Rope Warmers / Driers

Summary

Many towers have issues with ropes becoming damp and stiff during the winter months. In extreme cases this can make ringing difficult and in sometimes impossible. Traditionally towers have addressed this by building Rope Warmers using a candescent (filament) light bulb, which is either on all the time or for long periods of time. ADVICE FROM NUMEROUS SOURCES (INCLUDING INSURANCE COMPANIES) SUGGEST THAT MOST OF THESE ROPE WARMERS ARE NOW CONSIDERED DANGEROUS AND SHOULD NOT BE USED.

This report investigates how to overcome stiff ropes and will show that towers should now be using one of two options:

1. Insulating the ropes to prevent them getting damp
2. Warming the ropes with a heat source made for that purpose (NOT A LIGHT BULB) and protected with a Thermostat

Please read this even if you have an existing Rope Warmer to see if you comply with 2024 safety recommendations. We have investigated the options and now show you how you can solve this problem.

Why did we look into Rope Warmers?

Whilst travelling to towers around Dorset we have seen a number of towers with Rope Warmers using candescent (filament) light bulbs. Due to UK law changes to protect the environment, candescent (filament) light bulbs are no longer available to buy. We therefore checked with The Central Council of Church Bell Ringers (CCCBR) for some advice, but found this is limited and not directly implementable (see Appendix A). The DCA therefore decided to do some research into solutions during the winter of 2023/4 and the results can be found here.

Background

In the past the idea of taking a fragile glass globe, putting it in a plastic tube and heating it up was considered acceptable, but is now recognised as extremely dangerous both to the people around it and to the fabric of the building. (NB. If you burn the church down with a home-made heater then the insurance company is likely to refuse to pay out!)

Churches are legally classified as a business premise and therefore a whole bundle of Health and Safety Laws apply, which would not be an issue in your own home (e.g. Church Fire Extinguishers must be professionally serviced every year). Therefore prevention of accidents is a serious matter, as although the church insurance may help with injuries, it will not help you if the Health and Safety authorities decide to become involved. Apart from routine maintenance checks of the bells themselves, one of the biggest dangers during the winter months are stiff bell ropes. Hence if your tower suffers from damp stiff ropes it is in everyone's interest to ensure corrective measures are taken and that these measures do not introduce new risks or breach other business safety rules.

Although legally the church incumbent, PCC and Church Wardens are responsible for safety, in the tower this is normally delegated to the Tower Captain and so we strongly advise ringers to take these matters seriously.

Further information on the options have we found:

Insulation / Non-electrical approach:

When doing our early research we came across a tower using water pipe insulation to keep the ropes dry. We tried this over the 2023/4 winter at Milbourne St Andrew and the results were amazing giving perfectly flexible ropes during the whole winter. (This church will not allowed electrical devices on the Ropes and we had to stop ringing in 2022/3 as they became so stiff!). We would highly recommend water pipe insulation as being both cheap, easy to fit and with no safety implications or issues to address.

Electrical approach:

With the electrical approach there are a number of issues which have to be addressed:

- Fire Risk: The most important of the above is the risk of fire when heating a natural fibre (i.e. rope) over long periods of time. This is why CCCBR recommend always using a Thermostat, something which traditionally has not been used by bell ringers. The DCA can't over emphasise how important having a Thermostat is to ensure things do not overheat, something a simple timer will not guarantee and we would recommend any existing warmers / driers to be modified ASAP. We advise a thermostat to be essential.
- Electrical Safety: This is obviously important, but a qualified electrician is not essential for anyone with a good working knowledge of electrical safety who should be able to build a rope warmer / drier. Further electrical details of how we built one on the following pages.
- Public Access: This is a difficult subject. If you have a locked tower then this is not an issue but in an open public space you should probably carry out a full risk assessment with your Church Wardens (forms available from most of the church insurance companies). <u>If in doubt then go for the non-electrical approach.</u>
- Cost: Costs are two fold; construction and running. Construction you should budge £100 but should be able to get it slightly cheaper. N.B. The traditional 20 watt heater on all the time (not recommended – see above) costs about £50 per year in electricity today (at the peak post Covid prices nearer £200!). We know the bell ringers do not get this bill, but they should consider the bigger picture to the church which may already be paying for the heating of the ringing chamber in winter.

