

SEPTA Engineering Change Notice

ECN #4391-1

Summary Description of Change: Improvements to the LRV Car Air Leakage Test

Affected Fleet(s):				Effectivity:		Documents Affected:			
<input type="checkbox"/>	B IV	<input type="checkbox"/>	N5	<input type="checkbox"/>	SL IV	<input checked="" type="checkbox"/>	Change: All Cars	<input type="checkbox"/>	Drawing(s)
<input checked="" type="checkbox"/>	LRV DE	<input type="checkbox"/>	PCC II	<input type="checkbox"/>	SL V	<input type="checkbox"/>	Change Car #'s:	<input type="checkbox"/>	Specification(s)
<input checked="" type="checkbox"/>	LRV SE	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	IPC <input type="checkbox"/> RMM <input type="checkbox"/> HRM <input type="checkbox"/>
<input type="checkbox"/>	M4	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	Evaluate/Test Only Car Nos.:	<input type="checkbox"/>	Operator's Manual
<input type="checkbox"/>	Wk Car/Loco:				<input type="checkbox"/>			<input type="checkbox"/>	Schematics
<input type="checkbox"/>	Facility/Equipment:				<input type="checkbox"/>	Documentation only:		<input type="checkbox"/>	Other
<input type="checkbox"/>	Other:				<input type="checkbox"/>			<input checked="" type="checkbox"/>	None

Description of change:
Rev. 1: Change pressure decay in step 4.5 from 3 psi to 4 psi.
Rev. 0: Establish appropriate air leakage rate and introduce a new test instrument to the process.

Reason for change:
Rev. 1: Accommodation for leaking manifolds presently in replacement program.
Rev. 0: Simplify car air leakage test and diagnosis.

System Safety Class: 2

VMIS Job Code: TE-LA

Priority: High Med Low Doc Only

Attachments:

Special Instructions:

New Stock Request: YES NO

Distribute to: LRV distribution list

Originator: Dean W. Rupp / Mabin Kurian		Date approved: 08/08/2016		
Engineering Manager: <i>John MacEwen</i>		Date approved: 08/10/2016		
REVISIONS	REV. NO.:	REVISION ORIGINATOR:	ENGINEERING MANAGER APPROVAL:	DATE APPROVED:
	Rev. 1	Dean W. Rupp	<i>John MacEwen</i>	02/03/2017
	Rev. 2			
	Rev. 3			
	Rev. 4			
	Rev. 5			

Change Details:

Car leakage tests on the LRV vehicles equipped with the bleeder-style Servotrol brake control unit present unique issues for leakage testing. To lower the labor intensity, the bleed rate (2 psi/min.) published in WABCO document E-A163-202, REV. E, will be incorporated into expected leakage rates. Adding the bleed rate to the standard in-service leakage rate of 2 psi/min., yields a 4 psi/min. maximum leakage rate for the LRV and its compliment of reservoirs.

To simplify testing, a DRUCK model DPI-705 digital pressure gauge with leak test function will be implemented. The leak test function is a pre-programmed, one-minute pressure change test, which performs starting and ending sampling, calculates the pressure change, and displays the resulting value on screen.

The procedure begins with a “whole car” evaluation, to determine if there is a high leakage rate or not. Many tests will stop here, with leakage rates below the limit. The balance of the procedure (or selected portions) can be used to determine singularly high leakage or multiple moderate leaks in various subsystems. This will help narrow down places to physically check, as opposed to the labor required to search the entire pneumatic system for a problem area(s). At the end is a description about the inseparable parts of the main reservoir system.

A work sheet follows the procedure.

