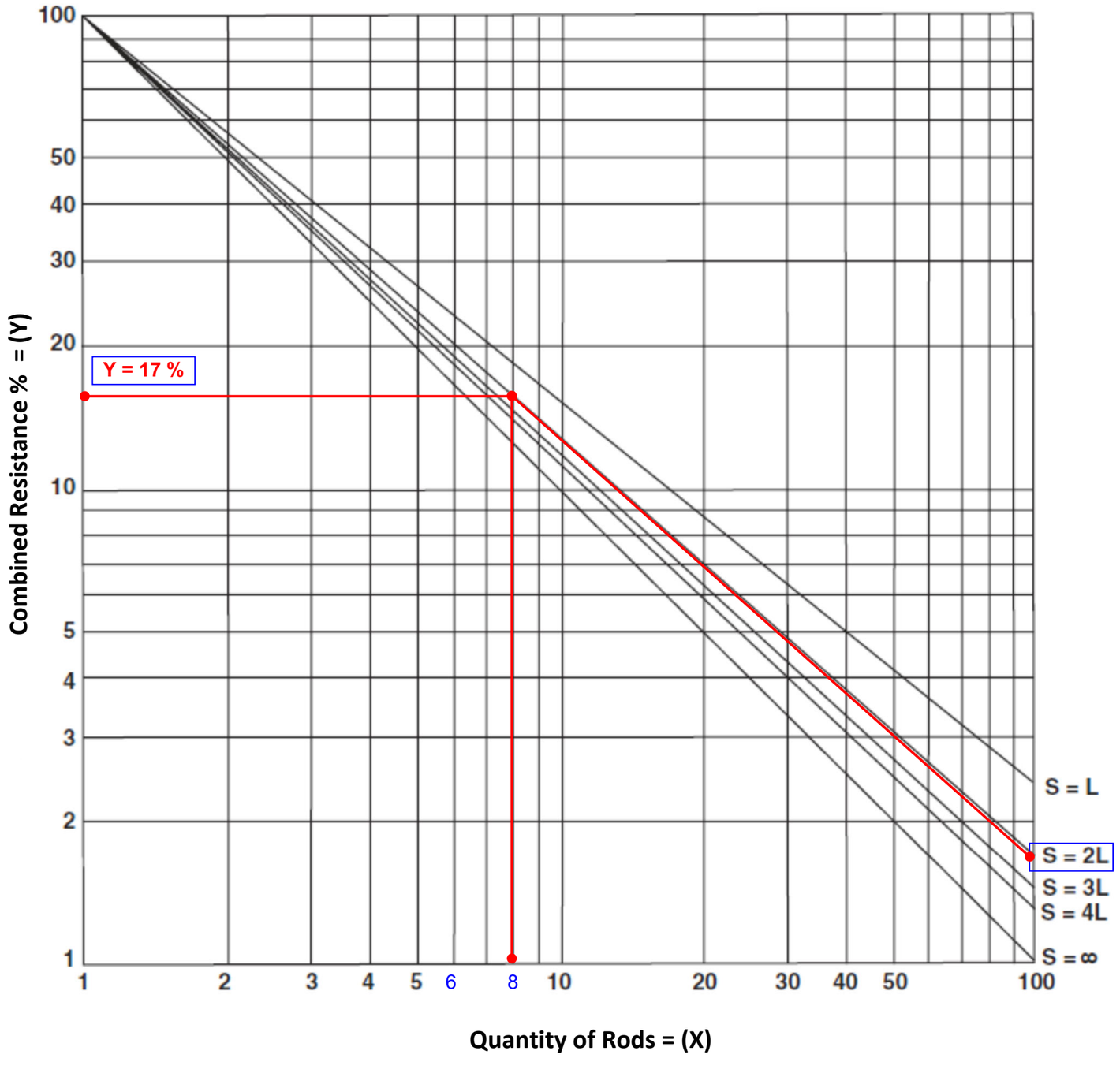
1) Draw a vertical line on **Number of Rods (X)** in graph.

