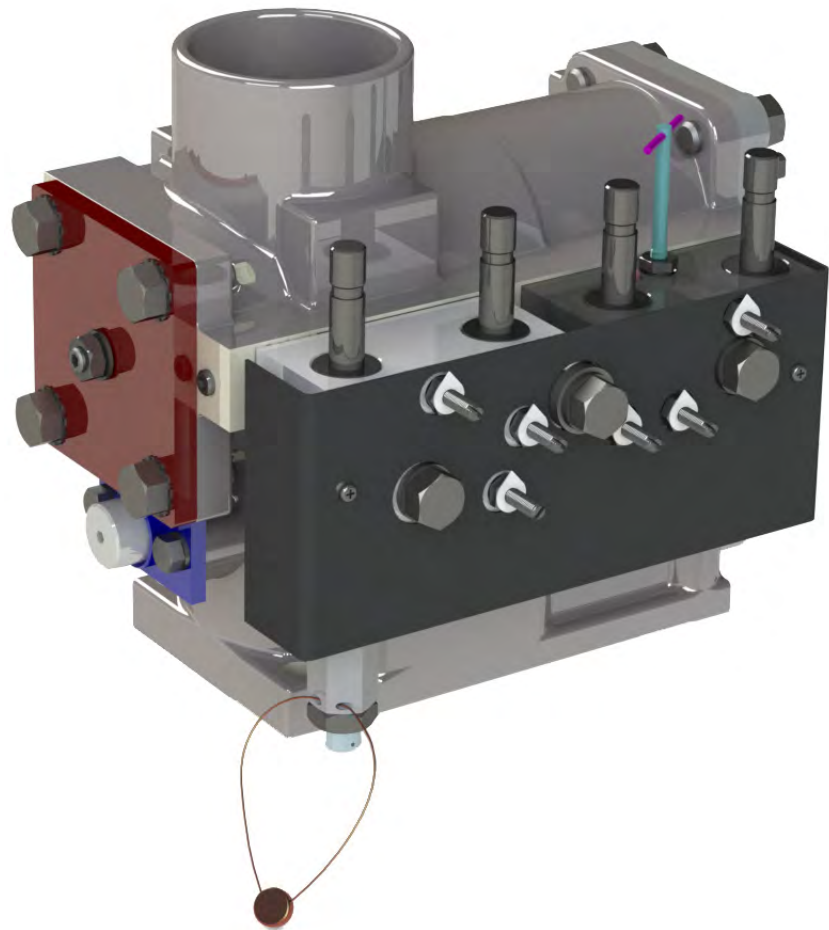




VERTICAL EXPRESS

# I-2<sup>®</sup> / I-3<sup>®</sup> Valve



Every attempt has been made to ensure that this documentation is as accurate and up-to-date as possible. However, Vertical Express assumes no liability for consequences, directly or indirectly, resulting from any error or omission. The material contained herein is subject to revision. Please report any problems with this manual to Vertical Express, P.O. Box 2019, Memphis, Tennessee 38101.

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Published August, 2019  
Third Edition  
Printed in the United States of America

Manual Number: 89130 v.3.0

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# Safety Precautions

## IMPORTANT!

Read this page before any work is performed on elevator equipment. The procedures contained in this manual are intended for the use of qualified elevator personnel. In the interest of your personal safety and the safety of others, do not attempt any procedure that you are not qualified to perform.

All procedures must be accomplished in accordance with the applicable rules in the latest edition of the National Electrical Code, the latest edition of ASME A17.1, and any governing local codes.

## Terms in This Manual

### CAUTION

CAUTION statements identify conditions that may result in damage to the equipment or other property if improper procedures are followed.

### WARNING

WARNING statements identify conditions that may result in personal injury if improper procedures are followed.

## General Safety

### CAUTION

Before applying power to the controller, check that all manufacturing wire connections are tight on relays, contactors, fuse blocks, resistors, and terminals on cards and DIN rail terminals. Connections loosened during shipment may cause damage or intermittent operation.

Other specific warnings and cautions are found where applicable and do not appear in this summary. See the *Elevator Employee Safety and Accident Prevention Program Manual* and the *Elevator Industry Field Employees' Safety Handbook* for electrical equipment safety information on installation and service.

## Electrical Safety

All wiring must be in accordance with the National Electrical Code and be consistent with all state and local codes.

### Use the Proper Fuse

To avoid fire hazards, use only a fuse of the correct type, voltage, and current rating. See the job specific drawings sheet (Power Supplies) for fusing information.

Electric shocks can cause personal injury or loss of life. Circuit breakers, switches, and fuses may not disconnect all power to the equipment. Always refer to the wiring diagrams. Whether the AC supply is grounded or not, high voltage will be present at many points.

### Printed Circuit Cards

Printed circuit boards may be damaged if removed or installed in the circuit while applying power. Before installation and/or removing printed circuit boards, secure all power. Always store and ship printed circuit cards in separate static bags.

### Mainline Disconnect

Unless otherwise directed, always Turn OFF, Lockout, and Tagout the mainline disconnect to remove power from elevator equipment. Before proceeding, confirm that the equipment is de-energized with a volt meter. Refer to the *Elevator Employees' Safety and Accident Prevention Program Manual* for the required procedure.

## Electrical Safety

(continued)

- Test Equipment Safety** Always refer to manufacturers' instruction book for proper test equipment operation and adjustments.
- Megger or buzzer-type continuity testers can damage electronic components. Connection of devices such as voltmeters on certain low level analog circuits may degrade electronic system performance. Always use a voltmeter with a minimum impedance of 1M Ohm/Volt. A digital voltmeter is recommended.
- When Power Is On** To avoid personal injury, do not touch exposed electrical connections or components while power is ON.

## Mechanical Safety

See the *Elevator Employees' Safety and Accident Prevention Program Manual* and the *Elevator Industry Field Employees' Safety Handbook* for mechanical equipment safety information on installation and service.

## Arrival of Equipment

- Receiving** Upon arrival of the equipment, inspect it for damage. Promptly report all visible damage to the carrier. All shipping damage claims must be filed with the carrier.
- Storing** During storage in a warehouse or on the elevator job site, precautions should be taken to protect the equipment from dust, dirt, moisture, and temperature extremes.

## Asbestos Compliance

Vertical Express elevator personnel will no longer drill or modify any doors with asbestos containing materials (ACM) or possible asbestos containing materials (PACM). All elevator doors manufactured or installed 1980 and earlier will be treated as having ACM/PACM.

Doors with ACM/PACM should be replaced rather than modified. If replacement is not feasible, abatement modifications shall be done by a licensed asbestos abatement company. Vertical Express mechanics will safely stage the equipment for the abatement team, or remove the doors and seal them with plastic for delivery or pick up by the asbestos abatement company.

Doors manufactured or installed 1980 and earlier may be modified by Vertical Express employees if a test is conducted by a licensed asbestos company prior to work showing zero evidence of ACM/PACM.

All employees that risk exposure to asbestos will complete Vertical Express safety department approved asbestos awareness training.

All employees will stop any work that could expose them to ACM/PACM, and immediately contact their supervisor and their safety manager. All exceptions must be approved by the Director of Health and Safety.

# Static Protection Guidelines

**IMPORTANT!**

Read this page before working with electronic circuit boards.

Elevator control systems use a number of electronic cards to control various functions of the elevator. These cards have components that are extremely sensitive to static electricity and are susceptible to damage by static discharge.

Immediate and long-term operation of an electronic-based system depends upon the proper handling and shipping of its cards. For this reason, Manufacturing bases warranty decisions on the guidelines below.

## Handling

- Cards shipped from Manufacturing in separate static bags must remain in the bags until time for installation.
- Anti-static protection devices, such as wrist straps with ground wire, are required when handling circuit boards.
- Cards must not be placed on any surface without adequate static protection.
- Only handle circuit cards by their edges, and only after discharging personal static electricity to a grounding source. Do NOT touch the components or traces on the circuit card.
- Extra care must be taken when handling individual, discrete components such as EPROMS (which do not have circuit card traces and components for suppression).

## Shipping

- Complete the included board discrepancy sheet.
- Any card returned to Manufacturing must be packaged in a static bag designed for the card.
- Any card returned to Manufacturing must be packaged in a shipping carton designed for the card.
- “Peanuts” and Styrofoam are unacceptable packing materials.

**Failure to adhere to the above guidelines will void the card warranty!**



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# Preliminary Settings

## Oil Viscosity and Viscosity Control


**WARNING**

Use extreme caution when making adjustments near moving belts. When operating the elevator from the controller, follow all safety precautions.

- Verify that the power unit is in a ventilated room that remains between 50°F and 90°F.
- Adjust the valve when the oil is at its operating temperature of 100°F to 170°F.
- Check the unit performance when the oil temperature is no less than 100°F.
- Changes in oil temperature cause changes in valve behavior.

## Relief Pressure Setting


**CAUTION**

The I-2/I-3 Valve requires a minimum static system pressure of 90 PSI.

1. Ensure that the car is empty.
2. Turn OFF, Lockout, and Tagout the mainline disconnect.
3. Open the manual lowering valve to lower the car onto the buffers. See Figure 1.
4. Close the manual lowering valve.
5. Install a pressure gauge on the quick connector located on the far side of the valve.
6. Turn the relief pressure adjustment screw OUT until  $\frac{5}{8}$ " extends beyond the relief assembly housing, and then tighten the locknut.

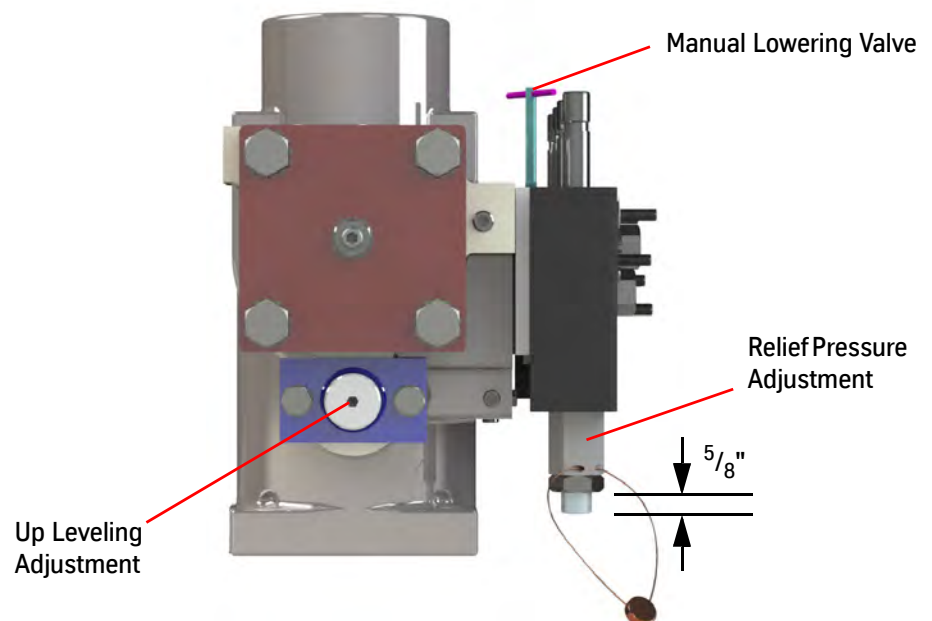


Figure 1 - Relief Pressure Setting

## Preliminary Settings

(continued)

### Low Pressure Setting



OUT = Counterclockwise (CCW), IN = Clockwise (CW)

1. Turn the low pressure adjustment screw OUT  $1\frac{3}{4}$ " beyond the cover plate. See Figure 2.
2. Turn the low pressure adjustment screw IN by hand until it touches the regulator piston.
3. Turn the up leveling adjustment screw OUT until it stops.
4. Turn the up leveling adjustment screw IN 4 turns.

### Adjustment Needles



To make adjustments, do not loosen the nuts on the adjustment needle stems. The nuts must be snug against the valve body at all times.

1. Turn the up start, up stop, and up slowdown adjustments IN to the fully closed position. See Figure 2.
2. Turn the up start adjustment OUT 9 turns.
3. Turn the up stop adjustment OUT 3 turns.
4. Verify that the up slowdown adjustment remains closed.

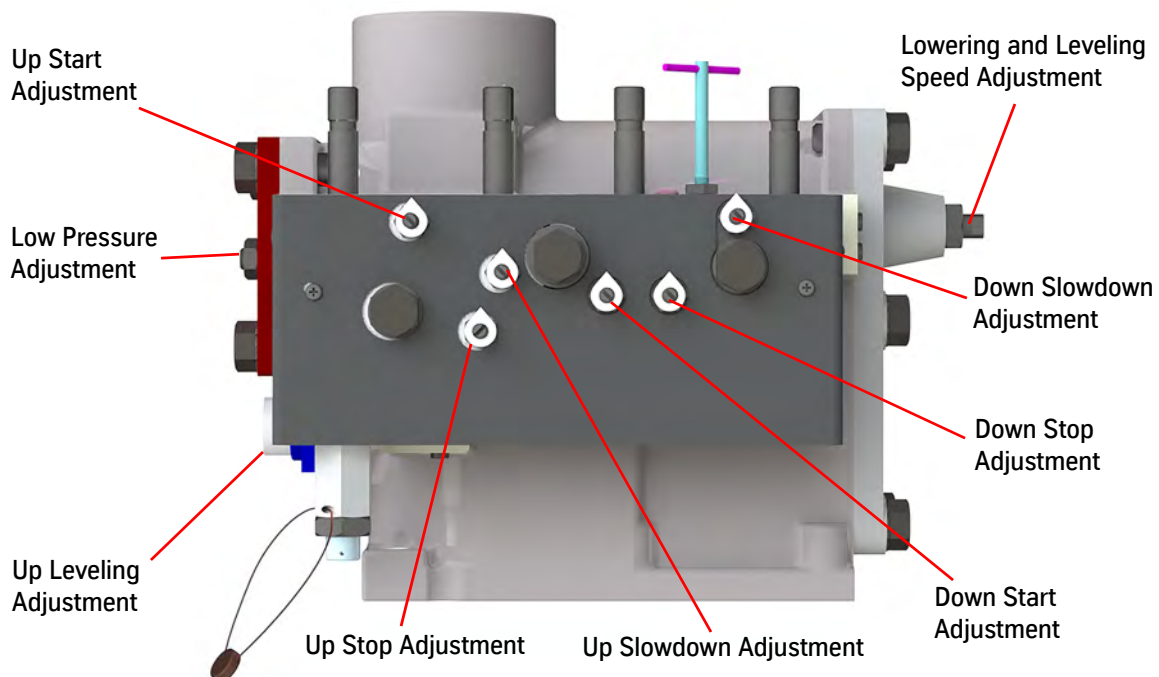


Figure 2 - Valve Adjustments

## Lowering and Leveling Speed Setting



To prevent damage to the piston face and seat, do not adjust the lowering and leveling screw unless the car is resting on the buffers or the car is in motion.

1. Lower the car onto the buffers.
2. Adjust the lowering and leveling screw so that  $\frac{3}{4}$ " extends beyond the valve body. See Figure 3.
3. Ensure the flat end of the screw points 45° counterclockwise to the tank return line.
4. Tighten the locknut.

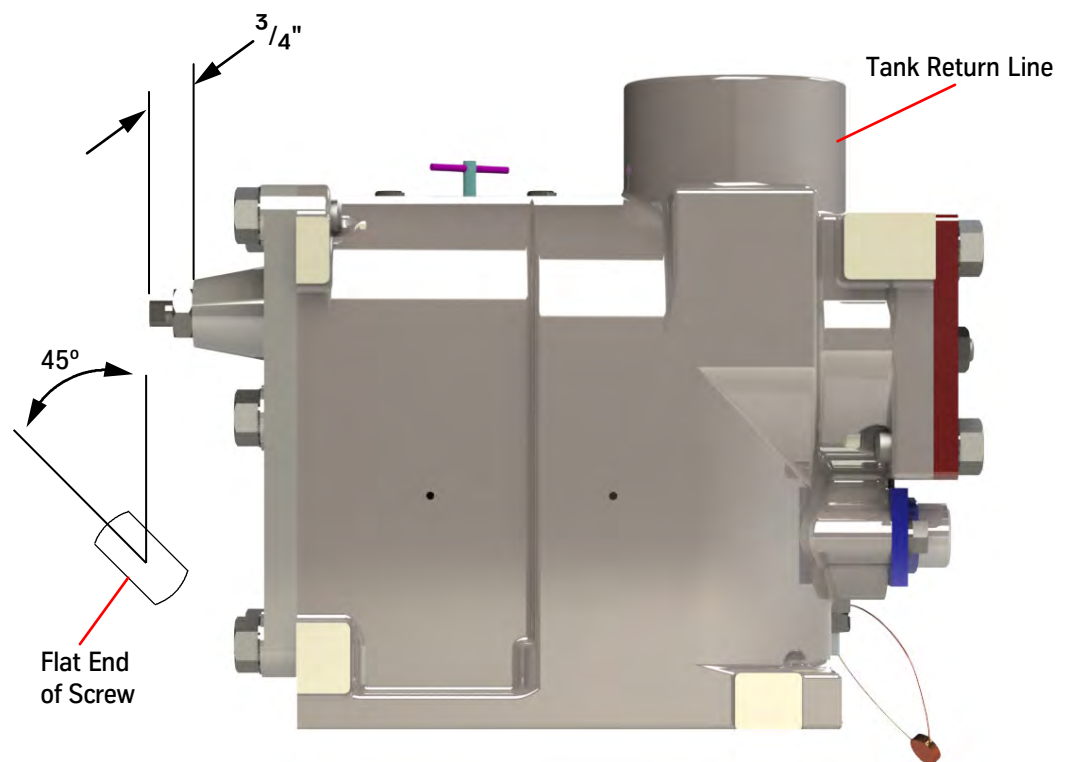


Figure 3 - Lowering and Leveling Speed Setting

### Adjustment Needles



To make adjustments, do not loosen the nuts on the adjustment needle stems. The nuts must be snug against the valve body at all times.

1. Turn the down start, down stop, and down slowdown adjustments IN to the fully closed position. See Figure 2 on page 8.
2. Turn the down start adjustment OUT 9 turns.
3. Turn the down stop adjustment OUT 10 turns.
4. Verify that the down slowdown adjustment remains closed.

# Preliminary Adjustments

**WARNING**

When operating the elevator from the controller, follow all safety precautions.

1. Ensure that the car is empty and the manual lowering valve is closed.
2. Turn OFF, Lockout, and Tagout the mainline disconnect.
3. Disconnect the solenoid wire from the controller to disable the up slow solenoid. See the appropriate controller diagrams.
4. Place the controller on Inspection Operation to disable the up fast solenoid.



The type of controller determines how Inspection Operation is accomplished.

5. Turn the power on, and start the motor.
6. Turn the low pressure adjustment IN just until the car starts to move.
7. Turn the low pressure adjustment OUT until the car movement stops.
8. After the car stops, turn the low pressure adjustment OUT an additional half turn.
9. On valves marked with SP on the cover plate or the valve nameplate:
  - a. Turn the low pressure adjustment OUT 3 turns.
  - b. Start and stop the car to check for excessive delay between the motor starting and the car moving.
  - c. If there is excessive delay, turn the low pressure adjustment IN slightly.
  - d. Repeat steps b and c until the excessive delay is eliminated.
10. Tighten the locknut.
11. Stop the motor, and turn the power off.
12. Remove any jumpers that may have been used.
13. Reconnect the up slow solenoid wire to the controller.

## Relief Pressure Adjustment

**WARNING**

Stop the power unit immediately if the pressure exceeds 625 PSI.

1. Close the line shut-off valve, and install a pressure gauge.
2. Place the controller on Inspection Operation.
3. Turn the power ON, start the motor, and read the pressure.
4. Adjust the relief valve to relieve at the pressure indicated on the power unit nameplate. See Figure 4.
5. Tighten the locknut.
6. Turn OFF, Lockout, and Tagout the mainline disconnect.
7. Open the manual lowering valve to relieve the jack pressure.
8. Close the manual lowering valve.

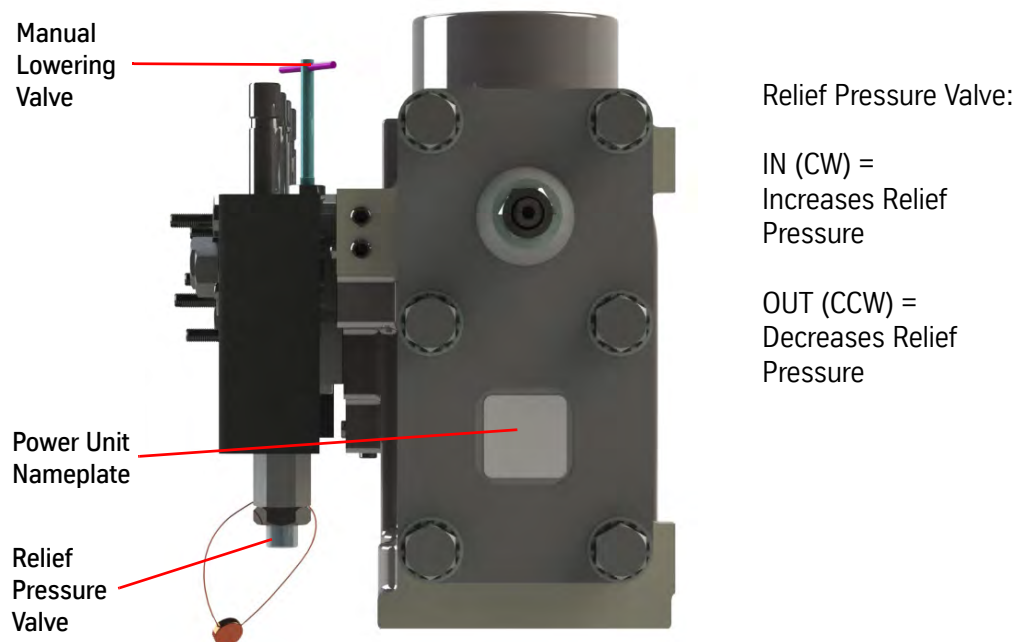


Figure 4 - Relief Pressure Adjustment

9. Turn the power ON, and recheck the relief pressure.
10. Turn OFF, Lockout, and Tagout the mainline disconnect.
11. Repeat steps 7 and 8.
12. Open the line shut-off valve.

## Up and Down Inspection Speed Adjustment

1. Turn the up slowdown adjustment screw OUT 10 turns to ensure that the car does not initially start up. See Figure 5.
2. Place the car on Inspection Operation, and start the car up.
3. Slowly turn the up slowdown adjustment screw IN until the car moves at 10 to 12 FPM.
4. Check the up leveling speed.
5. Turn the down stop adjustment screw OUT 10 turns to ensure that the car does not initially start down.
6. Place the car on Inspection Operation, and start the car down.
7. Slowly turn the down stop adjustment screw IN until the car runs down at 15 to 20 FPM.
8. Turn the lowering and leveling speed adjustment screw in less than one-quarter turn increments, pausing and observing between each change, until the leveling speed is 10 to 12 FPM.



If the adjustment screw is turned more than one-quarter turn, the car locks in the down direction. To unlock, run the car up on Inspection Operation while an assistant in the machine room turns the lowering and leveling speed adjustment screw OUT a small amount.

9. Tighten the locknut.



If the car does not stop, turn the down stop adjustment screw OUT until the car stops.

10. Check the down leveling speed.

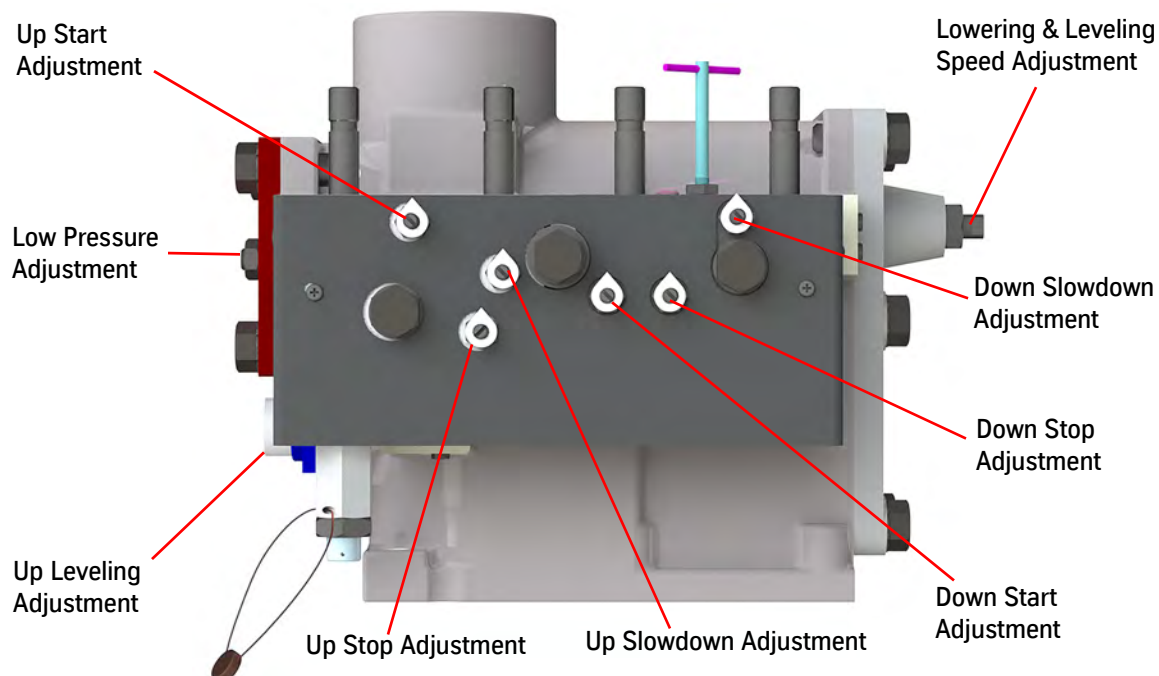


Figure 5 - Valve Adjustments

# Final Adjustments

The manufacturing presets of the valve adjustments are attached to the inside of the controller. These values ensure movement of the car and reduce final adjustment time.



