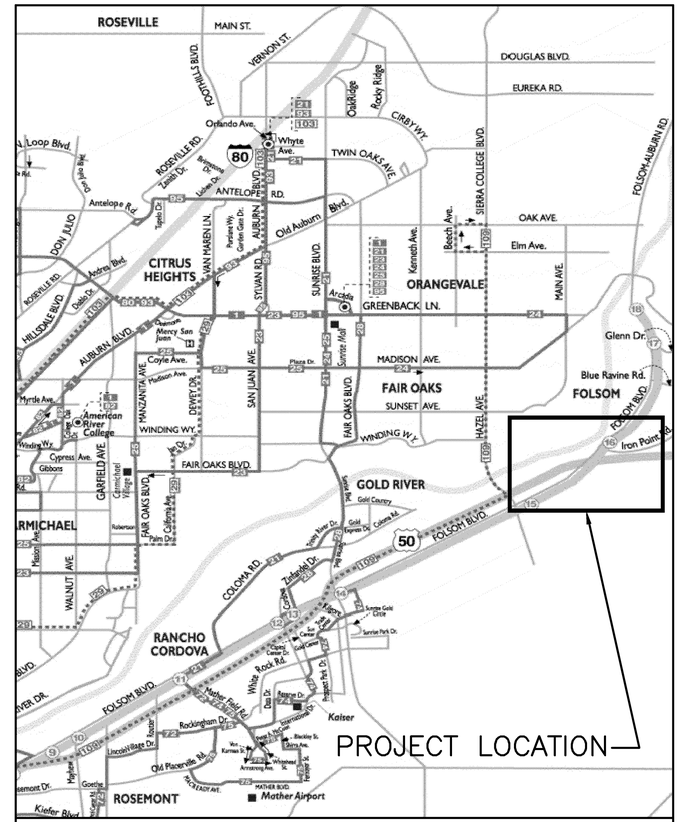
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	150	175

SACRAMENTO REGIONAL TRANSIT DISTRICT

NATOMA WIDENING PROJECT

OVERHEAD CONTACT SYSTEM



VICINITY MAP

TABLE OF CONTENTS

		OVERHEAD CONTACT SYSTEM
1	G-001	COVER PAGE
2	K-001	ABBREVIATIONS AND NOTES
3	K-002	LEGENDS AND SYMBOLS
		GENERAL ARRANGEMENTS
4	K-005	CATENARY SPANS HANGER ARRANGEMENT
		TECHNICAL SHEETS
5	K-100	CONDUCTOR CHARACTERISTICS AND PARAMETERS 350/500 MCM
6	K-101	STRUCTURE SPACING BLOWOFF PANTO SECURITY AND MIDSPAN OFFSET CHART
7	K-102	LOADING TABLES
8	K-103	ALONG TRACK MOVEMENT CHART
9	K-104	OCS CONDUCTOR CHARACTERISTICS 350 MCM
10	K-105	ANCILLARY WIRES
11	K-106	PANTOGRAPH DYNAMIC ENVELOPE
		ASSEMBLY REFERENCES
12	K-110	BALANCE WEIGHT TERMINATION ARRANGEMENTS TYPES BW9 (WIDE FLANGE) FOR TEMPORARY OCS AND BWIC FOR BALANCE WEIGHT INSULATOR CHANGE
13	K-111	REDUCED SYSTEM HEIGHT CANTILEVER PUSH OFF ASSEMBLY SYSTEM HEIGHT 18" – 36" CA15
14	K-112	CANTILEVER ASSEMBLY TYPES CA1, CA2, CA3, CA4
15	K-113	CANTILEVER ASSEMBLY TYPES CA5, CA6, CA14
16	K-114	CANTILEVER ASSEMBLY TYPES CA7, CA8, CA9, CA12
17	K-115	HANGER ASSEMBLY TYPES HA-60 TO HA-230, HO-01 TO HO-10, HM-1, HM-2
18	K-116	HANGER ASSEMBLY TYPES HA2, HA4, HA5, HA6, HA7, HA8
19	K-117	POLE BAND AND BRACKET ASSEMBLY TUBULAR TYPES BH, BR, BS
20	K-118	JUMPER ASSEMBLY TYPES JA1, JA2, JA3, JA4, JA5
		TEMPORARY OCS LAYOUT PLANS
21	K-201	TEMPORARY WIRING PLAN AND LAYOUT SCHEDULE
22	K-202	TEMPORARY WIRING PLAN AND LAYOUT SCHEDULE
23	K-203	TEMPORARY WIRING PLAN AND LAYOUT SCHEDULE
		RECONSTRUCTED OCS LAYOUT PLANS
24	K-301	RECONSTRUCTED WIRING PLAN AND LAYOUT SCHEDULE
25	K-302	RECONSTRUCTED WIRING PLAN AND LAYOUT SCHEDULE
26	K-303	RECONSTRUCTED WIRING PLAN AND LAYOUT SCHEDULE

REVISIONS					G-001
MARK	DATE	DESCRIPTION	BY	CHKD	SHEET
	5/23/14	ISSUE FOR BID			

F:\Projects\B-Current Projects\V24580 PSOMAS SRTD OEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\1 G-001.dwg Time:Aug07,2014-08:35am Loginsporter Dimscale:30 LTScale:1
Images: RT Gold Line Map.gif\Visio-LTK Cover Sheet.jpg:
Xrefs:

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	151	175

OVERHEAD CONTACT SYSTEM ABBREVIATIONS:

A	AMPERE
AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
AB	ANCHOR BOLT
ABD	ABANDON, ABANDONED
ABV	ABOVE
AC	ALTERNATING CURRENT
ACI	AMERICAN CONCRETE INSTITUTE
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
APPROX	APPROXIMATE
AS	AERIAL STRUCTURE
ASSY	ASSEMBLY
ASTM	AMERICAN SOCIETY OF TESTING AND MATERIALS
ATS	AUTOMATIC TRANSFER SWITCH, AUTOTENSIONED SYSTEM
AWG	AMERICAN WIRE GAUGE
AWS	AMERICAN WELDING SOCIETY
BRKR	BREAKER
BWA	BALANCE WEIGHT ANCHOR
C	CONDUIT, CLOSE
C(N)	CONDUIT ON NORTH SIDE
C(S)	CONDUIT ON SOUTH SIDE
CANT	CANTILEVER
CAT	CATENARY
CF	CUBIC FEET
CK	COMMUNICATIONS CIRCUIT
CL	CENTERLINE
CL TO CL	CENTERLINE TO CENTERLINE
COND	CONDUCTOR
CT	CURRENT TRANSFORMER
CU	COPPER
CW, C/W	CONTACT WIRE
DC	DIRECT CURRENT
DEV	DEVICE
DIA	DIAMETER
DWG	DRAWING
Ea	SUPERELEVATION IN INCHES
EMERG	EMERGENCY
EPR	ETHYLENE PROPYLENE RUBBER
EST	ESTIMATED
ETS	EMERGENCY TRIP STATION
EX	EXISTING
F	FAHRENHEIT
FA	FIXED ANCHOR
FDN	FOUNDATION
FT	FEET, FOOT
FTA	FIXED TERMINATION ANCHOR
GA	GAUGE
GALV	GALVANIZED
GFI	GROUND FAULT INTERRUPTER
GR	GROUND ROD
GRS	GALVANIZED RIGID STEEL
HDG	HOT DIP GALVANIZED
HEX	HEXAGONAL
HH	HANDHOLE
HS	HIGH STRENGTH
HT	HEIGHT
HV	HIGH VOLTAGE
IBT	INBOUND TRACK
ID	INSIDE DIAMETER, IDENTIFICATION
IMP	IMPEDANCE
IN, INS	INCH, INCHES
INSUL	INSULATION
INT	INTERNAL
JB	JUNCTION BOX
KCMIL	THOUSAND CIRCULAR MILS
KV	KILOVOLT
KVA	KILOVOLT AMPERE
KVAR	KILOVOLT AMPERES REACTIVE
KW	KILOWATT
KWH	KILOWATT HOUR
LA	LIGHTNING ARRESTER
LB	POUND, POUNDS
Lc	LENGTH OF CIRCULAR CURVE
LG	LONG, LENGTH
LRT	LIGHT RAIL TRANSIT, LIGHT RAIL TRAIN
LT	LIGHT, LEFT
LTG	LIGHTING
M/W	MESSENGER WIRE
MAX	MAXIMUM
MCM	THOUSAND CIRCULAR MILS
MESS	MESSENGER WIRE
MH	MANHOLE, MILLIHENRY
MIN	MINIMUM
MISC	MISCELLANEOUS
MPA	MID POINT ANCHOR
MPH	MILES PER HOUR
MV	MILLIVOLT, MEDIUM VOLTAGE
MW	MEGAWATT
N/A	NOT APPLICABLE
NB	NORTHBOUND
NEG	NEGATIVE
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NK	NEGATIVE CIRCUIT
NO	NORMALLY OPEN
NO.	NUMBER
NTS	NOT TO SCALE
O/L	OVERLAP
O/R	OUT OF RUNNING (NON-RIDING CONTACT WIRE
OBT	OUTBOUND TRACK
OC	ON CENTER
OCS	OVERHEAD CONTACT SYSTEM
OD	OUTSIDE DIAMETER
PB	PULLBOX, PUSHBUTTON
PDG	POLE TO POLE DOWNGUY
PITO	POINT OF INTERSECTION OF TURNOUT
PK	POSITIVE CIRCUIT
PS	POINT OF SWITCH
PSF	POUNDS PER SQUARE FEET
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
QTY	QUANTITY
R	RADIUS, RESISTANCE, RELAY, RIGHT
RECT	RECTIFIER
REF	REFERENCE
REINF	REINFORCE, REINFORCING, REINFORCEMENT
REQD	REQUIRED
RGS	RIGID GALVANIZED STEEL
RPM	REINFORCED PLASTIC MATERIAL
RT	RIGHT, REGIONAL TRANSIT
S	SOUTH
SB	SOUTHBOUND, SPLICE BOX
SC	SPRIAL TO CURVE, SIGNAL/COMMUNICATION
SCADA	SUPERVISORY CONTROL & DATA ACQUISITION
SCAT	SIMPLE CATENARY AUTO TENSION
SCH	SCHEDULE
SH	SYSTEM HEIGHT
SIG	SIGNAL
SIM	SIMILAR
SMUD	SACRAMENTO MUNICIPAL UTILITY DISTRICT
SS	STAINLESS STEEL
STA	STATION, STATIONING
STD	STANDARD
STL	STEEL
T	TRIP
TBD	TO BE DETERMINED
TEMP	TEMPERATURE, TEMPORARY
TERM	TERMINAL, TERMINATION HT
TOD	TOP OF DECK
TOR	TOP OF RAIL
TOT	TOP OF TRACK TIE
TPSS	TRACTION POWER SUBSTATION
TRK	TRACK
TYP	TYPICAL
UG, U/G	UNDERGRADE, UNDERGROUND
UPS	UNINTERRUPTIBLE POWER SUPPLY
V	VOLT
VAR	VARIOUS
VDC	VOLTS DIRECT CURRENT
VDE	VEHICLE DYNAMIC ENVELOPE
W	WATT, WIDTH, WIRE, WEST
W/	WITH
WF	WIDE FLANGE POLE
WP	WOOD POLE
WT	WEIGHT, WARNING TIME
X/O	CROSSOVER
XFMR	TRANSFORMER

CONSTRUCTION/DESIGN NOTES:

1. TEMPORARY CONTACT WIRE HEIGHT DESIGNED AT LOWEST HEIGHT ALLOWED BY RT DESIGN CRITERIA.
2. CONTACT WIRE GRADIENTS ARE IN ACCORDANCE WITH AREMA CHAPTER 33.
3. THE SYSTEM HEIGHT FOR THE TEMPORARY OCS PHASE WAS CALCULATED BASED ON THE TENSIONS IN THE OVERHEAD CONTACT SYSTEM, EXISTING SPAN LENGTHS, AND A MINIMUM HANGER LENGTH OF 7 INCHES AT THE CENTER OF THE SPAN.
4. DESIGN ASSUMES BOTTOM OF BRIDGE FALSEWORK AT 25'-2" ABOVE TOP OF RAIL AS SHOWN ON BUILDHIGH.DWG – FIGURE 1 DATED 7/23/13.

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 71189 CIVIL STATE OF CALIFORNIA
Jeffrey J. Boerma
Friday, Aug 1, 2014

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM ABBREVIATIONS AND NOTES

K-001
SHEET

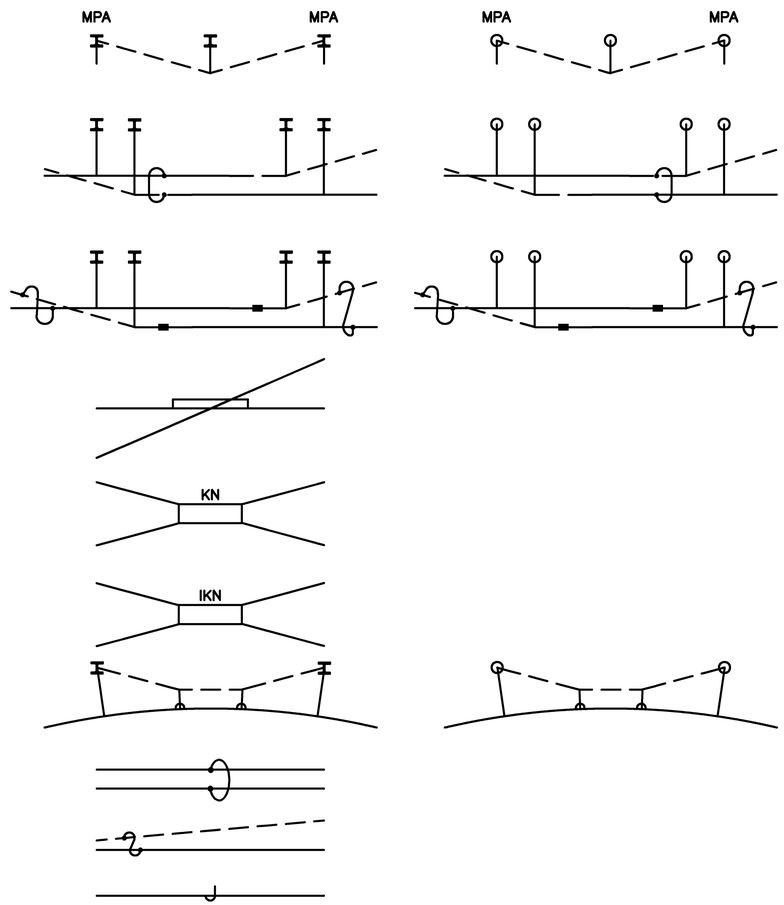
P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\2 K-001.dwg Time:Aug07,2014-08:35am Login:porter Dimscale:1 LTScale:1
Image: B_SIZE Layout: K-001

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	152	175

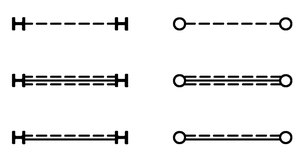
OVERHEAD CONTACT SYSTEM (OCS)

- OCS TAPERED TUBULAR POLE
- FEEDER — POLE WITH OCS DC FEEDER
- OCS WIDE FLANGE POLE
- 040 — OCS POLE ID NUMBER
- OCS CONDUCTORS IN RUNNING
- OCS CONDUCTORS OUT OF RUNNING
- OCS SINGLE CANTILEVER
- OCS BACK TO BACK CANTILEVER
- OCS TWIN CANTILEVER
- OCS CROSS SPAN
- OCS PULL–OFF
- PDG — POLE TO POLE DOWN GUY
- OCS DOWN GUY ANCHOR
- NB — NON–BRIDGING SECTION INSULATOR
- BRIDGING SECTION INSULATOR
- CUT–IN OR IN–SPAN INSULATOR
- TURNBUCKLE
- MPA, XXXX XXXX — MIDPOINT ANCHOR WITH DISTANCE TO TERMINATION
- XXXX — HALF TENSION LENGTH WITH DISTANCE TO TERMINATION
- DISCONNECT SWITCH
- SW — SWITCH
- XX — STRINGLINE (INCH)
- X — STAGGER (INCH)
- XXXX — TENSION LENGTH IDENTIFICATION NUMBER

OVERHEAD CONTACT SYSTEM (OCS)



- MIDPOINT ANCHOR
- UNINSULATED OVERLAP
- INSULATED OVERLAP
- CROSS CONTACT BRIDGE
- KNUCKLE (MW & CW)
- INSULATED KNUCKLE (MW & CW)
- BRIDLE ARRANGEMENT
- FULL CURRENT JUMPER
- POTENTIAL JUMPER
- IN–SPAN JUMPER



- STEADY SPAN
- 3 WIRE HEAD SPAN
- 2 WIRE HEAD SPAN WITH STEADY SPAN

OVERHEAD CONTACT SYSTEM (OCS)

- FEEDER — FEEDER POLE
- POLE FOUNDATION
- BWA — BALANCE WEIGHT ANCHOR POLE
- FT — FIXED TERMINATION POLE
- MPA — MIDPOINT ANCHOR POLE
- ANCHOR FOUNDATION
- 040 — OCS FOUNDATION ID NUMBER
- ATTACHMENT TO AERIAL STRUCTURE
- GRADE CROSSING
- SIGNAL MESSENGER WIRE
- TRACK CENTERLINE
- SURGE ARRESTOR
- FEEDER TAP ON OCS
- AERIAL STRUCTURE

DISCONNECT SWITCH LABELING:

DS S 9 I – IBT

- IBT INDICATES INBOUND TRACK
  OBT INDICATES OUTBOUND TRACK
- I INDICATES INBOUND BREAKER
  O INDICATES OUTBOUND BREAKER
- INDICATES SUBSTATION NUMBER 9
- RELATED TO SUBSTATION
- RELATED TO DISCONNECT SWITCH

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER — JEFFREY J. BOERMA — CIVIL — STATE OF CALIFORNIA

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

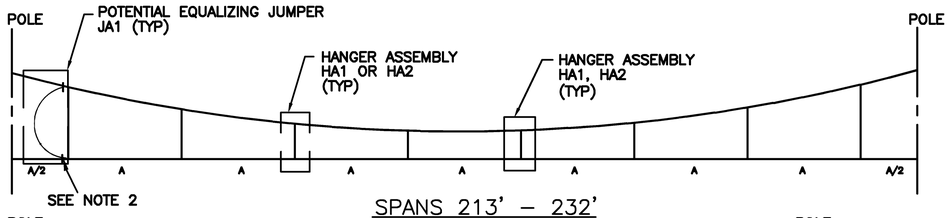
NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
LEGENDS AND SYMBOLS

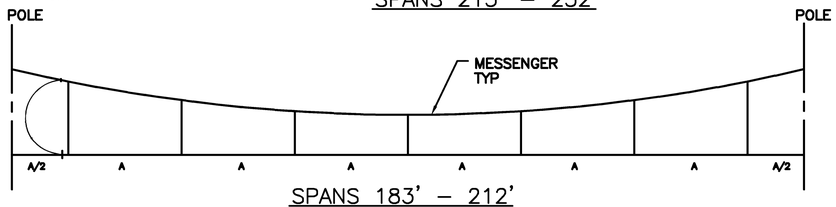
K-002
SHEET

P:\Projects\B-Current Projects\C4580 PSGMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\3 K-002.dwg Time:Aug07,2014-08:35am Login:porter Dimscale:1 LTScale:1
Images: B-TB-STDS.jpg
Wrapper: B-TB-STDS.dwg

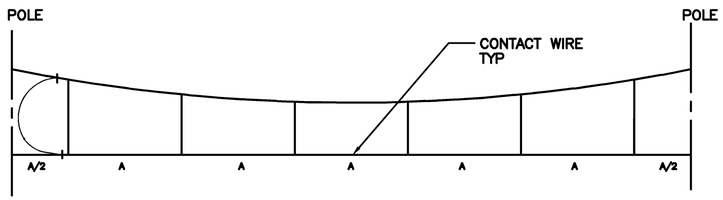
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	153	175



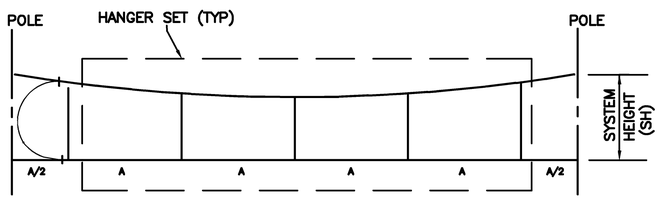
SPANS 213' – 232'



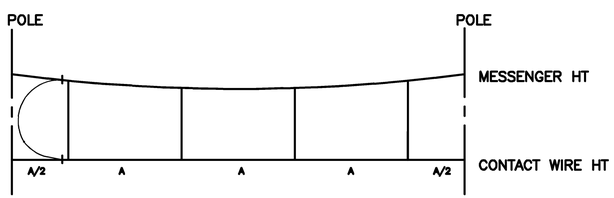
SPANS 183' – 212'



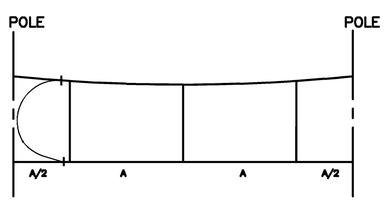
SPANS 153' – 182'



SPANS 123' – 152'



SPANS 93' – 122'

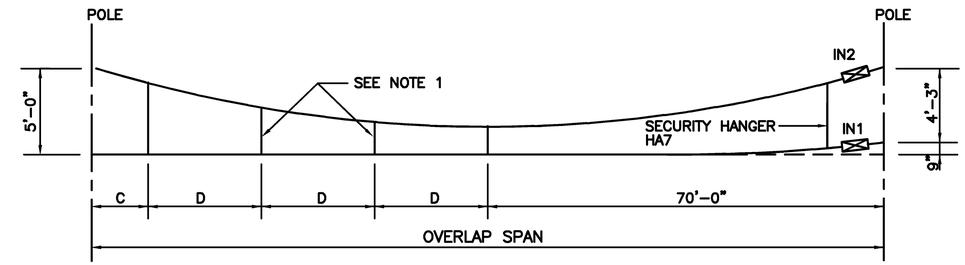


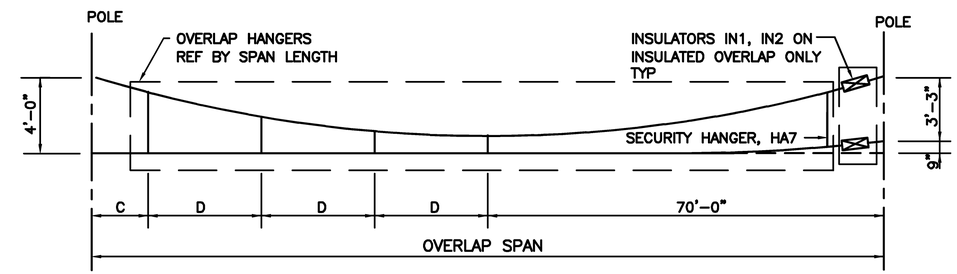
SPANS 63' – 92'

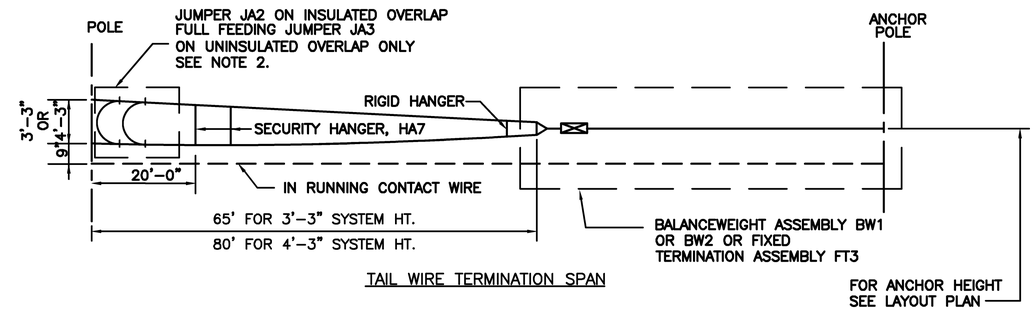
STANDARD SPANS

NOTES:

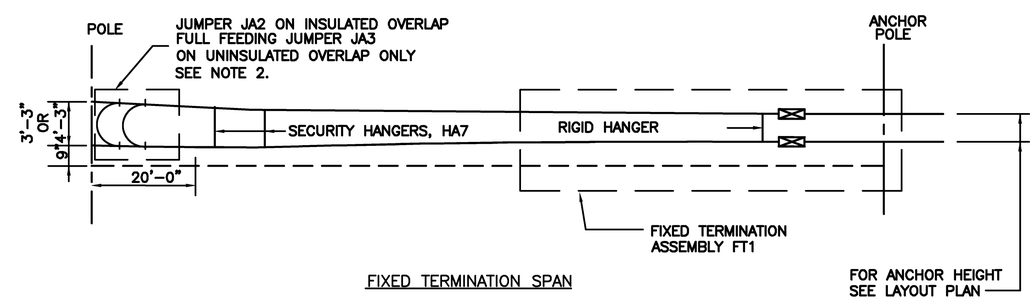
1. THE SET OF HANGERS REQUIRED FOR EACH SPAN IS SHOWN IN THE OCS PLAN AND LAYOUT SCHEDULE K-200 SERIES DWGS.
2. POTENTIAL EQUALIZING AND FEEDER JUMPERS OPEN AWAY FROM DIRECTION OF TRAVEL.







