GENERAL DESCRIPTION

NOTE:
This section only covers the pneumatic components of the braking system.
For information on the mechanical components of the braking system, such as linings, pads or discs, see sections 04:ZF FRONT AXLE OR 05:ZF REAR AXLE.
For information on the pneumatic supply system, see section 08-000: AIR SUPPLY SYSTEM in this manual.

Conforming to automotive vehicle safety standards, all Nova Bus LFS models are equipped with two separate braking systems:
1. The compressed-air braking system (service or foot brake), consisting of a primary system for the application of the rear brakes and a secondary system for the application of the front brakes.
2. The compressed-air spring-brake system (parking and emergency brake).

OPERATION

NOTE:
This heading applies to the 40 ft. Nova LFS vehicle. For information on the operation of the braking system for the Nova LFS Articulated vehicle, see the annex at the end of this section.

COMPRESSED-AIR BRAKING SYSTEM

See Figure 1 for the schematic that shows the principles of the compressed-air braking system. See the Nova LFS PARTS MANUAL for a detailed schematic of the braking system.

The compressed-air braking system governs the application of the service brakes. A primary braking system and a secondary braking system permit the simultaneous application of the service brakes for the front and rear axles.

In the event of a failure in one of the systems, the remaining system can operate independently and control the failed circuit, in order to engage the emergency braking mode.

In order to reduce the number of connections, and thus minimize the potential for leaks, the front and rear relay valves are mounted with the ABS valves in the form of modules. These are referred to as FAM (Front Axle Module) for the front axle and RAM (Rear Axle Module) for the rear axle.

Each braking circuit is connected to a transducer, installed on one of the Actia control modules, in order for a warning to be given whenever the pressure in the circuit falls below a predetermined safe limit for the operation of the braking system.

When the service brakes are applied, compressed air in the secondary circuit activates a pressure switch that lights up the brake lights through the multiplex system. The primary circuit transducer serves the same purpose in the primary braking circuit.

PRIMARY COMPRESSED-AIR BRAKING SYSTEM

The primary reservoir continuously supplies the input port of the relay valve ATR-3/R-15 of the RAM. When the brake pedal is pressed, the upper section of the E-10 brake valve opens. This action sends a pneumatic signal from the primary reservoir to the pilot port of the relay valve.

When the relay valve receives the signal from the E-10 valve, the input port opens and compressed air is sent to the rear brake chambers via the ABS modulator valve, proportionally to the signal received.

In order to reduce the response time for the application of the rear brakes, the relay valve ATR-3/R-15 sends compressed air to the brake chambers at a high flow rate.

When the operator releases the brake pedal, the air from the pilot is then exhausted through the exhaust port of the E-10 brake pedal valve. At the same time, air from the rear brake chamber is exhausted from the relay valve’s exhaust port. This operation releases the rear brakes.

BRAKE INTERLOCK

The brake interlock device is used as a security measure whenever the vehicle kneels, whenever the ramp is deployed or whenever the rear doors are opened, in order to prevent the vehicle from moving.

A pre-adjusted pressure regulator is installed at the front of the vehicle to create a moderated brake pressure of 50 ±5 psi (345 ±35 kPa) to the pilot port of the ATR-3/R-15 relay valve.
Figure 1 - Principle of Primary and Secondary Service Brake Circuits

1. PRIMARY BRAKING CIRCUIT (WITH INTERLOCK)
2. SECONDARY BRAKING CIRCUIT
3. PARKING AND EMERGENCY BRAKING CIRCUIT
4. PRIMARY BRAKING CIRCUIT (WITH INTERLOCK)
5. SECONDARY BRAKING CIRCUIT
6. PARKING AND EMERGENCY BRAKING CIRCUIT

NOTE: Transducer #4 in the primary circuit also activates the brake lights.
Whenever the ramp is deployed, the rear door is open or the vehicle kneels, the command from the interlock solenoid, which is normally closed, receives a signal from the multiplex system and opens to allow air to pass from the regulator to the relay valve. The ATR-3/R-15 valve then supplies the rear brake chambers.

The brake interlock is deactivated when the rear door is closed or locked, whenever the ramp is retracted and when the vehicle is at normal operating ride-height.

In case of emergency, the circuit may be manually deactivated by switching the emergency interlock override, located above the operator’s seat.

SECONDARY COMPRESSED-AIR BRAKING SYSTEM

The secondary braking system applies the front wheel service brakes through the front brake chamber.

Whenever the operator presses the brake pedal, the lower portion of the E-10 brake valve opens. This action allows compressed air to pass directly from the secondary reservoir to the inlet port of the QR-1 valve in the FAM, the function of which is to send compressed air to the front brake chambers at a high flow-rate, thus reducing the response time for brake application.

The QR-1 valve then sends air proportionally, directly from the E-10 brake valve, to the front brake chamber, via the ABS modulator valve.

When the operator releases the brake pedal, the air from the pilot is then exhausted through the exhaust port of the E-10 brake pedal valve. At the same time, air from the front brake chamber is exhausted from the QR1 valve’s exhaust port. This operation releases the front brakes.

COMPRESSED-AIR SPRING-BRAKE SYSTEM

See Figure 2 for the schematic showing the principles of the compressed-air spring-brake system. See the Nova LFS PARTS MANUAL for a detailed schematic of the braking system.

When the spring-brakes are applied, compressed air activates a pressure switch that lights up the brake lights through the multiplexing system. Also, the circuit is connected to a transducer, installed on the Actia control module, in order for a warning to be given whenever the pressure in the circuit falls below a predetermined safe limit for the operation of the braking system.

