



S.1 RP Updates

RP107C Seven Conductor Truck-Trailer/Converter Dolly Jumper Cable and Connector Selection

RP159 Installation and Inspection Guidelines for Seven Conductor Truck-Trailer/Converter Dolly Jumper Cable and Connector

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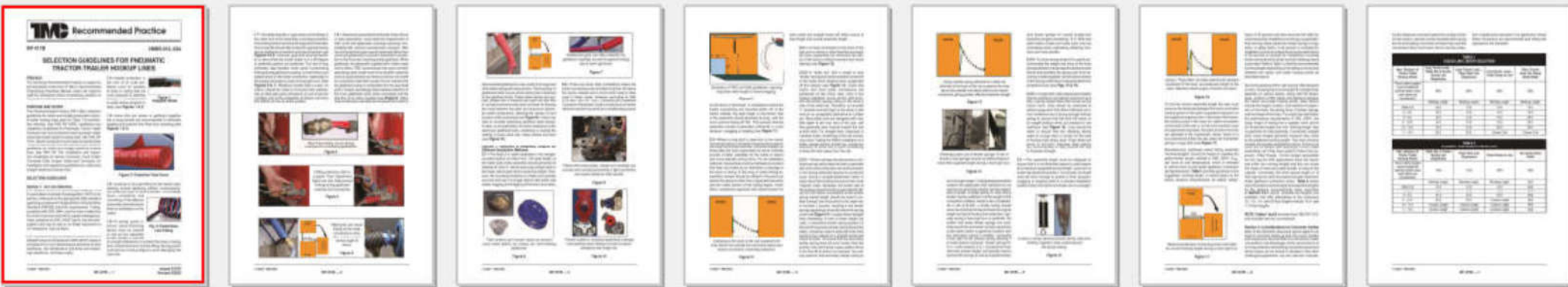
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RP Updates – S.1 Seven Conductor System

- Introduction & Update Rationale:

1. The last updates for these documents were in 2005.
2. They were reissued without changes in 2015.
3. Similar RPs were created for the Pneumatic Lines within S.4. These were updated in 2017 and again in 2023.
4. The most significant thing that prompted a review was the large increase in the use of straight, (particularly wrapped) hookup lines. There is some reference to straight cables in the present document but a number of considerations involving these lines need to be documented.
5. The expanded inclusion of the straight lines offers a good opportunity to update other areas of the RPs.
6. Each RP is separated from its partner RP for a given Study Group since the “Selection” element is an Engineering matter while “Installation and Inspection” is a Maintenance matter.
7. Ultimately, it would be useful to combine the topics into a visual presentation bearing all 4 of the (Pneumatic & Electrical) RP elements.



SEVEN CONDUCTOR TRUCK-TRAILER/CONVERTER DOLLY JUMPER CABLE AND CONNECTOR SELECTION

PREFACE

The following Recommended Practice is subject to the Disclaimer at the front of TMC's *Recommended Engineering Practices Manual*. Users are urged to read the Disclaimer before considering adoption of any portion of this Recommended Practice.

PURPOSE AND SCOPE

This Recommended Practice (RP) offers selection guidelines for coiled and straight electrical tractor-to-trailer hookup lines used on Class 7-8 combination vehicles. See TMC RP 417A, *Selection Guidelines for Pneumatic Tractor-Trailer Hookup Lines*, for recommendations on air line selection.

SELECTION GUIDELINES

1. Electrical Line Selection:

1.1—Seven conductor cable used in assemblies must bear the designation "SAE J2394—Type F" signifying compliance to the SAE performance standard for cable that is capable of dependably providing power output to the trailer ABS system in keeping with TMC RP 137, TMC RP 141 and SAE J2247. This cable may be used for non-ABS applications as well. The color of the primary ABS cable will generally be green designating compatibility with ABS systems. The color of the secondary cable for auxiliary power circuits will generally be yellow. (See Figure 1.)