TAIL WIRE TERMINATION SPAN



FIXED TERMINATION SPAN

SPANS IN OVERLAPS

REVISIONS				
MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA
Jeffrey J. Boerma (Aug 7, 2014)

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
GENERAL ARRANGEMENTS
CATENARY SPANS HANGER ARRANGEMENT

K-005
SHEET

P:\Projects\B-Current Projects\C4580 PSDMAS SRTD EEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\4 K-005.dwg Time:Aug07,2014-08:35am Login:sporter Dimscale:1 LTScale:1
Image: 1 STPTA Logo.jpg
Image: 2 LTK Logo.jpg

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	154	175

OCS CONDUCTOR PARTICULARS	UNITS	SIMPLE CATENARY AUTO–TENSIONED (SCAT)		DIRECT SUSPENSION SINGLE CONTACT (DSSC)
		CONTACT	MESSENGER	CONTACT
TYPE	–	350 MCM SOLID GROOVED	500 MCM 19 STRAND	350 MCM SOLID GROOVED
MATERIAL	–	HARD DRAWN COPPER	HARD DRAWN COPPER	HARD DRAWN COPPER
DIAMETER	IN.	0.620	0.811	0.620
CROSS SECTIONAL AREA	SQ IN	0.2758	0.3926	0.2758
WEIGHT OF CONDUCTOR	LB/FT	1.063	1.544	1.063
CONDUCTOR BREAKING LOAD	LB	11810	21590	11810
MODULUS OF ELASTICITY	PSI	17×10^6	17×10^6	17×10^6
COEFFICIENT OF EXPANSION	–/° F	9.4×10^{-6}	9.4×10^{-6}	9.4×10^{-6}

OCS DESIGN PARAMETERS	UNITS	SIMPLE CATENARY AUTO–TENSIONED (SCAT)		DIRECT SUSPENSION SINGLE CONTACT (DSSC)
		CONTACT	MESSENGER	CONTACT
WEIGHT OF SYSTEM WITH HANGERS	LB/FT	2.627		1.063
MAXIMUM SPAN @ 19'–6" CWH	FT	230		120
EQUIVALENT SPAN	FT	25	175	115
CONDUCTOR TENSIONS AT:				
70° F NO WIND	LB	3000	4500	2500
130° F NO WIND	LB	3000	4500	1322
25° F NO WIND	LB	3000	4500	4091
–5° F 40 MPH WIND	LB	4033	5496	5667
CONDUCTOR SAG ON MAXIMUM SPAN AT:				
70° F NO WIND	FT	–	3.82	0.765
130° F NO WIND	FT	–	3.82	1.488
25° F NO WIND	FT	–	3.82	0.467
–5° F 40 MPH WIND	–	–	3.16	0.338
SYSTEM HEIGHT	FT	4.5 (NOMINAL)		–
PRESAG	–	SPAN/1000		–
CONTACT WIRE HEIGHT AT 70° F	FT	19'–6"		19'–6"
LOWER LIMIT OF AUTO TENSIONING	° F	125 MIN		–
UPPER LIMIT OF AUTO TENSIONING	° F	25		–
MINIMUM FACTOR OF SAFETY	–	2.93	4.09	2.08
CONTACT WIRE 30% WORN	–			
WEIGHT OF SYSTEM WITH HANGERS	LB/FT	2.458		0.7441
BREAKING LOAD	LB	8,267	21590	8267
MINIMUM FACTOR OF SAFETY	–	2.15	4.09	2.26

DIRECT SUSPENSION SINGLE CONTACT (DSSC) ERECTION TENSIONS	
TENSION	TEMPERATURE
4091	25
3900	30
3712	35
3526	40
3343	45
3164	50
2990	55
2821	60
2657	65
2500	70
2350	75
2209	80
2076	85
1952	90
1837	95
1732	100
1635	105
1548	110
1468	115
1396	120
1331	125

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA
Jeffrey J. Boerma (Aug 7, 2014)

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
TECHNICAL SHEET CONDUCTOR CHARACTERISTICS
AND PARAMETERS 350/500 MCM

K-100
SHEET

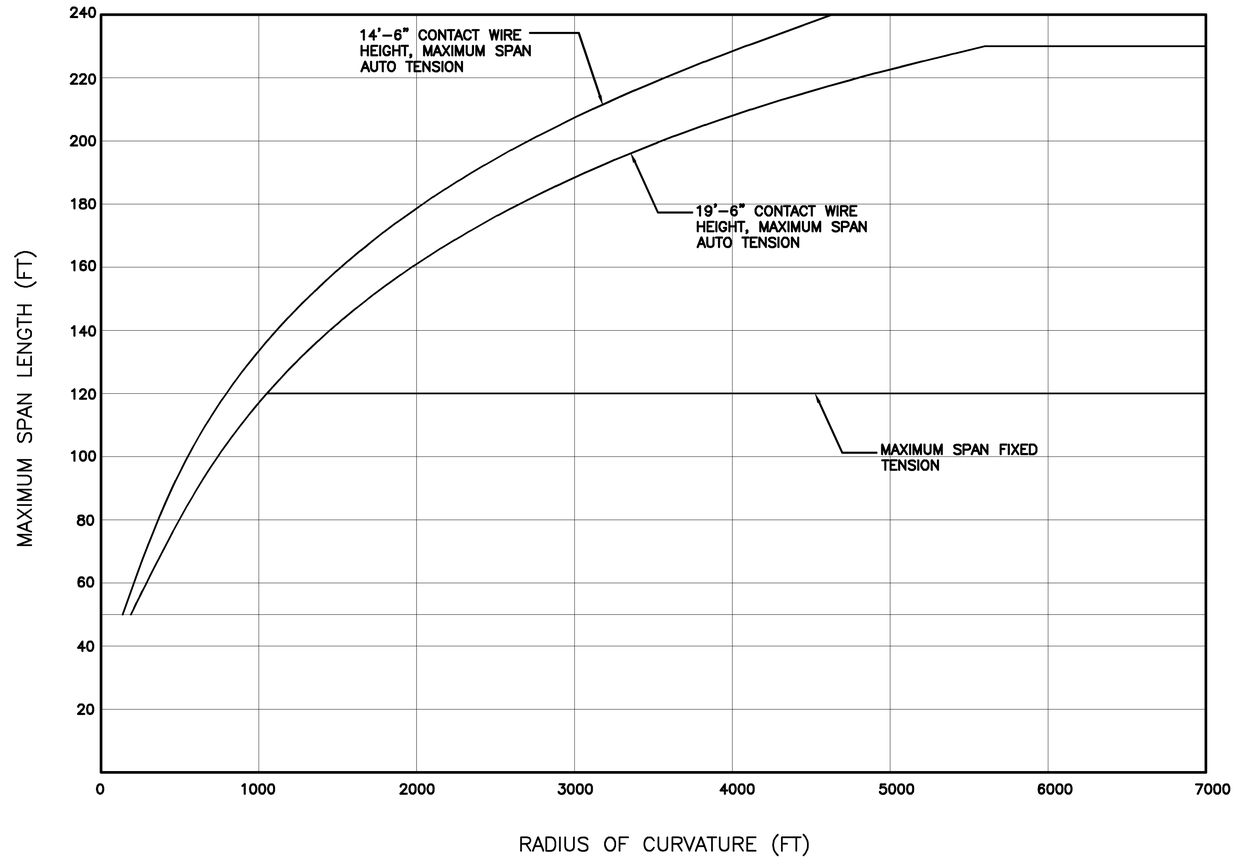
F:\Projects\B-Current Projects\C4590 PSOMAS SRTD OEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\5 K-100.dwg TimeAug07,2014-08:35am Loginsporter Dimscale:1 LTScale:1
Images: 0k 0k 1.75MB
Xrefs: 0k 0k 1.75MB

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	155	175

BLOW OFF		PERMISSIBLE OFFSET OF CW AT MID-SPAN (NOTE 3)			
SPAN	BLOW OFF	MAXIMUM @19'-6"		MAXIMUM @14'-6"	
(FEET)	(INCHES)	TANGENT	CURVE	TANGENT	CURVE
50	0.50	9.5	9.5	13.5	13.5
60	0.72	9.5	9.5	13.5	13.5
70	0.98	9.5	9.5	13.5	13.5
80	1.28	9.5	9.5	13.5	13.5
90	1.62	9.5	9.5	13.5	13.5
100	2.00	9.5	9.5	13.5	13.5
110	2.42	9.5	9.5	13.5	13.5
120	2.88	9.5	9.5	13.13	13.5
130	3.38	9.5	9.5	12.63	13.13
140	3.92	9.5	9.5	12.09	12.59
150	4.50	9.05	9.5	11.51	12.01
160	5.12	8.43	8.93	10.89	11.39
170	5.78	7.77	8.27	10.23	10.73
180	6.48	7.07	7.57	9.53	10.03
190	7.22	6.33	6.83	8.79	9.29
200	8.00	5.54	6.04	8.00	8.50
210	8.82	4.72	5.22	7.18	7.68
220	9.68	3.86	4.36	6.32	6.82
230	10.58	2.96	3.46	5.42	5.92
240	11.52	–	–	4.48	4.98
TRACK CLASS		4		4	
MAX STAGGER INCHES	TANGENT	9.5		13.5	
	CURVE		9.5		13.5

PANTOGRAPH SECURITY (IN)		
ALLOWANCE	@ 19'-6"	@ 14'-6"
TRACK ALIGNMENT (CLASS 4)	1.50	1.50
CROSS LEVEL (1 1/4")	5.18	3.85
VEHICLE SWAY INTO WIND ⊗	4.56	3.25
PANTOGRAPH SWAY INTO WIND ⊗	0.75	0.75
CAR LATERAL MOVEMENT @ 50%	1.16	1.16
STAGGER CHANGE/EFFECT	3.00	3.00
CONSTRUCTION TOLERANCE	1.00	1.00
POLE DEFLECTION	2.00	2.00
MIDSPAN OFFSET (ASSIGNED)	2.00	4.00
BLOW OFF – (SPAN (FT))	11.05 (235)	12.01 (245)
TOTAL	32.20	32.52
HALF PANTOGRAPH WIDTH	39.00	39.00
PANTOGRAPH SECURITY	6.80	6.48

⊗ AREA RECOMMENDED: 50% INTO WIND



STRUCTURE SPACING CHART

NOTES:

1. THE SPANS SHOWN ON THE SPACING CHART MAY BE INCREASED UP TO 5 FEET TO MISS OBSTRUCTIONS.
2. THE BLOW OFF VALUES GIVEN ARE CALCULATED USING A MAXIMUM WIND SPEED OF 55 mph AND CONTACT WIRE TENSION OF 3000 lbs.
3. FOR SPANS LESS THAN 2000 FT. DISTANT FROM THE FIXED OR MIDPOINT ANCHOR THE PERMISSABLE MIDSPAN OFFSET AND STAGGER VALUES MAY BE INCREASED BY ONE INCH BECAUSE OF REDUCED STAGGER CHANGE.
4. THE PERMISSIBLE STATIC OFFSET AND STAGGER VALUES MAY BE INCREASED BY ONE INCH FOR INSTALLATION ACCEPTANCE.

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
TECHNICAL SHEET STRUCTURE SPACING
BLOWOFF PANTO SECURITY AND MIDSPAN OFFSET CHART

K-101
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\6 K-101.dwg Time:Aug07,2014-08:35am Login:sporter Dimscale:1 LTScale:1
Image: Ltk_TB_TSA (ltb.jpg)
Image: Ltk_TB_TSA (ltb.jpg)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	156	175

VERTICAL AND WIND LOADS (LB)

	CAT	MPA TIE WIRE	M/W	C/W	SIGNAL
SPAN (FT)	VERT LOAD	VERT LOAD	WIND LOAD (LB) NOTE 3		
60	164	30	66	51	227
70	192	35	77	59	265
80	219	40	88	67	303
90	246	45	99	76	341
100	274	50	110	84	379
110	301	55	121	93	417
120	328	60	132	101	455
130	356	65	143	110	493
140	383	70	154	118	531
150	411	75	165	126	569
160	438	80	176	135	607
170	465	85	187	143	645
180	493	90	198	152	682
190	520	95	209	160	720
200	547	100	220	169	758
210	575	105	231	177	796

STAGGER LOADS TANGENT TRACK

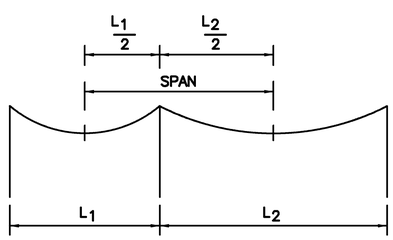
	AUTOTENSIONED CATENARY 10" STAGGERS (NOTE 1)	
SPAN	MESSGR 500 MCM	CW 350 MCM
60	125	83
70	107	71
80	94	63
90	83	56
100	75	50
110	68	45
120	63	42
130	58	38
140	54	36
150	50	33
160	47	31
170	44	29
180	42	28
190	39	26
200	38	25
210	36	24

RADIAL LOAD BY ANGLE CURVED TRACK (LB)

	AUTOTENSIONED CATENARY		MPA (NOTE 1)
A (DEG)	MESSGR	CW	TIE WIRE
1	79	52	38
2	157	105	76
3	236	157	115
4	314	209	153
5	393	262	191
6	471	314	230
7	549	366	268
8	628	419	306
9	706	471	344
10	784	523	383
11	863	575	421
12	941	627	459
13	1019	679	497
14	1097	731	535
15	1175	783	573
16	1252	835	611
17	1330	887	649
18	1408	938	687

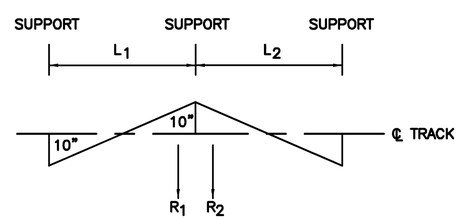
NOTES: (VERTICAL & WIND LOADS)

1. NO ICE LOADING REQUIREMENT.
2. WIND SPEED: 70 MPH (16.4 PSF)
3. WIND PRESSURE: 0.00256 X WS X WS X SF(LB)
4. TO OBTAIN LOADING AT STRUCTURE, LOADS FOR SPANS ON EACH SIDE OF SUPPORT MUST BE SUMMATED AND HALVED.
5. VERTICAL LOADS ARE INCLUSIVE OF MISCELLANEOUS IN-SPAN MATERIAL, HANGER CLAMPS, HANGER WIRE, ETC.
6. SHADE FACTOR (SF) = 1.0.
7. GUST FACTOR (GF) = 1.3.



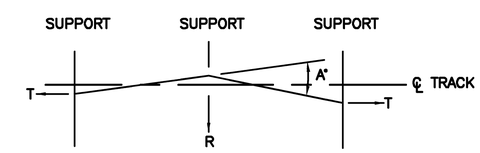
NOTES: (STAGGER LOADS)

1. RADIAL LOAD BASED ON 9" NOMINAL STAGGER PLUS 1" ERECTION TOLERANCE.
2. TO OBTAIN LOADING AT STRUCTURE, LOADS FOR SPANS ON EACH SIDE OF SUPPORT MUST BE SUMMATED.



NOTES: (RADIAL LOADS)

1. MPA RADIAL LOADS ARE BASED ON TENSION AT 20°F MINIMUM TEMPERATURE.
2. MESSENGER WIRE IS 500 MCM HARD DRAWN COPPER, CONTACT WIRE 350 MCM GROOVED HARD DRAWN COPPER.
3. TENSIONS:
   a. MESSENGER: AUTOTENSIONED = 4500 lb
   b. CONTACT WIRE: AUTOTENSIONED = 3000 lb
   c. MIDPOINT ANCHOR (MPA): 1500 lb @ 60°F, 2195 lb @ 20°F
4. RADIAL LOAD = 2SIN(A/2) x TENSION



REVISIONS				
MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA
Jeffrey J. Boerma (Aug 7, 2014)

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
TECHNICAL SHEET
LOADING TABLES

K-102
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD OEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\7 K-102.dwg Time:Aug07,2014-08:35am Login:porter Dimscale:1 LTScale:1
Image: R:\TSTRA Logo.jpg
Image: R:\TSTRA Logo.jpg
Image: R:\TSTRA Logo.jpg

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	157	175

NOTES:

1. CHART SHOWS ALONG TRACK POSITION OF CONTACT WIRE REGISTRATION CLAMP ATTACHMENT RELATIVE TO OCS SUPPORT POLE CENTER LINE FOR THE DESIGN TEMPERATURE RANGE.
2. INTERMEDIATE VALUES TO BE INTERPOLATED.

	T CONDUCTOR TEMP °F	D = DISTANCE FROM DEAD END OR MID–POINT ANCHOR (FEET)																			
		150	300	450	600	750	900	1050	1200	1350	1500	1650	1800	1950	2100	2250	2400	2550	2700	2850	3000
MOVEMENT (M) AWAY FROM M.P.A. (INCHES)	120	0.85	1.69	2.54	3.38	4.23	5.08	5.92	6.77	7.61	8.46	9.31	10.15	11.00	11.84	12.69	13.53	14.38	15.23	16.07	16.92
	115	0.76	1.52	2.28	3.05	3.80	4.57	5.33	6.09	6.85	7.61	8.38	9.14	9.90	10.66	11.42	12.18	12.94	13.71	14.47	15.23
	110	0.67	1.35	2.03	2.70	3.38	4.06	4.74	5.41	6.09	6.77	7.44	8.12	8.80	9.48	10.15	10.83	11.51	12.18	12.86	13.54
	105	0.59	1.18	1.78	2.37	2.96	3.55	4.15	4.74	5.33	5.92	6.51	7.11	7.70	8.29	8.88	9.48	10.07	10.66	11.25	11.84
	100	0.51	1.01	1.52	2.03	2.54	3.05	3.55	4.06	4.57	5.08	5.58	6.09	6.60	7.11	7.61	8.12	8.63	9.14	9.64	10.15
	95	–	0.85	1.27	1.69	2.12	2.53	2.96	3.38	3.81	4.23	4.65	5.08	5.50	5.92	6.35	6.77	7.19	7.61	8.04	8.46
	90	–	0.68	1.01	1.35	1.69	2.03	2.37	2.71	3.05	3.38	3.72	4.06	4.40	4.74	5.08	5.41	5.75	6.09	6.43	6.77
	85	–	0.51	0.76	1.01	1.27	1.52	1.78	2.03	2.28	2.54	2.79	3.05	3.30	3.55	3.81	4.06	4.31	4.57	4.82	5.08
	80	–	–	0.51	0.68	0.85	1.02	1.18	1.35	1.52	1.69	1.86	2.03	2.20	2.37	2.54	2.71	2.88	3.05	3.21	3.38
	75	–	–	–	–	–	0.51	0.59	0.68	0.76	0.85	0.93	1.02	1.10	1.18	1.27	1.35	1.44	1.52	1.61	1.69
	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MOVEMENT (M) TOWARDS M.P.A. (INCHES)	65	–	–	–	–	–	0.51	0.59	0.68	0.76	0.85	0.93	1.02	1.10	1.18	1.27	1.35	1.44	1.52	1.61	1.69
	60	–	–	0.51	0.68	0.85	1.02	1.18	1.35	1.52	1.69	1.86	2.03	2.20	2.37	2.54	2.71	2.88	3.05	3.21	3.38
	55	–	0.51	0.76	1.01	1.27	1.52	1.78	2.03	2.28	2.54	2.79	3.05	3.30	3.55	3.81	4.06	4.31	4.57	4.82	5.08
	50	–	0.68	1.01	1.35	1.69	2.03	2.37	2.71	3.05	3.38	3.72	4.06	4.40	4.74	5.08	5.41	5.75	6.09	6.43	6.77
	45	–	0.85	1.27	1.69	2.12	2.53	2.96	3.38	3.81	4.23	4.65	5.08	5.50	5.92	6.35	6.77	7.19	7.61	8.04	8.46
	40	0.51	1.01	1.52	2.03	2.54	3.05	3.55	4.06	4.57	5.08	5.58	6.09	6.60	7.11	7.61	8.12	8.63	9.14	9.64	10.15
	35	0.59	1.18	1.78	2.37	2.96	3.55	4.15	4.74	5.33	5.92	6.51	7.11	7.70	8.29	8.88	9.48	10.07	10.66	11.25	11.84
	30	0.67	1.35	2.03	2.70	3.38	4.06	4.74	5.41	6.09	6.77	7.44	8.12	8.80	9.48	10.15	10.83	11.51	12.18	12.86	13.54
	25	0.76	1.52	2.28	3.05	3.80	4.57	5.33	6.09	6.85	7.61	8.38	9.14	9.90	10.66	11.42	12.18	12.94	13.71	14.47	15.23
	20	0.85	1.69	2.54	3.38	4.23	5.08	5.92	6.77	7.61	8.46	9.31	10.15	11.00	11.84	12.69	13.53	14.38	15.23	16.07	16.92
	15	0.93	1.86	2.79	3.72	4.65	5.58	6.51	7.44	8.38	9.31	10.24	11.17	12.10	13.03	13.96	14.89	15.82	16.75	17.68	18.61

