HIGH TEMPERATURE STANDARD PLATINIUM RESISTANCE THERMOMETER MODEL 96178

User Maintenance Manual/Handbook

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GUARANTEE

This instrument has been manufactured to exacting standards and is guaranteed for twelve months against electrical break-down or mechanical failure caused through defective material or workmanship, provided the failure is not the result of misuse.

In the event of failure covered by this guarantee, the instrument must be returned, carriage paid, to the supplier for examination and will be replaced or repaired at our option.

FRAGILE CERAMIC AND/OR GLASS PARTS ARE NOT COVERED BY THIS GUARANTEE INTERFERENCE WITH OR FAILURE TO PROPERLY MAINTAIN THIS INSTRUMENT MAY INVALIDATE THIS GUARANTEE

The company is always willing to give technical advice and assistance where appropriate. Equally, because of the programme of continual development and improvement we reserve the right to amend or alter characteristics and design without prior notice. This publication is for information only.

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CAUTIONARY NOTE

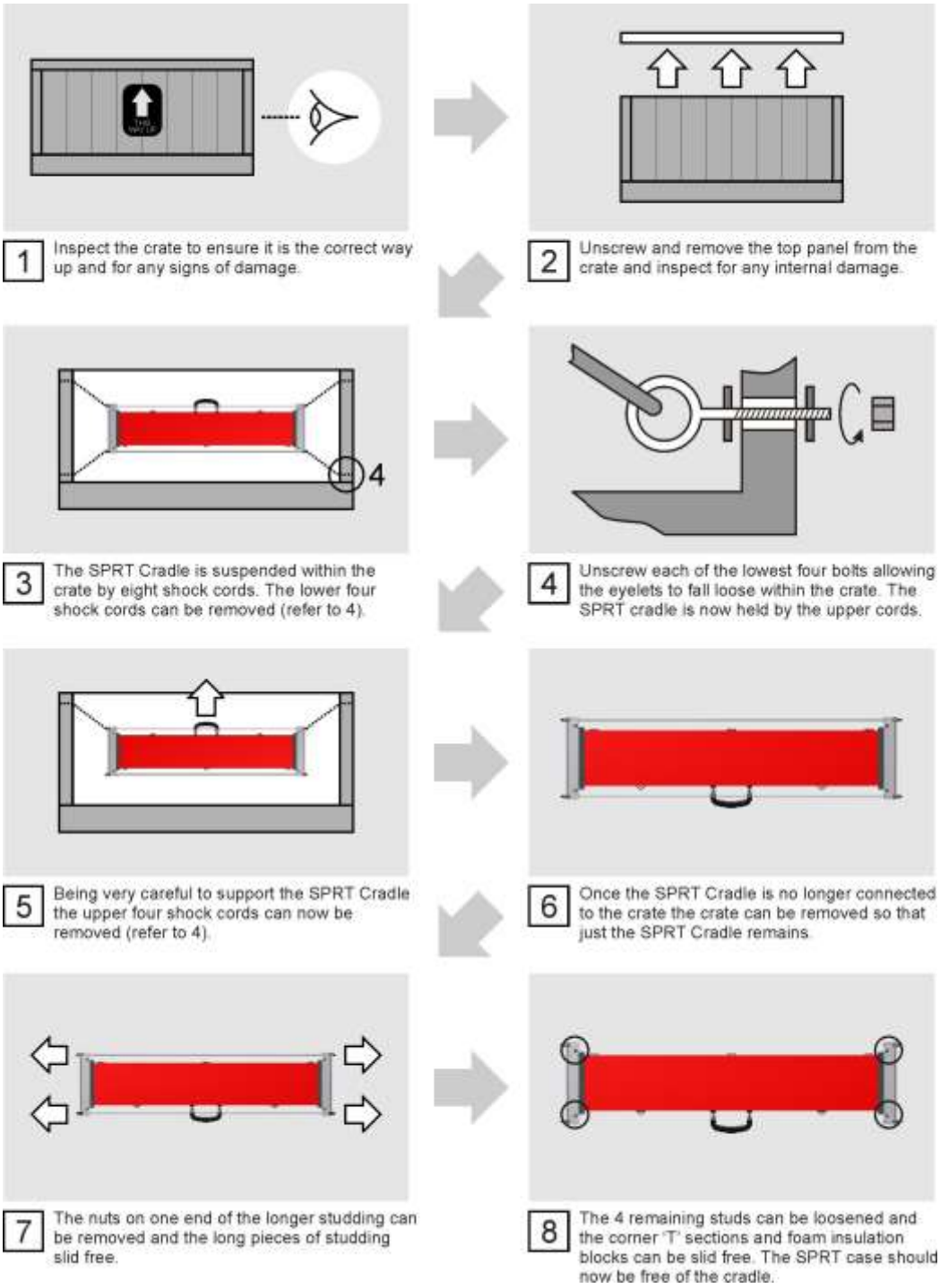
ISOTECH PRODUCTS ARE INTENDED FOR USE BY TECHNICALLY TRAINED AND COMPETENT PERSONNEL FAMILIAR WITH GOOD MEASUREMENT PRACTICES.

