ESAOTE

MyLab

STRESS ECHO OPTION

Doc # 29B63EN05

STRESS ECHO OPTION

This section explains how to use the Stress Echo option.

The section includes the following chapters :

- Chapter 1: The Stress Option

  This chapter describes the basic principles of a wall motion protocol.

- Chapter 2: Performing a Wall Motion Protocol

  This chapter explains how to perform a wall motion protocol.

- Chapter 3: Reviewing a Wall Motion Exam

  This chapter explains how to create the Primary Quad option and how to review a wall motion exam.

- Chapter 4: Stress Report

  This chapter explains how the Stress report is organized.

- Chapter 5: Configuring Wall Motion Protocols

  This chapter explains how to create, modify and delete wall motion protocols.

- Appendix A: Bibliographic References

  This chapter lists the bibliographic references.

In this manual, control panel keys and software keys are indicated using the following graphical conventions:

Control panel keys   They are indicated by **BLUE CAPITAL LETTERS**. Multifunction keys (e.g. **CLIP IMAGE** on MyLab25 Gold and MyLab 30 Gold models) are indicated with the mention of the first function only (i.e. **CLIP** in this example).

Software keys   They are indicated by **BLACK CAPITAL LETTERS**

The confirmation key is always indicated throughout the manual as **ENTER**, while the menu context key as **UNDO**.

WARNING	In this manual a **WARNING** pertains to possible injury to a patient and/or the operator.

CAUTION	In this manual a **CAUTION** describes the precautions, which are necessary to protect the equipment.

Be sure that you understand and observe each of the cautions and warnings.

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Chapter

1

1 - The Stress Option

Stress Icon

The Stress Echo option requires a software licence to be installed on the **MyLab**.

A kinetic assessment of the left ventricle (LV) requires multiple echographic views to visualize all segments. Typically, parasternal long axis (LAX) and short axis at the papillary level (SAX PM), apical 4 (A4C) and apical 2 (A2C) chambers are considered the ideal combination for wall motion (WM) assessments

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STRESS

1. Systolic loops

2. Quad display

3. Loop comparison

Appendix A provides a short overview of scientific papers.

The Stress Echo package offers specific Real Time modes to capture a number of ECG R wave triggered 2D ***loops***. Each loop consists of eight consecutive frames and is representative of one cardiac cycle, from end-diastole to end-systole. These loops can then be combined into ***WM Quads***. A WM Quad displays up to four 2D loops in cine mode at user selectable speeds. It is useful to display different cardiac views simultaneously

This package also allows the user to serially build multiple WM Quads and compare acquired loops at different times. A WM Quad consisting of one "preferred" cardiac cycle for each view is a ***Primary Quad***. The user can then assess LV motion through one Primary Quad or study the variations through serial Primary Quads. A typical application of this option is Stress Echo where detection of the occurrence of stress-induced wall motion abnormalities is derived through comparison of 2D loops, displaying wall motion at rest and during or after stress.

Principle of Operations

WM loops are obtained through special modes, ***Wall Motion Protocols***. The WM Review features allow the user to select preferred cycles into Primary Quads for comparison and digital data storage.

Note

Stress files are compressed, and have a minimal loss of information. Carefully read the "Measurements and Calculations" section of the Getting Started manual.

GS

A protocol contains all the elements to automatically run a wall motion test.

Cardiac Loops Capture

There are two ways to capture loops: **Prospective** and **Retrospective** Modes. In Prospective Mode, the **ACQUIRE** key starts the loops acquisition: the number of captured loops depends on the protocol settings. In Retrospective mode, the system continuously captures consecutive loops: the **ACQUIRE** key stops the acquisition and the last captured loops (whose number is set by the protocol) are shown on the screen. In both cases, the system will save a region of interest (i.e. not the entire sector) to minimize the memory requirements for each cycle.

Stages Number

The programming of the protocol can include a specific number of **STAGES**; each stage will require its own Primary Quad. For example, a typical treadmill stress echo would require a three stages protocol, with a rest QUAD, an immediate post exercise QUAD and a post exercise control QUAD.

Stages Names

Each stage can be labelled to identify loops while reviewing the test.

Stage Views

For each stage, the views can be independently set (1 to 5) to be acquired, as well as the acquisition order.

Loops Number

Definition of the number of loops must be temporarily saved to build the Primary Quad. For example, the rest Quad may be built by directly saving one cycle for each view and saving a larger amount of memory for the peak stage.

