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Engineering Standard Practice

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

PRACTICE: **ESP 96**

ISSUE: **1**

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

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1.0 INTRODUCTION

Electromagnetic fields associated with HIRF and Lightning can cause damage and/or upset of electrical/electronic circuitry by means of direct penetration through the equipment enclosure and coupling into the cable harness. Effective shielding of cable to connector termination is important in achieving electromagnetic compatibility. Cable to connector termination is achieved through the proper selection of backshells (connector adaptor) which maintain electrical continuity and shielding effectiveness from the cable shields to the connector. Note that the terms “backshell” and “connector adapter” may be used interchangeably.

The connector backshells recommended in ESP 96 are applicable to all cable harnesses on the DHC-8 Series 400 aircraft with the exception of the engine nacelle. Backshells utilized within the nacelle forward of the firewall are specified by PW&C, Dowty, Shorts and Westland.

The information provided below identifies the cable shield termination methodology recommended by the Lightning/EMI/HIRF group for the following connector types:

1. Circular Connectors
2. MIL-C- 24308 “D” Subminiature Connectors
3. ARINC Connectors

The DHC-8 Series 400 connector backshells (connector adapters) must be capable of the following shield terminations.

1. Termination of individual wire shields.
2. Termination of an overall shield
3. Termination of individual wire shields and overall shield.

In addition, shield transfer impedance data is provided for the shielded wires and conduit defined herein.

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2.0 CIRCULAR BACKSHELL DESIGN

2.1 For Systems Which Perform Critical Functions

Wiring associated with systems which perform critical functions must be designed with two levels of shielding for all wires routed external to the pressure vessel . The first level of shielding must be at the wire level (e.g. shielded singles, pairs and triplets). The second level of shielding may be at the wire level (resulting in double shielded singles, pairs and triplets) or using an overall shield. The Electromagnetics Group recommend an overall shield.

The DHI Wire Integration and Installation Groups (with the support of the Weights Group) will define the type of second level shield (wire level or overall shield) for all wiring which DHI is responsible for supplying.

The EMI circular backshell shall comply with the following specifications.

a. The backshell which terminates an overall shield must be designed such that the convoluted tubing of the overall shield threads inside the “tail-form” of the backshell. The overall shield should be terminated with a “band clamp/tinel lock ring” (or equivalent) to the backshell.

b. The backshell which terminates individual wire shields only shall be designed with a strain relief.

c. 360 degree termination of individual wire shields require termination of the wire shields inside the backshell.

d. The backshell must be designed with an anti-rotational device to prevent the backshell/shields from “backing off” in service and compromising the shield termination.

e. The backshell must be conductive (Electroless Nickel or equivalent)

f. The backshell must interface with the following connectors recommended in the DHC-8 Series 400 Permitted Parts and Materials Catalogue.

    i. MIL-C-38999 Series I and Series III

    ii. MIL-C-26482 Series II

    iii. MIL-C-83723 Series III

    iv. MIL-C-5015

Note: The EMC group *recommends* MIL-C-38999 Series I and III connectors

g. The backshell must be available in different angular configurations (straight, 45 degree, 90 degree).

h. The backshell should be equipped with drain holes (OPTION).

i. The DC electrical resistance measured from the connector flange to a point on the cable shield located as near as possible to the rear of the backshell should not exceed 2.5 milliohms

Equipment which performs critical functions shall utilize a backshell with a 360 degree shield termination methodology. ***The System Partner must specify the requirement for 360 degree shield termination on the electrical schematic.*** For equipment which performs critical functions, the Lightning/EMI/HIRF group *recommends* the following circular backshell design concept.

TABLE 1. 360 degree Circular Backshell Termination of Individual Wire Shields (One or Two Levels of Shielding)

Cable Shield Configuration	Recommended Backshell Configuration	Comments
Shielded Singles, Pairs and Triplets	ICORE P/N 3CGA Series*	As listed in S400 Permitted Parts and Materials Catalogue

*For specific connector types refer to Table 10.

TABLE 2. 360 degree Circular Backshell Termination of Overbraid only (One Level of Shielding)

Cable Shield Configuration	Recommended Backshell	Comments
Overall Shield	ICORE P/N 3CFU Series*	As listed in S400 Permitted Parts and Materials Catalogue

*For specific connector types refer to Table 11.

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Note: The backshell listed in Table 2 conforms to Bombardier Standard B081700.

TABLE 3. 360 degree Circular Backshell Termination of Individual Wire Shields and Overbraid (Two Levels of Shielding)

Cable Shield Configuration	Recommended Backshell	Comments
Shielded Singles, Pairs and Triplets with an Overall Shield	ICORE P/N 3CFUGA Series*	As listed in the S400 Permitted Parts and Materials Catalogue

*For specific connector types refer to Table 12.

3.0 OVERALL SHIELD DESIGN

3.1 For Systems Which Perform Critical Functions (Wiring External To Fuselage Pressure Vessel)

The electromagnetics group recommend an overall shield which consists of an inner teflon convoluted tubing with an outer woven nickel coated copper braid (ICORE Part Number 3C-CML-1NSNJ series). The convoluted tubing must be equipped with drain holes. Conduit data sheets and the 3CFU series of transitions and fittings which are to be utilized where branching is required are available in the DHC-8 Series 400 Permitted Parts and Materials Catalogue. Associated shield transfer impedance for this conduit is shown in Figure 7.

4.0 MIL-C-24308 “D” STYLE CONNECTOR BACKSHELLS

4.1 For Systems Which Perform Critical Functions

For applications where the System Partner requires the use of MIL-C-24308 “D” Type connectors, ***the System Partner must specify the requirement for 360 degree shield termination on the electrical schematic.***

Equipment which performs critical functions shall utilize a backshell with a 360 degree shield termination methodology. For equipment which performs critical

functions, the Lightning/EMI/HIRF group *recommends* the following backshell design concept.

TABLE 4. 360 degree "D" Style Termination of Individual Wire Shields and Overbraid (Two levels of Shielding)

Cable Shield Configuration	Recommended Backshell	Comments
Shielded Singles, Pairs and Triplets and Overall Shield	Glenair P/N 550-003 Series*	As listed in the S400 Permitted Parts Catalogue

*Refer to Figure 1 for illustration of connector

TABLE 5. 360 degree "D" Style Termination of Individual Wire Shields OR Overbraid (One level of Shielding)

Cable Shield Configuration	Recommended Backshell	Comments
Shielded Singles, Pairs and Triplets OR Overall Shield	Glenair P/N 550-004 Series*	As listed in the S400 Permitted Parts Catalogue

*Refer to Figure 2 for illustration of connector.

5.0 ARINC STYLE CONNECTOR BACKSHELLS

5.1 For Systems Which Perform Critical Functions

EMI backshells for ARINC connectors do not exist as an "off the shelf" item. For applications which require the use of ARINC type connectors, ***the System Partner must provide to the DHI Wire Integration Group a list of ARINC connectors which require an EMI backshell.*** The Wire Integration Group must order suitable EMI backshells to terminate the shields in a manner which is acceptable to the System Partner.

The Wire Integration Group shall specify a general purpose backshell (if required) where Lightning/HIRF protection is not required.

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

6.0 CIRCULAR BACKSHELL DESIGN

6.1 For Systems Which Perform Essential and Non Essential Functions

For wires associated with systems which perform essential (hazardous severe-major and major) as well as non-essential (minor, no effect) functions, ***the System Partner must identify any wires which require shielding to meet the Lightning/HIRF as well as the emissions requirements. Wiring associated with systems that perform essential functions must be shielded in EM Regions 1 and 2 (External to fuselage pressure vessel).*** Only one level of shielding is permitted and must be at the wire level (e.g. shielded singles, pairs and triplets). To protect against the effects of Lightning/HIRF, the shields must be grounded at both ends. ***An overall shield (overbraid) is not permitted unless approved by the EM Group.***

Essential and non-essential wiring routed to equipment which performs critical functions must be shielded in accordance with the requirements for critical functions.

Equipment which performs essential and non-essential functions may utilize a backshell with a 360 degree shield termination methodology or a pigtail shield termination methodology (if pigtails are used they must be as short as possible and not longer than 3 inches). ***The shield termination method must be specified by the System Partner on the electrical schematic*** and is dependent upon the LRU's ability to meet the EMI emissions and susceptibility requirements.

The DHI Wire Integration Group shall utilize the information on the electrical schematic to select the appropriate backshell (360 degree vs pigtail termination).

For equipment which performs essential/non-essential functions, the Lightning/ EMI/HIRF group recommends the following backshell design concept.

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TABLE 6. 360 degree Backshell Termination of Individual Wire Shields (One level of Shielding)

Cable Shield Configuration	Recommended Backshell	Comments
Shielded Singles, Pairs and Triplets	ICORE P/N 3CGA Series*	As listed in the S400 Permitted Parts Catalogue

*For Connector types refer to Table 10.

TABLE 7. Pigtail Termination of Individual Wire Shields (One Level of Shielding - General Purpose Backshell

Cable Shield Configuration	Recommended Backshell	Comments
Shielded Singles, Pairs and Triplets	ICORE P/N 3CSR Series*	As listed in the S400 Permitted Parts and Materials Catalogue

*For connector types refer to Table 13.

Note: The Backshell specified in Table 7 is also recommended as the general purpose backshell where Lightning/HIRF protection is not a requirement.

7.0 MIL-C-24308 "D" STYLE CONNECTOR BACKSHELLS

7.1 For Systems Which Perform Essential and Non Essential Functions

For wires associated with systems which perform essential (hazardous severe-major and major) as well as non-essential (minor, no effect) functions, ***the System Partner must identify any wires which require shielding to meet the Lightning/HIRF as well as the emissions requirements. Wiring associated with systems that perform essential functions must be shielded in EM Region 1 and 2 (External to the fuselage pressure vessel).*** Only one level of shielding is permitted (if required by the System Partner) and must be at the wire

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

level (e.g. shielded singles, pairs and triplets). To protect against the effects of Lightning/HIRF, the shields must be grounded at both ends. ***An overall shield (overbraid) is not permitted unless approved by the EM Group.***

Essential and non-essential wiring routed to equipment which performs critical functions must be shielded in accordance with the requirements for critical functions.

Equipment which performs essential and non-essential functions may utilize a backshell with a 360 degree shield termination methodology or a pigtail shield termination methodology (if pigtails are used they must be as short as possible and not longer than 3 inches).

