

The logo for United Medical Maintenance Services (UMMS) features the letters "UMMS" in a white, sans-serif font. To the left of the text is a bright white starburst or light flare. Below the text is a white, curved line that resembles a stylized underline or a swoosh.

United Medical Maintenance Services

Engineering Publications

T/S ACR Failures on GE CT

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This publication is designed to guide you on the proper testing of any CT system prior to ACR testing.

Overview:

Items that need to be tested:

- Patient table accuracy
- Laser light alignment
- Protocol linearity
- Protocol uniformity
- Low contrast detect ability
- High contrast detect ability
- Contrast scaling

Though the OEM methods and standards for image quality are the current guidelines needed to meet FDA compliance, we have found that even when a machine meets the OEM standards it can fail ACR accreditation.

It is important to pay attention to detail. For example, one site a General Electric CT/I, and Lightspeed QX/I passed all OEM specifications for image quality:

- Laser alignment test
- Patient Table accuracy
- Protocol linearity and uniformity
- Low and High contrast detect ability
- Contrast scaling

However, in figure one, there is a slight pronounce ring artifact with in the low contrast testing section of the ACR phantom. Tuning and calibration would not remove the ring artifact. ACR will fail any unit that has artifact. In the remaining testing for ACR there was no evidence of rings any where. In the OEM image quality testing there was evidence of ringing in the images. On anatomy studies the radiologist and technologist had no complaints of any artifact issues.

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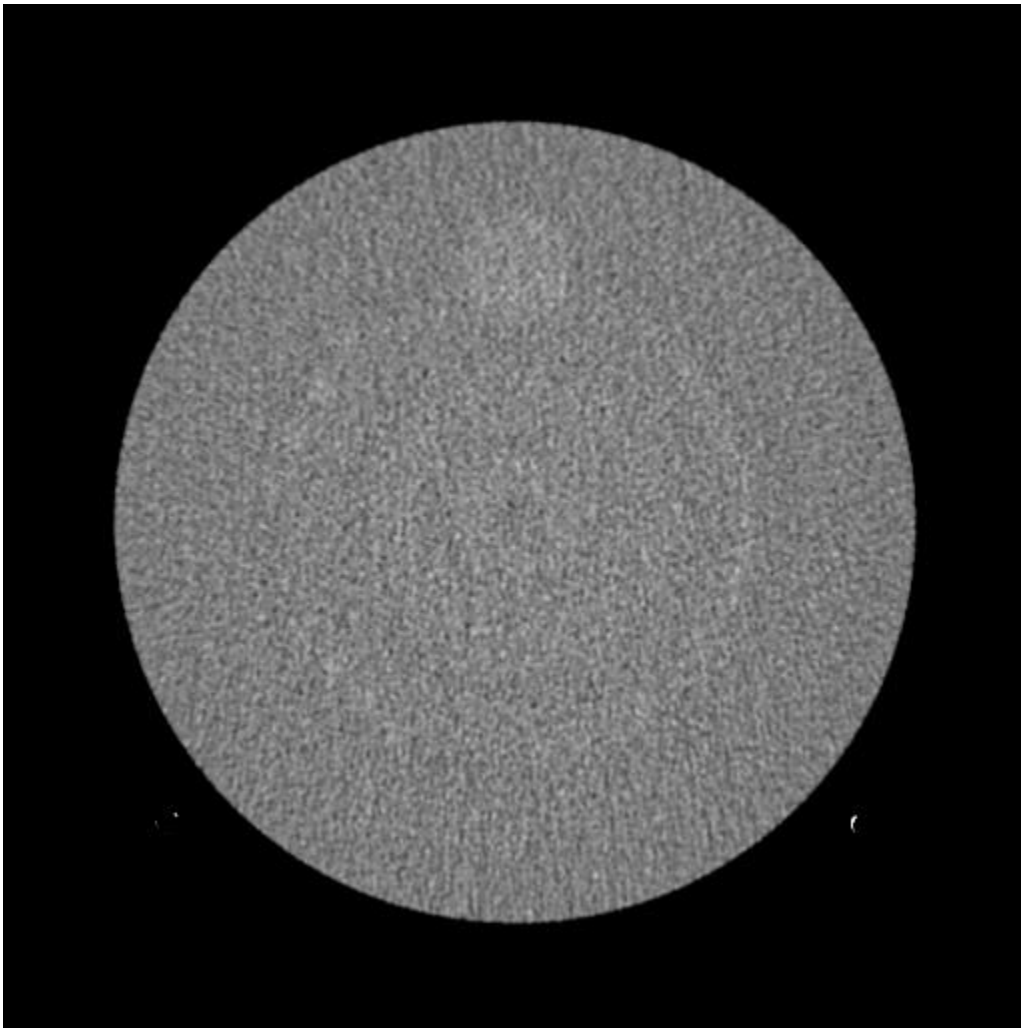


