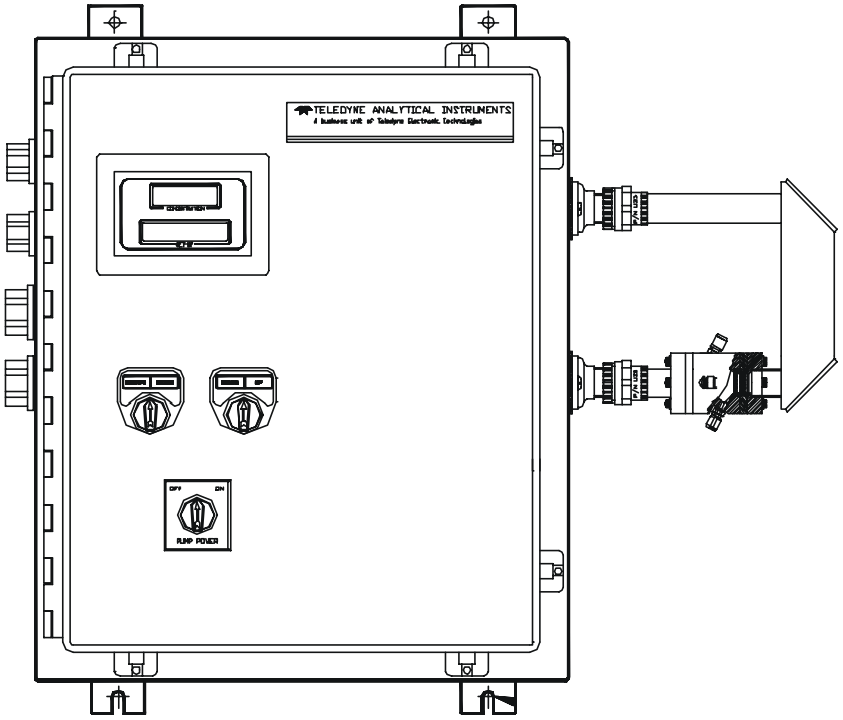
OPERATING INSTRUCTIONS

Model 6600

Oil in Water Analyzer



DANGER

HIGHLY TOXIC AND OR FLAMMABLE LIQUIDS OR GASES MAY BE PRESENT IN THIS MONITORING SYSTEM.

PERSONAL PROTECTIVE EQUIPMENT MAY BE REQUIRED WHEN SERVICING THIS SYSTEM.

HAZARDOUS VOLTAGES EXIST ON CERTAIN COMPONENTS INTERNALLY WHICH MAY PERSIST FOR A TIME EVEN AFTER THE POWER IS TURNED OFF AND DISCONNECTED.

ONLY AUTHORIZED PERSONNEL SHOULD CONDUCT MAINTENANCE AND/OR SERVICING. BEFORE CONDUCTING ANY MAINTENANCE OR SERVICING CONSULT WITH AUTHORIZED SUPERVISOR/MANAGER.

P/N M71055
12/22/99
ECO # 99-0000

Warranty

This equipment is sold subject to the mutual agreement that it is warranted by us free from defects of material and of construction, and that our liability shall be limited to replacing or repairing at our factory (without charge, except for transportation), or at customer plant at our option, any material or construction in which defects become apparent within one year from the date of shipment, except in cases where quotations or acknowledgements provide for a shorter period. Components manufactured by others bear the warranty of their manufacturer. This warranty does not cover defects caused by wear, accident, misuse, neglect or repairs other than those performed by Teledyne or an authorized service center. We assume no liability for direct or indirect damages of any kind and the purchaser by the acceptance of the equipment will assume all liability for any damage which may result from its use or misuse.

We reserve the right to employ any suitable material in the manufacture of our apparatus, and to make any alterations in the dimensions, shape or weight of any parts, in so far as such alterations do not adversely affect our warranty.

Important Notice

This instrument provides measurement readings to its user, and serves as a tool by which valuable data can be gathered. The information provided by the instrument may assist the user in eliminating potential hazards caused by his process; however, it is essential that all personnel involved in the use of the instrument or its interface, with the process being measured, be properly trained in the process itself, as well as all instrumentation related to it.

The safety of personnel is ultimately the responsibility of those who control process conditions. While this instrument may be able to provide early warning of imminent danger, it has no control over process conditions, and it can be misused. In particular, any alarm or control systems installed must be tested and understood, both as to how they operate and as to how they can be defeated. Any safeguards required such as locks, labels, or redundancy, must be provided by the user or specifically requested of Teledyne at the time the order is placed.

Therefore, the purchaser must be aware of the hazardous process conditions. The purchaser is responsible for the training of personnel, for providing hazard warning methods and instrumentation per the appropriate standards, and for ensuring that hazard warning devices and instrumentation are maintained and operated properly.

Teledyne Analytical Instruments, the manufacturer of this instrument, cannot accept responsibility for conditions beyond its knowledge and control. No statement expressed or implied by this document or any information disseminated by the manufacturer or its agents, is to be construed as a warranty of adequate safety control under the user's process conditions.

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OPERATING INSTRUCTIONS

Model 6600

Oil in Water Analyzer

Part I: Control Section of the Control/Analysis Unit

Z-PURGED
CLASS I, DIVISION II, GROUPS B, C, and D

Table of Contents

Introduction

1.1 Overview

The Teledyne Analytical Instruments Model 6600 Control Section, together with a 6600 Analysis Section, is versatile microprocessor-based instrument.

Part I, of this manual covers the Model 6600 General Purpose, Bulk-head Mount Control Section. (The Analysis Section is covered in Part II of this manual, and Oil in Water application is covered in Part III) The Control Section is for indoor/outdoor use in hazardous environment only. The Analysis Section (or Remote Section) can be designed for a variety of hazardous environments. All Sections are mounted in a NEMA-4 enclosure (24"x20"x10").

1.2 Typical Applications when Configured with the appropriate Sample System

A few typical applications of the Model 6600 are:

- Offshore platforms, Produced Water, Sea Water
- Waste Water, Tank Farms, Fuel Depots, Refinery Effluents
- Oil Chemical Separators
- On-Board Ship
- Boiler Return Steam Condensate
- Process Cooling Water
- Bilge/Deballast Water Treatment
- Water Soluble Oils
- All Aromatic Hydrocarbons
- Many Organic Hydrocarbons (Contact Factory)

1.3 Main Features of the Analyzer

The Model 6600 Photometric Analyzer is sophisticated yet simple to use. The main features of the analyzer include:

- A 2-line alphanumeric display screen, driven by microprocessor electronics, that continuously prompts and informs the operator.
- High resolution, accurate readings of concentration from low ppm levels through to 100%. Large, bright, meter readout.
- Versatile analysis over a wide range of applications.
- Microprocessor based electronics: 8-bit CMOS microprocessor with 32 kB RAM and 128 kB ROM.
- Three user definable output ranges (from 0-1 ppm through 0-100 %) allow best match to users process and equipment.
- Calibration range for convenient zeroing or spanning.
- Auto Ranging allows analyzer to automatically select the proper preset range for a given measurement. Manual override allows the user to lock onto a specific range of interest.
- Two adjustable concentration alarms and a system failure alarm.
- Extensive self-diagnostic testing, at startup and on demand, with continuous power-supply monitoring.
- RS-232 serial digital port for use with a computer or other digital communication device.
- Analog outputs for concentration and range identification. (0-1 V dc standard, and isolated 4–20 mA dc)
- Superior accuracy.
- Internal calibration-Manual or Automatic (optional).

1.4 Operator Interface

All controls and displays on the standard 6600 are accessible from outside the housing. The instrument has two simple operator controls. The operator has constant feedback from the instrument through an alphanumeric display, and a digital LED meter. The displays and controls are described briefly here and in greater detail in chapter 3. See Figure 1-1.

1.4.1 UP/DOWN Switch

The UP/DOWN switch is used to select between any subfunctions displayed on the VFD screen such as in the main menue, the system menue, the Alarm menue, etc. When modifiable values are displayed on the VFD, the UP/DOWN switch can be used to increment or decrement the values.

1.4.2 ESCAPE/ENTER Switch

The ESCAPE/ENTER switch is used to input the data, to enter a function, or to exit a function displayed in the alphanumeric display:

- **Escape** Moves VFD display back to the previous screen in a series. If none remains, returns to Analyze mode screen.
- **Enter** Within a menue: the funtion selected is entered moving on to the next screen in a series.

  With Value selected: Enters the value into the analyzer as data. Advances cursor on VFD to the next operation.

  In the Analyze mode: it calls the main menue. Functions called out by the main menue:

  -System This function is a menu that calls a number of functions that regulate the analyzer operation.

  -Span This function spans the instrument.

  -Zero This function zeros the instrument.

  -Alarms This functions sets the alarm preferences.

  -Range This function selects whether analyzer is autoranging or locked on one range.

  -Standby Places the analyzer in a sleep mode.

WARNING:

The power cable must be disconnected to fully remove power from the instrument.

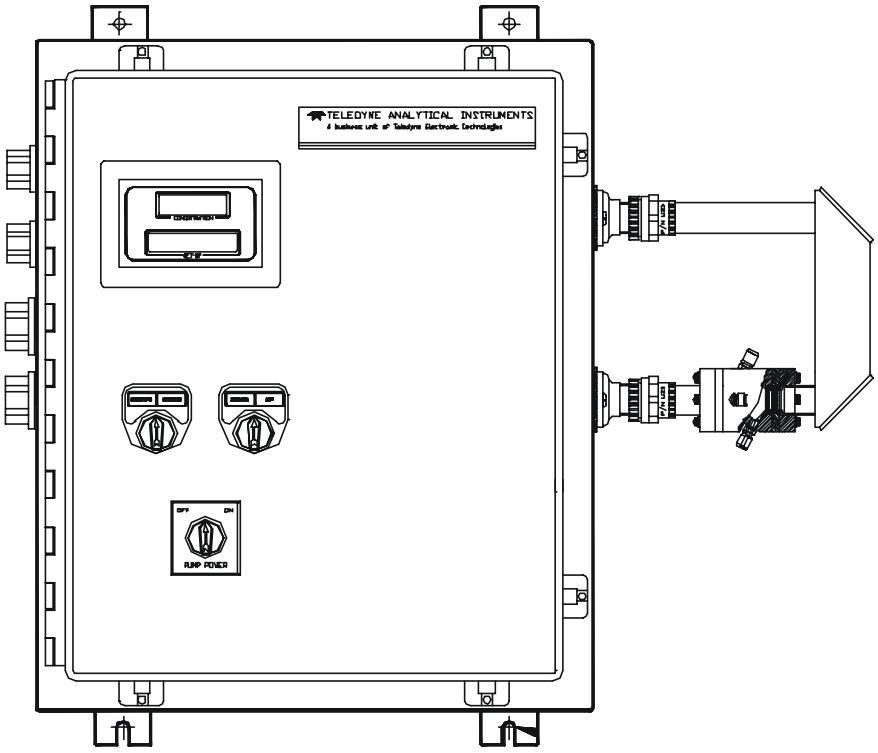

Figure 1-1: Model 6600 Controls, Indicators, and Connectors

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Digital Meter Display: The meter display is a Light Emitting Diode LED device that produces large, bright, 7-segment numbers that are legible in any lighting. It is accurate across all analysis ranges. The 6600 models produce continuous readout from 0-10,000 ppm and then switch to continuous percent readout from 1-100 %.

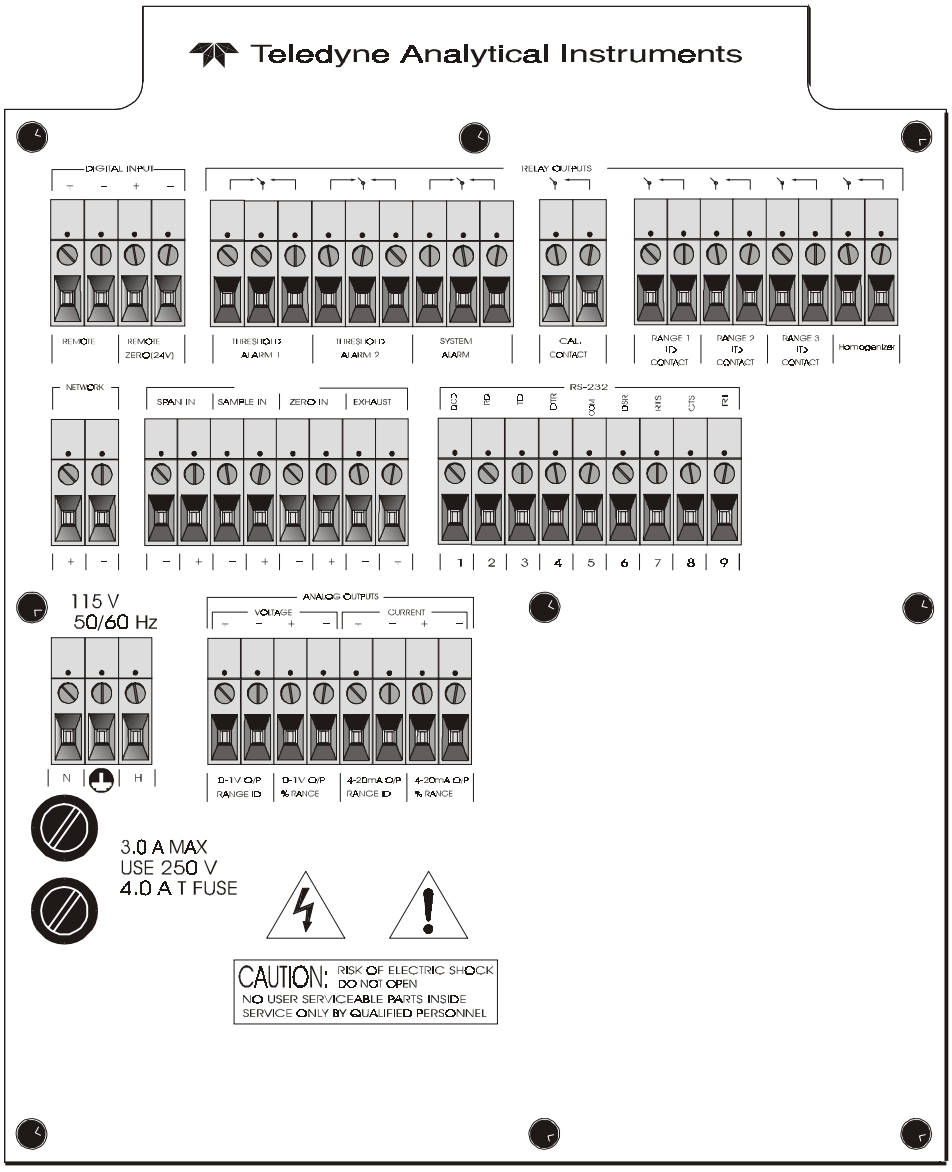


Figure 1-2: Model 6600 Interface Panel

Alphanumeric Interface Screen: The backlit VFD screen is an easy-to-use interface between operator and analyzer. It displays values, options, and messages for immediate feedback to the operator.

1.5 Control Section Interface Panel

The Control Section interface panel, shown in Figure 1-2, contains the electrical terminal blocks for external inputs and outputs. The input/output functions are described briefly here and in detail in the *Installation* chapter of this manual.

- **Power Connection** — AC power source, 115VAC, 50/60 Hz
- **Analog Outputs** — 0-1 V dc concentration and 0-1 V dc range ID. Isolated 4-20 mA dc and 4-20 mA dc range ID.
- **Alarm Connections** — 2 concentration alarms and 1 system alarm.
- **RS-232 Port** — Serial digital concentration signal output and control input.
- **Remote Bench** — Provides all electrical interconnect to the Analysis Section.
- **Remote Span/Zero** — Digital inputs allow external control of analyzer calibration.
- **Calibration Contact** — To notify external equipment that instrument is being calibrated and readings are not monitoring sample.
- **Range ID Contacts** — Four separate, dedicated, range relay contacts.
- **Network I/O** — Serial digital communications for local network access. For future expansion. Not implemented at this printing.

Note: If you require highly accurate Auto-Cal timing, use external Auto-Cal control where possible. The internal clock in the Model 6600 is accurate to 2-3 %. Accordingly, internally scheduled calibrations can vary 2-3 % per day.

Installation

Installation of Model 6600 Analyzers includes:

1. Unpacking, mounting, and interconnecting the Control/Analysis Section
2. Making gas connections to the system
3. Making electrical connections to the system
4. Testing the system.

This chapter covers installation of the Control Section. (Installation of the Analysis Section is covered in Part II of this manual.) The Oil in Water application is covered in Part III.

2.1 Unpacking the Control/Analysis Unit

The analyzer is shipped with all the materials you need to install and prepare the system for operation. Carefully unpack the Control/Analysis Unit and inspect it for damage. Immediately report any damage to the shipping agent. Figure 2-2: Required Front Door Clearance

Allow clearance for the door to open in a 90-degree arc of radius 15.5 inches. See Figure 2-2.

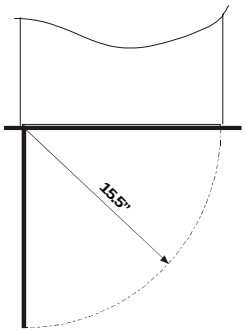


Figure 2-2: Required Front Door Clearance

2.2 Electrical Connections

Figure 2-3 shows the Control/Analysis Unit interface panel. Connections for power, communications, and both digital and analog signal outputs are described in the following paragraphs. Wire size and maximum length data appear in the Drawings at the back of this manual.

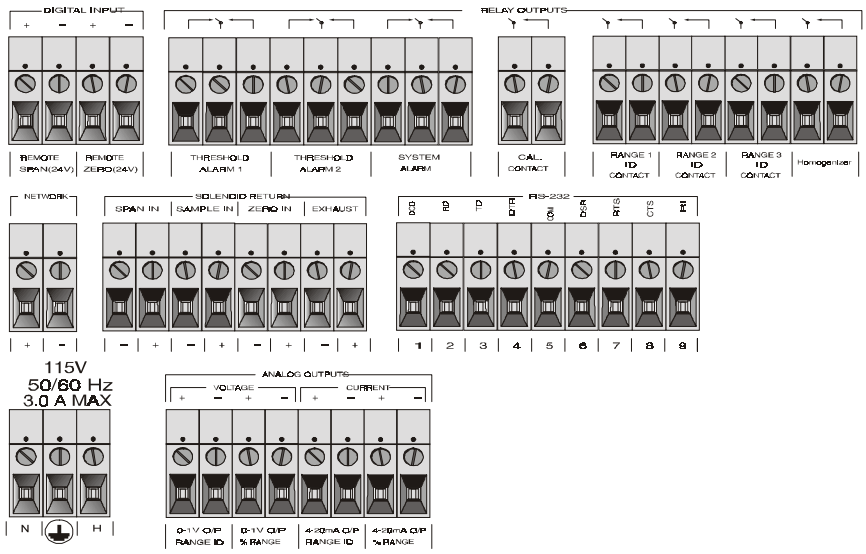


Figure 2-3: Interface Panel of the Model 6600 Control Section

For safe connections, ensure that no uninsulated wire extends outside of the terminal blocks. Stripped wire ends must insert completely into terminal blocks. No uninsulated wiring should come in contact with fingers, tools or clothing during normal operation.

Primary Input Power: The power supply in the Model 6600 will accept a 115 Vac, 50/60 Hz power source. See Figure 2-4 for detailed connections.

DANGER: Power is applied to the instrument's circuitry as long as the instrument is connected to the power source. The standby function switches power on or off to the displays and outputs only.

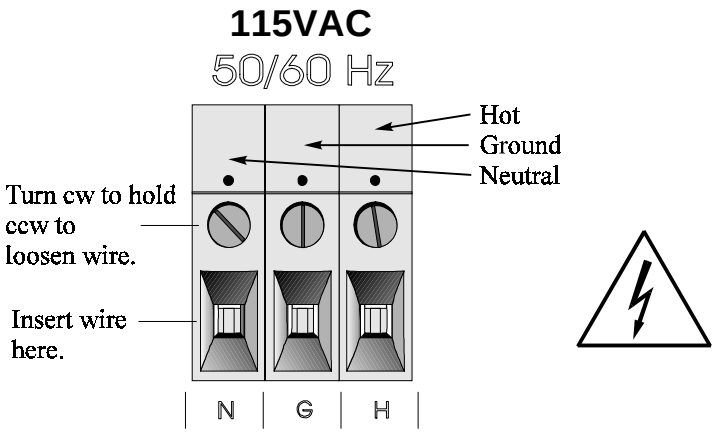


Figure 2-4: Primary Input Power Connections

Fuse Installation: The fuse holders accept 5 x 20 mm, 4.0 A, T type (slow blow) fuses. Fuses are not installed at the factory. Be sure to install the proper fuse as part of installation (See *Fuse Replacement* in chapter 4, *maintenance*.)

Analog Outputs: There are eight DC output signal connectors on the ANALOG OUTPUTS terminal block. There are two connectors per output with the polarity noted. See Figure 2-5.

The outputs are:

0–1 V dc % of Range:	Voltage rises linearly with increasing sample concentration, from 0 V at 0% to 1 V at 100%. (Full scale = 100% programmed range.)
0–1 V dc Range ID:	0.25 V = Range 1, 0.5 V = Range 2, 0.75 V = Range 3.
4–20 mA dc % Range:	(-M Option) Current increases linearly with increasing sample concentration, from 4 mA at 0% to 20 mA at full scale 100%. (Full scale = 100% of programmed range.)
4–20 mA dc Range ID:	(-M Option) 8 mA = Range 1, 12 mA = Range 2, 16 mA = Range 3.

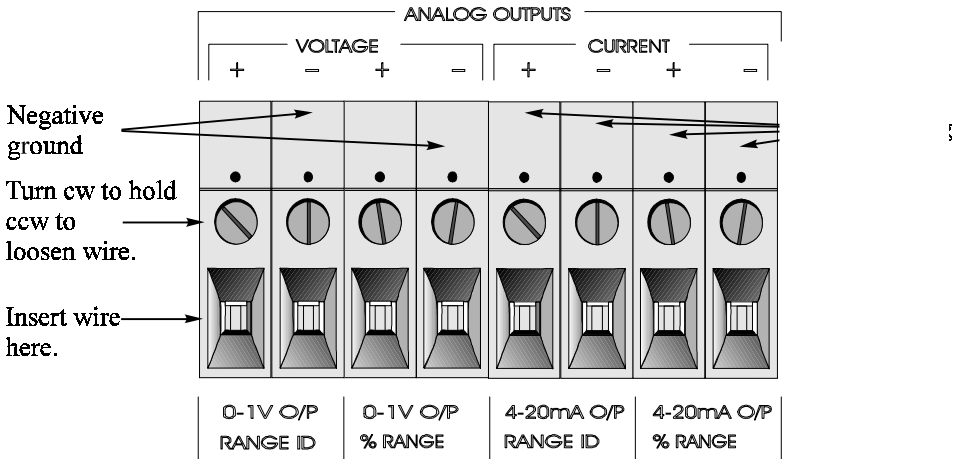


Figure 2-5: Analog Output Connections

Examples:

The analog output signal has a voltage which depends on the sample concentration AND the currently activated analysis range. To relate the signal output to the actual concentration, it is necessary to know what range the instrument is currently on, especially when the analyzer is in the autoranging mode.

The signaloutput for concentration is linear over currently selected analysis range. For example, if the analyzer is set on a range that was defined as 0-10 %, then the output would be as shown in Table 2-1.

Table 2-1: Analog Concentration Output-Examples

Concentration %	Voltage Signal Output (V dc)	Current Signal Output (mA dc)
0	0.0	4.0
1	0.1	5.6
2	0.2	7.2
3	0.3	8.8
4	0.4	10.4
5	0.5	12.0
6	0.6	13.6
7	0.7	15.2
8	0.8	16.8
9	0.9	18.4
10	1.0	20.0

To provide an indication of the range, a second pair of analog output terminals are used. They generate a steady preset voltage (or current when using the current outputs) to represent a particular range. Table 2-2 gives the range ID output for each analysis range.

Table 2-2: Analog Range ID Output - Example

Range	Voltage (V)	Current (mA)
Range 1	0.25	8
Range 2	0.50	12
Range 3	0.75	16

Alarm Relays:

There are three alarm-circuit connectors on the alarm relays block (under RELAY OUTPUTS) for making connections to internal alarm relay contacts. Each provides a set of Form C contacts for each type of alarm. Each has both normally open and normally closed contact connections. The contact connections are indicated by diagrams on the rear panel. They are capable of switching up to 3 ampers at 250 V AC into a resistive load (Figure 2-6).

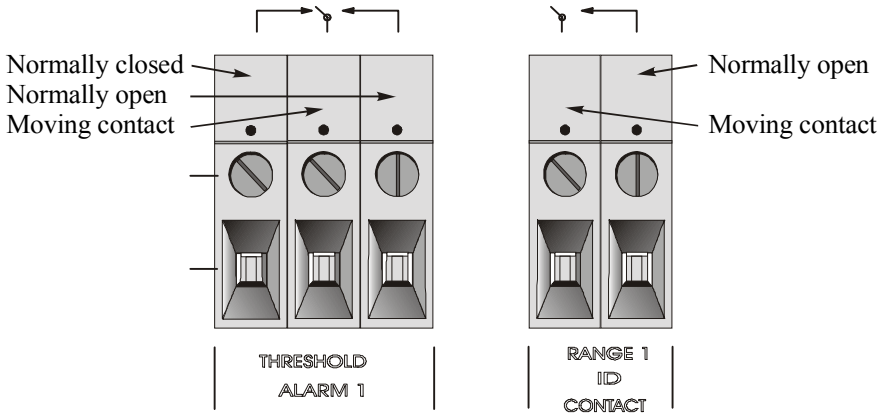


Figure 2-6: Types of Relay Contacts

The connectors are:

Threshold Alarm 1:
- Can be configured as high (actuates when concentration is above threshold), or low (actuates when concentration is below thresh old).
- Can be configured as fail-safe or non-fail-safe.
- Can be configured as latching or nonlatching.
- Can be configured out (defeated).

