

SECTION V

CONTROL EQUIPMENT AND "REAL TIME" INSTRUMENTATION

### A. PURPOSE

We have compiled this section of the test plan to describe control equipment, "Real Time" instrumentation, and the interfaces between them. This equipment will be used for Propellant Loading System test control.

### B. SUMMARY

Specific equipment covered in this section has been summarized in Table V-a. Figure V-a shows interfaces between the instrument racks and control consoles. All "Real Time" instruments are listed in Table V-b, which also shows interconnections between origin and display of every instrument point. A detailed listing of instrumentation requirements is covered in Table V-c.

### C. DESCRIPTION OF INSTRUMENTATION LAYOUT

PLS-OSTF instrumentation falls into four categories:

1. Basic PLS instrumentation and systems controls needed to operate the facility. This equipment will be installed partly by the general contractor and partly by The Martin Company. It includes the Propellant Loading and Pressurization Systems Pallet (No. 2020).

2. OSTF test instrumentation provided by The Martin Company as part of its test instrumentation contract. This equipment will be installed after the Air Force acceptance of the PLS. It includes all recording equipment such as:

- a. Oscillographs (CEC pallet 5650),
- b. Strip Charts (Pallet 5630),
- c. Event Recorders (Pallet 5710),
- d. Direct Writing Recorders  
(Pallet 5640), and
- e. Event Recorders  
(Equipment Terminal).

ADL requirements for this instrument category have been covered in Section IV.

3. ADL-provided controls and instrumentation necessary for ADL test operation. This equipment will be installed by ADL prior to PLS acceptance, since it does not include any sensors or other equipment directly tied to the PLS. All connections to the ADL equipment will be electrical and will be made to either the PL & PS Pallet (2020) or to the Martin test instrumentation. The ADL-provided equipment includes:

- a. PLS Test Control Panel,
- b. Test Selector Panel, and
- c. Fuel Control, Checkout, and Test Panels.

4. Controls and associated instrumentation, as well as test instrumentation required for the simulated missile tanks. The tanks and tank-mounted instruments will be provided by The Martin Company as part of its SM tank contract. The instrumentation connections and recorders will be provided under the Martin test instrumentation contract as for item (2) above.

#### D. UTILIZATION OF CONTROL EQUIPMENT

Three locations will be used for test control:

1. The Command Control Center, used for all operational transfer tests;
2. The Equipment Terminal, used for missile fuel loading and limited subsystem tests requiring the use of the PL & PS Pallet; and
3. The Propellant Terminal, or entrance to same, for initial safety tests.

The specific location of test control for each ADL test has been shown in Table V-f. The table also identifies specific control equipment in operation for each test.

In order to achieve necessary variations from normal operation, additional test controls have been provided. These are included in the PLSTest Control Panel (Control Center) and in the Test Selector Panel in the equipment terminal. Variations, such as helium transfer in the absence of liquid oxygen, will be set up on the Test Selector Panel prior to test. Normal operation calls for the manual reconnect of umbilicals. ADL test plans (with one exception) call for signal simulation of the disconnect operation. The simulation will be set up on the Test Selector Panel. Actual unload operation will then be initiated from the PLS Test Control Panel.



## E. DESCRIPTION OF CONTROL EQUIPMENT

### 1. PLS Test Control Panel

The PLS Test Control Panel, furnished by ADL, will operate the propellant loading system remotely from the Control Center. This panel will take the place of the Launch Control Console, which will not be available for these tests. It will also provide the additional controls, system status indication, and "Real Time" test instrumentation required for the operation of the PLS performance tests. The PLS Test Control Panel will be a desk-type console which will be installed near the Launch Control Console Station.

The operating panel on this unit will be divided into sections for:

- a. Countdown progress and control,
- b. LO<sub>2</sub> system indicators,
- c. Missile helium indicators, and
- d. Time indicators.

The "Real Time" data is to be displayed on this panel and on The Martin Company Strip Charts Rack No. 5630. The "real time" data will be the only data available to the test conductor during the test and will form the basis for his decisions.

The general physical layout of the PLS Test Control Panel is shown in Figures V-b through V-f. The individual controls and indications to be provided on the PLS Test Control Panel are listed in Table V-c.

### 2. Strip Charts 5630

The Strip Charts identified as "Rack 5630" will be provided by The Martin Company as part of its test instrumentation contract. While all other recorded information falls in the "Quick Look" category, the data on Rack 5630 is "Real Time" information displayed by means of strip-chart recorders. This data will provide the test conductor with information and supplement the PLS Test Control Panel display. The strip-chart recorded trend information has been summarized in Table V-d. It has also been covered in Section IV.

### 3. Test Selector Panel

The Test Selector Panel furnished by ADL will be used for the pretest selection of the operating sequence for individual test runs of the propellant loading system. This panel will provide a centralized location for making necessary circuit selections. It will be rack-mounted and located near the PL & PS Sequencer in the equipment terminal.

The sequence selection capability will provide means for:

- a. Independent operation of the LO<sub>2</sub> system,
- b. Holding the LO<sub>2</sub> sequence in the cooldown phase,
- c. Independent operation of the helium system,
- d. Holding the helium pressure at 500 psi, and
- e. Simulating the disconnection of LO<sub>2</sub> and cold helium umbilicals.

The arrangement of the controls and indications to be provided on the Test Selector Panel are shown in Figure V-g.

### 4. The Propellant Loading and Pressurization System (PL & PS 2020) Sequencer

The PL & PS Sequencer, furnished by The Martin Company, will program and check the operation of the propellant loading system. This unit will be part of the rack-type pallet 2020, which will be located in the equipment terminal.

When the mode selector switch on this unit is placed in the "Launch" position, the propellant loading operation can be controlled remotely from the PLS Test Control Panel in the Control Center. When the mode selector switch is in the "Checkout" position, the checkout panels on the PL & PS unit will be activated. For the PLS tests, the checkout mode will provide the following functions:

- a. Ability to perform a dry run of a planned test by electrically simulating command and process signals and operating remotely controlled valves in the proper sequence.
- b. Ability to operate individually all remotely controlled valves and pumps, irrespective of sequence, by depressing and holding panel push buttons.
- c. Detailed status information of all valve positions plus an indication of a malfunction.

### 5. Fuel Control, Fuel Checkout, and Fuel Test Panels

The Fuel Control, Fuel Checkout, and Fuel Test Panels are furnished by ADL and are used to operate the fuel system. They are to be located on an ADL-provided rack, together with the Test Selector Panel. The rack will be located near PL & PS Launch Control and Checkout equipment in the equipment terminal. The fuel system of OSTF differs from those at TBF and OBF. The ADL fuel panels have been specifically designed for OSTF operation and will remain as a part of the basic OSTF.

Fuel loading and unloading will be considered a maintenance operation which will be initiated and monitored from the PL & PS and Fuel Control Panels. These operations will be accomplished outside of the countdown period and will not be programmed automatically. The procedure, however, will be simplified wherever practicable by combining control functions to minimize the number of controls. Switches for the operation of individual valves during maintenance will be grouped in the Fuel Checkout Panel. Position-indicating lights will be located with these switches. Fuel ullage pressure and flood signals displayed on the Fuel Test Panel are shown in Table V-e. The arrangement of the controls and indicators on the Fuel Checkout, Fuel Test, and Fuel Control Panels is shown in Figures V-h, V-i, and V-j, respectively.

