

# 11 Discrete Wiring

Discrete wiring refers to a substrate or base upon which discrete wiring techniques are used to obtain electronic interconnections. Separate visual criteria for each type are depicted in this section.

### Discrete Wiring Acceptability Guidelines

The routing and terminating of discrete wires to form point-to-point electrical connections by use of special machines or tools may be employed to replace or supplement printed conductors on board assemblies. Application may be in planar, two-dimensional or three-dimensional configurations.

This section defines the criteria for acceptability of interconnections produced by some of the important discrete wiring processes in electronic assemblies. The illustrations are presented to depict particular characteristics of the techniques. They are classified in the following categories:

1. Semi-Permanent Connections
2. Permanent Connections

In addition to the criteria in this section the criteria of Section 5 are applicable.

The following topics are addressed in this section:

### 11.1 Solderless Wrap

- 11.1.1 Number of Turns
- 11.1.2 Turn Spacing
- 11.1.3 End Tails, Insulation Wrap
- 11.1.4 Raised Turns Overlap
- 11.1.5 Connection Position
- 11.1.6 Wire Dress
- 11.1.7 Wire Slack
- 11.1.8 Wire Plating
- 11.1.9 Damaged Insulation
- 11.1.10 Damaged Conductors & Terminals

### 11.2 Component Mounting - Connector Wire Dress Strain/Stress Relief

## 11 Discrete Wiring

### 11.1 Solderless Wrap

This section establishes visual acceptability criteria for connections made by the solderless wrap method. It is assumed that the terminal/wire combination has been designed for this type of connection.

The tightness of the wire wrap should be validated by the tool verification process.

It is also assumed that a monitoring system exists that uses test connections to verify that the operator/tooling combination is capable of producing wraps that meet strip force requirements.

Depending on the service environment, the connecting instructions will specify whether the connection will be conventional or modified.

Once applied to the terminal, an acceptable solderless wrap connection **shall** not be subjected to excessive heat nor have any mechanical operations performed on it.

It is not acceptable to attempt to correct a defective connection by reapplying the wrapping tool or by applying other tools.

The reliability and maintainability advantages of the solderless wrap connection method are such that no repair of a defective wrap by soldering is to be made. Defective connections are unwrapped using a special tool (not stripped off the terminal) and then a new wire wrapped to the terminal. New wire **shall** be used for each wrap/rewrap, but the terminal may be rewrapped many times.

## 11 Discrete Wiring

### 11.1.1 Solderless Wrap – Number of Turns

For this requirement, countable turns are those turns of bare wire in intimate contact with the corners of the terminal starting at the first contact of bare wire with a terminal corner and ending at the last contact of bare wire with a terminal corner; see Table 11-1.

A modified wrap is required for Class 3. It has an additional amount of insulated wire wrapped to contact at least three corners of the terminal.

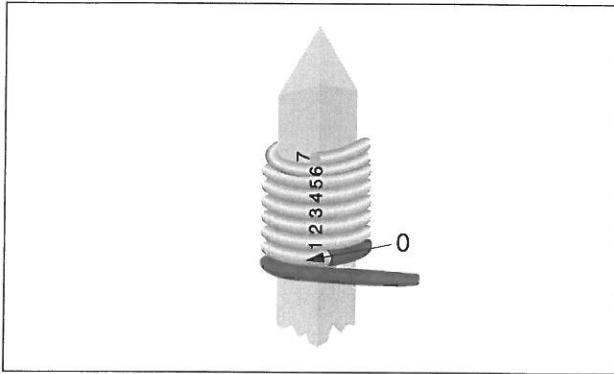


Figure 11-1

#### Target - Class 1,2,3

- One half (50%) more turn than the minimum shown in Table 11-1.

#### Acceptable - Class 1,2

- Countable turns meet the requirements of Table 11-1.

#### Acceptable - Class 3

- Countable turns meet the requirements of Table 11-1.
- Meets requirements of modified wrap.

Table 11-1 Minimum Turns of Bare Wire

Wire Gauge	Turns
30	7
28	7
26	6
24	5
22	5
20	4
18	4

**Note:** Maximum turns of bare and insulated wire is governed only by tooling configuration and space available on the terminal.

#### Defect - Class 1,2,3

- Number of countable turns does not comply with Table 11-1.

#### Defect - Class 3

- Does not meet requirements of modified wrap.

