American College of Radiology
MR Accreditation Program

Testing Instructions

(Revised August 20, 2019)

This guide provides all of the instructions necessary for clinical tests, phantom tests and general submission for the ACR MR Accreditation Program.

For assistance, contact the ACR Monday through Friday 8:30 am to 5:00 pm (ET).
Telephone: 800-770-0145
Email: mri@acr.org
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## I. Revisions

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<th>Page(s)</th>
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<th>Description of Revisions</th>
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<tbody>
<tr>
<td>5-28-17</td>
<td>All</td>
<td>All</td>
<td>Combined the clinical testing instructions, clinical image quality guide and large and small phantom testing instructions into one document</td>
</tr>
<tr>
<td>5-28-17</td>
<td>17-47</td>
<td>G. Exam Specific Parameters</td>
<td>Reviewed and edited sequence and technique submission requirements within each exam as needed</td>
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<tr>
<td>17-47</td>
<td></td>
<td></td>
<td>Removed the following exams:</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• MRA Distal Peripheral Runoff</td>
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<td></td>
<td></td>
<td></td>
<td>• MRA Brain</td>
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<td></td>
<td></td>
<td></td>
<td>• Male Pelvis</td>
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<td>• Black Blood</td>
</tr>
<tr>
<td>5-28-17</td>
<td>37 and 39</td>
<td>3. Body Module</td>
<td>Added the following exam choices:</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Pediatric Male/Female Pelvis</td>
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<tr>
<td>6-9-17</td>
<td>28</td>
<td>Instructions for MSK MRI Examinations</td>
<td>Clarified subsection f.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Removed “strictly” from strictly enforced</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Added “but should not be interpreted as being, in and of itself, the only criterion for failure” to the specified spatial resolution requirement</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• Updated less than to “less than or equal to” pixel dimensions and areas values specified</td>
</tr>
<tr>
<td>12-18-17</td>
<td>17</td>
<td>Instructions for Head/Neck MRI Examinations</td>
<td>Added subsection f.: DIR FLAIR is an acceptable substitute for T2 FLAIR for the brain for suspected demyelinating disease</td>
</tr>
<tr>
<td>12-18-17</td>
<td>29</td>
<td>Instructions for Musculoskeletal (MSK) MRI Examinations</td>
<td>Added subsection l.: For the knee exam, if all the sagittal requirements listed are met by one sagittal sequence, then an additional sagittal sequence will not be required. Please review the requirements carefully for both sagittal sequences.</td>
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<tr>
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<tr>
<td>12-28-17</td>
<td>29</td>
<td>Instructions for Musculoskeletal (MSK) MRI Examinations</td>
<td>Added subsection m: Coronal long TR/short TE sequence, which is an intermediate or proton-density weighted sequence, is NOT a substitute for the requisite coronal dark fluid sequence. Coronal dark fluid sequence must be T1-weighted with short TR/short TE, dark fluid and bright fat.</td>
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<tr>
<td>1-16-18</td>
<td>24</td>
<td>Cervical Spine</td>
<td>Axial Bright Fluid sequence must cover contiguously from C3 to T1. Added clarification: It does not state “inclusive”. It means from C3 inferior endplate to T1 superior endplate must be included.</td>
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<tr>
<td>1-16-18</td>
<td>25</td>
<td>Cervical Spine with CID</td>
<td>Axial Bright Fluid sequence must cover contiguously from C3 to T1. Added clarification: It does not state “inclusive”. It means from C3 inferior endplate to T1 superior endplate must be included.</td>
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<td>Lumbar Spine</td>
<td>Sagittal Dark Fluid &amp; Sagittal Bright Fluid sequences: Added clarification: **In the sagittal lumbar sequences: T12 to S2 inclusive means from T12 superior endplate to the S2 inferior endplate.</td>
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<td>Shoulder</td>
<td>Coronal oblique dark fluid sequence: Added that required sequence may be obtained in sagittal plane</td>
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<tr>
<td>2-28-18</td>
<td>20</td>
<td>Brain for TIA or stroke</td>
<td>Axial or coronal T2* weighted gradient echo: Added that susceptibility weighted imaging or SWAN sequence is an acceptable substitute and if submitted, CSF does not need to be hyperintense relative to the brain</td>
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<tr>
<td>4-10-18</td>
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<td>Instructions for Spine MRI Examinations</td>
<td>Clarified: The sagittal dark fluid sequence should not be fat suppressed. The fat MUST be bright, but not so intense that it masks the fat/muscle plane</td>
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<td>4-10-18</td>
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<td>Shoulder Required Sequences</td>
<td>Coronal or sagittal oblique dark fluid changed to “Coronal oblique, sagittal or axial” dark fluid</td>
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<td>Knee Required Sequences</td>
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<td>Instructions for Body MRI Examinations</td>
<td>Clarified: Single shot techniques are not acceptable substitutions for a high resolution sequence for any of the body module exams.</td>
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<td>Submission of Materials for Accreditation</td>
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<td>Exam Identification</td>
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<td>Electronic Submissions</td>
<td>All images submitted must be in DICOM only format</td>
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<tr>
<td>8-20-19</td>
<td>34</td>
<td>Knee Required Sequences</td>
<td>Added NOT PD weighted to “Coronal, sagittal or axial” dark fluid</td>
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II. General Instructions

A. Introduction

Successful accreditation is a team effort involving the lead supervising physician, MR technologist and qualified medical physicist. It is important that each pertinent member of the team read and understand the documents listed below before beginning the MR Accreditation process:

- ACR MR Accreditation Program Requirements
- ACR MR Accreditation Testing Instructions to ensure that your facility’s protocols meet the revised requirements before continuing

The following items are available under Testing and QC forms on the MR Accreditation page of the ACR website:

1. Clinical Data Form
2. Large Phantom Data Form
3. Small Phantom Data Form
4. Large Phantom Test Guidance booklet
5. Small Phantom Test Guidance booklet
6. Large Phantom Order Form (JM Specialty Parts)
7. Small Phantom Order Form (JM Specialty Parts)
8. Frequently Asked Questions (FAQs)
9. User Instructions for Electronic Submission of Images

Forms 1-3 are generic forms designed to assist you in gathering data. Do not submit these forms. You must log on to the ACR accreditation database ACredit (https://acredit.acr.org) to enter the data in your online testing package and submit the package online.

Follow all instructions for every unit being reviewed for accreditation. Every unit must apply for all modules routinely performed on each unit for a facility to be accredited. Please see the MRI Accreditation Program requirements for “Emergency Use of the Magnet”. Keep copies of all documents and images submitted to ACR for your records.

There are three portions to your ACR MR Accreditation submission:

1. Annual System Performance Evaluation Summary
2. Clinical Testing
3. Phantom Testing

You must utilize the services of a qualified medical physicist/MR scientist for the Annual System Performance Evaluation. The ACR strongly recommends using the services of a qualified medical physicist/MR scientist during both the process of accreditation and for oversight of your site’s technologist quality control program.
B. **Online Application**

The application for ACR MR Accreditation is found online through the ACR website at https://acredit.acr.org. If your facility has never applied for accreditation before, you will “register” as a new facility. New facilities will be assigned a unique identification number (MRAP #) after the online application is submitted. This number appears on all correspondence from the ACR, your online records. Please use this number on all submitted materials and to identify your facility when contacting the ACR for assistance.

Approximately eight months prior to the expiration of the MR Accreditation, the ACR will email an Accreditation Renewal Notice to the facility login user. The facility user should login to the online database (https://acredit.acr.org) and select the “start renewal” link no later than 6 months prior to expiration of your current accreditation to ensure that there are no gaps in your continuous accreditation that could affect your reimbursement.

After your application is processed, an online testing packet will be activated which will contain all of the clinical and phantom data forms required for accreditation review. Your facility will receive an email with a link to the online testing packet as well as a link to the electronic PDF version of the MR Quality Control Manual. Your facility user must log into the account and fill out all forms required in the online testing package.

To achieve ACR MR Accreditation, a MR unit must pass both the clinical and phantom image quality tests.

The ACR accreditation website (www.acraccreditation.org) provides a listing of accredited facilities and facilities that are under review. If a third party payer requests verification of your participation in one of the accreditation programs, please refer them to the ACR website accredited facility search.

C. **Materials Due Date**

The online testing packet has the image submission due date. You must collect your images and submit them to the ACR by that date. Failure to meet this due date will jeopardize completion of your accreditation. Thus, if your facility is renewing its accreditation, we cannot guarantee completion in a timely fashion before your ACR certificate expires. If your site cannot submit the required materials by your due date, notify the ACR **immediately**.

D. **Image Collection Time Period for Phantom and Clinical Images**

All examinations submitted must have been performed within 6 months of the date on the application. No images will be accepted for review that predates the application by more than six months.
III. **Annual System Performance Evaluation and Quality Control Testing**

Medical physicists/MR scientists for all sites applying for accreditation or renewal must demonstrate compliance with the ACR requirements for quality control and Annual System Performance Evaluation or Acceptance Testing Evaluation (for new units) as outlined in the MR Quality Control Manual. These must be performed by a qualified medical physicist/MR scientist.

Additional routine QC testing by the MR technologist is also required. If you have been conducting QC for less than one quarter, you may perform QC testing every business day for two weeks to achieve baseline data and set up your action limits. Additionally, if the Annual System Performance Evaluation and/or weekly on-site QC data show performance deficits (e.g. problems with the system and/or data outside of the action limits), the facility must take steps to correct the problems and submit documentation of the corrective action with the image submission.

Submit the following:

1. **Annual System Performance Evaluation Summary** (to include evaluation of the technologist QC and MR Safety checklist) signed by a qualified medical physicist. Your medical physicist must use the summary form provided by the ACR or one similar that itemizes the pass-fail results of all the same tests using the same names and order as is outlined on the ACR form.

2. Documentation of any corrective action taken if recommended in the Annual System Performance Evaluation (i.e. test failures or data outside of action limits).

The annual system performance evaluation summary form and MR Safety checklist can be found on the [ACR MR Accreditation webpage](https://www.acr.org).
IV. Clinical Testing Instructions

A. Evaluate Your Facility’s Protocols

With your supervising physician, ensure that all of your facility’s protocols meet the minimum requirements listed in the Clinical Image Quality Guide section of these instructions.

B. Select Images for Submission

1. Select examples of your best work and have them approved by your supervising physician prior to submission. Your supervising physician should review all materials submitted for accreditation.

2. Submit the entire exam, including the required sequences listed in the Clinical Image Quality Guide section of these instructions.

3. Submit localizer or scout sequences with all examinations with cross-reference locations.

4. The submission of examinations performed on models or volunteers is strictly prohibited and may jeopardize accreditation. In addition, images submitted for each individual examination must be from the same patient (i.e. all brain images must be from the same brain examination) with the following exception: facilities submitting only one examination for the cardiac module may submit the Black Blood and Delayed Enhanced Cine sequences on two different patients.
V. Spatial/Temporal Resolution Assessment

Before the collection of any images can begin, first evaluate your clinical image spatial resolution, and compare it with ACR criteria. The MR Accreditation Clinical Image Quality Guide section lists the formulas to determine spatial and temporal resolution. If your site determines that you need to adjust your protocols, please make changes before proceeding to the phantom testing instructions. Please be aware that further changes in clinical image spatial resolution may be warranted based on evaluation of phantom images performed during the test image collection phase.

Please note that if you make any alterations in any resolution parameters (matrix, field of view or slice/slab thickness) as a result of ACR recommendations, it will result in a modification of the voxel volume, the signal-to-noise ratio (SNR) of the image and the amount of partial volume averaging exhibited in the image. Alterations in the number of phase encoding steps (Np) affects scan time, while alterations in the number of frequency encoding steps (Nf) may affect the maximum number of slices as well as the minimum possible TE for the imaging sequence. Your site will be responsible for making any necessary corresponding changes in scan protocols to maintain image quality.
VI. Clinical Image Quality Guide

The requirements used by the accreditation reviewers represent a technical baseline for producing acceptable diagnostic examinations. Prior to submission of any images for evaluation, the interpreting physicians and technologists at your facility must review the accreditation criteria contained in this section. Although some aspects of MRI examinations are requirements for accreditation, other aspects in this document are only intended as a guide, and the technique parameters mentioned in this section are only suggestions unless otherwise stated.

The sequences required for accreditation submission should not be construed as a complete clinical exam. Submit the entire exam for accreditation review. All the sequences submitted will not be scored.