AUTO–TENSION O.C.S. TEMPERATURE CHART

INDICATING EFFECT OF TEMPERATURE CHANGE ON SYSTEM LENGTH
(FOR USE IN SETTING SUPPORT AND REGISTRATION ASSEMBLIES)

$M = \text{ALONG TRACK MOVEMENT} = D \times (T-70) \times 9.4 \times 10^{-6}$

REVISIONS				
MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA
(Expires Aug 7, 2014)

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
TECHNICAL SHEET
ALONG TRACK MOVEMENT CHART

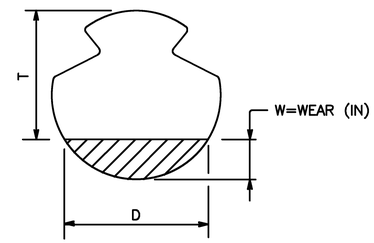
K-103
SHEET

P:\Projects\B-Current Projects\C4580 PSGMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\8 K-103.dwg Time:Aug07,2014-08:36am Login:porter Dimscale:1 LTScale:1
Image: N:\TSTRA Logo.jpg
Image: N:\RT Logo.jpg
Image: N:\LTK Logo.jpg

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	158	175

ANCILLARY WIRES

MATERIAL	DESCRIPTION	BREAKING LOAD (MIN.)	USAGE
STAINLESS STEEL	7/19 AIRCRAFT WIRE	1,760 LB	HANGERS
GALV. STEEL	HIGH STRENGTH – 3/8"	15,000 LB	PULL OFF'S CROSS SPANS
GALV. STEEL	HIGH STRENGTH – 1/2" 19 STRAND	19,000 LB	TERMINATION & MIDSPAN GUYS
STAINLESS STEEL	19/17 NONROTATING – 1/2"	20,500 LB	COUNTERWEIGHT PULLEY ROPE
GALV. STEEL	HIGH STRENGTH – 5/8"	29,600 LB	DOWN GUY STRANDS
COPPER	4/0 FLEX	5,983 LB	OCS POLE GROUNDING
COPPER	4/0 FLEX	5,983 LB	OVERHEAD BRIDGE GROUNDING
COPPER	4/0 FLEX	5,983 LB	SUBSTATION GROUND MAT

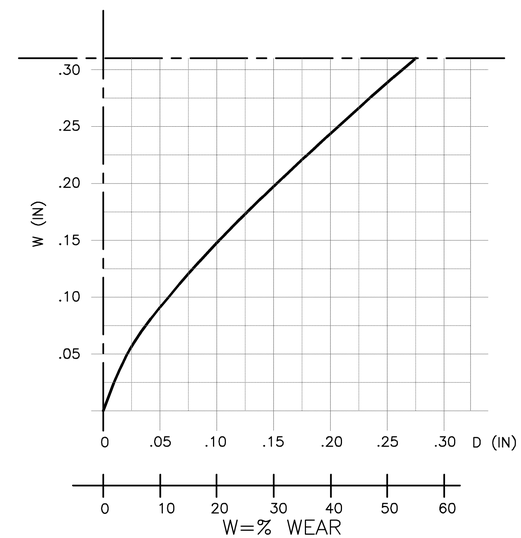


350 MCM CONTACT WIRE

DIAMETER = 0.620 (IN)

CONTACT WIRE WEAR

T (IN)	%	W (IN)
.60	2	.02
.58	4	.04
.56	6	.06
.54	9	.08
.52	12	.10
.50	15	.12
.48	18	.14
.46	22	.16
.44	26	.18
.42	30	.20
.40	34	.22
.38	38	.24
.36	43	.26



REVISIONS				
MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA
Expiration Date: Aug 7, 2014

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
TECHNICAL SHEET
OCS CONDUCTOR CHARACTERISTICS 350 MCM

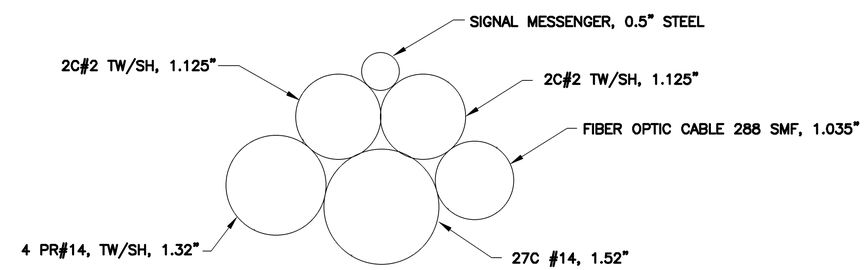
K-104
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\9 K-104.dwg Time:Aug07,2014-08:36am Login:porter Dimscale:1 LTScale:1
Images: 3.75"DIA Logo.jpg
Image: 0.6" Dia Logo.jpg

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	159	175

SIGNAL SYSTEM PARTICULARS	UNITS	SIGNAL MESSENGER	SIGNAL CROSS-SPAN MESSENGER	SIGNAL CABLE (1)	SIGNAL CABLE (2)	SIGNAL CABLE (3)	FIBER OPTIC
TYPE	–	1/2" 7 STRAND		4PR#14	2C#2 TW/SH	27C#14	288SMF
MATERIAL	–	H.S. STEEL GALV.		CU	CU	CU	FIBER
DIAMETER	IN.	0.5"		1.32"	1.125"	1.52"	1.035"
CROSS SECTIONAL AREA	Sq.In.	–					
WEIGHT OF CONDUCTOR	LB/FT	.517		0.387	770 (EA)	1.216	0.335
WEIGHT OF SYSTEM (FOR SAG CALC)	LB/FT	3.000					
CONDUCTOR BREAKING LOAD	LB	18800					9000
MODULUS OF ELASTICITY	PSI	27×10^6					
COEFFICIENT OF EXPANSION	–/° F	6.5×10^{-6}					
MAXIMUM SPAN	FT	220	40				
MESSENGER TENSIONS AT:							
70° F NO WIND	LB	4500	600	–			
125° F NO WIND	LB	2480	500	–			
25° F NO WIND	LB	7646	950	–			
–5° F NO WIND	LB	10135	1200	–			
CONDUCTOR SAG ON 230 FT SPAN AT:							
70° F NO WIND	FT	4.40	N/A	–			
125° F NO WIND	FT	7.98	N/A	–			
25° F NO WIND	FT	2.59	N/A	–			
–5° F NO WIND	FT	1.96	N/A	–			
MINIMUM FACTOR OF SAFETY	–	1.85	N/A	–			

ANCILLARY WIRES			
MATERIAL	DESCRIPTION	BREAKING LOAD (MIN.)	USAGE
STAINLESS STEEL	7/19 AIRCRAFT WIRE		HANGERS
GALV. STEEL	HIGH STRENGTH – 3/8"	15,000 LB	PULL OFF'S & CROSS SPANS
GALV. STEEL	HIGH STRENGTH – 1/2" 19 STRAND	19,000 LB	TERMINATION & MIDSPAN GUYS
STAINLESS STEEL	19/17 NONROTATING – 1/2"	20,500 LB	COUNTERWEIGHT PULLEY ROPE
GALV. STEEL	HIGH STRENGTH – 5/8"	29,600 LB	DOWN GUYS
COPPER	4/0 19 STRAND	5,983 LB	OCS POLE GROUNDING
COPPER	4/0 19 STRAND	5,983 LB	OVERHEAD BRIDGE GROUNDING
COPPER	4/0 19 STRAND	5,983 LB	SUBSTATION GROUND MAT



REVISIONS				
MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77484 Aug 7, 2014 CIVIL STATE OF CALIFORNIA

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

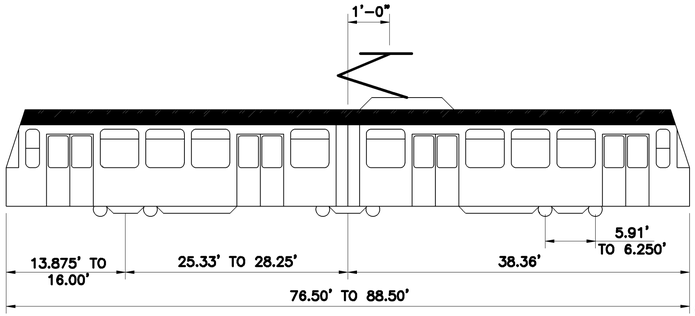
NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
TECHNICAL SHEET
ANCILLARY WIRES

K-105
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\10 K-105.dwg Time:Aug07,2014-08:36am Login:porter Dimscale:1 LTScale:1
Project: by: STORA Layout: 1
Image: by: STORA

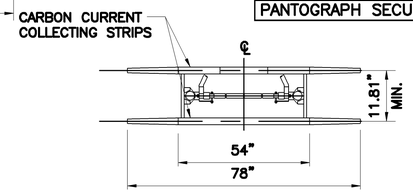
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	160	175



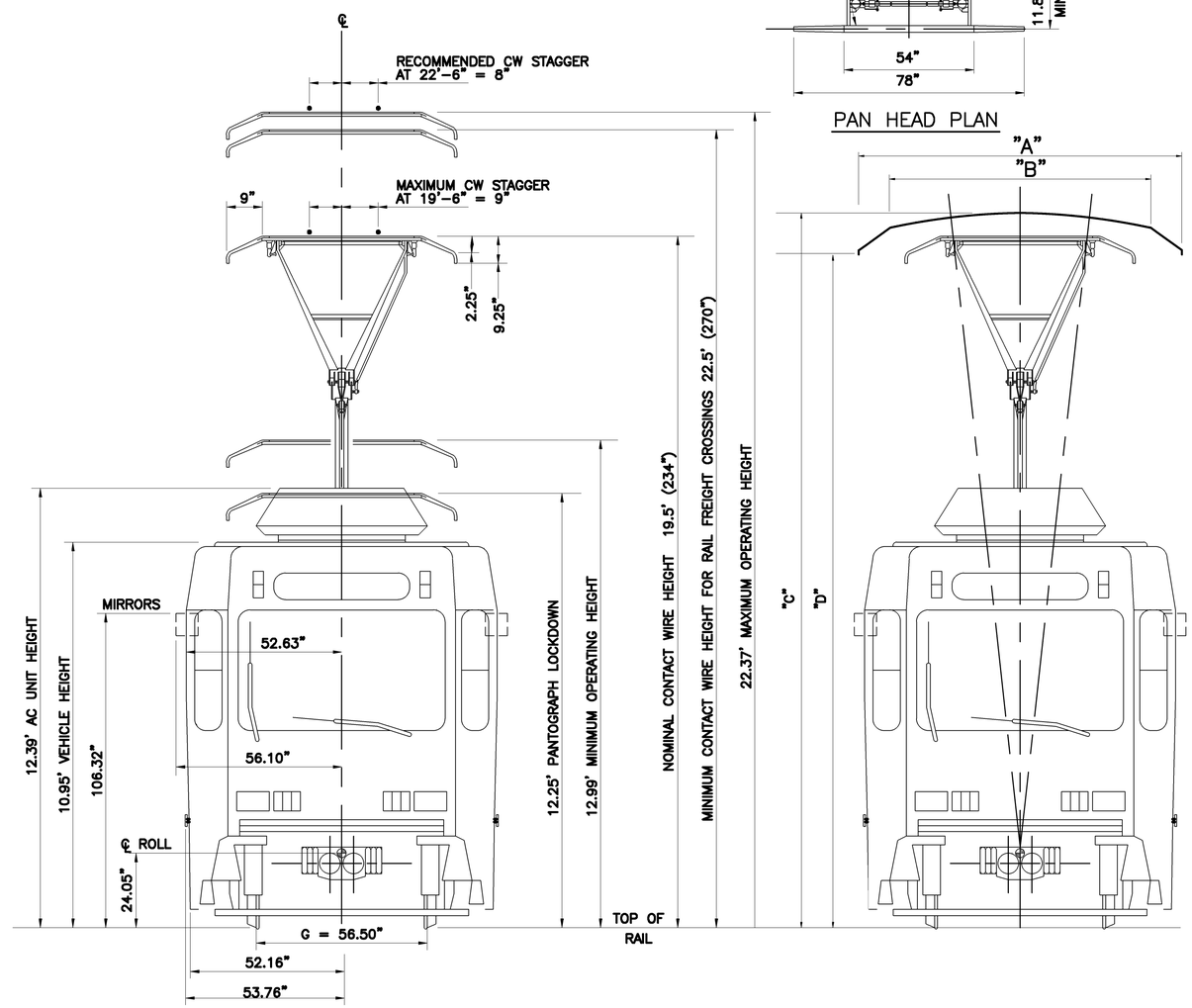
VEHICLE CRITERIA

PANTOGRAPH DYNAMIC ENVELOPE DIMENSIONS	LIVE ASSEMBLIES (NOTE1)						GROUNDED STRUCTURES (NOTE 2)					
DESCRIPTION	INCHES	FEET	INCHES	FEET	INCHES	FEET	INCHES	FEET	INCHES	FEET	INCHES	FEET
CONTACT WIRE HEIGHT	168.00	14.00	234.00	19.50	270.00	22.50	168.00	14.00	234.00	19.50	270.00	22.50
MAXIMUM PANTOGRAPH ENVELOPE WIDTH "A" (NOTE 6)	107.84	8.99	118.62	9.89	121.26	10.11	120.23	10.02	136.32	11.36	139.65	11.64
PANTOGRAPH ENVELOPE WIDTH "B"	89.84	7.49	100.62	8.39	103.26	8.61	102.23	8.52	118.32	9.86	121.65	10.14
MAXIMUM PANTOGRAPH ENVELOPE HEIGHT "C" (NOTE 7)	175.00	14.58	241.00	20.08	277.00	23.08	178.00	14.83	244.00	20.33	280.00	23.33
PANTOGRAPH HEIGHT AT HORNS "D"	164.05	13.67	229.88	19.16	265.86	22.16	166.52	13.88	232.04	19.34	267.98	22.33

PANTOGRAPH SECURITY	REGISTRATION POINT						MIDSPAN					
DESCRIPTION	INCHES	FEET	INCHES	FEET	INCHES	FEET	INCHES	FEET	INCHES	FEET	INCHES	FEET
CONTACT WIRE HEIGHT	168.00	14.00	234.00	19.50	270.00	22.50	168.00	14.00	234.00	19.50	270.00	22.50
PANTOGRAPH SECURITY	14.39	1.20	10.04	0.84	7.68	0.64	7.99	0.67	5.09	0.42	3.51	0.29



PAN HEAD PLAN



VEHICLE DIMENSIONS

PANTOGRAPH CLEARANCE ENVELOPE

NOTES:

1. LIVE ASSEMBLIES ARE ALL OCS ASSEMBLIES THAT ARE INSULATED FROM GROUND BY AT LEAST ONE LEVEL OF RATED INSULATION AND NOT CONNECTED TO A CIRCUIT OTHER THAN THE CIRCUIT POWERING THE PANTOGRAPH.
2. GROUNDED STRUCTURES ARE OCS STRUCTURES THAT ARE CONNECTED TO A GROUNDING SYSTEM AND INSULATED FROM THE CIRCUIT CONNECTED TO THE PANTOGRAPH BY TWO LEVELS OF INSULATION.
3. LATERAL TRACK, OCS AND VEHICLE ALLOWANCES IS THE SUM OF THE TRACK HORIZONTAL ALIGNMENT, THE VEHICLE LATERAL SHIFT, THE PANTOGRAPH SWAY, THE OCS TOLERANCES AND THE POLE DEFLECTION.
4. LATERAL SHIFT AT CONTACT WIRE HEIGHT DUE TO VEHICLE SWAY FOR LIVE ASSEMBLIES IS THE OFFSET AT THE CONTACT WIRE HEIGHT ABOVE THE VEHICLE ROLL CENTER HEIGHT DUE TO THE RECOVERABLE VEHICLE ROLL ANGLE.
5. LATERAL SHIFT AT CONTACT WIRE HEIGHT DUE TO VEHICLE SWAY FOR GROUNDED STRUCTURES IS THE OFFSET AT THE CONTACT WIRE HEIGHT ABOVE THE VEHICLE ROLL CENTER HEIGHT DUE TO THE MAXIMUM VEHICLE ROLL (BROKEN SPRINGS).
6. MAXIMUM PANTOGRAPH ENVELOPE WIDTH IS THE SUM OF THE PANTOGRAPH WIDTH, TWICE THE LATERAL SHIFTS AND THE CLEARANCES.
7. MAXIMUM PANTOGRAPH ENVELOPE HEIGHT IS THE SUM OF VERTICAL TRACK, OCS AND VEHICLE ALLOWANCES INCLUDING PANTOGRAPH UPLIFT, CARBON WEAR, OCS TOLERANCES AND CONTACT WIRE WEAR.
8. PANTOGRAPH SECURITY CALULATIONS APPLY 50% OF VEHICLE AND PANTOGRAPH SWAY AT MAXIMUM OPERATING WIND PRESSURE IN ACCORDANCE WITH AREMA.
9. PANTOGRAPH SECURITY CALCULATIONS APPLY STAGGER CHANGE AT 2200' FROM MIDPOINT AT 150 DEGREES ON 10'-0" CANTILEVER REACH.
10. PANTOGRAPH SECURITY CALCULATIONS APPLY STAGGER EFFECT FOR STAGGER DIFFERENTIAL OF 6", BLOW OFF OF 8.5" AND VERSINE OF 2".
11. PANTOGRAPH SECURITY CALCULATIONS APPLY BLOW OFF AND MIDSPAN OFFSET FOR SPAN LENGTH OF 200'-0" FOR CATENARY SYSTEM.
12. PANTOGRAPH SECURITY CALCULATIONS APPLY LATERAL SHIFT AT CONTACT WIRE HEIGHT DUE TO VEHICLE SWAY FOR OPERATING CONDITIONS USING THE RECOVERABLE VEHICLE ROLL ANGLE.
13. PANTOGRAPH SECURITY CALCULATIONS APPLY NO WIND PRESSURE AT REGISTRATION, MAXIMUM WIND PRESSURE AT MIDSPAN.
14. MECHANICAL PASSING CLEARANCE IS 1".
15. ELECTRICAL CLEARANCE IS 0" TO LIVE ASSEMBLIES AND 3" TO GROUNDED STRUCTURES.
16. DIMENSIONS ARE FROM SUPERELEVATED TRACK CENTERLINE.
17. DIMENSIONS FOR ALL OTHER CONTACT WIRE HEIGHTS MAY BE INTERPOLATED.
17. CONTRACTOR TO VERIFY VEHICLE DIMENSIONS WITH RT.

OCS PARAMETERS		
DESCRIPTION	INCHES	FEET
WIRE LENGTH – FIXED TO AUTO TENSIONED EQUIPMENT	33600.00	2800.00
MAXIMUM DESIGN STAGGER	9.00	0.75
VERTICAL ERECTION AND MAINTENANCE TOLERANCE	1.00	0.08
HORIZONTAL ERECTION & MAINTENANCE TOLERANCE	1.00	0.08
HORIZONTAL POLE DEFLECTION AT CWH DUE TO WIND	2.00	0.17
MAXIMUM POLE DEFLECTION AT ANY HEIGHT	2.5% OF HEIGHT	
CONTACT WIRE WEAR	0.25	0.02

PANTOGRAPH PARAMETERS		
DESCRIPTION	INCHES	FEET
OVERALL WIDTH OVER HORNS	78.00	6.50
CARBON WIDTH	54.00	4.50
WIDTH OVER HORN POINTS OF INTERSECTION	60.00	5.00
LOCKDOWN HEIGHT	146.85	12.24
MINIMUM OPERATING HEIGHT	155.91	12.99
MAXIMUM OPERATING HEIGHT	268.39	22.37
MAXIMUM HEIGHT	275.65	22.97
PANTOGRAPH OFFSET FROM CENTER OF TRUCK	12.00	1.00
UPLIFT ON CONTACT WIRE DUE TO PANTOGRAPH	3.00	0.25
PANTOGRAPH SWAY AT ALL HEIGHT	1.50	0.13
PANTOGRAPH UPLIFT PRESSURE	18LB	
PANTOGRAPH CARBON WEAR	0.75	0.06

TRACK PARAMETERS	INCHES	FT
AREMA TRACK CLASS 4 BALLAST TRACK		
GAUGE	56.50	4.71
HORIZONTAL ALIGNMENT TOLERANCE	1.50	0.13
CROSSLEVEL ALIGNMENT TOLERANCE	1.25	0.10
GAUGE TOLERANCE	0.50	0.04
MAXIMUM SUPER ELEVATION	6.00	0.50
MINIMUM RADIUS	984.00	82.00

VEHICLE PARAMETERS (NOTE 18)	UTDC		SIEMENS U2A		CAF	
	INCHES	FEET	INCHES	FEET	INCHES	FEET
VEHICLE LENGTH OVER BODY			920.50	76.71	972.80	81.07
VEHICLE LENGTH OVER COUPLER			954.30	79.53	1004.72	83.73
VEHICLE WIDTH OVER MIRRORS	109.00	9.08	116.30	9.69	123.00	10.25
VEHICLE WIDTH OVER BODY	106.30	8.86	104.30	8.69	105.24	8.77
VEHICLE HEIGHT TO TOP OF MIRRORS	114.00	9.50	105.00	8.75	108.30	9.03
VEHICLE HEIGHT TO TOP OF ROOF SCREEN	135.50	11.29	112.70	9.39	119.60	9.97
VEHICLE HEIGHT TO TOP OF EQUIPMENT	150.00	12.50	127.40	10.62	127.60	10.63
TRUCK ROLL CENTER HEIGHT (AW2)	23.90	1.99	24.84	2.07	24.06	2.01
LATERAL SUSPENSION MOTION	1.48	0.12	1.61	0.13	1.81	0.15
VEHICLE WHEELBASE	339.00	28.25	303.90	25.33	317.70	26.48
MAXIMUM VEHICLE ROLL TO STOPS (IN DEGREES)	3.20	0.27	4.00	0.33	4.30	0.36
MAXIMUM RECOVERABLE ROLL (IN DEGREES)	2.50	0.21	2.50	0.21	2.50	0.21

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 71489 CIVIL STATE OF CALIFORNIA
Exp. Aug 2, 2014

