MODEL 300 SUMP TESTING SYSTEM

Installation and Operations Manual

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barrett engineering

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SECTION I – INTRODUCTION

PURPOSE

Developments regarding environmental testing within the State of California have focused attention on the need for verification of containment sump integrity. Specifically, the focus is on containment sumps used in fuel distribution sites. Other states and jurisdictions are also evaluating the need for such testing.

This document presents a practical and viable method, procedure and apparatus for the verification of containment sump integrity.

The method, procedure and apparatus presented in this document are applicable to many containers, including both open and covered, vented types. In fuel distribution facilities, open sumps generally fall into three categories: 1) those used under dispensing apparatus, 2) those used above underground storage tanks and incorporating a submersible pump and 3) those used above underground storage tanks and incorporating fuel transfer or vapor recovery equipment. The method, procedure and apparatus presented should be considered for application to these types of sumps, but should not be deemed as limited in application to these specific sumps.

The detection threshold used in this apparatus is modeled on the definitions of *leak* and *tolerance* as defined by the Southern California Regional Joint Powers Authority of the California Certified Unified Program Agency (Cal-CUPA). The method and procedure presented in this document meets the requirements as understood at this time. The calculation of a detection threshold is explained later in this manual.

RESPONSIBLE PARTIES

Barrett Engineering provides equipment, technical support and service. Questions or comments regarding regulatory and application issues should be directed to Vaporless Manufacturing.

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CERTIFICATION

It has been demonstrated that the method, procedure and apparatus presented in this document satisfies the requirements for leak detection in containers, including both open and covered, vented types. The method has the advantage of being able to both detect leaks in containers and to report the actual leak rate without reference to the volume of the container under test. It has also been demonstrated that the accuracy of the reported leak rate is within reasonable and acceptable limits.

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SECTION II – DESCRIPTION OF METHOD

METHOD

The method of containment sump validation is summarized in four statements:

1. With the sump containing a test media, establish the beginning conditions of the test.
2. Let the sump remain undisturbed for the period of the test.
3. At the end of the test time, reestablish the conditions present at the beginning of the test.
4. Given the accumulated time that the sump was under test (including the time required to reestablish the beginning conditions) and given the volume of media required to reestablish the beginning conditions, calculate the leak rate using the formula: Leak Rate = (Replaced Volume) / (Total Test Time).

DISCUSSION OF THE METHOD

Following is an expanded discussion of the test method. Additional information may also be found in the sections discussing the test procedure and accuracy of the method.

To test for the presence of a leak, the sump must be filled with a liquid test media. It is the goal of the method to monitor for the loss of media through any leak point(s). For proper operation the test media must be electrically conductive. Typical medias would include, but not be limited to, water, water containing a surfactant (surface active agent), and non-toxic antifreeze fluid (either diluted or undiluted).

The sump must be filled to a level specified by regulatory protocols. The fill level is generally referenced to the penetrations and seals contained within the walls of the sump. The SoCal-CUPA guidelines state that this level is to be two inches above the highest piping penetration. The definition of *piping* includes utilities for product, vent, vapor or siphon. Note that the guidelines do not specify explosion proof electrical boxes or conduit which may not be watertight. It is recommended that the technician be informed regarding the guidelines applicable in the local jurisdiction.

It is a feature of the method that, having completed an initial test with negative results (i.e. leak present), the level of the media may be reduced and another test conducted. The results of the second test may give insight to determine the general location of the leak. Subsequent tests with various media levels may be conducted to further localize the leak.

Having manually established the initial level of the test media, the system controller will automatically establish the beginning test conditions with reference to a senor which has been positioned in the sump by the technician. This is done by transferring media between the calibrated vessel and the sump until a precise initial condition has been established.

The controller accepts sump surface area information provided by the technician. The controller will allow the entry of sump areas between a minimum of 1 square foot and a maximum of 13 square feet. This information is used by the controller to established leak threshold values, other operating parameters and calculated results.

The minimum total elapsed time for a test is set within the application software at 15 minutes. This test time is divided in half resulting in two consecutive tests segments of equal duration. Process information is collected at the mid-interval to verify test performance.

During a test the media in the sump remains undisturbed and is allowed to escape through any leak point at a rate determined by the geometry of the leak point, the head pressure produced by depth of the media in relation to the leak point, and the viscosity and surface tension of the media.

