HSL-RT6
REYNOLDS RT-6 TESTER
CONTROL (M4030/31 BASED)
USER'S MANUAL

Systems Engineering Associates, Inc.
14989 West 69th Avenue
Arvada, Colorado 80007 U.S.A.
Telephone: (303) 421-0484
Fax: (303) 421-8108

HSL-RT6
REYNOLDS RT-6 TESTER
CONTROL (M4030/31 BASED)
USER'S MANUAL

Revision 1, July 1996

TABLE OF CONTENTS

APPENDICES

1 GENERAL DESCRIPTION

1.1 FEATURES

- o Allows detection and rejection of leakers at speeds in excess of 2400CPM.
- o Performs the following control functions:
  1) Detection of leakers (pin holes, split flanges, gross leakers, etc.). Does not reject good cans following a gross leaker or missing can.
  2) Auto photo multiplier tube (PMT) calibrate feature which continuously calibrates the PMT offset with machine running in normal operation.
  3) Static PMT gain calibration feature allows operator to calibrate the gain of the PMT at the push of a button using a calibrated leak can with the machine not running.
  4) Controls Odd and Even reject solenoids to reject cans at speeds greater than 2400CPM using the existing solenoids.
  5) Detects the following alarm conditions: Bad Pocket (excessive rejects from pocket), excessive good can rejection (light seals of machine compromised), timing signal failure, and PMT calibrate error.
  6) Data collection built-in including: total number of cans rejected count, number of cans rejected per pocket, and total number of good cans processed. (For both current shift and last shift).
- o Halogen light source replaces both the existing fluorescent lamps and high frequency lamp driver for both increased test lumens and reliability.
- o Set-up and monitoring performed using "SETUPRT6", an easy to use menu driven software package which runs on any IBM PC or compatible.
- o Based on high performance M4031 PLC/PMT module which allows easy trouble-shooting and user customization using SYSdev (DOS-based) programming package.

1.2 GENERAL DESCRIPTION

The HSL-RT6 light tester package interfaces directly with the machine mounted photo multiplier tube (referred to hereafter as the PMT), machine mounted encoder, and the odd and even reject solenoids. The HSL-RT6 detects defective cans (leakers), via the PMT, and rejects these cans by activating the respective odd or even reject solenoid at speeds up to 2400CPM. The photo multiplier tube (PMT) outputs a low level, high frequency analog value which is proportional to the amount of light entering the tube. This output is input directly to the M4031 module and conditioned as necessary by the module to deduce the actual amount of light the tube detected. The tube is extremely sensitive and easily capable of detecting a hole of .002 or less diameter in a can. The gain of the tube is adjustable by adjusting the voltage applied to the tube (0-1200 volts). The light tester package contains a 0 to 2000 volt variable power supply which supplies this voltage for the tube.

1.2 GENERAL DESCRIPTION (cont'd)

Two timing signals, provided by the machine mounted encoder, are used to generate the PMT sample timing and reject timing. These signals are a Marker pulse, generated once per 12 cans and used to specify pocket #1, and a Sync pulse, generated once per pocket and used for the PMT sample and reject timing. The PMT tube is gated "on" at both the leading and trailing edges of the sync pulse. The leading edge gate pulse is used to actually sample the can for leaks and occurs when the tube is aligned with the pocket. The trailing edge gate pulse occurs in-between pockets, at the dark portion of the shutter, and is used as a base "dark" measurement for offset calibration. Note that the tube is only gated "on" at these leading and trailing edge transitions for less than one millisecond and not just enabled continuously. This prevents the tube from saturating when a gross leaker or missing can is present at the pocket, allowing the following cans to be fully tested and not just rejected while the tube recovers from saturation.

Two parameters, set in the M4031 module, are used to calibrate the tube. They are: the PMT gain and PMT input offset. The PMT gain is a 0 to 6 volt analog output on the M4031 which is feed into the 0 to 2000 volt power supply which supplies power to the tube. This parameter is used to set the gain of the tube such that the desired minimum leak will be rejected. Adjusting this output between 0 and 6 volts adjusts the voltage applied to the PMT between 0 and 1200 volts, where 0 volts would result in no light detected (zero gain) and 1200 volts would result in the maximum sensitivity (maximum gain). The M4031 provides both manual and automatic modes of adjustment for the PMT gain (see sections 3.3 and 3.5).

The PMT input offset parameter is an internal M4031 adjustment which adjusts the offset of the PMT output at the input to the M4031. This adjustment is used to set the proper balance between the PMT value of good cans and the PMT value of bad cans such that the good cans are not rejected while the bad (leak) cans are (this essentially gets the PMT value into the proper range). The M4031 provides both manual and automatic modes of adjustment for the offset (see sections 3.1 and 3.2).

In general, optimum performance is achieved when both automatic offset and gain adjustment is selected. The automatic offset adjustment allows the M4031 to compensate for PMT drift due to temperature, etc. continuously while the machine is running. The automatic gain or calibration mode provides the simplest method of calibrating the PMT gain, allowing the operator to calibrate the PMT using just a calibrated leak can and no other special equipment.

1.3 ALARM DETECTION

The package detects the following alarms:

BAD POCKET: If any pocket rejects more than a 4 cans per 10 revolutions of the tester, this alarm is generated for that pocket. This indicates that either the light seal for the respective pocket is bad, or that some other mechanical problem relating to that pocket is occurring.

1.3 ALARM DETECTION (cont'd)

EXCESSIVE GOOD CAN REJECTION: If ten consecutive cans are rejected, this alarm is generated. Once ten consecutive good cans are detected, the alarm is cleared. This generally indicates that a major light leakage has occurred either between the PMT shoe (gimbal) and the shutter wheel or in the pocket seals. This output can be used by the existing control system to stop the machine, preventing the rejection of excessive good cans.

TIMING SIGNAL FAILURE DETECTION: The timing signal fail occurs when any of the timing signals generated in the encoder to change state periodically while the machine is running.

PMT CALIBRATE ERROR: If the M4031 is unable to calibrate the gain of the tube when a static calibration is performed, this alarm is set. This occurs either when the PMT does not detect enough light and the gain is maximized, or when the PMT detects too much light and the gain is minimized. In addition, this alarm occurs if the automatic offset adjustment routine adjusts the offset to the maximum or minimum offset but still cannot compensate for the offset of the PMT.

The above alarms can be mapped to discrete outputs on the M4031 to interface with the existing system if desired.

1.4 DATA COLLECTION

The following data is collected for both the current shift and the previous (last) shift:

1) Total number of good cans tested
2) Total number of rejected cans
3) Total number of rejected cans for each pocket

This data can either be viewed viewed through the "SETUPRT6" set-up program or read by another S3000/M4000 system over the S3000 network. These variables can also be reset through "SETUPRT6" or by another S3000/M4000 system over the S3000 network.

1.5 HALOGEN LIGHT SOURCE

The HSL-RT6 package is provided with a halogen light source which replaces the existing fluorescent lamps and high frequency lamp driver. This provides light in the spectrum the PMT is optimized for but provides a number of additional benefits as well including:

1) Increased test lumens which allows for a greater degree of system sensitivity.

2) Elimination of the high frequency lamp driver and the failures associated with the driver. The halogen lamps are powered directly from 120VAC, 50/60HZ for the ultimate in lamp source simplification and reliability.

3) Reduction of light emitted in the UV spectrum (as compared to the use of black light fluorescent) for increased personnel safety.

The halogen light source is mounted on the existing lamp hood once the existing fluorescent lamps, ballast, and hood cover are removed.

1.6 LED STATUS INDICATIONS

The following 7 status LEDs are locatedon the front of the M4031:

PWR: "On" when +24VDC power is applied to the M4031.

CAL: "On" after the calibrate procedure has been performed and the M4031 was able to calibrate the PMT gain successfully. "Off" if the PMT gain was not successfully calibrated. "Flashing" while the calibrate procedure is in process. See section 3.3 for details on the calibrate procedure.

MAINT: "On" when an offset error has occurred. See section 5.2 for details.

REJ: "On" when a leaker can is detected by the PMT. "Off" when a good can is detected by the PMT.

RUN: "On" steady when the M4031 PLC section is running a valid user's program. "Off" when an internal fault is detected or when a valid user's program has not been loaded. The RUN LED will flash during program download as well.

