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# ACSS

## **AUTOMATIC CALIBRATION STABILITY SYSTEM**

- OPTIC IS CALIBRATED FOR MAXIMUM POSSIBLE DIAMOND RECOVERY
- OPTICS CALIBRATION IS AUTOMATICALLY MAINTAINED BY REFERENCING IT TO AN “ELECTRONIC DIAMOND SIMULATOR”. (EDS)
- VARIATIONS IN X-RAY RADIATION ARE AUTOMATICALLY COMPENSATED FOR BY REGULAR CHECKS OF X-RAY INDUCED TRACER LUMINESCENCE
- WEAR WITHIN A SORTERS FEEDING SYSTEM IS MONITORED BY CHECKING THE STABILITY OF FLOW “MARBLE-TRACERS”
- WHENEVER THE ACSS REQUIRES TRACERS FOR ITS TEST AND CHECK FUNCTIONS, TRACERS ARE AUTOMATICALLY SUPPLIED BY FLOW’S “AUTOMATIC TRACER DISPENSER” (ADT).
- EJECTOR RESPONSE IS AUTOMATICALLY CHECKED AT EVERY EJECTION
- SHOULD A FAULT CONDITION OCCUR THAT CANNOT AUTOMATICALLY BE RECTIFIED BY THE ACSS, SUCH AS REPLACEMENT OF WEAR PARTS, UNDOING BLOCKAGES ETC, THE ACSS WILL SHUT DOWN THE FEED TO THE SORTER, CLEARLY INDICATE AND REPORT THE FAULT ENCOUNTERED AND PREVENT THE SORTER FROM BEING USED UNTIL THE FAULT CONDITION HAS BEEN CLEARED!

***NOTE: ALL EXISTING FLOW X-RAY RECOVERY MACHINES CAN BE RETROFITTED WITH OUR ACSS. THIS UPGRADE CAN BE DONE ON SITE!***

# 1. INTRODUCTION

A FLOW SORT X-ray diamond recovery machine can only achieve the best possible sorting results if it is operated within its capabilities (specifications) AND if the sorter is optimally set-up for specific material type and conditions.

A sorter's set-up does however change over time due to 'aging' of critical components such as P.M. tubes, X-Ray tubes, changes in clarity of optical windows etc) and due to wear and tear of its parts that make contact with the feed material such as feed slides window frames, feed stabilizing curtains ejector gates etc.

A sorters performance must be regularly checked, calibration corrections and re-adjustments made, to keep a sorter at its peak performance. Worn parts must be replaced BEFORE a sorter's performance starts to deteriorate.

Traditionally such checks and tests are carried out by a 'capable, competent and reliable' plant (sorter) operator. Our experience has shown that, 'traditionally' such operators are few and far between.

Poor sorter set-up, poor maintenance and incompetent sorter operation WILL lead to a drop in a sorters diamond recovery efficiency and WILL lead to diamonds reporting to tailings. We found that even using a twin-stage sorter does not substitute for 'incompetent careless, lazy operators. The unfortunate thing is that many mine owners and/or shareholders suffer losses without knowing that they are due to poor sorter performance caused by negligent sorter operation and poor maintenance. If a tailings audit shows missed diamonds. The very same operators (managers etc.) that are responsible for these losses, as useless as they may be, immediately have explanations, as to why and how diamonds reported to the x-ray tailings! That it was their own fault they obviously would never admit!

It was with this dilemma in mind that FLOW developed an AUTOMATIC CALIBRATION STABILITY SYSTEM (**ACSS**)

FLOW'S ACSS is designed to: **continuously** carry out calibration **corrections**, necessary to keep a sorter running at **peak performance without any operator involvement**. Totally "HANDS-OFF".

FLOW'S ACSS is designed to **automatically detect** any wear and tear that could negatively affect a sorter's performance AND immediately report problems it detected **and prevent** a sorter from being operated before worn or damaged parts have been properly replaced.

## 2. PRINCIPLE OF OPERATION OF FLOW'S ACSS

FLOW'S ACSS interacts with FLOW'S XR or TSXR models in four particular ways:

- **Learning the optimal setup.** In this learning cycle the ACSS records optimal sorting parameters.
  - In order to provide a calibration reference base for the ACSS a sorter must first be manually calibrated (set-up) to achieve optimal diamond recovery for a given application.
  - This "base-calibration must be executed by a fully qualified (Flow certified) person. A ACSS that is given 'bad' calibration data is of no use!
  - The learning cycle is a 'once-off' task carried out during commissioning. A new learning cycle needs to be entered when a sorter is to be used on different feed material or some major components such as P.M. tubes or X-ray tubes have been replaced.