2) Determine diagonal line for **Rod Spacing** (S) based on distance between rods by dividing the Distance between rods (d) by the rod length (L) <S = (*d* / L)> (1L) 1 rod length, (2L) 2 rod lengths (3L) 3 rod lengths (4L) 4 rod lengths

3) At the intersection of the vertical **Number of Rods (X)** line and the diagonal **Rod Spacing (S)** line, draw a horizontal line to the **Combined Resistance (CR)** axis at left.

Note: The point where the horizontal line crosses the **Combined Resistance (R)** axis is the **Percentage (Y)** to use in the calculations to determine the **Combined Resistance (CR)** resistance of the grounding electrode system.

4) Multiply the **Single Rod Ground Resistance (R)** times the **Combined Resistance Percentage (Y)** to obtain the **Combined Resistance (CR)** of the grounding electrode system.



Technical Evaluation and Development Services, LLC
(T.E.D.S)
tsummers@tedswireless.com
(303) 903-6347

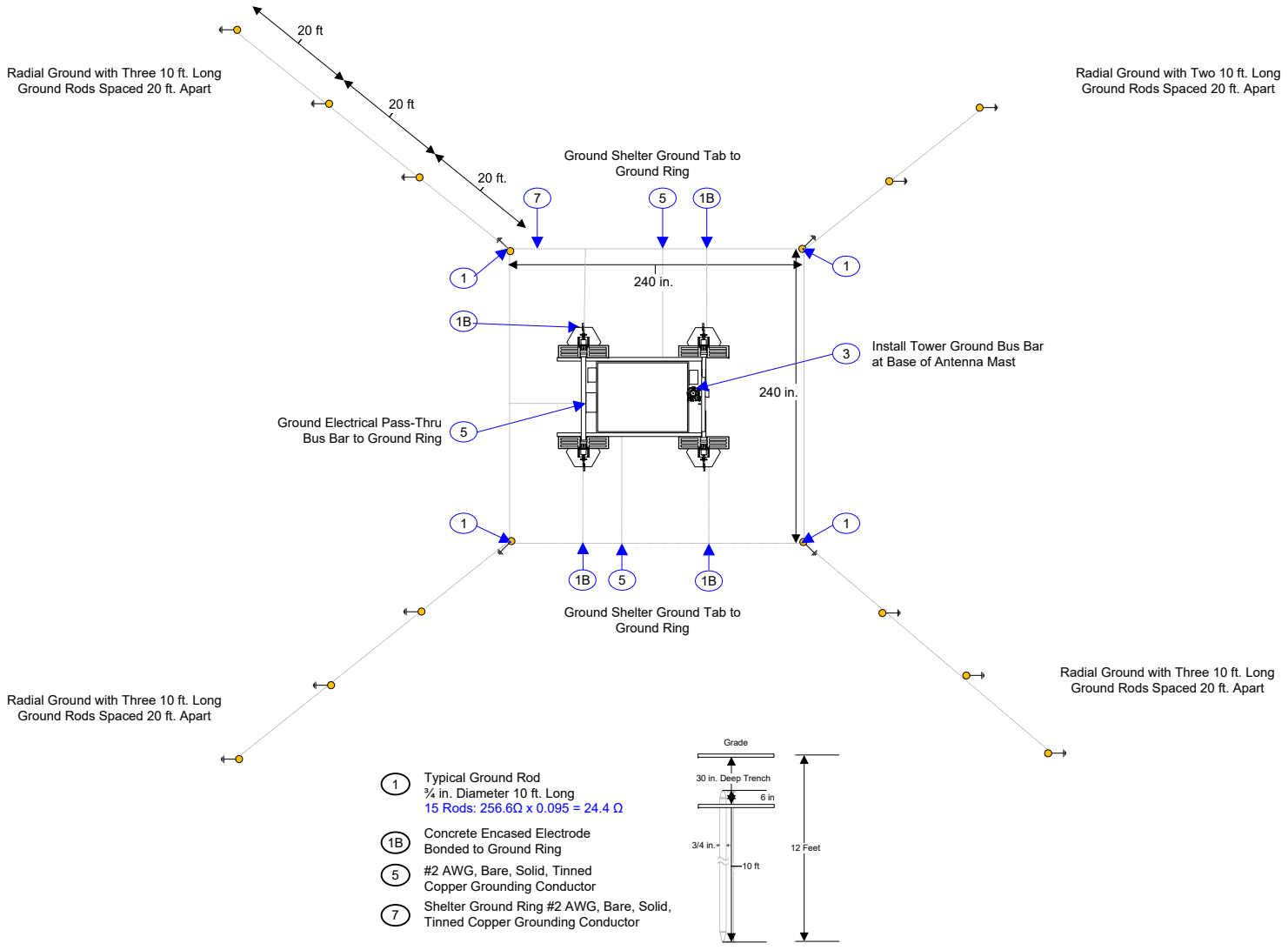
ORGANIZATION NAME
SITE NAME
State

PROJECT NO:
DESIGN OFFICE:
DESIGNED BY: Ted Summers
DRAWN BY: Ted Summers
CHK'D BY:
DATE: 03/07/2020

E1 - 3

SITE NAME

GROUNDING ELECTRODE SYSTEM DESIGN WITH RADIALS



1. Typical Ground Rod
   ¾ in. Diameter 10 ft. Long
   15 Rods: 256.6Ω x 0.095 = 24.4 Ω
- 1B Concrete Encased Electrode Bonded to Ground Ring
- 5 #2 AWG, Bare, Solid, Tinned Copper Grounding Conductor
- 7 Shelter Ground Ring #2 AWG, Bare, Solid, Tinned Copper Grounding Conductor

Technical Evaluation and Development Services, LLC (T.E.D.S)
tsumners@tedswireless.com
(303) 903-6347

