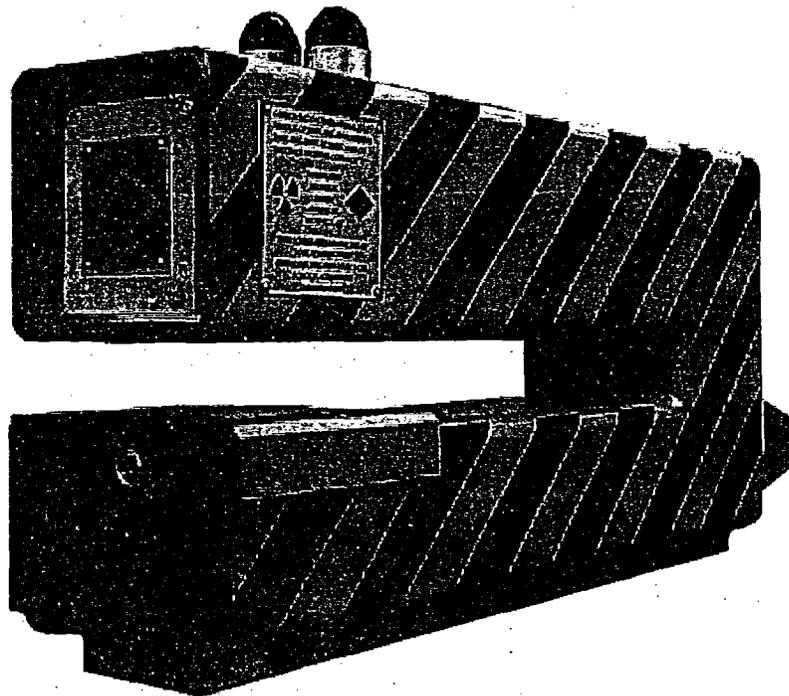


INTERGRATED INDUSTRIAL SYSTEMS

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GAUGE SIGNAL PROCESSING UNIT MANUAL

May 2003

ROLLING MILL SPECIALISTS-WORLDWIDE!

!WARNING!

IMPORTANT NOTICE

Proper operation of all mill safety
features are to be verified
BEFORE operating equipment

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APPENDIX A.....Gauge Signal Processing Unit Test Procedure

APPENDIX B.....

ILLUSTRATIONS:..... I²S AGC - English

..... I²S AGC - Metric

.....Gamma Gauge Interface Junction Box

..... Gamma Gauge Interconnect Diagrams

..... Gamma Gauge Pre-amp Diagram

.....Gauge Signal Interface Diagrams

..... Gauge Power Interface Diagram

..... Gamma Gauge Computer Assembly Diagrams



1.0 FEATURES

The typical I2S Gamma Gauge system is shown in *Figure 1*.

The main parts of the system are 2 Gamma Gauge C-frames which are mounted on the mill or the processing line in such way that the measured material (sheet) passes through the measuring gap. The C-frames can be traversed "On" or "Off" the measured sheet.

The lower part of the C-frame contains the Americium source, the upper part houses the detector assembly.

The signal from the detector is processed by the Gauge Signal Processing Unit (GSP) which is designed to serve two gauges. The connection between the gauges and the GSP is facilitated by the Junction Box, which is typically mounted in proximity to both gauges. The GSP is connected to the junction box by 2 cables.

The GSP is based on an IBM compatible computer with 486DX-33 processor and the ISA bus. Besides the usual peripherals, floppy disks and hard disk drive, it is equipped with a touch screen CRT which serves as a display and the operator control panel. The touch screen CRT provides means of setting the composition and nominal value of the gauges, turning the sources "On" and "Off", performing the standardization, setup and diagnostics. It also displays the actual thickness, deviation from the nominal and error messages.

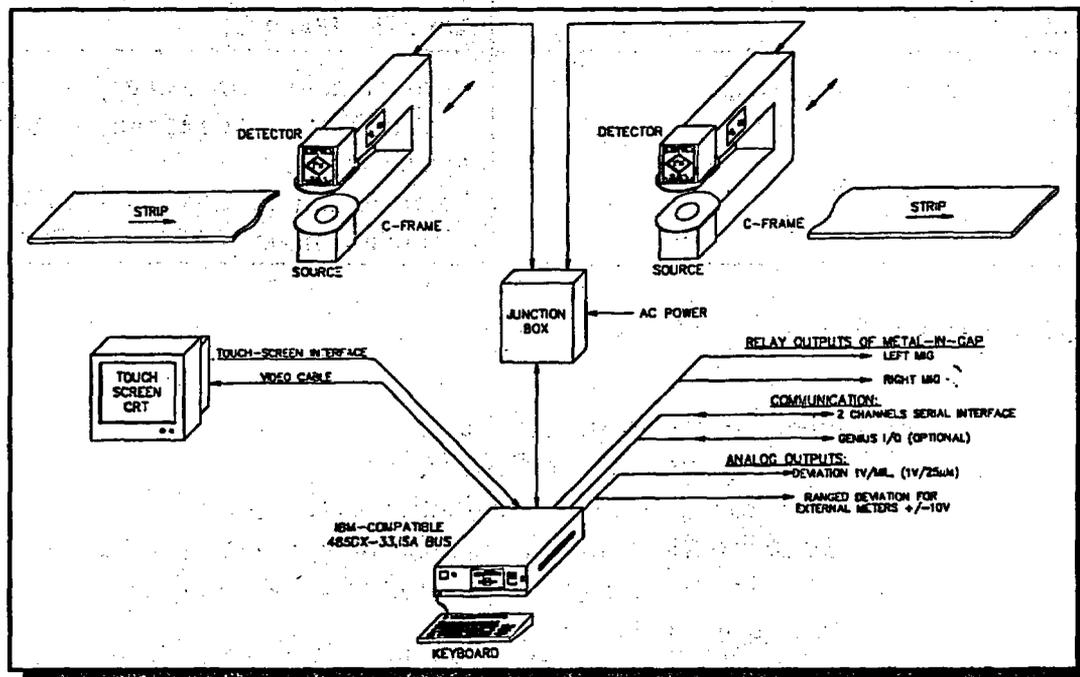


Figure 1 Typical I2S Gamma Gauge System



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I2S Gage Processing Unit.wpd • 2002-11-08

The GSP software is equipped with the **SETUP** screens to provide easy means of customizing and testing. The access to the **SETUP** screens is protected by a security code.

The setup of the GSP can be saved on disk, restored or printed out. The serial interface and the optional GE Fanuc GENIUS interface are provided to communicate with the host computer or other subsystems.

The deviation signal is provided in the analog form at the fixed scale factor of 1 Volt / mil
(1 Volt / 25 μ m if the Metric operation is selected).

To accommodate the external deviation meters with 3 ranges, a ranged voltage output is provided.

2.0. I²S GAUGE SPECIFICATIONS

Power Requirements	115VAC - +/- 10% - 60Hz - 3 Amp.
Temperature	0 - 40 Degrees C
Range - Steel	7.6mm (.300")
Range - Copper	5mm (.200")
Air Gap	75mm (3")
Accuracy	+/- 0.20% or +/-0.00003, Whichever Greater
Source	Am 241, 1000 mCi
Noise for 90% of Time (Steel)	From 0 mm to 3.5mm (0 to .140") +/- 0.10% or +/- .00125mm (+/- 0.00005") whichever better 3.5mm to 6.3mm (.250") +/-0.25% 6.3mm to 7.6mm (.300") +/- 0.35%

3.0. OPERATION

The operation of the gauges consists of:

- Turning the sources ON or OFF
- Performing the standardization of the gauges
- Entering the nominal value of the left and right gauge
- Entering the composition number for given alloy
- Selecting the full scale range
- Observing the deviation meters and recorders

These steps are most often performed manually by the operator. It is also



possible to operate the gauges entirely from an external computer. This can be done by either a serial connection or optionally via the GE Fanuc Genius bus. This allows the host computer to read and write the set gauges for example.

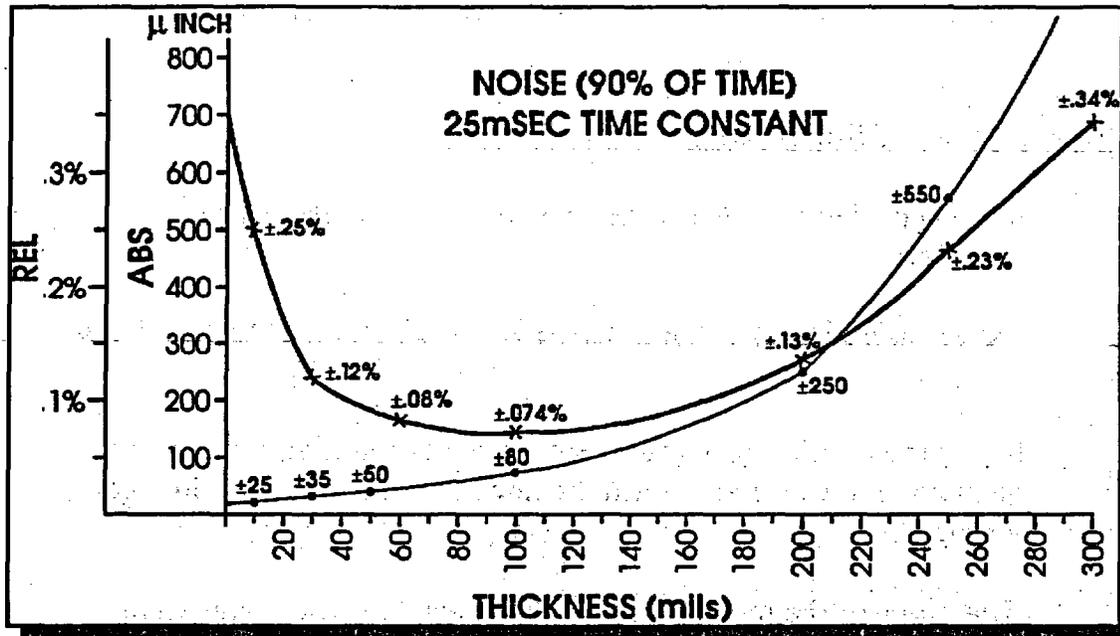


Figure 2 Noise vs. Thickness for Steel - English

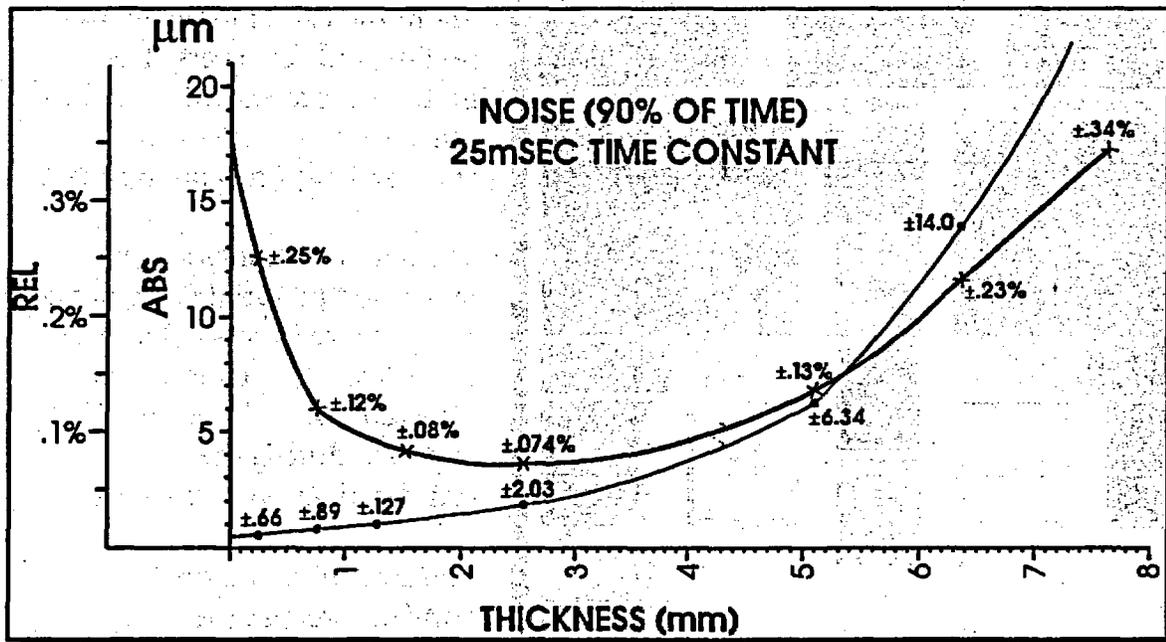


Figure 3 Noise vs. Thickness for Steel - Metric



4.0 MANUAL OPERATION

4.1 Operator Panel

The GSP program powers up in the OPERATOR PANEL screen. This is the only screen needed to operate the gauge. The screen is depicted in figure 3.

4.2 Elements of the Screen

In the upper left and right corners are the displays of the left and right gauge set (nominal).

The middle display is the composition number. It is common to both gauges.

Below the nominal gauge sets are the deviation meter/recorders displaying in the analog form the deviation from the nominal gauge setting.

The range of the meter/recorders is selectable. The meter scale graduations match the selected range.

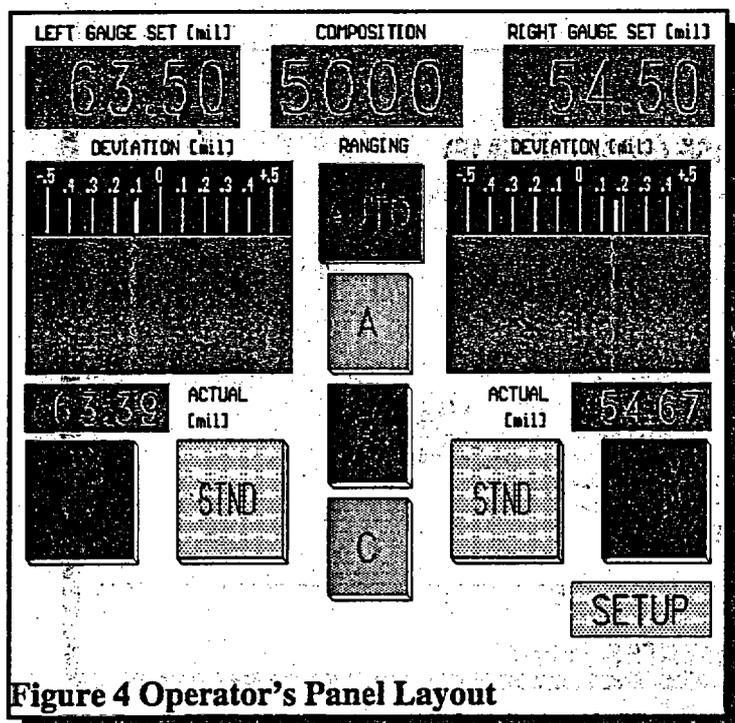


Figure 4 Operator's Panel Layout

There are 3 ranges labeled A, B and C. The range selector buttons are in the center between the meters and recorders. The meter/recorders are turned to 0 if the source is "Off" or the standardization is taking place.

The actual thickness of the measured material is displayed in the small readouts below the recorders. The readouts are blanked when the source is "Off" and also during the standardization of the gauge.

The control and monitoring applications use the nominal-deviation format of thickness rather than the single number representing the actual dimension. This is why the gauge set and deviation displays dominate the



screen, while the actual thickness is a relatively small item.

SOURCE and *STND* buttons form the horizontal row of large buttons at the bottom of the screen.

The *SETUP* field in the lower right corner is the entry into the *MENU* screen. If touched, the message line below will prompt for the security code. The acceptance or rejection of the code will be acknowledged. If the code was accepted, the subsequent touch of the *SETUP* field will open the *MENU* screen.

4.3 Selecting the Entries

The gauge set and composition displays can be selected for entry of new quantity by simply touching the values you wish to change. The frame of the selected display will be highlighted and a large numeric keypad will pop out in the middle of the screen. See *Figure 4*.

The principal means of selecting and entering the numbers is the touch screen, though everything can also be done using the computer keyboard. To use the keyboard:

- the selection of the display is done by means of the cursor control keys
- to toggle the selection "On" and "Off", use the *SPACE* key
- to enter numbers, use numerical keys of the main keyboard (not the number keypad)
- 's' key is for entry to the setup screens
- 'r' key is for return from the setup screen

NOTE: *The ACTUAL thickness displays of the OPERATOR PANEL screen cannot be selected, they serve strictly as the outputs.*

See the *Figure. 4* for the layout of the *OPERATOR PANEL* screen with a display selected for entry.

4.4 Entering the Numbers

The numbers are entered by touching the numeric keys and the decimal point. Limited editing is provided by the *BSP* (back-space) key. The selected numeric value can also be jogged up and down by touching the *INC* (increase) and *DEC* (decrease) buttons.

The process of number entry will be aborted if one touches a different display. The original number will be restored in the old one, and the new



display will be selected, highlighted and ready for the entry.

Pressing the *ENTER* key will enter the new quantity, terminate the selection, restore the display in normal colors and remove the keypad from the screen.

4.5 Entering Nominal Gauge Set

The units are mils (0.001 inches) in the English and mm in the Metric system.

If more decimal places are entered, the result is rounded to the display resolution.

