

# KENWOOD

KENWOOD CORPORATION

## TEST REPORT

for MIL-STD-810F

### KENWOOD


FM TRANSCEIVER

MODEL: TK-2202, 2207,3202,3207

March 12/2004

TEST REPORT No. 7507

TESTED BY:



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## OBJECTIVE

The purpose of this project was to determine if the MODEL TK-2202, TK-2207, TK-3202, TK-3207 Portable transceiver meet the requirements of Military Standard 810F.

## REFERENCES

1. MIL-STD-810F, Military Standard for Environmental Test Methods and Engineering Guidelines.

## SAMPLE DESCRIPTION

The following items were identified and tested.

1 pc. Model TK-2202, VHF portable transceivers,  
Serial No. 51005001

1 pc. Model TK-3202, UHF portable transceivers,  
Serial No. 51005001

## PRELIMINARY

Before testing began, a performance evaluation was conducted under normal operating conditions, and numerical values for each of the test parameters were obtained.

All subsequent test results were then compared with these initial figures, and any degradation of performance could be determined.

METHOD 500.4 – PROCEDURE IILow Pressure (Altitude) Test

-Operation/Air carriage-

Procedure:

The transceiver was placed into a chamber where the air pressure was monitored and decreased to simulate a climb rate of 2,000 feet per minute. Once a pressure equivalent to an altitude of 15,000 feet was achieved inside the chamber, the pressure was maintained for one hour. This pressure was then increased to simulate a rate of descent equivalent to 2,000 feet per minute until ambient pressure was attained.

Results:

A complete visual and operational examination revealed no adverse effects of the low pressure (altitude) test on the performance of the transceiver.

<u>S/N 51005001</u>	<u>Before Exposure</u>	<u>After Exposure</u>
12 dB SINAD	-121.0dBm	-121.2dBm
Power Output	5.22 Watts	5.10 Watts
Maximum Deviation	± 4.02 kHz	± 4.12 kHz
Frequency Error	+ 0.31 ppm	+ 0.21 ppm
Squelch Sensitivity	-119.0dBm	- 119.3dBm

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 500.4, Procedure II, Low Pressure (Altitude) Test.

METHOD 501.4 – PROCEDURE IIHigh Temperature Test

-Operation-

Procedure:

The transceiver was stored for 15 hours in an environmental chamber which was stabilized at +32°C (+90°F). The temperature in the chamber was then increased to +49°C (+120°F), and the transceiver was stored at this temperature for nine more hours. This cycle was repeated seven times for total exposure duration of 168 hours. At the completion of the last cycle, ambient temperature was restored and maintained in the test chamber until temperature stabilization of the transceiver was achieved.

Results:

A complete visual and operational examination revealed no adverse effects of the high temperature test on the performance of the transceiver.

<u>S/N 51005001</u>	<u>Before Exposure</u>	<u>After Exposure</u>
12 dB SINAD	-121.2dBm	-121.4dBm
Power Output	5.10 Watts	5.15 Watts
Maximum Deviation	± 4.12 kHz	± 4.15 kHz
Frequency Error	+ 0.21 ppm	+ 0.33 ppm
Squelch Sensitivity	-119.3dBm	- 119.1dBm

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 501.4, Procedure II, High Temperature Test.

METHOD 502.4 – PROCEDURE IILow Temperature Test-Operation-Procedure:

The transceiver was stored for 24 hours in an environmental chamber with an internal temperature of -57°C (-71°F). At the conclusion of this exposure, the test sample was allowed to stabilize at standard ambient conditions and was then checked for proper operation.

Results:

Visual and operational examination of the transceiver revealed no degradation of performance resulting from the low temperature exposure.

<u>S/N 51005001</u>	<u>Before Exposure</u>	<u>After Exposure</u>
12 dB SINAD	-121.4dBm	-121.0dBm
Power Output	5.15 Watts	5.20 Watts
Maximum Deviation	± 4.15 kHz	± 4.18 kHz
Frequency Error	+ 0.33 ppm	+ 0.23 ppm
Squelch Sensitivity	-119.1dBm	- 118.7dBm

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 502.4, Procedure II, Low Temperature Test.

METHOD 503.4 – PROCEDURE ITemperature Shock Test

-Steady State-

Procedure:

The transceiver was stored for two hours in a cold temperature chamber with an internal temperature of  $-30^{\circ}\text{C}$  ( $-22^{\circ}\text{F}$ ). The transceiver was then removed, and within five minutes it was placed into a high temperature chamber that was stabilized at  $+71^{\circ}\text{C}$  ( $+160^{\circ}\text{F}$ ). After two hours, the transceiver was removed, and within five minutes it was returned to the low temperature chamber where it was conditioned  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ) for two more hours.