NOTE: There is some configuration complication regarding the correct style of quick-disconnect fitting within the compressor control box. The original fitting WABCO supplied will remain to be used in this location. Any non-standard fittings discovered during test set-up, are to be changed out for the correct part. It is their part number 548844 (our C/L 50-02103-L01), and accepts the mating nipple pictured below. The length of the tip to the first ring is 5/16”:

Nipples

Female Pipe Thread



65-04350-B

Male Pipe Thread



65-04350-A

LRV Air Leakage Test:

This leakage test will cover the pneumatic brake system and sub-systems that utilize compressed air to operate. The goal of this procedure is to keep the duty cycle of the air compressor low. The compressor duty cycle is determined by the pneumatic system consumption during service, plus any system leakage. Lower duty cycles are important in single tower dryer installations to allow sufficient desiccant recovery time, and in general to improve compressor longevity.

The **WHOLE-SYSTEM DECAY TEST** will cover the entire pneumatic system (as is practical) and should be used as a first step in the diagnosis of overall system condition. If needed, sections thereafter will subdivide the pneumatic system should it be necessary to search for a singular, high leakage point or multiple low leakage sub-systems sufficient to cause failure of the leakage test.

Subsequent test results thereafter will be evaluated by comparison to the WHOLE-SYSTEM TEST. Large differences in results will likely indicate a problem area. IF a numerical value for the decay in a particular subsystem is also desired, simply subtract the subsystem test number from the whole system test number.

1. EQUIPMENT REQUIRED:

Electronic Pressure Instrument and connection hosing as defined in Specification ST-4734. The device is to be configured per "LRV" details.

2. AREAS TESTED:

Main Reservoir (MR) system

Emergency Pipe (EP) system (not including coupler hoses)

Brake cylinder (BC) system (whole and individual trucks)

Sub-systems:

- a. Air spring & load weigh system
- b. Door engines
- c. Wiper control valves
- d. Horn control valve(s)
- e. Sanding control valve(s)
- f. Coupler control valves (in the uncoupled state)
- g. Motor Control Box
- h. Pressure gauges*
- i. Pantograph control valves*

*— items that are inseparably connected to the MR system

3. CAR SET-UP:

3.1) Turn on Druck Leak Tester to warm up.

3.2) Apply 600 VDC power to car.

3.3) All cut-out cocks and brake cylinder switches are to be in their normal, revenue service positions.

3.4) Parking brake is released (charged).

3.5) All high voltage circuit breakers are to be "on".

3. CAR SET-UP (continued):

- 3.6) All low voltage circuit breakers are to be “on”.
- 3.7) Wiper(s) are to be “off”.
- 3.8) Place car into “**STAND-BY**” & “**NEUTRAL**”
- 3.9) Recharge emergency pipe.
- 3.10) Open all passenger doors using the toggle switches.
- 3.11) With Druck Leak Tester unconnected, check for zero. Zero-out as needed, by pressing the two indicated buttons on the front at the same time.
- 3.12) Open the air compressor’s control box and connect Druck leak tester to the quick-disconnect fitting within.

NOTE: Air compressor charge time for a car in a totally deflated state is about 8-minutes. (Totally deflated means no air in main reservoir, service reservoir, emergency reservoirs, nor air springs).

NOTE: The S-1 Servotrol portion is a “bleeder” style device for improved stability and accuracy. The bleeder function is fed when the emergency pipe is charged and the car is in service brake mode. It is not possible to separate the bleeder function out, so it has been accommodated within the leak test target numbers. This is to simplify the leak testing process.

NOTE: If the emergency pipe dumps due to pressure decline during any test, that test is invalid.

4. WHOLE-SYSTEM DECAY TEST:

- 4.1) The air compressor **MUST** have just finished a recharge cycle to start the test. If needed, crack open the main reservoir drain cock to trigger a recharge cycle.
- 4.2) When compressor cuts-out, start a 5 minute count for reservoir cooling **AND** disable the air compressor. This may be done by whichever of the following is easiest:
 - a) Placing car in “car wash” mode.
 - b) By pulling the pole from the wire.
 - c) Turning off the high voltage circuit breaker ACMB in the under-seat three-phase panel.
- 4.3) After the 5 minute cooling period, check pressure shown on the leak tester. It must show at least 100 psi to continue the test.