- To prevent unauthorized tampering with the ACSS base-calibration a learning stage can only be entered by unlocking the ACSS by means of a special key-switch.
- This key switch also allows to by-pass the ACSS should this be required.
- **At every sorter start-up.**
  - Whenever a sorter is powered up the ACCS will re-establish the calibration that was active at the time when the sorter switched off (powered down). This includes:
    - Setting the sorters optic (P.M. tubes) to the same sensitivity.
    - Checking if the x-ray reference luminescence of the sorter is within limits.
    - Checking the optics response to calibrated light pulses
    - Checking if tracer signals are within limits.
  - If any of these test results fall outside acceptable limits the ACSS will automatically make the necessary adjustments.
    - As soon as the ACSS has established the correct sorter settings it will enable the sorters feeder to be started.
    - Should the ACSS not be able to re-establish a sorter operating parameters it will raise an appropriate alarm and prevent material from passing through the sorter.
- **At every auto-test** of the sorter (on starting the feeder and repeated every 20 minutes)
  - At the start of an auto test cycle the sorters feeder is turned off
  - A tracer is first passed down the left channel and then the right channel
    - The luminescence levels of both tracers are analyzed and optics adjustments made if a tracer's response is out of limits.
    - The ejector response is monitored and if such response is out of limits, an auto-test failed alarm raised. In this case the sorters feed-system remains turned off until the ejector fault has been rectified.
  - A calibrated diamond luminescence simulation pulse is sent to the left P.M. tube followed by another pulse to the right P.M. tube.
    - The corresponding P.M. tube signals are analyzed and if found to be within acceptable limits the auto-test cycle ends and the sorters feeder is automatically re-started.
    - Should the P.M. tube signals be out of limits the ACSS will indicate this by raising the appropriate alarm and keeping the sorters feeder turned off until the fault has been cleared.
- **Throughout the entire sorting operation** (for as long as a sorter remains switched on)
  - The ACSS continuously monitors the sorter's x-ray induced background luminescence level. It checks if it remains within preset limits. Should it exceed these limits in either direction the sorter's feed will be stopped and the appropriate alarm raised. Sorting can only be resumed after the fault has been rectified.

All in all, FLOW'S ACSS provides long term, hands-off sorter stability.

New sorters come now standard fitted with an ACSS. Sorters supplied without FLOW'S ACSS can be upgraded in the field.

### 3. **To up grade an existing sorter, the following components are required.**

- a. **FLOW'S ELECTRONIC-DIAMOND-SIMULATORS (EDS)** to which the sorters optical detection system is continuously referenced. This device is a calibrated, high precision light source. This device emits light at the wavelength and luminescence value typical for a diamond.  
2 x EDS with Part No. 3860 are required per sorter.



- b. **FLOW'S AUTOMATIC TRACER (MARBLE) DISPENSER (ATD)** Part No.4660, which injects tracers into the sorter whenever they are required by the ACSS to check factors such as X-ray induced luminescence values, feed system stability and ejector response. Deviations from optimum values are automatically corrected and feed-stability as well as ejector problems are immediately indicated and the material flow through the sorters remains blocked until the fault has been rectified.
- c. **FLOW'S ACSS** (Part No. 2450), designed to 'take over' (learn) a sorting experts sorter calibration and then ensures that this optimal set-up remains "spot-on" day after day WITHOUT any operator intervention! TOTALLY HANDS OFF!

### 4. **ACSS FUNCTIONS EXPLAINED STEP BY STEP**

Glossary, location and functions of various controls and indicators referred to in the following text.

- a. **ACSS (AUTOMATIC CALIBRATION STABILITY SYSTEM)**
- Located on top of the x-ray generator enclosure
  - Receives and processes various "input" information and controls all relevant sorter components.
- b. **EDS (ELECTRONIC DIAMOND SIMULATOR)**
- Located inside a sorters sorting zone.
  - Generates calibrated light pulses simulating diamond luminescence.
- c. **ATD (AUTOMATIC TRACER DISPENSER)**
- Located on upper section of feed chute cover.
  - Dispenses tracers into a sorters feed chute when triggered to do so.