The pulse sequences that are used clinically for examinations of different body regions are variable due to personal preferences of the users as well as due to the capabilities of the different MRI systems. Despite this variability, experienced interpreting physicians are able to agree on what constitutes “acceptable” and “unacceptable” diagnostic exams based on both objective and subjective criteria. The intention of accreditation is to provide guidelines on what constitutes optimal image quality above that which is normally acceptable and to promote the best practice at all times.

Submit normal or near normal examinations if possible. The submitted examinations should demonstrate as little pathology as possible. **Note: The purpose of the accreditation evaluation is to review the quality of the practice of MRI at applicant facilities and not to comment on abnormal findings. The ACR is not responsible for clinical findings shown on the studies. Submitting abnormal examinations may significantly delay the accreditation process.**

The ACR provides comprehensive practice parameters and technical standards for MR imaging which are independent of the accreditation program but provide guidance for compliance with the accreditation process. As needed, please visit the ACR website ([http://www.acr.org/Quality-Safety/Standards-Guidelines](http://www.acr.org/Quality-Safety/Standards-Guidelines)) for a listing of practice parameters and technical standards.

Additional guidance and educational materials may be found at the following webpages:

- [MR Safety - American College of Radiology](http://www.acr.org)

A. MR Clinical Evaluation Categories

The categories for scoring examinations submitted for ACR MR Accreditation are:

A. Pulse Sequence and Image Contrast
B. Anatomic Coverage and Imaging Planes
C. Spatial and Temporal Resolution
D. Artifacts
E. Exam Identification: Missing Information

B. Category A: Pulse Sequences and Image Contrast

The type of pulse sequence (e.g. conventional SE, multishot RARE or gradient echo) and the precise imaging parameters (e.g. TR, TE, FA, ETL, etc.) are not specified and are left to the discretion of the imaging facility **unless otherwise stated.**

**Submit complete examinations.** Not all of your sequences may be scored. The Examination Specific Parameters section of this document lists the sequences considered to be the minimum necessary for a quality examination.
Note: If any of these sequences is not submitted, the examination will fail.

If your facility performs more sequences than the required minimum, you should submit these additional sequences. You must submit localizer or scout sequences with cross-reference locations for each clinical examination.

All sequences must demonstrate sufficient Signal to Noise (SNR), and not appear too grainy.

If contrast is required, it is very important that patient selection is appropriate for the examination using contrast. Please refer to the ACR Quality and Patient Safety/MR Safety web page for more information on IV contrast safety.

C. Category B: Anatomic Coverage and Imaging Planes:
Proper anatomic coverage and imaging planes are important components of clinical MRI exams. The minimum sets of images required for each examination and the anatomy to be included on those images are listed in the Examination Specific Parameter section.

Important: Failure to meet minimum coverage specifications outlined in this section will result in failure for that examination.

D. Category C: Spatial/Temporal Resolution
The spatial resolution necessary for quality MRI images varies by examination and sequence. MRI facilities must use the determinants and formulas listed below to determine the spatial resolution of their clinical MRI examinations.

The five determinants of pixel/voxel dimensions in an MRI examination are listed below:

- Slice thickness (ST)
- Field of view along the phase encode direction (FOVp)
- Field of view along the frequency encode direction (FOVf)
- Number of phase encoding steps (Np) (This is your phase matrix)
- Number of frequency encoding steps (Nf) (This is your frequency or read matrix)

Your images will be scored on acquisition parameters, not interpolated parameters. Use the pixel/voxel dimensions from your scan protocols and the formulas below to calculate you’re in plane pixel size in both the phase and frequency directions for all of the sequences you are submitting for accreditation review (see Examination Specific Parameters section below for list of required sequences). Compare the values calculated in the Clinical Test Image Data forms to the values listed in the Examination Specific Parameters section of this document.

Note: If you are using a rectangular field of view, your phase FOV will be different from your frequency FOV. This may also be true for your matrix. If you are not sure, consult your manufacturer.

To determine the pixel size in the phase direction, use this formula: FOVp/Np
The field of view in the phase encoding direction divided by the number of steps in the phase encoding direction equals the pixel size in the phase encoding direction.

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To determine the pixel size in the read or frequency direction, use this formula: \( \text{FOV}_f / N_f \)

The field of view in the frequency encoding direction divided by the number of steps in the frequency encoding direction equals the pixel size in the frequency direction.

To determine the pixel area (use this for 2D sequences), use this formula: the pixel size in the read or frequency direction times the pixel size in the phase direction equals the pixel area.

To determine the voxel volume (use this for 3D sequences), use this formula: the pixel size in the read or frequency direction times the pixel size in the phase direction times the slice thickness.

The determinants of temporal resolution are:

1. Speed of frames per millisecond
2. Temporal resolution = msec/frames
3. For cine images, the number of views per segment (NVS) or segmentation factor also controls acquired temporal resolution.

Note that most manufacturers use phase sharing (view sharing techniques) to increase the visual smoothness of the cine movies. The parameters in the Examination Specific Parameters refer to temporal resolution before these view sharing techniques.

With view sharing, images that are acquired every 80 msec can be interpolated, so that the cine display shows a new image every 40 msec (or less). However, each image still contains 80 msec worth of data.

To determine the temporal resolution, use this formula:

\[
\text{Temporal resolution (cine)} = \text{TR} \times \text{NVS}
\]

Where NVS is the number of views per segment, or segmentation factor and TR is the intrinsic or minimum TR of the pulse sequence. Some manufacturers may not display this TR value. If in doubt, please contact your manufacturer’s application specialist.

E. Category D: Image Artifacts

Artifacts on any image may interfere with image interpretation. Although some artifacts may be unavoidable on certain images (e.g. susceptibility artifacts near sinuses on T2 weighted brains); others may be indicators of inadequate equipment or lack of preventive maintenance at an MRI facility.

The artifacts listed are among the most common. All of the images should be assessed to determine if any of these artifacts are present and especially if they could potentially compromise the diagnostic value of the images. Your examinations will be reviewed for excessive artifacts that may interfere with image quality.

- Aliasing: The image appears wrapped around into itself. This is due to a large body portion included in a too small FOV.

- Parallel imaging: Mismatches between the anatomy on calibration images and diagnostic images appear as chemical shift, motion, ghosting and misregistration along the phase-encoding direction in the middle of the FOV.

- Truncation (Edge ringing): Periodic parallel lines or ringing adjacent to borders or tissue discontinuity, in either the phase and/or frequency encoding directions. This is due to a small matrix.
• Black Boundary (India ink): Well-defined black contours outlining regions of MR anatomy, without corresponding anatomical structure.

• Heterogeneous brightness (Shading): This is due to RF heterogeneity, improper patient positioning, or metal in the magnet or on the patient.

• Heterogeneous fat suppression: Uneven darkening of the fat signal in different portions of the image set. This may be due to either a heterogeneous magnetic field or a heterogeneous RF field.

• Susceptibility: Localized field distortion or non-uniformities produced by differing tissue magnetic susceptibility (especially at air-tissue interfaces).

• Chemical shift: Occurs along the frequency encoding axis at fat/water soft tissue interfaces as a thin intense band of high signal or low signal.

• Ghosting: Periodic replication of partial copies of images of the original structure along the phase encoding axis due to motion. It includes artifacts from swallowing (C-spine), respiration and peristalsis (L-spine), CSF pulsation (brain and spine), vascular pulsation (brain and knee) and cardiac motion (T-spine).

• Geometric distortion: Size, orientation or shape is not accurately represented on the image.

• Excessive filtering: Excessive smoothing using software to reduce apparent noise in the image. Excessive filtering or smoothing obscures true anatomical structure and/or contrast.

• Misregistration of 2D images: Consecutive 2D images do not line up so some anatomy is skipped and other regions are imaged twice. This can also be a particularly serious problem on 2D time-of-flight MRA MIPs.

• Misregistration of subtracted images: On subtracted images, there is incomplete subtraction of the background tissue signal with prominent signal at edges that do not align properly.

• Ringing: Accentuation of edges due to either under sampling of k-space (not enough phase encoding steps) or at the leading edge of the bolus on an enhanced 3D MRA study due to IV contrast being present during acquisition of peripheral k-space but not as much during acquisition of the center of k-space.

• Stair step (Venetian blind artifact): In MRA, a vessel goes obliquely through slices, due to slice thickness and vessel size. Venetian blind occurs on multi slab MRA (typically on reformations and MIPs), when the adjacent slabs are not properly and seamlessly overlapped.

• Reformatting artifacts: Improper MIP and reformations may give the false appearance of vessel occlusion or stenosis when it is only partially included in the MIP volume. Superimposed vessels may falsely appear stenotic on MIP due to stealing of voxels at the vessel edges. Stair step artifact may occur on oblique reconstruction when the slices are too thick or there is insufficient zero filling.

• ECG lead artifacts: The ECG leads used for cardiac gating should not produce excessive artifacts that would interfere with the interpretation of the image.
• RF leak or “zipper” artifact: Linear hyperintensity parallel to the phase encoding direction often caused by unwanted sources of RF signals originating within (e.g., light bulb failure) or outside (e.g. inadequate RF shielding) the scanner room.

• Echo train blurring: Image blurring due to excessively long echo spacing and/or echo train length.

• Peripheral signal artifacts:
  a. Star artifact: A bright spot close to the image center originates very far from isocenter because FID signal from RF 180 pulse or SAT pulse is not crushed out and aliases back into image center.
  b. Annefact artifact: Smeared, bright, ribbon ghosting signals in the phase-encoding direction are uncompensated eddy currents that also originate far from isocenter where gradients are non-linear.

• Other: There are other artifacts that are not as common as those listed above but which may be important.

F. Category E: Exam Identification

Patient and technical data must be displayed on the images or be readily accessible in the DICOM header. All patient information will be kept confidential by the ACR as stated in the Practice Site Accreditation Survey Agreement.

Warning: If the parameters listed below in Bold and Italics are not available to the reviewer, that examination will fail.

1. Each exam
   • Patient name (First and last)
   • Patient age (or date of birth)
   • Patient identification number
   • Date of examination
   • Study number
   • Institution name

2. Each sequence
   • Type of sequence
   • TR
   • TE
   • TI (if applicable)
   • Flip angle
   • Slice thickness
   • Trigger delay (if applicable)
   • Interslice gap (can be inferred from slice position)
   • Field of view (reconstructed diameter-frequency FOV-is often found in DICOM tag #s 0018,1100; %FOV is often used to calculate phase FOV and may be found in DICOM tag 0018,0094)
   • Acquired matrix (number of frequency encoding steps and number of phase encoding steps – interpolation or other post acquisition enhancements should not be taken into consideration)
   • Acquisition time (indicated or easily calculated)
• Size scale e.g. scored lines indicating centimeters. *(If this information is missing from hard film submission, that examination will fail.)*
• Number of excitations
• Plan scan or scout identifying the location of each sagittal or axial slices. The location of the “plan scan” should be readable and easily related to the diagnostic images. *(If this information is missing on spine examinations, that examination will fail.)*

3. **Each image**
   • Location
   • *Laterality (left or right, e.g. knee), left or right of midline (e.g. brain and spine studies)*
   • *Label that indicate location of slice relative to other slices*
   • *Number that correlates with “plan scan” or scout identifying the location for each slice*

4. **The following labels are not required but are strongly recommended for each sequence.**
   • Echo train length
   • Bandwidth
   • Initials or name of technologists who performed the exam
G. Examination Specific Parameters

Head/Neck Module

Instructions for Head/Neck MRI Examinations

In addition to the exam-specific instructions in the following tables, review the following information prior to examination selection and submission. **Note that failure to follow the guidance below may result in failure of the submitted examination.**

a. ADC map is now required for brain for TIA DWI sequence. Omission of the ADC map will result in failure of the submitted examination.

b. The axial bright fluid sequence for the brain for suspected demyelinating disease, encephalitis, or acute disseminated encephalomyelitis should be a Fast Spin Echo (Turbo Spin Echo, RARE) and not a gradient echo.

c. Reformatted axial T2 FLAIR images from the 3D sagittal T2 FLAIR are acceptable for the brain for suspected demyelinating disease, encephalitis, or acute disseminated encephalomyelitis exam.

d. Fat must be bright in the axial dark fluid sequence of the Orbit exam. Failure to achieve bright fat may result in a fail of the submitted examination.

e. Failure to meet anatomic coverage and imaging plane specifications may result in failure.

f. DIR FLAIR is an acceptable substitute for T2 FLAIR for the brain for suspected demyelinating disease.

