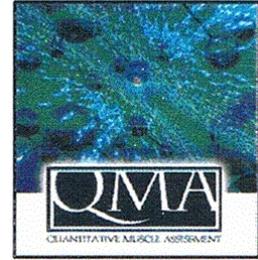
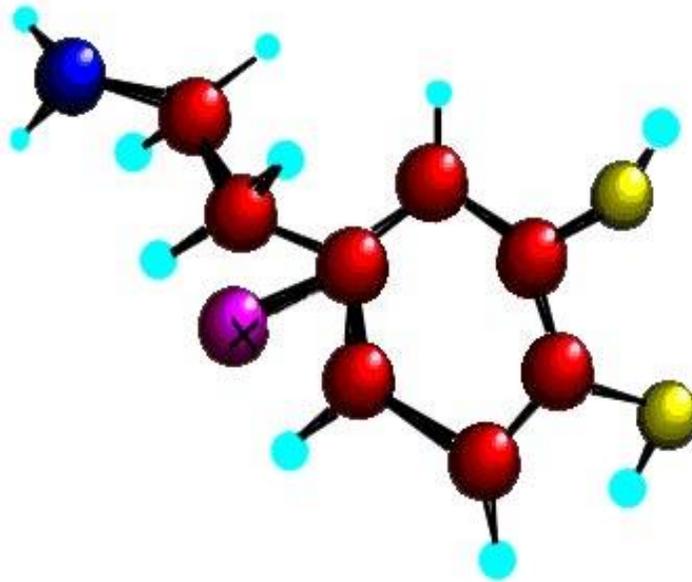


Quantitative Muscle Assessment



QMA 4.6 and previous versions

USER GUIDE



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Quantitative Muscle Assessment “QMA”
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A. About this manual

This manual is topically organized, includes information for both the administrator & physical therapist, and may be updated at the discretion of AEVERL MEDICAL, LLC. This manual is written using MS Office. With the manual on-line, a search may be made in MS-Word of any topic or word combination. Go to HOME, and then FIND, type in your word and a search will be made of this manual.

Organization

This manual is compiled as an operationally progressive set of instructions, utilizing commonly accepted nomenclature for a user that is experienced with MS-Windows operating systems and products.

Contribution

Those contributing to the programming and validation of this system include:

James Fielding – Managing Director / Hardware Compliance / System Quality Assurance / co-author User Manual, Revisions, QMA Report Generator
Craig Petrie - Senior Programmer –co-author QMA system, co-author User Manual
Robert Sandage - Programmer – co-author QMA system, Revisions – Daqtron, Inc .- CEO
Matthew Kelton- Daqtron Programmer – Upgrades, Revisions – v 3.0 – v 3.4
Jason Smith - Daqtron Programmer – v 4. 0 Improvements & Enhancements
Jason Smith - Ind. Contractor - v4.1, v4.2, v4.7.1 - Query Engine, Multiple Device
Matthew Kelton- Ind. Contractor - Upgrades, Revisions vXL, 4.5, 4.6 QMA Report Generator

Acknowledgment:

Many improvements of QMA 40 are a direct result of collaborating efforts with Charles Thornton and the personnel of the Neuro Muscular Disease Center at the University of Rochester - Rochester, New York- including Richard Moxley, Rabi Tawil, Andrew Goodman, Shree Pandya, Michael McDermott, William Martens and Barbara Herr, and QMA Systems personnel.

The developers of the QMA System, acknowledge and express their appreciation to the National Institutes of Health (NIH) which has been contributory to the continuing work of QMA v 4.0 with the award of grant – # 1R41AR45530- 01A2, dated 26 July 2000.

Individuals making timely suggestions and critiquing the system include

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Laura Herbelin - Neurology Department – Univ of Texas/ Dallas – Univ of Kansas/KS
Brian Kotajarvi – Neurology Department – Mayo Clinic – Rochester, MN
Lois Finch – Neurology Department – McGill Univ. – Montreal, Canada

Benjamin Brooks and Mohammed Sanjak -
Neurology Department - University. of Wisconsin.- Madison, Wisconsin

Barbara Polkinghorn, David Tierney, and Dave Mason -
Elan Pharmaceutical / Elan Holdings Gainesville, Georgia

1. Introduction

Quantitative Muscle Assessment "QMA" is an accurate PC or notebook based MS Windows compliant maximal voluntary isometric contraction (MVIC) fixed and hand held myometry testing system developed to objectively assess muscle strength and fatigue.

1.1. Types of users

In a typical setup, the QMA system will have two different types of users: *Administrators (Admin)* and *Physical Therapists (PT)*. The Administrator has the primary responsibility of protocol setup compliance. This area is password protected in the Main Menu. The Physical Therapist is responsible for the accuracy and consistency of the data collected. These responsibilities include verifying the accuracy of the system periodically and testing each muscle group as directed by a protocol.

1.2. Types of tests

The different tests performed by QMA are categorized by the type of action required by the patient and the measurements associated with each test. Currently, there are five types of tests that can be performed with QMA:

1. Strength. The patient exerts the maximum possible force for approximately three to eight seconds. Maximum force achieved, rise time, sustain time and coefficient of effort are calculated. See Sec 2.4.1
2. Static Fatigue. The patient tries to sustain a maximum possible force over a longer period of time (15-40 seconds). Average force, maximum force and area are calculated for up to five different time regions. See Sec. 2.4.2 & 2.4.3
3. Dynamic Fatigue. The patient repeatedly exerts and releases (approximately once every second) with the maximum possible force. Maximums and averages are calculated using the peaks of the exerted force. Area is also calculated. Only three time regions are analyzed. See Sec. 2.4.4
4. Stopwatch. The patient tries to perform a task (such as walking or running a marked distance) in the least amount of time possible. Time, not force, is measured.
5. Other. Other tests allow for keyboard input that is associated with each test and is independent of the electronic data acquisition.

The first three types are performed with connectors (cables or straps) and a strain gauge assembly or hand dynamometer. The fourth type is performed by using the remote switch or a keyboard "Enter" to start and stop an on-screen timer. The fifth is direct data entry.

1.3 Log In Screen

The screen that appears upon start-up is the Login screen. The login name or initials of the person conducting the testing entered in this screen will be recorded with the data for each test. If your site has more than one user of the QMA system, recommendation is made that you login with your name and have the notebook user/password protected. Most all tasks are initiated from the Main Menu screen, which appears after a user presses the "OK" button on the Login screen.

1.4 About QMA

About QMA displays the version number, and contact information for technical support.

1.5 Initially Speaking – A Quick Setup guide and Program Tutorial

1.5.1 Setting up the equipment software

Your QMA system may have been preloaded onto a laptop quality assured prior to your receipt. Certification of the QA process may be obtained by requesting same from QMA Technical Services. Setup media and associated drivers may be obtained for the QMA application. The QMA application may install to the destination drive of your choice. The default is C:\QMA or C:\QMA4.x).

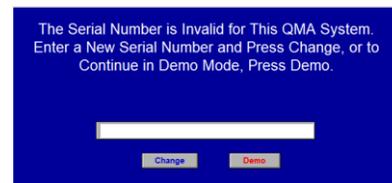
1.5.2 Setting up the equipment hardware

The hardware normally consists of one of each of the following for an active testing system: distribution box which houses an Analog/Digital converter and USB cable, hand dynamometer with analog output, strain gauge or transducer, and **remote switch**. Each instrument & component has *unique* connectors and identifiers. Make all connections secure. Remote switch must be connected to have an active / TEST mode system. The use of power surge protection or Uninterrupted Power Supply (UPS) is highly recommended.

1.5.3 QMA - System Password

A Password is required & provided for the QMA System. The distribution box must be connected to the Laptop/Notebook to enable LIVE / REAL TIME patient or subject effort to be acquired. The password may be found in **documents / C Drive or on the Desktop**.

- A. Initiating the QMA application with the distribution box connected will display the grey box displayed & prompt for the entry of the Password. Locate and copy the password in the document located in **DOCUMENTS**, on the **DESKTOP** or on the **C DRIVE** and paste the password in the requested area.



1.5.4 Site and Protocol Preparation - FAST START

To begin the basic configuration of your system, please **LOGIN** -using your name or initials & OK. This will take you to the **Main Menu Screen**. Under **Setup**, select **GENERAL/ PROTOCOL**. A password is requested to enter this function, the default password is **qma** & OK.

1. Protocol Setup

- A. Go to SETUP, then SITE / PROTOCOL SETUP, and then GENERAL / PROTOCOLS –
- B. Highlight NEW PROTOCOL and select NEW
- C. Enter a name for your protocol. (Suggest – LEARN) [make this the current protocol] & OK.
- D. Click on your new protocol name / and To the left – Under GENERAL – change the following
 1. TEST SITE – - Identify your site –example MAYO-MN, or OSU-GNE
 2. PATIENT INFORMATION – English / American or International
 3. UNIT OF MEASUREMENT – Kg, Lbs, or Newton
- E. Select UPDATE / RENAME, - your new protocol LEARN – should be displayed
- F. Place an x in the area that states “Make this the current protocol” – and OK, and DONE
 - ✘ NOTE - TEST MUSCLES and TEST ORDER are already setup in your protocol.
 - ✘ NOTE -To setup different muscles to test, or their testing order–refer to section 2.1 and 2.2.
- G You can now LOGOUT of SETUP or proceed as instructed in section 2.1 and 2.2.
- H. Confirm your site and protocol in the lower part of the screen,
 - ✘ HINT A different Protocol may be selected by going to FILE, and then CHANGE PROTOCOL
- I. As an example : Go to FILE, and select NEW PATIENT
- J. Using up to sixteen (16) alpha/numeric characters – compose a patient or screen Identifier.(ID).
 - ✘ NOTE Do not use a personal identifier in the Patient ID to avoid having the patient’s confidentiality being compromised.
- K. Finish the New Patient entries

1.6. QMA System Tour & Tutorial

1.6.1 If the QMA application remains in DEMO mode insert the password as previously instructed or contact QMA Technical Services for assistance -

- A. Select **Begin Visit**.
- B To select a patient - DOUBLE CLICK (DC) the PATIENT'S IDENTIFIER (ID).
- ✘ NOTE- **DEMO MODE – No LIVE DATA** - Continue through unload load cell and hand dynamometer. Patient's efforts, test results and display will be [software](#) generated.
- ✘ NOTE -**TEST MODE - LIVE DATA** - The UNLOAD subroutine constructs a zero baseline for each input instrument. Patient's efforts, test results and display are **ACTIVE & REAL**.
- C. Unload the Load Cell & the Hand Dynamometer - Follow online prompts.
- D. You should now be viewing the **Category, Tests, and Side** for Muscle Testing.
Basic patient information is shown to confirm the patient and visit number are correct.
- E . **Begin Test** (Manually select the test sequence by highlighting category, test & side)
A manually selected test -example, **Strength - Elbow Extension - Left**. *or /*
- F . **Begin Sequence** (Pre-selected test sequence – described in 4.2.2).
- G USING THE REMOTE SWITCH - Click on Ready (press button), notice ready *flashing*, then when you are ready to test, press button again, and the test will begin.
- ✘ NOTE – in DEMO mode – use the ENTER key.
- H. To Accept the trial (effort or trace) Click the button –To test the same muscle- Repeat G.
- I. Following acceptance of the final test of this muscle, HOLD DOWN the remote switch to a count of seven (7) – this will advance the test to the next test in the sequence.
- J. Repeat G & H to test this muscle.
- K. To end this test – repeat K, or after accepting the final trace, select END TEST
- L. A manual selection of the next test can be made – Choose the category, test, and side.
- M. When a trial is not acceptable – HOLD DOWN the remote switch to a count of seven (7), and a rejection screen will appear. Select the correct reason, and annotate.
- ✘ **NOTE** – A note can be made at any time, and is included in the acquired data.
- P. To end the testing and the visit – END TEST, then select **File**, then **End Visit**.
- Q. To conclude this tour and exit the system select **File**, then **Logout**.
This takes you back to the Login Screen..
- R. Select **QUIT**, this returns you to the desktop of Windows OS.

