

Investigation of the September 27, 2017, Gin Pole Collapse at an Antenna Tower in Miami Gardens, Florida.

U.S. Department of Labor
Occupational Safety and Health Administration
Directorate of Construction

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Report

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Executive Summary

On September 27, 2017, an incident occurred in Miami Gardens, Florida where three construction employees were killed. The employees were engaged in installing a new antenna for a local TV station at the top of a 951-foot tall antenna tower constructed in 2009. The three employees were killed when the gin pole they were using suddenly disengaged from the tower structure plunging several hundred feet to the ground. The employees were tied to the gin pole and fell with it. The cause of the disengagement was the failure of attachment between the gin pole and the tower structure. The owner of the tower, Miami Tower LLC, contracted with Tower King II of Cedar Hills, TX in 2017 to perform the installation of the new antenna and related work. Tower King II retained Stainless/FDH Velocitel of Northbrook, Illinois as a “qualified engineer” to perform structural review of the rigging plan proposed by Tower King II.

The Regional Administrator, Region IV, and the Fort Lauderdale Area Office requested the Directorate of Construction, National OSHA Office to provide engineering assistance in the incident investigation and for causal determination. Two structural engineers visited the site on three occasions to observe the incident site, obtain relevant information, take photographs, examine failed pieces and obtain necessary documents. Attached is our report. After reviewing the documents and conducting independent structural analysis, we conclude the following:

- 1) The cause of the failure was the inadequate capacity of the bridle attachment of the gin pole to the tower structure. Tower King II sized the rigging of the gin pole attachment to the tower structure without any guidance or approval of an engineer. This was a violation of the industry standard. The rigging did not have the required factor of safety as per industry standard A10.48.
- 2) Tower King II violated the industry standard ANSI A10.48 by not engaging a qualified engineer for a Class IV structure to perform the analysis of all the components including attachments of the gin pole to the tower structure. The qualified engineer retained by Tower King II to review the rigging plan, as required by ANSI A10.48, clearly excluded the review of the means and method of all rigging during construction. This exclusion was conveyed to Tower King II in the qualified engineer’s review letter of September 13, 2017 sent a few days before the construction began.
- 3) Tower King II violated ANSI A10.48 by preparing an incomplete rigging plan in that it did not include the bridle attachments to the tower structure. Section 4.8.6.3 of ANSI A10.48 requires that the rigging plan include “sling size, type, angle and connection details to the structure and to the gin pole.”

- 4) The structural computations performed by the engineering consultant, Stainless, retained by Tower King II to review its rigging plan were flawed because Stainless' analyses were based on invalid assumptions resulting in significantly lower forces for the gin pole connections to the tower structure. The forces computed by Stainless at the bridle and basket locations of the gin pole were grossly underestimated.
- 5) The slings and the rigging provided by Tower King II to attach the gin pole to the tower structure would have been adequate to support the loads computed by Stainless and provided to Tower King II. The provided rigging would not have a factor of safety of 5 as required by the standard. However, these loads were grossly underestimated by Stainless by a factor of 4.5.
- 6) Tower King II changed the length of the gin pole and used a heavier gin pole without informing Stainless, the qualified engineer of the project. It had an implication on the evaluation of the rigging system but did not contribute to the collapse.
- 7) Contrary to the recommendation of the qualified engineer, Tower King II attached the tag line to the arbor instead of the gin pole without conferring with the qualified engineer. This, however, did not contribute to the collapse as connecting the tag line to the arbor reduced the forces at the bridle connection. The rigging for the jump line and load line was satisfactory.
- 8) The deceased employees' fall protection devices were anchored to the gin pole at three different locations. ANSI standard A10.48 requires that the anchor can support 5,000 pounds for a non-engineered system, 3,600 pounds for an engineered system or two times the maximum fall arresting force. Stainless did not evaluate the gin pole connections to the tower for such forces. Tower King II rigging plan did not indicate any required anchorage for fall protection on the gin pole.

Introduction

On September 27, 2017, three Tower King II, Inc. (Tower King) employees were killed due to the failure of the gin pole rigging while working on a repack project in Miami Gardens, FL. The location of the site and the tower are shown in Figure 1 and Figure 2 respectively. The height of the tower steel (from grade to the top of the candelabra steel framing) is 951 feet (1,042 feet tall from grade to top of antenna) and is comprised of 12-foot wide triangular frames. The typical tower section is 30 feet tall with 7'-6" bays. An elevation of the tower and a typical tower section are shown in Figure 3. At the peak of the tower were three arbors (see Figure 4). On two of the arbors are functioning television antennas. On the third arbor, Apex C, a dummy pole was placed to counterbalance the weight of the other two antennas. A partial elevation of Apex C, the dummy pole and its pedestal is shown in Figure 5. The repack project involved removing an existing dummy pole from one of the three arbors of the candelabra tower, removing the pedestal upon which the dummy pole was installed, installing a new pedestal and installing a new antenna. Tower King decided to use a gin pole rigged to Apex C to lift the equipment and framing from the ground to the top of the tower and vice versa. At the time of the incident, the existing dummy pole was already successfully removed and resting on the ground. Later on the same day, the existing pedestal was lowered to the parking lot adjacent to the base of the tower, and the Tower King employees were in the process of relocating the pedestal from the parking lot to the adjacent grass field. Separating the parking lot from the grass field is an approximately six-foot tall fence. According to interviews, the pedestal was about five feet off the ground when it abruptly fell back to the ground. Then the gin pole separated from the arbor and fell approximately 1,000 feet to the ground. Three employees of Tower King were tied off to the gin pole and died at the scene. Two other Tower King employees working on the ground (fork lift operator and hoist operator) were not injured. A site overview of the construction site is shown in Figure 6.

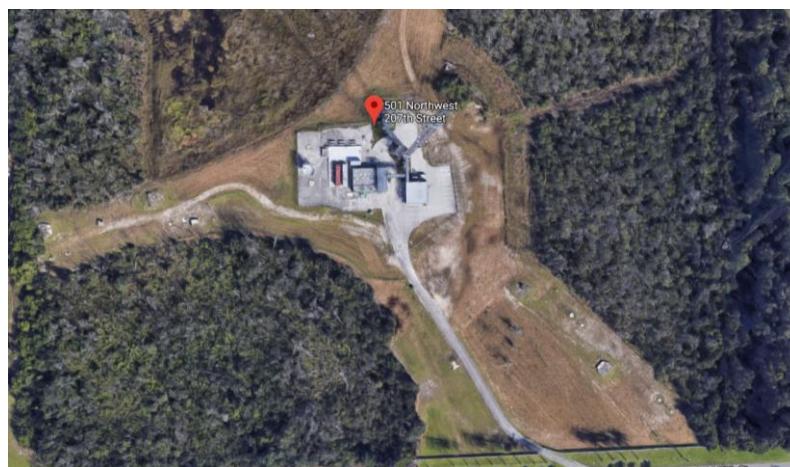


Figure 1 – Site Location



Figure 2 – Existing Tower

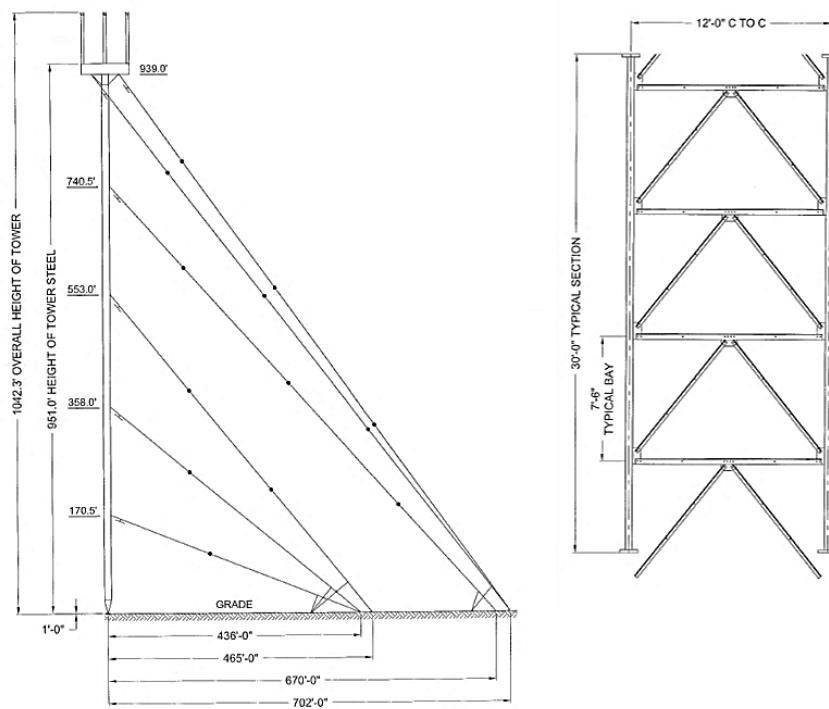


Figure 3 – Tower Elevation and Typical Section

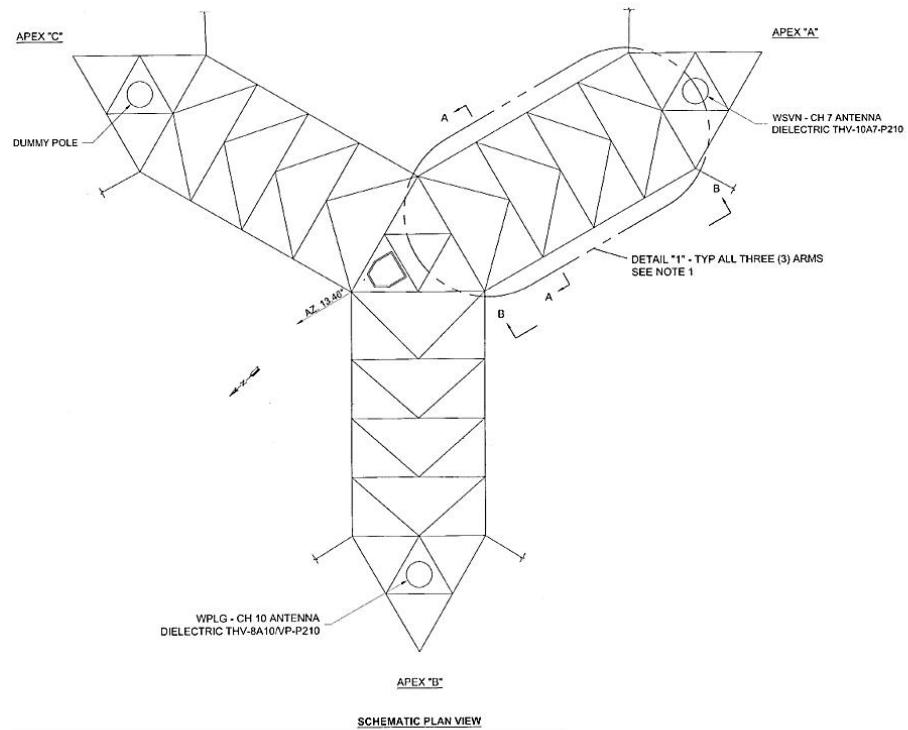


Figure 4 – Arbor Configuration

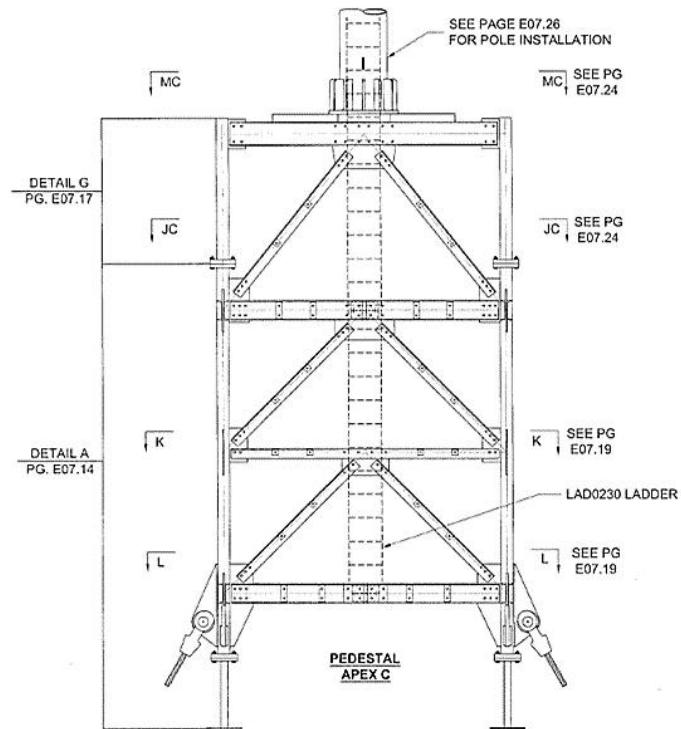


Figure 5 – Dummy Pole Pedestal Elevation

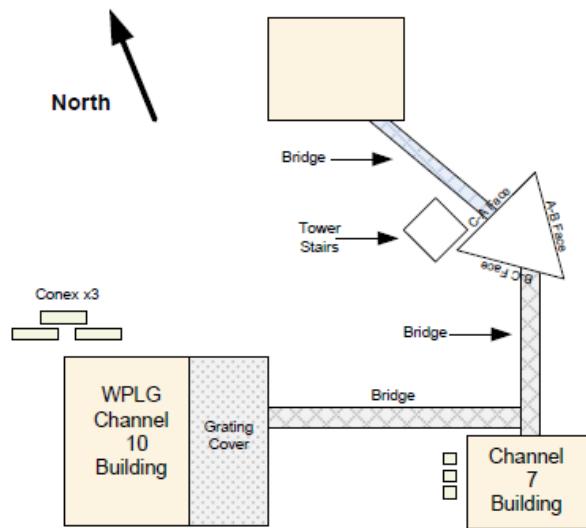


Figure 6 – Site Overview (from Stainless Condition Assessment Report of October 2017)

The Occupational Safety and Health Administration's (OSHA) Regional Administrator, Region IV, asked the Directorate of Construction (DOC), OSHA National Office in Washington, D.C. to provide technical assistance in a causal determination and to render engineering assistance to the Fort Lauderdale, FL OSHA Area Office in its investigation. Structural engineers from DOC travelled to Miami Gardens, FL to observe and document the site conditions. Materials and equipment relevant to the investigation were identified and photographed. Later, the Compliance Safety and Health Officer (CSHO) from the local Fort Lauderdale, FL OSHA Area Office along with representatives of Tower King secured the evidence in a fenced-in lay down area and in a locked connex. Q.C. Metallurgical, Inc. (QC Met) of Hollywood, FL took possession of several pieces from the gin pole rigging for materials testing and forensic analysis. A chain of custody was maintained.

