

DOCKET NO. SA-539

EXHIBIT NO. 17-C

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

AIRWORTHINESS – EXAMINATION OF ENVELOPE AND BASKET LOAD CABLES

(25 Pages)

(15 Pictures)

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

Airworthiness Group Examination of Envelope and Basket Cables

December 1, 2016

A. ACCIDENT DCA16MA204

Location: Lockhart, Texas
Date: July 30, 2016
Time: 0742 Local Time
Aircraft: Balony Kubicek BB85Z, registration N2469L

B. GROUP

Chairman: Tom Jacky
National Transportation Safety Board
Washington, D.C.

Member: Joe Panagiotou
National Transportation Safety Board
Washington, D.C.

Technical Advisor to Czech Air Accidents Investigation Institute:

Albert Padelt
Best Aviation Services/Kubicek Balloons
Bally, PA

On July 30, 2016, about 0742 central daylight time (CDT), a Kubicek Balloon, registration N2469L, impacted power lines in Lockhart, Texas. The basket was located between Towers 127 and 128 power lines.

The group met at the NTSB's Material Laboratory in Washington, DC for further examination of the cables removed from the accident site. Generally, each cable segment was laid out, measured, photographed, and assessed for damage.

Some of the cable ends were selected for further photo documentation.

At the conclusion of the examination, all pertinent documentation and photographs were provided to each of the parties.

D. DETAILS OF INVESTIGATION

For the examination, the cables were removed from secure storage and examined in the NTSB's Materials Laboratory. The cables examined were removed by the group during the initial, accident scene examination. The cable segments were grouped as follows:

- 1) Basket and Envelope Load Cables as attached to the burner support frame, numbered by the burner frame connection points;
- 2) Envelope Load Cables that were severed from their burner frame connection point, identified by the envelope load strap number;
- 3) Basket Load Cables, identified by the found position on the basket floor;
- 4) Miscellaneous loose cable segments, found near the final basket position.

The group laid out, measured, photographed, and assessed the damage to each cable segment. The end of each cable was documented for the type and amount of damage.

1. Examination of Basket Load and Envelope Cables Attached to the Burner Support Frame

The cable groupings were numbered by the burner support frame attachment points. Each attachment point grouping consisted of two carabiners, a number of envelope load cables, and one or two basket load cables.

Each grouping was removed from their packaging and laid out on the laboratory floor. Measurements were taken of the length of cable from the eyelet connection. Observations of each of the cable were made, noting discoloration, burning, arcing evidence, and description of the cable end condition. Some of the cables had a clear plastic sheath; the condition of the sheath was noted as well.

The burner support frame number was determined during the on-scene examination. The group documented each grouping as follows:

- a. **Burner Support Frame 1**

The connection consisted of two basket support cables, three balloon load cables on two eyelets, and two associated carabiners. A carabiner for the envelope scoop was also attached.

- Basket Cable 1 Measurements

Eyelet to cable end (plastic sheath ended at cable end): 3' 7"
The severed end showed evidence of strand fusing (Figure 1)

- Basket Cable 2 Measurements

Eyelet to cable end (plastic sheath ended at cable end): 3' 7"
The severed end showed evidence of strand fusing (Figure 2)

The two carabiners and the eyelets connected to them exhibited evidence of electrical arcing

(Figure 3).

Balloon Load Cable Eyelet Number 1 Measurements

Cable was a fused stub (Figure 4), no measurement available.

Balloon Load Cable Eyelet Number 2 Measurements

Cable Segment 1: 9"

Overload evidence noted at cable end (Figure 5), with some abrasion on the cable noted.

Cable Segment 2: 3"

Overload evidence noted at cable end (Figure 6).

b. Burner Support Frame 2

The connection consisted of one basket support cable, three balloon load support cables, two associated carabiners, and a red carabiner. The carabiners and the red carabiner all showed evidence of electrical arcing. The basket load cable included a plastic sheath.

Basket Cable Measurements

Eyelet to arcing spot on cable:	3' 6"
Eyelet to plastic sheath end:	3' 6" + 2"
Eyelet to severed end of cable:	6' 8"

The severed end of the cable showed evidence of strand fusing (Figure 7).