IT IS EXPECTED THAT PERSONNEL USING THIS EQUIPMENT WILL BE COMPETENT WITH THE MANAGEMENT OF APPARATUS WHICH MAY BE POWERED OR UNDER EXTREMES OF TEMPERATURE, AND ARE ABLE TO APPRECIATE THE HAZARDS WHICH MAY BE ASSOCIATED WITH, AND THE PRECAUTIONS TO BE TAKEN WITH, SUCH EQUIPMENT.

SPRT UNPACKING INSTRUCTIONS WHEN PACKED IN WOODEN TRANSPORT CRATE 912-00-00

In the event that this SPRT has been transported by courier in the specially designed wooden transport crate you must follow the unpacking instructions.

Please keep this crate and all its internal pieces should the SPRT be required to be returned.



1 Inspect the crate to ensure it is the correct way up and for any signs of damage.

2 Unscrew and remove the top panel from the crate and inspect for any internal damage.

3 The SPRT Cradle is suspended within the crate by eight shock cords. The lower four shock cords can be removed (refer to 4).

4 Unscrew each of the lowest four bolts allowing the eyelets to fall loose within the crate. The SPRT cradle is now held by the upper cords.

5 Being very careful to support the SPRT Cradle the upper four shock cords can now be removed (refer to 4).

6 Once the SPRT Cradle is no longer connected to the crate the crate can be removed so that just the SPRT Cradle remains.

7 The nuts on one end of the longer studding can be removed and the long pieces of studding slid free.

8 The 4 remaining studs can be loosened and the corner 'T' sections and foam insulation blocks can be slid free. The SPRT case should now be free of the cradle.

DO NOT DISCARD THE CRATE AND ITS INTERNAL PIECES – IT CAN BE REUSED

SPRT UNPACKING INSTRUCTIONS WHEN PACKED IN WOODEN TRANSPORT CRATE 931-22-128

In the event that this SPRT has been transported by courier in the specially designed wooden transport crate you must follow the unpacking instructions.

Please keep this crate and all its internal pieces should the SPRT be required to be returned.

1 Visually inspect the wooden crate to ensure it is the correct way up and for any signs of damage, if the shock/tilt watch labels have been activated this must be noted to the carrier preferably on delivery.

2 Unscrew and remove the top panel to reveal the inner cardboard carton which is holding the SPRT in its storage case.

3 The inner carton is attached and permanently suspended by pre-fixed elastic cords and sealed by two velcro straps.
DO NOT CUT OR TRY TO REMOVE THE ELASTIC CORDS OR STRAPS.

4 To open the inner carton lid carefully undo the velcro straps.

5 The SPRT case is held inside the carton with poly end foam blocks.

6 Supporting the SPRT case from underneath very carefully lift from the carton and remove the poly end foam blocks from the SPRT case.

DO NOT DISCARD THE CRATE AND ITS INTERNAL PIECES – IT CAN BE REUSED

OPERATING INSTRUCTIONS

INTRODUCTION

You or your company has just paid a considerable sum of money to purchase this 96178.

Although the materials to make the 96178 are very costly, it has also taken up to 1000 hours to prepare the 96178 for your use.

