



TITLE BLOWER / DRYER / FILTRATION SYSTEM FOR BEAM TUBE POSITIVE AIR FLOW SPECIFICATION AND PROCEDURE PRODUCT LIGO BEAM TUBE MODULES CALIFORNIA INSTITUTE OF TECHNOLOGY	IDENTIFICATION			
	BDF-1 LIGO-E950054-03-B			
	REFERENCE NO. 930212		SHT 1 OF 7	
	OFFICE RSE		REVISION 3	
	MADE BY SDH	CHKD BY KHF	MADE BY SDH	CHKD BY WLR
DATE 11/6/93	DATE 12/29/93	DATE 11/09/95	DATE 11/09/95	

1.0 SCOPE

This procedure covers the activities associated with the Blower/Dryer/Filtration System(BDF) located at the stationary beginning of the construction of the beam tube modules. The use of the BDF system is to provide tempered, filtered, dry air for the purpose of supply to men working inside the beam tube. These steps and procedures are written to preclude the contamination of hydrocarbons and other harmful products into the beam tube.

- 1.1 The BDF System provides a positive air flow of clean, dry air through the tube during construction activities.
- 1.2 Two(2) redundant units will be used. Controls shall be arranged to provide automatic start-up of one unit based on the condition or failure of the first. The second unit will provide back-up during servicing of the first and visa versa.
- 1.3 The following activities are described in this procedure:
 - 1) General Arrangement and Specifications for the BDF Units.
 - 2) Operating procedures for the BDF Units.
 - 3) Maintenance Procedures for the BDF Units.
 - 4) Storage and Shipping of BDF Units.
 - 5) Field installation of BDF units and system.

2.0 REFERENCES

The procurement and operation of the BDF Units are based on the following references:

- 1) Summary of concepts and Reference Design for a Laser Gravitational-Wave Observatory, CAL TECH; Feb-92.
- 2) Project Safety Manual, LIGPSM.
- 3) Planned Approach to Cleaning and Cleaning Maintenance for LIGO Project, LIGOCP.

3.0 EQUIPMENT

- 3.1 Equipment referenced in other LIGO Project procedures will be incorporated into this procedure. For specific items, see applicable references.

APPROVED

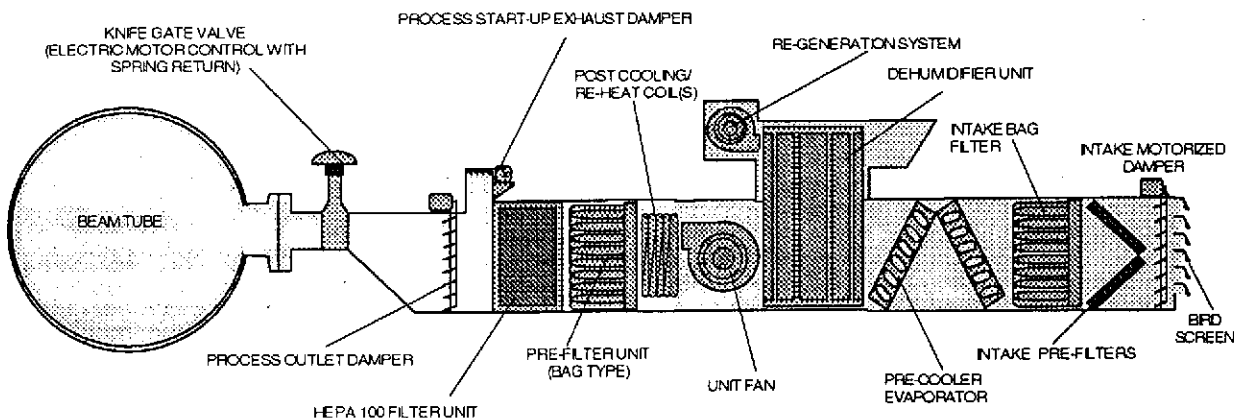
J. Jones LIGO 11/10/95

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- 1) 1500 CFM System Fan and Motor
- 2) Pre-Cooling Coil & DX System
- 3) After Cooling Coil & DX System common with pre-cooler.
- 4) 30% Efficient Pre-Filters
- 5) Outside Air Motorized Dampers
- 6) Bag Type Pre-Filter Unit
- 7) HEPA 100 Filter, rated at <0.3 Microns
- 8) Motorized start-up and by-pass dampers
- 9) Electric Re-Heat Coils, SCR controlled
- 10) Fire/Smoke detectors
- 11) Control for Redundant Operation
- 12) Weatherproof/Outdoor Construction



3.2 The following specifications regarding Beam Tube air input from the BDF Unit is as follows:

- | | |
|--|-------|
| 1. Process CFM | 1500 |
| 2. Process Ext Static(in. w.c.) | 2.5 * |
| 3. Reactivation Ext. Static(in. w.c.) | 0.75 |
| 4. Intake Air - Dew Point(at 29.92"hg) | 100 |
| 5. Intake Air Moisture Content in Grains/Pounds of Dry Air | 280 |
| 6. Process Exhaust Temperature in Degrees F | 50 |
| 7. Process Exhaust Dew Point in Degrees F | 0 |