Threshold Alarm 2:
- Can be configured as high (actuates when concentration is above threshold), or low (actuates when concentration is below threshold).
- Can be configured as fail-safe or non-fail-safe.
- Can be configured as latching or nonlatching.
- Can be configured out (defeated).

System Alarm: Actuates when DC power supplied to circuits is unacceptable in one or more parameters. Permanently configured as fail-safe and latching. Cannot be defeated. Actuates if self test fails.

To reset a System Alarm during installation, disconnect power to the instrument and then reconnect it

Further detail can be found in chapter 3, section 3-5.

Digital Remote Cal Inputs

Remote Zero and Span Inputs: The REMOTE SPAN and REMOTE ZERO inputs are on the DIGITAL INPUT terminal block. They accept 0 V (OFF) or 24 V dc (ON) for remote control of calibration (See *Remote Calibration Protocol below*.)

Zero: Floating input. 5 to 24 V input across the + and – terminals puts the analyzer into the ZERO mode. Either side may be grounded at the source of the signal. 0 to 1 volt across the terminals allows ZERO mode to terminate when done. A synchronous signal must open and close the external zero valve appropriately. See *Remote Probe Connector* at end of section 3.3. (With the -C option, the internal valves automatically operate synchronously).

Span: Floating input. 5 to 24 V input across the + and – terminals puts the analyzer into the *SPAN* mode. Either side may be grounded at the source of the signal. 0 to 1 volt across the terminals allows *SPAN* mode to terminate when done. A synchronous signal must open and close the external span valve appropriately. See *Remote Probe Connector* at end of section 3.3. (With the -C option, the internal valves automatically operate synchronously.)

Cal Contact: This relay contact is closed while analyzer is spanning and/or zeroing. (See *Remote Calibration Protocol* below.)

Remote Calibration Protocol: To properly time the Digital Remote Cal Inputs to the Model 6600 Analyzer, the customer's controller must monitor the Cal Relay Contact.

When the contact is OPEN, the analyzer is analyzing, the Remote Cal Inputs are being polled, and a zero or span command can be sent.

When the contact is CLOSED, the analyzer is already calibrating. It will ignore your request to calibrate, and it will not remember that request.

Once a zero or span command is sent, and acknowledged (contact closes), release it. If the command is continued until after the zero or span is complete, the calibration will repeat and the Cal Relay Contact (CRC) will close again.

For example:

1) Test the CRC. When the CRC is open, Send a zero command until the CRC closes (The CRC will quickly close.)
2) When the CRC closes, remove the zero command.
3) When CRC opens again, send a span command until the CRC closes. (The CRC will quickly close.)
4) When the CRC closes, remove the span command.

When CRC opens again, zero and span are done, and the sample is being analyzed.

Note: The Remote Bench terminal strip (section 3.6 Part III) provides signals to ensure that the zero and span gas valves will be controlled synchronously.

Range ID Relays: Four dedicated RANGE ID CONTACT relays . The first four ranges are assigned to relays in ascending order—Range 1 is assigned to RANGE 1 ID, Range 2 is assigned to RANGE 2 ID, Range 3 is assigned to RANGE 3 ID, and Range 4 is assigned to RANGE 4 ID.

Network I/O: A serial digital input/output for local network protocol. At this printing, this port is not yet functional. It is to be used in future versions of the instrument.

RS-232 Port: The digital signal output is a standard RS-232 serial communications port used to connect the analyzer to a computer, terminal, or other digital device. The pinouts are listed in Table 2-3.

Table 2-3: RS-232 Signals

RS-232 Sig	RS-232 Pin	Purpose
DCD	1	Data Carrier Detect

RD	2	Received Data
TD	3	Transmitted Data
DTR	4	Data Terminal Ready
COM	5	Common
DSR	6	Data Set Ready
RTS	7	Request to Send
CTS	8	Clear to Send
RI	9	Ring Indicator

The data sent is status information, in digital form, updated every two seconds. Status is reported in the following order:

- The concentration in percent
- The range is use (HI< MED< LO)
- The span of the range 0-100%, etc)
- Which alarm - if any - are disabled (AL-x DISABLED)
- Which alarms - if any - are tripped (AL-x ON)

Each status output is followed by a carriage return and line feed.

Three input functions using RS-232 have been implemented to date. They are described in Table 2-4.

Table 2-4: Commands via RS-232 Input

Command	Description
as<enter>	Immediately starts an autospan.
az<enter>	Immediately starts an autozero.
st<enter>	Toggling input. Stops/Starts any status message output from the RS-232, Until **st**<enter> is sent again.

The RS-232 protocol allows some flexibility in its implementation. Table 2-5 lists certain RS-232 values that are required by the 6000B/6600.

Table 2-5: Required RS-232 Options

Parameter	Setting
Baud	2400
Byte	8 bits
Parity	none
Stop Bits	1
Message Interval	2 seconds

Remote Bench and Solenoid Valves: The 6600 is a single-chassis instrument. However, the REMOTE BENCH and SOLENOID RETURN connectors are provided on the interface PCB. The Remote Bench is wired at the factory as well as any optional solenoid valves included in the system.

2.3 Testing the System

After The Control/Analysis Unit is **both** installed and interconnected, and the system gas and electrical connections are complete, the system is ready to test. **Before** plugging the unit into its power sources:

- Check the integrity and accuracy of the gas connections. Make sure there are no leaks.
- Check the integrity and accuracy of all electrical connections. Make sure there are no exposed conductors
- Check that sample pressure typically between 0 and 30 psig, according to the requirements of your process.
- Turn homogenizer power potentiometer fully counter-clockwise (OFF), see section 3.3.8 for operation of homogenizer.

Warning: Do not operate the "ultrasonic homogenizer" in the instrument for more than one (1) minute without a liquid sample properly flowing through the homogenizer.

Power up the system, and test it by performing the following operation:

1. Repeat the Self-Diagnostic Test.
2. Zero the instrument.
3. Span the instrument.

For steps 2 and 3, refer to part II for gas calibration, and part III for Oil in Water application.

Operation

3.1 Introduction

Although the Model 6600 is usually programmed to your application at the factory, it can be further configured at the operator level, or even, **cautiously**, reprogrammed. Depending on the specifics of the application, this might include all or a subset of the following procedures:

- Setting system parameters:
  - Establish a security password, if desired, requiring Operator to log in (secure in safe file for referrence).
  - Establish and start an automatic calibration cycle, if desired.

- Routine Operation:
  - Calibrate the instrument.
  - Choose autoranging or select a fixed range of analysis.
  - Set alarm setpoints, and modes of alarm operation (latching, fail-safe, etc).
- Program/Reprogram the analyzer:
  - Define new applications.
  - Linearize your ranges.

If you choose not to use password protection, the default password is automatically displayed on the password screen when you start up, and you simply press *Enter* for access to all functions of the analyzer.

3.2 Using the Controls

To get the proper response from these controls, turn the control toward the desired action (ESCAPE or ENTER—DOWN or UP), and then release it. Turn-and-release once for each action. For example, turn-and-release twice toward UP to move the VFD screen two selections upwards on the list of options (menu).

The item that is blinking on the screen is the item that is currently selectable by choosing ENTER (turn-and-release toward ENTER with the ESCAPE/ ENTER control).

In these instructions, to ENTER means to turn-and-release toward ENTER, and To ESCAPE means to turn-and-release towards ESCAPE. To scroll UP (or scroll DOWN) means to turn-and-release toward UP (or DOWN) as many times as necessary to reach the required menu item.

3.2.1 Mode/Function Selection

After the instrument has been powered up, and its initilization routine performed, the instrument will settle in the Analyze mode. To call up the Main menu from the Analyze mode, toggle the Enter switch. To return to the Analyze mode, toggle the Escape switch. The Main menu screens looks as shown below:

SYSTEM SPAN ZERO
ALARM RANGE STBY

The Main menue screen is the top level in a series of screens used to configure the analyzer. The DOWN/UP selects the different options displayed in the VFD screen. The selectable option blinks on the VFD screen when you reach the desired option, toggle the Enter switch.

The Escape switch takes you back up to hierarchy of screens until you return back to the Analyze screen mode. Here is a brief description of the Main Menu:

- ***System.*** The system function consists of nine subfunctions.

Four of these are for ordinary setup and operation:

- Setup an Auto-Cal
- Assign Passwords
- Log out to secure system
- Initiate a Self-Test

Three of the subfunctions do auxiliary tasks:

- Checking model and software version
- Adjust electronic filter of the signal
- Display more subfunctions

Two of these are for programming/reprogramming the analyzer:

- Define gas applications and ranges (Refer to programming section, or contact factory.)

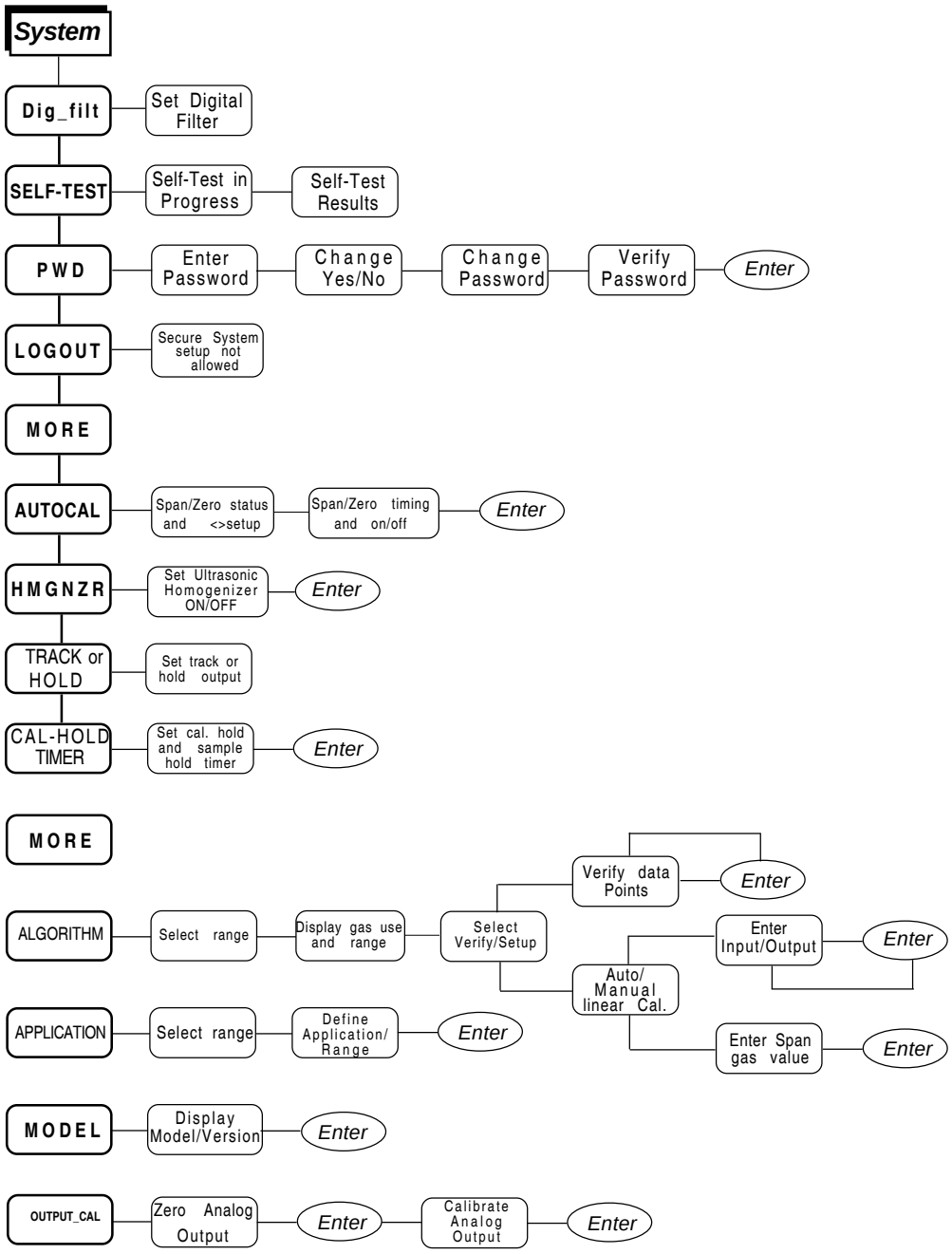


Figure 3-1: Hierarchy of System Functions and Subfunctions

- Use the Curve Algorithm to linearize output. (Refer to programming section, or contact factory.)

- ***Zero***. Used to set up a zero calibration.
- ***Span.*** Used to set up a span calibration.
- ***Alarms.*** Used to set the alarm setpoints and determine whether each alarm will be active or defeated, HI or LO acting, latching, and/or fail-safe.
- ***Range***. Used to set up four analysis ranges that can be switched automatically with autoranging or used as individual fixed ranges.

Any function can be selected at any time in the analyze mode (unless password restrictions apply). The order as presented in this manual is appropriate for an initial setup.

Each of these functions is described in greater detail in the following procedures. The VFD screen text that accompanies each operation is reproduced, at the appropriate point in the procedure, in a `Monospaced` type style.

3.3 The *System* Function

The subfunctions of the *System* function are described below. Specific procedures for their use follow the descriptions:

- **Dig_Filt:** Adjust how much digital filtering should be on the signal
- **SELF-TEST:** Performs a self-diagnostic test to check the integrity of the power supplies, outputs, detector signal and preamplifier.
- **PWD:** Login security system for accessing to the setup functions.
- **LOGOUT:** Prevents an unauthorized tampering with analyzer settings.
- **AUTOCAL:** Set the automatic calibrated timer schedule for Zero and Span cycling.
- **HMGNZR:** Turn Ultrasonic homogenizer ON and OFF on the analyze mode.
- **TRACK:** Set the system reading to be held or followed by the concentration "gas or filter" during calibration.
- **CAL-HOLD-TIMER:** Set the timing for calibration holding and timing for the sample reading after return to analyze mode.
- **ALGORITHM:** Linearize the output for nonlinear characteristic.

- **APPLICATION:** Used to define the analysis ranges and application (gas used).
- **MODEL:** Displays model number and software version.
- **OUTPUT_CAL:** 4-20 MA: Adjust 4 and 20 mA output.

The hierarchy of the system menu is shown in figure 3-1.

3.3.1 Setting up an AUTO-CAL

When proper automatic valving is connected, the Analyzer can cycle itself through a sequence of steps that automatically zero and span the instrument.

Note: Before setting up an AUTO-CAL, be sure you understand the *Zero* and *Span* functions as described in section 4.4, and follow the precautions given there.

Note: If you require highly accurate AUTO-CAL timing, use external AUTO-CAL control where possible. The internal clock in the Model 6600 is accurate to 2-3 %. Accordingly, internally scheduled calibrations can vary 2-3 % per day.

To setup an Auto–Cal cycle:

Choose *System* from the main manu. The VFD will display five subfunctions.

```
DIG_FILT   SELF–TEST
PWD   LOGOUT   MORE
```

Select MORE and Enter

```
AUTOCAL   HMGNZR   HOLD
CAL-HOLD-TIMER     MORE
```

Use **UP/DOWN** to blink AUTO–CAL, and *Enter*. A new screen for ZERO/SPAN set appears.

```
ZERO in    Ød  Øh off
SPAN in    Ød  Øh off
```

Use UP/DOWN to blink ZERO (or SPAN), then *Enter* again. *(You won't be able to set OFF to ON if a zero interval is entered.)* A Span Every ... (or Zero Every ...) screen appears.

```
Zero schedule: OFF
Day:   Ød Hour:   Øh
```

Use **UP/DOWN** to set the day interval, hour interval, then Enter

Enter to turn ON the SPAN and/or ZERO cycles (to activate AUTO–CAL). Use the UP/DOWN to toggle the field between ON and OFF. Press Enter to return to The AUTO-CAL menu. You should be able to see that the screen has been updated with your new input. Escape to return to the System menu.

For Oil & Water Samples only setting of the Zero schedule is needed. Instrument will automatically perform a Span at the end of a scheduled Zero.

If instrument is turned off, the next time the instrument is powered, the instrument will automatically perform a calibration cycle after 3 minutes of entering the sample mode if AUTOCAL functions were on prior to shut down.

3.3.2 Password Protection

Before a unique password is assigned, the system assigns TAI by default. This password will be displayed automatically. The operator just uses the Enter switch to be allowed total access to the instrument's features.

If a password is assigned, then setting the following system parameters can be done only after the password is entered: **alarm** setpoints, assigning a new **password, range/application** selections, and **curve algorithm** linearization. (APPLICATION and ALGORITHM are covered in the programming section.) However, the instrument can still be used for analysis or for initiating a self-test without entering the password. To defeat security the password must be changed back to TAI.

NOTE: If you use password security, it is advisable to keep a copy of the password in a separate, safe location.

3.3.2.1 Entering the Password

To install a new password or change a previously installed password, you must key in and *ENTER* the old password first. If the default password is in effect, using *ENTER* three times will enter the default TAI password for you.

Enter the *System* menu...

```
DIG_FILT   AUTO—CAL
PWD   LOGOUT   MORE
```

Use theUP/DOWN to scroll the blinking over to PWD, and *Enter* to select the password function. Either the default TAI password or AAA place holders for an existing password will appear on screen depending on whether or not a password has been previously installed.

```
Enter password:
       T A I
```

or

```
Enter password:
       A A A
```

The screen prompts you to enter the current password. If you are not using password protection, *Enter* three times to accept TAI as the default password. If a password has been previously installed, enter the password using the **UP/DOWN SWITCH** to change the first letter.

Use Enter to move to the next letter. You cannot go back. If a mistake is made, Escape to the System menu and return.

When you finish adjusting the last letter, toggle the Enter switch

In a few seconds, you will be given the opportunity to change this password or keep it and go on.

```
Change Password?
<ENT>=Yes    <ESC>=No
```

Escape to move on, or proceed as in *Changing the Password*, below.

3.3.2.2 Installing or Changing the Password

If you want to install a password, or change an existing password, proceed as above in *Entering the Password*. When you are given the opportunity to change the password:

```
Change Password?
<ENT>=Yes    <ESC>=No
```

nter to change the password (either the default TAI or the previously assigned password), or *Escape* to keep the existing password and move on.

If you chose *Enter* to change the password, the password assignment screen appears.

```
Select new password
       T A I
```

Enter the password using the **UP/DOWN SWITCH** to change the letters to the new password. The full set of 94 characters available for password use are shown in the table below.

Characters Available for Password Definition:

A	B	C	D	E	F	G	H	I	J
K	L	M	N	O	P	Q	R	S	T
U	V	W	X	Y	Z	[	¥	]	^

```
_    `    a    b    c    d    e    f    g    h
i    j    k    l    m    n    o    p    q    r
s    t    u    v    w    x    y    z    {    |
}    →    !    "    #    $    %    &    '    (
)    *    +    '    -    .    /    0    1    2
3    4    5    6    7    8    9    :    ;    <
=    >    ?    @
```

When you have finished typing the new password, press *Enter*. A verification screen appears. The screen will prompt you to retype your password for verification.

```
Enter PWD To Verify:
      A A A
```

Use the UP/DOWN to retype your password and *Enter* at the end of each letter. Your password will be stored in the microprocessor and the system will immediately switch to the *Analyze* screen, and you now have access to all instrument functions.

If all alarms are defeated, the *Analyze* screen appears as:

```
  1.95    ppm SO2
nR1:    Ø — 1Ø Anlz
```

If an alarm is tripped, the second line will change to show which alarm it is:

```
  1.95    ppm SO2
AL—1
```

NOTE: If you log off the system using the LOGOUT function in the system menu, you will now be required to re-enter the password to gain access to Alarm, and Range functions.

3.3.3 Logging Out

The LOGOUT function provides a convenient means of leaving the analyzer in a password protected mode without having to shut the instrument off. By entering LOGOUT, you effectively log off the instrument leaving the system protected against use until the password is reentered. To log out, enter the *System* menu.

```
DIG_FILT   SELF-TEST
PWD   LOGOUT   MORE
```

Use the UP/DOWN to position the blinking over the LOGOUT function, and *Enter* to Log out. The screen will display the message:

```
Protected until
password entered
```

After two seconds it will return to the System menu.

3.3.4 System Self-Diagnostic Test

The Model 6600 has a built-in self-diagnostic testing routine. Pre-programmed signals are sent through the power supply, output board, preamp board and sensor circuit. The return signal is analyzed, and at the end of the test the status of each function is displayed on the screen, either as OK or as a number between 1 and 1024. (See *System Self Diagnostic Test* in chapter 5 for number code.)

Note: The sensor will always show failed unless Zero fluid is present in the sampling cell at the time of the SELF-TEST input thru the sample inlet.

The self diagnostics are run automatically by the analyzer whenever the instrument is turned on, but the test can also be run by the operator at will. If any of the functions fails, the System Alarm is tripped, but is not tripped at the startup because it might give false alarm after a power failure. To initiate a self diagnostic test during operation enter the System menu.

```
DIG_FILT  SELF-TEST
PWD  LOGOUT  MORE
```

Use the UP/DOWN again to move the blinking to the SELF–TEST and *Enter*. The screen will follow the running of the diagnostic.

```
 RUNNING DIAGNOSTIC
Testing Preamp – Cell
```

When the testing is complete, the results are displayed.

```
Power: OK  Analog: OK
Cell:    2  Preamp: 3
```

The module is functioning properly if it is followed by OK. A number indicates a problem in a specific area of the instrument. Refer to Chapter *5 Maintenance and Troubleshooting* for number-code information. The results screen alternates for a time with:

```
Press Any Key
To Continue...
```

Then the analyzer returns to the initial System screen.

3.3.5 The Model Screen

Enter the System menu, select more and Enter. The second screen appears. Select more again and Enter. In the third screen select MODEL. With MODEL blinking, *Enter*. The screen displays the manufacturer, model, and software version information. Escape to return to the System menu.

3.3.6 Checking Linearity with ALGORITHM

From the *System* Function screen, select ALGORITHM, and *Enter*.

```
sel rng to set algo:
–> Ø1  Ø2  Ø3    <–
```

Use the UP/DOWN switch to select the range: 01, 02, or 03. Then *Enter*. (Some ranges may not be available, depending on your application, but at least range 01 should be).

```
Gas Use:   SO2
Range:   Ø  – 10%
```

Enter again.

```
Algorithm setup:
  VERIFY   SET UP
```

Select and *Enter* VERIFY to check whether the linearization has been accomplished satisfactorily.

```
Dpt  INPUT    OUTPUT
 Ø   Ø.ØØ     Ø.ØØ
```

The leftmost digit (under Dpt) is the number of the data point being monitored. Use the UP/DOWN switch to select the successive points.

The INPUT value is the input to the linearizer. It is the simulated output of the analyzer. **You do not need to actually flow gas**.

The OUTPUT value is the output of the linearizer. It should be the ACTUAL concentration of the span gas being simulated.

If the OUTPUT value shown is not correct, the linearization must be corrected. Press *ESCAPE* to return to the previous screen. Select and Enter SET UP to Calibration Mode screen. (set-up will not work without a PC being connected to the analyzer)

```
Select algorithm
  mode :  AUTO
```

There are two ways to linearize: AUTO and MANUAL: The auto mode requires as many calibration gases as there will be correction points along the curve. The user decides on the number of points, based on the precision required.

The manual mode only requires entering the values for each correction point into the microprocessor via the front panel buttons. Again, the number of points required is determined by the user.

NOTE: If input and output are set to 0.00 for all data points, it might be that your application is linear.

3.3.7 Digital Filter Setup

The 6600 has the option of decreasing or increasing the amount filtering on the signal. This feature enhances the basic filtering done by the analog circuits by setting the amount of digital filtering effected by the microprocessing. To access the digital filter setup, you must:

1. Enter the System menu

```
DIG_FILT    SELF-TEST
PWD LOGOUT    MORE
```

2. DIG_FILT will flash, ENTER,

```
Weight of digital
Filter:     9
```

3. The number on the second row will flash and can be set by using the Up/Down switch
4. Press Escape to return to the System menu.

The settings go from zero, no digital filtering, to 10, maximum digital filtering. The default setting is 8 and that should suffice for most applications. In some applications where speeding the response time with some trade off in noise is of value, the operator could decrease the number of the digital filter. In applications where the signal is noisy, the operator could switch to a higher number; the response time is slowed down though.

90% response time on the different settings to a step input is shown below. This response time does not include the contributions of the bench sampling system and the preamplifier near the detector.

Setting	90% Response time (seconds)
0	4.5

1	4.5
2	5.0
3	5.0
4	5.5
5	7.0
6	9.0
7	14.0
8	25.0
9	46.0
10	90.0

At a setting of "zero", the response time is purely set by the electronics to 4.5 seconds. The numbers above can and will change depending on application and they merely serve to illustrate the effect of the digital filter.

3.3.8 Homogenizer Function Setup

Depending on the application, the 6020 sampling system may have an Ultra Sonic Homogenizer. The function of this part is to prevent the oil in the water from clumping together. The homogenizer should turn on after the initial warm up and self-diagnostic period when the analyzer enters the Analyze mode. The homogenizer will turn off automatically as soon as the analyzer enters the Zero and Span mode, turning back on at the end.

Under some conditions, it might be desirable to manually turn the Ultra Sonic Homogenizer off. The homogenizer set up function is provided in the System menu. To access the Homogenizer function setup:

1. Enter the System menu.
2. Select MORE in the first System menu using the UP/DOWN switch.
3. Select HMGNZR in the second System menu, the screen will display

```
Set Ultra Sonic
Homogenizer:     ON
```

4. By using the UP/DOWN switch the homogenizer can be toggled on and off.
5. Enter or Escape to return to the analyze mode.

Every time the power is cycled, the homogenizer defaults to ON. So if homogenizer was off and the power is cycled, the homogenizer will turn on.

Warning: Do not operate the "ultrasonic homogenizer" in the instrument for more than one (1) minute without a liquid sample properly flowing through the homogenizer.