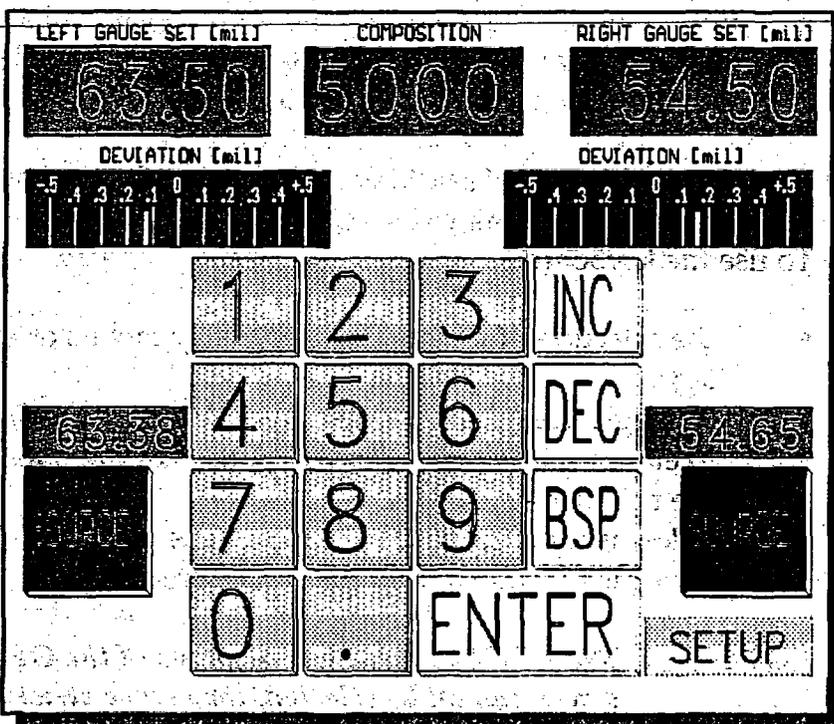


Figure 5 Operator's Screen Numeric Entry

Negative numbers cannot be entered.

The lowest number is 0.

The highest number is 299.99 mils in English and 7.600 mm in the Metric system.



4.6 Entering Composition Number

Composition number is an integer in range from 0000 to 9999. It is common to both gauges.

Materials with heavy absorption require low composition numbers, lighter metals require higher composition numbers.

4.7 Turning Source *ON/OFF*

SOURCE buttons toggle "On" and "Off". One push turns the source "On", next push turns it "Off". The color of the button top indicates the current state. (*Red is On*).

If using a keyboard, control of the sources is done by pressing F9 for left side and F10 for the right side.

NOTE: *The SOURCE button displayed "On" (with the lit top) means only that the power was turned "On" to the shutter solenoid circuit. The actual state of the shutter is indicated by the lights on the C-frame. If there is no metal in the gauge gap, the source will turn itself "Off" after certain amount of time. For the definition of the metal in gap state and the selection of the source timeout interval, see the SETUP section.*

4.8 Performing Standardization

Standardization is performed to eliminate the influence of the:

- DC offsets in the circuitry
- changes of the scale factors of the components
- oil film on the source and detector windows
- individuality of the pre-amp.

New zero offsets and scale factors are established by this process.

STND buttons toggle "On" and "Off". One push turns it "On", next push turns it OFF. The color of the button top indicates the current state.

If using a keyboard, control of the standardization is done by pressing F7 for left side and F8 for the right side.

The standardization will not start if the source is "Off". Standardization will terminate if the source is turned "Off" during its course.

If the standardization was not successful, the *STND* button will blink and



the message line below will give a brief description of the problem.

Subsequent push of the *STND* button will terminate the unsuccessful standardization and clear the message line. The gauge will require maintenance to solve the problem.

4.9 Changing Ranges Manually

Ranges are changed to display the deviation variations with reasonable magnitude within the meter/recorder span. It is up to the operator to decide what is suitable for current conditions.

A is the most sensitive and the C is the least sensitive range.

A touch on A, B or C will do the following:

- Redraw the button pushed-in and highlight it
- Other range buttons will pop out and be displayed in the "Off" state (dark)
- If the *AUTO* mode was "On", the button will be popped out and turned "Off"
- The meter/recorder scale will be redrawn to match the new range

Keyboard control of the ranges:

- A range F4 key
- B range F5 key
- C range F6 key

The full scale ranges associated with the A, B and C buttons can be customized. See the *SETUP* section.

4.10 Selecting Autoranging

The deviations are typically larger on the thicker material and smaller on the thinner. This primitive relationship is put to use by the *AUTORANGING*.

Two switchpoints are defined, *LOW* and *HIGH*. The range switching is always based on the smaller of the 2 gauge sets.

If the smaller gauge set is:

- Below the *LOW* point range A is selected,



- Between the LOW and HIGH, range B is selected,
- Above the HIGH point, range C is selected.

Touching the *AUTO* button pushes it in, lightens the button top and turns the autoranging "On". The A, B and C buttons pop out, but their button top colors still indicate which range is currently active.

Keyboard control of the autoranging is done by the F3 key.

The switchpoints are easily customized. See the *SETUP* section of this manual

4.11 Remote Operation

4.11.1 Serial Communication

The basic serial ports *COM1* and *COM2* are located on the CPU card. *COM1* is used for the touch screen interface, *COM2* is reserved.

There are two additional serial channels used for the communication with a host or outside devices. These are based on the separate interface card, and are configured as *COM3* and *COM4*. The setup for buad rates and the like is done from the *autoexec.bat* during the power-up of the GSP computer.

Only the parameters needed for the operation of the GSP are accessible by the communication commands.

The commands consist of:

- Processing of the command will not start until the <<cr>> is received.
- Received characters are normally NOT echoed, unless the "Serial comm. echo" in the *MISC* screen is set to 1. This feature is intended only for troubleshooting.

The read command consists only of the prefix character and the <<cr>>. in Metric

Command I<<cr>> returns Id[ddd]<<cr>><<lf>>



where d[ddd] is 1 up to 4 decimal digits representing the COMPOSITION.

units: none

Command J<<cr>> returns Jh[hhh]<<cr>><<lf>>

where the h[hhh] is 1 up to 4 hex digits representing the bit pattern of the gauge status word.

Bit Number	Description
15	Reserved
14	RIGHT standardization FAULT
13	LEFT standardization FAULT
12	active SIO commands BLOCKED
11	active PCIM commands BLOCKED
10	measurement units ENGLISH
9	RIGHT standardization ON
8	LEFT standardization ON
7	AUTORANGE ON
6	RIGHT metal-in-gap is TRUE
5	LEFT metal-in-gap is TRUE
4	RIGHT source ON
3	LEFT source ON
2	range C is selected
1	range B is selected
0	range A is selected

Gauge Status Word Table

command K<<cr>> returns Kd[ddd]<<cr>><<lf>>

where d[ddd] is 1 up to 5 decimal digits representing the current full scale range.

units: 10 μ inch in English, 1 μ m in Metric



command L<<cr>> returns Ld[dddd]<<cr>><<lf>>

where d[dddd] is 1 up to 5 decimal digits representing the *PSEUDO* gauge set. See the Section V.VIII.N for more on this topic.

4.11.2 Writing

The external device sends the command string consisting of the prefix character, followed by at least one digit and <<cr>>.

command Gd[dddd]<<cr>>

d[dddd] is 1 to 5 decimal digits representing the new value of the LEFT gauge set.

units: 10 μ inch in English, 1 μ m in Metric

command Hd[dddd]<<cr>>

d[dddd] is 1 to 5 decimal digits representing the new value of the RIGHT gauge set.

units: 10 μ inch in English, 1 μ m in Metric

command Id[ddd]<<cr>>

d[ddd] is 1 up to 4 decimal digits representing the COMPOSITION.

units: none

command Jh[hhh]<<cr>>

h[hhh] is 1 up to 4 hex digits representing the bit pattern of the gauge STATUS word.

See the *Data Bits Table* on the following page for the bits that accept the written information. Data written into the other bits will be ignored.



Bit Number	Description	Write
15	Reserved	
14	RIGHT standardization FAULT	
13	LEFT standardization FAULT	
12	active SIO commands BLOCKED	
11	active PCIM commands BLOCKED	
10	measurement units ENGLISH	
9	RIGHT standardization ON	YES
8	LEFT standardization ON	YES
7	AUTORANGE ON	YES
6	RIGHT metal-in-gap is TRUE	
5	LEFT metal-in-gap is TRUE	
4	RIGHT source ON	YES
3	LEFT source ON	YES
2	range C is selected	YES
1	range B is selected	YES
0	range A is selected	YES

DATA BITS TABLE

command Ld[dddd]<<cr>>

d[dddd] is 1 up to 5 decimal digits representing the *PSEUDO* gauge set. See Section V.VIII.N for more on this topic.

units: 10 uinch in English, 1 um in Metric.

4.12 GE Fanuc Genius Interface

The *GENIUS* interface is based on the *PCIM* module, which is a general purpose I/O Controller for the *GENIUS* I/O system. It is designed to be integrated into the user-developed *IBM PC* microprocessor-based systems.



BROADCAST DATA TABLE

TYPE	VARIABLE	METRIC	ENGLISH
Float	Left Gauge Set	mm	Mil
Float	Right Gauge Set	mm	Mil
Float	Composition		
Unsigned long	Status		
Float	Left Actual Thickness	mm	Mil
Float	Right Actual Thickness	mm	Mil
Float	Full Scale of Dev. Meters	mm	Mil
Float	Pseudo Gauge Set	mm	Mil

Note: The last variable, pseudo gauge set, is broadcast only when pseudo gauge set is selected in the MISC screen. See the section V.VIII.N for more on this topic.

DATAGRAM CONFIGURATION TABLE

TYPE	VARIABLE	METRIC	ENGLISH
Float	Left Gauge Set	mm	Mil
Float	Right Gauge Set	mm	Mil
Float	Composition		
Unsigned long	Status		
Unsigned long	Change Flags		
Float	Pseudo Gauge Set	mm	Mil

The "Change Flags" variable indicates which portion of the datagram needs attention of the GSP program.



Bit Number	Description
0	Left Gauge Set
1	Right Gauge Set
2	Composition
3	Status
4	Pseudo Gauge Set

Note: The last variable in both tables, pseudo gauge set, exists only when pseudo gauge set is selected in the MISC screen. See the section V.VIII.N for more on this topic.

5.0 OPTIONAL FEATURES

5.1 Strip Profile

5.1.1 Purpose

The purpose of this feature is to gather the distribution of the thickness deviation across the width of the strip. The result is plotted on the screen and can also be printed out.

5.1.2 Description

The gauge C-frames must be large enough to move across the full width of the strip. The C-frame carriages are equipped with the position transducers so the thickness measurements can be properly related to the location in the strip.

The traversing motion of the C-frames is done by hydraulics. Each gauge has two (2) limit switches. One must turn on when the gauge is off the strip. The other must turn on when the gauge reaches the center of the strip. The hydraulic power is controlled by the solenoids.

The interface to the limit switches and solenoids is provided by an OPTO 22 unit and "IP-Digital 24" module in the position #3 of the IP Carrier circuit card.

The profile sequence of C-frame motions starts by getting into the position on the far side of the strip. The thickness and the position data are then read while the gauge moves forward. The data gathering is



finished when the C-frame passes over the edge of the strip. The C-frame returns to the center of the strip or to the *OFF STRIP* position, depending on where the motion sequence started.

5.1.3 Limitations

The measurement in proximity of the strip edges is not accurate. As the gauge passes over the edge of the strip, only a part of the radiation goes through the metal, the rest misses it. This distorts the readings and the samples laying in the area influenced by the edge must be rejected from the plot. The width of the rejection band can be adjusted from the setup screen. The remaining strip width, referred to as "Clipped" width corresponds to the width of the profile plot.

5.1.4 Operation

The profiling option must be selected in the *MISCELLANEOUS* screen by turning the item "Strip Profiling Selection" from 0 to 1. See *Figure 5*.

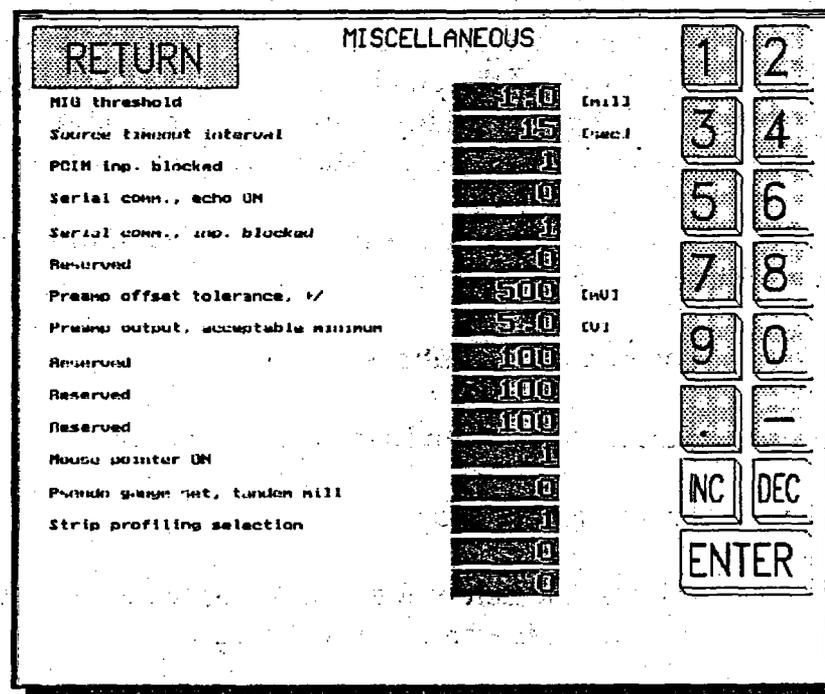


Figure 6 Miscellaneous Screen

As shown in figure 6, on the next page, with the profiling option on the *OPERATOR PANEL* screen is slightly modified. It includes the buttons for bringing the gauges on and off the strip during normal operation.

The profile operation is performed from the *STRIP PROFILE* screen. This screen can be entered any time directly from the *OPERATOR PANEL*.



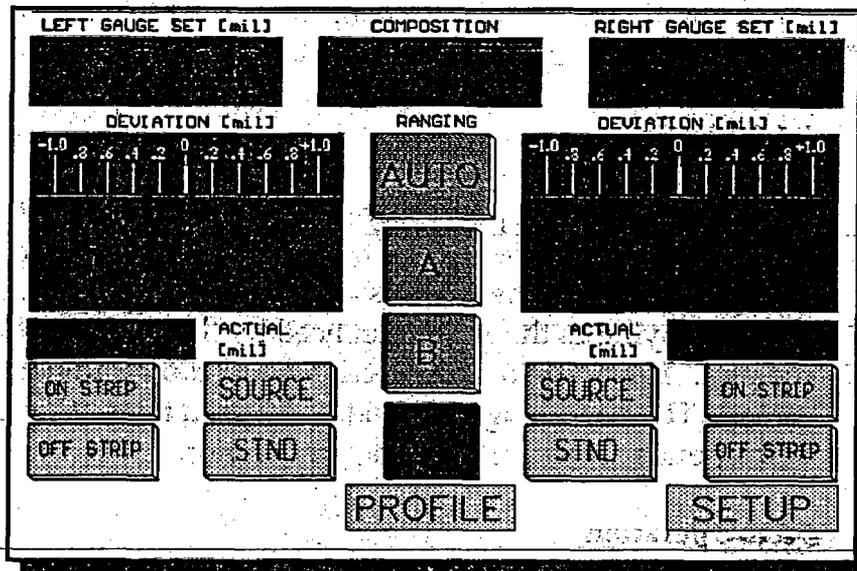


Figure 7 Operator Panel Screen with Profiling Option On

The center of the *STRIP PROFILE* screen, see Figure 7, is taken by the large area where the plot of the deviation across the strip is displayed. The vertical scale of the plot is adjustable, the horizontal is fixed to 0... 100% of clipped strip width. This is the width adjusted by removing the border regions where the deviation measurement is not accurate.

The bottom of the screen has four (4) pairs of buttons for control of the profiling. From right to left:

- Source Control Buttons

- Turning the Left or Right source on or off

- Profile Start or Stop

- Initiates the Left or Right profiling sequence. Aborts the sequence if hit while the profiling is in progress.

- Deviation Scale

- Allows the selection of finer or coarser vertical scale of the deviation plot.



- **Get Printout Buttons**

Starts the printout of the profile record. Lower or density printing can be selected. Aborts the printout if hit while printing is in progress.

Each side of the screen has three (3) status indicators and a pair of jog buttons.

- **MIG**

Indicator displays the Metal-In-Gap status as seen by the gauge.

- **ON SW**

Indicator displays the status of the On-Strip limit switch. This is the switch that turns ON when the C-frame is in the middle of the strip.

- **OFF SW**

Indicator displays the status of the Off-Strip limit switch. This is the switch that turns ON if the gauge is in removed off the strip.

- **JOG ON and JOG OFF**

Momentary switches allow the jogging of the gauge in both directions by direct control of the hydraulic solenoid. This is provided mainly for the gauge setup for verification of the limit switch function.

At the top of the graph is a display of:

- Position of each gauge in % of total C-frame travel
- Number of samples taken in the current profile scan

At the bottom of the display is the table listing the following variables:

- **Front Edge Thickness**
- **Rear Edge Thickness**
Deviations at the clipped edges averaged over an adjustable width. See the Profile Setup Screen.



- Wedge: as Front Edge - Rear Edge
- Crown: as: Center $((\text{front edge} + \text{rear edge})/2)$
- Gauge Set: Nominal Gauge Set
- State: Logical state of the profile sequencer, to be used only during trouble shooting.