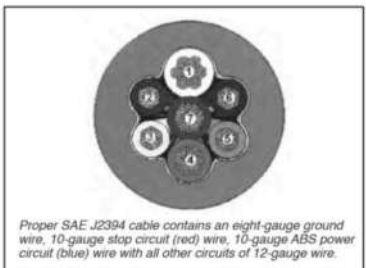


Figure 1

1.2—Seven-conductor plugs and receptacles used in primary cable assemblies must bear the designation "SAE J560" signifying compliance to the SAE standard. In cases where the receptacle uses a non-SAE-compliant, split-pin terminal style, the manufacturer must certify compliance to all dimensional and performance requirements of the SAE J560 standard. (See Figures 2 and 3.)



Figure 2



Standard seven-pin connectors for primary electrical lines include all-female terminals in the plug and all-male terminals in the receptacle.

Figure 3

1.3—Seven-conductor plugs and receptacles used in secondary cable assemblies for auxiliary power may bear the designation "ISO 3731" though newer connectors will bear the designation SAE J560 and may be identified with the designation

Seven-pin connectors for auxiliary electrical lines may include a male ground terminal in the plug and a female ground terminal in the receptacle.



Figure 4



Figure 5

Updates:

1. Cable...Add references to
 - a) Cold weather performance as many cables used today fail cold bend at temperatures in the -20C range rather than -40C when considering the stress applied to the cable at the trailer connection during tight turns.
2. Plugs & Sockets...Add references to:
 - a) Use of sealing devices where practical provided that they are of a permanent enough nature that they do not come off for thousands of coupling cycles and that they don't entrap moisture and restrict its egress from the connector.
 - b) Sockets need to be made with a sufficient draft to facilitate moisture egress. Ribs in the socket may be used to help prevent "rocking" within the plug and to help provide an outflow path for moisture.
 - c) Sockets should have a deep enough "throat" to ensure that mating plugs are properly supported during the application.



Electrical lines are regularly exposed to pulling and tugging, whether due to constant movement while in use or during connector disconnection.

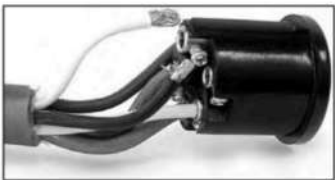
Figure 6

"AUX" and be of a yellow color. These connectors generally possess an inverted ground terminal prohibiting connection to the primary electrical receptacle. (See Figs 4 and 5.)

1.4—Plugs must be equipped with a means by which the user may grasp the plug housing when uncoupling the plug from the receptacle. This will alleviate the connection strain that occurs when the user uncouples the connectors by pulling on the cable.

1.5—Plugs should have an integral or separate method of strain-relief such as a clamp, or molded-over section, intended to protect the cable from movement during trailer articulation and the resulting strain on the wire-to-terminal connections. (See Figure 6.)

1.6 The connection of the individual wire conductors to the plug terminals must be of a permanent nature. Crimping or welding the conductors to the terminals are acceptable methods while a wire-inserted screw attachment method has generally been found to be unacceptable over time. (See Figure 7.)



Over time, plugs with wire-inserted screw terminals do not provide adequate protection against wire breakage, disconnection and shorting.

Figure 7

1.7—Assemblies that are molded or have a permanently attached boot or sealing mechanism at the back end of the plug housing will inhibit the entry of corrosion-causing moisture, chemicals and contaminants.

1.8—Corrosion-causing moisture could penetrate into the "front" side of the plug where the female terminals are exposed. When storing the plug, it is recommended that an appropriate retainer be used allowing the plug to be stored with its front side down to allow any moisture to escape.

1.9—No sharp surfaces should be present at the back end of the plug housing where the cable exits the plug as it may cause cable chafing or cutting.

2. Selection of Assembly Lead Length, Installation Method and Overall Length:

2.1—The lead of a coiled assembly is the straight, uncoiled section on either end. The lead length on the trailer side of the assembly should generally be between 6" and 12." Some users mount a longer lead on the trailer side to gain extra overall line length. However, the mounting locations on trailers are typically very low and the use of a longer lead on the trailer side makes sagging and dragging of the lines more likely.