Incident Description

The incident occurred in the late afternoon on September 27, 2017. As the Tower King crew was relocating the dummy pole pedestal, the components of the bridle connection suddenly failed. The reasons for this failure are discussed in the next section of the report (Structural Analysis and Discussion – page 17). The 160-foot-long gin pole began to freely rotate away from the tower about the base of the arbor. Next the basket slings frayed and ruptured from its contact with the base of the arbor. Finally, the gin pole fell freely approximately 1,000 feet and impacted the ground. The force from the impact buried the rooster head nearly 10 feet into the ground. Additionally, the impact of the gin pole with the

ground resulted in axial deformations consistent with large compressive forces. Finally, the weight of the remaining length of the gin pole above the ground combined with the weakened state of the gin pole from its impact with the ground caused the gin pole to snap into two separate pieces. One section of the gin pole was buried in a crater approximately 10 feet deep and the second section fell backwards onto the ground. Images of the debris field are shown in Figure 7 and Figure 8. The remaining pieces of the gin pole track and its attachment to the arbor are shown in Figure 9. Three Tower King employees' fall arrest protection systems were tied off to the gin pole at the time of the collapse. According to CSI photographs provided by Miami Gardens Police Department, the employees were tied off near the base of the cantilevered section of the gin pole.



Figure 7 –Debris Field (Bird's Eye View)

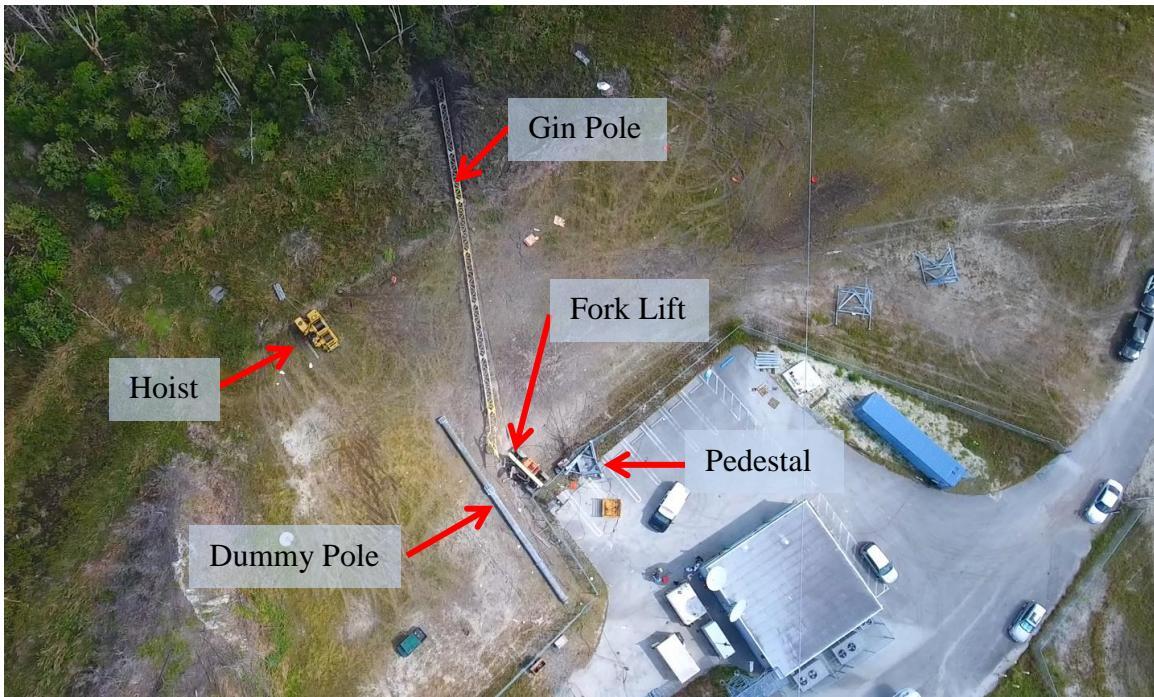


Figure 8 – Debris Field (Close Up View)



Figure 9 – Overview of Tower Arbors

Items within the debris field on the ground included two sections of the gin pole (see Figure 10 through Figure 15), three-drum hoist (see Figure 16 and Figure 17), dummy pole (see Figure 18), dummy pole pedestal (see Figure 19), fork lift (see Figure 20 and Figure 21),

hundreds of feet of wire rope (jump, tag and load lines – see Figure 22) and their associated blocks and assemblies. The fractured basket sling is shown in Figure 23. To the extent possible, these items were stored in a secure, fenced-in area for specimen preservation and for further testing and examination as needed.



Figure 10 – Lower Sections of Gin Pole



Figure 11 – Gin Pole Base



Figure 12 – Gin Pole Sections



Figure 13 – Gin Pole Sections



Figure 14 – Gin Pole Section Break



Figure 15 – Rooster Head Section Buried



Figure 16 – Three Drum Hoist (Front)



Figure 17 – Three Drum Hoist (Side)



Figure 18 – Dummy Pole



Figure 19 – Dummy Pole Pedestal



Figure 20 – Fork Lift



Figure 21 – Fork Lift (Opposite Side)



Figure 22 – Jump, Tag and Load Lines



Figure 23 – Fracture in Basket Sling

Some parts of the gin pole assembly remained fastened to the arbor of the tower. These items included the track and its attachment slings, jump blocks, bridle connection components (come-alongs, slings etc.) and tag block. These items are shown in Figure 24.

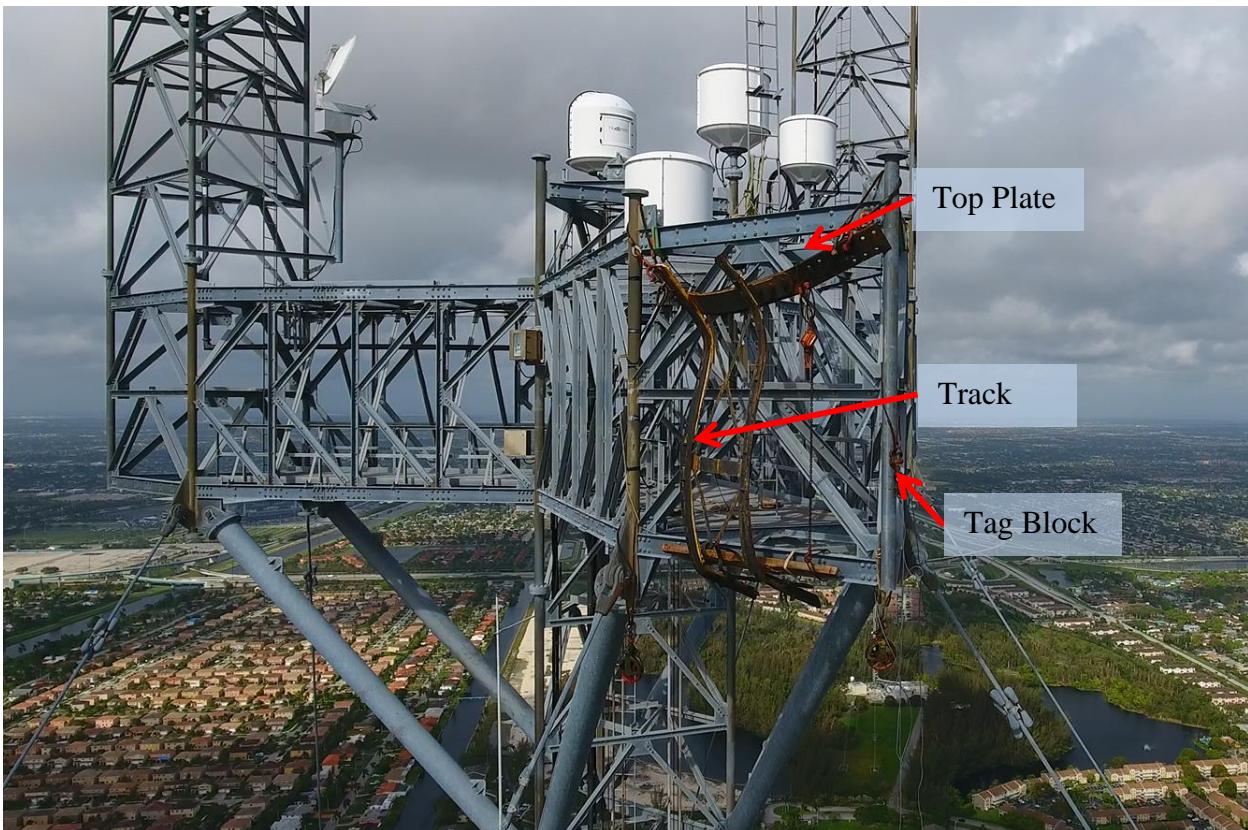


Figure 24 – Damaged Track Components



Figure 25 – Bent Top Track Plate (provided by Stainless)



Figure 26 – Close-up of Plastic Hinge in Top Track Plate (provided by Stainless)

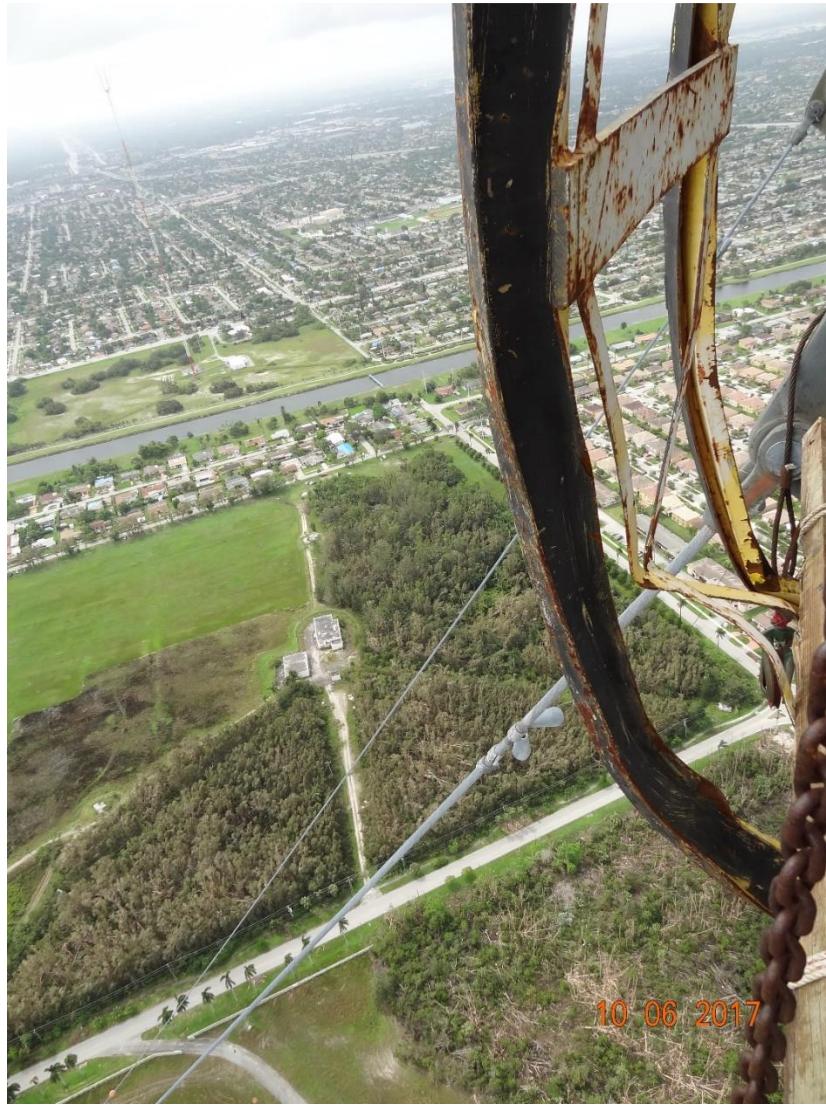


Figure 27 – Buckled Gin Pole Track (provided by Stainless)

Following the incident, on October 5 and 6, 2017 inspectors from Stainless assessed the post-incident condition of the tower. Although Stainless did not perform a structural analysis or an in-depth examination of the tower, the inspectors' visual inspection determined that the tower did not undergo any significant damage due to the detachment and collapse of the gin pole structure. They did note minor damage of the bottom channel section of Apex C (the apex of the arbor where the gin pole was located). There was additional damage to tower-mounted appurtenances and the components thereof. The vertical alignment of the tower was determined to be within expected tolerances for twist and plumb.

Structural Analysis and Discussion

Stainless, a business of FDH, Velocitel, Inc. had an extensive role in this project, apart from designing the original tower known as candelabra tower with three projecting wings identified as arbors. The tower was designed in 2008 as per ANSI/TIA 222-G-2005, and constructed in 2009. As stated earlier, the 952-ft. high guyed tower is owned by Miami Tower, LLC (Miami Tower) and at the top are placed two transmission antennas, one each for WSVN and WPLG TV stations, one on each of the two projecting wings. On the third projecting wing was placed a dummy pole, an antenna like structure, to balance the loads of the two antennas on the tower to reduce eccentricity. The current project essentially consisted of removing the dummy pole and erecting a new antenna on the third projecting wing. This involved multiple steps, e.g., remove the dummy pole, remove the base pedestal on which the dummy pole was seated, install lower and upper pieces of the new pedestal, and finally erect the new antenna.

Stainless' involvement in the current project began in early 2017 when Sunbeam Television retained Stainless to check the structural adequacy and stability of the tower to support the load of the new proposed antenna in accordance with ANSI/TIA 222-G. Stainless submitted the final report entitled "Rigorous Structural Analysis" to Miami Tower in June 2017 affirming the structural adequacy of the tower. Thereafter, Miami Tower contracted with Stainless to design, detail, fabricate and furnish the new pedestal for the proposed antenna. Stainless designed, fabricated and transported the new pedestal to the site before construction began.

