United States Department of Agriculture
Grain Inspection, Packers and Stockyards Administration
Federal Grain Inspection Service

Directive 9160.4

12/15/97

GRAIN HANDLING SYSTEM TESTING

1. PURPOSE

This directive transmits new requirements for regular testing of grain handling systems used to officially weigh grain for export to assure grain flow integrity.

2. REPLACEMENT HIGHLIGHTS

This directive supersedes the instructions in Chapters 1.5.b.(2)(d)2) and 1.5.b.(2)(e) of the FGIS Weighing Handbook for biweekly verification that all indicating elements accurately depict the actual positions of flow control devices. Effective upon receipt of this directive, all references to biweekly verifications of indicating lights in the FGIS Weighing Handbook are replaced with 180-day intervals when performed as stated in this instruction.

3. BACKGROUND

Existing instructions require official personnel to monitor grain weighing and material handling operations on a continuous basis to assure that all exported grain is correctly weighed, delivered, and stowed aboard the carrier. Control panels with electrical indicators, lock out switches, or computers with visual displays are used by official weighers to monitor grain flow. The instructions have required monitoring devices to be verified and documented for correct operation on a biweekly basis.

While these procedures verify that grain flow paths are properly set, they do not account for the possibility of gates, spouting, or conveying systems leaking into encased areas of the elevator or other grain flow paths. Vulnerability to grain flow problems has increased as the industry has increased the number and complexity of remotely operated material handling systems. At the same time, GIPSA has diminished its use of personnel (rovers) to physically examine grain flow. Fewer official personnel spending less time in an elevator greatly diminishes the ability to find problems occurring in the elevator. This situation has created the need for more sophisticated procedures for testing and documenting material handling system operation to assure that system integrity is maintained. At the same time, this type of system testing must not interfere with or slow down elevator operations.

4. POLICY

GIPSA will now require official personnel to inspect and document the condition of flow control devices and spouting, and the proper functioning of grain flow indicating devices at critical monitoring points. Each critical monitoring point shall be inspected at least once every 180 days; however, this inspection should proceed incrementally, with only a small number of devices being checked at any one time. Critical monitoring points are where the amount of grain in an official flow path can be increased or decreased by a flow diverting device or a leak. Official flow paths carry outbound grain after it has been weighed, inbound grain before it has been weighed, or grain that cannot be loaded, to be weighed back before it has been weighed. This policy is in addition to the present policy where official personnel give cursory inspections of this equipment on daily walk-throughs. This instruction applies only to export elevators.

5. ACTION

Perform the following procedures at critical monitoring points in the grain flow system.

a. Develop the following checklists for each elevator:

(1) A checklist of critical monitoring points to be used for leak testing, as described in 5.b. below, and for verifying the proper operation of limit switches and grain flow indicators, as described in 5.c. below (Attachment 1, Table 1).

(2) For each critical monitoring point, a table of all possible settings for the gates and the corresponding states of the indicators used to monitor grain flow, as described in 5.c. below (Attachment 1, Tables 2 and 3).

(3) A checklist of all shipping bin gate permissives, as described in 5.e. below (Attachment 1, Table 4).

(4) A checklist of all critical bin level sensors, as described in 5.g. below (Attachment 1, Table 5).

The tables shown in Attachment 1 are examples only and do not prescribe a required format. Actual checklists and limit switch check tables developed for an elevator may follow a different format, such as leaving spaces for comments in a checklist, or including a check table for a gate's limit switches on the same page as a leak checklist which includes that gate. The goal is to make the checklists and tables complete, legible, and easy to use.

b. While grain is present, physically check the opposite sides of the gates for leaks. Where gates have no inspection openings, verify that grain is not accumulating where the grain would terminate. Avoid checkpoints terminating at moving conveyors, legs, or drags, unless they are shut down.

