

The English translation is believed to be accurate. In case of discrepancies the German version shall govern.

VOLKSWAGEN AG	Solderless Electrical Connections Crimp Connections	VW 603 30
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Konzernnorm		
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1 Scope

This standard applies to solderless, electrical crimp connections that are manufactured using multi, fine and very fine wire stranded conductors (FLK (vehicle line K, normal thick-walled) and FLR (vehicle line R, reduced insulation) lines) ¹⁾.

2 Aim

The aim of these regulations is to establish definitions, requirements and testing criteria for the evaluation of crimp connections. In addition, it should be ensured that comparable test results and equal quality features are attained when using plug elements and tools from varying manufacturers.

3 Definitions

3.1 Receptacles (Plug Connection)

Contact element in which the connection is established by axial force (push-on) and the separation (pull-off) is limited by friction.

3.2 Crimp Area (Crimp Connection)

The area of the crimp sleeve that is deformed and forms the actual crimp connection.

3.3 Open Crimp Sleeve (Wire Crimp)

A crimp sleeve that is open prior to crimping and is closed by the crimping process.

3.4 Insulation Bracket (Insulation Crimp)

The area of the element that is also deformed in the crimping process in order:

- a) to encompass the insulation of the conductor and
- b) to support the line vibration.

- 1) Crimp connections with FLR lines are only permissible for cross sections up to 2.5 mm². Double-line crimps with FLK lines shall be avoided.
- 2) Crimp height and width (at the widest point) are used for process monitoring after the production release process and are not a replacement for the pull-out strength test.
- 3) A run-in curve is present if the crimp height – adjusted to the different conductor cross sections – is visibly exceeded at point A.
(Borderline-case consideration: Run-in curve for single crimps up to conductor cross section of 4 mm² > 0.05 mm).
- 4) The line tears at the crimp under vibration stress.

Continued on pages 2 to 10

Fachverantwortung/Responsibility E/SN-NO Kutsche	Normung/Standards (EZTN, 1733) Tel: +49-5361-9 Sobanski
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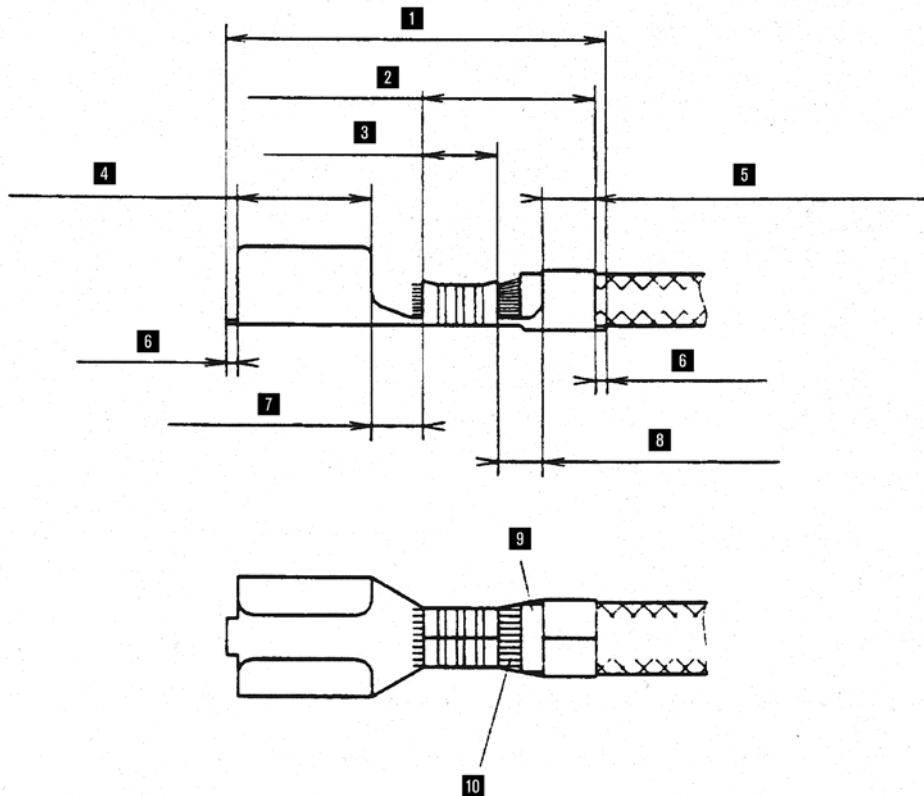
Form FE 41 - 09.00

3.5 Connection A

Transition area from the receptacle (plug connection) to the wire crimp.

