NATIONAL TRANSPORTATION SAFETY BOARD

SYSTEMS GROUP CHAIRMAN FACTUAL REPORT ADDENDUM,
AIRCRAFT CONTROL CABLE TEMPERATURES
April 17, 2003

A. ACCIDENT: DCA03MA022

LOCATION: Charlotte-Douglas International Airport, North Carolina

DATE OF ACCIDENT: January 8, 2003, at about 0850 Hours (Local)

AIRCRAFT: Raytheon Model 1900D, N233YV, operated by Air Midwest Airlines, d.b.a. USAirways Express flight 5481

B. GROUP MEMBERS:

Group Chairman: Robert L. Swaim
Washington, DC

Member: John Oxley
Air Midwest Airlines
Huntington, West Virginia

Member: Jamison Murphy
Airline Pilots Association
Fort Mill, South Carolina

Member: Gary Sneary
Raytheon Aerospace Company
Madison, Mississippi

Member: Robert Ramey
Raytheon Aircraft Company
Wichita, Kansas

C. SUMMARY:

On January 8, 2003, at about 0848 Eastern Standard Time, Air Midwest flight 5481 (d.b.a. US Airways Express), a Beech 1900, N233YV, crashed shortly after takeoff from Charlotte-Douglas International Airport (CLT), Charlotte, North Carolina after a distress call was made by the Captain. The flight was a scheduled passenger flight to Greenville-Spartanburg, South Carolina. The 2 crewmembers and 19 passengers onboard were killed and one person on the ground received minor injuries. The airplane was destroyed due to impact forces and a post crash fire.

The Maintenance Records Group found maintenance log pages showing that the tension of the pitch control cables in the accident airplane were adjusted two days prior to the

accident. Maintenance documents show that cable tension may be affected by temperature.

The Systems Group convened at the Raytheon Aerospace hangar in Huntington, WV, at about 10pm on Monday, February 24, 2003. The goal of the activity was to measure temperatures along the route of pitch control cables in a Model 1900D. The general sequence of activities was intended to match the sequence that occurred during the maintenance activity performed on the accident airplane, in the same facility, and on a night with similar temperature.

D. DETAILS OF THE INVESTIGATION:

MAINTENANCE DOCUMENTS CITING RELATIONSHIP BETWEEN TEMPERATURE AND CABLE TENSION

Beech 1900D Airliner Maintenance Manual (AMM), Section 27-30-02, Page 207, Figure 203, and labeled as "3/16 ELEVATOR CABLE TENSION GRAPH." Ref. Attachment 2.

Raytheon Electronic Publication System (REPS) for the Beech 1900D Airliner Maintenance Manual (AMM), Section 27-10-03-201, Page 3, Figure 203, and labeled as "AILERON CONTROL SYSTEM RIGGING." Ref. Attachment 3.

Advisory Circular (AC) 43.13-1B, titled Acceptable Methods, Techniques, and Practices - Aircraft Inspection and Repair (Change 1, Dated 9/27/01, Section 7-153, TITLED CABLE TENSION ADJUSTMENT). Ref Attachment 4.

TEMPERATURE MEASURING DEVICES AND CALIBRATION

Prior to arrival of the airplane, the group members examined the devices to be used for measuring temperatures.[1] The group noted that:

1. The measuring device provided by Raytheon Aircraft Company was a Thermo Electric Micromite II Multi-Function Calibrator, equipped with a thermocouple and corresponding temperature range of measurement. The multimeter had a valid calibration sticker. In attached data, the values for measurements made with this thermometer are followed by the letter "b."

2. A mechanic at the hangar provided a multimeter that contained a thermocouple function that was similar to what had been provided by Raytheon Aircraft. The multimeter had no calibration sticker. Placed next to the Raytheon multimeter, the two

[1] All temperatures were recorded in Fahrenheit, except those from the OAT gauges, which were calibrated in Celsius. For discussion, the group used the Air Midwest Temperature Conversion Chart (ref. Attachment 5). The conversion of data from Celsius to Fahrenheit used was 1.8 X [Celsius value] + 32 = Fahrenheit value.

displays were within 0.1 degrees Fahrenheit. In attached data, the measurements made with this thermometer are followed by the letter "r."

3. The NTSB provided an electronic digital thermometer. Placed next to the Raytheon multimeter, the two displays were within 0.2 degrees Fahrenheit. Placed in a cup of half-melted snow (which may have contained road salt), the display read 31.1 degrees Fahrenheit. In attached data, the measurements made with this thermometer are followed by the letter "d."

4. The NTSB provided a bi-metallic analog thermometer that had two-degree graduations. Placed next to the NTSB electronic digital thermometer, the two displays were within 1.0 degrees Fahrenheit.[2] Placed in the same cup of half-melted snow, the display read slightly more than 31 degrees Fahrenheit. In attached data, the measurements made with this thermometer are followed by the letter "m."

5. The NTSB provided a fluid analog thermometer that had two-degree graduations. Placed next to the NTSB electronic digital thermometer, the two displays were within 0.5 degrees Fahrenheit. Placed in the same cup of half-melted snow, the display read slightly more than 31 degrees Fahrenheit. This thermometer provided the slowest response of the group. In attached data, the measurements made with this thermometer are followed by the letter "L."

6. The installed airplane outside air temperature (OAT) gauge, with two-degree graduations in Celsius. This gauge was installed to the left of the Captain's seat and the closest to the steel hangar door. Visual examination revealed that the probe portion of the gauge projected more than three inches to the left of the fuselage skin, within a protective aluminum tube that was part of the fuselage. Raytheon personnel referred to the aluminum tube as a sun shield. In attached data, the measurements made with this thermometer are contained in a clearly labeled column. As all other data was in Fahrenheit, a second column shows the same data, converted to Fahrenheit.

7. Spare outside air temperature (OAT) gauge, similar to the previous gauge. This part was obtained from spare airplane parts and was not installed. As a cross-reference, the spare OAT was loosely wired to the protective sunshield for the probe of the installed gauge during the measurements taken at 02:50am and 03:04am. When placed next to the installed OAT, the spare OAT read 3.2 and 3.6 degrees (F) warmer, respectively. The spare gauge was later placed on a work stand (referred to as the podium), next to the NTSB digital thermometer.

The locations for sampling temperatures with these devices followed the pitch control cable routes (Ref. Figure 1)

[2] The units marked on the bi-metallic thermometer were interpolated to the most accurate measurements that could be agreed to.

