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HighVoltageharness

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**ProductDesignValidationSpecification**

Change History

20131020- first vision released _V1.0

1. Updated the crimp resisterance-20131021

20140220- the Second released _V1.1

1. Updated some translation error-20140220

Contents

# 1 Scope 适用范围

The Specification listed applied on all the Delphi high voltage harness product, all the high voltage harness product should meet the related design validation requirement according to this specification except the customer have the own special design validation requirement.

本标准针对德尔福派克设计和开发的高压线束产品，如果客户针对线束产品有特殊的要求，需要参照客户的相关规定，否则必须遵守该标准的相关要求；

# 2 Purpose 目的

The purpose of this Spec information report is to provide a test method which can be operated by Test lab for high voltage wiring harness development.

本标准的目的是针对高压线束总成产品，提供可操作性强的验证方法，帮助对高压线束产品进行验证。

# 3 ReferenceDocuments 相关标准

SAE/USCAR-21: Performance Specification for Cable-to-Terminal Electrical Crimps

端子压接性能规范

SAE/USCAR37: High Voltage Connector Performance for Automotive

汽车用高压接插件性能要求

IEC60068-2-1: Environmental testing – Part 2-1: Tests –Test A: Cold

环境试验，第二章节试验A-低温

IEC60068-2-2: Environmental testing – Part 2-1: Tests –Test B: Dry heat

环境试验, 第二章节试验B-高温

IEC60068-2-14: Environmental testing .Part 2-14: Tests. Test N: Change of temperature

环境试验，第二章节试验N-温度变化

IEC60068-2-38: Environmental testing-Part2-Test Z/AD: Composite temperature/humidity

环境试验，第二章节试验 Z/AD-温度和湿度交变

ISO 20653 ： 2006 Road vehicles - Degrees of protection (IP-Code) –

Protection of electrical equipment against foreign objects, water and access

电气设备防护等级定义

SAE J1742: Connections for High Voltage On-Board Road Vehicle Electrical Wiring Harnesses —Test Methods and General Performance Requirements

道路行驶车辆电线束产品-高压接插件产品试验方法和通用性能要求

IEC 60529- Degrees of protection provided by enclosures (IP Code)

国际电气设备防护等级定义

SAEJ2223-Connections for On-Board Road Vehicle Electrical Wiring Harnesses —

Part 2: Tests and General Performance Requirements

道路行驶车辆电线束产品-线束产品接插件产品试验方法和通用性能要求

# 4 General 通用准则

The tests detailed in this specification are qualitative in nature and are not expected to stress Any part beyond its anticipated application limit， the test procedures that follow were written as stand-alone tests and may be used as such. However, they are intended to be performed in sequence as specified; Common sense is required to overcome any redundancies in sample, preparation or in procedures. Should any conflicts or questions arise concerning procedures and/or requirements, contact the Authorized Person.

本试验标准定义了在整车正常状态下，线束产品应该完成的定性试验要求，并预期不会超出产品的使用极限。该标准的每一条测试项，都有独立的测试程序，但是需要参照该标准规定的试验排序进行，具体的样品数量和试验前的准备工作，以及相关试验步骤也有详细的说明，如果出现任何试验步骤和试验要求问题的冲突，请联系相关授权人员。

In additional, the low voltage connector on high voltage wiring harness does not to do the high potential test before and after test.

对于高压线束中的低压接插件，在试验前后的检查项，不需要进行耐高压检测；

# 5 DefinitionsandAbbreviations 定义和缩写

## 5.1 Definitions 定义

I. For DC HV circuits, voltage range
直流高压回路，电压等级

60 V DC <= U <= 1 500 V DC

II. For AC HV circuits, voltage range
直流高压回路，电压等级

25 V AC (rms) < =U <= 1 000 V AC (rms)

## 5.2 Abbreviations 缩写

| | |
|---|---|
| I | Current 电流 |
| R | Resistance 电阻 |
| U | Voltage 电压 |
| IEC | InternationalElectrotechnicalCommission 国际电工技术委员会 |
| SAE | SocietyofAutomotiveEngineers 美国汽车工程师学会 |
| RMS | Rootmeansquare 有效值 |
| IP | Internationalprotection,ingressprotection 国际防护 |
| ISO | InternationalOrganizationforStandardization 国际标准化组织 |
| AC | Alternatingcurrent 交流 |
| DC | Directcurrent 直流 |

# 6 Classifications 分类

## 6.1 VoltageClass 电压分类

Delphi identifies the voltage class as follows. See the table 1 in details.