Miami Tower received multiple bids for the construction and installation of the new antenna. Stainless also bid the job but the contract was awarded to Tower King of Cedar Hills. At the request of Tower King, Stainless submitted a proposal (see Appendix C) on June 21, 2017 to Tower King to perform the following services:

1. *Engineering review of your completed rigging plan*
 2. *Engineering will review the adequacy of the materials and the effects on the tower.*
-

The proposal was accepted by Tower King on August 11, 2017 without any changes. The above scope of services lacked clarity in that it did not state whether the rigging plan will be reviewed by Stainless as per provisions contained in ANSI/TIA-322 or ANSI A10.48. Stainless, however, clarified it in its final report of September 13, 2017 submitted to Tower King a few days before construction began stating that “*the contractor shall be fully responsible for the means and methods of all rigging in accordance with ASSE A10.48, Criteria for Safety practices with the Construction, Demolition, Modification and Maintenance of Communication Structure*”. A review of the Stainless’ final report of September 13, 2017 indicates that Stainless reviewed the rigging plan to a great length commenting on the jump line and load line angles, the maximum cantilever length of the gin pole, and even the size of the wire rope sling around the dummy pole. Stainless also produced a set of computations indicating the forces imparted to the tower structure by the gin pole at the bridle and basket levels of the gin pole. The magnitude of the forces was a part of the qualified engineer review letter along with the rigging plan developed and submitted by Tower King. Tower King’s rigging plan submitted to Stainless did not contain the details of the attachment of the gin pole to the structure. The bridle attachment details were left to one of the employees at the site who decided the manner of attachment on his own based on his judgement and experience. Stainless could not have reviewed the manner of the bridle attachment of the gin pole to the arbor which became the pivotal point of this investigation, because Tower King never provided the details to Stainless for their review nor did Stainless ask for them. Unfortunately, no qualified engineer reviewed the bridle attachments.

During the review of the rigging plan, there were multiple emails from Stainless to Tower King seeking clarification of the proposed rigging plan involving gin pole, track, jump, load and tag lines. In addition, there were discussions of the load line and tag line angles as they have significant impact on the forces imposed on the tower by the gin pole. Finally, on September 13, 2017 Stainless provided the “certified rigging plan review letter” signed by a professional engineer registered in Florida. Tower King did not engage any other qualified engineer to assess the capacity and suitability of the slings and come-alongs used to attach the gin pole to the arbor at the bridle or the basket sling locations.

The involvement of Stainless with the project continued even after the incident. Miami Tower asked Stainless after the incident to conduct a “condition assessment” of the tower to evaluate if any serious damage has occurred during the incident. On October 5 and 6, 2017,

Stainless performed the condition assessment of the tower, and concluded that no serious damage has occurred.

Tower King decided to use a gin pole to accomplish the removal of the dummy pole and install a new antenna. The required rigging plan was classified as Class IV because the lifted loads exceeded 2,000 pounds. Tower King retained Stainless to perform the role of a “qualified engineer” as defined in ANSI A10.48 of 2016. Reproduced below is an excerpt of Section 4.8 of ANSI A10.48:

Rigging Plans: All construction activities regardless to the type of activity shall have a rigging plan classification outlining the project and the responsibilities within that project. Class II, III, IV rigging plans shall have a documented rigging plan.

*An onsite competent rigger shall be designated for all classes of construction to identify hazards and authorize corrective measures. For class III and IV construction, a qualified person shall coordinate the involvement of a qualified engineer as required when establishing rigging plans. A **qualified engineer shall perform the analysis of structures and/or components for class IV construction.** (Emphasis ours).*

The following were considered by Stainless to determine tower's structural adequacy and to review rigging plan:

- Dummy pole weight: approximately 10,300- 11,000 pounds
- Existing pedestal for the dummy pole: approximately 9,800 pounds, 6'-2" high
- New pedestal for proposed antenna: approximately 12,750 pounds, 26'-9" high (to be erected in two parts)
- Proposed antenna: approximately 14,300 pounds
- Gin pole: 140 ft. high: approximately 16,200 pounds inclusive of the rooster head. (Note that the actual gin pole used was 160 ft. high weighing approximately 18,200 pounds. TK did not inform stainless of longer gin pole)
- Headache ball: 2,000 pounds
- Impact factor: 1.2
- Sheave efficiency: 98.5%
- Tag angle: between 60 and 70 degrees to horizontal
- Load line angle: 3 degrees to the vertical.
- Track depth (centerline between bolted connections): 12'
- Arbor depth: 12'-10"

- Tag line with inverted trolley to be used.
- Tag line connection to the gin pole at 3 ft. from the top.
- Cantilever height of the gin pole: 70 ft.

Our review indicated that the Stainless' computations, provided to us by Stainless in response to our request, were generally satisfactory except for the error discussed below. Stainless computed the forces the gin pole will exert on the tower at the bridle and basket levels under different loading conditions of the rooster head. The computations assumed that the distance between the bridle and basket attachments (lever arm) was approximately 70 ft. However, the gin pole was, in fact, attached to the arbor and not to the tower resulting in a much shorter lever arm of approximately 12 ft. Therefore the assumption of a lever arm of 70 ft. resulted in significantly lower forces and proved to be a grievous error on the part of Stainless. Under the lifting condition of 11,000 pounds, Stainless computed the tension at the bridle location was approximately 3,300 pounds. However, our independent computations indicated that the forces at the bridle location would be approximately 15,000 pounds. ANSI A10.48 requires that the slings and attachments be designed with a factor of safety of 5 (in the absence of a manufacturer's working load limit). Therefore, all slings and components at the bridle connection needed to resist a failure load of 75,000 pounds.

Of significance to this report was the way the gin pole was attached to the arbor structure, in particular the connection at the bridle, because the gin pole exerts considerable tensile forces on the rigging hardware. There were four connections made, as shown below:

Bridle connections are identified for this report as CA-1, CA-2, CA-3 and CA-4. Sketches of the bridle connection, as drawn by Tower King, are provided in Appendix A. CA-1 and CA-2 consisted of chain links with $\frac{1}{2}$ " wire rope slings at each end with a 2-ton come-along. The wire rope slings engaged the vertical legs of the arbor and the gin pole. According to Tower King, the attachments were made at the top most horizontal plane of the arbor. $2\frac{1}{2}$ ft. below was the next attachment identified as CA-3 that consisted of chain link with a 3-ton come-along and $\frac{1}{2}$ " wire rope slings at each end. $2\frac{1}{2}$ ft. below the CA-3 rigging, was another attachment identified as CA-4 that consisted of wire rope with wire rope slings and a 2-ton come-along. The following is a table showing the sizes and the manner of failure:

Table 1. Bridle Come-along Configuration and Failure Mechanism

	Slings	Tension Member	Come-along	Length	Failure
CA-1	Wire rope	7.2 mm chain	2-ton	5'-6"	Chain
CA-2	Wire rope	7.2 mm chain	2-ton	5'-6"	Sling
CA-3	Wire rope	8.4 mm chain	3-ton	10'-6"	Chain
CA-4	Wire rope	Wire rope [2-part]	2-ton	10'-6"	Wire rope

Ultimate breaking strength of the 7.2 and 8.4 mm chain links have been estimated as 14,600 and 24,800 pounds respectively. The ultimate breaking strength of the $\frac{1}{2}$ " wire rope slings has been estimated to be 16,000 pounds.

It must be noted here that in addition to the elastic deflection of the gin pole under eccentric loading of the rooster head, there would be additional deflection at the top of the gin pole due to the removal of the inherent slacks in the chain links and wire ropes. At the time of the application of the tension at the bridle location, the slack must be overcome before the chain link could take up the tension. Due to the shorter arbor depth, the slack will be magnified approximately seven times further increasing the tension of the bridle connection. For example, a one inch slack will create seven inch displacement at the top.

CA-1 and CA-2 will be the first to take up the tension as per the sketch drawn by Tower King. A tensile force of 15,000 pounds would translate into a force of 16,100 pounds in each of the chain links because of the angle each chain link makes with the direction of the tensile force. This force is close to the failure load of the chain link. With the failure of CA-1 and CA-2, CA-3 located $2\frac{1}{2}$ ft. below will be called upon to take up the load. Unfortunately, the magnitude of tension will be increased as the lever arm will be shortened to $9\frac{1}{2}$ ft. from 12 ft., increasing the tension to an approximate ratio of 12/9. It is estimated that the tension will be approximately 20,000 pounds. However, this force would be further magnified due to removal of slack inherent in the 10-ft. long rigging at CA-3. The additional movement of the rooster head due to magnified deflection at the top of the gin pole because of slack removal would further increase the tension. The P-delta phenomena would occur with increasing deflection with increasing tension. CA-3 is expected to fail with increasing tension. Next is the rigging of CA-4 $2\frac{1}{2}$ ft. below CA-3. The tension would be increased due to a much shorter lever arm by an approximate ratio of 12/7. Therefore, the tension would be approximately 30,000 pounds without considering the deflection of the gin pole. If the deflection of the gin pole is considered, the tension would be further magnified, and failure would be imminent.

A few days before the completion of this report, Tower King stated during the interview with OSHA personnel that the tag line was attached directly to the arbor, and not to the gin pole. Stainless had asked that the tag line be attached to the gin pole three feet below the rooster head. Stainless was not aware of this change. This deviation, which should have been done with the consent of Stainless, reduced the tensile forces at the bridle connection of the gin pole to the arbor to Tower King's advantage. The deviation in the configuration of the tag line is shown in Figure 28. The solid red line is the layout of the tag line on the day of the incident and the dashed red line is the layout used by Stainless to calculate the reaction forces. The force was reduced to approximately 13,000 pounds from 15,000 pounds. Nevertheless, the rigging was inadequate even for the reduced forces, and did not meet the required factor of safety of 5.0

As mentioned earlier, the fall protection devices of three employees were anchored to the gin pole. Stainless neither evaluated the adequacy of the gin pole to resist the anchorage forces from the fall protection devices nor did they evaluate the increased tension on the bridle rigging due to the additional weight of three employees and their equipment, and the anchorage forces of fall protection. Tower King failed to inform Stainless of the use of the gin pole as anchorage points for three employees, and therefore, Stainless did not include these additional forces in their calculations.

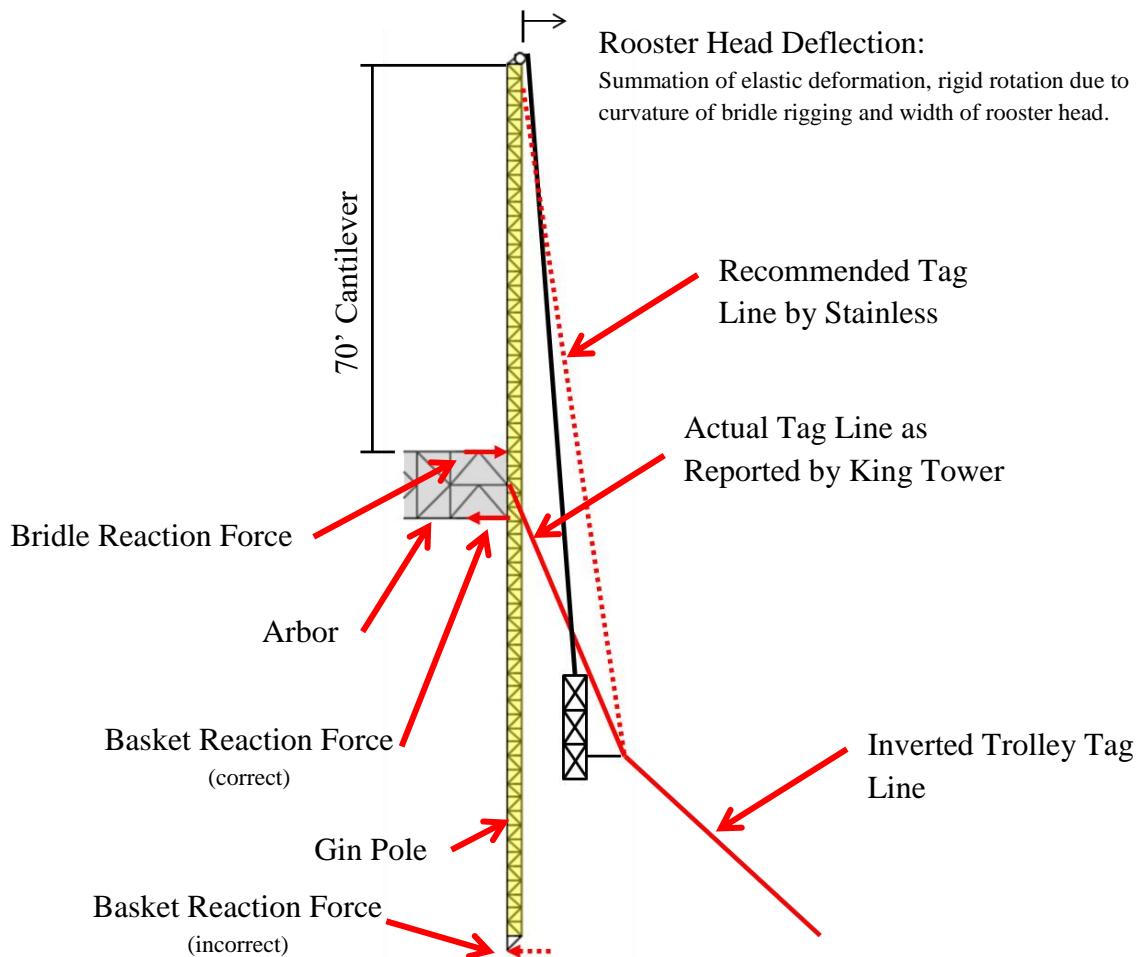


Figure 28 –Tag Line Rigging and Reaction Forces

Materials and Forensic Analysis Discussion

QC Met was contracted to perform an analysis of the materials from the bridle connection. QC Met took custody of the materials on January, 30, 2018. The materials included the following:

- (2) Two-ton come-alongs
- (1) Two-ton wire come-along
- (1) Three-ton come-along
- (2) Wire slings
- (4) Basket slings (each side of the fracture of both basket slings)

The bridle connection materials being examined by QC Met are shown in Figure 29. At the time of this report, QC Met had not provided a report of their findings.