3.3.9 Hold/Track Setup

The 6600 has ability to disable the analog outputs and freeze the display while undergoing a scheduled or remote calibration. **The 6600 will track changes in the concentration if calibration is started through the front panel.** To setup this feature, the operator must:

1. Enter the System menu:

```
DIG_FILT   SELF-TEST
PWD LOGOUT    MORE
```

2. Using the UP/DOWN switch, select MORE and Enter. The Second System screen appears:

```
AUTOCAL HMGNZR TRACK
CAL-HOLDER-TIMER   MORE
```

or

```
AUTOCAL HMGNZR HOLD
CAL-HOLD-TIMER   MORE
```

3. The option on the right of the first row can be set to TRACK or HOLD by toggling Enter switch. By selecting the TRACK option, the analog outputs are enabled and with the display will track the concentration changes while the instrument is undergoing scheduled or remote calibration (either zero or span). By selecting the HOLD option, the analog outputs and display are disabled and will not track the concentration changes while the instrument is undergoing scheduled or remote calibration (either zero or span). In the HOLD option, the analog outputs and display will freeze on the last reading before entering calibration.

The analog outputs are both 0 to 1 volt outputs and both 4 to 20 mA outputs.

3.3.10 Calibration/Hold Timer Setup

This Calibration Timer lets the operator adjust the time the instrument purges the calibration gas prior to actually starting the calibration computations. The Sample timer lets the operator adjust the time the instrument purges sample gas after finishing a calibration before it lets the analog outputs and display track the change in concentration.

This function and the TRACK/HOLD feature will prevent false alarms while performing remote or autoscheduled calibrations. These functions are not applicable if the calibration is initiated through the front panel. To enter the Calibration/Hold Timer function, you must:

1. Enter the System menu:

```
DIG_FILT   SELF-TEST
PWD  LOGOUT    MORE
```

2. Using theUP/DOWN switch, select MORE and press Enter: The Second System screen appears:

```
AUTOCAL  HMGNZR  TRACK
CAL-HOLD-TIMER   MORE
```

or

```
AUTOCAL  HMGNZR  HOLD
CAL-HOLD-TIMER   MORE
```

3. Select with the UP/DOWN switch CAL-HOLD-TIMER, and press the Enter key to access this function menu:

```
Calbrt  hold:   3 min
Sample  hold:   1 min
```

The calibration hold time is set on the first row, while the sample hold time is set on the second row. To select one or the other, use the Right or Left keys. To modify the time of either timer, use the Up or Down keys. The time is in the minutes.

3.3.11 Analog 4-20mA Output Calibartion

This function will let the operator calibrate the 4 to 20 mA analog output to match the display reading. A DMM configure as a DC ammeter is needed. The DMM should be connected across the output terminals of the 4 to 20 mA output to monitor the output current. To enter the 4 to 20 mA output adjust function, you must:

1. Enter the System menu:

```
DIG_FILT   SELF-TEST
PWD  LOGOUT   MORE
```

2. Using the Right or Left arrow keys, select MORE and press Enter. The second System screen appears:

```
AUTOCAL  HMGNZR  TRACK
CAL-HOLD-TIMER   MORE
```

or

```
AUTOCAL  HMGNZR  HOLD
CAL-HOLD-TIMER   MORE
```

3. Using the Right or the Left arrow keys, select MORE and press Enter. The third System screen appears:

```
ALGORITHM  APPLICATION
MODEL  OUT_CAL    ANLZ
```

4. Select OUTPUT_CAL and Enter

```
Use  UP/DOWN  arrow  to
Adjust  4  ma:          250
```

The number on the second row is the setpoint of the 4 mA output. It is analogous to a potentiometer wiper. The number can be set anywhere from 0 to 500. The default is 250, in the middle. At the default setting, the output should be very close to 4 mA. If not, slowly adjust the number using the Up or the Down keys until DMM reads 4.00 mA. Enter when done.

5. A screen similar to the one above will appear and the DMM should read close to 20 mA. If not, slowly adjust the number using the Up or Down key until DMM reads 20.0 mA. Enter when done to return to system menu.

The range of adjustment is approximately +/- 10% of scale (+/- 1.6 ma). Since the 4 to 20 mA output is tied to the 0 to 1 volt output, this function can be used to calibrate the 0 to 1 volt output, if the 4 to 20 mA output is not used. By using a digital Volt meter on the 0-1 Volt output.

3.3.12 Manual control of filter and solenoids

For troubleshooting purposes, you have manual access to control calibration filter and solenoid on the Analyze mode. To have manual access to the calibration filter and solenoid:

-Enter the System Menu

-Select MORE on the first and second System menu screens.

-In the last System Menu screen you will see:

ALGORITHM APPLCATION

MODEL OUT_CAL ANLZ

-Select the last field "ANLZ" using the Up/Down switch.

-Press Enter to change the mode of the filter and the solenoid. The sequence is as follows:

1. **ZERO:** Sets the Filter and solenoid in the zero mode (span filter off, zero solenoid on).
2. **SPN1:** Sets the Filter and solenoid in the span mode (span filter on, zero solenoid on).
3. **SPN2:** Sets second span filter on (usually not installed) and zero solenoid on
4. **SPNB:** Sets both span filter on (usually only one filter installed) and zero solenoid on.
5. **ANLZ:** Returns Filters and solenoid to the Analyze mode (span filter off, zero solenoid off).

-Press Escape to see the effect

NOTE: FOR PROPER OPERATION OF THE ANALYZER RETURN TO ANLZ MODE.

3.4 The *Zero* and *Span* Functions

The Model 6600 can have as many as three analysis ranges plus a special calibration range (Cal Range). Calibrating any one of the ranges will automatically calibrate the other ranges.

CAUTION: Always allow one hour warm-up time before calibrating, if your analyzer has been disconnected from its power source. This does not apply if the analyzer was plugged in but was in STANDBY.

The analyzer is calibrated using zero, and span gases.

Note: Shut off the gas pressure before connecting it to the analyzer, and be sure to limit pressure to 40 psig or less when turning it back on.

Readjust the gas pressure into the analyzer until the flowrate through the Sample Cell settles between 50 to 500 cc/min (approximately 0.1 to 0.4 SCFH).

Note: Always keep the calibration gas flow as close to the flowrate of the sample gas as possible

3.4.1 Zero Cal

The *Zero* function on the main menu is used to enter the zero calibration function. Zero calibration can be performed in either the automatic or manual mode.

Make sure the zero fluid is flowing to the instrument. If you get a CELL CANNOT BE BALANCED message while zeroing skip to section 3.4.1.3.

3.4.1.1 Auto Mode Zeroing

Observe the precautions in sections 3.4 and 3.4.1, above. Enter the zero function mode. The screen allows you to select whether the zero calibration is to be performed automatically or manually. Use the UP/DOWN switch to toggle between AUTO and MAN zero settling. Stop when AUTO appears, blinking, on the display.

```
Select zero
mode: AUTO
```

Enter to begin zeroing.

```
####.## ppm OIL
Slope=#.###   C—Zero
```

The beginning zero level is shown in the upper left corner of the display. As the zero reading settles, the screen displays and updates information on Slope= in percent/second (unless the Slope starts within the acceptable zero range and does not need to settle further). The system first does a coarse zero, shown in the lower right corner of the screen as C—Zero, for 3 min, and then does a fine zero, and displays F—Zero, for 3 min.

Then, and whenever Slope is less than 0.01 for at least 12 sec, instead of Slope you will see a countdown: 9 Left, 8 Left, and so fourth. These are

software steps in the zeroing process that the system must complete, AFTER settling, before it can go back to *Analyze*. Software zero is indicated by S–Zero in the lower right corner.

NOTE: In a Oil/Water sampling system, when performing a scheduled zero, instrument will go to span mode automatically (when span flag option has been purchased).

```
####.##  ppm    OIL
4 Left=#.###  S–Zero
```

The zeroing process will automatically conclude when the output is within the acceptable range for a good zero. Then the analyzer automatically returns to the *Analyze* mode.

3.4.1.2 Manual Mode Zeroing

Enter the *Zero* function. The screen that appears allows you to select between automatic or manual zero calibration. Use the UP/DOWN switch between AUTO and MAN zero settling. Stop when MANUAL appears, blinking, on the display.

```
Select zero
mode: MANUAL
```

Enter to begin the zero calibration. After a few seconds the first of three zeroing screens appears. The number in the upper left hand corner is the first-stage zero offset. The microprocessor samples the output at a predetermined rate.

```
####.##     ppm  OIL
Zero adj:2048 C–Zero
```

The analyzer goes through C–Zero, F–Zero, and S–Zero. During C–Zero and F–Zero, use the **UP/DOWN SWITCH** to adjust displayed Zero adj: value as close as possible to zero. Then,*Enter*.

S–Zero starts. During S–Zero, the Microcontroller takes control as in *Auto Mode Zeroing*, above. It calculates the differences between successive samplings and displays the rate of change as Slope= a value in parts per million per second (ppm/s).

```
####.##   ppm   OIL
Slope=#.###   S–Zero
```

Once zero settling completes, the information is stored in the analyzer's memory, and the instrument automatically returns to the *Analyze* mode.

3.4.1.3 Detector Failure

Detector failure in the 6600 is usually associated with inability to zero the instrument with a reasonable voltage differential between the reference and measure voltages. If this should ever happen, the 6600 system alarm trips, and the LCD displays a failure message.

```
Detector cannot be balanced
Check your zero fluid
```

Before optical balancing:

a. Check your zero fluid to make sure it is within specifications.
b. Check for leaks downstream from the Sample Cell, where contamination may be leaking into the system.
c. Check flowmeter to ensure that the flow is no more than 200 SCCM for liquids and 1000CCM for gases.
d. Check temperature controller board.
e. Check sample temperature.
f. Check the Sample Cell for dirty windows.
g. Perform a Zero calibration in the manual mode.
h. Check for air bubbles in liquid applications.

If none of the above, proceed to perform an optical balance as described in chapter 3, part II.

3.4.1.4 Zero Offset Calibration

To access this function, the instrument zero mode must be entered by pushing the Zero key on the front panel of the control unit. The VFD display will show the following menu selection:

```
Select zero
mode: AUTO
```

or

```
Select zero
mode: MAN
```

Select whether you want the instrument to do an automatic or manual zero. If you do an automatic zero, the instrument does the zero by itself. If you do a manual zero you must manually enter inputs to the instrument to accomplish the zero, see in the corresponding section of the manual on how this two functions differ.
When the Enter key is pressed, the following menu will appear:

Zero off: 0.0 ppm
<ENT> to begin Zero

The offset value can be modified by using the Up/Down keys. Next section shows how to select this value. Suffice to say that whatever value you enter, will be automatically ***added*** to the reading. Thus, if you entered -0.1 ppm, at the end of the zero the display will show -0.1 ppm.

Once the Enter key is pressed the instrument enters the zero mode. If you chose AUTO zero mode, the instrument will do the work of bringing the reading back to zero ***plus*** the offset value that was entered. If you chose MANual zero mode, then you must enter input to the instrument as explained in the corresponding section of the manual but with one difference: instead of bringing the display to read zero, you must make the display read zero ***plus*** the value entered as offset.

How the offset value is selected:
To find out what the offset value should be, the intended zero calibration gas and the a mix of the process background gas must be procured. This of course assumes that the zero gas and the process background gas are very different and that an offset will occur.
1. Let the intended zero calibration gas flow through the 6600 sample cell (this assumes that you have started up you system as recommended by the manual or technical personnel) and do a zero on the instrument. Leave the offset set to zero value.
2. At the end of the zero function, make sure the analyser reads zero.
3. Flow the process background gas mix through the 6000 sample cell on the Analyse mode. Wait for the reading to become stable. Write the reading down. Change the sign of the reading: This is the offset to be entered.
4. Do a manual run to check. Reintroduce the zero calibration gas. Start a zero on the analyser but this time enter the offset value.
5. At the end of the zero function, check that the instrument reads the entered offset.
6. Reintroduce the process background gas mix to the 6000 sample cell in the Analyse mode. It should read close to zero once the reading is stable (+/- 1% error of full scale).

Spanning the 6600:
Since the instrument might be spanned with background gas the same as the zero calibration gas, the span value to be entered should be the span concentration plus the offset value (if the offset value has a minus sign then algebraically it becomes a subtraction).

3.4.2 Span Cal

The *Span* function on the main menu is used to span calibrate the analyzer. Span calibration can be performed in either the automatic or manual mode.

Make sure the span fluid is flowing to the instrument.

3.4.2.1 Auto Mode Spanning

Observe all precautions in sections 3.4 and 3.4.2, above. Enter the span function. The screen that appears allows you to select whether the span calibration is to be performed automatically or manually. Use the **UP/DOWN SWITCH** to toggle between AUTO and MAN span settling. Stop when AUTO appears, blinking, on the display.

```
Select span
mode: AUTO
```

Enter to move to the next screen.

```
Span Val:   20.00 %
<ENT> twice  to  start
```

The unit field should be blinking first (%/ppm). Use the UP/DOWN switch to set the proper unit of the span fluid and enter. Then, use the UP/DOWN switch to set the concentration. When you have set the concentration of the span fluid you are using, *Enter* to begin the Span calibration.

```
  ####.## ppm        OIL
Slope=#.###     Span
```

The beginning span value is shown in the upper left corner of the display. As the span reading settles, the screen displays and updates information on Slope. Spanning automatically ends when the span output corresponds, within tolerance, to the value of the span gas concentration. Then the instrument automatically returns to the analyze mode.

3.4.2.2 Manual Mode Spanning

Enter the *Span* function. The screen that appears allows you to select whether the span calibration is to be performed automatically or manually.

```
Select span
mode: MANUAL
```

Use the UP/DOWN switch to toggle between AUTO and MAN span settling. Stop when MAN appears, blinking, on the display. *Enter* to move to the next screen.

```
Span Val:  100 ppm
<ENT> To begin span
```

The unit field should be blinking first (%/ppm). Use the UP/DOWN switch to set the proper unit of the span fluid and enter. Then, use the UP/DOWN switch to set the concentration.

When you have set the concentration of the span fluid you are using, *Enter* to begin the Span calibration.

Once the span has begun, the microprocessor samples the output at a predetermined rate. It calculates the difference between successive samplings and displays this difference as Slope on the screen. It takes several seconds for the first Slope value to display. Slope indicates rate of change of the Span reading. It is a sensitive indicator of stability.

```
####.## ppm        OIL
Slope=#.###      Span
```

When the Span value displayed on the screen is sufficiently stable, *Enter*. (Generally, when the Span reading changes by 1 % or less of the range being calibrated for a period of 30 seconds it is sufficiently stable.) Once the span ends, the calibration is stored in memory. The instrument then **automatically** enters the *Analyze* function.

3.5 The *Alarms* Function

The Model 6600 is equipped with 2 fully adjustable set points concentration with two alarms and a system failure alarm relay. Each alarm relay has a set of form “C" contacts rated for 3 amperes resistive load at 250 V ac. See Figure in Chapter 2, *Installation* and/or the Interconnection Diagram included at the back of this manual for relay terminal connections.

The system failure alarm has a fixed configuration described in chapter 2 *Installation*.

The concentration alarms can be configured from the front panel as either *high* or *low* alarms by the operator. The alarm modes can be set as *latching* or *non-latching*, and either *failsafe* or *non-failsafe*, or, they can be *defeated* altogether. The setpoints for the alarms are also established using this function.

Decide how your alarms should be configured. The choice will depend upon your process. Consider the following four points:

1. Which if any of the alarms are to be high alarms and which if any are to be low alarms?

   Setting an alarm as HIGH triggers the alarm when the contaminant concentration rises above the setpoint. Setting an alarm as LOW triggers the alarm when the contaminant concentration falls below the setpoint.

   Decide whether you want the alarms to be set as:

   - Both high (high and high-high) alarms, or
   - One high and one low alarm, or
   - Both low (low and low-low) alarms.

2. Are either or both of the alarms to be configured as failsafe?

   In failsafe mode, the alarm relay de-energizes in an alarm condition. For non-failsafe operation, the relay is energized in an alarm condition. You can set either or both of the concentration alarms to operate in failsafe or non-failsafe mode.

3. Are either of the alarms to be latching?

   In latching mode, once the alarm or alarms trigger, they will remain in the alarm mode even if process conditions revert back to non-alarm conditions. This mode requires an alarm to be recognized before it can be reset. In the non-latching mode, the alarm status will terminate when process conditions revert to non-alarm conditions.

4. Are either of the alarms to be defeated?

   The defeat alarm mode is incorporated into the alarm circuit so that maintenance can be performed under conditions which would normally activate the alarms.

   The defeat function can also be used to reset a latched alarm. (See procedures, below.)

If you are using password protection, you will need to enter your password to access the alarm functions. Follow the instructions in section 3.3.3 to enter your password. Once you have clearance to proceed, enter the *Alarm* function.

Select the *Alarm* function on the main menu to enter the *Alarm* function. Use UP/DOWN to select either AL1 or AL2. If you must change the %/ppm units, keep using UP/DOWN until you get to the units to be modified. Use Enter to toggle between % and ppm.

Use the **UP/DOWN** to choose the alarm again. Then *Enter* to move to the next screen.

```
AL1: 1000   ppm  HI
Dft:N  Fs:N  Ltch:N
```

Five parameters can be changed on this screen:

- Value of the alarm setpoint, AL1: ####
- Out-of-range direction, HI or LO
- Defeated? Dft:**Y/N** (Yes/No)
- Failsafe? Fs:**Y/N** (Yes/No)
- Latching? Ltch:**Y/N** (Yes/No).

- To define the setpoint use the UP/DOWN switch to change the number. Holding down the key speeds up the incrementing or decrementing. Enter when done, blinking cursor moves to the next field.
- To set the other parameters use the **UP/DOWN key, and then Enter to move to the next field.**.
- Once the parameters for alarm 1 have been set, Enter the *Alarms function* again, and repeat this procedure for alarm 2 (AL2).
- To reset a latched alarm, go to Dft– and then toggle either Up or DOWN two times. (Toggle it to **Y** and then back to **N.**)

  –OR –

  Go to Ltch– and then toggle either UP two times or DOWN two times. (Toggle it to **N** and back to **Y.**)

3.6 The *Range* Select Function

The *Range* function allows you to manually select the concentration range of analysis (MANUAL), or to select automatic range switching (AUTO).

In the MANUAL screen, you are further allowed to define the high and low (concentration) limits of each Range, and select a single, fixed range to run.

CAUTION: If this is a linearized application, the new range must be within the limits previously programmed using the System function, if linearization is to apply throughout the range. Furthermore, if the limits are too small a part (approx 10 % or less) of the originally linearized range, the linearization will be compromised.

3.6.1 Manual (Select/Define Range) Screen

The Manual range-switching mode allows you to select a single, fixed analysis range. It then allows you to redefine the upper and lower limits, for the range.

Enter the *Range* function to start the Range function.

```
Select range
mode: MANUAL
```

If above screen displays, use the UP/DOWN switch to Select MANUAL, and *Enter.*

```
Select range to run
–> Ø1  Ø2  Ø3 <–
```

NOTE: Oil in Water applications require single range (01) measurement.

Use the UP/DOWN switch to select the range: 01, 02, 03, or 04. Then *Enter*.

```
Gas use:   OIL
Range:   Ø –  100 ppm
```

The high-end of the range field should blink first. Use UP/DOWN switch to change the value of the field, Enter to move to the low-end of the range field.

Escape to return to the previous screen to select or define another range.

Enter to return the to the *Analyze* function.

3.6.2 Auto Screen

Autoranging will automatically set to the application that has at least two ranges setup with the same gases.

In the autoranging mode, the microprocessor automatically responds to concentration changes by switching ranges for optimum readout sensitivity. If the upper limit of the operating range is reached, the instrument automatically shifts to the next higher range. If the concentration falls to below 85% of full scale of the next lower range, the instrument switches to the lower range. A corresponding shift in the DC concentration output, and in the range ID outputs, will be noticed.

The autoranging feature can be overridden so that analog output stays on a fixed range regardless of the contaminant concentration detected. If the conce-

tration exceeds the upper limit of the range, the DC output will saturate at 1 V dc (20 mA at the current output).

However, the digital readout and the RS-232 output of the concentration are unaffected by the fixed range. They continue to read beyond the full-scale setting until amplifier saturation is reached. Below amplifier saturation, the overrange readings are accurate UNLESS the application uses linearization over the selected range.

The concentration ranges can be redefined using the *Range* function Manual screen, and the application gases can be redefined using the *System* function, **if** they are not already defined as necessary.

CAUTION: Redefining applications or ranges might require relinearization and/or recalibration.

To setup automatic ranging:

Enter the *Range* function to start the Range function.

```
Select range
mode : AUTO
```

If above screen displays MAN, use the UP/DOWN switch to Select AUTO, and *Enter.*

Press *Escape* to return to the previous Analyze Function.

3.6.3 Precautions

The Model 6600 allows a great deal of flexibility in choosing ranges for automatic range switching. However, there are some pitfalls that are to be avoided.

Ranges that work well together are:

- Ranges that have the same lower limits but upper limits that differ by approximately an order of magnitude
- Ranges whose upper limits coincide with the lower limits of the next higher range
- Ranges where there is a gap between the upper limit of the range and the lower limit of the next higher range.

Range schemes that are to be avoided include:

- Ranges that overlap

- Ranges whose limits are entirely within the span of an adjoining range.
- Ranges where the zero is suppressed, is 1-10, 1-100, etc, however, 80-100, 90-100 is ok where the zero gas is actually 100% concentration and the calibration is inverted.
- In Oil and Water applications, because the range and cell path are pertinent to the water background and preparation of zero fluid by the sample system, the autorange feature should not be used. Only single range is recommended.

Figure 3-2 illustrates these schemes graphically.

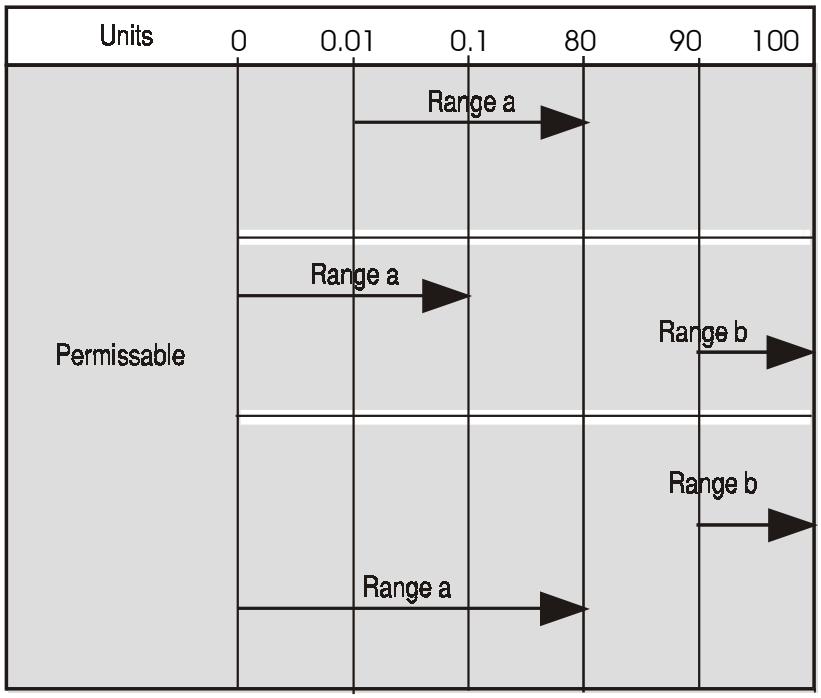


Figure 3-2: Examples of Autoranging Schemes

3.7 The *Analyze* Function

Normally, all of the functions automatically switch back to the *Analyze* function when they have completed their assigned operations. The *Escape* key in many cases also switches the analyzer back to the *Analyze* function.

The *Analyze* function screen shows the impurity concentration in the first line, and the range in the second line. In the lower right corner, the abbreviation

Anlz indicates that the analyzer is in the *Analyze* mode. If there is an * before the Anlz, it indicates that the range is linearized.

```
1.95  ppm     SO2
R1:Ø –10  *Anlz
```

If the concentration detected is overrange, the first line of the display blinks continuously.

3.8 Programming

CAUTION: The programming functions of the Set Range and Curve Algorithm screens are configured at the factory to the users application specification. These functions should only be reprogrammed by trained, qualified personnel.

To program, you must:

1. Enter the password, if you are using the analyzer's password protection capability.
2. Connect a computer or computer terminal capable of sending an RS-232 signal to the analyzer RS-232 connector. (See chapter 2 *Installation* for details). Send the **rp** command to the analyzer.
3. Enter the *System* menu.

```
DIG_FILT   SELF-TEST
PWD   LOGOUT   MORE
```

Use the UP/DOWN switch to blink MORE, then *Enter*.

```
AUTOCAL   HMGNZR   HOLD
CAL-HOLD-TIMER     MORE
```

Select MORE and ENTER one more time

```
ALGORITHM          APPLICATION
MODEL  OUTPUT:     4MA
```

Now you will be able to select the APPLICATION and ALGORITHM set-up functions.

3.8.1 The Set Range Screen

The Set Range screen allows reprogramming of the three analysis ranges and the calibration range (background gas, low end of range, high end of range, and % or ppm units). Original programming is usually done at the factory according to the customer's application.

Note: It is important to distinguish between this *System* programming subfunction and the *Range* button function, which is an operator control. The Set Range Screen of the *System* function allows the user to DEFINE the upper and lower limits of a range AND the application of the range. The *Range* function only allows the user to select or define the limits, or to select the application, but not to define the application.

Normally the Model 6600 is factory set to default to manual range selection, unless it is ordered as a single-application multiple-range unit (in which case it defaults to autoranging). In either case, autoranging or manual range selection can be programmed by the user.

In the autoranging mode, the microprocessor automatically responds to concentration changes by switching ranges for optimum readout sensitivity. If the upper limit of the operating range is reached, the instrument automatically shifts to the next higher range. If the concentration falls to below 85% of full scale of the next lower range, the instrument switches to the lower range. A corresponding shift in the DC concentration output, and in the range ID outputs, will be noticed.

The autoranging feature can be overridden so that analog output stays on a fixed range regardless of the contaminant concentration detected. If the concentration exceeds the upper limit of the range, the DC output will saturate at 1 V dc (20 mA at the current output).

However, the digital readout and the RS-232 output of the concentration are unaffected by the fixed range. They continue to read beyond the full-scale setting until amplifier saturation is reached. Below amplifier saturation, the overrange readings are accurate UNLESS the application uses linearization over the selected range.

