Multiple Analysis Cement System (MACS II)

User Manual (P/N 101677665)

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Multiple Analysis Cement System (MACS II) User Manual

Printed in USA

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Document Conventions

The following icons are used in this manual to distinguish elements of text.

	Contains additional information for the reader that is not safety related.
	Describes a situation or practice that if ignored, will result in equipment damage or loss of data.
	**Describes an unsafe condition or practice that, if not corrected, will result in personal injury, possibly death.**

The MACS II is designed for conformance with relevant standards and practices as published by API Subcommittee 10 on Well Cements.

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Table of Contents

Table of Figures

Overview

Section 1

Table of Contents

1.1. Multiple Analysis Cement System II

The Multiple Analysis Cement System (MACS) II is a device that performs static gel strength tests on cement slurry samples. Following are several pictures of the unit.

Figure 1-1 MACS II Front View (Shown with Customer Laptop)

Figure 1-2 MACS II with Door Open

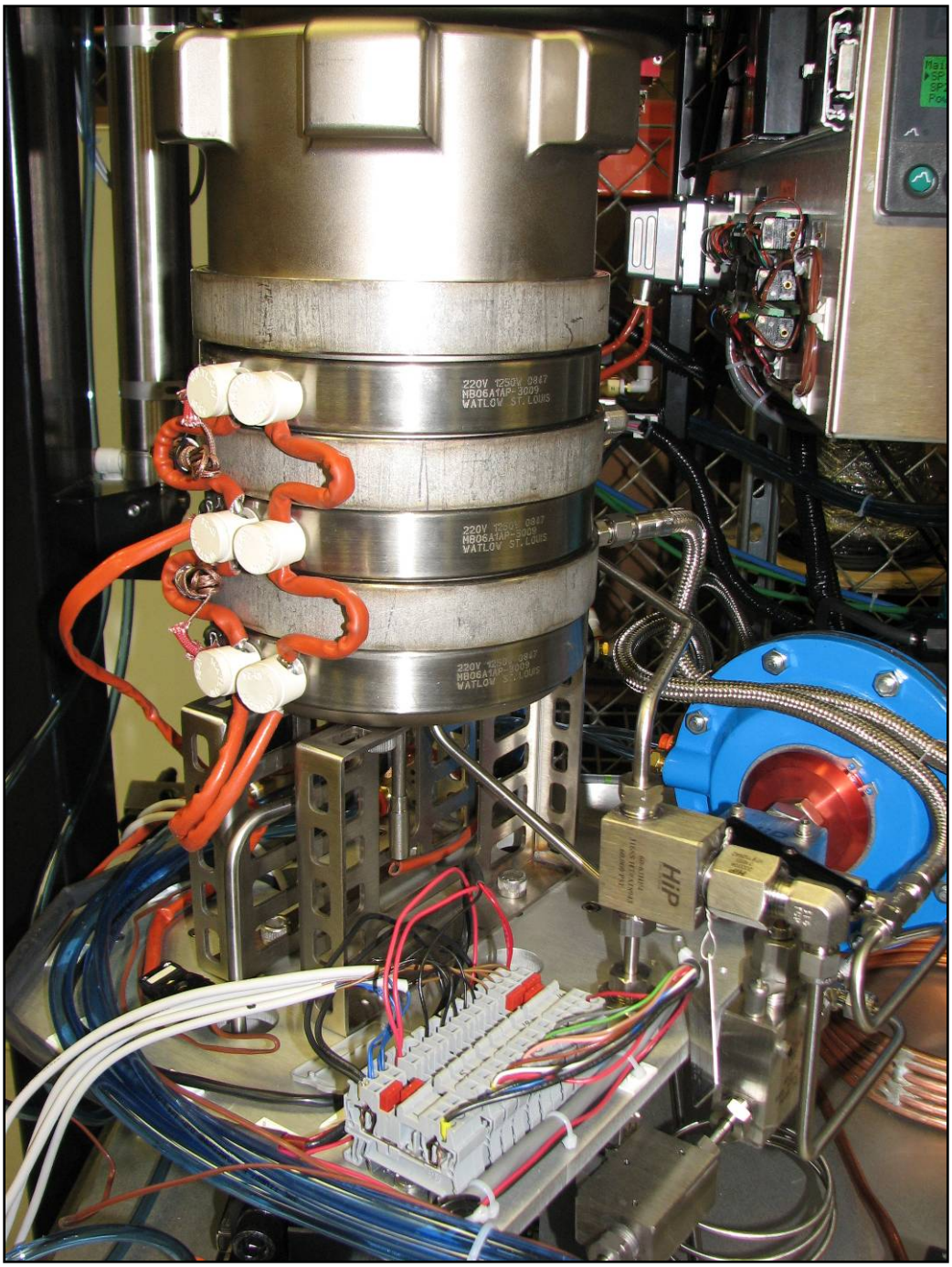

Figure 1-3 Turn Table Assembly And Pressure Cell

The MACS II conducts these tests under simulated down-hole pressure and temperature conditions to determine the following characteristics of cement:

- Transition time.

In these tests, the MACS II accepts a sample of cement slurry and applies a controlled set of temperature, agitation, and pressure parameters that simulate the

down-hole conditions of a well. During testing, it monitors, controls, and records these parameters to form a data set. This data can then be analyzed to assist in predicting the performance of cement slurry in a well.

If a situation exists that a well presents particular problems or special conditions of temperature and/or pressure, the MACS II can assist to minimize possible problems by providing a safe and controlled environment in which to test different cement slurries for the drilling process.

The maximum temperature for the MACS II analyzer is 600°F. The maximum pressure for the MACS II analyzer is 30,000 PSI.

1.1.1. Transition Time

Transition time is determined by the measuring the static gel strength of cement slurry. Transition time is the elapsed time from the occurrence of static gel strength of 100 lb/100 ft^2 to the occurrence of static get strength of 500 lb/100ft^2.

This test determines the gel strength development of cement slurry after it has been placed in a well and allowed to remain static. Rapid static gel development (short transition time) indicates good gas migration control.

1.2. Special Considerations

The MACS II is a unique device that performs analysis for cement slurry. In order to perform reliable tests, the unit generates significant temperatures and pressures. Care and caution should be exercised to minimize the potential for personal injury and/or damage to facilities.

- The mag drive, pressure inlet port, pressure control port, manual and dump valve ports are all intricately designed so that routine connections and disassembly are not necessary on the chamber. This helps prevent thread wear in the chamber and cap.
- The manual relief valve located in one of the three ports located in the chamber bottom is designed for relieving pressure from the chamber when all other means have failed. Do not use this to routinely relieve pressure. Do not use this manual value until the slurry temperature is below 140°F. .
- When a test is to be run at a higher temperature, use an O-ring rated for higher temperature (P/N 101710014) on the chamber lid. On tests less than 20000 PSI and 250°F, use the standard O-ring (P/N 206712).

Be alert to symptoms indicating the pressure does not reduce. This may be an indication of a blocked control outlet line or filter. The pressure control is a multi tiered design with separate ports being used for pressure up, absolute overpressure safety, manual release, controlled dump and automatic release.

- ❑ Do not use PVC or similar materials for drain lines. The hot water and/or steam can cause melting or other significant damage.
- ❑ Do not pour the slurry down a drain because it can easily clog pipes.
- ❑ If the slurry is hazardous to the environment, use proper disposal procedures.

Safety

Section 2

Table of Contents

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2.1. Machine hazard

MACS II has multiple subsystems that if not understood and operated correctly can be hazardous to the operator which can cause serious harm including death. Faulty procedures or inadequate precautions can also damage the machine rendering it inoperable.

2.1.1. Pressure

The Macs II has pressurized air and water lines that present a hazard if not depressurized before maintenance or disassembly.

Shop air is needed at the unit to operate the hydraulic pump, the pressure control system, the cell lid, the cell body and drawer assemblies. This air is pressured to 100 psi. Before working on any of these devices or connected air lines, shut off the shop air to the machine. The air lines are plastic and are connected by quick-connect type fittings.

Domestic water is used by the machine for cell cooling and as a pressurizing fluid. Shut off the domestic water before working on either of these systems. In some labs, a separate chilled water system is used for cooling below ambient. This system may also be under pressure so it should be turned off or disconnected. The drain line has no pressure on it; it does not need to be disconnected.

The high pressure lines present the greatest hazard as they can hold up to 30,000 PSI water. These lines are ¼ inch OD stainless steel. Operators must ensure that the pressure in these lines has been bled down to zero before attempting to disassemble any lines or access the high pressure filter. Dump any pressure using the manual pressure down system provided in software and verify this by opening the manual dump valve located on the right side of the turn table assembly. Confirm that all pressure in the system has been relieved using the pressure gauge located at front-top of the Macs II machine.

2.1.2. Temperature

The pressure chamber has an electric heating jacket that can heat the cement slurry to 600°F (315°C). The metal jacket and lid itself will be even hotter than that. Before opening the pressure chamber or performing any work on the heating jacket, use the cooling system to lower the temperature below120°F (49°C). Use the temperature display in the software to gauge the temperature.

The coolant return line can be very hot [212°F (100°C)] at the beginning of a cool down cycle. Take precautions to not touch the coolant return line. Connect the coolant return line to drain in a manner which will not cause a burn hazard.

2.1.3. Electrical

The power source for the Macs II is 230 Volts. Disconnect the power from the plug before attempting any electrical or mechanical maintenance.

There are still hot electrical terminals inside the panel when the power switch is turned off It is always safe to physically disconnect the machine from the Power source rather than using Power On/Off Switch to isolate power.

Refer to the electrical schematic before performing any maintenance or troubleshooting.

2.1.4. Pinch Points

The pressure cell, lid and drawer are all controlled by air and operate slowly. However, the operator should not interfere, place tools or body parts in paths of these controlled motion.

The cell assembly is very heavy and can cause severe injury if an obstruction is placed in its path. When Cell motion is initiated keep hands away and well clear of the cell assembly.

The cell lid lifts up and facilitates easy removal of O-ring. While operating Cell Lid make sure to stand clear and keep an unobstructed path for the cell lid.

The cell drawer can also be controlled in and out of the Macs II. Ensure that the front doors are open and that nothing blocks the drawer when the process is initiated. Do not stand in front of this area while Drawer motion is initiated

2.2. Ergonomic Considerations

The Macs II is a large, heavy machine that must be handled carefully when moving during installation or maintenance. The casters allow the machine to be rolled easily in the lab, operators should only roll the machine slowly and should watch for debris on the floor. If the machine must go on an incline or decline, more than one person should help guide it.

The pressure chamber has a heavy lid that that is slowly raised and lowered automatically with air. The cell body as well as the cell drawer is also slowly controlled with air. There are no heavy components that the operator must move other than a sample loaded slurry cup at less than 10 lbs.

2.3. Environmental Considerations

This machine tests cement slurries with additives, using water as a pressurizing fluid. The operator must be aware of proper handling and disposal practices for these materials.

Features and Specifications

Section 3

Table of Contents

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3.1. MACS II Installation Preparation

Qualified Fann staff shall be needed to professionally commission the MACS II system. Before and after commissioning; there are facilities, computing, and knowledge prerequisites that must be meet for the proper functioning of the MACS II device. In addition, certain materials and tools are necessary for the mechanical installation and maintenance that are not supplied with the MACS II system.

There are certain facility requirements to consider in designating a location for the MACS II system. It is necessary to provide a facility space at which to locate and operate the MACS II system that is properly designed, equipped, and HSE assessed for SGS testing.

- ❑ Physical Requirements
- ❑ Operational Considerations
- ❑ Computer Specifications

3.2. Physical Requirements

The MACS II instrument is approximately 146 ft^3 (4.15 m^3) in size. It occupies an area of 52.0 in. D x 58.0 in. W (132 x 48cm) or 20.0 ft^2 (2.00 m^2) of floor space.

For safe access, installation and continued reliable operation, Fann recommends 12 in. clearance in the back and on the side of the unit. In the front at least 18 in. of clearance is needed. Minimum space dimension requirements are as follows.

Description	Measurement
Width (front and back)	35.0 in (89 cm)
Depth (sides)	28.0 in (72 cm)
Height (floor-to-roof)	80.00 in (203 cm)
Total floor space	52.0 in. D x 58.0 in. W (132 x 148 cm)
Total floor area	20.0 ft^2 (2.00 m^2)
Weight	750 Lbs (340 Kgs)

Refer to Section 9 Accessories and Schematics for more information.

3.3. Operational Considerations

The operation of the MACS II requires electric connection and supply/drainage of compressed air, water, and/or coolant. These services need to be available at the location where the MACS II system resides, as per the following minimum specifications.

Description	Measurement
Electric	Single-phase 230 V, 30 Amps, 50/60 Hz AC power supply
Compressed air	100 PSI (0.79 MPa), filtered, 50 micron
Water	30 PSI (0.31 MPa), filtered, 250 micron/60 mesh
Water drain	212°F (100°C)
Coolant In & Out differential	5PSI (0.14 MPa)

The machine comes equipped with Power Cord which has a specific 250V/30A power plug (Fann P/N 101648380, Hubbell P/N HBL2621) Please ensure you have a suitable electrical outlet that mates with the supplied Power cord.

3.4. Computer Specifications

The MACS II system includes state-of-the-art software that runs on a Microsoft Windows-based computer connected via USB. The software can also receive updates via the Internet. Provided with the MACS II is a DVD-ROM containing the software to install on the computer.

Following are the minimum computer system requirements for the MACS II system.

Component	Specification
Type of computer	Laptop or small form factor PC
Operating system	Microsoft Windows® XP or Windows® 7
Processor	Single or dual core, 1.6 MHz clock speed, Intel or AMD
Memory	2 GB of RAM
Graphics	WSXGA (1200x800) resolution or higher
Hard drive	5 GB available
Optical drive	DVD
Input devices	Keyboard and mouse
Internet access	1.5 Mbits/s data transmission rate (Tier 1 broadband)

Fann does not include a computer with the MACS II system for running the software provided on the DVD-ROM. The computer is the sole responsibility of the user and must be purchased separately.

Installation

Section 4

Table of Contents

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4.1. Pre-Installation Considerations

Before installing the MACS II, the operator has these knowledge prerequisites:

- ❑ Mechanical/Pneumatic/Hydraulic familiarity.
- ❑ Basic Microsoft Windows familiarity
- ❑ Knowledge of Gel Strength test procedures

The physical installation of the equipment requires the following materials and tools:

- ❑ Tubing for water in/out and hot water discharge
- ❑ Tubing for air in (100 PSI minimum)
- ❑ External chiller (if testing below ambient temperature)
- ❑ Connectors and fittings (pneumatic & hydraulic)
- ❑ Adjustable wrenches and/or pliers

The installation consists of two separate components:

- ❑ Hardware (Mechanical) Installation
- ❑ Software Installation

4.2. Hardware (Mechanical) Installation

This section for the hardware installation assumes the site for the equipment has been prepared and contains all of the requisite electrical and plumbing components to install the equipment.

4.2.1. Water, Air, and Coolant Connections

In order to function, it is necessary to connect the MACS II to water, compressed air, and coolant sources. Ports for connecting these services are on the back of the unit.

Component	Connect to…
Air In (100 PSI minimum)	Compressed air supply
Water In (30-60 PSI)	City water supply
Water Out (Open, No restrictions)	City water supply
Hot Out (Open, No restrictions)	Drain
Chill In	Coolant supply
Chill Out	Coolant supply

This list is the correct order of the connectors on the back of the unit. Figure 4-1 shows the type and arrangement of hydraulic and pneumatic ports in the back of the MACS II unit. Use only flexible hose lines for connecting the services to the ports.

The available ports are 0.25 inch (0.635 cm) female national pipe thread labeled as follows:

WARNING Always use separate hoses for connecting “Water Out” and “Hot Out” ports to drain. Never use a single hose with a T-connector for these two outlets.

Figure 4-1 MACS II Hydraulic and Pneumatic Ports

WARNING Depending on the cooling fluid and ambient conditions at the site, it is possible for drained coolant to be classified as a hazardous waste. This is because of high pH or high lead content. Therefore, disposal of coolant may require special procedures and compliance with local, state, or federal environmental regulations.

4.2.2. Electric Power Connection

The MACS II is supplied with a 6 foot (1.83 m), 50 amp power cord to connect to a current protected electrical outlet. Because of the variety of electrical outlets throughout the world, a plug is not already attached. Wire the MACS II directly into an electrical disconnect (circuit breaker) or attach an appropriate plug and connect the MACS II into an electrical outlet with fault interrupt protection.

There is also a 110 volt outlet on the back of the unit for powering the computer that runs the MACS II software. This outlet should be used with a laptop computer only. A desktop computer initiates a shutdown in case of power glitch losing the test.

4.2.3. Power Up MACS II Unit

Ensure that the circuit breaker or circuit interrupt reset is engaged before powering on the MACS II unit. Use the power switch located at the back of the unit to switch “on” the MACS II unit.

4.2.4. Initial Verification of Alignment

The following methods are available to adjust the MACS II to achieve the optimal alignment of the cell bottom to the cell top.

- ❑ X Direction (left-right). Use the pillow block fixtures to align the cell top with the cell bottom.

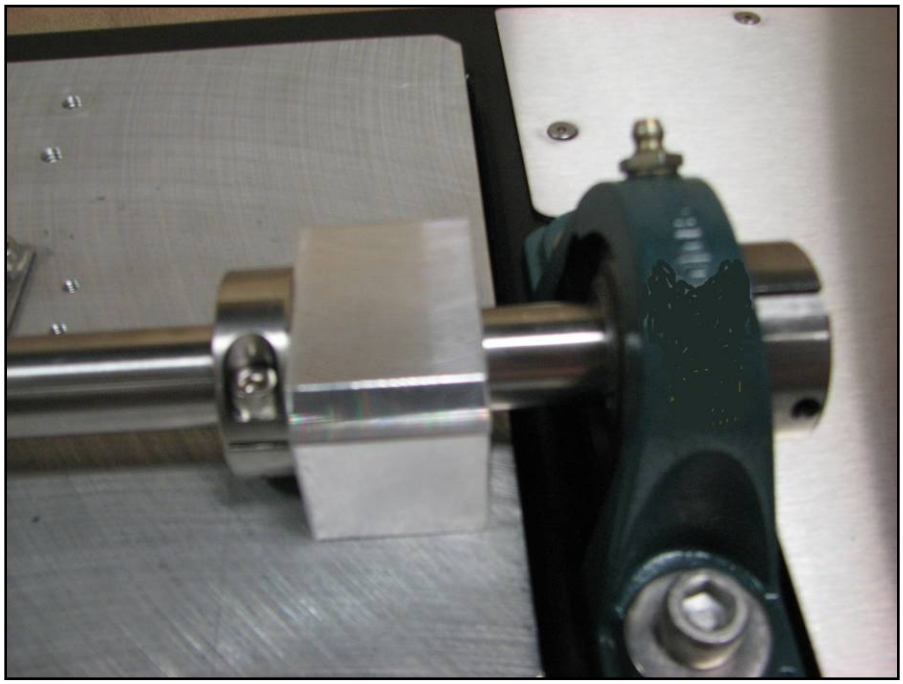

Figure 4-2 X Direction Adjustment

- Y Direction (up-down). Use the bolting mechanism on the actuator to raise or lower the cell bottom.

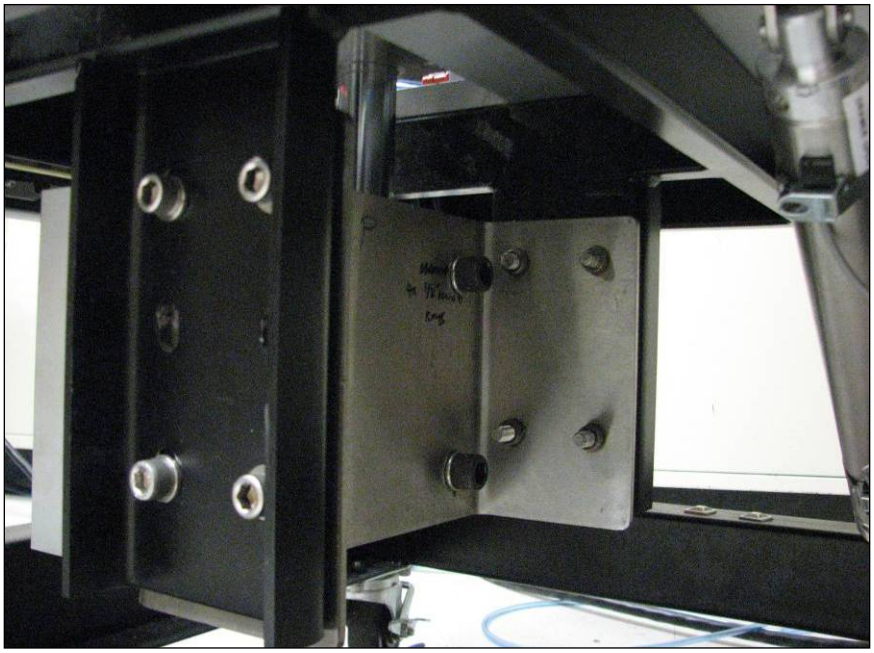

Figure 4-3 Y Direction Adjustment

- Z Direction (in-out). Use the drawer cylinder and drawer stop mechanisms to perform this adjustment.

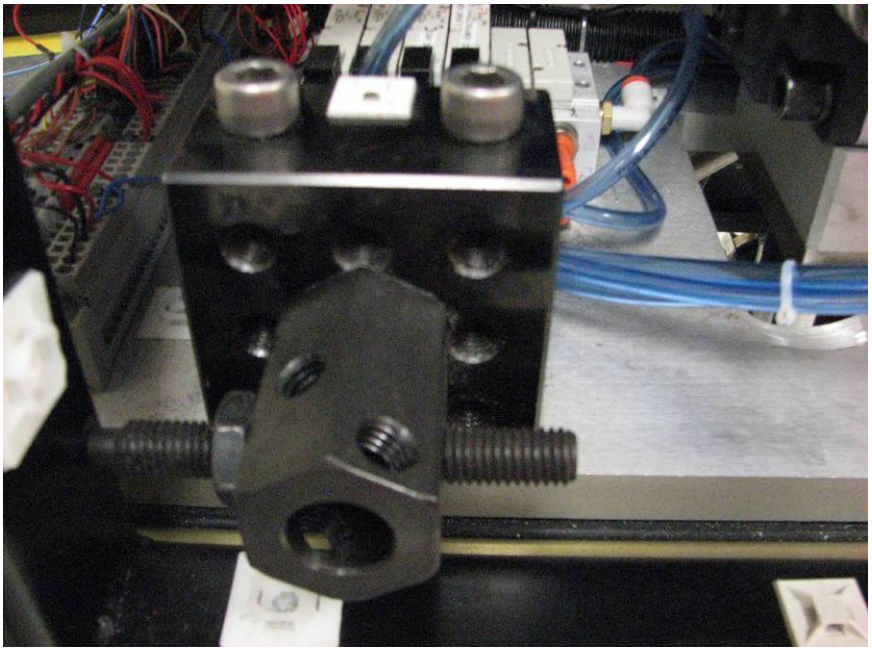

Figure 4-4 Z Direction Adjustment

- ❑ R Direction (rotation). Use the locking bolt on the rotary actuator to adjust the rotation so that the cell tabs are aligned to mate.

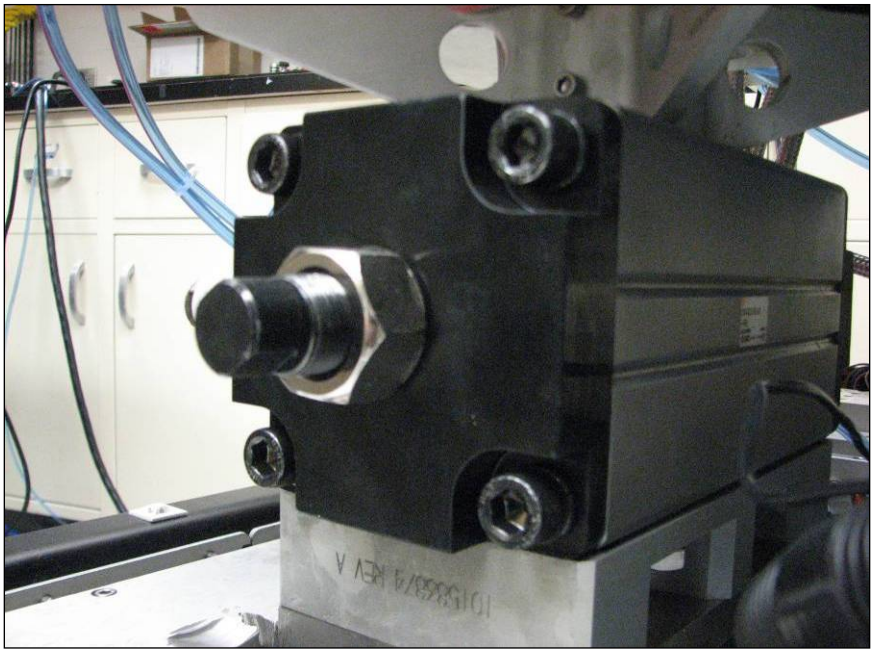

Figure 4-5 R Direction Adjustment

There are several switches that limit the motion of the unit. These include a linear actuator which moves the cell up/down, a rotary actuator that controls cell rotation, and actuating cylinders that control drawer in/out and top plate up/down.

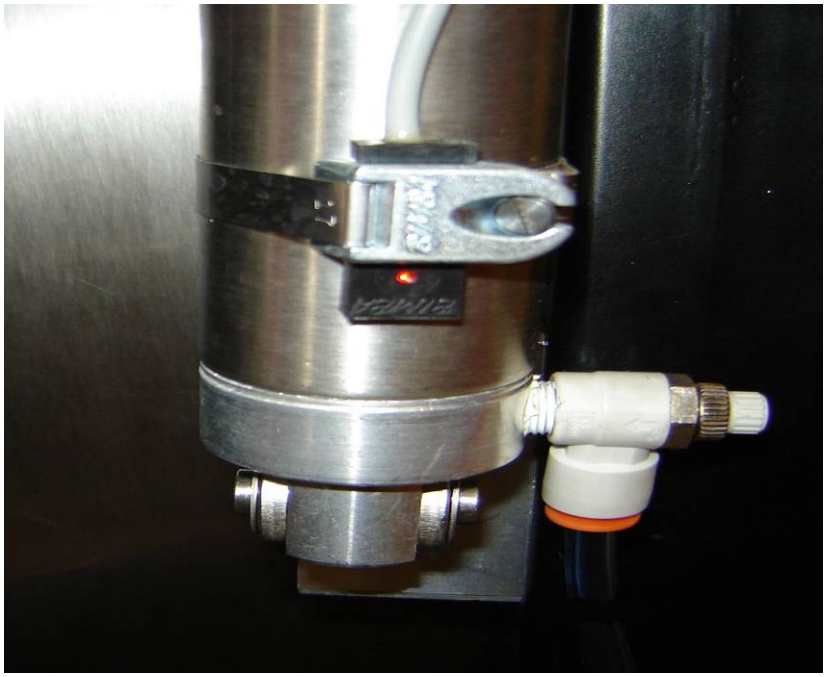

Figure 4-6 MACS II Limit Switches

Ensure these limit switches are adjusted to stop the rotation when the end limit is attained.

Use the following checklist to verify proper motion and alignment of the various MCS components. Perform the alignments using the software or by manually actuating the respective solenoids.

- ❑ Verify that the cell top and bottom align and mate properly without interference.
- ❑ Verify that the drawer moves in and out freely.
- ❑ With the drawer at out position, verify that the slurry cup can be easily loaded into the cell.
- ❑ Verify that the top plate assembly raises and lowers properly.
- ❑ Verify that the cell can rise and lower smoothly. If necessary, use 0.020-in and 0.060-in filler gauges to adjust the height. Note that the 0.020-in gauge should move freely between the cell top and cell bottom when the cell is raised. A 0.060-in gauge should not move or be hard to put between the two assemblies.

4.2.5. Water Test

A heated and pressurized water test can detect leaks and other problems. Perform the following steps:

1. Fill the slurry cup with water.
2. Apply heat and pressure to the water to a maximum of 250°F (121.1°C) and 20,000 PSI (137.9 MPa; 1,406.5 Kg/cm; 1,379.3 Bar).
3. Inspect for any leaks or other obvious problems.
4. Fix minor problems by tightening or reconnecting.
5. Document any problems found and contact Fann Customer Support.

4.3. Software Installation

Fann provides the following software to operate and configure the MACS II on a DVD-ROM included with the system:

- ❑ MACS II SGS Software Components
- ❑ Edgeport USB Drivers for Microsoft Windows

Install the software on the dedicated computer associated with the unit. Verify that this computer meets or exceeds the requirements. Refer to Section 3.4 Computer Specifications for computer hardware specifications to run the MACS II SGS software.

If you have experience installing software on Microsoft Windows operating systems, the instructions in Section 4.3.1 Software Quick Install may suffice. If a more detailed description is necessary, refer to Section 4.3.2 MACS II SGS Software Installation.

- ❑ Software Quick Install
- ❑ MACS II SGS Software Installation
- ❑ USB Connection Configuration
- ❑ Software Updates

4.3.1. Software Quick Install

Perform the following procedure for a quick install of the MACS II software:

1. Run the Setup program on the DVD to launch the MACS II software installation wizard.
2. Read the dialogs and follow the on-screen prompts.
3. When prompted, shutdown the computer.
4. With the computer turned “off”, connect the two provided USB cables from the MACS II device to the computer.
5. Power “on” the computer and it should find the new hardware and install the USB drivers.
6. If the computer prompts for a search for compatible drivers, browse to the **Edgeport** folder on the hard drive root (typically C:\Edgeport).

By default, the setup program copies the MACS II USB drivers from the DVD-ROM to the **Edgeport** folder on the hard drive root during installation. Depending on the computer’s operating system configuration, the **Found New Hardware** wizard may or may not install the USB drivers, prompting a manual search for the drivers. For details, refer to Section 4.3.3. USB Connection.

4.3.2. MACS II SGS Software Installation

Perform the following procedure to install the MACS II software:

1. Insert the supplied software installation DVD-ROM into the DVD drive of the computer. If auto run is enabled, the software installation wizard starts automatically. Alternatively, open **Windows Explorer** and navigate to the DVD drive root on the computer. Double click **Setup.exe.**

2. Once the installation wizard loads, read the start screen. Click **Next**.

Click **Back** to return to a previous screen in the wizard.

NOTE

It is possible to exit the wizard at any time during the install. Click **Cancel** to exit the installation wizard.

Rerun the installation wizard from the start when you wish to complete the software installation.

3. Read the product information before proceeding. Optionally, click **Save File** to save this information to the computer as a text file. Click **Next**.
4. Review the installer default locations. Click **Next**. For purposes of automatic online updates, Fann recommends to not change these locations.
5. Read the National Instruments software license agreement. Click **Next**. If you do not accept the agreement, the wizard terminates.
6. Read the Interchangeable Virtual Instruments, Inc. software license agreement. Click **Next**. If you do not accept the agreement, the wizard terminates.
7. Review the list of software to be added to the computer. Optionally, click **Save File** to save this information to the computer as a text file. Click **Next** to start the installation process.
8. During the installation, the progress bars indicate the status of the progress in. To stop the install, click **Cancel** at any time during the process. Rerun the installation wizard from the start when you wish to complete the software installation.
9. The installation wizard prompts upon completion of the installation. Click **Finish**.
10. Once the wizard exits, a message box displays prompting a restart of the computer. Click **Shut Down**. This is necessary for the next step in the installation process.

NOTE

The computer must be powered “off” before connecting it for the first time to the MACS II device via Universal Serial Bus (USB).

4.3.3. USB Connection Configuration

The MACS II system uses Universal Serial Bus (USB) plug and play interface technology to communicate with the MACS II SGS software installed on a Microsoft Windows-based computer. To connect the MACS II device for the first time to the computer with the SGS software, setup the USB connection as follows:

1. Ensure that both the MACS II device and the computer are powered “off”.

2. Plug the “B” type male connector of one of the two supplied USB cables to one of the USB Standard “B” female plugs located on the back of the MACS II. Plug the other USB cable to the remaining female plug on the MACS II.

“B” Type Connector

3. Plug the other end of each of the two supplied USB cables, which is an “A” type male connector, to the USB ports of the dedicated computer.

“A” Type Connector

NOTE

During boot up, the Windows operating system on the computer should detect the USB connection and install the necessary drivers. In this case, the installation is complete and it is not necessary to perform the remaining steps. If it cannot find the drivers however, Windows launches the **Found New Hardware** wizard. Then it is necessary to proceed with the remaining steps below.

4. Read the welcome screen. Select **No, not this time** to respond to the question: Can Windows connect to Windows Update to search for software? Click **Next**.

5. Select **Install from a list or specific location (Advanced)**. Click **Next**.

6. Select **Search for the best driver in these locations**. Select the **Include this location in the search** check box. Click **Browse** to navigate to the path **C:\Edgeport** which is the folder where the USB driver files were copied from the DVD during the MACS II SGS software installation. Click **Next**.

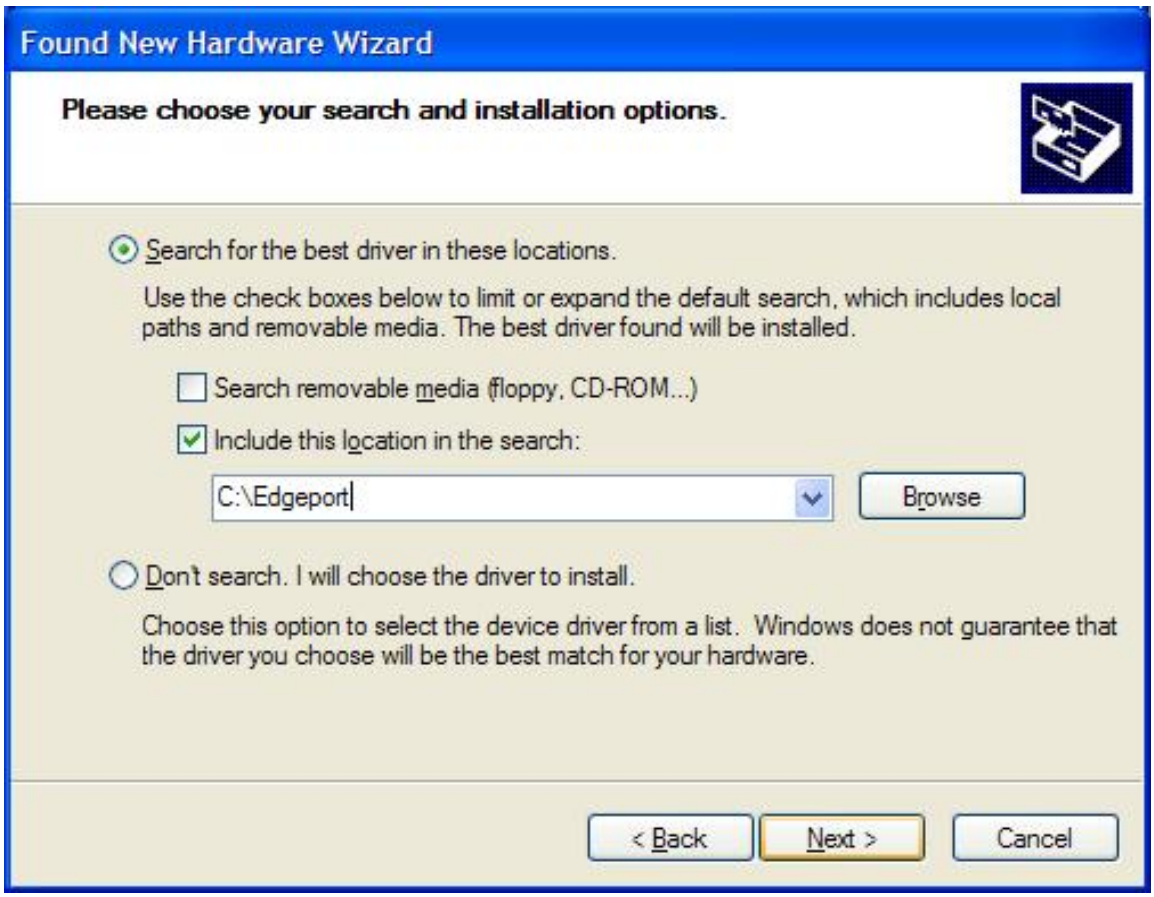

Figure 4-7 Found New Hardware Wizard

7. Once the USB drivers have been installed, the wizard prompts that it has finished installing the **Edgeport** software. Click **Finish.**

If the error dialog box displays, the USB connection may have failed to set up properly. Read this screen and click **Automatic** to proceed with troubleshooting the problem. Alternatively, refer to the instructions from the beginning in Section 4.3.3. USB Connection.

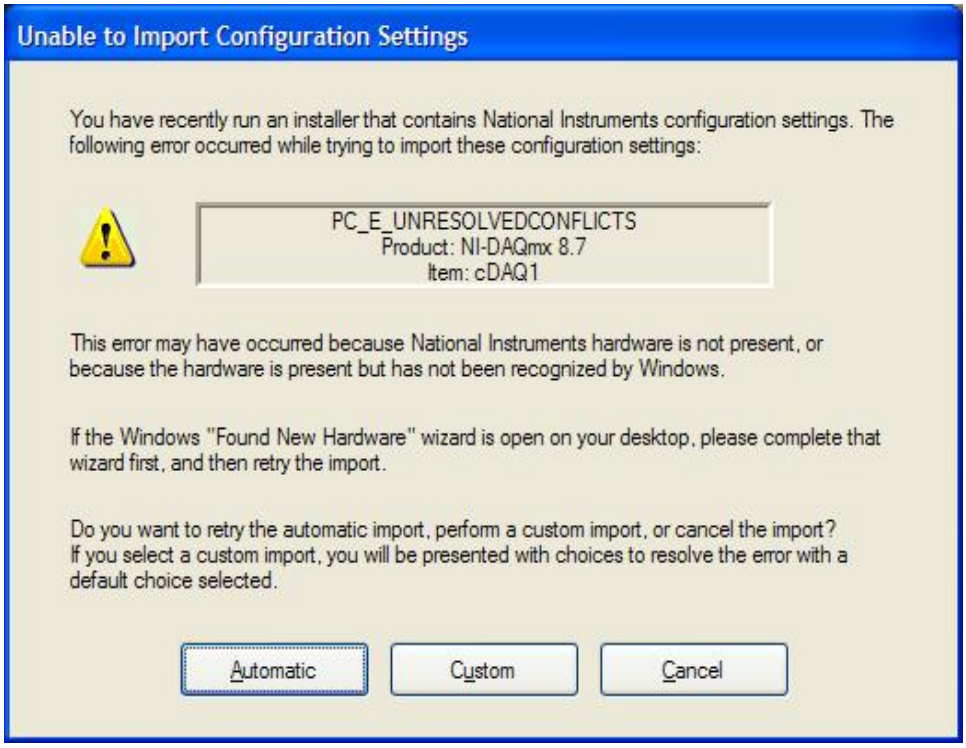

Figure 4-8 Unable to Import Configuration Settings Dialog Box

The MACS II system is ready to perform the post-installation verification procedure. Refer to Section 4.4 Post-Installation Verifications for this information.

4.3.4. Software Updates

The MACS II system is set up to receive automatic software updates remotely over the Internet. When connected to the Internet, click **Help > Check for Updates…** and a dialog box displays.

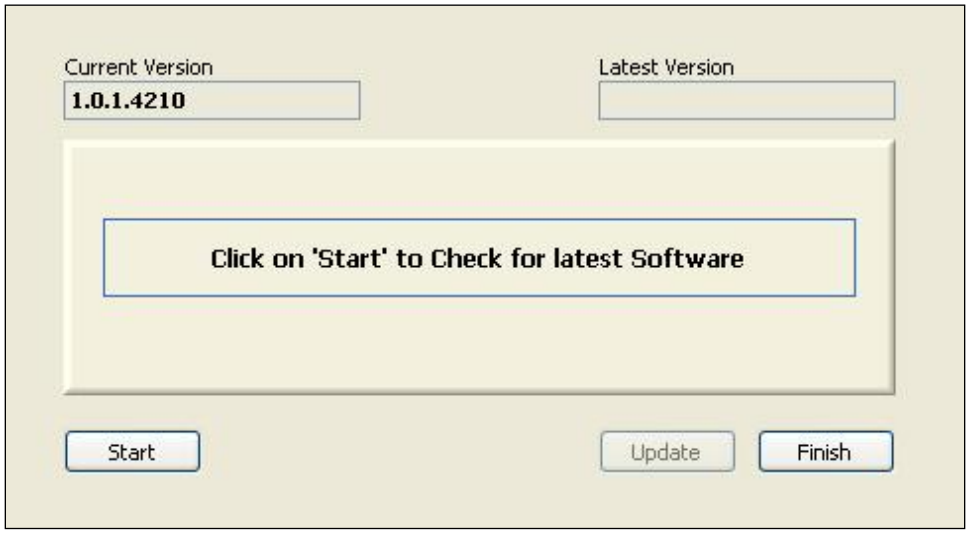

Figure 4-9 Software Updates Dialog Box

Click **Start** to check for updates. If the current version is the latest, a message displays to confirm that status. If a later version is available, it notifies of this event. Click **Update** to download the latest version of the software to the computer.

NOTE

Do not perform this task when running a test. When the software updates, it closes the program and loses all data. It is necessary to restart the program to resume testing.

4.4. Post-Installation Verifications

Before calibrating, configuring, and running tests with the MACS II system, Fann strongly recommends the following post-installation verifications.

Visually inspect the MACS II system for loose connections and fittings or any other obvious problems. Using the appropriate tools, tighten anything that is loose. Be careful not to over-tighten the connections. Verify that none of the hoses leak or that there are any faulty connections. Refer to Section 5 MACS II Software to understand how the MACS II Software operate

Verify the following subsystems using MACS II software.