Figure 29 – Materials Collected by QC Met for Examination

Conclusions

Based upon the above, we conclude that:

- 1) The cause of the failure was the inadequate capacity of the bridle attachment of the gin pole to the tower structure. Tower King sized the rigging of the gin pole attachment to the tower structure without any guidance or approval of an engineer. This was a violation of the industry standard. The rigging did not have the required factor of safety as per industry standard A10.48.
- 2) Tower King violated the industry standard ANSI A10.48 by not engaging a qualified engineer for a Class IV structure to perform the analysis of all the components including attachments of the gin pole to the tower structure. The qualified engineer retained by Tower King to review the rigging plan, as required by ANSI A10.48, clearly excluded the review of the means and method of all rigging during construction. This exclusion was conveyed to Tower King in the qualified engineer's review letter of September 13, 2017 sent a few days before the construction began.
- 3) Tower King violated ANSI A10.48 by preparing an incomplete rigging plan in that it did not include the bridle attachments to the tower structure. Section 4.8.6.3 of ANSI A10.48 requires that the rigging plan include "sling size, type, angle and connection details to the structure and to the gin pole."
- 4) The structural computations performed by the engineering consultant, Stainless, retained by Tower King to review its rigging plan were flawed because Stainless' analyses were based on invalid assumptions resulting in significantly lower forces for the gin pole connections to the tower structure. The forces computed by Stainless at the bridle and basket locations of the gin pole were grossly underestimated.
- 5) The slings and the rigging provided by Tower King to attach the gin pole to the tower structure would have been adequate to support the loads computed by Stainless and provided to Tower King. The provided rigging would not have a factor of safety of 5 as required by the standard. However, these loads were grossly underestimated by Stainless by a factor of 4.5.
- 6) Tower King changed the length of the gin pole and used a heavier gin pole without informing Stainless, the qualified engineer of the project. It had an implication on the evaluation of the rigging system but did not contribute to the collapse.
- 7) Contrary to the recommendation of the qualified engineer, Tower King attached the tag line to the arbor instead of the gin pole without conferring with the qualified engineer. This, however, did not contribute to the collapse as connecting the tag line to the arbor

reduced the forces at the bridle connection. The rigging for the jump line and load line was satisfactory.

- 8) The deceased employees' fall protection devices were anchored to the gin pole at three different locations. ANSI standard A10.48 requires that the anchor can support 5,000 pounds for a non-engineered system, 3,600 pounds for an engineered system or two times the maximum fall arresting force. Stainless did not evaluate the gin pole connections to the tower for such forces. Tower King rigging plan did not indicate any required anchorage for fall protection on the gin pole.

Appendix A

SKETCHES OF GIN POLE CONNECTIONS (prepared by Tower King)

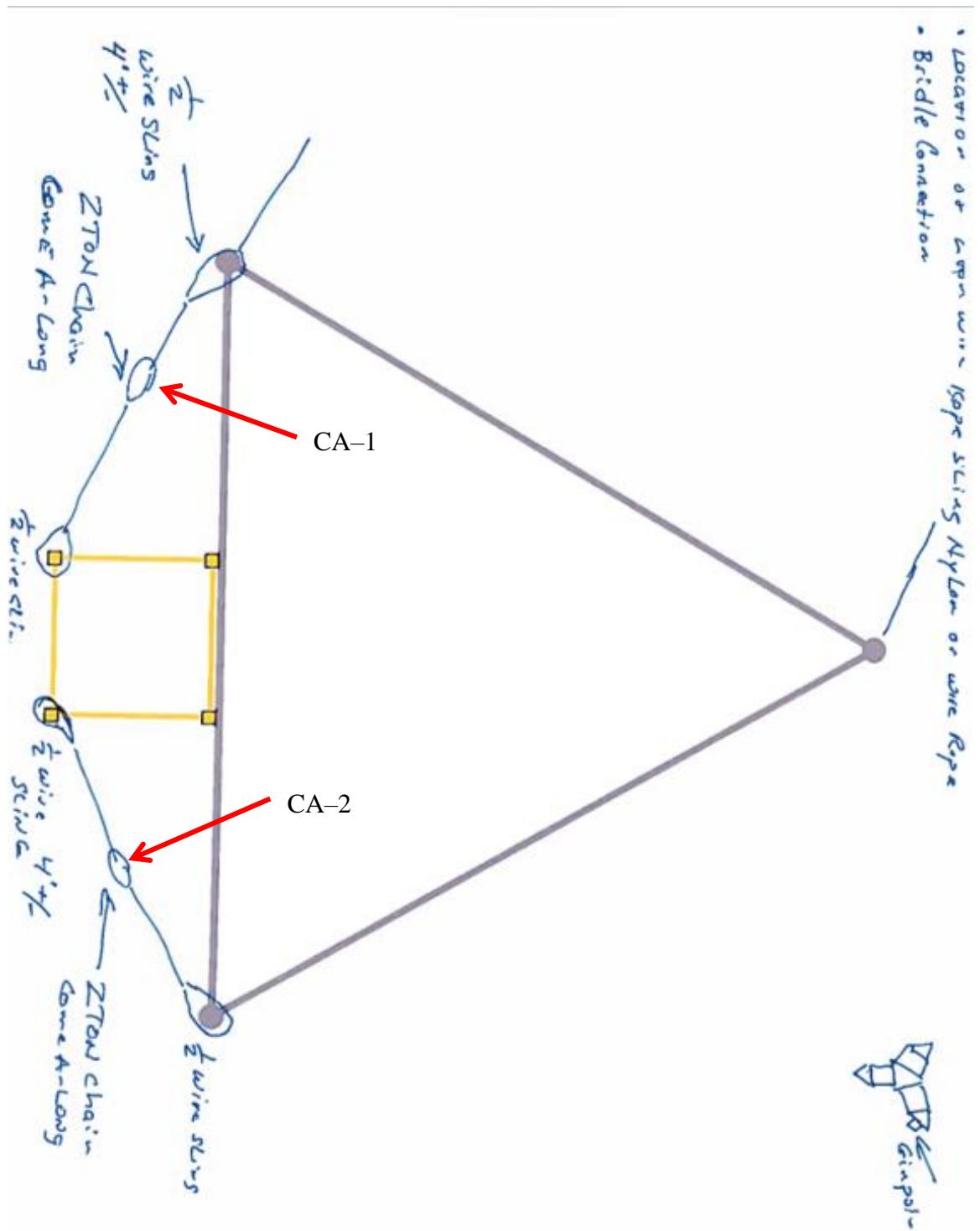


Figure 30 – Bridle Connection Sketch (1 of 4)

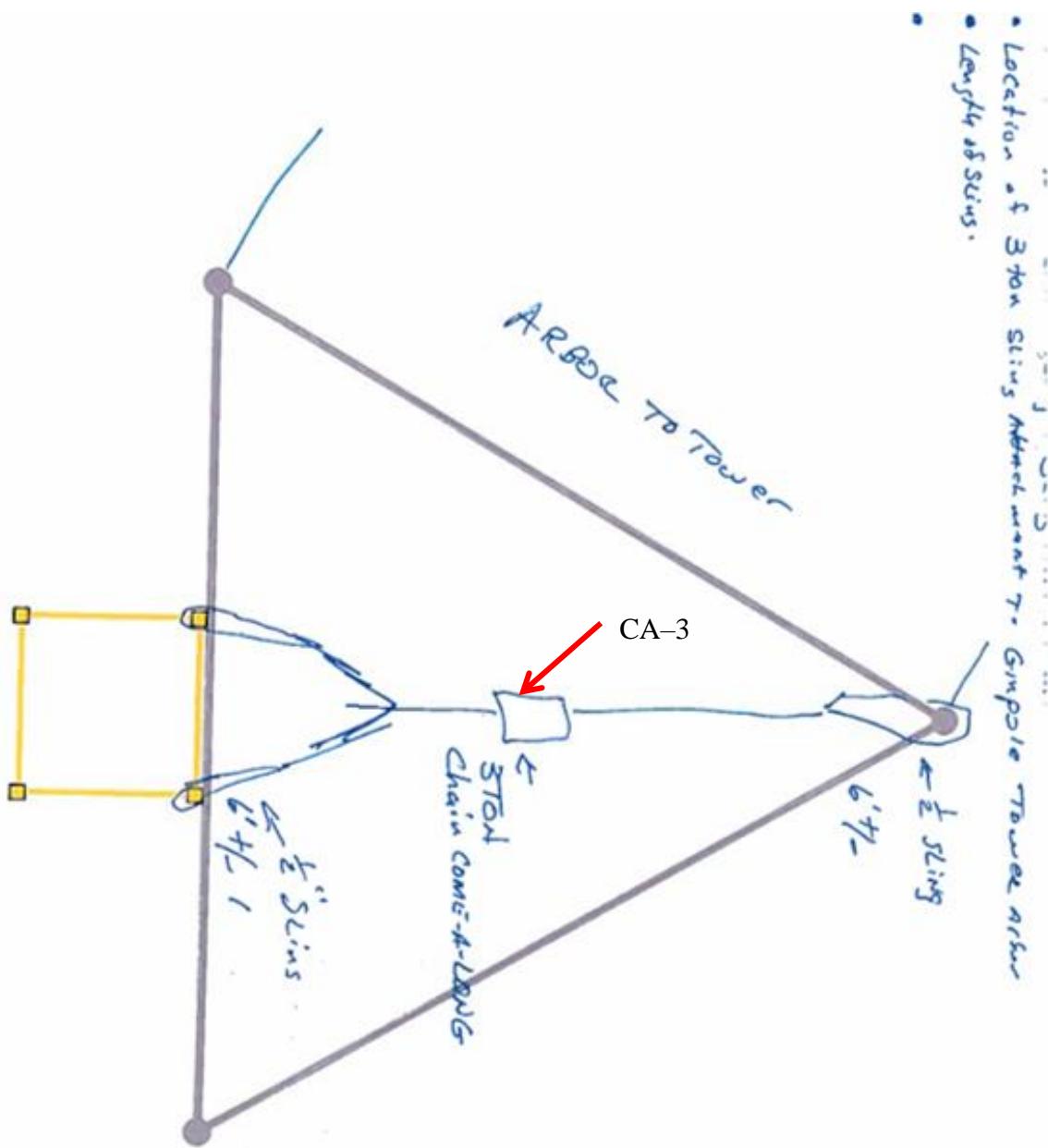


Figure 31 – Bridle Connection Sketch (2 of 4)

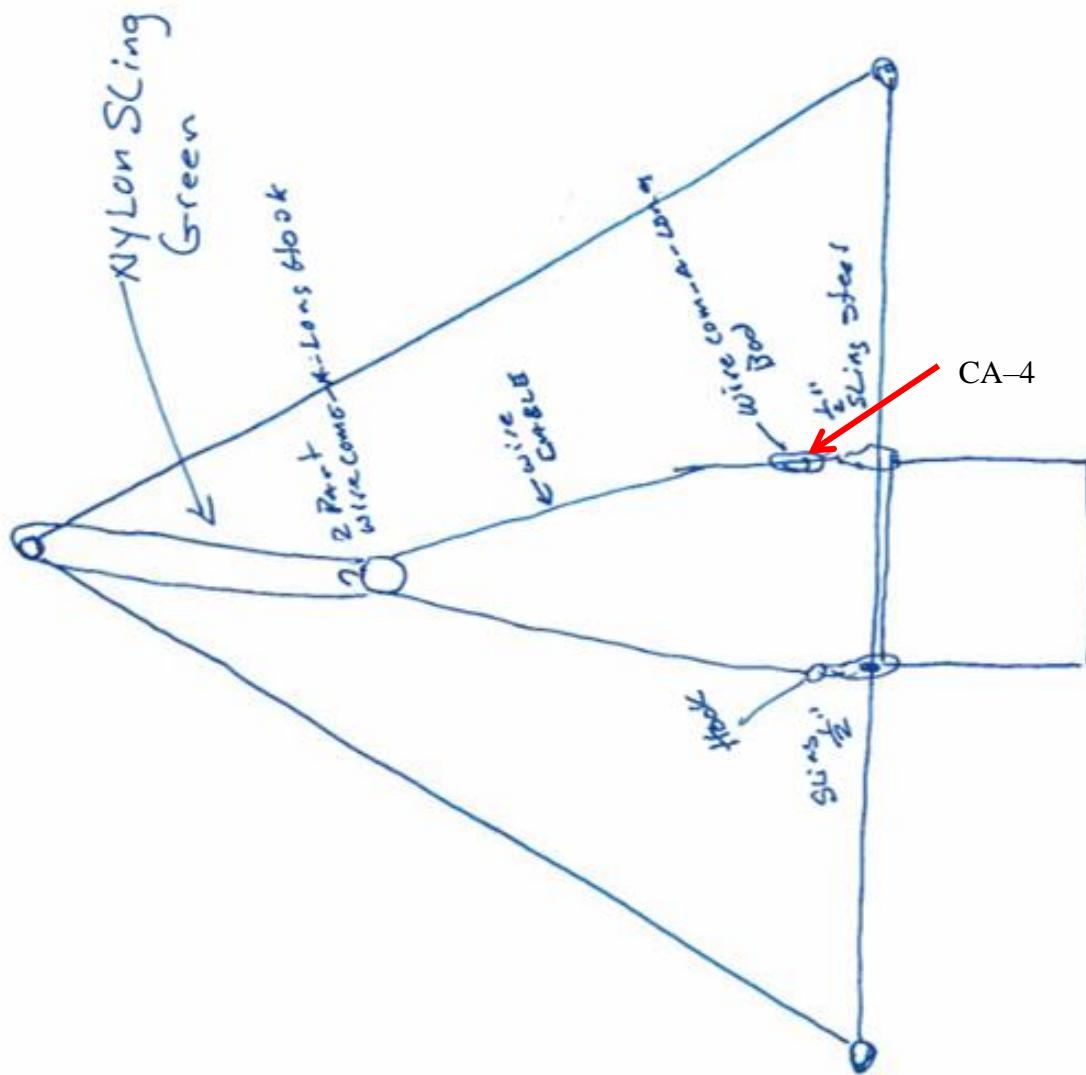


Figure 32 – Bridle Connection Sketch (3 of 4)

