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Prepared for
Office of Civil Defense
Office of the Secretary of the Army
Washington, D. C. 20310

SUMMARY OF REPORT

VENTILATION KITS

GARD Final Report 1477 November 1969

Contract No. DAHC 20-68-C-0123
OCD Work Unit 1423D

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by

A. L. Kapil
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OCD REVIEW NOTICE

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GENERAL AMERICAN RESEARCH DIVISION

SUMMARY OF REPORT

This report describes the design, development and testing of three types of manually powered ventilator kits for use in Civil Defense Shelters. The kits developed are: a one-operator bicycle ventilator kit (BVK), a two-operator bicycle ventilator kit and a Kearny pump kit (KPK).

The bicycle ventilators are pedal-powered and are designed to be stocked almost fully assembled to eliminate in-shelter assembly problems. Both utilize 30-inch diameter fans and 30-inch diameter exhaust ducts. The particular size of the duct was selected to allow it to be deployed without restriction and pressure loss through 31" wide doorways which is the minimum width of doorways in commercial-institutional buildings. Results of performance tests on the ventilator fan and on the duct are included in the report.

The Kearny pump is arm-powered and consists of a rectangular frame supporting a number of plastic one-way flap valves backed by a coarse wire mesh. The pump is pivoted at one end and when swung causes air to move unidirectionally. Components for making one full-door (double-section) Kearny pump and one half-door (single-section) Kearny pump are included in the KPK. The pump can be installed either in a doorway, pumping air between rooms, or within a room, mixing the air in the room.

Operating instructions for assembly and deployment of the ventilator kits, developed under OCD Task Order 1522B, Contract DAHC 20-68-C-0123, and the military specifications for the kits are included in the report.

The one-operator bicycle ventilator and its 30-inch diameter duct, the double-section doorway Kearny pump and the double-section A-frame Kearny pump were all blast-tested in a simulated shelter room in the URS Research Company Shock Test Facility. All the ventilators were rendered inoperative in the 12 ft. by 15 ft. floor area by jet blasts with peak estimated flow velocities of about 630 to 700 ft/sec.

The following major recommendations are made in the report regarding shelter ventilators:

1) The two-operator bicycle ventilator should be dropped from consideration as a shelter ventilator.

The use of the one-operator units only will result at most in a 10% higher total cost as compared to the use of an "optimum mix" of one- and two-operator units. This higher cost will probably be more than offset by the elimination of the complications of deploying two types of ventilators.

2) The bicycle ventilator should be used only as an exhaust device.

The use of ventilators to supply air results in the elimination of the duct in only one out of six shelter parts and hence cannot be justified, especially in view of the added complication and cost of supplying self-supporting duct.

3) Prefabricated duct sections (elbows, etc.) should be eliminated.

Bending of the duct, in lieu of using prefabricated sections, leads in general to a reduction of flow of at the most of 9%. This is small in comparison to the added BVK cost, the more complicated deployment instructions

and the more complicated deployment that will result if prefabricated sections are used.

4) An in-depth investigation of alternative deployment concepts of equipment and supplies within shelters to minimize blast damage should be conducted.

5) Since the Kearny pump uses arm power which is an inefficient method of operating a mechanical device, other designs of novel shelter ventilators should be investigated. These should meet the following criteria: move air continuously at high flow rates; use no duct; be low in cost; be foot-powered; and be easily assembled and deployed.

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FOREWORD

This report was prepared by the General American Research Division of General American Transportation Corporation, Niles, Illinois for the Office of Civil Defense, under OCD Task Order 1423D, Contract DAHC 20-68-C-0123. The work was monitored by Mr. Robert G. Hahl of the Office of Civil Defense.

The report covers the work performed on the contract during the period of 27 June 1968 to 27 June 1969 and describes the design, development and testing of ventilators for Civil Defense Shelters.

The authors wish to thank Mr. J. F. Halsey of SRI (now at URS Research Company) and Mr. A. B. Willoughby, Mr. C. Wilton, Mr. J. F. Melichar and the crew of the Shock Test Facility of URS for their cooperation in conducting the blast tests on the ventilators. Thanks are also due to Mr. R. V. Rouse of GARD for his assistance in writing the report and Mr. R. C. Friedman and Mr. J. A. Anderson, also of GARD, for furnishing the assembly and deployment instructions for the ventilators, developed under OCD Task Order 1522B, Contract DAHC 20-68-C-0123.

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ABSTRACT

This report describes the design, development and testing of three types of manually powered ventilator kits for use in Civil Defense Shelters. The kits developed are: a one-operator bicycle ventilator kit (BVK), a two-operator bicycle ventilator kit and a Kearny pump kit (KPK).

The bicycle ventilators are pedal-powered and are designed to be shipped and stocked almost fully assembled. Both utilize 30-inch diameter fans and 30-inch diameter exhaust ducts. Results of performance tests on the ventilator fan and on the duct are included in the report.

The Kearny pump is arm-powered and consists of a rectangular frame supporting a number of plastic one-way flap valves backed by a coarse wire mesh. The pump is pivoted at one end and when swung causes air to move unidirectionally. Components for making one full-door (double-section) Kearny pump and one half-door (single-section) Kearny pump are included in the KPK. The pump can be installed either in a doorway, pumping air between rooms, or within a room, mixing the air in the room.

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SECTION 1

INTRODUCTION

The need for portable fallout shelter ventilation equipment was pointed out by an OCD Task Group formed in 1963 to study the feasibility of various modes of ventilation.(1) The design and development of the MIL-V-40645 modular package ventilation kit resulted from the recommendations of the Task Group.(2) This kit employs a 20-inch diameter propeller fan that can be electric-driven or pedal-driven by one or two persons.

Subsequent shelter equipment evaluations conducted by the American Institutes for Research and GARD showed that the ventilator as designed, could not be readily assembled by untrained persons. Also, a cost optimization study - limited to fans with diameters of 36 inches or less - revealed that a shelter ventilation system of minimum cost would require three units with 36-inch diameter fans, rather than 20-inch diameter fans.(3) These units would be a one-operator pedal-driven unit; a four-operator pedal-driven unit; and a 5-hp electric motor-powered unit.(4) The study was limited to fans with diameters of 36 inches or less since it was assumed the minimum width of doorways in shelters was 36 inches.

A later study, however, disclosed that the minimum width of doorways in commercial-institutional buildings is 31 inches. To avoid excessive pressure losses in ducts caused by restrictions at the doorways and to avoid in-shelter assembly problems, it was decided with OCD's approval to develop pre-assembled

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(1) Superscripts refer to Section 9, References, p. 9-1.

one and two-operator bicycle ventilators using a fan and duct system of less than 31 inches in diameter. Sections of this report describe the design, prototype fabrication and tests on such units, and the costs of the one and the two-operator bicycle ventilator kits.

In addition, thoroughly engineered designs of the Kearny pump which can be economically mass-produced were developed. The Kearny pump is a ventilation device consisting of a rectangular frame backed by a coarse wire mesh and provided with a number of plastic one-way flap valves.(5) When pivoted at one end and swung, the flap valves open in one direction and close in the other, causing the air to move unidirectionally. It can be used to ventilate side rooms in shelters or mix air within rooms in shelters. Sections of this report describe the design, prototype fabrication and tests on the Kearny pumps and the cost of the Kearny pump kit.

SECTION 2

BICYCLE VENTILATORS

Two types of bicycle ventilators were developed under the contract, a one-operator unit and a two-operator unit. The military specifications for these units are given in Appendix B.

2.1 Design Criteria

The design criteria which these ventilators were required to meet were the following: 1) use as many "off the shelf" components as possible to minimize cost; 2) use one-step chain and sprocket transmission to keep costs low; 3) be almost fully assembled when packaged to minimize in-shelter assembly; 4) use a fan and duct system that can be deployed through minimum width, standard doorways - 31 inches wide - without constriction and loss of flow; and 5) be capable of discharging either into or out of shelters.

2.2 One-operator Bicycle Ventilator - Initial Design

The one-operator bicycle ventilator developed to meet the above criteria is a modified version of the 36-inch unitary ventilator developed previously by GARD under SRI Subcontract No. 11616(6300A-180).[4] The new ventilator, see Figure 2-1, is based on a 0.1 hp input with a pedal speed of 55 rpm, the optimum value found in a previous GARD study.[6]

An equipment optimization analysis conducted by GARD under SRI Subcontract No. B70925(4949A-28)-US showed that single-step chain and sprocket transmissions are feasible for fans with diameters of 30 inches or greater.[3] As a result of this

and of the survey which showed standard doorways to be at least 31 inches wide, the ventilator was designed with a 30-inch diameter fan and duct system. The flow of a larger diameter system would be restricted at minimum width doorways, while a smaller diameter system would require a two-step speed increase.

The same equipment optimization analysis referred to above also showed that for a 0.1 hp input, the optimum 30-inch diameter fan is the Torrington R-3020-4. This has four blades with 20° pitch angles. This fan was thus selected for the bicycle ventilator; its expected performance curves with a 0.1 hp input are given in Figure 2-2. A bellmouth fan shroud was selected for use with this fan since of the three basic types of orifices - sharp edged, cylindrical and converging (cone or bellmouth) - the bellmouth orifice causes the smallest static pressure loss, and thus for a given power input, the largest flow.

Since the fan speed is low, 400 to 500 rpm, a one-step speed increase sprocket and chain transmission is feasible. Using 15 teeth on the fan sprocket and 131 teeth on the pedal sprocket, the fan-to-crank ratio is 8.73 to 1. This ratio means that pedal speeds in the range of 46 to 57 rpm are required to operate the unit, with the optimum pedal speed of 55 rpm producing a fan speed of 480 rpm.

Because of the large number of teeth on the large sprocket, an ASA Standard No. 35, 3/8-inch pitch drive chain was selected. A chain of a larger pitch, while cheaper, would require a larger diameter sprocket to hold the same number of teeth.

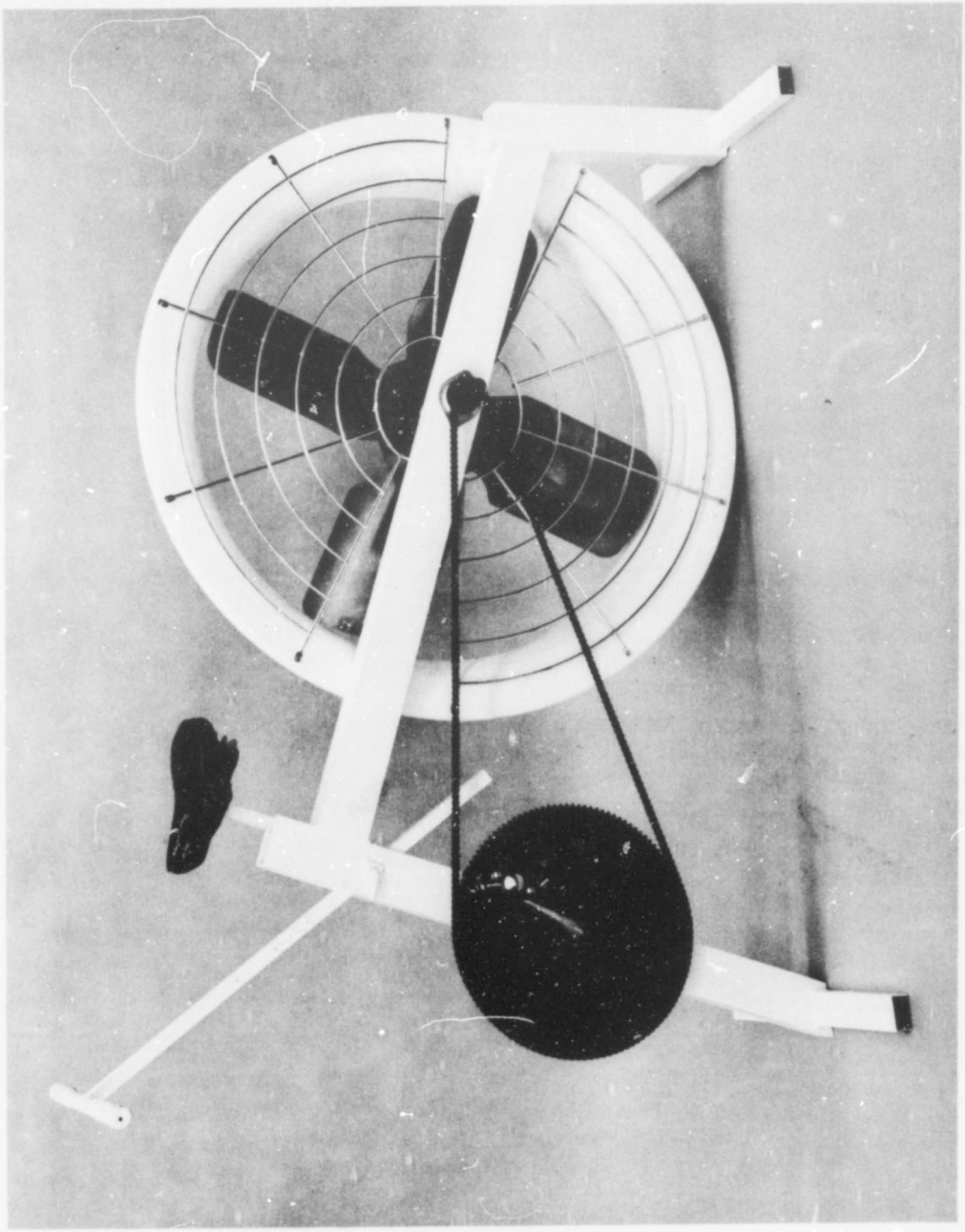


Figure 2-1 ONE-OPERATOR, 30-INCH DIAMETER BICYCLE VENTILATOR, INITIAL DESIGN

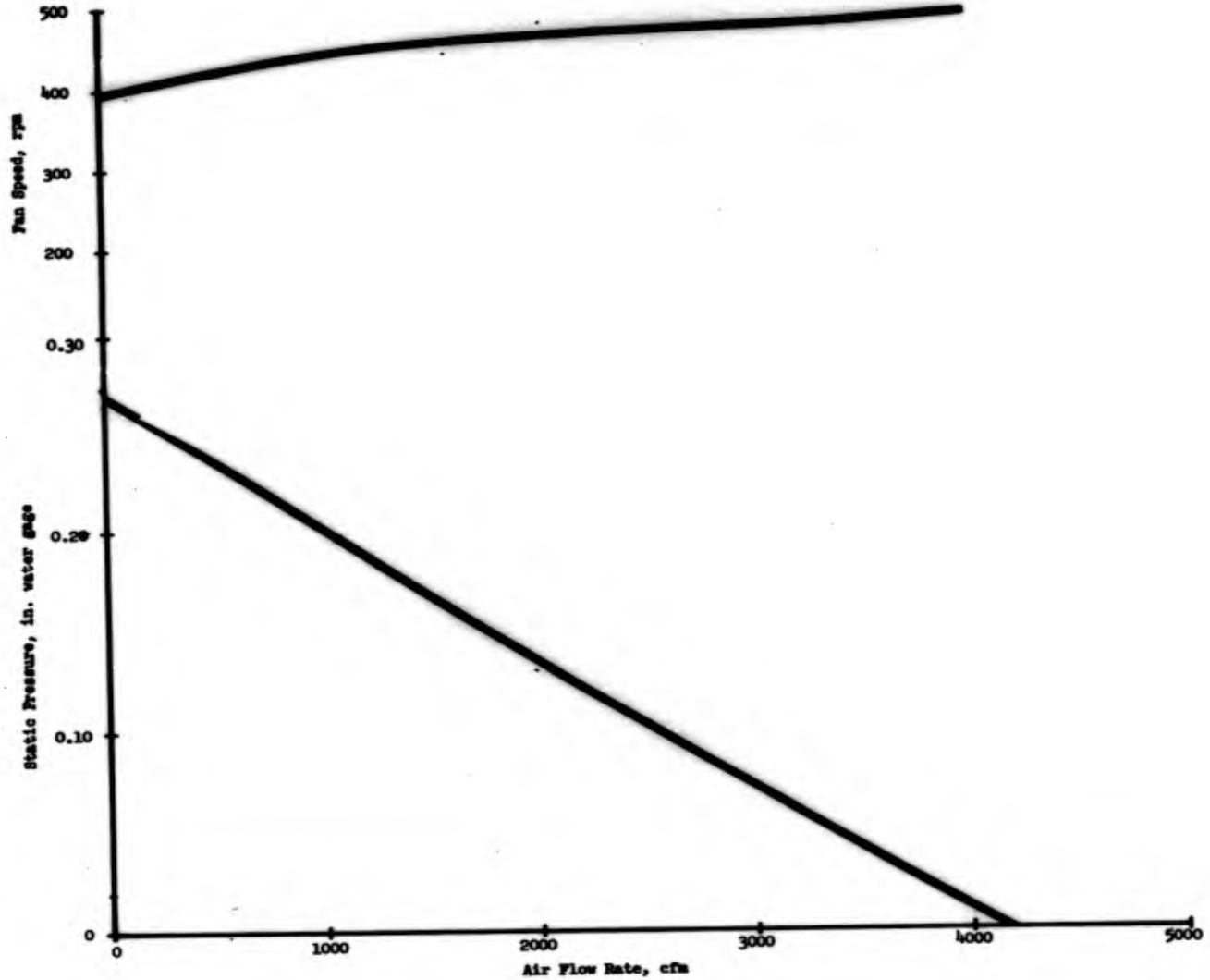


Figure 2-2 EXPECTED PERFORMANCE CURVES FOR TORRINGTON R-3020-4 FAN, 0.1 HP INPUT

The center-to-center distance between the sprockets was selected to give a chain length of an even number of links. A chain containing an odd number of links requires an offset link, which does not have the dynamic strength of a standard link. Both the chain and the sprockets are available commercially. The pedal crank, crank bearing parts, pedals and saddle are standard bicycle components.

The frame of the one-operator ventilator is made up of sections of rectangular aluminum tubing welded together. The rear support stand and the handlebar are separate and must be attached to the frame for operation. The only other assembly required is the attachment and deployment of the duct.

Previous GARD design studies produced a speedometer for attachment to a bicycle ventilator,[7] the purpose of which is to help the operator of the ventilator maintain the proper fan speed. This speedometer was included in the initial design of this unit.

2.3 Two-operator Bicycle Ventilator - Initial Design

The two-operator bicycle ventilator designed under this contract is similar to the one-operator unit described above. The initial design of this ventilator is shown in Figure 2-3.

Several methods of seating the operators were investigated to minimize the overall size of the unit, see Figure 2-4. The smallest preassembled package volume results from locating the seats over the fan shroud and having the

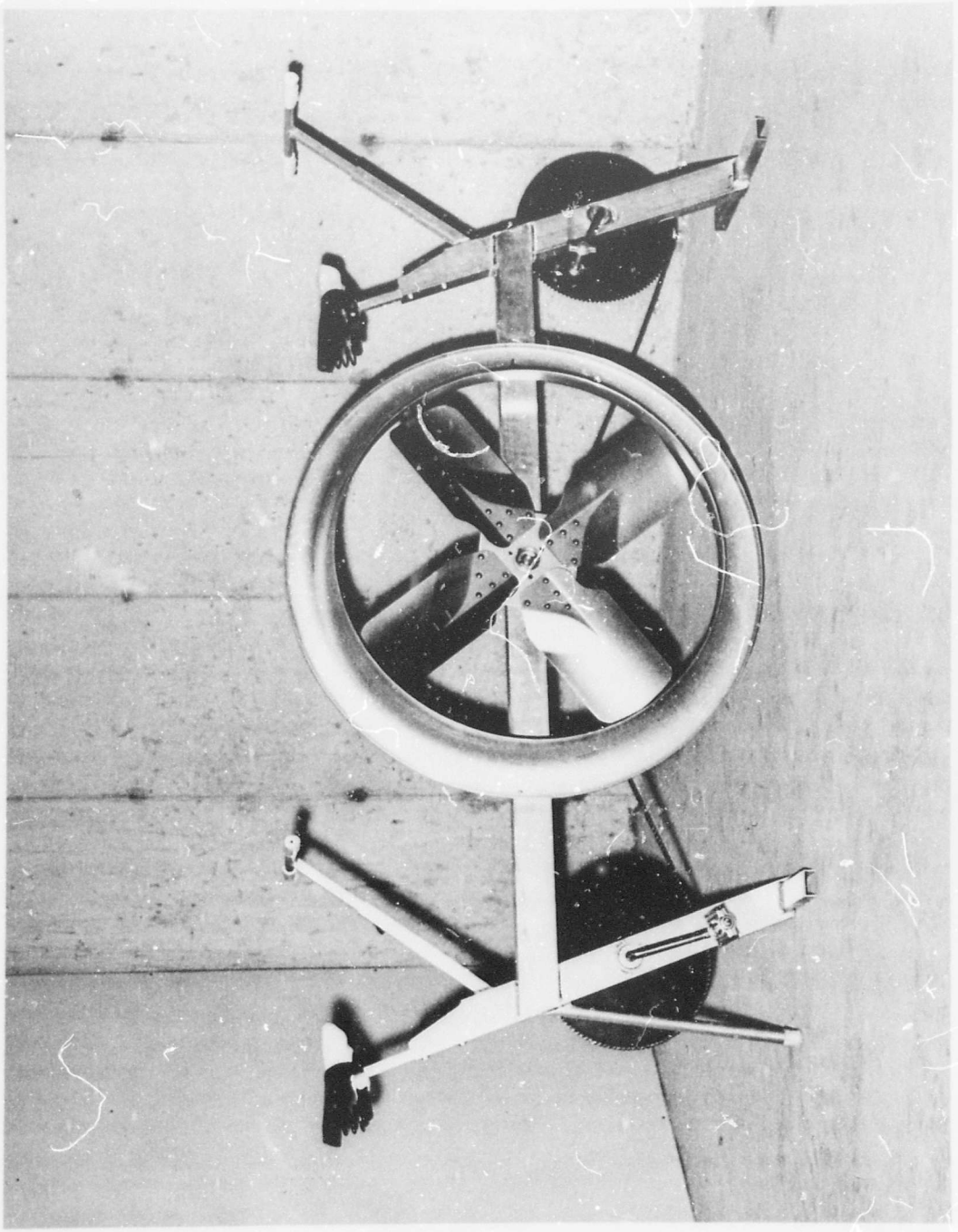
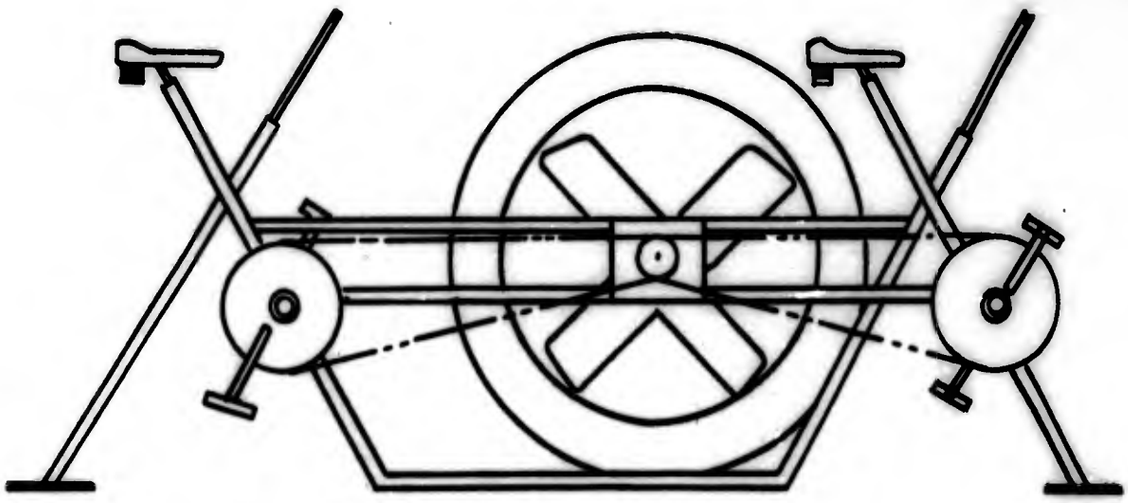
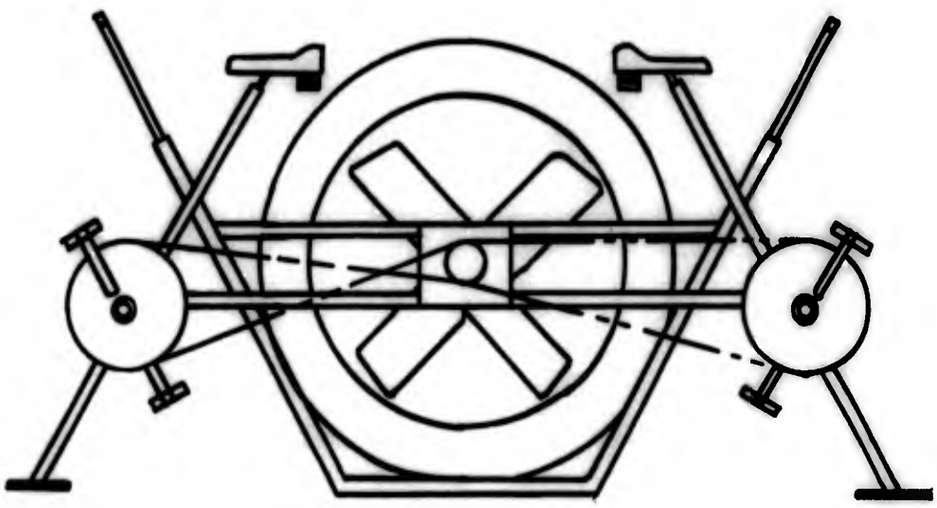


Figure 2-3 TWO-OPERATOR, 30-INCH DIAMETER BICYCLE VENTILATOR, INITIAL DESIGN



Operators Facing Same Direction



Operators Facing Opposite Directions

Figure 2-4 TWO-OPERATOR BICYCLE VENTILATOR, ALTERNATE SEATING ARRANGEMENTS

operators sit back-to-back. With the operators then pedaling in opposite directions, a reversal of direction is required between one pedal crank and the fan. A gear drive reversal is too expensive and a crossed V-belt drive too inefficient to be practicable. For these reasons the face to back design was adopted.

Since two operators supply power to this unit, the power input is assumed to be 0.2 hp. The same propeller fan was found to be the optimum 30-inch diameter propeller with a power input of 0.2 hp[3]. The expected performance curves of this propeller with a 0.2 hp input are presented in Figure 2-5.

The same fan shroud and bearing assembly were chosen for this unit as are used with the one-operator unit.

The fan speed is again low, 500-650 rpm, so a one-step speed increase sprocket and chain transmission is feasible. Using 14 teeth on the fan sprocket and 150 teeth on the pedal sprockets, the fan-to-crank ratio is 10.71 to 1. This ratio means that pedal speeds in the range of 47 to 58 rpm are required to operate this unit, with the optimum pedal speed of 55 rpm producing a fan speed of 589 rpm.

The chains and sprockets are again available commercially, as are the pedal cranks, crank bearing parts, pedals and saddles, which are standard bicycle components.

The frame of the initial design of this unit was constructed in the same manner as the one-operator ventilator. The only assembly required for operation of this unit is insertion of the handlebars and attachment and deployment of the duct.

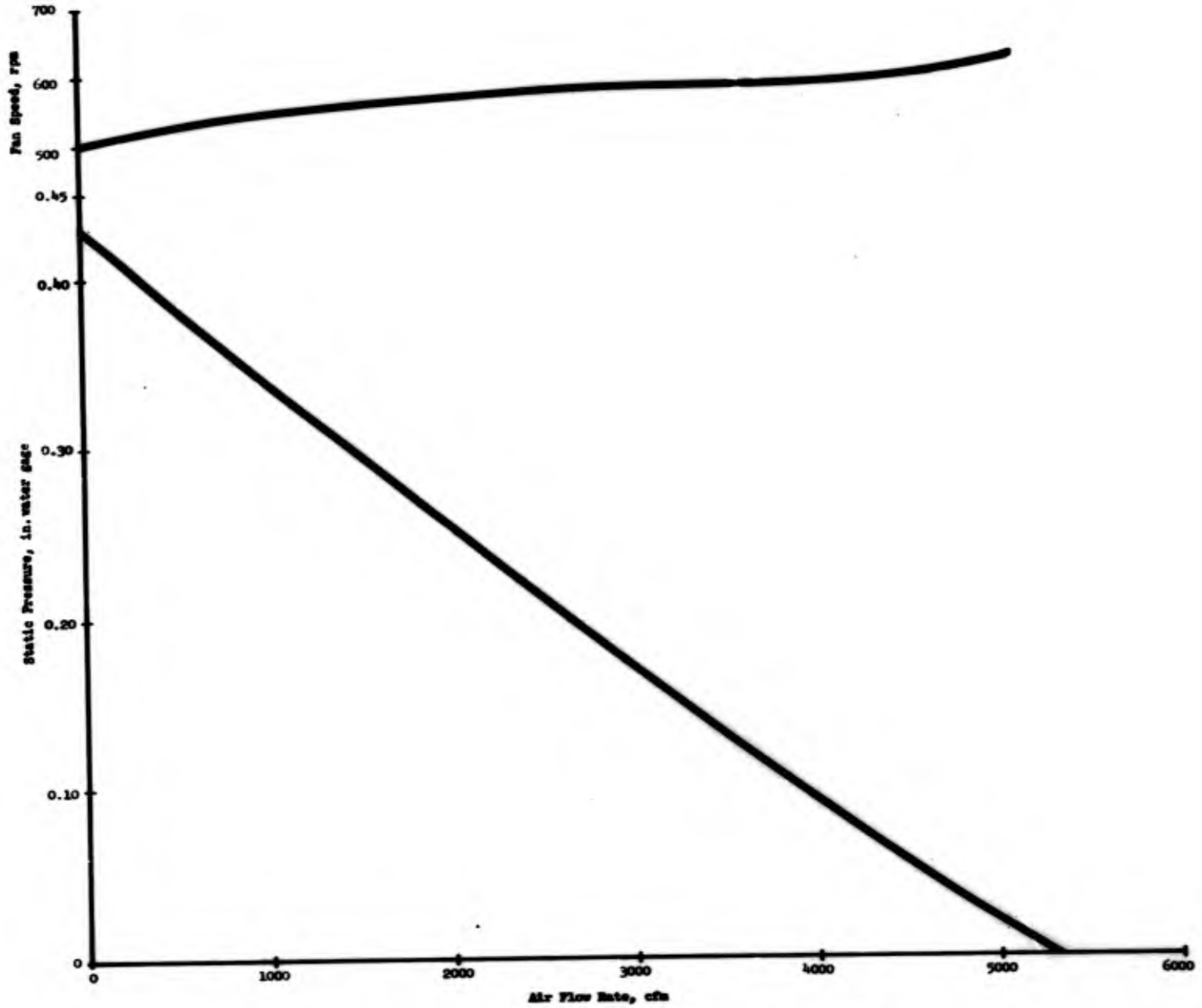


Figure 2-5 EXPECTED PERFORMANCE CURVES FOR TORRINGTON R-3020-4 FAN, 0.2 HP INPUT

2.4 Testing

2.4.1 Human Factors Tests

The initial design one-operator bicycle ventilator was tested in shelter occupancy exercises conducted under Task Order 1522B of OCD Contract DAHC 20-68-C-0123. Shelterees were able to assemble and operate the ventilator, but experienced difficulty in determining an adequate deployment for the ventilator. In the first tests, the speedometer only had a lower limit marked; the shelterees pedaled at excessive speeds and quickly exhausted themselves. In later tests, the markings were changed to show a narrow range of desired speeds; the shelterees successfully maintained the proper speeds with this arrangement.