3.6 Connection B

Transition area (clearance) from the wire crimp to the insulation crimp.



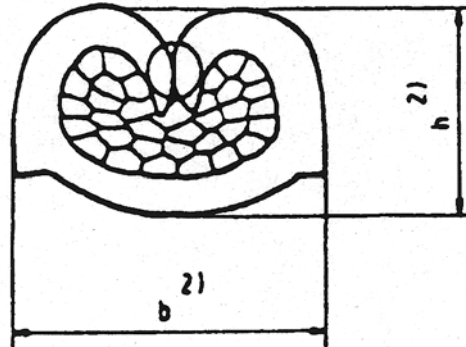
- | | | | |
|----------------------|---------------------------|----------------|-------------------|
| 1 Plug contact | 2 Crimp area | 3 Wire crimp | 4 Plug connection |
| 5 Insulation bracket | 6 Separation bridge | 7 Connection A | 8 Connection B |
| 9 Insulation | 10 Conductor single wires | | |

4 Type

The connections (wire and insulation crimp) must be manufactured carefully and accurately and meet the state of the art. The crimp area of the element should not be bent, twisted or deformed in any way when the line is crimped (desired break point) that can call the quality of the connection into doubt. The contacts may not exhibit any damage.

4.1 Wire Crimp

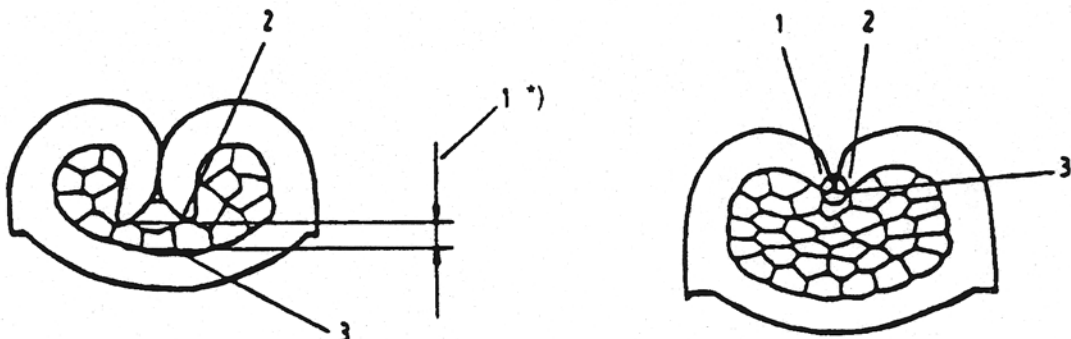
4.1.1 Example of Proper Single-Wire Crimp



Requirement:

- All single wires in the wire crimp must be deformed in honeycomb fashion.
- The crimp tabs (crimp claws) must mutually support each other. The support may be interrupted along the wire crimp length. The run-in and run-out must mutually support each other.
- The minimum pull-out force (VW 751 73, with open insulation crimp) must be attained.

4.1.2 Examples of still Usable Single-Wire Crimps



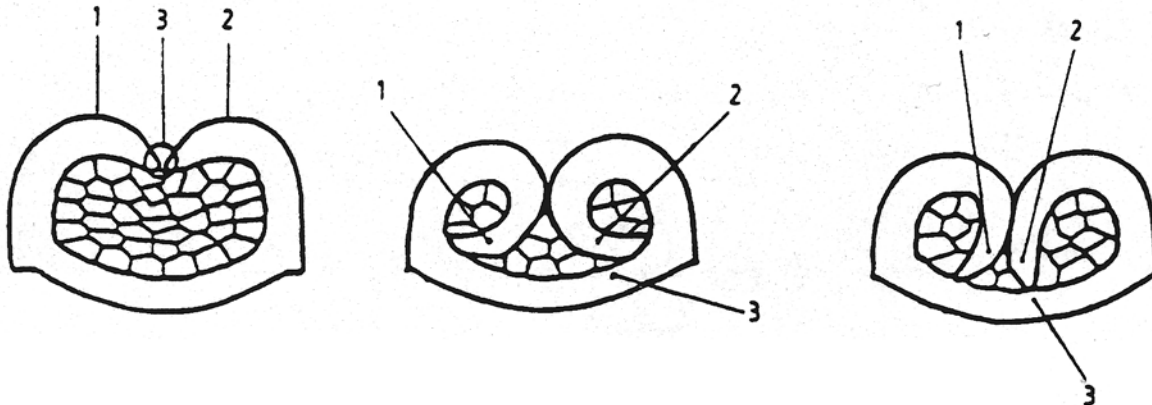
Characteristics

The distance (1) between crimp claw (2) and crimp base (3) is min. 1/2 the thickness of the contact material

The crimp claws (1 and 2) are still supported at point (3).
All single wires are pressed in honeycomb fashion.

