ENGINEERING
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STRUCTURAL CALCULATION

PROJECT No.
GS2100214
Fence Post and Solar Panel Support Post Analysis

OWNER / LOCATION:
Neff Rental
8455 Sierra College Blvd
Roseville, CA 95661

CLIENT:
Electric Guard Dog
121 Executive Center Dr, Suite 230
Columbia, SC 29210

ENGINEER:

DocuSigned by:
Nicholas Clay Jasper
CF2BB6F1CDEE4DF...
3/16/2015

SUMMARY:

This analysis is for poles for an Electric Fence.

Post size, post embedment depth, post hole diameter and backfill is given in the body of the calculation. The posts will be modeled as cantilevers that are fixed at the base.

REFERENCES:

1. 2013 Edition of the California Building Code

2. ASCE 7 - 10 Minimum Design Loads for Buildings and Other Structures
American Society of Civil Engineers

3. AISC 14th Edition

DESIGN INPUT VALUES:

Dimensions

$L_{post\_height} := 120$ in Height of fence

Design Loads for Building:

Occ_Category := "I"

Wind Design Values:

Fastest wind speed (3 second gust)

$V_{3\_wind} := 105$ MPH

Wind Exposure:

$E_{exposure} := "C"$

Footing and Post Hole Design Values:

$q_{soil} := 1500$ psf Assumed soil vertical bearing capacity

$S_{soil} := 150$ psf Assumed soil lateral bearing capacity

$d_{a\_footing} := 1.25$ ft post footing diameter

Concrete_backfill := "Yes" Backfill in main posts

(GO TO LAST PAGE FOR SUMMARY OF RESULTS)

Next, Check for compact, non-compact, or slender element section:

$WT_{ratio\_c1} := \frac{D_{c1}}{t_{c1}}$ $WT_{ratio\_c1} = 19.0$ Width-Thickness ratio

$NCS_{limit\_c1} := \frac{.11 \cdot E_{steel}}{F_{y\_c1}}$ $NCS_{limit\_c1} = 91.1$ non-compact section limit

$SL_{limit\_c1} := 4.71 \cdot \left(\frac{E_{steel}}{F_{y\_c1}}\right)^{.5}$ $SL_{limit\_c1} = 135.6$ Slenderness equation chooser limit (Equations E3-2, E-3, E7-2, E7-3)

Next Calculate Q:

$WT_{low\_limit\_c1} := \frac{.11 \cdot E_{steel}}{F_{y\_c1}}$ $WT_{low\_limit\_c1} = 91.1$

$WT_{high\_limit\_c1} := \frac{.45 \cdot E_{steel}}{F_{y\_c1}}$ $WT_{high\_limit\_c1} = 372.9$

$Q_{c1} := \frac{.038 \cdot E_{steel}}{\frac{F_{y\_c1} \cdot (D_{c1})}{t_{c1}}} + \frac{2}{3}$ $Q_{c1} = 2.32$

$Q_{c1} := if\left(WT_{ratio\_c1} \le WT_{high\_limit\_c1}, Q_{c1}, 1\right)$

$Q_{c1} := if\left(WT_{low\_limit\_c1} \le WT_{ratio\_c1}, Q_{c1}, 1\right)$

$Q_{c1} := if\left(Q_{c1} \le 1, Q_{c1}, 1\right)$

$Q_{c1} := if\left(WT_{ratio\_c1} \le NCS_{limit\_c1}, 1, Q_{c1}\right)$

$Q_{c1} = 1.000$

Note: Use this Q if the Width-thickness ratio is between high and low limits calculated above. Otherwise use Q=1.0 Also, Q cannot be greater than 1.0 because it is considered a reduction factor.

Note: If column is not a slender element section, then Q = 1.

Next, determine allowed critical axial load.

$$F_{e\_c} := 3.1416^2 \cdot \frac{E_{steel}}{S_{slenderness\_c}^{\,2}} \qquad F_{e\_c} = 10.27$$

$$F_{cr\_a\_c} := Q_c \cdot \left(.658^{\frac{Q_c \cdot F_{y\_c}}{F_{e\_c}}} \right) \cdot F_{y\_c} \qquad F_{cr\_a\_c} = 8.41 \text{ ksi}$$

$$F_{cr\_b\_c} := .877 \cdot F_{e\_c} \qquad F_{cr\_b\_c} = 9.01 \text{ ksi}$$

$F_{cr\_c} = 9.01$ ksi (allowable compression stress)

$$P_{a\_c} := \frac{F_{cr\_c} \cdot A_c}{1.67}$$ Equation E3-1, E7-1 (ASD)

$P_{a\_c} = 17.1$ kips Allowed axial load

Next, Determine Allowable Bending load:

Determine h/t and check for compact, non-compact, or slender element section: (flexure)

$WT_{f\_ratio\_c} = 19.0$ Width-Thickness ratio

$$CS_{fl\_limit\_c} := .07 \cdot \left(\frac{E_{steel}}{F_{y\_c}} \right) \qquad CS_{fl\_limit\_c} = 58.0$$ compact section limit

$$NCS_{fl\_limit\_c} := .31 \cdot \left(\frac{E_{steel}}{F_{y\_c}} \right) \qquad NCS_{fl\_limit\_c} = 256.9$$ non-compact section limit

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First, Determine allowable moment based on Yielding (a):

$M_{ex\_ct} := Z_{x\_ct} \cdot F_{y\_ct}$ $M_{ex\_ct} = 150.90$ kip-in Allowable moment based on yielding

Next, Determine allowable moment for non-compact sections (b):

$M_{nc\_ct} := .021 \cdot \frac{E_{steel}}{WT_{c\_ratio\_ct}} - F_{y\_ct} \cdot S_{x\_ct}$

$M_{nc\_ct} = 215.61$ kip-in Allowable moment for non-compact sections

Next, Determine allowable moment for slender element sections (c):

$M_{se\_ct} := \left(\frac{.33E_{steel}}{WT_{c\_ratio\_ct}}\right) \cdot S_{x\_ct}$

$M_{se\_ct} = 1620.17$ kip-in Allowable moment for slender element sections

Note, Based on the values of the three calculations above, the allowable moment is:

$M_{a\_ct} = 150.90$ kip-in Allowable flexural moment

Next, check combined bending and axial load stresses:

$M_{ex\_ct} := \frac{M_{a\_ct}}{1.67}$ $M_{ex\_ct} = 90.36$ kip-in Available flexural moment (ASD)

$P_{n\_ct} = 17.1$ kips Allowed axial load (from above)

Determine Applied Axial Loads:

$P_{dead\_ct} := .500$ $P_{dead\_ct} = 0.5$ kips Applied axial dead load

Next, Check all load cases that may control (ASD):

$$Col\_usage_{ct} := \frac{P_{dead\_ct}}{P_{n\_ct}} + \left[\frac{\left[\left(M_{f\_wind\_ct} + M_{wire\_tension\_D!}\right)^2 + M_{wire\_tension\_D!}^2\right]^{.5}}{M_{ex\_ct}}\right]^2$$

$Col\_usage_{ct} = 0.23$ Combined usage of column (Worst Load Case condition). Note: Less than 1.00, thus OK

EMBEDMENT FOR Primary Electric Fence Posts::

Calculate the minimum required post embedment depth for lateral loading.

Concrete_backfill = "Yes"

$V_g = 672$ lbf Lateral shear load at the groundline

$M_{gl} = 25279$ in-lb Moment at the groundline (based on combined wind and dead loads)

$d_{in\_post\_dg} = 1.25$ ft Main post footing diameter

$S_{soil} = 150$ psf Lateral capacity of soil

$H_{post} := \frac{L_{post\_grade}}{12 \cdot 2}$ $H_{post} = 5$ ft Height at which an equivalent lateral load is applied to determine required footing depth.

$d_{depth\_trial} = 4.5$ ft Trial depth of post hole to determine final required embedment depth.

$S_{1\_dg} := \frac{2 S_{soil} \cdot d_{depth\_postmc}}{3} \cdot 1.33$ $S_{1\_dg} = 609$

$A := 2.34 \cdot \frac{P_{post}}{(S_{1\_dg}) \cdot b_{post}}$ $A = 2.06$

$$d_{depth\_lowerpost} := 0.5 \cdot A \cdot \left[1 + \left[1 + \left(\frac{4.36 \cdot H_{post}}{A}\right)^{0.5}\right]\right]$$

The final post hole depth is determined by iterating to a final depth.

$d_{depth\_lowerpost} = 4.5$ ft. This is the minimum required post embedment depth for lateral loading

Next, Check the poles for an Electric Fence Control / Solar Panel Support.

$d_{ft\_footing} :=$ 1 ft post footing diameter

$L_{post\_bndg} :=$ 108 in Height of support

$q_{h\_ult} =$ 20.8 psf Velocity Pressure

Calculate the moment induced by the control boxes and the solar panels.