<u>Details of non-electrical approach to keeping Ropes Dry</u>

Implementation is very simple. We purchased 6 x Essentials Economy Pipe Insulation 22mm x 13mm x 1m which are £1.30 each from Screwfix (also available at all good DIY shops) and cut down the scored side. We then slipped them over the tail ends after ringing with just the final inch showing and hooked them on to the spider:

Details of Electrical Approach

When we started work on this report we asked for advice from the CCCBR to further expand on the published article (Appendix 1) as it did not provide enough information to actually build a Rope Warmer without a light bulb. Unfortunately they were unable to provide further information and so we sought advice from other sources.

Philip Pratt of Avon Ropes Ltd was very helpful and provided some useful background information:

> 'I can sympathise with the advice being given from the CCCBR. I have a vague recollection of speaking with Marcus Booth of the Ecclesiastical Insurance (he rings about 5 miles away from me) a couple of years ago and him mentioning that [Rope Warmers] was one of their biggest risks in a ringing chamber, particularly as they are all unique, they're often made by people with various competency and there's certainly no product testing that's gone into the material selection such that they would ever meet a BS standard as an assembly or even obtain a CE or CA UK mark typically like most kettles/irons have, and there'll be no product liability insurance in place for them. As these are often unattended products, this increases the risks further than if they were operational under attended operation. I am not sure that the hesitancy in them is just around the use, or not of a lightbulb.
>
> I suspect there's probably been some background with the CCCBR and EIG[(Ecclesiastical Insurance Group)]. that the CCCBR want to step to one side from specifying something, limiting their liability and distancing themselves from specifying something that may not pass any requirements or potentially cause injury to someone or something. I get the impression that Alison's [of CCCBR] driver is probably from a liability perspective and that's probably come from EIG'

Philip was also able to give us some information about temperature requirements:

> 'The temperature tail ends probably need to be kept at is not much more than room temperature 15-20deg Centigrade, there's almost no need to go higher as that's the temperature/humidity they're typically at this time of year [September]. To achieve this temperature one does need to consider the thermal losses through the heater system and also the internal ambient temperature expected in the tower, which could be down to freezing. I have come across tail ends that the local ringers think has got too close to a bulb in their rope heater which has meant the fibres degraded very quickly and mean they fell apart, although having not seen the application or the rope heater they have I'm not in a position to comment with my view on the matter. One thing that is key is that whilst loose and floppy tail ends are nice to ring on, it is the friction between the fibres that holds the whole (natural fibre) rope together.
>
> When the tail ends are looser the friction is less and the longevity of the tail ends are reduced, particularly where ropes go into compression by hitting a floor/box etc. (it doesn't matter what the floor covering is).'

We will now review the physical build of a Rope warmer, options for heating, thermostatic control and electrical safety. For the avoidance of doubt, The Dorset Country Association of Church Bell Ringers nor any of the contributors (i.e. Avon Ropes Ltd) are not specifying any particular design or selection of products to be used within any rope warmer. Any liability associated with their construction, design and use will be yours and your churches.

Electrical Approach part 1 – Physical Build

Basically the physical aim is to warm the ropes so they do not get damp. Instead of warming the whole room the ropes are put in a tube with a heat source at the base. There are many ways of achieving this which can be found on the internet and rather than re-inventing the wheel here we have reproduced one of these in Appendix 2. Please note that article still talks about a light bulb without a thermostat, which is now considered dangerous (see below), but the rest of the article provides a good basic guide.

Electrical Approach part 2 – Heating Element

As already stated, traditionally Rope Warmers have used a candescent (filament) light bulb but these are no longer available to buy, very energy inefficient and are considered dangerous to use both due to their fragile nature, the fire risk they can pose.

CCCBR do not give advice on what alternatives to use so we looked at some options:

- PTC Heating Element Thermostat Heater Plate
  These are metal plates which self-regulate to hold a constant temperature. We tried a 12V 35x21mm one and found that although it holds the required temperature it does not have a large enough surface area to heat the surrounding air. The ropes (which have to be in air instead of touching the heater to prevent damage) never warms up and the ropes remain cold. A fan below was tried but this still did not resolve the issue and we felt the complexity of fixing heat sinks was beyond the normal DIY scope of this project.
- Fan Heater
  We did investigate fan heater options but again found the complexity of these were beyond the normal DIY scope of this project. (i.e. They are either mains powered where electrical safety enclosures do not exist in the right size or they are for cars where the power consumption was greater than the normal transformers available in the home marketplace). Given that, it is possible to build one and we know of one in Dorset[1].
- Ceramic Heat Emitter
  These devices are intended to give out heat in the form of infra-red and are normally used for animal enclosures. They are not glass and so are fairly robust and come in various different sizes. Being designed to produce heat instead of light they are also fairly efficient. This is the option we went for and tested at Puddletown during last winter (2023/4) with very successful results.