The above procedure was repeated twice. The transceiver was allowed to stabilize at ambient room temperature and was then checked for proper operation.

Results:

The transceiver was fully functional at the conclusion of the temperature shock test.

<u>S/N 51005001</u>	<u>Before Exposure</u>	<u>After Exposure</u>
12 dB SINAD	-121.0 dBm	-119.8dBm
Power Output	5.20 Watts	5.15 Watts
Maximum Deviation	$\pm 4.18$ kHz	$\pm 4.22$ kHz
Frequency Error	+ 0.23 ppm	+ 0.33 ppm
Squelch Sensitivity	-118.7dBm	- 118.5dBm

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 503.4, Procedure I, Temperature Shock Test.

METHOD 505.4 – PROCEDURE I

Solar Radiation (Sunshine) Test

-Cycling (heating effects)-

Procedure:

The transceiver, S/N 51005001 was exposed to continuous 24-hour cycles of controlled simulated solar radiation and dry bulb temperature as indicated in Procedure I of MIL-STD-810F, Method 505.4 of table 505.4-1. The number of cycles performed was seven cycles.

Results:

Visual and operational examination of the transceiver revealed no degradation of performance resulting from the Solar Radiation exposure.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 505.4, Procedure I, Solar Radiation (Sunshine) Test.

METHOD 506.4 – PROCEDURE I

Rain test

-Rain and Blowing Rain-

Procedure:

The transceiver, S/N 50405002, was installed in a test apparatus as described in Procedure I of MIL-STD-810F, Method 506.4. Rain and wind was allowed to blow at rain rate of 4.0 in/hr with a wind velocity of 40-mph for at least 30 minutes. Repeat above steps with rotation of each 6 specified axes. Then the transceiver was opened and examined for any signs of water intrusion, and was checked for proper operation.

Results:

No evidence of water penetration could be observed inside the transceiver's main enclosure, and the unit was found to operate properly at the conclusion of the Blowing Rain test.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 506.4, Procedure I, Blowing Rain Test.



METHOD 506.3 – PROCEDURE IIIRain test-Drip-Procedure:

The transceiver, S/N 51005001, was installed in a test apparatus as described in Procedure II of MIL-STD-810F, Method 506.4. Water was allowed to drop from a height of three feet for 15 minutes, while a water level of three inches was maintained in the dispenser of the test apparatus. After 15 minutes, the transceiver was opened and examined for any signs of water intrusion, and was checked for proper operation.

Results:

No evidence of water penetration could be observed inside the transceiver's main enclosure, and the unit was found to operate properly at the conclusion of the rain test.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 506.4, Procedure III, Rain Test (Drip).

METHOD 507.4 - PROCEDURE

Humidity Test

Procedure:

The transceiver, S/N 51005001, was tested in accordance with Method 507.4 Procedure of MIL-STD-810F, utilizing the cycling procedures depicted in Figures 507.4-1.

Results:

A complete visual and operational examination revealed no adverse effects of the humidity test on the performance of the transceiver.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 507.4, Humidity Test.

METHOD 509.4 – PROCEDURESalt Fog TestProcedure:

The transceiver, S/N 51005002, was placed into a salt fog chamber that was stabilized at a temperature of +35°C (+95°F) with a salt concentration of 5% ± 1%. After a 48-hour exposure to the salt fog, the transceiver was removed from the chamber and allowed to dry for 48 hours. The transceiver was then visually examined for any signs of corrosion and was subjected to a performance test to verify proper operation.

Results:

A complete visual and operational examination revealed no adverse effects of the salt fog test on the performance of the transceiver.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 509.4, Salt Fog Test.

METHOD 510.4 – PROCEDURE I

Sand and Dust

-Blowing dust-

Procedure:

The transceiver, S/N 51005001, was placed into a test chamber and exposed for six hours to silicon dust which was blowing continuously at a velocity of 1750 ft./min. This exposure was then discontinued for 16 hours to allow the test sample to stabilize. This cycle was repeated once, and the transceiver was then evaluated for evidence of dust penetration.

Results:

A complete evaluation of the transceiver revealed no surface deterioration of the outer casing or damage to any internal components. No evidence of dust penetration into the sample's main enclosure was observed at the conclusion of the dust test.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 510.4, Procedure I, Sand and Dust Test.