PARKING BRAKE

See Figure 3 for a schematic illustrating the operation of the spring-brake chambers.

Under normal operating conditions, the rear chamber springs are compressed by the amount of air pressure provided by the primary or secondary reservoirs. The choice of reservoir is determined by a double anti-return valve that allows the passage of air from the reservoir having the highest pressure, while simultaneously blocking access from the other reservoir.

Compressed air is routed toward the rear spring-brake chambers by way of the brake release valve to release the emergency brake. The air passes through a QR-1C valve, which sends the air at a high-flow rate to the rear brake chambers.

To apply the parking brake, the operator pushes on the button of the parking brake valve to cut the supply of air to the QR-1C valve. At this point, the piston in the QR-1C valve rises, the air in the brake chambers purges through the exhaust port and the pressure of the spring on the stem in each brake chamber starts the braking. The parking brake is fully applied once the air has been completely evacuated from the brake chamber.

To release the parking brake, the operator pulls on the button of the parking brake valve to reestablish the air supply to the QR-1C valve.

The QR-1C valve also ensures a balancing function that permits an automatic release of the parking brake when a request from the service brake is made. A line is connected directly from the discharge port of the ATR-3/R-15 valve of the RAM to the balance port of the QR-1C valve. Thus, when the request from the service brake is made, air pressure is sent to the rear brake chambers and the parking brake is released.

EMERGENCY BRAKE

When the pressure in the circuit reaches approximately 60 psi (414 kPa), the force exerted by the air pressure on the brake chamber diaphragm is decreased and the spring begins to decompress; then the parking brake begins to apply without any action from the driver. At approximately 30 psi (207 kPa), the release valve of the emergency brake opens and air is completely exhausted from the circuit. As soon as the pressure reaches 0 psi (0 kPa), the parking brake is completely applied.

If the vehicle must be moved to a secure place following the application of the emergency brake, the brake must be released. Depending on the chosen option, the operator either pushes or pulls on the button of the emergency brake release valve, while simultaneously pulling on the button of the parking brake valve. This action opens the passage to the compressed air of the emergency reservoir and reestablishes the supply of air to the QR-1C valve in order to supply the spring brake chambers. The springs are then compressed by the air pressure and the emergency brake is immediately released. No additional pressure on the valves is required to maintain the brakes in a released state.
Figure 2 - Principle of the Parking and Emergency Braking System
To reapply the emergency brake, the emergency brake release valve and the parking brake valve must be returned to their initial positions.

**WARNING:**
The air supply for emergency spring brake release is supplied ONLY from the emergency reservoir. The amount and the air pressure in the reservoir only permits three applications for release of the parking brake.

**WARNING:**
Even though the emergency spring brake release permits the vehicle to be removed to a safe place, it is not recommended to continue driving the vehicle that is experiencing a significant loss of pressure.
TO MANUALLY RELEASE THE PARKING BRAKE

In the case of a complete loss of air in the emergency reservoir, it is still possible to manually release the parking brake. The release bolt can be accessed through a trap door located on the rear wheelhouses. The bolt release procedure is relatively simple, since the bolt is already screwed-in the brake cylinder housing in its normal position, thus protecting it from corrosion and dirt.

**WARNING:**

Before releasing the brakes, block the wheels to prevent any movement of the vehicle.

1. Raise the vehicle.

**NOTE:**

For additional information, see section 18: HOISTING AND TOWING in this manual.

2. To release the brake cylinder unscrew the release bolt completely.
3. Before returning the vehicle to normal service, ensure that this release bolt is returned to its normal screwed-in position.

**NOTE:**

For more information on the manual releasing of the brakes, see the ZF and Knorr-Bremse maintenance manual.

BRAKE TESTS

**NOTE:**

A Tapley Brake Meter, or an equivalent, is required to perform all the following braking tests. See Figure 4.

**NOTE:**

Before performing the tests make sure air pressure is greater than 100 psi (689 kPa) (check the dashboard) and that the tire pressure meets the manufacturers recommendations.

SERVICE BRAKE TEST

Current safety standards require that the service brakes are capable of keeping the vehicle stationary on an incline of 65%, regardless of whether the vehicle is facing uphill or downhill. The standards are applicable to the Gross Vehicle Weight Rating (GVWR) and for its curb weight.

1. Install the Tapley brake meter (or equivalent) at the front of the vehicle near the operator’s area. Make sure that the brake meter is installed horizontally and facing forward.
2. Once the meter is installed, set the lever to FREE. The indicator should display 0. Next, set the lever to TEST.

ABS/ATC SYSTEMS

To increase the safety of braking during operation, Nova LFS vehicles are equipped with an ABS system on the front and rear wheels. The FAM module contains the front ABS valves and the RAM module contains the rear ABS valves. The modular configuration of the valves affords better protection against dirt and splashing. Additionally, for even more protection, the RAM is housed in a protective enclosure.

During braking in service, wheels can lock up. The ABS manages the application of brakes in service in order to modulate braking and maintain control of the vehicle.

In addition, during slippery driving conditions, when the vehicle is accelerating, the ATC, integrated in the ATR-3/R-15 valve within the RAM, may activate the rear brakes. The ATC system is activated when the speed difference between each set of rear wheels reaches 15%. The ATC system activates the rear ABS valves, to regain traction.

For more information on the ABS and ATC systems, see section 08-224: ANTILOCK BRAKING SYSTEMS.