- d. LEFT CHANNEL LED (GREEN), REFER TO FIGURE 1 BELOW
  - g. Located at the ACSS enclosure
    - i. In newer models this indicator is also repeated at the sorters mimic panel
  - h. Indicates specific conditions that apply to the left sorting channel
  
- e. RIGHT CHANNEL LED (WHITE), REFER TO FIGURE 1 BELOW
  - i. Located at the ACSS enclosure
    - i. In newer models this indicator is also repeated at the sorters mimic panel
  - j. Indicates specific conditions that apply to the right sorting channel
  
- f. ACSS ALARM LED (RED), REFER TO FIGURE 1 BELOW
  - k. Located at the ACSS enclosure
    - i. In newer models this indicator is also repeated at the sorters mimic panel
  - l. Indicates ACSS alarms in conjunction with either Left, Right or both channel LED'S
  
- g. FEEDER ENABLED LED (RED) indicates that the feeder can not be started.
  - m. This indicator toggles with the GREEN FEEDER ENABLED LED.
  - n. Located at the STATUS DISPLAY PANEL of the sorters control-panel (mimic-panel).
  - o. Indicates that the ACSS is keeping the sorters feeder switched off.
  
- h. FEEDER ENABLED LED (GREEN) indicates that the ACSS has enabled the feeder to be started.
  - p. This indicator toggles with the RED FEEDER ENABLED LED
  - q. Located at the STATUS DISPLAY PANEL of the sorters control-panel (mimic-panel).
  - r. Indicates that the ACSS has unblocked the sorters feeder. Feeder can be switched on.
  
- i. SORTER'S GENERAL ALARM LAMP (RED)
  - s. Located at the sorters control panel
  - t. Will also illuminate at any sorter alarm. It also replicates ACSS alarms as indicated by the RED ACSS ALARM LED.
  
- j. SORTER ALARM Reset key-switch
  - u. Located at the sorters control panel
  - v. Allows alarms, as indicated by the SORTER ALARM LAMP, to be cancelled
  
- k. LEFT  $\mu$ A-METER
  - w. Located at the sorters "mimic-panel"
  - x. Indicates the P.M. tube current of the left channel. The ACSS uses this instrument to replicate an alarm as indicated by the WHITE CHANNEL LED at the ACSS box.
  
- l. RIGHT  $\mu$ A-METER
  - y. Located at the sorters "mimic-panel"
  - z. Indicates the P.M. tube current of the right channel. The ACSS uses this instrument to replicate an alarm as indicated by the GREEN CHANNEL LED at the ACSS box.

- m. PM TEST LED (RED and GREEN)
  - i. This indication toggles between RED and GREEN
  - aa. Located at the sorters status display panel (“mimic-panel”)
  - bb. Whenever an automated P.M. test pulse is sent to the sorter the RED PM TEST LED is ‘pulsed’ OFF whilst the RED LED is ‘pulsed’ on.
- n. AUTO TEST LED (RED and GREEN)
  - i. This indication toggles between RED and GREEN
  - cc. Located at the sorters status display panel (“mimic-panel”)
  - dd. At the successful completion of an auto-test sequence, a momentarily switch from RED to GREEN back to RED, indicates that the feeder is switched back on.
- o. EJECTION COUNTERS (LEFT and RIGHT)
  - ee. Located at the sorters control panel (“mimic-panel”)
  - ff. Count the number of ejections of the respective sorter channels.
- p. INCIDENCE PRINTER
  - gg. Located at the sorters control panel (“mimic-panel”)
  - hh. Provides a hard-copy of a sorters operational status as well as alarm conditions etc.