### 11.1.2 Solderless Wrap – Turn Spacing

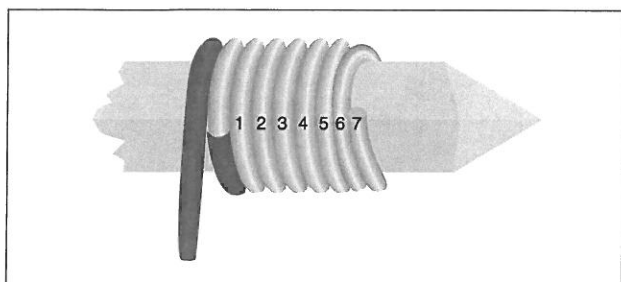


Figure 11-2

#### Target - Class 1,2,3

- No space between any turns.

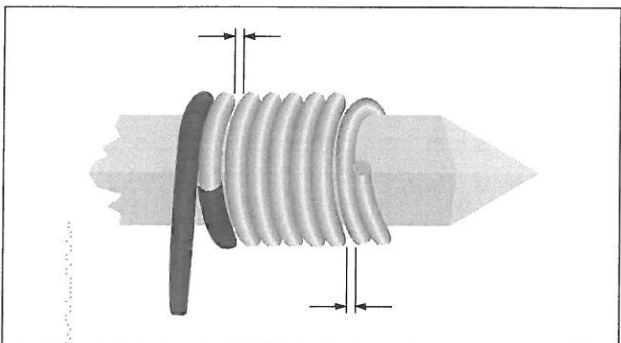


Figure 11-3

#### Acceptable - Class 1

- No space over one wire diameter.

#### Acceptable - Class 2

- No space over 50% diameter of wire within countable turns.
- No space over one wire diameter elsewhere.

#### Acceptable - Class 3

- No more than three turns spaced apart.
- No space over 50% diameter of wire within the wrap.

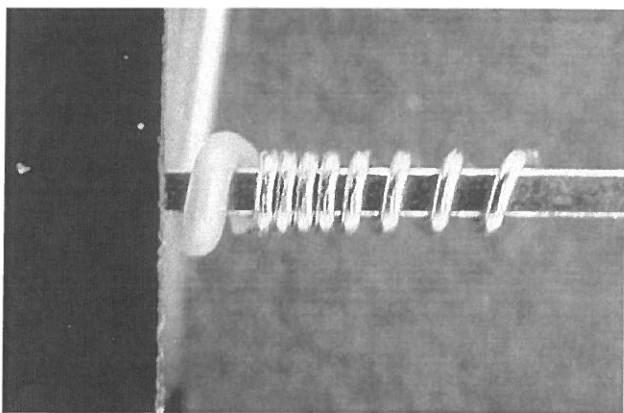


Figure 11-4

#### Defect - Class 1

- Any space over one wire diameter.

#### Defect - Class 2

- Any space over half wire diameter within countable turns.

#### Defect - Class 3

- Any space more than half wire diameter.
- More than three spaces any size.

### 11.1.3 Solderless Wrap – End Tails, Insulation Wrap

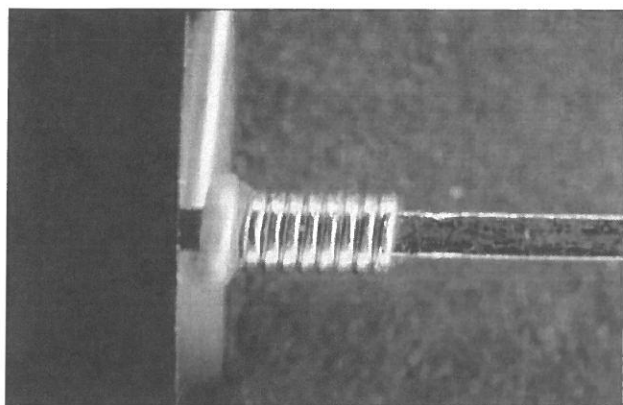


Figure 11-5

#### Target - Class 1,2

- End tail does not protrude beyond outer surface of wrap.
- Insulation reaches terminal.

#### Target - Class 3

- End tail does not protrude beyond outer surface of wrap with insulation modified wrap, see 11.1.1.

