

*Continuous Weighing Monitor Systems*

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1	DESCRIPTION
2	THEORY
3	INSTALL/START
4	OPERATION
5	CALIBRATION
6	DETECTOR
7	ELECTRONICS
8	OPTIONS
9	REGULATIONS
10	DRAWINGS



**Chapter 1** provides a general overview of Ronan's Retrofit Units.

In most cases, Retrofit Units supply Ronan Detectors and Electronics to existing source/holders.

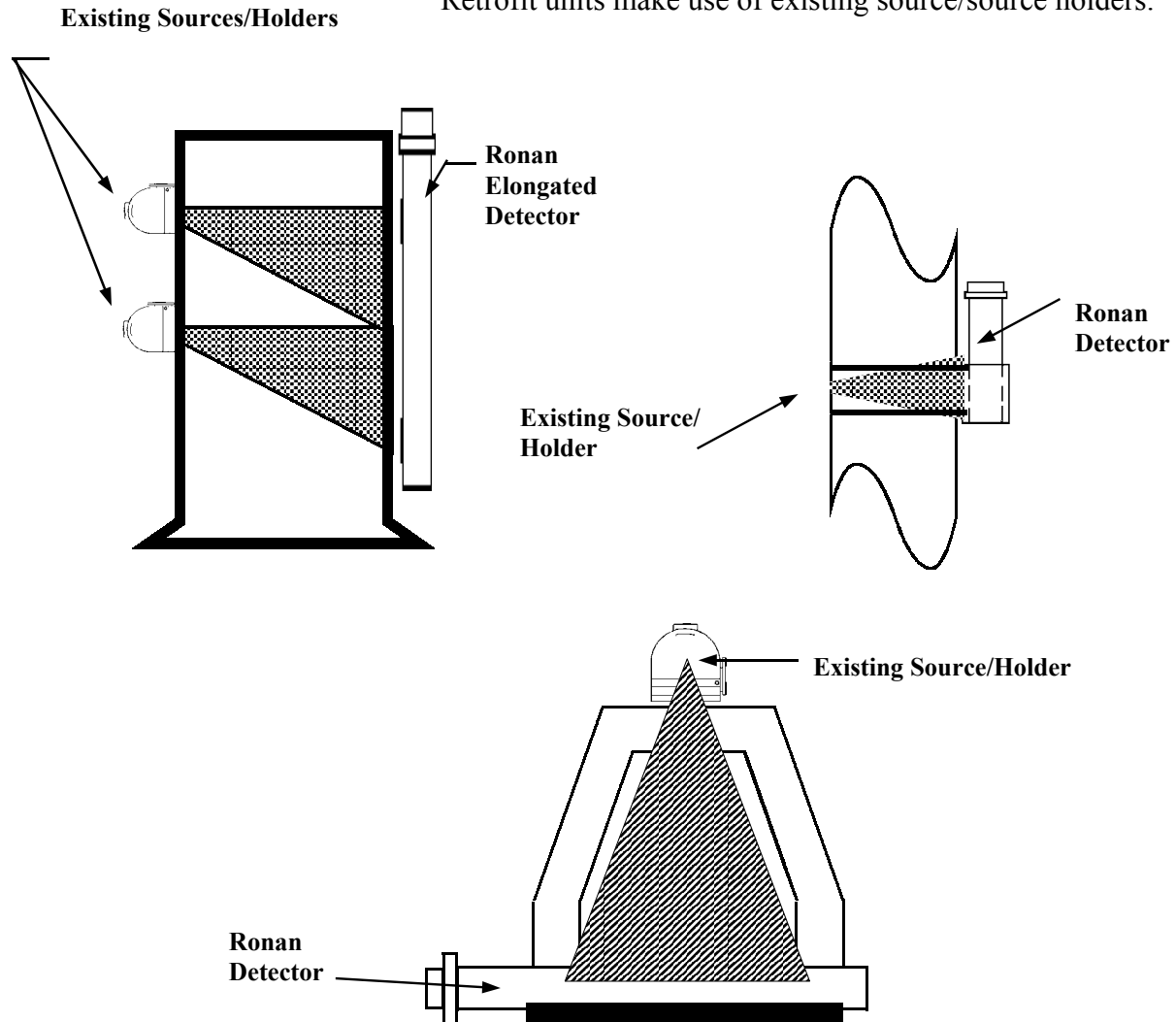
- 1.0 System Description
- 1.1 System Configuration/Components
  - Detector
  - Microprocessor
  - Cable



## System Configuration

The user's application determines the system configuration requirements. Ronan's detector and electronics can be retro-fitted to update Level, Density, and Weight monitoring systems.

Retrofit units make use of existing source/source holders.



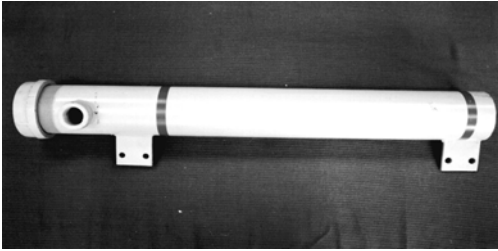
## System Components

Many system configurations are available for a number of different retrofit applications. However, in most cases there are at least three major components included with each Retrofit Unit:

- Detector
- X96N Microprocessor
- Interconnect Cable

## Detector

The detector, which may be either an ion chamber or scintillator, is mounted in a protective housing. When radiation from the source strikes the "active" length of the detector a signal is generated.

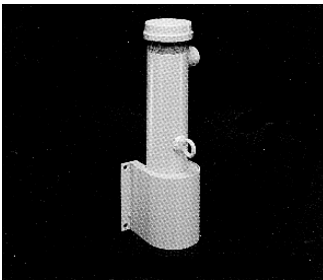


The active length of the detector corresponds to the full measurement range of interest, and is designated by bands of tape at the top and bottom of the detector housing.



The *ion chamber* detector produces a picoampere current that is converted into a voltage signal, amplified, and sent to the microprocessor.

The *scintillation* detector produces a light pulse that is detected by a phototube, converted into an electrical pulse, amplified, and sent to the microprocessor.

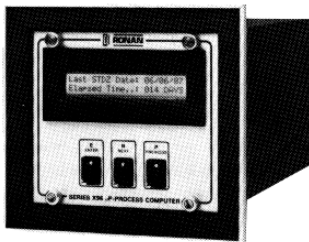


Chapter 6 contains more information about the detector that is supplied with your retrofit unit.

## X96N Microprocessor

Ronan's X96N Microprocessor electronically manipulates the detector output signal and displays the results in a useful format.

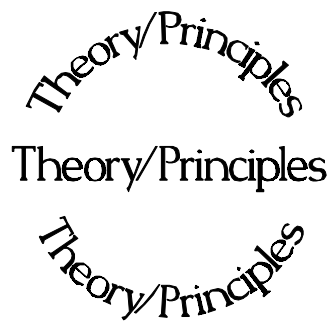
With just three push buttons, a liquid crystal display screen, and pre-programmed menus, the process level, density, or weight is continuously monitored with minimal operator effort.



Chapter 7 contains details about the hardware used in the X96N, and Chapter 4 explains the software used for this application.

## Interconnect Cable

The interconnect cable provides a signal from the detector to the X96N Microprocessor. The cable is supplied with a pre-wired MS connector.



**Chapter 2** gives a simplified explanation of how radiation gages work.

The "Theory of Radiation Gaging" Section reviews the concepts of radiation transmission and absorption.

The "Principles of Operation" Section explains signal processing and the calibration procedure.

- 2.0 Theory / Principles
- 2.1 Theory of Radiation Gaging
- 2.2 Principles of Operation
  - Signal Processing
  - Calibration
  - Cal. Verify

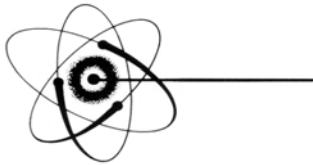


## Theory of Radiation Gaging

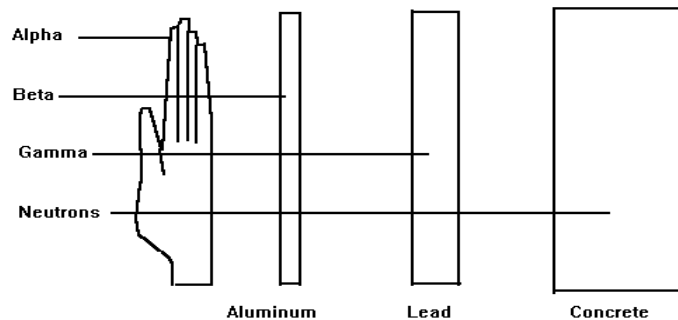
Radiation gages operate on the principle of radiation absorption and transmission.

A beam of gamma radiation is directed from the source holder, through the process and the conveyor, and onto the surface of the detector.

Some amount of radiation is *absorbed* by the material through which it passes, and some of the radiation is *transmitted* to the surface of the detector.

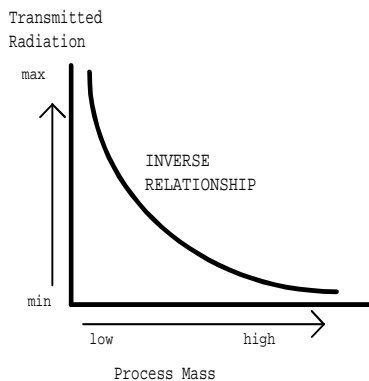


## Absorption / Transmission



### Gamma's advantages:

- Passes through process material
- Does not make material radioactive
- Does not change the material
- Can be shielded by lead

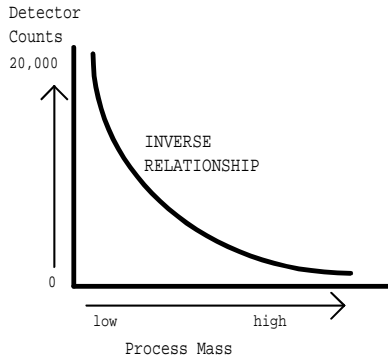


Process measurement is possible because the amount of radiation *absorbed and transmitted* is predictable.

The absorbed radiation is directly related to the mass of the process material on the conveyor while the transmitted radiation is inversely related to the mass of the process material on the conveyor.

**Therefore, an increase in process mass results in a decrease of transmitted radiation.**



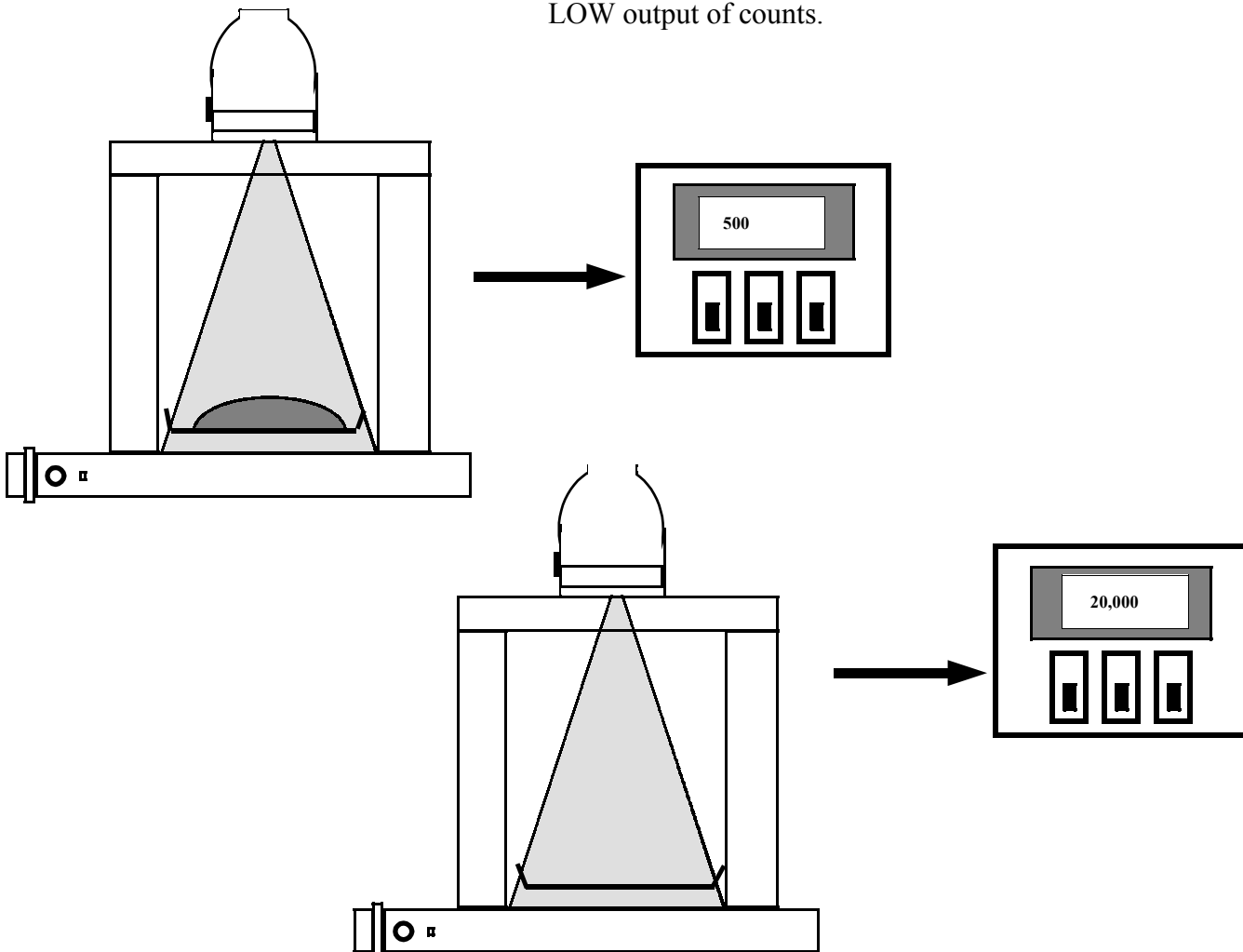


Since the radiation that's not being *absorbed* is being *transmitted*, the mass of the process can be inferred by measuring the amount of radiation reaching the detector at any point in time and multiplying this signal with a length-per-unit-time signal representing speed.

The detector's output signal, in counts, also *varies inversely* to the amount of process on the conveyor. Shown here is a typical response curve for a continuous weight application.

When the process on the conveyor is absent the detector is exposed to a maximum amount of radiation which produces a HIGH output of counts.

When there is increased process on the conveyor the process material "shields" the detector which prevents as much radiation from reaching the detector, producing a LOW output of counts.



## Principles of Operation

The detector's raw output signal is processed through several stages of software in the X96N.

Some of the more significant stages of signal processing are:

- Units Conversion
- Measurement Range
- Digital Filtering
- Dynamic Tracking
- Source Decay Compensation
- Calibration
- Cal. Verify

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### Units Conversion

The X96N Microprocessor converts the detector signal to user's measurement units of metric ton/hr, short tons/min, short tons/hr, long tons/min, long tons/hr, pounds/hr, kilograms/sec, pounds/min, kilograms/min, and metric tons/min.

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### Measurement Range

The X96N displays the output measurement range in the selected user units. For Continuous Weighing Monitor Systems the "range" is established by the minimum and maximum weights and loading rates.

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### Digital Filtering

Reduction of the signal "noise" due to radiation statistics is handled in the stage of signal processing known as digital filtering. Digital filtering is a form of statistical averaging used to smooth, or dampen, random radiation as well as process-related noise. Increasing the digital filter's "time constant" results in decreased signal noise.

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### Dynamic Tracking

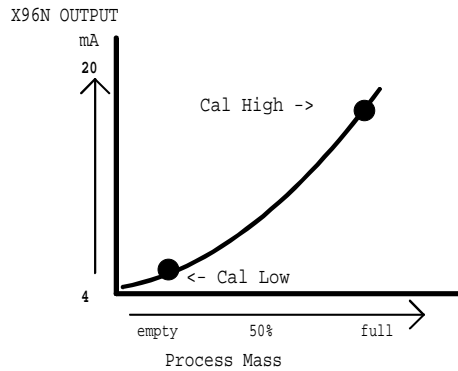
Dynamic tracking permits the gage response to temporarily by-pass the digital filter. This is helpful in some processes where sudden or drastic step changes in process must be observed in their true, or unfiltered, state.

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### Source Decay Compensation

Software also compensates for the decay of the radioactive source activity. On-going adjustments are made automatically for the rate of decay, or source half-life.

## Calibration

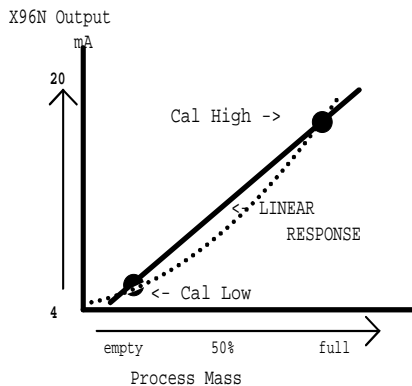


Calibration relates detector output (in counts) to numeric values that accurately represent the actual process level. The calibration procedure establishes reference points of known conditions against which the system can make ongoing comparisons. It requires at least two known points of reference - a low value and a high value. For best calibration results, the two reference points should cover as much of the full measurement range as possible.

As this example response curve shows, the calibration procedure also reverses the relationship between detector counts and actual process level. Now, a direct relationship exists, so that as the process level moves from empty to full, the X96N's display screen indicates an increase in user units from minimum to maximum - (example: 0 feet to 80 feet.).

**AND** the transmitter output signal also increases from minimum to maximum - (usually 4 to 20 mA).

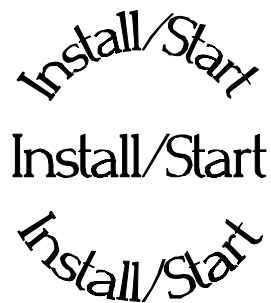
## Curve Correction



Level measurement non-linearity can be caused by an irregular distribution of the radiation field over the full length of the detector. Vessel size and geometry, vessel wall construction, cross paths from multiple source fields, and other system configurations are among the potential causes of an irregular field distribution.

Because a linear output is desired, the adjustment is accomplished through another stage of software signal processing, curve correction.

The nature and form of the curve correction required for each application depends on a number of variables such as system configurations, detector geometry, process conditions, etc. Shown here is a typical response curve with curve correction applied.



- 3.0 Installation
- 3.1. Unpacking/Inspection/Storage
- 3.2 Precautions
- 3.3 Mounting
  - Mechanical
  - Electrical
- 3.4 Microprocessor Verification
  - Identification/Documentation
  - Power-up
  - Pushbuttons

**Chapter 3** covers preliminary information that will help prepare for equipment installation and power-up.

Read the section on "Safety Precautions" before beginning to unpack or install the equipment.

The push-button guide and menu overview will familiarize you with how the X96N functions.

The specific and detailed installation instructions are provided on the Installation Drawings which are included in Chapter 10 of this manual.



**Caution**

Ronan's Monitor Systems use a sealed radioactive cesium (Cs-137) source which is safe if handled properly.

**Specific License**

Most Level Monitors are mounted to large vessels. Installations on vessels that permit personnel access require a specific license. Your company's specific license will name a Radiation Safety Officer (RSO) or Radiation Protection Officer (RPO). The RSO for your company must be notified immediately upon receipt of the gage. DO NOT proceed with unpacking, storage, or installation without the RSO's authorization.

**General License**

Other monitor systems, such as Density Monitors, are mounted to small-diameter process pipes. Those applications do not require a specifically licensed person to unpack or mount the equipment, as long as the source holder remains padlocked in the OFF position. Only a specifically licensed individual is permitted to remove the padlock and turn the source holder to the ON position.

Ronan's field service personnel are available for advice or assistance. (606) 342-8500.

**Unpacking**

All equipment manufactured by Ronan is carefully packaged to prevent shipping damage. Unpack the equipment in a clean, dry area.

Examine the contents and compare them to the packing list. Immediately report any discrepancy or damage to Ronan, the company's RSO, and the carrier. File a claim with the carrier.

**Storage**

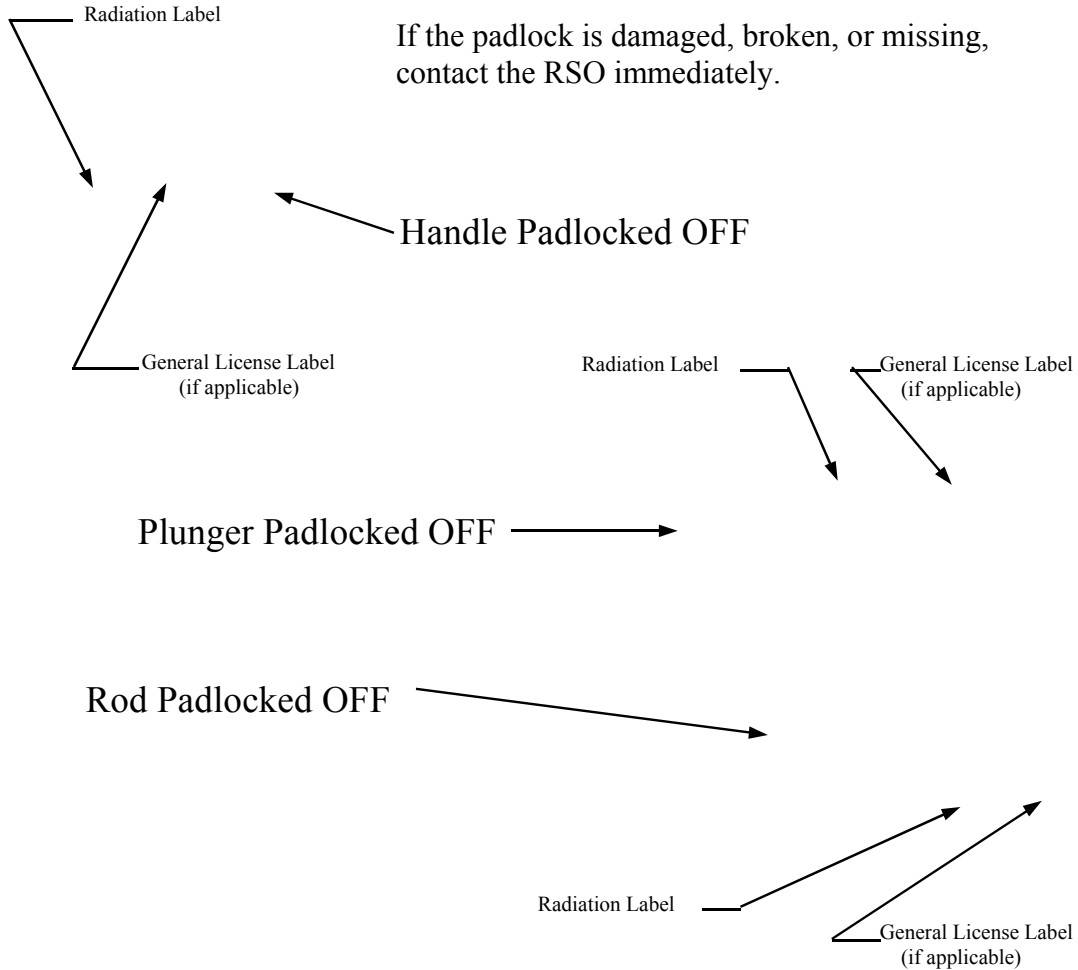
If it is necessary to store this equipment before mounting, the RSO will assign a safe and secure location with no personnel access.

