Your guide to fault analysis and repairs on Warmup undertile and underfloor heating cables

Fault Tracing

warmup®
sustainable heating solutions

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Fault Analysis

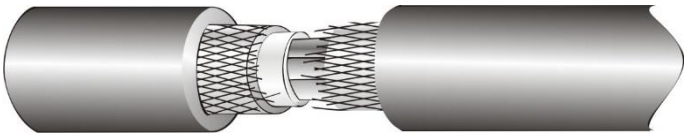
Three types of faults may occur with Warmup undertile and underfloor heating cables. Note that these faults can also occur simultaneously.

1) Open Circuit 'Clean Break'

The circuit is no longer continuous, neither is there an earth leakage.

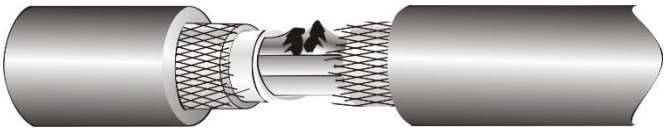
2) Earth Fault

The insulation has been damaged or broken, but the multi-stranded heating cable is still continuous, and showing the correct resistance reading. There is contact with the earth shield, screed, or adhesive, which causes the earth leakage breaker to trip.



3) Heating Cable Damage and Earth Fault

A number of the strands of the heating cable are damaged, as well as a break in the insulation of the cable, causing incorrect resistance and an earth fault.



Using a Multimeter

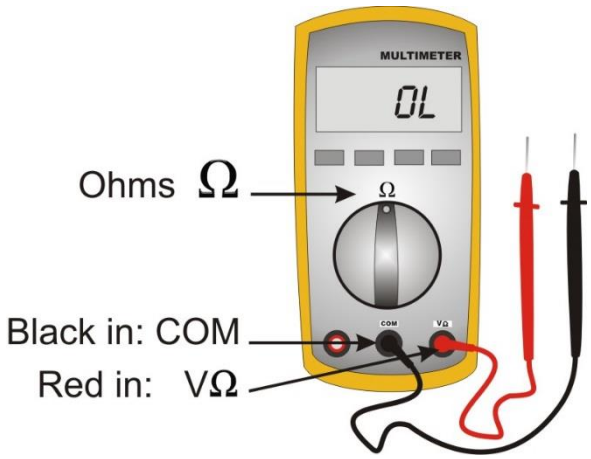
Always perform several tests to determine the type of fault you are trying to repair.

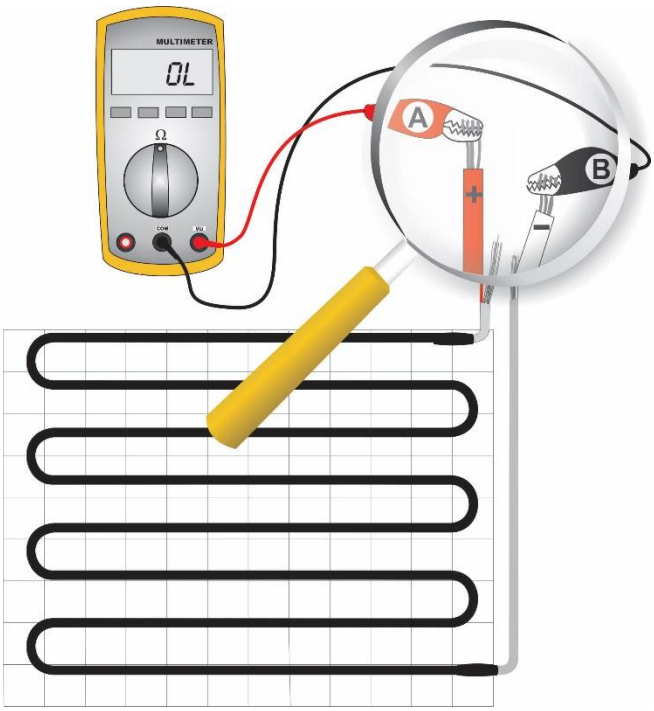
1) Disconnect the mains power from the heating element. THIS IS A VERY IMPORTANT SAFETY REQUIREMENT.