Figure 4 - Tapley Brake Meter
3. Check the braking efficiency.

**NOTE:**
When a service brake test is carried out using the Tapley brake meter, the vehicle must be traveling at a speed of 30-35 km/h. The efficiency must be a minimum of 65%. If this is not the case, try to obtain this figure by adjusting the pressure regulator. For more information on the regulator and its adjustment, see the heading AIR PRESSURE REGULATOR in this section.

**NOTE:**
If the wheels lock on a wet or slippery road surface and the reading is below 65%, the test must be performed again on a dry roadway.

4. If the brakes need adjusting, perform another test after adjustment.

**NOTE:**
The performance figures of the air brake test report apply to the LFS vehicle. This test report is available on request from Nova Bus Customer Service.

### PARKING BRAKE TEST

Current safety standards require that the parking brake are capable of keeping the vehicle stationary on an incline of 20%, regardless of whether the vehicle is facing uphill or downhill. The standards are applicable to the Gross Vehicle Weight Rating (GVWR) and for its curb weight.

1. Install the Tapley brake meter (or equivalent) at the front of the vehicle near the operator’s area. Make sure that the brake meter is installed horizontally and facing forward.
2. Once the meter is installed, set the lever to **FREE**. The indicator should display 0. Next, set the lever to **TEST**.

### BRAKE INTERLOCK TEST

1. Install the Tapley brake meter at the front of the vehicle near the operator’s area. Make sure that the Tapley brake meter is installed horizontally and facing forward.

**NOTE:**
Once the meter is installed, set the lever to **FREE**. The indicator should display 0. Next, set the lever to **TEST**.

2. Drive the vehicle.

**NOTE:**
When testing the brake interlock, the vehicle must be traveling at a minimum speed of 3-5 mph (5-8 km/h).

3. Activate the switch. The brake interlock should apply.
4. If the brake interlock requires adjustment, make the adjustment, then perform a further test.
BRAKING SYSTEM COMPONENTS

TWIN BRAKE-APPLYING VALVE (TYPE E-10)

For information on the operation, the verification and the maintenance of the E-10 valve, see the manufacturer’s documentation.

PARKING BRAKE CONTROL VALVE

See Figure 5.

REMOVAL

1. Block the wheels in order to prevent any motion of the vehicle when compressed air is released from the system.
2. Release air from the system.
3. Open the access panel on the operator’s left-hand side, to gain access to the valve lines.
4. Identify air lines in order to facilitate reassembly. Disconnect the lines.
5. Loosen the locking nut from the control button. Unscrew the button, then remove the locking nut.
6. Unscrew the retaining bolts holding the valve to the instrument panel.

INSTALLATION

1. Repeat the above operations in the reverse order for the control valve installation.
2. Pressurize the vehicle’s pneumatic system.
3. Check the valve for proper operation and for leaks.

EMERGENCY BRAKE RELEASE VALVE

See Figure 6.

REMOVAL

1. Block the vehicle’s wheels before proceeding with the braking system maintenance.
2. Completely drain air from all supply reservoirs.
3. Open the access panel on the operator’s left-hand side, to gain access to the valve lines.
4. Identify, mark and disconnect all valve lines.
5. Unscrew and remove the button.
6. Unscrew the retaining bolts holding the valve to the instrument panel.

INSTALLATION

1. Repeat the above operations in the reverse order for the control valve installation.
2. Pressurize the vehicle’s pneumatic system.
3. Check the valve for proper operation and for leaks.

---

Figure 5 - Parking Brake Valve

Figure 6 - Emergency Release Valve
FRONT BRAKE CHAMBERS

See Figure 7.

A pneumatic brake chamber, located at each front wheel, transforms the compressed-air energy into the mechanical power that is necessary for applying the brakes. The front brake chamber, attached to the axle, activates an internal lever, which in turn, applies or releases the front disk brakes. For more information on the mechanical operation of the front brakes, see section 04: FRONT AXLE, in this manual.

REMOVAL

⚠️ CAUTION:
Block the vehicle’s wheels before removing the brake chambers from the vehicle.

1. Completely drain air from all supply reservoirs. All hoses must be cleared of air.

⚠️ WARNING:
Before attempting any work on pneumatic system components, and in order to prevent injury, release air pressure from the system by opening the discharge valves from all air reservoirs.

2. Hold the hose fitting nut with a wrench while unscrewing the adaptor out of the fitting or elbow in the brake chamber.

3. If a new brake chamber must be installed, remove the adaptor fitting or elbow for future installation on the replacement part.

4. Loosen, remove and dispose of both retaining bolts from the brake chamber. Use new bolts during reinstallation.

5. Remove the brake chamber.

INSTALLATION

⚠️ CAUTION:
Ensure to block the vehicle’s wheels before installing the brake chambers.

1. Apply white grease, such as Renolit HLT2, or equivalent, to the spherical cup in the lever, before mounting the replacement unit. See Figure 8.

⚠️ CAUTION:
Do not use grease containing molybdenum disulphate.

2. Position the brake chamber at the disc brake flange and install retaining bolts. Torque to 100 to 115 lb-ft (135 to 156 N•m), using a hand wrench. Do not use an impact wrench.

3. Install the adaptor fitting in the brake chamber. Ensure proper alignment of the air inlet ports and the vehicle’s air supply hoses. Do not use any shims or spacers.
4. Connect the hose as follows:
   a. Screw the adaptor in the fitting or the elbow while firmly holding the hose-fitting nut with a wrench.
   b. Install the hose in the brake chamber, ensuring that there are no bends or kinks in the line.
   c. Apply a torque of 25 to 30 lbs-in. (34 to 41 N•m) to the air hose fittings.