c. The limit switches at a flow diverting device (gate, turnhead, valve, or distributor) control the display elements (such as indicator lights or icons on a computer display) which indicate the state of the device. The table developed in 5.a.2. shall show the date of verification and the names or initials of personnel performing the test. The table shall relate every possible position of the device to the state its associated indicators should display when the device is in that position. For example, see Attachment 1, Table 2. The complexity of the table is determined by the type of gate(s) used in the diversion point and the number of limit switches involved. A two-way diverter with two limit switches such as a basket valve has three possible positions: two end positions in which one limit switch is actuated and an intermediate position in which neither limit switch is actuated. In this intermediate position, both possible flow paths through the gate are OPEN, so the display for the gate must indicate that both paths are OPEN. The display may do this in any of several ways, such as by turning on indicators which show the paths as OPEN or by turning off indicators which show the paths as CLOSED. The display for a turnhead placed in an intermediate position where no limit switches are actuated may instead show all possible flow paths as CLOSED. In no case shall a display show one flow path OPEN and the rest CLOSED when, in fact, more than one flow path is open.

d. Testing of limit switch operation requires two official personnel communicating by radio: one in the elevator at the location of the device being tested and one observing the corresponding display element in the control room or inspection lab. Ask elevator personnel to move the device into each position shown on the table described in (c) above. Visually verify that the device is in the correct position, and record on the table whether the display indicates correctly. If the display is incorrect, record the observed state of the indicating elements. After the test is completed, record the pass/fail status of the diversion point on the checklist. Stopping an electric or hydraulic device in an intermediate position may be accomplished by cutting power to the electric motor or by closing the valves to the hydraulic cylinder. Moving a pneumatic device to an intermediate position may require removing air pressure from the cylinder and moving the device manually.

e. The checklist of all shipping bin gate permissives developed in 5.a.3. shall show the date of verification and the name or initials of the personnel performing the test. A shipping bin gate permissive is a control that lets FGIS prevent the bottom gate on a shipping bin from being opened until the grain in the bin has been graded and the flow path is set to the correct location. The permissive may be operated by a key

switch on a control panel or by setting the shipping bin status on a computer workstation. In the latter case, the status will commonly be one of the following: Fill, Hold, Ship, Reject, Weighback, or Transfer, with "Hold" status keeping the gate closed at all times. If the status does not follow this pattern, refer to the standard operating procedure for the elevator's automated weighing system. The shipping bin may have a display element to inform FGIS personnel of the current state of the permissive, such as an indicator light or a status indication on the shipping bin icon, or it may be necessary to view the position of the key switch.

f. Testing of shipping bin gate permissives requires two official personnel communicating by radio: one in the elevator at the location of the bin being tested and one in the control room or inspection lab. Test the gate permissive by setting the key switch to the "hold" position or by setting the shipping bin status to "hold" and asking elevator personnel to attempt to open the shipping bin gate from the elevator control room. Testing of any electronic logic associated with a permissive is not covered under this directive.

g. The checklist of critical bin empty sensors developed in 5.a.4. shall show the date of verification and the name or initials of the personnel performing the test. Testing of empty indicators requires two official personnel communicating by radio: one in the elevator at the location of the bin being tested and one observing the corresponding display element in the control room or inspection lab. Test the bin empty sensor when the bin is being emptied. Physically verify that the discharge stops and the bin is empty very soon after the indicator changes from "not empty" to "empty." Make sure that elevator personnel do not have to activate the bin empty sensor by hand, such as by banging on a stuck sensor.

h. Conduct the tests during normal operations or with test grain.

i. If a gate is found leaking or a limit switch is incorrectly wired, issue a “Repair/Modification Notice, FGIS-9601” and immediately take the gate out of service until repaired. If it is impractical to take gates out of service, rejected shipping bin grain shall be weighed back to the house for accurate certification of weight.

6. INSTRUCTIONS FOR SPECIFIC TYPES OF GATES

a. SLIDE GATES can be used to stop or throttle the flow of grain. The bottom gates of shipping bins are of this type. A pair of slide gates at an inverted “Y” connection can be used to direct grain into one of two ducts. If both gates are closed, the grain flow is blocked. If both gates are open, grain flows into both ducts. Properly functioning **pneumatic** slide gates have only two stable positions: fully open and fully closed. They may, however, get stuck partway open. Such a

gate can also be manually positioned partway open if the gate's air supply is cut off. **Electric** slide gates may be positioned partway open by their controls.

A slide gate is normally equipped with two limit switches: one actuated when the gate is fully closed; the other actuated when the gate is fully open. The fully-closed limit switch must be present as it is required for official flow path monitoring; however, except in certain circumstances, the fully-open limit switch is not required by GIPSA. A pair of slide gates used to divert grain between two flow paths normally has four limit switches, two of which are the required switches which indicate when each slide is fully closed.