Balloon Load Cable – cables were gone, only the eyelet remained. No measurable cable.

c. Burner Support Frame 3

The connection consisted of one basket load cable, three balloon load cables, and associated carabiners. The basket cable included a plastic sheath. No electrical arcing damage was noted on the carabiners.

Basket Cable Measurements

Eyelet to end of plastic sheath:	3' 9½"
Eyelet to severed end of cable:	7' 1½"

The cable end exhibited evidence of strand fusing (Figure 8) and arcing along the lower cable length.

Balloon Cable 1 Measurements

No measurement possible - No cable evident, fused at sheath end (Figure 9).

Balloon Cable 2 Measurements

Eyelet to end of severed cable: ~2½"

Cable end had evidence of overload, with a metallic substance abraded onto the cable (Figure 10).

d. Burner Support Frame 4

The connection consisted of two basket support cables and four balloon load support cables. The four cables were connected to two eyelets, two cables per eyelet. The grommets for each of the eyelets were red.

Basket Cable 1 Measurement

Eyelet to end of severed cable: 3' 9"

Severed end exhibited evidence of overload (Figure 11) and was coincident with end of plastic sheath.

Basket Cable 2 Measurement

Eyelet to severed end of cable: 7' 3"

Severed end exhibited evidence of strand fusing (Figure 12). No plastic sheath was noted.

Balloon Load Cable 1 Measurement

Eyelet to severed end of cable: 6"

Balloon Load Cable 2 Measurement

Eyelet to severed end of cable: 7"

Balloon Load Cables 1 and 2 were connected to the same eyelet.

Balloon Load Cable 3 Measurement

Eyelet to severed end of cable: 9"

Balloon Load Cable 4 Measurement

Eyelet to severed end of cable: 13"

Balloon Load Cables 3 and 4 were connected to the same eyelet.

The severed ends of each of the four balloon load cables exhibited evidence of overstress (Figure 13). In addition, each of the cables had what was determined using a handheld XRF alloy analyzer to be aluminum, adhering to the outside the cables. An example of the adhering aluminum

is shown in Figure 14.

e. Burner Support Frame 5

The connection consisted of two basket support cables and four balloon load support cables, connected by two carabiners. The four cables were connected to two eyelets, two cables per eyelet. The balloon load support cables were noted as 22-25 (of the 28 envelope load cables). Each of the balloon load support cables were intact and not severed.

Basket Cable 1 Measurements

Eyelet to end of plastic sheath:	49"
Eyelet to burn mark and gouge:	3' 7"
Eyelet to severed end of cable:	7' 3 $\frac{1}{8}$ "

Basket Cable 2 Measurements

Eyelet to severed end of cable:	7' 4"
---------------------------------	-------

The cable did not have a plastic sheath.

Both of the basket cable ends exhibited strand fusing (Figure 15).

f. Burner Support Frame 6

The connection consisted of one basket support cable and three balloon load support cables, connected by two carabiners. The three cables were connected to two eyelets, two cables on one eyelet and one on the other. The balloon load support cables were noted as 26-28 (of the 28 envelope load cables). Each of the balloon load support cables appeared intact and not severed.

Along the balloon support cables there appeared several small areas of arcing evidence.

Basket Cable Measurements

Eyelet to 1 st arcing discoloration spots:	3' 6"
Eyelet to 2 nd area of localized arcing spots:	3' 10"
Eyelet to severed end of cable:	7' 1 $\frac{1}{2}$ "

No plastic sheath and the severed end of the cable exhibited evidence of strand fusing.

g. Burner Support Frame 7

The connection consisted of one basket support cable and three balloon load support cables, connected by two carabiners. The three balloon load cables were connected to two eyelets, two cables on one eyelet and one on the other. Each of the balloon load support cables appeared intact and not severed.