Following expiration of the segment test time, the controller will reestablish the condition present at the beginning of the test. This is accomplished by first drawing media from the sump to void the sensor and then transferring the media from the vessel back to the sump to reconstruct the precise condition established at the beginning of the test. If no media is lost during the test, the volume in the calibrated vessel will return to the same point as established at the beginning of the test. If media leaked from the sump during the test time, the volume in the calibrated vessel will be less than that established at the beginning of the test. Volumetric readings from the calibrated vessel are entered into the controller by the technician. The time elapsed during this process will be automatically calculated by the controller and added to the total test time.

Now given the accumulated time that the sump was under test (the sum of the test time and the time required to reestablish the initial condition) and given the volume of media required to reestablish the condition present at the beginning of the test, the controller automatically calculates the leak rate using the formula: Leak Rate = (Replaced Volume) / (Total Test Time).

A leak rate is calculated independently for each consecutive test segment. Additional tests will be automatically executed until the calculated leak rates of two consecutive test segments falls within the stability factor established in the software. When this occurs, the leak rate detected over the latest two test segments will be calculated and displayed. This will end the test.

In addition to the leak rate, the equivalent media displacement value and total elapsed time for the test will also be displayed. Refer to *Section V - Test Procedure* for additional information

The reported units of measure are established in the controller's application software. In the current version, leak rate is reported to a resolution of 0.0001 gallons per hour, displacement is reported to a resolution of 0.001 inches and elapsed test time is reported to a resolution of 0.1 minutes.

Calculated rates that are lower than the test threshold are interpreted as a *pass*.

Rates in excess of 1 gph in any test segment are indicated by the message *Leak > 1 gph* and the test it is automatically terminated.

Negative leak rates caused by the ingress of water can also be detected and reported. Rates exceeding -1 gph are indicated by the message *Leak > -1 gph* and the test is automatically terminated.

Negative leak rates greater that the test threshold, but less than -1 gph, are indicated by the message ** *Media Ingress*.

DETECTION THRESHOLD CALCULATION

According to the SoCal-CUPA guidelines, any detected or calculated leak is to be reported. The goal is the detection and correction of all leaks; the presence of a leak is unacceptable.

In the guidelines it is also understood that there are tolerances associated with the measurement of any variable. The tolerance for level measurement is ±0.002 inches. This tolerance is independent of the surface area or volume of the sump. Using this tolerance as a mathematical basis for threshold detection margins, the controller calculates a detection threshold which is linked to the surface area of the sump. This value is used to determine the pass/fail criteria of the calculated leak rate.

ACCURACY OF METHOD AND APPARATUS

Factors affecting the accuracy of the leak rate calculation fall into four categories:

1) relating to the precision of the sensor and controller performance,
2) relating to the size of the sump under test (more accurately stated, those relating to the magnitude of the surface area of the sump),
3) relating to thermal effects acting on the media, and
4) relating to physical deformation of the sump due to loading by the media.

Apparatus Performance

1. It has been demonstrated that the equipment under consideration is capable of detecting level changes which comply with the SoCal-CUPA guidelines. This is to say that the media level in a sump can be reproduced repeatability as necessary to produce a valid leak rate calculation.
2. It is observed that there are conditions under which external physical disturbance results in the formation of ripples on the surface of the media. The sensor has been designed with a double baffle which blocks the transfer of this ripple action to the conductive probe elements. This has been shown to affectively block ripple which is produced external to the sensor.
3. It is also be observed that there are conditions under which external disturbance results in vibrations which are transferred through the sensor mounting mechanism and therefore directly to the probe assembly. Under these conditions, this disturbance results in the creation of ripples within the baffles of the sensor. This could produce erroneous level detection due to the sensitivity of the detection interface. While it is difficult to quantify this error, it does influence system performance and the resultant calculated leak rate. To combat this problem, a software filter has been implemented which averages large scale vibration effects over time. This filter does function as intended with the result that system performance is maintained.

Influence of Sump Size

1. An important feature of the method is that it is not required to know the volume of media contained by the sump in order to detect a leak and accurately report its rate. However, the surface area of the sump does have an indirect bearing on the precision of a test. Reasonable care should be taken in calculating the sump surface area.
2. The larger the sump surface area, the larger the volume which must be removed to cause the surface to be displaced such that the sensor can be voided and then reengaged. This condition in itself is not relevant, but rather that the larger the surface area, the slower the level will change for a constant media transfer rate. It has been noted that when the media's surface level changes very slowly, the interaction between the media and the probe elements, often referred to as capillarity caused by surface tension, has opportunity to introduce error due to the inconsistency of the wetting action at the molecular level. Particular attention has been given to the sensor design to minimize error introduced by this phenomenon.
3. Because of the limitations presented above, it has been determined that the system as presented should not be used to monitor containers with a surface area of greater than 13 square feet. While the method is theoretically applicable to containers with larger surface areas, it is suggested that additional evaluation be undertaken to approve such application.