1.7. Y2K Statement -

The Quantitative Muscle Assessment System "QMA" is a Year 2000 and *beyond* compliant 32 bit program, initiated with QMA version 3.1.

- ✘ **NOTE – DO NOT use New Protocol as a testing protocol !!! Programming updates, and problem sourcing may modify or replace your local copy of New Protocol.**
- ✘ NOTE The **UNIT of MEASUREMENT** may be set to **Kilograms (KG) Pounds (LB), or Newtons (N)** / without regard or compromise to the Patient settings – English / American or International.
- ✘ NOTE - If you encounter **any** problems, contact customer support at 770/ 540-6044, or through the WEB at QMASystem@gmail.com We are here to assist you.

2. Setup

At the main menu, Setup opens to the following Protocol selections:
General Site / Protocol, Test Parameters, Test Names, and Test Order.

Default password for Setup is **qma**

a. The password may be changed under SETUP, and ADVANCED.

✂ **NOTE - If you anticipate multiple users, then setup multiple accounts with unique passwords for each user to gain entry to the notebook or PC..**

Make a note of the new Password. – You are responsible for the new password and any difficulties encountered due to the loss of your password.

✂ **Hint: Always** check the site and protocol numbers when considering a change to the system. Under "FILE" Go to "change protocol" and select the protocol needed when in doubt.

2.1. Protocol and Site

The protocol is the underlying foundation of this testing and information system.

✂ **NOTE - All data**, including, patient data, visit numbers and test data, test parameters, site, measuring unit and patient display, are unique to the respective protocol identifier; ie **ALL data is protocol specific.**

2.1.1 Construct a Protocol to Learn and to conduct active Testing

At Setup – Site / Protocol – Select General / Protocol. Default password is qma. Select NEW - A new Protocol may be constructed, using an existing protocol as a template. If you wish to use a protocol for a template that is not highlighted, scroll and make your selection. Make this the current protocol ? Click for YES.

✂ **NOTE** – We recommend making a protocol to LEARN (with expendable data), and a protocol to being active testing of patients.

2.1.2 Setup A Site - [NEW](#)

Now that the Protocol is constructed, Update your site and testing preferences

Protocols can now be constructed in two ways:

1. Site, Measuring Unit and Patient display consistent at your location **OR**
2. Site, Measuring Unit and Patient display can be unique as needed.

The Site Information can be setup as follows:

- A. Create or choose a PROTOCOL, and indicate it to be the current protocol.
- B. To the left – Under GENERAL – Change the following as needed -
 1. Test Site - Your UMC, Institution or Clinic
 2. Patient Information American or International (military)
 3. Units of Measurement - LBs, KGs, Newton
- C. Select UPDATE / RENAME – the PROTOCOL should be displayed, if not return to 2.1.1. Make certain the PROTOCOL to update is highlighted.
- D. OK – for changes completed. Cancel – to discard changes.

2.1.3 Site

Identifies the testing facility- university, hospital, or clinic or designated research study group.

2.1.4 Measuring Units

Measuring Units may be selected as Pounds (Lbf , Kilograms (KGs), or Newtons (N)

2.1.5 Patient Information Display or Profile

Patient information display may be selected as English-American or International.

2.2 TEST NAMES

Tests can be renamed, added or deleted by selecting **Test Names** in the **Setup** pull-down menu in the Main Menu screen. A different screen entitled **Test Definitions** appears.

2.2.1. Adding a test

Adding a test is accomplished from the TEST DEFINITION screen. First select the desired test category by clicking on the category name in the selection box on the left. The selection box on the right lists the currently defined tests. Your new test will be added before the highlighted test in the right selection box. Your new test will become the last test in the test sequence regardless of what is highlighted in the right selection box. With the appropriate selections made, press the ADD button.

The sequence will be corrected in a minute – refer to (2.3)

A box appears requesting some information. Enter a name for the new test. If the test will use the hand dynamometer for input (strength and fatigue tests only), use the word “HAND” in the name of the test. The MAX GRAPH SCALE entry is used as the maximum value for the data graph displayed on the screen during the test.

✂ **NOTE** – The graph display maximum chosen does not affect the data acquired.

Next, select the desired side of the body in the SUB-TESTS pull-down menu. If you select LEFT & RIGHT, two tests will be created; otherwise, only one test will be created.

Finally, select an appropriate filename(s) for the new test(s). An example of a test could be *Shoulder Extension Left* – *SHOULDER EXTENSION LEFT*. To discard any changes you made while in the Test Definitions screen, press the CANCEL button.

SELECT INPUT EQUIPMENT – A list of available input equipment may be seen by scrolling down in SELECT. Choose the input equipment for this test for each side and OK. To accept changes press OK.

✂ **NOTE** - check the test names format before making new files. It is your responsibility to make certain filenames are not repeated. To view the file format and see which filenames have already been used, in explorer, examine (but do not modify) the C:\QMA\ (protocol) \TESTINFO.TXT file Open with Explorer, then Note Pad, WordPad or MS Word.

2.2.2. Editing a test -

To edit a test, first select the desired category and test in the two selection boxes in the Test Definitions screen and then press the EDIT button. A box appears with the current definitions for the selected test. Consult section 2.1.1 above for information on the entries for this box.

✂ **NOTE** – If a test does not have the correct file name, delete the test and make a new test. Do not change the file name of an existing test at EDIT. Edit prior to initializing testing.

✂ **NOTE** – To change the filenames from short file names to long file name, see section 3.5.

2.2.3. Deleting a test from the eligible list to test

✂ - **NOTE** – *Deleting a test is important, make certain your are in the correct protocol.*

To delete a test, first select the desired category and test in the two selection boxes in the Test Definitions screen and then press the DELETE button. Undo deletes (and other changes made in the screen) by pressing the CANCEL button.

2.3. Changing the test sequence

QMA can automatically sequence through the list of tests in any order you choose. To define the order of tests, select Test Order in the Setup pull-down menu in the Main Menu Screen. A screen entitled “Test Order Definition” appears. As you use the selection boxes on the left to select the test you want to move, the current place of the highlighted test in the test sequence is displayed. The display on the right contains a list of all tests in order. Change the position of the selected test by using the keyboard or up/down buttons to change the number in the ORDER control, or highlight and change to the desired number in the sequence. The display on the right is updated as you change the control.

✂ - **Hint** – Single Left Click in the BLUE after each entry, to set the entry – this will permit you to continue in the function until you are ready to exit. When finished click OK –.

2.4. Defining the measurements

The raw data from the strain gauge or hand dynamometer is written to a file during testing. QMA will also take measurements on this data which will be shown on the screen and included in the data files and printouts. These measurements allow for some flexibility in their definition. To change the measurement definitions, select **Test Parameters** under **Protocol Setup** from the **Setup** pull-down menu in the Main Menu screen. A screen entitled “Test Parameters” appears.

2.4.1. Strength measurements

Strength tests report the following five measurements:

1. **Maximum**. The maximum force attained.
A. **Mean** – The maximum of each trace, summed, and the Mean documented.
2. **Rise time**. The time it takes for rising edge of the data to go from 10% to 90% of the maximum. You can change both the lower (default 10%) and upper (default 90%) threshold values.
3. **Sustain time**. The amount of time the force remains above 70% (by default) of the maximum. You can change the 70% default value.
4. **Coefficient of effort** - “Peak rate of force development”
Observing the slope rising from a resting point to peak force iteratively and determine the fastest rate of force increase in the slope (the steepest slope). It is the point on the curve where the greatest number for the change in force(newtons)/change in time (sec) may be observed

2.4.2. Static fatigue measurements

Static fatigue measurements operate on five different time regions of the acquired data waveform. For each time region, the maximum value, average value and area under the waveform (curve) may be calculated. To define a time region, click the numeric control underneath the MEASUREMENT PARAMETERS label in the STATIC FATIGUE section of the Configure Tests screen. This control should only display a number one through five to indicate which interval you are modifying. The controls under the INTERVAL label define the region in time. The checkboxes indicate which analyses will be applied to this time region. These measurements are named “W#XXX” in the data reports, where # is the interval number and XXX is either “MAX”, “AVG”, or “AREA”.

2.4.3 Static Fatigue Models,

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Fatigue in multiple sclerosis: Current understanding and future directions

Steven R. Schwid, MD; Melissa Covington, BS; Benjamin M. Segal, MD; Andrew D. Goodman, MD :
Neuroimmunology Unit, Department of Neurology, University of Rochester Medical Center,
Rochester, NY : <http://www.rehab.research.va.gov/jour/02/39/2/schwid.htm> ; also

Schwid SR, Thornton C, Pandya S, et al, American Academy of Neurology: 1999: 743-750

C.6c. Modeling fatigue: analysis. Three methods have been used to analyze fatigue during sustained maximal contraction. The simplest method is to express maximal strength at the end of the contraction as a ratio with the initial strength¹⁵ (model 1 below). Alternatively, Bigland-Ritchie and others found that force generation by small, intrinsic hand muscles declines linearly during sustained maximal contraction. The slope of the force versus time curve provides an indicator of fatigue. However, we found that this method was not suitable for larger muscles, because the decline in force generation was non-linear when we inspected individual and mean (normalized for peak strength of each subject) data from MS or healthy subjects. To overcome this problem, a third approach (applicable in non-linear situations) developed by Djaldetti et al is to integrate the area under the force vs time curve, and relate this value to the theoretical area that would be expected in the absence of fatigue¹⁷ (calculated as the maximal force × duration of contraction)(models 3 and 4 below).