Basket Cable Measurements

Eyelet to first arcing evidence:	3' 5½"
Eyelet to second arcing evidence:	3' 11"
Eyelet to end of plastic sheath:	3' 9½"
Eyelet to severed end of cable:	7' 1¼"

Severed end exhibited evidence of strand fusing, similar to basket cables on burner support frames 5 and 6. Also, small spots that appeared to be consistent with balled, reconstituted metal splatter were noted along the length of the cable.

h. Burner Support Frame 8

The connection consisted of two basket support cables and four balloon load support cables, connected by two carabiners. The two basket cables had plastic sheaths. The four balloon load cables were connected to two eyelets, two cables on each eyelet. Each of the balloon load support cables appeared intact and not severed.

Basket Cable 1 Measurements

Eyelet to severed cable end:	7' 3"
Eyelet to sheath abrasion:	3' 6"
Eyelet to sheath end:	3' 11½"
Severed end exhibited evidence of strand fusing.	

Basket Cable 2 Measurements

Eyelet to severed cable end:	3' 9"
------------------------------	-------

The plastic sheath ends at the severed cable end. The severed end did not exhibit evidence of strand fusing; but it did indicate overstress.

One of the balloon load cables on each eyelet was shorter than the other. The two inner cables were shorter than the outer cables.

Two of the load cables had a piece of red fabric attached, consistent with the scoop. Each of the balloon load cables had several small abrasion marks and small splatter of reconstituted metal particles.

2. Examination of Envelope Load Cables Severed from Burner Frame Connection

These cables were envelope load cables severed from the burner support frame connections but still attached to the envelope. The cables were laid out on the laboratory floor. The cables

were numbered by the gore connections, from number 8 – 21.

a. Cable Number 8

Eyelet to severed end: 4' 5"

The severed end exhibited evidence of strand fusing. The eyelet did not exhibit arcing evidence.

b. Cable Number 9

Eyelet to severed cable end: 7' 11"

The cable exhibited evidence of overload. The eyelet did not show evidence of arcing damage.

c. Cable Number 10

Eyelet to 1st area of arcing damage: 1' 9"

Eyelet to 2nd area of arcing damage: 5' 2"

Eyelet to severed end of cable: 7' 10"

Severed end of cable exhibited evidence of overload. The eyelet did not show evidence of arcing damage.

d. Cable Number 11

Eyelet to 1st area of arcing damage: 4"

Eyelet to 2nd area of arcing damage: 3' 1"

Eyelet to 3rd area of arcing damage: 6' 5"

Eyelet to severed end of cable: 8' 0"

Severed end of cable exhibited evidence of overload. The eyelet did not show evidence of arcing damage.

e. Cable Number 12

Eyelet to severed end of cable: 1"

The cable showed evidence of strand fusing with no arcing damage noted on the eyelet.

f. Cable Number 13

Eyelet to severed end of cable: 8' 6"

The cable showed evidence of strand fusing with arcing damage noted on the eyelet. Also, several small areas of arcing noted along the length of the cable.

g. Cable Number 14

No measurable cable evident, only the eyelet remained. The severed end showed evidence

of strand fusing and the eyelet exhibited evidence of arcing.

h. Cable Number 15

Eyelet to severed cable end: 14"

The severed end showed evidence of strand fusing and arcing evidence was noted on the eyelet.

i. Cable Number 16

No measurable cable, only the eyelet remained. The severed end showed evidence of strand fusing and the eyelet exhibited evidence of arcing.

j. Cable Number 17

No measurable cable, only the eyelet remained. The severed end showed evidence of strand fusing and the eyelet exhibited evidence of arcing.

k. Cable Number 18

Eyelet to severed end of cable: 14"

The cable exhibited evidence of strand fusing and arcing damage on the eyelet. The cable also exhibited evidence of abrasion along the length of the cable.

l. Cables 19, 20, and 21

No measurable cable, only the eyelet remained. The severed end showed evidence of strand fusing and the eyelet exhibited evidence of arcing.

3. Examination of Basket Load Cables

These cables were found attached to the basket floor and were exposed and then cut from the floor. Therefore, one end of the cable exhibited evidence of cutting; the group only documented the severed end of the cables.

