Schedule AW-2

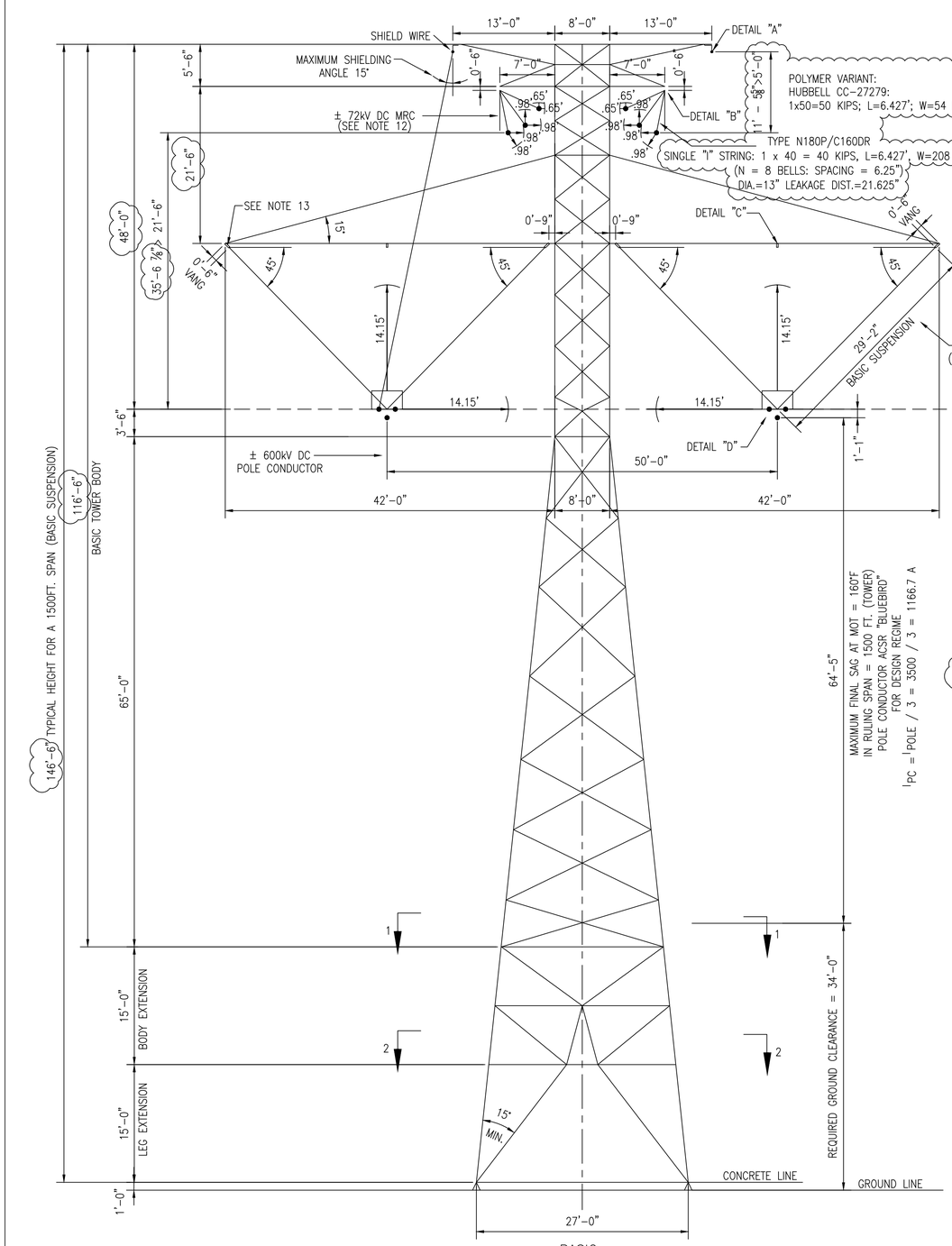
****Public****

BASIC SUSPENSION (SST-00)

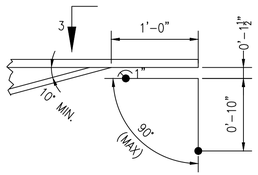
Required Clearances								
Mechanical	Electrical	+/- 600 kV DC Pole Conductor	+/- 72 KV DC Metal Return Conductor (See Note 12)	+/- 72 KV DC MRC "I" String Swing Angle (See Note 12)				
				Glass Insulators		Polymer Insulators		
				Min.	Max.	Min.	Max.
60 ° F, No Wind	Lightning Impulse Withstand Voltage	14.15'	0.98'	-3°	3°	-3°	3°
60 ° F, Medium Wind: 6 psf	Switching Impulse Withstand Voltage	14.15'	0.98'	-28°	28°	-28°	28°
60 ° F, Extreme Wind: 23.9 psf	Steady State, Normal Regime	5'	0.65'	-64°	64°	-64°	64°
Swing Angle Calculations covers all possible scenarios: $LA_{min}=0^0$ & $LA_{max}=0.5^0$; Wind from both Left (+) & Right (-),								
Line Angle to Right (+) & Left (-); Both Left & Right Crossarms; Design Wind Span (Horizontal Span): HS=1500' (Basic);								
Design Minimum Weight Span (Vertical Span): VS_{min} =1050' (Basic); $A_{INS\ Wind}$=2.98 sqft; W_{INS}=171 lbs								