德尔福定义的新能源汽车的电压分类，参见表 1.

| Type | Mild Hybrid | Plug-in Hybrid | EV |
|---|---|---|---|
| Voltage | 144V | 288V | 400V |

Table 1 voltage class

表1 电压分类

## 6.2 TemperatureClassification 温度等级分类

HV Harness to be tested must be assigned a class from the table below according to the Expected environment in their intended vehicle application. Care must be taken to ensure that the components of harness selected for the application or any test will itself withstand the maximum temperature for the class selected ， or the test criteria will be adjust according the actual condition.

高压线束产品在被测试时，应该遵照下表的耐温度等级进行试验除非客户提出特殊的整车应用温度条件。在进行试验时，必须确保所有线束零部件产品的耐温度能力可以承受下表中的最大温度等级，否则，相关的试验判定依据需要进行相应调整，因为相关零部件超出最大工作温度，可能零部件性能会存在降低。

| Class | Work temp | Expose temp |
|---|---|---|
| | -40C-85°C | -40C-95°C |
| I | -40C-105°C | -40C-115°C |
| II | Tmin-Tmax | Tmin+10- |

Table 2 temperature class

表2温度等级要求

备注：

1. Tmin-客户规定的最低工作温度
2. Tmax-客户规定的最高工作温度

## 6.3 SealingClassification 密封性能分类

High Voltage Harness to be tested must be assigned a class from the table below according to the Expected environment in their intended vehicle application ， except the special requirement for the customer. pls see the table3 in details.

高压线束产品在进行密封测试时，应该遵守下表中的密封等级要求，除非客户对整车使用情况有特殊的密

封要求,高压线束产品的密封等级要求入下表3：

| Class | IPXX | 说明 |
|---|---|---|
| S1 | IP55-sealed | 针对慢充和快充座线束产品 |
| S2 | | |
| S3 | IP67-sealed | 针对除慢充和快充线束外的普通高压线束 |

Table 3 sealing class

表3 高压线束产品密封等级要求

A. The connectors of high voltage wiring harness should be mated, and related header should be sealed at the same time.

高压线束产品在做 IP 等级试验时，确保高压线束上的接插件处于对配装配，并且对配端需要相应的密封处理；

B. IP Test General Test conditions: temperature range: 23 ± 5C, relative humidity: 25% -75%. Atmospheric pressure: 86kpa-106kpa

IP 试验通用测试条件：温度范围为： 23±5C ，相对湿度为： 25%-75%。大气压力为： 86kpa-106kpa

C. For slow and quick charging socket wiring harness assembly, the existence of the harness connectors to IP55 requirements charging socket, the other connector is IP67 requirements, the test sequence as below: first complete HV wiring harness IP55 test, if the others connector has also been used at the same project and already passed IP67 test, so the connectors do not require re-IP performance test, if not, IP67 test should been done.

对于快慢充插座线束总成而言，存在线束充电插座接插件为 IP55 要求，另外一端接插件为 IP67 要求的现象，试验时：先完成 IP55 试验，如果另外一端接插件在本项目高压线束中也被使用并通过 IP67 测试，因此不需要重新对该接插件再做 IP 性能测试，如果没有，把 IP55 端接插件密封处理，再针对总成做 IP67 试验。

# 7 VisualInspection 外观检验

## 7.1 Purpose 试验目的

This test is used to document the physical appearance of test samples and to assist in the evaluation of the effects of environmental conditioning on test samples. A comparison can then be made with other test samples. Examinations in most cases can be accomplished by a person with normal or corrected vision, and normal color sensitivity, under cool white fluorescent lighting. Photographs and/or videos are encouraged as a more complete means of documentation. An appropriately identified untested sample from each test group must be retained for post-test physical comparisons if photographs/video is not taken.