> **Note**
>
> While running a WM protocol, most system features and Real Time modes will be available; scrolling memories will be reduced while saving loops.

Loops Timing

While capturing in prospective protocols, the ECG R wave trigger automatically starts up a loop acquisition. In retrospective modes, the system will start each loop from the frame nearest to the R wave trigger.

Loops are composed of up to thirty consecutive frames, which must be timed to cover the set cardiac cycle. The factory setting covers a full cardiac cycle.

The horizontal line displayed below the ECG trace identifies the part of the cardiac cycle which is used for the acquisition

When an internal trigger is available, the **PHYSIO** key sets the part of cardiac cycle used for the acquisition. The **L-MARK** and **R-MARK** keys move the end of the line towards left or towards right respectively.

The Screen Lay-Out

The following figure shows the screen lay-out while running a WM test:

Th:mm:ss and Smm:ss are the two test timers: T can be used to monitor the entire test duration, S as the single stage timer.
DLY is the set delay for the R trigger
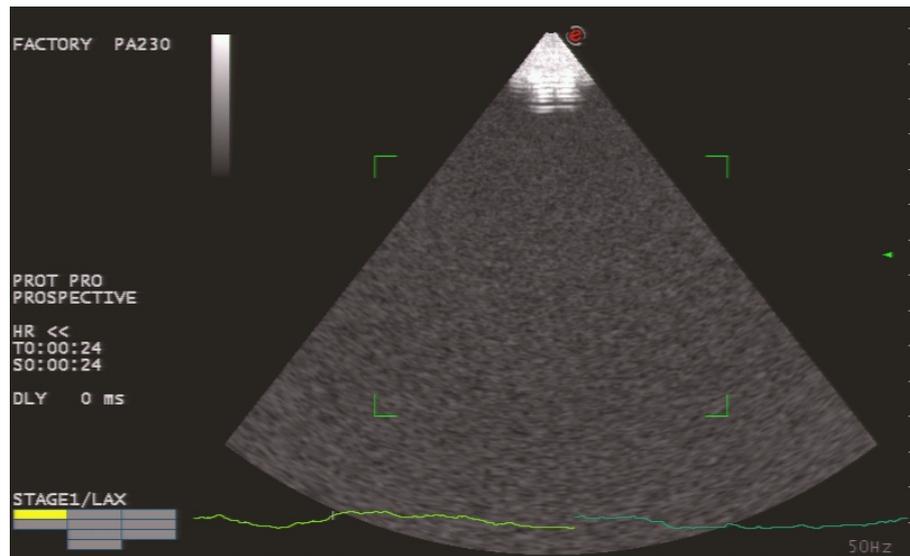
The VIEWS Box (bottom left side of the screen) shows the current protocol stage, the view being captured (yellow background), the number of stages which have already been captured (green background) and the number of stages which have been selected for the Primary Quad (blue background).

Captured loops are shown on the screen with the following layout.

Timers are shown on the top left portion of the screen; the labels on the top middle part of the screen indicate the heart rate and the view, while the stage appears on the right bottom portion. Frequency and depth are displayed on the top right side of the screen.

Chapter

2

2 - Performing a Wall Motion Protocol

The Stress package can be activated at any time through the **TOOLS** key: the system will display the protocol list on the right, from which the desired protocol should be selected.

> **Note**
>
> The Stress Echo protocol can only be activated from the cardiac and pediatric cardiac applications.

See later in this section how to reprogram the protocols.

While in a WM protocol, the system keys and controls are available; a complete cardiac study can be run prior to starting the protocol; during the protocol, the modes may be switched to one other than 2D.

Starting a WM Protocol

- Press **STARTEND** to display the page allowing the start of the exam.

- Insert the patient data.

- Select the desired cardiac application and press OK to confirm.

- Press **TOOLS**, select the Stress option and then the desired protocol.

- Make sure that the patient's ECG is correctly displayed.

> **Note**
>
> During the test, the system will acquire in triggered mode. If the ECG is absent or of poor quality, loops will be generated with a 60 bpm heart rate.

ROI cursor icon

The ROI (region of interest) cursor is automatically displayed on the 2D sector and can be positioned with the trackball. To modify the ROI box dimensions: press **ACTION** to activate the cursor and change its size with the trackball.

The VIEWS boxes show the number of stages which have been defined for the selected protocol (corresponding to the number of columns) and the number of views for each stage (corresponding to the number of rows).

