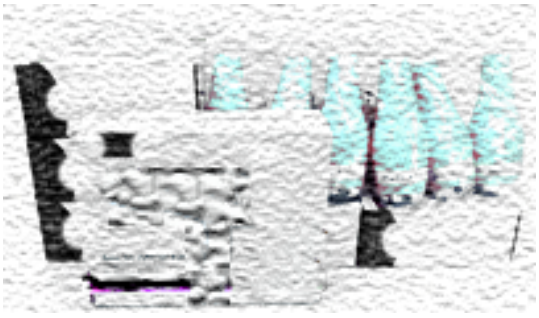
01.01.00 **UPDATED** (see page 2)

INTRODUCTION



360° Product Testing has been retained to analyze the design, build and function of the Brand Model 1875W hair dryer. For this purpose a total of twelve driers were supplied (pictured at right), six driers were labeled “fixed” (date coded ...) and six driers were labeled “defective” (date coded ...).

Design and Build

The Model 1875W hair dryer is a handheld dryer with a soft texture plastic housing and permanently attached power cord. Three switches on the handle select Off/Low/High fan speed, Low/Med/High heat, and a momentary switch that temporarily lowers heat output. Markings on the housing imply ETL certification.

Within the housing a brushed motor drives a fan at the inlet, downstream of the fan are three heating elements surrounding an ion generator and an infrared LED. Thermal fuses in line with the heating elements provide over-temperature protection. Aside from many mediocre solder joints at the switches, no immediate concerns were found. Almost all solder joints were cold joints (insufficient heat when made), had minimal solder, and some had loose wire strands; these issues could result in early failure and/or localized heating during operation.

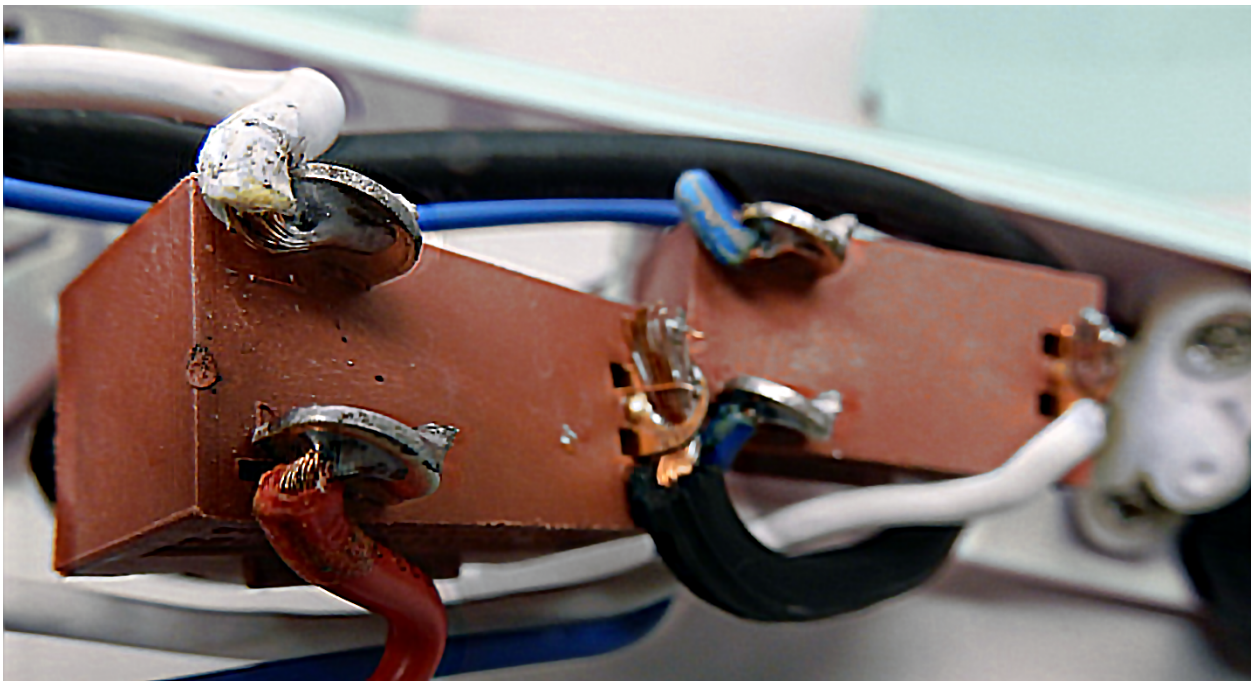


Figure 1: Mediocre solder joints example

Defective Units
Each dryer labeled “defective” was tested and found to produce no heat. Each of these dryers were then disassembled to isolate the cause of no heat. In all six dryers, it was found that the Brand Model type thermal fuse was open or high resistance. Bypassing this thermal fuse restored the proper function of the defective dryers.