CABLES REMOVED FROM BACK SIDE OF BASKET

a. Cable Number 1

Cable length: 3' 8"

End of cable showed evidence of strand fusing.

b. Cable Number 2

Cable length: 4"

Cable end showed evidence of strand fusing.

c. Cable Number 3

Cable length: 4"

Cable end showed evidence of strand fusing.

d. Cable Number 4

Cable length: 4½"

Cable end showed evidence of strand fusing.

e. Cable Number 5

Cable Length: 5"

Cable end showed evidence of strand fusing.

f. Cable Number 6

Cable Length: 3"

Cable end showed evidence of strand fusing.

CABLES REMOVED FROM BACK SIDE OF BASKET

g. Cable Number 7

Cable Length: 3' 10"

Cable end exhibited evidence of overstress. Cable was discolored by heat.

h. Cable Number 8

Cable Length: 4"

Cable end showed evidence of strand fusing.

i. Cable Number 9

Cable Length: 4½"

Cable end showed evidence of strand fusing.

j. Cable Number 10

Cable Length: 9½"

Cable end showed evidence of strand fusing.

k. Cable Number 11

Cable Length: 4' 0"

Cable end showed evidence of overstress.

l. Cable Number 12

Cable Length: 3' 6"

Cable end showed evidence of strand fusing.

4. Examination of Miscellaneous Loose Cable Segments

Two loose segments of cable were located near the basket site but not in the area with heat and fire damage. The two segments were examined as follows:

a. Loose Segment Number 1

Length of segment: 5' 6"

The cable exhibited evidence of strand fusing on one end and evidence of overstress on the other end. Several areas of discoloration and reconstituted metallic splatters were noted along the length of the cable.

b. Loose Segment Number 2

Length of segment: 3' 4"

The cable exhibited evidence of strand fusing on one end and evidence of overstress on the other end. The cable exhibited a small fleck or area of reconstituted metal near the overstress end of the cable.