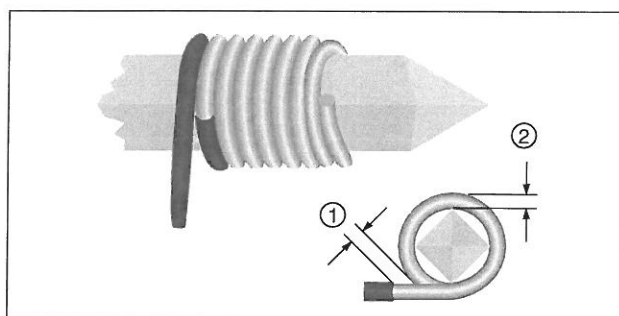


Figure 11-6

1. Insulation clearance
2. Wire diameter (viewed from bottom)

#### Acceptable - Class 1

- Does not violate minimum electrical clearance.
- Exposed conductor in the insulation.

#### Acceptable - Class 2

- Insulation end meets clearance requirements to other circuitry.
- End tail does not extend more than 3 mm [0.12 in] from outer surface of wrap.

#### Acceptable - Class 3

- End tail projects no more than one wire diameter from outer surface of wrap.
- Insulation must contact minimum of three corners of post.

### 11.1.3 Solderless Wrap – End Tails, Insulation Wrap (cont.)

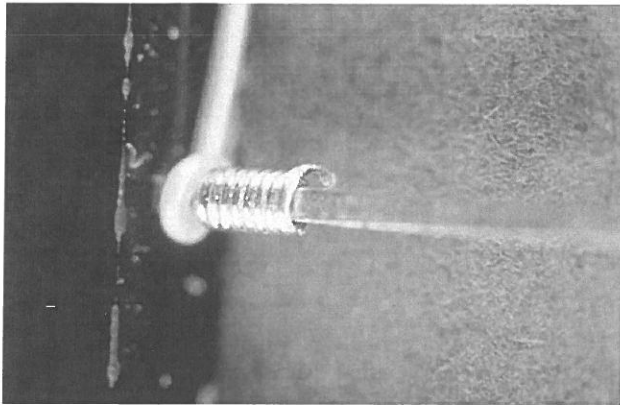


Figure 11-7

**Acceptable - Class 1**

**Defect - Class 2,3**

- End tail is greater than 3 mm [0.12 in].

**Defect - Class 3**

- End tail is greater than one wire diameter.

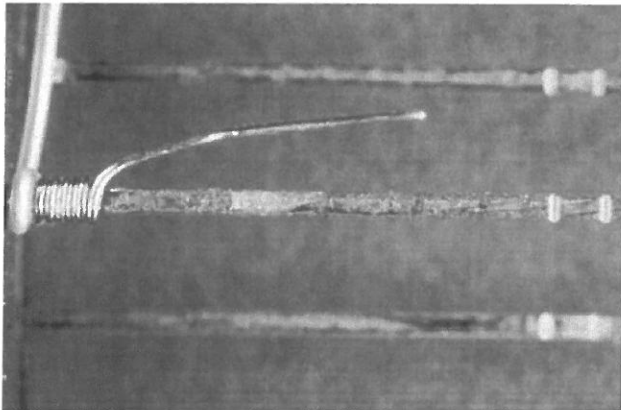


Figure 11-8

**Defect - Class 1,2,3**

- End tail violates minimum electrical clearance.

### 11.1.4 Solderless Wrap – Raised Turns Overlap

Raised turns are squeezed out of the helix, therefore no longer have intimate contact with the terminal corners. Raised turns may overlap or override other turns.

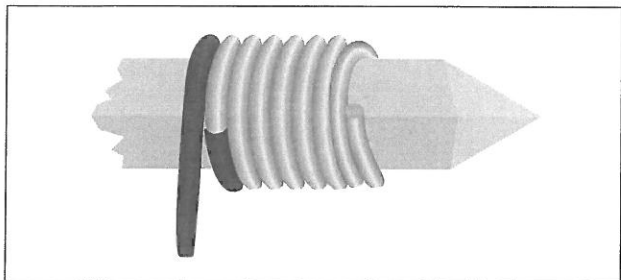


Figure 11-9

#### Target - Class 1,2,3

- No raised turns.

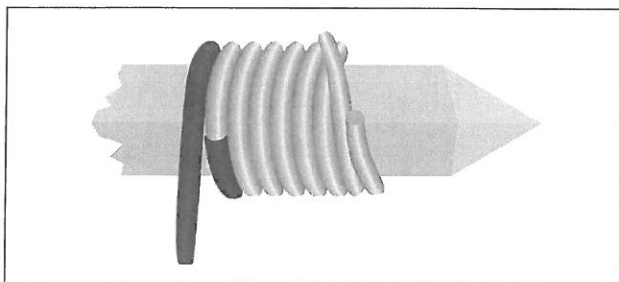


Figure 11-10

#### Acceptable - Class 1

- Raised turns anywhere provided remaining total turns still have contact and meet minimum turns requirement.