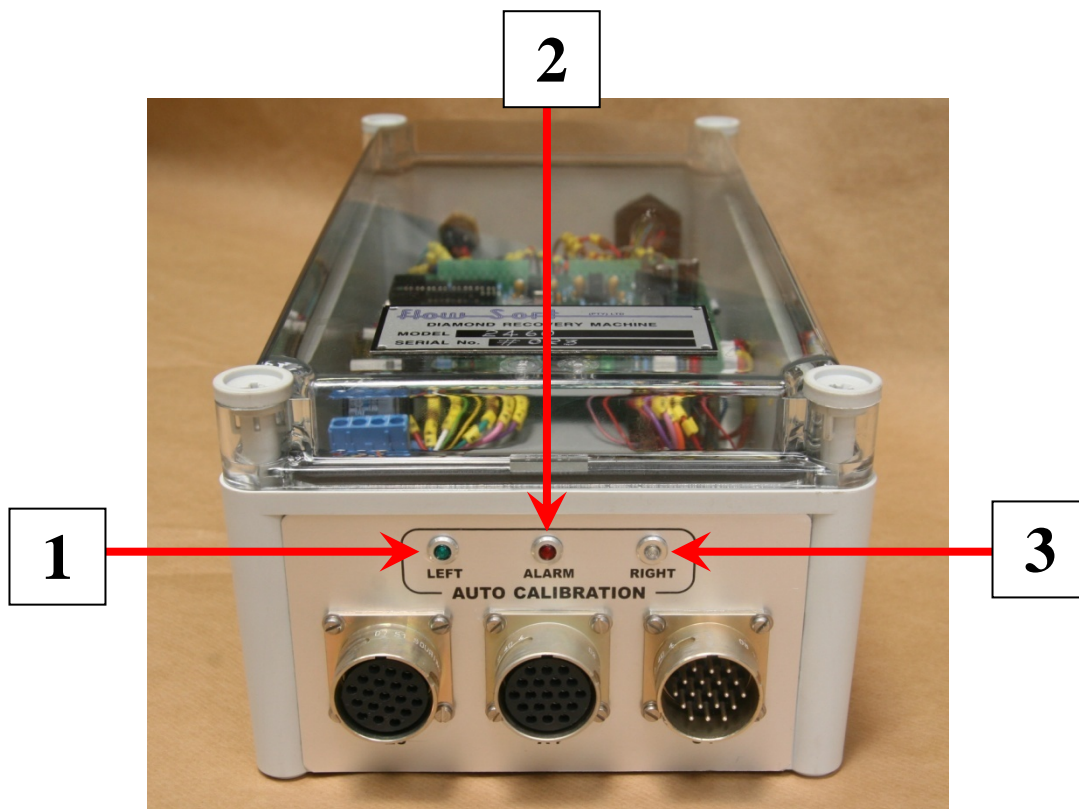


Figure 1

1. ACSS Left hand side indication LED “**GREEN**”
2. ACSS Alarm indication LED, “**RED**”
3. ACSS Right hand side indication LED, “**WHITE**”

## 5. AUTOMATIC CALIBRATION START-UP SEQUENCE

- a. An “**ACSS START-UP SEQUENCE**” is performed at every sorter start-up and when a sorters optic alarm condition is reset. In this sequence the **ACSS** checks and adjusts the Optic’s ‘Micro-Amps’ (PM TUBE CURRENT) and Optic’s HT (High Voltage supplied to the PM tubes).
- b. During an “**ACSS START-UP SEQUENCE**” the **ACSS** keeps the sorters feeder switched off (disabled). This situation is indicated by an illuminated **RED FEEDER ENABLED LED**. Only after the calibration has been successful will the **ACSS** turn the **RED FEEDER ENABLED LED** off and the **GREEN FEEDER ENABLED LED** on, indicating that the sorter is ready to sort.
- c. During the start up sequence the **ACSS** slowly start-up ramps-up the high voltage (HT) to the left and right P.M. Tubes until the “**P.M. Tubes**” receive the same high voltage (kV), or the “**P.M. Tubes**” generate the same PM-tube current ( $\mu\text{A}$ ); that has been stored at the last sorter-shut-down. Whichever value of  $\mu\text{A}$  or kV, is reached first stops the ramp-up process.
- d. On start up all LED’S at the **ACSS** panel are on until the sorters X-ray source has been turned on. The following “ramp-up” phase is indicated by both, the “**GREEN LEFT CHANNEL LED**” and “**WHITE RIGHT CHANNEL LED**” flashing at 1(one) second on, one second off intervals
- e. A ramping up phase is stopped after the HT supply to both P.M. tubes falls within pre-specified limits of the HT setting (typically  $\pm 300\text{V}$ ) and the  $\mu\text{A}$ -value is within a specified windows (typically  $\pm 0.3\mu\text{A}$ ) of the values as stored at the sorter’s last shut down. If this target is not achieved the **ACSS** will raise an alarm and indicate the fault
- f. After this initial calibration process the **ACSS** triggers the left and right EDS and check that the P.M. tube signals are within specifications. (Typically  $\pm 0.15\text{V}$ ) If the calibration signal falls within limits the “**RED ACSS ALARM LED**” is turned off.
- g. If the EDS signals are not within the preset limits (Typically  $\pm 0.15\text{V}$ ) the **ACSS** will automatically correct the error by increasing or decreasing the HT to the P.M. Tube (Left and/or Right) until the EDS signal is obtained. During this time the “**RED ACSS ALARM LED**” will be on and simultaneously the “**LEFT (RIGHT) CHANNEL LED**” will flash 1 (one) second on 1(one) second off, indicating the channel(s) being adjusted.
- h. After this recalibration the HT and  $\mu\text{A}$  for both PMT’S must be within specified windows (typically  $\pm 300\text{V}$  and  $\pm 0.3\mu\text{A}$ ) of the values as stored at the sorter’s last shut down. If this target is not achieved the **ACSS** will raise an alarm and indicate the fault.
- i. Now the **ACSS** requests the **ATD** to drop 10 tracers (FLOW MARBLES) into the sorter, alternating between left and right channel. (5 into each channel).
- j. Only after 10 tracers have passed trough the sorter (5 through the left 5 through the right sorting channel) and all 10 have all been detected will the **ACSS** release enable the feeders start-up circuit. (“All detected” means that at least 3 consecutive tracer signals out of 5 tracers (FLOW MARBLES) must be above the expected minimum signal level and none may fall below a predetermined absolute minimum level).

