

ET12-ARF-FOP-001
REVISION D
EFFECTIVE DATE: October 11, 2005

ORGANIZATIONAL ISSUANCE

ET12 EXPERIMENTAL FLUIDS BRANCH

Aerodynamic Research Facility (ARF) Operating Procedure

REVISION D

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DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
AS-IS	BASELINE	10/15/1997	Baseline AS IS, 14x14 Inch Trisonic Wind Tunnel Standard Operating Procedure dated September 1993.
AS-IS	A	7/19/1999	Due to the reorg this Baseline supersedes the document OWI-ED34-TWT-001 by the same title.
	B	N/A	Updating procedures to reflect new organization
	C	10/11/2004	Updated due to CAITS 04-DA01-0387 Section 1: Replaced 14" Trisonic Wind Tunnel (TWT) with Aerodynamic Research Facility (ARF). Section 3: Replaced document MPG 1700.1 with document MPR 8715.1 and OI-TD74-100. Section 4: Added 'Personal Protective Equipment (PPE)'. Section 5: Renumbered steps. 5.1.1: Replaced wind tunnel with ARF. 5.2: Changed title from Operational Guidelines to Start-Up Guidelines 5.2.8: Replaced voltmeters with power supply. 5.2.16: Added step 'Turn the water pump on by pushing the "WATER PUMP START" button, located on cab. 1000'. 5.3.1: Changed phone number from 544-5972 to 544-6339. 5.4.4: Added step 'Turn off water pump on by pushing the "WATER PUMP STOP" button, located on cab. 1000'. 5.4.6: Replaced voltmeters with power supply. 5.4.13: Replaced north wall with east wall. 5.5.2: Replaced 350+ psi with 325+ psi. 5.5.3: Replaced 40 mmHg with 60 mmHg. Added Note after Step 5.5.4. 5.5.7: Replaced 'usually 93-98 F' with 'usually 93-98 deg. F'. 5.6.4: Deleted sentence 'Set top and bottom wall porosity' from step. 5.6.8: Changed sentence to read 'Set the auxiliary vacuum, diffuser, and east and west porous walls by using the selector switch', etc. 5.6.18: Replaced 'pushing the "BUZZER OFF/ON" button, located on cab. 1000' with 'turning the safety valve key, located on cab. 1200, to position 1'. 5.6.19: Deleted step 'Turn the water pump on by pushing the "WATER PUMP START" button, located on cab. 1000'. 5.6.20: Added 'to position 2' to end of sentence. 5.6.32: Replaced 'pushing the "BUZZER OFF/ON" button, located on cab. 1000' with 'turning the safety valve to the "O" position'. 5.6.34: Deleted step 'Turn the warning bells off by pushing the "WATER PUMP STOP" button, located on panel 1000'. 5.7.3: Added vacuum gage readings to step. 5.7.4: Added sentences to step. 'Every time the model is installed on to the balance, there shall be 2 nd party verification that the model "hold-down" screw has been installed. This will be documented on a TPS'. 5.7.10: Added step 'The stagnation temperature control, located on cab. 1000, should be set at the correct temp. (usually 140F)'. Changed Step 5.8.4 to a Note. 5.8.5: Deleted step 'Set the stagnation temp. control, located on cab. 1000'. 5.8.12: Replaced 'pushing the "BUZZER OFF/ON" button, located on cab. 1000' to 'turning the safety valve open key, located on cab. 1200, to position 1'. 5.8.15: Deleted step 'Turn the water pump on by pushing the "WATER PUMP START" button, located on cab. 1000'. 5.8.17: Deleted step 'Turn the "SAFETY VALVE OPEN" button, located on cab. 1200, to position 2'. 5.8.14: Added step 'Turn the "SAFEY VALVE OPEN" button, located on cab.

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			<p>1200 to position 2'. 5.8.15: Added step 'Push the "VACUUM EXHAUST" button, located on cab. 1100. Red light on button indicates actuation'. 5.8.25: Replaced 'pushing the "BUZZER OFF/ON" button, located on cab. 1000' to 'turning the safety valve key, located on cab. 1200, to position 0'. 5.8.29: Deleted step 'Turn the water pump off by pushing the "WATER PUMP STOP" button, located on panel 1000'. 8.5: Renumbered steps. 10.0: Added 'All personnel who work in the TWT area should wear Personal Protective Equipment (PPE) where appropriate. This may include but is not limited to safety shoes, hearing protection, eye protection, gloves, etc'.</p>
	D	10/07/2005	<p>OPR Designee changed to "Rebecca Fari" "TD72" replaced with "ET12" throughout Note added to Section 5.9: "(Note: The Special Purpose Test Section has not been utilized for many years and is currently stored in Warehouse Building 8023.)"</p>

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1. PURPOSE

This Organizational Issuance (OI) shall define the methods and instructions used to operate the Aerodynamic Research Facility (ARF) in building 4732.

2. APPLICABILITY

This OI shall apply to all personnel operating the ARF.

3. APPLICABLE DOCUMENTS

MPR 8715.1, Marshall Safety, Health and Environmental (SHE) Program

ET12-OWI-100, Experimental Test Project Process

4. DEFINITIONS

Data: Electronic or written information (obtained during test programs) stored in any of several media (magnetic tapes, computer files, photographs, reports, etc).

Facility: A group of mechanical, electrical, and control subsystems designed to prepare for, conduct, and acquire data for a test run of a test article.

Facility Engineer: Lead and point-of-contact for a specified facility. Shall be responsible for the operation, maintenance, and development of that facility.

Facility Operator: Shall be authorized by the ET12 Group Leader to operate a specified facility.

OI: Organizational Issuance

PPE: Personal Protective Equipment

Test Engineer: Shall be responsible for the planning, data collection, and reporting for a specified test.

Waiver: A written authorization to depart from specified requirements in a controlled document.

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5. INSTRUCTIONS

NOTE: Steps in this procedure shall be performed in the order listed, as stated, unless deviation is permitted by the facility engineer.

-All steps shall be performed by the facility operator unless otherwise noted.

5.1 START-UP PREREQUISITES

- 5.1.1 The ARF isolation valve control switch, located on the south wall by exit door, shall be in the open position.
- 5.1.2 The water level shall be visible in the sight glass, located on the front of the water tank.
- 5.1.3 Work Control/Teledyne Brown (544-9540) has been notified of air requirements.
- 5.1.4 The psi measuring system should be on and properly hooked up (if required).