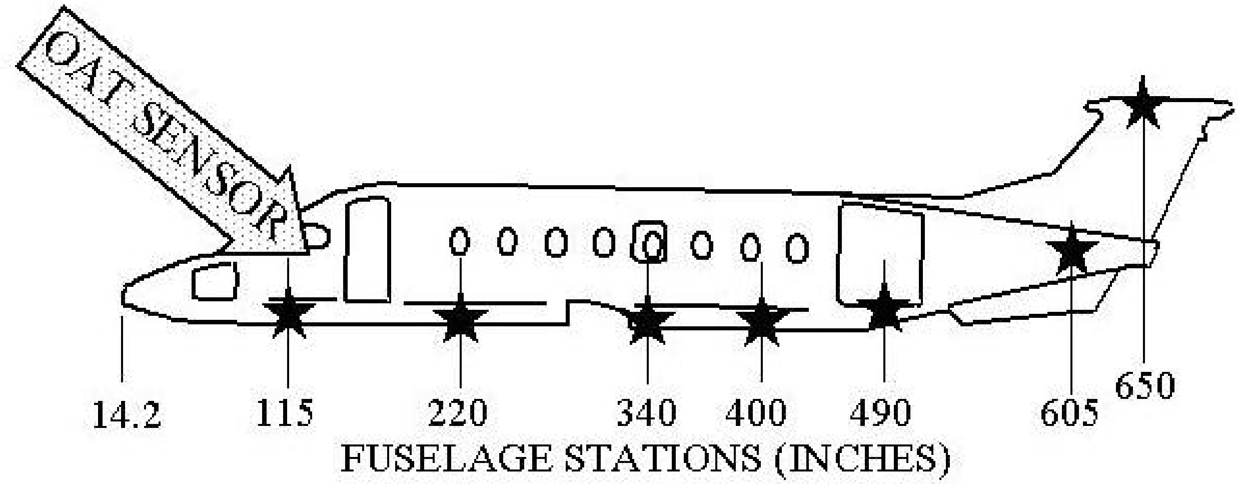


Figure 1. Fuselage Stations and locations for temperature sampling along pitch cable control paths.

HANGAR AND PARKING SPOT

The airplane (N144ZV, manufacturer serial number UE-144) used for the testing was from the same operator as the accident airplane. The hangar was an uninsulated steel building that could fit only a single Beech 1900D Airliner. The floor of the hangar had painted spots that denoted the location for each tire of the parked airplane. (Ref Photograph 1) The nose of the airplane was within several feet of the closed hangar door.

Photograph 1. The photograph shows the hangar before the door was lowered, the airplane parking position, the location of OAT sensor (beneath Captain's side window), and the two heaters between roof trusses of the hangar. The portable heaters had not yet been placed, although one is visible (yellow) to the left of the nose tire and a (black) second portable heater is behind the knee of the person walking. This is not the accident airplane.

The hangar was heated with two radiant heaters supported between the roof trusses, at either end of the hangar. In addition, three portable kerosene-burning heaters were oriented toward portions of the airplane. (Ref. Photographs 2, 3, 4) The portable heaters were started before the hangar doors were opened.

Photograph 2. Kerosene-burning heater pointed toward the right side of the airplane, ahead of wing. Master Model B110BT with placarded output of 110,000 BTU. Note: The location for the OAT probe is on the opposite side of the airplane, beneath the Captain's side window.

Photograph 3. Kerosene-burning heater pointed toward the right rear of the airplane. DESA Heater Model REM150B with placarded output of 150,000 BTU.

Photograph 4. Kerosene-burning heater pointed toward the left rear of the airplane. Master Model B110BT with placarded output of 110,000 BTU

DATA COLLECTION:

> NOTE: The collection of temperature data may be found in a spreadsheet labeled as Attachment 1.

The airplane was flown to the airport on a revenue flight and arrived after 11pm. Following removal of passengers and baggage at the terminal, maintenance personnel were sent to start the engines and taxi the airplane from the terminal to the hangar. At the hangar, three right-side floorboards were removed from the airplane cabin and replaced with custom-cut corrugated cardboard that was taped into place (Ref. Figure 1). Each cardboard floor panel had a hole for the insertion of the temperature probes.

The engines were restarted, the airplane was taxied away from the hangar for engine run-up checks. Temperature data was collected from the three accessible locations near the cable runs during the run-up. The hangar doors were opened after the airplane was taxied back to the hangar, and the engines were shutdown. The airplane tires were placed on marks painted on the hangar floor, the hangar doors were closed within minutes, and the kerosene heaters were moved closer to the airplane.

The mechanics opened the access panels to the configuration of the night that maintenance was performed on the accident airplane. This included opening the cockpit floor on the side of the First Officer, removing the floor of the cargo compartment, removing the access plates to access the turnbuckles from both sides, and removing inspection panels from near the aft bellcrank. Data collection expanded after the hangar doors were closed and areas became accessible.

The measurements did not fill all cells in the spreadsheet used for data collection for two reasons. First, not all areas could be accessed at all times. Second, due to the smaller number of devices than locations to measure, the devices had to be moved and the readings had to stabilize. This led to charts with gaps in data that became difficult to interpret. (Ref. Charts 1 and 2)

> NOTE: Two reference systems were used and are cited. One was in fuselage station measurements, for relatively definitive locations within the airplane. The pitch cable system is not routed in a straight line between the nose and tail of the airplane, so approximate cable distances from the front of the pitch cable installation were also used and are cited.

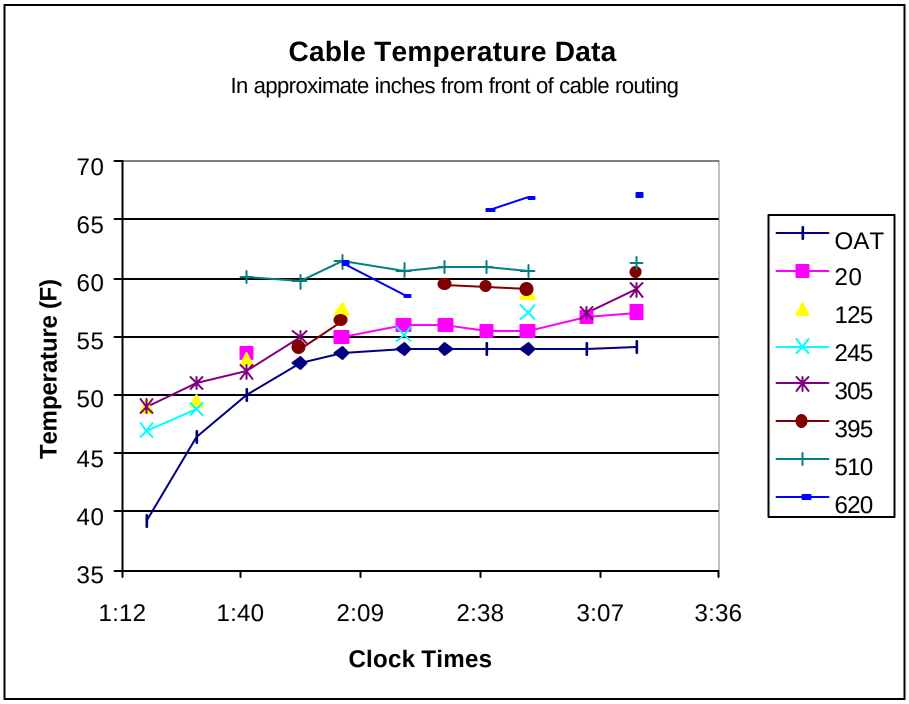


Chart 1. Cable temperature data after hangar door was shut, as collected. Each line/symbol represents an inch-distance from the front of the pitch control system. The weather outside of the un-insulated hangar was measured to be 23.5 to 25 degrees F.