5. Start the vehicle and recharge the pneumatic system until a minimum pressure of 100 psi (689.5 kPa) has been reached.

6. Test the brake chamber as described under the heading NORMAL CONDITION OPERATIONAL TESTS, in section 08-000: AIR SUPPLY SYSTEM in this manual.

REAR BRAKE CHAMBERS

See Figure 9.

The rear brake chambers are comprised of two sections, one standard section for the primary braking circuit for the service brakes and one spring section for the parking and emergency braking circuit.

REMOVAL

CAUTION:
Block the vehicle’s wheels before removing the brake chambers from the vehicle.

1. Release the parking brake.
2. Unscrew the release bolt with a maximum torque of 26 lb-ft (35 N•m).
3. Completely drain air from all supply reservoirs. All hoses must be cleared of air.

WARNING:
Do not attempt to repair the brake actuator because of inner sealing. Use only approved replacement units.

WARNING:
Do not attempt to open a brake chamber. Disassembling the brake chamber can cause injuries, due to the tension of its powerful spring. In order to prevent injuries, all discarded brake springs should be released in a safe manner.

INSTALLATION

CAUTION:
Block the vehicle’s wheels before installing the brake chambers on the vehicle.

1. Replacement units have drain plugs installed. Remove the bottom drain plugs only. All other drain holes should be plugged.
2. Before installing the new unit, the sealing surfaces must be cleaned. Apply white grease, such as Renolit HLT2, to the spherical cup in the lever, before mounting the replacement unit. See Figure 7.

CAUTION:
Do not use grease containing molybdenum disulphate.

Figure 9 - Rear Brake Chamber (Typical)
3. Install the brake chamber with new nuts and torque to the values indicated in Figure 9. Use a hand wrench. Do not use an impact wrench.

4. Connect the hoses as follows:
   a. Screw the adaptor in the fitting or the elbow while firmly holding the hose-fitting nut with a wrench.
   b. Install the hose in the brake chamber, ensuring that there are no bends or kinks in the line.
   c. The air hose fittings should be torqued to 25 to 30 lbs-in. (34 to 41 N•m).

5. Release the parking brake.

6. Move the hand control valve to the RUN position and check for any leakage.

7. Torque the brake chamber release bolt as indicated in Figure 9.

8. The fitting screw must always be mounted on the left and right output side in the driving direction (front side). (See Figure 9). Ensure that the installation position of this fitting screw is correct.

9. Start the vehicle and recharge the pneumatic system up to a minimum pressure of 100 psi (690 kPa).

10. Verify the pneumatic system’s circuit as described under the heading NORMAL CONDITION OPERATIONAL TESTS in section 08-000: AIR SUPPLY SYSTEM in this manual.

DOUBLE ANTI-RETURN VALVE

See Figure 10.

Two double anti-return valves are installed in the vehicle’s braking system. One is connected to the interlock solenoid, at the front of the vehicle and the other is installed on the secondary reservoir.

The valves must be inspected every 6 months, or less, depending on operating conditions.

LEAK TEST

1. Disconnect the valve at one of the air input ports.
2. Apply soapy water to the open ends of the anti-return valve and apply air pressure to the opposite air input port. The appearance of a bubble of more than 1 in. (2.5 cm) in 5 seconds indicates an excessive leak.
3. If a leak is observed, remove and clean the valve. If no leak is evident, reconnect the valve and repeat on the opposite air input port.

REMOVAL

To disassemble the anti-return valve, unscrew the cap at each valve end and remove the seals, the ball and the sleeve.

CLEANING

1. Immerse all parts in solvent for cleaning, except seals and linings.
2. Wipe or dry parts with compressed air.
3. Inspect all parts and check for wear and burrs. Replace with new parts if necessary.

ASSEMBLY

1. Place the sleeve and the ball in the body, and then place the seals.
2. Position the seals on the caps and screw the caps in the body.
3. Tighten the caps securely.

QUICK-RELEASE VALVE — QR-1

For information on the operation, the verification, the maintenance and the installation of the QR-1 valve, see the manufacturer’s documentation.
QUICK RELEASE VALVE/ DOUBLE ANTI-RETURN — QR-1C

For information on the operation, the verification, the maintenance and the installation of the QR-1C valve, see the manufacturer’s documentation.

AIR PRESSURE REGULATOR

The air-pressure regulating valve sets the air pressure at 45 - 55 psi (310 - 380 kPa) for the rear service brakes. The allowable pressure through the valve should be checked periodically with a pressure gauge.

AIR PRESSURE CHECK

See Figure 11.
1. Connect the pressure gauge to the reduced pressure line fitting, or to the rear brake line. Then apply air pressure to the valve inlet. The pressure should be 45 - 55 psi (310 - 380 kPa).
2. To adjust the regulator, Loosen the lock-nut, then turn the adjustment screw until the correct pressure is shown on the gauge. If the check does not indicate the correct pressure, inspect the diaphragm and replace it if necessary, as described under the heading DIAPHRAGM REPLACEMENT.

DIAPHRAGM REPLACEMENT

The diaphragm can be replaced without a complete disassembly of the valve and without disturbing the pressure adjustment. See Figure 12.
1. Cut off air supply to the pressure-regulating valve by disconnecting the full pressure line.
2. Turn the ring nut until the pressure-regulating valve can be removed.
3. The diaphragm becomes exposed. The diaphragm support and the plate should be loosened.
4. Replace the diaphragm if damaged.
5. Insert the support (14) in the spring. Place the supporting plate above the diaphragm.
6. Pass the cover through the torquing collar (13).
7. Screw the ring nut on the body. Turn until tight.
8. Reconnect the full pressure line and proceed with the reduced pressure check.