5.2 START-UP PROCEDURES

Facility Operator Shall:

- 5.2.1 Start the vacuum pumps, located in building 4734, according to the procedure in Appendix A.
- 5.2.2 Turn on the laser printer, located on top of Rack B.
- 5.2.3 Turn on the hard-drive(s), located in Rack A.
- 5.2.4 Turn on the data acquisition, located in Rack A.
- 5.2.5 Turn on the digital voltmeter, located in Rack A.
- 5.2.6 Turn on the computer screen, located on the counter top in front of cabinet 2100.

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- 5.2.7 Switch on power supply 1 and/or 2 (if necessary), located on cabinet 1900.
- 5.2.8 Verify that the top two amplifiers (Po, Ps) are on, push/on – pull/off. Located on cabinet 1400.
- 5.2.9 Switch on the 24 volt power supply, located under the counter top in front of the operator's chair.
- 5.2.10 Push the red "POWER" button on. The button will illuminate when on. (Located on cabinet 1200).
- 5.2.11 Start the 1,000 and 2,000 psi hydraulic system, according to the procedure in Appendix B.
- 5.2.12 Push the "REF RESET" button on the calibration panel, located on the south wall.
- 5.2.13 Push the red "EMERGENCY RESET" button, located on cabinet 1200.
- 5.2.14 Reset all fail-safe buttons, located on cabinet 1400.
- 5.2.15 Turn the water pump on by pushing the "WATER PUMP START" button, located on cabinet 1000.
- 5.2.16 Follow the tunnel operating guidelines in Section 5.5 for the transonic test section, Section 5.6 for the supersonic test section, or Section 5.7 for the special purpose test section.

5.3 **SHUTDOWN PREREQUISITES**

- 5.3.1 Notify the compressor station (544-6339) when the last run of the day will be made.

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5.4 SHUTDOWN PROCEDURES

Facility Operator Shall:

- 5.4.1 Shut down the vacuum pumps, according to the guidelines in Appendix A.
- 5.4.2 Shut down the 1000 and 2000 psi hydraulic system, according to the guidelines in Appendix B.
- 5.4.3 Push the red "POWER" button off. The button will no longer be illuminated. (Located on cabinet 1200).
- 5.4.4 Turn off water pump on by pushing the "WATER PUMP STOP" button, located on cabinet 1000.
- 5.4.5 Switch off the 24 volt power supply, located under the counter top in front of the operator's chair.
- 5.4.6 Switch off power supply 1 and/or 2 (if necessary), located on cabinet 1900.
- 5.4.7 Turn off the computer screen, located on the counter top in front of cabinet 2100.
- 5.4.8 Turn off the digital voltmeter, located in Rack A.
- 5.4.9 Turn off the data acquisition, located in Rack A.
- 5.4.10 Turn off the hard-drive(s), located in Rack A.
- 5.4.11 Turn off the laser printer, located on top of Rack B.
- 5.4.12 Lock door on the south wall.
- 5.4.13 Turn off the control room lights, located on the east wall.

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5.5 TUNNEL OPERATION WITH THE TRANSONIC TEST SECTION

For clarification on equipment location, refer to Figure-2.

START-UP PREREQUISITES

5.5.1 The transonic test section shall be installed.

5.5.2 The supply air gage, located on cabinet 1300, shall indicate that there is a sufficient amount of air, (usually 325+ psi), in the storage tank for a run.

5.5.3 The vacuum gage, located on top of cabinet 1200, shall not read more than 60 mmHg, for Mach numbers greater than 0.80.

5.5.4 The **test engineer** shall verify correct model configuration, orientation, and tightness.

NOTE: Every time the model is installed onto the balance, there shall be 2nd party verification that the model "hold-down" screw has been installed. This shall be documented in the ARF run log.

5.5.5 Facility operator shall visually inspect the test section and sector areas for loose tubing, tools, etc.

5.5.6 Facility operator shall verify that the Mach number selector switch, located on cabinet 1000, is in the "OFF" position.

5.5.7 The stagnation temperature control, located on cabinet 1000, shall be set at the correct temperature. (Usually 93 – 98 deg F)

5.5.8 Facility operator shall verify that the settings behind the "RAMP PROGRAMMER" panel, located on cabinet 1200, are correct. Refer to the transonic settings chart located on the panel.

5.5.9 The atmospheric exhaust light, located on cabinet 1400, shall indicate that the valve is

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open. If the light indicates the closed position, push the "ATMOS. EXHAUST OPEN/CLOSE" button, located on cabinet 1000, and wait a few seconds for the valve to open.

5.6 REPETITIVE OPERATION

5.6.1 The **test engineer** shall select a Mach number and notify the tunnel operator.

Facility Operator Shall:

5.6.2 Verify/install the correct set of nozzle blocks for the selected Mach number.

5.6.2.1 Mach 1.00 blocks = $0.20 \leq \text{Mach} \leq 1.30$

5.6.2.2 Mach 1.46 blocks = Mach 1.46

5.6.2.3 Mach 1.96 blocks = Mach 1.96

5.6.2.4 Mach 2.50 blocks = Mach 2.50*

***NOTE:** **Test engineer** should use caution when running Mach 2.50. Blocks contain a machine flaw which may cause inaccurate data.

5.6.3 Refer to the "Transonic Wind Tunnel Operations Chart" for all tunnel settings, which include the static pressure, wall porosity, wall angle, diffuser, auxiliary vacuum, and stagnation pressure.

5.6.4 Open the east door on the test section, and set the tunnel top and bottom wall angles with the two externally actuated wall jacks. Visually inspect markings in tunnel to verify settings.

5.6.5 Set the flaps by pushing the "FLAPS OPEN" or "FLAPS CLOSE" buttons, located on cabinet 1000. Visually inspect to ensure the flaps are flush with the tunnel top and bottom walls. Close the test section door.