The other problem observed in these tests was due to the exposed fan blades. Shelterees did not maintain a safe distance from the blades or keep children away from them. In addition, there was observed a danger of the fan sucking in loose articles of clothing. Addition of a wire fan guard to the unit was suggested.

2.4.2 Fan Performance Tests

The one-operator ventilator was tested by the Air Moving and Conditioning Association, Inc., Arlington Heights, Illinois. A constant speed test curve of horsepower vs. flow was obtained for the entire range from zero static pressure (free-air) to zero flow. The test data were obtained for a constant speed of 590 rpm. By applying the fan laws, this was converted to static pressure vs. air flow curves for constant inputs of 0.1 hp and 0.2 hp, which are presented in Figures 2-6 and 2-7. The fitted curves of Figures 2-2 and 2-5 (taken from the optimization analysis) are superimposed for comparison.

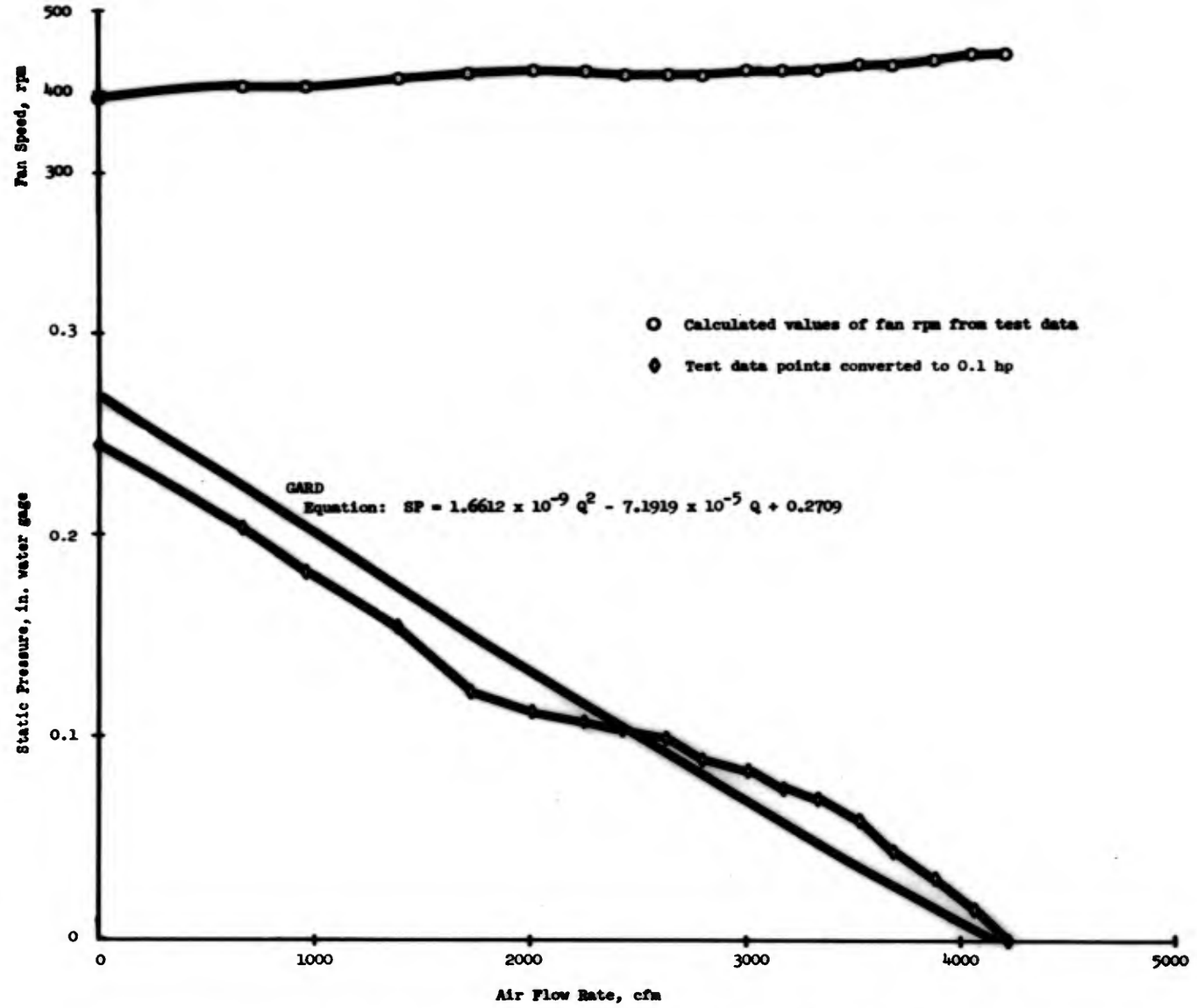


Figure 2-6 ACTUAL PERFORMANCE CURVE FOR TORRINGTON R-3020-4 FAN, 0.1 HP INPUT

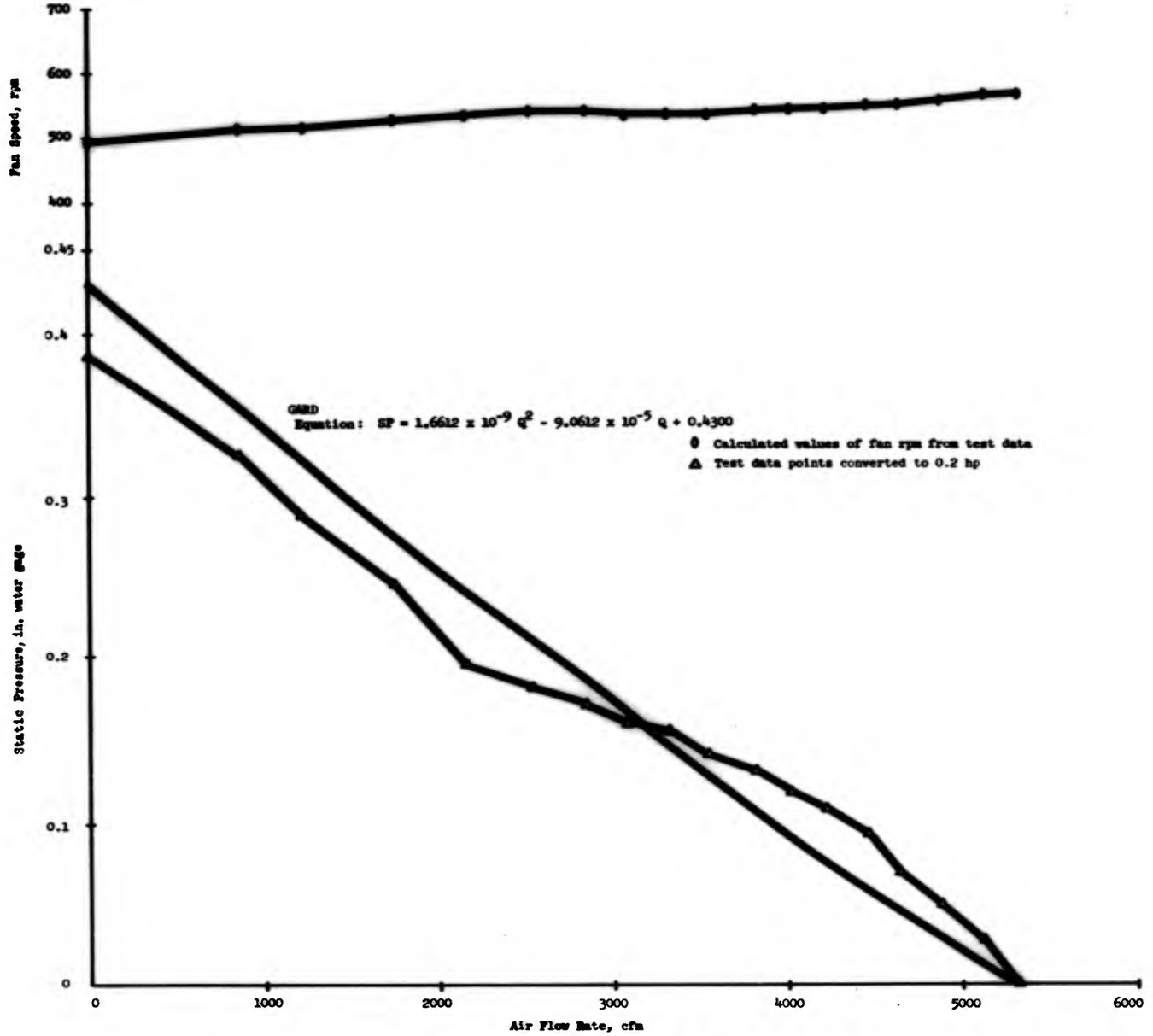


Figure 2-7 ACTUAL PERFORMANCE CURVE FOR TORRINGTON R-3020-4 FAN, 0.2 HP INPUT

It should be noted that the approximating curves are always within 11% of the 0.1 hp test curves and within 17% of the 0.2 hp test curve.

2.5 Bicycle Ventilators - Final Design

The final designs of the one- and two-operator bicycle ventilator are the same as their initial designs with the following exceptions - a fan guard is added, the speedometer removed, and the manner of the frame construction changed.

The fan guard is added to the intake side of the fan to protect shelterees from injury and to keep out loose articles of clothing. A speedometer is not at present included with the ventilator but can be incorporated after the required design studies have been completed.

The frame of the one-operator ventilator is changed to a one-piece frame of 0.083-inch wall electric welded rectangular tubing, 1-1/4 x 3 inches. The material is changed from aluminum to steel to reduce cost. The frame is manufactured by simply bending the tube in two places, slitting the ends and bending the slit ends outward to form the base, see Figure 2-8.

The frame of the two-operator unit is also constructed from 0.083-inch wall electric welded rectangular steel tubing, 2 x 3 inches, see Figure 2-9. The one-piece design for this unit was not completed since the results of the study conducted under T/O 1217C, Contract DAHC 20-68-C-0123 indicate that this size unit be dropped from further consideration.

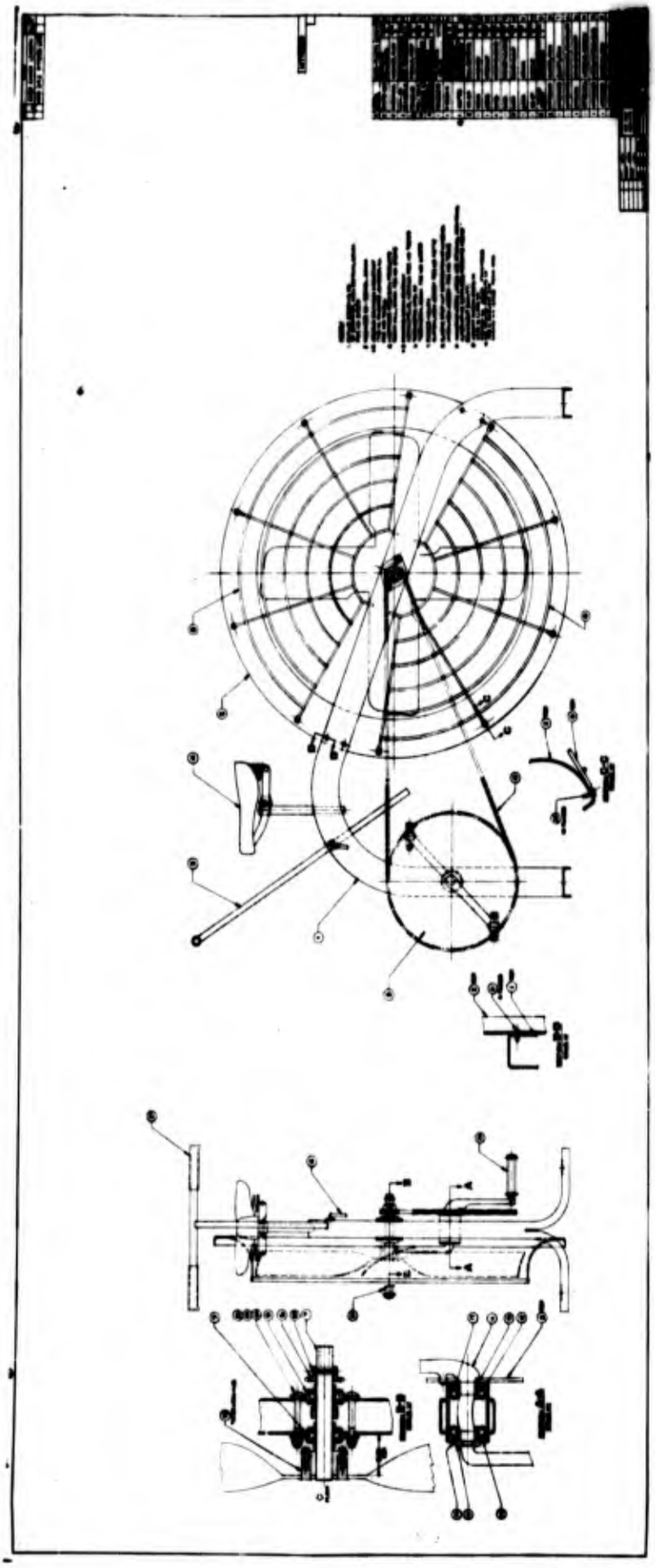


Figure 2-8 ONE-OPERATOR, 30-INCH DIAMETER BICYCLE VENTILATOR, FINAL DESIGN

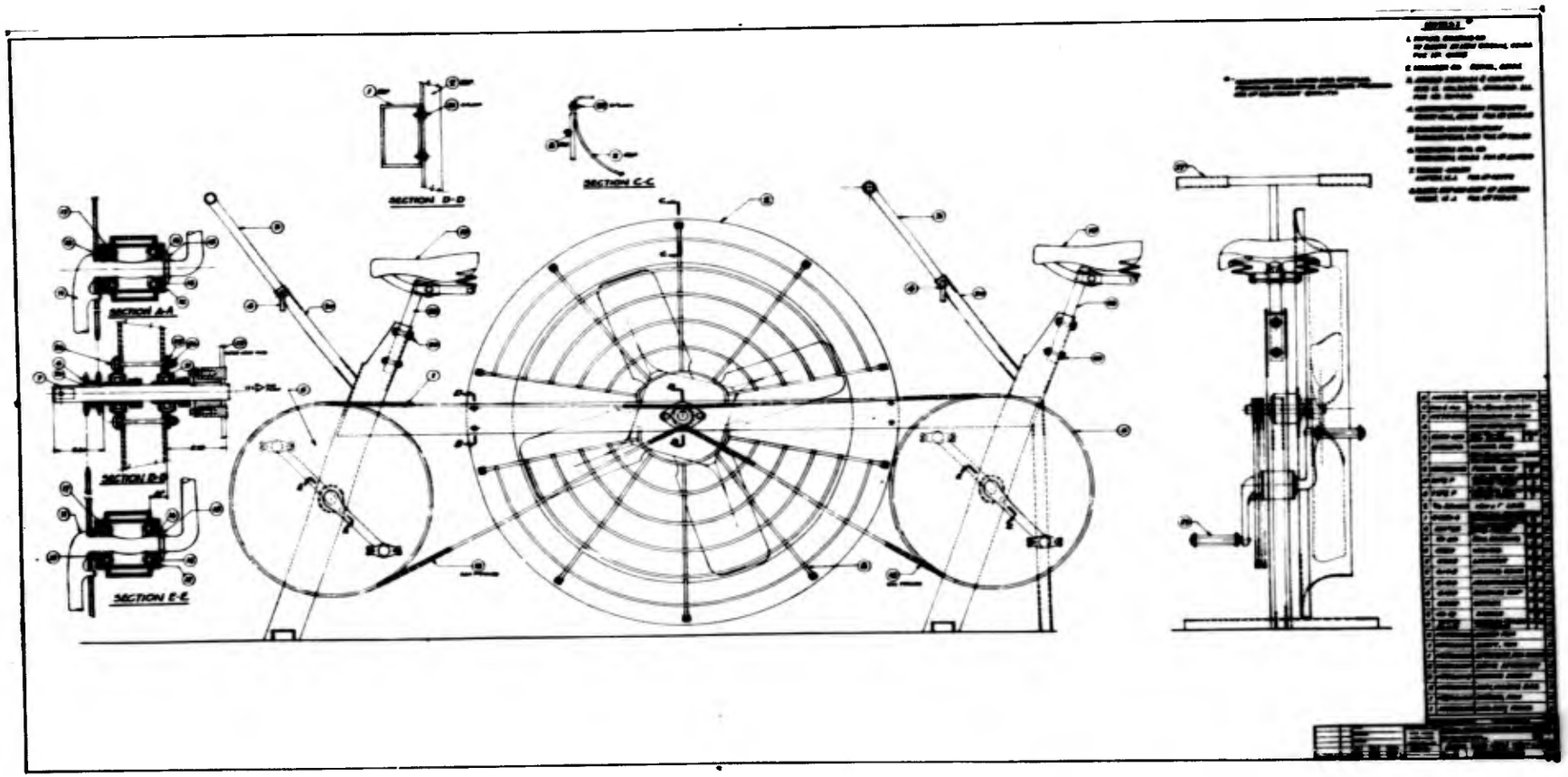


Figure 2-9 TWO-OPERATOR, 30-INCH DIAMETER BICYCLE VENTILATOR, FINAL DESIGN

The only assembly required for operation of the final design bicycle ventilators is adjustment of the handlebars and attachment and deployment of the duct.

2.6 Ventilator Performance and 30-Inch Duct System Curves

The ventilator performance and 30-inch duct system curves are given in Figure 2-10. The static pressure vs. air flow rate for ducts between 100 ft. and 1000 ft. in length are presented with the performance curves of the one-operator (0.1 hp) and two-operator (0.2 hp) ventilators superimposed on them. The flow rate for a given effective duct length for the two ventilators can be quickly estimated from these curves. The expected fan rpm's are also indicated.

The curves are based on duct tests conducted in accordance with the American Moving and Conditioning Association (AMCA) Test Standard 210-67. The details of the tests are covered in SECTION 4, DUCT STUDIES.

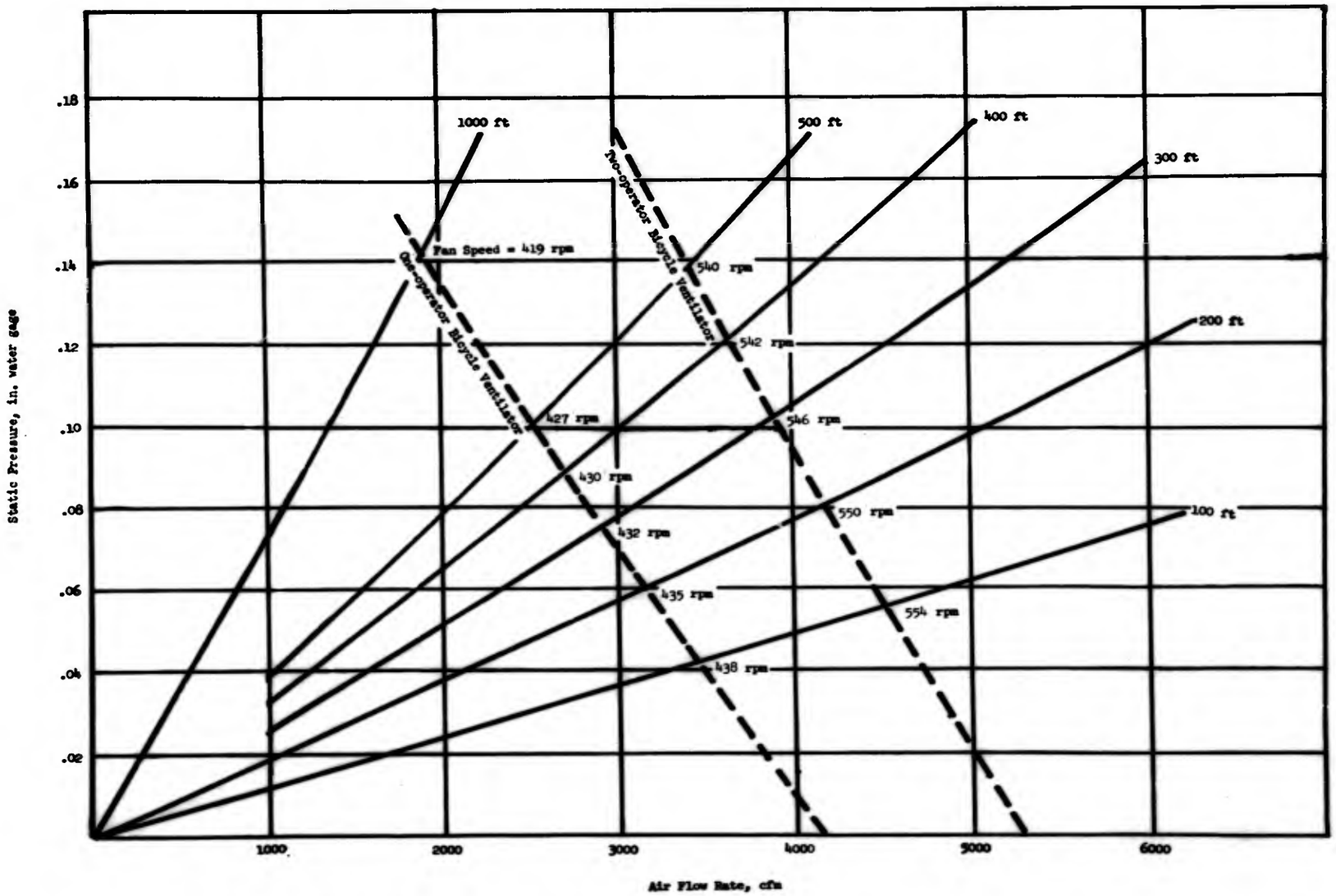


Figure 2-10 VENTILATOR PERFORMANCE AND 30-INCH DUCT SYSTEM CURVES

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SECTION 3

KEARNY PUMP VENTILATOR

In addition to the bicycle ventilator (BV), a Kearny pump (KP) design was developed. The Kearny pump consists of a rectangular frame supporting a number of plastic one-way flap valves and covered by a coarse wire mesh screen, see Figure 3-1. When the Kearny pump is pivoted at one end and manually swung, the flap valves close during the power stroke and open during the return half of the cycle, causing air to be moved unidirectionally. The coarse wire mesh insures that the valves remain closed during the power stroke.

The KP is an air-moving device that provides a means for ventilating a room which has only one aperture (dead-end room) without using ducting, as required by the bicycle ventilator, see Figure 3-2. The KP can also be used instead of the bicycle ventilator in a room with at least two apertures (flow-through room) if the pressure head requirement to move air through the room is low (several hundredths of an inch of water)[8], see Figure 3-3. In addition, the KP can be used in conjunction with the BV to distribute the air within a shelter room by diverting a portion of the main air stream created by the BV to areas which otherwise would not be ventilated, see Figure 3-4.

The initial idea for the Kearny pump was that it should be constructed with materials found in the home by "do-it-yourselfers"[5]. The study undertaken in this contract constitutes an effort to develop a low cost KP based upon a thoroughly engineered design, which could be mass produced inexpensively.

