USING A TRANSMITTER

I. GENERAL SAFETY INSTRUCTIONS

Please, read carefully the operating and safety manual prior to setup. The non-respect of these instructions can lead to people or animals getting hurt or damaged.

These notes warn for things that can lead to people or animals getting hurt or to equipment getting damaged

Read carefully the operating and safety instructions as all labels affixed to the device. Be sure you understand their signification before use. If you do not understand or have doubts about any point of this user's manual, contact IRIS INSTRUMENTS for an explanation, a demonstration or a formation.

- Keep the user's manual with the device for future reference. Thus keep it intact, readable and at the disposable of qualified persons during the entire life of the device. Be sure that all the interveners have read the user's manual and safety instructions.
- The use of a device in accordance with the safety instructions does not guaranty the absence of risks. Proceed carefully. Do not use this device if you have a doubt on the correct and safe way to use it.
- In all circumstances, the user must scrupulously respect the entire instructions of the user's manual. He must also comply with all applicable local and national laws of the jurisdiction of using of the device.
- People under the influence of drugs, alcohol, pharmaceutical products or any other product that might disrupt their reaction should not perform any operation or manipulation of the device or associated parts.
- This device is designed for industrial use only.
- IRIS devices are not designed for use in hazardous environments.

1. List of the major risks and precautions to be followed before and during the use of the device

- Be sure that the equipment is in good working order before leaving on the field.
- The device can be heavy, be careful when you wear it. Use your knees, and not your back, to carry the device. When you carry the device by the front face, use either its handles or carrying strap.
- The device must not fall during its use. Place it down flat, directly on the ground, or slightly elevated to avoid any falls from heights and not create obstacles with the cables (especially if they are rigid).
- Follow rigorously handling and operation instructions. A wrong plug might be dangerous.

- The device may in no circumstances be connected to the electricity distribution network.
- Observe the supply voltage of the device. The connection of the device to excessive voltage source can cause irreversible damages to the device. Make sure you use the right voltage source.
- Do not modify the jack and unroll totally the power cable. Protect it from sharp pieces. A damaged or twisted power cable increases the overheating risks.
- Use only cable in good conditions, sufficiently isolated and well adapted, regarding operating current and voltage levels of the device. Replace any worn cable.
- Use non-metallic objects and tools to avoid any electrical contact with the cables and electrodes (meter tape, hammer, …)

- Wear your personal protective equipment.

- Observe the safety distance between you and the electrodes or cables (determination of the step voltage)
- Always inform about your presence on the field.
- Communicate clearly between operators on the field using walkie-talkies that have been checked before the leaving on the field.
- Be sure that nothing and nobody can touch the cables and electrodes during the functioning of the device.
- The transmitter should never be left unattended.

- Include a fire extinguisher in your list of equipment.
- Protect the working area using safety cones.
- Protect and identify the measurement area. Use safety cones, labels and panels “Danger, high voltage” wherever there is people present.
- Be sure to thoroughly clean the area around the injection electrodes. The passage of current in the electrode can produce sparks and cause a fire if the vegetation is abundant.
- In case of problem, press the emergency push button to stop immediately the injection process. Before releasing the emergency button, make sure that everything is in order and warn all the operator of the power reconnection.

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2. Maintenance et assembly

The assembly and maintenance operations must be realized according to the procedure, the preparation conditions and the environment described in the maintenance documentation, by persons with the training and qualifications required to work on electrical equipment.

- Before any intervention, disconnect the energy source. In some cases, input voltage is present in the device even if the general switch is OFF.
- Make sure that the capacitors are discharged. They can maintain high voltages within the device, even when the power is off. The contact could result in death or serious injuries. Wait at least 10 minutes before opening the device.
- Some parts of the device are used to dissipate excess of heat produced by the components. The parts and components remain hot for some time after switching off the device. Be careful not to burn yourself in contact with these parts.
- Use tools in good conditions and suitable for the work to be done. Be careful not to drop any piece of metal into the device (screw, wiring cables, tools…)
- During all life phases of the device, all operation that is not described in the user's manual is strictly prohibited. Always use accessories and spare parts approved by IRIS INSTRUMENTS

II. Personal protective equipment

Considering the voltage levels present, the wearing of personal protective equipment is more than highly recommended. These are mainly electrically insulating shoes and insulated gloves.