本试验是检查试验样品的物理外观性能，以用来评估被测试样品在环境试验条件下的影响；通过试验前后的比较，用来检验评估的目的。外观检验在大部分情况下通过人工来完成，并辅助一些冷白灯光，颜色识别卡，照片以及视频工具。如果在没有图片和视频的条件下，适当数量试验前后的样品应该保存下来，作为试验证据。

## 7.2 Equipment 试验设备

Video/photography equipment

## 7.3 Procedure 试验步骤

1. Visually examine each test specimen prior to testing and/or conditioning, noting in detail any manufacturing or material defects such as cracks, deformation, etc. When specified in the test request/order, take photographs and/or video recordings of representative samples to be tested and keep a properly method to identify the each test samples, such as with label.

   在试验前和试验进行时，观察高压线束产品物理外观： 1 产品是否破损。 2 产品是否变形 3产品的尺寸测量， 4 相关，并把相关的现象使用视频和图片设备记录，并对检查过的试验样品通过适当的方法来区分，比如贴标签。

2. After testing, re-examine each test sample and note in detail any observable changes, such as physical distortions, cracks, etc. Compare the tested and/or conditioned samples to the control samples, the videos, and/or the photographs, recording any differences in the test report

   在实验完成后，重新对被测线束产品进行检查，观察产品物理外观： 1产品是否出现物理变形。 2 线束产品是否出现物理腐蚀。 2 产品是否破损。 3 测量线束总成尺寸，并通过视频和图片设备把相关证据记录下来，并在实验报告中列出。

3. Return test samples to requestor after all tests are completed and all related test samples are recommend to keep for one month at least.

   在所有实验完成之后，把实验样品保持起来，至少一个月。

## 7.4 AcceptanceCriteria 接受标准

### 7.4.1 Harness 高压线束

The harness under test must not show any evidence of deterioration, cracks.

The test temperature is higher than some component, such as tape and conduit, those part have little color change is allowed ，but the cracks is forbidden. After completion of the test, there should be no crack, color change, distortion and Swelling. Functional performance should confirm requirements. The test sample dimensions before or after test should meet the drawing spec.

试验前后，高压线束产品必须没有任何物理破损和变形等现象。在试验过程中，胶带或者波纹管等部件表面稍许的颜色变化是允许的，但不允许有脱离和破裂现象出现 ，另外，所有被测试的样品试验前后的尺寸必须满足客户的确认图纸要求。

### 7.4.2 LabelofHVHarness 高压线束标签

Marking and labeling shall remain visible and legible

高压线束警示标签，还有普通出厂标签都应该清晰可见。

### 7.4.3 Platedparts 镀层零件

There should be no degradation of performance or function, and only minimal traces of corrosion should be allowed；

对于完成盐雾试验的样品，在清洗之后，相关功能测试满足要求，表面可允许有稍许锈迹出现；

### 7.4.4 HVConnector 高压接插件

1. IP5X test, allows a portion of the connector inside the dust penetration;
   IP5X 试验后，接插件内部可以允许有部分粉尘渗入；
2. IP6/6kX After the test, no dust penetrate inside the connector;
   IP6/6kX 试验后，接插件内部无粉尘渗入；
3. IPX5/7/9k- After the test, the connector cannot have water into the interior;
   IPX5/7/9k-试验后，接插件内部不能有水进入；
4. HV connector on the test, can not appear to change color, physical breakage;
   高压接插件在试验后，不能出现颜色改变，物理破损现象；

### 7.4.5 Shieldbraid 屏蔽网

1. Shield braid is intact and clean before the test

   试验前，屏蔽编织网完整，压接区光亮清洁，整齐;
2. No physical damage observed after test
   试验后没有物理的损伤出现;
3. Shield braid inside was intact —only minor corrosion in some area after test
   试验后屏蔽编制网完整，允许存在少部分的腐蚀现象;
4. Braid shield crimp area inside the crimp ring was clean