In this example, the protocol includes three stages. The first stage has two views (previously selected for the Primary Quad); the second has four views (one in green, previously acquired; the yellow one is being captured, and is labeled as SAX PM); the third stage has three views.
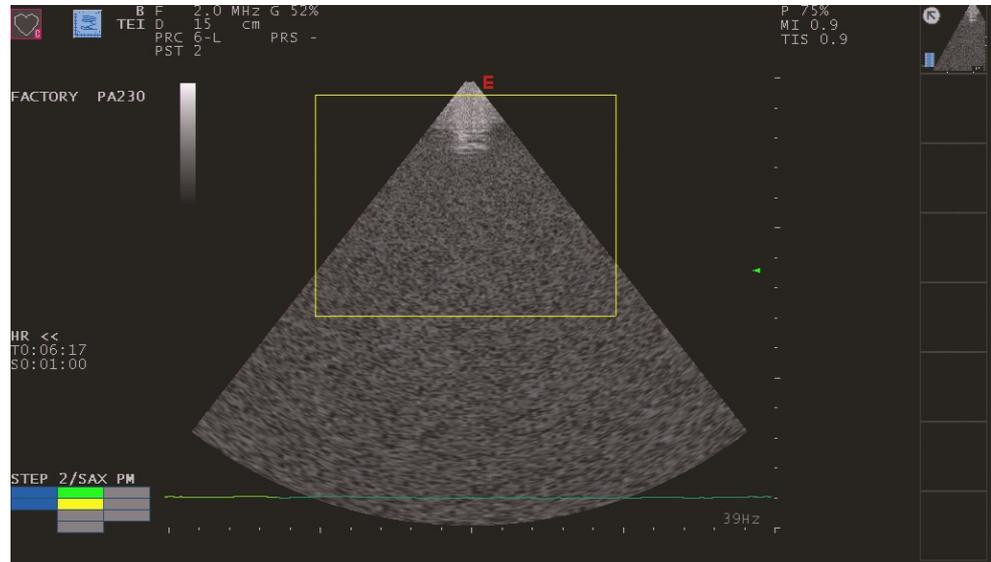
The **1 ST MORE/1 ST LESS** key adds or removes a step to any phase of the active protocol. Up to eight steps can be set. During the first step, the **1 VW MORE/1 WW LESS** adds or removes a view to all steps of the active protocol.

In every view of any step the **LOOP** key changes in real time the number of cardiac cycles to be acquired.

How to Run a Protocol

Because of the large memory capability, running a protocol basically consists of capturing all programmed views for all programmed stages. Once the last view of the last stage has been acquired, selection of the Primary Quads may begin and review of the exam.

See later in this chapter - how to interrupt a protocol

To zero Timer S, press the **TIMER** software key.

> **Note**
>
> Timer S is automatically zeroed at the beginning of each stage.

Independently from the type of protocol, the screen displays the active stage, the number of views to be acquired and the stage of the acquisition process.

Capturing Views in Prospective Mode

- Display a 2D sector.

- Display the desired view.

- Position (trackball) the ROI cursor on the sector area to be captured; press the **ACTION** key to match the area with the ROI cursor.

- Press **ACQUIRE** when ready to begin acquisition. The system sequentially acquires the protocol defined number of loops. The **MyLab** screen is updated to show which view/stage is to be captured.

- If the Quad observe at the end of any acquisition is enabled, press **FREEZE** or **B-MODE** to proceed to next view capture.

- To recapture the same view, press **CLEAR** (displayed in Exam Review and in Quad Observe) to unprotect the loops.

For each view, the system saves the settings, which are then proposed again at the next stage.

The acquired loops can be reviewed at any time by pressing **EXAMREV** key

Capturing in Retrospective Mode

- Display a 2D sector and the desired view.

- Position (trackball) the ROI cursor on the sector area to be captured; press **ACTION** to match the area with the ROI cursor.

- On **MyLabFive**, **MyLab40**, **MyLab25**, **MyLab30** and **MyLab50** models, the system is in acquisition mode when the hard disk icon displays a blinking yellow box.

- If the Quad observe at the end of any acquisition is enabled, press **ACQUIRE** to display the captured cardiac cycles: the screen will then switch to the Quad layout and show the captured loops.

- To recapture the same view, press **CLEAR** (displayed in Exam Review and in Quad Observe) to unprotect the loops..

The view settings are saved and proposed at the next stage.

The acquired loops can be reviewed at any time by pressing **EXAM REV** key

QUAD Observation

Refer to next chapters for protocols configuration

The protocol can be configured to include the **Quad Observation** at the end of every acquisition, as shown in the following figure. The screen shows, in cine mode, the acquired loops with their thumbnails displayed on the right.