1. Verify that all valves operate by using the **Operate Valves** screen.
2. Verify that the motor locks and rotates in CW and CCW directions.
3. Verify that the unit pressures up to 2000 PSI.

4. Verify that the unit heats up when temperature setpoint is set 20 degrees above ambient

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MACS II Software

Section 5

TABLE OF CONTENTS

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5.1. Software Basics

Fann MACS II software is intuitive to use. If the user has had experience using Microsoft Windows and has basic knowledge about SGS testing, there should be no difficulty understanding the information in this section or using the software.

Double click the **MACS II** desktop icon. Alternatively from the Windows task bar, select **Start > All Programs > Fann > MACS SGS**. The software loads. A message dialog box displays notifying of this activity. Upon loading, the **Calibration** and **Operate** menus are unavailable (gray) until you connect to the MACS II unit.

5.2. Interface Elements

Figure 5-1 shows the desktop for the MACS II program. Following are descriptions of each of the elements of this interface.

Figure 5-1 MACS II SGS Software Main Screen

The primary components of the desktop include:

- ❑ Menu Bar

- ❑ Variable Indicators
- ❑ Status Indicator
- ❑ Start/Stop Test button
- ❑ Results Graph

5.2.1. Menu Bar

The **Menu Bar**, at the top of the desktop, provides top level control for the program. The available options include:

- ❑ File
- ❑ Edit
- ❑ Calibration
- ❑ Operate
- ❑ Help

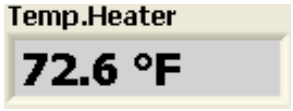
Refer to Section 5.3 File Menu for more information on these options.

5.2.2. Variable Indicators

The variable indicators located across the top of the desktop, display the current values of the measured parameters.

- ❑ **Elapsed Time** – Elapsed time since start of test. Display format is HH:MM:SS.

- ❑ **Temp.Heater** – Current heater temperature. Unit of measure is degrees Fahrenheit.



- ❑ **Temp.Sample** – Current sample temperature. Unit of measure is degrees Fahrenheit.

- ❑ **Torque (oz.in.)** – Current torque value. Unit of measure is ounce-inches.

- ❑ **Pressure** – Current pressure value inside cell. Unit of measure is PSI.

- **SGS (lb/100 Sq. Ft.)** – Current static gel strength (SGS) value as computed from torque value. Unit of measure is lbs/100 ft^2.

5.2.3. Status Indicator

The **Status Indicator**, located right of the variable indicators, displays the mode of the MACS II device, as follows:

- **Idle** – The software is disconnected from the MACS II unit.
- **Connected** – The software is communicating with the MACS II unit and is updating values shown in the indicators.
- **Running** – A test has been started and the software is updating the indicators, the graph, and logging data.
- **Safe Mode** – The Emergency Safety Switch has been activated and the system is inoperable.

5.2.4. Start/Stop Test Button

Click this button to start or stop a test. Depending on the status, the button changes color.

- **Start Test** – When the status is in **Connected** mode, the button displays **Start** and its color is a shade of **blue**. Click to launch the **Start Test** wizard.
- **Stop Test** – When in **Running** mode, the button displays **Stop** and its color is a shade of **green**. Click to abort the test.

NOTE

If stopping a test, it is necessary to restart from the beginning. Refer to Section 5.8 Start Test Wizard for more information on starting, running, and stopping tests.

5.2.5. Results Graph

The Results Graph is the main component and dominant portion of the desktop. It is the large portion of the screen below the variable indicators and status indicator. During a test, the XY Graph displays the temperature, pressure, SGS, and consistency that compose the test results.

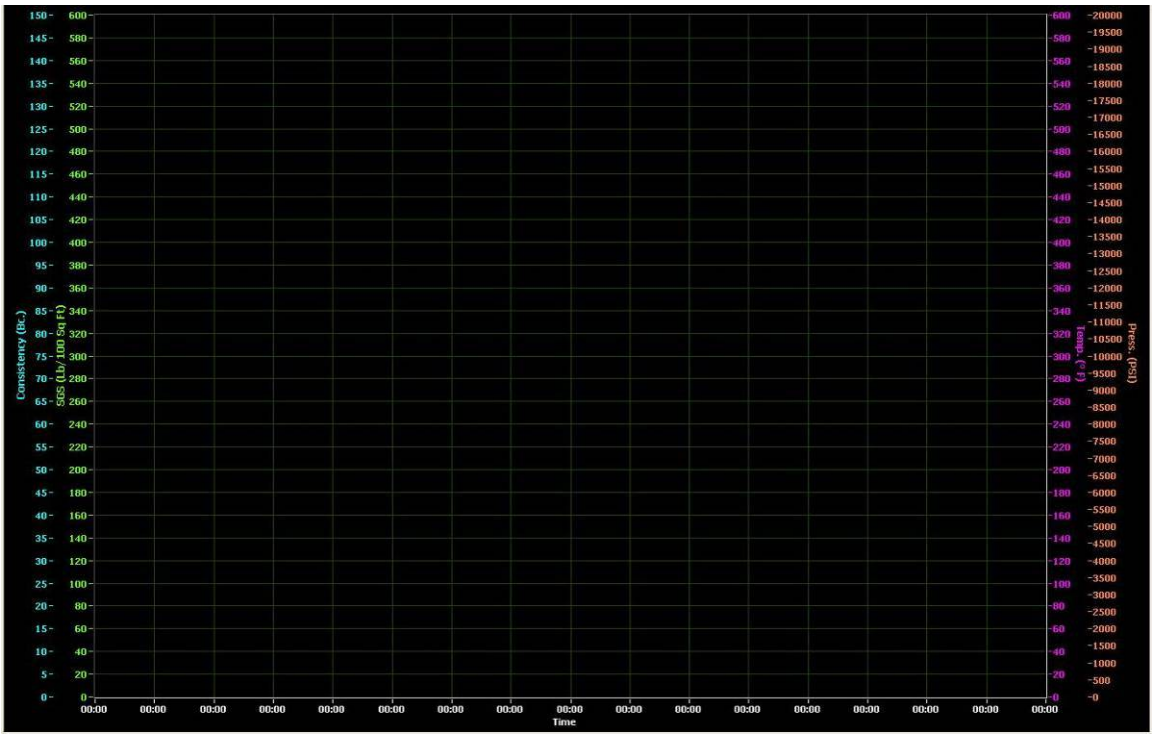


Figure 5-2 XY Graph

With the cursor inside the graph, right click to display a context menu with the following options:

- ❑ Show Bc (factory use only)
- ❑ Show Torque
- ❑ Show Cursor
- ❑ Hide Cursor
- ❑ AutoScale X
- ❑ AutoScale Y

AutoScale Y becomes available only when the mouse hovers over a particular Y-scale. Autoscaling for that particular Y-scale then can be turned “on” or “off”.

5.3. File Menu

The **File Menu** provides access to the following commands:

- ❑ Connect
- ❑ Disconnect
- ❑ Save Data
- ❑ Exit

Depending on the current status of the software connection with the MACS II unit, some of the file menu commands are unavailable (gray). When the status indicator displays **Idle** all other commands except **Connect** & **Exit** are unavailable.

5.3.1. Connect Command

The **Connect** command establishes communication with the MACS II unit.

1. Before connecting, note that the status indicator displays **Idle** and that all measurements are zero.
2. From the **File** menu, choose **Connect**.
3. It may take a couple of minutes to establish the communication link. A "Please Wait..." message displays to notify of this status.
4. The software first automatically adjusts the drive mechanisms. A message displays to notify of this status.
5. The software is now connected to the MACS II unit. The status indicator shows as **Connected**.
6. The **Variable indicators** start displaying current measured values.

5.3.2. Disconnect Command

The **Disconnect** command terminates communication with the MACS II unit.

1. From the **File** menu, choose **Disconnect**.
2. The software is now disconnected from MACS II unit. The status indicator displays **Idle**.

5.3.3. Save Data Command

The system automatically saves test data to the designated location in Step One of the **Start Test** wizard. The **Save Data** command provides a method to save test data to a different location. Both methods of saving data, writes the data with the *.tdms* extension. Note that a test cannot be in progress when executing a save command.

1. From the **File** menu, click **Save**.
2. The software writes the data to the designated drive and file.

5.3.4. Exit

The **Exit** command closes and exits the program.

1. From the file menu, choose **Exit**.
2. The software terminates.

5.4. Edit Menu

The **Edit Menu** controls the settings and configuration of the unit. This menu provides access to the following commands:

- ❑ Machine Settings
- ❑ Profile Editor

> **NOTE** In normal operations, it should be unnecessary to change most of the Machine Settings values and settings in these screens. Only advanced or experienced users should change these values significantly.

5.4.1. Machine Settings

The **Machine Settings** option under the **Edit** menu is a tabbed screen with several options. When first initialized, the **General** tab is the default display. The tabs on this screen include:

- ❑ General
- ❑ Test Header
- ❑ Motion
- ❑ Constants
- ❑ PID

5.4.1.1. General Tab

Click **Edit > Machine Settings** to display the **Edit Machine Settings General** screen. The first display in this group is the **General** tab.

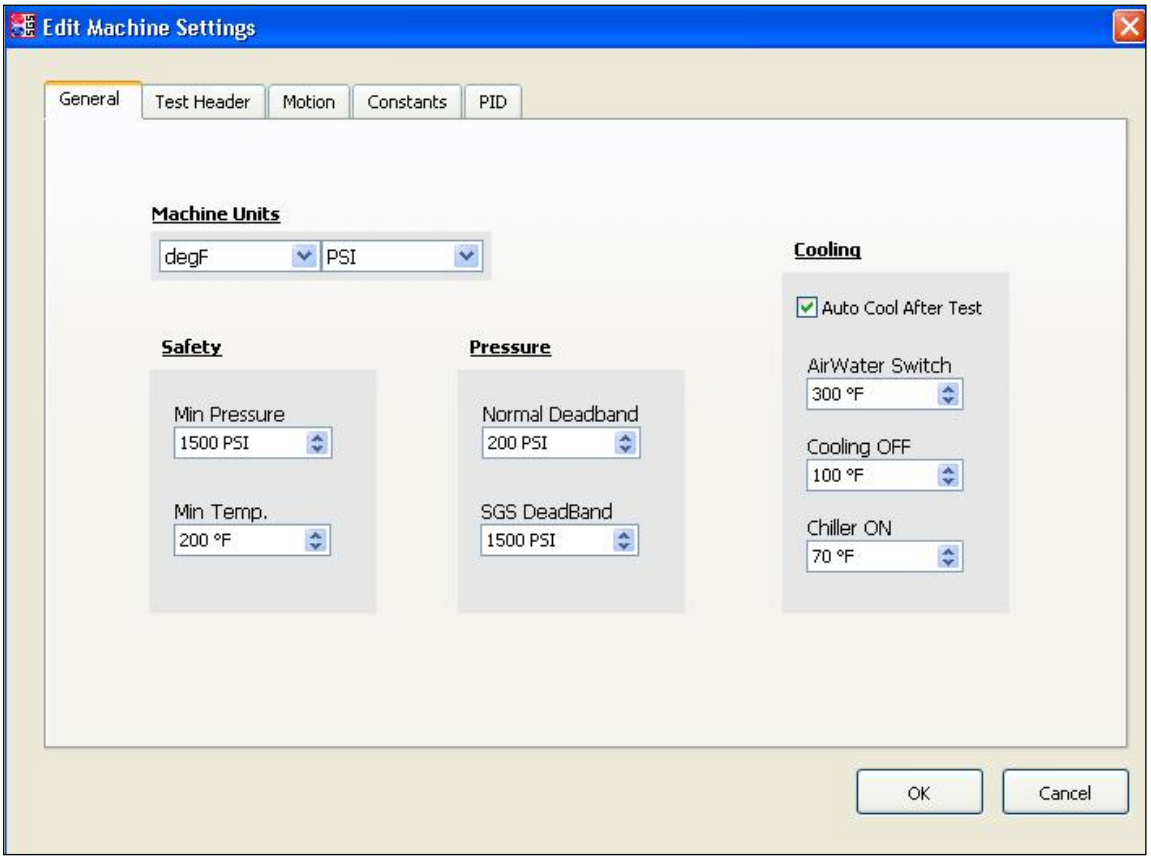


Figure 5-3 General Tab Screen

Below is the explanation of the individual items on this screen

1. **Machine Units** – This is where units of measurement for Temperature and Pressure can be set. Currently, this setting has no functionality as the units are fixed to degF and PSI for temperature and pressure respectively.
2. **Safety** – This section sets up interlocks within the software for safe operation.
    a. **Min Pressure** – This tells the machine to not allow the pressure to drop below the “Min Pressure” value if current temperature is above the “Min Temp.” value.
    b. **Min Temp**. – This determines if pressure can be dropped below the “Min Pressure” value. If current temperature exceeds the “min Temp.” value then pressure cannot be reduced below the safety value.
3. **Pressure** – These setting determines the tolerance to which the pressure seeks to adjust for any given setpoint.
    a. **Normal DeadBand** – If the measured pressure when compared to Set Pressure is within the tolerance as specified by this value, then all

pressure control activity is suspended. Pressure control is resumed once the measured pressure drifts outside of this tolerance value. The nominal tolerance for the machine is 200 PSI.

b. **SGS DeadBand** – This works in the same manner as "Normal DeadBand" except that it is effective only during the Static or Gel phase of the test. Normally during the Static or Gel phase, any pumping of pressure disturbs the gel formation of the cement. By selecting a higher value of pressure tolerance such pumping can be prevented. The disadvantage is that pressure may drift from setpoint by the tolerance specified. Typically this value is set to 1500 PSI.

4. **Cooling** – The cooling action of the machine is controlled by settings in this group.

   a. **Auto Cool After Test** – If this check box is chosen the machine begins a cooling cycle after test is over.

   b. **AirWater Switch** – This determines the cooling medium used for cooling. If the heater temperature is above this value, then air is used as the cooling medium. If the heater temperature is below this value then water is used as the cooling medium.

Be careful when selecting the **AirWater Switch** temperature. If temperature is above 212°F, then the unit uses water to cool a heater above the boiling point of water and superheated steam will come out of the Hot Out line at the back of the machine.

   c. **Cooling Off** – This determines at what sample temperature, cooling automatically turns off.

   d. **Chiller On** – For tests below ambient, an external chiller can be employed. This setting tells the machine to use chiller below the specified temperature. The chiller runs continuously once the temperature setpoint is below the Chiller On temperature.

5.4.1.2. Test Header Tab

From **Edit Machine Settings**, select **Test Header** and the **Test Header** screen displays.

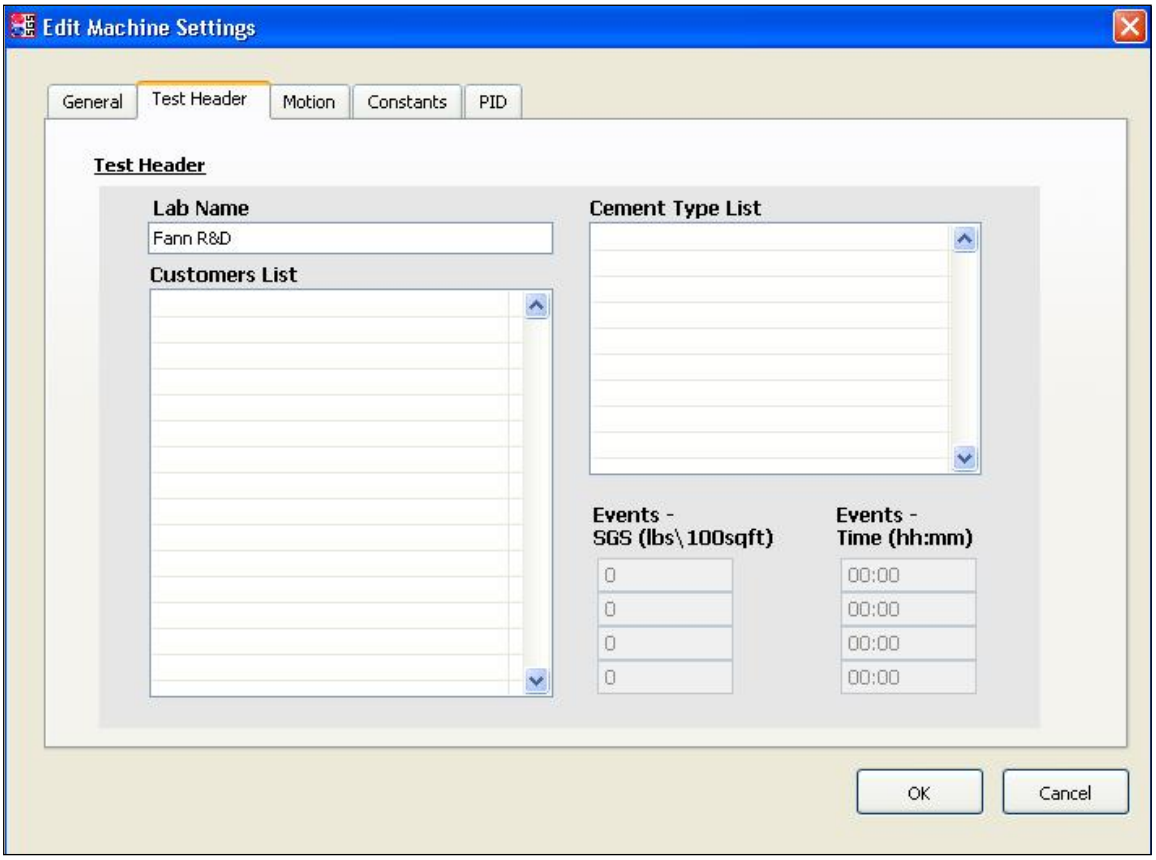


Figure 5-4 Test Header Tab Screen

Below is the explanation of this tab.

1. **Test Header** – By adding values here, the user can make these values default so that these values do not have to be input every time the test information is input.
    a. **Lab Name** – Type the name of the Lab that is desired for every test report. Generally this is the name of the Lab where machine is installed.
    b. **Customers List** – Type names of Customers, so that users can pull customer information on the test Information screen. This way Customer name is always correct and consistent.
    c. **Cement Type List** – Same as above, but this refers to types of cement being used.
    d. **Events SGS** – Type up to four values of SGS for which the program should log the event and its corresponding time.
    e. **Events Time** – Type up to four values of time foe which the program should log the event and its corresponding value in SGS.

NOTE Currently, the events section of this tab is not available. It is necessary for the user to find SGS and Time events manually using the cursor.

5.4.1.3. Motion Tab

From **Edit Machine Settings**, select **Motion** and the **Motion** screen displays.

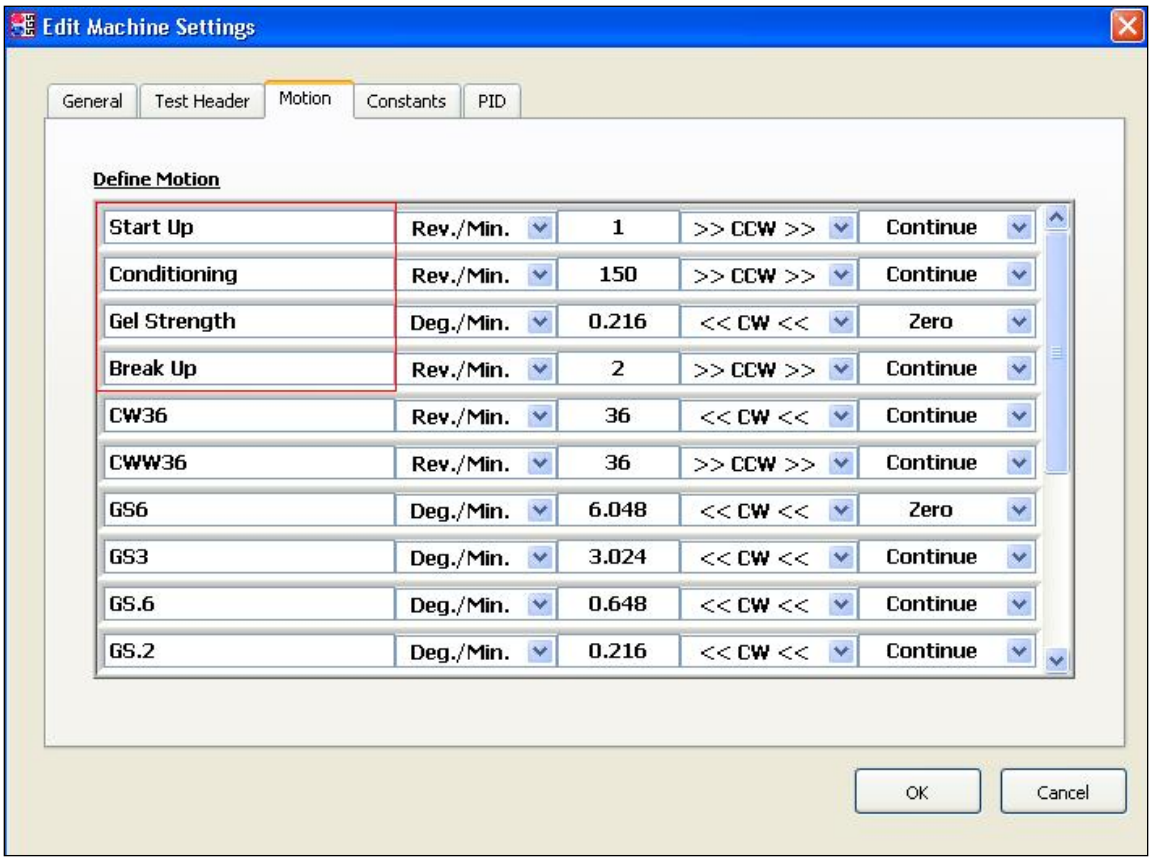


Figure 5-5 Slurry Cup Paddle Motion Tab Screen

In this tab the user can define and name different motions. A test profile is nothing but a collection of different motions running at different temperatures and pressure for a specific period of time. In this way a complex set of motor movements can be accomplished by using the defined motions.

The process of defining a motion consists of the following:

1. Give it a name – Please note that the first four motions cannot be renamed and are factory defaults.
2. Select a unit for motor speed – If Rev./Min .is chosen, it is possible to set speeds from 1 RPM to 150 RPM. If Deg./Min. is chosen, you can set speeds from 0.216 Deg./Min. to 360 Deg./Min.

3. Set motor speed – Type speed of the motor in conjunction with the units chosen above.
4. Select direction of the motor – The direction can be clockwise (CW) or counter clockwise (CCW). The direction is referenced by standing in front of the machine and looking down at the machine.
5. Select Start Mode – The defined motion can be set to begin immediately or can be preceded by the zeroing process. The zeroing process returns the motor to its mechanical zero position before starting the motion as defined by steps 1 to 4 above. The zeroing process ensures that paddle is engaged at all times. The zeroing step is necessary every time the current defined motion is opposite of previous motion.

By defining motions, probability of errors and mistyping is greatly reduced. To delete a particular motion, right click and select option to delete a particular motion.

5.4.1.4. Constants Tab

From **Edit Machine Settings**, select **Constants** and the **Constants** screen displays.

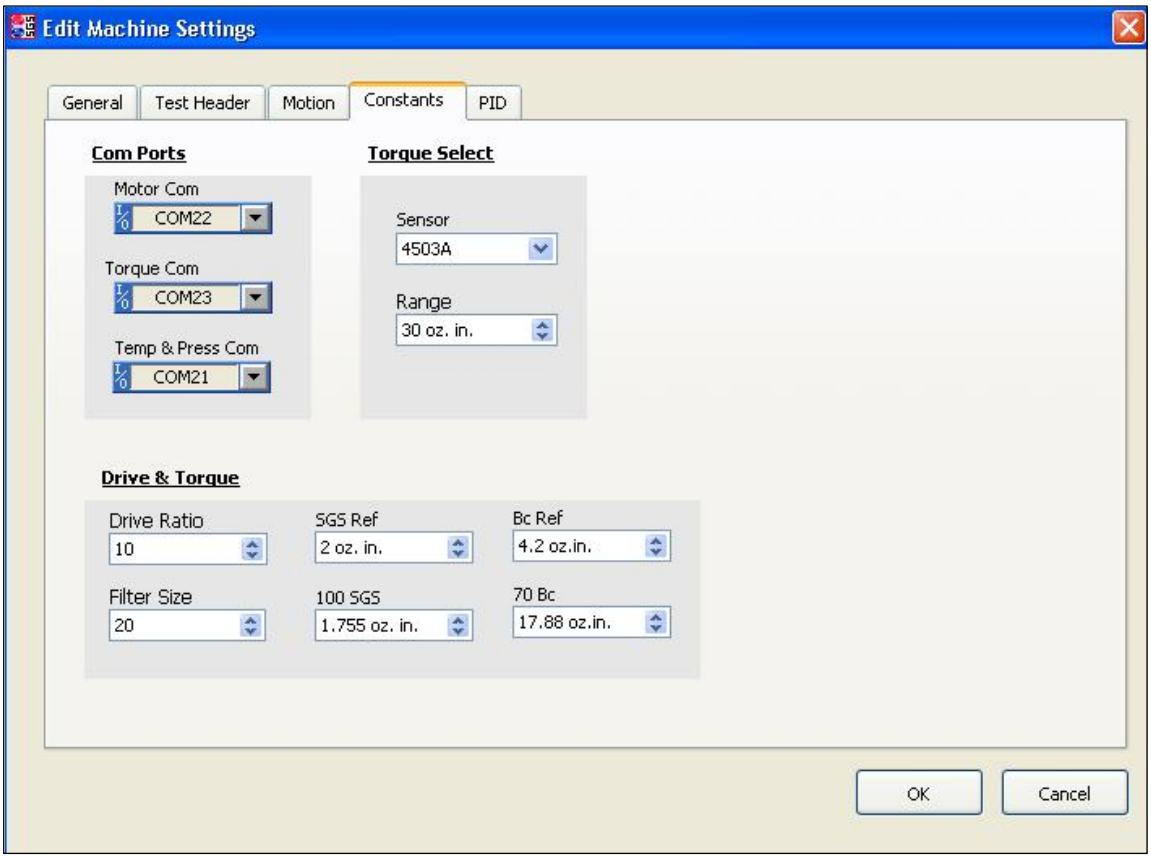


Figure 5-6 Constants Tab Screen

This screen controls motor and torque settings along with the sensor and sensor range selections. Note that these are default values and should not change.

1. **Com Ports** - In the **Com Ports** portion of the screen, use the arrow keys to view a list of available options for **Motor Com**, **Torque Com**, and **Temp & Press Com**. Alternatively, type the appropriate entry in the text boxes.

NOTE Do not change the COM ports unless you are instructed or know the correct COM ports for each of the subsystems

2. **Torque Select -** The machine can be configured to work with three different Torque sensor assemblies. Select the Torque **Sensor** that is installed on your machine and select appropriate range for the chosen sensor.
3. **Drive & Torque** - This controls different aspects of the drive, filter, and torque for the test. For each of these text boxes, type the appropriate value or use the arrow keys to change the values up or down. The Drive ratio is fixed at 10 and Filter size is set to 20. The SGS Reference should not be changed.

5.4.1.5. PID Tab

From Edit Machine Settings, select PID and the PID screen displays.

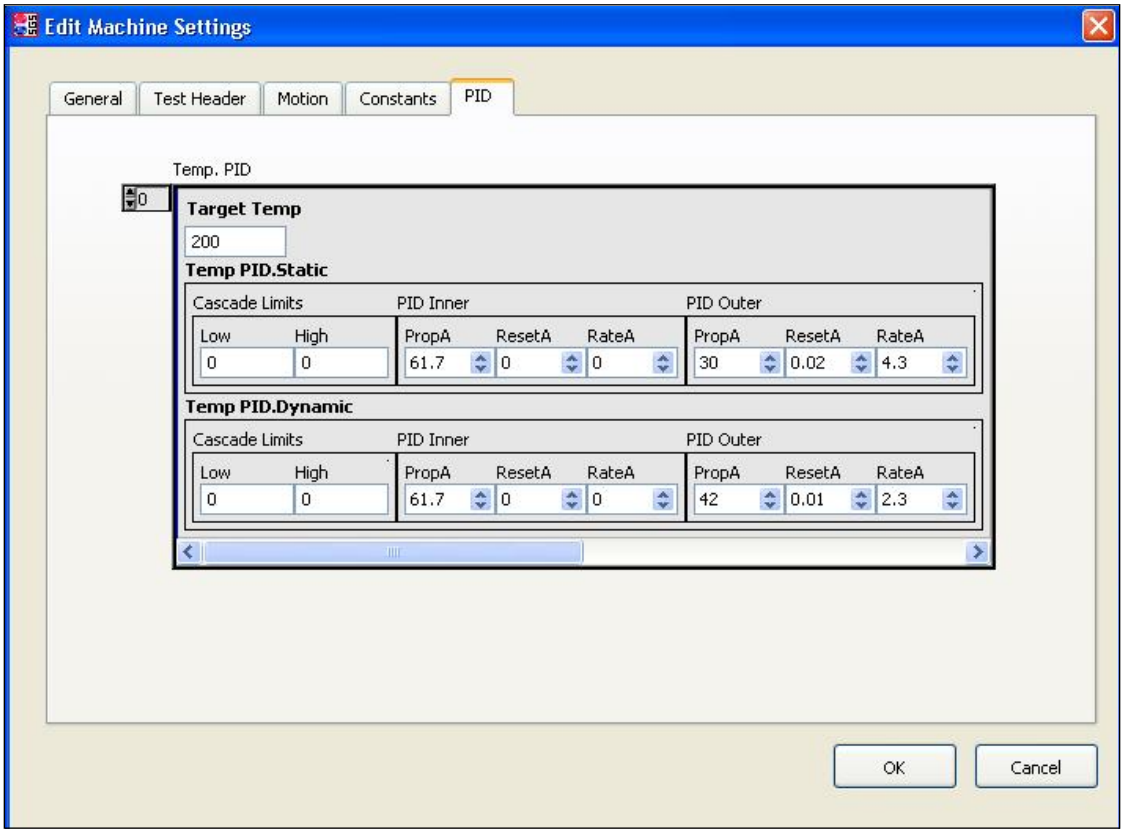


Figure 5-7 PID Tab Screen

This screen manages the configuration constants for the dynamic and static conditions for temperature control. Note that these are default values and only experienced technicians should change these settings.

Click **OK** to save any changes and close this screen. Click **Cancel** to exit this screen without saving any changes.

5.4.2. Profile Editor

Click **Edit > Profile Editor** to display the **Profile Editor** screen to change various settings and values for the testing procedure.

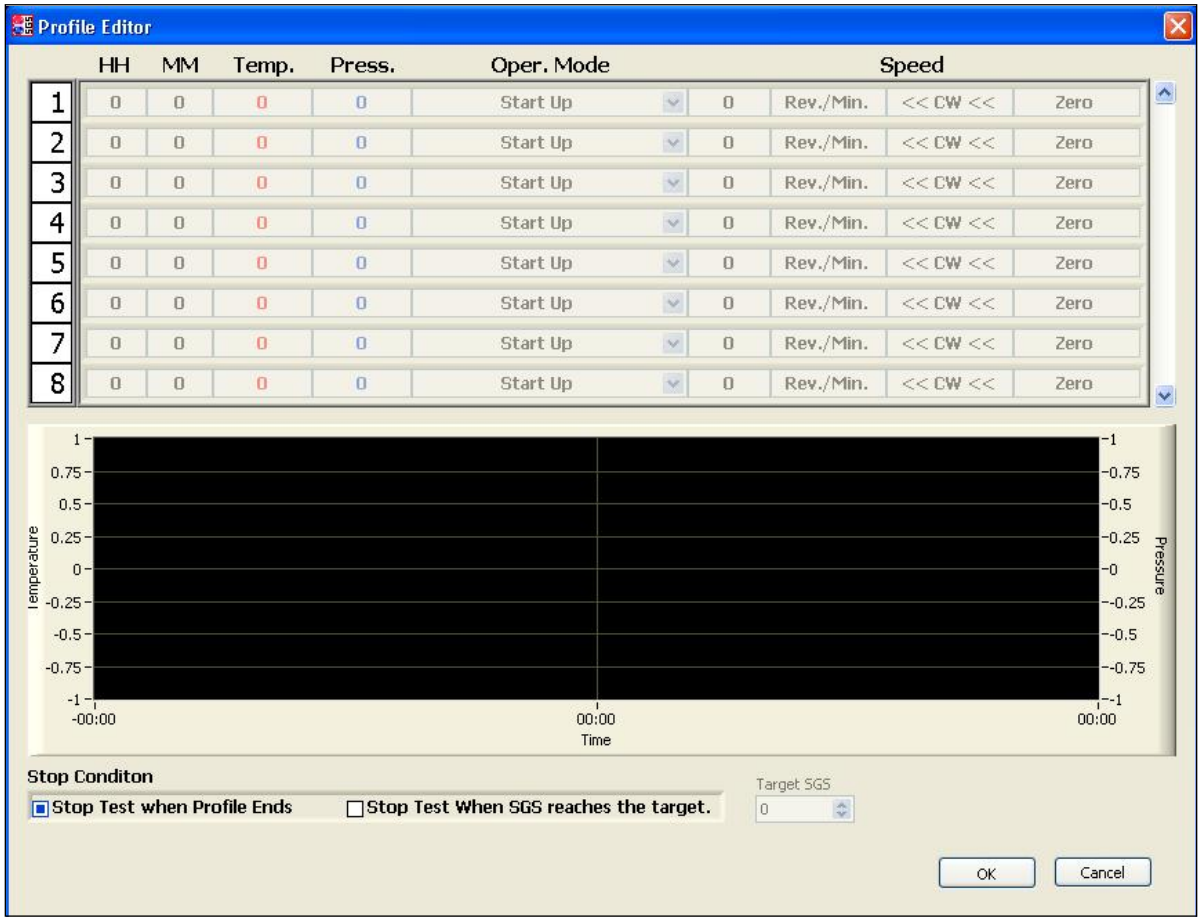


Figure 5-8 Profile Editor Screen

The **Profile Editor** is the portion of the program that sets up the test sequence.

The test sequence consists of the following parameters.

1. **HH** - Type the hour portion of the step time.
2. **MM** – Type the minute portion of the step time.
3. **Temp**. – Type the final temperature to be attained at the end of step time. The program tries to set up a ramp so that the temperature is reached in the time specified.

4. **Press**. – Same as above but for pressure.
5. **Oper**. **Mode** – This pull down list are motions previously defined on the **Machine Settings** screen. Selecting one of the defined motion steps automatically fills in the **Speed** section of that step.

NOTE The **Speed** section cannot be edited in the **Profile** editor. All changes for motion have to set through the **Motion** tab on the **Machine Settings** screen.

6. **Speed** – This section only provides information to the user as to what each **Oper. Mode** does.

By right clicking, on the step number on the left side of the sequence, it is possible to add, delete, copy, and paste individual steps in the profile.

The **Stop Condition** determines whether to stop the test when the sequence is complete or when the test attains a specified SGS target. Specify the Target SGS if the second option is chosen.

Click **OK** to save any changes and close this screen. Click **Cancel** to exit this screen without saving any changes.

5.5. Calibration Menu

The **Calibration Menu** manages various calibration tasks for the MACS II system. This menu contains the following options.

- ❑ Zero Drive
- ❑ Calibrate Pressure
- ❑ Calibrate SGS
- ❑ Test Repeatability

5.5.1. Zero Drive

Click **Calibration > Zero Drive** to initialize the stepper drive to a known position. This operation is independent of other functions in the program. When the process begins, a dialog box displays.

Figure 5-9 Zero Drive Adjusting Drive Mechanism Message

During the adjusting drive mechanism process, it is imperative to not adjust the drive system. When the adjustments are complete, the following dialog box displays.

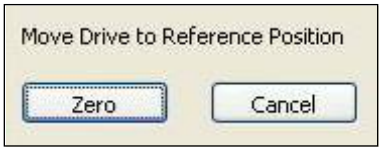


Figure 5-10 Reference Position Dialog Box

Physically rotate the drive mechanism to the marked reference location. When the drive is properly set, select **Zero** to accept the new reference point. Alternatively, select **Cancel** to ignore.

5.5.2. Calibrate Pressure

Click **Calibration > Calibrate Pressure** to display the **Calibrate Pressure** screen. The screen contains two portions: Old Calibration and New Calibration.

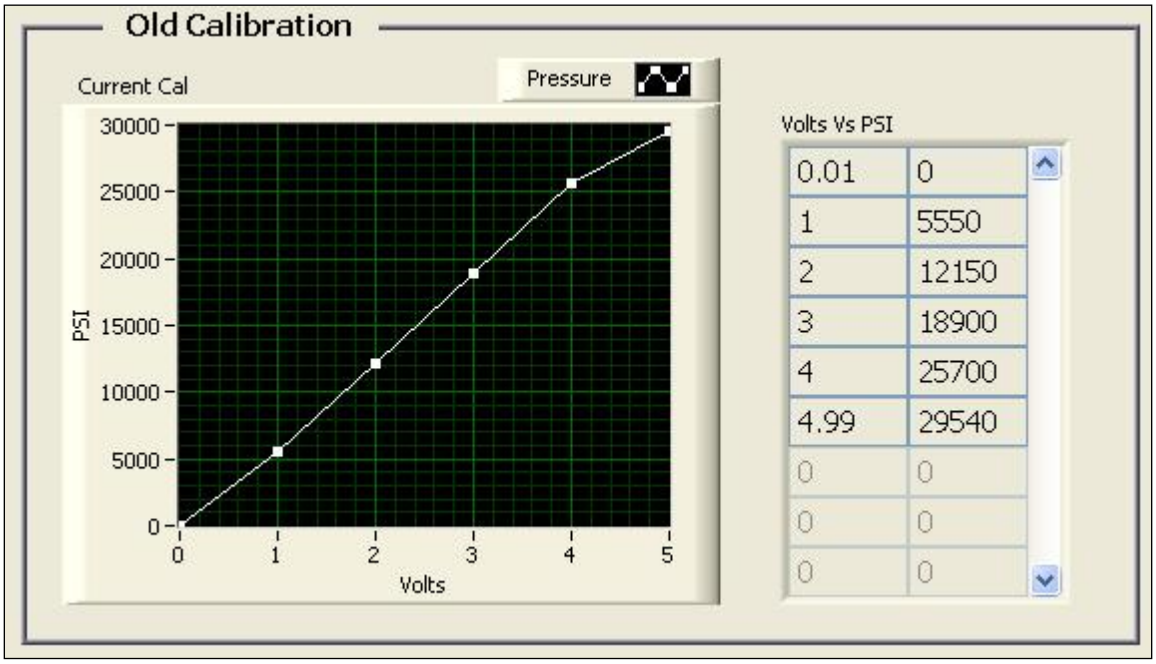


Figure 5-11 Calibrate Screen Old Calibration (Top) Portion

The **Old Calibration** shows the values of current calibration. This way one can check the values and curve of pressure calibration. The **New Calibration** section is where, a new calibration takes place.

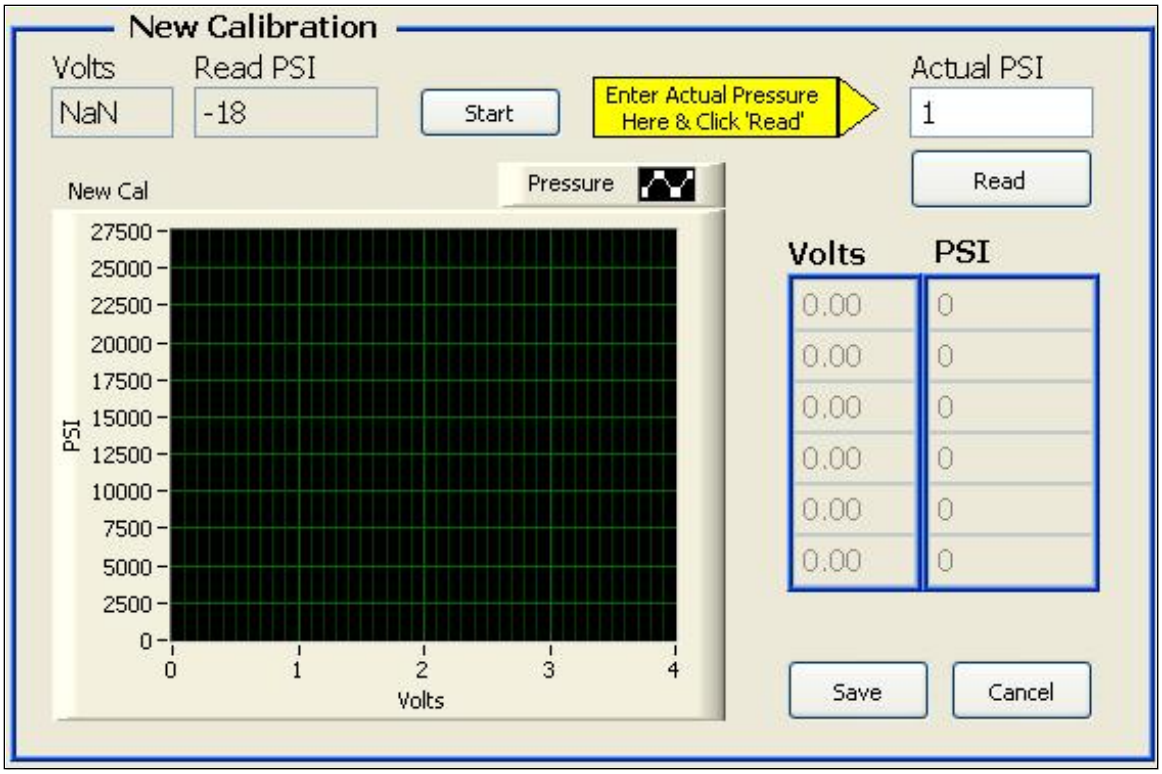


Figure 5-12 Calibrate Screen New Calibration (Bottom) Portion

Follow this procedure to calibrate the pressure.