## 6. ACSS ACTIVITIES DURING A SORTERS AUTO TEST SEQUENCE

- a. The "**FEEDER ENABLED**" indication changes from GREEN to RED.
- b. The Sorters Feeder is switched off
- c. The "**PM TEST LED'S**" will momentarily change from RED to GREEN and back to RED indicating that an auto-test is being performed.
- d. The ACSS triggers the left and right EDS and check that the P.M. tube signals are within specifications. (Typically  $\pm 0.15V$ ) If the calibration signal falls within limits the "**RED ACSS ALARM LED**" is turned off.
  - i. If the EDS signals are not within the preset limits (Typically  $\pm 0.15V$ ) the ACSS will automatically correct the error by increasing or decreasing the HT to the P.M. Tube (Left and/or Right) by one step (8V). During this time the "**RED ACSS ALARM LED**" will be on and simultaneously the "**LEFT (RIGHT) CHANNEL LED**" will flash 1 (one) second on 1(one) second off, indicating the channel(s) being adjusted.
- e. Following the EDS response check the "**ACSS**" dispenses a tracer via the sorters "**ATD**" into the left and then into the right channel.
- f. Now the ACSS requests the ATD to drop 2 tracers (FLOW MARBLES) into the sorter, alternating between left and right channel. (1 into each channel).
- g. Only after 2 tracers have passed through the sorter (1 through the left 1 through the right sorting channel) and 2 have been detected will the ACSS release enable the feeders start-up circuit. ("All detected" means that at least 3 consecutive tracer signals out of 5 tracers (FLOW MARBLES) must be above the expected minimum signal level and none may fall below a predetermined absolute minimum level).
- h. The appropriate "**EJECTION COUNTERS**" are incremented.
- i. The "**FEEDER ENABLED LED'S**" change from RED back to GREEN indicating that the auto-test was successful and the sorters feeder has been re-started.
- j. The feeder will start automatically.

- k. The “**GREEN FEEDER ON**” lamp will illuminate and the sorter will process material until the next auto-test cycle is due. (Typically every 20 minutes).
  
- l. The “**SORTERS INCIDENCE PRINTER**” will print the following “auto-test- data: (See Figure 2 below.)

```
FR = 4.1  
  
FEEDER ON  
L Cnt: 5653  
R Cnt: 6205  
AUTOTEST LEFT OK  
uA LEFT: 064  
Date : 080609 141120  
AUTOTEST RIGHT OK  
uA RIGHT: 060  
Date : 080609 141119  
Feeder ON  
L Cnt: 5652  
R Cnt: 6204
```

Figure 2

## 7. CONTINUOUS ACSS ACTIVITIES

The P.M. current ( $\mu\text{A}$ ) of the left as well as the right sorting channel is constantly monitored for reaching unacceptable levels in either direction.

If the P.M. current, of either side, exceeds a maximum permitted level, typically set to  $3 \mu\text{A}$ . (as for instance caused by light leaking into the sorter), the ACSS sees to it that the feeder and the optics of the sorter is immediately shut down and the appropriate alarm indication initiated.

If the P.M. current, of either side, drops below a minimum permitted level, typically set to  $0.2 \mu\text{A}$ . (as for instance caused by a blockage in the sorters feeding system), the ACSS sees to it that the feeder of the sorter is immediately shut down and the appropriate alarm indication initiated.

In both instances the fault must be rectified and the alarm cleared before normal sorter operation can continue. (Refer to chapter XX )

## 8. OPTIC CALIBRATION SEQUENCE (LEARNING MODE)

After major component replacements a sorter might have to be re-programmed with a new set of optimal sorting parameters. (Learn a new optimal calibration setting)

To prevent unauthorized tampering with this feature, it requires a special ACSS LEARNING KEY.

Changing a sorters BASE-CALIBRATION may only be carried out by persons authorised by FLOW SORT to do so.