Use the **SCROLL** *key to scroll the acquired loops; press the* **PLAY** *key to scroll the single frames of the selected loops.*
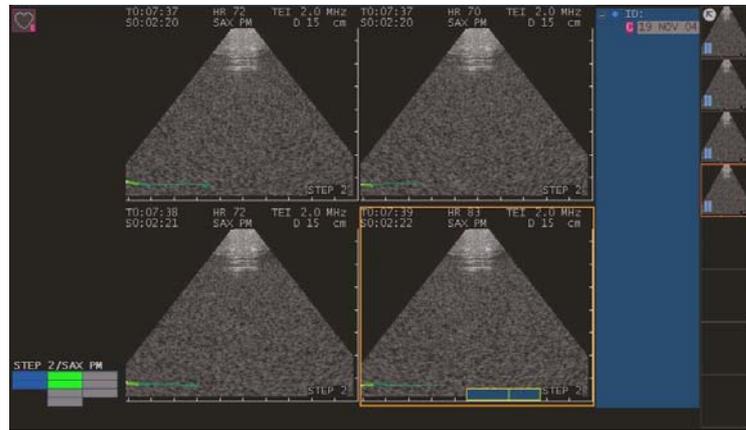

The protocol can also be configured without Quad observation: for more details refer to next chapters.

This window allows reviewing of the previously captured stage or view (ex:. stage 2 has been captured and the user wants to review stage 1), by using the **STAGE** and **VIEW** keys. The **CLEAR** key unprotects the selected view (its box is then displayed in orange); in this case only views of the active stage can be reacquired. At this stage the desired loop can be selected to compose the Primary Quad (**PRIMARY** key).

Once all loops have been acquired, they are played again in cine mode.

*At the end of the protocol, you can review any loop (***STAGE** *and* **VIEW** *keys) and also unprotect an acquired view (***CLEAR***).*
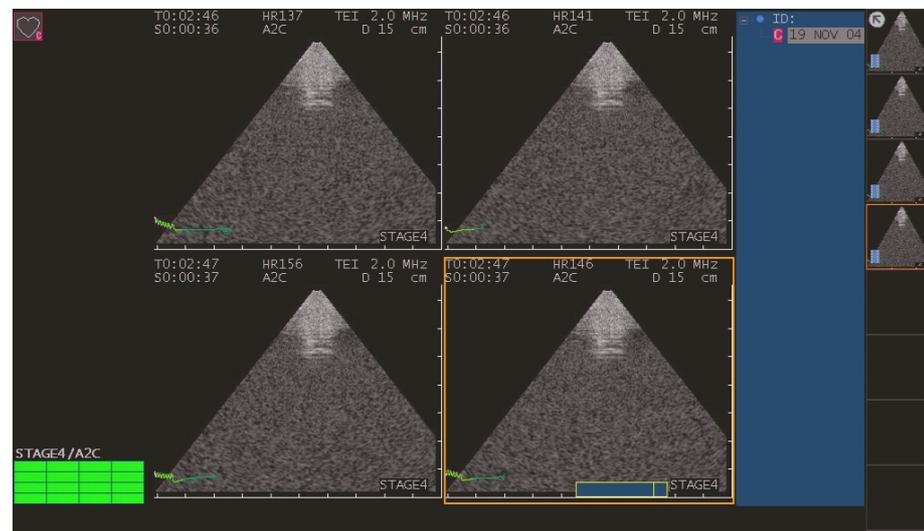
Ending the WM Test

The test is automatically ended when all programmed stages have been captured: the system returns to Real Time. The **EXAM REV** key activates the exam review and automatically displays the wall motion cycles, if Primary Quads have not been yet selected.   See later in this section for how to select the Primary Quad and review a WM analysis.

See later in this section for how to select Primary Quads.

The test can be ended independently from the protocol using the **PROT END** menu or the **START END** key. The system will then automatically prompt the user to select either the Primary Quads or to end the exam without saving.

Ending a test will stop the protocol at the last completed stage; any ongoing acquisition will be lost. Primary Quads of the completed steps can be selected.

W A R N I N G

All Quads that are not selected as Primary will be erased at the end of the protocol or when interrupting it.

System Controls During a WM Protocol

There are no inherent system limitations during a WM protocol, except while capturing a view: when the system is acquiring, the user cannot activate a different mode. The system must first finish the ongoing view capturing (Prospective) or pause acquisition (Retrospective).