NOTES

1. HORIZONTAL SECTION OF TOWER SHALL BE SQUARE ; FROM THE WAIST DOWN BRACING MEMBERS SHALL BE THE SAME ON BOTH THE TRANSVERSAL AND LONGITUDINAL FACES, BUT THE ANGLE SIZES OF MEMBERS MAY DIFFER.
2. THE WIDTH OF THE TOWER BODY IN DIFFERENT SECTIONS IS SUBJECT TO OPTIMIZATION.
3. CLEARANCE DIMENSIONS SHOWN ON TOWER DRAWING ARE THE MINIMUMS TO BE PROVIDED FROM THE SURFACE OF SUPPORTING STEEL AND OUTSTANDING LEGS OF WEBS TO THE CORONA RING HOT BOX OR CONDUCTOR.
4. ALL TOWER TYPES SHALL BE DESIGNED TAKING INTO CONSIDERATION THAT ANY COMBINATION (OF ADJACENT OR DIAGONAL OPPOSITE LEGS) OF MINIMUM AND MAXIMUM HEIGHT CAN BE USED WITH A COMMON PART OR WITH ANY TOWER BODY EXTENSION.
5. ALL DIMENSIONS ARE IN FEET.
6. SWING ANGLES, LINE ANGLES, DEPARTURE ANGLES, ETC. ARE BASED ON 360 DEGREES CIRCLES.
7. STEEL WORK CONSTRUCTION IS INFORMATIVE ONLY FOR ESTIMATING PURPOSES.
8. BODY EXTENSIONS: +15FT, +30FT, +45FT.
   LEG EXTENSIONS: +5FT TO +45FT, IN INCREMENTS OF: 5FT.
   THE TOWER DESIGNS SHOULD INCLUDE THE FOLLOWING DESIGN HEIGHTS:
   BASIC SUSPENSION: 120' – 190' IN 5' INCREMENTS.
9. DETAILED VANG ATTACHMENT INFORMATION WILL BE PROVIDED AT FINAL DESIGN.
10. THE ANGLES SHOWN REFLECT THE MINIMUM AND MAXIMUM INSULATOR POSITION UNDER AN EVERYDAY, 60°, 6 PSF, & 60°, 23.9 PSF CONDITION.
11. PROVIDE DEADEND AND SUSPENSION ATTACHMENT @ OPGW & SHIELD WIRE LOCATIONS. DEADEND VANG ON SHIELD ARM IS INTENDED FOR DEADENDING THE OPGW AT SPLICE LOCATIONS ONLY. THE TOWER IS NOT DESIGNED TO HANDLE FULL DEADEND LOADING UNDER EXTREME EVENTS.
12. MRC DESIGNED FOR WORST EXPECTED DROP VOLTAGE 72 KV DC: 72 KV DC: 8 BELLS 40 K; L=6.427'; CLEARANCES: 0.98'; 0.65'
13. THE POLE CONDUCTOR V-STRING ATTACHMENT VANGS ARE TO BE POSITIONED IN THE AXIS OF THE V-STRING, AT 45 DEGREES, AND WITH THE HOLE PERPENDICULAR TO THE SPAN.



BASIC
TANGENT SUSPENSION TOWER



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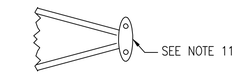
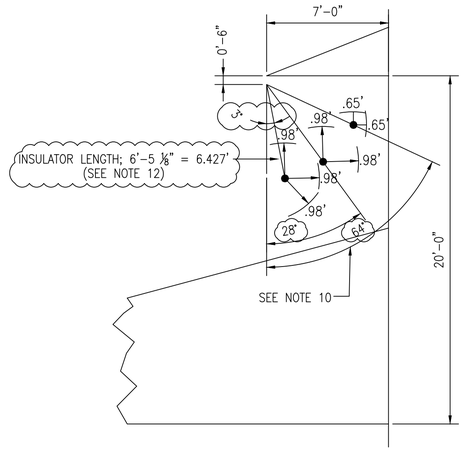


SECTION 3-3



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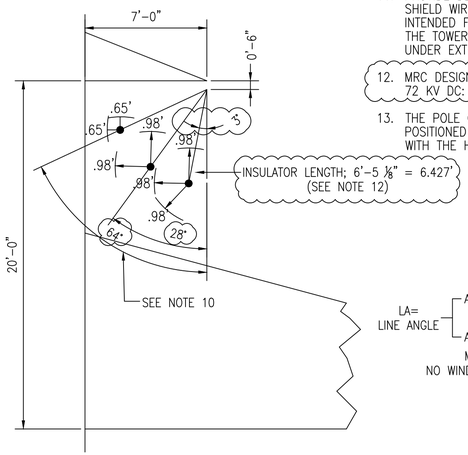

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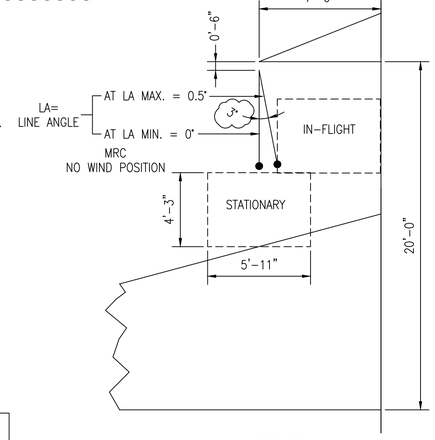
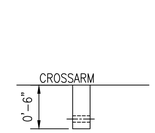
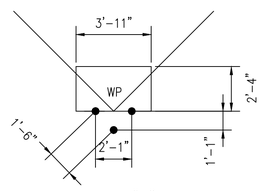


AVIAN HOT BOX
H x L = 51" x 71"



DETAIL "C"
MAINTENANCE VANG



DETAIL "D"
CORONA RING HOT BOX

SECTION 1-1 & 2-2

GBX-D-T007-1.DWG

Grain Belt Express
TRANSMISSION LINE

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD	REFERENCE DRAWINGS
M	UPDATED 60°F, NO WIND SWING ANGLE	03/03/22	KPK	JSK	JRW	MJL	
L	MRC UPDATED TO BLUEBIRD FOR BASIC TAN	02/22/22	KPK	JSK	JRW	MJL	
K	UPDATED STRUCTURE NAME DESIGNATION	09/24/21	KB	JSK	CIM	CDM	
J	REVISED TOWER INFORMATION	06/15/21	KB	JSK	CIM	CDM	
I	ISSUED FOR DETAILED DESIGN	11/25/20	KB	JSK	CIM	CDM	