During storage avoid temperatures below freezing, and areas with excessive humidity, moisture, or dirt.

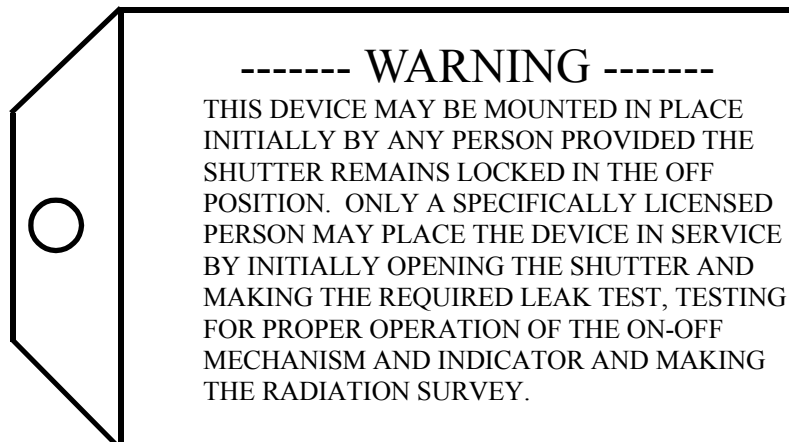
### Inspection

The source holder is equipped with an ON/OFF mechanism. During shipment and storage the mechanism **MUST BE SECURED** in the OFF position with a padlock.

If the padlock is damaged, broken, or missing, contact the RSO immediately.

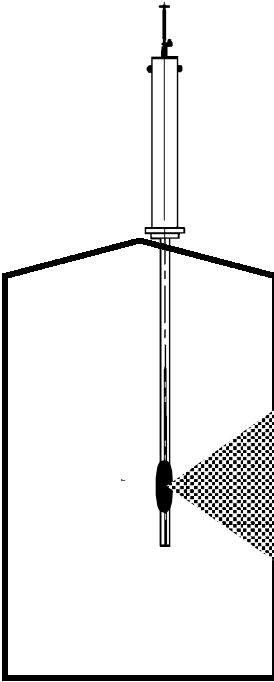


### Lock Tag



## Safety Precautions

During installation the RSO will provide guidelines to assure safety. Consider the information presented in the Regulation/Safety Chapter of this manual, as well as the following general guidelines:



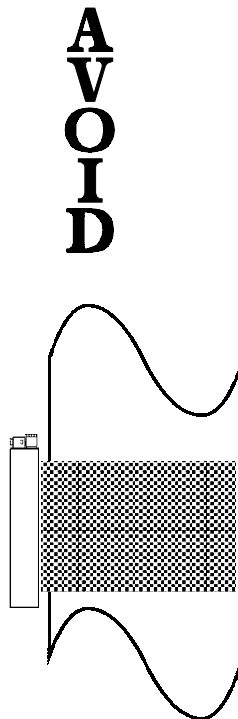
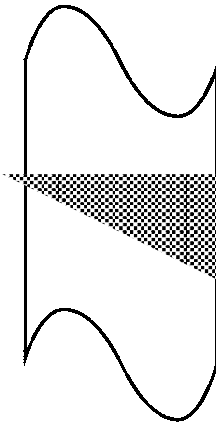
The source holder must remain padlocked in the OFF position until installation is complete.

Take all necessary precautions to assure that the source holder is not dropped or damaged.

**A specifically licensed individual MUST inspect the installation** prior to placing the source holder in the ON position.

Always turn the source holder to the OFF position when working around it, the detector, or the area between these two components which is referred to as the "measuring gap."

When the source holder is placed in the ON position, avoid the "active beam."



**A  
V  
O  
I  
D**

**A  
C  
T  
I  
V  
E**

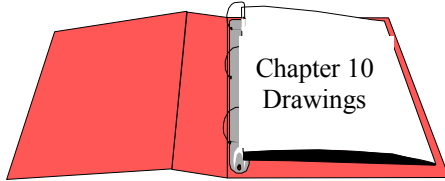
**B  
E  
A  
M**



## Mechanical Mounting

Review the Configuration Drawing which is included in the Drawing Chapter of this manual.

Please reference the dimensional drawings located in Chapter 10 when installing the equipment.



Consider the following general guidelines when mounting the sensor and detector:

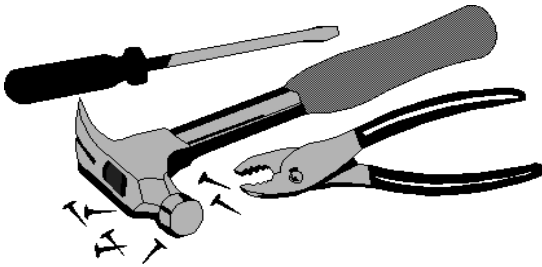
Avoid internal vessel obstructions such as baffles, agitators, manways, heater/cooler tubes, etc. which could interfere with the transmission through the vessel of the radiation's "active beam."

Drawings:  
Configuration  
Installation

The source and detector must be rigidly mounted so they do not move with respect to each other. Such movement will destroy the system's calibration and/or its measurement.

Insulation must be used at the point of installation IF:

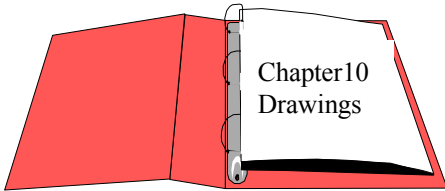
- the temperature of the process pipe at that spot exceeds 131°F (55°C), or
- the voltage transmission through the pipe could interfere with the signal transmission from the source to the detector.



## Electrical Installation of Interconnect Wiring

DO NOT APPLY POWER until wiring is carefully checked.

Wire the equipment according to the detailed interconnect drawing which is included in the Drawing Chapter of this manual.



Follow local and national electrical codes for all interconnections.

Consider the following guidelines before making any electrical connections:

Drawings:  
Interconnect

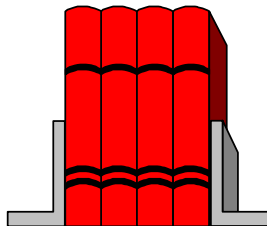
Use continuous conduit runs and protect housing junction boxes from dripping of condensed moisture off of conduit.

Plug unused conduit holes to prevent entry of dirt and moisture.

Run the interconnect cable in a separate conduit. Feed the cable through the conduit starting at the detector end and terminate at the microprocessor end.

DO NOT run AC power cable in the same conduit with any of the low-level cables (signal, mV, mA, etc.)

Maintain transient-free AC power sources between 105-130 VAC for the microprocessor. DO NOT use a line that is connected to a large motor, welding equipment, solenoids, etc.

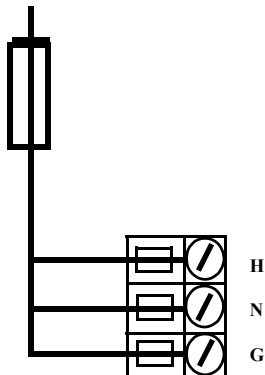


LOCAL CODE  
NATIONAL CODE

WITH POWER OFF - - -

Connect cable pre-wired MS connector to detector.

Immediately replace lid of detector housing to keep out water and dirt.

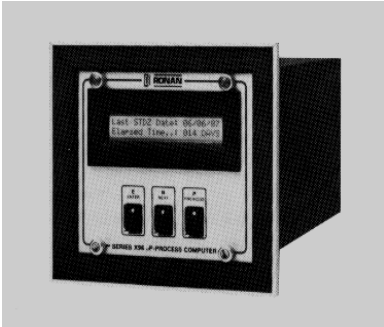


POWER INPUT

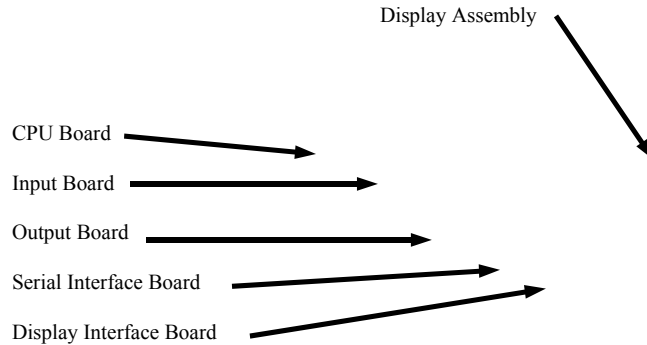
Check connections at microprocessor chassis terminals. Verify that all wires are fully inserted in terminal sockets and the screws firmly tightened.

## Microprocessor Verification

Loosen the four thumb screws to open the front cover and check the board and cable connections. Identify the CPU and other major boards from the drawing below. **Optional configurations are possible.**



Press the push/pull latch to eject the CPU Board.

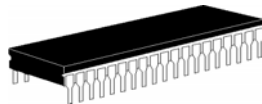
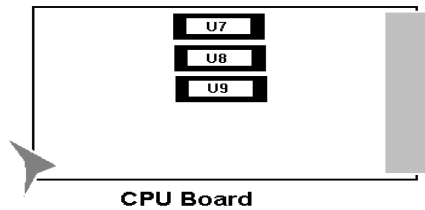


**NOTE:**  
These boards are interchangeable in the frame's slots, but the ribbon cables **MUST** be connected to the correct boards.

- Some Hardware Options:**
- No Serial Board
  - 2 Serial Boards
  - No Input Board
  - 2 Input Boards
  - No Output Board

## Identification/Documentation

The Ronan X96N Microprocessor can be programmed for a variety of applications and configurations. *The specific application supplied with each system is determined by the combination of software EPROMS located on the CPU Board and the unique hardware configuration used to support these EPROMS.* See Chapter 7 for details about your specific hardware configuration.



Your own set of EPROMS (U7, U8, U9) will be labeled with a specific Software Version Number. This software identification number should be documented for future reference.

### CPU BOARD EPROMS:

- U7 \_\_\_\_\_
- U8 \_\_\_\_\_
- U9 \_\_\_\_\_

Replace the CPU Board back into the X96N's frame. Verify all boards are fully seated and cable connections fully inserted.

**Power-up**

Before applying power, ensure all boards are fully seated in frame's slots and ribbon cables fully inserted. Close front door of the X96N and tighten the thumbscrews.

When power is applied the X96N runs a self-diagnostic program.

RONAN (MONITOR SYSTEM)  
VERSION XXXXXX

First the software version number is displayed.

RONAN (MONITOR SYSTEM)  
SELF TEST OK

The LED's flash and the X96N scrolls through an operation guide.

OPERATION GUIDE  
N - DISPLAY NEXT FIELD

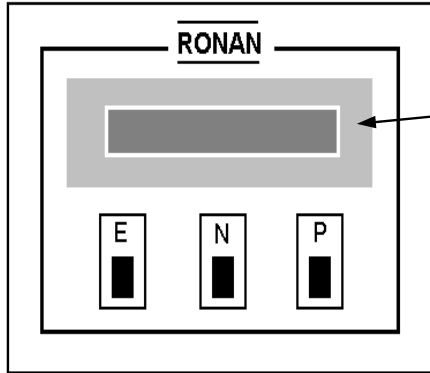
(P - PREVIOUS FIELD )  
(E - ACCESS FIELD)

**Press <N>**

OPERATION GUIDE  
TO START PRESS N

NOTE: If the operator does not Press <N> as instructed within one minute, X96N automatically goes to the first status display.

(Status Display #1)



LIQUID CRYSTAL DISPLAY SCREEN  
STATUS DISPLAYS  
PROGRAMMABLE FUNCTIONS (MENUS)

### Pushbutton Guide

This list summarizes the functional uses for each of the three pushbutton.

**Press <E>**  
to:

- Access the programmable functions from the status displays (ACCESS CODE REQUIRED).
- Access the programmable function named on a menu.
- Exit from the last programmable function back to the status displays.
- Enter a choice (or number) from a menu (FLASHING LED).

**Press <N>** to:

- Advance to the NEXT status display.
- Advance to the NEXT programmable function .
- Answer "NO" to a question.
- Increase a given number (FLASHING LED).

**Press <P>** to:

- Return to the PREVIOUS status display.
- Return to the PREVIOUS programmable function.
- Answer "YES" to a question.
- Decrease a given number (FLASHING LED).

### Displays/Menus

The programmed software, supplied to each system will determine the series of menus that are presented on the X96N display screen. Chapter 4 gives details about the software.



**Chapter 4** gives details about the software used to program the microprocessor.

It includes an overview of the menus as well as detailed information about each of the status displays and the programmable functions.

- 4.0 Software Operation (WGT-STD)
- 4.1 Getting Started
- 4.2 Status Displays
- 4.3 Programmable Functions
  - Level A - Customer
  - Level B - Factory



**Getting Started**

This chapter explains how to use the X96N Microprocessor's software.

**Menu Overview**

The programmed software supplied to each system will determine the series of menus that are presented on the X96N display screen. The menu overview on the next page shows all possible displays. Your own system may not require all of these displays and menus. Your series of screens may vary depending upon the hardware and software configurations required by your application. Details follow for the software displays which are included in your own system.

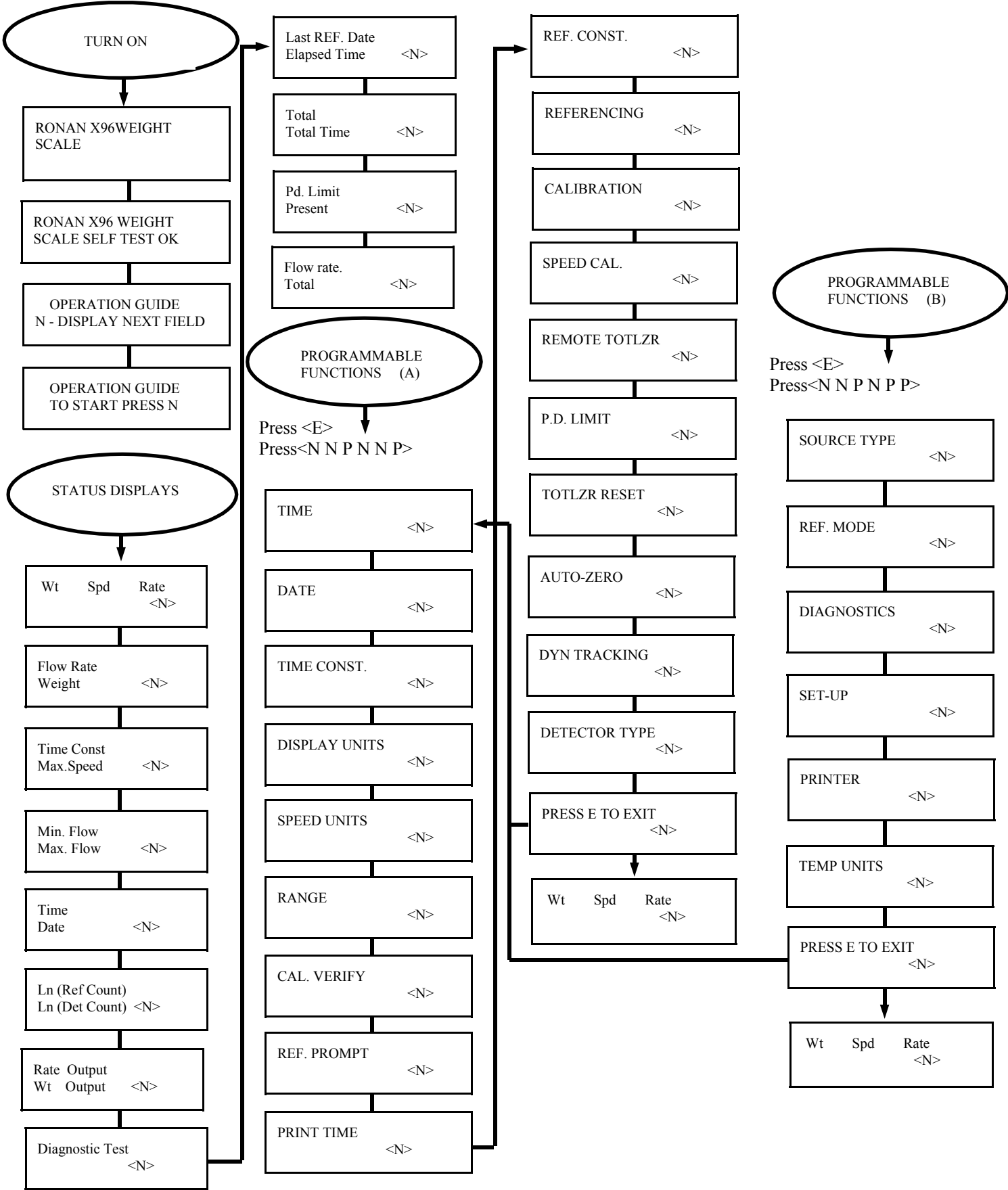
**Status Displays**

Status Displays are the system "reporters." Incoming measurements from the detector, settings used by the system, and output variables are among the information you can observe on the status displays.

**Programmable Functions**

Programmable functions are more than "reporters." The programmable function series of menus are used to enter and change information that's required to configure your system.





## Programmable Functions

The programmable functions are more than information "reporters." The programmable function menus allow you to change the settings, limits, and parameters that govern your measurement system. There are two levels of programmable functions: user and factory.

## Customer-Programmable

Ronan factory personnel tested the equipment using settings, limits, and parameters that closely resembled your circumstances. However, your specific equipment and process conditions will produce their own unique results.

The programmable functions permit you to re-configure the measurement output to accommodate your own specific process conditions and customized measurement needs.

A code is required to access the programmable function menus.

To *access* the customer-programmable functions, do this:

Press **<E>** LEDs flash

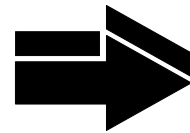


Exam/Alter Functions

Press **<N N P N N P>**



Exam/Alter Functions



### NOTE:

To *exit* the customer-programmable functions, do this:

Press **<N>** or **<P>** until the display reads  
"Press E to Exit"

Press **<E>** to return to Status Display #1

TIME            E = Access

HH:MM:SS

**TIME:**

The X96N keeps the current time in 24-hour format. Use this module to change the time.

A small lithium battery maintains the time in the event of a power loss.

Note that when entering a new time that the system response is slower than other screens. This is intentional, due to the limited range of values, to aid in setting the correct time.

Hours:Minutes:Seconds

**Press <N>**

DATE            E = Access

MM/DD/YY

**DATE:**

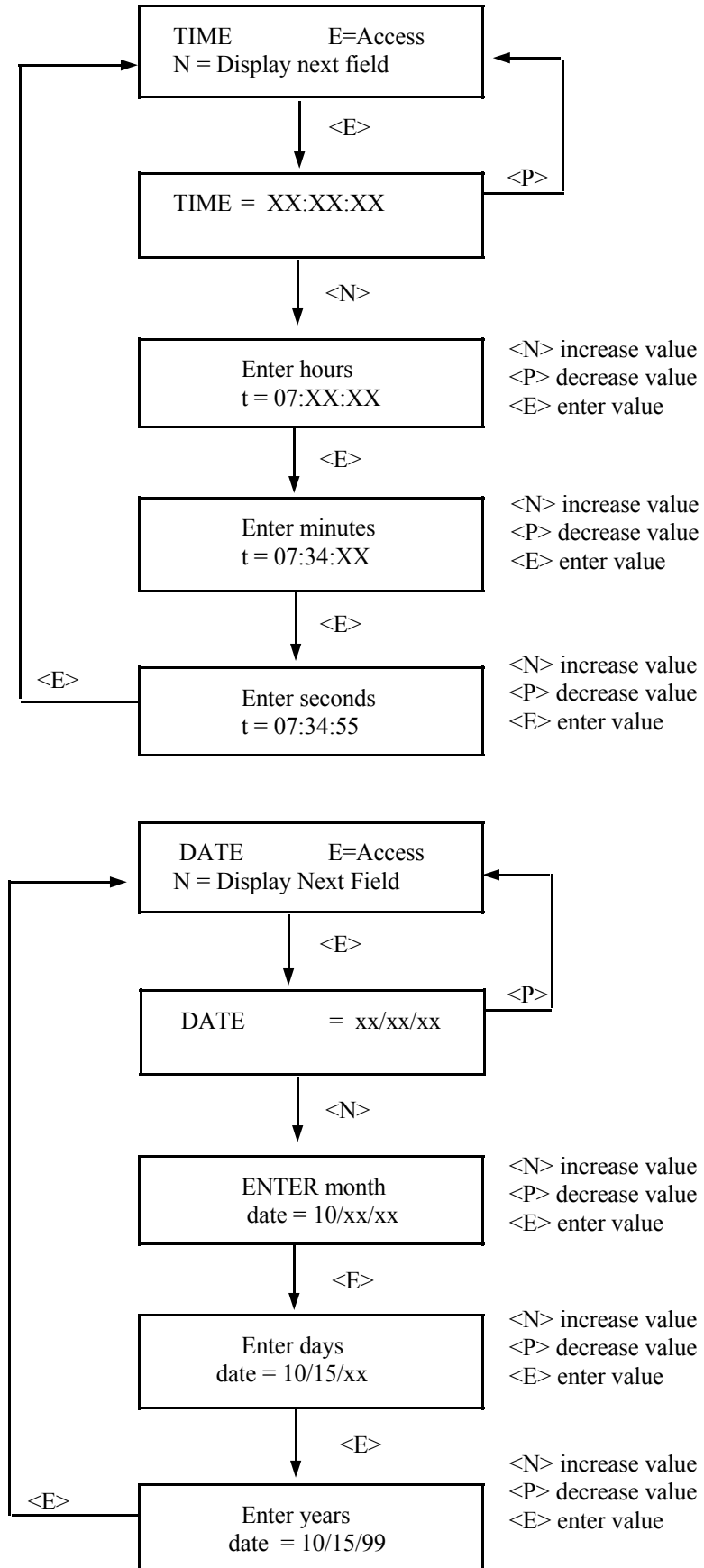
The X96N increments the date each day at midnight. Use this module to change the date.