ORGANIZATION NAME
SITE NAME
State

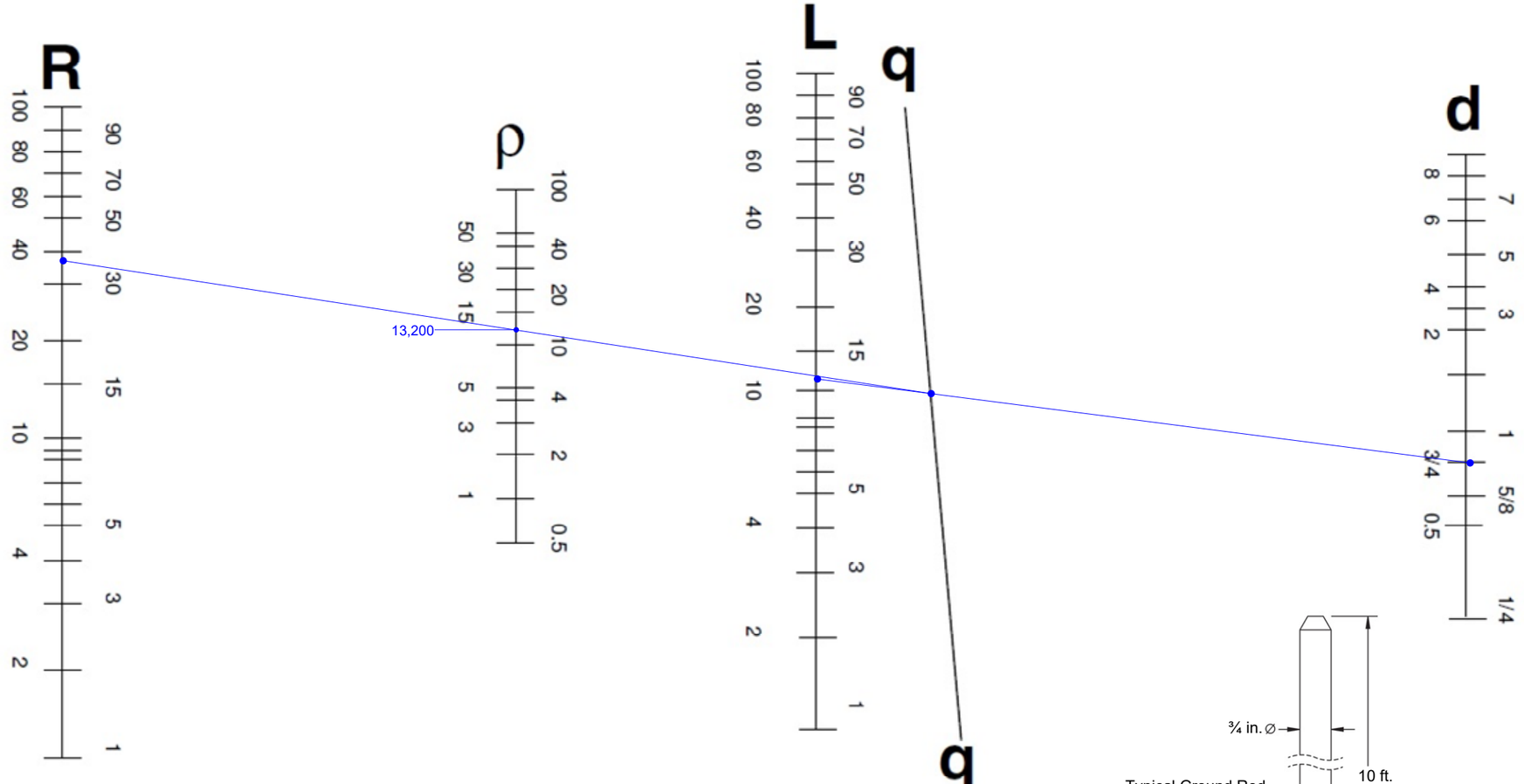
PROJECT NO:				
DESIGN OFFICE:				
DESIGNED BY:	Ted Sumners			
DRAWN BY:	Ted Sumners			
CHK'D BY:				
APPROVED BY:		MARK	DESCRIPTION	DATE
DATE:	03/07/2020			APPROVED

E3

NEWPORT RANGER STATION

SOIL RESISTIVITY NOMOGRAPH

Single Electrode Ground Resistance	Value From Worksheet ρ= (Ω-cm)	Depth of Grounding Electrode	Grounding Electrode Diameter
37 Ω	13,200 Ω-cm	12.5 feet	3/4"



Typical Ground Rod
¾ in. Diameter
10 ft. Long

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(T.E.D.S)
tsummers@tedswireless.com
(303) 903-6347

ORGANIZATION NAME
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DESIGNED BY:	Ted Summers			
DRAWN BY:	Ted Summers			
CHK'D BY:				
APPROVED BY:		MARK	DESCRIPTION	DATE
DATE:	03/07/2020			APPROVED

E1 - 2

NEWPORT RANGER STATION

GROUNDING ELECTRODE SYSTEM RESISTANCE

GROUNDING ELECTRODE SYSTEM DESIGN

Single Rod Ground Resistance (from Nomograph) = (R) 37 Ω

Depth of Ground Rods (from Nomograph) = (D) 20 ft.

Diameter of Ground Rods (from Nomograph) 3/4 in.

Ground Rod Qty (X) 8 ea.

Ground Rod Length <Rod Length> = (L) 10 ft.

Distance Between Rods (*d*) 20 ft.