2) Using your electronic multimeter, select Ohms (Resistance), and test the heating cable for continuity (resistance).

   Connect the RED lead from the multimeter to the RED or BROWN (live) cold lead of the heating cable.

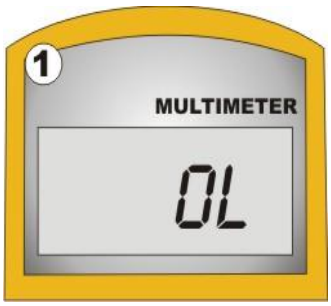
   Connect the BLACK lead from the multimeter to the BLACK or BLUE (neutral) cold lead of the heating cable.



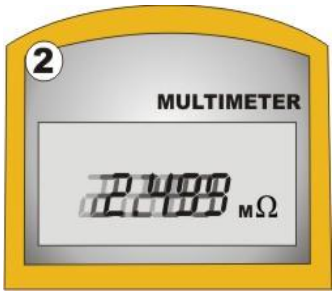


Using a Multimeter

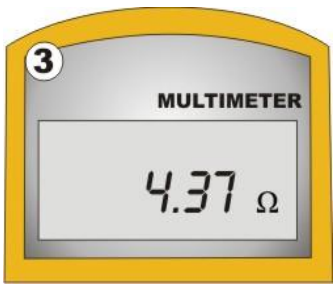
The electronic multimeter will show one of four readings described below. Based on this reading, we are now able to analyse what type of damage or break has occurred.



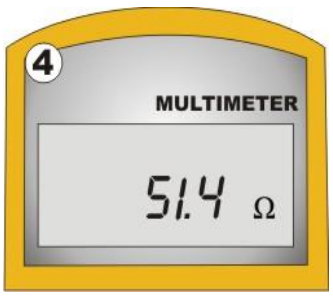
1) If the screen reading is 'O.L.', this indicates that there is a 'Clean Break' in the multi-stranded heating cable.



2) If the screen reading is not stable, but keeps increasing and decreasing, and indicating mega-Ohms and kilo-Ohms, this indicates that a number of the strands of the heating cable have been damaged or broken, thus causing an unstable resistance reading.



3) If the screen reading has a stable resistance, but is not indicated on the Warmup undertile or underfloor heating cable resistance chart provided, the following applies:
- the resistance cable may be intact, but there are multiple cables in the floor, connected through one set of cold leads, or
- The heating cables have been shortened or lengthened, or
- The heating cables have been joined together in *series,* or
- The heating cables may not be a Warmup product.



4) If the screen reading has a stable resistance as per the Warmup undertile or underfloor heating cable resistance chart, the multistranded heating cable may be intact.

Information Chart - Undertile

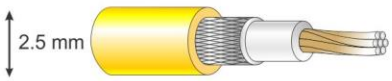
STANDARD UNDERTILE HEATING CABLES

Recommended spacing: 75mm - Whare floor space allows, Eg: Lounge Dining room, Bed rooms, Passage ways, Study.
50mm - Where floor space is limited Eg: Kitchens, Bathrooms and Toilets.

		Coverage - m2						
Cable code	Colour	50mm Spacing	75mm Spacing	Power @230volts Watts	Ohms	Amps	Length in metres	Room Square mtr
UTST0150	White	0.500	**0.733**	150w	352	0.65	12.5	1 to 1.5
UTST0275	Clear	0.984	**1.447**	275w	192	1.20	22.9	2 to 2.5
UTST0380	Orange	1.384	**2.043**	380w	139	1.65	31.6	3 to 4
UTST0500	Violet	1.834	**2.718**	500w	105	2.17	41.6	4.5 to 5.5
UTST0750	Red	2.819	**4.187**	750w	70	3.26	62.5	6 to 8
UTST1000	Yellow	3.802	**5.656**	1000w	53	4.35	83.3	8.5 to 10.5
UTST1250	Pink	5.115	**7.610**	1250w	42	5.43	110.0	10.5 to 13
UTST1500	Black	5.817	**8.664**	1500w	35	6.52	125.0	13 to 16.5
UTST2000	Blue	7.837	**11.683**	2000w	26	8.70	166.7	17 to 21
UTST2500	Grey	9.670	**14.400**	2500w	21	10.86	208.3	21 to 27
UTST3000	Brown	11.951	**17.816**	3000w	17	13.40	250.0	27 to 32