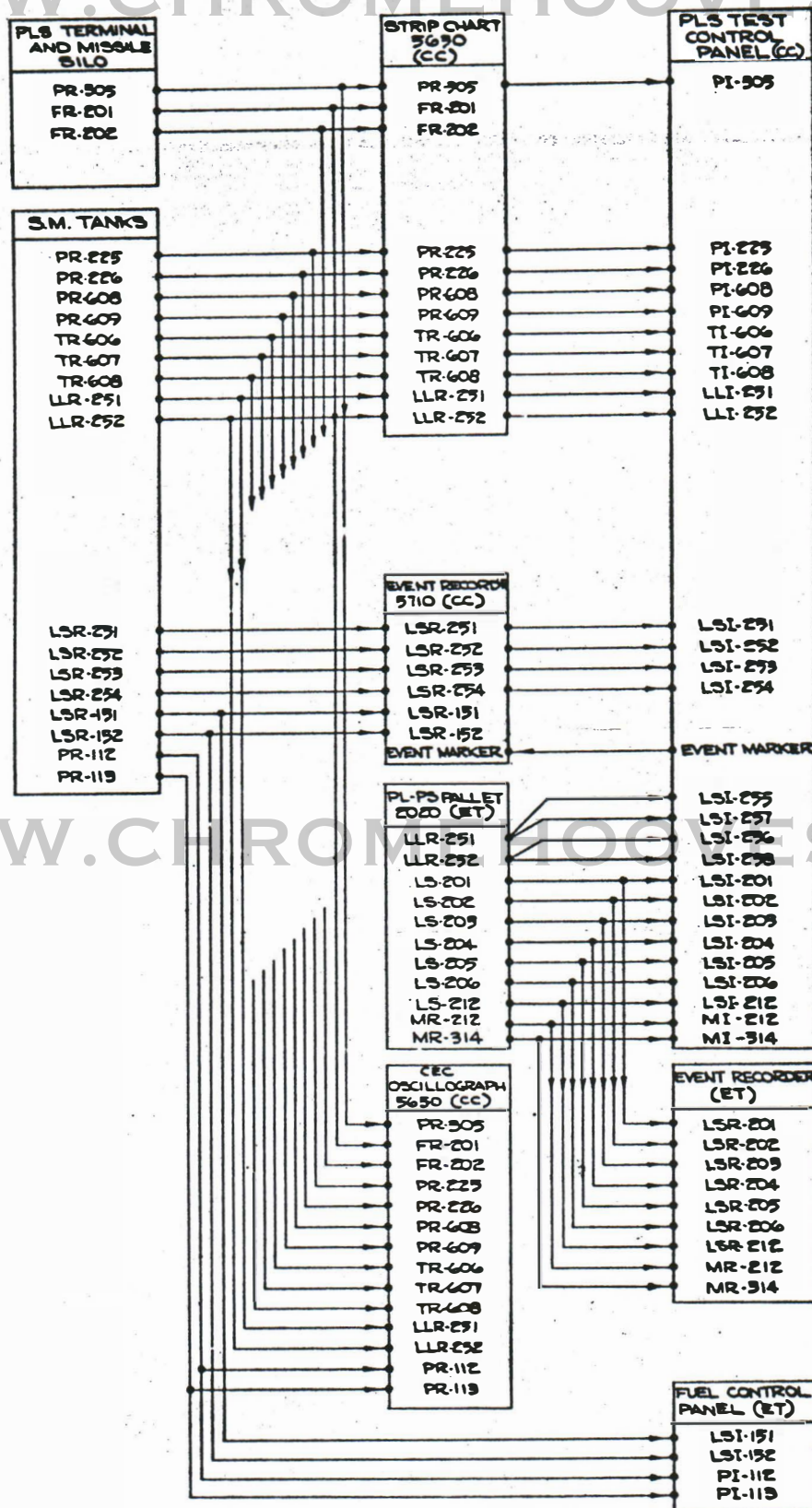
### 6. Equipment and Facilities Console

The Equipment and Facilities Console, furnished by The Martin Company as part of basic OSTF equipment, will operate the ventilating, gas-detecting, and fire-fighting systems. A detailed description of this unit is not available at this time.



TABLE V-aCONTROL EQUIPMENT

| <u>Item</u> | <u>Unit</u>                         | <u>Location</u>       | <u>Justification</u>            | <u>Page<br/>Reference</u> |
|-------------|-------------------------------------|-----------------------|---------------------------------|---------------------------|
| 1.          | PLS Test Control Panel              | Control Center        | Test Plan I-5<br>Requirements   |                           |
| 2.          | Strip Charts (5630)                 | Control Center        | OSTF Test In-<br>strumentation  |                           |
| 3.          | Test Selector Panel                 | Equipment<br>Terminal | Test Plan I-5<br>Requirements   |                           |
| 4.          | PL & PS Launch Control              | Equipment<br>Terminal | Basic OSTF<br>Equipment         |                           |
| 5.          | Fuel Control & Check-<br>out Panels | Equipment<br>Terminal | Basic OSTF<br>Equipment         |                           |
| 6.          | Fuel Test Panel                     | Equipment<br>Terminal | OSTF Test In-<br>strumentation  |                           |
| 7.          | Equipment & Facility<br>Console     | Control Center        | Basic OSTF In-<br>strumentation |                           |



PLS REAL TIME INSTRUMENTATION LAYOUT

TABLE V-b

Table V-b

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PLS "REAL TIME" INSTRUMENTATION LAYOUT



TABLE V-c

CONTROLS AND INDICATORS ON PLS TEST CONTROL PANELLO<sub>2</sub> SUB PANEL

178

| <u>Panel Indicator</u> <sup>1</sup> | <u>Sensor or Signal Origin</u> <sup>2</sup> | <u>Sensor Location</u>                 | <u>Purpose</u>                      | <u>Signal Color/Range</u> | <u>Source of Signal</u> <sup>3</sup> |
|-------------------------------------|---|--|-------------------------------------|---------------------------|--------------------------------------|
| LSI-201                             | LS-201                                      | St. I LO <sub>2</sub> Fill Line L-203  | LO <sub>2</sub> in Line             | White                     | PL-PS Pallet (2020)                  |
| LSI-202                             | LS-202                                      | St. II LO <sub>2</sub> Fill Line L-204 | LO <sub>2</sub> in Line             | White                     | PL-PS Pallet (2020)                  |
| LSI-203                             | LS-203                                      | St. I LO <sub>2</sub> Umbilical L-203  | LO <sub>2</sub> in Line             | White                     | PL-PS Pallet (2020)                  |
| LSI-204                             | LS-204                                      | St. II LO <sub>2</sub> Umbilical L-204 | LO <sub>2</sub> in Line             | White                     | PL-PS Pallet (2020)                  |
| LSI-205                             | LS-205                                      | St. I LO <sub>2</sub> Drain L-216      | LO <sub>2</sub> in Line             | White                     | PL-PS Pallet (2020)                  |
| LSI-206                             | LS-206                                      | St. II LO <sub>2</sub> Drain L-215     | LO <sub>2</sub> in Line             | White                     | PL-PS Pallet (2020)                  |
| LSI-251                             | LSR-251                                     | Top of St. I LO <sub>2</sub> SMT       | SMT Flooded                         | Red                       | C.C. Event Recorder (5710)           |
| LSI-252                             | LSR-252                                     | Top of St. II LO <sub>2</sub> SMT      | SMT Flooded                         | Red                       | C.C. Event Recorder (5710)           |
| LSI-253                             | LSR-253                                     | St. I LO <sub>2</sub> SMT Entry        | LO <sub>2</sub> Entering SMT        | White                     | C.C. Event Recorder (5710)           |
| LSI-254                             | LSR-254                                     | St. II LO <sub>2</sub> SMT Entry       | LO <sub>2</sub> Entering SMT        | White                     | C.C. Event Recorder (5710)           |
| LLI-251                             | LLR-251<br>Bogue Sensor                     | St. I LO <sub>2</sub> SMT              | SMT LO <sub>2</sub> Level Indicator | -                         | C.C. Strip Chart (5630)              |
| LLI-252                             | LLR-252<br>Bogue Sensor                     | St. II LO <sub>2</sub> SMT             | SMT LO <sub>2</sub> Level Indicator | -                         | C.C. Strip Chart (5630)              |
| LSI-255                             | LLR-251                                     | St. I LO <sub>2</sub> SMT 95% Level    | SMT 95% Full                        | White                     | PL-PS Pallet (2020)                  |