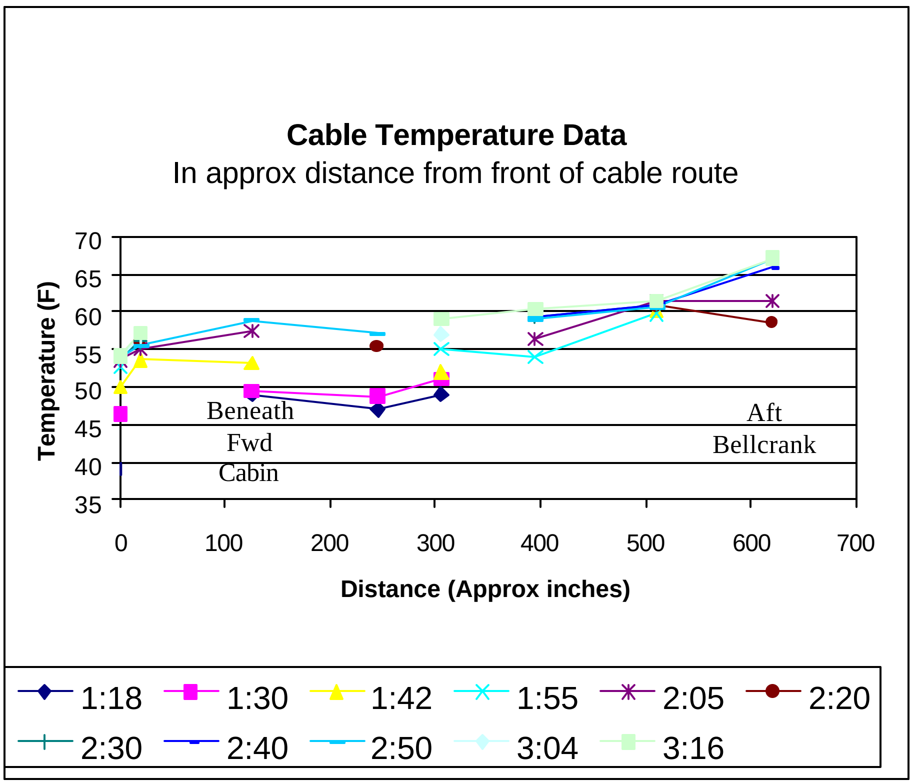


Chart 2. Cable temperature data after hangar door was shut, as collected. Each line/symbol represents a time across the various locations being measured. The "O" on the X-axis (at lower left of chart) represents OAT data.

The data in the spreadsheet was used to create "best-fit" fill for the blank data entries to smooth the data for charting. An overall three-dimensional model was created from the data and the fill-data was entered to create the smoothest surface. (Ref. Chart 3) Individual data ranges were also plotted. (Ref. Charts 4-10) and averages established (Ref. Chart 11).

Note: The fill values are depicted by italics in the attached spreadsheet and do not contain the letter for a corresponding temperature measurement device.

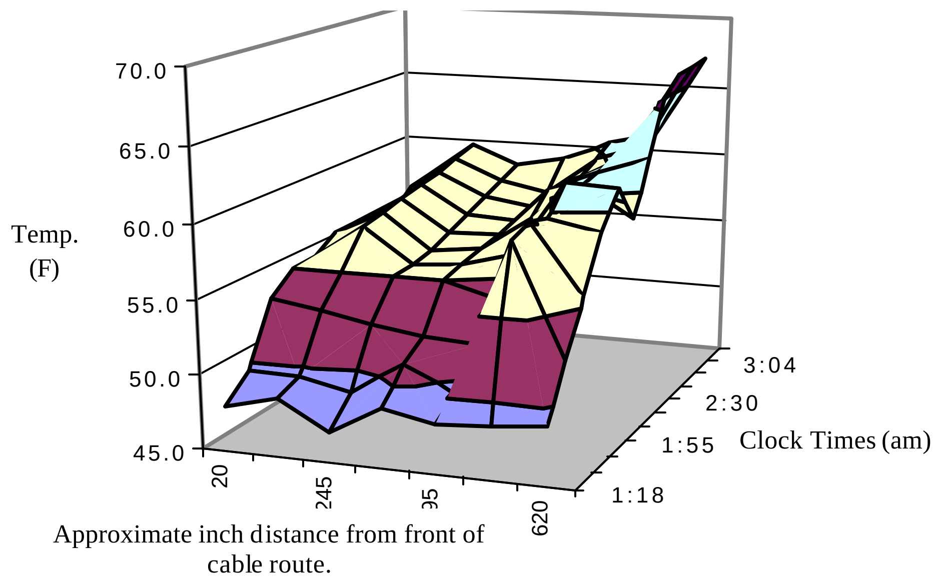


Chart 3. Three dimensional surface plot of temperature data. This chart includes fill-data for smoothing.

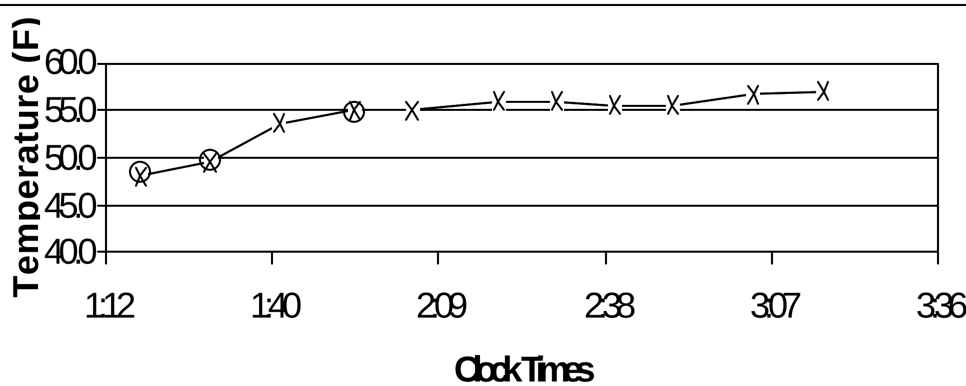


Chart 4. Cable temperature beneath cockpit, about 20 inches from front of cable route. Circled points denote fill data.