   试验完成后，剪开压接环，观察屏蔽层压接区和压接换内部整齐、光亮，没有腐蚀现象；

# 8 VoltageDrop(1) 电压降测试 1

## 8.1 Purpose 试验目的

1. This test is intended to be used for terminals crimped on >5 mm2 wire size ；
   该测试只针对大于 5mm2 的导线压接规范要求
2. This procedure defines measuring the termination voltage drop of static crimped contacts the current through the specimen will be applied at a level per table 3 as follows. This current is applied to the sample under test so voltage drop of the termination can be measured.

   本试验定义了线束产品端子压接部分压降的测量方法，并用来评估线束产品在完成环境试验后端子压接区的压接是否满足要求，相关的测试电压见表格 4；

## 8.2 Equipment 试验设备

1. DC Power supply (0~20V. (200A min recommended)) Or 0~20 V current as required.
   直流电源装置
2. Digital Volt meter
3. 数字电压计

## 8.3 Procedure 试验步骤

1. A minimum sample length of 250 mm is recommended. Cut the samples based on each terminal on high voltage harness from the harness after test.

   从完成实验的高压线束产品中，以每个端子为基准，分别剪取 250mm 长的短样 pigtail。

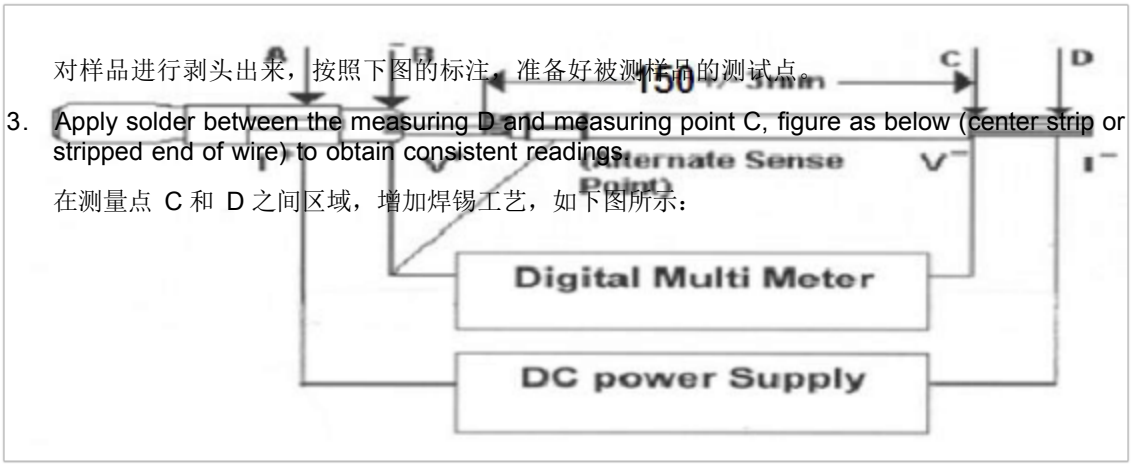
2. Prepare the voltage drop measurement points on the test samples at a point on the cable 150 ± 3 mm from the rear edge of the terminal conductor grip.

**Title:** High Voltage Wiring Harness DV Specification

对样品进行剥头出来，按照下图的标注，准备好被测样品的测试点。

3. Apply solder between the measuring D and measuring point C, figure as below (center strip or stripped end of wire) to obtain consistent readings.

