March 24, 2000

42 V PowerNet Battery Connection System Workgroup

Dual/higher voltage electrical systems for automotive applications have been under discussion for several years and, with a change in system voltage, there is a unique opportunity to achieve global standardization on key components. A Working Group of Vehicle OEMs, Battery and Connection Manufacturers has been meeting for the past 6 months with the following goal:

Goal: “To propose a universal 42-volt PowerNet battery connection system specification that will allow for all manufacturers to build 42-volt batteries that can be electrically interchangeable in any application specifying that design.”

Scope: “All 42 V PowerNet vehicle battery applications where currents expected from the battery are at least 50 amperes (initially pertaining to passenger vehicle and light trucks). The specification should be accepted worldwide.”

You are being invited to make a connection design proposal at a meeting on April 13, 2000 in Conference Room #7 at the USCAR office at 1000 Town Center Bldg., Suite 300, Southfield, Mi. 48075. The meeting will begin at 9 am and run to 3 pm.

If your organization is interested in proposing a candidate design for a standard 42 V battery connection system, **please respond** to Norman Traub, Delphi Automotive Systems, e-mail “norman.traub @delphiauto.com” **by March 31, 2000**. Details of the meeting will be issued in a follow up e-mail to all who wish to present. (The time you will be allocated for your technical presentation will be determined by the number of respondents requesting to make a proposal – one half hour maximum is anticipated). Our plan is to obtain an awareness of the proposed designs at the April 13 meeting. The audience will be vehicle OEMs, battery manufacturers and connection suppliers. Desired system requirements and some questions you will be asked to address are included in the pages that follow. We are attempting to arrange a follow up meeting with the vehicle OEM and battery manufacturers on Friday morning, April 14, 2000 to receive feedback on the various concepts proposed. (Alternative is to extend the Thursday meeting and attempt to finish in one day). As long as your proposed design meets the desired system requirements, you will be invited to make prototypes and do standard testing as described in the attached document. Another meeting will be scheduled in September, 2000 to present results.

We are investigating the possibility of using Video Conferencing for organizations that want to participate in the meeting but cannot travel to the Detroit area. Additional details will follow – please let me know if you desire this and have the capability.

More information and requirements (including the beginnings of a FMEA for the battery connection) can be obtained by going to the following Web site:
http://auto.mit.edu/consortium/
In the “Public Access” section, go to “Battery Termination” for details.

I will be in Europe all next week and will not have access to my e-mail until Thursday and Friday, March 30 – 31, 2000. I will attempt to monitor and respond to telephone calls.

I look forward to meeting with you in April.

Regards

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Specifications for 42 V battery connections

Desirable system requirements

1. Separate connections will be specified for positive and negative terminals.
2. Centerline distance between positive and negative terminals will not be specified by this workgroup.
3. Location of connections (top, side, etc.) will not be specified by this workgroup.
4. Electrical shorts between terminals of different voltage potential and between positive & vehicle ground must be minimized if using simple metal tools for assembly or disconnect. (screwdrivers, wrenches, etc.)
5. Possibility of accidental electrical shorts between the harness positive terminal and vehicle ground must be minimized when disconnected. (Generator may still be operating)
6. Battery connections must be designed to prevent direct connection of standard automotive (“alligator” type) jumper cables (either with the connection mated or unmated).
7. Battery connections must be designed to prevent electrical access (current carrying) when connected. (Terminals should be inaccessible when mated.) If a vehicle OEM wants to probe voltage on the battery side of the connection, this capability can be specified separately with the battery manufacturers.
8. Connector indexing must be specified to prohibit connecting to a battery of different voltage. (Indexing must prevent electrical continuity)
9. Connector indexing must be specified to prevent reverse polarity battery installation.
10. Connector indexing must be specified to differentiate between battery technologies.
11. Battery connection will be a panel mount. (“Pigtailed” solutions will not be disallowed; however, they will not be considered at this time.)

Open issues to be resolved based on connection supplier recommendations

1. Will a family of battery connections be needed based on battery current/time profiles?
2. Should battery connections be mated/unmated with or without tools?
3. Should the battery terminal be “male” or “female”?
4. Can the connection system accommodate the ability to insert an electronic module for energy/load management between the battery and the vehicle battery cable harness?
5. How much space is required to install the battery connections?