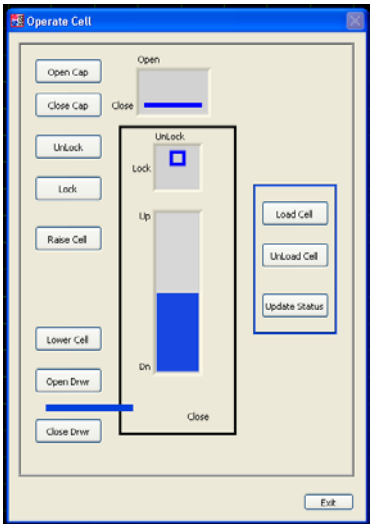
1. Click **Start**.
2. In the **Actual PSI** text box, type the actual pressure. If the **Read PSI** is reading a negative number, then type **0** (zero).
3. Click **Read**. The process populates the first line in the **Volts and PSI Table** with zero value. The **Start** button changes to **Next**.
4. Click **Next**. Wait for the pressure to stabilize and then type the actual pressure from a calibrated gauge in the **Actual PSI.**
5. Click Read. Subsequent lines in the **Volts and PSI Table** are now populated with voltage applied and actual pressure generated due to it.
6. Repeat step 4 until the **Next** button changes back to **Start** at which point, the whole calibration process starts repeating.

Click **Save** to save any changes and close this screen. Click **Cancel** to exit this screen without saving any changes. While exiting this screen, the pressure vents out of the system to render the system safe.

SGS Calibration Setup

1. On the **Operate** menu, click **Cell Operations**.

2. When the **Operate Cell** dialog appears, click **Open Cap**.

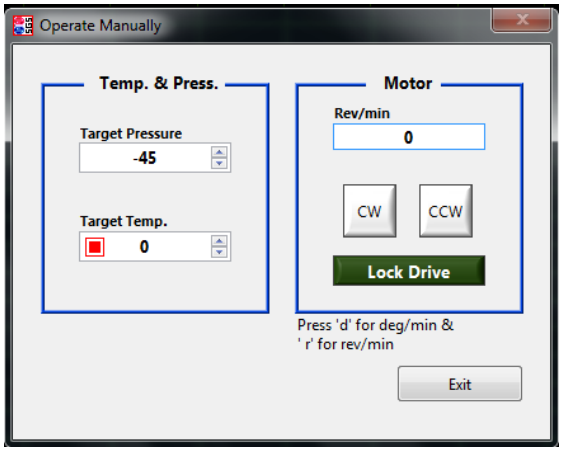


3. After the cap opens, verify that the O-ring and backup ring, located inside the cell cap, are in good condition, properly aligned, and lubricated with approved grease.

4. Fill the sample cup with water. Assemble the cup and rotate the coupling to ensure free movement.
5. Click **Open Drwr**.
6. Install the sample cup into the pressure vessel. Rotate the sample cup until it is locked in place.
7. Fill the void between the top of the sample cup and the top of the pressure vessel with water to reduce the pressurization time.
8. Click **Close Cap**, and then **Close Drwr**.
9. Place a towel over the open thermocouple port to prevent excess water from coming out.
10. Click **Load Cell**. Wait for the cell to load.
11. Install the thermocouple and ensure the fitting is tight.
12. Click **Exit** to close the Operate Cell window.

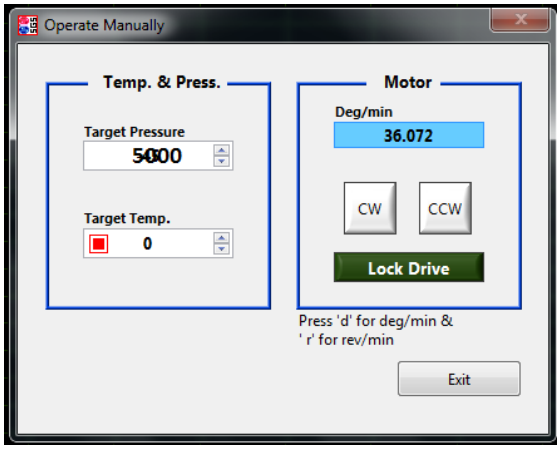
To perform the SGS calibration, the sample cup must be in contact with the magnedrive coupling. The following steps show how to do that.

13. On the **Operate** menu, click **Manual Operations**.
14. On the **Operate Manually** dialog, enter the desired pressure in the **Target Pressure** box.



The pressure entered for calibration should be: 7000 psi for 0 to 10,000 psi tests; 17,000 psi for 10,000 to 20,000 psi tests; and 27,000 psi for 20,000 to 30,000 psi tests.

15. Install the calibration fixture in the calibration position at the front of the unit.
16. Properly align the guide height and bearing to the same height as the calibration pulley.
17. Hook the ball of calibration string to the magnedrive calibration pulley, and then lay the other end of the string around the calibration fixture bearing guide.
18. Type the letter *d* on the keyboard. This will change the units for motor rotation from revolution per minute to degrees per minute.
19. On the Operate Manually window, enter *36* in the **Deg/min** box, and then select **CW** to begin clockwise rotation at 36 degrees per minute. Wait approximately 10 minutes for the string to completely rotate around the magnedrive pulley.



20. When the rotation is completed, click on the rotating arrows (on the **CW** button) to stop rotation of the magnedrive.
21. Manually erase *36* and enter *0.2* in the **Deg/min** box.
22. Click **CW** again to start rotating the motor and paddle clockwise at 0.2 deg/min.
23. Select **Exit**.
24. From **Calibration** menu, select **Calibrate SGS**. The Calibrate SGS window will appear.


File
Edit
View
Calibration
Operate
Help
Zero Drive
Calibrate Pressure
Calibrate SGS
Test Repeatability
Elapsed Time
00:00:0
Temp.Sample
73.6 °F
Pressure
-45 PSI
Torque (oz.in.)
0.73
Consistency (Bc)
-97.3
SGS (Lb/100 Sq. Ft.)
-72.7
Connected
Start Test
Consistency (Bc)
SGS (Lb/100 Sq Ft)
Torque (oz.in.)
Press. (PSI)
Time

5.5.3. Calibrate SGS

Calibrating SGS must be done with Slurry cup installed and Cell locked. The paddle must be rotating at 0.2 deg/min to simulate a SGS test. Use the calibration fixture to hook the string so that appropriate Weights can be loaded. Before calibrating for SGS ensure that a speed of .2 deg/min turning in the direction of SGS must be implemented.

Click **Operate**> **Manual Operation** then press'd' and enter 0.2 deg/min. As soon as you click **CW** the motor and paddle will start rotating.

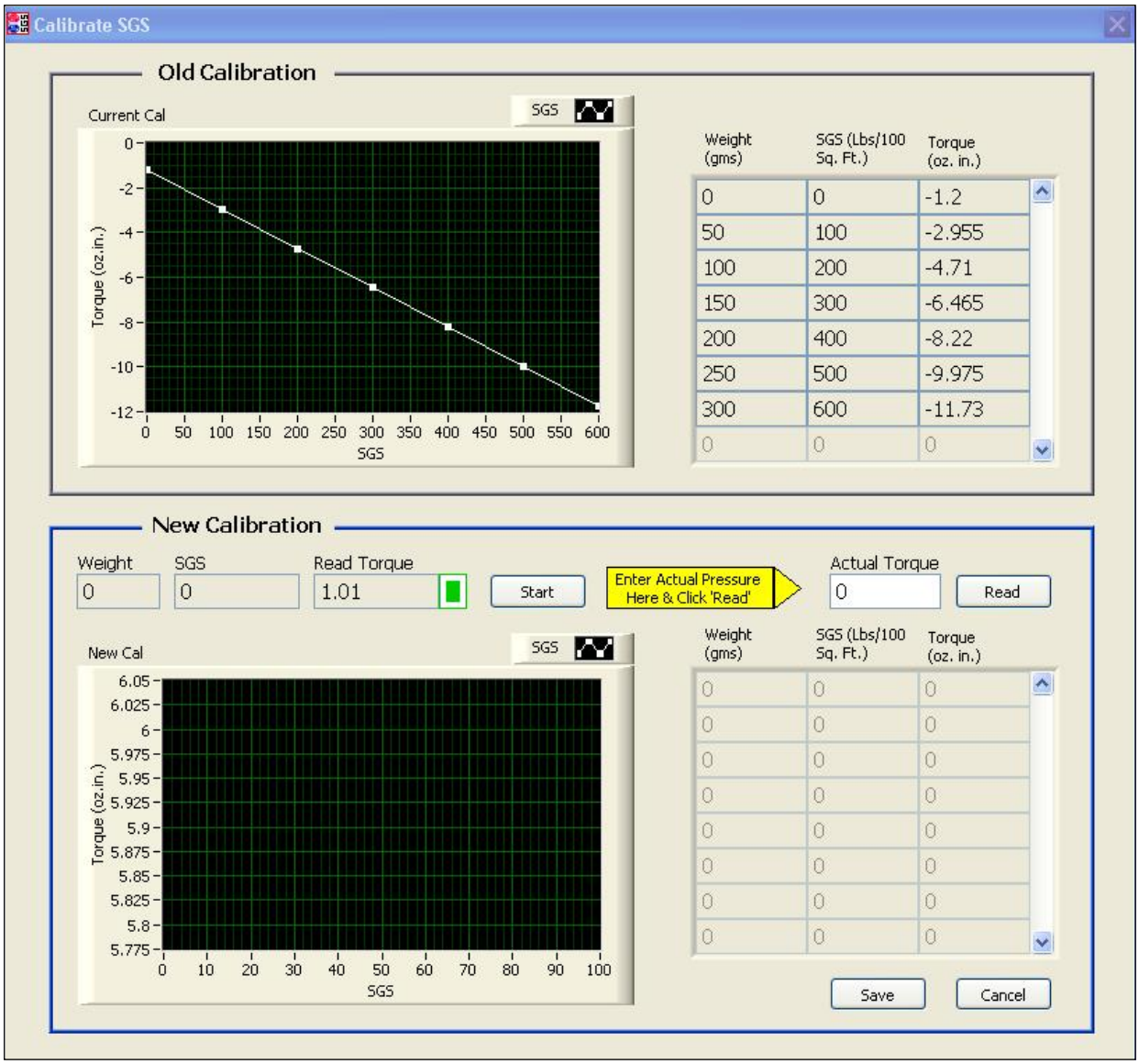


Figure 5-13 Calibrate SGS Screen

The machine should not be unattended during the calibration process with a weight installed. Only 0.2 deg/min revolution should be used for the deadweight calibration process.

Click **Calibration > Calibrate SGS** to display the **Calibrate SGS** screen.

This interface performs dead weight static gel strength (SGS) calibration. This screen is identical to pressure calibration procedure. With no weight hung on the pulley, follow this procedure to perform a SGS calibration.

1. Click **Start**.
2. Wait for torque to stabilize. In the **Actual Torque** text box, type the value of the **Read Torque**.
3. Click **Read**. The process populates the **Weights, SGS, and Torque Table** with the appropriate values. The **Start** button changes to **Next**.
4. Click **Next**. The system populates the next value of weight to be used in the **Weight** text box.
5. Hang the actual dead weight on the calibration device. When the system stabilizes, the **Read Torque** value indicator turns green. Type this number in the **Actual Torque** text box.
6. Click **Read** and the next line in **Weights, SGS, and Torque Table** is populated with appropriate Weight Torque and SGS values.
7. Continue the process until the system reaches the last reading of 300 grams.

Click **Save** to save any changes and close this screen. Click **Cancel** to exit this screen without saving any changes.

5.5.4. Test Repeatability

Click **Calibration > Test Repeatability** to display the initial **Test Repeatability** screen. Follow the prompts to complete the repeatability calibration. Click **Cancel** at any time to close this screen and exit the procedure. Click **Next** and **Back** to move between different steps.

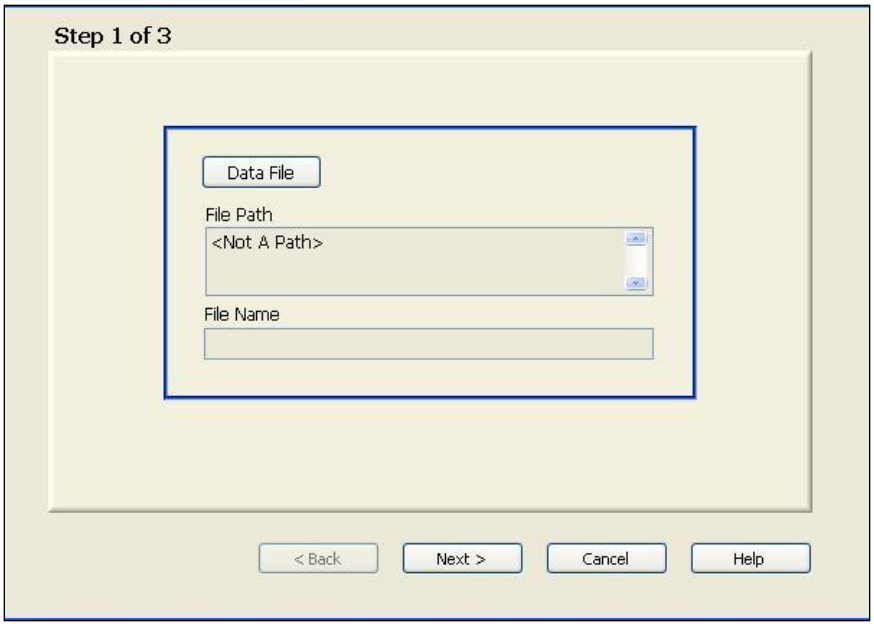


Figure 5-14 Test Repeatability Step One Dialog Box

1. Click **Data File** to display a standard Windows dialog box to select a file. Click **Next** for the next step.
2. The next step in the Test Repeatability is to zero the drive. Click **Zero Drive** and follow Section 5.5.1 Zero Drive to zero the drive.

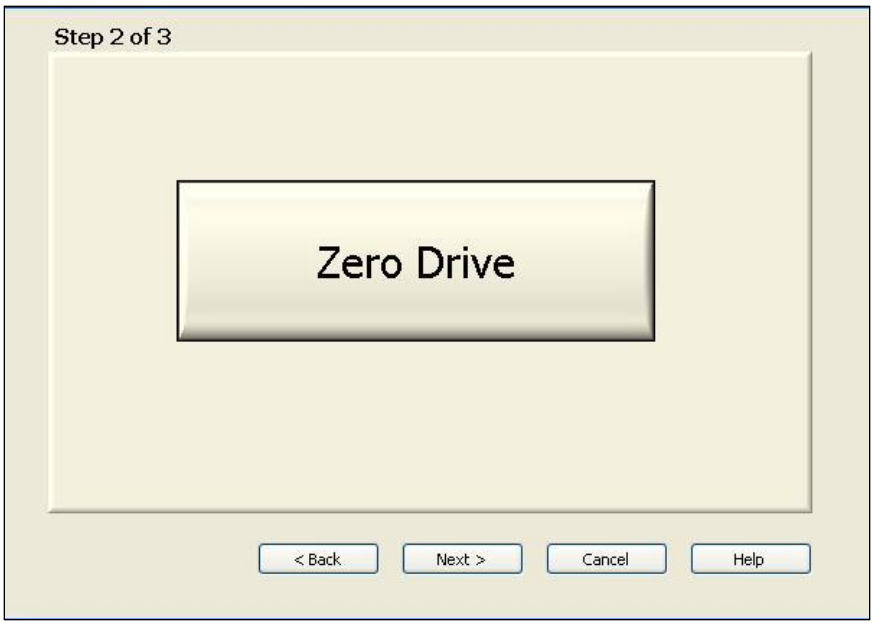


Figure 5-15 Test Repeatability Step Two Dialog Box

3. The last step is to set parameters such as temperature, pressure and motor speed to begin the repeatability check. Generally, the motor is rotated at 36 deg/min clockwise (CW) direction with no pressure and temperature. This generates one revolution every five minutes. So in thirty (30) minutes the unit performs six revolutions and it is then appropriate to asses the repeatability.

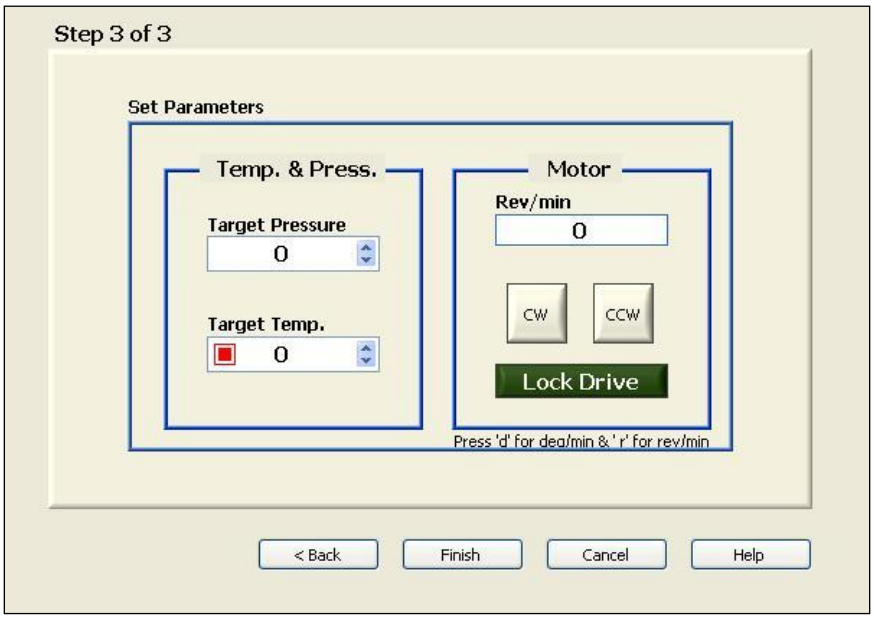


Figure 5-16 Test Repeatability Step Three Dialog Box

4. Click **Finish** to begin the test. With motor turning, the system measures and displays the SGS value. It is possible to run repeatability tests for any length of time. Fann recommends to run at least two full revolutions at speeds less than 36 deg/min.
5. To stop the test, click **Stop Test** on the main screen.
6. Once the test stops, a dialog box displays the results and statistics of the test.
7. Looking through the **SGS Statistics without Outliers** the **SGS Variation** should report to be less than +/- 36 SGS units and **Std. Dev**. of 12 SGS units.
8. If the machine meets this criteria, the machine is repeatable. The **Variation** establishes the precision of SGS measurement.

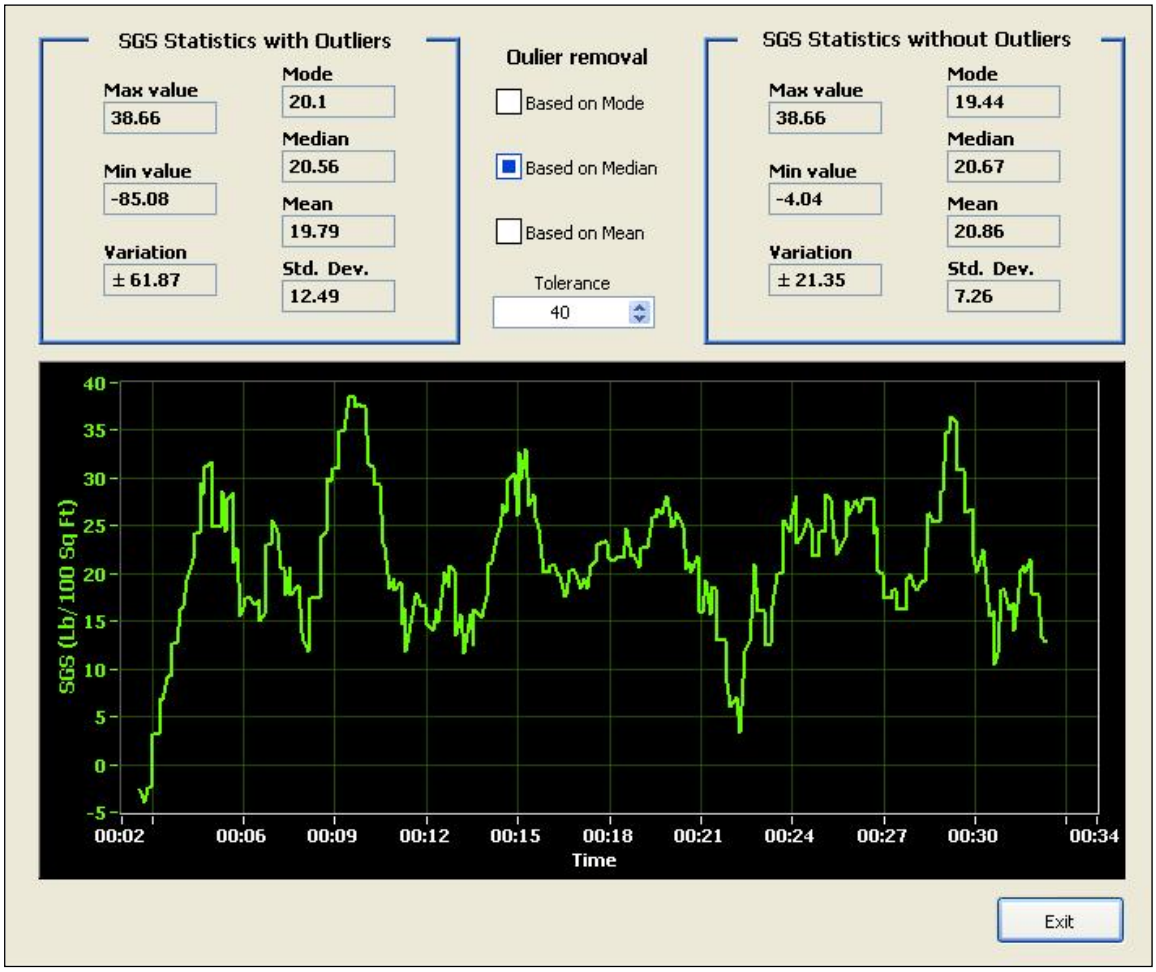


Figure 5-17 Test Repeatability Results Screen

9. Click **Exit** to close this screen and return to the main screen.

5.6. Operate Menu

The **Operate Menu** is where the user controls the physical actions of the device. This section contains the following options:

- Cell Operations
- Valve Operations
- Manual Operations
- Release Pressure

5.6.1. Cell Operations

Click **Operations > Cell Operations** to display the **Cell Operations** dialog box.

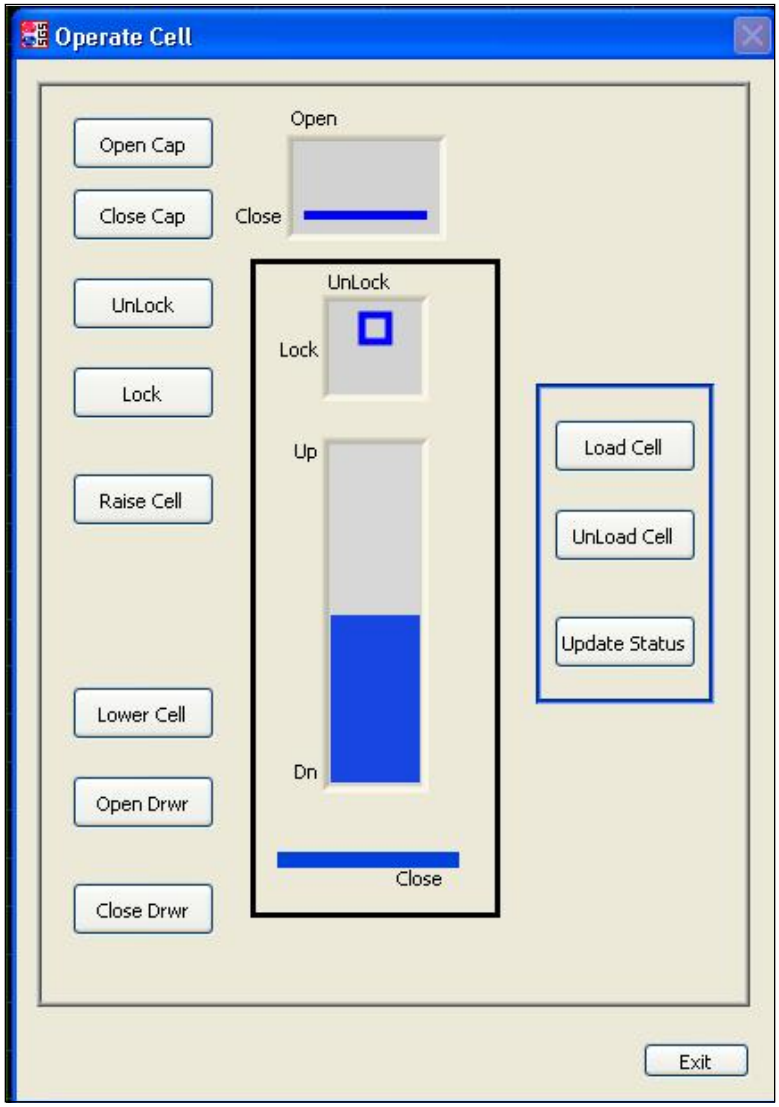


Figure 5-18 Cell Operations Dialog Box

The Cell Bottom, Cell Top (Cap) and Drawer assemblies can be operated and moved automatically. This is necessary to open the cell for loading the Slurry cup and locking the cell back. The graphic on the screen pictorially depicts the position of the cell.

1. **Load Cell** – The Load Cell operations raises the Cell and turns it to lock the Bottom cell inside the Top Cell assembly.
2. **UnLoad Cell** – This is reverse of Load Cell operation. The cell is turned and then lowered.
3. **Update Status** – This enquires the status of the cell and updates the graphic on this screen.
4. **Open Cap, Close Cap** – These buttons raise and lower the Cell top and the lid. This helps in replacing the O-ring and the back up ring.
5. **Unlock, Lock** – These two buttons rotate the cell to lock and unlock with the Cell Top.
6. **Raise Cell**, **Lower Cell** – These buttons raise or lower the cell and mates or unmates the Cell Bottom to Cell Top.
7. **Open Drwr, Close Drwr** – These buttons push in or pull out the drawer from the frame so that a slurry cup can be loaded inside the cell.

Note that the MACS II unit does not perform certain operations due to mechanical interference. For example, if the cell is raised, then it is not possible to pull out the drawer. The software flags such an operation as illegal.

If the cell is under pressure, none of the operations can be performed until the pressure is released. In such a case all elements of the screen are unavailable (gray).

8. Click **Exit** to close this dialog box.

5.6.2. Valve Operations

Click **Operations > Valve Operations** to view the **Valve Operations** screen.

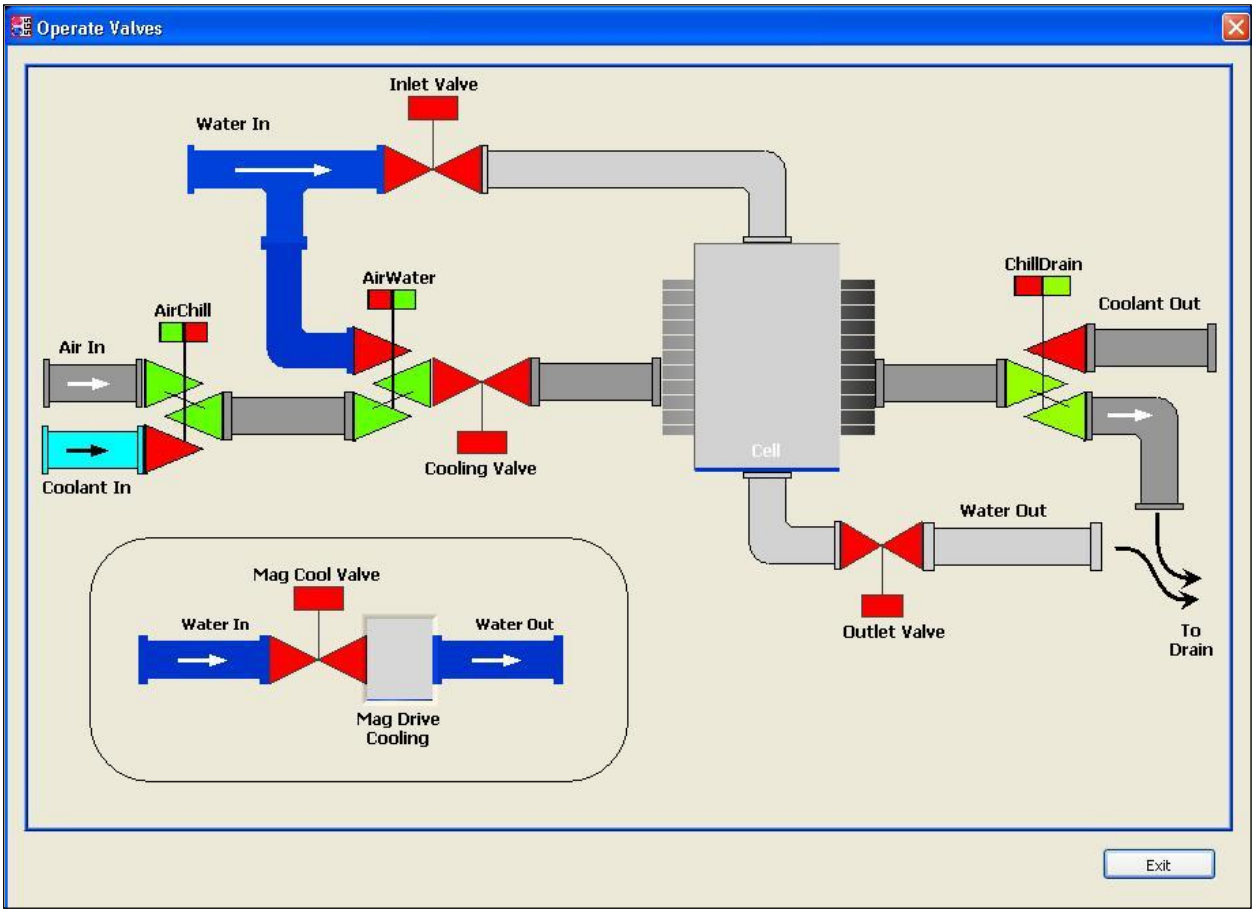


Figure 5-19 Valve Operations Screen

This screen allows the user to interactively operate the various valves in the system. Every valve (colored Red/Green) is clickable and operates the respective valve.

Normally the automatic process governs the operations of all these valves, but for diagnostic and evaluation reasons, the user may operate these valves. Once on this screen the user is in control of the valves and must have adequate knowledge and understanding of Hydraulic/pneumatic system to operate these valves.

This interface does not permit certain activities due to protocol and/or safety factors. Click **Exit** to close this dialog box.

5.6.3. Manual Operation

Click **Operations > Manual Operations** to access the **Manual Operations** dialog box.

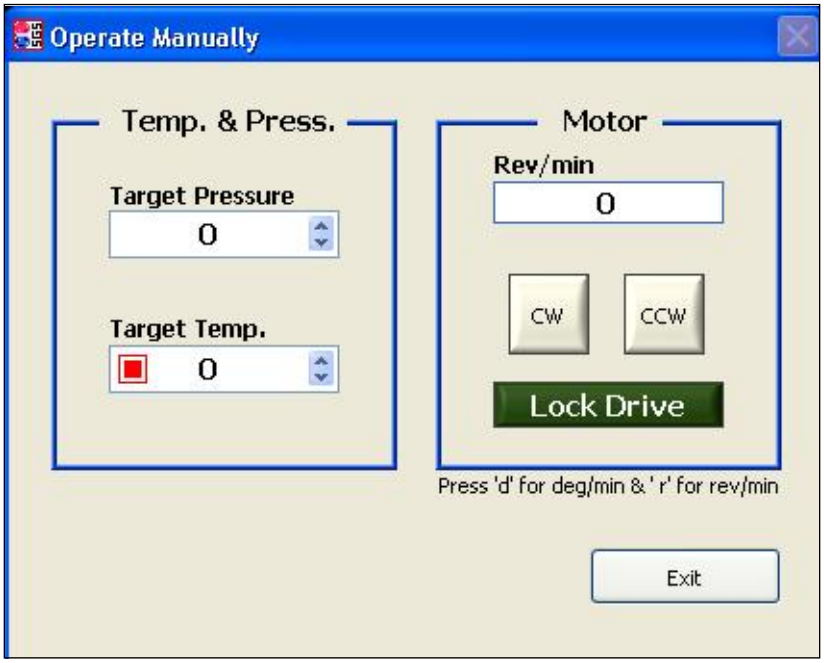


Figure 5-20 Operate Manually Dialog Box

This screen allows control of temperature, pressure and motor subsystems independently and immediately for verification and diagnostics.

- **Target Pressure** – Type a pressure setpoint and the machine starts pumping. To release pressure completely, type a value of 0 (zero). Ensure that the cell is closed and sealed before applying pressure as water will pump into the cell.
- **Target Temp.** – Type a temperature setpoint and the cell starts heating and trying to get to the set temperature as fast as it can. To turn off the heater, type a value of less than 40°F. The red indicator signifies that heater is off.
- **Rev/min | Deg/min** – Type a speed for the motor. Press D to change the units to Deg/min or press R to change the units to Rev/min. Note that the for Deg/min units, the settable speed is 0.216 deg/min to 360 deg/min and for Rev/min units, the settable speed is from1 RPM to 150 RPM.
- **CW, CCW** – Click **CW** to rotate the motor in a clockwise direction. Click **CCW** to rotate the motor in a counter-clockwise direction.
- **Lock Drive, Unlock Drive** – Click **Unlock Drive** to unlock the drive mechanism to free the motor and rotate the drive and paddle assembly as necessary. Click **Lock Drive** to lock the drive.

Click **Exit** to close this dialog box.

5.6.4. Release Pressure

Click **Operations > Release Pressure** to instruct the machine to allow pressure to escape. If the temperature above the **Safety Min. Temp**. as set in Section 5.4.1.1 General Tab, the system will not release any pressure.

5.7. Help Menu

The **Help Menu** provides access to help and support topics for the MACS II software. This menu contains the following options.

- ❑ Online Help
- ❑ Check for Updates
- ❑ About

5.7.1. Online Help

Click **Help > Online Help** to display the on-line help document. This feature has not been implemented yet.

5.7.2. Check for Updates

Click **Help > Check for Updates** to begin the process to update the MACS II software.

5.7.3. About

Click **Help > About** and a dialog box containing pertinent company and software version displays.

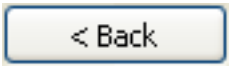
5.8. Start Test Wizard

The **Start Test Wizard** helps a novice or expert user step through various rigors of starting a test. The wizard walks the user through a series of steps to ensure that all significant procedures are completed before the test to obtain meaningful results.

To launch the **Start Test Wizard**, click **Start Test**. The **Start Test** button is at the upper-right of the MACS II software desktop.

Several buttons at the bottom of the wizard provide navigation through the process.

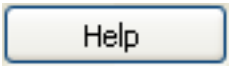
- ❑ **Back** – Return to the previous step in the wizard. This is unavailable if you are on the first step of the process. When the process moves to the second step, **Back** becomes active.



- ❑ **Next** – Proceed to the next step in the wizard. Note that when procedure is on the last step, this button changes to **Finish**.

- ❑ **Finish** – Close the wizard and initiate the test. 

- ❑ **Cancel** – Exit the wizard without performing test. If chosen, it is necessary to go through the steps to restart the test. 

- ❑ **Help** – Launch context-sensitive help. 

Execute the following steps to start the test.

5.8.1. Step One

The first step in the process is to ensure all the relevant information about the test.

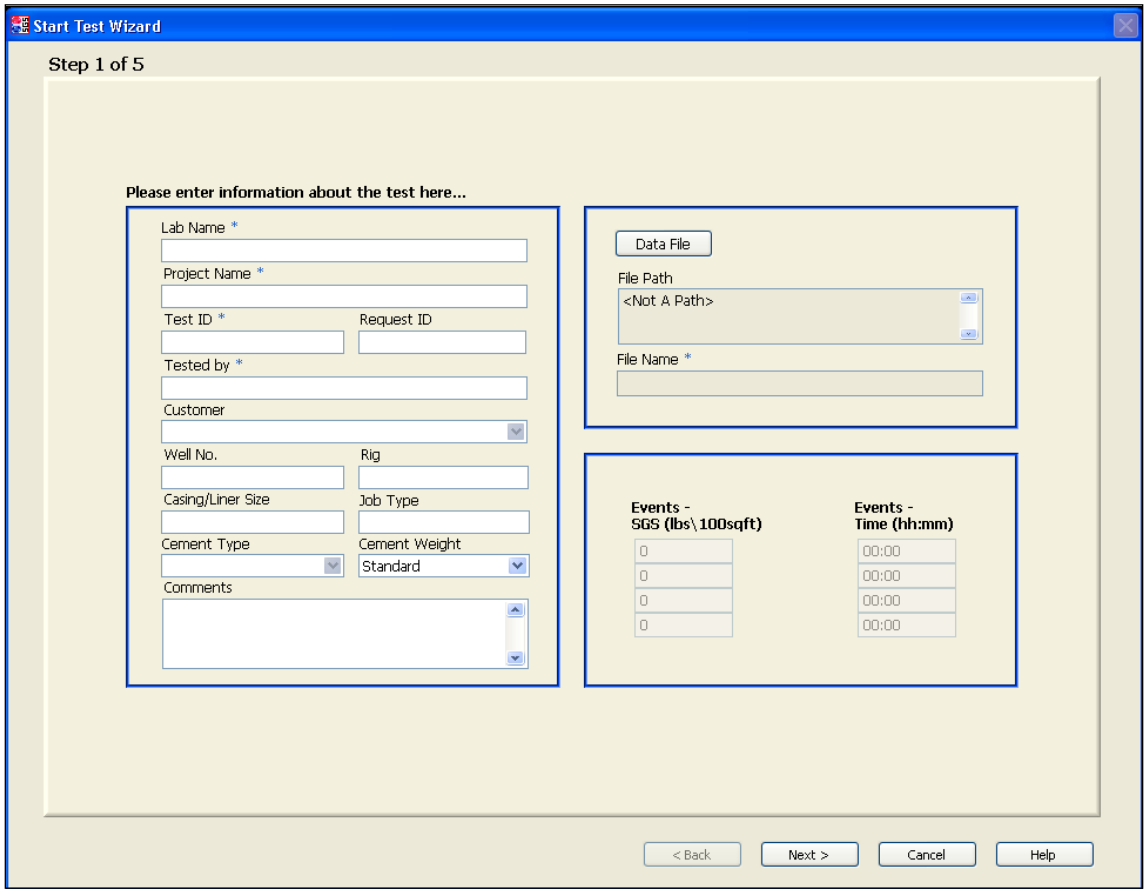


Figure 5-21 Test Information Screen

8. Input information about the test. The following fields are mandatory.
   - ❑ Lab Name
   - ❑ Project name

- ❑ Test ID
- ❑ Tested By
- ❑ File name - Click Data File to open a standard window file dialog and navigate to the folder to save the data file. Type a file name and click OK.

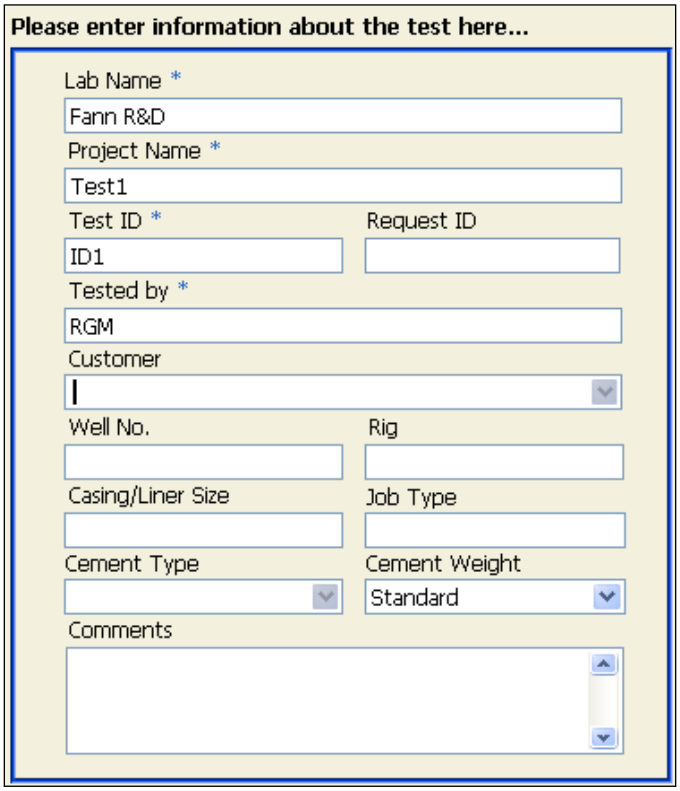


Figure 5-22 Mandatory Text Boxes

9. Following are the optional fields.
   - ❑ Request ID
   - ❑ Customer – This is a free text field with a drop down list. This allows selection of a customer from a list.
   - ❑ Well No.
   - ❑ Rig
   - ❑ Casing/Liner Size
   - ❑ Job Type
   - ❑ Cement Type – This performs in the same manner as the Customer field.
   - ❑ Cement Weight
   - ❑ Comments
   - ❑ File Path - This field is input using **Data File** as explained previously.

- ❑ Events SGS – Type SGS values at which to record the time
- ❑ Events Time – Type the time in *hh:mm* format at which to record the SGS.

NOTE

Default settings for Customer List, Comment Types, Strength, and Time Events can be set by the Configure System menu item from the main screen. Refer to Section 5.4.1.2 Test Header Tab for more information.