在测量点 C 和 D 之间区域，增加焊锡工艺，如下图所示：



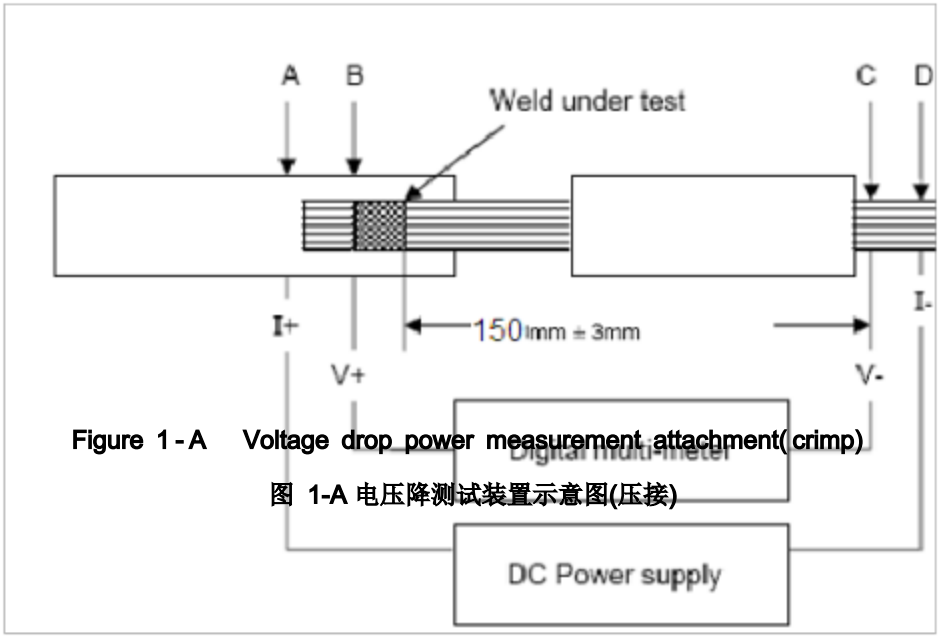




**Figure 1 - A Voltage drop power measurement attachment( crimp)**

**图 1-A 电压降测试装置示意图(压接)**

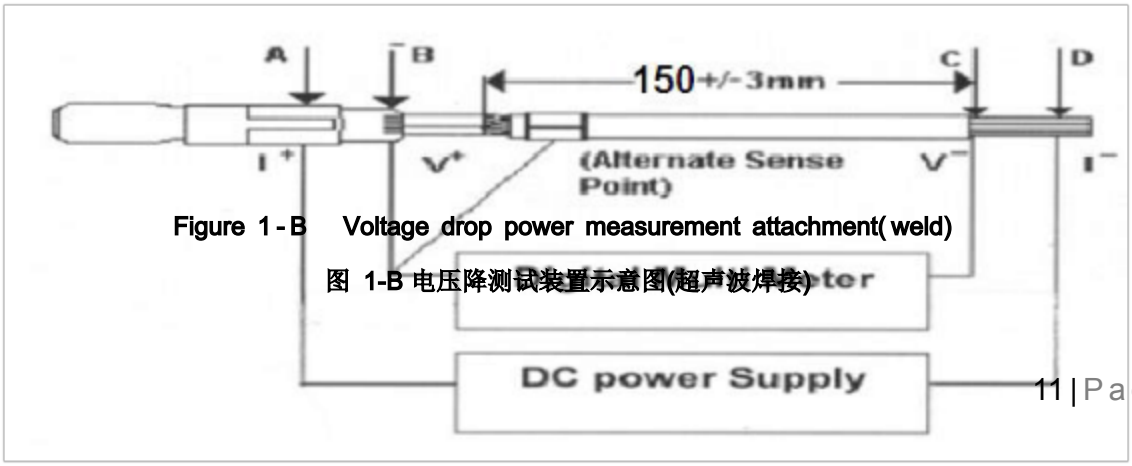
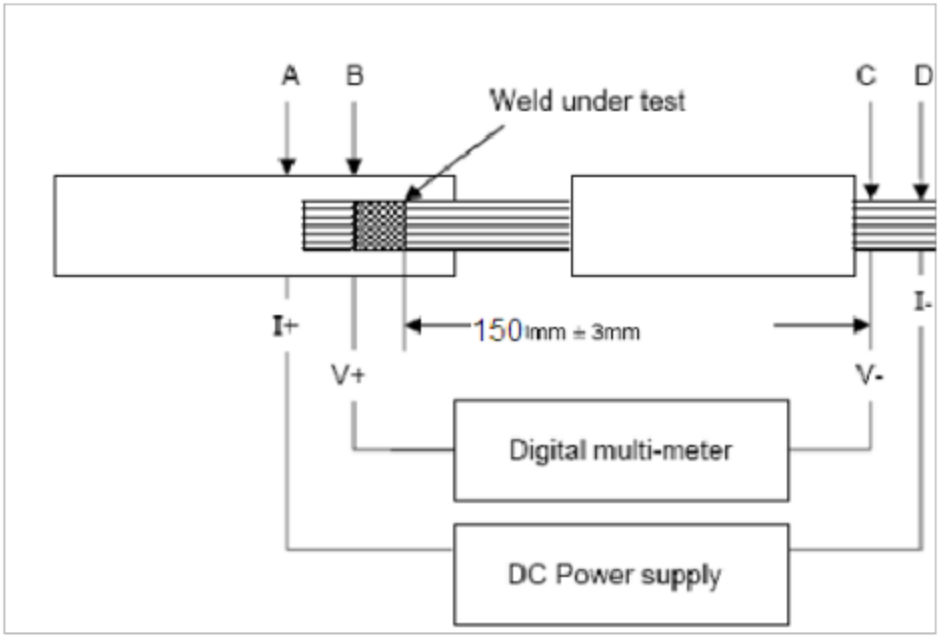