DSGN	CIM	5/21/14
DRN	DVW	5/21/14
CKD	CIM	5/21/14
SCALE:	NTS	
FOR 22x34 DWG ONLY		

POWER ENGINEERS

INVENERGY
GRAIN BELT EXPRESS ± 600kV HVDC LINE
BASIC SUSPENSION
SELF SUPPORTING SUSPENSION TOWER 0°-0.5° MRC ABOVE (V-STRING)

JOB NUMBER 162750 | REV M

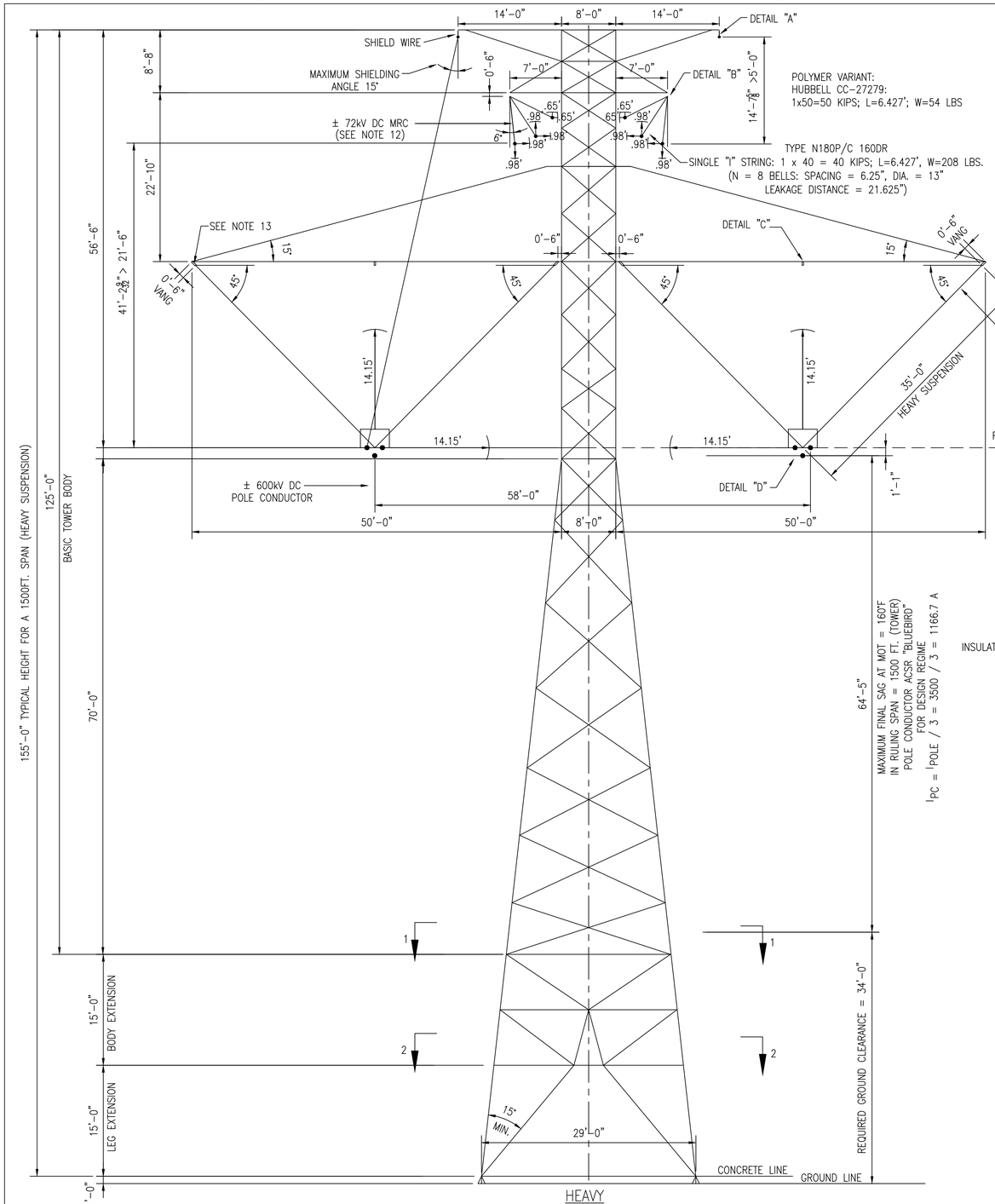
DRAWING NUMBER GBX-D-T007-1

HEAVY SUSPENSION (SST-02HT)

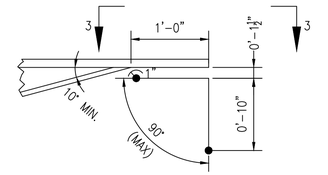
Required Clearances								
Mechanical	Electrical	+/- 600 kV DC Pole Conductor	+/- 72 KV DC Metal Return Conductor (See Note 12)	+/- 72 KV DC MRC "I" String Insulator Swing Angle (See Note 12)				
				Glass Insulators		Polymer Insulators		
				Min.	Max.	Min.	Max.
60 ° F, No Wind	Lightning Impulse Withstand Voltage	14.15'	0.98'	-6°	6°	-6°	6°
60 ° F, Medium Wind: 6 psf	Switching Impulse Withstand Voltage	14.15'	0.98'	-31°	31°	-32°	32°
60 ° F, Extreme Wind: 23.9 psf	Steady State, Normal Regime	5'	0.65'	-65°	65°	-65°	65°
Swing Angle Calculations covers all possible scenarios: LA_{min}=0° & LA_{max}=2°; Wind from both Left (+) & Right (-), Line Angle to Right (+) & Left (-); Both Left & Right Crossarms; Design Wind Span (Horizontal Span): HS=2500' Design Minimum Weight Span (Vertical Span): VS_{min} =1750'; $A_{INS\ Wind}$=3.24 sqft; W_{INS}=208 lbs								