IF car fails at this early point, the check box should be marked on the test sheet. A test may still be conducted to get an initial value, but further tests are required to pin-down the problem area(s). Testing at this pressure is too close to the automatic dump point (90psi) for the emergency pipe. If the emergency pipe dumps due to pressure decline during the test, the test is invalid.

NOTE: NO persons may be in the car or enter it during this test. The added weight will cause the air springs to consume air, and this will ruin any leak test.

- 4.4) Press the “LEAK” button until the leak test engages. The device will count down for 1 minute.

4. WHOLE-SYSTEM DECAY TEST (continued):

4.5) At the end of the test period, the leak tester will show the pressure decay (indicated with a minus symbol) over one minute.

- A pressure decay of 4.00 psi/min OR less is acceptable and all testing is complete.
- A pressure decay of 4.01 psi/min OR greater is indicative of high leakage which needs to be sought and corrected. See the next sections on ways to subdivide the car to narrow-down problem areas. Once leak(s) is/are corrected, repeat WHOLE-SYSTEM DECAY TEST to confirm status.

4.6) Reinstate air compressor power.

4.7) If testing is concluded, remove leak tester and close compressor compartment.

4.8) Close car doors 2, 3 & 4.

NOTE: A slight increase in leakage in the following individual tests, above that determined in the **WHOLE SYSTEM TEST**, indicates a new leak has been added to the picture. This is typically leakage through the thrown vented cut-out cock's vent port or around the stem.

5. BRAKE CYLINDER SYSTEM DECAY TESTS:

From service manifold feed to brake cylinders inclusive:

5.1) Chock the car wheels against all movement. (Brake cylinders will be cut out and the parking brake is still released)

5.2) Close the service reservoir vented cut-out cock (S.R.):

SE car: under-car, at the rear right-corner, next to the back-up alarm.

DE car: under-car, by the J-3 Control Unit, toward the A-end, right side.

5.3) The air compressor **MUST** have just finished a recharge cycle to start the test. If needed, crack open the main reservoir drain cock to trigger a recharge cycle.

5.4) Recharge emergency pipe if lost during the previous test.

5.5) When compressor cuts-out, start a 5 minute count for reservoir cooling **AND** disable the air compressor.

5.6) After the 5 minute cooling period, check pressure shown on the leak tester. It must show at least 100 psi to continue the test.

5.7) Press the "LEAK" button until the leak test engages. The device will count down for 1 minute.

5.8) At the end of the test period, the leak tester will show the pressure decay (indicated with a minus symbol) over one minute. This is the whole system *without* the brake cylinder decay. Compare the decay in this section with the WHOLE SYSTEM TEST decay. If the two numbers are nearly identical, then the BRAKE CYLINDER SYSTEM doesn't present a large leak.

NOTE: If a large leak is not present in this subsystem, then the leakage determined in the WHOLE SYSTEM TEST could be a combination of minor leaks from multiple, low leakage subsystems.

5.9) Reinstate air compressor power.

5.10) Open the service reservoir vented cut-out cock.

5. BRAKE CYLINDER SYSTEM DECAY TESTS (continued):

5.11) Remove wheel chocks if finished with this section.

To test individual trucks:

5.12) Isolate a truck #1 using the disc brake cut-out switch in the floor box behind the operator's seat.

5.13) Perform steps 5.3 through 5.8 above to test truck #1.

5.14) Press the "leak" button once to return the tester to pressure reading mode.

5.15) Switch off truck #1 disc brake cut-out switch.

5.16) Isolate truck #2 using the disc brake cut-out switch.

5.17) Perform recharge steps 5.3 through 5.5 above, IF MR pressure (shown on the tester) is less than 120 psi. The test may be continued if pressure is still above 120 psi.

5.18) Perform steps 5.7 through 5.8 to test truck #2.

5.19) Reinststate air compressor power.

5.20) Switch off truck #2 disc brake cut-out switch.

5.21) Remove wheel chocks.

6. PARKING BRAKE CYLINDER SYSTEM DECAY TEST:

6.1) Close the park brake cut-out cock on the floor of the front compartment (by the fire extinguisher), or the B-end compartment.