COMM: This LED is flashed every time an access to the serial network is made by any module or board on the network. If the LED is "on" solid, continuous communications is occurring. If the LED is "off", no communications is occurring. This is not a fault LED, but simply an indication of activity on the serial network, if used.

FLT: "On" when an internally detected fault has occurred in the M4031 PLC section. See section 5.3 for details.

In addition to the LEDs on the M4031, the HSL-RT6 provides a lamp on the front of the enclosure labeled "CALIBRATE". This lamp is illuminated when the calibrate procedure is initiated with the "CALIBRATE" PB inside the HSL-RT6 enclosure. This lamp will be "on" solid while calibration is in process and then turned "off" if calibration was successful. If the lamp is flashing, either a calibration error occurred (see section 5.1) or an offset error occurred (see section 5.2).

2 INSTALLATION

The standard HSL-RT6 package is provided in a NEMA 12 enclosure for mounting on the machine directly.

2.1 WHAT'S INCLUDED

Verify that the following items are included when unpacking the HSL-RT6:

1ea. HSL-RT6 NEMA 12 enclosure including the following:
  1ea. M4031 PLC/PMT module
  1ea. PS2000N1 High Voltage (2000 volts) Power Supply

1ea. 9956B-16 Photo Multiplier Tube
1ea. B2F-RFI PMT Housing (with A1H PMT Preamp and GB1BH PMT Gating Circuit)
1ea. PMT Mounting bracket set (15-002-1 and 15-002-2)
1ea. PMT Cable Set (2ea. BNC Cables-4ft., 1ea. Lemo Cable-4ft)

1ea. 63-AAEF-0012-AO 12PPR Encoder

1ea. Halogen Light Source Assembly

1ea. HSL-RT6 User's Manual
1ea. M4500 User's Manual
1ea. HSL-RT6-16 Program Disk

2.2 HSL-RT6 INSTALLATION

2.2.1 POWER REQUIRED

The HSL-RT6 is powered from 115VAC and +24VDC. The 115VAC is used to power the the Halogen Light source while the +24VDC is used to power the M4031, 2000 volt power supply, and +24VDC I/O (odd/even reject solenoids, etc.). The +24VDC current required by the HSL-RT6 is approximately 4.0 amps. Note that the +24VDC must be regulated (+/-10%).

2.2.2 MOUNTING THE HSL-RT6 ENCLOSURE

The HSL-RT6 enclosure should be mounted on the machine frame or right next to the machine. In either case, the enclosure should be mounted in close proximity to the PMT such that the provided coax cable set can reach the PMT without stress being applied to the cables. The signal from the PMT is alow level analog signal, thus necessitating the coax cable and close proximity of the enclosure to the PMT. The enclosure should be oriented with the M4031 inside the enclosure upright to facilitate cooling.

2.2 HSL-RT6 INSTALLATION (cont'd)

2.2.3 MOUNTING THE 12PPR ENCODER

The HSL-RT6 uses a 12 pulse per revolution (PPR) encoder instead of the 6PPR existing encoders. To mount the encoder, perform the following:

1) Remove the existing encoder.

2) Mount the 12PPR encoder making sure the encoder shaft does not bind when the machine is rotated. The encoder shaft position will be timed in section X.X once the installation is complete and the HSSL-RT6 is powered up.

2.2.4 MOUNTING THE PMT HOUSING

The HSL-RT6 PMT replaces the entire existing Reynolds PMT assembly (with the exception of the shutter gimbal which is used) and is actually mounted in the same location. To mount the PMT, perform the following:

1) Remove the existing Reynolds PMT assembly.

2) Mount the supplied 15-002-2 PMT collet to the 15-002-1 mounting plate as shown in figure 1 on the drawing at the back of this manual, if not already done.

3) Carefully slide the 15-002 assembly over the PMT housing from the rear as shown in figure 1 and slide up until seated against the front lip of the PMT housing. Tighten the collet set screws against the PMT to hold the PMT in the collet.

4) Mount the entire PMT assembly to the machine frame, using the existing PMT mounting holes. When mounting the assembly, make sure the front of the PMT assembly is seated and sealed in the existing shutter gimbal.

2.2.5 INSTALLING THE PMT TUBE INSIDE THE PMT HOUSING

These instructions are used to install the tube in the housing both at the initial installation of the HSL-RT6 and when it is necessary to replace the tube. The 9956B-16 tube is installed inside the B2F-RFI housing once the housing is installed on the machine as follows:

IMPORTANT: For your safety, power to the PMT housing must be "off" prior to removing the Preamp/Gating Circuit assembly from the B2F-RFI housing. The Preamp/Gating Circuit and PMT are supplied with as much as 2000 volts DC. This power must be removed before any part of the B2F-RFI housing seal is broken. The housing is powered from the PS2000N1 which is powered from the +24VDC power supply. Therefore disconnecting the +24VDC power supply will power down the PS2000 power supply.

2.2 HSL-RT6 INSTALLATION (cont'd)

2.2.5 INSTALLING THE PMT TUBE INSIDE THE PMT HOUSING (cont'd)

1) Disconnect the +24VDC power supply which powers the M4031 and PS2000N1 high voltage power supply.

2) Remove the Preamp/Gating circuit assembly from the B2F-RFI housing by unscrewing the connector plate from the housing and then removing the Preamp/Gating assembly. The Preamp/Gating assembly is attached to the connector plate and is removed from the housing with the plate.

3) Carefully install the 9956B-16 tube in the Preamp assembly connector. The tube is keyed (by a missing pin in the tube) and should fit in the Preamp connector only one way.

4) Carefully install the Tube/Preamp/Gating assembly back in the housing making sure the tube seats in the nose of the housing correctly and then screw the connector plate into the housing.

2.2.6 WIRING THE HSL-RT6

Perform the following to wire the HSL-RT6:

1) Wire the encoder and odd/even reject solenoids and machine interlocks (sync timing output, leaker reject output, etc.) to the existing control system, referring to the electrical control schematic at the back of this manual, keeping all +24VDC wiring away from high voltage (motor leads) wiring.

2) Wire +24VDC power from the user supplied +24VDC power supply to FU1 and wire #500 as shown.

3) Connect the BNC cable marked "GATE" to the "GATE" connector on the B2F-RFI housing and then to the "GATE" connector on the side of the HSL-RT6 enclosure. This signal "gates" the PMT "on" (applies the high voltage to the PMT) when the sample is taken.

4) Connect the BNC cable marked "SIG" to the "SIG" connector on the B2F-RFI housing and then to the "SIGNAL" connector on the side of the HSL-RT6 enclosure. This is the output of the preamp from the PMT.

5) Connect the MHV connector on the end of the PS2000N1 cable to the "HV" connector on the B2F-RFI housing.

6) Connect the Lemo cable to the corresponding connectors on the B2F-RFI housing and the side of the HSL-RT6 enclosure. This supplies +/-12VDC to the Preamp/Gating circuits of the B2F-RFI housing.

7) Keep the coax cables mounted in steps (3) through (6) above away from all other wiring. These signals are low level signals and should not be mixed with any other wiring.

2.2 HSL-RT6 INSTALLATION (cont'd)

2.2.7 MOUNTING THE HALOGEN LIGHT SOURCE

The HSL-RT6 package is provided with a halogen light source which replaces the existing fluorescent lamps and high frequency lamp driver. Mount the halogen light source assembly as follows:

1) Remove the cover from the existing fluorescent lamp hood.

2) Remove the existing fluorescent lamps, ballast, lamp brackets, and wiring (essentially "gut" the existing lamp hood).

3) The existing curved plexi-glass cover (mounted on the hood between the star wheel and hood) is retained. This prevents grease from being slung onto the halogen lamp glass covers. Clean the inside of the curved plexi-glass cover before mounting the halogen lamp assembly.

4) Mount the halogen light source assembly on top of the hood in the same fashion that the hood cover was mounted (the halogen lamp assembly replaces the hood cover).

5) Wire 115VAC power to the halogen lamps and fans of the assembly as shown in the schematic at the end of this manual.

6) This is also a good time to make sure the plexi-glass light windows at the pocket seals are clean and free of contaminates.