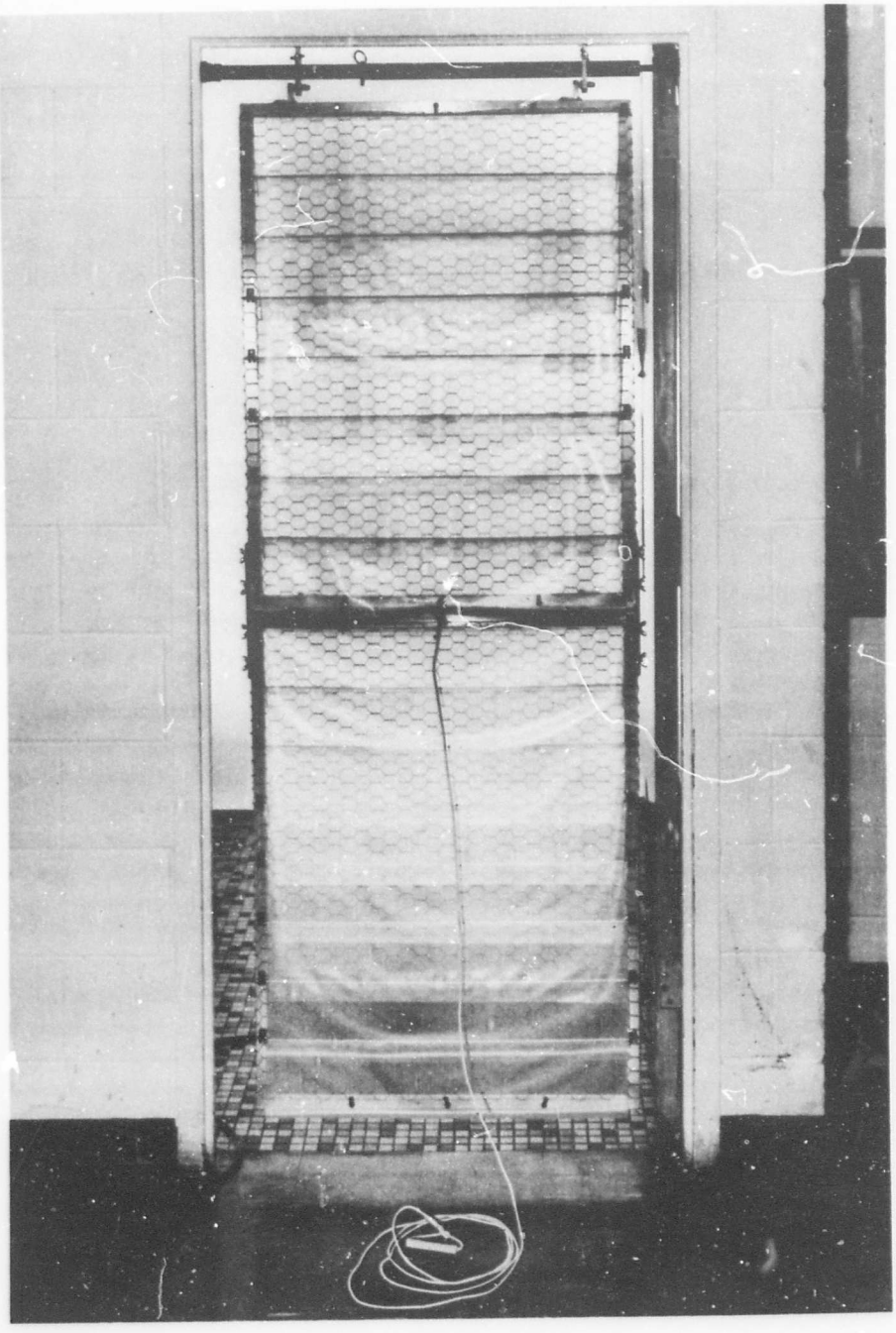

Figure 3-1 KEARNY PUMP

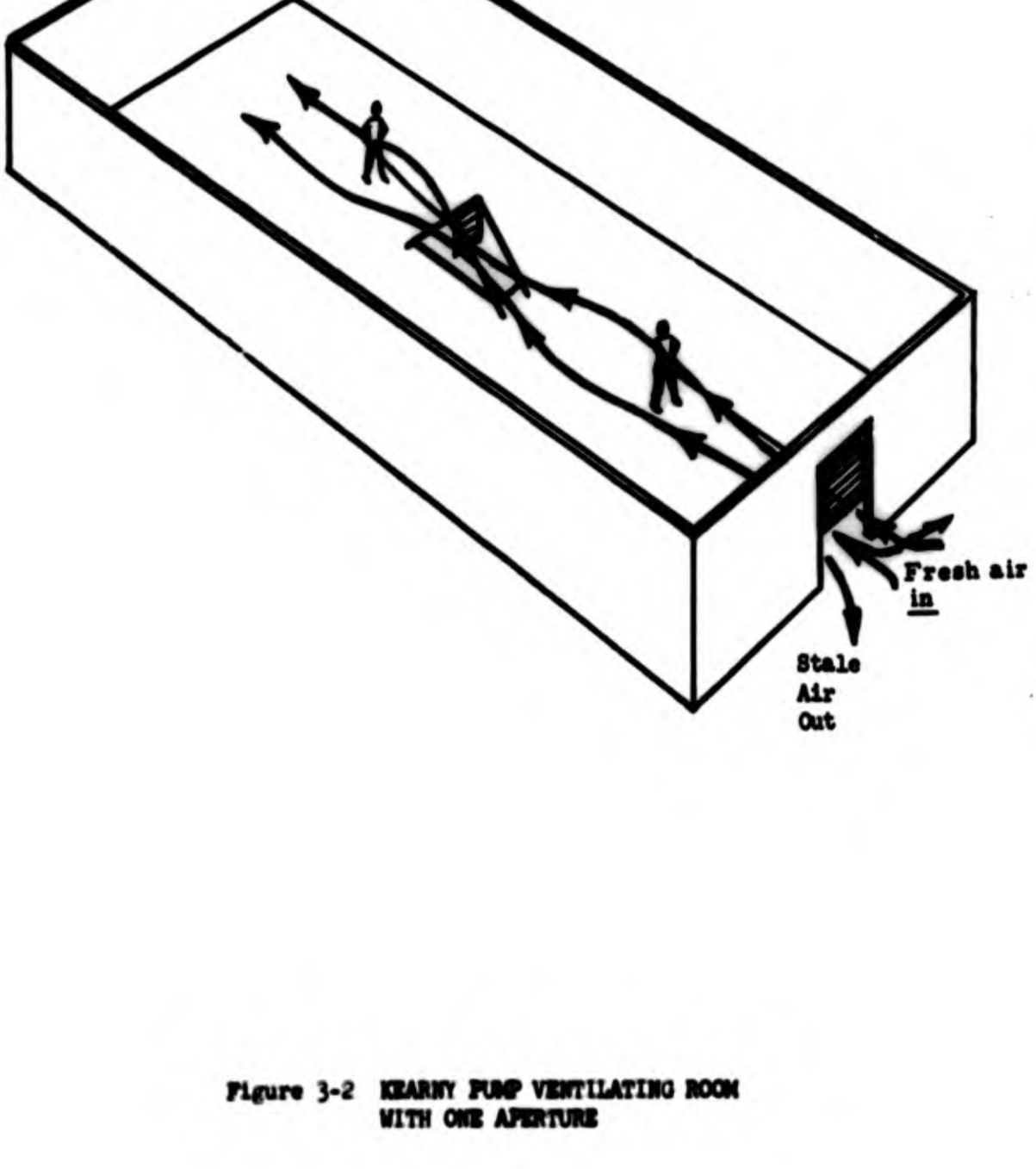

Figure 3-2 KEARNY PUMP VENTILATING ROOM WITH ONE APERTURE

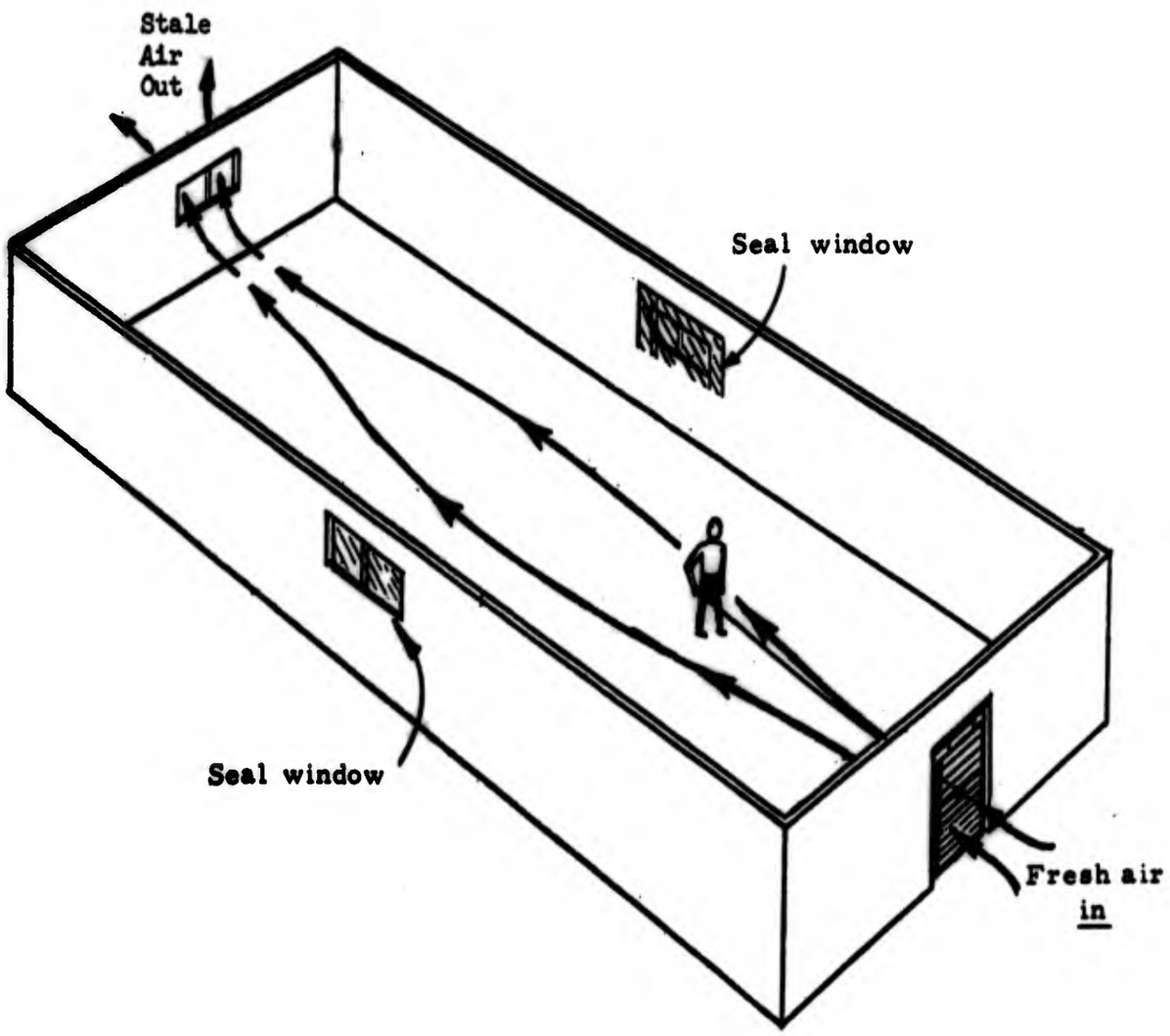

Figure 3-3 KEARNY PUMP VENTILATING ROOM WITH AT LEAST TWO APERTURES

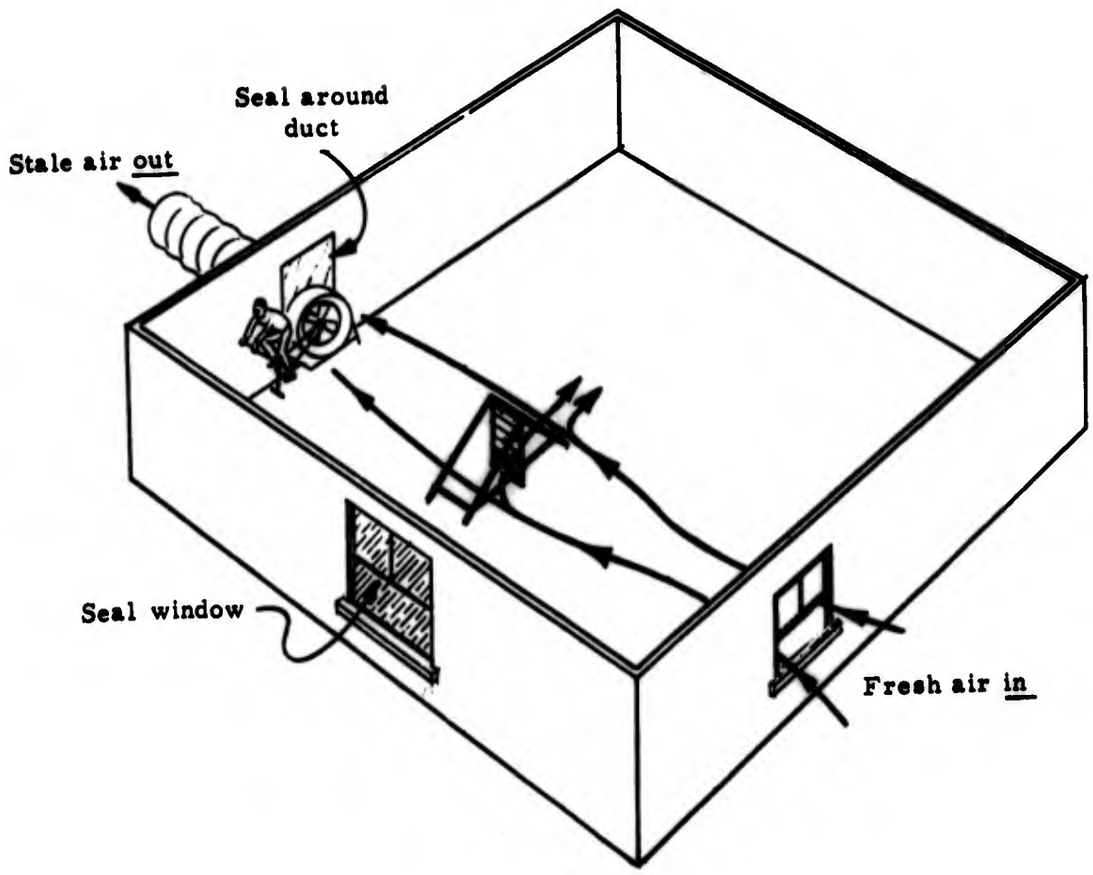

Figure 3-4 KEARNY PUMP USED WITH BICYCLE VENTILATOR

3.1 Design Criteria

Several concepts which evolved as preliminary design criteria for the KP were: 1) it must be adaptable to move air into shelter rooms and to distribute air within a room; 2) it must be light weight; 3) it must be a low cost item; 4) it must have a doorway support which must fit in the confines of a door jamb and not be permanently fastened by nails, screws, glue, etc.; 5) it must be in two sections to fit the complete height of a doorway, or one-half the height of a doorway; 6) it must be adjustable in width to fill various sizes of doorways; 7) it must be locatable anywhere within a room. The initial design of the KP was an attempt to satisfy these design criteria.

3.2 Initial Designs

The original prototype of the KP consisted of two flap sections 29 inches wide by 37-1/2 inches long. The frame of each flap section was constructed from 1.75 x 1.00 x 0.125 inch aluminum channel extrusion. These frames were laced with 0.018 inch diameter steel wire to support the flaps constructed from 4 mil thick polyethylene. The two flap sections were hinged together by two slip-joint hinges and locked together by two Camloc latches. The bottom horizontal member of the KP frame of the lower flap section consisted of a 2.00 x 1.00 x 0.12 inch wall rectangular aluminum tube provided with a removable plug so that the tube could be filled with sand if additional weight were required to improve its performance. The upper flap section had two 1.50 x 1.50 x 0.25 inch aluminum angles welded to it, each containing a 0.312 inch diameter hinge pin. The hinge pin was fastened with a cotter

pin after passing through a support bearing. The bearing was welded to a 3/4 inch black pipe section to form an adjustable C-clamp. The two flap sections were hung in a doorway by fastening the two C-clamps onto the top of the doorway jamb, see Figure 3-5.

One design of the Kearny pump incorporated adjustable flap sections. This design would have the capability of expanding in width from 30 inches to 40 inches. The adjustability feature requires that the flap valves have enough material to fill the pump at its widest opening, and that the shelterees cut off the excess material from each valve for doorways narrower than the widest allowed. It was decided that the adjustable Kearny pump flap sections required too much decision ability from the shelterees to achieve easy assembly. Because of its higher cost and because the maximum increase in width is only ten inches, this adjustable design was dropped from further consideration.

The C-clamp suspension system described above is not useable in doorways extending to the ceiling which have no doorway jamb on the top. A device designed to work in all doorways and to replace the C-clamps is the doorway support bar, see Figure 3-6. This adjustable support bar is constructed from steel tubing. The coarse width adjustment is a sliding inner tube which is held in place by a detented steel pin which fits into one of the several holes in the tube. The fine adjustment is a threaded stud which can be turned out against the sides of the door frame. Both ends of the bar are rubber tipped to prevent slippage. A static load of 200 pounds will be supported by the bar if it is properly installed. Two sliding bearing

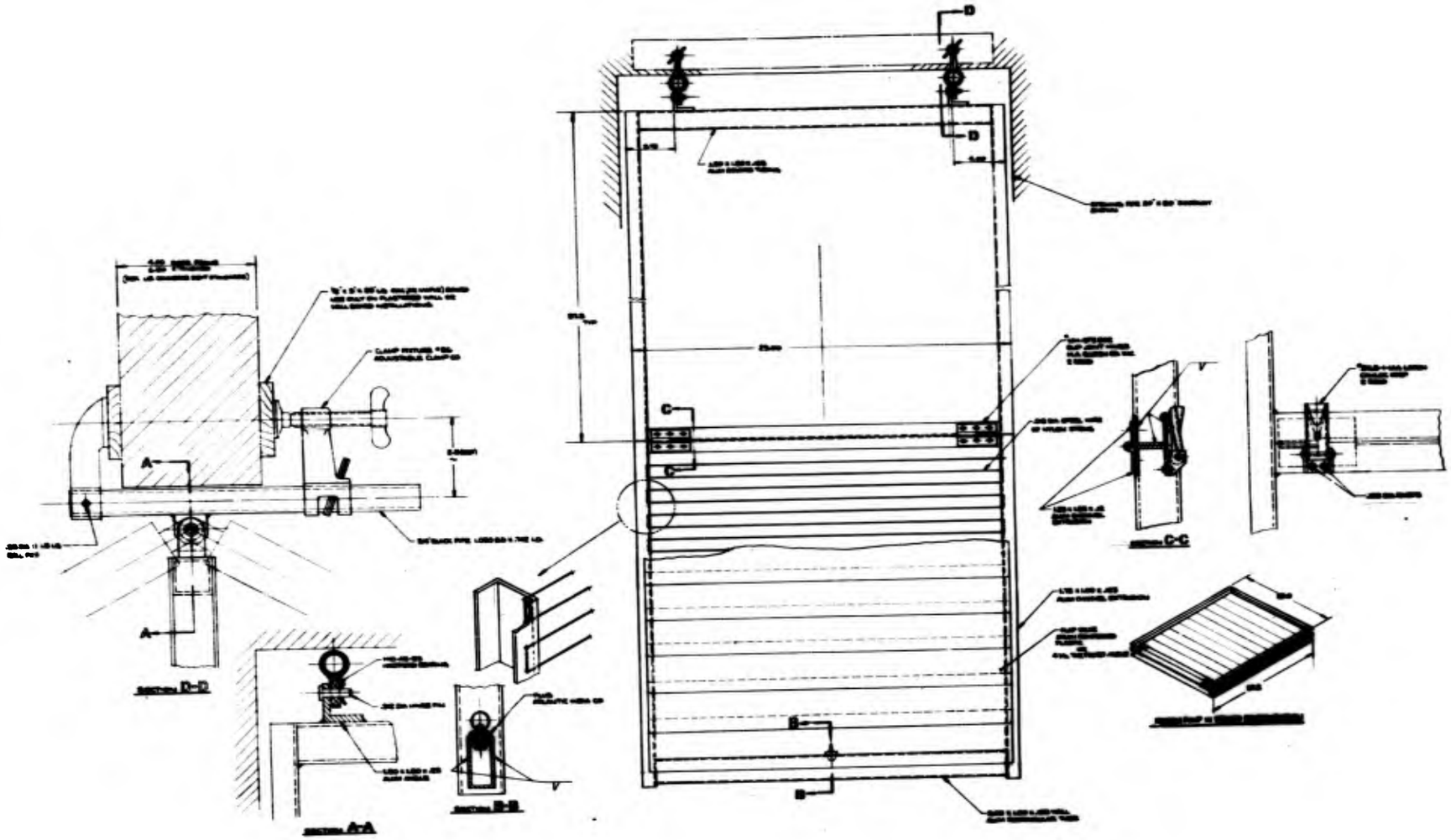

Figure 3-5 FIXED WIDTH KEARNY PUMP, INITIAL DESIGN

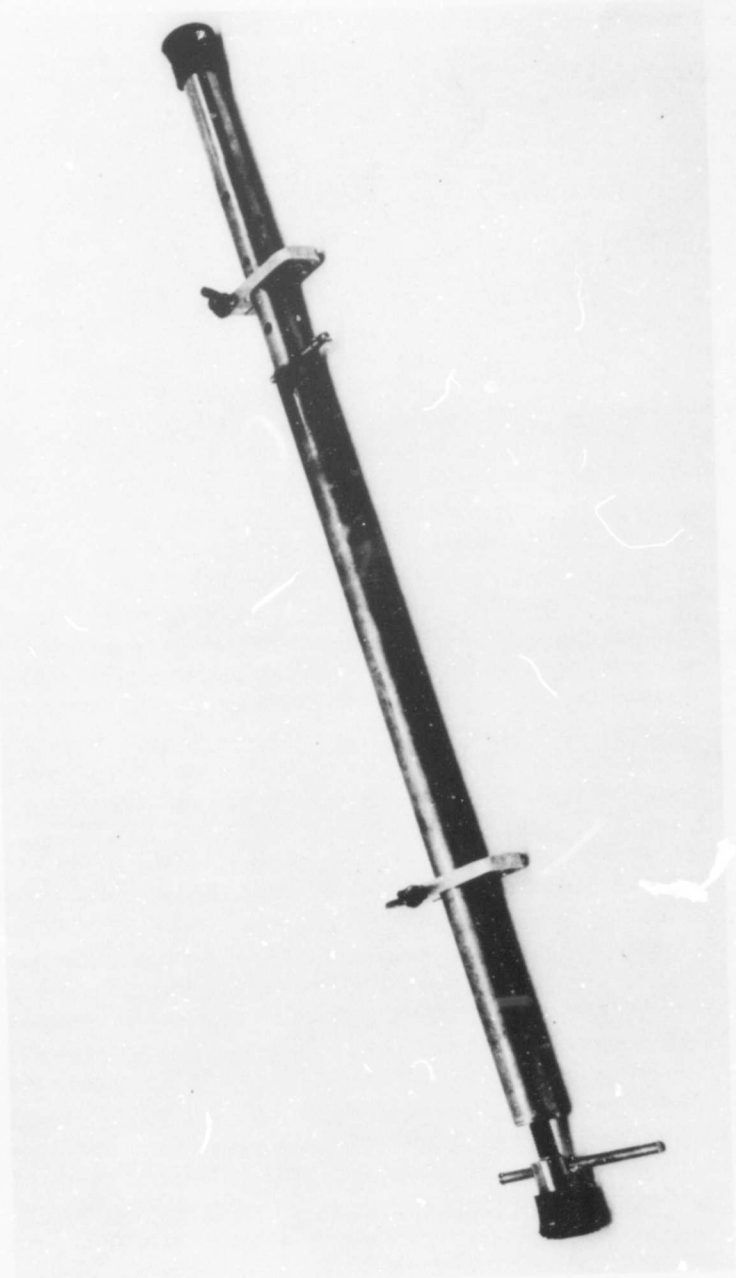

Figure 3-6 ADJUSTABLE DOORWAY SUPPORT BAR

supports secured by thumbscrews are provided to enable the shelterees to center the Kearny pump in the doorway. The Kearny pump is fastened to these bearing supports using two clevis pins and two cotter pins.

The upright single pole support is designed for mid-room deployment of the Kearny pump for ceiling heights up to 15 feet, see Figure 3-7. This unit is constructed from heavy wall steel pipe to provide the necessary rigidity for this type of support. The ceiling bearing plates which are covered with sheet rubber, are designed to offer a large contact area to prevent slippage during operation. A modified automotive type bumper jack provides the necessary lifting force. Unlike the doorway bar, the bearing supports on which the Kearny pump will swing are rigidly mounted to the crosspiece.

Another device for mid-room deployment is the A-frame support, see Figure 3-8. This support is constructed from light gage steel tubing and has complete portability within a shelter. The frame can be assembled without any tools, using the wing nuts and thumbscrews provided. The bearing supports are fixed to the top crossbar to automatically center the Kearny pump within the frame. Rubber tips are provided on the legs to prevent walking of the frame during operation.

3.3 Tests

3.3.1 Air Flow Tests

Several configurations of Kearny pumps were tested using a smoke generator to indicate air movement. Films taken of these tests and personal

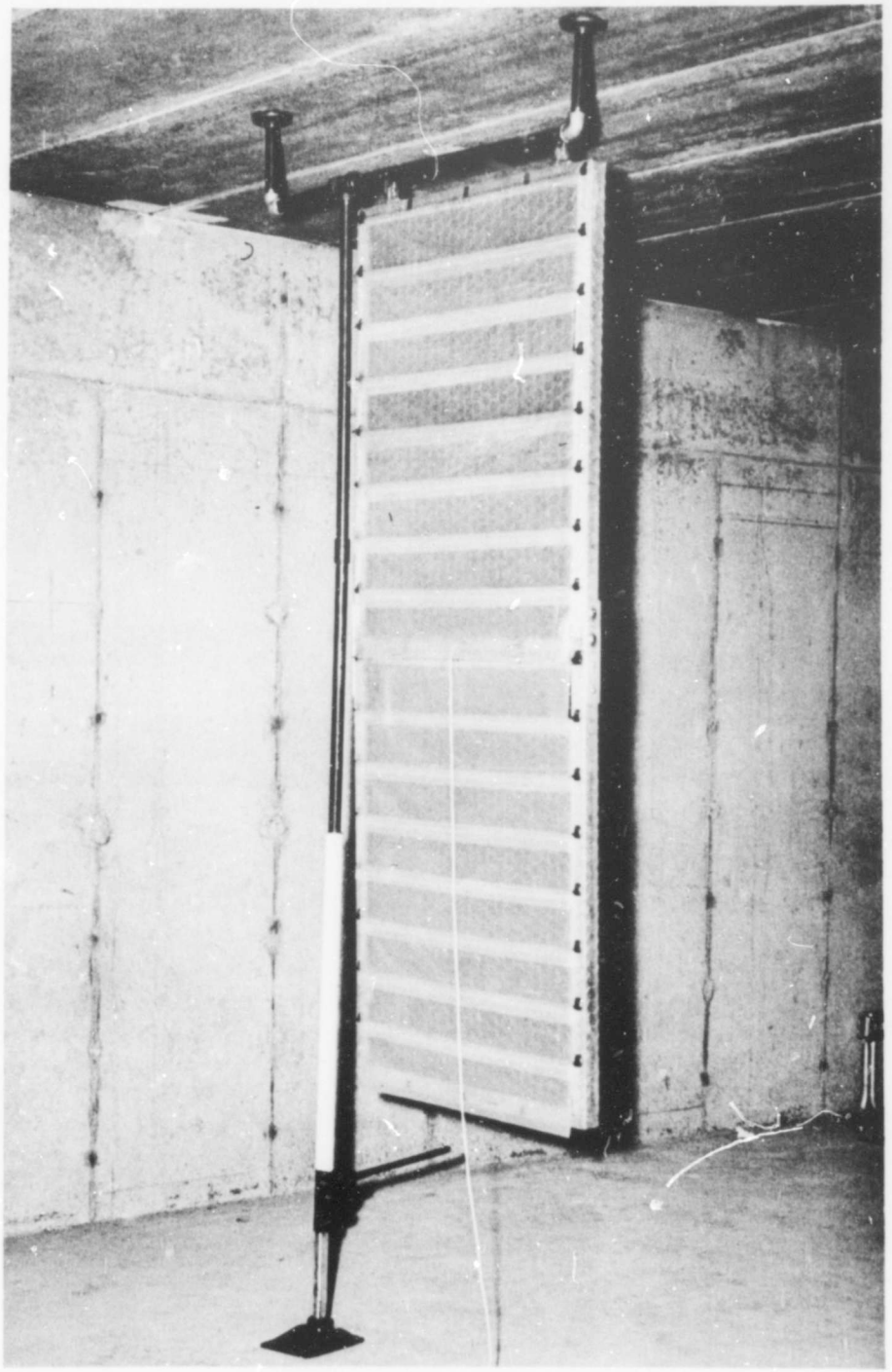

Figure 3-7 UPRIGHT SINGLE POLE SUPPORT
FOR KEARNY PUMP

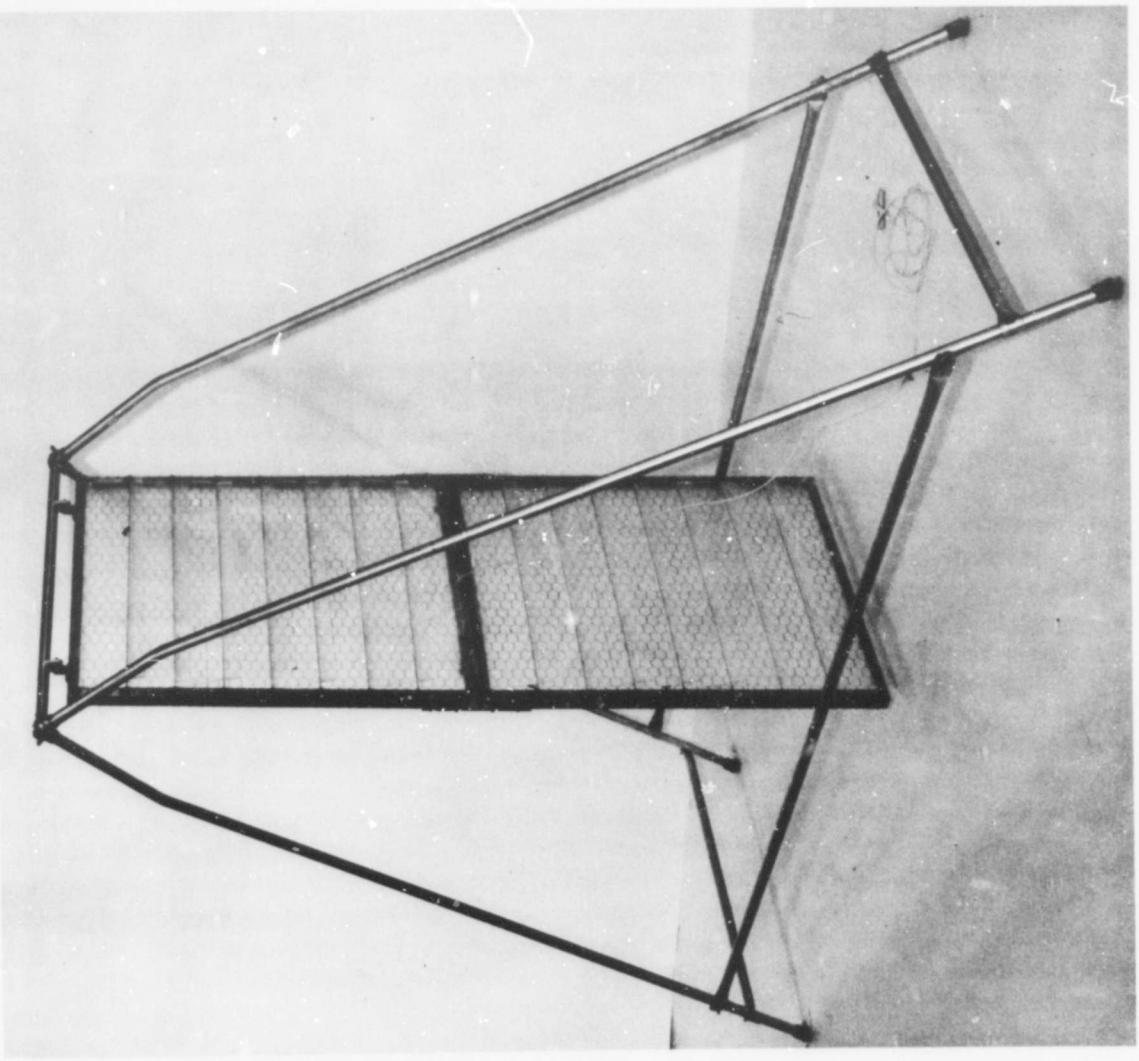

Figure 3-8 A-FRAME SUPPORT FOR KEARNY PUMP

observations led to the following conclusions: 1) dead-end rooms are most effectively ventilated with a single-section Kearny pump suspended from a doorway support bar so that air can exhaust through the open area below the flap section; 2) a double-section doorway Kearny pump is most effective for use in a flow-through room situation; 3) the double-section pump is a good mid-room air mixer.

3.3.2 Human Factors Tests

The various Kearny pumps were tested in shelter occupancy exercises conducted under Task Order 1522B of OCD Contract DAHC 20-68-C-0123.

The test subjects were able to assemble and operate the doorway Kearny pump. The only assembly problem occurred when in one case the shelterees failed to use the coarse adjustment on the support bar and overextended the fine adjustment screw. This screw has now been shortened to require the use of the coarse adjustment.

No problems were encountered in the assembly or use of the A-frame Kearny pump.

While some groups of shelterees were able to correctly install the upright Kearny pump, others found the support unwieldy and experienced difficulty in assembling it. Some shelterees also jacked the support up too far and deformed it, see Figure 3-9. Since the A-frame support only requires 42.5 sq. ft. which is 9% more floor area than the upright pole support when used with double flap sections, the upright support was dropped from consideration.

Three overall problems were also observed during these tests. Shelterees frequently operated the Kearny pumps with too small an amplitude. A swing

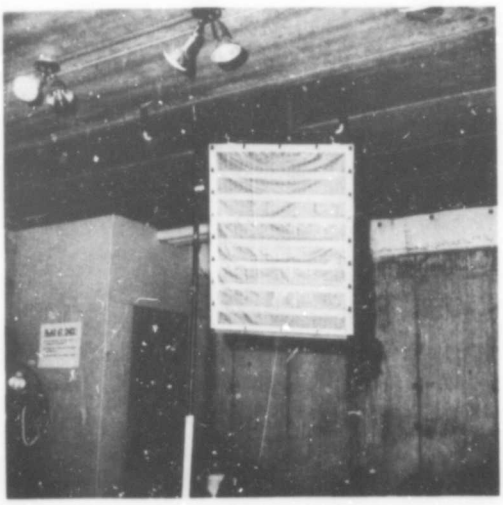

Figure 3-9 UPRIGHT SINGLE POLE SUPPORT, DEFORMED DURING SHELTER TEST

indicator, Figure 3-10, was designed in an attempt to solve this problem. However, shelterees experienced difficulty in setting the indicator for the proper angle and its incorporation into the unit has been temporarily postponed until a better version becomes available.

Since the shelterees occasionally lost some of the thumbscrews and wing nuts, these have now been permanently attached to the units. In one instance shelterees installed a double-section doorway Kearny pump with the flap sections facing opposite directions. The sections have been redesigned to allow their assembly only in one orientation.

3.4 Final Design

Final designs for the Kearny pump flap sections, the doorway support bar and the A-frame supports are described below and presented in detail in the specifications of Appendix C.

The flap sections are 26.5 inches wide by 37.36 inches long rectangles of 1 x 1.5 x .125 inch aluminum channel extrusion. Ball detent pins and their supports are attached to the top of the sections. The sections are covered with 1" mesh poultry netting to support the flaps on the power stroke. The 6 mil vinyl flaps are suspended on .125" steel wire. Two holes are cut in the bottom element of each flap section to allow the hinge pins of the lower section to pass through, providing for a close fit when two sections are joined. The holes are cut in such a manner as to allow the sections to be oriented in one direction only. The two flap sections are identical except for the tie plates which are fixed to the lower section. To join the two sections together, the plates are loosened and swung up to hook over the thumbscrews

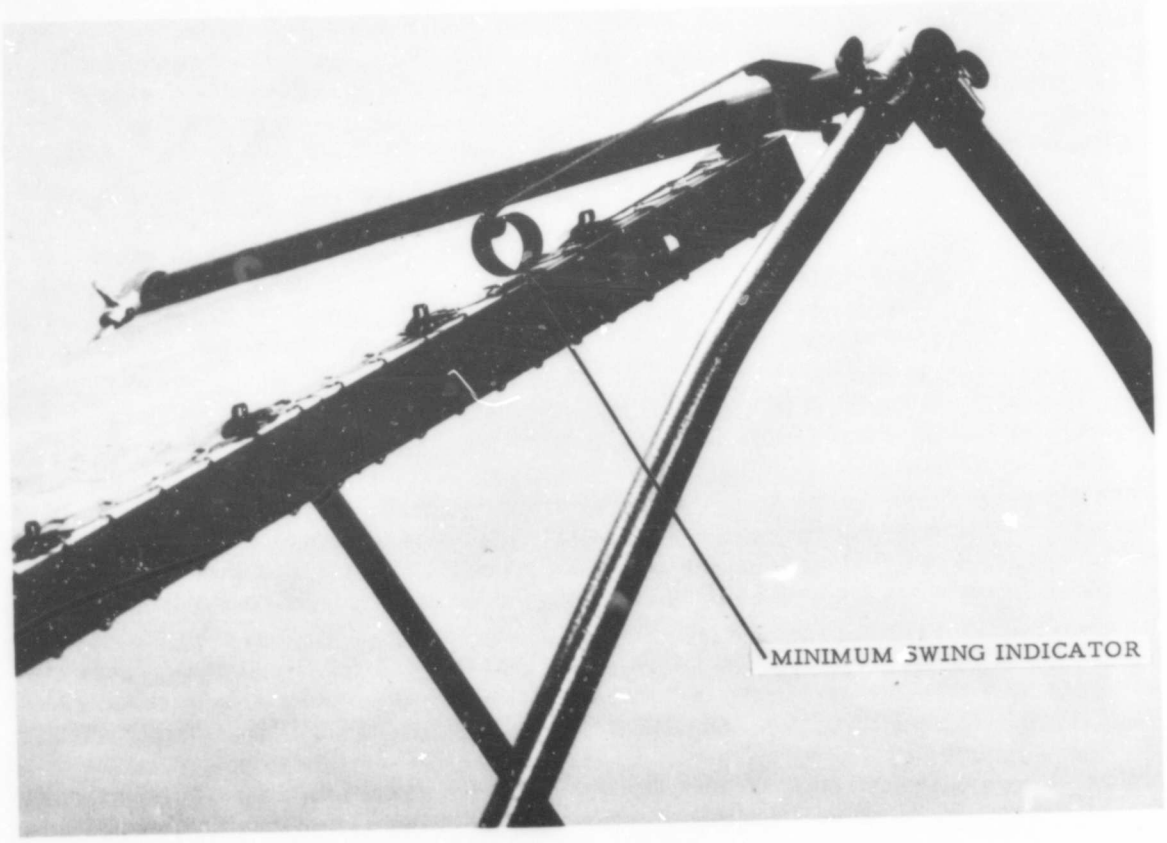

Figure 3-10 SWING INDICATOR TO INSURE PROPER AMPLITUDE OF SWING OF KEARNY PUMP

on the upper section, see Figure 3-11. The thumbscrews which hold these plates in place have nut retainers on the inside and are not removable.