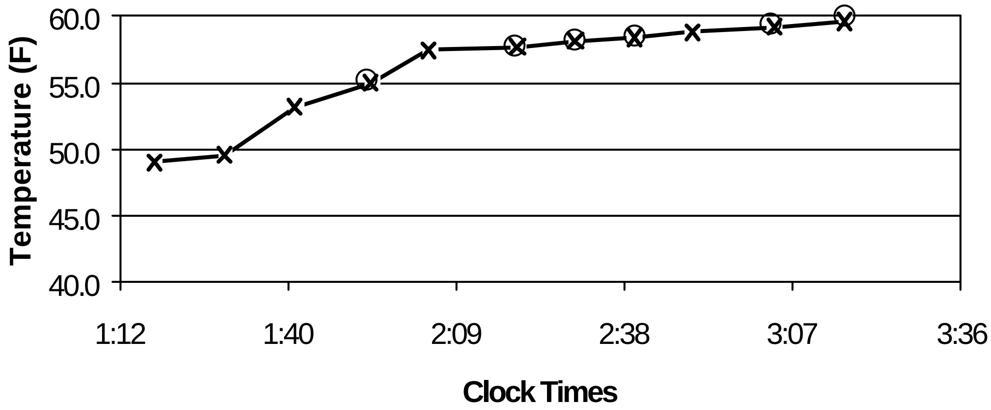


Chart 5. Cable temperature beneath forward cabin, about 125 inches from front of cable route. Circled points denote fill data.

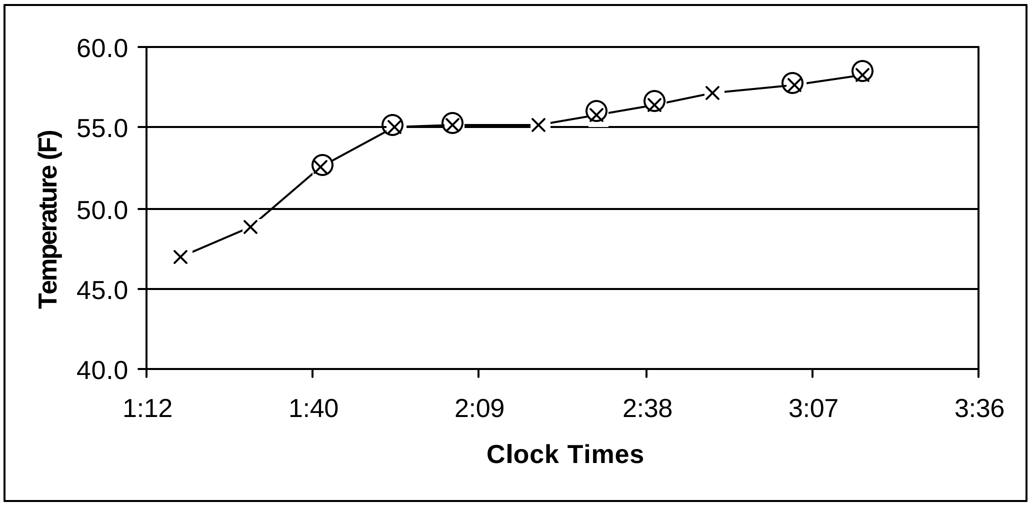


Chart 6. Cable temperature beneath mid cabin, about 245 inches from front of cable route. Circled points denote fill data.

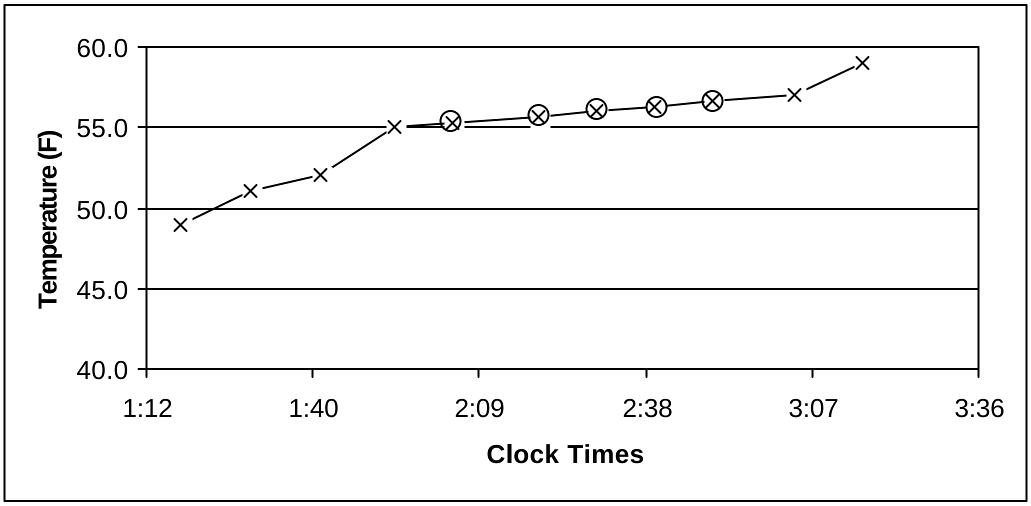


Chart 7. Cable temperature beneath aft cabin, about 305 inches from front of cable route. Circled points denote fill data.

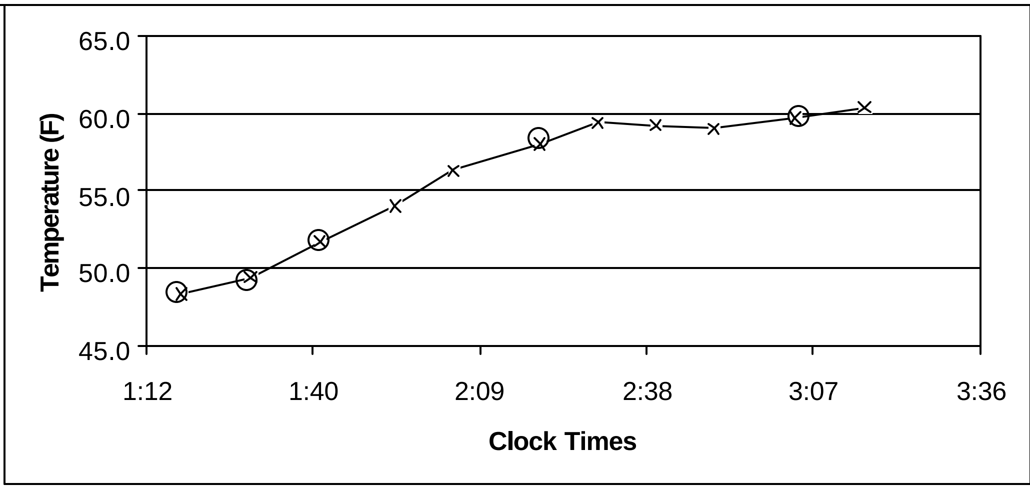


Chart 8. Cable temperature beneath cargo compartment, about 395 inches from front of cable route. Circled points denote fill data.