**CAUTION**

Adjustment of the I-2/I-3 Valve requires a minimum static system pressure of 90 PSI.



**WARNING**

When operating the elevator from the controller, follow all safety precautions.

## Valve-Up Section

### Up Slowdown and Up Leveling Speed

1. Verify that the car is empty.
2. Place the controller on Automatic Operation, and send the car to the lowest landing.
3. While observing the leveling zone, run the car to the floor above.
4. Adjust the up slowdown for 3 to 4 inches of leveling.

Up Slowdown - Adjust for 3 to 4 inches of Leveling	
IN (CW)	Shorten Leveling Zone
	Increase Leveling Speed
	Softer Up Slowdown



**WARNING**

Each time the up slowdown is adjusted, the up leveling speed must be rechecked.

5. Adjust the up leveling speed adjustment for an up leveling speed of 10 to 12 FPM. Run the car up on Inspection Operation after each change and check the speed until 10 to 12 FPM is obtained.

Up Leveling - 10 to 12 FPM	
IN (CW)	Increase Leveling Speed
	Softer Up Slowdown

6. Place the car on Automatic Operation.
7. Check the leveling zone for 3 to 4 inches, and the leveling speed for 10 to 12 FPM.
8. Continue to adjust the up slowdown and the up leveling until achieving the desired performance.

## Valve-Up Section

(continued)

### Up Stop and Up Start

The up stop adjustment must be adjusted first because it affects the up start adjustment.

1. Adjust the up stop for a soft but positive stop.
2. Adjust the up start for a smooth but positive start.
3. Verify that full up speed is reached on a one-floor run, which may require the up start to be more positive.
4. Slightly adjust the slowdown to achieve optimum performance, if necessary.

	Up Stop	Up Start
IN (CW)	Stop Softer	Start Smoother
	Start Firmer	Limit High Speed

## Valve-Down Section

### Lowering Speed



**If no speed change occurs with one full turn on the lowering speed adjuster, do not continue to turn it out. Check for a stop open wider than a start, or a mechanical piston binding.**

1. Place the car on Automatic Operation.
2. Set the lowering speed.
  - a. Use an empty car, and turn the lowering speed adjustment in one-half turn increments.
  - b. After each adjustment, leave the flat end of the screw pointed 45° to the tank return line.

Lowering Speed	
OUT (CCW)	One-half Turn Increments
	Increase Lowering Speed



## Valve-Up Section

*(continued)*

### Down Leveling Speed and Down Stop

The down leveling speed and the down stop adjustment must be performed together since the down stop adjustment affects the down leveling speed. However, the down leveling speed does not affect the down stop adjustment.

1. Place the controller on Inspection Operation.
2. Adjust the down stop for a positive stop.
3. Adjust the down leveling speed to 10 to 12 FPM.
4. Tighten the locknut on the down leveling speed adjustment.
5. Check the down leveling speed.

Down Stop	
IN (CW)	Stop Softer
	Increase Leveling Speed
Down Leveling Speed	
OUT (CCW)	Less than one-quarter turn increments
	Increase Leveling Speed

### Down Start

1. Place the controller on Automatic Operation.
2. Adjust the down start adjustment to obtain a smooth start.
3. Ensure that the car achieves full speed on a one-floor run. If it does not, make the down start more positive.

Down Start	
IN (CW)	Start Smoother

## Valve-Up Section

(continued)

### Down Slowdown

The effect of the down slowdown adjustment is the opposite of the previous adjustments. Turning OUT on the down slowdown adjustment shortens the leveling zone. Turning IN on the down slowdown adjustment lengthens the leveling zone. Make this adjustment in small increments as soon as a change is observed in the leveling zone. The car will overshoot the landing if the adjustment is turned OUT too far.

1. Turn the down slowdown adjustment OUT in small increments until the car has a leveling zone of 3 to 4 inches.

Typical adjustment:

- a. Ensure that the down slowdown adjustment screw is 3 turns out from closed.
- b. Make single, complete turns, one at a time, until the slowdown leveling changes.
- c. Turn the down slowdown adjustment screw less than 1 turn to achieve 10 to 12 FPM and 3 to 4 inches of leveling.

2. Use the UIT to verify the leveling zone by selecting Show Stabilized Leveling.



It may be necessary to slightly alter the point in the hoistway where the slowdown is initiated to achieve optimum valve and car performance. This action is usually accomplished by either switch location or selector settings.

## Performance Check with Full Load

1. Place a capacity load on the car.
2. Run the car on Automatic Operation, and check its performance at all floors.



- Valve functions are firmer at upper landings. Adjustments affect empty car performance.
- The down leveling speed increases and the down leveling zone shortens. It may be necessary to change the down slowdown adjustment to verify at least 2 inches of leveling.
- If necessary, turn IN on the down slowdown adjustment to increase the down leveling zone.
- The up leveling speed increases. The up leveling zone changes between no load and full load. Do not change any adjustments made with no load if there is at least one 1 inch of up leveling zone with a full load.
- If necessary, turn OUT on the up slowdown adjustment to increase the up leveling zone.

3. Verify that the car reaches full speed in both directions on a one-floor run.

4. Record the working pressure in the up direction.



The working pressure value is used in the next procedure.

5. Remove the capacity load from the car.

## Final Relief Pressure with Full Load

**WARNING**

Stop the power unit immediately if the pressure exceeds 625 PSI.

1. Place the controller on Inspection Operation, and close the line shut-off valve.
2. Start the pump, and read the relief pressure.
3. Add 25% to the working pressure recorded previously (see step 4 on page 16), and set the relief valve to relieve at this new pressure value.
4. Stop the power unit, and tighten the locknut on the relief pressure adjustment.
5. Recheck the relief pressure.
6. Open the line shut-off valve, and place the car on Automatic Operation.

# Valve Tests

## Relief Pressure Verification

This test ensures that the pipe couplings and valve cannot be damaged if the elevator system's oil flow or platform become restricted.

**WARNING**

**Stop the power unit immediately if the pressure exceeds 625 PSI.**

1. Close the shut-off valve.
2. Install a pressure gauge on the silencer's quick connect.
3. While monitoring the pressure gauge, use a runbug to run the power unit in the up direction in short bursts. After confirming that the pressure does not exceed 625 PSI, the pump motor can run constantly to verify the relief pressure setting.
4. If the pressure exceeds 625 PSI, adjust the pressure relief to reduce pressure.
  - OUT = Counterclockwise (CCW) = Decrease Relief Pressure
  - IN = Clockwise (CW) = Increase Relief Pressure
5. Briefly open the manual lowering valve to relieve pressure from the valve, and confirm that the valve is fully closed when finished.

## Low Pressure Adjustment

**WARNING**

When operating the elevator from the controller, follow all safety precautions.



If the CPU Card is online when the low pressure adjustment is made, temporarily set the Z44 timer to 10 seconds, and run the motor less than 10 seconds at a time from Inspection Operation.

1. Ensure that the car is empty and the manual lowering valve is closed.
2. Turn OFF, Lockout, and Tagout the mainline disconnect.
3. Disconnect CON15 on the IO\_ Card to disable the valve's up slow solenoid.
4. Turn the low pressure adjustment screw OUT  $1\frac{3}{4}$ " beyond the cover plate.
5. Turn the low pressure adjustment screw IN by hand until it touches the regulator piston.
6. Turn the power ON, and use a runbug to start the motor.
7. Turn the low pressure adjustment screw IN just until the car starts to move.
8. Turn the low pressure adjustment screw OUT until the car movement stops.
9. After the car stops, turn the low pressure adjustment screw OUT an additional one-half turn.
10. Tighten the locknut.
11. Stop the motor, and turn the power OFF.
12. Reconnect CON15 to enable the valve's up slow solenoid.

# Troubleshooting

Verify the following list before using the troubleshooting tables. See also: Troubleshooting Flowcharts on page 23.

- No binding is present in the hoistway.
- The proper voltage is supplied to the power unit.
- All valve adjustments have been completed as recommended.
- All vee belts on the power unit have the proper tension.
- There is no oil on the belts to cause slippage.

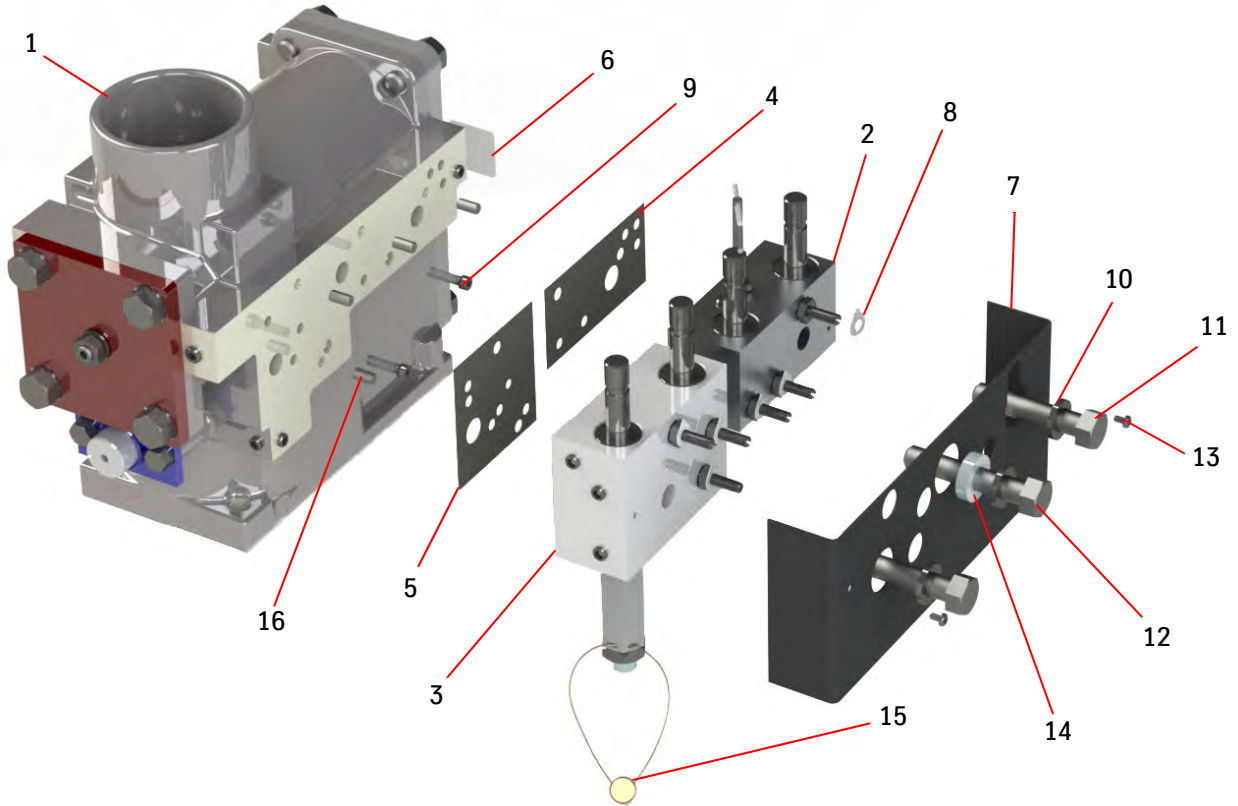
## Troubleshooting Table - Up Operation

Problem	Solution
The pump runs, but the car will not run at high speed.	<ol style="list-style-type: none"> <li>1. Check that the line shut-off valve is fully open.</li> <li>2. Check for the correct motor rotation.</li> <li>3. Check for the correct relief pressure setting.</li> <li>4. Check that the up fast solenoid pulls IN.*</li> <li>5. Turn OUT on the up start adjustment.</li> <li>6. Turn IN on the up stop adjustment.</li> <li>7. Make sure that the regulator piston is free.</li> <li>8. Make sure that the up pilot piston is free.</li> </ol>
The car will not slow down to leveling speed.	<ol style="list-style-type: none"> <li>1. Check that the up slow solenoid pulls IN.*</li> <li>2. Check that the up fast solenoid drops OUT.*</li> <li>3. Turn OUT on the up slowdown adjustment.</li> <li>4. Check the up leveling speed. Set for 10 to 12 FPM.</li> <li>5. Make sure that the regulator piston is free.</li> <li>6. Make sure that the pressure control piston is free.</li> </ol>
The car will not make a hydraulic stop.	<ol style="list-style-type: none"> <li>1. Check that the up slow solenoid drops OUT.*</li> <li>2. Check for the correct low pressure adjustment.</li> <li>3. Turn OUT the up stop adjustment.</li> <li>4. Make sure that the regulator piston is free.</li> <li>5. Make sure that the up pilot piston is free.</li> </ol>
Acceleration, deceleration, leveling speed, or stop are erratic.	<ol style="list-style-type: none"> <li>1. Make sure that the check valve piston is free.</li> <li>2. Make sure the spring on the regulator piston does not bind.</li> </ol>
The leveling speed slows down, or the car stalls after slowdown (check if releveling speed slows down).	<ol style="list-style-type: none"> <li>1. Turn IN on the slowdown adjustment.</li> <li>2. Replace the leveling adjuster/strainer.</li> </ol>
<p>* Check the solenoids for voltage and for damage to the solenoid tube. Check the plunger for binding. Do not reseat. If the seat in the pilot body is damaged, replace the pilot.</p>	

## Troubleshooting Table - Down Operation

Problem	Solution
The car will not lower.	<ol style="list-style-type: none"> <li>1. Check that the line shut-off valve is fully open.</li> <li>2. Check the solenoids.*</li> <li>3. Turn OUT on the down start adjustment.</li> <li>4. Turn IN on the down stop adjustment.</li> </ol>
Down start is slow or bouncy.	<ol style="list-style-type: none"> <li>1. Turn OUT on the down start adjustment.</li> <li>2. Turn IN on the down stop adjustment.</li> <li>3. Bleed the jack of air, or loosen packing, if possible.</li> </ol>
Down start is abrupt.	<ol style="list-style-type: none"> <li>1. Turn IN on the down start adjustment.</li> <li>2. Turn OUT on the down stop adjustment.</li> </ol>
The car will not stop when started down.	<ol style="list-style-type: none"> <li>1. Tighten the manual lowering valve.</li> <li>2. Turn OUT on the down stop adjustment.</li> <li>3. Check if the solenoid valve is not closing (residual magnetism).*</li> </ol>
Down stop is too soft or bouncy.	<ol style="list-style-type: none"> <li>1. Turn OUT on the down stop adjustment.</li> <li>2. Bleed the jack of air, or loosen packing, if possible.</li> </ol>
Down stop is rough.	<ol style="list-style-type: none"> <li>1. Turn IN fully on the down slowdown adjustment.</li> <li>2. Turn IN on the down stop adjustment.</li> <li>3. Turn OUT, in small increments, on the down slowdown.</li> </ol>
Leveling is bouncy.	<ol style="list-style-type: none"> <li>1. Check the leveling speed. Set for 10 to 12 FPM.</li> <li>2. Bleed the jack of air, or loosen packing, if possible.</li> </ol>
The car will not slow down to leveling speed.	<ol style="list-style-type: none"> <li>1. Check the down fast solenoid.*</li> <li>2. Check whether the down slowdown adjustment may be open too much (too soft).</li> <li>3. Check whether the leveling speed may be set too fast. Set for 10 to 12 FPM.</li> </ol>
Slowdown is rough.	Turn OUT on the down slowdown adjustment.
The car settles (leaks) down.	<ol style="list-style-type: none"> <li>1. Run the car to the lowest position.</li> <li>2. Inspect the oil line, the jack, and the power unit for leaks.</li> <li>3. Close the line valve.</li> </ol>
The car settles (leaks) down, and the oil level in the tank is less than when first set.	<ol style="list-style-type: none"> <li>1. Tightly close the manual lowering valve, and run the car to the top.</li> <li>2. Shut off the power, and record the car location.</li> <li>3. Wait 15 minutes, record the car location, and note the amount the car has settled as "X."</li> <li>4. Let the car sit for 8 hours, record the car location, and note the amount the car has settled as "Y."</li> <li>5. If "Y" is not more than 25 times "X," arrange for homing to the lowest floor and verify proper performance.</li> <li>6. Close down the first car location, wait 15 minutes, and then record the car location. Note the amount the car has settled as "Z."</li> <li>7. If "Z" is less than "X," replace the down pilot body, and adjust the down functions.</li> <li>8. Remove and examine the lowering and check valve pistons.</li> <li>9. If the piston seat is damaged, reseal the piston and verify proper operation.</li> <li>10. If the piston seat is not damaged, replace the valve, and adjust the job.</li> </ol>
* Check the solenoids for voltage and for damage to the solenoid tube. Check the plunger for binding. Do not reseal. If the seat in the pilot body is damaged, replace the pilot.	

# Replacement Parts



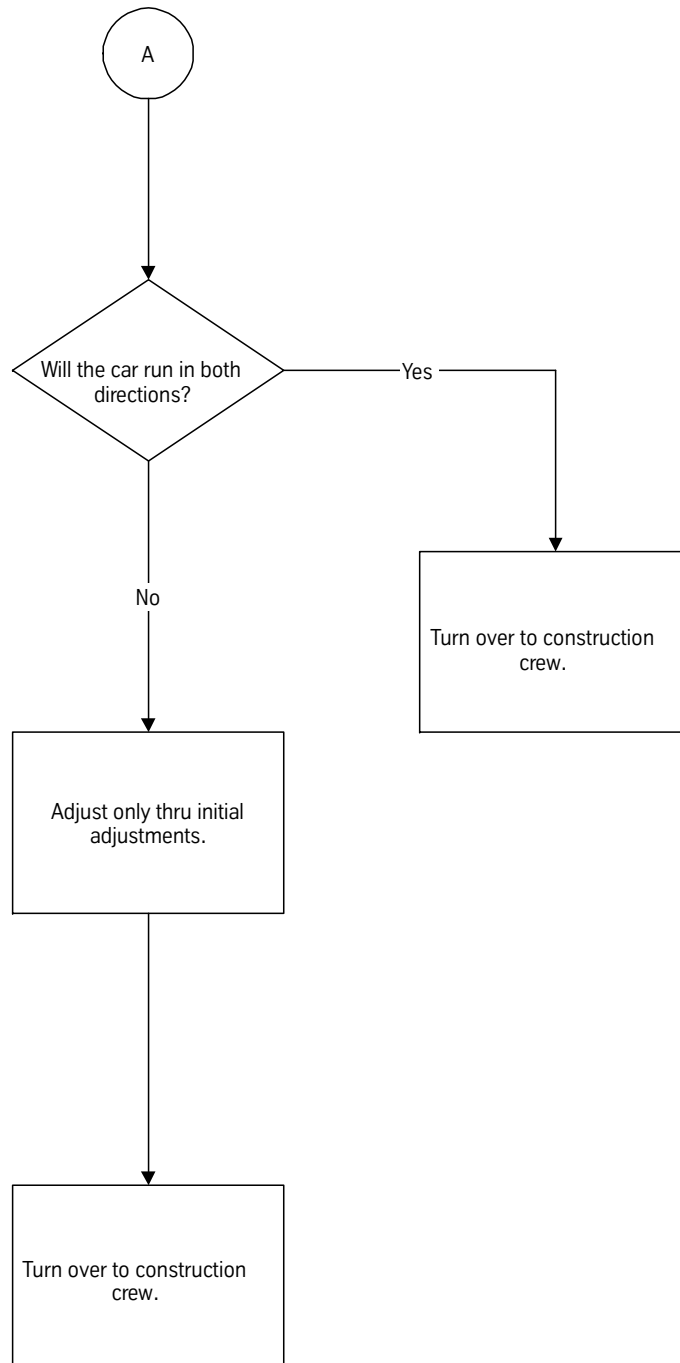
ITEM	PRINT NO.	DESCRIPTION
1	114874	Valve Main Body Assembly, I-3, Down
	148323	Valve Main Body Assembly, I-2, 125 GPM EP Units
	137744	Valve Main Body Assembly, I-2, 120-215 GPM Units
	137743	Valve Main Body Assembly, I-2, 30-100 GPM Units
	189131	Valve Main Body Assembly, I-2F, 125 GPM EP Units
	189128	Valve Main Body Assembly, I-2F, 120-215 GPM Units
	189127	Valve Main Body Assembly, I-2F, 30-100 GPM Units
	2	886BC1
3	886BD1	Valve Pilot Assembly Up
4	124213	Gasket, Down Pilot
5	124214	Gasket, Up Pilot
6	606DG1	Nameplate Valve
7	141ED2	Valve Faceplate, I-3
	141EC2	Valve Faceplate, I-2, I-2F
8	117327	Indicator Adjustment
9	799AB1	Strainer Assembly, Stainless Steel
10	70083	FS Washer LWHR 0.500 Z
11	70113	FS Screw CSH 0.500-13 x 2.500 Z
12	70431	FS Screw CSH 0.500-13 x 2.750 Z
13	29161	Spacer
14	396AF6	FS Screw MSPP .138 (#6) x .250 Z
15	70455	Lead Sealing
16	78150	FS Pin PDHS .350 x .500 U





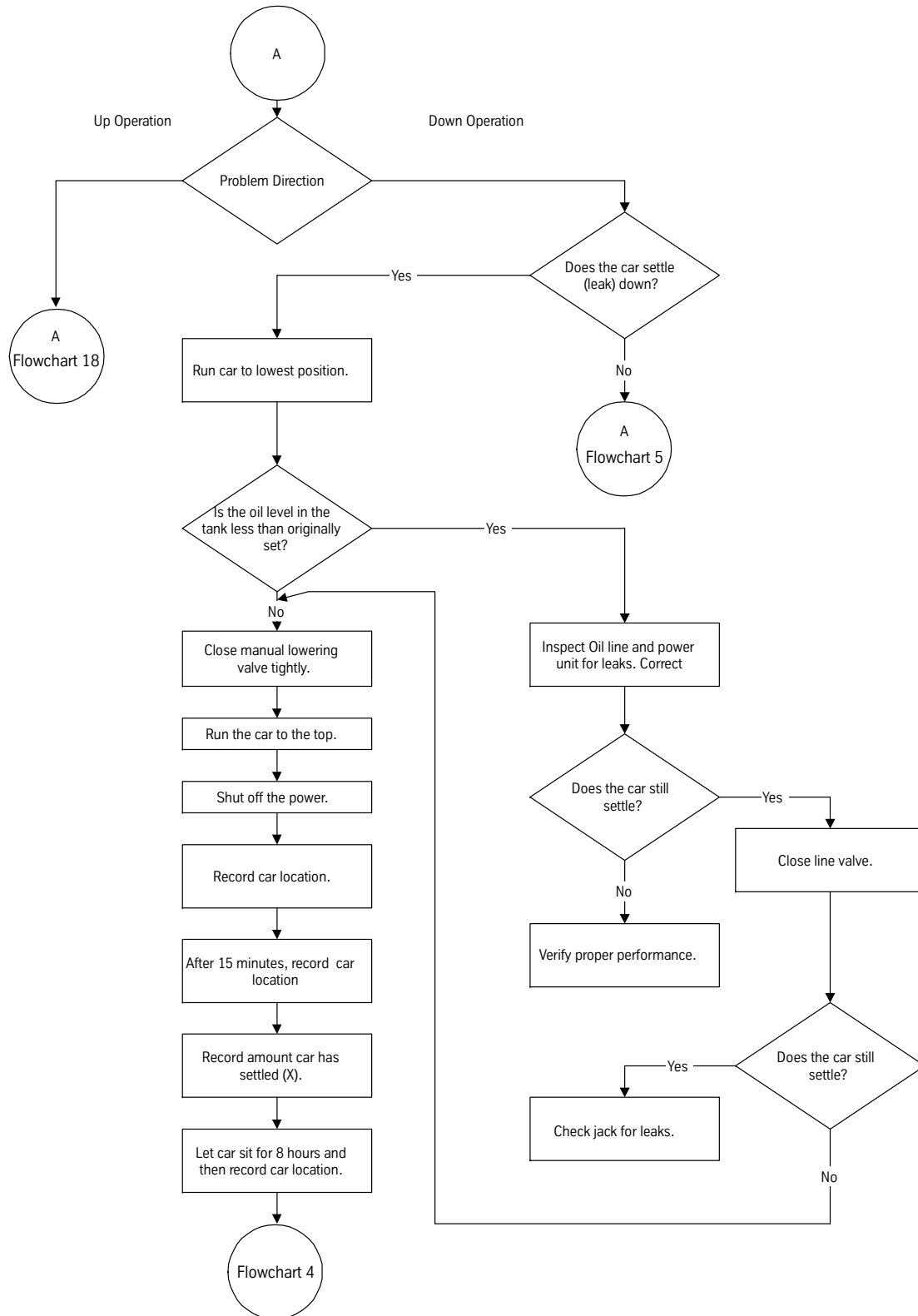
### Troubleshooting Flowcharts

*(continued)*



Flowchart 2

Troubleshooting Flowcharts  
(continued)