g. Susceptibility weighted imaging or SWAN sequence is an acceptable substitute for “axial or coronal T2* weighted gradient echo” requirement for the brain for TIA or stroke exam. If submitted, the CSF does not need to be hyperintense relative to the brain.
<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| Axial, sagittal or coronal dark fluid | • Must have good discrimination between the brain and CSF                                                      | • Axial must cover convexity to foramen magnum  
• Coronal must cover entire brain from anterior to posterior cranial vault  
• Sagittal must cover entire brain from left to right and the top of the brain to the C2 level | Slice thickness ≤ 5.0 mm  
Gap ≤ 2.5 mm if coronal  
Gap ≤ 2.0 mm if axial or sagittal  
Pixel area ≤ 1.2 mm² |
| Sagittal T2 FLAIR               | • Must have good water suppression  
• CSF must be hypointense relative to white matter                                                              | • Sagittal must cover entire brain from left to right and the top of the brain to the C2 level                  | Slice thickness ≤ 5.0 mm  
Gap ≤ 2.0 mm  
Pixel area ≤ 2.0 mm² |
| Axial T2 FLAIR                  | • Must have good water suppression  
• CSF must be hypointense relative to white matter                                                              | • Axial must cover from convexity to foramen magnum                                                           | Slice thickness ≤ 5.0 mm  
Gap ≤ 2.0 mm  
Pixel area ≤ 1.2 mm² |
| Axial bright fluid              | • The CSF must be hyperintense relative to the brain  
• Must have good contrast between the gray matter and white matter                                                  | • Axial must cover from convexity to foramen magnum                                                           | Slice thickness ≤ 5.0 mm  
Gap ≤ 2.0 mm  
Pixel area ≤ 1.2 mm² |
| Axial or coronal dark fluid post contrast | • Must have good discrimination between the brain and CSF                                                      | • Axial must cover from convexity to foramen magnum  
• Coronal must cover entire brain from anterior to posterior cranial vault                                        | Slice thickness ≤ 5.0 mm  
Gap ≤ 2.0 mm  
Pixel area ≤ 1.2 mm² |
<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial or coronal high resolution dark fluid without fat suppression</td>
<td>• Must have good discrimination of the 7th and 8th cranial nerves.</td>
<td>• Must cover top of IACs to cervico-medullary junction</td>
<td>Slice Thickness ≤ 3 mm Gap ≤ 0.2 mm Pixel Area ≤ 0.6 mm²</td>
</tr>
<tr>
<td>Axial or coronal high resolution bright fluid</td>
<td>• Must have good discrimination of the 7th and 8th cranial nerves.</td>
<td>• Must cover top of IACs to foramen magnum</td>
<td>Slice thickness ≤ 2.0 mm Gap = 0 mm (zero gap) Pixel Area ≤ 0.6 mm²</td>
</tr>
<tr>
<td>Axial high resolution dark fluid with or without fat suppression post contrast</td>
<td>• Must have good discrimination of the 7th and 8th cranial nerves.</td>
<td>• Must cover top of IACs to foramen magnum</td>
<td>Slice thickness ≤ 3.0 mm Gap ≤ 0.2 mm Pixel area ≤ 0.6 mm²</td>
</tr>
<tr>
<td>Coronal high resolution dark fluid with or without fat suppression post contrast</td>
<td>• Must have good discrimination of the 7th and 8th cranial nerves.</td>
<td>• Must cover top of IACs to foramen magnum</td>
<td>Slice thickness ≤ 3.0 mm Gap ≤ 0.2 mm Pixel area ≤ 0.6 mm²</td>
</tr>
<tr>
<td>Brain for TIA or stroke</td>
<td>Category A: Pulse Sequence and Image Contrast</td>
<td>Category B: Anatomic Coverage and Imaging Planes</td>
<td>Category C: Spatial Resolution</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>------------------------------</td>
</tr>
</tbody>
</table>
| **Sagittal, axial or coronal dark fluid** | • Must have good discrimination between the brain and cerebral spinal fluid (CSF) | • Axial must cover the entire brain | Slice thickness ≤ 5.0 mm  
Gap ≤ 2.5 mm if coronal  
Gap ≤ 2.0 mm if axial or sagittal  
Pixel area ≤ 1.2 mm² |
| **Axial diffusion weighted imaging (DWI) including ADC map** | • Must have include ADC map and B value must be ≥ 800 | • Axial must cover the entire brain | Slice thickness ≤ 5.0 mm  
Gap ≤ 2.0 mm  
Pixel area ≤ 4.0 mm² |
| **Axial or coronal T2 FLAIR** | • Must have good water suppression  
• CSF must be hypointense relative to white matter | • Axial must cover the entire brain  
• Coronal must cover the entire brain from the anterior cranial vault to the posterior cranial vault | Slice thickness ≤ 5.0 mm  
Gap ≤ 2.0 mm  
Pixel area ≤ 1.2 mm² |
| **Axial bright fluid** | • The CSF must be hyperintense relative to the brain  
• Must have good contrast between the gray matter and white matter | • Axial must cover the entire brain | Slice thickness ≤ 5.0 mm  
Gap ≤ 2.0 mm  
Pixel area ≤ 1.2 mm² |
| **Axial or coronal T2* weighted gradient echo** | • The CSF must be hyperintense relative to the brain | • Axial must cover the entire brain  
• Coronal must cover the entire brain from the anterior cranial vault to the posterior cranial vault | Slice thickness ≤ 5.0 mm  
Gap ≤ 2.5 mm  
Pixel area ≤ 1.2 mm² |
## Orbits for vision loss or tumor

<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| **Axial dark fluid** | • Must have good optic nerve sheath discrimination  
• Fat must be bright | • Must cover entire orbits and optic nerves | Slice thickness ≤ 3.0 mm  
Gap ≤ 1.0 mm  
Pixel area ≤ 1.0 mm² |
| **Coronal bright fluid with fat suppression which includes STIR or frequency-selective fat suppression techniques** | • Must have good optic nerve sheath discrimination  
• Must have good fat suppression | • Must cover eyelids to dorsum sella | Slice thickness ≤ 5.0 mm  
Gap ≤ 1.0 mm  
Pixel area ≤ 1.0 mm² |
| **Axial dark fluid with fat suppression post contrast** | • Must have good optic nerve sheath discrimination  
• Must have good fat suppression | • Must cover entire orbits and optic nerves | Slice thickness ≤ 3.0 mm  
Gap ≤ 1.0 mm  
Pixel area ≤ 1.0 mm² |
| **Coronal dark fluid with fat suppression post contrast** | • Must have good optic nerve sheath discrimination  
• Must have good fat suppression | • Must cover eyelids to dorsum sella | Slice thickness ≤ 5.0 mm  
Gap ≤ 1.0 mm  
Pixel area ≤ 1.0 mm² |

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### Pituitary with contrast enhancement

<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sagittal dark fluid</td>
<td>• Must have good discrimination between brain and CSF</td>
<td>• Must cover from medial temporal lobe to medial temporal lobe</td>
<td>Slice thickness ≤ 3.3 mm Gap ≤ 0.3 mm Pixel area ≤ 0.6 mm²</td>
</tr>
<tr>
<td>Coronal dark fluid</td>
<td>• Must have good discrimination between brain and CSF</td>
<td>• Must cover from orbital apex to dorsum sella</td>
<td>Slice thickness ≤ 3.3 mm Gap ≤ 0.3 mm Pixel area ≤ 0.6 mm²</td>
</tr>
<tr>
<td>Sagittal dark fluid post contrast</td>
<td>• Must have good discrimination between brain and CSF</td>
<td>• Must cover medial temporal lobe to medial temporal lobe</td>
<td>Slice thickness ≤ 3.3 mm Gap ≤ 0.3 mm Pixel area ≤ 0.6 mm²</td>
</tr>
<tr>
<td>Coronal dark fluid post contrast</td>
<td>• Must have good discrimination between brain and CSF</td>
<td>• Must cover orbital apex to dorsum sella</td>
<td>Slice thickness ≤ 3.3 mm Gap ≤ 0.3 mm Pixel area ≤ 0.6 mm²</td>
</tr>
</tbody>
</table>
Spine Module

Instructions for Spine MRI Examinations

In addition to the exam-specific instructions in the following tables, review the following information prior to examination selection and submission. **Note that failure to follow the guidance below may result in failure of the submitted examination.**

a. The CSF on the axial bright fluid sequence for the cervical spine must be bright. The recommendation is to consider a 2D/3D GRE sequence or a 3D T2 sequence. 2D RARE (e.g. FSE, TSE) sequences frequently do not achieve homogeneously bright CSF due to CSF pulsation artifacts.

b. Failure to achieve bright fluid in axial sequence will result in fail of the submitted examination.

c. Axial or oblique axials are acceptable for the axial dark fluid or bright fluid sequence.

d. Failure to meet anatomic coverage and imaging plane specifications may result in a fail of the submitted examination.

e. The sagittal dark fluid sequence should not be fat suppressed. The fat MUST be bright, but not so intense that it masks the fat/muscle plane.
### Cervical Spine

<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| Sagittal dark fluid | • Should not have non-anatomic heterogeneous signal intensity of the cord.  
• CSF must be hypointense to the cord/nerve roots so that cord/nerve roots are clearly defined.  
• Fat must be bright, but not be so intense that it masks the fat/muscle plane.  
• Must show good contrast between the cord and CSF.  
• T1 FLAIR is acceptable for this. | • Must cover foramen magnum to T1.  
• Must cover laterally through the neural foramina. | Slice thickness ≤ 3.0 mm  
Gap ≤ 1.0 mm  
Pixel area ≤ 1.0 mm² |
| Sagittal bright fluid | • Should not have non-anatomic heterogeneous signal intensity of the cord.  
• CSF must be hyperintense to the cord/nerve roots so that cord/nerve roots are clearly defined.  
• Fat must not be so intense that it masks the fat/muscle plane.  
• Must show good contrast between the cord and CSF. | • Must cover foramen magnum to T1.  
• Must cover laterally through the neural foramina. | Slice thickness ≤ 3.0 mm  
Gap ≤ 1.0 mm  
Pixel area ≤ 1.0 mm² |
| Axial bright fluid*** | • Should not have non-anatomic heterogeneous signal intensity of the cord.  
• CSF must be hyperintense to the cord/nerve roots so that cord/nerve roots are clearly defined.  
• Fat must not be so intense that it masks the fat/muscle plane.  
• Must show good contrast between the cord and CSF. | • Must cover contiguously from C3 to T1.  
(from C3 inferior endplate to T1 superior endplate) | Slice thickness ≤ 3.0 mm  
Gap ≤ 1.0 mm  
Pixel area ≤ 1.0 mm² |

