Recommended shielding connections

Following are some examples of the recommended method of connecting shielding cables in a system using Rinstrum weight indicators. As the signal from the load transducer is very small, in the order of millionths of a volt, close attention paid to these connections is necessary to get the best performance from your scale system.

All of the application specific examples show how to connect the shielding conductors to satisfy the general recommendations.

General Recommendations

- Power supply must be isolated from Earth

  Any power supply that connects GND (or positive) to earth breaks the next recommendation and should not be used. All Rinstrum power supplies are isolated. Test by ensuring that both output terminals are open circuit with respect to mains earth.

- No signal lines are connected to shield

  Connection of any signal line (load cell or communications) to the shield gives a path for noise to couple onto the measurement electronics. There is also the possibility that balancing current will flow through this connection and cause damage to the indicator or remote system that will not be covered under warranty.

- Shield is connected to earth at one point only

  Multiple earth connections result in ground loops. This should be avoided for two reasons. The first is that in almost all cases the two grounds will be at separate potentials, this will result in a current to flow between the two and induce noise into the system that is being shielded. The second is that loops are very effective magnetic field antennas, in fact most AM radio antennas are loops. Creating such a loop allows environmental RF fields a path to couple into the measurement system.

- Six wire load cell connection is used

  Except for systems where a single un-extended 4 wire load cell is used six wire load cell connections provide the best noise protection. Any multiple load cell system should have at least the home cable, preferably all load cell cables, run as 6 wire. The addition of sense wires to measure the excitation as applied to the cell compensates for both the variation of the cable resistance and common mode noise on the signal.

Some real world examples of shield connections that satisfy these rules are shown on the following pages. To highlight the shielding circuit shield and earth connections are shown in all of the examples with a dot, •. Where AC powered devices are used the earth connection to the case is built in for safety reasons and need not be made separately.

A single platform scale with remote display

This example shows a multiple load cell platform scale. The platform is assumed to be isolated from the installation earth.

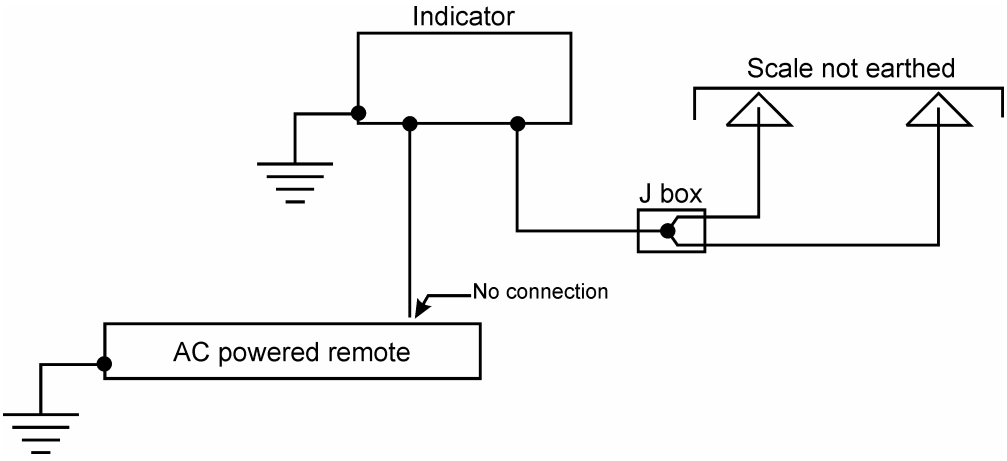

Figure 1 Platform with remote

In this example the single earth connection is the indicator case. Note that the communications cable to the remote is not connected at the remote to avoid a loop via the remote case earth.

A single deck weighbridge with remote display

A weighbridge is similar to a platform except in the case where the deck is earthed independently. Some load cells have the shield connected to the load cell body which creates two earth loops when the shields are connected as for a platform. In this case the connections shown in Figure 2 should be used. Otherwise connect as in Figure 3.

