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Mr. D. L. Riggin
Manager, ANM-100S
Department of Transportation
Federal Aviation Administration
Seattle Aircraft Certification Office
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Renton, WA 98055-4056

BOEING

Dear Mr. Riggin:

Subject: **RA164 Center Wing Tank Wire Bundle Analysis (Revised) - TWA Flight 800 Accident Investigation**

References: (a) Boeing Letter B-T113-96-3442, October 31, 1996

(b) FAA Letter 96-130S-935, November 13, 1996

The reference (a) analysis has been revised to include wire bundles W350, W066 and W144 as requested by reference (b). The reference (a) table for wire bundle W186 was also revised. A summary of the wire bundles and voltages follows.

The purpose of this analysis was to identify all voltage carrying wires routed together with the center wing tank fuel quantity wire bundle. This information is tabulated in the enclosed pages.

A review of the airplane production illustration drawings showed that no other system wires are routed with the center tank fuel quantity bundle from the flight engineer's panel to the center tank (W480). The locations that other system wires are routed with the center tank are as follows:

- Flight engineer panel internal bundle (W186)
- Between flight deck and electronics equipment shelf (W350, W066)
- Refuel panel internal bundle (W144)

A list was generated for the W186, W144, W350 and W066 wire bundles showing all affected ATA chapters which have wires in the center tank Fuel Quantity Indicating System wire bundle; from that list all of the affected system wire diagrams were acquired. Each system wire diagram was analyzed and the following information was tabulated:

System	System with potential hot wire(s)
Wire Diagram	ATA reference
Threat Voltage	Threat source voltage
Threat C/B	States the circuit breaker nomenclature and number

C/B Rating	Threat circuit breaker rating in Amperes
Wire Number	Identifies wire numbers of potential hot wires
Threat Condition	Configuration requirement for hot wires

Note that this was a worst case bundle analysis since it is assumed that all wires in the bundle are at some point physically routed with the center wing tank wires.

A summary of the analysis is shown in the following table:

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Bundle	Voltage	Number of Conductors
W186	28 VDC	115
	12 VDC	5
	28 VAC	21
	115 VAC	33
	5 VAC	46
	192VAC	12
	26 VAC	12
	4.91 VAC	4
W144	115 VAC	8
	5 VAC	8
	28 VDC	42
	Seeking ground	1
	Signal Wire	7
W350	115 VAC	9
	5 VAC	3
	28 VDC	21
	4.91 VDC	3
	Seeking ground	4
	Signal Wire	15
W066	115 VAC	6
	5 VAC	4
	40 VAC	8
	28 VDC	24
	4.91 VDC	4
	Seeking ground	4
	Signal Wire	33

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Very truly yours,

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RPH

Enclosures

A. TWA RA164 Center Wing Tank Bundle Analysis, P4 Flight Engineer Panel Bundle (W186) 20 pages

B. TWA RA164 Center Wing Tank Bundle Analysis, Bundle (W144) 10 Pages

C. TWA RA164 Center Wing Tank Bundle Analysis, Bundle (W350) 5 pages

D. TWA RA164 Center Wing Tank Bundle Analysis, Bundle (W066) 10 pages

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Generator Drive - Oil Temperature Indicators	24-11-21	28 VDC	CSC Disc. No. 1 (C377)	5	1D1-24 1D2-24 1D3-24	Signal from N1 Oil temp Indicator to CSD generator.
Generator Drive - Oil Temperature Indicators	24-11-21	28 VDC	CSC Disc. No. 2 (C378)	5	2D1-24 2D2-24 2D3-24	Signal from N1 Oil temp Indicator to CSD generator.
Generator Drive - Oil Temperature Indicators	24-11-21	28 VDC	CSC Disc. No. 3 (C379)	5	3D1-24 3D2-24 3D3-24	Signal from N1 Oil temp Indicator to CSD generator.
Generator Drive - Oil Temperature Indicators	24-11-21	28 VDC	CSC Disc. No. 4 (C380)	5	4D1-24 4D2-24 4D3-24	Signal from N1 Oil temp Indicator to CSD generator.
Fire Detection - Master Warning and Reset	26-11-61	28 VDC	Fire Warning Test (C428)	2.5	W549-20	Fire or Loop Fault NOT detected
Fire Protection - Wheel Well Warning	26-17-11	28 VDC 28 VAC	Fire Detection Control Elec Module Fire Detection Control Elec Module	Regulated Output from Detector Card	W210-22 W213-22	Loop Fault detected Loop monitoring voltage
Overheat Detection - Wing Leading Edge	26-18-11	28 VDC	Engr Ind Lights (C579)	5	W476-22R W470-22R	Overheat NOT detected in Right wing.
Overheat Detection - Wing Leading Edge	26-18-11	28 VDC	Engr Ind Lights (C579)	5	W481-22R W483-22R	Overheat NOT detected in Left wing.
Fuel Scavenge Pump	28-15-11	28 VDC	Scavenge Pump Control (C292)	1	Q533-20	Directly downstream of threat C/B
Fuel Transfer Valves	28-16-11	28 VDC	1 and 4 Fuel Reserve Transfer Valves (C82)	7.5	Q88-20 Q90-20	No. 1 reserve valve commanded open No. 1 reserve valve commanded closed

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Transfer Valves	28-16-11	28 VDC	1 Main Fuel Transfer Valves (C83)	2.5	Q97-20 Q98-20 Q693-20	No. 1 main transfer valve commanded open No. 1 main transfer valve commanded closed Directly downstream of threat C/B
Fuel Quantity - AC and DC Power	28-21-11	115 VAC	Fueling Gauges (C94)	2.5	Q242-22	C685 C/B primary power open
Fuel Quantity - AC and DC Power	28-21-11	115 VAC	Fueling Gauges (C685)	2.5	Q242-22	C685 C/B primary power Closed
Engine Fuel Shut Off Control	28-22-11	28 VDC	Engine 1 Fuel Shut Off Valve (C35)	5	Q1Q2-20 Q1Q3-20	Engine 1 fuel shut off valve commanded open Engine 1 fuel shut off valve commanded closed or Fire switch to "Fire"
Engine Fuel Shut Off Control	28-22-11	28 VDC	Engine 2 Fuel Shut Off Valve (C36)	5	Q2Q2-20 Q2Q3-20	Engine 2 fuel shut off valve commanded open Engine 2 fuel shut off valve commanded closed or Fire switch to "Fire"
Fuel Crossfeed Valves	28-22-21	28 VDC	No. 1 Crossfeed Valve (C76)	5	1Q28-20 1Q29-20	No. 1 crossfeed valve commanded open No. 1 crossfeed valve commanded closed

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Crossfeed Valves	28-22-21	28 VDC	No. 1 Crossfeed Valve (C77)	5	2Q28-20 2Q29-20	No. 2 crossfeed valve commanded open No. 2 crossfeed valve commanded closed
Fuel Boost Pumps 1 & 2 AFT, 3 & 4 FWD	28-22-31	28 VDC	No. 1 AFT and No. 4 FWD Boost Pump Control (C454)	2.5	Q482-22 Q483-22 Q486-22	Directly downstream of threat C/B No. 1 Main Aft Boost Pump commanded on No. 4 main Fwd Boost Pump commanded on
Fuel Boost Pumps 1 & 2 AFT, 3 & 4 FWD	28-22-31	28 VDC	No. 2 AFT and No. 3 FWD Boost Pump Control (C560)	2.5	Q484-22 Q495-22 Q485-22	Directly downstream of threat C/B No. 2 Main Aft Boost Pump commanded on No. 3 main Fwd Boost Pump commanded on
Fuel Boost Pumps 1 & 2 AFT, 3 & 4 FWD	28-22-31	28 VDC	No. 2 Main AFT Boost Pump Control (C561)	2	Q495-22	Ground handling bus on, and No. 2 Main Aft Boost Pump commanded on