NOTES

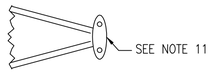
1. HORIZONTAL SECTION OF TOWER SHALL BE SQUARE ; FROM THE WAIST DOWN BRACING MEMBERS SHALL BE THE SAME ON BOTH THE TRANSVERSAL AND LONGITUDINAL FACES, BUT THE ANGLE SIZES OF MEMBERS MAY DIFFER.
2. THE WIDTH OF THE TOWER BODY IN DIFFERENT SECTIONS IS SUBJECT TO OPTIMIZATION.
3. CLEARANCE DIMENSIONS SHOWN ON TOWER DRAWING ARE THE MINIMUMS TO BE PROVIDED FROM THE SURFACE OF SUPPORTING STEEL AND OUTSTANDING LEGS OF WEBS TO THE CORONA RING HOT BOX OR CONDUCTOR.
4. ALL TOWER TYPES SHALL BE DESIGNED TAKING INTO CONSIDERATION THAT ANY COMBINATION (OF ADJACENT OR DIAGONAL OPPOSITE LEGS) OF MINIMUM AND MAXIMUM HEIGHT CAN BE USED WITH A COMMON PART OR WITH ANY TOWER BODY EXTENSION.
5. ALL DIMENSIONS ARE IN FEET.
6. SWING ANGLES, LINE ANGLES, DEPARTURE ANGLES, ETC. ARE BASED ON 360 DEGREES CIRCLES.
7. STEEL WORK CONSTRUCTION IS INFORMATIVE ONLY FOR ESTIMATING PURPOSES.
8. BODY EXTENSIONS: +15FT, +30FT, +45FT.
   LEG EXTENSIONS: +5FT TO +45FT, IN INCREMENTS OF: 5FT.
   THE TOWER DESIGNS SHOULD INCLUDE THE FOLLOWING DESIGN HEIGHTS:
   HEAVY SUSPENSION: 130' – 215' IN 5' INCREMENTS.
9. DETAILED VANG ATTACHMENT INFORMATION WILL BE PROVIDED AT FINAL DESIGN.
10. THE ANGLES SHOWN REFLECT THE MINIMUM AND MAXIMUM INSULATOR POSITION UNDER AN EVERYDAY, 60°, 6 PSF, & 60°, 23.9 PSF CONDITION.
11. PROVIDE DEADEND AND SUSPENSION ATTACHMENT @ OPGW & SHIELD WIRE LOCATIONS. DEADEND VANG ON SHIELD ARM IS INTENDED FOR DEADENDING THE OPGW AT SPLICE LOCATIONS ONLY. THE TOWER IS NOT DESIGNED TO HANDLE FULL DEADEND LOADING UNDER EXTREME EVENTS.
12. MRC DESIGNED FOR WORST EXPECTED DROP VOLTAGE 72 KV DC: 72 KV DC: 8 BELLS 40 K; L=6.427'; CLEARANCES: 0.98'; 0.65'
13. THE POLE CONDUCTOR V-STRING ATTACHMENT VANGS ARE TO BE POSITIONED IN THE AXIS OF THE V-STRING, AT 45 DEGREES, AND WITH THE HOLE PERPENDICULAR TO THE SPAN.



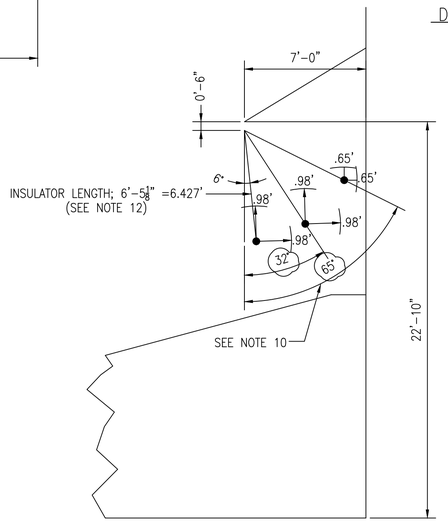
HEAVY
TANGENT SUSPENSION TOWER



DETAIL "A"



SECTION 3-3



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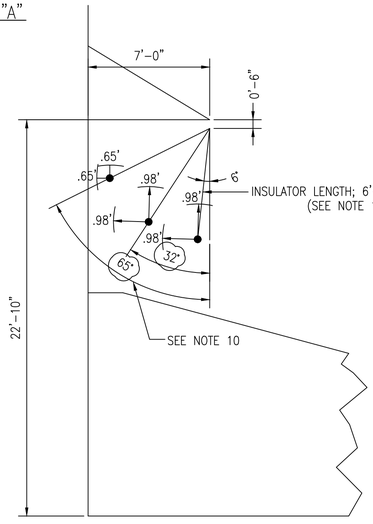

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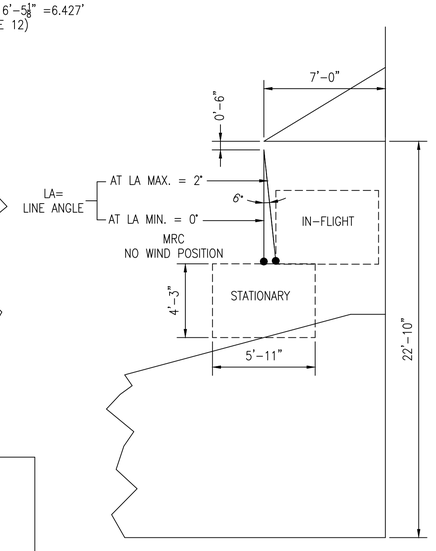
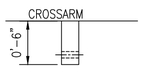
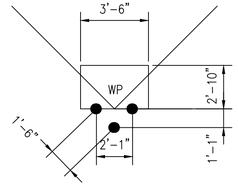
DETAIL "B"



AVIAN HOT BOX
H x L = 51" x 71"



DETAIL "C"
MAINTENANCE VANG



DETAIL "D"
CORONA RING HOT BOX

SECTION 1-1 & 2-2

GBX-D-T007-2.DWG

Grain Belt Express
TRANSMISSION LINE

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD	REFERENCE DRAWINGS
L	MRC UPDATED TO BLUEBIRD FOR HEAVY TAN	02/25/22	KPK	JSK	MJL	JRW	
K	UPDATED STRUCTURE NAME DESIGNATION	09/24/21	KB	JSK	CIM	CDM	
J	REVISED TOWER INFORMATION	06/15/21	KB	JSK	CIM	CDM	
I	ISSUED FOR DETAILED DESIGN	11/25/20	KB	JSK	CIM	CDM	
H	ISSUED FOR TOWER DESIGN BID	10/30/20	KB	JSK	CIM	CDM	