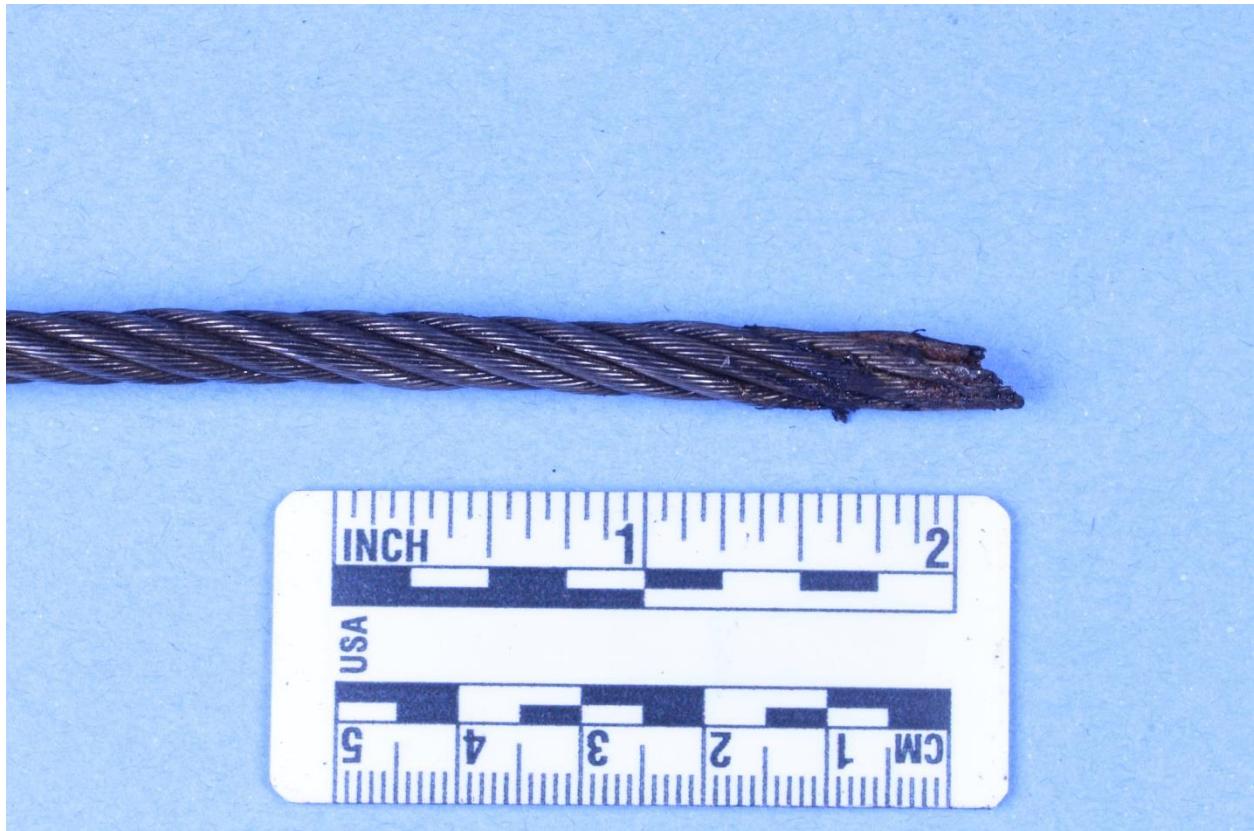


Figure 1: Severed cable end exhibiting strand fusing (Burner Support Frame Corner 1)



Figure 2: Severed cable end exhibiting strand fusing (Burner Support Frame 1)



Figure 3: Carabiners with electrical arcing damage (Burner Support Frame 1)



Figure 4: Load cable fused and separated at eyelet (Burner Support Frame 1)



Figure 5: Load cable exhibiting overload failure (Burner Support Frame 1)

