BUCKLEYS

MANUFACTURERS OF SPECIALIST TEST EQUIPMENT

ST-AC Pro'

Operating Instructions

English Version

Please read carefully before use

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Description

The ST-AC Pro' high frequency tester comprises of a lightweight, hand-held probe connected by a cable to a portable generator.

A robust aluminium case houses the generator and its components. On the front panel of the case there is:

- ON/OFF Indicator lamp
- Output ON/OFF/Control knob
- Handle probe connection

On the back panel of the case there is:

- Earth return socket
- Mains voltage selector switch
- IEC mains input socket
- Mains ON/OFF switch

Technical data

Operating temperature range:	0°C to +30°C
Storage temperature range:	-10°c to +40°c
Supply voltage:	110/120 volts or 220/240V AC (see rear panel of generator unit)
Supply frequency:	50Hz to 60Hz
Power consumption:	52W
Output voltage:	10 to 55KV
Output frequency:	100KHz – ring pulsed 50Hz
Net Weight:	4.05kg
Dimensions:	W = 175mm H = 90mm D = 235mm
Altitude:	Up to 2000m
Relative Humidity:	80% max. (non-condensing) Installation
Category:	Category II (over-voltage transients)

This product has been manufactured under the controls established by a quality management system that meets the requirements of ISO9001.

Unpacking

The ST-AC Pro' and the handle should be removed from their bags and be checked for damage. If any part is damaged, the carrier and supplier should be notified immediately. All packing material should be kept for inspection and the ST-AC Pro' should not be used.

The package contains the following items:

1 x Generator unit	1 x Probe handle	1 x Mains power lead
1 x Flexible probe lead	1 x Operating instructions	

If any of these are missing, contact your supplier immediately.

The packaging should be retained for the future to be used if the unit needs to be sent back for repair or needs to be stored.

Safety precautions and symbols

Caution, risk of danger

Caution, risk of shock

Earth (ground) terminal

Read the information in this manual carefully before using the equipment.

Note: The use of this equipment should be reviewed as part of the process risk assessment.

IMPORTANT: Service and repair of this product and its components **MUST ONLY** be undertaken by trained, approved technicians working in full accordance with Buckleys' service guidelines. Failure to do so may expose the operator to potentially lethal voltages.
Under no circumstances should anyone other than trained approved technicians attempt to dismantle or repair this product.

The ST-AC Pro' Spark Tester is intended to generate a powerful high frequency, high voltage discharge; therefore it should only be used by responsible and authorised personnel that have read and understood this manual.

The ST-AC Pro' Spark tester is designed to protect the operator from receiving a dangerous electric shock. The case is earthed and the high-voltage output is isolated from the mains supply.

The probe should **NEVER** be directed at the body.

The high voltage generated by this unit is at a frequency of 100KHz, well above the motor frequency of the human central nervous system. A serious shock is unlikely if the probe is accidentally touched during operation, however it is likely to be painful, and may result in localised burns. A greater risk is to those who might have an incipient heart condition or from the reflex action when receiving a high-frequency shock, relating to contact by the operator if working near hot surfaces or rotating machinery. Injury could also occur if the spark reached sensitive parts of the body (e.g. eyes).

In a reasonably ventilated room of a volume greater than 40m^3, the exposure to ozone produced by the high voltage spark is not expected to present a major risk to health.

In a confined space situation, it is likely that ozone levels will exceed the exposure limit and present some risk to health. This may also be the case where the user has some particular sensitivity or a pre-existing lung condition. Under these conditions adequate ventilation should be provided.

When in use always position the unit so that mains ON/OFF switch is easily accessible to the operator.

Operation

IMPORTANT: We strongly advise that individuals with pacemakers do not use our high-voltage test equipment under any circumstances.

WARNING: This equipment should **NOT** be used in a potentially explosive atmosphere as the high voltage **WILL** cause a spark and an explosion could result.

WARNING: This equipment should not be used in damp or wet conditions, or where the amount of conductive dust is greater than would normally occur.

Check that the operating voltage is in accordance with the available supply voltage by reference to the voltage selector switch on the back of the generator unit.

Connect a suitable plug (preferably fused at 3 Amps) to the mains supply cable as follows: **Brown** - Live, **Blue** - Neutral, **Green/Yellow** - Earth

WARNING: This equipment MUST be earthed

WARNING: the equipment should not be operated if any part is in a damaged condition.

Ensure that the mains supply is disconnected, and then screw the flexible probe electrode into the red end of the handle.

WARNING: do not connect electrodes whilst the generator is connected to the mains supply.

Set the output control knob fully anti-clockwise (Output OFF) and check that the mains ON/OFF switch is in the OFF position. Connect the plug to the mains supply socket and switch on. Holding the probe handle in one hand so that the probe tip is at least 20cm from any object and switch ON the generator.

WARNING: The handle should not be put down whilst the unit is switched on.