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Jettison Valves	28-31-11	28 VDC	Jettison and Nozzle Valves - L - Ctr (C85)	7.5	Q531-20 Q93-20 Q94-20 Q304-20 Q305-20	Directly downstream of threat C/B L Center Wing Jettison valve commanded open L Center Wing Jettison valve commanded closed L Jettison Nozzle valve commanded open L Jettison Nozzle valve commanded closed
Fuel Jettison Pumps	28-31-21	28 VDC	Ctr left Jett-Ovrd Pump Control (1071)	2.5	Q475-22 Q476-22	Directly downstream of threat C/B Ctr Wing Ovrd/Jett Pump Left commanded on
Fuel Jettison Pumps	28-31-21	28 VDC	No. 2 & No. 3 Outbd Jett Pump Control (C19)	5	Q472-20 Q473-20 Q474-22	Directly downstream of threat C/B No. 2 outbd Jett pump commanded on No. 3 outbd Jett Pump commanded on

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Fanel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Quantity Gages Signal 2	28-41-12	----------	No Direct C/B Voltage Source From N45 Total Fuel Indicator	----------	Q608-20 Q613-20 Q618-20 Q623-20 Q628-20 Q633-20 Q638-20	Signal Wire Between Total Fuel Indicator and Volumetric Shut - off Unit
Fuel Quantity Gages - Power	28-41-13	115 VAC	Fueling Gauges (C685) or Fueling Gauges (C94)	2.5 2.5	Q243-22 Q753-22 Q752-22 Q750-22 Q749-22 Q748-22 Q747-22 Q746-22 Q745-22	Either Primary (C685) or Alternate (C94) Connect directly downstream.
Hyd Fluid Shut Off and Pump Depress - Sys 1 and 2	29-11-11	28 VDC	Depressurization Valve - EDP 1 (C15)	5	1M16-20 1M17-20	Engine 1 fire switch in "Normal" position Engine 1 fire switch in "Normal" position and Sys 1 Hydraulic Control in "Depress" position

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Hyd Fluid Shut Off and Pump Depress - Sys 1 and 2	29-11-11	28 VDC	EDP HYD, Supply (C1)	5	1M18-20 1M297-20 1M19-20	Engine 1 fire switch in "Normal" position Engine 1 fire switch in "Normal" position and Sys 1 Hydraulic Control in "Normal or Depress" position Engine 1 fire switch in "Normal" position and Sys 1 Hydraulic Control in "Off" position
Pneumatic Drive - Hydraulic Control	29-11-21	28 VDC	ADP No. 1 Control (C489)	5	1M292-20 1M252-20 1M253-20	Directly downstream of threat C/B Sys 1 Hydraulic control switch in "AUTO" position Sys 1 Hydraulic control switch in "CONT" position
Hydraulic Fluid Pressure Indicators	29-31-11	----------	Hydraulic Press N5	Milli Amp	1D222-20 1D28-20	Input Signal Wire to IND-Sys Hydraulic press (N5)
Hydraulic Fluid Pressure Indicators	29-31-11	28 VAC	Hydraulic Pressure Ind 1 (C5)	5	D1037-20 1D136-20 1D30-20	Directly downstream of threat C/B
Hydraulic Fluid quantity Indicators - System 1 and 2	29-33-11	115 VAC	Hyd Fluid Qty Ind (C1114)	2.5	D214-22 1D211-22 2D211-22	Ground handling bus on, Directly downstream of threat C/B

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Hydraulic Fluid quantity Indicators - System 1 and 2	29-33-11	----------	No direct C/B, Voltage Source from M171 Module System No.1 Hydraulic Control	----------	1D209-22 1D207-22 1D206-22 1D208-22 1D204-22 1D205-22 1D210-22	Signal Wire between M171 Module System No.1 Hydraulic control and T401 Transmitter Hydraulic System 1 Quantity
Hydraulic Fluid Low Pressure Lights - System 1 and 2	29-34-11	28 VDC	EDP 1 Low Press Cont (C271)	2.5	1M269-20	Directly downstream of threat C/B
Landing Gear - Primary Display	32-61-11	28 VDC	Landing Gear Lever Lock (C1435)	2	G710-22	Directly downstream of threat C/B
Background and Floodlights - Flight Engr Panel	33-13-21	115 VAC	Engineers Fluorescent Background Lt (C110)	2.5	L1307-22 L1332-22 L1292-22 l1293-22 L1334-22	Directly downstream of threat C/B Dimmer off Storm SW is on OR Storm SW is off and Dimmer is off.
Background and Floodlights - Flight Engr Panel	33-13-21	192 VAC	No Direct C/B Voltage Source From Ballast M322	----------	L1303-22R L1304-22B L1305-22R L1306-22B	Storm SW is on OR Storm SW is off and Dimmer is off.
Background and Floodlights - Flight Engr Panel	33-13-21	192 VAC	No Direct C/B Voltage Source From Ballast M283	----------	L1295-22R L1296-22B L1297-22R L1298-22B	Storm SW is on OR Storm SW is off and Dimmer is off.

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Background and Floodlights - Flight Engr Panel	33-13-21	192 VAC	No Direct C/B Voltage Source From Ballast M72	----------	L1299-22R L1300-22B L1301-22R L1302-22B	Storm SW is on OR Storm SW is off and Dimmer is off.
Background and Floodlights - Flight Engr Panel	33-13-21	0 to 28 VDC	Engineers Background Lt (C108)	2.5 at full Scale 2.5	L1308-16 24L1310-16 L1331-24	Through to the Light control transformer Directly downstream of threat C/B
Instrument Panel Lights - Engr Lower Console P4	33-12-31	5 VAC	T164 Secondary (C1178)	5	L962-20 L968-20 L970-20 L972-20 L974-20 L976-20 L978-20 L980-20 L990-20 L992-20 L966-20	Directly downstream of threat C/B
Instrument Panel Lights - Engr Lower Console P4	33-12-31	5 VAC	T164 Secondary (C1168)	5	L996-20 L998-20 L1000-20 L1002-20 L1004-20 L1006-20 L935-20 L938-20 L940-20 L942-20 L960-20 L937-20	Directly downstream of threat C/B

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Instrument Panel Lights - Engr Lower Console P4	33-12-31	5 VAC	T164 Secondary (C1176)	5	L952-20 L901-20 L944-20 L853-20 L851-20	Directly downstream of threat C/B
Instrument Panel Lights - Engr Upper Console P4	33-12-11	0 to 5 VRMS	No Direct C/B Voltage Source from Light Dimmer T164	7 MA	L657-22	Between M187 LT Cont and Light Dimmer T164,
Instrument Panel Lights - Engr Lower Console P4	33-12-31	5 VAC	T164 Secondary (C1167)	5	L1009-20 L906-20 L909-20 L911-20 L913-20 L915-20 L917-20 L919-20 L921-20 L923-20 L925-20 L927-20 L929-20 L931-20	Directly downstream of threat C/B
Master Dim and Test Indicator Lights - Engr Lower Pnl	33-12-41	28 VDC	Flight Engineers Warning Lights A (C348)	2.5	L1056-22 L1070-22	Directly downstream of threat C/B
Master Dim and Test Indicator Lights - Engr Lower Pnl	33-12-41	28 VDC	Flight Engineers Warning Lights B (C27)	2.5	L1055-22 L1071-22 L5665-22 L7695-22 L1078-22	Directly downstream of threat C/B