***The recommendation is to consider GRE or 3D T2**
## Cervical Spine with contrast for intramedullary disease

<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| **Sagittal dark fluid** | • Should not have non-anatomic heterogeneous signal intensity of the cord.  
                       • CSF must be hypointense to the cord/nerve roots so that cord/nerve roots are clearly defined.  
                       • Fat must be bright, but not so intense that it masks the fat/muscle plane.  
                       • Must show good contrast between the cord and CSF.  
                       • T1 FLAIR is acceptable for this sequence | • Must cover foramen magnum to T1.  
                       • Must cover laterally through the neural foramina. | Slice thickness ≤ 3.0 mm  
                       Gap ≤ 1.0 mm  
                       Pixel area ≤ 1.0 mm² |
| **Sagittal bright fluid** | • Should not have non-anatomic heterogeneous signal intensity of the cord.  
                        • CSF must be hyperintense to the cord/nerve roots so that cord/nerve roots are clearly defined.  
                        • Fat must not be so intense that it masks the fat/muscle plane.  
                        • Must show good contrast between the cord and CSF. | • Must cover foramen magnum to T1.  
                       • Must cover laterally through the neural foramina. | Slice thickness ≤ 3.0 mm  
                       Gap ≤ 1.0 mm  
                       Pixel area < 1.0 mm² |
| **Axial bright fluid** | • Should not have non-anatomic heterogeneous signal intensity of the cord.  
                         • CSF must be hypointense to the cord/nerve roots so that cord/nerve roots are clearly defined.  
                         • Fat must not be so intense that it masks the fat/muscle plane.  
                         • Must show good contrast between the grey and white matter | • Must cover contiguously from C3 to T1.  
                         (from C3 inferior endplate to T1 superior endplate) | Slice thickness ≤ 3.0 mm  
                         Gap ≤ 1.0 mm  
                         Pixel area ≤ 1.0 mm² |
| **Axial dark fluid post contrast** | • Should not have non-anatomic heterogeneous signal intensity of the cord.  
                          • CSF must be hypointense to the cord/nerve roots so that cord/nerve roots are clearly defined.  
                          • Fat must not be so intense that it masks the fat/muscle plane.  
                          • Must show good contrast between the cord and CSF. | • Must cover contiguously from the foramen magnum to T1 | Slice thickness ≤ 3.0 mm  
                          Gap ≤ 1.0 mm  
                          Pixel area ≤ 1.0 mm² |
| **Sagittal dark fluid post contrast** | • Should not have non-anatomic heterogeneous signal intensity of the cord.  
                           • CSF must be hypointense to the cord/nerve roots so that cord/nerve roots are clearly defined.  
                           • Fat must not be so intense that it masks the fat/muscle plane.  
                           • Must show good contrast between the cord and CSF. | • Must cover foramen magnum to T1.  
                           • Must cover laterally through the neural foramina. | Slice thickness ≤ 3.0 mm  
                           Gap ≤ 1.0 mm  
                           Pixel area ≤ 1.0 mm² |
<table>
<thead>
<tr>
<th>Sagittal dark fluid</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Should not have non-anatomic heterogeneous signal intensity of the cord.</td>
<td>• Must cover C7 to L1 inclusive</td>
<td>Slice thickness ≤ 4.0 mm</td>
<td></td>
</tr>
<tr>
<td>• CSF must be hypointense to the cord/nerve roots so that cord/nerve roots are clearly defined.</td>
<td>• Must cover laterally through the neural foramina</td>
<td>Gap ≤ 1.0 mm</td>
<td></td>
</tr>
<tr>
<td>• Fat must be bright, but not be so intense that it masks the fat/muscle plane.</td>
<td></td>
<td>Pixel area ≤ 1.6 mm²</td>
<td></td>
</tr>
<tr>
<td>• Must show good contrast between the cord and CSF.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• T1 FLAIR is acceptable for this sequence</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sagittal bright fluid</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Should not have non-anatomic heterogeneous signal intensity of the cord.</td>
<td>• Must cover C7 to L1 inclusive</td>
<td>Slice thickness ≤ 4.0 mm</td>
<td></td>
</tr>
<tr>
<td>• CSF must be hyperintense to the cord/nerve roots so that cord/nerve roots are clearly defined.</td>
<td>• Must cover laterally through the neural foramina</td>
<td>Gap ≤ 1.0 mm</td>
<td></td>
</tr>
<tr>
<td>• Fat must not be so intense that it masks the fat/muscle plane.</td>
<td></td>
<td>Pixel area ≤ 1.6 mm²</td>
<td></td>
</tr>
<tr>
<td>• Must show good contrast between the cord and CSF.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Axial bright fluid - contiguous or angled</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Should not have non-anatomic heterogeneous signal intensity of the cord.</td>
<td>• Axials may be angled or contiguous</td>
<td>Slice thickness ≤ 4.0 mm</td>
<td></td>
</tr>
<tr>
<td>• CSF must be hyperintense to the cord/nerve roots so that cord/nerve roots are clearly defined.</td>
<td>• Angled slices must cover at least six disc spaces</td>
<td>Gap ≤ 1.0 mm</td>
<td></td>
</tr>
<tr>
<td>• Fat must not be so intense that it masks the fat/muscle plane.</td>
<td>• Angled slices must include at least three spaces per disc</td>
<td>Pixel area ≤ 1.6 mm²</td>
<td></td>
</tr>
<tr>
<td>• Must show good contrast between the cord and CSF.</td>
<td>• Angled slices must include center slice through the disc space</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Contiguous slices must cover at least six contiguous vertebrae (inclusive).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sagittal localizer</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Must be able to number the vertebrae C2 through T6 and include landmarks on the localizer and at least one thoracic sagittal series that allows unambiguous labeling of the thoracic vertebrae.</td>
<td>• Must include C2 through T12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Landmarks may include a skin marker and/or sternal notch</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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### Lumbar Spine

<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| **Sagittal dark fluid** | • Should not have non-anatomic heterogeneous signal intensity of the cord.  
  • CSF must be hypointense to the cord/nerve roots so that cord/nerve roots are clearly defined.  
  • Fat must be bright, but not so intense that it masks the fat/muscle plane.  
  • Must show good contrast between the cord and CSF.  
  • T1 FLAIR is acceptable for this | • Must cover T12 – S2 inclusive**  
  • Must cover from and through one pedicle, all the way through to the contra-lateral pedicle inclusive. | Slice thickness ≤ 5.0 mm  
  Gap ≤ 1.5 mm  
  Pixel area ≤ 1.5 mm² |
| **Sagittal bright fluid** | • Should not have non-anatomic heterogeneous signal intensity of the cord.  
  • CSF must be hyperintense to the cord/nerve roots so that cord/nerve roots are clearly defined.  
  • Fat must not be so intense that it masks the fat/muscle plane.  
  • Must show good contrast between the cord and CSF. | • Must cover T12 – S2 inclusive**  
  • Must cover from and through one pedicle, all the way through to the contra-lateral pedicle inclusive. | Slice thickness ≤ 5.0 mm  
  Gap ≤ 1.5 mm  
  Pixel area ≤ 1.5 mm² |
| **Axial dark fluid and/or bright fluid** | • Should not have non-anatomic heterogeneous signal intensity of the cord.  
  • Dark fluid sequence – CSF must be hypointense to the cord/nerve roots so that cord/nerve roots are clearly defined.  
  • Bright fluid sequence – CSF must be hyperintense to the cord/nerve roots so that cord/nerve roots are clearly defined.  
  • Fat must not be so intense that it masks the fat/muscle plane.  
  • Must show good contrast between the cord and CSF. | • Must cover the L3-4, L4-5, and L5-S1 levels including each disc and contiguous endplates. | Slice thickness ≤ 4.0 mm  
  Gap ≤ 1.0 mm  
  Pixel area ≤ 1.5 mm² |

**In the sagittal lumbar sequences: T12 to S2 inclusive means from T12 superior endplate to the S2 inferior endplate.**
MSK Module

Instructions for Musculoskeletal (MSK) MRI Examinations

In addition to the exam-specific instructions in the following tables, review the following information prior to examination selection and submission. Note that failure to follow the guidance below may result in failure of the submitted examination.

a. Direct or indirect MR arthrograms are NOT Acceptable in place of non-contrast enhanced examinations.

b. ALL joint examinations require three imaging planes. Unless otherwise noted, these can be orthogonal to each other or mildly angulated to better demonstrate specific conditions, as long as all pertinent anatomic structures are completely demonstrated.

c. ALL examinations must include at least one non-fat-suppressed, T1-weighted sequence. This can be acquired as a spin-echo acquisition, or as a fast spin-echo acquisition with scanning parameters (including echo-train length, inter-echo spacing, effective TE, and readout bandwidth) optimized to reduce blurring. Bone marrow, trabeculae, cortex, skeletal muscle, and extra-articular structures bounded by fat should all be sharply defined on the T1-weighted images.

d. ALL examinations should also include at least one fluid-sensitive sequence with suppressed fat signal. These can be acquired as intermediate-TE or long-TE (or effective-TE) spin-echo or fast spin-echo acquisitions, or as T2*-weighted gradient-recalled acquisitions. Suppression of fat signal may be accomplished with a chemical (spectral) based method, an inversion recovery method (e.g. STIR), a phase-dependent method (e.g. Dixon technique), or selective water excitation. The signal intensity of fluid should be bright and the signal intensity of fat should be darker than fluid (but does not have to be completely saturated and black). Nevertheless, the images should still demonstrate a gray scale that allows visualization of normal anatomic structures.

e. Sequences can be acquired in 2D or 3D mode; however, separate acquisitions are required for each required sequence. Images acquired in one imaging plane and reformatted into another plane CANNOT be used in place of a second acquired sequence.

f. The specified spatial resolutions for each required sequence will be enforced, but should not be interpreted as being, in and of itself, the only criterion for failure. Note that the pixel dimensions and areas must be less than or equal to the value specified. Do NOT use “interpolated” matrix dimensions when determining the pixel dimensions – the number of phase-encoding or frequency-encoding steps actually acquired should be used. Check your calculations carefully.

g. Refer to the individual ACR Practice Parameters for Musculoskeletal MRI examinations for more detailed explanations and justifications for the required examination elements.

h. Fluid must be dark and fat must be bright (i.e. T1-weighted) on the submitted coronal oblique dark fluid sequence for the wrist exam.

i. The axial sequences for the elbow exam must cover the entire biceps tendon insertion on the radial tuberosity.

j. The spatial resolution pixel area values indicated in the tables below are optimal values. Deviations from these values may be acceptable as long as other image quality parameters are acceptable.

k. Failure to meet anatomic coverage and imaging plane specifications may result in a fail of the submitted examination.

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l. For the knee exam, if all the sagittal requirements listed are met by one sagittal sequence, then an additional sagittal sequence will not be required. Please review the requirements carefully for both sagittal sequences.

m. For the knee exam, coronal long TR/short TE sequence, which is an intermediate or proton-density weighted sequence, is NOT a substitute for the requisite coronal dark fluid sequence. Coronal dark fluid sequence must be T1-weighted with short TR/short TE, dark fluid and bright fat.
<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Optimal Spatial Resolution</th>
</tr>
</thead>
</table>
| Axial dark fluid or long TR/short TE | • Trabeculae and cortex must be sharply defined  
• Must have good definition of surrounding tissues  
• Must have good contrast between fat and non-fat tissues  
• Tendons must be well discriminated  
  o Biceps and brachialis tendon  
  o Common flexor and extensor tendon  
  o Triceps tendon  
• Must have good definition of surrounding tissues  
• Tendons must be well discriminated  
  o Biceps and brachialis tendon  
  o Common flexor and extensor tendon  
  o Triceps tendon | • Images must be perpendicular to the long axis of the elbow  
• Must cover the entire soft tissues of the elbow  
• Must cover from above the humeral epicondyles to the entire biceps tendon insertion on the radial tuberosity  
• Images must be perpendicular to the long axis of the elbow  
• Must cover the entire soft tissues of the elbow  
• Must cover from above the humeral epicondyles to the entire biceps tendon insertion on the radial tuberosity | Slice thickness ≤ 4.0 mm  
Gap ≤ 1.2 mm  
Pixel area ≤ 0.4 mm² |
| Axial STIR or bright fluid with or without fat suppression | | | |
| Coronal dark fluid | • Trabeculae and cortex must be sharply defined  
• Must have good definition of surrounding tissues  
• Must have good contrast between fat and non-fat tissues  
• Must have good cartilage visualization  
• Must have good definition of collateral ligaments  
• Must have good discrimination of common flexor and extensor tendons | • Images must be parallel to the epicondylar axis as prescribed from the axial image  
• Must cover the entire soft tissues of the elbow  
• Must cover from above the humeral epicondyles to the entire biceps tendon insertion on the radial tuberosity | Slice thickness ≤ 3.0 mm  
Gap ≤ 1.0 mm  
Pixel area ≤ 0.4 mm² |
| Coronal bright fluid with fat suppression which includes STIR or frequency selective fat suppression techniques | • Must have good definition of surrounding soft tissues  
• Must have good discrimination of  
  o Fluid vs. soft tissue  
  o Common flexor and extensor tendon  
  o Cartilage vs. joint fluid  
• Must have good definition of collateral ligaments | • Images must be parallel to the epicondylar axis as prescribed from the axial image  
• Must cover the entire soft tissues of the elbow  
• Must cover from above the humeral epicondyles to the entire biceps tendon insertion on the radial tuberosity | Slice thickness ≤ 3.0 mm  
Gap ≤ 1.0 mm  
Pixel area ≤ 0.4 mm² |
| Sagittal bright fluid | • Trabeculae and cortex must be sharply defined  
• Must have good definition of surrounding tissues  
• Must have good discrimination of  
  o Triceps tendon  
  o Biceps tendon  
  o Cartilage from joint fluid | • Images must be perpendicular to the epicondylar axis as prescribed from the axial image  
• Must cover the entire soft tissues of the elbow  
• Must cover from above the humeral epicondyles to the entire biceps tendon insertion on the radial tuberosity | Slice thickness ≤ 3.0 mm  
Gap ≤ 1.0 mm  
Pixel area ≤ 0.4 mm² |
<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| Short axis dark fluid (perpendicular to the metatarsals) | • Must have good definition of trabeculae and cortex  
• Must have good definition of surrounding soft tissues  
• Must have good contrast between fat and non-fat tissues  
• Must have good discrimination of tendons  
• Must visualize metatarsophalangeal joint capsule  
• Must have good visualization of plantar plate | • Must include proximal interphalangeal joint (PIP)  
• Must include at least the distal half of all metatarsals  
• Must align perpendicular to the long axis of the metatarsals  
• Must cover entire soft tissues of the forefoot | Slice thickness ≤ 3.0 mm  
Gap ≤ 0.3 mm  
Pixel area ≤ 0.4 mm² |
| Short axis (perpendicular to the metatarsals) bright fluid with fat suppression which includes STIR or frequency selective fat suppression techniques | • Must have good definition of surrounding soft tissues  
• Must have good contrast between tissue and fluid  
• Must have good discrimination of tendons  
• Must visualize metatarsophalangeal joint capsule  
• Must have good visualization of plantar plate | • Must include proximal interphalangeal joint (PIP)  
• Must include at least the distal half of all metatarsals  
• Must align perpendicular to the long axis of the metatarsals  
• Must cover entire soft tissues of the forefoot | Slice thickness ≤ 3.0 mm  
Gap ≤ 0.3 mm  
Pixel area ≤ 0.4 mm² |
| Long axis (parallel to the metatarsals and plantar surface) bright fluid with fat suppression which includes STIR or frequency selective fat suppression techniques | • Must have good definition of surrounding soft tissues  
• Must have good contrast between tissue and fluid  
• Must have good discrimination of tendons  
• Must visualize metatarsophalangeal joint capsule | • Must include tips of toes  
• Must include at least the distal half of all metatarsals  
• Must align parallel to the long axis of the metatarsals  
• Must cover entire soft tissues of the forefoot | Slice thickness ≤ 3.0 mm  
Gap ≤ 0.3 mm  
Pixel area ≤ 0.4 mm² |
| Sagittal (parallel to the metatarsals) | • Must have good definition of trabeculae and cortex  
• Must have good definition of surrounding soft tissues  
• Must have good discrimination of tendons | • Must include tips of toes  
• Must include at least the distal half of all metatarsals  
• Must align perpendicular to the long axis sequence and parallel to the long axis of the metatarsals  
• Must cover entire soft tissues of the forefoot | Slice thickness ≤ 3.0 mm  
Gap ≤ 0.3 mm  
Pixel area ≤ 0.4 mm² |
## Shoulder for internal derangement