VALVE REPLACEMENT

1. Release pressure from the vehicle’s pneumatic system.
2. Remove the dashboard panel.
3. Remove the screws fastening the valve assembly to the floor.
4. Support the valve assembly and disconnect the supply line by pulling it down through the floor. The valve can then be unscrewed from the magnetic valve fitting.
5. Apply a small quantity of Permatex or an equivalent product on line fitting threads when installing the valve.
6. Tighten fittings.

Figure 11 - Pressure Regulator

Figure 12 - Pressure Regulator
VALVE DISASSEMBLY

See Figure 12.
1. Disassemble the unit by unscrewing the ring nut. The diaphragm support and the support plate may then be removed.
2. Remove the lock-nut. Remove the adjustment screw. The spring may then be removed.
3. If the plunger or the spring must be replaced, remove the ring. The plunger, the spring and the seal may then be removed.

VALVE ASSEMBLY

1. Place the plunger and the seal in the body. Apply a small quantity of Special Lubricant (S-17) on the plunger before reassembling.
2. Install the spring, the washer and the ring. Check if the washer and spring operate properly.
3. Insert the spring in the adjustment screw.
4. Turn the adjustment screw in the body. Insert the membrane support in the spring lower end.
5. Install the diaphragm into position. Place the diaphragm support plate on the diaphragm.
6. Place the cover and the springs on the diaphragm. Firmly tighten the ring nut.
7. Install the lock-nut. Do not tighten at this stage.
8. Check reduced pressure operation by connecting the air supply line to the full pressure fitting and by connecting the pressure gauge to the reduced pressure fitting.
9. Turn the end cap of the adjustment screw until the pressure in the pressure-regulating valve reaches 45 - 55 psi (310 - 380 kPa). Tighten the cover end nut after the pressure adjustment is complete.

MAGNETIC BRAKE-LOCK VALVE

See Figure 13.

MAINTENANCE

Foreign matter or particles present in the compressed-air system may enter the magnetic valve and damage contact surfaces and valve seats to such an extent that air leaks may result.

The magnetic valve test can easily be performed at a test bench or with the valve installed on the vehicle. Test by applying a soapy solution on all joints and watching for air bubbles when the valve is actuated. A sticking or leaking valve should immediately be removed and repaired or replaced as needed.

DISASSEMBLY

1. Remove screws (1), then lift the coil section of the unit.
2. Remove the spacer (9) from the valve body (13). Remove the valve shutter (10) and the spring (11).
3. Wipe up and carefully inspect all components.
4. Replace worn or damaged parts.
5. Immerse the valve body in solvent for cleaning.
6. Blow compressed air into the lines.
7. Clean and dry the plunger (5).
8. Check the seal condition (12) and replace if necessary.
ASSEMBLY

1. Insert the valve shutter (10) into the spacer (9).
2. Insert the spring in the valve body (13) and the seal.
3. Install the spacer, the coil and the case on the valve.
4. Install the plunger into position.
5. Install the cap and the terminal plate (7).
6. Tighten all screws equally until they are fully torqued.

GENERAL MAINTENANCE

The entire pneumatic system must be checked regularly to detect any leaks. See section 08-000: AIR SUPPLY SYSTEM in this manual for more information on general maintenance of the pneumatic system.

Table 1: PREVENTIVE MAINTENANCE GUIDE can serve as a quick reference for the elements of the system that require periodic maintenance.

This table is not an exhaustive list of all brake maintenance operations that are required. Also, it does not suggest that some of the more frequent inspections can be omitted. CORRECTIVE MAINTENANCE SHOULD BE INITIATED AS SOON AS THE BRAKING SYSTEM PERFORMANCE BECOMES UNSATISFACTORY. See Table 2: TROUBLESHOOTING GUIDE at the end of this section.

Intervals listed in the PREVENTIVE MAINTENANCE TABLE, must be considered according to the actual operating conditions of a specific vehicle. These intervals are recommended by the manufacturer and should be considered as maximum limits.

**NOTE**
Each time an assembly is removed and disassembled for maintenance, it is recommended to replace all grommets, seals, o-rings, etc., and any other worn or damaged part.

### PREVENTIVE MAINTENANCE GUIDE

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>INTERVAL (1)</th>
<th>MAINTENANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front brake chamber</td>
<td>Re lined brakes - 1 year</td>
<td>Remove, disassemble, clean, inspect.</td>
</tr>
<tr>
<td>Spring brake control</td>
<td>2 years</td>
<td>Disassemble, replace.</td>
</tr>
<tr>
<td>E10 brake valve</td>
<td>See manufacturer’s documentation</td>
<td>See manufacturer’s documentation</td>
</tr>
<tr>
<td>Emergency brake-releasing valve</td>
<td>3,600 hours - 160,000 km (100,000 mi) - 1 yr</td>
<td>Disassemble, clean, inspect.</td>
</tr>
<tr>
<td>Normal duty brake in ter lock ing valve</td>
<td>1,800 hours - 80,000 km (50,000 mi) - 6 months</td>
<td>Disassemble, clean, inspect.</td>
</tr>
<tr>
<td>QR-1 Valve</td>
<td>See manufacturer’s documentation</td>
<td>See manufacturer’s documentation</td>
</tr>
<tr>
<td>QR-1C Valve</td>
<td>See manufacturer’s documentation</td>
<td>See manufacturer’s documentation.</td>
</tr>
<tr>
<td>Quick-release valve</td>
<td>See manufacturer’s documentation</td>
<td>See manufacturer’s documentation.</td>
</tr>
</tbody>
</table>

(1) When two or more intervals are mentioned, the operation must be performed at the first interval.