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Master Dim and Test Indicator Lights - Engr Lower Pnl	33-12-41	28 VDC	Flight Engineers Warning Lights C (C1064)	2.5	L1079-22 L1058-22	Directly downstream of threat C/B
Master Dim and Test Indicator Lights - Engr Lower Pnl	33-12-41	28 VDC	Flight Engineers Warning Lights C (C1065)	2.5	L1083-22	Directly downstream of threat C/B
Master Dim and Test Indicator Lights - Engr Lower Pnl	33-12-41	28 VDC	Engr Dim & Test Cont (C578)	5	L1066-22	Engineer panel lights NOT in DIM mode
Master Dim and Test Indicator Lights - Engr Lower Pnl	33-12-41	28 VDC	Engr Ind Lights (C1117)	5	L1074-22	Engineer panel Master Dim and Test Switch in TEST mode
Master Dim and Test Indicator Lights - Engr Lower Pnl	33-12-41	28 VDC	Engr Ind Lights (C310)	5	L1123-22 L1184-22 L1081-22	Engineer panel Master Dim and Test Switch in TEST mode Directly downstream of threat C/B Engineer panel lights NOT in DIM mode
Master Dim and Test Indicator Lights - Engr Lower Pnl	33-12-41	12 VDC	No Direct C/B Voltage From Dimmer Assy	----------	L6019-22 1065-22 1080-22 L5666-22	Engineer panel lights in DIM mode
Master Dim and Test Indicator Lights - Engr Lower Pnl	33-12-41	28 VDC	Engr Ind Lts (C579)	5	L1064-22 L1075-22 L1092-22	Directly downstream of threat C/B, and Engineer panel lights NOT in DIM mode
Master Dim and Test Indicator Lights - Engr Upper Pnl	33-12-42	28 VDC	Engr Ind Lts (C579)	5	L1099-22	Directly downstream of threat C/B

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Master Dim and Test Indicator Lights - Engr Ctr Pnl (Cont)	33-12-45	28 VDC	Engr Dim & Test Cont (C578)	5	L1089-22 L1066-22	Engineer panel lights NOT in DIM mode
Master Dim and Test Indicator Lights - Engr Ctr Pnl (Cont)	33-12-45	28 VDC	Engr Ind Lights (C1117)	5	L6681-22 L1074-22	Engineer panel Master Dim and Test Switch in TEST mode
Master Dim and Test Indicator Lights - Engr Ctr Pnl (Cont)	33-12-45	28 VDC	Flight Engineers Warning Lights A (C348)	2.5	L1171-22	Directly downstream of threat C/B
Master Dim and Test Indicator Lights - Engr	33-12-46	28 VDC	Engr Ind Lts (C1065)	5	L5876-22	Directly downstream of threat C/B
Accessory Lights - Upper Deck - Lavatory and Crew	33-13-41	28 VAC	Map And Utility Lights (C116)	5	L1821-22 L1822-22 L1823-22	Directly downstream of threat C/B
Pushbutton Switches - Lighted P4 Panel	33-13-61	12 VDC	No Direct C/B Voltage From Dimmer Assy	----------	L5980-22	Engineer panel lights in DIM mode
Pushbutton Switches - Lighted P4 Panel	33-13-61	28 VDC	ENG. DIM. & Test CONT. (C578)	5A	L4945-22 L4943-22	Fuel Control Module
Valve Control - Pylon Shut off and Pressure Regulating	36-11-11	28 VDC	Bleed Air Valve Engine 1 (C508)	2.5	1H11-20 1H1002-20	Directly downstream of threat C/B No. 1 Bleed Air switch in "CLOSE" position
Valve Control - Pylon Shut off and Pressure Regulating	36-11-11	28 VDC	Bleed Air Valve Engine 2 (C509)	2.5	2H11-20 2H1002-20	Directly downstream of threat C/B No. 2 Bleed Air switch in "CLOSE" position
Valve Control - Pylon Shut off and Pressure Regulating	36-11-11	28 VDC	Bleed Air Valve Engine 3 (C510)	2.5	3H1002-20	No. 3 Bleed Air switch in "CLOSE" position

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Valve Control - Pylon Shut off and Pressure Regulating	36-11-11	28 VDC	Bleed Air Valve Engine 4 (C511)	2.5	4H1002-20	No. 4 Bleed Air switch in "CLOSE" position
Valve Control - Pylon Shut off and Pressure Regulating	36-11-11	28 VDC	Engr Ind Lights (C579)	5	1H1451-22	Valve 1 Pylon PRSOV closed
Valve Control - Pylon Shut off and Pressure Regulating	36-11-11	28 VDC	Engr Ind Lights (C579)	5	2H1451-22	Valve 2 Pylon PRSOV closed
Valve Control - Pylon Shut off and Pressure Regulating	36-11-11	28 VDC	Engr Ind Lights (C579)	5	3H1451-22	Valve 3 Pylon PRSOV closed
Valve Control - Pylon Shut off and Pressure Regulating	36-11-11	28 VDC	Engr Ind Lights (C579)	5	4H1451-22	Valve 4 Pylon PRSOV closed
Valve Control - Wing Isolation	36-11-21	115 VAC	Isolation Valve - Left Hand (C518)	2.5	H672-20 H427-20 H426-20	Directly downstream of threat C/B Isolation Valve Switch S13 in "CLOSE" position Isolation Valve Switch S13 in "OPEN" position
Valve Control - Wing Isolation	36-11-21	115 VAC	Isolation Valve - Right Hand (C519)	2.5	H673-20 H425-20 H424-20	Directly downstream of threat C/B Isolation Valve Switch S14 in "CLOSE" position Isolation Valve Switch S14 in "OPEN" position

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Valve Control - High Stage Bleed	36-11-41	28 VDC	Bleed Air Valve Engine 1 (C508)	2.5	1H1953-20 1H207-20	No. 1 Bleed Air switch in "CLOSE" position
Valve Control - High Stage Bleed	36-11-41	28 VDC	Bleed Air Valve Engine 2 (C509)	2.5	2H1953-20 2H207-20	No. 2 Bleed Air switch in "CLOSE" position
Valve Control - High Stage Bleed	36-11-41	28 VDC	Bleed Air Valve Engine 3 (C510)	2.5	3H1953-20 3H207-20	No. 3 Bleed Air switch in "CLOSE" position
Valve Control - High Stage Bleed	36-11-41	28 VDC	Bleed Air Valve Engine 4 (C511)	2.5	4H1953-20 4H207-20	No. 4 Bleed Air switch in "CLOSE" position
Indicator System - Bleed Air Pressure Relief	36-13-11	28 VDC	Engr Ind Lights (C579)	5	1H208-22 2H208-22 3H208-22 4H208-22	Engine 1 Bleed Air Pressure Relief valve closed Engine 2 Bleed Air Pressure Relief valve closed Engine 3 Bleed Air Pressure Relief valve closed Engine 4 Bleed Air Pressure Relief valve closed
Fuel De-Ice	73-14-11	28 VDC	Eng No. 1 Fuel Heat Valve (C415)	2.5	1H1105-20 1H92-20	Directly downstream of threat C/B Eng 1 Fuel Heat Valve commanded open
Fuel De-Ice	73-14-11	28 VDC	Eng No. 2 Fuel Heat Valve (C417)	2.5	2H1105-20 2H92-20	Directly downstream of threat C/B Eng 2 Fuel Heat Valve commanded open
Fuel De-Ice	73-14-11	28 VDC	Eng No. 3 Fuel Heat Valve (C418)	2.5	3H92-20	Eng 3 Fuel Heat Valve commanded open