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

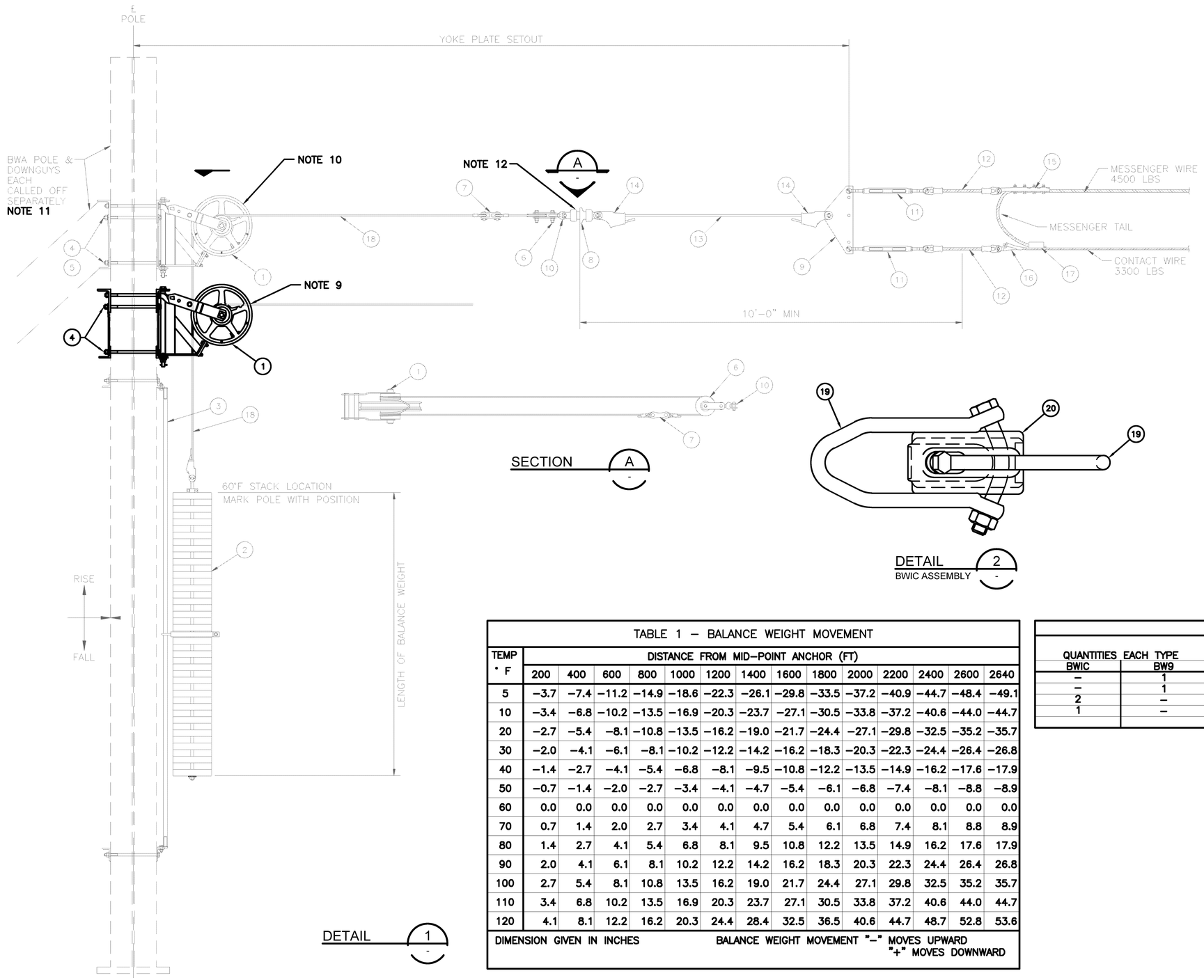
NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
TECHNICAL SHEET
PANTOGRAPH DYNAMIC ENVELOPE

K-106
SHEET

P:\Projects\B-Current Projects\C4580 PSGMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\11 K-106.dwg Time:Aug07,2014-08:36am Login:porter Dimscale:1 LTScale:1
Image: Hide: STDA, bdrp.jpg
Image: Hide: STDA, bdrp.jpg

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	161	175



NOTES:

1. THE ASSEMBLY SHALL APPLY A COMBINED TENSION TO THE MESSENGER AND CONTACT WIRES.
2. TENSION ASSEMBLY SHALL HAVE A RATIO OF 1:3. TENSION ASSEMBLY SHALL BE DESIGNED SO THAT IT WILL BECOME LOCKED IN CASE OF A TENSION RELIEF.
3. THE INFORMATION FURNISHED IN TABLE 1 IS BASED ON A 1:3 RATIO PULLEY SYSTEM AND IS PROVIDED FOR REFERENCE ONLY. CONTRACTOR SHALL DETERMINE THE ACTUAL BALANCE WEIGHT MOVEMENT, BASED ON ACTUAL PULLEY AND BALANCE WEIGHT ASSEMBLIES PROVIDED.
4. THE BALANCE WEIGHT SHALL MOVE FREELY WITHIN THE TEMPERATURE RANGE OF 5° F TO 120° F, AND WITHIN THE SPACE GIVEN BETWEEN BWA TERMINATION AND TOP OF BASEPLATE. TEMPERATURE STOP CLAMPS SHALL BE INSTALLED TO PREVENT BALANCE WEIGHT MOVEMENT BEYOND THE SET TEMPERATURE RANGE.
5. THE MOUNTING ARRANGEMENT OF BALANCE WEIGHT ASSEMBLY AS SHOWN IS TYPICAL. THE CONTRACTOR SHALL DEVELOP THE DESIGN BASED ON THE EQUIPMENT ACTUALLY USED AND THE MANUFACTURER'S RECOMMENDATIONS AS APPROVED BY THE RESIDENT ENGINEER.
6. THE CONTRACTOR SHALL INSURE THAT NO INTERFERENCE OCCURS BETWEEN ALL POLE CLAMPS & BRACKETS AND THE BWA–WIRE ROPE TERMINATIONS FOR THEIR TOTAL VERTICAL TRAVEL. PROVIDE A MINIMUM OF 2" OF FREE SPACE TO ALL MOVING WIRE COMPONENTS.
7. THE BILL OF MATERIALS DETAILS ARE TYPICAL FOR THE ASSEMBLY STYLES SHOWN. THE CONTRACTOR SHALL ITEMIZE THE TABLE WITH DESCRIPTIONS AND PART NUMBERS OF COMPONENTS REQUIRED TO COMPLETE EACH ASSEMBLY.
8. THE TENSIONING WHEEL ASSEMBLY SHALL BE ABLE TO ALIGN ITSELF IN THE DIRECTION OF PULL OF THE OCS WIRING.
9. TRANSFER EXISTING OCS WIRE RUN TO TEMPORARY TENSION WHEEL ASSEMBLY BW9.
10. REMOVE EXISTING TENSION WHEEL IF REQUIRED TO CREATE ADEQUATE CLEARANCE FOR THE TEMPORARY TENSION WHEEL.
11. IF REMOVAL OF EXISTING TENSION WHEEL IS REQUIRED FOR CLEARANCE, CONTRACTOR SHALL NOT REMOVE OR ADJUST DOWNGUY.
12. REPLACE EXISTING INSULATOR WITH GUY STRAIN INSULATOR AND STRAIN INSULATOR CLEVISES AS SHOWN IN DETAIL 2.
13. CENTER WEIGHT STACK AT THE 60 DEGREE FAHRENHEIT MARK.

TABLE 1 – BALANCE WEIGHT MOVEMENT

TEMP °F	DISTANCE FROM MID–POINT ANCHOR (FT)													
	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2640
5	–3.7	–7.4	–11.2	–14.9	–18.6	–22.3	–26.1	–29.8	–33.5	–37.2	–40.9	–44.7	–48.4	–49.1
10	–3.4	–6.8	–10.2	–13.5	–16.9	–20.3	–23.7	–27.1	–30.5	–33.8	–37.2	–40.6	–44.0	–44.7
20	–2.7	–5.4	–8.1	–10.8	–13.5	–16.2	–19.0	–21.7	–24.4	–27.1	–29.8	–32.5	–35.2	–35.7
30	–2.0	–4.1	–6.1	–8.1	–10.2	–12.2	–14.2	–16.2	–18.3	–20.3	–22.3	–24.4	–26.4	–26.8
40	–1.4	–2.7	–4.1	–5.4	–6.8	–8.1	–9.5	–10.8	–12.2	–13.5	–14.9	–16.2	–17.6	–17.9
50	–0.7	–1.4	–2.0	–2.7	–3.4	–4.1	–4.7	–5.4	–6.1	–6.8	–7.4	–8.1	–8.8	–8.9
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70	0.7	1.4	2.0	2.7	3.4	4.1	4.7	5.4	6.1	6.8	7.4	8.1	8.8	8.9
80	1.4	2.7	4.1	5.4	6.8	8.1	9.5	10.8	12.2	13.5	14.9	16.2	17.6	17.9
90	2.0	4.1	6.1	8.1	10.2	12.2	14.2	16.2	18.3	20.3	22.3	24.4	26.4	26.8
100	2.7	5.4	8.1	10.8	13.5	16.2	19.0	21.7	24.4	27.1	29.8	32.5	35.2	35.7
110	3.4	6.8	10.2	13.5	16.9	20.3	23.7	27.1	30.5	33.8	37.2	40.6	44.0	44.7
120	4.1	8.1	12.2	16.2	20.3	24.4	28.4	32.5	36.5	40.6	44.7	48.7	52.8	53.6

DIMENSION GIVEN IN INCHES

BALANCE WEIGHT MOVEMENT "–" MOVES UPWARD
"+" MOVES DOWNWARD

BILL OF MATERIALS

QUANTITIES EACH TYPE BWIC	BW9	DESCRIPTION	ITEM NO.	PART NO./REMARKS
–	1	TENSIONING WHEEL ASSEMBLY	1	
–	1	MOUNTING BRACKETS WIDE FLANGE POLE	4	
2	–	HEAVY STRAIN INSULATOR CLEVIS	19	
1	–	GUY STRAIN INSULATOR	20	

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 71489 CIVIL STATE OF CALIFORNIA
Expires Aug 7, 2015

CI:
FILE:
SUBMITTAL:
5/23/14

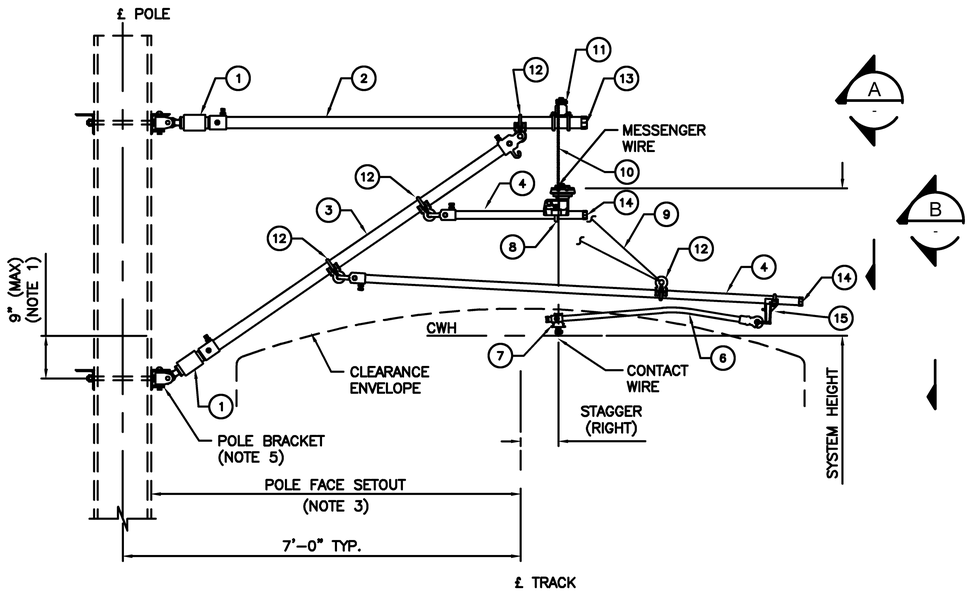
Regional Transit

NATOMA OCS WIDENING PROJECT
OVERHEAD CONTACT SYSTEM
BALANCE WEIGHT TERMINATION ARRANGEMENTS
TYPES BW9 (WIDE FLANGE) FOR TEMPORARY OCS
AND BWIC FOR BALANCE WEIGHT INSULATOR CHANGE

K-110
SHEET

P:\Projects\B-Current Projects\C4580 PSGMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\12 K-110.dwg Time:Aug07,2014-08:36am Login:porter Dimscale:1 LTScale:1
Image: BW9-BWIC.jpg
Image: BW9-BWIC.jpg

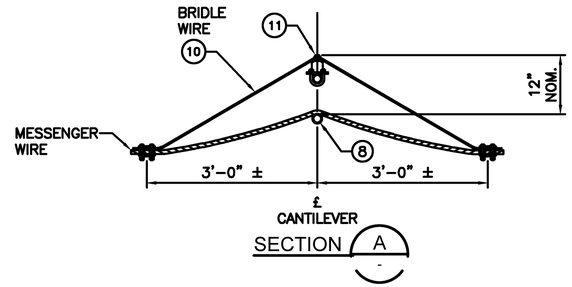
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	162	175

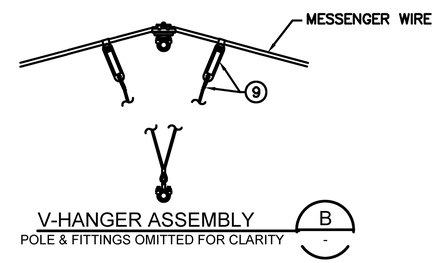


REDUCED SYSTEM HEIGHT MEDIUM PUSH/PULL

ASSEMBLY CA-15 PULL OFF RADIAL LOAD FROM 200-500 LB

ASSEMBLY CA-15 PUSH OFF RADIAL LOAD FROM 80-500 LB (AS SHOWN)





NOTES:

1. LOWER BRACKET TO CONTACT WIRE DIMENSION OF 9" IS FOR 7'-0" POLE TO CENTERLINE OF TRACK OFFSET. THIS DIMENSION MAY BE INCREASED 1" FOR EACH 6" INCREASE IN POLE OFFSET DIMENSION.
2. SUPPLIER MAY OFFER ALTERNATIVE CANTILEVER DESIGN WITHOUT BRACE.
3. FIELD VERIFY THIS DIMENSION PRIOR TO FABRICATION OF CANTILEVER ASSEMBLY.
4. FOR CATENARY DETAILS AT EACH LOCATION, SEE APPROPRIATE OCS LAYOUT SCHEDULE.
5. POLE BRACKET ASSEMBLY CALLED OFF SEPARATELY.
6. CONTRACTOR SHALL DETERMINE COMPONENT DETAILS AND LOADING LIMITS.

BILL OF MATERIALS

DESCRIPTION	ITEM NO.	PART NO./ REMARKS
CANTILEVER INSULATOR	1	
TOP PIPE W/ END FITTINGS	2	
STRUT PIPE W/ END FITTINGS	3	
REGISTRATION PIPE W/END FITTINGS	4	
STAEDY ARM	5	
STEADY ARM, CURVED	6	
CONTACT WIRE SWIVEL & INSULATOR	7	
MESSENGER WIRE CLAMP, INSULATED	8	
V-HANGER ASSEMBLY W/ INSUALTORS	9	
M/W BRIDLE ASSEMBLY W/ M/W CLAMPS	10	
BRIDLE INSULATOR	11	
EYE CLAMPS	12	
SYNTHETIC CAP, 2" PIPE	13	
SYNTHETIC CAP, REGISTRATION PIPE	14	
DROP BRACKET, SINGLE STEADY ARM	15	

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA
Expiration Date: Aug 7, 2014

CI:
FILE:
SUBMITTAL: 5/23/14

Regional Transit

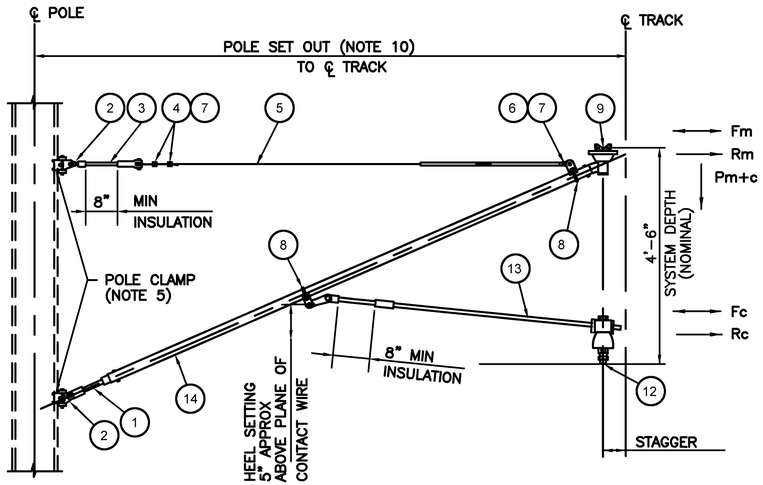
NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
REDUCED HEIGHT CANTILEVER PUSH OFF ASSEMBLY
SYSTEM HEIGHT 18" - 36" CA-15

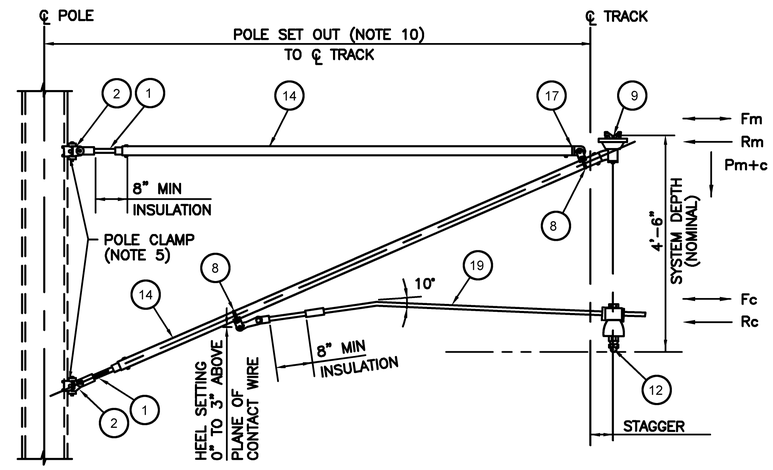
K-111
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD CEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\13 K-111.dwg TimeAug07,2014-08:36am Login:porter Dimscale:1 LTScale:1
Image: ltk_title_block_v1.jpg
Image: ltk_logo.jpg

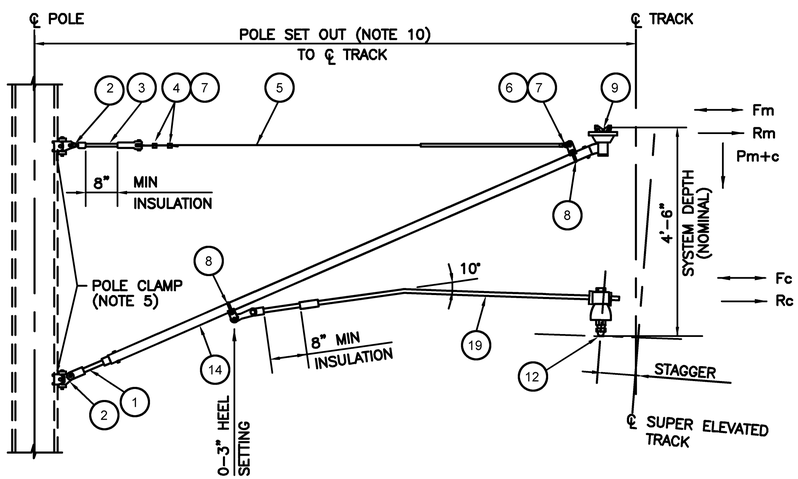
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	163	175



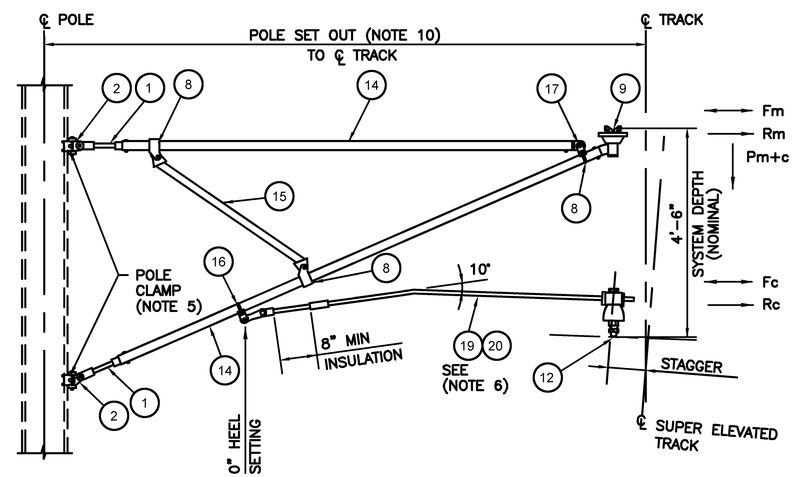
TYPE CA1
PULL OFF TANGENT TRACK CANTILEVER
LIGHT DUTY LOAD



TYPE CA2
PUSH OFF TANGENT TRACK CANTILEVER
LIGHT DUTY LOAD



TYPE CA3
PULL OFF CURVED TRACK CANTILEVER
MEDIUM RADIAL LOADS



TYPE CA4
PULL OFF CURVED TRACK CANTILEVER
HEAVY RADIAL LOAD

NOTES:

1. SWIVEL HINGE SHALL PERMIT CANTILEVER ASSEMBLY TO FREELY MOVE THROUGHOUT 180° RANGE.
2. HARDWARE SHALL BE SUITABLE FOR THE RANGE OF DIMENSIONS AND LOADINGS INDICATED.
3. ALTERNATIVE ASSEMBLY CONFIGURATIONS MAY BE USED IF ELECTRICAL AND MECHANICAL FUNCTIONS ARE EQUIVALENT AND APPROVED BY THE ENGINEER.
4. REFER TO TECHNICAL SHEET DWGS FOR REQUIRED FACTORS OF SAFETY. LOADINGS SHOWN ARE FOR MAXIMUM WORKING LOADS.
5. FOR POLE CLAMPS AND/OR BAND DETAILS FOR CANTILEVERS, SEE APPROPRIATE DRAWING. FOR LOCATION SEE OCS PLAN AND LAYOUT SCHEDULE K-200 SERIES DWGS.
6. CANTILEVER CA-4 SHALL HAVE TWO STEADY ARMS.
7. FOR STAGGERS SEE OCS LAYOUT SCHEDULE DRAWINGS.
8. BOTTOM POLE CANTILEVER BRACKET TO BE AT 6" BELOW NOMINAL IN-RUNNING CONTACT WIRE HEIGHT AT 7'-0" OFFSET; TO 2'-2" BELOW IN-RUNNING CONTACT WIRE HEIGHT AT 12'-0' OFFSET.
9. TOP TUBE MAY BE SUBSTITUTED FOR THE TOP TIE ARRANGEMENTS SHOWN ON CA1, CA2, & CA3.
10. CONTRACTOR TO VERIFY DIMENSIONS AND SUBMIT A COMPLETED MAXIMUM LOADING TABLE.

