

1. What is a Q.A.?
2. Where do the standards come from?
3. Who performs a Q.A.?
4. What equipment would require a Q.A.?
5. What does a Q.A. test for?
6. How are some of tests performed?
7. How does a monthly Q.A. compare to an annual?

# WHAT IS Q.A.?

## QUALITY ASSURANCE FOR RADIATION THERAPY

A set of policies and procedures  
to maintain the quality of patient care

## WHERE DO THE STANDARDS COME FROM?

### Mandatory Components

1. Nuclear Regulatory Commission
2. Individual States

### Standards and Criteria

1. National Council of Radiation Protection and Measurements
2. International Commission of Radiation Units and Measurements
3. International Commission on Radiological Protection
4. International Electrotechnical Commission

### Proposed Programs

1. American College of Radiology
2. American Association of Physicists in Medicine
3. American College of Medical Physics

# WHO PERFORMS A Q.A.?

ACR suggests a Q.A. committee



Many Treatment Machine Q.A. duties belong to the Physicist

## MINIMUM PERSONEL REQUIREMENTS FOR PHYSICISTS

\* 1 Physicist per 400 patients treated annually \*

More Physicists For...

\* Research \*

\* Teaching \*

\* Administrative Functions \*

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## External Beam Units

1 Low Energy Photon (4-6 MV)

1 High Energy Photon (6-20 MV)

Number of Electron beams up to 18 or 20 MeV

\*\* Should have at least 1 machine \*\*  
\*\* per 30 patients treated daily \*\*

## Brachytherapy Sources

Good for Uterine Cervical, Prostate,  
Gynecological Cancers, and others!

Intracavity application – Radium and Cesium sources

Interstitial implants – Iridium-192 or Iodine-125

Q.A.'s done on Remote Afterloaders

## Simulator

- \*Need geometric accuracy in order to reproduce proper fields for treatment
- \*Require good image quality
- \*Fluoroscopic capability is desirable

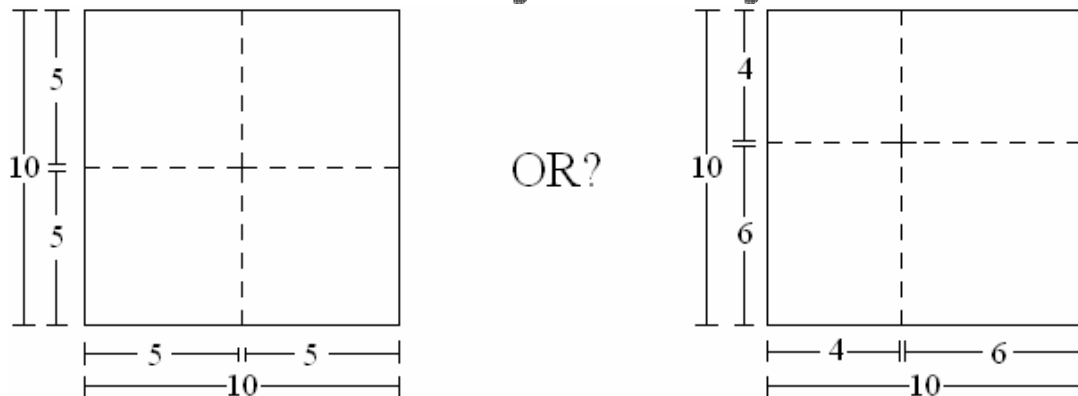
# WHAT DOES A QA TEST FOR?

First requires installation, acceptance testing, and commissioning

## Radiation Survey

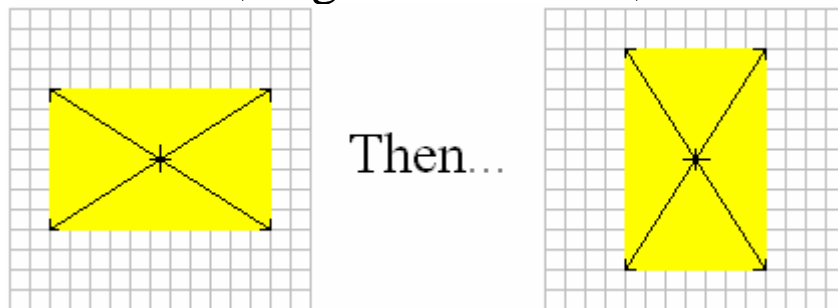
- \*Make sure exposure levels outside the room do not exceed permissible limits
- \*Preliminary calibration of the machine output (cGy/MU)
- \*Tests of interlocks, warning lights, and emergency switches