The Ceramic Heat Emitter we tested is fairly unique as it is shorter than most and thus took less space in the tube (in our case an advantage as we were converting an existing light bulb tube to use this and didn't want to move the chicken wire! We used a Bonlux 75W Heat Bulbs for Reptiles from Amazon (https://www.amazon.co.uk/dp/B09XHQJ23P) which are £4.45 each. The one issue is they have a screw thread connection (called E27) whereas most UK light fittings have a bayonet cap fitting (known as B22). After much looking we found a pair of converters at B&Q for just £2.

Bonlux 75W Heat Bulbs for Reptiles, E27 Infrared Heat Bulb 220-240V Ceramic Reptile Bulb Ceramic Heat Emitter for Reptiles/snake/Lizards/Tortoise/Bearded Dragon (2-Pack, Black)

Masterlite B22 to E27 Light bulb cap converter, Pack of 2

[1] When we last visited the tower using a fan heater it still did not have a thermostat but relied upon timers. We would strongly advise that this be looked at and a Thermostat be added ASAP.

Electrical Approach part 3 – Thermostat

The main recommendation which CCCBR are clear upon is that a Thermostat should be used. We agree that this is essential as it prevents excessive heat build-up and this saves energy, prevents rope damage and significantly reduces the fire risk.

There are many different types on the market place but one of the cheapest is called a W3002 temperature controller and seems to be made by a number of companies. This consists of a probe which is inserted into the tube of the Warmer, where the Ropes will be, and a control unit outside the tube. In Appendix 3 we have reproduced the technical description of this device.

To fit the probe we drilled a small hole about 60cm above where the ropes end and then used a cable tie to ensure it was held in place on the inside edge of the tube. (See the pictures which shows what it looks like inside the tube and outside the tube. This is a little fiddley to fit as most arms are only just long enough to hold the probe in place whilst fitting the cable tie).

The W3002 has 4 cables, 2 to power the device and 2 to control the heater. The W3002 also comes in 3 voltage types; 12V, 24V or 240V[2] (i.e. mains). Originally we hoped to use this with a 12 Volt DC PTC Heating Element Thermostat Heater Plate and so we opted for the 12 Volt DC version. This has the advantage of not having mains power cables to connect to the Thermostat and so did not need to be in an insulated box[3]. The disadvantage is that you need a 12 volt transformer and if, like us, you decide to use a mains heater, you need a Relay Module (uses the 12 volt thermostat output to switch the mains on and off). To the right is a picture of the Relay Module connected to the mains cables about to be sealed into a small outdoor electrical junction box.

As stated above the Relay Module is basically a mains switch which is controlled by the 12 volt DC supply. On the mains side you have a common wire and a choice of a Normally Open (NO) connection or Normally Closed (NC) connection. We use the Normally Open side so the switch is off when no 12 volt power and on when the thermostat provides 12 volt power.