<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| **Coronal oblique, sagittal or axial dark fluid** | • Must have good definition of trabeculae and cortex  
• Must have good definition of surrounding soft tissues  
• Must have good definition of labrum  
• Must have good definition of tendons  
  o Supraspinatus  
  o Infraspinatus  
  o Subscapularis | • Must be parallel to supraspinatus tendon as seen on axial cut through the superior portion of the shoulder or perpendicular to the articular surface of the glenoid fossa as seen on axial images  
• Must include the teres minor muscle posterior to the humeral head through the anterior coracoid tip | Slice thickness ≤ 4.0 mm  
Gap ≤ 0.8 mm  
Pixel area ≤ 0.8 mm² |
| **Axial long TR/short TE** | • Must have good definition of trabeculae and cortex  
• Must have good definition of surrounding soft tissues  
• Must have good definition of labrum  
• Must have good definition of biceps in bicapital groove | • Must cover from the top of the acromion to the bottom of the glenohumeral joint using the coronal scout image as a localizer | Slice thickness ≤ 4.0 mm  
Gap ≤ 0.8 mm  
Pixel area ≤ 0.8 mm² |
| **Coronal bright fluid with fat suppression which includes STIR or frequency selective fat suppression techniques** | • Must have homogeneous fat saturation  
• Must have good definition of surrounding soft tissues  
• Must have good definition of labrum  
• Must have good definition of tendons  
  o Supraspinatus  
  o Infraspinatus  
  o Subscapularis | • Must be parallel to supraspinatus tendon as seen on axial cut through the superior portion of the shoulder or perpendicular to the articular surface of the glenoid fossa as seen on axial images  
• Must include the teres minor muscle posteriorly to the humeral head through the anterior coracoid tip | Slice thickness ≤ 4.0 mm  
Gap ≤ 0.8 mm  
Pixel area ≤ 0.8 mm² |
| **Sagittal oblique bright fluid** | • Must have good definition of surrounding soft tissues  
• Must have good definition of rotator interval  
• Must have good definition of tendons  
  o Supraspinatus  
  o Infraspinatus  
  o Subscapularis  
  o Teres minor  
  o Biceps | • Must be parallel to the articular surface of the glenoid fossa as seen on the axial images  
• Must cover the scapular neck through the lateral margin of the humerus | Slice thickness ≤ 4.0 mm  
Gap ≤ 0.8 mm  
Pixel area ≤ 0.8 mm² |
<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| **Coronal oblique dark fluid** | - Must have good definition of trabeculae and cortex  
- Must have good definition of surrounding soft tissues  
- Must have good definition of Scapholunate ligament  
- Must have good definition of Triangular fibrocartilage complex  
- Must have dark fluid and bright fat | - Must cover entire wrist including extrinsic ligaments and tendons  
- Must cover from Lister’s tubercle through the bases of the metacarpals | Slice thickness ≤ 3.0 mm  
Gap ≤ 0.5 mm  
Pixel area ≤ 0.3 mm² |
| **Coronal oblique bright fluid** | - Must have bright fluid  
- Must have good definition of surrounding soft tissues  
- Must have good definition of Scapholunate ligament  
- Must have good definition of Triangular fibrocartilage complex | - Must cover entire wrist including extrinsic ligaments and tendons  
- Must cover from Lister’s tubercle through the bases of the metacarpals | Slice thickness ≤ 3.0 mm  
Gap ≤ 0.5 mm  
Pixel area ≤ 0.3 mm² |
| **Axial dark fluid or long TR/short TE** | - Must have good definition of trabeculae and cortex  
- Must have good definition of surrounding soft tissues  
- Must have good definition of individual extensor tendons | - Must cover entire soft tissues anterior through posterior  
- Must cover distal radioulnar joint through the bases of the metacarpals | Slice thickness ≤ 3.0 mm  
Gap ≤ 0.6 mm  
Pixel area ≤ 0.3 mm² |
| **Axial bright fluid** | - Fluid must be bright  
- Must have good definition of surrounding soft tissues  
- Must have good definition of individual extensor tendons | - Must cover entire soft tissues anterior through posterior  
- Must cover distal radioulnar joint through the bases of the metacarpals | Slice thickness ≤ 3.0 mm  
Gap ≤ 0.6 mm  
Pixel area ≤ 0.3 mm² |
| **Sagittal** | - Must have good definition of trabeculae and cortex  
- Must have good definition of surrounding soft tissues | - Must cover entire soft tissues anterior through posterior  
- Must cover distal radioulnar joint through the bases of the metacarpals | Slice thickness ≤ 3.0 mm  
Gap ≤ 0.6 mm  
Pixel area ≤ 0.3 mm² |
### KNEE such as for internal derangement

<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sagittal PD-weighted: 2D or 3D; SE, FSE, or GRE; with or without fat suppression (for menisci)</td>
<td>• Must have good definition of menisci • Must have good contrast between menisci and articular cartilage • Must have good contrast between menisci and joint fluid</td>
<td>• Must cover entire menisci, including any potentially-displaced fragments</td>
<td>Slice thickness ≤ 4.0 mm Gap ≤ 1.0 mm Pixel area ≤ 0.6 mm²</td>
</tr>
<tr>
<td>Sagittal bright fluid with or without fat suppression (for articular cartilage, ligaments, tendons)</td>
<td>• Must have good definition of articular cartilage • Must have good definition of cruciate ligaments • Must have good definition of extensor mechanism • Must have bright fluid relative to articular cartilage and fibrocartilage</td>
<td>• Must include suprapatellar recess, distal quadriceps tendon and tibial tubercle • Must cover entirety width of tibia and fibula</td>
<td>Slice thickness ≤ 4.0 mm Gap ≤ 1.0 mm Pixel area &lt; 0.6 mm²</td>
</tr>
<tr>
<td>Coronal bright fluid with or without fat suppression which includes STIR or frequency selective fat suppression techniques</td>
<td>• Must have good definition of menisci, cruciate ligaments and collateral ligaments • Must have good contrast between joint fluid and articular cartilage and menisci • Must have bright fluid</td>
<td>• Must include knee from above patella through distal MCL insertion • Must cover patella through popliteal vessels</td>
<td>Slice thickness ≤ 4.0 mm Gap ≤ 1.0 mm Pixel area ≤ 0.6 mm²</td>
</tr>
<tr>
<td>Coronal, sagittal or axial dark fluid (NOT PD weighted)</td>
<td>• Must have good definition of trabeculae and cortex • Must have good definition of menisci • Must have good definition of skeletal muscles, collateral ligaments and other extra-articular structures • Must have dark fluid and bright fat</td>
<td>• Must include knee from above patella through distal MCL insertion • Must cover patella through popliteal vessels</td>
<td>Slice thickness ≤ 4.0 mm Gap ≤ 1.0 mm Pixel area ≤ 0.6 mm²</td>
</tr>
<tr>
<td>Transverse bright fluid with or without fat suppression</td>
<td>• Must have good definition of cruciate ligaments and collateral ligaments • Must have good contrast between joint fluid and articular cartilage • Must have bright fluid</td>
<td>• Must include all anterior, posterior, medial and lateral soft tissues • Must cover entire patella and tibial tubercle</td>
<td>Slice thickness ≤ 4.0 mm Gap ≤ 1.0 mm Pixel area ≤ 0.6 mm²</td>
</tr>
</tbody>
</table>

Must have fat suppression on at least one sagittal or coronal sequence
Body Module

Instructions for Body MRI Examinations

In addition to the exam-specific instructions in the following tables, review the following information prior to examination selection and submission. **Note that failure to follow the guidance below may result in failure of the submitted examination.**

f. Single shot techniques (HASTE, SSFSE, SSTSE and steady state free precession such as FIESTA, TRUE FISP, BFFE) are not acceptable substitutions for a high resolution sequence for **any** of the body module exams.

g. The adult female pelvis exam must include a uterus and is a high resolution protocol.

h. The fat must be bright on the female pelvis “axial whole pelvis dark fluid sequence”.

i. The “in/out of phase” sequence of the hepatobiliary exam must be prior to contrast.

j. Either extracellular gadolinium-based contrast agents (GBCA) or combined extracellular-hepatobiliary GBCA (Gadoxetate disodium-EOVIST™) are acceptable for the abdomen “axial 3D dark fluid dynamic with fat suppression post contrast” sequence.

k. For the renal exam, a pre-contrast phase must be included in the dynamic axial or coronal dark fluid with fat suppression post contrast sequence Omission of the pre-contrast phase will result in a fail of the submitted examination.

l. Failure to meet anatomic coverage and imaging plane specifications may result in a fail of the submitted examination.
Female Pelvis such as for uterine or adnexal disease
***This examination is a high resolution female pelvis protocol. The exam must include a uterus***