2.2—There are some older installations where the tractor connections are mounted more than 18" above the tractor frame rails, catwalk or deckplate and a short tractor lead is often used in these cases. However, according to SAE J702 and TMC guidelines, the tractor connections on newer vehicles must be mounted low to enable easy access by the driver or mechanic. In installations where the tractor connections are mounted within 18" of the tractor frame rails, catwalk or deckplate, the lead length on the tractor side of the assembly should generally be long (24" to 72" with the most common being 48"). This ensures that the assembly remains suspended sufficiently to avoid abrasion, snagging or tangling. In choosing an overall coil length, the user will also find that the use of a long tractor lead enables use of a shorter coiled length. (See Figure 8.)

2.3—Where a long lead is used due to low tractor mounting locations, the leads are generally suspended using one of three methods. Correctly applied, all three keep the lines suspended but some methods provide a better capability for the leads to extend and move laterally during turns. (See Figs. 9, 10, 11 and 12.)

Updates:

1. Propose the use of strain relief and bend-restricting devices that reduce the risk of cable breaks at the juncture of the cable and connector during turns at cold temperature.

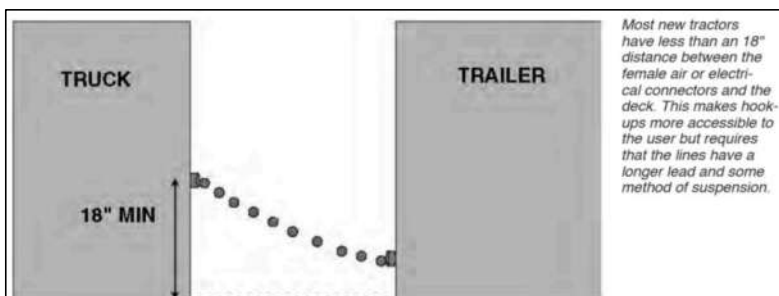


Figure 8

2.3.1—A fixed connection to the back of the cab using a clamp or other fixed device keeps the lines suspended but minimizes the ability of the lines to extend and move laterally.

2.3.2—A "slider bar" with a single or dual "tender" spring and clamp enables movement of the leads while keeping them suspended off the deck.

2.3.3—A "pogo stick" with a clamp also enables this line extension and lateral movement as it has a spring-loaded base that moves as the tractor turns.

2.4—The assembly length must be adequate to ensure that it is not stretched beyond a safe degree at its maximum expected service length, (such as in a trailer near-jack-knife position). Conversely, its length must be short enough to protect it from abrasion, snagging or tangling when in a relaxed installation

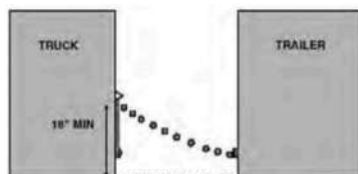


Figure 10

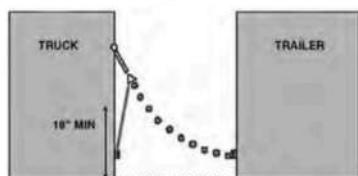


Figure 11

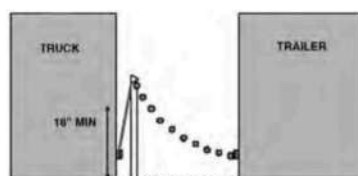


Figure 12

When installing lines with long leads, be sure to allow enough height to prevent the line from rubbing on the deck or snagging. Be sure to consider the lateral movement of the lines when choosing a suspension method. Sliding tenders and pogo sticks enable this side-to-side movement.



Figure 9

Some installers can't make up their minds whether or not to suspend hookup lines. Even though the trailer connection shown here is up off the tractor deck, the low tractor connection dooms the unsuspended electrical line to sagging, abrasion and snagging.