Ground Rod Spacing (S) 2L

Combined Resistance Percentage = (Y)
Y = The point on the graph where X intersects L (Horizontal Line) 17 %

Combined Resistance of Proposed Grounding Electrode System = CR

(CR = R x Y)

37 Ω x 0.17 = 6.29 Ω

Instructions:

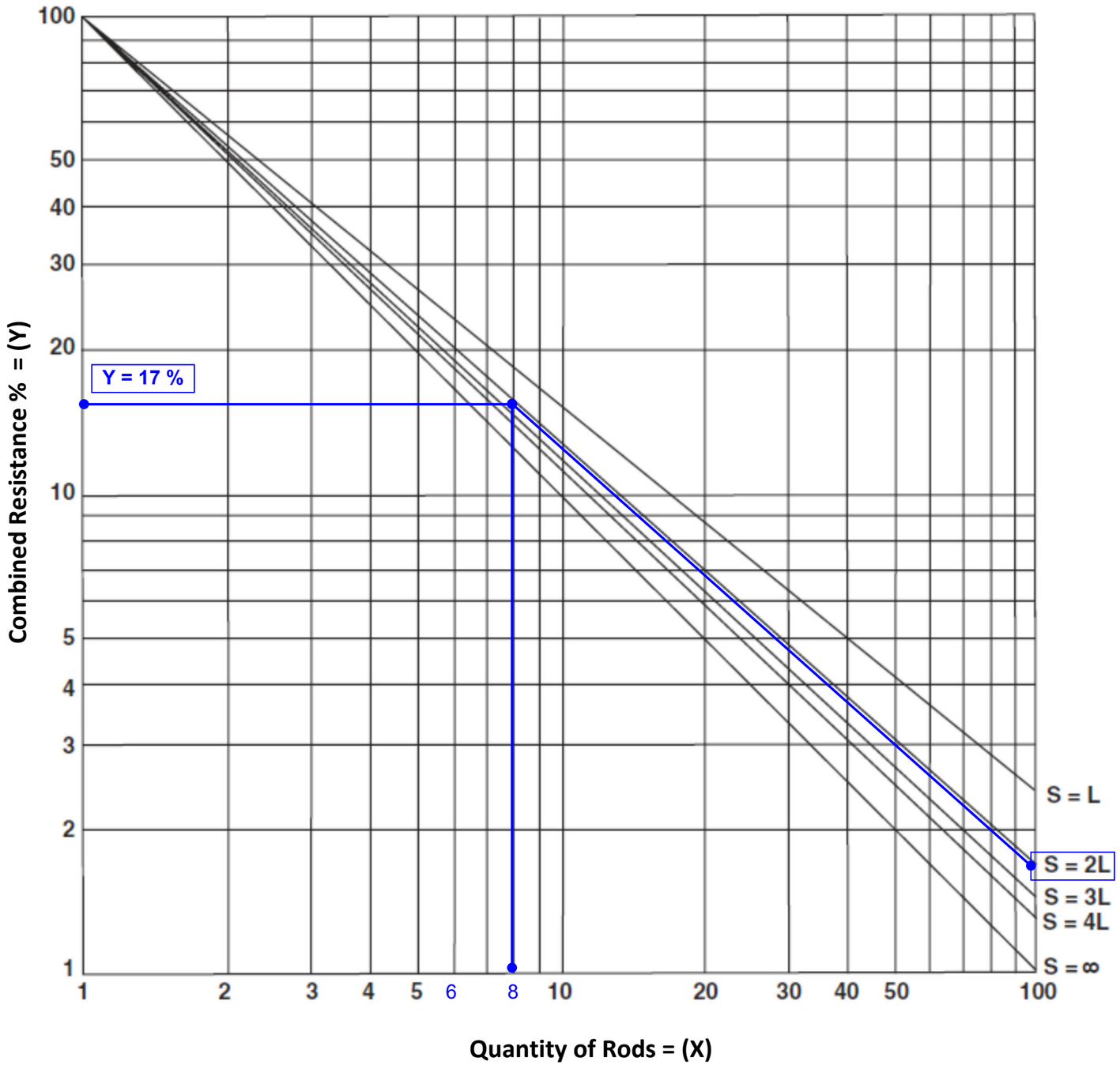
1) Draw a vertical line on **Number of Rods (X)** in graph.