PARTS LIST	PART No	REMARKS
'Y' CLEVIS EYE	20	
INSULATED STEADY ARM W/10° BEND	19	
EYE-END FITTING FOR PIPE	17	
CLEVIS PIPE CLAMP FOR 2 ARMS	16	
5/8"x1 1/2" STRAP	15	
SUPPORT PIPE 2" DIA SCH 40	14	
INSULATED STEADY ARM	13	
C.W. SWIVEL CLAMP	12	
MESSENGER SADDLE (INSULATED)	9	
CLEVIS PIPE CLAMP	8	
3/8" THIMBLE (CLOSED)	7	
SPIRAL GUY GRIP	6	
3/8" WIRE ROPE	5	
GUY CLIP	4	
STRAIN INSULATOR - CLEVIS/EYE	3	
SWIVEL HINGE WITH PIN	2	
STRUT INSULATOR	1	

MAXIMUM LOADING TABLE (LB) (NOTE 10)

CANTILEVER TYPE	CAT LOAD	MESSENGER		CONTACT WIRE	
	VERTICAL Pm+c	RADIAL Rm	WIND Fm	RADIAL Rc	WIND Fc
CA1					
CA2					
CA3					
CA4					

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER
JEFFREY J. BOERMA
C 77489
Jeffrey J. Boerma
Expires Aug 7, 2014
CIVIL
STATE OF CALIFORNIA

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

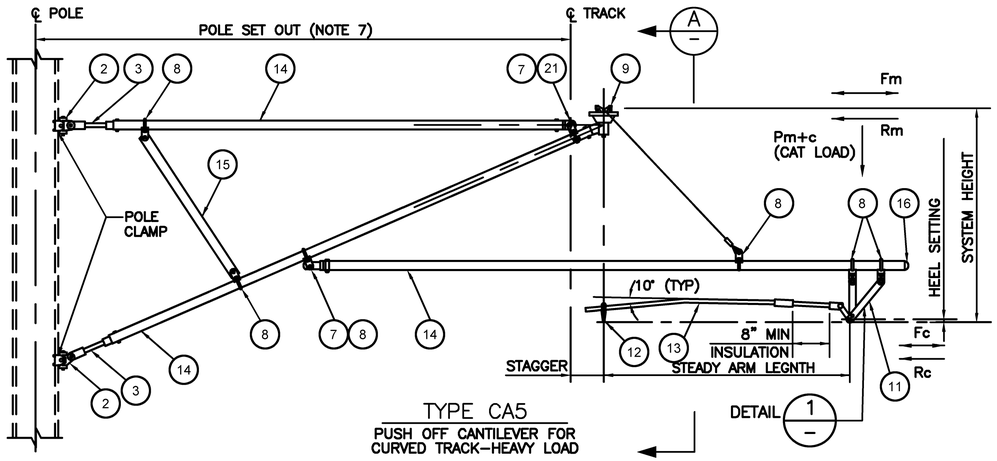
NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
CANTILEVER ASSEMBLY TYPES
CA1, CA2, CA3, CA4

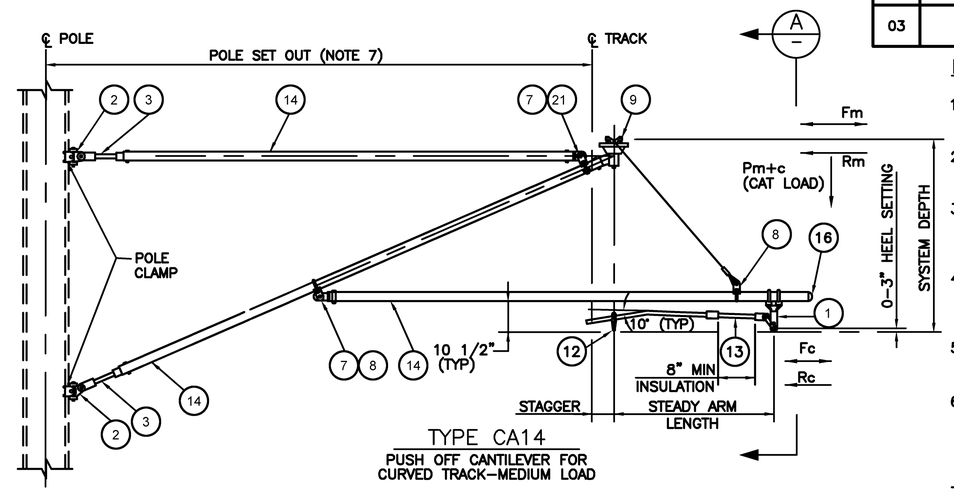
K-112
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\14 K-112.dwg Time:Aug07,2014-08:36am Login:spotter Dimscale:1 LTScale:1
Images: None
Xrefs: TB-STRCA, TB-Base
Layouts: K-112

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	164	175



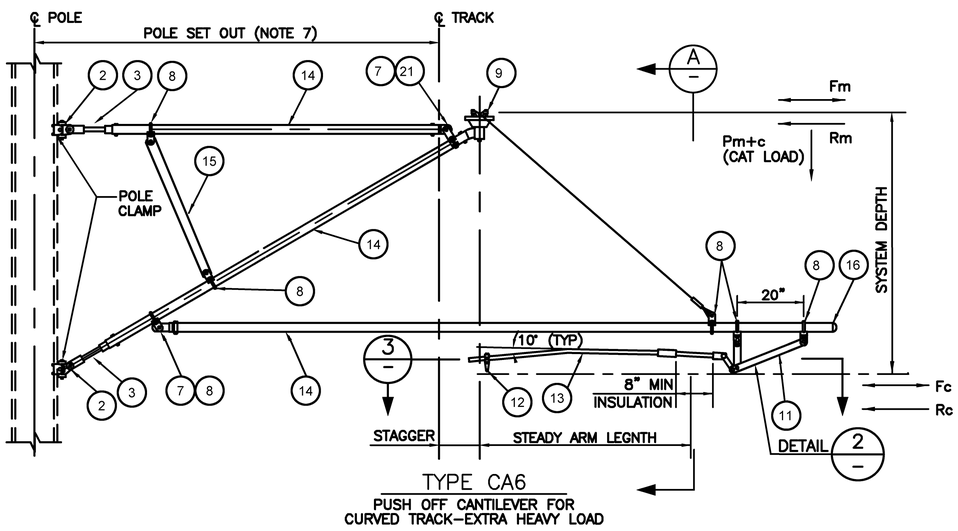
TYPE CA5
PUSH OFF CANTILEVER FOR CURVED TRACK–HEAVY LOAD



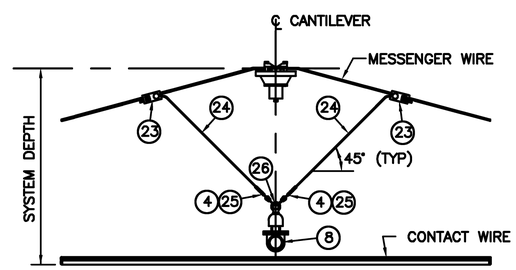
TYPE CA14
PUSH OFF CANTILEVER FOR CURVED TRACK–MEDIUM LOAD

NOTES:

1. SWIVEL HINGE SHALL PERMIT CANTILEVER. ASSEMBLY TO FREELY MOVE THROUGHOUT 180° RANGE.
2. HARDWARE SHALL BE SUITABLE FOR THE. RANGE OF DIMENSIONS AND LOADINGS INDICATED.
3. ALTERNATIVE ASSEMBLY CONFIGURATIONS. MAY BE USED IF ELECTRICAL AND MECHANICAL FUNCTIONS ARE EQUIVALENT AND APPROVED BY THE ENGINEER.
4. REFER TO TECHNICAL SHEET DWGS FOR REQUIRED FACTORS OF SAFETY. LOADINGS SHOWN ARE FOR MAXIMUM WORKING LOADS.
5. TWO STEADY ARMS REQUIRED FOR ASSEMBLY. TYPE CA6.
6. BOTTOM POLE CANTILEVER BRACKET TO BE AT 6" BELOW NOMINAL IN–RUNNING CONTACT WIRE HEIGHT AT 7'–0" OFFSET; TO 2'–2" BELOW IN–RUNNING CONTACT WIRE HEIGHT AT 12'–0' OFFSET.
7. CONTRACTOR TO VERIFY DIMENSIONS AND SUBMIT A COMPLETED MAXIMUM LOAD TABLE.



TYPE CA6
PUSH OFF CANTILEVER FOR CURVED TRACK–EXTRA HEAVY LOAD

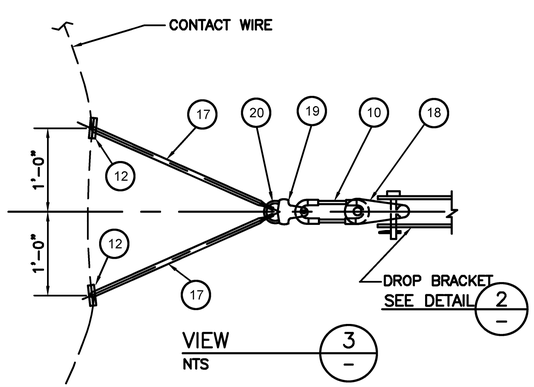


ELEVATION A
V–HANGER

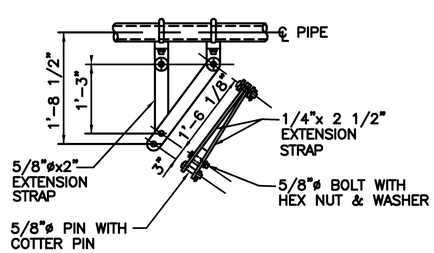
MAXIMUM LOADING TABLE (LB) (NOTE 7)

CANTILEVER TYPE	CAT LOAD	MESSENGER		CONTACT WIRE	
	VERTICAL Pm+c	RADIAL Rm	WIND Fm	RADIAL Rc	WIND Fc
CA14					
CA5					
CA6 (NOTE 9)					

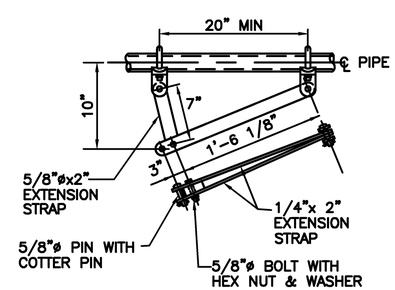
PARTS LIST	PART No	REMARKS
STRAIN INSULATOR WITH EYE BOLT	26	
1/4" THIMBLE CLOSED	25	
1/4" STAINLESS STEEL WIRE ROPE	24	
TWO BOLT WIRE CLAMP	23	
DROP BRACKET ASSEMBLY FOR EXTRA HEAVY LOAD	22	STEEL GALV
DOUBLE CLEVIS PIPE CLAMP	21	
BOW	20	
FISHPLATE	19	
SHACKLE FOR LOOP INSULATOR	18	
UNINSULATED STEADY ARM	17	
PIPE CAP	16	
5/8" x 1 1/2" STRAP	15	STEEL GALV
SUPPORT PIPE	14	STEEL GALV
INSULATED STEADY ARM WITH 10° BEND	13	
CONTACT WIRE SWIVEL CLAMP	12	
DROP BRACKET ASSEMBLY FOR HEAVY LOAD	11	STEEL GALV
LOOP INSULATOR	10	
MESSENGER SADDLE	9	
CLEVIS PIPE CLAMP	8	
EYE–END FITTING FOR SUPPORT PIPE	7	IRON GALV
THIMBLE FOR 3/16"ø WIRE ROPE	6	
3/16"ø WIRE ROPE	5	STAINLESS STEEL
COMPRESSION SLEEVE	4	COPPER
STRUT INSULATOR	3	
SWIVEL HINGE WITH PIN	2	
DROP BRACKET CLAMP	1	



VIEW 3
NTS



DETAIL 1
DROP BRACKET
PART No 11



DETAIL 2
DROP BRACKET
PART No 22

REVISIONS				
MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA
Expiration Date: Aug 7, 2016

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

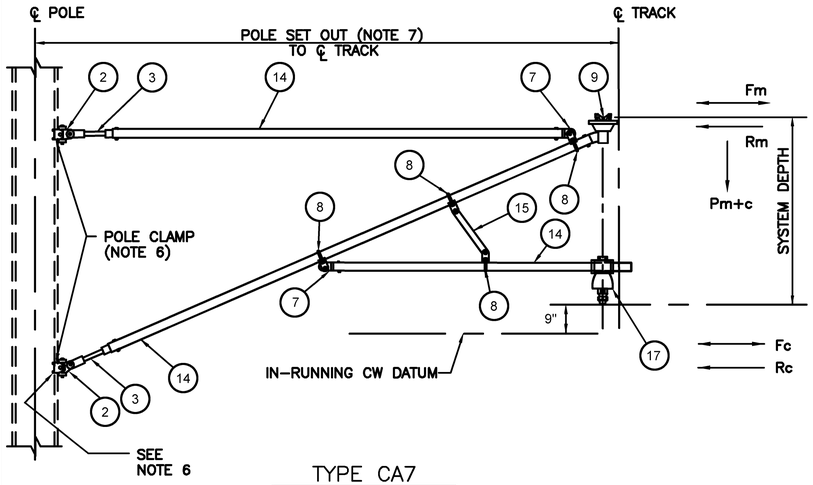
NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
CANTILEVER ASSEMBLY TYPES
CA5, CA6, CA14

K-113
SHEET

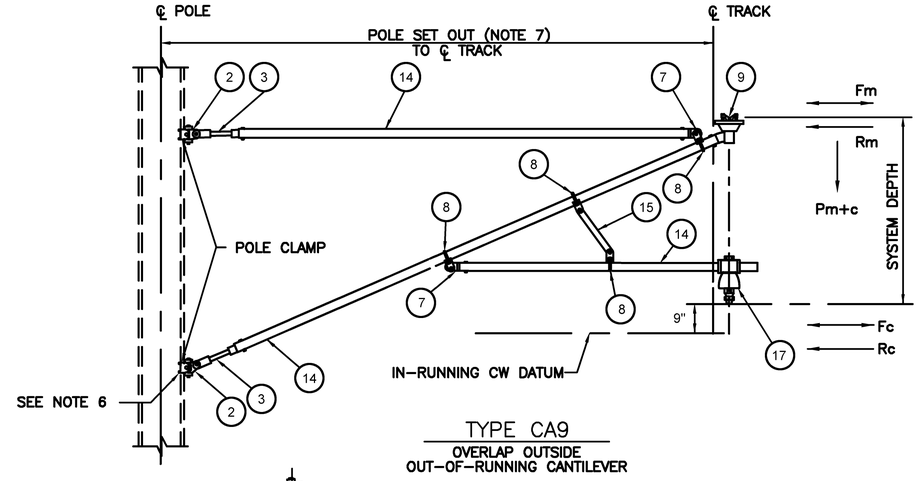
P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\15 K-113.dwg Time:Aug07,2014-08:36am Login:sporter Dimscale:1 LTScale:1
Images: Xrefs: STSTDA Lsdwgs:
Layouts: K-113

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	165	175



TYPE CA7

OVERLAP INSIDE
OUT-OF-RUNNING CANTILEVER

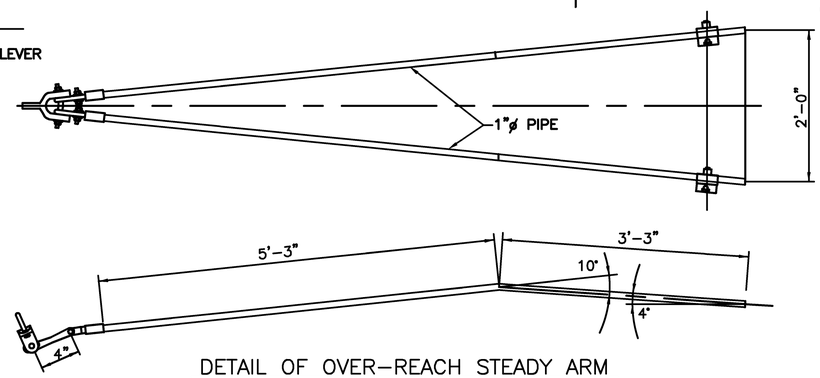


TYPE CA9

OVERLAP OUTSIDE
OUT-OF-RUNNING CANTILEVER

NOTES:

1. SWIVEL HINGE SHALL PERMIT CANTILEVER ASSEMBLY TO FREELY MOVE THROUGHOUT 180° RANGE.
2. HARDWARE SHALL BE SUITABLE FOR THE RANGE OF DIMENSIONS AND LOADINGS INDICATED.
3. ALTERNATIVE ASSEMBLY CONFIGURATIONS MAY BE USED IF ELECTRICAL AND MECHANICAL FUNCTIONS ARE EQUIVALENT AND APPROVED BY THE ENGINEER.
4. REFER TO TECHNICAL SHEET DWGS FOR REQUIRED FACTORS OF SAFETY. LOADINGS SHOWN ARE FOR MAXIMUM WORKING LOADS.
5. FOR STAGGERS SEE OCS PLAN AND LAYOUT SCHEDULE K-200 SERIES DWGS.
6. BOTTOM POLE CANTILEVER BRACKET TO BE AT 6" BELOW NOMINAL IN-RUNNING CONTACT WIRE HEIGHT AT 7'-0" OFFSET; TO 2'-2" BELOW IN-RUNNING CONTACT WIRE HEIGHT AT 12'-0' OFFSET EXCEPT AS SHOWN ON CANTILEVER C12.
7. CONTRACTOR TO VERIFY DIMENSIONS AND SUBMIT A COMPLETED MAXIMUM LOAD TABLE.

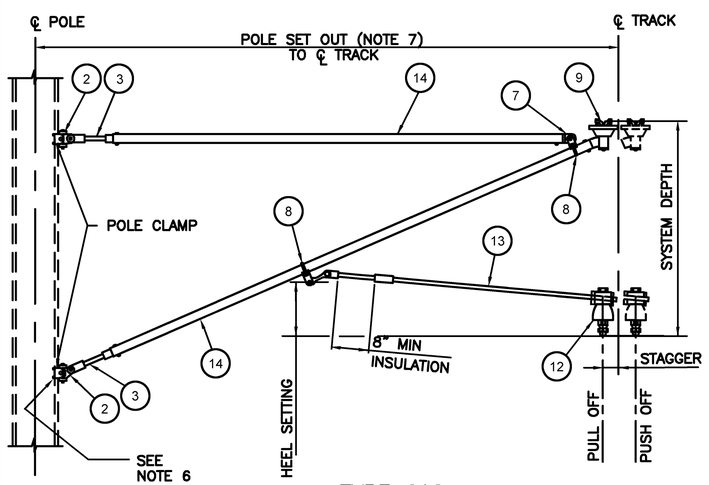


DETAIL OF OVER-REACH STEADY ARM

MAXIMUM LOADING TABLE (LB) (NOTE 7)

CANTILEVER TYPE	CAT LOAD	MESSENGER		CONTACT WIRE	
	VERTICAL Pm+c	RADIAL Rm	WIND Fm	RADIAL Rc	WIND Fc
CA7					
CA8					
CA9					
CA12					

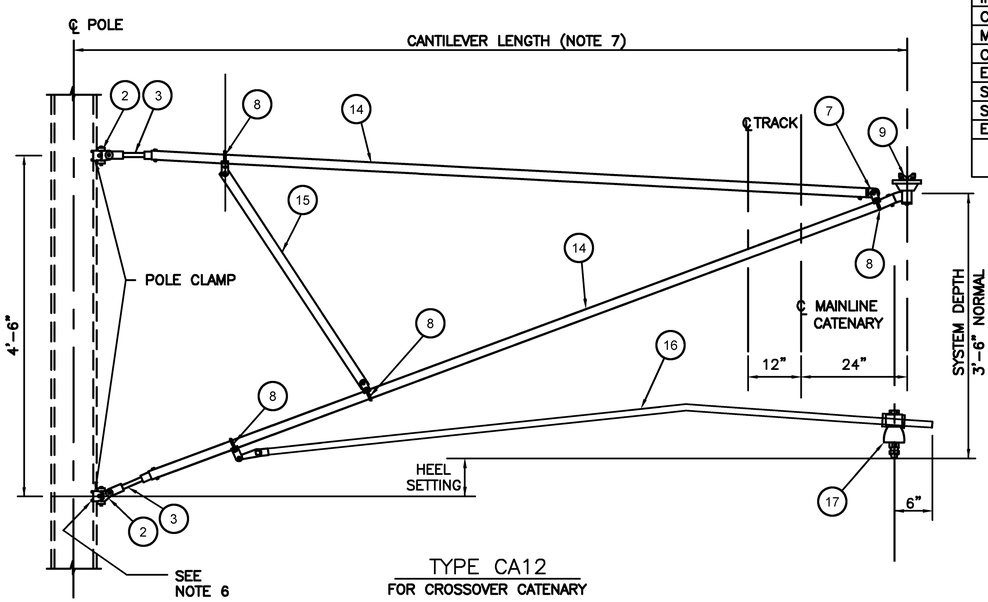
PARTS LIST	PART No	REMARKS
"Y" CLEVIS EYE FITTING	18	
INSULATED CW CLIP ASSEMBLY	17	
OVER REACH STEADY ARM	16	SEE DETAIL
5/8" x 1 1/2" LINK	15	
SUPPORT PIPE 2" ø	14	STEEL GALV
INSULATED STEADY ARM	13	
CONTACT WIRE SWIVEL CLAMP ASSEMBLY	12	
MESSENGER SADDLE (INSULATED)	9	
CLEVIS PIPE CLAMP	8	
EYE-END FITTING FOR SUPPORT PIPE	7	IRON GALV
STRUT INSULATOR	3	
SWIVEL HINGE WITH PIN	2	
EYE-EYE STRAIN INSULATOR	1	



TYPE CA8

MIDPOINT ANCHOR CANTILEVER

TANGENT TO 9000' RADIUS



TYPE CA12

FOR CROSSOVER CATENARY

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER
JEFFREY J. BOERMA
C 77489
CIVIL
STATE OF CALIFORNIA

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
CANTILEVER ASSEMBLY TYPES
CA7, CA8, CA9, CA12

K-114
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\16 K-114.dwg TimeAug07,2014-08:36am Loginsporter Dimscale=1 LTScale=1
Images: ie: STORM LOGO.jpg
Images: ie: STORM LOGO.jpg

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	166	175

STANDARD SPANS: NORMAL SYSTEM HEIGHT (4'-6")

HANGER SET REFERENCE	SPAN (FT)	END SPAN	MID SPAN	NO. OF HANGERS	HANGER LENGTHS (FT)							
		A	B		H_1	H_2	H_3	H_4	H_5	H_6	H_7	H_8
HA–230	230	14.38	28.75	8	3.54	2.14	1.20	0.73	0.73	1.20	2.14	3.54
HA–225	225	14.06	28.13		3.58	2.24	1.34	0.89	0.89	1.34	2.24	3.58
HA–220	220	13.75	27.50		3.62	2.34	1.48	1.05	1.05	1.48	2.34	3.62
HA–215	215	13.44	26.87		3.66	2.43	1.61	1.20	1.20	1.61	2.43	3.66
HA–210	210	15.00	30.00	7	3.59	2.32	1.56	1.31	1.56	2.32	3.59	
HA–205	205	14.64	29.29		3.63	2.42	1.70	1.46	1.70	2.42	3.63	
HA–200	200	14.29	28.57		3.67	2.52	1.83	1.60	1.83	2.52	3.67	
HA–195	195	13.93	27.86		3.71	2.62	1.97	1.75	1.97	2.62	3.71	
HA–190	190	13.57	27.14		3.75	2.72	2.09	1.89	2.09	2.72	3.75	
HA–185	185	13.21	26.43		3.79	2.81	2.22	2.02	2.22	2.81	3.79	
HA–180	180	15.00	30.00	6	3.72	2.72	2.22	2.22	2.72	3.72		
HA–175	175	14.58	29.17		3.76	2.82	2.34	2.34	2.82	3.76		
HA–170	170	14.17	28.33		3.80	2.91	2.46	2.46	2.91	3.80		
HA–165	165	13.75	27.50		3.84	3.00	2.58	2.58	3.00	3.84		
HA–160	160	13.33	26.67		3.88	3.09	2.70	2.70	3.09	3.88		
HA–155	155	12.92	25.83		3.92	3.18	2.81	2.81	3.18	3.92		
HA–150	150	15.00	30.00	5	3.85	3.11	2.87	3.11	3.85			
HA–145	145	14.50	29.00		3.89	3.21	2.98	3.21	3.89			
HA–140	140	14.00	28.00		3.93	3.29	3.08	3.29	3.93			
HA–135	135	13.50	27.00		3.97	3.38	3.18	3.38	3.97			
HA–130	130	13.00	26.00		4.01	3.46	3.28	3.46	4.01			
HA–125	125	12.50	25.00		4.05	3.54	3.37	3.54	4.05			
HA–120	120	15.00	30.00	4	3.98	3.52	3.52	3.98				
HA–115	115	14.38	28.75		4.02	3.60	3.60	4.02				
HA–110	110	13.75	27.50		4.06	3.68	3.68	4.06				
HA–105	105	13.13	26.25		4.10	3.75	3.75	4.10				
HA–100	100	12.50	25.00		4.14	3.82	3.82	4.14				
HA–95	95	11.88	23.75		4.17	3.89	3.89	4.17				
HA–90	90	15.00	30.00	3	4.11	3.91	4.11					
HA–85	85	14.17	28.33		4.15	3.98	4.15					
HA–80	80	13.33	26.67		4.19	4.04	4.19					
HA–75	75	12.50	25.00		4.23	4.09	4.23					
HA–70	70	11.67	23.33		4.26	4.15	4.26					
HA–65	65	10.83	21.67		4.30	4.19	4.30					
HA–60	60	15.00	30.00	2	4.24	4.24						

HANGER LENGTHS BASED ON 4.5/4.5 FT SYSTEM HEIGHT AND 4,500 LBS MESSENGER TENSION.