TABLE V-c (Continued)

LO<sub>2</sub> SUB PANEL (Continued)

| <u>Panel Indicator<sup>1</sup></u> | <u>Sensor or Signal Origin<sup>2</sup></u> | <u>Sensor Location</u>                          | <u>Purpose</u>                           | <u>Signal Color/Range</u> | <u>Source of Signal<sup>3</sup></u> |
|------------------------------------|--|---|--|---------------------------|-------------------------------------|
| LSI-256                            | LLR-252                                    | St. II LO <sub>2</sub> SMT 95% Level            | SMT 95% Full                             | White                     | PL-PS Pallet (2020)                 |
| LSI-257                            | LLR-251                                    | St. I LO <sub>2</sub> SMT 100.5% Full           | SMT 100.5% Full                          | White                     | PL-PS Pallet (2020)                 |
| LSI-258                            | LLR-252                                    | St. II LO <sub>2</sub> SMT 100.5% Full          | SMT 100.5% Full                          | White                     | PL-PS Pallet (2020)                 |
| MI-212                             | MR-212                                     | P-201 LO <sub>2</sub> Unloading Pump Starter    | Pump on/off indicator                    | White                     | PL-PS Pallet (2020)                 |
| MI-314                             | MR-314                                     | FCV 301 LO <sub>2</sub> Transfer Pressure Valve | Propellant Terminal Trouble <sup>4</sup> | Red                       | PL-PS Pallet (2020)                 |
| LSI-212                            | LSR-212                                    | L-338 above St. II Drain Catch Pot              | Suction LO <sub>2</sub> for Pump P-201   | Red                       | PL-PS Pallet (2020)                 |
| PI-305                             | PR-305                                     | LO <sub>2</sub> Storage Tank Vent L-303         | Storage Tank Ullage Pressure             | 0-100 psig                | C.C. Strip Chart                    |
| PI-225                             | PR-225                                     | St. I LO <sub>2</sub> SMT                       | SMT Ullage Pressure                      | 0-40 psig                 | C.C. Strip Chart                    |
| PI-226                             | PR-226                                     | St. II LO <sub>2</sub> SMT                      | SMT Ullage Pressure                      | 0-30 psig                 | C.C. Strip Chart                    |

HELIUM SUB PANEL

|        |                  |  |                        |                 |                  |
|--------|------------------|--|------------------------|-----------------|------------------|
| TI-606 | TR-606 or TR-608 | St. I Helium In-Flight Bottle #1 or St. I Helium In-Flight Bottle #2 | Helium Gas Temperature | -150 to -300° F | C.C. Strip Chart |
| TI-607 | TR-607           | St. II Helium In-Flight Bottle                                       | Helium Gas Temperature | -150 to -300° F | C.C. Strip Chart |

TABLE V-c (Continued)HELIUM SUB PANEL (Continued)

| <u>Panel Indicator</u> <sup>1</sup> | <u>Sensor or Signal Origin</u> <sup>2</sup> | <u>Sensor Location</u>          | <u>Purpose</u>      | <u>Signal Color/Range</u> | <u>Source of Signal</u> <sup>3</sup> |
|-------------------------------------|---|---------------------------------|---------------------|---------------------------|--------------------------------------|
| PI-608                              | PR-608                                      | St. I Helium In-Flight Bottle   | Helium Gas Pressure | 500 to 3500 psig          | C. C. Strip Chart                    |
| PI-609                              | PR-609                                      | St. II Helium In-Flight Bottles | Helium Gas Pressure | 500 to 3500 psig          | C. C. Strip Chart                    |

TIME SUB PANEL

| <u>Panel Indicator</u> | <u>Signal From:</u>         | <u>Purpose</u>             | <u>Range</u>                 |
|------------------------|-----------------------------|----------------------------|------------------------------|
| Real Time Clock        | Operated Manually           | Total Elapsed Time of Test | 0 to several hours           |
| Countdown time Clock   | Actuated by Command Signals | Countdown Time             | Full Range of Countdown Time |

CONTROL SUB PANEL (SWITCHES)

| <u>Panel Switch</u> | <u>Signal Sent To:</u>  | <u>Purpose</u>  |
|---------------------|-------------------------|---|
| Power On            | Test Control Panel      | To apply power to Test Control Panel                                  |
| Load                | PL and PS (2020 Pallet) | To execute "Load" command to start LO <sub>2</sub> and Helium Loading |
| Stop Topping        | PL and PS (2020 Pallet) | To execute "Stop Topping" command                                     |
| Shutdown            | PL and PS (2020 Pallet) | To execute "Shutdown" command   |



TABLE V-c (Continued)

CONTROL SUB PANEL (SWITCHES) (Continued)

| <u>Panel Switch</u>              | <u>Signal Sent To:</u>                         | <u>Purpose</u>   |
|----------------------------------|--|--|
| Unload Helium                    | PL and PS (2020 Pallet)                        | To execute "Unload Helium" command   |
| Helium Recovered                 | PL and PS (2020 Pallet)                        | To stop Helium unload  |
| Unload LO <sub>2</sub>           | PL and PS (2020 Pallet)                        | To execute "Unload LO <sub>2</sub> " command                                       |
| Restore Sequence LO <sub>2</sub> | Test Selector Panel                            | To cancel the "Extend Cooldown" order previously placed on the Test Selector Panel |
| Restore Sequence Helium          | Test Selector Panel                            | To cancel the "Helium Low" order previously placed on the Test Selector Panel.     |
| Event Marker                     | Event Recorder (5710) in Control Center        | To enable test conductor to manually mark an event occurring during test           |
| Light test - Green               | All green lights on Test Control Panel         | To test green lights on Test Control Panel   |
| Light test - Red and White       | All red and white lights on Test Control Panel | To test red and white lights on Test Control Panel                                 |

CONTROL SUB PANEL (LIGHTS)

| <u>Panel Light</u> | <u>Signal From:</u>     | <u>Purpose</u>                                      | <u>Color</u>   |
|--------------------|-------------------------|---|--|
| Power              |                         | To indicate power applied to Test Control Panel     | Green  |
| Status             | PL and PS (2020 Pallet) | To indicate system status: ready/not ready/checkout | Green - ready<br>Red - not ready<br>Amber - checkout |

TABLE V-c (Continued)

182

CONTROL SUB PANEL (LIGHTS) (Continued)

| <u>Panel Light</u>      | <u>Signal From:</u>                     | <u>Purpose</u>  | <u>Color</u>  |
|-------------------------|---|---|---|
| Load                    | Internal signal from Test Control Panel | To indicate LO <sub>2</sub> and Helium loading started  | White   |
| LO <sub>2</sub> Loading | PL and PS (2020 Pallet)                 | To indicate St. I and St. II in rapid load status   | White   |
| LO <sub>2</sub> Loaded  | PL and PS (2020 Pallet)                 | To indicate St. I and St. II LO <sub>2</sub> SMT 100.5% full plus Helium SMT bottles loaded                   | White   |
| Stop Topping            | Internal signal from Test Control Panel | To indicate St. I and St. II topping has stopped  | Green - Stop Topping" switch enabled.<br>White - Topping has stopped  |
| Shutdown                | Internal signal from Test Control Panel | To indicate system has been shut down   | White   |
| Unload Helium           | Internal Signal from Test Control Panel | To indicate Helium unloading in progress  | Green - "Unload Helium" switch enabled<br>White - Helium recovery (or venting) in progress                    |
| Helium Recovered        | Internal signal from Test Control Panel | To indicate that Helium SMT bottles unloaded to 500 psig or less - safe for Unload LO <sub>2</sub> to proceed | Green - "Helium Recovered" switch enabled<br>White - Helium bottles unloaded to 500 psig or less <sup>5</sup> |
| Unload LO <sub>2</sub>  | Internal signal from Test Control Panel | To indicate that LO <sub>2</sub> SMT unloading is in progress   | Green - "Unload LO <sub>2</sub> " switch enabled<br>White - LO <sub>2</sub> unload g in progress              |