Flowchart 3

Troubleshooting Flowcharts

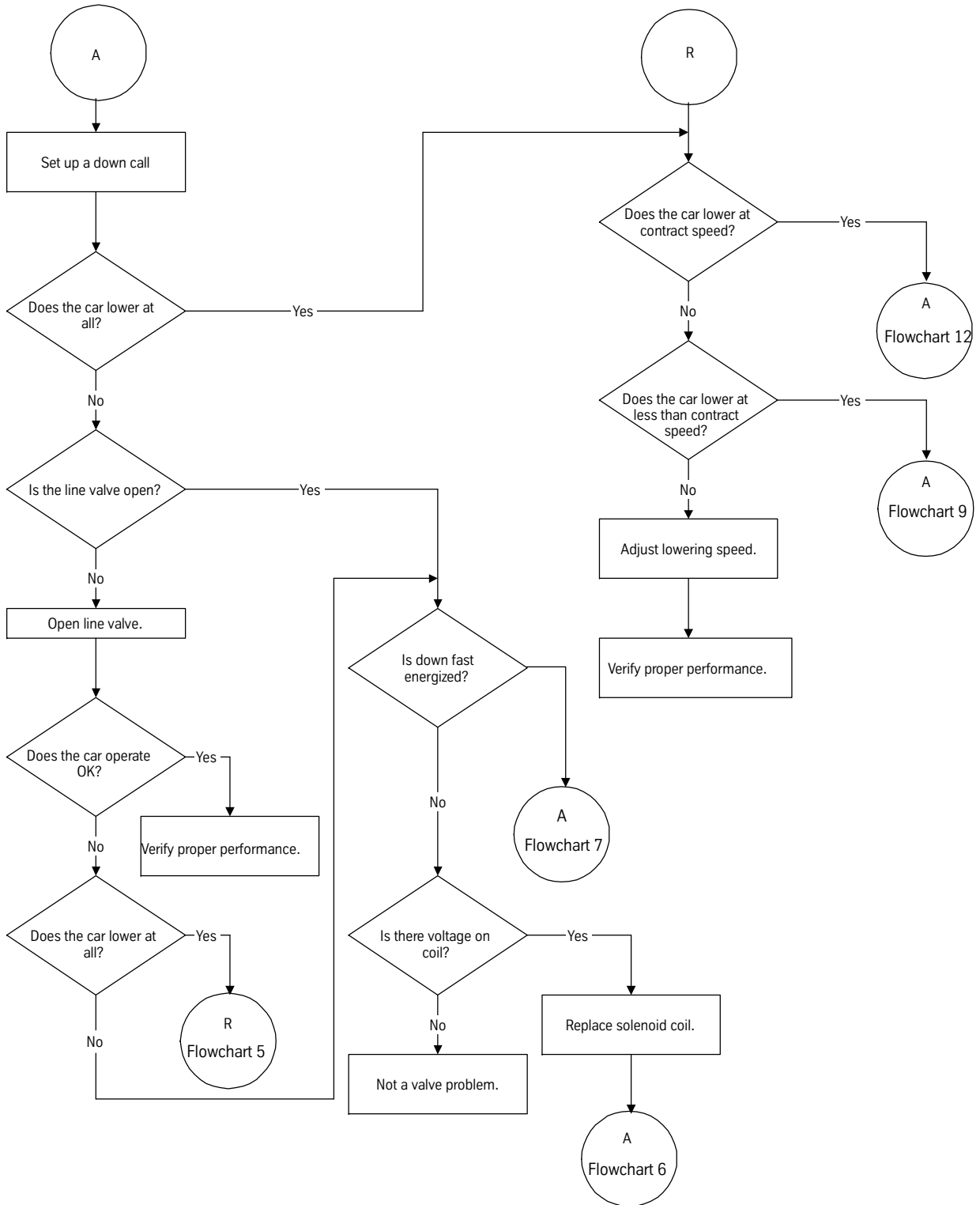
(continued)



Flowchart 4

### Troubleshooting Flowcharts

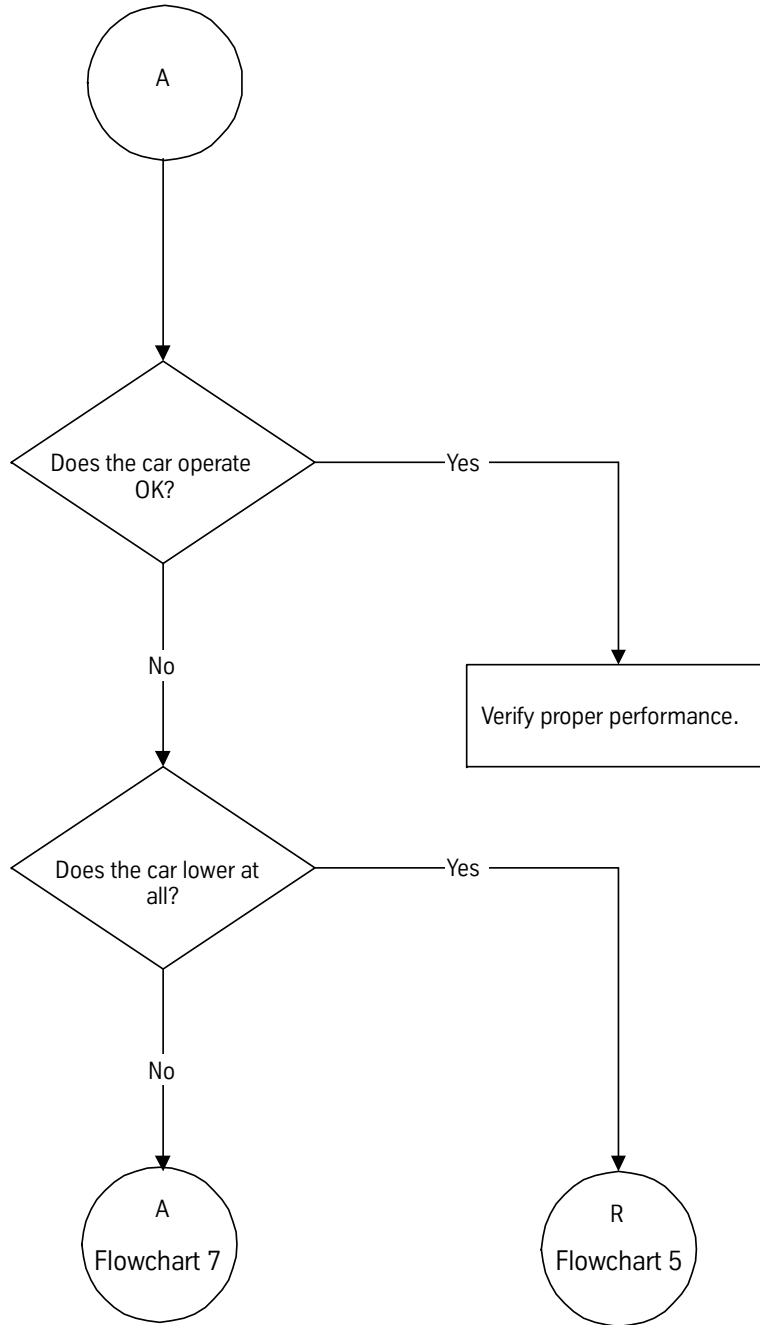
(continued)



Flowchart 5

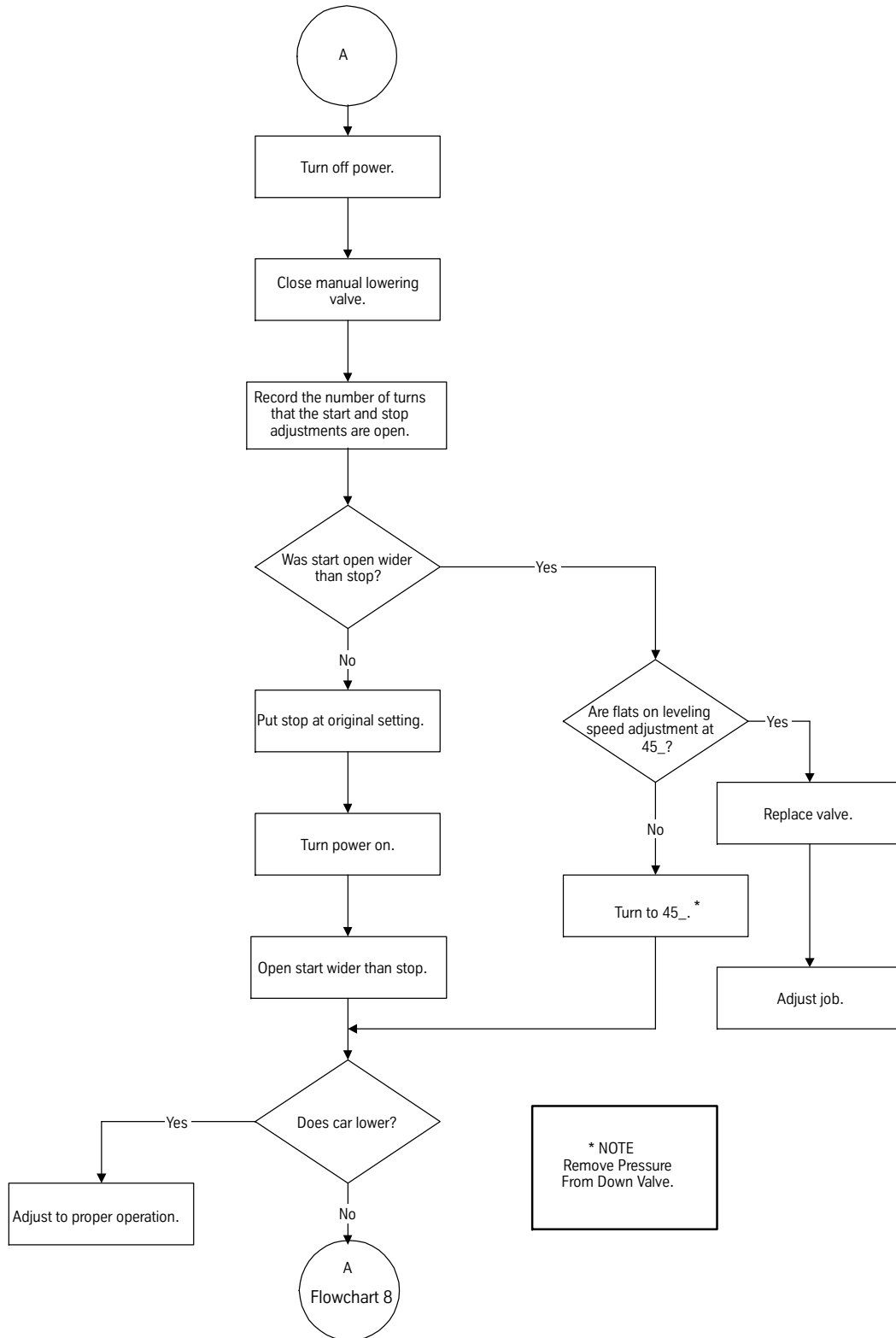
### Troubleshooting Flowcharts

(continued)



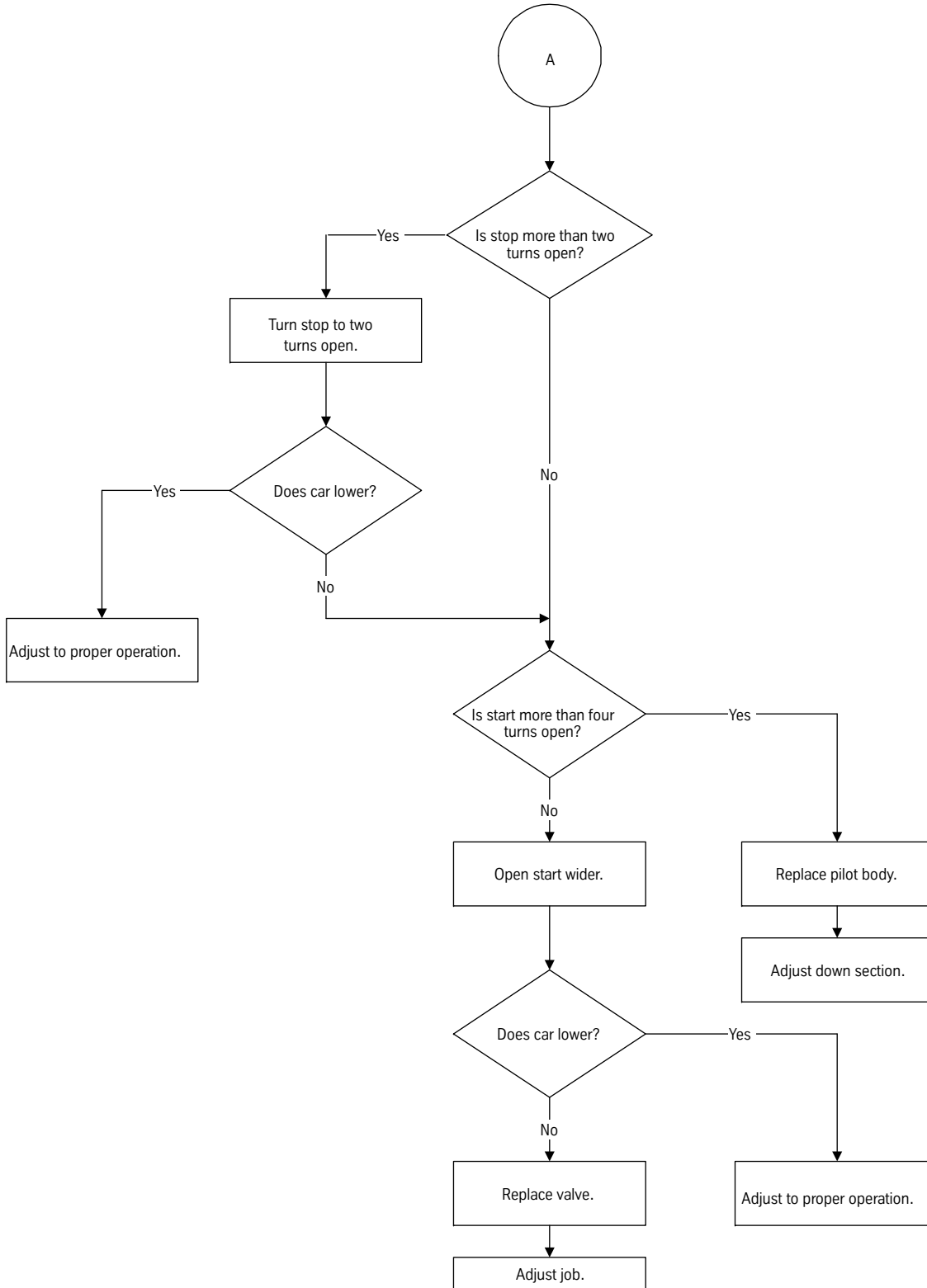
Flowchart 6

### Troubleshooting Flowcharts (continued)



Flowchart 7

Troubleshooting Flowcharts  
(continued)

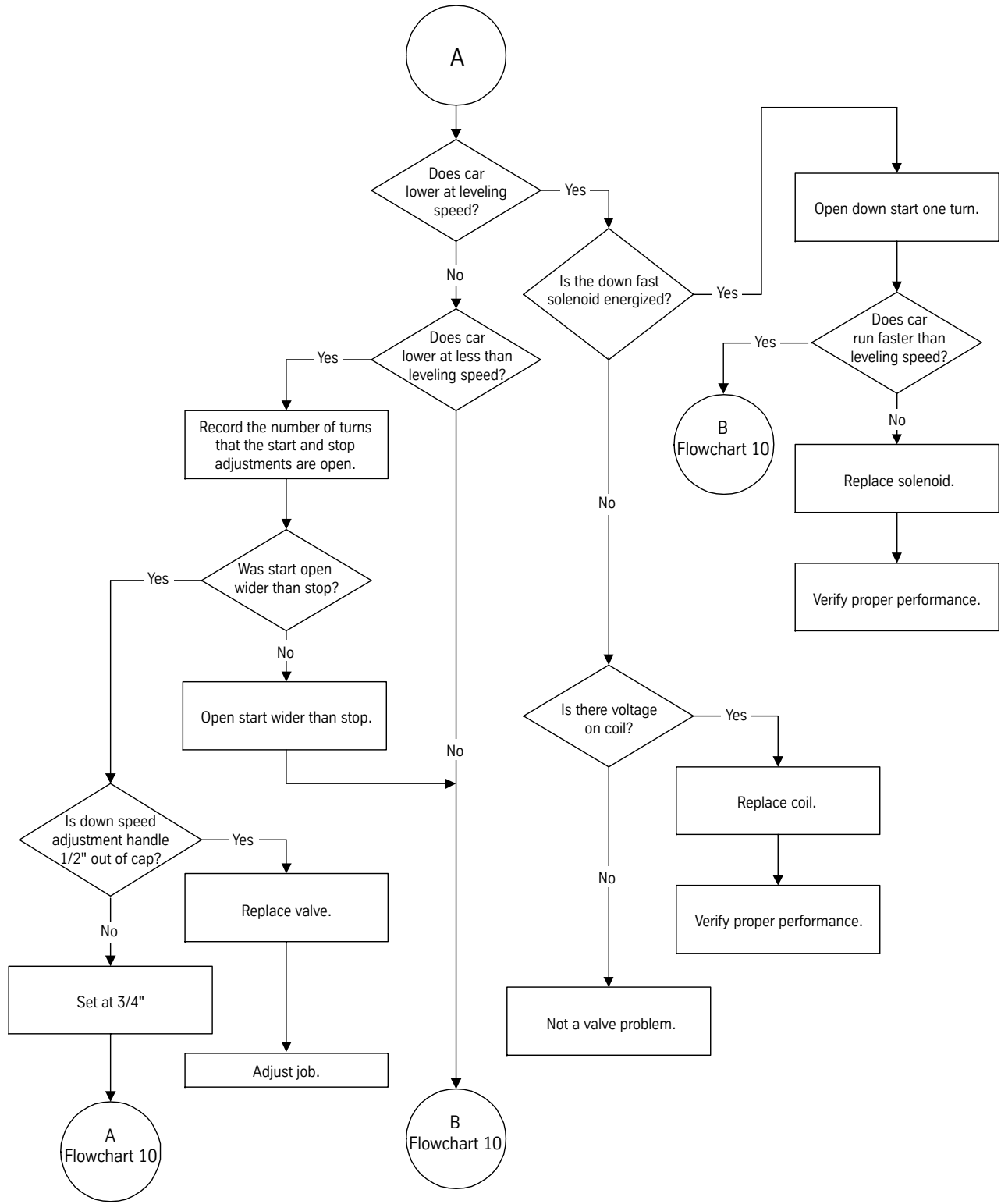


Flowchart 8



### Troubleshooting Flowcharts

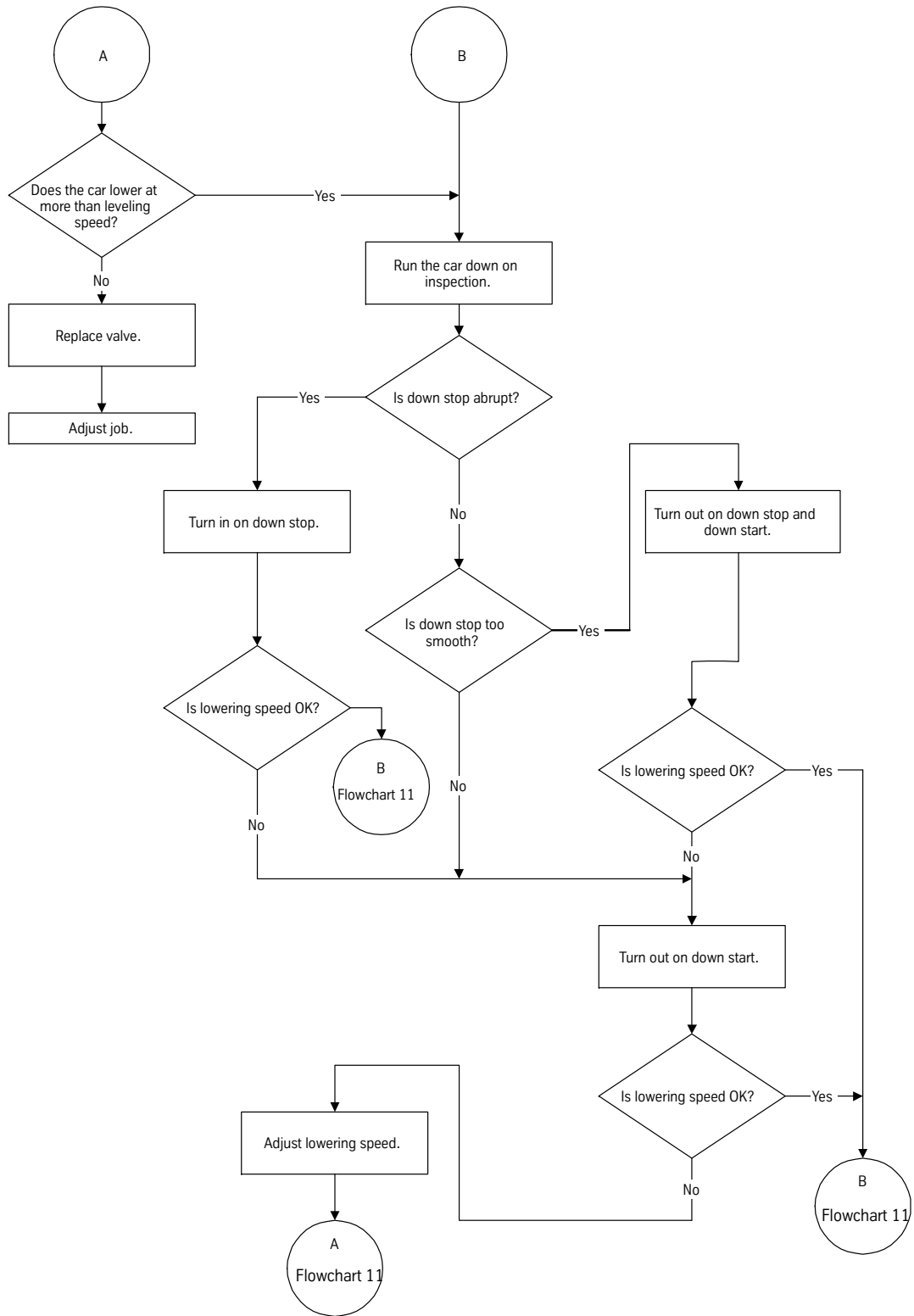
(continued)



Flowchart 9

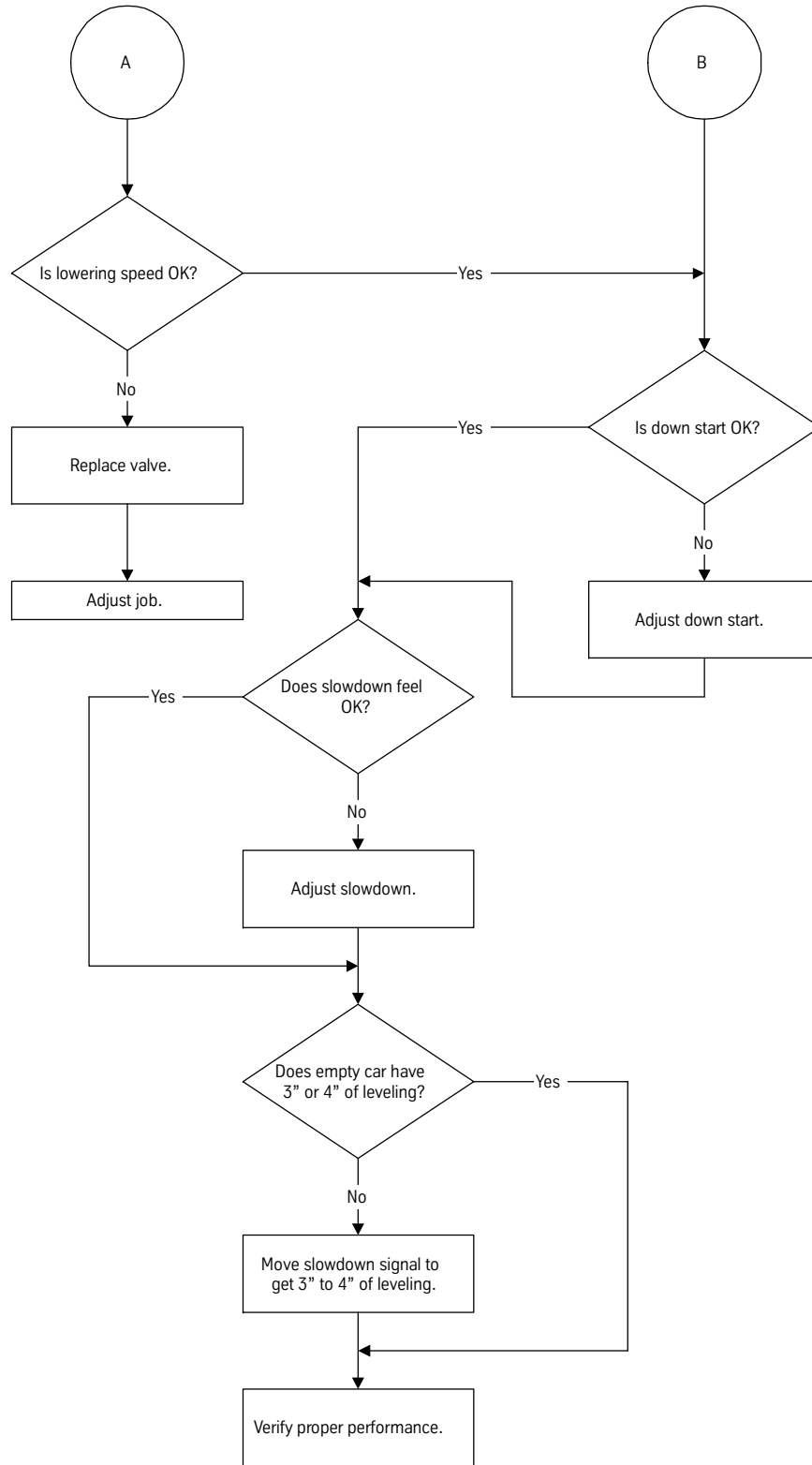
### Troubleshooting Flowcharts

(continued)