MIL-STD-810E, METHOD 514.5 – PROCEDURE I CATEGORY 20Vibration Test

- General vibration-

Procedure:

The transceiver S/N 51005001 was vibrated along each of three different axes: the vertical, the horizontal, and the transverse. The transceiver was vibrated for one hour on each axis at the levels stated below.

<u>Frequency</u>	<u>Level</u>
20-1000 Hz	0.04 g <sup>2</sup> /Hz
1000-2000 Hz	-6 dB/Oct

Results:

The transceiver was fully operational at the conclusion of the vibration test.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 514.5, Procedure I, Vibration Test.

METHOD 516.5 - PROCEDURE IShock Test-Functional Shock-Procedure:

The transceiver was subjected to three shocks in each of the plus and minus directions of each axis.

Each shock pulse was a saw tooth wave with an overall duration of 11 milliseconds and peak amplitude of 20 g's. At the conclusion of the test, the transceiver was checked for proper operation.

Results:

The transceiver was fully operational at the conclusion of the shock test.

<u>S/N 51005001</u>	<u>Before Exposure</u>	<u>After Exposure</u>
12 dB SINAD	-119.8 dBm	-120.2dBm
Power Output	5.15 Watts	5.18 Watts
Maximum Deviation	± 4.22 kHz	± 4.15 kHz
Frequency Error	+ 0.33 ppm	+ 0.20 ppm
Squelch Sensitivity	-118.5dBm	- 119.0dBm

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 516.5, Procedure I, Shock Test.

MIL-STD-810E, METHOD 516.5 – PROCEDURE IVShock Test

-Transit drop-

Procedure:

The transceiver was enclosed in its shipping package and subjected to 26 drops from a height of 48 inches. The location of each impact was marked on the outside of the package. After all impacts were completed, the transceiver was checked for proper operation.

Results:

The transceiver was fully operational at the conclusion of the shock test.

<u>S/N 51005001</u>	<u>Before Exposure</u>	<u>After Exposure</u>
12 dB SINAD	-120.2 dBm	-120.5dBm
Power Output	5.18 Watts	5.20 Watts
Maximum Deviation	± 4.15 kHz	± 4.22 kHz
Frequency Error	+ 0.20 ppm	+ 0.15 ppm
Squelch Sensitivity	-119.0dBm	- 119.3dBm

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 516.5, Procedure IV, Shock Test (Transit Drop).

METHOD 500.4 – PROCEDURE IILow Pressure (Altitude) Test

-Operation/Air carriage-

Procedure:

The transceiver was placed into a chamber where the air pressure was monitored and decreased to simulate a climb rate of 2,000 feet per minute. Once a pressure equivalent to an altitude of 15,000 feet was achieved inside the chamber, the pressure was maintained for one hour. This pressure was then increased to simulate a rate of descent equivalent to 2,000 feet per minute until ambient pressure was attained.

Results:

A complete visual and operational examination revealed no adverse effects of the low pressure (altitude) test on the performance of the transceiver.

<u>S/N 510005001</u>	<u>Before Exposure</u>	<u>After Exposure</u>
12 dB SINAD	-120.5dBm	-119.8dBm
Power Output	4.01 Watts	3.95 Watts
Maximum Deviation	± 4.01 kHz	± 4.12 kHz
Frequency Error	- 0.11 ppm	- 0.18 ppm
Squelch Sensitivity	-120.5dBm	- 119.7dBm

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 500.4, Procedure II, Low Pressure (Altitude) Test.



METHOD 501.4 – PROCEDURE IIHigh Temperature Test

-Operation-

Procedure:

The transceiver was stored for 15 hours in an environmental chamber which was stabilized at +32°C (+90°F). The temperature in the chamber was then increased to +49°C (+120°F), and the transceiver was stored at this temperature for nine more hours. This cycle was repeated seven times for total exposure duration of 168 hours. At the completion of the last cycle, ambient temperature was restored and maintained in the test chamber until temperature stabilization of the transceiver was achieved.

Results:

A complete visual and operational examination revealed no adverse effects of the high temperature test on the performance of the transceiver.

<u>S/N 510005001</u>	<u>Before Exposure</u>	<u>After Exposure</u>
12 dB SINAD	-119.8dBm	-120.4dBm
Power Output	3.95 Watts	4.05 Watts
Maximum Deviation	± 4.12 kHz	± 4.08 kHz
Frequency Error	- 0.18 ppm	- 0.10 ppm
Squelch Sensitivity	-119.7dBm	- 120.2dBm

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 501.4, Procedure II, High Temperature Test.