Updates:

1. Add the points that are relevant to straight cable assemblies adding devices needed to suspend these off the tractor deck and supporting these away from the tractor cab. (draw from RP417B)

position, (such as when the tractor and trailer are in a straight position).

2.5—To find the correct assembly length the user must measure the distance between the tractor and trailer hookup points at the point of greatest extension. In the case of the tractor, the hookup point is the electrical connection on the back of the cab or, in the more common case of suspended long leads, it is the point at which the lines are attached to the suspension clamp, (which is in turn attached to either the cab, slider bar tender or pogo stick).

2.6—Figure 13 shows that during a full right turn, the trailer connections are at an extreme angle as compared to when the tractor is in a straight position. While plugs and sockets are designed to breakaway during dock drive-offs, they are required to withstand the straight pull force specified in SAE J560. The angular forces that occur at the trailer during the full extension of the electrical line enable these connectors to withstand a much greater pull force. In fact, SAE tests have proven that plugs and sockets that barely meet the minimum straight pull force, will withstand considerably more force at various pulling angles. This enables the coiled cable manufacturer to develop an electrical line that will have improved sag resistance when it is returned to the straight position.

2.7—Figure 13 also shows that the tractor connections are in the straight position even during the right turn. This is why the choice of whether or not to clamp leads at the tractor and the method of

clamp suspension, both contribute to the selection of overall assembly length.

2.8—While manufacturers' published "working lengths" are based on meeting the test results outlined in SAE J2222, a user will rarely subject a line to this full length, (normally 15 ft.), during normal operation. An added "safety" factor of 25 percent has been built into the following chart for installations involving a suspended, free-moving clamp (slider bar tender or pogo stick). A safety factor of 35 percent is included for installations involving a fixed clamp and a safety factor of 50 percent is included for installations involving tractor connections for which no strain-relieving clamp is provided. The tractor manufacturer must ensure that a satisfactory power output is provided to support ABS for the long and shorter length electrical lines. (See Table 1.)

2.9—Due to the absence of the "self-storing" effect present in coils, choosing the correct length for straight lines depends on various factors. Along with the wheelbase, position of fifth wheel and distance between tractor and trailer hookup points, other factors include the height, location and method of suspension of the lines, the spring force of tender springs and the weight of the lines. There are so many variables that it is best to begin with the chart below as a starting point and conduct field trials to optimize. Really, the method of suspension is best chosen after determining the safe extended distance that the lines are required to operate within and then to determine the position of the lines in relation to the deck when the tractor and trailer are in a straight position. A satisfactory method for storage of disconnected lines is also required. (See Table 2.)

INSTALLATION AND INSPECTION RECOMMENDATIONS

See TMC RP 159, *Installation and Inspection Guidelines for Seven Conductor Truck-Trailer/Converter Dolly Jumper Cable and Connector*, for installation and inspection guidelines for coiled and straight electrical hookup lines. See TMC RP 435, *Installation and Inspection Guidelines for Pneumatic Tractor-Trailer Hookup Lines*, for procedures covering trailer-trailer pneumatic brake system hookup lines.

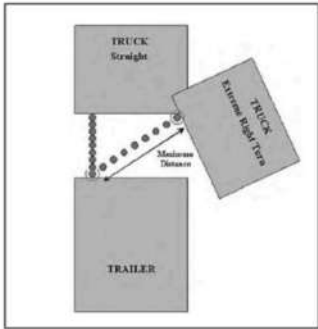


Figure 13

Updates:

1. Address the line protection/wrap, clamps, etc. as with RP417B

**TABLE 1
COILED LINE LENGTH SELECTION**

Max. Distance of Tractor-Trailer Hookup Points	Long Tractor Lead ... Slider Bar & Tender Spring Line Suspension	Long Tractor Lead ... Pogo Stick Line Suspension	Long Tractor Lead ... Fixed Clamp to Cab	Short Tractor Lead...No Clamp Strain Relief
These safety margins beyond published working lengths have been taken into consideration:	25%	25%	35%	50%
	Working Length:	Working Length:	Working Length:	Working Length:
Under 6 ft.	12 ft.	12 ft.	12 ft.	12 ft.
6 - 8 ft.	12 ft.	12 ft.	12 ft.	15 ft.
8 - 9 ft.	12 ft.	12 ft.	15 ft.	20 ft.
9 - 10 ft.	15 ft.	15 ft.	15 ft.	20 ft.
10 - 11 ft.	15 ft.	15 ft.	20 ft.	20 ft.
11 - 15 ft.	20 ft.	20 ft.	Custom Coil	Custom Coil

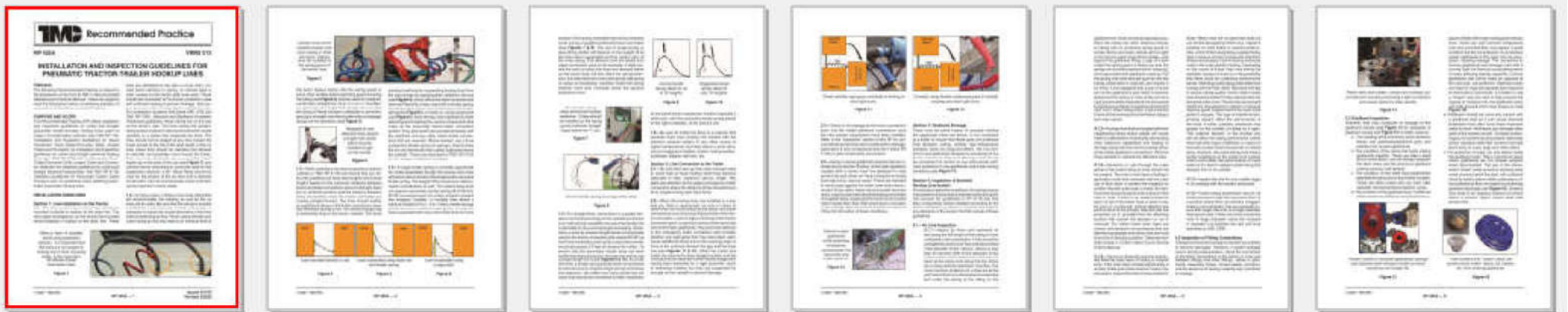
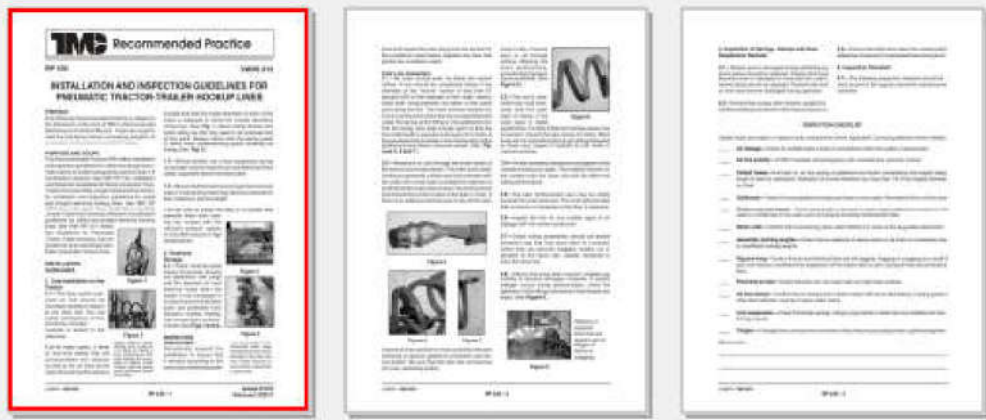
**TABLE 2
STRAIGHT LINE LENGTH SELECTION**

