

## Comments on one way vs. two way 42 V battery connectors

DaimlerChrysler

Arguments against / for dual pole connectors

Contra:

- Reduced freedom for positioning of the connectors
- ?

Pro:

- Smaller cost than two single poles, esp. if considering latches
- Faster connection / disconnection on vehicle assembly
- Much better safety, because of avoiding of a „hot“ free cable end after connecting first cable
- If a third contact for sensing the correct position of the contacts and/or for shut-off during connection process is to be used, this would also need a fourth contact with two single poles
- Is much better distinguished from conventional 12V batteries

Hans-Peter Schoener  
DaimlerChrysler

EPC

-EPC is a little skeptical on the ability of the male connection side to be leak proof due to multi piece design and battery cover material. Because of that isolation resistance, leakage current, and corrosion become an issue making the two circuit single connector a poor choice. It could also be difficult to seal due to the battery cover material and tolerances given to it. Depending upon terminal design a single connector with two terminals may not meet the 70N requirement with out mechanical assist. EPC is confident that a single terminal connector will meet the engagement force requirements.

Exide Technologies

After tallying our individual responses about the issue of a single versus a separate battery connector, our joint response is as follows:

1.- We are in favor of a SEPARATE connector for positive and negative terminals due to the need to have flexibility in the geometry of the battery cell layout, avoid costly and complicated molding in cover bus bars and the possibility of current leakage in a high voltage environment.

2.- We are also in favor of "keying" the battery positive and negative terminals, for example a round male pin in the positive terminal and a female in the negative terminal of the battery...or...if male pins are preferred on the battery, different diameter pins for each positive and negative connectors.

Regards  
Fred Feres  
Exide Technologies

JCI

ADVANTAGES OF 2-WAY CONNECTOR:

May be more convenient for installation/service.

May simplify manufacturing for the cable connector manufacturer.

May be slightly cheaper than two one-way connectors (especially if a positive locking feature is part of the design).

DISADVANTAGES OF 2-WAY CONNECTOR:

Greatly higher risk of an acid film leakage current path forming across the terminals.

(Note that batteries are typically washed at some stage in their manufacture, leaving water residue -- add any ionic substance, e.g., road salt, and you have a current leakage path that can be significant).

Two-way connector may cause one or both cables to have to be lengthened slightly, in order to get both to the same point on the battery.

We feel that the disadvantages of two-way connectors outweigh the advantages.

Jim Bolstad

Sr. Product Engr.

Johnson Controls - Automotive Systems Group

Pros for single two-way: One connection does both polarities/one fewer connection to deal with under the hood.

Cons for single two-way: Battery processing issues in formation with closeness of both polarities (current paths between opposite polarities, expense of formation jumpers for dual connection).

Pros for two one-way: Simplicity of connection, reduced leakage current between opposite polarities during formation process.

Cons for two one-way: Two connections required.

Ron Rizzo

Director, AGM Development Battery

Johnson Controls - Automotive Systems Group

Delphi Automotive Systems

I would like to comment on the merits of separate connections for the battery. I believe that the present approach is best for two reasons. First, the space around the battery is different for every vehicle. We need to maintain the flexibility in cable design and routing that is offered by using separate connections for positive and negative battery cables. Second, if we put both connections in a single entity going to a pair of terminals, we require more insertion force and we must control another dimension, namely center-to-center distance in the connector and on the battery. In general, if you can eliminate a variable by design, then the device is inherently easier to manufacture.

Dell Crouch

Delphi Automotive Systems (battery)

Two one-way connections to the SLI Battery are preferred:

- Engage Force:
  - » A single connector with a peripheral seal and lock arm will meet USCAR engage force guidelines. No mechanical assist would be required.
- Application Limitations:
  - » The positive and negative battery cables would not have to be design integrated into a common harness.
  - » The positive and negative cables could be dressed in different orientations.
  - » The cable harness length could be optimized for each application. This could result in approx. 1 ft. less cable with associated voltage drops and cost.
  - » The ergonomics of routing and plugging two battery cables may force higher cable strand count for flexibility. (Large cables become structural members.)
- Design:
  - » The mass of two cables will mandate more robust shrouds and locks, possibly increasing engage force.
  - » Strain relieving a single cable to eliminate leakage around the cable seal is easier to achieve. Also, the TPA tooling is smaller and less expensive.
- Electrical Isolation:
  - » Cavity isolation at 42V is much more critical than at 14 V.
  - » Any leak path within a connector will promote electrochemical corrosion.
  - » Terminal to terminal isolation is maximized with two connector design . Isolation loss between terminals would require a double fault.
  - » A single two-cavity connector would require a higher level of sealing validation.
- ◆ Summary
  - Two cavity connector advantage:
    - » one connector body
    - » one peripheral seal
    - » one TPA
  - Two Single-cavity connector advantage:
    - » Simplified tooling
    - » No mechanical assist required
    - » Improved electrical isolation
    - » Optimized harness routing
    - » Reduced Cable cost and length
    - » Improved harness build ergonomics
    - » Lower sealing requirement
    - » Smaller sealing/alignment shrouds and locks
    - » Common components - TPA, CPA, Cable Seals, Peripheral Seals

Bob Beer  
Delphi Automotive Systems (harness/connection)

### PSA

Disadvantages of an integral 2-way connector versus two single connectors:

- the insertion force will be more important than for a one way connector. A mechanical assist on connection will be needed, this system could be useless for a one way connector.
- insulation distance between the two ways has to be far enough to prevent electrical arcs. This condition is related to the dimensions of the connector.

Advantages of an integral 2-way connector :

- there are less keyings.

Regards,  
Alexandre Genevaux

### Tyco Electronics

As far as feedback Tyco believes that a single one piece housing would be less expensive and therefore be a favored proposal.

Benefits - a system solution, for power management, of adding a third circuit can easily be incorporated into a one piece housing. The third circuit would be used as a signal to turn the power on and off to prevent arcing. It would also benefit in the jumper cable by only attaching one housing with both circuits at the same time. It could also provide benefits to voltage sensing in the battery for diagnostics for the OEM's. We would recommend solid copper for the terminal for conductivity and tin lead plating for corrosion resistance against acid vapors. The initial estimate is 8mm dia.

Concern is pin alignment and true position relative to each other. It needs to be held tightly.

Best Regards  
Garold M. Yurko

## Summary of one way vs. two way

<u>Issue</u>	<u>2 - one ways</u>	<u>1 - two way</u>
Isolation resistance between terminals	+	
Dimensional tolerance between two terminals	+	
Flexibility in battery cell geometry	+	
Internal battery buss bars		
Method to detect connector opening/closing		
Requires battery electrical contact		+
Does not require battery electrical contact	0	0
Battery sensing circuit	0	0
Mate/unmate force	+	
Number of operations to mate/unmate		+
Difficulty to mate/unmate connection	+	
Stiffness of cables (higher strand cable?)		
Strength of plastic connection	+	
Cable routing flexibility/length (cost/voltage drop)	+	
Strain relief for cable	+	
Separate harnesses for positive and negative	+	
Number of indexing (keying) combinations required		+
Jumper cable connection		+
Touch safety		+
Differentiation from today's 12 V batteries		+
Number of plastic pieces		+
May be less cost?		+

## Preferences

### **2 - one ways**

EPC  
 Exide  
 JCI  
 Delphi (battery)  
 Delphi (harness/connection)  
 PSA ?  
 Douglas Battery

### **1 – two way**

DaimlerChrysler  
 Hoppecke  
 Tyco