For applications where the System Partner requires the use of MIL-C-24308 "D" Type connectors, ***the System Partner must specify the requirement for 360 degree shield termination on the electrical schematic*** and is dependent upon the LRU's ability to meet the EMI emissions and susceptibility requirements.

The DHI Wire Integration Group shall utilize the information on the electrical schematic to select the appropriate backshell (360 degree vs pigtail termination).

For equipment which performs essential/non-essential functions, the Lightning/ EMI/HIRF group ***recommends*** the following backshell design concept for MIL-C-24308 "D" style connectors where 360 degree shield termination is specified by the System Partner.

The Wire Integration Group shall specify a general purpose backshell (if required) where Lightning/HIRF protection is not required.

TABLE 8. 360 degree "D" Style Termination of Individual Wire Shields OR Overbraid (One Level of Shielding)

Cable Shield Configuration	Recommended Backshell	Comments
Shielded Singles, Pairs and Triplets OR Overall Shield	Glenair P/N 550-004*	As listed in the S400 Permitted Parts and Materials Catalogue.

*For illustration of connector refer to Figure 2.

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8.0 ARINC STYLE CONNECTOR BACKSHELLS

8.1 For Systems Which Perform Essential and Non Essential Functions

EMI backshells for ARINC connectors do not exist as an "off the shelf" item. For applications which require the use of ARINC type connectors, ***the System Partner must provide to the DHI Wire Integration Group a list of ARINC connectors which require an EMI backshell. The Wire Integration Group must order suitable EMI backshells*** to terminate the shields in a manner which is acceptable to the System Partner.

The Wire Integration Group shall specify a general purpose backshell (if required) where Lightning/HIRF protection is not required.

9.0 WIRE SHIELD TRANSFER IMPEDANCE DATA

The DHC-8 Series 400 Permitted Parts Catalogue specifies the wire shown in Table 9 .The transfer impedance from 10 Khz to 1 GHz for the wire shown in Table 9 is provided in Figures 3 to 6.

TABLE 9. Wire Types

Bombardier Part Number	Cage Code 06090
B0801402 (two conductor, tin coated, twisted shielded	55PC1121
B0801403 (three conductor, tin coated, twisted shielded)	55PC1131
B0801404 (four conductor, tin coated, twisted shielded)	55PC1141
B0801440 (two conductor, tin coated, twisted double shielded)	55PC6021

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

TABLE 10. Individual Wire Shield Termination [360 degree Circular Backshell Termination of Individual Wire Shields (One or Two levels of Shielding)

Connector	Straight (P/N)	90 degree (P/N)	45 degree (P/N)
MIL-C-38999 Series I and II	3CGA00AC41	3CGA90AC41	3CGA45AC41
MIL-C-38999 Series III and IV	3CGA00AC40	3CGA90AC40	3CGA45AC40
MIL-C-81703 MIL-C-26482 Series 2 MIL-C-83723 MIL-C-5015 Crimp	3CGA00AC54	3CGA90AC54	3CGA45AC54

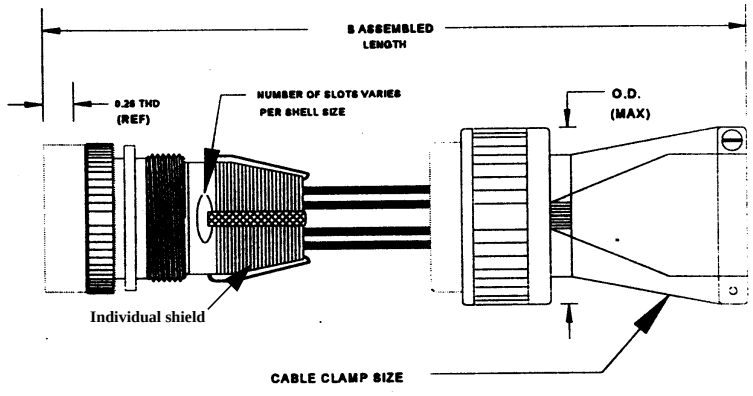

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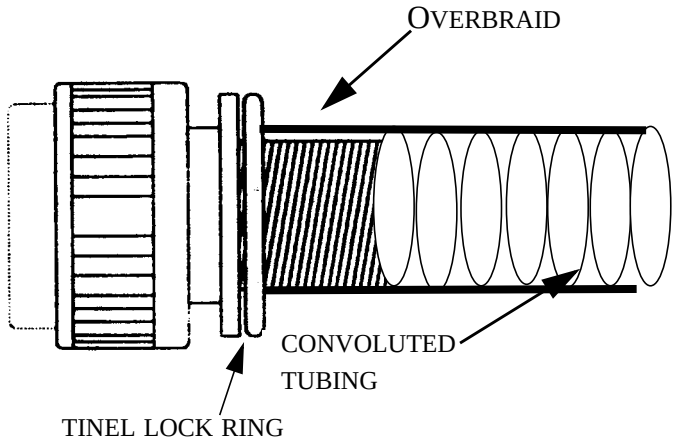
TABLE 11. Overall Shield Termination: 360 degree Termination of Overbraid Only (One Level of Shielding)

Connector	Straight (P/N)	90 degree (P/N)	45 degree (P/N)
MIL-C-38999 Series I and II	3CFU00AC41	3CFU90AC41	3CFU45AC41
MIL-C-38999 Series III and IV	3CFU00AC40	3CFU90AC40	3CFU45AC40
MIL-C-81703 MIL-C-26482 Series 2 MIL-C-83723 MIL-C-5015 Crimp	3CFU00AC54	3CFU90AC54	3CFU45AC54

360 DEGREE TERMINATION (ONE LEVEL OF SHIELDING)
CONNECTOR ADAPTOR OPTILOCK



Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

TABLE 12. Individual Wire Shield and Overall Shield Termination: 360 degree Termination of Individual Wire Shields and Overbraid (Two Levels of Shielding)

Connector	Straight (P/N)	90 degree (P/N)	45 degree (P/N)
MIL-C-38999 Series I and II	3CFUGA00AC41	3CFUGA90AC41	3CFUGA45AC41
MIL-C-38999 Series III and IV	3CFUGA00AC40	3CFUGA90AC40	3CFUGA45AC40
MIL-C-81703 MIL-C-26482 Series 2 MIL-C-83723 MIL-C-5015 Crimp	3CFUGA00AC54	3CFUGA90AC54	3CFUGA45AC54

360 DEGREE OF TERMINATION (TWO LEVELS OF SHIELDING)

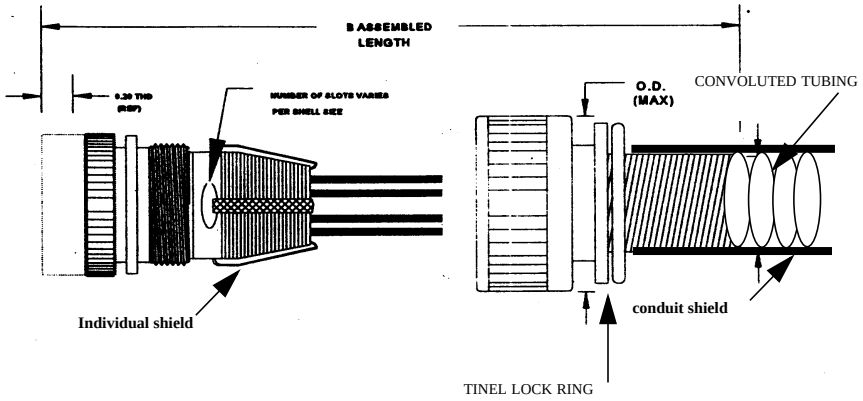


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FIGURE 1. MIL-C-24308 "D" Style Connector Backshells - Individual Wire Shield *and* Overall Shield Termination (GLENAIR P/N 550-003 Series)

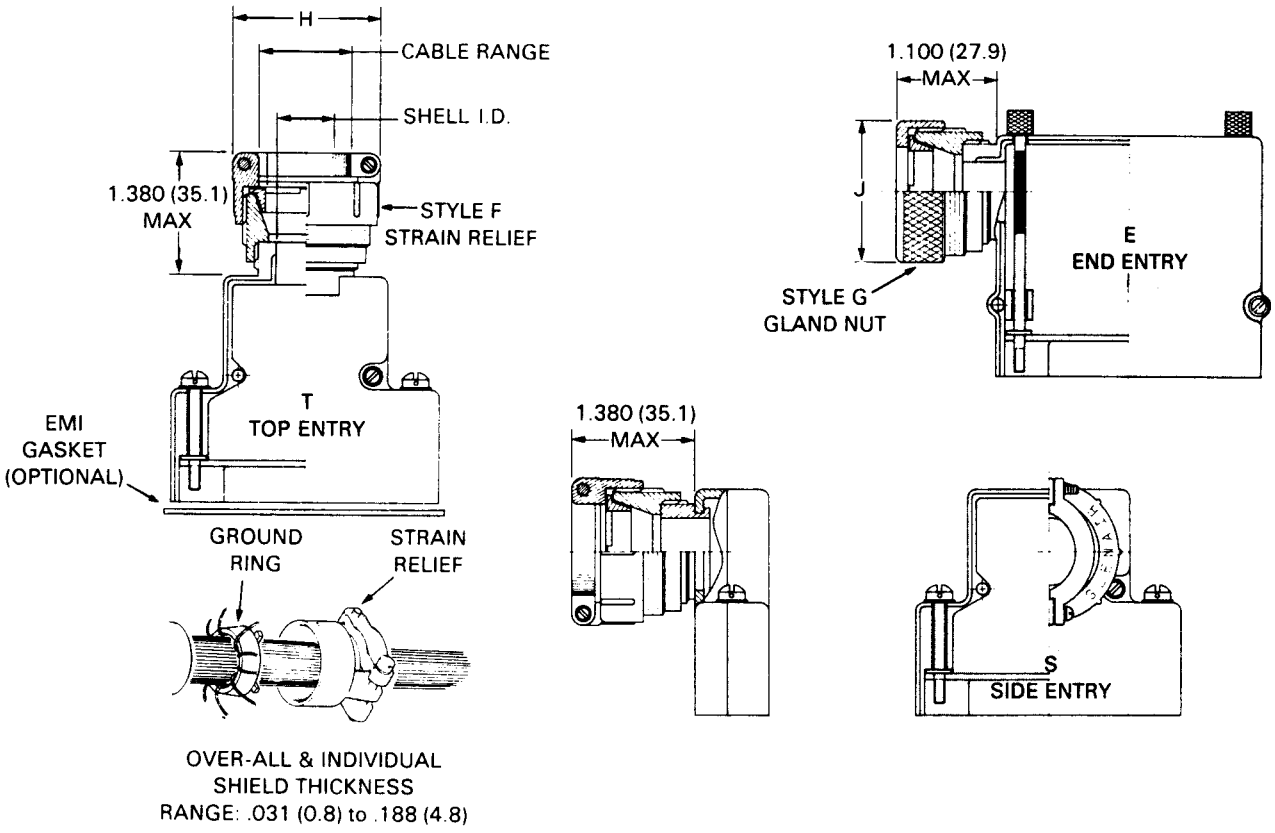

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FIGURE 2. MIL-C-24308 "D" Style Connector Backshells - Individual Wire Shield *or* Overall Braid Termination(GLENAIR P/N 550-004 Series)