To program the ranges, you must first perform the four steps indicated at the beginning of section 3.8 *Programming*. You will then be in the second *System* menu screen.

```
ALGORITHM    APPLICATION
MODEL         OUTPUT: 4MA
```

Use the UP/DOWN switch again to move the blinking to APPLICATION and *Enter*.

```
Sel rng to set appl:
  –> Ø1 Ø2 Ø3 <–
```

Use the UP/DOWN switch to increment/decrement the range number to 01, 02, 03, or CAL, and *Enter*.

```
Gas Name     **********
FR:Ø   TO:1Ø  %
```

Use the UP/DOWN switch to increment the respective parameters as desired, and *Enter* to move to the next. On the last field %/ppm Enter to accept the values and return to range selection menu. (See note below.) Repeat for each range you want to set.

Note: The ranges must be increasing from low to high, for example, if Range 1 is set to 0–10 % and Range 2 is set to 0–100 %, then Range 3 cannot be set to 0–50 % since that makes Range 3 lower than Range 2.

Ranges, alarms, and spans are always set in either percent or ppm units, as selected by the operator, even though all concentration-data outputs change from ppm to percent when the concentration is above 9999 ppm.

Note: When performing analysis on a fixed range, if the concentration rises above the upper limit as established by the operator for that particular range, the output saturates at 1 V dc (or 20 mA). However, the digital readout and the RS-232 output continue to read regardless of the analog output range.

To end the session, send:

st<enter>
st<enter>

to the analyzer from the computer.

3.8.2 The Curve Algorithm Screen

The Curve Algorithm is a linearization method. It provides from 1 to 9 intermediate points between the ZERO and SPAN values, which can be normalized during calibration, to ensure a straight-line input/output transfer function through the analyzer.

Each range is linearized individually, as necessary, since each range will usually have a totally different linearization requirement.

To linearize the ranges, you must first perform the four steps indicated at the beginning of section 3.8 *Programming*. You will then be in the second *System* menu screen.

3.8.2.1 Manual Mode Linearization

To linearize manually, you must have previous knowledge of the nonlinear characteristics of your gases. You enter the value of the differential between the actual concentration and the apparent concentration (analyzer output). TAI has tabular data of this type for a large number of gases, which it makes available to customers on request. See Appendix for ordering information. To enter data:

From the *System* Functions Screen—

1. Select ALGORITHM , and *Enter*.
2. Select and *Enter* SETUP.
3. *Enter* MANUAL from the Calibration Mode Select screen.

```
Dpt   INPUT     OUTPUT
 Ø    Ø.ØØ      Ø.ØØ
```

The data entry screen resembles the verify screen, but the gas values can be modified and the data-point number cannot. Use the UP/DOWN key to modufy the input field, then Enter to modify the output field, Enter again to move to the next data field.

After each point is entered, the data-point number increments to the next point. Moving from the lowest to the highest concentration.

```
Dpt   INPUT     OUTPUT
 0    Ø.ØØ      Ø.ØØ
```

Repeat the above procedure for each of the data points you are setting (up to nine points: 0-8). Set the points in unit increments. Do not skip numbers. The linearizer will automatically adjust for the number of points entered.

When you are done, *ESCAPE*. The message, Completed. Wait for calculation, appears briefly, and then the main *System* screen returns.

To end the session, send:

st<enter>
st<enter>

to the analyzer from the computer.

3.8.2.2 Auto Mode Linearization

To linearize in the Auto Mode, you must have on hand a separate calibration gas for each of the data points you are going use in your linearization. First,

the analyzer is zeroed and spanned as usual. Then, each special calibration gas, for each of the intermediate calibration points, is flowed, in turn, through the sensor. As each gas flows, the differential value for that intermediate calibration point is entered from the front panel of the analyzer.

Note: The span gas used to span the analyzer must be >90% of the range being analyzed.

Before starting linearization, perform a standard calibration. See section 4.4. To enter data:

From the *System* Functions screen—

1. Select ALGORITHM , and *Enter*.
2. Select and *Enter* SETUP.
3. *Enter* AUTO from the Calibration Mode Select screen.

The Auto Linearize Mode data entry screen appears.

```
19.5 ppm   SO2
Input(Ø)  :20.00
```

5. Use the UP/DOWN switch to set the proper value of calibration gas, and *Enter*. Repeat this step for each cal-point number as it appears in the Input (*x*) parentheses.
6. Repeat step 5 for each of the special calibration gases, from the lowest to the highest concentrations. *Escape* when done.

To end the session, send:

st<enter>
st<enter>

to the analyzer from the computer.

Maintenance

Aside from normal cleaning and checking for leaks at the gas connections, routine maintenance is limited to replacing filter elements and fuses, and recalibration.

WARNING: *SEE WARNINGS ON THE TITLE PAGE OF THIS MANUAL.*

4.1 Fuse Replacement

The 6600 requires two 5 x 20 mm, 4 A, T type (Slow Blow) fuses.

The fuses are located inside the main housing on the Electrical Connector Panel, as shown in Figure 4-2. To replace a fuse:

1. Disconnect the Unit from its power source.
2. Place a small screwdriver in the notch in the fuse holder cap, push in, and rotate 1/4 turn. The cap will pop out a few millimeters. Pull out the fuse cap and fuse, as shown in Figure 4-1

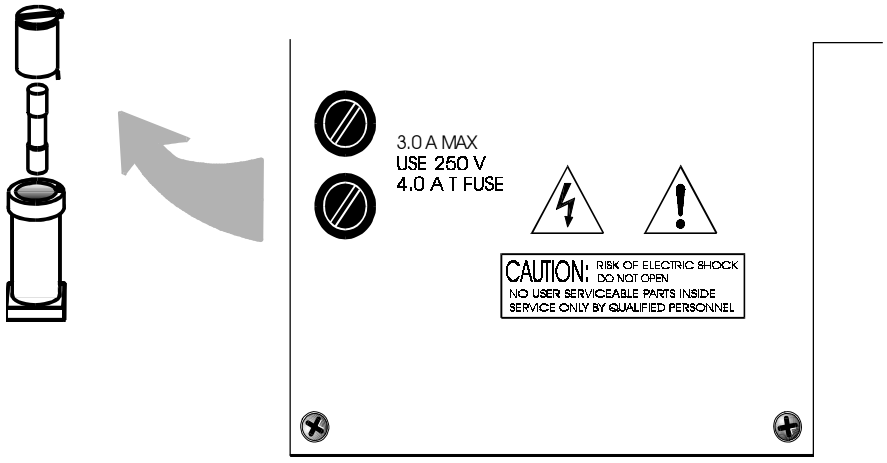


Figure 4-1: Removing Fuse Block Cap and Fuse from Housing

2. Replace fuse by reversing process in step 1.

4.2 System Self Diagnostic Test

1. Press the *System* button to enter the system mode.
2. Use the < > arrow keys to move to More, and press *Enter*.
3. Use the < > arrow keys to move to Self-Test, and press *Enter*.

The following failure codes apply:

Table 5-1: Self Test Failure Codes

Power

0	OK
1	5 V Failure
2	15 V Failures
3	Both Failed

Analog

0	OK
1	DAC A (0–1 V Concentration)
2	DAC B (0–1 V Range ID)
3	Both Failed

Preamp

0	OK
1	Zero too high
2	Amplifier output doesn't match test input
3	Both Failed
>3	Call factory for information

Detector

0	OK
1	Failed (open filament, short to ground, no power.)
2	Unbalance (deterioration of filaments, blocked tube)

4.3 Major Internal Components

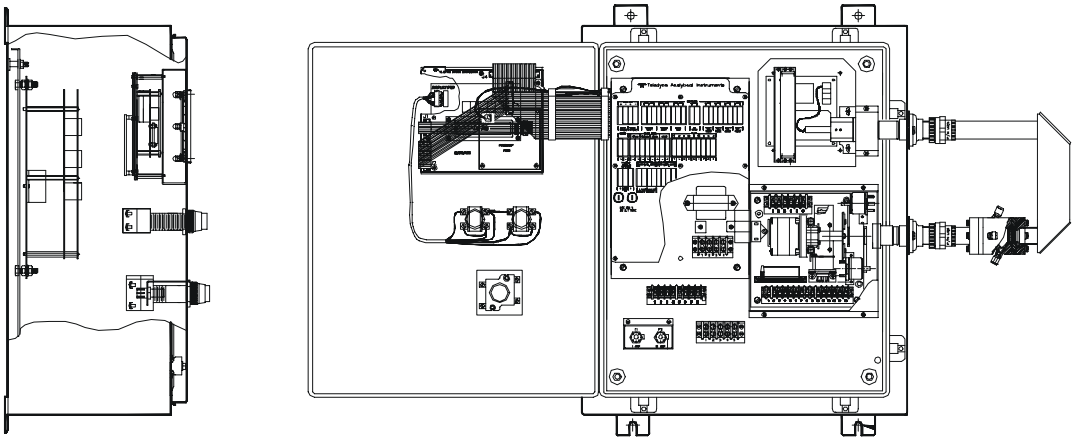
All internal components are accessed by unbolting and swinging open the front cover, as described earlier. The major internal component locations are shown in Figure 4-2, the cell block is illustrated in Figure 3-2, and the fuse receptacle is shown in Figure 3-3

The 6600 contains the following major internal components:

- Customer Interface PCB (Power Supply on bottom surface)
- Preamp PCB (Contains Microprocessor)
- Front Panel PCB (Contains Displays)
  - 5 digit LED meter
  - 2 line, 20 character, alphanumeric, VFD display

See the drawings in the Drawings section in back of this manual for details.

For Optical/Detector Alignments, refer to parts II or III of this manual



Side View **Open Door**

Figure 4-2: Control Section Major Internal Components

To swing open the cover panel, remove all screws.

WARNING: *HAZARDOUS VOLTAGES EXIST ON CERTAIN COMPONENTS INTERNALLY WHICH MAY PERSIST FOR A TIME EVEN AFTER THE POWER IS TURNED OFF AND DISCONNECTED.*

OPERATING INSTRUCTIONS

Model 6600

Oil in Water Analyzer

Part II: Analysis Section of the Control/Analysis Unit

6600C - GP, Rack, Panel (Integral or Remote)
6600Z - GP, Bulkhead (Z-Purged in Div II areas) (Integral or Remote)
6600X - (X-Proof, 1,1,B, C, D) (Integral or Remote)

Table of Contents

Appendix

Operational Theory

1.0 Introduction

The Teledyne Photometric Analyzer uses the ultraviolet (UV) absorption principle to detect and continuously measure a component of interest in a sample stream. The analyzer consists of a single sample cell, chopped beam, folded optics, dual-wavelength UV process photometer and associated microprocessor based control unit and electronics.

1.1 Method of Analysis

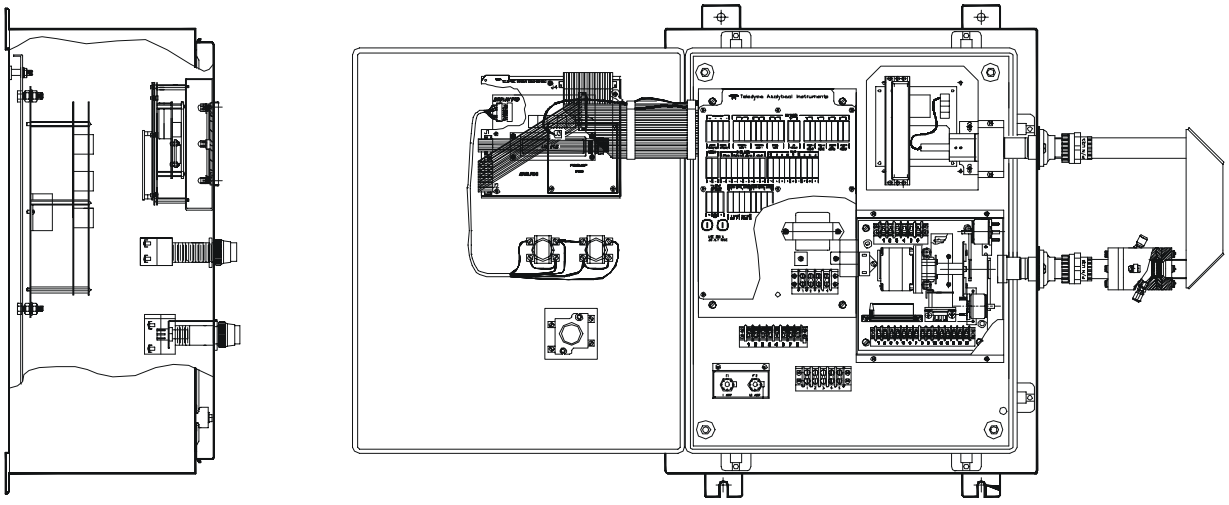
The following description shows the course of optical energy in the analyzer. The optical energy is emitted from a source lamp in the source module, passed through the sample cell, and received by the sensor, which converts the optical energy to pulses of electrical energy. These pulses of electrical energy are processed further in the detector module.

The result is separate pulses that are compared in the control unit to reveal the measurable difference between optical absorption of the sample at a selected wavelength (determined by the measuring optical filter) and a zero-absorption condition (set by the reference optical filter). The magnitude of that difference represents the concentration of the component of interest in the sample.

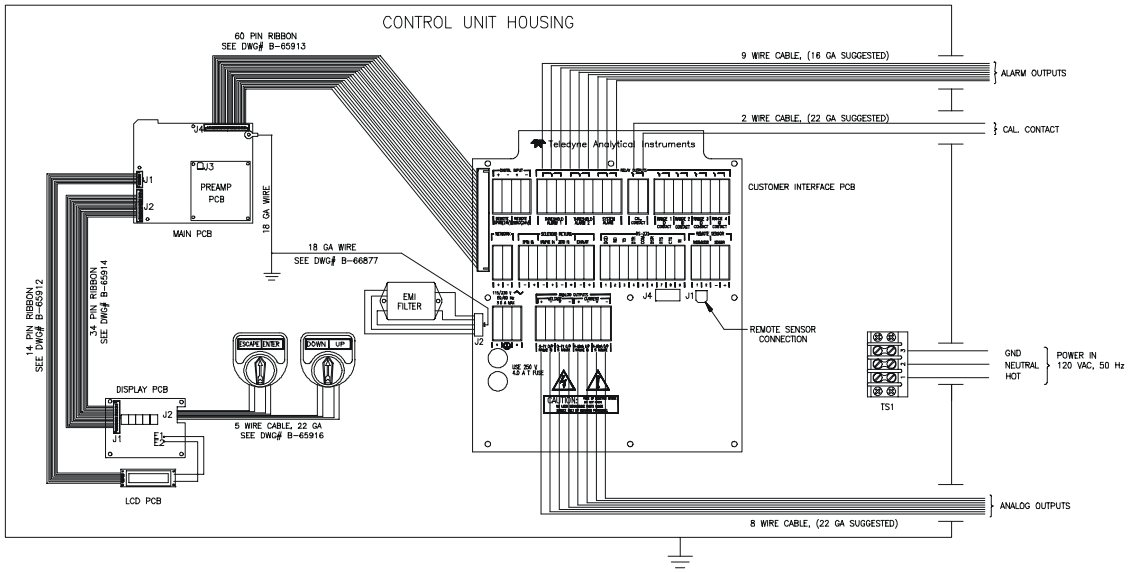
1.2 Optical Bench

Depending on the application, the analyzer comes with one of the following types of lamps: Deuterium (D), Quartz Iodine (L), or Mercury (Hg). Energy from the lamp, used as a source, is focused through a sample cell onto a photo detector. In front of the detector is a motor-driven filter disc containing two optical filters mounted 180 degrees apart that alternately and continuously rotate into and out of the light beam. Sample flows continuously through the sample cell and absorbs optical energy at various wavelengths depending on its composition.

The analyzer monitors two wavelengths: a measuring wavelength selected where the component of interest has a characteristic absorption peak and a reference wavelength that provides stability by compensating for extraneous phenomena such as turbidity, cell window deposits, unequal optical component aging, etc.



Shown with an Integral General Purpose Control and Analysis Unit with external folded optical bench and Sample Cell



Interconnection Diagram

1.3 Photometer Amplifier

The photo detector converts the photo energy striking it to electrical energy. The magnitude of the photo energy pulses that strike the detector is determined by absorbance by the sample and the properties of the optical filters.

The detector output, which is a sequence of pulses that directly reflect the photo energy transmitted by the measuring and reference filter, is a measure of the concentration of the component of interest in the sample. The difference in energy between the measuring and reference pulse is related exponentially to the concentration of the component of interest.

The photo detector current output is amplified by a current to voltage (I to E) converting amplifier, followed by a second amplifier. The gain of the amplifier can be adjusted to obtain any desired output level.

To obtain analyzer options that are linearly related to the concentration of the component of interest, the output of the I to E converting amplifier is fed to the input of a logarithmic amplifier, which produces a signal that represents the logarithm of the output signal of the second amplifier. The output of the logarithmic amplifier is fed to the input of an inverting amplifier, which acts like a buffer between log amplifier and switch and inverts the input signal for further processing.

The output of the inverting amplifier is fed to a magnetically activated SPDT reed switch, synchronized in such a way that all measuring pulses are collected on one switch contact and all reference pulses on the other.

The pulses pass through diodes that isolate the integrating networks from each other. The integrators convert the reference and measuring pulse energy to a DC level representing them. These reference and measuring DC levels are applied to the subtracting amplifier in the Control Unit. The output of the subtractor is a DC voltage linearly related to the concentration of the component of interest.

From the subtractor, the signal progresses to the analog to digital converter on the motherboard of the Control Unit.

The microcontroller reads the A to D converter and displays the result on the front panel.

The procedure to set up the optical bench, the signal processing front-end amplifiers, the standardization of outputs, and alarm systems are described in separate sections of the manual.

1.4 Automatic Zero System

To compensate for zero drift, which may occur during sampling, the analyzer zero reading is updated by the Auto-Cal function of the controller. An electronics timing circuit provides a timing cycle that is user programmable. The Auto-Zero system is turned off (see chapter 3 section 5). You have the option of setting the analyzer for one six minute zero cycle during hourly intervals of time from one to 23 hours, and daily from one to 30 days.

The Auto Zero system compares the present zero reading of the zero fluid with the zero reading of the zero fluid as it was in the last zero calibration. When there is a difference, the electronic zero circuit sets the zero reading to

what it was in the last scheduled zero calibration. This zero reading is set at zero. The Auto Zero circuit is a digital circuit, which employs a DAC (Digital to Analog Converter) that can go out of range.

When the threshold cannot be found (oscillation persists), this means that measuring and reference peak signals as viewed on the oscilloscope at the output of the second amplifier in the detector module are too far out of balance on zero fluid. When this occurs, you must initiate optical balancing of the optical filters for equal light transmission on zero fluid. Measuring and reference peaks must be within one volt with zero fluid in the cell.

Zero drift may occur in the following cases:

1. The output source changes or chemical or solid deposits form on the cell windows, but the application is such that interfering chemicals (sample background changes) are not a problem. The zero fluid in this case may be the major component of the sample, void of the component of interest. For oil in very clean water applications, the Zero fluid can be a hydrocarbon free air or N_2.

2. The sample may contain chemicals that are not of interest, but absorb UV energy at the measuring wavelength used for analysis of the component of interest (for example, oil in water applications). These chemicals produce a signal that adds to the signal of the component of interest and makes it inaccurate. The Auto Zero system discriminates the two signals and drives the interfering signal of the background chemicals below zero on an hourly basis. The zero fluid in this case is the sample of which the component of interest is filtered out while the background chemicals are preserved. The Auto Zero system corrects for background changes on an hourly basis, if the analyzer is set to Auto-Zero in an hourly basis.

1.5 System Description

The photometric analyzer is constructed for hazardouz area (Models 6600, 6600Z-divII or 6600X-div I) use and is mounted on a BACKPLATE, an open rack, or in a closed cubicle.

1.6 Photometer

The photometer modules are mounted on a BACKPLATE inside a NEMA Enclosure (See D-71055). Facing the mounted photometer, the source module is at the right top, the sample module is externally located in the folded optics loop, and the detector module is on the right bottom. A source power supply module is placed near the HG source module.

1.6.1 Source Module

Any one of three types of source modules may be used in your system. For oil in water applications the Source module contains a HG source within its ellipsoid reflector containing a lens and clamp to focus the lamp energy through the folded optical train.

The QI (Quartz-Iodine) and D_2 (Deuterium Arc) sources are mounted in the source module which also contains the focusing lens.

The source power supply module provides power to the lamps. The source power supply module houses the power supply, a connector for an optional temperature controller to heat the sample cell, and an optional span filter power supply.

The Quartz-Iodine lamp power supply is a switching regulator that maintains a constant voltage (5 VDC) across the filament of the lamp. The lamp is incandescent. Its envelope is filled with a halogen to avoid sputtering of the filament, blackening the lamp envelope.

The D_2 lamp power supply is a combination current and voltage regulator. It maintains a constant anode current in the D_2 lamp and controls the voltage across the lamp's cathode (filament).

When power is turned on, relay K1 is activated and applies 10 VDC across the filaments. After ionization of the Deuterium vapor, the lamp starts to conduct from cathode (filament) to anode. This causes K1 to deactivate and the filament voltage drops to 7 VDC, which is the operating voltage. The voltage from anode to cathode which was 365 V before ionization, drops to about 60 VDC after ignition. This is the operating voltage. A constant current of 350 mADC is the anode current.

The Deuterium arc lamp is employed with samples whose component of interest does not absorb at the high intensity peaks of the HG source emission spectrum. The Deuterium arc produces a broadband of energy (200 to 400 nanometer) in the UV spectrum.

The HG (Mercury arc) source and its power supply reside in one enclosure. A quartz lens focuses the energy into a beam for transmission. A collecting lens is also used at the exit of the folded optical train to focus the source energy on to the photodetector.

WARNING: UNDER NO CIRCUMSTANCES SHOULD THE SOURCE MODULE BE OPEN AND THE LAMP ALLOWED TO OPERATE UNLESS PERSONNEL IN THE IMMEDIATE VICINITY ARE WEARING UV FILTERING EYE GOGGLES.

1.6.2 Sample Cell

The sample cell rests external to the Control and Analysis electronics placed between the source and detector modules.

1.6.3 Detector Module

The detector module houses the photo detector, chopper assembly, and the signal processing stages of the electronics circuitry. The synchronized chopper motor rotates at 1800 rpm. The detector type found in your analyzer can be identified from the Source module sub-assembly (See. D-65306).

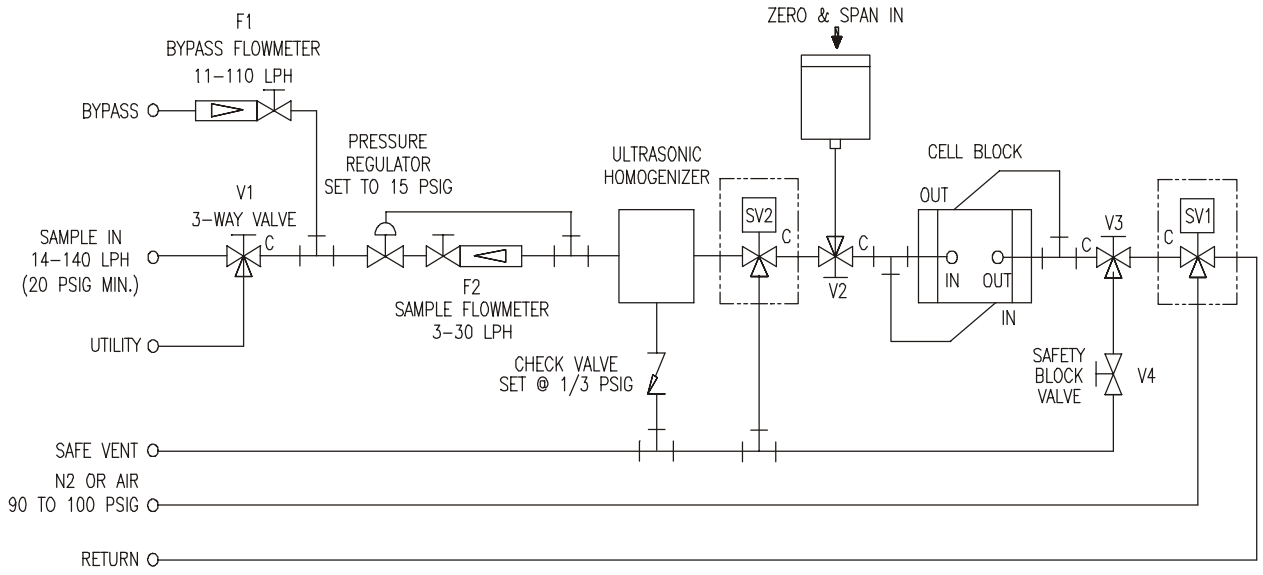
The filter wheel that carries the optical filters is marked with (M) for measuring and R for reference filter. If you remove the filter wheel, you must align a reference mark on the wheel with a reference mark on the shaft. When the switch activating disc is removed, align with the marks on the switch plate and motor mount when you put it back.

The phototube detector PC board contains the I to E converter stage, second amplifier, logarithmic amplifier, inverter, and first stage of integration. The solid state detector has its I to E converter stage built in on the detector PC board. A system with a solid state detector has a second converter PC board containing the second amplifier, logarithmic amplifier, inverter, and first stage of integration.

The magnetically activated reed switch is mounted on the motor mount. Oscilloscope test points are available and are mounted on a bracket inside the housing for explosion-proof models; test points are available on the outside in the bottom for general-purpose units. An optional zero and/or span filter is located in this module also.

1.7 Sample Systems

Below is a typical sample systems that deliver to the sample fluid 6600 sample cell for Analysis. Depending on the mode of operation either sample or calibration gas is delivered.



Installation

Installation of the Model 6600 Photometric Analyzer includes:

1. Unpacking
2. Mounting
3. Fluid connections
4. Electrical connections
5. Testing the system.

2.1 Unpacking the Analyzer

The analyzer is shipped with all the materials you need to install and prepare the system for operation. Carefully unpack the analyzer and inspect it for damage. Immediately report any damage to the shipping agent.

2.2 Installing and Connecting the Analyzer

Without Temperature Control, the system must be installed in an area where the ambient temperature is not permitted to drop below 32°F freezing nor rise above 122°F (0-50°C).