It is not a product that can be assembled, tested and sold; it is produced, calibrated, aged and re-calibrated, until its characteristics are stable enough to meet the exacting needs of ITS 90.

The weeks of work that go into its production make each 96178 more than another product. Each 96178 already has a character and a history before it leaves us. Please look after it. Regard yourself as its custodian rather than its owner.

1. Always keep the 96178 in its case when not in use.

2. When in use, support the handle.

3. Cool and store the 96178 in the same place as you normally use it.

4. Each time before you use the 96178 clean off all traces of grease by using a chlorinated solvent.

5. Even go so far as using gloves to handle the 96178, and keep the gloves clean.

6. Quartz is glass. It is a supercooled liquid. At 800°C and above, your 96178 will bend and bow if you do not support it along its complete length. At high temperatures I recommend that the 96178 be housed inside a close fitting recrystallised Alumina closed ended tube, which has been pre-fired to 1000°C, or better still a silicon carbide tube.

7. Quartz is transparent in two senses of the word. At temperatures above 700°C metallic vapours can pass through the quartz and attack the pure platinum sensing element. Isotech have developed a product which can be attached to the 96178 to prevent this happening to a 960 Ioniser. A Model 960 Ioniser is provided free with each 96178.

8. If you have purchased the 'Open' version of the 96178, open the valve at high temperatures and close it before bringing the 96178 down to room temperature. This will ensure that no moisture builds up inside the thermometer.

STABILITY EVALUATION

INTRODUCTION

The 96178 is one of a new generation of thermometers designed at Isotech. It is a high temperature thermometer working up to 1000°C and being 0.25 ohms at 0°C.

Its main radical and new features are:

1. The 96178 can be supplied pre-sealed with an inert gas containing 10% oxygen or with a valve built into the handle so the user can allow the thermometer to breath.

2. The quartz used is a new and more pure material.

3. The internal construction is made of many small parts to eliminate stem conduction.

4. The internal structure contains a platinum light scattering disc to reflect radiant energy.

In this report the first production unit was cycled to the silver point to test the reproducibility of the W value at silver, and to check the stability of R_{TPW}.

METHOD

The 96178 thermometer, like all high temperature thermometers will change its characteristics if subjected to step changes of temperature. The way in which the thermometer is temperature cycled is therefore very important.

In this series of tests the following strategy was adopted:-

The thermometer was placed in a pre-warming/annealing furnace at 400°C. The furnace temperature was then slowly raised to 850°C (The apparatus used was the Isotech Dual Furnace which has been pre-programmed with ramp-rates suitable for pre-warming the High Temperature Thermometers). From this furnace, the thermometer was transferred to a heat pipe furnace in which was placed a silver cell. The silver had previously been melted and partially frozen.

After 30 minutes in the cell, during which time and after stabilisation 4 to 6 readings were recorded, the thermometer was transferred back to the annealing furnace, still at 850°C.

The annealing furnace was then cooled to 425°C overnight and R_{TPW} measured the next morning.

Other thermometers of proven good stability were cycled with the 96178 to add further confidence that the method gave stable results.

RESULTS

The following results were obtained during two temperature cycles to the silver point. Mean values are tabulated.

Serial No. 96178/1 is the new thermometer.

Serial No. 962/148 the best thermometer from my store of standards - it also "breathes" i.e. the air inside the stem is not sealed in.

Ohms or ratio	962/148	96178/1
Initial R_{TPW}	0.2362608	0.2100675
R Ag	1.0127804	0.9004547
R TPW	0.2362600	0.2100668
W Ag	4.2867197	4.2865160
W Ga	1.1181537	1.1181429
R Ag (2)	1.0127804	0.9004532
R TPW (2)	0.2362602	0.2100667
W Ag (2)	4.2867160	4.2865109
W Ga (2)	1.1181541	1.1181439

DISCUSSION OF RESULTS

High temperature thermometers take a long while - many hundred, if not thousands of hours - to stabilise completely. Thermometer 962/148 is some 3 to 4 years old and has proved to be our most stable thermometer.

96178/1 was stabilised only overnight after its arrival from manufacture; even so the stability of the new thermometer is remarkable.

