Title:

Malcom Heat Gun Test
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Requester: Four Powers Working Group

Reason: Test and Evaluation

Heat Gun in Portable Carry Case

EXECUTIVE SUMMARY

The United States Air Force Headquarters Air Force Materiel Command ABDR Technical Support Office has located and tested a portable heat gun from the Malcom Corporation and conducted several tests to evaluate ABDR capabilities. We began with conducting three baseline tests to evaluate optimum heat range, time required to reach maximum temperature and service life of batteries in use. The next portion of the testing surrounded the actual soldering of 22 AWG and coaxial cable systems. This tool is currently in use by the U.S. Navy and has met all requirements for use in an explosive atmosphere in accordance with MIL-STD-810F (Method 511.4) dated January 2000.

ACKNOWLEDGEMENTS/POINT OF CONTACT

The author would like to thank Mr. Don Brown (Malcom Company) for supplying the battery powered heat gun part# MCH-100-A and technical manuals for test purposes. Point of Contact: Mr. Don Brown, Tele: 401-683-3199 FAX: 401-682-1904
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PURPOSE

The purpose of this project was to research an acceptable portable heat gun for soldering electrical connectors used for aircraft maintenance. The Four Powers group requested a tool for use in intrinsically safe areas acceptable for aircraft battle damage repairs.

BACKGROUND

Availability of a portable heat gun for soldering electrical connectors on aircraft has been a goal of the four powers working group since 2003. Some of the considerations requested were lightweight, portable, and intrinsically safe in explosive areas and delivers acceptable energy life to sustain repairs in a conflict. Current procedures for soldering electrical connectors require aerospace ground equipment (AGE) for an air source and electrical power. Maintenance support is required to deliver and sustain use of the AGE equipment and soldering is allowed only in non-explosive environments. The United States ABDR Technical Support Office has located and tested a portable heat gun from the Malcom Corporation and conducted several tests to evaluate ABDR capabilities.

Test Plan:

The first phase of testing the Malcom heat gun consisted of establishing a baseline heat survey to evaluate temperature rise from ambient temperature to the maximum temperature delivered by the heat gun. Data captured included: start temperature, time measured in seconds at each 50°F (10°C) increment. Temperatures are posted in, Fahrenheit, Celsius, Kelvin and Rankine measurements.

a.) (ref. Figure 1). Inside environment (enclosed building)
b.) (ref. Figure 2). Open hanger environment
c.) (ref. Figure 3). Final run, determine battery life after recharge
d.) (ref. Figure 4). Solder test results

The investigation revealed a steady rise in temperature in each environment. There was a variable in time required to reach temperatures. The outside environment required an average of 63 additional seconds to reach a maximum temperature.

As shown in *Fig. 1 (inside environment)* Batteries were depleted and fully charged prior to test. The heat gun maintained 950°F (510°C) for 5 minutes and decreased 1°F (-17.22°C) per minute down to 918°F (492°C) and held steady for 6 minutes. The temperature continued to decrease by 3-5°F (-16°C - 15°C) per minute to the lowest temperature of 884°F (473.3°C) until the batteries were depleted. The batteries lasted 23 minutes.

As shown in *Fig. 2 (open hangar environment)* Batteries were depleted and fully charged prior to test. The heat gun maintained 900°F (482.2°C) for 5 minutes and decreased 1°F (-17.22°C) per minute down to 890°F (476.7°C) and held steady for 7 minutes. The temperature continued to decrease by 3-5°F (-16°C - 15°C) per minute to the lowest temperature of 774°F (412.2°C) until the batteries were depleted. The batteries lasted 33 minutes.

As shown in *Fig. 3 (final run)*   The batteries were not depleted prior to test, however were fully charged before final run. The heat gun maintained a temperature of 850°F (454°C) and depleted after only 7 minutes and 30 seconds into the test.

As shown in Fig. 4 *(solder test results)* We did not experience any problems in obtaining solder flow in each of the 24 solder applications during a 2-hour period. The tool worked perfectly for all heat shrink applications as well. We checked continuity of 24 soldered wires and found 100% satisfactory results. During the soldering process the gun was turned off between soldering applications and the batteries retained approximately 50% of their power. The times recorded for battery life in figures 1 through 3 were based on a steady run of the tool from start to finish. In normal applications the tool will be turned on and off as required and should deliver numerous hours of run time.

DISCUSSION

Temperature results gathered during this project provided data to validate portability of the heat gun unit, temperature ranges available for use, ability to solder electrical connectors and battery life. Batteries can be fully charged in a matter of two hours. The heat gun was supplied with five different types of nozzles that are easily exchanged in seconds; the vendor can supply a large variety of nozzles. We discovered during our testing, that after exhausting the batteries during each tests it is advantageous to perform the manual power depletion (discharge caps provided) of the batteries prior to a full recharge. This action allows for a longer run time by approximately 65%.