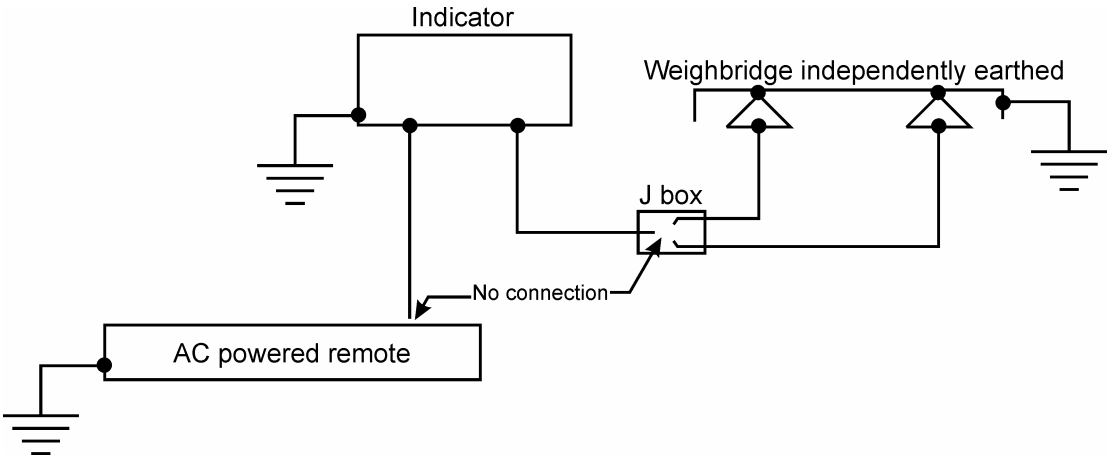

Figure 2 Weighbridge with shield/body connected load cells

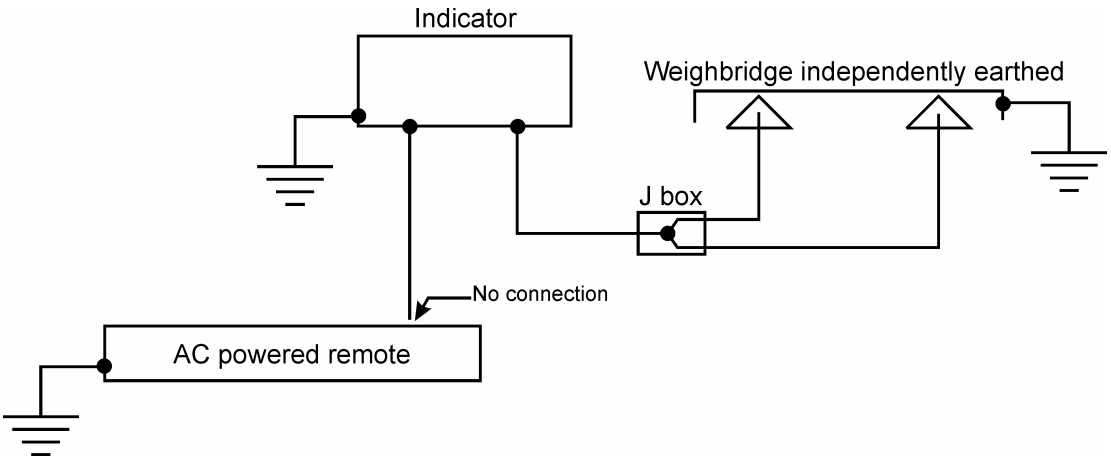

Figure 3 Weighbridge with shield isolated load cells

Junction box with built in transient protection

Some junction boxes are fitted with surge protection devices such as transorbs or gas arrestors. To keep the path for the transient noise short these junction boxes are best earthed directly. The next two examples show the recommended methods of connecting these when using either shield connected or shield isolated load cells. These methods are also acceptable alternatives for those shown above regardless of if the j-box is protected or not.

