Code of practice for Quality Assurance of Applicators and Transfer Tubes for Ir-192 Afterloaders

NEDERLANDSE COMMISSIE VOOR STRALINGSDOSIMETRIE

Pre-publication of the Netherlands Commission on Radiation Dosimetry

6 March 2017

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Subcommittee QA of Afterloaders for Brachytherapy
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This pre-publication should be revised before October 2017

Preface

The Nederlandse Commissie voor Stralingsdosimetrie (NCS, Netherlands Commission on Radiation Dosimetry, http://www.radiationdosimetry.org) was officially established on 3 September 1982 with the aim of promoting the appropriate use of dosimetry of ionising radiation both for scientific research and practical applications. The NCS is chaired by a board of scientists, installed upon the suggestion of the supporting societies, including the Nederlandse Vereniging voor Radiotherapie en Oncologie (Netherlands Society for Radiotherapy and Oncology), the Nederlandse Vereniging voor Nucleaire Geneeskunde (Dutch Society of Nuclear Medicine), the Nederlandse Vereniging voor Klinische Fysica (Dutch Society for Medical Physics), the Nederlandse Vereniging voor Radiobiologie (Netherlands Radiobiological Society), the Nederlandse Vereniging voor Stralingshygiëne (Netherlands Society for Radiological Protection), the Nederlandse Vereniging voor Medische Beeldvorming en Radiotherapie (Dutch Society for Medical Imaging and Radiotherapy), the Nederlandse Vereniging van Klinisch Fysisch Medewerkers (Dutch Society for Medical Physics Engineers), the Nederlandse Vereniging voor Radiologie (Radiological Society of the Netherlands) and the Belgische Vereniging voor Ziekenhuisfysici/Société Belge des Physiciens des Hôpitaux (Belgian Hospital Physicists Association). To pursue its aims, the NCS accomplishes the following tasks: participation in dosimetry standardisation and promotion of dosimetry intercomparisons, drafting of dosimetry protocols, collection and evaluation of physical data related to dosimetry. Furthermore, the commission shall maintain or establish links with national and international organisations concerned with ionising radiation and promulgate information on new developments in the field of radiation dosimetry.

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This report was prepared by a subcommittee of the Netherlands Commission on Radiation Dosimetry (NCS).

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Notice for readers

This part is a pre-publication of the NCS subcommittee “QA of Afterloaders for Brachytherapy” (see http://radiationdosimetry.org/qa-of-afterloaders-for-brachytherapy).
Medical physicists in the Netherlands requested a rapid publication of this part of the report as a response to urging discussions about deterioration of transfer tubes and applicators and their technical lifetime.

Validity of this pre-publication

Since the report is still under construction, this part may be subject to frequent changes. Therefore, it is under version control, with an expiry date. After that date a new version should be available and the revised parts are described below.

Version Control
Version 1.0, 1-7-2015
Version 1.1, 9-7-2015.
Version 1.2, 8-11-2015
Version 1.2.1, 16-06-2016
Version 1.2.2, 6-03-2017

Expiry date: 1-10-2017

Revisions:
Version 1.0: first version
Version 1.1: NCS format is implemented.
Version 1.2: minor textual changes & defining the maximum overpressure of 0.2 bar (p8)
Version 1.2.1: only date of current version and new expiry date have been set
Version 1.2.2: only date of current version and new expiry date have been set

As the final reports is still in preparation, remarks, comments and experiences are welcome at the NCS at secretary@radiationdosimetry.org

QA tests for Applicators and Transfer Tubes

Introduction

Over time, both applicators and transfer tubes / source guide tubes [1] may show (signs of) mechanical wear and tear due to, among others, cleaning, disinfection and sterilisation, aging of the fabric, wear due to movement of the source and check cable (friction), bending of the tubes and (dis) connecting the transfer tube from the afterloader and applicator(s). Worldwide there have been several reports of damaged applicators or transfer tubes and poor connectivity between transfer tubes, afterloader and applicator. Wearing of material may compromise hygiene or radiation safety if the source cannot retract due to a faulty connection or biological contamination in either transfer tubes or applicator.

Therefore, it is highly recommended to check both applicators and transfer tubes carefully for integrity, leakage and proper connectivity.

Life expectancy

Usually, the manufacturer provides instructions for recommended checks along with an average life expectancy of the various parts. However, it is the user's responsibility to ascertain good functioning, irrespective of this expected life span. Since wear and tear depend both on intensity and degree of usage as well as on cleaning, disinfection and sterilisation frequencies, these factors may be considered along with the date of purchase of the applicator or transfer tube. If the manufacturer expresses the life expectancy in years, rather than in number of treatments or usage, it is advised to check which assumptions, for instance number of treatments per week, are made when determining this period.