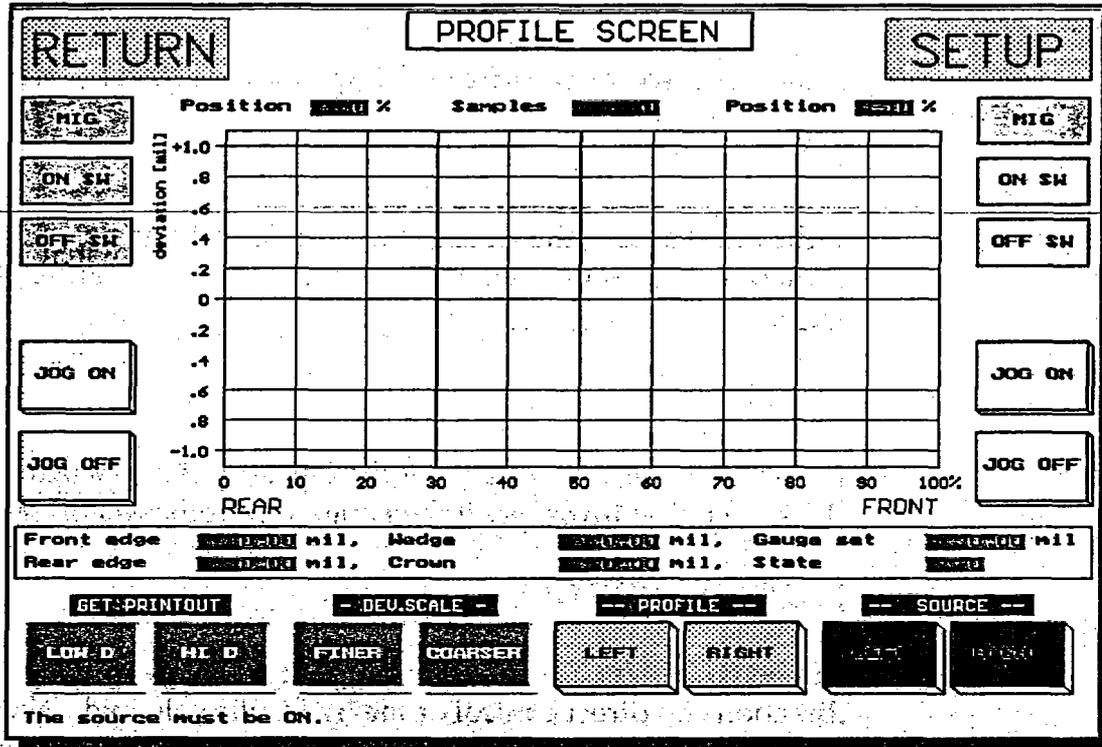


Figure 8 Strip Profile Screen

5.2 Profile Setup Screen

A separate Profile Setup Screen exists for the purpose of setting up the profiling operation. See Figure 8.

The following are items of the Profile Screen Setup:

- Time Based Graph

The X-axis of the profile plot is normally based of the displacement signal provided by the position transducer. In the absence of the position transducer the time base may be used. A constant-speed traverse motion of the C-frame is assumed.



0.....Position Transducer Based Plot, Default Setting

1.....Time-Based Plot

- Rear Margin
- Front Margin

The thickness measurement close to the strip edge is not accurate. This Portion of the plot has to be clipped off. These variables select the width (% strip width) to be removed on front and rear of the strip. The graph is normalized to the remaining width.

The screenshot shows a terminal window titled "PROFILE SETUP". On the left, there is a "RETURN" button and a list of parameters: "Time-based graph", "Rear margin, % of width", "Front margin, % of width", "Timeout, sec", "Dwell, sec", and "Averaging band, % of width". The main area contains a vertical stack of 14 digital displays, each showing a value. The values are: 0, 0.20, 7.20, 30.40, 3.20, 5.20, 0, 0, 0, 0, 0, 0, 0, and 0. On the right side, there is a numeric keypad with buttons for digits 1-9, 0, a decimal point, a minus sign, "INC", "DEC", and "ENTER".

Figure 9 Profile Set-up Screen

- Time Out

Any motion in the profiling sequence must be completed within this time interval or the profiling will be aborted. Units are in seconds.

- Dwell

The motion is stopped for this time interval before starting to move in the reverse direction. Units are seconds.



- Averaging band

The reported values of the thickness at the edges and in the middle are derived by averaging the readings in the band of this width. The width is expressed in the % of the clipped strip width.

6.0 SETUP

6.1 How to Get Into Setup Screens

The SETUP field in the lower right corner of the OPERATOR PANEL screen provides the access to the SETUP screens. The SETUP screens are protected from unauthorized tampering by the security code.

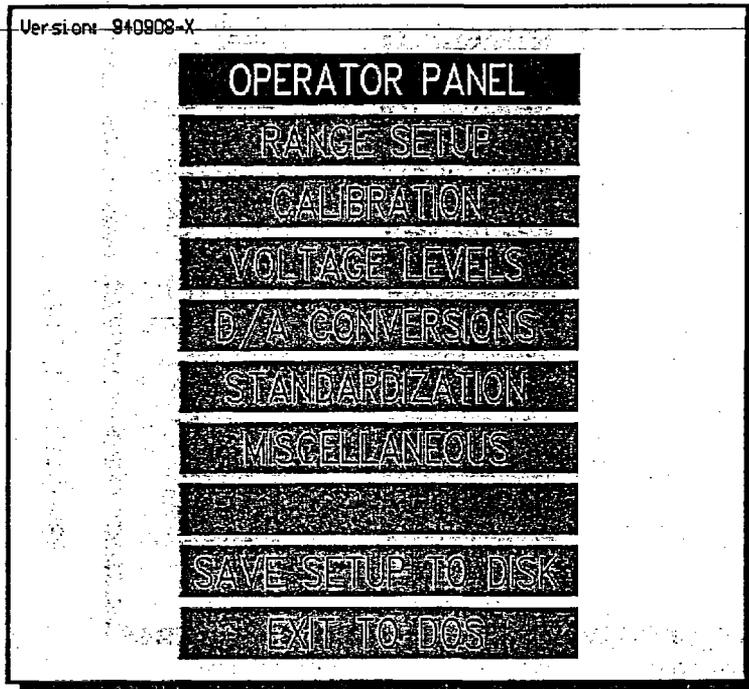


Figure 10 Menu Selections

If the SETUP field is touched, the message line below prompts for the security code and the numeric keypad pops on the screen. A small entry box also appears on the message line.

The numeric keys do not move in or light as the keys are touched. The entered characters are echoed into the entry box as '*'. These measures are taken to make the security code entry operation as discrete as possible.

Back-spacing is allowed if an error is made during the entry

of the code.

The keyboard entry into setup screen is done by pressing the 's' key, the code is entered using the numeric keys of the keyboard and the keyboard ENTER button.

The acceptance or rejection of the code is acknowledged on the message line. If the code was accepted, the subsequent touch of the SETUP field will open the MENU screen.



Once unlocked, the access stays free for one hour. This allows good measure of freedom in screen switching during the setup procedures but automatically re-locks the setup screen.

The default security code is 2655684 (I²S phone number) and the unlocked time interval is 60 minutes. They cannot be changed from within the GSP program.

Editing of the *POINTS.DAT* file is the only way to change these 2 variables.

6.2 Menu Screen

6.2.1 List of Screens

See figure 8 on page 19 for the available selections for the setup and troubleshooting of the GSP.

The top item performs the return back to the *OPERATOR PANEL* screen. It is followed by the following selections:

- RANGE SETUP Screen
- CALIBRATION Screen
- VOLTAGE LEVELS Screen
- D/A CONVERSIONS Screen
- STANDARDIZATION Screen
- MISCELLANEOUS Screen

6.2.2 Selecting Items

Selection of the items is provided by touching of the appropriate box. It can also be done from the keyboard.

Highlight the desired item using the cursor movement keys, then press *RETURN*.

6.2.3 Software Version

Software version identification code is in the left top part of the screen.



6.3 Range Setup Screen

See the Figure 10 for the layout of the *RANGE SETUP* screen.

6.3.1. English / Metric Selection

Toggling between the *ENGLISH* and *METRIC* system of units is accomplished by touching the field labeled *ENGLISH* or *METRIC* in the top right portion of the screen. The label displays current measuring system of units.

RETURN	RANGES		ENGLISH	1	2
METRIC	RANGES	SWITCHPOINTS		3	4
A: ±	5 [μm]	1.000	[mm]	5	6
B: ±	10 [μm]	3.000	[mm]	7	8
C: ±	25 [μm]			9	0
ENGLISH	RANGES	SWITCHPOINTS			-
A: ±	0.20 [mil]	50.00	[mil]	INC	DEC
B: ±	0.50 [mil]	100.00	[mil]	ENTER	
C: ±	1.00 [mil]				

Figure 11 Range Setup Screen

The keyboard equivalent is hitting of the 'e' key.

The switching is possible only when the *SOURCE* on both gauges is *OFF*. If this condition is not met, a reminder is displayed in the message box at the bottom of the screen.

During the switch, the present gauge set values are recalculated into the other system of units and the deviations are displayed in the new units.



A touch on the RETURN field will close this screen and return back to the MENU screen.

Upon return to the OPERATOR PANEL screen, the scales of meter/recorders will be redrawn to correspond with the new definition of the ranges. The labels of all readouts will be updated to the current units.

6.2.2 Setup of Ranges and Switchpoints

Each system, *Metric* and *English* has its own definition of the ranges and the switchpoints for autoranging.

The center portion of the screen contains the table of these items. The first column contains the range settings, the second the settings of the switchpoints. Notice the slight vertical offset of the switchpoint column. So the vertical position of the switchpoint indicates which 2 ranges it serves.

Touching of the display will select it for entry. The message box will be updated to show a brief description of the variable. Use the keypad to enter the new quantity, do not forget to finish with the RETURN key.

Keyboard selection is done using the cursor keys. Use the keyboard numeric keys for entering of the number. Finish the entry with the keyboard RETURN.

There is only limited number of ranges available.

English:

0.1, 0.2, 0.25, 0.3, 0.5, 1.0, 2.0, 2.5, 3.0 and 5.0 mil.

Metric:

3, 5, 10, 20, 25, 30, 50, 100, 200 and 250 um.

If the number entered is not in the list above, the entry will snap to the nearest available range.

When entering new value, please:

- Pay attention to the units of the variable,
- keep the entries in each column monotonic, A as the lowest and C the highest number.



7.0 CALIBRATION SCREEN

The *CALIBRATION* screen groups the variables intimately associated with the gauging and thickness calculation. It sets up proper scaling and the numerical match of the measured thickness with selected engineering units.

See the Figure 11 for the layout of the *CALIBRATION* screen.

It has following components:

- Digital Readouts
- Numeric Keypad
- Message Window
- RETURN Field
- 8 Function Buttons

	CALIBRATION																			
	LEFT	RIGHT	1	2																
Calib. coefficient	10000	10000	3	4																
Calib. offset [mV]	0.0	0.0	5	6																
Shutter ref. [mil]	180.00	180.00	7	8																
Shutter factor [%]	0.000	0.000	9	0																
V minimum [mV]	0.0	0.0	.	-																
V maximum [V]	9.000	9.000	INC	DEC																
V present [V]	1.967	2.425	ENTER																	
Thickness [mil]	63.38	54.68																		
<table border="0"> <tr> <td colspan="2">CALIBRATE</td> <td colspan="2">SHUTTER CORR.</td> <td colspan="2">STANDARDIZE</td> <td colspan="2">SOURCE</td> </tr> <tr> <td>L</td><td>R</td> <td>L</td><td>R</td> <td>L</td><td>R</td> <td>L</td><td>R</td> </tr> </table>					CALIBRATE		SHUTTER CORR.		STANDARDIZE		SOURCE		L	R	L	R	L	R	L	R
CALIBRATE		SHUTTER CORR.		STANDARDIZE		SOURCE														
L	R	L	R	L	R	L	R													

Figure 12 Calibration Screen



7.1 Variables Displayed

The variables are arranged in 2 columns for *LEFT* and *RIGHT* gauges.

Calibration Coefficient - Dimension: none. Description: The *PRIMARY* calibration adjustment. Adjust to get true reading of the calibration sample at desired composition number.

Calibration Offset - Dimension: mV. Description: The *SECONDARY* calibration adjustment. Use to calibrate the thick sample at the end of the application range.

Shutter Reference - Dimension: mil or mm. Description: The Reference reading of the apparent thickness of the shutter, taken on the first standardization following the enable of the *SHUTTER*.

CORR. Used to improve the long-term stability.

Shutter Factor - Dimension: % Description: The Scale factor change since the "Shutter ref." reading was taken.

V Minimum - Dimension: Volt. Description: The conditioned* output of the pre-amp with the source OFF. The value was established during the last standardization.

V Maximum - Dimension: Volt. Description: The conditioned* output of the pre-amp with the source ON and no metal in the measuring gap. The value was obtained during the last standardization.

V Present - Dimension: Volt. Description: The conditioned* output of the pre-amp.

Thickness - Dimension: mil, mm. Description: The calculated thickness.

***Note:** *The "conditioned" output of the pre-amp. The conditioning involves the offset and magnitude adjustment of the pre-amp output signal. See the VOLTAGE LEVELS screen for the unadjusted pre-amp output.*



7.2 Elements of Standardization

The standardization determines the voltage level at the end points of the measuring range.

V Minimum is determined during the standardization. It is the conditioned* pre-amp voltage, measured with the ion chamber disconnected from the pre-amp. This is the condition that would be encountered with the infinitely thick sample in the measuring gap.

V Maximum is determined during the standardization. It is the conditioned* pre-amp voltage, measured with the source ON and no sample in the measuring gap.

V Present is the present reading of the conditioned* pre-amp voltage.

***Note:** *The "Conditioned" output of the pre-amp. The conditioning involves the offset and magnitude adjustment of the pre-amp output signal. See the VOLTAGE LEVELS screen for the unadjusted pre-amp output.*

7.3 Calibrating the Gauge Manually

1. Get two (2) good samples of the material most commonly used. If the material is steel, the first sample should have thickness of about 100 mil, the second one should be the maximum thickness that will be encountered, but less than 300 mils. If other materials are used, the samples should be proportionally thicker or thinner, depending on the absorption coefficient.
2. Decide what composition number you want to use for the sample material. Get into the OPERATOR PANEL screen and enter the composition number.
3. Verify that there is nothing in the gap of the gauge.
4. Standardize the gauge. Make sure the standardization was successful. There should be no blinking of STND button, no messages on the message line. The THICKNESS reading should be 0.
5. Turn the source OFF.
6. Insert the first (thin) sample.
7. Turn the source ON.



8. Get into the *CALIBRATION* screen.
9. Select the "Calib. coefficient" item on the screen and adjust it to get the "Thickness" item display the desired thickness in proper engineering units.
10. Turn the source *OFF*.
11. Remove the first sample and insert the second (thick) one.
12. Turn the source *ON*.
13. Adjust the "*Calibration Offset*" display to get the proper thickness reading in the "*Thickness*" readout window.
14. Turn the source *OFF*.
15. Go back to step 6 and the repeat the sequence until no adjustments are necessary.
16. You may want to verify the operation on the low end by getting a thin sample and measuring it. There is nothing to adjust at this point. An error may indicate inconsistency in the samples: Either one of the thicknesses is improperly marked or, possibly, the composition is not the same among the samples.
17. Move back into the MENU screen and touch the "*SAVE SETUP TO DISK*"

7.4 Calibrating the Gauge Automatically.

This procedure simplifies step 9 of the sequence above.

Adjusting of the "Calibration Coefficient" to get the proper reading of the thickness is done automatically. In order for it to work, the thickness of the first sample must be entered in the OPERATOR PANEL screen into the Gauge SET readout of the gauge being calibrated.

Here is the complete listing of the new sequence.

1. Get 2 good samples of the material most commonly used. If the material is steel, the first sample should have thickness of about 100 mil, the second one should be the max thickness that will be encountered, but less than 300 mils. If other materials are used, the samples should be proportionally thicker or thinner, depending on the absorption coefficient.



2. Enter the thickness of the first sample into the *L/R Gauge SET* window on the *OPERATOR PANEL* screen.
3. Decide what composition number you want to use for the sample material. Get into the *OPERATOR PANEL* screen and enter the composition number.
4. Verify that there is nothing in the gap of the gauge.
5. Standardize the gauge. Make sure the standardization was successful. There should be no blinking of *STND* button, no messages on the message line. The *THICKNESS* reading should be 0.
6. Turn the source *OFF*.
7. Insert the first (thin) sample.
8. Turn the source *ON*.
9. Get into the *CALIBRATION* screen.
10. Touch the *L/R CALIBRATE* button in the lower left portion of the *CALIBRATION* screen. The button will light up and after a few seconds the new value will appear in the "Calibration Coefficient" readout and the "Thickness" reading will match the thickness of the sample (entered as the *L/R Gauge SET* before in the *OPERATOR PANEL* screen). The *CALIBRATE* button will go *OFF* at the end of this step.
11. Turn the source *OFF*.
12. Remove the first sample and insert the second (thick) one.
13. Turn the source *ON*.
14. Adjust the "Calibrate Offset" display to get the proper thickness reading in the "Thickness" readout window.
15. Turn the source *OFF*.
16. Go back to step 7 and the repeat the sequence until no adjustments are necessary.



17. You may want to verify the operation on the low end by getting a thin sample and measuring it.

There is nothing to adjust at this point. An error may indicate inconsistency in the samples: Either one of the thicknesses is improperly marked or, possibly, the composition is not the same among the samples.

18. Move back into the *MENU* screen and touch the "SAVE SETUP TO DISK".

7.5 Shutter Correction

The thickness of the source shutter is equivalent to about 180 mils of steel. It can be used as an additional calibration point. This improves the long term stability of the gauge.

This feature is turned *ON* or *OFF* by the *L/R SHUTTER CORR.* buttons. Turning *ON* should be only done after the gauge has been calibrated to full satisfaction by following the procedures above.

The Shutter Correction follows the normal standardization sequence with extra steps:

The *SOURCE* is turned *OFF*, *STND* button will stay lit to indicate the standardization is still active.

The thickness of the shutter is measured by averaging a large number of readings.

a) if this is the first standardization following the turning *ON* of this feature, the result of the averaging is saved as "Shutter Reference".

b) on all subsequent standardizations the result of the averaging is compared with the "Shutter ref." value. The ratio will appear in the box labeled "Shutter factor". It represents the gain change that occurred since the reference reading was taken. This gain change is taken into consideration in the thickness calculation.

the value of "*Shutter Factor*" is tested against reasonable limits. If the limits are exceeded, the error is generated. *STND* button will be flashing and an error message will appear.