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel De-Ice	73-14-11	28 VDC	Eng No. 4 Fuel Heat Valve (C419)	2.5	4H92-20	Eng 4 Fuel Heat Valve commanded open
Fuel Flow Meter - Engine 1 and 2	73-31-11	115 VAC	Eng 1 Fuel Flow (C1278)	1	1E221-22 1E69-22	Directly downstream of threat C/B
Fuel Flow Meter - Engine 1 and 2	73-31-11	4.91 VAC	No Direct C/B From Fuel Flow Module	----------	1E80-22B	Fuel Flow Rate IND Input Signal
Fuel Flow Meter - Engine 1 and 2	73-31-11	5 AC	No Direct C/B From Fuel Flow Module	----------	1E81-22Y	Fuel Flow IND Ref. Voltage
Fuel Flow Meter - Engine 1 and 2	73-31-11	115 VAC	Eng 2 Fuel Flow (C1279)	1	2E221-22 2E69-22	Directly downstream of threat C/B
Fuel Flow Meter - Engine 1 and 2	73-31-11	4.91 VAC	No Direct C/B From Fuel Flow Module	----------	2E80-22B	Fuel Flow Rate IND Input Signal
Fuel Flow Meter - Engine 1 and 2	73-31-11	5 AC	No Direct C/B From Fuel Flow Module	----------	2E81-22Y	Fuel Flow IND Ref. Voltage
Fuel Flow Meter - Engine 3 and 4	73-31-12	115 VAC	Eng 3 Fuel Flow (C1280)	1	3E221-22 3E69-22	Directly downstream of threat C/B
Fuel Flow Meter - Engine 3 and 4	73-31-12	4.91 VAC	No Direct C/B From Fuel Flow Module	----------	3E80-22B	Fuel Flow Rate IND Input Signal
Fuel Flow Meter - Engine 3 and 4	73-31-12	5 AC	No Direct C/B From Fuel Flow Module	----------	3E81-22Y	Fuel Flow IND Ref. Voltage
Fuel Flow Meter - Engine 3 and 4	73-31-12	115 VAC	Eng 4 Fuel Flow (C1281)	1	4E221-22 4E69-22	Directly downstream of threat C/B

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Flow Meter - Engine 3 and 4	73-31-12	4.91 VAC	No Direct C/B From Fuel Flow Module	----------	4E80-22B	Fuel Flow Rate IND Input Signal
Fuel Flow Meter - Engine 3 and 4	73-31-12	5 AC	No Direct C/B From Fuel Flow Module	----------	4E81-22Y	Fuel Flow IND Ref. Voltage
Engine Ignition - Engine 1 and 2	74-31-11	28 VDC (lamp pwr seeking gnd)	Engr Ind Lights (C27)	2.5	J-38-20	Eng 1 or 2 engine ignition lamp on
Vibration Monitor Engine 1 and 2	77-31-11	----------	Output from AVM	500 micro Ampers DC	2E62-11B 2E61-22-R 1E62-22B 1E61-22R	Direct output from AVM module
Vibration Monitor Engine 3 and 4	77-31-12	115 VAC	Engine Vibration (C101)	2.5	E66-22B	Directly downstream of threat C/B
Vibration Monitor Engine 3 and 4	77-31-12	----------	Output from AVM	500 micro Ampers DC	4E62-22B 4E61-22-R 3E62-22B 3E61-22R	Direct output from AVM module
Oil Quantity Indicator-Engine	79-31-11	115 VAC	Engine 1 EPR and Oil Quantity (C41)	2.5	1E192-20	Directly downstream of threat C/B
Oil Quantity Indicator-Engine	79-31-11	----------	No direct C/B voltage source from N14 Engine #1	----------	1E37-20B 1E36-20R	Signal Wire Between Engine No.1 Oil Quantity Compensator & tank Unit. and Indicator
Oil Quantity Indicator-Engine	79-31-11	115 VAC	Engine 2 EPR and Oil Quantity (C42)	2.5	2E192-20	Directly downstream of threat C/B

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Oil Quantity Indicator-Engine	79-31-11	----------	No Direct C/B voltage source from N15 Engine #2	----------	2E37-20B 2E36-20R	Signal Wire Between Engine No.2 Oil Quantity Compensator & tank Unit. and Indicator
Oil Quantity Indicator-Engine	79-31-11	115 VAC	Engine 3 EPR and Oil Quantity (C43)	2.5	3E192-20	Directly downstream of threat C/B
Oil Quantity Indicator-Engine	79-31-11	----------	No Direct C/B voltage source from N16 Engine #3	----------	3E37-20B 3E36-20R	Signal Wire Between Engine No.3 Oil Quantity Compensator & tank Unit. and Engine No.3 Indicator
Oil Quantity Indicator-Engine	79-31-11	115 VAC	Engine 4 EPR and Oil Quantity (C44)	2.5	4E192-20	Directly downstream of threat C/B
Oil Quantity Indicator-Engine	79-31-11	----------	No Direct C/B voltage source from N17 Engine #4	----------	4E37-20B 4E36-20R	Signal Wire Between Engine No.4 Oil Quantity Compensator & tank Unit. and Engine No.4 Indicator
Dual Oil Pressure Indicators - Engine	79-32-11	26 VAC	Engine No. 1 Oil Temp & Press (C49)	1	1E22-22 1E25-22 1E136-22	Directly downstream of threat C/B
Dual Oil Pressure Indicators - Engine	79-32-11	----------	No Direct C/B voltage source from T422 Engine #1	----------	1E129-22	Signal Wire Between Engine No.1 Oil Pressure Transmitter and Indicator.
Dual Oil Pressure Indicators - Engine	79-32-11	26 VAC	Engine No. 2 Oil Temp & Press (C50)	1	2E22-22 2E25-22 2E136-22	Directly downstream of threat C/B

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Dual Oil Pressure Indicators - Engine	79-32-11	---------- -	No direct C/B voltage source from T422 Engine #2	----------	2E129-22	Signal Wire Between Engine No.2 Oil Pressure Transmitter and Indicator.
Dual Oil Pressure Indicators - Engine	79-32-11	26 VAC	Engine No. 3 Oil Temp & Press (C51)	1	3E22-22 3E25-22 3E136-22	Directly downstream of threat C/B
Dual Oil Pressure Indicators - Engine	79-32-11	---------- -	No direct C/B voltage source from T422 Engine #3	----------	3E129-22	Signal Wire Between Engine No.3 Oil Pressure Transmitter and Indicator.
Dual Oil Pressure Indicators - Engine	79-32-11	26 VAC	Engine No. 4 Oil Temp & Press (C52)	1	4E22-22 4E25-22 4E136-22	Directly downstream of threat C/B
Dual Oil Pressure Indicators - Engine	79-32-11	---------- -	No direct C/B voltage source from T422 Engine #4	----------	4E129-22	Signal Wire Between Engine No.4 Oil Pressure Transmitter and Indicator.
Oil Temperature Indicator - Engine	79-34-11	28 VAC	Engine 1 Oil Temp and Press (C49)	1	1E178-22	Directly downstream of threat C/B
Oil Temperature Indicator - Engine	79-34-11	---------- -	No direct C/B voltage source from N18 Engine #1	----------	1E13-20	Signal Wire Between Engine No.1 Oil Temp Bulb and Indicator.
Oil Temperature Indicator - Engine	79-34-11	28 VAC	Engine 2 Oil Temp and Press (C50)	1	2E178-22	Directly downstream of threat C/B
Oil Temperature Indicator - Engine	79-34-11	----------	No direct C/B voltage source from N18 Engine #2	----------	2E13-20	Signal Wire Between Engine No.2 Oil Temp Bulb and Indicator.
Oil Temperature Indicator - Engine	79-34-11	28 VAC	Engine 3 Oil Temp and Press (C51)	1	3E178-22	Directly downstream of threat C/B
Oil Temperature Indicator - Engine	79-34-11	----------	No direct C/B voltage source from N18 Engine #3	----------	3E13-20	Signal Wire Between Engine No.2 Oil Temp Bulb and Indicator.