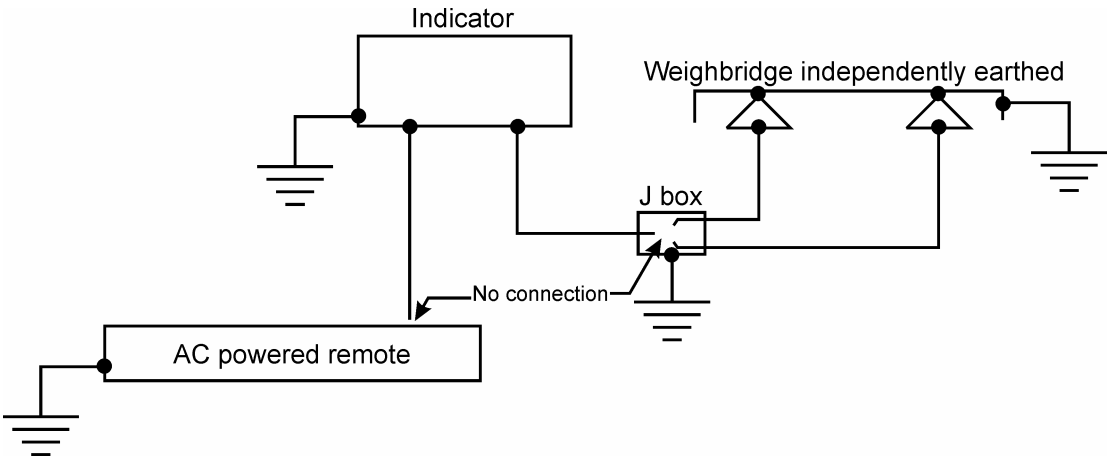

Figure 4 Weighbridge with shield connected cells and earthed j-box

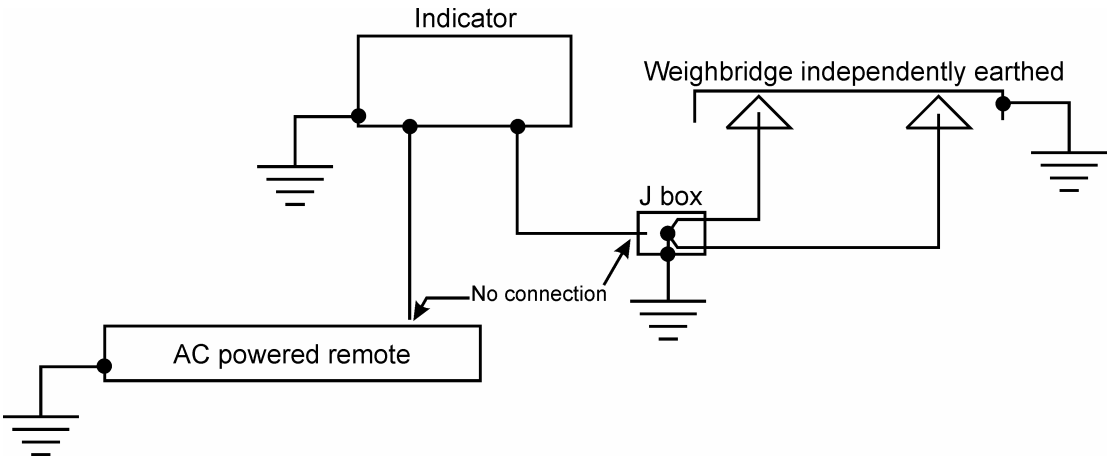

Figure 5 Weighbridge with shield isolated cells and earthed j-box

Multi deck weighbridge with summing indicator

In the case where there are multiple bridges connected to a summing system each of the bridges can be considered a standalone installation. In this case install, test and commission each bridge individually using the appropriate shielding connections referring to the diagrams shown above.