$W_{ind\_solar} :=$ 4.7 s^f $W_{ind\_BCP} :=$ 3 s^f

$W_{ind\_solar} =$ 95.84 lbs $W_{ind\_BCP} =$ 61.18 lbs

NOTE: The center of area of the solar panel will be at 121"
The center of area of the lowest control box will be 36"
The center of area of the middle control box will be 52"
The center of area of the top control box will be 68"

$$M_{tot} := \frac{W_{ind\_solar} \cdot 121 + W_{ind\_BCP} \cdot 36 + W_{ind\_BCP} \cdot 52 + W_{ind\_BCP} \cdot 68}{1000}$$

$M_{tot} =$ 21.14 kip - inches

NOTE : Use 3" diameter RMT galvanized conduit This section can be shown to have a section modulus of 2.3 in3 (S) and an allowable yield stress of 50 ksi.

Determine fiber stress:

$$f_b := \frac{M_{tot}}{2.3} \qquad f_b = 9.19 \text{ ksi} < 50 \text{ ksi} \quad \text{OK}$$

Check slenderness:

$k_{cl} :=$ 2.1 $r :=$ 1.16 in $L_{unsupported} := L_{post\_bndg}$ $L_{unsupported} =$ 108 in

$$S_{slenderness\_ck} := k_{cl} \cdot \frac{L_{unsupported}}{r} \qquad S_{slenderness\_ck} = 196 \text{ Slenderness ratio}$$

Note: Slenderness ratio is less than 200, thus OK

Footing Calculation For Electric Fence Control / Solar Panel Support Post:

Calculate the required footing depth

NOTE: Determine the point load required to produce a equal moment - see above

$$P_{post} := \frac{q_p \cdot 1000}{\frac{L_{post\_bw\_2}}{2}} \qquad P_{post} = 378 \text{ lbs} \qquad H_{post} := \frac{L_{post\_bw\_2}}{2 \cdot 2} \qquad H_{post} = 3.5 \text{ ft}$$

$S_{soil} = 150$ psf Assumed soil lateral bearing capacity

$b_{post} = 1$ ft

$d_{depth\_post} = 3.9$ ft Trial depth of post hole to determine final required embedment depth.

$$S_{1\_ag} := \frac{2 S_{soil} \cdot d_{depth\_post}}{3} \cdot 1.33 \qquad S_{1\_ag} = 518.7$$

$$A := 2.34 \cdot \frac{P_{post}}{(S_{1\_ag}) \cdot b_{post}} \qquad A = 1.7$$

$$d_{depth\_post} := 0.5 \cdot A \cdot \left[1 + \left[1 + \left(\frac{4.36 \cdot H_{post}}{A}\right)^{0.5}\right]\right]$$

$d_{depth\_post} = 3.9$ This is the minimum required post embedment depth calculated for lateral loading

NOTE: Use 5' - 6" embedment

THE END

MET Laboratories, Inc. Safety Certifications - EMI - Telecom - Environmental Simulation - NRTL/NVLAP
901 Sheldon Drive · Cary, North Carolina 27513 · Ph: (919) 481-9319 or (800) 321-4655· Fax: (919) 481-6716

Mr. Michael Pate
Electric Guard Dog
7608 Fairfield Rd.
Columbia, SC 29203

June 2, 2014

Reference:	Job Number SAFN7634
Initial Review Date:	March 3, 2014
Final Review Date:	March 4, 2014
Final Inspection Facility Name:	Electric Guard Dog
Final Inspection Facility Address:	7608 Fairfield Road, Columbia, SC 29203

Dear Mr. Pate,

We have completed our referenced field inspection in accordance with our Field Labeling program. The inspection included 70 total pieces of equipment (units) as noted on pages 2 through 6.

The equipment was evaluated in accordance with the applicable sections of the National Electrical Code (NEC), the Recommended Practice and Procedures for Unlabeled Electrical Equipment Evaluation (NFPA791), and the IEC Standard as noted with each piece of equipment (units) on pages 2 through 6.

This test report contains only findings and results regarding the indicated equipment when it is installed per the IEC guidelines and manufacturer's instructions. Any modifications other than normal maintenance items will require re-inspection before being placed back into service. This equipment was evaluated as extensively as possible in the field with respect to electrical fire and electrical shock hazards only.

This completes the work anticipated under our Field-Labeling program. If you should have any questions, please do not hesitate to contact us.

Sincerely,

Mr. Tim Douthit
Sr. Project Engineer
MET Southeast

Reviewed By,

Brad Collison
Managing Engineer
MET Southeast

	Unit 1	Unit 2	Unit 3
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF170	EF170	EF170
Serial #	S0377	S0379	S0375
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 1 Zone – 2J	12VDC, 1 Zone – 2J	12VDC, 1 Zone – 2J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186501	186502	186503

	Unit 4	Unit 5	Unit 6
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF170	EF170	EF170
Serial #	S0381	S0385	S0384
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 1 Zone – 2J	12VDC, 1 Zone – 2J	12VDC, 1 Zone – 2J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186504	186505	186506

	Unit 7	Unit 8	Unit 9
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF170	EF170	EF170
Serial #	S0382	S0378	S0380
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 1 Zone – 2J	12VDC, 1 Zone – 2J	12VDC, 1 Zone – 2J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186507	186508	186509

	Unit 10	Unit 11	Unit 12
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF170	EF170	EF170
Serial #	S0376	S0374	S0383
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 1 Zone – 2J	12VDC, 1 Zone – 2J	12VDC, 1 Zone – 2J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186510	186511	186512

	Unit 13	Unit 14	Unit 15
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF170	EF170	EF171
Serial #	S0387	S0386	S0401
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 1 Zone – 2J	12VDC, 1 Zone – 2J	12VDC, 1 Zone – 5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186513	186514	186515

	Unit 16	Unit 17	Unit 18
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF171	EF171	EF171
Serial #	S0400	S0395	S0388
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 1 Zone – 5J	12VDC, 1 Zone – 5J	12VDC, 1 Zone – 5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186516	186517	186518

	Unit 19	Unit 20	Unit 21
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF171	EF171	EF171
Serial #	S0393	S0396	S0399
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 1 Zone – 5J	12VDC, 1 Zone – 5J	12VDC, 1 Zone – 5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186519	186520	186521

	Unit 22	Unit 23	Unit 24
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF171	EF171	EF171
Serial #	S0397	S0402	S0392
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 1 Zone – 5J	12VDC, 1 Zone – 5J	12VDC, 1 Zone – 5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186522	186523	186524

	Unit 25	Unit 26	Unit 27
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF171	EF171	EF171
Serial #	S0391	S0390	S0389
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 1 Zone – 5J	12VDC, 1 Zone – 5J	12VDC, 1 Zone – 5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186525	186526	186527

	Unit 28	Unit 29	Unit 30
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF171	EF172	EF172
Serial #	S0398	S0411	S0403
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 1 Zone – 5J	12VDC, 2 Zones – 2J	12VDC, 2 Zones – 2J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186528	186529	186530

	Unit 31	Unit 32	Unit 33
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF172	EF172	EF172
Serial #	S0410	S0406	S0405
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 2J	12VDC, 2 Zones – 2J	12VDC, 2 Zones – 2J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186531	186532	186533

	Unit 34	Unit 35	Unit 36
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF172	EF172	EF172
Serial #	S0407	S0409	S0404
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 2J	12VDC, 2 Zones – 2J	12VDC, 2 Zones – 2J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186534	186535	186536

	Unit 37	Unit 38	Unit 39
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF172	EF172	EF172
Serial #	S0408	S0751	S0750
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 2J	12VDC, 2 Zones – 2J	12VDC, 2 Zones – 2J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186537	186538	186539

	Unit 40	Unit 41	Unit 42
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF172	EF172	EF173
Serial #	S0749	S0778	S0419
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 2J	12VDC, 2 Zones – 2J	12VDC, 2 Zones – 5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186540	186541	186542

	Unit 43	Unit 44	Unit 45
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF173	EF173	EF173
Serial #	S0414	S0415	S0422
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 5J	12VDC, 2 Zones – 5J	12VDC, 2 Zones – 5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186543	186544	186545

	Unit 46	Unit 47	Unit 48
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF173	EF173	EF173
Serial #	S0779	S0758	S0420
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 5J	12VDC, 2 Zones – 5J	12VDC, 2 Zones – 5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186546	186547	186548

	Unit 49	Unit 50	Unit 51
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF173	EF173	EF173
Serial #	S0413	S0757	S0418
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 5J	12VDC, 2 Zones – 5J	12VDC, 2 Zones – 5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186549	186550	186551

	Unit 52	Unit 53	Unit 54
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF173	EF173	EF174
Serial #	S0417	S0421	S0431
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 5J	12VDC, 2 Zones – 5J	12VDC, 2 Zones – 2/5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186552	186553	186554

	Unit 55	Unit 56	Unit 57
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF174	EF174	EF174
Serial #	S0425	S0426	S0423
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 2/5J	12VDC, 2 Zones – 2/5J	12VDC, 2 Zones – 2/5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186555	186556	186557