#### Acceptable - Class 2

- No more than half turn raised within countable turns, any amount elsewhere.

#### Acceptable - Class 3

- No raised turns within countable turns, any amount elsewhere.

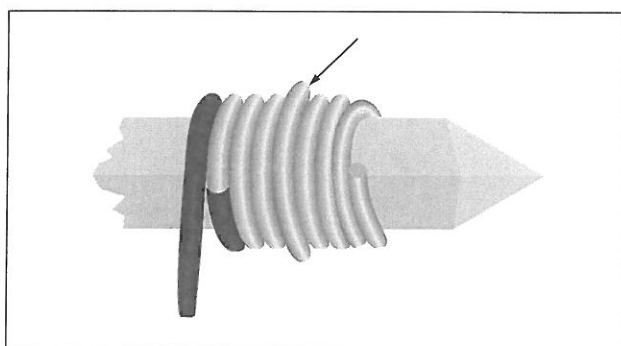


Figure 11-11

#### Defect - Class 1

- Remaining total turns that still have contact do not meet minimum turn requirements.

#### Defect - Class 2

- More than half raised turn within countable turns.

#### Defect - Class 3

- Any raised turns within countable turns.

## 11.1.5 Solderless Wrap – Connection Position

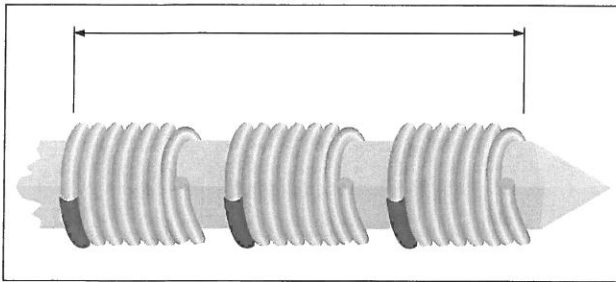


Figure 11-12

### Target - Class 1,2,3

- All turns of each connection on working length of terminal.
- Visible separation between each connection.

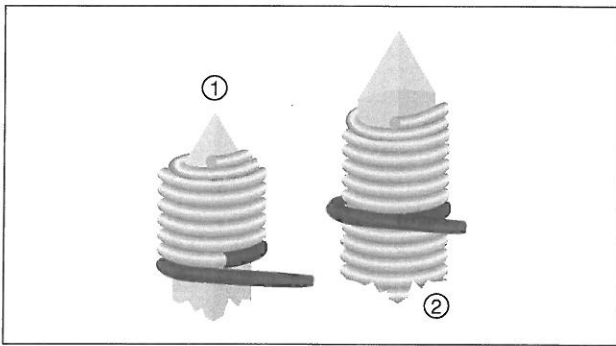


Figure 11-13

1. Wrap extends above working length
2. Insulation turn overlaps previous wrap

### Acceptable - Class 1,2

- Extra turns of bare wire or any turns of insulated wire (whether or not for modified wrap) beyond end of working length of terminal.

### Acceptable - Class 1

- Extra turns of bare wire or any turns of insulated wire overlap a preceding wrap.

### Acceptable - Class 2

- Turns of insulated wire only overlap a preceding wrap.

### Acceptable - Class 3

- Wraps may have an insulated wire overlap the last turn of uninsulated wire.
- No turns of bare or insulated wire beyond either end of working length.



### 11.1.5 Solderless Wrap – Connection Position (cont.)

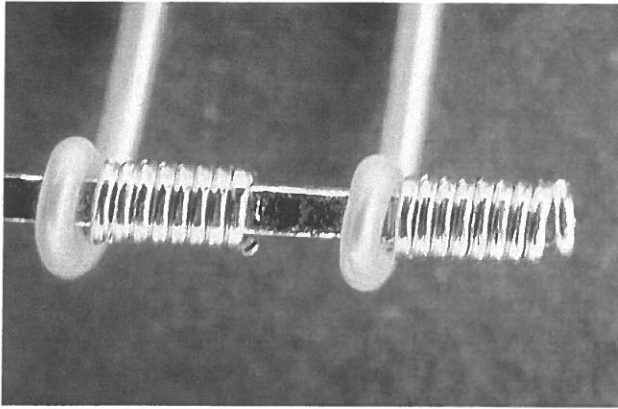


Figure 11-14

**Defect - Class 1,2,3**

- Insufficient number of countable turns in contact with the terminal.
- Wire overlaps the wire turns of a preceding connection.

