# The Encyclopaedia of Medical Physics II Edition: The update of General Terms field

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***Abstract:*** **The paper describes briefly the update of the Medical Physics Thesaurus of terms and the related update of General Terms field of the Encyclopaedia of Medical Physics II Edition (published 2021).**

***Keywords*** *– Medical Physics Encyclopaedia, Medical Physics Education, Medical Physics resources.*

## I. Introduction

The Encyclopaedia of Medical Physics development and its update took over 20 years. The articles of the Encyclopaedia I Edition (published by CRC Press in 2013 [1]) were based on the Medical Physics Thesaurus of terms, developed in 2003 and updated in 2008. An additional minor update of the full Thesaurus was made in 2011. The Encyclopaedia Edition I included over 2800 articles explaining the foundation terms in medical physics. Some of those terms were General terms, supporting the medical physics knowledge. Edition I was published by CRC Press (in paper) as a two-volume set and uploaded (together with the Scientific Dictionary of Medical Physics Terms in 32 languages) on the dedicated website www.emitel2.eu as a free reference and educational resource.

During the following 10 years materials for the Thesaurus update were collected and a major update was made in the period 2019-2020. This update included about 650 new terms plus additional diagrams, tables and other information. The Encyclopaedia II Edition is listed alphabetically, but it has specific parts (fields), managed by different teams, as per the narrow specialty of the contributors. These fields are on Physics of: Diagnostic Radiology; Radiotherapy; Nuclear Medicine; Ultrasound Imaging; Magnetic Resonance Imaging; Radiation Protection; Non-ionising radiation protection; General terms (including Management). This new II Edition of the Encyclopaedia of Medical Physics was printed and published by CRC Press in 2021 [2]. The materials from the update were uploaded at the same website: www.emitel2.eu

## II. General terms update

This paper describes briefly the nature of the update and the new General terms of the Encyclopaedia. The initial Thesaurus of Diagnostic Radiology terms (from 2003) included General terms related to mathematics, physics, medicine, materials, engineering, etc., supporting the knowledge database of medical physics.

The mathematical terms, related to medical physics included topics covering image reconstruction and processing, statistics, etc. All these are covered in specific publications, but their existence in the Encyclopaedia intended to give condensed knowledge and starting point for further studying of the subject (this was additionally supported by lists with Further Reading at the end of each encyclopedic article). Many of these terms were updated in Edition II. Care was taken the explanation of these General terms to be with educational value. Fig. 1 shows part of one such article.

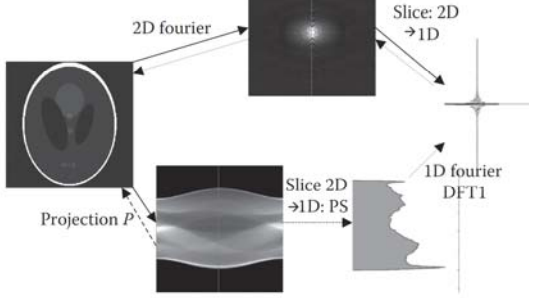
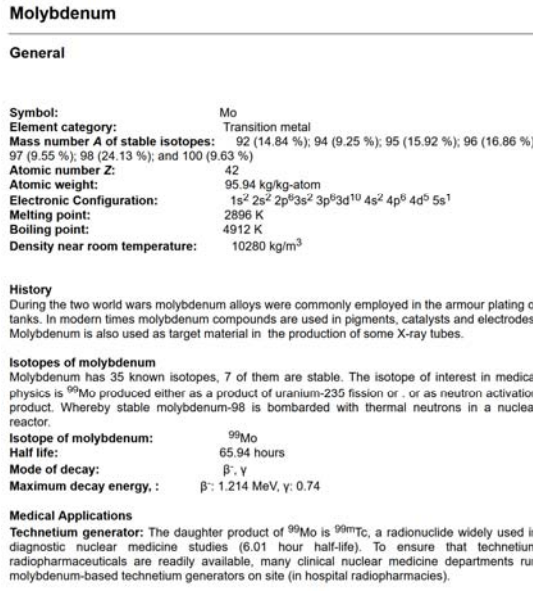



Fig.1 Graphical example for image reconstrction – *from article: Back projection reconstruction*

Most of the General terms from medicine were covered in Edition I (such as radiographic projections, parameters of some organs – e.g. densitometric values, etc.), but still some additional terms and values were added in Edition II.

The terms related to physics included many articles covering specific elements used in medical physics. These terms were updated, where necessary. Figure 2 shows a typical description of one element (Molybdenum) with the included parameters. The Encyclopaedia included also an addendum with fundamental physics constants and the Periodic Table of the Elements.



**Molybdenum**

**General**

| | |
|---|---|
| **Symbol:** | Mo |
| **Element category:** | Transition metal |
| **Mass number *A* of stable isotopes:** | 92 (14.84 %); 94 (9.25 %); 95 (15.92 %); 96 (16.86 %) 97 (9.55 %); 98 (24.13 %); and 100 (9.63 %) |
| **Atomic number *Z*:** | 42 |
| **Atomic weight:** | 95.94 kg/kg-atom |
| **Electronic Configuration:** | $1s^2\ 2s^2\ 2p^6 3s^2\ 3p^6 3d^{10}\ 4s^2\ 4p^6\ 4d^5\ 5s^1$ |
| **Melting point:** | 2896 K |
| **Boiling point:** | 4912 K |
| **Density near room temperature:** | 10280 kg/m$^3$ |

**History**

During the two world wars molybdenum alloys were commonly employed in the armour plating c tanks. In modern times molybdenum compounds are used in pigments, catalysts and electrodes Molybdenum is also used as target material in the production of some X-ray tubes.