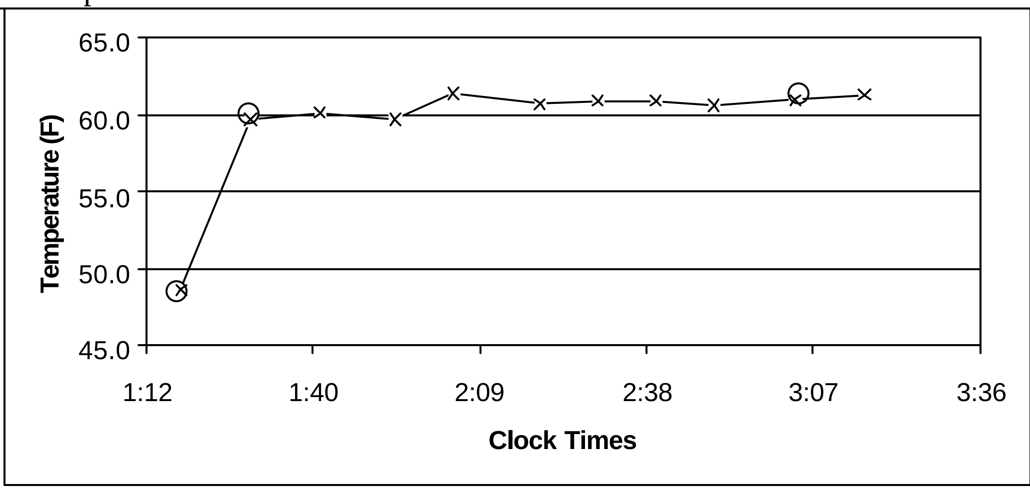


Chart 9. Cable temperature at turnbuckles in aft fuselage, about 510 inches from front of cable route. Circled points denote fill data.

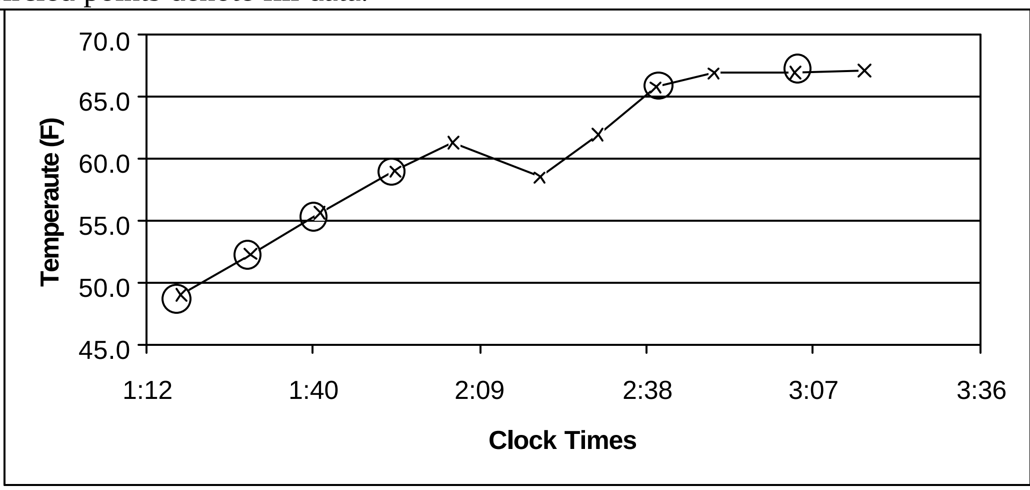


Chart 10. Cable temperature at aft bellcrank at top of tail, about 620 inches from front of cable route. Circled points denote fill data.

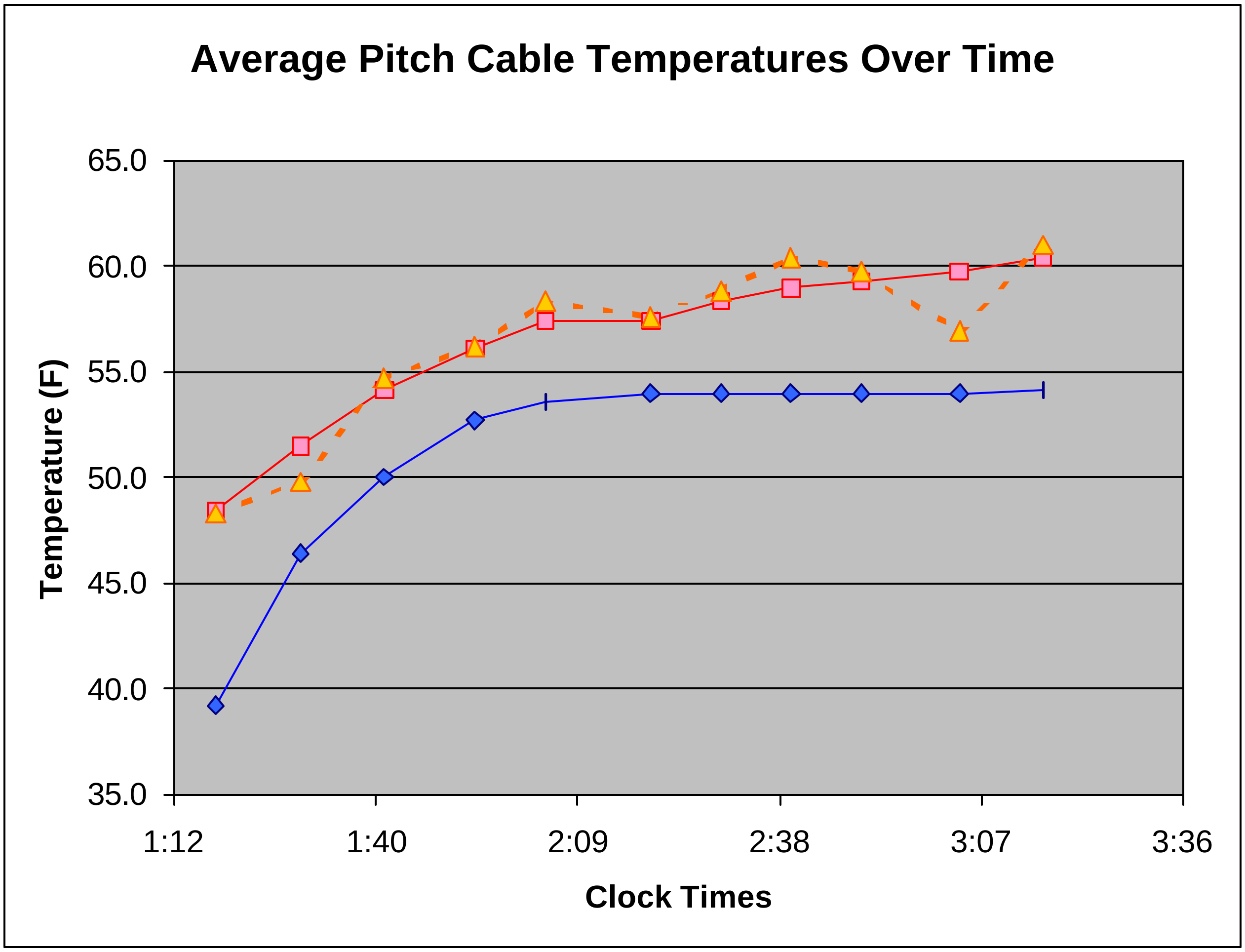


Chart 11. Average cable temperatures for basic data and smoothed data, shown with OAT data. The dashed line and triangles represent averages of collected data. The red solid line with squares represents smoothing of the same data. The lower line with diamonds represents OAT temperatures from the installed gauge.