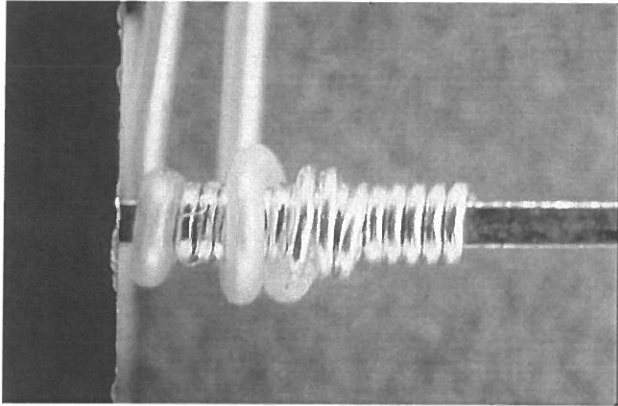


Figure 11-15

## 11 Discrete Wiring

### 11.1.6 Solderless Wrap – Wire Dress

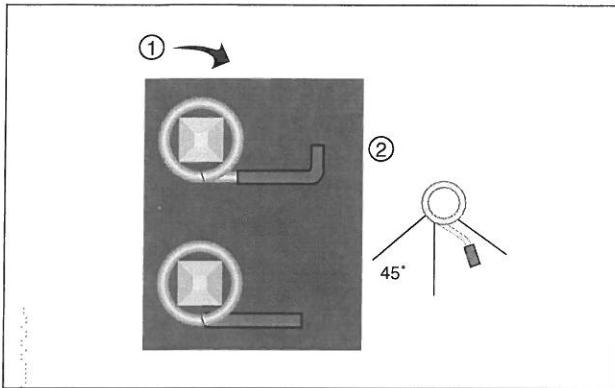


Figure 11-16

1. Direction of turns
2. Proper radius

#### Acceptable - Class 1,2,3

- The dress of wire needs to be oriented so that force exerted axially on the wire will not tend to unwrap the connection, or to relieve the bite of wire on the corners of the terminal post. This requirement is satisfied when the wire is routed so as to cross the 45° line as shown.

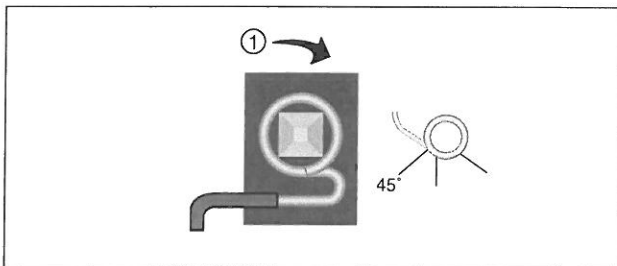


Figure 11-17

1. Direction of turns

#### Defect - Class 1,2,3

- Axially exerted external forces on the wrap will cause the wrap to unwind or loosen the wire bite at the post corners.

## 11 Discrete Wiring

### 11.1.7 Solderless Wrap – Wire Slack

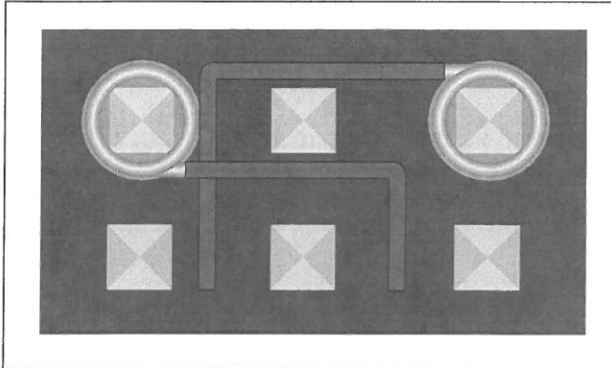


Figure 11-18

#### Acceptable - Class 1,2,3

- Wiring needs to have sufficient slack so that it will not pull around corners of the other terminal posts or bridge and load other wires.