5.8.2. Step Two

This prompts to verify the test profile for the test. Refer to explanation in Section 5.4. Edit Menu to understand this step. It is possible to modify the whole profile in this step.

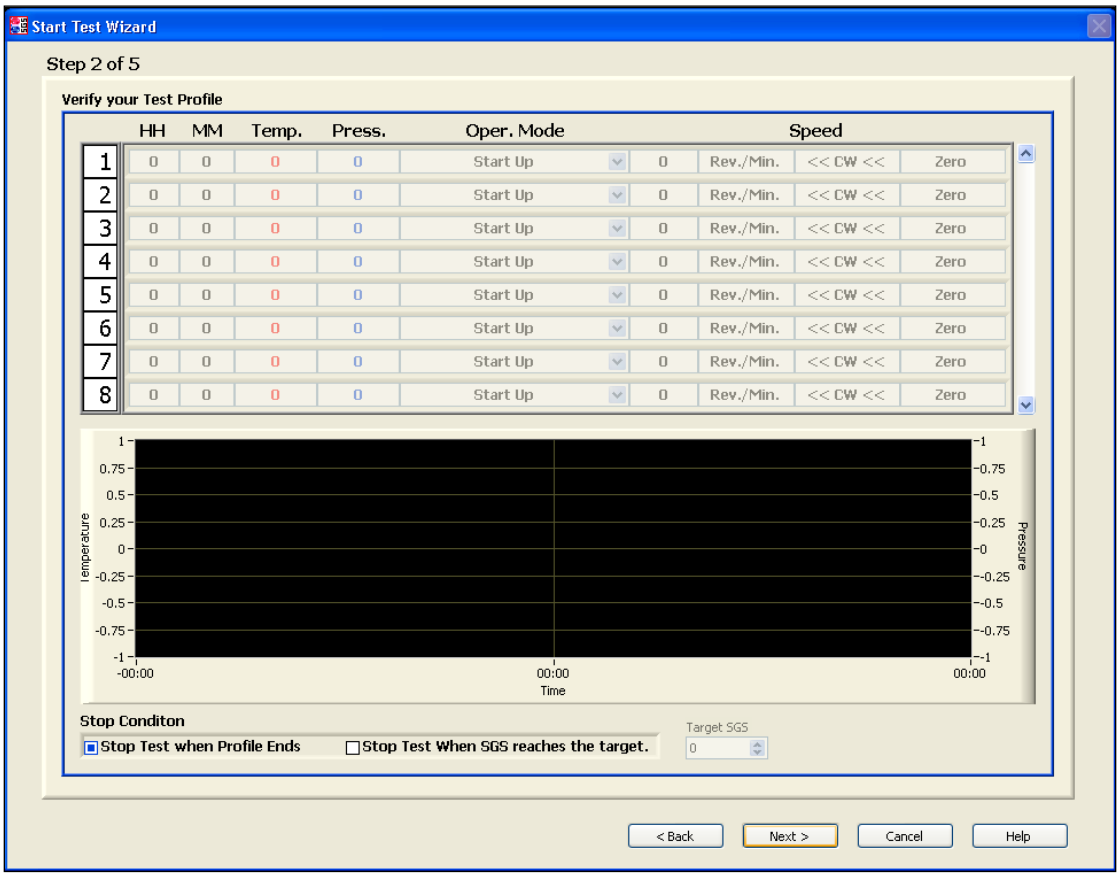
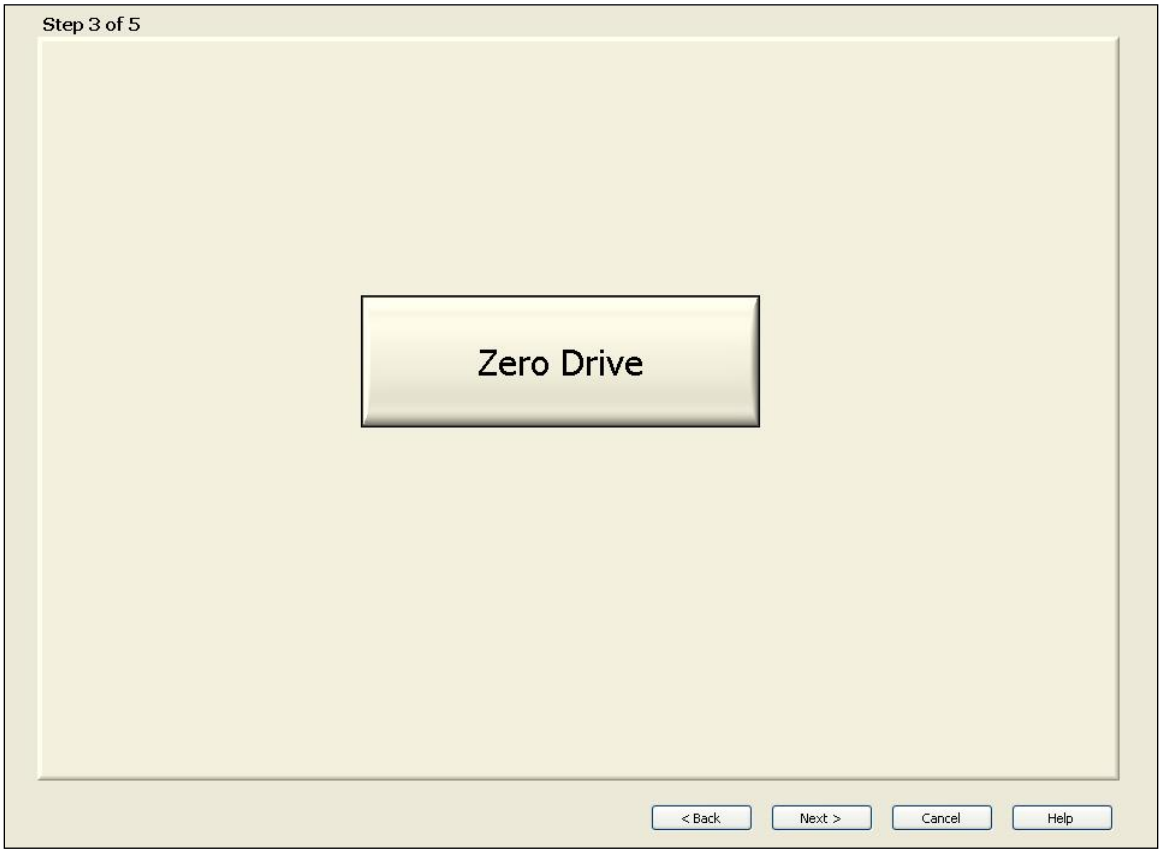


Figure 5-23 Temperature Reference Screen

5.8.3. Step Three

This step performs the task to zero the drive of the motor.



Follow instructions in Section 4.5.1 and zero the drive.

5.8.4. Step Four

At this point, prepare the cement sample and load it into the cell. Notice that the cell operations screen is embedded here to perform the relevant steps to load the slurry cup. Refer to Section 5.6.1 Cell Operations to understand how to operate the cell.

Note that all cell operations is unavailable (gray) if the cell is found to have pressure in it.

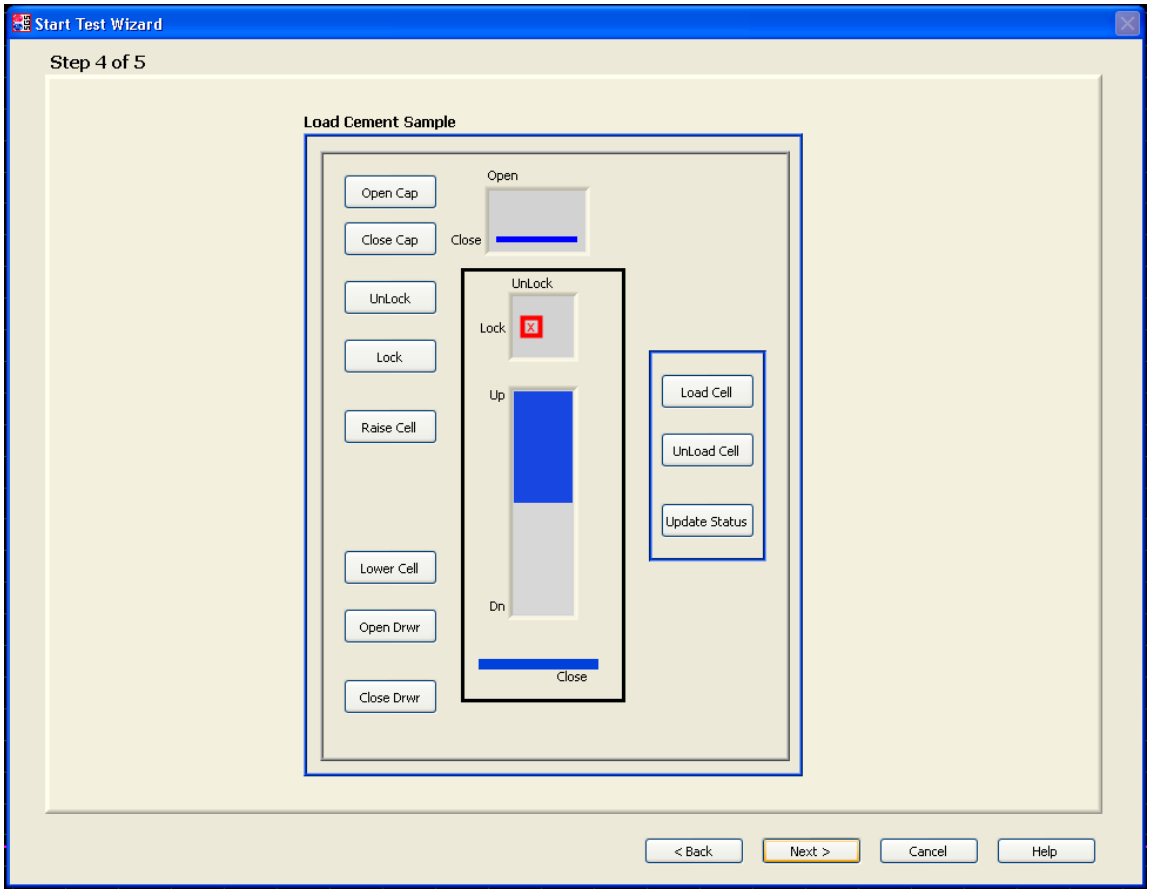


Figure 5-24 Cement Sample Cell Dialog Box

5.8.5. Step Five

At this point in the process, it is possible to start the test. Before starting the test, ensure that certain physical actions are complete before beginning the test.

In this step, it is mandatory to verify the check items. If all the check boxes for the items are chosen, **Finish** becomes available. Click **Finish** to start the test.

If any of the verifications fail, make appropriate changes or **Cancel** to exit the wizard.

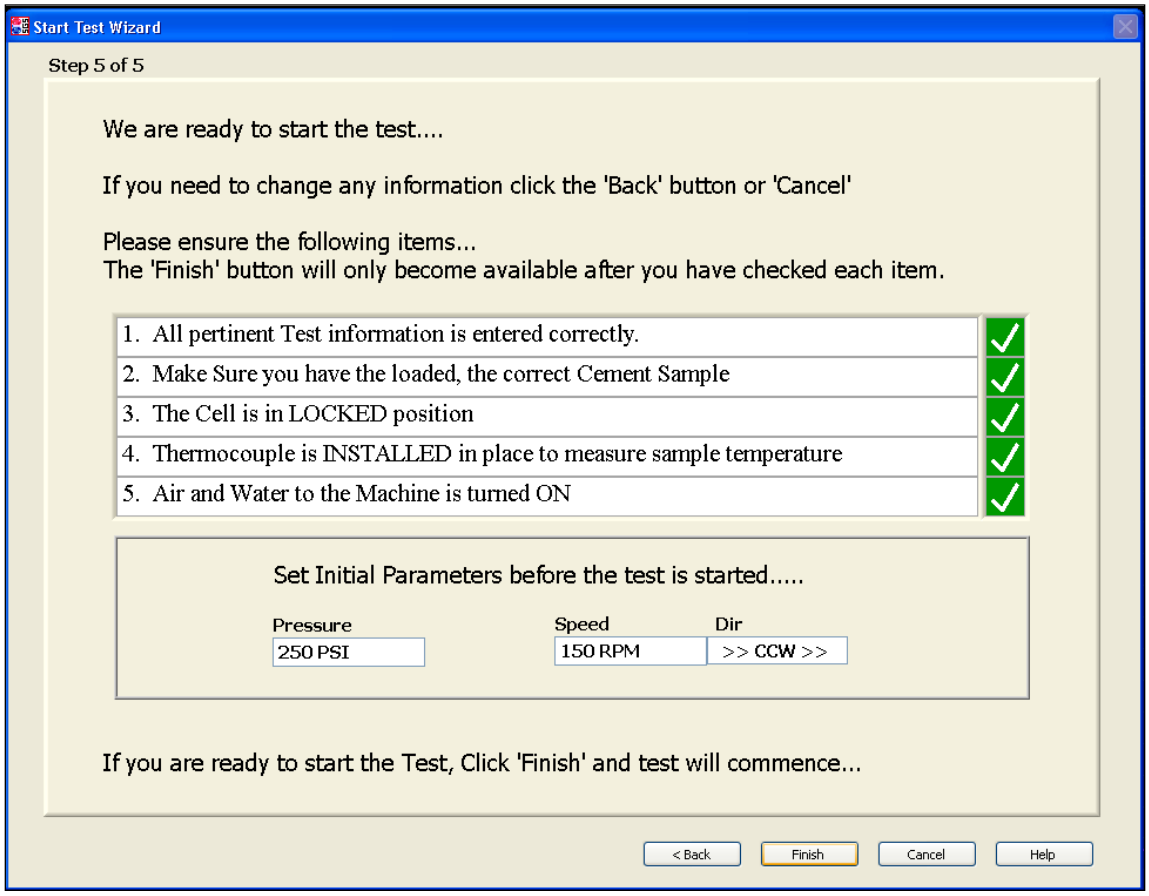
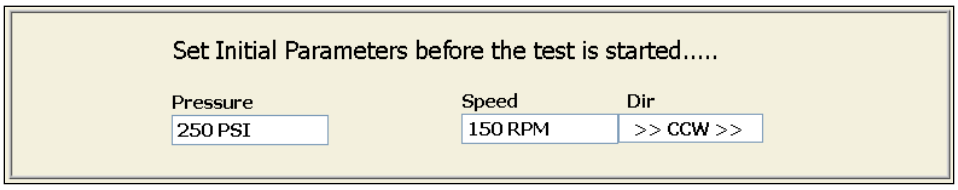


Figure 5-25 Wizard Complete Screen

In addition to the check boxes, the user can set initial parameters for pressure and speed the unit needs to attain before the test can begin.

Type the values in the corresponding fields to set initial test parameters:

- ❑ Pressure
- ❑ Speed
- ❑ Dir

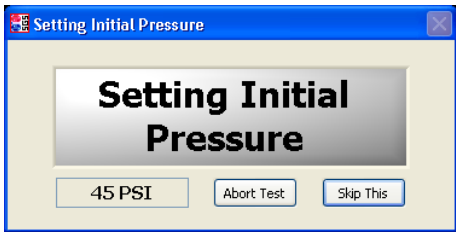


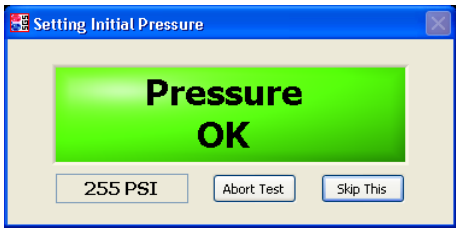
Click **Finish** to exit the wizard and proceed with the test or click **Cancel** to exit the wizard without starting the test.

5.9. Test Run

After the **Start Test** wizard completes, the software sets the initial parameters for the test run, as follows:

The software sets the initial pressure, prompting with the dialogs shown in the images on the right. To abort the test at this point click “Abort Test” or to start a test without waiting for the initial steps, click on “Skip This”





After the initial settings have met, the test starts. During the test, the machine steps through the test profile, managing the temperature, pressure and motor speed. It continually monitors SGS, plots the graph and logs the data.

5.10. Stop Test

To stop a test when the status indicator shows **Running** mode, do the following:

1. Click **Stop Test** (Upper-right of the main screen).
2. A dialog box displays to confirm the action. Click **Yes** to stop the test or **No** to cancel the stop test operation.
3. A “Test is Over” message displays. Click **OK**.
4. Once test has stopped, the machine may begin auto cooling if this has been enabled.
5. The pressure on the cell will be held to the last setpoint.
6. If the cell is sufficiently cool, release the pressure and open the cell to take out the slurry cup.

> **NOTE** After stopping the test, it is mandatory is release the pressure. Refer to Section 5.6.4 Release Pressure for more information.

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Instrument Operations

Section 6

Table of Contents

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6.1. Start Test Wizard Module

The process of starting a test can be followed by invoking the **Start Test Wizard**. Press the **Start** button to begin the test. Fill in all pertinent information and proceed through the **Start Test** wizard up to step three. Stop at step four - **Load Cement Sample**. Unload the cell and open the drawer in preparation to load the slurry cup in the device.

6.2. Physical Equipment Activity

With MACS II software is on the **Load Cement Sample** step, attention focuses on the physical unit itself.

Verify that the cell O-ring and backup ring are in place. Change and lubricate if necessary.

Prepare the sample.

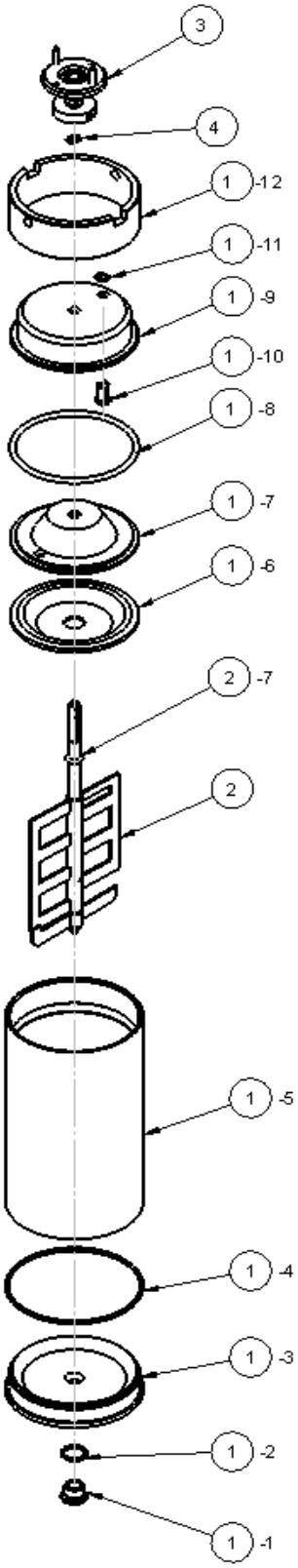

Figure 6-1 Complete Slurry Cup and Paddle Assembly (Eng. Drawing #101636768)

Prepare the SGS slurry cup.

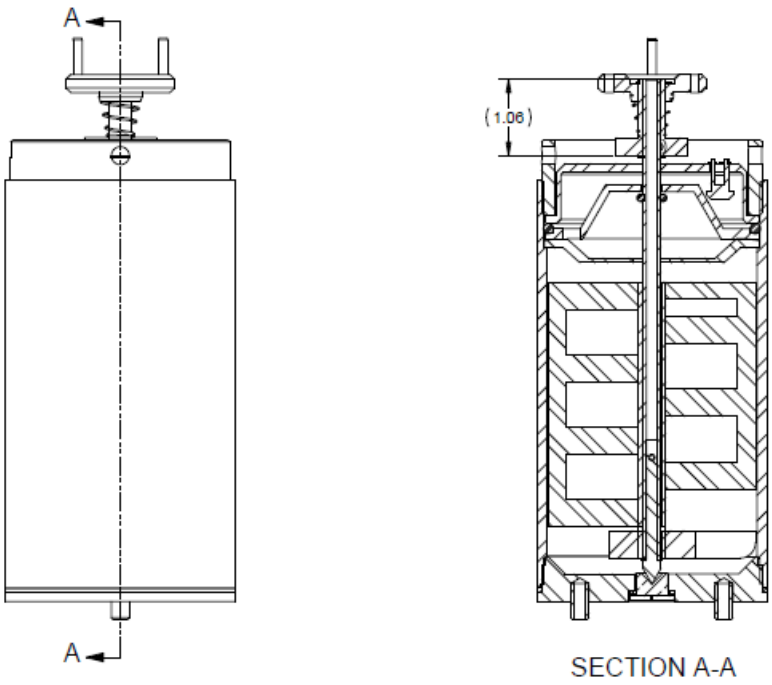

Figure 6-2 Slurry Cup and Paddle (Eng. Drawing #101636768)

1. Grease the plug threads and bottom sleeve threads that accepts the base.

2. Install the bottom (#1-6) and top baffles (#1-7), O-ring (#1-8), top cap (#1-9), and lock ring (#1-12) in the top of the slurry cup as shown in the assembly (DWG # 101636768).

NOTE The valve stem (#1-10) and retaining ring (#1-11) should be permanently installed in the top cap.

3. Insert the paddle assembly (#2) in the slurry cup bottom insuring the shaft O-ring (#7) is in place.

4. Place the slurry cup on a slurry cup holder to tighten the slurry cup lock ring into the slurry sleeve (#1-5).

5. With the slurry cup upside down on the cup holder, pull down on the valve (#1-10) and fill the cup with slurry up to the surface just below the thread relief.

6. Momentarily push up on the valve, until slurry flows from the top of the cup to vent any air that may be trapped in the isolation baffle area.

7. Pull down on valve to reseal.

8. Reciprocate the paddle assembly up and down several times to work additional air out of the paddle area.

9. Add additional slurry as needed to insure a full slurry cup taking care not to get slurry in the thread area.

10. Install the slurry cup base (#1-3) with gasket (#1-4) if slurry does not come out of the of the plug hole in the base, add slurry then install and tighten the plug (#1-1) with gasket (#1-2) wiping excess slurry from base.

11. Remove slurry cup and turn right side up and install the coupling alignment retaining ring (#4) in the groove on the top of the paddle shaft.

12. Install the cup coupling (#3) on paddle shaft until it rest on the retaining ring insuring to align the coupling setscrews up with the flats on the shaft and tighten. Spin the coupling to insure no excessive drag on the shaft.

13. Place the filled slurry cup in the MACS II pressure chamber.

14. To install the cup, lower the cup with the supplied bail into the pressure chamber and rotate the cell until the pins on the bottom of the cup engage in the holes on the plate in the bottom of the pressure chamber.

15. Close the cell drawer, load the cell and install the sample thermocouple.

6.3. **Cement Test**

At this point, both the software and the hardware are ready to test the cement. The next step in the process returns to the software. Proceed with Step Four of the **Start Test** wizard and pull the drawer in and load the cell.

Proceed with step five of the wizard and start the test. Click **Finish**.

At this point test has begun and results are being logged in the file specified.

Results Analysis

Section 7

Table of Contents

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7.1. MACS II Software

The MACS II software controls the functionality of the physical machines.

In addition to controlling the software, there is functionality available for viewing and understanding data.

Right click in the Results Graph to invoke a set of tools. The following tools are available to analyze data.

- ❑ Show Cursor
- ❑ Show Bc (for factory use only)
- ❑ Show Torque
- ❑ Show Cursor
- ❑ Autoscale X
- ❑ Autoscale Y

7.1.1. Show Cursor

Click in the results graph and select this option from the list. The cursor appears as a vertical line. Drag this cursor along the time axes and the corresponding values of the cursor display at the top of the results graph, in dedicated cursor boxes.

7.1.2. Show Torque

Select this option to display the torque values.

7.1.3. Autoscale X

If this option is chosen, the X-scale performs an auto-scale to accommodate the full test time and display the graph. De-select this option to not auto-scale. The user can now type any value on the left and right axes to view a section (or slice) of time from the whole test.

7.1.4. Autoscale Y

This option operates on individual Y axes. Position the cursor on any Y-axis, right click and select/deselect this option. If auto-scale is deselected for a particular Y-axis, type values on the scale endpoints to display a section of data on the Y-axis.

7.2. Data Manager Software

The Data Manager software is available to view, analyze, and print the data after the test is complete. The Data Manager also allows manipulation of test data for different units and to customize the report as necessary. It also allows printing and importing data to TXT and CSV formats for import into spreadsheet programs.

7.3. Data Interpretation

Interpreting the data is easy because the individual graphs for temperature, pressure, SGS, and Torque are color coded to respective scales. The software plots all of the data with respect to these parameters.

The data contains meaning only during the Gel Stage. Data collected during conditioning is of no value.

Analysis and interpreting different SGS values is beyond the scope of this manual. Please refer to a Subject Matter Expert (SME) for assistance on this subject.

Maintenance and Troubleshooting

Section 8

Table of Contents

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8.1. Preventive Maintenance

Preventive maintenance can be grouped into the following categories:

- ❑ Pneumatic
- ❑ Hydraulic
- ❑ Mechanical

8.1.1. Pneumatic Maintenance

Every 30 days, inspect the inline air filter for water. If water is present, adjust the air pressure down and up gradually to engage the designed purge feature.

8.1.2. Hydraulic Maintenance

8.1.2.1. Inline Filter

The inline (30 microns) filter should be cleaned every thirty (30) days of operations. If the inline filter is damaged or deformed, replace it. Fann recommends keeping a spare filter for this purpose.

8.1.2.1.1 Filter Disassembly

8.1.2.1.1.1 Turn bowl off in counter-clockwise direction. Never use any tool other than a strap wrench to remove the bowl.

8.1.2.1.1.2 Pull element off post.

8.1.2.1.1.3 Remove seal from element.

8.1.2.1.1.4 Remove seals (o-ring & backup) from bowl.

8.1.2.1.2 Filter Element Cleaning

8.1.2.1.2.1 Remove external dirt in a separate container with cleaning fluid, and light brush.

8.1.2.1.2.2 Submerge the filter for thirty minutes in an approved cleaning fluid.

8.1.2.1.2.3 Following the soak, purge element from inside to outside with clean compressed air or similar clean gas. DO NOT EXCEED 120 PSI.

8.1.2.1.2.4 Remove any remaining cleaning solution by dipping the element in isopropyl alcohol or drying appropriately.

NOTE

The element life is based upon cleaning cycles and pressure drop. The estimated life of the element is 10 to 15 cleaning cycles. If the element has exceeded this level, discard and replace.

Recommended cleaning fluids are acetone, mineral spirits and a variety of others. Halo-carbon grease, Krytox, and silicone are the only recommended lubricants.

8.1.2.1.3 Filter Reassembly

8.1.2.1.3.1 Lubricate and install new bowl seals. The backup ring is installed closest to the threads.

8.1.2.1.3.2 Lubricate a new seal with a compatible lubricant and install into outlet port of element.

8.1.2.1.3.3 Slip element over mandrel. Be aware that teflon (T) o-rings are difficult to engage.

8.1.2.1.3.4 Inspect all threads for debris and clean thoroughly. Lubricate the threads on head and bowl and assemble. Never use any tool other than a strap wrench to turn the bowl. When screwing the bowl into the head it should take approximately 7-1/2 turns of the bowl to reach the point where the bowl seal engages the head. At this point there will be noticeable resistance when turning the bowl. It should take approximately 1-5/8 turns of the bowl past this point to reach metal-to-metal contact of the bowl face with the head. The bowl is properly seated in the head at this point. If this metal-to-metal contact is not achieved, the unit is not properly assembled and the bowl must be unscrewed and examined to determine if there is a problem with the installation of the seals or if there is some type of debris in the threads.

8.1.2.1.3.5 Correct the problem and repeat this step if necessary.

8.1.2.1.3.6 After assembly, check for leaks while re-pressurizing.

8.1.2.2. Tescom High Pressure Valve Repair

The following items are needed to perform valve repair on the MACS:

- 2 ½ inch open end wrench (101582697)
- 2 inch open end wrench (101582698)
- Repair Kit (101629337)
- Torque Sensor Tool (101629332)

- Loctite 271
- A light lithium or silicone based grease

8.1.2.2.1 Locating the Tescom high pressure valve

The Tescom high pressure valve can be most easily accessed from the back of the unit.

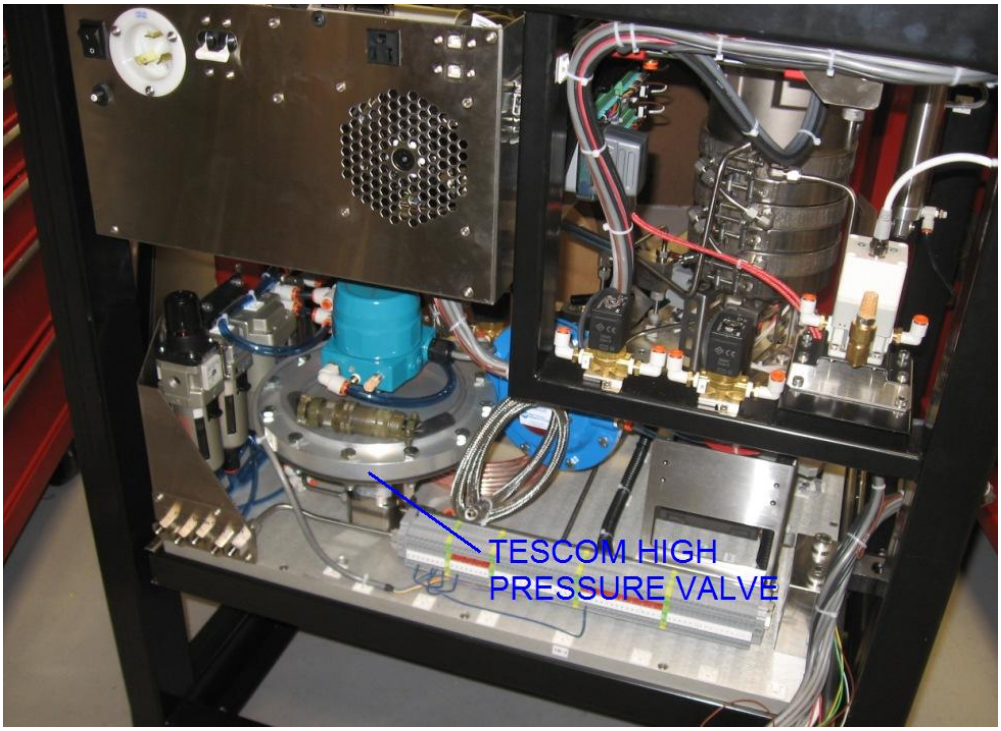

Figure 8-1 High Pressure Valve Location

8.1.2.2.2 Disassembling the High Pressure Valve

8.1.2.2.2.1 Disconnect power, air, and water from the MACS.

8.1.2.2.2.2 Ensure there are no high temperature surfaces near the high pressure valve. Use a temperature measuring device to safely check for heated surfaces.

8.1.2.2.2.3 Disconnect the electrical plug and inlet tubing as shown in the figure below.

Figure 8-2 Items to Disconnect

8.1.2.2.2.4 Use the 2 and 2-1/2 inch wrenches for valve disassembly.

8.1.2.2.2.5 Ensure that there is ample clearance to use the wrenches.

8.1.2.2.2.6 Loosen the right hand threaded body assembly from the air actuator assembly.

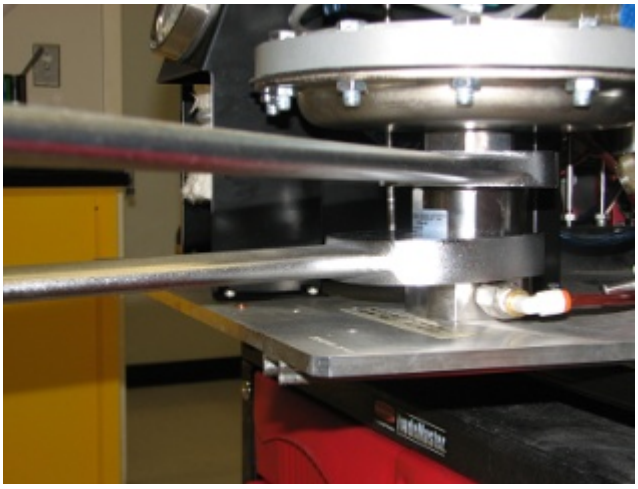

Figure 8-3 Wrenches on Valve

8.1.2.2.2.7 Spin the valve off by hand once it is loosened.

8.1.2.2.2.8 Remove and set the air actuator assembly aside.

Figure 8-4 Removing Air Actuator Assembly

8.1.2.2.3 Rebuilding Internal Valve Body

The following steps are performed to rebuild the internal valve body including all stems, seats, and seals.

8.1.2.2.3.1 Locate and remove the internal sensor assembly.

Figure 8-5 Internal Sensor Assembly Location

Figure 8-6 Internal Sensor Assembly Removal

8.1.2.2.3.2 Remove the Seat Retainer with a medium flat blade screw driver.

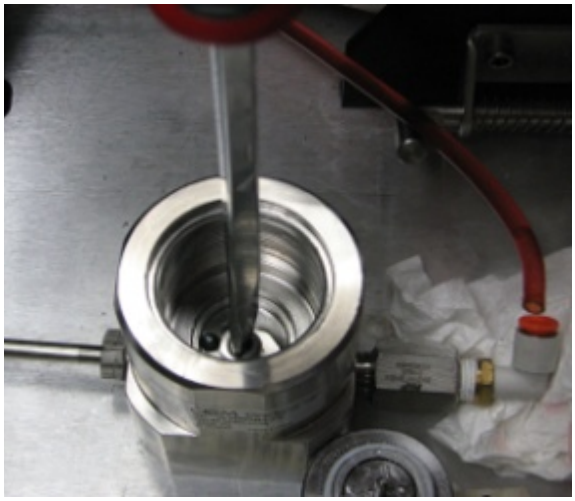

Figure 8-7 Seat Retainer

8.1.2.2.3.3 Lubricate and reinstall the threads. After the lubrication, replace the seat in the retainer.

NOTE

Refer to the valve drawings and BOM in this document for detailed parts and lubrication information.

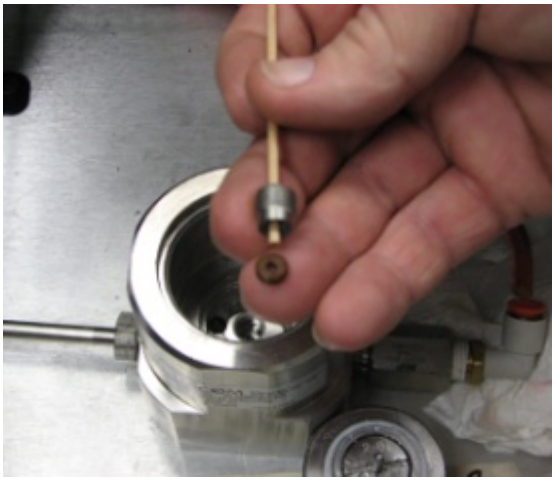

Figure 8-8 - Lubrication of Threads

8.1.2.2.3.4 Use the torque sensor tool to disassemble and reassemble the sensor.

Figure 8-9 Torque Sensor Tool

8.1.2.2.3.5 Using soft jaws, chuck the flats on the sensor assembly in vise with the stem facing up.

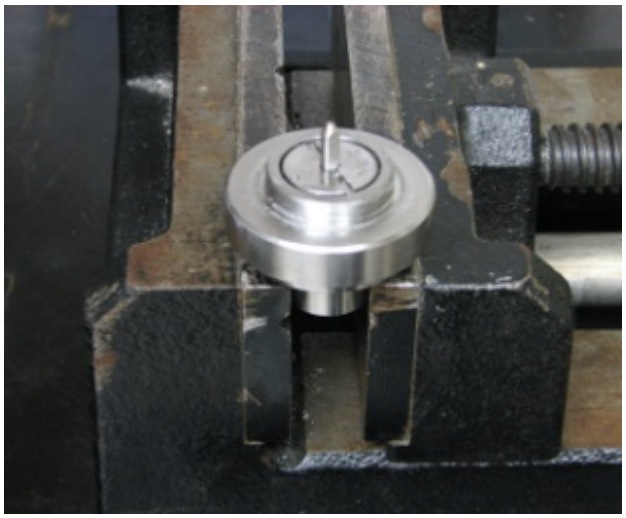

Figure 8-10 Vise with Soft Jaws

8.1.2.2.3.6 Unscrew the sensor from the spring pad.

Figure 8-11 Spring Pad

8.1.2.2.3.7 Replace the sensor and valve parts (as shown below). Reassemble the parts.

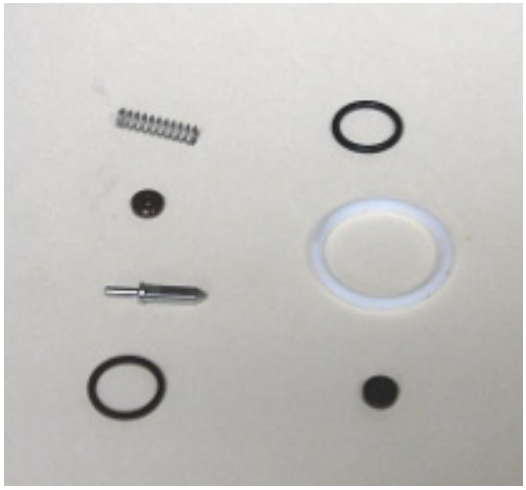

Figure 8-12 Valve Parts

Figure 8-13 Stem and Spring

Figure 8-14 O-ring and Backup Ring

8.1.2.2.3.8 Before assembling the Spring Pad and Sensor, apply one drop of Loctite on the threads.

Figure 8-15 Loctite Application

8.1.2.2.3.9 Reassemble in reverse order using the valve drawings as a reference.

NOTE

Observe the torque and lubrication requirements in the drawing notes.

Figure 8-16 Reassembled Sensor

8.1.2.2.3.10 Flush all high pressure lines before the filter to remove any debris and sediment.

8.1.2.2.3.11 Replace the filter element as described in the previous section.

8.1.3. Mechanical Maintenance

Before every test, inspect the cell body for sediments, dirt, and other abnormalities. Use soapy water and brush the chamber with a soft brush. Do not use a wire brush as this might damage the sealing area. Upon completion, vacuum the soap residue from the unit. Do not flush the water through the drain line as this could clog the drain line and high-pressure relief valve.

Check the O-ring seal and back-up ring on the cell top cap to verify that it is lubricated and seated.

Inspect the timing belt for any fraying and/or wear indicating increased torque.

8.2. Troubleshooting

This section lists potential problems with the MACS II unit and solutions. If the problem is not correctable, contact Fann for assistance.

230 volts may be present so only a qualified technician should perform these actions.

Item	Problem	Cause	Solution
1.	MACS II unit does not power up. No fan or controller displays.	Main power inlet and plug.	Check plug and circuit breaker panel for 230 volts
		MACS II power switch “off” at rear of unit.	Turn “on” switch.
		Circuit breaker “off” at rear of unit.	Turn “on” breaker.
2.	MACS II unit powers up, but fan does not operate.	Remove panels to gain access and check connector and wiring from fan to terminal block.	Reconnect or replace wiring.
		Bad fan.	Replace fan.
3.	MACS II unit powers up, the fan is “on”, but there is no display on controller.	Check connector and wiring from controller to terminal block.	Reconnect or replace wiring.
		Bad controller.	Replace controller.
4.	Communication error when trying to connect.	USB cable(s) not connected.	Close MACS II program, reconnect cables, wait ten seconds, restart program and connect.
		Possible problems with internal Edgeport connectivity.	Inspect and verify Edge-port communication ports are correct with supplied Edgeport Configuration Utility software.
		Possible problem with NI cDAQ-9172 connectivity.	Inspect and verify NI cDAQ communication ports are correct with supplied measurement & automation software.

Item	Problem	Cause	Solution
5.	After selecting **Connect** unit goes into yellow Safe mode.	Emergency stop button is pressed.	Twist emergency stop button counterclockwise, disconnect, and re-connect to initialize the torque sensor.
6.	Yellow Safe mode indication during test.	Emergency stop button has been pressed.	Twist emergency stop button counterclockwise. If a test has been started, abort it and start a new test. There is no recovery from this situation.
7.	MACS II does not hold pressure at low values <3000 psig but holds at high values>8000 psig.	Bad Tescom valve seat.	Rebuild Tescom valve with Soft Goods Kit (P/N 101629340).
8.	MACS II holds pressure at low values <3000 psig but does not hold at high values>8000 psig.	Bad Tescom valve stem and seat.	Rebuild Tescom valve with Repair Kit (P/N 101629342).
9.	MACS II does not hold any pressure but does pump.	No water supply.	Turn on water.
		Bad Tescom valve.	Rebuild Tescom valve with Repair Kit (P/N 101629342).
		Leaking cell or mag drive o-ring.	Replace o-ring.
		Leaking dump or manual valve.	Replace dump valve, tighten, and/or replace manual valve.
		Leaking high pressure fittings.	Look for leak, tighten or replace.

WARNING High pressure is present. Before manual disassembly, remove pressure by opening the manual valve or, as a last resort slowly loosen a high pressure ¼ inch fitting ensuring the temperature is below 100°F. Use proper PPE for safety.

10.	MACS II does not depressurize.	Dirty inline filter.	Clean or replace cartridge filter (P/N 101626358).
		Clogged high pressure line from bottom of cell or 1/8th line to filter.	Disconnect fittings and remove clogged lines. Clean by reverse pressure flow or replace lines.
11.	MACS II does not? Pump when pressure is requested.	No air supply to system or regulator turned down.	Connect air supply and ensure regulator is set at 100 PSIG.
12.	Cell and drawer movements are inoperable.	No air supply.	Connect air supply or turn up air regulator.
		No 24 VDC power supplied to solenoids.	Inspect 24 VDC supply in electronic enclosure, check associated connectors and wiring to/from terminal blocks.
13.	Cell does not engage properly.	Cell, top cap or drawer misaligned.	Refer to alignment procedures in manual.

