AMERICAN ASSOCIATION of PHYSICISTS IN MEDICINE

Date: December 11, 2023
To: CLA sub-committee and ADCLs
From: CLA
Subject: Data Matrix Code (DMC) data format for ADCL calibrations

The attached document specifies a Data Matrix Code (DMC) data format for use in conjunction with radiation detector calibrations provided by Accredited Dosimetry Calibration Laboratories (ADCLs).

The DMC data format follows the ISO/IEC 16022:2006 standard and is intended to enable accurate input of calibration data into systems (via a bar code scanner) used for dosimetry measurements (i.e. electrometers) with a data format that is universal for all equipment manufacturers. The data embedded in the proposed ADCL DMC is a subset of the information provided on an official ADCL calibration certificate.

This document explains the allowed DMC usage and the limitations of the AAPM's involvement in this initiative. Please note the following points:

- The DMC cannot appear on, or be attached to the official calibration certificate that has the AAPM logo on it. The DMC is an optional and supplementary feature that does not replace or modify the official calibration certificate. The DMC may be printed on a separate medium (paper, tag, label or sticker) that does not contain the AAPM logo.

- The AAPM is not liable for the information contained on the DMC nor miss-use of the DMC. The AAPM does not guarantee the accuracy, completeness, or validity of the data encoded in the DMC. The AAPM is not responsible for any errors, omissions, or damages that may arise from the use or misuse of the DMC. The users of the DMC should always verify the data with the official calibration certificate and follow the instructions and precautions provided by the ADCLs.

# ADCL Data Matrix Code - Data Format Specification

**Introduction**

In this document, a Data Matrix Code (DMC) data format is defined for use in conjunction with radiation detector calibrations provided by Accredited Dosimetry Calibration Laboratories (ADCLs). The DMC follows the ISO/IEC 16022:2006 standard format[1]. The intent of a DMC is to enable accurate input of calibration data into systems (via a bar code scanner) used for dosimetry measurements (i.e. electrometers) with a data format to be universal for all equipment manufacturers. The data embedded in this proposed ADCL DMC is a subset of the information provided on an official ADCL calibration certificate.

| Key | Designation | Value Options | Value Format |
|---|---|---|---|
| CN | Calibration Certificate (Report) Number | | Alphanumeric Text: 10 characters maximum |
| CD | Calibration Date/Time | | Date/Time: ISO8601 - UTC |
| CS | Calibration Radiation Beam Quality | | Text: 30 characters maximum |
| ME | Calibration Measurement Quantity | ADW\|AK\|EX\|DLP\|AKS | (see Note 1 for description) |
| CF | Calibration Factor (coefficient) | | x.xxxe+yy (where x.xxx denotes the mantissa value, and yy denotes the exponential value) |
| UN | Calibration Coefficient Units (numerator) | GY\|R\|mGY_CM\|uGY_M2_HR-1\|GY_M2_HR-1 | (see Note 2 for description) |
| UD | Calibration Coefficient Units (denominator) | C\|A | |
| CT | Calibration Reference Temperature [°C] | 20\|22 | |
| MF | Detector Manufacturer | | Text: 30 characters maximum |
| TN | Detector Model | | Text: 30 characters maximum |
| SN | Detector Serial Number | | Text: 30 characters maximum |
| DN | Detector Type | OPEN\|SEALED\|LIQUID\|DIODE\|DIAMOND | |
| | Checksum | CRC16-CCITT (XMODEM) Checksum | Last parameter in the DMC |

**Note 1:**
ADW = Absorbed Dose to Water
AK = Air Kerma
EX = Exposure
DLP = Dose Length Product [applies to CT]
AKS = Air Kerma Strength [applies to LDR/HDR]
AKR = Air Kerma Rate [applies to EBT]

**Note 2:**
GY = Gray
R = Roentgen
mGY_CM = mGy·cm [applies to CT]
uGY_M2_HR-1 = µGy·$m^2$/hr [applies to LDR]
GY_M2_HR-1 = Gy·$m^2$/hr [applies to HDR]
uGy_MIN-1 = µGy/min. [applies to EBT]

# ADCL Data Matrix Code - Data Format Specification

**Data Matrix Code example content and bar code (should be one continuous string):**
CN0123456789;CD2022-06-25T12:00:00Z;CSCo-60;MEAK;CF5.417e+07;UNGY;UDC;CT22;MFManufacturer;TNModel;SNSerialNumber;DNOPEN;32252

**CRC16-CCITT (XMODEM) Checksum example calculation (to verify the code used for the calculation):**
Data Matrix Code String (do not include the quotation marks): "ABC;123"
CRC16-CCITT (XMODEM) Checksum value: 28299

**Additional DMC Requirements:**

- The DMC shall be built according to ISO/IEC 16022:2006 standards.
- The finder pattern shall be located on the bottom-left. The timing pattern shall be located on the top-right.
- A data point should have a minimum size of 0.380 mm and maximum size of 0.615 mm.
- The quiet zone border (margin) around the DMC should be larger than one data point.
- The data content of the DMC is text. The encoding, and thus the character range for characters, is defined according to Unicode UTF-8.
- The maximum number of alphanumeric characters shall be 3116.
- The coding shall consist of "keys" (described in the above table) followed by "values".
- A semicolon (;) shall be used as a separator between key-value pairs.
- Decimal numbers are separated by a period (.). In exponential notation, the letter "e" (lower or upper case) separates mantissa from exponent.
- The Calibration Coefficient Units keys (numerator [key: UN] and denominator [key: UD]) are used in conjunction to define both the radiological unit and the readout device measured quantity (Coulomb or Ampere).
- The DMC shall end with a cyclical redundancy check (CRC16-CCITT [XMODEM]), calculated from the first to the last character of the message (including the last semicolon).

**Recommended Report Disclaimer:**

The [name of ADCL] has verified the calibration data incorporated into this Data Matrix bar code report. It is up to the user to verify that the data is transferred accurately to a readout device and that the correct data is used for dosimetry measurements.

References

1. ISO/IEC 16022:2006 – Automatic identification and data capture techniques – Data Matrix bar code symbology specification (2006)