OUTSIDE AIR TEMPERATURE GAUGE LOCATIONS

The installed OAT gauge is installed on the left side of the fuselage, near the steel hangar door. (Ref. Photograph 5)

Photograph 5. Installed OAT gauge, beneath Captain's side window. The air-stair is at the right edge of the photograph.

Following collection of data, a person who had been present at the time of the January 6, 2003 maintenance on UE-233 (the accident airplane) provided a hand-written paper (copy attached as ref. 6), stating that:

> 2-25-03
>
> At the time the cable tensions were adjusted on A/C 233 the OAT gage reading was taken while it was laying on the top shelf of the podium. The podium was located at the nose of the A/C approximately 6 ft from the right avionics bay door.
>
> [Signature]
> George A. States

Following receipt of the statement, the podium was placed in the location specified by Mr. States (in his presence) and the spare OAT gauge was laid on top. The NTSB digital thermometer was placed next to the spare OAT gauge and the OAT read about 13.5C (56.3F) while the digital display read 56.8 degrees Fahrenheit. (Ref. Photograph 6) The installed OAT display was 1.8C to 2.0C (3.6F) cooler than the spare OAT at 02:50am and 03:04am.

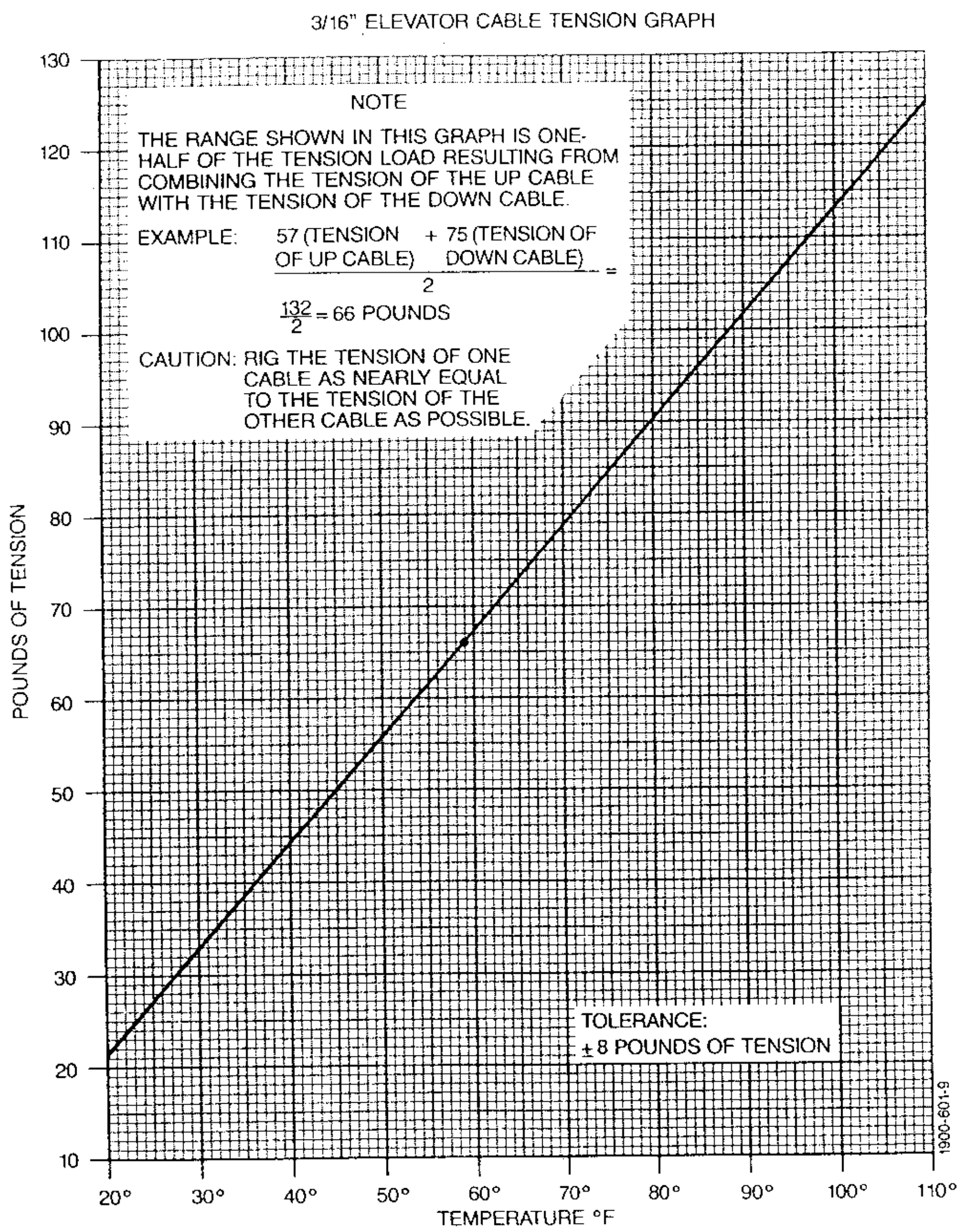
Photograph 6. Spare OAT and digital thermometer on podium at 04:00am. The proximity of the fuselage and air-stair referenced in previous photo to the steel hangar door is visible in background.

Attachments

1. Spreadsheet of data and sources for the temperatures.
2. Raytheon Aircraft Beech 1900D Airliner Maintenance Manual, 27-30-02, Page 207, Feb 22/02, Figure 203 – Elevator Cable Tension Graph.
3. Raytheon Aircraft Beech 1900D Airliner Maintenance Manual, 27-10-03-201, Page 3, Revision 7, December 2002, AILERON CONTROL RIGGING – MAINTENANCE PRACTICES.
4. Advisory Circular (AC) 43.13-1B, Paragraph 7-153 CABLE TENSION ADJUSTMENT.
5. Air Midwest Temperature Conversion Chart.
6. Handwritten statement of 2-25-03, by Mr. George States.