6.2) The air compressor **MUST** have just finished a recharge cycle to start the test. If needed, crack open the main reservoir drain cock to trigger a recharge cycle.

6.3) Recharge emergency pipe if lost during the previous test.

6.4) When compressor cuts-out, start a 5 minute count for reservoir cooling **AND** disable the air compressor.

6.5) After the 5 minute cooling period, check pressure shown on the leak tester. It must show at least 100 psi to continue the test.

6.6) Press the "LEAK" button until the leak test engages. The device will count down for 1 minute.

6.7) At the end of the test period, the leak tester will show the pressure decay (indicated with a minus symbol) over one minute. This is the whole system without the parking brake cylinder decay. Compare the decay in this section with the **WHOLE SYSTEM TEST** decay. If the two numbers are nearly identical, then the **PARKING BRAKE CYLINDER** system doesn't present a large leak.

NOTE: If a large leak is not present in this subsystem, then the leakage determined in the **WHOLE SYSTEM TEST** could be a combination of minor leaks from multiple, low leakage subsystems.

6.8) Reinststate air compressor power.

6.9) Open the parking brake cut-out cock.

7. AIR SPRING & LOAD WEIGH SYSTEM DECAY TEST:

7.1) Close both air spring vented cut-out cocks. These are located:

SE car: left underside, at the trailing edge of the truck opening in the skirts.

DE car: left underside, at the upper points of the center skirt section between trucks.

Be sure to close the air spring cut-cock and **NOT** the load weigh cut-cock.

7. AIR SPRING & LOAD WEIGH SYSTEM DECAY TEST (continued):

- 7.2) The air compressor **MUST** have just finished a recharge cycle to start the test. If needed, crack open the main reservoir drain cock to trigger a recharge cycle.
- 7.3) Recharge emergency pipe if lost during the previous test.
- 7.4) When compressor cuts-out, start a 5 minute count for reservoir cooling **AND** disable the air compressor.
- 7.5) After the 5 minute cooling period, check pressure shown on the leak tester. It must show at least 100 psi to continue the test.
- 7.6) Press the "LEAK" button until the leak test engages. The device will count down for 1 minute.
- 7.7) At the end of the test period, the leak tester will show the pressure decay (indicated with a minus symbol) over one minute. This is the whole system *without* the air spring system decay. Compare the decay in this section with the **WHOLE SYSTEM TEST** decay. If the two numbers are nearly identical, then the **AIR SPRING & LOAD WEIGH SYSTEM** doesn't present a large leak.

NOTE: If a large leak is not present in this subsystem, then the leakage determined in the **WHOLE SYSTEM TEST** could be a combination of minor leaks from multiple, low leakage subsystems.

- 7.8) Reinstate air compressor power.
- 7.9) Open **BOTH** air spring vented cut-out cocks.

To test individual trucks:

- 7.10) Isolate a truck #1 using the associated air spring vented cut-out cock.
- 7.11) Perform steps 7.2 through 7.7 above to test truck #1.
- 7.12) Press the "leak" button once to return the tester to pressure reading mode.
- 7.13) Open the vented cut-out cock for truck #1.
- 7.14) Close the vented cut-out cock for truck #2.
- 7.15) Perform recharge steps 7.2 through 7.4 above, IF MR pressure (shown on the tester) is less than 120 psi. The test may be continued if pressure is still above 120 psi.
- 7.16) Perform steps 7.6 through 7.7 above to test truck #2.
- 7.17) Open the vented cut-out cock for truck #2.
- 7.18) Reinstate air compressor power.

8) EMERGENCY PIPE SYSTEM + BLEEDER DECAY TEST:

- 8.1) Vent emergency pipe with the console plunger.
- 8.2) The air compressor **MUST** have just finished a recharge cycle to start the test. If needed, crack open the main reservoir drain cock to trigger a recharge cycle.
- 8.3) When compressor cuts-out, start a 5 minute count for reservoir cooling **AND** disable the air compressor.
- 8.4) After the 5 minute cooling period, check pressure shown on the leak tester. It must show at least 100 psi to continue the test.
- 8.5) Press the "LEAK" button until the leak test engages. The device will count down for 1 minute.