There is always an initial shift in the characteristics of a high temperature thermometer during its first cycle to the silver point. In this instance, both thermometers became more fully annealed, and so the R_{TPW} was reduced by 0.7 & 0.8 mK; then, between the first and second calibrations the R_{TPW} remained stable at 0.1 and 0.2 mK.

Some high temperature thermometers exhibit better stability in the reproducibility of the resistance at the silver point, whilst others keep better W silver stability. In this evaluation we can look at both R silver and W silver.

The R silver reproducibility of Serial No. 962/148 was perfect -a very unusual - if not unique - situation.

96178/1 thermometer reproduced R silver by 1.5 mK, still exceptionally good.

962/148 reproduced W silver to within the equivalent of about 1 mK

96178/1 to within the equivalent of about 1.5 mK.

These are both exceptionally good results.

To put the above results into context; N.P.L. would permit a shift of up to 5 mK in R_{TPW} and a spread of 20 mK in W silver during a full calibration cycle.

CONCLUSION

The 96178/1 thermometer has shown itself to be as stable as our very best standard thermometer after only an overnight anneal.

FURTHER WORK

As more thermometers are produced and tested further reports will be issued to confirm the results above.

Uncertainties vary depending on the temperature range of calibration.

Isotech's Models 670H and 96178 Standard Platinum Resistance Thermometers (SPRT's) can be calibrated using procedural techniques aimed at achieving the uncertainties outlined in Issue 13 of our Schedule of Accreditation.

Alternatively, at an extra cost the SPRT's can be calibrated in line with a specific procedure aimed at achieving the uncertainties outlined in Issue 35 of our Schedule of Accreditation.

RETURNING YOUR THERMOMETER TO ISOTECH

The Model 96178 is an extremely fragile HSPRT and we strongly recommend that this it is personally hand carried, however due to strict customs procedures imposed worldwide this is not always possible.

In the event that this HSPRT has to be transported by courier one of our specially designed wooden transport crates with or the original cardboard carton will have been used.

In all instances we recommend that you keep the packing and all its internal pieces.

Full re-packing instructions can be found later in the manual.

ISOTECH

Schedule of Accreditation

issued by

United Kingdom Accreditation Service

21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK

UKAS CALIBRATION

0175

Accredited to ISO/IEC 17025:1999

Isothermal Technology Ltd

Issue No: 035 **Issue date:** 06 March 2006

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Calibration performed at the above address only

DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (k=2)	Remarks
TEMPERATURE			
Platinum thermocouples Calibration by comparisons	-50 °C to 0 °C 0 °C to 50 °C 50 °C to 660 °C 660 °C to 1100 °C 1100 °C to 1300 °C	0.5 °C 0.45 °C 0.4 °C 0.7 °C 1.7 °C	
Calibrations at fixed points	232 °C up to 962 °C	0.4 °C	
Gold/Platinum thermocouples Calibration at fixed points	0 °C to 1000 °C 420, 660, 962 °C	0.1 °C 0.06 °C	
Other thermocouples	-196 °C -80 °C to 0 °C 0 °C to 50 °C 50 °C to 300 °C 300 °C to 420 °C 420 °C to 660 °C 660 °C to 1100 °C 1100 °C to 1300 °C	0.3 °C 0.25 °C 0.1 °C 0.25 °C 0.30 °C 0.4 °C 0.8 °C 2.2 °C	
Compensating and extension cables	-25 °C to 200 °C	1 °C	
4-wire platinum resistance thermometers			
Calibration at fixed points			
BP Nitrogen TP Mercury MP Gallium FP Indium FP Tin FP Zinc FP Aluminium FP Silver	-195.798 °C -38.8344 °C 29.7646 °C 156.5985 °C 231.928 °C 419.527 °C 660.323 °C 961.78 °C	5 mK 0.24 mK 0.15 mK 1.0 mK 1.0 mK 1.2 mK 4.0 mK 11 mK	Uncertainty in the determination of $W(t_{90})$ used to calculate ITS-90 coefficients Note: TP = Triple Point FP = Freezing Point MP = Melting Point BP = Boiling Point