## Jaw Symmetry



## Coincidence

- \*Collimator Axis, Light Beam Axis, and Cross-hairs



- \*Light Beam with X-ray Beam

0°



90°



180°



270°



# Mechanical Isocenter

## DEFINITION

The intersection point of the axis of rotation of the collimator and the axis of rotation of the gantry

## COLLIMATOR ROTATION

Be sure that the alignment of the isocenter for each collimator angle stays within a 2-mm diameter circle

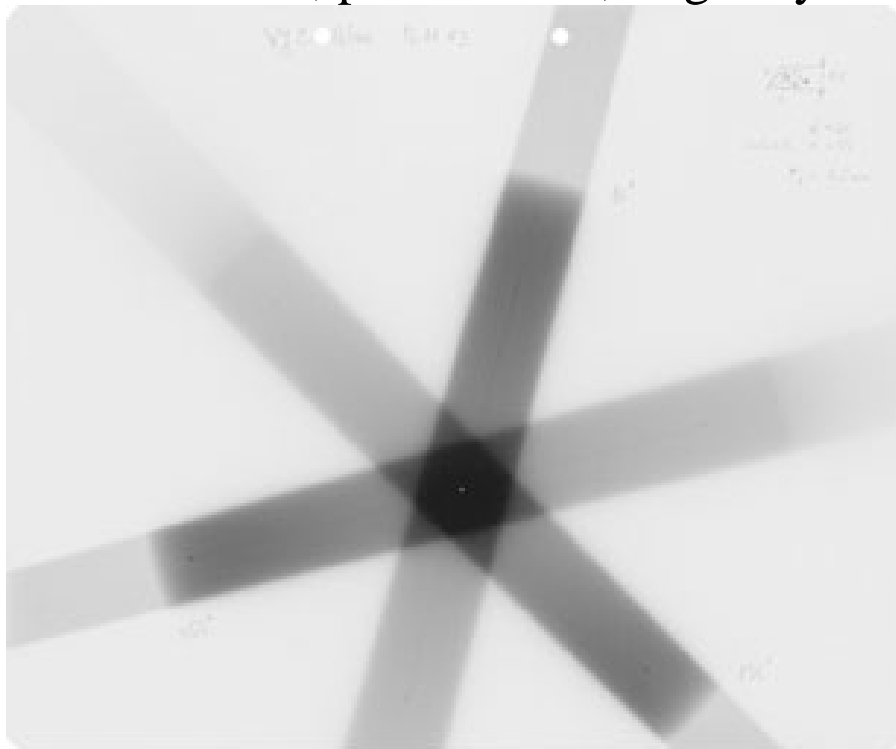
## GANTRY ROTATION

The tolerance of the isocenter motion with full gantry rotation is  $\pm 1$  mm

# Radiation Isocenter

## DEFINITION

The intersection point of radiation beams when either the collimator, patient table, or gantry is rotated



# Beam Performance



FLATNESS

**SYMMETRY**

## Monitor Chambers

Check that monitor chamber readings are a linear function of dose rate

## Wedges and Trays

- \*Check the wedge and tray factors
- \*Be sure they latch properly to the mounting device