8) EMERGENCY PIPE SYSTEM DECAY TEST (continued):

8.6) At the end of the test period, the leak tester will show the pressure decay (indicated with a minus symbol) over one minute. In this case, this is the whole system *without* the combined decays of the emergency pipe system plus the Servotrol bleeder. This subsystem is harder to evaluate due to the normal variations in Servotrol bleed rates.

Compare the decay in this section with the WHOLE SYSTEM TEST decay. If the decay tested here is about half of the WHOLE SYSTEM TEST decay, then the AIR SPRING & LOAD WEIGH SYSTEM doesn't present a large leak.

8.8) Reinstate air compressor power.

8.9) Recharge emergency pipe.

9) WIPER CONTROL VALVES, HORN CONTROL VALVE(S), SANDER CONTROL VALVE(S) & COUPLER CONTROL VALVES DECAY TEST:

NOTE: These items may be tested as a group to save time or individually if a particular area is suspect. Only one, collective entry line is on the work sheet.

9.1) Close the following cut-out cocks:

> Wiper cut-out cock:

SE car: Located under-car, above and just behind the coupler release handle.

DE car: Two, each located under-car, behind the A-left and B-right corner skirts.

> Auxiliary vented cut-out cock(s):

SE car: Located under-car, outboard of the horn trumpet, controlling sander, horn and front coupler control valves.

DE car: Two, each located under-car, behind the A-left and B-right corner skirts, controlling sander, horn and coupler control valves on that end.

> Rear coupler control vented cut-out cock:

SE car: Located under-car, right rear corner at the skirt, next to the J-3 Unit.

9.2) The air compressor **MUST** have just finished a recharge cycle to start the test. If needed, crack open the main reservoir drain cock to trigger a recharge cycle.

9.3) Recharge emergency pipe if lost during the previous test.

9.4) When compressor cuts-out, start a 5 minute count for reservoir cooling **AND** disable the air compressor.

9.5) After the 5 minute cooling period, check pressure shown on the leak tester. It must show at least 100 psi to continue the test.

9.6) Press the "LEAK" button until the leak test engages. The device will count down for 1 minute.

9.7) At the end of the test period, the leak tester will show the pressure decay (indicated with a minus symbol) over one minute. This is the whole system *without* the wiper/horn/sander/coupler control decay. Compare the decay in this section with the WHOLE SYSTEM TEST decay. If the two numbers are nearly identical, then the WIPER/HORN/SANDER/COUPLER CONTROL VALVES doesn't present a large leak.

9) WIPER CONTROL VALVES, HORN CONTROL VALVE(S), SANDER CONTROL VALVE(S) & COUPLER CONTROL VALVES DECAY TEST (continued):

NOTE: If a large leak is not present in this subsystem, then the leakage determined in the WHOLE SYSTEM TEST could be a combination of minor leaks from multiple, low leakage subsystems.

9.8) Reinstate air compressor power.

9.9) Open wiper/auxiliary/rear coupler control cut-out cocks.

10) MAIN RESERVOIR PIPES TO COUPLERS & MOTOR CONTROL BOX DECAY TEST:

10.1) Close both main reservoir pipe vented cut-out cocks:

- > SE car: The front coupler vented cut-out cock is located under car, near the gong, toward the skirt.
- > SE car: The rear coupler vented cut-out cock is located under car, behind the compressor
- > DE car: Vented cut-out cocks are located behind the A-left and B-right corner skirts.

- > The motor control box vented cut-out cock is located on the back of the box toward the rear of the car or B-end.

10.2) The air compressor MUST have just finished a recharge cycle to start the test. If needed, crack open the main reservoir drain cock to trigger a recharge cycle.

10.3) Recharge emergency pipe if lost during the previous test.