3 - Reviewing a Wall Motion Exam

This chapter explains how to select the Primary Quads and review the exam.

How to Select the Primary Quads

At the end of the WM protocol, the memory contains all acquired cardiac cycles: each loop is identified by its view label and stage. Before reviewing the study, the user must select, for each Step of the protocol, the best loop for each view in order to build the Primary Quad(s)

> **Note**
>
> When pressing **EXAM REV**, the system will automatically prompt the user to protect the acquired loops, if this has not already been done.

By pressing **EXAM REV** in Real Time, the Primary Quad revision session will be activated.

This is the lay-out allowing selection of the Primary Quads.
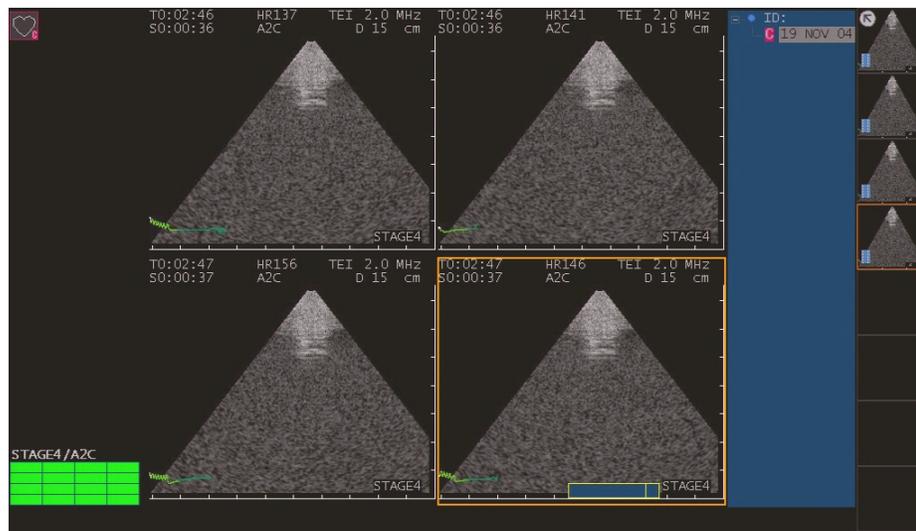
The system shows Quads sorted by stages, starting from the first stage.

The active keys, which allow selection of the best loops, are the following: **STAGE** (to change the phase), **VIEW** (to select the desired view) and **SCROLL** (to select the optimal loop). Once the selection has been completed, the **PRIMARY** key protects the Primary Quad stage-by-stage. The Primary Quad will then be automatically saved to the hard disk.

This procedure is repeated until all Primary Quads have been archived.

> **Note**
>
> The user may repeat the Primary Quad selection for each single stage as many times as desired through the review session menu.

Completed Stress Exam Icon

When the Primary Quad selection is completed, the whole stress exam is identified by the corresponding icon on the thumbnails column..

The Primary Quad can be reedited in Archive Review: the **EDIT PR** key allows the user to change, for each Step of the protocol, the loop for each view in order to rebuild Primary Quad(s).

How to Review your Exam

The **EXAMREV** key pressed in real-time activates exam revision.

> **Note**
>
> Only after the protocol is completed (i.e., all Primary Quads have been selected) it is possible to review all images and clips saved during the exam. So far the Primary selection is not completed , the **EXAM REV** key shows the Stress test only.

Once the Primary quads are selected, the screen turns to the Stress revision layout:
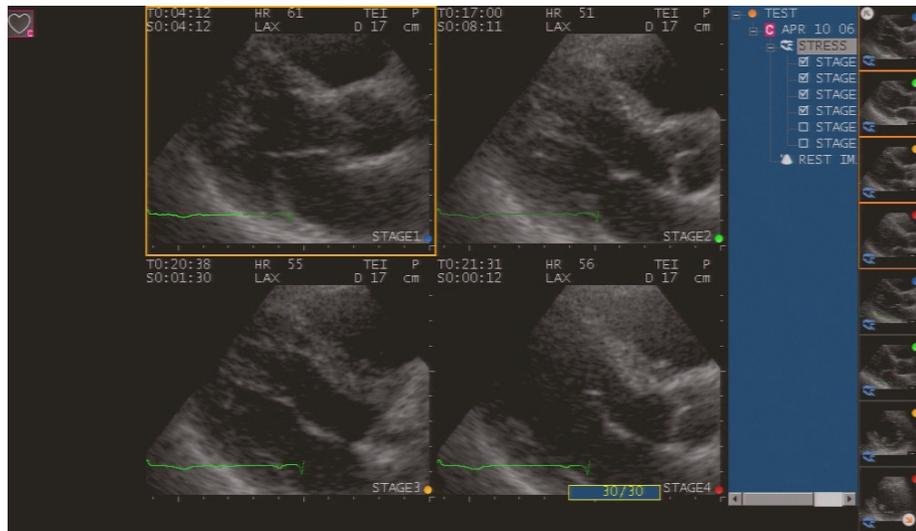
In the summary column on the right of the screen, exam images are organized in two groups: Stress Images and Rest Images. The pointer allows to select the desired group: the displayed thumbnail corresponds to the selected group.

