



HWH

AIR LEVELING SYSTEMS

TEXT BOOK

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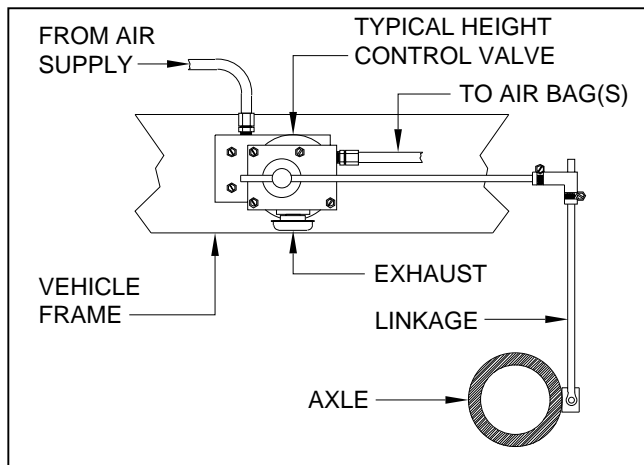
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AIR SUSPENSIONS

HWH air leveling uses the vehicle's air suspension to level the vehicle instead of using hydraulic cylinders. Air leveling can only be used on vehicles with a full active air suspension. A full active air suspension uses air springs (air bags) on the front and rear axles. These air bags are controlled by devices called "Height Control Valves"

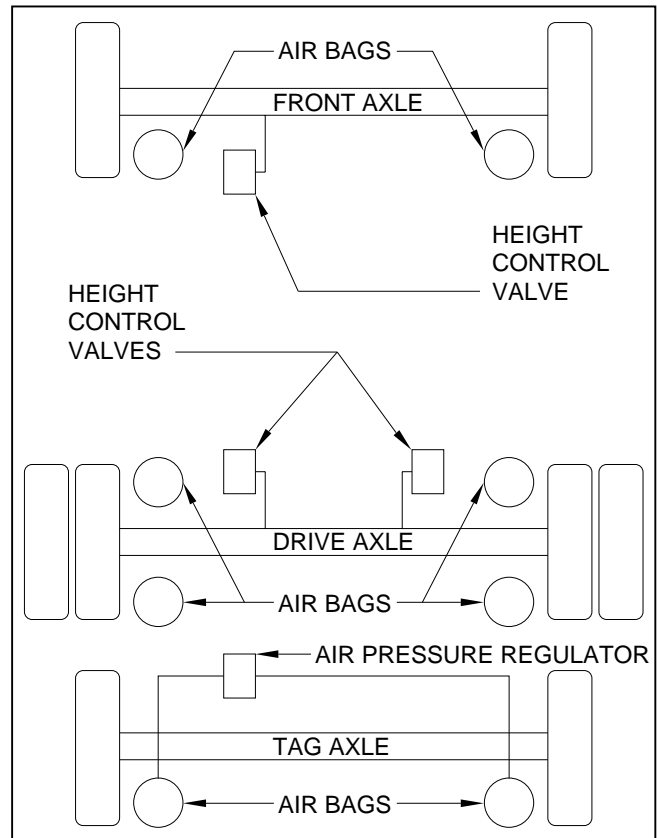
NOTE: Height Control Valves are sometimes referred to as "Leveling Valves". For the purpose of discussing the HWH air leveling system, we will refer to these as Height Control Valves. These valves maintain a specific distance between the vehicle frame and axles. This distance is determined and set by the vehicle manufacturer. We call this "Ride Height". The ride height is not controlled by the HWH leveling system.

The height control valve is mounted to the frame of the vehicle and is attached to the axle through an "L" shaped linkage. As the axle gets closer to the frame, the height control valve allows more air into the air bag(s). This pushes the axle away from the frame to maintain the proper ride height. As the axle moves away from the frame, the height control valve releases air from the air bag(s). This allows the axle to move closer to the frame to maintain the proper ride height.



There can be different height control valve arrangements. There can be one valve for the front axle and two valves for the rear. That can be reversed having two valves on the front axle and one valve on the rear. There can also be different air bag arrangements. There can be one or two air bags for each wheel. Sometimes, the front axle will be different than the rear axle.

Some vehicles will be equipped with a tag axle. The tag axle will normally have one air bag per wheel. Some tag axles are simply tied into the drive axle. Most tag axles will be independently controlled. Some will be controlled with a regulated air supply. Normally, Height Control Valves are not used to control the tag axle. Some tag axles can have their air bags dumped separately from the other axles air bags. Some tag axles will have an air dump with a tag lift.



All of these different situations must be considered when designing an air leveling system for a vehicle. The HWH air leveling system works in conjunction with the vehicle suspension not only for leveling but also when the vehicle is in the travel mode.

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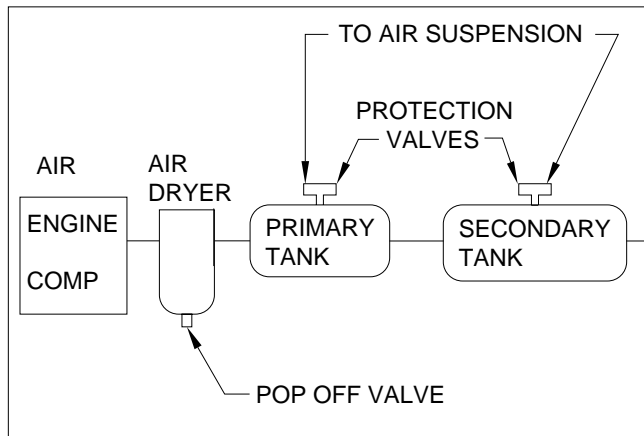
VEHICLE AIR SUPPLY

Most vehicles with an air suspension also use an air brake system. These vehicles need a constant air supply.

Normally the vehicle is equipped with an air compressor powered by the vehicle's engine. There will be a series of tanks to maintain the air supply. Although some vehicles, have different arrangements, they all have the same basic requirements.

There should be at least two air tanks. The primary function of the air tanks is to supply air to the brake system of the vehicle. The suspension draws air from these tanks through protection valves. These valves protect the braking system from loss of air due to engine failure or failures in the suspension system. If the air pressure in the tanks drop to a set pressure, usually between 60 and 70 psi, the protection valves will not allow air into the suspension from the tanks. It is important not to disturb this protection system when adding an air leveling system to the vehicle.

How the HWH leveling equipment should connect to the existing air system and suspension should be decided by the vehicle manufacturer.



Although it may vary between different vehicles, it normally takes at least 60 psi to start lifting a vehicle. Most vehicles will require 90 psi to obtain maximum lift. Some may require up to 130 psi to obtain maximum lift.

DASH AIR PRESSURE GAUGES

Normally there is a pressure gauge for the primary and secondary tanks. Sometimes there will be an individual gauge for each tank and sometimes there is one gauge with two indicators, one for each tank. Usually there will not be a gauge for monitoring pressure available for the suspension. If the air pressure in the suspension drops to zero, the pressure gauges will still indicate the pressure maintained by the protection valves.

There should also be an audible warning if the air pressure in the main system drops below 60 psi. The vehicle should not be moved if a low air pressure warning indicator is on.

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BASIC AIR LEVELING

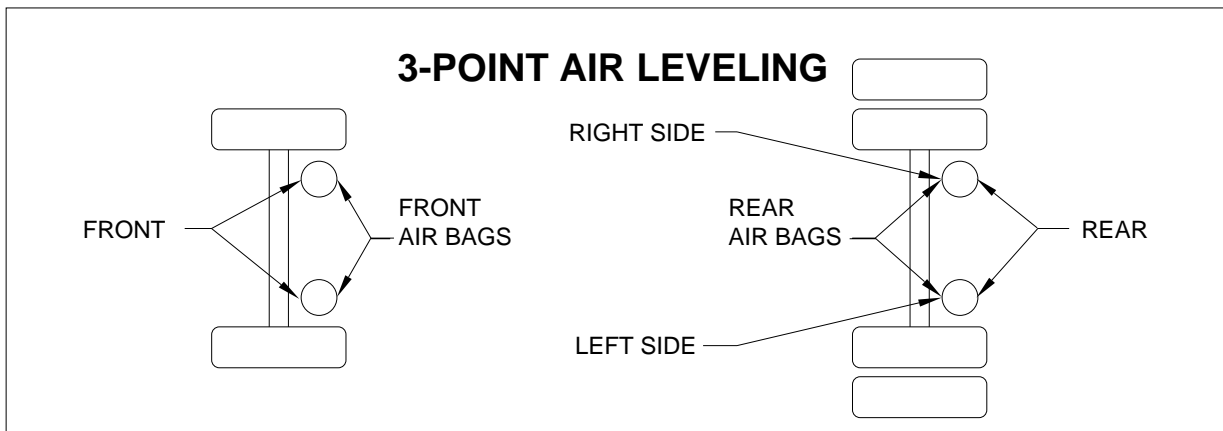
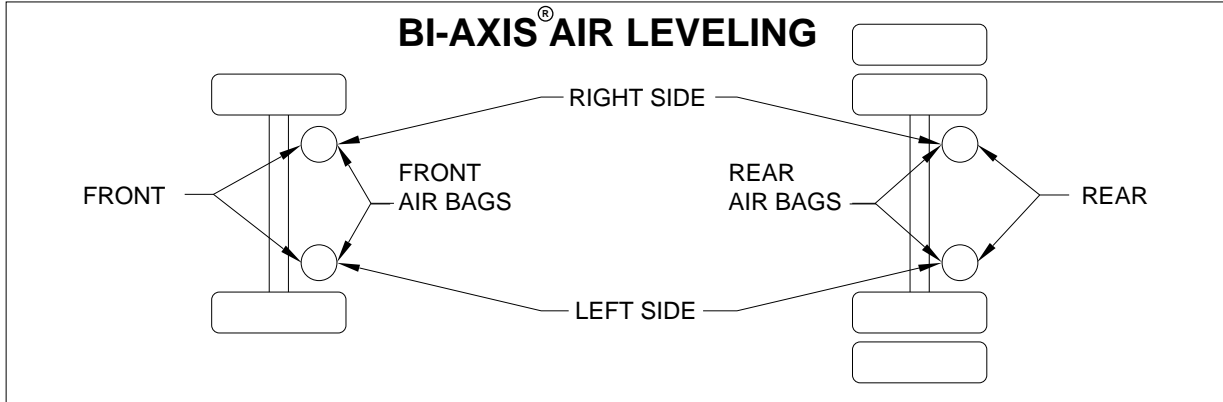
HWH provides (2) basic types of air leveling systems. In one, HWH supplies a series of air solenoid manifolds to control the air suspension for leveling. The other type of leveling system is for Prevost busses. For the Prevost, HWH supplies only the electronics to control the Prevost air solenoid valves.

With either type of system, leveling is accomplished by isolating the air bags from the height control equipment. Air is then released from the air bags to lower the vehicle (or) air is added to the air bags to raise the vehicle.