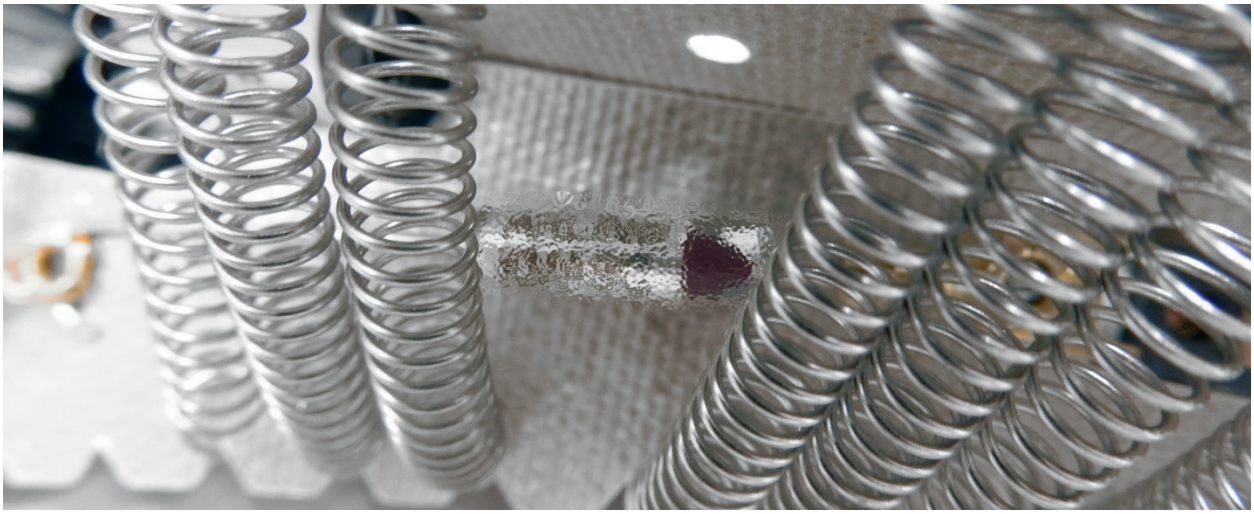


Figure 2: An Brand thermal fuse located within heating element windings

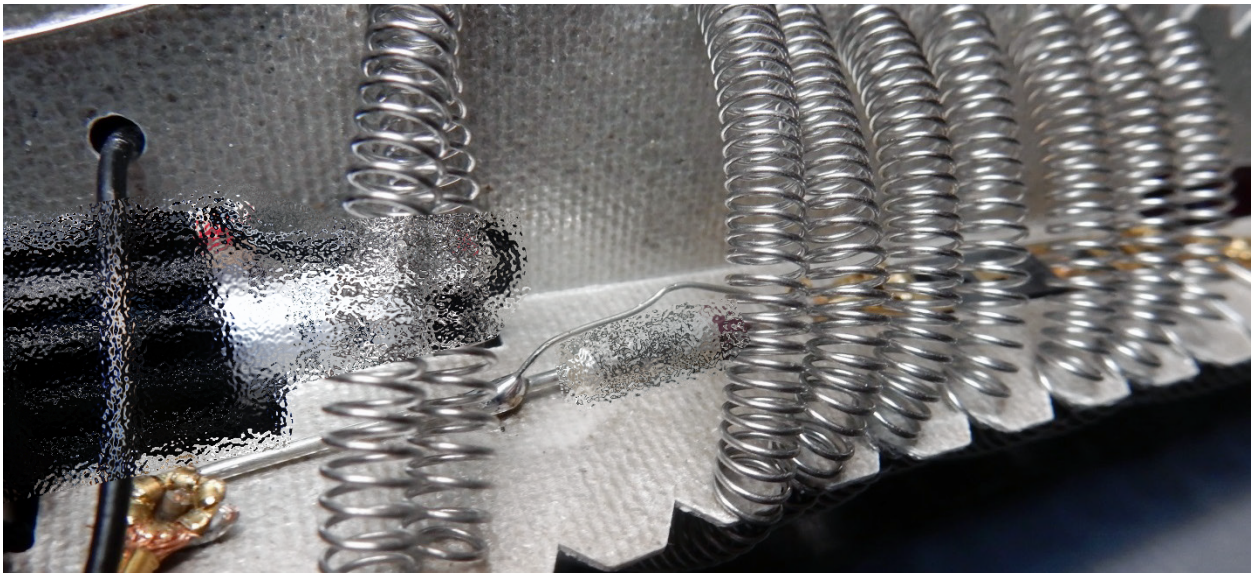


Figure 3: Brand thermal fuse bypassed to isolate malfunction

The Brand thermal fuse is marked with a 72°C temperature rating, the datasheet for the fuse states that a 72°C fuse has an operating temperature of 67-71°C.

UPDATE: A “Fixed” dryer did survive 100-cycles of tripping its fuse. This limited testing, i.e., a single “Fixed” dryer sample, suggests that the new lot of Brand Model type 72°C thermal fuses seem capable of many trips over a condensed period of time. It is unknown if the same type Brand thermal fuse from the differing lot used in the “defective” dryers would have similar tripping durability. (See top of page #4 for test method.)

In order to determine typical operating conditions, a dryer was fitted with a thermocouple in close proximity to the thermal fuse. Two additional thermocouples gathered ambient and outlet air temperatures. The dryer was then operated low speed / high heat for one hour, followed by high speed/high heat for an additional hour. In both use cases, the temperature in the vicinity of the thermal fuse never exceeded 35°C suggesting that the thermal fuse temperature rating has sufficient headroom to avoid nuisance tripping during normal proper use.