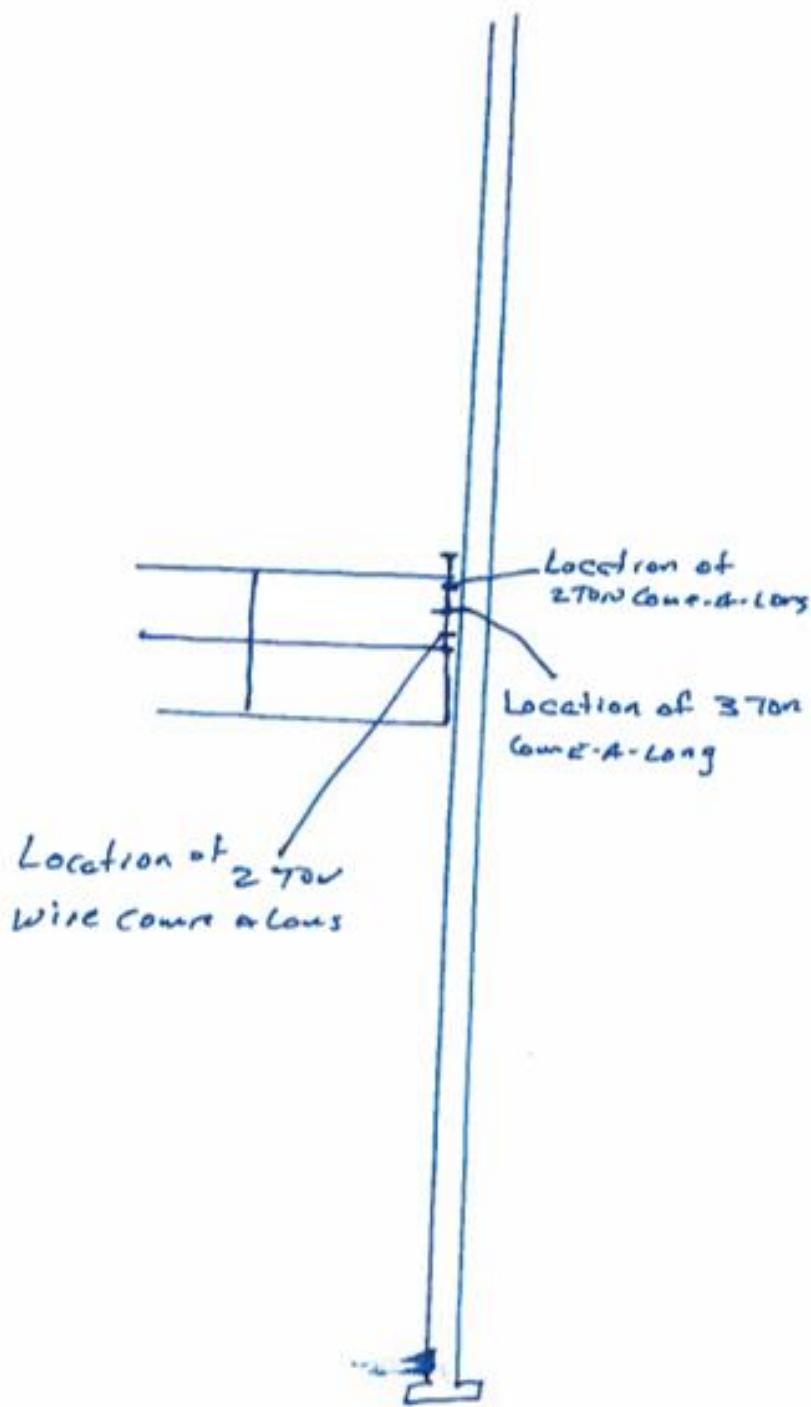


Figure 33 – Bridle Connection Sketch (4 of 4)

Appendix B

QUALIFIED ENGINEER REVIEW LETTER
(prepared by Stainless)



PENNSYLVANIA OFFICE
200 North Warner Road, 2nd Floor
King of Prussia, PA 19406-2886
O: (610) 992-4101, F: (610) 992-4109
info@stainless Towers.com
www.stainless Towers.com

September 13, 2017

Kevin Barber
Tower King II, Inc.
1570 W. Beltline Road
Cedar Hill, TX 75104
Cell Phone: [REDACTED]
E-mail: [REDACTED]

Subject:	Qualified Engineer Review Letter	
Contractor Designation:	Rigging Plan:	WSVN CH9 Antenna Installation Rigging Plan
	Qualified Person:	Kevin Barber
	Onsite Competent Rigger:	Kevin Barber
EOR Design/Analysis:	EOR Firm:	Stainless
	EOR Project Number:	373010
	Date:	07/21/2017
Tower Designation:	Sunbeam Television Call Letter: WSVN Sunbeam Television Site Name: Miami, FL	
Engineering Firm Designation:	Stainless, A business of FDH Velocitel Project Number: 373011	
Site Data:	Latitude: 25.9670; Longitude: 80.2118 Dade County, FL 958' steel height candelabra tower	

Dear Mr. Barber:

Stainless is pleased to submit this Qualified Engineer Review Letter to determine the structural stability of the above mentioned tower for the construction activities specified in the Contractor's Rigging Plan referenced above. This construction analysis has been performed in accordance with TIA-322, Loading, Analysis, and Design Criteria Related to the Installation, Alteration and Maintenance of Communication Structures, and TIA-222-G-2, Structural Standard for Antenna Supporting Structures and Antennas – Addendum 2.

Based on our analysis, the structure possesses adequate strength and stability to support the construction activities and sequencing stated in the Rigging Plan developed and provided by the Contractor. The following additional conditions shall be implemented in order for our analysis to be valid:

- For using jump line as load line to pick up and remove ginpole, the jump line angle shall not greater than 2.5 degree. If the jump line angle is greater than 2.5 degree, the tag line safety factor will be less than 5.

Qualified Engineer Review Letter
Stainless, A Business of FDH Velocitel Report Number: 373011

September 13, 2017
Page 2

- Per dummy pole removal description in rigging plan letter, the ginpole cantilever above the dummy pole base shall be 64-ft instead of 65'. If the cantilever above the dummy pole base is 65-ft, the total cantilever length is 71-ft (65-ft plus 6ft of pedestal height). The ginpole load chart provided only 70-ft cantilever.
- For using 7/8" wire rope sling wrap around the dummy pole to remove it. The 7/8" wire rope final set up's minimum working load limit shall be greater than 11 kips.
- Ginpole loading line angle must be limited to a maximum of 3 degrees from vertical.

Please note, the Contractor shall be fully responsible for the means and methods of all rigging in accordance with the ASSE A10.48, Criteria for Safety Practices with the Construction, Demolition, Modification and Maintenance of Communication Structures.

Our assessment has been made assuming all information provided to us is accurate and that the tower has been properly erected and maintained. In the event site conditions exist whereby the specified procedures in the referenced Rigging Plan cannot be followed, immediately contact FDH Velocitel for review and explicit written approval prior to proceeding with work. Please contact us should you require additional information.

Sincerely,

Phil Changfei Chen, PE
Project Engineer

Dennis Abel, PE
Director, New Product Development

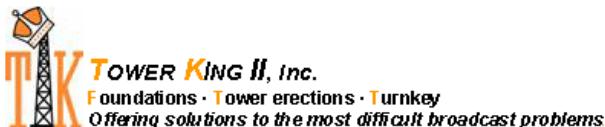


Qualified Engineer Review Letter
Stainless, A Business of FDH Velocitel Report Number 373011

September 13, 2017
Page3

Appendix A

Rigging Plan



Office 469-272-3388
Fax 469-2723728

To: Alan Pang

From: Kevin Barber

REF: WSVN CH 9 Antenna Installation Rigging Plan”

Ginpole Kline 30 (30" x 140") (Weight 16,500lb)

- Bottom verticals are 1-3/8 break over's are 1-1/4" x 7.5'
- Track slings are 1-1/8" 7.5' long
- Jump blocks are Skookum 16" 13.5 tons

Hoist HPSI 115 3 drum

- Load 5/8" Trefileurope (SWL 10,800 lb.)
- Jump 5/8" Trefileurope (SWL 10,800 lb.)
- Tag 3/8 GAC (SWL 2,800lb)

Note the load line will have a poured socket termination The Jump line will have a wedge socket termination

Base Rigging

- The base block rigging for the load and the jump line will be attached to the Stainless base rigging plates Part # PA900Z
- Base and Jump blocks are Skookum 16" (13.5 ton Blocks)
- Tag Block is a McKissick 6" (4 ton) Block

We will install the jump line on the end of the arbor in a 3 part. See Fig A

- Jump line top rigging 1" in a basket with a 18" Skookum Block (SWL 17.5 tons)
- We will bring the 3 parts down to the ground and then install it on the ginpole.

Ginpole Installation (30" x 140') (Total Weight 16,500lb)

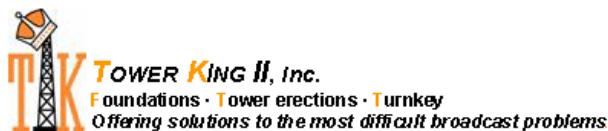
The entire ginpole will be erected in the following manner.

- We will rig the ginpole with the 3 part jump line and install the dead-end of the two part and the jump line blocks 5ft from the top of the arbor and raise the ginpole to the arbor See Fig. B
- We will install the ginpole on the tower and then jump up with 65ft of cantilever above the top dummy pole pedestal

Dummy Pole Removal

- The ginpole will be jumped up to 65' of cantilever above the Dummy pole base pedestal and we will remove the entire Dummy pole (5.5 tons) in a 2 part.
- We will then remove the 6'- 2" tall dummy poll base pedestal section (weight 3.3 tons)

Note: the ginpole will be left at this location and we will set the new antenna pedestal sections Weight 1st section 16'-9" tall weight 3.5 tons) then we will set the antenna pedestal mounting section (10' weight 2 tons)



Office 469-272-3388
Fax 469-2723728

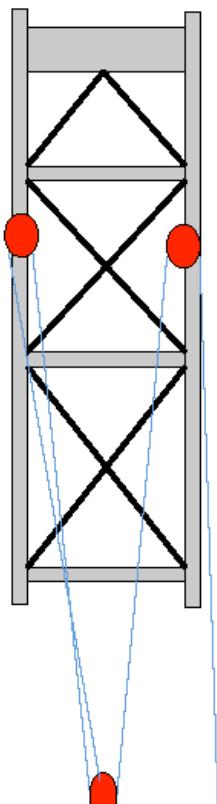
Antenna Installation

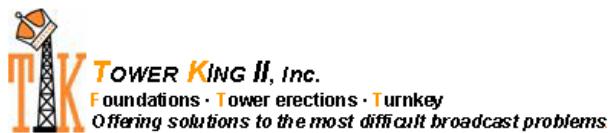
- We will jump the ginpole up with 65' of cantilever above the top of the new pedestal section.
- We will install the new antenna (weight 14,300lb)

Ginpole Removal

- We will jump the ginpole down and install the top blocks to the ginpole and lower it to the ground in a 3 part.

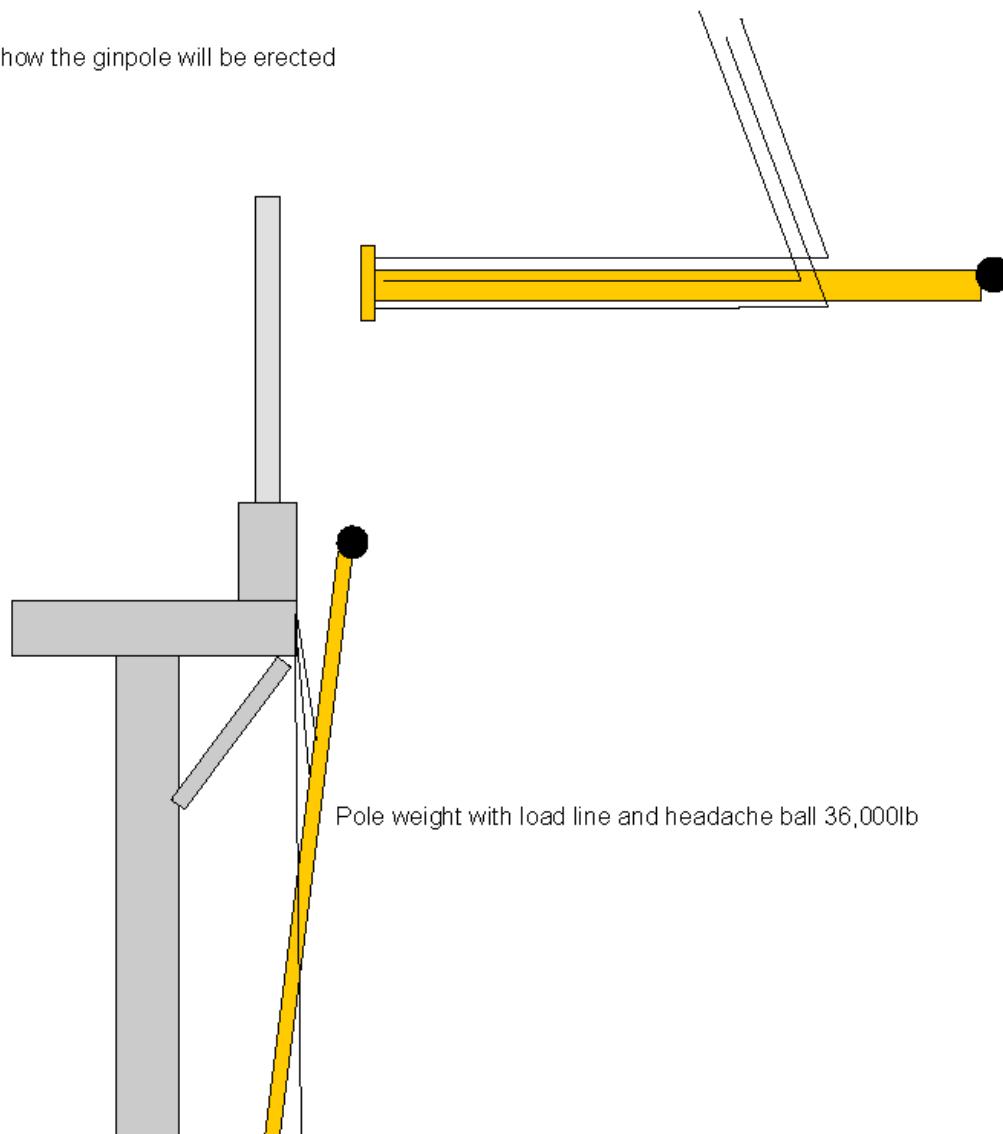
FIG A
Shows the location of the jump blocks 3 part at the end of the arbor