DSGN	CIM	5/21/14
DRN	DVW	5/21/14
CKD	CIM	5/21/14
SCALE:	NTS	
FOR 22x34 DWG ONLY		

POWER ENGINEERS

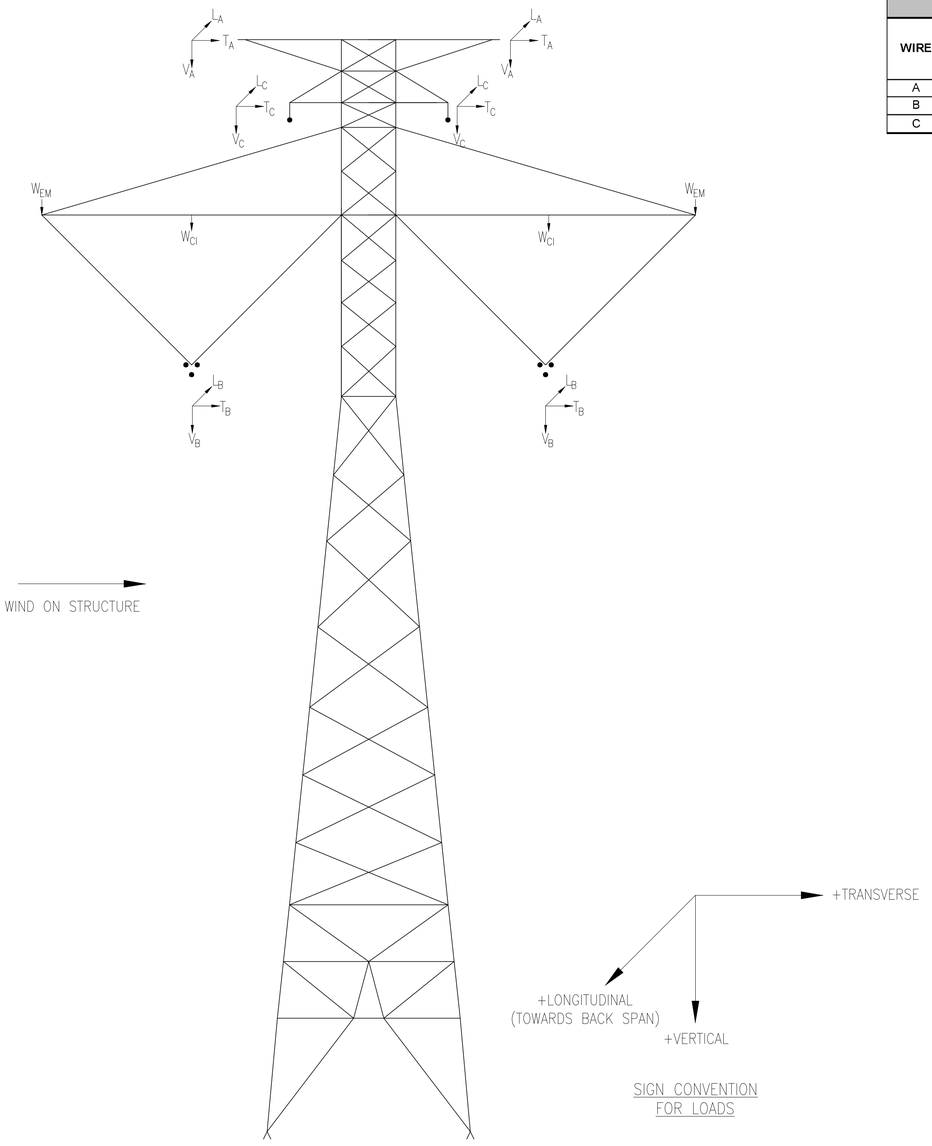
INVENERGY

GRAIN BELT EXPRESS ± 600kV HVDC LINE
HEAVY SUSPENSION

SELF SUPPORTING SUSPENSION TOWER 0°-2°
MRC ABOVE (V-STRING)

JOB NUMBER 162750 | REV L

DRAWING NUMBER GBX-D-T007-2



SIGN CONVENTION FOR LOADS

DESIGN PARAMETERS										BASIC TANGENT		HEAVY TANGENT	
WIRE	WIRE TYPE	STRAND (al/st)	WEIGHT (lbs./ft.)	DIA. (in.)	INS. WT (lbs.)	BASIC ANGLE (deg)	HEAVY ANGLE (deg)	RULING SPAN (ft.)	MIN WT SPAN (ft.)	WIND SPAN (ft.)	MAX WT SPAN (ft.)	WIND SPAN (ft.)	MAX WT SPAN (ft.)
A	(1) - OPGW (11391 72h80DSG)	NA	0.540	0.678	SEE TABLE 1	0.5°	2°	1500	100	1500	2250	2500	3750
B	(3) - 2156 KCM ACSR "Bluebird"	84/19	2.511	1.762		0.5°	2°	1500	100	1500	2250	2500	3750
C	(1) - 2156 KCM ACSR "Bluebird" w/ E3X	84/19	2.511	1.762		0.5°	2°	1500	100	1500	2250	2500	3750