All present systems operate as a four-point, BI-AXIS[®] system with the exception of the Prevost. HWH controls the side air bags and the front or rear air bags of the vehicle to obtain a level position. Leveling the vehicle side to side should always be done first before leveling the vehicle from front to rear. Older air leveling systems and Prevosts use a three-point air leveling system. The front air bags work as one to raise or lower the vehicle front to rear but the side to side leveling is done with the rear air bags only.

As with hydraulics, BI-AXIS[®] air leveling minimizes twisting of the vehicle. Air leveling is also accomplished easier and quicker when using combinations of air bags to raise and lower the vehicle. At this time, Prevosts can not be set up to do four-point BI-AXIS[®] leveling.

At this point, we will begin to discuss the air leveling systems in detail. It is important to remember that the plumbing, wiring, and leveling programs may differ from one vehicle to another. The engineering departments of the vehicle manufacturer and HWH should be involved when designing a new system.



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THE DIFFERENT SERIES OF AIR LEVELING SYSTEMS

There are three series of automatic air leveling systems.

The 500 Series which uses a 9" X 14" control box. This series uses a 2 inch wide flat ribbon cable to connect the touch panel to the control box.

The 600 Series also uses a 9" X 14" control box, but uses a flat 1/2" wide modular cable to connect the touch panel to the control box.

The 680 Series uses a 14" X 18" control box and also uses the 1/2" wide modular cable to connect the touch panel to the control box.

Almost all new vehicles use either the 600 Series or 680 Series leveling system. The only manufacturers using a 500 Series leveling system are Country Coach and converters of Prevost buses without room extensions.

SYSTEM COMPONENTS

The average HWH air leveling system contains the following equipment:

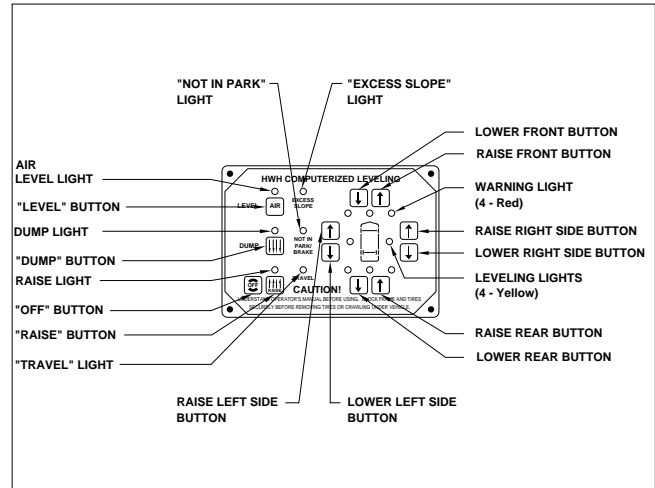
- Touch Panel
- Control Box
- Ribbon Cable or Modular Cable
- Electrical Harnesses
- Level Sensing Unit
- Air Solenoid Manifolds
- Air Pressure Switches (part of manifold)
- Air Compressor

Prevost coaches use a different type of system. HWH uses the Prevost air valves to level the vehicle. The air solenoid manifolds are not used. Also Prevost coaches are based on a 24 volt electrical system. This means a different control box is needed.

It is important to understand that each different vehicle manufacturer may have different requirements. There are different automatic leveling programs. This means different control boxes. There are different air bag arrangements and tubing sizes. This requires different air solenoid valve manifold arrangements. There are different air compressor requirements and electrical harness lengths and arrangements. When designing a new system or repairing an existing system, you must know exactly what the vehicle requirements are or what parts are being used. In most cases if a component is not replaced with a like component, the system will not work properly.

The following component descriptions will not describe or show all the possible variations of the component. Again, make sure the proper components for a particular vehicle are used.

TOUCH PANEL BUTTONS AND INDICATOR LIGHTS



All HWH air leveling touch panels have the same buttons and indicator lights. However, it is important to note that some of the buttons and lights react differently with different systems.

The "LEVEL" (AIR) Button: This button is used to turn the system on. It is also used to start the automatic leveling procedure. The one thing that is the same for all systems is if the ignition switch is on, the park brake must be set. If the park brake is not set, the system will not latch in. The "NOT IN PARK/BRAKE" light and the AIR LEVEL LIGHT will come on while the AIR button is being pushed and will go out when the button is released.

With some 600 Series Systems and all 680 Systems, the ignition switch must be on or the system will not latch in. The AIR LEVEL LIGHT and some touch panel lights will be on while the AIR button is being pushed and all touch panel lights will go out when the button is released.

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The 500 Series Systems and some 600 Series Systems can be turned on with the ignition in the off position. The park brake does not have to be on if the ignition is off. The park brake signal must be present only if the ignition is on.

The AIR LEVEL LIGHT. This red indicator light will be on steady when the system is on, either with the ignition on or off. The AIR LEVEL LIGHT will flash during automatic air leveling and manual operation of the system. The AIR LEVEL light will NOT flash when the "RAISE" or "DUMP" button is being used.

The "NOT IN PARK/BRAKE" Light. All HWH systems need a park brake signal to be able to turn the system on, if the ignition is on. If this red indicator light comes on while the AIR button is being pushed, check to see if the park brake is set. This light is not a park brake indicator. It will only come on while the AIR button is being pushed. It will go out when the AIR button is released.

The "EXCESS SLOPE" Light. This red indicator light comes on if the system is not able to level the vehicle in a specified time. It will work with the ignition on or off.

The "TRAVEL" Light. This green indicator light will only work with the ignition on. This light is on whenever the ignition is on if the leveling system panel is off, provided there is sufficient air pressure in the suspension. The "TRAVEL" light only means the leveling system is off and the air system has started to build air pressure. It does not mean the vehicle is at the proper ride height.

The "OFF" Button. On some touch panels this button is referred to as the "EMERGENCY STOP" button. The "OFF" button simply turns the leveling system off if the panel is on. If the "OFF" button is pushed and the ignition is on, the system will go into the travel mode and the vehicle may return to ride height.

NOTE: On the Newell panel with the "TRAVEL" button, pushing the "OFF" button will not put the system in the travel mode.

The "DUMP" Button. When this button is pushed all the lower solenoid valves will open allowing the vehicle to lower. This is a momentary button on some systems and will latch in and stay on with other systems. Refer to the "DUMP" and "RAISE" section for a detailed explanation.

The "DUMP" Light. This red indicator light will flash when the "DUMP" button is pushed.

The "RAISE" Button. When the button is pushed all the raise solenoid valves will open allowing the vehicle to raise. This is a momentary button on some systems and will latch in on other systems. Refer to the "DUMP" and "RAISE" section for a detailed explanation.

The "RAISE" Light. This red indicator light will flash when the "RAISE" button is pushed.

The WARNING Lights. These four red indicator lights are on the right half of the panel at the four corners of the little coach emblem. When these lights are on, the "TRAVEL" light should be off. The ignition must be on for the WARNING lights to function.

For all systems using the modular cable between the touch panel and the control box, these lights only come on when the "AIR" button is pushed. When these lights are on, the height control valves are disabled. These four lights flash briefly when the "DUMP" or "RAISE" buttons are pushed.

For systems using the ribbon cable, the WARNING lights will function like the other systems, but they also function as low air pressure warning lights. If the ignition is on and an air bag or combination of air bags have low air pressure, the corresponding red WARNING light(s) will come on and the "TRAVEL" light will go out.

The LEVELING Lights. These four yellow indicator lights are located on the right half of the touch panel. They are situated at the front, rear, and both sides of the little coach emblem. A lit yellow LEVEL light indicates that side or end of the vehicle is low. Two lit LEVEL lights indicate that corner of the vehicle is low. When all the yellow LEVEL lights are out, the vehicle is level. There should never be more than two LEVEL lights on at a time. There should never be both side lights or the front and rear light on at the same time.

The sensing unit has an accuracy tolerance of +/- 3/4 degrees. This translates into approximately 1 inch from side to side and 5.4" from front to rear on a 36' vehicle when the sensing unit is mounted in the middle of the vehicle. The length of the vehicle and where the sensing unit is mounted can change these figures.

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The **RIGHT SIDE, LEFT SIDE, FRONT and REAR RAISE and LOWER buttons**. These buttons are used to manually level the vehicle. The LOWER (down arrow) buttons open lower solenoid valves to release air from the air bags. The RAISE (up arrow) buttons open raise solenoid valves, letting air into the air bags, raising the vehicle.

The buttons operate pairs of solenoid valves. This way the sides and ends of the vehicle are raised and lowered using combinations of air bags. Refer to the BASIC AIR LEVELING section of this book for an explanation of BI-AXIS leveling.

These buttons will work after the "AIR" button has been pushed one time. The manual buttons will not work if the system has been put in the automatic leveling mode.

MASTER WARNING INDICATOR: (Not part of the touch panel). The vehicle should be equipped with a MASTER WARNING INDICATOR, either a light or an audible warning, that is connected to the HWH control box. This is a low air pressure warning.

CONTROL BOXES

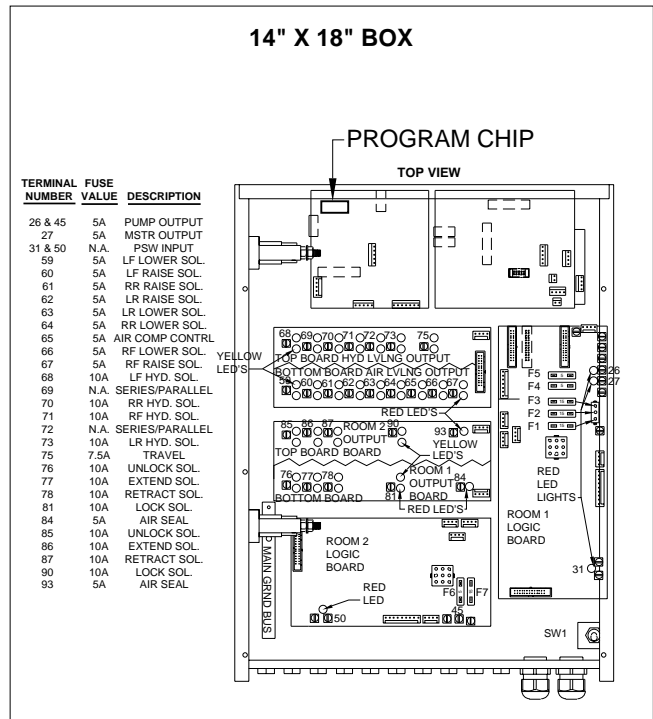
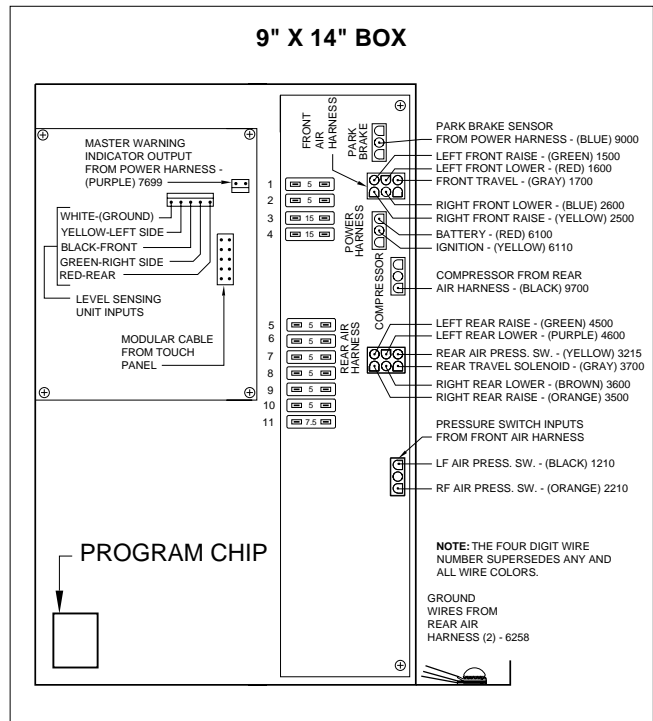
There are two sizes of control boxes used with air leveling, a 9" x 14" and a 14" x 18" box. The main reason the one control box is larger is that it controls more equipment. The larger control box is used on vehicles with room extensions and room locks.