Once you are satisfied each bridge and its associated systems are working and stable connections can be made to the summing unit from each bridge indicator. Connect the communications cable shields at the bridge indicator end only. An example of this is shown in Figure 6 on page 5.

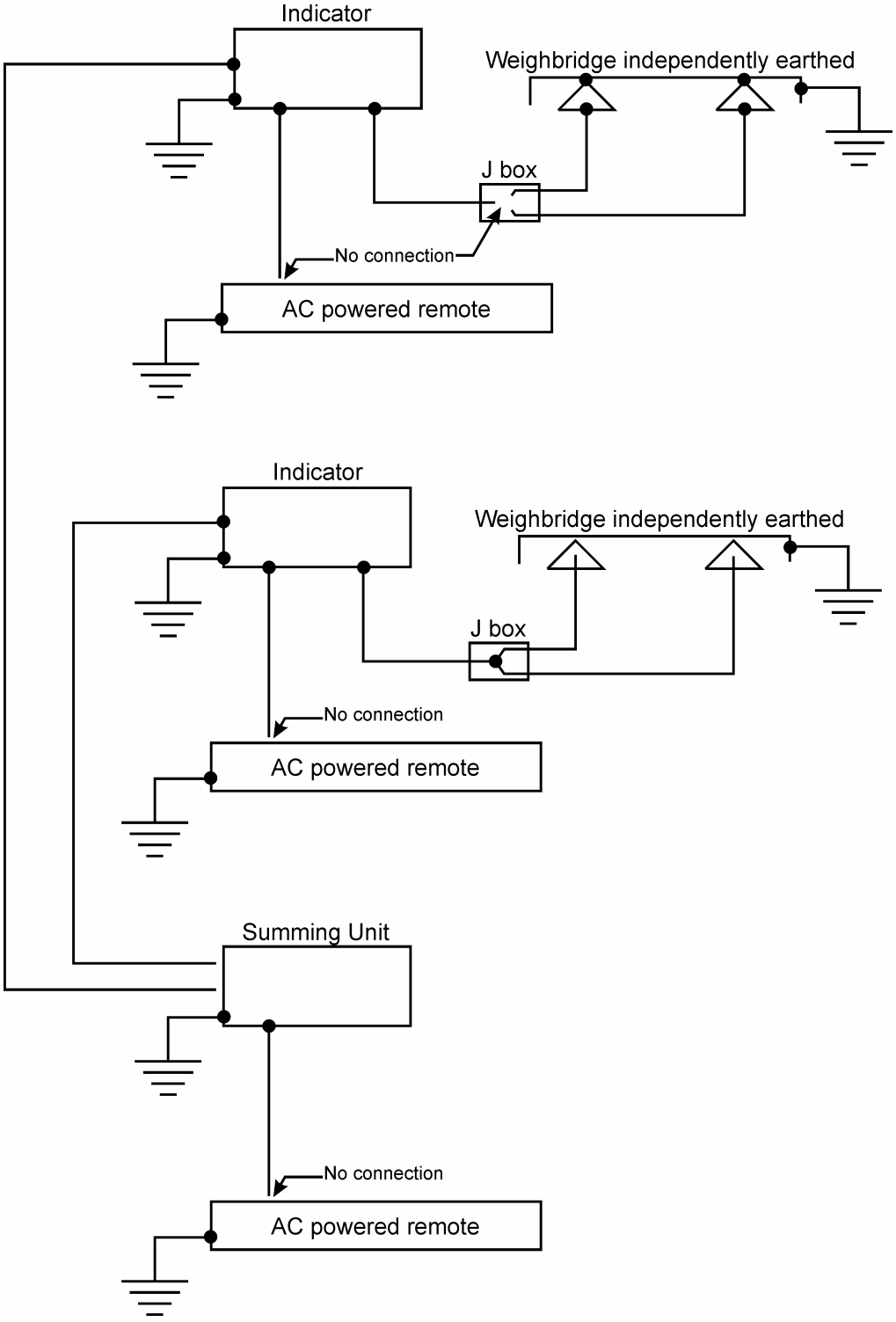

Figure 6 Multi deck weighbridge with summing unit

Scale system connected to third party remote system

A common cause of problems is when connecting to a desktop PC for data collection. The problem arises as most PC serial ports are not isolated from the earth and connect signal (RS232) ground to the system earth.