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- 5.6.6 Make sure that the tunnel is closed and secured with the red safety nut.
- 5.6.7 The auxiliary vacuum switch, located on cabinet 1000, shall be in the "CLOSED" position for $0.20 \leq \text{Mach} \leq 0.80$. The auxiliary vacuum shall be "OPEN" for $0.90 \leq \text{Mach} \leq 1.30$.
- 5.6.8 Set the auxiliary vacuum, diffuser, and east and west porous walls by using the selector switch, dialing in the correct setting, and pushing the appropriate open or close buttons until the null meter reads zero with the sensitivity button depressed. (Located on cabinet 1000).
- 5.6.9 Set the stagnation pressure with the dial located on cabinet 1200. Nominal settings are 10(Po-14.7).
- 5.6.10 Set the "PRESSURE READ" switch located on cabinet 1200, to "LOW" for $\text{Mach} \leq 1.46$; switch to "HIGH" for $\text{Mach} \geq 1.96$.
- 5.6.11 The **test engineer** shall set each angle of attack on cabinet 1700 by dialing in the correct angle, locking with the black lever, and pushing the "ADVANCE" button to set the next angle. When all angles have been set, push the "HOME" button to return to the initial setting, which shall be zero (unless otherwise permitted).
- 5.6.12 The **test engineer** shall read the barometer and notify the operator of the reading.
- 5.6.13 The **test engineer** shall input the required test information in to the computer.
- 5.6.14 Record test information in tunnel log sheet.
- 5.6.15 Check for a blue light over the setting chamber.
- 5.6.16 Check for a green "TUNNEL READY" light on cabinet 1200.

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- 5.6.17 Verify that the doors to room 131 are shut and all other personnel have left the room.
- 5.6.18 When ready to initiate a blowdown, turn the warning bell on by turning the safety valve key, located on cabinet 1200, to position 1.
- 5.6.19 All personnel in room 131 should don hearing protection.
- 5.6.20 Turn the "SAFETY VALVE OPEN" switch, located on cabinet 1200, to position 2.
- 5.6.21 Check for a green "PERMISSIVE" light, located on cabinet 1200.
- 5.6.22 Push the "BLOWDOWN START" button, located on cabinet 1200.

CAUTION: Keep hand near the "BLOWDOWN STOP" button, located on cabinet 1200. Be ready to push if any anomalies occur.

- 5.6.23 Observe the stagnation pressure read-out, located on top of cabinet 1200, and wait for the pressure to settle out. Adjust pressure with dial if necessary.
- 5.6.24 Observe the static pressure read-out, located on cabinet 1200. The pressure can be adjusted by adjusting the diffuser setting for $Mach \leq 0.80$; or the pressure can be adjusted by adjusting the auxiliary vacuum setting for $Mach \geq 0.90$. The diffuser and auxiliary vacuum setting are adjusted by pushing the appropriate open and close buttons located on cabinet 1000. The close button will give a more positive value of the static pressure; the open button will give a more negative value of the static pressure.
- 5.6.25 When the desired static pressure has been obtained, signal the test engineer.

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- 5.6.26 The **test engineer** shall initiate the data acquisition.
- 5.6.27 Continue to observe the static pressure; adjust as necessary.
- 5.6.28 Throughout the run, monitor the vacuum pressure gage and air supply, located on cabinet 1300. Do not drop the air supply below 100 psi. Terminate run if necessary.
- 5.6.29 Observe the temperature read-out, located on cabinet 1200.
- 5.6.30 The **test engineer** shall signal the tunnel operator when to end the run.
- 5.6.31 Push the "BLOWDOWN STOP" button, located on cabinet 1200.
- 5.6.32 Turn the warning bell off by turning the safety valve to the "0" position.
- 5.6.33 All personnel may remove hearing protection.
- 5.6.34 Record the temperature reading in the tunnel log sheet.

5.7 TUNNEL OPERATION WITH THE SUPERSONIC TEST SECTION

For clarification on equipment location, refer to Figure-2.

START-UP PREREQUISITES

- 5.7.1 The supersonic test section shall be installed with bolts engaged in the stilling chamber.
- 5.7.2 The supply air gage, located on top of cabinet 1300, shall indicate that there is a sufficient amount of air, (usually 350+ psi), in the storage tank for a run.

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5.7.3 The vacuum gage, located on top of cabinet 1200, shall read as follows:

- Mach 2.74 - \leq 60 mm Hg
- Mach 2.99 - \leq 50 mm Hg
- Mach 3.27 - \leq 45 mm Hg
- Mach 3.48 - \leq 40 mm Hg
- Mach 3.76 - \leq 35 mm Hg
- Mach 4.00 - \leq 35 mm Hg
- Mach 4.25 - \leq 35 mm Hg
- Mach 4.45 - \leq 30 mm Hg
- Mach 4.79 - \leq 25 mm Hg
- Mach 4.96 - \leq 20 mm Hg

5.7.4 The **test engineer** shall verify correct model configuration, orientation, and tightness. Every time the model is installed on to the balance, there shall be 2nd party verification that the model "hold-down" screw has been installed. This will be documented on a TPS.

5.7.5 Facility operator shall visually inspect the test section and sector areas for loose tubing, tools, etc.

5.7.6 The auxiliary vacuum switch, located on cabinet 1000, shall be in the "CLOSED" position.

5.7.7 The "NOZZLE POWER ON" button, located on cabinet 1000, shall be lit. Push button to verify.

5.7.8 Facility operator shall verify that the settings behind the "RAMP PROGRAMMER" panel, located on cabinet 1200, are correct. Refer to the supersonic settings chart located on the panel.

5.7.9 The atmospheric exhaust light, located on cabinet 1400, shall indicate that the valve is closed. If the light indicates the open position, push the "ATMOS. EXHAUST OPEN/CLOSE" button, located on cabinet 1000, and wait a few seconds for the valve to close.

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5.7.10 The stagnation temperature control, located on cabinet 1000, shall be set at the correct temperature. (Usually 140 deg F).

5.8 REPETITIVE OPERATION

5.8.1 The **test engineer** shall select a Mach number and notify the tunnel operator.

Facility Operator Shall:

5.8.2 Push the "SEAL PRESSURE OFF/ON" button to release the seal pressure. Set the Mach number selector switch to the desired Mach number. Push the "RESET" button to start the automatic nozzle block positioners. After the blocks are positioned, press the "RESET" button again to check for final setting. (Located on cabinet 1000).

5.8.3 Set the flaps by pushing the "FLAPS OPEN" or "FLAPS CLOSE" buttons, located on cabinet 1000. Visually inspect to ensure the flaps are flush with the tunnel top and bottom walls.

NOTE: Refer to the "Supersonic Test Section Tunnel Settings" chart for all tunnel settings, which include the stagnation pressure, temperature, diffuser, and auxiliary vacuum.

5.8.4 Set the diffuser by using the selector switch, dialing in the correct setting, and pushing the "DIFFUSER OPEN" or "DIFFUSER CLOSE" buttons until the null meter reads zero with the sensitivity button depressed. (Located on cabinet 1000).