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Oil Temperature Indicator - Engine	79-34-11	28 VAC	Engine 4 Oil Temp and Press (C52)	1	4E178-22	Directly downstream of threat C/B
Oil Temperature Indicator - Engine	79-34-11	----------	No direct C/B voltage source from N18 Engine # 4	----------	4E13-20	Signal Wire Between Engine No.4 Oil Temp Bulb and Indicator.
Oil Filter Bypass Warning Indicator	79-35-11	28 VDC	Engr Ind Lights (C1065)	5	L5876-22	Lights not in Dim Position
Pressure Indicator - Engine Breather	79-36-11	28 VAC	Eng 1 Breather Pressure (C45)	1	1E16-20 1E19-22 1E20-22	Directly downstream of threat C/B
Pressure Indicator - Engine Breather	79-36-11	----------	No direct C/B voltage source from N34 Engine # 1	----------	1E18-22	Signal Wire Between Engine No.1 Breather Pressure Transmitter and Indicator.
Pressure Indicator - Engine Breather	79-36-11	28 VAC	Eng 2 Breather Pressure	1	2E16-20 2E19-22 2E20-22	Directly downstream of threat C/B
Pressure Indicator - Engine Breather	79-36-11	----------	No direct C/B voltage source from N35 Engine # 2	----------	2E18-22	Signal Wire Between Engine No.2 Breather Pressure Transmitter and Indicator.
Pressure Indicator - Engine Breather	79-36-11	28 VAC	Eng 3 Breather Pressure	1	3E16-20 3E19-22 3E20-22	Directly downstream of threat C/B
Pressure Indicator - Engine Breather	79-36-11	----------	No direct C/B voltage source from N36 Engine # 3	----------	3E18-22	Signal Wire Between Engine No.3 Breather Pressure Transmitter and Indicator.
Pressure Indicator - Engine Breather	79-36-11	28 VAC	Eng 4 Breather Pressure	1	4E16-20 4E19-22 4E20-22	Directly downstream of threat C/B
Pressure Indicator - Engine Breather	79-36-11	----------	No Direct C/B voltage source from N37 Engine # 4	----------	4E18-22	Signal Wire Between Engine No.4 Breather Pressure Transmitter and Indicator.

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

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DESCRIPTION	Drawing Number	Drawing Page Number	Page Number
Generator Drive - Oil Temperature Indicators	24-11-21	1	1
Fire Detection - Master Warning and Reset	26-11-61	2	1
Fire Protection - Wheel Well Warning	26-17-11	5	1
Overheat Detection - Wing Leading Edge	26-18-11	6	1
Fuel Scavenge Pump	28-15-11	7	1
Fuel Transfer Valves	28-16-11	8	1-2
Fuel Quantity - AC and DC Power	28-21-11	9	2
Engine Fuel Shut Off Control	28-22-11	10	2
Fuel Crossfeed Valves	28-22-21	11	2-3
Fuel Boost Pumps 1 & 2 AFT, 3 & 4 FWD	28-22-31	12	3
Fuel Jettison Valves	28-31-11	13	4
Fuel Jettison Pumps	28-31-21	14	4
Fuel Quantity Gages Signal 2	28-41-12	16	5
Fuel Quantity Gages - Power	28-41-13	18	5
Hyd Fluid Shut Off and Pump Depress - Sys 1 and 2	29-11-11	21	5-6
Pneumatic Drive - Hydraulic Control	29-11-21	22	6
Hydraulic Fluid Pressure Indicators	29-31-11	23	6-7
Hydraulic Fluid Low Pressure Lights - System 1 and 2	29-34-11	26	7
Landing Gear - Primary Display	32-61-11	29	7
Background and Floodlights - Flight Engr Panel	33-13-21	63	7-8
Instrument Panel Lights - Engr Lower Console P4	33-12-31	37	8-9
Instrument Panel Lights - Engr Upper Console P4	33-12-11	36	9
Instrument Panel Lights - Engr Lower Console P4	33-12-31	37	9
Master Dim and Test Indicator Lights - Engr Lower Pnl	33-12-41	38	9-10
Master Dim and Test Indicator Lights - Engr Upper Pnl	33-12-42	39	10
Master Dim and Test Indicator Lights - Engr Ctr Pnl (Cont)	33-12-45	40	11
Master Dim and Test Indicator Lights - Engr	33-12-46	41	11
Accessory Lights - Upper Deck - Lavatory and Crew	33-13-41	42	11

TWA RA164 Center Wing Tank Bundle Analysis
P4 Flight Panel Bundle (W186)

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DESCRIPTION	Drawing Number	Drawing Page Number	Page Number
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Valve Control - Pylon Shut off and Pressure Regulating	36-11-11	45	11-12
Valve Control - Wing Isolation	36-11-21	46	12
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Indicator System - Bleed Air Pressure Relief	36-13-11	49	13
Fuel De-Ice	73-14-11	50	13-14
Fuel Flow Meter - Engine 1 and 2	73-31-11	51	14
Fuel Flow Meter - Engine 3 and 4	73-31-12	52	14-15
Engine Ignition - Engine 1 and 2	74-31-11	54	15
Vibration Monitor Engine 1 and 2	77-31-11	55	15
Vibration Monitor Engine 3 and 4	77-31-12	56	15
Oil Quantity Indicator-Engine	79-31-11	58	15-16
Dual Oil Pressure Indicators - Engine	79-32-11	59	16-17
Oil Temperature Indicator - Engine	79-34-11	60	17
Oil Filter Bypass Warning Indicator	79-35-11	61	18
Pressure Indicator - Engine Breather	79-36-11	62	18

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W144)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Quantity AC and DC Power	28-21-11	28 VDC	Fueling Valve (C86)	10	Q230-18	Directly downstream of threat C/B
Fuel Quantity AC and DC Power	28-21-11	28 VDC BAT. BUS	Fueling Valve (C86)	10	Q231-18	Refuel Power Switch is in Battery Position
Ground Refueling Valves-Left Wing.	28-21-21	28 VDC Ground Hand. BUS	Fueling Valves (C90)	10	Q407-16 Q401-16 Q404-16	Fueling Panel Door Open & Standby Power Switch is On, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), and Fuel Tank not at Vol. Shut-off level. OR Standby Switch is off and Refuel Power Switch in Normal Position **On the Ground**
Ground Refueling Valves-Left Wing.	28-21-21	28 VDC BAT. BUS	Fueling Valves (C86)	10	Q407-16 Q401-16 Q404-16	Fueling Panel Door Open & Standby Power Switch is Off, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), Refuel Power Switch in Battery Position and Fuel Tank not at Vol. Shut-off level. **On the Ground**

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W144)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Ground Refueling Valves-Left Wing.	28-21-21	28 VDC GRD Handling BUS	Fueling Valves (C90)	10	Q410-16 Q408-16 Q405-16	Fueling Panel Door Open & Standby Power Switch is On, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), and Refuel Switch in Open Position (S81-S83) and Fuel Tank not at Vol. Shut-off level. OR Standby Switch is off and Refuel Power Switch in Normal Position **On the Ground**
Ground Refueling Valves-Left Wing.	28-21-21	28 VDC BAT. BUS	Fueling Valves (C86)	10	Q410-16 Q408-16 Q405-16	Fueling Panel Door Open & Standby Power Switch is Off, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), Refuel Power Switch in Battery Position , Refuel Switch in Open Position (S81-S83), and Fuel Tank not at Vol. Shut-off level. **On the Ground**

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W144)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Ground Refueling Valves-Left Wing.	28-21-21	28 VDC GRD Handling BUS	Fueling Lights (C1142)	5	Q237-16 Q238-18 Q791-18 Q792-18 Q793-18 Q431-18 Q433-18 Q435-18 Q437-18	Fueling Panel Door Open & Refuel Power Switch in Normal Position
Ground Refueling Valves-Left Wing.	28-21-21	28 VDC BAT. BUS	Fueling Lights (C1143)	5	Q237-16 Q238-18 Q791-18 Q792-18 Q793-18 Q431-18 Q433-18 Q435-18 Q437-18	Fueling Panel Door Open & Refuel Power Switch in Battery Position

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W144)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Ground Refueling Valves-Left Wing.	28-21-21	28 VDC GRD Handling BUS	Fueling Valves (C90)	10	Q402-16	Fueling Panel Door Open & Standby Power Switch is On, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), and Fuel Tank not at Vol. Shut-off level and Reserve Fuel Tank Switch is Open. OR Standby Switch is off and Refuel Power Switch in Normal Position **On the Ground**
Ground Refueling Valves-Left Wing.	28-21-21	28 VDC BAT. BUS	Fueling Valves (C86)	10	Q402-16	Fueling Panel Door Open & Standby Power Switch is On, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), Refuel Power Switch in Battery Position, and Fuel Tank not at Vol. Shut-off level. and Reserve Fuel Tank Switch is Open . **On the Ground**