1. Insulated gloves

Gloves are to be used if you must or may inadvertently touch metal parts which can be under electrical tension under normal or abnormal conditions.

You must use gloves in good condition and adapted for the voltage involved

- Class 0 up to 1000 VAC
- Class 1 up to 7500 VAC

2. Electrically insulated shoes

Wearing electrically insulating shoes suitable for the voltages involved allows you to isolate yourself from the ground and therefore effectively protect yourself against step voltage.

Indeed, if you are standing near an energized grounded stakes, you may to be traversed by a current, generated by the step voltage. This current is variable and depends on many parameters:

- The soil resistivity,
- The resistance of the human body,
- The intensity of the injected current,
- The distance between you and the point of injection,
- The distance between your two feet when the current passes

The current induced by the step voltage can be lethal. A DC current of 130 mA is a threshold for cardiac fibrillation.

3. Calculation of the step voltage

Difference in voltage between the feet of a person : $U_{p(d)}$

$$U_{p(d)} = \frac{\rho I}{2\pi d}\frac{p}{p+d}$$ with:

ρ = resistivity of the ground (Ωm)
I = intensity of the current(A)
p = distance between the two feets of the person (m)
d = distance of the injection point (m)

Current crossing the person: I_{body}

$$I_{body} = \frac{U_{p(d)}}{R}$$ with:

R = Resistance of the human body (Ω)

It's necessary to be extra vigilant in soils with high resistivity.

Exemple: p = 0,70 m ; R = 3 kΩ et I = 2,5 A.						
	ρ (Ωm)	50	100	500	1000	10 000
I_{body} (mA)	d = 3 m	0,4	0,8	4,1	8,3	83
	d = 1 m	2,7	5,5	27,3	54,6	546
	d = 0,5 m	8	15	77	155	1547

Exemple: p = 0,70 m ; R = 3 kΩ et I = 10 A.						
	ρ (Ωm)	50	100	500	1000	10 000
I_{body} (mA)	d = 3 m	1,6	3,3	16,7	33	330
	d = 1 m	11	22	109	218	2184
	d = 0,5 m	30	62	310	620	6190

Walking with small steps significantly reduces the risks.

Exemple: ρ = 500 Ωm ; R = 3 kΩ et I = 2,5 A.				
	p (m)	0,8	0,6	0,3
I_{body} (mA)	d = 3 m	4,6	3,6	2
	d = 1 m	29,5	24,8	15,3
	d = 0,5 m	80	72	49,7

Exemple: ρ = 500 Ωm ; R = 3 kΩ et I = 10 A.				
	p (m)	0,8	0,6	0,3
I_{body} (mA)	d = 3 m	18,6	14,7	8
	d = 1 m	118	99,5	61
	d = 0,5m	326	290	198

4. Face Shield

The face shield is used to protect the eyes and face of operators from electric arcs. They can appear if a line opening occurs during an injection (cable disconnected for example). Wearing the screen is necessary when the face is less than 30 cm from a bare live part (end of the cable).

5. Safety earplugs

The generator powering the device is noisy. Protect yourself with adapted protective earplugs.

III. Field marking

To help you, IRIS INSTRUMENTS propose a « Security Pack » that features Safety cones labelled « Danger, High voltages » and warning plates labelled « Caution Electrical Hazard ».

They allow to warn people about the possible danger in the area and minimize the risk of contact with the electrodes, especially if they are distant from the operator and hidden by vegetation.

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