NOTES:

1. NORMAL SYSTEM DEPTH FOR SIMPLE AUTO–TENSIONED CATENARY IS 4.50 FEET.
2. HANGER LENGTHS ARE FOR STANDARD SPANS ONLY, DIMENSION "B" SHALL NOT EXCEED 30 FEET.
3. HANGER LENGTHS ARE FOR AUTO–TENSIONED, PRE–SAGGED EQUIPMENT. DEPTHS ARE NORMAL SYSTEM BASED ON A 500 MCM HARD DRAWN COPPER MESSENGER AT 4,500 POUND TENSION AND A 350 MCM HARD DRAWN GROOVED CONTACT WIRE AT 3000 lb TENSION, 0.02 lb/ft HAS BEEN ADDED TO WEIGHT OF MESSENGER FOR MISCELLANEOUS HARDWARE.
4. WHERE ACTUAL SPAN IS MARGINALLY SHORTER OR LONGER THAN THE PRECISE SPAN OF HANGERS ALLOCATED. HANGER SPACING SHALL BE ADJUSTED AT MIDSPAN AND THE HANGER LENGTHS SHALL NOT BE CHANGED.
5. CONTRACTOR TO ACCOUNT FOR SUPER ELEVATION WHEN DETERMINING HANGER LENGTHS FOR CURVE SPANS.

STANDARD OVERLAP SPANS

HANGER SET REFERENCES	SYSTEM HEIGHT		NUMBER OF HANGERS	SPAN LENGTH	END SPAN	MID SPAN	LIFT SPAN	END SPAN	HANGER LENGTHS (FT)					
	SH1	SH2		(FT)	C	D	J	N	H1	H2	H3	H4	H5	H6
HO–1	4'–0"	4'–0"	5	160	10	26.65			3.58	2.79	2.41	2.44	2.06	–
HO–2	4'–0"	5'–0"	5	160	10	26.65			3.65	3.02	2.81	3.00	3.06	–
HO–3	5'–0"	4'–0"	5	160	10	26.65			4.52	3.56	3.02	1.84	2.88	–
HO–4	5'–0"	5'–0"	5	160	10	26.65			4.58	3.79	3.41	2.84	3.44	–
HO–5	4'–0"	3'–3"	5	160	10	26.67	65	5	3.54	2.61	2.11	2.06	3.26	–
HO–6	5'–0"	4'–3"	5	160	10	26.67	65	5	4.54	3.61	3.11	3.06	4.26	–
HO–7	4'–0"	3'–3"	6	168	10	22	65	5	3.51	2.66	2.1	1.84	1.88	3.26
HO–8	5'–0"	4'–3"	6	168	10	22	65	5	4.5	4.61	3.1	2.84	2.88	4.26
HO–9	4'–0"	3'–3"	6	175	10	23.75	65	5	3.49	2.53	1.92	1.65	1.73	3.26
HO–10	5'–0"	4'–3"	6	175	10	23.75	65	5	4.49	3.53	2.92	2.65	2.73	4.26

INSULATED MIDPOINT SPANS

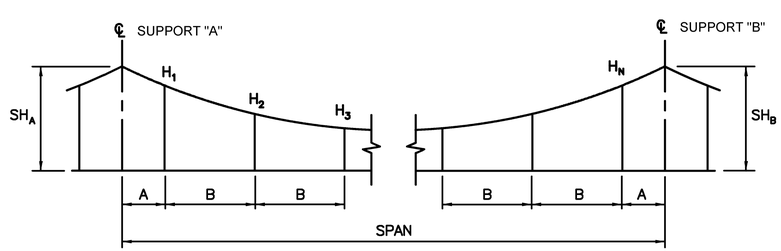
HANGER SET REFERENCES	SYSTEM HEIGHT		SPAN (FT)	END SPAN	MID SPAN	HANGER LENGTHS (FT)					
	SH1	SH2		C	D	H1	H2	H3	H4	H5	H6
HM–1	5'–10"	5'–10"	160	10	26.65	5.41	4.62	4.24	4.27	4.83	
HM–2	4'–6"	4'–6"	160	10	26.65	4.08	3.29	2.91	2.94	3.50	

REDUCTION IN HANGER LENGTH

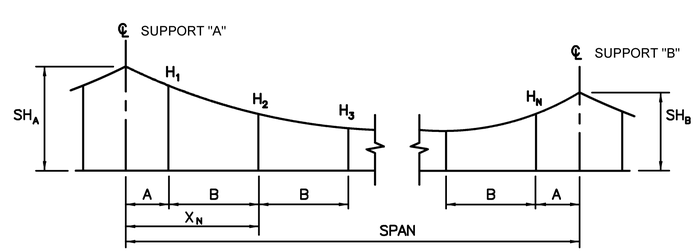
1. IF THE SYSTEM HEIGHT (SH) AT EACH END OF THE SPAN IS THE SAME, BUT LESS THAN NORMAL SYSTEM HEIGHT; REDUCE ALL HANGER LENGTHS BY THE DIFFERENCE (NORMAL – SH).
2. FOR UNEQUAL SYSTEM HEIGHT, SH_A AND SH_B, CORRECT HANGER LENGTH WILL BE:

$$H = H_N - \text{NORMAL SYSTEM HEIGHT} + SH_A - (SH_A - SH_B)\frac{X_N}{L}$$

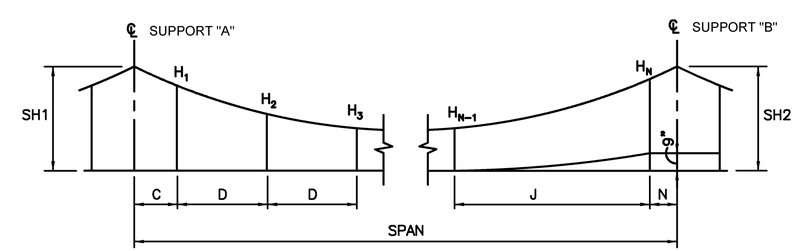
WHERE; H_N IS EACH STANDARD HANGER LENGTH GIVEN IN TABLE AND X_N IS THE DISTANCE TO HANGER FROM SUPPORT "A".



STANDARD SPANS
EQUAL SYSTEM HEIGHTS



STANDARD SPANS
UNEQUAL SYSTEM HEIGHTS



UNINSULATED & INSULATED OVERLAP SPANS

REVISIONS				
MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

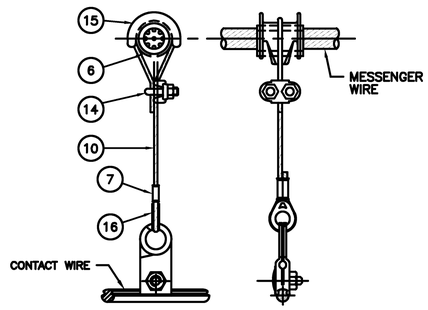
NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
HANGER ASSEMBLY TYPES
HA-60 TO HA-230, HO-01 TO HO-10, HM-1, HM-2

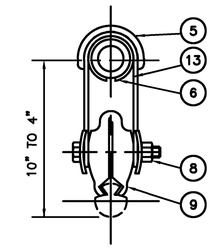
K-115
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\17 K-115.dwg Time:Aug07,2014-08:36am Login:sporter Dimscale:1 LTScale:1
Image: HA-STD-A Logo:jpg
Image: HA-STD-B Logo:jpg

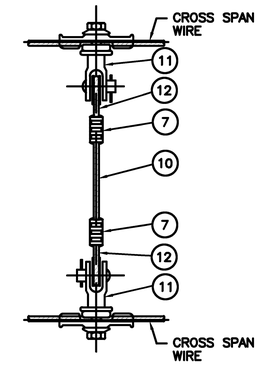
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	167	175



TYPE HA2
FLEXIBLE HANGER



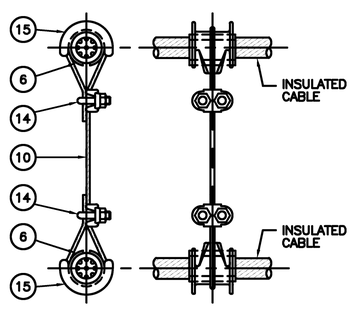
TYPE HA4
SHORT CATENARY HANGER



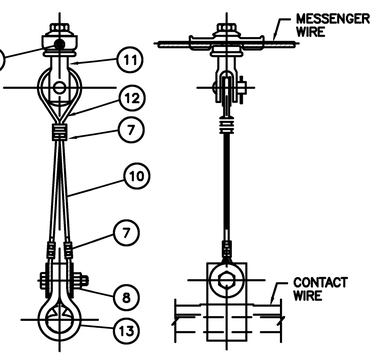
TYPE HA5
MULTI – TRACK
HEADSPAN HANGER

NOTES:

1. ALTERNATE ASSEMBLY CONFIGURATIONS MAY BE USED IF ELECTRICAL AND MECHANICAL FUNCTIONS ARE EQUIVALENT AND APPROVED BY THE ENGINEER.
2. CONTRACTOR TO DETERMINE QUANTITIES REQUIRED OF EACH HANGER TYPE TO MEET DESIGN REQUIREMENTS SHOWN ON OCS PLAN AND LAYOUT SCHEDULE DWGS.



TYPE HA6
ONE, TWO, AND THREE TRACKS
INSULATED HEADSPAN HANGER



TYPE HA7
SECURITY HANGER FOR OVERLAP

PARTS LIST	PART No	REMARKS
INSULATED THIMBLE	16	
SPAN WIRE ARMOR	15	
WIRE ROPE CLIP	14	
3/4" x 1/8" CU STRAP	13	
1/4" THIMBLE (CLOSED)	12	
SPAN WIRE SUPPORT CLAMP	11	
1/4"ø STAINLESS STEEL WIRE ROPE	10	
CONTACT WIRE CLAMP	9	
BOLT, SELF LOCKING NUT, WASHER (STAINLESS STEEL)	8	
COMPRESSION SLEEVE	7	
INSULATED LINER	6	
MESSENGER WIRE ARMOR	5	
CAM – COPPER	4	
CONTACT WIRE CLIP – BRONZE	3	
STAINLESS STEEL HANGER RETAINER	2	
3/16"ø STAINLESS STEEL ROD	1	

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

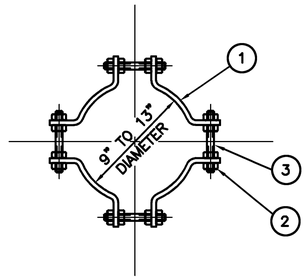
NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
HANGER ASSEMBLY TYPES
HA2, HA4, HA5, HA6, HA7, HA8

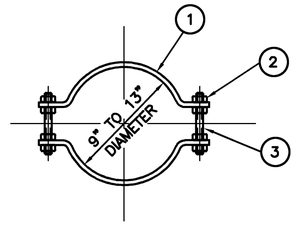
K-116
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\18 K-116.dwg Time:Aug07,2014-08:36am Login:sporter Dimscale:1 LTScale:1
Image: 1 Ref: 5-25-14 Layer: 0
Image: 2 Ref: 5-25-14 Layer: 0

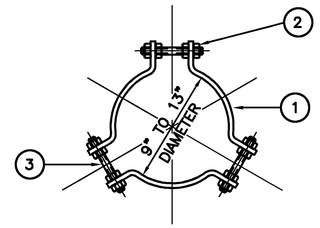
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	168	175



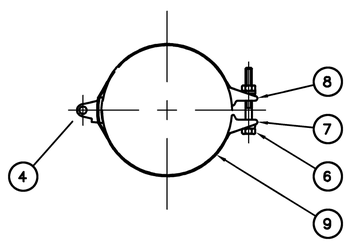
TYPE BR1
FOUR PIECE POLE BRACKET
(NOTE 4)
FOR GUY WIRES



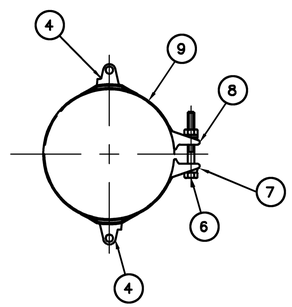
TYPE BR2
TWO PIECE POLE BRACKET
(NOTE 4)
FOR TERMINATIONS



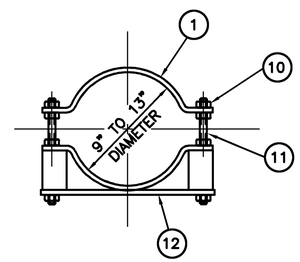
TYPE BR3
THREE PIECE POLE BRACKET
(NOTE 4)
FOR GUY WIRES



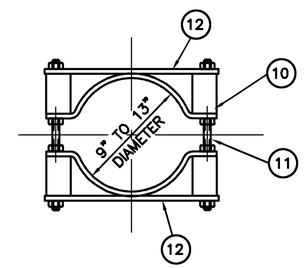
TYPE BH1
FOR SINGLE CANTILEVERS



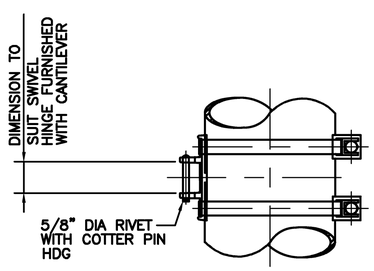
TYPE BH2
FOR BACK TO BACK CANTILEVERS



TYPE BS1
TWO PIECE POLE BRACKET
FOR ONE DISCONNECT SWITCH



TYPE BS2
TWO PIECE POLE BRACKET
FOR TWO DISCONNECT SWITCHES



TYPE BH1 & BH2
POLE BAND HINGE TYPE
(NOTE 2 & 3)
FOR CANTILEVERS

NOTES:

1. QUANTITIES FOR ASSEMBLY BH1 ARE ENOUGH TO BUILD TWO BRACKETS FOR ONE CANTILEVER.
2. ASSEMBLY TYPE BH2 SHALL BE USED FOR BACK TO BACK BRACKETS FOR 2 CANTILEVERS.
3. USE BAND CLAMP TYPE BH1 OR BH2 FOR LOADS UNDER 3000 LB PER CLEVIS. FOR HEAVIER LOADS USE POLE BRACKET TYPES BR.
4. ALL STEEL HARDWARE IS TO BE HOT DIP GALVANIZED AFTER FABRICATION PER ASTM 153.
5. CONTRACTOR TO ALLOCATE POLE BAND AND BRACKET ASSEMBLIES TO MEET DESIGN REQUIREMENTS SHOWN ON OCS PLAN AND LAYOUT SCHEDULE K-200 SERIES DWGS.

TABLE 1

TYPE	CAPACITY	APPLICATION
BR	8000 LB	CATENARY TERMINATIONS & GUY WIRES
BH	1000 LB	CANTILEVER BRACKETS

PARTS LIST	PART No	REMARKS
4" DISCCONNECT SWITCH MOUNTING BRACKET	12	STEEL HDG
5/8" THREADED STUD (LENGTH TO SUIT)	11	STEEL HDG
5/8" SQUARE NUTS	10	
POLE BAND STRAP	9	STAINLESS STEEL
CLAMP HALF – NUT SIDE	8	MI HDG
CLAMP HALF – BOLT HEAD SIDE	7	MI HDG
3/4"øx 6" LG BOLT WITH SELF LOCKING NUT AND WASHER	6	STEEL HDG
HINGE BRACKET	4	MI HDG
7/8" x 8" LG THREADED STUD	3	STEEL HDG
7/8" SQUARE NUTS	2	
3/8" x 4" BAND SECTION	1	STEEL HDG

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA
Expires Aug 7, 2014

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

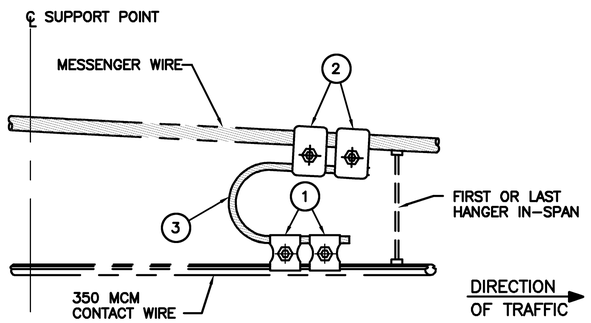
NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
POLE BAND AND BRACKET ASSEMBLY TUBULAR TYPES
BH, BR, BS

K-117
SHEET

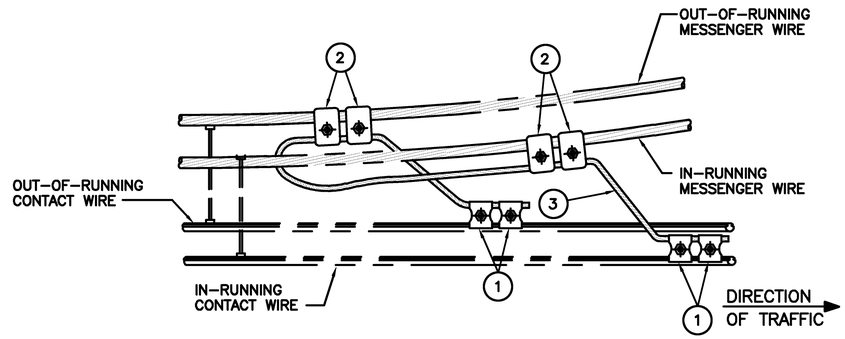
F:\Projects\B-Current Projects\C4580 PSOMAS SRTD OEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\19 K-117.dwg TimeAug07,2014-08:36am Login:porter Dimscale:1 LTScale:1 Images: BR BH BS
Xrefs: LTBTA LTBTB
Layout: K-117

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	169	175



TYPE JA1

IN-SPAN POTENTIAL EQUALIZING JUMPER

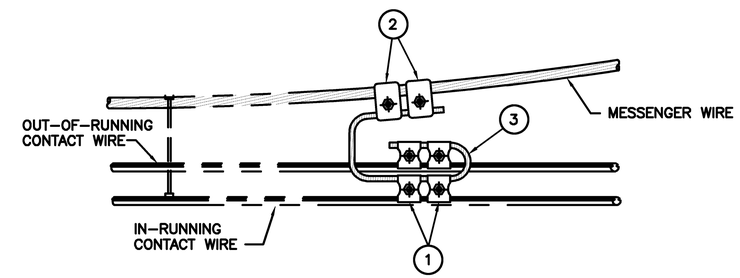


TYPE JA2

INSULATED OVERLAP POTENTIAL EQUALIZING JUMPER

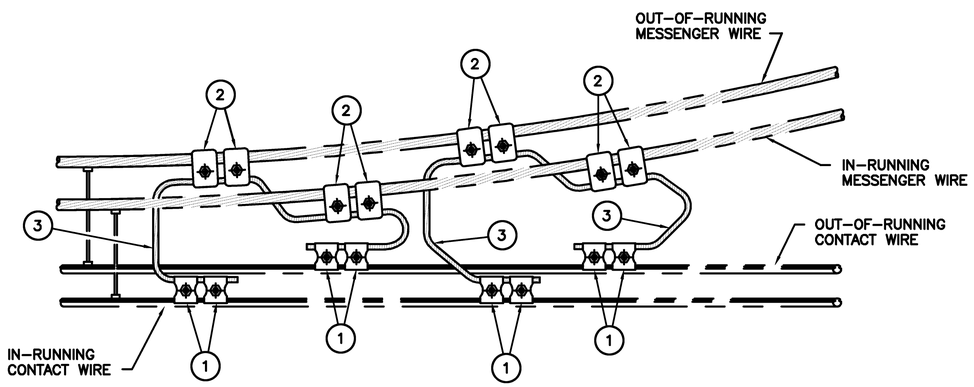
NOTES:

1. ALL JUMPERS SHALL BE INSTALLED WITH CABLE ENDS POINTING IN THE DIRECTION OF TRAFFIC.
2. MINIMUM RADIUS FOR ALL JUMPER CABLE BENDS SHALL BE 12 INCHES.
3. FOR JA2 AND JA3 SUFFICIENT SLACK SHALL BE PROVIDED TO MAINTAIN GENERAL SHAPE OF JUMPER AS CATENARIES MOVE RELATIVE TO ONE ANOTHER DUE TO TEMPERATURE.