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W144)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Ground Refueling Valves-Center and Right Wing.	28-21-22	28 VDC GRD Handling BUS	Fueling Valves (C90)	10	Q412-16 Q417-16 Q422-16 Q425-16 Q811-18 Q810-18	Fueling Panel Door Open & Standby Power Switch is On, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), and Fuel Tank not at Vol. Shut-off level. OR Standby Switch is off and Refuel Power Switch in Normal Position **On the Ground**
Ground Refueling Valves-Center and Right Wing.	28-21-22	28 VDC BAT. BUS	Fueling Valves (C86)	10	Q412-16 Q417-16 Q422-16 Q425-16 Q811-18 Q810-18	Fueling Panel Door Open & Standby Power Switch is Off, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), Refuel Power Switch in Battery Position and Fuel Tank not at Vol. Shut-off level. **On the Ground**

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W144)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Ground Refueling Valves-Center and Right Wing.	28-21-22	28 VDC BAT. BUS	Fueling Valves (C86)	10	Q413-16 Q415-16 Q418-16 Q420-16 Q423-16 Q426-16	Fueling Panel Door Open & Standby Power Switch is Off, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), Refuel Power Switch in Battery Position and Fuel Tank not at Vol. Shut-off level. and Refuel Switch in Open Position (S84-S89). **On the Ground**
Ground Refueling Valves-Center and Right Wing.	28-21-22	28 VDC GRD Handling BUS	Fueling Valves (C90)	10	Q413-16 Q415-16 Q418-16 Q420-16 Q423-16 Q426-16	Fueling Panel Door Open & Standby Power Switch is On, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), Refuel Power Switch in Normal Position and Fuel Tank not at Vol. Shut-off level. and Refuel Switch in Open Position (S84-S89). OR Standby Switch is off and Refuel Power Switch in Normal Position **On the Ground**

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W144)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Ground Refueling Valves-Center and Right Wing.	28-21-22	28 VDC GRD Handling BUS	Fueling Lights (C1142)	5	Q794-18 Q795-18 Q796-18 Q797-18 Q798-18 Q799-18 Q439-18 Q441-18 Q443-18 Q445-18 Q447-18 Q449-18	Fueling Panel Door Open & Refuel Power Switch in Normal Position
Ground Refueling Valves-Center and Right Wing.	28-21-22	28 VDC BAT. BUS	Fueling Lights (C1143)	5	Q794-18 Q795-18 Q796-18 Q797-18 Q798-18 Q799-18 Q439-18 Q441-18 Q443-18 Q445-18 Q447-18 Q449-18	Fueling Panel Door Open & Refuel Power Switch in Battery Position

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W144)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Quantity Gages Signal 1	28-41-11	----------	No Direct C/B Voltage Source From Fuel Quantity Indicator	----------	Q642-18 Q643-18 Q644-18 Q645-18 Q641-18 Q640-18 Q639-18	Signal Between Probes and Fuel Quantity Indicator
Fuel Quantity Gages Signal 2	28-41-12	----------	No Direct C/B Voltage Source From Volumetric Shut-off Unit B324	----------	Q646-18	Seeking Ground Through to Test Gage Switch
Fuel Quantity Gages - Power	28-41-13	115 VAC STBY. INV	Fueling Gauges (C685)	2.5	Q361-18 Q362-18 Q363-18 Q364-18 Q365-18 Q366-18 Q367-18 Q368-18	Fueling Panel Door Open & Standby Power Switch is Off. Refueling Power Switch in Battery Position.

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W144)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Quantity Gages - Power	28-41-13	115 VAC GRD SER. XFR. BUS	Fueling Gauges (C94)	2.5	Q361-18 Q362-18 Q363-18 Q364-18 Q365-18 Q366-18 Q367-18 Q368-18	Fueling Panel Door Open & Standby Power Switch is On OR Standby Power Switch is Off. Refueling Power Switch in Normal Position.
Fuel Quantity Gages - Power	28-41-13	5VAC STBY. INV	Fueling Gauges (C685)	2.5	Q353-18 Q354-18 Q355-18 Q356-18 Q357-18 Q358-18 Q359-18 Q360-18	Fueling Panel Door Open & Standby Power Switch is Off. Refueling Power Switch in Battery Position.
Fuel Quantity Gages - Power	28-41-13	5VAC	Fueling Gauges (C94)	2.5	Q353-18 Q354-18 Q355-18 Q356-18 Q357-18 Q358-18 Q359-18 Q360-18	Fueling Panel Door Open & Standby Power Switch is On OR Standby Power Switch is Off. Refueling Power Switch in Normal Position.

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W144)

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DESCRIPTION	Drawing Number	Drawing Page Number	Page Number
Fuel Quantity AC and DC Power	28-21-11	1	1
Ground Refueling Valves-Left Wing	28-21-21	2	1-4
Ground Refueling Valves- Center and Right Wing	28-21-22	3	5-7
Fuel Quantity Gages Signal 1	28-41-11	4	8
Fuel Quantity Gages Signal 2	28-41-12	13	8
Fuel Quantity Gages - Power	28-41-13	15	8-9

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W350)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fire Detection Master Warning and Reset	26-11-61	28 VDC	Fire warning test C428	5	W549-20R	Engine Fire Detector Fault Exists
Fire Detection Master Warning and Reset	26-11-61	28 VDC	Capts. Ind. Lt. (C358)	5	W549-20R	In Test Condition
Leading Edge Flap Annuciator Master Lights	27-88-13	28 VDC	Capts. Ind. Lt. (C613)	5	C334-22 C335-22	
Fuel Quantity AC and DC Power	28-21-11	115 VAC GRD SER XFR BUS	Fuel QTY. GA Refuel (C94)	2.5	Q242-22	Standby Power Switch is On Position **On the Ground**
Fuel Quantity AC and DC Power	28-21-11	115 VAC STBY INV	Fuel QTY. GA Refuel (C685)	2.5	Q242-22	Standby Power Switch is Off Position **On the Ground**
Fuel Quantity AC and DC Power	28-21-11	28 VDC Ground Handling Bus	Fueling Valve (C90) Fueling valves (C86)	10 10	Q227-14 Q228-12	Fueling Panel Door Open & Standby Power Switch is On, (No Fuel in either Surge Tanks), OR Standby Power Switch is Off **On the Ground**

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W350)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Quantity Gages Signal 2	28-41-12	----------	No Direct C/B Voltage Source From N45 Total Fuel Indicator	----------	Q607-20 Q612-20 Q617-20 Q622-20 Q627-20 Q632-20 Q637-20	Signal Wire Between Total Fuel Indicator and Volumetric Shut - off Unit
Anti Skid System Annunciation	32-42-13	28 VDC	Capts. Ind. LT (C613)	5	G258-22	Directly downstream of threat C/B
Landing Gear Primary Display	32-61-11	----------	No Direct C/B Voltage Source From Aural Warning Control Logic and Landing Gear Primary System Logic	----------	G44-22 G487-22 N815-22	Seeking Ground
Landing Gear primary display	32-61-11	28 VDC	Landing gear Lever Lock (C1435)	2	G710-22	Directly downstream of threat C/B
Landing Gear primary display	32-61-11	28 VDC	Landing gear Lever Lock (C1435)	2	G46-22	Seeking Ground