NOTE: With the Shutter Correction ON, the successful standardization finishes with both SOURCE and STND buttons OFF.

With the Shutter Correction OFF, the SOURCE will be ON and the STND button OFF.

8.0 Voltage Levels Screen

The VOLTAGE LEVELS screen displays the status of the power supplies in the junction box, pre-amps and the A/D converter card.

See the Figure 12 for the screen layout. Notice the absence of the keypad, this is strictly a read-only screen.

The readouts can be selected by touching or by using the cursor keys, but only to display the brief description of the parameter.

SOURCE and STND buttons are also provided. They can be controlled by touching or by the function keys from the keyboard.

F7 toggles the left standardization ON/OFF

F8 toggles the right standardization ON/OFF

F9 toggles the left source ON/OFF

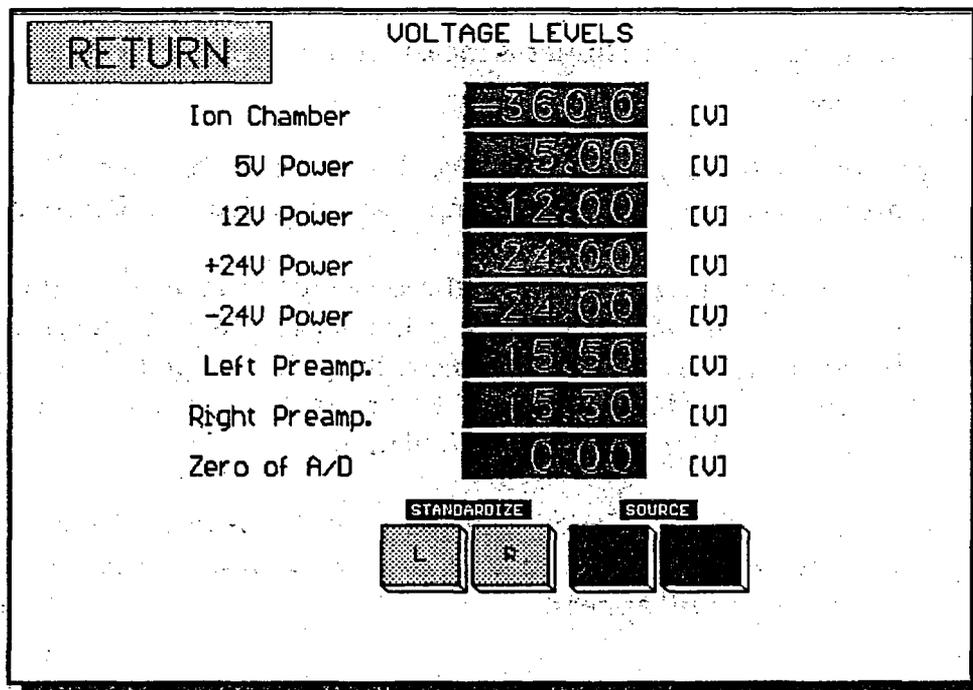


Figure 13 Voltage Levels Screen



F10 toggles the right source ON/OFF

The touch of the *RETURN* field or typing of 'r' will result in the return to the *MENU* screen.

8.1 Variables Displayed

1. Ion Chamber

Nominal value is -360V, tolerance 10%. This is the high voltage power supply. It is a DC-DC modular converter operating from 12V DC and located in the junction box. It provides the bias of the ionization chamber. The loss of voltage would result in 0 output of the pre-amp. High noise or ripple on this power supply would degrade the signal of the pre-amp.

2. 5V Power

Nominal value is 5V, tolerance 5%.

This is 5V used locally in the junction box. It is derived by the 12V power supply by the on-board regulator. Important for several logic functions performed on the signal card of the junction box.

3. 12V Power

Nominal value is 12V, tolerance 5%.

Power supply is located in the junction box, operates the relays of the pre-amplifier.

4. +24V Power

5. -24V Power

Nominal value is 24V, tolerance 5%.

This a dual-voltage power supply located in the junction box. It supplies power to the analog section of the pre-amplifiers. 15V for analog circuits is derived by the local regulators.

6. Left Pre-amp

7. Right Pre-amp

Outputs of the pre-amplifiers. 12 to 16 Volts on the typical gauge.



Note: *Do not confuse with the CALIBRATION screen display of the variables "V minimum", "V maximum" and "V present". These are based on the "conditioned" pre-amp output, and cannot be readily related with the levels displayed here.*

8. Zero of A/D

Nominal value is 0.00, tolerance +/- 0.02 Volt.

Zero of the A/D converter card.

9.0 D/A CONVERSIONS SCREEN

9.1 Purpose

The standard GSP system has total of 8 D/A converters. Each converter has a pair of registers associated with it. The GSP program writes the into the data register, the zero-trim registers serve as the offset adjustment. This screen allows these values to be observed.

The registers are arranged in 2 columns with data in the first and the trim registers the second.

See Figure 13 for the screen layout.

9.2 Gauge Bias D/A's

The two 16-bit D/A converters are located on the National Instruments Data Acquisition card. Their range is +/- 10V. They are meant to be used as the bias for the summing amplifier located on the Signal card of the junction box.

The standard gauge software does not use this function, therefore the data and zero-trim values should both be left at the default setting of 0.

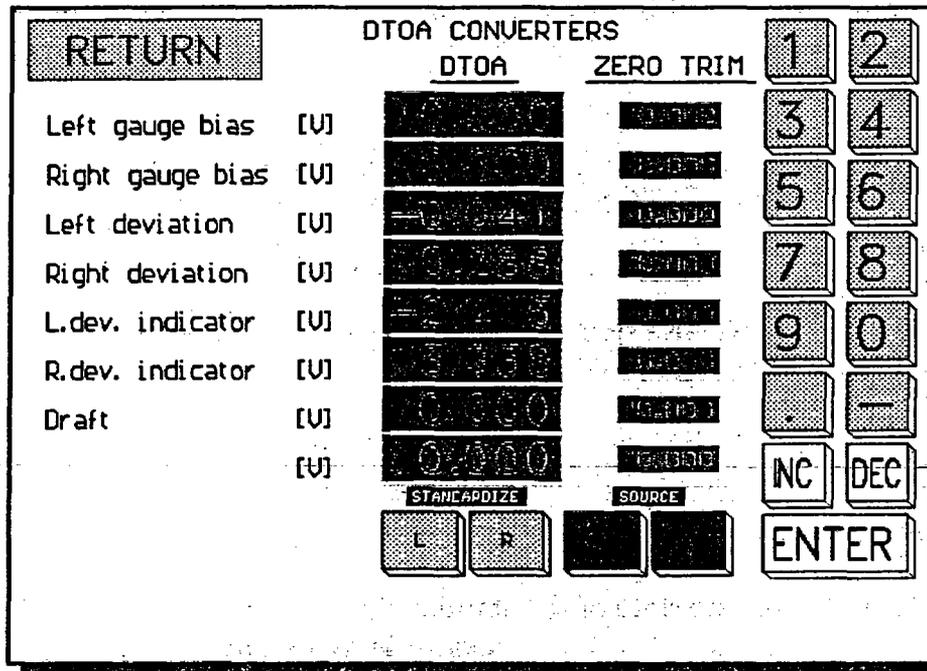
9.3 Other D/A's

The IP-DAC module on the Industry Pack Carrier board provides six 12-bit D/A converters. They are configured for +/- 10 V output.



The "Left deviation" and the "Right Deviation" D/A's are used to produce the analog voltage proportional to the gauge deviation. The scale factor is,

in English units, 1V per mil or Metric 1 V per 25.4 μm . The output is zero during the standardization or when the SOURCE is OFF. The output range of the analog deviation is ± 10 mils or $\pm 254 \mu\text{m}$



The "L.Dev. Indicator" and "R.Dev. Indicator" D/A's are used to generate voltage for driving the external meter with the ± 10 V span. This can

Figure 14 D/A Conversions Screen

be used as deviation display with 3 ranges operating in parallel with the deviation meters on the OPERATOR PANEL screen of the GSP.

The "Draft" D/A serves as an analog output of the draft.

The draft is the ratio of the lower gauge set to the higher gauge set expressed in %.

9.4 Zero Trims

The zero-trim registers serve as the offset adjustment. They can be manually manipulated and are saved as the part of the gauge setup.

The zero trim registers cover the full range of the D/A. This makes them useful for testing of the D/A converters.

Ideally, in properly functioning converter outputs, the voltage is the sum of data and zero-trim registers.



10.0 Standardization Screen

See the *Figure 14* for the layout of the *STANDARDIZATION* screen.

10.1 Purpose

This screen is useful for the debugging of standardization problems and for the verification of some of the steps performed during the standardization.

Most of the variables are not easy to interpret without a deeper understanding of the gauge software.

10.2 Items

- Program Counter.

This register indicates the state of the standardization sequencer. For example, when the standardization is OFF, the sequencer is at 0. The

standardization starts with the sequencer forced into the state 1. The finishing and closing down occurs at the state 100. This is not a register to be casually tampered with.

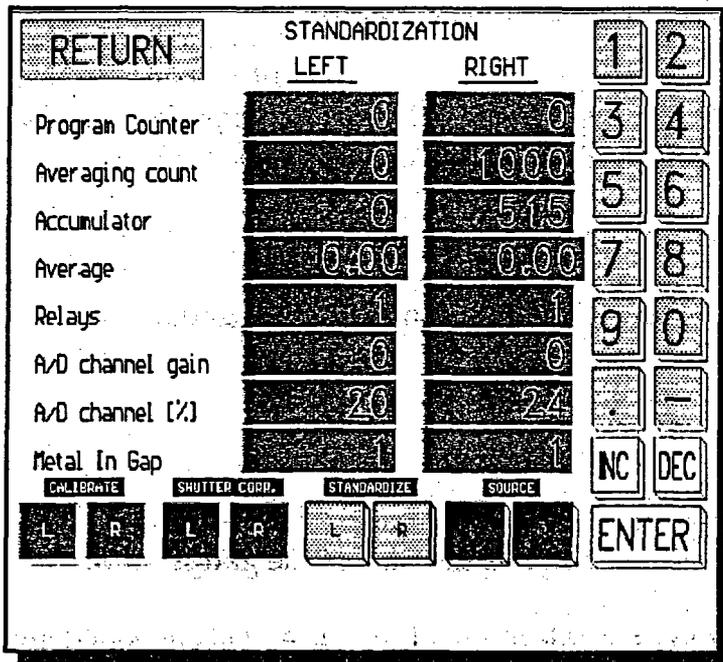


Figure 15 Standardization

The accurate standardization depends on averaging multiple readings. The averaging process is made visible by displaying the number of samples to be taken, contents of the summing accumulator and the result of the averaging. This is what the next 3 variables are.



- Averaging count - Number of samples to take during this averaging.
- Accumulator - Contents of the summing accumulator.
- Average - Result of the averaging.
- Relays - The state of the pre-amp relays is visible in this register. The relays can also be set to particular configuration from here.

See the table below for the meaning of the relay configurations and the corresponding value of the "Relays" variable.

Relay State : 1...On 0...Off

STATE	KH4	KH3	KH2	KH1	"RELAYS"
Measure	0	0	0	1	0001
Z1	1	0	0	0	0010
Z2 Precharge	0	1	0	1	1001
Z2					0101
Comment	Precharge filter	Filter On	Disconn. Ion Chamber	Unground Ion Chamber	"Relays" Variable

- A/D channel gain - The default value of 0 should be left here. Changing of the gain is not supported by the standard gauge software.
- A/D channel [%] - The default value of 0 should be left here. This item is associated with the variable above which is not supported by the standard gauge software.
- Metal In Gap - This variable displays the status of the Metal-In-Gap (MIG) signal. Logical variable, 0 means *FALSE*, 1 means *TRUE*.

See the *MISCELLANEOUS* screen for setting of the *MIG* threshold.

11.0 MISCELLANEOUS SCREEN

11.1 Purpose

The variables in this screen are not directly associated with the gaging. They perform important selections, error threshold settings, etc. for both gauges. See the screen layout in the *Figure 15* on the next page.

The screen has room for 16 variables, not all are assigned and used.



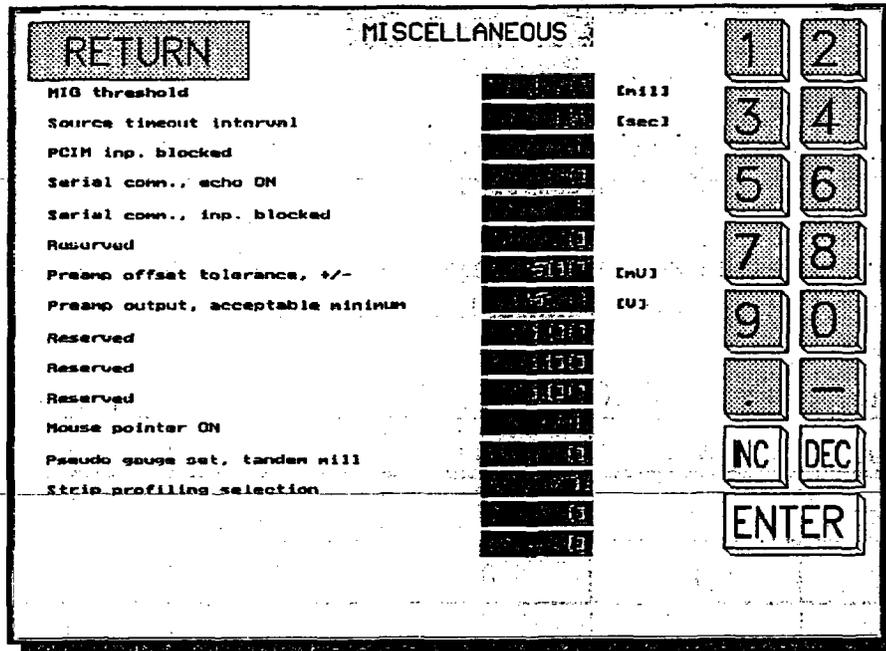


Figure 16 Miscellaneous Screen

n

g
listing

will discuss the meaning of each item.

11.2 MIG Threshold

Dimension: mil or mm depending on the English / Metric.

If the English / Metric selection changes, the threshold is recalculated, so the physical dimension remains unchanged. The Metal-In-Gap signal is 0 (FALSE), if the measured thickness is below this threshold, and it is 1 (TRUE), if the measured thickness is above.

This variable is saved as the part of the gauge setup.

11.3 Source Time-out

Dimension: seconds.

With the Metal-In-Gap *FALSE* and no standardization taking place, the shutter will close after the time determined by this variable.

This variable is saved as the part of the gauge setup.



11.4 PCIM Blocking

This logical variable pertains to the operation of the PCIM card, which provides the optional interface with the GE Fanuc GENIUS I/O system.

If 1 (*TRUE*), this variable blocks any changes caused by the commands from the PCIM datagrams. This is convenient during the start up, setup or debugging. This does not stop the broadcasting of the global data from the GSP.

The 0 (*FALSE*) will let the commands be executed as designed.

This variable is saved as the part of the gauge setup.

11.5 Serial Comm. Echo

This logical variable pertains to the operation of the serial interface.

If 1 (*ON*), the received characters are echoed as they are received. This feature is useful during troubleshooting. The gauge behaves and responds like a terminal.

The change will not take effect until the GSP program restarts.

This variable is saved as the part of the gauge setup. The default value is 0 (*OFF*).

11.6 Serial Comm. Blocking

This logical variable pertains to the serial interface.

If 1 (*TRUE*), this variable blocks any changes caused by the commands received by the serial interface. This is convenient during the start up, setup or debugging. This does not stop the replies to the inquiries directed to the DSP.

The 0 (*FALSE*) will let the commands execute normally.

This variable is saved as the part of the gauge setup.

11.7 Reserved



11.8 Pre-amp Offset Tolerance

Dimension: mV.

This variable sets the limits of the acceptable offset of the gauge pre-amplifier. Large offset of the pre-amp may be an indication of the serious problems.

If the "*V Minimum*" in the *CALIBRATION* screen falls outside of this limits, the standardization error will be indicated.

This variable is saved as the part of the gauge setup.

The default value is 500mv.

11.9 Pre-amp Output Tolerance

Dimension: V.

This variable sets the minimum acceptable level of the pre-amp output. Low pre-amp voltage (with no metal in the gap) indicates problems with the pre-amp, source or ion chamber.

If the "*V maximum*" in the *CALIBRATION* screen falls below this limit, the standardization error will be indicated.

This variable is saved as the part of the gauge setup.

The default is 5 volts

11.10 Reserved

11.11 Reserved

11.12 Reserved

11.13 Mouse Pointer

This logical variable makes the mouse pointer visible.

This is needed when operating the gauge with the mouse. It may be useful during the troubleshooting of the touch screen operation. The arrow marks the position where the touch was recognized.

1 turns the pointer *ON*, 0 turns the pointer *OFF*.



The change will not take effect until the GSP program restarts.

This variable is saved as the part of the gauge setup.

11.14 Pseudo Gauge

The nominal gauge set is frequently used to determine the reduction ratio which is used to set up the speed relations between the electrical drives of the mill.

The special case of a 3-stand mills operating with only 2 gauges requires the nominal gauge setting even for the gauge that is not present, the pseudo-gauge.

When a pseudo gauge is used the OPERATOR PANEL changes to include it.