	Unit 58	Unit 59	Unit 60
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF174	EF174	EF174
Serial #	S0429	S0430	S0792
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 2/5J	12VDC, 2 Zones – 2/5J	12VDC, 2 Zones – 2/5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186558	186559	186560

	Unit 61	Unit 62	Unit 63
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF174	EF174	EF174
Serial #	S0794	S0791	S0790
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 2/5J	12VDC, 2 Zones – 2/5J	12VDC, 2 Zones – 2/5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186561	186562	186563

	Unit 64	Unit 65	Unit 66
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF174	EF174	EF174
Serial #	S0793	S0795	S0427
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 2/5J	12VDC, 2 Zones – 2/5J	12VDC, 2 Zones – 2/5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186564	186565	186566

	Unit 67	Unit 68	Unit 69
Description	Electric Fence Controller	Electric Fence Controller	Electric Fence Controller
Model	EF174	EF174	EF175
Serial #	S0432	S0424	S0772
Manufacturer	Advanced Perimeter Systems	Advanced Perimeter Systems	Advanced Perimeter Systems
Ratings	12VDC, 2 Zones – 2/5J	12VDC, 2 Zones – 2/5J	12VDC, 3 Zones – 5J
Standard(s)	IEC 60335-2-76	IEC 60335-2-76	IEC 60335-2-76
Field Label #	186567	186568	186569

	Unit 70
Description	Electric Fence Controller
Model	EF177
Serial #	S0774
Manufacturer	Advanced Perimeter Systems
Ratings	12VDC, 3 Zones – 2J
Standard(s)	IEC 60335-2-76
Field Label #	186570

Equipment Evaluation

General Product Ratings (as tested)

		EF170	EF171	EF172	EF172	EF173	EF173	EF174	EF174
Total Energy	A^2ms	3.74	4.73	3.75	3.72	4.54	4.47	4.55	3.81
95% Energy Duration	µs	53	53	53	53	55	54	53	53
Irms	A	8.22	9.17	8.20	8.18	8.86	8.83	9.00	8.24
IEC Standard Irms	A	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7
Impulse repetition rate (IRR)	Hz	0.82	0.82	0.82	0.82	0.81	0.81	0.82	0.82
IEC Standard IRR	Hz	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Energy/Impulse	J	1.90	2.40	1.90	1.89	2.30	2.27	2.31	1.93
IEC Standard Energy/Impulse	J	5	5	5	5	5	5	5	5
Pass IEC Standard	Yes/No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

ENCLOSURE

- The enclosures for the battery and solar panel connections are constructed of galvanized steel.
- The enclosure for the Advance Permiter Systems Controller is contained in a minimum 3R rated polymeric enclosure.
- Knockouts are provided for the enclosure (High Voltage Fence Wiring & Control Wiring). These wires are not to be contained in the same raceway.
- All enclosures are provided with a lock to protect unintentional contact with electrically live parts.
- All enclosures are intended to be mounted vertically with their provided mounting holes.
- A disconnect switch is not provided within the control enclosure, since the power source (12VDC battery) is contained within a separate enclosure.

CONDUCTORS

- All internal control wiring is NRTL Listed cable rated at 18AWG with 2, 8 or 10 conductors.
- The insulation rating of these conductors is 300V.
- All internal control wiring is separated from the high voltage fence wiring and is contained in a separate raceway.
- The high voltage fence wiring is rated at #14 19/27 tinned copper, dielectric strength of 15kV, insulation resistance of 2.5kV, and spark voltage of 15kV.

CONNECTORS

- All internal connections are made via NRTL Listed wire terminals secured to a NRTL certified terminal blocks.
- A installation drawing with a terminal block diagram of connection means is provided with the enclosure.

POWER SOURCE

- All units are intended for connection only to a 12VDC supply source.
- These units are not rated for connection to mains or line voltage source.
- The 12VDC source is in the form of a lead acid battery. Normally a photovoltaic cell is provided to charge the battery.

MARKINGS

- The fence charger enclosure was supplied with the following permanent markings.

1. Manufacturers Identification, Model Number, Serial Number and Ratings located inside the enclosure.
2. WARNING – DO NOT CONNECT TO MAINS located on the front door/cover.
3. DO NOT RUN FENCE AND CONTROL WIRING IN SAME RACEWAY located inside the enclosure.
4. 12VDC POWER SOURCE ONLY located inside the enclosure.

FENCE INSTALLATION REQUIREMENTS

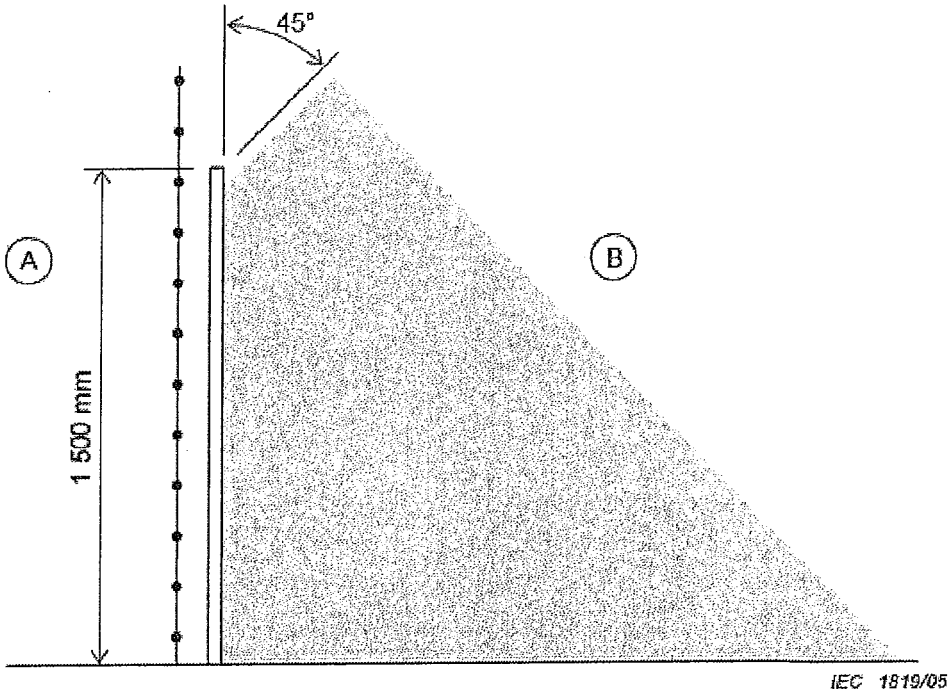
- Final approval and acceptance of all electric fence installations is up to the local AHJ (Authority Having Jurisdiction).
- All electric fences must only be installed by qualified and trained personnel.
- All electric fences must be installed in accordance with the National Electrical Code (NEC) as well as any other applicable federal, state or local requirements.
- All electric fences must have a physical barrier installed to prevent public access. The electric fences shall be installed in accordance with the following requirements from Annex CC from IEC 60335-2-76 and the manufacturers installation instructions:

CC.3 Prohibited zone for pulsed conductors

Pulsed conductors shall not be installed within the shaded zone shown in Figure CC1.

NOTE 1 Where an **electric security fence** is planned to run close to a site boundary, the relevant government authority should be consulted before installation begins.

NOTE 2 Typical **electric security fence** installations are shown in Figure CC2 and Figure CC3.



Key

A = **Secure area**

B = **Public access area**

Physical barrier

Prohibited area

Electric security fence

Figure CC.1 – Prohibited area for pulse conductors

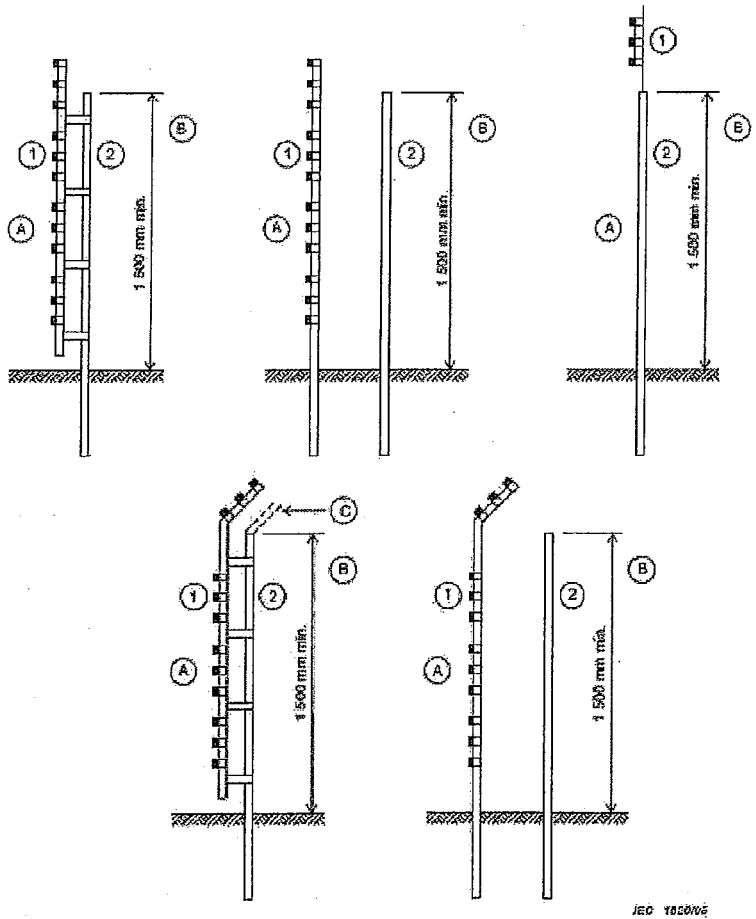
CC.4 Separation between electric fence and physical barrier

Where a **physical barrier** is installed in compliance with CC.3 at least one dimension in any opening should be not greater than 130 mm and the separation between the **electric fence** and the **physical barrier** should be

- within the range of 100 mm to 200 mm or greater than 1 000 mm where at least one dimension in each opening in the **physical barrier** is not greater than 130 mm;
- greater than 1 000 mm where any opening in the **physical barrier** has all dimensions greater than 50 mm;
- less than 200 mm or greater than 1 000 mm where the **physical barrier** does not have any openings.