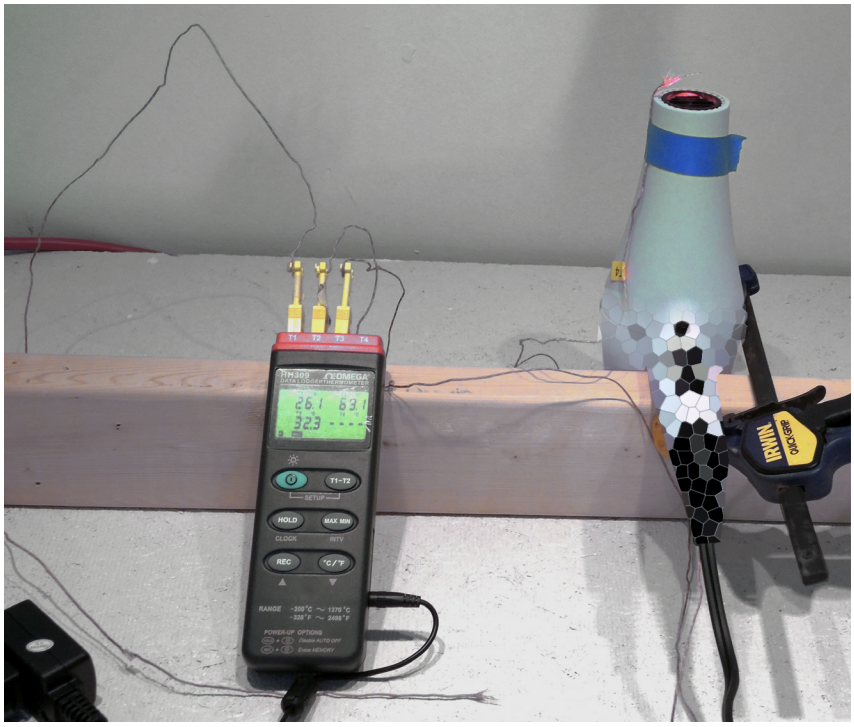


Figure 4: Setup for thermal characterization

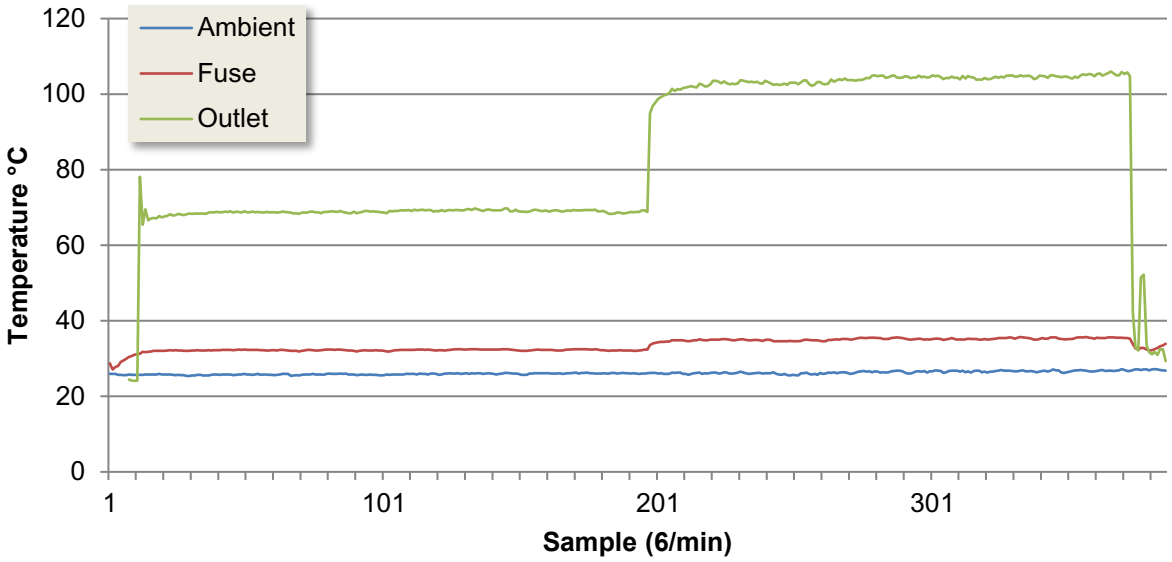


Figure 5: Thermal characteristics...
Left: low speed / high heat Right: high speed / high heat)

Blocking the “new / good” dryers’ outlet results in the Brand thermal fuse tripping within a few seconds, as it should, and the fuse resets within a few seconds after removing the blockage. Notably, the thermal fuse datasheet does not specify a rated number of cycles. Therefor it is unknown if there was a bad batch of fuses, or if the fuse is even capable of a numerous cycles, such as due to improper use. The fuses in the “new / good” dryers are of the same type as the “defective” dryer fuses, excepting the lot number having changed.