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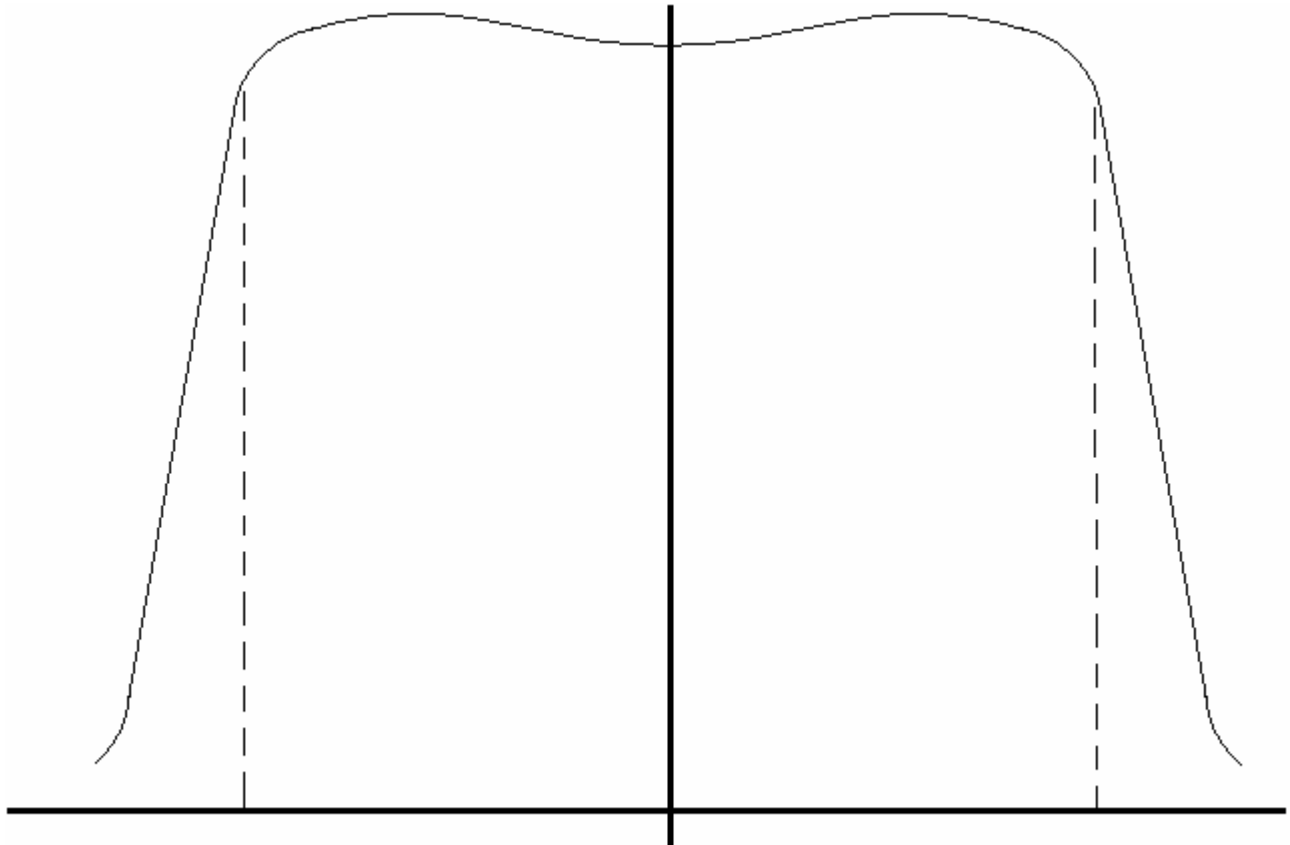
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## Other Possible Checks

- \*Optical distance indicators
- \*Field size indicators
- \*Gantry and collimator angles
- \*Laser alignment
- \*Table sag
- \*any other devices provided with vendor specifications

# Flatness and Symmetry

Flatness – the variation of dose relative to the central axis over the central 80% of the field size at a given depth in a plane perpendicular to the central axis



$$F = \frac{M-m}{M+m} \times 100\%$$

# Output and Energy

$$\text{cGy/MU} = k_q * R_{av} * C_{T,P} * N_{D,W} * P_{ion} / (100 \text{MU} * P_{dd})$$

$k_q$  – quality conversion factor, which accounts for the change in the absorbed-dose to water calibration factor between the beam quality of interest and the beam quality for which the absorbed-dose calibration factor applies (usually  $^{60}\text{Co}$ )

$R_{av}$  – average reading

$$C_{T,P} = \left( \frac{273.2 + T}{295.2} \right) \left( \frac{760}{P} \right)$$

$N_{D,W}$  – the absorbed dose to water calibration factor for an ion chamber located under reference conditions in a radiation beam

$P_{ion}$  – the recombination correction factor which takes into account the incomplete collection of charge from an ion chamber

$P_{dd}$  – Percent depth dose – the quotient of the absorbed dose at any depth,  $d$ , to the absorbed dose at a fixed reference depth,  $d_0$

$$P = \frac{D_d}{D_{d_0}} \times 100$$