WEATHER CASES				OVERLOAD FACTORS			WIRE TENSIONS		
DESCRIPTION	TEMP (°F)	RADIAL ICE (in.)	WIND (psf)	WIND OLF	TENSION OLF	VERTICAL OLF	A (lbs.)	B (lbs.)	C (lbs.)
1. NESC HEAVY	0	0.50	4.00	2.50	1.65	1.50	8900	23900	23900
2. NESC EXTREME WIND	60	0.00	23.90	1.00	1.00	1.00	7600	22300	22300
3. NESC EXTREME WIND - YAW 45°	60	0.00	11.95	1.00	1.00	1.00	5200	16900	16900
4. NESC EXTREME WIND- LONGITUDINAL 90°	60	0.00	0.00	1.00	1.00	1.00	3600	14300	14300
5. NESC EXTREME ICE WITH CONCURRENT WIND	15	1.00	4.10	1.00	1.00	1.00	12600	30300	30300
6. EVERYDAY	60	0.00	0.00	1.00	1.00	1.00	3600	14300	14300
7. CONSTRUCTION SNUB OFF 3:1	0	0.00	0.00	1.50	1.50	1.50	4100	15900	15900
8. STRINGING INTACT	0	0.00	4.00	1.50	1.50	1.50	4300	16200	16200
9. STRINGING/BROKEN SHIELDWIRE	0	0.00	4.00	1.50	1.50	1.50	3010 (A) / 0 (B) *	16200	16200
10a. STRINGING/BROKEN CONDUCTOR	0	0.00	4.00	1.50	1.50	1.50	4300	14580 (A) 10800 (B) *	16200
10b. STRINGING/BROKEN MRC	0	0.00	4.00	1.50	1.50	1.50	4300	16200	11340 (A) / 0 (B) *
11. TORNADO WIND - STRUCTURE ONLY	60	0.00	63.10	-	-	-	-	-	-

*(A)= AHEAD SPAN TENSION, (B)= BACK SPAN TENSION

NOTES

1. WIRE TENSIONS PROVIDED PER SUBCONDUCTOR. VECTOR LOADS PROVIDED PER PHASE.
2. LOAD CASE (9) TO BE APPLIED TO ONLY 1 SHIELD WIRE ATTACHMENT POINT (MOST SEVERE). APPLY LOAD CASE (8) TO ALL OTHER ATTACHMENT POINTS.
3. LOAD CASE (10A) TO BE APPLIED TO ONLY 1 SUB-CONDUCTOR (IN THE BUNDLE) AT ATTACHMENT POINT (MOST SEVERE) OF ONE POLE (POSITIVE OR NEGATIVE). APPLY LOAD CASE (8) TO ALL OTHER ATTACHMENT POINTS.
4. LOAD CASE (10B) TO BE APPLIED TO ONLY 1 MRC ATTACHMENT POINT (MOST SEVERE). APPLY LOAD CASE (8) TO ALL OTHER ATTACHMENT POINTS.
5. THE WEIGHT OF CLAMP FOR SHIELD WIRE AND INSULATOR FOR POLE CONDUCTOR AND METAL RETURN CONDUCTOR FOR THE BASIC, MEDIUM, AND HEAVY SUSPENSION ARE PROVIDED IN TABLE 1. THESE WEIGHTS HAVE BEEN INCLUDED IN THE LOADING TREE FORCES. FOR WIND ON CLAMPS / INSULATORS, USE AREA EXPOSED TO WIND FROM TABLE 1.
6. APPLY AN OLF OF 1.5 ON STRUCTURE WEIGHT FOR LOAD CASES 1,7,8,9 & 10.
7. APPLY AN OLF OF 1 ON STRUCTURE WEIGHT FOR LOAD CASES 2,3,4,5 & 6.
8. THE WIND PRESSURE ON THE STRUCTURE SHALL BE APPLIED WITH THE WIND SHAPE FACTORS PER NESC 2017 RULE 252.B.
9. THE STRUCTURE SHALL BE DESIGNED FOR AN ADDITIONAL LOAD CASE 12, FOR LOADS ANTICIPATED DUE TO RIGGING FOR WIRE CLIP IN DURING CONSTRUCTION. LOADS SHALL BE APPLIED AS FOLLOWS;

   AT ONE PHASE LOCATION, APPLY LOAD (W_{CI}) DIRECTLY ABOVE THE WORKPOINT. EACH LOCATION SHOULD BE ANALYZED SEPARATELY;

   DC-BASIC W_{CI} = 26,650 LBS.
   DC-HEAVY W_{CI} = 43,600 LBS.

   APPLY LOAD CASE (6) TO ALL OTHER ATTACHMENT POINTS.
10. ALL TOWER MEMBERS TO WITHSTAND A VERTICAL LOAD OF 350LBS APPLIED AT THEIR MIDPOINT WITH NO OTHER LOADS ACTING.
11. CASE 6 – MAX WEIGHT SHALL INCLUDE AN ADDITIONAL 800LB LOAD (W_{EM}) AT THE TIP OF EACH ARM TO ACCOUNT FOR MAINTENANCE WITH TWO MEN AND EQUIPMENT.
12. LOAD CASE (3) WIND PRESSURE TO BE APPLIED TO THE TRANSVERSE FACE AND LONGITUDINAL FACE SIMULTANEOUSLY.
13. LOAD CASE (2, 3, & 4) WIND PRESSURE DEVELOPED UTILIZING A 100 YR RETURN PERIOD BASED OFF OF ASCE 74, 4TH EDITION WIND PRESSURE CALCULATION RESULTS IN A MORE CONSERVATIVE VALUE COMPARED TO THE CURRENT NESC 2017 CALCULATION.
14. TOWER TO BE DESIGNED TO ACCOMMODATE OSHA FALL PROTECTION REQUIREMENTS.
15. LOAD CASES 9, 10a, & 10b APPLIED ONLY TO HEAVY SUSPENSION, NOT APPLIED TO BASIC SUSPENSION.
16. LOAD CASE 11 SHALL BE APPLIED ON STRUCTURE ONLY, IN TRANSVERSE, 45°, LONGITUDINAL DIRECTIONS.
17. TORNADO LOADING DOES NOT APPLY TO BASIC TANGENT STRUCTURE.