One difference between the two boxes is that connections for control outputs are made inside the 9" x 14" box and outside the 14" x 18" box. Both boxes use automotive type blade fuses. With the exception of Prevest equipment, both boxes use +12 volt outputs to control relays and solenoid valves. Information inputs, such as the level sensing unit, are ground signals.

All control boxes will have a part number sticker on the box. The sticker is inside the larger boxes and on the outside of the smaller boxes.

An important part of the control box is the program chip. Sometimes it is important to obtain the number on the chip. This number will let HWH figure out which leveling program is in a particular control box. This can be important when deciding if a leveling program is correct for a vehicle. The two control box diagrams show the location of the chip. The number will be a four or five digit number preceded by the letter A. There may be a dash followed by a number. This is an example of a chip number "A1619-7". The program number is "A1619". The "-7" is the number of times that program has changed. The dash number will indicate if the chip has the most recent program changes.

All control boxes for air leveling must have ignition voltage and constant battery voltage supplied into the control box. Battery voltage is used for most functions of the control box including the SLEEP mode. The ignition voltage is used for the warning circuits and the TRAVEL outputs.



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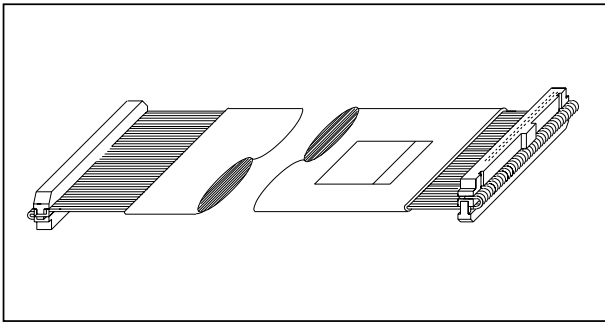
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RIBBON AND MODULAR CABLES

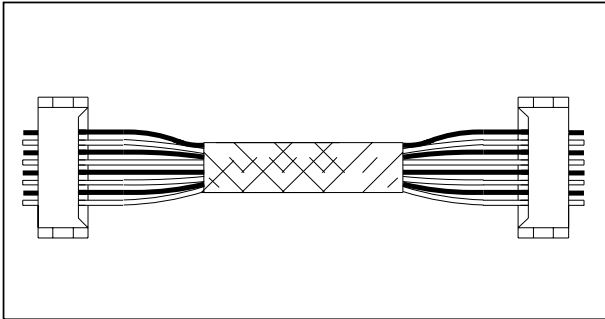
There is one cable that connects the touch panel to the control box. The 500 Series Systems use the ribbon cable. The 600 and 680 Series Systems use a modular cable. Touch panels and control boxes using a ribbon cable are not interchangeable with modular cable equipment.

It is recommended that the shortest possible length of the cable is used when designing a system or replacing a cable.

RIBBON CABLE



MODULAR CABLE



ELECTRICAL HARNESSSES

The electrical harnesses are used to send and receive signals for system operation. There are many different lengths and types of harnesses. The older harnesses used wires that were color coded. New wire harnesses use a numbering system to label the wires. On most of the connectors used by HWH the pin positions are numbered or lettered. It is very important to maintain the correct wire positions in the connectors. Reversing wires especially power and ground wires can cause component damage and system failure.

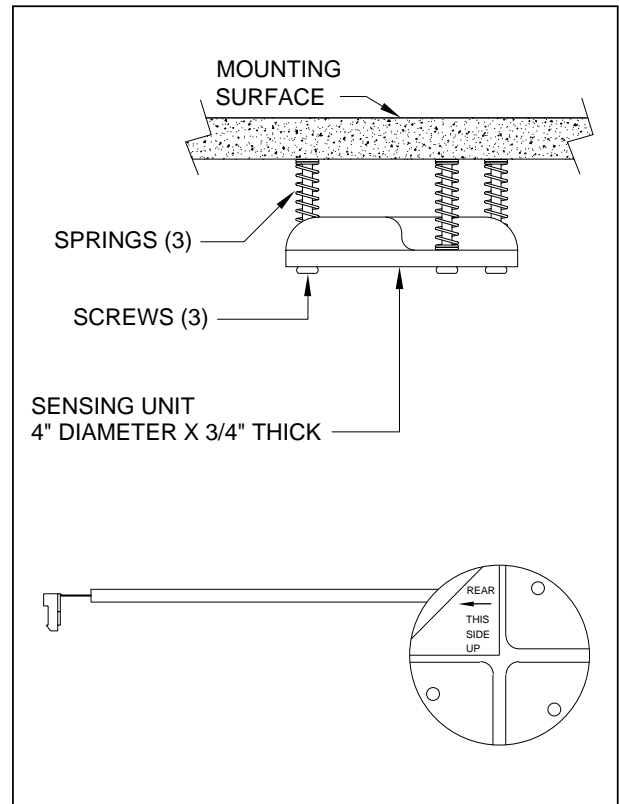
HWH can supply specific harness drawings and system schematics. Contact the HWH electrical engineering department to obtain these drawings or other electrical information.

LEVELING SENSING UNITS

The level sensing unit senses the level position of the vehicle. The level sensing unit uses four mercury switches to determine the position of the vehicle. When a side or end of the vehicle is low, the mercury in the appropriate switch will short the contacts in the that switch. This will complete a ground circuit for a yellow level indicator light in the touch panel.

The sensing unit is a five wire unit. One wire is a common ground for the four mercury switches. The other four wires are for the four individual switches.

The sensing unit is mounted to the vehicle with three screws. There is a spring between the sensing unit and the mounting surface. There is a sticker on the sensing unit that indicates the proper mounting position for the sensing unit. The body of the sensing unit is neutral and does not need to be grounded. The unit does need to be mounted to a good solid surface. It should not be exposed to heat sources. If the sensing unit is not mounted and adjusted correctly it can cause improper leveling.



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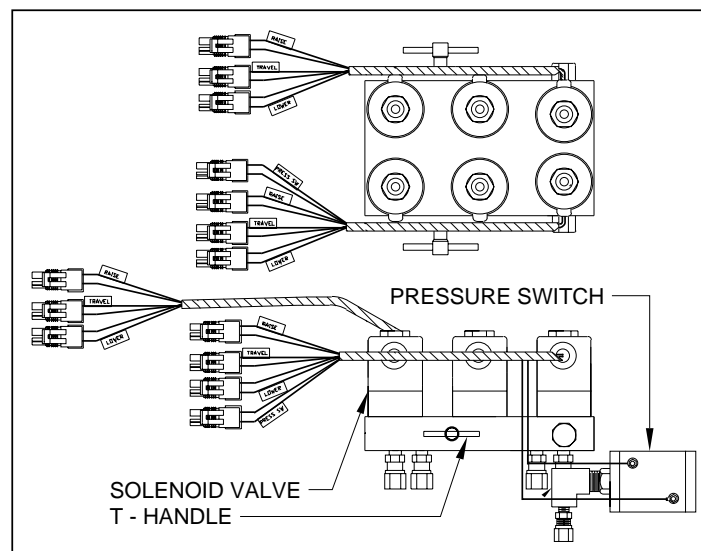
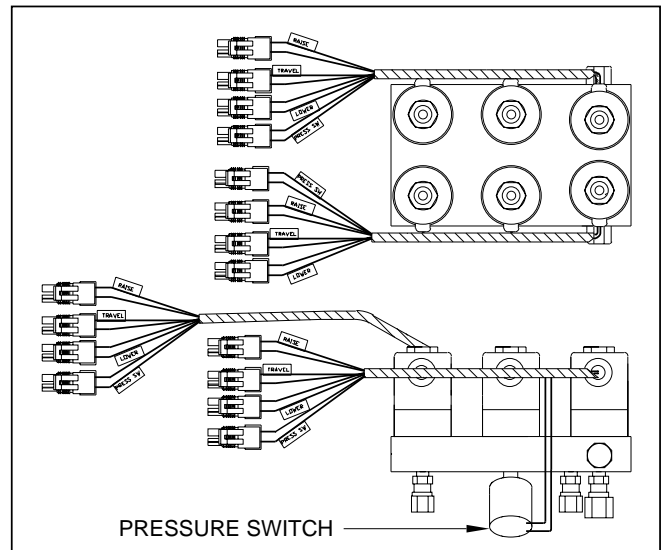
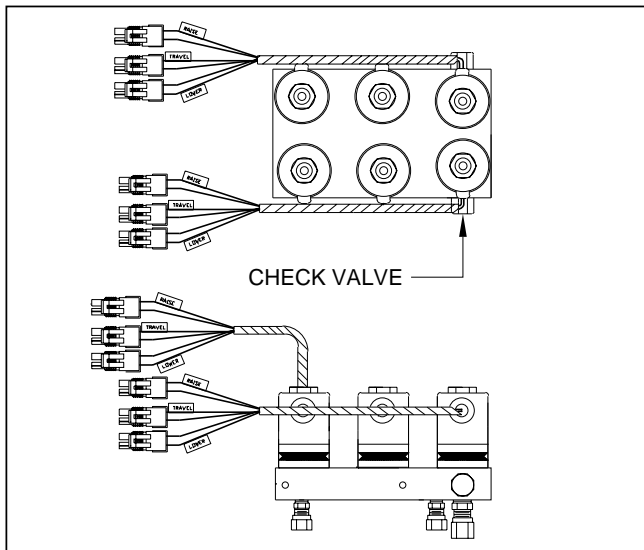
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AIR SOLENOID MANIFOLDS

The air solenoid manifolds are used to isolate the air bags from the height control valves during leveling procedures. The manifold also directs air to and from the air bags for leveling. With one exception, all air manifolds presently being used have six air solenoid valves and two check valves. One of the manifolds for MCI busses only has four valves. Some manifolds have two pressure switches and some have one pressure switch. A solenoid manifold used on a tag axle may have no pressure switches. Some manifolds have T-handles on the side of the manifold block. These T-handles are used to by-pass the travel solenoid valves. The following diagrams show several different manifold arrangements.