Accessories and Schematics

Section 9

Table of Contents

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9.1. MACS II Tool Kit

Find #	Name	Drawing/Rev	Quantity	Reference	Description
	101708266		1		KIT, TOOL, MACS II
0001	101582697 / A		1.0	101582697	WRENCH, 2.00 INCH, OPEN END AND SOCKET END
0002	101582698 / A		1.0	101582698	WRENCH, 2.50 INCH, OPEN END AND SOCKET END
0003	101710008 / A		1.0	101710008	WRENCH, 5/8 INCH, OPEN END AND SOCKET END
0004	101710009 / A		1.0	101710009	WRENCH SET ALLEN 13-PC, .050 THRU 3/8 INCH, W/ PLASTIC INDEXED CADDY
0005	101623038 / A		1.0	101623038	WRENCH, OIL FILTER, NYLON STRAP
0006	101629332 / A		1.0	101629332	TOOL, SENSOR TORQUE, 20,000 PSIG AND 30,000 PSIG, TESCOM REGULATOR
0007	100072377 / A	800.61388 / A	1.0	800.61388	BAIL, SLURRY CUP, 50 KSI CEMENT CONSISTOMETER
0008	100072505 / E	800.62143 / U	1.0	800.62143	HOLDER, SLURRY CUP, HP-HT CONSISTOMETER
0009	100072506 / D	800.62144 / C	1.0	800.62144	WRENCH, SLURRY CUP, HP-HT CONSISTOMETER
0010	101711419 / A		1.0	101711419	TOOL, ALIGNMENT, TORQUE MEASUREMENT SYSTEM, 50 OZF IN, 10000 RPM 12 VDC
0011	101711420 / A		1.0	101711420	BEARING REMOVAL TOOL, SNAPTITE MAGNEDRIVE30B-1957

9.2. MACS II Accessory Parts Kit

Find #	Name	Drawing/Rev	Quantity	Reference	Description
	101708367		1		KIT, ACCESSORY PARTS, MACS II
0001	204129 / A		5.0	C7006	FUSE 10 AMP EUROPEAN 5MM X 20mm MOD

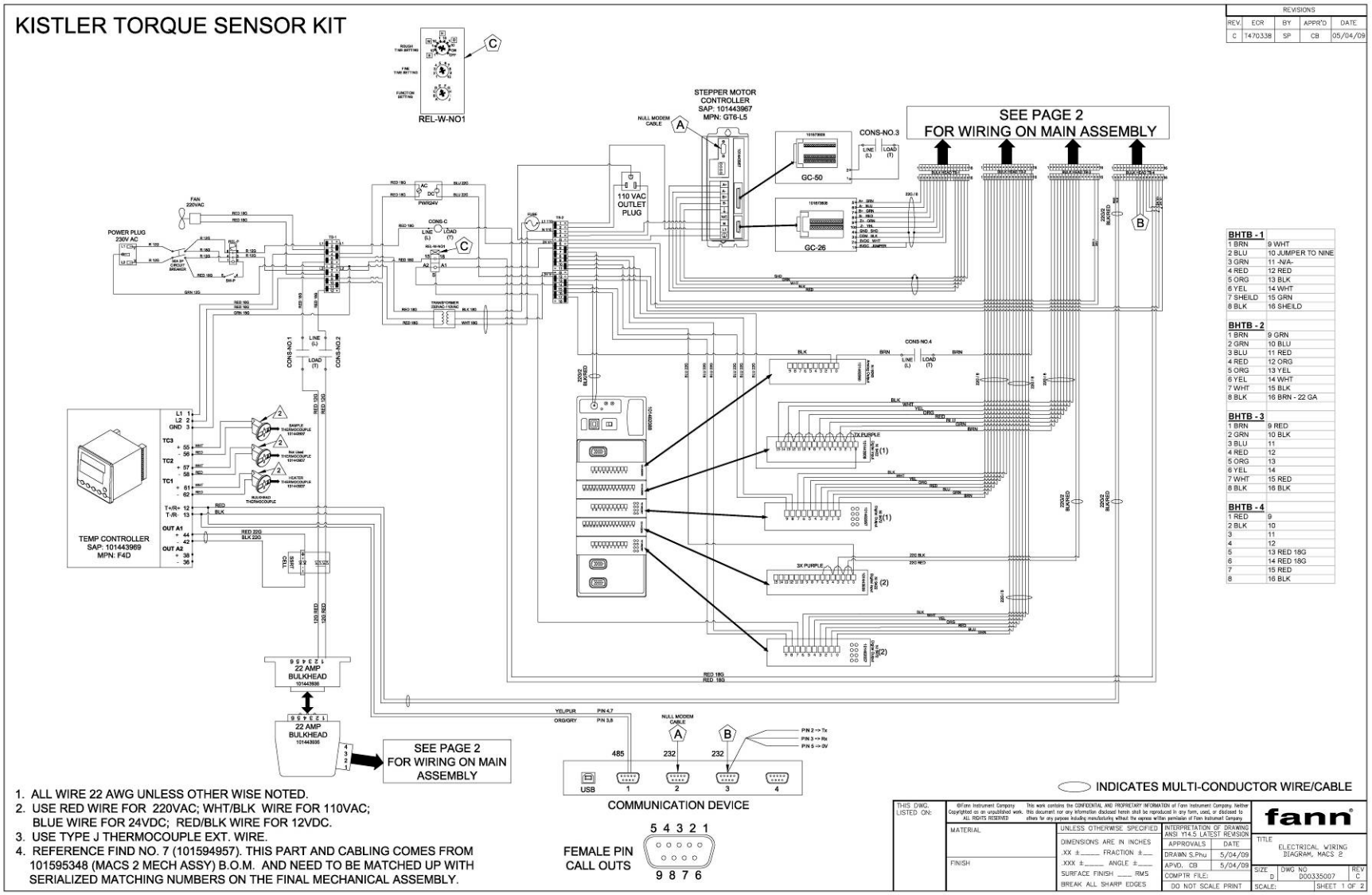
Find #	Name	Drawing/Rev	Quantity	Reference	Description
0002	101626358 / A		1.0	101626358	FILTER, 40 MICRON, 304 WIRE MESH, 3B FILTER
0003	101630287 / A		1.0	101630287	KIT, 3 ORINGS FOR P8791-HP-40WEV ORING 212V, 138V, AND 138VP
0004	101629342 / C		1.0	101629342	KIT, REPAIR, TESCOM 54-21N0T44A-074 REGULATOR, 30,000 PSIG
0005	101629340 / B		1.0	101629340	KIT, SOFT GOODS, 30,000 PSIG, TESCOM REGULATOR
0006	204816 / A		1.0	F4160	GREASE HIGH TEMP PERMATEX 82325
0007	210435 / A		1.0	87009	LUBRICANT HIGH TEMPERATURE 1 OUNCE TUBE
0008	101594774 / D	101594774 / D	1.0	101594774	BACKUP RING, PRESSURE VESSEL, MACS II
0009	206712 / A		12.0	11512	ORING 3 X 3-1/4 V-23 234-90 VITON 90 DUROMETER USE ENCLOSED SPEC SHEET FOR DUROMETER
0010	101710014 / A		6.0	101710014	O-RING, ULTRA PARAFLUOR, ID 2.984, COLOR WHITE, SIZE 2-234, DUROMETER 75
0011	101443948 / C	101443948 / C	1.0	101443948	BACKUP RING, MAG DRIVE, MACS II
0012	101710015 / A		2.0	101710015	O-RING, ULTRA PARAFLUOR, ID .739, COLOR WHITE, SIZE 2-018, DUROMETER 75
0013	101667558 / B	101667558 / B	1.0	101667558	THERMOCOUPLE, J TYPE, MACS II, TOP, 30000 PSI RATED, 56 IN LEADS

9.3. MACS II Calibration Kit

Find #	Name	Drawing/Rev	Quantity	Reference	Description
	101780235		1		KIT, CALIBRATION, MACS II
0001	204178 / A		1.0	D4026	WEIGHT HANGER 50gm ALUMINUM
0002	204179 / A		1.0	D4027	WEIGHT SLOTTED BRASS 50gm
0003	204180 / A		1.0	D4028	WEIGHT SLOTTED BRASS 100gm
0004	204181 / A		1.0	D4029	WEIGHT SLOTTED BRASS 200gm
0005	207781 / A		1.0	31278	BEAD CALIBRATION KIT 3/32in. DIA
0006	101780256 / A		10.0	101780256	Braided line, 20lb Test SPIDERWIRE STEALTH 1085179 MFG PART NUMBER SS20Y-150

9.4. MACS II Schematics

The following pages contain various pertinent schematic drawing. Note that the schematics are also included in larger, easier-to-read format on the CD.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C T470338 SP CB 05/04/09
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SEE PAGE 2 FOR WIRING ON MAIN ASSEMBLY
110 VAC OUTLET PLUG
GC-50
GC-26
CONS-NO.3
CONS-NO.4
POWER PLUG 230V AC
FAN 220VAC
PWR24V
TRANSFORMER
TEMP CONTROLLER SAP: 101443969 MPN: F4D
22 AMP BULKHEAD
SEE PAGE 2 FOR WIRING ON MAIN ASSEMBLY
COMMUNICATION DEVICE
USB
485
232
FEMALE PIN CALL OUTS
5 4 3 2 1
9 8 7 6
BHTB - 1
1 BRN 9 WHT
2 BLU 10 JUMPER TO NINE
3 GRN 11 -N/A-
4 RED 12 RED
5 ORG 13 BLK
6 YEL 14 WHT
7 SHEILD 15 GRN
8 BLK 16 SHEILD
BHTB - 2
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2 GRN 10 BLU
3 BLU 11 RED
4 RED 12 ORG
5 ORG 13 YEL
6 YEL 14 WHT
7 WHT 15 BLK
8 BLK 16 BRN - 22 GA
BHTB - 3
1 BRN 9 RED
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3 BLU 11
4 RED 12
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8 BLK 16 BLK
BHTB - 4
1 RED 9
2 BLK 10
3 11
4 12
5 13 RED 18G
6 14 RED 18G
7 15 RED
8 16 BLK
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1. ALL WIRE 22 AWG UNLESS OTHER WISE NOTED.
2. USE RED WIRE FOR 220VAC; WHT/BLK WIRE FOR 110VAC; BLUE WIRE FOR 24VDC; RED/BLK WIRE FOR 12VDC.
3. USE TYPE J THERMOCOUPLE EXT. WIRE.
4. REFERENCE FIND NO. 7 (101594957). THIS PART AND CABLING COMES FROM 101595348 (MACS 2 MECH ASSY) B.O.M. AND NEED TO BE MATCHED UP WITH SERIALIZED MATCHING NUMBERS ON THE FINAL MECHANICAL ASSEMBLY.
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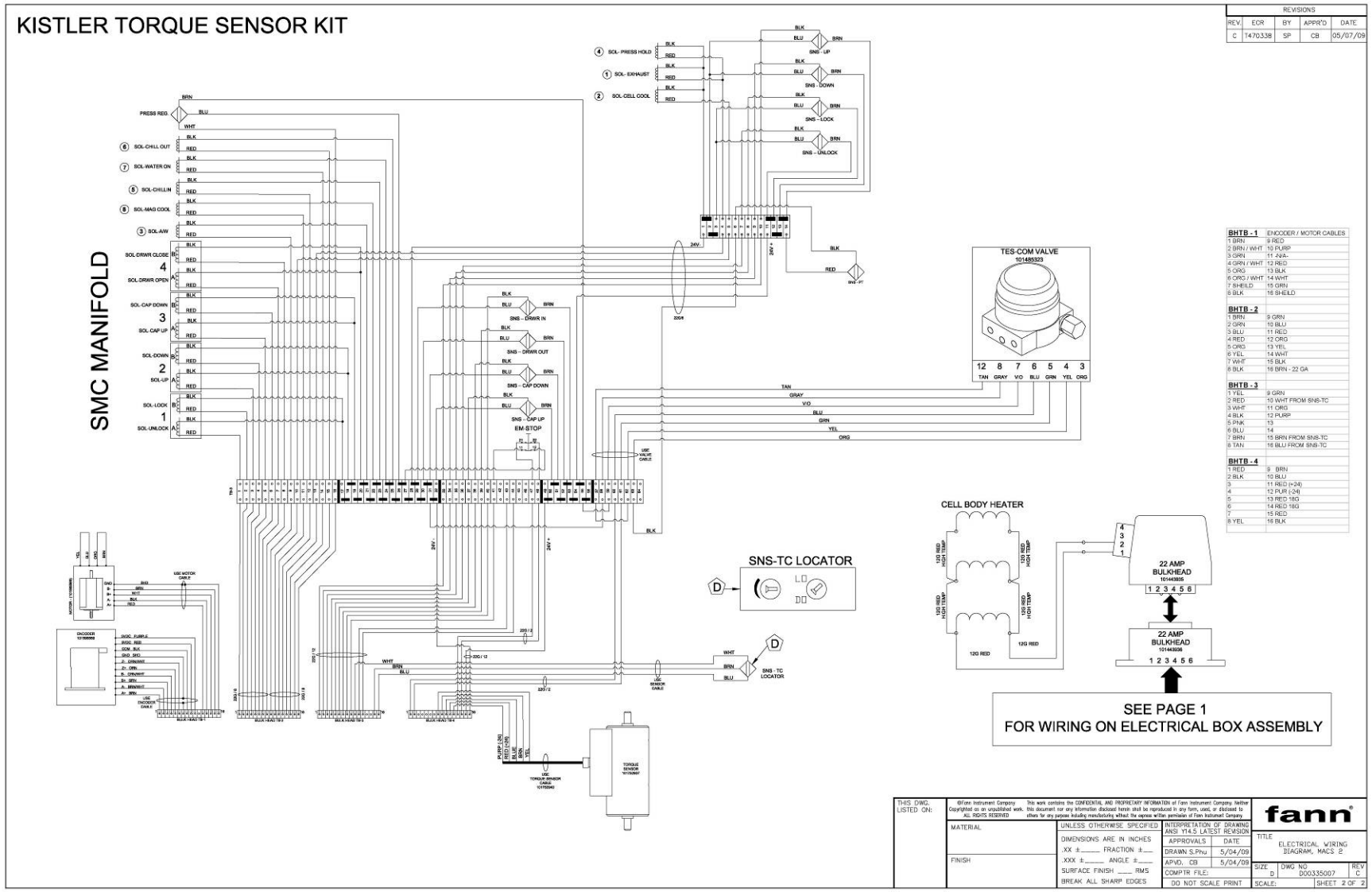
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CELL BODY HEATER
TES-COM VALVE
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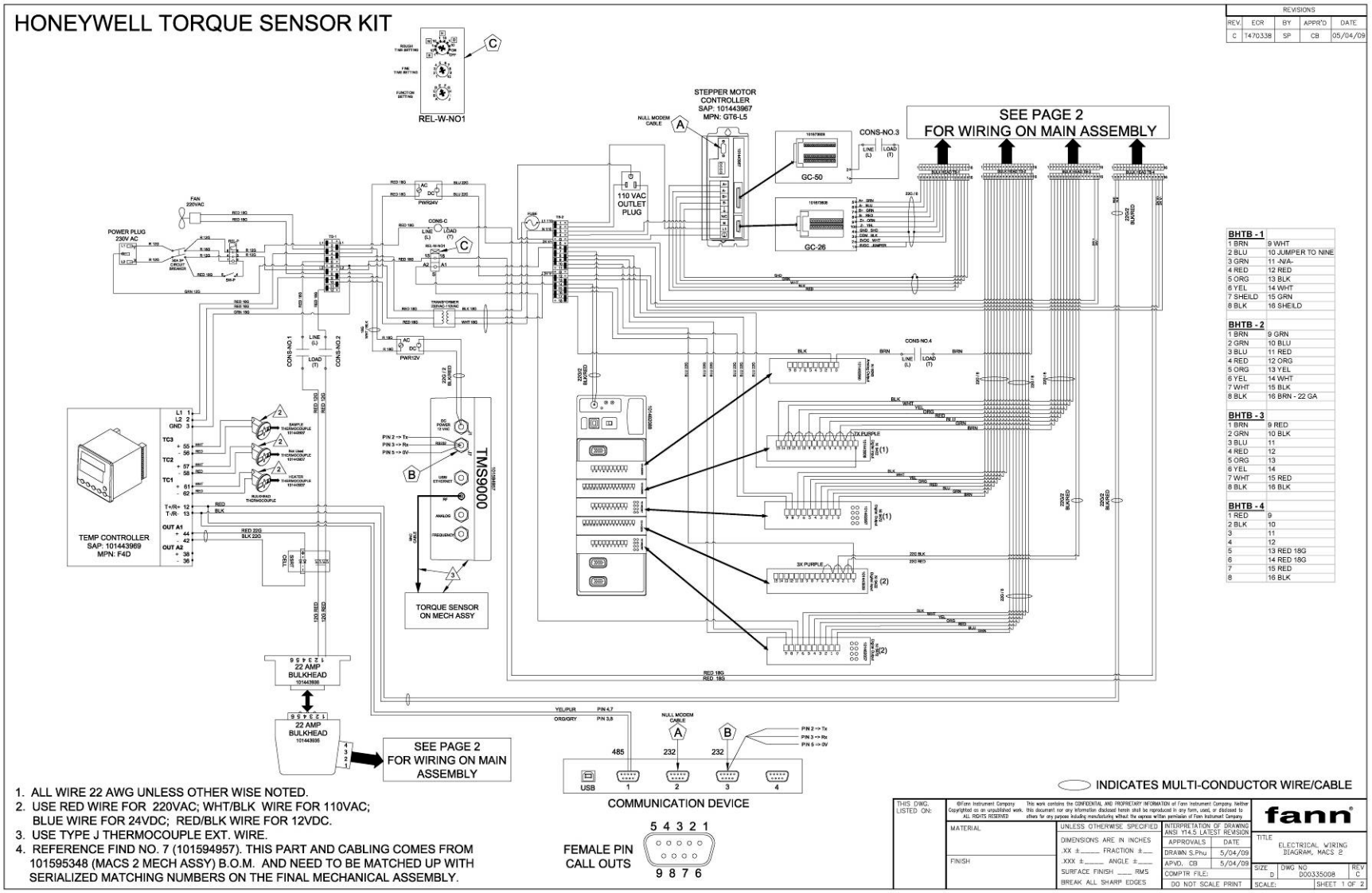
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GC-26
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CONS-NO.4
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PWR24V
PWR12V
TMS9000
TORQUE SENSOR ON MECH ASSY
TEMP CONTROLLER SAP: 101443969 MPN: F4D
22 AMP BULKHEAD
SEE PAGE 2 FOR WIRING ON MAIN ASSEMBLY
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FEMALE PIN CALL OUTS
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9 8 7 6
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1 BRN 9 WHT
2 BLU 10 JUMPER TO NINE
3 GRN 11 ANAL
4 RED 12 RED
5 ORG 13 BLK
6 YEL 14 WHT
7 SHEILD 15 GRN
8 BLK 16 SHEILD
BHTB - 2
1 BRN 9 GRN
2 GRN 10 BLU
3 BLU 11 RED
4 RED 12 ORG
5 ORG 13 YEL
6 YEL 14 WHT
7 WHT 15 BLK
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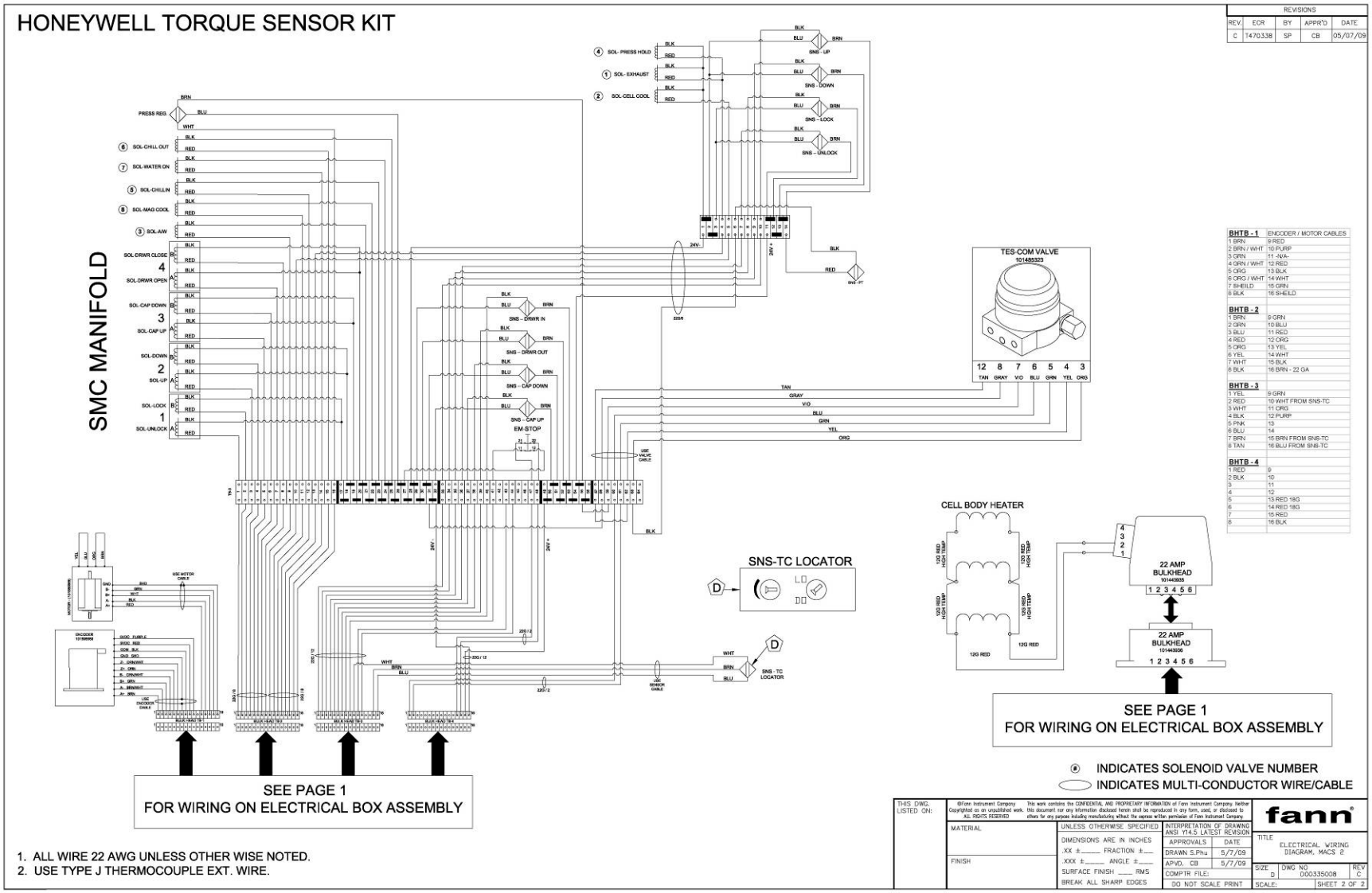
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22 AMP BULKHEAD
101443936
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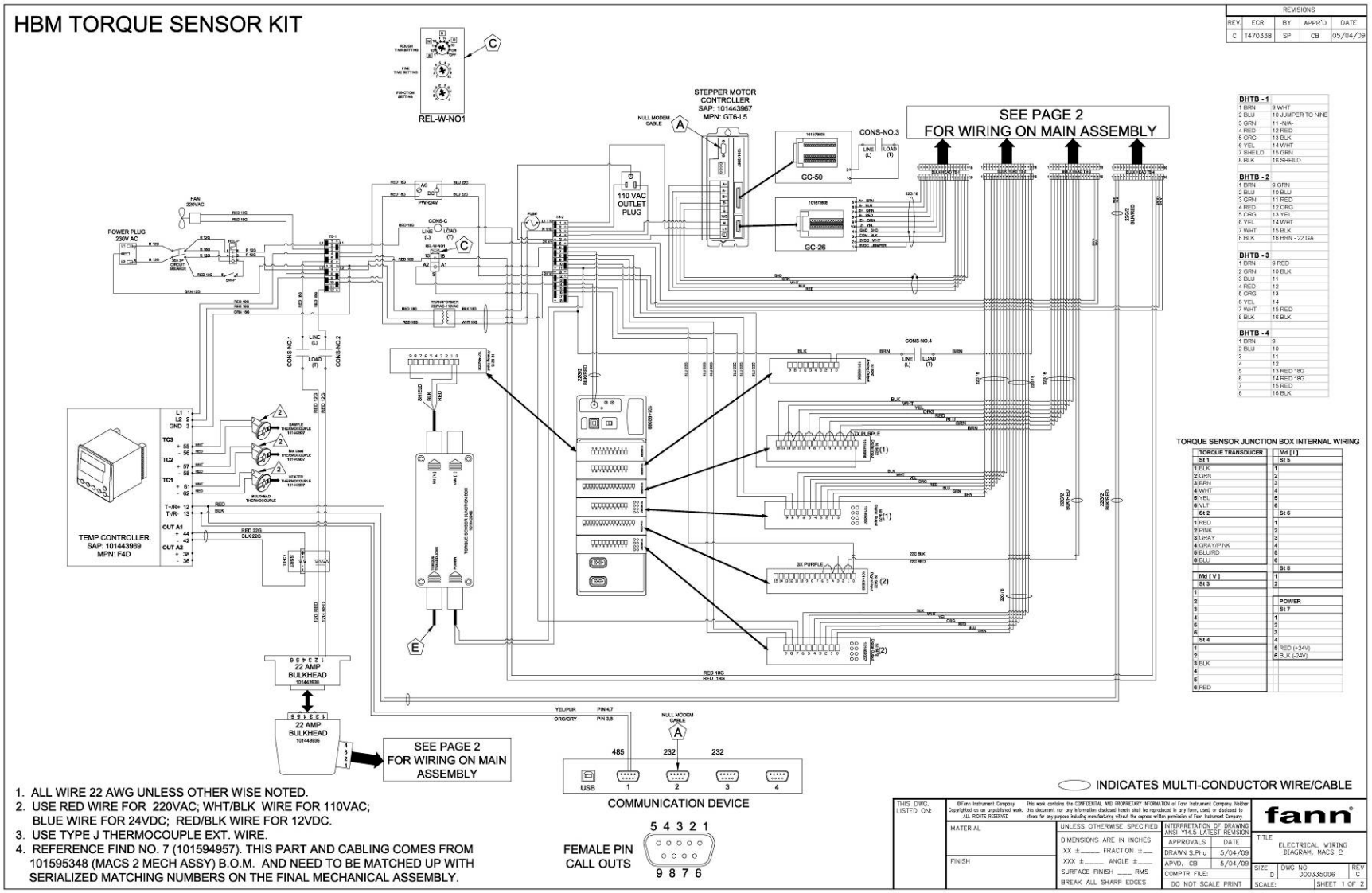
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232
COMMUNICATION DEVICE
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9 8 7 6
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BHTB - 2
BHTB - 3
BHTB - 4
TORQUE SENSOR JUNCTION BOX INTERNAL WIRING
TORQUE TRANSDUCER
Md [i]
Md [V]
POWER
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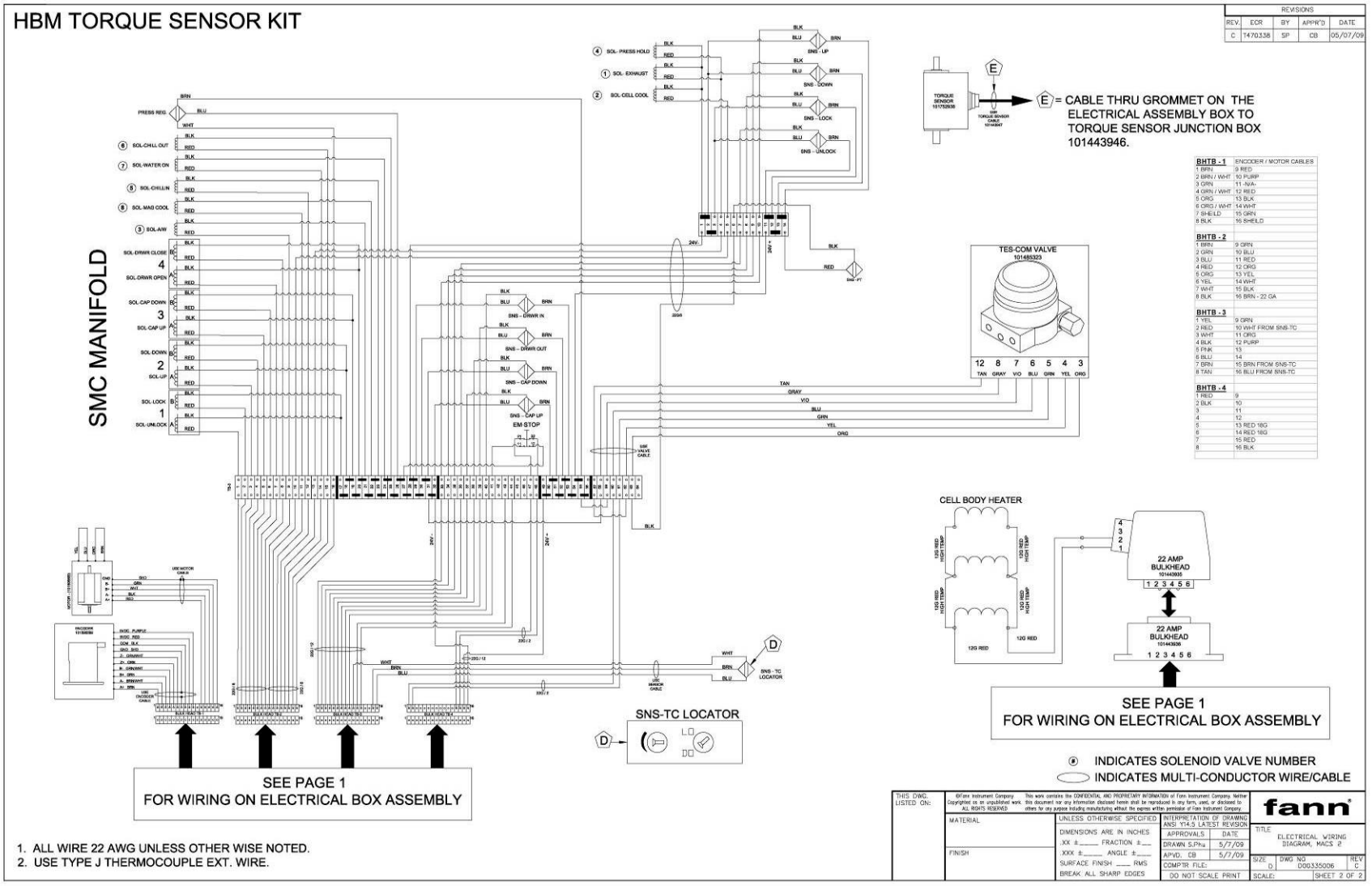
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SEE PAGE 1
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TES-COM VALVE
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22 AMP
BULKHEAD
101443935
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BHTB - 2
BHTB - 3
BHTB - 4
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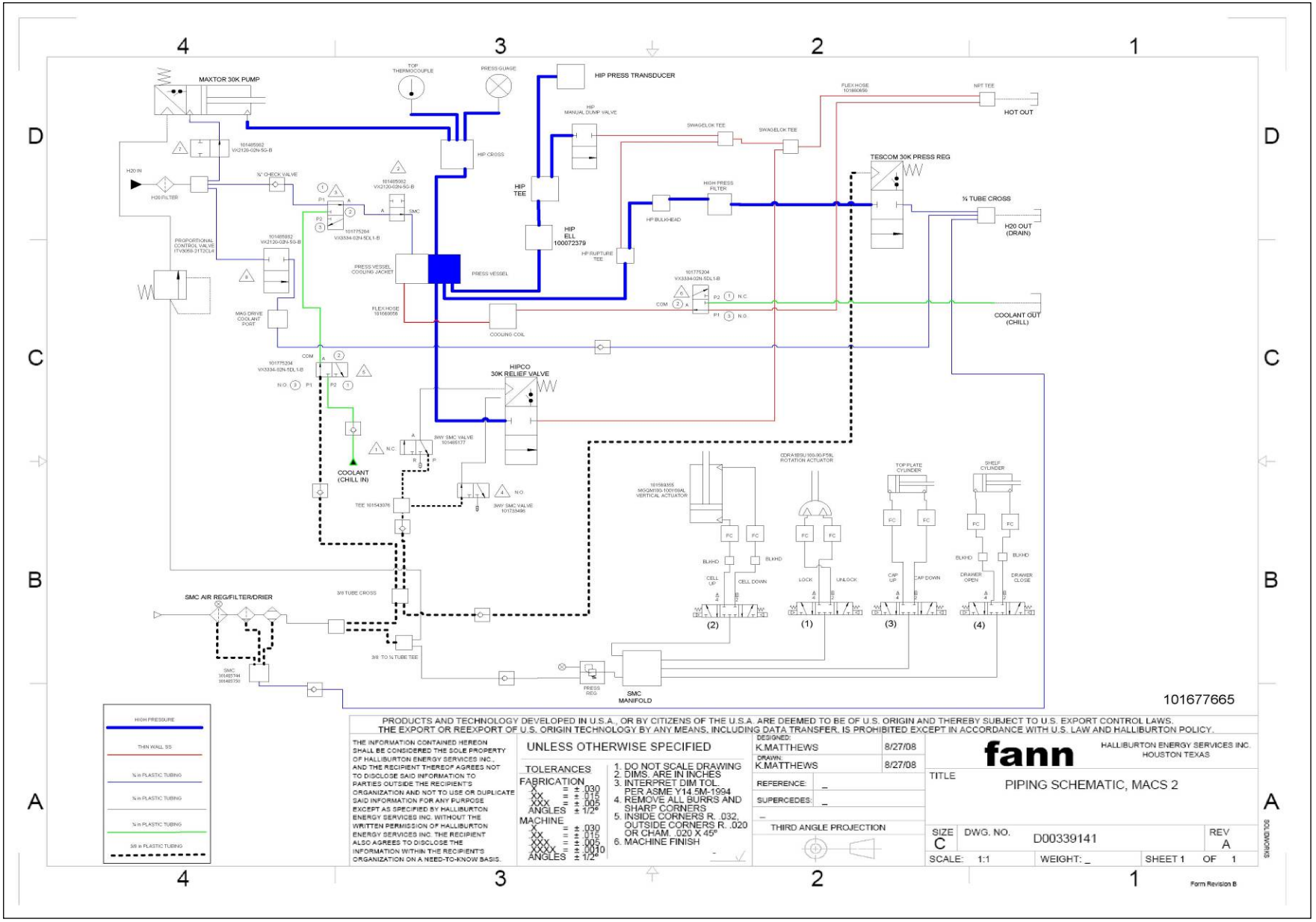
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101677665
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HOUSTON TEXAS
UNLESS OTHERWISE SPECIFIED
THIRD ANGLE PROJECTION
PRODUCTS AND TECHNOLOGY DEVELOPED IN U.S.A., OR BY CITIZENS OF THE U.S.A. ARE DEEMED TO BE OF U.S. ORIGIN AND THEREBY SUBJECT TO U.S. EXPORT CONTROL LAWS.
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Parts List

Section 10

Table of Contents

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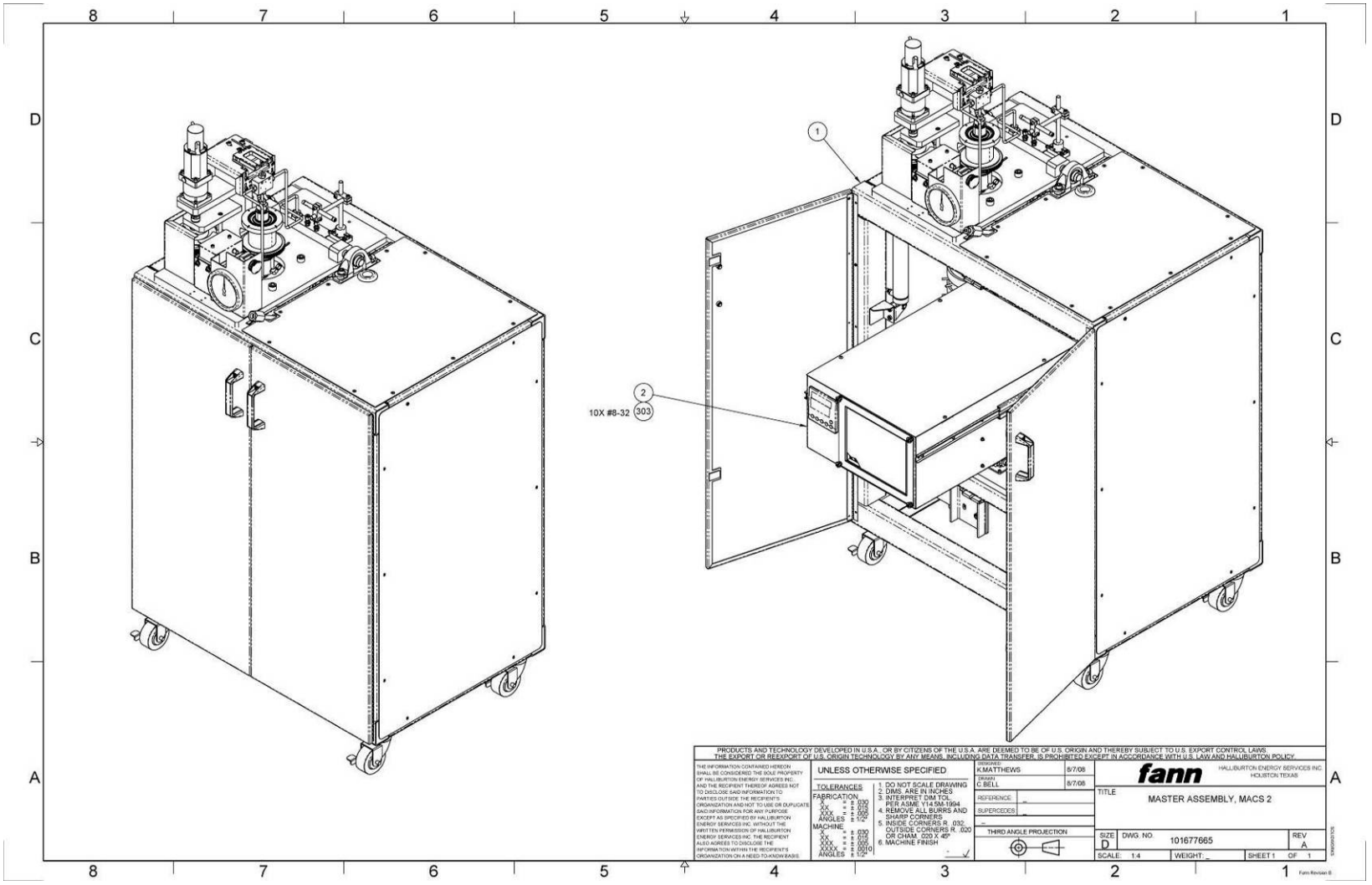
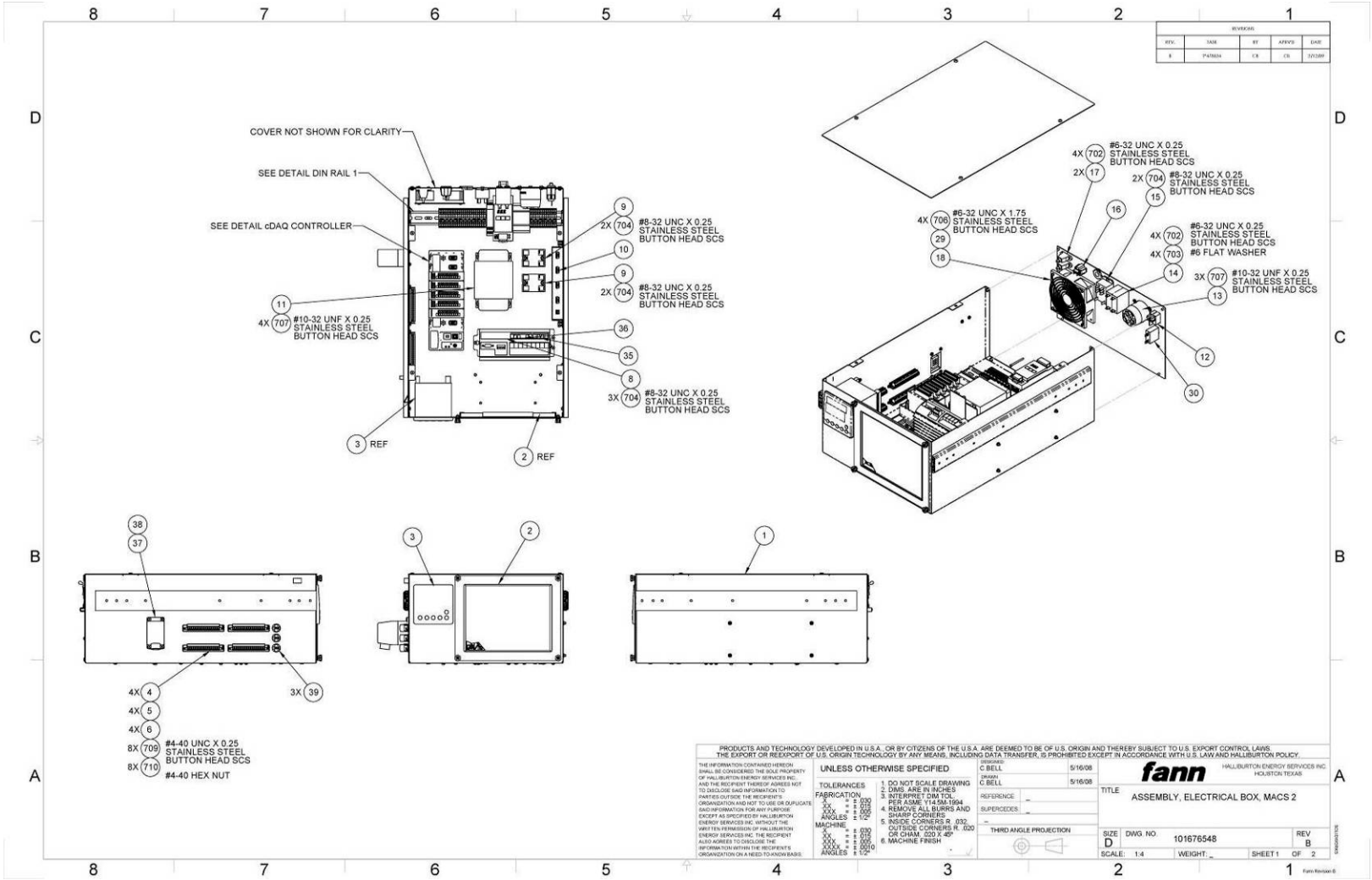
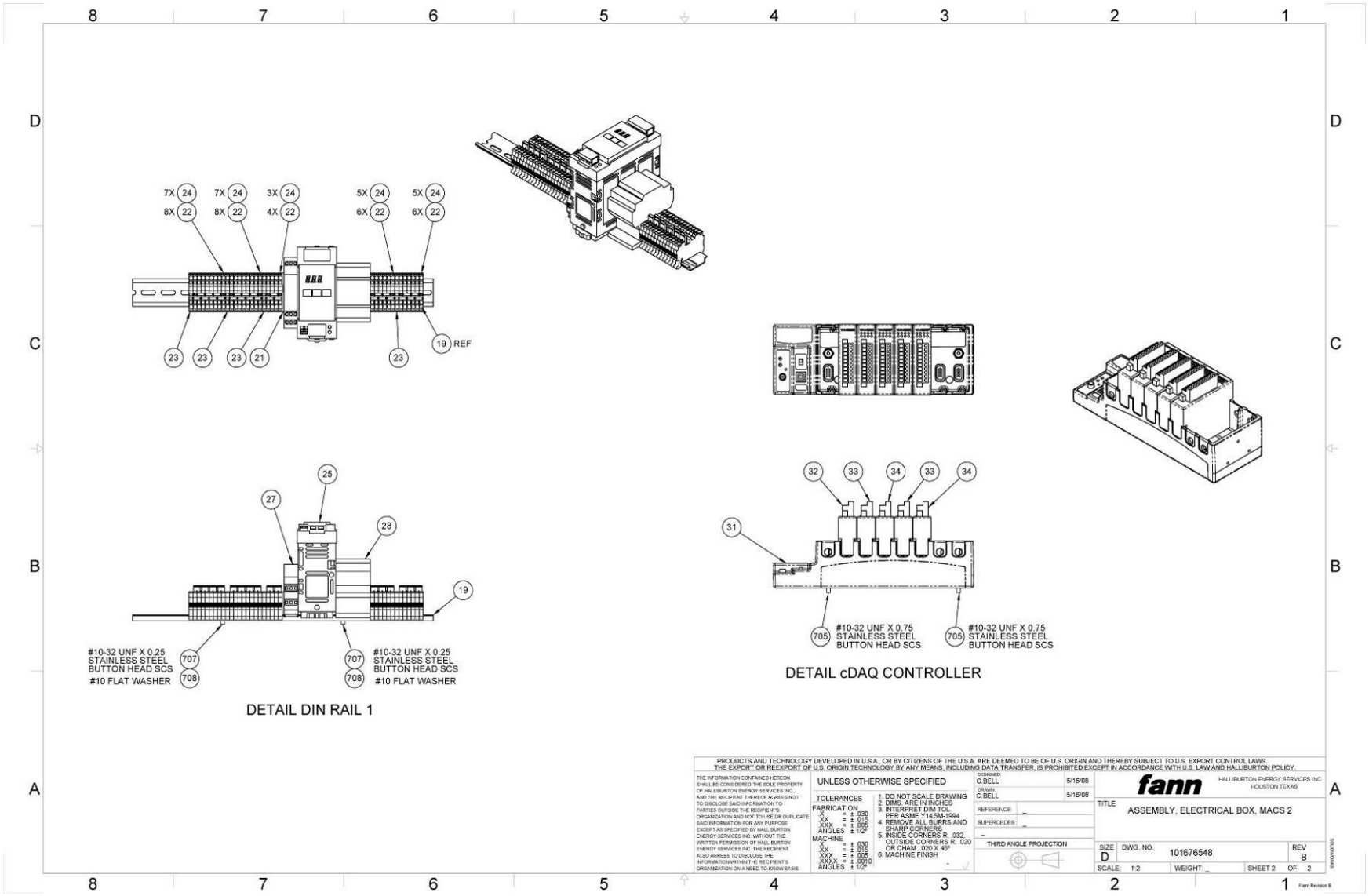
10.1. **Master Assembly 101677665**