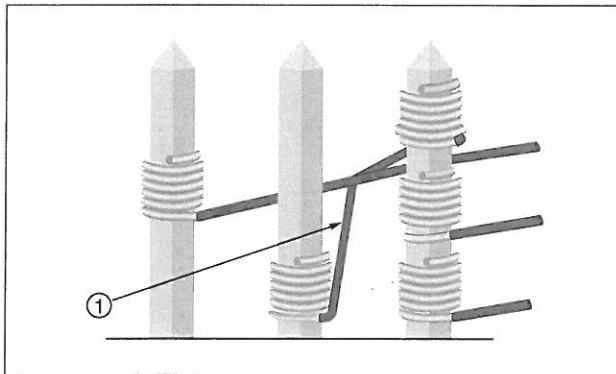


Figure 11-19  
1 Wire crossing

#### Defect - Class 1,2,3

- Insufficient wire slack causing:
  - Abrasion between wire insulation and wrap post.
  - Tension on wires between wrap post causing distortion of posts.
  - Pressure on wires that are crossed by a taut wire.

### 11.1.8 Solderless Wrap – Wire Plating

#### Plating

Wire used for solderless wrap is normally plated to improve connection reliability and minimize subsequent corrosion.

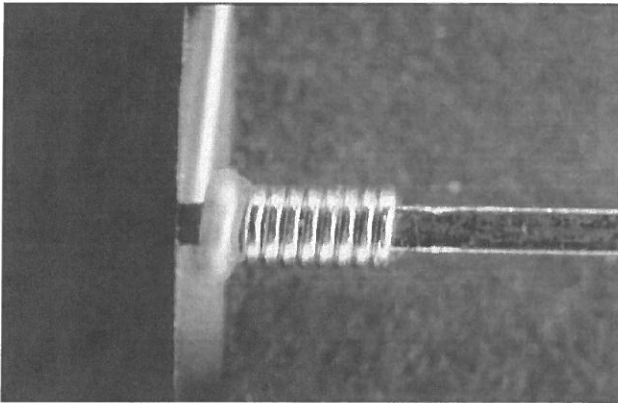


Figure 11-20

#### Target - Class 1,2,3

- After wrapping, uninsulated wire has no exposed copper.

#### Acceptable - Class 1

- Any amount of exposed copper.

#### Acceptable - Class 2

- Up to 50% of countable turns show exposed copper.

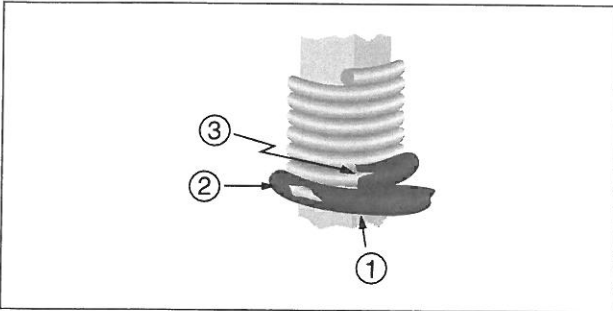
#### Defect - Class 2

- More than 50% of countable turns show exposed copper.

#### Defect - Class 3

- Any exposed copper (last half turn and wire end excluded).

### 11.1.9 Solderless Wrap – Damaged Insulation

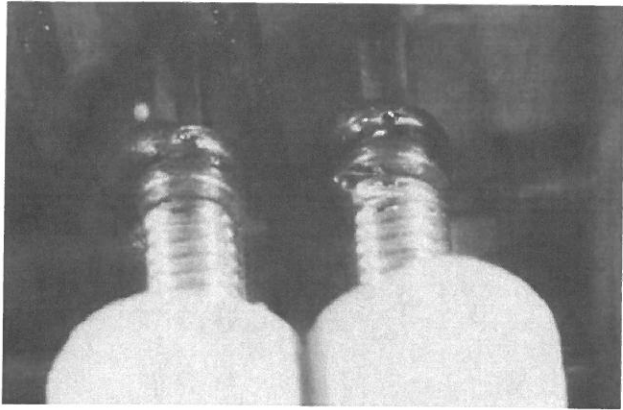


**Figure 11-21**

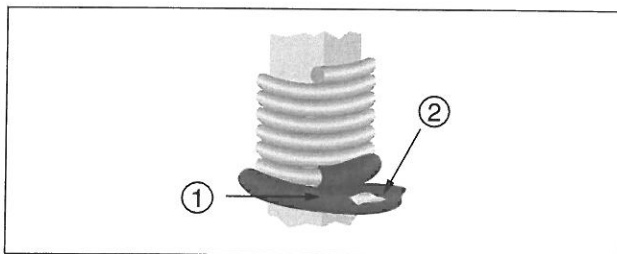
1. Initial corner
2. Insulation split
3. Insulation cut or frayed

**Acceptable - Class 1,2,3**

- After initial contact with post:
  - Insulation damage.
  - Splits.
  - Cut or frayed insulation.