BRAIDED UNDERTILE HEATING CABLES

SAFE FOR WET AREAS



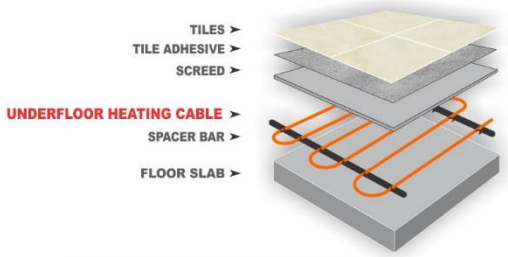
		Coverage - m2					
Cable code	Colour	50mm Spacing	75mm Spacing	100mm Spacing	Watts	Ohms	Length in metres
UTBROJ0275	Clear	**0.984**	1.447	1.892	275w	192	22.9m
UTBROJ0380	Orange	**1.384**	2.043	2.681	380w	139	31.6m
UTBROJ0500	Violet	**1.834**	2.718	3.581	500w	105	41.6m
UTBROJ0750	Red	**2.819**	4.187	5.529	750w	70	62.5m
UTBROJ1000	Yellow	**3.802**	5.656	7.481	1000w	53	83.3m
UTBROJ1500	Black	**5.817**	8.664	11.472	1500w	35	125.0m

Information Chart - Underfloor

STANDARD UNDERFLOOR HEATING GUIDE

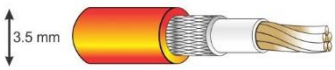
Standard Rooms 100 watts @ 100mm spacing:
Calculate in m2 eg: 4m x 4.8m = 19.20m2
19.20m2 x 100 watts = 1920 watts required
Therefore a UFST2000 will heat the required area.

Colder Rooms 120 watts @ 100mm spacing:
Calculate in m2 eg: 4m x 4.8m = 19.20m2
19.20m2 x 120 watts = 2304 watts required
Therefore 2304 watts will heat the required area (UFST2100 + UFST300)



						Coverage - m2		
Room Square mtr	Watts	Ohms	Cable Code	Colour	Length	75mm Spacing	100mm Spacing	Spacer Bar 3.00m each
2.5 to 3	300w	176	UFST0300	White	18.75m	1.170	**1.870**	1
4.5 to 6	600w	88	UFST0600	Violet	37.5m	2.480	**3.360**	2
7 to 9	900w	59	UFST0900	Red	56.25m	3.780	**5.170**	2
10 to 12.5	1250w	42	UFST1250	Yellow	78.13m	5.360	**7.300**	3
13.5 to 17	1700w	31	UFST1700	Black	106.25m	7.390	**9.800**	3
17.5 to 21	2100w	25	UFST2100	Blue	131.25m	9.165	**12.480**	4
21 to 25	2500w	21	UFST2500	Grey	156.25m	10.914	**14.840**	4
25 to 31	3100w	17	UFST3100	Brown	193.75m	13.578	**18.870**	4
31 to 37	3700w	14	UFST3700	Orange	231.25m	16.241	**22.680**	6
Extra's: Nails, Repair kit, Cable monitor, Thermostat,(recomended floor sensing thermostat for tiles.)								

BRAIDED UNDERFLOOR HEATING GUIDE FOR "WET" AREAS



Recommended spacing: .75mm Wet areas: Eg: Bathrooms, Jacuzzi, Sauna etc.