- *) the distance can be less for conductor cross sections $\leq 0.5 \text{ mm}^2$; the wire crimp, however, may not exhibit the features according to Section 4.1.3, i.e., the crimp claws may not make contact with the base.

4.1.3 Examples of Unusable Single-Wire Crimps



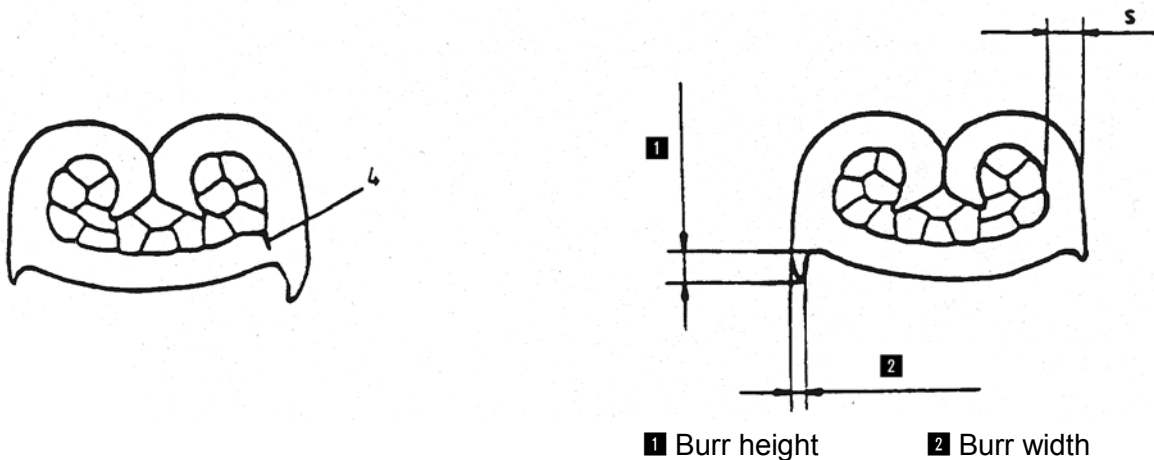
Characteristics

The crimp claws (1 and 2) are not supported at point (3).
 (Crimp overfilled)

Crimp claws (1 and 2) are rolled in laterally and touch the crimp base (3)
 (Crimp underfilled)

Crimp claws (1 and 2) touch the crimp base (3).
 Crimp claws are too long.
 (Crimp underfilled)

4.1.3.1 Examples of Defects on the Crimp Base



Characteristics

Crimp cracked (4)
 (tool defective)

Impermissible burr formation on the crimp base

Requirement

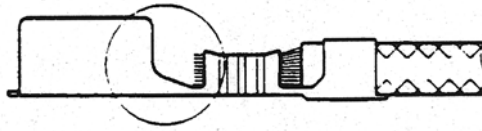
- a) The base of the crimp must be visibly deformed, but may not exhibit any impermissible burrs.
- b) The material shall not be cracked.

The burr height of the tip may not be greater than the material thickness s of the contact; the burr width may not be greater than half of the material thickness s .

4.2 Connection A

4.2.1 Transition Area between the Plug Connection and the Wire Crimp

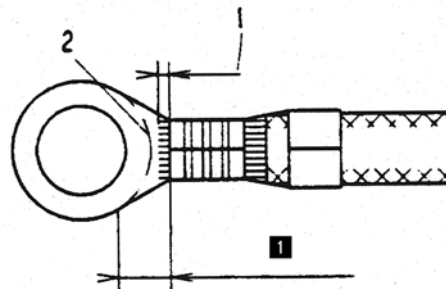
4.2.1.1 Wire Projection on the Receptacle



Requirement

- The end of the conductor must at least terminate flush with the wire crimp
- The plug and locking functions (for primary and secondary locks) may not be influenced by projecting single wires.