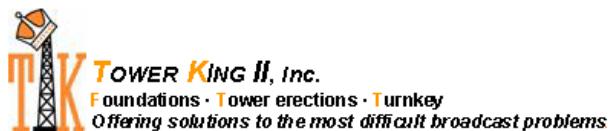




Office 469-272-3388
Fax 469-2723728

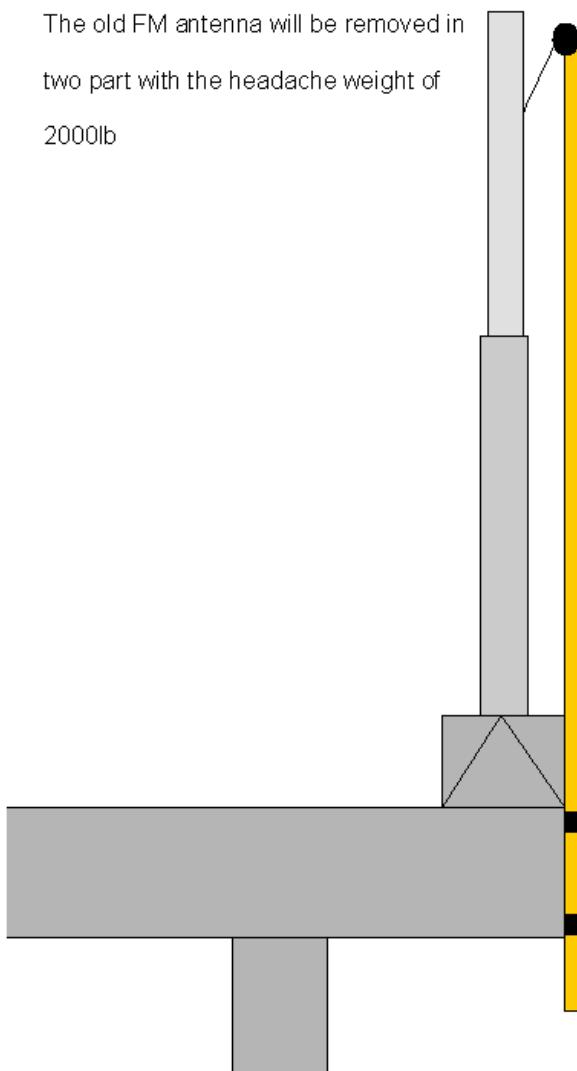
Shows how the ginpole will be erected

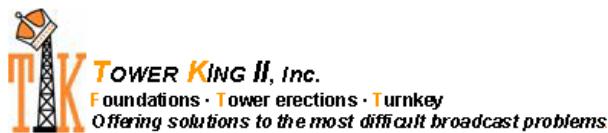




Office 469-272-3388
Fax 469-2723728

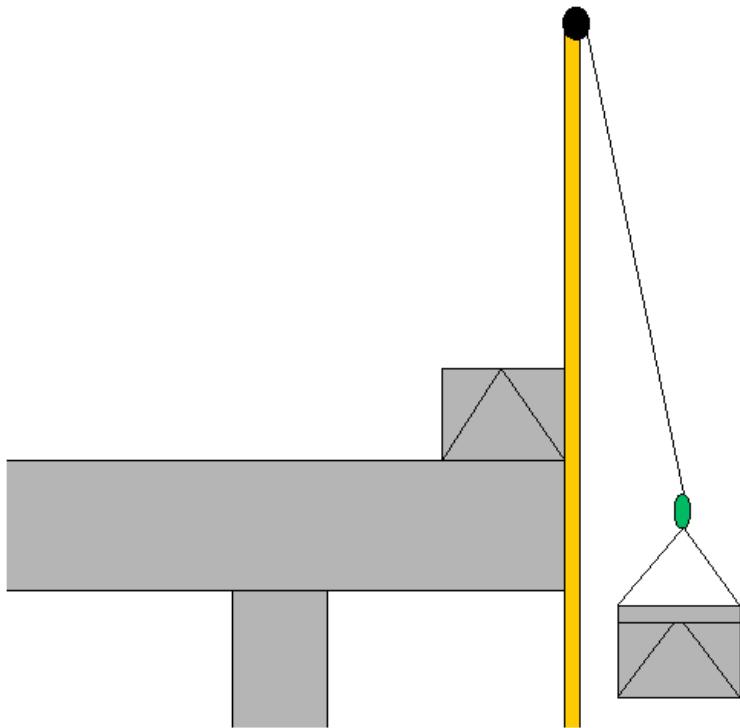
The old FM antenna will be removed in
two part with the headache weight of
2000lb



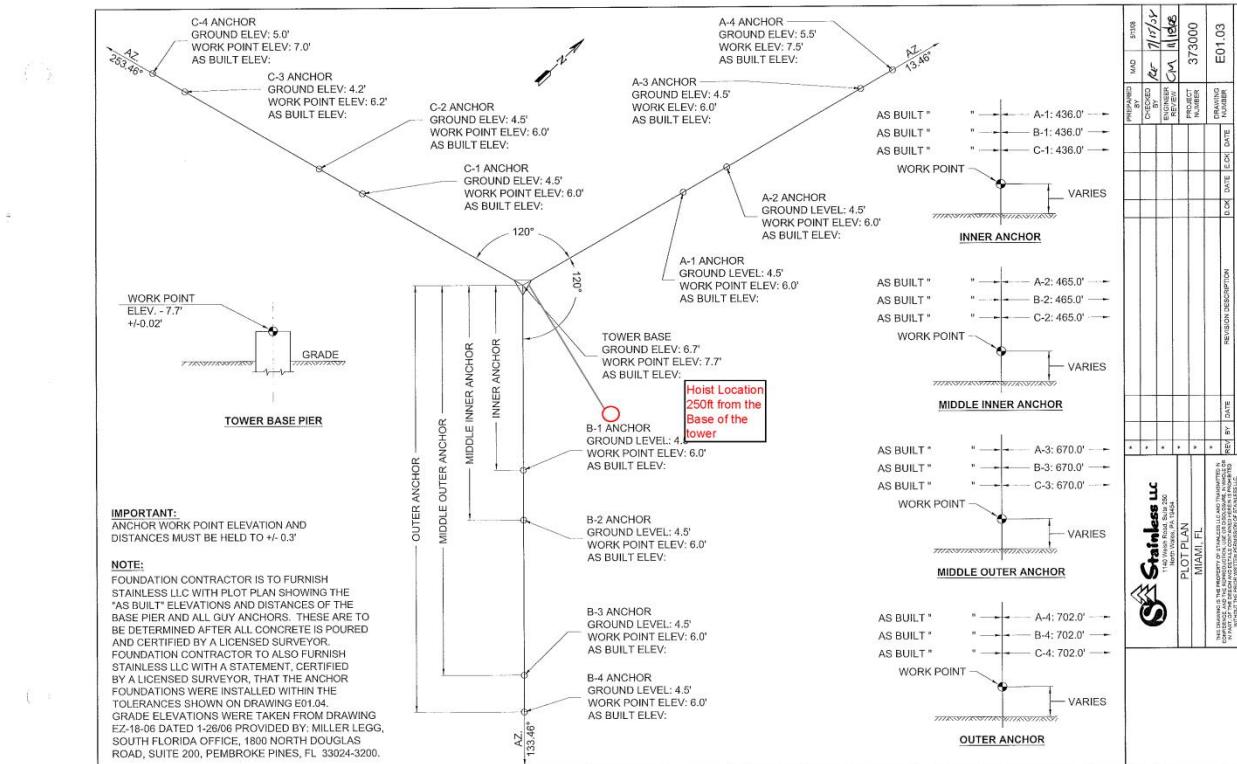
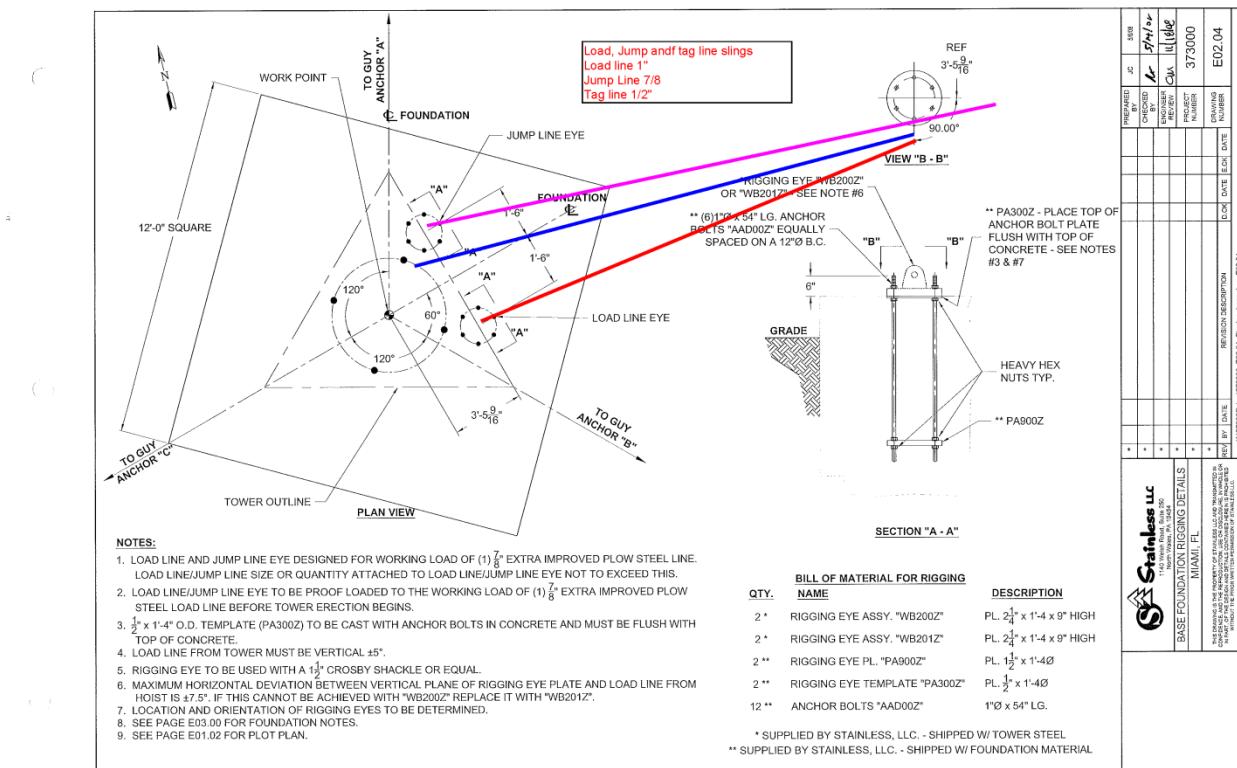


Office 469-272-3388
Fax 469-2723728

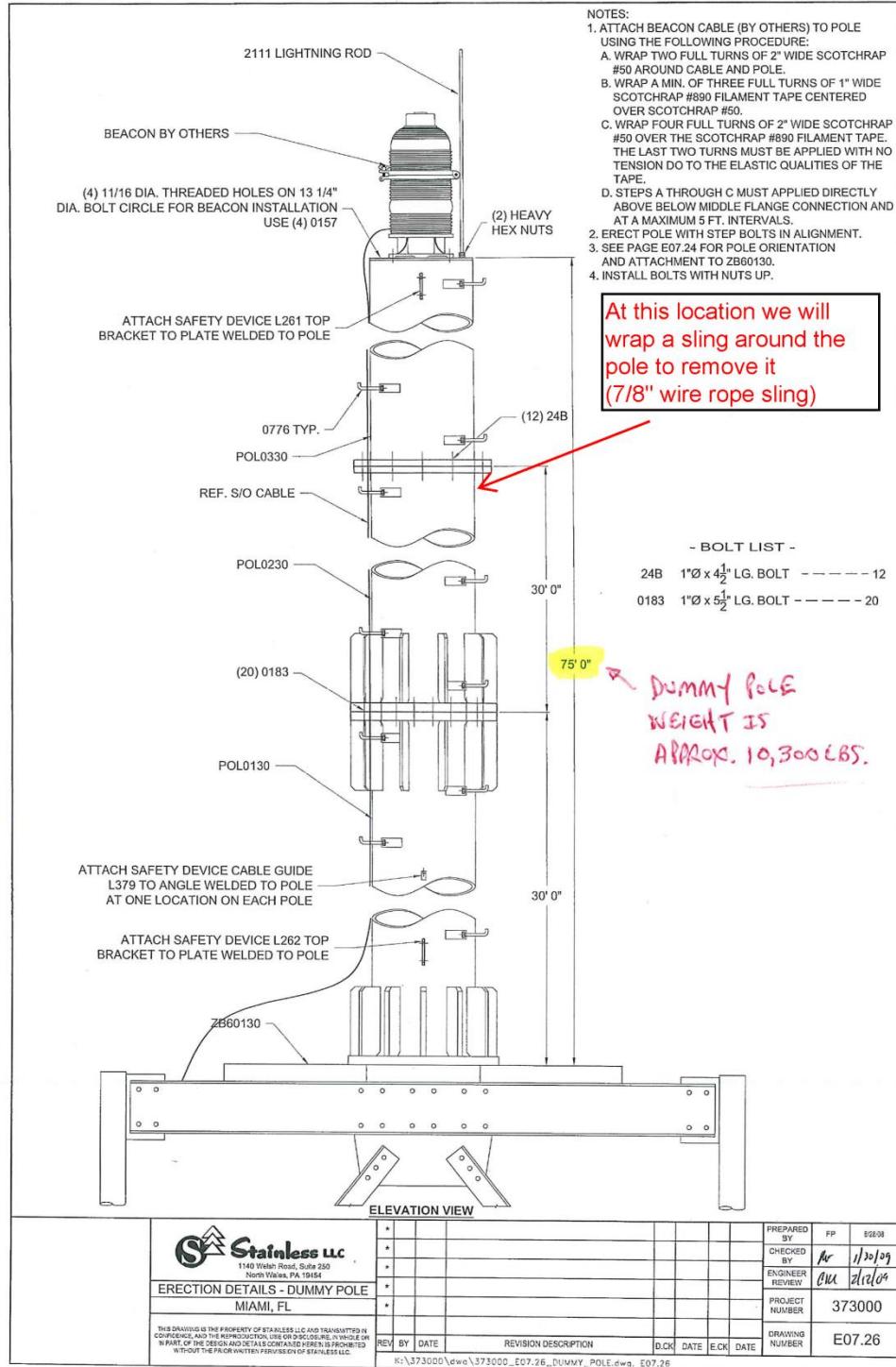
We will remove the small pedestal section in a 2 part with the headache ball weight of 2000lb

