MD GROUP
HANDLING INSTRUCTION
For assembled Multi-Core-Cables for the data transmission in the automotive sector

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1. Abbreviations and Definitions

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<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>MCC</td>
<td>Multi-Core-Cable</td>
</tr>
<tr>
<td>HSD</td>
<td>High Speed Data</td>
</tr>
<tr>
<td>Assembled cables</td>
<td>Cables consisting of goods on reels and connector(s)</td>
</tr>
<tr>
<td>Coding</td>
<td>Unambiguous distinction of the coding housings in terms of geometry and color</td>
</tr>
<tr>
<td>Interface specification</td>
<td>Definition of an electrical supply terminal on the basis of the geometry and the mechanical and electrical parameters</td>
</tr>
<tr>
<td>OEM</td>
<td>Original Equipment Manufacturer</td>
</tr>
<tr>
<td>Cable harness engineer</td>
<td>Engineer (OEM or Tier1) for cable harnesses in the automotive sector</td>
</tr>
<tr>
<td>DMU / PMU</td>
<td>Digital Mock Up / Physical Mock Up</td>
</tr>
<tr>
<td>Customer</td>
<td>Requester or ordering party of the assembled cables (OEM, Tier1, other customers)</td>
</tr>
</tbody>
</table>

2. Range of Application

This norm describes the intended installation/the intended handling of assembled Multi-Core-Cables of MD ELEKTRONIK. The data and values indicated in this MD norm refer to the technical specifications of the individual components and to the experiences in the automotive field of application. The (mechanical, electrical, thermal and environmental) requirements are binding for the intended use and for the handling of the products.

3. General Requirements

When handling assembled cables and their components, all mechanical influences that are not caused by the mating process itself have to be avoided. During the installation of the cable harness and its components, it is not allowed to step on the assembled cables. In general, tensile loads are not allowed. It is not allowed to throw assembled cables (e.g. into the vehicle body). The assembled cables have to be designed by the customer according to the installation situation in the vehicle (e.g. static/dynamic, engine compartment/passenger compartment, tensile loads, ...)

Continuous loads (e.g. tensile loads) during operation are not covered by the manufacturer specifications (see respective data sheets) and have to be coordinated with the component manufacturer if necessary (see chapter 4).

Only lubricants and media that are approved according to the manufacturer's standard and OEM specification and that are qualified in combination with the assembled cables are allowed to be used during processing.

In order to minimize the loads on the assembled cables, an optimum design and installation of the cable harness (DMU/PMU) is to be strived for. In order to ensure this requirement, the wide variety of connectors (e.g. cable exit directions) is to be used and low loads are explicitly to be considered.
3.1 Interface

Only components that are qualified and released according to the respective OEM interface specification are allowed to be used. The mating compatibility has to be ensured by the individual manufacturers.

3.2 Order and cleanliness

When handling assembled Multi-Core-Cables, any type of dirt has to be avoided and order and cleanliness are required at any time.

3.3 Delivery and storage

The delivery, receipt and storage of assembled cables (see also document C11569) must not take place outdoors without any protection. Under such conditions, the protection of the mating areas against dirt or humidity is not ensured. Additionally, UV irradiation and increased temperature can result in an unintentional aging.

3.4 Simplified installation by healthing

The cables must not be preconditioned above 60 °C (140 °F) for the purpose of simplified cable harness installation because this can result in an unintentional aging/damage of the cables. In consequence, this can adversely affect their function and lifetime.

3.5 Handling

In order to avoid injuries during mating, disconnecting and installing cables, it is recommended to wear protective gloves.
4. Mechanical and Thermal Loads

4.1 Tensile load

Regarding the mechanical load, Multi-Core-Cables are subject to special criteria. During processing and operation, tensile forces on the cable or the connector are not allowed. Tensile forces between the cable and connector that will result in the malfunction of the assembly can be caused by:
- a cable length that is too short
- a cable fixation that is under tension
- an insufficient fixation and therefore damage due to self-weight, vibration or strokes.

The manufacturer specifications refer to the pure qualification tests according to the required specifications for the components. They are only a snapshot of the moment of qualification. In case of a deviation from these requirements, a qualification according to these conditions is recommended.

4.2 Bending load

During the installation of assembled cables, it has to be ensured that the bending radii on the entire assembled cables are complied with. This applies to all variants.

4.2.1 Static installation in the vehicle

For a static installation of the cables, i.e. installation without movement, the values can be found in the manufacturer specifications under the item “Bending radius” (e.g. under “Single” or at “Single bending”).

4.2.2 Dynamic installation in the vehicle

For the installation with dynamically recurring bending of the cable (e.g. in doors, exterior mirrors or tailgates), the values can be found in the manufacturer specifications under the item “Bending radius” (e.g. under “Multiple” or at “Repeated bending”).
Loads that exceed the specifications of the individual components (connectors) have to be validated on a case-by-case basis or they must be independently applied by the OEM or the cable harness supplier.
4.2.3 Definition of the bending radius

Correct bending

Incorrect bending

4.2.4 Use of MQS stranded wires

If additional stranded wires are used with dynamic applications, the addition of the stranded wire length according to the bending radius has to be considered. Otherwise, the risk of damaging the points 1-3 arises. Furthermore, the length of the additional stranded wires has to be selected accordingly so that an axial load on the cables is avoided.

When taping, the loop of the additional stranded wires has to be in such a shape that it cannot come into contact with the outer conductor (see picture below).