No other build changes were observed between the “new / good” and “defective” dryers.

Figure 6: Durability and performance testing setup

Durability and Performance

In this phase, three of the supplied hair dryers were cycled between a ~ 15-minute period of “ON” status (at high speed and heat) followed by ~15-minutes of “OFF” status. The temperature of each dryer was monitored via thermographic measurements during testing. The dryers were cycled a total of fifty times, one cycle being a single on and off period.

All three dryers successfully completed 50 “On” / “Off” cycles with no significant heat issues.[1] A hot spot was typically seen near the outlet and switch areas, and the cords became slightly warm.

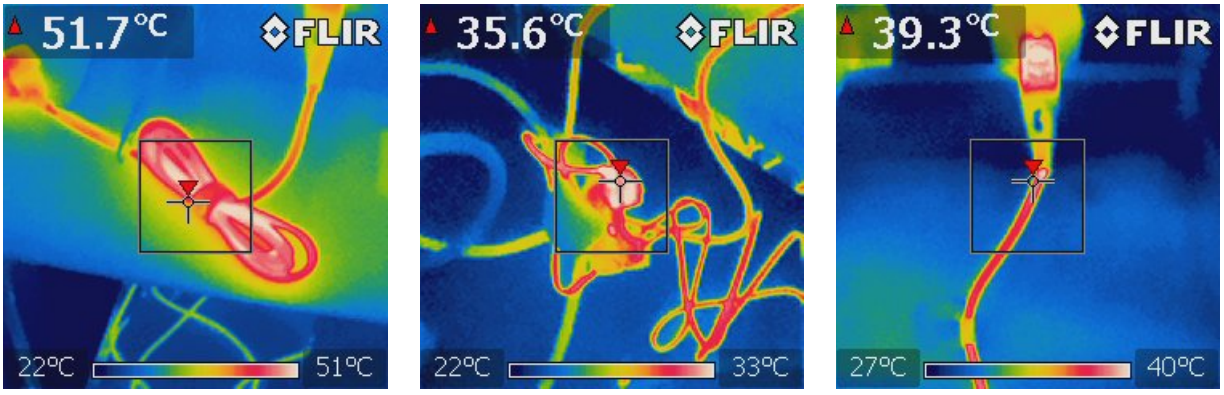
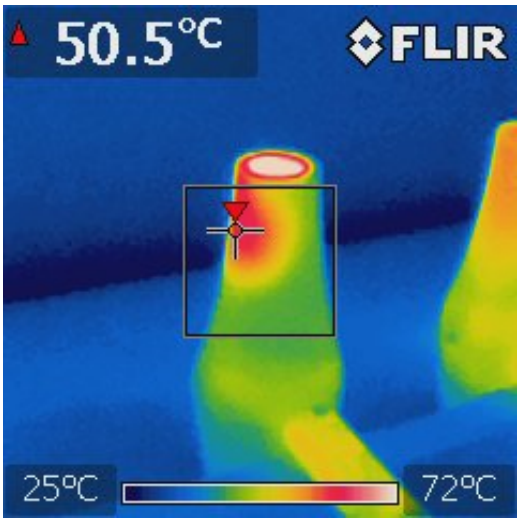