5.8.5 The **test engineer** shall set each angle of attack on cabinet 1700 by dialing in the correct angle, locking with the black lever, and pushing the "ADVANCE" button to set the next angle. When all angles have been set, push the "HOME" button to return to the initial setting, which must be zero (unless otherwise permitted).

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- 5.8.6 The **test engineer** shall read the barometer and notify the operator of the reading.
- 5.8.7 The **test engineer** shall input the required test information in to the computer.
- 5.8.8 Record test information in tunnel log sheet.
- 5.8.9 Check for a blue light over the setting chamber.
- 5.8.10 Check for a green "TUNNEL READY" light on cabinet 1200.
- 5.8.11 Verify that the doors to room 131 are shut and all other personnel have left the room.
- 5.8.12 When ready to initiate a blowdown, turn the warning bell on by turning the safety valve open key, located on cabinet 1200, to position "1".
- 5.8.13 Ensure all personnel in room 131 don hearing protection.
- 5.8.14 Turn the "SAFETY VALVE OPEN" button, located on cabinet 1200 to position "2".
- 5.8.15 Push the "VACUUM EXHAUST" button, located on cabinet 1100. Red light on button indicates actuation.
- 5.8.16 Check for a green "PERMISSIVE" light, located on cabinet 1200.
- 5.8.17 Push the "BLOWDOWN START" button, located on cabinet 1200.

CAUTION: Keep hand near the "BLOWDOWN STOP" button, located on cabinet 1200. Be ready to push if any anomalies occur.

- 5.8.18 Observe the stagnation pressure read-out, located on top of cabinet 1200, and wait for the pressure to settle out. Adjust pressure with dial if necessary.

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- 5.8.19 When the desired pressure has been obtained, signal the test engineer.
- 5.8.20 The **test engineer** shall initiate the data acquisition.
- 5.8.21 Facility operator shall, throughout the run, monitor the vacuum pressure gage and air supply, located on cabinet 1300. Do not drop the air supply below 100 psi. Terminate run if necessary.
- 5.8.22 Observe the temperature read-out, located on cabinet 1200.
- 5.8.23 The **test engineer** shall signal the tunnel operator when to end the run.
- 5.8.24 Push the "BLOWDOWN STOP" button, located on cabinet 1200.
- 5.8.25 Turn the warning bell off by turning the safety valve key, located on cabinet 1200, to position "0".
- 5.8.26 All personnel may remove hearing protection.
- 5.8.27 Record the temperature reading in the tunnel log sheet.

5.9 TUNNEL OPERATION WITH THE SPECIAL PURPOSE TEST SECTION

For clarification on equipment location, refer to Figure-2, Figure-E1, and Figure-E2.

(Note: The Special Purpose Test Section has not been utilized for many years and is currently stored in Warehouse Building 8023.)

START-UP PREREQUISITES

- 5.9.1 The special purpose test section shall be installed.

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- 5.9.2 The high pressure line shall be properly connected to the special purpose test section.
- 5.9.3 The high pressure air gage shall read >2000, located on the supply air panel next to the settling chamber.
- 5.9.4 The **test engineer** shall verify correct model configuration, orientation, and tightness.
- 5.9.5 Facility operator shall visually inspect the test section and other areas for loose tubing, tools, etc.
- 5.9.6 The auxiliary vacuum switch, located on cabinet 1000, shall be in the "CLOSED" position.
- 5.9.7 The atmospheric exhaust light, located on cabinet 1400, shall indicate that the valve is open. If the light indicates the closed position, push the "ATMOS. EXHAUST OPEN/CLOSE" button, located on cabinet 1000, and wait a few seconds for the valve to open.
- 5.9.8 Facility operator shall tighten the fitting located behind the pressure gage panel.
- 5.9.9 Facility operator shall put warning chains in place, located outside.
- 5.9.10 Facility operator shall tighten the bottom fitting, located outside.
- 5.9.11 Facility operator shall fully open the high pressure wheel valve, located outside.
- 5.9.12 Facility operator shall verify that the pressure gages, located on the wall next to the settling chamber, read 150 and 500.
- 5.9.13 Facility operator shall open the safety valve by flipping the switch located on the pressure gage panel.

5.10 REPETITIVE PROCEDURE

Facility Operator Shall:

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- 5.10.1 Record test information in tunnel log sheet.
- 5.10.2 Verify that the doors to room 131 are shut and all other personnel have left the room.
- 5.10.3 Load the dome valve by turning the hand-loader knob clockwise.
- 5.10.4 When ready to initiate a blowdown, turn the warning bell on by pushing the "BUZZER OFF/ON" button, located on cabinet 1000.
- 5.10.5 Ensure all personnel in room 131 don hearing protection.
- 5.10.6 Open the dome valve by flipping the switch located on the pressure gage panel.
- 5.10.7 Wait for the pressure gage indicator to come up to the set pressure.
- 5.10.8 Adjust pressure with the hand-loader if necessary.
- 5.10.9 When the desired pressure has been obtained, signal the test engineer.
- 5.10.10 Monitor the pressure setting.
- 5.10.11 The **test engineer** shall signal the tunnel operator when to end the run.
- 5.10.12 Close the dome valve by flipping the switch located on the pressure gage.
- 5.10.13 Turn the warning bell off by pushing the "BUZZER OFF/ON" button located on cabinet 1000.
- 5.10.14 All personnel may remove hearing protection.
- 5.10.15 Turn hand-loader counter-clockwise until fully unloaded.

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5.11 SHUTDOWN GUIDELINES

Facility Operator Shall:

- 5.11.1 Verify that the dome valve has been turned off.
- 5.11.2 Verify that the hand-loader knob has been turned fully counter-clockwise.
- 5.11.3 Close the safety valve by flipping the switch located on the pressure gage panel.
- 5.11.4 Fully close the high pressure wheel valve, located outside.
- 5.11.5 Slowly loosen the bottom fitting, located outside.
- 5.11.6 Take down the warning chains, located outside.
- 5.11.7 Loosen the fitting located behind the pressure gage panel.

6. NOTES

None

7. SAFETY PRECAUTIONS AND WARNING NOTES

- 7.1 All steps shall be performed by the tunnel operator, unless stated otherwise.
- 7.2 All prerequisites shall be completed, if possible, prior to commencing a section of a procedure.
- 7.3 Exercise caution in the vicinity of rotating equipment and high temperature systems.
- 7.4 Any conflicts encountered during the performance of this procedure shall be resolved prior to completion of the procedure.

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7.5 Personnel Protective Equipment (PPE) shall be worn when necessary by all personnel working in this test area.