Regardless of configuration, the system must be installed on a level surface with sufficient space allocated on either side for personnel and test equipment access. Subject to the foregoing, the system should be placed as close to the sample point as possible and bolted to its supporting surface. A waterproof mastic should be liberally applied to the under surfaces of all four supporting legs of the cubicle system before placing it in position and bolting it in place.

2.2.1 User Connections

All user connections are around the periphery of the equipment panel (or cubicle) and appear in the outline diagram in the back of the manual.

2.2.2 Electrical Power Connections

Unless specifically ordered, the standard system requires a supply of 115 VAC, single-phase power. Power connections are made inside the control unit. Refer to the input-output diagram for more specific information. The electrical power service must include a high-quality ground wire. A high-quality ground wire is a wire that has zero potential difference when measured to the power line neutral.

2.2.3 Compressed Air Supply

The system may require a supply of clean, oil and particulate free air to drive pneumatically activated valves, create suction (pumping) eductor action (demand more flow), or for use as zero fluids. In general, a 2 liter/minute supply of compressed air between 80 to 120 psig is usually sufficient. The air supply must have far greater capacity when purging of the system or when eductors ejectors are used (special systems).

2.2.4 Pipe Connections

Refer to Appendix Piping Drawings for information about pipe connections. On special systems, consult the text in the manual that describes your particular sample system in detail.

2.2.5 Signal and Alarm Output Connections

Signal and alarm output connections are made inside the control unit to terminal blocks mounted on the interface PC board.

Note: For current outputs, the signal circuit resistance, including accessory devices, must not exceed 1000 ohms. The alarm contact circuit must not draw more than 3 amperes at 250 VAC (non-inductive) or 30 VDC. Refer to the following section.

2.2.6 Sample Delivery System

The sample delivery system should be designed to operate reliably and must be of large enough capacity to avoid flow stops or bubbles in liquid samples. A pump is required only if there is insufficient pressure to reliably supply the sample to the system equipment panel. Do not complicate the delivery system by adding a pump unless it is absolutely necessary. If a pump is required, select a type that can handle the sample (corrosion), as well as meet the area classification and Environmental conditions. Choose a pump that can also supply sufficient flowrates to meet anticipate flow response times based upon sample delivery take-off distances, line sizes and pressure drops expected to and from the analysis system.

2.2.7 Draining the System

In liquid analysis systems, the system return must terminate back to the process or a safe area as the sample may be poisonous or corrosive. Olso, the return pressure must be always sufficiently low enough from the inlet pressure to maintain proper response times within the system.

2.3 Testing the System

Before plugging the instrument into the power source:

- Check the integrity and accuracy of the fluid connections. Make sure there are no leaks.
- Check the integrity and accuracy of the electrical connections. Make sure there are no exposed conductors
- Check that sample pressure is between 3 and 40 psig, according to the requirements of your process.

NOTE: Special designed systems may require checks under vacuum or high pressure (consult manual addendum). Consult commissioning start-up section in the manual addendum.

Warning: Do not operate the "ultrasonic homogenizer" in the instrument for more than one (1) minute without a liquid sample properly flowing through the homogenizer.

Power up the system, and test it by performing the following operations:

1. Repeat the Self-Diagnostic Test, section 3.3.4, part I

2.4 Calibration

2.4.1 Calibration Fluids

Zero and span fluids must be made by the chemistry lab or certified zero and span fluids bought from a supplier. The zero fluid must be the major component of the sample, free from the component of interest.

The span fluid must be the major component of the sample mixed with a small amount of the component of interest. The concentration must be 60 to 80% of the range or the widest range of the instrument (if the instrument provides more than one range).

2.4.2 Calibration

Refer to Section 3.3.8 section I of the manual to determine how to manipulate the mode setting. Two calibration methods are available.

1. Calibration with zero and span fluids.
2. Calibration with a span filter.

Method One:

1. Inject zero fluid and set zero as referred in Part I

2. Inject span fluid and set the concentration of the span fluid with the span procedure referred in Part I

Method Two:

1. Determine the span setting using Method One.
2. Activate the span filter (as referred in section 3.3.8) Part I
3. Record the display reading (this is the span filter reading and must be recorded).
4. You can calibrate the instrument now with the span filter.

Power up the system, and test it as follows:

1. Repeat the Self-Diagnostic Test.

Maintenance

3.0 Routine Maintenance

3.1 Automatic operation and routine operational duties

The system operates continuously without adjustment. Under normal conditions, after you program the system for automatic operation, only routine maintenance procedures are necessary. The most common failure condition is a temporary interruption of the power serving the instrument. If the power service is interrupted, the source lamp in the analyzer will restart automatically as long as there is no defect in the lamp circuit or its starter.

You can detect a lamp off condition with the signal failure alarm circuit, but you must connect the relay contacts from the alarm to your indicating device. In addition, you will experience an alarm condition when the cell windows are extremely dirty or the electronics fail in the detector-converter, log amplifier, or inverter circuits. When the alarm circuit is powered independently from the analyzer power source, the alarm circuit is fail-safe and will detect power failure.

A message such as **"Cell Fail check the detector signal"** might be displayed if lamp off condition occurs

3.2 System Visual Check and Response Procedure

1. Verify that the signal failure alarm is not in failure condition.

2. Verify that the zero and span control setting have not been disturbed (See Part 1).

3. Verify that the chart recorder contains a normal display.

4. Verify that the recorder has a sufficient supply of chart paper and ink.

3.3 Routine Maintenance

Keep the sample lines and components, including the measuring cell within the analyzer sample module, free of deposits and leaks. You must determine the interval between cleaning procedures empirically, because the duration of time that the system runs without attention is related directly to the sample's condition. (Some self-cleaning capability has been incorporated into the inlet flow pattern (turbalent flowingsweep across cell windows) of the sample cell design.

3.4 Suggested Preventive Maintenance Schedule

DAILY (these suggestions are perinent to your particular system design)

1. Visually inspect the complete system for obvious defects, such as leaking tubes or connectors.

2. Verify that the sample pump (if applicable) is running.

3. Verify that the signal failure alarm is not in failure condition.

4. Verify that zero and span settings are correct.

MONTHLY

1. Examine sample cell windows for accumulation of solids. Remove and clean as necessary.

2. Calibrate the system. (Check manually the Zero and Span using prepared Zero/Span fluids obtained from startup or previous calibration practices).

ANNUALLY

1. Check the electronics calibration.

2. Check the UV source.

NOTE: Be sure to wear UV filtering eye goggles.

3. Check the solenoid valves.

3.5 Service Procedures and Adjustments

3.5.1 Electronics

TAI aligns the system's electronics. However, you may need to touch up the circuitry, using the following procedure.

Equipment Required:

Oscilloscope (dual trace is preferred, but not required) To observe oscilloscope test points switch the vertical input selector of the scope to DC.

Switch to AC to observe the demodulator switch signals.

DVM (Digital Voltmeter)

3.5.2 Power Supply Test Points

Measure +15 volt ±1 volt DC and -15 volt ±1 volt DC on the differential power supply PC board in the control unit. Refer to the power supply schematic in the back of the manual to identify the power supply test points, or section 3.6 in this chapter.

3.5.3 Setup of the Signal Processing Front-End Amplifiers

Fill the sample cell with air or a stable fluid, such that the photo energy that strikes the detector is constant. A stable fluid is distilled or tap water. This step may be omitted when the system is stable in its present state.

If you open the detector module, keep stray light out by covering the opening with a dense black cloth. If you do not take this precaution, the result is a misinterpretation of the scope patterns. On general-purpose systems, the scope test points are in the bottom of the detector module and are accessible without opening the module.

3.5.4 Oscilloscope Display of the I to E Converter Output

The output of the I to E Converter is observed at the output of the second amplifier. The objective of this operation is to set up the optical system and the gain of the second amplifier in such a way that the analyzer keeps operating within its dynamic range.

Connect the oscilloscope to TP3. The oscilloscope displays the measuring and reference pulses in an alternating pattern. The display is created by the light passing through the reference and measuring filters as they are brought in and out of the light beam by the rotating filter wheel. These light pulses are converted to electronic energy which is amplified and brought to TP2. The base line represents the blocking of the light beam by the opaque part of the filter wheel.

To identify which of the pulses is the measuring peak, insert the span filter (when present) or a piece of flat glass or clear plastic in the light beam. The peak that becomes the shortest (retracts excessively) is the measuring filter pulse.

In case you cannot set the gain properly, because the peaks are too short, too tall, or too much out of balance, adjust R2 trimpot on the converter PC board until you obtain the desired peak height as observed on the scope (usually 8 to 9 volt) for the tallest of the two peaks. Never leave the system operating with peaks exceeding 10 volts or you may saturate the logarithmic amplifier. You should not permit oscillations or distortions in the peaks.

3.5.5 Balancing the Optics for Equal Light Transmission with Zero Fluid in the SAMPLE CELL

The objective of this procedure is to obtain measuring and reference peak heights as displayed on the oscilloscope that are approximately equal, with the tallest peaks set at 8 to 9 volts. This must be done with zero fluid in the cell. (Collect a Zero prepared fluid from the sample system ifor all oil in water analyzers). See Part III, Section 5.5

The procedure is purely mechanical and consists of adjusting the amount of light passing through either the measuring or reference filter, never both. Screens (wire mesh) of varying density are used for this operation and are part of the small took kit accompanying the instrument.

1. Observe the oscilloscope and judge if optical balancing is needed. When the difference is less than 1 volt, balancing is not required. The tallest of the two peaks should be adjusted to 8 or 9 volts with the gain control R2 on the detector PC board. When this cannot be done because both peaks are too short or too long, search for screens mounted in the light path, usually located in a holder on the light pipe which interconnects the detector and sample module, and remove or add screens, as necessary.

2. When balancing is needed, identify the peaks as outlined under Section

3. For example, if the reference peak is the shorter one, stop the filter wheel with your hand and see if screens are located behind the reference filter. The reference filter is identified by the letter “R” engraved on the filter wheel.

4. If screens are found, remove them after taking the filter wheel off the shaft with the special Allen wrench supplied in the tool kit.

5. After removal of the screens and remounting the filter, mount the filter wheel back on the shaft. Position it correctly on the shaft by lining up the two paint marks on shaft and wheel.

6. Turn on the instrument and observe the balance on the oscilloscope.

a. If the reference peak is now too tall, remove the filter wheel and add a screen of lesser density behind the reference filter. Repeat this procedure until the peaks are within 1 volt of each other.

b. If the measuring peak is equal to or within 1 volt of thereference peak, the system is optically balanced and ready for calibration.

c. If the peak is still too short, repeat the procedure, but thistime put a screen behind the measuring filter to shorten its peak.

7. After the peaks are balanced, adjust the gain control until the tallest of the two peaks is 8 to 9 volts. The peaks should still be within1 volt of each other.

8. It is always good practice to operate the analyzer with as low a gain as possible. Therefore, with the gain control just barely off its stop, once again remove or add screens in the light path to obtain as high a voltage as possible without exceeding 9 volts for the highest peak. Read-just gain for 8 to 9 volts.

This concludes the balancing procedure and the instrument is ready for calibration.

3.5.6 Setup of the Logarithmic Amplifier

The amplifier is inverting and continuously taking the logarithm of the output signal of the second amplifier. You can observe the output by connecting the scope probe to TP4.

The correct wave shape has a rounded negative going pulse that is the signal and a flat-topped positive pulse that depicts saturation of the log amplifier.

You should not permit distortions or oscillations in the rounded peaks.

When the positive going pulse is not flat or is distorted, adjust trimpot R3 only enough to obtain a flat positive pulse. If you over adjust, you may lose part of the second decade of absorption and affect the accuracy of analysis for high concentrations of the component of interest where the measuring pulse can become very short. The log amplifier saturates because the amplifier is incapable of taking the logarithm of the slightly negative baseline.

3.5.7 Inverting Amplifier

The amplifier is inverting and has a gain of 1. It inverts the output signal of the logarithmic amplifier and acts as a buffer between the logarithmic amplifier and the reed switch and integrators. To observe the output of the inverter, connect the scope probe to TP5. The wave must be a duplicateof that observed on TP4, except that it is inverted.

3.5.8 Integrated Reference and Measuring Signals

You can observe the reference and measuring signal at the first stage of integration by connecting the scope probe to TP6 (reference signal) and TP7 (measuring signal) at the detector unit. A dual trace scope is advantageous but not required for this observation.

The test points' significance is that they reveal proper switch action. The display shows a sawtooth pattern that is a charge-discharge of the first capacitor in the integrating network. This ripple is the AC component of the reference and measuring signal after the pulses are converted to DC. The sawtooth patterns must be displayed 180° with respect to each other as viewed with a dual trace scope. They must both be present.

If one is missing, the switch is not switching. If the sawtooth shows a broken pattern, the switching action is feeble or irregular. Usually, you can fix the faulty condition of the switch by slightly changing the switch position.

The action of a bar magnet and a rotating chopper disc activate themagnetic mercury reed switch. An aluminum motor mounting block houses a bar magnet. This bar magnet is parallel with the mercury chopper switch.

The chopper disc is a green and black disc mounted on the filter wheel shaft next to the motor. The disc is composed of both magnetic and non-magnetic materials. As the shaft rotates, the magnetic portion of the disc shorts the magnetic flux as it passes between the magnet and the switch. The non-magnetic portion of the disc enables flux lines from the bar magnet to activate the mercury switch.

3.5.9 Battery-Powered Oscilloscope Synchronization Point

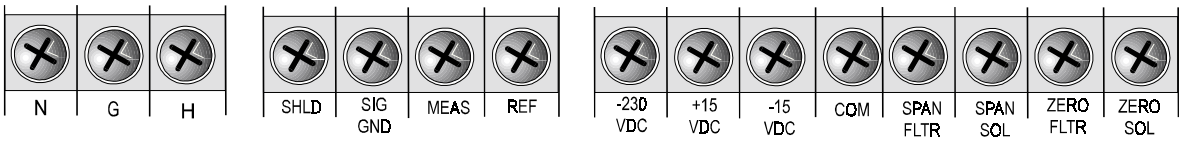
Because the line frequency cannot synchronize battery-powered oscilloscopes, use TP8 at the detector module to provide external synchronization.

3.6 Interface Board Terminals Strip

At the bottom of the interface PCB on the Control/Analysis Unit, are three terminal strips where wiring is distributed to other sections of the Model 6600 System. Such as AC power for the D2 lamp power supply, DC Power to the preamplifier, High DC voltage for the photodetector, and

signals to control calibration solenoids and filters. To gain access to this terminals, the silkscreen cover must be removed. These terminals are wired in the factory.

WARNING: DANGEROUS HIGH VOLTAGES ARE PRESENT AT THESE TERMINALS. TRAINED PERSONNEL MUST REMOVE THE SILKSCREEN COVER ONLY. EXERCISE EXTREME CAUTION.



The first strip terminal has three contacts labeled N, G and H. The labels stand for Neutral, Ground, and Hot. This is the AC power strip terminal. It feeds AC power to other components of the Model 6600 System, such as the D2 lamp power supply, heater, and temperature controller PCB.

The second strip terminal has four contacts labeled SHLD, SIG, GND, MEAS and REF. This strip terminals are dedicated to the signals coming from the photodetector amplifier. The labels stand for:

SHLD: Shield. Shield form the preamplifier cable connects to this contact.

SIG GND: Signal Ground. Ground reference for both the measure and the reference signal.

MEAS: Measure Signal voltage.

REF: Reference Signal voltage.

The third terminal strip has eight contacts labeled -230 VDC, +15 VDC, -15 VDC, COM, SPAN FLTR, SPAN SOL, ZERO FLTR, ZERO SOL. This strip feeds the high voltage needed on the cathode of the photodetector, DC power for the photodetector preamplifier, and control signals for the solenoids and filters. The labels stand for:

-230 VDC: This is the negative high voltage fed to the photodetector cathode, about -230 VDC.

+15 VDC: Power Supply voltage fed to the photodetector preamplifier, +15 VDC.

-15 VDC: Power Supply voltage fed to the photodetector preamplifier, -15 VDC.

COM: Common reference to the +/- 15 VDC and the -230 VDC power supplies.

SPAN FLTR: Span filter signal, AC voltage.

S**PAN SOL:** Span solenoid signal, AC voltage.

ZERO FLTR: Zero filter signal, AC voltage.

ZERO SOL: Zero solenoid signal, AC voltage.

OPERATING INSTRUCTIONS

Model 6600

Oil in Water Sample Conditioning System Operation

Part III: Sample System

X-Proof

Part Number D-

6600 - GP, Rack, Panel (Integral or Remote)
6600Z - GP, Bulkhead (Z-Purged in Div II areas) (Integral or Remote)
6600X - (X-Proof, 1,1,B, C, D) (Integral or Remote)

Table of Contents

1.0 Introduction

The Teledyne Oil-in-Water Analyzer utilizes the ultraviolet (UV) absorption principle to detect and continuously measure oil concentration in water. The analyzer consists of two integrated systems: (1) a single external sample cell, chopped beam, dual-wavelength UV process photometer and associated control analysis unit and electronics, and (2) a sample system that delivers to the photometer a sample which represents the true oil content of the stream being analyzed, or a "zero" fluid of oil-free sample delivered to the photometer at a preset interval once each hour. This oil-free sample is used to reset the zero reference point on the recorder.

NOTE: Previously, to differentiate between oil and other organic compounds, oil was formally defined as any material in the sample stream that could be extracted by carbon tetrachloride, chloroform, hexane, or petroleum ether. We now know, however, that our oil in water analysis system correlates exceptionally well to EPA and marine testing methods based upon a more realistic definition pertinent to how our system works. That is, the definition of what is truly oil in water from fossil fuel sources is what can be coarse filtered (non-dissolved oils) and what can be ultra fine filtered (dissolved oils) from the process water sample. The above definition is a result of a one year continuous field evaluation by the EPA during the early 80's which specified that the Teledyne oil in water system showed good correlation with results obtained by EPA method 413.1 (superceded in February 1999, by method 1664A using hexane). The field tests were conducted at primary and secondary effluent sampling points at a refinery. The investigation determined calibration curves for process oil versus EPA reference oils and validation of the calibration and sample measurement process against EPA method 413.1 "oil and grease total recoverable." The report and evaluation was conducted by the Environmental monitoring and support laboratory, at EPA Cincinnati, Ohio. The Teledyne Oil-in-Water Analyzer is designed to operate effectively within the parameters established by this newer accepted definition of oil.

Analytical accuracy of the equipment is better than 2% when it has been calibrated with an oil identical to that being measured. Reproducibility of analysis equals or exceeds that of any known laboratory or analytical method. When calibrated in a range of 0-10 ppm, changes as little as 0.1 ppm are detected (1% sensitivity).

2.0 The Method of Analysis

The following description follows the course of an optical beam, emitted from a source lamp in the SOURCE MODULE, passed through the sample to be analyzed in the SAMPLE CELL, and received (through optical filters), converted to pulses of electrical energy, and further conditioned, in the DETECTOR MODULE. The result is separate pulses which are compared in the control/analysis unit to reveal the measurable difference between optical absorption of the sample at a selected wavelength (determined by the MEASURING optical filter) and a zero-absorption condition (set by the REFERENCE optical filter). The magnitude of that difference represents the concentration of the component of interest in the sample.

2.1 The Optical Bench

Energy from a Mercury Line lamp, used as a source, is optically focused through a folded path through a sample cell onto a photo detector. In front of the detector is a motor-driven filter disc containing two optical filters mounted 180 degrees apart which alternately and continuously rotate into and out of the light beam. Sample flows continuously through the sample cell and absorbs optical energy at various wavelengths in accordance with its composition.

The analyzer monitors two of the wavelengths: a measuring wavelength selected where the components of interest has a characteristic spectral peek absorbance, and a reference wavelength (where oil does not absorb) utilized to provide stability by detecting extraneous phenomena such as turbidity, cell window deposits, unequal optical component aging, etc. The reference wavelength is also sometimes selected at a point where automatic compensation is attained for interference from other sample components.

2.2 The Photometer Amplifier

The photo detector converts the photo energy impinging on it to electrical energy. The magnitude of the photo energy pulses which strike the detector is related to absorbance by the sample and the properties of the optical filters.

The detector output, which is a sequence of pulses which directly reflect the photo energy transmitted by the measuring and reference filter, is a measure of the concentration of the component of interest in the sample. The difference of the energy in the measuring and reference pulse is exponentially related to the concentration of the component of interest.

The photo detector current output is amplified by a current to voltage (I to E) converting amplifier, followed by a second amplifier. The gain can be adjusted to obtain any desired output level.

To obtain electrical signals which are linearly related to the concentration of the component of interest, the output of the I to E Converting amplifier is fed to the input of a logarithmic amplifier, which produces a signal that represents the logarithm of the output signal of the second amplifier. The output of the logarithmic amplifier is fed to the input of an inverting amplifier, which acts like a buffer between log amplifier and switch and inverts the input signal for further processing.

The output of the inverting amplifier is fed to a magnetically activated SPDT reed switch, synchronized in such a way that all measuring pulses are collected on one switch contact and all reference pulses on the other.

The pulses pass through diodes which isolate the integrating networks from each other. The integrators convert the reference and measuring pulse energy to a DC level representing them. These reference and measuring DC levels are applied to the subtracting amplifier. The output of the subtractor is a DC voltage linearly related to the concentration of the component of interest.

From this point on the signal progresses to the A to D converter, where the signal is digitized for micro controller. The micro controller performs operation on the signal such as spanning, zeroing, triggering alarms, etc..

The technique of dual wavelength spectroscopy provides compensation for such phenomena as turbidity, sediment, algae, cell window coatings, component aging and other extraneous electro-optical attenuation.

The procedure to set up the optical bench, the signal processing front-end amplifiers, the standardization of outputs, and alarm systems are described in separate sections for each access.

2.3 The Automatic Zero System

The sample may contain chemicals which are not oil, but absorb UV energy at the measuring wavelength used for oil analysis, thereby interfering with the oil analysis (their signals add to the oil signal, which is the only signal of interest).

The automatic zero system is included to discriminate the two signals. It involves an electronics circuit, which drives the signal developed by the interfering, non-oil, background chemicals below zero on an hourly basis.

The electronics zero circuit works in conjunction with a specially designed sample system.

The sample, which contains oil and background chemicals, is fed to the sample return port, where it progresses to the various subsections for enhancement in order to present the sample to the measuring cell in such a way so as to maintain the highest degree of accuracy for oil measurements.

2.4 From B71046-0 (or customer's) piping schematic

Each of these subsections with piping flow components are identified with rectangular dotted lines to indicate their importance based upon a particular oil measurement application.

For Example, there are 4 basic process sampling considerations:

1. Required use of a homogenizer/dearator and filter assemblies for high oil range (>20ppm high background applications).
2. Required use of filter assemblies for low oil (<20ppm oil, high background).
3. Required use of back-flush solenoids for low oil range, very low background applications
4. Required use of a pump assembly for low pressure (<10 psig) or no gravity feed applications).

In general, but not without exceptions, the following applications could involve items 1 through 4 above or combinations thereof.A. 0-20ppm oil down to 0-10ppm oil in very clean waters such as steam condensates, cooling waters, clear sea waters: (***3 and 4****, if no sample pressure or gravity feed available).*

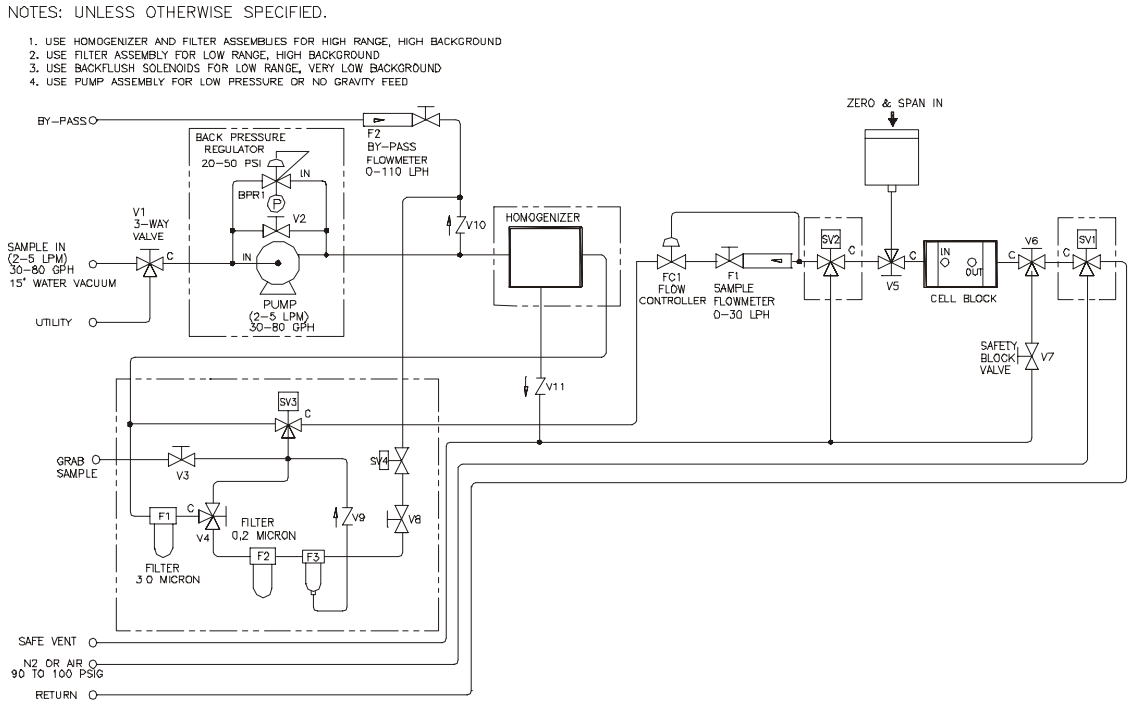
Note: Assume sample inlet contains dissolved oil and is homogeneous.

B. 0-20ppm down to 0-10ppm oil ranges in high background waters such as off-shore platforms, produced waters, sea water, wastewater, effluents, ponds, bilge/deballasting treatments, on-board ship applications: (**2 and 4**, if no sample pressure or continuous gravity feed available. (Note: Assume sample inlet contains dissolved oil and is homogeneous).