TABLE V-c (Continued)

CONTROL SUB PANEL (LIGHTS) (Continued)

| <u>Panel Light</u>               | <u>Signal From:</u>                        | <u>Purpose</u>   | <u>Color</u>                               |
|----------------------------------|--|--|--|
| Restore Sequence LO <sub>2</sub> | Internal signal from Test Selector Panel   | To indicate cancellation of the "Extend Cooldown" order previously placed on Test Selector Panel | White - Indicates order has been cancelled |
| Restore Sequence Helium          | Internal Sequence from Test Selector Panel | To indicate cancellation of the "Helium Low" order previously placed on Test Selector Panel      | White - Indicates order has been cancelled |
| Spare<br>(1 light)               | -  | -  | -  |

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1. See PLS Test Control Panel.
2. See ADL Flow Diagrams (Figures B-1, B-2, B-3, in Appendix B).
3. Signal Source for ADL Pickup.
4. Indicates FCV 301 wide open and no longer controlling.
5. Test conductors should normally wait until Helium SMT bottle pressure is reduced to 500 psig before depressing "Helium Recovered" switch.



**STRIP CHARTS (5630)**  
**"Real Time" Trend Information\***

| <u>Item</u> | <u>Sensor Location</u>               | <u>Test No.</u>   | <u>Purpose</u>                      | <u>Test Control Panel Indicator</u> |
|-------------|--------------------------------------|-------------------|-------------------------------------|-------------------------------------|
| TR-606      | St. I Helium Missile Tank #1         | 6.1<br>6.2<br>PLS | Temp. of helium in missile tank     | TI 606**                            |
| TR-607      | St. II Helium Missile Tank           | 6.1<br>6.2<br>PLS | Temp. of helium in missile tank     | TI 607                              |
| TR-608      | St. I Helium Missile Tank #2         | 6.1<br>6.2<br>PLS | Temp. of helium in missile tank     | TI 606**                            |
| PR-225      | St. I LO <sub>2</sub> SMT Ullage     | 2.1<br>2.2<br>PLS | LO <sub>2</sub> SMT ullage pressure | PI 225                              |
| PR-226      | St. II LO <sub>2</sub> SMT Ullage    | 2.1<br>2.2<br>PLS | LO <sub>2</sub> SMT ullage pressure | PI 226                              |
| PR-608      | St. I Helium Missile Tanks #1 and #2 | 6.1<br>6.2<br>PLS | Pressure in helium missile tanks    | PI 608                              |
| PR-609      | St. II Helium Missile Tank           | 6.1<br>6.2<br>PLS | Pressure in helium missile tank     | PI 609                              |
| LLR-251     | St. I LO <sub>2</sub> SMT            | 2.2<br>PLS        | Liquid level in LO <sub>2</sub> SMT | LLI 251                             |

TABLE V-d (Continued)

| <u>Item</u> | <u>Sensor Location</u>   | <u>Test No.</u>   | <u>Purpose</u>  | <u>Test Control Panel Indicator</u> |
|-------------|--|-------------------|---|-------------------------------------|
| LLR-252     | St. II LO <sub>2</sub> SMT   | 2.2<br>PLS        | Liquid level in LO <sub>2</sub> SMT                   | LLI 252                             |
| FR-201      | St. II L 211 downstream from<br>FCV 203                            | 2.1<br>2.2<br>PLS | Topping flow to LO <sub>2</sub> SMT                   | No Indicator                        |
| FR-202      | St. I L 210 downstream from<br>FCV 205                             | 2.1<br>2.2<br>PLS | Topping flow to LO <sub>2</sub> SMT                   | No Indicator                        |
| PR-305      | LO <sub>2</sub> Storage tank T 201 low<br>pressure side of LLI 201 | 2.1<br>2.2<br>PLS | Ullage pressure LO <sub>2</sub> storage<br>tank T 201 | PI 305                              |

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\* See Table IV-d for Range and Accuracy Details.

\*\* Temperature of helium in only one tank will be displayed on Test Control Panel.

TABLE V-e

CONTROLS AND INDICATORS ON PLS FUEL CONTROL PANEL

186

FUEL TEST PANEL

| <u>Panel Indicator</u> | <u>Sensor or Signal Origin</u> | <u>Sensor Location</u>          | <u>Purpose</u>                          | <u>Signal Color/Range</u> | <u>Source of Signal</u>       |
|------------------------|--------------------------------|---------------------------------|---|---------------------------|-------------------------------|
| LSI-151                | LSR-151                        | Top of St. I Fuel SMT           | To Indicate St. I Fuel SMT Flooded      | Red                       | Equipment Terminal Patch Rack |
| LSI-152                | LSR-152                        | Top of St. II Fuel SMT          | To Indicate St. II Fuel SMT Flooded     | Red                       | Equipment Terminal Patch Rack |
| PI-112                 | PR-112                         | St. I Fuel SMT Ullage Pressure  | To Indicate St. II Fuel Ullage Pressure | 0-30 psig                 | Equipment Terminal Patch Rack |
| PI-113                 | PR-113                         | St. II Fuel SMT Ullage Pressure | To Indicate St. I Fuel Ullage Pressure  | 0-30 psig                 | Equipment Terminal Patch Rack |



TABLE V-f

## UTILIZATION OF CONTROL EQUIPMENT

| Test Number        | Type of Test                                      | Control Equipment |             |                |               |           | Test Control Location |           |            |
|--------------------|---|-------------------|-------------|----------------|---------------|-----------|-----------------------|-----------|------------|
|                    |   | PLS Test          | Test        | Fuel           | Equipment     | Temporary | Control               | Equipment | Propellant |
|                    |   | Control Panel     | PL&PS Panel | Selector Panel | Control Panel |           |                       |           |            |
| 1. 2. 1            | Fuel transfer                                     |                   | X           |                | X             | X         |                       | X         |            |
| 1. 2. 2            | Fuel transfer as part of "PLS Test"               |                   | X           |                | X             | X         |                       | X         |            |
| 2. 1. 1 to 2. 1. 4 | LO <sub>2</sub> cooldown                          | X                 | X           | X              |               | X         |                       | X         |            |
| 2. 2. 1 to 2. 2. 6 | LO <sub>2</sub> transfer                          | X                 | X           | X              |               | X         |                       | X         |            |
| 2. 2. 7            | LO <sub>2</sub> transfer as part of "PLS Test"    | X                 | X           |                |               | X         |                       | X         |            |
| 6. 1. 1            | Helium, warm                                      | X                 | X           | X              |               |           |                       | X         |            |
| 6. 2. 1 to 6. 2. 5 | Helium simultaneous with LO <sub>2</sub> transfer | X                 | X           |                |               |           |                       | X         |            |
| SC-1. 1            |   |                   |             |                |               |           |                       |           | X          |
| SC-1. 2            |   |                   |             |                |               |           |                       |           | X          |
| SC-1. 3            |   |                   |             |                |               |           |                       |           | X          |
| SC-2. 1            |   |                   | X           |                |               |           |                       | X         |            |
| SC-2. 2            |   |                   | X           |                |               |           |                       | X         |            |
| SC-2. 3            |   |                   | X           |                |               |           |                       | X         |            |
| S-1. 1 to S-1. 4   |   |                   |             |                |               |           | X                     |           |            |
| S-2. 1 to S-2. 4   |   |                   |             |                |               |           | X                     |           |            |
| S-6. 1             |   |                   |             |                |               |           | X                     |           |            |