Air solenoid manifolds can have different fitting arrangements. If a vehicle has two air bags per wheel, the manifold may have two outputs to the air bags per side. There may be different tubing sizes used.

The solenoid valves are all the same and are interchangeable. Each valve has two o-rings between the manifold and valve. The valves are normally closed, +12 volt valves. Each coil has two wires, one for ground and one for +12 volt.



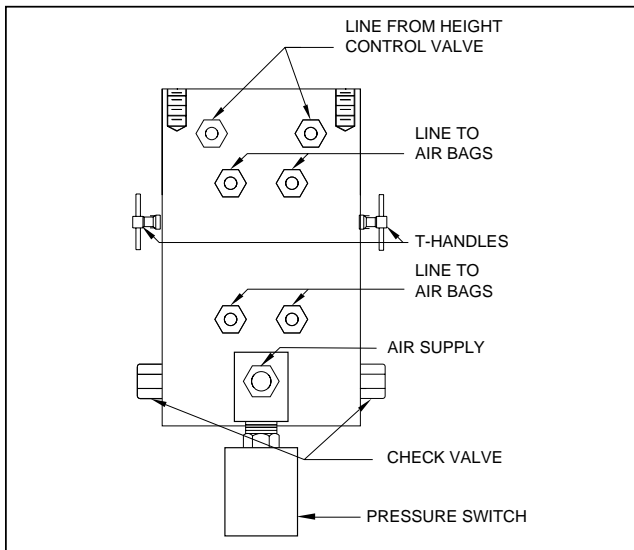
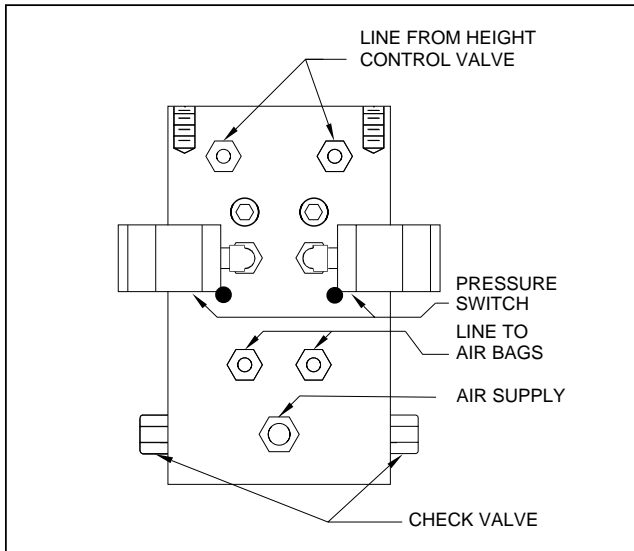
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SYSTEM PRESSURE SWITCHES

All current HWH air leveling systems using HWH air solenoid manifolds incorporate air pressure switches in the system. The following diagrams show the two pressure switch arrangements that are used.



The manifold with two pressure switches monitors air pressure in the air bags. The single pressure switch on a manifold monitors system air pressure.

The pressure switches are normally closed switches. When the air pressure is equal to or above the pressure switch setting, the switch will open. The pressure switches complete a ground circuit when closed.

Normally a system will have a manifold with two pressure switches on the front and a manifold with one pressure switch for the drive axle. If a vehicle has a tag axle and a manifold for the tag axle, usually that manifold will NOT have any pressure switches. There can be different arrangements. Some vehicles such as Country Coach may have manifolds with two pressure switches front and rear.

The pressure settings for the switches are different. The pressure switches that monitor air bag pressure are usually set at a low pressure, normally 20 psi. Foretravel supplies the pressure switches for the front manifold and these switches are 10 psi switches. The air bag pressure switches for Newell are 35 psi switches.

Pressure switches used to monitor system air pressure are usually set at 85 psi, although some manifolds have a pressure switch set at 100 psi.

Pressure switches may be marked with their settings. If not, use the specific air manifold part number to get the correct pressure switch setting.

The air manifold pressure switches have two functions. They serve as low pressure warning switches and the front pressure switches are used when performing lower functions with the touch panel.

When the switches are working as warning switches, if a pressure switch sees low air pressure, that switch will send a ground signal to the leveling system control box. This will turn a master warning light on if the vehicle ignition is on. The "TRAVEL" light on the touch panel will turn off.

The pressure switches on 500 Series Leveling System, such as Country Coach uses, are only used as warning switches. They serve no function during any leveling procedures. A pressure switch that sees low pressure will turn a red warning light, on the touch panel, on for that corner of the vehicle if the ignition is on. The travel light will turn off. It will also turn a master warning light on.

The front air pressure switches on all **600 and 680 Series Leveling Systems** are used during any lower functions, manual operation, automatic operation or use of the "DUMP" button. When the pressure switch for a front bag turns on, it sends a ground signal to the control box. This will inhibit the opposite side front air bags from lowering.

EXAMPLE: While pushing the right side lower button, the right front air pressure switch sees low air pressure. The front lower button is then pushed. The right front lower solenoid valve will turn on and open, but the left front lower solenoid valve will not turn on. The left front bag will not lower. This is done to prevent the front of the vehicle from twisting. If one side of the front of the vehicle is as low as it can go, lowering the other side will twist the vehicle.

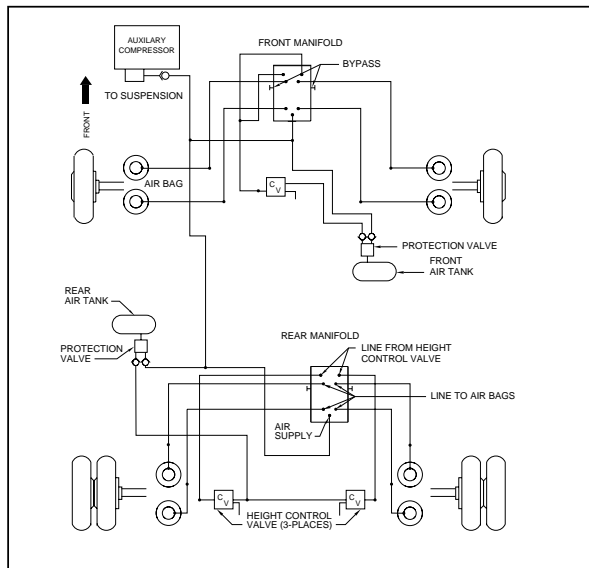
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AIR COMPRESSOR

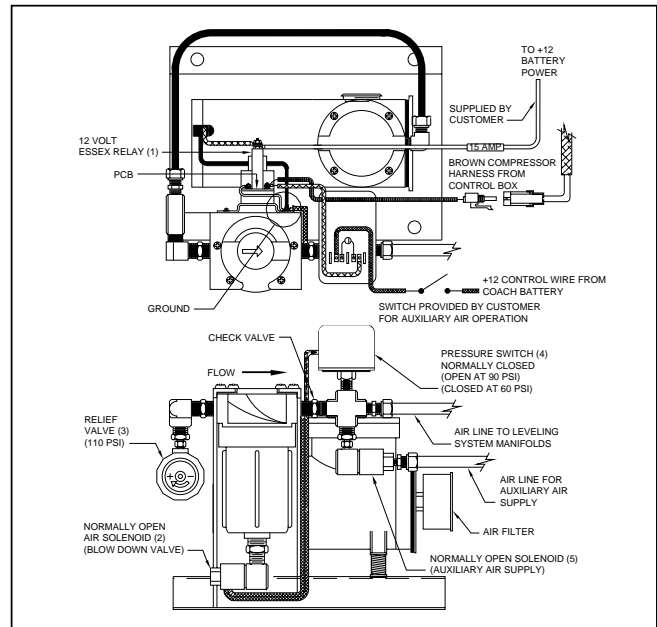
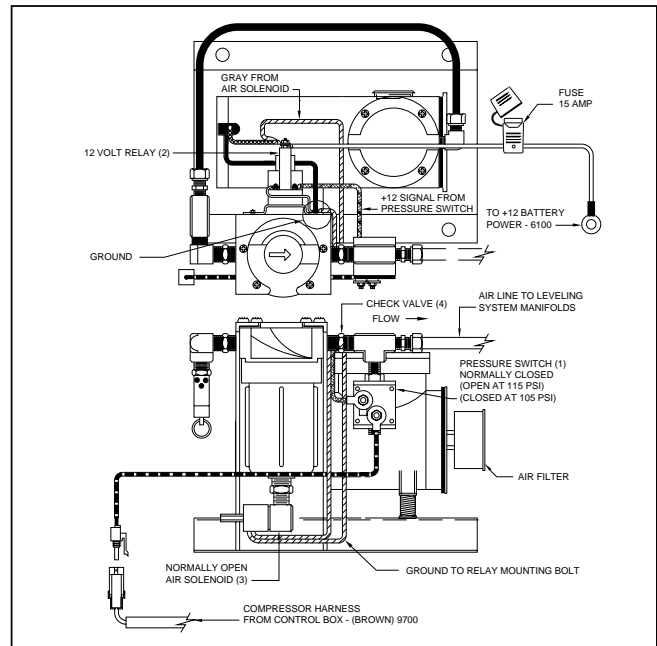
Almost all HWH automatic air leveling systems use an auxiliary air compressor. The automatic system has a "SLEEP" mode. This will be described later. The auxiliary compressor supplies air to the system for leveling when the system is in the "SLEEP" mode. Some vehicle manufacturers supply their own auxiliary compressor. The following diagrams shows a correctly plumbed system including the auxiliary air compressor. Note that the check valve arrangement allows air from the auxiliary compressor to only be used as an air supply for the air solenoid manifolds.



The next two diagrams show two different air compressor arrangements. The first compressor only has one air outlet. It should only be used to supply air for the leveling system. The second air compressor has two outlets, one is for the leveling system and the other supplies air to the main vehicle air system.

Normally the vehicle engine air compressor provides an adequate air supply for leveling or any other air needs of the vehicle. The auxiliary air compressor may run when the vehicle engine is running. That is ok. The main reason for the auxiliary compressor is to supply air for HWH air leveling when the vehicle engine is not running.

Air compressor assemblies consist of several components. There is the 12 volt compressor and a relay to control voltage to the compressor. The pressure switch on the compressor assembly controls signal voltage to the relay. There is a water trap with a normally open 12 volt air solenoid. This solenoid will close whenever the compressor is running. The two output compressor has a second normally open air solenoid. This valve closes whenever there is a +12 volt signal from the leveling system control box to run the compressor.



Anytime a raise function-automatic, manual up arrow or the "RAISE" button - is being used, a +12 volt signal is sent to the compressor from the control box. This turns a single output compressor on if air pressure in the system is below approximately 105 psi. A +12 volt signal from the control box will turn a two output compressor on at anytime. A +12 volt signal through the auxiliary pressure switch for auxiliary air will turn the compressor on if system air pressure drops below 60 psi.