7) The hub of the starwheel is used as a reflector to illuminate the underside of the can to be tested. Verify that the hub is clean and well polished.

Due to the high radiated heat levels of halogen lamps, the lamps are turned "off" after a time delay when the machine stops. This prevents the halogens from baking the can that stops at the light test pocket. Once the machine starts again, the lamps are turned "on" immediately. This is controlled by relay in the existing user's control system. In addition, a buck transformer is used to reduce the voltage on the lamps to about 80% of nominal line voltage. This reduces the radiated heat from the lamps without significantly reducing the lumens produced.

2.2 HSL-RT6 INSTALLATION (cont'd)

2.2.8 HALOGEN BULB REPLACEMENT

Perform the following to replace either of the Halogen bulbs:

1) Disconnect power to the light source assembly and let the lamps and lamp housing glass covers cool.

2) Remove the lamp housing glass cover by removing the two wing nuts which secure the glass cover retainer with one hand and holding the glass cover with the other hand while the wing nuts are removed. Remove the glass cover from the assembly.

3) With a clean rag, remove the Halogen bulb from the fixture. One contact of the fixture is spring loaded, the bulb is removed by compressing the spring loaded contact and then removing the bulb.

4) Replace bulb with GE part number Q350T3/CL/HIR bulbs only. These are 350W, Halogen-IR lamps which produce approximately 50% more lumens per watt than ordinary Halogen lamps.

5) Install new bulb again using a clean rag to hold the bulb while it is being installed. Do not handle the quartz envelope directly as fingermarks or any type of grease may cause devitrification of the quartz resulting in reduced performance and possible breakage or shattering.

6) Once the bulb is re-installed, mount the glass cover back over the lamp housing, securing the cover with the retainer and wing nuts. Do not operate the light source assembly without the glass covers installed. The glass covers perform a number of functions including: preventing debris from being expelled inside the hood if the halogen lamp shatters, filtering the UV component of the light spectrum emitted from the lamp, and reflecting much of the heat generated from the halogen lamp out the top of the light source assembly instead of down into the machine.

2.3 HSL-RT6 SOFTWARE INSTALLATION

Follow the steps below to install the "SETUPRT6" Set-up software package and the HSL-RT6 application programs onto the IBM PC or compatible which will be used to support the HSL-RT6 package.

2.3.1 "SETUPRT6" SET-UP SOFTWARE INSTALLATION

The "SETUPRT6" set-up software is used to tune (set-up) the user adjustable variables of the HSL-RT6, and view rejects per pocket and shift data on the IBM PC used to support the HSL-RT6. To install the set-up software, perform the following steps:

1) Install the disk labeled "HSL-RT6 PROGRAMS" into the A: drive. Switch to the root directory of the hard drive you want to install "SETUPRT6" on and type "A:INSTALL<ENTER>".

2) The install program will create a directory called "HSLSETUP" and copy the "SETUPRT6" program to this directory.

3) Add the "SETUPRT6" set-up program to your computer's menu software by creating a selection called "SET-UP HSL-RT6". The DOS commands executed for this selection should be:

   For the "SET-UP HSL-RT6" selection:
   CD \HSLSETUP<ENTER>
   SETUPRT6<ENTER>
   CD \<ENTER>

4) To execute the set-up program, simply select the "SET-UP HSL-RT6" selection from the menu software's menu.

2.3.2 SYSdev PROGRAM DEVELOPMENT SOFTWARE INSTALLATION

The SYSdev Program Development software is used to perform on-line trouble-shooting and program modifications to the HSL-RT6. If SYSdev was purchased with the HSL-RT6 package and is not already installed on the your computer, install SYSdev onto the hard drive of your computer following the steps in section 1.5 of the SYSdev Program Development manual.

2.3 HSL-RT6 SOFTWARE INSTALLATION (cont'd)

2.3.3 "TSTV02" APPLICATION PROGRAM INSTALLATION

The "TSTV02" application program is a SYSdev based program which is loaded into the M4031 module and performs the HSL-RT6 logic. The "TSTV02" program is written in a combination of Ladder logic and High-level. If the user desires to make program changes or perform on-line monitoring of the program execution, the files which constitute the "TSTV02" program will have to be loaded onto the hard drive of the PC which is used to support the HSL-RT6. The SYSdev Program Development Software will also have to be loaded on the PC (see section 2.3.2). To install this program perform the following:

1) If not already done, perform steps 1 through 3 of section 2.3.1. This creates the directories and menu selections which will be used to store and select the SETUPRT6 application programs.

2) Install the disk labeled "HSL-RT6 PROGRAMS" into the A: drive. Switch to the HSLSETUP directory and install the "TSTV02" application program by typing the following at the DOS prompt:

```
CD \HSLSETUP<ENTER>
COPY A:TSTV02.*<ENTER>
CD \<ENTER>
```

3) Add the "TSTV02" application program to your computer's menu software by creating a selection called "HSL-RT6 PROGRAM". The DOS commands executed for this selection should be:

```
CD \<ENTER>
SYSDEV \HSLSETUP TSTV02<ENTER>
```

4) To initiate SYSdev with the "TSTV02" program, simply select the "HSL-RT6 PROGRAM" selection from the menu software's menu. The main development menu of SYSdev will be initiated with the HSLRT6 program. See the SYSdev Program Development manual and the M4031 Program Development manual for complete details on on-line monitoring and program development with SYSdev.

2.4 TUNING THE HSL-RT6

The HSL-RT6 is shipped from the factory with the PLC program "TSTV02" loaded in the M4031 module (PLC section). This is the standard program used to implement the standard HSL-RT6 light tester algorithms. In addition, as shipped, the user variables of the PMT section of the M4031 are set to the following defaults:

PMT Gain (PMT Voltage 0-1200V)_____: 1101
Gain Calibrate PMT Input Average_____: XXX
M4031 PMT Input Sensitivity_____: 7
PMT Input Offset (-75 to 75)_____: 000
PMT Reject Can Threshold_____: 075
Automatic Offset Mode:
    Enabled (Y/N)_____: YES
    Desired Good Can PMT Value_____: 030
    Allowed Good Can Error_____: 002
PMT Gain Calibration Mode:
    Enabled (Y/N)_____: YES
    Desired Calibrated Leaker Reject PMT value_____: 120
    Allowed Calibrated Leaker Reject Error_____: 005

Where "XXX" in the "Gain Calibrate PMT Input Average" is any number. This will change when a calibrate cycle is performed.

Once the HSL-RT6 is installed and the control system is powered back up, perform the following to set-up and tune the HSL-RT6. The set-up is performed using an IBM PC or compatible running the "SETUPRT6" set-up program. See section 4 for a description of the "SETUPRT6" menus and variables and how to use the "SETUPRT6" program.

At the initial installation, prior to performing the following set-up steps, verify that the user variables shown above are set to the default values listed by viewing the M4031 Set-up Menu of the "SETUPRT6" set-up program (see section 4.1).

2.4 TUNING THE HSL-RT6 (cont'd)

2.4.1 TIMING THE 12PPR ENCODER

To time the 12PPR encoder, perform the following:

1) Rotate the machine in the forward direction, by hand, and verify that the marker pulse (input IN1 on the M4031) turns "on" when the PMT is somewhere between pocket #12 and pocket #1. This is the pocket #1 marker and must go "on" in the station before the sync pulse for pocket #1. If not, adjust the 12PPR encoder shaft until it does.

2) Rotate the machine in the forward direction, by hand, and verify that the sync pulse (input IN0 on the M4031) just turns "on" when a pocket is perfectly aligned with PMT. This is where the can sample is taken to determine whether the can is a leaker or not. If the sync pulse does not turn "on" at the exact alignment of the pocket and PMT, adjust the 12PPR encoder shaft until it does.

3) Again rotate the machine in the forward direction, by hand, and verify that the sync pulse (input IN0 on the M4031) just turns "off" when the PMT is exactly between pockets. Note: the PMT must not be able to see any light at this location. This is where the in-between pocket (dark) measurement is taken. If step (1) above was performed correctly, IN0 will naturally turn "off" at this location.

4) If the encoder shaft was adjusted in steps (2) or (3), re-verify that the marker pulse (IN1 on the M4030) still turns "on" somewhere after the sync pulse for pocket #12 turned "on" but before the sync pulse for pocket #1 turns "on".