Max. Distance of Tractor-Trailer Hookup Points	Slider Bar & Tender Spring Line Suspension	Pogo Stick Line Suspension	Fixed Clamp to Cab	No Clamp Strain Relief
These safety margins beyond published working lengths have been taken into consideration:	10%	10%	20%	N/A
	Working Length:	Working Length:	Working Length:	N/A
Under 6 ft.	10 ft.	10 ft.	12 ft.	N/A
6 - 8 ft.	15 ft.	15 ft.	15 ft.	N/A
8 - 9 ft.	20 ft.	20 ft.	20 ft.	N/A
9 - 10 ft.	20 ft.	20 ft.	Custom Length	N/A
10 - 11 ft.	Custom Length	Custom Length	Custom Length	N/A
11 - 15 ft.	Custom Length	Custom Length	Custom Length	N/A

Updates:

1. Adjust chart as appropriate per RP417B

This exemplifies the expansion of educational information made available through the S.4 Pneumatic “Installation & Inspection” rewrite...



**INSTALLATION AND INSPECTION GUIDELINES FOR
SEVEN CONDUCTOR TRUCK-TRAILER/CONVERTER
DOLLY JUMPER CABLE AND CONNECTOR**

PREFACE

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PURPOSE AND SCOPE

This Recommended Practice (RP) offers installation and inspection guidelines for coiled and straight electrical tractor-to-trailer hookup lines used on Class 7-8 combination vehicles. See TMC RP 435, *Installation and Inspection Guidelines for Pneumatic Tractor-Trailer Hookup Lines*, for procedures covering trailer-trailer pneumatic brake system hookup lines.

See TMC RP 107C, *Seven Conductor Truck-Trailer/Converter Dolly Jumper Cable and Connector Selection*, for selection guidelines for coiled and straight electrical hookup lines. See TMC RP 417, *Selection Guidelines for Pneumatic Tractor-Trailer Hookup Lines*, for guidance when choosing trailer-trailer pneumatic brake system hookup lines.

INSTALLATION

1. Line Installation on the Tractor:



Figure 1

1.1—In many cases, a three or four-hole clamp that will accommodate the cable(s) as well as the air lines will be used. Be sure that the clamp is durable and that the inside diameter of each of the holes is adequate to clamp the outside diameters of the lines. (See Figure 1.)

1.2—Where needed, use a hose suspension spring (or springs) sized to keep electrical lines safely supported above the deck plate.

Incorrect storage of disconnected trailer plugs and glad-hands will cause damage to the lines and may create hazards to surrounding equipment or personnel.



Figure 2



Figure 3

1.3—Be sure to install the lines in a manner that prevents them from coming into contact with the vehicle's exhaust system or any other source of high temperatures.

2. Plug Storage:

2.1 There must be some means of securely stowing the plugs and the attached electrical lines when the tractor is not connected to a trailer to ensure that these parts are protected from abrasion, cutting, chafing, high temperature surfaces and dirt. (See Figures 2 and 3.)

INSPECTION

NOTE: Periodically inspect the installation to ensure that it remains according to the above guidelines and inspect the lines along their full section for the conditions noted below. Replace any lines that exhibit the conditions noted.



Figure 4

3. Electrical Line Inspection:

3.1—Abrasions, cuts, cracks or voids in the cable jacket should not be present. The inner insulated conductors should not show through the cable jacket. (See Figure 4.)

Updates:

1. Add points per RP435B involving the actual installation, suspension of different working lengths in specified ways, etc.

3.2—The sun's ultraviolet rays may eventually fade the cable jacket. If the cable jacket is faded significantly, it is likely brittle and hairline cracks may be present. Inspect the cable closely for these.

3.3—A coiled cable assembly should not exhibit excessive sag that may place it in a position where it can become snagged, chafed, cut or abraded on the frame rails, catwalk, deckplate or even the driveline.