Figure 1

In course of T/S this problem, several factors we considered:

- X-ray tube output
- Collimation
- X-ray tube alignments
- DAS / Detector channel crosstalk
- DAS / Detector channel absorption
- Calibration files – Air and Phantom cals
- Calibration files – Q-CAL, Crosstalk and Alpha Vector

I started the T/S process by first understanding the material makeup of the ACR phantom low contrast section. This material is extremely light in attenuation, which allows for more background air to appear inside this section. In figure 2, with only the table cradle in the field of view, I ran test scans at:

1 second scan time
5 mm slice thickness
120kV @ 200mA
48cm DFV
Phantom type: AIR

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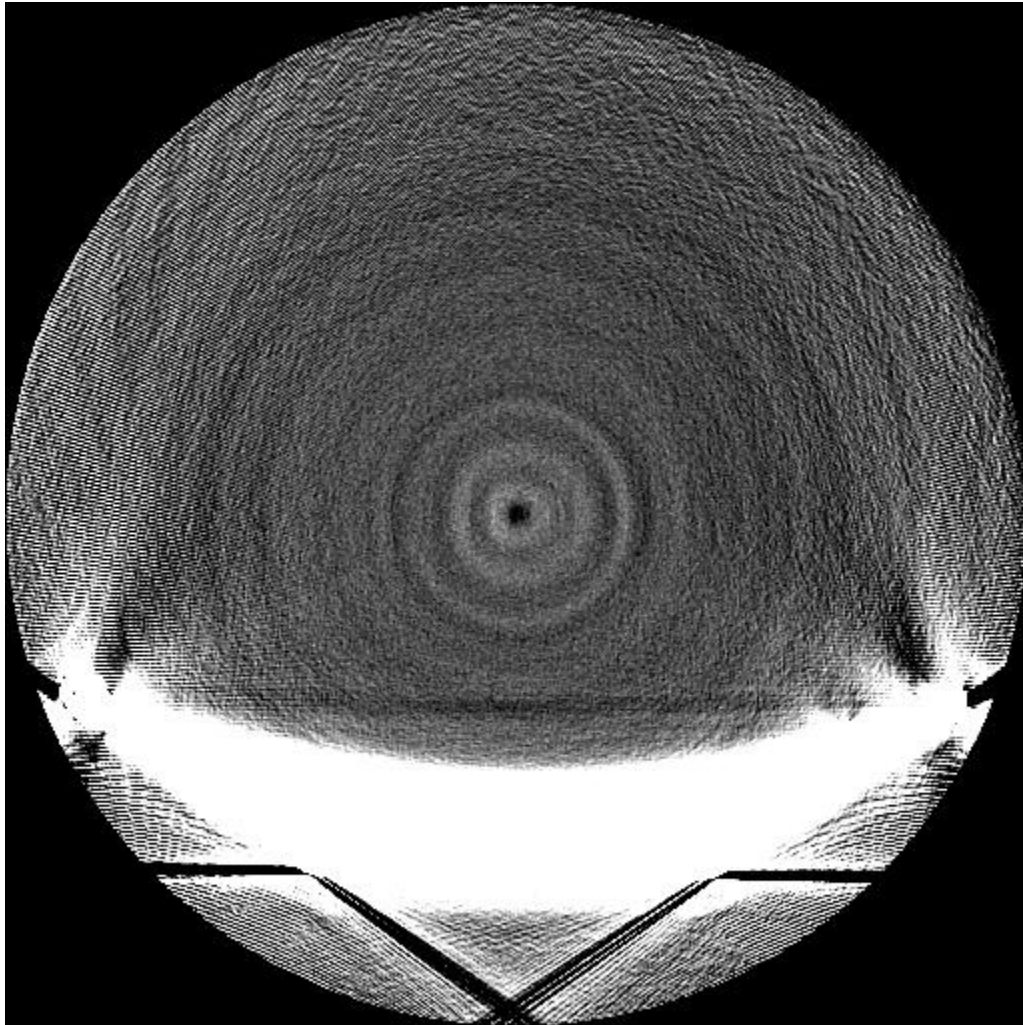


Figure 2

In figure 2, notice the rings in the center of scan field of view. Now refer back to figure 1. Though figure 2 was scanned at 48cm scan field of view, I decided to take this one step further. Ran another test at:

1 second scan time
5 mm slice thickness
120kV @ 200mA
23cm DFV
Phantom type:AIR

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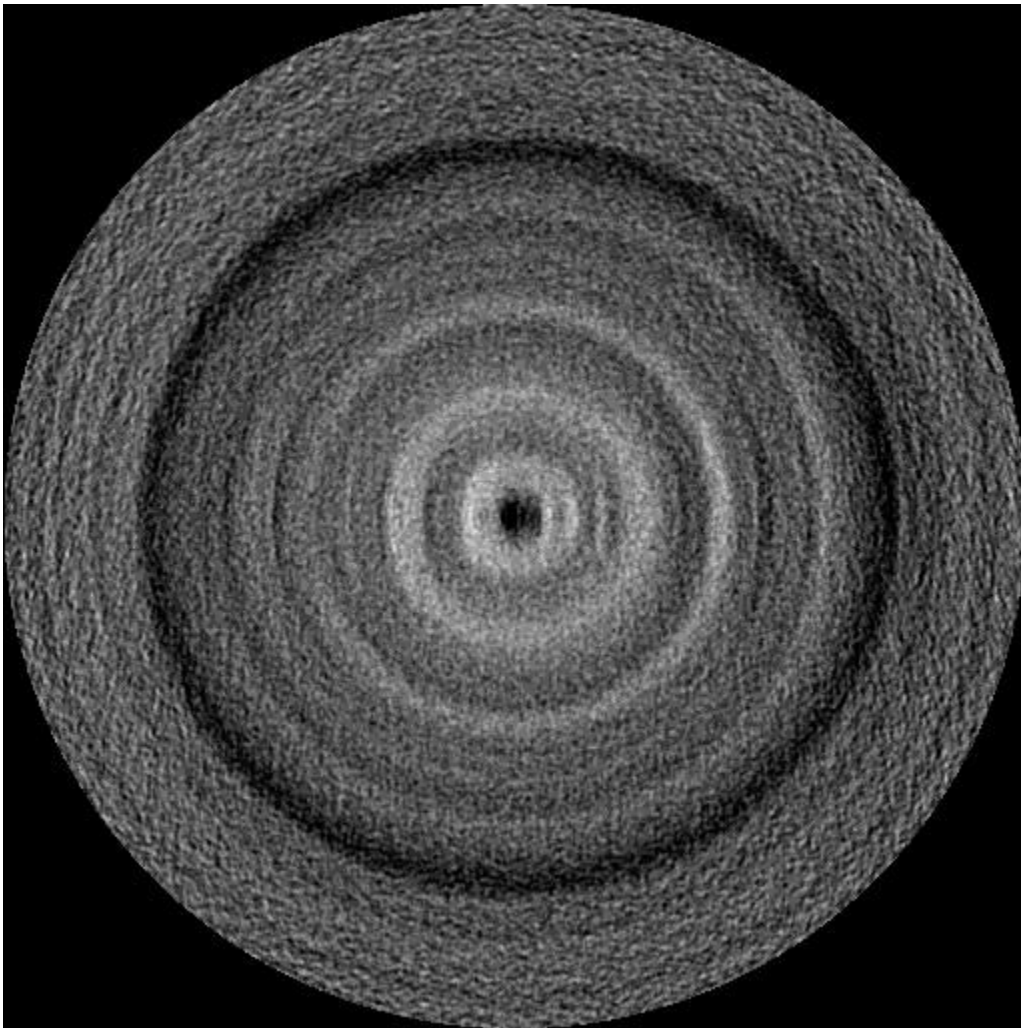


Figure 3

In figure 3, the artifact appears and corresponds to the artifact seen in figure 1. Problem is why only the ACR phantom?

Next we took the OEM phantom and scan the low contrast section using the OEM protocols. Refer to figure 4.

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Figure 4

In figure 4, the low contrast testing doesn't show any artifacts. Low contrast passes OEM specifications. Conclusion, the material makeup of the phantom is so light that the attenuation x-rays through this section is extremely close to that of air. The GE phantoms contain water that surrounds all the testing materials.

Now what factors to consider:

- X-ray tube output
- Collimation
- X-ray tube alignments
- DAS / Detector channel crosstalk
- DAS / Detector channel absorption and linearity
- Calibration files – Air and Phantom cals
- Calibration files – Q-CAL, Crosstalk and Alpha Vector

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As far as X-ray tube, collimation, and detector alignments. This item can be ruled by simply running the low and high contrast testing. Now this leaves us with:

- X-ray tube output
- DAS / Detector channel crosstalk
- DAS / Detector channel absorption and linearity
- Calibration files – Air and Phantom cals
- Calibration files – Q-CAL, Crosstalk and Alpha Vector

In this case air, phantom, QCAL, crosstalk and alpha vector calibration were performed with no change in the problem. Now what's left?

- X-ray tube output
- DAS / Detector channel absorption and linearity
- Corrupt phantom or air cal vector files

Test the x-ray tube output and found it to be slightly above specifications but posed a concern. Check Kv , Ma and exposure accuracy. All test pass.

Now at this point we are left with either a x-ray that has degraded over time and hasn't produced and Kv or Ma error or tube spiting when scanning or maybe a absorption linearity problem in the detector array.