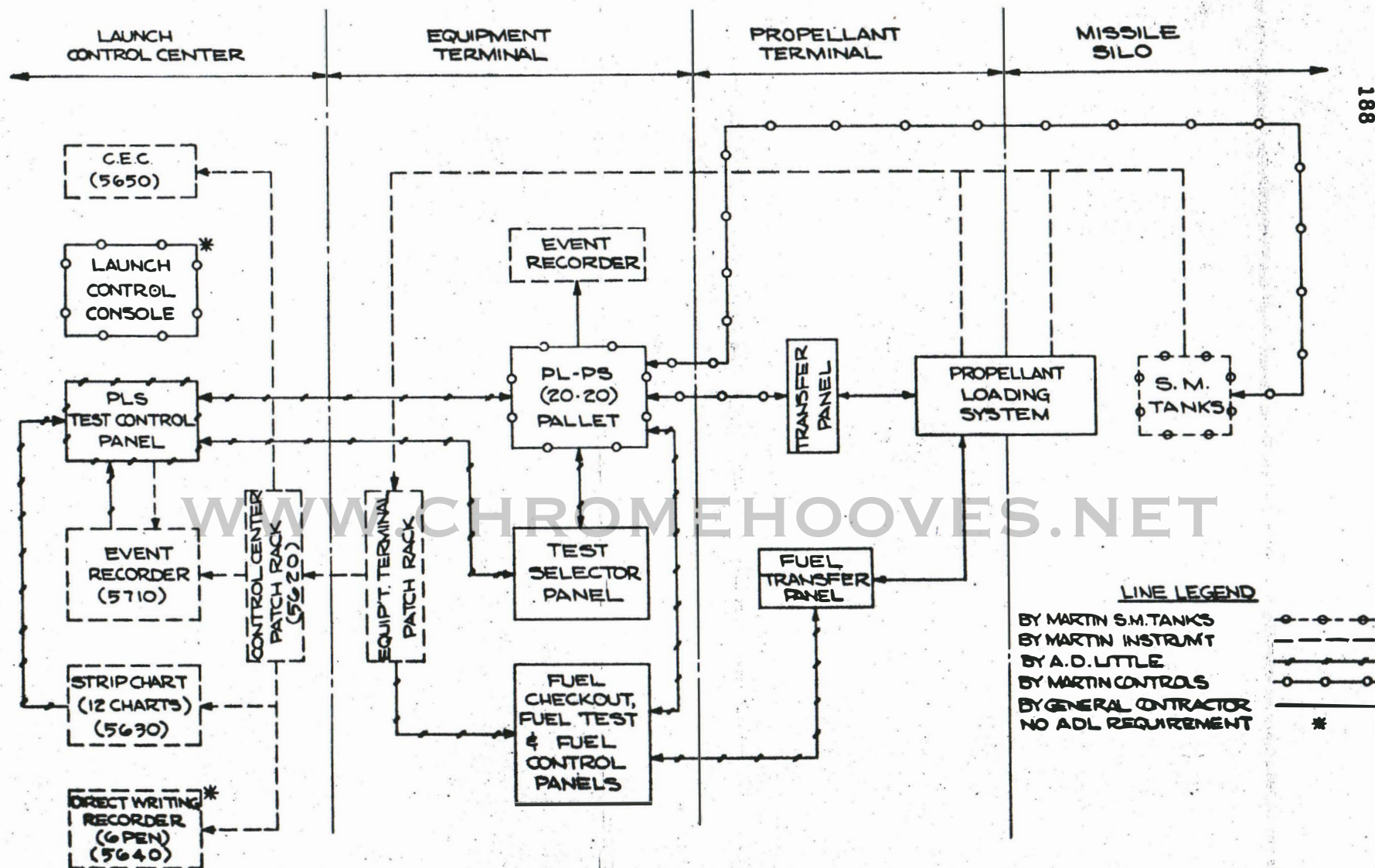


Figure T-a  
OSTF PLS SYSTEMS AND TEST INSTRUMENTATION  
INTERFACES

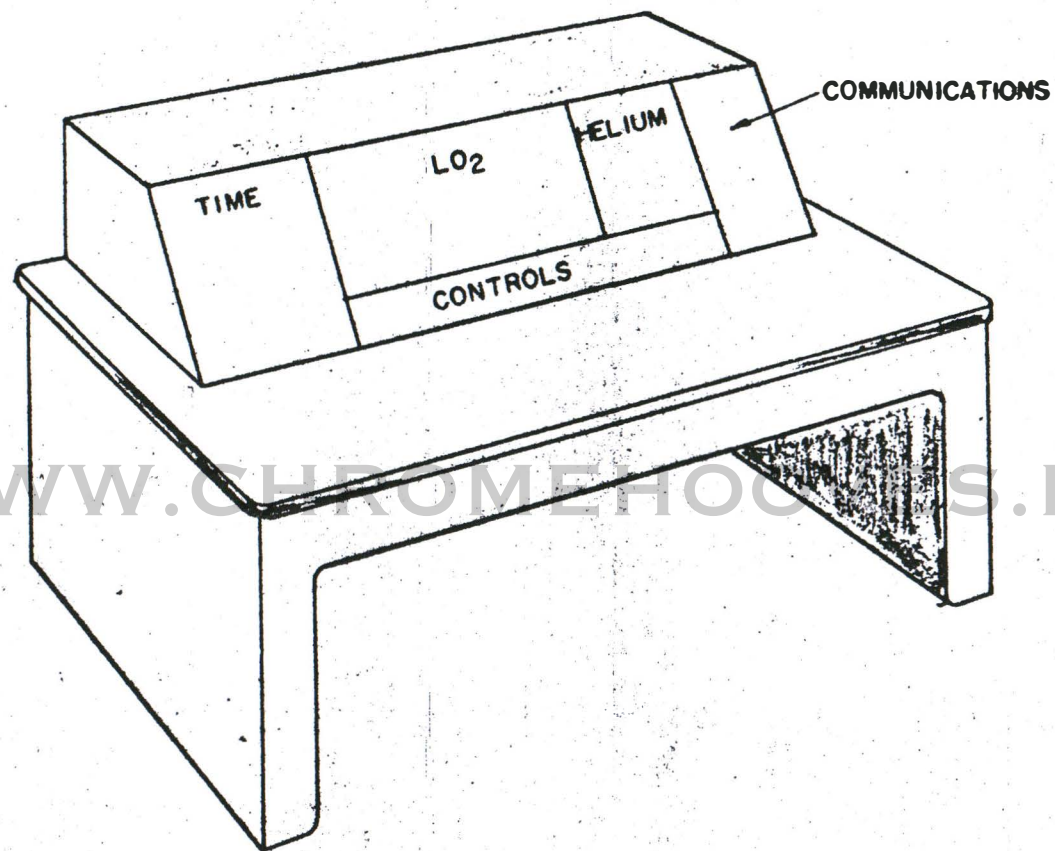


Figure Y-b  
GENERAL ARRANGEMENT OF PLS TEST CONTROL PANEL