The doorway support bar consists of an outer, 1.125 inch O.D. x .058 inch thick steel pipe and an inner, 1.000 inch O.D. x .049 inch thick steel pipe. The inner pipe has holes drilled in it through which a ball detent pin fits for coarse adjustment. The fine adjustment is a 3.31 inch threaded rod. Two movable supports with bronze bushings are slipped over the rods. Rubber tips are placed on the ends of the rods to prevent slippage.

The A-frame support bar is made of 1-1/16 inch outside diameter steel pipe with wall thicknesses of .035 inch and .049 inch. The bronze bushings and their supports are permanently located on the top crossbar. All wing nuts on this unit are not removable.

Both the doorway support bar and the A-frame support as well as the flap sections can be assembled without any tools.

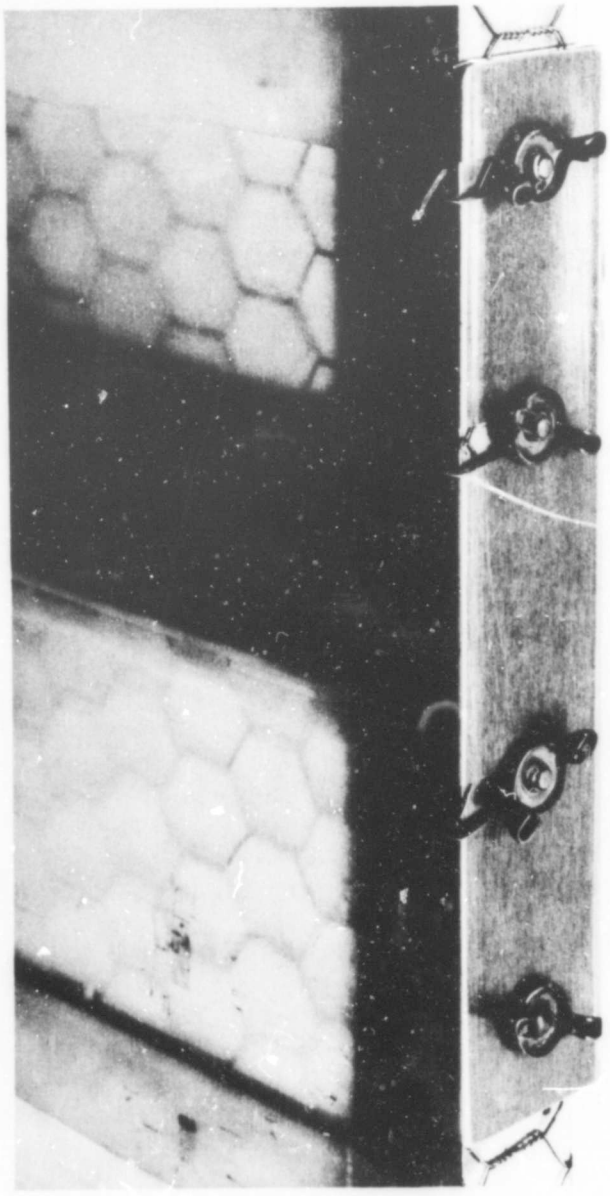

Figure 3-11 TIE PLATE FOR JOINING THE TWO FLAP SECTIONS OF KEARNY PUMP

SECTION 4

DUCT STUDIES

4.1 Friction Loss in Plastic Ducting

The primary factor limiting the air flow developed by a bicycle ventilator is the friction loss that the flow undergoes while passing through the polyethylene exhaust ducting. This friction loss is measured as the static pressure head required at the fan outlet to produce a given flow when the air is exhausted at ambient pressure.

Lengths of straight duct were tested to determine the relationship between volume of air flow and static pressure head at the inlet and length of duct. Various types of preformed elbows and bent duct sections were also tested to determine their equivalent duct length. With these results, the flow and pressure characteristics of a ducting system can be calculated in terms of the equivalent duct length of the system; that is, the sum of the length of straight duct and the equivalent duct length of any bends or elbows in the system.

4.1.1 Test Setup

The 30-inch duct tests were conducted in accordance with the Test Code for Air Moving Devices, Figure 1.1 of Air Moving and Conditioning Association (AMCA) Standard 210-67, see Figure 4-1. The test setup used a D.C. motor to drive the one-operator bicycle ventilator. The rotational speed was measured by an rpm indicator attached to the bicycle ventilator, see Figure 4-2.

Between the fan and the section of the plastic duct to be tested was a 26-foot length of 30-inch diameter steel duct containing an air straightener,

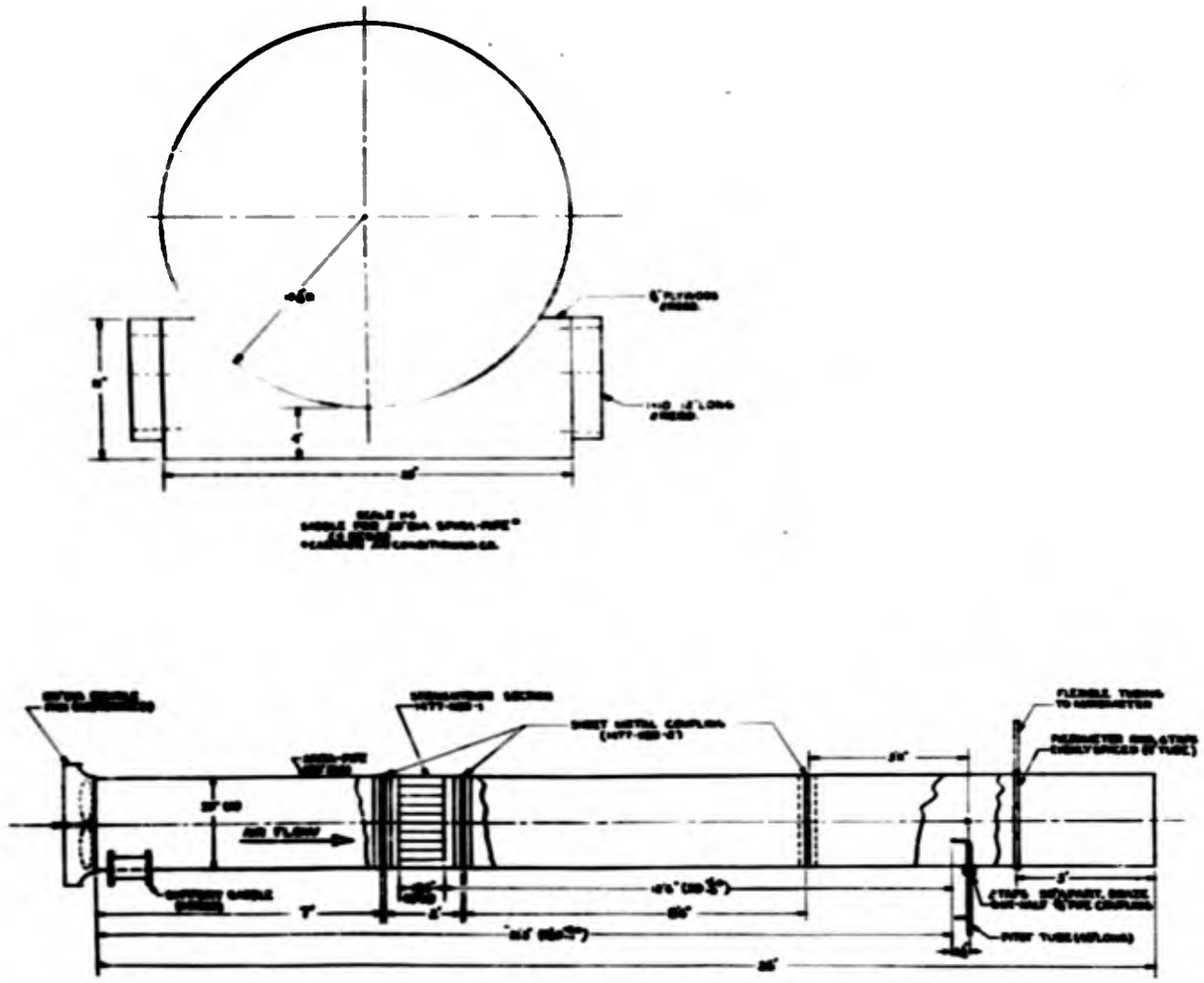

Figure 4-1 TEST SETUP FOR MEASURING FRICTION LOSSES IN 30-INCH DIAMETER DUCT

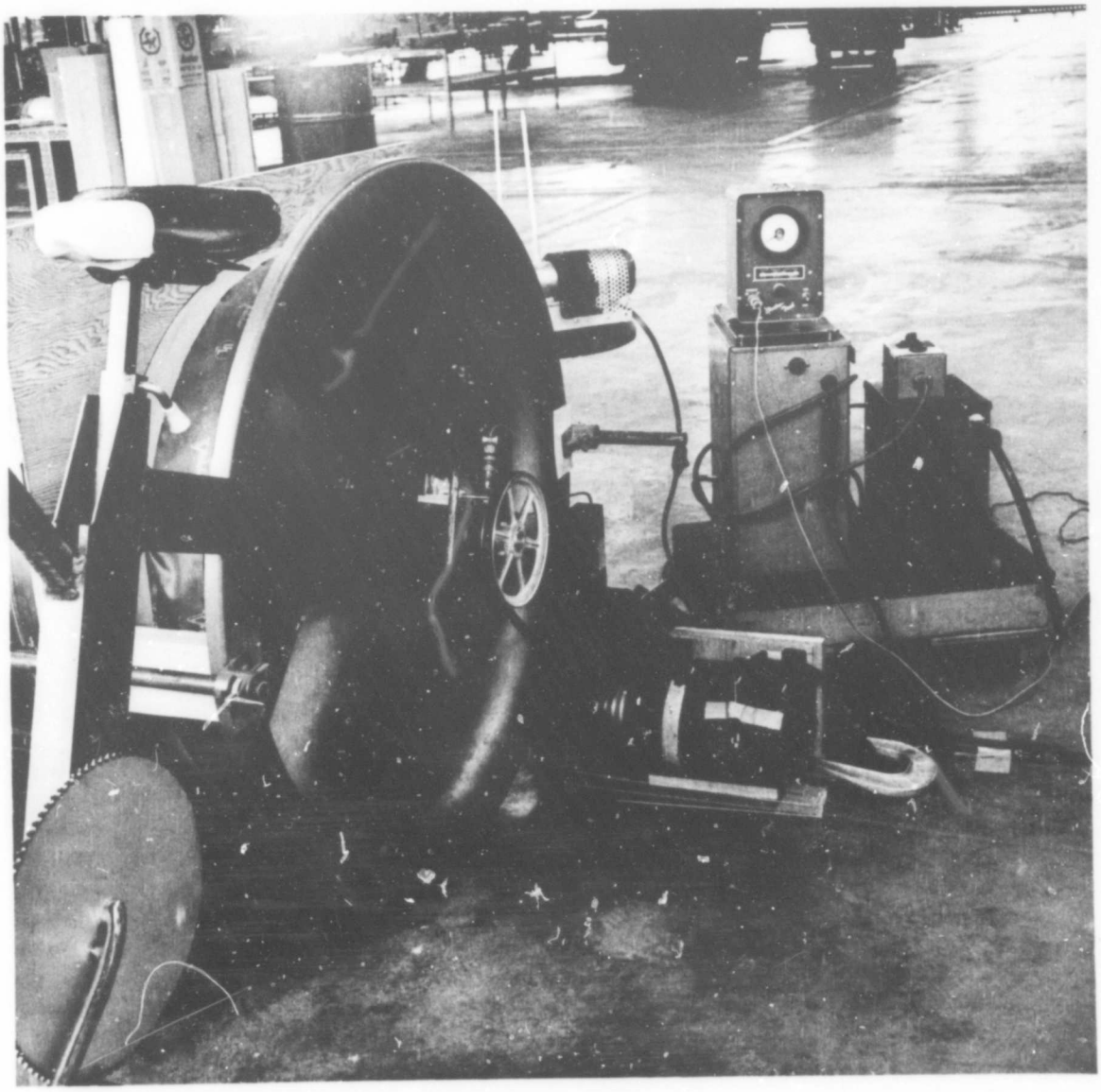

Figure 4-2 TEST SETUP OF VENTILATOR FAN (SHOWING D.C. MOTOR, MOTOR CONTROL AND RPM INDICATOR)

two taps for inserting a pitot tube, and six taps for a piezometer ring, see Figure 4-3. The straightener was located seven feet downstream from the fan. The two taps for inserting and positioning a pitot tube were located at 90 degrees from each other, 12 feet 5 inches from the air straightener. This pitot tube was used to sense dynamic pressure which was indicated on an inclined tube manometer. Downstream of these taps and three feet upstream of the plastic duct, six taps in the duct were connected to form a piezometer ring to sense static pressure, which was indicated on a second inclined tube manometer. This static pressure, although measured three feet away from the beginning of the plastic duct, was taken to be equal to the static pressure head at the inlet to the polyethylene duct.

A psychrometer was used to determine air conditions to correct for differences in the density of the air needed for conversion from actual cfm to standard cfm.

4.1.2 Duct Test

Lengths of straight polyethylene duct from 31 to 250 feet were tested. The flow rates and the corresponding static pressures were measured for fan speeds from 300 rpm to 800 rpm at 100 rpm intervals. Each flow rate measurement involved making two 10-point equal area pitot tube traverses of the test section. Static pressure at the piezometer ring considered to be the duct inlet was measured simultaneously.

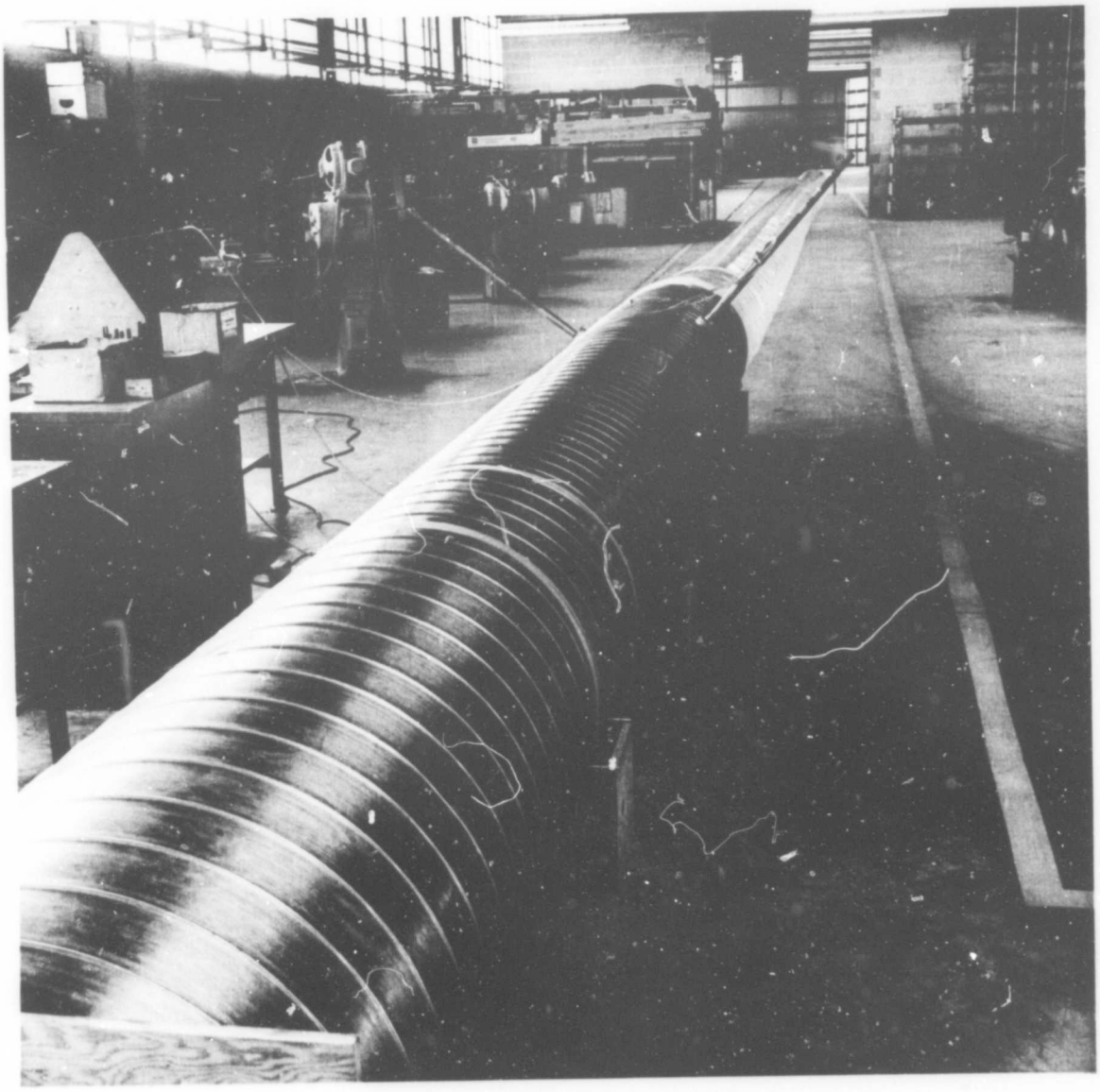

Figure 4-3 STEEL DUCT SECTION SHOWING PIEZOMETER RING AND PITOT TUBES

The data points are shown in Figure 4-4, with fitted curves from the equation

$$SP = e^{aQ} - 1$$

where

SP = static pressure, inches H_2O

Q = flow rate, cfm

with a = $0.06498\ (EDL) + 5.6916 \times 10^{-6}$, min/ft^3

where EDL = equivalent duct length of system, ft.

It should be remembered that this equation was developed from data consisting of flow rates between 1500 and 6600 cfm and EDL's between 31 and 250 ft.

4.1.3 Tests of Bends in Ducts and Fabricated Elbows

Factory-fabricated plastic 90° elbows of 30 and 45-inch radii were tested, as were ducts bent 90° and 45° without elbows, to determine the pressure losses associated with them.

The test setup involved a straight section of plastic duct (at least 62 ft.) followed by the bend or elbow and a straight section of duct 50 or 100 ft. long.

The static pressure loss of each bend or elbow was found to be equivalent to that of the following section of straight duct:

Geometrical Element	Equivalent Duct Length (EDL)
90° fabricated elbow, 30" radius	220 ft.
90° fabricated elbow, 45" radius	160 ft.
90° bend in duct	615 ft.
45° bend in duct	470 ft.

The static pressure loss associated with a duct system can be calculated with these values and the equation of Section 4.1.2.

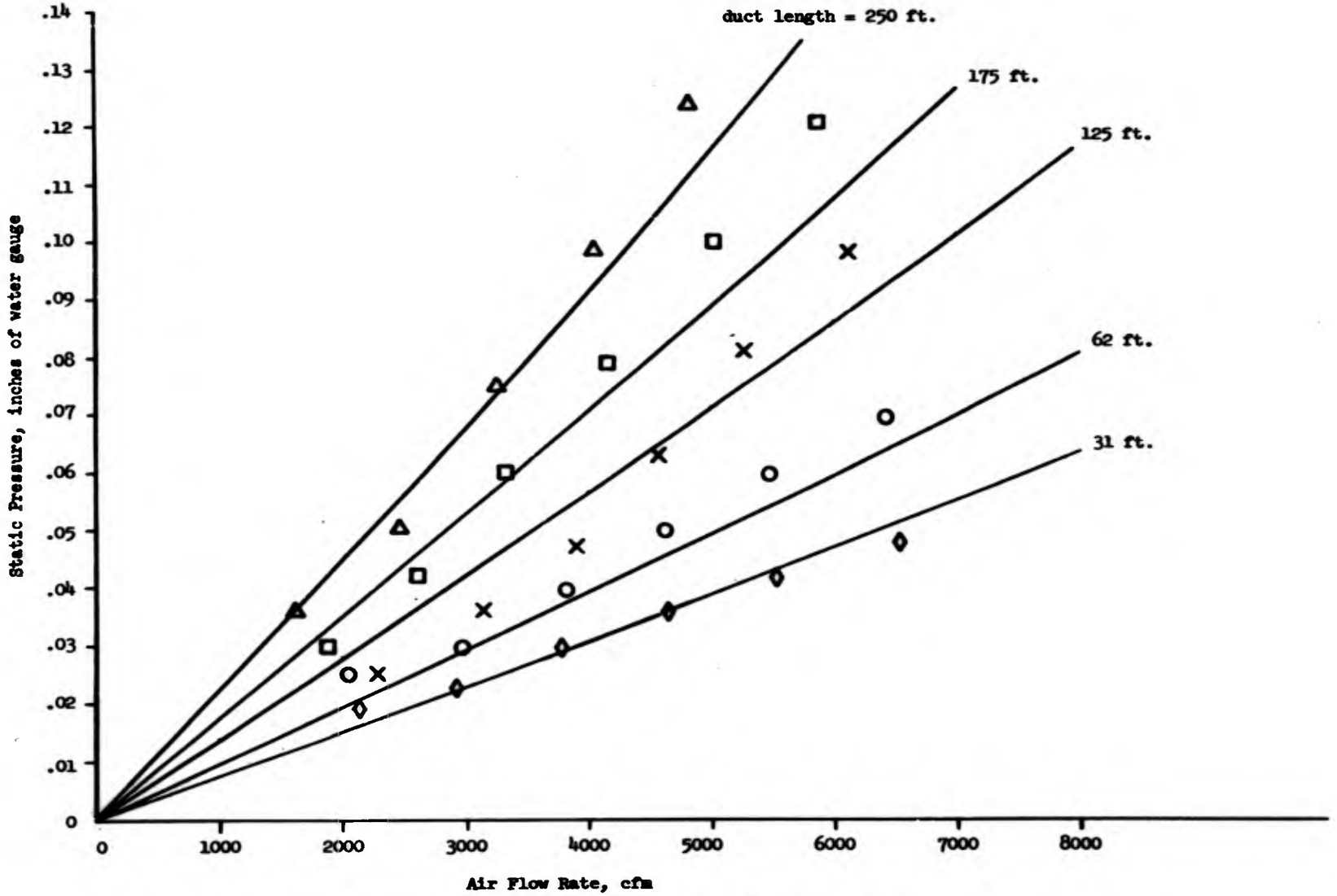

Figure 4-4 STATIC PRESSURE VS. AIR FLOW RATE FOR DIFFERENT DUCT LENGTHS

Although the use of fabricated elbows instead of bends in the duct decreases the EDL substantially, their inclusion in the ventilator kit is not recommended for several reasons. Studies performed under Task Order No. 1217C of OCD Contract DAHC 20-68-C-0123 showed that by bending the duct where required, the resulting airflow is not decreased by more than 9% from what it would be if elbows were installed. Also, in occupancy tests conducted by GARD, shelterees have exhibited extreme difficulty in the proper utilization and installation of elbows.(9)

4.2 Preformed Duct Sections and Adaptors

In previously developed ventilation kits, a doorway duct adaptor was included with the ventilator. Its purpose was to allow shelterees to easily seal-off the area around a duct in a doorway through which a bicycle ventilator was exhausting air. Occupancy tests conducted under Task Order No. 1522B of OCD Contract DAHC 20-68-C-0123 have shown that shelteress are able to seal doorways satisfactorily without it using sections of the duct plastic as specified on page 14 of the instruction booklet included with the BVK.

In another commonly occuring situation it is necessary to run the exhaust duct from the floor of a belowgrade shelter to a high basement window or other elevated exhaust location. This usually requires bending the duct several times along its length. This raises the question as to the use of a prefabricated ducting section so that the bends in the duct would be replaced by preformed elbows reducing the duct pressure losses. The results of the studies performed under Task Order No. 1217C of OCD Contract DAHC 20-68-C-0123 revealed that in general the use of preformed elbows in place

of bends in the duct decreases the air flow delivered by at most 9%. In addition, due to the various applications for such a preformed duct section, it would be difficult to specify its configuration. Also, it has been found that shelterees will deploy a ventilator duct system several times before settling on a system. If the preformed duct sections were taped in, it could tend to set a particular deployment scheme, whereas a bent duct could be easily straightened or bent for another deployment scheme.

Because of the reasons given above, and since the use of a doorway adaptor or preformed section complicates deployment and the deployment instructions, and increases the cost of the kit, it was decided not to include either of these items with the present ventilation kit.

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SECTION 5

BLAST TESTS

The possibility exists for the bicycle ventilator and the Kearny pump to be subjected to the blast effects from a nuclear detonation. It was believed that the Kearny pump might survive the shock wave encounter and be bent easily back into shape. With the cooperation of OCD, SRI and URS Research Company, a series of tests was conducted to investigate the blast resistance of the double-section doorway Kearny pump, the double-section A-frame Kearny pump, the 30-inch polyethylene exhaust duct for the bicycle ventilator and the one-operator bicycle ventilator under SRI Subcontract No. 11618 (6300A-250) to URS.

5.1 Test Site and Plan

The tests were conducted in the URS Shock Tunnel, see Figure 5-1. The tunnel consists of a 63-foot long, 8-foot diameter cylindrical compression chamber, an 8-foot transition section and a 100-foot long, 8.5-foot high by 12-foot wide test section.

The Shock Tunnel employs the volume detonation technique, with Primacord as the explosive material. In this mode of operation, strands of Primacord are strung along the axis of the compression chamber and fused. On detonation of the Primacord, a quasi-static pressure is built up very rapidly throughout the entire compression chamber. This high-pressure gas expands into the remaining part of the tunnel and generates the desired shock wave.

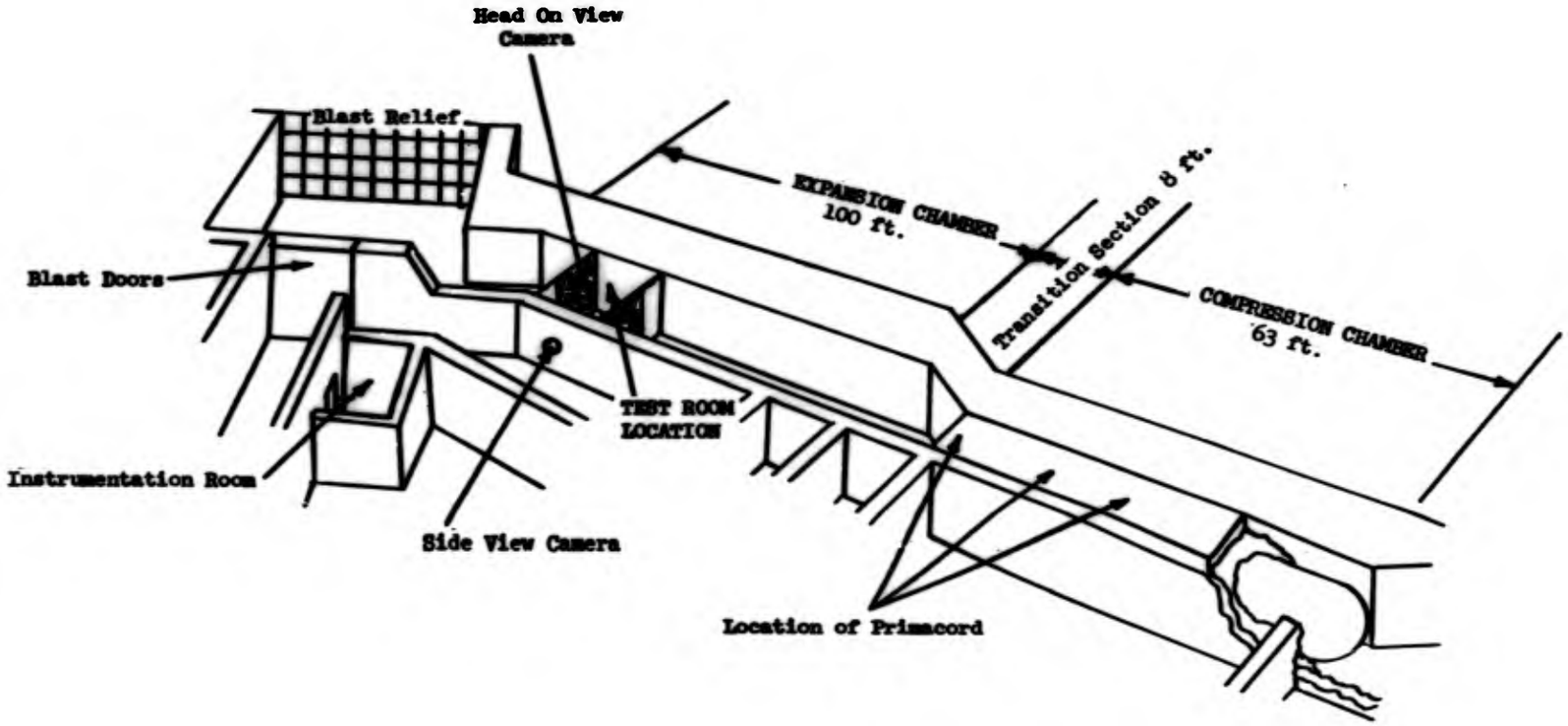

Figure 5-1 URS SHOCK TUNNEL

Two nonfailing walls were installed in the test section of the tunnel. This arrangement created a room 12 ft. wide, 8-1/2 ft. high and 15 ft. deep. Sections of each nonfailing wall were removed to create doorways as required for each of the tests. The room was arranged so as to provide a doorway in the front (upstream) wall for the high pressure gas to enter and a doorway in the back (downstream) wall from which the gas could exit. The two doorways were placed as far out-of-line with each other as space would permit to reduce the jet effect of the doorways and to promote as much turbulence in the entire test room as possible, to create the "worst" case for the test.

The series consisted of four tests of the following items of ventilation equipment:

Test 1 - Double-section doorway KP

Test 2 - Double-section A-frame KP

Test 3 - Inflated 30-inch polyethylene exhaust duct

Test 4 - One-operator BV.

The equipment used in these four tests was deployed as it is normally used. The duct test was conducted to determine if the duct could survive the blast wave in a reusable condition.

High-speed motion pictures were taken from two locations for each test. The head-on camera was mounted in the back wall, pointing towards the front wall doorway. The side-view camera was mounted on the side wall of the room looking the width of the room. Both cameras filmed at 294 frames per second (a statistically measured mode). Timing pips of 1/120 sec. provided a time reference on the film records. Photographs were taken before and after each test of the test setup and the equipment tests. Pressure gages

mounted in the walls of the expansion section monitored the pressure history of the blast wave. The pressure records were recorded along with a 1 KHz sine wave time reference on magnetic tape for future data readout.

5.2 Test 1 - Doorway Kearny Pump

The Kearny pump for the first test was mounted motionless in the doorway of the front wall with the plastic flaps facing toward the blast, see Figure 5-2. Since the door in the wall was slightly smaller than the KP frame, metal plates were welded to the front wall supports and the doorway support bar of the KP was mounted between them, see Figure 5-3.