The date is stored as the "Last Cal Date" in the Status Display each time the system is calibrated.

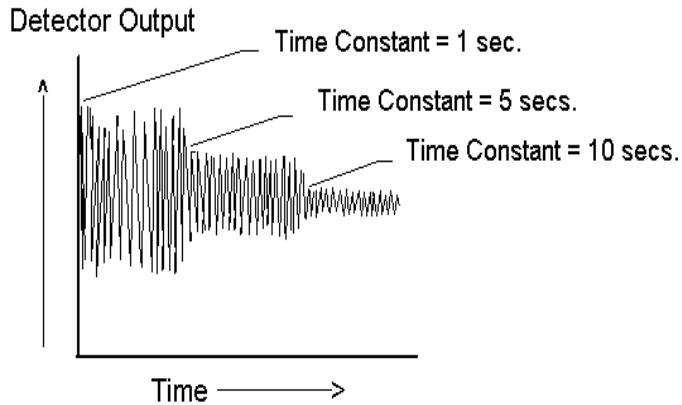
Battery back-up maintains the date during power loss.

Month/Day/Year

**Press <N>**



TIME CONST    E = Access



**NOTE:**

Values from 0.40 to 250.00 seconds can be used as the time constant entry.

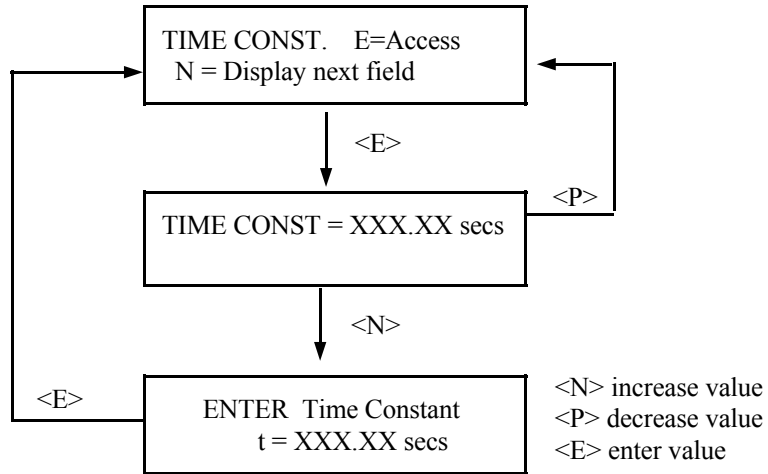
**TIME CONSTANT:**  
Counts received from the detector are fed into a digital filter module. This digital filter uses statistical averaging to smooth, or dampen, any random, radiation, and process related noise.

The statistical averaging is adjusted through a time constant setting in this module. Increasing the time constant will increase the filter time and decrease the noise.

The digital filter is bypassed during calibration (See CALIB. module).

The digital filter is also bypassed if dynamic tracking is enabled and process interruptions occur that exceed the established threshold. (See DYN. TRACK. module).

**Press <N>**

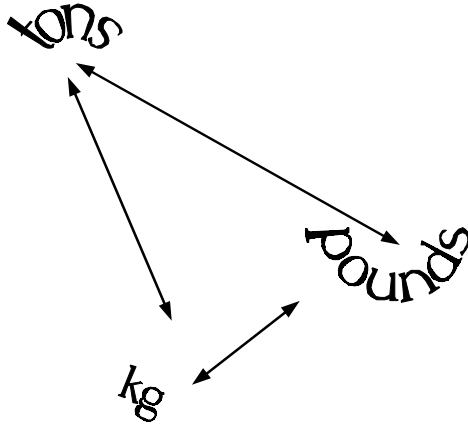


**DISPLAY UNITS**    E = Access**DISPLAY UNITS:**

This menu determines the user's units being displayed for the process measurement.

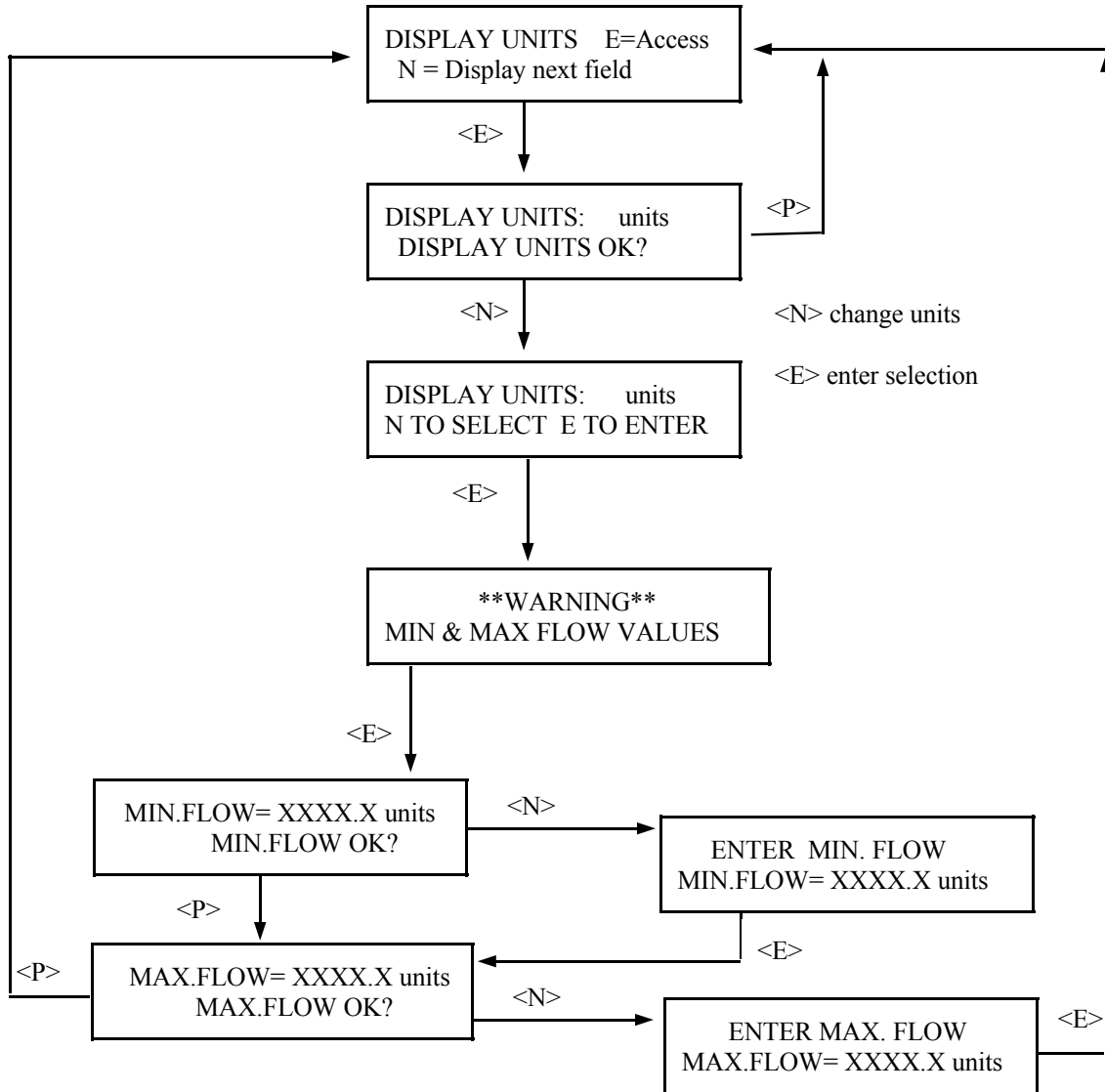
Weight applications choose from:

- 1) Metric Tons/hr
- 2) Short Tons/min
- 3) Short Tons/hr
- 4) Long Tons/min
- 5) Long Tons/hr
- 6) Pounds/hr
- 7) Kilograms/sec
- 8) Pounds/min
- 9) Kilograms/min
- 10) Metric Tons/min



Should you select units other than those currently selected, the system will issue you a warning, that as a change of units has been selected, it will now be necessary for you to enter the new minimum and maximum values for the new selected units.

**Press <N>**





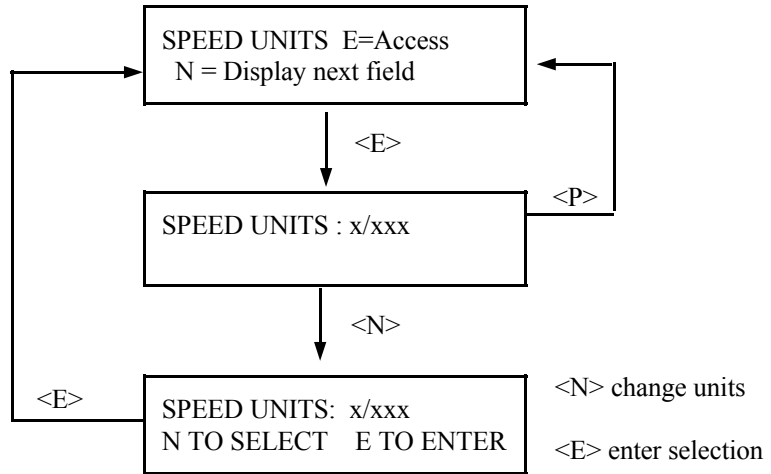
**SPEED UNITS**

E = Access

This menu allows you to select the desired speed units for your application.

The options available are:

- 1) Feet/Minute
- 2) Meters/Second.



RANGE    E = Access
---------------------

**RANGE:**

This menu allows you to enter the range for the output transmitters.

The outputs transmitters reflect the current flow rate and belt loading with respect to the range of minimum and maximum values that are to be set in this menu. In other words, if you have set a flow rate of 0-500 MT/hr and a belt loading of 0-70 Kg/m, then the following will be true:

Flow Rate	Output(1)	Weight	Output(2)
0MT/hr	4mA	0Kg/m	4mA
125MT/hr	8mA	17.5Kg/m	8mA
250MT/hr	12mA	35Kg/m	12mA
500MT/hr	20mA	70Kg/m	20mA

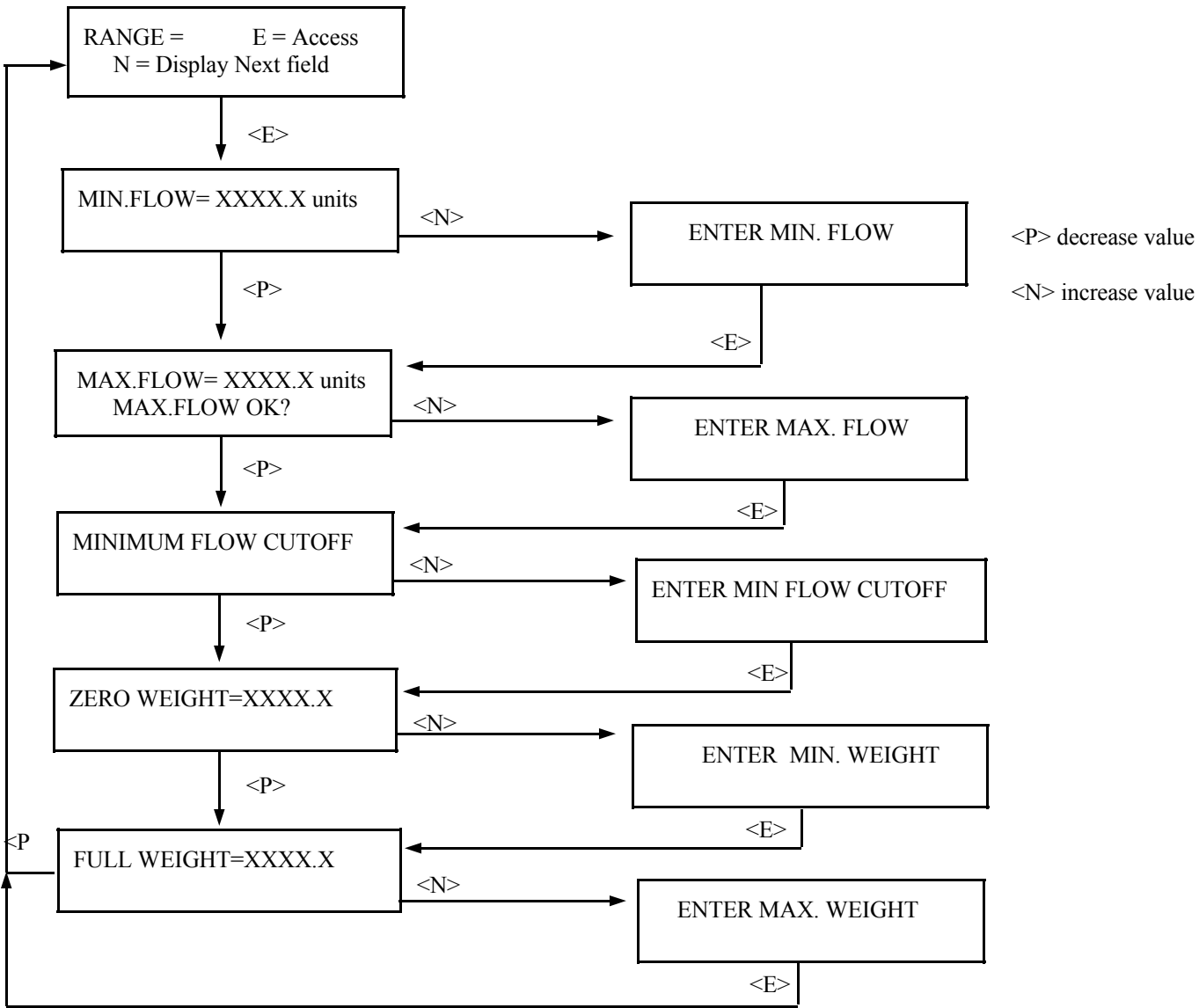
The X96 system has 2 output transmitters. The second output (Channel 2) reflects the belt loading (weight) in the selected units.

In addition to the two above features, the system is also fitted with a minimum flow cut-off. This is entered as a % of full scale loading.

While performing a zero reference residue may be left on an apparently empty belt, and this may be a normal process condition.

You may wish to regard this small residue as an empty belt, therefore, if you were to set this level at 5% while carrying out a zero referencing, the module would ignore any signal accumulations less than 5% and regard this as an empty belt. This feature can of course be set to 0% if required

**Press <N>**



## CAL. VERIFY E = Access

This menu permits correction for variation between actual and indicated weight values.

To obtain the greatest accuracy and also to verify that the calibration is good over the whole range selected, it is possible to obtain grab samples (Belt-Cuts) and compare the results against those indicated by the display. Any small errors detected can be corrected using up to 10 correction points.

This menu should be used for minor corrections only. Large error calls for a recalibration. It is not always necessary to employ this menu, and if not being used this module must be disabled, as incorrect use of this module can cause major errors. If the module is used, it operates in the following manner.

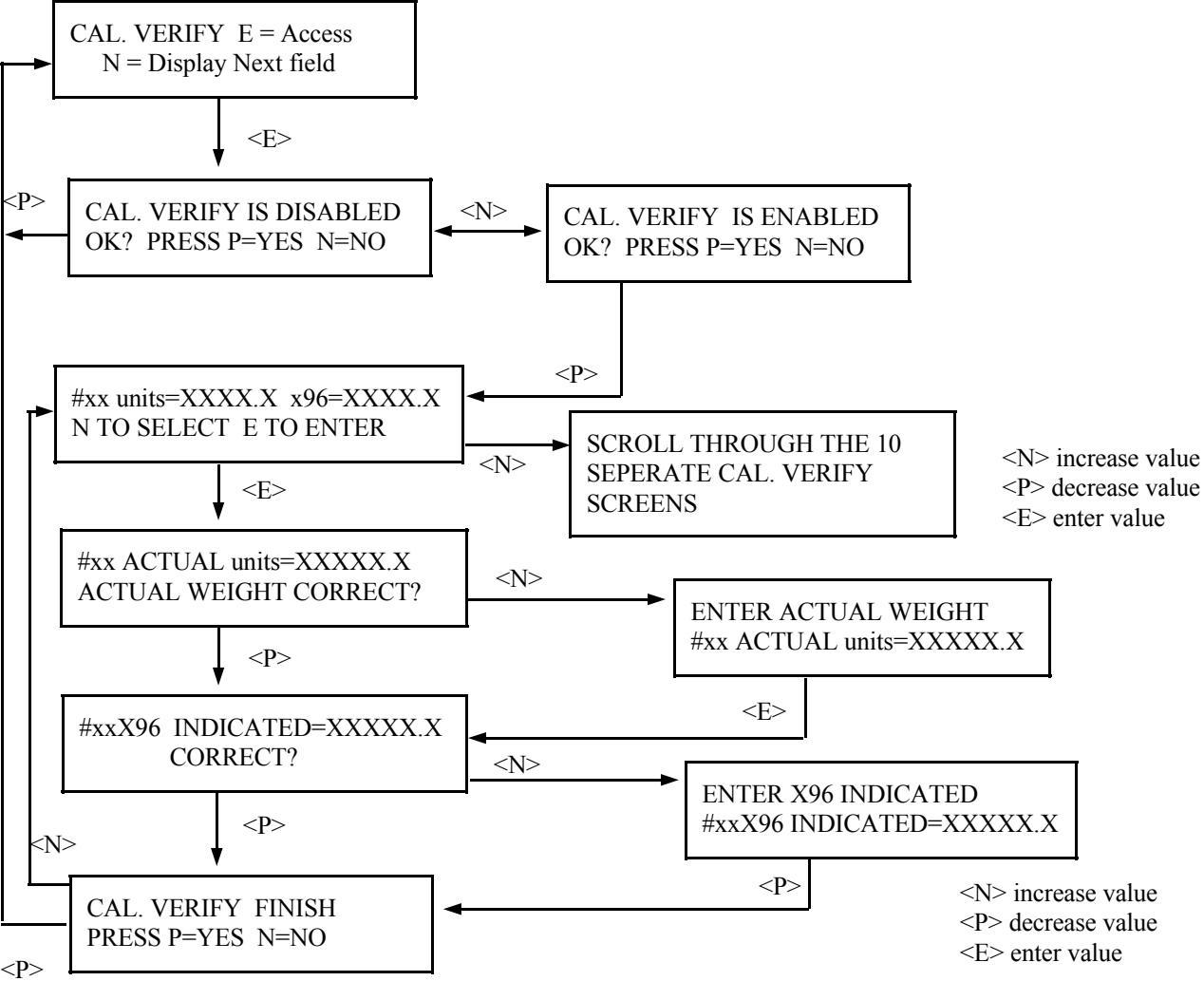
The system stores the values of X96 computed weight versus actual weight and constantly corrects the X96 computed weight according to the table of values you enter. The values you enter in the table need not be in numerical order, as the system sorts the entries to an internal table at power-up or on any change to the table values. The internal table is then used by the Calibrate Verify module. You should set unused entries in the table to 0 or to another valid entry in the table.

The table format is as follows:

Entry Number	X96 Computed Weight	Actual Weight
0	X.XXXX	X.XXXX
1	X.XXXX	X.XXXX
.	.	.
9	X.XXXX	X.XXXX

Where X.XXXX are the values you enter and represent Weight.

When the system prompts for the Weight, enter the actual value. When prompted for the X96 value, enter the X96 computed value for the associated value.



REF. PROMPT    E=Access

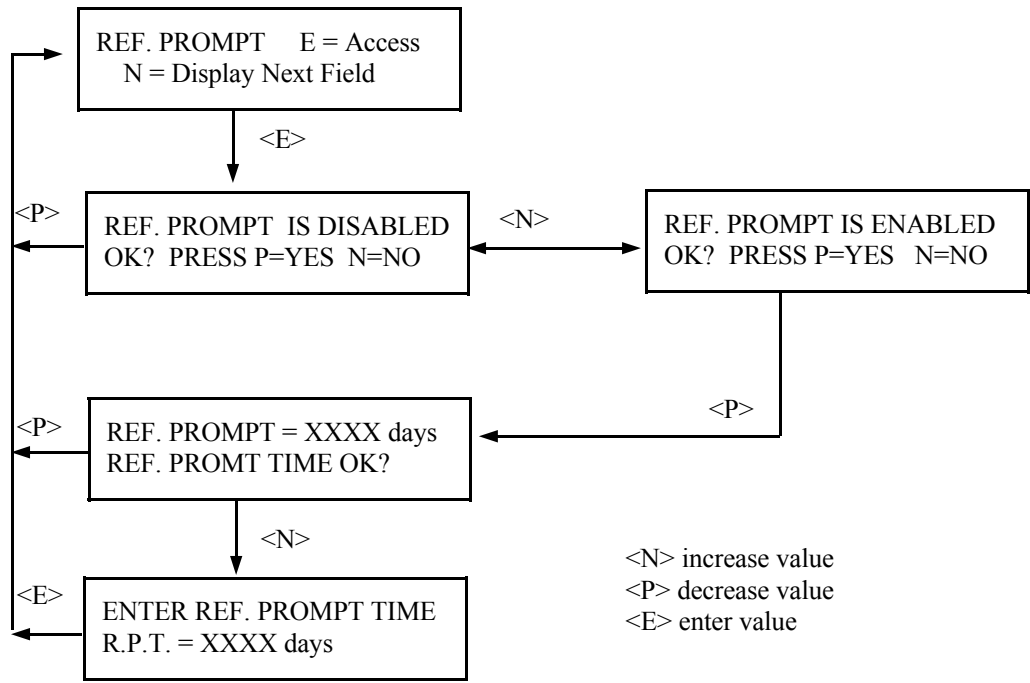
You may set the 'Time to Reference' prompt time in this module.