10.4) When compressor cuts-out, start a 5-minute count for reservoir cooling **AND** immediately disable the air compressor. Do this by pulling the pole or turning off the high voltage circuit breaker ACMB on the under-seat three phase panel.

10.5) After the 5-minute cooling period, check pressure shown on the leak tester. It must show at least 100 psi to continue the test.

10.6) Press the "LEAK" button until the leak test engages. The device will count down for 1 minute.

10.7) At the end of the test period, the leak tester will show the pressure decay (indicated with a minus symbol) over one minute. This is the whole system *without* the main reservoir to coupler pipe decay. Compare the decay in this section with the WHOLE SYSTEM TEST decay. If the two numbers are nearly identical, then the MAIN RESERVOIR TO COUPLER PIPE doesn't present a large leak.

NOTE: If a large leak is not present in this subsystem, then the leakage determined in the WHOLE SYSTEM TEST could be a combination of minor leaks from multiple, low leakage subsystems.

10.8) Open the main reservoir pipe vented cut-out cocks and motor control box vented cut-out cock.

10.9) Reinstate air compressor power.

11) DOOR SYSTEM DECAY TEST:

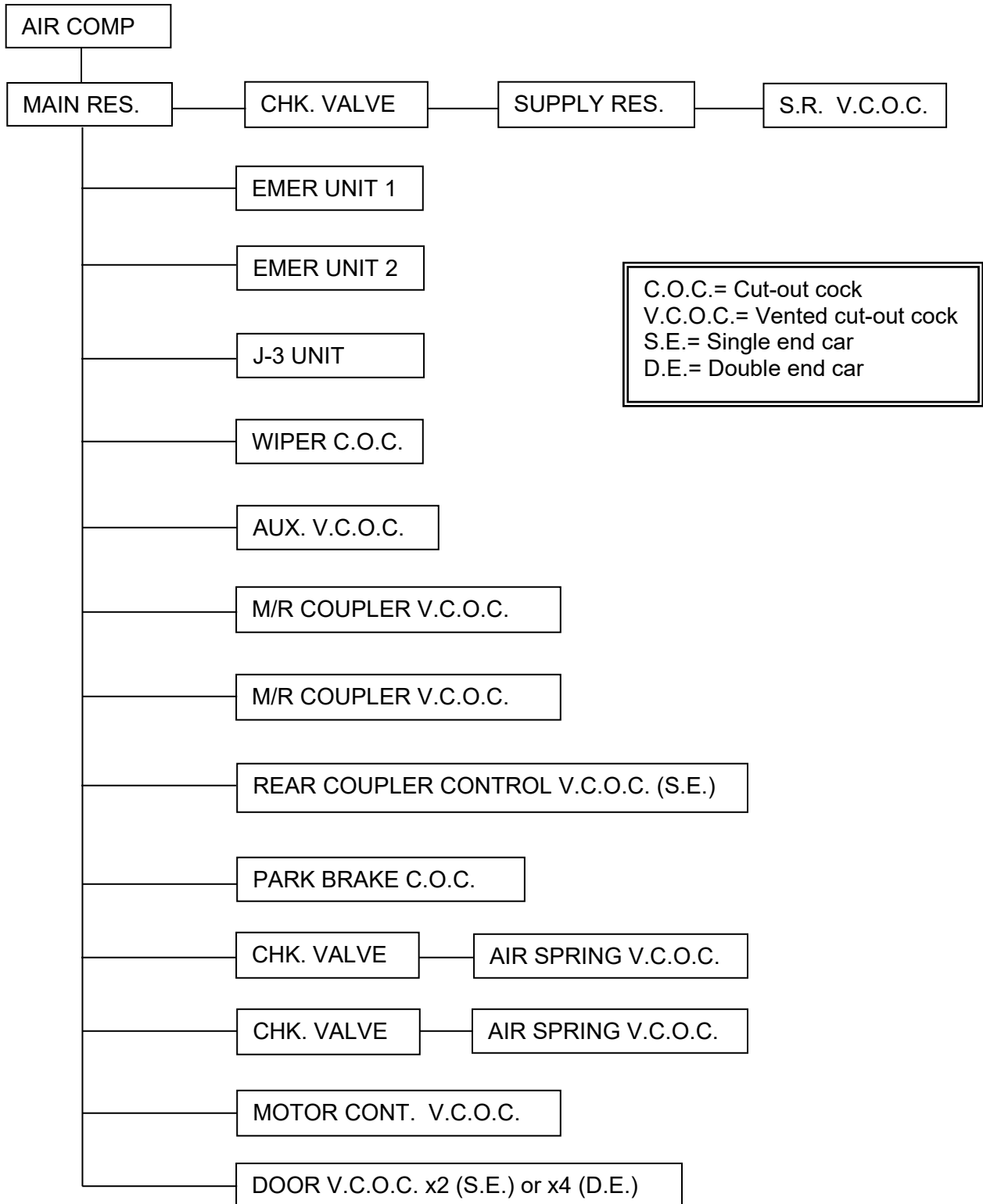
- 11.1) Close all door vented cut-out cocks, which are located at the left end of the compartment over each door-set.
- 11.2) The air compressor **MUST** have just finished a recharge cycle to start the test. If needed, crack open the main reservoir drain cock to trigger a recharge cycle.
- 11.3) Recharge emergency pipe if lost during the previous test.
- 11.4) When compressor cuts-out, start a 5-minute count for reservoir cooling **AND** immediately disable the air compressor. Do this by pulling the pole or turning off the high voltage circuit breaker ACMB on the under-seat three phase panel.
- 11.5) After the 5-minute cooling period, check pressure shown on the leak tester. It must show at least 100 psi to continue the test.
- 11.6) Press the "LEAK" button until the leak test engages. The device will count down for 1 minute.
- 11.7) At the end of the test period, the leak tester will show the pressure decay (indicated with a minus symbol) over one minute. This is the whole system *without* the door system decay. Compare the decay in this section with the **WHOLE SYSTEM TEST** decay. If the two numbers are nearly identical, then the **DOOR SYSTEM** doesn't present a large leak.