Note that the minimum number of limit switches required to adequately monitor any diverting device of any type is equal to the number of its outlets.

Since the flow of grain is stopped only when the gate is fully closed, the display element which indicates the gate is **closed** must be activated **only** by the **fully closed** limit switch. On some shipping bins, the bottom gate is required to be pulled 100% open to purge the shipping bin before it may be filled. A display element which indicates that the gate is **100% open** must be activated **only** by the **fully open** limit switch.

Some hoppers or garners may have several bottom gates which are opened simultaneously to allow faster emptying, but only one display element for all of the gates. In such a case, each gate must have its own set of limit switches. The display element which indicates the gates are **closed** must do so **only** when the **fully closed** limit switches on **all** of the gates are activated. Any display element which indicates the gates are **100% open** must do so **only** when the **fully open** limit switches on **all** of the gates are activated.

b. FLAP GATES or BASKET VALVES are used to direct grain to one of two ducts. If the gate is stuck partway between the two end positions, grain flows into both ducts.

A flap gate or basket valve must have two limit switches: one activated when the gate is in end position #1; the other activated when the gate is in end position #2. Since grain can flow into both ducts when the gate is between the two end positions, the display elements must indicate that **both ducts are open** when neither limit switch is activated.

c. DISTRIBUTORS or TURNHEADS are used to direct grain to one of many ducts. Ideally, the flow of grain is **blocked** when the distributor or turnhead is positioned between two ducts. However, some devices allow grain to flow into **both** ducts instead.

A distributor or turnhead must have one limit switch for each outlet duct and it must be activated when the distributor or turnhead is properly aligned with that duct. Normally the limit switch for a particular duct is activated by contact with an arm which moves with the distributor. This arm must be properly aligned with the distributor, or the positions indicated by the limit switches will not be accurate. The display element which indicates a duct is selected must be activated **only** by **that duct's** limit switch. All such display elements must be **off** when the distributor is between positions. Grain flowing when all of the display elements are off is an alarm condition.

d. PROPORTIONAL SLIDE GATES may be precisely positioned partially open to regulate the flow rate of grain so it does not overload a conveyor or leg. These gates are frequently used at the bottom of shipping bins. A pair of proportional gates in an inverted "Y" configuration may be used to divide a grain stream between two destinations, such as two holds of a ship. This configuration may be found in a gallery. The position of the gate may be indicated by a CABLE-ACTUATED POTENTIOMETER ("pot"), which has a thin steel cable wrapped around a spring-loaded reel. The free end of the cable is connected to the gate. As the gate moves, it either pulls more cable from the reel or allows the reel to retract. A variable resistance element inside the potentiometer measures the degree of rotation of the reel and converts it to a proportional voltage, which is used as feedback by the control system.

The GIPSA flow monitoring system will normally be concerned only that the gate is fully closed, fully open, or at some specific intermediate position. The gate should be equipped with limit switches at those specific positions so the potentiometer can be ignored. If the limit switches are absent, the position of the gate must be sensed by an analog input device, such as an analog-to-digital converter or a comparator, which receives the potentiometer output directly and is under GIPSA control. Testing the potentiometer involves moving the gate to each position of interest. If the indicating device is a light, it should be lighted only when the gate is in the desired position. If the indicating device is a numeric readout, record its value when the gate reaches the desired position. If the value has changed since the previous test or if the readout does not change smoothly, note this and notify the field office and headquarters.

7. SAFETY

Exercise caution around machinery. When testing the equipment, do not place your body in possible pinch points. Avoid contact with belts, drags, legs, etc., even when they are stopped, as machinery may start suddenly without warning. Avoid contact with electrical wiring or leaking hydraulic lines. Flow control devices should be positioned by elevator personnel, who may need to follow the location's "Lock Out/Tag Out" procedures during the test.

8. COMMENTS

Some elevators use proximity switches as limit switches. A proximity switch is essentially a metal detector. Instead of being actuated by a mechanical arm, it is actuated when a large piece of metal comes sufficiently close to the switch.

Find out whether gates and limit switches are already described by the elevator's maintenance department. Contact elevator management to see if they will share gate and switch information. This could save the time for developing new schematic diagrams or numbering systems. However, carefully evaluate such records for how they pertain to the official weighing system and for omissions.