The X96 gage should be Referenced periodically to eliminate errors due to process changes, build-up, etc. If you decide that your process requires that the gage be re-referenced every so often, then you may enter the number of days between Referencing in this module, and connect an annunciator to the output from this module. When the number of days since the last reference has elapsed, the system will enable output pin number 14 on the terminal strip panel labeled Input (A). This acts as a reminder to you that you should re-Reference the gage.

When the gage is Referenced, the number of days since Reference is set to zero, and the system begins counting all over again. This action, in turn, turns off the prompt output until the number of days has elapsed again.

A typical value for the Reference Prompt - Days, is 31.

**Press <N>**





PRINT TIME E=Access

This menu allows you to specify the Reporting Interval.

This module may only be accessed if you purchased the optional Serial Link Interface board for your X96 system. The report is produced on a time interval, specified in this module. Every time the number of seconds entered in this module elapses, the report will be printed.

The report gives a good record of events for gage setup or for process questions. Following is the definition of what is printed.

Time: Time of this line being printed.

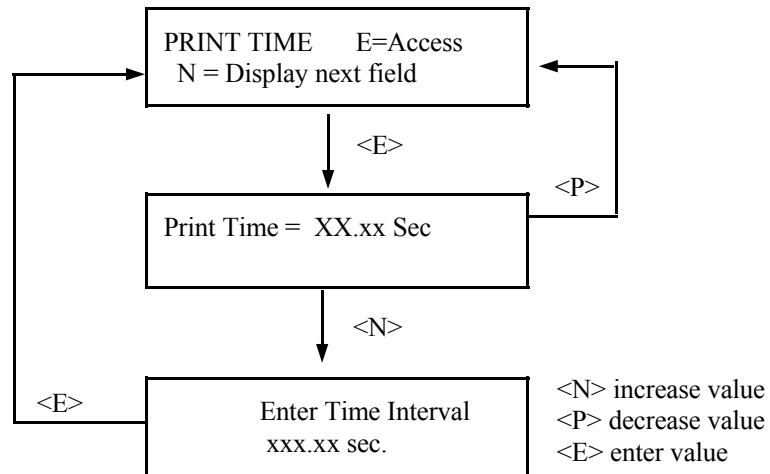
Detector Counts: Current detector counts

Weight: Current belt loading

Flow Rate: Current flow rate

Detector Temperature:  
Current detector temperature

A value of zero (0) turns the print report off.



**NOTE:** This menu does not operate unless a printer is attached to the system's optional serial link.

REF. CONST    E = Access

Here you enter the Referencing control limits.

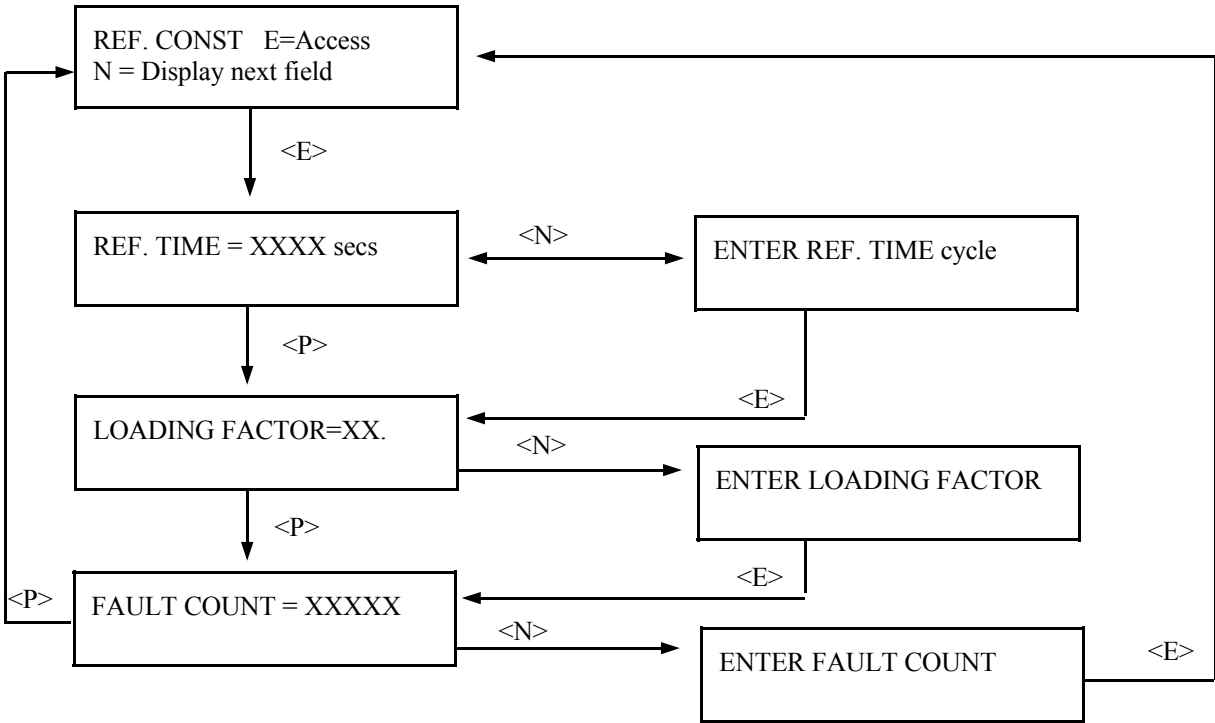
This module allows you to set certain values used to control the Referencing and Calibration modules. The system will ask you for the following information:

**Ref. Time** - This is the length of time the Referencing and Calibration modules actually spend performing the reference and calibration. These modules will average the counts over this time period. The noise band of the signal determines the value you should use here. Typically, multiply the filter time constant (entered in the Time Constant module) by 7, and use this value as the reference time.

**Loading Factor** - This refers to belt loading in respect of the belt width, and typically if the belt width is 3 ft, then this value will be set at 3 and if belt width was 1 ft, then the factor would be 1.

This value will be automatically calculated by the system when a calibration is performed.

**Fault Count** - Set this value to the lowest count value you expect to receive during calibration or referencing. Typically, the counts received with the source shutter closed minus 1%, is the value you would enter here.



<N> increase value  
 <P> decrease value  
 <E> enter value

**REFERENCING    E = Access**

Referencing allows you to establish the X96 system's low reference.

The system will use the method of referencing you selected in the Reference Mode module. When you are ready, the X96 system will prompt you to set the proper conditions for referencing: Empty the conveyor or insert absorber plate, etc.

When you start the actual cycle, the system will display the reference counts. The cycle will continue for the reference time you set in the reference constants module.

During the cycle, two things will cause the system to abort the referencing.

- 1) The average of the counts being received is below the Low Fault count you entered in the Reference Constants module.
- 2) You press any key on the front panel to manually abort the referencing.

If any of the above conditions occur during referencing, the system will abort the cycle and display a message describing the reason for the abortion, then give you a chance to retry the referencing if you wish.

When the reference cycle has completed, you will be asked to verify the Low Reference weight, (and change it if needed), if you selected the Reference Mode with absorber or process in the Reference Mode module.

When the Reference has successfully completed, the system will perform the following steps automatically:

- Reference counts saved
- Reference
- Reference date saved
- Days since last Reference set to zero



**CALIBRATION    E = Access**

A common method to calibrate a weigh scale is to use an absorber plate. The procedure is much the same as that used for a process calibration, the only difference is that instead of material being placed on the belt, the equivalent absorber plate is inserted into the space provided and the value assigned to the plate is used as the calibration value.

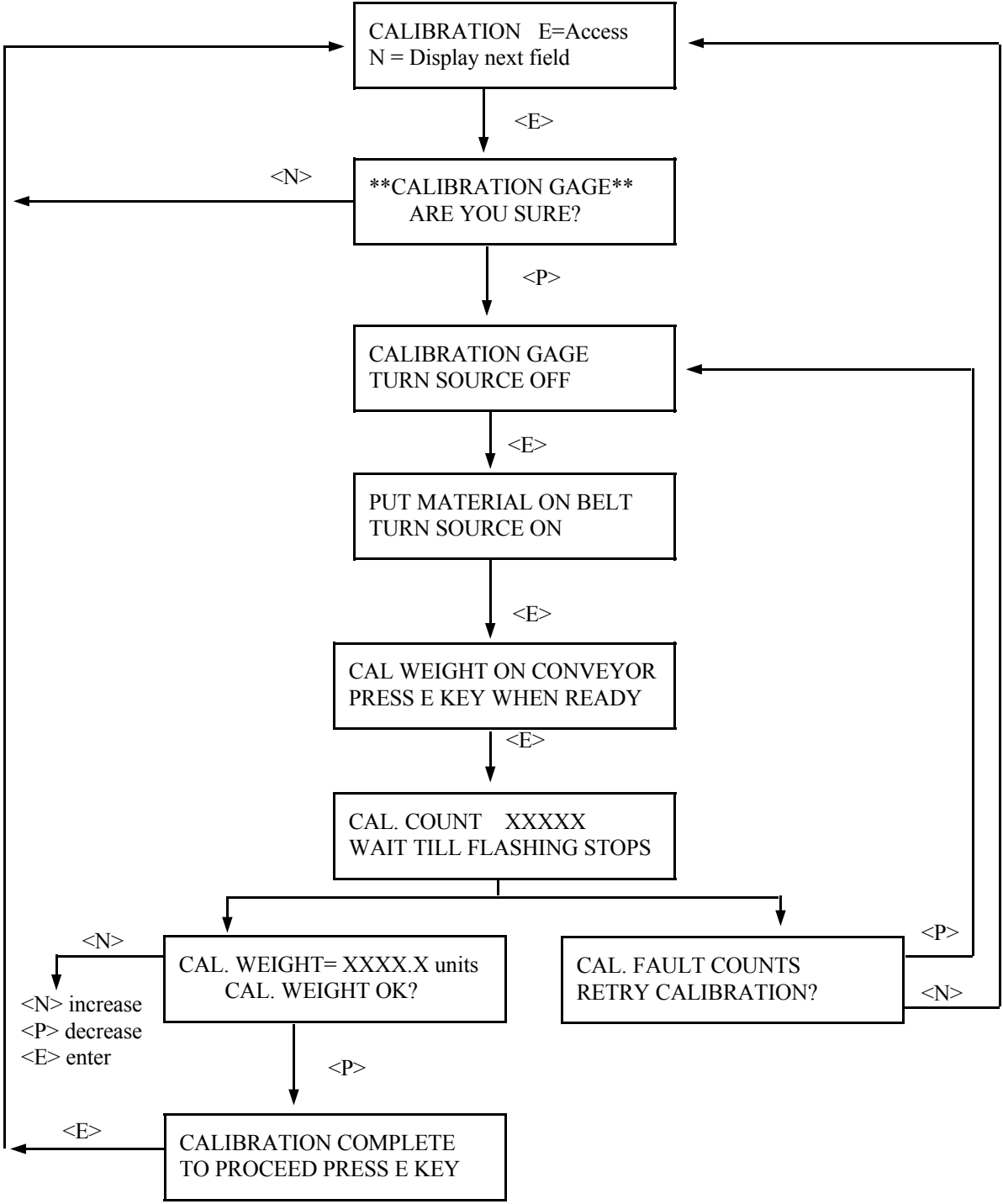
NOTE: The value of the absorber plate must be assigned during the initial calibration.

When you begin the calibration, the system will display the average of the counts being received. There are two things that will cause the system to abort the calibration cycle:

- 1) The average of the counts being received is below the Low Fault count you entered in the Reference Constants menu.
- 2) You press a key on the front panel to manually abort the calibration.

If any of the above two conditions occur during calibration, the cycle will abort and ask if you would like to retry.

Once the calibration cycle has successfully completed, you will be asked to verify the weight of the materials just calibrated. If the weight is incorrect, you may change it.

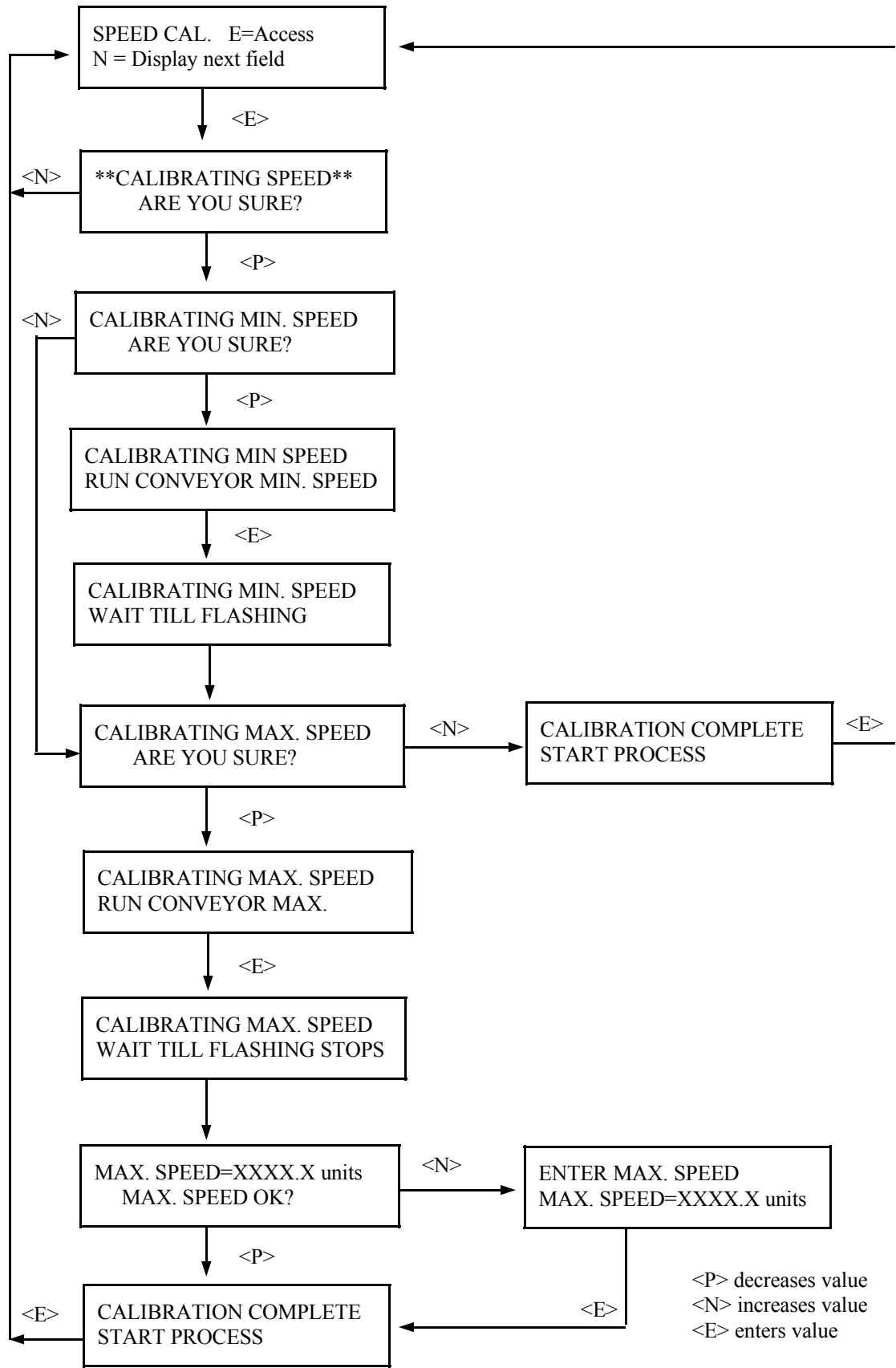




SPEED CAL.    E = Access

This menu allows the system to record the minimum and maximum speed your conveyor will be running at, and is used in the system to calculate mass per unit time.

You will first be asked to run the conveyor at minimum speed. The system will note the value it obtains and use this as the minimum speed. You will then be asked to run the conveyor at max speed, this value will also be noted and stored. The system will instruct you to verify or change the maximum noted speed, at the end of the calibration frame.

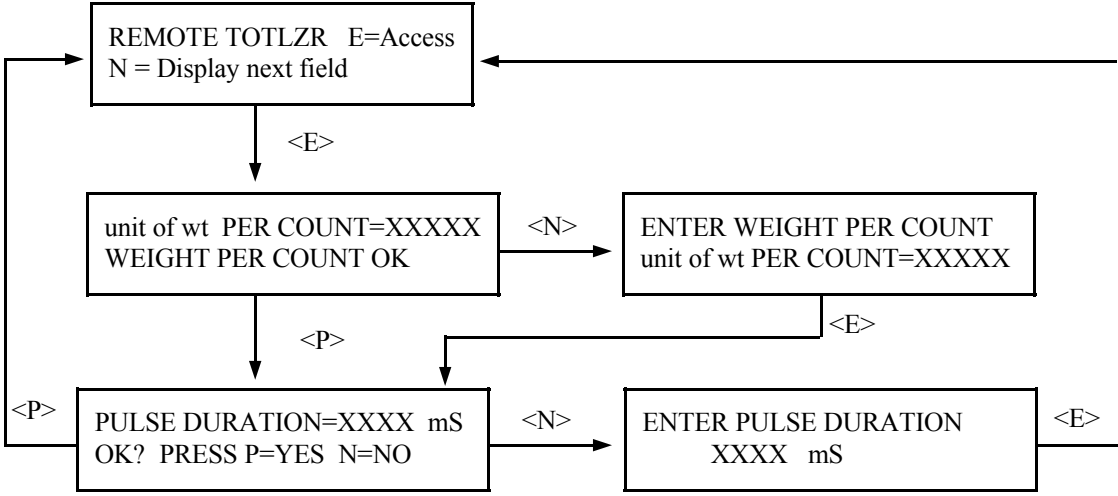


REMOTE TOTLZR    E = Access

This menu enables a remote totalizer pulse scaled to parameters suitable for your application. The pulse can be scaled in either lbs or kilograms and its pulse width is variable.

The on-board totalizer scales in either single digit pounds or kilograms, the remote totalizer has the ability to output pulses to your particular application. The pulse duration can be set in duration from 0-999 mS, in increments of eight.

- 1) Kg per count = 10  
Then the system will output an open collector pulse every 10 Kg.
- 2) Pound per count = 50  
Then the systems will output a pulse every 50 lbs.



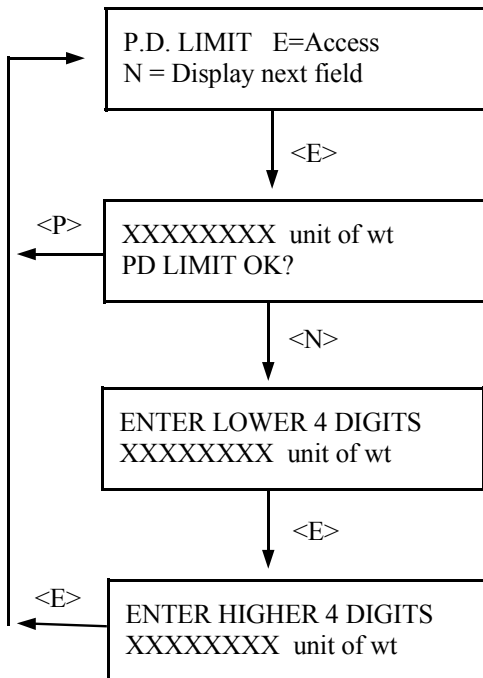
<P> decreases value  
 <N> increases value  
 <E> enters value

P.D. LIMIT    E = Access

This menu allows you to set a pre-determined limit, for use when batching etc.

The system will output an open collector pulse then reset itself and count again to a limit set in this menu. The system will do this on a continuous basis. The pulse duration is 400 mS.

This limit can be set in either pounds or kilograms, dependant on the pre-selected display units.



<P> decreases value

<N> increases value

<E> enters value

TOTLZR RESET    E = Access

This menu allows you to reset the on board totalizer.





AUTO-ZERO	E = Access
-----------	------------

This menu allows the system to automatically perform a zero reference on the conveyor, when certain pre-determined conditions exist.

There are three ways to initiate an auto zero:

- 1) Remote Auto Zero
- 2) Local Auto Zero with continuous Auto Zero Function
- 3) Local Auto Zero with timed Auto Zero Function.

It is important that the auto zero function is only employed when the correct conditions exist. This would normally be when the belt is running in its normal empty condition for a certain period of time. If these predetermined conditions change while the system is performing an auto zero, the auto zero will be aborted.

- 1) Remote Auto Zero  
In this method the auto zero is initiated via a remote push-button or switch which is hard-wired into the system. As previously mentioned, it is important that when this method is used that the belt is running in the empty condition. The switch, or button, must also be kept in the closed position for a pre-set time before the system will perform an auto zero function.
- 2) Local Auto Zero with Continuous Auto Zero Function  
When this method is selected an auto zero will be performed whenever the detector counts exceed the last auto zero counts minus a selected threshold limit, providing the system notes that the conveyor is running and this condition exists for a certain time.

Example

Last Auto Zero Counts	= 15000
Delay Period	= 10 Seconds
Threshold %	= 1%

An auto zero will now be performed when the system notes that the detector counts exceed 14850, this condition exists for a period of 10 seconds and the conveyor is running.

- 3) Local Auto Zero with Timed Auto Zero Function  
This method works in much the same way as 2, and the same conditions in respect of threshold and delay period must be met. However, the difference here is that instead of performing the auto zero function on a continuous basis, the function is performed on a pre-selectable time basis.

This time is programmed into the system in days.