In any Rinstrum indicator the internal power supply is isolated from any other as well as the earth. This allows multi scale systems to be connected together without the need for additional isolation. When a system that does not have an isolated power supply, such as a PC, is connected to the system the earth-ground connection will reference the whole system's internal supplies to earth, see the diagram below.

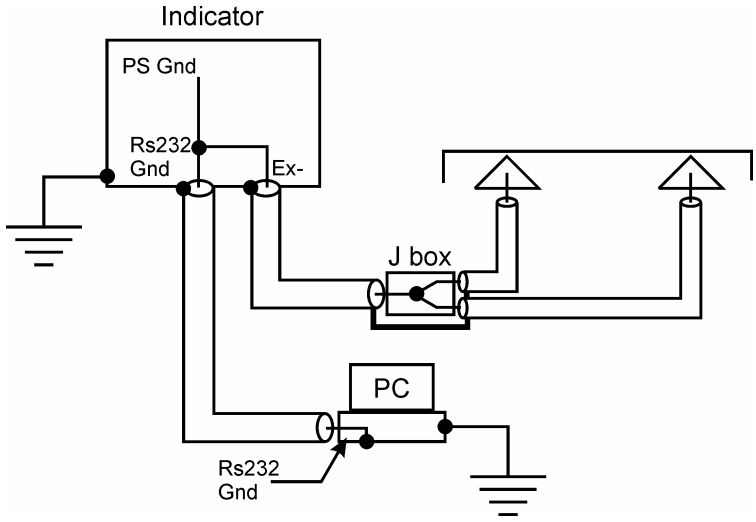

Figure 7 Scale system internal ground connections with PC, avoid where possible

The system above breaks the rule that no signal should be connected to earth but may not cause any obvious problem as the earth-ground connection is only made once. It does however provide an additional path for noise to appear in the measurement system and is not ideal.

There is a much larger chance of causing damage to the indicator if the scale system already has a signal line connected to earth. Some load cells or junction boxes have a connection from excitation negative to shield as in Figure 8. Damage can be caused when, as is normally the case, the earth at the PC and the shield are at different potentials. This voltage (Ve) causes a current to flow through the ground circuit. It is this current that burns out the indicator's ground circuit or the communications driver IC, at best the loop formed acts as a path for measurement noise.

The best way to solve this problem is to ensure that the system has no signal to ground connections. In the case where a PC must be connected and a signal-ground connection is made it will do no damage when there are no other paths for current to flow. For the best noise performance a communications port isolating device should be included on the PC connection.

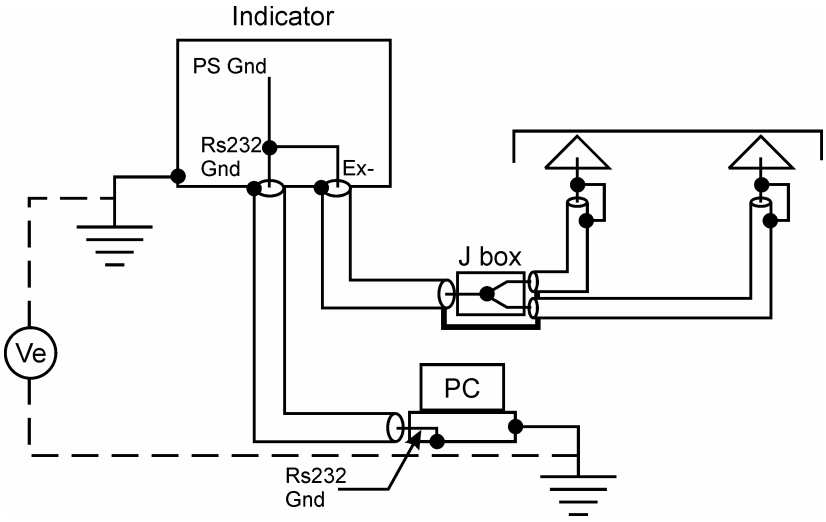

Figure 8 System with multiple signal ground connections, risk of damage to indicator