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W350)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Landing Gear Alternate Display	32-61-21	28 VDC	Capts. Ind. LT (C613)	5	G64-22 G104-22 G105-22	Directly downstream of threat C/B
Master Dim and Test Indicator Lights Distr & Cont Stand	33-11-71	28 VDC	Capts. Ind. LT (C613)	5	W0001-22 W0002-22 L465-22 L422-22	Directly downstream of threat C/B
Master Dim and Test Indicator Lights Distr & Cont Stand	33-11-71	28 VDC	Capts. Ind. LT (C614)	5	L490-22	Pilots Dim Relay (YL1K04) De Energize
Fuel Flow Meter - Engine 1 and 2	73-31-11	115 AC	Engine 1 Fuel Flow (1278)	1	1E76-22 1E75-22 1E69-22 1E221-22	Directly downstream of threat C/B
Fuel Flow Meter - Engine 1 and 2	73-31-11	4.91 VDC	No Direct C/B From Fuel Flow Module	----------	1E225-22B 1E80-22B 1E224-22B	Fuel Flow Rate IND Input Signal
Fuel Flow Meter - Engine 1 and 2	73-31-11	5 AC	No Direct C/B From Fuel Flow Module	----------	1E226-22Y 1E227-22Y 1E81-22Y	Fuel Flow IND Ref. Voltage
Engine Pressure Ratio Indicator	77-11-11	115 VAC	Engine 1 EPR & Oil Quantity (C41)	2.5	1E3-20	Directly downstream of threat C/B
Engine Pressure Ratio Indicator	77-11-11	115 VAC	Engine 1 EPR & Oil Quantity (C41)	2.5	1E4-20 1E5-20 1E6-20	Signal Wire between Engine # 1 IND. and EPR Servo Control

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W350)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Engine Tachometer Indicating N1	77-12-11	28 VDC	CB-ENG 1 N1 Tach. XMTR (C12)	1	1E87-20	Directly downstream of threat C/B
Engine Tachometer Indicating N1	77-12-11	----------	No Direct C/B Voltage Source form XMTR ENG 1 N1 Tach.	----------	1E250-20B 1E249-20B 1E247-20R 1E248-20R 1E85-20R 1E86-20B	Signal Wire between IND Eng.1 N1 RPM and P4 Panel- Flight Engineers Instrument & XMTR ENG 1 N1 Tach.
Engine Tachometer Indicating N2	77-12-21	----------	No Direct C/B Voltage Source form XMTR - N2 Tach.	----------	1E49-22R	Signal Wire between IND Eng. N2 RPM and XMTR ENG - N2 Tach.
Temperature Indication - Engine Exhaust Gas	77-21-11	----------	No Direct C/B Voltage Source from Engine 1	----------	1E90-20D	Signal Wire between JCT BOX EGT TC & IND Engine Exhaust Gas Temperature.
Thrust Reverser Operating Indicator Engine 1 and 2	78-36-11	28 VDC	ENG 1 T/R and Auto Dclr (C405)	2.5	1E1-20	Directly downstream of threat C/B
Thrust Reverser Operating Indicator Engine 1 and 2	78-36-11	28 VDC	ENG 1 T/R and Auto Dclr (C405)	2.5	1E42-22 1E46-22	When the Airplane is on the Ground and T/R is Activated, (S149) Not Extended
Low Oil Pressure Indicator- Engine	79-33-11	28 VDC	Capts. Ind. LT (C613)	5	1E12-20	Directly downstream of threat C/B

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W350)

Table of content

DESCRIPTION	Drawing Number	Drawing Page Number	Page Number
Fire Detection Master Warning and Reset	26-11-61	1	1
Leading Edge Flap Annuciator Master Lights	27-88-13	4	1
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TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W066)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Quantity AC and DC Power	28-21-11	115 VAC STBY INV	Fueling Gauges (C685)	2.5	Q242-22	Refuel Power Switch in Battery Position & Standby Power switch is in Off Position, **On the Ground**
Fuel Quantity AC and DC Power	28-21-11	115 VAC GRD SER XFR BUS	Fueling Gauges (C94)	2.5	Q242-22	Standby Power switch is in On Position, **On the Ground**
Fuel Quantity AC and DC Power	28-21-11	28 VDC BAT. BUS	Fueling Valve (C86)	10	Q227-16 Q228-16 Q1212-18 Q1211-18 Q1215-20	Fueling Panel Door Open & Standby Power Switch is Off, (No Fuel in either Surge Tanks), Refuel Power Switch in Battery Position **On the Ground**
Fuel Quantity AC and DC Power	28-21-11	28 VDC GRD Handling BUS	Fueling Valve (C90)	10	Q227-16 Q228-16 Q1212-18 Q1211-18 Q1215-20	Fueling Panel Door Open & Standby Power Switch is On, (No Fuel in either Surge Tanks), OR Standby Switch is off and Refuel Power Switch in Normal Position. **On the Ground**

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W066)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Quantity AC and DC Power	28-21-11	28 VDC GRD Handling BUS	Fueling Valve (C90)	10	Q1214-16 Q1213-16	Fueling Panel Door Open & Standby Power Switch is On, and Fueling Shutoff Relay is not activated (No Fuel in either Surge Tanks). OR Standby Switch is off and Refuel Power Switch in Normal Position **On the Ground**
Fuel Quantity AC and DC Power	28-21-11	28 VDC BAT. BUS	Fueling Valve (C86)	10	Q1214-16 Q1213-16	Fueling Panel Door Open & Standby Power Switch is Off, Refuel Power Switch in Battery Position, Fueling Shut-off Relay is not activated (No Fuel in either Surge Tanks), **On the Ground**
Fuel Quantity AC and DC Power	28-21-11	28 VDC GRD Handling BUS	Fueling Valve (C90)	10	Q1216-22 Q1218-22	Seeking Ground, Through Fueling Shut-off Relay (R699) **On the Ground**
Fuel Quantity AC and DC Power	28-21-11	28 VDC BAT. BUS	Fueling Valve (C86)	10	Q1216-22 Q1218-22	Seeking Ground, Through Fueling Shut-off Relay (R699) **On the Ground**

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W066)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Ground Refueling Valves-Left Wing.	28-21-21	28 VDC GRD Handling BUS	Fueling Valves (C90)	10	Q407-16 Q401-14 Q404-14	Fueling Panel Door Open & Standby Power Switch is On, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), and Fuel Tank not at Vol. Shut-off level. OR Standby Switch is off and Refuel Power Switch in Normal Position **On the Ground**
Ground Refueling Valves-Left Wing.	28-21-21	28 VDC BAT. BUS	Fueling Valves (C86)	10	Q407-16 Q401-14 Q404-14	Fueling Panel Door Open & Standby Power Switch is Off, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), Refuel Power Switch in Battery Position and Fuel Tank not at Vol. Shut-off level. **On the Ground**

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W066)

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Ground Refueling Valves-Left Wing	28-21-21	2	3
Ground Refueling Valves- Center and Right Wing	28-21-22	3	4
Fuel Quantity Gages Signal 2	28-41-12	7	4-5
Windshield Heat System 1- Left	30-41-12	14	5-7
Fuel Flow Meter - Engine 1 and 2	73-31-11	19	7-8
Fuel Flow Meter - Engine 3 and 4	73-31-12	20	8-9

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W066)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Ground Refueling Valves-Center and Right Wing.	28-21-22	28 VDC GRD Handling BUS	Fueling Valves (C90)	10	Q412-14 Q417-16 Q422-14 Q425-14	Fueling Panel Door Open & Standby Power Switch is On, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), and Fuel Tank not at Vol. Shut-off level. OR Standby Switch is off and Refuel Power Switch in Normal Position **On the Ground**
Ground Refueling Valves-Center and Right Wing.	28-21-22	28 VDC BAT. BUS	Fueling Valves (C86)	10	Q412-14 Q417-16 Q422-14 Q425-14	Fueling Panel Door Open & Standby Power Switch is Off, Fueling Shut off relay is not activated, (No Fuel in either Surge Tanks), Refuel Power Switch in Battery Position and Fuel Tank not at Vol. Shut-off level. **On the Ground**
Fuel Quantity Gages Signal 2	28-41-12	----------	No Direct C/B Voltage Source From N45 Total Fuel Indicator	----------	Q607-20 Q612-20 Q617-20 Q622-20 Q627-20 Q632-20 Q637-20	Tank Compensator LO - Z