Flowchart 10

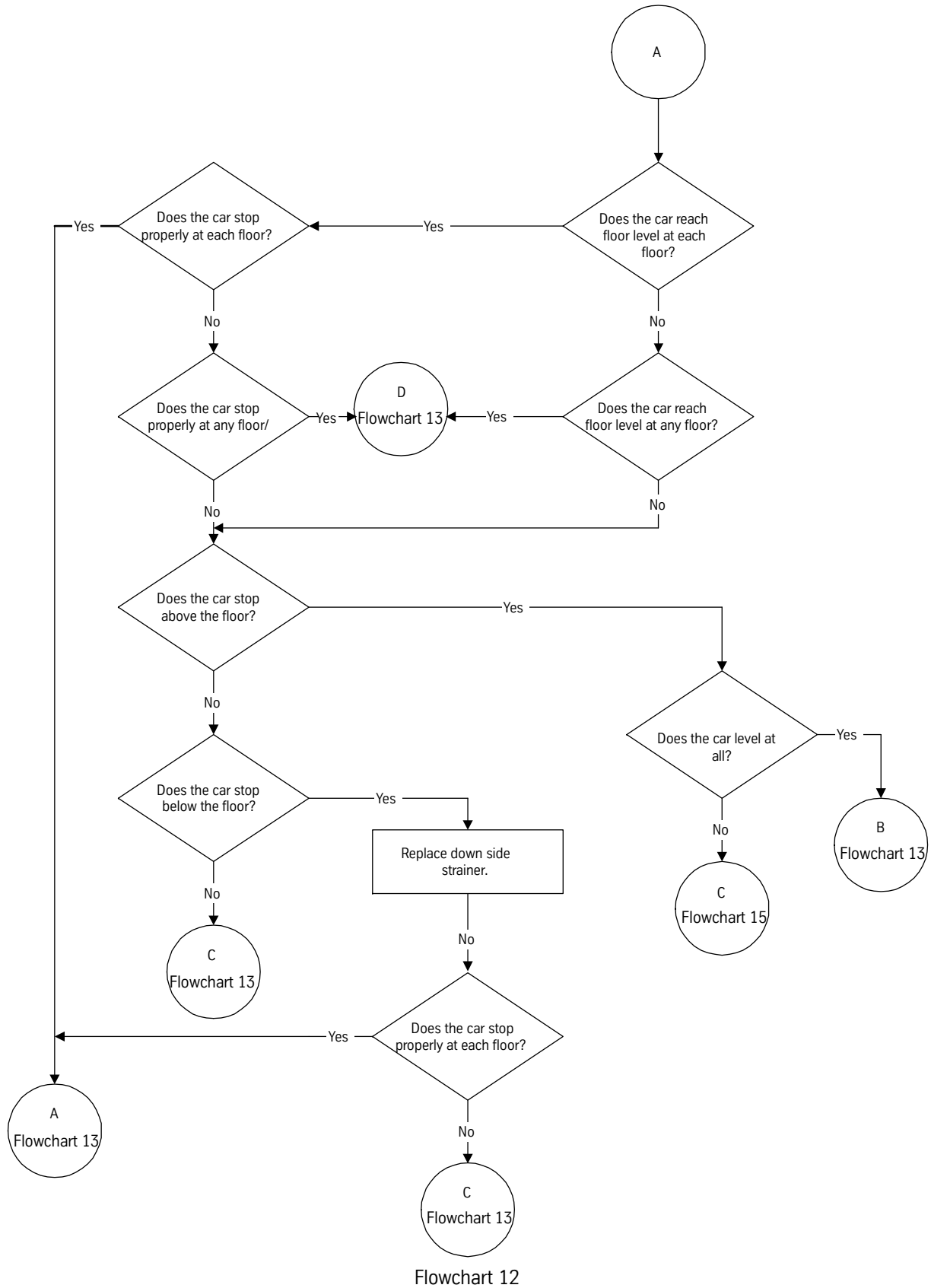
### Troubleshooting Flowcharts (continued)



Flowchart 11

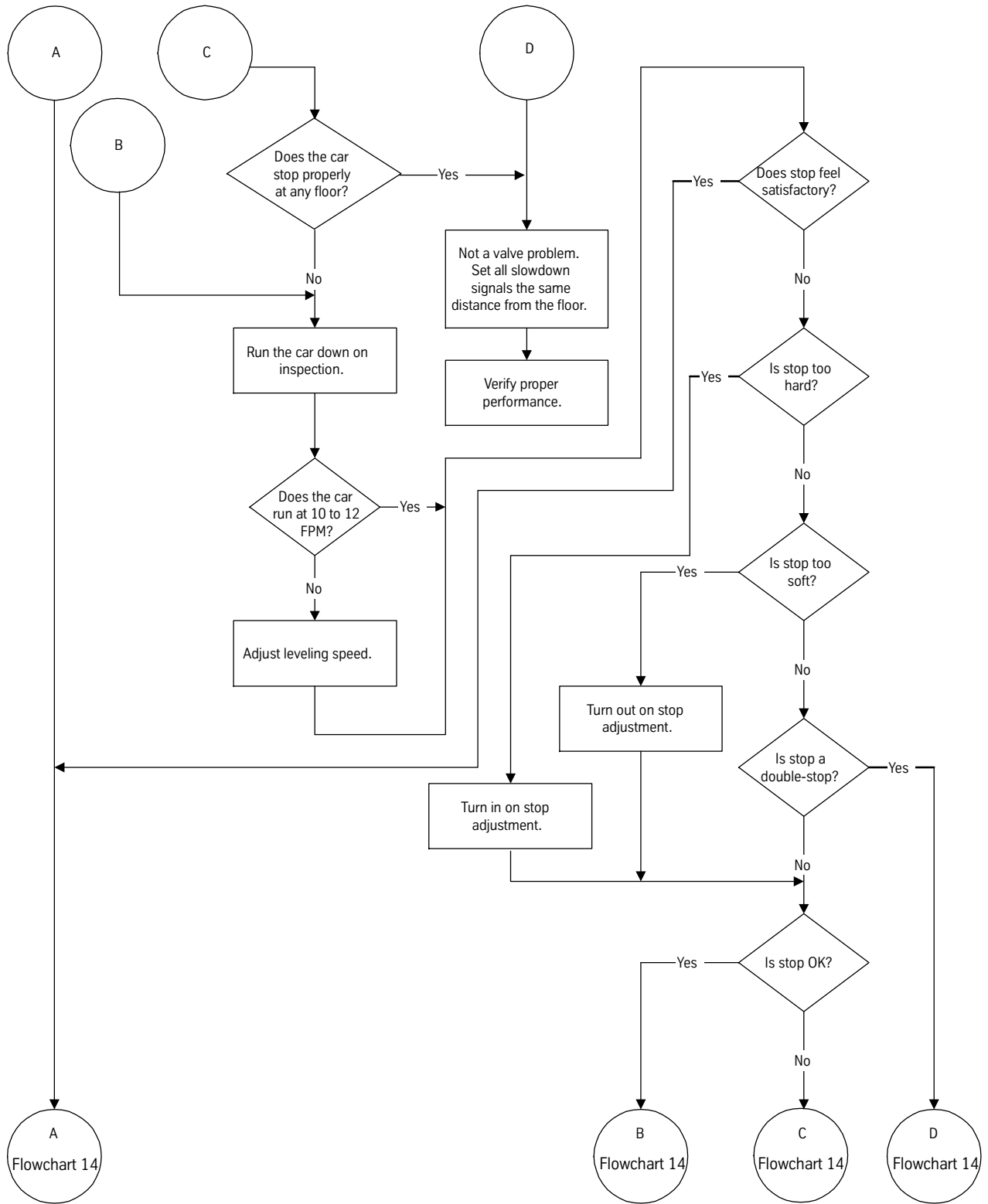
## Troubleshooting Flowcharts

(continued)



### Troubleshooting Flowcharts

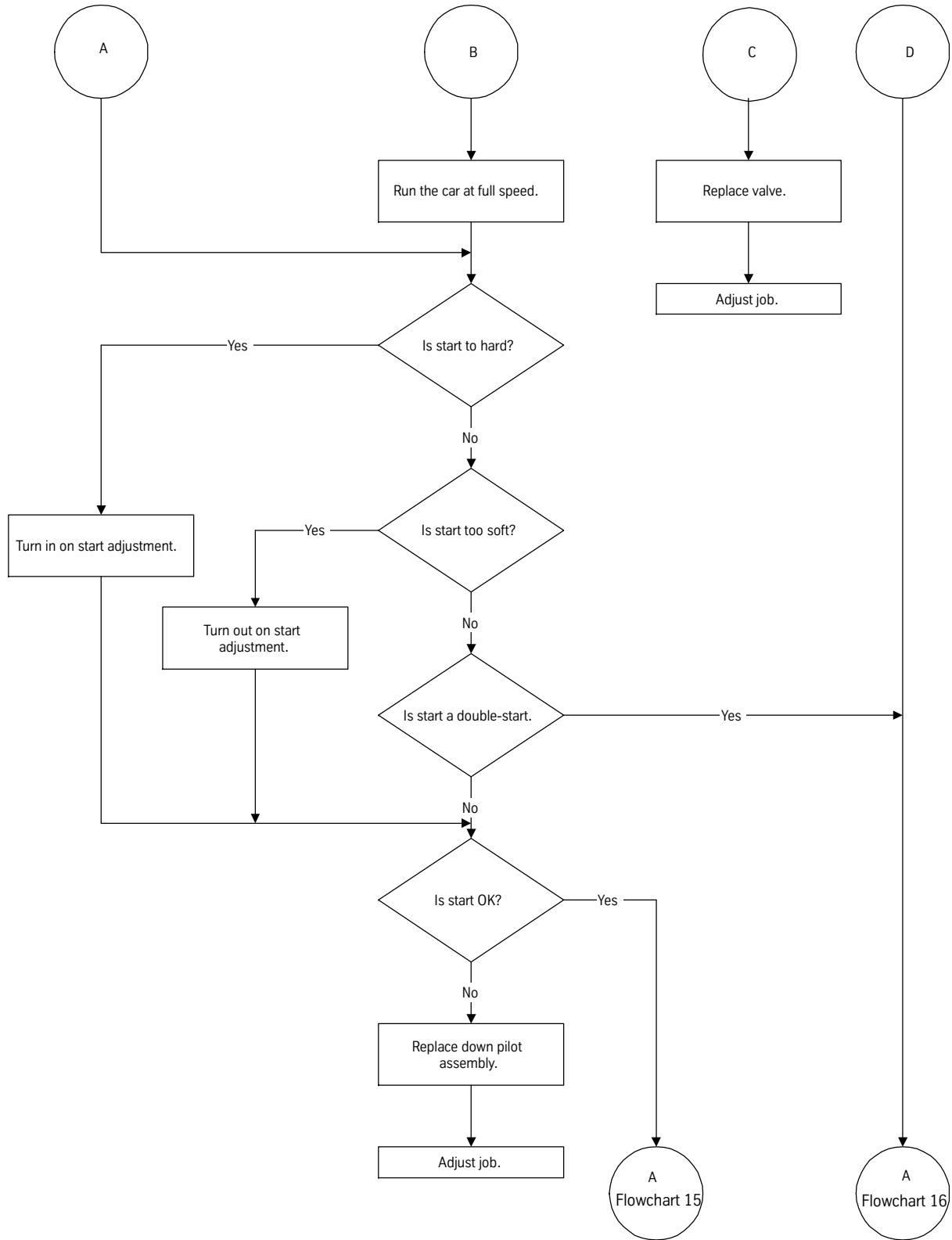
(continued)



Flowchart 13

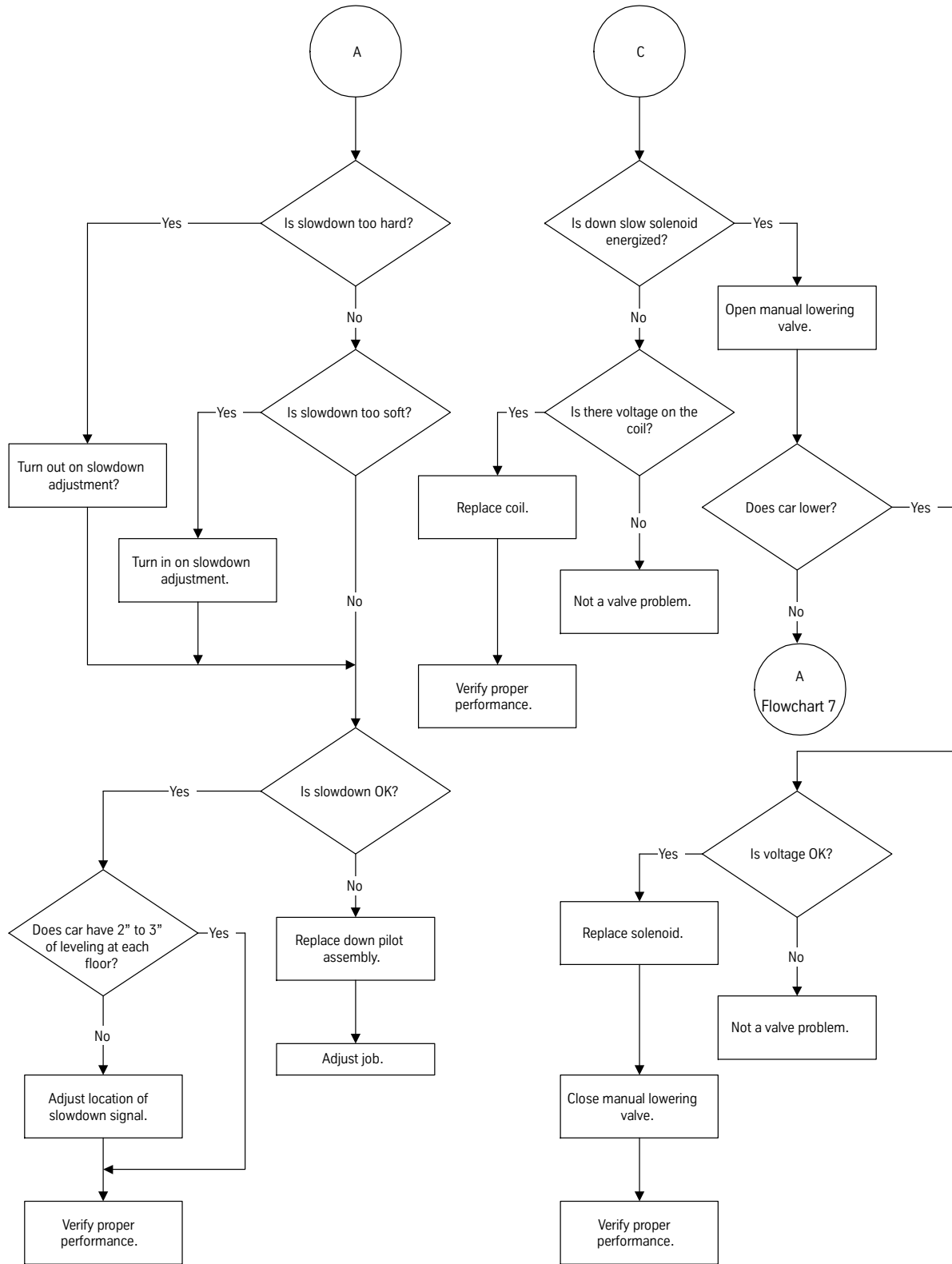
### Troubleshooting Flowcharts

(continued)



Flowchart 14

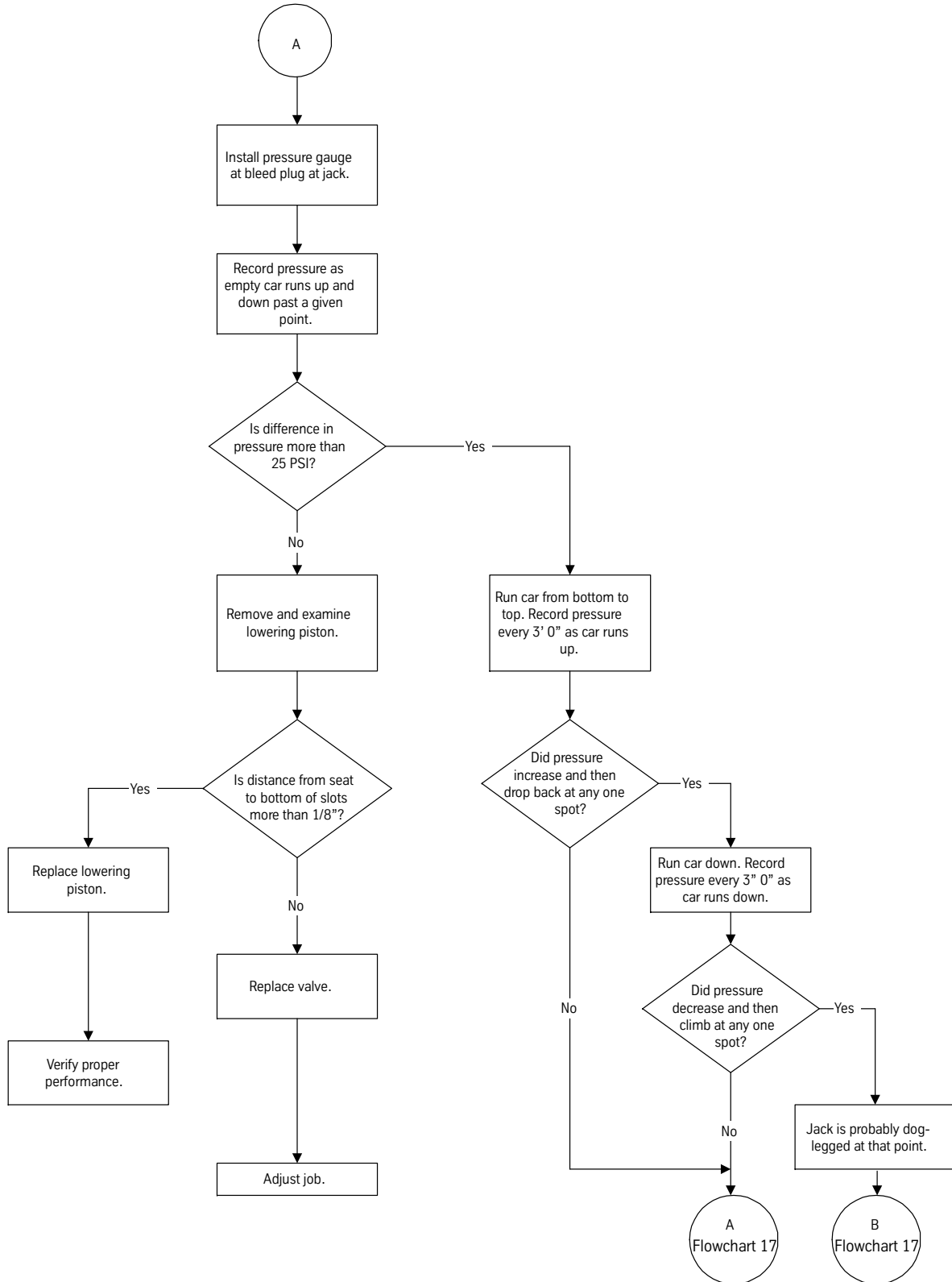
Troubleshooting Flowcharts  
(continued)



Flowchart 15

### Troubleshooting Flowcharts

(continued)

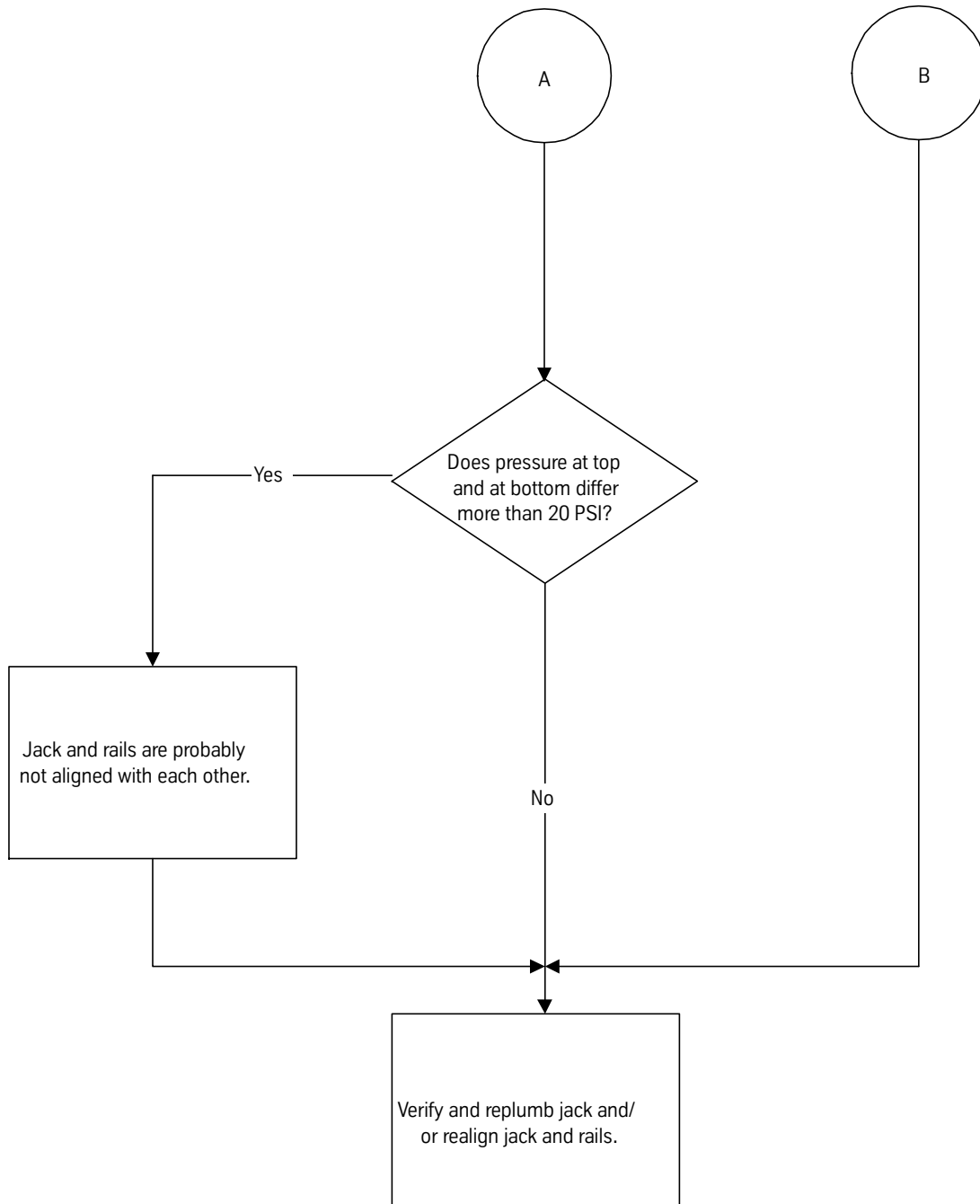


Flowchart 16



### Troubleshooting Flowcharts

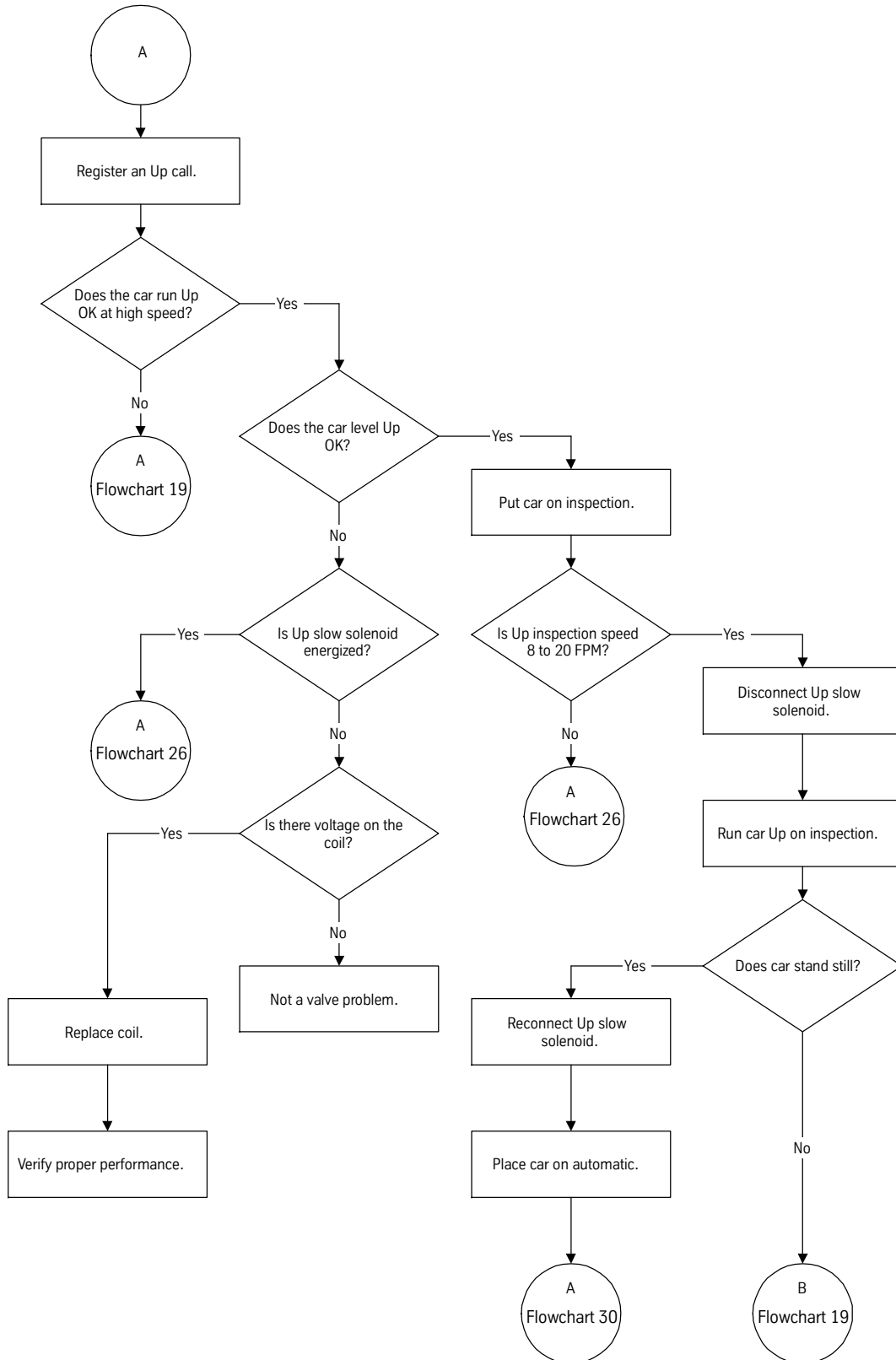
*(continued)*



Flowchart 17

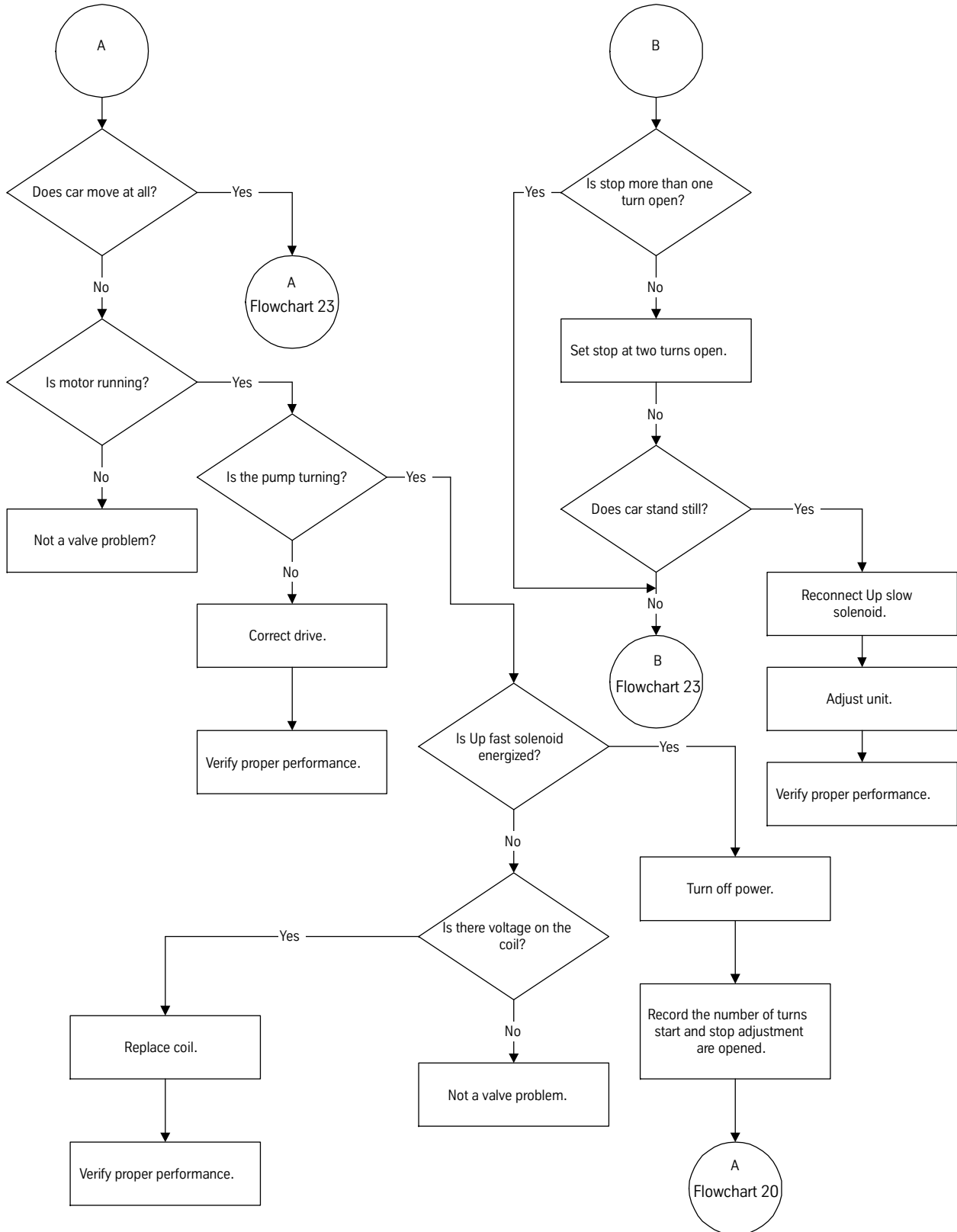
### Troubleshooting Flowcharts

(continued)