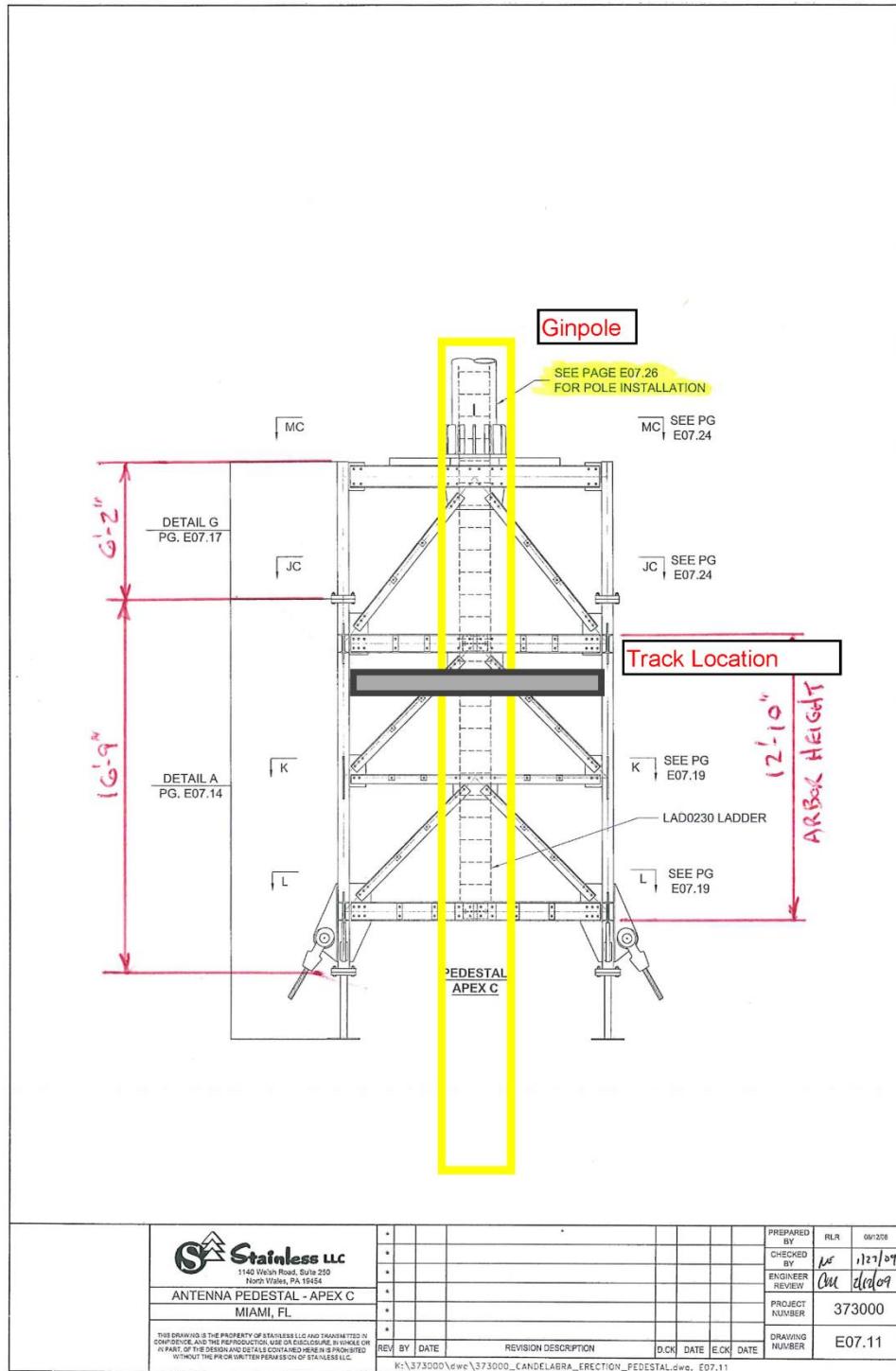


Investigation of the September 27, 2017, Gin Pole
Collapse at an Antenna Tower in Miami Gardens, Florida

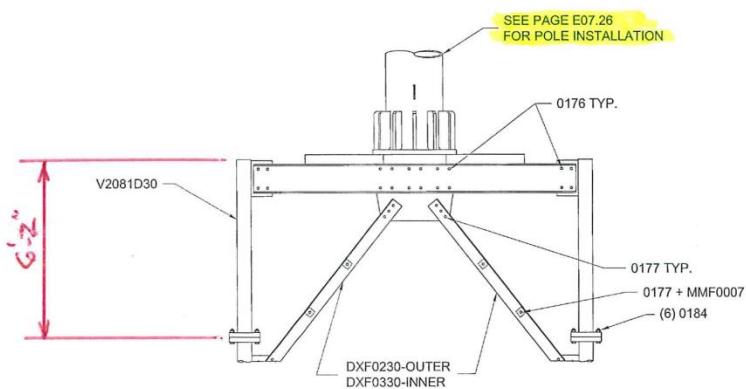


Investigation of the September 27, 2017, Gin Pole
Collapse at an Antenna Tower in Miami Gardens, Florida





	Stainless LLC							PREPARED BY	R.L.	09/20/08
	1140 Welsh Road, Suite 250 North Wales, PA 19454							CHECKED BY	ME	1/27/09
	ANTENNA PEDESTAL - APEX C MIAMI, FL							ENGINEER REVIEW	CM	did/d9
	THIS DRAWING IS THE PROPERTY OF STAINLESS LLC AND TRANSMITTED IN CONFIDENCE AND THE PRODUCTION, USE OR DISCLOSURE, IN WHOLE OR IN PART, OF THE DESIGN AND DETAILS CONTAINED HEREIN IS PROHIBITED WITHOUT THE EXPRESSED WRITTEN PERMISSION OF STAINLESS LLC.							PROJECT NUMBER	373000	
REV	BY	DATE	REVISION DESCRIPTION		D.C.K.	DATE	E.C.K.	DATE	DRAWING NUMBER	E07.11
			K:\373000\ewc\373000_CANDLABRA_ERCTION_PEDESTAL.dwg, E07.11							



DETAIL G

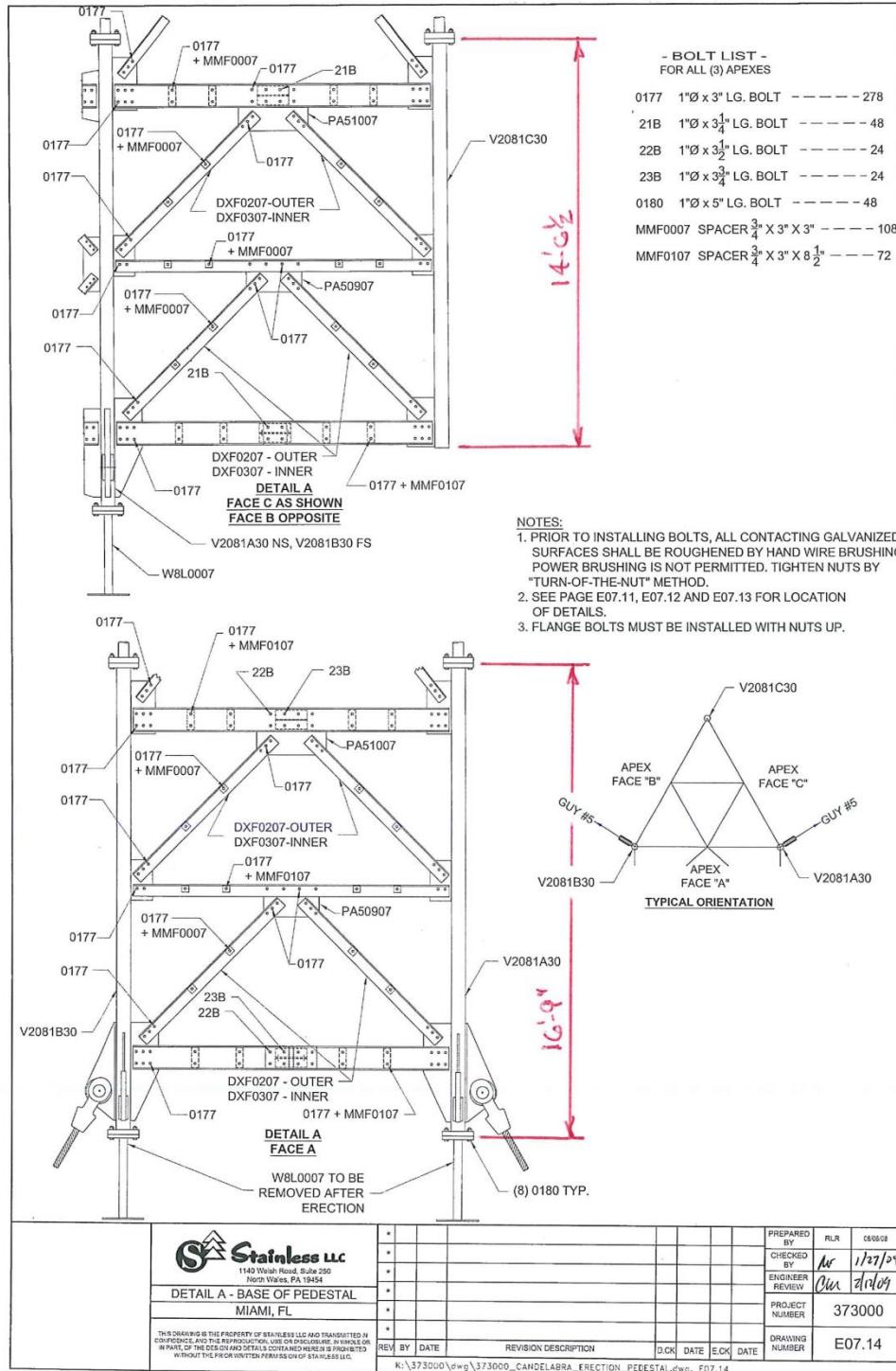
NOTES:

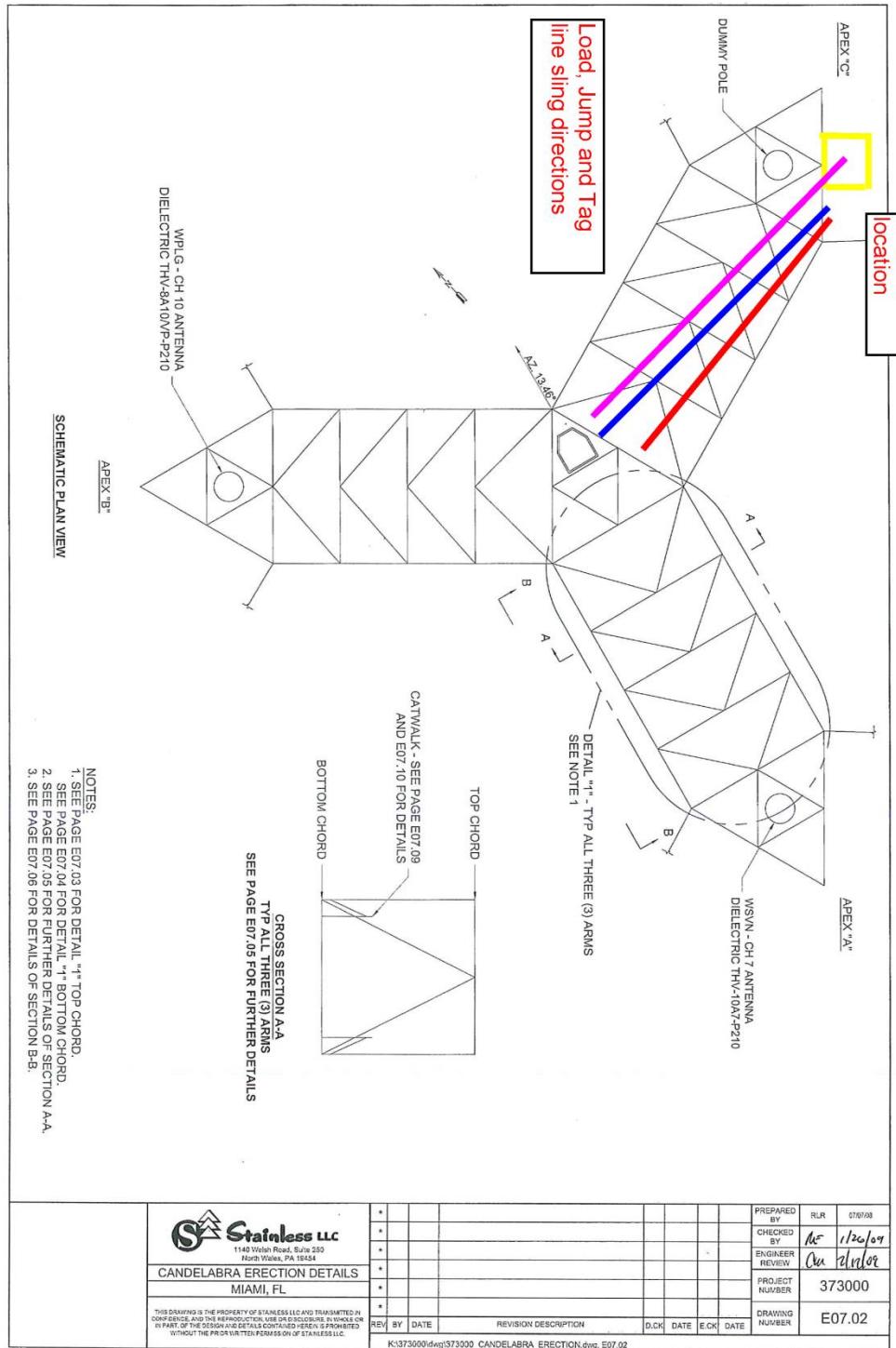
1. PRIOR TO INSTALLING BOLTS, ALL CONTACTING GALVANIZED SURFACES SHALL BE ROUGHENED BY HAND WIRE BRUSHING. POWER BRUSHING IS NOT PERMITTED. TIGHTEN NUTS BY "TURN-OF-THE-NUT" METHOD.
2. SEE PAGE E07.11 FOR LOCATION OF DETAILS.
3. INSTALL SPACERS BETWEEN CONNECTING TOWER MEMBERS.
4. FLANGE BOLTS MUST BE INSTALLED WITH NUTS UP.

- BOLT LIST -

0176	1"Ø x 2 ³ / ₄ " LG. BOLT	-----	60
0177	1"Ø x 3" LG. BOLT	-----	30
0184	1"Ø x 6" LG. BOLT	-----	18
MMF0007	SPACER 3 ¹ / ₂ " X 3" X 3"	-----	12

REV	BY	DATE	REVISION DESCRIPTION	D.C.K.	DATE	E.C.K.	PREPARED BY	RLR	CS/12/08
							CHIEFED BY	ENGINEER REVIEW	PROJECT NUMBER
								CW	373000
K:\373000\ewe\373000_CANDLABRA_ERCTION_PEDESTAL.dwg. E07.17									





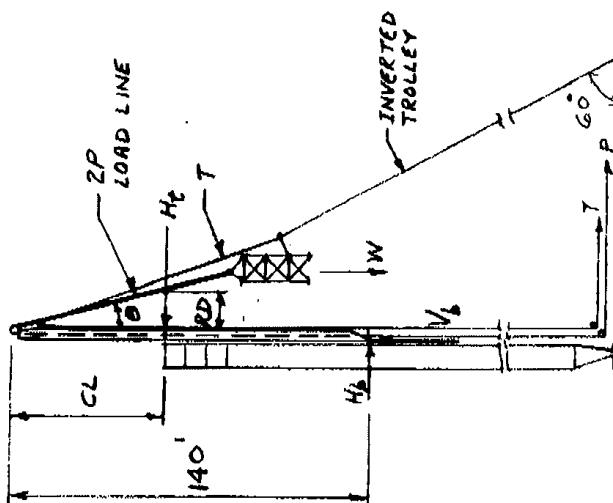
9/5/07

DOTY MOORE NO 710 3F" x 140' GIN POLE

NOTES:

1. W = Safe load and includes the weight of the lifted lead, headache ball and cables above the lifted lead.
2. The values given for P and T must be multiplied by a safety factor of 5 for sizing the lead and trolley cables.
3. The values of Ht, Hb, and Vb must be multiplied by a safety factor of 5 for sizing the connections to the tower.
4. RD = horizontal distance at the bridle connection from the face of the gin pole to the lead line for the angle θ.
5. D = Horizontal deflection at the top of the gin pole from its no load position.