4.3 Load due to torsion

Since in case of multi-pin connectors rotation of the connector in the cable axis (see pictures of examples below) cannot be avoided due to the pitch length of the cores, it may happen that the assembled cable has to be twisted up to an angle of 180°. Regarding the taping, it has to be considered that a minimum free cable length must be complied with (see point 5.2).
4.4 Combined load (bending-torsional load)

Combined loads that occur due to special applications (e.g. retracting the mirror, panorama display, retractable display, tailgate) have to be minimized by the cable harness design. Since combined loads exceed the specified loads, it is necessary to prove the fulfillment of the application-related requirements of the customer.

4.5 Thermal load

The individual components of an assembled cable have different thermal specifications. The total load limit depends on the weakest part of the assembled cable, thus specifying the area of application. The temperature ranges can be found in the component data sheets.

5. Add-on Parts and Taping

5.1 Add-on parts

The improper assembling of add-on parts can result in changed properties, damage and/or additional loads. MD ELEKTRONIK does not assume warranty for subsequently assembled add-on parts and affixed tapings.

5.2 Taping of Multi-Core-Cables

When taping an assembled cable, no torsional and/or tensile loads are allowed to occur. The non-taped minimum length between the end of the connector and the end of the taping that is specified below, must be complied with in any case.

<table>
<thead>
<tr>
<th>System</th>
<th>Case</th>
<th>Distance between component and taping</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSD 4x0.14 mm²</td>
<td>Single HSD cable</td>
<td>L ≥ 30 mm</td>
</tr>
<tr>
<td></td>
<td>Several cables within one taping</td>
<td>L ≥ 150 mm</td>
</tr>
<tr>
<td>HSD 4x0.50 mm²</td>
<td>Single HSD cable</td>
<td>L ≥ 50 mm</td>
</tr>
<tr>
<td></td>
<td>Several cables within one taping</td>
<td>L ≥ 250 mm</td>
</tr>
<tr>
<td>HSDe 4x0.35 mm²</td>
<td>Single HSDe cable</td>
<td>L ≥ 30 mm</td>
</tr>
<tr>
<td></td>
<td>Several cables within one taping</td>
<td>L ≥ 150 mm</td>
</tr>
</tbody>
</table>
Taped single cable (example: HSD)

Several cables within one taping
(The example shows 2 HSD cables; this also applies to combinations with other cable types)

5.3  **Torsion-free processing in the case of multiple systems**

The manner of taping and the location where the cable is fixed have a direct influence on the torsion of every single cable within the multiple system. No rotational load is allowed to occur during taping. The minimum clamping length (distance between the mated housing on the cable side and the cable fixation) ensures that a twist (torsion) of the cables towards each other is avoided. In case of multiple systems, the minimum distance (see table 5.2) without taping/fixation has to be complied with.

5.4  **Attaching fixing elements (e.g. cable ties, holders)**

The cable fixation must be designed in such a way that it does not require additional physical effort when mating. Squeezing/damaging the cable by the fixing elements is not allowed. Fixing with cable ties is only allowed on taped surfaces.

For fixing inline connections only fixing elements of MD ELEKTRONIK are allowed.

5.5  **Splice connections**

Splice connections must not be exposed to mechanical loads neither during further assembling nor during the installation in the vehicle.
6. Mating of Assembled Cables

6.1 Mating process of assembled cables

As a basic principle, it has to be ensured that the assembled cable is held during mating on the connector housing or contact (if partially assembled), but not on the cable itself. The connector has to be inserted in the correct direction into the correct slot (coding) until it locks clearly audibly.

Incorrect handling

Holding on the connector housing

Correct handling

Holding on the connector contact

During the mating process, the housings must not tilt. The male and female housing must be connected without any large physical effort until the locking latch has locked clearly audibly.

Incorrect mating

Bent inner contacts
6.2 Disconnecting the connectors / cable

In order to disconnect the connectors, it is necessary to follow these steps: First push the housings together to make the connection free of forces. Then push the locking latch with the finger and finally pull the two connectors off in axial direction. The two connectors are only allowed to be held at the housings. Tools, such as screwdrivers, knives or similar, must not be used for pushing the locking latch.

6.3 Mating cycles

The quantity of the maximum permissible mating cycles is defined by the component manufacturer.

7. Positioning of the Cable Exit

For Multi-Core-Cables, there are solely fixed exit directions (left, right, up and down) which have to be taken into consideration for cable harness design.
8. Tests

It is not allowed to mate the contacts before the installation in the vehicle (according to various OEM specifications).

8.1 Error test

In some instances, the automotive manufacturers have specifications for tests in the event of errors. If a test is necessary, solely test devices and test adapters being suitable for the connector, both approved by MD ELEKTRONIK, are allowed to be used. Only instructed persons are allowed to perform this error analysis. Furthermore, the test devices are solely allowed to be used for their intended purpose.

These test devices can be purchased from MD ELEKTRONIK upon request. The following test devices are available:

- MD short-circuit tester for HSD/HSDe/antenna

Correct testing equipment
8.2 Not allowed electrical tests

8.2.1 Use of not allowed testing equipment

It is not allowed in any case to use contacts for the electrical test of assembled cables. Reason: Using contacts can damage the connector.

The following pictures show examples for tests of HSD/HSDe connectors that are not allowed:

Example: HSD connector

Example: HSDe connector