NOTE 1 These restrictions are intended to reduce the possibility of persons making inadvertent contact with the **pulsed conductors** and to prevent them from becoming wedged between the **electric fence** and the **physical barrier**, thereby being exposed to multiple shocks from the **energizer**.

NOTE 2 The separation is the perpendicular distance between the **electric fence** and the physical barrier.

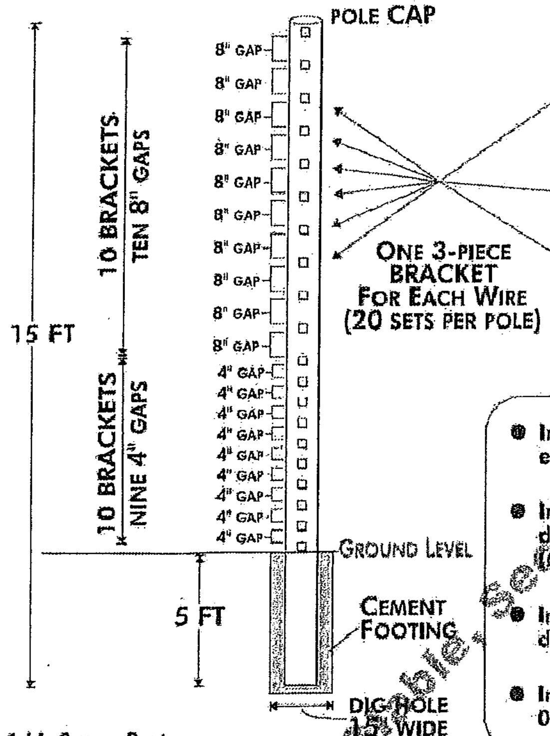


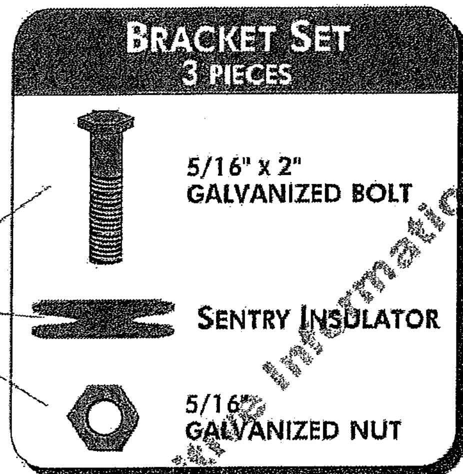
Key
A = Secure area
B = Public access area
C = Barrier where required
1 = Electric security fence
2 = Physical barrier

Figure CC.2 – Typical constructions where an electric security fence is exposed to the public

5C

INSTALLING A STEEL POLE





- Install brackets FACING the direction of pull, except when used as an End Pole.
- Install END POLE brackets FACING the direction of chain link Gate Pole (6" maximum from Gate Pole).
- Install ROLL GATE brackets FACING the direction of pull.
- Install CORNER POLE EYES 0-8" from Chain Linke Pole at 90° diagonally.

INSTALLATION 1.1

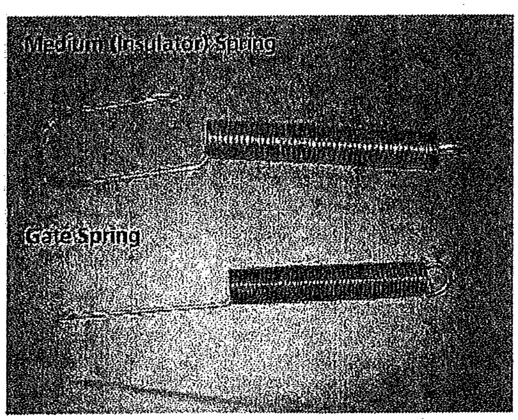
1.1A Corner Post
If the metal poles are scratched, paint them, especially in the front or by gates.

1.1B Corner Post
Bolts on bottom of insulators should be tight and insulators must be able to spin, freely acting as a pulley.

1.1C Corner Post
Install metal poles in MIDDLE of hole vs front or back of hole with concrete. Fill in hole with concrete to ground level.

1.1D Corner Post
The #2 wire must be hot in every section. The #1 wire must be flat on the ground.

1.1E Corner Post
Medium springs are required on both ends of every section over 250 feet.



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1.2B Steel poles
The steel pole has to be set in the correct place. There should be no more than 6 inches from the insulators on a steel pole beside the gate, and the fiberglass pole that is mounted on the gate. If the steel pole cannot be set close enough to the gate pole or against a building, due to concrete footers, etc., causing a potential breach of security, attach a fiberglass pole to the building or gate post to close any gaps.

1.2C Steel poles
Steel posts should be installed with a slight back lean, depending on the soil condition, so that after the fence settles and the concrete dries, the poles will not lean into the yard. Poles should be set 5 ft deep with a 15" hole minimum. Unstable soil conditions will require a better foundation.

1.2D Double Poles
Every site regardless of size must have break down points for troubleshooting. No section can be longer that 1,000 feet without a double bracket pole for a break down spot.

1.2E Double Poles Cut off switches- are installed on the double bracketed pole and to bypass or isolate a section of fence.

1.2F Short Sections
A section of fence line that start and stops with footage of less than 251'. This section will have jumpers on each side, such as a section between two gates or a gate and a building or a roof section under 250ft. Short sections require springs on one end unless there is a 90 degree turn, in that case add a set of gate springs to the other end.

FIBERGLASS POLES RAPID TIGHTENERS & WARNING SIGNS

RAPID TIGHTENERS

RAPID TIGHTENERS ARE INSTALLED IN EVERY SECTION – BETWEEN 6 INCHES AND 3 FEET FROM A FIBERGLASS POLE – TOWARD THE CENTER OF THE PULL.

THE TIGHTENERS ARE ALTERNATED ON OPPOSITE SIDES OF THE POLE TO PREVENT GROUNDS FROM HITTING HOTS.

WIRE SHOULD BE WRAPPED TWO OR THREE TIMES AROUND EACH TIGHTENER.

WARNING SIGNS

WARNING SIGNS MUST BE INSTALLED EVERY 60 FEET, WHICH IS THE MAXIMUM DISTANCE BETWEEN WARNING SIGNS.

THE EXTERNALLY VISIBLE LANGUAGE SHOULD BE ALTERNATED, SO THAT EVERY SIGN SHOWING THE ENGLISH SIDE IS FOLLOWED BY ONE SHOWING THE SPANISH SIDE TO PEOPLE SITUATED OUTSIDE THE FENCE.

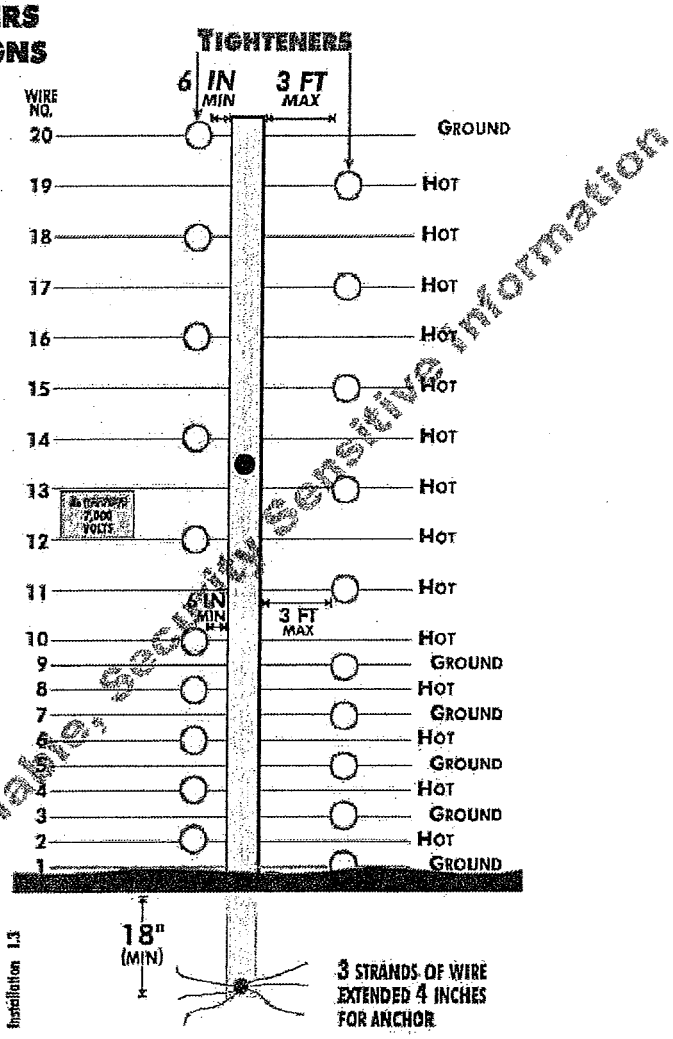
ALL WARNING SIGNS SHOULD BE MOUNTED BETWEEN WIRES 12 & 13.