**Figure 11-22**



**Figure 11-23**

1. Initial contact corner
2. Split insulation, etc., prior to initial contact of post. Conductor is exposed.

**Defect - Class 1,2,3**

- Minimum electrical clearance violated.

**Defect - Class 2,3**

- Splits, cuts or fraying of insulation prior to initial contact of wire to corner of post.
- Spacing requirements are violated.

### 11.1.10 Solderless Wrap – Damaged Conductors & Terminals

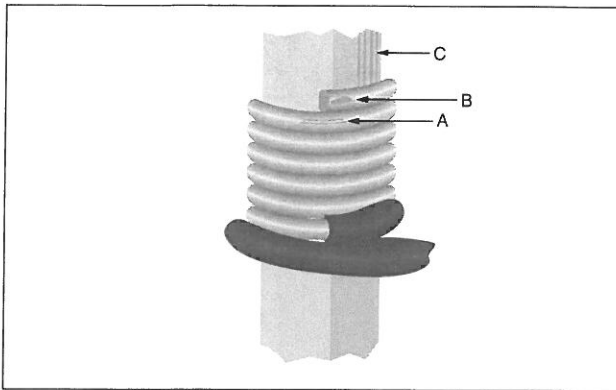


Figure 11-24

#### Target - Class 1,2,3

- Wire finish is not burnished or polished, nicked, scraped, gouged or otherwise damaged.
- Wire wrap terminals are not burnished, scraped or otherwise damaged.

#### Acceptable - Class 1,2,3

- Finish on the wire is burnished or polished (slight tool marks) (A).
- The top or last turn damaged from the wrap tool such as nicks, scrapes, gouges, etc., not exceeding 25% of wire diameter (B).
- Damage to terminal caused by tool such as burnishing, scraping, etc., (C).

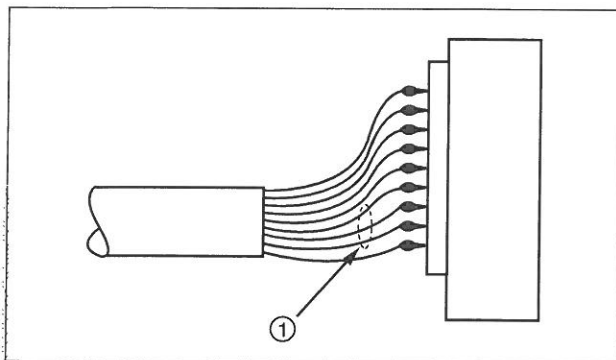
#### Acceptable - Class 1,2

#### Defect - Class 3

- Base metal is exposed on terminal.

### 11.2 Component Mounting – Connector Wire Dress Strain/Stress Relief

Wires connecting to multi-contact connectors have slack adjusted to preclude stress of individual wires.

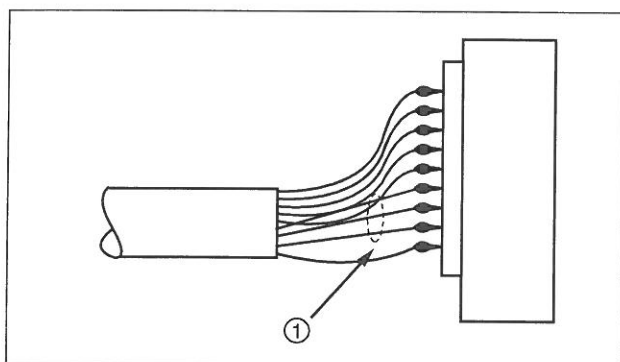


**Figure 11-25**

1. Lead dress is more critical on these wires

#### Acceptable - Class 1,2,3

- All wires are dressed with even bends to prevent stress at contact connections.
- Shortest wires are in direct line with center axis of cable.



**Figure 11-26**

1. Leads are stressed

#### Defect - Class 1

- Wires are separated from the connector.

#### Defect - Class 2,3

- Slack is inadequate to prevent stress of individual wires.

## 11 Discrete Wiring

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