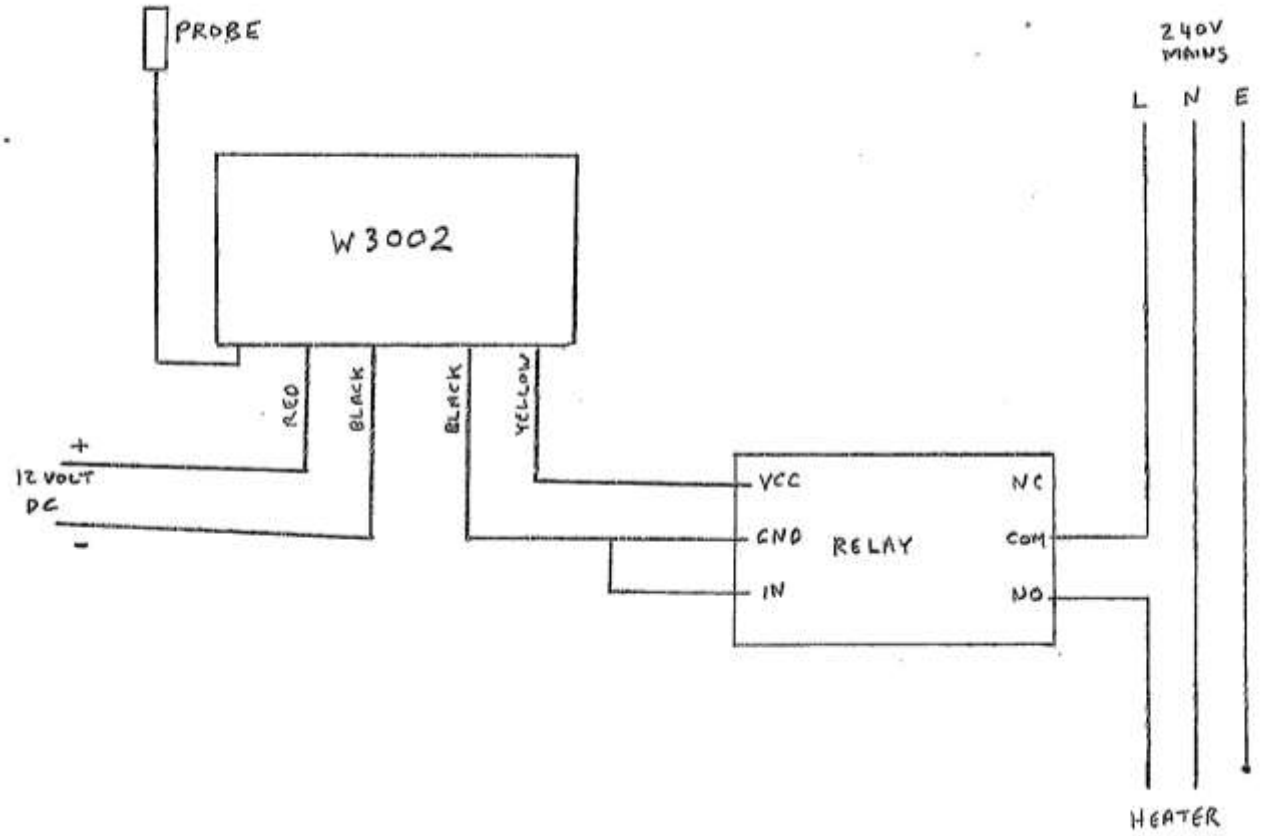
The 12 volt W3002 has a Black and Yellow output cables, the Yellow cable is connected to the VCC connection and Black cable is connected to both the GND and IN connections[4].

[2] Throughout this report we reference mains as 240 volts. In fact UK technically uses 230 volts but equipment has to work with a nominal 220v – 240v range. Therefore equipment, wire etc. can be labelled 220v, 230v or 240v.

[3] Electrical Safety rules only apply when dealing with electricity above 50 volts. Mains is 240 volts!

[4] These Relay modules can be purchased with either pin connections or screw connections on the 12V DC side. We opted for a pin connection as we had a connection cable spare and they are slightly cheaper.

Below is a diagram of how we wired these all up.



Cost wise for the Thermostatic control we used the following (prices as of Sept 2023):

W3002 Thermostat Control Switch Heating Cooling Control Instrument (DC12V) ·	£4.91
12V Power Supply AC to DC Adapter	£6.99
10pcs 12V DC Male / Female Power Connector Adapter Plug Jack Socket (so we did not have to cut the Adapter cables)	£2.90
12V Relay Module with Optocoupler 1 Channel for Arduino Pi UK	£2.79
Total (All available from ebay and other online shops)	£17.59

Alternatively you could buy a 240 volt AC version which makes wiring very simple (mains power in and controlled power out) but you have to ensure all the connections are made with mains rated terminal blocks and these are in a mains approved enclosure.