Thermal Effects

Most materials which might be used as a test media exhibit a significant coefficient of thermal expansion. Contraction or expansion of the media during the test time will introduce an unobserved error into the rate calculation.

As described in this document, the total test time has been divided into two consecutive, but independent segments. If the calculated leak rates for these tests are within the stability tolerance established in the software, it is determined that the system is stable. At this point a new rate calculation is made across the two test segments. This is the rate presented as the result.

If the leak rates for the two segments do not match to the desired tolerance, subsequent tests are initiated until the require stability is achieved. Using this method, the system determines stability before presenting test results.

Sump Deformation

The addition of media to a containment sump causes the sump to deform. This is directly due to the weight of the media which can be greater than 2,000 pounds in the case of larger sumps. The time for this deformation to stabilize is not easily calculated and is influenced by sump material, media weight, media and surround temperatures, support method, and other factors. Deformation of the sump has a direct affect on the level of the media and therefore a direct affect on the determination of a leak rate.

As indicated above under *Thermal Effects*, the total test is divided into consecutive test segments which must exhibit leak rates to within a specified tolerance. Using this method, the system determines stability, including sump deformation, before presenting test results.

Surface Tension Effects

As noted under *Influence of Sump Size*, surface tension can introduce errors due to inconsistency of the wetting action of the media. The application of a surfactant (surface active agent) to surface of the media will tend to minimize this error. A detergent product such as Simple Green may be used for this purpose. However, surfactants with more aggressive properties are also available. Contact Barrett Engineering for additional information.

BENEFITS OF THE METHOD

Following is a brief discussion of some of the benefits of the method. Refer to the section on accuracy for additional information and benefits.

The method, process and apparatus combine to reliably detect and quantify a leak rate and to accurately report leak rates within the defined thresholds. This is in contrast to devices and procedures which only measure media displacement without any reliable and quantifiable reference to volume.

The method, process and apparatus combine to allow the detection of leak rates from a variety of sumps and other containers, including both open and covered, vented types.

The method is equally applicable to sumps or vessels to which a conductive media is added and to containers using their normal product as the media, as long as the normal media is conductive.

SECTION III – DESCRIPTION OF APPARATUS

The Model 300 Sump Leak Tester is packaged as three subassemblies:

1) Control Module,
2) Sensor Kit, and
3) Calibrated Vessels.

Control Module — The Control Module forms the heart of the test system. This micro-computer driven controller contains the operator interface and peristaltic pump assembly. The operator interface includes a keyboard and 16-character alphanumeric display. The keyboard is used to direct the test process and to enter operating parameters. The display is used to communicate system status and to confirm the entry of parameters.

The Control Module is powered by a 12 volt battery. This battery may be recharged using the charging module provided with the system. The battery is replaceable allowing it to be recharged while continuing operation with a second battery. This design choice was made to prevent the possible presence of 115 Vac in a potentially hazardous environment at the test site.

An optional battery powered printer is available which can produce a hard copy record of test results. A battery charger and interface cable are also provided

Sensor Kit — The Sensor is suspended in the sump during the test procedure. The sensor contains two conduction elements which are used to detect the liquid media. The sensor's cable plugs into the Control Module which supplies an intrinsically safe voltage to the detector elements. The ferromagnetically coupled design of the interface provides full galvanic isolation in addition to passing minimal current through the media. This eliminates any electrolytic action and provides reliable level sensing even under conditions of deposit build up on the probe elements.

The Sensor Kit also contains hardware which is used to suspend the probe in the sump. This hardware consists of several types of metal rods and connection clamps which are used to suspend the sensor in a range of sump sizes and shapes.

Additionally, the Sensor Kit contains two lengths of plastic tubing which connect the pump located on the control module to the calibrated vessel and the sump under test. It is through this tubing that the media is transferred between the calibrated vessel and the sump.

The sensor is provided with ten feet of cable. This cable is long enough to accommodate mounting of the sensor in all sump sizes and shapes.

Calibrated Vessels — The test method is based on the delivery of an accurately quantifiable volume of media to the sump under test. This volume is taken from the calibrated vessel and transferred to the sump using the peristaltic pump which is incorporated into the Control Module. Two vessels are provided. The larger has a capacity greater than 1200 ml, while the smaller has a capacity exceeding 360 ml.

The vessels include shut-off valves to facilitate relocation of the system without emptying the vessel.