(2) Depending on how severe the operating conditions.

Table 1 - Preventive Maintenance Guide
# NO BRAKING

<table>
<thead>
<tr>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No air pressure.</td>
<td>1. Check for leaks, broken lines, etc. Check for malfunction of air dryer and a blocked emergency valve. Repair or replace as required.</td>
</tr>
<tr>
<td>2. Blocked line or hose.</td>
<td>2. Replace faulty parts.</td>
</tr>
<tr>
<td>3. Faulty braking valve.</td>
<td>3. Repair or replace.</td>
</tr>
</tbody>
</table>

# INSUFFICIENT BRAKING

<table>
<thead>
<tr>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Primary and/or secondary system low line pressure.</td>
<td>1. Check for leaks in primary and/or secondary system, etc., and repair.</td>
</tr>
<tr>
<td>2. Excessive travel of push rod in brake chamber.</td>
<td>2. Adjust as required.</td>
</tr>
<tr>
<td>3. Worn brake pads or disks.</td>
<td>3. Replace as necessary.</td>
</tr>
<tr>
<td>4. Leaking brake chamber membrane.</td>
<td>4. Replace brake chamber</td>
</tr>
<tr>
<td>5. Badly adjusted slack adjusters.</td>
<td>5. Adjust as required.</td>
</tr>
<tr>
<td>6. Incorrect brake chamber installed.</td>
<td>6. Replace.</td>
</tr>
</tbody>
</table>

# SLOW BRAKING

<table>
<thead>
<tr>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Low brake line pressure.</td>
<td>1. Check for leaks etc. and repair.</td>
</tr>
<tr>
<td>2. Linkage hardware binding.</td>
<td>2. Lubricate the linkage.</td>
</tr>
<tr>
<td>3. Excessive travel of push rod in brake chamber.</td>
<td>3. Adjust.</td>
</tr>
<tr>
<td>4. Line restriction.</td>
<td>4. Eliminate restriction or replace line.</td>
</tr>
<tr>
<td>5. Leaking braking valve.</td>
<td>5. Repair or replace.</td>
</tr>
<tr>
<td>6. Worn brake pads or disks.</td>
<td>6. Replace as needed.</td>
</tr>
<tr>
<td>7. Leaking brake chamber membrane.</td>
<td>7. Replace brake chamber</td>
</tr>
<tr>
<td>8. Seized brake components.</td>
<td>8. Loosen, replace or lubricate as required.</td>
</tr>
<tr>
<td>10. Shaft rings binding or worn.</td>
<td>10. Lubricate or replace.</td>
</tr>
</tbody>
</table>

# SLOW BRAKE RELEASING

<table>
<thead>
<tr>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Binding linkage.</td>
<td>1. Lubricate the linkage.</td>
</tr>
<tr>
<td>2. Primary system failure - Emergency braking</td>
<td>2. Check primary system pressure.</td>
</tr>
<tr>
<td>3. Line restriction.</td>
<td>3. Eliminate restriction or replace line.</td>
</tr>
<tr>
<td>4. Excessive travel of pushrod in brake chamber.</td>
<td>4. Adjust</td>
</tr>
<tr>
<td>5. Incorrect braking valve collar.</td>
<td>5. Repair or replace.</td>
</tr>
<tr>
<td>6. Cames ou arbres à cames grippés.</td>
<td>6. Lubricate, if possible, or replace.</td>
</tr>
<tr>
<td>7. Weak springs.</td>
<td>7. Replace the springs.</td>
</tr>
</tbody>
</table>

# BRAKE BINDING

<table>
<thead>
<tr>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Grease or dirt on brake pads.</td>
<td>1. Clean or replace pads.</td>
</tr>
<tr>
<td>2. Weaving disk.</td>
<td>2. Turn or replace disk.</td>
</tr>
<tr>
<td>3. Faulty braking valve.</td>
<td>3. Repair or replace.</td>
</tr>
</tbody>
</table>

# UNEQUAL BRAKING

<table>
<thead>
<tr>
<th>PROBABLE CAUSE</th>
<th>CORRECTIVE ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Weak or broken brake pads.</td>
<td>2. Replace.</td>
</tr>
<tr>
<td>3. Faulty brake chamber.</td>
<td>3. Replace.</td>
</tr>
<tr>
<td>4. Faulty brake disk.</td>
<td>4. Replace.</td>
</tr>
<tr>
<td>5. Unequal springs in brake chambers or between brake pads.</td>
<td>5. Replace in pairs.</td>
</tr>
</tbody>
</table>

---

*Table 2 - Troubleshooting Guide*
OPERATION

COMPRESSED AIR BRAKING SYSTEM

See Figures 1A and 2A for a diagram illustrating the principle of the compressed-air braking system. See the Nova LFS PARTS MANUAL for a detailed illustration of the braking system.

The compressed-air braking system manages the application of the service brakes. A primary braking system and a secondary braking system permit the simultaneous application of the service brakes of the front, central and rear axles.