Flowchart 18

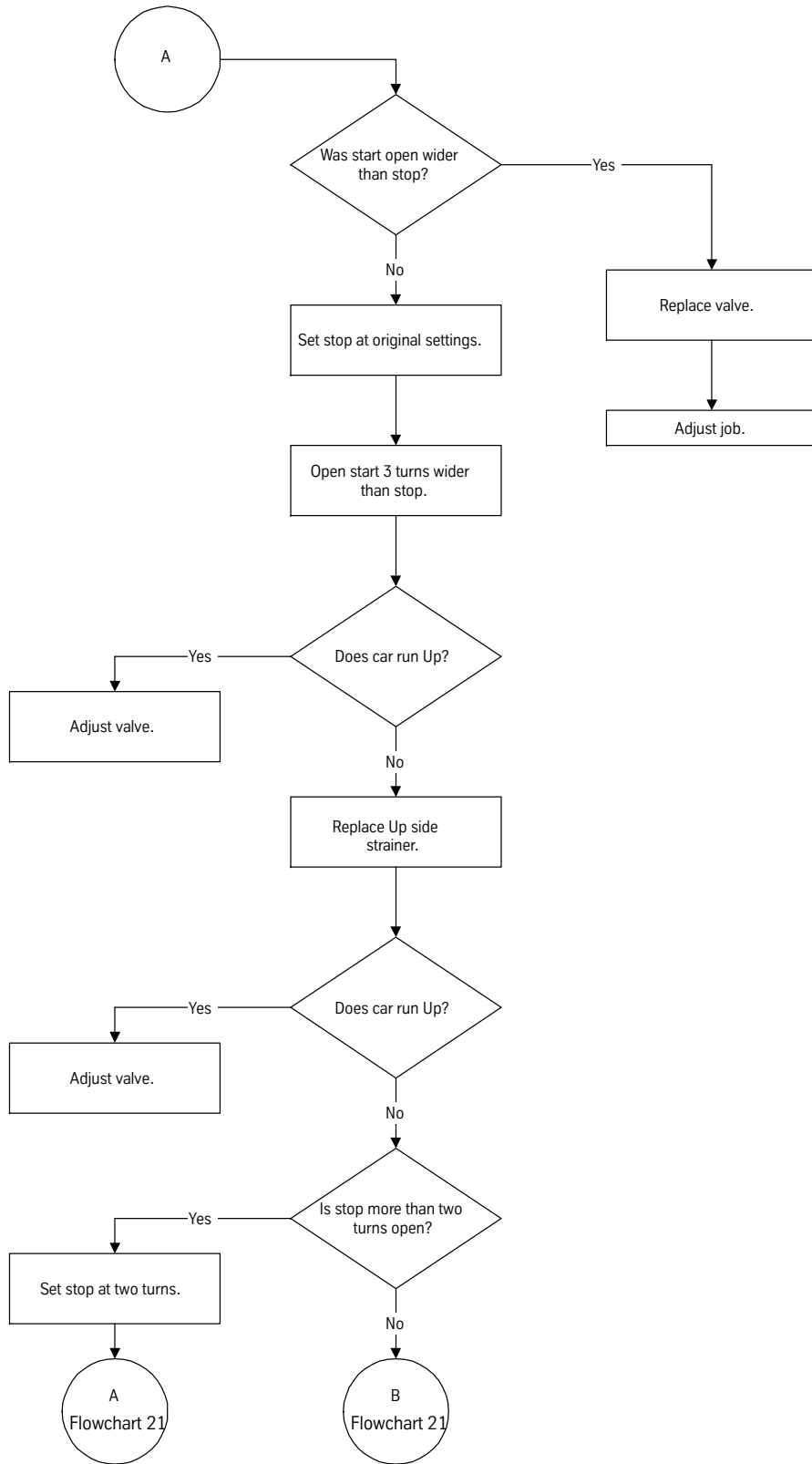
Troubleshooting Flowcharts  
(continued)



Flowchart 19

### Troubleshooting Flowcharts

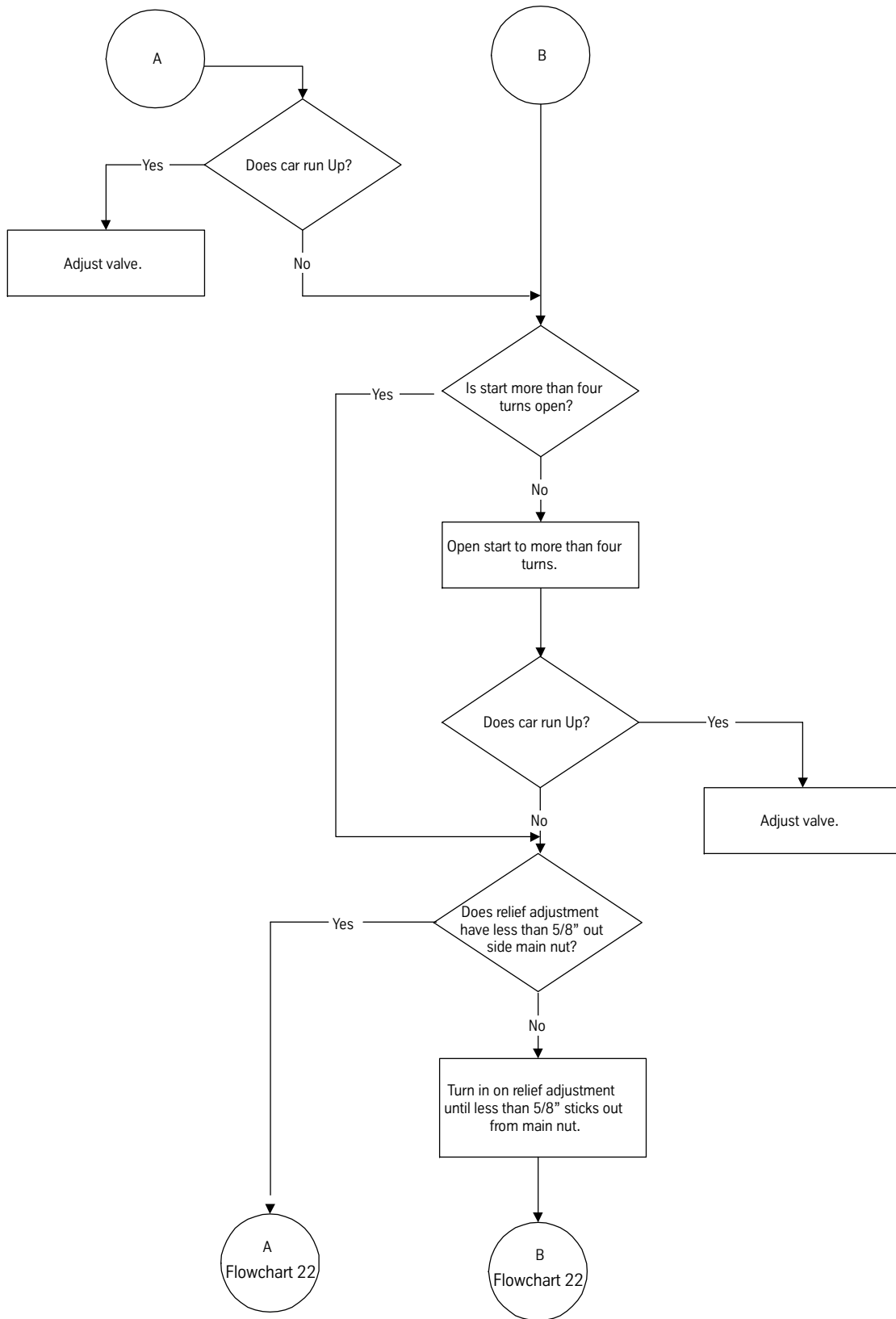
(continued)



Flowchart 20

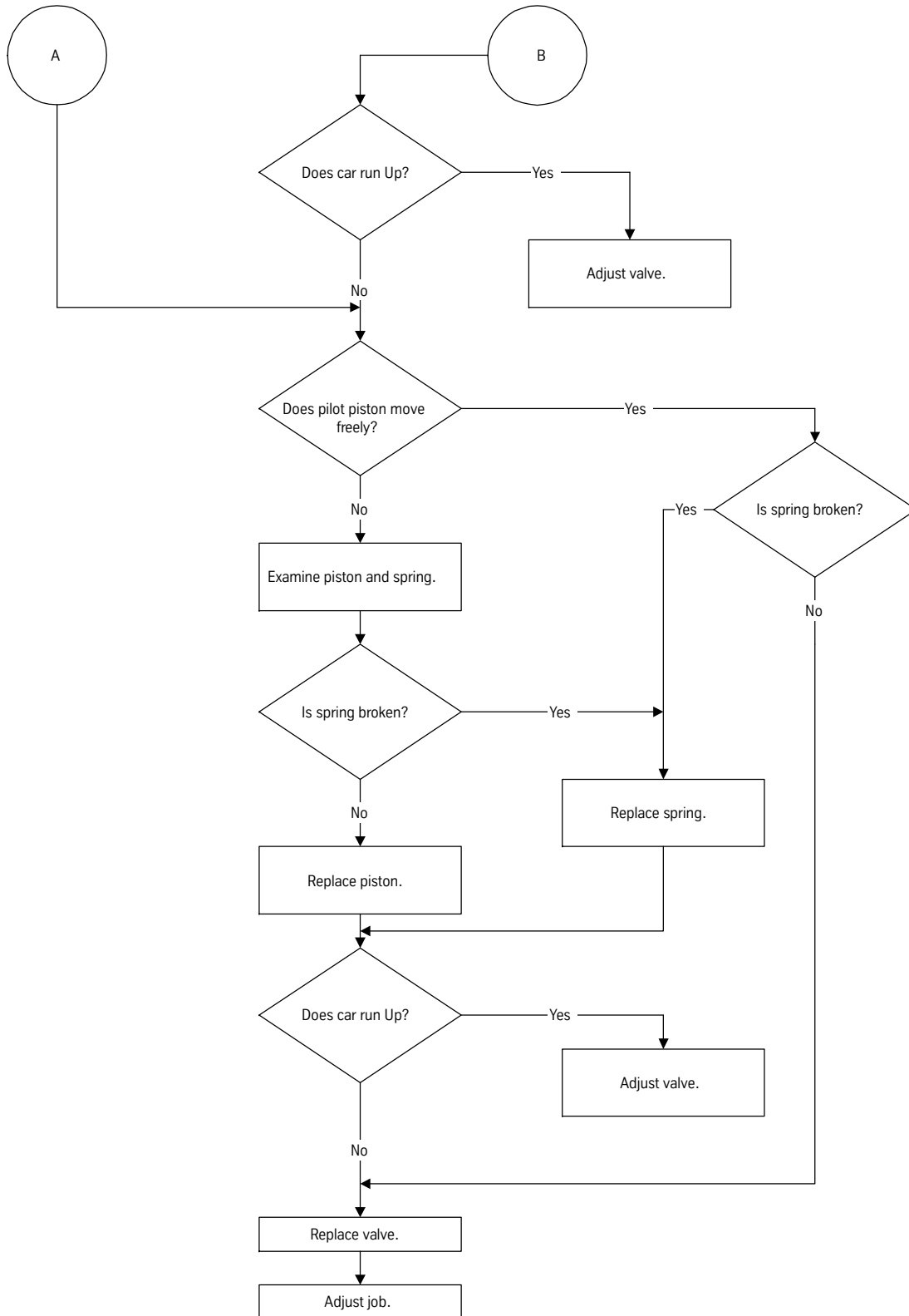
### Troubleshooting Flowcharts

(continued)



Flowchart 21

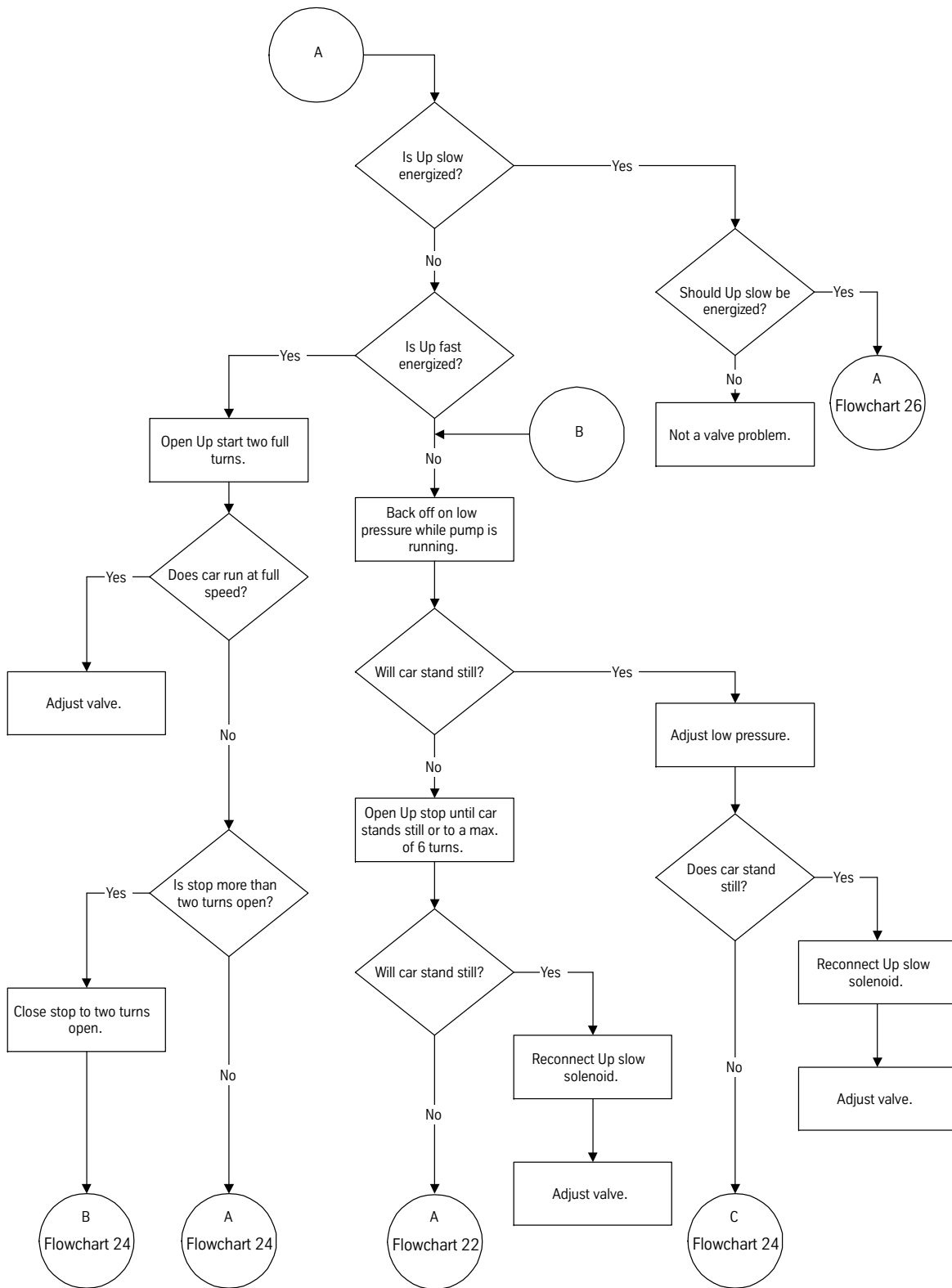
Troubleshooting Flowcharts  
(continued)



Flowchart 22

### Troubleshooting Flowcharts

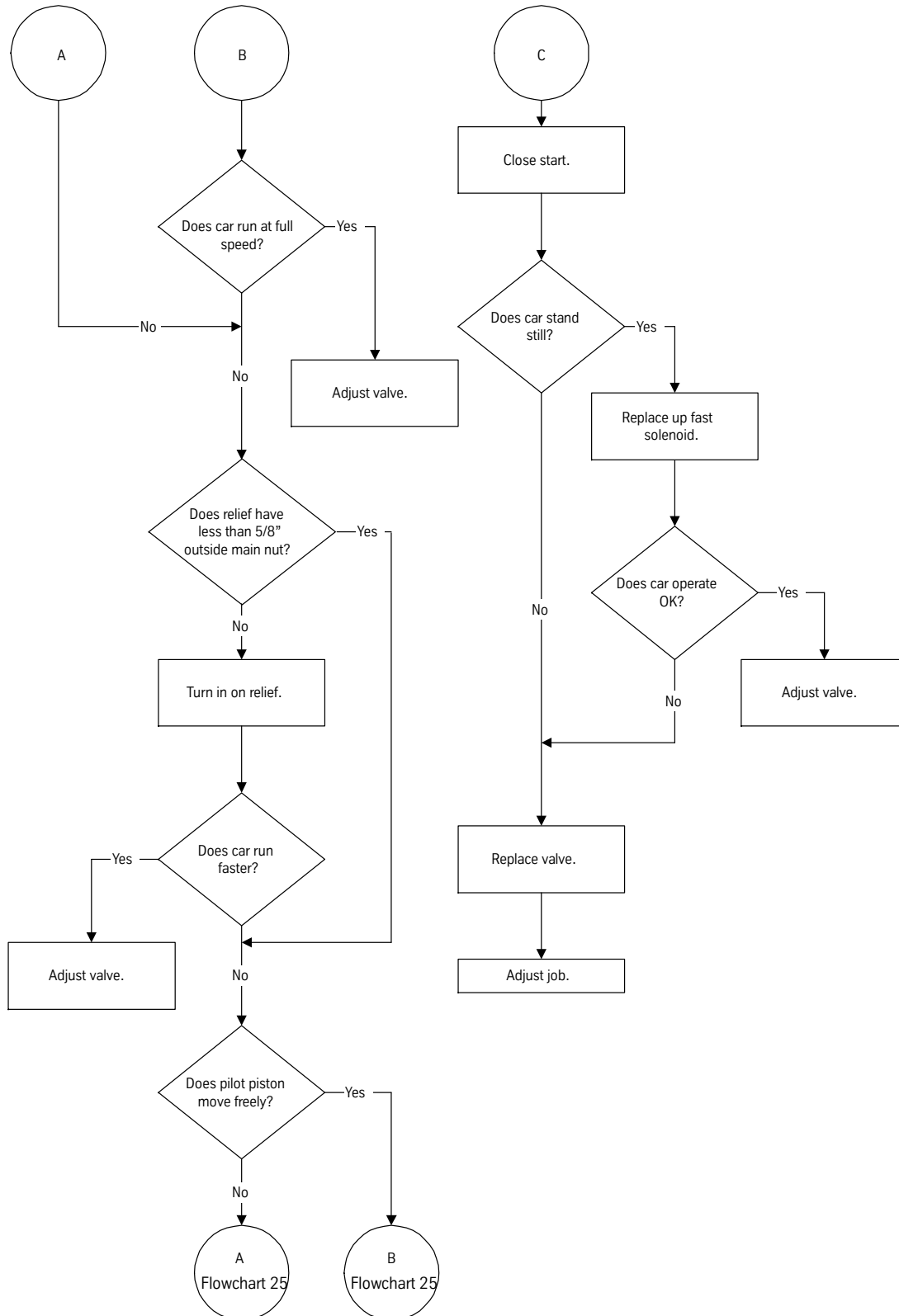
(continued)



Flowchart 23

### Troubleshooting Flowcharts

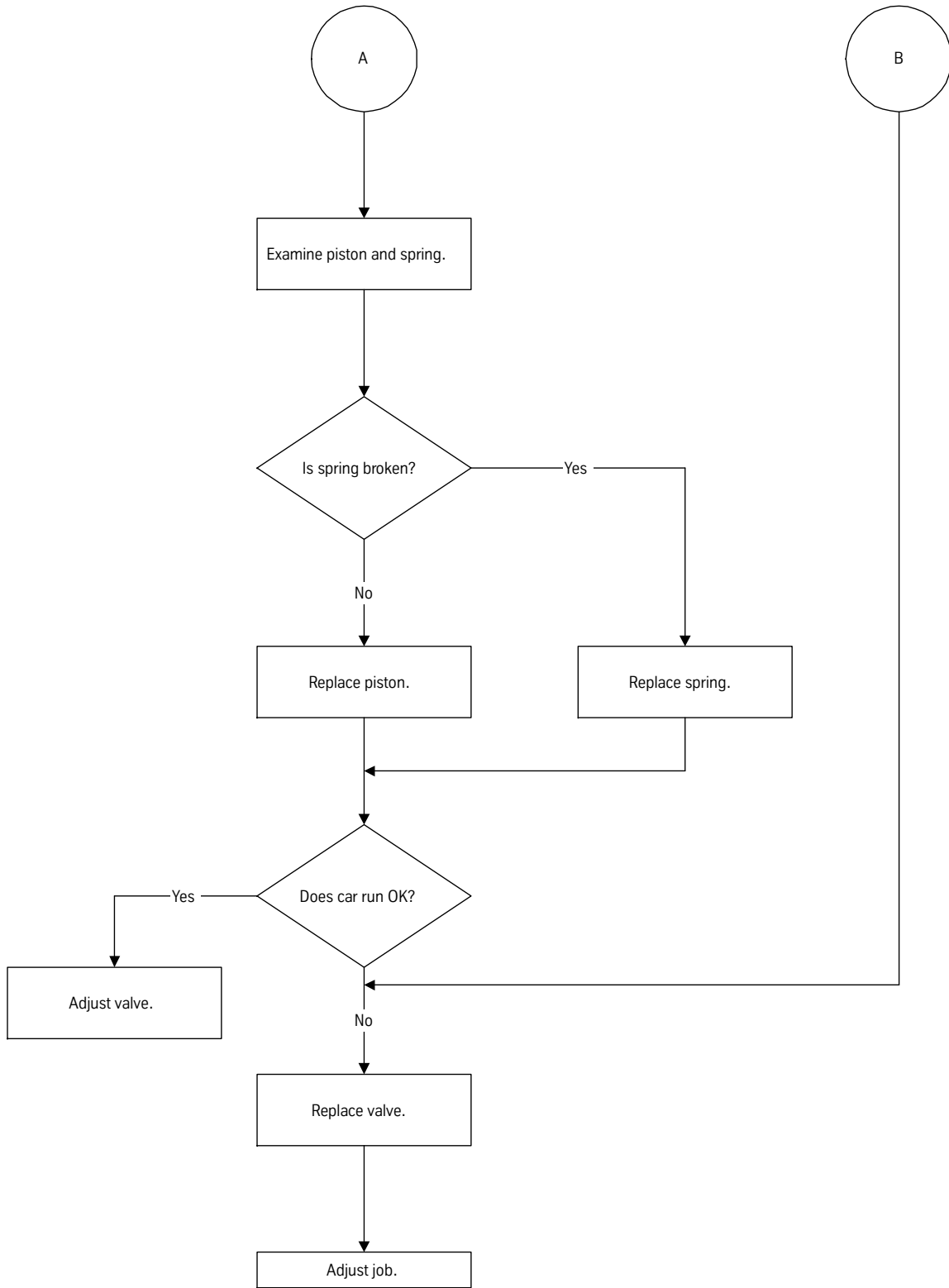
(continued)