Example

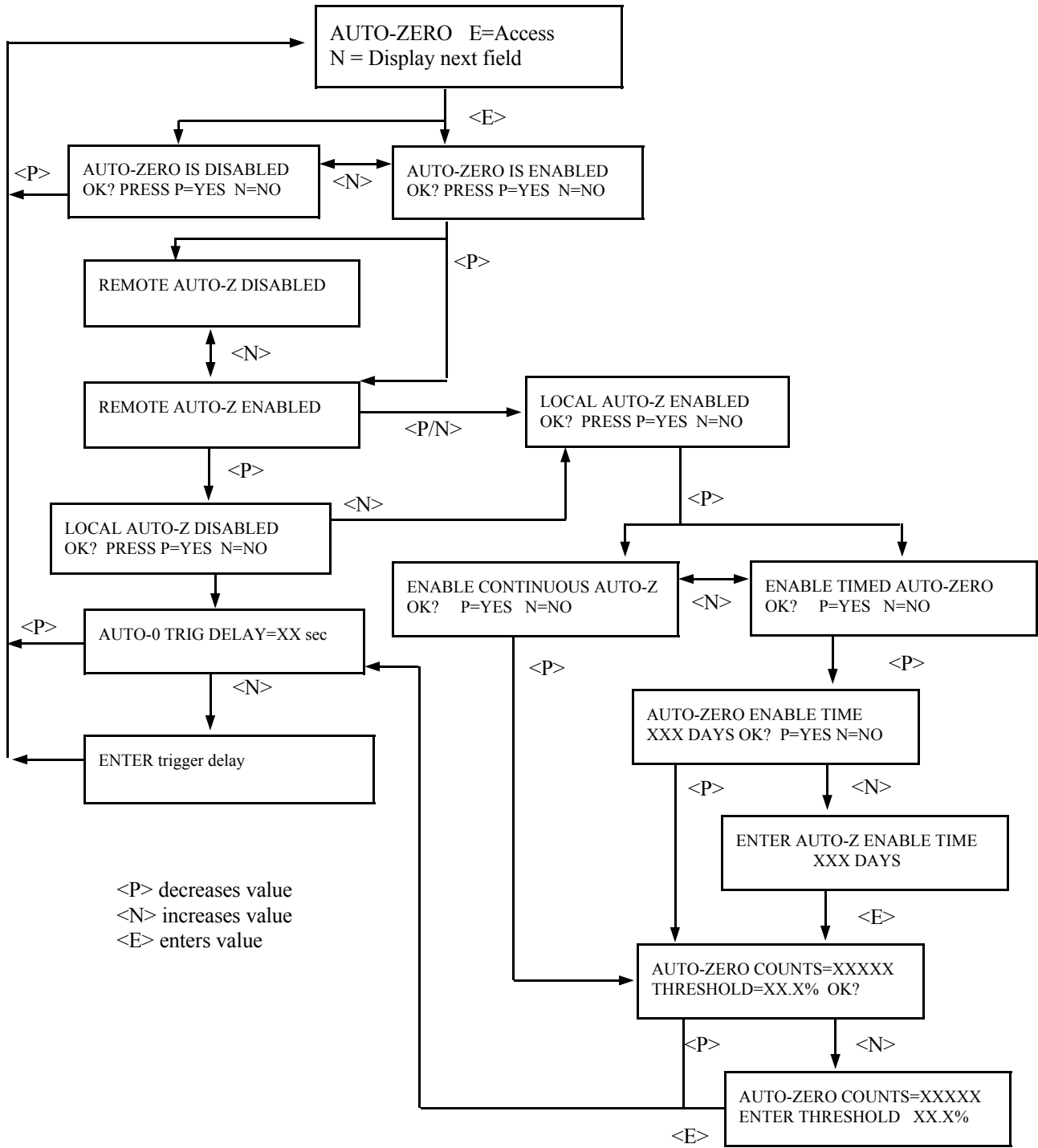
Last Auto Zero Counts = 15000

Threshold Level = 1%

Delay Period = 10 Seconds

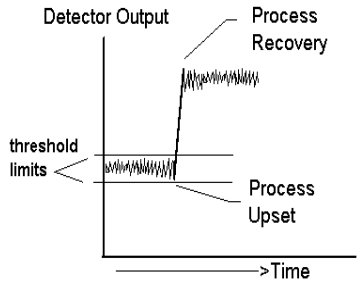
Timed Days = 5 Days

An auto zero will now take place every five days providing the correct conditions exist, that is when the detector counts exceed 14850 for a period longer than 10 seconds. If after the time period these conditions do not exist, an auto zero will not take place, and the system will wait until the next time the correct conditions do exist. Then an auto zero will then be carried out again. The system will abort if the conditions changed during the auto zero period.

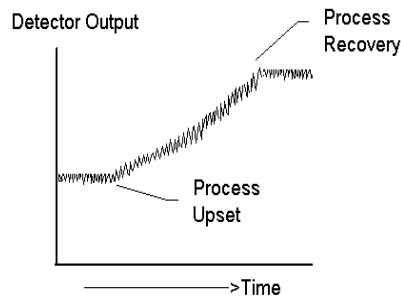


DYN TRACK

E = Access



Time Constant = 10 secs.  
Dynamic Tracking Enabled

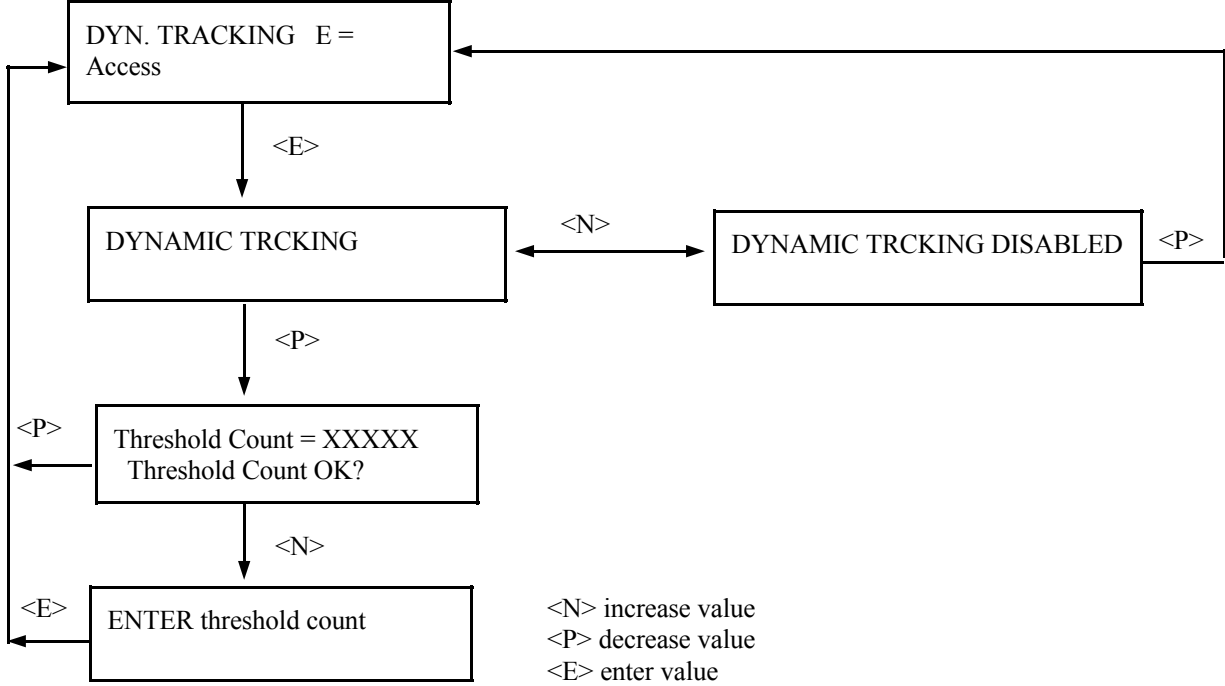


Time Constant = 10 secs.  
Dynamic Tracking Disabled

You may select Dynamic Tracking with this menu.

The Dynamic Tracking menu provides automatic Time Constant switching for rapid process changes. The response threshold is adjustable and normal process fluctuations must be taken into account when setting this value. The X96N checks in each calculation cycle if the difference in the current counts and the previous counts (last scan cycle) are higher than the set threshold value. If a sudden process change occurs which exceeds the threshold, the measuring Time Constant is reduced to 0.4 seconds. Upon process recovery the Time Constant switches back to the normal selected operating Time Constant.

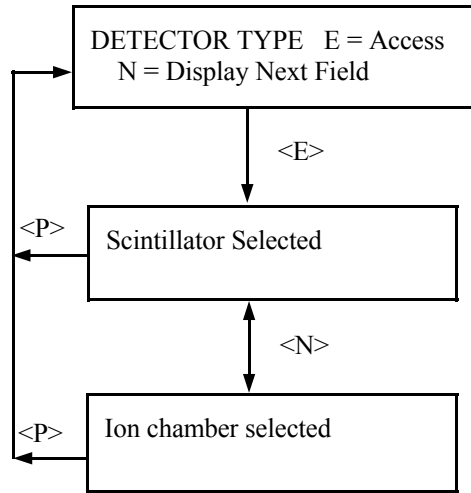
**Press <N>**



DETECTOR TYPE

E =

You may select the type of detector that is supplied by the factory. The detector type will be preprogrammed by the factory.



PRESS E TO EXIT

This screen will exit the customer programmable functions.



**Factory-Programmed**

Some of the programmable functions were set at the factory based on information provided at the time your Monitor System was ordered.

Oftentimes, these settings will be appropriate and will NOT require revision. However, if one or more of the parameters need to be re-configured, a code is required to access the menus.

To *access* the factory-programmed functions, do this:

Press <E> LEDs flash

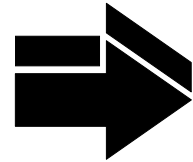


Exam/Alter Functions

Press <N N P N P P>



Exam/Alter Functions

**NOTE:**

To *exit* the factory-programmed functions, do this:

Press <N> **or** <P> until the display reads  
"Press E to Exit"

Press <E> to return to Status Display #1.

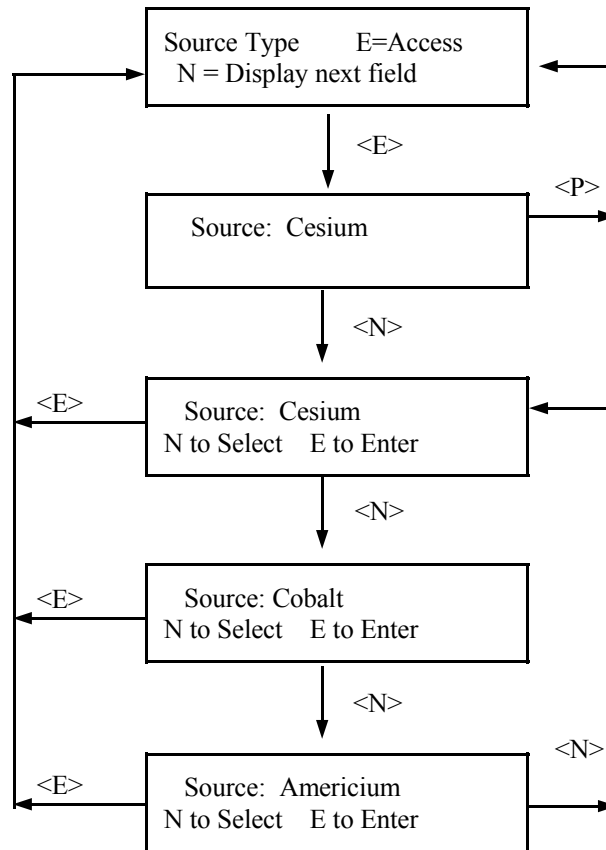
SOURCE TYPE    E = Access

Choose one of these source types:

CESIUM  
COBALT  
AMERICIUM

**SOURCE TYPE:**  
Selects radioisotope being used. This permits the appropriate source decay factor to be applied through software signal processing.

**Press <N>**



REF. MODE

E = Access

REF. MODE:

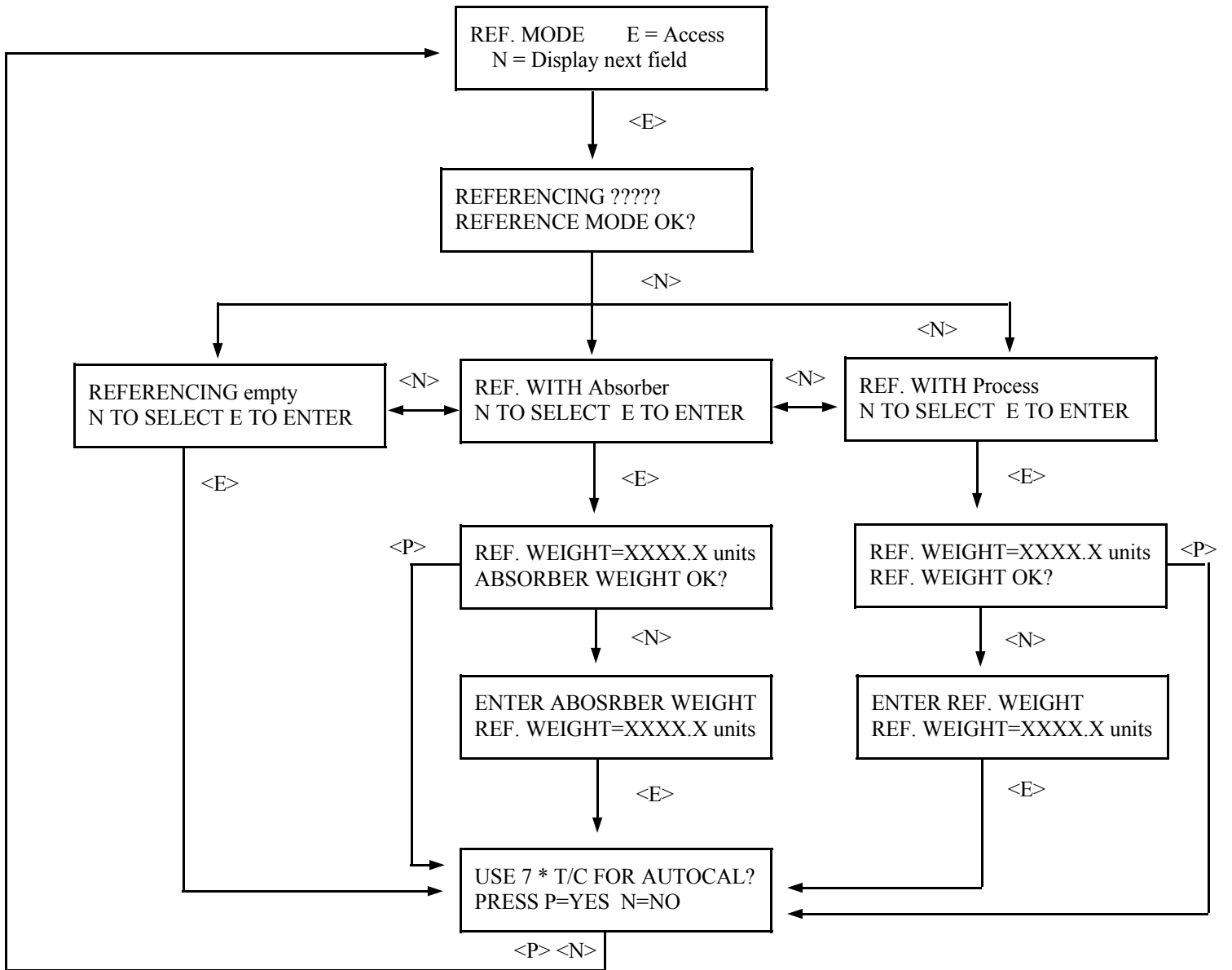
Allows the selection of the Low Reference Method.

The Low Reference permits the X96 Referencing Module to establish the minimum belt loading value for the conversion from counts to mass

Choose one of three methods:

- 1) REFERENCE EMPTY - Select this mode when the conveyor or feeder is to be referenced on an empty condition. The system will automatically set the Low value loading to 0.00 kg/m when this mode is selected.
- 2) REFERENCE WITH ABSORBER - This mode is for users who have a fixed static plate that represents a known loading when the conveyor is running empty. The plate is placed in the radiation path during referencing to establish the counts associated with a known loading.
- 3) REFERENCE WITH PROCESS - A reference with process material will normally be carried out if it is impractical or you are unable to empty the conveyor belt or feeder.

**Press <N>**

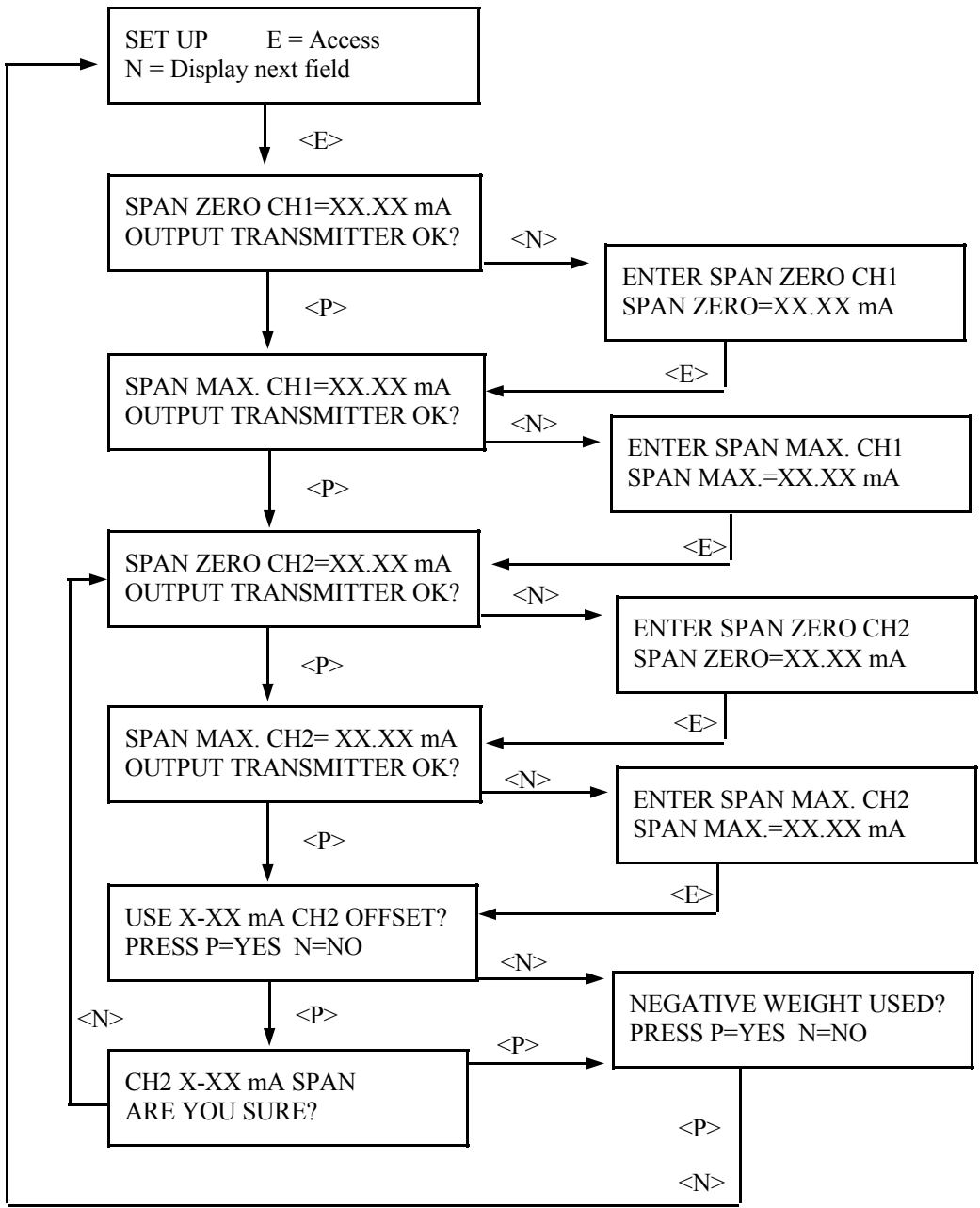


SET UP

E = Access

This module would not be accessed in normal operation, and should not be changed or tampered with.

This function will be factory set.

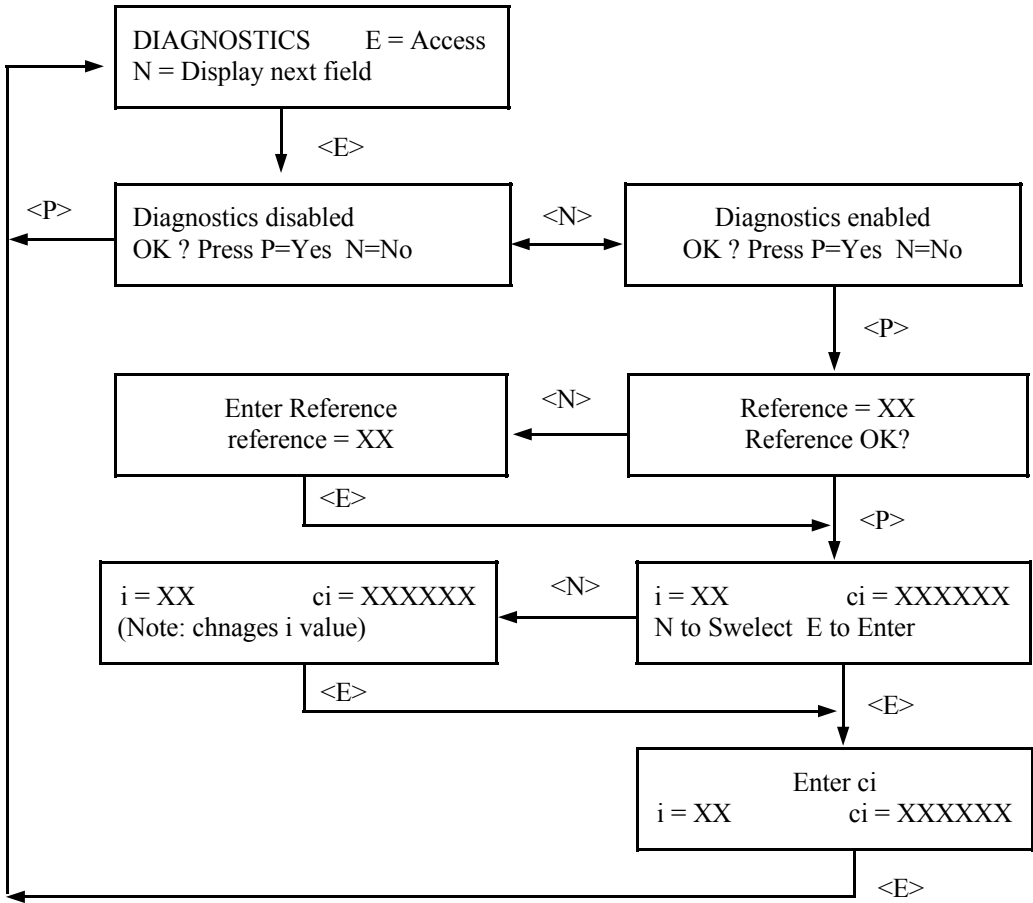


DIAGNOSTICS      E = Access

This module is not accessed in normal operation, and should not be changed or tampered with.

