

**South African Medical Physics Society (SAMPS)**  
**South African Association of Physicists in Medicine and Biology (SAAPMB)**  
**South African Standards for Quality Assurance in Radiotherapy (SASQART)**

**Medical Linear Accelerators**

Designator	Test	Performance		
		Tolerance	Action	Value
Daily				
DL1	Door interlock/last person out	Functional		
DL2	Beam status indicators	Functional		
DL3	Patient audio-visual monitors	Functional		
DL4	Output constancy - photons	2.00%	3.00%	
DL5	Output constancy - electrons	2.00%	3.00%	
Monthly				
ML1	Motion interlock	Functional		
ML2	Couch brakes	Functional		
ML3	Room radiation monitors (where available)	Functional		
ML4	Beam interrupt/ counters	Functional		
ML5	Emergency off (alternate monthly)	Functional		
ML6	Lasers/crosswires	1	2	
ML7	Optical distance indicator	1	2	
ML8	Optical back pointer (where available)	2	3	
ML9	Field size indicator	1	2	
ML10	Wedge factors (dynamic or virtual)	1.00%	2.00%	
ML11	Gantry angle readouts	0.5°	1°	
ML 12	Collimator angle readouts	0.5°	1°	
ML13	Couch position readouts	1	2	
ML14	Couch isocentre	1	2	
ML15	Couch angle	0.5°	1°	
ML16	Crosswire centering	1	2	
ML17	Light/radiation coincidence	1	2	
ML18	Central axis depth dose reproducibility	1%/2mm	2%/3mm	
ML19	Beam flatness	4.00%	5.00%	
ML20	Beam symmetry	2.00%	3.00%	
ML21	Records	Complete		
Annually				
AL1	Accessories: integrity and centering	Functional		

AL2	Accessories: latching and interlocks	Functional		
AL3	Optical distance indicator	1	2	
AL4	Light/radiation coincidence	1	2	
AL5	Field size indicator with gantry angle	1	2	
AL6	Reference dosimetry – TRS398	1.00%	2.00%	
AL7	Relative output factor reproducibility	1.00%	2.00%	
AL8	Wedge transmission factor reproducibility	1.00%	2.00%	
AL9	Accessory transmission factor reproducibility	1.00%	2.00%	
AL10	Output reproducibility vs. gantry angle	1.00%	2.00%	
AL11	Beam symmetry reproducibility vs. gantry angle	2.00%	3.00%	
AL12	Monitor chamber linearity	1.00%	2.00%	
AL13	End monitor effect	0.1 MU	0.2 MU	
AL14	Collimator rotation isocentre	1	2	
AL15	Gantry rotation isocentre	1	2	
AL16	Couch rotation isocentre	1	2	
AL17	Coincidence of collimator, gantry, couch axes	1	2	
AL18	Coincidence of isocentres	1	2	
AL19	Couch deflection	3	5	
AL20	Independent quality control review	Complete		

Tolerances and action levels are specified in millimetres unless otherwise stated

## Notes

### Daily:

- DL1-3 The configuration of these tests will depend on the design of the facility and equipment. Safety is the concern and tests should be designed accordingly. As a minimum, manufacturer's recommendations and applicable regulations must be followed.
- DL4-5 All energies in use on the particular treatment day. Standard local geometry.