2.4 TUNING THE HSL-RT6 (cont'd)

2.4.2 VERIFY THE B2F-RFI PMT HOUSING OFFSET

The C634 A1H Preamp board inside the B2F/RFI housing contains an offset potentiometer which is used to null out any offset of both the PMT and amplifier circuitry. If this inherent offset of the PMT and amplifier is too great, this potentiometer may have to be adjusted to null the offset to zero. This is done by running cans through the machine and verifying the value the PMT offset automatically obtains. The PMT housing offset only needs to be set at the initial installation or any time the B2F-RFI PMT housing is replaced. All other offset variations due to temperature, etc. are automatically compensated for with the automatic offset adjustment feature of the M4031. This adjustment simply makes sure the offset potentiometer of the PMT housing is not set outside the normal range of operation. Verify the offset as follows:

1) Run the machine with cans at normal line speeds and verify that the offset is automatically adjusted until the "PMT Input Average" is equal to the "Desired Good Can PMT Value" within plus or minus 2. "Up Peak (Max)" and "Down Peak (Min)" should also be within plus or minus 5 of the "PMT Input Average".

2) If the offset exceeds + or -250 in an attempt to set the "PMT Input Average" equal to the "Desired Good Can PMT Value", the MAINT LED on the M4031 will be illuminated. This indicates that the PMT is detecting an excessive amount of light both when the cans are sampled and at the in-between pocket measurement. Verify that the machine is timed properly per section 2.4.1 and that no light leakage is occurring at any of the PMT seals (machine shutter to light seal plate, PMT to light seal plate, or at the PMT housing itself).

3) If the offset is greater then +/-20, disconnect the +24VDC power that powers the PS2000N1 high voltage power supply and remove the top of the B2F/RFI housing (side that contains connectors) and adjust the potentiometer on the A1H Preamp board (first board below connectors). Turning the pot clockwise will decrease the offset, turning it counter clockwise will increase the offset. One turn of the potentiometer changes the offset by about 40 to 50.

4) Re-install the top of the B2F/RFI housing, power up the +24VDC power supply that powers the M4031 and the PS2000N1 power supply and perform step 1 again. Repeat steps 1 thru 3 until the offset is less than +/-20 while the machine is running with good cans. The closer the offset is to zero, the better.

2.4 TUNING THE HSL-RT6 (cont'd)

2.4.3 CALIBRATE THE PMT GAIN

Stop the machine, install a calibrated leaker in the machine at the PMT and perform the gain calibration per section 3.4. If no calibration error occurred proceed to section 2.4.4.

If a calibration error did occur ("CAL" LED on front of M4031 "off" at completion of the calibration procedure), observe the value of the PMT gain on the "M4031 Set-up" menu of the "SETUPRT6" set-up program and verify the following:

1) If the "PMT Gain" is less than 500 volts and the "Gain Calibrate PMT Input Average" is greater than the "Desired Calibrated Leaker Reject PMT Value" by more than 5, the PMT detected too much light and was not able to reduce the gain of the PMT adequately to compensate for the amount of light detected. Verify that the calibrated leaker has a .0025 or less calibration hole in it and does not have any other areas of light leakage in the can. Verify that the seal at the pocket used for calibration is not leaking. Verify that no light leakage is occurring at any of the PMT seals (machine shutter to light seal plate, PMT to light seal plate, or at the PMT housing itself).

2) If the "PMT Gain" is at 1101 volts and the "Gain Calibrate PMT Input Average" is less than the "Desired Good Can PMT Value" by more than 5, then the PMT did not detect enough light and was not able to increase the gain enough to calibrate the M4031. Verify that the calibrated leaker has a .0025 calibration hole in it and also verify that the light source is generating an adequate supply of light (lamps are "on" when calibration is performed). If so, set the "Desired Calibrated Leaker Reject PMT Value" to a lower value (it can be set as low as 10 above the "Desired Good Can PMT Value") and try the calibration again. If the "Desired Calibrated Leaker Reject Value" is lowered, the "PMT Reject Can Threshold" should also be lowered (it should be between the "Desired Good Can PMT Value" and the "Desired Calibrated Leaker Reject Value").

2.4 TUNING THE HSL-RT6 (cont'd)

2.4.4 VERIFY CALIBRATED LEAKER REJECTION

Run the machine at normal production speeds and verify that calibrated leakers, when run through the machine, are rejected. From the "View M4031 PMT Data" Menu of the "SETUPRT6" set-up program, observe both the Good Can Data and the Rejected Can Data. The "PMT Input Average" should be within plus or minus 2 of the "Desired Good Can PMT Value" set in the "M4031 Set-up Menu" (normally set to 30). The "Up Peak (Max)" and "Down Peak (Min)" should be within plus or minus 5 of the "PMT Input Average". As leaker cans are rejected, they will appear in the "Last Reject Value" through "8th to Last Reject Value" stack. When the calibrated leakers are run through the machine, the reject values of these cans will also appear in this stack.

If any of the calibrated leakers are not rejected when run through the machine, lower the "PMT Reject Can Threshold" and try again. This value can be lowered to within 5 above the "Desired Good Can PMT Value". If some of the calibrated leakers still are not rejected, increase the "PMT Gain" (this can be increased to a maximum of 1200 volts) and try again. Note that running the gain of the PMT above 1100 volts will shorten the life of the PMT. If some of the calibrated leakers are still not rejected, verify that the quality of light is adequate (both halogen lamps are "on" and hub of starwheel is polished).

If the machine seems to be rejecting an excessive amount of cans, select the "4: View Can/Reject Counts" selection from the Main Menu of the "SETUPRT6" set-up program and observe the Per Pocket Reject Totals. If a particular pocket is rejecting a significantly higher number of cans than the other pockets, then that pocket most likely has a bad light seal (or some other mechanical problem). In general, this menu can be used to evaluate the reject performance of the machine.

2.5 M4031 INSTALLATION

The following is provided only as a reference. These steps are performed by the factory prior to shipping the HSL-RT6. These steps need only be performed in the event the M4031 module needs to be replaced.

2.5.1 M4031 MODULE INSTALLATION

To install the M4031 module, perform the following:

1) Mount the M4031 chassis to the HSL-RT6 backpanel using two 8-32 screws with external star lock washers.

2) Install the respective field wiring arms on all the I/O boards of the M4031 (I/O slots0 and 2, IN0 and IN1 connector, and PMT section connector). Make sure all the field wiring connectors are fully mated in the M4031.

3) Install the "GATE" and "SIG" coax cables to the respective BNC connectors of the M4031 PMT section (upper BNC connector is "GATE", lower BNC connector is "SIGNAL").

2.5.2 DOWNLOAD "TSTV02" PROGRAM TO M4031

Once the M4031 is installed, perform the following to download the TSTV02 application program to the M4031:

1) Power up the M4031 and the IBM PC or compatible used to interface with the HSL-RT6.

2) Connect an RS-232 cable from the computer COM port to the "PROG" port on the M4031.

3) From the computer's menu program, select the "HSL-RT6 PROGRAM" selection (this was set in section 2.3.3). The SYSdev program development software will be invoked with the "TSTV02" application program.

4) From the SYSdev "Main Development Menu" select the "6:Target Board Interface" selection.

5) Download the "TSTV02" application program to the M4031 by selecting "1: Download Program to Target Board" from the "Target Board Interface" menu. A prompt will be displayed verifying the download, press the <ENTER> key to start the download. Once the download is complete, press any key to return to the "Target Board Interface" menu. Press 12<ENTER> to return to the main menu, 12<ENTER> to return to the SYSdev shell, and <ESC> to exit the shell.

6) Verify the PMT offset, calibrate the PMT Gain, and verify the calibrated leaker rejection as outlined in sections 2.4.2 thru 2.4.4.

7) The M4031 is now ready to run.

3 DESCRIPTION OF OFFSET, GAIN, AND CALIBRATION MODES

The following sections describe the different offset and gain modes as well as the calibration procedure in detail.