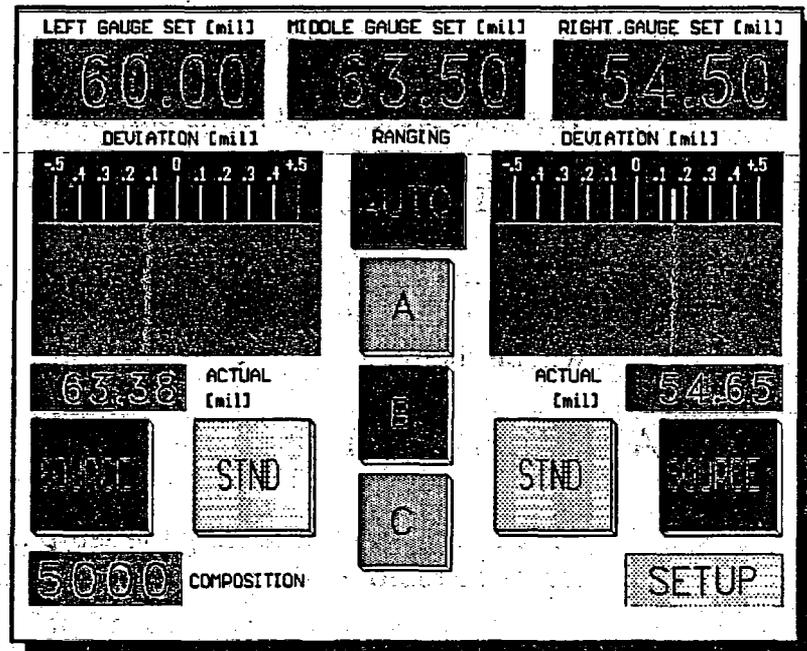


Figure 17 Pseudo Gauge Screen

The pseudo gauge set readout is located in the upper row of the main readouts of the OPERATOR PANEL screen. The composition readout is in the lower left corner of the screen.

See the Figure 16 for the layout of the screen with the pseudo gauge in the middle.



This variable provides the selection of the pseudo gauge set:

- 0 ... no pseudo gauge set, normal screen,
- 1 ... pseudo gauge left,
- 2 ... pseudo gauge center,
- 3 ... pseudo gauge right.

NOTE: *GSP program must be restarted after the change.*

This variable is saved as the part of the gauge setup.

11.15 Strip Profiling Selection

Selects the strip profile operation. The "IP Digital 24" module must be installed for control of the *On/Off* strip motion. The main screen layout will be changed.

12.0 SAVING THE SETUP

All the variables influencing the setup need to be saved in a file, so they can be restored on the power-up or the *GSP* program restart.

The file name is *POINTS.DAT*. It is located in the *.\DAT* subdirectory which must be created for this purpose during the gauge installation.

If the *GSP* program is running with the "-d" command line option (Demo mode of operation), the *POINTS.DAT* file that is created will be the current directory on the first save command.

If the file does not exist, or was deleted, the gauge restarts with the default parameters.

The command for saving of the setup is issued by touching the "SAVE SETUP TO DISK" bar in the MENU screen. By keyboard it can be done by selecting the bar using the cursor keys and pressing the *ENTER*.

The old *POINT.DAT* file is renamed to *POINTS.BAK* before the new *POINTS.DAT* is created.

When editing, the care has to be observed to edit only the numerical data and to keep the original formatting.



12.1 Sample File

```
Program Version:   Version 940913-b
COMMAND LINE OPTIONS
Demo Run:         -d
PCIM Port:        -pxxx Default is 0x3e0
PCIM Mem:         -Pxxxx Default is 0xc800
IPAC Port:        Default is 0x610
IPAC Mem:         -lxxxx Default is 0xc000
'X' is Hex Digit
```

12.2 Manual Editing

The file is in readable form and can be easily viewed and edited with any editor program.

variables that are not accessible from the *GSP* program for any changes.

By default the security code is 2655684.0 and the time-out interval is 60.0. If the change is desired, these 2 entries must be edited.

13.0 EXITING TO DOS

13.1 Purpose

During the setup or startup the *GSP* program needs to be exited in order to run utilities or any other programs.

The orderly exit is in the MENU screen, the bottom bar labeled "EXIT TO DOS". Touching it will stop the *GSP* operation and the familiar *DOS* prompt will appear.

13.2 Restarting the *GSP* Program

The *GSP* program name is GAUGE.EXE. Typing the GAUGE.EXE at command prompt will restart the program.



13.3 Command Line Options

There are several command line options available.

NOTE: 'x' below is a hex digit and '-' can be substituted by '/'

- -d is the demonstration version that will run on any *IBM AT* compatible computer with the *VGA* adapter and the mouse. It bypasses checking for some key peripherals, simulates the *A/D* outputs etc.
- -pxxx sets *PCIM I/O* port address, xxx are hex digits
- -Pxxxx sets *PCIM* memory segment, xxxx hex digits
- -ixxx sets the *IP* carrier board port address, xxx are hex digits
- -Ixxxx sets the *IP* carrier board memory segment.
- -? prints following help message:



APPENDIX A

APPENDIX A - Gauge Signal Processing Unit Test Procedure

This procedure describes the steps required to get the gauge up and running for the first time. It is assumed that the associated desk is powered and **PROPERLY GROUNDED**.

The following documents should be referenced during this procedure.

- Gauge Signal Processing Unit Manual
- Gauge Interconnect Drawings

STEPS	TASKS
<p>1. Initial System Check</p>	<p>a. Check ALL cables, wiring and connections. An error in wiring can cause costly damage to system ports.</p> <p>b. Check and configure the option jumpers and/or switches on the following cards:</p> <ul style="list-style-type: none"> • National Instruments Multifunction I/O Card • SeaLevel Systems Serial I/O Card (if used) • Industry Pack ATC40 Carrier Board • Industry Pack IP-Opto Driver Module • Industry Pack IP-DAC Module • PC Interface Module (PICM) (if used) <p>c. Disconnect cables to the National Instruments Multifunction card and the IP0 Opto driver Module before proceeding.</p> <p>d. Before installing the source capsule into the source head assembly, check shutter operation with the shop testing fixture.</p>
<p>2. External Voltage Check</p>	<p>a. Check for presence of +24 volt power on the Phoenix terminal block for the Opto Driver Module. <u><i>NOTE: This is the Desk +24V supply, not the power supply in the junction box.</i></u></p> <p>b. Apply power to the gauge computer.</p>
<p>3. Gauge Software and Touch-Screen Verification</p>	<p>a. Be sure that the software for gauge operation is properly loaded and the touch screen is calibrated.</p> <p>b. Turn off power to the gauge computer.</p> <p>c. Connect the cable to the IP-Opto Driver Module.</p>
<p>4. System Power and Voltage Check</p>	<p>a. Apply power to the gauge computer.</p> <p>b. Check that the gauge junction box has powered up, as indicated by the power LED's located in the junction box.</p> <p>c. The green "Source Off" lamps on the C-Frames should be on, and the red "Source On" lamps should be off.</p>



Touch Screen Gamma Gauge Entering and Editing Alloy Compensation Numbers

1. From the "Operators Panel" touch the "SETUP" box in the lower left -hand corner. A keyboard will appear and you will be asked to enter the security code to unlock the screens. Type in the security code, which is 2655684, then touch "ENTER". This unlocks the test screens for a period of 1 hour.

2. Touch the "SELECT ALLOY" box located in the middle of the "Operators Panel" above the composition number. This will open up the "COMPENSATION TABLE".
Note: "SELECT ALLOY" is the boot up name. This name will change to the name of the alloy you select or entered into the "COMPENSATION TABLE".

3. To enter a new alloy select any empty box in the "COMPENSATION TABLE" and then touch the "EDIT" box in the top right hand corner. This opens the "COMPENSATION TABLE EDITOR" screen.

4. The "COMPENSATION TABLE EDITOR" has a touch keyboard with three columns for alloy information:
 - "ALLOY NAME" : Enter the name of the alloy
 - "COMPOSITION": Enter the composition number that you determined is needed for this particular alloy.
 - "COMMENTS": Enter any notes or comments you might deem necessary.

5. When finished touch the "SAVE" box and then "RETURN" to get back to the "OPERATORS PANEL".

You will notice that the new composition number is displayed and that the "SELECT ALLOY" box now is displaying the name of the new alloy. You can toggle between the "OPERATORS PANEL" and the "COMPENSATION TABLE" without entering the security code. The security code is only needed to add or change alloys in the table.

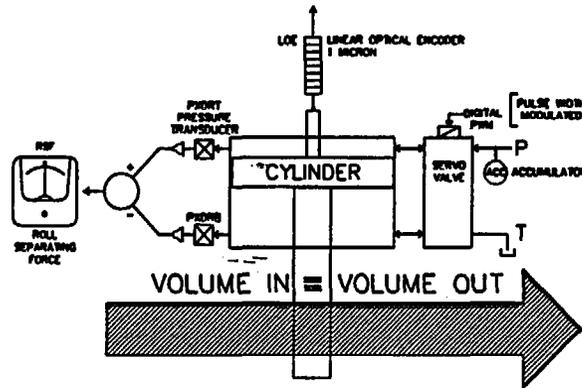
ILLUSTRATIONS

i²S AGC

GENERAL COMMENT:

ROLL ECCENTRICITY WILL LIMIT ANY AGC PERFORMANCE. GOOD ROLL GRINDING PROCEDURES MUST BE EMPLOYED. HOWEVER THE I²S AGC CORRECTS AT INTERVALS AS SHORT AS 50 MM. ANY ECCENTRICITY RESULTS IN AN IMMEDIATE CHANGE IN MEASURED LENGTH OUT (L_{out}). THUS THE AGC WILL REACT QUICKLY TO MAINTAIN CONSTANT EXIT THICKNESS.

NONUNIFORM HARDNESS IN THE MATERIAL WILL RESULT IN AN IMMEDIATE CHANGE IN LENGTH OUT. THE AGC WILL DETECT THIS IN THE FIRST 50 MM LENGTH AND OUTPUT A PROPORTIONAL CORRECTION TO THE HYDRAULIC SCREWDOWN.



AGC PRIMARY LOOP VOLUME EQUATION

$$\begin{aligned} \text{VOLUME IN} &= \text{VOLUME OUT} \\ \text{LENGTH}_{in} \times \text{THICK}_{in} \times \text{WIDTH}_{in} &= \text{LENGTH}_{out} \times \text{THICK}_{out} \times \text{WIDTH}_{out} \\ \text{Lin} \times \text{Tin} \times \text{Win} &= \text{Lout} \times \text{Tout} \times \text{Wout} \\ \text{Lin} \times \text{Tin} &= \text{Lout} \times \text{Tout} \\ \text{Tin} &= \text{Gin NDM} \pm \text{Gin DEV} \\ \text{Lin} \times [\text{Gin NDM} \pm \text{Gin DEV}] &= \text{Lout} \times \text{Tout} \\ \therefore \text{Tout} &= \frac{\text{Lin} \times [\text{Gin NDM} \pm \text{Gin DEV}]}{\text{Lout}} \end{aligned}$$

DIGITAL TACHS OUTPUT 20,000 PPM TO CORRECT EVERY 50 MM $L_i = 1000$

$$\frac{L_i}{L_o} = \frac{\text{ENTRY LENGTH}}{\text{EXIT LENGTH}}$$

AGC SECONDARY LOOP EXIT GAGE AVERAGING

THE HIGH SPEED PRIMARY LOOP DOES NOT REQUIRE OR USE EXIT DEVIATION. (GAGE) HOWEVER IF STRIP WIDTH CHANGES DURING REDUCTION, OR IF SLIGHT ERRORS IN TACH WHEEL SIZES, OR DIFFERENCES IN GAGE CALIBRATION THE SYSTEM WILL AUTOMATICALLY COMPENSATE.

THE SECONDARY AGC LOOP CONTINUOUSLY AVERAGES THE EXIT GAGE DEVIATION. IF THE AVERAGE IS NOT ZERO THE COMPUTER WILL PROPORTIONALLY MODIFY THE PRIMARY LOOP ENTRY LENGTH COUNT TO BRING THE EXIT GAGE AVERAGE TO EXACTLY ZERO.

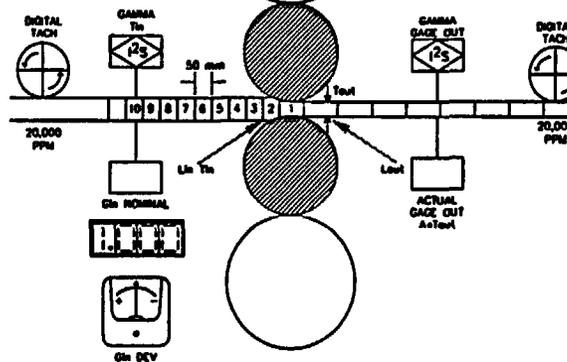
ALSO THE AGC HAS AUTOMATIC MATERIAL HARDNESS COMPENSATION SOFTWARE WHICH COMPARES ACTUAL THICKNESS OUT (A_{Tout}) WITH CALCULATED (T_{out}) AFTER THE CORRECTION.

EXAMPLES

Lin	X	(Gin NDM + Gin DEV)	=	Lout	X	Tout?	Tout RESULT	SCREWDOWN CORRECTION
1000	1.000mm	0mm	=	2000	.500mm	0mm	0	
1000	1.000mm	+ .005mm	=	2000	.504mm	+ .004mm	DOWN 4	
1000	1.000mm	- .005mm	=	2000	.497mm	- .003mm	UP 3	
1000	1.000mm	0mm	=	1990	.502mm	+ .002mm	DOWN 2	
1000	1.000mm	0mm	=	2012	.497mm	- .003mm	UP 3	
1000	1.000mm	+ .010mm	=	2020	.500mm	0mm	0	
1000	1.000mm	- .030mm	=	1980	.490mm	- .010mm	UP 1	
1000	1.000mm	+ .021mm	=	1998	.511mm	+ .011mm	DOWN 11	
1000	1.000mm	+ .051mm	=	2088	.503mm	+ .003mm	DOWN 3	
1000	1.000mm	- .081mm	=	1930	.478mm	- .024mm	UP 24	

NOTE: THICKNESS AND LENGTH VALUES ARE EXAGGERATED FOR EXAMPLE ONLY

TOTAL Lin = 10000 = .5 METERS STRIP AND 10 PROPORTIONAL CORRECTIONS HAVE BEEN MADE!

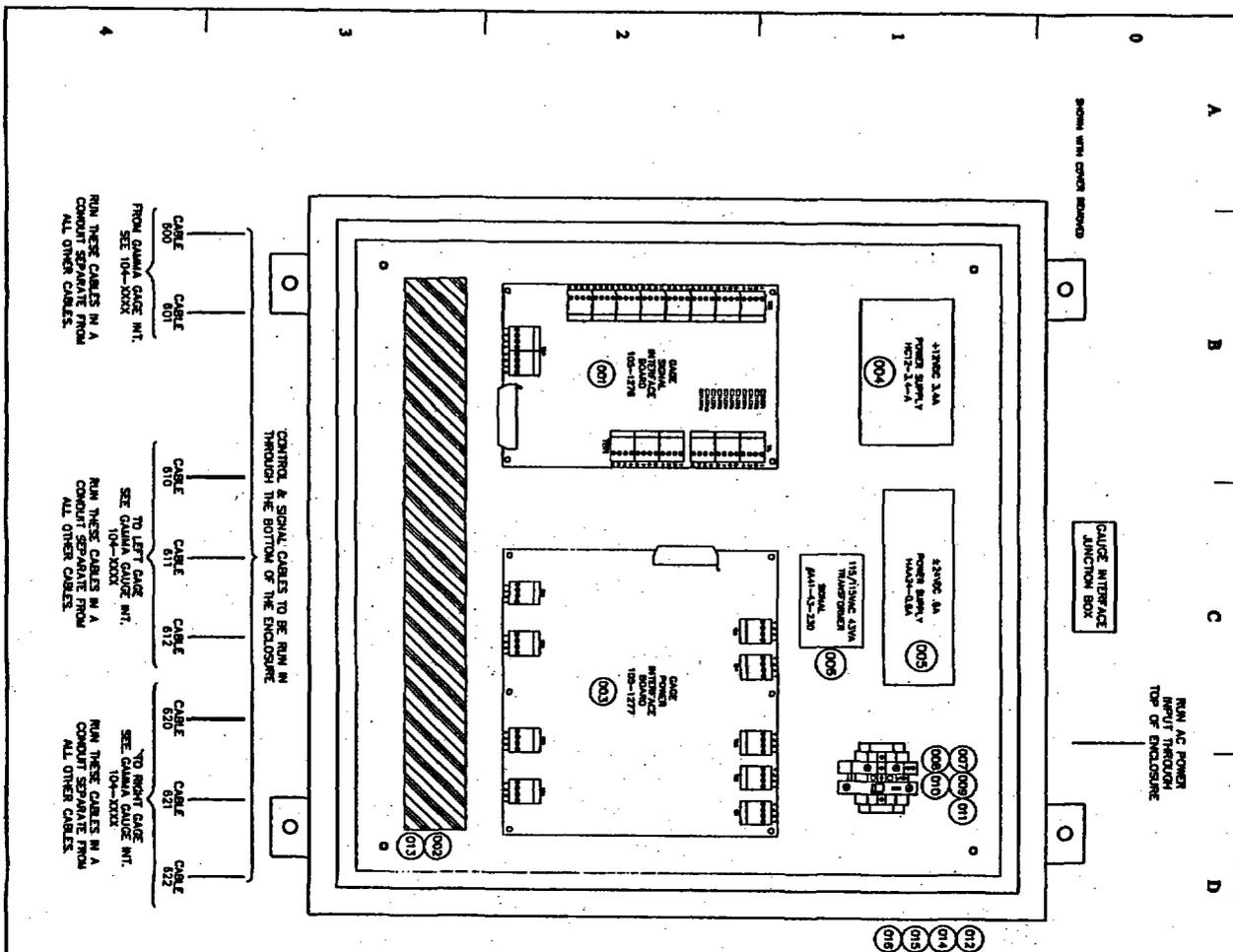


US-JAPAN-EUROPE PATENTS

i²S PATENTED HYDRAULIC SCREWDOWN

100% DIGITAL
VERY FAST - TYP 25 MICRON in .02 SEC.
ACCURATE - 1 MICRON RESOLUTION ZHI-4HI
.1 MICRON RESOLUTION Z MILL
HIGH YIELDS - TIGHT TOLERANCE