						Coverage - m2		
Room Square mtr	Watts	Ohms	Cable code	Colour	Length	75mm Spacing	100mm Spacing	Spacer bar 3.00m each
2.5 to 3	300w	176	UFBR0300	White	18.75m	**1.170**	1.870	1
3.5 to 4.5	450w	117	UFBR0450	Green	28.12m	**1.820**	2.380	1
4.5 to 6	600w	88	UFBR0600	Violet	37.50m	**2.480**	3.360	2
6 to 7	750w	70	UFBRO750	Pink	46.87m	**3.130**	4.080	2
7 to 9	900w	58	UFBRO900	Red	56.25m	**3.780**	5.170	2
10 to 12.5	1250w	42	UFBR1250	Yellow	78.13m	**5.360**	7.300	3
13.5 to 17	1700w	31	UFBR1700	Black	106.25m	**7.390**	9.800	3
Extra's: Nails, Repair kit, Cable monitor, Thermostat,(recomended floor sensing thermostat for tiles.)								

Using a Mega Tester

Next, we will use a Mega Tester to determine if there is an earth fault on the heating cable. The Mega Tester tests the integrity of the insulation on the heating cable.

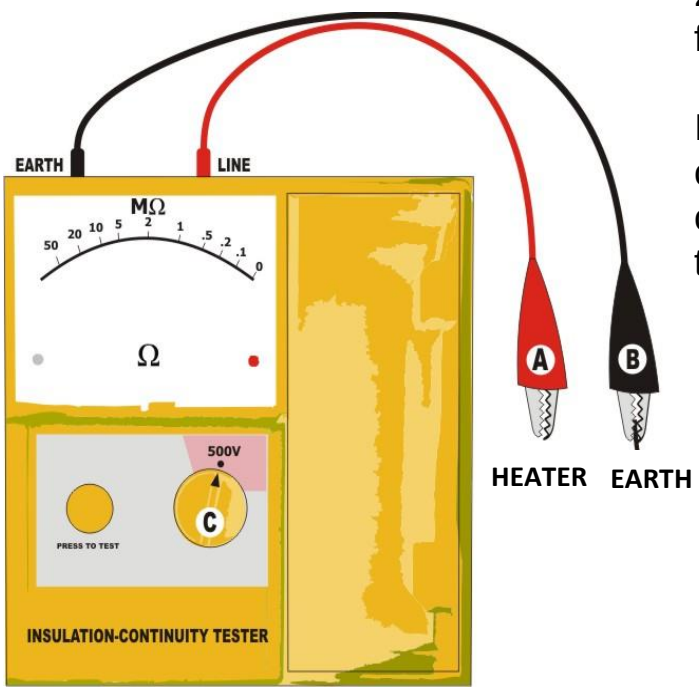
1) Disconnect the mains power from the heating element. THIS IS A VERY IMPORTANT SAFETY REQUIREMENT.

2) Using your Mega Tester, connect the leads as follows:

   A) Connect the BLACK lead from the Mega Tester to the building earth.

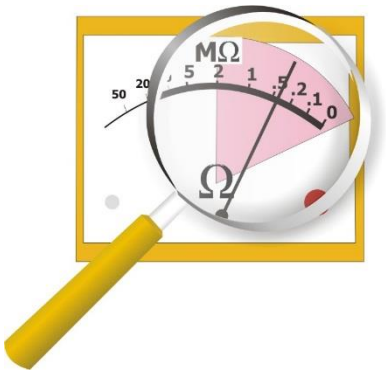
   B) Connect the RED lead from the Mega Tester to either the LIVE or NEUTRAL cold lead from the heating cable.

   C) Set the 'Function' selector on the Mega Tester to 500V.



Press the test button on the Mega Tester. The needle will indicate a reading. If the reading is less than 2 mega-Ohms, there is an earth fault on the heating cable.