TYPE JA4

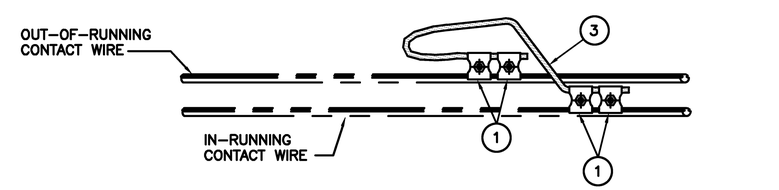
OVERLAP POTENTIAL EQUALIZING JUMPER
SIMPLE CATENARY TO SINGLE CONTACT WIRE



TYPE JA3

OVERLAP FULL FEEDING CONTINUITY JUMPER

DIRECTION OF TRAFFIC



TYPE JA5

OVERLAP POTENTIAL EQUALIZING JUMPER
SINGLE CONTACT WIRE TO SINGLE CONTACT WIRE

PARTS LIST	PART No	REMARKS
500MCM CLASS "H" CU CABLE (BARE)	3	NOTE 3
UNIVERSAL FEEDER CLAMP 500MCM TO 500MCM	2	
DUPLEX FEEDER CLAMP 500MCM TO 350MCM CW	1	

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: N/A
SCALE: HORIZONTAL: N/A
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA
Expires Aug 7, 2016

CI:
FILE:
SUBMITTAL: 5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

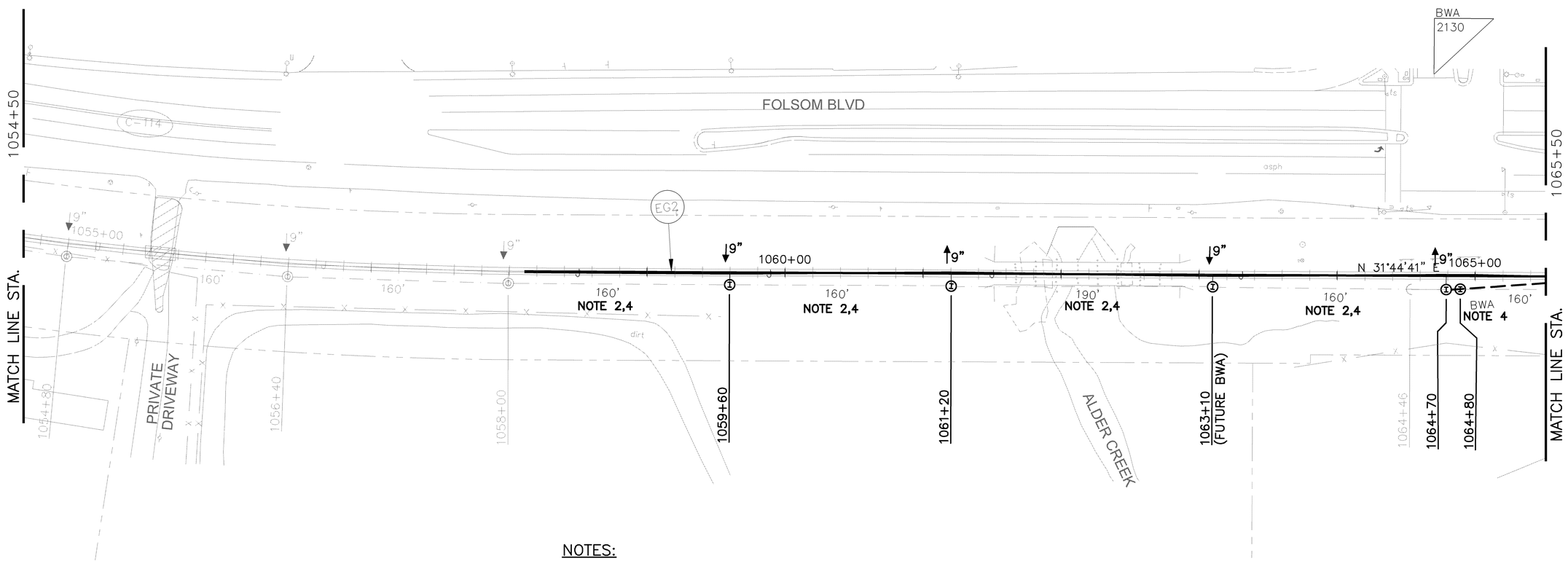
OVERHEAD CONTACT SYSTEM
JUMPER ASSEMBLY TYPES
JA1, JA2, JA3, JA4, JA5

K-118
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\20 K-118.dwg TimeAug07,2014-08:36am Login:sporter Dimscale:1 LTScale:1
Image: 3-75-TSA Logo.jpg
Image: 3-75-TSA Logo.jpg

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	170	175

MISCELLANEOUS ASSEMBLIES AND FEEDERS	SB2	SB2	SB2	–	–	–	–	–	–
POLE BANDS, BRACKETS, AND MISC. ASSEMBLIES	BF3	BF3	BF3	–	–	–	–	–	–
JUMPERS	JA1	JA1	JA1	JA1	JA1	JA1	–	JA2	–
HANGERS	HA160	HA160	HA160	HA160	HA190	HA160	–	HA160	(2)HA160
SUPPORT REGISTRATION REFERENCE	CA3	CA3	CA3	CA3	CA2	CA1	–	CA2	–
GUY – HEIGHT (ft/ins)	–	–	–	–	–	–	–	–	20'–0"
GUY – REFERENCE	–	–	–	–	–	–	–	–	–
GUY – FOUNDATION	–	–	–	–	–	–	–	–	–
POLE – TERMINATION	–	–	–	–	–	–	–	–	BW9
POLE – REFERENCE	PC11	PC11	PC11	–	–	–	–	–	–
POLE – FOUNDATION	FB11	FB11	FB11	–	–	–	–	–	–
MESSENGER WIRE HEIGHT (ft/ins)	24'–0"	24'–0"	24'–0"	23'–0"	22'–0"	21'–0"	–	20'–0"	–
CONTACT WIRE HEIGHT (ft/ins)	19'–6"	19'–6"	19'–6"	19'–0"	18'–6"	17'–6"	–	16'–6"	–
℄ POLE TO ℄ SC1 TRACK (ft/ins)	9'–0"	9'–0"	9'–0"	–	–	–	–	–	–
LOCATION (POLE ℄)	1054+80	1056+40	1058+00	1059+60	1061+20	1063+10	1064+46	1064+70	1064+80
STRUCTURE NUMBER	7733	7734	7735	7736	7737	7738	7739A	7739	7741
MILE POST	F 19788	F 19818	F 19848	F 19879	F 19909	F 19945		F 19975	F 19977
REMARKS				NOTE 3	NOTE 3	NOTE 3		NOTE 3	NOTE 1



NOTES:

1. INSTALL BW9 TEMPORARY TENSION WHEEL ASSEMBLY AT THE TERMINATION HEIGHT GIVEN IN THE ALLOCATION TABLES. TRANSFER WIRE RUN TERMINATION LEADS AND BALANCE WEIGHT LEADS TO THE NEW BW9 ASSEMBLY. REMOVE EXISTING TENSION WHEEL IF ADDITIONAL CLEARANCE IS REQUIRED FOR BW9 ASSEMBLY. ADJUST WEIGHT STACK POSITION SO THAT AT 70 DEGREES FAHRENHEIT THE WEIGHT STACK IS AT THE MIDDLE MOVEMENT MARK ON THE POLE.

2. INSTALL TEMPORARY HANGERS TO REGULATE THE CONTACT WIRE AT THE DESIGNED HEIGHT. LEAVE ENOUGH WIRE LENGTH IN THE HANGER TO BE EXTENDED DURING THE RECONSTRUCTION PHASE. HANGERS SHALL USE TWO CROSBY CLAMPS TO ENSURE THE TAIL OF THE WIRE DOES NOT DROP BELOW THE CONTACT WIRE HEIGHT.

3. INSTALL NEW CANTILEVERS TO SUPPORT AND REGISTER THE CONTACT AND MESSENGER WIRES. ADJUST EXISTING BRACKET HEIGHTS AS NECESSARY. REMOVE THE EXISTING CANTILEVERS AND SAFELY STORE THEM FOR REUSE ON THE RECONSTRUCTION PHASE.

4. INSTALL NEW JUMPERS TO ACCOMMODATE REVISED SYSTEM HEIGHT. RETAIN EXISTING JUMPER FOR REUSE ON RECONSTRUCTION PHASE.

HORIZONTAL GRAPHIC SCALE
40 20 0 20 40
1 inch = 40 ft.

REVISIONS				
MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: 1:40
SCALE: HORIZONTAL: 1:40
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA
Aug 7, 2014

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

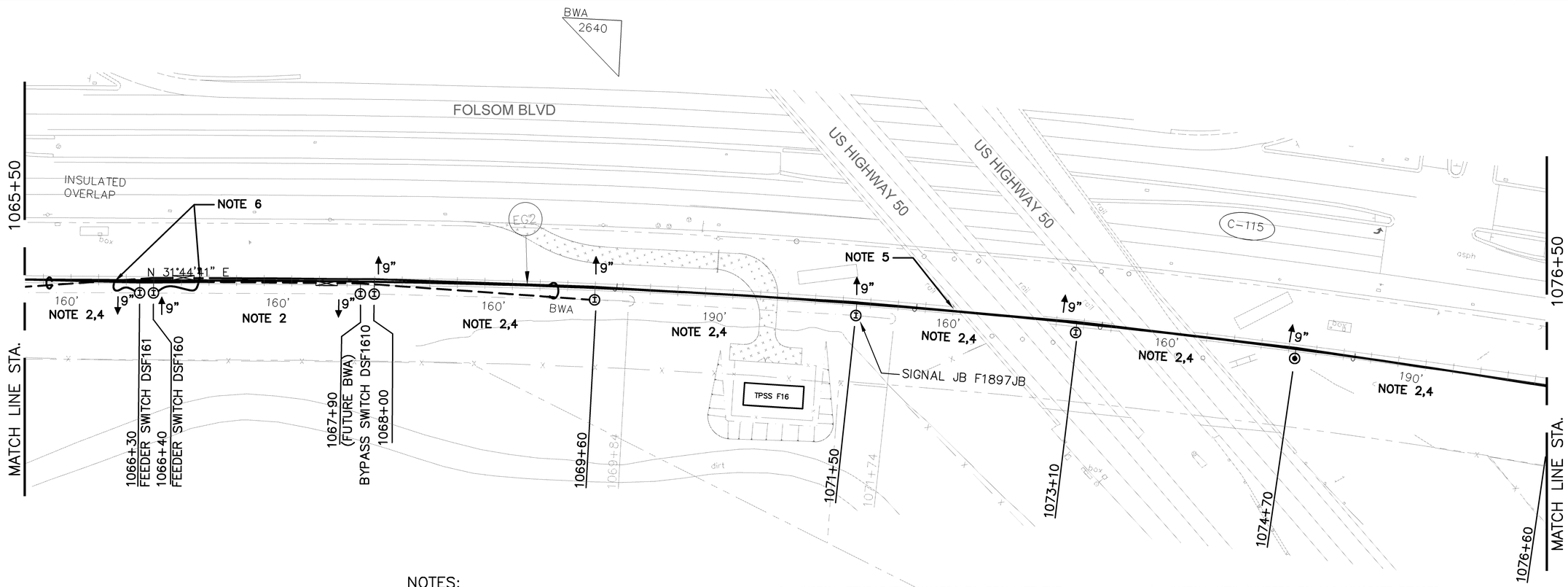
OVERHEAD CONTACT SYSTEM
TEMPORARY WIRING PLAN AND
LAYOUT SCHEDULE

K-201
SHEET

P:\Projects\B-Current Projects\C4580 PSGMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\21 K-201.dwg Time:Aug07,2014-08:36am Login:spotter Dimscale:1 LTScale:1
Images: BW-1TRLA.jpg; JPG
Xrefs: XTOPOC2.dwg;XTOPOC2.dwg;XROWC2.dwg;XstationC2.dwg;X-OCSC2.dwg;X-OCSC2.dwg;X-TPSIBC2.dwg

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	171	175

MISCELLANEOUS ASSEMBLIES AND FEEDERS		–	–	–	–	–	–	–	–	–	–
POLE BANDS, BRACKETS, AND MISC. ASSEMBLIES		–	–	–	–	–	–	–	–	–	BH1
JUMPERS		JA1	JA1	JA1	JA2	JA1	–	JA1	–	JA1	JA1
HANGERS		HA160	HA160	(2)HA160	HA160	HA190	–	HA160	–	HA160	HA190
SUPPORT REGISTRATION REFERENCE		CA1	CA9	CA7	CA14	CA14	–	CA15	–	CA15	CA15
GUY	HEIGHT (ft/ins)	–	–	–	–	20'–0"	–	–	–	–	–
	REFERENCE	–	–	–	–	–	–	–	–	–	–
	FOUNDATION	–	–	–	–	–	–	–	–	–	–
POLE	TERMINATION	–	–	–	–	BW9	–	–	–	–	–
	REFERENCE	–	–	–	–	–	–	–	–	–	–
	FOUNDATION	–	–	–	–	–	–	–	–	–	–
MESSENGER WIRE HEIGHT (ft/ins)		20'–6"	19'–6"	20'–6"	19'–6"	18'–0"	–	17'–0"	–	17'–0"	17'–0"
CONTACT WIRE HEIGHT (ft/ins)		15'–6"	16'–3"	16'–3"	15'–6"	15'–0"	–	14'–6"	–	14'–6"	14'–6"
℄ POLE TO ℄ SC1 TRACK (ft/ins)		–	–	–	–	–	–	–	–	–	–
LOCATION (POLE ℄)		1066+30	1066+40	1067+90	1068+00	1069+60	1069+84	1071+50	1071+74	1073+10	1074+70
STRUCTURE NUMBER		7742	7743	7744	7745	7746	7746A	7747	7747A	7748	7749
MILE POST		F 20006	F 20008	F 20036	F 20038	F 20068		F 20104		F 20134	F 20165
REMARKS		NOTE 3	NOTE 3	NOTE 3	NOTE 3	NOTE 1,3		NOTE 3,5		NOTE 3,5	NOTE 3,5



NOTES:

1. INSTALL BW9 TEMPORARY TENSION WHEEL ASSEMBLY AT THE TERMINATION HEIGHT GIVEN IN THE ALLOCATION TABLES. TRANSFER WIRE RUN TERMINATION LEADS AND BALANCE WEIGHT LEADS TO THE NEW BW9 ASSEMBLY. REMOVE EXISTING TENSION WHEEL IF ADDITIONAL CLEARANCE IS REQUIRED FOR BW9 ASSEMBLY. ADJUST WEIGHT STACK POSITION SO THAT AT 70 DEGREES FAHRENHEIT THE WEIGHT STACK IS AT THE MIDDLE MOVEMENT MARK ON THE POLE.
2. INSTALL TEMPORARY HANGERS TO REGULATE THE CONTACT WIRE AT THE DESIGNED HEIGHT. LEAVE ENOUGH WIRE LENGTH IN THE HANGER TO BE EXTENDED DURING THE RECONSTRUCTION PHASE. HANGERS SHALL USE TWO CROSBY CLAMPS TO ENSURE THE TAIL OF THE WIRE DOES NOT DROP BELOW THE CONTACT WIRE HEIGHT.
3. INSTALL NEW CANTILEVERS TO SUPPORT AND REGISTER THE CONTACT AND MESSENGER WIRES. ADJUST EXISTING BRACKET HEIGHTS AS NECESSARY. REMOVE THE EXISTING CANTILEVERS AND SAFELY STORE THEM FOR REUSE ON THE RECONSTRUCTION PHASE.
4. INSTALL NEW JUMPERS TO ACCOMMODATE REVISED SYSTEM HEIGHT. RETAIN EXISTING JUMPER FOR REUSE ON RECONSTRUCTION PHASE.
5. MESSENGER WIRE UNDERNEATH US HIGHWAY 50 SHALL NOT BE ABOVE 17'–0" ABOVE TOP OF RAIL.
6. WHEN REVISING WIRE HEIGHTS, FEEDER CABLE FROM DISCONNECT SWITCH TO OCS SHALL BE LENGTHENED.

N

HORIZONTAL GRAPHIC SCALE
40 20 0 20 40
1 inch = 40 ft.

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: 1:40
SCALE: HORIZONTAL: 1:40
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA
Jeffrey J. Boerma (Aug 7, 2014)

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

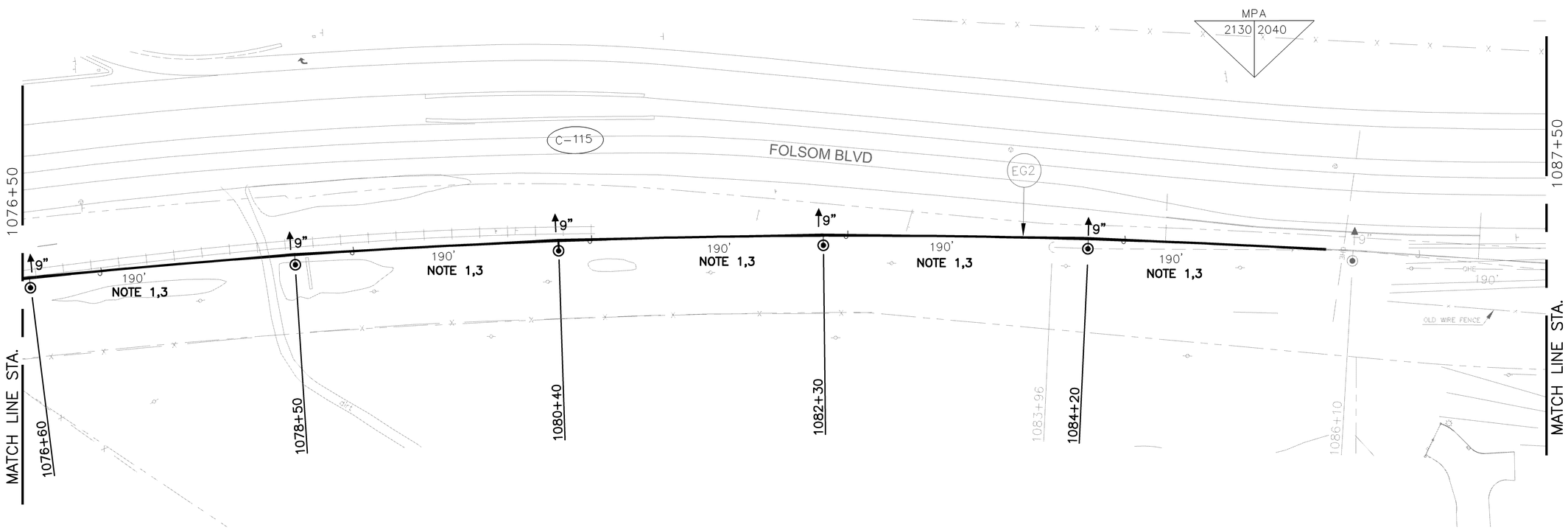
OVERHEAD CONTACT SYSTEM
TEMPORARY WIRING PLAN AND
LAYOUT SCHEDULE

K-202
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD CEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\22 K-202.dwg Time:Aug07,2014-08:36am Login:sporter Dimscale:1 LTScale:1
Images: 1 TRUE 1 TRUE 1 TRUE 1 TRUE
P:\Projects\B-Current Projects\C4580 PSOMAS SRTD CEC 2013\TASK 3 - Natoma OCS Widening\CAD\Xrefs\Design\XM-STRUCC2.dwg;X-OCSC2.dwg;X-ROWC2.dwg;Rotation\C2.dwg;X-TOPOC2.dwg;X-TPSUBC2.dwg

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	172	175

MISCELLANEOUS ASSEMBLIES AND FEEDERS		–	–	–	–	–	–	–	MP1	–	–
POLE BANDS, BRACKETS, AND MISC. ASSEMBLIES		BH1	BH1	BH1	BH1	–	BH1	–	BH1	–	–
JUMPERS		JA1	JA1	JA1	JA1	–	JA1	–	JA1	–	–
HANGERS		HA190	HA190	HA190	HA190	–	HA190	–	HA190	–	–
SUPPORT REGISTRATION REFERENCE		CA14	CA14	CA14	CA14	–	CA14	–	CA14	–	–
GUY	HEIGHT (ft/ins)	–	–	–	–	–	–	–	–	–	–
	REFERENCE	–	–	–	–	–	–	–	–	–	–
	FOUNDATION	–	–	–	–	–	–	–	–	–	–
POLE	TERMINATION	–	–	–	–	–	–	–		–	–
	REFERENCE	–	–	–	–	–	–	–	PA3	–	–
	FOUNDATION	–	–	–	–	–	–	–	FA15	–	–
MESSENGER WIRE HEIGHT (ft/ins)		20'–0"	20'–0"	20'–0"	21'–0"	–	22'–6"	–	24'–0"	–	–
CONTACT WIRE HEIGHT (ft/ins)		15'–0"	16'–0"	17'–0"	18'–0"	–	19'–0"	–	19'–6"	–	–
℄ POLE TO ℄ SC1 TRACK (ft/ins)		–	–	–	–	–	–	–	9'–0"	–	–
LOCATION (POLE ℄)		1076+60	1078+50	1080+40	1082+30	1083+96	1084+20	–	1086+10	–	–
STRUCTURE NUMBER		7751	7752	7753	7754	7755A	7755	–	7756	–	–
MILE POST		F 20201	F 20237	F 20273	F 20309		F 20345		F 20381		
REMARKS		NOTE 2	NOTE 2	NOTE 2	NOTE 2		NOTE 2				



NOTES:

1. INSTALL TEMPORARY HANGERS TO REGULATE THE CONTACT WIRE AT THE DESIGNED HEIGHT. LEAVE ENOUGH WIRE LENGTH IN THE HANGER TO BE EXTENDED DURING THE RECONSTRUCTION PHASE. HANGERS SHALL USE TWO CROSBY CLAMPS TO ENSURE THE TAIL OF THE WIRE DOES NOT DROP BELOW THE CONTACT WIRE HEIGHT.
2. INSTALL NEW CANTILEVERS TO SUPPORT AND REGISTER THE CONTACT AND MESSENGER WIRES. ADJUST EXISTING BRACKET HEIGHTS AS NECESSARY. REMOVE THE EXISTING CANTILEVERS AND SAFELY STORE THEM FOR REUSE ON THE RECONSTRUCTION PHASE.
3. INSTALL NEW JUMPERS TO ACCOMMODATE REVISED SYSTEM HEIGHT. RETAIN EXISTING JUMPER FOR REUSE ON RECONSTRUCTION PHASE.

N

HORIZONTAL GRAPHIC SCALE
40 20 0 20 40
1 inch = 40 ft.