Flowchart 24



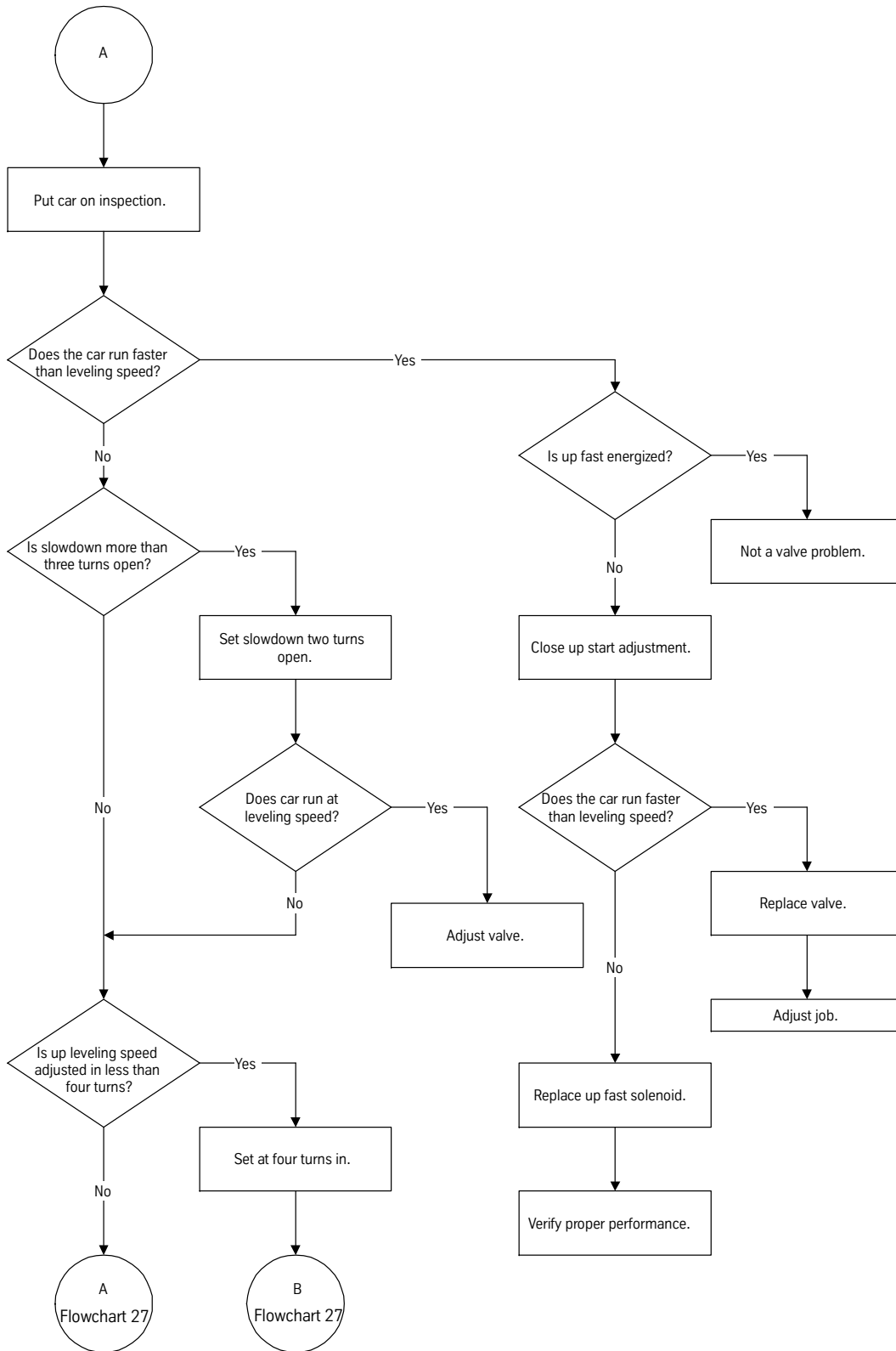
### Troubleshooting Flowcharts *(continued)*



Flowchart 25

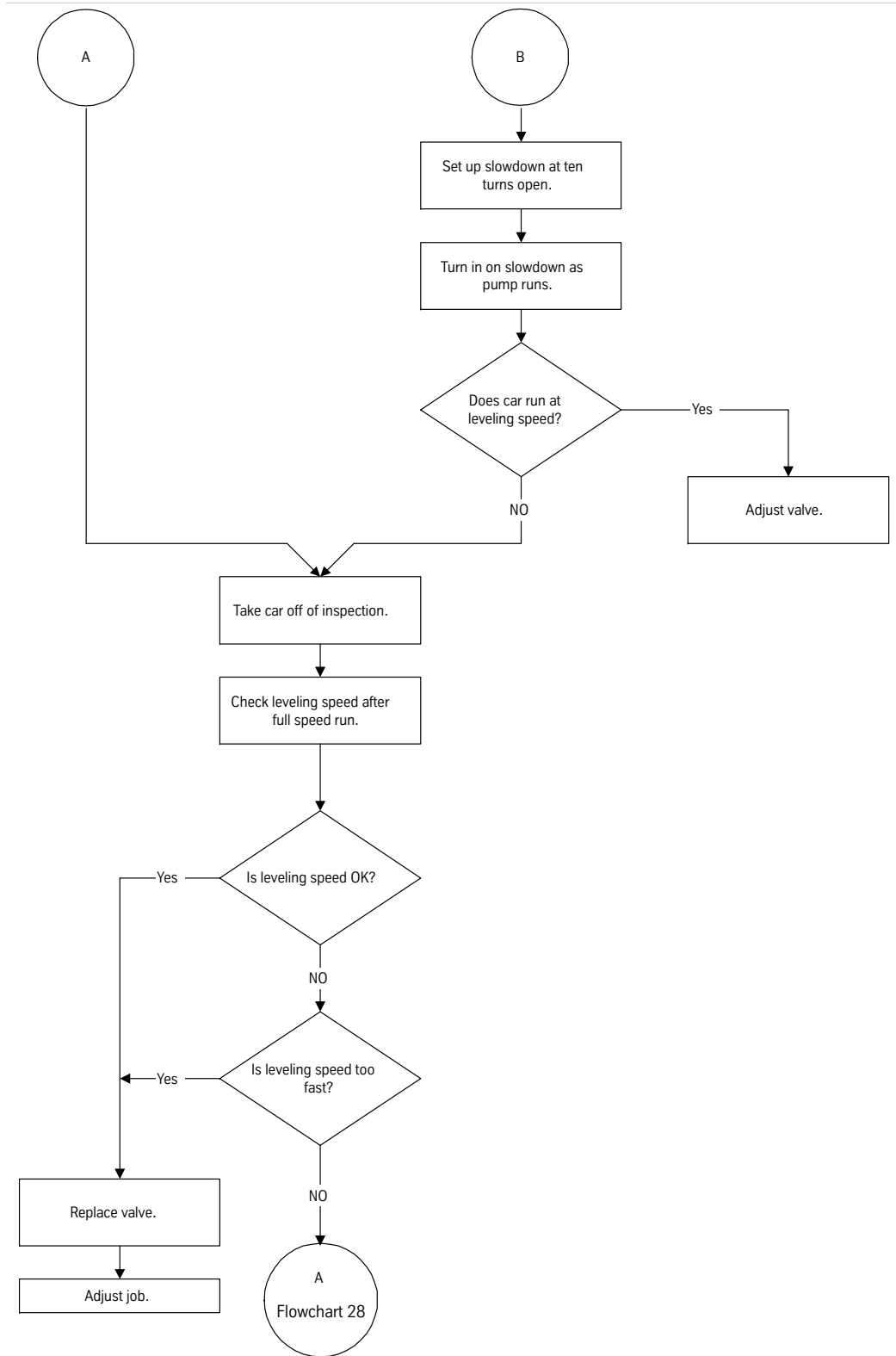
Troubleshooting Flowcharts

(continued)



Flowchart 26

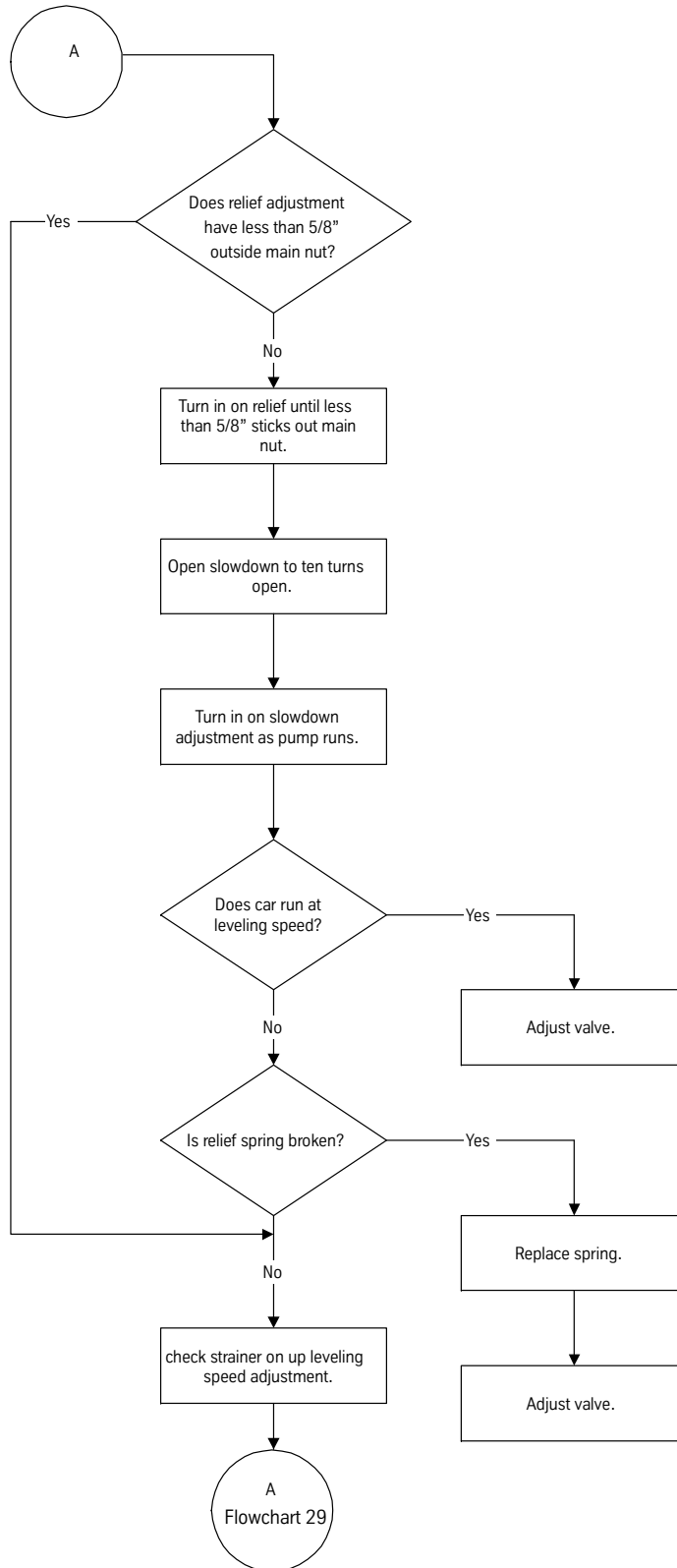
### Troubleshooting Flowcharts (continued)



Flowchart 27

## Troubleshooting Flowcharts

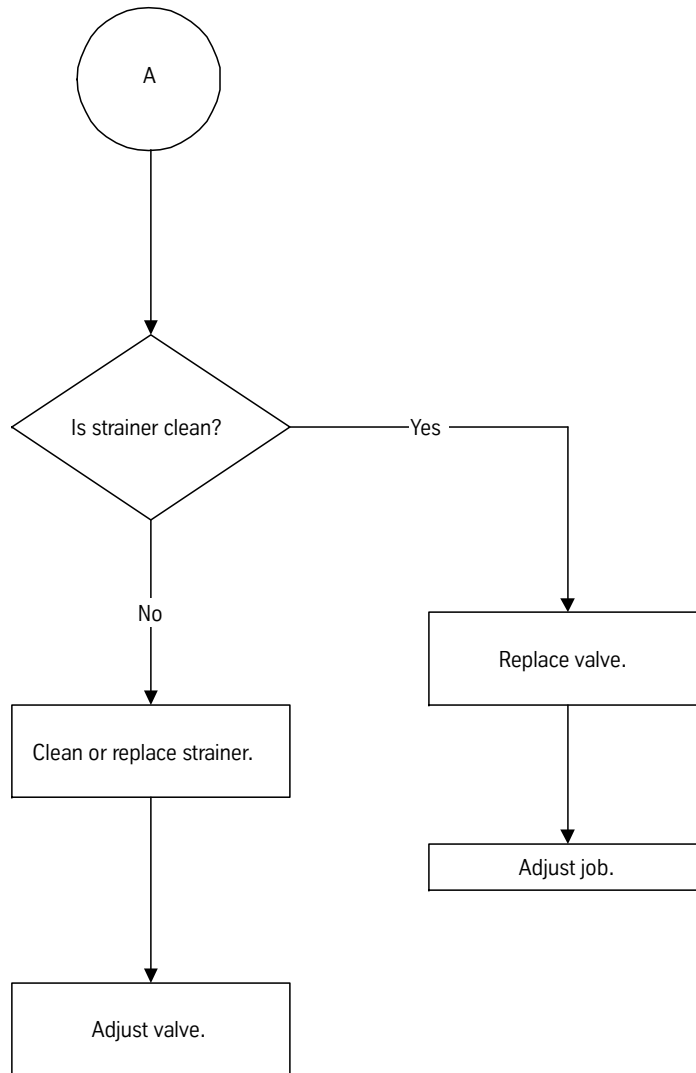
(continued)



Flowchart 28

### Troubleshooting Flowcharts

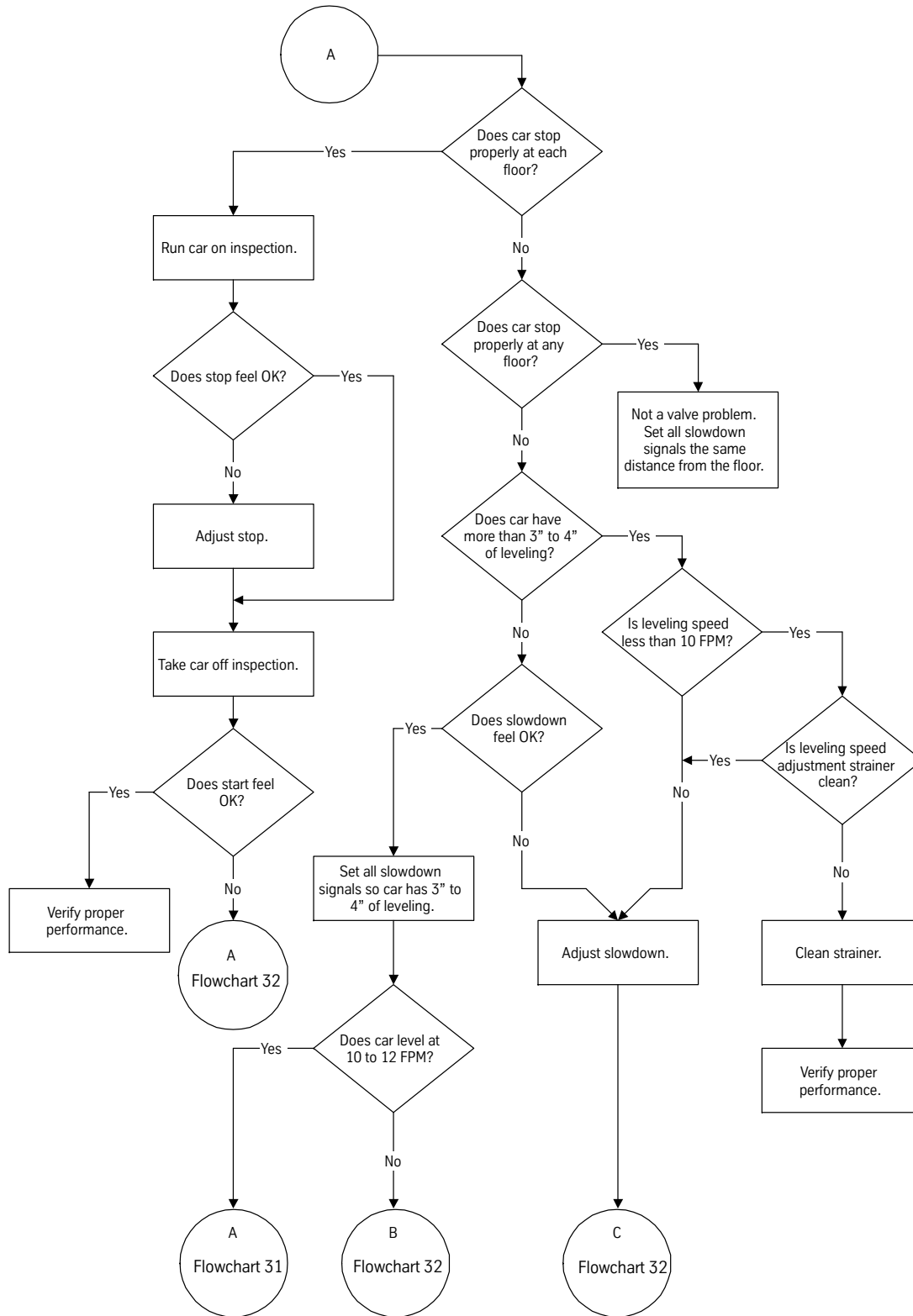
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Flowchart 29

### Troubleshooting Flowcharts

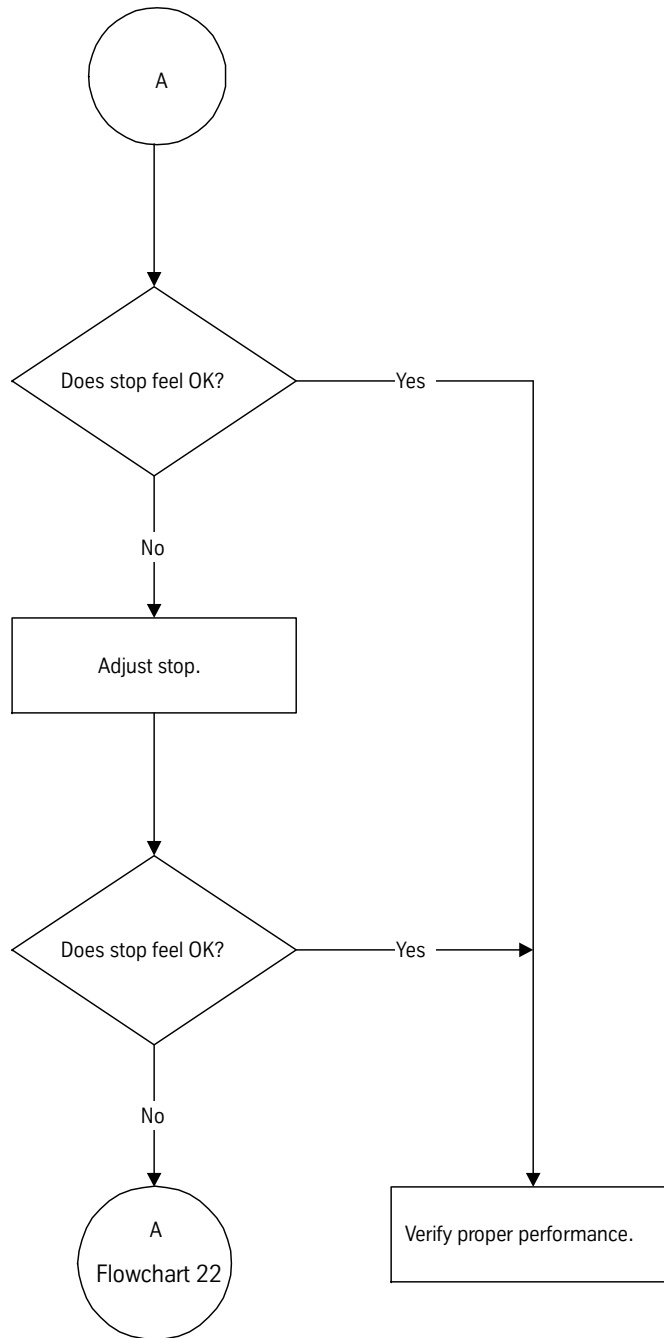
(continued)



Flowchart 30

### Troubleshooting Flowcharts

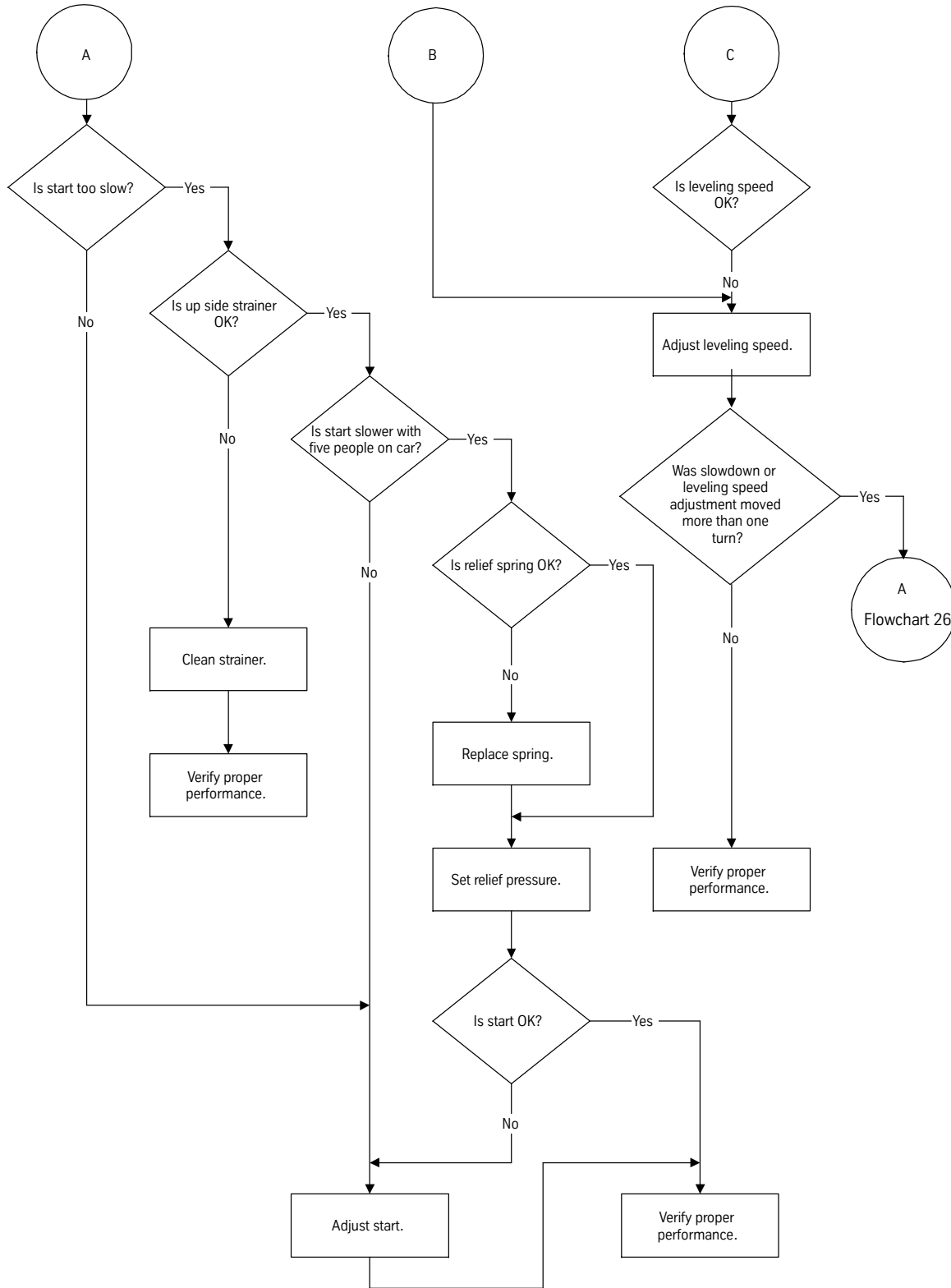
*(continued)*



Flowchart 31

### Troubleshooting Flowcharts

(continued)



Flowchart 32



## Sequence of Events

- Up Valve Section
- Consists of an up leveling speed adjustment, a check valve piston, a regulator piston, and a relief valve.
  - Provides acceleration to full speed, slowdown to leveling speed, hydraulic stopping, and high-pressure relief for the car in the up cycle.
  - Operates in the following sequence:
    1. To start the car, the pump starts, and the up fast solenoid energizes. See Figure 6 below and Figure 7 on page 56.
    2. The regulator piston is held open by its spring and also the pump pressure on the face of the piston against the low pressure adjustment. At the beginning, all of the oil bypasses to the tank past the regulator piston, through the up start adjustment, and to the up stop adjustment.
    3. The up start adjustment is open more than the up stop adjustment, making pressure build behind the regulator piston and causing it to move toward the closed position. The open amount of the up start adjustment governs how fast the regulator piston moves and how rapidly the car starts.
    4. As the regulator piston closes, pressure from the pump builds up in the valve and causes the check valve piston to open. This action allows oil to flow from the pump into the jack.