TABLE 1
CLAMP/INSULATOR PARAMETERS

TOWER TYPE			BASIC					HEAVY				
WIRE	WIRE TYPE	CLAMP/INSULATOR TYPE	LENGTH	DIAMETER	AREA EXPOSED TO WIND	TOTAL WEIGHT (INCLUDING HARDWARE)	UTS	LENGTH	DIAMETER	AREA EXPOSED TO WIND	TOTAL WEIGHT (INCLUDING HARDWARE)	UTS
			[FT]	[IN]	[FT²]	[LBS]	[KIPS]	[FT]	[IN]	[FT²]	[LBS]	[KIPS]
A	0 kV Optical Ground Wire (1) - OPGW (11391 72h80DSG)	Suspension Clamp	0.83	2	0.14	22	15.75	0.83	2	0.14	22	25
B	600 kV Pole Conductor (PC) (3) - 2156 KCM ACSR "Bluebird"	Single "V" String Suspension 1x90 = 90 kips (Glass or Polymer) (Basic) V-String: 45° (L); 45° (R) Single "V" String Suspension 1x120 = 120 kips (Glass or Polymer) (Heavy) V-String: 45° (L); 45° (R)	29.17 (ONE SIDE) HB: 3.9' X 2.3'	14.1732 (ONE SIDE)	17.1 (ONE SIDE)	2976 (Glass) (BOTH SIDES) 587 (Polymer)	90 (ONE SIDE) (Glass or Polymer)	35 (ONE SIDE) HB: 3.5' X 2.8'	14.1732 (ONE SIDE)	20.4 (ONE SIDE)	3545 (Glass) (BOTH SIDES) 829 (Polymer)	120 (ONE SIDE) (Glass or Polymer)
C	72 kV Metal Return Conductor (MRC) (1) 2156 KCM ACSR "Bluebird" w/ E3X	Single "I" String Suspension 1x40 = 40 kips (Glass) 1x50=50 kips (Polymer) (Basic and Heavy)	6.427 No HB	13	3.24	208 (Glass) 54 (Polymer)	40 (Glass) 50 (Polymer)	6.427 No HB	13	3.24	208 (Glass) 54 (Polymer)	40 (Glass) 50 (Polymer)

HB: Corona Ring Hot Box: L x H (L=Length, H=Height) (L): Left Side, (R): Right Side

Note:
Assembly weights listed above with glass insulator bells were utilized in the maximum weight span loading calculation.
Reduced assembly weights with polymer insulators were utilized for the minimum weight span loading calculation.

Grain Belt Express
TRANSMISSION LINE

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD	REFERENCE DRAWINGS
K	MRC UPDATED TO BLUEBIRD FOR HEAVY TAN	02/25/22	KPK	JSK	MJL	JRW	
J	MRC UPDATED TO BLUEBIRD FOR BASIC TAN	02/22/22	KPK	JSK	MJL	JRW	
I	REVISED TOWER INFORMATION	06/15/21	KB	JSK	CIM	CDM	
H	ISSUED FOR DETAILED DESIGN	11/25/20	KB	JSK	CIM	CDM	
G	ISSUED FOR TOWER DESIGN BID	10/30/20	KB	JSK	CIM	CDM	

DSGN	CIM	5/21/14
DRN	DVW	5/21/14
CKD	CIM	5/21/14

SCALE: NTS
FOR 22x34 DWG ONLY

POWER ENGINEERS

INVENERGY
GRAIN BELT EXPRESS ± 600kV HVDC LINE
BASIC AND HEAVY SUSPENSION
SELF SUPPORTING SUSPENSION TOWER 0°-2°
MRC ABOVE (V-STRING)-LOAD DRAWING

JOB NUMBER 162750 | REV K

DRAWING NUMBER GBX-D-T007-3

GBX-D-T007-3.DWG

BASIC SUSPENSION - MAX WEIGHT (0.5 Degree Line Angle)

LOAD SCHEDULE (KIPS): ALL LOADS INCLUDE OVERLOAD CAPACITY FACTORS

DESCRIPTION	V_A	T_A	L_A	V_B	T_B	L_B	V_C	T_C	L_C	WIND ON STRUCTURE (psf)
1. NESC HEAVY	4.40	2.30	0.00	47.00	11.40	0.00	13.50	3.80	0.00	10.00
2. NESC EXTREME WIND	1.30	2.10	0.00	21.80	16.40	0.00	5.90	5.50	0.00	27.1
3. NESC EXTREME WIND- YAW 45°	1.30	1.10	0.10	21.80	8.40	0.10	5.90	2.80	0.10	13.6
4. NESC EXTREME WIND- LONGITUDINAL 90°	1.30	0.10	0.10	21.80	0.40	0.10	5.90	0.20	0.10	27.1
5. NESC EXTREME ICE WITH CONCURRENT WIND	6.00	1.50	0.00	45.00	6.60	0.00	13.60	2.20	0.00	4.10
6. EVERYDAY	1.30	0.10	0.00	21.80	0.40	0.00	5.90	0.20	0.00	0.00
7. CONSTRUCTION SNUB OFF 3:1	2.90	0.30	0.30	35.00	2.50	2.60	11.70	0.90	0.90	0.00
8. STRINGING INTACT	1.90	0.60	0.00	32.70	4.70	0.00	8.80	1.60	0.00	6.00

BASIC SUSPENSION - MIN WEIGHT (0.5 Degree Line Angle)

LOAD SCHEDULE (KIPS): ALL LOADS INCLUDE OVERLOAD CAPACITY FACTORS

DESCRIPTION	V_A	T_A	L_A	V_B	T_B	L_B	V_C	T_C	L_C	WIND ON STRUCTURE (psf)
1. NESC HEAVY	0.30	2.30	0.00	2.40	11.40	0.00	0.70	3.80	0.00	10.00
2. NESC EXTREME WIND	0.10	2.10	0.00	1.20	16.40	0.00	0.30	5.50	0.00	27.1
3. NESC EXTREME WIND- YAW 45°	0.10	1.10	0.10	1.20	8.40	0.10	0.30	2.80	0.10	13.6
4. NESC EXTREME WIND- LONGITUDINAL 90°	0.10	0.10	0.10	1.20	0.40	0.10	0.30	0.20	0.10	27.1
5. NESC EXTREME ICE WITH CONCURRENT WIND	0.30	1.50	0.00	2.20	6.60	0.00	0.70	2.20	0.00	4.10
6. EVERYDAY	0.10	0.10	0.00	1.20	0.40	0.00	0.30	0.20	0.00	0.00
7. CONSTRUCTION SNUB OFF 3:1	2.90	0.30	0.30	35.00	2.50	2.60	11.70	0.90	0.90	0.00
8. STRINGING INTACT	0.20	0.60	0.00	1.70	4.70	0.00	0.50	1.60	0.00	6.00