Figure 7: Typical cord temperatures, the folded cord on the left retaining the greatest heat

[1] ~15 minutes ON / ~15 minutes OFF at highest speed and heat



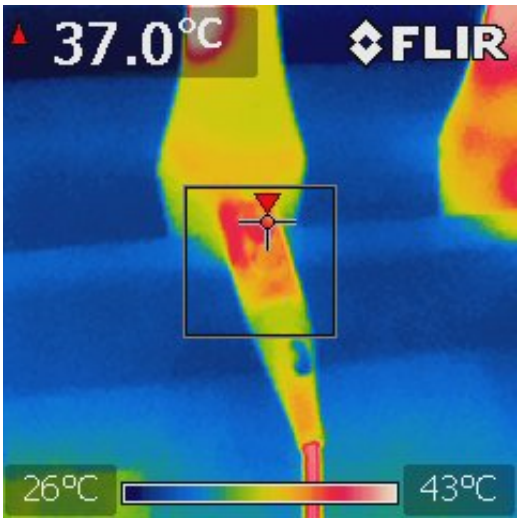
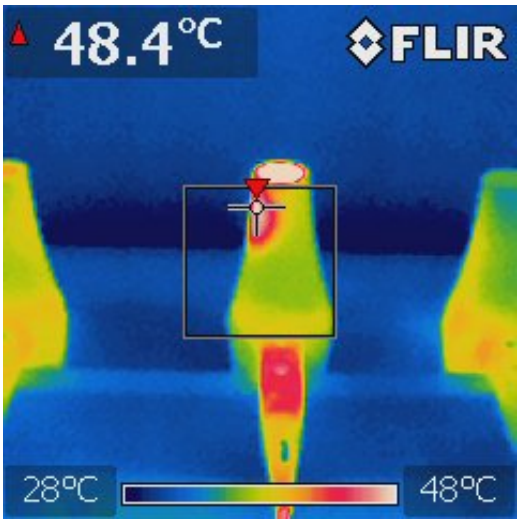


Figure 8: Typical temperatures of left dryer



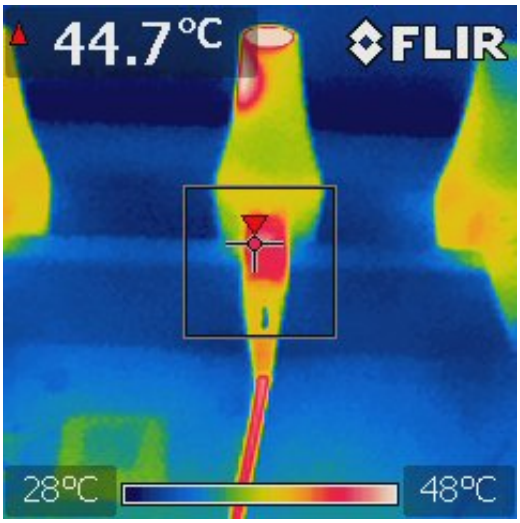
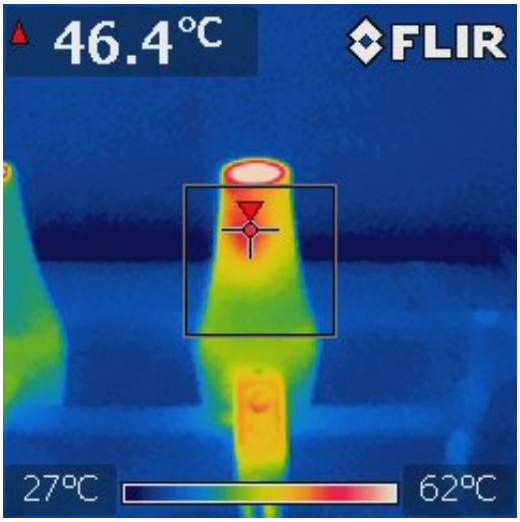