8. APPENDICES, DATA, REPORTS, AND FORMS

APPENDIX A

VACUUM PUMP SYSTEM OPERATION

For clarification on equipment location, refer to Figure-A1.

A.1 START-UP PREREQUISITES

- A.1.1 The vacuum valve panel shall indicate that the valves are open. (Located on the south wall near the oil drum).
- A.1.2 The pressure gage for the air pump shall read approximately 40 psi. (Located on the south wall behind the oil drum).
- A.1.3 The oil drum shall contain a sufficient amount of oil. (Located along the south wall behind pump four).

A.2 OPERATIONAL GUIDELINE

Facility Operator Shall:

- A.2.1 Turn on light (if needed). The light switches are located on the east wall behind the controller box for pump one.
- A.2.2 During warm weather, turn on the exhaust fan. The exhaust fan control switch is located on the east wall next to the light switches.
- A.2.3 Start the oil lubricating pump by pushing the "START" button (located on the "LP" panel).
- A.2.4 Select the vacuum pumps to be started by

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switching the indicator to the "ON" position (located on the "LP" panel).

- A.2.5 If starting pumps 1, 2 or 3, close the oil drain valves, (located at each end of the pumps), for the pumps selected to be started.
- A.2.6 If starting pumps 1 or 2, open the water valve (located next to pump 1).
- A.2.7 If starting pumps 3 or 4, open the water valve (located next to pump 4).
- A.2.8 During warm weather, open the rear doors 1-2 feet.
- A.2.9 Observe the lights on the phase monitors for the oil system. For each pump selected, the corresponding phase monitor should have a green light illuminated. If the red light is on, instead of the green, press "RESET" on panel "LP". (The red light should be on for the pumps not selected).
- A.2.10 Observe the counters on the phase monitors, for each pump selected, for approximately 120 seconds.
- A.2.11 Don hearing protection.
- A.2.12 Start each pump selected by pressing the "START" button on the appropriate motor controller boxes.
- A.2.13 All pumps should be switched to the "AUTO" position on panel "LP".
- A.2.14 Observe the pressure gauges, after the pumps have been started, to ensure that the pressure settles down to at least 12 inches of water.
- A.2.15 Make sure the front door is closed when exiting the building.

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- A.2.16 Turn the power supply on to the vacuum pump system monitor panel "CP", located in the new wind tunnel control room.
- A.2.17 Press the bulb test button to ensure that all bulbs are working.
- A.2.18 Monitor panel "CP" during vacuum pump operation. If alarm sounds, indicating a failure, press the acknowledge button. A flashing light will indicate where the failure occurred.

A.3 SHUTDOWN GUIDELINES

Facility Operator Shall:

- A.3.1 Turn the power supply off to the vacuum pump system monitor panel "CP", located in the new wind tunnel control room.
- A.3.2 Don hearing protection, before entering building 4734.
- 8.3.3 Push the "STOP" button on panel "LP" to shut-down the oil lubricating pump and the vacuum pump.
- 8.3.4 Open the oil drain valves, (located at each end of pumps 1, 2, and 3), for the pumps that were in operation.
- 8.3.5 Close the water valve next to pump 1 (if open).
- 8.3.6 Close the water valve next to pump 4 (if open).
- 8.3.7 Close and lock the rear door (if open).
- 8.3.8 Turn off the exhaust fan (if on).
- 8.3.9 Turn off the lights (if on).
- 8.3.10 Close and lock the front door.

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APPENDIX B

HYDRAULIC SYSTEM OPERATION

For clarification on equipment location, refer to Figure-B1.

B.1 START-UP PREREQUISITES

- B.1.1 The hydraulic oil level shall read at least $\frac{3}{4}$ full on the reservoir sight gages.
- B.1.2 The hydraulic bleed valve shall be closed.
- B.1.3 The accumulator nitrogen pressures should be $\frac{3}{4}$ of the respective operating pressures.
- B.1.4 The water cooling should be on during warm weather.

B.2 OPERATIONAL GUIDELINES

Facility Operator Shall:

- B.2.1 Turn on lights (if needed).
- B.2.2 During warm weather, prop door open.
- B.2.3 Push the "START" button on the east wall to turn the hydraulic pumps on.
- B.2.4 Monitor pressure gages on the pumps to ensure that the pressure reaches 1000 and 2000 psi.

B.3 SHUTDOWN

B.3.1 OPERATIONAL GUIDELINES.

Facility Operator Shall:

- B.3.2 Push the "STOP" button on the east wall to turn the hydraulics off.
- B.3.3 Bleed hydraulic system.

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B.3.4 Turn lights off (if on).

B.3.5 Close door (if open).

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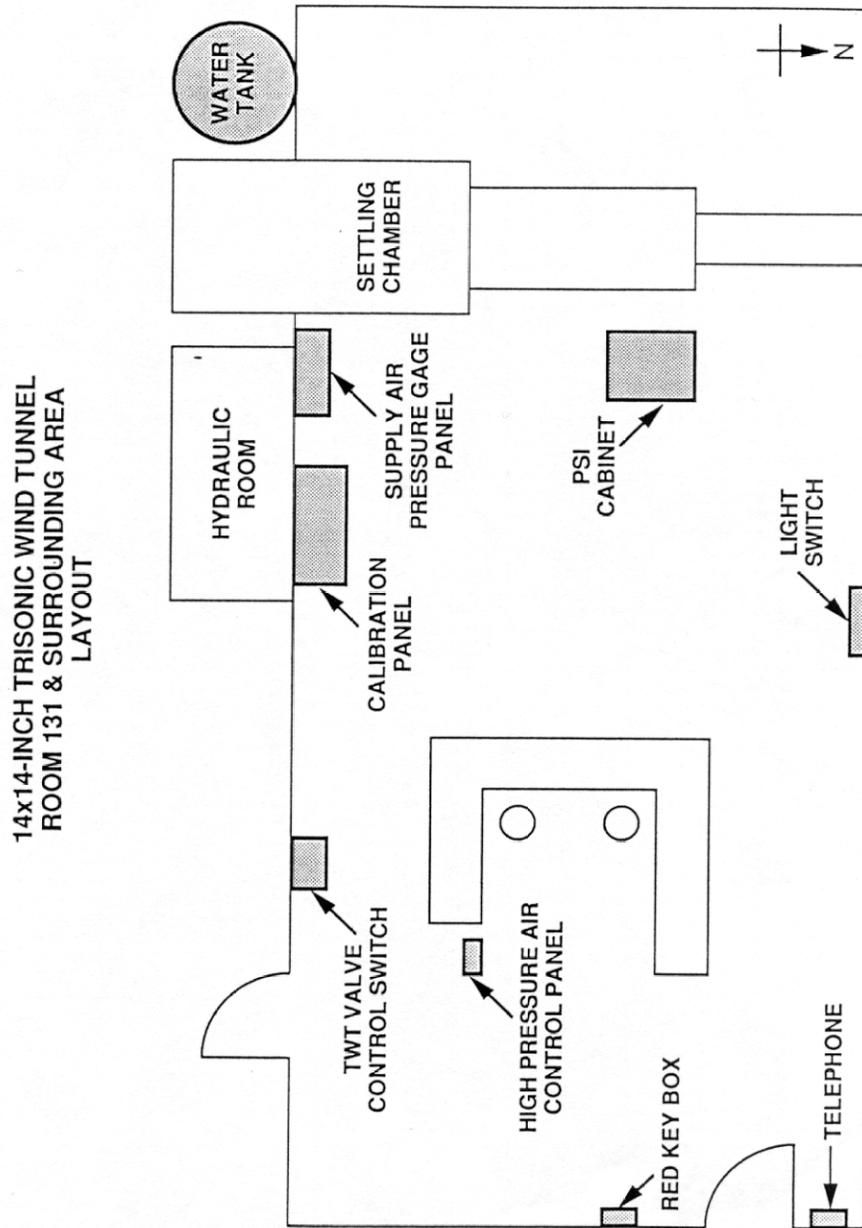