**Isotopes of molybdenum**

Molybdenum has 35 known isotopes, 7 of them are stable. The isotope of interest in medica physics is $^{99}$Mo produced either as a product of uranium-235 fission or . or as neutron activatio product. Whereby stable molybdenum-98 is bombarded with thermal neutrons in a nuclea reactor.

| | |
|---|---|
| **Isotope of molybdenum:** | $^{99}$Mo |
| **Half life:** | 65.94 hours |
| **Mode of decay:** | $\beta^-$, γ |
| **Maximum decay energy, :** | $\beta^-$: 1.214 MeV, γ: 0.74 |

**Medical Applications**

**Technetium generator:** The daughter product of $^{99}$Mo is $^{99m}$Tc, a radionuclide widely used i diagnostic nuclear medicine studies (6.01 hour half-life). To ensure that technetiu radiopharmaceuticals are readily available, many clinical nuclear medicine departments ru molybdenum-based technetium generators on site (in hospital radiopharmacies).

Fig. 2 Presentation of data for Molybdenum – *from article: Molybdenum*

The terms related to medical engineering were very important for "opening of the black box" of some medical equipment (as X-ray, Ultrasound, MRI, etc). Information was included also for specific electronic components used in the equipment – Fig.3, as well as their parameters, relevant for medical physics. A number of equipment were presented with educational engineering block diagrams – Fig.4. The General terms related to various monitors (and visualization in general) were often combined with similar terms from the other fields (mainly Imaging).

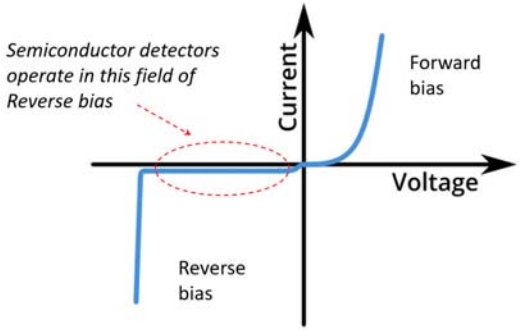



Fig.3 Semiconductor diode characteristic - *from article: Diode*

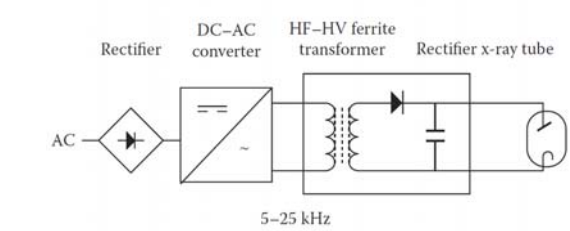



Fig.4 Block diagram of medium (high) frequency high-voltage x-ray generator - *from article: High-frequency generator*

A new area of the General terms, added in Edition II, was related to Medical Equipment management. The importance for including these was related to the fact that in small countries (especially in LMI countries) medical physicists often perform clinical engineering tasks. These terms covered the fields of Life cycle of equipment, Procurement, Servicing, etc. Fig. 5 gives an example for such terms.

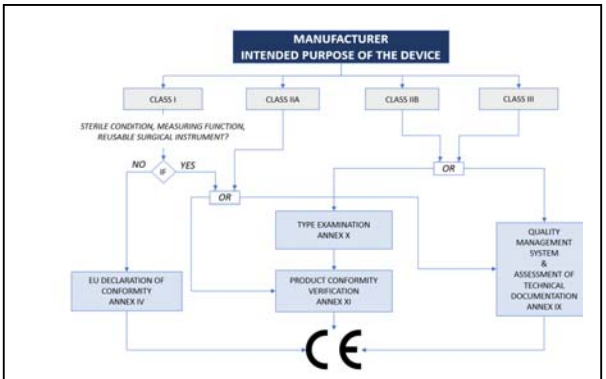



Fig.5 A diagram illustrating the necessary steps to obtain the CE mark for a medical device - *from article: Certificate of conformity*

Significant update of the information about PACS (Picture Archiving and Communication Systems) was updated (and new added) to cover this very dynamic new field of the profession. As with the engineering information, this area was often combined with terms from the Imaging fields. Fig. 6 gives a block diagram related to PACS.

Another General terms area covered information about various medical physics and related organisations and bodies, international projects/activities, professional development, etc. The existing data about IUPESM, IFMBE, IOMP, its Regional Organisations, etc was updated (these include various website addresses).

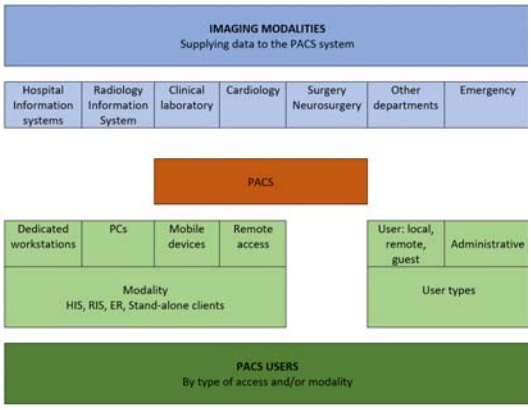



Fig.6 PACS - *from article: PACS*

The general terms also included brief articles about new areas entering medical as Artificial Intelligence, Data Mining, etc. Further references are shown for these areas.

## III. CONCLUSION

The update of the field with General terms (some related to other fields) included about 110 new articles. These were managed by the Coordinators of the Working Group on General Terms: Slavik Tabakov, Magdalena Stoeva, Franco Milano, Ernesto Iadanza.

The update covered many new areas and included a lot of udates of existing articles. The Editorial Board shall be grateful to information from our colleagues about new methods and equipment to be included in the III Edition of the Encyclopaedia (possibly around 2031).

## ACKNOWLEDGEMENTS

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