As described in the method statement and discussion, following the completion of the test time the system can calculate a differential volume by comparing the beginning volume reading and the ending volume reading of the media in the vessel. This data is used to calculate the leak rate.

SECTION IV – SETUP PROCEDURE

Following is a description of the apparatus installation procedure.

1. Prepare access to the sump to be put under test including filling it with the test media.
2. Using the elements provided in the sensor kit, securely install the probe in the sump at a level which meets regulatory requirements. The sensor should be positioned so that the cable exits the top of the assembly. The line located near the bottom of the sensor is used as an approximate reference for the final level of the media.
3. Locate the control module and the calibrated vessel in proximity to the sump.

> *Technical Note:* Two sizes of calibrated vessels are provided with the system. The smaller will contain more than 360 ml of media, while the larger will contain more than 1200 ml of media. It is recommended that the smaller be used on sumps of 5 square feet or less, while the larger is appropriate for sumps measuring more than 6 square feet.

4. Insert the sensor's cable connector into the jack located on the left side of the control module.
5. Push the end of the long transfer tube onto the upper fitting of the pump housing located on the front of the control module. Suspend the weighted end of the transfer tube below the media level in the sump.
6. Connect the short piece of transfer tubing from the lower fitting of the pump housing to the discharge valve on the calibrated vessel.
7. Fill the calibrated vessel with the selected media. Make sure that the valve on the calibrated vessel is in the OPEN position.
8. Move the POWER switch located on the front panel of the control module to the ON position. The display will present an initial message:

   Tester Model 3xx

   where xx represents the revision level of the control module and software.
9. After a delay of approximately six seconds, the general welcome message will appear in the display:

   Sump Leak Tester
10. Pressing the PURGE push-button on the control panel will activate the pump and allow media to be transferred from the vessel to the sump. Continue operation of the purge process until all air has been flushed from the transfer tubing. Refill the vessel as needed.
11. Adjust the location of the sensor until the PROBE lamp turns off. It is important to find the point where the lamp changes from the on-state to the off-state.
12. This completes the system set-up procedure.

SECTION V – TEST PROCEDURE

Following is a description of the system operating and test procedures.

1. *General Note:* The control module will emit three types of audio responses as outlined below:

   a. A single short tone is emitted to acknowledge an appropriate operation of a keyboard push-button.

   b. A series of three short tones is emitted to acknowledge an inappropriate operation of a keyboard push-button.

   c. A single long tone is emitted to prompt the operator for data input.

2. Push the START push-button to initiate the sump test procedure. The controller will respond with a long tone and the display will present the area request message:

   Sump Area= 00 sf

3. Using the numeric keys on the keyboard, enter the requested information. The selected numeric value will be placed in the least significant location in the display after shifting the current digits to the left. After the desired value, in whole integers, appears in the display, push the ENTER push-button.

   > *Technical Note:* When calculating the surface area of the sump in square feet use the following equations.
   >
   > For square or rectangular sumps:
   >
   > Area = Length (ft) x Width (ft)
   >
   > For circular sumps:
   >
   > Area $= \pi d^2 / 4 \approx 3 d^2 / 4$
   > where d is in feet
   >
   > It is recommended to round up fractional results to the next larger integer value.

   The controller will allow the entry of area data ranging between a minimum of 1 square foot and a maximum of 13 square feet. When the ENTER push-button is activated, acceptable values will be acknowledged by a single short tone. If a value less than 1 is entered, the controller will automatically adjust the area up to 1. If a value greater than 13 is entered, the controller will automatically adjust the area down to 13. Values which have been adjusted will be acknowledged by a series of three short tones. In all cases the controller will proceed with the test.

   During the data entry process, if an incorrect value is enter into the display, simply continue to enter digits until the correct value is in the display or push the RESET push-button to clear the display to zero. A new area value may now be entered using the normal process.

   If the RESET push-button is activated with 00 showing in the display, the test procedure will be aborted and the display will again present the general welcome message.

4. Following entry of the area value, the pump will automatically start in the CW direction. Media will be transferred from the sump to the calibrated vessel until the media level drops below the sensor's detection level. When this occurs the PROBE lamp will turn on. During this process, monitor the media level in the vessel and deal with any overflow. Over filling the vessel at this point in the test will not void the procedure.

5. When the sensor has been voided, the pump will stop and then restart in the CCW direction. Media will be transferred from the vessel to the sump until the media level is detected by the sensor. At this time the PROBE lamp will turn off, the pump will be stopped, and the precise initial conditions will have been established.