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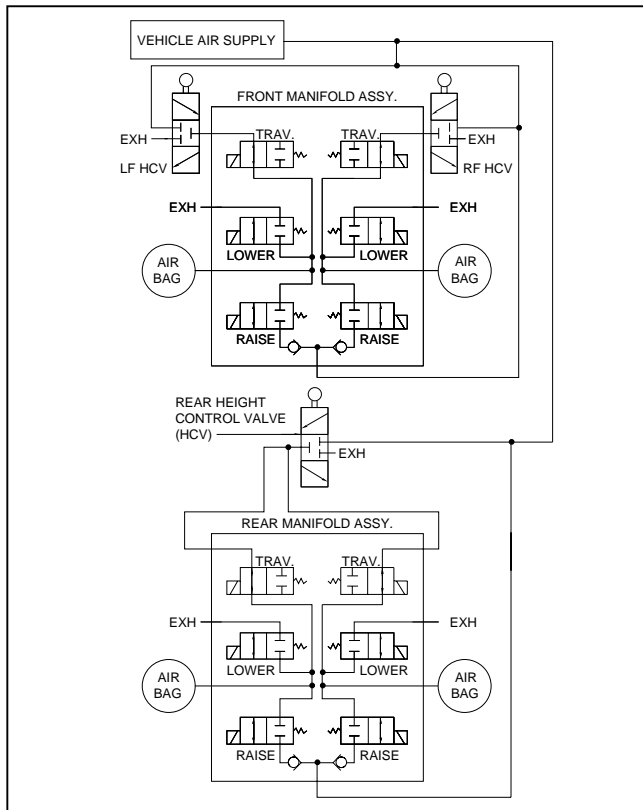
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We will first address vehicles using HWH air leveling manifolds. Prevost systems are completely different and will be discussed separately.

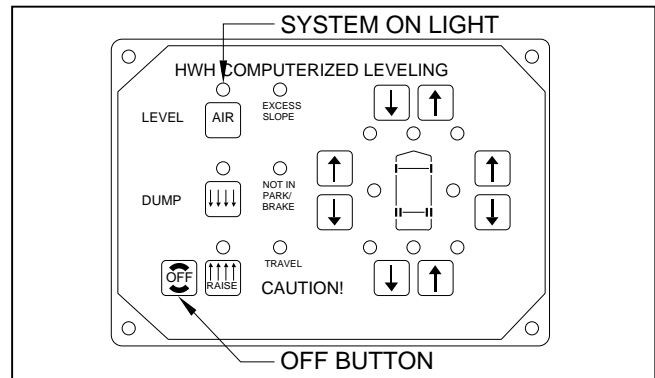
TRAVEL MODE

When a vehicle is in the travel mode, the correct ride height is maintained by the height control valves. the HWH system is not used to raise or lower the vehicle when traveling. **NOTE:** The "Dump" and "Raise" functions of the HWH Leveling system allow the vehicle to be moved at very slow speed for a short distance with the suspension in a lowered or raised position. The "DUMP" and "RAISE" functions will be discussed in depth later in this text book. The following schematic shows a basic two-axle air leveling system in the travel mode.



Note that there are three valves for each air bag. There is a raise valve, a lower valve, and a travel valve. The valves are very simple, electronically operated valves. All of the valves are normally closed valves, which means that they will not let the air by until they are electronically activated. Each valve has an electronic coil which is activated by applying (+12) volts to one side of the coil and grounding to the other side of the coil.

With HWH air leveling systems, the (+12) volts to the valve is switched while the ground for the valve is constant. All of the valves are the same and are interchangeable. In the schematic, the travel valve is drawn in the on (open) position. This allows the height control valve to function by letting the air pass to and from the air bags through the travel solenoid valve. Again, the raise and lower valves are not used when the system is in the travel mode.



Anytime the travel valves are closed, the air bags are isolated from the height control valves. To energize the travel valves the vehicle ignition switch must be in the "ON" position. The travel valves can not work if the ignition is off. Also, the HWH leveling system panel must be off. If the system on light on the panel is lit, the travel valves will remain off. By pushing the "OFF" button, if the ignition is on, the travel valves will be energized. Also, if the ignition is on and the leveling system panel is on, the travel valves can be energized by releasing the park brake. This will turn the leveling system off and energize the travel valves with a (+12) volt signal.

The only exception to this, at this time, is on Newell vehicles with air leveling only. The Newell leveling system panel has a "TRAVEL" button above the "OFF" button. The ignition must be "ON" for the vehicle to return to the travel mode but the system will not return to the travel mode until the "TRAVEL" button is pushed or the park brake is released, even if the leveling system panel is off. If the leveling system panel is on and the ignition is in the "ON" position, the "TRAVEL" button must be pushed to return the system to the travel mode. Pushing the "OFF" button will only turn the system off. This was done so that when the leveling system panel is off, the ignition key could be turned on without the vehicle returning to travel height.

IMPORTANT: Except for Newells the "TRAVEL" light on the touch panel indicates the travel valves are on when the "TRAVEL" light is lit. The "TRAVEL" light being off does not indicate the travel valves are off.

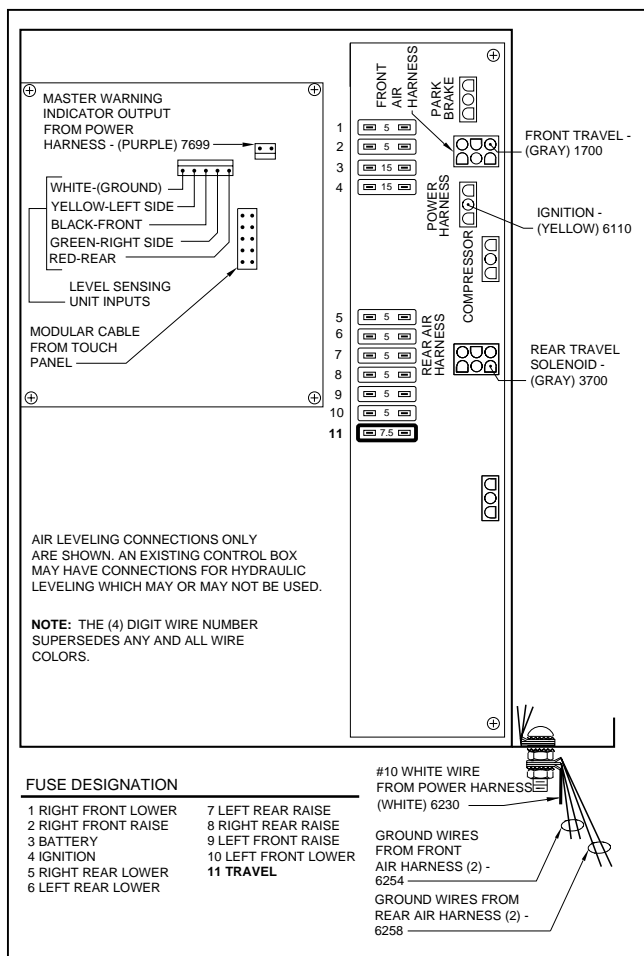
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The number of travel valves used depends on the vehicle and the type of system. The older three-point leveling systems will have three travel valves, one for the front and two for the rear. The four-point leveling systems will have four travel valves, one for each wheel.

Electrically the travel valves are tied together. Normally there is a separate harness for the front and rear axles. If the vehicle is equipped with a tag axle, it is normally wired through the drive axle harness. All travel valves are energized through a single fuse. A problem with one travel valve may cause a problem with all of the travel valves.



T-HANDLES

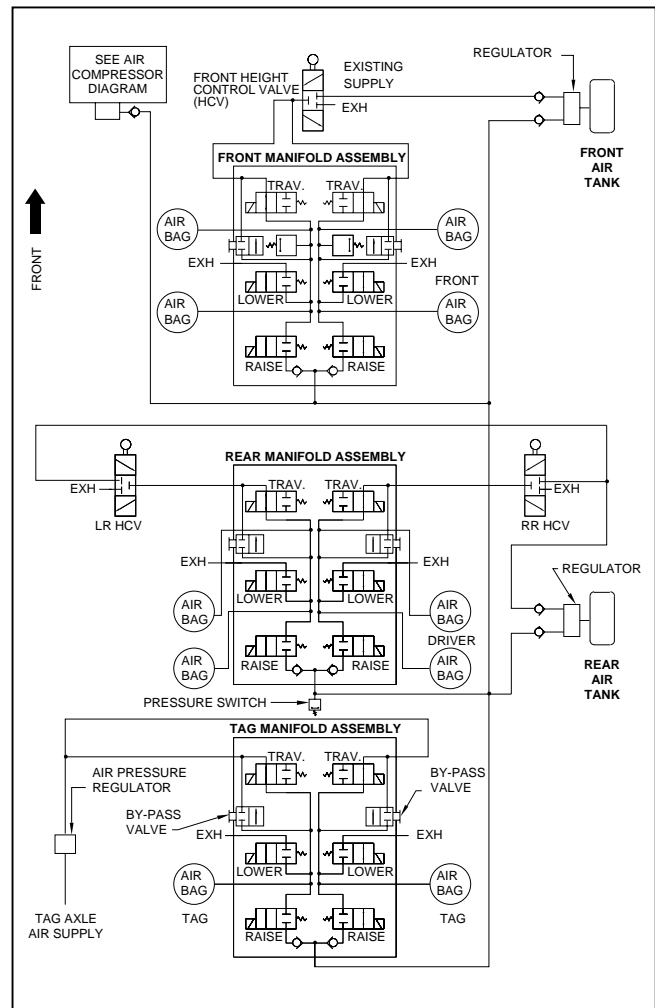
The T-handles on air solenoid manifolds are used to bypass the travel solenoid valves. When the T-handles are opened, (turned counter-clockwise) air is allowed to pass between the air bags and height control valves without the travel solenoid

being energized. When the T-handles are closed, the travel valves must be on for the height control valves to function.

The T-handles were designed to be used during the manufacture of the vehicle. Since most manifolds are not mounted to be accessible from outside the vehicle, it is not recommended that the T-handles are used for emergency TRAVEL purposes. No one should be under a vehicle when it is supported solely by the air suspension.

VEHICLES WITH TAG AXLES

If the vehicle is equipped with a tag axle, normally there will be one travel valve for each wheel. The following schematic is of a Monaco coach with a tag axle. The travel valves are drawn in the ON (open) position.