HEAVY SUSPENSION - MAX WEIGHT (2 Degree Line Angle)

LOAD SCHEDULE (KIPS): ALL LOADS INCLUDE OVERLOAD CAPACITY FACTORS

DESCRIPTION	V_A	T_A	L_A	V_B	T_B	L_B	V_C	T_C	L_C	WIND ON STRUCTURE (psf)
1. NESC HEAVY	7.20	4.10	0.00	76.30	21.40	0.00	22.30	7.20	0.00	10.00
2. NESC EXTREME WIND	2.10	3.70	0.00	35.10	28.70	0.00	9.60	9.60	0.00	27.1
3. NESC EXTREME WIND- YAW 45°	2.10	1.90	0.10	35.10	15.00	0.10	9.60	5.00	0.10	13.6
4. NESC EXTREME WIND- LONGITUDINAL 90°	2.10	0.20	0.10	35.10	1.50	0.10	9.60	0.50	0.10	27.1
5. NESC EXTREME ICE WITH CONCURRENT WIND	9.90	2.80	0.00	73.70	12.90	0.00	22.50	4.30	0.00	4.10
6. EVERYDAY	2.10	0.20	0.00	35.10	1.50	0.00	9.60	0.50	0.00	0.00
7. CONSTRUCTION SNUB OFF 3:1	2.90	0.30	0.30	35.00	2.50	2.60	11.70	0.90	0.90	0.00
8. STRINGING INTACT	3.10	1.10	0.00	52.60	9.20	0.00	14.40	3.10	0.00	6.00
9. STRINGING/BROKEN SHIELDWIRE	3.10	1.00	-4.60	52.60	9.20	0.00	14.40	3.10	0.00	6.00
10a. STRINGING/BROKEN CONDUCTOR	3.10	1.10	0.00	52.60	8.70	-17.10	14.40	3.10	0.00	6.00
10b. STRINGING/BROKEN MRC	3.10	1.10	0.00	52.60	9.20	0.00	14.40	2.50	-17.10	6.00
11. TORNADO WIND - STRUCTURE ONLY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	63.10

HEAVY SUSPENSION - MIN WEIGHT (2 Degree Line Angle)

LOAD SCHEDULE (KIPS): ALL LOADS INCLUDE OVERLOAD CAPACITY FACTORS

DESCRIPTION	V_A	T_A	L_A	V_B	T_B	L_B	V_C	T_C	L_C	WIND ON STRUCTURE (psf)
1. NESC HEAVY	0.30	4.10	0.00	2.50	21.40	0.00	0.70	7.20	0.00	10.00
2. NESC EXTREME WIND	0.10	3.70	0.00	1.20	28.70	0.00	0.30	9.60	0.00	27.1
3. NESC EXTREME WIND- YAW 45°	0.10	1.90	0.10	1.20	15.00	0.10	0.30	5.00	0.10	13.6
4. NESC EXTREME WIND- LONGITUDINAL 90°	0.10	0.20	0.10	1.20	1.50	0.10	0.30	0.50	0.10	27.1
5. NESC EXTREME ICE WITH CONCURRENT WIND	0.30	2.80	0.00	2.30	12.90	0.00	0.70	4.30	0.00	4.10
6. EVERYDAY	0.10	0.20	0.00	1.20	1.50	0.00	0.30	0.50	0.00	0.00
7. CONSTRUCTION SNUB OFF 3:1	2.90	0.30	0.30	35.00	2.50	2.60	11.70	0.90	0.90	0.00
8. STRINGING INTACT	0.20	1.10	0.00	1.80	9.20	0.00	0.50	3.10	0.00	6.00
9. STRINGING/BROKEN SHIELDWIRE	0.20	1.00	-4.60	1.80	9.20	0.00	0.50	3.10	0.00	6.00
10a. STRINGING/BROKEN CONDUCTOR	0.20	1.10	0.00	1.80	8.70	-17.10	0.50	3.10	0.00	6.00
10b. STRINGING/BROKEN MRC	0.20	1.10	0.00	1.80	9.20	0.00	0.50	2.50	-17.10	6.00
11. TORNADO WIND - STRUCTURE ONLY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	63.10

Grain Belt Express
TRANSMISSION LINE

REV	REVISIONS	DATE	DRN	DSGN	CKD	APPD	REFERENCE DRAWINGS
L	MRC UPDATED TO BLUEBIRD FOR HEAVY TAN	02/25/22	KPK	JSK	MJL	JRW	
K	MRC UPDATED TO BLUEBIRD FOR BASIC TAN	02/22/22	KPK	JSK	MJL	JRW	
J	REVISED TOWER INFORMATION	06/15/21	KB	JSK	CIM	CDM	
I	REVISED TORNADO LOADING	03/03/21	KB	JSK	CIM	CDM	
H	ISSUED FOR DETAILED DESIGN	11/25/20	KB	JSK	CIM	CDM	

DSGN	CIM	5/21/14
DRN	DVW	5/21/14
CKD	CIM	5/21/14

SCALE: NTS

FOR 22x34 DWG ONLY

POWER ENGINEERS

INVENERGY

GRAIN BELT EXPRESS ± 600kV HVDC LINE
BASIC AND HEAVY SUSPENSION

SELF SUPPORTING SUSPENSION TOWER 0°-2°
MRC ABOVE (V-STRING)-LOAD DRAWING

JOB NUMBER 162750

REV L

DRAWING NUMBER
GBX-D-T007-4

GBX-D-T007-4.DWG