METHOD 502.4 – PROCEDURE IILow Temperature Test-Operation-Procedure:

The transceiver was stored for 24 hours in an environmental chamber with an internal temperature of -57°C (-71°F). At the conclusion of this exposure, the test sample was allowed to stabilize at standard ambient conditions and was then checked for proper operation.

Results:

Visual and operational examination of the transceiver revealed no degradation of performance resulting from the low temperature exposure.

<u>S/N 510005001</u>	<u>Before Exposure</u>	<u>After Exposure</u>
12 dB SINAD	-120.4dBm	-120.6dBm
Power Output	4.05 Watts	4.02 Watts
Maximum Deviation	± 4.08 kHz	± 4.05 kHz
Frequency Error	- 0.10 ppm	- 0.05 ppm
Squelch Sensitivity	-120.2dBm	- 120.5dBm

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 502.4, Procedure II, Low Temperature Test.

METHOD 503.4 – PROCEDURE ITemperature Shock Test

-Steady State-

Procedure:

The transceiver was stored for two hours in a cold temperature chamber with an internal temperature of  $-30^{\circ}\text{C}$  ( $-22^{\circ}\text{F}$ ). The transceiver was then removed, and within five minutes it was placed into a high temperature chamber that was stabilized at  $+71^{\circ}\text{C}$  ( $+160^{\circ}\text{F}$ ). After two hours, the transceiver was removed, and within five minutes it was returned to the low temperature chamber where it was conditioned  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ) for two more hours.

The above procedure was repeated twice. The transceiver was allowed to stabilize at ambient room temperature and was then checked for proper operation.

Results:

The transceiver was fully functional at the conclusion of the temperature shock test.

<u>S/N 510005001</u>	<u>Before Exposure</u>	<u>After Exposure</u>
12 dB SINAD	-120.6dBm	-120.2dBm
Power Output	4.02 Watts	4.10 Watts
Maximum Deviation	$\pm 4.05$ kHz	$\pm 4.08$ kHz
Frequency Error	- 0.05 ppm	-0.14 ppm
Squelch Sensitivity	-120.5dBm	-120.1dBm

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 503.4, Procedure I, Temperature Shock Test.

METHOD 505.4 – PROCEDURE I

Solar Radiation (Sunshine) Test

-Cycling (heating effects)-

Procedure:

The transceiver, S/N 51005001 was exposed to continuous 24-hour cycles of controlled simulated solar radiation and dry bulb temperature as indicated in Procedure I of MIL-STD-810F, Method 505.4 of table 505.4-1. The number of cycles performed was seven cycles.

Results:

Visual and operational examination of the transceiver revealed no degradation of performance resulting from the Solar Radiation exposure.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 505.4, Procedure I, Solar Radiation (Sunshine) Test.

METHOD 506.4 – PROCEDURE IRain test-Rain and Blowing Rain-Procedure:

The transceiver, S/N 51005001, was installed in a test apparatus as described in Procedure I of MIL-STD-810F, Method 506.4. Rain and wind was allowed to blow at rain rate of 4.0 in/hr with a wind velocity of 40-mph for at least 30 minutes. Repeat above steps with rotation of each 6 specified axes. Then the transceiver was opened and examined for any signs of water intrusion, and was checked for proper operation.

Results:

No evidence of water penetration could be observed inside the transceiver's main enclosure, and the unit was found to operate properly at the conclusion of the Blowing Rain test.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 506.4, Procedure I, Blowing Rain Test.

METHOD 506.3 – PROCEDURE IIIRain test-Drip-Procedure:

The transceiver, S/N 51005001, was installed in a test apparatus as described in Procedure III of MIL-STD-810F, Method 506.4. Water was allowed to drop from a height of three feet for 15 minutes, while a water level of three inches was maintained in the dispenser of the test apparatus. After 15 minutes, the transceiver was opened and examined for any signs of water intrusion, and was checked for proper operation.

Results:

No evidence of water penetration could be observed inside the transceiver's main enclosure, and the unit was found to operate properly at the conclusion of the rain test.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 506.4, Procedure III, Rain Test (Drip).

METHOD 507.4 - PROCEDURE

Humidity Test

Procedure:

The transceiver, S/N 51005001, was tested in accordance with Method 507.4 Procedure of MIL-STD-810F, utilizing the cycling procedures depicted in Figures 507.4-1.

Results:

A complete visual and operational examination revealed no adverse effects of the humidity test on the performance of the transceiver.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 507.4, Humidity Test.