C. 0-50ppm to 0-200ppm oil in high background waters such as off-shore platforms, produced waters, sea water, wastewater, effluents, ponds, bilge/deballasting treatments, on-board ship applications, tank farms, fuel depots, rig-washing decks, etc., (**1, 2 and 4** if no sample pressures or gravity feed available). NOTE: for ranges higher than 200ppm oil a dilution system is required.

Note: Assume sample inlet contains both dissolved and non-dissolved oil with non-oil organic background compositions and is representative. It should also be uniform and kept homogeneous up to the homogenization step.

NOTE: By adjusting valve, V4 in a position for "F1 only", filtering versus "F1, F2" and F3 filtering during the auto-zero functioning selects whether the customer wishes to measure "Total oil and grease recoverable" or "non-dissolved oil" only. This becomes advantageous when environmental regulation agencies allow tolerable dissolved oil level compositions in the waters. Many times, cost savings are realized in clean-up operations.



Oil in Water Piping Diagram (B71046)

Should Teledyne receive no representative sample of water or oil for testing purposes, Teledyne will not be held responsible for the unsatisfactory functioning of the analyzer due to sample related nonconformities. If the end user is unable to provide samples, a spectral scan or a detailed description of the type(s) of oil(s) present is prefferred. The user is responsible for proper calibration of the unit, at commissioning stage, against the oil(s) found in the sample fluid to be analyzed. TAI assumes that the sample background is clear of strong U.V. absorbers at 254nm, i.e., no aromatic hydrocarbons other than oil and grease listed and NO Fe+3 or H_2S are present. Maximum turbidity allowed is 1 NTU per 10 ppm oil range up to a maximum range of 0-50 ppm oil (20NTU/200ppm). When no samples are supplied, TAI will ship unit calibrated with ppm EPA#2 oil in tap water. In some cases, particularly for very high ranges, a surfactant such as glycol (non-absorbing, non-interfering) is added to the water sample which increases the miscibility for the oil to go into solution.

The automatic zero cycle is initiated by a signal from the Model 6600 microprocessor based timer circuit. The timing cycle is 1 hour. The timing cycle can be modified through the system menu, refer to chapter 3 of the control unit part of this manual. The zero cycle lasts for about 5 minutes and the sample cycle lasts about 55 minutes.

The sequential switching from sample to zero is operated by the 6600 control unit, where the zero reading of the output is automatically, hourly upgraded by the auto zero circuit.

2.5 ZERO CORRECTION FOR CLEAN BACKGROUND STREAMS (REFERENCE B71441 PIPING)

1. The activation of all solenoid valves in the sample system are performed by the 6600 timer circuit.

2. Backflush solenoids (sv1, sv2) around the sample cell are used to prepare a reproducible autozero. These solenoids allow oil free air or nitrogen (N2), (80-120 psig, 5.62-8.44kg/cm2 g) supply is required to purge out the cell in reverse flow fashion. This action completely cleans the cell windows and drys them to a stable reproducible background for the autozero functioning. Because the process is very clean without impurities the autozeroing primariy corrects for lamp, detector and particulate (dirt) accumulation that may occur on the cell windows.
3. When the span filter with its solenoid is selected/programmed and used

for correcting any gain in the system, its introduction commences at this time after the zero has been accomplished. The duration to the calibration of the auto zero is about 10-15 secs longer. This is considered a full auto-cal updated function where both zero and span are updated each hour. The air/N2 backflush causes a great disturbance in the detector preamplifiers. The recorder when used and the ppm oil reading on the control unit digitial display, however, will not notice it due to the hold action of the sample and hold circuitry (if the analyzer is configured to "hold" and not track, as mentioned in section 3.39, part I).

2.6 ZERO CORRECTION FOR HIGH BACKGROUND STREAMS (REFERENCE B71046-0 PIPING) OR CUSTOMER SPECIFIC PIPING)

1. When the stream contains high background impurities, these must be cancelled out in the autozeroing each hour due to their possible normal variances in the process stream. In this case we are measuring "total oil and grease recoverable" and any non-oil organic background hydrocarbons must be corrected for on a continuous basis. In this way, the filter assemblies are used wherein the filter labeled (F1, 3 micron) eliminates the non-dissolved oil in the process steam; while filter(s) labeled (F2, 0.2 to 1 micron) and (F3, 0.2 micron teflon element filter) eliminates over 98% of the dissolved oil species. When only the F1 filter is selected by V4 (in the up position), the autozeroing will cancel out the dissolved oil left in the process sample; thereby allowing one to measure only the non-dissolved oil (This becomes important for some users who are allowed low levels of dissolved oil in their process stream). For "total oil and grease recoverable" the V4 3-way valve is selected (in the down positon) to choose both F1, F2 and F3 filter assemblies thereby autozeroing for all oil and grease applications. In this way, the non-oil organic background is cancelled out on a hourly basis.

   During the normal measuring function, sv3 is normally opened allowing the sample to enter the analysis sample cell for oil analysis. When an autozero timing signal occurs, sv3 is activated and diverts the process through the filter assembly(s) to correct the background anomolies usually on a hourly basis.
   (NOTE: During calibration practices, a grab sample of the zero process fluid is obtained here at the Grab zero/Sample Cal Drain Collection. Valves, V6 and V7 are carefully opened (**Caution:Be aware of any high pressure that may be in the sample**) to collect a suitable zero

sample (selected for total oil or non-dissolved oil applications based upon valve V4 position).

The zero water may be supplied to the measuring cell by the existing process available pressure, by a user gravity feed system or by a pump (user supplied at the take-off) or by TAI either remotely at the takeoff source or within the analyzer sampling system. Normal measuring mode flowrates (commonly are 100-1000 liter/minute) will render response times of under 10 seconds typically for 90% FSD (this does not include any lag-time associated by the fast loop in the system). Each system may be slightly different depending upon components used (see B71046 piping), but generally the system is quite fast and many times can be tailored to meet fast response requirements.

The 6600 timer will now activate the auto zero circuit and correct the meter and recorder to read the zero level previously set to the true absolute zero for the process fluid.

If the output of the subtractor remains as it was on the preceding zero cycle, then no correction of the auto zero circuit is required. This means that no background change has occurred during the past hour.

When the output of the subtractor is other than the previous zero cycle value, the Auto Zero circuit would compensate for the difference, resulting in zero volts at its output. This zero voltage, applied to the input of the Sample and Hold/Buffer circuitry.

The 6600 then (optionally) can insert a manual or automatic employed span flag that simulates an upscale reproducible calibration analyte of interest.

This function adds another 10-20 seconds to the zero/span check/correction.

After auto zero/span is taken all solenoid valves are de-energized with the following consequences:

1. The sample is delivered to the sample cell for the next 55 min. The instrument has returned to the sample cycle and the analyzer monitors the sample for oil.

3.0 System Description

The oil-in-water analyzer is generally constructed as either an explosion-proof 6600Z or X Purge or general-purpose (Model 6600) unit, open rack or closed cubicle mounted. An equipment panel is used to support the analyzer components.

All sample-filtering (fluid) components are located on the same side of the equipment panel as the electrical components.

3.1 Photometer

The photometer control/analysis unit module is mounted on a back panel. Modules for General Purpose; I, II, B, C & D; and I, I, B, C & D are available and mounted within sheet metal Nema enclosures as well as Nema stainless enclosures depending upon customer preference for the intended environmental areas. These enclosures are either Z-purged or X-purged to meet hazardous area classifications. In some cases, Teledyne has supplied non-purged, Division II Oil in Water systems self-certified to FM standard 3600 for non-incendive equipment and ISA S12.12-1994 standard for the same type equipment (Class I, Div II, B, C, D).

3.1.1 Source Module

The source module contains a mercury-line lamp (the source of UV energy) located within a parabolic reflector which captures most of the emitted lamp output energy. A quartz lens is used to focus the energy into a beam for transmission through the optical path and sample cell before reaching the detector (PMT).

WARNING:

The lamp is installed within a parabolic reflector. It emits strong UV radiation. When the module is opened with the lamp on, UNDER NO CIRCUMSTANCES SHOULD THE OPERATOR VIEW THE LAMP DIRECTLY OR BE ALLOWED TO OPERATE THE UNIT UNLESS PERSONNEL IN THE IMMEDIATE VICINITY ARE PROTECTED WITH SUITABLE UV ABSORBING EYEGLASSES.

3.1.2 Sample Cell

All systems, the Aluminum/CPVC sample cell couples the source and detector modules together along a folded optical train of the photometer. The sample cell includes double windows (inner sapphire, outer Quartz), at either end, to prevent condensate from forming in the optical path.

3.1.3 Detector Module

The detector module contains the phototube detector, chopper assembly, and the first four stages of the electronics circuitry. The synchronized chopper motor rotates at 1800 rpm.

The filter wheel which carries the optical filters is marked with an “M” for measuring and an “R” for reference filter. A reference mark on the filter wheel must be aligned with a reference mark on the shaft in case the filter wheel is removed from its shaft. Another reference mark is inscribed on the switch plate and motor mount for the same reason. The detector printed circuit board holds the I to E Converter stage, second amplifier, logarithmic amplifier and inverter.

The magnetically activated reed switch is mounted on the motor mount. Oscilloscope test points are available and are mounted on a bracket inside the housing for explosion- proof models; test points are available on the outside in the bottom for general-purpose units.

3.1.4 Control/Analysis Unit

The control/analysis unit contains the majority of the electronics employed by the analyzer as well as operator controls. There are four PCB assemblies. Three of them are located on the door: the Display PCB, The Main PCB, and the Amplifier PCB. The Interface PCB is located on the backplate assembly.

The Interface PCB: This large board is where the customer interconnects output signals, Alarm signals, unit receives its AC power, and holds the DC power supply for the electronics (+5, +/-15 VDC), as well as the phototube DC power supply to generate -250 VDC. Valve control signals are interconnected to this board too.

The Amplifier PCB: This board receives the DC voltage signals of the Measurement and Reference coming from the detector amplifier. The difference of these signals is amplified on this board. Any electronic zeroing action occurs on this board too. This board mounts on headers that are available only for that purpose on the Main PCB.

The Display PCB: This board holds the VFD display and the LED display, and carries the signals to and from the Operator switches on the door of the 6600.

The Main PCB: This board is mainly digital. The micro controller, EPROM, RAM, and RS232 driver, as well as digital drivers for alarms, and valves are located here. There is an analog section where the ADC, DAC, 0-1 VDC output and 4-20 mA modules are located.

3.3 Electrical Connections

There are no electrical junction boxes in the system; power, signal, failure alarm, and distribution connections are made to terminal blocks located inside the control/analysis unit housing. Refer to the Interconnection and Wiring Diagrams at the rear of the manual for details, and chapter of part 1 of this manual.

3.4 The Sampling System

3.4.1 Sample Water Preconditioning System

The sample water preconditioning system prepares the sample for analysis on a continuous basis. The sample is homogenized (when range is above 20ppm Oil) so that any undissolved oil fraction will be uniformly dispersed into solution along with the dissolved oil fraction of the sample prior to presentation for analysis. Sample pressures ranging up to 150 psi can be accommodated. The control manifold has a utility water connection selected by a 3-way valve and inlet port, so that the sample line can be periodically flushed to clear it of accumulated debris. The untreated sample flows to a high-shear homogenizer whose purpose is to break up undissolved oil fractions in the sample into droplets so small that they literally appear to be in solution. This conversion permits the energy generated at the 254nm measuring wavelength to be absorbed by oil that would otherwise appear opaque when presented for analysis.

Output of the homogenizer is delivered under a controlled flow for proper homogenization of the sample water. The homogenized sample is delivered to the analysis sample cell or through the cell from the auto-zero filter assembly(s).

During the Sample Analysis Cycle, all solenoid valves are de-energized. SV3 is N.O. and permits the sample to be delivered to the sample cell.

(CONSULT COMMISSIONING/STARTUP PROCEDURE SECTION IN THE ADDENDUM).

PRESSURIZED INLET SAMPLE DELIVERY

In the case of a high background process stream, the sample is delivered to the sample cell through the homogenizer/deaerator then SV3 (N.O.) directly to the measuring sample cell for analysis or to the autozero section filter assembly section before passing through the sample cell. The return must go to a 5 psig lower pressure point suitable for maintaining a good dynamic response of the system as well as providing sufficiently high enough flow to the sample cell in order to maintain some self-cleaning action minimizing periodic cleaning of the cell assembly. All standard sample handling components selected to contact the process fluid are rated for up to 150 psig (10.5 kg/cm2g). Any pressures higher than this could cause failures and pose an unsafe condition. It is the customers responsibility to assure the inlet(s) nor return point(s) do not exceed 150 psig.

In the case of a clean stream, only sv2 and sv1 are used for zero purposes and are N.O. to allow sample to return to a lower pressure point. This return point must be at least 10 psig lower than the inlet takeoff (when no pump is used); otherwise no flow will occur through the system.

NO PRESSURIZED INLET FOR SAMPLE DELIVERY (PUMP REQUIRED)

When no sample pressure is available either the customer or TAI will have provided a suitable pump for the delivery of the process fluid.

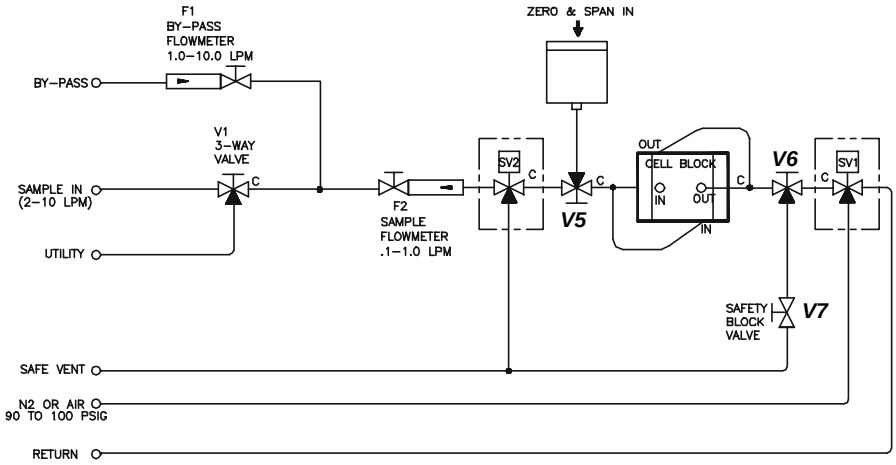
GRAVITY FEED SYSTEM (Suitable on clean water application only)

For gravity feed systems, the user must provide sample from a suitable head so as to continuously deliver sample through the highest internal sample system point of the TAI sample system based upon its commisioned intended location. The gravity return point must also be suitably below this high point so as to render sufficient continuous flow through the system.

CALIBRATION SAMPLE DELIVERY

On each side of the sample cell, v5 (before cell) and v6 (after cell) 3-way valves (followed by v7 an adjustable safety needle valve to a grab safety port) are placed so as to allow gravity fed entrance of calibration fluids prepared with the calibration kit (A48715). Sample is blocked off by these valves and calibration samples prepared can be poured into the zero/span in calibration reservoir and allowed to flow through the sample cell while

manually calibrating the analyzer system.



Oil in Water Piping Diagram (simplest)

Homogenizing

Input flowrate to the sample homogenizer module inlet is precisely and accurately controlled by a mechanical flow controller designed for continuous duty. Because of the style, construction, and position in the sample system, the controller solves many of the problems associated with sample handling at the flowrates dictated by the preconditioning technique. For sample concentration over 20 ppm total oil homogenization is always required-regardless of the analyzer used to measure the oil above 20 ppm, most waters are so enriched that oils do not remain homogenized nor miscible enough to measure accurately.

3.4.2 Zero Water Preconditioning System

Since the analyzer operates at a fixed measuring wavelength, and many soluble organic compounds absorb to some degree at this wavelength, the effects of organics other than oil must be eliminated from the analysis. Thus, a solution is prepared that is essentially free of oil, but retains all the other organic characteristics of the unconditioned sample. When presented to the analyzer, the absorption caused by the unknown organic compounds in this oil-free water can be nullified by eliminating any electronic signal that is generated while the solution is undergoing analysis.

The nondissolved oil is removed by coarse filtering, and the dissolved oil removed by fine filtering, the water contains only the non-oil organic fraction of the effluent stream; i.e., it can be used as a reference or "zero oil" water. During the zero cycle, all solenoid valves are energized and the zero water is pumped through SV3 to the sample cell. Since turbidity is ratioed out by the electro-

optics of the photometer design, the analyzer will measure the zero-oil water as only the non-oil organic fraction. If a differential measurement is made between the homogenized sample and the zero-oil water, the difference is the oil content of the stream. If the zero fluid is then made to read zero, the analyzer readout is a true indication of the oil content of the stream.

NOTE: ***Should the fine filter system be by-passed, the analyzer is then configured to measure non-dissolved oil only***.

Because the non-oil organic background of the effluent stream can vary with time, a correction for its variation is made once each hour. This ensures a valid oil measurement.

3.4.3 The Automatic Sample Cell Cleaning System

The backflushing of the process fluid can be designed in and to occur for various reasons depending upon the application. For example,
Ultra clean process applications for leaks into the like:

1 steam condensates
2 process cooling water
3 boiler return condensates

In these applications, backflushing is used not to keep the cell windows clean but to flush out the process fluid and supply a reproducible zero background fluid (in this case a gas such as oil free air or Nitrogen). When the process is ultra clean, a clean oil free gas background serves as an excellent meduim to autozero the instrument on a hourly basis while correcting for the optics, source and detector anomolies that occur over time. The backflush supply required (preferred 80-120 psig, 5.6-8.4 kg/cm2g) must be oil free. Depending upon the oil measuring range of the instrument, a zero offset factor is programmed into the electronics zeroing function. This is usually set up at the factory for N2 versus demineralized water. This “zero offset” eliminates any bias between the ultra clean process liquid zero fluid which is difficult to obtain on the users site and the surrogate clean air or N2 zero gas usually readily available. This small bias usually a small percentage of the range of the instrument is cancelled out by adding in an opposite bias (opposite zero offset, programmed in after field calibration, where the actual zero offset is determined between the zero pure process water and the surrogate oil free air or N2). This then, allows the instrument to perform an autozero function using air or N2 gas instead of preparing a pure zero steam condensate, etc. The bias (called zero offset) is caused by the difference in refractive

index between the ultra pure clean process zero water and air or N2 gas. Signal level amplitude changes (usually <+/- 25%) will also occur, but their ratio differences between gas and liquid remain very close also resulting in close zero readings between gas and liquid.

Entering the zero offset

Determine the valve of the zero offset after field calibrating the unit using the process fluid. Zero and span calibrate the unit as instructed in part III, sections 5.5 through 5.6.4. Once done, the zero sample in the cell is emptied from the cell, dried and the reading recorded. Backflushing out the cell can be done momentarily by commencing a normal autozero function from the control unit as follows:
On the front panel of the control/analysis unit, operate the switches in the following manner:

1 hit or scroll the switch labelled escape/enter to enter	display indicates system flashing
2 hit or scroll the switch labelled down/up to down once	display indicates span flashing
hit again to down once	display indicates zero flashing
3 hit enter once	display indicates select zero manual or auto
4 hit down or up once if display not reading manual and flashing	
5 hit enter once	display indicates “zero off” and “ppm” flashing
6 hit up or down to enter in offset value (oposite sign, + or -) determined above between zero water and air or N2 backflush gas.	
7 hit enter to start zero function; unit will	display air purging flashing

If in auto mode of unit proceed to calibrate the unit with the entered zero offset value put in.
If in manual mode, proceed to calibrate the unit with the coarse and fine zero adjustments as previously described in Part I, section 3.4.

Particulate laden, turbid, dirtier waters where algae, bacteria, etc., could collect on the sample cell windows, such as:

1 refinery effluents
2 ponds
3 stagnated effluents
4 oil chemical separators, etc.

In these applications, in addition to the normal autozero liquid functioning, the backflushing can be used preceding the liquid autozeroing by momentarily actuating when optioned the two solenoid valves sv1 and sv2 across the sample cell for about 15 seconds before the zero liquid is allowed to enter the sample cell for background non-organic compound corrections. The preset open period of the solenoid valves (approximately 15 seconds) is sufficient to provide a stream of air to the sample cell inlet port at the beginning of each zero cycle. This jet air evacuates the process water and any collected residue from the sample cell once each hour, vastly reducing the maintenance that would otherwise be required to keep the cell free of algae and other debris. The cell inlet/outlet ports are designed with proper sample inlet/outlet angles across the sapphire windows (non-scratching) thereby creating high velocity and turbulence both in the normal measuring liquid stream mode and also during the backflushing cleaning and/or autozeroing modes described above.

3.5 The Signal Outputs

The standard signal output of the analyzer is 0-1 volt located on the control unit Interface Board.

The current outputs of the analyzer are isolated 4-20 mA.. The circuit adjustment procedures the described on section 3, part 1 of this manual.

3.6 Recorder Requirement

The system requires a recorder with input sensitivity which matches the specified system signal output.

Instruments with floating (ungrounded) current outputs can be connected to any current input recorder.

The chart speed must be at least 1 inch per hour.

A stripchart recorder is recommended.

3.7 The Process Alarm System

Refers to the control unit part of this manual for interconnection and programming.

3.8 The amplifier PCB

This board, C67999, contains a differential amplifier. It will take the difference between the Measurement and the Reference signals to create the actual output of the amplifier. There are gain settings that are under the control of the micro controller in the second and the third stage before delivering the signal to the ADC on the Main PCB.

3.8.1 Auto Zero Circuit

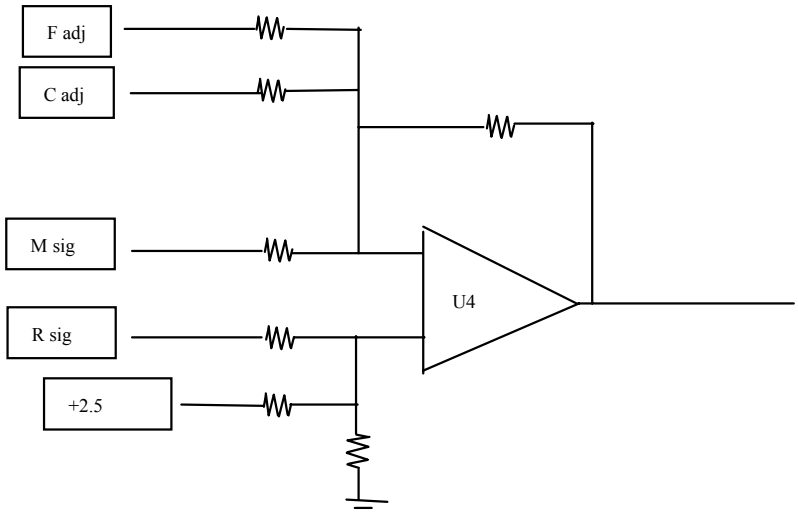
When the oil-in-water sampling system is in long term operation, a zero signal drift may be caused by various conditions, among which are physical changes in sample cell conditions (deposits on sample cell windows, etc.), source and detector changes and electronics drift (with temperature change, for example).

Periodic compensation for zero drift is accomplished by electronically nulling the zero offset, with an equal but opposite signal, while zero fluid is flowing through the system. Thus, a zero point is obtained, and subsequent sample measurements will produce a signal representing the difference between the sample measurement signal and the zero reference signal.

The differential amplifier U4 is to be zeroed by signals fed from the multiple channel DAC on the Main PCB. There are two signals: A Coarse, and a Fine adjustments. The coarse adjustment is fed thru J2-4 and the Fine adjustment is fed thru J2-3. Both signals can swing between 0 to 5 volts. But they have a different effect on the output of the amplifier due the series resistor value size of each one. The simplified schematic of the amplifier is shown below. As it can be seen under ideal conditions, setting both the

Coarse and the Fine adjustments to 2.5 VDC should set the output of the amplifier to zero provided the Measure and the Reference signals have the same magnitude.

When the control unit enters the zero mode, the micro controller drops the amplifier to a low gain. The coarse adjustment is first used to zero out the amplifier on this gain. When the output of the amplifier is reasonably close to zero, the amplifier goes to the highest gain. Whatever residual offset was left from the coarse adjustment is now magnified. Now with the coarse adjustment fixed, the Fine adjustments tries to bring the output of the amplifier back to zero. When the high gain offset is close to zero, the micro controller freezes the Fine and the Coarse adjustments and proceeds to read the residual offset with the ADC. It goes through all of the ten gains available, thus the micro controller stores the offset of each gain, so that later they can be subtracted from the readings. This period of time is called the Software zero and it takes about 70 seconds to be finished.



3.8.2 Signal Failure Alarm

System contacts are activated when the reference voltage as measured at the junction of R3 and R4 of the amplifier board, has fallen below 0.50 millivolts The VFD display will show the following message:

Detector Fail Check the
Detector signal

The reference voltage is checked by the ADC every ten minutes.

This indicates one or more of the following potential failure conditions:

1. The lamp has failed.
2. The cell windows have become so dirty that no light can pass through the sample.
3. The sample is opaque, due to the presence of solids or undesirable optical phenomena in the sample.
4. Condensation has occurred on the cell windows.
5. The signal processing electronics, phototube, signal cable, or demodulator switch has failed.
6. The filter wheel is loose on the motor shaft.
7. The reference optical filter is dirty or defective.
8. The optical bench or lamp is out of alignment.

4.0 INSTALLATION

The oil-in-water system must be installed in an area where the ambient temperature is not permitted to drop below 32°C or rise above 122°F (50°C),(for salt water applications, the freezing point is lower due to the salt content). Cubicle installed systems (Models 6600), subject to the preceding conditions, may be installed outdoors. Rack-supported systems must be completely sheltered from the elements.

Note: Ambient temperatures below 0°C, requires heated enclosures.

Rack-supported systems must be installed in a well-ventilated area to prevent the surrounding atmosphere from becoming saturated with the moisture being generated by the sample preconditioning processes of the system.