Mechanical requirements

1. Connection system must be able to be mated/unmated 50 times over the life of the product.
2. Hand mated connection systems must have < 75 N of mating force. Mechanically assisted connection systems may be used to keep mating force < 75 N.
3. Other mechanical specifications (vibration, bend resistance, etc.) will pertain to the final product but will not be used to choose the preferred design concept.

Electrical requirements

1. Actual current profiles will vary greatly based on individual vehicle OEM usage. (See chart “Vehicle OEM Response” in the MIT Website.
2. A standard current cycling test will be used to compare the proposed design concepts – see the document “42 Volt Battery Connection Test Procedure”.
3. 0.5 mohm is the maximum acceptable connection resistance. A standard test procedure to measure connection resistance is specified in the document “42 Volt Battery Connection Test Procedure”.
4. Other electrical specifications (isolation resistance, etc.) will pertain to the final product but will not be used to choose the preferred design concept.

Environmental Requirements

1. Ambient temperature range, for the purposes of this test, is assumed to be -40^0C to $+80^0$C.
2. Connection suppliers will need to recommend the level of sealing necessary to pass normal underhood environmental validation requirements.
3. Other environmental specifications (humidity, fluid resistance, etc.) will pertain to the final product but will not be used to choose the preferred design concept.

Information required to make a proposal for the design standard

The following questions will assist the Workgroup in evaluating various design proposals for a standard 42 V battery connection system. If you wish to propose a design(s), please address the following points. Some of the questions below may be answerable at the initial design proposal meeting on April 13, 2000 – some may require testing or additional design and can be answered in September, 2000.

One half of the connection system will be designated as the "standard" design, while the other half can be modified by the supplier community as required to meet performance, manufacturing and cost objectives.

Design proposal for the standard terminal

1. Battery or harness side?
   - Should the "standard" design be on the battery or the wiring harness?
2. Description of the standard terminal (blade, pin, cone, screw, ?)
3. Number of sizes recommended to cover the current range? (See the file "Vehicle OEM Response" at http://auto.mit.edu/consortium/ for several vehicle OEM projected current ranges)
   - Would you recommend one size for all applications or several? (state #) (Can be answered after testing)
4. Dimensions of standard terminal(s)? (Can be answered after testing)
5. Material(s) of standard terminal(s)? (Can be answered after testing)

Non-standard (mating) terminal design

1. Material(s) (Can be answered after testing)

Terminal/Terminal Performance

See accompanying document titled "**42 V Battery Connection Test Procedure**"

Connection System

(May be answered in April – must be answered by September, 2000

1. Method for mating and unmating the connection?
   - Hand plug?
     - Maximum force required in Newtons (N)
     - Mechanical assist?
       - On connection? (Force required?)
       - Separate tool? (Force required?)
2. Method to assure connection retention?
3. Method to index the connection?
   - (positive & negative) (12V & 36V) (3-4 battery technologies)
4. Method to limit access for jump starting with alligator clamps?
5. Wire dress
   - Degree of freedom?
     - Can the battery cable leave the connection in multiple directions?
       - Is the angle determined by the terminal design or by bending the cable?
       - Vehicle OEMs have stated a desire to have multiple conductors connected to the harness terminal (doubles/triples in the crimp)
     - Space required?
   - Ability to maintain orientation of the wire dress?
6. Space required to make the connection?
   - Include access for hand connection or a mechanical assist mechanism
7. Recommendations to meet environmental requirements?
   - Open?, splashproof?, sealed? (remember the possibility for multiple cables in a crimp)
8. Do you have any test data or experience in mating or unmating a 42 V connection under power? How much current can be flowing before permanent damage is possible? Are there any design characteristics in your proposal that should help this situation?
9. Ability to place an electronic module between the battery and the wiring harness?
   - Some vehicle OEMs have expressed the need for an electronic module for power/energy management. This module may be directly connected to the positive battery post and the wiring harness will then connect to the module. Please comment on how your design can accommodate this situation.
10. Serviceability?
    - How will the service personnel repair a damaged connection?