3.1 AUTOMATIC OFFSET ADJUSTMENT

Automatic PMT input offset mode is enabled by setting the "Automatic Offset Mode Enabled" prompt on the "M4031 Set-up Menu" of the "SETUPRT6" set-up program to "YES". In addition, the user must set the value of the "Desired Good Can PMT value" as well as the "Allowed Good Can Error" (deviation) from the specified good can value. The "Desired Good Can PMT value" is typically set at 25 to 35. The "Allowed Good Can Error" (deviation) is typically set to 2 or 3. When the automatic offset feature is enabled, the M4031 averages the value of all good cans detected as well as the in-between pocket "dark" measurement over 36 consecutive pockets and automatically adjusts the PMT input offset until this average equals the "Desired Good Can PMT value" within the specified error (Allowed Good Can Error). This adjustment occurs continuously and compensates for any drift in the PMT due to temperature variations, etc.

3.2 MANUAL OFFSET ADJUSTMENT

Manual PMT input offset mode is enabled by setting the "Automatic Offset Mode Enabled" prompt on the "M4031 Set-up Menu" of the "SETUPRT6" set-up program to "NO". In this case the user enters the absolute value of the offset when prompted for after the automatic offset is disabled. The offset is set to a number between -250 and +250.

Perform the following to manually set the offset:

1) Monitor the average value of the "PMT input" on the "View M4031 PMT Data Menu". This is the average of all good cans and the in-between pocket "dark" measurement through 36 consecutive pockets.

2) From the "M4031 Set-up Menu", adjust the PMT offset by selecting the "3: Automatic Offset Mode" selection, answer "N" to the "Enable Automatic Offset Mode" prompt and then setting the offset as necessary until the "PMT Input" on the "View M4031 PMT Data Menu" is set between 25 and 30 (this assumes the reject threshold is set to 35 or above). This establishes the proper base value for good cans, such that bad (leaker) cans can be detected.

3) If the PMT gain is subsequently manually adjusted (see section 3.5), the PMT offset will then again have to be adjusted and so forth until both values are set properly.

NOTE: The automatic offset mode is strongly recommended for use over the manual offset mode. The automatic offset mode automatically compensates for PMT drift due to temperature, etc. The manual mode would require adjustment periodically as climate changes, etc. take place.

3 DESCRIPTION OF OFFSET, GAIN, AND CALIBRATION MODES

3.3 AUTOMATIC GAIN ADJUSTMENT (CALIBRATION)

The automatic PMT gain adjustment mode is enabled by setting the "PMT Gain Calibration Mode Enabled" prompt on the "M4031 Set-up Menu" of the "SETUPRT6" set-up program to "YES". In addition the user must set the "Desired Calibrated Leaker Reject PMT value" for calibrated leak cans as well as the "Allowed Calibrated Leaker Reject Error" (deviation) from the specified calibrated leak can value. The "Desired Calibrated Leaker Reject PMT value" is typically set between 50 to 200. The "Allowed Calibrated Leaker Reject Error" (deviation) is typically set to 5.

When the automatic gain feature is enabled, calibration is performed by stopping the machine and placing a calibrated leak can (a can with a .0025" calibrated leak hole) in the machine lined up exactly with the PMT. The calibration is initiated either from the "CALIBRATE" push-button inside the M4031 housing box. The M4031 will now generate a series of sync pulses and take a series of samples from the PMT. During this sampling process, the M4031 will adjust the gain of the PMT until the samples read from the PMT are equal to the number entered in the "Desired Calibrated Leaker Reject PMT value", within the "Allowed Calibrated Leaker Reject Error". The "CAL" LED on the front of the M4031 will flash while the calibration is in progress. Once the calibrate process is complete, the "CAL" LED on the front of the M4031 will either illuminate continuously, indicating the calibration was successful, or will extinguish, indicating a calibration error occurred.

Note that when locating the calibrated leak can in front of the PMT, the can should be oriented with the .0025 hole in the least light intensive area. Generally this is with the hole facing the direction of movement of the can along the wheel. Thus when the M4031 is calibrated, it will be calibrated for the worst case lighting situation.

3.4 CALIBRATION PROCEDURE

Perform the following to calibrate the gain of the PMT:

1) Stop the machine and place a calibrated leak can (a can with a .0025" hole) in the machine. With the can oriented with the .0025 hole facing the direction of movement of the can along the wheel, line the leak can up exactly with the PMT.

   NOTE: Orienting the can with .0025 facing the direction of movement along the wheel, places the hole at the least light intensive area of the PMT sampling station. This is done so that when the PMT is calibrated, it is calibrated for the worst case lighting situation.

2) With the calibrated leak can positioned in front of the PMT, initiate the calibration either by pressing the "CALIBRATE" push-button inside the M4031 housing box.

3) The "CAL" LED on the M4031 will flash while the PMT gain calibration is taking place. The "CAL" LED will illuminate solid if the calibration is successful. If the calibration is not successful, the "CAL" LED will extinguish after the calibration was attempted.

3.4 CALIBRATION PROCEDURE (cont'd)

4) If a calibration error did occur ("CAL" LED on front of M4031 "off" at completion of the calibration procedure), observe the value of the PMT gain on the "M4031 Set-up" menu of the "SETUPRT6" and verify the following:

   a) If the "PMT Gain" is less than 500 volts and the "Gain Calibrate PMT Input Average" is greater than the "Desired Calibrated Leaker Reject PMT Value" by more than 5, the PMT detected too much light and was not able to reduce the gain of the PMT adequately to compensate for the amount of light detected. Verify that the calibrated leaker has a .0025 or less calibration hole in it and does not have any other areas of leakage in the can. Verify that the seal at the pocket used for calibration is not leaking. Verify that no light leakage is occurring at any of the PMT seals (machine shutter to light seal plate, PMT to light seal plate, or at the PMT housing itself).

   b) If the "PMT Gain" is at 1101 volts and the "Gain Calibrate PMT Input Average" is less than the "Desired Good Can PMT Value" by more than 5, then the PMT did not detect enough light and was not able to increase the gain enough to calibrate the M4031. Verify that the calibrated leaker has a .0025 calibration hole in it and also verify that the light source is generating an adequate supply of light (lamps are "on" when calibration is performed). If so, set the "Desired Calibrated Leaker Reject PMT Value" to a lower value (it can be set as low as 10 above the "Desired Good Can PMT Value") and try the calibration again. If the "Desired Calibrated Leaker Reject Value" is lowered, the "PMT Reject Can Threshold" should also be lowered (it should be between the "Desired Good Can PMT Value" and the "Desired Calibrated Leaker Reject Value".

5) Remove the calibrated leak can and restart the machine. With the machine running at normal speeds, run calibrated leak cans through the machine and verify that all the calibrated leak cans are rejected. If any are not rejected, repeat steps 1 through 3 using the calibrated leak cans which were not rejected.

3.5 MANUAL GAIN ADJUSTMENT

Manual PMT gain mode is enabled by setting the "PMT Gain Calibration Mode Enabled" prompt on the "M4031 Set-up Menu" to "NO". In this case the user enters the absolute value of the PMT Gain when prompted for after the automatic gain is disabled. The PMT Gain is set to a number between 500 and 1200volts. This corresponds to the voltage applied to the PMT (note that the gain will round off to + or -5 volts of the value entered).

As an alternative, the gain can be increased or decreased by 5 from the "View M4031 PMT Data Menu" of the HSLRT6 set-up program. In this case, the gain can be adjusted manually regardless of whether the PMT auto gain calibration mode is enabled or disabled.

3.5 MANUAL GAIN ADJUSTMENT (cont'd)

Manually setting the PMT gain requires the user to run calibrated leakers through the machine to verify the PMT gain is set high enough to reject the calibrated cans. To set the gain, perform the following:

1) From the "View M4031 PMT Data Menu" monitor the "Average Reject Value" and the last 8 rejects ("Last Reject Value" through "8th to Last Reject Value"). The "Average Reject Value" is the average of the last 8 rejects.

2) Run some calibrated leak cans through the machine. The M4031 should reject all the cans. If the M4031 does not reject the cans, increase the "PMT Gain" (re-adjust the offset as well, if the manual offset mode is used - see section 3.2) and run the calibrated leakers through the machine again. Repeat this step until the M4031 always rejects the calibrated leakers.