The learning sequence for a ACSS is:

- a. Turn the sorter off
- b. Whilst the sorter is powered down insert the Key into the “**ACSS KEY-SWITCH-LOCK**”  
Turn the Key clock-wise into the “**LEARN**” position and remove it in this position.  
(Calibration-position.)
- c. Start up the sorter
- d. Set up the sorter to 100% recovery efficiency. (Refer to Chapter 6.1 FINDING THE MACHINES 100% RECOVERY LEVEL)
- e. Set up the sorter to 100% recovery efficiency. (Refer to Chapter 6.1 FINDING THE MACHINES 100% RECOVERY LEVEL)
- f. Set up the sorter to 100% recovery efficiency. (Refer to Chapter 6.1 FINDING THE MACHINES 100% RECOVERY LEVEL)
- g. Re-insert the ACSS calibration Key and turn the Key anti-clock-wise into the “**NORMAL OPERATION**” position and remove.
  - i. NOTE:Leaving the key-switch in the “learning-mode” position allows the sorter to be operated “manually”, without any ACSS functions being enabled!
  - ii. **IMPORTANT: Make sure that no unauthorised person has access to this key!**
- h. Press the “**P.M. TEST BUTTON**” at the sorters mimic-display panel.
- i. The ACSS will flash the left “**EDS**” 5 times
- j. The ACSS will flash the right “**EDS**” 5 times
- k. The “**ACSS**” now takes control of the “**OPTIC**” circuit and continues with an “**AUTOMATIC CALIBRATION START-UP SEQUENCE**”.

FOR DECODING ACSS MESSAGES AND INDICATIONS REFER TO THE ATTACHED TABLE:  
FLOW\_ACSS\_WRITE-UP-V3\_080823\_M19.XLS [e:\DOCUMENTS\WRITE\_UPS\...]