REV	DATE	NAME	COMMENT	BY
001				
002				
003				
004				
005				
006				
007				
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012				
013				
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FROM GAUZA GAUGE MNT.
SEE 104-XXXX

TO LEFT GAUGE MNT.
SEE GAUZA GAUGE MNT.
104-XXXX

TO RIGHT GAUGE MNT.
SEE GAUZA GAUGE MNT.
104-XXXX

CONTROL & SIGNAL CABLES TO BE RUN IN THROUGH THE BOTTOM OF THE ENCLOSURE

CABLE 000

CABLE 001

CABLE 010

CABLE 011

CABLE 012

CABLE 020

CABLE 021

CABLE 022

TO LEFT GAUGE MNT.
SEE GAUZA GAUGE MNT.
104-XXXX

TO RIGHT GAUGE MNT.
SEE GAUZA GAUGE MNT.
104-XXXX

TO LEFT GAUGE MNT.
SEE GAUZA GAUGE MNT.
104-XXXX

TO RIGHT GAUGE MNT.
SEE GAUZA GAUGE MNT.
104-XXXX

TO LEFT GAUGE MNT.
SEE GAUZA GAUGE MNT.
104-XXXX

TO RIGHT GAUGE MNT.
SEE GAUZA GAUGE MNT.
104-XXXX

CONTROL & SIGNAL CABLES TO BE RUN IN THROUGH THE BOTTOM OF THE ENCLOSURE

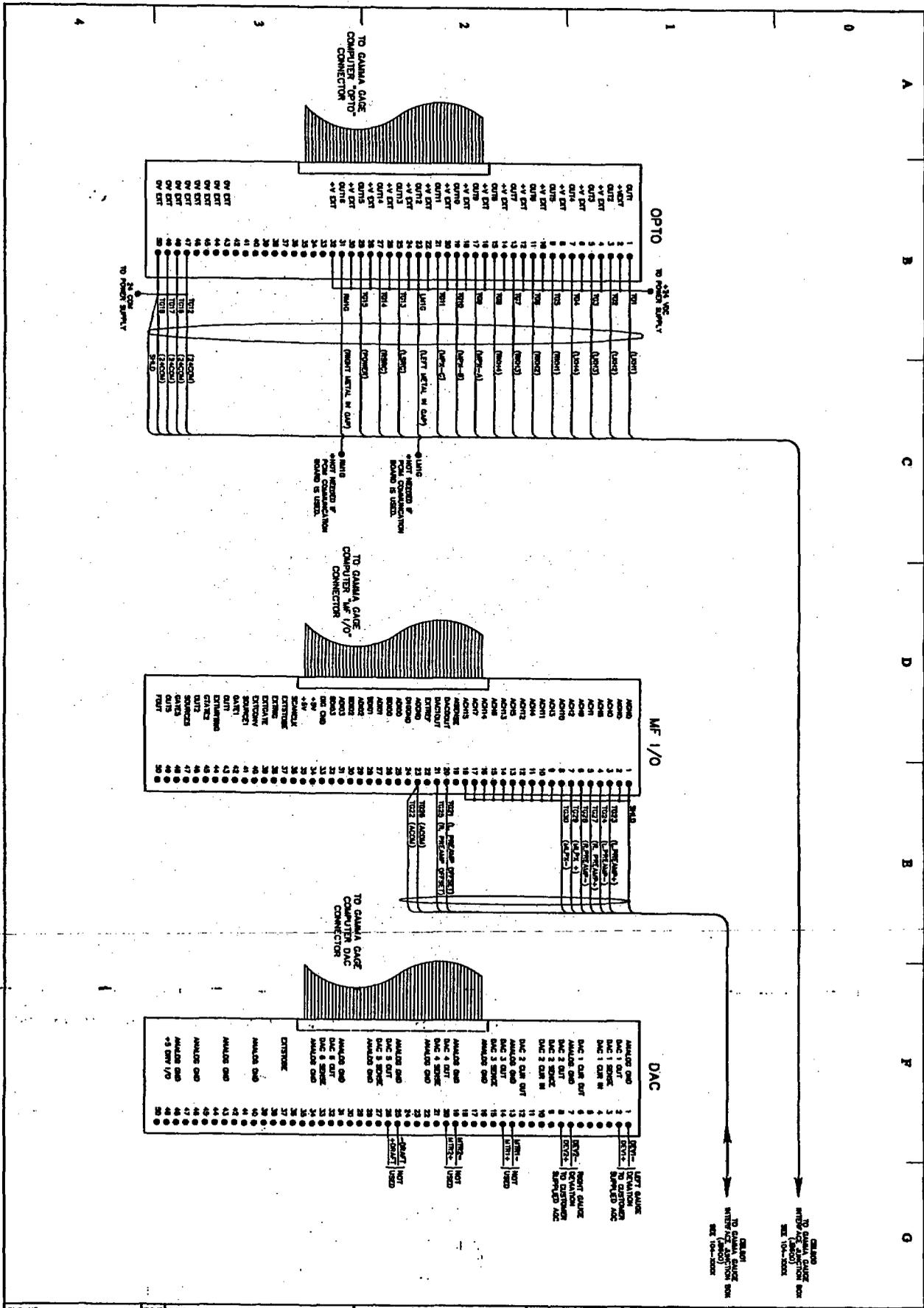
NOTES:

1. MOUNT GAUGE INTERFACE JUNCTION BOX 1/4" ON OUTSIDE OF COVER.

2. SEPARATE SIGNAL AND POWER WIRING AS SHOWN.

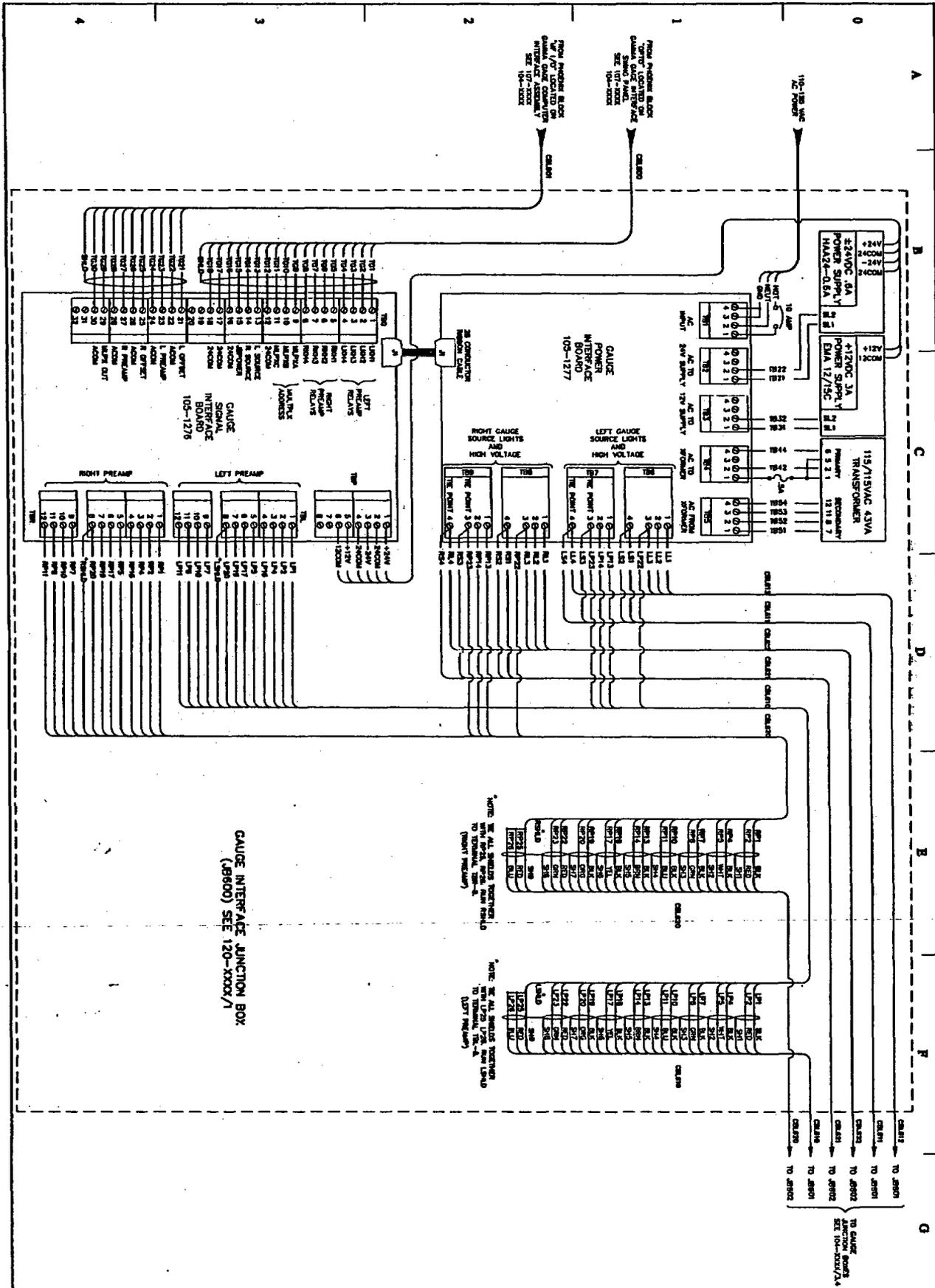
3. SEE DWG. 104-XXXX/1 & 2 FOR INTERCONNECTION WIRING.

REV	DATE	DESCRIPTION	BY	CHKD	APP'D
1	10-17-79	GAUGE SIGNAL INTERFACE 104-1729			
2	10-17-79	GAUGE POWER INTERFACE 104-1727			
3	10-17-79	115/115VAC 15VA TRANSFORMER 104-1728			
4	10-17-79	3.0A POWER SUPPLY 104-1724			
5	10-17-79	3.0A POWER SUPPLY 104-1725			
6	10-17-79	3.0A POWER SUPPLY 104-1726			
7	10-17-79	3.0A POWER SUPPLY 104-1727			
8	10-17-79	3.0A POWER SUPPLY 104-1728			
9	10-17-79	3.0A POWER SUPPLY 104-1729			
10	10-17-79	3.0A POWER SUPPLY 104-1730			
11	10-17-79	3.0A POWER SUPPLY 104-1731			
12	10-17-79	3.0A POWER SUPPLY 104-1732			
13	10-17-79	3.0A POWER SUPPLY 104-1733			
14	10-17-79	3.0A POWER SUPPLY 104-1734			
15	10-17-79	3.0A POWER SUPPLY 104-1735			
16	10-17-79	3.0A POWER SUPPLY 104-1736			
17	10-17-79	3.0A POWER SUPPLY 104-1737			
18	10-17-79	3.0A POWER SUPPLY 104-1738			
19	10-17-79	3.0A POWER SUPPLY 104-1739			
20	10-17-79	3.0A POWER SUPPLY 104-1740			
21	10-17-79	3.0A POWER SUPPLY 104-1741			
22	10-17-79	3.0A POWER SUPPLY 104-1742			
23	10-17-79	3.0A POWER SUPPLY 104-1743			
24	10-17-79	3.0A POWER SUPPLY 104-1744			
25	10-17-79	3.0A POWER SUPPLY 104-1745			
26	10-17-79	3.0A POWER SUPPLY 104-1746			
27	10-17-79	3.0A POWER SUPPLY 104-1747			
28	10-17-79	3.0A POWER SUPPLY 104-1748			
29	10-17-79	3.0A POWER SUPPLY 104-1749			
30	10-17-79	3.0A POWER SUPPLY 104-1750			

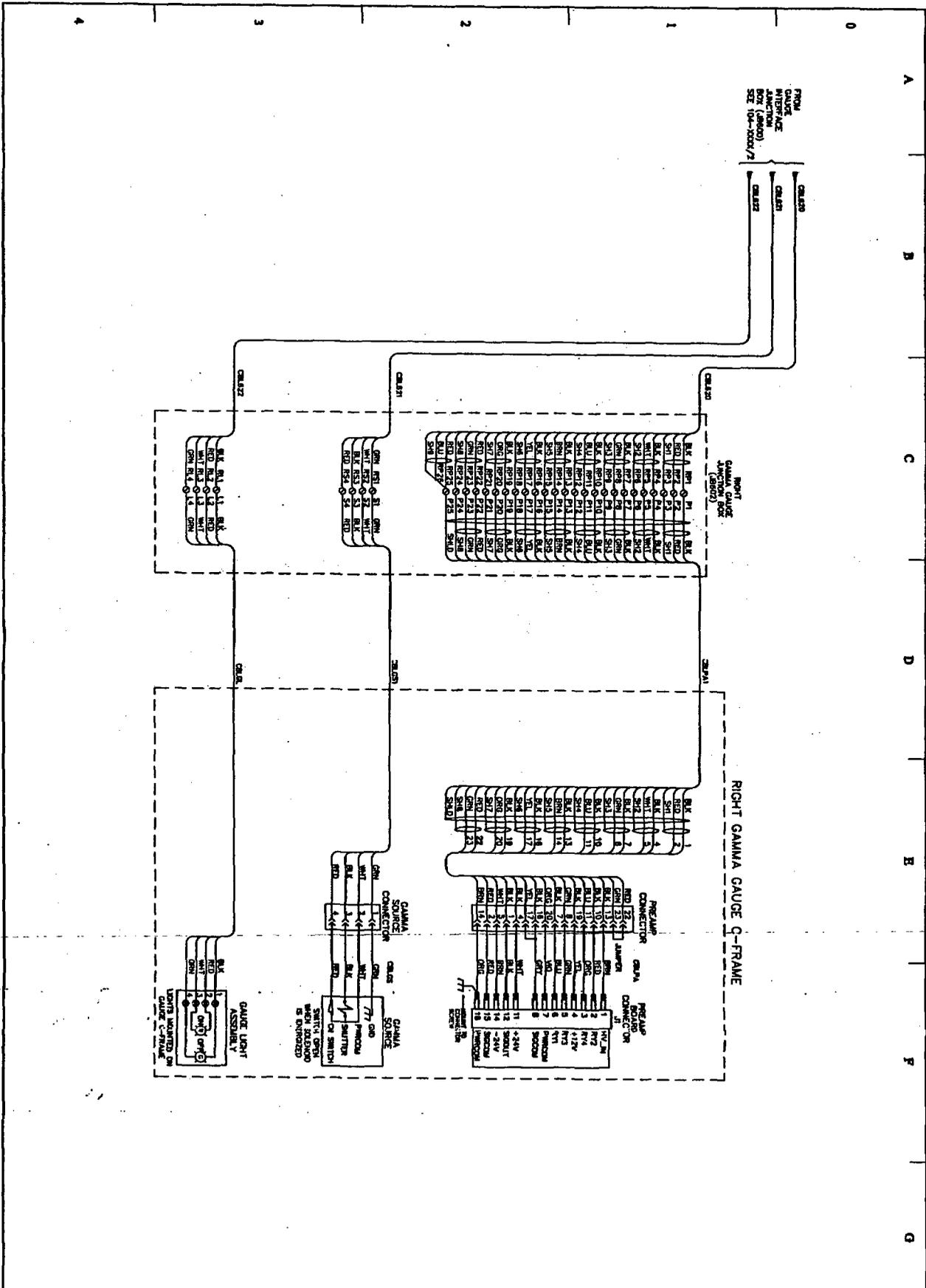


DWG. NO. 104-XXXX SHT 1 OF 1	TITLE: GAMMA GAUGE INTERCONNECT	 INTERGRATED INDUSTRIAL SYSTEMS 475 MAIN STREET YALEVILLE, CONNECTICUT 06492	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th>REV.</th> <th>DATE</th> <th>BY</th> <th>CHK.</th> <th>APP.</th> <th>DESCRIPTION</th> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> </table>	REV.	DATE	BY	CHK.	APP.	DESCRIPTION																		
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DWG. NO. 104-XXXX	ISSUE A	TITLE GAMMA GAUGE INTERCONNECT	 INTEGRATED INDUSTRIAL SYSTEMS 478 MAIN STREET VALLESHALE, CONNECTICUT 06462	DESIGNER JKMO	DATE	NAME	REV.	DATE	BY	REL.	CON. NO.	DESCRIPTION
SHT 2 OF 4	JOB NO.	SCALE: FULL		BRANCH JKMO	DATE	NAME	REV.	DATE	BY	REL.	CON. NO.	DESCRIPTION



DWG. NO. 104-XXXX		ISSUE A	TITLE GAMMA GAUGE INTERCONNECT	 INTERGRATED INDUSTRIAL SYSTEMS VALLEYVILLE, CONNECTICUT 06482	REVISIONS	DATE	NAME	REV.	DATE	BY	REL.	EDR. NO.	DESCRIPTION
SHEET 4 OF 4 12/11/98 08:27 JOP					1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50								

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7. **GAMMA GAUGE WARNING LABELS**
8. **CUSTOMER ACKNOWLEDGMENT FORMS**



OVERVIEW

This I²s Radiation Training Program is designed to help you, the customer, to understand the basic operation and safety procedures.

First and foremost, **SAFETY** is our primary concern. The gage itself is a very safe device and is virtually impossible to damage in such a way as to pose a radiation hazard. This does **NOT** mean that untrained personnel are allowed to do anything they want to.

This is **NOT** a maintenance manual, only an Operations and Regulations Manual.

This does **NOT** allow you to perform any maintenance on the gage itself, with the exception of changing indicator lights with power off.

If, after completing the material in this manual, you have unresolved questions or desire more in-depth training, please contact us at (203) 265-5684. Your inquiries are always welcomed.



2. SAFETY

Congratulations on receiving your I'S Gamma Radiation Gauge. Our company has many years of experience with these gauges and is extremely proud of our safety record. While the gauges we produce are low level, our company's primary concern is the continued safety of all our customers. It is therefore appropriate to establish some guidelines on how to conduct yourself in the areas where these gauges are in use.