C.6d. Multiple sclerosis, a paradigm for central fatigue (pathologic fatigue due to CNS disease). Patients with MS list fatigue as one of their most important sources of disability²⁰, and they often report that fatigue is present even in limbs that are not overtly weak. Pathologic “central fatigue” presumably occurs in MS because demyelination of CNS axons leads to activity-dependent conduction block. We studied 20 patients with multiple sclerosis (MS), and 20 healthy volunteers matched for age and gender, to validate four models for analysis of fatigue. The bases for selection of an optimal model were: (1) optimal test-retest reliability, and (2) greatest sensitivity for detecting increased fatigue in MS compared to normals. Fatigue was assessed in four muscle groups in each subject. Maximal isometric contractions were sustained for 30 seconds. QMA can partition each force vs time curve into 5 independent (overlapping or non-overlapping) intervals. Maximal force (F_{max} , in newtons) and area-under-curve (AUC, in newtons·seconds) is automatically determined for each interval. These intervals were set at 0-30 seconds, 0-5 seconds, 5-30 seconds, 25-30 seconds, 2-7 seconds. The four fatigue models are:

Model 1. This is the conventional model for fatigue analysis. This model simply analyzes force reduction during the contraction. F_{max} in the final five seconds of the contraction (F_{max}^{25-30}) is compared to the initial five seconds (F_{max}^{0-5}):

$$\text{Fatigue index (in \%)} = 100 \times [1 - (F_{max}^{25-30} \div F_{max}^{0-5})]$$

Model 2. This modification of model 1 was suggested by Dr Mohamed Sanjak. Instead of using F_{max} , it integrates the AUC in five second epochs at the beginning and end of the contraction, in order to smooth out fluctuations in the force vs time curve. AUC in the final five seconds (AUC^{25-30}) is compared to early in the contraction (AUC^{2-7}):

$$\text{Fatigue index (in \%)} = 100 \times [1 - (AUC^{25-30} \div AUC^{2-7})]$$

Model 3. The model used by Djaldetti et al¹⁷. This model derives information from the entire force vs time curve. The AUC that would be expected in the absence of fatigue (AUC_{exp}^{0-30} , the product of $F_{max}^{0-5} \times 30$ seconds) is compared to the observed AUC over the entire 30 second contraction (AUC_{obs}^{0-30}):

$$\text{Fatigue index (in \%)} = 100 \times [1 - (AUC_{obs}^{0-30} \div AUC_{exp}^{0-30})]$$

Model 4. A slight modification of model 3, in which the “upswing”, or initial 5 seconds of the force vs time curve, is neglected. This portion of the curve is variable, and it does not represent fatigue. The AUC that would be expected in the absence of fatigue during the final 25 seconds of the contraction (AUC_{exp}^{5-25} , the product of $F_{max}^{0-5} \times 25$ seconds) is compared to the observed AUC over final 25 seconds of the contraction (AUC_{obs}^{5-30}).

$$\text{Fatigue index (in \%)} = 100 \times [1 - (AUC_{obs}^{5-30} \div AUC_{exp}^{5-25})]$$

2.4.4. Dynamic fatigue measurements

Dynamic fatigue measurements are similar to static fatigue measurements with two exceptions: 1) three time regions are available, and 2) the peaks of the waveform are used to calculate the maximum and the average.

2.5. Setting the length of tests

Stopwatch tests end when the button is pushed. Strength and fatigue tests can end in two ways: 1) when the button is pushed and 2) after a user-specified time-out time. Additionally, strength tests can end automatically after the maximum has been reached. All these test time settings are accessed by selecting **Test Parameters** from the **Setup** in the Main Menu screen

2.5.1. Time-out time

Strength, static fatigue and dynamic fatigue tests each have a separate time-out time. The time-out time defines the maximum time a trial will run. These are changed by using the controls labeled TIME OUT in the different sections of the Test Parameters screen.

2.5.2. Auto-stop setting

The control labeled AUTO STOP in the STRENGTH TESTS section of the Test Parameters screen controls when the testing will stop after a maximum is reached. When the falling waveform reaches 50% of the maximum value, the trial will end automatically. You can change the default value (50%) to a range of 1 % & 99 %.

2.5.3 Disconnect Auto-Stop -

A choice is now available in each test – to disconnect auto stop. This permits a single test to continue past maximum and continue to zero. This can be used for multiple traces, or to acquire data for analysis on the back slope of a particular test.

✂ HINT – Myotonic Dystrophy - use NOTES to indicate the release point, so measurement of the back slope may be analyzed.

2.6. Other setup parameters

The administrator also must specify other setup parameters such as the data acquisition rate.

2.6.1. Data acquisition rate -

The data acquisition rate may be set at your discretion (Admin) or in accordance with parameters established by a protocol. A range of 10 to 50 points per second may be set for the acquisition of data. These will be seen as data points in the protocol file. For example: a fatigue test set to run for 30 seconds at 30 points per second would have 900 data points acquired, when run to anticipated completion. An increment of time is displayed to the left of each data point.

Timing is now an integral part of the acquisition function. Algorithms and programming method have changed to provide more accuracy and co-relation of the data points to the time and effort expended.

3. Database Management

Database management involves updating, accessing, and printing patient information and data files.

3.1. Entering patient information

✂ HINT – Make certain you are in the correct PROTOCOL.

QMA keeps track of a patient's test data and background information based on the patient's Patient Identifier / screen number.

3.1.1 View Patients

From the Main Menu screen, select **View Patients** from the **File** pull-down menu. Patients may be sorted and accessed by Patient Identifier, Name, and Initials. Double Click on the Patient's Identifier to begin a task. Personal identification, including the Name identifier is stripped from the data for viewing and printouts.

3.1.2. Adding a new patient

From the Main Menu screen, select **New Patient** from the **File** pull-down menu. A new screen entitled "New Patient Information" appears. Simply enter the patient's identifier or screen number (up to 16 alphanumeric characters) and background information in the data fields. Move to the next field by either pressing <Tab> or clicking with the mouse. You must enter a unique patient identifier for each patient. Additionally, most of the fields are checked for errata data, such as numeric characters in the INITIALS field or characters other than "L" or "R" in the HAND DOMINANCE field. The new patient is created and the background information stored on disk when the OK button is pressed.

α - **Hint** - A combination of hospital number and last name may be used for the patient's identifier in internal or referral work.

**The patients / subjects Identifier is shown in raw data and summary data.
The patients name is not included in summary or raw test data.**

✂ - **NOTE** – It is a best practice to avoid using the patient's Name or identifying variation as the patient identifier in drug trials or studies.

3.1.3. Editing an existing patient's information

To change a patients background information to a patient, go to View Name/ Screen ID and select patient to edit. select **Edit Patient** from the **File** pull-down menu in the Main Menu screen. You can then edit this information in the same way you would enter a new patient's information as described in the previous section.

α - **NEW** - If the patient is displayed in the current patient box, simply choose Edit Patient from the File, and proceed with the necessary changes.

3.1.4. Referring Physician and Diagnosis -

Entries for Referring Physician and Diagnosis are now available to add to your patient's information sheet. This information, when completed, and will print on requested Summary test forms.

3.2. Keeping track of visits and patients

3.2.1. Updating and viewing visits

QMA will automatically keep track of visits. The current visit for a patient will be displayed when that patient is being tested. To quickly view the number of recorded visits and the date of each for a particular patient, select **View Visits** in the **File** pull-down menu in the Main Menu screen. Select the screen number from the provided menu using the mouse. You may also use the <Tab> key to highlight the menu and then use the up/down arrow keys to scroll through the list of screen numbers. The date and time displayed is the date and time when the visit was last modified. To finish a previously started visit, consult section 4.1.

3.2.2. Changing the Visit Number -

Qualifying or Pre-testing for a particular protocol, (PRT00001) or other changes in the visit number may be required, and can now be accomplished. When beginning a visit, continue the sequence if the visit number is correct, or change the visit to the correct visit number.

View Visits if a question exists concerning the correct visit number. Visit numbers can lead with 3 alpha characters, and follow with up to 5 numeric characters. Visit numbering will automatically sequence from the last visit number.

To Change the Visit Number

Choose patient, begin visit, if the visit number is incorrect, Change the visit number – highlight the visit number and change, then continue the testing sequence.

3.2.3. Deleting a visit that is erroneous or has not begun testing

If a user mistakenly begins a visit, he or she should immediately end the visit. However, an extra visit will be added to the screen number that the visit was initiated with. In this case, the new erroneous visit may be deleted for QMA to correctly keep track of the visit number. To accomplish this, select **Delete Visit** from the **File** pull-down menu in the Main Menu screen. You are then prompted for the patient's screen number. If you have only the patient's name, see section 3.2.3. After entering the screen number and pressing **OK** (or just hitting <Return>), a small window appears with a menu that contains the patient's recorded visits. After selecting the appropriate visit and recording a comment as to why this visit is being deleted, press the **OK** button. Any data recorded in the deleted visit is **NOT** removed from the hard drive and **WILL** be copied to media with the remaining valid visits, but is **NOT** accessed for analytical evaluation.

If you delete the most recent visit, QMA will “retest” that visit the next time the patient comes in. If you delete a visit other than the most recent one, the deleted visit must be manually enumerated to test. Testing sequence will resume.

3.3. Print & View Results -

QMA provides the option of viewing results and/or printing acquired data in individual tests, and printing visit summaries. When printing, QMA uses the printer driver setup under MS- Windows. Other MS products, including EXCEL are available to print and plot raw data, when needed. See section 3.4 – USING the qma compiler, query engine and export to EXCEL.

✂ - **NOTE** – Do **not** attempt to print while a patient is being tested.

3.3.1. PRINT TESTS - Printing and Viewing individual tests (graphically)

Printing or Viewing in this manner will present the results of a single test much as it appears on the test screen. When PRINT TESTS is selected, you have the option to view the test, cancel, or print. You may view longitudinal testing of one muscle, without printing. If you select the option to print many tests at the same time, please be aware that each test of a patient's visit will occupy one page. Results from strength and fatigue tests will be printed on a graph with the measurements listed below. Results from the stopwatch and other tests will look like the test screens for those tests.

To print or view a test, select **Print Tests** from the **File** pull-down menu in the Main Menu screen. A new screen entitled "Print Results" appears.

3.3.1.1 To print or view a single test from a patient's visit, first select the patient's identifier or screen number in the SCREEN # menu. Then select the desired visit in the VISIT menu. Finally, select the desired test to view / print in the TEST menu. Only tests which were completed for the selected visit will be highlighted.

3.3.1.2 To print or view all the tests in a particular visit, press the ALL button underneath the TEST menu label and make sure the correct visit is selected.

3.3.1.3 To print a particular test for every visit, press the ALL button underneath the VISIT menu label, then select the test to view/print.

✂ You may view the progress or degeneration of a particular muscle of a patient longitudinally by selecting several visits and one test.

✂ HINT - Print Tests provides a view of each test or generates one page for each test. Print Test has the advantage of generating graphs and data, but uses more paper. Print summary combines the tests, does not print graphs but minimizes paper usage.

3.3.2 Print Summaries

As each test is performed during a particular visit, results for each test are appended to a summary file for the entire visit. The summary file contains the date and time of each test and all the measurements associated with that test for each trial

3.3.2.1 To print a visit summary, select **Print Summaries** from the **File** menu in the Main Menu Screen. A window appears and you are given three options:

- 1) printing all the visit summaries in the system (ALL PATIENTS ALL VISITS),
- 2) printing all visit summaries for a particular patient (ONE PATIENT ALL VISITS), or
- 3) printing one visit summary for one patient (ONE PATIENT ONE VISIT).

If you select the second or third option, you must also specify the patient's screen number. If you select the third option, you must also specify which visit to print.

With the proper selection made, press OK to start the print job. For every summary that will be printed you will see a window of text quickly flash on the screen and then disappear. QMA calls C:\WINDOWS\notepad.exe to call up each visit summary (a text file) and send the file to the printer.

✂ NOTE - *You must not resume testing a patient until the printer stops printing.*

3.4 Exporting acquired qma data to MS EXCEL

Acquired data from the current protocol or other protocols may be selected for comparative analysis in MS Excel.

✘ **NOTE** – the QMA compiler and query engine exports to MS Office (EXCEL)
. MS Excel must be in place prior to using this function, and trust center and Macro settings options set to process macros originated in visual basic (VBA).

✘ To set MS EXCEL - to process macros originating with VBA -
a. Open Excel and select the MS Home (upper left corner) and select EXCEL OPTIONS.
b. Proceed to Trust Center, and then Trust Center Settings.
c. Proceed to Macro Settings, and then check “Trust access to the VBA project object model” – click OK and OK out of the sequence.