Next, DAS test was ran on the system. No failures whatsoever. Next, we looked at the detector linearity based on an error scan.

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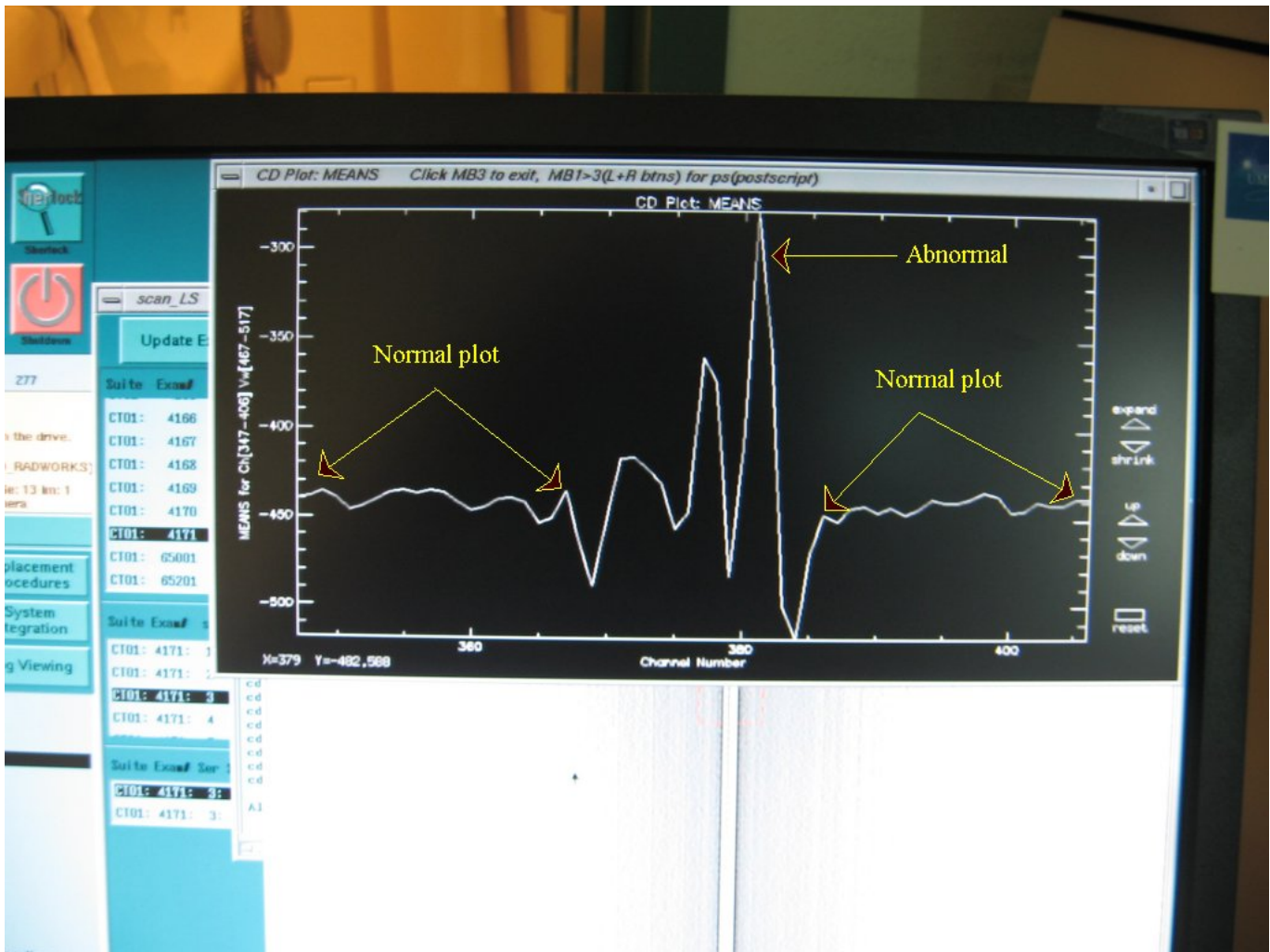


Figure 6

In figure 6, you see a distinct abnormality between detector channels 369 to 384. Next DAS filter card number 23 was replaced. Air and phantom calibrations were run. No change.

Swapped DAS filter cable between DAS filter card number 23 with number 24. Plotted that data and the abnormality move to channels 385 – 400.

Final resolution to the problem was a bad detector array. Replaced the array and the artifact problem cleared up.

CAUTION!

The General Electric HiLight detector arrays are prone to a failure of this type.

CAUTION!

When T/S a multi-slice detector system, YOU MUST evaluate all the detector arrays. For instance if this was a 4 slice system, each array of the 4 slices would have to be evaluated individually.

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