<table>
<thead>
<tr>
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</tr>
</thead>
</table>
| Sagittal high resolution bright fluid | • The uterine corpus zonal anatomy must be clearly defined.  
  • The uterine cervix zonal anatomy must be clearly defined. | • Must cover the uterus, cervix, adnexa and pelvic sidewalls | Slice thickness ≤ 5.0 mm  
  Gap ≤ 1.5 mm  
  Pixel area ≤ 1.0 mm² |
| Axial or oblique axial high resolution bright fluid | • The uterine corpus zonal anatomy must be clearly defined.  
  • The uterine cervix zonal anatomy must be clearly defined. | • Must cover from iliac crests to vaginal introitus  
  • Must cover pelvic sidewalls | Slice thickness ≤ 5.0 mm  
  Gap ≤ 1.5 mm  
  Pixel area ≤ 1.0 mm² |
| Axial whole pelvis dark fluid | Fat must be hyperintense | • Must cover entire boney pelvis | Slice thickness ≤ 5.0 mm  
  Gap ≤ 1.5 mm  
  Pixel area ≤ 2.4 mm² |
| Sagittal or axial dark fluid with fat suppression | • Fat must be hypointense  
  • All scan parameters must be identical to the post contrast | • Sagittal must cover the uterus, cervix, adnexa and pelvic sidewalls  
  • Axial must cover entire boney pelvis | If sagittal:  
  Slice thickness ≤ 4.0 mm  
  Gap ≤ 0.0 mm  
  Pixel area ≤ 2.4 mm²  
  If axial:  
  Slice thickness ≤ 5.0 mm  
  Gap ≤ 1.5 mm  
  Pixel area ≤ 2.4 mm² |
| Sagittal or axial dark fluid with fat suppression post contrast | • Fat must be hypointense  
  • All scan parameters must be identical to the pre contrast  
  • Must show sufficient uterine enhancement | • Sagittal must cover the uterus, cervix, adnexa and pelvic sidewalls  
  • Axial must cover entire boney pelvis | If sagittal:  
  Slice thickness ≤ 4.0 mm  
  Gap ≤ 0.0 mm  
  Pixel area ≤ 2.4 mm²  
  If axial:  
  Slice thickness ≤ 5.0 mm  
  Gap ≤ 1.5 mm  
  Pixel area ≤ 2.4 mm² |
<table>
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<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sagittal high resolution bright fluid</td>
<td>• The bladder, rectum and adjacent reproductive organs (if reproductive organs present) should be clearly defined • Must include soft tissues of the pelvis and bone marrow of the spine</td>
<td>• Must cover the pelvic sidewalls</td>
<td>Slice thickness ≤ 5.0 mm Gap ≤ 1.5 mm Pixel area ≤ 1.0 mm²</td>
</tr>
<tr>
<td>Axial high resolution bright fluid</td>
<td>• Must have good discrimination of bladder from rectum and adjacent reproductive organs (if reproductive organs present) • Must have good definition of the surrounding soft tissues and bone marrow</td>
<td>• Must cover entire bony pelvis and surrounding soft tissues and musculature and extend through perineum</td>
<td>Slice thickness ≤ 5.0 mm Gap ≤ 1.5 mm Pixel area ≤ 1.0 mm²</td>
</tr>
<tr>
<td>Axial whole pelvis dark fluid</td>
<td>• Fat must be hyperintense</td>
<td>• Must cover entire bony pelvis and surrounding soft tissues and musculature and extend through perineum</td>
<td>Slice thickness ≤ 5.0 mm Gap ≤ 1.5 mm Pixel area ≤ 2.4 mm²</td>
</tr>
<tr>
<td>Sagittal or axial dark fluid with fat suppression</td>
<td>• Fat must be hypointense • All scan parameters must be identical to the post contrast</td>
<td>• Sagittal must cover the pelvic sidewalls • Must cover entire bony pelvis and surrounding soft tissues and musculature and extend through perineum</td>
<td>If sagittal: Slice thickness ≤ 4.0 mm Gap ≤ 1.5 mm Pixel area ≤ 2.4 mm² If axial: Slice thickness ≤ 5.0 mm Gap ≤ 1.5 mm Pixel area ≤ 2.4 mm²</td>
</tr>
<tr>
<td>Sagittal or axial dark fluid with fat suppression post contrast</td>
<td>• Fat must be hypointense • All scan parameters must be identical to the pre contrast</td>
<td>• Sagittal must cover the pelvic sidewalls. • Must cover entire bony pelvis and surrounding soft tissues and musculature and extend through perineum</td>
<td>If Sagittal: Slice thickness ≤ 4.0 mm Gap ≤ 1.5 mm Pixel area ≤ 2.4 mm² If Axial: Slice thickness ≤ 5.0 mm Gap ≤ 1.5 mm Pixel area ≤ 2.4 mm²</td>
</tr>
</tbody>
</table>
### Hepatobiliary to include MRCP

<table>
<thead>
<tr>
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</tr>
</thead>
</table>
| In phase/out of phase dark fluid | • Must have adequate hepatic/ splenic contrast  
• Must display appropriate signal loss on opposed-phase images.  
• Must have good definition of surrounding soft tissues | • Must cover the entire liver | Slice thickness ≤ 7 mm  
Gap ≤ 1.5 mm  
Pixel area ≤ 7.2 mm² |
| Axial or coronal long TR bright fluid with or without fat suppression | • Must have good discrimination of liver from biliary tree.  
• Must have good definition of surrounding soft tissues.  
• Steady State Free Precession sequences, such as FIESTA and true FISP are not adequate substitutions for TSE, FSE or IR sequences at this time, and are not acceptable for this sequence. | • Must cover the entire liver | Slice thickness ≤ 7 mm  
Gap ≤ 1.5 mm  
Pixel area ≤ 3.75 mm² |
| MRCP 3D or 2D | • You may submit a 3D or 2D sequence for MRCP  
• One reformatted MIP image is required for 3D gated MRCP  
• Must have good fluid discrimination | • Must cover the central biliary tree including the second order branches  
• Must cover the entire pancreas  
• Bile ducts and pancreatic ducts must be well defined | 3D Slice thickness ≤ 2.0 mm  
Voxel volume ≤ 5.2 mm³  
2D thick slab Slice thickness > 40 mm, < 60 mm  
Gap 0.0  
Pixel area ≤ 1.0 mm² |
| Axial 3D dark fluid dynamic with fat suppression post contrast*** | • Must have good definition of surrounding soft tissues  
• Must have at least four phases:  
  o Pre contrast  
  o Parenchymal arterial  
  o Portal venous  
  o Equilibrium or delayed | • Must cover the entire liver | Slice thickness ≤ 6.0 mm  
Gap 0 mm  
Pixel area ≤ 4.5 mm² |

*** While this is a 3D series, please ensure submitted images meet pixel area requirements as noted above. The testing package will calculate spatial resolution as voxel volume, but your images must meet the pixel area requirements.
<table>
<thead>
<tr>
<th>Required Sequences</th>
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</tr>
</thead>
<tbody>
<tr>
<td>In phase/out of phase dark fluid</td>
<td>• Must have adequate hepatic/splenic contrast</td>
<td>• Must cover the entire liver</td>
<td>Slice thickness ≤ 5 mm</td>
</tr>
<tr>
<td></td>
<td>• Must display appropriate signal loss on opposed-phase images.</td>
<td></td>
<td>Gap ≤ 1.5 mm</td>
</tr>
<tr>
<td></td>
<td>• Must have good definition of surrounding soft tissues</td>
<td></td>
<td>Pixel area ≤ 7.2 mm²</td>
</tr>
<tr>
<td>Axial or coronal long TR bright fluid with or without fat suppression</td>
<td>• Must have good discrimination of liver from biliary tree.</td>
<td>• Must cover the entire liver</td>
<td>Slice thickness ≤ 5 mm</td>
</tr>
<tr>
<td></td>
<td>• Must have good definition of surrounding soft tissues.</td>
<td></td>
<td>Gap ≤ 1.5 mm</td>
</tr>
<tr>
<td></td>
<td>• Steady State Free Precession sequences, such as FIESTA and true FISP are not adequate substitutions for CSE, FSE or IR sequences at this time, and are not acceptable for this sequence.</td>
<td></td>
<td>Pixel area ≤ 3.75 mm²</td>
</tr>
<tr>
<td>Axial 3D dark fluid dynamic with fat suppression post contrast</td>
<td>• Must have good definition of surrounding soft tissues</td>
<td>• Must cover the entire liver</td>
<td>Slice thickness ≤ 5.0 mm</td>
</tr>
<tr>
<td></td>
<td>• Must have at least four phases:</td>
<td></td>
<td>Gap 0 mm</td>
</tr>
<tr>
<td></td>
<td>o Pre contrast</td>
<td></td>
<td>Pixel area ≤ 4.5 mm²</td>
</tr>
<tr>
<td></td>
<td>o Parenchymal arterial</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Portal venous</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>o Equilibrium or delayed</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>**Either extracellular gadolinium or hepatobiliary agents are acceptable post contrast</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Renal

<table>
<thead>
<tr>
<th>Required Sequences</th>
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</tr>
</thead>
</table>
| Axial or coronal bright fluid with fat suppression | • Must have good discrimination between the kidney and the collecting system                                                        | • Axial must cover both adrenal glands and kidneys entirely                                                             | Slice thickness ≤ 7.0 mm  
Gap ≤ 1.5 mm  
Pixel area ≤ 3.75 mm² |
| Axial in-phase/opposed-phase dark fluid | • Must have good cortico-medullary discrimination  
• Must have good definition of surrounding tissues                                                                 | • Must cover both adrenal glands and kidneys entirely                                                                    | Slice thickness ≤ 7.0 mm  
Gap ≤ 1.5 mm  
Pixel area ≤ 7.2 mm² |
| Dynamic axial or coronal dark fluid with fat suppression post contrast | • Must have sufficient IV contrast enhancement of the renal parenchyma over time  
• Must include a pre-contrast phase                                                                 | • Axial must cover both adrenal glands and kidneys entirely  
• Coronal must cover both kidneys anterior to posterior                                                                    | Slice thickness ≤ 5.0 mm  
Gap ≤ 1.5 mm  
Pixel area ≤ 2.4 mm² |
MRA Module

Instructions for MRA MRI Examinations

In addition to the exam-specific instructions in the following tables, review the following information prior to examination selection and submission. **Note that failure to follow the guidance below may result in failure of the submitted examination.**

m. If a time-resolved MRA (e.g. TWIST, TRICKS) is submitted for the MRA Arch/Carotid exam, the post contrast sequence containing all dynamic phases must be included. Post contrast source images of the single phase from which reformations are derived must also be included.

n. Reconstructed slice interval should be 50% of the acquired slice thickness for the MRA arch/carotid exam.

o. Reformatted images should be derived from the contrast MRA sequence.

p. Inflow-enhanced (SFFP) e.g. Inhance Suite (GE), NATIVE (Siemens), TRANCE or B-TRANCE (Philips), Time-SLIP, Time Space Angiography or TSA (Toshiba), VASC-ASL (Hitachi) sequences may replace gadolinium-enhanced carotid and renal MRA sequences.

q. Failure to meet anatomic coverage and imaging plane specifications may result in a fail of the submitted examination.
<table>
<thead>
<tr>
<th>Required Sequences</th>
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<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| 3D contrast enhanced source images or 3D non-contrast MRA renal images | • Must have good artery to background contrast  
• Must have minimal to no venous enhancement  
• Must have correct bolus timing if contrast enhanced | Must cover:  
• Origin of celiac artery  
• Origin of superior mesenteric artery (SMA)  
• Right and left renal arteries to the branching in the renal hilum with no motion blurring | Slice thickness ≤ 3.0 mm  
Reconstructed slice interval ≤ 1.5 mm  
Voxel volume ≤ 6.0 mm³ |
| 3D contrast enhanced reformatted Images (Angiographic Images) | • Must have good artery to background contrast | Must display:  
• Origin of celiac artery  
• Origin of superior mesenteric artery (SMA)  
• Right and left renal arteries | N/A |
<table>
<thead>
<tr>
<th>Required Sequences</th>
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<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| 3D contrast enhanced source images | • Must have good artery to background contrast  
• Must have uniform artery signal/ minimal to no intra-voxel phase dispersion  
• Must have minimal to no venous enhancement  
• Must have correct bolus timing | Must cover:  
• Aortic arch  
• Innominate artery  
• Right and left common carotid artery  
• Right and left carotid bifurcation  
• Right and left Subclavian arteries 2 cm distal to the vertebral origins  
• Right and left vertebral arteries  
• Basilar artery  
• Circle of Willis | Slice thickness ≤ 2.0 mm  
Reconstructed slice interval ≤ 1.0 mm  
Voxel volume ≤ 3.0 mm³ |
| Reformatted contrast enhanced angiographic images | • Must have good artery to background contrast  
• Must have uniform artery signal  
• Must have minimal to no venous enhancement | Must display in multiple views:  
• Aortic arch  
• Innominate artery  
• Right and left common carotid artery  
• Right and left carotid bifurcation (each must be displayed in separate MIP reconstructions)  
• Right and left Subclavian arteries 2 cm distal to the vertebral origins  
• Right and left vertebral arteries  
• Basilar artery  
• Circle of Willis | N/A |