3.4.1 – In QMA – make certain you are in the correct Protocol

3.4.2 – Select FILE, then EXPORT TO SPREADSHEET.

3.4.2 - Select specific information to export .

3.4.2.1- **PREFERENCES & PATIENT**- click on area to select each

3.4.2.1.1- **PREFERENCES**

- A. Renumber Trials, B. Include Maximum, C. Include Mean
- B. Apply Query when Exporting, B. Include Traces, C. Include Graphs
- C. Information Orientation - Rows or Columns

3.4.2.1.2 – **PATIENT**

- A. Screen Number or Patient ID
- B. Last Name – may be included for clinic evaluation, not studies or trials
- C. First Name – may be included for clinic evaluation, not studies or trials
- D. Gender
- E. Visit Number
- F. Visit Date

3.4.3 – Select **Compile** When compile has completed & before selecting Export

3.4.4 - **QUERY DATA** - Choose sequentially the three tabs for information to Export that will be included in the MS Excel spreadsheet -

3.4.4.1 – Patients –select – **a.** apply to checked patient, **b.** none, **c.** all

3.4.4.2 – Visits – select - **a.** apply to this patient, **b.** apply to checked patient – visits shown, **c.** apply to checked patient – all visits.

3.4.4.3 – Tests – patient shown -select – **a.** this patient, **b.** checked patients

3.4.4.4 - Apply to this Visit – visit shown – select – **a.** apply to this visit, **b.** apply to checked visits (tests shown), apply to all tests

3.4.5 – Select **Export** – The data will be queried and exported to MS EXCEL.

3.4.6 – Complete the query – **DONE** – skip to 3.4.9

3.4.7 – Add data from another protocol – **ADD PROTOCOL** and select the protocol that contains the data desired.

3.4.8 – repeat 3.4.3 through 3.4.5 complete – see 3.4.6, add more - see 3.4.7.

3.4.9 - Name the file – notice the location of the file when saved.

✘ **HINT** – Files generated by qma can be located by single right clicking on START – and then move up to Explore – move to the C drive and the QMA directory (QMA, QMAx) – look under the protocol for your Excel files.

3.5 Setup MS Excel Template for results comparison and analysis

✂ - Hint –Data placed in Excel is consistent, permitting the construction of templates with functions and arguments.

3.5.1. Build a Template

- A. Export requested information to Excel –
- B. Build arguments based on location of data.
- C. Save the arguments (as a book) as a different Excel file.

3.5.2. Use the Template

- A. Export requested information from qma to Excel (sec 3.4)
- B. Open both the newly created Excel spreadsheet and the template.
- C. Copy requested information (as lines) to the template.
- D. If constructed correctly – arguments will be executed as expected for further comparison and analysis.

3.6. Archiving data

Archiving data involves copying the QMA data files stored on the system's hard drive to either a USB drive or other storage media.

3.6.1. Saving data

To copy the acquired data from the system's hard drive to other medium, select **Copy Data** from the **File** pull-down menu in the Main Menu screen.

A window appears and you are given three options:

- 1) copying all the data files in the system (**ALL PATIENTS ALL VISITS**),
- 2) copying all the data files for all visits of a particular patient (**ONE PATIENT ALL VISITS**), or
- 3) copying all the data files from one visit of one patient (**ONE PATIENT ONE VISIT**).

If you select the second or third option, you must also specify the patient's screen number. If you select the third option, you must also specify which visit to print. You cannot copy individual data files. Visit summary files will also be copied along with raw data files. If you select the first or the second option, the appropriate files containing patient background information (e.g., name, screen number, height, weight, etc.) will be copied as well.

Files or Protocols may be copied or archived from a **DIRECTORY** level using Explorer. QMA is located on the C:\ drive (default), - C:\QMA, QMAXL or QMA4x, - open that directory, and you will find your **PROTOCOLS** listed. The patients and their respective visits reside in those protocols. Simply select and copy protocols to your designated media.

NOTE: You are responsible for HIPAA and HiTech compliance.

3.6.2 Directory and Files Structure

By default - The QMA program resides on the C:\ drive of your PC in one of the following directories – C:\QMA or C:\QMA4x.

Protocols (directories) will be seen below the QMA directory.

Patients (directories) will be available below the protocol directories.

Visits (directories) will be seen below the patients directories.

Test Data (nnn.dat – where nnn is the name of the test) and a summary file will be available for each visit.

3.6.2.1 – Longitudinal data as visits may reside under the patient’s directory.

3.6.3 Importing Data from other & previous QMA Systems –

Data acquired on other QMA systems (QMA v 1.11 – v 3.4) may be imported and used by your QMA system- up to qma v 3.4. (For use with qma42 please see 3.7 & 3.8)

Simply copy the protocol directories into the QMA directory. When QMA begins, the protocols will be available for testing or analysis. If the files are to be kept in their original transferring condition, mark them “read only”, and no updating will be possible.

✂ NOTE – Make certain files duplicating your current files are not being imported - If there is a question - Make and name a NEW FILE, and copy the directories into the newly constructed file. Then move them into QMA after reviewing the file names, etc.

✂ NOTE The Copy function may alter the visit dates, etc.

✂ NOTE - QMA 42 and continuing qma versions use a different file format than previous versions – this necessitates two different conversion STEPS to permit previous version data to be used in QMA42 !!

- 1. QMA v1.1 – QMA v 3.4 – used short file names – These file names must be converted to long file names to be able to be used in qma42 – see 3.7.*
- 2. QMA v1.1 – qma 4.1 – file format must be converted to consistent tab delimited file format used in qma42 – see 3.8*
- 3. It is necessary to complete these actions sequentially to complete them correctly.*

3.7 To Update short file names to Long file Names- QMA v1.1–v3.4 Inclusive

Previous versions of the QMA system used short DOS file names – QMA 4.0 and forward uses long file names for muscle or test names. The conversion utility located in QMA will change the short file names to long file name.

This is the first of two steps to use older files with QMA 42.

✂ - Data files acquired with QMA v 1.1 – QMA 3.4 requires both 3.7 AND 3.8.

✂ - Data files acquired with QMA 4.0 or QMA 4.1 requires only 3.8.6.

✂ - Illustrations of each step may be found on the CD or in C:\UPDATE

✂ - You may be requested to provide missing information during the conversion process prior to proceeding to 3.7.1. Open EXPLORER (right click START), In the older QMA Directory, Open (double left click) **sysinfo.txt** and write down the following information:

- 1- SITE: example OSU, 2- UNITS (of measurement): 0 – lbs, 1 – kgs, and 2 - newtons
3. PATINFO: 0 is US / ENGLISH 1 is INTERNATIONAL format for entry – day,mo,year
- 4- PROTOCOL: Not from sysinfo.txt – This is the protocol to convert– example CREATINE

➔ **The following is a recommend method to minimize difficulties**

3.7.1 Install a second copy of QMA42 – change the default directory to C:\qma42TEMP

3.7.2 Copy the protocols from the older qma to update into the qma42TEMP directory.

3.7.2.1 Using EXPLORER, in the older QMA version, Copy each of the protocols to convert to **QMA42TEMP**. (CTRL C / CTRL V). EXIT out of Explorer - X.

✂ - **If the protocols to change are in C:\qma42, the 3.8 conversion will attempt to overwrite the files, and the conversion will fail**

3.7.3 Start **QMA42TEMP**.

3.7.3.1 In Explorer, locate QMA42TEMP, and then locate and double left click QMA.EXE.

3.7.3.2 In the QMA program, Go to SETUP, cursor down to ADVANCE, and over to UPDATE FILE / MUSCLE NAMES and SELECT

✂ - The Instructions and prompts on the use of this utility are detailed on the screen.

3.7.3 On the lower left, ALL protocols available to the qma system will be displayed.

✂ - If the protocols to change are not present, then you may be in the wrong QMA42 - see 3.7.1 – 3.7.3

Protocols using long names will be checked. Protocols to update will be unchecked.

Select a protocol to update by highlighting, and press #1. The short names are displayed on the left, suggested long names are displayed on the right.

3.7.4 - If the names on the right are correct, then press # 4. The file is now written with the long file names. Proceed to 3.7.5.

3.7.4.1- If they are incorrect do not depress #4, and follow the process of obtaining an optional list, etc buttons 2 & 3.

3.7.5– You will now be requested to confirm or enter the protocol information – SITE, PROTOCOL, UNITS, and PATIENT INFO – enter or confirm each and OK

3.7.6 – This concludes this portion of the update on this protocol, select the next protocol

3.7.7 - When all of the protocols to convert are completed, depress DONE, and LOGOUT of SETUP. Go to FILE, and LOGOUT, and then QUIT the QMA program at this time.

✂ HINT–Do not open the new file at this time, until section 3.8 is read & completed satisfactorily.

✂ **NOTE** – QMA 42.. has a more consistent file structure to permit the exporting of files to MS EXCEL. Data acquired with previous versions of QMA do not have the improved file structure. In the event you wish to utilize the Export to Excel function of QMA 42 with previously acquired data, then that data must be updated to the qma42 format.

The following instructions located in Sections 3.7 and 3.8 are written to expedite the conversion. Please follow these instructions to avoid encountering undo difficulties.

*Previously acquired data (qma 1.1 – 3.4)(short name files) **must** be converted to long file names – use section 3.7 **PRIOR** to using section 3.8.*

Data files acquired with QMA 4.0 and 4.1 may use this conversion utility **only** to permit use of the qma compiler and query in QMA42. – see 3.8.5

3.8 Change format of previously acquired qma data to work with current qma-

3.8.1. On the desktop - Open the QMA converter -

3.8.2. **Ok** to open the converter



Select protocol to convert -

3.8.3 Using the scroll bar, locate QMA42TEMP on the C:\ drive.

3.8.4. From your list (3.7) locate a protocol to convert in QMA42TEMP.

3.8.4.1 – Double left click (highlight folder) & select “**Select Cur Dir**” on lower right

The Protocol must be listed in the header to be accepted. **GO to 3.8.6**

➔ **QMA 4.0 and QMA 4.1 ONLY - For data acquired in qma4.0 and 4.1 ONLY –**

3.8.5 – Using the scroll bar, locate the qma40 or 41 directory on the C:\ drive.

3.8.5.1 locate a protocol to convert

3.8.5.2 Double left click (highlight folder) and select “Select Cur Dir” on lower right

3.8.5.3 The Protocol must be listed in the header to be accepted

3.8.5.4. Go to 3.8.6

Select placement of converted folder

3.8.6. Select the C:\QMA42 Directory

3.8.6.1 Using the scroll bar, locate QMA42 on the C:\ drive

3.8.6.2 **Double** left click QMA42 folder & select “**Select Cur Dir**” on lower right

3.8.6.3 The QMA42 directory must be listed in the header to be accepted.

3.8.7 – The conversion process is automatic, and will end with DONE.

3.8.7.1 Start QMA42, change protocol to one of the converted protocols, and follow the instructions on exporting data to Excel.

4. Performing Tests

4.1 No Load – Load Cell and Hand Dynamometer

Upon beginning a test, a large box listing the different muscle tests should appear. You are then stepped through a no-load calibration for the load cell and the hand dynamometer. Due to infinitesimal changes in the electronics of the data acquisition equipment, the system should undergo a no-load calibration check periodically.

The no-load calibration check can also be executed between tests during a visit (see section 5.2). First, you are prompted to unload the load cell (or strain gauge). Make sure that no force pulling on the load cell, and then press OK (or hit <Return>). You are then asked to do the same for the hand dynamometer.