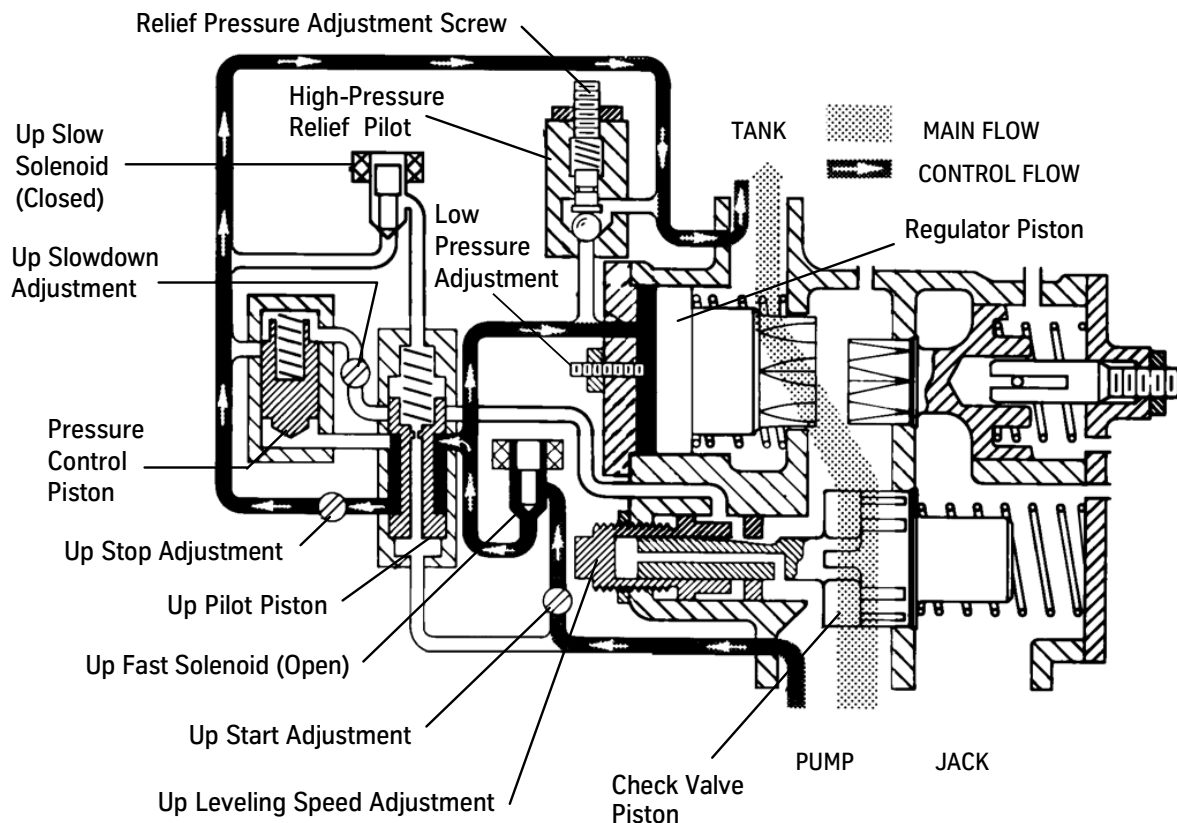


Figure 6 - Up Start Diagram

Sequence of Events

(continued)

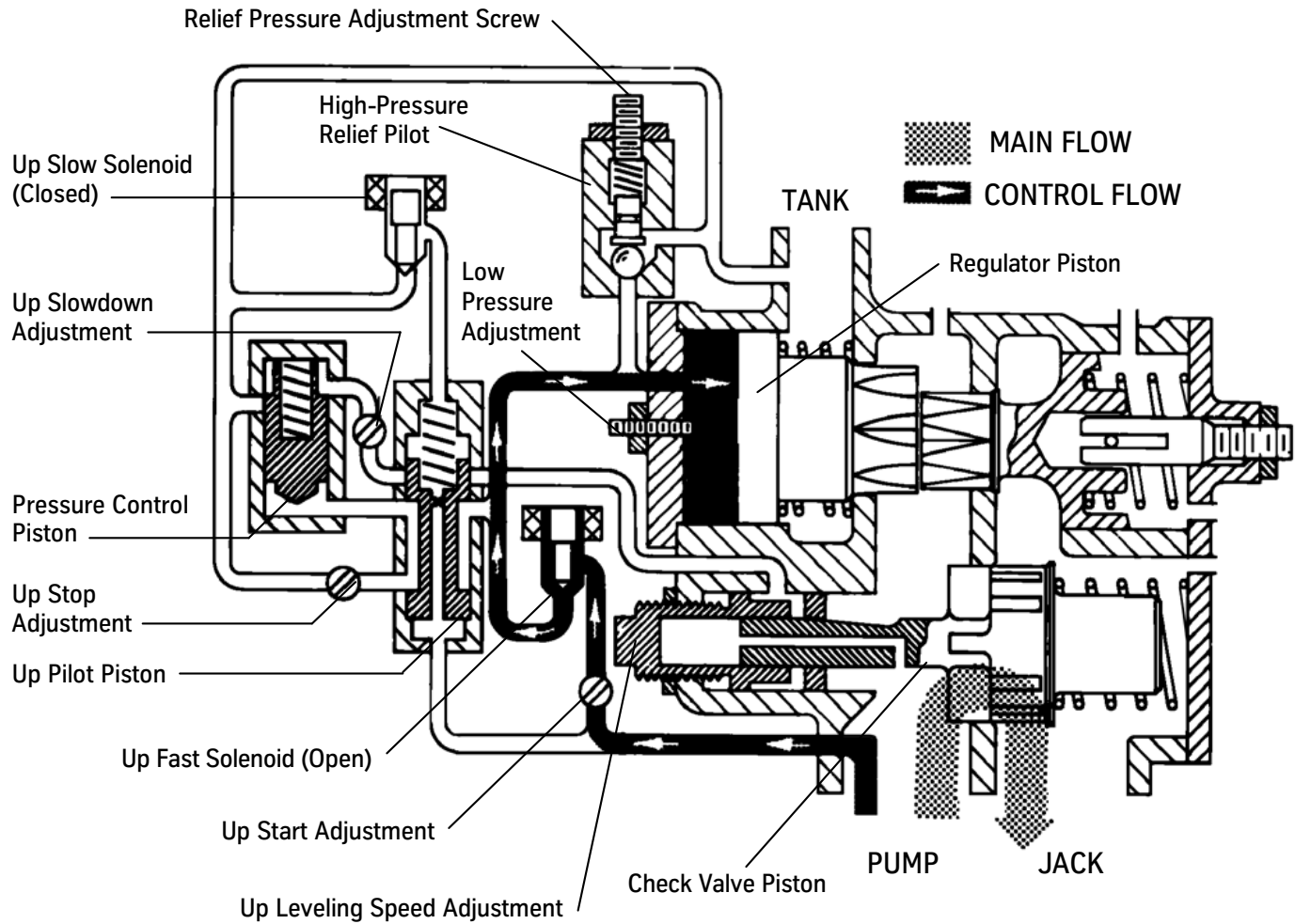


Figure 7 - Full Speed Diagram

## Sequence of Events

(continued)

- High-pressure Relief
1. The oil is transmitted to the high-pressure pilot. See Figure 8.
  2. The movement allows the oil in back of the regulator piston and at the high-pressure adjustment to escape to the tank.
  3. The regulator piston moves rapidly to the low-pressure stud, allows full bypass from the pump to the tank, and relieves the excess pressure.
  4. The system maintains relief pressure as long as the pump continues to run.

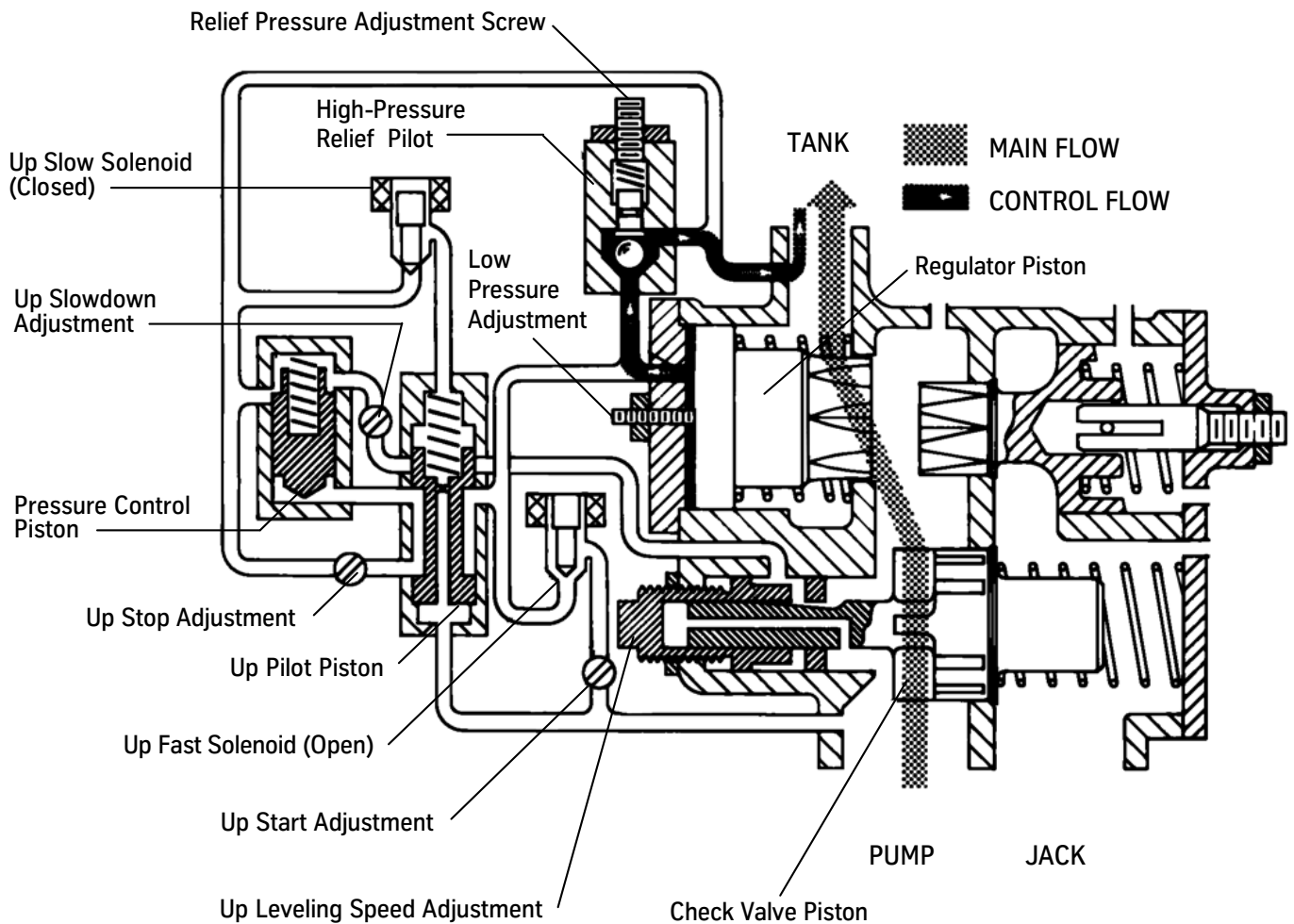


Figure 8 - High-Pressure Relief Diagram

## Sequence of Events

(continued)

### Up Slowdown and Leveling Speed

1. From slowdown to leveling speed, the up fast solenoid de-energizes, and the up slow solenoid energizes. See Figure 9.
2. The pressure on the spring end of the up pilot piston reduces, and the up pilot piston shifts to the up position.
3. The opening to the up stop adjustment closes, and the opening to the up slowdown and leveling adjuster opens to the back of the regulator piston.
4. Pressure behind the regulator piston reduces as the oil flows out through the up slowdown adjuster. The regulator piston starts to open.
5. The opening at the up slowdown adjuster determines the rate of oil flow from the low pressure adjuster end of the regulator piston back into the tank, which controls the rate of speed change. The wider the opening, the quicker the slowdown.
6. Valve pressure drops as the regulator piston opens. This action causes the check valve piston to begin to close.
7. When the slot on the check valve piston reaches the hole in the leveling speed adjuster, less oil flows from behind the regulator piston.
8. When the slot has opened enough to allow the same amount of oil to flow in the leveling speed adjuster as the amount that flows out through the up slowdown adjuster, the system reaches a hydraulic balance, known as leveling speed.
9. The leveling speed is changed by moving the hole in the leveling speed adjuster.

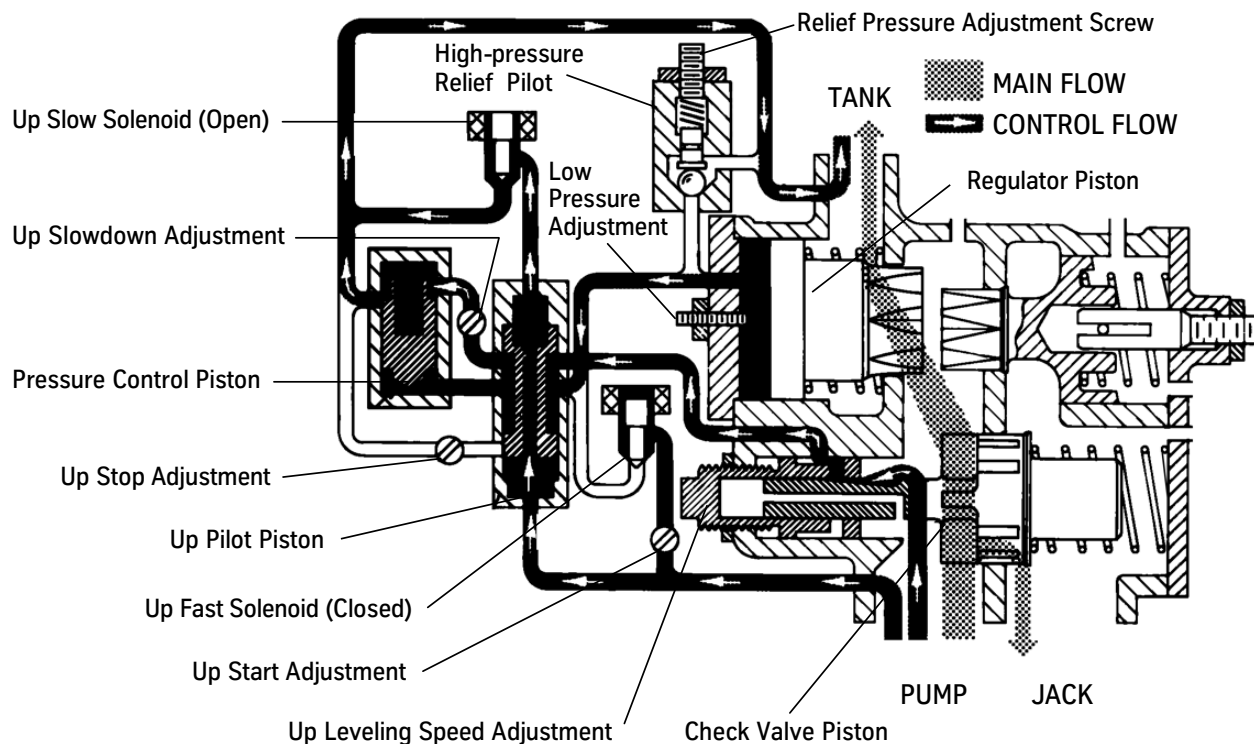


Figure 9 - Up Slowdown and Leveling Speed Diagram

## Sequence of Events

(continued)

- Up Stop
1. The up slow solenoid de-energizes to stop the car. The pump runs slightly longer on a timed delay to provide a valve stop instead of a pump stop. See Figure 10.
  2. With pressure equalized on both ends of the up pilot piston, the spring parks the piston in the down position. In this position, the openings of the up slowdown and leveling adjuster are closed, and the opening of the up stop adjuster opens.
  3. The up stop adjuster allows flow out from behind the regulator piston and causes the pressure to drop.
  4. Decreased oil pressure on the back of the regulator piston allows pressure from the jack (with the spring force) to push the piston against the low pressure adjustment stud allowing full bypass. At the same time, the check valve piston closes.
  5. The opening at the stop adjustment controls the stop rate. The wider the opening, the faster the stop.

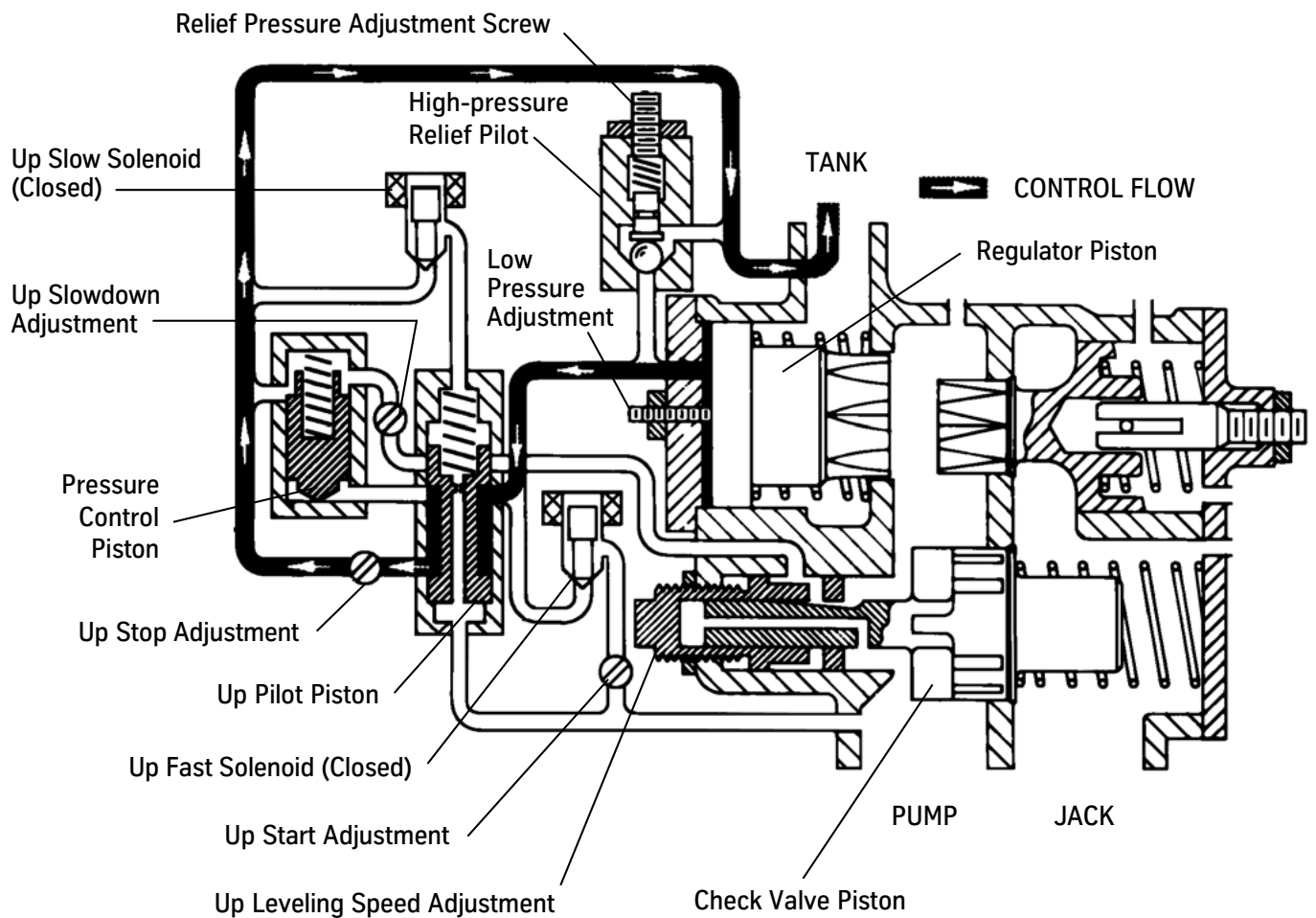


Figure 10 - Up Stop Diagram

## Sequence of Events

(continued)

### Down Valve Section

The down portion of the valve consists of a piston that seats and can be controlled in these positions:

- Closed to stop the car
- Partially open for slow speed
- Fully open for high speed

### Down Start and Full Speed

1. To start the car down, the down fast and down slow solenoids are energized simultaneously, allowing the oil behind the piston to flow to the tank through the down start adjustment. See Figure 11.
2. The reduction in pressure behind the piston causes the piston to lift. The down start adjustment must be open more than the down stop adjustment so that the oil entering through the down stop adjustment can be drained to the tank.
3. The size of the openings will govern how fast the piston moves and how rapidly the car starts. The lowering speed adjustment limits the amount the piston can open, thereby controlling the car down speed.

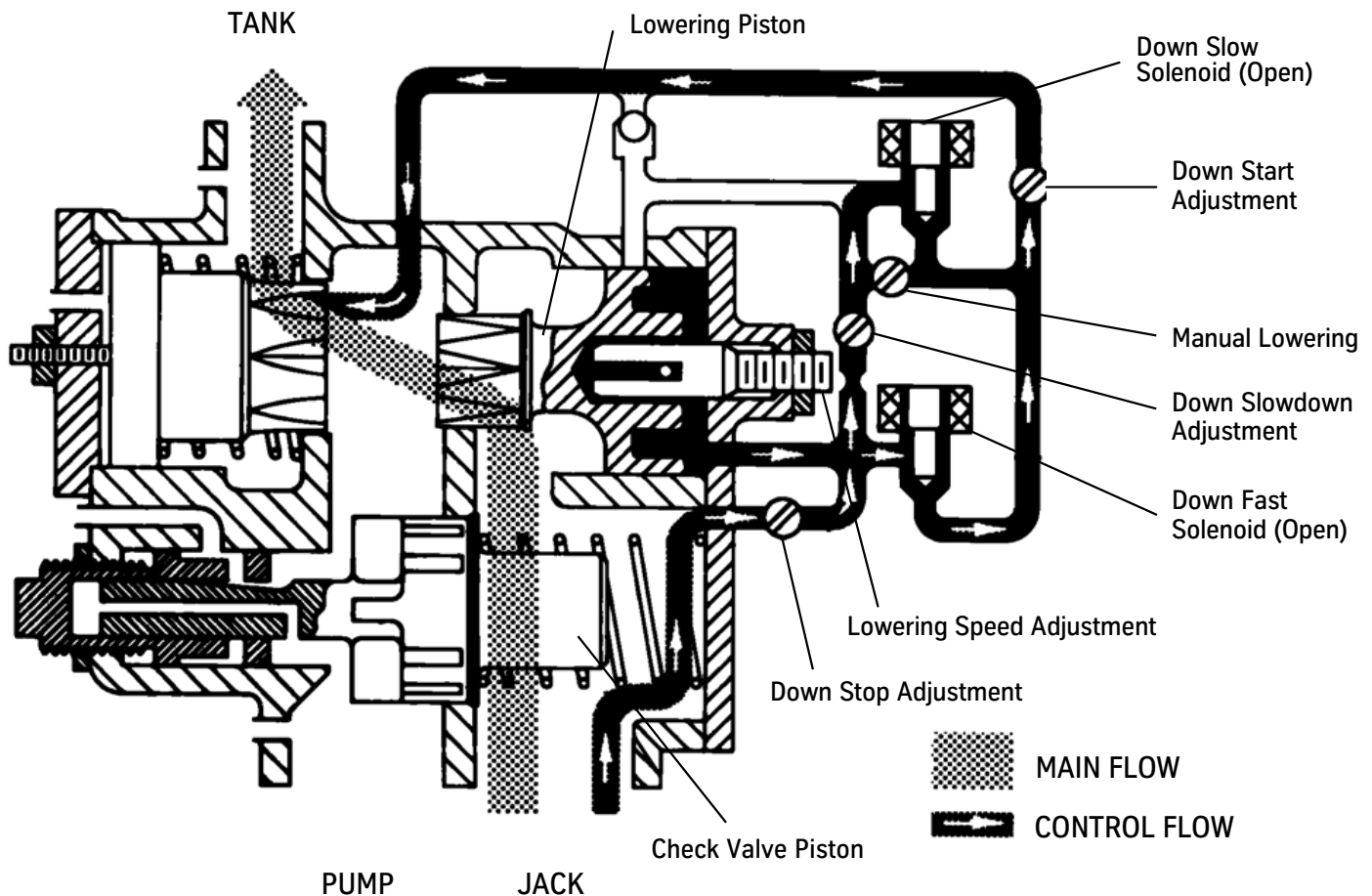


Figure 11 - Down Start and Full Speed Diagram

## Sequence of Events

(continued)

### Down Slowdown and Leveling

1. To change to leveling speed, the down fast solenoid closes. The lowering piston starts in the full open position, and the piston skirt blocks the oil passage to the tank. See Figure 12.
2. Oil flows in through the down stop adjustment to the rear of the lowering piston, and out through the slowdown adjustment. The down slow solenoid and the down start adjustment cause the lowering piston to move toward the closed position. The amount that the down slowdown adjuster is closed governs the speed at which the piston moves and the car slows down.
3. The piston stops when the piston skirt opens the oil passage to the tank through the down slow solenoid.
4. To control the lowering speed, turn the lowering and leveling adjustment in increments of half-turns. To control the leveling speed, turning the lowering and leveling adjustment in increments of less than one-quarter turns.