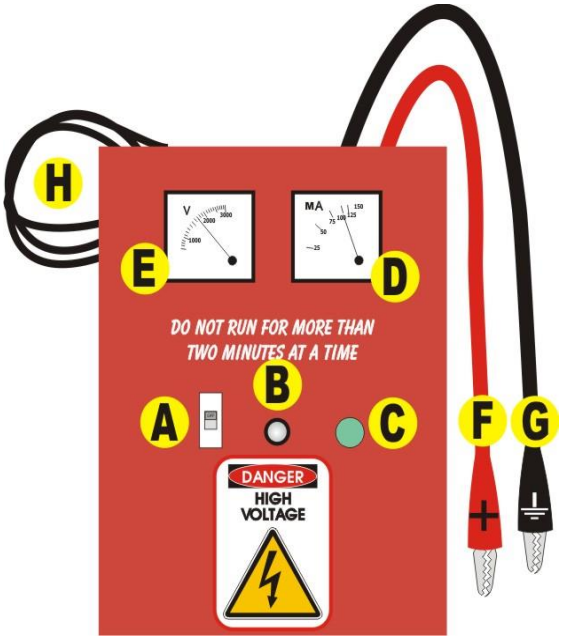
If the cable passes the above test, connect the RED lead to other cold lead of the heating cable, and test again.



Using a fault tracing machine

Based on the above tests, we now need to make use a fault tracing machine ('thumper'), to determine exactly where the damaged or broken section of heating cable is situated.

SPECIAL SAFETY PRECAUTIONS MUST BE FOLLOWED WHEN USING THE THUMPER. THE MACHINE PRODUCES HIGH VOLTAGE AND CAN CAUSE SERIOUS INJURY OR DEATH.



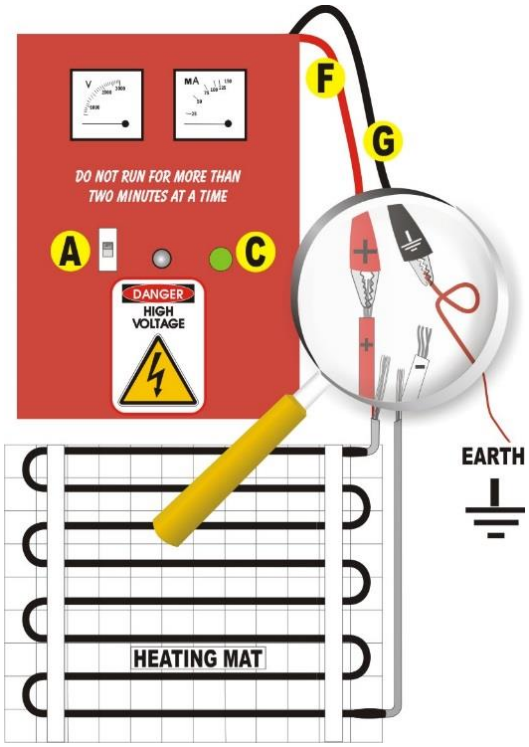
A) Isolator (on/off) switch
B) Voltage and amperage regulator dial
C) Power indicator light
D) Milli-Amp meter
E) Voltage meter
F) High-voltage power lead (RED)
G) Earth lead (BLACK)
H) 240v power lead with plug socket

IMPORTANT SAFETY PRECAUTIONS

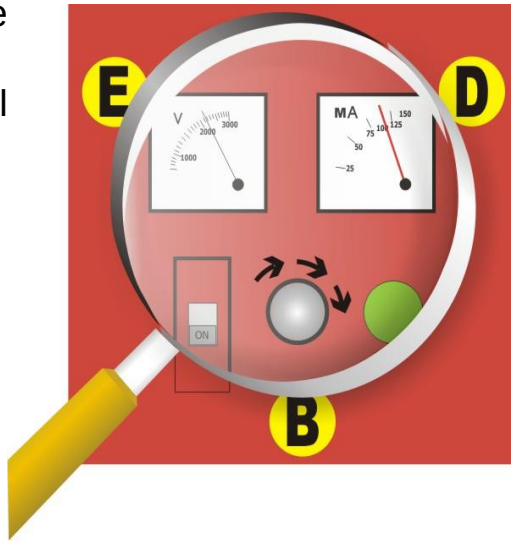
- The earth wires from the heater must be disconnected from each other, as well as the heater and ground earth.
- Once connected, NEVER touch these connections, if the power is on.
- NEVER walk on the area with bare feet while trying to locate the fault.
- NEVER allow children or pets near the area you are working on.
- NEVER attempt to the touch the floor or start repairs to the floor or heating cables while the thumper is on.