Note: If time-resolved MRA (e.g. TRICKS, TWIST) is submitted, only 2 contrast-enhanced series should be submitted, which must include:  
Dynamic phases  
Source images only from peak carotid enhancement phase
<table>
<thead>
<tr>
<th>MRA Carotid unenhanced</th>
<th>3D time of flight source images****</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| **Required Sequences**  | • Must have good artery to background contrast  
• Must have uniform artery signal  
• Must have minimal to no venous signal | **Must cover:**  
• 2 cm of the right and left common carotid arteries  
• 3 cm of the right and left internal carotid arteries  
• 2 cm of the right and left external carotid arteries | **Slice thickness ≤ 1.6 mm**  
**Voxel volume ≤ 1.7 mm³** |
| **Category A: Pulse Sequence and Image Contrast** |  | **Must display in multiple views:**  
• 2 cm of the right and left common carotid arteries  
• 3 cm of the right and left internal carotid arteries  
• 2 cm of the right and left external carotid arteries  
• Must show adequate segmentation of arteries such that each artery segment is visible in multiple views with no overlap from other vessels  
• The right and left carotid should be segmented separately | **N/A** |
| **3D time of flight reformedatted images (angiographic images)** |  | **Must cover:**  
• 4 cm of the right and left common carotid arteries  
• right and left internal carotid arteries to the petrous bone  
• right and left external carotid arteries  
• right and left vertebral arteries | **Slice thickness ≤ 2.0 mm**  
**Gap ≤ 0 mm**  
**Pixel area ≤ 1.1 mm²** |
| **2D time of flight multi slab source images** |  | **Must display in multiple views:**  
• 4 cm of the right and left common carotid arteries  
• right and left internal carotid arteries to the petrous bone  
• right and left external carotid arteries  
• right and left vertebral arteries  
• Must show adequate segmentation of arteries such that each artery segment is visible in multiple views with no overlap from other vessels  
• The right and left carotid and posterior circulation should be segmented separately | **N/A** |
| **Category B: Anatomic Coverage and Imaging Planes** |  |  |  |
| **2D time of flight reformedatted images (angiographic images)** |  |  |  |

***Hi-quality non-contrast MRA includes balanced steady state free precession and arterial spin labeling techniques may replace 3D time of flight e.g. NATIVE (Siemens), Inhance Suite (GE), TRANCE or B-TRANCE (Philips), Time-SLIP or Time Space Angiography (Toshiba), VASC-ASL (Hitachi)***

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## MRA Thoracic Aorta

<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| **Non-contrast black or bright blood source images** | - Must have good artery to background contrast  
- Must have uniform artery signal  
- Must have minimal to no venous signal | Must cover:  
- 2 cm of the origins of the arch vessels  
- Entire thoracic aorta from the aortic annulus to the diaphragmatic hiatus | Slice thickness ≤ 7.0 mm  
Gap ≤ 1.5 mm  
Pixel area ≤ 3.0 mm² |
| **3D contrast enhanced source images** | - Must have good artery to background contrast  
- Must have uniform artery signal  
- Must have minimal to no venous enhancement  
- Must have correct bolus timing | Must cover:  
- 2 cm of the origins of the arch vessels  
- Entire thoracic aorta from the aortic annulus to the diaphragmatic hiatus | Slice thickness ≤ 3.4 mm  
Reconstructed slice interval ≤ 1.7 mm  
Voxel volume ≤ 20.0 mm³ |
| **3D contrast enhanced reformatted images (angiographic images)** | - Must have good artery to background contrast  
- Must have uniform artery signal  
- Must have minimal to no venous enhancement | Must display in multiple views:  
- 2 cm of the origins of the arch vessels  
- Entire thoracic aorta from the aortic annulus to the diaphragmatic hiatus | N/A |
Cardiac Module

Instructions for Cardiac MRI Examinations

In addition to the exam-specific instructions in the following tables, review the following information prior to examination selection and submission. **Note that failure to follow the guidance below may result in failure of the submitted examination.**

a. The axial black blood sequence may be from a different patient from the other sequences.

b. Failure to meet anatomic coverage and imaging plane specifications may result in a fail of the submitted examination.
## Delayed Enhanced Cine with black blood

<table>
<thead>
<tr>
<th>Required Sequences</th>
<th>Category A: Pulse Sequence and Image Contrast</th>
<th>Category B: Anatomic Coverage and Imaging Planes</th>
<th>Category C: Spatial Resolution</th>
</tr>
</thead>
</table>
| **BLACK BLOOD – Axial or oblique axial** | • Must be gated to the cardiac cycle  
   • Must have no significant arrhythmia during the MRI cardiac cycle  
   • Must be T1 (1 R-R/short TE) or proton density weighted (2 R-R/short TE)  
   • Must be in the axial or oblique axial plane  
   • Must have good myocardium discrimination (including good blood suppression)  
   • TE can be optimized for your system, but should be proton density/ T1 weighted (less than approximately 45 msec).  
   • This sequence may be from a different patient from the other sequences. | • Must cover from aortic root to diaphragm ( axial) | Slice thickness ≤ 8.0 mm  
Gap ≤ 4 mm  
Pixel area ≤ 4.0 mm² |
| **SHORT AXIS CINE** | • Must be gated to the cardiac cycle  
   • Must have no significant arrhythmia during the MRI cardiac cycle  
   • Real time cine images are not acceptable  
   • Must show entire systolic cycle  
   • Must have good myocardium discrimination Must image end s Joyce and end diastole  
   • Steady State free precession technique is preferred, but fast gradient echo is allowed | • Must cover entire left ventricle from base to apex | Slice thickness ≤ 10.0 mm  
Pixel area ≤ 4.0 mm²  
Temporal resolution ≤80 msec (without view sharing) |
| **LONG AXIS CINE 2 Chamber** | • Must be gated to the cardiac cycle  
   • Must have no significant arrhythmia during the MRI cardiac cycle  
   • Real time cine images are not acceptable  
   • Must show entire systolic cycle  
   • Must have good myocardium discrimination Must image end s Joyce and end diastole  
   • Steady State free precession technique is preferred, but fast gradient echo is allowed | • Single slice oriented vertically through the middle portion of the left atrium and the middle portion of the left ventricle | Slice thickness ≤ 8.0 mm  
Pixel area ≤ 4.0 mm²  
Temporal resolution ≤80 msec (without view sharing) |
| **LONG AXIS CINE 4 Chamber** | • Must be gated to the cardiac cycle  
   • Must have no significant arrhythmia during the MRI cardiac cycle  
   • Real time cine images are not acceptable  
   • Must show entire systolic cycle  
   • Must have good myocardium discrimination Must image end s Joyce and end diastole  
   • Steady State free precession technique is preferred, but fast gradient echo is allowed | • Single slice oriented vertically through the middle portion of the left atrium and the middle portion of the left ventricle | Slice thickness ≤ 8.0 mm  
Pixel area ≤ 4.0 mm²  
Temporal resolution ≤80 msec (without view sharing) |
| **LONG AXIS CINE 3 Chamber (Aortic Outflow Tract)** | • Must be gated to the cardiac cycle  
   • Must have no significant arrhythmia during the MRI cardiac cycle  
   • Real time cine images are not acceptable  
   • Must show entire systolic cycle  
   • Must have good myocardium discrimination  
   • Must image end s Joyce and end diastole  
   • Steady State free precession technique is preferred, but fast gradient echo is allowed  
   • Must include left atrium, left ventricle, mitral and aortic valves and aortic root in the same imaging plane | • Single slice oriented vertically through the middle portion of the left atrium and the middle portion of the left ventricle | Slice thickness ≤ 8.0 mm  
Pixel area ≤ 4.0 mm²  
Temporal resolution ≤80 msec (without view sharing) |
| **DELAYED GADOLINIUM ENHANCED-Short axis** | • Must be gated to the cardiac cycle  
   • Must have no significant arrhythmia during the MRI cardiac cycle  
   • Inversion prepared gradient echo pulse sequence  
   • Must choose Ti so that there is good suppression of normal myocardium | • Must cover entire left ventricle from base to apex in the short axis | Slice thickness ≤ 10.0 mm  
Gap ≤ 2.0 mm  
Pixel area ≤ 5.9 mm² |

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VII. MR Large Phantom Testing Instructions

A. Introduction

The intent of the MRI Accreditation Program is to use the information obtained from the review of both clinical and phantom images to assess overall image quality. Your facility will need to perform two specified phantom scans using ACR protocols as well as two phantom scans using your site’s routine clinical head protocol as outlined in these instructions.

It has come to our attention that some manufacturers of MRI systems have sent “sample” or “recommended” phantom site scanning protocols to their users. Please be aware that the requirement for MRI accreditation is that in the second set of scans mentioned above, facilities use the same protocol for the phantom that the facility uses for head imaging. Failure to comply with this requirement could result in failure to achieve accreditation.

Please review the following site scanning instructions and follow them carefully before obtaining images for submission to the accreditation program. If you have any questions about the site scanning instructions please contact the ACR.

B. Phantom Set-Up and Alignment for Scanning

The MRI Accreditation Phantom should be scanned in the head coil with the cylindrical phantom aligned as a head would be in the coil. Transaxial slices should result in circular cross-sections of the phantom. The phantom should be positioned so that the word “Nose” is where the nose would be for a standard head study and the word “Chin” is where the chin would be located in a standard head study. The center of the phantom (the dark notch on the side of the phantom) should be placed in the center of the head coil and aligned with the positioning indicator light so that it will be in the isocenter of the scanner. Once grossly positioned, it is then necessary to “fine tune” the position of the phantom along all three axes. For this, you will need to use the non-metallic bubble level enclosed. Place the level along the top of the phantom running in and out of the scanner (along the z-axis) to ensure that the phantom is horizontal. Place a gauze pad under either end of the phantom to level the phantom horizontally. Next, place the level on top of the plastic bar at the chin surface, rotating the phantom so that the plastic bar is horizontal. With the phantom then clamped or wedged inside the head coil, check to see that the sagittal laser alignment light is parallel to the line running along the “nose” surface of the phantom. (To see the laser light reflection, it may be necessary to place a piece of white paper on top of the phantom.) After each position adjustment, recheck that the top of the phantom and the chin bar are still horizontal. After the phantom has been moved into the center of the magnet, verify it’s positioning by performing sagittal and, if desired, coronal plane localizer scans, until correct. (Please note some systems require that a weight be entered in order to scan the phantom. The ACR recommends that your site enter a weight of 200 lbs.) Once correctly aligned, the phantom should be kept in the same position during the entire series of scans.
C. Scanning the Phantom

In order to proceed with this part of your image collection process, you must have an ACR phantom. The large phantom is scanned in the head coil, and will be the phantom used by most facilities. The small phantom is scanned in the knee coil, and only used for extremity-only units. An order form for the phantom is available on the ACR website. You may use a nonmagnetic bubble level (not provided) for positioning the phantom.

Eight Channel Head Coils

If your facility uses an eight channel head coil, it is necessary to perform all phantom scans using the surface coil intensity correction option.

A sagittal locator sequence should be acquired with the acquisition parameters listed on the Site Scanning Data Form. Use exactly these pulse sequence parameters, if possible, placing a check mark under each prescribed parameter to indicate that it has been used. If alternative parameters must be used because of machine or software limitations, enter the alternative scan parameters actually used below the ACR prescribed scan parameters. Fill in alternative parameters only for those parameters that differ from the ACR prescribed parameters. Deviations from the specified imaging parameters will often require a different overall study time. List the actual scan time required on the data form.

![Sagittal locator view of ACR MRI Phantom with several inclusions of the phantom labeled.](image)

**Figure 1:** Sagittal locator view of ACR MRI Phantom with several inclusions of the phantom labeled.

The sagittal locator scan should result in an image similar to Figure 1. If the pairs of 45° crossed wedges are not visible in the scan, the phantom must be repositioned and rescanned. A horizontal line used for slice prescription (see Figure 2) should be parallel to the low contrast disks located at the top of Figure 1 or Figure 2. If not, the phantom must be repositioned.
The next two scan acquisitions are transaxial pulse sequences acquired with identical spatial parameters: 5 mm slice thickness, 5 mm gap, 25 cm FOV, 256 x 256 matrix. At least 11 slices should be obtained, aligned using graphic prescription from the sagittal locator as shown in Figure 2 (Note: This is the preferred method for slice positioning). The center of slice #1 should be aligned with the vertex of the crossed wedges (visible on the lower left in Figures 1 and 2) and through the center of the dark chemical shift and resolution insert (visible on the lower right). Slice #1 should result in a transaxial image that looks like Figure 3. The centers of slices #8–11 should align with the four low-contrast discs shown toward the top in Figures 1 and 2. (Record this sagittal locator image, using a 12 on 1 format, showing the locations of the prescribed transaxial slices.) If your scanner cannot obtain enough slices in a single scan, then perform multiple scans with the specified TR/TE and with the maximum number of slices allowed by the system. Repeat the scans, each with the specified scan time, until all 11 transaxial images have been obtained in the proper locations.
Figure 4: The sagittal localizer and all 11 slices of the SE 500/20 transaxial scan filmed in 12 on 1 format.