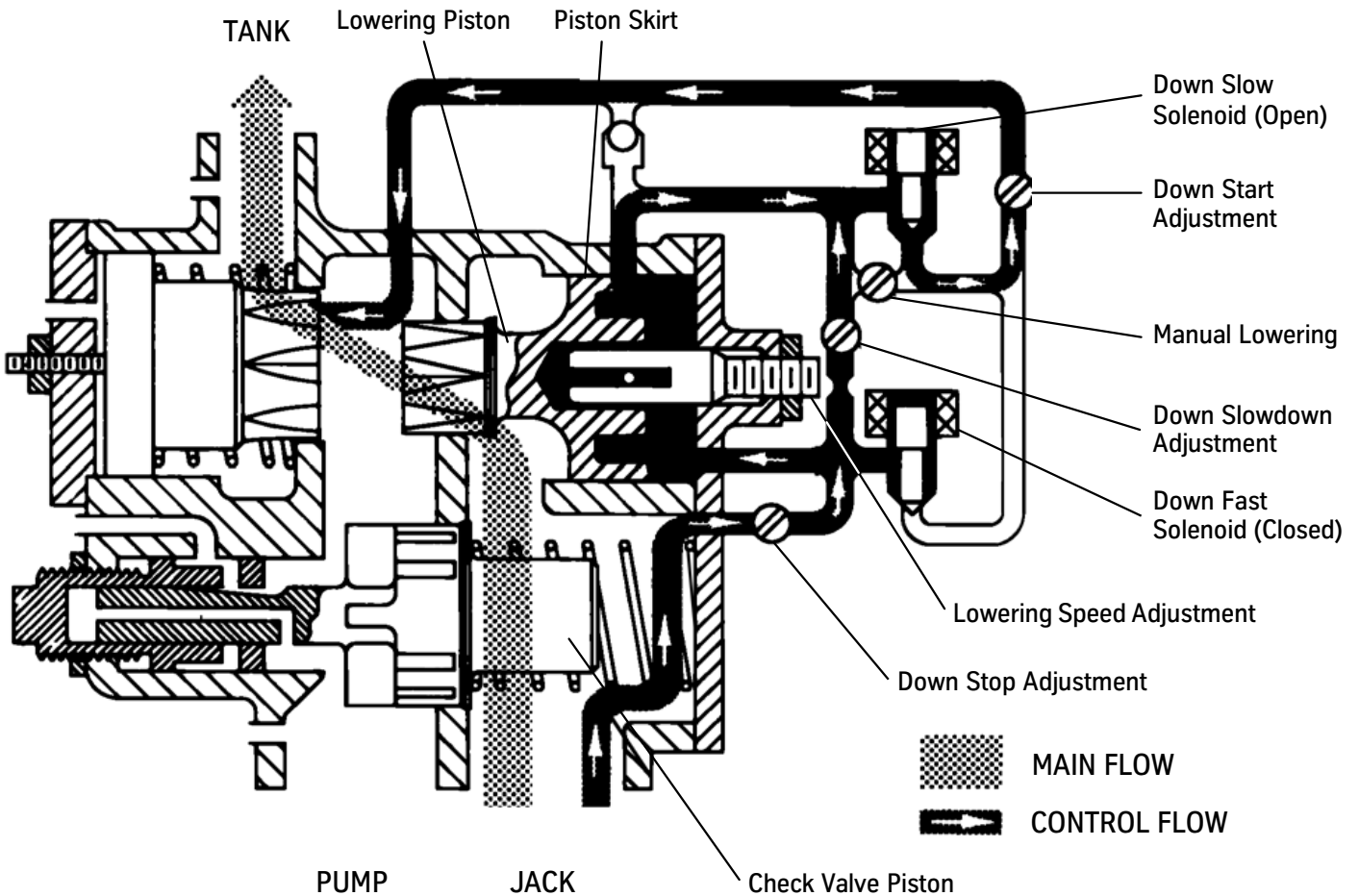


Figure 12 - Down Slowdown and Leveling Diagram

## Sequence of Events

(continued)

- Manual Lowering    The manual lowering valve is parallel to the down slow solenoid and, when opened, lowers the car at leveling speed during emergencies.
- Down Stop    1. The down slow solenoid de-energizes, stopping all flow to the tank and stopping the car.
2. Pressure from the jack and the spring causes the piston to close. See Figure 13.
3. The down stop adjustment controls the rate of closing and the smoothness.

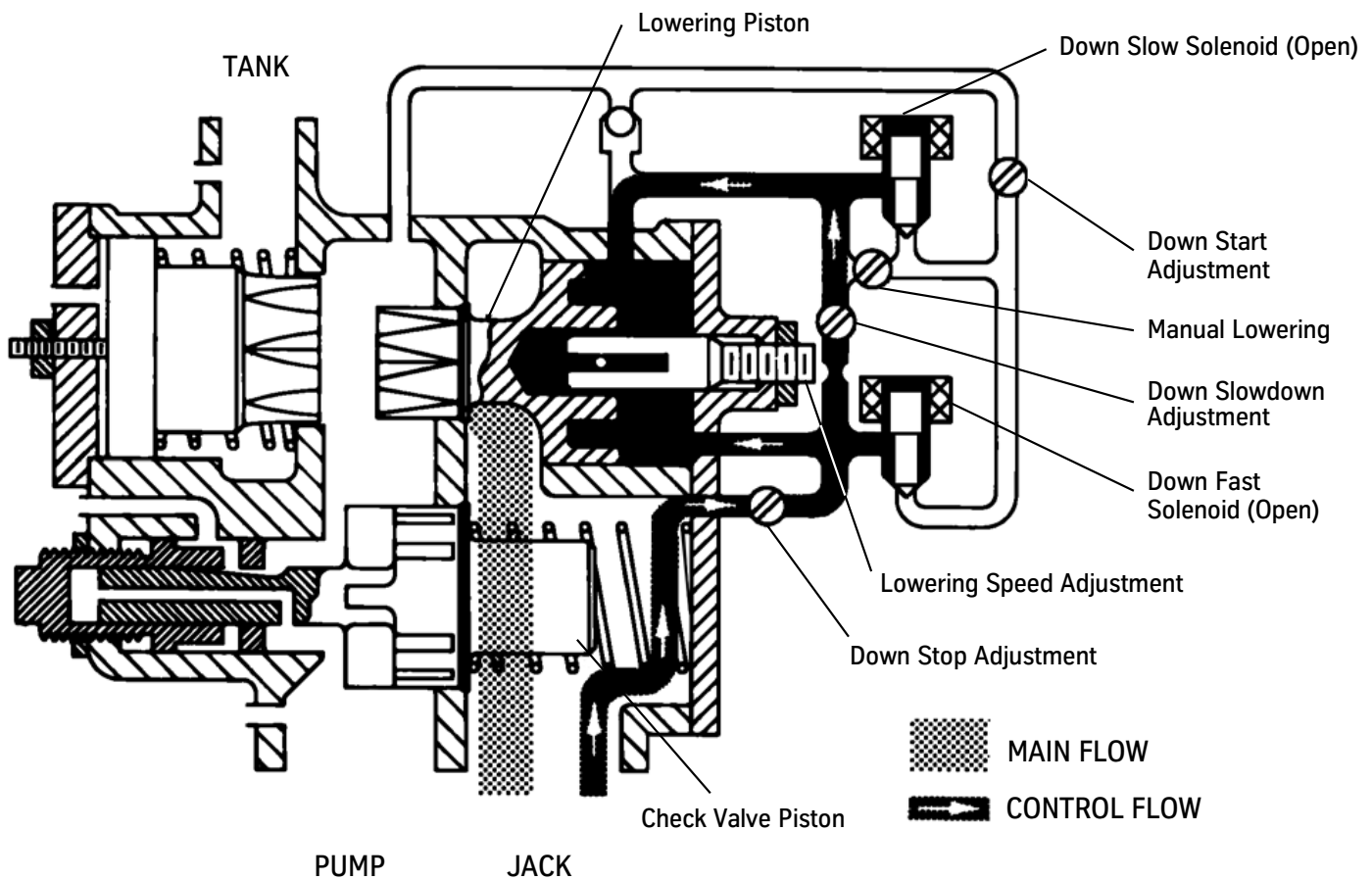


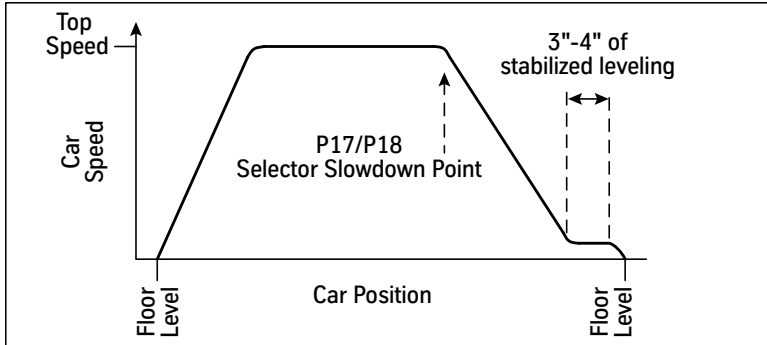
Figure 13 - Down Stop Diagram



## Quick Reference

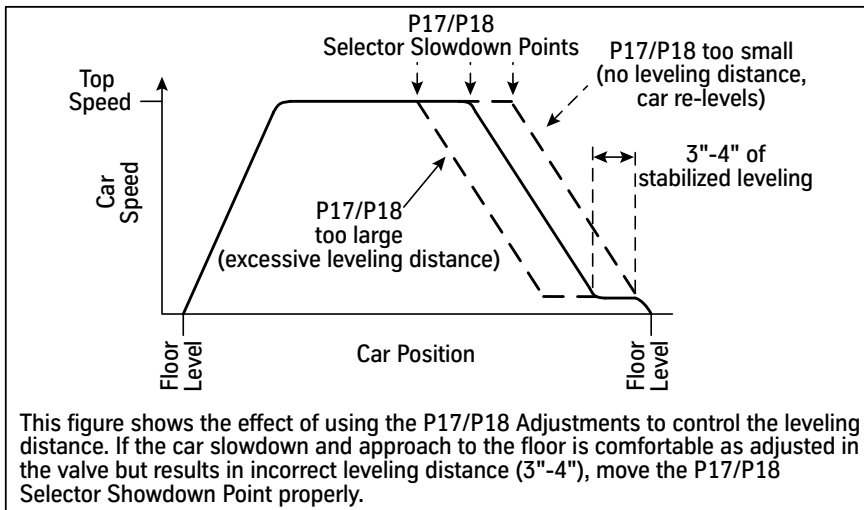
### Slowdown and Floor Approach

This illustration explains the effects of slowdown point and rate adjustments on car stabilized leveling distances. These adjustments should be referenced as needed, specifically during final valve adjustments or subsequent service calls.

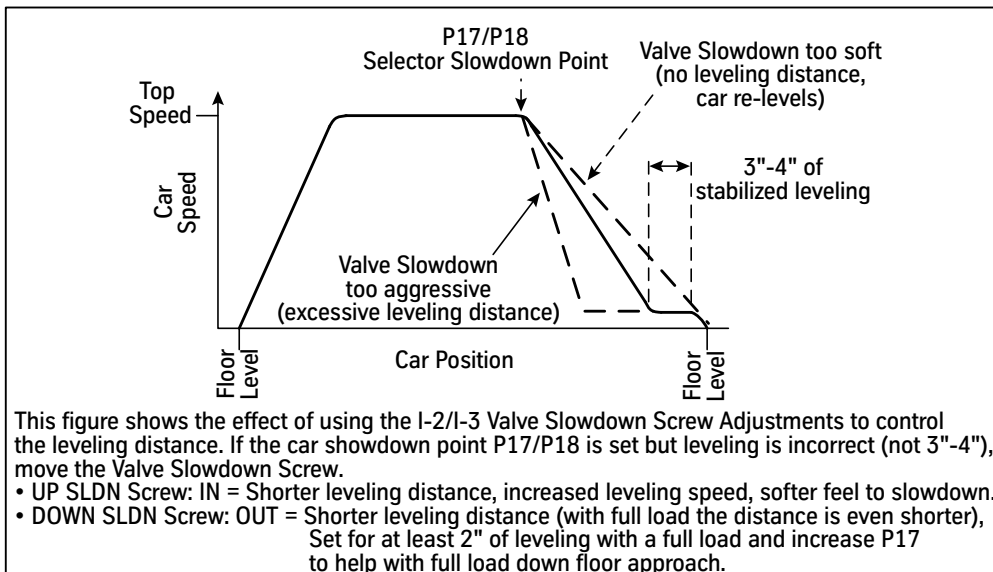


This figure shows the requirement of 3"-4" of leveling distance. If the car slowdown and approach to the floor results in longer leveling than 3"-4", car performance and fluid could degrade due to unnecessary fluid heating.

Use either of these:  
 • IMS: DSL Command  
 • UIT: Motion Quick CMD > Stabilized Leveling Readout



This figure shows the effect of using the P17/P18 Adjustments to control the leveling distance. If the car slowdown and approach to the floor is comfortable as adjusted in the valve but results in incorrect leveling distance (3"-4"), move the P17/P18 Selector Showdown Point properly.

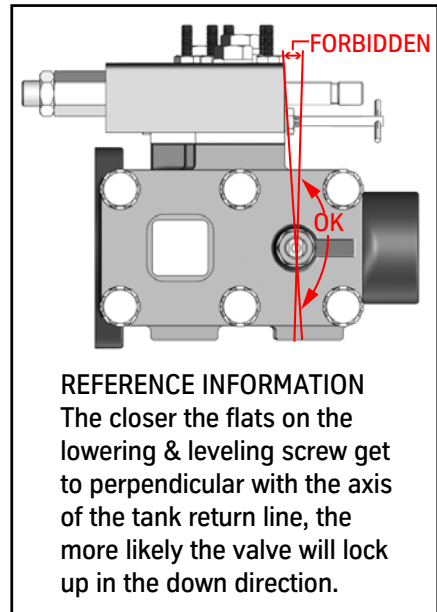
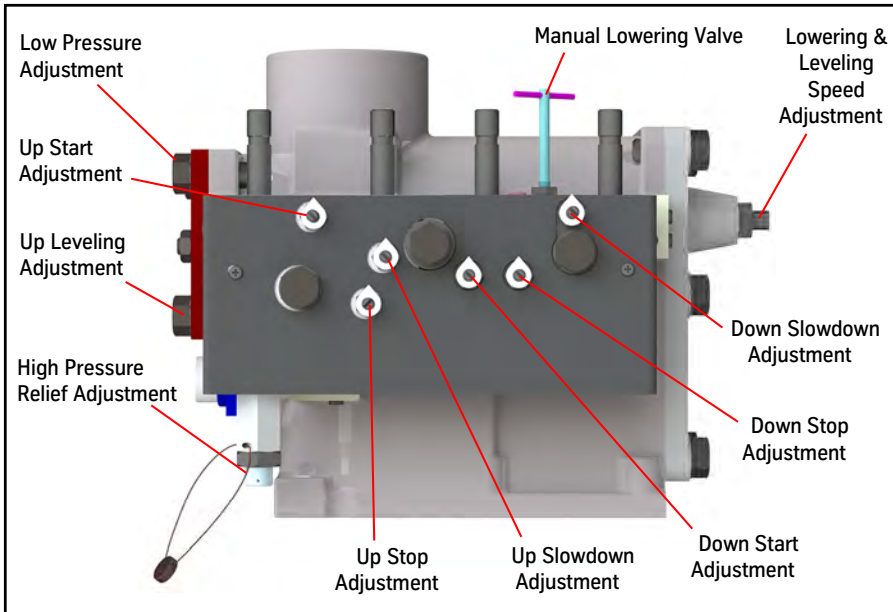


This figure shows the effect of using the I-2/I-3 Valve Slowdown Screw Adjustments to control the leveling distance. If the car slowdown point P17/P18 is set but leveling is incorrect (not 3"-4"), move the Valve Slowdown Screw.  
 • UP SLDN Screw: IN = Shorter leveling distance, increased leveling speed, softer feel to slowdown.  
 • DOWN SLDN Screw: OUT = Shorter leveling distance (with full load the distance is even shorter), Set for at least 2" of leveling with a full load and increase P17 to help with full load down floor approach.

Quick Reference

(continued)

Complete Valve Setup



**REFERENCE INFORMATION**  
 The closer the flats on the lowering & leveling screw get to perpendicular with the axis of the tank return line, the more likely the valve will lock up in the down direction.

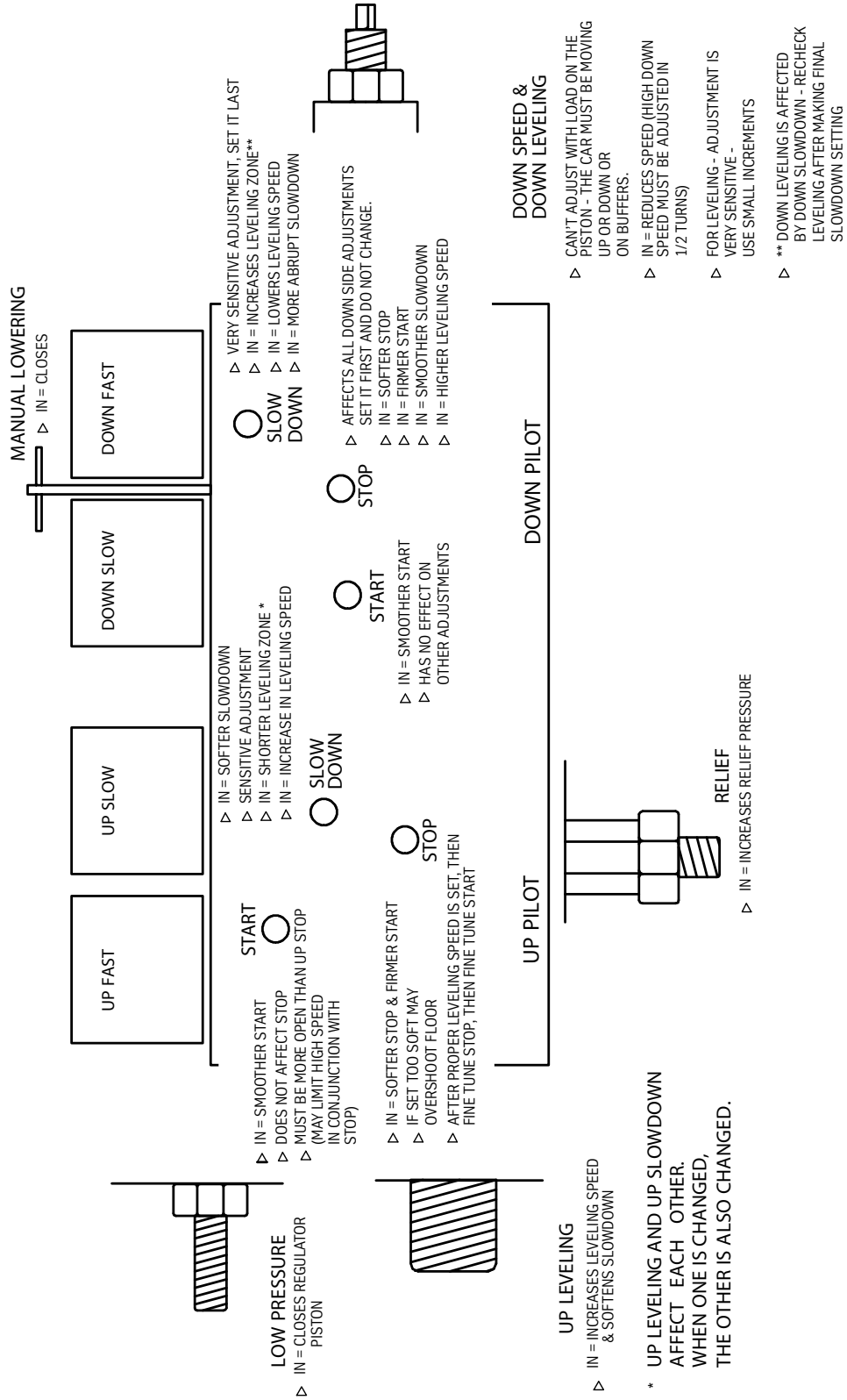
NOTES	ADJ. NAME	PRELIMINARY SETTINGS
1. Make adjustments with the car empty. 2. Ensure system has at least 90 PSI static pressure before adjusting. 3. Do not adjust the valve unless oil temperature is between 80° - 110° F. 4. Do not attempt to adjust the Lowering and Leveling Screw unless the car is moving or resting on the buffer stands with pressure off the lowering piston, or valve damage may result. 5. Leveling speed and zone adjustments are sensitive and may require multiple attempts. 6. After completing final adjustments, bleed the car down slightly with the manual lowering valve to see if it levels back up with the floor. If not, the slowdown adjustments need to be rechecked.	RELIEF	Appx. 5/8" out.
	LOW PRESSURE	Turn CCW until screw disengages from piston, then CW until resistance is felt, turn CCW an additional 3 turns.
	UP LEVELING	Turn CCW until the screw stops, then CW 2 turns.
	UP STOP	Turn CW until the screw stops, then CCW 2 turns.
	UP SLOWDOWN	Turn CW until the screw stops, then CCW 4 turns.
	UP START	Turn CW until the screw stops, then CCW 3 turns.
	DOWN START	Turn CW until the screw stops, then CCW 6½ turns.
	DOWN STOP	Turn CW until the screw stops, then CCW 6 turns.
	DOWN SLOWDOWN	Turn CW until the screw stops, then CCW 5¾ turns.
	LOWERING & LEVELING	Turn CW until the screw stops, then CCW 3 turns.
MANUAL LOWERING	Turn CW until the screw stops (closed).	

ADJ. NAME	PRELIMINARY ADJUSTMENTS
LOW PRESSURE	<b>Make this adjustment before any other!</b> Disconnect both UP solenoids (disconnect CON15 on IOF) and activate the pump (the car should not move at this point). SLOWLY turn the low pressure screw CW until the car begins to move, then CCW until it just stops. For 95 GPM pumps and lower, turn CCW an additional ¼ turn. For over 95 GPM pumps, turn CCW an additional ½ turn. Turn off the pump, tighten the lock nut, and reconnect both solenoids. No further adjustment should be necessary on low pressure. Turning CW closes the regulator piston.
RELIEF	<b>Never operate above 600 PSI!</b> Open the manual lowering valve slightly, shut off the valve to the jack line, and run the car up on Machine Room Inspection. Turn the relief screw CW to increase pressure or CCW to reduce pressure. Close the manual lowering valve, and recheck the pressure. Adjust the relief screw as necessary. Stop the run, vent pressure with the manual lowering valve, and open the shutoff valve.

Quick Reference  
(continued)

Valve Adjustment Effects

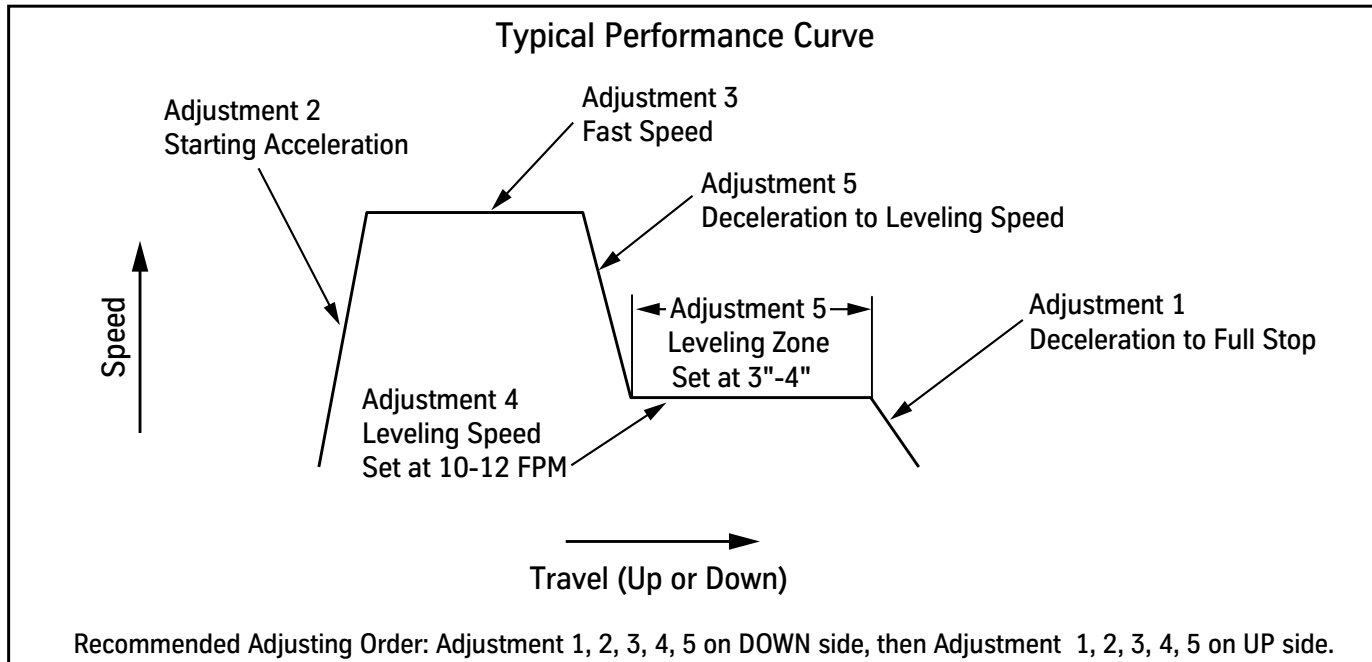
VALVE ADJUSTMENT EFFECTS



Quick Reference

(continued)

Final Adjustments



Adjustment		Effect On Performance		Notes
No.	Name	CW	CCW	
1	Down Stop	Softer stop, firmer start, faster leveling	Firmer stop, softer start, slower leveling	Set first, then leave alone. Affects other Down adjustments.
	Up Stop	Softer stop, firmer start	Firmer stop, softer start	Set before Up Start. Too soft will allow car to overshoot.
2	Down Start	Softer start	More abrupt start	Must be more open (CCW) than Down Stop. Increase CCW if full speed cannot be achieved on one-floor run.
	Up Start	Softer start	More abrupt start	Must be more open (CCW) than Up Stop. Increase CCW if full speed cannot be achieved on one-floor run.
3	Lowering & Leveling*	Reduce fast lowering speed	Increase fast lowering speed	Adjust in roughly 1/2 turn increments.
	Up Fast	N/A	N/A	No adjustment. Set by pump capacity.
4	Lowering & Leveling*	Reduce leveling speed	Increase leveling speed	Adjust in less than 1/8 turn increments. Hold screw to tighten locknut so settings don't change. Very sensitive.
	Up Leveling	Increase leveling speed, softer slowdown	Decrease leveling speed, firmer slowdown	May affect UP Slowdown.
5	Down Slowdown	Increase leveling zone, firmer slowdown	Decrease leveling zone, softer slowdown	Very sensitive. Must find "sweet spot" of about 1/8 turn range to affect adjustment. Affects Down Leveling.
	Up Slowdown	Decrease leveling zone, softer slowdown, increase leveling speed	Increase leveling zone, firmer slowdown, decrease leveling speed	Very sensitive. More CCW gives more abrupt slowdown. Affects Up Leveling.

\* If the valve locks up in the down direction due to the orientation of the flats on the lowering and leveling screw, run the car up, and change the orientation of the screw 90° while the car is moving to restore function.





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