### Monthly:

- ML1-4 The configuration of these tests will depend on the design of the facility and equipment. Safety is the concern and tests should be designed accordingly. As a minimum, manufacturer's recommendations and applicable regulations must be followed.
- ML5 Proper functioning of the emergency stop buttons, indicators and emergency circuits.
- ML6 Alignment of crosswires and appropriate lasers for collimator angle  $0^\circ$ , gantry angles  $0^\circ$ ,  $90^\circ$  and  $270^\circ$  at an SSD of SAD-10 cm
- ML7 Gantry angle  $0^\circ$  and at the isocentre and at SSD of SSD-10cm, or similar range
- ML8 Gantry angle  $0^\circ$  and at the isocentre
- ML9 Gantry angle  $0^\circ$ , 100cm SAD, field sizes of 5x5, 10x10, 20x20, max cm<sup>2</sup>
- ML10 Virtual or dynamic wedge factors for at least one wedge angle to be verified, relative to open beam outputs, for each photon energy.
- ML11 Mechanical and digital gantry angle readouts must be verified using a spirit level, or other appropriate levelling device, for at least  $0^\circ$ ,  $90^\circ$ ,  $180^\circ$  and  $270^\circ$ .
- ML12 Mechanical and digital collimator angle readouts must be verified using a spirit level, or other appropriate levelling device, for at least  $0^\circ$ ,  $90^\circ$  and  $270^\circ$ .
- ML13 Mechanical and digital couch position readouts must be verified over an appropriate clinical range in the directions of the three cardinal axes.
- ML14 Rotation of the couch about the optical collimator rotation axis must be verified.
- ML15 The couch rotation angle must be verified over an appropriate clinical range.
- ML16 The trajectory of the optical image of the crosswires is measured at the appropriate SSD for collimator angles of  $0^\circ$ ,  $90^\circ$  and  $270^\circ$ . Tolerances and Action Levels refer to the optical isocentre so measured.
- ML17 Geometric alignment of the radiation and optical field edges must be established at a clinically relevant field size at a gantry angles  $0^\circ$ . The field size and energy employed should be varied monthly.
- ML18 Measurements at two depths in an appropriate phantom serve to confirm that depth dose has not changed since commissioning the unit. Tolerances and Action Levels are specified in % for photon beams and mm for electron beams. Clinically relevant depths are used for these measurements
- ML19-20 Flatness and symmetry are compared with those measured at acceptance. A single, convenient gantry angle may be chosen.
- ML21 Documentation relating to the daily quality control checks, preventive maintenance, service calls and subsequent checks must be complete, legible and the operator identified.

### Annual:

- AL1 Physical integrity and centering of accessories, including physical wedges, trays and cones.
- AL2 Latching and interlocks of accessories, including physical wedges, trays and cones.
- AL3 The optical distance indicator should be checked over a clinically relevant range of SSD and gantry angle. The tolerance and action level may be twice as large (i.e. 2 and 4mm) at the clinical limits of the optical distance indicator's range.

- AL4 Geometric alignment of the radiation and optical field edges must be established over a range of field sizes at gantry angles  $0^\circ$ ,  $90^\circ$  and  $270^\circ$ . Representative half blocked fields must be included if available. A minimum of six field sizes will be required for this test. Tolerances and Action Levels apply to each edge of a rectangular field.
- AL5 Compliance of the radiation and optical field sizes with the indicated dimensions must be established over a range of field sizes at gantry angles  $0^\circ$ ,  $90^\circ$  and  $270^\circ$ . Jaw sizes at six representative sizes, e.g. 0,5,10,20,30,max cm.
- AL6 A full TRS-398 calibration is performed annually using a local primary standard. The output of all available beams is then measured using the local secondary standard, to provide a reference for daily readings.
- AL7-9 These tests confirm that essential parameters used for treatment time calculations have not changed. All accessories available in the treatment room must be checked.
- AL8 Wedge factors to be checked for all dynamic, virtual and physical wedges, for all photon energies. For non-physical wedges, this should be measured for at least four wedge angles
- AL10 An ion chamber with build-up cap may be used in air for these measurements. The chamber may be positioned at the isocentre or may be mounted on the head of the unit. In the latter case, effects due to head sag will not be observed.
- AL11 Gantry angles of  $0^\circ$ ,  $90^\circ$  and  $270^\circ$ , should be used.
- AL12-13 From a series of radiation measurements with different monitor units the linearity and the end monitor effect are determined.
- AL14-16 Using film, star or spoke patterns are produced and the three radiation axes of rotation are determined. Tolerances and Action Levels refer to the diameters so measured.
- AL17 By referencing the films in 14-16 above to the laser system the relative locations of the three axes of rotation at the isocentre may be determined.
- AL18 The radiation, optical and mechanical isocentres are determined with reference to the laser system and their degree of coincidence determined.
- AL19 Couch deflection is measured with 70 kg at the end with the couch extended to the isocentre.
- AL20 To ensure redundancy and adequate monitoring, a second qualified medical physicist must independently verify the implementation, analysis and interpretation of the quality control tests at least annually.