Our gauge, physically, looks like an elongated "C". In the open end of the C-Frame is where the radioactive source housing is located. **DO NOT** place any part of your body in this open air gap.

Mounted on top of the C-Frame are two (2) lights, one *Green*, one *Red*. With the gauge system powered, the *Green* light indicates the source is covered (shutter closed) and the gauge is not active. The *Red* light indicates that the source is exposed (shutter open) and radiation is present. When the *Red* light is lit, stay at least three (3) feet away from the gauge. To physically verify the position of the gauge shutter a glass peep hole has been installed on the front of the source housing. *Green* and *Red* strips have been painted on the shutter to correspond to the C-Frame lights. On the outboard side of the C-Frame is a label containing the "3 Foot Warning". This label must be maintained on the C-Frame in legible condition.

There are three (3) factors that should be used to minimize your exposure to radiation: **Time, Distance, and Shielding.**

Time: The less time a person remains in the area of radiation, the less of a radiation dose that person will receive.

Distance: The intensity of radiation and its effects fall off sharply as you move further away from the source. For example, by moving twice (2x) as far away from a radioactive source, you are exposed to *One-Quarter* the amount of radiation, moving three (3x) times as far away means *One-Ninth* the exposure and so on.

Shielding: Protective material placed between you and the source reduces the level of radiation passing thru, and thus the amount to which you will be exposed. In nuclear gauges, this protection is provided in the source housing.



It is appropriate to mention a word about ALARA. ALARA is an acronym. It's meaning is: As Low As Reasonably Achievable.

ALARA refers to the exposure level for those who work with radiation. It must be emphasized that ALARA is not a dose limit, it is a method of work. It is the responsibility of management and the individual worker to continuously strive to lower exposure levels. This joint commitment to a continued safe work environment Can Not Be Over Emphasized.

To summarize, if the shutter is open and it is not necessary to be in the direct vicinity of the gauge, DON'T. If you do need to work in that area, minimize you time, when possible close the shutter. If involved in a long term project, turn off the system power.

REMEMBER - The most important step in any procedure, is your personal saftey.



3. U.S. NUCLEAR REGULATORY COMMISSION REGULATIONS

I²S has two (2) licenses from the U.S. Nuclear Regulatory Commission. They are the following:

License #06-21253-01

- 1) Installation, relocation, repair and servicing of the gauge, including the leak testing of sealed sources and radiation surveys of devices for other persons.
- 2) Instruction and training of individuals in the use of the gauging device.

License #06-21253-02G

The licensee (I²S) is authorized to redistribute the devices containing sealed sources specified in this license to persons generally licensed pursuant to section 31.5, 10CFR part 31 (copy enclosed) or equivalent provisions of the regulations of any Agreement State.

Unless you, our customer, are specifically licensed by the U.S. Nuclear Regulatory Commission or an equivalent Agreement State, you are considered to be a general licensee. As such, you have certain responsibilities as regards to I²S Gamma Radiation Gauge. Title 10, code of Federal Regulations (10CFR) defines conditions for use of the gauge. The sections that pertain to you (copies enclosed), the general licensee are:

- Section 20.2201, 10CFR20
Reports of theft or loss of licenced material.
- Section 20.2202, 10CFR20
Notification of incidents.
- Section 30.34, 10CFR30
Terms and conditions of licenses.
- Section 30.51, 10CFR30
Records.
- Section 30.52, 10CFR30
Inspections.
- Section 30.53, 10CFR30
Tests.



- Section 30.61, 10CFR30
Modification and revocation of licenses.
- Section 30.62, 10CFR30
Right to cause the withholding of recall of by-product material.
- Section 30.63, 10CFR30
Violations.
- Section 31.5, 10CFR31
Certain measuring, gauging or controlling devices.

** Special Note: Section 31.5, 10CFR31, is the authorization for the issuing of a general license. There is no official document that is issued for general licenses.*

At the time of the initial installation, for the gauges, a Radiation Site Survey and Leakage Test will be performed for each gauge. Their purpose is as follows:

Radiation Site Survey:

The survey is performed to determine the level of exposure to radiation that your workers will receive. This is done to insure that this exposure level is below those levels permitted by Federal regulations. The survey is performed with a sensitive, calibrated ion chamber meter, designed to simulate exposure to the human body. The measurements taken will be recorded (sample form enclosed) and exposure levels determined. A copy of this report will be given to you along with an explanation as to how the exposure levels were determined. This report must be maintained on permanent file. A separate copy will also remain on permanent file at I²S.

Leakage Testing:

It is a U.S. Nuclear Regulatory Commission requirement that your gauge be examined at least every six (6) months for signs of leakage and/or contamination. The initial test is performed by I²S at the same time of installation (sample form enclosed). Thereafter the test must be performed at no more than six (6) month intervals by persons specifically licensed by the U.S. Nuclear Regulatory Commission or an Agreement State to perform this service. I²S can provide this service, if so desired. The responsibility for having this service performed and maintaining a permanent record of the test results, rests with you, the general licensee. A permanent record of those tests performed by I²S will also be maintained on file at I²S.



You should be aware that the warning label, mounted on the gauge, cannot be removed. You are also required to maintain these labels in legible condition.

After reading the enclosed sections of Title 10, Code of Federal Regulations if you should have any questions that cannot be answered by our field representative, contact I'S Radiation Safety Officer at (203) 265-5684.



4. OPERATION OF GAUGE

To operate the gauge, turn on the power switch on the back of the gauge electronics rack. Allow at least ten (10) minutes for the system to "Warm Up". To open and close the gauge source shutter press the source "On/Off" pushbutton. When the pushbutton is lit the source shutter is open, when the pushbutton is not lit the source shutter is closed.

It is very important to understand exactly how the gauge lights operate, so that an unsafe condition can be recognized. Light combinations are:

1. Source *On/Off* pushbutton not lit, *Green* light on gauge lit, source shutter is closed.
2. Source *On/Off* pushbutton lit, *Red* light on gauge lit, source shutter is open and radiation is present.
3. Source *On/Off* pushbutton not lit, no light on gauge lit. Source shutter is probably closed. Remove gauge system power, use the sight glass to physically verify the position of shutter. Repair *Green* light on gauge.
4. Source *On/Off* pushbutton not lit, no light on gauge lit. Source shutter is probably closed. Remove gauge system power, use the sight glass to physically verify the position of shutter. Repair *Red* light on gauge.
5. Both, *Green* light and *Red* light, on gauge lit regardless of source *On/Off* pushbutton indication. There is a shutter problem and the source gauge must be serviced. This service must be performed by persons specifically licensed by the U.S. Nuclear Regulatory Commission or an Agreement State. Since there is no valid indication to the correct position of the shutter it is necessary to use the sight glass to physically verify the actual position. If the shutter is stuck open refer to the *Emergency Procedure* section of this manual.

PLEASE NOTE:

The I²S Gamma Radiation Gauge has been designed so that when the system power is removed the shutter automatically closes (fail safe). This can be demonstrated by opening the source shutter and turning off the system power or by simply pulling the power cord. Use the sight glass to physically verify that the source shutter is indeed closed.



5. MAINTENANCE

The purpose of this section is to clearly define the maintenance that is permitted for the I's Gamma Radiation Gauge. All areas, not specifically addressed by this section, are restricted and no customer maintenance is allowed for these areas. It should, also, be mentioned that the gauge, itself, cannot be removed from the gauge track. Any removal, relocation or shipment of the gauge must be performed by persons specifically licensed by the U.S. Nuclear Regulatory Commission or an Agreement State.

WARNING:

Before performing any gauge maintenance procedure, REMOVE gauge system power and lockout. Failure to do so will result in a shock hazard. In addition, damage may occur to sensitive system electronics. Also, physically verify the source shutter is in the closed position.

Maintenance Items:

Shutter Indicator Lights

1. The light bulbs may be replaced by unscrewing the receptacle lens cap
2. The receptacle may be replaced by opening the top of the Hoffman enclosure. The mounting screws are now accessible.

Gauge Receiver Head

1. Facing the front of the gauge, on the upper half of the C-Frame, is the receiver head. There are eight (8) bolts that are visible. The four (4) in the front, secure the front cover to the receiver head. The four (4) in the back (2 per side) secure the receiver head to the C-Frame. Remove the four (4) bolts in the back.
2. Lift the receiver head straight out. Disconnect preamplifier cable on the back of the receiver head. Receiver head can now be placed on workbench.
3. Remove four (4) bolts on front cover. Remove cover. Preamplifier printed circuit board, its connector and ion chamber are now accessible for service.
4. To re-assemble, reverse the order.

REMINDER: **NO** service, by the customer, is permitted on the gauge source head.



6. EMERGENCY PROCEDURE

First, and foremost, SAFETY is our primary concern. The I²S Gamma Radiation Gauge has been designed for the mill environment and is virtually impossible to damage in such a way as to pose a radiation hazard. In the event that an emergency involving a radiation gauge should occur, the following steps should be taken.

1. Cease work immediately.
2. Do not attempt to work on the gauge yourself.
3. If the gauge has been partially damaged or destroyed, keep all personnel at least twenty (20) feet away, until the source has been repaired or shielded or until radiation levels are known.
4. Notify the I²S Radiation Safety Officer as soon after the incident as possible. Our company's main telephone number (203) 265-5684 also serves as a **24 Hour Emergency Number**.
5. Have leakage tests performed after any incident that may have resulted in damage to the source.
6. In case of accident or fire, do not use the gauge until any danger from or damage to the source has been assessed.
7. Inform the U.S. Nuclear Regulatory Commission within 24 hours of any theft, accident or incident involving the gauge. Full explanation of notification requirements are contained in the following regulations:
 - 0.1 10CFR20-2201 Reports of thefts or loss of licensed materials
 - 0.2 10CFR20-2202 Notification of incidents. Copies of these regulations are contained in this manual. In the event that notification is required, contact the nearest U.S. Nuclear Regulatory Commission regional office. They are:

U.S.N.R.C. Region I
475 Allendale Road
King of Prussia, Pa. 19406-1415
Tel. (610) 337-5000

U.S.N.R.C. Region II
Sam Nunn Atlanta Federal Center 23 T85
61 Forsyth Street, SW
Atlanta, Ga. 30303-8931
Tel. (404) 562-4400



U.S.N.R.C. Region III
801 Warrenton Road
Lisle, IL 60532-4351
Tel. (630) 829-9500

U.S.N.R.C. Region IV
Texas Health Resources Tower
611 Ryan Plaza Drive, Suite 400
Arlington, Tx. 76011-4005
Tel. (817) 860-8100



§20.2201 Reports of theft or loss of licensed material.

(a) Telephone reports. (1) Each licensee shall report by telephone as follows:

(i) Immediately after its occurrence becomes known to the licensee, any lost, stolen, or missing licensed material in an aggregate quantity equal to or greater than 1,000 times the quantity specified in appendix C to part 20 under such circumstances that it appears to the licensee that an exposure could result to persons in unrestricted areas; or

(ii) Within 30 days after the occurrence of any lost, stolen, or missing licensed material becomes known to the licensee, all licensed material in a quantity greater than 10 times the quantity specified in appendix C to part 20 that is still missing at this time.

(2) Reports must be made as follows:

(i) Licensees having an Installed Emergency Notification System shall make the reports to the NRC Operations Center in accordance with §50.72 of this chapter, and

(ii) All other licensees shall make reports by telephone to the NRC Operations Center (301)-816-5100.

(b) *Written reports.* (1) Each licensee required to make a report under paragraph (a) of this section shall, within 30 days after making the telephone report, make a written report setting forth the following information:

(i) A description of the licensed material involved, including kind, quantity, and chemical and physical form; and

(ii) A description of the circumstances under which the loss or theft occurred; and

(iii) A statement of disposition, or probable disposition, of the licensed material involved; and

(iv) Exposures of individuals to radiation, circumstances under which the exposures occurred, and the possible total effective dose equivalent to persons in unrestricted areas; and

(v) Actions that have been taken, or will be taken, to recover the material; and

(vi) Procedures or measures that have been, or will be, adopted to ensure against a recurrence of the loss or theft of licensed material.

(2) Reports must be made as follows:

(i) For holders of an operating license for a nuclear power plant, the events included in paragraph (b) of this section must be reported in accordance with the procedures described in §50.73(b), (c), (d), (e), and (g) of this chapter and must include the information required in paragraph (b)(1) of this section, and

(ii) All other licensees shall make reports to the Administrator of the appropriate NRC Regional Office listed in appendix D to part 20.

(c) A duplicate report is not required under paragraph (b) of this section if the licensee is also required to submit a report pursuant to §§30.55(c), 40.64(c), 50.72, 50.73, 70.52, 73.27(b), 73.67(e)(3)(vii), 73.67(g)(3)(iii), 73.71, or §150.19(c) of this chapter.

(d) Subsequent to filing the written report, the licensee shall also report any additional substantive information on the loss or theft within 30 days after the licensee learns of such information.

(e) The licensee shall prepare any report filed with the Commission pursuant to this section so that names of individuals who may have received exposure to radiation are stated in a separate and detachable part of the report.

[56 FR 23406, May 21, 1991, as amended at 58 FR 69220, Dec. 30, 1993; 60 FR 20186, Apr. 25, 1995]

§20.2202 Notification of incidents.

(a) Immediate notification. Notwithstanding any other requirements for notification, each licensee shall immediately report any event involving byproduct, source, or special nuclear material possessed by the licensee that may have caused or threatens to cause any of the following conditions --

(1) An individual to receive --

(i) A total effective dose equivalent of 25 rems (0.25 Sv) or more; or

(ii) A lens dose equivalent of 75 rems (0.75 Sv) or more; or

(iii) A shallow-dose equivalent to the skin or extremities of 250 rads (2.5 Gy) or more; or

(2) The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours, the individual could have received an intake five times the annual limit on intake (the provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures).

(b) Twenty-four hour notification. Each licensee shall, within 24 hours of discovery of the event, report any event involving loss of control of licensed material possessed by the licensee that may have caused, or threatens to cause, any of the following conditions:

(1) An individual to receive, in a period of 24 hours --

(i) A total effective dose equivalent exceeding 5 rems (0.05 Sv); or

(ii) A lens dose equivalent exceeding 15 rems (0.15 Sv); or

(iii) A shallow-dose equivalent to the skin or extremities exceeding 50 rems (0.5 Sv); or

(2) The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours, the individual could have received an intake in excess of one occupational annual limit on intake (the provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures).

(c) The licensee shall prepare any report filed with the Commission pursuant to this section so that names of individuals who have received exposure to radiation or radioactive material are stated in a separate and detachable part of the report.

(d) Reports made by licensees in response to the requirements of this section must be made as follows:

(1) Licensees having an installed Emergency Notification System shall make the reports required by paragraphs (a) and (b) of this section to the NRC Operations Center in accordance with 10 CFR 50.72; and

(2) All other licensees shall make the reports required by paragraphs (a) and (b) of this section by telephone to the NRC Operations Center (301) 816-5100.

(e) The provisions of this section do not include doses that result from planned special exposures, that are within the limits for planned special exposures, and that are reported under §20.2204.

[56 FR 23406, May 21, 1991, as amended at 56 FR 40766, Aug. 16, 1991; 57 FR 57879, Dec. 8, 1992; 59 FR 14086, Mar. 25, 1994]

§30.34 Terms and conditions of licenses.

(a) Each license issued pursuant to the regulations in this part and the regulations in parts 31 through 36 and 39 of this chapter shall be subject to all the provisions of the Act, now or hereafter in effect, and to all valid rules, regulations and orders of the Commission.

(b) No license issued or granted pursuant to the regulations in this part and parts 31 through 36, and 39 nor any interest in a license shall be transferred, assigned or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through transfer of control of any license to any person, unless the Commission shall, after securing full information, find that the transfer is in accordance with the provisions of the Act and shall give its consent in writing.

(c) Each person licensed by the Commission pursuant to the regulations in this part and parts 31 through 36 and 39 shall confine his possession and use of the byproduct material to the locations and purposes authorized in the license. ~~Otherwise provided in the license, a license issued pursuant to the regulations in this part and parts 31 through 39 of this chapter shall carry with it the right to receive, acquire, own, and possess byproduct material.~~ Preparation, shipment and transport of byproduct material shall be in accordance with the provisions of part 71 of this chapter.

(d) Each license issued pursuant to the regulations in this part and parts 31 through 36 and 39 shall be deemed to be subject to the provisions set forth in section 183b. - d., inclusive, of the Act, whether or not these provisions are expressly stated in the license.

(e) The Commission may incorporate, in any license issued pursuant to the regulations in this part and parts 31 through 36 and 39, at the time of issuance, or thereafter by appropriate rule, regulation or order, such additional requirements and conditions with respect to the licensee's receipt, possession, use and transfer of byproduct material as it deems appropriate or necessary in order to:

(1) Promote the common defense and security;

(2) Protect health or to minimize danger to life or property;

(3) Protect restricted data;

(4) Require such reports and the keeping of such records, and to provide for such inspections of activities under the license as may be necessary or appropriate to effectuate the purposes of the Act and regulations thereunder.

(f) Licensees required to submit emergency plans by §30.32(i) shall follow the emergency plan approved by the Commission. The licensee may change the approved plan without Commission approval only if the changes do not decrease the effectiveness of the plan. The licensee shall furnish the change to the appropriate NRC Regional Office specified in §30.32(i) and to affected offsite response organizations within six months after the change is made. Proposed changes that increase or potentially decrease the effectiveness of the approved emergency plan may not be implemented without prior application to and prior approval by the Commission.

(g) Each licensee preparing technetium-99m radiopharmaceuticals from molybdenum-99/technetium-99m generator shall test the generator eluates for molybdenum-99 breakthrough in accordance with §35.204 of this chapter. The licensee shall record the results of each test and retain each record for three years after the record is made.