CL (ft)	20	30	40	50	60	70
Φ (deg)	1.5					
RD (ft.)	18.3	21.4	24.6	27.7	30.9	34.0
W (Kips)	30.0	30.0	30.0	27.8	24.8	21.9
P (Kips)	17.3	17.3	17.3	16.2	14.7	13.3
T (Kips)	1.5	1.3	1.2	1.1	0.9	0.8
Ht (Kips)	2.24	2.47	2.78	2.95	3.12	3.35
Hb (Kips)	1.40	1.63	1.92	2.13	2.32	2.55
Vb (Kips)	61.0	60.8	60.6	57.1	52.2	47.7
D (ft.)	1.4	2.7	4.3	5.8	7.4	8.8
Φ (deg)	3.0					
RD (ft.)	24.6	30.9	37.2	43.4	49.7	56.0
W (Kips)	30.0	28.3	25.6	22.3	19.6	17.1
P (Kips)	17.3	16.9	15.1	13.5	12.1	10.9
T (Kips)	3.3	3.1	2.6	2.3	2.0	1.7
Ht (Kips)	3.43	3.67	3.85	3.98	3.92	4.02
Hb (Kips)	1.85	1.96	2.11	2.28	2.49	2.77
Vb (Kips)	64.4	62.9	58.6	51.0	46.3	42.2
D (ft.)	2.0	3.8	5.4	7.1	8.8	10.4
Φ (deg)	5.0					
RD (ft.)	33.0	43.5	54.0	64.5	75.0	85.5
W (Kips)	28.2	23.4	17.8	17.0	12.3	11.9
P (Kips)	16.4	14.0	11.2	10.8	8.4	8.2
T (Kips)	5.8	4.8	3.7	3.4	2.5	2.4
Ht (Kips)	4.86	4.59	4.05	4.37	3.86	4.38
Hb (Kips)	1.92	2.04	2.00	2.39	2.28	2.77
Vb (Kips)	66.2	57.1	48.7	45.0	38.4	35.5
D (ft.)	2.7	4.4	5.5	8.1	8.3	10.9
Φ (deg)	7.0					
RD (ft.)	41.5	56.2	70.8	85.7	100.4	115.1
W (Kips)	22.1	18.9	12.5	12.0	8.5	8.3
P (Kips)	13.3	11.7	8.6	8.3	6.5	6.4
T (Kips)	7.3	6.1	4.1	3.9	2.8	2.7
Ht (Kips)	5.61	5.30	4.15	4.48	3.88	4.39
Hb (Kips)	1.87	2.10	1.86	2.27	2.13	2.85
Vb (Kips)	59.7	52.7	39.7	38.4	31.2	30.8
D (ft.)	2.8	4.8	5.4	7.9	8.0	10.7



Changfei Chen

From: Kevin Barber [REDACTED] >
Sent: Tuesday, September 05, 2017 9:32 AM
To: Changfei Chen
Subject: Re: TKII Ginpole Data

Correct

Kevin Barber Sent from my iPhone

On Sep 5, 2017, at 9:17 AM, Changfei Chen <Changfei.Chen@FDHVelocitel.com> wrote:

Kevin,

This is to follow up our phone conversation about the jump line angle (use jump line as load line to lift ginpole up). We will use line angle 3 degree.

Thank you very much.

Phil Changfei Chen, PE
Project Engineer

<image001.jpg>

200 N. Warner Road, Suite 250
King of Prussia, PA 19406

Office: 215-631-1326
Fax: 215-631-1425
Email: [REDACTED]
Website: www.stainless towers.com

From: Kevin Barber [REDACTED]
Sent: Friday, September 01, 2017 3:21 PM
To: Changfei Chen [REDACTED]

1

Investigation of the September 27, 2017, Gin Pole
Collapse at an Antenna Tower in Miami Gardens, Florida

Cc: Gregg Fehrman [REDACTED] Donald Doty [REDACTED]; Alan Pang [REDACTED];
George Hottensen [REDACTED]
Subject: Re: TKII Ginpole Data

1. Provide jump line angle for the both picking-up and removing ginpole. **Not sure what you man you can call to discuss**
2. Provide ginpole load line angle for each removing or installation. **We will be keeping a 3 Deg. tag angle as what the chart states on the ginpole chart**
3. Provide tag line end termination condition (poured socket or wedge socket,...). **Wedge Socket**
4. Provide tag point to tower distance; or please let us know if it is ok to assume the tag line angle is 60 degree. **Yes**
5. It looks like a typo in one of page of sketch you provided (see attached). Is the weight of 36,000 lbs a typo? Is this a ball weight or total weight? **yes this is not correct total weight not to exceed 20,000.00**
6. Are you going to use Track (one of sketch indicated track used, see attached)? If so, please provide track weight. **Yes we will use the track and the track weight is 978 lb**
7. For install the new pedestal sections and new antenna, we assume that use a 2-part load line and 2000 lbs headache ball. Is this assumption correct? **Yes**
8. Please note that the dummy pole's base pedestal total weight is 4.9 tons instead of 3.3 tons in provided rigging plan. **NOTED**

Kevin Barber
Tower King II
1570 w. Beltline Rd.
Cedar Hill, TX 75104
kevin.barber@sbcglobal.net
Cell [REDACTED]

On Sep 1, 2017, at 2:23 PM, Changfei Chen [REDACTED] wrote:

Investigation of the September 27, 2017, Gin Pole
Collapse at an Antenna Tower in Miami Gardens, Florida

Kevin,

After review all information provided, we need the following additional information in order to finish the final rigging plan review.

1. Provide jump line angle for the both picking-up and removing ginpole.
2. Provide ginpole load line angle for each removing or installation.
3. Provide tag line end termination condition (poured socket or wedge socket,..).
4. Provide tag point to tower distance; or please let us know if it is ok to assume the tag line angle is 60 degree.
5. It looks like a typo in one of page of sketch you provided (see attached). Is the weight of 36,000 lbs a typo? Is this a ball weight or total weight?
6. Are you going to use Track (one of sketch indicated track used, see attached)? If so, please provide track weight.
7. For install the new pedestal sections and new antenna, we assume that use a 2-part load line and 2000 lbs headache ball. Is this assumption correct?
8. Please note that the dummy pole's base pedestal total weight is 4.9 tons instead of 3.3 tons in provided rigging plan.

Please let us know if you have any questions.

Thank you and have a great labor day weekend.

Phil Changfei Chen, PE
Project Engineer

<image002.jpg>

200 N. Warner Road, Suite 250
King of Prussia, PA 19406

Office: 215-631-1326
Fax: 215-631-1425
Email: [REDACTED]
Website: www.stainlessowers.com

From: Alan Pang
Sent: Friday, August 25, 2017 9:57 AM

3

Qualified Engineer Review Letter
Stainless, A Business of FDH Velocitel Report Number: 373011

September 13, 2017
Page 5

Appendix C

Qualified Engineer Review Calculations

Investigation of the September 27, 2017, Gin Pole
Collapse at an Antenna Tower in Miami Gardens, Florida

Job Number
020117-Miami FL
Date 09/27/17
Prepared By:
PCG

Tower Rigged									
Lift Description	Tower Face Width (ft)	Lift Weight (lbs)	Bail	Parts	Load Line/WI/Ft	Crown Top Block	# Sheave Eff	Impact Factor	Live Load
PickUp/Ginpole Remove/Ginpole	12	20000	0	3	0.0	0.0	95.5%	1.00	22350 22281

Gin Pole and Track									
Lift Description	Tower Face Width (ft)	Lift Weight (lbs)	Bail	Parts	Load Line Angle (degrees)	A	Brace Load (lbs)	Brace Load (tens)	Max. Line Tension (lbs)
Remove Dummy Pole Install 1st New Section Install 2nd New Section Install New Antenna	12	10000 8000 7000 4000 14,500	2000 2000 2000 2000	2 2 2 2	2 3 3 3	56 56 56 53	3025 3025 3025 44661	1298 1298 1298 3716	6611 6611 53175 1798

Tower Rigged Notes:

- 1 For lifting and removing ginpole, the jump line (as load line) angle shall not greater than 2.5 degree (if this angle is 3 degree, the tag line safety factor is 4.83 and tag line is not adequate)
- 2 Jump line safety is 5.73 and trolley line safety factor is 5.89.
- 3 Do not jump the track in tree spool mode. The jump line should always be slack when raising the jump track.
- 4 Jump line top station block 16" Skokum Block (SML 17.5 tons) and the 1" basket are both adequate.
- 5 Tower members at the jump line top station block location is adequate.
- 6 Jump line base Skokum 16" block (13.5 tons), 7/8" jump line sling and tower base rigging ring (Stainless Part # PA9002) are adequate.
- 7 Base tag block McKissic 6" (4 tons), and 1/2" tag base block sling are adequate.
- 8 Tower members at the tag line base block location is adequate.
- 9 The engineering review included only the items listed in the above notes.
- 10 The above chart shows the critical lifts and maximum loads.
- 11 DNG = Does not govern
- 12 When man basket is used to lift personnel, the load line safety factor shall be 10 minimum.

Gin Pole Notes:

- 1 A = Horizontal distance from pole face to load line at bridle.
- 2 Do not jump the track in tree spool mode. The jump line should always be slack when raising the jump track.
- 3 Load line safety factor is greater than 5 for each ginpole lifting.
- 4 Jump line safety factor is greater than 5 for each ginpole lifting.
- 5 Trolley line safety factor is greater than 5 for each ginpole lifting.
- 6 Gin pole track basket 1-1/8 IPS are adequate.
- 7 Ginpole bottom vertical 1-3/8" is adequate.
- 8 The engineering review included only the items listed in the above notes.
- 9 The above chart shows the critical lifts and maximum loads.
- 10 DNG = Does not govern
- 11 Ginpole is adequate for each lifting
- 12 Per provide sketch, the 7/8" wire rope sling is used around the dummy pole to remove dummy pole. The 7/8" wire rope sling is NOT adequate (WLL=10.3 kips, but pole weight is 11 kips)
- 13 Per dummy pole description in rigging plan letter, the ginpole is 65' of cantilever above the dummy pole base [pedestal], with the height of around 6' pedestal, the total cantilever is 71'.
- The ginpole chart provide maximum 70.4' of cantilever. 71'-it's beyond the loading chart limit.

Appendix C

QUALIFIED ENGINEER'S SCOPE OF WORK PROPOSAL (prepared by Stainless)



Kevin Barber, President
Tower King II Inc.
P.O. Box 185
Cedar Hill, TX 75106
Phone: 469-272-3388

Proposal Number P17_3730_002
WSVN

Your FDH Velocitel Contact is:
Jon Marcusse
200 North Warner Road, Suite 215
King of Prussia, PA 19406
Cell: [REDACTED]
E-Mail: [REDACTED]

We Rise To Challenges Everyday

(Quotation valid 60 Days from Proposal Date)

All proposals are subject to final review and acceptance by Stainless, a business of Velocitel, Inc. d/b/a FDH Velocitel



6/21/2017

Kevin Barber, President
Tower King II Inc.
P.O. Box 185
Cedar Hill, TX 75106

Re: **Proposal # P17_3730_002**
Stainless Tower
Location:

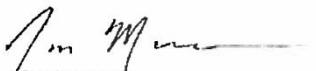
Dear Kevin,

Stainless, a business of Velocitel, Inc., d/b/a FDH Velocitel ("Stainless"), is pleased to submit the following proposal for rigging review on the tower located in Miami, FL.

Should you have any questions regarding this proposal or need further information at this time, please don't hesitate to contact me at [REDACTED]

Sincerely,

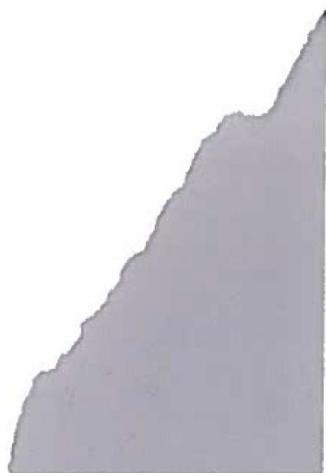
Stainless, a business of Velocitel, Inc. d/b/a FDH Velocitel


Jon Marcusse
National Sales Manager - Broadcast

Attachment

Tower King II
Proposal for Miami, FL

2 of 4





PROPOSAL: EXHIBIT "A"

Tower King II Inc.
P.O. Box 185
Cedar Hill, TX 75106
Attention: Kevin Barber

Lot 1. Services will include the following:

- a. Engineering review of your completed rigging plan (up to 24 hours of engineering time)
- b. Engineering will review the adequacy of the materials and the effects on the tower

PRICE FOR ALL SERVICES..... [REDACTED]

PAYMENT TERMS:

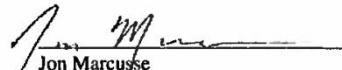
100% upon completion



GENERAL NOTES:

1. This proposal is for labor as stated. Any additional work to be performed will be quoted on a cost plus or fixed price basis.

Presented by:
Stainless, a business of Velocitel, Inc. d/b/a FDH Velocitel



Jon Marcuse
National Sales Manager - Broadcast

Accepted by:
Tower King II Inc.
Digitally signed by Kevin Barber
DN: cn=Kevin Barber, o=Tower King II, ou,
email=kevin.barber@sbcglobal.net, c=US
Date: 2017-08-11 08:48:03 -05'00'
Kevin Barber, President
Or Authorized Representative

ALL PROPOSALS ARE SUBJECT TO STAINLESS TERMS AND CONDITIONS OF SALE. EXCEPT FOR TERMS EXPRESSLY AGREED TO IN WRITING SIGNED BY AN AUTHORIZED STAINLESS REPRESENTATIVE, ANY TERMS THAT CONTRADICT THE PRINTED TERMS REFERENCED IN THIS PROPOSAL AND ANY PREPRINTED TERM AND CONDITION ON ANY COMPANY PURCHASE ORDER OR COMMUNICATION FOR CONDITIONS OF SALE, ARE VOID.