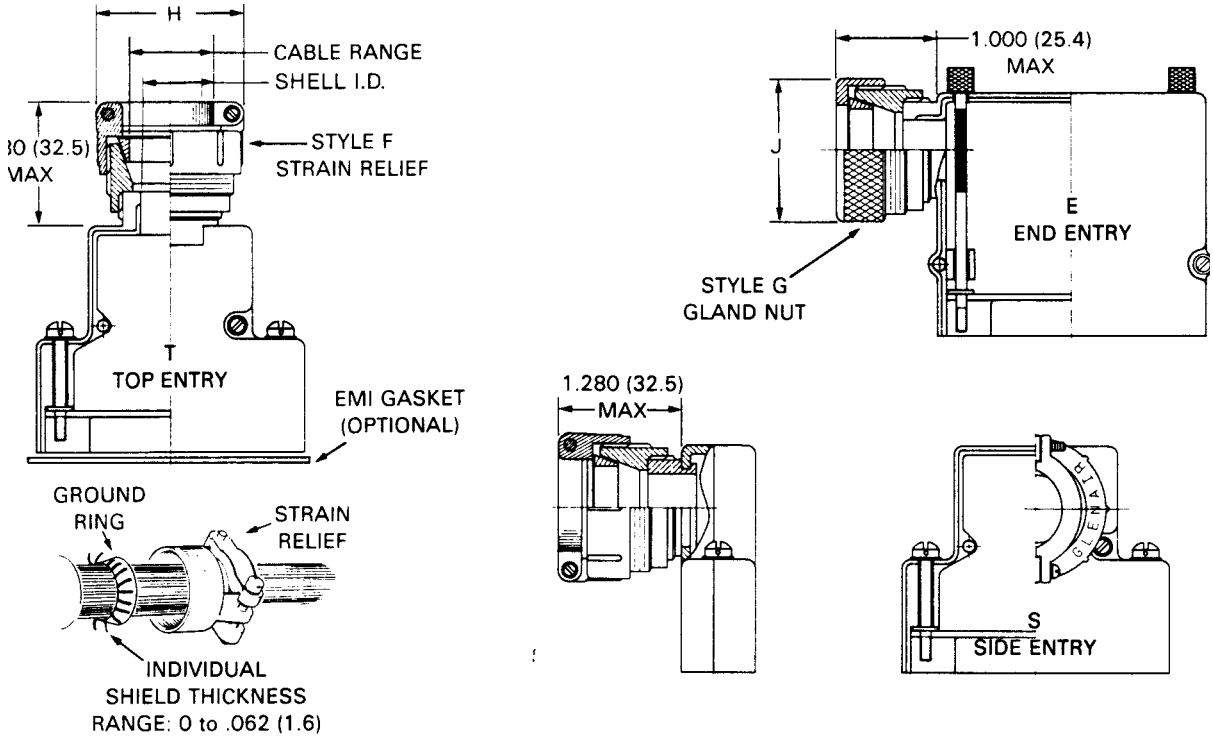

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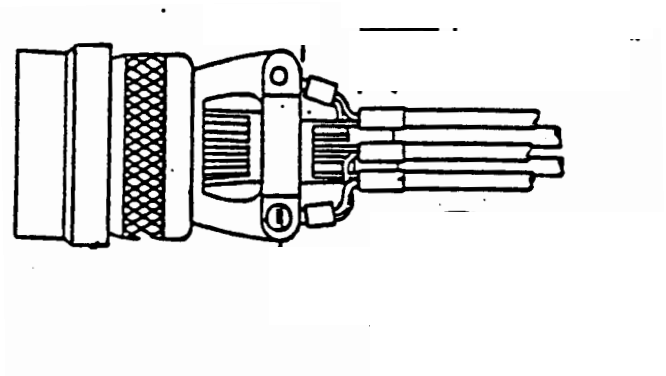
TABLE 13. Individual Wire Shield Pigtail Termination and General Purpose Backshell

Connector	Straight (P/N)	90 degree (P/N)	45 degree (P/N)
MIL-C-38999 Series I and II	3CSR00AC41	3CSR90AC41	3CSR45AC41
MIL-C-38999 Series III and IV	3CSR00AC40	3CSR90AC40	3CSR45AC40
MIL-C-81703 MIL-C-26482 Series 2 MIL-C-83723 MIL-C-5015 Crimp	3CSR00AC54	3CSR90AC54	3CSR45AC54



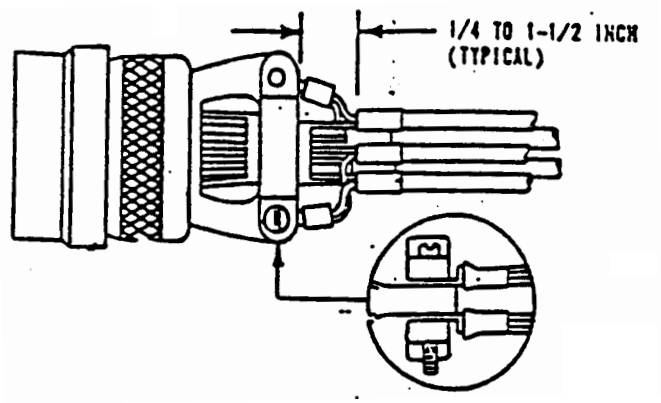
TYPICAL SHIELD TERMINATION

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

10.0 PIGTAIL SHIELD TERMINATIONS

The following illustrates the recommended methodology of termination of pigtail shields

Terminals must be firmly gripped to assure positive electrical contact of the ground terminal. The use of filler tape is recommended to assure a firm concentric grip on the wire bundle. The strain relief clamp must have metal-to-metal contact at both fastener locations between screws, clamps, terminals and clamp mounting bracket



If more than four terminals (16 shield pigtails) must terminate, two (2) terminals shall be stacked back to back as shown. Terminals shall be distributed between left and right sides of the cable clamp to insure balance of clamp. Six (6) terminals (24 shield pigtails) per cable clamp as shown below is the maximum allowable configuration.

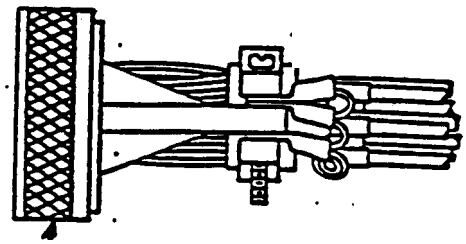


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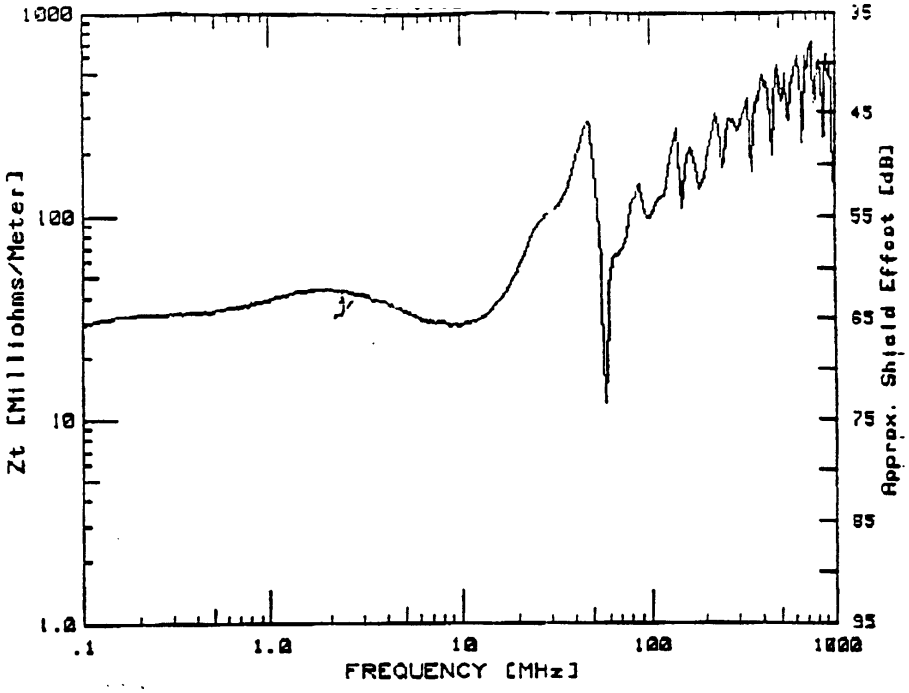
FIGURE 3. Surface Transfer Impedance - B0801402 Wire



Date Of Test: 4/2/96 Test Sample Length: 1.00

Measurement Performed On H.P.8568B Spectrum Analyzer & HP8657A Signal Generator By:
F. MELO

Test Sample Response To EMP: 48.5 dB

D.C. Resistance From Zt Measurement Is: 29.04 mOhms/meter
D.C. Resistance From DC Measurement Is: 40.68 mOhms/meter

The Maximum Measured Zt Value: 704.59573 mOhms/m
Value is between .1 and 1000 MHz

Detector End Termination:
All conductors to center pin, all shield(s) to backshell