Only in one case when the sample system uses gravity flow should the system be installed on a level surface otherwise all other systems ar5e to be with sufficient space allocated on either side (6 feet minimum) for personnel and test equipment access. Subject to the foregoing, the system should be placed as close to the sample point as possible and bolted to its supporting

surface. A waterproof mastic should be liberally applied to the under surfaces of all four supporting legs of the cubicle system before placing it in position and bolting it in place.

4.1 User Connections

All user connections are located around the periphery of the equipment panel (or cubicle) and are shown in the Outline Diagram.

4.1.1 Electrical Power Connections

The system requires a 1 KW supply of 115 VAC, single-phase power. Power connections are made inside the control unit. Refer to the Interconnection Diagram. The electrical power service must include a high-quality ground wire. A high-quality ground is defined as having zero potential difference when measured to the power line neutral.

4.1.2 Compressed Air Supply

The system requires a supply of compressed air at 80-120 psig.

NOTE: The air supply must be oil free. As a precaution, however, the air pressure line should contain a filter(s) to remove any traces of oil, supplied and maintained by the customer.

4.1.3 Sample Connection

The sample water input (see Flow Diagram) is connected at the manual valve input. A flowrate of 1 gallon/minute, minimum, is recommended. Maximum flow is governed by the impedance of the delivery system.

4.1.4 Signal and Alarm Output Connections

Signal and alarm output connections are made inside the control unit to terminal blocks mounted on the interface board. Refer to chapter 2 of control unit part of the manual.

NOTE: Signal circuit resistance, including accessory devices, must not exceed 1000 ohms. The alarm contact circuit must not draw more than 3 amperes at 250 VAC (None inductive), or 30VDC.

4.1.5 Sample Delivery System

The sample delivery system should be designed to operate at the full capacity of the interconnecting pipe. Ideally, both the sample and bypass valves should be adjusted to maximum so that the only impedance to sample flow is the length and diameter of the delivery pipe. Such a delivery system will virtually eliminate problems associated with oil and debris collecting in the sample line. Air ingestion will also be reduced to a minimum, as will analysis lag time.

TET/AI recommends that the sample line be constructed of 1/2" schedule 80 PVC pipe capable of pressure to 150 psig maximum. Unless absolutely necessary, do not install any valves or restrictions in the line other than those required to bypass the customer installed external sample pump. All control over sample flow should be performed at the system inlet and the pump if provided be allowed to operate at full efficiency against only the resistance of the line.

A pump is required only if there is insufficient pressure to lift the sample to the top of the system equipment panel. Do not complicate the delivery system by adding a pump unless it is absolutely necessary. A low pressure system will be prone to sample line depositing, but this can be alleviated by scheduled flushing with the high pressure utility water.

If a pump is required, TET/AI recommends a total submersion centrifugal type. Sub- merging the pump in the sample water automatically eliminates the most common problem - priming the pump. Also, the sample should be drawn from a point where there is a minimum of turbulence; in this way, air or turbid suspended solids will not be ingested along with the water.

The intake side of the system should be equipped with a coarse screen filter. However, do not filter the water downstream from the sample point, or use a fine filter anywhere in the sampling system. High filtration will prevent a representative analysis of the undissolved oil in the sample water.

The inlet of the pump should be placed at a depth where the best representative concentration of oil can be obtained. Positioning will vary with the application; however, as a general rule, to avoid skimming, the inlet should be about 2 feet beneath the surface of the sample water.

4.1.6 Safe Vent (Drainage)

The system safe vent should be equipped to accept a 1-1/2" drain pipe. Also, the diameter of the drain should be large enough to carry away the full capacity of the incoming 1/2" sample line. The system safe vent should be vented to atmosphere at the panel, but the user's system will have to include a trap and or scrubber (if H_2S present, etc.) if the effluent is to be discharged into a sewage system. It must be remembered that the vent to be is at floor level; flooding of the installation area will result in the event of stoppages, or when drain levels are not below the system vent connector. Also, note this vent is used to accept the auto-zero backflashing of the sample and as such high release pressure, liquid and/or gas velocities will be encountered. Never obstruct this vent by any human personnel means to eliminate any injuries.

5.0 SYSTEM START-UP/CALIBRATION

The information contained in the following subsections deals primarily with the steps necessary before the total system can be used for continuously monitoring oil in water. This information involves installation checks, electrical checks, fluid dynamics, and calibration.

Due to variations in water and oils as encountered under field conditions, certain adjustments must be made to optimize system performance for the specific site. This includes calibration.

5.1 Installation Check

1. Observe that power, signal and alarm connections are properly made and that the system is properly grounded. Refer to Installation Section of manual and to Outline and Interconnection Drawings.
2. Inspect the external sample delivery system, including sample pump (when applicable), sample take up point, and source of water sample.
3. Confirm that the recorder is of the correct type.

5.2 Electronics Check

1. Check that all PC boards are in place.
2. Turn off ultrasonic homogenizer by rotating the homogenizer potentiometer fully counter-clockwise (OFF). Refer to calibration section 5.6.5 for final adjustment.
3. Switch on electronics and confirm that 15 volt, and -230 volt, 10 volt is present.
4. With an oscilloscope, check test points and reed switch action with air or oil-free water in the cell.

5.3 Electrical Check

1. Inspect the source temperature controller in the source module. Voltage across the heater when ON should be 110 volt AC and close to 0 volt when OFF. For explosion-proof system measure at TS14-11 and 12. For general-purpose systems measure at TS6-11 and 12.
2. Observe that the automatic lamp starter has turned on the source. Open the source module and briefly glance inside. A violet glow must be visible when the lamp is on.

WARNING! UV RADIATION CAN DAMAGE THE EYES. Never look directly at the lamp for an extended period of time without the aid of special UV-attenuating goggles.

3. Momentarily turn on sample pump to confirm that no shipping damage has occurred. The motor must start.

5.4 Sample Delivery Check

1. Adjust the input V1 and V6 3-way with V2 safely block valve off so that incoming water is diverted to safety vent. Assure no leaks occur.
2. Open V2 safety valve and assure utility water flows out vent. Caution against any high pressure releases.
3. Request associate to turn on the external user installed sample pump (when applicable). Flush the lines until the water is consistent in appearance through the bypass flowmeter F2. If the water is very dirty, do not permit it to enter the instrument's sample system: The water source must be improved.
4. Once sample bypass flow appears very clean as noticed by the flow through bypass flowmeter, start homogenizer and open F2 sample flowmeter and with V2 and V3 normally open flush sample through cell for 10 minutes and notice oil ppm display. Assure analyzer is stable before proceeding to calibration (See manual addendum for commissioning/starup procedures).

5.5 Preparation for Calibration

Manual Sample Introduction

Manual sample introduction is sometimes desired for the following reasons:

1. Analyzer calibration.
2. Optical balancing on tap water, sea water, or zero water prepared from the sample.

Prepare the system as follows:

1. Make sure that the instrument is in the analyze mode. The solenoid valves are programmed to be deactivated so that the sample is connected to the pump or take-off and sample cell.
2. Turn off the homogenizer.
3. Turn off the sample pump.

5.5.1 Required Calibration Equipment

The following laboratory accessories will be required to properly calibrate the analyzer:

1. Blender: A Waring Model 1120 (or suitable equivalent) laboratory type blender will be required to prepare the span calibration fluid.

CAUTION

Do not attempt to use the system homogenizer assembly to prepare the span fluid. Correct control of the precise volumes required for the proper preparation of the span fluid cannot be achieved with the system homogenizer.

2. Microliter Syringe. Microliter syringes or pipettes will be required to prepare the span fluid.

3. Graduate. A 500 milliliter graduate will be required to measure the precise volume of water used in the preparation of the span fluid.

4. Analytical Filter Paper. A supply of Scheicher & Schuell #588, size 24 cm., fast speed, natural finish, 0.008" thickness filter paper will be required to properly prepare the sample water for use as zero and span standardization fluids. Glass fiber filters, such as GF/C from Whatman, may be used and are superior to paper filters. However, a disadvantage in using this filter is that a Buchner funnel, aspirator flash, and water aspirator must be used to pull the sample through the filter under vacuum. The advantages are that its fine particle retention capabilities are closely matched to the analyzer filter, and filtration proceeds much faster than gravity feed through paper.

5. Erlenmeyer Flask. Several 500 milliliter Erlenmeyer flasks will be required to collect, prepare, and handle the sample water during the preparation of the standardization fluids.

6. Beakers. At least two (2) one liter beakers will be required while preparing the zero standardization fluid.

7. Sample Bottles. A number of one (1) gallon bottles will be required to collect the sample for zero fluid preparation or corroborative lab analysis. The bottles should always be thoroughly cleaned before use.

5.5.2 Acquisition of Representative Oil Sample.

A representative oil must be obtained from the user to be used for calibration. When this oil is not readily available, skim off some of the oil floating on the surface of the water treatment tanks and remove water and solids with a centrifuge. Further dry over anhydrous sodium sulfate and filter.

5.5.3 Acquisition of Representative Sample Water.

The sample water is important since it may contain compounds other than oil which absorb at the measuring wavelength, causing background interference which requires compensation.

5.5.4 Oscilloscope Display of the I to E Converter Output.

The output of the I to E Converter is observed at the output of the second amplifier. The objective of this operation is to set up the optical system and the gain of the second amplifier in such a way that the analyzer keeps operating within its dynamic range, despite variations in turbidity and changes in background component levels. It is therefore important to measure these components in the sample water.

The "reference" medium against which this data is obtained is either deionized or distilled water, city tapwater, or pure ocean water in the sample cell. While the transmittance of the cell filled with different references may differ, for this purpose these are negligible. Choose the reference that is most abundantly available on the site, usually tap or ocean water, and use it as the reference water.

Connect an oscilloscope to TP2. The oscilloscope displays the measuring and reference pulses in an alternating pattern. The display is created by the light passing through the reference and measuring filters as they are brought in and out of the light beam by the rotating filter wheel. These light pulses are converted to electronic energy which is amplified and brought to TP2. The base line represents the blocking of the light beam by the opaque part of the filter wheel.

To identify which of the pulses is the measuring peak, insert a piece of flat glass or clear plastic in the light beam. The peak that becomes the shortest (retracts excessively) is the measuring filter pulse.

5.5.5 Background Signal Level Determination

1. Draw representative Zero fluid a sample from the grab sample port using valve V3 of the sample system into a clean(Hydrocarbon free) one gallon bottle.

2. Collect the sample through filters F1 and F2. This removes non-dissolved oils and solid particulates (turbidity). The filtered sample through both F1 and F2 removes both non-dissolved dissolved oils from the process fluid. The water is now free of oil and solids, and any remaining UV absorbance is caused by the non-oil background.

3. This ultra filtered water sample is called zero fluid for the process stream.

   a. Gravity feed introduce through the calibration reservoir into the sample cell this Zero fluid colected above. Record the heights of the reference and measuring peaks after identification of the peaks.

   b. Prepare a Span fluid using the same Aero fluids. See Part III, Section 5.6.2.

   Gravity feed the Span fluid into the calibration reservoir and Sample Cell. Record meter reading. Record the measuring and reference peak heights observed on the oscillioscope.

Interpretation of Observations

The upscale reading of the meter in Step b shows the relative signal level of the oil equivalent signal. The oscilloscope may show a gross imbalance of the peaks as compared to the Zero water peaks.

NOTE: The cell can be charged with zero water (filtered) (or Span) spaged sample) by pouring the fluid into the calibration reservoir.

5.5.6 Balancing the Optics for Equal Light Trans mission with Zero Fluid in the Sample Cell

The objective of this procedure is to obtain measuring and reference peak heights as displayed on the oscilloscope which are approximately equal, with the tallest of the peaks set at 7 to 8 volts. This must be done with filtered sample water (zero water) in the cell which contains background components.

The procedure is purely mechanical and consists of adjusting the amount of light passing through either the measuring or reference filter, never both. Screens (wire mesh) of varying density are used for this operation and are part of the small tool kit accompanying the instrument.

1. Observe the oscilloscope and judge if optical balancing is needed. When the difference is less than 2 volts, balancing is not required. The tallest of the two peaks should be adjusted to 7 or 8 volts with the gain control R1 on the detector PC Board. When this cannot be done because both peaks are too short or too long, search for screens mounted in the light path, usually located in a holder on the light pipe which interconnects the detector and sample module, and remove or add screens, as necessary.

2. When balancing is needed, identify the peaks as outlined under 5.5.4.

3. For example, if the reference peak is the shorter one, stop the filter wheel with the hand and see if screens are located behind the reference filter. The reference filter is identified by the letter R scribed on the filter wheel.

4. If screens are found, remove them after taking the filter wheel off the shaft with the special Allen wrench supplied in the tool kit.

5. After removal of the screens and remounting the filter, mount the filter wheel back on the shaft. Position it correctly on the shaft by lining up the two paint marks on shaft and wheel.

6. Turn on the instrument and observe the balance on the oscilloscope.

    a. If the reference peak is now too tall, remove the filter wheel and add a screen of lesser density behind the reference filter. Repeat the procedure until the peaks are within 2 volts of each other.

    b. If the measuring peak is equal to or within 2 volts of the reference peak, the system is optically balanced and ready for calibration.

    c. If the peak is still too short, repeat the procedure, but this time put a screen behind the measuring filter to shorten its peak.

7. After the peaks are balanced, adjust the gain control until the tallest of the two peaks is 7 to 8 volts. The peaks should still be within 2 volts of each other.

8. It is always good practice to operate the analyzer with as low a gain as possible. Therefore, with the gain control just barely off its stop, once again remove or add screens in the light path to obtain as high a voltage as possible without exceeding 8 volts for the highest peak. Readjust the gain for 7 to 8 volts. This concludes the balancing procedure and the instrument is ready for calibration.

5.6 Calibration with Prepared Sample

Zero and span fluids are prepared from the sample water which will be ultimately continuously analyzed.

5.6.1 Zero Fluid Preparation

1. Collect one gallon of water from grab sample port by opening V3. Make sure V4 is position down to collect sample through both F1, F2, and F3 Zero preparation filters.

2. Filter one liter of collected water to remove total oil.

3. Divide the solution into two 500 ml portions and set aside for later use.

NOTE: In the case of ultra pure water applications, obtain an oil free sample (Zero) of the steam condensate fluid, otherwise use demineralized water.

5.6.2 Span Fluid Preparation

1. Pour 500 milliliters of Zero water into the blender's container. Obtained from collecting sample out the grab sample port above in section 5.6.1

2. Calculate the number of microliters of oil that will be required to produce a span fluid of full scale concentration when mixed with the 500 milliliters of Zero water in the blender.

3. Obtain a small representative specimen of oil. Whenever possible, this specimen should be recovered from the actual sample water, so that the calibration will be as representative of the oil composition of the sample as is possible.

4. Prepare a syringe containing the number of microliters of oil calcu-

lated in Step 2. Carefully wipe off the residue of oil from the tip and outer body of the needle once the correct volume has been drawn into the syringe.

5. Run the blender with lid removed at the highest attainable speed without spillage.

6. Inject the contents of the syringe into the water midway between the center of the vortex and the wall of the blender container. Make sure oil injection happens under water, or part of the oil will be thrown against the wall of the blender container.

7. Put the lid on the blender container, bring the blender up to maximum speed, and homogenize the contents for exactly 2 minutes.

8. EMPTY THE CONTENTS OF THE BLENDER, WHICH IS NOW STABILIZED FOR ACCURATE PREPARATION OF SPAN FLUID. REPEAT THE ENTIRE PROCEDURE, THIS TIME PREPARED FROM THE COORSE FILTERED AND FINE FILTERED SAMPLE WATER SET ASIDE AT 5.6.1.4.

5.6.3 Calibration

For the most accurate results, calibration of the analyzer must be done as soon as the span fluid is made up, to avoid separation of oil and water.

The instrument, which was already prepared for manual calibration fluid introduction (See Section 5.5) and has been optically balanced on zero fluid prepared from the user's sample, is ready for calibration.

Recheck the following before fluid introduction:

1. Analyzer is in the Analyze mode.
2. Air blow down valves are turned off. (Manual Mode Required)

Calibration Fluid Introduction:

1. Introduce zero fluid through the calibration reservoir and allow to flow through all. This requires V2, V3 open and V4 (adjusted) to give flow of 50-200ccm as noticed by liquid level dropping in calibration reservoir for Zero and Span in. See 5.5, part I.

As soon as the sample cell is filled with zero fluid and the display reading stabilizes, zero the analyzer.

2. As soon as the zero fluid is about to be emptied from the reservoir, add a small amount of span fluid. Make sure that no air accidentally enters the sample system. This technique assures a quick exchange of zero fluid for span fluid and conserves span fluid. As soon as the sample cell is filled with span fluid and the display stabilizes for the analyzer span the analyzer (see Part I, Sec 5.5). The instrument is now calibrated.

Setup of Internal Span Flag Calibration

Reintroduce zero fluid through and fill sample cell and stabilize display again.. As soon as the sample cell is filled with zero fluid and the meter reading stabilizes at zero again, manually introduce and adjust the span flagreading according to the procedure outlines in section — of the 6600 Control Unit. The exact ppm value of the span filter (Flag) must be manually introduced first and ppm oil representation determined before the auto-span mode can be selected to correct any span errors from the original calibration automatically.The span flag optical filter has been chosen to give an approximate upscale reading between 50-90% of the range of the instrument. The span flag sensitivity once setup can be automatically programmed by the 6600 multiprocessor electronics to update the span sensitivity hourly during the auto-cal (zero plus span functions) of the instrument measurement. This enhanced auto-cal feature assures high accuracy is maintained between normal recommended manual field calibration using zero and span fluids which must occur within a 6 week period minimum.

Span Filter

This instrument employs a synthetic optical filter that can be operated manually or automatically which simulates the absorption characteristics of the required span fluid.

After the analyzer has been zeroed and spanned with known compositions of the appropriate calibration fluids, the span filter is setup for manual or automatic operation when introduced with a zero prepared fluid in the cell (Note: this fluid may be clean air or N2 for very clean water stream applications, i.e., clean condensates) and the appropriate equivalent absorption recorded. Use this setting for all subsequent auto calibrations involving the span filter.

Sample System

Please refer to all pertinent sections of the 6600 Oil in Water manual for operation of the Oil in water analyzer and sample system.

The sample system and analysis system are described in this manual.

5.6.4 Calibration by Correlation with Laboratory Analysis

Because of the nature of the analysis, and the unique manner in which it is accomplished, laboratory confirmation is recommended, particularly where initial calibration was accomplished with oil not actually recovered from the sample water.

The laboratory analytical method employed must be capable of detecting both dissolved and undissolved oil fractions in the sample. We recommend EPA method 413.1 (Replaced by method 1664A, gravemetric using hexane extracting solvent) for sampling and analyzing as mentioned in section 1.0 of the introduction.

Meaningful determination of the system's capabilities requires precise acquisition and processing of grab samples. Adhere to the following procedures:

1. Insure that the system is functioning correctly as described earlier in this manual.
2. Do not attempt to grab samples when the analyzer is indicating drastic changes in oil concentration.
3. Draw two 1-gallon samples from the port for grab sample opening V4 valve. Use clean containers, and fill alternately, not

individually, to insure that oil concentrations are identical in each. Two samples are used for duplicate analysis which are then averaged.

4. One minute after samples are drawn, record the meter reading, time, and date.
5. Do not allow samples to settle for any great length of time to avoid excessive adhesion of undissolved oil to the container walls.
6. Analyze both samples in the laboratory.
7. Average the results and plot versus the time and date the samples were taken. Also plot the systems oil reading on the same chart at the corresponding time.

Plot both the system and laboratory results twice a day, for four or five days, on the same graph. If the system is operating properly, and the analyzer is correctly calibrated, the system and laboratory graphs should be displaying very similar averages. If the system is operating properly, but the analyzer is off calibration, the system and laboratory graphs should be trending in the same directions, but the average of the system graph will be consistently higher or lower than the average laboratory results.

If the analytical results are consistently high or low, a corrected span setting can be derived mathematically. Note the average system and laboratory results. Calculate the percentage error existing between the two results. Note, the span setting of the control unit (refer to part I, section 3), use the calculated percentage error to calculate the new span setting.

Calculate the correction to be made to the span setting:

1. Average the chemical lab reports.
2. Average the analyzer results.
3. When the lab results differ from the analyzer results, correct the span setting:

(Lab Results) X (Span Setting)

Analyzer Results

4. Readjust the automatic zero reference point setting immediately after the change in span setting.

See the correlation table below as an example of how analyzer results and lab results are correlated.

5.6.5 Calibration of the ultrasonic homogenizer

1 Assure that the instrument has been calibrated normally. See sections 5.5 through 5.6.4.

2 Obtain a 1 to 2 liter representative grab process sample (from a steady state process condition) (ultrasonic homogenizer is "off"-power potentiometer fully counter-clockwise) from the safe vent port by operating valves V3 and V4. (Caution: be aware of any high process sample pressure when collecting the sample out of this vent).

3 Blend this process sample (500 cc) for 2 minutes in the waring blender from the calibration kit similarly to the procedure given in the calibration section 5.5 through 5.6.4.

4 once blended, pore the sample thorough the normal calibration fluid train to the safe atmospheric vent collection and record the ppm oil reading.

5 Within a short time period of a few minutes assuming the process oil concentration has not changed, adjust homogenizer as follows to the same steady state process sample reading as obtained for the calibration reading of the blended sample. This must be done at the prescribed factory sample flow rate setting.

Refer to the ultrasonic homogenizer sample flow rate setting set up at the factory and recorded in the addendum section of this manual for the proper calibration and oil response of the instrument.

6 adjust and record the "new" ppm oil reading for this power level potentiometer setting (also recorded) to obtain the same ppm oil reading of the steady state process sample recorded above in item 4.

The homogenizer is now power level calibrated to give the same ppm oil response as the calibration system while calibrated for the process sample flowrate response through the ultrasonic homogenizer.

Warning: Do not operate the "ultrasonic homogenizer" in the instrument for more than one (1) minute without a liquid sample properly flowing through the homogenizer.

Homogenizer Tuning

Follow the procedure in the manual for the homogenizer set up. The final factor power settings obtained for a 200 ccm flow rate on this system (EPA#2 oil in demineralized water) was estimated at 600 pot dial or 60% power (approx. 50 watts being used). To arrive at the field calibrated power homogenizer value based upon the unit being calibrated with the customer crude oil in process water, the homogenizer will have to be recalibrated in the field since the power setting will be different for the customers oil and water than for what TAI calibrated it for using EPA#2oil in demineralized water at the 200 ccm flow rate.

A representative collected process sample is pumped through the analyzer that has been field calibrated using the cal kit blender, etc., (p/n A48715) as outlined in this manual. This collected sample of process water is again blended for two minutes the same as the calibration samples and entered into/through the calibration reservoir through the sample cell. The reading is noted/recorded and thereafter, the homogenizer power level on the same process fluid (within a short time period from a steady state sample coming in) is tuned to the same reading as the blended sample reading recorded value. The homogenizer instrument power level is again recorded for this 6600 unit. Note the flowrate through the homogenizer is also recorded. (It should typically be recorded while the flow is controlled at 200ccc for any future calibrations. (This flow rate will give the most acceptable response times through the system).

CORRELATION

5.7 System Set-Up For Automatic Operation

5.7.1 Set-up for Automatic Sampling

After calibration with prepared samples, the system must be prepared for automatic sampling.

1. Insure that sample delivery system was checked per Section 5.4.
2. Close the utility water supply valve used for external sample line flashing.

3. Close the safety block valve V4.
4. Open the sample inlet valve V1.
5. Open the bypass flowmeter F1 fully.
6. Open sapmle the input header supply valve fully.
7. Start the user's external sample pump, when applicable.
8. Adjust the sample flowmeter until a flowrate through the bypasses and sample 5lpm/200ccm respectfully.
9. Switch the pump on, if applicable.
10. Switch the homogenizer on. (verify sample flow is 200ccm)
11. Insure that analyzer power is on and the lamp is on.
12. Make sure (or set) that the analyzer is in the analyze mode.
23. Inspect for proper pump performance. No bubbles should be visible in the pump tubing.

5.7.2 Electronics Set-up for Automatic Operation

The 6600 control unit timer should have been set on the factory. The instrument will do its first Automatic calibration three minutes after the instrument is in the Analyze mode after power up. If this does not happen, or you wish to confirm the timer setup, or wish to change the set up, check the AUTO-CAL function in the System menu of the control unit. Refer to chapter 3 of the control unit part of this manual.

6.0 AUTOMATIC OPERATION AND ROUTINE OPERATIONAL DUTIES

The system is designed to operate continuously without adjustment. Under normal conditions, once the system has been programmed for automatic operation, only routine maintenance procedures are necessary. Perhaps the most common failure encountered is a temporary outage of the power serving the system. If the power service is interrupted, the source lamp of the analyzer will restart automatically, as long as no defect has occurred in the lamp circuit and its starter. A lamp off condition can be detected by the Signal Failure Alarm circuit; the relay contacts that are switched by the circuit must be connected to the customer's indicating device. In addition, an alarm condition is indicated when the cell windows are extremely dirty or an electronics failure has occurred in the Detector-Converter, Log Amplifier or Inverter circuit. When the alarm circuit is powered independently from the analyzer power source, the alarm circuit is fail-safe and will detect power failure.

6.1 System Visual Check and Response Procedure

1. Make sure that the signal failure alarm is not in the alarm condition.
2. Check the sample pump operation and function, if applicable
3. Check to see that the homogenizer is running.
4. Check the recorder chart for a normal display, if applicable
5. Make sure that the recorder will not run out of chart or ink.

6.2 Routine Maintenance

The sample lines and components, including the measuring cell within the analyzer sample module, must be kept free of algae, debris, and undue quantities of deposited oil to insure accurate analysis.

The interval between cleaning procedures must be determined empirically, since the duration of time that the system will run without attention is directly related to the sample's condition. The frequency of attention is affected by the following conditions:

1. If the water has been bacteriologically treated, the growth of algae in the sample passages of the system is a prime consideration. This will dictate maintenance frequency or corrective action.
2. If undissolved oil is the predominant component of the sample, deposits in the system become a consideration, particularly if the concentration exceeds 50 ppm without the homogenizer, otherwise above 200ppm oil.
3. Debris and particulate matter suspended in the sample water will increase the need for frequent cleaning, since the sample cannot be filtered.
4. The zero water filter element may become clogged to the point of flow restriction, at which time it must be replaced or cleaned thoroughlly if possible with a detergent solvent. Filter element is polypropylane.