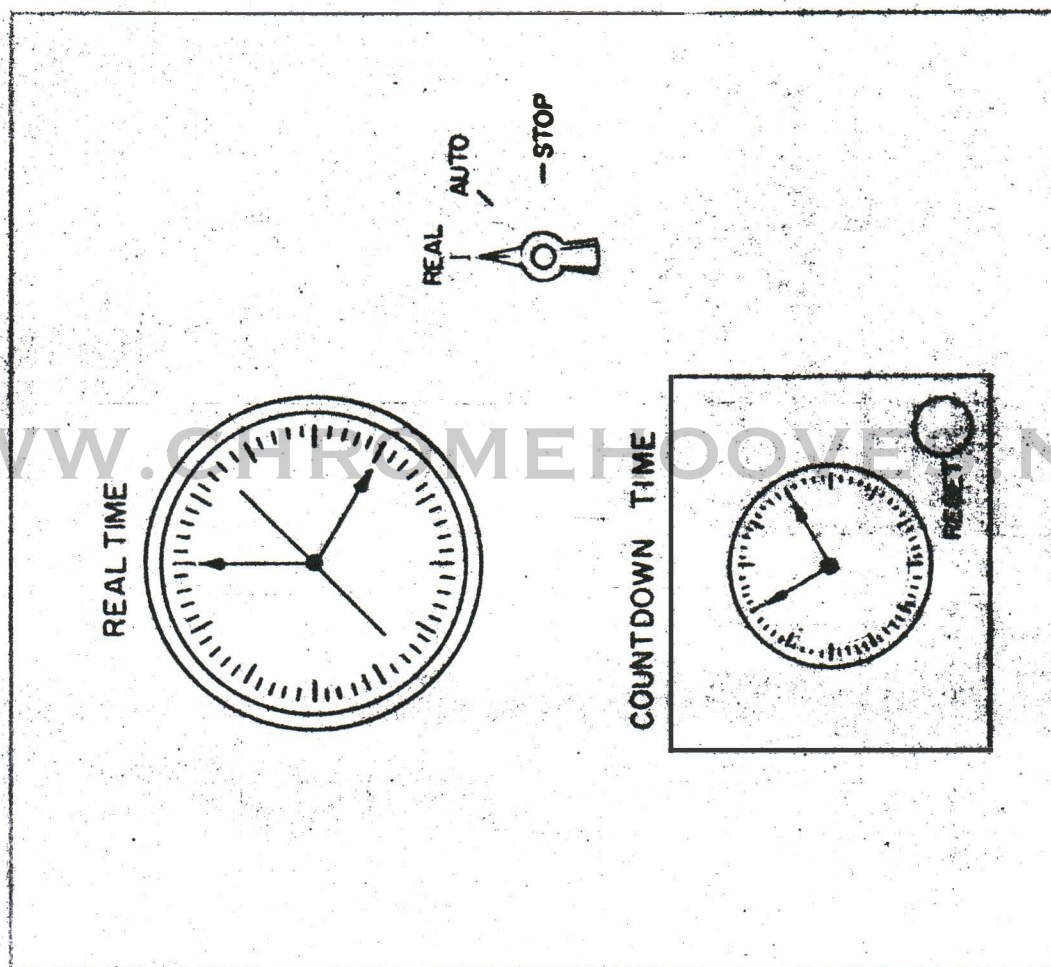


Figure V-c

TIME SECTION OF PLD TEST CONTROL PANEL

# LO<sub>2</sub> SYSTEM

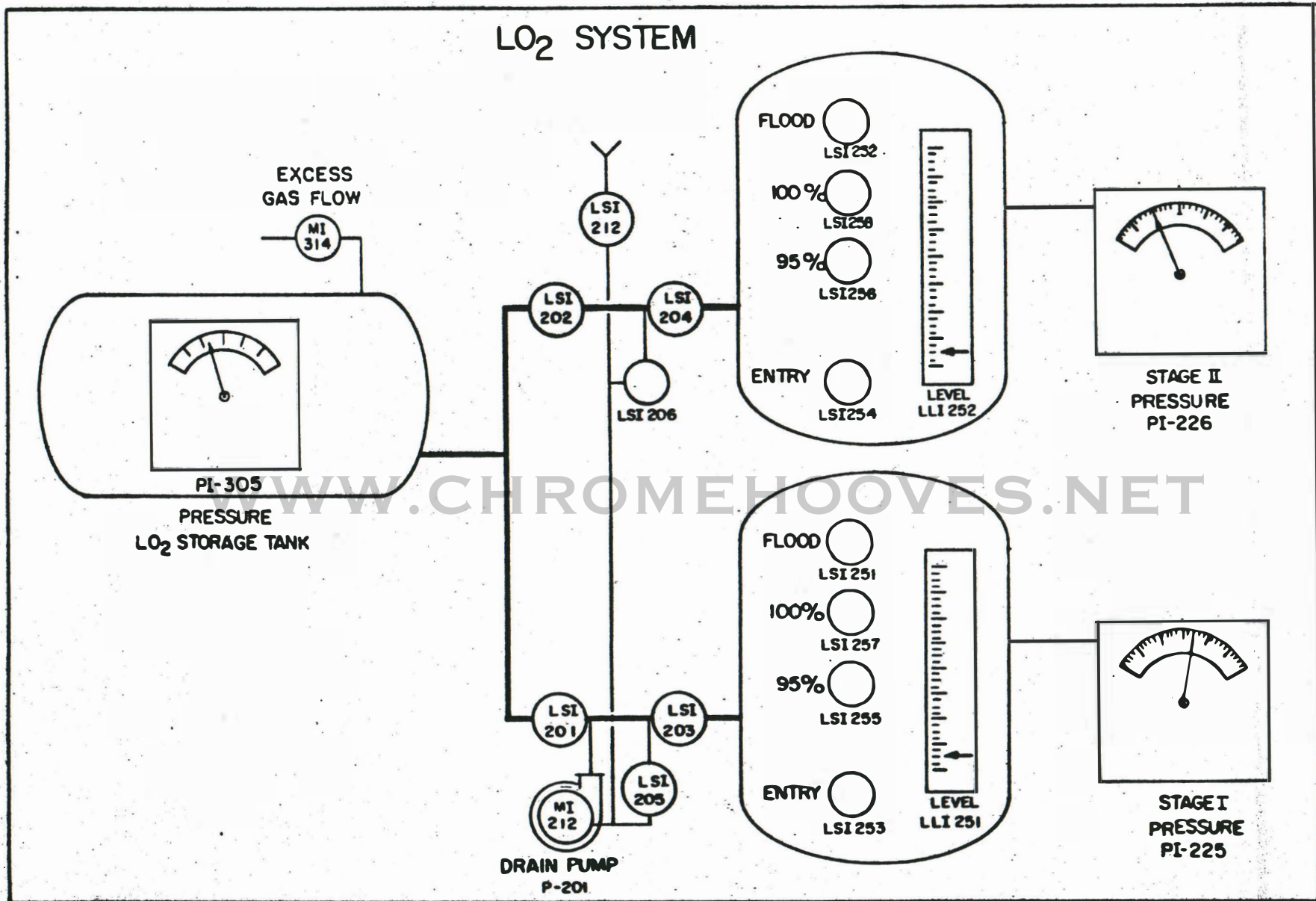
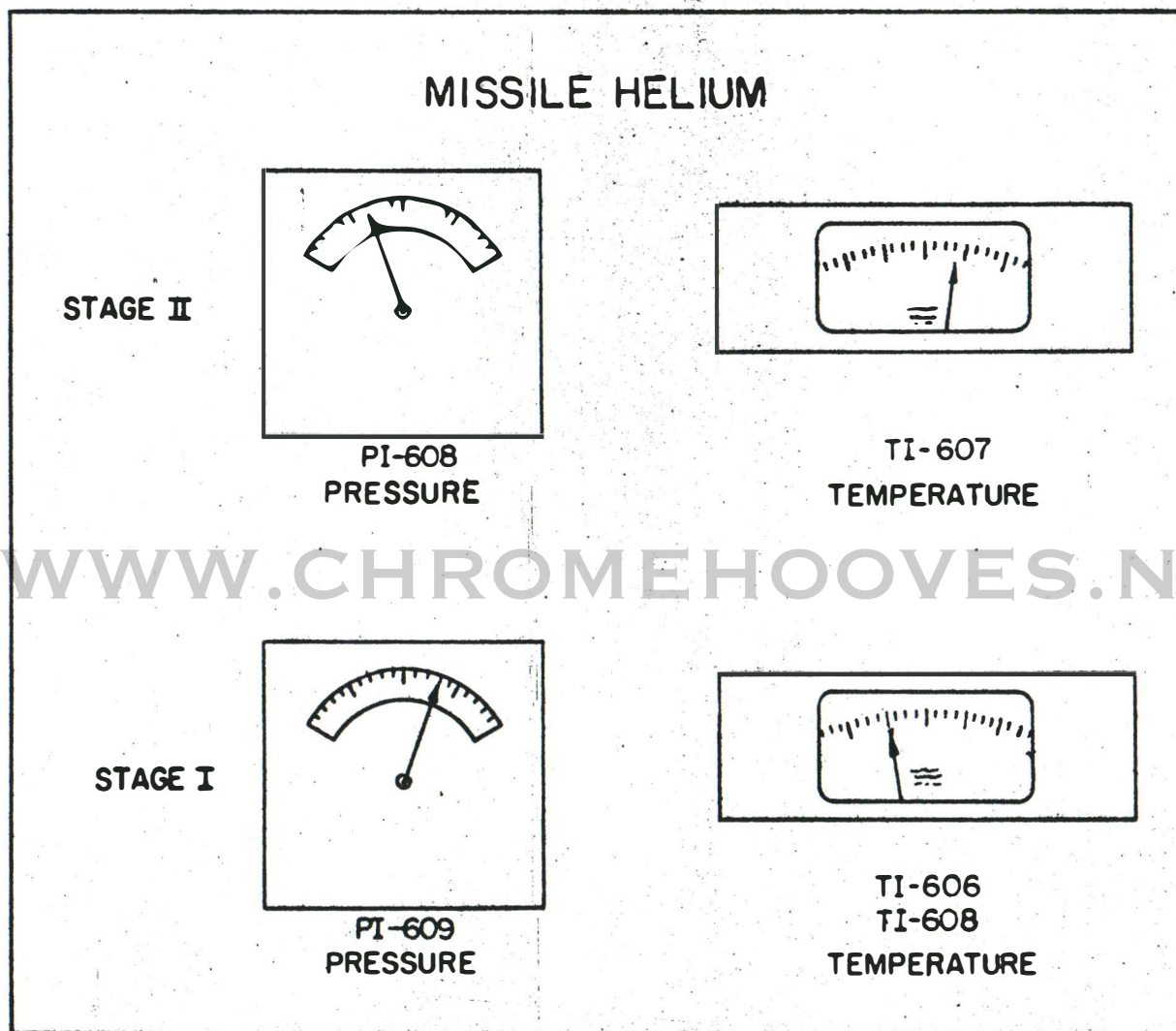