Pressure gages at station 6-0 measured a peak incident overpressure of 4.5 psi, a peak reflected overpressure of 8.2 psi and a positive phase duration of 89 msec. The actual data recorded by the pressure gages and pressure histories taken from these records are shown in Figures 5-4 to 5-6. This data also shows that the blast travelled down the tunnel at a speed of about 1400 ft/sec.

Motion picture films of the test revealed the following sequence of events:

Event	Time, msec.
Blast arrival - flaps & wire mesh bow out	0
Frame begins to distort and hole blown in wire mesh	3
Flaps begin to come free	7
KP comes loose from doorway	17

Average velocity = 211 ft/sec over first 11 ft. of travel

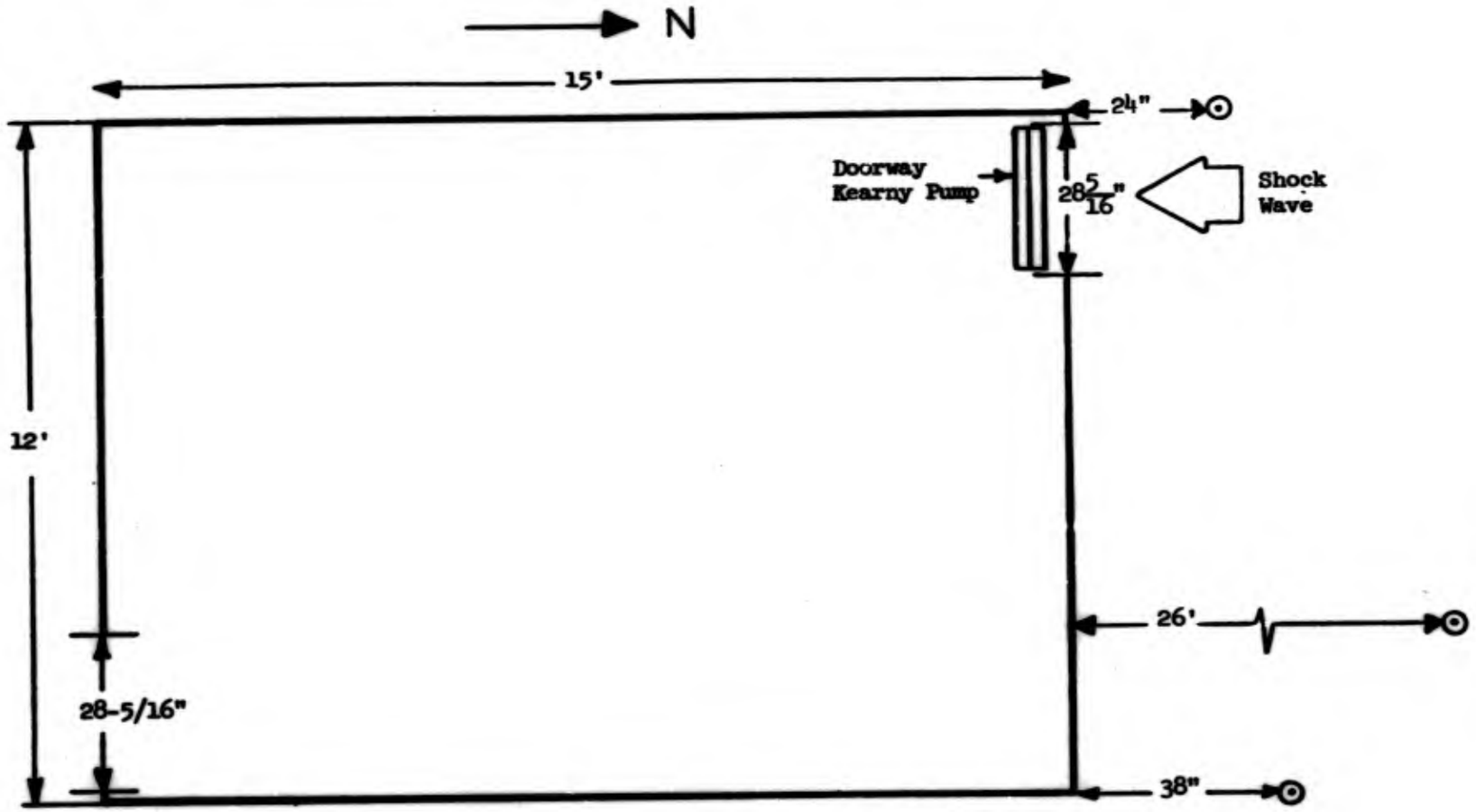

Figure 5-2 ROOM PLAN FOR DOORWAY KEARNY PUMP BLAST TEST

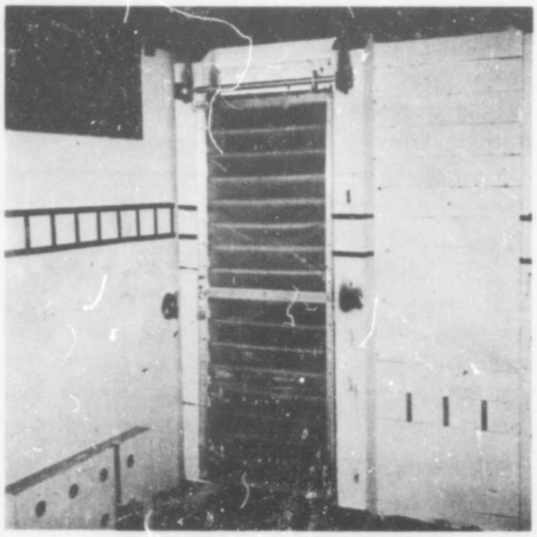

Figure 5-3 MOUNTING ARRANGEMENT FOR DOORWAY KEARNY PUMP

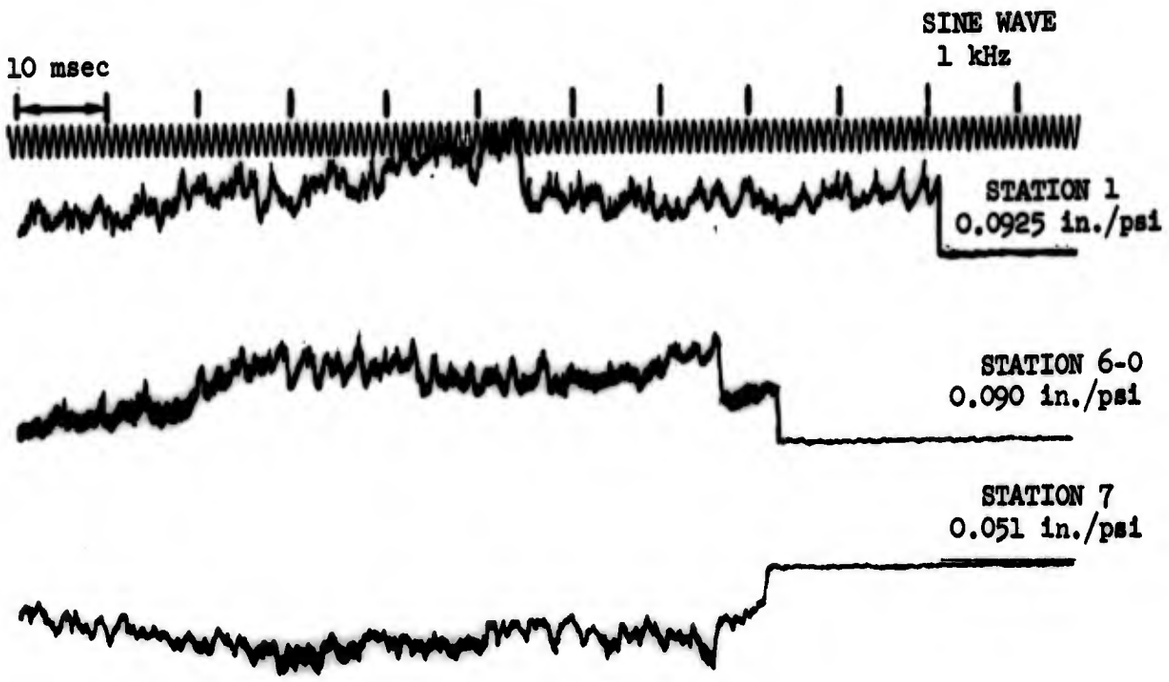

Figure 5-4 ACTUAL RECORD OF PRESSURE DURING FIRST BLAST TEST

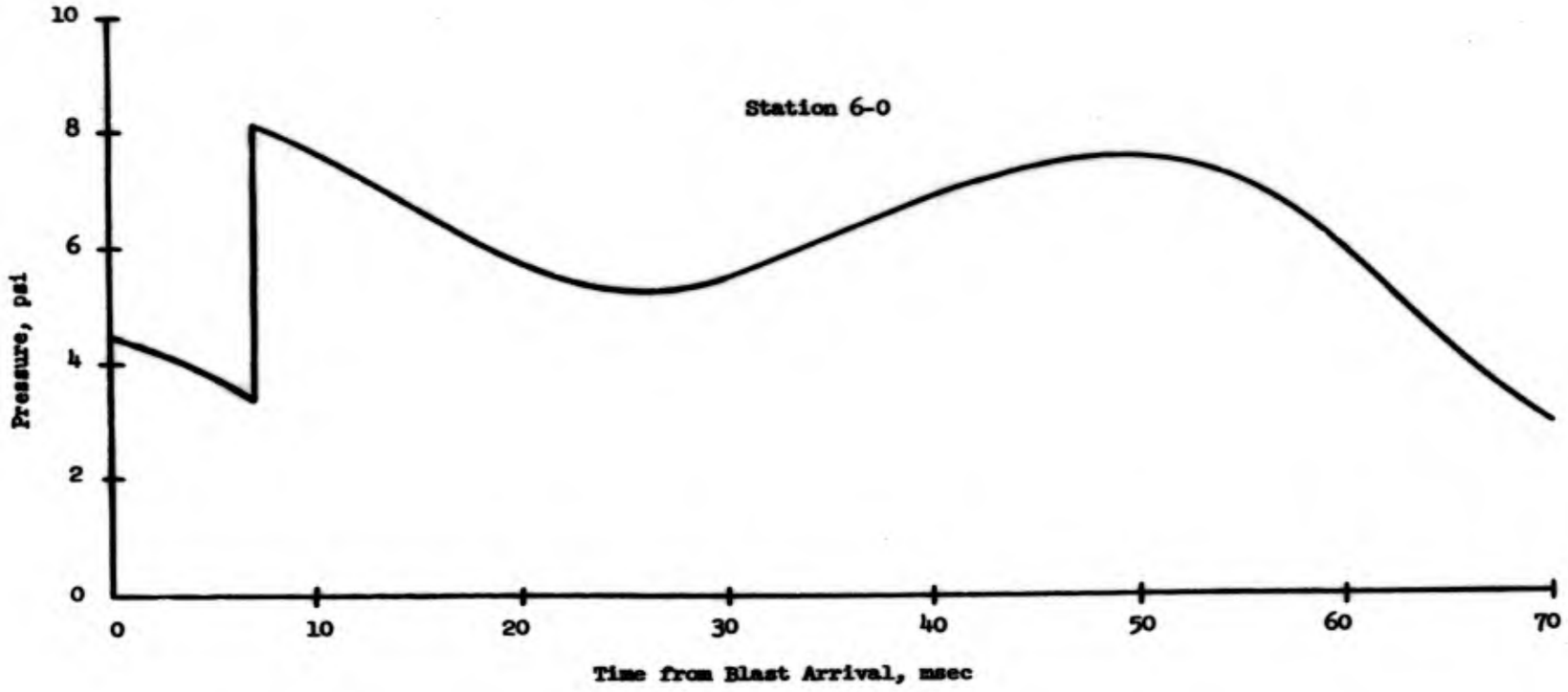

Figure 5-5 PRESSURE HISTORY AT STATION 6-0
DURING FIRST BLAST TEST

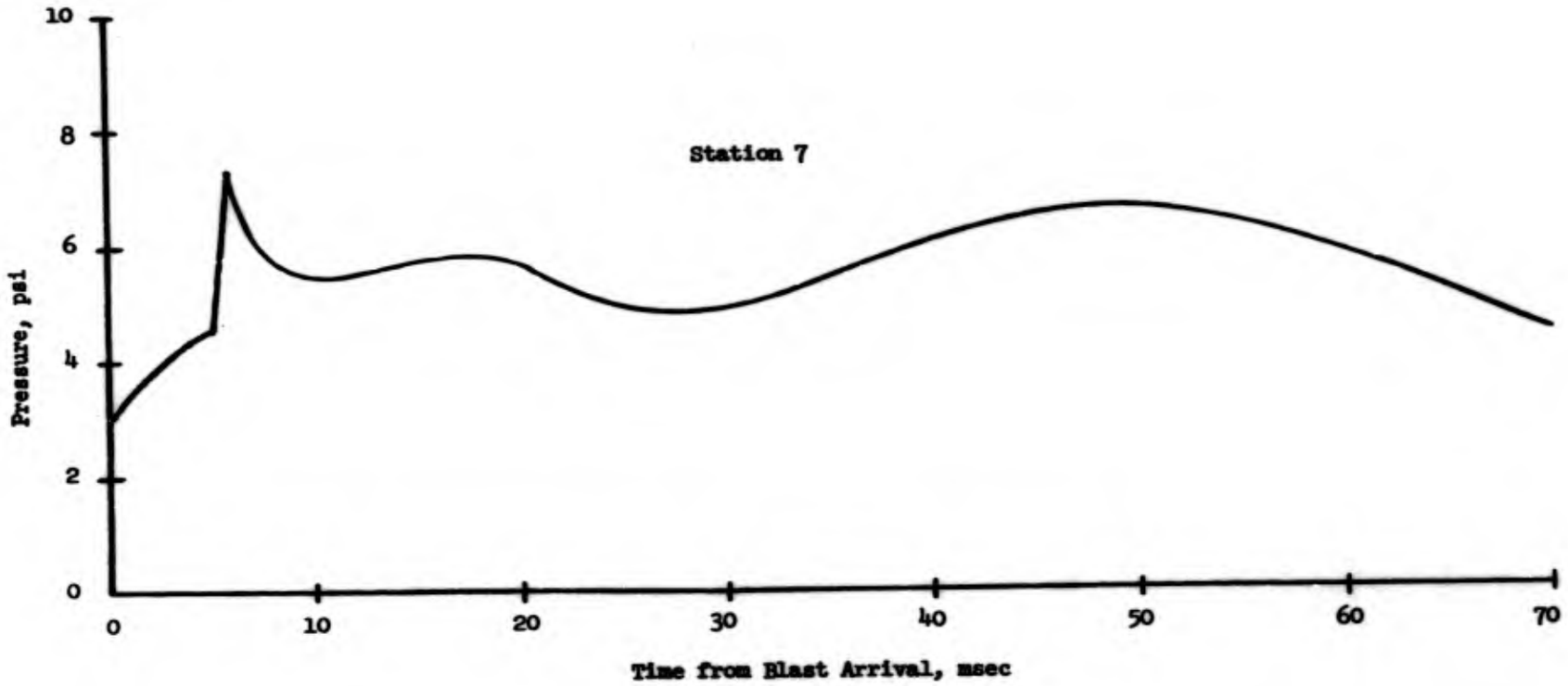

Figure 5-6 PRESSURE HISTORY AT STATION 7 DURING FIRST BLAST TEST

The film shows that the KP support bar was torn from the steel plates, shearing off at the fine adjustment screw on one end and through the rubber cap on the other end. This happened about 17 msec after the shock wave arrival at the ventilator. The frame of the KP began to deform before it tore loose from the mounting bracket. The plastic flaps and wire support rods tore loose and attained velocities of about 200 ft/sec, impaling themselves to depths of 3/8 to 1/2 inch in the plywood of the back wall and in the concrete wall 100 feet downstream from the back wall.

The KP frame flew across the room with the bottom flap section leading and rotating upward to impact against the back wall. It then fell forward to rest in the middle of the room directly in line with the doorway in the back wall. The upper flap section of the KP was fractured at the corners of the upper horizontal frame element to which the doorway support bar was fastened. The doorway support bar hinges and pins were still intact. The lower flap section frame elements were badly bent and the bottom horizontal element was sheared off. The stiffer horizontal elements joining the upper and lower flap sections were twisted about their longitudinal axes. The damage was judged severe enough to prohibit the operation or repair of the KP as a ventilator, see Figure 5-7.

It is obvious that if the plastic flaps of the KP are not removed sufficiently fast, it will appear as a solid slab to the impinging shock wave, with a resultant higher loading. Removal of the flaps before the shock wave arrival would be expected to considerably reduce the resultant damage and also eliminate the flaps and support wires as debris hazards.

a

b

c

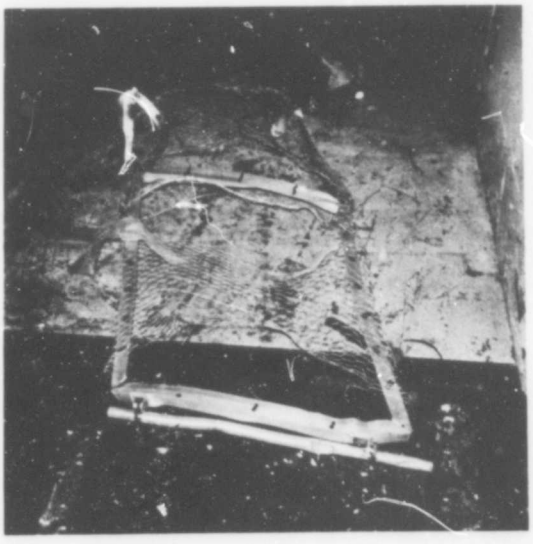

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Figure 5-7 POST-TEST CONDITION OF DOORWAY
KEARNY PUMP

5.3 Test 2 - A-frame Kearny Pump

The KP for the second test was mounted motionless on the A-frame and situated at a 45 degree angle to and in line with the doorway in the front wall. The plastic flaps were again facing toward the blast, see Figure 5-8. Pressure gage at station 6-0 measured a peak incident overpressure of 4 psi, a peak reflected overpressure of 7.9 psi and a positive phase duration of 100 msec.

The film of this test revealed the following data:

Event	Time, msec.
Blast arrives	0
Flap section rotates backward on A-frame	0 - 34
Flap section begins to twist and deform	27
Flaps come through wire mesh	44
One hinge breaks on A-frame horizontal element	58
A-frame leaves ground, deforms	92

This shows that major damage was done to the KP before it began to translate. When it did begin to translate, about 92 msec after the blast hit, the bottom flap section rotated upward, struck the back wall and fell to the floor, coming to rest in line with the doorway in the back wall. The A-frame, except for the missing KP horizontal support bar, which tore loose, and broken pipe fittings for the bar where it was attached, was only bent and could have been bent back into shape for further use. The hinge for the KP was torn from the horizontal support bar and the KP frame bent and fractured to an extent that it was judged to be beyond repair, see Figure 5-9. The relatively good

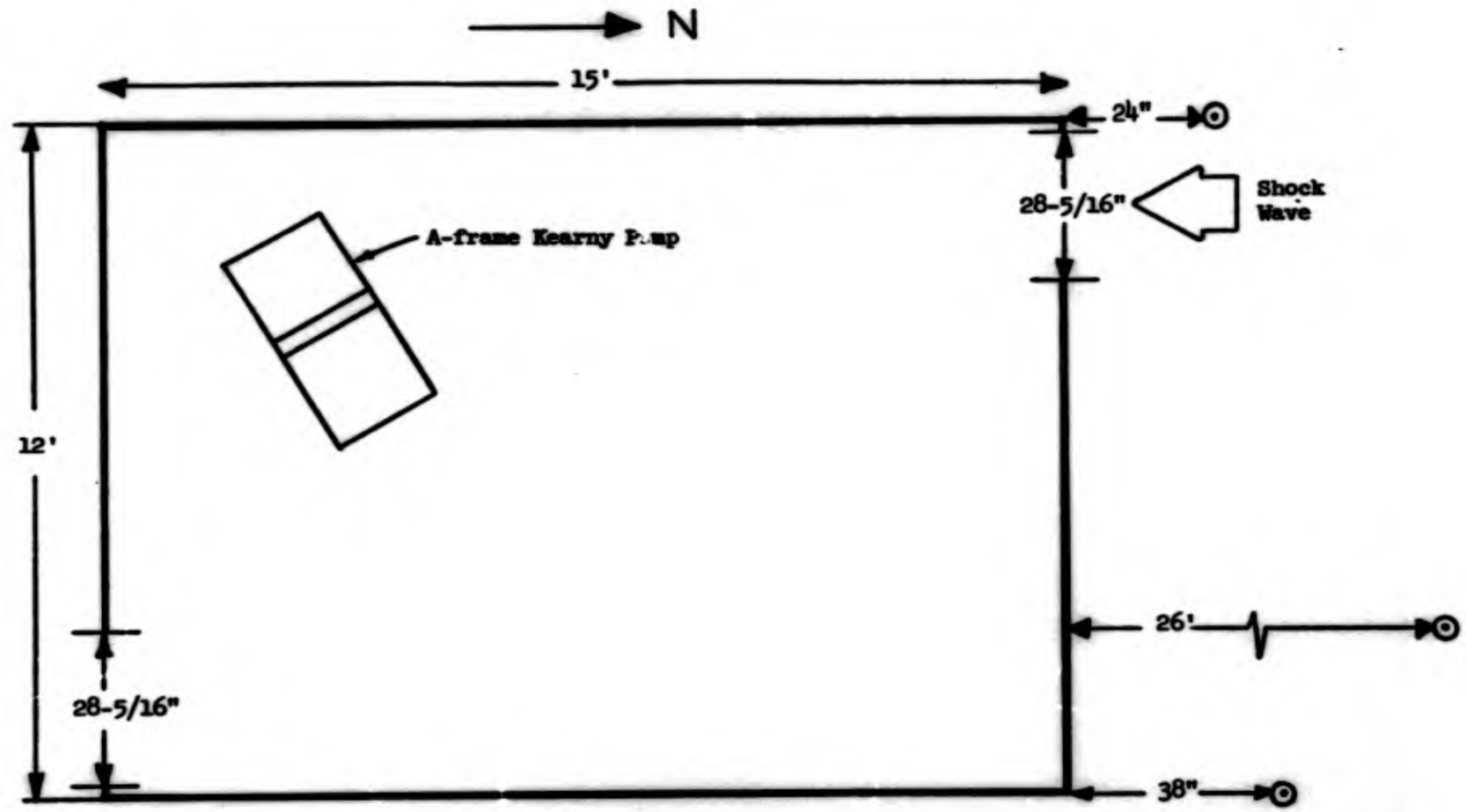


Figure 5-8 ROOM PLAN FOR A-FRAME KEARNY PUMP BLAST TEST

a

b

c

d

Figure 5-9 POST-TEST CONDITION OF A-FRAME KEARNY PUMP

post-test condition of the A-frame was attributed to its proximity to the back wall which restricted the A-frame from attaining any appreciable velocity before it impacted. Also, the small cross-section of the A-frame elements offered little load resistance. Again, as discussed for Test 1, previous removal of the plastic flaps would have greatly reduced the resultant pressure load on the KP and eliminated the flaps and support wires as debris hazards.

5.4 Test 3 - Inflated 30-inch Duct

The third test was conducted with a section of 30-inch polyethylene duct on the floor extending through the test room doorways from back to front, see Figure 5-10. The duct end was reinforced with tape and taped to the expansion chamber floor about 8 ft. in front of the doorway in the front wall, see Figure 5-11. A motor driven fan was attached to the duct just downstream of the doorway in the back wall. The fan inflated the duct to maintain it in a position comparable to that which the duct would attain when attached to the BV. Pressure gage at station 6-0 measured a peak incident overpressure of 5.8 psi, a peak reflected overpressure of 10.1 psi and a positive phase duration of 91 msec. The motion picture films of the test indicated that the shock wave caused the duct to bulge for 10 msec; the duct was then torn to shreds. Pieces of the duct were scattered throughout the room and beyond, with sections of the duct squeezed into cracks between the back wall and the concrete walls of the facility, see Figure 5-12. The electric fan was found approximately 80 ft. behind the room and was heavily damaged. The duct was completely destroyed.

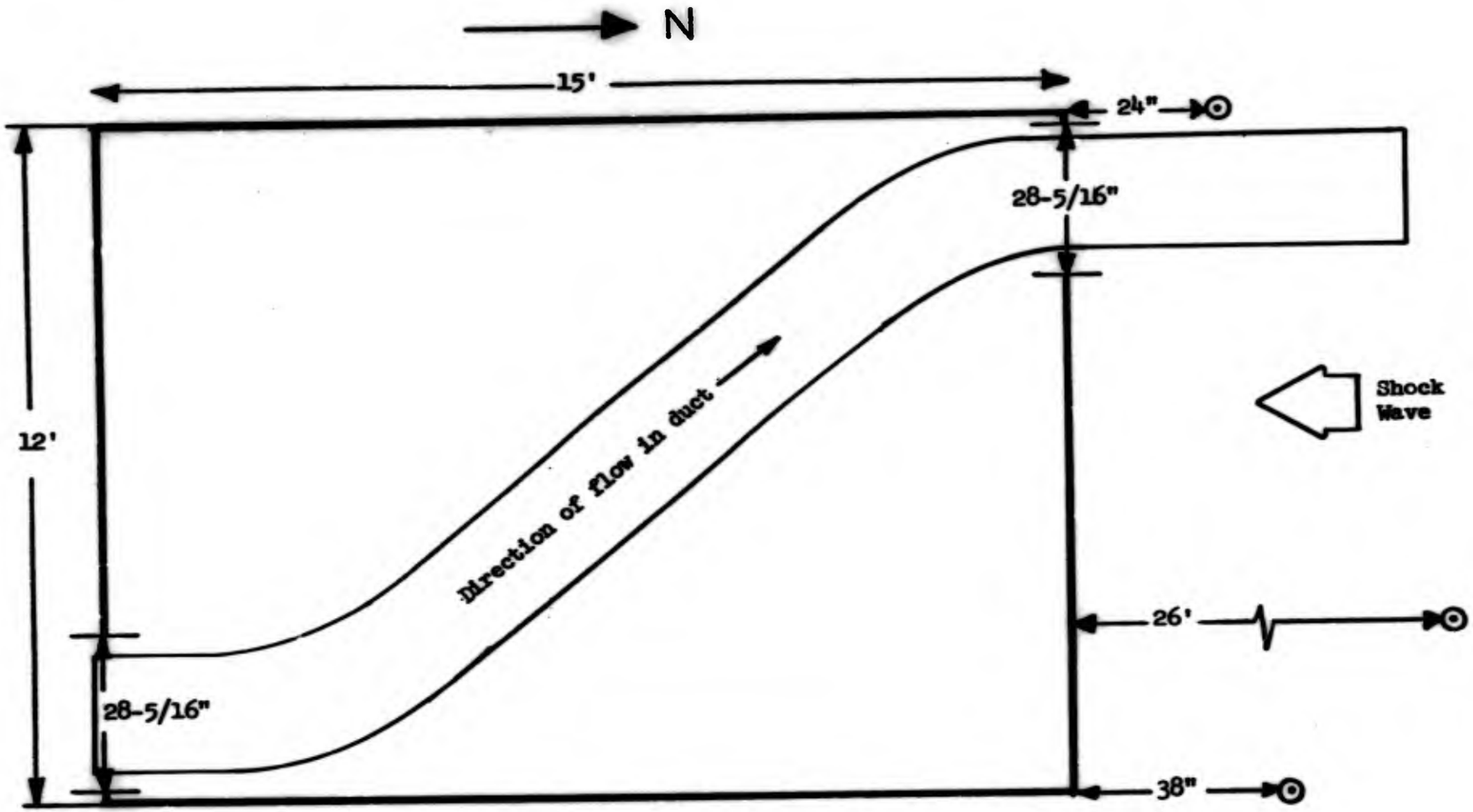


Figure 5-10 ROOM PLAN FOR VENTILATOR DUCT BLAST TEST

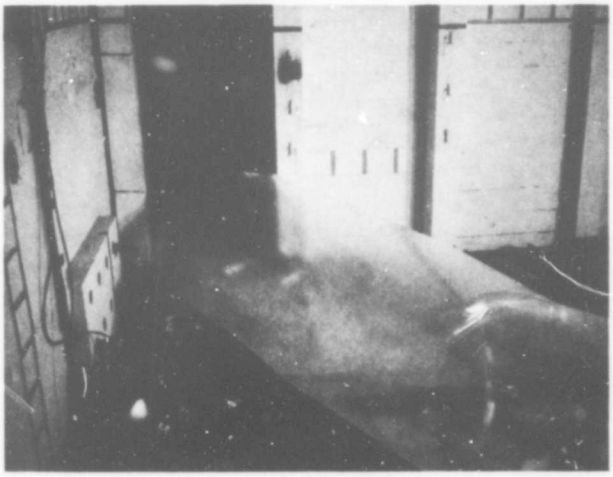


Figure 5-11 INFLATED DUCT IN TEST ROOM PRIOR TO THE TEST

Figure 5-12 POST-TEST CONDITION OF DUCT

5.5 Test 4 - One-operator Bicycle Ventilator

In this test the doorway in the front wall was moved to the position shown in Figure 5-13. This doorway was covered with a sheet of plastic cut from exhaust duct material. The ventilator was positioned behind the door as shown in Figure 5-14, and a short length of exhaust duct was attached to it. This duct was run through a hole cut in the plastic covering the door and extended a few feet into the tunnel. All joints around the duct and doorway were sealed with tape, and the end of the duct was reinforced and taped to the floor, see Figure 5-15. An electric motor was used to operate the bicycle ventilator at its standard pedal crank speed of 55 rpm.

The blast was produced for the test was similar to those of the first three tests, with a peak incident overpressure, as measured by the gage at station 6-0, of 4.8 psi, a peak reflected overpressure of 8.9 psi and a positive phase duration of 107 msec.