Stress images are grouped by steps. Up to four steps can be displayed at the same time: the cursor can be used to select or deselect the step to be displayed.

The system automatically displays the Stress exam. The Quad screen is sorted by views: the same view is shown in all subsequent stages. The **SCROLL** key allows selection of the Quads relating to the different views.

The **EDIT** key changes the label of the selected view.

> **Note**
>
> If two views have the same label in the selected step, one label has to be changed, otherwise it will be erased as soon as the step is changed.

Comparison icon

The comparison icon allows the user to switch to a layout sorted by stages: the screen will then show all views of the same stage. To activate this layout, place the cursor on this icon and press **ENTER**. In this presentation, the **SCROLL** key allows changes to the stage.

By placing the cursor on the comparison icon and pressing **ENTER** again, the user will return to the presentation by views.

How to End a Review Session

The user can restart the review with the **EXAM REV** *key.*

Press **B-MODE** to reactivate Real Time.

The memory content will only be erased when a new exam is started or the system is powered off.

Chapter

4

4 - Stress Report

This chapter explains how the **MyLab** Stress report is organized and how to use it.

Wall Motion Score

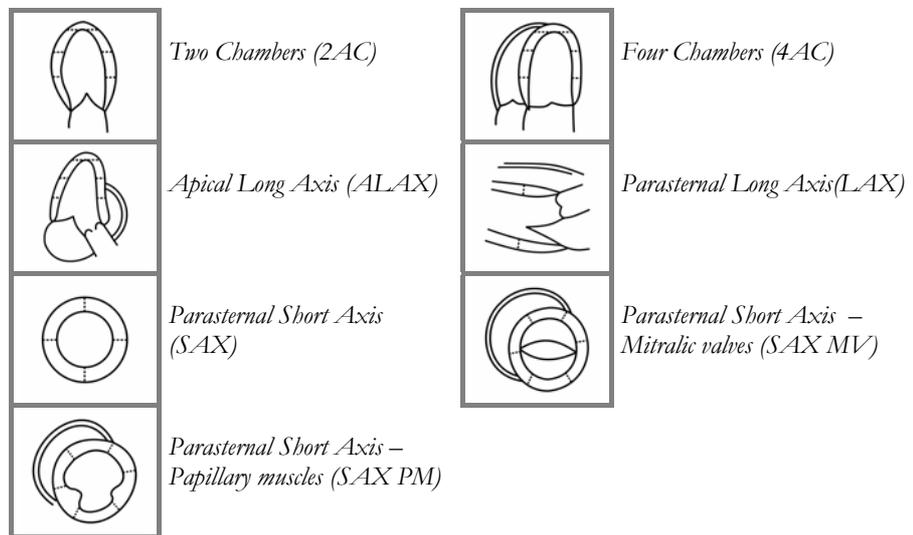ESAOTE Wall Motion Score is a qualitative method based on a generally accepted calculation based on sources in medical literature. When selecting appropriate views and characterizing regional wall motion on images, follow the current medical practice.

Scoring System

The LV is divided into segments; each segment can be scored depending on its motion patterns. Out of this score, the system generates two reports: a segments summary and the Wall Motion Score Index. The latter requires for maximum reliability that all segments are scored, i.e. that all views are analyzed.

The left ventricle is divided into seventeen segments:

	Two Chambers (2AC)
	Four Chambers (4AC)
	Apical Long Axis (ALAX)
	Parasternal Long Axis(LAX)
	Parasternal Short Axis (SAX)
	Parasternal Short Axis – Mitralic valves (SAX MV)
	Parasternal Short Axis – Papillary muscles (SAX PM)

The following table shows the values used to calculate the Wall Motion Score Index (WMSI) and the Percent of Normal Muscles:

4-2

When calculating the score index, numbers 6 and 7 are calculated as 3 and 4 respectively.