2) Determine diagonal line for **Rod Spacing** (S) based on distance between rods by dividing the Distance between rods (d) by the rod length (L) <S = (*d* / L)>
(1L) 1 rod length, (2L) 2 rod lengths (3L) 3 rod lengths (4L) 4 rod lengths

3) At the intersection of the vertical **Number of Rods (X)** line and the diagonal **Rod Spacing (S)** line, draw a horizontal line to the **Combined Resistance (CR)** axis at left.

Note: The point where the horizontal line crosses the **Combined Resistance (R)** axis is the **Percentage (Y)** to use in the calculations to determine the **Combined Resistance (CR)** resistance of the grounding electrode system.

4) Multiply the **Single Rod Ground Resistance (R)** times the **Combined Resistance Percentage (Y)** to obtain the **Combined Resistance (CR)** of the grounding electrode system.



Technical Evaluation and Development Services, LLC
(T.E.D.S)
tsumners@tedswireless.com
(303) 903-6347

ORGANIZATION NAME
SITE NAME
State

PROJECT NO:
DESIGN OFFICE:
DESIGNED BY: Ted Sumners
DRAWN BY: Ted Sumners
CHK'D BY:
DATE: 03/07/2020

E1 - 3
SHEET 3 of 4

Fall-of-Potential Ground Resistance Field Report

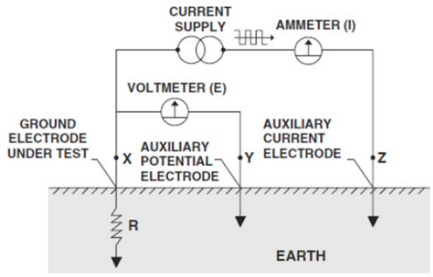
Date of Test: 09/15/2019

Radio Facility Name: Fox Mountain

Conditions: Dry, 52 Degrees

Facility Type: Remote Radio Facility

Resistance Requirement: 10 or 25 Ohms



Test Company: Technical Evaluation and Development Services (T.E.D.S. LLC)

Test Instrument Manufacterer: Extech

Tester Name: Ted Sumners

Test Instrument Model: GRT300

Calibration Date: 2/1/2019

Serial Number: 1804667

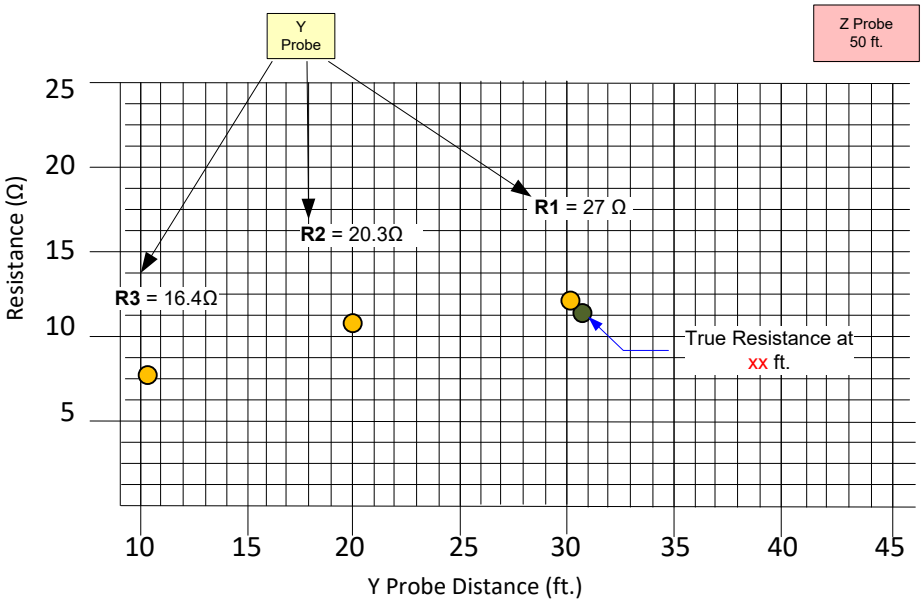
Test Configuration: Z- Probe set 60 ft. from grounding system