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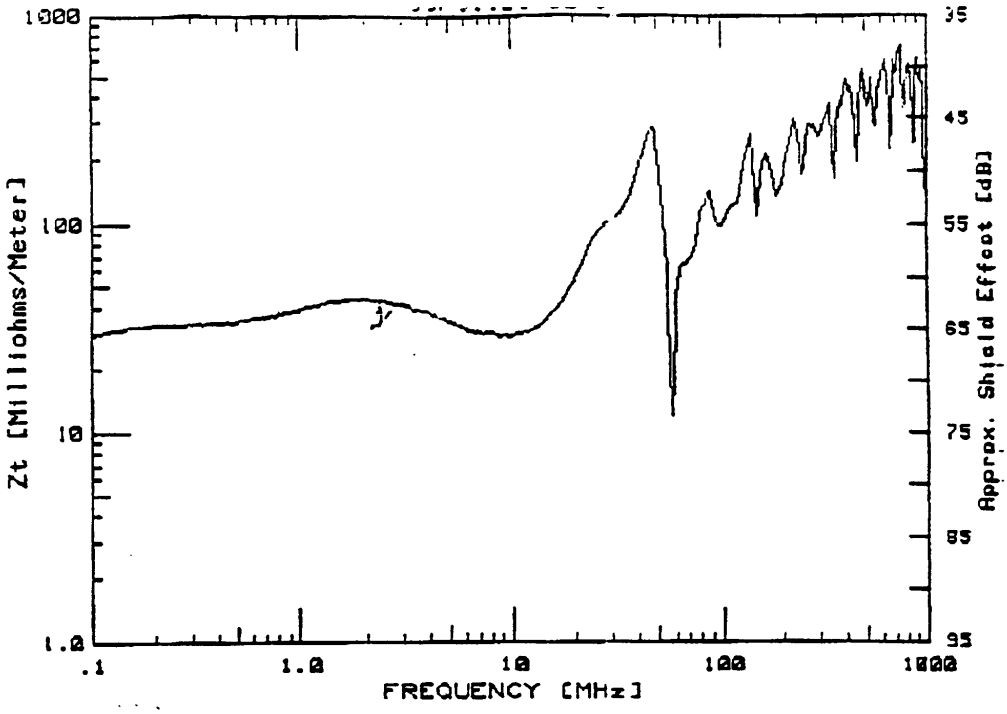
FIGURE 4. Surface Transfer Impedance B0801403 Wire



Date Of Test: 4/2/96 Test Sample Length: 1.00

Measurement Performed On H.P.8568B Spectrum Analyzer & HP8657A Signal Generator By:
F. MELO

Test Sample Response To EMP: 48.5 dB

D.C. Resistance From Zt Measurement Is: 29.04 mOhms/meter
D.C. Resistance From DC Measurement Is: 40.68 mOhms/meter

The Maximum Measured Zt Value: 704.59573 mOhms/m
Value is between .1 and 1000 MHz

Detector End Termination:
All conductors to center pin, all shield(s) to backshell

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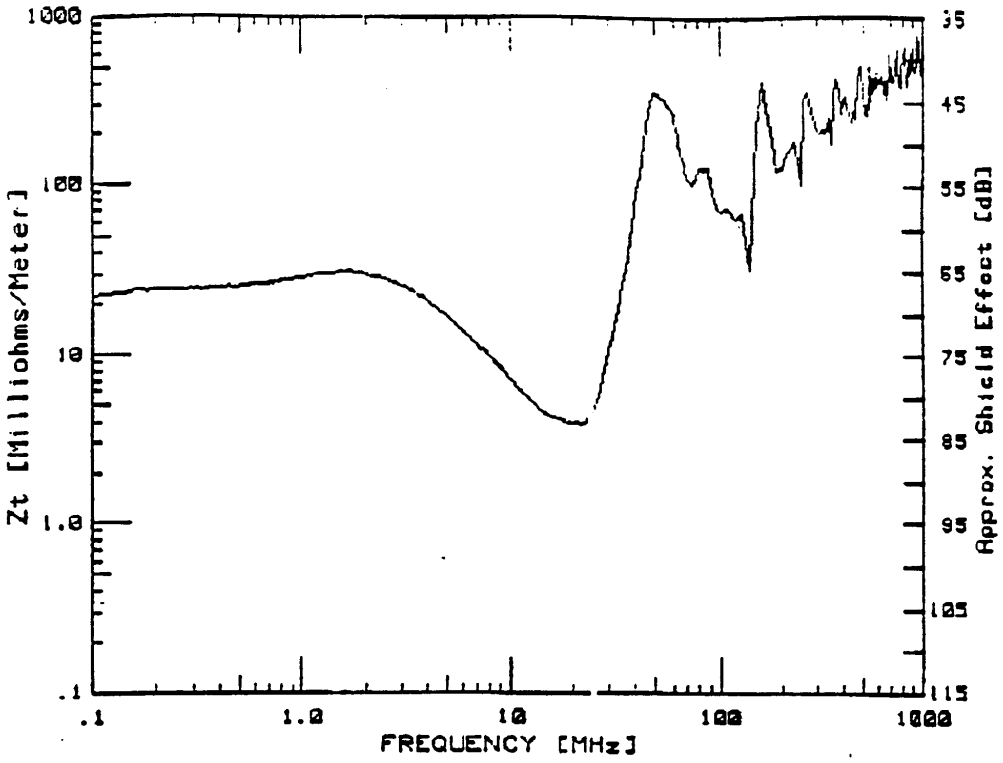
FIGURE 5. Surface Transfer Impedance - B0801404 Wire



Date Of Test: 4/2/96 Test Sample Length: 1.00

Measurement Performed On H.P.8568B Spectrum Analyzer &
HP8657A Signal Generator By:
F. MELO

Test Sample Response To EMP: 51.0 dB

D.C. Resistance From Zt Measurement Is: 22.03 mOhms/meter
D.C. Resistance From DC Measurement Is: 31.36 mOhms/meter

The Maximum Measured Zt Value: 790.56942 mOhms/m
Value is between .1 and 1000 MHz

Detector End Termination:
All conductors to center pin, all shield(s) to backshell

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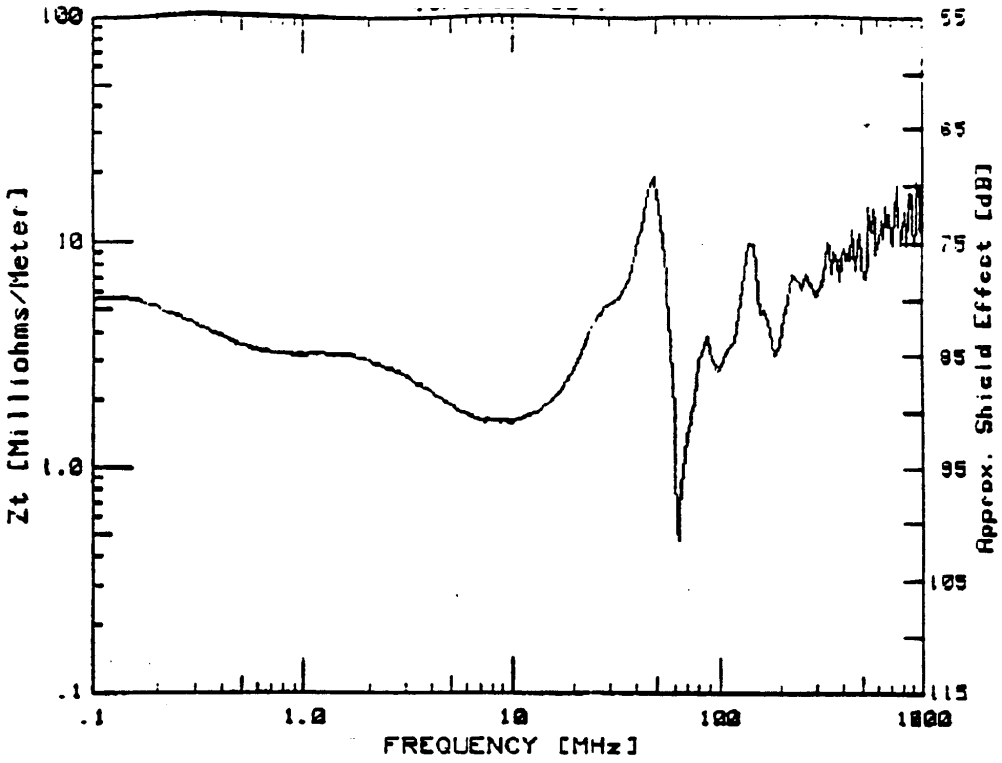
FIGURE 6. Surface Transfer Impedance - B0801440 Wire



Date Of Test: 4/2/96 Test Sample Length: 1.00

Measurement Performed On H.P.8568B Spectrum Analyzer & HP8657A Signal Generator By:
F. MELO

Test Sample Response To EMP: 65.8 dB

D.C. Resistance From Zt Measurement Is: 5.60 mOhms/meter
D.C. Resistance From DC Measurement Is: 8.79 mOhms/meter

The Maximum Measured Zt Value: 19.18404 mOhms/m
Value is between .1 and 1000 MHz

Detector End Termination:
All conductors to center pin, all shield(s) to backshell

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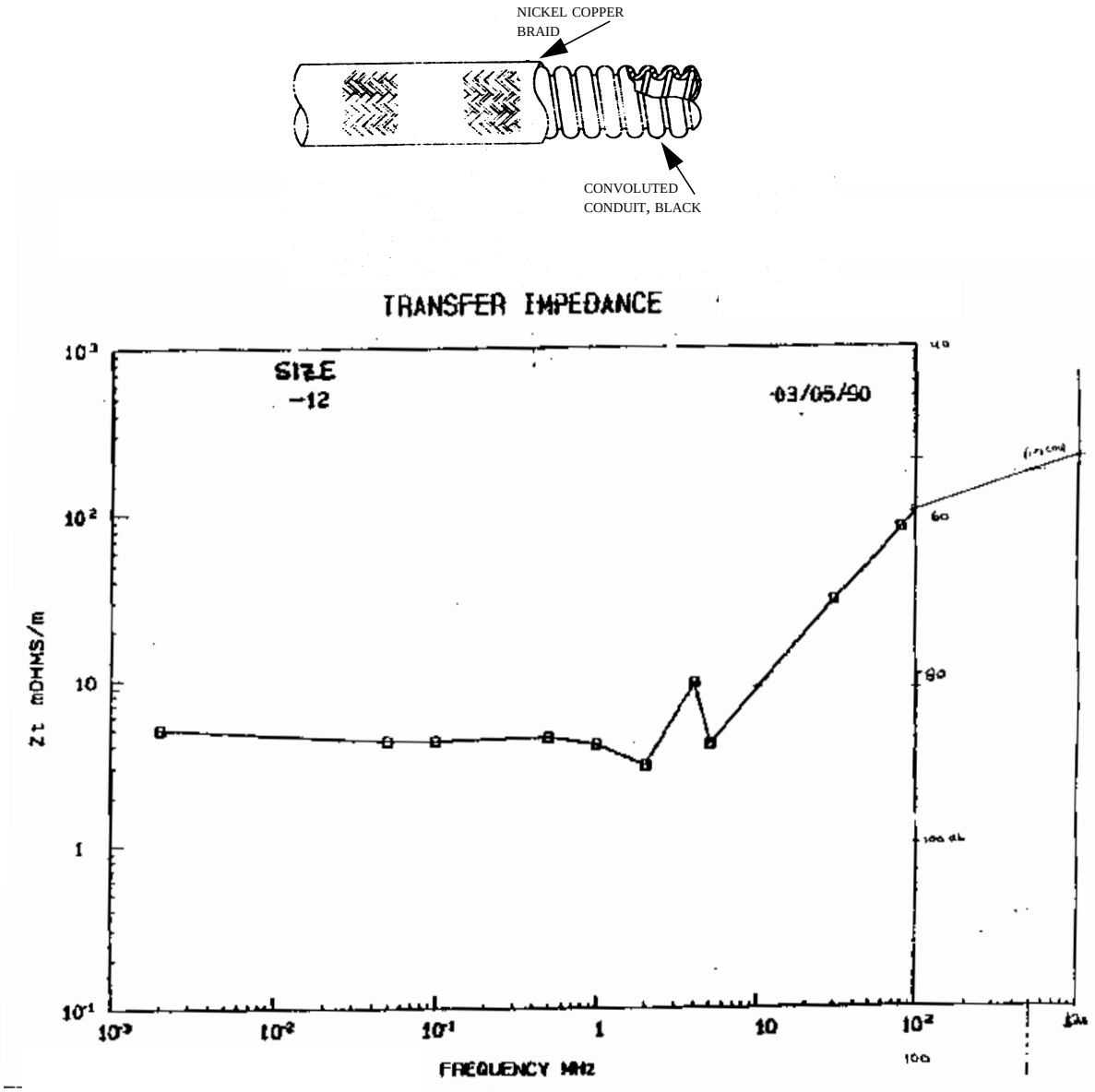
FIGURE 7. Shielded Conduit Transfer Impedance - (ICORE 3C-CML Series)