Score	Characterization
X	Not scored
0	Unable to interpret
1	Normal
2	Hypokinetic
3	Akinetic
4	Dyskinetic
5	Aneurysmal
6	Akinetic with scar
7	Dyskinetic with scar

Wall Motion Score Index

$$\text{WMSI} = (\text{Sum of assigned numbers})/(\text{number of scored segments})$$

The higher the value, the more abnormal the function of the left ventricle.

- Normal value = 1.00

- Abnormal values > 1.00

Percent of Normal Muscle

The system calculates the number of scored segments and the number of segments classified as normal and then computes the percentage.

- Normal value = 100%

- Abnormal values < 100%

Unlikely all other measurements whose results are displayed on-line, Wall Motion Score results must be specifically displayed, as explained later in this chapter.

To generate a WM Report, refer to current medical practice and to specific investigators recommendations

How to Score a Loop

The **MEASURE** key activates the loop scoring while reviewing a Stress exam.

As shown by the following figure, the system displays the graphic presentation of the view on the right side:

Segments are differently coloured depending on the score. The colour legend is displayed on the right.
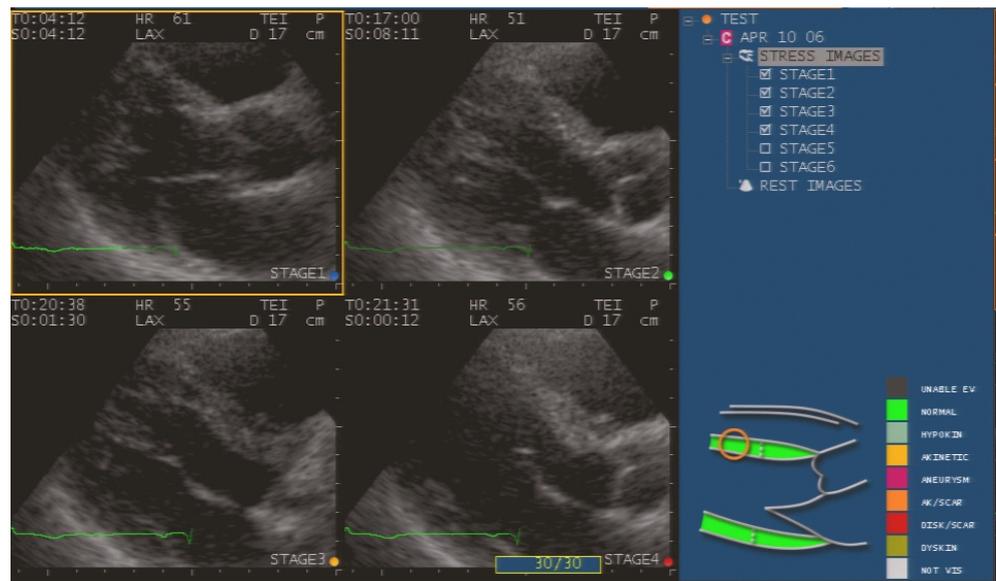
Both the cursor and the **SEGMENT** key can be used to select a different segment.

In the default settings, all segments are not evaluated

To score the segment use the **VALUE** key. Alternatively place the cursor on the segment to be evaluated and press **ENTER**: a menu for a rapid selection of the score is displayed.

The key **ALL NORM** scores all segments as normal.

Report Review

The **REPORT** key displays the values of all measured parameters. Pres **PREVIEW** to access to the Wall Motion report.

Wall Motion Report Organization

The report is divided in four parts. Patient data and advanced measurements are available in the first two parts.

A graphic presentation of all LV segments is available in the third part together with a segments and scores legend. The Segments Table and the WMSI Table are available in the fourth part.

The Segments table includes as many rows as the number of LV segments and as many columns as the number of protocol steps. The first column lists all segments, the other columns list the scores given to the segments in each step.

The WMSI Table lists the percentage of normal muscles for each step, the Wall Motion Score Index and the number of not interpretable segments.

The graphic presentation of each step is shown below these tables: colours depends on the assigned score.

Chapter

5

# 5 - Configuring Wall Motion Protocols and Labels

The "Tools Preset" option of the System Menu (**MENU** key) allows the user to create, modify and delete Stress Echo protocols and to edit the view labels.