FIBERGLASS POLES

FIBERGLASS POLES ARE SET AT A MAXIMUM OF 30-FOOT INTERVALS.

THEY ARE ALWAYS PLACED DIRECTLY IN FRONT OF A PERIMETER POST SO THEY CAN BE BRACED TO THE PERIMETER POST, IF NECESSARY.

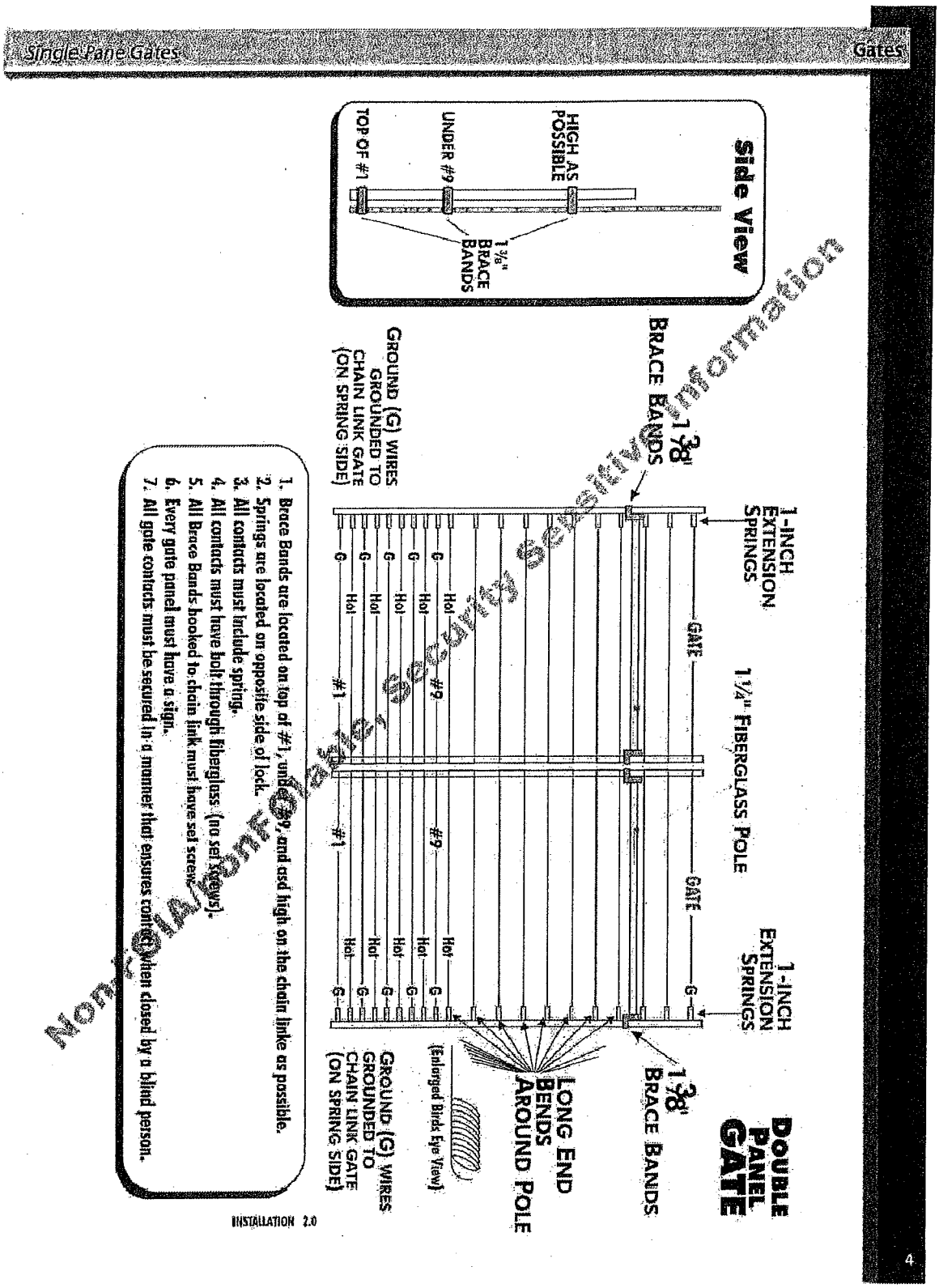
THE BOTTOM WIRE SHOULD BE FLAT ON THE GROUND.



1.3A Fiberglass line post
Fiberglass straight line. Install metal poles, pull bottom wire, then install fiber right behind line so fiber are in a straight line.

1.3B Fiberglass line post
Install rapid tightners in a safe, flat easily accessable area.

1.3C Fiberglass line post
Pins installed in the fiberglass poles need to have the end facing into the yard, level with the ground.



2.A Gates
Use splices on jumpers on gates, all other jumpers use joint clamps not splices.

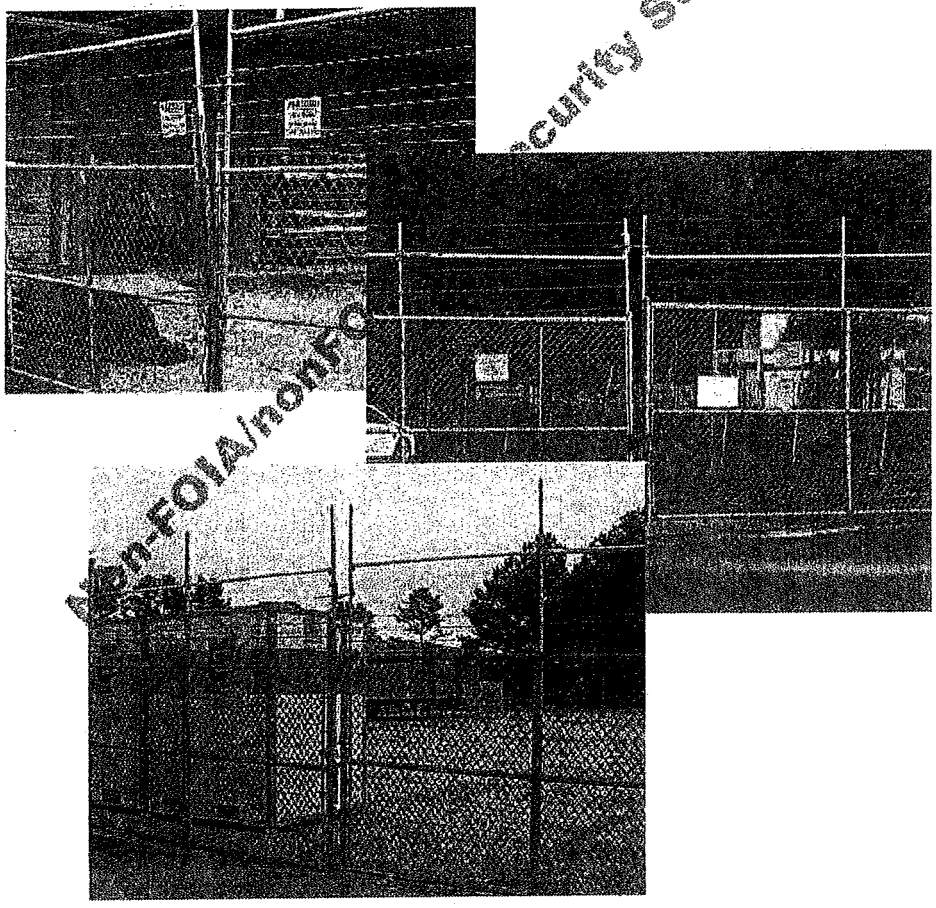
2.B Gates
Back side of roll gate must use steel pole not fiberglass pole. Gate must slide between electric and perimeter fence.

2.C Gates
Gates should close tightly without play. If customer closes his gate with a chain, ask to cut off any excess length, so chain only meets using last two links. This will avoid chain tail shorting out gate and close tight enough to avoid wind pushing it open and losing contact.