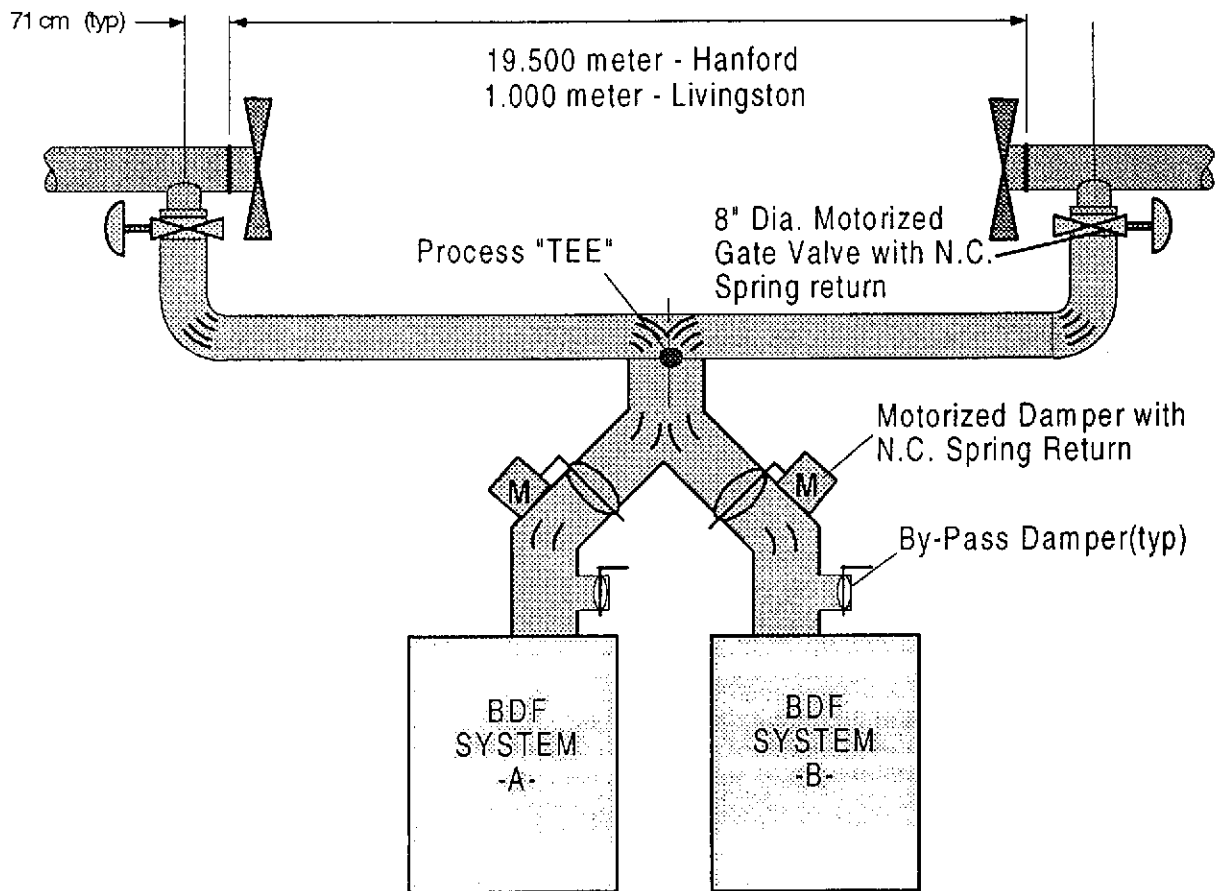
* Process Fan to be multitable speed and adjustable to $\pm 1.0''$ wc.



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4.0 FIELD INSTALLATION OF BDF SYSTEM

4.1 The BDF System shall be installed in a manner similar to beam tube installation using identical cleaning, handling and inside duct surface protection.



1. All air supply duct shall be fabricated from stainless steel and flanged for gasketed connection in the field.
2. All inside duct surfaces shall be cleaned using steam and 1:30 solution of Mirachem® and de-ionized water with water rinse. Surfaces shall be protecting by capping duct ends for transportation and installation in the field.



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**VENT ALL PROCESS AIR DURING TESTING
THROUGH THE BY-PASS DAMPER
ASSURE INLET VALVES AT THE BEAM TUBE
AND BEFORE THE "TEE"
ARE CLOSED DURING TESTS.**

3. Test all controls, alarms and default systems. Each BDF system is equipped with integral relief/by-pass dampers allowing venting of start-up system air.
4. Pressure test duct after installation using solution film method(soap). Use dry air or nitrogen to pressurize for test. Repair all leaks and final clean before operating system.
5. After Testing, purge system by venting through the duct system to the closed control valve(s) at the beam tube. A by-pass damper will be located near the valve for this purpose. A blind flange will be fit over the damper after this operation and sealed to prevent future use of this damper.
6. Insulate all duct using blanket type insulation and protect it from direct sunlight and weather conditions by wrapping with suitable reflective aluminized covering.
7. BDF Units shall be housed in temporary metal building on temporary slab to allow maintenance in all weather. Foundation and building shall be removed after beam tube installation.