6. If the RESET push-button is activated during the fill cycle, the test will be aborted and the display will present the message:

   Test Man Aborted

   Pushing the RESET push-button will clear this message and present the welcome message.

7. When the level has been established, a message requesting the beginning volume reading will be displayed. The operator will be prompted by a long tone.

   Begin Value= 000

   Using the numeric keys on the keyboard, enter the beginning volume as read from the calibrated vessel.

   > *Technical Note:* It makes no difference whether the reading is referenced to the top or bottom of the meniscus. It is only important to be consistent in the method of reading the volume.

   The data entry procedure is similar to that outline above regarding the entry of the sump area. Pushing the ENTER push-button will complete the data entry process. Pushing the RESET push-button with data in the display will clear the entry to zeros. Pushing the RESET push-button with zeros in the display will abort the test procedure.

   Because the test is actually in process during this procedure, it is important to provide information in a timely manner. The operator will be prompted every thirty seconds using an audio tone until the data entry process has been completed.

8. Following entry of the beginning volume value, the display will present a message indicating the remaining time in the current test.

   Rem Time= xx min

   where xx represents the remaining test time.

9. During the test, the process may be terminated by pushing the RESET push-button. The display will present a message indication that the test was manually aborted. This message may be cleared by again pushing the RESET push-button.

10. Following the expiration of the test time, the pump will be started in the CW direction. This will transfer media from the sump to the calibrated vessel. This is done to guarantee that the initial conditions can be reproduced, even in the case of a tight sump (i.e. no leak present).

    This process has two phases. First, the pump is run until the PROBE lamp indicates that the media is below the sensor's detection level. Observe that the vessel is not overfilled during this process. If this occurs, the test will need to be rerun starting with a lower media level in the vessel.

    As is true with all other phases of the test cycle, the RESET push-button may be used to terminate the test.

11. When the CW pump process has been completed, the pump will be started in the CCW direction. This will transfer media from the vessel to the sump. This phase of the process will run until the media reaches the sensor's detection threshold. Observe that the vessel does not run out of media. If this occurs, the test will need to be rerun starting with a higher media level in the vessel.

    As is true with all other phases of the test cycle, the RESET push-button may be used to terminate the test.

12. When the level has been reestablished, a message requesting the ending volume reading for the current test will be displayed. The operator will be prompted by a long tone.

    EndingValue= 000

Using the numeric keys on the keyboard, enter the volume as read from the calibrated vessel. The data entry procedure is similar to that previously outlined.

Pushing the ENTER push-button will complete the data entry process. Pushing the RESET push-button with data in the display will clear the entry. Pushing the RESET push-button with zeros in the display will abort the test procedure.

13. If required, the controller will automatically initiate a new test. At the end of the test time, the controller will reestablish the media conditions as previously described. The operator will then be prompted for an ending volume value as described above.

14. This process will continue until the controller verifies that the calculated leak rates for two consecutive tests are within the stability tolerance. When this condition exists, the controller will calculate and display the total leak rate for the two combined test segments.

    Several outcomes are possible as indicated below.

    a. If the leak rate is less than the rate threshold for the given sump size:

       Leak Rate = Pass

    b. If the leak rate is greater than the rate threshold, but less than 1 gph:

       Leak = .xxxx gph

       where .xxxx represents the leak rate.

    c. If the ending volume is greater than the beginning volume and the absolute value of the leak rate is greater than the threshold, but less than 1 gph:

       ** Media Ingress

    d. If a leak rate of greater than 1 gph was detected in any test, the test will be automatically terminated and the following message displayed:

       ** Leak > 1 gph

    e. If a leak rate of greater than -1 gph was detected in any test, the test will be automatically terminated and the following message displayed:

       ** Leak > -1 gph

15. Given a successful test result, the calculated displacement and elapsed time for the test will also be presented on the display. The three messages are cycled on the display at three second intervals. This process will continue until the RESET push-button is activated returning the controller to the initial state.

    a. If the leak rate indicates *pass*, the displacement message will read:

       Disp < .002 inch

    b. If the leak rate is greater than the test threshold, the displacement message will read:

       Disp = .xxx inch

       where .xxx represents the displacement.

    c. The elapsed time message will read:

       TestTime = xx.x m

16. This completes the system test procedure.

> *Note:* Refer to Section VI for information regarding the printing of test results.

SECTION VI – PRINTING TEST RESULTS

OPTIONAL PRINTER

A compact and lightweight portable thermal printer with a serial data interface is provided as optional equipment to the Model 300 Sump Testing System. This printer is powered from internal rechargeable batteries. A recharging unit is supplied with the printer. An interface cable is also supplied with the printer.