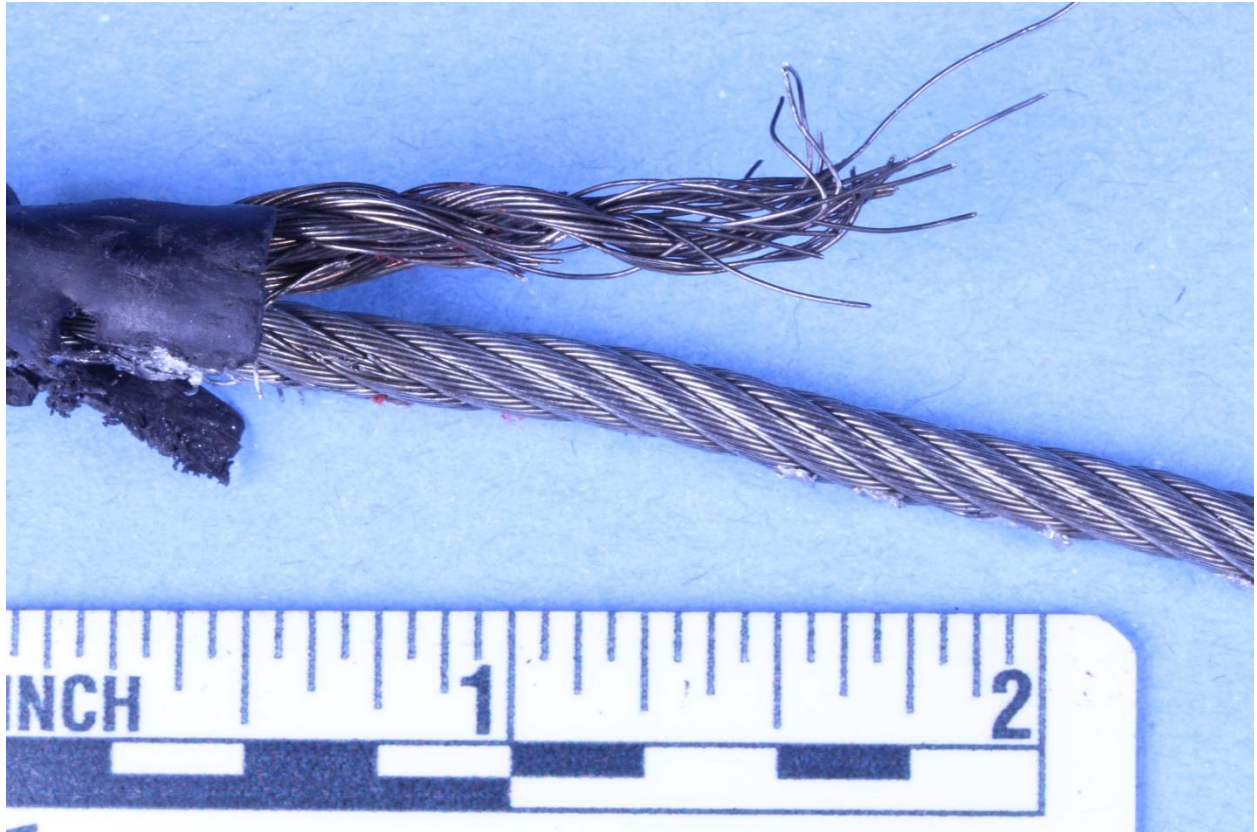


Figure 6: Load cable exhibiting overload failure (Burner Support Frame 1)



Figure 7: Basket cable exhibiting strand fusing (Burner Support Frame 2)



Figure 8: Basket cable exhibiting strand fusing (Burner Support Frame 3)



Figure 9: Load cable exhibiting strand fusing at the eyelet (Burner Support Frame 3)

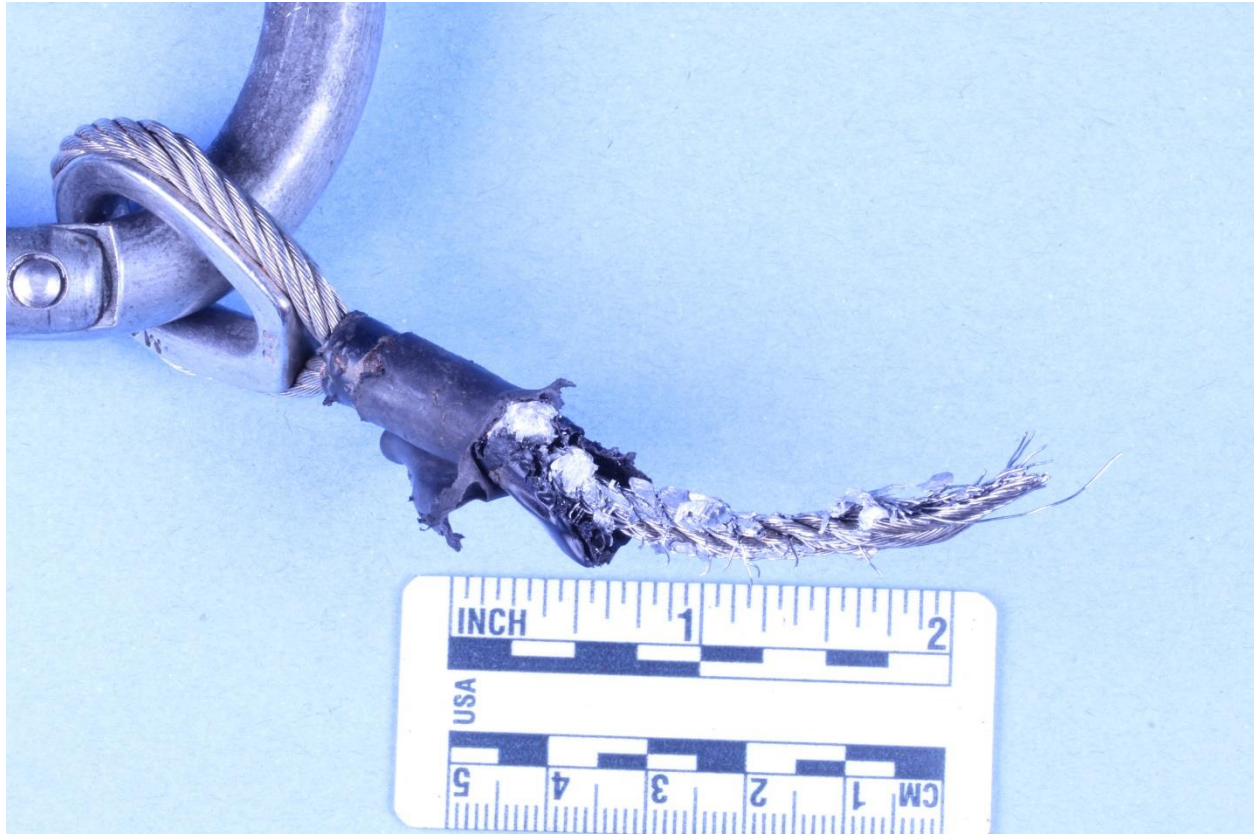


Figure 10: Load cable exhibiting overload failure and abrasion (Burner Support Frame 3)