The Thermostat also needs to be programmed. The technical details in Appendix 3 gives an overview but it is not obvious which values to use. We decided to try and keep the temperature at the ropes at 21 °C. The Thermostat could be used to control either a heater or a refrigerator and so has two temperature values to set; a temperature where the power is switched on (P0) and a temperature where the temperature is switched off (P1). To warm the ropes P0 must be lower than P1 and there must be enough gap for the Heater to cool a little. We set ours to have the cooling period between 21°C and 19°C. To achieve this the settings of the W3002 are:

P0	19.0	P1	21.0
P2	0	P3	0

Appendix 3 includes the instructions on how to set the values of P0 and P1 (P2 & 3 should default to zero).

Electrical Approach part 4 – Electrical Safety

Many churches are obsessed with electric safety probably because, as a business premises, they must have a current Electric Safety Certificate to cover all fixed wiring. By definition a Rope Warmer / Drier is something which is unplugged and moved out of the way during ringing and so is defined as a Portable Appliance. Many people believe that if your fixed electrics have to be inspected by an electrician then the Portable Appliances must be tested by the same electricians (PAT tested). This is NOT true as can be seen on the Health and Safety Executive's web site – see Appendix 4.

However although an electrician is not required there are some both obvious and not so obvious safety measures which should be considered (and perhaps have not been considered or adhered to by Bell Ringers when building Rope Warmers / Driers).

- All live wires must be joined with terminal blocks and insulated within insulation made for that purpose (not just insulation tape).
- The correct fuse should be used for the power being drawn by the device.
- The correct size (width) wire should be used – i.e. wire that is rated at least 3 amp at 240 volts.
- All elements of the equipment that people can touch, and can conduct electricity (i.e. metal), could come into contact with the electrical supply so must be protected against becoming live.

Most of this is obvious to those with an electrical background, but two of these elements are generally overlooked. The first is simply that appliances under 700 watts (i.e. ours) must have a 3amp fuse in the plug (a red one – not the brown one supplied which comes with most plugs).

The other issue, which is much more complex, is grounding / earth. Traditionally all exposed metal in an appliance should have an earth bond. Most Rope Warmers have metal brackets, so these would be wired to the earth feed and ideally would test for electrical conductivity between the external metal items and the earth pin on your plug using an electrical test meter. (We know of a church that had a historic metal lamp stand declared unsafe because the earth wire had a poor connectivity to the metal and needed the connection re-soldering). However, many fixed installations which in the past needed intensive grounding, or even were not allowed, are now permitted if a Residual Current Breaker[5] is provided. Therefore a way of avoiding grounding everything is by using a mains socket which has a Residual Current Breaker in the fuse-box (this will be the case in many modernised fuse box) or using a plug-in module at the socket (not both though!)

<u>Conclusion</u>

If stiff ropes in the winter are a problem in your tower then we strongly advise that action is taken but that this action takes account of ALL the latest safety requirements for a Business Premises (which the church legally is). We hope this report helps you to make informed decisions upon the best course of action bearing in mind cost, expertise for fitting and safety of all concerned.

Please note: The Dorset Country Association of Church Bell Ringers, or any of the contributors (i.e. Avon Ropes Ltd, induvial towers) do not accept liability associated with any of the advice given above which is up to individual towers and their churches to agree.

Nigel Pridmore on behalf of The Dorset Country Association of Church Bell Ringers
August 2024

[5] A Residual Current Device is an electrical device that disconnects the circuit as soon as it detects a current leak to earth. It therefore protects against electric electrocution or shock caused by direct contact.

Appendix 1 – CCCBR Advice: Rope Driers for Bell Towers - Some Suggestions

Ringers may wish to use a 'rope drier' to reduce stiffness in bell ropes that become damp in an unheated ringing room. Driers are usually designed and assembled by volunteers. However, questions have been raised about some of the rope driers that have been seen during checks and inspections of churches and towers. For non-ringers, it is not immediately evident what the units are used for or how they are to be used. Being electrical equipment fitted with a mains power plug, the concern is reasonable.

We offer suggestions that should be considered when ringers are designing and constructing a rope drier. This is not a definitive guide; knowledgeable and experienced people should design the rope drier using appropriately specified parts, assembled according to manufacturers' instructions.

Technical

- A low wattage (typically 10-20W) heater of the type used for electronics cabinets (often referred to as an 'enclosure heater'). Datasheets provided with such devices can be used to select the type of heater suitable for the volume of the rope drier

Filament light bulbs should **NOT** be used as a heat source. The surface of the bulb gets very hot and, if broken, live wires are exposed.