4.2.1.2 Wire Projection with the Cable Socket

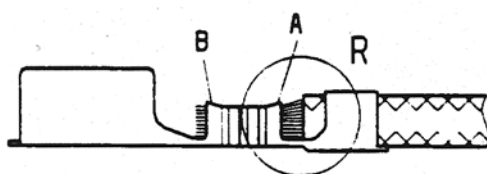


1 Connection A

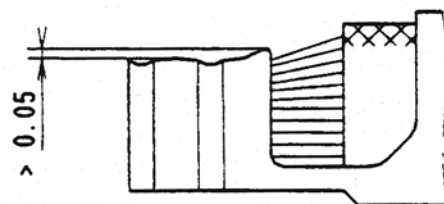
Requirement

The end of the conductor (1) may project max. 2 mm and may not touch the extended outer diameter (2) of the cable socket.

4.3 Run-in and Run-out Curve (Wire Crimp)



Detail R



Characteristic

Point B may have a run-out curve.

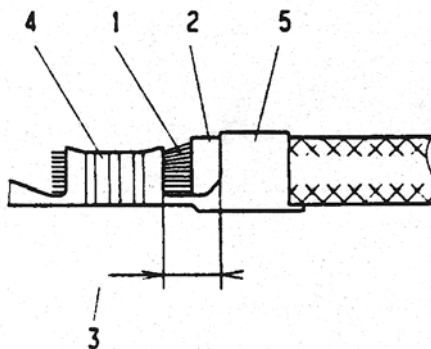
Requirement

- Point A may have a run-in curve ³⁾.
- The run-in curve must prevent notching or separation of individual wires.

4.4 Connection B

Transition area between the wire crimp and the insulation crimp

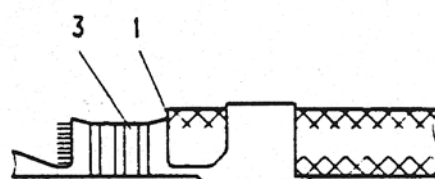
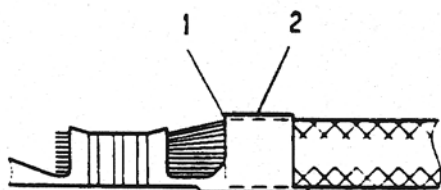
4.4.1 Ideal Condition



Requirement

The conductor (1) and the insulation (2) must be visible in the clearance (3) between the wire crimp (4) and insulation crimp (5).

4.4.2 Examples of still Usable Connections (Limit Samples)

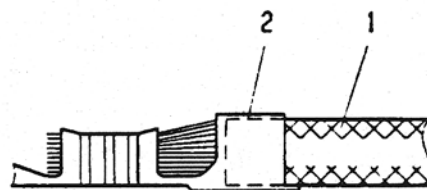
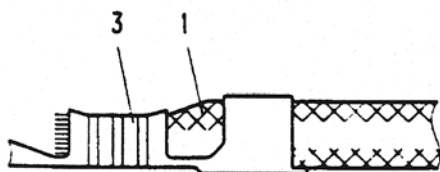


Characteristics

The trim edge of the insulation (1) terminates flush with the insulation crimp (2). The insulation is still visible.

The trim edge of the insulation (1) terminates flush with the wire crimp (3). The insulation is not yet encompassed by the wire crimp.

4.4.3 Examples of Unusable Connections



Characteristics

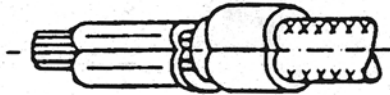
The insulation of the line (1) is crimped into the wire crimp (3).

The insulation of the line (1) is not encompassed by the entire length of the insulation crimp (2).

4.5 Insulation Crimps

4.5.1 Examples of Types

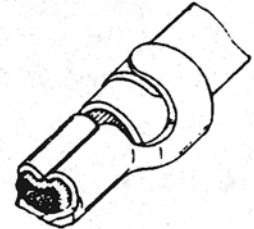
Form A
(F-Crimp)



Form B
(wrap-around crimp)

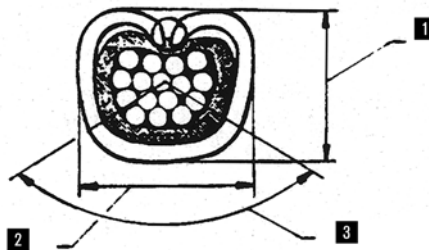


Form C
(overlapping crimp)