POOR GATE CONNECTIONS ARE A COMMON CAUSE OF FENCE ALARMS.

2.D Gates
Current travels only one way through the gate. If it returns, then trench under gate wire #19 to 19 with weather heads on each side.

2.2 Double Panel



2.0a Brackets

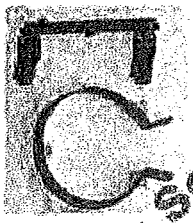
INSTALLATION 2.0 A

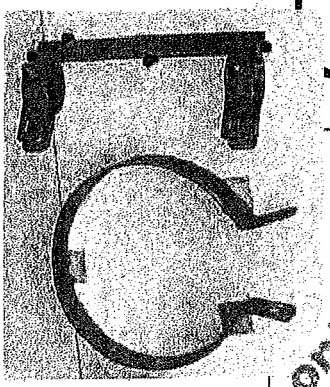
GATE BRACKETS

Though not restricted to usage on gates, the brackets and brace bands (a.k.a. tension bands) used to secure fence posts and gate posts are collectively referred to as GATE BRACKETS throughout this guide.

Specifically, two types of brackets (in many sizes) are used with our fence (see adjacent photo).

Both types of brackets should always be installed in a manner that ensures the pins (bolts) used in connecting these brackets are parallel to the ground, with the open end facing the fence interior.

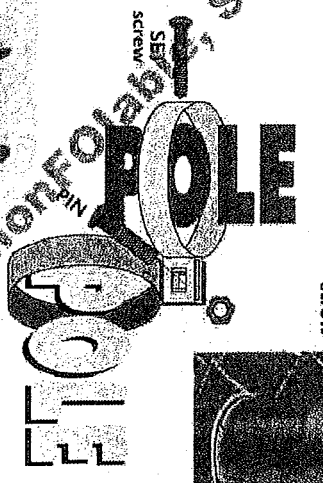


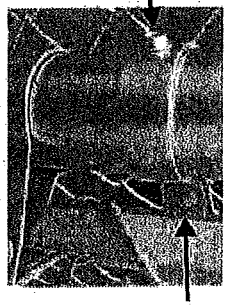


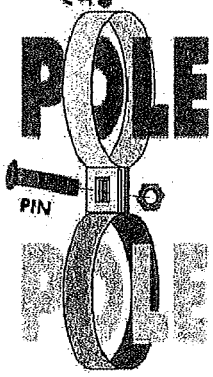
If indicated, "set screws" are used to secure a bracket's vertical position on the pole.

The adjacent drawings illustrate how a single pole is used to connect two brackets.

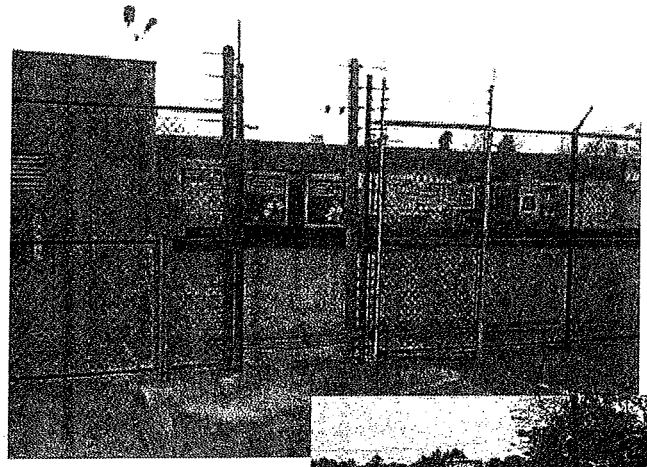
Notice the set screw location as well.

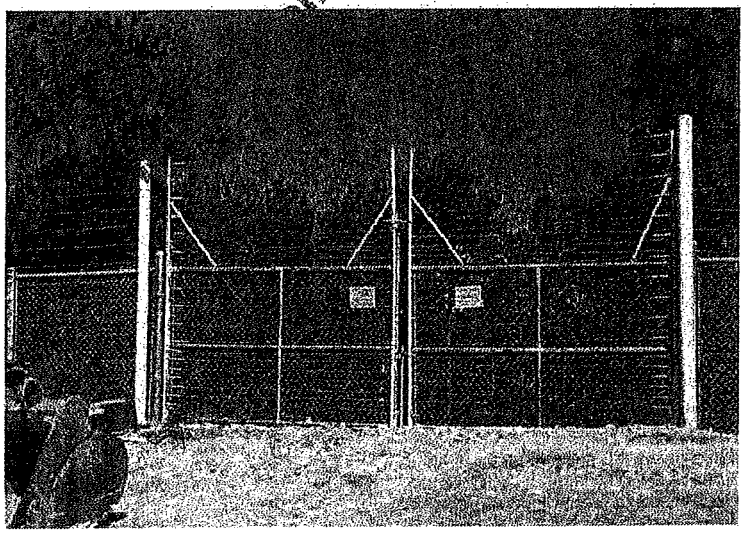






2.3 Bypass Gates





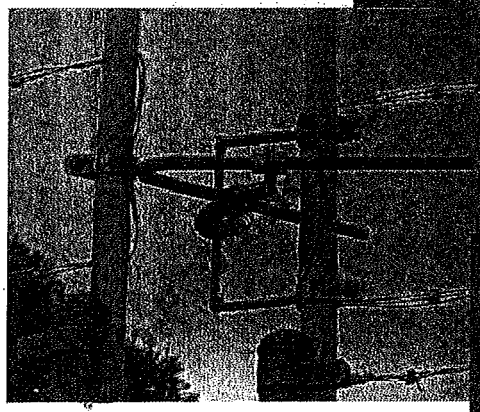
Contacts Gates

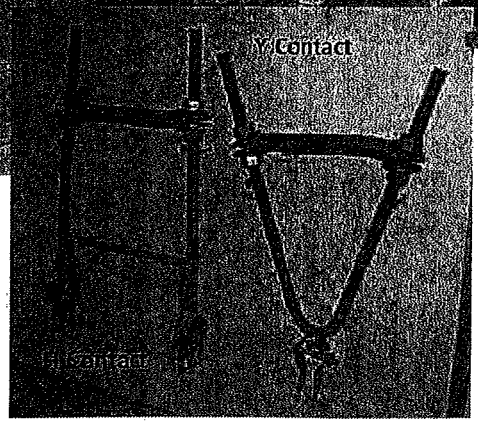
2.4A Contacts
All contacts must have a bolt through the contact and fiberglass pole. All contacts must have a spring on one side.

2.4B Contacts
Use a Y or straight bar contact at every gate connection. All contacts must involve a spring, no solid contacts. Spring should be extended no more than half distance of Y. Use a contact extension on every contact. Use the appropriate size extensions to close gaps at the gates.