Find #	Name	Drawing #	Quantity	Description
	101677665	101677665 D00339141		MASTER ASSEMBLY, MACS II ANALYZER DOES NOT INCLUDE COMPUTER.
1	101595348	101595348	1	MECHANICAL ASSEMBLY, MACS II, FANN
2	101676548	D00335007 D00335008 D00335006 101676548	1	ASSEMBLY, ELECTRICAL BOX, MACS II
200	101780235		1	KIT, CALIBRATION, MACS II
201	101708266		1	KIT, TOOL, MACS II
202	101708367		1	KIT, ACCESSORY PARTS, MACS II
203	101643568		1	SOFTWARE, DATA VIEWER FOR FANN MACHINES
204	101708267		1	SOFTWARE, MACS II
301	101443941	101443941	1	MAIN POWER CORD, 30 AMP, 250 V, 6 FT LONG
302	101367493		2	CABLE, USB, 6FT, 1.8 METER, TYPE A TO TYPE B
303	101262244		10	SCREW, THREADED, BUTTON HEAD SCS (US) - NO. 8 -32 UNC x 0.25 - 18-8 SS

10.2. **Electrical Box Assembly 101676548**




7X 24
8X 22
7X 24
8X 22
3X 24
4X 22
5X 24
6X 22
5X 24
6X 22
23
23
23
21
23
19 REF
25
27
28
19
#10-32 UNF X 0.25 STAINLESS STEEL BUTTON HEAD SCS
#10 FLAT WASHER
707
708
707
708
#10-32 UNF X 0.25 STAINLESS STEEL BUTTON HEAD SCS
#10 FLAT WASHER
DETAIL DIN RAIL 1
32
33
34
33
34
31
705
#10-32 UNF X 0.75 STAINLESS STEEL BUTTON HEAD SCS
705
#10-32 UNF X 0.75 STAINLESS STEEL BUTTON HEAD SCS
DETAIL cDAQ CONTROLLER
PRODUCTS AND TECHNOLOGY DEVELOPED IN U.S.A., OR BY CITIZENS OF THE U.S.A. ARE DEEMED TO BE OF U.S. ORIGIN AND THEREBY SUBJECT TO U.S. EXPORT CONTROL LAWS. THE EXPORT OR REEXPORT OF U.S. ORIGIN TECHNOLOGY BY ANY MEANS, INCLUDING DATA TRANSFER, IS PROHIBITED EXCEPT IN ACCORDANCE WITH U.S. LAW AND HALLIBURTON POLICY.
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UNLESS OTHERWISE SPECIFIED
TOLERANCES
FABRICATION
X = ± .030
.XX = ± .015
.XXX = ± .005
ANGLES ± 1/2°
MACHINE
X = ± .030
.XX = ± .010
.XXX = ± .005
.XXXX = ± .0010
ANGLES ± 1/2°
1. DO NOT SCALE DRAWING
2. DIMS. ARE IN INCHES
3. INTERPRET DIM TOL. PER ASME Y14.5M-1994
4. REMOVE ALL BURRS AND SHARP CORNERS
5. INSIDE CORNERS R. .032, OUTSIDE CORNERS R. .020 OR CHAM. .020 X 45°
6. MACHINE FINISH
DESIGNED C.BELL 5/16/08
DRAWN C.BELL 5/16/08
REFERENCE
SUPERCEDES
THIRD ANGLE PROJECTION
fann HALLIBURTON ENERGY SERVICES INC. HOUSTON TEXAS
TITLE ASSEMBLY, ELECTRICAL BOX, MACS 2
SIZE D
DWG. NO. 101676548
REV B
SCALE: 1:2
WEIGHT:
SHEET 2 OF 2

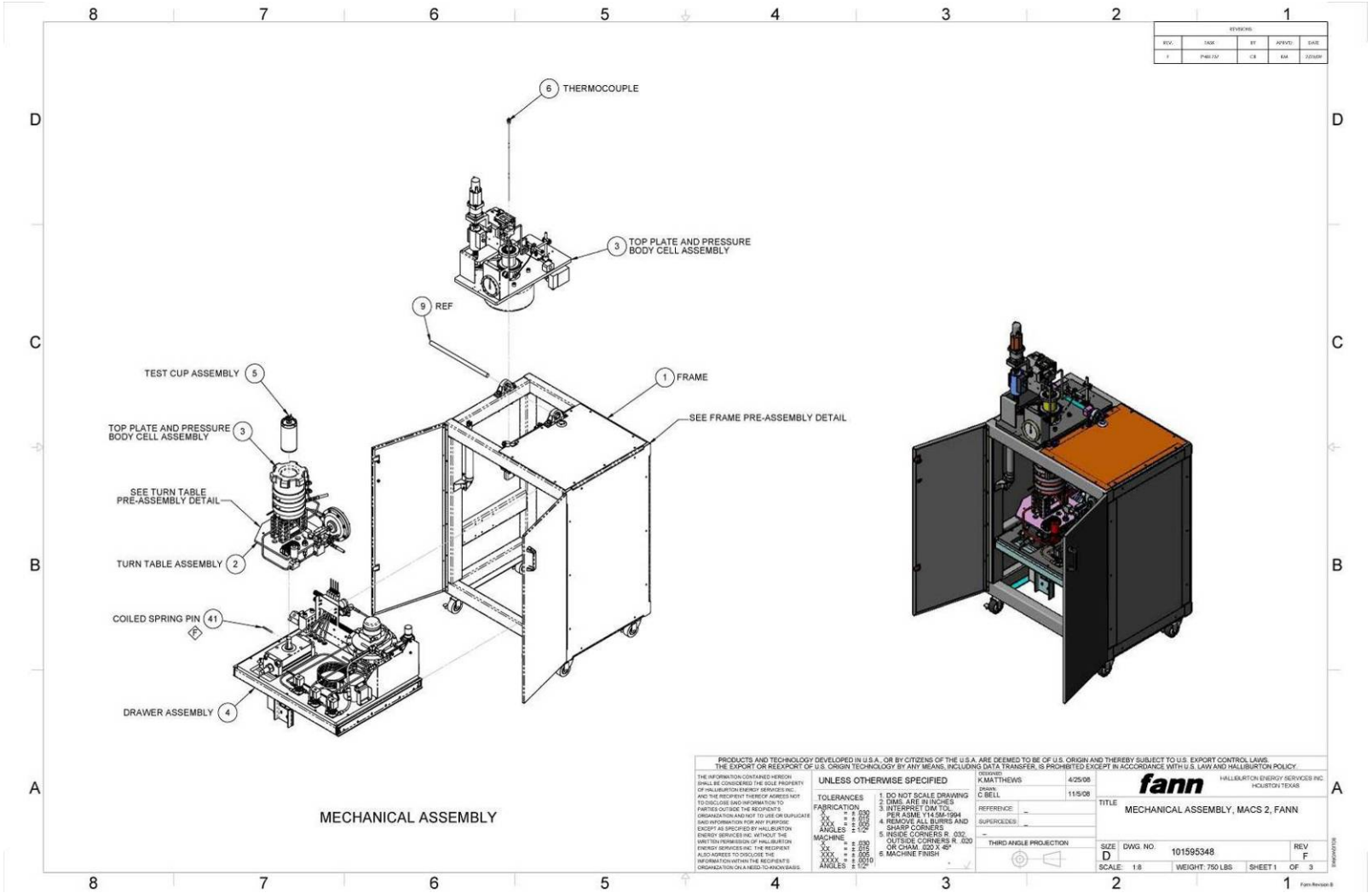
Find #	Name	Drawing	Quantity	Description
	101676548	101676548 D00335008 D00335006 D00335007		ASSEMBLY, ELECTRICAL BOX, MACS II
1	101443963	101443963	1	CHASSIS, ELECTRICAL BOX, MACS II
2	101443926	101443926	1	FILTER, INTAKE, 9.38 X 7.50 X .50 THICK FRAME, 30 PPI GRAY QUADRAFOAM II
3	101443969		1	TEMPERATURE CONTROLLER, DUAL CHANNEL, 1/4 DIN, PANEL MOUNT
4	101462041		4	FEED THRU, COMBICON/PHOENIX CONTACT 1852163
5	101461990		4	PLUG, COMBICON/PHOENIX CONTACT 1825640
6	101461967		4	PLUG, COMBICON/PHOENIX CONTACT 1778124
8	101443967		1	STEPPER DRIVE, MICROSTEPPING
9	101443970		1	SOLID STATE RELAY, DUAL OUTPUT, 25 A, OUTPUT 24-280 V AC, INPUT 17-32 V DC
10	101443958		1	CONVERTER, USB TO 4 232/422/485 SERIAL PORTS
11	205723		1	STEP DOWN TRANSFORMER 230 VAC TO 115 VAC 60HZ 1KW CAPACITY W/ RECEPTACLE & LINE
12	101450812		1	SWITCH, DOUBLE POLE, ROCKER
13	100021372		1	RECEPTACLE, 3 WIRE GROUNDING, FLANGED INLET, TWIST LOCK, 250 VAC, OR DC, 30 AMP, LEXAN CASE
14	101451383		1	CIRCUIT BREAKER, TWO POLE, SERIES TRIP, 30 AMP
15	101451384		1	RELAY, TWO POLE, 30 AMP, 220/240 VAC, PANEL MOUNT
16	101443929		1	OUTLET 5-15R, PANEL MOUNT, SNAP-IN, FRONT SIDE, SOLDER TERMINAL
17	101631176		2	USB PANEL MOUNT, TYPE B CABLE, LENGTH 3 FOOT

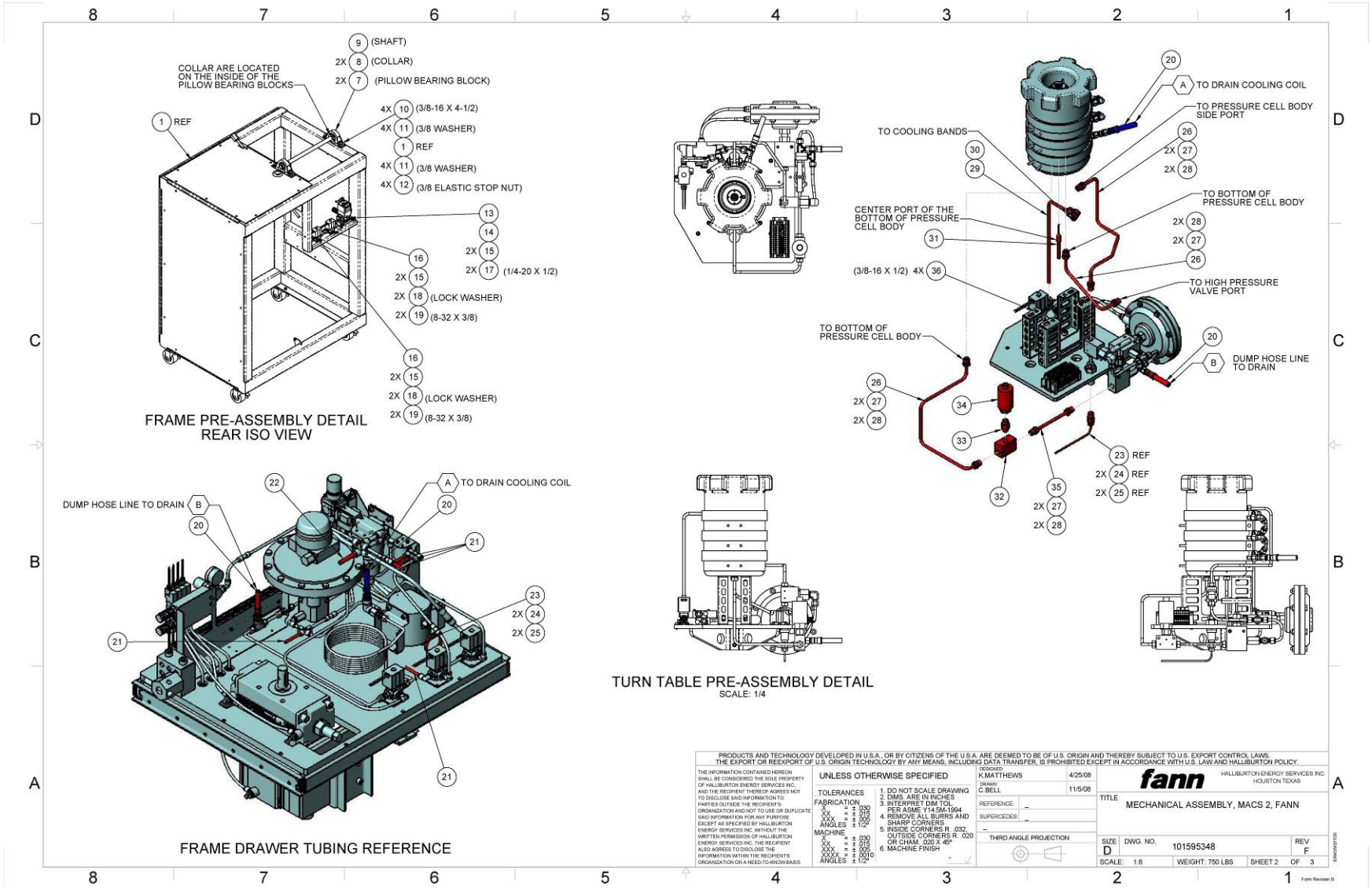
Find #	Name	Drawing	Quantity	Description
18	101613246		1	FAN, 4.73IN SQ X 1.50IN THK, 230 VAC, 105 CFM
19	100033128	70.81602	1	RAIL, MOUNTING, 35MM, X 1 METER, DIN,46277, SYMMETRICAL
20	101391619		2	CLAMP, END, UNIVERSAL, FOR 35 MM X 7.5 MM MOUNTING RAIL, E/NS 35 N
21	101462159		2	COVER, 2.2MM X 48.5 MM PHOENIX CONTACT 3030417
22	101483688		30	Feed-through terminal blocks with spring-cage connection, cross section: 0.2 - 2.5 mm, width: 5.2 mm, color: gray
23	101634351		4	SPRING CAGE GROUND TERMINAL BLOCK, AWG 24 TO 14, YELLOW GREEN
24	101483689		24	Plug-in bridge for cross-connections in the terminal center, 2-pos., color: Red
25	101761371		1	POWER SUPPLY, 24V, 5 AMP, LED DISPLAY, DIN RAIL MOUNT
27	101443927		1	RELAY, MULTIFUNCTION TIME, UNIVERSAL SUPPLY VOLTAGE AC/DC 12 - 240 V, OUTPUT CONTACT SPDT OR DPDT 16 A, DIN RAIL MOUNTED
28	101443956		1	CONTACTOR, 4 POLE, 30 AMP, 240V AC COIL
29	204387		1	GUARD FAN FINGER f/120mm MUFFIN
30	101752942		1	CIRCUIT BREAKER, 10 AMP, PUSH BUTTON, 125-250 VAC/32 VDC
31	101462088		1	DATA ACQUISITION SYSTEM, 8-SLOT CHASSIS FOR COMPACT DAQ NI cDAQ-9172
32	101462060		1	ANALOG OUTPUT MODULE NI cRIO-9263
33	101443939		2	DIGITAL INPUT AND COUNTER/TIMER MODULE NI cRIO-9422
34	101462057		2	DIGITAL OUTPUT AND RELAY MODULE NI cRIO-9472
35	101673608		1	CONNECTOR, GEMINI, 26P, WITH TERMINALS
36	101673609		1	CONNECTOR, GEMINI, 50P, WITH TERMINALS

Find #	Name	Drawing	Quantity	Description
37	101443936		1	KIT, PANEL HOUSING, 6 POSITION, 22A, 400V, 22-12 AWG WIRE
38	101443935		1	KIT, CABLE HOOD, 6 POSITION, 22A, 400V, 22-12 AWG WIRE
39	101443937		3	PANEL THERMOCOUPLE JACK, ROUND HOLE, RMJ MINIATURE
40	101443938		3	MINIATURE CONNECTOR, TYPE J MALE, SMPW-J-M
41	100155318	789.01325	2	Monitor ext Cable DB9(F)x DB9(F)x 6ft
42	101783537		1	Null Modem Cable DB9 Fem x DB9 Fem 6ft long
43	203723		14	TERMINAL FEMALE CRIMP 14-20 AWG
44	100032008	70.76197	16	TERMINAL, FEMALE, SLIP ON, FULLY INSULATED, FOR #10-12 GA WIRE, XS09788, HOLLINGSWORTH
45	101713992		10	HI-TEMP WIRE, 1200F, 12 AWG
46	365255		8	TERMINAL RING 10-12 AWG 10 HI TEMP HIGH TEMPERATURE RING TERMINAL NON-INSULATED 10 STUD SIZE 900 DEGREES F MAX
47	100022082	70.10506	8	COVER, TERMINAL, CERAMIC, FOR MICA BAND HEATER B6A1JP4
48	101784683		200	22 AWG stranded (7x30) TC conductors, S-R PVC insulation, overall Beldfoil® (100% coverage) + TC braid shield (65% coverage), PVC jacket.
49	206242		240	WIRE 22 AWG TEFLON STRANDED BLUE
50	208547		20	WIRE 22AWG TEFLON STRANDED BLACK
51	208548		20	WIRE 22 AWG TEFLON STRANDED RED
52	208549		20	WIRE 22 AWG TEFLON STRANDED WHITE
53	100032006	70.76195	2	TERMINAL, FEMALE, SLIP ON, FULLY INSULATED, FOR 18-22 GA WIRE, XS09770S, HOLLINGSWORTH
54	208485		3	WIRE THERMOCOUPLE DUPLEX TYPE
55	100029508	70.53835	2	TERMINAL, CRIMP, 12-10 GA, #10 STUD, RING TYPE, INSULATION CRIMP

Find #	Name	Drawing	Quantity	Description
56	100032007	70.76196	7	TERMINAL, FEMALE, SLIP ON, FULLY INSULATED, FOR #18-22 GA WIRE, XS09778, HOLLINGSWORTH
57	349301		8	TERMINAL FEMALE Q.C,.25X.032 12-10GA THOMAS & BETTS TNF10-250FD NYLON FULLY INSULATED FEMALE DISCONNECT WIRE RANG 12/10 AWG TAB SIZE .250 X .032 25 PER PACKAGE
58	203857		13	FERRULE INSUL 18 AWG WIRE
59	203858		6	FERRULE INSUL 12 AWG WIRE
60	204299		7	TERMINAL FEMALE Q.C .25X.032 1
61	208457		2	BUTT SPLICE 2RA-18
62	204288		2	DISCONNECT FEMALE .110 TAB 22-
702	101262200		8	SCREW, THREADED, BUTTON HEAD SCS (US) - NO. 6 -32 UNC x 0.25 - 18-8 SS
703	101267867		4	WASHER, FLAT (US) - NO. 6 SAE - 18-8 SS
704	101262244		7	SCREW, THREADED, BUTTON HEAD SCS (US) - NO. 8 -32 UNC x 0.25 - 18-8 SS
705	101262274		2	SCREW, THREADED, BUTTON HEAD SCS (US) - NO. 10 -32 UNF x 0.75 - 18-8 SS
706	101262218		4	SCREW, THREADED, BUTTON HEAD SCS (US) - NO. 6 -32 UNC x 1.75 - 18-8 SS
707	101262266		9	SCREW, THREADED, BUTTON HEAD SCS (US) - NO. 10 -32 UNF x 0.25 - 18-8 SS
708	101267873		2	WASHER, FLAT (US) - NO. 10 USS - 18-8 SS
709	101262156		8	SCREW, THREADED, BUTTON HEAD SCS (US) - NO. 4 -40 UNC x 0.25 - 18-8 SS
710	101256658		8	NUT, HEX MACHINE SCREW (US) - NO. 4 -40 - GRADE 8 ZINC-PLATED STL

10.3. **Mechanical Assembly 101595348**




COLLAR ARE LOCATED ON THE INSIDE OF THE PILLOW BEARING BLOCKS
9 (SHAFT)
2X 8 (COLLAR)
2X 7 (PILLOW BEARING BLOCK)
1 REF
4X 10 (3/8-16 X 4-1/2)
4X 11 (3/8 WASHER)
1 REF
4X 11 (3/8 WASHER)
4X 12 (3/8 ELASTIC STOP NUT)
2X 15
2X 17 (1/4-20 X 1/2)
2X 15
2X 18 (LOCK WASHER)
2X 19 (8-32 X 3/8)
2X 15
2X 18 (LOCK WASHER)
2X 19 (8-32 X 3/8)
FRAME PRE-ASSEMBLY DETAIL
REAR ISO VIEW
TO COOLING BANDS
A TO DRAIN COOLING COIL
TO PRESSURE CELL BODY SIDE PORT
CENTER PORT OF THE BOTTOM OF PRESSURE CELL BODY
TO BOTTOM OF PRESSURE CELL BODY
(3/8-16 X 1/2) 4X 36
TO HIGH PRESSURE VALVE PORT
TO BOTTOM OF PRESSURE CELL BODY
B DUMP HOSE LINE TO DRAIN
23 REF
2X 24 REF
2X 25 REF
DUMP HOSE LINE TO DRAIN
A TO DRAIN COOLING COIL
FRAME DRAWER TUBING REFERENCE
TURN TABLE PRE-ASSEMBLY DETAIL
SCALE: 1/4
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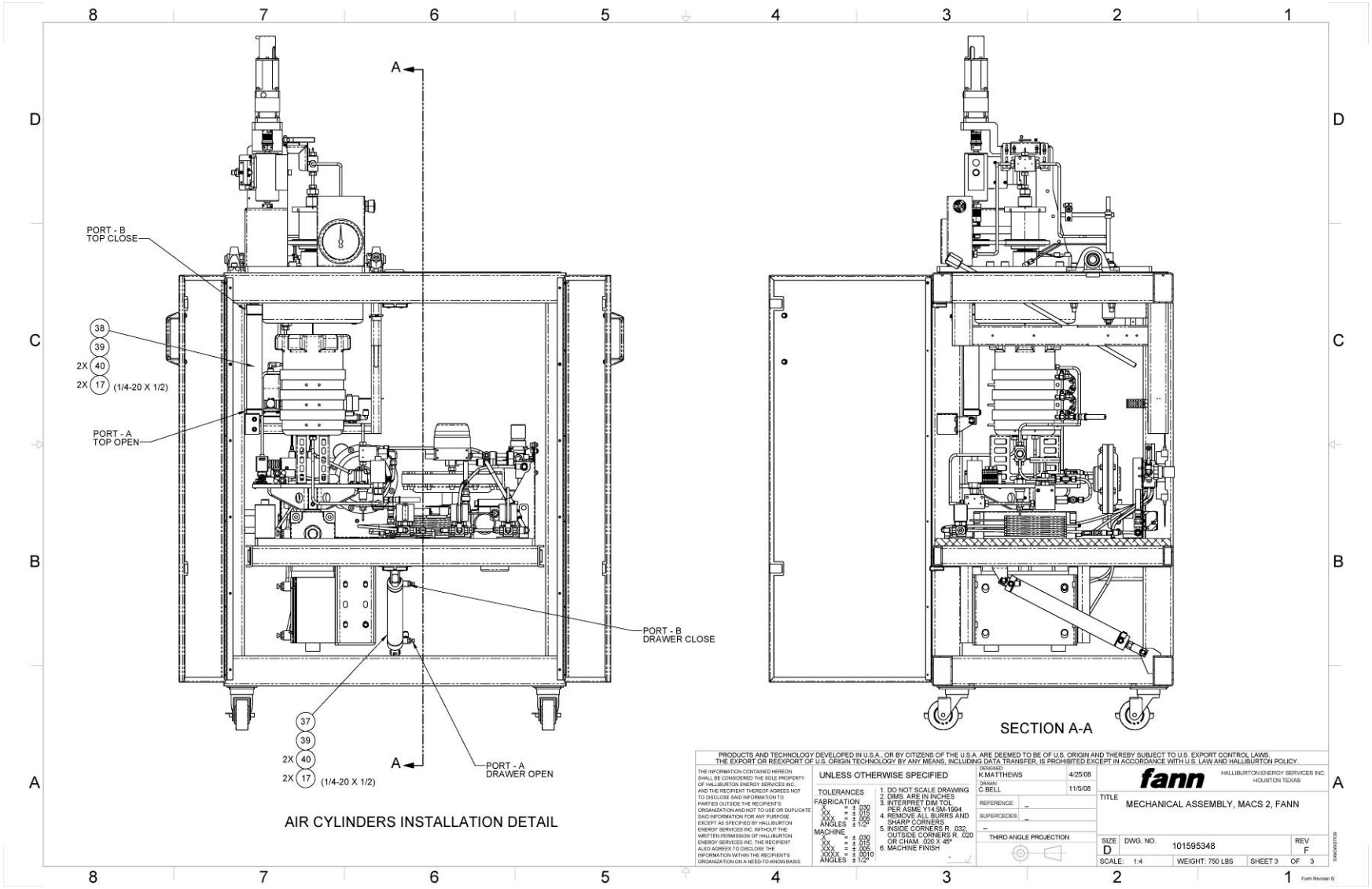
UNLESS OTHERWISE SPECIFIED
TOLERANCES
FABRICATION
X = ± .030
XX = ± .010
XXX = ± .005
ANGLES ± 1/2°
MACHINE
X = ± .030
XX = ± .015
XXX = ± .005
XXXX = ± .0010
ANGLES ± 1/2°
1. DO NOT SCALE DRAWING
2. DIMS. ARE IN INCHES
3. INTERPRET DIM TOL. PER ASME Y14.5M-1994
4. REMOVE ALL BURRS AND SHARP CORNERS.
5. INSIDE CORNERS R .032, OUTSIDE CORNERS R .020 OR CHAM. .020 X 45°
6. MACHINE FINISH
DESIGNED K.MATTHEWS 4/25/08
DRAWN C.BELL 11/5/08
REFERENCE: –
SUPERCEDES: –
THIRD ANGLE PROJECTION
fann
HALLIBURTON ENERGY SERVICES INC. HOUSTON TEXAS
TITLE MECHANICAL ASSEMBLY, MACS 2, FANN
SIZE D
DWG. NO. 101595348
REV F
SCALE: 1:8
WEIGHT: 750 LBS
SHEET 2 OF 3


PORT - B
TOP CLOSE
38
39
2X 40
2X 17 (1/4-20 X 1/2)
PORT - A
TOP OPEN
PORT - B
DRAWER CLOSE
37
39
2X 40
2X 17 (1/4-20 X 1/2)
PORT - A
DRAWER OPEN
A
A
AIR CYLINDERS INSTALLATION DETAIL
SECTION A-A
PRODUCTS AND TECHNOLOGY DEVELOPED IN U.S.A., OR BY CITIZENS OF THE U.S.A. ARE DEEMED TO BE OF U.S. ORIGIN AND THEREBY SUBJECT TO U.S. EXPORT CONTROL LAWS.
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TOLERANCES
FABRICATION
X = ± .030
XX = ± .010
XXX = ± .005
ANGLES ± 1/2°
MACHINE
X = ± .030
XX = ± .015
XXX = ± .005
XXXX = ± .0010
ANGLES ± 1/2°
1. DO NOT SCALE DRAWING
2. DIMS. ARE IN INCHES
3. INTERPRET DIM TOL PER ASME Y14.5M-1994
4. REMOVE ALL BURRS AND SHARP CORNERS
5. INSIDE CORNERS R .032, OUTSIDE CORNERS R .020 OR CHAM .020 X 45°
6. MACHINE FINISH
DESIGNED K.MATTHEWS 4/25/08
DRAWN C.BELL 11/5/08
REFERENCE –
SUPERCEDES –
–
THIRD ANGLE PROJECTION
fann
HALLIBURTON ENERGY SERVICES INC.
HOUSTON TEXAS
TITLE
MECHANICAL ASSEMBLY, MACS 2, FANN
SIZE D
DWG. NO. 101595348
REV F
SCALE: 1:4
WEIGHT: 750 LBS
SHEET 3 OF 3
Form Revision B

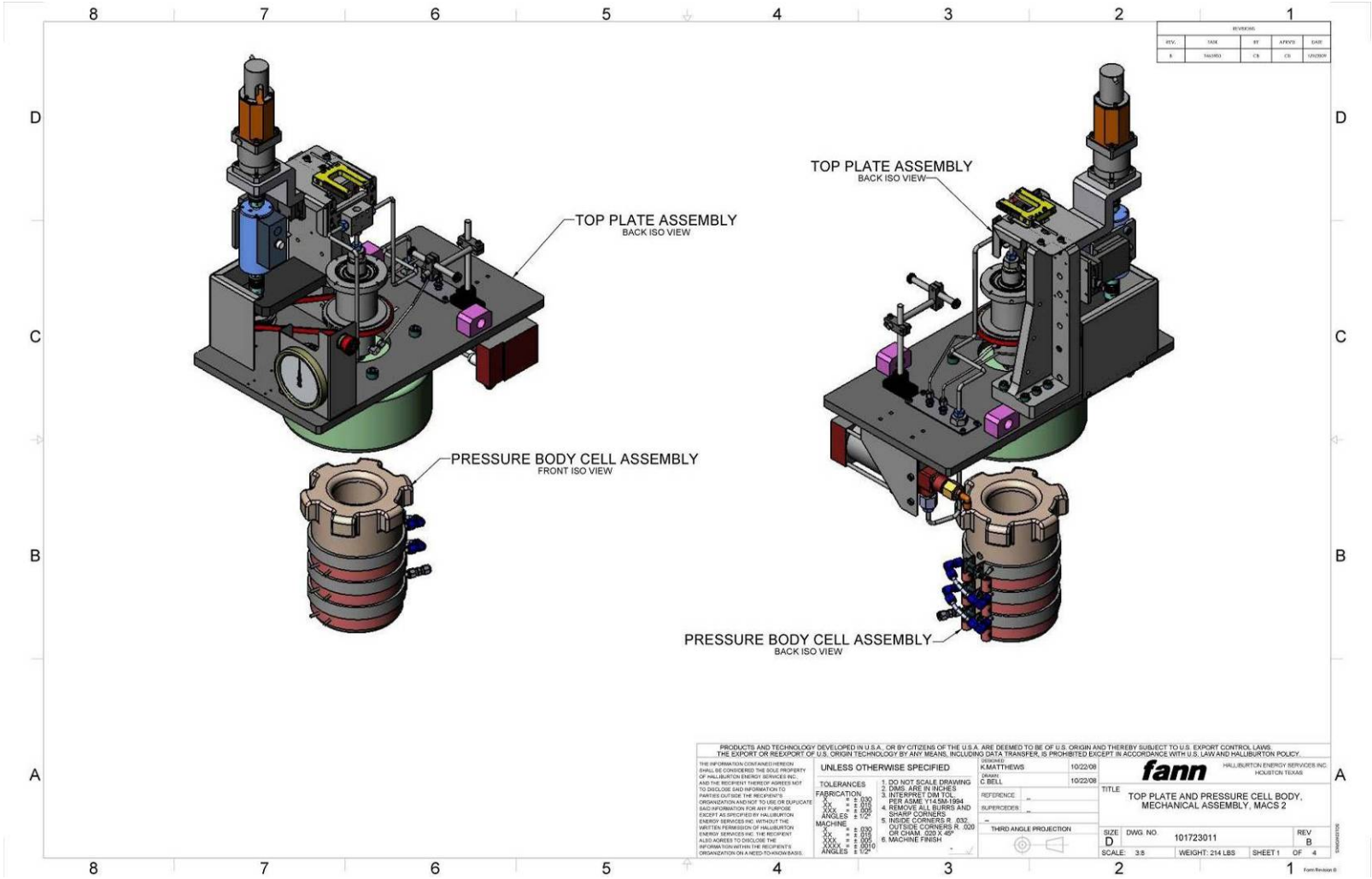
Find #	Name	Drawing / Rev	Quantity	Description
	101595348	101595348		MECHANICAL ASSEMBLY, MACS II, FANN
1	101586871	101586871	1	FRAME, MACS II
2	101723010	101723010	1	TURN TABLE ASSEMBLY, MECHANICAL ASSEMBLY, MACS II
3	101723011	101723011	1	TOP PLATE AND PRESSURE CELL BODY, MECHANICAL ASSEMBLY, MACS II
4	101723012	101723012	1	FRAME DRAWER, MECHANICAL ASSEMBLY, MACS II
5	101636768	101636768	1	SGS TEST CUP ASSY, MACS II
6	101667558	101667558	1	THERMOCOUPLE, J TYPE, MACS II, TOP, 30000 PSI RATED, 56 IN LEADS
7	101595801		2	BEARING, PILLOW BLOCK, 3/4 IN SHAFT SIZE
8	101595822		2	SHAFT, COLLAR, D SHAPE, .75 IN ID.
9	101595624		1	SHAFT, LINEAR PRECISION, .75 DIA, 16 IN LENGTH
10	101266066		4	SCREW, THREADED, CAP, SOC HEAD (US) - 0.375 DIA -16 UNC x 4.50 - 18-8 SS
11	101267885		8	WASHER, FLAT (US) - 0.375 DIA SAE - 18-8 SS
12	101676759		4	NUT, ELASTIC STOP, 3/8-16 NC, STAINLESS STEEL
13	101675112		1	ELECTRO-PNEUMATIC REGULATOR, 0.9 MPA, POWER VOLTAGE 24 VDC, INPUT SIGNAL 0-5 VDC, ANALOG OUTPUT 1-5 VDC, 1/4 PORT, PRESSURE DISPLAY UNIT PSI

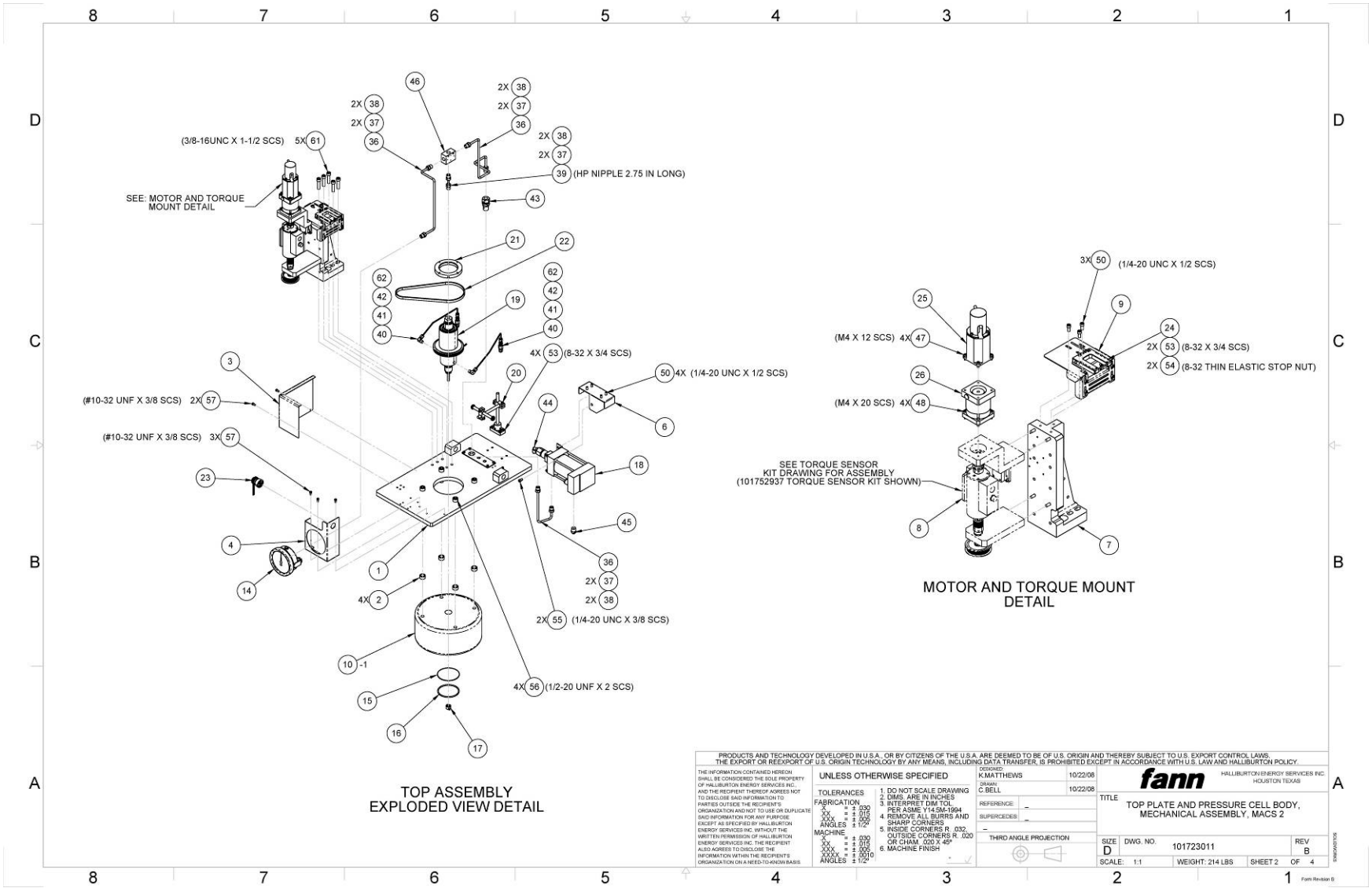
Find #	Name	Drawing / Rev	Quantity	Description
14	100032885	70.80372	1	MUFFLER, EXHAUST, PNEUMATIC, 1/4, MOSIER EM-2
15	100023811		6	CONNECTOR, PLASTIC TUBING, 90 DEG, 1/4 TUBE X 1/4 MPT, MILLER INSTANT TUBE, LEGRIS, 31095614
16	101485082		2	VALVE, SOLENOID, 2 PORT, NC, 1/4 FEMALE NPT, 24V
17	101265670		6	SCREW, THREADED, CAP, SOC HEAD (US) - 0.25 DIA -20 UNC x 0.50 - 18-8 SS
18	101267975		4	WASHER, LOCK, REGULAR SPRING (US) - NO. 8 - 18-8 SS
19	101263938		4	SCREW, THREADED, LOW HEAD SCS (US) - NO. 8 -32 UNC x 0.375 - 18-8 SS
20	101660656		2	HOSE, LOW PRESSURE METAL FLEXIBLE, 1/4 IN SS SWAGELOK TUBE AND 1/4 IN SS MALE NPT END, 36 IN LENGTH
21	101673153		120	1/4 TUBING, POLYURETHANE, 20 METER ROLL, BLUE
22	101485964		1	TUBING, 3/8 IN O.D. POLYURETHANE, BLUE, TIUB11BU-20
23	101443949		1	TUBING, STAINLESS STEEL, 1/8 OD X 0.020 ID, 60,000 PSI, 60-9H2, HIGH PRESSURE EQUIPMENT
24	101443950		2	GLAND, 1/8 IN HP MALE, 60K PSI
25	101443951		2	COLLAR, 1/8 IN, 60K PSI
26	205555		96	TUBING 1/4 OD X .083 ID 304 ST
27	100001771	70.24702	8	GLAND, AUTOCLAVE, ANGLE 40, 60000 POUNDS PER SQ IN, FOR 1/4 TUBE, F250C FEMALE THREAD
28	100001646	70.16576	8	COLLAR, AUTOCLAVE, ACL40, 1/4 TUBE, 60000 PSI, STAINLESS STEEL