Using a fault tracing machine

The thumper must now be connected to the heating system as follows.



1) Connect the F) RED live cable clamp to the cold tail wire of the heating cable that indicated the highest earth fault when tested with the Mega Tester.
2) Connect the G) BLACK earth cable clamp to the electrical / ground earth of the building.
3) Plug the thumper into a 240v power outlet socket, and switch on the power.
4) Switch the thumper isolator to the ON position, and the power indicator light should glow.



5) Slowly turn the B) voltage and amperage regulator dial clockwise. This will increase the power running into the heating cable.
6) The E) Voltage and D) Amperage needles will begin to rise as the volts and amps increase.
7) The milli-Amp output should not exceed 100mA.
8) The aim is to adjust the dial so that the milli-Amp needle stays at 100mA, and for the voltage needle to move as high as possible.
9) While the thumper is energizing the heating cable, slowly scan the floor surface using the infra-red non-contact digital thermometer, or the infra-red thermal imaging camera.

Using a fault tracing machine

Using the infra-red non-contact digital thermometer, slowly scan the floor, beginning in the area where the cold leads of the heating cable are located.

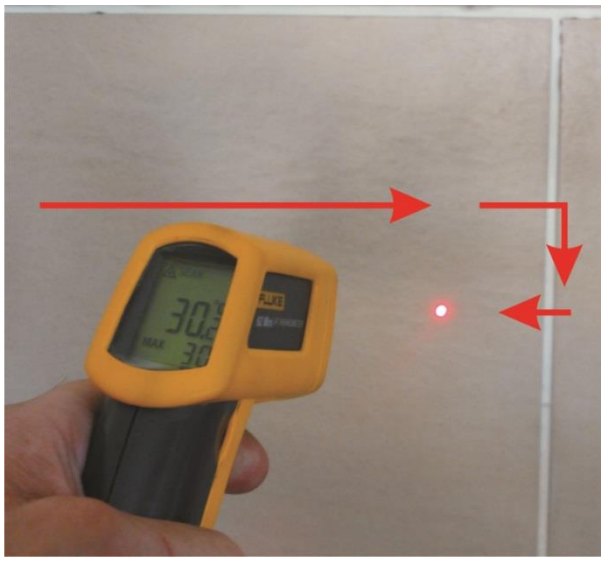
In a grid like pattern, scan the surface of the floor until the heat spot is detected.

Remember not to run the thumper for more than 2 minutes at a time. Switch the thumper off for intervals of 5 minutes, after 2 minutes is complete. Continue this cycle until the heat spot is detected.

The heat spot may be felt by hand (but ensure that the thumper is switched OFF and unplugged, before touching the surface).

You may also hear a clicking or sparking sound from under the surface.

You also may smell an unpleasant burning odour in the area of the heat spot.



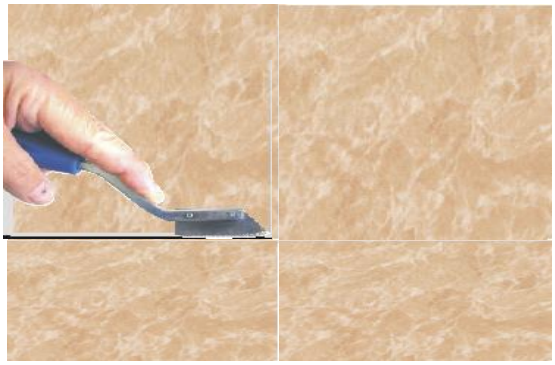
Now that the first damaged or broken section of the heating cable has been located, the repair work may begin.