3) Now observe the "Average Reject Value" and the last 8 rejects while running the calibrated leakers through the machine. The calibrated leakers should result in a reject value of approximately 100 to 200. If the value is just barely above the reject threshold, increase "PMT Gain" until the calibrated leakers result in reject values in the range of 100 to 200. If the calibrated reject value is always higher than 230, decrease "PMT Gain" until the calibrated leakers typically have a reject value around 100 to 200.

4) In general, the "PMT Gain" is set low enough where the calibrated leakers are easily detected but not so high that the M4031 becomes to sensitive and rejects good cans excessively. In addition, the higher the gain on the PMT, the shorter the life of the tube. As the tube ages, the sensitivity of the tube reduces, requiring the gain to be increased.

4 USING THE "SETUPRT6" SET-UP PROGRAM

The "SETUPRT6" set-up program is a DOS based menu driven program which allows the user to easily view the HSL-RT6 data or alter the HSL-RT6 set-up variables using an IBM PC or compatible. In addition to setting the set-up variables, "SETUPRT6" can be used to set the machine timing (machine offset, timing signal locations, etc.). The set-up variables are used to configure and tune the HSL-RT6 to match the configuration and performance of the specific light tester (see section 2.4).

The main menu of the "SETUPRT6" set-up program incorporates the following menu selections:

1: M4031 Set-up (CAL PORT)
2: View M4031 PMT Data (CAL PORT)
3: Number of Rejects per Pocket Data (PROG PORT)

Note that the "SETUPRT6" program is an on-line communications program used to interface with the M4031 module. The data displayed in the menus and set in the menus is communicated directly to the M4031. Therefore, prior to selecting any of the above selections, make sure an RS-232 cable is connected from the COM port on the computer running "SETUPRT6" to the respective port ("CAL" or "PROG") on the M4031 as indicated in the selection.

The following sections are a complete description of the "SETUPRT6" selections and menus.

4.1 M4031 SET-UP MENU (CAL PORT)

The M4031 Set-up Menu is used to set the offset and gain modes of the M4031 as well as the reject threshold. This menu is invoked by selecting "1: M4031 Set-up (CAL PORT)" from the Main Menu. Note: Prior to selecting this selection, make sure the RS-232 cable is connected from the COM1 port on the computer to the CAL PORT on the M4031.

4.1.1 M4031 SET-UP MENU VARIABLE SUMMARY

The M4031 Set-up Menu contains the following variables:

PMT Gain (PMT Voltage 0-1200V)_____: _____
Gain Calibrate PMT Input Average_____: _____
M4031 PMT Input Sensitivity_____: _____
PMT Input Offset (-75 to 75)_____: _____
PMT Reject Can Threshold_____: _____
Automatic Offset Mode:
    Enabled (Y/N)_____: _____
    Desired Good Can PMT Value_____: _____
    Allowed Good Can Error_____: _____
PMT Gain Calibration Mode:
    Enabled (Y/N)_____: _____
    Desired Calibrated Leaker Reject PMT Value___: _____
    Allowed Calibrated Leaker Reject Error_____: _____

4.1 M4031 SET-UP MENU (CAL PORT) (cont'd)

4.1.2 M4031 SET-UP MENU VARIABLE DEFINITIONS

PMT Gain (PMT Voltage 0-1200V): This value adjusts the voltage applied to the tube, thus adjusting the gain of the tube. The value is set in 5 volt increments, thus when a number is entered, it will be rounded to the nearest 5 volt increment. This parameter is set by the user in manual gain mode (see section 3.5) or is adjusted automatically when calibration is performed in the auto gain mode (see section 3.3).

Gain Calibrate PMT Input Average: This is the average PMT input value of the last 6 samples taken while a calibration cycle is in process. The M4031 compares this value to the "Desired Calibrated Leaker Reject PMT Value" and adjusts the PMT gain accordingly while a calibrate cycle is in progress (see section 3.4).

M4031 PMT Input Sensitivity: This is a value, from 0 to 7, which adjusts how much the output from the PMT (input to the M4031) is amplified internally in the M4031. The higher the number, the higher the M4031 sensitivity will be. In general, this is set at the highest amplification and is only lowered if the PMT is too sensitive.

PMT Input Offset (-250 to 250): This is the input offset value and adjusts the M4031 input offset proportionally. This parameter is set by the user in manual offset mode (see section 3.2) or is adjusted automatically when in the auto offset mode (see section 3.1).

PMT Reject Can Threshold: This value specifies the reject threshold. If the "PMT Input" value is below this threshold, the can is considered good and is not rejected. If the "PMT Input" value is above this threshold, the can is considered a leaker and is rejected. Typically this parameter is set between 35 and 75.

Automatic Offset Mode Enabled: When set to "YES", the automatic offset mode is enabled (see section 3.1). When set to "NO", the manual offset mode is enabled (see section 3.2).

Desired Good Can PMT Value: Used in the auto offset mode. This value is set by the user to specify the desired good can average. The M4031 adjusts the input offset until the average good can input is within the specified error (see section 3.1).

Allowed Good Can Error: This parameter is used in conjunction with the "Desired Good Can PMT Value" to adjust the PMT input offset in the auto offset mode. The M4031 will adjust the offset until the good can average is within the value entered in "Allowed Good Can Error" of the "Desired Good Can PMT Value" (see section 3.1).

PMT Gain Calibration Mode Enabled: When set to "YES", the automatic gain calibration mode is enabled (see section 3.3). When set to "NO", the manual gain mode is enabled (see section 3.5).

Desired Calibrated Leaker Reject PMT Value: Used in the auto gain mode. This value is set by the user to specify the desired reject average. The M4031 adjusts the PMT gain until the average calibrate value is within the specified error (see section 3.3).

4.1 M4031 SET-UP MENU (CAL PORT) (cont'd)

4.1.2 M4031 SET-UP MENU VARIABLE DEFINITIONS (cont'd)

Allowed Calibrated Leaker Reject Error: This parameter is used in conjunction with the "Desired Calibrated Leaker Reject PMT Value" to adjust the PMT gain in the auto gain mode. The M4031 will adjust the gain until the calibrate average is within the value entered in "Allowed Calibrated Leaker Reject Error" of the Desired Calibrated Leaker Reject PMT Value" (see section 3.3).

4.1.3 M4031 SET-UP MENU SELECTIONS

The menu selections on the "M4031 Set-up Menu" allow you to set the variables listed under the following menu selections:

1: Set Reject Threshold
- PMT Reject Can Threshold

2: Set M4031 PMT Input Sensitivity
- M4031 PMT Input Sensitivity

3: Automatic Offset Mode
if Enabled is set to "YES":
- Desired Good Can PMT Value
- Allowed Good Can Error

if Enabled is set to "NO":
- PMT Input Offset (-250 to +250)

4: PMT Gain Calibration Mode
if Enabled is set to "YES":
- Desired Calibrated Leaker Reject PMT Value
- Allowed Calibrated Leaker Reject Error

To set a particular variable, select the corresponding menu selection and follow the prompts as they occur.

4.2 VIEW M4030 PMT DATA (CAL PORT)

The View M4030 Data Menu is used to view the good can and reject data in real time as well as manually fine tune the PMT gain. This menu is invoked by selecting "2: View M4030 PMT Data (CAL PORT)" from the Main Menu. Note: Prior to selecting this selection, make sure the RS-232 cable is connected from the COM1 port on the computer to the CAL PORT on the M4031.

4.2.1 VIEW M4030 DATA VARIABLE SUMMARY

The View M4030 Data Menu contains the following variables:

PMT Gain_____: _____
PMT Offset_____: _____
PMT Input_____: _____
MAINT ALARM_____: _____

Good Can Data (averaged over last 36 cans)
PMT Input Average_____: _____
PMT Up Deviation_____: _____
PMT Down Deviation_____: _____
Up Deviation Count_____: _____
Down Deviation Count_____: _____
Up Peak (Max)_____: _____
Down Peak (Min)_____: _____

Rejected Can Data
Average Reject Value_____: _____
# of Rejects (of last 36 cans)____: _____
Last Reject Value_____: _____
2nd to Last Reject Value_____: _____
3rd to Last Reject Value_____: _____
4th to Last Reject Value_____: _____
5th to Last Reject Value_____: _____
6th to Last Reject Value_____: _____
7th to Last Reject Value_____: _____
8th to Last Reject Value_____: _____

4.2.2 VIEW M4030 DATA VARIABLE DEFINITIONS

PMT Gain: This value adjusts the voltage applied to the tube, thus adjusting the gain of the tube. The value is set in 5 volt increments, thus when a number is entered, it will be rounded to the nearest 5 volt increment. This parameter is set by the user in manual gain mode (see section 3.5), is adjusted automatically when calibration is preformed in the auto gain mode (see section 3.3), or is incremented or decremented by 5 from this menu (see section 4.2.3).