This function will be factory set.





<N> increase value  
 <D> decrease value  
 <E> enter value

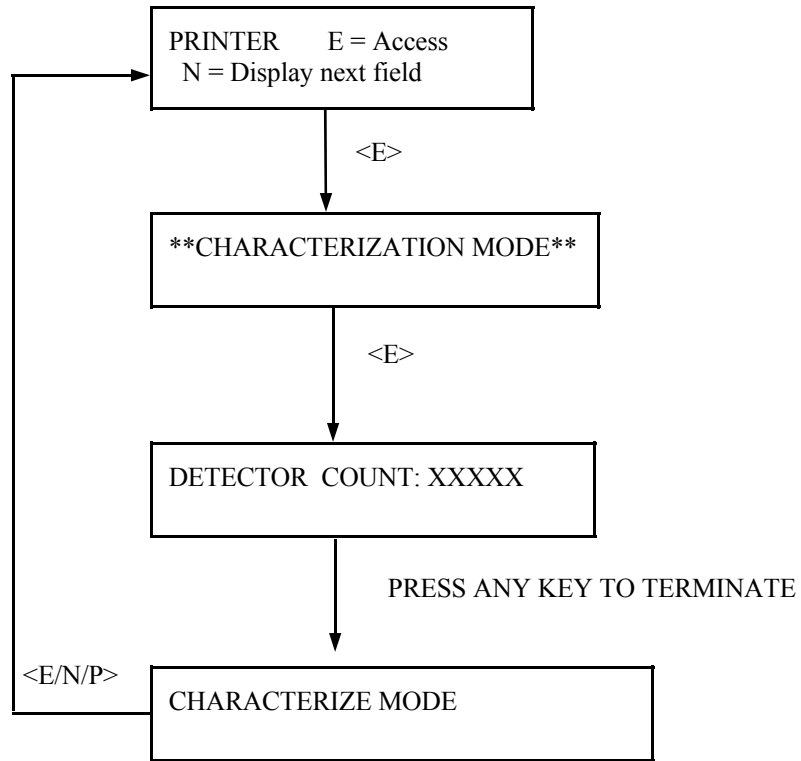
PRINTER E = Access

PRINT:  
Requires the optional serial  
link interface printer and  
board.

This module will produce a report in this format:

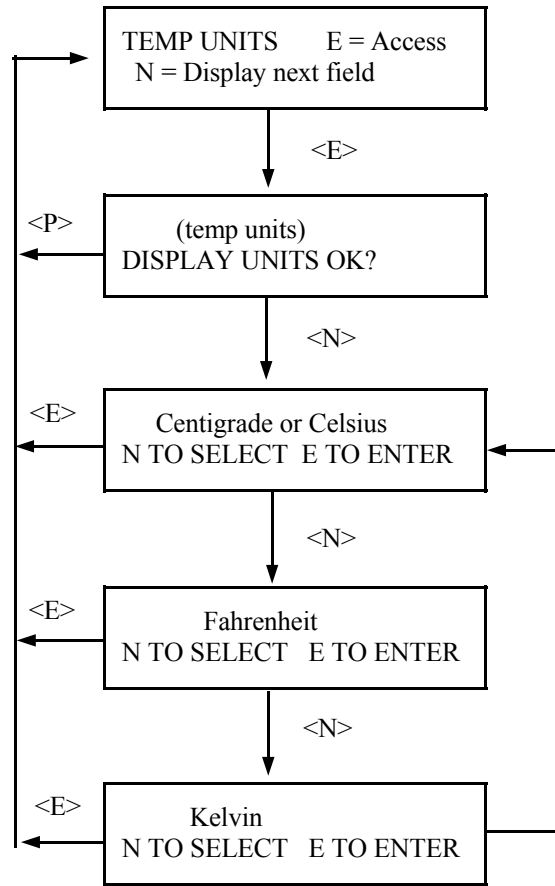
DATE TIME DET COUNT PRO. TEMP DET. TEMP

**Press <N>**



TEMP UNITS    E = Access

Allows selection of temperature units.



Wt	Spd	Rate
----	-----	------

Wt - Weight per unit length as of % full scale loading

Speed - Conveyor Speed in % of full scale

Rate - % of full scale weight per unit time

Flow Rate.	XXXXX	UNITS
------------	-------	-------

Flow Rate - Displays mass flow rate in selected units

Weight - displays weight in selected units

Time Const :	XXX.XX	Secs
--------------	--------	------

Time Constant - Filter time constant in seconds

Max. Speed - Displays max speed in ft/min

Min. Flow	XXXXX	UNITS
-----------	-------	-------

Min. Flow - Displays minimum flow in selected units

Max. Flow - Displays maximum flow in selected units

**Press <N>**

Time: XX:XX:XX

TIME:  
Current time of day in  
24-hour format

DATE:  
Current date in  
MM-DD-YY format.

Ln (Ref Count) : XX.XXX

Ln(Ref Count): Natural  
logarithm of the counts  
recorded during last  
“referencing” procedure.

Ln(Det Count): Natural  
logarithm of the  
UNFILTERED counts  
being received currently.

Rate Output : XX.XX mA

Rate Output: Displays flow  
rate output signal in milli-  
amps. Channel 1

Wt Output: Displays weight  
output signal in milli-amps.  
Channel 2

Diagnostic Test

Diagnostic Test -  
First value = Present  
detector temperature (in  
degrees K \* 10).

Second value = raw  
measurement counts

**Press <N>**

Last REF. Date: XX/XX/XX

REF Date: Last date the system was referenced.

Elapsed Time: Number of days since last reference was performed.

Total: XXXXXXXXXXXX UNITS

Total: Displays total accumulated weight in selected units

Total time: Total time in hrs to accumulate total weight.

Pd Limit...XXXXXXXXX UNITS

Pd.Limit: Displays predetermined limit at which system will output an open collector output (Batching)

Present: Displays current status of Pd Limit

Flow Rate: XXXXX UNITS

Flow rate: indicates flow rate in selected units

Total: Displays accumulated weight in selected units

**Press <N>**





**Chapter 5** describes calibrating the Weight Monitor System.

The calibration procedure is detailed, with step-by-step instructions.

Document all changes you make to the factory-default settings\* that are active in your system.

- 5.0 Calibration
- 5.1 Factory-Default Settings
- 5.2 Initial Calibration
  - Belt Speed
  - Mass Density
- 5.3 Documentation
- 5.4 Example

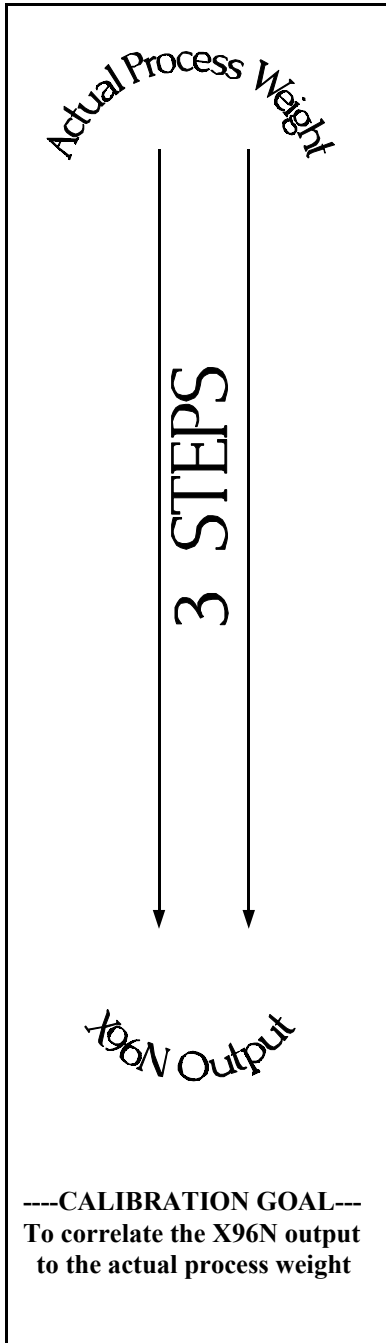
\* See "Factory Configuration and Inspection Sheets" filed in Chapter 10 with drawings.



## Reconfiguring the System

Ronan ships the Weight Monitor System with factory-default software settings. Those settings are responsible for the information that initially appears on the status displays.

After installation at your site, you will want to reconfigure the system to fit your application. The goal is to correlate the X96N output to actual process weight, so the X96N weight monitor can replace the time-consuming task of manual lab-sampling. The list below summarizes the activities that are detailed in the remainder of this chapter:

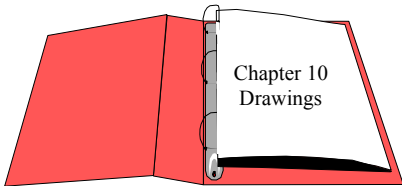


- 1 Check the factory-default settings to be sure they are appropriate for your circumstances. IF NOT, make the necessary changes and document those changes for future reference.
- 2
  - a) Perform an initial speed calibration.
  - b) Perform an initial calibration to correlate the X96 output to the process weight using predetermined loads.
- 3 Document detector output counts at calibrated percent density to assist in troubleshooting. Also, record changes you make to factory-default settings. Keep this information for future reference.

# 1 Factory-Default Settings

Locate the Factory Configuration Sheets which are filed with the drawings in Chapter 10 of this manual. That information will indicate how the system operated under factory conditions.

Those settings were made based on information provided at the time your Weight Monitor System was ordered. In most circumstances these settings should be appropriate for your circumstances.



You can check these settings through the X96N display modules by entering the programmable-functions access code: Press <E>  
 Press <N N P N N P>  
 Press <N> to reach the function....

Reference: :  
 Factory Configuration Sheet

**DOCUMENT ALL  
 CHANGES**

REF MODE  
 TIME CONSTANT  
 REF CONSTANTS  
     Loading Factor  
     Reference Time  
     Fault Counts (high/low)  
     Output Span (zero/max, Channels 1 & 2)  
 RANGE (zero/full span-Channels 1 & 2)

## Reference MODE

One of your first tasks will be to calibrate the system. The first step in the calibration procedure is to "reference" the gage on some known value. The steps involved in the referencing procedure will vary slightly depending upon the *mode* selected as the constant.

One of these three REFERENCE MODES will be active on your system:

Referencing EMPTY  
 Referencing with PROCESS OF KNOWN DENSITY  
 Referencing with ABSORBER

Changing the REFERENCE MODE requires access to the Factory-Programmable Functions.

## 2 Initial Calibration

Initial calibration consists of two parts, the belt speed calibration and the mass density calibration.

**Belt Speed Calibration** The belt speed calibration correlates the speed signal to the rate the material is moving. This is achieved by stopping the belt and calibrating the minimum speed and running the belt at full speed and calibrating the maximum.

**PROCEDURE:**

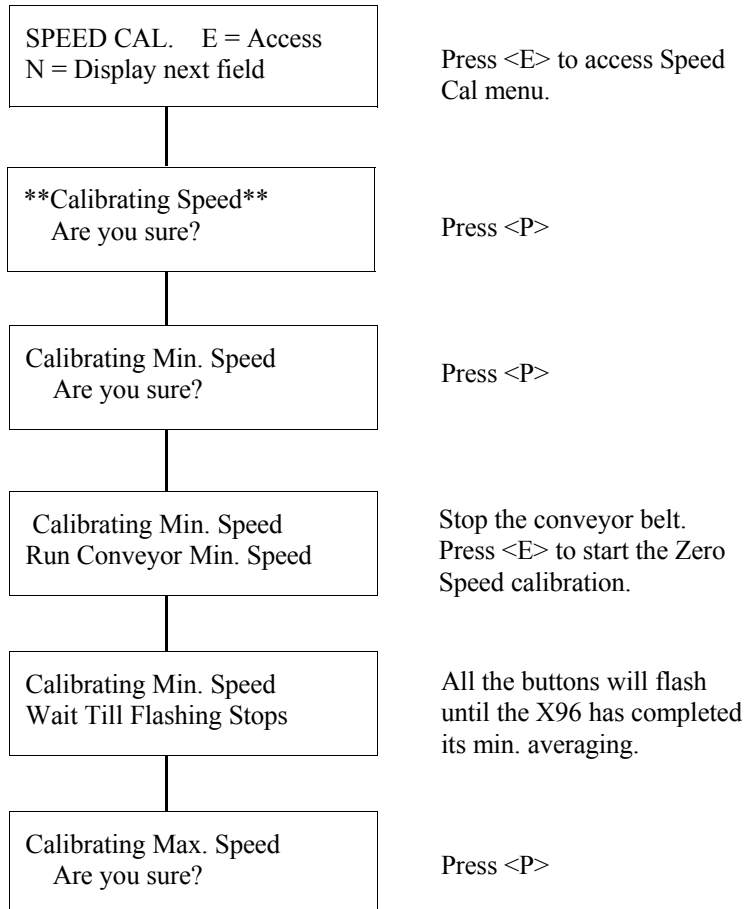
The **SPEED CALIBRATION** module is located in the customer-programmable functions.

Begin by entering the access code:

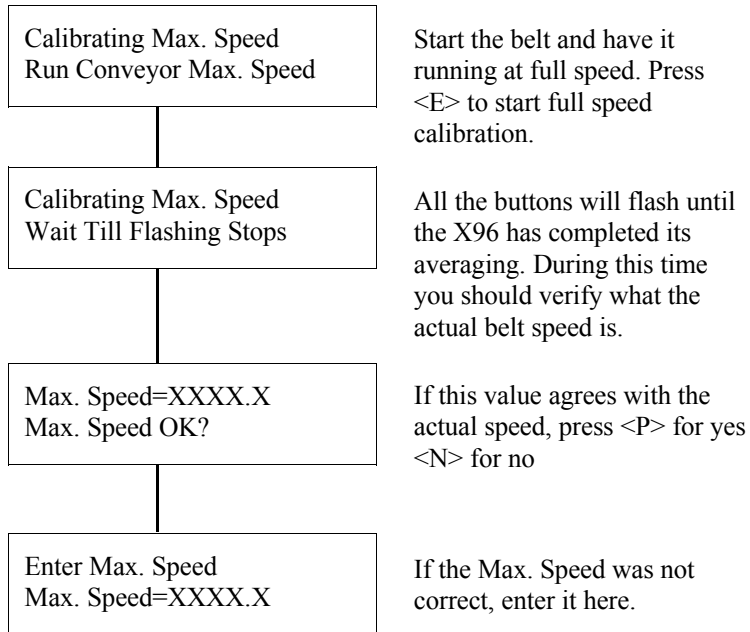
Press <E> LEDs flash

Press <N N P N N P>

Press <N> to reach SPEED CALIBRATION



**Belt Speed Calibration  
(continued)**



**b) Mass Density Calibration**

The mass density calibration correlates the detector counts to the mass upon belt. This can be achieved by several different methods. One method consists of Referencing on Empty Belt. The next step requires running predetermined weights past the gauge and comparing the indicated weight to the actual weight. For alternative calibration methods, consult Ronan Engineering.

First you will **REFERENCE** the system on Empty Belt. Then you will **CALIBRATE** the system by one of the following means, with an Absorber Plate of predetermined value, or with a static load on the belt that you must weigh.

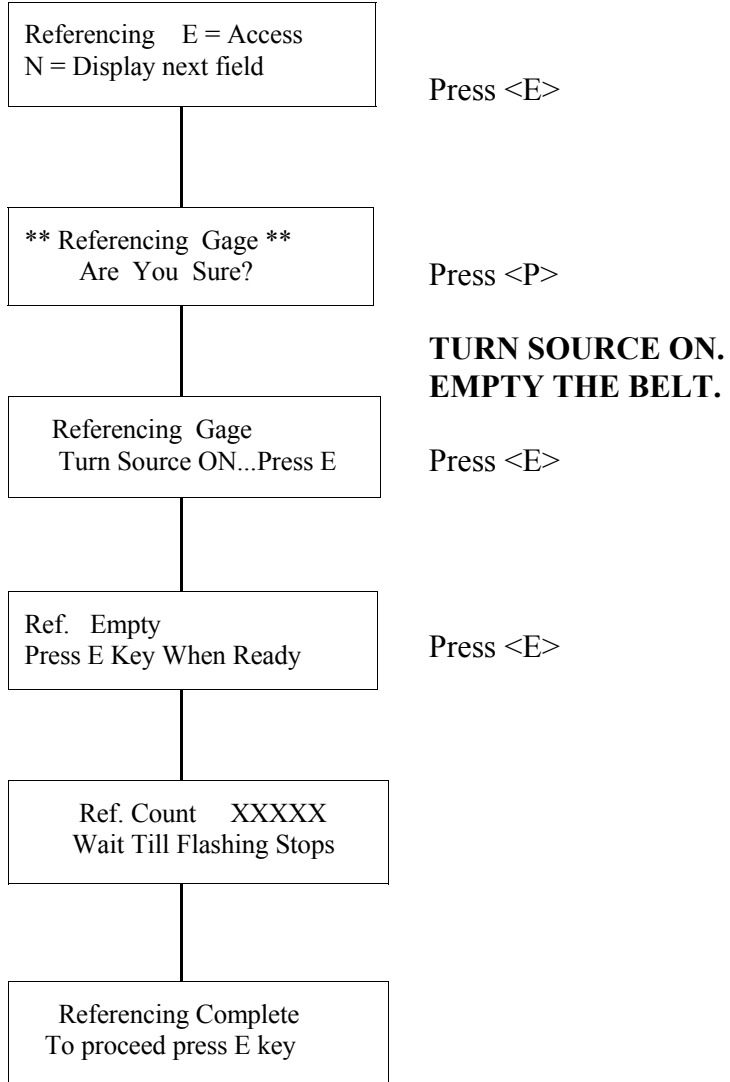
**Referencing Empty Belt**

The **REFERENCING** module is located in the customer-programmable functions.

Begin by entering the access code:

- Press <E> LEDs flash
- Press <N N P N N P>
- Press <N> to reach REFERENCING

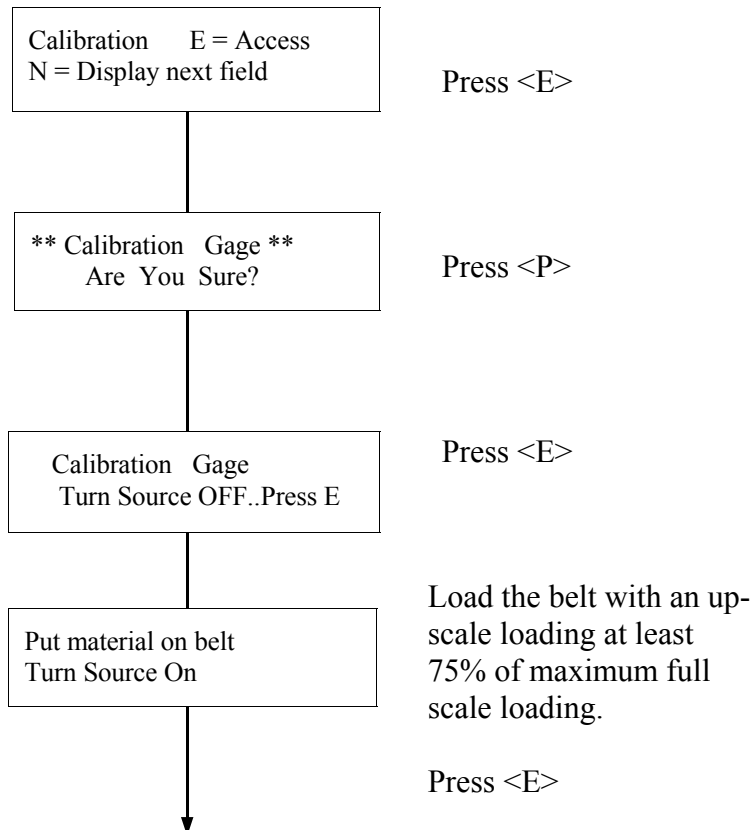
**NOTE:** The series of screens presented during the referencing procedure will vary depending on which mode of referencing is selected. You may go to the REF MODE module to change mode to Ref Empty.



**Calibration Using Process Material**

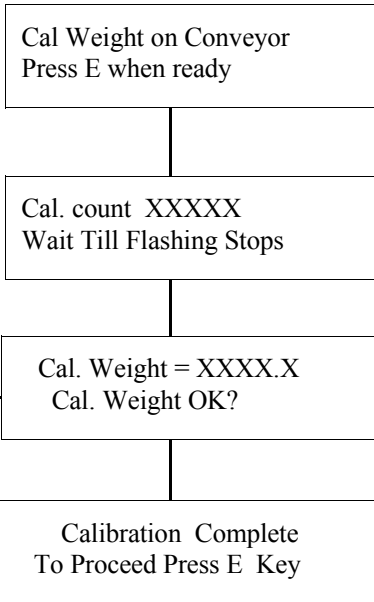
The second step in the mass density calibration can be to perform calibration using process material. The calibration must be carried out on a known conveyor loading e.g. lbs/foot or Kg/Meter. The calibration module also has no pre-established loading point as in the Reference module, and must be entered as actual weight placed per unit ft (or meter) on the conveyor.

Before proceeding ensure that the belt is loaded with an up-scale loading at least 75% of maximum full scale loading. The up-scale loading may be obtained by placing a static load onto a stopped conveyor, in the radiation beam. The loading in lbs/ft is obtained by taking the through-put in lbs/min and dividing by the speed (ft/min). The static loading should be a spread of material which covers at least two linear ft. of conveyor e.g., if the desired calibration loading is 20 lbs/ft, 2 ft. of loading is 40 lbs. The calibration is to be done with product spread evenly over the conveyor shaped to the natural slump of the product. The value of the calibration loading is assigned to the calibration after the gage output is read on the measured material.





**Calibrating Using  
Process Material  
(continued)**



Press <E>

Press <P> if this is the actual weight.

Press <E> to exit Calibration Mode.