ISOTECH

United Kingdom Accreditation Service

CALIBRATION LABORATORY
No. 0175

SCHEDULE

NAMAS
National Accreditation of Measurement And Sampling

Address of permanent laboratory	**Category 0** **Permanent Laboratory**
Isothermal Technology Ltd Pine Grove Southport Merseyside PR9 9AG Telephone : Southport (01704) 543830/544611 Fax : 01704 544799	Calibration performed on permanent laboratory premises APPROVED SIGNATORIES Head of Laboratory: Mr J P Tavener Deputy: Mr D J Ayres Mrs A S Blundell, Mr D Southworth, Mr N Davies, Mr A Orme Issue No: 13 Date: 24 February 1997

Measured Quantities for which UKAS has granted NAMAS Accreditation

Item	Measured Quantity Instrument or Gauge	Range	Best Measurement Capability Expressed as an Expanded Uncertainty (±)*
	TEMPERATURE		
1	Platinum thermocouples	0 to 1100 °C	1 K
		Above 1100 to 1300 °C	2 K
2	Other thermocouples	-196 °C	0.5 K
		-80 to 250 °C	0.3 K
		Above 250 to 660 °C	1 K
		Above 660 to 900 °C	2 K
		Above 900 to 1100 °C	3 K
		Above 1100 to 1300 °C	4 K
3	Compensating and extension cables	-25 to 200 °C	1 K
4	4-wire platinum resistance thermometer		

Uncertainty (±)

Temperature	(°C)	Range 1	Range 2	Range 3	Range 4	Range 5
BP Nitrogen	-196		10 mK	10 mK	10 mK	
TP Mercury	-38.8344	2 mK	2 mK	2 mK	5 mK	
TP Water	0.01	1mK	1 mK	2 mK	5 mK	10 mK
MP Gallium	29.7646	2 mK				
FP Indium	156.5985		3 mK			
FP Tin	231.928		3.5 mK	3.5 mK	5 mK	10 mK
FP Zinc	419.527			3.5 mK	5 mK	10 mK
FP Aluminium	660.323				10 mK	25 mK
FP Silver	961.78					40 mK

Note: TP = Triple Point, MP = Melting Point,
FP = Freezing Point, BP = Boiling Point

*The Expanded Uncertainty is given for k=2, providing a level of confidence of approximately 95%

Issued by the United Kingdom Accreditation Service Sheet 1 of 3

GLOSSARY OF METROLOGICAL TERMS

ACCURACY OF MEASUREMENT

The closeness of the agreement between the result of a measurement and the (conventional) true value of the measurand*

REPRODUCIBILITY OF MEASUREMENTS

The closeness of the agreement between the results of measurements of the same measurand, where the individual measurements are carried out changing conditions such as:

- method of measurement
- oberserver
- measuring instrument
- location
- conditions of use
- time

NOTES:

1. A valid statement of reproducibility requires specification of the conditions changed.

2. Reproducibility may be expressed quantitatively in terms of the dispersion of the results.

UNCERTAINTY OF MEASUREMENT

An estimate characterising the range of values within which the true value of a measurand lies.

Note: Uncertainty of measurement comprises, in general, many components. Some of these components may be estimated on the basis of the statistical distribution of the results of series of measurements and can be characterised by experimental standard deviations. Estimates of other components can only be based on experience or other information.

STABILITY

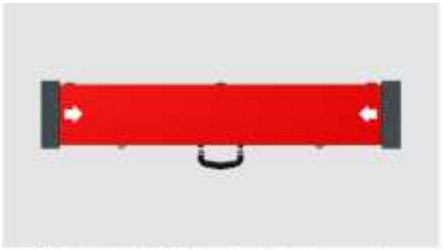
The ability of a measuring instrument to maintain constant its metrological characteristics.

DRIFT

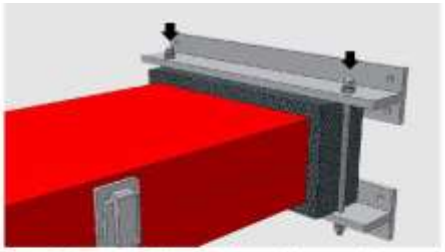
The slow variation with time of metrological characteristic of a measuring instrument.