3.4—Frequently inspect connector terminals for dirt and corrosion. Remove any dirt and corrosion with a wire brush and cleaner. Apply a corrosion preventative material—as per TMC RP 155, *Selection and Application of Corrosion Preventive Materials for Electrical Terminals and Connectors*—to fully coat the plug and socket terminals.

3.5—Inspect for loose or poorly made wire-to-terminal connections and repair or replace these.



Figure 5

(See Figure 5.)

3.6—Where practical, with assemblies made with short leads, reverse the assembly so that the trailer plug that has endured many coupling and uncoupling cycles and has been exposed to weather, chemicals and dirt, is connected to the tractor socket, giving the other plug equal time of use.

3.7—Inspect the cable-to-connector strain relief clamp or other mechanisms to ensure that the cable has not begun to pull out of the connector. (See Figure 5.)

3.8—Check that the latching lug and spring force on the socket lid and the latching lug on the plug provide adequate latching force. (See Figure 6.)



The condition of the index lug on the plug housing and the latch and socket lid spring are the primary things to check in an electrical plug and socket.

Figure 6

3.9—Inspect the spring-loaded female terminals in the plug and the wear, condition and position of the male socket pins to ensure proper electrical contact.

3.10—Inspect for proper operation of lamps, ABS system and other electrical devices on the trailer. Ideally, voltage checks should be performed. Seven-way circuit checkers may be useful in isolating incomplete or intermittent circuits.

3.11—Any weather-sealing mechanisms at the back end of the plug or socket housings should be intact providing an adequate seal. Trapped moisture will facilitate corrosion.

4. Inspection of Springs, Clamps And Hose Suspension Devices:

4.1—Rusted, worn or damaged springs exhibiting any sharp edges should be replaced. Clamps that have become loose or damaged or have slid onto unprotected tubing should be replaced. Rusted bolts and/or nuts may become dislodged during operation.

4.2—Ensure that a pogo stick remains upright but will flex enabling movement of the lines during turns.

4.3—Ensure that slider bars allow the unobstructed sideways movement of suspended lines during turns.

5. Inspection Checklist:

5.1—The following inspection checklist should be used as part of the regular preventative maintenance schedule.

Updates:

1. Address each component for inspection details, causes of failure, and remedial actions similar to RP435B

INSPECTION CHECKLIST

Isolate faults and repair or replace faulty components where applicable. Consult guidelines where needed.

- _____ **Electrical function**—Check operation of all lights, ABS modules and other electrical devices.
- _____ **Cable selection**—Confirm green cable marked SAE J2394 for ABS-equipped trailers.
- _____ **Auxiliary hookup**—Confirm that any auxiliary electrical lines are connected to the correct receptacles.
- _____ **Chafes, cuts and cracks**—Check along length of electrical lines for wear. Inspect faded lines closely for fine cracks or brittleness in the outer cover.
- _____ **Connector terminals**—Check plug and socket terminals for wear & corrosion. Apply anti-corrosion grease. Where short leads are present on both cable ends, (no clamps), reverse the assembly end-for-end to “even out” the wear on the trailer connection.
- _____ **Strain relief**—Confirm that a functioning strain relief method is in place at the plug/cable attachment.
- _____ **Connector mating**—Check that mated plugs and sockets are not loose-fitting and that the socket lid spring and plug/socket latching mechanisms function properly.
- _____ **Assembly working lengths**—Check that no evidence of stress exists on electrical lines or connections due to insufficient working lengths.
- _____ **Sag and snag**—Confirm that electrical lines are not sagging, dragging or snagging as a result of poor coil memory, insufficient line suspension off the tractor deck or poor routing of lines around obstructions.
- _____ **Proximity to heat**—Check that lines are not routed near any high heat surfaces.
- _____ **Line suspension**—Check that tender springs, clamps, pogo sticks or slider bars are installed and functioning properly.
- _____ **Tangles**—Untangle lines to ensure free movement unless lines are purposely joined or gathered together.

Comments: _____

Updates:

1. Inspection points would be included more comprehensively within the RP document rather than on a checklist.





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