H Contact with 3"male contact

'Y' Contact with 3"male contact extension





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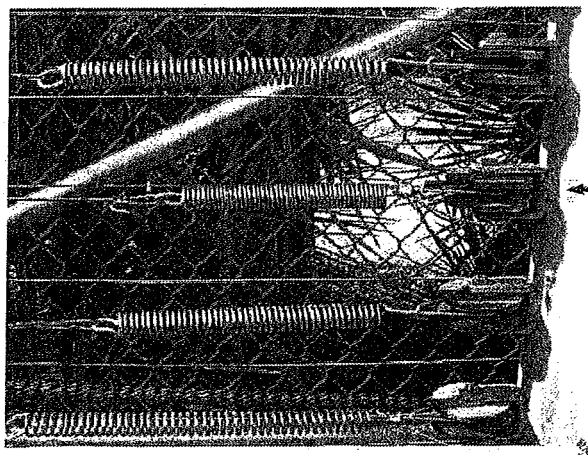
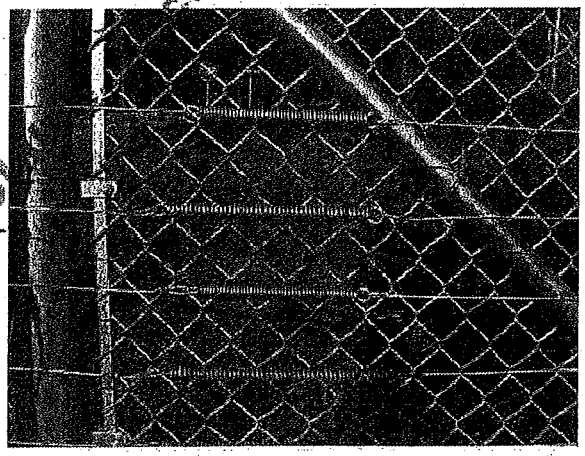
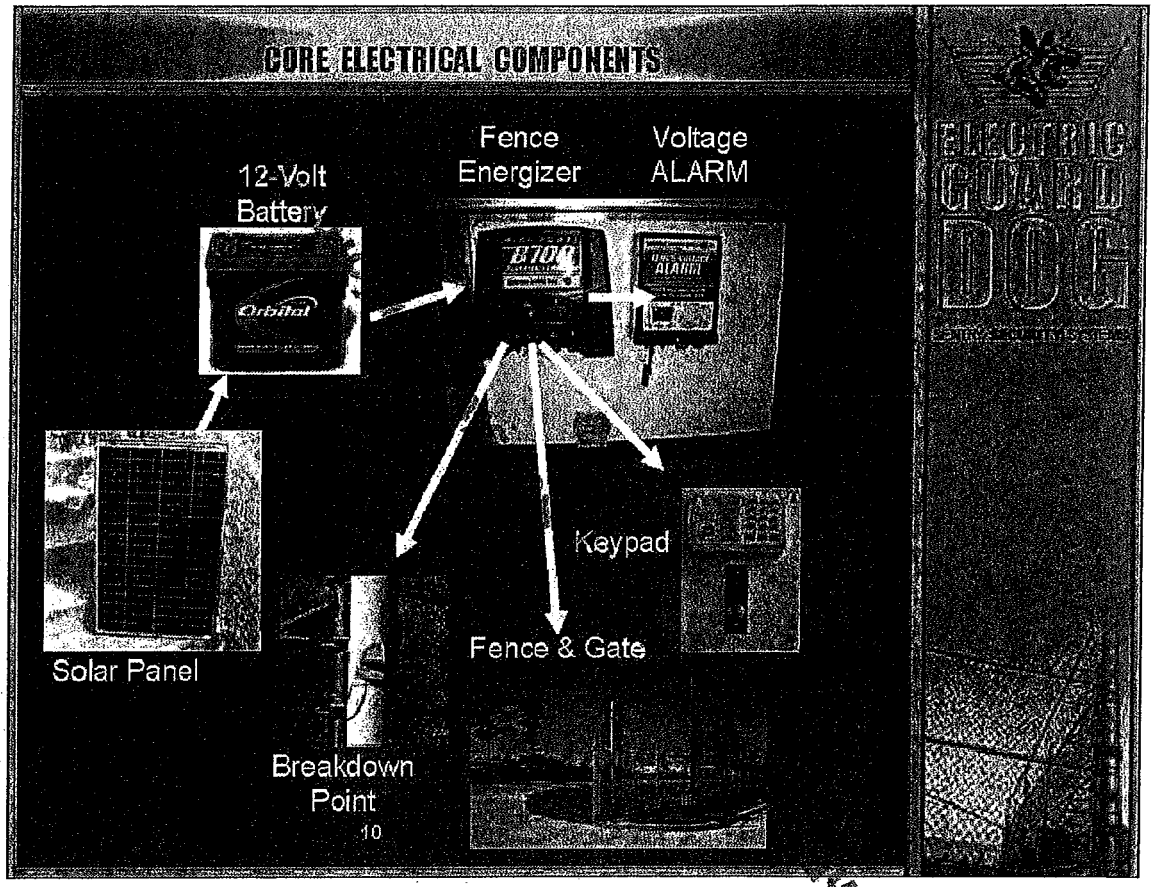
2.5A Gate Springs
Gate springs are used on every gate and all sections under 250 feet. Gate springs are required on both ends if there is a bend in the section.

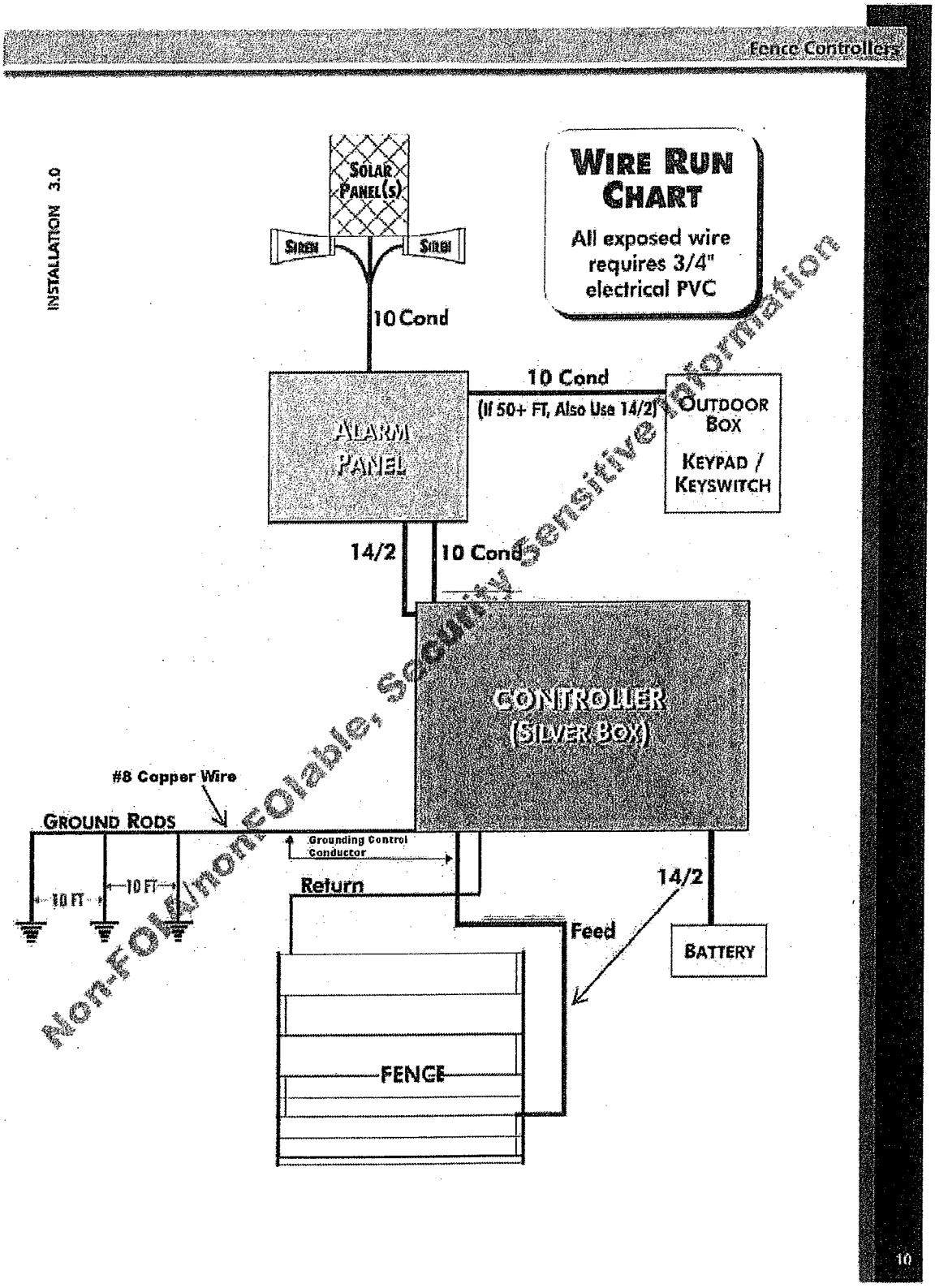
2.5B Gate Springs
"Air' gate springs. If gate loses tension, cut wire and re-pull.