✂ - **NOTE** – The weight of Testing straps or cables may be cancelled by hanging them from the load cell during the No Load process. Check the protocol or administrator.

4.2. Beginning a visit

To start the testing procedure for a patient, you can either begin a new visit or finish a previous visit

4.2.1. Beginning a new visit

✂ - **HINT** – When all of the patients are missing or look unfamiliar, check the protocol.

When a patient is ready for a new visit, select **Begin Visit** from the **File** pull-down menu in the Main Menu screen. Basically, four options will be available.

1. No patients are available in this protocol – add patients. Return to File, then New Patient and enter the required information. Sec 3.1.

✂ - **NOTE** – If the patient information display is not correct, the patient display screen needs to be changed. Sec 2.1.2-5.

2. Patients are displayed, but no patient is selected. – Select the patient you wish to test by Double Clicking on the patient's information.

✂ - **HINT** – You can sort on the patients Name, Identifier, or Initials.

3. Patient is shown in the Patient Identifier (large rectangle area), and is the correct patient to begin testing.

A. Go to Begin Visit, and begin tests.

4. Patient is shown in the Patient Identifier, but is NOT the correct patient to test.

A. Go to View Patient/ Screen, then Logout the incorrect patient. Return to Begin Visit, and select the patient to test by double clicking on the patient information.

NOTE – One of the most consistent mistakes made is to begin a visit with the wrong patient. **MAKE CERTAIN YOU ARE TESTING THE CORRECT PATIENT.**

THEIR DATE OF BIRTH IS ON THE SCREEN / TAKE A MOMENT AND CONFIRM.

4.2.2. Finishing a previous visit

If a patient's visit must be interrupted or the therapist finishes a visit prematurely, it may be necessary to go back and finish a previous visit. To do this, select **Finish Previous Visit** from the **File** pull-down menu in the Main Menu screen. Please refer to 4.1.1 to select the patient to test.

After selecting a patient, you will be prompted with a menu of previously recorded visits for that screen number. Select the visit you want to finish and then press **OK**.

See section 4.1.2 about stepping through the no-load calibration check before a visit. After the accuracy of the calibration is confirmed, the tests that were already performed during the previous visit will be disabled in the test selection boxes. See section 4.2 for information about selecting a test to perform.

✂ - NOTE: When testing Make CERTAIN you are utilizing the correct unit of measurement - Shown on the TOP Left of the Graph.

4.3. Selecting which test to perform

Once a visit has begun, the therapist can perform any of the tests defined by the administrator (see section 2.2). The tests can be hand-selected in any order or they can be performed in the order (sequence) defined by the administrator (see section 2.3).

4.3.1. Selecting Tests Individually – Manual Sequence

To manually select a test, click on the appropriate test category in the **CATEGORY** selection box in the Main Menu screen. Then select the name of the test and the side of the body in the **TEST** and **SIDE** selection boxes. These selection boxes are visible only if you have begun a visit as described in section 4.1. If a certain test or category has been completed, the corresponding text in the selection boxes will turn gray and cannot be selected. With the desired test selected, press the button labeled **BEGIN TEST** beneath the selection boxes. The Strength and Fatigue Test screen, Stopwatch Test screen or Other Test screen will then appear depending on your test selection. See sections 4.3 through 4.5 for more information on these screens.

4.3.2. Following a Test Sequence – Automatic Sequence

The administrator can define a test sequence to ensure all visits follow the exact same test procedure. To start the test sequence, press the button labeled **BEGIN SEQUENCE** beneath the selection boxes in the Main Menu screen. The button and selection boxes are visible only if you have begun a visit as described in section 4.1. QMA then starts the first test in the sequence regardless of what is highlighted in the selection boxes. If certain tests in the sequence were completed by hand, they are skipped in the sequence.

Each test screen has a button labeled **NEXT TEST**. For strength, fatigue and stopwatch tests, *holding down the red button* on the remote switch to a count of seven, at the appropriate time is equivalent to pressing the **NEXT TEST** button. Pressing this button and holding it down for a count of seven will end the current test and initiate the next test in the sequence even if there is an unfinished test that is earlier in the sequence.

If a test is begun in error, simply stop the test (single click), make a note that the test was started in error, select **CANCEL** and select the test to begin or select begin sequence and the next test in the sequence will start. (see 4.6.6 for more detail)

4.4. Strength and fatigue tests

The graphical test screen is similar for strength tests, static fatigue tests, and dynamic fatigue tests. See section 4.2 on how to initiate the test screen.

4.4.1. Beginning a trial (trace)

Before beginning a trial, it is important to make certain the title of the screen matches the test you intend to perform. The current trial number is displayed underneath the TRIAL label at the bottom of the screen. Before preparing the patient for the trial, press the hand-held button once to enter into ready mode. You can also press the READY button in the bottom left corner of the screen or simply press <Enter> on the keyboard to enter into ready mode. “Ready” will blink slowly and, for all trials except the first, the trial indicator will increment by one. The patient should be prepared for the test at this time by placing the patient, hand grip, and/or connectors and strain gauge in the appropriate position. The therapist may begin the test on SET to start the data acquisition and then exclaims, “GO!” and the patient will expend effort. Clicking in the small circle labeled GO in the bottom right corner of the screen or simply pressing <Enter> will also start the data acquisition.

✂ - **HINT** – Beginning the trial on “Set”, and the patient’s effort beginning on “Go” will display a zero baseline prior to the patient’s efforts being displayed. This is normally preferred.

4.4.2. Ending a trial

Under normal circumstances, the trial or data acquisition will stop automatically. However, a trial can end in a variety of ways:

- when the therapist again presses the red hand-held button (only try to stop with the button after a few seconds into the trial),
- when the end of the graph has been reached (this is the time-out time; see section 2.5.1),
- when the therapist clicks in the circle labeled STOP in the bottom right corner of the screen,
- when the therapist again presses <Enter>, or
- for strength tests, when the falling edge of the acquired data waveform reaches 50% of the maximum (the 50% value is changeable by the administrator; see section 2.4.2)

After the acquisition has ended, the measurements for that trial are displayed at the bottom of the screen. For definitions of these measurements, see section 2.4. Only three values are displayed at one time. If there are more than three measurements for the fatigue tests, you can scroll through the list by pressing the on-screen left- and right-arrow buttons immediately above the numeric displays. At this point you must either accept or reject the trial before proceeding.

4.4.3. Accepting or rejecting a trial

You can accept or reject a trial only immediately after the acquisition for that trial has stopped. Click the hand-held button once to accept the trial and hold down to a count of seven to reject it. Additionally, pressing the on-screen **ACCEPT** button or simply pressing <Return> will accept the trial and pressing the on-screen **REJECT** button will reject the trial. If you accept the trial, the trial indicator will increment by one and you are now ready to begin a new trial or end the test. If you reject the trial, a new window appears requesting the reason for the rejection and any additional comments. After pressing **OK** in this window, you are now ready to begin a new trial or end the test. You should see a red “X” to the right of the trial indicator denoting a rejection for that trial.

Single click to continue to test this muscle, or hold the button down for a count of seven to move to the next muscle in the testing sequence. (See Sec 1.6)

Rejecting a trace or test –Refer to section 5.9.IV for Best Practices in data documentation.

4.4.4. Displaying all trial measurements

Normally, only the measurements for the current trial are displayed on the test screen. Measurements for all trials can be displayed by pressing the **ALL** button to the right of the **READY** button. A new window appears with the measurements for all trials displayed. If there are more than three measurements for the fatigue tests, you can scroll through the list by pressing the on-screen left- and right-arrow buttons immediately above the numeric displays.

If there are more than seven trials, you can scroll through the trials by pressing the on-screen up- and down-arrow buttons to the left of the numeric displays. Press **OK** to close the window.

After displaying all the trial measurements, you cannot enter ready mode by simply pressing <Enter>; you must either press the hand-held button or press the on-screen **READY** button.

4.4.5. Ending the test

After accepting or rejecting a trial (or before starting the first trial), you can either start another trial or end the test. There are three ways to end the current test:

1. Begin the next test in the sequence. This is done by either holding down the button to a count of seven or pressing the **NEXT TEST** button. Make sure to hold the button long enough; a single-click will begin a new trial. See section 4.2.2 for more information on following the test sequence.
2. End the test and return to the Main Menu screen. This is done by pressing the **END TEST** button. This will save all the trial data on the hard disk and close the test screen. From the Main Menu screen you can either choose the next test, end the visit or perform other QMA tasks.
3. Cancel the test and return to the Main Menu screen. This is done by pressing the **CANCEL** button. The data will not be saved and the test can be retaken later.

4.5. Stopwatch tests – A stopwatch is integrated into the qma program, utilizing the accuracy of the processor of the pc or notebook.

4.5.1. Beginning a trial

Before beginning a trial, it is important to make sure the title of the screen matches the test you intend to perform. The current trial number is displayed underneath the TRIAL label at the bottom of the screen. Before preparing the patient for the trial, press the hand-held button once to enter into ready mode. You can also press the READY button or simply press <Enter> to enter into ready mode. “Ready” button will blink slowly and, for all trials except the first, the trial indicator will increment by one. The patient should be prepared for the test at this time, the next push of the remote button will begin the trace. The therapist states “Ready” and presses the hand-held button at the same time to start the data acquisition, then exclaims “GO”. This will produce a zero starting point for the trace. Be consistent on the time between Ready, and Go. If an exerted effort is desired at the origin of the trace, exclaim “GO” and start the acquisition simultaneously. Clicking in the small circle labeled GO in the bottom right corner of the screen or simply pressing <Enter> will also start the data acquisition. .

4.5.2. Ending a trial

The test can be ended by either depressing the red button, or click on “end test”.

4.5.3. Accepting or rejecting a trial

See 4.4.3 on accepting or rejecting options.

4.5.4. Displaying trial data

Trial data can be observed by selecting the trial number or depressing the scroll bar.

4.5.5. Ending the test

See 4.4.5 on ending and continuing a test.

4.6. Other tests

Other tests results or simple data entry that will be associated with the visit can be made by utilizing this area. See “adding a test” 2.2.1.

✂ - **Hint** – Record Height and Weight during a longitudinal study

Do you want to observe the height and weight of patients during a longitudinal study ? Then add Height, and Weight as two tests in Other Tests. Each time the patient is tested, these tests will be completed.

✂ - **Hint** - Data transcribe MMT data -

MMT data can be transcribed into QMA by setting up a test in the protocol under the fifth test category (OTHER). This would permit keyboard entry for each test, and may simplify data retrieval by the statistician. These tests are not muscle specific.

All data may be reviewed or transferred from the Summary.txt file.

4.7. Special Testing Features

4.7.1. “ Rejection Annotation ”

During testing, a trial can be rejected, and comments attached to that rejection, these become part of the test data. Comments made be made in addition to the

following reasons chosen –

1. Improper Test Position,
2. Subject unable to maintain test position,
3. Unable to test due to pain,
4. Equipment malfunction,
5. User/Button – trace started in error,
6. Other – with comment.

NOTE - Refer to section 5.9 IV for documentation of data.

4.7.2. “POP UP NOTES”

“Pop UP Notes” are now available throughout the tests to make comment. These comments are made a part of the acquired data – the patient, the visit, and the specific test. These are separate from rejection annotations.