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1996-06-14

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PRACTICE: **ESP 96**

ISSUE: **1**

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1.0 INTRODUCTION

Electromagnetic fields associated with HIRF and Lightning can cause damage and/or upset of electrical/electronic circuitry by means of direct penetration through the equipment enclosure and coupling into the cable harness. Effective shielding of cable to connector termination is important in achieving electromagnetic compatibility. Cable to connector termination is achieved through the proper selection of backshells (connector adaptor) which maintain electrical continuity and shielding effectiveness from the cable shields to the connector. Note that the terms “backshell” and “connector adapter” may be used interchangeably.

The connector backshells recommended in ESP 96 are applicable to all cable harnesses on the DHC-8 Series 400 aircraft with the exception of the engine nacelle. Backshells utilized within the nacelle forward of the firewall are specified by PW&C, Dowty, Shorts and Westland.

The information provided below identifies the cable shield termination methodology recommended by the Lightning/EMI/HIRF group for the following connector types:

1. Circular Connectors
2. MIL-C- 24308 “D” Subminiature Connectors
3. ARINC Connectors

The DHC-8 Series 400 connector backshells (connector adapters) must be capable of the following shield terminations.

1. Termination of individual wire shields.
2. Termination of an overall shield
3. Termination of individual wire shields and overall shield.

In addition, shield transfer impedance data is provided for the shielded wires and conduit defined herein.

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

2.0 CIRCULAR BACKSHELL DESIGN

2.1 For Systems Which Perform Critical Functions

Wiring associated with systems which perform critical functions must be designed with two levels of shielding for all wires routed external to the pressure vessel . The first level of shielding must be at the wire level (e.g. shielded singles, pairs and triplets). The second level of shielding may be at the wire level (resulting in double shielded singles, pairs and triplets) or using an overall shield. The Electromagnetics Group recommend an overall shield.

The DHI Wire Integration and Installation Groups (with the support of the Weights Group) will define the type of second level shield (wire level or overall shield) for all wiring which DHI is responsible for supplying.

The EMI circular backshell shall comply with the following specifications.

a. The backshell which terminates an overall shield must be designed such that the convoluted tubing of the overall shield threads inside the “tail-form” of the backshell. The overall shield should be terminated with a “band clamp/tinel lock ring” (or equivalent) to the backshell.

b. The backshell which terminates individual wire shields only shall be designed with a strain relief.

c. 360 degree termination of individual wire shields require termination of the wire shields inside the backshell.

d. The backshell must be designed with an anti-rotational device to prevent the backshell/shields from “backing off” in service and compromising the shield termination.

e. The backshell must be conductive (Electroless Nickel or equivalent)

f. The backshell must interface with the following connectors recommended in the DHC-8 Series 400 Permitted Parts and Materials Catalogue.

    i. MIL-C-38999 Series I and Series III

    ii. MIL-C-26482 Series II

    iii. MIL-C-83723 Series III

    iv. MIL-C-5015

Note: The EMC group *recommends* MIL-C-38999 Series I and III connectors

g. The backshell must be available in different angular configurations (straight, 45 degree, 90 degree).

h. The backshell should be equipped with drain holes (OPTION).

i. The DC electrical resistance measured from the connector flange to a point on the cable shield located as near as possible to the rear of the backshell should not exceed 2.5 milliohms

Equipment which performs critical functions shall utilize a backshell with a 360 degree shield termination methodology. ***The System Partner must specify the requirement for 360 degree shield termination on the electrical schematic.*** For equipment which performs critical functions, the Lightning/EMI/HIRF group *recommends* the following circular backshell design concept.

TABLE 1. 360 degree Circular Backshell Termination of Individual Wire Shields (One or Two Levels of Shielding)

Cable Shield Configuration	Recommended Backshell Configuration	Comments
Shielded Singles, Pairs and Triplets	ICORE P/N 3CGA Series*	As listed in S400 Permitted Parts and Materials Catalogue

*For specific connector types refer to Table 10.

TABLE 2. 360 degree Circular Backshell Termination of Overbraid only (One Level of Shielding)

Cable Shield Configuration	Recommended Backshell	Comments
Overall Shield	ICORE P/N 3CFU Series*	As listed in S400 Permitted Parts and Materials Catalogue

*For specific connector types refer to Table 11.

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

Note: The backshell listed in Table 2 conforms to Bombardier Standard B081700.

TABLE 3. 360 degree Circular Backshell Termination of Individual Wire Shields and Overbraid (Two Levels of Shielding)

Cable Shield Configuration	Recommended Backshell	Comments
Shielded Singles, Pairs and Triplets with an Overall Shield	ICORE P/N 3CFUGA Series*	As listed in the S400 Permitted Parts and Materials Catalogue

*For specific connector types refer to Table 12.

3.0 OVERALL SHIELD DESIGN

3.1 For Systems Which Perform Critical Functions (Wiring External To Fuselage Pressure Vessel)

The electromagnetics group recommend an overall shield which consists of an inner teflon convoluted tubing with an outer woven nickel coated copper braid (ICORE Part Number 3C-CML-1NSNJ series). The convoluted tubing must be equipped with drain holes. Conduit data sheets and the 3CFU series of transitions and fittings which are to be utilized where branching is required are available in the DHC-8 Series 400 Permitted Parts and Materials Catalogue. Associated shield transfer impedance for this conduit is shown in Figure 7.

4.0 MIL-C-24308 “D” STYLE CONNECTOR BACKSHELLS

4.1 For Systems Which Perform Critical Functions

For applications where the System Partner requires the use of MIL-C-24308 “D” Type connectors, ***the System Partner must specify the requirement for 360 degree shield termination on the electrical schematic.***

Equipment which performs critical functions shall utilize a backshell with a 360 degree shield termination methodology. For equipment which performs critical

functions, the Lightning/EMI/HIRF group *recommends* the following backshell design concept.

TABLE 4. 360 degree "D" Style Termination of Individual Wire Shields and Overbraid (Two levels of Shielding)

Cable Shield Configuration	Recommended Backshell	Comments
Shielded Singles, Pairs and Triplets and Overall Shield	Glenair P/N 550-003 Series*	As listed in the S400 Permitted Parts Catalogue

*Refer to Figure 1 for illustration of connector

TABLE 5. 360 degree "D" Style Termination of Individual Wire Shields OR Overbraid (One level of Shielding)

Cable Shield Configuration	Recommended Backshell	Comments
Shielded Singles, Pairs and Triplets OR Overall Shield	Glenair P/N 550-004 Series*	As listed in the S400 Permitted Parts Catalogue

*Refer to Figure 2 for illustration of connector.

5.0 ARINC STYLE CONNECTOR BACKSHELLS

5.1 For Systems Which Perform Critical Functions

EMI backshells for ARINC connectors do not exist as an "off the shelf" item. For applications which require the use of ARINC type connectors, ***the System Partner must provide to the DHI Wire Integration Group a list of ARINC connectors which require an EMI backshell.*** The Wire Integration Group must order suitable EMI backshells to terminate the shields in a manner which is acceptable to the System Partner.

The Wire Integration Group shall specify a general purpose backshell (if required) where Lightning/HIRF protection is not required.

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

6.0 CIRCULAR BACKSHELL DESIGN

6.1 For Systems Which Perform Essential and Non Essential Functions

For wires associated with systems which perform essential (hazardous severe-major and major) as well as non-essential (minor, no effect) functions, ***the System Partner must identify any wires which require shielding to meet the Lightning/HIRF as well as the emissions requirements. Wiring associated with systems that perform essential functions must be shielded in EM Regions 1 and 2 (External to fuselage pressure vessel).*** Only one level of shielding is permitted and must be at the wire level (e.g. shielded singles, pairs and triplets). To protect against the effects of Lightning/HIRF, the shields must be grounded at both ends. ***An overall shield (overbraid) is not permitted unless approved by the EM Group.***

Essential and non-essential wiring routed to equipment which performs critical functions must be shielded in accordance with the requirements for critical functions.

Equipment which performs essential and non-essential functions may utilize a backshell with a 360 degree shield termination methodology or a pigtail shield termination methodology (if pigtails are used they must be as short as possible and not longer than 3 inches). ***The shield termination method must be specified by the System Partner on the electrical schematic*** and is dependent upon the LRU's ability to meet the EMI emissions and susceptibility requirements.

The DHI Wire Integration Group shall utilize the information on the electrical schematic to select the appropriate backshell (360 degree vs pigtail termination).

For equipment which performs essential/non-essential functions, the Lightning/ EMI/HIRF group recommends the following backshell design concept.