If your scanner is not capable of obtaining 5 mm slices with 5 mm gaps, then use the closest slice thickness to 5 mm for the specified TR and TE. Set the slice gap so that slice thickness plus slice gap.
gap equals 10 mm and be careful that the images are positioned as specified in Figure 2. If necessary, perform multiple scans, each with the specified scan parameters, to get these 11 images in as close to the proper locations as possible. Record each of these 11 transaxial images on the same sheet of film as the sagittal localizer image. The full sheet should look like the 11 images in Figure 4 in terms of window settings and image positions on the film. Please note: Your axial slices must be positioned as shown in Figure 2 in order for your images to be acceptable for evaluation. If your MRI system is unable to prescribe a 5-mm slice gap then you should try the following alternative slice positioning method: Either perform an interleaved multislice acquisition or perform 11 single slice acquisitions. Please make sure that each slice is positioned as shown in Figure

If you are unable to perform the axial slice positioning as indicated in this manual, then stop and contact the ACR before proceeding any further.

The conventional spin-echo (SE) 500/20 scan should be acquired with one acquisition per phase encoding step (one signal average acquisition or NEX) and the bandwidth used routinely for brain studies. This should take a total scan time of approximately two minutes. Enter the exact scan time required, along with the bandwidth (in kHz) on the Site Scanning Data Form. Remember to place check marks below the scan parameters that are used exactly as they appear on the table of Pulse Sequence Acquisition Parameters or enter the alternative parameters in each blank.

Acquire the SE 2000/20, 80 double-echo scan with one acquisition per phase encoding step at the same 11 slice locations as used for the previous scan. If a double echo at TEs of 20 and 80 ms cannot be obtained, then use the closest multiecho TEs to 20 and 80 ms (e.g., 40 and 80 ms). This scan should take approximately 8.5 minutes. (Record the sagittal localizer and each of the 11 SE 2000/80 images only on one sheet of film. The PD weighted images do not need to be filmed.) Enter the bandwidth for the scan in the space provided on the Site Scanning Data Form; enter the exact scan time required in the blank below scan time on the Data Form if it differs from the scan time specified on the form. Place check marks or enter the revised scan parameter in each block of the Data Form.

The ACR protocols do not specify any scan options, such as autoshim or image filtering, and you are not required to use any. If you wish, you may use the scan options you normally use for clinical head imaging, provided those options do not interfere with attaining the scan parameters and slice prescriptions specified for the ACR protocols. Record all scan options used in the space provided on the Data Form.

For the ACR protocols, on scanners that have a range of image filter settings available, we recommend against strong filter settings because they are often detrimental to high-contrast resolution.

Next, scan the phantom using your site’s T1- and T2- weighted scan protocols. It is important to acquire images with 5 mm slice thickness, if possible, or as close to 5 mm slice thickness as possible, and to acquire slices with center-to-center spacing of 10 mm for both T1- and T2-weighted images. Please try to adapt your normal scan protocols to obtain the 5 mm slice thickness and the specified 11 slice locations for both T1- and T2-weighted images. Enter the precise scan parameters used for T1- and T2-weighted scans (adapted to 5-mm slice thickness and the 11 prescribed slice locations) in the Site Scanning Data Form.

When adapting your site’s sequences, only change slice thickness and slice spacing. Do not change other scan parameters. Many sites normally use a reduced field of view in the right-left dimension on their axial head images. This leads to wrap-around (aliasing) artifact when scanning the ACR phantom. Do not change the field of view of your sequences to avoid this artifact. This artifact does not interfere with our assessment of the images, and you will not be penalized for it.
VIII. MR Small Phantom Testing Instructions

A. Introduction

The intent of the MRI Accreditation Program is to use the information obtained from the review of both clinical and phantom images to assess overall image quality. Your facility will need to perform two specified phantom scans using ACR protocols as well as two phantom scans using your site’s routine clinical knee protocols as outlined in this instruction book.

Please be aware that the requirement for MRI accreditation is that in the second set of scans mentioned above, facilities use the same protocol for the phantom that the facility uses for knee imaging. Failure to comply with this requirement could result in failure to achieve accreditation.

Please review the following site scanning instructions and follow them carefully before obtaining images for submission to the accreditation program. If you have any questions about the site scanning instructions please contact the ACR.

B. Phantom Set-up and Alignment for Scanning

The Small MRI Accreditation Phantom should be scanned in the standard knee coil (see Figure 1). It should be centered and aligned as a knee would be positioned in the coil. For some types of equipment this can be accomplished by assembling the mounting plates as shown in the photos supplied. Once positioned, the phantom should protrude equal amounts from both ends of coil and be parallel to the walls when placed into the magnet. You may have to reverse position of phantom if it cannot be centered in one orientation. Once centered properly, you may proceed with the next section.

C. Scanning the Phantom

A sagittal locator sequence should be acquired with the acquisition parameters listed on the Site Scanning Data Form. If possible, use exactly these pulse sequence parameters. Place a check mark under each prescribed parameter to indicate that it has been used. If machine or software limitations force alternative parameters, enter the scan parameters actually used directly below the ACR prescribed parameters. Fill in all parameters. Deviations from the specified imaging
parameters will often require a different overall study time. List the actual scan time required on the
data form.

The sagittal locator scan should result in an image similar to Figure 2A. If the pair of 45' crossed
wedges (“W” shape) is not visible in the scan, the phantom is not centered and must be repositioned
and rescanned. A horizontal line used for slice prescription (see arrow on Figure 2B) should be
parallel to the low contrast disks located at the top of Figure 2B. If not, the slice prescription
line should be rotated until parallel.

![Figure 2A: Sagittal locator view of Small ACR Phantom Figure 2B: Sagittal locator with slice locations for axial scans](image)

The next two scan acquisitions are transaxial pulse sequences acquired with identical spatial
parameters: 5 mm slice thickness, 3 mm gap, 12 cm FOV, 192 x 152 matrix. Seven slices should
be obtained, aligned using graphic prescription from the sagittal locator as shown in Figure 2B.
(Note: This is the preferred method for slice positioning). The center of slice #1 should be aligned
with the center of the crossed wedges (visible on the lower right in Figure 2B), and through the
center of the dark resolution insert and the slice thickness bar. Slice #1 should result in a transaxial
image that looks like the first slice on Figure 3. The centers of slices # 6 and #7 should align with
the two low-contrast discs shown in Figure 2B. If your scanner cannot obtain enough slices in a
single scan, then perform multiple scans with the specified TR/TE and with the maximum number
of slices allowed by the system. Repeat the scans, each with the specified scan time, until all 7
transaxial images have been obtained in the proper locations.

If your scanner is not capable of obtaining 5 mm slices with 3 mm gaps, then use the closest slice
thickness to 5 mm, for the specified TR and TE. Set the slice gap so that slice thickness plus slice
gap equals 8 mm and be careful that the images are positioned as specified in Figure 2B. If
necessary, perform multiple scans, each with the specified scan parameters, to get these 7 images
in as close to the proper locations as possible. Please note: Your axial slices must be positioned as shown in Figure 2B in order for your images to be acceptable for evaluation. If your MRI system is unable to prescribe a 5mm slice gap then you should try the following alternative slice positioning method: Either perform an interleaved multi-slice acquisition or perform 7 single slice acquisitions. Please make sure that each slice is positioned as shown in Figure 2B. If you are unable to perform the axial slice positioning as indicated in this manual, then stop and contact ACR before proceeding any further.

The conventional spin-echo (SE) 500/20 scan should be acquired with one acquisition per phase encoding step (one signal average acquisition or NSA) and the bandwidth used routinely for knee studies. This should take a total scan time of approximately 1 minute 20 seconds. Enter the exact scan time required, along with the bandwidth (in kHz or Hz/pixel) on the Site Scanning Data Form. Remember to place check marks below the scan parameters that are used exactly as they appear on the table of Pulse Sequence Acquisition Parameters or enter the alternative parameters in each blank. If other scan options are available (e.g., autoshim), include the options normally used for clinical knee scanning. List the additional options used in the space provided on the data form just below the table of pulse sequence acquisition parameters.

Acquire the SE 2000 / 80 scan with one acquisition per phase encoding step at the same 7 slice locations as used for the previous scan. This scan should take approximately 5 minutes 30 seconds. Enter the bandwidth for the scan in the space provided on the Site Scanning Data Form; enter the exact scan time required in the blank below scan time on the Data Form if it differs from the scan time specified on the form. Place check marks or enter the revised scan parameter in each block of the Data Form. Enter any scan options used on the lines below the table.

Next, scan the phantom using your site’s T1 and T2 weighted knee scan protocols. It is important to acquire images with 5 mm slice thickness, if possible, or as close to 5 mm slice thickness as possible, and to acquire slices with center-to-center spacing of 8 mm for both T1 and T2 weighted images. Please try to adapt your normal scan protocols to obtain these 5mm slice thickness and the specified 7 slice locations for both T1 and T2 weighted images. Enter the precise scan parameters used for T1 weighted and T2 weighted scans (adapted to 5mm slice thicknesses and the 7 prescribed slice locations) in the Site Scanning Data Form.
**D. Evaluating the large or small phantom image quality**

After scanning the phantom, you and/or your physicist will use the appropriate Large or Small Phantom Test Guidance booklet to evaluate your images using the same procedures that ACR physicist reviewers will use. If the images do not pass, the physicist will inform the supervising physician, and service engineer, as corrective action may be warranted. If your site service engineer makes system adjustments and/or the supervising physician makes scan protocol changes, rescan the phantom. In order to ensure that your phantom data is accessible and passes all of the measurements the phantom reviewer will be making, you must download the Osiris DICOM viewer or K-Pacs DICOM viewer to a computer that is not attached to PACs and not attached to a scanner.

Download Osiris software at: [http://www.sim.hcuge.ch/osiris/01_Osiris_Presentation_EN.htm](http://www.sim.hcuge.ch/osiris/01_Osiris_Presentation_EN.htm)

Download K-Pacs software at: [http://www.k-pacs.net/](http://www.k-pacs.net/)

Once your images pass, proceed to step 3.
IX. Submitting Material for Accreditation

1. Log into the ACRedit database and fill out all required clinical and phantom data forms and upload all required documentation

2. Follow the ACR Accreditation Image Upload Instructions

   **IMPORTANT:** All sites are now required to upload their images for accreditation. In addition to decreasing the turnaround time for receiving an accreditation final report, uploading images mitigates the risk of losing images during transit. If your facility has a technical limitation that prohibits you from uploading images electronically, please contact ACR staff at 800-770-0145 for assistance.

3. View all uploaded images and documents before submitting within the online testing package to ensure all appropriate items have been uploaded and are viewable

4. Submit the testing package

5. Review and/or print the submitted data report for your records

Note the following regarding electronic image submission:

- Anonymized images should not be submitted for accreditation purposes
- **All images submitted must be in DICOM format**
- Only post processed images (not raw) should be submitted for accreditation
- Do not submit lossy compressed images for accreditation
- Do not upload patient reports with images being uploaded
- ACRedit Web Client should be used when uploading images that are saved on the computer, disk or thumbdrive
- TRIAD Windows Client must be used if uploading images directly from PACs to our system
- All images should be viewed prior to submission to ensure all images are uploaded successfully
- While viewing the phantom images within the testing package, please ensure that a measurement can be made. Measurement tool must display in mm on the ACR MR Phantom images prior to submission
- Images within a series should all have the same compression ratios
- Multiphase/dynamic scans may appear in one series as long as they are not interleaved
X.  MR Accreditation Checklist

Be sure to keep copies of the completed application, submitted images and any additional submitted information for your records.

Please ensure that all items below are complete before submitting to the ACR for accreditation review. The review process will not begin until your submission is complete. All items must be submitted for each unit being accredited.

A.  Electronic Submissions

- All appropriate items have been uploaded (i.e. Annual System Performance Evaluation summary, MR Safety Checklist)

- All images for entire exam have been uploaded (including all required sequences, scouts etc.) in DICOM format

- All images can be viewed within the testing package

- Ensure that the Annual System Performance Evaluation summary form is signed by a qualified medical physicist and includes an evaluation of technologist QC, MR Safety Checklist and any corrective action documentation for any problems found on the annual system performance evaluation

- Online testing package is in a submitted status