(h)(1) Each general licensee that is required to register by Sec. 31.5(c)(13) of this chapter and each specific licensee shall notify the appropriate NRC Regional Administrator, in writing, immediately following the filing of a voluntary or involuntary petition for bankruptcy under any chapter of title 11 (Bankruptcy) of the United States Code by or against:

(i) The licensee;

(ii) An entity (as that term is defined in 11 U.S.C. 101(14)) controlling the licensee or listing the licensee or licensee's

property of the estate; or

(iii) An affiliate (as that term is defined in 11 U.S.C. 101(2)) of the licensee.

(2) This notification must indicate:

(i) The bankruptcy court in which the petition for bankruptcy was filed; and

(ii) The date of the filing of the petition.

§30.51 Records.

(a) Each person who receives byproduct material pursuant to a license issued pursuant to the regulations in this part and parts 31 through 36 of this chapter shall keep records showing the receipt, transfer, and disposal of the byproduct material as follows:

(1) The licensee shall retain each record of receipt of byproduct material as long as the material is possessed and for three years following transfer or disposal of the material.

(2) The licensee who transferred the material shall retain each record of transfer for three years after each transfer unless a specific requirement in another part of the regulations in this chapter dictates otherwise.

~~(3) The licensee who disposed of the material shall retain each record of disposal of byproduct material until the Commission terminates each license that authorizes disposal of the material.~~

(b) The licensee shall retain each record that is required by the regulations in this part and parts 31 through 36 of this chapter or by license condition for the period specified by the appropriate regulation or license condition. If a retention period is not otherwise specified by regulation or license condition, the record must be retained until the Commission terminates each license that authorizes the activity that is subject to the recordkeeping requirement.

(c)(1) Records which must be maintained pursuant to this part and parts 31 through 36 of this chapter may be the original or a reproduced copy or microform if such reproduced copy or microform is duly authenticated by authorized personnel and the microform is capable of producing a clear and legible copy after storage for the period specified by Commission regulations. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records such as letters, drawings, specifications, must include all pertinent information such as stamps, initials, and signatures. The licensee shall maintain adequate safeguards against tampering with and loss of records.

(2) If there is a conflict between the Commission's regulations in this part and parts 31 through 36 and 39 of this chapter, license condition, or other written Commission approval or authorization pertaining to the retention period for the same type of record, the retention period specified in the regulations in this part and parts 31 through 36 and 39 of this chapter for such records shall apply unless the Commission, pursuant to §30.11, has granted a specific exemption from the record retention requirements specified in the regulations in this part or parts 31 through 36 and 39 of this chapter.

(d) Prior to license termination, each licensee authorized to possess radioactive material with a half-life greater than 120 days, in an unsealed form, shall forward the following records to the appropriate NRC Regional Office:

(1) Records of disposal of licensed material made under §§20.2002 (including burials authorized before January 28, 1981⁽¹⁾), 20.2003, 20.2004, 20.2005; and

(2) Records required by §20.2103(b)(4).

(e) If licensed activities are transferred or assigned in accordance with §30.34(b), each licensee authorized to possess radioactive material, with a half-life greater than 120 days, in an unsealed form, shall transfer the following records to the new licensee and the new licensee will be responsible for maintaining these records until the license is terminated:

(1) Records of disposal of licensed material made under §§20.2002 (including burials authorized before January 28, 1981), 20.2003, 20.2004, 20.2005; and

(2) Records required by §20.2103(b)(4).

(f) Prior to license termination, each licensee shall forward the records required by §30.35(g) to the appropriate NRC Regional Office.

[41 FR 18301, May 5, 1976, as amended at 43 FR 6922, Feb. 17, 1978; 52 FR 8241, Mar. 17, 1987; 53 FR 19245, May 27, 1988; 58 FR 7736, Feb. 9, 1993; 61 FR 24673, May, 16, 1996]

¹ A previous §20.304 permitted burial of small quantities of licensed materials in soil before January 28, 1981, without specific Commission authorization. See §20.304 contained in the 10 CFR, parts 0 to 199, edition revised as of January 1, 1981.

§30.52 Inspections.

(a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect byproduct material and the premises and facilities wherein byproduct material is used or stored.

(b) Each licensee shall make available to the Commission for inspection, upon reasonable notice, records kept by him pursuant to the regulations in this chapter.

[30 FR 8185, June 26, 1965]

§30.53 Tests.

Each licensee shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part and parts 31 through 36 and 39 of this chapter, including tests of:

- (a) Byproduct material;
- (b) Facilities wherein byproduct material is utilized or stored;
- (c) Radiation detection and monitoring instruments; and
- (d) Other equipment and devices used in connection with the utilization or storage of byproduct material.

[30 FR 8185, June 26, 1965, as amended by 43 FR 6922, Feb. 17, 1978; 52 FR 8241, Mar. 17, 1987; 58 FR 7736, Feb. 9, 1993]

§30.61 Modification and revocation of licenses.

(a) The terms and conditions of each license issued pursuant to the regulations in this part and parts 31 through 35 of this chapter shall be subject to amendment, revision or modification by reason of amendments to the Act, or by reason of rules, regulations and orders issued in accordance with the terms of the Act.

(b) Any license may be revoked, suspended or modified, in whole or in part, for any material false statement in the application or any statement of fact required under section 182 of the Act, or because of conditions revealed by such application or statement of fact or any report, record or inspection or other means which would warrant the Commission to refuse to grant a license on an original application, or for violation of, or failure to observe any of the terms and provisions of the Act or of any rule, regulation or order of the Commission.

(c) Except in cases of willfulness or those in which the public health, interest or safety requires otherwise, no license shall be modified, suspended or revoked unless, prior to the institution of proceedings therefor, facts or conduct which may warrant such action shall have been called to the attention of the licensee in writing and the licensee shall have been accorded an opportunity to demonstrate or achieve compliance with all lawful requirements.

[30 FR 8185, June 26, 1965, as amended at 35 FR 11460, July 17, 1970; 43 FR 6922, Feb. 17, 1978]

§30.62 Right to cause the withholding or recall of byproduct material.

The Commission may cause the withholding or recall of byproduct material from any licensee who is not equipped to observe or fails to observe such safety standards to protect health as may be established by the Commission, or who uses such materials in violation of law or regulation of the Commission, or in a manner other than as disclosed in the application therefor or approved by the Commission.

[30 FR 8185, June 26, 1965, as amended at 40 FR 8785, Mar. 3, 1975]

§30.63 Violations.

(a) The Commission may obtain an injunction or other court order to prevent a violation of the provisions of --

- (1) The Atomic Energy Act of 1954, as amended;
- (2) Title II of the Energy Reorganization Act of 1974, as amended; or
- (3) A regulation or order issued pursuant to those Acts.

(b) The Commission may obtain a court order for the payment of a civil penalty imposed under section 234 of the Atomic Energy Act:

(1) For violations of --

(i) Sections 53, 57, 62, 63, 81, 82, 101, 103, 104, 107, or 109 of the Atomic Energy Act of 1954, as amended;

(ii) Section 206 of the Energy Reorganization Act;

(iii) Any rule, regulation, or order issued pursuant to the sections specified in paragraph (b)(1)(i) of this section;

(iv) Any term, condition, or limitation of any license issued under the sections specified in paragraph (b)(1)(i) of this section.

(2) For any violation for which a license may be revoked under section 186 of the Atomic Energy Act of 1954, as amended.

[57 FR 55072, Nov. 24, 1992]

§31.5 Certain detecting, measuring, gauging, or controlling devices and certain devices for producing light or an ionized atmosphere.⁽²⁾

(a) A general license is hereby issued to commercial and industrial firms and research, educational and medical institutions, individuals in the conduct of their business, and Federal, State or local government agencies to acquire, receive, possess, use or transfer, in accordance with the provisions of paragraphs (b), (c) and (d) of this section, byproduct material contained in devices designed and manufactured for the purpose of detecting, measuring, gauging or controlling thickness, density, level, interface location, radiation, leakage, or qualitative or quantitative chemical composition, or for producing light or an ionized atmosphere.

(b)(1) The general license in paragraph (a) of this section applies only to byproduct material contained in devices which have been manufactured or initially transferred and labeled in accordance with the specifications contained in--

(i) A specific license issued under Sec. 32.51 of this chapter; or

(ii) An equivalent specific license issued by an Agreement State.

(2) The devices must have been received from one of the specific licensees described in paragraph (b)(1) of this section or through a transfer made under paragraph (c)(9) of this section.

(c) Any person who acquires, receives, possesses, uses or transfers byproduct material in a device pursuant to the general license in paragraph (a) of this section:

(1) Shall assure that all labels affixed to the device at the time of receipt and bearing a statement that removal of the label is prohibited are maintained thereon and shall comply with all instructions and precautions provided by such labels;

(2) Shall assure that the device is tested for leakage of radioactive material and proper operation of the on-off mechanism and indicator, if any, at no longer than six-month intervals or at such other intervals as are specified in the label; however:

(i) Devices containing only krypton need not be tested for leakage of radioactive material, and

(ii) Devices containing only tritium or not more than 100 microcuries of other beta and/or gamma emitting material or 10 microcuries of alpha emitting material and devices held in storage in the original shipping container prior to initial installation need not be tested for any purpose;

(3) Shall assure that the tests required by paragraph (c)(2) of this section and other testing, installation, servicing, and removal from installation involving the radioactive materials, its shielding or containment, are performed:

(i) In accordance with the instructions provided by the labels; or

(ii) By a person holding a specific license pursuant to parts 30 and 32 of this chapter or from an Agreement State to perform such activities;

(4) Shall maintain records showing compliance with the requirements of paragraphs (c)(2) and (c)(3) of this section. The records must show the results of tests. The records also must show the dates of performance of, and the names of persons performing, testing, installing, servicing, and removing from the installation radioactive material and its shielding or containment. The licensee shall retain these records as follows:

(i) Each record of a test for leakage or radioactive material required by paragraph (c)(2) of this section must be retained for three years after the next required leak test is performed or until the sealed source is transferred or disposed of.

(ii) Each record of a test of the on-off mechanism and Indicator required by paragraph (c)(2) of this section must be retained for three years after the next required test of the on-off mechanism and indicator is performed or until the sealed source is transferred or disposed of.

(iii) Each record that is required by paragraph (c)(3) of this section must be retained for three years from the date of the recorded event or until the device is transferred or disposed of.

(5) Shall immediately suspend operation of the device if there is a failure of, or damage to, or any indication of a possible failure of or damage to, the shielding of the radioactive material or the on-off mechanism or indicator, or upon the detection of 185 bequerel (0.005 microcurie) or more removable radioactive material. The device may not be operated until it has been repaired by the manufacturer or other person holding a specific license to repair such devices that was issued under parts 30 and 32 of this chapter or by an Agreement State. The device and any radioactive material from the device may only be disposed of by transfer to a person authorized by a specific license to receive the byproduct material in the device or as otherwise approved by the Commission. A report containing a brief description of the event and the remedial action taken; and, in the case of detection of 0.005 microcurie or more removable radioactive material or failure of or damage to a source likely to result in contamination of the premises or the environs, a plan for ensuring that the premises and environs are acceptable for unrestricted use, must be furnished to the Director of Nuclear Material Safety and Safeguards, ATTN: GLTS, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001 within 30 days. Under these circumstances, the criteria set out in Sec. 20.1402, "Radiological criteria for unrestricted use," may be applicable, as determined by the Commission on a case-by-case basis;

(6) Shall not abandon the device containing byproduct material;

(7) Shall not export the device containing byproduct material except in accordance with part 110 of this chapter;

(8)(i) Shall transfer or dispose of the device containing byproduct material only by export as provided by paragraph (c)(7) of this section, by transfer to another general licensee as authorized in paragraph (c)(9) of this section, or to a person authorized to receive the device by a specific license issued under parts 30 and 32 of this chapter, or part 30 of this chapter that authorizes waste collection, or equivalent regulations of an Agreement State, or as otherwise approved under paragraph (c)(8)(iii) of this section.

(ii) Shall furnish a report to the Director of Nuclear Material Safety and Safeguards, ATTN: GLTS, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001 within 30 days after the transfer of a device to a specific licensee or export. The report must contain--

(A) The identification of the device by manufacturer's (or initial transferor's) name, model number, and serial number;

(B) The name, address, and license number of the person receiving the device (license number not applicable if exported); and

(C) The date of the transfer.

(iii) Shall obtain written NRC approval before transferring the device to any other specific licensee not specifically identified in paragraph (c)(8)(i) of this section.

(9) Shall transfer the device to another general licensee only if--

(i) The device remains in use at a particular location. In this case, the transferor shall give the transferee a copy of this section, a copy of Secs. 31.2, 30.51, 20.2201, and 20.2202 of this chapter, and any safety documents identified in the label of the device. Within 30 days of the transfer, the transferor shall report to the Director of Nuclear Material Safety and Safeguards, ATTN: GLTS, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001--

(A) The manufacturer's (or initial transferor's) name;

(B) The model number and the serial number of the device transferred;

(C) The transferee's name and mailing address for the location of use; and

(D) The name, title, and phone number of the responsible individual identified by the transferee in accordance with paragraph (c)(12) of this section to have knowledge of and authority to take actions to ensure compliance with the appropriate regulations and requirements; or

(ii) The device is held in storage by an intermediate person in the original shipping container at its intended location of use prior to initial use by a general licensee.

(10) Shall comply with the provisions of §§20.2201, and 20.2202 of this chapter for reporting radiation incidents, theft or loss of licensed material, but shall be exempt from the other requirements of parts 19, 20, and 21, of this chapter.

(11) Shall respond to written requests from the Nuclear Regulatory Commission to provide information relating to the general license within 30 calendar days of the date of the request, or other time specified in the request. If the general licensee cannot provide the requested information within the allotted time, it shall, within that same time period, request a longer period to supply the information by submitting a letter to the Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001 and provide written justification as to why it cannot comply.

(12) Shall appoint an individual responsible for having knowledge of the appropriate regulations and requirements and the authority for taking required actions to comply with appropriate regulations and requirements. The general licensee, through this individual, shall ensure the day-to-day compliance with appropriate regulations and requirements. This appointment does not relieve the general licensee of any of its responsibility in this regard.

(13)(i) Shall register, in accordance with paragraphs (c)(13)(ii) and (iii) of this section, devices containing at least 370 MBq (10 mCi) of cesium-137, 3.7 MBq (0.1 mCi) of strontium-90, 37 MBq (1 mCi) of cobalt-60, or 37 MBq (1 mCi) of americium-241 or any other transuranic (i.e., element with atomic number greater than uranium (92)), based on the activity indicated on the label. Each address for a location of use, as described under paragraph (c)(13)(iii)(D) of this section, represents a separate general licensee and requires a separate registration and fee.

(ii) If in possession of a device meeting the criteria of paragraph (c)(13)(i) of this section, shall register these devices annually with the Commission and shall pay the fee required by Sec. 170.31 of this chapter. Registration must be done by verifying, correcting, and/or adding to the information provided in a request for registration received from the Commission. The registration information must be submitted to the NRC within 30 days of the date of the request for registration or as otherwise indicated in the request. In addition, a general licensee holding devices meeting the criteria of paragraph (c)(13)(i) of this section is subject to the bankruptcy notification requirement in Sec. 30.34(h) of this chapter.

(iii) In registering devices, the general licensee shall furnish the following information and any other information specifically requested by the Commission--

(A) Name and mailing address of the general licensee.

(B) Information about each device: the manufacturer (or initial transferor), model number, serial number, the radioisotope and activity (as indicated on the label).

(C) Name, title, and telephone number of the responsible person designated as a representative of the general licensee under paragraph (c)(12) of this section.

(D) Address or location at which the device(s) are used and/or stored. For portable devices, the address of the primary place of storage.

(E) Certification by the responsible representative of the general licensee that the information concerning the device(s) has been verified through a physical inventory and checking of label information.

(F) Certification by the responsible representative of the general licensee that they are aware of the requirements of the general license.

(iv) Persons generally licensed by an Agreement State with respect to devices meeting the criteria in paragraph (c)(13)(i) of this section are not subject to registration requirements if the devices are used in areas subject to NRC jurisdiction for a period less than 180 days in any calendar year. The Commission will not request registration information from such licensees.

(14) Shall report changes to the mailing address for the location of use (including change in name of general licensee) to the Director of Nuclear Material Safety and Safeguards, ATTN: GLTS, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001 within 30 days of the effective date of the change. For a portable device, a report of address change is only required for a change in the device's primary place of storage.

(15) May not hold devices that are not in use for longer than 2 years. If devices with shutters are not being used, the shutter must be locked in the closed position. The testing required by paragraph (c)(2) of this section need not be performed during the period of storage only. However, when devices are put back into service or transferred to another person, and have not been tested within the required test interval, they must be tested for leakage before use or transfer and the shutter tested before use. Devices kept in standby for future use are excluded from the two-year time limit if the general licensee performs quarterly physical inventories of these devices while they are in standby.

(d) The general license in paragraph (a) of this section does not authorize the manufacture or import of devices containing byproduct material.

² Persons possessing byproduct material in devices under a general license in Sec. 31.5 before January 15, 1975, may continue to possess, use, or transfer that material in accordance with the labeling requirements of Sec. 31.5 in effect on January 14, 1975.

CUSTOMER ACKNOWLEDGMENT FORM

On behalf of my company I acknowledge that we have received a copy of the "I²S Gamma Radiation Gauge Radiation Safety Program". The contents of the program have been reviewed with me. It is understood that we are responsible for the information contained within this program.

Company (please print)

Customer Representative (signature)

Customer Representative (please print)

Date

Customer Copy



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CUSTOMER ACKNOWLEDGMENT FORM

On behalf of my company I acknowledge that we have received a copy of the "I²S Gamma Radiation Gauge Radiation Safety Program". The contents of the program have been reviewed with me. It is understood that we are responsible for the information contained within this program.

Company (please print)

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Customer Representative (please print)

Date

I²S Copy



INTERGRATED INDUSTRIAL SYSTEMS

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