- 13A power supply using UK standard 3 pin plug and appropriately rated flex
- Thermostat
- Timer to enable drier to be operated for a limited period before ringing
- On / off switch on the unit itself (as well as with mains socket)
- Warning pilot "on light" on the unit
- Over-temperature cut-out
- Residual current device
- Materials and parts used must not be combustible or flammable
- Adequate air flow to enable moisture to escape, not drip or condense particularly onto electrical parts

Design

- Dust and rope debris cannot build up on the heater
- Heater cannot be touched by people or the ropes while warm
- Easily cleaned inside and outside
- Easy to install ropes correctly and remove them
- Easy to disassemble and reassemble safely for portability
- Cannot be disassembled while electrically powered
- Compact for safe storage when not in use during ringing
- Stable when in use

Documentation

- Electrical and mechanical design and construction should be documented and retained with the unit
- Instructions for use and routine maintenance (including cleaning) should be available with the unit
- Unit should be labelled as to its function
- Drier should be included in register of electrical equipment for routine testing (PAT)

Disclaimer

Whilst every effort has been made to ensure the accuracy of this information, neither contributors nor the Central Council of Church Bell Ringers can accept responsibility for any inaccuracies or for any activities undertaken based on the information provided.

Appendix 2 – How to build a Rope Warmer from 'Trebles Going' https://www.treblesgoing.org.uk

How to build a Rope Heater

Rope Heater, by Philip Kinsman from All Saints, Wrington

This time of year bell rope ends are often damp and stiff from hanging in an unheated ringing chamber. This makes the ropes more hazardous and harder to manipulate skilfully. Heaters have been around for some time, to deal with this problem, but often tower members have hesitated to make them due to the time involved, and a shortage of storage space in the ringing chamber once ringing commences.

In response to this I have come up with the following design, that is low cost and is quick to make. The base is made from an inverted ringing box, that doubles up as an aid for shorter ringers while ringing is taking place. During ringing the heating tube can be stood/hung in the corner of the chamber, occupying the minimum amount of space. If you want you can drill a 25mm hole in the side of the top of the soil pipe and hang it on a coat hanger.

Having floated this design through our discussion group in the Bath & Wells diocese, I have incorporated suggestions made by a number of correspondents, and would like to thank them for their contributions.

Materials:

1, 4" (102mm)ID plastic soil pipe, 1920mm long

1, pipe connector to fit

1, B22 Female Base Light Lamp Socket (£2 from Amazon.com) Do not use the older all-metal designs.

1, 5-10mm Plastic Waterproof Cable Gland

2, 100mm diameter discs of pine or plywood or mdf, 25mm thick

4 Metres of lighting cable with 3 pin plug

2 wire coathangers.

Roll of masking or insulation tape

14, m3.5 30mm screws. 2, m5 50mm screw

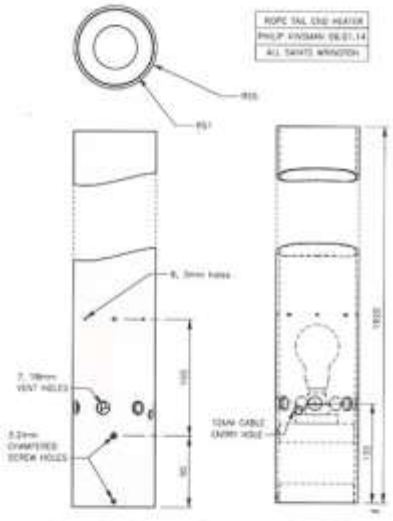
105mm disk of chicken wire, or wire sieve of the same diameter, minus its frame & handle.

Tools:

Electric drill. Drill bits: 2.5mm, 3mm, 3.2mm, 12mm, 18mm

Hack saw. Jig saw. Wire cutters, Philips screwdriver, pliers. File. Sharp knife.

Method



Take the pipe connector. With the knife cut into one of the rubber seals inside. Grip the severed end with the pliers and pull it out. Take out the second in the same way. Drill 12 2.5mm holes around the lip of the connector. Using the narrow 30mm screws, attach it to centre of the underside of the box. If the screw points go right through, use shorter screws!