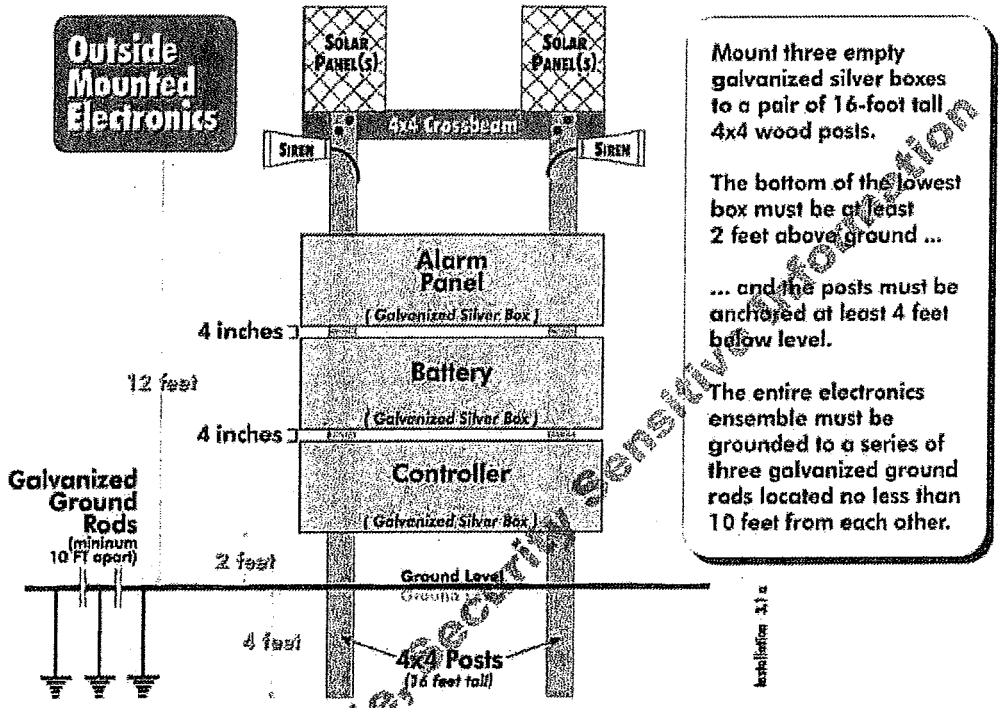


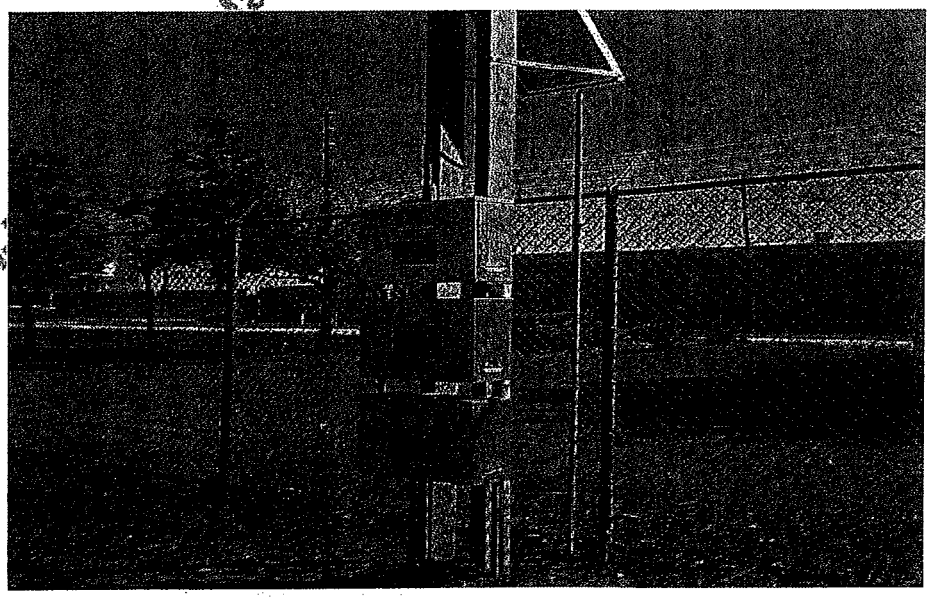


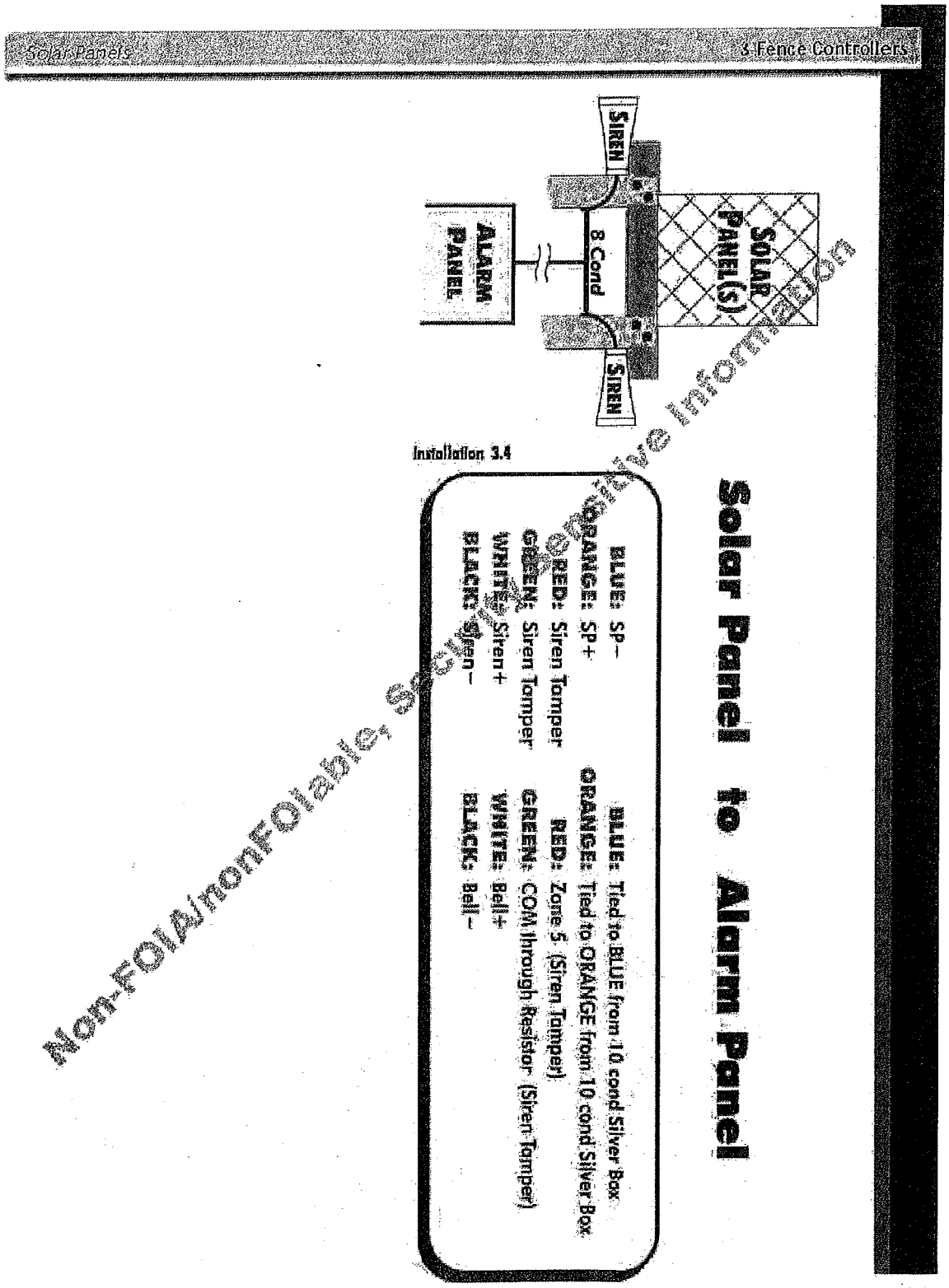
6C


CORE ELECTRICAL COMPONENTS
12-Volt Battery
Fence Energizer
Voltage ALARM
Keypad
Solar Panel
Fence & Gate
Breakdown Point
10
ELECTRIC GUARD DOG


Fence Controllers
INSTALLATION 3.0
SOLAR PANEL(S)
SIREN
SIREN
10 Cond
WIRE RUN CHART
All exposed wire requires 3/4" electrical PVC
10 Cond
(If 50+ FT, Also Use 14/2)
OUTDOOR BOX
KEYPAD / KEYSWITCH
ALARM PANEL
14/2
10 Cond
CONTROLLER (SILVER BOX)
#8 Copper Wire
GROUND RODS
Grounding Control Conductor
10 FT
10 FT
Return
Feed
14/2
BATTERY
FENCE
Non-FOIA/non-Olable, Security Sensitive Information
10







FIELD CONNECTION REQUIREMENTS

- All Field Installed components shall comply with the applicable sections of the NEC. The Electric Security Fence System has the option to be energized from a isolated Solar Panel or supplied by a 120Vac circuit for a battery charger for the 12VDC batteries. In the event that the system is connected to a 120Vac circuit, the system shall be installed in accordance to the NEC and shall utilize a UL listed trickle battery charger.
- Installations with a solar panel shall include a UL Listed unit which installed in full accordance with the UL guide card and manufacturers installation instructions.
- All electrical components (batteries, chargers, energizers, etc..) must be installed in their supplied enclosures or with a minimum 3R rated enclosure.
- All fence connections shall be in accordance with the supplied installation instructions. The wiring shall be UL listed wire.
- Any modifications to the installation instructions or requirements set forth in this report is subject to violating compliance to this certification.

Electrical Components

Some items noted in the table below are optional and are not used in every installation.

Item	Component	Mfg	Part No.	Ratings	Cert.
1	Electric Fence Controller	Advanced Perimeter Systems	EF170, EF171, EF172, EF173, EF174, EF175, or EF177	12VDC, 2J or 5J, 1, 2, or 3 zones.	CE
2	Voltage Alarm	Electric Guard Dog/Gallagher Group	IPX4, CAN 005 550 845	Battery type = 12V, 10-100mA, IPX4	CE
3	Relay	Adv. Signal	ASRB-1	12-24VDC	UL
4	Solar Controller	Sunguard	Solar Controller	12V, 4.5A	CE
5	External Power Wiring from Charger to Fence	Multiple	Multiple	0.030 in. thick PVC Jacketed, 14 AWG, 19 x 37 Tinned Copper. Dielectric Strength: 15 kV, Insulation Resistance: 2.5 kV, Spark Voltage: 15 kV.	UL
6	Photovoltaic Cell	Kyocera	KC60	16.9VDC, 3.55A	UL
7	Batteries	Random	Random	12VDC, Deep Cycle AGM	CE
8	Charge Controller	Sun Selector	M-4	25VDC, 6A	CE

Electrical Block Diagram