Find #	Name	Drawing / Rev	Quantity	Description
29	207377		216	TUBING SOFT COPPER 1/4 X .032
30	120147184		1	ELBOW MALE SS-400-2-4
31	101671856	101671856	1	THEROMCOUPLE, TYPE J, UNGROUNDED, 1.125 30000 PSI, MALE HP PORT
32	101671154		1	TEE, 1/4 HP, 600000 PSI RATING WITH SPECIAL MOUNTING HOLES
33	101392264		1	60K MALE TO MALE 1/4 HIGH PRESSURE CONNECTOR HIP 60-21HM4HM4
34	100022028	70.10235	1	TRANSDUCER, PRESSURE, 30000 PSI, 4-20 MA, 0.5% ACCURACY, F-250C AUTOCLAVE PRESSURE PORT, 2 WIRE ELECTRICAL CONNECTION WITH 1/2-14 CONDUIT FITTING, ADJ ZERO AND SPAN POTS
35	101632138		1	NIPPLE, HIP 60-HM4-6, 316 STAINLESS STEEL, 6 IN LONG, 60K PSI, 1/4 IN OD TUBE CONNECTIONS
36	101266018		4	SCREW, THREADED, CAP, SOC HEAD (US) - 0.375 DIA -16 UNC x 0.50 - 18-8 SS
37	101443961		1	PNEUMATIC CYLINDER, 1.5 INCH BORE, 8 INCH STROKE, REAR PIVOT, PIVOT BUSHING,
38	101443962		1	PNEUMATIC CYLINDER, 1.5 INCH BORE, 10.25 INCH STROKE, REAR PIVOT, PIVOT BUSHING,
39	101675071		2	PIVOT BRACKET, 3/8 INCH PIN, 5/8 INCH GAP, STAINLESS STEEL FOR BIMBA CYL CM-17_-DPWY
40	101675084		4	PNEUMATIC SPEED CONTROLLER, ELBOW, 1/4 INCH TUBING, 1/8 MNPT
41	101762949		1	COILED SPRING PIN, 1/4 INCH DIA X 2.5 INCH LENGTH, STAINLESS STEEL
42	101536645		1	ADAPTER 1/4 HIGH PRESS TUBE X 1/8 NPT (FEM)

Find #	Name	Drawing / Rev	Quantity	Description
43	101443938		2	MINIATURE CONNECTOR, TYPE J MALE, SMPW-J-M
44	208404		1	CONNECTOR 2 PRONG TYPE J THERM
45	101443937		1	PANEL THERMOCOUPLE JACK, ROUND HOLE, RMJ MINIATURE
46	101775783		2	PISTON ROD CLEVIS (17-)
47	101779959		4	POSITION SENSOR, BIMBA HSKX-17
48	100072379	800.61514	1	ELBOW, FITTING, FEMALE, AUTOCLAVE, CL4400, F250C
49	100016383	22.2003	1	ELBOW, 90 DEG, STREET, 1/4, BRASS
50	208447		72	CABLE CONTROL SINGLE PAIR 22 A
51	101645179		2	Locknut 1/4-20 SS
52	101791035	101791035	1	MOUNT PLATE, ELECTRO-PNEUMATIC REGULATOR, MACS II

10.4. **Top Plate and Pressure Cell Body 101723011**




(3/8-16UNC X 1-1/2 SCS) 5X 61
SEE: MOTOR AND TORQUE MOUNT DETAIL
(HP NIPPLE 2.75 IN LONG)
4X 53 (8-32 X 3/4 SCS)
4X (1/4-20 UNC X 1/2 SCS)
(#10-32 UNF X 3/8 SCS) 2X 57
(#10-32 UNF X 3/8 SCS) 3X 57
2X 55 (1/4-20 UNC X 3/8 SCS)
4X 56 (1/2-20 UNF X 2 SCS)
TOP ASSEMBLY EXPLODED VIEW DETAIL
3X 50 (1/4-20 UNC X 1/2 SCS)
(M4 X 12 SCS) 4X 47
(M4 X 20 SCS) 4X 48
2X 53 (8-32 X 3/4 SCS)
2X 54 (8-32 THIN ELASTIC STOP NUT)
SEE TORQUE SENSOR KIT DRAWING FOR ASSEMBLY (101752937 TORQUE SENSOR KIT SHOWN)
MOTOR AND TORQUE MOUNT DETAIL
PRODUCTS AND TECHNOLOGY DEVELOPED IN U.S.A., OR BY CITIZENS OF THE U.S.A. ARE DEEMED TO BE OF U.S. ORIGIN AND THEREBY SUBJECT TO U.S. EXPORT CONTROL LAWS. THE EXPORT OR REEXPORT OF U.S. ORIGIN TECHNOLOGY BY ANY MEANS, INCLUDING DATA TRANSFER, IS PROHIBITED EXCEPT IN ACCORDANCE WITH U.S. LAW AND HALLIBURTON POLICY.
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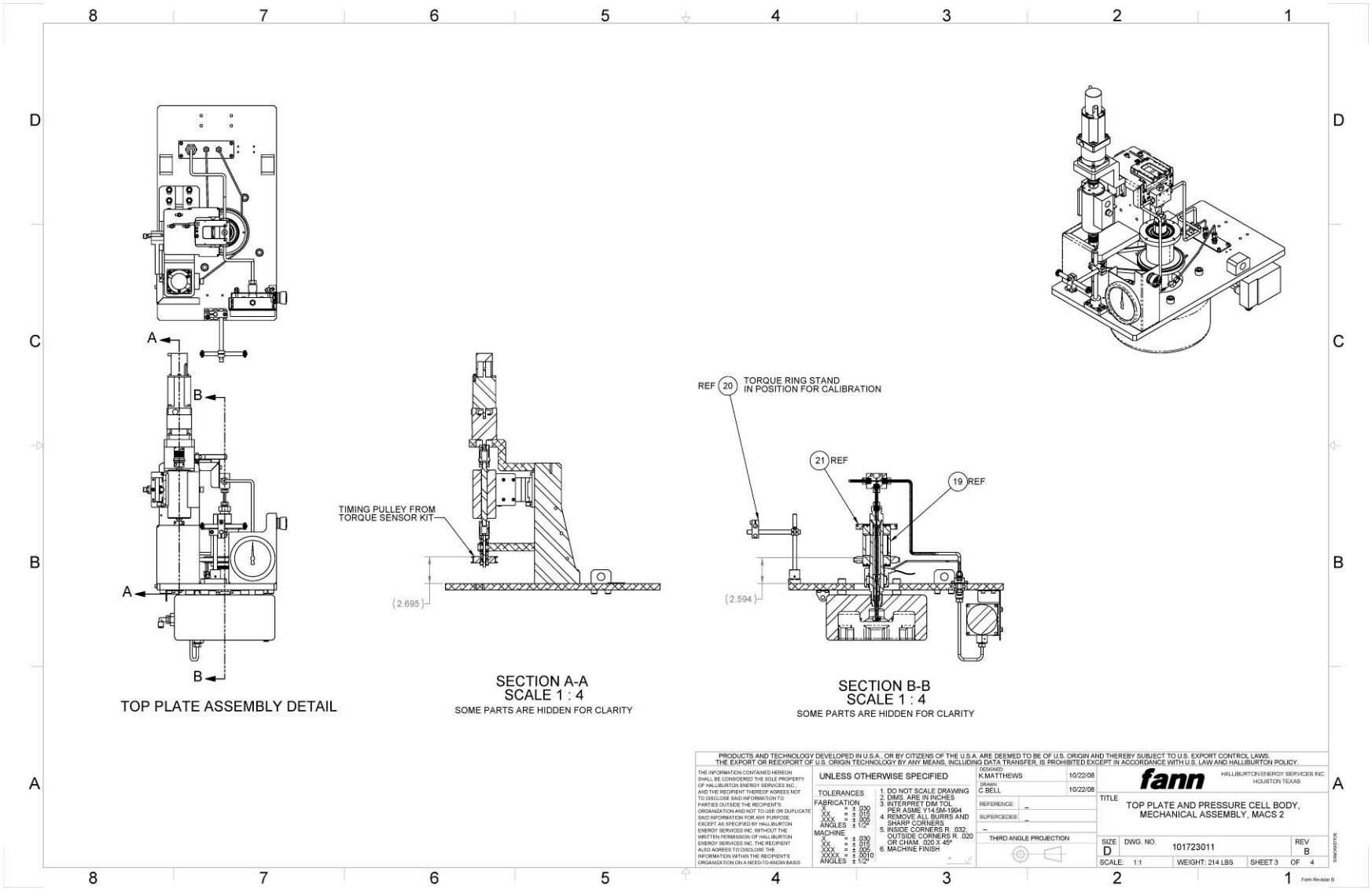
UNLESS OTHERWISE SPECIFIED
TOLERANCES
FABRICATION
X = ± .030
XX = ± .010
XXX = ± .005
ANGLES ± 1/2°
MACHINE
X = ± .030
XX = ± .015
XXX = ± .005
XXXX = ± .0010
ANGLES ± 1/2°
1. DO NOT SCALE DRAWING
2. DIMS. ARE IN INCHES
3. INTERPRET DIM TOL PER ASME Y14.5M-1994
4. REMOVE ALL BURRS AND SHARP CORNERS
5. INSIDE CORNERS R. .032, OUTSIDE CORNERS R. .020 OR CHAM. .020 X 45°
6. MACHINE FINISH
DESIGNED K.MATTHEWS 10/22/08
DRAWN C.BELL 10/22/08
REFERENCE
SUPERCEDES
THIRD ANGLE PROJECTION
fann HALLIBURTON ENERGY SERVICES INC. HOUSTON TEXAS
TITLE TOP PLATE AND PRESSURE CELL BODY, MECHANICAL ASSEMBLY, MACS 2
SIZE D DWG. NO. 101723011 REV B
SCALE: 1:1 WEIGHT: 214 LBS SHEET 2 OF 4


TOP PLATE ASSEMBLY DETAIL
TIMING PULLEY FROM TORQUE SENSOR KIT
(2.695)
SECTION A-A
SCALE 1 : 4
SOME PARTS ARE HIDDEN FOR CLARITY
REF 20 TORQUE RING STAND IN POSITION FOR CALIBRATION
21 REF
19 REF
(2.594)
SECTION B-B
SCALE 1 : 4
SOME PARTS ARE HIDDEN FOR CLARITY
PRODUCTS AND TECHNOLOGY DEVELOPED IN U.S.A., OR BY CITIZENS OF THE U.S.A. ARE DEEMED TO BE OF U.S. ORIGIN AND THEREBY SUBJECT TO U.S. EXPORT CONTROL LAWS.
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MACHINE
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ANGLES ± 1/2°
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2. DIMS. ARE IN INCHES
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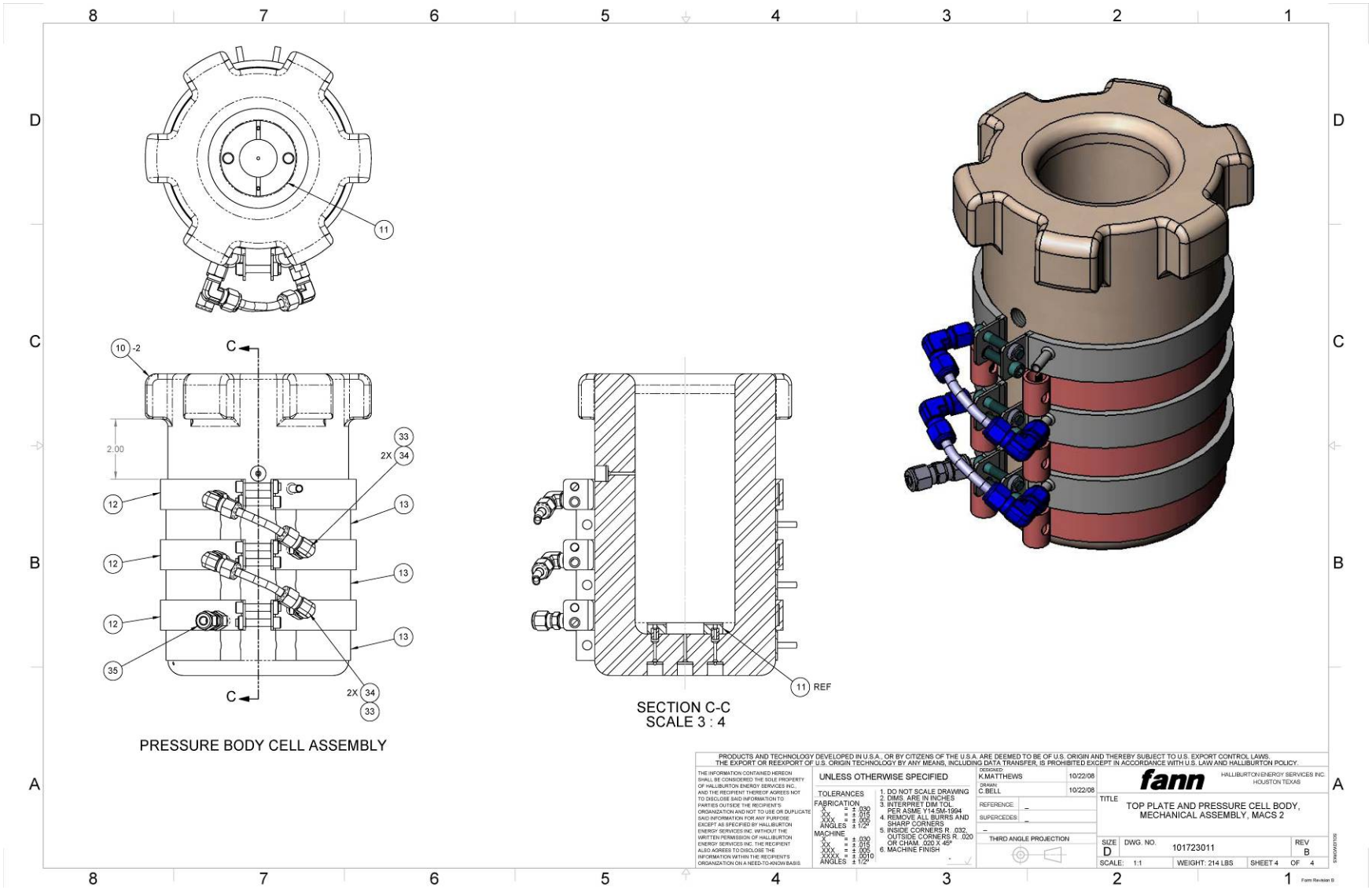
4. REMOVE ALL BURRS AND SHARP CORNERS
5. INSIDE CORNERS R .032, OUTSIDE CORNERS R .020 OR CHAM .020 X 45°
6. MACHINE FINISH
DESIGNED K.MATTHEWS 10/22/08
DRAWN C.BELL 10/22/08
REFERENCE –
SUPERCEDES –
–
THIRD ANGLE PROJECTION
fann
HALLIBURTON ENERGY SERVICES INC. HOUSTON TEXAS
TITLE
TOP PLATE AND PRESSURE CELL BODY, MECHANICAL ASSEMBLY, MACS 2
SIZE D
DWG. NO. 101723011
REV B
SCALE: 1:1
WEIGHT: 214 LBS
SHEET 3 OF 4
Form Revision B


11
10 -2
C
2.00
33
2X 34
12
13
35
2X 34
33
C
PRESSURE BODY CELL ASSEMBLY
11 REF
SECTION C-C
SCALE 3 : 4
PRODUCTS AND TECHNOLOGY DEVELOPED IN U.S.A., OR BY CITIZENS OF THE U.S.A. ARE DEEMED TO BE OF U.S. ORIGIN AND THEREBY SUBJECT TO U.S. EXPORT CONTROL LAWS.
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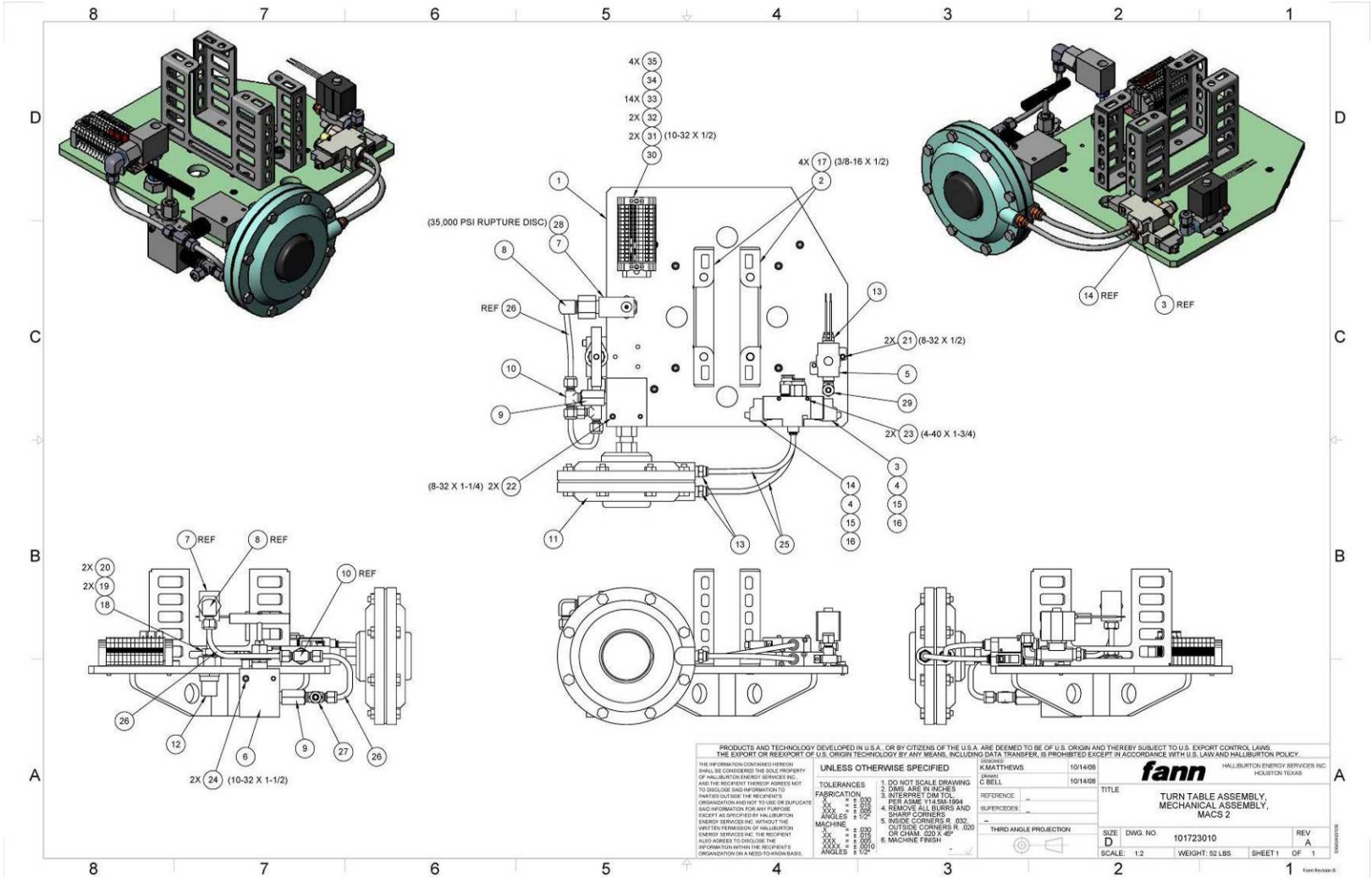
6. MACHINE FINISH
DESIGNED K.MATTHEWS 10/22/08
DRAWN C.BELL 10/22/08
REFERENCE: –
SUPERCEDES: –
THIRD ANGLE PROJECTION
fann
HALLIBURTON ENERGY SERVICES INC.
HOUSTON TEXAS
TITLE
TOP PLATE AND PRESSURE CELL BODY, MECHANICAL ASSEMBLY, MACS 2
SIZE D
DWG. NO. 101723011
REV B
SCALE: 1:1
WEIGHT: 214 LBS
SHEET 4 OF 4
Form Revision B

Find #	Name	Drawing #	Quantity	Description
	101723011	101723011		TOP PLATE AND PRESSURE CELL BODY, MECHANICAL ASSEMBLY, MACS II
1	101592165	101592165	1	TOP SHELF, MACS II
2	101595614	101595614	4	STANDOFF, LID, MACS II
3	101673132	101673132	1	GUARD, BELT COVER, MACS II
4	101443964	101443964	1	BRACKET, GAUGE, EMERGENCY STOP, MACS II
6	101592341	101592341	1	MOUNT, HIGH PRESSURE PUMP, MACS II
7	101586876	101586876	1	ANGLE MOUNT, MOTOR AND TORQUE MEASUREMENT, MACS II
8	101752937	101752937	1	KIT, KISTLER TORQUE SENSOR, MACS II
9	101443921	101443921	1	BRACKET, TOP THERMOCOUPLE, MACS II
10	101570647	101570647	1	SET, PRESSURE VESSEL, MACS II, FANN
11	101636934	101636934	1	ADAPTER, SLURRY CUP RISER, MACS II
12	101654535	101654535	3	COOLING BAND, MACS II
13	101664360		3	HEATER BAND, 6 IN ID X 1 IN ID WIDE 220V 1250 WATTS, TYPE J THERMOCOUPLE WITH 36 IN LEAD WIRE
14	101539543		1	GAUGE, PANEL MOUNT, 0-35K, SS MFG: McDANIEL MFG P/N: G35KU-1/4HPF-G
15	101594774	101594774	1	BACKUP RING, PRESSURE VESSEL, MACS II
16	101710014		1	O-RING, ULTRA PARAFLUOR, ID 2.984, COLOR WHITE, SIZE 2-234, DUROMETER 75
17	101723009	101723009	1	MAG COUPLING, MACS II MAG DRIVE TO PADDLE AND SAMPLE CUP
18	390009		1	PUMP, LIQUID, AIR OPERATED, 1:440 RATIO MAXIMATOR MAXPRO PP189-2
19	101443954		1	MAGNEDRIVE, HIGH PRESSURE, 33,000 PSI
20	101705761	101705761	1	TORQUE CALIBRATION STAND, MACS II

Find #	Name	Drawing #	Quantity	Description
21	101710024	101710024	1	TORQUE CALIBRATION RING, MACS II
22	101596797		1	TIMING BELT, 240XL, 120 TEETH, 3/8 WIDTH, 0.20 PITCH
23	101727314		1	SWITCH, Emergency-stop non illuminated, ribbon cable, twist release, 32mm diameter for 22.5mm mounting, foolproof to EN 60947-5-5, EN 418, 250V, 3 Amp
24	101443933		1	SENSOR, U-SHAPED, 30MM SLOT WIDTH, VISIBLE RED BEAM
25	101595569		1	MOTOR, STEPPER, ENCODER, NEMA 23, 170 VDC WINDING, DOUBLE SHAFT
26	101595461		1	GEARHEAD, 5:1, NEMA 23, FLANGE FACE
33	207377		1	TUBING SOFT COPPER 1/4 X .032
34	120149512		4	ELBOW SS-400-9
35	347021		1	ADAPTER, UNION, 1/4 TUBE
36	205555		1	TUBING 1/4 OD X .083 ID 304 ST
37	100001771	70.24702	8	GLAND, AUTOCLAVE, ANGLE 40, 60000 POUNDS PER SQ IN, FOR 1/4 TUBE, F250C FEMALE THREAD
38	100001646	70.16576	8	COLLAR, AUTOCLAVE, ACL40, 1/4 TUBE, 60000 PSI, STAINLESS STEEL
39	100034542	70.88705	1	NIPPLE - 2.75 IN LONG - 1/4 AE HIGH PRESSURE - 60000 PSI - F250C CONNECTION
40	100029698	70.57414	1	TUBING, STAINLESS STEEL, 1/8 OD X 1/16 ID, 15-151, AUTOCLAVE
41	101443952		2	SS SWAGELOK TUBE FITTING, MALE ELBOW, 1/8 IN. TUBE OD X 1/8 IN. MALE NPT
42	101443953		2	SS SWAGELOK TUBE FITTING, BULKHEAD FEMALE CONNECTOR, 1/8 IN. TUBE OD X 1/8 IN. FEMALE NPT
43	101392263		1	60K BULKHEAD FOR 1/4 F HIGH PRESSURE X 1/4 F HIGH PRESSURE HIP 60-21HF4-B
44	101452502		1	ADAPTER, ELBOW, BRASS, 3/8 MNPT X 1/4 TUBE
45	101463369		1	ADAPTER, STRAIGHT, 1/4 MALE NPT TO 1/4 INSTANT TUBE

Find #	Name	Drawing #	Quantity	Description
46	100033092	70.81424	1	CROSS, AUTOCLAVE ENGINEERS, CX4444-PM, 60 KPSI @RT, WITH F250C FEMALE HIGH PRESSURE EQUIPMENT CO: 60-24HF4-SP1
47	101255666		4	SCREW, THREADED, CAP, SOCKET HEAD (METRIC) - M4 x 12 - 18-8 SS
48	101255802		4	SCREW, THREADED, CAP, SOCKET HEAD (METRIC) - M4 x 20 - 18-8 SS
53	101265328		6	SCREW, THREADED, CAP, SOC HEAD (US) - NO. 8 -32 UNC x 0.75 - 18-8 SS
54	101631188		2	NUT, JAM, ELASTIC INSERT, 8-32 NC, STAINLESS STEEL
55	101265667		2	SCREW, THREADED, CAP, SOC HEAD (US) - 0.25 DIA -20 UNC x 0.375 - 18-8 SS
56	101266303		4	SCREW, THREADED, CAP, SOC HEAD (US) - 0.50 DIA -20 UNF x 2 - 18-8 SS
57	101265406		5	SCREW, THREADED, CAP, SOC HEAD (US) - NO. 10 -32 UNF x 0.375 - 18-8 SS
61	101266036		5	SCREW, THREADED, CAP, SOC HEAD (US) - 0.375 DIA -16 UNC x 1.50 - 18-8 SS
62	101705712		2	ADAPTER, STRAIGHT, 1/8 MALE NPT TO 1/4 INSTANT TUBE
63	207783		4	GROMMET RUBBER 1/4in. ID X 3/8in.
64	101443948	101443948	1	BACKUP RING, MAG DRIVE, MACS II
65	101710015		1	O-RING, ULTRA PARAFLUOR, ID .739, COLOR WHITE, SIZE 2-018, DUROMETER 75
66	100028829	70.44830	4	SCREW, SET, #10-32 NF X 3/8, CUP PORT, HEX SOCKET, STAINLESS STEEL
902	101751741	101751741	1	KIT, HONEYWELL TORQUE SENSOR, MACS II

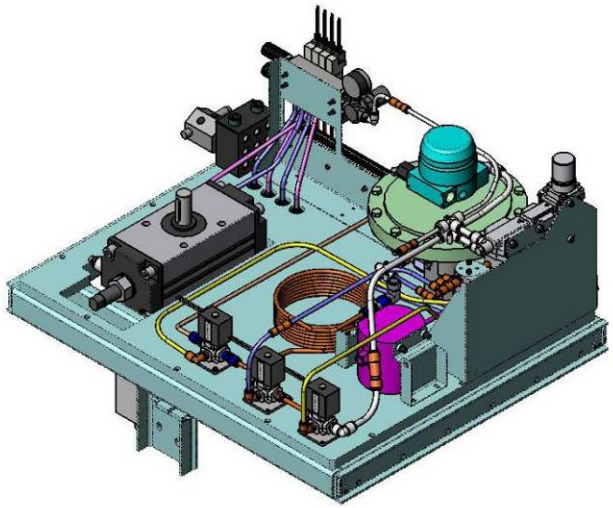
10.5. **Turn Table Assembly 101723010**



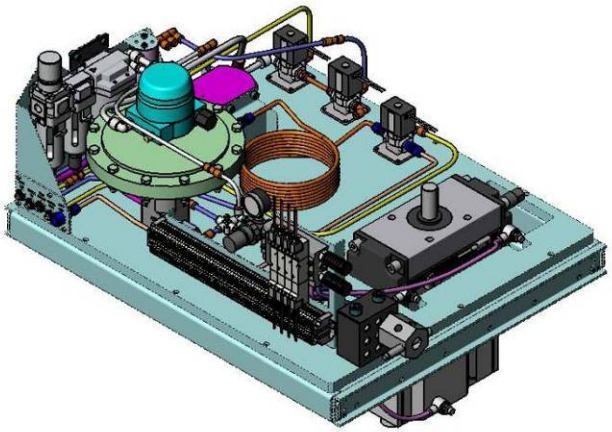
Find #	Name	Drawing #	Quantity	Description
	101723010	101723010		TURN TABLE ASSEMBLY, MECHANICAL ASSEMBLY, MACS II
1	101591604	101591604	1	MOUNT, ROTATION PLATE, MACS II
2	101643875	101643875	2	MOUNT, CUP RISER, MACS II
3	101485177		1	VALVE, 3 PORT SOLENOID, BODY PORTED, 1/4 INSTANT TUBE FITING (A), 1/4 FNPT (P), 1/8 FNPT (R)
4	101542810		2	CONNECTOR, L PLUG WIRE, FOR SMC VALVE VQZ322-5LO-N7T
5	101485082		1	VALVE, SOLENOID, 2 PORT, NC, 1/4 FEMALE NPT, 24V
6	100047760	130.11749	1	VALVE, 60-11HF4, HIGH PRESSURE PRODUCTS
7	100072640	800.86480	1	SAFETY HEAD ASSEMBLY, TEE, 1/4 50000 PSI RUPTURE DISC, HIGH PRESSURE EQUIPMENT, CO 60-63HF4
8	101085670	93F1051	1	ELB,90 04T-06 MP SK SS-400-2-6
9	101388195		2	ADAPTER, HIGH PRESSURE FITTING, 30K FEM-1/4 NPT X MALE 1/4 HP (HM4) HIP 30-21NFBHM4
10	100022114	70.10803	1	TEE, MALE BRANCH, 1/4 IN SWAGELOK X 1/4 IN SWAGELOK X 1/4 IN NPT PIN, STAINLESS STEEL
11	101733497		1	VALVE, AIR OPERATED, 30000 PSI, DUAL ACTING, WITH 209276 PACKING SET
12	101392263		1	60K BULKHEAD FOR 1/4 F HIGH PRESSURE X 1/4 F HIGH PRESSURE HIP 60-21HF4-B
13	101463369		3	ADAPTER, STRAIGHT, 1/4 MALE NPT TO 1/4 INSTANT TUBE
14	101733496		1	VALVE, 3 PORT SOLENOID, BODY PORTED, 1/4 INSTANT TUBE (A), 1/4 FNPT (P), 1/8 FNPT (R), N.C
15	101485630		2	SILENCER, NAN(BC SINTERED), GENERAL PURPOSE, NOISE REDUCTION: 16db, 1/8 MALE NPT
16	101539546		2	ADAPTER, STRAIGHT, 1/4 MALE NPT, 3/8 TUBE
17	101266018		4	SCREW, THREADED, CAP, SOC HEAD (US) - 0.375 DIA -16 UNC x 0.50 - 18-8 SS

Find #	Name	Drawing #	Quantity	Description
18	100034542	70.88705	2	NIPPLE - 2.75 IN LONG - 1/4 AE HIGH PRESSURE - 60000 PSI - F250C CONNECTION
19	100001771	70.24702	2	GLAND, AUTOCLAVE, ANGLE 40, 60000 POUNDS PER SQ IN, FOR 1/4 TUBE, F250C FEMALE THREAD
20	100001646	70.16576	2	COLLAR, AUTOCLAVE, ACL40, 1/4 TUBE, 60000 PSI, STAINLESS STEEL
21	101265322		2	SCREW, THREADED, CAP, SOC HEAD (US) - NO. 8 -32 UNC x 0.50 - 18-8 SS
22	101265337		2	SCREW, THREADED, CAP, SOC HEAD (US) - NO. 8 -32 UNC x 1.25 - 18-8 SS
23	101264821		2	SCREW, THREADED, CAP, SOC HEAD (US) - NO. 4 -40 UNC x 1.75 - 18-8 SS
24	101265427		2	SCREW, THREADED, CAP, SOC HEAD (US) - NO. 10 -32 UNF x 1.50 - 18-8 SS
25	101673153		1	1/4 TUBING, POLYURETHANE, 20 METER ROLL, BLUE
26	208977		24	TUBING 1/4 OD X .035 WALL 304S
27	101464507		1	SWAGELOK STAINLESS MALE RUN TEE FOR 1/4 IN OD TUBE WITH 1/4 IN OD MALE NPT
28	101542809		1	RUPTURE DISC, BURST PRESSURE 35000 PSI @ 72 F, 1/4 ANGLED SEAT
29	120147184		1	ELBOW MALE SS-400-2-4
30	100033128	70.81602	1	RAIL, MOUNTING, 35MM, X 1 METER, DIN,46277, SYMMETRICAL
31	101262270		2	SCREW, THREADED, BUTTON HEAD SCS (US) - NO. 10 -32 UNF x 0.50 - 18-8 SS
32	101391619		2	CLAMP, END, UNIVERSAL, FOR 35 MM X 7.5 MM MOUNTING RAIL, E/NS 35 N
33	101483688		14	Feed-through terminal blocks with spring-cage connection, cross section: 0.2 - 2.5 mm, width: 5.2 mm, color: gray
34	101462159		1	COVER, 2.2MM X 48.5 MM PHOENIX CONTACT 3030417
35	101483689		5	Plug-in bridge for cross-connections in the terminal center, 2-pos., color: Red
36	120170870		1	HI PRES 1/8`` FEM TO 1/4`` MALE

10.6. **Frame Drawer, Mechanical Assembly 101723012**



FRONT ISO VIEW



REAR ISO VIEW

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UNLESS OTHERWISE SPECIFIED

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XXX = ± .005
ANGLES ± 1/2°
MACHINE
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XX = ± .015
XXX = ± .005
XXXX = ± .0010
ANGLES ± 1/2°

1. DO NOT SCALE DRAWING
2. DIMS. ARE IN INCHES
3. INTERPRET DIM TOL PER ASME Y14.5M-1994
4. REMOVE ALL BURRS AND SHARP CORNERS
5. INSIDE CORNERS R. 032, OUTSIDE CORNERS R. .020 OR CHAM. .020 X 45°
6. MACHINE FINISH

THIRD ANGLE PROJECTION

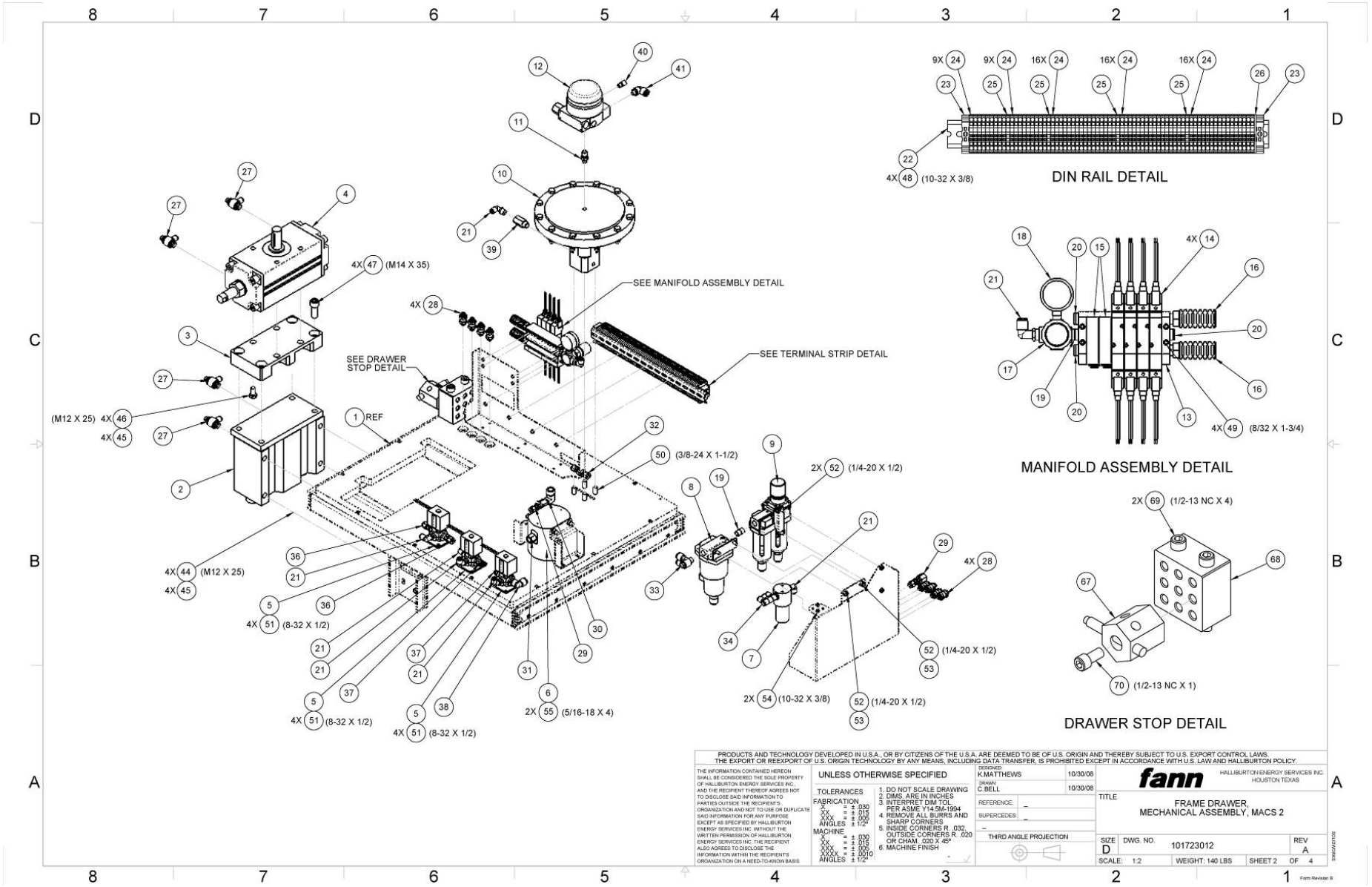
DESIGNED K.MATTHEWS 10/30/08
DRAWN C.BELL 10/30/08
REFERENCE: –
SUPERCEDES: –

fann HALLIBURTON ENERGY SERVICES INC. HOUSTON TEXAS

TITLE: FRAME DRAWER, MECHANICAL ASSEMBLY, MACS 2

SIZE D | DWG. NO. 101723012 | REV A

SCALE: 1:3 | WEIGHT: 140 LBS | SHEET 1 OF 4


SEE MANIFOLD ASSEMBLY DETAIL
SEE TERMINAL STRIP DETAIL
SEE DRAWER STOP DETAIL
DIN RAIL DETAIL
MANIFOLD ASSEMBLY DETAIL
DRAWER STOP DETAIL
4X 47 (M14 X 35)
4X 28
1 REF
50 (3/8-24 X 1-1/2)
2X 52 (1/4-20 X 1/2)
4X 44 (M12 X 25)
4X 45
4X 51 (8-32 X 1/2)
2X 55 (5/16-18 X 4)
2X 54 (10-32 X 3/8)
4X 48 (10-32 X 3/8)
4X 49 (8/32 X 1-3/4)
2X 69 (1/2-13 NC X 4)
70 (1/2-13 NC X 1)
PRODUCTS AND TECHNOLOGY DEVELOPED IN U.S.A., OR BY CITIZENS OF THE U.S.A. ARE DEEMED TO BE OF U.S. ORIGIN AND THEREBY SUBJECT TO U.S. EXPORT CONTROL LAWS.
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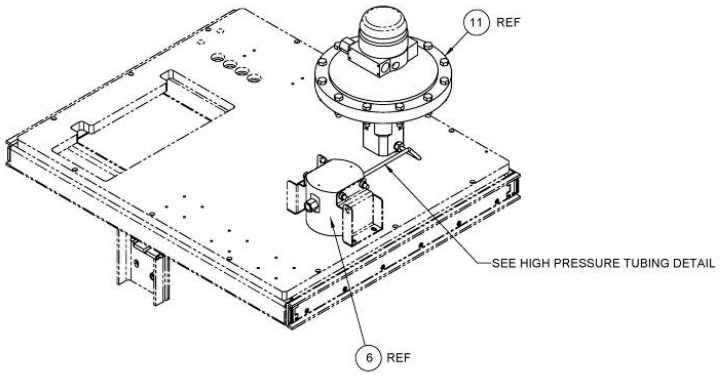
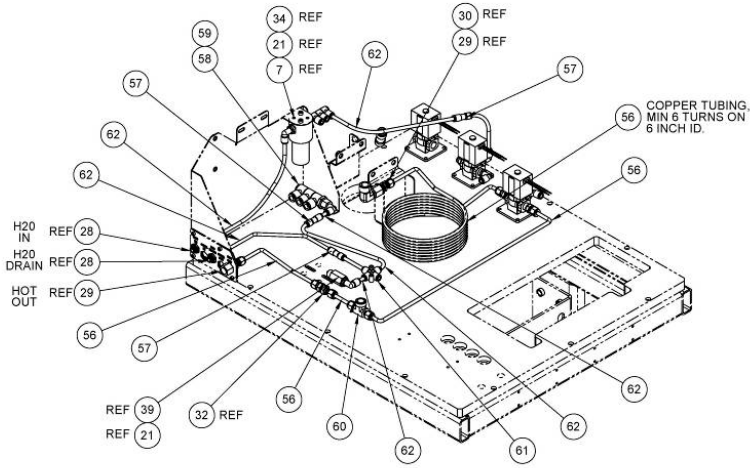
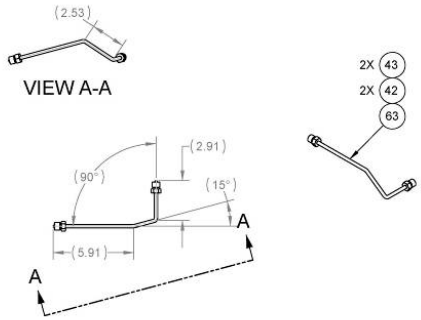
UNLESS OTHERWISE SPECIFIED
1. DO NOT SCALE DRAWING
2. DIMS. ARE IN INCHES
3. INTERPRET DIM TOL. PER ASME Y14.5M-1994
4. REMOVE ALL BURRS AND SHARP CORNERS
5. INSIDE CORNERS R .032, OUTSIDE CORNERS R. .020 OR CHAM. .020 X 45°
6. MACHINE FINISH
THIRD ANGLE PROJECTION
HALLIBURTON ENERGY SERVICES INC.
HOUSTON TEXAS
FRAME DRAWER, MECHANICAL ASSEMBLY, MACS 2
DWG. NO. 101723012
REV A
SIZE D
SCALE: 1:2
WEIGHT: 140 LBS
SHEET 2 OF 4



