

Cohen, Dippell and Everist, P.C.

TO: Hossein Hashemzadeh  
cc: Nathan Schenkel  
Andrew Knitt  
Tom Van Wazer  
TOPIC: Caterpillar Test Procedure - Peoria and Tucson  
DATE: November 28, 2007  
FROM: Donald G. Everist

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Per our discussion, please find a summary of the test procedure entitled, "Summary of Proposed EMC Testing Procedure." This overview depicts that the test signal is very narrow in comparison to 6 MHz and emits in a very small timeframe. Therefore, the test procedure limits the potential for interference to broadcast operations in the VHF and UHF bands.

This test procedure is based on Caterpillar's internal requirements and ISO specifications for international compliance.

Also provided are two frequency/channel charts. One is for the Peoria test site and the second is for the Tucson test site. This gives an overview of these channels in the TV broadcast band which encompass Channels 2-69 in the area which

- an STA has already been received
- consent has been received from the relevant station, and
- de minimis interference has been predicted based on the Digital Low-Power Television Longley-Rice Analysis (those channels marked OK) which would impact any broadcast station by less than 0.5%
- Call letters are provided by a station(s) receiving interference greater than 0.5%

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The Digital Low-Power Television Longley-Rice Analysis will over predict the computed interference due to the narrow band nature of the test signal, its abbreviated duty cycle, and the transmit test antenna which is only 2 to 3 meters above ground level rather than the 30 meters used in the low power digital analysis. Further, each test site (Peoria and Tucson) has surrounding ground elevation higher in almost every direction than the transmit test antenna, thereby providing inherent terrain shielding of the test signal to the general test site area.

Please give me a call at your convenience.

Attachments

**Caterpillar, Inc.**  
**Summary of Proposed EMC Testing Procedures**

Caterpillar has requested special temporary authority to conduct electromagnetic compatibility (EMC) immunity testing on the channel edge of specified channels in television band at its Peoria Proving Grounds and Tucson Proving Grounds sites. Caterpillar typically conducts outdoor EMC testing on its large equipment approximately 10 times per year.

The EMC testing is directed to critical electronic components on large earth moving equipment that could potentially be affected if operated in a high electromagnetic field environment. The EMC testing is conducted across a large number of frequencies to ensure both product safety and compliance under different international regulatory schemes, including those of the European Union, that

**Testing Procedures**

EMC immunity testing involves illuminating the equipment under test with an electromagnetic field of specified, uniform electric field strength across the applicable frequency range. Because of the wide range of frequencies that the equipment under test must be subjected to, various antennas are used in the testing phase. These include horn style, log periodic yagi, and other broadband antennas. The antennas are typically mounted two meters or less off the ground and three to five meters from the equipment under test. The antenna radiation pattern will be omnidirectional below 200 MHz (biconical antenna) and directional above 200 MHz (log periodic antenna).

Industry and internal standards for Caterpillar earth moving equipment require testing of electronic systems on machines at a field strength level of 100 V/m. The transmitter output power required for testing at this field strength varies due to the efficiency of the antenna at a given frequency. At lower frequencies where the transmitting antenna is an inefficient radiator, the transmitter output power will be much greater than the ERP due to high-reflected power. At high frequencies where the transmitting antenna has significant gain, the transmitter output power will be much lower than the ERP. Caterpillar has requested 500 watts of effective radiated power to conduct this testing, although the actual transmitter power output will be much less in most cases.

The test signals will be centered at the edge of any television channel used and will have a maximum bandwidth of 2 kHz at frequencies below 800 MHz. Above 800 MHz, the maximum bandwidth is 20 kHz. The transmitted test signal is either an unmodulated carrier an 80 percent AM modulated at 1 kHz, or pulse modulated (only above 800 MHz).

Starting at the lowest frequency of interest, the signal generator is stepped through the frequencies of interest by computer control. The computer normally dwells on one particular frequency for less than 10 seconds per frequency sweep. A normal test regimen consists of six frequency sweeps (three antenna positions x two antenna polarizations) over the course of several hours. Given these parameters, the transmitter duty cycle at any particular frequency is approximately 60 seconds (or .4 percent) for a four-hour test.

### **Interference Mitigation**

The likelihood of interference with broadcast signals is low and will be reduced in the following ways:

- Antennas mounted close (2 meters or less) to the ground and close (3 to 5 meters) to the equipment under test which will greatly limit the range of the transmitted signal
- Use of directional antennas for all frequencies above 200 MHz
- Test signal centered at the edge of any television channel with a maximum bandwidth of 2 kHz.
- Dwell time on any frequency is less than 10 seconds
- The outdoor testing occurs infrequently (once every several months)
- The outdoor test site is in a low-lying area relative to surrounding terrain, which will limit signal propagation

In addition, Caterpillar personnel will be present for all aspects of the investigation, testing will be coordinated with various public safety agencies in the area, and standards of good engineering practice will be followed, with applicable FCC rules available as a reference.