Attachment 1. Spreadsheet of data and sources for the temperatures.

Notes:	CLOCK TIMES	Installed OAT gauge (Celcius)	Installed OAT temp converted to F	Sub-floor, beneath cockpit	Sub-floor, beneath fwd cabin	Sub-floor, beneath mid cabin	Sub-floor beneath aft cabin	Under cargo comptmnt (open door & floor)	Tail cone (Trnbckls)	Aft bellcrank	Average of basic data set, before adding to smooth charts.	Average of values with data added to smooth charting.	Top of first seat in cabin (height of mid-window)	Top of last seat (not bench)
Fuselage Station (Approximate) ==>				115	220	340	400	490	605	650			225	423
Distance from front of cable route (approx.) ==>			**0**	20	125	245	305	395	510	620			(Not Applicable)	
Engines running & cabin heat on.	0:44	0	32.0	No access to area.	35.6 d	34.9 b	38.5 m	Engines running & cabin heat on. Locations not accessible for measurement.					44.4 d	
	0:55				54.7 d	49.0 b	50.0 m							
	1:05	-10	14.0		59.5 d	56.3 b	63.0 m						78.4 d	81.3 b
	1:10	Stopped the engines at the hangar.												
	1:16	Airplane in hangar and the hangar doors were shut.												
	1:18	4	39.2	48 f	49 d	47 b	49 m	48.3 f	48.6 f	49 f	48.3	48.4		
	1:30	8	46.4	49.5 f	49.5 d	48.8 b	51 m	49.4 f	59.7 f	52.3 f	49.8	51.5		
	1:42	10	50.0	53.6 d	53.1 d	52.5 f	52 m	51.7 f	60.1 b	55.6 f	54.7	54.09		
65 (L) on toolbox outside of cargo compart.	1:55	11.5	52.7	55 f	55 f	55 f	55 m	54 d	59.7 b	59 f	56.2	56.1		
	2:05	12	53.6	55 m	57.4 d	55.1 f	55.33 f	56.3 d	61.4 b	61.3 r	58.3	57.4		
	2:20	12.2	54.0	56 m	57.7 f	55.2 d	55.66 f	58.05 f	60.7 b	58.5 r	57.6	57.4		
	2:30	12.2	54.0	56 m	58.1 f	55.8 f	55.99 f	59.4 d	60.9 b	62 f	58.8	58.31		
	2:40	12.2	54.0	55.5 m	58.4 f	56.45 f	56.32 f	59.2 d	60.9 b	65.8 r	60.4	58.9		
	2:50	12.2	54.0	55.5 m	58.8 d	57.1 b	56.65 f	59 d	60.6 b	66.9 r	59.7	59.2		
	3:04	12.2	54.0	56.7 b	59.2 f	57.7 f	57 m	59.7 f	60.95 f	67 f	56.9	59.8		
67 (L) on toolbox outside of cargo compart.	3:16	12.3	54.1	57.1 b	59.6 f	58.3 f	59 m	60.4 d	61.3 b	67.1 r	61	67.1		
Ramp temp: 23.5 d 24 L 25 m	3:40	Note: Letters following the data represents source. b=Beech (Previous name for airplane manufacturer.) thermocouple with Fluke multimeter. d= Digital NTSB thermometer. f = Fill data inserted to smooth charting. L= Liquid NTSB thermometer. m = bi-Metallic NTSB thermometer. r = Raytheon Aerospace thermocouple with Fluke multimeter.												



Elevator Cable Tension Graph (Effectivity: All)
Figure 201

AILERON CONTROL RIGGING - MAINTENANCE PRACTICES

AILERON CONTROL SYSTEM RIGGING

CAUTION: IF A FA2100 FLIGHT DATA RECORDER SYSTEM IS INSTALLED ON THIS AIRCRAFT, PERFORM THE LINK ASSEMBLY REMOVAL PORTION OF THE **AILERON SURFACE POSITION SYNCHRO TRANSMITTER (SENSOR) REMOVAL** PROCEDURE. REFER TO **CHAPTER 31-31-13 IN THE BEECH 1900D AIRLINER FLIGHT DATA RECORDER (FA2100) MAINTENANCE MANUAL SUPPLEMENT, P/N 129-590000-109.**

CAUTION: WHERE THE CABLES PASS THROUGH STRUCTURE, THE AREAS OF POSSIBLE CONTACT BETWEEN THE CONTROL CABLES AND ADJACENT STRUCTURE MUST BE PROTECTED WITH GROMMETS, RUB STRIPS, BLOCKS OR GUIDE FAIRINGS. WHERE CONTACT OF CONTROL CABLES DOES OCCUR WITH THE PROTECTIVE ELEMENTS, A FORCE NO GREATER THAN EIGHT (8) OUNCES SHALL BE REQUIRED TO MOVE THE CABLE TO A POSITION OF NO CONTACT. AT NO TIME SHOULD FLIGHT CONTROL CABLES CONTACT METAL STRUCTURE.

NOTE: The aileron/rudder interconnect system must be disconnected before any rigging is started. Do not connect the actuating components of the autopilot until all flight control systems have been properly rigged. This will permit aileron forces to be measured properly.

a. Remove all flight compartment seats (refer to Chapter 25-10-00), carpet (refer to Chapter 25-10-01), and floorboards, and all passenger compartment seats (refer to Chapter 25-20-00), center aisle and left carpet (refer to Chapter 25-20-01) and center aisle and left floorboards (refer to Chapter 6-00-00) forward of the rear spar.

b. If installed, remove the autopilot aileron servo cable from the fuselage quadrant. Refer to Chapter 22-10-03.

c. Install the aileron travel board (1, Chart 1, 27-00-00) at wing station 276.01. All aileron travel measurements will be made with this travel board.

NOTE: With the aileron hinge bolts torqued to the standard value and the control system fully installed, but not tight, the ailerons must move freely throughout the fully up and down range. Refer to Chapter 20-01-00.

d. Place the aileron quadrant in the neutral position and install a rig pin.

e. Tighten the cables between the control column and the quadrant to the tension shown (refer to Figure 201). The pilot's control wheel must be level within ± 1/2° .

f. Tighten the chain and cable assembly between the pilot's and copilot's control wheel to a tension of 10 to 25 pounds. The control wheels must align to within 1/2° of each other.

NOTE: Rigging should be accomplished at a stabilized temperature as close to 59° F as possible. ***DO NOT RIG CABLES WHEN THE AIRPLANE IS UNDER DIRECT SUNLIGHT.***

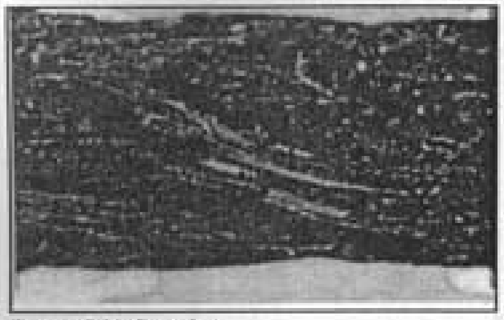


FIGURE 7-21. Corrosion.