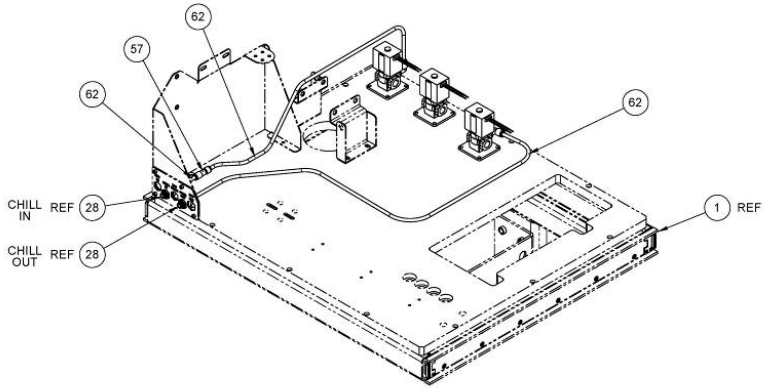
HIGH PRESSURE TUBING ASSEMBLY DETAIL
FRONT ISO VIEW
DRAWER MOUNTS NOT SHOW FOR CLARITY



REAR DRAWER ISO VIEW 1
REAR DRAWER MOUNT NOT SHOW FOR CLARITY



HIGH PRESSURE TUBING DETAIL



REAR DRAWER ISO VIEW 2
REAR DRAWER MOUNT NOT SHOW FOR CLARITY

UNLESS OTHERWISE SPECIFIED

TOLERANCES
FABRICATION
X = ± .030
XX = ± .015
XXX = ± .005
ANGLES ± 1/2°
MACHINE
X = ± .030
XX = ± .015
XXX = ± .005
XXXX = ± .0010
ANGLES ± 1/2°

1. DO NOT SCALE DRAWING
2. DIMS. ARE IN INCHES
3. INTERPRET DIM TOL. PER ASME Y14.5M-1994
4. REMOVE ALL BURRS AND SHARP CORNERS
5. INSIDE CORNERS R. .032, OUTSIDE CORNERS R. .020 OR CHAM. .020 X 45°
6. MACHINE FINISH

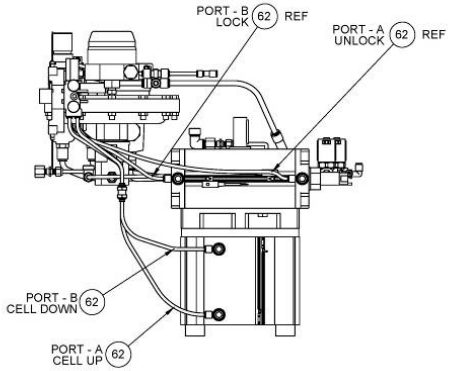
THIRD ANGLE PROJECTION

DESIGNED: K.MATTHEWS 10/30/08
DRAWN: C.BELL 10/30/08
REFERENCE: –
SUPERCEDES: –

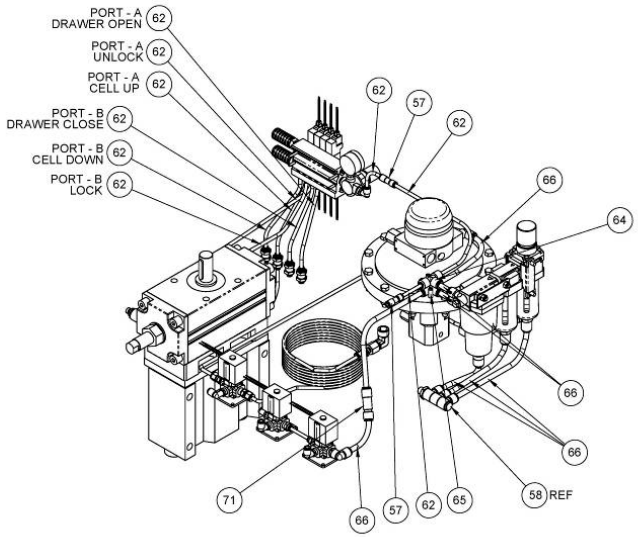
fann HALLIBURTON ENERGY SERVICES INC. HOUSTON TEXAS

TITLE
FRAME DRAWER, MECHANICAL ASSEMBLY, MACS 2

SIZE D | DWG. NO. 101723012 | REV A
SCALE: 1:4 | WEIGHT: 140 LBS | SHEET 3 OF 4



DRAWER ASSEMBLY AIR TUBING DETAIL
LEFT SIDE VIEW
DRAWER HIDDEN CLARITY



DRAWER ASSEMBLY AIR TUBING DETAIL
ISO FRONT VIEW
DRAWER HIDDEN CLARITY

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UNLESS OTHERWISE SPECIFIED

TOLERANCES
FABRICATION
X = ± .030
XX = ± .015
XXX = ± .005
ANGLES ± 1/2°
MACHINE
X = ± .030
XX = ± .015
XXX = ± .005
XXXX = ± .0010
ANGLES ± 1/2°

1. DO NOT SCALE DRAWING
2. DIMS. ARE IN INCHES
3. INTERPRET DIM TOL PER ASME Y14.5M-1994
4. REMOVE ALL BURRS AND SHARP CORNERS
5. INSIDE CORNERS R. .032, OUTSIDE CORNERS R. .020 OR CHAM. .020 X 45°
6. MACHINE FINISH

THIRD ANGLE PROJECTION

DESIGNED: K.MATTHEWS 10/30/08
DRAWN: C.BELL 10/30/08
REFERENCE: –
SUPERCEDES: –

fann HALLIBURTON ENERGY SERVICES INC. HOUSTON TEXAS

TITLE
FRAME DRAWER,
MECHANICAL ASSEMBLY, MACS 2

SIZE D | DWG. NO. 101723012 | REV A
SCALE: 1:4 | WEIGHT: 140 LBS | SHEET 4 OF 4

Form Revision B

Find #	Name	Drawing #	Quantity	Description
	101723012	101723012		FRAME DRAWER, MECHANICAL ASSEMBLY, MACS II
1	101586871	101586871	1	FRAME, MACS II
2	101569355		1	CLYLINDER, COMPACT GUIDE, 100MM BORE, 100MM STROKE
3	101586874	101586874	1	ADAPTER, LINEAR TO ROTATIONAL, MACS II
4	101595347		1	ROTARY ACTUATOR, RACK & PINION, 90 DEG, SINGLE SHAFT
5	101775204		3	VALVE, SOLENOID, DIRECT OPERATED 3 PORT, COMMON, 1/4 FNPT, 24 VDC , 3mm ORIFICE, BRACKET, DIN TERMINAL WITH LIGHT
6	101539542		1	FILTER, 17-4PH, 30000 PSI RATED, 1/4 HP PORTS
7	101485628		1	FILTER, 3 PORT 1/4 NPT, 10 MICRON, GENIEFILTERS AVENGER SERIES 91
8	101485473		1	WATER SEPARATOR, AMG, 1/4 NPT PORTS, 3/8 INSTANT TUBE, WITH AUTO DRAIN, BRACKET
9	101485137		1	FILTER, REGULATOR, MIST SEPARATOR, 1/4 FEMALE NPT, 3/8 INSTANT TUBE AUTO DRAIN
10	101516393		1	VALVE, BACK PRESSURE REGULATOR, 30,000 PSI, 1/4 HIGH PRESSURE HYDR. PORTS, TESCOM
11	208603		1	ADAPTER 1/4 X 1/8 NPT SPECIAL TAPER STAINLESS STEEL WILCO: 1/4 X 1/8 HN SPECIAL TAPER ON 1/4 ONLY 10/22/2002
12	101485323		1	ELECTRONIC PRESSURE CONTROLLER, PID, 1/8 NPT INLET PORT, 1/4 NPT CONTROLLED OUTLET PORT, TESCOM ER3000SI-1
13	101645850		1	MANIFOLD, 6 PORT, 1/4 TUBE, SMC

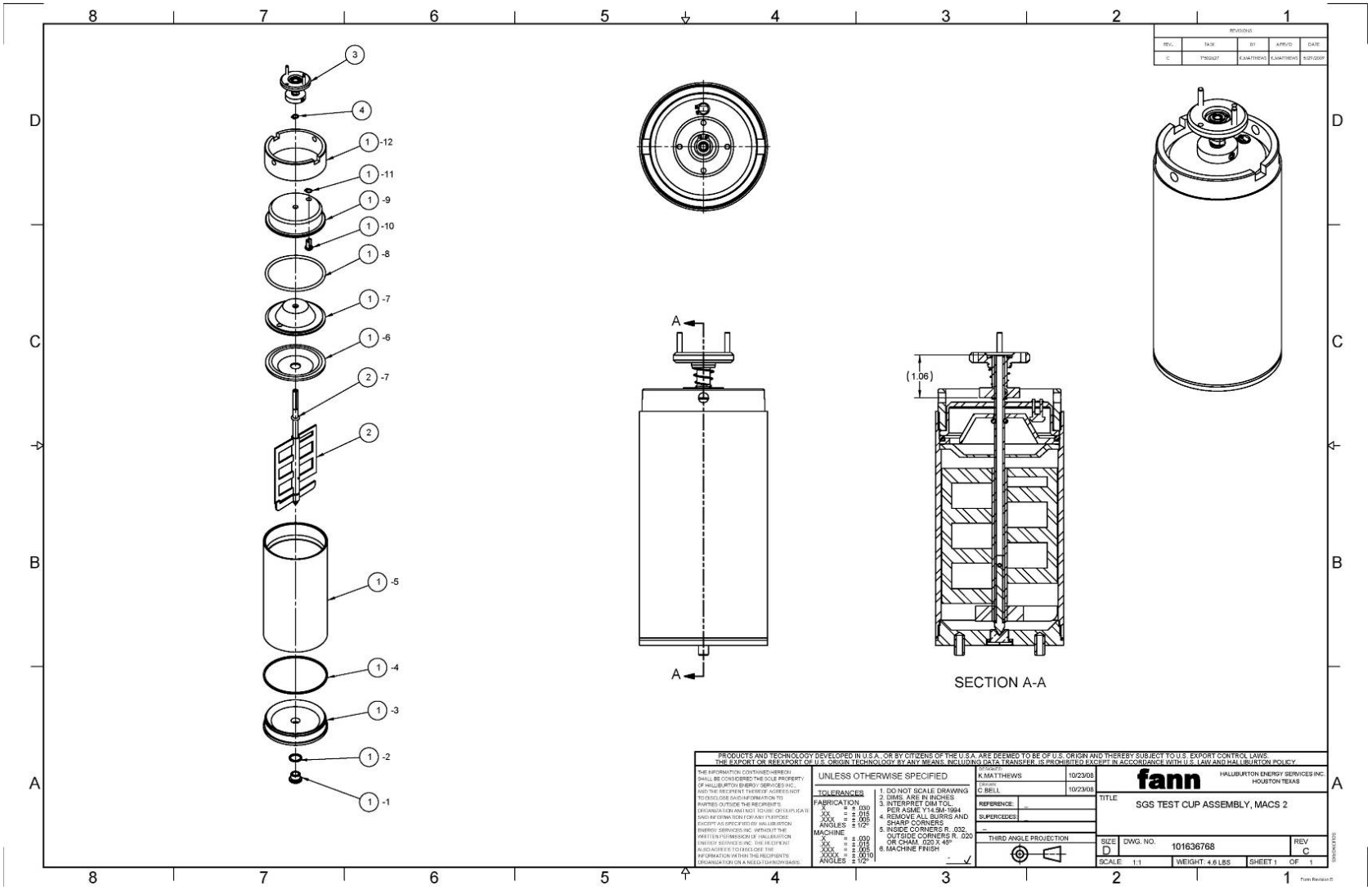
Find #	Name	Drawing #	Quantity	Description
14	101712396		4	SOLENOID VALVE, 5 PORT, 3 POSITION CENTER CLOSED, FOR MANIFOLD, 24V DC
15	101710635		2	COVER PLATE, FOR VVQZ200 MANIFOLD
16	101485667		2	SILENCER, NAN, GENERAL PURPOSE, NOISE REDUCTION: 35db, 1/4 MALE NPT
17	100126559		1	REGULATOR, NPT 1/4 INCH, 15CFM, GRAINGER PART 4ZM08
18	208602		1	GAUGE 160 PSI 1.5in DIAL 1/8 BOTTOM CONN
19	101485740		2	NIPPLE, 1/4 MALE NPT ALL THREAD, 7/8 LENGTH, SS
20	206626		3	PLUG PIPE 1/4 NPT SOCKET HEAD STAINLESS
21	100023811		7	CONNECTOR, PLASTIC TUBING, 90 DEG, 1/4 TUBE X 1/4 MPT, MILLER INSTANT TUBE, LEGRIS, 31095614
22	100033128	70.81602	1	RAIL, MOUNTING, 35MM, X 1 METER, DIN,46277, SYMMETRICAL
23	101391619		2	CLAMP, END, UNIVERSAL, FOR 35 MM X 7.5 MM MOUNTING RAIL, E/NS 35 N
24	101483688		64	Feed-through terminal blocks with spring-cage connection, cross section: 0.2 - 2.5 mm, width: 5.2 mm, color: gray
25	101634351		4	SPRING CAGE GROUND TERMINAL BLOCK, AWG 24 TO 14, YELLOW GREEN
26	101462159		1	COVER, 2.2MM X 48.5 MM PHOENIX CONTACT 3030417
27	101644288		4	ADAPTER, FLOW CONTROL, RC 3/8 TO 1/4 TUBE
28	101452507		8	BULKHEAD, PANEL MOUNT, BRASS, 1/4 TUBE
29	101304414		1	CONNECTOR, BULKHEAD, FEMALE, STAINLESS STEEL, 1/4-INCH O.D. - 1/8-INCH FNPT
30	208607		1	STREET ELL 1/4 SS-4-SE SWAGELOK 4-4-SE PARKER

Find #	Name	Drawing #	Quantity	Description
31	120170870		1	HI PRES 1/8`` FEM TO 1/4`` MALE
32	100068597	685.40729	1	UNION, BULKHEAD, 1/4 IN OD TUBE X 1/4 IN OD TUBE
33	101539545		1	ADAPTER, ELBOW, BRANCH, 1/4 MNPT, 2X 3/8 TUBE, SMC KQ2Z11-35S
34	101463367		1	ADAPTER, TRIPLE ELBOW, 1/4 MALE NPT TO 3X 1/4 INSTANT TUBE
36	100022111	70.10799	2	CONNECTOR, MALE, STRAIGHT, 1/4 IN SWAGELOC X 1/4 IN NPT PIN, STAINLESS STEEL
37	101463369		2	ADAPTER, STRAIGHT, 1/4 MALE NPT TO 1/4 INSTANT TUBE
38	101543078		1	ADAPTER, ELBOW, 3/8 TUBE TO 1/4 MNPT
39	101388195		1	ADAPTER, HIGH PRESSURE FITTING, 30K FEM-1/4 NPT X MALE 1/4 HP (HM4) HIP 30-21NFBHM4
40	101485630		1	SILENCER, NAN(BC SINTERED), GENERAL PURPOSE, NOISE REDUCTION: 16db, 1/8 MALE NPT
41	101543075		1	ADAPTER, ELBOW, 3/8 TUBE TO 1/8 MNPT
42	100001771	70.24702	2	GLAND, AUTOCLAVE, ANGLE 40, 60000 POUNDS PER SQ IN, FOR 1/4 TUBE, F250C FEMALE THREAD
43	100001646	70.16576	2	COLLAR, AUTOCLAVE, ACL40, 1/4 TUBE, 60000 PSI, STAINLESS STEEL
44	101256016		4	SCREW, THREADED, CAP, SOCKET HEAD (METRIC) - M12 x 25 - 18-8 SS
45	101602091		8	WASHER, LOCK, M12, SPRING, 18-8 STAINLESS STEEL
46	101674525		4	METRIC 18-8 SS HEX HEAD CAP SCREW M12, 25MM LENGTH, 1.75MM PITCH, FULLY THREADED
47	101672614		4	Metric 18-8 SS Socket Head Cap Screw M14 Thread, 35mm Length, 2mm Pitch

Find #	Name	Drawing #	Quantity	Description
48	100123752		4	SCREW, MACHINE, 10-32 X 3/8, BUTTON, ALLEN, SS1(UNBRAKO)
49	101265343		4	SCREW, THREADED, CAP, SOC HEAD (US) - NO. 8 -32 UNC x 1.75 - 18-8 SS
50	101696683		4	SCREW, 3/8-24 X 1.5, SS, SOCKET HEAD CAP
51	101265322		12	SCREW, THREADED, CAP, SOC HEAD (US) - NO. 8 -32 UNC x 0.50 - 18-8 SS
52	101265670		4	SCREW, THREADED, CAP, SOC HEAD (US) - 0.25 DIA -20 UNC x 0.50 - 18-8 SS
53	100035270	70.93472	2	NUT, ELASTIC STOP, 1/4-20 NC, LIGHT HEX, STAINLESS STEEL, ESNA #79NE-040
54	100112806		2	SCREW, SOCKET HEAD CAP, #10-32 UNF X 3/8, STAINLESS STEEL, HEXAGONAL SOCKET
55	101265889		2	SCREW, THREADED, CAP, SOC HEAD (US) - 0.3125 DIA -18 UNC x 4 - 18-8 SS
56	207377		1	TUBING SOFT COPPER 1/4 X .032
57	101485749		6	VALVE, CHECK, 1/4 INSTANT PUSH TUBE PORTS, AKH07-00
58	101485744		1	ADAPTER, TRIPPLE UNIVERSAL MALE ELBOW, 1/4 MALE NPT TO 3X 3/8 INSTANT PUSH TUBE, KQ2VT11-35S
59	101485750		1	ADAPTER, ELBOW, 1/4 FEMALE NPT TO 1/4 INSTANT PUSH TUBE, KQ2LF07-35
60	100020617	70.01468	1	TEE, FEMALE BRANCH, SWAGELOC, 1/4 TUBE, 1/4 FNPT, STAINLESS STEEL
61	101696554		1	ADAPTER, CROSS, 1/4 TUBING SMC
62	101673153		1	1/4 TUBING, POLYURETHANE, 20 METER ROLL, BLUE
63	205555		1	TUBING 1/4 OD X .083 ID 304 ST
64	101708447		1	TEE, INST TUBE, DIFFERENT DIAMETER, 2X 1/4 TO 1X 3/8

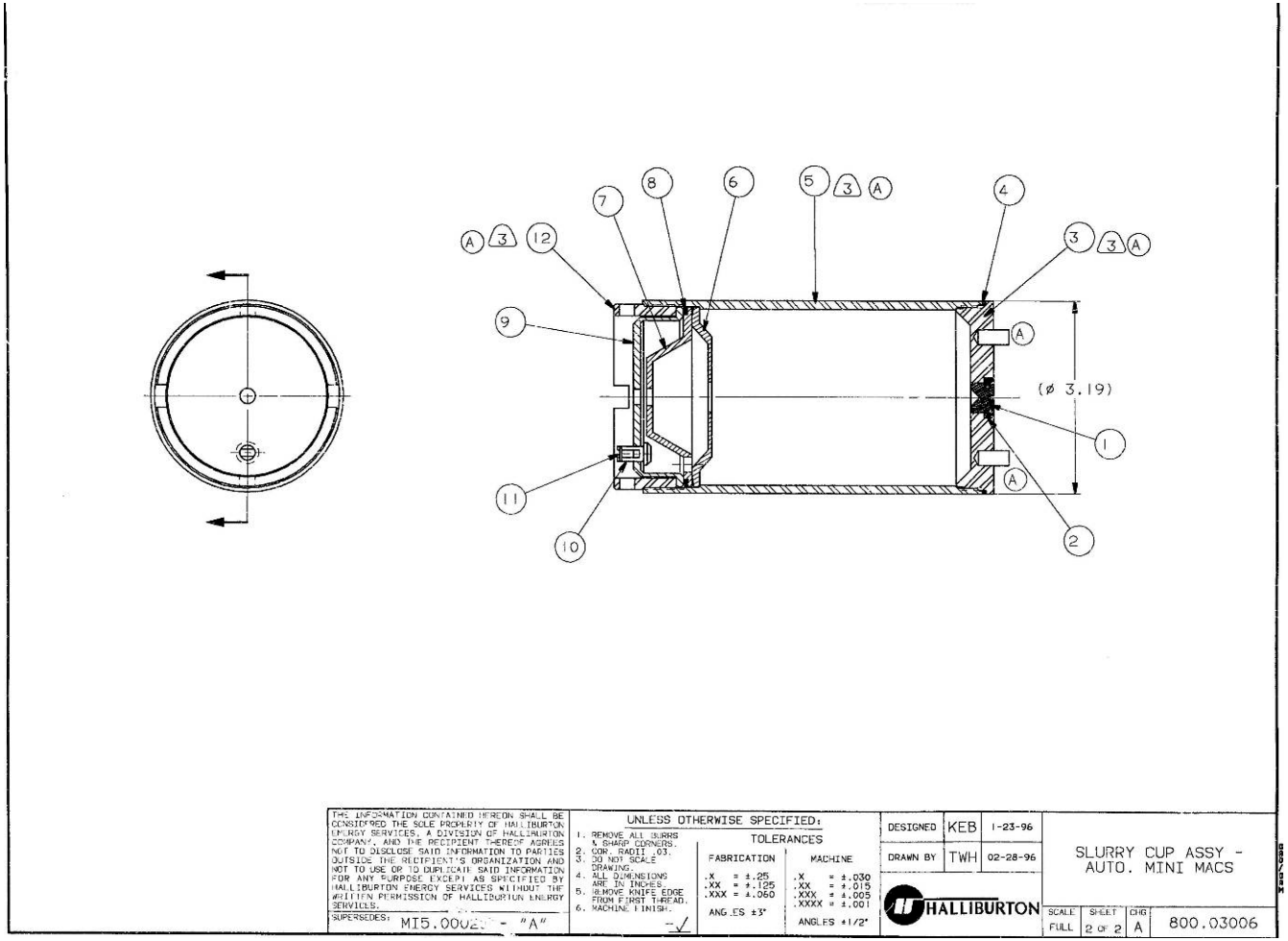
Find #	Name	Drawing #	Quantity	Description
65	101708752		1	CROSS, 3/8 TUBE
66	101485964		1	TUBING, 3/8 IN O.D. POLYURETHANE, BLUE, TIUB11BU-20
67	101645666		1	ADJUSTABLE STOP, STANDARD, CARR LANE
68	101645668		1	BLOCK, SIDEWAYS MOUNTING, CARR LANE
69	101266411		2	SCREW, THREADED, CAP, SOC HEAD (US) - 0.50 DIA -13 UNC x 4 - 18-8 SS
70	101266378		1	SCREW, THREADED, CAP, SOC HEAD (US) - 0.50 DIA -13 UNC x 1 - 18-8 SS
71	101543077		3	VALVE, CHECK, 3/8 TUBE
72	101483689		25	Plug-in bridge for cross-connections in the terminal center, 2-pos., color: Red
74	204056		1	BULKHEAD FEMALE 1/4T X 1/4FNPT
75	101543076		1	TEE, 3/8 TUBE
76	101486173		2	SCREW, CAP, SOCKET HEAD, 5/16-18 X 4, STAINLESS STEEL
77	100029924	70.58962	4	WASHER, LOCK, 5/8, STEEL, PL, SPEC 70.59034
78	101566781		4	FITTING, FEMALE CONNECTOR, BRASS, 1/4 IN OD TUBE X 1/4 IN NPT FEMALE, PUSH ASSEMBLY FOR SOFT TUBING (POLYETHYLENE, NYLON, SOFT METAL), PARKER PRESTOLOK
79	208510		240	CABLE AUDIO 2 COND GEOPHONE 31

10.7. **SGS Test Cup Assembly 101636768**



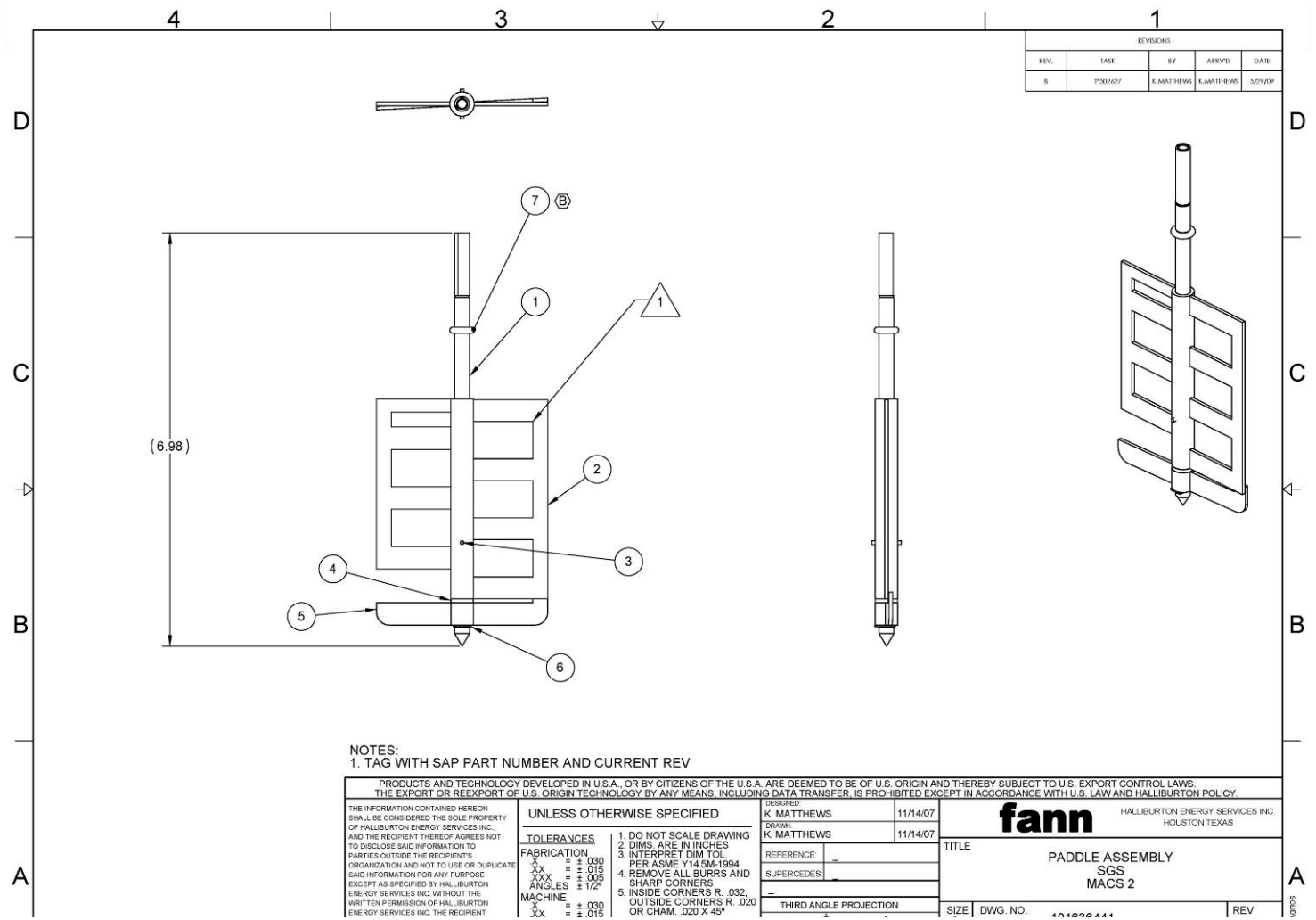
Find #	Name	Drawing #	Quantity	Description
	101636768	101636768		SGS TEST CUP ASSY, MACS II
1	101837418	800.03006	1	SLURRY CUP ASSEMBLY, MACS 2
2	101636441	101636441	1	PADDLE ASSEMBLY, SGS, MACS II
3	101698207	101698207	1	CUP COUPLING, MACS II MAG DRIVE TO PADDLE AND SAMPLE CUP
4	100001522	70.10643	1	RING, RETAINING, EXTERNAL, 0.25 SHAFT, STAINLESS STEEL

10.8. **Slurry Cup Assembly 101837418**



Find #	Name	Drawing #	Quantity	Description
	100072017	800.03006		SLURRY CUP ASSEMBLY, AUTO MINI MACS
1	100007912	800.59772	1	PLUG, BASE, SLURRY CUP, MINIMACS
2	101836939	101836939	1	GASKET, CUP PLUG, HIGH TEMPERATURE MACS 2
3	100072323	800.59771	1	BASE, SLURRY CUP, MINMACS
4	101836938	101836938	1	GASKET, CUP BASE, HIGH TEMPERATURE MACS 2
5	100007920	800.64101	1	SLEEVE, SLURRY CUP, CONSISTOMETER, 30 KPSI
6	100072315	800.59725	1	BAFFLE, BOTTOM, SLURRY CUP, WATER PRESSURIZED CONSISTOMETER
7	100072316	800.59727	1	BAFFLE, TOP, SLURRY CUP, WATER PRESSURIZED CONSISTOMETER
8	101837384		1	O-RING, 568-232, PERFLUORO WHITE 90 DURO 600F
9	100072318	800.59729	1	CAP, TOP, NON ROTATING, SLURRY CUP, WATER PRESSURIZED CONSISTOMETER
10	100072317	800.59728	1	STEM, VALVE, SLURRY CUP, WATER PRESSURIZED CONSISTOMETER
11	100001522	70.10643	1	RING, RETAINING, EXTERNAL, 0.25 SHAFT, STAINLESS STEEL
12	100072313	800.59723	1	RING, LOCK, EXTRA LONG, SLURRY CUP, MINI MACS CONSISTOMETER

10.9. **Paddle Assembly, SGS 101636441**



Find #	Name	Drawing #	Quantity	Description
	101636441	101636441		PADDLE ASSEMBLY, SGS, MACS 2
1	101636267	101636267	1	SHAFT, MODIFIED, SLURRY CUP, MACS 2
2	100007913	800.59774	1	BLADE, UPPER, SGS PADDLE, MINIMACS
3	100021371	800.59774	1	PIN, ROLL, 1/16 X 1/2, STAINLESS STEEL
4	100002427	800.59774	1	O-RING, TEFLON, 3/8 OD X 1/4 ID X 1/16 ROUND 568-010
5	100007914	800.59774	1	BLADE, LOWER, SGS PADDLE, MINIMACS
6	100001522	800.10643	1	RING, RETAINING, EXTERNAL 0.25 SHAFT, SS
7	101837396		1	O-RING, 568-107, PERFLUORO WHITE 90 DURO 600F
8	100007910	800.59774	1	COUPLING, DRIVE, PADDLE, AUTO MINI MACS
9	100040541	800.59774	1	CONTAINER, 4 1/2 X 4 1/2 X 10 1/2 ID, REGULAR SLOTTED CARTON 200, SINGLE WALL, C-FLUTE, GLUED, PRINTED, 1 COLOR, 2 PANELS, STYLE C, REV. 3/30/90

10.10. Spares 1 Year MACS II Analyzer 101877938

P/N	Quantity	Description
101667558	1	PREMIUM GRADE; TYPE JJ CALIBRATION T/C WITH SPECIAL LIMITS OF +/- 0.4%; 0.063 IN OD; SINGLE UNGROUNDED JUNCTION; 21 IN LONG; 316SS MATERIAL; LEAD WIRE: 20AWG TEFLON INSULATED LEAD WIRE; 68 IN LONG; MINIATURE PLUG (MP)
101671856	1	THERMOCOUPLE, TYPE J, UNGROUNDED, 1.125 30000 PSI, MALE HP PORT
101918773	1	THERMOCOUPLE, SPRING ADJUSTABLE, UNGROUNDED TYPE J, PIG TALE USED WITH BAYONET ADAPTOR, 48 INCH LENGTH WITH SS WIRE BRAID
101594774	8	BACKUP RING, PRESSURE VESSEL
101710014	4	O-RING, ULTRA PAROFLUOR, ID 2.984, SIZE 2-234, DUROMETER 75
101710015	4	O-RING, ULTRA PAROFLUOR, ID .739, SIZE 2-018, DUROMETER 75
101596797	2	TIMING BELT, 240XL, 120 TEETH, 3/8 WIDTH, 0.20 PITCH
101542809	1	RUPTURE DISC, BURST PRESSURE 34500 PSI @ 72 F, 1/4 ANGLED SEAT, 316 SS
101636441	5	PADDLE ASSEMBLY, SGS
70.10643	50	RING, RETAINING, EXTERNAL, 0.25 SHAFT, STAINLESS STEEL
101836939	30	GASKET, CAP PLUG, HIGH TEMP
101836938	10	GASKET, CUP BASE, HIGH TEMP
101837384	4	O-RING,568-232, PERFLUORO, 90 DURO 600F
101626358	1	FILTER ELEMENT, HIGH PRESSURE, 25 MICRON, 304 WIRE MESH, 3B FILTER,VITON O-RING, USED WITH FILTER 101539542
101629340	3	KIT, SOFT GOODS, 30,000 PSIG, TESCOM REGULATOR
101629342	3	KIT, REPAIR, TESCOM 54-21N0T44A-095 REGULATOR, 30,000 PSIG
101837396	4	O-RING 568-107 PERFLUORO, 90 DURO 600 F
70.82789	50	O-RING, TEFLON, 3/8 OD X 1/4 ID X 1/16 ROUND 568-010
102052994	5	WATER FILTER ELEMENT, 10 MICRON SS
101673153	120	1/4 TUBING, POLYURETHANE, 20 METER ROLL
101485964	10	TUBING, 3/8 IN O.D. POLYURETHANE, TIUB11BU-20
101630287	4	KIT, 3 ORINGS FOR P8791-HP-40WEV ORING 212V, 138V, AND 138VP

10.11. Spares 2 Year MACS II Analyzer 101877945

P/N	Quantity	Description
101667558	2	PREMIUM GRADE; TYPE JJ CALIBRATION T/C WITH SPECIAL LIMITS OF +/- 0.4%; 0.063 IN OD; SINGLE UNGROUNDED JUNCTION; 21 IN LONG; 316SS MATERIAL; LEAD WIRE: 20AWG TEFLON INSULATED LEAD WIRE; 68 IN LONG; MINIATURE PLUG (MP)
101671856	2	THERMOCOUPLE, TYPE J, UNGROUNDED, 1.125 30000 PSI, MALE HP PORT
101918773	1	THERMOCOUPLE, SPRING ADJUSTABLE, UNGROUNDED TYPE J, PIG TALE USED WITH BAYONET ADAPTOR, 48 INCH LENGTH WITH SS WIRE BRAID
70.10235	1	TRANSDUCER, PRESSURE, 30000 PSI, 4-20 MA, 0.5% ACCURACY, F-250C AUTOCLAVE PRESSURE PORT, ADJ ZERO AND SPAN POTS
101594774	20	BACKUP RING, PRESSURE VESSEL
101710014	10	O-RING, ULTRA PAROFLUOR, ID 2.984, SIZE 2-234, DUROMETER 75
101710015	10	O-RING, ULTRA PAROFLUOR, ID .739, SIZE 2-018, DUROMETER 75
101596797	5	TIMING BELT, 240XL, 120 TEETH, 3/8 WIDTH, 0.20 PITCH
101542809	2	RUPTURE DISC, BURST PRESSURE 34500 PSI @ 72 F, 1/4 ANGLED SEAT, 316 SS
101636441	12	PADDLE ASSEMBLY, SGS
70.10643	100	RING, RETAINING, EXTERNAL, 0.25 SHAFT, STAINLESS STEEL
101836939	50	GASKET, CAP PLUG, HIGH TEMP
101836938	15	GASKET, CUP BASE, HIGH TEMP
101837384	10	O-RING,568-232, PERFLUORO, 90 DURO 600F
101626358	4	FILTER ELEMENT, HIGH PRESSURE, 25 MICRON, 304 WIRE MESH, 3B FILTER,VITON O-RING, USED WITH FILTER 101539542
101629340	5	KIT, SOFT GOODS, 30,000 PSIG, TESCOM REGULATOR
101629342	5	KIT, REPAIR, TESCOM 54-21N0T44A-095 REGULATOR, 30,000 PSIG
101837396	10	O-RING 568-107 PERFLUORO, 90 DURO 600 F
70.82789	100	O-RING, TEFLON, 3/8 OD X 1/4 ID X 1/16 ROUND 568-010
102052994	10	WATER FILTER ELEMENT, 10 MICRON SS
101673153	240	1/4 TUBING, POLYURETHANE, 20 METER ROLL
101485964	20	TUBING, 3/8 IN O.D. POLYURETHANE, TIUB11BU-20
101630287	10	KIT, 3 ORINGS FOR P8791-HP-40WEV ORING 212V, 138V, AND 138VP

Warranty and Return

Section 11

Fann Instrument Company
P.O. Box 4350

LIMITED WARRANTY
Fann warrants only title to the equipment, products and materials supplied and that the same are free from defects in workmanship and materials for one year from date of delivery. THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED OF MERCHANTABILITY, FITNESS OR OTHERWISE BEYOND THOSE STATED IN THE IMMEDIATELY PRECEDING SENTENCE. Fann's sole liability and Customer's exclusive remedy in any cause of action (whether in contract, tort, breach of warranty or otherwise) arising out of the sale, lease or use of any equipment, products or materials is expressly limited to the replacement of such on their return to Fann or, at Fann's' option, to the allowance to Customer of credit for the cost of such items. In no event shall Fann be liable for special, incidental, indirect, consequential or punitive damages. Notwithstanding any specification or description in its catalogs, literature or brochures of materials used in the manufacture of its products, Fann reserves the right to substitute other materials without notice. Fann does not warrant in any way equipment, products, and material not manufactured by Fann, and such will be sold only with the warranties, if any, that are given by the manufacturer thereof. Fann will only pass through to Customer the warranty granted to it by the manufacturer of such items.

Out of warranty products will be repaired for a nominal charge.

Please refer to the accompanying warranty statement enclosed with the product

For your protection, items being returned must be carefully packed to prevent damage in shipment and insured against possible damage or loss. Fann will not be responsible for damage resulting from careless or insufficient packing.

Before returning items for any reason, authorization must be obtained from Fann Instrument Company. When applying for authorization, please include information regarding the reason the items are to be returned.

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