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: 1:40
SCALE: HORIZONTAL: 1:40
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER
JEFFREY J. BOERMA
C 77489
CIVIL
STATE OF CALIFORNIA
Aug 7, 2014

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

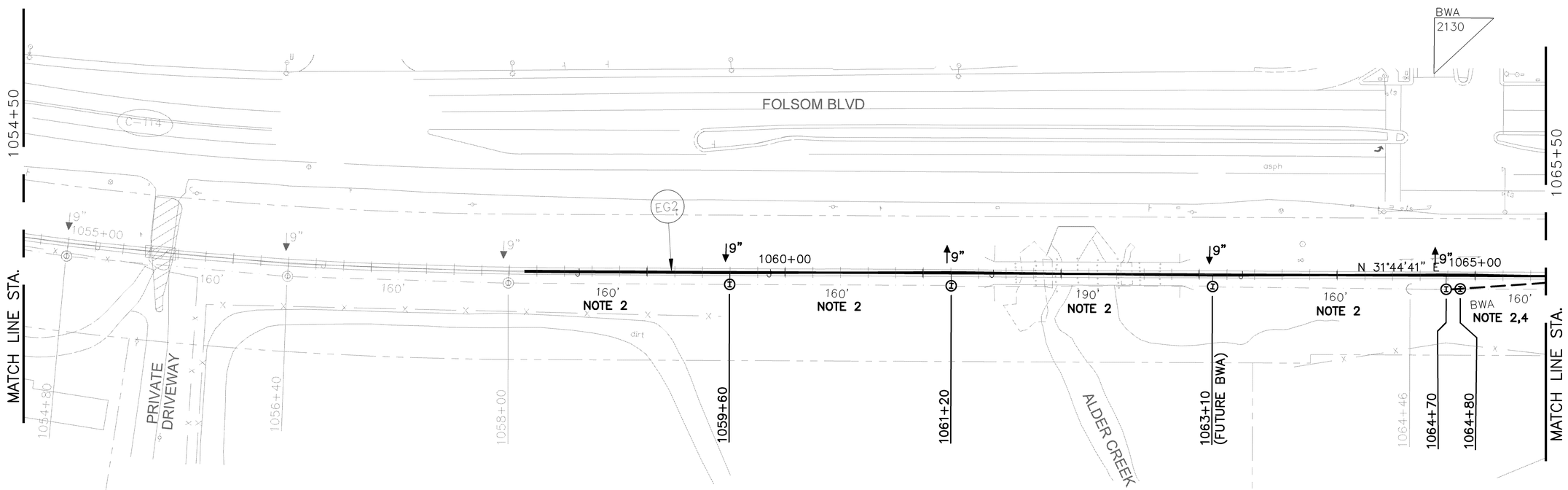
OVERHEAD CONTACT SYSTEM
TEMPORARY WIRING PLAN AND
LAYOUT SCHEDULE

K-203
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 – Natoma OCS Widening\CAD\Sheets\23 K-203.dwg TimeAug07,2014-08:36am Login:porter Dimscale:1 LTScale:1
Images: 0K-1-TRIA Logo.jpg
Xrefs: 0K-1-TRIA Logo.dwg;
P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 – Natoma OCS Widening\CAD\Sheets\23 K-203.dwg;X-OCSC2.dwg;XRDWG2.dwg;XtitleinC2.dwg;XTGPOC2.dwg;X-TPSIBC2.dwg

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	173	175

MISCELLANEOUS ASSEMBLIES AND FEEDERS		SB2	SB2	SB2	**SB2**	**SB2**	**SB2**	–	**SB2**	**SB2**
POLE BANDS, BRACKETS, AND MISC. ASSEMBLIES		BF3	BF3	BF3	**BF3**	**BF3**	**BF4**	–	**TB3,BF4**	**TB4**
JUMPERS		JA1	JA1	JA1	**JA1**	**JA1**	**JA1**	–	**JA2**	**–**
HANGERS		HA160	HA160	HA160	**HA160**	**HA190**	**HA160**	–	**HA160**	**(2)HA7, HA8**
SUPPORT REGISTRATION REFERENCE		CA3	CA3	CA3	**CA3**	**CA2**	**CA1**	–	**CA2**	**–**
GUY	HEIGHT (ft/ins)	–	–	–	**–**	**–**	**–**	–	**24'–0"**	**24'–0"**
	REFERENCE	–	–	–	**–**	**–**	**–**	DG1	**HG1**	**–**
	FOUNDATION	–	–	–	**–**	**–**	**–**	FD10	**–**	**–**
POLE	TERMINATION	–	–	–	**–**	**–**	**–**	–	**–**	**BWIC**
	REFERENCE	PC11	PC11	PC11	**PC11**	**PC11**	**PD13**	–	**PD12**	**PD13**
	FOUNDATION	FB11	FB11	FB11	**FB11**	**FB11**	**FB12**	–	**FB12**	**FB12**
MESSENGER WIRE HEIGHT (ft/ins)		24'–0"	24'–0"	24'–0"	**24'–0"**	**24'–0"**	**24'–0"**	–	**24'–0"**	**–**
CONTACT WIRE HEIGHT (ft/ins)		19'–6"	19'–6"	19'–6"	**19'–6"**	**19'–6"**	**19'–6"**	–	**19'–6"**	**–**
℄ POLE TO ℄ SC1 TRACK (ft/ins)		9'–0"	9'–0"	9'–0"	**9'–0"**	**9'–0"**	**9'–0"**	9'–0"	**9'–0"**	**9'–0"**
LOCATION (POLE ℄)		1054+80	1056+40	1058+00	**1059+60**	**1061+20**	**1063+10**	1064+46	**1064+70**	**1064+80**
STRUCTURE NUMBER		7733	7734	7735	**7736**	**7737**	**7738**	7739A	**7739**	**7741**
MILE POST		F 19788	F 19818	F 19848	**F 19879**	**F 19909**	**F 19945**		**F 19975**	**F 19977**
REMARKS					**NOTE 3**	**NOTE 3**	**NOTE 3**		**NOTE 3**	**NOTE 1**



NOTES:

1. IF EXISTING TENSION WHEEL WAS REMOVED TO ALLOW CLEARANCE FOR THE BW9 TEMPORARY TENSION WHEEL ASSEMBLY, REINSTALL THE TENSION WHEEL AT THE ORIGINAL TERMINATION HEIGHT. MATERIALS TO BE REUSED SHALL BE INSPECTED BY RT PRIOR TO RE–INSTALLATION. TRANSFER WIRE RUN TERMINATION LEAD AND BALANCE WEIGHT LEAD TO THE TENSION WHEEL AT THE ORIGINAL TERMINATION HEIGHT. REMOVE TEMPORARY TENSION WHEEL ASSEMBLY BW9 FROM TEMPORARY PHASE AND DELIVER TO RT.

2. LENGTHEN TEMPORARY HANGERS AND CRIMP IN FINAL POSITION ONCE THE REQUIRED WIRE HEIGHTS ARE ATTAINED.

3. REMOVE, PROTECT, AND SAFELY STORE TEMPORARY CANTILEVER ARMS. INSTALL CANTILEVER ARMS THAT WERE RETAINED FOR REUSE DURING THE TEMPORARY PHASE. MATERIALS TO BE REUSED SHALL BE INSPECTED BY RT PRIOR TO RE–INSTALLATION. DELIVER THE TEMPORARY CANTILEVERS TO RT.

4. INSTALL JUMPERS THAT WERE RETAINED FOR REUSE DURING THE TEMPORARY PHASE. MATERIALS TO BE REUSED SHALL BE INSPECTED BY RT PRIOR TO RE–INSTALLATION. DELIVER THE TEMPORARY JUMPERS TO RT.

N

HORIZONTAL GRAPHIC SCALE
40 20 0 20 40
1 inch = 40 ft.

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: 1:40
SCALE: HORIZONTAL: 1:40
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77484 CIVIL STATE OF CALIFORNIA
Aug 7, 2014

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

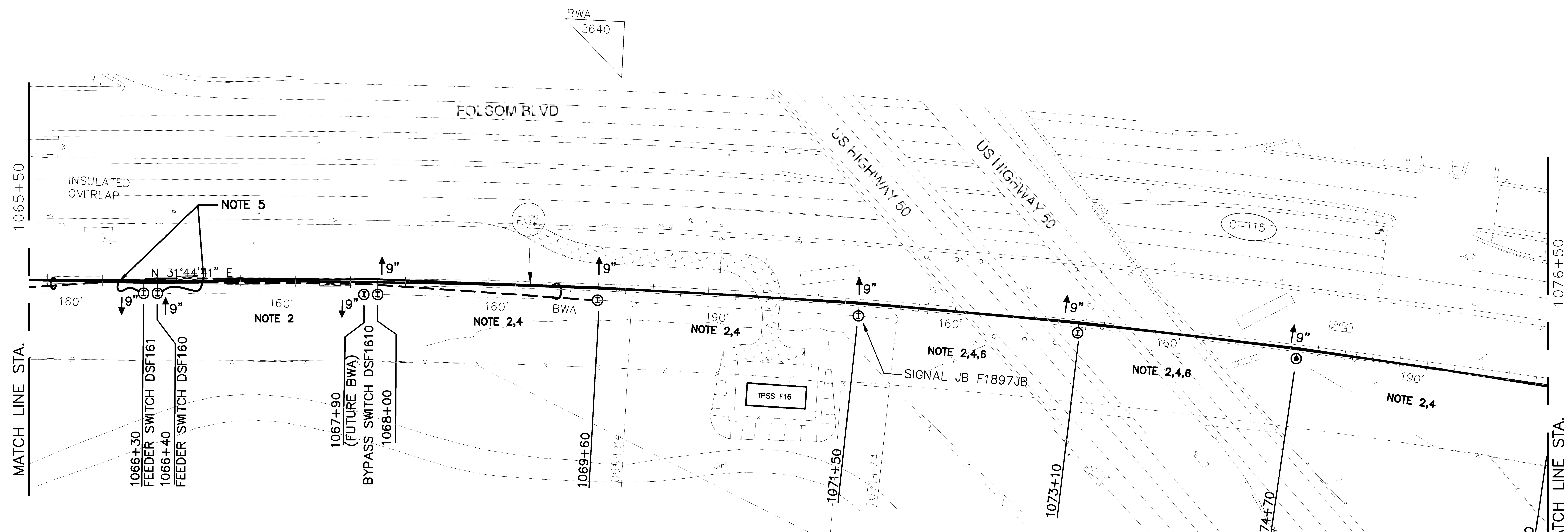
OVERHEAD CONTACT SYSTEM
RECONSTRUCTED WIRING PLAN AND
LAYOUT SCHEDULE

K-301
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\24 K-301.dwg Time:Aug07,2014-08:36am Login:spotter Dimscale:1 LTScale:1
Project: B-Current Projects
Layout: 24 K-301
Image: B-Current Projects\Image\Logo.jpg
Image: B-Current Projects\Image\Logo.jpg
Xrefs: C2.dwg;X-OCSC2.dwg;XROWC2.dwg;XtoIlion2.dwg;XTOPOC2.dwg;X-TPSUBC2.dwg

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	174	175

MISCELLANEOUS ASSEMBLIES AND FEEDERS		TA7, SB2, LA4, SA1	TA8,SB2,SA1,LA4	SB2	SB2,TA5	SB2	–	SB3	–	–	–
POLE BANDS, BRACKETS, AND MISC. ASSEMBLIES		BF4	BF4	BF4	BF4	BF4,TB3	–	BF3	–	BF3	BH1
JUMPERS		–	–	–	JA2	JA1	–	JA1	–	JA1	JA1
HANGERS		H05	H06	(2)HA7, HA8	HA160	HA190	–	HA160	–	HA160	HA190
SUPPORT REGISTRATION REFERENCE		CA1	CA9	CA7	CA14	CA14	–	CA14	–	CA14	CA14
GUY	HEIGHT (ft/ins)	–	–	–	–	24'–0"	–	25'–0"	–	–	–
	REFERENCE	–	–	–	–	–	DG1	–	DG1	–	–
	FOUNDATION	–	–	–	–	–	FD10	–	FD10	–	–
POLE	TERMINATION	–	–	–	–	BWIC	–	–	–	–	–
	REFERENCE	PF13	PF13	PD13	PD15	PD13	–	PF11	–	PC11 (NOTE 3)	PA1
	FOUNDATION	FFB12	FFB12	FB12	FB12	FB12	–	FFB11	–	FB11	FA15
MESSENGER WIRE HEIGHT (ft/ins)		24'–6"	23'–6"	24'–6"	23'–6"	23'–6"	–	22'–0"	–	22'–0"	23'–0"
CONTACT WIRE HEIGHT (ft/ins)		19'–6"	20'–3"	20'–3"	19'–6"	19'–6"	–	19'–6"	–	19'–6"	19'–6"
℄ POLE TO ℄ SC1 TRACK (ft/ins)		9'–0"	9'–0"	9'–0"	9'–0"	9'–0"	9'–0"	9'–0"	9'–0"	9'–0"	9'–0"
LOCATION (POLE ℄)		1066+30	1066+40	1067+90	1068+00	1069+60	1069+84	1071+50	1071+74	1073+10	1074+70
STRUCTURE NUMBER		7742	7743	7744	7745	7746	7746A	7747	7747A	7748	7749
MILE POST		F 20006	F 20008	F 20036	F 20038	F 20068		F 20104		F 20134	F 20165
REMARKS		NOTE 3	NOTE 3	NOTE 3	NOTE 3	NOTE 3,7		NOTE 3		NOTE 3	NOTE 3



NOTES:

1. INSTALL THE TENSION WHEEL AT THE ORIGINAL TERMINATION HEIGHT. MATERIALS TO BE REUSED SHALL BE INSPECTED BY RT PRIOR TO RE-INSTALLATION. TRANSFER WIRE RUN TERMINATION LEAD AND BALANCE WEIGHT LEAD TO THE TENSION WHEEL AT THE ORIGINAL TERMINATION HEIGHT. REMOVE TEMPORARY TENSION WHEEL ASSEMBLY BW9 FROM TEMPORARY PHASE AND DELIVER TO RT.
2. LENGTHEN TEMPORARY HANGERS AND CRIMP IN FINAL POSITION ONCE THE REQUIRED WIRE HEIGHTS ARE ATTAINED.
3. REMOVE, PROTECT, AND SAFELY STORE TEMPORARY CANTILEVER ARMS. INSTALL CANTILEVER ARMS THAT WERE RETAINED FOR REUSE DURING THE TEMPORARY PHASE. MATERIALS TO BE REUSED SHALL BE INSPECTED BY RT PRIOR TO RE-INSTALLATION. DELIVER THE TEMPORARY CANTILEVERS TO RT.
4. INSTALL JUMPERS THAT WERE RETAINED FOR REUSE DURING THE TEMPORARY PHASE. MATERIALS TO BE REUSED SHALL BE INSPECTED BY RT PRIOR TO RE-INSTALLATION. DELIVER THE TEMPORARY JUMPERS TO RT.
5. WHEN REVISING WIRE HEIGHTS, FEEDER CABLE FROM DISCONNECT SWITCH TO OCS SHALL BE SHORTENED SO THERE IS NOT EXCESSIVE SLACK/LENGTH IN THE FEEDER CABLE.
6. FIELD VERIFY ELEVATION OF THE BOTTOM OF THE BRIDGE AND ADJUST THE MESSENGER WIRE HEIGHT TO MAINTAIN A MINIMUM CLEARANCE OF 12 INCHES BETWEEN THE BRIDGE STRUCTURE AND THE MESSENGER WIRE.
7. CANTILEVER SHALL BE FIELD ADJUSTED TO ACCOMMODATE WIRE HEIGHT THAT IS LOWER THEN ORIGINALLY EXISTED.

HORIZONTAL GRAPHIC SCALE 40 20 0 20 40
1 inch = 40 ft.

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: 1:40
SCALE: HORIZONTAL: 1:40
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

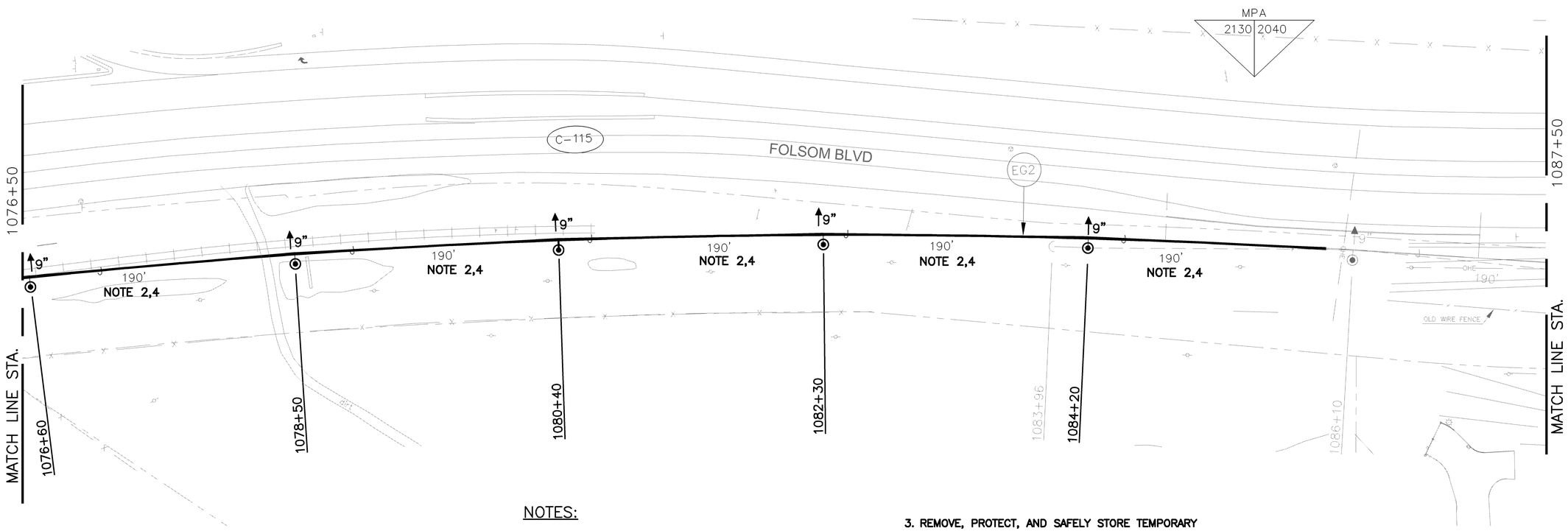
NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM RECONSTRUCTED WIRING PLAN AND LAYOUT SCHEDULE

K-302
SHEET

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
03	SAC	50	17.1	175	175

MISCELLANEOUS ASSEMBLIES AND FEEDERS		–	–	–	–	–	–	–	MP1	–	–
POLE BANDS, BRACKETS, AND MISC. ASSEMBLIES		BH1'	BH1'	BH1'	BH1	–	BH1',BR2	–	BH1	–	–
JUMPERS		JA1	JA1	JA1	JA1	–	JA1	–	JA1	–	–
HANGERS		HA190	HA190	HA190	HA190	–	HA190	–	HA190	–	–
SUPPORT REGISTRATION REFERENCE		CA14	CA14	CA14	CA14	–	CA14	–	CA14	–	–
GUY	HEIGHT (ft/ins)	–	–	–	–	–	24'–0"	–	–	–	–
	REFERENCE	–	–	–	–	DG1	–	–	–	–	–
	FOUNDATION	–	–	–	–	FD10	–	–	–	–	–
POLE	TERMINATION	–	–	–	–	–	–	–		–	–
	REFERENCE	PA3	PA3	PA3	PA3	–	PA3	–	PA3	–	–
	FOUNDATION	FA15	FA15	FA15	FA15	–	FA15	–	FA15	–	–
MESSENGER WIRE HEIGHT (ft/ins)		24'–0"	24'–0"	24'–0"	24'–0"	–	24'–0"	–	24'–0"	–	–
CONTACT WIRE HEIGHT (ft/ins)		19'–6"	19'–6"	19'–6"	19'–6"	–	19'–6"	–	19'–6"	–	–
℄ POLE TO ℄ SC1 TRACK (ft/ins)		9'–0"	9'–0"	9'–0"	9'–0"	9'–0"	9'–0"	–	9'–0"	–	–
LOCATION (POLE ℄)		1076+60	1078+50	1080+40	1082+30	1083+96	1084+20	–	1086+10	–	–
STRUCTURE NUMBER		7751	7752	7753	7754	7755A	7755	–	7756	–	–
MILE POST		F 20201	F 20237	F 20273	F 20309		F 20345		F 20381		
REMARKS		NOTE 3	NOTE 3	NOTE 3	NOTE 3		NOTE 3				



NOTES:

1. TRANSFER WIRE RUN TERMINATION LEAD AND BALANCE WEIGHT LEAD TO THE TENSION WHEEL AT THE DESIGNED TERMINATION HEIGHT. REMOVE TEMPORARY TENSION WHEEL ASSEMBLY BW9 FROM TEMPORARY PHASE AND DELIVER TO RT.
2. LENGTHEN TEMPORARY HANGERS AND CRIMP IN FINAL POSITION ONCE THE REQUIRED WIRE HEIGHTS ARE ATTAINED.
3. REMOVE, PROTECT, AND SAFELY STORE TEMPORARY CANTILEVER ARMS. INSTALL CANTILEVER ARMS THAT WERE RETAINED FOR REUSE DURING THE TEMPORARY PHASE. MATERIALS TO BE REUSED SHALL BE INSPECTED BY RT PRIOR TO RE–INSTALLATION. DELIVER THE TEMPORARY CANTILEVERS TO RT.
4. INSTALL JUMPERS THAT WERE RETAINED FOR REUSE DURING THE TEMPORARY PHASE. MATERIALS TO BE REUSED SHALL BE INSPECTED BY RT PRIOR TO RE–INSTALLATION. DELIVER THE TEMPORARY JUMPERS TO RT.

N

HORIZONTAL GRAPHIC SCALE
40 20 0 20 40
1 inch = 40 ft.

REVISIONS

MARK	DATE	DESCRIPTION	BY	CHKD
	5/23/14	ISSUE FOR BID		

SCALE: VERTICAL: 1:40
SCALE: HORIZONTAL: 1:40
SCALE:
ORIGINAL SCALE IN INCHES FOR REDUCED PLAN
0 1 2 3

		DATE
PROJECT ENGINEER:	J. BOERMA	
DESIGNED BY:	J. WIESE	5/14/14
DRAWN BY:	S. PORTER	5/16/14
CHECKED BY:	J. BOERMA	5/19/14

LTK
LTK Engineering Services

REGISTERED PROFESSIONAL ENGINEER JEFFREY J. BOERMA C 77489 CIVIL STATE OF CALIFORNIA
Aug 7, 2014

CI:
FILE:
SUBMITTAL:
5/23/14

Regional Transit

NATOMA OCS WIDENING PROJECT

OVERHEAD CONTACT SYSTEM
RECONSTRUCTED WIRING PLAN AND
LAYOUT SCHEDULE

K-303
SHEET

P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\26 K-303.dwg Time:Aug07,2014-08:35am Login:sporter Dimscale:1 LTScale:1
Image: B: 3D_TEMP.dwg
Image: B: 3D_TEMP.dwg
Image: P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\26 K-303.dwg
Image: P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\26 K-303.dwg
Image: P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\26 K-303.dwg
Image: P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\26 K-303.dwg
Image: P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\26 K-303.dwg
Image: P:\Projects\B-Current Projects\C4580 PSOMAS SRTD GEC 2013\TASK 3 - Natoma OCS Widening\CAD\Sheets\26 K-303.dwg