4.7.3. Disable Auto Stop -

A choice is now available in each particular test – to disconnect auto stop. This permits a single test to continue past maximum and continue to zero. This can be used for multiple traces, or to acquire data for analysis on the back slope of a particular test.

α HINT – Myotonic Dystrophy - use NOTES to indicate the release point.

4.7.4. Set Zero – Check Zero -

In a test, the weight of an extremity may now be excluded from the effort exerted by the patient. Example – Hip Extension -

1. Place the extremity into a testing cuff.
2. Request the patient to let the extremity rest with no effort exerted.
3. Select “Zero Test” and then Ok.
4. To check that the weight of the leg is negated, depress “Check Zero”.
5. Perform the test on Hip Flexion.
6. “Set Zero” is for a single trial – each additional trial (trace) will require # 2 & #3 to be repeated.
7. Upon the conclusion of this test, the load cell resumes its normal zero setting.

4.7.5. Change Visit Number -

To Change the Visit Number choose patient, begin visit, if the visit number is incorrect, Change the visit number – highlight the visit number and change, then continue the testing sequence. Sequencing will continue on the last digits.

4.7.6. Change the Y Axis Limits

In a test, the limits of the Y axis or vertical axis may be changed by highlighting the limit, and changing as desired. This affects the immediate test only, and may be made during a test. To make a permanent change go to Setup and change the individual test graphing attributes. Example of use – Ankle Dorsiflexion – The upper limit is too high – change and continue testing. .

NOTE - The top effort may not be seen, but NO DATA IS LOST

4.8. Correct a Test or a Visit -

While visits are updated automatically and cannot be tampered with the QMA system is capable of handling or correcting problems encountered in muscle testing and data acquisition. In the File menu, select Fix Tests, Finish Previous Visit or Delete Visit depending on the problem experienced in gathering information and the following examples. See Sec 3.1 to select the correct patient, etc.

NOTE – REFER to section 5.9 for data retention and documentation.

4.8.1. A muscle test was completed erroneously, or perhaps no data was collected, and you want to discard the data.

You must be in the visit number containing the bad test. In the main menu screen select **File** and then **Fix Tests**. In the windows that appears, select the bad muscle test using the selection box on the left. Then press the DELETE button on the right. This muscle can now be re-tested from the main menu screen.

4.8.2. A muscle test was completed (with valid data) under the wrong muscle name.

You must be in the visit number containing the misnamed test. In the main menu screen select File and then Fix Tests. In the windows that appears, select the wrong muscle name that the test was completed under using the selection box on the left. Then press the MOVE button on the right. Then, using the selection box on the right, select the proper name for the test. The second name you select must NOT have been tested already in this visit.

4.8.3 Two muscle tests were completed (with valid data) under the wrong muscle names, and the data must be swapped.

Same as example #2- with the following exception: select SWAP instead of MOVE after the first test has been selected.

4.8.4 A visit was completed accidentally with erroneous (or no) data and it needs to be deleted.

If you are in the visit you want to delete, first end the visit. Then select **File** and then **Delete Visits**. Select the screen number and the visit number of the bad visit and press OK. If the deleted visit is the most recent visit for that patient, that patients visit number will be properly updated. If the deleted visit is not the most recent, the visit number may have to be manually corrected.

4.8.5 A visit was partially completed (with valid data) but ended prematurely, and needs to be fully completed

Select File and then Finish Previous Visit. Enter the screen number of the patient in the prompt that appears. Then select the visit that needs to be completed in the screen that appears.

4.8.6 PT wants to move to next test, but the button/switch is depressed too short a time, and the same test is available & the header is flashing red.

Start the test (short button depress), stop the test (sbd), reject the test (long depress – 6-7 seconds), select – TRACE STARTED IN ERROR and OK.

Move to the next test by selecting NEXT TEST, or END TEST and select the test.

4.8.7 Remote button is depressed too long. A new test is available, and the desired test was skipped or closed out early.

Whenever you are in a test you do not want to test – select CANCEL

At the Main Menu, go to FILE, and select FIX TESTS

Select the category, test and side that was missed and DELETE, then OK

The missed test is now available to continue testing

4.8.8 Graph is not displaying effort exerted (QMA 42, XL)

Input equipment may not be selected correctly for test – to correct: End Visit.

Select SETUP and TEST NAMES. Select Test to correct and Input Equipment.

Select correct input equipment and OK.

Correct Input Equipment should now be available for testing.

4.8.9 Input equipment maximum capacity is too small to “Check & Tweak” QMA XL permits input equipment with 1.1 lbf to be calibrated with “Check & Tweak” – contact support@qmasysqtem.com for update information.

4.8.10 System not able to measure after completing check and tweak - NAN

If C&T was completed with too small a weight or no weight was present when the subroutine was completed/ Done or OK was selected, then a temporary amount needs to be entered. Go to Sysinfo.txt file located in the QMA directory, locate the instrument and restore them to an amount as seen in an adjoining sysinfo file.

4.8.11 Export to Excel not working (QMA 42, XL)

Depending on the version of Excel that you are using:

1. In Excel XP go to TOOLS, MACRO and then SECURITY – change to MEDIUM, and then Click on the Tab – Trusted Sources and permit Visual basic from trusted sources.

2. In Excel 2007 go to left top corner and select Excel Options.

Proceed to Trust Center and Trust Center Options and click- Permit access to VBA Object Project and close.

4.8.12 Report Generator not able to load Macros

Depending on the version of Excel that you are using:

1. In Excel XP go to TOOLS, MACRO and then SECURITY – change to MEDIUM, and then Click on the Tab – Trusted Sources and permit Visual basic from trusted sources.
2. In Excel 2007 go to left top corner and select Excel Options. Proceed to Trust Center and Trust Center Options and click- Permit access to VBA Object Project and close.

4.8.13 Custom Input instrument test crashes

The remote switch is momentary and permits electrical current to pass until it is interrupted by activating the switch. Without the switch connected and in place in the distribution box, the flow of electrical current is not recognized by the software and the test (lip bite) will fail. Connect remote switch and test should work.

4.8.14 For questions concerning the QMA Patient Progress Report – see 4.9.5

4.9. TEST RESULTS

4.9.1 View Test Results – QMA parameters

The following analytical data of the efforts expended in the current test may be observed within the qma program - :

- A. Strength Test (see Sec. **2.4.1**)
 - 1. Maximum
 - 2. Rise Time
 - 3. Sustained Time

- B. Static Fatigue Test – for Five distinct areas (see Sec. **2.4.2**)
 - 1. Maximum
 - 2. Average Value
 - 3. Area Under the waveform

- C. Dynamic Fatigue Test – for Three distinct areas (see Sec. **2.4.4**)
 - 1. Maximum
 - 2. Average Value
 - 3. Area Under the waveform

Press View Data – Use the scroll bar to display data not readily available.

4.9.2 View Test Results – Queried and exported to MS Excel parameters

- A. All of the above – (sec **4.7.7**)
- B. Mean of each test
- C. Coefficient of effort – “Peak rate of force development”
Observing the slope rising from a resting point to peak force iteratively and determine the fastest rate of force increase in the slope (the steepest slope). It is the point on the curve where the greatest number for the change in force (Newtons)/change in time (sec) may be observed.
- D. Select the data to view, and comparisons to make. See (sec.**3.5**)

4.9.3 QMA Patient Progress & Evaluation Report (optional)- Overview

The QMA Patient Progress and Evaluation Report is designed to provide the following information in an accurate manner and professional format:

4.9.3.1 The header is automatically & primarily populated with the following from the patient's setup information:

- a. Patient Name,
- b. Patient ID,
- c. Today's date,
- d. Visit or Test number,
- e. Date of Birth (dob) and corresponding age in English/American (mm/dd/yyyy or International/ Military dd/mm/yyyy)
- f. Gender,
- g. BMI Information - Height (Ft/In or Kgs), & h. Weight (Lbs or Kgs)
- i. Diagnosis,
- j. Referring Physician,
- k. Test Date, L
- l. Time of Test
- m. Testing Measurement Units (LB, KG, N)

4.9.3.2 The Testing Area is automatically populated with the following:

- a. Baseline (Test designated by user to be the baseline, first test or comparison test)
- b. This Test (Test designated by user as the second or comparison test)
- c. Mean (An average of predicted normal based on age, gender, and BMI)
- d. Either side of Mean (acceptable or designated acceptable deviation from normal)
- e. Change in Percent (Change from one test to the next)
- f. Last Test Predicted Change (An increase or decreased amount to the expected Mean)
- g. This Test Predicted Change (An increase or decreased amount to the expected Mean)
- h. Total Upper Extremities (Total, Right & Left)
- i. Total Lower Extremities (Total, Right & Left)

4.9.3.3 The Areas for evaluation include the following:

- a. Interpretation – Area to enter evaluation, comments, or notes
- b. Physician
- c. Physical Therapist
- d. Place mark (x) in Header –
 1. Verify diagnosis
 2. Disability Evaluation
 3. Evaluate Response to Therapy
 4. Research
 5. Physician (add Name)

✦ NOTICE - All data and argument fields are protected to maintain data integrity.

4.9.4 How to Use the Progress & Evaluation File

✦ **NOTICE** – Before you begin with the QMA P&E File, please go to Explorer and locate the Protocols and patient information that you wish to access – most probably the information will be located in C:\QMA 4.xx, or C:\QMA.

✦ **NOTICE** The security level of your Excel program may need to be revised to enable Macros – for this application. This program currently works with Microsoft Office, and may require the assistance of your IT personnel.

✦ **Recommendation** – *When beginning to utilize the P&E File, please copy the original to several locations as accessible backup files.*

This will minimize the opportunity for difficulties in the future

- a. When opening the QMA Predictor file, always **ENABLE MACROS**.
- b. On the EXCEL Header (to the right of File, Edit, etc) is the Indicator **QMA**
- c. When you click on QMA, you will find the following:
 1. Import Baseline Data
 2. Import Visit Data
 3. Clear Baseline Data
 4. Clear Visit Data
 5. Clear All Data

d. **An example:** When you click on Import Baseline Data – the program will prompt you for the location of the QMA directory and the protocol. If the protocol is located in the QMA42 directory on the C drive, then select COMPUTER and then C and then QMA42.

A .If you wanted to access the first visit of 9988Lopez then double click on 9988Lopez, and then the first visit.

B. You will then have the option of requesting the MAX or the MEAN of the tests.

C. To proceed with the second visit – click on Import Visit Data, follow the same procedure to locate the directory and select the second visit.

D .All of the data and information cells should populate automatically.

E. Make any necessary comments and other indications,

SAVE AS (rename file) and close..

4.9.4 A report was not automatically filled with the tests completed.

The Tests completed and the expected tests must be the same.

Check the name of the test in SETUP / TEST NAMES Example follows -

The SUB & FILENAME configuration must be as follows: left Elbow flexion left

NAME	KNEE FLEXION	SUB-TESTS	LEFT & RIGHT
SUB-TEST NAME(S)	FILENAME(S)	DEVICE(S)	
LEFT	KNEE FLEXION LEFT	SM 250 a	Select

4.9.5 The Interpretation area of the report does not permit a large pasting of data. (Following error message)

“The data you’re pasting isn’t that same size as the selection”

You may have summarized your evaluation in a word document, to paste that information into excel consider the following:.

a. Pasting data into a closed excel field

1. Open a new Excel sheet
2. From Word or another data source copy the data to paste
3. Copy the entire list of data - (right click / COPY)
4. Select a **cell** and Paste the data into the new excel sheet
(the data will run along the row to the end the paste)

NOTICE - (note the first cell of the paste)

5. Copy the first cell of the data copy that you just completed
(that will copy the entire list of data)
6. Proceed to the Excel sheet with the closed excel field
7. Place the cursor in the evaluation area / field
8. Select the paste option (right click / **PASTE – FORMULA F**)
9. Save Excel sheet

5. Checking / Modifying / Confirming Calibration -

The Unit of measurement can be selected at the time of measuring

Each instrument is designed to maintain accuracy through the full range of measurement (linearity), perform in an expected manner (hysteresis) and retain their functionality (consistency) and accuracy through repeated exertions (reliability) with minimal creep (drift).