Wrap tape around the soil pipe, 1920mm from the end, to use as a marker for cutting it. Cut with the hacksaw and file smooth. 132mm from the end, wrap round the adhesive tape and drill 7 or 8 18mm holes in the pipe. Between two of these, drill a 12mm hole to take the cable.

250 mm from the end of the pipe, wrap adhesive tape around and mark carefully 8 equally spaced points; drill 8, 3mm holes to take the steel coathanger wire that prevents the rope tail ends from touching the bulb.

Drill a 3.2mm hole 95mm up and chamfer it. This will take the screw that holds the lamp socket in place. Using a jigsaw cut two 100mm diameter discs of pine or plywood, 25mm thick. Make sure they will slide up inside the tube. Near the top edge of one of the disks drill a 12mm hole to take the wire. Also one in the middle. Wire the socket and thread the end down through the middle hole. Knot it to make a cable strain relief and thread it back up through to the top of the wooden disk. Screw the socket to the disk. Put the cable gland into the cable entry hole.

Thread the wire through the gland and out through the cable entry hole. Push the gland into place so it grips the cable and provides strain relief. Plug in the 40 watt* light bulb. Slide the disk and socket and bulb assembly up the tube until you can see the wooden side of the disk through the 3.2mm chamfered hole. Put in the 50mm screw to hold it in place. Look through the ring of 8, 3mm holes to check that the top of the bulb you are using is beneath their level.

Cut the coathangers to make 150mm straight lengths. With the pliers make a bend 15mm from one end of each of the wires. Thread them through the ring of 3mm holes so they come out at the opposite sides of the pipe. Bend the emerged ends so they stay in place. The last couple may need to be bent a bit so they thread over and under the first two. Then cut a disk of chicken wire – or use a steel mesh wire sieve, so it is slightly bigger than the ID of the soil pipe and push it down so it fits snugly against the 4 bits of coathanger wire. This will prevent any contact between the rope ends and the bulb. Make sure the bulb works by wiring the cable end to a plug. Slide the second disk into the bottom of the soil pipe to provide protection to the cable and double insulate the unit. Fix it into place with a second countersunk screw.

Do not use a bulb of wattage higher that 40, or the pipe will melt. The unit can be run on a timer for a few hours each day and that will be enough. If you use a low energy 11 watt bulb you can leave it running continuously through the winter.

This design should pass any test as it is double insulted and all electrical parts are shrouded in plastic. If you include the risks that arise from using damp stiff tail ends in ringing to your identified Risk Assessments, this may deflect any complaints from your using home-produced electrical equipment in the tower.

Good luck!

Appendix 3 – W3002 Thermostat Specifications and Manual

XH-W3002
TEMPERATURE CONTROL THERMOSTAT

Housing Meterial	Plastic (IP22)
Temperature Range	-50 ... 110 °C
Working Mode	Heating and Cooling
Temperature Accuracy	0.2 °C
Measuring Accuracy	0.1 °C
Input Measurement	NTC 10K, 1 meter waterproof probe
Input Power Suply	12V DC / 24V DC / 230V AC
Output Power	120W, Direct 2 point On/Off output
Output Current	Max. 10A
Size	60X45X31mm
Mounting	DIN-Rail / Wall Surface

>When connect to power supply, press the UP and DOWN buttons at the same time more than 3 seconds, display show 888
>If display LLL. means the sensor is fault, need to check the sensor.
>If displat HHH, means the temperature is above the range
>Display always shows the real-time temperature

>Start temperature < Termination temperature will be Heating mode
>Start temperature > Termination temperature will be Cooling mode

Models	Power Supply
XH-W3002-12	12 VDC
XH-W3002-24	24 VDC
XH-W3002-230	230 VAC

P0: Set Start temperature
Press the setting button, enter the internal menu, the default display for the P0, and then click the settings button, use up and down buttons to set the starting temperature.