INSTALLING THE PRINTER

1. Plug one end of the interface cable into the data port on the right side of the control module.
2. Plug the other end of the interface cable into the data port on the back of the printer.
3. Move the power switch on the left side of the printer to the forward position. The printer will respond by advancing the paper one line and the power lamp light.
4. This completes the installation procedure.

> *Technical Note:* Do not change the settings of the dip switches located on the left side of the printer. This will change the parameter settings of the printer and will most likely render it dysfunctional.

> *Technical Note:* The printer may be powered directly from the battery charging module. To operate in this mode plug the charger into the connector on the left side of the printer and move the power switch towards the rear of the unit.

> *Technical Note:* A fully charged battery will give approximately two hours of continuous printer operation.

PRINTING TEST RESULTS

1. Two categories of test results may be listed on a printout:
   - Tests which result in a *pass* decision.
   - Test which result in a valid leak rate.

   All other results indicating a major sump failure are not available to the printer.
2. The test result may be printed following the end of the test while the END indicator is illuminated. The test result may also be printed following the end of the test and after the RESET push-button has been activated. Once the START push-button has been activated to initiate a new test, results from the previous test are no longer available to the printer.
3. A test's result may be printed at the appropriate time by operating the PRINT push-button on the keyboard.

PRINTOUT FORMAT

```
Sump Leak Tester  Model 300
   Barrett Engineering
      Fortuna, CA

Site: ____________________
__________________________
__________________________
Sump: ____________________
__________________________
Date:   06/21/2002
Time:   16:13
Rate:   Pass
Disp:   <.002 inches
Elap:   15.9  minutes

Tech: ____________________
```

SECTION VII – SETTING TIME-OF-DAY CLOCK

Following is the procedure for setting the time-of-day clock. The date and time appear on the optional printed test result report.

1. With the WELCOME message present in the display, push the CLOCK push-button. The YEAR message will appear in the display.

   Enter Year: 1980

2. Using the numeric buttons, enter the four digit code for the year. Error checking is applied to the year entry. Only the numbers from 1980 through 2047 are valid.

   If an error in data entry is made simply continue to enter numeric data until the correct information is in the display.

   Pushing the RESET push-button will terminate the data entry process and return the welcome message without changing the date and time information in memory.

3. Push the ENTER push-button to advance the process to the MONTH entry.

   Enter Month: 01

4. Using the numeric buttons, enter the two digit code for the month. Error checking is applied to this entry. Only the numbers from 01 through 12 are valid.

5. Push the ENTER push-button to advance the process to the DAY entry.

   Enter Day: 01

6. Using the numeric buttons, enter the two digit code for the day. Error checking is applied to this entry. Only the numbers from 01 through 31 are valid.

7. Push the ENTER push-button to advance the process to the HOUR entry.

   Enter Hour: 00

8. Using the numeric buttons, enter the two digit code for the hour. Error checking is applied to this entry. Only the numbers from 00 through 23 are valid.

9. Push the ENTER push-button to advance the process to the MINUTE entry.

   Enter Minute: 00

10. Using the numeric buttons, enter the two digit code for the minutes. Error checking is applied to this entry. Only the numbers from 00 through 59 are valid.

11. Push the ENTER push-button to advance the process to the SUMMARY screen.

    01/01/1980 00:00

12. Push the ENTER push-button to accept and record the displayed data. Push the RESET push-button to reject the displayed data and to not change the information in memory.

13. In either event, the WELCOME message will be displayed.

    Sump Leak Tester

14. This completes the date and time programming sequence.

SECTION VIII – MAINTENANCE

REPLACING PAPER ROLL

The printer uses rolled thermal paper with a width of 2.25 inch (59 mm). This paper is available at retail office supply stores.

1. When the paper roll needs replacing, open the paper cup lid (see figure below) and remove the remaining paper using the PAPER FEED push-button. **Do not pull paper out of the rear of the printer mechanism**.
2. Reel off an inch of paper from the new roll and check that the end has a clean angled edge (see figure below).
3. Slide the leading edge of the paper through the paper entry slot, with the leading edge of the paper feeding forwards from the bottom of the roll until you feel resistance.
4. Press the PAPER FEED push-button and feed the paper through the printer mechanism (see figure below).
5. Keep the button depressed until enough paper is fed through the mechanism to pass through the paper exit slot.
6. Put the new paper roll in the paper cup and close the lid.