Select the output for the required size of spark by holding the probe tip close to the 4mm earth terminal on the back panel of the generator and turn the control knob to set the required spark length.

Anticlockwise = Reduce output/output OFF;
Clockwise = Output ON/increase output

The high voltage spark should only be taken from the metal end of the flexible probe and not from the side i.e. through the probe's plastic covering, as the heat of the spark may melt the plastic and could cause a fire hazard.

The output control should be adjusted for the lowest output at which an effective test can be carried out.

The probe should always be kept moving when testing as the high frequency output can cause localised heating in the article under test and could burn a hole in it.

When the testing has finished, switch OFF the generator before putting down the handle and then remove the plug from the mains supply.

Calculating the test voltage

The test voltage needs to be high enough to find the fault but not so high as to make one. With reference to BS EN 60052:2002 (Measurement of Voltage with Sphere-Gaps) it can be seen that 32,000 volts will jump a gap of 1cm between spheres of 5cm diameter. The same voltage will jump a gap of nearly 3cm between needles. This is because the shape of the electrode affects the point at which corona discharge starts i.e. the sharper the points on the electrode the lower the voltage necessary for corona discharge to start.

'Spark-over', or complete temporary breakdown of the air between the electrodes, will occur when the voltage is increased to cause localised breakdown. This soon spreads throughout the whole of the inter-electrode space and generates the required number of ions to carry the current (this may be tens of amperes). With this sudden increase in current there is a corresponding fall in the voltage across the electrode to a very low level.

For the thicker types of material in the range 1mm to 30mm the formula used in the NACE Standard SP-02-74 has been found to work well in most cases.

SP-02-74 test voltage formula

$$\text{Test Voltage} = 1250 \times \sqrt{T_{coating}}$$

Where $T_{coating}$ is the coating thickness in mils (0.001").

Alternatively

$$\text{Test Voltage} = 250 \times \sqrt{T_{coating}}$$

Where $T_{coating}$ is the coating thickness in microns (0.001mm).

After the test voltage has been calculated, it is necessary to check that the voltage is not so high as to damage the material under test. The dielectric strength is the voltage at which the material starts to break down, this is expressed in volts per mm, normally referring to DC.

To take an example, using the above formula, a 2mm thick sheet of PVC would require a test voltage of at least 11,180 volts.

Referring to the plastic manufacturer's technical data, the dielectric strength of PVC is 8,400 volts per mm. 2mm x 8,400 =16,800V, so the test voltage is not expected to damage the material.

If the dielectric strength of the material was only 5,000 volts per mm, then the test voltage would be too high, and this may result in damage to the part under test. In this case a high voltage test may still be used if tests are carried out to ensure that the test is valid.

Make a small hole in a test piece, then with the electrode over the hole, increase the voltage until a spark jumps the gap. Make a note of that voltage (for example, 10,000 volts) and then use a voltage half way between that and the dielectric strength of the material (7,500 volts). Now make some more holes in the test piece, this time at an angle, and using a 7,500V test voltage, make sure that all the faults are detected.

The output voltage of the ST-AC Pro' can be roughly set by dividing the test voltage by 1700, the answer is in mm e.g. 20,000/1700 = 11.75mm. Hold the test probe at the calculated gap from a piece of earthed metal and increase the output voltage until the spark jumps the gap.

Maintenance

The ST-AC Pro' has been designed so that no maintenance is required by the user. The ST-AC Pro' should be inspected regularly, check for damage to the unit. If damage is found, the ST-AC Pro' must not be used and should be returned to the manufacturer for repair.

IMPORTANT: Service and repair of this product and its components **MUST ONLY** be undertaken by trained, approved technicians working in full accordance with Buckleys' service guidelines. Failure to do so may expose the operator to potentially lethal voltages.
Under no circumstances should anyone other than trained approved technicians attempt to dismantle or repair this product.

Applications

Insulation Testing:
The insulation to be tested should have a conductive backing, e.g. if a joint in plastic or rubber is to be tested, it should be laid on a metal sheet. If this is not practical, aluminium foil or copper wire can be placed behind the joint. It is recommended that this should be earthed, although it is not necessary if the area of the metal backing is very much larger than the area of the probe, e.g. greater than 1000:1.

Adjust the output of the ST-AC Pro' for the item under test (see: How to choose the test voltage). Slowly sweep the area to be tested, looking at the probe at all times. When a fault is passed over, the high-voltage probe discharge will change to a single spark. Remove the probe from the surface and mark the point where the fault was detected.

NOTE: Electrode size influences the output voltage. For this reason, we recommend a maximum size of 150mm.

Gas Discharge Lamp Testing
The ST-AC Pro' can be used to excite gas discharge lamps, to confirm that the vacuum has not been lost e.g. fluorescent tubes.

The lamp/tube should not be fitted, as the high voltage could contact the fitting and be passed into the wiring, and could damage other equipment connected to that wiring.

Hold the probe against the glass of the lamp and increase the output voltage from minimum, if the lamp is correctly evacuated, the lamp will glow where the probe touches the glass.