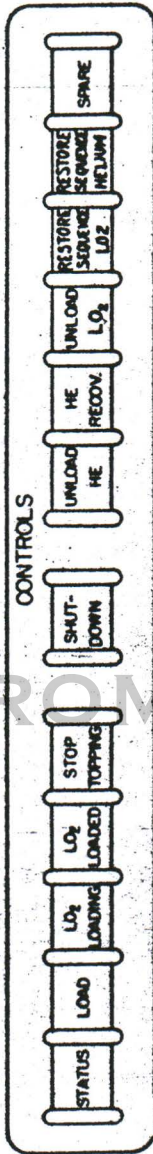
Figure T-d  
LO<sub>2</sub> SECTION OF PLS TEST CONTROL PANEL



**Figure T-e**  
**MISSILE HELIUM SECTION OF PLS TEST CONTROL PANEL**



EVENT  
MARKER



LIGHT TESTS  
GREEN  
RED  
& WHITE



Figure T-f  
CONTROLS SECTION OF PLS TEST CONTROL PANEL

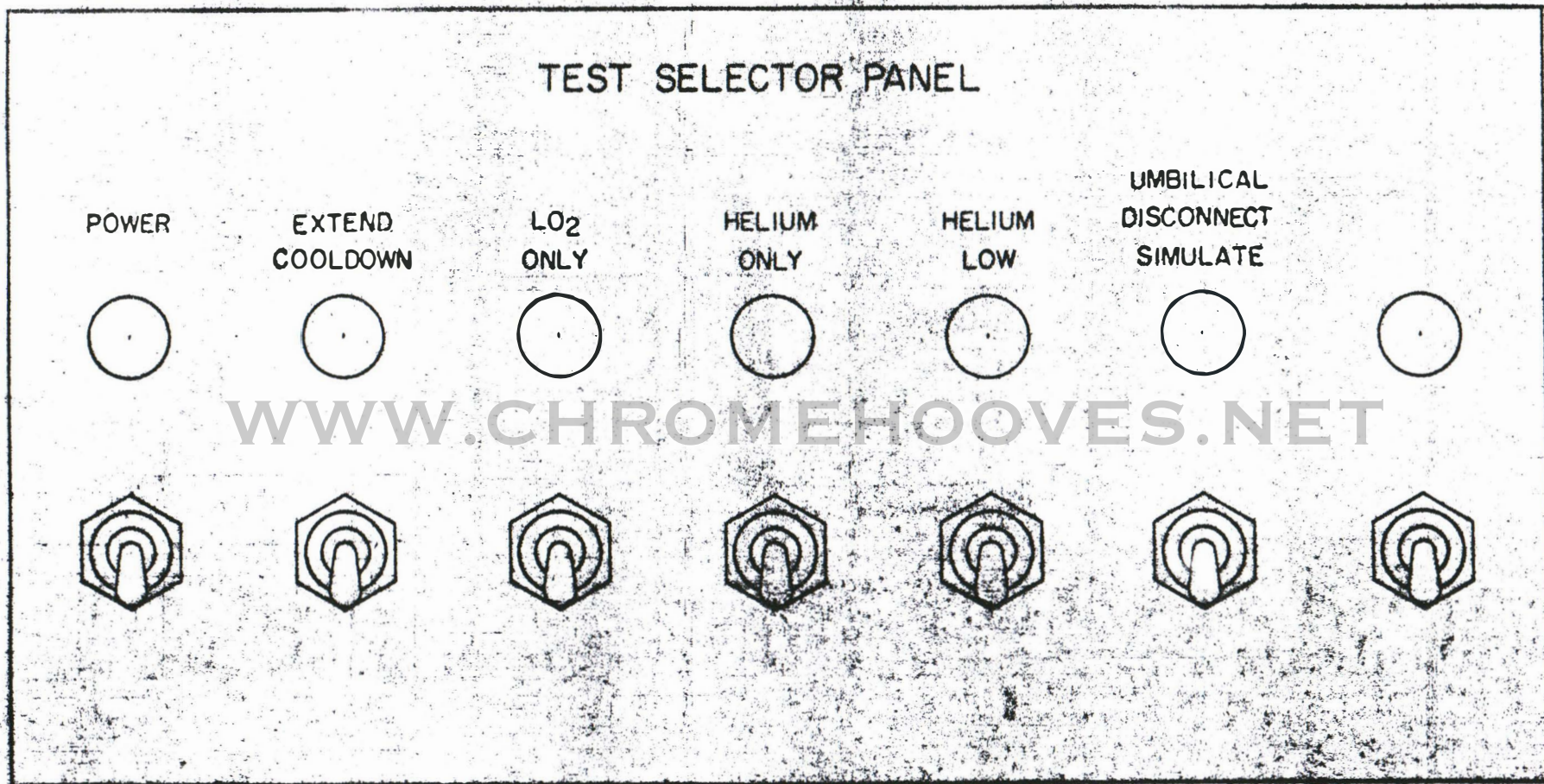


Figure 7-9  
TEST SELECTOR PANEL



# FUEL CHECKOUT PANEL

## STAGE II



LIGHT  
TEST

C

O



LINE  
BLANKET  
SOV 552

O

O

O

C

C

C



LINE END  
FCV 105



LINE DRAIN  
FCV 111



PURGE  
FCV 514

## STAGE I

C

O

O

C



TANK  
VENT  