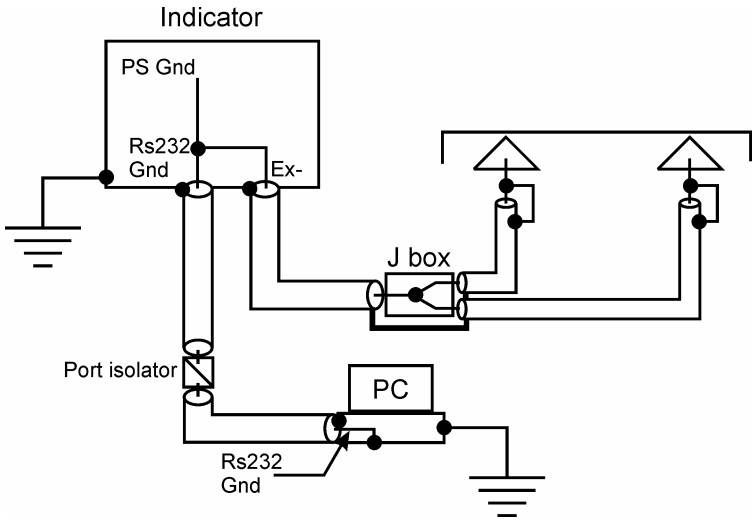

Figure 9 System with port isolator to break signal-ground connection

Test guide for scale systems

The tables following can be used as a checklist when trouble shooting or a commissioning test record. All of the measurements can be made with a digital multi meter in resistance (ohms) mode. When contacting us for advice this information will make it easier to solve any issue you might have.

Scale Details		
Load Cells	Make	
	Model	
	Capacity	
	Output at capacity (mV/V)	
	Bridge resistance (R)(ohms)	
	Number(N)	
Scale	Type (bridge, platform, etc)	
	Capacity	
	Count-by	
Junction box	Make	
	Model	
Instrument	Make	
	Model	
Power supply	Make and model	
	Rated voltage and output current	
	Is supply isolating?	
Remote display	Make	
	Model	
	Connection type (RS232, 485)	
Other systems connected	Type	
	Connection type	

Power the system down, disconnect the load cell cable from the instrument and measure the resistance between each signal line and the shield. Record the measurements in the table below. There should be no connection (infinite resistance) from any of these signals to the shield. There should also be no connection between the shield and the instrument earth point with the load cell cable disconnected.

Next measure the resistance between the pairs of signals shown in the table. These should be all roughly the same and equal to the load cell resistance divided by the number of load cells (R/N). Any of these measurements that appear out of range could indicate a crossed wire, faulty cable or faulty load cell.

Finally measure the shield to signal line resistance on any communications interfaces, these should also have no connection.

Measurements		
Cable	**Measurement pair**	**Measurement (ohms)**
Load cell cable	Excitation + to shield	(open)
	Excitation - to shield	(open)
	Signal + to shield	(open)
	Signal - to shield	(open)
	Sense + to shield	(open)
	Sense - to shield	(open)
	Shield to earth (at indicator)	(open)
	Excitation+ to Excitation-	(R/N)
	Signal+ to Signal-	(R/N)
	Sense+ to Sense-	(R/N)
RS232 interface	Transmit to shield	(open)
	Receive to shield	(open)
	Ground to shield	(open)
	Remote system shield to ground	(open)
Power supply	Power supply negative to AC earth	(open)
	Power supply positive to AC earth	(open)