

Ensuring data quality, reliability, and reproducibility through Quality Assurance Procedures in Preclinical in (PET)/MR

Francesco Moneta¹, Claudia Oerther¹, Tim Wokrina

¹Bruker BioSpin MRI GmbH, Rudolf-Plank-Straße 23, 76275 Ettlingen, Germany

Quality Assurance (QA) is process of checking functionalities and the reproducibility of their outcome. Quality depends on several factors such as the method used, the setup, the sample, the workflow and the PET and MRI system condition. QA procedures should be performed at defined time points to monitor system performances and guarantee reliability of results. MRI systems may differ because of configuration and brand, users should verify QA procedure results when comparing data from different systems.

Every Bruker system is delivered with QA protocols and standard phantoms. QA procedures cover image quality: homogeneity, signal to noise ratio (SNR), image ghosting, water suppression, temporal stability and apply to: spin echo (MSME), gradient echo (FLASH), and among the most demanding sequences in terms of eddy current distortions: fast spin echo (RARE), volume selected spectroscopy (PRESS), echo planar imaging (EPI). To properly perform QA loading phantoms are used in combination with phantom holders for reproducible positioning. Phantoms contain a fluid with defined chemical composition that imitates the loading of a certain animal body part. QA tests are automatically performed and stored; results saved in a report (Fig.1).

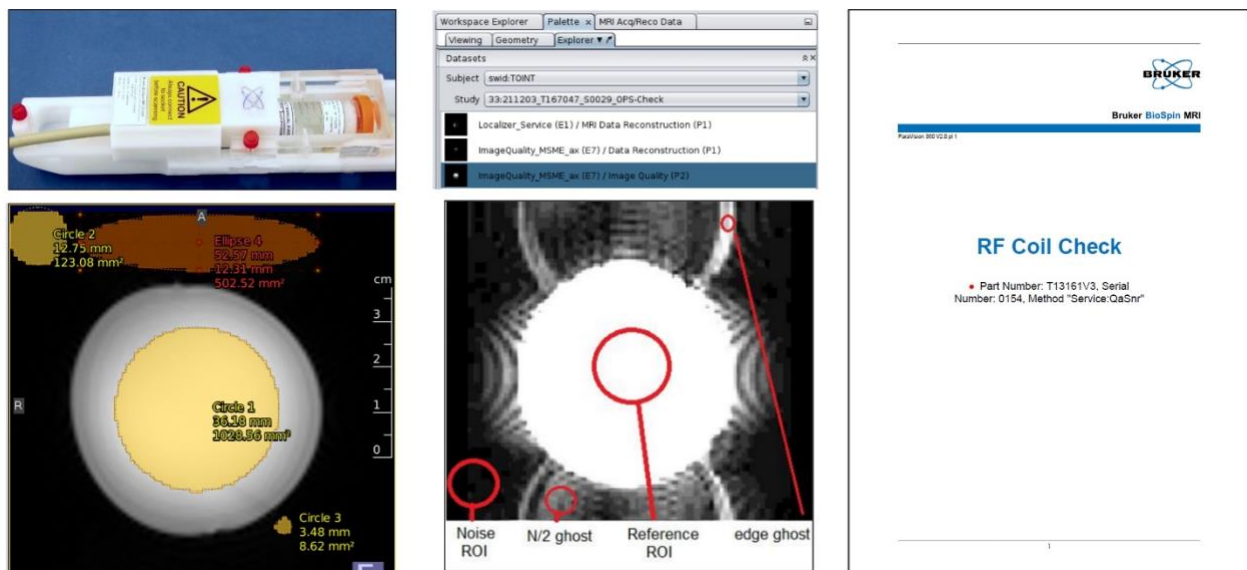


Fig. 1: Phantom and holder positioned under RF-coil. QA MRI methods, Ghost detection algorithm: report of QA procedure.

Analyzing hundreds of QA protocols during installation and maintenance of preclinical MRIs with different configurations (field strength, gradient strength, shim strength, etc. shows that ghost level on FLASH, MSME, RARE is <2.5%, Nyquist N/2 ghost level in EPI is always <5%, and edge ghost level is always <10%. The temporal stability in EPI is <2%. The water linewidth of a 3x3x3 mm³ voxel is <0.05 ppm, the eddy current spectral distortion is < 2.5%, the on-resonance water suppression factor is >500, and 0.7 ppm off-resonant <1.2. Only the SNR results are RF-coil individual. The above specifications must be met also when a PET-insert is used in combination with an MRI. PET/MRIs that do not meet these specifications, often have a problem with eddy

current compensation or shim calibration, field drift prevention, can be diagnosed. As a vendor it is important to have a common quality procedure applicable to every configuration in order to verify if the system is in specs.

We propose to perform regular QA tests with standardized phantoms to verify the functionality of the instrument and the capability of providing true quantification. An automatic QA test protocol with an automatic quantitative output report is provided as a starting point (QA_SNR). Mapshim calibration, pulse power and ghosting quantification are available on an admin level and can be made available to the scientific community.