5.1. Performing a simple measurement – confirm accuracy- no documentation

To make a simple measurement, to quickly & personally confirm the accuracy of an input device, or to make certain an input device is functioning prior to testing the following is suggested: release any force or weight on the input equipment chosen and select *CALIBRATE*, then *NO-LOAD* –scroll through the input equipment and select the input device. Then choose *PROCEED* and *OK*. Now select *MEASURE*, and place the weight or force to measure. The unit of measurement may be changed as needed. The measured weight or effort exerted will be displayed. Select *Cancel* or *Done* when completed.

✘ **NOTE To confirm and document** the accuracy of the input equipment, confirm & update the working files with the most recent weight/ measurement algorithms and append the QMA Calibration Log Directory (QMA Cal Log) use *CHECK & TWEAK*, as described in **5.3**.

✘ **NOTE – If you are testing, complete a simple measurement as 5.1 and change the unit of measurement, then return to the test, the unit of measurement will change to the last used / this may not be the unit of measurement requested by the protocol.**

NOTE – It may be wise when conducting a simple test of the instrument to always remain in the unit of measurement that is utilized in patient testing

5.2. The function of No-Load

“NO LOAD” will zero the selected input equipment.

Remove all force and weights that are not part of the measured effort, and select *CALIBRATE*, then *NO-LOAD* –scroll through the input equipment and select the input device. Then choose *PROCEED* and *OK*.

✘ **NOTE – “NO LOAD” forces a zero measurement on the selected input equipment** and does not recognize or take into account any extraneous force or weights (hangers or straps) that may be present.

✘ **NOTE -** During a test, “ZERO TEST” may be selected, and the input equipment of that test will be forced to a zero measurement. This may be of benefit when a *TARE* (a force or weight that is to be deducted from the overall measurement) is present.

NOTE: - You may check the use of ZERO TEST - see **4.7.4**.

5.3 Checking and Tweaking (confirming, modifying & documenting the Calibration

I The following is the typical method of calibrating SM 250 Load Cell.

NOTE – The weight of the attaching strap may be measured previously- @ 250g

1. Open the QMA application – go to CALIBRATE and then CHECK AND TWEAK, place the instrument on its side and select the instrument to set to zero.
2. Hang the SM250 from an upper access point on the frame, with a carabineer.
3. Place a 1" strap (testing strap) to the other access point of the Load Cell with an attaching carabineer or hook on the other end. –
4. Attach a "weight hanger" to the strap hanging down with the Load Cell.
5. Set the KNOWN WEIGHT on the left side of Check & Tweak / example 41 kg.
NOTE The complete weight /hanging weight (40 kg), Hanger 1 kg.
in this example.
6. Physically hang the hanger and weight from the strap and compare the known weight to the measured hung weight.
7. When they are "acceptably" Equal, then select "DONE" and close the application.
NOTE – This will write the file and update the Calibration Log File.

NOTE If they *do not equal and you want to proceed – skip step #7 and go to # 8.*

8. If the known weight and measured weight do not equal, then select "TWEAK".
9. You will now be able to press Up or Down to increase or diminish the measured weight display.
10. When the known weight and measured weight equal, select "TWEAK" again to end the adjustment process.
11. Now select "DONE". This will update the algorithm, close the file and update the documentation
12. Remove the hanging weight and straps.
13. The instrument is now ready to be utilized in testing.
14. To test another Load Cell or Hand dynamometer, repeat the process as written.
15. To C&T another input device Select NEXT, and repeat **1 - 14**
16. To Cancel any entries, but remain in C&T Select CANCEL
17. To Cancel any entries, and exit C&T Select EXIT CAL.

NOTE *To provide documentation prior to the adjustment of the measured weight, prior to adjustment select "DONE" after step 6.*

II The following is the typical method of calibrating a hand dynamometer with analog output*

NOTE – The weight of the attaching strap may be measured previously- @ 250g.

The hand dynamometer is constructed with a flat edge on the back of the grip.

1. Open the QMA application – go to CALIBRATE and then CHECK AND TWEAK, place the instrument on its side and select the instrument to set to zero.
2. a. Place the hand dynamometer in the cradle of the calibration platform.
b. No platform - Place two equally high flat top structures (desks, bookcase, etc.) approximately 5-6 inches from one another creating an area between the two structures.
3. Place a 2" strap (testing strap) around the grip with the connector.
4. no platform- Place the hand grip on its back and between the two structures with the strap hanging down with the connector hanging down.
5. Set the KNOWN WEIGHT on the left side of Check & Tweak / example 41.0 kg
NOTE The complete weight /hanging weight (40 kg) + Hanger 1 kg.
6. Physically hang the hanger and weight from the strap and compare the known weight to the measured hung weight.
7. When they are "acceptably" Equal, then select "DONE" and close the application.

NOTE – This will write the file and update the Calibration Log File

NOTE If they *do not equal and you want to proceed – skip step #7 and go to # 8.*

8. If the known weight and measured weight do not equal, then select "TWEAK".
9. You will now be able to press Up of Down to increase or diminish the measured weight display.
10. When the known weight and measured weight equal, select "TWEAK" again to end the adjustment process.
11. Now select "DONE". This will update the algorithm, close the file and update the documentation
12. Remove the hanging weight and straps.
13. The instrument is now ready to be utilized in testing.
14. To test another Load Cell or Hand dynamometer, repeat the process as written.
15. To C&T another input device Select NEXT, and repeat **1 - 14**
16. To Cancel any entries, but remain in C&T Select CANCEL
17. To Cancel any entries, and exit C&T Select EXIT CAL.

NOTE *To provide documentation prior to the adjustment of the measured weight, prior to adjustment select "DONE" after step 6.*

5.4 Load Cell Capacity and Calibration

The Interface SM 250 (250 lbf capacity) is the most common load cell utilized with the QMA System. The recommended minimum test weight utilized in Check & Tweak for the SM250 is 40 kg.

Other load cells are also utilized from maximum capacities from 5 lb (2.27 kg) to 500 lb (226.80 kg). The recommended test weight for load cells varies due to the extremes in the capacities of the load cell.

- A. When utilizing a SM250- 250lb capacity load cell, a recommendation may be made to
 - 1. utilize a known weight that approximates or is greater than the effort of the larger muscle or muscle group to be tested.
 - 2. Utilize the full capacity of the load cell for the testing weight.
- B. When confirming the accuracy of a smaller capacity load cell the full capacity of the load cell may be considered / as in the example of a 5 lb or similar load cell

✘ NOTE - The examination table (Electric Hi/Low) may be used as a lifting platform, to minimize the strain on the PT or testing personnel of placing testing weights .

5.5 Calibration LOG FILE - QMA Cal Log

When Check & Tweak (C&T) is utilized to confirm or adjust the accuracy of the input equipment utilized in acquiring data with the QMA System, an operating file (sysinfo.txt) is updated and a duplicate file written and appended to a CALIBRATION LOG DIRECTORY.

This process permits the continuing appending of the CALIBRATION LOG DIRECTORY – “QMA Cal Log” directory with the updated information of the C&T – the data, algorithm, and date and time. The QMA Cal Log directory may normally be found on the "C" drive in the QMA (QMA42, QMAXL) directory, the appending files are located within that directory, and may be accessed using MS Word, WordPad, or NotePad.

Please notice that the files within the QMA Cal Log directory are uniquely identified as to the completion of C&T by date and time - an example may be - sysinfo_01_19_2016__15_26_09.

This file name indicates that a C&T was completed on January 19, 2016 at 3:26 09 PM, the internal data and structure of the file will confirm that indication.

The Calibration Log File continues to append successful “Check & Tweak” of the instruments utilized, and will construct longitudinal documentation of the Check and tweak processes.

5.6. Frequency of Completing Check & Tweak (C&T)

- A. Manufacturer's recommendation is to have the measuring instrument checked periodically. If the instrument is not providing accurate readings of known weights, contact support@AEVERL.com so the accuracy of the instrument may be evaluated.
- B. Statement was made by the manufacturer that the QMA method of "check & tweak" was an improvement to their recommendation in certifying the accuracy of measured weight to the known weight on a continuing basis.
- C. Check and Tweak" is easy to utilize to confirm and document the accuracy of the instruments utilized in the protocol.

We recommend utilizing C&T once a week to confirm the accuracy of the various instrument in a system having continuing utilization

- D. As a load cell is used, several things can happen that may adversely affect accuracy.
 - 1. Physical Overload - the capacity of a load cell is exceeded that may cause irreversible damage to the physical integrity of the instrument's structural integrity. The Interface SM250 (250 lbf capacity) can be safely overloaded to 150% of capacity.
 - 2. Cabling or wiring broken – A measurement that is "out of sight" may be a result of a broken cable, internal wire in the cabling, at the head of the instrument or distribution box.
 - a. Physical Wiring -Problems have been encountered with the transfer wiring at the head of the load cell. The wiring may be flexed and have effort extended against it during normal use. The continuing flexing action will cause the wiring to fatigue and break inside the wirings sheathing. See NOTE.

✘ **NOTE** – It is recommended to move the flex and pull point from the head of the load cell, with use of a plastic tie, to a neutral point on the body of the load cell. This will dramatically reduce wiring fatigue and breakage.

Because this breakage is contained within the sheathing, it is not apparent, and may only be detected by confirming the output accuracy of the load cell.

We recommend using Check & Tweak to confirm accuracy, and inspect the wiring of the load cell for spikes or movement in measurement (integrity) near or on the day of a visit and at least once a week prior to a visit.

Once this is accomplished, there may be no need to repeat the process more frequently, unless a problem is suspected or observed, or a sponsor/protocol calls for additional documentation.

If a concern is present, then utilize Check and Tweak to confirm accuracy and document the input instruments.

✘ **NOTE** – It may be advisable to have a second or replacement sm250 load cell or hand dynamometer available for testing. If the primary unit is found to have a problem the testing process is not interrupted and patients are not inconvenienced. Contact Support@AEVERL.com. for assistance.

5.7 Best data practices of the QMA system

I - System Accuracy – Input instruments utilized in the QMA system are selected for their manufactured excellence, including native accuracy, sensitivity, expected hysteresis and nonlinearity, and lack of drift.

- A. Algorithms are utilized to set the accuracy of the various load cells to a known calibrated and certified weight.
- B. Check and Tweak is a subroutine initialized to set the accuracy of each of the input instruments, and may be modified periodically as discussed in 5.6.
- C. Each time check & tweak is utilized & completed successfully, a QMA Calibration Log file is generated to document the longitudinal history and periodic modification of the algorithms of each input instrument.