Motion picture films revealed the following sequence of events:

Event	Time, msec.
Blast arrival - doorway seal blown out	0
Blades begin to bend	10
Shroud begins to deform	20
BVK leaves doorway	48

Average velocity = 105 ft/sec over first 5 feet of travel

= 40 ft/sec over first 15 feet of travel

This data shows that the fan and shroud were deformed before the BV left the doorway and began to translate. The BV was translated in an upward

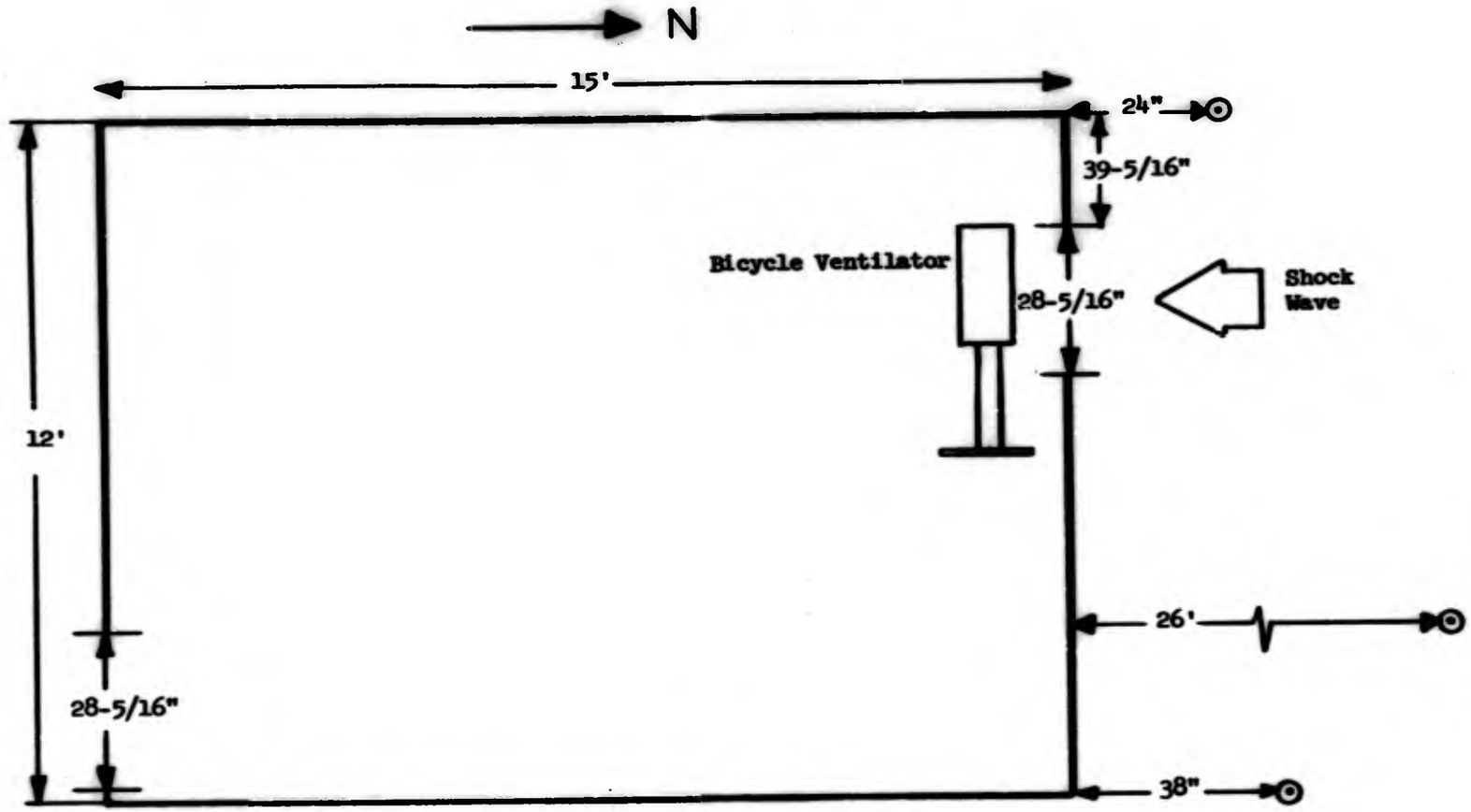


Figure 5-13 ROOM PLAN FOR BICYCLE VENTILATOR BLAST TEST

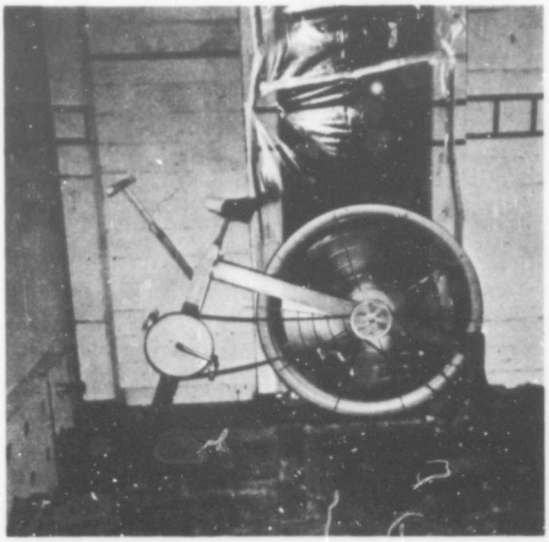


Figure 5-14 UPSTREAM VIEW OF BICYCLE VENTILATOR PRIOR TO TEST

Figure 5-15 DOWNSTREAM VIEW OF BICYCLE VENTILATOR DUCT PRIOR TO TEST

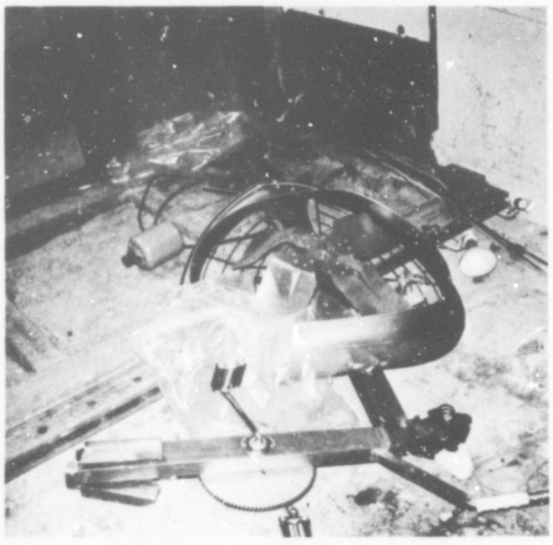
direction straight back toward the back wall, rotating 360 degrees about an axis parallel to the sprocket centerline of the frame before it struck the wall. At the wall, the handlebar, frame base support and pedals were damaged and the BV fell, rotating 90 degrees about an axis parallel to the pedal crank bearing before striking the floor where the seat and pedals were further damaged.

In its final condition, see Figure 5-16, the one-operator bicycle ventilator was judged incapble of operation or repair. All the ducting and plastic sheet covering the doorway were torn apart.

5.6 Blast Test Results

The tests showed that for jet blasts with maximum flow velocities of about 630 to 700 ft/sec[10] induced by peak incident overpressure levels of 4 to 5.8 psi in a 12 foot by 15 foot floor area room, the double-section Kearny pump, either door or A-frame mounted, the polyethylene duct and the one-operator bicycle ventilator are damaged beyond repair. Study of the test firms reveals that each of these pieces of equipment was deformed substantially by the initial blast, so that a different room geometry, which might eliminate the impact on the back wall, would not allow the equipment to survive undamaged. However, the A-frame support was considered to be easily repairable if spare parts were available and the KP's might have suffered much less damage if the plastic flaps had been removed prior to the blast striking them. This last action would have also removed an additional unforeseen danger, the high velocity debris hazards created by the plastic flaps with their wire supports. These results point out that the KP ventilators need not necessarily be rendered inoperative at the 4 to 5.8 psi incident overpressure level if time were available to take protective measures.

a



b

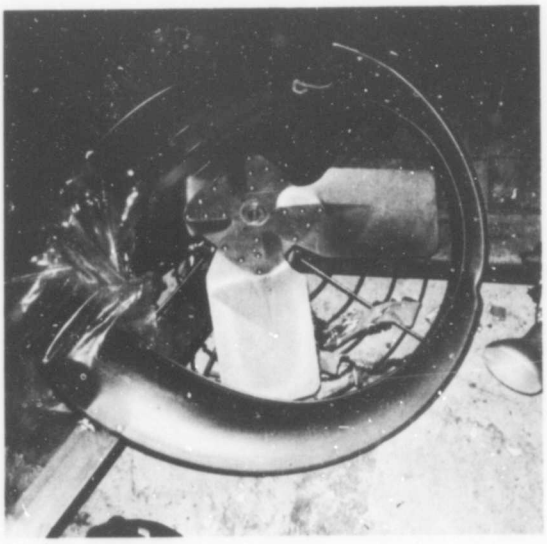


Figure 5-16 POST-TEST CONDITION OF BICYCLE VENTILATOR

SECTION 6

BICYCLE VENTILATOR KIT

After both the one-operator and the two-operator bicycle ventilators were designed, studies conducted under Work Unit 1217C of OCD Contract DAHC 20-68-C-0123 revealed that the use of combinations of one- and two-operator units in shelters results in savings of not more than 10% in total cost over the use of the one-operator ventilators alone. Since this savings would probably not offset the complications arising in the physical deployment of two types of ventilators, it is recommended that the one-operator unit be the only bicycle ventilator considered and that the two-operator unit be dropped from further study.

The one-operator bicycle ventilator kit (BVK) includes the following items: a one-operator bicycle ventilator; a 50-foot roll of 30-inch diameter, 4 mil polyethylene duct; a 30-yard roll of two-inch wide duct tape; a four-inch long scissors; a 1-1/2 oz. container of chain lubricating oil; and three copies of the instruction book.

The length of duct included is that recommended by studies under Work Unit 1217C of OCD Contract DAHC 20-68-C-0123. Estimations of the amount of tape needed to seal a doorway, attach the duct to the ventilator and to reinforce the end of the duct led to a length of 16 yards. Using a safety factor of about two, a 30-yard roll was decided upon. The instruction books are those developed under Work Unit 1522B of OCD Contract DAHC 20-68-C-0123, see Appendix A. Tests conducted under this same program determined that three copies should be included in the kit to insure proper deployment since three people normally composed the team which deployed the bicycle ventilator.

6.1 Packaging

Packaging is required that protects the bicycle ventilator kit from physical damage as well as damage due to corrosion from moisture for a storage period of 15 years.

The one-operator bicycle ventilator kit is packed in an inner box, which is surrounded by a vapor proof heat sealed barrier bag, which in turn is enclosed in an outer box which is wax-resin impregnated. The outer box will be imprinted with messages identifying the contents of the box for warehousing and dissemination to individual shelters and to alert the shelterees to the importance of the enclosed equipment. These messages were developed under Work Unit 1522B of OCD Contract DAHC 20-68-C-0123. Since wax-resin impregnated cardboard is dark brown, the messages will be printed with yellow ink, for greater visibility.

6.2 Costs

Estimates of costs for the one-operator bicycle ventilator kit were made based on production lots of 2,000 and 10,000 kits. An itemization of this estimate is shown in Table 6-1. The estimated cost for one kit, including packaging, is $130.94 and $121.65 in production lots of 2,000 and 10,000 kits respectively. Fixed tooling cost - for both manufacturing and assembly - is estimated as $5100.

The estimated costs for the two-operator bicycle ventilator kit is given in Table 6-2 for comparison. The cost for one kit, including packaging, is $169.34 and $162.86 in production lots of 2,000 and 10,000 kits respectively. The fixed tooling cost is estimated as $4500.

TABLE 6-1

COST ESTIMATE

ONE-OPERATOR BICYCLE VENTILATOR KIT

	Dwg. No.	Qty.	Description	Cost/Kit 2,000 pcs.	Cost/Kit 10,000 pcs.
BICYCLE VENTILATOR					
Components	1477R-1001	1	Frame	$ 37.44	$ 32.44
	1477B-1005	1	Hanger, Crank	0.60	0.55
	1477B-1004	1	Stem, Saddle	0.30	0.28
	1477E-1002	1	Shroud, Fan	11.95	11.10
	1477B-1006	1	Locking Screw	0.30	0.25
	1477B-1009	1	Shaft, Fan	0.73	0.70
	1477D-1010	2	Guard, Fan	3.50	3.20
	1477C-1003	1	Handle Bar Assembly	1.45	1.35
	1477B-1008	1	Sprocket, Fan Shaft	1.05	1.05
	1477C-1011	1	Sprocket, Drive	10.45	10.20
	---	2	Bearing, Fan	3.82	3.82
	---	1	Fan Blade, 30"	7.11	7.11
	---	1	Saddle	1.02	1.00
	---	1	Crank	1.21	1.21
	---	2	Bearing Cap	0.30	0.30
	---	1	Adjusting Cone	0.15	0.15
	---	1	Locking Cone	0.17	0.17
	---	1	Lock Nut	0.07	0.07
	---	1	Washer	0.01	0.01
	---	2	Ball Bearing	0.24	0.20
	---	2	Peddle, Foot	0.55	0.55
	---	2	Grips, Plastic	0.07	0.07
	---	1	Chain	4.99	4.99
	---	1	Pin, Spring	0.02	0.01
	---	4	Screw Tapping 10 - 32 x 3/8"	0.04	0.02
	---	10	Screw Tapping 6 - 32 x 3/8"	0.04	0.03
	---	2	Bolt Carriage 5/16" - 18 x 2-5/8"	0.06	0.06
	---	2	Washer, Flat	0.03	0.02
	---	2	Nut, Self-Locking	0.06	0.06
Assembly Labor	1477R-1000	1	Bicycle Ventilator	3.00	2.95
Finishing	1477R-1000	1	Bicycle Ventilator	1.50	1.45
			Bicycle Ventilator Cost, Sub-Total	$ 92.23	$ 85.37
DUCT					
Components	---	1	Polyethylene Duct 48" x .004" x 50'	2.15	2.08
Packaging	---	1	Duct	1.00	0.95
			Duct Cost, Sub-Total	$ 3.15	$ 3.03
ACCESSORIES					
Components	---	1	Duct Tape 2" x 30 yds.	1.57	1.42
		1	Scissors, 4"	0.24	0.22
		1	Lubricating Oil, 1-1/2 oz. SAE 20	0.15	0.12
Packaging	---	1	Accessories	0.45	0.42
			Accessories Cost, Sub-Total	$ 2.41	$ 2.18
INSTRUCTION BOOK PACKET		1		0.35	0.25
PACKAGING					
Components	---	1	Inner Box	1.61	1.61
	---	1	Outer Box	2.44	2.43
	---	1	Vapor Barrier	0.75	0.60
	---	1	Wood Lattice	1.75	1.75
Packaging Labor	---	1	Bicycle Ventilator Kit	3.75	3.52
			Packaging Cost, Sub-Total	$ 10.30	$ 9.91
			Cost of One-Operator Bicycle Ventilator Kit	$ 108.44	$ 100.74
			G & A (5%)	5.42	5.04
			Sub-Total	$ 113.86	$ 105.78
			Profit (15%)	17.08	15.87
			Total Cost of One-Operator Bicycle Ventilator Kit	$ 130.94	$ 121.65

TABLE 6-2

COST ESTIMATE

TWO-OPERATOR BICYCLE VENTILATOR KIT

	Dwg. No.	Qty.	Description	Cost/Kit 2,000 pcs.	Cost/Kit 10,000 pcs.
BICYCLE VENTILATOR					
Components	1477R-5010	1	Frame Assembly	$ 42.00	$ 40.00
	1477C-5030	2	Handle Bar	2.50	2.30
	1477A-5017	2	Locking Screw	0.60	0.50
	1477C-5050	2	Sprocket, Drive	22.20	21.70
	1477B-5060	1	Sprocket, Fan Shaft	3.25	3.15
	1477C-5020	1	Shroud, Fan	11.95	11.10
	1477B-5070	1	Shaft, Fan	0.90	0.88
	1477D-5080	2	Guard, Fan	3.50	3.20
	1477B-5090	2	Saddle, Support	0.68	0.65
	---	2	Bearing, Fan	3.82	3.82
	---	1	Fan Blade, 30"	7.11	7.11
	---	2	Saddle	2.04	2.00
	---	2	Crank	2.42	2.42
	---	4	Bearing Cap	0.60	0.60
	---	2	Adjusting Cone	0.30	0.30
	---	2	Locking Cone	0.35	0.35
	---	2	Lock Nut	0.14	0.14
	---	2	Washer	0.03	0.03
	---	4	Ball Bearing	0.48	0.40
	---	1	Chain, No. 35, 260 pitches	5.36	5.36
	---	1	Chain, No. 35, 236 pitches	4.87	4.87
	---	2	Key, 3/16" x 3/16" x 1"	0.15	0.15
	---	4	Screw Tapping 10 - 32 x 3/8"	0.04	0.02
	---	10	Screw Tapping 6 - 32 x 3/8"	0.04	0.03
	---	4	Peddle, Foot	1.10	1.10
	---	2	Bolt, Carriage 5/16"- 18 x 2-5/8"	0.06	0.06
	---	2	Washer Flat	0.03	0.02
	---	2	Nut, Self-Locking	0.06	0.06
	---	4	Bolt & Nut 1/4" - 20 x 1-1/4"	0.07	0.07
	---	4	Grips, Plastic	0.14	0.14
Assembly Labor	1477R-5000	1	Bicycle Ventilator	4.50	4.30
Finishing	1477R-1000	1	Bicycle Ventilator	1.90	1.85
			Bicycle Ventilator Cost, Sub-Total	$ 123.19	$ 118.68
DUCT					
Components	---	1	Polyethylene Duct 48" x .004" x 50'	2.15	2.05
Packaging	---	1	Duct	0.70	0.65
			Duct Cost, Sub-Total	$ 2.85	$ 2.70
ACCESSORIES					
Components	---	1	Duct Tape 2" x 30 yds.	1.57	1.42
		1	Scissors, 4"	0.24	0.22
		1	Lubricating Oil, 1-1/2 oz. SAE 20	0.15	0.12
Packaging	---	1	Accessories	0.45	0.42
			Accessories Cost, Sub-Total	$ 2.41	$ 2.18
INSTRUCTION BOOK PACKET		1		0.35	0.25
PACKAGING					
Components	---	1	Inner Box	2.07	2.07
	---	1	Outer Box	2.37	2.35
	---	1	Vapor Barrier	0.90	0.75
	---	1	Wood Lattice	2.00	2.00
Packaging Labor	---	1	Bicycle Ventilator Kit	4.10	3.90
			Packaging Cost, Sub-Total	$ 11.44	$ 11.07
			Cost of Two-Operator Bicycle Ventilator Kit	$ 140.24	$ 134.88
			G & A (5%)	7.01	6.74
			Sub-Total	$ 147.25	$ 141.62
			Profit (15%)	22.09	21.24
			Total Cost of Two-Operator Bicycle Ventilator Kit	$ 169.34	$ 162.86

SECTION 7

KEARNY PUMP KIT

The Kearny pump kit (KPK) consists of two separate boxes. Box 'A' contains two flap sections, a doorway support bar, two pull cords and three copies of the instruction book. Box 'B' contains the A-frame support and three copies of the instruction book.

The contents of the kit were selected in consultation with OCD. The kit allows the shelterees to assemble any of the following combinations of ventilators, depending upon the shelter situation:

1) One single-section doorway pump and one single-section mid-room air mixer.
2) Two single-section pumps deployed in doorways (with the A-frame placed in a doorway).
3) One double-section doorway pump.
4) One double-section A-frame pump for mid-room application.

The instruction books are those developed under Work Unit 1522B of OCD Contract DAHC 20-68-C-0123, see Appendix A. Tests conducted under this same program determined that three copies should be included in each box to insure proper assembly and deployment since three people normally composed the teams assembling these ventilators.

7.1 Packaging

Packaging is required that protects the Kearny pump kit from physical damage as well as damage due to corrosion from moisture for a storage period

of 15 years. The doorway support bar is packed in a separate box which is then packed with the flap sections, pull cords and the three instruction books in an inner box. The inner box is surrounded by a vapor proof heat sealed barrier bag, and then enclosed in a wax-resin impregnated outer box. The A-frame is packed in a similar manner. The outer boxes are imprinted with messages identifying the contents of the box for warehousing and dissemination to individual shelters, and to alert the shelterees to the importance of the enclosed equipment. These messages were developed under Work Unit 1522B of OCD Contract DAHC 20-68-C-0123. Since wax-resin impregnated cardboard is dark brown, the messages will be printed with yellow ink, for greater visibility.

7.2 Costs

Estimates of costs for the Kearny pump kit were made based on production lots of 2,000 and 10,000 kits. An itemization of this estimate is shown in Table 7-1. The estimated cost for one kit, including packaging, is $65.91 and $58.63 in production lots of 2,000 and 10,000 kits respectively. The fixed tooling cost - for both manufacturing and assembly - is estimated as $3500.

TABLE 7-1

COST ESTIMATE

KEARNY PUMP KIT

BOX 'A'

	Dwg. No.	Qty.	Description	Cost/Kit 2,000 pcs.	Cost/Kit 10,000 pcs.
KEARNY PUMP FRAME					
Components	1477D-3010	1	Frame, Top	$ 3.31	$ 3.21
	1477D-3015	1	Frame, Bottom	3.31	3.21
	1477B-3040	1	Tie Plate, Left	0.35	0.30
	1477B-3041	1	Tie Plate, Right	0.35	0.30
	1477C-3030 Item 1	2	Netting	0.52	0.45
	1477C-3020 Item 1	16	Flap, Plastic	1.11	1.06
	1477C-3020 Item 2	16	Hinge Wire	0.36	0.33
	1477C-3030 Item 2	4	Hinge Pin Support	1.50	1.45
	1477A-3035	4	Hinge Pin	1.12	0.78
	---	8	Thumb Screw 1/2" - 21 x 1"	0.20	0.20
	---	32	Speed Clip	1.09	1.09
	---	12	Polyclamp	0.16	0.16
	---	8	Nut Retainer	0.36	0.36
Assembly Labor	1477E-3000	1	Pump Frame	2.10	1.80
Welding Labor	1477D-3010	1	Pump Frame Top	3.75	3.30
	1477D-3015	1	Pump Frame Bottom		
	1477C-3030 Item 2	4	Hinge Pin Support		
Finishing	1477E-3000	1	Pump Frame	0.30	0.25
			Kearny Pump Frame Cost, Sub-Total	$ 19.89	$ 18.25
DOORWAY SUPPORT BAR					
Components	1477C-2010 Item 1	1	Outer Extending Tube	9.25	8.75
	1477C-2010 Item 2	1	Inner Extending Tube		
	1477C-2020 Item 3	1	End Plug		
	1477C-2020 Item 4	1	Swivel		
	1477C-2020 Item 5	1	Swivel Base		
	1477C-2020 Item 6	1	Threaded Rod		
	1477C-2020 Item 7	1	Tee Handle		
	1477B-2030	1	Bearing Support		
	1477B-2031	1	Bearing Support		
	1477C-2020 Item 8	2	End Slug	0.24	0.20
	1477A-2050	1	Crutch Tip	0.04	0.03
	1477A-2051	1	Crutch Tip	0.08	0.07
	---	1	Pin Assembly	0.45	0.23
	---	1	Push Nut	0.01	0.01
	---	2	Bronze Bearing	1.08	0.74
	---	2	Wing Screw	0.06	0.05
Assembly Labor	1477D-2000	1	Doorway Support Bar	0.90	0.80
Finishing	1477D-2000	1	Doorway Support Bar	0.15	0.10
Packaging	1477D-2000	1	Doorway Support Bar	0.49	0.47
			Doorway Support Bar Cost, Sub-Total	$ 12.75	$ 11.45
CORDS					
Components	1477B-3042	2	Pull Cord	0.46	0.40
	1477B-3042 Item 1	2	Pull Cord Handle	0.10	0.08
Packaging Labor	1477B-3042	2	Pull Cord	0.05	0.05
	1477B-3042 Item 1	2	Pull Cord Handle		
			Cords Cost, Sub-Total	$ 0.61	$ 0.53
INSTRUCTION BOOK PACKET				0.35	0.25
PACKAGING					
Components	---	1	Inner Box	0.43	0.42
	---	1	Outer Box	0.63	0.62
	---	1	Vapor Barrier	0.15	0.12
Packaging Labor	---	1	Box 'A'	2.25	2.15
			Packaging Cost, Sub-Total	$ 3.46	$ 3.31
			Total Cost of Box 'A'	$ 37.06	$ 33.79

TABLE 7-1 (CONT.)

BOX 'B'

	Dwg. No.	Qty.	Description	Cost/Kit 2,000 pcs.	Cost/Kit 10,000 pcs.
A-FRAME					
Components	1477D-4001 Item 3	2	Longitudinal Brace	$ 6.95	$ 5.22
	1477D-4002 Item 1	2	Cross Brace		
	1477D-4001 Item 1	2	Leg 'A'		
	1477D-4001 Item 2	2	Leg 'B'		
	1477D-4002 Item 2	1	Top Support		
	1477B-4005	2	Slip-on Fitting	1.77	1.72
	1477D-4002 Item 4	8	Stud	0.10	0.08
	1477D-4002 Item 3	2	Bearing Support	0.36	0.30
	---	2	Bearing, Bronze	1.09	0.75
	---	8	Wing Nut, Stamped 1/4"- 20	0.16	0.14
	---	2	Set Screw 5/16"- 18 x 5/16"	0.06	0.06
	---	4	Thumb Screw 5/16"- 18 x 1/2"	0.12	0.10
	---	4	Crutch Tip	0.13	0.12
Assembly Labor	1477C-4006	1	Top Support	0.52	0.45
Welding Labor	1477C-4006	1	Top Support	2.25	2.02
Finishing	1477J-4000	1	A-frame Assembly	0.50	0.45
		A-frame Cost, Sub-Total		$ 14.01	$ 11.41
INSTRUCTION BOOK PACKET		1		0.35	0.25
PACKAGING					
Components	---	1	Inner Box	0.27	0.26
	---	1	Outer Box	0.34	0.32
	---	1	Vapor Barrier	0.15	0.12
Packaging Labor	---	1	Box 'B'	2.40	2.40
		Packaging Cost, Sub-Total		$ 3.16	$ 3.10
		Total Cost of Box 'B'		$ 17.52	$ 14.76
		Total Cost of Box 'A' and Box 'B'		$ 54.58	$ 48.55
		G & A (5%)		2.73	2.43
		Sub-Total		$ 57.31	$ 50.98
		Profit (15%)		8.60	7.65
		Total Cost of Kearny Pump Kit		$ 65.91	$ 58.63

SECTION 8

RECOMMENDATIONS

The following recommendations regarding shelter ventilators are made as a consequence of the work completed under the various Task Orders of OCD Contract DAHC 20-68-C-0123.

1) Based on the study conducted under T/O 1217C, the two-operator bicycle ventilator should be dropped from further consideration.

The use of the one-operator units only will result at most in a 10% higher total cost as compared to the use of an "optimum mix" of one- and two-operator units. This higher cost probably will be more than offset by the elimination of complications of deploying two types of ventilators.

2) The bicycle ventilator should be used only as an exhaust device.

The use of the ventilators to supply air results in the elimination of the duct in only one out of six shelter parts and hence cannot be justified, especially in view of the complication and cost of supplying self-supporting ducts.

3) Prefabricated duct sections (elbows, etc.) should be eliminated.

Bending of the duct, in lieu of using prefabricated sections, leads in general to a reduction of flow of at the most of 9%. This is small in comparison to the added BVK cost, and the more complicated deployment instructions and more complicated deployment that will result if prefabricated sections are used.

4) The fixed width Kearny pump is to be preferred to the variable width Kearny pump.

Although the latter will be somewhat more efficient when deployed in wider doors, the added complication of assembling it and its higher cost make it undesirable.

5) The A-frame and the doorway support bar are the best methods for deploying a Kearny pump in a room or in a doorway respectively.

6) The instructions for ventilator location, assembly and operation given in Appendix A represent the present state-of-the-art.

7) An in-depth investigation of alternative deployment concepts of equipment and supplies within shelters to minimize blast damage should be conducted.

8) Further evaluation of the BVK, KAP and other new equipment, and the deployment instructions should be conducted. Such evaluation should uncover remaining problems, if any, with the equipment or with the deployment instructions.

9) Since the Kearny pump uses arm power - an inefficient method of operating a mechanical device - and produces a low air flow rate, designs of novel shelter ventilators with better performance characteristics should be investigated. These should meet the following criteria: (1) move air continuously at high flow rates; (2) uses no duct; (3) be low in cost; (4) be foot-powered; and (5) be easily assembled and deployed.

SECTION 9

REFERENCES

1. A. D. Morrell, et. al., "Feasibility of Utilizing Packaged Ventilation Units in Identified Shelters", Department of Defense, Office of Civil Defense, Washington, D. C., February 1963. (Official use only)

2. B. A. Libovicz and H. F. Behls, "Shelter Package Ventilation Kit", OCD Task Order No. 1423A, GARD Report 1244, General American Research Division, Niles, Illinois, October 1965.

3. S. J. Lis and H. F. Behls, "Ventilation Equipment Analysis for Basement Shelters", OCD Task Order No. 1423A, GARD Report 1278, General American Research Division, Niles, Illinois, February 1968.

4. B. A. Licovicz, "Shelter Portable Ventilation Equipment", OCD Task Order No. 1423A, GARD Report 1430, General American Research Division, Niles, Illinois, January 1969.

5. C. H. Kearny, "Instructions for Building a Homemade Large-volume Shelter-ventilating Punkah-pump", Contract No. W-7405-eng-26, ORNL Report TM-1745, Oak Ridge National Laboratory, Oak Ridge, Tennessee, March 1967.

6. B. A. Libovicz and H. F. Behls, "Experimental Prototype Package Ventilation Kit, First Structural and Human Factors Test", OCD Task Order 1423A, GARD Report 1278-4.1, General American Research Division, Niles, Illinois, May 1965.

7. A. L. Kapil and R. J. Baschiere, "Shelter Atmosphere Monitoring Devices", OCD Task Order 1233C, GARD Report 1277, General American Research Division, Niles, Illinois, January 1966.

8. O. W. Svaeri and N. I. Stein, "Air Distribution Studies in Multi-room Shelters", OCD Task Order 1217A, PSDC Report TR-21/22, Protective Structures Development Center, Fort Belvoir, Virginia, March 1967.

9. J. F. Hale and H. F. Behls, "Psychological, Engineering, and Physiological Evaluation of Shelter Equipment and Procedures", Volume II - Laboratory Studies, OCD Task Order 1522A, GARD Report 1292, General American Research Division, Niles, Illinois, February 1967.

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APPENDIX A

INSTRUCTIONS FOR VENTILATOR LOCATION, ASSEMBLY AND OPERATION

INSTRUCTIONS FOR VENTILATOR LOCATION, ASSEMBLY AND OPERATION

DO NOT UNPACK VENTILATORS UNTIL INSTRUCTIONS SAY TO DO SO.

YOU MUST FIGURE OUT THE LOCATION OF THE VENTILATORS NOW, OR THE SHELTER MAY BECOME TOO HOT TO OCCUPY WITHIN ONE HOUR, WITHOUT ANY WARNING !

TO SET UP VENTILATION FOR A TWO-WEEK STAY YOU MUST READ THESE INSTRUCTIONS PAGE BY PAGE AT ONCE! . THEN YOU CAN :

1. DETERMINE VENTILATOR LOCATIONS
2. MOVE BOXES TO LOCATIONS
3. UNPACK BOXES
4. ASSEMBLE VENTILATORS
5. OPERATE VENTILATORS CONTINUOUSLY

OFFICE OF CIVIL DEFENSE

OFFICE OF THE SECRETARY OF THE ARMY

READ CAREFULLY!

You are in a fallout shelter. It may consist of one room or a number of rooms and areas together. You have been provided with one or more of the following:

- BICYCLE VENTILATOR
- A-FRAME/DOORWAY "KEARNY" VENTILATOR

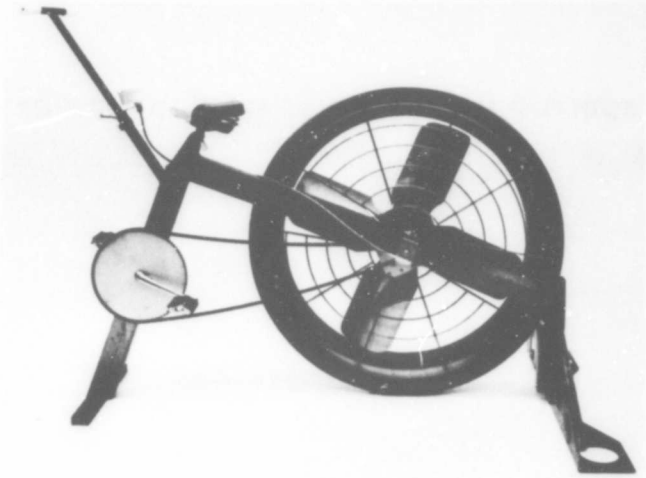
PHOTOGRAPHS OF ASSEMBLED VFNTILATORS ARE SHOWN ON THE NEXT TWO PAGES. STUDY THEM.