Figure 1-B Voltage drop power measurement attachment(weld)

图 1-B 电压降测试装置示意图(超声波焊接)





4. Apply current (based on wire size) per table 4.5.6.5 at points A and D
按照下表电流值，在 A 和 D 点通电流。

5. Allow the temperature of samples to stabilize with current applied.

The temperature is stable when the grip on the sample under test changes less than 2°C in 5 minutes.

在通电流后，需要保证样件温度达到稳定条件， 5 分钟内，温升少于 2°C。

6. Cut the 200mm samples, measure and record the voltage drop of the 3samples with soldered grips. The measurement is made at a point 150±3 mm from the rear edge of the terminal conductor grip. The average voltage drop value of these 3 samples will be used in step 8

从完成实验的样线中，剪取 200mm 长度导线 3 端，并两头剥头，绝缘部分保留 150mm±3 短样 3 段，两端剥头使用焊接工艺处理。并测量该短样的电压降 V， 该电压降的平均值 Vs.。

7. Measure and record the voltage drop on each sample between the cable measuring point C and point B on the terminal, just in front of the conductor grip.

测量点 C 和点 B 点(压接区末端)的电压降 Vbc，并做记录。

8. Calculate and record the crimped grip voltage drop: The crimped grip voltage drop is equal to the overall sample voltage drop measured in step 6, minus the average voltage drop of the 3 soldered grip samples measured in step 6.

计算和记录压接区的电压降， Vc=Vbc-Vs.其中 Vbc 为测量点 C 和测量点 B 的电压降, Vs 为 3 段 150mm 短样的平均值。

## 8.4 AcceptanceCriteria 接受标准

Maximum allowable Voltage Drop for terminal/wire combinations wire shall be equal to or less than the values shown in table.
端子压接区最大电压降标准参见下表：

| Mm2 wire size | Test current | Maximum(mΩ) | Maximum Change (mΩ) |
|---|---|---|---|
| >5<13 | 60A | 0.13 | 0.07 |
| >=13<19 | 75A | 0.10 | 0.06 |
| >=19<32 | 100A | 0.08 | 0.05 |
| >=32<40 | 100A | 0.05 | 0.03 |

1 mΩ=1mV/A

Table 4 the current and voltage requirement

表 4 电压降试验测试电流要求和电压降标准

# 9 VoltageDrop(2) 电压降测试 2

## 9.1 Purpose 试验目的

1. This test is intended to be used for terminals crimped on <=5 mm2 wire size.
   该测试只针对小于或等于 5mm2 的导线压接规范要求
2. The test require that the maximum voltage impressed across the test sample be limited to 20 millivolts, and the maximum current through the sample be limited to 100 mill amperes..