METHOD 509.4 – PROCEDURESalt Fog TestProcedure:

The transceiver, S/N 51005001, was placed into a salt fog chamber that was stabilized at a temperature of +35°C (+95°F) with a salt concentration of 5% ± 1%. After a 48-hour exposure to the salt fog, the transceiver was removed from the chamber and allowed to dry for 48 hours. The transceiver was then visually examined for any signs of corrosion and was subjected to a performance test to verify proper operation.

Results:

A complete visual and operational examination revealed no adverse effects of the salt fog test on the performance of the transceiver.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 509.4, Salt Fog Test.



METHOD 510.4 – PROCEDURE ISand and Dust-Blowing dust-Procedure:

The transceiver, S/N 51005001, was placed into a test chamber and exposed for six hours to silicon dust which was blowing continuously at a velocity of 1750 ft./min. This exposure was then discontinued for 16 hours to allow the test sample to stabilize. This cycle was repeated once, and the transceiver was then evaluated for evidence of dust penetration.

Results:

A complete evaluation of the transceiver revealed no surface deterioration of the outer casing or damage to any internal components. No evidence of dust penetration into the sample's main enclosure was observed at the conclusion of the dust test.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 510.4, Procedure I, Sand and Dust Test.

MIL-STD-810E, METHOD 514.5 – PROCEDURE I CATEGORY 20Vibration Test

- General vibration-

Procedure:

The transceiver S/N 51005001 was vibrated along each of three different axes: the vertical, the horizontal, and the transverse. The transceiver was vibrated for one hour on each axis at the levels stated below.

<u>Frequency</u>	<u>Level</u>
20-1000 Hz	0.04 g <sup>2</sup> /Hz
1000-2000 Hz	-6 dB/Oct

Results:

The transceiver was fully operational at the conclusion of the vibration test.

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 514.5, Procedure I, Vibration Test.

METHOD 516.5 - PROCEDURE IShock Test-Functional Shock-Procedure:

The transceiver was subjected to three shocks in each of the plus and minus directions of each axis.

Each shock pulse was a saw tooth wave with an overall duration of 11 milliseconds and peak amplitude of 20 g's. At the conclusion of the test, the transceiver was checked for proper operation.

Results:

The transceiver was fully operational at the conclusion of the shock test.

<u>S/N 510005001</u>	<u>Before Exposure</u>	<u>After Exposure</u>
12 dB SINAD	-120.2 dBm	-119.8dBm
Power Output	4.10 Watts	4.05 Watts
Maximum Deviation	± 4.08 kHz	± 4.02 kHz
Frequency Error	- 0.14 ppm	-0.22 ppm
Squelch Sensitivity	-120.1 dBm	-119.5dBm

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 516.5, Procedure I, Shock Test.

MIL-STD-810E, METHOD 516.5 – PROCEDURE IVShock Test

-Transit drop-

Procedure:

The transceiver was enclosed in its shipping package and subjected to 26 drops from a height of 48 inches. The location of each impact was marked on the outside of the package. After all impacts were completed, the transceiver was checked for proper operation.

Results:

The transceiver was fully operational at the conclusion of the shock test.

<u>S/N 510005001</u>	<u>Before Exposure</u>	<u>After Exposure</u>
12 dB SINAD	-119.8 dBm	-120.2dBm
Power Output	4.05 Watts	4.02 Watts
Maximum Deviation	± 4.02 kHz	± 4.05 kHz
Frequency Error	- 0.22 ppm	-0.17 ppm
Squelch Sensitivity	-119.5 dBm	-120.3dBm

Conclusion:

The transceiver was found to meet the requirements of MIL-STD-810F, Method 516.5, Procedure IV, Shock Test (Transit Drop).

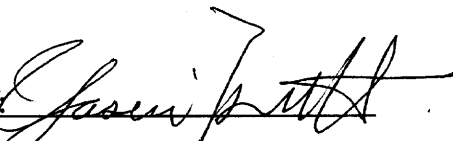
## STATEMENT OF CERTIFICATION

### THIS IS TO CERTIFY:

1. That the document was prepared either by, or under the direct supervision of, the undersigned.
2. That the technical data supplied with the document was taken under my direction and supervision.
3. That the data was obtained on representative units, randomly selected.
4. That, to the best of my knowledge and belief, the facts set forth in the accompanying technical data are true and correct.

SIGNED FOR THE COMPANY

BY:



YASUNORI KURIMOTO

General Manager

Quality Management Department  
Communications Equipment Division