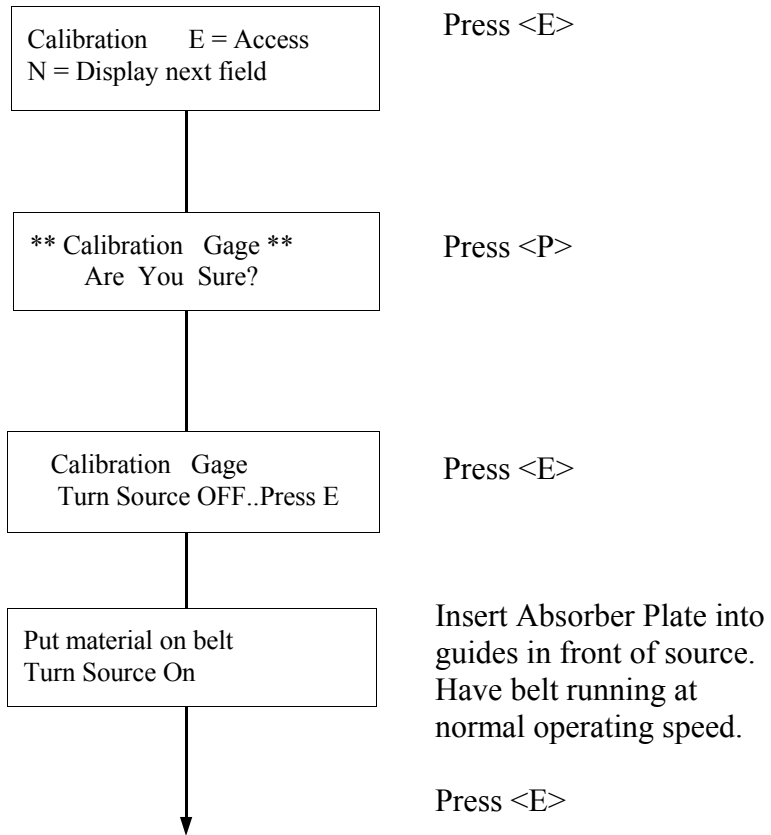
Use <N> to increase value  
Use <P> to decrease value  
Use <E> to correct value

**Calibration with Absorber Plate**

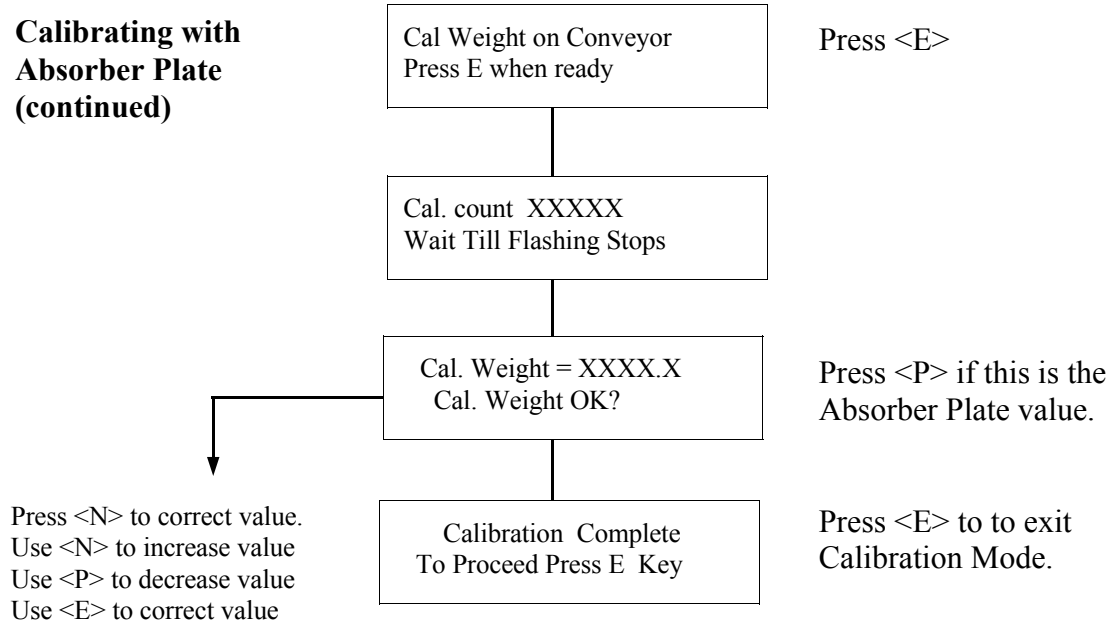
An alternative to calibrating with process material is to use an absorber plate with predetermined weights. The procedure is much the same as that used for a process calibration, the only difference is that instead of material being placed on the belt, the equivalent absorber plate is inserted into the space provided and the value assigned to the plate is used as the calibration value.

Begin by entering the access code:

Press <E> LEDs flash  
 Press <N N P N N P>



**Calibrating with Absorber Plate (continued)**



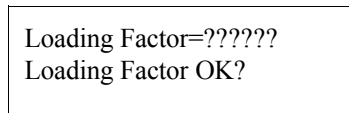
**Manually Entering New Loading Factor**

The weight can be calibrated by manually entering the New Loading Factor. Follow this procedure.

Determine new loading factor and enter the customer programmable functions (Press <E>; Press <N N P N N P>; Press <N> to reach Ref. Const)

Press <E> to enter Reference Constants.

When the X96 displays “Ref. Time=?????” Press <P>.



This is the current loading factor.

To determine new loading factor, use the following equation:  
Press <N> for no to Loading Factor OK? Use <N> to

$$\text{New Loading Factor} = \frac{(\text{Current Loading Factor} \times \text{Actual Weight})}{\text{Measured Weight}}$$

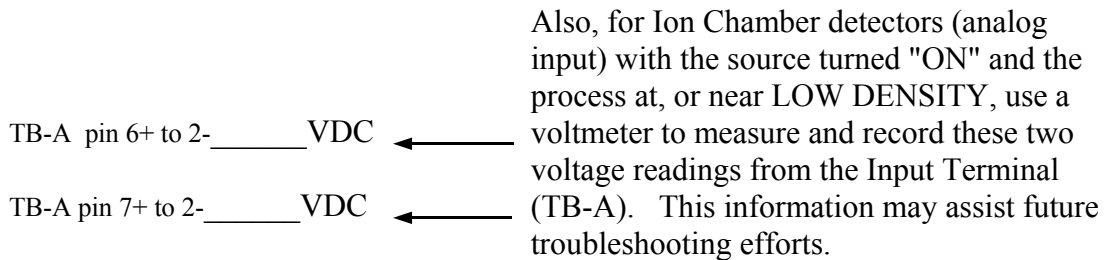
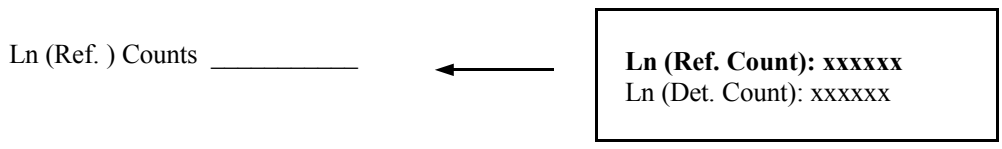
increase the value or <P> to decrease the value to the new loading factor. Press <E> to enter the new value.

When the X96 displays “Fault Count=????,” press <P>.

# 4 Documentation

For future reference, document these items:

- (a) Environmental/process conditions (densities, temperatures, etc.) that influence the reference/calibration. The next time a calibration is performed, you will need to duplicate the conditions, or account for the differences.
- (b) All changes made to factory-default settings such as time constant, reference constants (loading factor),, etc.
- (c) A record of "counts" being received from the detector may assist with future troubleshooting efforts.



Technical

**Scintillator**

Technical

**Chapter 6** contains technical information and reference drawings for the detector.

The Scintillation Detector is NOT field servicable.

Instructions are given for replacing the detector.

- 6.0 Technical
- 6.1 Detector Description
- 6.2 Detector Service
- 6.3 Detector Replacement
- 6.4 Notes/Drawings



## Scintillator Detector Description

The Ronan scintillation detector consists of three main components: The plastic scintillation crystal, the photomultiplier tube (PMT), and the associated electronics.

### Scintillation Crystal

The crystal (3) used for the Continuous Level Monitor System is polyvinyltoluene (PVT) plastic. The crystal produces light pulses which are proportional to the incident radiation events striking it.

Typically mounted in a stainless steel shell the entire crystal assembly is sealed against moisture and dirt and is non-repairable. An integral flange serves to mount the crystal to the PMT. A special silicone membrane serves as an optical coupling (19) medium between the crystal and the PMT.

---

### Photomultiplier Tube

The PMT (6) is a light sensitive vacuum tube with a photosensitive layer that converts the light pulses to an electrical current. Light pulses from the crystal strike the photosensitive layer and release electrons. A high voltage power supply connected to the photosensitive layer accelerates the electrons through stages of current amplification.

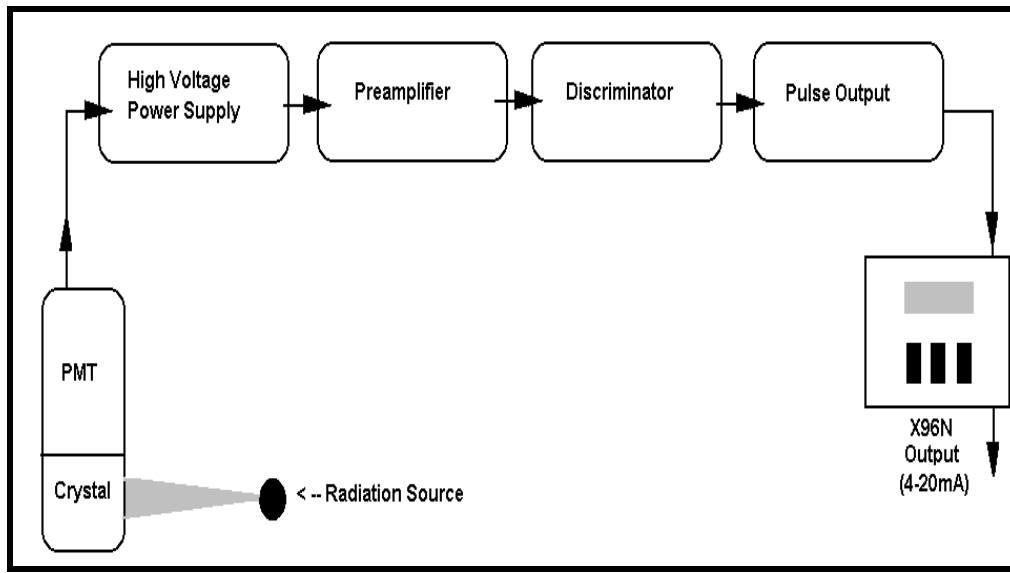
The PMT and its associated components are housed in a special magnetic shield. The tube is shock-mounted internally, with an interface plate at the top which also mounts the electronics and the outer shell (7).

---

### Electronics

Four boards, housed in a stainless steel shell, comprise the electronics and their functions.

- \* High Voltage Power Supply
- \* Preamplifier
- \* Discriminator
- \* Pulse Output



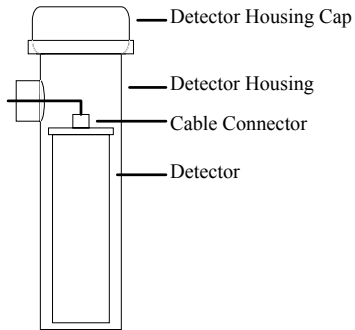
### Detector Service

The critical components of the electronic circuit and the PMT/Crystal Assembly are aligned before leaving the factory. (See Factory Configuration and Check Out Sheets, Chapter 10). If any component of the Scintillation Detector is adjusted or replaced, the performance of the entire system will be adversely affected and will require realignment before continued use is possible.

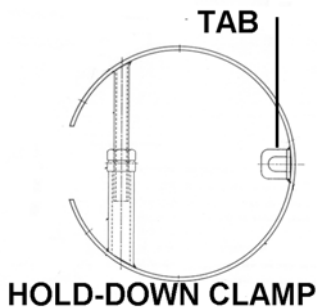
Therefore, the **scintillation detector IS NOT field servicable**. Should a problem arise with the detector, the entire Detector Assembly should be returned to Ronan for repair/replacement.



## Detector Removal/ Replacement



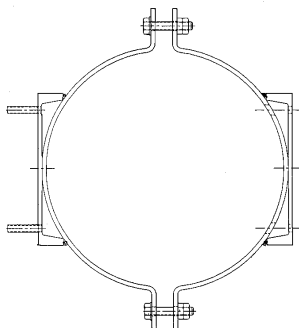
- 1) Check NOTES below for illustrations and cautions that apply to your specific equipment.
- 2) Unscrew cap on detector housing.
- 3) Unscrew connector on top of detector.
- 4) Remove detector from housing.
- 5) Carefully install replacement detector in housing.
- 6) Screw connector back onto detector.
- 7) Immediately replace detector housing cap.
- 8) Follow instruction to REFERENCE or CALIBRATE new detector.



### ELONGATED DETECTOR NOTES:

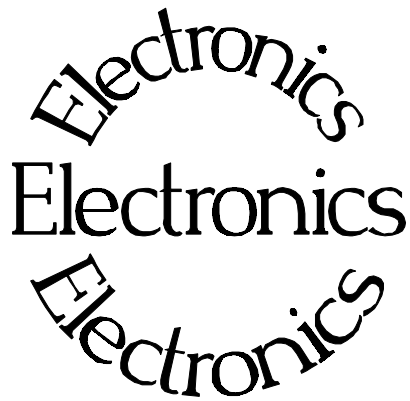
To avoid damage in shipment or installation, the elongated detectors are packaged separate from the housing. Avoid subjecting detectors to mechanical shock. Avoid supporting detector by its chain handle, or other lifting devices, for prolonged periods of time.

When detector is properly seated on the bottom of the housing, the hold-down clamp "tab" will engage and the extension rod screw can be adjusted to tighten detector assembly into housing.



### DETECTOR HOUSING/ BRACKET ASSEMBLY NOTES:

Many detectors are shipped inside the housing/bracket assembly. Bolts at the top and bottom of the C-Clamp are used to adjust the assembly around a pipe.



B-9742-K

**Chapter 7** contains information about the Electronics used in your Weight Monitor System.

Troubleshooting tips are also included.

Most measurement problems can be isolated to one of four areas:

- \* Accessory related
- \* Installation related
- \* Process related
- \* Monitor System  
Equipment

- 7.0 X96N Microprocessor
  - Board Setup
  - Alarm Trips
  - Reference Drawing
- 7.1 Troubleshooting Tips - Isolate Problem
  - Accessories/Configuration/  
Process/Measurement Equipment
- 7.2 Using X96N Status Displays to Troubleshoot

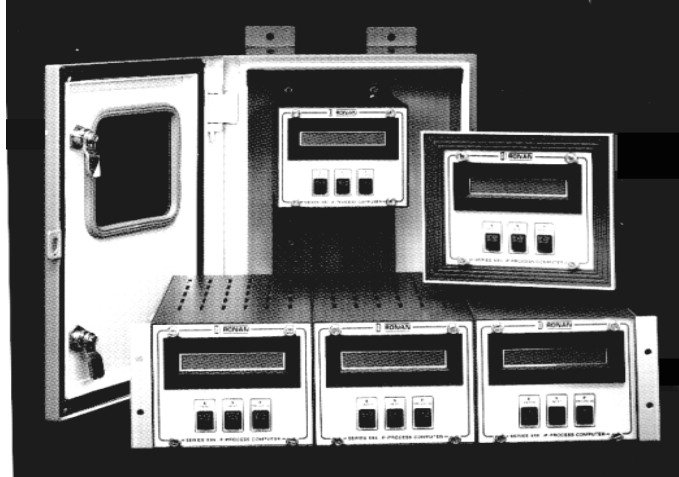


## X96N Microprocessor

### Power Supply Assembly

**Input: 24VDC**  
 110VAC +/-15% 50/60Hz  
 220VAC +/-15% 50/60Hz

**Output: +/-15VDC**  
 +5VDC



To remove fuse for inspection,  
**PUSH IN** and **TWIST**  
 COUNTERCLOCKWISE:



Test the power supply with a voltmeter by temporarily disconnecting all input wiring from TB-A. Do not allow the wires to touch other terminals or chassis. Suspect power supply problems if:

- +15V, -15V or +5V LEDs are NOT illuminated.
- +15V is NOT measured across pins 1 and 2 of TB-A.
- 15V is NOT measured across pins 2 and 3 of TB-A.

If necessary, access the power supply assembly by removing the four screws around the **OUTSIDE** edge of the panel.

Four screws around outside edge of panel will access Power Supply Assembly.



Temporarily disconnect TB-A input wiring.



Check LEDs



**X96N Microprocessor Boards**

Most troubleshooting of the X96N can be done to the board level. Loosen the four thumbscrews from the front cover of the display/keypad. Open the front cover and refer to Drawing B-9742-K for board identification.

Reference:  
B-9742-K

Each board can be easily removed and replaced. Replacement part numbers are given on the Factory Checkout and Test Sheets in Chapter 10.

**NOTICE:**

---

The boards are interchangeable in the chassis slots, however each ribbon cable **MUST** be plugged into the correct board.

---

**CPU Board**

The central processor unit (CPU) consists of the Intel 8088 Microprocessor, clock generator, the RAM, ROM and E<sup>2</sup> ROM memory devices and the buffers providing the interface to the input and output busses.

Suspect CPU board problems if readings on the display screen are incorrect or erratic.

Before replacing the entire board, check to be sure the EPROMS are positioned correctly. Also, try replacing EPROMS on U7, U8, and U9.

**Input Board**

---

The input board provides analog-to-digital conversion to condition the detector output and signal(s) for processing by the CPU.

Suspect problems with input board if any of the following conditions arise:

-15/+5V LEDs on back panel are not illuminated.

Detector input (analog or pulse) is not being converted to counts on the display screen.

The open collector outputs from TB-A do not function properly. (Measured at TB-A pins 12,13,14).

**Output Board**

The output board converts digital values of active units to two transmitter outputs (4-20 mA or 10-50 mA.) Also, two alarm trips with single setpoints providing two SPST contact outputs each. A fail-safe relay, supervised by the system watchdog, transfers if the unit fails or if it loses power.

The output board may need to be replaced if a problem arises with either one of the output signals, or if the alarm trips are not initiating properly.

---

**Display Interface Board**

The display interface board connects the main bus to the display board. It contains decoder/buffers, power failure battery back-up, and the real-time clock.

This board may need replaced if the Time and Date on the X96N do not work correctly.

---

**Display Assembly**

The display assembly is comprised of the Display Board, LCD Board, and Switch board. This assembly contains the operator display screen and three pushbuttons.

Suspect problems here if the pushbutton inputs send errant signals to the microprocessor.

---

**Serial Interface Board**

The *optional* serial interface module provides output facilities to a hard-copy printer or a computer.

Suspect problems here if devices external to the X96N are setup with correct system parameters, but are still not receiving a communication signal.

## X96N Transmitter Output Board Setup

Reference:  
B-9742-K

The output range (normally 4-20 mA) is supplied according to system requirements. The output range is normally factory-calibrated according to customer specifications and should not need any adjustment unless a change of range is required.

The values of zero and span, in milli-Amps, entered in the set-up module should match the selection on the output board.

Two methods for setting up the transmitter output are given on the following pages:

Setup Using a Calibrator and  
Setup Using the Gage Signal

## Transmitter Output Board Setup Using Gage Signal

Reference:  
B-9742-  
K

1 (-) Ch 1  
2 (+) Ch 1  
3 (-) Ch 2  
4 (+) Ch 2

1. Turn source ON and calibrate gage, including speed cal
2. For a current or voltage output, connect a milliammeter in series with the output load or a voltmeter directly across the B output terminal, with proper load connected.
3. Select Status Display #1 and note the reading for weight, speed and rate.
4. With the conveyor stopped and the belt empty, ensure that the weight, speed and rate all read 000.00%.
5. Adjust the output zero control Z1 for channel 1 (Rate) and Z2 channel 2 (weight) to obtain an output current/voltage corresponding to zero of range, for instance 4mA.
6. Turn source off.
7. Run conveyor at max speed.
8. Note that weight, speed and rate all indicate 100% or greater.
9. Adjust SP1 for channel 1 and SP2 for channel 2 to obtain a voltage or current equal to maximum range, for instance 20mA.
10. Turn source back on and resume normal operation.

RECORD FOR REFERENCE:

Step # 5 (Ch1) \_\_\_\_\_

(If Used-Ch2) \_\_\_\_\_

Step # 11(Ch1) \_\_\_\_\_

(If Used-Ch2) \_\_\_\_\_

## Transmitter Output Board Setup Using Two Calibrators

Reference:

B-9742-K

1. Temporarily disconnect the yellow wire from "A" input terminals TB6. (Do not allow it to touch other terminals or chassis)
2. Connect calibrator 1 to "A" input terminals TB6 (+V) & TB2 (-V).
3. Temporarily disconnect the speed input wires from "A" input TB5 & TB8.
4. Connect calibrator 2 set to correct output, current or voltage (check speed sensor output) to TB5 (+V) and TB8 (-V).
5. Select the first status frame and adjust calibrator 2 (voltage, current, or pulse output) until speed indicates 100%.
6. Now adjust calibrator 1 (set to d.c. voltage output) until weight indicates 000.00%, note rate output should also read 000.00% (3v d. c.)
7. Adjust the output, zero control Z1 for Channel 1 (Rate) and Z2 for channel 2 (Weight) to obtain output corresponding to zero, for example 4mA.
8. Now adjust calibrator 1 until both weight and rate indicate 100% or more.
9. Adjust the output span control (SP1) for channel 1 and SP2 for channel 2 for output corresponding to maximum of the output range, for example 20mA.
10. Disconnect both calibrators and replace yellow wire in Terminal A TB6, and speed sensor wires back into TB5 and TB8.
11. The output transmitters are now calibrated.

pin 2 (-)

pin 6 (+)



## Alarm Trip Setup Using a Calibrator

Reference:  
B-9742-K

Ch 1: 7 = C  
8 = NC  
9 = NO  
Ch 2: 10 = C  
11 = NC  
12 = CO

pin 2 (-)

pin 6 (+)

1. The alarm trip set-points are normally field-calibrated after initial system span calibration. Periodic re-calibration of these modules is normally not necessary.
2. The alarm outputs control two relays. Each relay has normally open and normally closed contacts. These can be found on the terminal strip marked Output or B.  
Channel 1: alarm pin7 (C), pin8 (NC) and pin9 (NO)  
Channel 2: alarm pin10 (C), pin11 (NC) and pin12 (NO)
3. Connect two calibrators as previously described in "Calibration using two calibrators."
4. Adjust calibrators til weight output is at alarm trip point.
5. Now adjust calibrators until the alarm just occurs, indicated by the front red LED. (Counter clockwise decreases set-point)
6. Set the hysteresis to the desired value by using the control HS 2. The hysteresis control starts at 5% of input span, and adds about 1.5% of span each turn. (Counter clockwise increases hysteresis)
7. Now adjust calibrators until rate output indicates alarm point.
8. Proceed as in (c) above, but adjust TP1 channel 1, until alarm just occurs.
9. Set hysteresis to desired value as in (d) above, using HS 1.