该试验要求通过被测样品的电压值不超过20mV，通过被测样品的电流值不超过100mA

## 9.2 Equipment 试验设备

Micro-ohmmeter

毫欧表

## 9.3 Procedure 试验步骤

1. A minimum sample length of 150 mm is recommended. Cut the samples based on each terminal on high voltage harness from the harness after test.

   从完成实验的高压线束产品中，以每个端子为基准，分别剪取 150mm 长的短样 pigtail。

2. Prepare the voltage drop measurement points on the test samples at a point on the cable 75 ± 3 mm from the rear edge of the terminal conductor grip.

   对样品进行剥头出来，按照下图的标注，准备好被测样品的测试点。

3. Apply solder to area between the point C and point D, figure as below (center strip or stripped end of wire) to obtain consistent readings.

   并在测量点 C，D 之间段增加焊锡工艺，如下图所示：

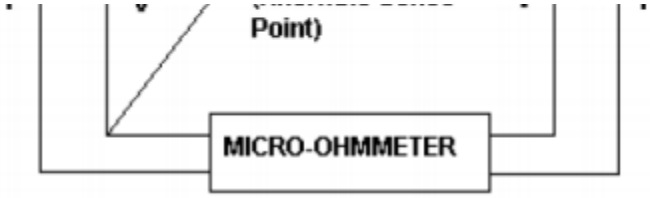



**Figure 2 Crimping Resistance measurement attachments**

**图 2 压接电阻测试装置示意图**

4. Apply current (based on wire size) per table 4.5.6.5 at points A and D
   按照下表电流值，在 A 和 D 点通电流。

5. Cut the 100mm samples, measure and record the voltage drop of the 3samples with soldered grips. The measurement is made at a point 75+ 3 mm from the rear edge of the terminal conductor grip. The average voltage drop value of these 3 samples will be used in step 8

   从完成实验的样线中，，剪取 100mm 长度导线 3 端，并两头剥头，绝缘部分保留 75mm±3 短样 3 段，两端剥头使用焊接工艺处理。并测量该短样的电阻值，并计算出平均值 Rs。

6. Measure and record the voltage drop on each sample between the cable measuring point C and point B on the terminal, just in front of the conductor grip.

测量点 C 和点 B 点(压接区末端)的电压降 Rbc ，并做记录。

7. Calculate and record the crimped grip resistance: The crimped grip voltage drop is equal to the overall sample voltage drop measured in step 6, minus the average voltage drop of the 3 soldered grip samples measured in step 6.

计算和记录压接区的电阻值， Rc=Rbc-Rs.其中 Rbc 为测量点 C 和测量点 B 的电压降, Vs 为 3 段 75mm 短样的平均值。

## 9.4 AcceptanceCriteria 接受标准

The terminal of samples crimping resistance as follow.

端子压接电阻要求如下：

| Mm2 wire size | Test current | Maximum(mΩ) |
|---|---|---|
| <=5 | NA | 0.3 |

Table 5 crimping resistance

表5 端子压接电阻

# 10 ShieldingCrimpingResistance 屏蔽压接电阻

## 10.1 Purpose 试验目的

Shielding performance is one of key item on high voltage harness system. The test clarify the test procedure the test criteria to help judge the shielding effect based on the crimping resistance. The test require that the maximum voltage impressed across the test sample be limited to 20 millivolts, and the maximum current through the sample be limited to 100 mill amperes..

屏蔽性能是高压线束系统判定中比较重要的一个指标，通过该试验来验证定高压线束产品的屏蔽压接性能 该试验要求通过被测样品的电压值不超过 20mV，通过被测样品的电流值不超过 100mA。

## 10.2 Equipment 试验设备

Micro-ohmmeter

毫欧姆计

## 10.3 Procedure 试验步骤

1.

2.

3.