Fig 3: Squeeze cup lid to gain access to paper roll

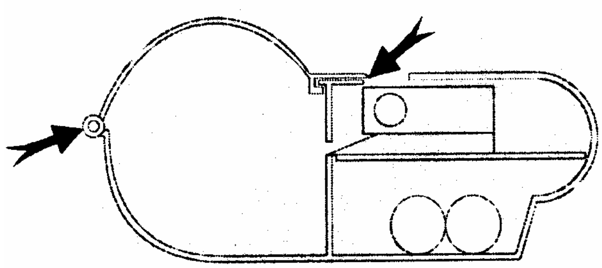


Fig 4: Cut the end off the paper roll so that the end has a clean angled edge

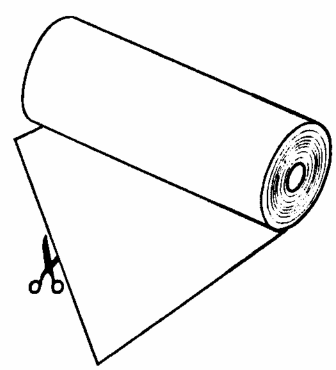
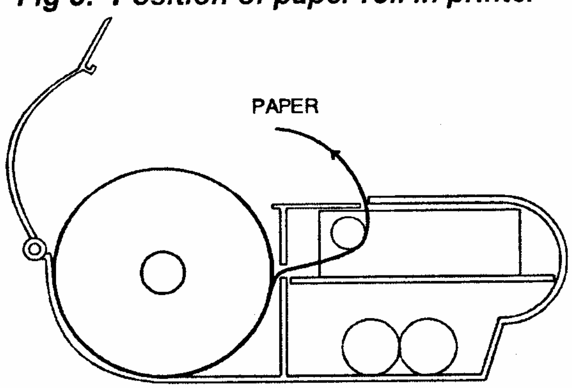


Fig 5: Position of paper roll in printer



REPLACING CONTROLLER'S BATTERY

The Control Module's battery must be removed for replacement or recharging.

1. Place the control unit face down.
2. Loosen the two thumb screws located on the bottom of the unit.
3. Swing the battery cover back giving easy access to the battery.
4. Unplug the battery's power connection. Try not to pull on the wires; grip the body of the connector.
5. Lift the battery out of the enclosure.
6. Replace the battery by following the procedure in reverse order. Make sure that the thumb screws are securely fastened before turning the unit right side up.

RECHARGING CONTROLLER'S BATTERY

The Control Module's battery is rechargeable. The battery must be removed from the module in order to be recharged.

Recharging should be done in a non-hazardous environment.

1. Remove the battery from the control module.
2. Using the charging unit with the connector which mates to the battery's connector, plug the charger's connector onto the battery's connector. Note that these connectors have shapes which indicate polarity. **Do not attempt to force the connectors together in reversed polarity.** Doing so will cause damage to the battery and charger and may cause personal injury.
3. Plug the charger into a standard 115 Vac wall outlet. The battery is now being recharged. It may take six to eight hours to recharge a fully discharged battery.

RECHARGING PRINTER'S BATTERY

The printer (optional) contains a rechargeable battery. This battery cannot be removed from the printer and is recharged in place. The BATTERY status indicator on the printer will light when the battery is in nearly exhausted.