4.5.2 Examples of Applications

4.5.2.1 F-Crimp



1 Crimp height ²⁾

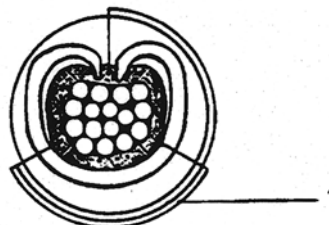
2 Crimp width

3 Angle of wrap

Requirement

- The specified crimp width must be complied with.
- At least 1/3 of the line circumference must be encompassed by the insulation crimp at the smallest cross section.
- The crimp claws must penetrate into the insulation.
- The insulation can be punctured by the crimp claws, but the single wires may not be damaged.
- The bending test according to DIN 41 611 Part 3 (Movement of the Conductor, 3 Cycles) must be fulfilled.

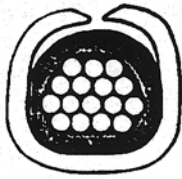
4.5.2.1.1 Example of a still Usable Insulation Crimp (Limit Sample)



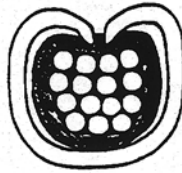
Characteristics

1/3 of the line is encompassed by the insulation crimp (1). The line is securely fixed. The line may not move out laterally. The joining process in the plug housing is not hindered by the insulation crimp.

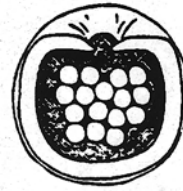
4.5.2.1.2 Examples of Unusable Insulation Crimps



Characteristics
The crimp is open.
(The line no longer has a secure fit).



Line insufficiently enclosed by crimp (line can move out laterally).



The crimp is over-pressed.
(When pressed too far, there is white fracture on the insulation)⁴⁾

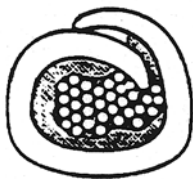
4.5.2.2 Overlapping Crimp



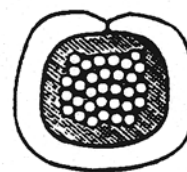
Requirement

- a) At least 60% of the conductor insulation must be encompassed by the insulation crimp at the smallest cross section.
- b) The insulation wrap must at least be closed (abutting or overlapping)
- c) The insulation can be punctured by a crimp claw, but the single wires may not be damaged.
- d) The line must be visibly secured.
- e) The bending test according to DIN 41 611 Part 3 (Movement of the Conductor, 3 Cycles) must be fulfilled.

4.5.2.2.1 Examples of still Usable Overlapping Crimps



Characteristics
One crimp side penetrates into the insulation, but the single wires are not damaged.



The insulation wrap is closed. The line is securely fixed.

4.5.2.2.2 Examples of Unusable Overlapping Crimps



Characteristics

The crimp is open.
(The line no longer has a secure fit).



The crimp is over-pressed. ⁴⁾ The effective length of the crimp sleeve is too short. (Conductor cross section incorrectly assigned).

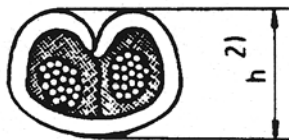
4.6 Double-Line Crimps

Double-line crimps shall be avoided. As a result of which, usage and type must first be tried in the release process.

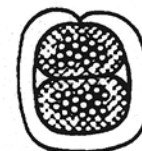
4.6.1 Examples of Double-Line Crimps

4.6.1.1 F-Crimp

Form A



Form B

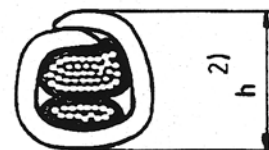


4.6.1.2 Overlapping Crimp

Form A



Form B



Requirement

- At least 60% of the conductor insulation must be encompassed by the insulation crimp at the smallest cross section.
- The insulation wrap must at least be closed (abutting or overlapping)
- The insulation can be punctured by a crimp claw, but the single wires may not be damaged.
- The lines must be visibly secured.
- When conductors are one above the other, the conductor with the smaller cross section must always lie on the base of the crimp sleeve.
- The bending test according to DIN 41 611 Part 3 (Movement of the Conductor, 3 Cycles) must be fulfilled.

5 Referenced Standards

DIN IEC 352/2

VW 751 73