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

TABLE 6. 360 degree Backshell Termination of Individual Wire Shields (One level of Shielding)

Cable Shield Configuration	Recommended Backshell	Comments
Shielded Singles, Pairs and Triplets	ICORE P/N 3CGA Series*	As listed in the S400 Permitted Parts Catalogue

*For Connector types refer to Table 10.

TABLE 7. Pigtail Termination of Individual Wire Shields (One Level of Shielding - General Purpose Backshell

Cable Shield Configuration	Recommended Backshell	Comments
Shielded Singles, Pairs and Triplets	ICORE P/N 3CSR Series*	As listed in the S400 Permitted Parts and Materials Catalogue

*For connector types refer to Table 13.

Note: The Backshell specified in Table 7 is also recommended as the general purpose backshell where Lightning/HIRF protection is not a requirement.

7.0 MIL-C-24308 "D" STYLE CONNECTOR BACKSHELLS

7.1 For Systems Which Perform Essential and Non Essential Functions

For wires associated with systems which perform essential (hazardous severe-major and major) as well as non-essential (minor, no effect) functions, ***the System Partner must identify any wires which require shielding to meet the Lightning/HIRF as well as the emissions requirements. Wiring associated with systems that perform essential functions must be shielded in EM Region 1 and 2 (External to the fuselage pressure vessel).*** Only one level of shielding is permitted (if required by the System Partner) and must be at the wire

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

level (e.g. shielded singles, pairs and triplets). To protect against the effects of Lightning/HIRF, the shields must be grounded at both ends. ***An overall shield (overbraid) is not permitted unless approved by the EM Group.***

Essential and non-essential wiring routed to equipment which performs critical functions must be shielded in accordance with the requirements for critical functions.

Equipment which performs essential and non-essential functions may utilize a backshell with a 360 degree shield termination methodology or a pigtail shield termination methodology (if pigtails are used they must be as short as possible and not longer than 3 inches).

For applications where the System Partner requires the use of MIL-C-24308 "D" Type connectors, ***the System Partner must specify the requirement for 360 degree shield termination on the electrical schematic*** and is dependent upon the LRU's ability to meet the EMI emissions and susceptibility requirements.

The DHI Wire Integration Group shall utilize the information on the electrical schematic to select the appropriate backshell (360 degree vs pigtail termination).

For equipment which performs essential/non-essential functions, the Lightning/ EMI/HIRF group ***recommends*** the following backshell design concept for MIL-C-24308 "D" style connectors where 360 degree shield termination is specified by the System Partner.

The Wire Integration Group shall specify a general purpose backshell (if required) where Lightning/HIRF protection is not required.

TABLE 8. 360 degree "D" Style Termination of Individual Wire Shields OR Overbraid (One Level of Shielding)

Cable Shield Configuration	Recommended Backshell	Comments
Shielded Singles, Pairs and Triplets OR Overall Shield	Glenair P/N 550-004*	As listed in the S400 Permitted Parts and Materials Catalogue.

*For illustration of connector refer to Figure 2.

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

8.0 ARINC STYLE CONNECTOR BACKSHELLS

8.1 For Systems Which Perform Essential and Non Essential Functions

EMI backshells for ARINC connectors do not exist as an "off the shelf" item. For applications which require the use of ARINC type connectors, ***the System Partner must provide to the DHI Wire Integration Group a list of ARINC connectors which require an EMI backshell. The Wire Integration Group must order suitable EMI backshells*** to terminate the shields in a manner which is acceptable to the System Partner.

The Wire Integration Group shall specify a general purpose backshell (if required) where Lightning/HIRF protection is not required.

9.0 WIRE SHIELD TRANSFER IMPEDANCE DATA

The DHC-8 Series 400 Permitted Parts Catalogue specifies the wire shown in Table 9 .The transfer impedance from 10 Khz to 1 GHz for the wire shown in Table 9 is provided in Figures 3 to 6.

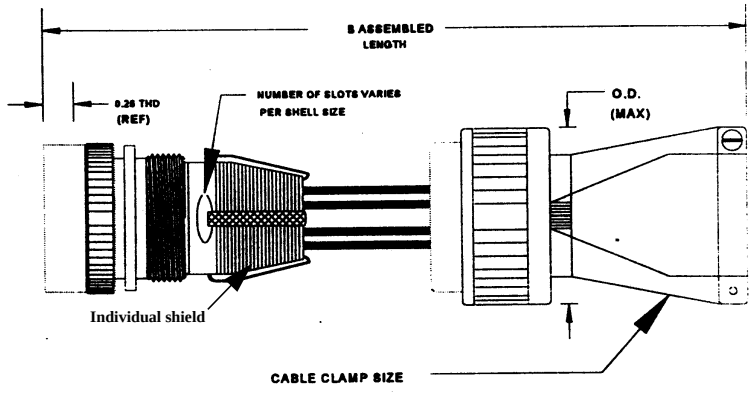
TABLE 9. Wire Types

Bombardier Part Number	Cage Code 06090
B0801402 (two conductor, tin coated, twisted shielded	55PC1121
B0801403 (three conductor, tin coated, twisted shielded)	55PC1131
B0801404 (four conductor, tin coated, twisted shielded)	55PC1141
B0801440 (two conductor, tin coated, twisted double shielded)	55PC6021

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

TABLE 10. Individual Wire Shield Termination [360 degree Circular Backshell Termination of Individual Wire Shields (One or Two levels of Shielding)

Connector	Straight (P/N)	90 degree (P/N)	45 degree (P/N)
MIL-C-38999 Series I and II	3CGA00AC41	3CGA90AC41	3CGA45AC41
MIL-C-38999 Series III and IV	3CGA00AC40	3CGA90AC40	3CGA45AC40
MIL-C-81703 MIL-C-26482 Series 2 MIL-C-83723 MIL-C-5015 Crimp	3CGA00AC54	3CGA90AC54	3CGA45AC54

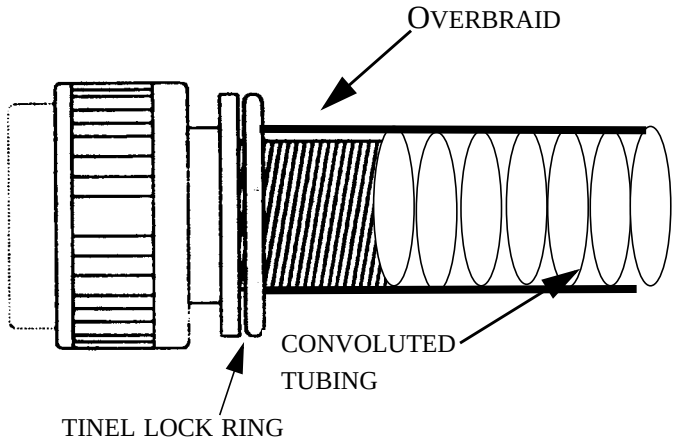


Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

TABLE 11. Overall Shield Termination: 360 degree Termination of Overbraid Only (One Level of Shielding)

Connector	Straight (P/N)	90 degree (P/N)	45 degree (P/N)
MIL-C-38999 Series I and II	3CFU00AC41	3CFU90AC41	3CFU45AC41
MIL-C-38999 Series III and IV	3CFU00AC40	3CFU90AC40	3CFU45AC40
MIL-C-81703 MIL-C-26482 Series 2 MIL-C-83723 MIL-C-5015 Crimp	3CFU00AC54	3CFU90AC54	3CFU45AC54

360 DEGREE TERMINATION (ONE LEVEL OF SHIELDING)
CONNECTOR ADAPTOR OPTILOCK

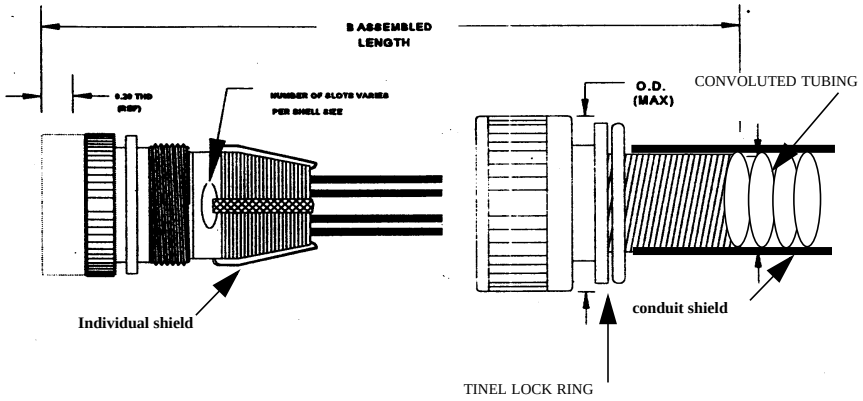


Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

TABLE 12. Individual Wire Shield and Overall Shield Termination: 360 degree Termination of Individual Wire Shields and Overbraid (Two Levels of Shielding)