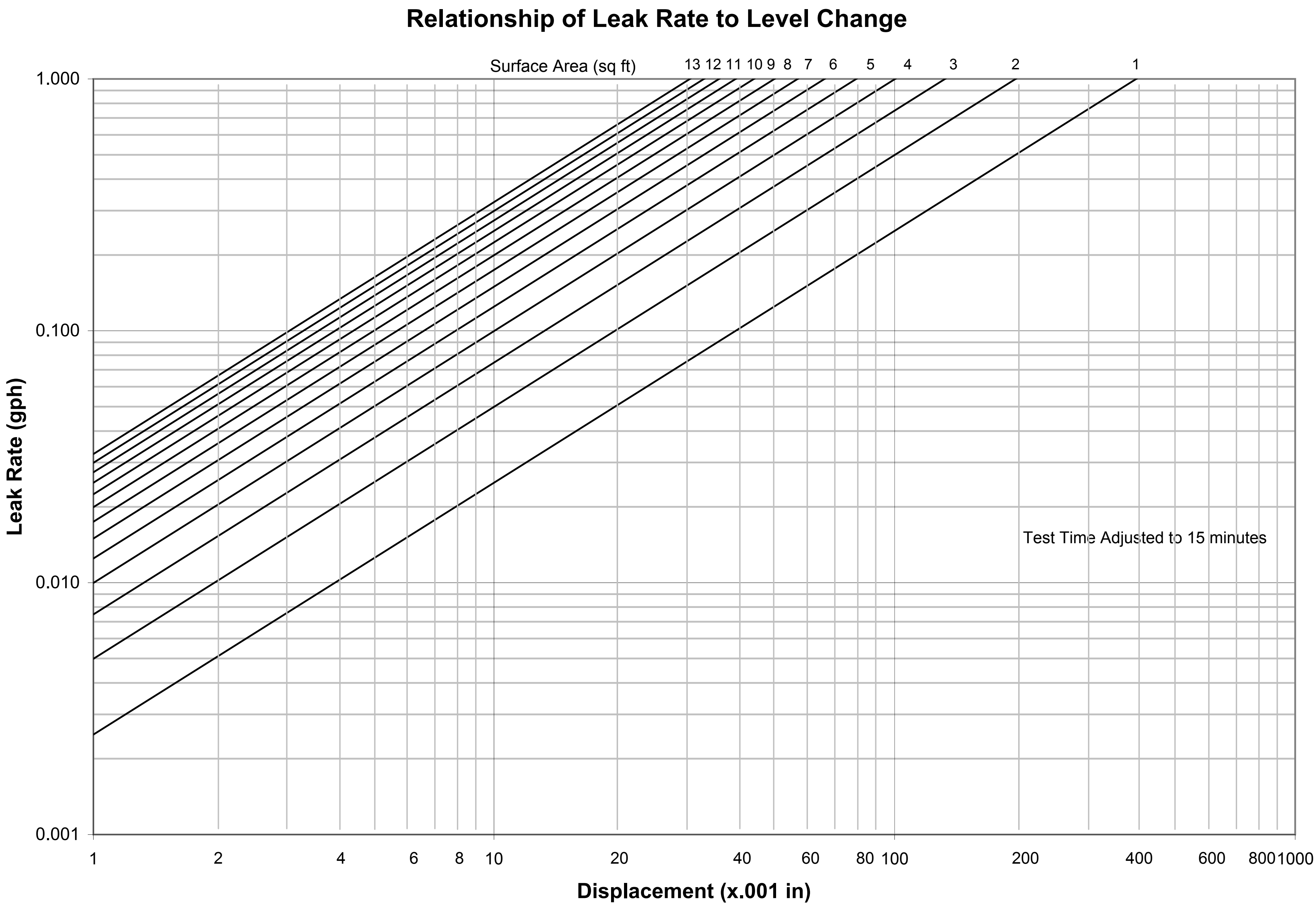
Recharging should be done in a non-hazardous environment.

1. Plug the printer's charger into the connector on the left side of the printer.
2. Plug the charger into a standard 115 Vac wall outlet. With the power switch on the left side of the unit in the middle or back position, the battery is being recharged. It may take 16 hours to recharge a fully discharged battery.
3. The printer may be operated while the battery is charging. Refer to Section VI for details.

DEEP SUMP PROBE CONFIGURATION

The sensor may be positioned at depths of up to 24 inches below the top of the sump using the hardware provided with the sensor kit. For deep sump applications use the following procedure.

1. Purchase a 3/8" diameter by 6 foot long aluminum rod from your local hardware store.
2. Attach the sensor in the normal manner near the end on the rod.
3. Slide the manway clamp supplied with the sensor kit onto the rod.
4. Lower the assembly into the deep sump and secure the clamp to the fiberglass manway using the thumbscrew.
5. Adjust the rod so that the sensor is properly located and secure the rod using the thumbscrew.


Relationship of Leak Rate to Level Change
Surface Area (sq ft)
13 12 11 10 9 8 7 6 5 4 3 2 1
1.000
0.100
0.010
0.001
Leak Rate (gph)
1 2 4 6 8 10 20 40 60 80 100 200 400 600 800 1000
Displacement (x.001 in)
Test Time Adjusted to 15 minutes

System Component List

1 Control Unit
2 Carrying Strap
3 Battery, spare (optional)
4 Battery charger, control unit
5 Printer (optional)
6 Printer cable (optional)
7 Battery charger, printer (optional)
8 Probe assembly
9 Support rod, 12”
10 Support rod, 24”
11 Support bar, 24”
12 Cross clamps
13 Manway clamp
14 Spring clamps
15 Calibrated vessel, 1200 ml
16 Calibrated vessel, 360 ml
17 Sump filling tube, 10’
18 Vessel connection tube, 3’
19 Operation Manual (not shown)