Repairing the heating cable

You will need the following tools:

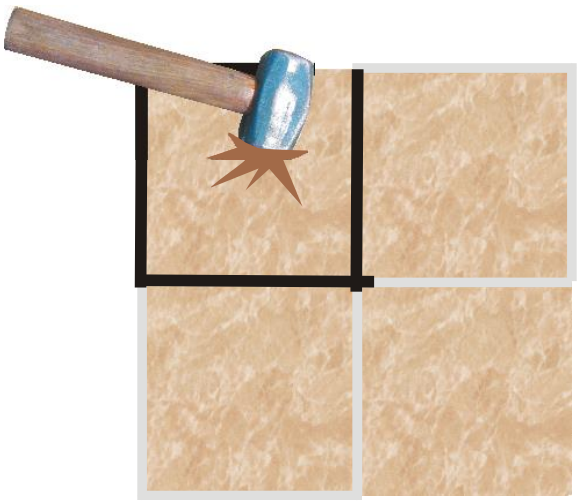
- Protective goggles
- Tile grout remover
- 1inch brick bolster
- 3inch brick bolster
- Heavy hammer / mallet.

1) Remove all the grout between the tiles using a grout remover. Be careful not to remove the grouting deeper than the thickness of the tile, as this could cause further damage to the heating cable.



2) Using the heavy hammer, break the center of the tile. Remove the broken tile from the center outwards, lifting the tile from the adhesive using the bolsters.

Take care not to damage the surrounding tiles.



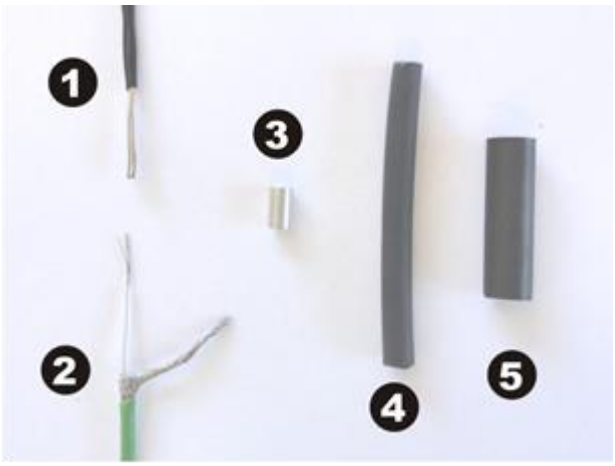
Once the entire tile is removed, begin removing the tile adhesive in small sections. Take care not to further damage the heating cable below.

The reinforcing mesh and heating cable should now be visible. You may notice discolouration around the damaged area.

Repairing the heating cable

You will need the following tools:

- Crimping Tool
- Hot air gun with deflector nozzle
- Wire Stripper
- A Repair Kit from Warmup, consisting of a cold lead, ferrule, and two different sizes of adhesive lined heatshrink.

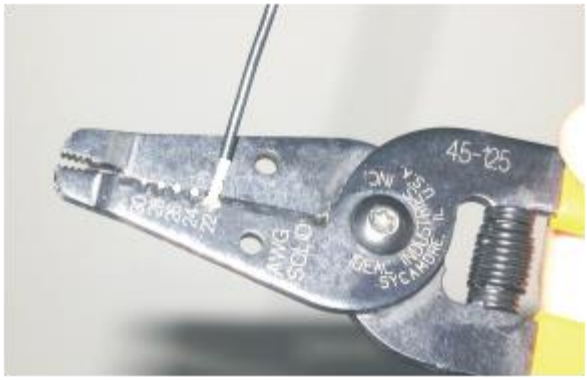


In this view you can see various parts as follows:

1) Cold lead
2) Heating cable
3) Crimping ferrule
4) 0.23mm Heatshrink
5) 0.31mm Heatshrink.