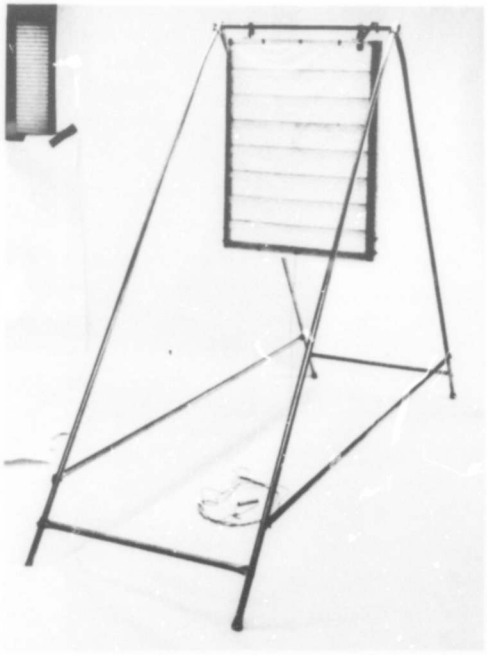
READ THE LABELS ON ALL VENTILATOR BOXES IN THE ENTIRE SHELTER TO DETERMINE WHICH ONES YOU HAVE!

IF YOU DO NOT HAVE A BICYCLE VENTILATOR SKIP TO PAGE 18

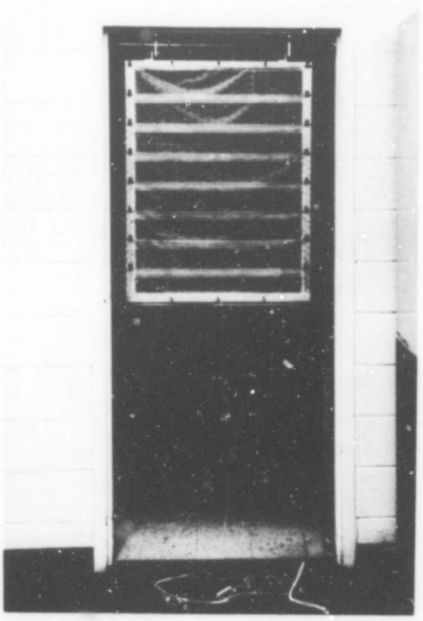
OTHERWISE CONTINUE READING.

BICYCLE VENTILATOR
(duct not shown)





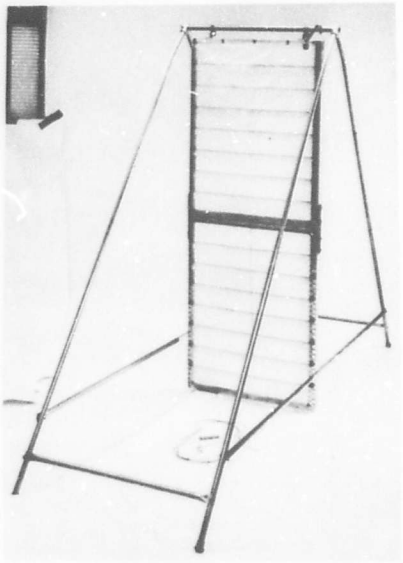
A-FRAME "KEARNY" VENTILATOR
with <u>one</u> Flap Section attached



DOORWAY "KEARNY" VENTILATOR
with <u>one</u> Flap Section attached
(from inside room).

THERE ARE TWO FLAP SECTIONS PACKAGED WITH THE A-FRAME AND DOORWAY PARTS. EACH FLAP SECTION CAN BE HUNG SEPARATELY, AS SHOWN ABOVE, OR, SEE NEXT PAGE

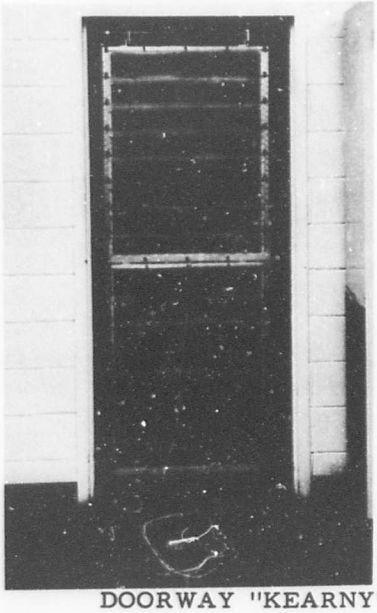
BOTH FLAP SECTIONS CAN BE ATTACHED TOGETHER AND HUNG FROM EITHER THE A-FRAME OR THE DOORWAY SUPPORT ROD. BOTH SET UPS ARE BELOW.



A-FRAME "KEARNY" VENTILATOR
with both Flap Sections attached

YOU CAN ASSEMBLE THIS VENTILATOR

OR



DOORWAY "KEARNY" VENTILATOR
with both Flap Sections attached (from inside room)

THIS VENTILATOR

READ EVERY PAGE COMPLETELY AND THOROUGHLY. NOW! IT WILL TELL YOU HOW TO DETERMINE THE BEST LOCATIONS FOR THE VENTILATORS.

LOCATION INSTRUCTIONS FOR BICYCLE VENTILATOR

IMPORTANT: READ AND FOLLOW INSTRUCTIONS STEP BY STEP. DO NOT UNPACK VENTILATORS UNTIL BEST LOCATION FOR ALL IS DETERMINED.

1. The bicycle ventilator has two parts:

   a. A fan to pull hot, stale air from the shelter

   b. A duct to carry this air out of the shelter.

   Fresh air then enters the shelter from windows or other openings to replace the hot stale air.

2. There must be an opening from the outside so that the path taken by this fresh air can extend from the outside openings to the intake of the Bicycle Ventilator.

3. This path must pass through as much of the shelter as possible for adequate ventilation. To learn how to do this, read every word of the following section. THIS IS VITAL!

4. Incoming, fresh air will be safe. After the ventilators are operating, if you are uncertain about radiation effects and shelter ventilation, use the appendices at the back of this booklet. Not now!

DETERMINING LOCATIONS

LOCATION PRINCIPLES

1. When the Bicycle Ventilator is placed inside a room with more than one opening:

   - Seal all but the two openings which will form the longest air flow path between them,
   - Place the Ventilator right next to the opening where the duct will exit,
   - After the Bicycle and duct are in place, seal the opening around the Bicycle.

2. When the Bicycle Ventilator is placed inside a room with only one opening:

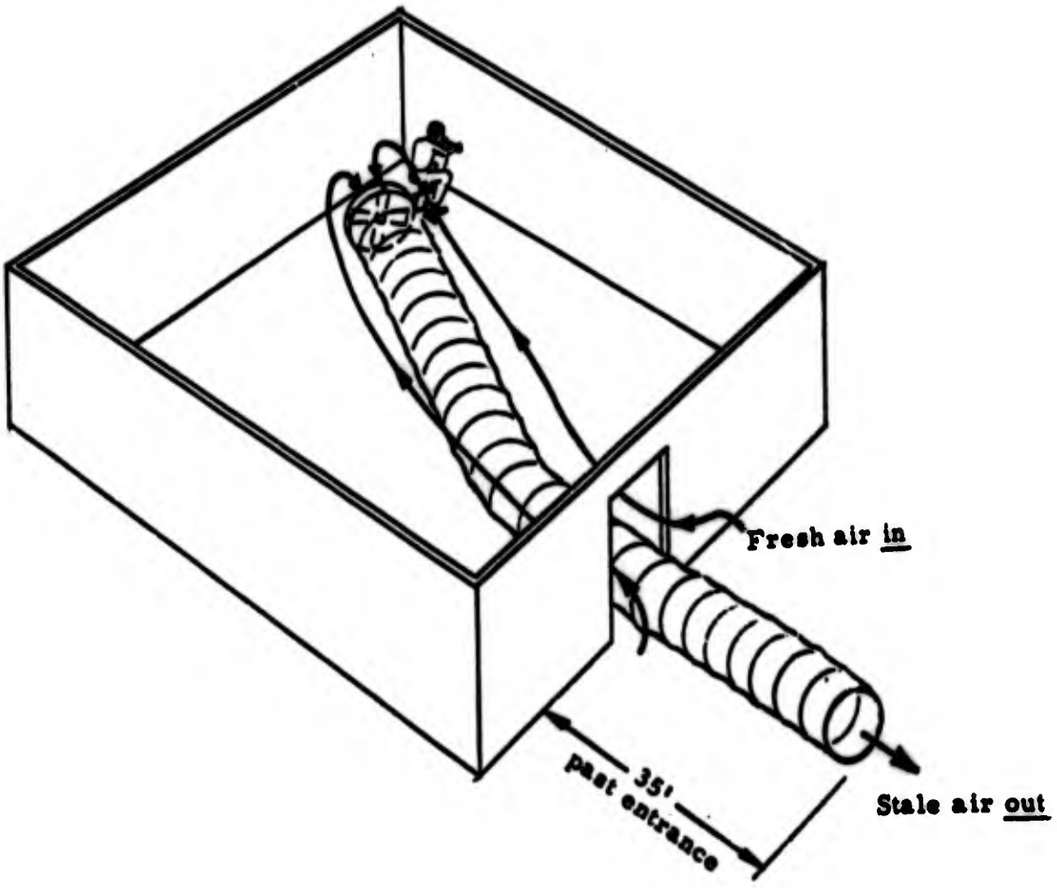
   - Place the Ventilator as far from the opening as possible.
   - Lead the duct out the opening.
   - DO NOT seal the opening.

The following models of shelters differ in the arrangement of outside openings and rooms. This arrangement determines the placement of the Bicycle Ventilator for the best air flow. Although the models may not be similar to the shelter you are in, each one illustrates important location principles and should be read carefully.

DO NOT UNROLL THE PLASTIC DUCT UNTIL THE INSTRUCTIONS SAY TO DO SO.

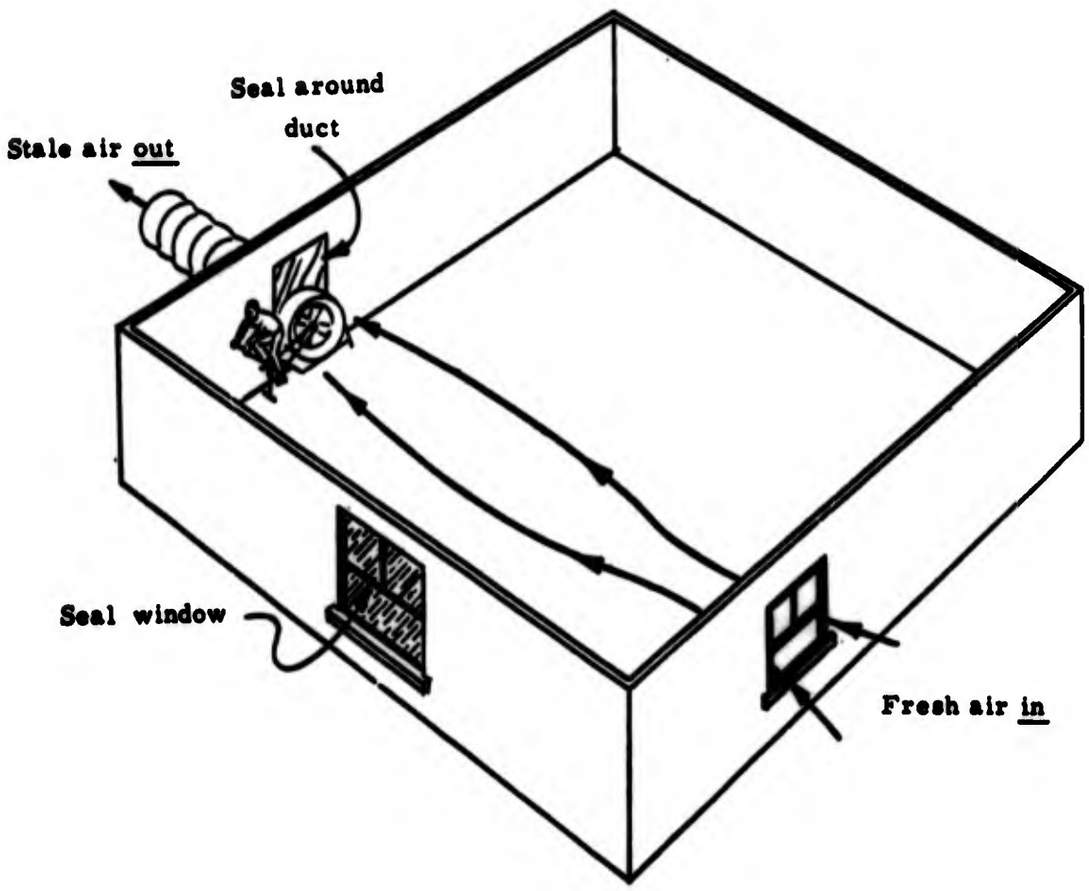
REMEMBER, MAKE THE AIR FOLLOW THE LONGEST PATH FROM ANY OPENING TO THE VENTILATOR.

Figure 1. Shelter with Only One Opening



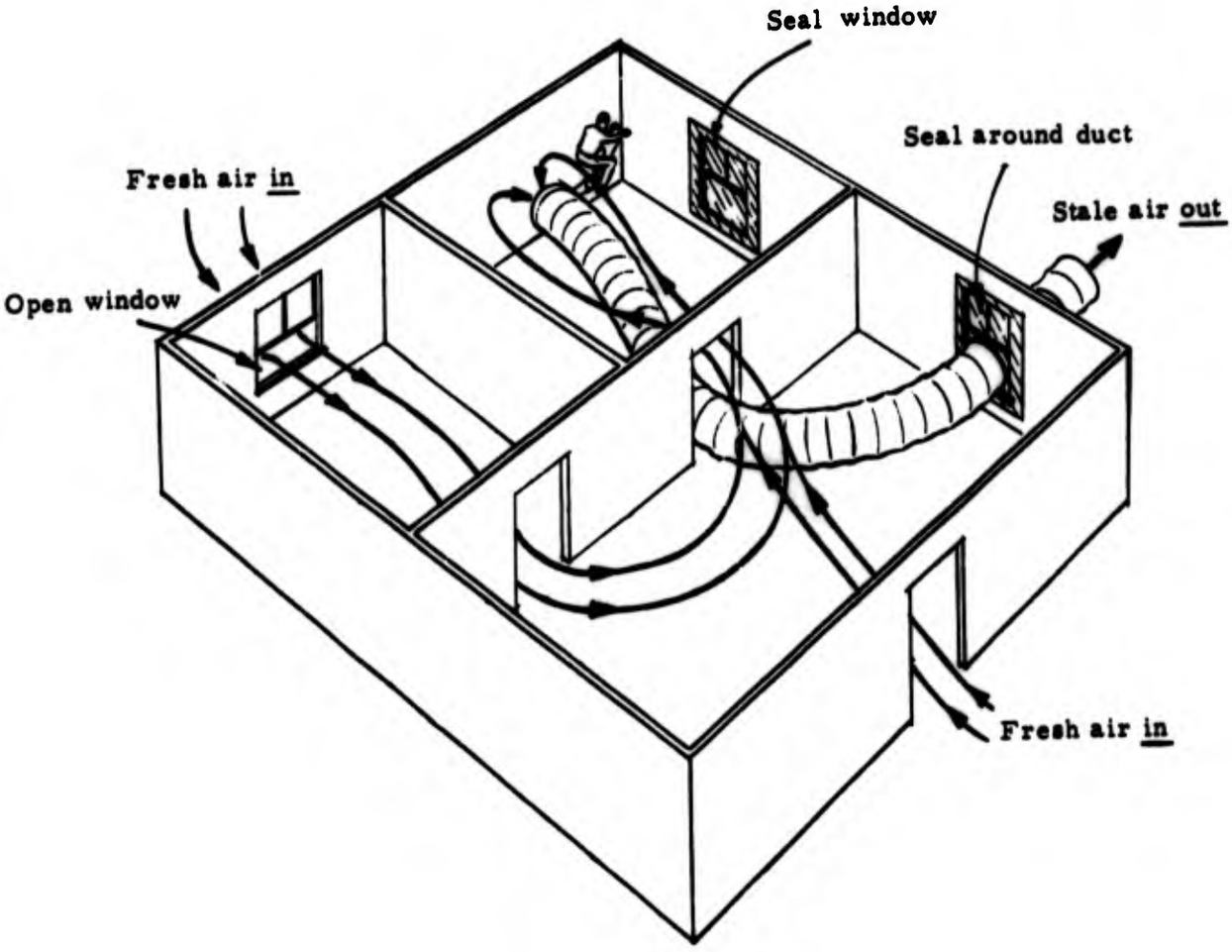
- Stale air is pulled in by the fan, and blown out through the duct.
- Fresh air enters through the doorway and flows alongside the duct.
- The fan is in the far corner to create the longest possible flow path for the incoming fresh air.

Figure 2. Shelter with Openings at Opposite Ends.



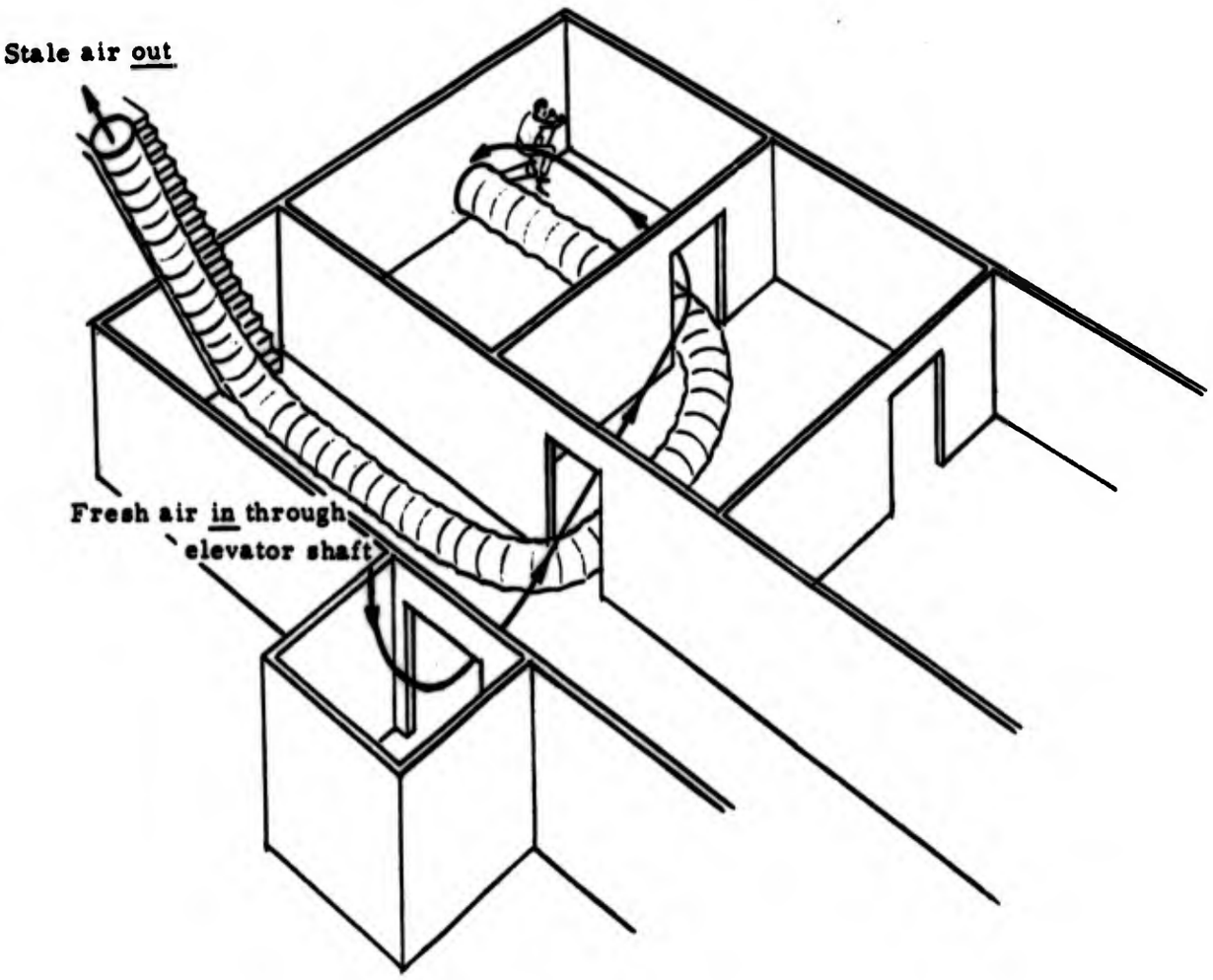
- Stale air is pulled out by the fan. Note seal around duct.
- Fresh air enters through window and flows into room.
- Side window is sealed to create longest possible path.

Figure 3. Shelter with More Than One Room



- Stale air is pulled by the fan and blown out through the duct.
- Fresh air enters the shelter through a doorway and open window.
- Note sealed window, seal around duct, and fan in corner to create longest possible flow path.

Figure 4. Basement Shelter without Direct Opening to Outside



- Stale air is pulled from the basement by the fan and blown out through the duct which is run up the stairs.
- Fresh air enters through the elevator shaft.
- Fan is placed as far from the elevator shaft as possible.

IF AN A-FRAME/DOORWAY 'KEARNY' VENTILATOR IS NOT IN THE SHELTER, SKIP TO PAGE 23 OTHERWISE CONTINUE

DO NOT UNPACK ANY BOXES YET!

YOU CANNOT SET UP ADEQUATE VENTILATION UNLESS YOU HAVE READ THE LOCATION INSTRUCTIONS FOR THE BICYCLE VENTILATOR (PAGES 1-9).

LOCATION INSTRUCTIONS FOR A-FRAME/DOORWAY 'KEARNY' VENTILATOR WHEN USED WITH BICYCLE

IMPORTANT: READ AND FOLLOW INSTRUCTIONS STEP BY STEP. DO NOT UNPACK VENTILATORS UNTIL BEST LOCATION FOR ALL IS DETERMINED.

LOCATION PRINCIPLES

The "Kearny" Ventilators are used to move fresh air from the air stream caused by the Bicycle Ventilator to areas requiring ventilation. These areas could be:

- part of a room which would not get enough fresh air from the Bicycle alone, or
- a room which will not have the Bicycle air stream in it.

1. To ventilate part of a room which would not get enough fresh air from the Bicycle alone,

   Use an "A-Frame" Ventilator, with both Flap Sections (unless a section is used for the "Doorway" Ventilator).

   Place the "A-Frame" as close to the middle of the air stream as possible.

   Point the Flap Section(s) of the "A-Frame" toward the area to be ventilated, so that the flaps open toward that area.

2. To ventilate a room which will not have the Bicycle air stream in it,

Use a "Doorway" Ventilator with:

two Flap Sections, if the room has two or more openings (preferred arrangement) or

one Flap Section, if the room has only one opening

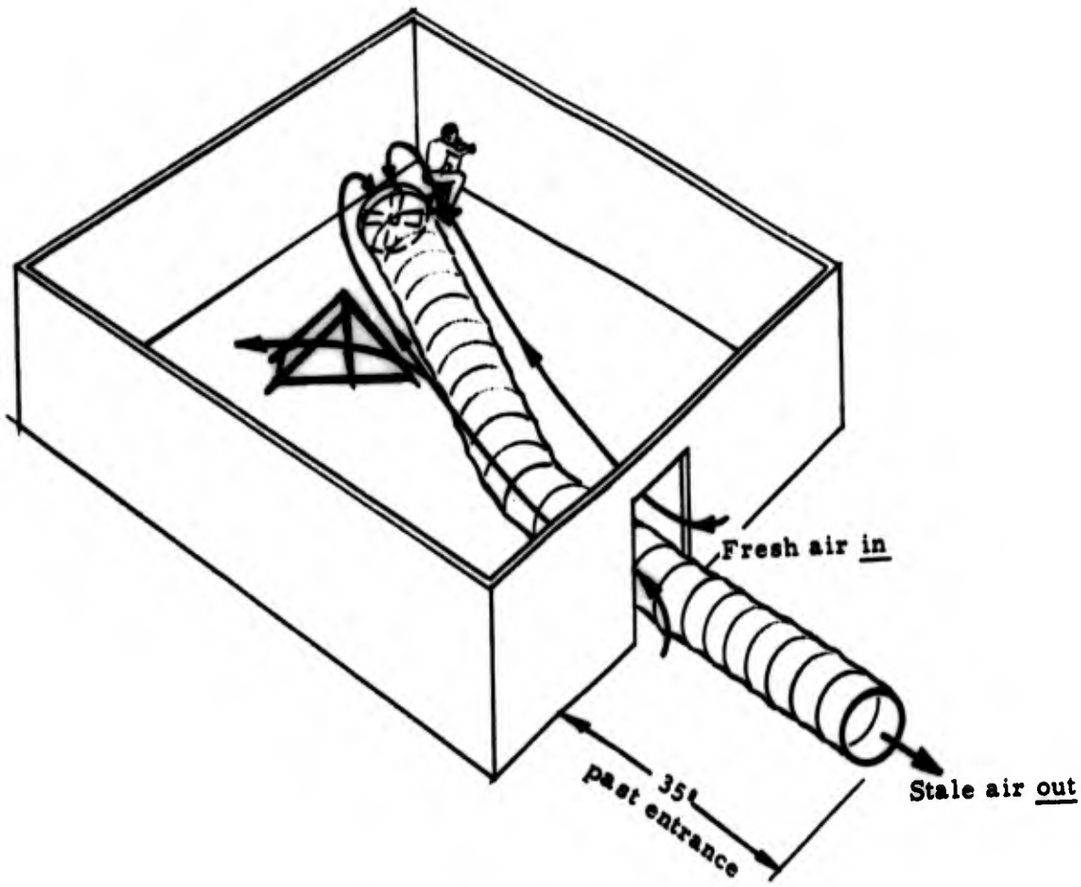
NOTE: an "A-Frame" could be used instead.

Place the "Doorway" Ventilator in the doorway.

Attach the Flap Section(s) so that they open into the room to be ventilated

The following models of shelters are the same ones shown in the Location Instructions for the Bicycle Ventilator, but also show how to locate the "Kearny" Ventilators in combination with the Bicycle Ventilator. Although the models may not be similar to the shelter you are in, each one illustrates important location principles and should be read carefully.

Figure 5. Shelter with Only One Opening

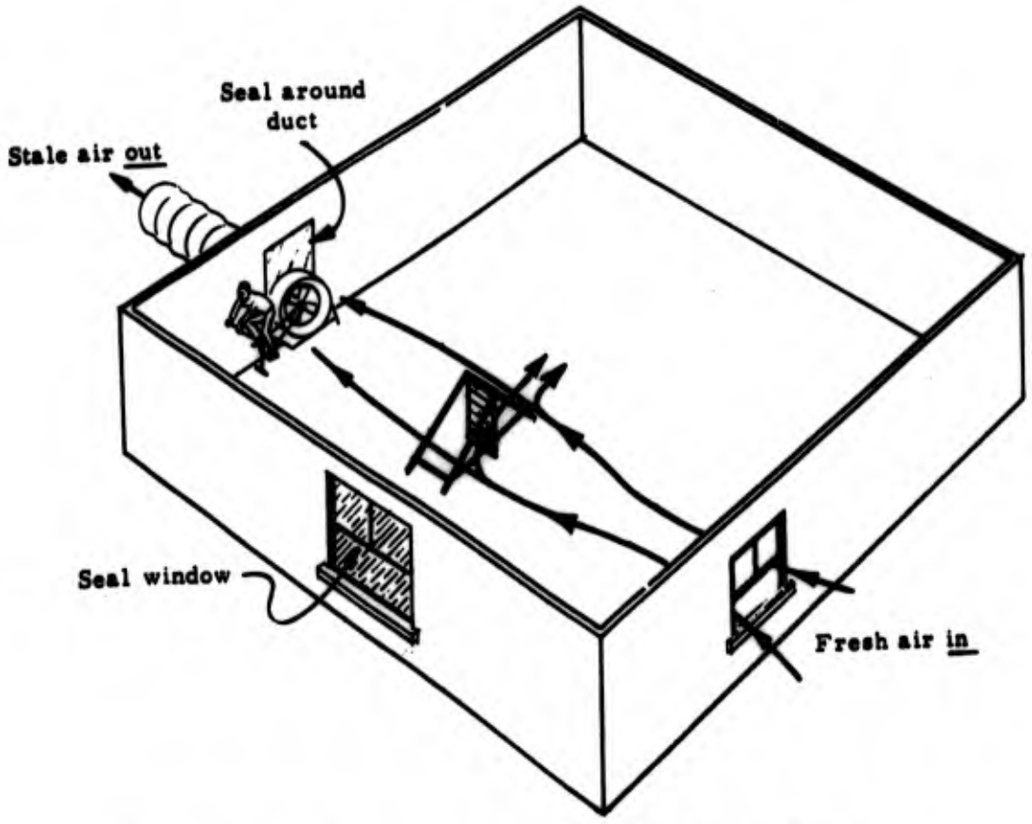


- Stale air is pulled in by the fan, and blown out through the duct.
- Fresh air enters through the doorway and flows alongside the duct.
- The fan is in the far corner to create the longest possible flow path for the incoming fresh air.

TO VENTILATE THE CORNER, WHICH WOULD NOT GET ENOUGH AIR

- INCOMING FRESH AIR IS PULLED FROM THE AIR STREAM (ALONG THE DUCT) BY AN "A-FRAME" VENTILATOR AND FED TO THE POORLY VENTILATED CORNER.
- BOTH FLAP SECTIONS ARE USED, AND THE "A-FRAME" IS PLACED RIGHT NEXT TO THE AIR STREAM, WITH THE FLAP SECTIONS FACING THE CORNER.
- THE FLAPS ARE ON THE SIDE OF THE "A-FRAME" FACING THE CORNER AND OPEN TOWARD THE CORNER.