In order to decrease the number of connections and thus decrease the potential for leaks, the front, central and rear relay valves are installed with the ABS valves as modules, either a FAM module (Front Axle Module) for the front axle, a MAM module (Middle Axle Module) for the central axle or a RAM module (Rear Axle Module) for the rear axle.

Each braking circuit is connected to a transducer, installed on one of the Actia control modules, in order for a warning to be given whenever the pressure in the circuit falls below a predetermined safe limit for the operation of the braking system. In case of a breakdown in one of the systems, the system that remains operational will be able to function independently and take some load from the failed circuit, in order to maintain the integrity of the emergency braking.

When the service brakes are applied, compressed air in the secondary circuit activates a pressure switch that lights up the brake lights through the multiplex system. The primary circuit transducer serves the same purpose in the primary braking circuit.

PRIMARY COMPRESSED AIR BRAKING SYSTEM

The primary braking system of the articulated vehicle is divided into two interdependent circuits. The first circuit serves to supply the central brake chambers from the primary reservoir #1, located in the front section of the vehicle. The second circuit serves to supply the rear brake chambers from the primary reservoir #2, located in the rear section of the vehicle.

When the driver presses the brake pedal, the upper part of the E-10 double brake valve opens. This action sends an air signal from primary reservoir #1 to the inlet port of the QR-1 valve.

The QR-1 valve transmits the signal proportionally to the pilot port of the R-14 relay valve of the MAM module at a high flow rate, thus reducing the amount of response time for the application of the brakes.

The primary reservoir #1 continuously feeds the inlet port of the R-14 valve of the MAM module. When the R-14 valve receives the signal from the QR-1 valve, the inlet port opens and compressed air is sent from the primary reservoir #1 to the central brake chambers via the ABS modular valves, proportional to the signal received from the E-10 brake valve, at a high flow rate, thus reducing the response time for braking.

The air signal sent from the primary reservoir #1 to the QR-1 valve is transmitted simultaneously to the double relay valve. The primary reservoir #2 continuously supplies the inlet port of the double relay valve. When the double relay valve receives a signal, it opens the inlet port and compressed air from primary reservoir #2 is sent to the ATR-3/R-15 valve of the RAM module, proportional to the signal received, at a high flow rate, thus reducing the response time for the application of the rear brakes.

At the time of application of the service brakes, the secondary circuit also sends a signal to the double relay valve. In case of a loss of pressure of the primary system, this signal will indicate to the relay valve that a braking request has been made and the air from the primary air reservoir #2 must be sent to the rear brake chambers.

When the operator releases the brake pedal, the air in the pilot port is expelled via the exhaust port of the E-10 brake valve. At the same time as the exhaust port opens, compressed air from the brake chambers is exhausted from the R-14 relay valve’s exhaust port and air from the rear brake chambers is exhausted from the exhaust port of the ATR-3/R-15 valve. This operation releases the central and rear brakes, and deactivates the brake lights switch.

BRAKE INTERLOCK

See Figure 2A.

The brake interlock device is employed as a safety measure during kneeling of the vehicle, when the ramp is deployed, or when the rear doors are open, in order to prevent the vehicle from moving.

A pre-adjusted pressure regulator is installed in the front of the vehicle to apply a moderate braking pressure of 50 ±5 PSI (345 ±35 kPa) to the pilot port of the R-14 valve, and to the pilot port of the ATR-3/R-15 valve via the double relay valve.

When the ramp is deployed, the rear door is open or the vehicle kneels, the brake interlock, normally closed, receives a signal from the multiplex system and opens up to allow air to pass from the regulator toward the MAM module’s R-14 valve that supplies the central brake chambers, and then toward the ATR-3/R-15 valve of the RAM module that supplies the rear brake chambers.
Figure 1A – Schematic of the Principle Circuits of the Primary and Secondary Service Brakes (without Interlock)
Figure 2A - Schematic of the Principle Circuits of the Primary and Secondary Service Brakes (with Interlock)
The brake interlock is deactivated when the central and rear doors are closed or locked, when the ramp is retracted and when the vehicle is at its normal ride height. In case of an emergency, the circuit can be manually deactivated by engaging the interlock switch located in the upper left of the driver’s area.

AIR BRAKING SYSTEM

SECONDARY CIRCUIT

The secondary air braking system actuates the service brakes at the front wheels by means of the front brake chambers.

When the driver presses the brake pedal, the lower part of the E-10 brake valve opens up. This action moves compressed air from the secondary reservoir toward the inlet port of the FAM module’s QR-1 valve.

The QR1 valve then sends compressed air to the front brake chambers at a high flow rate, in order to reduce the brake application time, by way of the ABS valve module.

Air from the QR-1 valve is sent to the front brake chambers proportionally to the signal received from the E-10 brake valve.

At the time of the application of the service brakes, the secondary circuit sends a signal to the double relay valve. In case of a loss of pressure in the primary system, this signal will indicate to the relay valve that a braking request has been implemented and air from the primary air reservoir #2 must be sent to the rear brake chambers.

When the operator releases the brake pedal, air from the pilot port is then expelled by the opening of the exhaust port of the E-10 brake valve. At the same time, compressed-air from the front brake chambers is expelled from the exhaust port of the QR-1 valve. This operation releases the front brakes.

COMPRESSED AIR SPRING BRAKING SYSTEM

See Figures 3A and 4A for a schematic of the principles of the compressed air spring braking system. See the Nova LFS PARTS MANUAL for a detailed diagram of the braking system.