When limit switches or indicators are found incorrectly wired, answer the questions suggested in Chapter 1 of the Weighing Handbook for "Unauthorized Seal or Lock Breakage Procedures" before issuing Form FGIS-9601. This method will most likely assure suitable measures are taken to correct problems.

9. QUESTIONS AND RECORD KEEPING

Checklists of critical diversion points, shipping bin permissives, and bin level sensors will require 180 days to fill out. During this time, they shall be maintained at the facility along with the tables of gate positions and indicator elements for each diversion point. If new critical monitoring points are added or existing ones are modified, the changes shall be included on attachments to the checklists, new tables of indicator elements and gate positions shall be made, and the new or modified equipment shall be tested as soon as possible. At the end of each 180-day cycle, the completed checklists and their associated

tables will be filed at the field office. Facilities served by Delegated States will file their records with the State office and make copies for their supervising field office. Field offices will review the checklists and tables. Until further notice, copies will also be forwarded to the Weighing and Equipment Branch. The office which generates the checklists and tables is the office of record and will store them for 5 years. Direct questions to the Weighing and Equipment Branch at (202) 720-0262.

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Scale 2 System Gate Leak Diagram

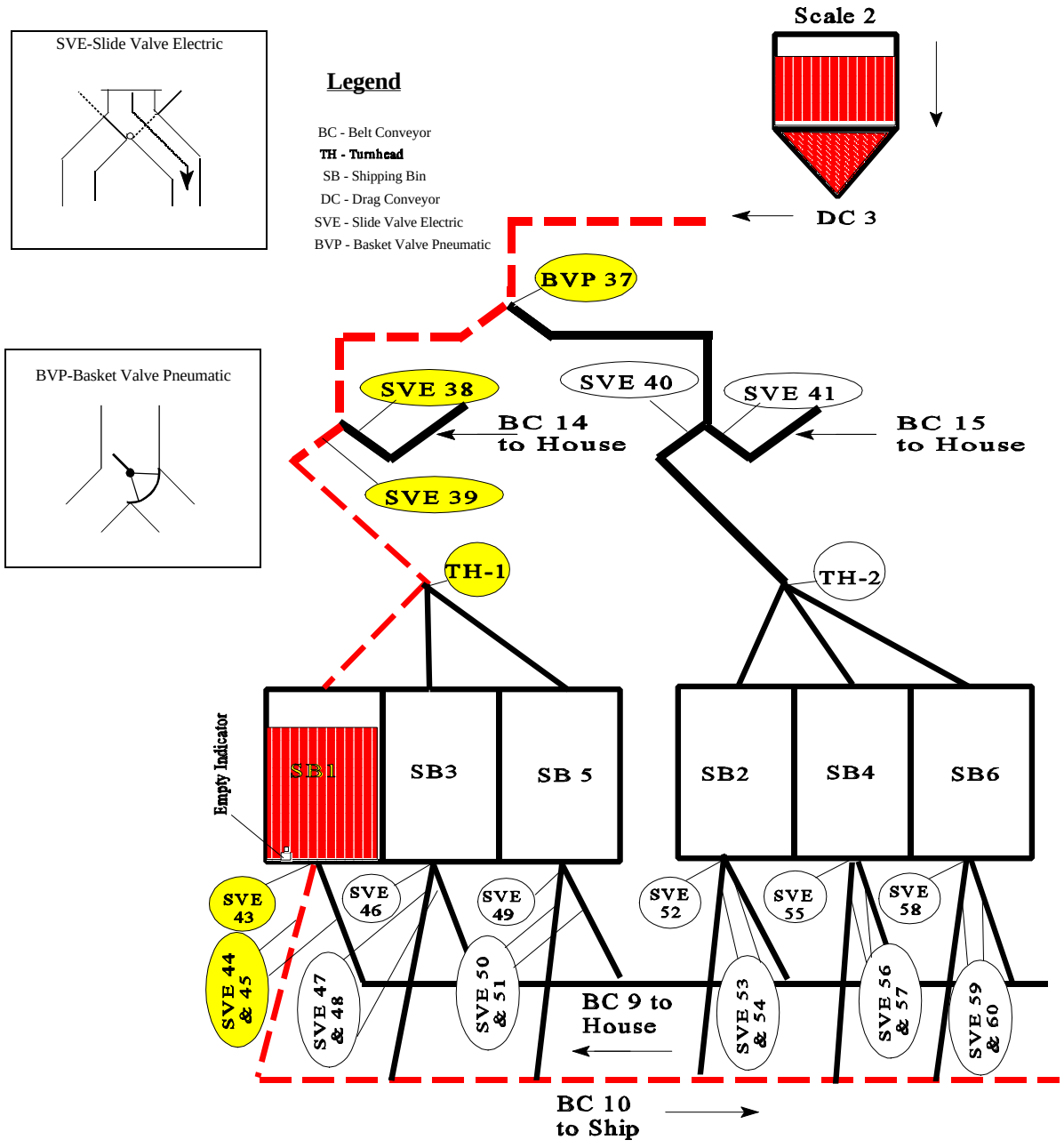

Table 1. Scale 2 System Critical Monitoring Point Checklist[1]
(See 5.a.(1) and 5.b.)

Location	Date	Status	Initials
BVP 37 Open to TH-1 BVP 37 Closed to TH-2	2/28/97	OK	MB
BVP 37 Closed to TH-1 BVP 37 Open to TH-2	2/28/97	OK	MB
BVP 37 Limit Switches[2]	3/21/97	OK	MB
SVE 38 Open to BC 14 SVE 39 Closed to TH-1	2/25/97	OK	NB