FIGURE - 1

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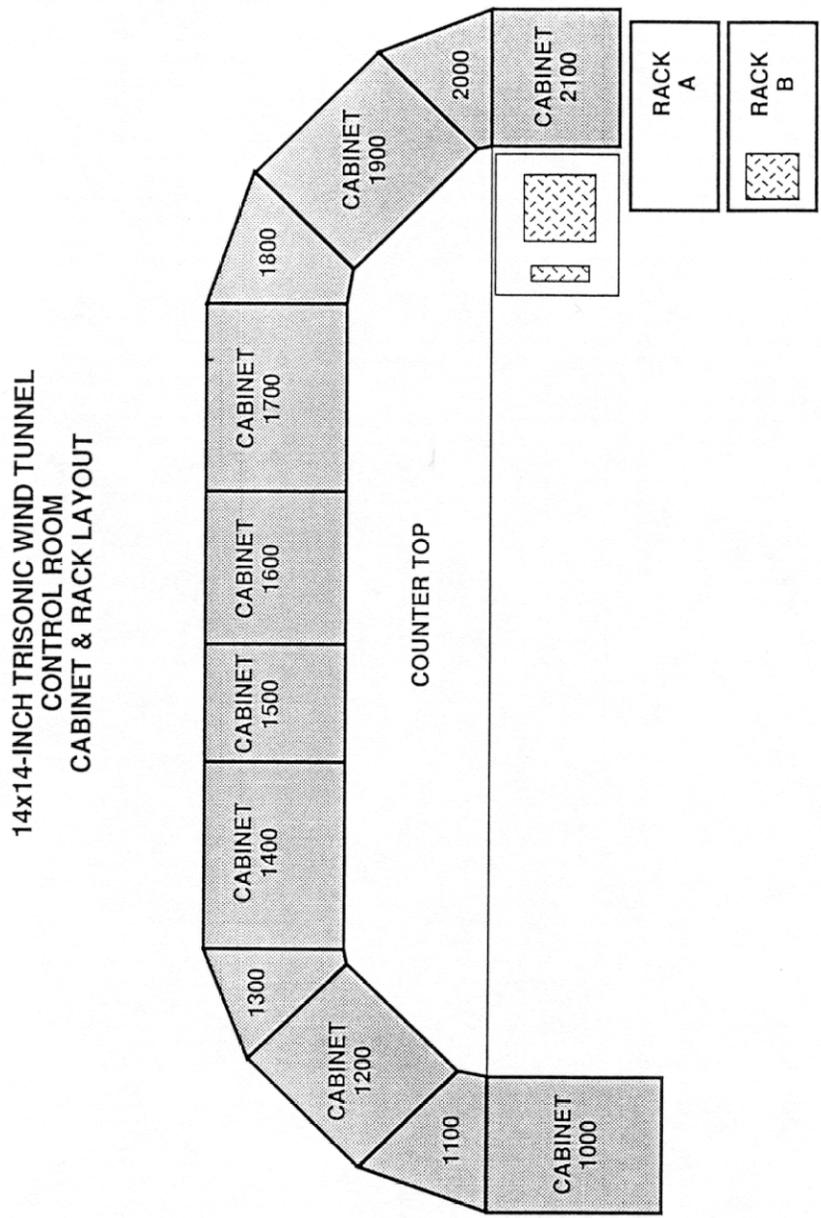
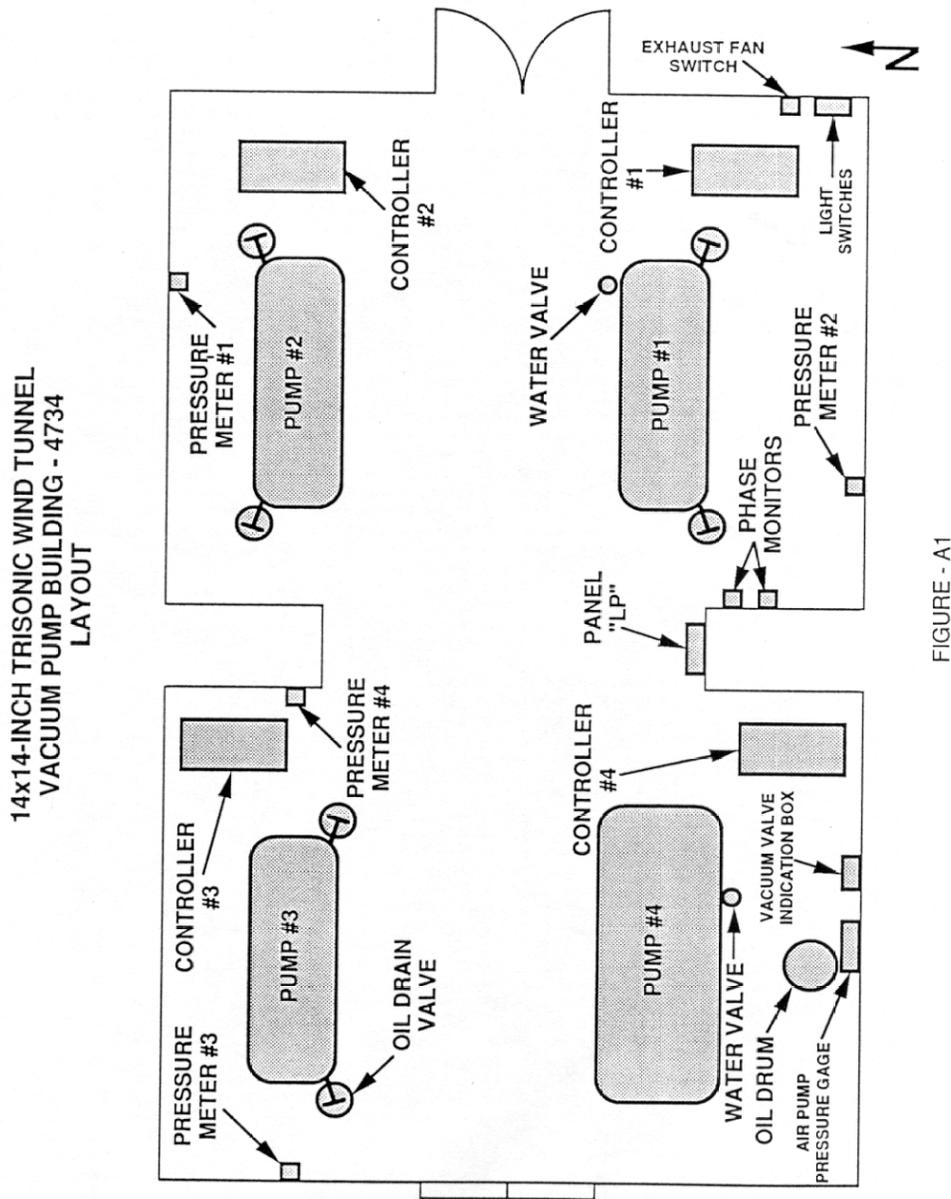