A minimum sample length of 200mm is recommended. Cut

the samples from the harness after test .从完成实验的线束产品中，剪取 200mm 长的短样。

Prepare the voltage drop measurement points on the test samples at a point. Distance of point B and point C is 75mm±3mm; the point B is end of crimp area.

按照下图的方式准备好样件，已经相关的测试点,并要求 BC 点为 75mm.其中 B 点为压接的末端。
Apply solder on the area between point D and point C.

在区域 CD 之间增加焊锡工艺。

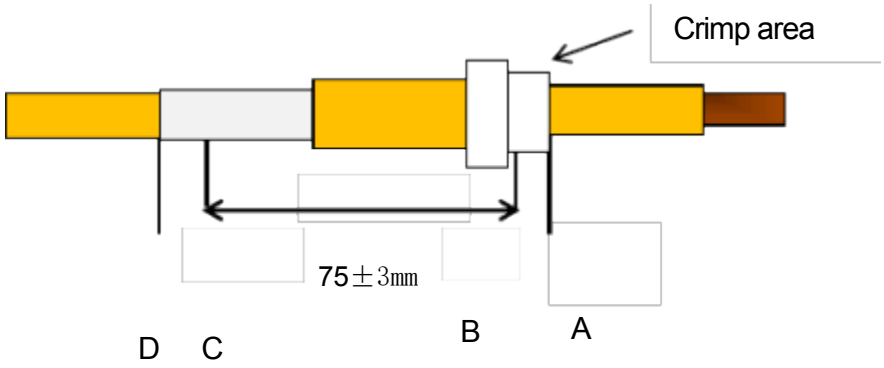


**Figure 3 shielding crimp resistance measurement attachments**

**图 3 屏蔽压接电阻测量示意图**

4. Measure and record the voltage drop of the 3samples with soldered grips. Cut the 150mm sample from sample after test, the measurement is made at a point 75+ 3 mm from the rear edge of the terminal conductor grip. The average voltage drop value of these 3 samples will be used in step 8

   从被测样品线，剪取 150mm 样线 3 套，在两端焊锡工艺后，分别测试 75±3mm 屏蔽层的直流电阻，并计算出平均值 Rs.

5. Measure and record the crimp resistance on each sample between the cable measuring point A and point C on the terminal, A is the end of crimp area.

   测量 A 点和 C 点的压接电阻，并记录为 Rac 其中 A 点为压接起点。

6. Calculate and record the crimped grip resistance: The crimped grip voltage drop is equal to the overall sample voltage drop measured in step 6, minus the average voltage drop of the 3 soldered grip samples measured in step 4.

   计算和记录压接区的压接电阻， Rc=Rac-Rs.其中 Rac 为测量点 C 和测量点 A 的压接电阻， , Vs 为 3 段 75mm 短样的平均值。

## 10.4AcceptanceCriteria 接受标准

屏蔽层压接电阻要求如下：

| Connector | Type | Maximum(mΩ) |
| --- | --- | --- |
| HV280(<=5mm2) | Ferrule | 3 |
| | | |
| PP1000(>5<=25mm2) | Ferrule | 2.5 |
| | | |
| PP2000(>25<=100mm2) | Ferrule | 1.5 |

Table 6 resistance criteria of shielding crimping

表 6 屏蔽压接电阻标准

# 11 IsolationResistance 绝缘电阻测试

## 11.1 Purpose 试验目的

This test verifies that the electrical resistance between any two cavities in high voltage connector, and the between shielding layer and terminal on the harness assembly. In o, this test is typically done before and after other environmental stress tests to ensure that any contaminants that may have entered the connector during testing are not sufficient to create an unintended electrical path. In order to protect consumers from potentially fatal electric shock

此测试验证，高压线束产品中任何两个高压接插件端子之间，以及屏蔽端和高压接插件端子之间的电阻。目的是通过测量相关的绝缘电阻值来判断高压线束产品的安全性，以来确保高压线束产品不会形成电气回路，导致相关人员免受潜在致命的电击。