**FLOW SORT X-RAY DIAMOND RECOVERY MACHINE AUTOMATIC CALIBRATION SYSTEM OPERATION STATUS TABLE**

EVENT REFERENCE No.	EVENT TYPE	GREEN LEFT CHANNEL LED ON ACCS	WHITE RIGHT CHANNEL LED ON ACCS	RED ALARM LED ON ACCS	LEFT $\mu$ A METER ON CONTROL PANEL	RIGHT $\mu$ A METER ON	FEEDER ENABLED LED'S ON C/P	P.M. TEST LED'S ON C/P	AUTO TEST LED'S ON C/P	ALARM LAMP STATUS & PRINT-OUT/C/P	DESCRIPTION OF EVENT	LIKELY CAUSE OF PROBLEM AND POSSIBLE SOLUTION
1	STATUS INDICATION	ON	ON	ON	0	0	RED	RED	RED	OFF	WAITING FOR X-RAYS	N/A
2L	AUTO CALIBRATION	1 sec ON / 1 sec OFF...REPEAT..	OFF	OFF	$\mu$ A READING IS INCREASING	$\mu$ A READING SHOWS ZERO	TOGGLES BETWEEN RED AND GREEN	RED	RED	OFF	H.T. FOR LEFT P.M. TUBE BEING ADJUSTED	N/A
2R	AUTO CALIBRATION	OFF	1 sec ON / 1 sec OFF...REPEAT..	OFF	$\mu$ A READING IS STABLE	$\mu$ A READING IS INCREASING	TOGGLES BETWEEN RED AND GREEN	RED	RED	OFF	H.T. FOR RIGHT P.M. TUBE BEING ADJUSTED	N/A
3	GENERAL ALARM	OFF	OFF	ON	N/A	N/A	N/A	N/A	N/A	ON_XXX	ALARM ORIGINATES FROM "OUTSIDE" THE ACCS. ALARM LED ON ACCS ONLY REPLICATES THE ALARM INDICATION	ATTEND TO ALARM AS PER ALARM INDICATION ON THE SORTERS CONTROL PANEL (SEE ALSO MESSAGE ON INCIDENT PRINTER)
4L	FAULT	1 x 0.3 sec FLASH REPEATED EVERY 1 sec	OFF	FLASHING AT 0.3 SEC INTERVALS	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	GOES TO ZERO	RED	RED	RED	ON_127	LEFT P.M. TUBE CURRENT HAS REACHED "DANGER" LEVEL (>3.0 $\mu$ A)	LIGHT IS ENTERING SORTER. CHECK IF OPTIC BOX IS PROPERLY SEATED. CHECK OPTIC BOX SEALS. CHECK CONCENTRATE AND TAILINGS CHUTES FOR HOLES, ETC.
4R	FAULT	OFF	1 x 0.3 sec FLASH, REPEAT EVERY 1 sec	FLASHING AT 0.3 SEC INTERVALS	GOES TO ZERO	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	RED	RED	RED	ON_131	RIGHT P.M. TUBE CURRENT HAS REACHED "DANGER" LEVEL (>3.0 $\mu$ A)	LIGHT IS ENTERING SORTER. CHECK IF OPTIC BOX IS PROPERLY SEATED. CHECK OPTIC BOX SEALS. CHECK CONCENTRATE AND TAILINGS CHUTES FOR HOLES, ETC.
5L	FAULT	2 x 0.3 sec FLASHES REPEATED EVERY 1 sec	OFF	FAST FLASHING AT 0.3 SEC INTERVALS	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	GOES TO ZERO	RED	RED	RED	ON_127	LEFT P.M. TUBE CURRENT TOO LOW	THE P.M. TUBES DO NOT DETECT SUFFICIENT LUMINESCENCE FROM THE OPTIC WINDOW. CHECK FOR BLOCKAGES INSIDE THE SORTER.
5R	FAULT	OFF	2 x 0.3 sec FLASHES REPEATED EVERY 1 sec	FAST FLASHING AT 0.3 SEC INTERVALS	GOES TO ZERO	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	RED	RED	RED	ON_131	RIGHT P.M. TUBE CURRENT TOO LOW	THE P.M. TUBES DO NOT DETECT SUFFICIENT LUMINESCENCE FROM THE OPTIC WINDOW. CHECK FOR BLOCKAGES INSIDE THE SORTER.
6L	FAULT	3 x 0.3 sec FLASHES REPEATED EVERY 1 sec	OFF	FAST FLASHING AT 0.3 SEC INTERVALS	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	GOES TO ZERO	RED	RED	RED	ON_127	LEFT P.M. TUBE H.T. SUPPLY TOO LOW	SOME INTERNAL LUMINESCENCE IS PRESENT OR LIGHT IS ENTERING THE SORTER. CHECK FOR LIGHT-LEAKS, REMOVE LUMINESCENT SUBSTANCES FROM SORTER (ALGAE, CHEMICALS ETC)
6R	FAULT	OFF	3 x 0.3 sec FLASHES REPEATED EVERY 1 sec	FAST FLASHING AT 0.3 SEC INTERVALS	GOES TO ZERO	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	RED	RED	RED	ON_131	RIGHT P.M. TUBE H.T. SUPPLY TOO LOW	SOME INTERNAL LUMINESCENCE IS PRESENT OR LIGHT IS ENTERING THE SORTER. CHECK FOR LIGHT-LEAKS, REMOVE LUMINESCENT SUBSTANCES FROM SORTER (ALGAE, CHEMICALS ETC)
7L	FAULT	1 x 0.3 sec FLASHES REPEATED EVERY 1 sec	OFF	SLOW FLASHING AT 1 SEC INTERVALS	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	GOES TO ZERO	RED	RED	RED	ON_127	LEFT CALIBRATION PULSE DID NOT TRIGGER EJECTOR	MOST LIKELY A COMPONENT FAILURE. FAULT MUST BE INVESTIGATED BY FULLY QUALIFIED TECHNICIAN.
7R	FAULT	OFF	1 x 0.3 sec FLASHES REPEATED EVERY 1 sec	SLOW FLASHING AT 1 SEC INTERVALS	GOES TO ZERO	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	RED	RED	RED	ON_131	RIGHT CALIBRATION PULSE DID NOT TRIGGER EJECTOR	MOST LIKELY A COMPONENT FAILURE. FAULT MUST BE INVESTIGATED BY FULLY QUALIFIED TECHNICIAN.