II – Hierarchy of Documentation

- A Hierarchy is established by the utilization of Directories as follows:
 - a. QMA application /
 - b. Protocol Name /
 - c. ID of subject/patient
 - d. Visit Number /
 - e. Test Names (Raw Data) and Summary file

III. Check and Tweak

- A. Checking and Tweaking is utilized to confirm, modify and **document** the accuracy of each of the input instruments. (see 5.3 – 5.6)
 1. Notation is made on utilizing C&T as a confirmation of accuracy with and without documentation. (see 5.3 II 7)
 - a. Recommendation is made to document all modifications of data.
 2. Selecting DONE writes and saves entries (TWEAK) made to the Sysinfo.txt file and the Calibration Log File (CLF)(longitudinal record)
 - a. Remove the calibrated or known weights AFTER DONE is selected**
 3. Selecting NEXT – permits the selection of more than one input instrument in succession. At the conclusion of TWEAK, select NEXT and another input instrument is available to check. Remove the weight prior to testing. The CLF is updated at the conclusion of each instruments modification (Next) and write separate files for each instrument.
 4. Selecting CANCEL – ends the choice of instrument, but remains in C&T.- No data is modified or collected
 5. Selecting EXIT CAL – ENDS C&T with no data further modification or data documentation.

IV. Calibrated Weight Set / Recalibration - Recertification

- A. A certified calibrated weight set may be available to you to utilize in Check & Tweak.
- B. Troemner Manufacturing recommends to the weight set owner to have the weight set recertified and recalibrated at their discretion from one to five years / but not to exceed five years.

V –Correcting an Error in Testing

1. Trace in Test rejected – Patient/ Subject does not provide acceptable effort.
NOTICE: Subject learning how to provide good effort, may not give full effort. Subject may be tiring on multiple efforts in same test and efforts are not representative of the subjects' normal effort.
 - A. When collecting Maximum effort only, recommend reject if effort is a spike.
 1. A spike (greater than normal effort by subject) may be caused by the subject exerting a single un-sustained effort or burst.
 - B. When collecting MEAN of effort / it is important to reject traces that are inconsistent with normal efforts of the subject.
 1. If efforts are 58.63 and 58.11, and another trace is 49.81/ the lower trace will reduce the overall Mean & may not represent the true effort of the individual.
2. The PT may select reasons that the trace is being rejected and a comment field is available to elaborate or collaborate on the reason of the rejection.
 - A. PT may select reason – Unable to test due to pain, instrument slipped or make their own comment: Subject caused spike in measured effort.
 - B. PT or assistant may make comment for the rejection in the area provided.
 - C. If agreement is made to reject a trace / do it now.
You do not have the option to reject a trace later in the data fields.
3. **How To document effort to be rejected:**
 1. Complete all of the traces in the test / example /Elbow Extension Left
 - 2, Select ALL – from the Lower Dashboard
 3. Select the TRACE (s) to reject
 4. Print Screen to **document** trace (s) to be rejected
 5. Open Paint – and paste contents from Print Screen onto the canvas.
 - a/ Save the paint canvas – QMA directory\“protocol” “patient” “Visit” “Test”
 6. Ok the rejection of the Trace(s)
 7. Select and Make comment as to the reason to the rejection and OK
 8. Select Next to move to next TEST..

4. Fix Test - Tested left side as right – need to correct – this will minimize the fatigue of the patient
 - A. Proceed to test the right side of the Test & accept if acceptable effort made.
 - B. Go to File and select Fix Test
 - C. Proceed to SWAP the two tests, make comment and OK.
 - D. The test files are corrected and contain the reasoning made for the correction.
 - E. **Testing data is retained.**
 - F. Comment is made in each of the .dat raw data files effected / (open with Excel)

5. Fix Test – After test is accepted / situation requires that test is rejected
 - A. Highlight test and side to be deleted
 - B. Area for Comment by PT is provided for explanation
 - C. complete as led by script
 - D. Test is deleted.
 - E. **Testing data is retained** in the .dat raw data files effected (open with Excel) and in summary file (Open with Word) of the test effected.

6. Visit Deleted after Test rejected – Subject is not able to complete tests (fatigue, illness, nausea, etc) and Visit is stopped.
 - A. Area for Comment by PT is provided for explanation
 - B. Test Visit is retained but the visit number is marked xxx – 000001.xxx
 - C. The Visit data is not acceptable
 - D. Test sequence is maintained when a new visit is initiated.
 - E. **Documentation** - Test data may be viewed in .dat raw data files effected (open with Excel) and in summary file (Open with Word), but is not included in usable data.
 - F. See hierarchy of data documentation / II 1

7. Visit deleted after test data is accepted - - Subject is not able to complete tests (fatigue, illness, nausea, etc) and Visit is stopped.
 - A. Area for Comment by PT is provided for explanation
 - B. Test Visit is retained but marked xxx – – 00000001.xxx
 - C. The Visit data is not acceptable
 - D. Test sequence is maintained when a new visit is initiated
 - E. **Documentation** - Test data may be viewed in raw data file and summary file, but is not included as usable data.
 - F. See hierarchy of data documentation / II 1

VI – Inter-Rater Reliability

It is important that the test results of a patient are consistent from one certified testing personnel to another.

1. A standard for the testing of each muscle or muscle group may be established.
2. The standard may be a guide; such as the Maximal Voluntary Isometric Contraction Testing and Patient Positioning Manual / Lindsay Alfano, Linda Lowes and Wendy King / or standard method of consensus of Institution, sponsor or PTs.
3. Train and certify each new physical therapists (pt) that will utilize the QMA system in the use of the QMA system.
4. Train each new physical therapist (pt) in the placement and positioning of patients for each muscle or muscle group.
5. Utilize or establish a percentage of acceptable variation of measured results for each test.
6. Compare the testing results of a visit of a new pt to those of an experienced PT / recommend using the same patient and same tests for comparison.
7. Utilize the efforts of new pts after they have exhibited consistent and acceptable testing results.

6. File Structure and Format

6.1 File Structure and Format

Located within QMA (C:\ drive default), the PROTOCOL is the parent directory. Each Patient has a unique information directory sorted by patient identifier or screen number under the **Protocol** directory. Files are tab delimited and may be accessed through **Microsoft - Notepad, WordPad, Word, or Excel.**

Each visit of that patient opens a new directory under his patient identifier or screen number, with the data of that visit building individual files and a summary file of the requested data of each test.

All files are stamped with time and date, to protect the integrity of the data. Unaccepted trials or visits are noted with XXX.

6.1.1 PATIENT HIERARCHAL DATA LINKING:

C:\QMA\PROTOCOL

\Measurement info, (measinfo.txt Units – 0 = LB, 1 = KG, 2 = Newton)

\Test Names, (Testinfo.txt describes type of test, test description, max graph and input device)

\Test Order (An array is constructed for the tests order – computer friendly but not user friendly)

\Patient ID\Visit Number\testing data and Summary File

✂ - **Hint** – In **Notepad** - Under file and format, Set the global Font to 10 or as needed, to correct word wrapping and data carrying forward.

✂✂ - **NOTE** - **The current protocol in use by QMA may not be replaced or transferred.** In QMA, select or make a new protocol, and select it as the current protocol - close QMA, & then copy or replace desired protocols.

✂✂ - **NOTE** – It is strongly advised to **NEVER USE “NEW PROTOCOL”** as an active testing protocol. **NEW PROTOCOL may be overwritten with updates.**

6.2 Maintaining directory and file structure - copy or backup.

Patient information and the location to copy or backup may be selected.

6.2.1

1. In FILE, scroll down to COPY
2. Use scroll bar to choose on of the following:
 - a. All patients all visits
 - b. One patient all visits
 - c. One patient one visit
3. Use the locator to choose the drive or media, and OK

7. Graph Plots and Cursors Animation Option

7.1 Graph, Plots and Cursors Defined

Plot and cursor animated images may be utilized to track the efforts of the patient. These may be changed for the test desired in the setup of the testing. The size of the images may not be modified in QMA.

7.2 Maintaining Animations – File Location

- 7.2.a All Images – Plot and Cursor are expected to be found in the path <QMA Directory>\Plot Images
- 7.2.b Plot Images may be .bmp, .jpg or .png files Only .png files support transparency.
- 7.2.c Cursor Images must be a cursor file (.cur or .ani)
- 7.2.d The size of the images may not be modified within the QMA application, but may be resized or modified with applications such as:
GIMP: <http://www.gimp.org/downloads/> or
RealWorld Cursor Editor: <http://www.rw-designer.com/cursor-maker>

✂ **NOTE** Applications are suggested and are not endorsed.

7.3 Change Plot or Cursor – Simplified

Depending on which type of test is running, the section corresponding will be used to setup the plot. Basic testing are currently setup in the INI file.

- 7.3.a A test may utilize a specific plot and cursor image.
- 7.3.b The Plot Image directory holds the images that may be utilized. This directory may be opened and the imaged viewed. Note the complete name for images that may be desired to be utilized.
- 7.3.c The Plot Setup file defines the image to the test.
 - 1, Open the Plot setup file and view the construction and placement.
 2. The PLOTFOREGROUNDIMAGE is the image tracking the patient effort. Please notice that it is the full name of the file, and placed within the quotation indicators.
 3. The CURSORIMAGE is the image for the cursor. Same criteria.
- 7.3.d One or both of the images may be changed.
- 7.3.e In the event the desired image is not active when testing, the cause may be an error in name or quotations of either the cursor or plot.

7.4 Plot, Cursor, Background Defined

.The characteristics of each of the above are controlled by functions of Labview a coding application from National Instruments:

- `backgroundColor` - the background color to use for the graph. This is a number corresponding to LabVIEW's color value.
- `plotColors` - an array of colors to use for the plots. if changing the number of values here, make sure the `size(s)` number gets updated. Again, this is a number corresponding to LabVIEW's color value.
- `useGraphics` - Whether to use graphics on the plot or not. Note that if this is set to false, none of the settings below do anything. The colors still are used, though.
- `plotBackgroundImage` - the image to use for the plot background. Note that this is filename only and not full path. It is assumed to be in `<QMA Directory>\Plot Images`.
- `plotForegroundImage` - the image to use for the plot point. Note that this is filename only and not full path. It is assumed to be in `<QMA Directory>\Plot Images`.
- `cursorImage` - the cursor file to use. Note that this is filename only and not full path. It is assumed to be in `<QMA Directory>\Plot Images`.
- `cursorHotspotX` - this sets the "point" of the cursor. In pixels, from the top, left corner of the image, this is what is considered the pointer of the cursor to press buttons, etc. this is the X value.
- `cursorHotspotY` - this sets the "point" of the cursor. In pixels, from the top, left corner of the image, this is what is considered the pointer of the cursor to press buttons, etc. this is the Y value

8. Locate and Identify the Analog/Digital Converter associated with your QMA System

8.1 An Analog/Digital Converter is associated with this system that may be found for evaluation and serial number retrieval.

- A. Make certain the distribution box is connected to the PC/notebook, and recognized by the computer system.
- B. On your Desktop / find an icon for MEASUREMENT AND AUTOMATION



- C. Double left click icon to begin application
- D. On the top left you will find MY SYSTEM
- E. From MY SYSTEM go down and locate Devices and Interfaces
- F. Double left click icon to open Devices and interfaces
- G. The devices connected will now be visible
- H. Single left click on the Device
- I. The **Serial number** of the device should be visible in the center section
- J. The **NI-DAQmx number** may be visible also.

Notice – This is **not the serial number for the QMA system**, but may be required for the QMA serial to be located.

- K. Diagnostic Tests may be run on the Analog/Digital Converter to confirm functionality