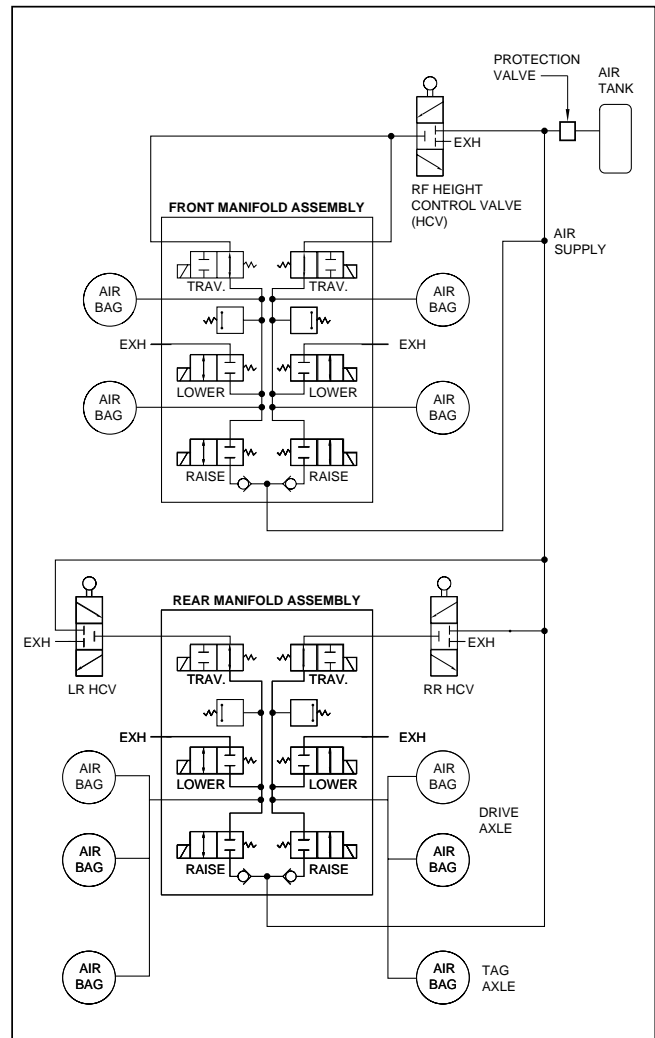
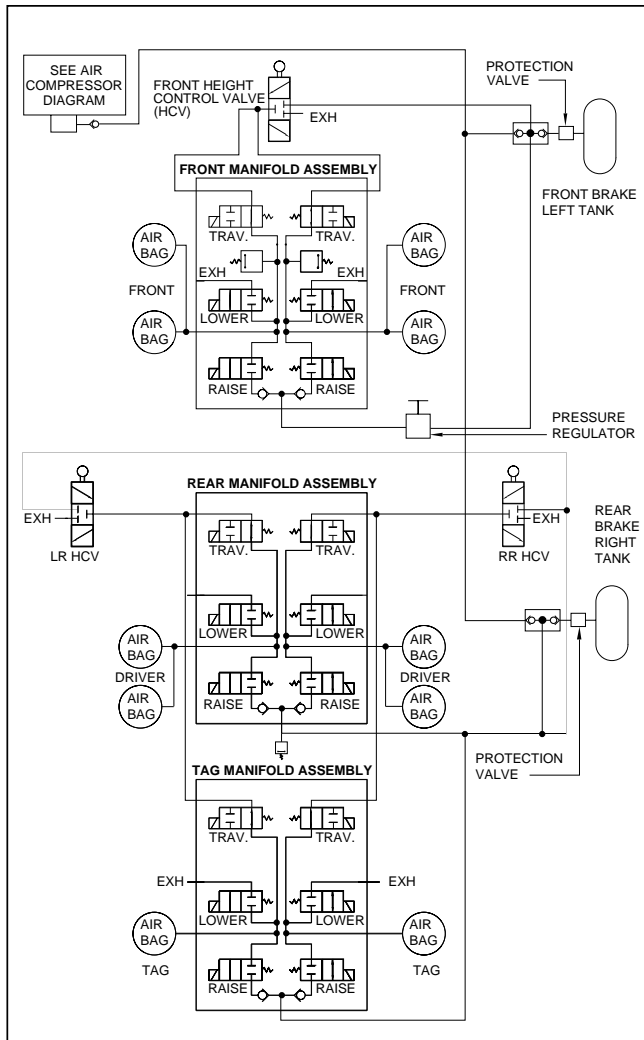
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In this schematic, the tag axle is controlled independantly from the drive axle. The air pressure for the tag axle suspension bags is controlled by a pressure regulator. Other arrangements for controlling the tag axle are possible. It is important to determine how the tag axle is controlled when designing the correct leveling system for the vehicle.

The following two schematics show tag axles controlled by the drive axle height control valves. Note that one tag axle has a separate leveling system manifold. The other system shows the tag axles air bags plumbed directly into the drive axle air bags. These schematics are also drawn with the travel solenoid valves in the ON (open) position.



When the leveling system is in the travel mode the tag axle is allowed to function as it normally would.

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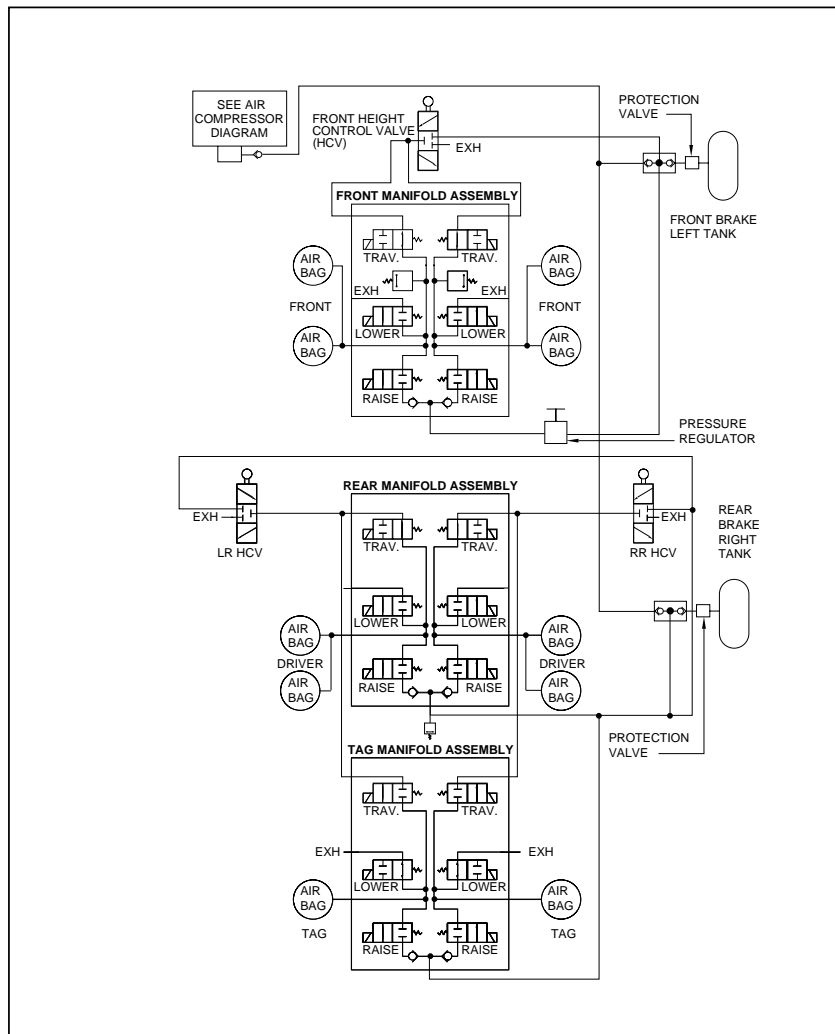
TAG AXLE DUMP AND LIFT

Some vehicles equipped with a tag axle will have the capability to dump the air in the tag axle air bags. Some vehicles have the capability to dump the air in the tag axle air bags and then lift the tag axle.

One of the reasons this feature is used would be when the vehicle is making very sharp turns. Dumping the tag axle air bags allows the tag axle to slide from side to side during a sharp turn, putting less strain on the suspension. If a tag lift is used, the tag axle is lifted as the air bags are dumped. The tag axle is then not in contact with the ground.

The other reason a tag axle dump/lift is used is to put more weight on the drive axle. This gives the vehicle more traction when in a muddy condition or when road surfaces are slick from rain, ice or snow.

When using the tag dump/lift, the tag axle air bags must be isolated from the drive axle air bags. The following schematic shows how the valves work during a tag dump operation. The front axle and the drive axle travel solenoid valves are still energized allowing the height control valves to function. The tag axle travel solenoid valves are closed isolating the tag axle air bags. The tag axle lower solenoid valves are opened, dumping air from the tag axle air bags.



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The switch that controls the tag dump/lift is supplied by the vehicle manufacturer. The wiring for the switch is supplied by HWH. The switch needs two constant on positions, one for travel and one for tag dump. HWH supplies a three wire harness for the switch. One wire is a +12 volt supply from the travel circuit in the control box. One wire will supply +12 volts to the tag axle travel solenoid valves. The other wire supplies +12 volts to the tag axle lower solenoid valves and a +12 volt signal for a tag lift valve. The lower solenoid valves are part of the HWH tag axle manifold assembly. The tag lift valve would be supplied by the vehicle manufacturer.

When the tag dump switch is in the TRAVEL position, +12 volts is supplied to the tag axle travel solenoid valves. The tag axle will function as it normally should. The +12 volts for the tag axle travel solenoid valve comes through the same fuse as the front and drive axle travel solenoid valves.

When the tag dump switch is in the DUMP position, the tag axle travel solenoid valves are turned off. This isolates the tag axle from the rest of the suspension. +12 volts is switched to the tag axle lower solenoid valves. This allows the air from the tag axle air bags to be exhausted. The tag axle lower solenoid valves are isolated from the drive axle lower solenoid valves through the use of relays and or diodes in the control box. For a 680 Series System, +12 volts for the tag lift is fused through the travel fuse and the tag axle lower solenoid valves are fused by the fuse for ignition voltage. For a 600 Series System, the tag lift and tag axle lower solenoid valves are supplied voltage through the travel fuse.

The tag axle solenoid valves are isolated from the front and drive axle solenoid valves only during a tag dump/lift operation. During normal travel or leveling operations the tag axle solenoid valves work in conjunction with the drive axle solenoids valves.

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LEVELING PROCEDURES

MANUAL AIR LEVELING

All current HWH air leveling systems can be operated in the manual mode. This is accomplished using the RAISE (up arrow) and LOWER (down arrow) buttons on the right side of the touch panel in conjunction with the four yellow LEVEL lights. These are momentary buttons. The operation will stop when the button is released.

IMPORTANT: It should be noted at this time that this system is designed to be a computerized leveling system. Manual operation is provided for operator convenience and system diagnostics. Leveling the vehicle manually when the computer cannot level the vehicle may put the vehicle in a bind.

The ignition key should be on with the engine running. Running the engine while leveling will provide a better air supply for leveling the vehicle. Remember that some systems cannot be turned on unless the ignition is in the on position. The park brake must be set or the system will not latch in.

Push the AIR button, the AIR LEVEL light will come on steady. The four red WARNING lights will come on. The TRAVEL light will go out. One or two yellow LEVEL lights may be on. A lit yellow light indicates a side or end of the vehicle is low. When no yellow LEVEL lights are on, the vehicle is level.

IMPORTANT: With some systems and all older systems, anytime the AIR button is pushed one time the computer will monitor the use of the system. If the system is left unattended for approximately five minutes, the system will shut down and the touch panel will turn off. If the ignition is on the vehicle will return to ride height.