FCV 502



TRANSFER  
LINE  
FCV 103

O

O

O

C

C

C



LINE END  
FCV 107



LINE DRAIN  
FCV 109



PURGE  
FCV 515

L

M

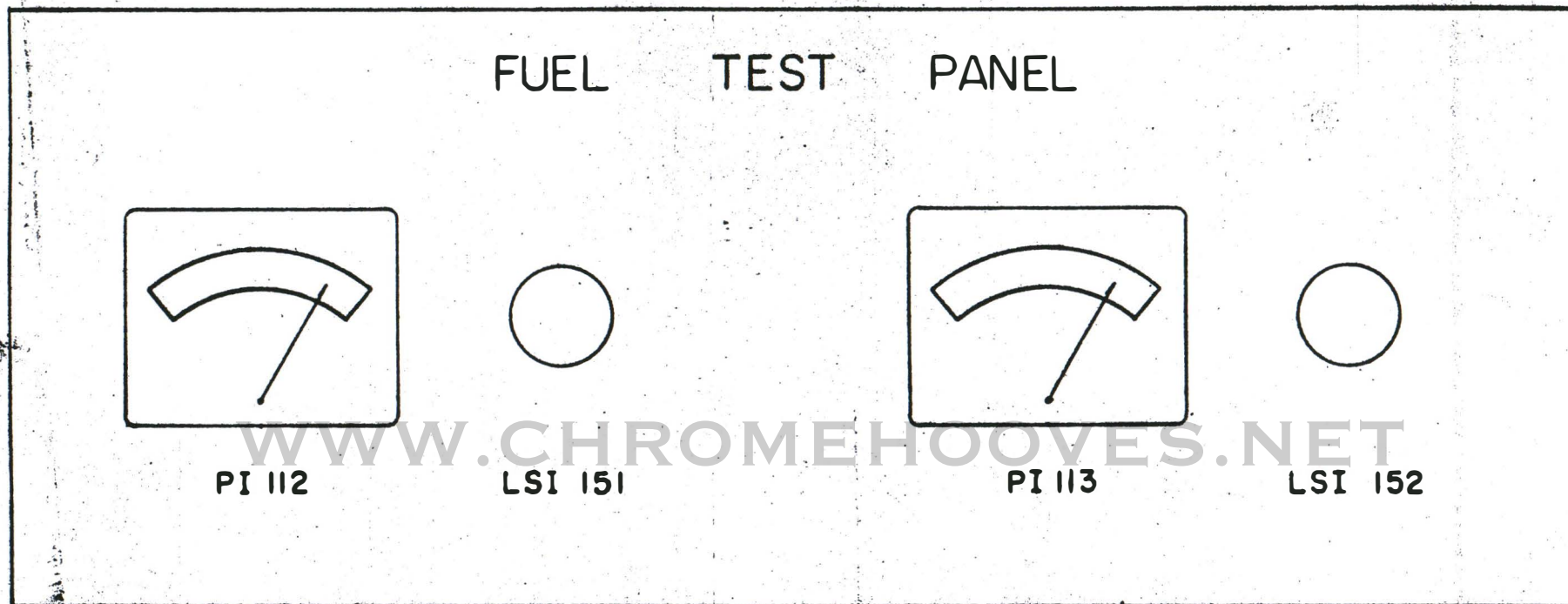


LIQUID  
SENSOR  
TEST

Figure T-h

FUEL CHECKOUT PANEL ARRANGEMENT





**Figure T-1**  
**FUEL TEST PANEL ARRANGEMENT**

# FUEL CONTROL PANEL

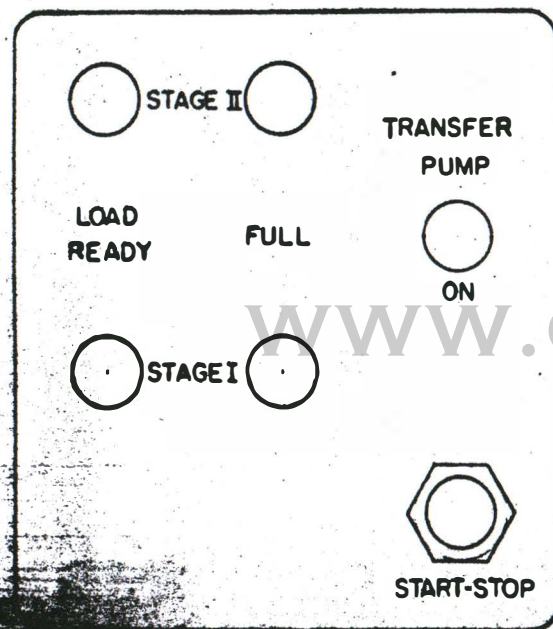
CHECKOUT



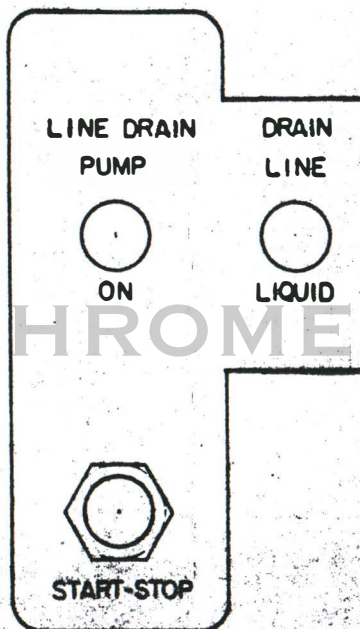
POWER



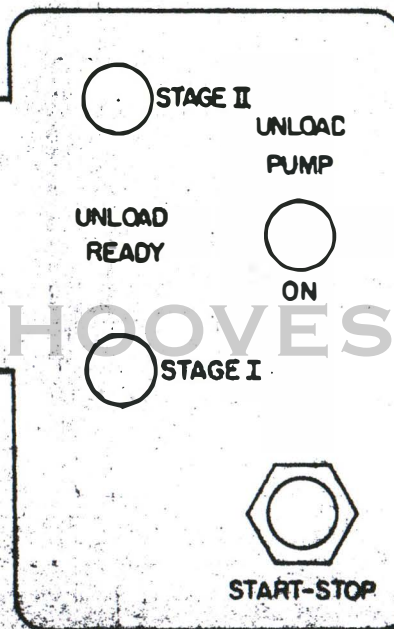
LOAD



LINE - DRAIN



UNLOAD



PURGE

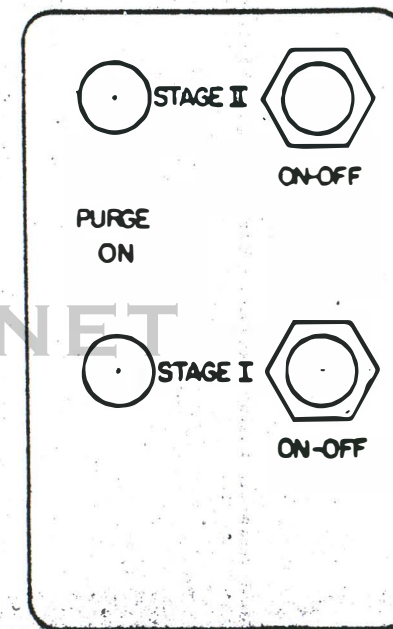


Figure V-J

FUEL CONTROL PANEL ARRANGEMENT