Test Procedure: **Slope Method (Intersecting Curves)**
Y-Probe moved in 20% increments to obtain values R_1, R_2 and R_3
Calculations made to obtain True Resistance Distance

TESTING RESULTS – PASSED or Failed at 27 Ohms

μ	D_P/D_c	μ	D_P/D_c	μ	D_P/D_c
0.40	0.643	0.83	0.575	1.26	0.477
0.41	0.642	0.84	0.573	1.27	0.474
0.42	0.640	0.85	0.571	1.28	0.471
0.43	0.639	0.86	0.569	1.29	0.468
0.44	0.637	0.87	0.567	1.30	0.465
0.45	0.636	0.88	0.566	1.31	0.462
0.46	0.635	0.89	0.564	1.32	0.458
0.47	0.633	0.90	0.562	1.33	0.455
0.48	0.632	0.91	0.560	1.34	0.452
0.49	0.630	0.92	0.558	1.35	0.448
0.50	0.629	0.93	0.556	1.36	0.445
0.51	0.627	0.94	0.554	1.37	0.441
0.52	0.626	0.95	0.552	1.38	0.438
0.53	0.624	0.96	0.550	1.39	0.434
0.54	0.623	0.97	0.548	1.40	0.431
0.55	0.621	0.98	0.546	1.41	0.427
0.56	0.620	0.99	0.544	1.42	0.423
0.57	0.618	1.00	0.542	1.43	0.418
0.58	0.617	1.01	0.539	1.44	0.414
0.59	0.615	1.02	0.537	1.45	0.410
0.60	0.614	1.03	0.535	1.46	0.406
0.61	0.612	1.04	0.533	1.47	0.401
0.62	0.610	1.05	0.531	1.48	0.397
0.63	0.609	1.06	0.528	1.49	0.393
0.64	0.607	1.07	0.526	1.50	0.389
0.65	0.606	1.08	0.524	1.51	0.384
0.66	0.604	1.09	0.522	1.52	0.379
0.67	0.602	1.10	0.519	1.53	0.374
0.68	0.601	1.11	0.517	1.54	0.369
0.69	0.599	1.12	0.514	1.55	0.364
0.70	0.597	1.13	0.512	1.56	0.358
0.71	0.596	1.14	0.509	1.57	0.352
0.72	0.594	1.15	0.507	1.58	0.347
0.73	0.592	1.16	0.504	1.59	0.341
0.74	0.591	1.17	0.502	1.60	0.338
0.75	0.589	1.18	0.499	1.61	0.335
0.76	0.587	1.19	0.497	1.62	0.331
0.77	0.585	1.20	0.494	1.63	0.328
0.78	0.584	1.21	0.491	1.64	0.325
0.79	0.582	1.22	0.488	1.65	0.322
0.80	0.580	1.23	0.486	1.66	0.319
0.81	0.579	1.24	0.483	1.67	0.316
0.82	0.577	1.25	0.480	1.68	0.313

Reading	Distance to Y Probe (ft.)	Measurment Ohms	R3 - R2 = u R2 - R1	D_P/D_c from Table	Distance to Z Probe (ft.) (DZ)	True Resistance Distance (ft.) = (u x DZ)	True Resistance (Ohms)
R_1	30	27					
R_2	20	20.3	0.58	0.617	50	31	27 Ohms
R_3	10	16.4					



Certification:
I certify the results depicted on this form regarding grounding system testing and resulting calculations to be accurate and true.

Name: Ted Sumners **Signature:** **Date:** 09/15/2019

Technical Evaluation and Development Services, LLC (T.E.D.S)
tsumners@tedswireless.com – (303) 903-6347