Figure 9: Typical temperatures of middle dryer



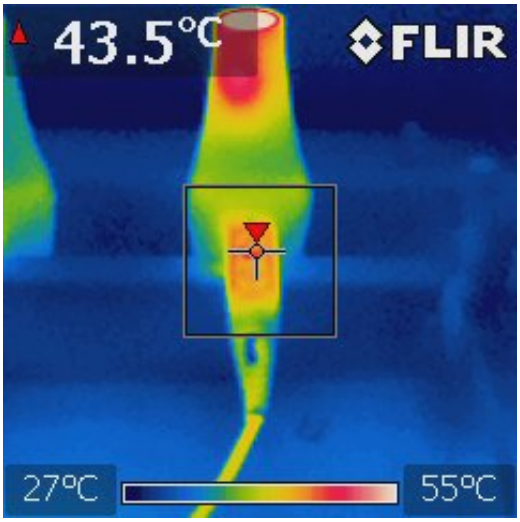


Figure 10: Typical temperatures of right dryer

Below is an International Standard reference for heat on bare skin, which puts context to measured appliance heat, particularly as it relates to the switch area (i.e., dryer holding area) of the Model:

Table 4C – Touch temperature limits

Parts in OPERATOR ACCESS AREAS	Maximum temperature (T_{max}) °C		
	Metal	Glass, porcelain and vitreous material	Plastic and rubber [b]
Handles, knobs, grips, etc., held or touched for short periods only	60	70	85
Handles, knobs, grips, etc., continuously held in normal use	55	65	75
External surfaces of equipment that may be touched [a]	70	0	95
Parts inside the equipment that may be touched [c]	70	80	95

Figure 11: IEC 60950-1

Infrared Emissions

An infrared LED at the dryer outlet emits a small amount of infrared light when the dryer is switched to medium of high heat. The emitted infrared was then measured in watts/meter2 using a Newport 818-SL photodetector connected to a Newport 843-R power meter. The photodetector was fixed in position approximately 8” directly above the dryer outlet.

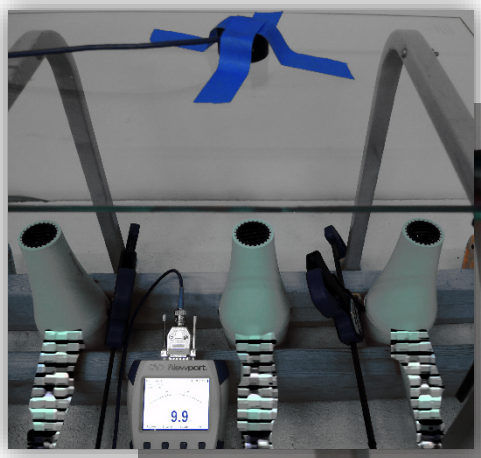


Figure 12: Left - Infrared testing setup

Below – Under infrared test

Measurements of the nominal infrared emissions were taken just after turning the dryer on, then after operating the dryer for two hours. Between those measurements, the emitted infrared varied 0.001mW.

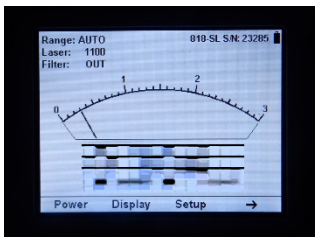


Figure 13: Starting infrared output

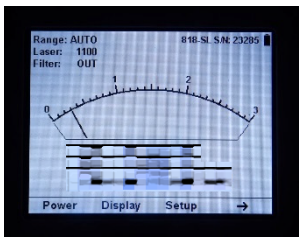


Figure 14: Infrared output after two hours

Reviewed by: MCB TAL