PMT Offset: This is the input offset value and adjusts the M4031 input offset proportionally. This parameter is set by the user in manual offset mode (see section 3.2) or is adjusted automatically when in the auto offset mode (see section 3.1).

4.2 VIEW M4031 PMT DATA (CAL PORT) (cont'd)

4.2.2 VIEW M4031 DATA VARIABLE DEFINITIONS (cont'd)

PMT Input: This is the value (0 to 255) of the last PMT sample and is proportional to the amount of light detected by the PMT where 0 equals no light detected and 255 equals maximum light detected.

PMT Input Average: This is the average of all good cans and the in-between pocket "dark" measurements for 36 consecutive cans.

PMT Up Deviation: This is the average up deviation from the good can "PMT Input Average" for 36 consecutive cans. The lower the number, the less deviation between all good cans, the higher the number, the more deviation.

PMT Down Deviation: This is the average down deviation from the good can "PMT Input Average" for 36 consecutive cans. The lower the number, the less deviation between all good cans, the higher the number, the more deviation.

Up Deviation Count: This is the number of good cans that deviated up from the good can "PMT Input Average" in the last 36 consecutive pockets.

Down Deviation Count: This is the number of good cans that deviated down from the good can "PMT Input Average" in the last 36 consecutive pockets.

Up Peak (Max): This is the highest PMT input value detected as a good can in the last 36 consecutive pockets.

Down Peak (Min): This is the lowest PMT input value detected as a good can in the last 36 consecutive pockets.

Average Reject Value: This is the average value of the PMT input for the last 8 rejects.

# of Rejects (of Last 36 cans): This is the number of leakers (rejects) detected in the last 36 consecutive pockets.

Last Reject Value through 8th to Last Reject Value: These 8 variables are a stack that contain the values of the last 8 rejects.

4.2.3 VIEW M4031 PMT DATA MENU SELECTIONS

The menu selections on the "View M4031 PMT Data Menu" allow you to increase or decrease the PMT gain by 5 volts each time either "1: Increase PMT gain" or "2: Decrease PMT gain" is selected regardless of whether the PMT gain mode is in auto or manual.

4.3 VIEW CANS/REJECTS COUNT DATA (PROG PORT)

The View Cans/Rejects Count Data Menu is used to view the infeed, outfeed, total number of cans rejected, and the per pocket number of cans rejected count. In addition, this menu is used to reset these counts. This menu is invoked by selecting "3: View Can/Reject Counts (PROG PORT)" from the Main Menu. Note: Prior to selecting this selection, make sure the RS-232 cable is connected from the COM1 port on the computer to the PROG PORT on the M4030.

4.3.1 VIEW CAN/REJECT COUNTS VARIABLE SUMMARY

The View Can/Reject Count Menu contains the following variables:

Reject Totals
- # of Leakers rejected_____: _____
- # of Silver Cans rejected_____: _____

Can Count Totals
- Infeed Can Count_____: _____
- Outfeed Can Count_____: _____

Per Pocket Totals
- Pocket #01 Rejects_____: _____
- Pocket #02 Rejects_____: _____
- Pocket #03 Rejects_____: _____
- Pocket #04 Rejects_____: _____
- Pocket #05 Rejects_____: _____
- Pocket #06 Rejects_____: _____
- Pocket #07 Rejects_____: _____
- Pocket #08 Rejects_____: _____
- Pocket #09 Rejects_____: _____
- Pocket #10 Rejects_____: _____
- Pocket #11 Rejects_____: _____
- Pocket #12 Rejects_____: _____

4.3.2 VIEW CAN/REJECT COUNTS VARIABLE DEFINITIONS

# of Leakers rejected: This is the total number of leak cans rejected from all pockets since the last count reset.

# of Silver Cans rejected: This is the total number of silver cans rejected (if silver can detector is used) since the last reset.

Infeed Can Count: This is the total number of cans that have entered the machine, as counted by the infeed count sensor (if used), since the last reset.

Outfeed Can Count: This is the total number of good cans that have exited the machine, as counted by the outfeed count sensor (if used), since the last reset.

4.3 VIEW CANS/REJECTS COUNT DATA (PROG PORT) (cont'd)

4.3.2 VIEW CAN/REJECT COUNTS VARIABLE DEFINITIONS (cont'd)

# of Good Cans Tested: This is the total number of cans tested that were not rejected, since the last reset. When the PMT samples a pocket and does not detect a leaker, this count is incremented.

Pocket #01 Rejects through **Pocket #12 Rejects:** These variables are the number of leakers rejected from each pocket since the last reset.

4.3.3 VIEW CAN/REJECT COUNTS MENU SELECTIONS

The menu selections on the "View Cans/Rejects Count data Menu" allow you to reset (clear) the variables listed under the following menu selections:

1: Reset Leaker/Silver/Infeed/Outfeed counts
- # of Leakers rejected
- # of Silver Cans rejected
- Infeed Can Count
- Outfeed Can Count

2: Reset Per Pocket Reject counts
- Pocket #01 Rejects
  through
- Pocket #12 Rejects

3: Reset All Counts
- reset all counts on menu

5 TROUBLE-SHOOTING

This section provides information for fault situations (Calibrate error, offset error (MAINT), and an M4031 fault) as well as set-up or tuning problems (excessive cans rejected, calibrated leakers not rejected). With the exception of the M4031 fault, all trouble shooting is performed with "SETUPRT6".

5.1 GAIN CALIBRATE ERROR

PROBLEM:
"CAL" LED on M4031 "off" after calibration is performed and "CALIBRATE" lamp on front of HSL-RT6 enclosure flashing.

SOLUTION:
Select the "M4030 Set-up" and verify the following:

1) Verify that the "PMT Calibration Mode Enabled" is set to YES. If the PMT calibration mode is disabled, the M4031 cannot adjust the gain and sensitivity when the calibration procedure is performed, and this will result in the calibrate error. Enable the "PMT Calibration Mode" per section 4.1 and perform the calibration procedure again.

2) Verify that the "Desired Calibrated Leaker Reject PMT value" is at a reasonable value (40 to 200). If this value is outside this range (say 0 or 255), the M4031 cannot adjust the gain to achieve calibration. Set the "Desired Calibrate Leaker Reject PMT value" between 40 and 200 and try again. Note that the "Desired Calibrated Leaker Reject PMT value" must be greater than the "PMT Reject Can Threshold" (35 to 75) which in turn must be greater than the "Desired Good Can PMT Value" (20 to 30). Perform the calibration procedure again. If the problem persists, proceed to steps (3) and (4) below.

3) If, after calibration, the "PMT Gain" is less than 500 volts and the "Gain Calibrate PMT Input Average" is greater than the "Desired Calibrated Leaker Reject PMT value", the PMT detected too much light and was not able to reduce the gain of the PMT adequately to compensate for the amount of light detected. Verify that the calibrated leaker has a .0025 calibration hole in it and does not have any other areas of leakage in the can. Verify that the seal at the pocket used for calibration is not leaking. Verify that no light leakage is occurring at any of the PMT seals (machine shutter to light seal plate, PMT to light seal plate, or at the PMT housing itself). Perform the calibrate procedure (per section 3.4) and try again. Proceed to step (5) if the problem persists.

4) If, after calibration, the "PMT Gain" is at 1101 volts and the "Gain Calibrate PMT Input Average" is less than the "Desired Good Can PMT Value" by more than 5, then the PMT did not detect enough light and was not able to increase the gain enough to calibrate the M4031. Verify that the calibrated leaker has a .0025 calibration hole in it and also verify that the light source is generating an adequate supply of light (lamps "on" during calibration). If so, set the "Desired Calibrated Leaker Reject PMT Value" to a lower value (it can be set as low as 10 above the "Desired Good Can PMT Value") and try the calibration again. If the "Desired Calibrated Leaker Reject Value" is lowered, the "PMT Reject Can Threshold" should also be lowered (it should be between the "Desired Good Can PMT Value" and the "Desired Calibrated Leaker Reject Value". Perform the calibrate procedure (per section 3.4) and try again.