Always level from side to side first. If no side yellow lights are on, the vehicle may be leveled front to rear. Lowering the vehicle completely before leveling is not recommended. If the vehicle has three point air leveling it should not be lowered before leveling. A corner of the vehicle can be raised by first raising a side then the end of the vehicle.

Pushing an up or down arrow sends a +12 volt signal to the appropriate valves. Remember current HWH air leveling systems will operate the valves as a BI-AXIS[®] system.

When leveling, push and hold the LOWER (down arrow) button opposite the lit yellow light starting with the side LEVEL lights. If a yellow light will not go out in the down mode, push and hold the RAISE (up arrow) for the yellow lights, starting with the side LEVEL lights.

If a side and front or rear yellow light is on and the side light will not go out in the down mode, but goes out after raising the low side, use the RAISE (up arrow) buttons when leveling the vehicle from front to rear. Trying to lower the ends of the vehicle when one side is completely lowered may twist the

vehicle. On the front of the vehicles with 600 and 680 series leveling, if one side is completely lowered the opposite front air bags will not lower.

When manual leveling is complete, turn the ignition off. Then push the touch panel "OFF" button. If the touch panel is turned off before the ignition, the vehicle will return to ride height. If the touch panel is not turned off, it will turn itself off and the vehicle will return to ride height of the ignition is on. The system will NOT go into the SLEEP mode if manual leveling is used.

NOTE: Newell vehicles will not return to TRAVEL when the OFF button is pushed until the TRAVEL button is pushed when the ignition is on.

AUTOMATIC AIR LEVELING

The 500, 600 and 680 series leveling systems are designed to be automatic systems. The control box contains a program chip that makes decisions on how to level the vehicle when the system is in the automatic mode. The level sensing unit sends ground signals to the control box to turn yellow LEVEL lights on when a side, end or corner of the vehicle is low. The control box monitors the yellow lights and performs leveling functions accordingly.

Turn the ignition to "ON". The engine should be running. This provides a better air supply for leveling. Some systems cannot be turned on if the ignition is not on. The park brake must be set if the ignition is on. If the park brake is not set the AIR LEVEL light and the NOT IN PARK light will come on while the "AIR" button is being pushed. The panel will turn off when the button is released.

Pressing the AIR button one time turns the system on. The AIR LEVEL light will be on steady. The "TRAVEL" light will be out. The four red WARNING lights will be on and one or two yellow LEVEL lights may be on.

DO NOT dump all the air from the air bags at this time. Allow the system to level the vehicle from travel height.

Press the air button a second time. The AIR LEVEL light will start flashing and the system will start leveling the vehicle. If all the yellow LEVEL lights go out, the AIR LEVEL light will quit flashing and stay on steady. The system goes into a "SLEEP" mode and will maintain level until the system is turned off. If all of the yellow lights will not go out, the system will indicate EXCESS SLOPE and hold until the system is shut off.

See the following two sections for detailed explanations of the "SLEEP" mode and the "EXCESS SLOPE" mode.

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All air leveling programs are based on timed sequences and the yellow LEVEL lights. An example would be in one program a lower solenoid valve has to be on for 45 seconds or the yellow light has to go out before the computer will go to the next function. Times used to perform different functions is the main difference between programs.

There are two basic leveling programs, but there can be variations of these programs. Locating the program chip number will allow you to get the exact leveling program being used.

The most common leveling program is one where we first attempt to level the vehicle by lowering the high side or end of the vehicle. The computer will always level the vehicle side to side before leveling front to rear. If a side light comes on during front to rear leveling, the computer will stop front to rear leveling and level the vehicle side to side. After a set amount of time, usually 45 seconds, if the yellow light will not go out in the lower mode, the system will go into a raise mode. It will put air into the air bags for the side or end of the vehicle that is low, trying to put out the yellow light by raising the vehicle. Once the system goes into the raise mode it will not return to a lower mode. The following is an example of how this program would level a vehicle:

A right side and front yellow LEVEL light is on. Dump air from the left side (high side) for 35 seconds and the right side LEVEL light goes out. Front light is still on. Dump air from the rear (high end) for 45 seconds, the front LEVEL light does not go out. Switch to raise mode. Add air to the front to raise. While adding air to the front, the right side LEVEL light comes back on. Quit the front raise and raise the right side until the right side LEVEL light goes out. Quit right side raise. Return to front raise because the front LEVEL light is still on. After a few seconds the front LEVEL light goes out. The vehicle is level and the system goes into the sleep mode.

The other program is designed for a vehicle that because of the weight of the rear of the vehicle and the suspension being used, side to side leveling is hard to accomplish. When the system is turned on and the computer sees a rear LEVEL light or a rear and side LEVEL light the first thing that is done is the raise solenoids for the rear are turned on and the rear of the vehicle is raised for 30 seconds. Any change in the yellow lights during this process will not affect the 30 second raise function. If either or both yellow LEVEL lights go out, the 30 second raise function will continue until complete.

After the 30 second raise function is complete, the computer will check the yellow lights and level the vehicle starting with the lower high side program.

If a side or side and front LEVEL light is on, the computer will start with the lower high side program. The lower high side program is the same as the first program that was discussed.

After an initial 30 second raise function, the system will not use a 30 second raise function again, no matter which yellow LEVEL lights are on. The computer will not use the 30 second raise function when it is in the SLEEP mode.

SLEEP MODE

The SLEEP mode is a routine that will maintain the level position of the vehicle over an extended period of time. If the vehicle is leveled, all yellow LEVEL lights go out during the automatic leveling procedure, the computer will go into a SLEEP mode. This happens automatically after all the LEVEL lights go out. The system will NOT go into a SLEEP mode if manual air leveling is done.

The SLEEP mode starts after all the yellow LEVEL lights have gone out. The computer goes to sleep. The red AIR LEVEL lights stay on steady. The ignition can be turned off. After 30 minutes, the computer wakes up. It will now stay awake and monitor the yellow LEVEL lights. Flashing LEVEL lights will not affect the computer. The computer must see a LEVEL light on constant for one minute. If a LEVEL light comes on constant, the computer will re-level the vehicle, starting with the original lower high side leveling routine. (A 30 second raise routine will not be used when the computer is in the SLEEP mode.) After the yellow lights go out and the vehicle is re-leveled, the computer goes back to sleep for 30 minutes. The computer will then wake up and begin monitoring the yellow LEVEL lights. It will continue this routine until the touch panel is turned off.

If no yellow LEVEL lights are observed by the computer, the computer stays awake and monitors the LEVEL lights. The only time the computer goes back to sleep is if the vehicle has been re-leveled.

There is no SLEEP indicator on the touch panel that indicates the computer is asleep or awake. When the computer is awake the red AIR LEVEL light will flash vary rapidly while a yellow light is lit. If a yellow light stays on constant for one minute, the AIR LEVEL light will flash slower indicating a leveling process has started.

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EXCESS SLOPE

EXCESS SLOPE is a situation where a vehicle can not be leveled automatically, (all yellow lights will not go out) in a set amount of time. EXCESS SLOPE is normally 10 or 15 minutes. A few systems may allow as much as 45 minutes before going EXCESS SLOPE.

The EXCESS SLOPE time does not start until the computer starts the raise low side or end functions. EXCESS SLOPE time is not the accumulative time of all raise functions. The air solenoids for a specific raise function must be on without interruption for the specified EXCESS SLOPE time before the system will go into EXCESS SLOPE.

With older systems, the computer would go into the SLEEP mode if the system went into EXCESS SLOPE. All current programs will leave the touch panel on if the system goes into EXCESS SLOPE, but will not go into the SLEEP mode. The AIR LEVEL light and the EXCESS SLOPE light will stay on until the panel is turned off.

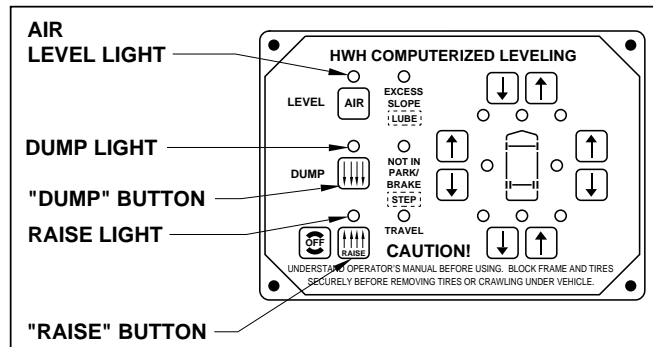
A few programs have a background level timer of 15 minutes. This is 15 minutes of accumulative time for all functions after the "AIR" button is pushed a second time. The system will go into the SLEEP mode not EXCESS SLOPE mode if this timer reaches 15 minutes, even if yellow LEVEL lights are still on. The EXCESS SLOPE time for this system is 10 minutes. If 10 minutes of leveling in the raise mode happens before the 15 minutes background level time expires, the system will go into EXCESS SLOPE and not go into the SLEEP mode.

"DUMP" AND "RAISE" BUTTONS

The "DUMP" and "RAISE" buttons are provided to allow the operator to raise or lower the vehicle while the vehicle is moving short distances to avoid an obstacle, such as lowering the vehicle to get into a building.

CAUTION: The vehicle should not be moved at speeds in excess of 5 m.p.h. unless the vehicle is at the proper ride height. It is the operator's responsibility to check that the vehicle is at the proper ride height for traveling.

The "DUMP" and "RAISE" buttons are on the left side of the touch panel beneath the AIR button. Each button has its own indicator light. The "DUMP" and "RAISE" buttons will work one of two ways. With one system the buttons will be momentary, working only while being pushed. The other system allows the "DUMP" and "RAISE" buttons to latch in after being pushed.



Momentary "DUMP" and "RAISE" buttons. If the system has momentary "DUMP" and "RAISE" buttons, the buttons can be used about anytime. The ignition can be on or off. The park brake does not have to be set. The touch panel can be on or off. The only time the "DUMP" and "RAISE" buttons will not work is if the touch panel is in the automatic leveling or SLEEP mode.

When a momentary "DUMP" button is pushed, a +12 volt signal is sent to all lower solenoid valves in the system. The red AIR LEVEL light will come on steady. The red DUMP light will flash. Air will be exhausted from all the air bags lowering the vehicle. When the "DUMP" button is released, the lower solenoid valves will close. The indicator lights will go out. If the ignition is off, the vehicle will stay in the position it was when the button was released. If the ignition is on, the system will go to the TRAVEL mode and the vehicle will return to travel height. If the touch panel was on when the "DUMP" button was pushed, the touch panel will turn off when the button is released.

When a momentary "RAISE" button is pushed, a +12 volt signal is sent to all raise solenoid valves in the system. The red AIR LEVEL light will come on steady. The red RAISE light will flash. Air will be added to all the air bags, raising the vehicle. When the "RAISE" button is released, the raise solenoid valves will close. The indicator lights will go out. If the ignition is off, the vehicle will stay in the position it was when the button was released. If the ignition is on, the system will return to the TRAVEL mode and the vehicle will return to travel height. If the touch panel was on when the "RAISE" button was pushed, the touch panel will turn off when the button is released.