8L	FAULT	1 x 0.3 sec FLASHES REPEATED EVERY 1 sec	OFF	ON	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	GOES TO ZERO	RED	RED	RED	ON_127	3 x TRACERS INSERTED INTO LEFT CHANNEL TRIGGERED RIGHT EJECTOR	PART BLOCKAGE IN THE SORTERS FEED CHANNEL, DAMAGED STABILIZING CURTAINS, SORTER LEANING TO ONE SIDE. CHECK ALL RELEVANT PARTS.
8R	FAULT	OFF	1 x 0.3 sec FLASHES REPEATED EVERY 1 sec	ON	GOES TO ZERO	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	RED	RED	RED	ON_131	3 x TRACERS INSERTED INTO RIGHT CHANNEL TRIGGERED LEFT EJECTOR	PART BLOCKAGE IN THE SORTERS FEED CHANNEL, DAMAGED STABILIZING CURTAINS, SORTER LEANING TO ONE SIDE. CHECK ALL RELEVANT PARTS.
9L	FAULT	2 x 0.3 sec FLASHES REPEATED EVERY 1 sec	OFF	ON	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	GOES TO ZERO	RED	RED	RED	ON_127	LEFT TRACER SIGNALS APPROACHING LOW SIGNAL LIMIT 3 TIMES IN SUCCESSION	LIKELY AN UNSTABLE FEED-SYSTEM (FEEDER TO CHUTE TRANSFER, SPRAY BAR ALIGNMENT, WARN FEED SLIDE AND OR WINDOW FRAME. CHECK POSSIBLY AN X-RAY PROBLEM. CALL QUALIFIED TECHNICIAN!
9R	FAULT	OFF	2 x 0.3 sec FLASHES REPEATED EVERY 1 sec	ON	GOES TO ZERO	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	RED	RED	RED	ON_131	RIGHT TRACER SIGNALS APPROACHING LOW SIGNAL LIMIT THREE x IN SUCCESSION	LIKELY AN UNSTABLE FEED-SYSTEM (FEEDER TO CHUTE TRANSFER, SPRAY BAR ALIGNMENT, WARN FEED SLIDE AND OR WINDOW FRAME. CHECK POSSIBLY AN X-RAY PROBLEM. CALL QUALIFIED TECHNICIAN!
10L	FAULT	2 x 0.3 sec FLASHES REPEATED EVERY 1 sec	OFF	SLOW FLASHING AT 1 SEC INTERVALS	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	GOES TO ZERO	RED	RED	RED	ON_127	TRACER IN LEFT CHANNEL DID NOT TRIGGER EJECTOR(S)	STEP-UP FROM FEED SLIDE TO WINDOW-FRAME, WARN WINDOW FRAME AND OR FEED-SLIDE. CHECK, RECTIFY AND / OR REPLACE WARN PART(S).
10R	FAULT	OFF	2 x 0.3 sec FLASHES REPEATED EVERY 1 sec	SLOW FLASHING AT 1 SEC INTERVALS	GOES TO ZERO	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	RED	RED	RED	ON_131	TRACER IN RIGHT CHANNEL DID NOT TRIGGER EJECTOR(S)	STEP-UP FROM FEED SLIDE TO WINDOW-FRAME, WARN WINDOW FRAME AND OR FEED-SLIDE. CHECK, RECTIFY AND / OR REPLACE WARN PART(S).
11L	FAULT	3 x 0.3 sec FLASHES REPEATED EVERY 1 sec	OFF	SLOW FLASHING AT 1 SEC INTERVALS	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	GOES TO ZERO	RED	RED	RED	ON_127	TRACER PASSED UNDETECTED THROUGH LEFT CHANNEL OF SORTER OR NO TRACER WAS DISPENSED	STEP-UP FROM FEED SLIDE TO WINDOW-FRAME, WARN WINDOW FRAME AND OR FEED-SLIDE. CHECK, RECTIFY AND / OR REPLACE WARN PART(S). TRACER DISPENSER (ATD) IS EMPTY, CHECK ATD STATUS LED'S.
11R	FAULT	OFF	3 x 0.3 sec FLASHES REPEATED EVERY 1 sec	SLOW FLASHING AT 1 SEC INTERVALS	GOES TO ZERO	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	RED	RED	RED	ON_131	TRACER PASSED UNDETECTED THROUGH RIGHT CHANNEL OF SORTER OR NO TRACER WAS DISPENSED	STEP-UP FROM FEED SLIDE TO WINDOW-FRAME, WARN WINDOW FRAME AND OR FEED-SLIDE. CHECK, RECTIFY AND / OR REPLACE WARN PART(S). TRACER DISPENSER (ATD) IS EMPTY, CHECK ATD STATUS LED'S.
12L	FAULT	1 x 1 sec FLASHES REPEATED EVERY 1 sec	OFF	SLOW FLASHING AT 1 SEC INTERVALS	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	N/A	RED	RED	RED	ON_127	OPTIC SENSITIVITY LEFT HAND SIDE HAS REACHED MAXIMUM BUT $\mu$ A STAY BELOW THE SET-UP VALUE	LUMINESCENCE FROM THE OPTIC WINDOW IS NOT REACHING THE P.M. TUBES(S). CHECK FOR BLOCKAGES INSIDE THE SORTER. POSSIBLE HARDWARE FAILURE PM TUBE, HT SUPPLY, X-RAY TUBE ECT...
12R	FAULT	OFF	1 x 1 sec FLASHES REPEATED EVERY 1 sec	SLOW FLASHING AT 1 SEC INTERVALS	N/A	JUMPS TO 3 $\mu$ A THEN STAYS AT 1.5 $\mu$ A	RED	RED	RED	ON_131	OPTIC SENSITIVITY RIGHT HAND SIDE HAS REACHED MAXIMUM BUT $\mu$ A STAY BELOW THE SET-UP VALUE	LUMINESCENCE FROM THE OPTIC WINDOW IS NOT REACHING THE P.M. TUBES(S). CHECK FOR BLOCKAGES INSIDE THE SORTER. POSSIBLE HARDWARE FAILURE PM TUBE, HT SUPPLY, X-RAY TUBE ECT...