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W066)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Quantity Gages Signal 2	28-41-12	----------	No Direct C/B Voltage Source From Volumetric Shut-off Unit	----------	Q603-20 Q598-20	Signal Wire Between Volumetric Shut-off Unit & Surge tank **Lo- Z**
Fuel Quantity Gages Signal 2	28-41-12	----------	No Direct C/B Voltage Source From Volumetric Shut-off Unit	----------	Q602-20 Q600-20 Q597-20 Q595-20	Signal Wire Between Volumetric Shut-off Unit & Volumetric Comp. **Lo - Z**
Fuel Quantity Gages Signal 2	28-41-12	----------	No Direct C/B Voltage Source From Volumetric Shut-off Unit	----------	Q601-20 Q599-20 Q596-20 Q594-20	Signal Wire Between Volumetric Shut-off Unit & Volumetric Comp. **HI - Z**
Fuel Quantity Gages Signal 2	28-41-12	----------	No Direct C/B Voltage Source From Volumetric Shut-off Unit B324	----------	Q646-20	Seeking Ground Through to Test Gage Switch
Windshield Heat System 1 - Left	30-41-12	----------	No Direct C/B Voltage Source From Controler Window Heat Right No. 1	----------	H70-22	Seeking Ground Through to Power Test Switch Switch
Windshield Heat System 1 - Left	30-41-12	28 VDC	Capts Ind Lt (C613)	5	H75-22	Pilots Dim Relay is De Energize

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W066)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Windshield Heat System 1 - Left	30-41-12	28 VDC	Engr Dim & Test Cont (C578)	5	H1109-22 H113-22	Through Window 1 OVHT IND.
Windshield Heat System 1 - Left	30-41-12	115 VAC	Window Heat Cont L1 (C335)	----------	H67-22	Switch is ON Position
Windshield Heat System 1 - Left	30-41-12	28 VDC	Window Heat Cont L1 (C439)	----------	H62-22	Switch is OVRD Position
Windshield Heat System 1 - Left	30-41-12	28 VDC	Window Heat Cont L1 (C439)	----------	H61-22 H2150-22 H2152-22 H2151-22	Switch is ON Position
Windshield Heat System 1 - Left	30-41-12	----------	No Direct C/B Voltage Source From Controller Window Heat Left No. 1	----------	H72-22 H2147-22	Signal Between Controller Window Heat Left No.1 and Window Heat Spare Sensor (Relay R615 "GND Mode - R1" Energized)
Windshield Heat System 1 - Left	30-41-12	----------	No Direct C/B Voltage Source From Controller Window Heat Left No. 1	----------	H2148-22 H2181-20 H101-22R	Relay R615 "GND Mode - R1" Energized.

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W066)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Windshield Heat System 1 - Left	30-41-12	----------	No Direct C/B Voltage Source From Controller Window Heat Left No. 1	----------	H595-24R H99-22R H100-22B H1165-24B	Signal Between Controller Window Heat Left No.1 and Window Heat Control Sensor
Fuel Flow Meter - Engine 1 and 2	73-31-11	115 VAC	Eng 1 Fuel Flow (C1278)	1	1E76-22	Directly downstream of threat C/B
Fuel Flow Meter - Engine 1 and 2	73-31-11	4.19 VDC	No Direct C/B From Fuel Flow Module	----------	1E80-22B	Fuel Flow Rate IND Input Signal
Fuel Flow Meter - Engine 1 and 2	73-31-11	5 VAC	No Direct C/B From Fuel Flow Module	----------	1E81-22y	Fuel Flow IND Ref. Voltage
Fuel Flow Meter - Engine 1 and 2	73-31-11	115 VAC	Eng 2 Fuel Flow (C1279)	1	2E76-22	Directly downstream of threat C/B
Fuel Flow Meter - Engine 1 and 2	73-31-11	4.19 VDC	No Direct C/B From Fuel Flow Module	----------	2E80-22B	Fuel Flow Rate IND Input Signal
Fuel Flow Meter - Engine 1 and 2	73-31-11	5 VAC	No Direct C/B From Fuel Flow Module	----------	2E81-22Y	Fuel Flow IND Ref. Voltage
Fuel Flow Meter - Engine 1 and 2	73-31-11	40 VAC	No Direct C/B Voltage Source From Fuel Flow Module	----------	1E72-22 1E73-22	To Fuel flow Syn Motor Engine No 1.

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W066)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Flow Meter - Engine 1 and 2	73-31-11	----------	No Direct C/B Voltage Source From Fuel Flow Module	----------	1E53-22R 1E55-22Y	Signal Wires between Fuel Flow Module and Fuel flow meter Transmitter
Fuel Flow Meter - Engine 1 and 2	73-31-11	40 VAC	No Direct C/B Voltage Source From Fuel Flow Module	----------	2E72-22 2E73-22	To Fuel flow Syn Motor Engine No 1.
Fuel Flow Meter - Engine 1 and 2	73-31-11	----------	No Direct C/B Voltage Source From Fuel Flow Module	----------	2E53-22R 2E55-22Y	Signal Wires between Fuel Flow Module and Fuel flow meter Transmitter
Fuel Flow Meter - Engine 1 and 2	73-31-11	----------	No Direct C/B Voltage Source From Fuel Flow Module	----------	1E68-22 2E68-22	Signal Wires between Fuel Flow Module and IND - ENG Fuel Used 1, 2.
Fuel Flow Meter - Engine 3 and 4	73-31-12	115 VAC	Eng 3 Fuel Flow (C1280)	1	3E76-22	Directly downstream of threat C/B
Fuel Flow Meter - Engine 3 and 4	73-31-12	4.19 VDC	No Direct C/B From Fuel Flow Module	----------	3E80-22B	Fuel Flow Rate IND Input Signal Engine No. 3.
Fuel Flow Meter - Engine 3 and 4	73-31-12	5 VAC	No Direct C/B From Fuel Flow Module	----------	3E81-22y	Fuel Flow IND Ref. Voltage Engine No. 3.
Fuel Flow Meter - Engine 3 and 4	73-31-12	115 VAC	Eng 4 Fuel Flow (C1281)	1	4E76-22	Directly downstream of threat C/B

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W066)

SYSTEM	Wire Diagram	Threat Voltage	Threat C/B (Number)	C/B rating (A)	Wire Number	Threat Condition
Fuel Flow Meter - Engine 3 and 4	73-31-12	4.19 VDC	No Direct C/B From Fuel Flow Module	----------	4E80-22B	Fuel Flow Rate IND Input Signal Engine No. 4.
Fuel Flow Meter - Engine 3 and 4	73-31-12	5 VAC	No Direct C/B From Fuel Flow Module	----------	4E81-22Y	Fuel Flow IND Ref. Voltage Engine No. 4.
Fuel Flow Meter - Engine 3 and 4	73-31-12	40 VAC	No Direct C/B Voltage Source From Fuel Flow Module	----------	3E72-22 3E73-22	To Fuel flow Syn Motor Engine No 3.
Fuel Flow Meter - Engine 3 and 4	73-31-12	40 VAC	No Direct C/B Voltage Source From Fuel Flow Module	----------	4E72-22 4E73-22	To Fuel flow Syn Motor Engine No 4.
Fuel Flow Meter - Engine 3 and 4	73-31-12	----------	No Direct C/B Voltage Source From Fuel Flow Module	----------	4E53-22R 4E55-22Y	Signal Wires between Fuel Flow Module and Fuel flow meter Transmitter Engine No. 4.
Fuel Flow Meter - Engine 3 and 4	73-31-12	----------	No Direct C/B Voltage Source From Fuel Flow Module		3E68-22 4E68-22	Signal Wires between Fuel Flow Module and IND - ENG Fuel Used 3, 4.

TWA RA164 Center Wing Tank Bundle Analysis
Bundle (W066)

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