SVE 39 Open to TH-1 SVE 38 Closed to BC 14	2/25/97	OK	NB
SVE 38 & SVE 39 Limit Switches	2/25/97 2/28/97	**BAD**** OK	MB MB
SVE 40 Open TH-2 SVE 41 Closed to BC 15	5/5/97	OK	MB
SVE 41 Open to BC 15 SVE 40 Closed to TH-2	5/5/97	OK	MB
SVE 40 & SVE 41 Limit Switches	5/7/97	OK	MB
TH-1 set to SB 1 (may be substituted by visually verifying alignment of spouting) SB 3 Empty SB 5 Empty	4/8/97	OK	NB
TH-1 set to SB 3 SB 1 Empty SB 5 Empty	4/8/97	OK	NB
TH-1 set to SB 5 SB 3 Empty SB 1 Empty	4/8/97	OK	NB
TH-1 Limit Switches	4/8/97	OK	NB

**FGIS 9601 Issued 2/25/97, gate taken out of service. Problem corrected 2/28/97.

[1]Limit switch operation is checked using a separate table of gate positions such as Table 2 for each diversion point. The results are also summarized on the checklist for ease of reference.

Table 1. Scale 2 System Critical Monitoring Point Checklist (Cont.)

Location	Date	Status	Initials
TH-2 set to SB 2 SB 4 Empty SB 6 Empty	4/16/97	OK	MB
TH-2 set to SB 4 SB 2 Empty SB 6 Empty	4/16/97	OK	MB
TH-2 set to SB 6 SB 2 Empty SB 4 Empty	4/16/97	OK	MB
TH-2 Limit Switches	4/16/97	OK	MB
SVE 43 (SB 1) Closed and SVE 44(or 45) Open	2/25/97	OK	NB
SVE 43 Limit Switches	2/25/97	OK	NB
SVE 46 (SB 3) Closed and SVE 47 (or 48) Open	5/15/97	OK	MB
SVE 46 Limit Switches	5/15/97	OK	MB
SVE 49 (SB 5) Closed and SVE 50 (or 51) Open	7/21/97	OK	MB
SVE 49 Limit Switches	7/21/97	OK	MB
SVE 52 (SB 2) Closed and SVE 53 (or 54) Open	3/6/97	OK	NB
SVE 52 Limit Switches	3/6/97	OK	NB
SVE 55 (SB 4) Closed and SVE 56 (or 57) Open	6/17/97	OK	NB
SVE 55 Limit Switches	6/17/97	OK	NB
SVE 58 (SB 6) Closed and SVE 59 (or 60) Open	4/8/97	OK	MB
SVE 58 Limit Switches	4/8/97	OK	MB
SVE 43 (SB 1) Open and SVE 45 Closed	5/20/97	OK	NB
SVE 43 (SB 1) Open and SVE 44 Closed	5/20/97	OK	NB
SVE 44 & 45 Limit Switches	4/29/97	OK	MB

Table 1. Scale 2 System Critical Monitoring Point Checklist (Cont.)