6.3 Suggested Preventive Maintenance Schedule (Application dependent)

DAILY

1. Visually inspect complete system for obvious defects, such as leaking tubing or connectors, pump failure, and the like.
2. Insure that sample pump is running and that there are no air bubbles in tubing.
3. Check that homogenizer is running.
4. Check that signal failure alarm is out of alarm condition.
5. Check for correct span setting.

WEEKLY

1. Check condition of zero filter and clean or replace as necessary.
2. Examine sample cell for dirt or oil film accumulation. Remove and clean as necessary. Clean and reassemble in a dry area to avoid condensation.

MONTHLY (or 6 weeks maximum)

1. Flush out sample system to remove dirt and oil. (Use utility water)
2. Replace tubing system if obvious deterioration or contamination ob served.

THREE MONTHS

1. Remove filter element fromcartridge holder. Wash with detergent and hot water and rinse thoroughly.
2. Flush out piping in analyzer with water or air.
   Do not clean F2, micron fine filter. If contaminated replace with new one.
3. Backflush main sample line.

4. Replace any pump malfanctioning parts as necessary.
5. Replace any tubing which cannot be properly cleaned.
6. Check calibration. Review correlation results. Adjust span setting as required. Make minor adjustments only. If serious discrepancies are encountered, use an oscilloscope to check electronics.
7. Re-configure span flag if used (especially if automatic mode used).

ANNUALLY

1. Check electronics calibration.
2. Perform correlation checks.
3. Check UV source.
4. Check solenoid valves.

7.0 SERVICE PROCEDURES AND ADJUSTMENTS

The system's electronics are factory aligned. However, when the need arises to touch up the circuitry, the following procedure is suggested.

1- Oscilloscope (dual trace preferred but not required).

To observe oscilloscope test points (see Detector Module Assembly Dwg.) switch the vertical input selector of the scope to DC.

2-DVM (Digital Voltmeter)

The PC Board Extender is used whenever trimpot adjustments must be made. Because all PC Board connectors are keyed to avoid wrong positioning in the connectors, the key must be removed and later after testing, reinstalled with long nose pliers. Turn power off during this operation.

7.1 Set up of the Signal Processing Front End Amplifiers

Fill the sample cell with air or a stable fluid, such that the photo energy which strikes the detector is constant. A stable fluid is distilled or tap water, clean ocean water or filtered and sparged sample. This step may be omitted when the system is stable in its present state.

Open the detector module for scope probe access to test points in explosion proof systems. Always keep stray light out by covering the opening with a dense black cloth. If this precaution is not taken, misinterpretation of the scope pattern results.

The scope test points on general purpose systems are located in the bottom of the detector module and accessible without opening the module.

7.2 Set Up of the I to E Converter

The I to E Converter converts the small current pulses, produced by the phototube to a voltage, the output of this amplifier goes to the input of the second amplifier which output magnitude can be adjusted by means of a gain control

R2. Its location is on PC Board 1 inside the detector module and on E.P. Analyzers.

The output of the I to E Converter can be observed, by connecting the ground lead of the scope to TS11-5 and the scope probe to TS2-1 for explosion-proof systems and TS5-1 and TS5-2 for general purpose systems.

The oscilloscope displays the measuring and reference pulses in an alternating pattern.

The display is created by the light passing through the reference and measuring filters as they are brought in and out of the light beam by the rotating filter wheel. The baseline represents the blocking of the light beam by the opaque part of the filter wheel.

To identify which of the pulses is the measuring peak, insert a piece of flat glass or Plexiglas and the peak that becomes the shortest (retracts excessively) is the measuring filter pulse.

In case the gain cannot be properly set due to either too short, too tall or too much out of balance peaks, refer to Section 1.5. Adjust R2 trimpot on PC1 until the desired peak height is obtained as observed on the scope, usually 7 to 8 volt, for the tallest of the two peaks. Never leave the system operating with peaks exceeding 10 volts or the logarithmic amplifier may saturate. No oscillations or distortions are permitted on the peaks.

The I to E Converter also has an input offset trimpot R3, which function is to offset the signal baseline slightly, to clean up the log amplifier outputs signal. Its adjustment will be covered under Section 7.1.5.

7.3 Set Up of the Logarithmic Amplifier

The amplifier is inverting and continuously takes the logarithm of the output signal of the second amplifier. The output can be observed by connecting the scope probe to TS2-3 for E.P. systems and TS5-4 for G.P. systems.

The correct wave shape must have a rounded negative going pulse which is the signal and a flat topped positive pulse which depicts saturation of the log amplifier.

No distortions or oscillations are permitted on the rounded peaks. When the positive going pulse is not flat or is distorted, adjust the offset adjustment trimpot R3 on the I to E Converter. However, adjust no more than required to just obtain a flat positive pulse. Over adjusting can result in losing part of the amplifier's capability to operate in the second decade of its logarithmic operating range and will affect the accuracy of analysis for high concentrations of the component of interest where the measuring pulse can become very short. Saturation of the log amplifier's output is due to the amplifiers incapability to take the logarithm of the slightly negative baseline.

7.4 The Inverting Amplifier

The amplifier is inverting and has a gain of 1. Its function is to invert the output signal of the logarithmic amplifier and to act as a buffer between the logarithmic amplifier and the reed switch and integrators. To observe the output of the inverter, connect the scope probe to TS2-2 for E.P. systems and TS5-5 for G.P. systems.

The wave shape must be a duplicate of that observed on TS2-2, except it is inverted.

7.5 The Integrated Reference and Measuring Signals

The reference and measuring signal at the first stage of integration can be observed by placing the scope probe across capacitors C4 and C5 respectively located at PC Board 1 in the detector unit. A dual trace scope is advantageous but not required for this observation.

The test points' significance is that they reveal proper switch action. The display shows a sawtooth pattern which is a charge-discharge of the first capacitor in the integrating network. This ripple is the AC component of the reference and measuring signal after the pulses are converted to DC. The sawtooth patterns must be displayed 180 with respect to each other as viewed with a dual trace scope. They must be both present.

If one is missing, this means that the switch is not switching.

If the sawtooth shows a broken pattern, this means the switching action is feeble or irregular.

The faulty condition of the switch can usually be corrected by moving the switch up and down or rotating it in its holder.

The magnetic mercury reed switch is activated by the action of a bar magnet and a rotating chopper disc.

An aluminum motor mounting block houses a bar magnet. This bar magnet is positioned in parallel with the mercury chopper switch.

The chopper disc is the green and black disc mounted on the filter wheel shaft next to the motor. The disc is composed of both magnetic and nonmagnetic materials.

As the shaft rotates, the magnetic portion of the disc shorts the magnetic flux as it passes between the magnet and the switch. The nonmagnetic portion of the disc will allow flux lines from the bar magnet to activate the mercury switch.

7.6 Sample Cell Maintenance

The Sample Cell needs inspection every 6 weeks. For E.P. systems, open the sample compartment and inspect the cell windows for dirt and oil film. This inspection can be quickly done by removing the external folded optyical path assembly from the main Control/Analysis Unit. Disassemble all, clean and reassemble exactly as before. Re-zero and span calibrate the unit preferably with zero prepared water and span fluids. Thereafter, recheck span flow as applicable. Reset span flag valu to new calibration values as performed during startup procedure.

CAUTION: wear UV goggles if lamp left on.

Shine a flashlight through the cell.

For G.P. Systems, open control/analysis unit and check optical train for proper beam alignment from source end to detector input.

Remove the cell assembly. Inspect the cell as described in E.P. Systems. Disassemble the cell in a dry room where needed and clean the cell with hot water and detergent.

7.7 Sample System Maintenance

The sample system can be quickly cleaned. All components are connected to the equipment panel by Swaglok type fitting. Remove all components and clean with hot water and detergent. It is recommended to renew, rather than clean the piping which makes up the sample flowpath.

7.8 Zero Filter Replacement

The system is equipped with a polypropylene element when the range is 10 ppm or less. A new filter releases small amounts of signal producing chemicals, which produce an unacceptable zero reading for this narrow range. The poly propylene filter(s) element must be cleaned and rinsed of contaminats before use. Wash thoroughly in dtergent, hot eater, then rinse capiously with very clean dimeneralized or tap water severa times before re-assembly and use. Several manual auto-zero's may be required before a stable reproducible zero is obtained. The only correct gasket material is Viton 4.

Clean througly or replace the filter element:

1. Stop the sample flow.
2. Open the zero system vent valve. This will vent most of the zero system water.
3. With an adjustable wrench, open the filter housing.
4. Replace the polypropylene filter element. Clean the element when it not appear very dirty and reinstall or replace with a spare unit. For cleaning procedure see Section 7.8.
5. After installation, with the proper care that the gaskets are in place and the filter housing properly tightened, start the sample flow. Flush the new filter element by filling and draining the filter housing with sample several times, by means of the safety vent valves, V4 and V3.

NOTE: To avoid excessive foaming, when a new polypropylene filter is installed, it is recommended to flush the filter with tap water for 1 hour prior to installation. This removes chemicals used to manufacture the filter and which cause the foaming.

7.9 316 Zero Filter Cleaning Procedure

Because of its construction, the filtering element may be recovered after use by employing the proper cleaning procedure. This procedure extends the useful life of a given element immeasurably. The procedure should be faithfully adhered to, and is as follows:

1. Remove the filter element from the housing, and the gaskets from the filter element.

2. Immerse the element in a boiling bath of 15% reagent grade caustic soda solution for30 minutes. DO NOT FLOW THROUGH THE ELEMENT AS CAUSTIC PARTICLES COULD BE REMOVED BY THE CLEANING AND FORCED INTO THE FILTER MEDIUM - THUS CLOGGING THE ELEMENT.

CAUTION: Wear protective goggles and gloves, when dealing with chemicals such as caustics or acids!

3. Neutralize the boiled filter by immersing it in a 160F bath of 10% Nitric acid for a period of not over 5 minutes.

4. Immerse the filter in a tank of flowing water and rinse until the pH of the water is neutral. Again, do not force water through the filter, but allow the water to overflow from the container holding the filter. Periodically stop the flow of water and check the pH of the water in the container holding the filter.

5. After the rinse water is verified as being neutral, remove, drain, and air dry the element. Store in a plastic container, or place back in service.

7.10 Lamp Replacement

After 1 year operation the lamp may be in need of replacement. The procedure does not require critical alignment of the optical bench; only an oscilloscope check on the front end amplifiers is recommended after replacement.

PROCEDURE

1. Turn power off to the control unit.

2. Open the source module.

3. Replace the old lamp.
4. Reassemble components in reverse .
5. Check the oscilloscope test points as described under Section 5.5.4.

NOTE: Observe eye protection warning as described under Section 3.1.1, final text.

7.11 Phototube Replacement

The phototube has a very long life and is only in need for replacement when a leak has developed in its quartz envelope, the base or around the connector on top of the tube, which is almost always caused by rough handling or mechanical shock.

1. Turn power off to the control unit.
2. Open the detector module.
3. Remove the signal cable.
4. Remove the phototube shield.
5. Replace the phototube.
6. Reassemble the components in reverse order.
7. Check the oscilloscope test point as described under Section 5.5.4.

NOTE: The phototube envelope is very thin quartz for optimum UV transmission and therefore extremely fragile. Extreme care must be taken, when the signal cable is disconnected from its top connector to avoid a leak.

8.0 TROUBLESHOOTING SECTION

8.1 The Lamp Refuses to Light

Possible Causes Remedy

1. The lamp has failed due to long service.1. Replace the lamp as per Section 7.10.

2. The power supply has failed. Remove the power supply from its mount, located in the source module and replace with a new unit.

8.2 Water Delivery Problems

8.2.1 The Water Refuses to Flow Through the Tubing

This can happens during start-up, after installation of new tubing or when the system is left dry for a long period of time particularly in gravity fed systems. The cause may be air trapped in the tubing. The small driving force used to make the water flow is not able to overcome the resistance offered by an air bubble trapped inside a dry tube.

Remedy: Force the affected tube to become wet, by opening up the connector on its down stream side and point the tube downwards to generate a siphon effect and let the water flow freely for awhile.

The tube sections most often suffering of this phenomena are the tube connection between the output of the homogenizer and the input of the deaerator and the tube connection between the zero filter output to the solenoid valve and from the solenoid valve to the input of the fine filter. The deaerator drain tube leading to the solenoid valve F_1 and SV_3 must always have a downward slope.

8.2.2 Sample Pump Failure

Refer to Pump manufacturers recommendations or maintenance.

Repair the above conditions by replacement of the defective component.

Pump trouble reveals itself usually by the malfunction of other sample system components.

1. Assume the pump is primed with water, if not prime and design inlet, go as always to have a suitable head for ease of priming the pump.

2. Turn on the pump and observe that water flows out of the tube.

3. Turn off the pump. The flow must come immediately to a stop. A slight drip of water is permissible but not more than approximately 1 droplet per 5 seconds.

4. If the drip rate is unacceptable, check for leaks or faulty connections. Take extra care in installing it.

8.3 Zero Drift Problems

1. When the recorder shows a persistent drift in one direction during the sample cycle, the drift could be caused by an exceptional long upset in the water treatment facility; this can be discriminated by operating the system temporarily with air in the sample cell. Make sure that the output of the I to E Converter displays peak heights not exceeding 10 volts.

2. Check the quality of both F1, F2, and F3, Zero filters; replace or clean as necessary.

Commissioning and Start-up Guide for Oil in Water Analyzer Systems:

Please refer to your particular piping, outline, and wiring drawings of your supplied system in the addendum portion of this manual.

General requirements for the oil in water systems are'

Notes:- Sample must be representative and single phase with no high particulates (<40 NTU) nor slugs of oil present that could plug inlet lines. Plugging may require flushing with utility water and/or disassembly of components for maintenance or cleaning.

- Sampling time delays must fit the process control requirements

A Site requirements:

1 Protection from the elements: We recommend the customer provide protection on the Enclosure (especially on an offshore platform) concerning the following: i.e., direct sunlight, wind sheltering with suitable mechanical floor and wall supports if possible.

2 Protection (shock mounts) from large vibrations such as pumps and valve operations.

3 Always continuous and free flowing with proper high enough sample inlet gravity fed lines for prevention of cavitation and easy self-priming of

pumps. (Some pumps depending upon their application requirements, may be required to supply high flow, high differential pressures, high suction (lift) or head pressures and high absolute operating pressures). Because of this and other functions, certain pumps may not be allowed to run dry. (Consult factory for recommendations on your particular pump used).

4 Recommend instrument power source be within+/- 10% of recommended nominal line voltages and current.

5 Recommend spacing be made available for maintenance and access thereof, i.e., cabinet door openings, etc.

6 Sample tap requirements:

a) Heat tracing to prevent freezing of water(s), or salt laden produced or rig-wash sample fluids

b) Proper gravity fed lines as indicated above

c) Drain openings or returns for the system that won't plug

d) Sampling probes to be placed for homogenous and representative extraction without stagnation or dead-volumes and to prevent entrained air, suspended solids withdrawal without using fine filters which could remove oil being measured.

B Installation:

1 Electrical connections-

Please refer to the Control Unit Section Part I of the manual.

a power

1 utility power (requires remote circuit breaker operation) for pumps if elected.. In the event the systems are turned off for maintenance, etc.(in particular, a bypass pump, homogenizer).

2 Sample Utility manually 3-way solenoid water valve, (selects between sample or utility water- usually operated manually).

3 Instrument power into control unit (requires external circuit breaker operation) for all autozero valves in sample system, controlled by the Instrument control unit.

Note: The cell purge solenoids may be used in a particular application, instead of zero prepared water.

b Signal and Alarm connections

1 Please refer to the Reference drawings below for connections and test points for the signals and alarms.

2 a) See Analog Outputs as indicated under Section electrical connections.

b) See also section 1 for the Analog 4-20 mA Output Calibration, setup, testing and functioning.

4 See section for the Alarms Function

a) See Alarm Relays, Section 2.2, Part I under electrical connections

c DCS connections

1 Please refer to Section 1.5 Control Unit

Interface Panel for input/output functions related to remote communications.

2 See Alarm Relays, section 2.2

3 See Digital Remote Cal Inputs for Zero and Span; section 2.2

Reference drawings

a Outline drawing (see addendum drawings)

-physical locations and sizes of electrical and sample connections

b Interconnect drawing (see addendum drawings)

-indicates where electrical connections go

3 Sample Connections

a The customer connection to the oil in water analysis system should enter in a downward position enabling a constant available gravity fed non-freezing sample with continuous flows capable of up to 5 liters per minute at pressure provided.

b Assure there are no blockages nor fine filters at the sample tap nor beyond up to the oil in water analysis system.

c Check to see that lines are properly heat traced if required for ambient temperature extremes and that the sample will not boil from being too hot (for example: (Maximum temperature allowed is:52 degrees C (limited by the plastic filter housings), Internal sample system operation Pressure limit is:150psig G for produced water). The inlet sample pressure (457 psig) is reduced by a forward pressure regulator (PR1) which is followed by a protecting relief valve in the event of failure of PR1).

d Check and familiarize oneself of the analyzer and sample system components and to assure the entire piping flow agrees with the Piping Drawing (see addendum drawings)

1 Sample connections; Refer to Piping diagram (see addendum drawings)

a inlet-

-sample enters the pump.

b returns

- sample flows through Cell then exits the system to a common return

c drain

Assure the common drain(s) is always free flowing and always at atmospheric pressure (unless back to process by suitable differential or pumping) and will never freeze or block (backup) under icy conditions.

d Grab Sample port: Refer to your particular piping scheme for obtaining the sample for analysis, etc. **OBSERVE EXTREME CAUTION** when operating any needle

valve(s) and wear protective goggles before opening grab sample valving as the outlet could exert pressures to 150 psig at this tap.

4 utility water inlet

a This feature allows flushing of the entire sampling train including the bypass loop. It is operated manually.

Reference drawings:

a Piping Diagram, (see addendum drawings)

b Outline drawing (see addendum drawings)

5 Check for shipping integrity of all components

6 Inspect all connections above for proper installation recommendations

B Start up of System

On the pump control module if applicable, assure the control switch is in the off position.

1 Check that:

a the sample pump switch is off

b Sample/utility valve is in the utility position.

2 Apply instrument power— after assurance that all electrical interconnections are correct. Refer to section 2.3 of the manual "Testing the System".

3 Preliminarily use gravity feed into pump which is set to the inlet position, and allow all air, minor particulates, etc., to be bled through the inlet bypass before the bypass pump is turned on. Once you are assured of proper sample inlet bypass cleanliness (observe water clarity of outlet to a drain), proceed as follows:

4 Turn on utility power using circuit breaker switch to systems.

5 Turn on bypass pump when applicable, and assure back-pressure regulator or recirculation loop around pump is OK for its protection. Allow 10-30 minutes of flushing inlet bypass while observing the water outlet to drain cleanliness.

7 Once assured sample inlet is proceed as follows:

a Switch on V1 using the sample/utility valve set to utility position with the same V1 open Observe the cleanliness of the utility water to the drain. (You can again also check water quality at the sample grab point).

If clear, then turn on Sample pump using sample pump power (which also turns on the homogenizer when applicable (application dependent) Allow several minutes for the sample to flush through the entire measuring train of the system to drain or safe vent.

8 Allow warm-up for 1 hour

The UV lamp in particular requires the most time to stabilize from a cold start. If the unit has been turned of temporarily for only a few minutes, warm-up can usually be reduced but observation of the output current or voltage should be checked for stability of at least +/- 1% full scale range. During the initial power-on the instrument performs an auto zero (autocal if span flag used) if AUTOCAL functions are on, so stability should be observed after the hold/ tracking output has been released (typically commences after 3 minutes when power on). See Section 3.3.9 Hold/Track setup.

C Testing the system

A Control Unit

1 Perform a self-diagnostic check of the Control Unit as indicated under Section 3.3.4 of the manual.

2 Refer to Section 2.3, Part I, for Testing of System on Control Unit.

3 Please refer to Section 3.0 for Setup parameters, operation, programming of the Control Unit.

B Analysis Unit

1 Refer to Section 2.3, Part II, for Testing of System on Analysis Unit.

C Sample Conditioning System Operation

Please read the conditioning system of part III thoroughly.

1 Starting with the Flow path entering the main sample system after the initial bypass loop, refer to the piping diagram (B74592) for the following sample train for the measuring path through the analyzer and to drain:

a *Measuring flow train*: Sample exits 3 way solenoid valve SV1.

b *Auto zero path flow train* is: Out of sample header and/or homogenizer if applicable, splits into the 3 micron Filter, thru F1 and 0.2 micron of F2 if total oil needed, then into F3 (0.2 micron filter) a continuous bypass filter then on into the sample cell, Sv1.

c The F2 0.2 micron which removes the dissolved oil. NOTE: Dissolved oil measuring is an option that the customer may so choose depending upon the need to measure total oil or only the non-dissolved oil fraction.

d Automatic cell cleaning system is built in into the sample cell design and the N2 blowback when specific to certain applications.

D Calibration

1 Review Section 5.0 thru 5.4, then proceed at 5.5 of the manual.

2 Check to assure that the blender is available for sample homogenization. See 5.5.1.

3 Continue thru sections 5.5.2 thru 5.6.3 using known specific oil encountered in the process.

4 Follow 5.6.4 for correlation to lab test results if alternate acceptable lab methods available.

E Set up of internal calibration span flag

1 See section 5.6.3 after cal fluid introduction. The span flag is then introduced into the light path of the detection system on top of the N2 background which resembles the clean steam condensate stream, etc., The set up procedure is explained in the manual under 3.3.8 of the Control Unit section.

F Set up for Automatic Sampling

Sample System

1 Follow the standard recommended procedures at indicated under 5.7.1 of the manual.

Electronics

1 Follow the standard recommended procedures at indicated under 5.7.2 of the manual.

G Automatic Operation and Routine Duties: See Section 6.0 of the manual.

Potentially a power failure could indicate a lamp failure from the instruments signal failure alarm. The relay contacts provided that are switched by the circuit must be connected to the customers indicating device, (DCS system?). In addition, an alarm condition is indicated when the cell windows are extremely dirty or an electronics failure has occurred in the detector-converter, log amplifier or inverter circuit. When the alarm circuit is powered independently from the analyzer power source, the alarm circuit is fail-safe and will detect power failure.

Please refer to final system check under Section 6.1 in the manual, Part I.

Appendix

A-1 Specifications

6600 Digital Control Module:

Ranges: Three Programmable Ranges, field selectable within limits (application dependent) and Auto Ranging

Display: 2 line by 20 alphanumeric VFD accompanied by 5 digit LED display

Signal Output: Two 0-1V DC (concentration and range ID)

Two 4-20mADC isolated (concentration and range ID)

RS232

Alarm: Two fully programmable concentration alarm set points and corresponding Form C, 3 amp contacts. One system failure alarm contact to detect power, calibration, zero/span and sensor failure.

Mounting: General Purpose NEMA enclosure with optional Z or X-Purge for Division II or I areas, or Cenelec Purge

Operating Temperature: 0-50°C

***Typical Analytical Performance Specifications*:**

(*will vary per application***)**

Accuracy:	±2% of full scale possible (Oil in Water) When calibrated on specific oil of interest.
Noise:	Less than ±1%
Drift:	Less than ±1% per auto Zero cycle (source/ detector dependent)
Sample Cell:	(Aluminum/CPVC for Oil in Water) with Sapphire/Quartz windows standard. (Kynar, Kalrez optional)
Cell Length:	1/8 to 3.5" (application dependent)
Flow Rate:	100 ccm to 2 lpm (application dependent)
Light Source:	Mercury, Hg
Sensitivity:	.08 to 1.0 absorbance units.
Reproducibility:	+/-1% of scale or better
Filter Wavelength:	210 to 1000 millimicrons. (application dependant - oil in water 254/365mm).
Sample Pressure:	150 psi maximum (oil in water applications)
Sample temperature:	1-120 °C (34-250 °F) (non freezing, non-boiling)

A-2 Recommended 2-Year Spare Parts List

Model 6600

Qty	P/N	Description
1	C-67435B	Motherboard, Control Unit
1	C-67999	Amplifier, Control Unit
1	D-67990	6600 Interface PCB
1	C-13716	Detector-Converter PCB
1	L-269	HG Source Lamp
5	F-57	Fuse, 5A Slo-Blo
2	F-14	Fuse, 10A Slo-Blo
1	P-43	Phototube
2	C87	Sample Cell Window (Quartz)
2	C128	Sample Cell Window (Sapphire)
4	O52	Viton O-Ring
2	O51	Viton O-Ring
1	A-16776	Accessory Kit
2	F1295	Fuse, 4A slo-blo
2	F9	Fuse, 1 amp
2	F68	Fuse, 3 amp
1	K101	Repair Kit
1	A48715	Cal Kit
1	S1202	Syringe w/tip

Optional: For when customer has a Filtering autozeroing system.

For high background applications --an autozero fitler system is needed to cancel out non-oil background organics, etc.

1	F1484	Element, filter of 3 micron (polypropylene)
2	F1483	Element, filter of <1 micron (polypropylene)
3	F1538	#6750 Filter replacement kit assy for F1537 Filter housing.

Note: Orders for replacement parts should include the part number (if available) and the model and serial number of the instrument for which the parts are intended.

Orders should be sent to:

TELEDYNE Analytical Instruments

16830 Chestnut Street
City of Industry, CA 91749-1580

Phone (626) 934-1500, Fax (626) 961-2538
TWX (910) 584-1887 TDYANYL COID

Web: www.teledyne-ai.com

or your local representative.

A-3 Drawing List (See manual addendum)

D-	Outline Diagram, System
B-	Piping Diagram
D-	Wiring Diagram
C-	Interconnection Diagram
A-	Interconnection Diagram
A-	Schematic - Span Filter

Generic Drawing List

B-36470	Schematic - Detector Module - Phototube
B-37533	Schematic - Detector - Converter PCB - Phototube
C-36468	Wiring Diagram - Detector Module - Phototube
C-65371	Wiring Diagram - Backpanel - Hg Source Module
B-69728	Wiring Diagram - Span Filter