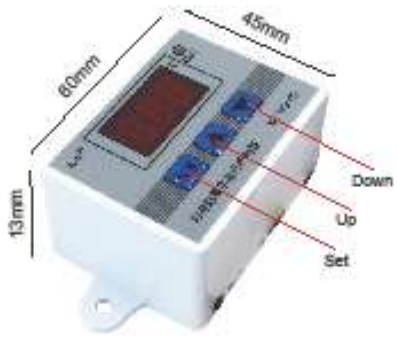
P1: Set stop temperature
Press the setting button, enter the internal menu, the default display for the P0, use up and down button to change to P1, and then press the settings button, use up and down buttons to set the starting temperature

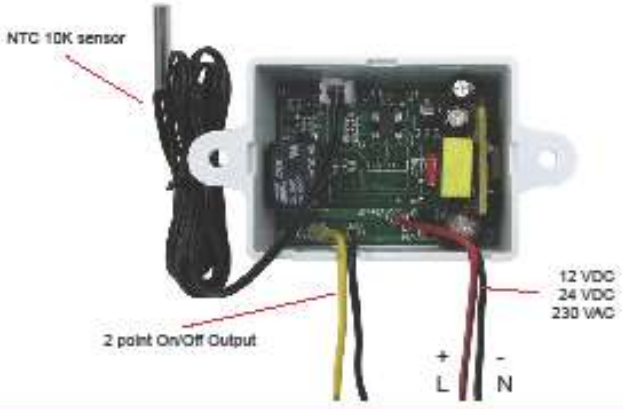
P2: Set temperature calibration
Press the setting button, enter the internal menu, use up and down buttons to change to P2, press the set button again, use the up and down button to do the calibration.
If the detetion temperature is above the actual tempeature of 0.5°C, need to set the calibration temperature is 0.5°C
If the detetion temperature is below the actual tempeature of 1°C, need to set the calibration temperature 1°C

P3: Set delay start
Press the setting button, enter the internal menu, use up and down buttons to change to P3, press the set button again, use the up or down button to set delay time(Minutes).

To control a water heater, heated water to 65 degrees to stop, when the temperature dropped to 50 degrees to start heating again
The first step: Determine the working mode for the heating mode, start the temperature
The second step: Long press "up" button, start temperature digital flash, set the starting temperature of 50 degrees
The third step: long press the "down" button to terminate the temperature digital flashing, set termination temperature of 65 degrees.

When setting the heating mode, if the set temperature value is set to the opposite, the output indicator will not light, the load will not work. If the above situation occurs after setting, you can check whether the set temperature value has the opposite.





Appendix 4 - Health and Safety Executive Information on Portable appliance testing

The following extract is from the Health and Safety Executive's web site at https://www.hse.gov.uk/electricity/faq-portable-appliance-testing.htm

PAT - Portable appliance testing FAQs

There are many common myths about portable appliance testing (PAT) - find out the key facts about the inspection and testing of portable electrical equipment here.

What is portable appliance testing?

Portable appliance testing (PAT) is the term used to describe the examination of electrical appliances and equipment to ensure they are safe to use. Most electrical safety defects can be found by visual examination but some types of defect can only be found by testing. However, it is essential to understand that visual examination is an essential part of the process because some types of electrical safety defect can't be detected by testing alone.

A relatively brief user check (based upon simple training and perhaps assisted by the use of a brief checklist) can be a very useful part of any electrical maintenance regime. However, more formal visual inspection and testing by a competent person may also be required at appropriate intervals, depending upon the type of equipment and the environment in which it is used.

I've been told that, by law, I must have my portable electrical appliances tested every year. Is this correct?

The Electricity at Work Regulations 1989 require that any electrical equipment that has the potential to cause injury is maintained in a safe condition. However, the Regulations do not specify what needs to be done, by whom or how frequently (ie they don't make inspection or testing of electrical appliances a legal requirement, nor do they make it a legal requirement to undertake this annually).

How frequently do I need to test my electrical appliances?

The frequency of inspection and testing depends upon the type of equipment and the environment it is used in. For example, a power tool used on a construction site should be examined more frequently than a lamp in a hotel bedroom. For guidance on suggested frequencies of inspection and testing, see: Maintaining portable and transportable electrical equipment.

Do I need to test new equipment?

New equipment should be supplied in a safe condition and not require a formal portable appliance inspection or test. However, a simple visual check is recommended to verify the item is not damaged.

I have been told that I have to get an electrician to do portable appliance testing work. Is that correct?

The person doing testing work needs to competent to do it. In many low-risk environments, a sensible (competent) member of staff can undertake visual inspections if they have enough knowledge and training.
However, when undertaking combined inspection and testing, a greater level of knowledge and experience is needed, and the person will need:

- the right equipment to do the tests
- the ability to use this test equipment properly
- the ability to properly understand the test results