NOTE: If a large leak is not present in this subsystem, then the leakage determined in the **WHOLE SYSTEM TEST** could be a combination of minor leaks from multiple, low leakage subsystems.

- 11.8) Reinstate air compressor power.
- 11.9) Open door vented cut-out cocks.

12) THE UNDIVIDABLE MAIN RESERVOIR SYSTEM:

When the preceding tests do not expose the leak that causes failure of the initial test, the problem is located within the main reservoir system that cannot be divided further into smaller sections. At this point, testing joint by joint is required with leak test solution. The block diagram below is to serve as a guide of the parts of the system to check.



LEAK TEST WORK SHEET

DATE: / /

CAR #: _____

4. WHOLE-SYSTEM DECAY TEST: **FAILS 100psi low limit**
ENTER VALUE FROM TESTER: 4 _____

5. BRAKE CYLINDER SYSTEM DECAY TEST: 5) _____

5.1 TRUCK #1 BRAKE CYLINDER TEST: 5.1) _____

5.2 TRUCK #2 BRAKE CYLINDER TEST: 5.2) _____

6. PARKING BRAKE CYL. SYSTEM DECAY TEST: 6) _____

7. AIR SPRING & LOAD WEIGH SYSTEM DECAY TEST: 7) _____

7.1 TRUCK #1 AIR SPRING DECAY TEST: 7.1) _____

7.2 TRUCK #2 AIR SPRING DECAY TEST: 7.2) _____

8. EMERGENCY PIPE SYSTEM + BLEEDER DECAY TEST: 8) _____

9. WIPER CONT-VLVs, HORN CONT-VLV(s), SANDER CONT-VLV(s), COUPLER CONT-VLVs DECAY TEST: 9) _____

10. MAIN RESERVOIR PIPES TO COUPLERS & MOTOR CONTROL BOX: 10) _____

11. DOOR SYSTEM DECAY TEST: 11) _____