The repair is made using a short section of cold lead as a ‘filler’ or ‘jumper’ to bridge the damaged section of heating cable.

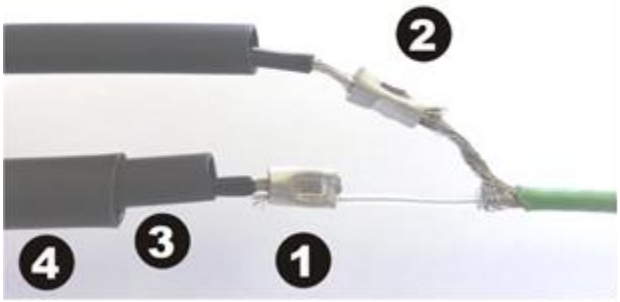
Strip the end of the cold lead, to expose about 0.4mm of the stranded wire. Avoid damage to any of the strands of wire, as this could cause problems at a later stage.



Repairing the heating cable

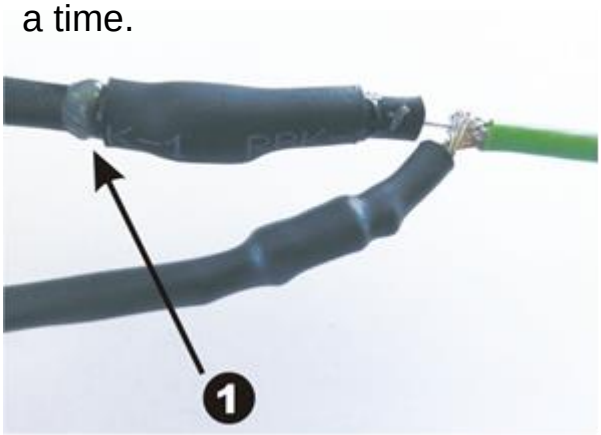
Insert the ferrule into the jaws of the crimping tool. The crimping tool illustrated here has a ratchet action that prevents the strands of wire being crushed. The jaws will release before the wire is damaged.

Remember to slide the heatshrink onto the cable before you crimp!



1) Ferrule crimping the heating cable to the cold lead
2) Ferrule crimping the earth braid to the earth cold lead
3) The 0.23mm heat shrink
4) The 0.31mm heat shrink.

Slide the 0.23mm heatshrink over the ferrule. Slide the 0.31mm heatshrink until it is in the center of the 0.23mm heatshrink.
Using the hot air gun with the heat deflector nozzle, melt one heatshrink at a time.



The adhesive lining around the inside of the heatshrink will waterproof the connection, preventing any ingress of moisture. Note 1) where the excess adhesive has sealed the edges of the heatshrink.

Repairing the heating cable

Now that the connection is complete, proceed with the following:

1) Chisel a small indent into the floor, to allow the joins in the heating cable to be recessed beneath the floor.
2) Secure the joins into this recess using hot melt glue or adhesive.
3) Pour a small amount of water over this connection, and test the heating cable with your mega tester. Should the needle not deflect to less than 2 mega-Ohms, your connection is acceptable.
4) Test the heating cable with your electronic multimeter. If the reading on the multimeter matches the required reading for the heating cable as per Warmup's information chart, then your heating cable has been successfully repaired.

IF YOU NEED TECHNICAL INFORMATION AND SUPPORT, PLEASE FEEL FREE TO CONTACT A WARMUP TECHNICAL CONSULTANT. WE ARE ABLE TO ASSIST YOU WITH TELEPHONE SUPPORT ON FAULT FINDING DURING NORMAL OFFICE HOURS.

Gauteng: 011 673 5063
Western Cape: 021 531 1896

Email: info@warmup.co.za

Warmup, a division of A J Pudney (SA) cc

www.warmup.co.za

Gauteng: 011 673 5063
info@warmup.co.za

Western Cape: 021 531 1896
capesales@warmup.co.za

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