7-151. WIRE SPLICES. Standard manufacturing splices have been mistaken for defects in the cable because individual wire end splices were visible after assembly of a finished cable length. In some instances, the process of twisting outer strands around the core strand may also slightly flatten individual outer wires, particularly in the area of a wire splice. This flattening is the result of die-sizing the cable, and does not affect the strength of the cable. These conditions (as shown in figure 7-22) are normal, and are not a cause for cable rejection.

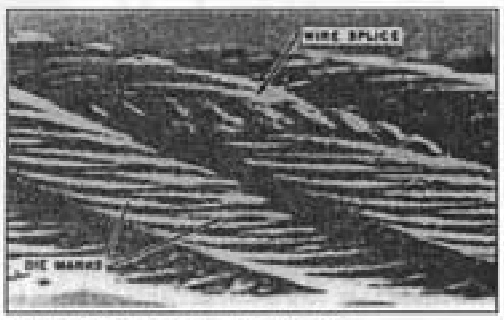


FIGURE 7-22. Manufacturer's wire splice.

7-152. CABLE MAINTENANCE. Frequent inspections and preservation measures such as rust-prevention treatments for bare carbon steel cable areas, will help to extend cable service life. Where cables pass through fair-leads, pressure seals, or over pulleys, remove accumulated heavy coatings of corrosion-prevention compound. Provide corrosion protection for these cable sections by lubricating with a light coat of grease or general-purpose, low-temperature oil.

7-153. CABLE TENSION ADJUSTMENT. Carefully adjust, control cable tension in accordance with the airframe manufacturer's recommendations. On large aircraft, take the temperature of the immediate area into consideration when using a tension meter. For long cable sections, use the average of two or three temperature readings to obtain accurate tension values. If necessary, compensate for extreme surface temperature variations that may be encountered if the aircraft is operated primarily in unusual geographic or climatic conditions such as arctic, arid, or tropic locations. Use rigging pins and gust locks, as necessary, to ensure satisfactory results. At the completion of rigging operations, check turnbuckle adjustment and safetying in accordance with section 10 of this chapter.

7-154.—7-164. [RESERVED.]

Air Midwest, Inc.
Standard Procedure FO-19
BEECH Model 1900 Performance Data

TEMPERATURE CONVERSION CHART

C	C or F	F	C	C or F	F	C	C or F	F	C	C or F	F
-40.0	-40	-40.0	-17.2	1	33.8	5.6	42	107.6	28.3	83	
-39.4	-39	-38.2	-16.7	2	35.6	6.1	43	109.4	28.9	84	
-38.9	-38	-36.4	-16.1	3	37.4	6.7	44	111.2	29.4	85	
-38.3	-37	-34.6	-15.6	4	39.2	7.2	45	113.0	30.0	86	
-37.8	-36	-32.8	-15.0	5	41.0	7.8	46	114.8	30.6	87	
-37.2	-35	-31.0	-14.4	6	42.8	8.3	47	116.6	31.1	88	
-36.7	-34	-29.2	-13.9	7	44.6	8.9	48	118.4	31.7	89	
-36.1	-33	-27.4	-13.3	8	46.4	9.4	49	120.2	32.2	90	
-35.6	-32	-25.6	-12.8	9	48.2	10.0	50	122.0	32.8	91	
-35.0	-31	-23.8	-12.2	10	50.0	10.6	51		33.3	92	
-34.4	-30	-22.0	-11.7	11	51.8	11.1	52		33.9	93	
-33.9	-29	-20.2	-11.1	12	53.6	11.7	53		34.4	94	
-33.3	-28	-18.4	-10.6	13	55.4	12.2	54		35.0	95	
-32.8	-27	-16.6	-10.0	14	57.2	12.8	55		35.6	96	
-32.2	-26	-14.8	-9.4	15	59.0	13.3	56		36.1	97	
-31.7	-25	-13.0	-8.9	16	60.8	13.9	57		36.7	98	
-31.1	-24	-11.2	-8.3	17	62.6	14.4	58		37.2	99	
-30.6	-23	-9.4	-7.8	18	64.4	15.0	59		37.8	100	
-30.0	-22	-7.6	-7.2	19	66.2	15.6	60		38.3	101	
-29.4	-21	-5.8	-6.7	20	68.0	16.1	61		38.9	102	
-28.9	-20	-4.0	-6.1	21	69.8	16.7	62		39.5	103	
-28.3	-19	-2.2	-5.6	22	71.6	17.2	63		40.0	104	
-27.8	-18	-0.4	-5.0	23	73.4	17.8	64		40.6	105	
-27.2	-17	1.4	-4.4	24	75.2	18.3	65		41.1	106	
-26.7	-16	3.2	-3.9	25	77.0	18.9	66		41.7	107	
-26.1	-15	5.0	-3.3	26	78.8	19.4	67		42.2	108	
-25.6	-14	6.8	-2.8	27	80.6	20.0	68		42.8	109	
-25.0	-13	8.6	-2.2	28	82.4	20.6	69		43.3	110	
-24.5	-12	10.4	-1.7	29	84.2	21.1	70		43.9	111	
-23.9	-11	12.2	-1.1	30	86.0	21.7	71		44.4	112	
-23.3	-10	14.0	-0.6	31	87.8	22.2	72		45.0	113	
-22.8	-9	15.8	0.0	32	89.6	22.8	73		45.6	114	
-22.2	-8	17.6	0.6	33	91.4	23.3	74		46.1	115	
-21.7	-7	19.4	1.1	34	93.2	23.9	75		46.7	116	
-21.1	-6	21.2	1.7	35	95.0	24.4	76		47.2	117	
-20.5	-5	23.0	2.2	36	96.8	25.0	77		47.8	118	
-20.0	-4	24.8	2.8	37	98.6	25.6	78		48.3	119	
-19.4	-3	26.6	3.3	38	100.4	26.1	79		48.9	120	
-18.9	-2	28.4	3.9	39	102.2	26.7	80		49.5	121	
-18.3	-1	30.2	4.4	40	104.0	27.2	81		50.0	122	
-17.8	0	32.0	5.0	41	105.8	27.8	82				

Converting °F to °C - Enter C or F column with °F, read left for °C.

Converting °C to °F - Enter C or F column with °C, read right for °F.

2-25-03

At the time the cable tensions were adjusted on A/C 233 the OAT gage reading was taken while it was laying on the top shelf of the podium. The podium was located at the nose of the A/C ~~to~~ ~~the~~ approximately 6 ft ~~to the right~~ from the right avionics bay door.

[signature]

George A. Slates