*Measurand = a quantity subjected to measurement

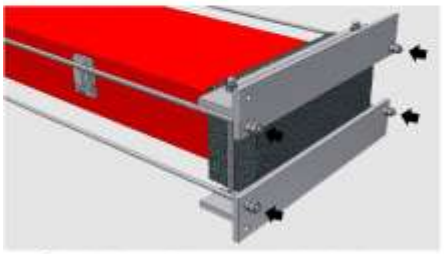
SPRT REPACKING INSTRUCTIONS USING THE WOODEN TRANSPORT CRATE 912-00-00



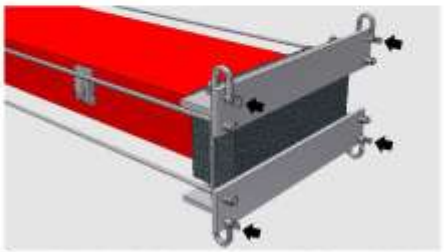
1 Once the SPRT is safe within the carrying case a foam end piece is placed over each end.



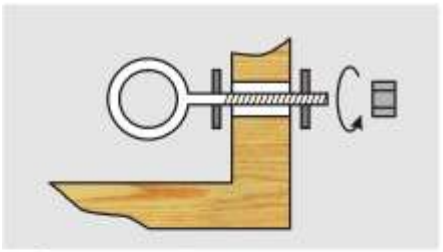
2 Place two of the 'T' shaped bars on either end of the foam as shown and tighten into place with the four shorter threaded rods, with dome nuts and above and two normal nuts beneath.



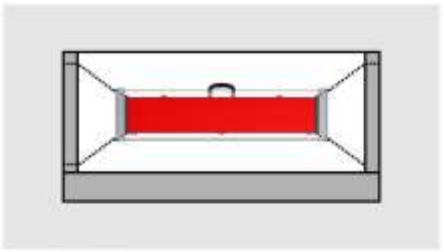
3 With all four 'T' bars in place the four longer threaded rods are now used to pull the foam blocks towards each other. Once tight they are held in place with two nuts at each end.



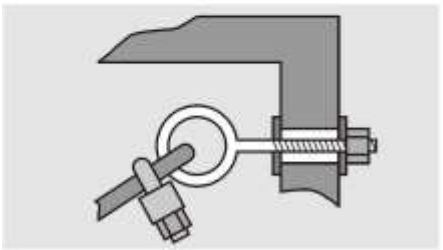
4 Now that the foam blocks and 'T' bars hold the SPRT case securely in place the shackles are threaded through each of the four outermost holes on the 'T' bars as shown.



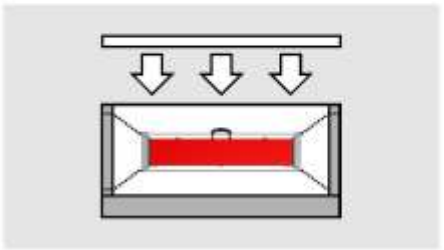
5 Putting the SPRT case aside the eight eye-bolts are pushed through the four holes in the side panels of the shipping crate and fastened as shown above.



6 The SPRT case can now be suspended in the crate using the eight shock-cords. The SPRT case can be rested at the correct height before the upper four shock-cords are pulled tight.



7 Once the shock-cords have been pulled tight the 'U' shackles are used to hold the shock-cord tight as shown above. This is repeated at all eight corners of the crate.



8 Once the SPRT case is held firmly in the centre of the crate replace the top panel of the shipping crate and fasten in place with screws. The SPRT is now ready to send.

Ensure to label the crate thoroughly with "FRAGILE" and "THIS WAY UP" labels and arrange adequate insurance cover.