5.0 OPERATION OF UNITS

5.1 The BDF System shall produce the following output of air:

1. Air Flow volume of 1500 CFM to be divided equally in two directions. This air volume will provide an air flow velocity of 60 fpm within the beam tube. Metering of air flow will be performed using gauge type manometers.
2. Air quality shall be controlled using a HEPA 100 type filter system capable of capturing 0.3 micron particle size with 99.97% efficiency. Pre-filters shall be replaced based on increased pressure drop across filters. Final HEPA filters shall be replaced based on particle count.



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3. Testing shall be performed for the initial HEPA filter installation and each time the filter is replaced. Testing shall be performed using a commercial grade particle counting meter capable of measuring 0.2 micron particles. The testing will be performed to identify seal and/or filter leaks for particles of size 0.5 microns or larger.
4. De-humidifier system shall be serviced to maintain a moisture content equal to or below 50° F outlet temperature and 0° F dew point.

5.2 The BDF System shall be operated continuously during construction activities. The following event and response shall be controlled automatically.

- 1) Controls shall provide automatic unit start-up on the loss of the operating unit.
- 2) Alarms shall be provided at the BDF Units and each Clean Room to warn of system failure.
- 3) Controls shall shut down units and close all dampers upon detection of smoke or fire.
- 4) Spring control shall be provided on all dampers to close upon loss of power to the unit.
- 5) Equip all units with control voltage magnetic type contactors for motor and compressor operation.

6.0 MAINTENANCE OF UNITS

Maintain the BDF System per the following schedule. Keep a maintenance log with the dates and initials of the technician performing the work. One unit shall be kept operating while the other unit is maintained.

WHEN UNITS ARE OPENED FOR INSPECTION AND/OR MAINTENANCE
THE UNIT SHALL BE RUN AND TESTED BY EXHAUSTING
PROCESS AIR THROUGH OUTLET BY-PASS DAMPER
BEFORE INPUT INTO THE BEAM TUBE DUCT SYSTEM



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- 6.1 Pre-Maintenance and Post Maintenance Requirements and Test
1. Before inspecting and/or servicing a unit isolate it from the Beam Tube Duct System by disabling the motorized damper by disconnecting the power to the motor.
 2. When repair or inspection involves the exposure of interior air flow surfaces, a purge step shall be performed before returning the unit to service.
 - a) Assure all work is complete and the unit sealed.
 - b) Open the By-Pass Damper to exhaust process air before the unit is started.
 - c) Start unit and run of a minimum of 1 minute before testing.
 - d) Perform particulant counting test by sampling outlet air at the by-pass vent. Monitor the particulate flow until the reading is equal to or below the Class 100 requirements.
 - e) Close the By-Pass Damper, enable the motorized damper to the duct system by re-connecting the power to the motor and shut down unit until needed.
- 6.2 Daily Maintenance:
- 1) Record all gauge and instrument readings for pressure and flow.
 - 2) Inspect and replace as necessary pre-filters for each unit.
 - 3) Perform particle counting test at the process "Tee" for particles of 0.5 microns or greater. Evaluate readings and determine HEPA filter efficiency. Compare particle counts to Class 100 Clean Room(0.5 microns/cuft) per "*Clean Room and Work Station Requirements, Controlled Environment*" [Fed. Specification 209a.].
 - 4) Determine if filter and/or seals are creating leakage based on particle test results and replace and/or reseal unit as necessary.
- 6.3 Weekly Maintenance:
- 1) Deleted.
 - 2) Inspect all door and panel joints for signs of leakage. Shut down and repair as required.
 - 3) Inspect all intake screens, exhaust screens and condenser fans for dirt, debris, and corrosion. *Clean and protect* as required.
- 6.4 Monthly Maintenance:
- 1) Inspect coil fins and tubing clean as required.



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- 2) Inspect all electrical connections, contactors, and switches for proper operation.
- 3) Operate all dampers to assure proper operation and air leakage. Adjust as necessary.

7.0 STORAGE AND TRANSPORTATION

The BDF Units shall be transportable from one area or site to another. This is accomplished by equipment mounted skids loaded on flatbed trailers.



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7.1 Short term storage shall comply with all activities noted below.

- 1) Lock all Doors and panels during storage.
- 2) Seal all inlet and outlet ducts.
- 3) Cover all electrical cords and connections to protect from the weather and outside abuse.

7.2 Long term storage and transportation shall comply with all activities noted below.

- 1) Complete all activities noted in 7.1 prior to long term storage or shipping.
- 2) Cover the unit in a weather proofing sealer or a tarp to prevent direct contact with rain, snow and/or sunlight.