FIGURE - 2

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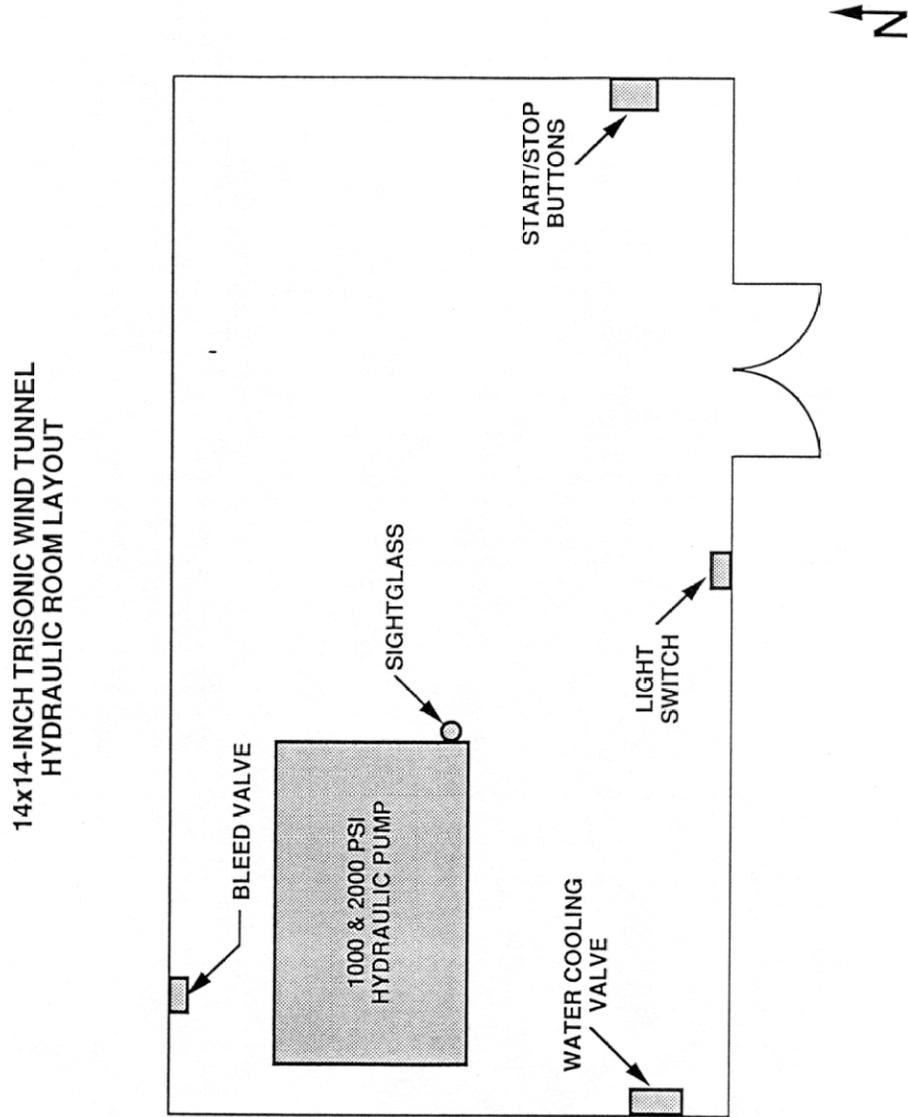