Location	Date	Status	Initials
SVE 46 (SB 3) Open and SVE 48 Closed	4/18/97	OK	MB
SVE 46 (SB 3) Open and SVE 47 Closed	4/18/97	OK	MB
SVE 47 & 48 Limit Switches	4/18/97	OK	MB
SVE 49 (SB 5) Open and SVE 51 Closed	3/25/97	OK	NB
SVE 49 (SB 5) Open and SVE 50 Closed	3/25/97	OK	NB
SVE 50 & 51 Limit Switches	3/25/97	OK	NB
SVE 52 (SB 2) Open and SVE 54 Closed	5/2/97	OK	NB
SVE 52 (SB 2) Open and SVE 53 Closed	5/2/97	OK	NB
SVE 53 & 54 Limit Switches	5/2/97	OK	NB
SVE 55 (SB 4) Open and SVE 57 Closed	5/14/97	OK	MB
SVE 55 (SB 4) Open and SVE 56 Closed	5/14/97	OK	MB
SVE 56 & 57 Limit Switches	5/14/97	OK	MB
SVE 58 (SB 6) Open and SVE 60 Closed	6/12/97	OK	NB
SVE 58 (SB 6) Open and SVE 59 Closed	6/12/97	OK	NB
SVE 59 & 60 Limit Switches	6/12/97	OK	NB

Table 2. BVP 37 Limit Switch Check Table
(See 5.a.(2))

Settings	Indicators		Checked		
	BVP 37 to TH-1 Open	BVP 37 to TH-2 Open	Date	Status	Initials
BVP 37 to TH-1	On	Off	3/21/97	Okay	MB
BVP 37 in Intermediate Position	On	On	3/21/97	Okay	MB
BVP 37 to TH-2	Off	On	3/21/97	Okay	MB

Table 3. SVE 38&39 Limit Switch Check Table
(See 5.a.(2))

Settings		Indicators				Checked		
SVE 38	SVE 39	SVE 38 Open	SVE 39 Open	SVE 38 FO	SVE 39 FO	Date	Status	Initials
FC	FC	Off	Off	Off	Off	2/25/97	Okay	MB
FC	Middle	Off	On	Off	Off	2/25/97	Okay	MB
FC	FO	Off	On	Off	On	2/25/97	Okay	MB
Middle	FO	**X** On **X**	On	Off	On	2/25/97	**BAD**	MB
Middle	Middle	**X** On **X**	On	Off	Off	2/25/97	**BAD**	MB
Middle	FC	**X** On **X**	Off	Off	Off	2/25/97	**BAD**	MB
FO	FC	On	Off	On	Off	2/25/97	Okay	MB
FO	Middle	On	On	On	Off	2/25/97	Okay	MB
FO	FO	On	On	On	On	2/25/97	Okay	MB

Table 4. Scale 2 System Shipping Bin Gate Permissive Checklist
(See 5.e.)

Location	Settings GIPSA Controls[3]	Setting Elevator Controls[4]	Checked		
			Date	Initials	Status
SVE 43	Hold	Reclaim	2/25/97	MB	Okay
SVE 46	Hold	Reclaim	5/15/97	MB	Okay
SVE 49	Hold	Reclaim	7/21/97	MB	Okay
SVE 52	Hold	Reclaim	3/6/97	MB	Okay
SVE 55	Hold	Reclaim	6/17/97	MB	Okay
SVE 58	Hold	Reclaim	4/8/97	MB	Okay

Table 5. Bin Empty Indicator Verification
(See 5.g.)

Shipping Bin Empty Sensors						
Location	1	2	3	4	5	6
Status	OK	OK	OK	OK	OK	OK
Date	8/5/97	7/19/97	3/22/97	5/20/97	6/11/97	3/19/97
Initials	MB	MB	NB	NB	NB	MB

[3]Put the switch (permissive) under Federal supervision in the neutral or "HOLD" postion.

[4]Go into the elevator control room and have them attempt to activate the gate back to the house while the permissive is set to "HOLD", e.g., SVE 45.