Ozone Production
Small quantities of ozone can be produced from the high-voltage spark, useful for chemistry lecture demonstrations etc.

Electromagnetic compatibility

Electromagnetic Emissions - European Union Directive:
Before operating this equipment it is essential that the following action be taken.

Risk assessment
As this equipment will produce an electromagnetic emission, when actually arcing down through a fault to earth, a risk assessment of the area in which the unit will be used should be carried out. For example, the equipment should not be operated where the electromagnetic disturbance generated may hinder the operation of such apparatus as:

A Domestic radio and television receivers.
B Industrial manufacturing equipment.
C Mobile radio equipment.
D Mobile radio and commercial radiotelephone equipment.
E Medical and scientific apparatus.
F Information technology equipment.
G Domestic appliances and household electronic equipment.
H Aeronautical and marine radio apparatus.
I Educational electronic equipment.
J Telecommunication's networks and apparatus.
K Radio and television broadcast transmitters.
L Lights and fluorescent lamps.

The Directive also requires the above types of equipment to have an adequate level of electromagnetic immunity from such emissions. However, it should be borne in mind, when doing an assessment, that the directive applies to equipment supplied or taken into service after the 1st January 1996. The equipment you are assessing, although legal but because of age, may not have this immunity.

The more common areas of risk are computers, critical safety equipment on process or machine tools (fail/safe electronics), supply cables, control cables, signalling and telephone cables above, below and adjacent to the area where the tests are being carried out.

The wearers of pacemakers and hearing aids should also be considered. Measuring and calibration equipment may also be susceptible.

To make a comparison; arc welders, when in use, would create interference far greater than this type of tester. It would, therefore, be reasonable to assume that if an arc welder had been used in the area, without problems, then an AC pinhole detector would be safe. However, it would be unwise to use both pieces of equipment on the same site at the same time as they may interfere with each other.

The test area itself should also be considered. For example, the layout of the area would affect the distances which the emissions would travel. Buildings and metal structures tend to shield against, or reduce, emissions. If the tester were being used inside a metal tank, for instance, the tank would act as a very good shield. This would not, however,

have the same effect if you were testing a plastic tank. If you were testing the circumference of a metal pipe then the pipe could act as an aerial and transmit the emissions further than expected.

Please bear in mind that electromagnetic emissions travel in all directions and can even be bent or deflected. This includes upwards and downwards so proximity to other floors of buildings and even airports must be considered. Neighbouring works or sites should also be considered as there may well be equipment in use that could be affected by your tester's emissions.

Some of the time this type of tester will be used on outdoor sites and be remote from susceptible equipment, but the SITE SAFETY OFFICER should always be consulted before any testing is carried out. This is particularly necessary where electronically controlled equipment is being used.

Timing of the testing should also be considered as a means to avoiding interference problems. Consider testing when all susceptible equipment in the test area is switched off.

Other hints
If your tester is only used in one area, simple tests will ascertain where the tester interferes with other equipment and these can be resolved by scheduling the proper testing accordingly. Again, you should remember neighbouring works. You may have switched off your computer but the computer next door may still be working and would therefore be susceptible.

We have designed this unit with EMC in mind and therefore all leads are of optimum length. If longer leads are used, then they could transmit in a similar way to aerials and cause interference.

Always ensure that the tester and test piece is securely earthed because this will reduce any interference generated by the spark. This also prevents static build-up in the operator, thereby avoiding electric shock.

Wherever you are intending to use equipment of this type, on your site or on a customer's, always obtain clearance from the company safety officer.

Disposal information

Producer registration number: WEE/HJ0051TQ

This product must be disposed of in accordance with UK WEEE regulations.

For further information on UK WEEE regulations click on: www.gov.uk/government/publications/weee-regulations-2013-government- guidance-notes

EC Declaration of conformity

We:

Buckleys (UVRAL) Ltd

As manufacturer of the apparatus listed, declare that the product:

ST-AC Pro' High Frequency Spark Tester

Is manufactured in conformity with the
following directives:

2014/30/EU
2014/35/EU

Authorised by:

J P Hoveman
CEO, Buckleys (UVRAL) Ltd.

CE

Contact details

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Distributor details

Product registration

Thank you for choosing a Buckleys product, we are sure it will provide you with many years of reliable service.

Please register this product via Buckleys' website and download the Warranty Registration Certificate.

Register your product in 5 minutes
Once your product is registered, you will receive the following benefits:

- **FREE** annual service & calibration reminders by email
- **Latest** industry news relating to your product
- Be the **first** to hear about our new products

We strive to improve the quality of our products and service.
Registering your product helps us monitor overall quality of our products, service and dealer network. Additionally, if we ever need to contact you regarding your product, we are able to do so immediately.

We will also send you annual service/calibration reminders by email to help ensure your product is always in perfect working order.

To register your product, simply visit:

www.buckleysinternational.com/registration

...Complete the online form and click on SUBMIT.