CONCLUSIONS

The Malcom battery powered heat gun MCH-100-A works as advertised.

Heat Gun Test Results for baseline temperatures

Inside environment

Start Temp °F	Start Temp °C	Start Temp Kelvin	Rankine	Time/Sec
250	121.1	394.3	709.7	2
300	148.9	422	759.7	8
350	176.7	449.8	809.7	9
400	204	477.6	859.7	13
450	232.2	505.4	909.7	17
500	260	533.1	959.7	20
550	287.8	560.9	1010	25
600	315.6	588.7	1060	35
650	343.3	616.5	1110	45
700	371.1	644.3	1160	60
750	398.9	672	1210	75
800	426.7	699.8	1260	100
850	454.4	727.6	1310	130
900	482.2	755.4	1360	190
950	510	783.1	1410	220

Notes:

Maintained 950°F for 5 minutes and decreased 1°F per minute to 918°F
Decreased to 914°F in 6 minutes, held steady for 3 minutes
Decreased each minute by @ 3-5 degrees per minute to 884°F, batteries exhausted

Figure 1.

Inside Environment

Open hangar environment

Start Temp °F	Start Temp °C	Start Temp Kelvin	Rankine	Time/Sec
250	121.1	394.3	709.7	15
300	148.9	422	759.7	18
350	176.7	449.8	809.7	25
400	204	477.6	859.7	35
450	232.2	505.4	909.7	45
500	260	533.1	959.7	50
550	287.8	560.9	1010	60
600	315.6	588.7	1060	70
650	343.3	616.5	1110	90
700	371.1	644.3	1160	110
750	398.9	672	1210	135
800	426.7	699.8	1260	175
850	454.4	727.6	1310	245
900	482.2	755.4	1360	600
950	510	783.1	1410	N/A

Notes:

Maintained 900°F for 10 minutes and decreased 1°F per minute to 890°F
Decreased to 888°F in 6 minutes, held steady for 3 minutes
Decreased each minute by @ 3-5 degrees per minute to 744°F, batteries exhausted
Batteries lasted @ 33 minutes

Figure 2.

Open Hangar Environment

Final run

Start Temp °F	Start Temp °C	Start Temp Kelvin	Rankine	Time/Sec
250	121.1	394.3	709.7	5
300	148.9	422	759.7	10
350	176.7	449.8	809.7	25
400	204	477.6	859.7	30
450	232.2	505.4	909.7	32
500	260	533.1	959.7	45
550	287.8	560.9	1010	60
600	315.6	588.7	1060	75
650	343.3	616.5	1110	95
700	371.1	644.3	1160	125
750	398.9	672	1210	155
800	426.7	699.8	1260	245
850	454.4	727.6	1310	N/A
900	482.2	755.4	1360	N/A
950	510	783.1	1410	N/A

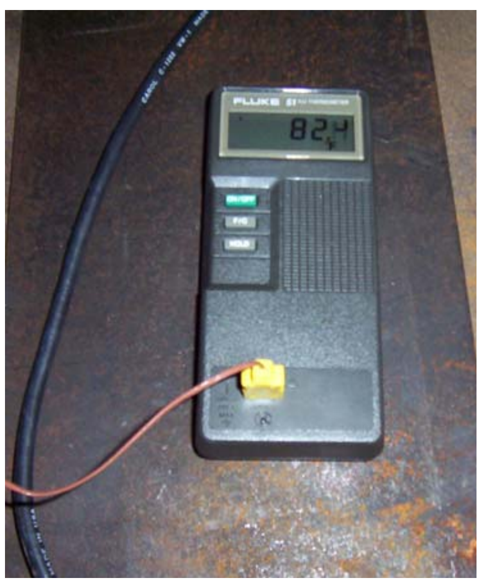
Notes:

Did not deplete batteries, charged and conducted run

Maintained 850°F for 3 minutes until batteries exhausted

Batteries lasted @ 7 minutes 30 seconds

Figure 3.



Fluke Meter

Solder Test Results

Test#	Wire Type	Time/Flow	°F	°C	Kelvin	Rankine
1	Coax/outside	30 SEC	355°F	179.4	452.6	814.7
2	18 AWG	17 SEC	365°F	185	458.2	824.7
3	18 AWG	9 SEC	360°F	182.2	455.4	819.7
4	Coax/inside	13 SEC	357°F	180.6	453.7	816.7
5	Caox//Outside	11 SEC	409°F	209.4	482.6	868.7
6	Caox/Outside	17 SEC	442°F	227.8	500.9	901.7

NOTES:

Solder flow began @ 350°F when wire was covered with a single insulation

Multiple insulation (sleeves required a slightly higher temperature to obtain solder flow

All wires were checked for proper continuity with satisfactory results

Figure 4.

Soldering Test

Finished Coaxial Cable