---

If Low Reference counts are below 10,000 or above 20,000 counts, the signal gain may need adjusted. Follow this procedure:

## ION Chamber Detector Signal Gain

Reference:  
B-9742-K

RefLo xxxxxx RefHi xxxxxxx  
Det Counts xxxxxx

Diagnostic Test  
xxxx / 15000

1. Make sure that the Diagnostics module is disabled.
2. Set your process up as if you were going to do a Low Reference (i.e. Empty, with Process, etc.) and open the source shutter.
3. Bring up the Diagnostic Status screen on the X96N front panel.
4. Refer to drawing B-9742-K.
5. Adjust (R2) control on Input Board until the display reads between 10,000 and 20,000 counts
6. Adjust the R2 control on the Input board in the X96N until the screen reads between 10,000 and 20,000 counts

**Isolate Problem**

Most problems can be isolated to one of four overall causes. Eliminate each, one at a time, until the cause is determined.

**Accessories**

Begin by disconnecting potentiometers, recorders, and controllers from the system. Accessories, when operating properly, should have NO effect on the X96N display.

**Configuration/  
Installation**

If the problem is not affected by the accessories, look for configuration changes that may have occurred since the Measurement System was installed.

When troubleshooting, it is important to consider the "Theory and Principles of Operation" information in Chapter 2. Process measurement is possible due to the principles of radiation transmission and absorption. The total mass of material between the radiation source and the detector (i.e. "measuring gap") will affect the final measurement. You must eliminate possible configuration/installation type of changes as the cause of your problem.

For example, consider the following:

- Could dust from process material or surrounding environment be collecting in "dead space" between the radiation source and detector? This would also indicate a higher level.
- Could process be building up on the belt? This would indicate a higher level.

If configuration causes are eliminated, consider the process conditions themselves.

**Process Conditions**

## Measurement Equipment

After eliminating the accessories, installation/configuration, and process conditions as possible causes of the problem, you will want to consider the measurement equipment. The X96N Microprocessor itself will be of great help in this troubleshooting procedure.

\* If the problem is traced to the Detector, Chapter 6 contains technical information that may help to further isolate the problem.

\* If the problem is traced to the Optional Accessories the information in Chapter 8 may assist you.

## Using the X96N Status Displays to Troubleshoot

The X96N continuously monitors system operation. The following Status Displays may help to uncover the cause of system malfunctions.

### ALL STATUS DISPLAYS:

Begin by ensuring the displays are operational. If all of the **display screens are blank** consider these possible causes:

(blank display)

- Power off - Check AC power line or fuses.
- Total system failure - Check for faulty power supply  
Check for faulty CPU board.
- Faulty display board - Check for shorts at X96N:  
TB-A pins 1-2 and 2-3  
TB-B pins 1-2 or 3-4

If all display screens begin flashing:

(flashing display)

- Radiological Discrimination may have detected outside source of radiation. Check Calibration Constant for Fault Count.

**STATUS DISPLAY #1:**

Detector signal below calibration range  
(UNDERRANGE):

-Wt	+Spd	-Rate
UNDRNG	%	UNDRG

- Empty belt
- Calibration error
- Faulty input board

Detector signal above calibration range  
(OVERRANGE):

+Wt	+Spd	+Rate
OVERRANGE	%	

**Weight**

- Belt Overloaded
- Source OFF
- Calibration error
- Faulty input board
- Faulty detector
- Wrong range setting

**Speed**

- Calibration error
- Faulty speed transducer
- Faulty input board

Detector signal erratic:

+Wt	+Spd	+Rate
?%	?%	?%

- Response time too fast - increase time constant.
- Dynamic tracking threshold too low - increase threshold.
- Radiaiton field varying independent of process - check to ensure source holder handle in secured in the ON position.

**COUNTS STATUS DISPLAY:**

Detector counts greater than Reference (low) counts:

Ln (Ref. Counts):	xxxxxx
Ln (Det. Counts):	10500

- Weight measurement below limits - check for calibration error.
- IF Ion Chamber Detector, check detector signal adjustments.

**OUTPUT STATUS DISPLAY:**

**Output always 4.0** - Detector signal is below the calibration range:

Rate Output: 4.00 mA  
Weight Output: 4.00 mA

- Process condition
- Calibration error
- Empty belt

**Output always 20.00** - Detector signal is above the calibration range:

Rate Output: 20.00 mA  
Weight Output: 20.00 mA

- Process Conditions
- Calibration error
- Source OFF
- Wrong detector selected

**Erratic output:**

Rate Output: xx.xx mA  
Weight Output: xx.xx mA

- Response time too fast: increase time constant.
- Dynamic tracking threshold too low - increase threshold.
- Radiation field varying independent of process - check to ensure source holder handle is secured in the ON position.

**DIAGNOSTIC TEST DISPLAY:  
(Second Value)**

No detector signal:

Diagnostic Test  
-----/00000

- Faulty detector
- Faulty detector amplifier
- Faulty +/- 15V power
- Faulty cabling
- Source OFF
- Wrong detector selected

Detector signal above expected limit of counts:

Diagnostic Test  
-----/32767

- Calibration error
- Faulty detector/detector amplifier

Rev 0 - 9/94

Accessories/Options  
Accessories/Options  
Accessories/Options

**Chapter 8** includes details about optional features, accessory equipment, and other special items that may be included with your gage.

The information in this chapter applies only to the Weight Monitor Systems that use these options.

## 8.0 Accessories/Options



## **Conveyor Speed Monitoring**

The velocity of the conveyor must be inputted into our X96N microprocessor to complete the Rate measurement.

### **When is a speed sensor needed?**

A speed sensor is required when ever the conveyor speed is not constant.

### **What if the conveyor speed is constant?**

The customer may provide a dry contact input into our X96N microprocessor which indicates when the conveyor is moving. The contact would need to be open when running and closed when stopped.

### **What if the conveyor speed is variable, can other signals be used?**

Ronan's X96N microprocessor is capable of accepting a pulse input (open collector) or an analog 4-20 mA signal for speed signal. If this signal is available a Ronan speed sensor is not required. Otherwise a Ronan speed sensor is required.





**Chapter 9** contains a summary of personnel safety issues that pertain to radiation gages.

An example is provided for determining radiation field intensity, with Dose Rate, RAD, and REM calculated.

Source holder shutter and leak testing is reviewed.

Current regulations are subject to change. You **MUST** obtain a copy of the current Regulations that apply to the State or Country in which your gage is used.

- 9.0 Radiation Safety
- 9.1 Introduction
- 9.2 ALARA
- 9.3 Calculations
- 9.4 Leak Test





Many personnel safety issues can be addressed by one basic principle - limit access to the source of radiation, and thereby reduce personnel exposure. The primary goal is to maintain exposure levels "As Low As Reasonably Achievable."

Known as the principle of ALARA, this basic philosophy is the United States Nuclear Regulatory Commission's overriding guideline for limiting radiation exposure in the workplace.

A basic understanding of the principles of radiation transmission can help in meeting ALARA guidelines and other National and Local regulatory requirements.

A<sub>s</sub>

L<sub>ow</sub>

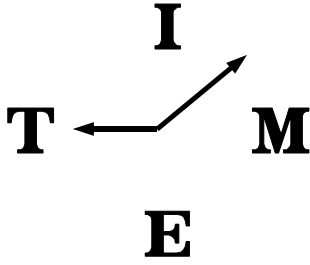
A<sub>s</sub>

R<sub>easonably</sub>

A<sub>chievable</sub>

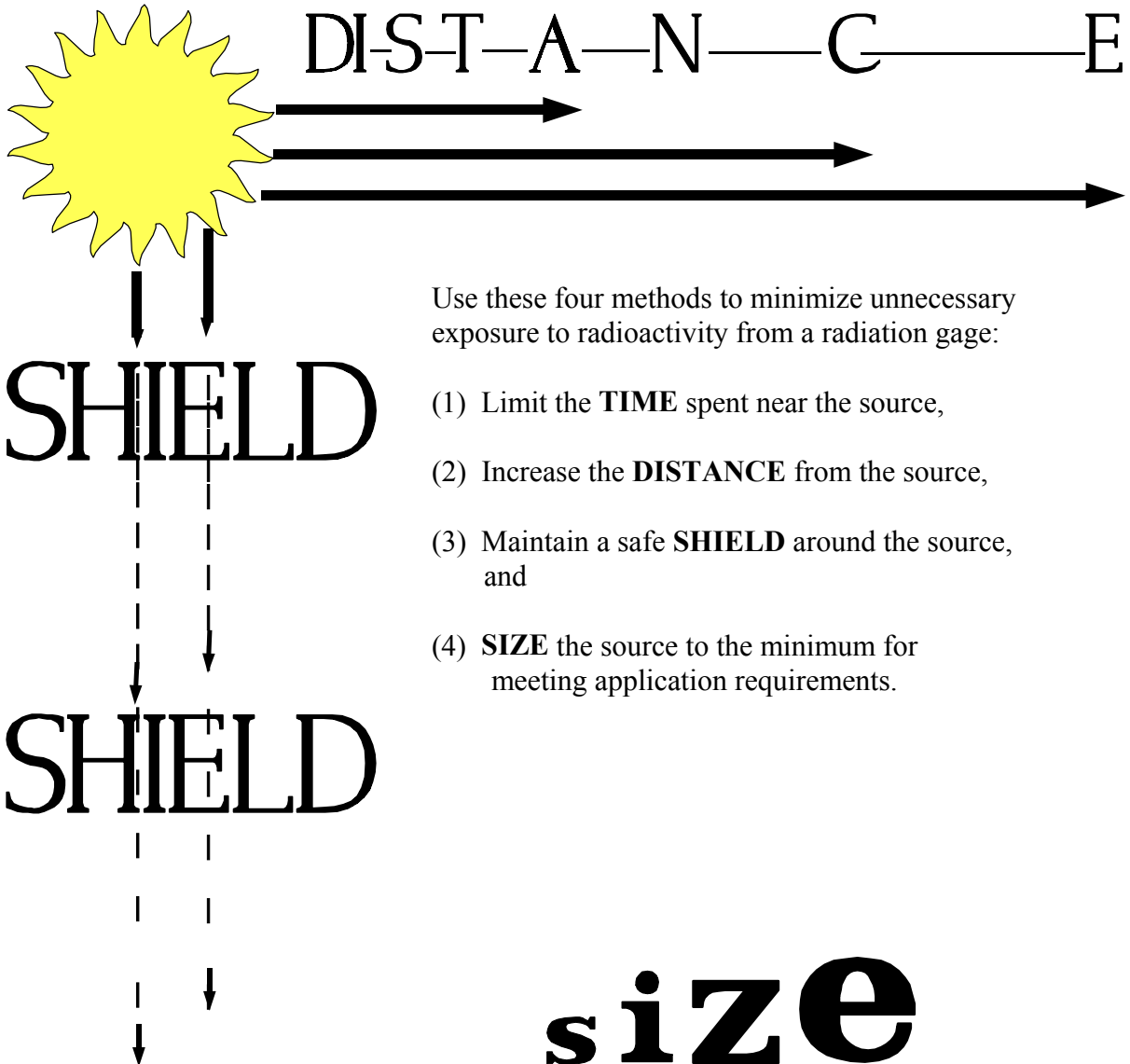
**RADIATION TRANSMISSION:** For example, if we consider the light energy radiating from an incandescent bulb, we can understand the need for these precautions. Many of us work under light from an incandescent bulb on a daily basis. We are surrounded in many rooms by this type of radiated energy with no ill-effects. The glass "shield" prevents us from contact with the filament which could cause a harmful shock. We can even hold our hand directly on a small-wattage bulb for a few seconds without causing discomfort. If, however, we come too close to a high-wattage bulb for an extended period of time we will suffer immediate pain and injury.





Gamma radiation emits electromagnetic energy which is similar to light, except that it readily penetrates opaque materials. Its ability to pass through dense materials is advantageous for applications such as radiation gaging, however, it does require some additional safety precautions for the personnel who are working in the immediate vicinity of the radioactive source.

The precautions required in the case of the light bulb, on the previous page, are similar to those required when working near a radioactive source:



Use these four methods to minimize unnecessary exposure to radioactivity from a radiation gage:

- (1) Limit the **TIME** spent near the source,
- (2) Increase the **DISTANCE** from the source,
- (3) Maintain a safe **SHIELD** around the source, and
- (4) **SIZE** the source to the minimum for meeting application requirements.

**size**

## Calculating the Intensity of the Radiation Field

### Dose Rate in milliRoentgen per hour (mR/hr)

k = constant:

Cs-137 = 0.50

Co-60 = 2.000

Using a calibrated survey meter to measure the radiation field intensity provides the most accurate result. However, it is also possible to mathematically calculate the radiation field intensity with this equation:

$$D = \frac{(k) (mCi)}{d^2} * 1000$$

Where:

D = Dose rate (mR/hr)

mCi = source activity (mCi)

d = distance from source (inches)

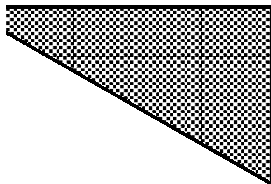
k = constant for radioisotope

### EXAMPLE:

Suppose the source holder from a radiation gage is involved in an industrial accident. The Ronan source holder is not damaged and remains firmly attached to the vessel 20 feet above ground. However, workers cannot immediately reach the top of the vessel to turn the source "OFF." We know the source capsule is 10 millicuries of Cesium (Cs-137). What is the field intensity at ground level in the direct path of the radiation's "active beam?"

### Roentgen (R):

Measure of field intensity in AIR.



$$\text{Dose Rate} = \frac{(k) (mCi)}{d^2} * 1000$$

$$\text{Dose Rate} = \frac{(0.5) (10)}{(20*12)^2} * 1000$$

$$\text{Dose Rate} = 0.087 \text{ mR/hr}$$

This exposure dose rate is expressed in milli Roentgen (mR) per hour and is a measure of field intensity in AIR.

Now, how do we determine the EFFECT that produces on a human being?

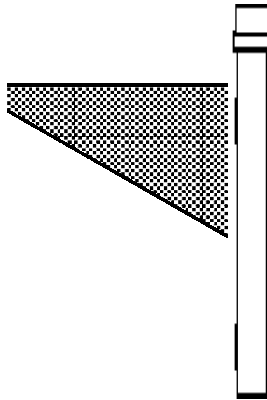
## Calculating the Effect on Man

First, it's important to distinguish between the concept of "RAD" and "REM."

The **RAD** is used to express the amount of energy imparted to matter. It is the dose absorbed by any matter over a specified period of exposure time.

**RAD:** Dose absorbed by MATTER

The **REM** is the Roentgen Equivalent Man. It is a measure of radiation absorbed by the body AND it takes into consideration the effects on human tissue. It is a biological dose.



This distinction is necessary because not all radiation affects the body in the same manner. The type of radiation must be taken into account when attempting to calculate the biological effects.

EXAMPLE:

In our example on the previous page, suppose we had to calculate the potential exposure to a worker who spends one and one-half (1-1/2) hours working on the ground below the source holder before it can be turned "OFF."

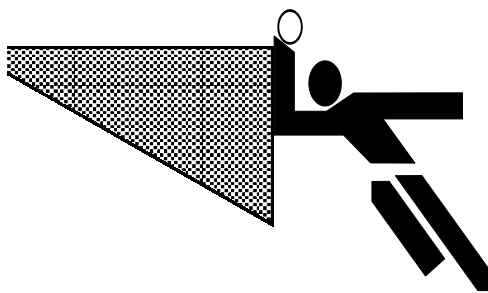
First we would calculate the absorbed dose by factoring in the time (t):

$$\text{Absorbed Dose} = (t) (\text{Dose Rate})$$

$$\text{Absorbed Dose} = \frac{90 \text{ min}}{60 \text{ min/hr}} * 0.087 \text{ mR/hr}$$

$$\text{Absorbed Dose} = 0.13 \text{ milli RAD}$$

**REM:** Biological effect on MAN



And now to determine the biological effect on the worker, we must multiply the absorbed dose by the Quality Factor (Q). Q is the modifying factor used to derive dose equivalent from absorbed dose. In the case of gamma radiation the Q=1. Therefore:

$$(0.13 \text{ milli RAD}) (1) = 0.13$$

milli REM

## Leak Test/ Shutter Test Requirements

The integrity of the containment and shielding around a radioactive source must be verified at periodic intervals specified by your own governing authority.

For example, the U.S. NRC regulations involve verifying two conditions: (1) the integrity of the source capsule and (2) the function of the ON/OFF mechanism (shutter).

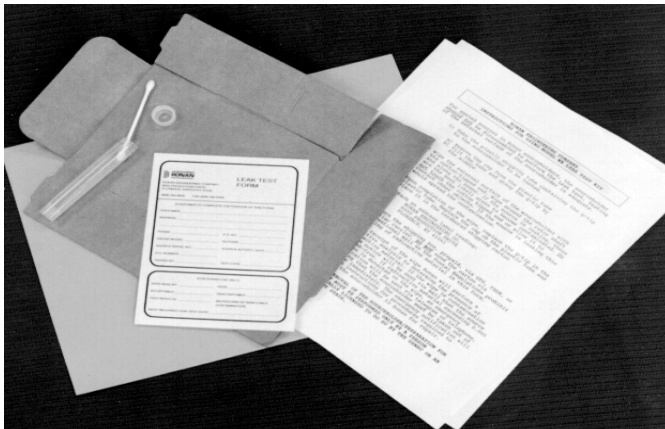
Ronan provides leak test training and a leak testing service to assist in meeting these requirements. The service can be purchased on a contract basis for each individual source. After the source holder is wiped by the customer, the kit is returned to Ronan for analysis. Ronan issues a report and maintains a record of the results.

You **MUST** abide by the regulations issued by your own national and local governing authority.

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## Leak Test Kit

The leak test procedure described here applies only to the Leak Testing Kit (WPTST) purchased from Ronan. As part of the service Ronan provides a leak test kit consisting of these items:



A small plastic tube containing a cotton swab (Q-tip).

A Leak Test Form for processing the leak test.

Instructions for using the cotton swab and completing the form.

A cardboard shipping container for returning the plastic tube, Q-tip, and Leak Test Form to Ronan for processing. (The cardboard shipping container requires easy assembly)

## Preparing for the Leak Test

DO NOT disassemble the sealed source assembly.

Test only the external, or exposed, portion of the source holder.

Keep the cotton swab inside the plastic tube while carrying it to the source holder.

Place the source holder shutter in the OFF or LOCKED position. See Figure 1.

DO NOT touch the cotton swab to any surface other than the one source holder being tested.

## Leak Test Procedure

Remove the cap from the plastic tube.

Tilt the plastic tube and grasp the cotton swab by the wooden end.

With the cotton-tipped end wipe the external surface of the source holder, covering at least  $100\text{ cm}^2$  of the surface. (Approximately

## Completing the Leak Test

With the cotton tip DOWN, replace the cotton swab in the plastic tube.

Replace the cap on the plastic tube.

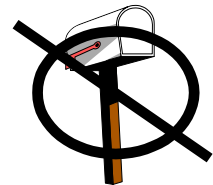


Check the Radiation Label attached to the source holder AND copy the information from that label onto the top portion of the Leak Test Form.

Place the plastic tube AND the completed Leak Test Form into the cardboard shipping tube.

Seal the cardboard shipping tube.

Label the cardboard shipping tube as follows:  
 Ronan Engineering Company  
 8050 Production Drive  
 Florence, KY 41042 USA



## Returning the Leak Test



DO NOT mail the completed leak test by conventional mail. U. S. Postal Regulations prohibit mailing radioactive material.

Return the leak test to Ronan in the cardboard shipping tube, prepaid, by a parcel express service such as UPS, FEDX, or similar carrier.



## Processing the Completed Leak Test

Upon receipt of the leak test, Ronan will perform a sensitive analysis to determine the presence of radioactive material. If the cotton swab is contamination-free, Ronan will mail a certificate to the user indicating the results of the leak test. If radioactive material exceeding 0.005 micro Curies is detected on the cotton swab, Ronan will issue an emergency notification to the user, via telephone or FAX, advising that the source holder must be taken out of service and sent back for repair.

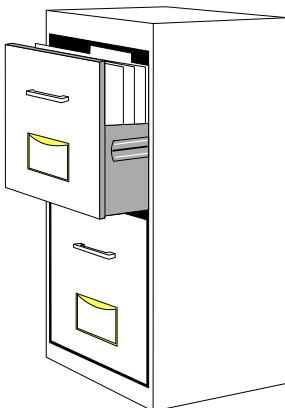
The emergency notification will contain detailed instructions for removing and shipping the source holder. Only Specifically Licensed individuals can remove a source holder and prepare to ship it.

Ronan maintains a record of each leak test analysis they perform. The record will include:

## Records Requirement

- Name and address of the customer
- Date the leak test was performed
- Name of person performing the leak test
- Name of person performing the analysis
- Date the analysis was performed
- Unique identification of the source being tested
- Source serial number
- The radioactive material and mass number of the source
- The leak test results expressed in microCuries

YOU are also responsible for maintaining records:



Transfer Documents shipped with gage.

Initial Radiation Survey.

Periodic Leak/Shutter Tests.

Others documents as required by Federal, State, and/or local agencies.

## Keep Records !