SPRT REPACKING INSTRUCTIONS USING THE WOODEN TRANSPORT CRATE 931-22-128

1 Check that the inner carton is still attached and permanently suspended by its pre-fixed elastic cords.

2 Place the two poly end foam blocks over the ends of the closed storage case.

3 Lower into the inner cardboard carton.

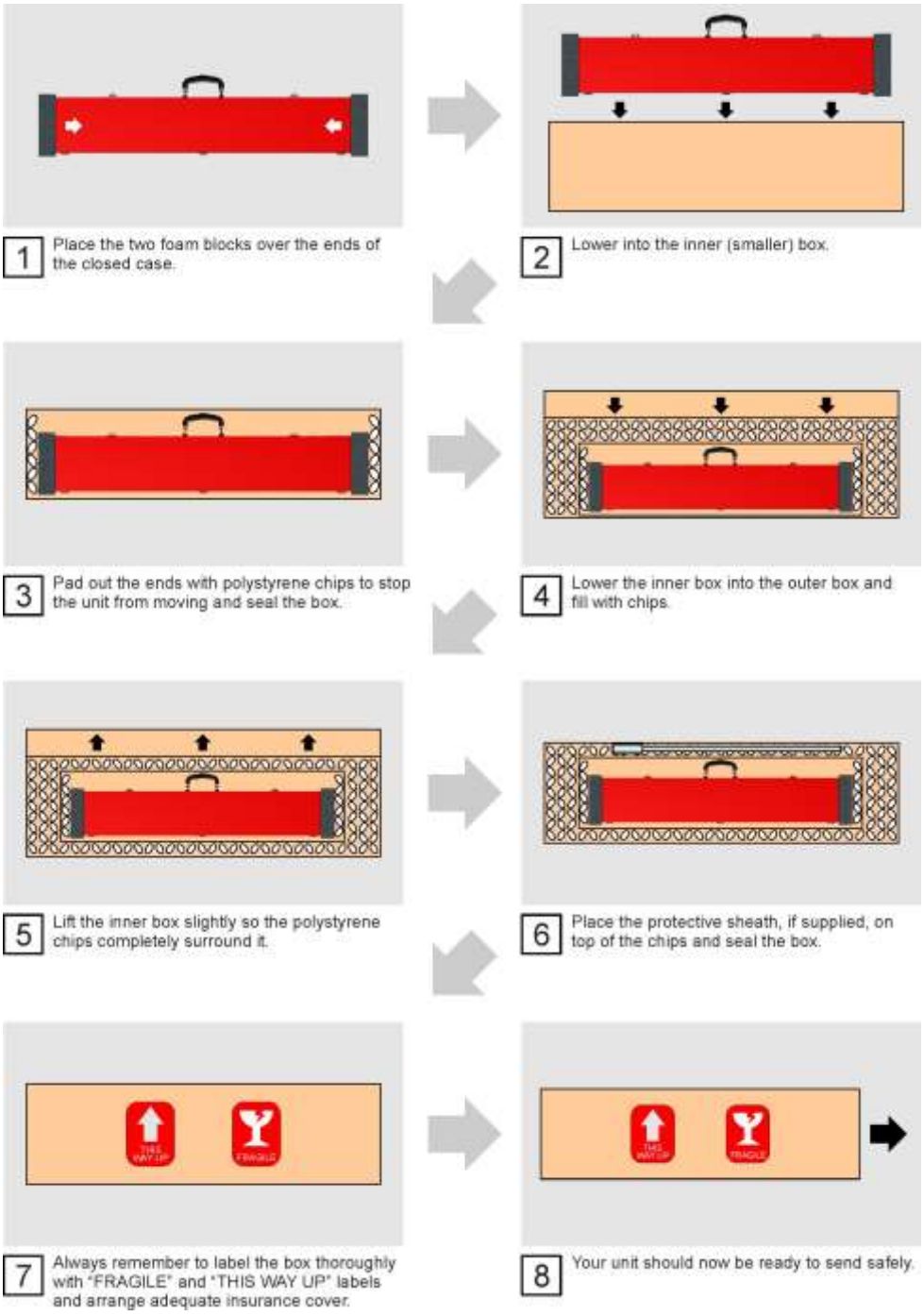
4 Carefully close the inner carton lid and seal using the velcro straps (when supplied) or strong packing tape.

5 Replace the top panel and fasten in place with screws.

6 The SPRT is ready to send.

Ensure to label the crate thoroughly with "FRAGILE" and "THIS WAY UP" labels and arrange adequate insurance cover.

SPRT REPACKING INSTRUCTIONS USING THE CARDBOARD CARTON



Ensure to label the carton thoroughly with "FRAGILE" and "THIS WAY UP" labels and arrange adequate insurance cover.