Latching "DUMP" and "RAISE" buttons. A system with latching "DUMP" and "RAISE" buttons must have the ignition on to function. The park brake does not have to be set. The touch panel can be off or on. The "DUMP" and "RAISE" buttons will not work if the touch panel is in the automatic level or SLEEP mode.

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MOSCOW, IOWA 52760

HWH SYSTEMS TEXT BOOK

Systems with latching "DUMP" and "RAISE" buttons are connected to a transmission speed switch. A +12 volt signal is supplied, to the control box if the vehicle is moving at a slow speed, usually below 15 m.p.h. When the vehicle exceeds 15 m.p.h., or whatever speed the speed switch is set at, the +12 volt signal is turned off. If the +12 volt speed switch signal is not present, the "DUMP" and "RAISE" buttons will work like momentary "DUMP" and "RAISE" buttons.

CAUTION: The "DUMP" and "RAISE" buttons should not be pushed if the vehicle speed exceeds 15 m.p.h.

When a latching "DUMP" button is pushed, a +12 volt signal is sent to all the lower solenoid valves. The AIR LEVEL light will come on steady. The red DUMP light will flash. Air will be exhausted from all the air bags lowering the vehicle. The vehicle will lower as far as it can go. The touch panel and system will stay in the DUMP mode when the button is released and the vehicle will remain in a completely lowered position. The panel will remain in the DUMP mode until the "OFF" button is pushed or until the vehicle speed exceeds 15 m.p.h. This speed may be set lower on some vehicles. The system will not return to the TRAVEL mode and the ve-

hicle will not return to travel height until the "OFF" button is pushed or the vehicle exceeds the speed switch setting.

When a latching "RAISE" button is pushed, a +12 volt signal is sent to all the raise solenoid valves. The AIR LEVEL light will come on steady. The red RAISE light will flash. Air will be added to all the air bags raising the vehicle. The vehicle will raise as far as it can go. The touch panel and system will stay in the RAISE mode when the button is released and the vehicle will remain in a completely raised position. The panel will stay in the RAISE mode until the "OFF" button is pushed or until the vehicle speed exceeds the speed switch setting. The system will not return to the TRAVEL mode and the vehicle will not return to travel height until the "OFF" button is pushed or the vehicle exceeds the speed switch setting.

NOTE: Newell systems with the TRAVEL button on the touch panel will not go into the TRAVEL mode when the OFF button is pushed, unless the park brake is released. If the park brake is on, the TRAVEL button must be pushed to return the system to the TRAVEL mode.

PREVOST AIR LEVELING

SYSTEM COMPONENTS AND FUNCTIONS

Prevost automatic air leveling systems are not like other HWH air leveling systems. Prevost air leveling systems are always 3-point leveling systems. At this time, they cannot be done as a 4-point leveling system. Prevost air leveling systems do not use air solenoid manifolds. The Prevost air valves are used for leveling functions.

Prevost air leveling systems are controlled either by a 500 series ribbon cable control box or a 680 series modular cable control box.

Prevost buses are equipped with a manual leveling system referred to as the LEVEL LOW system. This system can be used to manually raise or lower the vehicle to level it. The HWH system disables the LEVEL LOW system when the HWH touch panel is on. The Prevost valves are +24 volt operated valves. Some Prevost buses with room extensions and a leveling system installed at HWH or 680 Series systems installed at Country Coach, have had the coils for the air valves, except the TRAVEL valve, replaced by HWH with +12 volt operated coils. The LEVEL LOW system is completely eliminated on these buses. The TRAVEL valve on any Prevost bus will always be a +24 volt valve.

There are five electrically operated air solenoid valves in the Prevost system. These valves control a series of air pilot operated valves to perform the travel and leveling functions. There is an AIR SUPPLY valve used for raise functions. There is a FRONT CONTROL valve, a TRAVEL valve and there is one valve each for LEFT REAR and RIGHT REAR.

When the TRAVEL valve is energized, the air operated valves are shifted into a position allowing the height control valves to regulate the air flow to and from the air bags.

There is an air operated valve that controls the flow of air to and from the air bags during leveling procedures. This valve will normally allow air to exhaust from the air bags when a FRONT CONTROL, RIGHT REAR or LEFT REAR air solenoid is energized. When the AIR SUPPLY valve is energized, the pilot valve is shifted allowing air into the air bags when control valves are energized.

When a FRONT CONTROL, RIGHT REAR or LEFT REAR air solenoid is energized, this shifts air operated valves into a position allowing air into or out of the air bags for leveling functions.

HWH supplies a control box, touch panel, sensing unit, harnesses and on most Prevosts, an air compressor. These components perform the same functions for the Prevost bus as they do with other systems. The control box is the main difference. It needs +12 volt battery voltage to run the system, but also has a +24 volt ignition input to supply power for the TRAVEL valve. Except the Prevost done at HWH and 680 Series systems done at Country Coach, the box supplies +24 volt outputs to run the air solenoid valves. Also the park brake signal is a +24 volt signal instead of a ground signal. The control box also has circuitry to interrupt the LEVEL LOW system.

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MOSCOW, IOWA 52760

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PREVOST AIR LEVELING (CON'T)

LEVELING SYSTEM OPERATION

Never completely lower a Prevost bus before leveling the bus, either in manual or automatic leveling. The Prevost is a three point leveling system. Leveling the vehicle from side to side after dumping all the air from the bags may put undo stress on the vehicle.

With either series of leveling systems, the engine should be running for initial leveling. This provides a better air supply for leveling. With the 500 series system, the ignition does not have to be on to turn the touch panel on. With the 680 series system, the ignition must be on or the touch panel will not latch in and stay on. With all systems, if the ignition is on, the park brake must be set or the touch panel will not latch in. With the 500 series Prevost leveling system, the ignition does not need to be on to use the "DUMP" or "RAISE" buttons.

When the AIR button is pushed, the +24 volt power to the LEVEL LOW system is interrupted. This turns the TRAVEL valve off. The LEVEL LOW system is disabled. The LEVEL LOW warning light is turned on indicating the leveling system is in use. The AIR LEVEL light comes on steady. The "TRAVEL" light on the touch panel will go out. The four red WARNING lights on the touch panel will come on. One or two yellow LEVEL lights may come on.

As with any HWH system, the side to side leveling should always be done first. With the Prevost bus, side to side leveling is accomplished using only the rear bags.

After the AIR button has been pushed one time, the vehicle can be leveled manually, using the RAISE (up arrows) and LOWER (down arrows) buttons on the right side of the touch panel, or automatically. The following is valve operations to obtain a specific raise or lower function either in manual or automatic leveling:

RAISE FRONT - Energize AIR SUPPLY and FRONT CONTROL valves.

LOWER FRONT - Energize FRONT CONTROL valve.

RAISE RIGHT SIDE - Energize AIR SUPPLY and RIGHT REAR valves.

LOWER RIGHT SIDE - Energize RIGHT REAR valve.

RAISE LEFT SIDE - Energized AIR SUPPLY and LEFT REAR valves.

LOWER LEFT SIDE - Energize LEFT REAR valve.

RAISE REAR - Energize AIR SUPPLY, RIGHT REAR and LEFT REAR valves.

LOWER REAR - Energize RIGHT REAR and LEFT REAR valves.

MANUAL AIR LEVELING

The RAISE (up arrows) and LOWER (down arrows) buttons are momentary buttons. They must be pushed and held to perform a function. Releasing the button will end a particular function.

Use the RAISE and LOWER buttons in conjunction with the yellow LEVEL lights to level the vehicle. If a side LEVEL light is on, push and hold the LOWER button for the opposite side. If the LEVEL light will not go out lowering the high side, push and hold the RAISE button for the side with the LEVEL light on.

IMPORTANT: It should be noted at this time that this system is designed to be a computerized leveling system. Manual operation is provided for operator convenience and system diagnostics. Leveling the vehicle manually when the computer cannot level the vehicle may put the vehicle in a bind.

When the side lights are out, level the vehicle front to rear. If the side was leveled by lowering the high side, try leveling front to rear by lowering the high end before raising the low end. If the side was leveled by raising the low side, go immediately into raising the low end of the vehicle to level from end to end. When all of the LEVEL lights are out the vehicle is level.

The touch panel will NOT go to the SLEEP mode and keep the vehicle level if manual leveling is used. After pushing the AIR button one time, if the touch panel is not used, the touch panel will turn the system off in 4 or 5 minutes. If the ignition is on, the vehicle will return to travel height.

AUTOMATIC AIR LEVELING

The automatic air leveling sequence for Prevost buses is the same as the other 600 Series and 680 Series Leveling Systems. Side to side leveling is done first. Lowering the high side or end is tried first before raising the low end of the vehicle. If the side cannot be leveled by lowering and a front or rear light is on after the side to side leveling is accomplished by raising, the computer goes immediately into a raise mode to level the vehicle front to rear.

SLEEP MODE

When all the LEVEL lights are put out in the automatic mode, the system will go into a SLEEP mode. The ignition can be turned off. The AIR LEVEL light will remain on. The sleep mode is the same for all HWH air leveling systems. The computer sleeps for 30 minutes and wakes to monitor the LEVEL lights. It will not go back to sleep unless the vehicle is re-leveled. A LEVEL light must be on continuously for one minute before the computer will react to it. The vehicle is re-leveled using the original leveling down program. After the vehicle is re-leveled, the computer will sleep for 30 minutes and awake to monitor the LEVEL lights. The system will continue this routine until the touch panel is turned off.

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HWH CORPORATION

MOSCOW, IOWA 52760

HWH SYSTEMS TEXT BOOK

PREVOST AIR LEVELING (CON'T)

EXCESS SLOPE

The EXCESS SLOPE feature works the same with a Prevost bus as it does with other systems. The EXCESS SLOPE time for Prevost buses is 45 minutes after starting raise procedures for leveling. If the system goes into EXCESSIVE SLOPE, it will not go into the SLEEP mode. The touch panel will stay on with the EXCESS SLOPE light on until the "OFF" button is pushed.

"DUMP" AND "RAISE" BUTTONS

Please refer to the previous "DUMP" and "RAISE" buttons section. These buttons function for the Prevost buses the same as the other systems. The 500 Series Prevost System has momentary "DUMP" and "RAISE" buttons. The 680 Series Prevost System has latching "DUMP" and "RAISE" buttons tied to the transmission speed switch.

TAG AXLE

For all HWH leveling system functions, the tag axle works with the drive axle. Any TAG DUMP/RAISE operations are performed by Prevost equipment. HWH equipment is not used in any way for TAG DUMP/RAISE operations.

EPILOGUE

HWH manufactures many different air leveling systems for many different manufacturers, BUT the touch panel functions for all systems are the same. Only automatic leveling procedures, timing sequences, ignition positions criteria and DUMP and RAISE functions change. These features depend on the control box and vehicle your are dealing with. Know the vehicle you're dealing with and know where to get the information about the system that is used on that vehicle.