5) If the solutions in (3) and (4) above do not correct the problem, verify all cables between the M4031 and the PMT and try again.

5.1 GAIN CALIBRATE ERROR (cont'd)

6) If the problem persists, verify that + and - 12VDC is present at the +12VDC, -12VDC, and AGND pins of the PMT of the M4031 and try again.

7) If the problem persists, verify that +24VDC is being supplied to the PS2000N1 power supply and try again.

8) If the problem persists, replace the 9956B-16 PMT tube and try again.

9) If the problem persists, replace the PMT housing, A1H Preamp, GB1BH Gating circuit and try again.

10) If the problem persists, replace the M4031 module. Set the module up per section 2.5 and try again.

5.2 OFFSET ERROR

PROBLEM:
"MAINT" Led on M4031 is "on".

SOLUTION:
Select the "M4030 Set-up" and verify the following:

1) If the "MAINT Alarm" entry in the Set-up menu displays either "Offset Exceeded +250" or "Offset Exceeded -250", then the automatic offset routine attempted to adjust the offset outside the maximum + or - minus offset limits. If the offset exceeds + or -250 in an attempt to set the "PMT Input Average" equal to the "Desired Good Can PMT Value", the MAINT LED on the M4031 will be illuminated. This indicates that the PMT is detecting an excessive amount of light both when the cans are sampled and at the in-between pocket measurement or that the offset potentiometer in the PMT B2F-RFI housing is set incorrectly.

2) Verify that the "Desired Good Can PMT Value" is within a reasonable range (20 to 35). If this value is outside this range (say 0 or 255), the M4031 cannot adjust the offset enough to compensate for this unrealistic value. If the value was outside the range, set the "Desired Good Can PMT Value" between 20 and 35 and proceed to step (5). Note that the "Desired Calibrated Leaker Reject PMT value" must be greater than the "PMT Reject Can Threshold" (35 to 75) which in turn must be greater than the "Desired Good Can PMT Value" (20 to 30).

3) Verify that the B2F-RFI PMT housing offset potentiometer is set correctly (see section 2.4.2).

4) Verify that the machine is timed properly per section 2.4.1 and that no light leakage is occurring at any of the PMT seals (machine shutter to light seal plate, PMT to light seal plate, or at the PMT housing itself).

5.2 OFFSET ERROR (cont'd)

5) Reset the "MAINT Alarm" by selecting "3: Reset MAINT alarm". Run the machine with cans at normal line speeds and verify that the offset is automatically adjusted until the "PMT Input Average" is equal to the "Desired Good Can PMT Value" plus or minus 2. If the offset is again adjusted either up to the +250 max limit or down to the -250 max limit, perform step (6) below.

6) Verify all cables between the M4031 and the PMT and try again.

7) If the problem persists, verify that + and - 12VDC is present at the +12VDC, -12VDC, and AGND pins on the M4031 and try again.

8) If the problem persists, verify that +24VDC is being supplied to the PS2000N1 power supply and try again.

9) If the problem persists, replace the 9956B-16 PMT tube and try again.

10) If the problem persists, replace the PMT housing, A1H Preamp, GB1BH Gating circuit and try again.

11) If the problem persists, replace the M4031 module. Set the module up per section 2.5 and try again.

5.3 M4031 FAULT

PROBLEM:
"FLT" LED on M4031 module "on". M4031 none functional.

SOLUTION:
The "FLT" LED on the M4031 is illuminated when either the PMT Interface section of the M4031 or the PLC section of the M4031 incurs an internal fault. Perform the following to read the M4031 fault code:

1) Connect computer to "PROG" port of M4031.

2) Initiate "SYSdev" and select the "TSTV02" program (or program which is normally downloaded to M4031).

3) From the "Main Development Menu", select "6: Target Board Interface".

4) From the Target Board Interface menu, select "4: Target Board Fault Codes/Status".

5) If the fault code displayed was "45H: User program system fault sfunc09 call", the PMT Interface section incurred the fault. All other fault codes pertain to the PLC section of the M4031.

6) Perform the corrective action described in the SYSdev fault menu and reset the fault code as prompted to by SYSdev. If the M4031 faults again, try cycling power to the M4031. If the M4031 faults again and will not run, replace the M4031, downloading the "TSTV02" program (or other program if used) and perform the setup per section 2.5

5.4 EXCESSIVE GOOD CANS REJECTED

PROBLEM:
Excessive good cans rejected from machine.

SOLUTION:
Excessive good cans are rejected from the machine either when a particular pocket or pockets has a bad light seal or when the M4031 is setup too sensitive. Perform the following to trouble shoot:

1) Select the "3: View Can/Reject Count Data" selection from the "SETUPRT6" main menu and observe the Per Pocket Reject Totals. If a particular pocket is rejecting a significantly higher number of cans than the other pockets, that pocket most likely has a bad light seal (or some other mechanical problem). Fix that pocket's seal and try again. If all pockets show high reject rates, continue to step (2).

2) Verify that all pocket seals are in good condition with no visible leaks. Verify pocket air pressure. Verify that no light leakage is occurring at any of the PMT seals (machine shutter to light seal plate, PMT to light seal plate, or at the PMT housing itself). If these all look good, proceed to step (3).

3) If the M4031 is setup too sensitive ("PMT Reject Can Threshold" too low, "Desired Calibrated Leaker Reject PMT Value" too high, or "PMT Gain" too high) excessive good cans will be rejected. Perform steps (4) through (7) to lower the sensitivity.

4) Select the "M4031 Set-up" menu and set the "Desired Calibrated Leaker Reject PMT Value" to a lower value (between 40 and 200). Note that the "Desired Calibrated Leaker Reject PMT value" must be greater than the "PMT Reject Can Threshold" (35 to 75) which in turn must be greater than the "Desired Good Can PMT Value" (20 to 30). Perform the calibration procedure and try again. If a calibrate error occurs at this point, trouble shoot per section 6.1.

5) If excessive cans are still being rejected, from the "M4031 Set-up" menu, increase the "PMT Reject Can Threshold" (normal range is 35 to 75). Note if this is increased too high, calibrated leakers will not be rejected. Run calibrated leakers through the machine and verify they are still rejected.

6) If excessive cans are still being rejected, select the "View M4031 PMT Data" menu and manually lower the "PMT Gain". Again verify that the calibrated leakers are rejected at the lower gain settings.

7) If the problem persists, perform steps (5) through (10) of section 6.1.

5.5 CALIBRATED LEAKERS NOT REJECTED

PROBLEM:
Some or all of the calibrated leakers are not rejected when run through the machine.

SOLUTION:
In this case, either the sensitivity of the M4031 or PMT tube is too low. Other causes could be an inadequate light source (burned out tubes) or dirty shutter or starwheel. Perform the following:

1) Verify that the light source is adequate and that there are no burned out bulbs.

2) Verify that the machine is clean. The windows in the shutter must be free of dust and oil, and the plexi-glass starwheel should be clean. Verify that the PMT tube end window is also clean.

3) If the machine is clean and the light source adequate, select the "M4031 Set-up" menu and lower the "PMT Reject Can Threshold" and try again. This value can be lowered to within 5 above the "Desired Good Can PMT Value".

4) If the problem persists, increase the "PMT Gain" on the "View M4031 Data" menu and try again. This can be increased to a maximum of 1200 volts. Note, however, that running the "PMT Gain" above 1100 volts will shorten the life of the PMT.

5) If the problem still persists, perform steps (5) through (10) of section 6.1.

6 RECOMMENDED SPARES

The following are the recommended spares for the HSL-RT6. All parts are available through Systems Engineering.

Qty	Part Number	Description
1ea.	M4031	PLC/PMT Module
1ea.	PS2000N1	2K Volt PMT Power Supply
1ea.	9956B-16	Photo Multiplier Tube
1ea.	B2F-RFI	PMT Housing with C634 PMT Preamp and C641 PMT Gating Circuit
1ea.	63-AAEF-0012-AO	12PPR Encoder