FIGURE - B1

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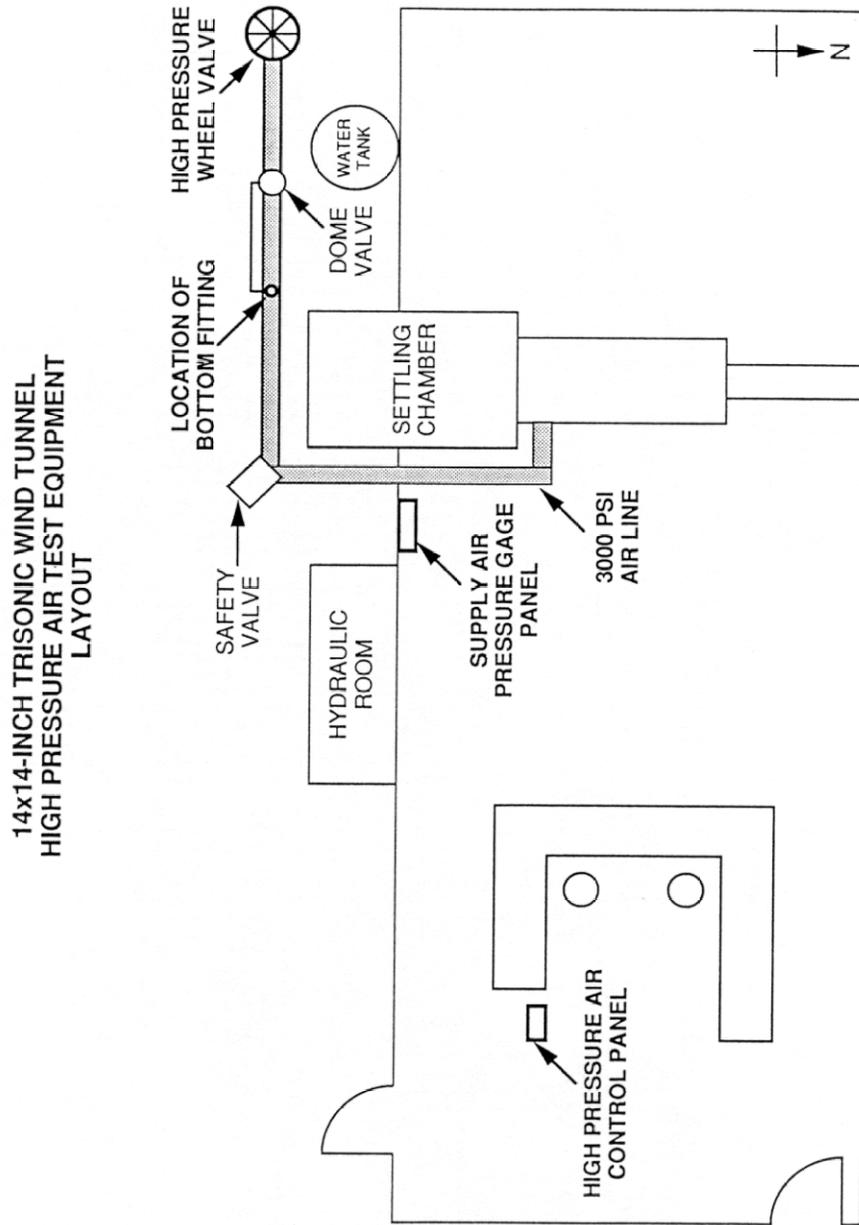


FIGURE - E1

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14x14-INCH TRISONIC WIND TUNNEL
 HIGH PRESSURE AIR CONTROL PANEL

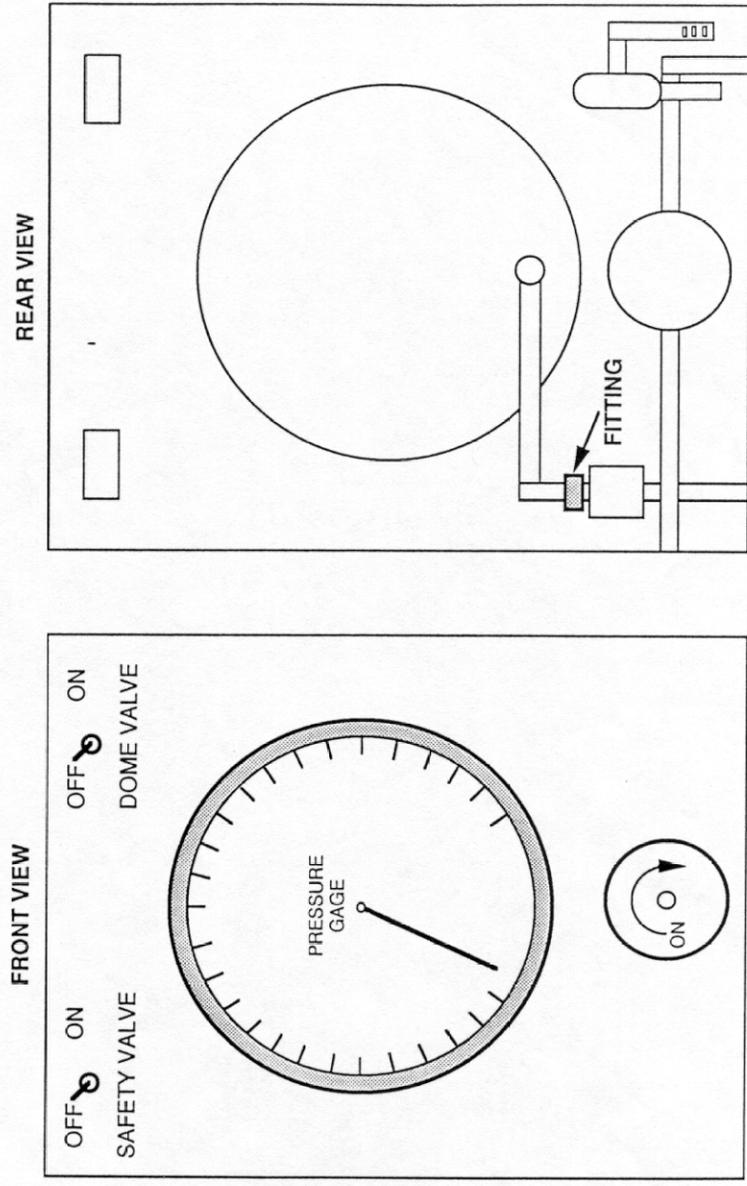


FIGURE - E2

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9. RECORDS

None

10. TOOLS, EQUIPMENT, AND MATERIALS

All personnel who work in the TWT area shall wear Personal Protective Equipment (PPE) where appropriate. This may include but is not limited to safety shoes, hearing protection, eye protection, gloves, etc.

11. PERSONNEL TRAINING AND CERTIFICATION

Personnel who operate the TWT shall undergo training and certification by authorized TWT personnel. This training is performed at the discretion of the TWT Facility Engineer along with the ET12 Group Leader and as a minimum shall consist of the following:

- a. Read and understand all TWT and ET12 applicable documentation as stated in OI-ET12-ORG-001.
- b. 3 months of on-the-job training supervised by the TWT Facility Engineer and/or the certified TWT Facility Technician.

Personnel who complete this training shall not be deemed "certified" until the TWT Facility Engineer and the ET12 Group Lead approve them.

- 11.1 In addition to operator training, test area personnel may be required to complete the requirements for operator certification for crane, forklift, confined space, respirator, etc. This necessity shall be determined on an "as needed" basis for the specific test facility.

12. FLOW DIAGRAM

N/A

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