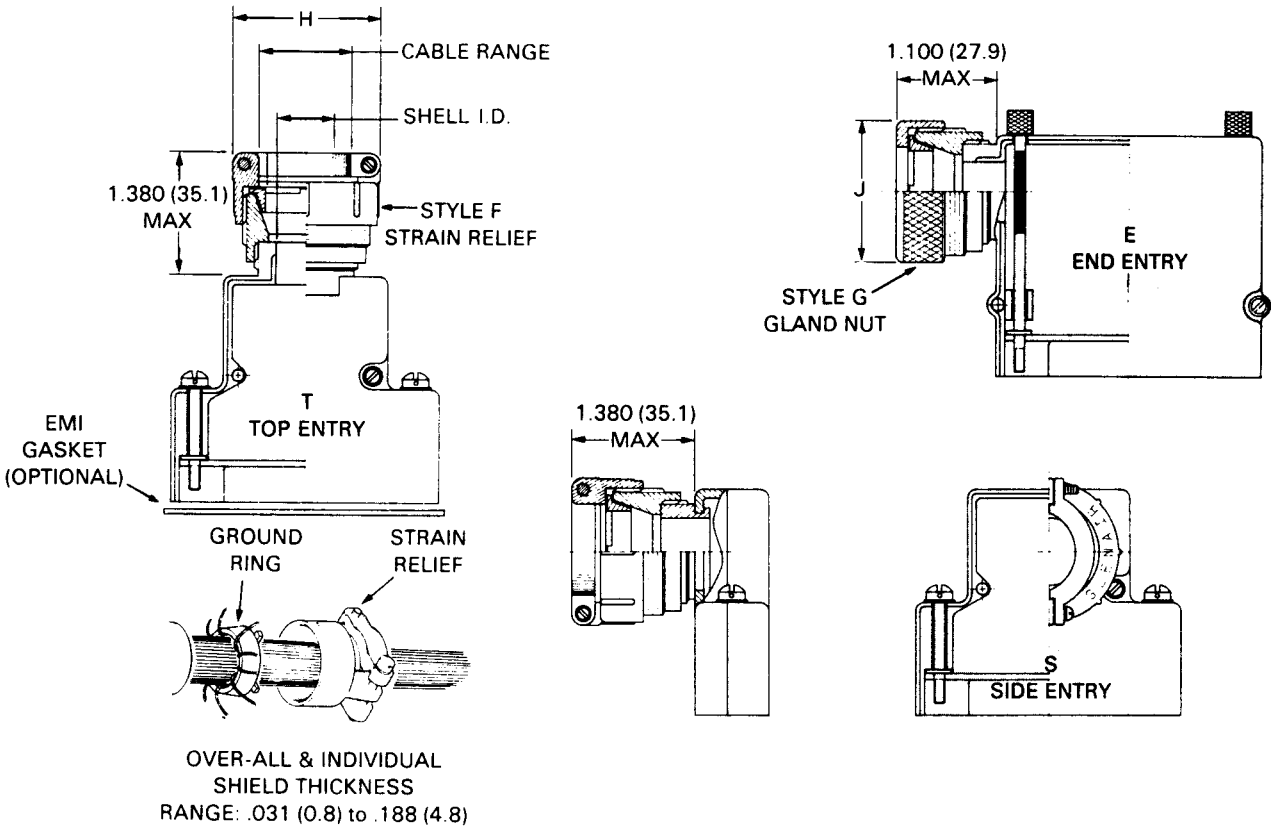
Connector	Straight (P/N)	90 degree (P/N)	45 degree (P/N)
MIL-C-38999 Series I and II	3CFUGA00AC41	3CFUGA90AC41	3CFUGA45AC41
MIL-C-38999 Series III and IV	3CFUGA00AC40	3CFUGA90AC40	3CFUGA45AC40
MIL-C-81703 MIL-C-26482 Series 2 MIL-C-83723 MIL-C-5015 Crimp	3CFUGA00AC54	3CFUGA90AC54	3CFUGA45AC54

360 DEGREE OF TERMINATION (TWO LEVELS OF SHIELDING)



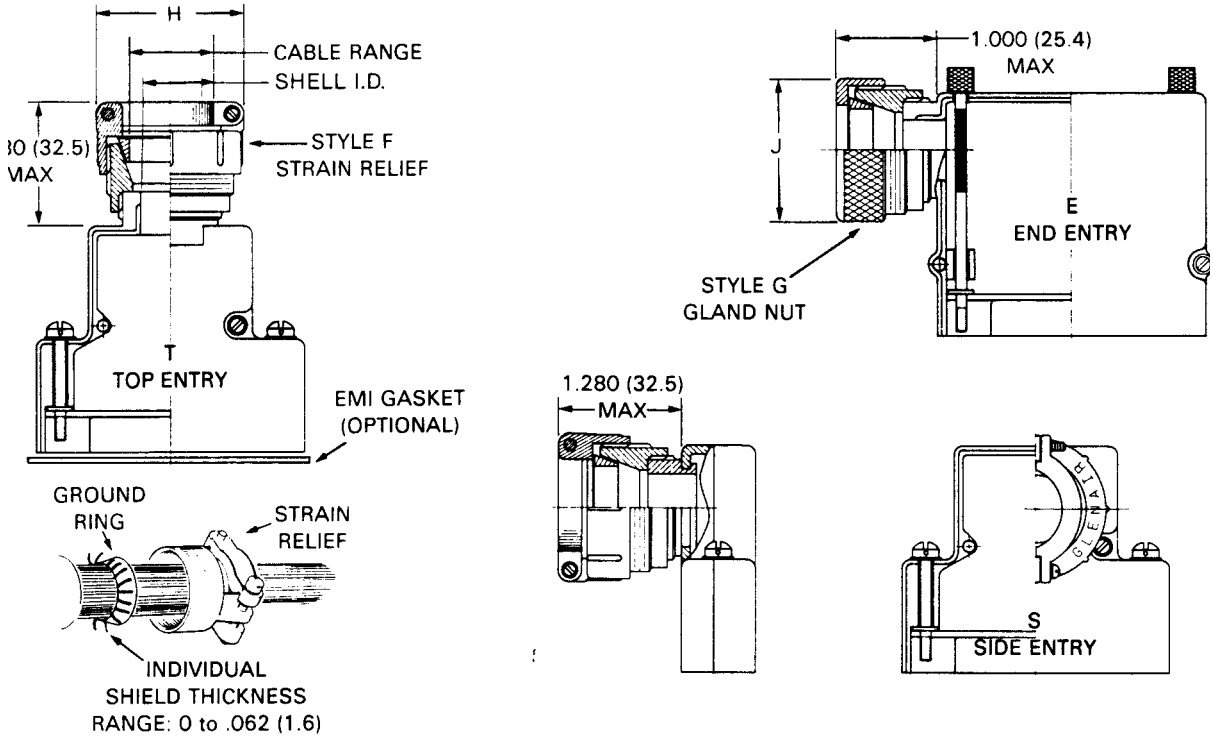
Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

FIGURE 1. MIL-C-24308 "D" Style Connector Backshells - Individual Wire Shield *and* Overall Shield Termination (GLENAIR P/N 550-003 Series)



Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

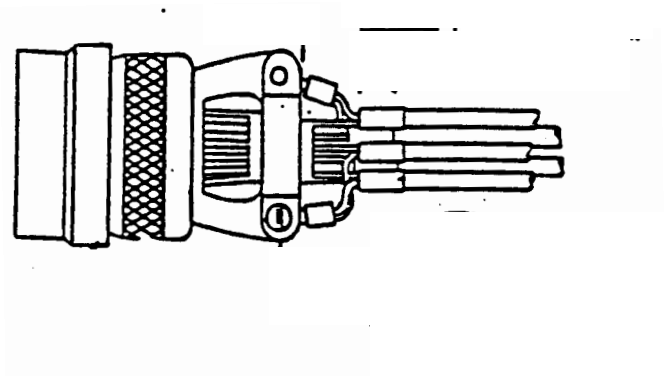
FIGURE 2. MIL-C-24308 "D" Style Connector Backshells - Individual Wire Shield *or* Overall Braid Termination(GLENAIR P/N 550-004 Series)



Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

TABLE 13. Individual Wire Shield Pigtail Termination and General Purpose Backshell

Connector	Straight (P/N)	90 degree (P/N)	45 degree (P/N)
MIL-C-38999 Series I and II	3CSR00AC41	3CSR90AC41	3CSR45AC41
MIL-C-38999 Series III and IV	3CSR00AC40	3CSR90AC40	3CSR45AC40
MIL-C-81703 MIL-C-26482 Series 2 MIL-C-83723 MIL-C-5015 Crimp	3CSR00AC54	3CSR90AC54	3CSR45AC54



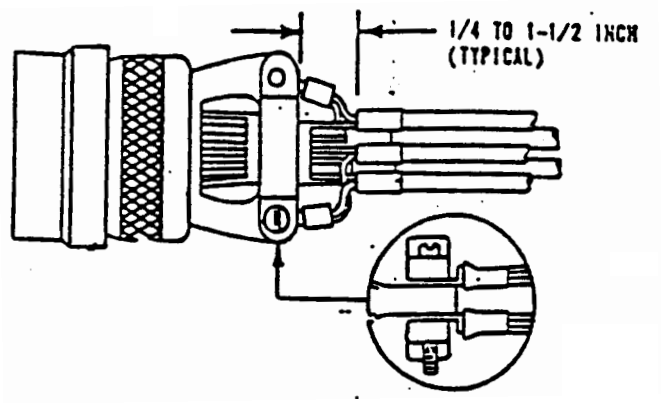
TYPICAL SHIELD TERMINATION

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

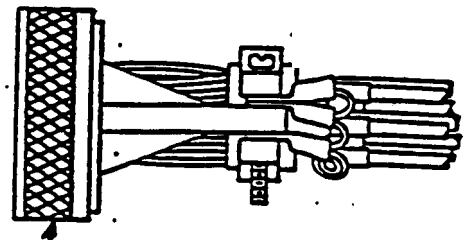
10.0 PIGTAIL SHIELD TERMINATIONS

The following illustrates the recommended methodology of termination of pigtail shields

Terminals must be firmly gripped to assure positive electrical contact of the ground terminal. The use of filler tape is recommended to assure a firm concentric grip on the wire bundle. The strain relief clamp must have metal-to-metal contact at both fastener locations between screws, clamps, terminals and clamp mounting bracket

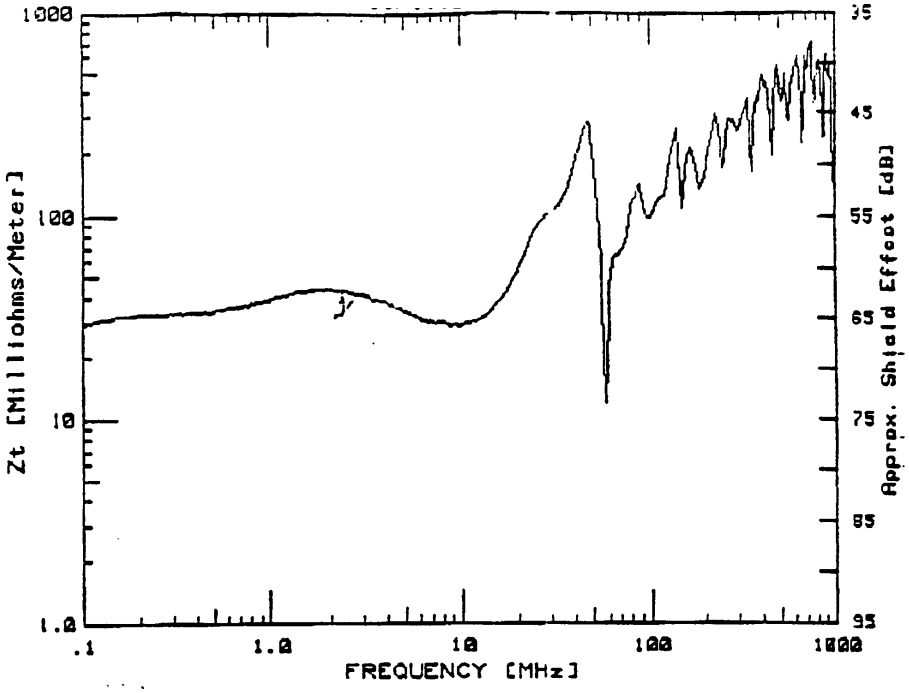


If more than four terminals (16 shield pigtails) must terminate, two (2) terminals shall be stacked back to back as shown. Terminals shall be distributed between left and right sides of the cable clamp to insure balance of clamp. Six (6) terminals (24 shield pigtails) per cable clamp as shown below is the maximum allowable configuration.



Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

FIGURE 3. Surface Transfer Impedance - B0801402 Wire



Date Of Test: 4/2/96 Test Sample Length: 1.00

Measurement Performed On H.P.8568B Spectrum Analyzer & HP8657A Signal Generator By:
F. MELO

Test Sample Response To EMP: 48.5 dB

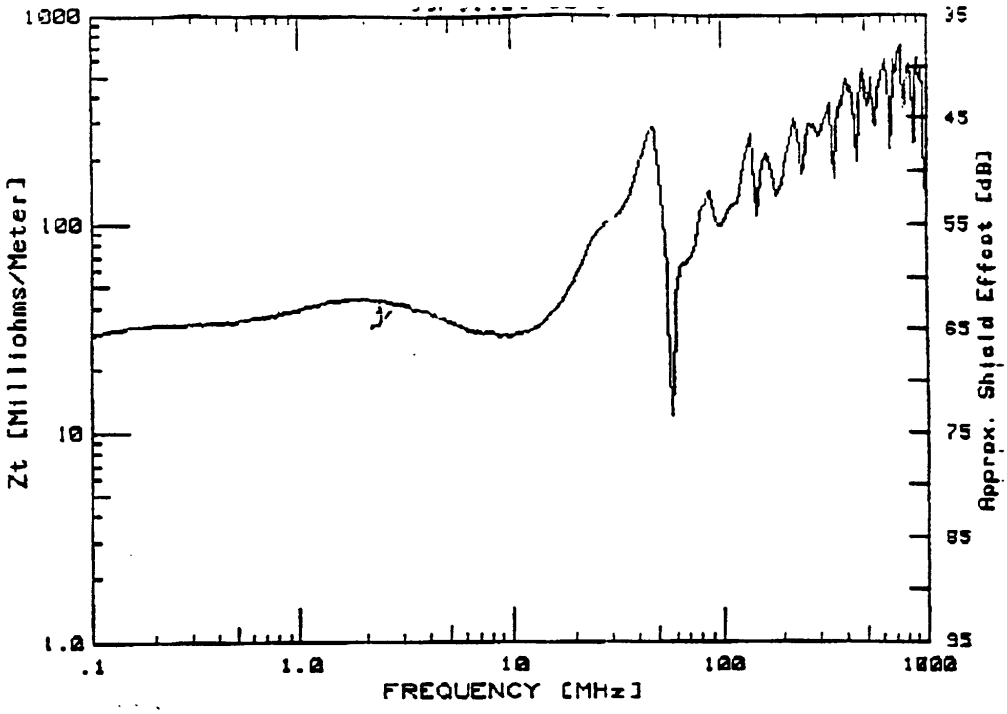
D.C. Resistance From Zt Measurement Is: 29.04 mOhms/meter
D.C. Resistance From DC Measurement Is: 40.68 mOhms/meter

The Maximum Measured Zt Value: 704.59573 mOhms/m
Value is between .1 and 1000 MHz

Detector End Termination:
All conductors to center pin, all shield(s) to backshell

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

FIGURE 4. Surface Transfer Impedance B0801403 Wire



Date Of Test: 4/2/96 Test Sample Length: 1.00

Measurement Performed On H.P.8568B Spectrum Analyzer & HP8657A Signal Generator By:
F. MELO

Test Sample Response To EMP: 48.5 dB

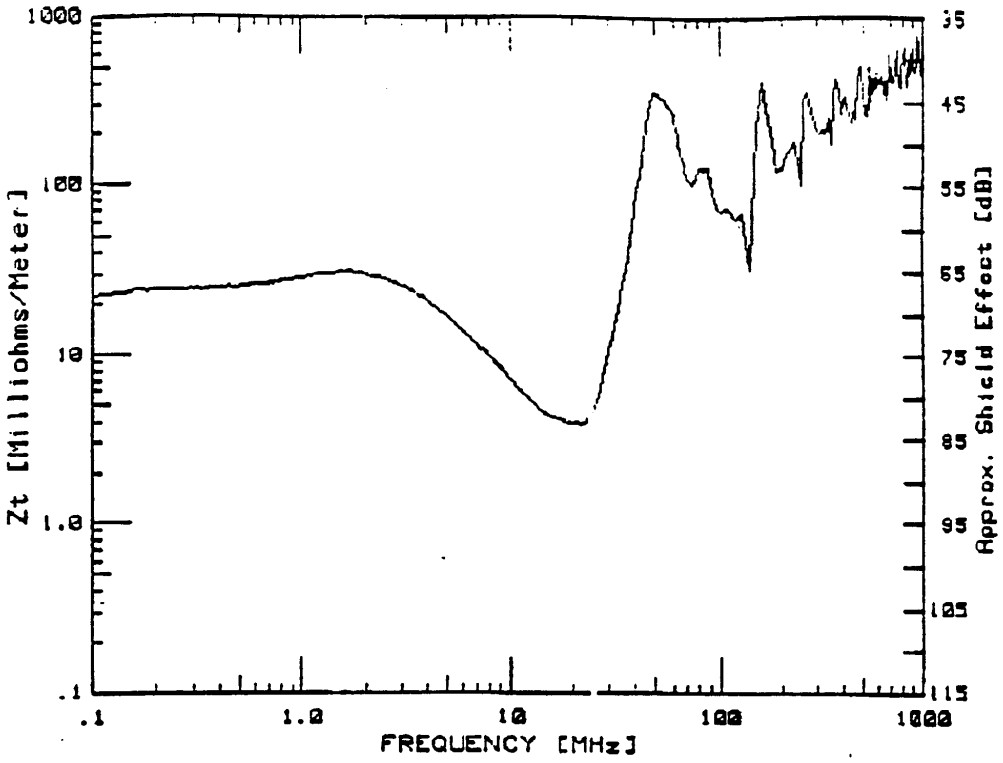
D.C. Resistance From Zt Measurement Is: 29.04 mOhms/meter
D.C. Resistance From DC Measurement Is: 40.68 mOhms/meter

The Maximum Measured Zt Value: 704.59573 mOhms/m
Value is between .1 and 1000 MHz

Detector End Termination:
All conductors to center pin, all shield(s) to backshell

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

FIGURE 5. Surface Transfer Impedance - B0801404 Wire



Date Of Test: 4/2/96 Test Sample Length: 1.00

Measurement Performed On H.P.8568B Spectrum Analyzer &
HP8657A Signal Generator By:
F. MELO

Test Sample Response To EMP: 51.0 dB

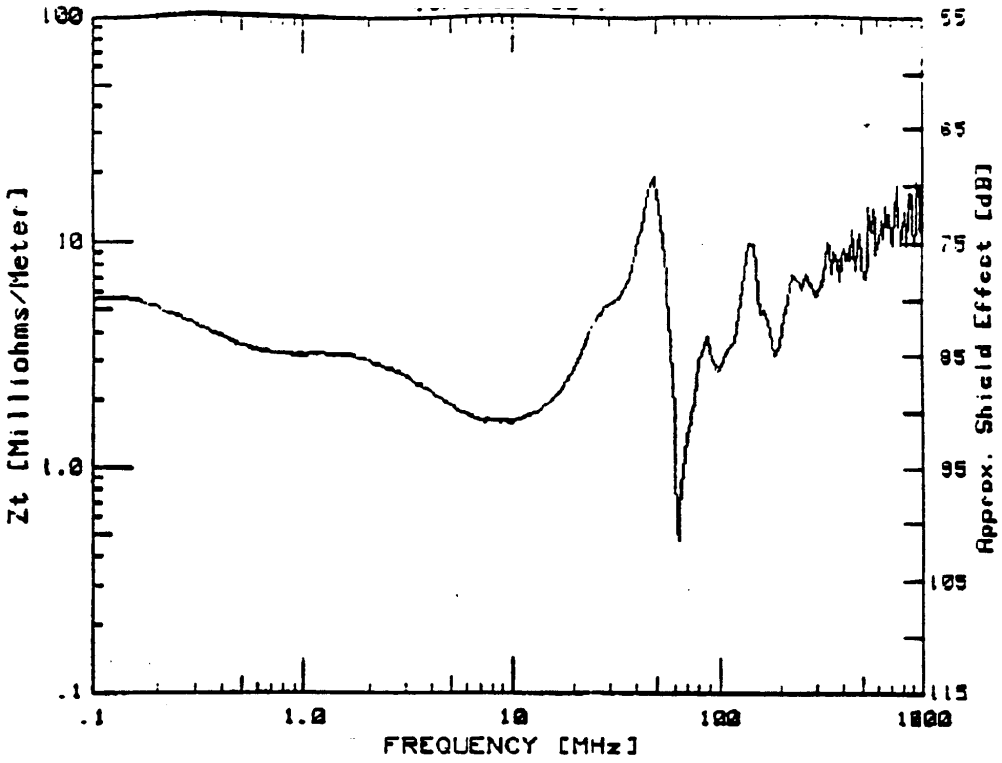
D.C. Resistance From Zt Measurement Is: 22.03 mOhms/meter
D.C. Resistance From DC Measurement Is: 31.36 mOhms/meter

The Maximum Measured Zt Value: 790.56942 mOhms/m
Value is between .1 and 1000 MHz

Detector End Termination:
All conductors to center pin, all shield(s) to backshell

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

FIGURE 6. Surface Transfer Impedance - B0801440 Wire



Date Of Test: 4/2/96 Test Sample Length: 1.00

Measurement Performed On H.P.8568B Spectrum Analyzer & HP8657A Signal Generator By:
F. MELO

Test Sample Response To EMP: 65.8 dB

D.C. Resistance From Zt Measurement Is: 5.60 mOhms/meter
D.C. Resistance From DC Measurement Is: 8.79 mOhms/meter

The Maximum Measured Zt Value: 19.18404 mOhms/m
Value is between .1 and 1000 MHz

Detector End Termination:
All conductors to center pin, all shield(s) to backshell

Cable Shield Transfer Impedance Data and Recommended Connector Backshells - DHC-8 Series 400 Aircraft

FIGURE 7. Shielded Conduit Transfer Impedance - (ICORE 3C-CML Series)