At the time of the spring brake application, the compressed air activates a pressure switch, which in turn, uses the multiplex system to illuminate the brake lights. Also, the circuit is connected to a pressure sensor installed in the Actia command module to give an alarm when the pressure in this circuit falls below a pre-set safety limit for operation of the braking system.

PARKING BRAKE

Under normal working conditions, the springs in the central and rear brake chambers are compressed by air pressure from the #1 primary reservoir or from the secondary reservoir. The selection of the reservoir relies on a double anti-return valve that allows air to flow from the reservoir having the greatest amount of pressure, while blocking the other.

Compressed air is routed toward the spring section of the central and rear brake chambers via the emergency brake release valve and the parking brake valve. To supply the central brake chambers, air passes directly via a QR-1C valve, located, close to the central axle. To supply the rear brake chambers, air first passes through a QR-1 valve, that sends air at a high rate of flow toward a second QR-1C valve, located at the rear of the vehicle.

To apply the parking brake, the operator pushes the button of the parking brake valve in order to cut the supply of air to the QR-1C valves. At that moment, the piston of each QR-1C valve rises, air from the brake chambers is purged through the exhaust port and the pressure of the spring on the thrust stem of each brake chamber enacts the brakes. The parking brake is fully applied when air is completely evacuated from the brake chambers.

To remove the parking brake, the operator pulls on the parking brake valve button, in order to re-establish the supply of air to the QR-1C valves.

The central and rear QR-1C valves also ensure a balancing function that permits the automatic release of the parking brake when a service braking request is made. A conduit from the discharge port of the MAM module’s R-14 valve is connected to the balance port of the central QR-1C valve. A second conduit from the exhaust port of the RAM module’s ATR-3/R-15 valve is connected to the balance port of the rear QR-1C valve. Once a service braking request is made, air pressure is sent to the central and rear brake chambers and the parking brake is released.

EMERGENCY BRAKE

When the pressure in the circuit reaches approximately 60 psi (414 kPa), the force exerted by the air pressure on the brake chamber diaphragm is decreased and the spring begins to decompress; then the parking brake begins to apply without any action from the driver. At approximately 30 psi (207 kPa), the release valve of the emergency brake opens and air is completely exhausted from the circuit. As soon as the pressure reaches 0 psi (0 kPa), the parking brake is completely applied.

If the bus must be moved to a safe place and the emergency brake is applied, the brake must be released. Depending on the option, the operator either pushes or pulls on the emergency brake valve button, while simultaneously pulling on the parking brake valve button. This action opens the passage to the compressed air in the emergency reservoirs and re-establishes the supply of air to the QR-1C valves, in order to supply the spring brake chambers. The springs are then compressed by the air pressure and the parking brake is immediately released. No additional pressure on the valves is required to maintain the brakes in a released state.
Figure 3A - Schematic of the Principles of the Parking Brake and Emergency Brake Circuits (Parking Brake Released)

NOTE: Transducer #4 in the primary circuit also activates the brake lights.
Figure 4A - Schematic of the Principles of the Parking Brake Circuit (Emergency Released)
To tighten the brakes, the emergency release brake valve and the parking brake valve must be placed in their initial positions.

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**CAUTION:**

Although the brake release system does allow the bus to be moved in an emergency for reasons of safety, it is not recommended to continue to drive a bus that has experienced a major loss of pressure.

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**CAUTION:**

The air supply for emergency spring brake release is supplied ONLY from the emergency reservoirs. The quantity and the pressure in the reservoirs only permits three release applications of the parking brake.

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**NOTE:**

In the event of a total loss of pressure in the system, the emergency brake can be loosened by hand. See the heading MANUAL RELEASE OF THE EMERGENCY BRAKE in this section for the procedure.

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**ANTI-LOCK (ABS) AND ANTI SKID (ATC) SYSTEMS**

In order to increase the security of service braking, Nova LFS Artic vehicles are equipped with an ABS system at the front, rear and central wheels. The FAM module contains the front ABS valves, the MAM module contains the central ABS valves and the RAM module contains the rear ABS valves. The modular configuration of the valves gives better protection against splashing, etc. For an increased protection of the ABS rear valves, the RAM module is installed in a protective housing.

When using service brakes, wheels can lock. The ABS system manages the application of the service brakes, in order to modulate braking and to maintain control of the vehicle. In addition, when the vehicle accelerates on a slippery surface, the ATC system, integrated into the ATR-3/R-15 valve of the RAM module, can activate the rear brakes. The ATC system is activated as soon as a variation of the speed between each set of rear wheels reaches 15%. The ATC system activates the ABS rear valves to regain traction.

For more information on the ABS system and the ATC systems, see section 08-224: ANTI-LOCK BRAKING SYSTEM.

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**IDLE BRAKE INTERLOCK (OPTIONAL)**

In addition to the standard ABS and ATC safety systems, the articulated vehicle features an optional IDLE BRAKE INTERLOCK that, in conjunction with the articulation system and the electronic system, is designed to eliminate the sliding of the middle axle at idle speed during braking on very slippery surfaces, such as a bus wash. As well, it prevents any unnecessary forward thrust, generated by the drive axle, of the vehicle at idle speed on slippery surfaces. The normal idle speed of the vehicle would typically generate a forward motion of between 3 and 7 km/h (2 and 4.5 mph).

There are no special maintenance requirements of this system, over and above normal, regular maintenance.

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**CENTRAL BRAKE CHAMBERS**

The operation and maintenance of the central brake chambers are identical to those of the rear brake chambers. For more details, see the heading REAR BRAKE CHAMBERS in this section.