Wall Motion Protocols Configuration Menu

Follow the procedure described below, to access to the configuration menu:

Procedure

- Press the **MENU** key

- Select "Tools Preset" and press the **ENTER** key

- Place the trackball on the "Stress Eco Preset" option and press the **ENTER** key.
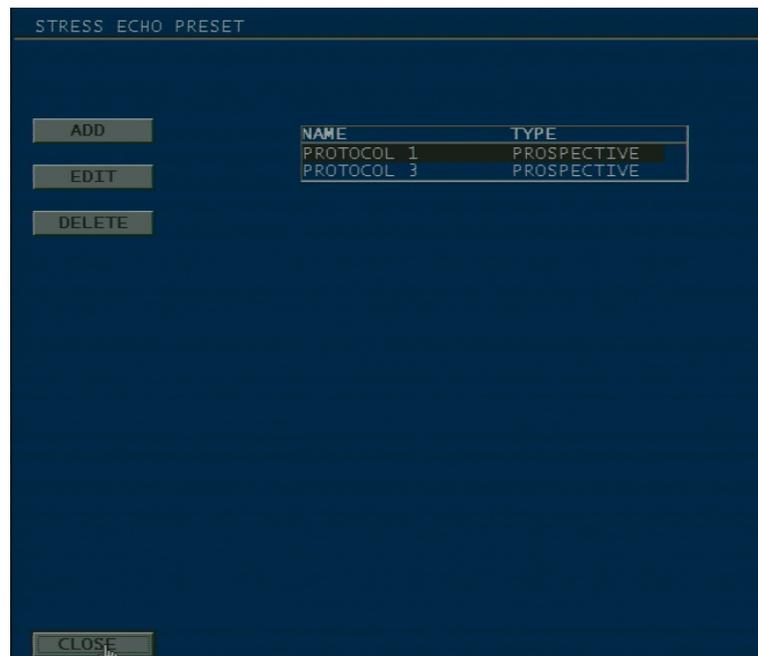
The system allows the user to create a new Stress protocol and to modify or delete an existing protocol.

How to Set your Parameters

The menu, which allows configuration of a WM protocol, has the following layout:

*To quickly move within the configuration menu, use **Tab ⇆** key and the **Pgdn ⬇** key to open the drop-down menus.*

In this example, a Prospective protocol has been chosen. The protocol includes 4 stages; all stages require four views . Each view is composed of 4 loops.

NAME identifies the protocol to be selected to start the exam. Available descriptions can be modified or re-labeled through the alphanumeric keyboard.

DICOM PROTOCOL sets the protocol as DICOM Stress Protocol. Once it has been set, the **OBSERVE TYPE** fields are active to select the DICOM typology of each stage.

Setting Stages

Each stage is identified by its label. Place the cursor on the desired stage and press **ENTER**. Enter the desired name and press **ENTER** again to confirm.

Each stage may include from one to five views (**VIEW** field). Each view may have from one, four or eight loops (**LOOP** field).

The views that can be set (**VIEW n** fields) are the following:

View labels can be changed: see further in this chapter

View	Label
Lomg Axis	LAX
Short Axis – papillary muscle	SAX PM
Apical 4 chambers	A4C
Apical 2 chanbers	A2C
Short Axis – mitral valve	SAX MV
Short Axis -Apex	SAX AP
Apical Long Axis	ALAX

The **QUAD OBSERVE** field enables or disables the Quad Observation at the end of each step.

NUMBER OF STAGES shows the number of stages included in the protocol (from one to eight).

CYCLE defines whether to use the full cardiac cycle or the systolic part only.

Note

At normal heart rates, systole usually represents less than 350 msec and remains relatively constant at higher heart rates.

PROTOCOL can be Prospective or Retrospective.

A certain delay on the ECG trigger (**ACQUISITION DELAY** field) can be set for the pacemaker management.

ECG TRIGGER must be set to EXTERNAL when an ECG system is used to generate the QRS trigger. The **ECG DISPLAY** field shows whether the ECG is displayed and saved with each loop.

To save the settings, press SAVE. By pressing CLOSE, the menu will be closed without saving. The preset factory settings (key FACTORY SETTINGS) may also be assigned.

The ⬅ returns the to the User Preset menu without saving the settings.

Editing View Labels

Follow the procedure described below, to access to the configuration menu:

Procedure

- Press the **MENU** key

- Select "Tools Preset" and press the **ENTER** key

- Place the trackball on the "Edit View Labels" option and press the **ENTER** key.

This option lists the preset labels of cardiac views used in Stress exams. To modify the labels, place the cursor on the desired field and press **ENTER**. Edit the new label by using the alphanumeric keyboard. Press OK to confirm.

Appendix

A

Appendix A - Bibliographic References

Bibliographic References

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