Figure 11: Basket cable exhibiting overload (Burner Support Frame 4)



Figure 12: Basket cable exhibiting strand fusing (Burner Support Frame 4)

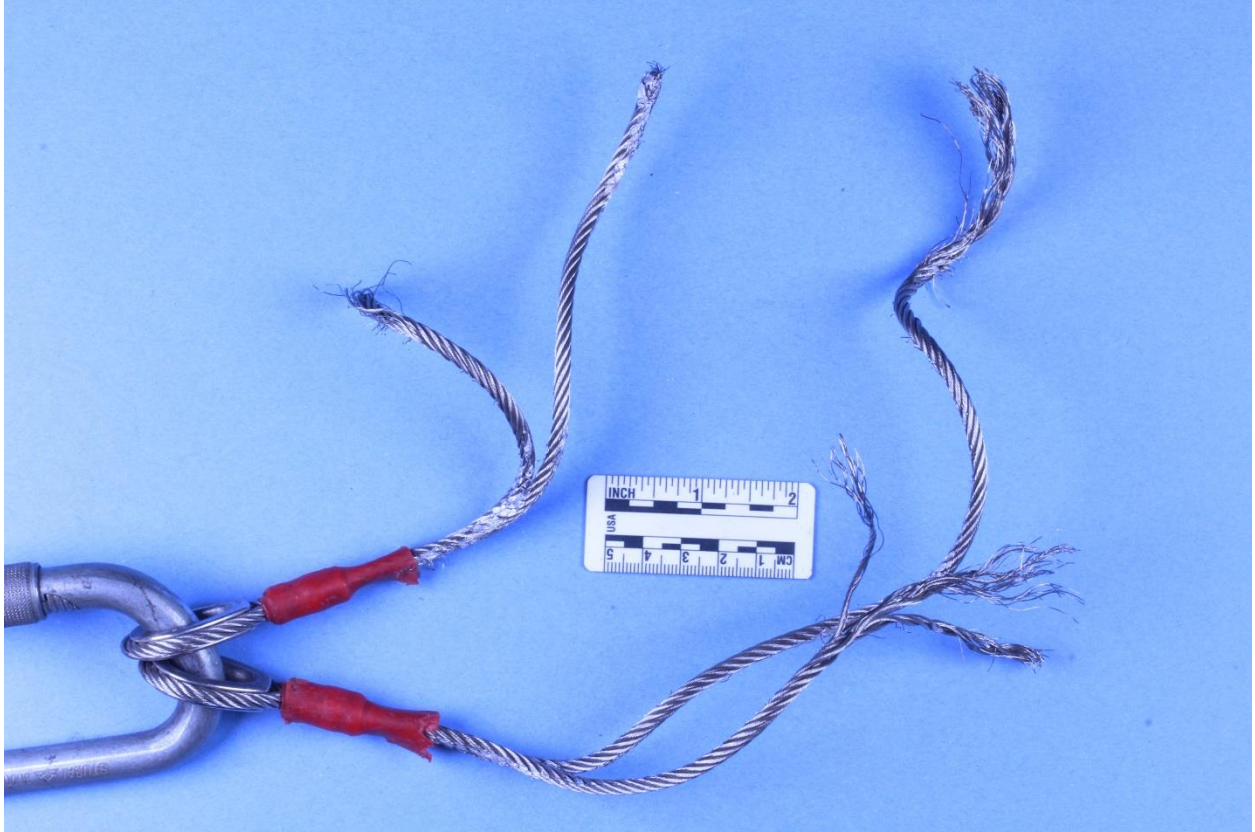


Figure 13: Load cables exhibiting overload (Burner Support Frame 4)



Figure 14: shavings of aluminum recovered from cable exterior (Burner Support Frame 4)



Figure 15: Basket cables exhibiting strand fusing (Burner Support Frame 5)