Dominant factors determining life expectancy

The NCS subcommittee considers the dominant factors determining deterioration to be:

- The number and type of cleaning, disinfection and sterilisation cycles
- Wear and tear due to repeatedly (dis)connecting the various parts
- Wear and tear due to source and check cable movement
- Aging of materials (physical ageing, chemical ageing, thermal ageing, radiation exposure)
- Storage conditions

Which factor is dominant depends on local procedures and usage of the particular equipment.

Recommended checks

The recommendations in table 1 and 2 aim for minimization of the occurrence of obstructions or other malfunctioning during treatment execution. However, these recommendations cannot guarantee an unproblematic treatment performance. Therefore, safety recommendations as described elsewhere for instance by manufacturers, still apply. If the table states that a check should be done according to 'local protocol', this means there should be a clear protocol on how to check that particular item. Since local workflow highly influences the most practical approach, the subcommittee chooses not to prescribe how to perform checks in detail. Recommended checks and frequencies depend on the equipment used, the intensity and degree of usage and local procedure. The manufacturers' manual can be a starting point to set up local procedures, however,

[1] In this document "transfer tubes" will be used for brevity.

well-substantiated deviations can be considered. The responsibility of having a clear and comprehensive protocol lies with medical physicists.

Table 1 Integrity checks for transfer tubes

What	How	Frequency
Check that combination of afterloader, transfer tube and applicator is correct and has been commissioned ("Is this the right combination?")	Local protocol	Before each treatment fraction
Visual check ("Are they clean and undamaged?")	Visually check transfer tube and connectors. Ensure there is no visible damage, contaminants nor kinks present.	Before each treatment fraction
Ensure correct connection between transfer tube and applicator and afterloader ("Are they properly secured?")	Local protocol	Before each treatment fraction
Visual inspection	Visually inspect all items: -Biological contamination, integrity, kinking. If contaminated, clean tubes and connections according to manufacturer's protocol. If unacceptably damaged, document this (photograph) and decommission transfer tube.	After each treatment fraction
Elaborate inspection	Measure reference length with a tape measure or by performing source position check. Inspect connectors and check that obstruction or missing applicator is detected.	Annually

Further recommendations:
-To avoid bends or kinks, it is recommended to store the tubes fully elongated, either horizontally or vertically.
-It is recommended to have a reliable estimate on the frequency of use of each transfer tube in relation to the value used to calculate life expectancy.
-If transfer tubes are not used for more than 12 months, perform visual and elaborate inspection.

Table 2 Integrity checks for applicators including re-usable needles

What	How	Frequency
Check that combination of afterloader, transfer tube and applicator is correct and has been commissioned ("Is this the right combination?")	Local protocol	Before each treatment fraction
Visual check ("Is it clean and undamaged?")	Visually check the applicator: -Mechanical integrity of joint (glued) parts, colour changes, cracking. Note sterility!	Before inserting the applicator
Cleaning	Clean applicator according to manufacturer's protocol.	After removal of the applicator
Visual inspection	Visually inspect the applicator: -Damage, mechanical integrity of joint (glued) parts. If unacceptably damaged, document this (photograph) and decommission applicator.	After removal of the applicator
Geometrical check of source dwell positions	Local protocol Ensure that dwell positions correspond to values at commissioning and values in TPS	Annually

Further recommendations:
-If dummy markers are used for geometrical checks, ensure correspondence between the correct marker and the most distal dwell position.
- Some plastic applicators are prone to develop micro-fractures. For these applicators it is recommended to check after the clinical procedure for hair cracks by applying slightly elevated air pressure (max. 0.2 bar), while submerging the applicator under water.
-In particular for re-usable flexible tubes, it is recommended to check the length of a random combination of applicator and transfer tube after procedures involving physical or chemical stress (e.g. sterilisation or disinfection). It has been reported that changes in length may occur[2].
-If applicators are not used for more than 12 months, perform visual inspection and geometrical checks.
-It is recommended to have proper administration of the usage and number of cleaning, disinfection and sterilisation cycles for each applicator.

In case of problems or doubt, a medical physicist responsible for brachytherapy should be consulted. Parts that cannot or should not be used for treatment should be taken out of clinical use.

[2] Vendors may recommend checking the combined applicator and transfer tube length regularly or before each fraction.