Figure 6. Shelter with Openings at Opposite Ends

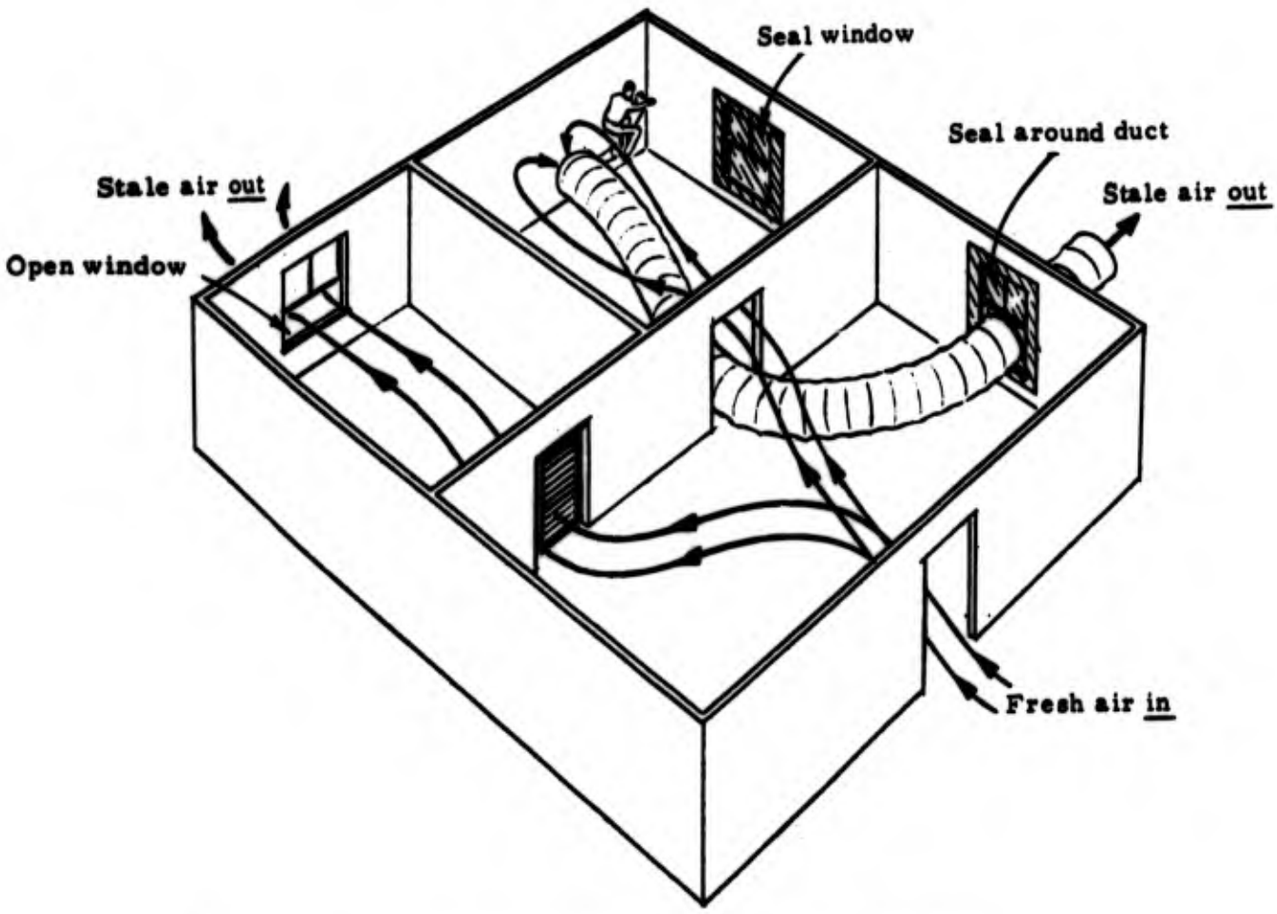


- Stale air is pulled out by the fan. Note seal around duct.
- Fresh air enters through window and flows into room.
- Side window is sealed to create longest possible path.

TO VENTILATE THE RIGHT SIDE OF THE ROOM WHERE THE AIR STREAM WOULD NOT REACH

- INCOMING FRESH AIR IS PULLED FROM THE AIR STREAM BY AN "A-FRAME" VENTILATOR AND FED TO THE SIDE OF THE ROOM.
- BOTH FLAP SECTIONS ARE USED, AND THE "A-FRAME" IS PLACED IN THE MIDDLE OF THE AIR STREAM AND POSITIONED MID-WAY BETWEEN THE OPEN WINDOW AND THE FAN.
- THE FLAPS OPEN TO THE RIGHT SIDE OF THE ROOM.

Figure 7. Shelter with More Than One Room

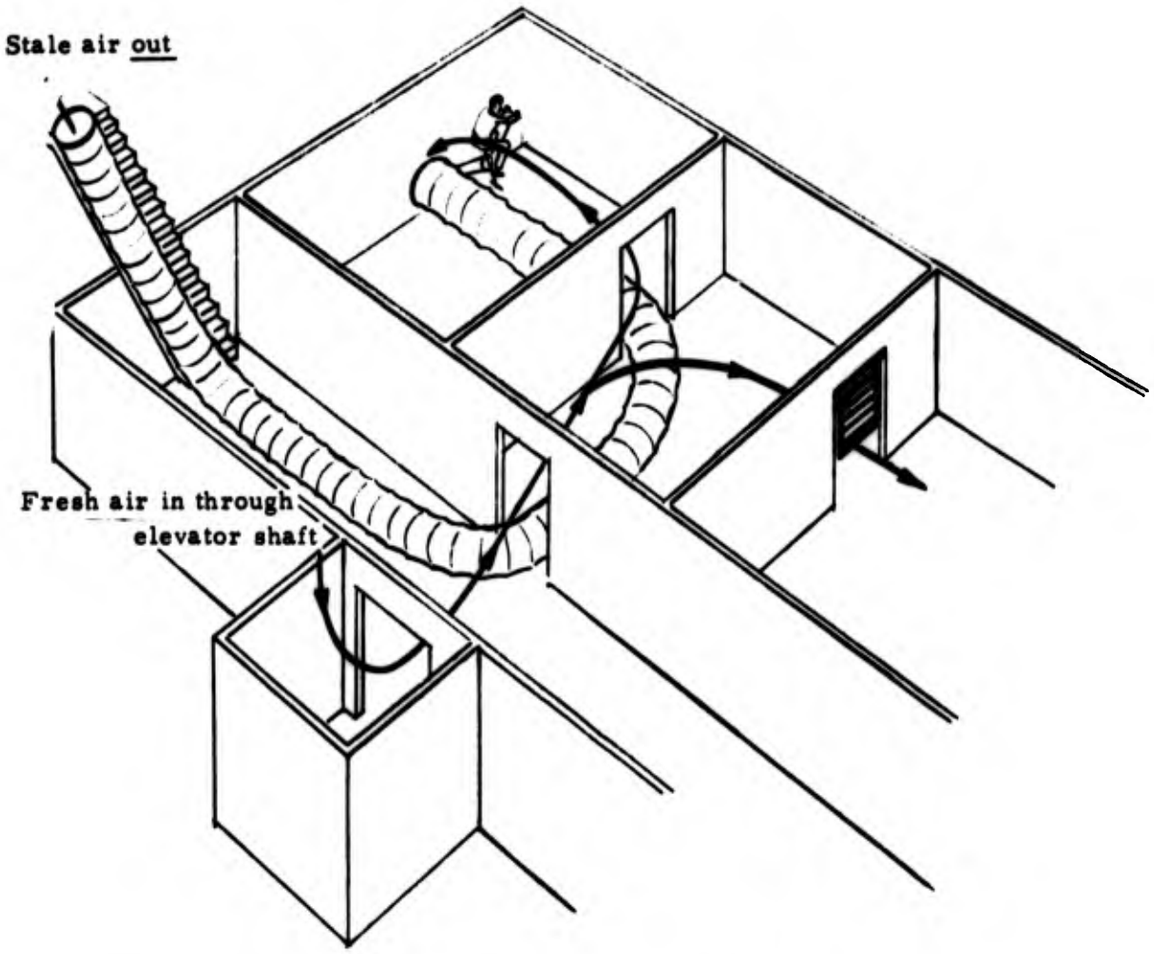


- Stale air is pulled by the fan and blown out through the duct.
- Fresh air enters the shelter through a doorway and open window.
- Note sealed window, seal around duct, and fan in corner to create longest possible flow path.

TO VENTILATE THE ROOM WITHOUT THE DUCT IN IT

- OPEN THE WINDOW FURTHEST FROM THE ENTRANCE
- FRESH AIR WILL BE PULLED FROM THE INCOMING AIR STREAM AND FED TO THE ROOM.
- PLACE THE "DOORWAY" VENTILATOR IN THE DOORWAY OF THE ROOM TO BE VENTILATED, AND USE BOTH FLAP SECTIONS.
- THE FLAPS OPEN INTO THE ROOM TO BE VENTILATED.
- NOTE: AN "A-FRAME" VENTILATOR WITH BOTH FLAP SECTIONS COULD BE USED INSTEAD.

Figure 8. Basement Shelter without Direct Opening to Outside



- Stale air is pulled from the basement by the fan and blown out through the duct which is run up the stairs.
- Fresh air enters through the elevator shaft.
- Fan is placed as far from the elevator shaft as possible.

TO VENTILATE THE ROOM WITHOUT THE DUCT IN IT

- USE A "DOORWAY" VENTILATOR WITH ONLY ONE FLAP SECTION.
- PLACE THE FLAP SECTION SO THAT THE FLAPS OPEN INTO THE ROOM TO BE VENTIALTED.
- FRESH AIR WILL BE PULLED FROM THE INCOMING AIR STREAM ALONG THE DUCT.
- NOTE: AN "A-FRAME" VENTILATOR WITH ONLY ONE FLAP SECTION COULD BE USED INSTEAD.

IF YOU HAVE FINISHED READING
PAGES 1 THROUGH 16 SKIP TO PAGE 23

DO NOT UNPACK ANY BOXES YET!

READ EVERY PAGE COMPLETELY AND THOROUGHLY. NOW! IT WILL TELL YOU HOW TO DETERMINE THE BEST LOCATIONS FOR THE VENTILATORS.

LOCATION INSTRUCTIONS FOR A-FRAME/DOORWAY 'KEARNY' VENTILATOR

IMPORTANT: READ AND FOLLOW INSTRUCTIONS STEP BY STEP. DO NOT UNPACK VENTILATORS UNTIL BEST LOCATION FOR ALL IS DETERMINED.

1. The A-Frame/Doorway "Kearny" Ventilator is used to:

   a. pull fresh air into the shelter, and

   b. sometimes distribute incoming fresh air to parts of the shelter.

2. There must be an opening from the outside (window, doorway, etc.) so that fresh air can enter the shelter.

3. You must set up your ventilation system to make fresh air paths go through as much of the shelter as possible. To learn how to do this, read every word of the following section. THIS IS VITAL!

4. Incoming, fresh air will be safe. After the ventilators are operating, if you are uncertain about radiation effects and shelter ventilation, use the appendices at the back of this booklet. Not now!

DETERMINING LOCATIONS

LOCATION PRINCIPLES

1. To pull fresh air into a shelter,

   Use a "Doorway" Ventilator with:

   two Flap Sections, if there are two or more shelter openings to the outside (preferred arrangement) or

   one Flap Section, if there is only one shelter opening to the outside.

   Place the "Doorway" Ventilator in the doorway.

   Attach the Flap Section(s) so that they face into the shelter

   Seal all but the two openings which will form the longest flow path.

2. If both Flap Sections are not used to pull fresh air in, one section can be used to distribute incoming fresh air to parts of the shelter.

   Use an "A-Frame" Ventilator with the one Flap Section.

   Place the "A-Frame":

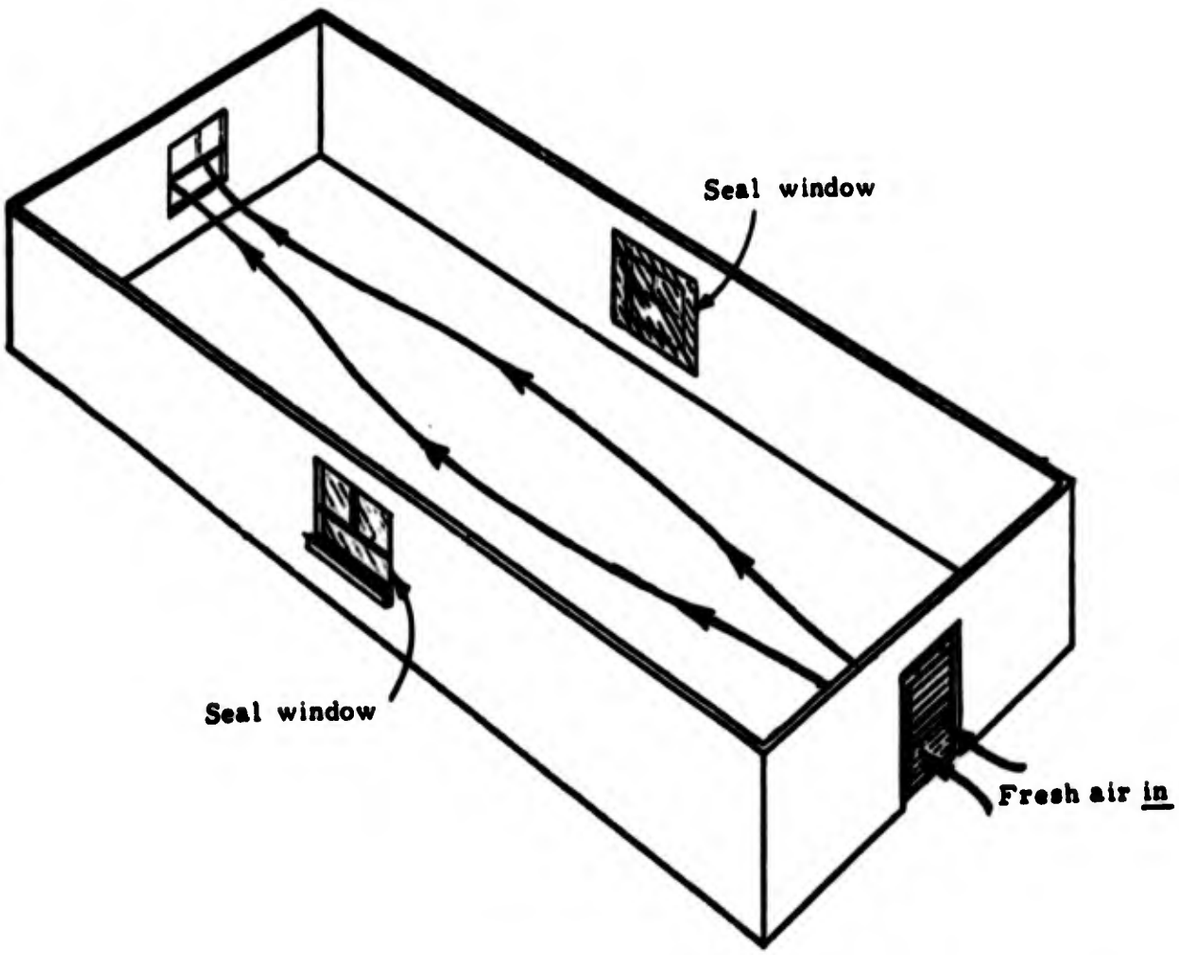
   in the doorway of a second room, if it is to get fresh air, or

   in the room to which the "Doorway" Ventilator is feeding air. Place the "A-Frame" halfway between the "Doorway" Ventilator and the farthest part of that room.

   Attach the Flap Section so that it faces into the room, or toward the part of the room, to receive fresh air.

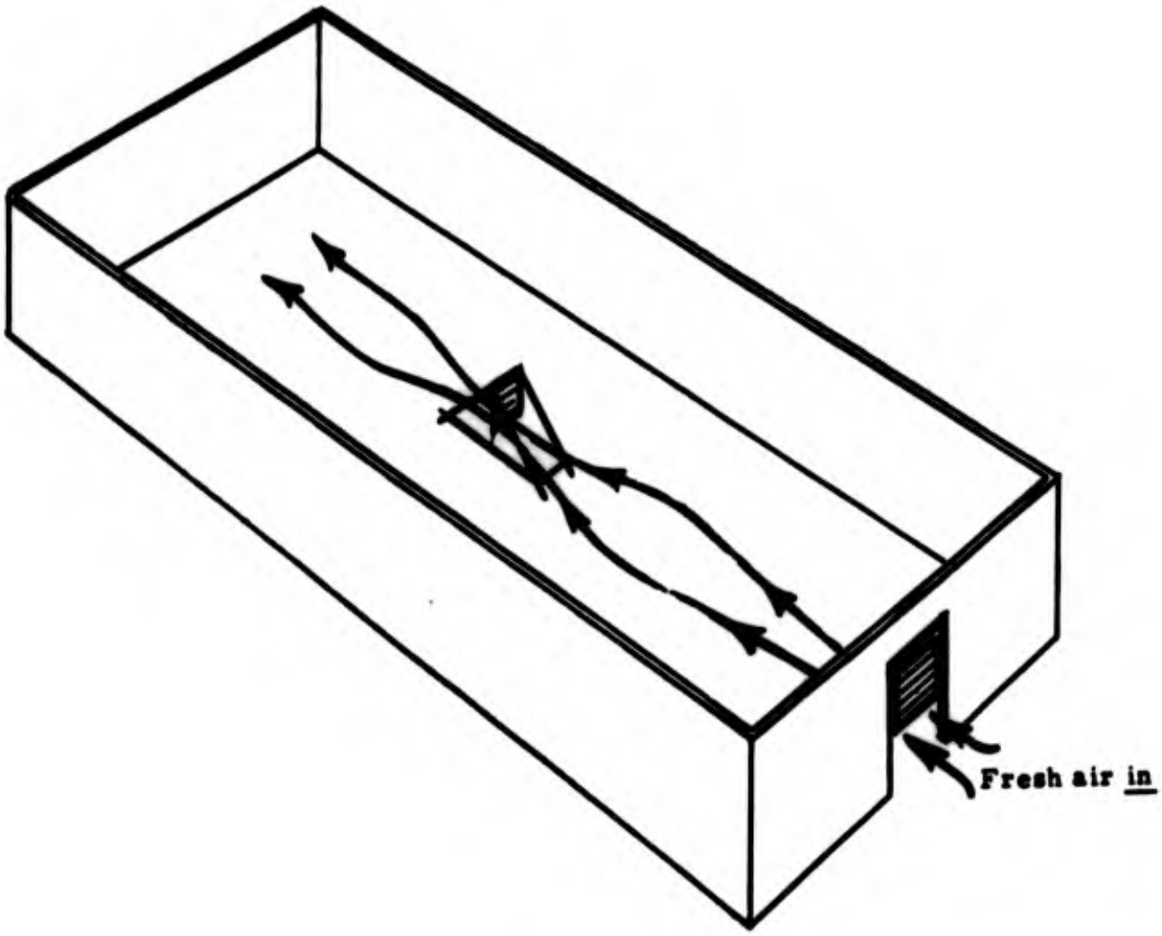
The following models of shelters differ in the arrangement of outside openings and rooms. This arrangement determines the placement of the "Kearny" Ventilator for the best air flow. Although the models may not be similar to the shelter you are in, each one illustrates important location principles and should be read carefully.

Figure 1. Multi-Opening Shelter



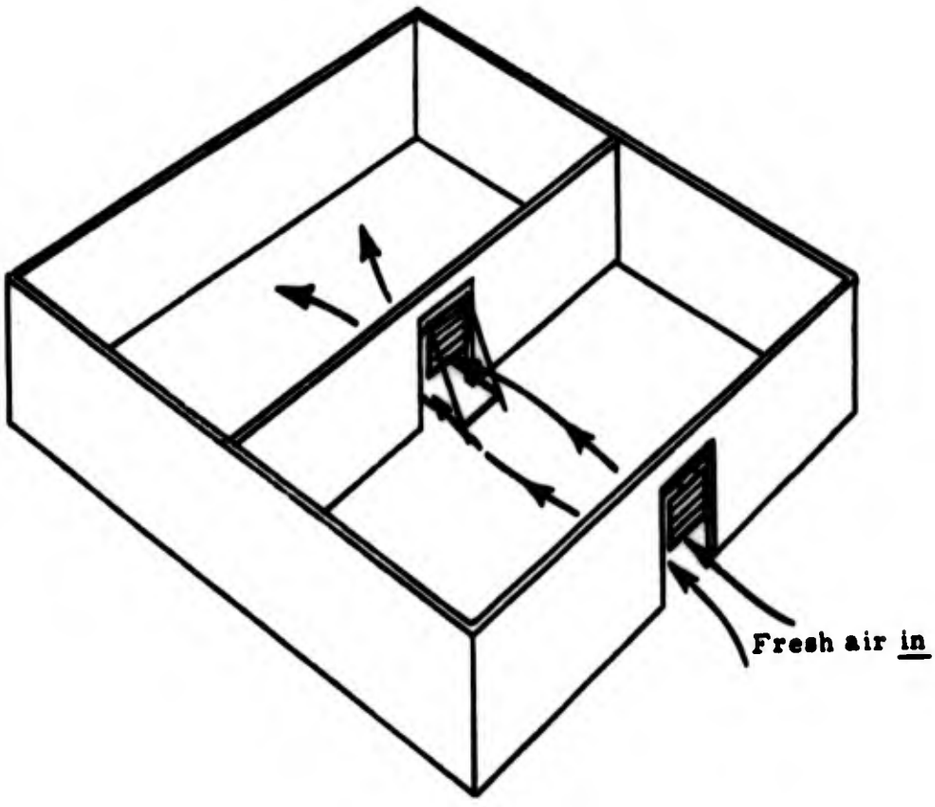
- A "Doorway" Ventilator with two Flap Sections is used to pull fresh air in through the doorway.
- The two side windows are sealed to create the longest possible flow path.
- The flaps open into the shelter.

Figure 2. One Opening Shelter



- A "Doorway" Ventilator with only one Flap Section is used to pull fresh air into the shelter.
- The flaps open into the shelter.
- An "A-Frame" Ventilator is used to distribute incoming fresh air to the far end of the shelter. The other Flap Section is attached so that the flaps open toward the far end.
- NOTE: If extra Flap Sections are available, use two Flap Sections on the "A-Frame".

Figure 3. Multi-Room Shelter



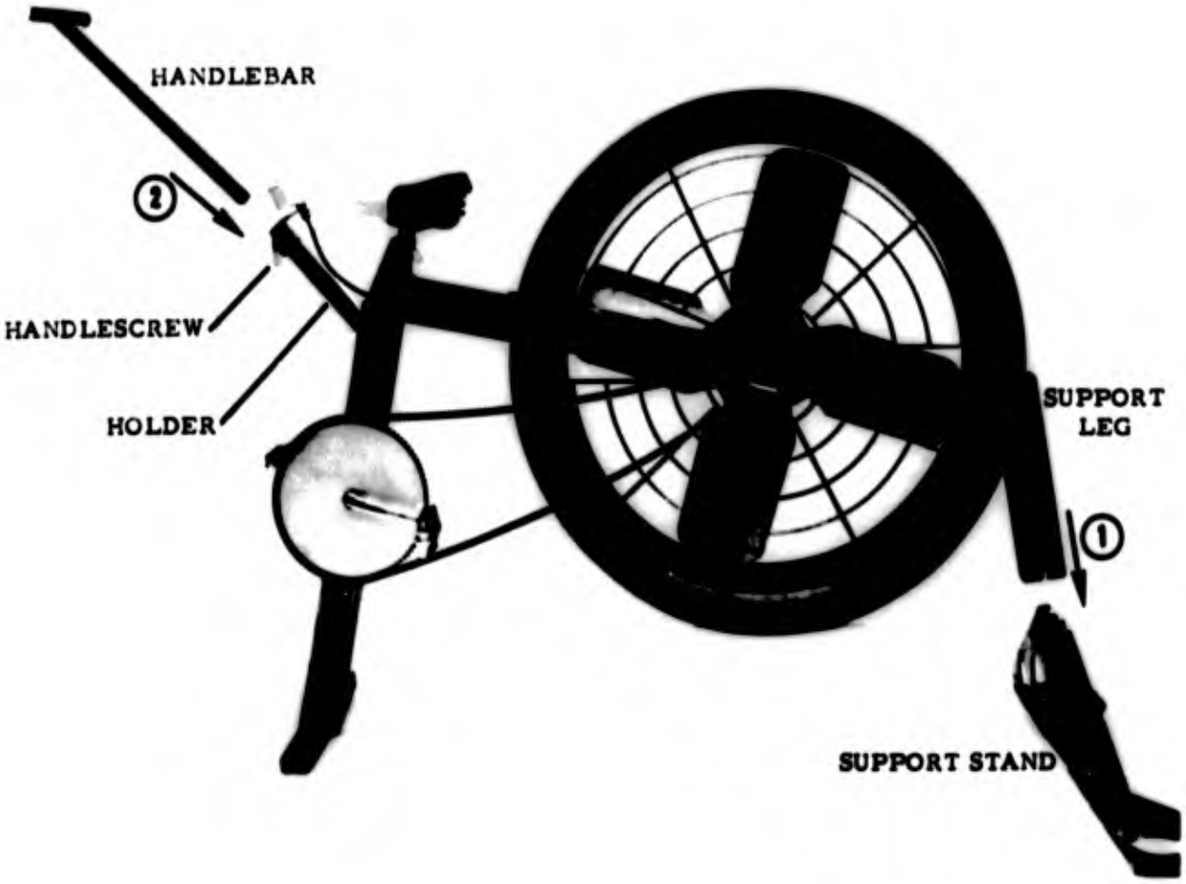
- A "Doorway" Ventilator with only one Flap Section is used to pull fresh air into the shelter.
- The flaps open into the shelter.
- An "A-Frame" Ventilator is used to distribute incoming fresh air to the far room. The other Flap Section is attached so that the flaps open into the far room.

IF A BICYCLE VENTILATOR IS NOT IN THE SHELTER,
SKIP TO PAGE 30
OTHERWISE CONTINUE

ASSEMBLY INSTRUCTIONS FOR BICYCLE VENTILATOR

FOLLOW CAREFULLY!

AFTER YOU HAVE PLACED ALL VENTILATOR BOXES IN THE PROPER LOCATIONS UNPACK THEM AND ASSEMBLE THEM USING THE FOLLOWING INSTRUCTIONS



Step 1 - Insert support leg into support stand.

Step 2 - Insert handlebar into holder and tighten handlescrew.

The BICYCLE VENTILATOR is now fully assembled.

NOW READ ALL DIRECTIONS BEFORE WORKING ON EXHAUST DUCT

DUCT LAYOUT PRINCIPLES

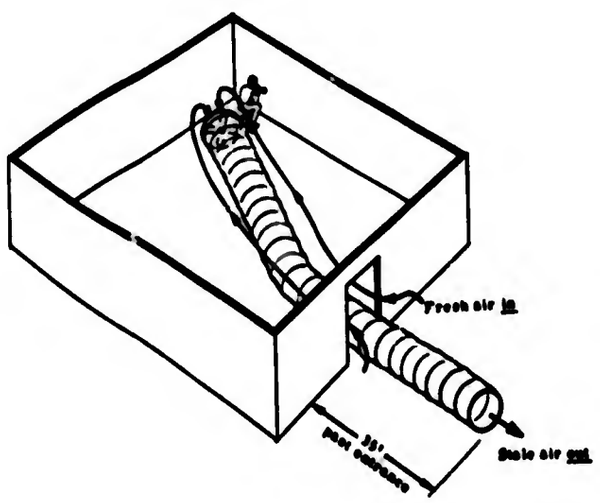
DO NOT WALK ON DUCT AT ANY TIME. IT WILL RIP!!

The duct must run from the Bicycle Ventilator to the outside of the entire shelter area (through a window, doorway, or other large opening) following the shortest and straightest path possible. Use the figures on page 27 as a guide.

One Opening Shelter - Figure 1

- The duct exits and fresh air enters the shelter through the same, distant opening.
- The duct must run at least 35 feet beyond the shelter opening to prevent stale air from blowing back into the shelter.
- The opening should not be sealed around the duct.

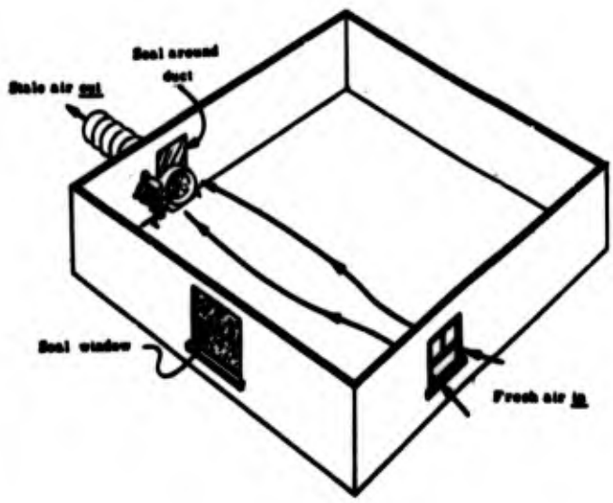
Figure 1. Shelter with Only One Opening



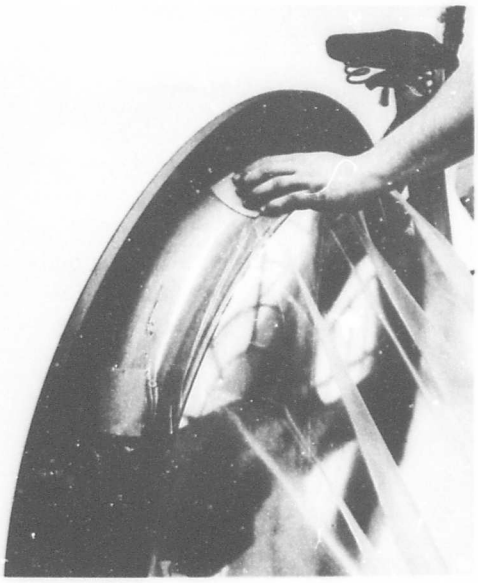
Multi-Opening Shelter - Figure 2

- The duct exits through one opening and fresh air enters through a separate, distant opening.
- The duct need extend only a foot or two beyond the shelter opening.
- Seal the opening around the duct, using excess duct material and duct tape, to prevent air from flowing back into the shelter around the duct.
- Also, seal any openings between the Bicycle Ventilator and the air entrance to create a long flow path.

Figure 2. Shelter with Openings at Opposite Ends



Connecting the Duct - The collapsible plastic duct material is 30 inches in diameter and may be cut to the desired length and connected, using the adhesive duct tape supplied.

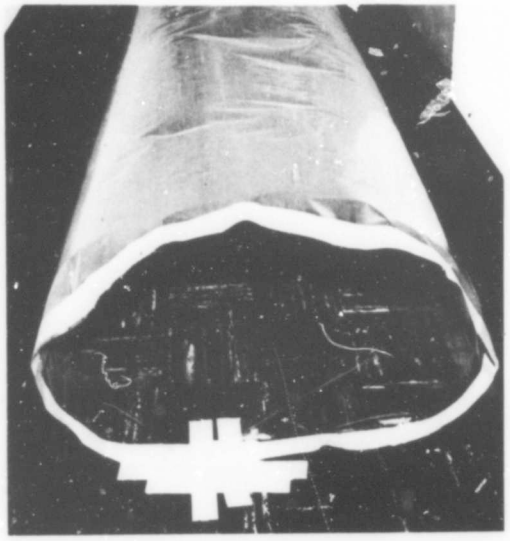


- Stretch the end of the duct around the fan ring

- Secure the duct end in place with several pieces of duct tape.

- Form a complete duct-ring attachment by unrolling and securing the duct tape around the entire fan ring.

Reinforcing the Duct end



- To prevent the free end of the duct from tearing, use duct tape to form a complete ring around the free end.

- Tape the bottom of the free end to the floor with several strips of duct tape.

Operating the Bicycle Ventilator

- Pedal the ventilator like an ordinary bicycle

- Watch the speedometer and pedal the ventilator so that the needle remains within the green area.

- The duct must be inspected for leaks and any leaks must be sealed with duct tape.

ASSEMBLY INSTRUCTIONS FOR A-FRAME/DOORWAY 'KEARNY' VENTILATOR

FOLLOW CAREFULLY!

AFTER YOU HAVE PLACED ALL VENTILATOR BOXES IN THE PROPER LOCATIONS UNPACK THEM AND ASSEMBLE THEM USING THE FOLLOWING INSTRUCTIONS

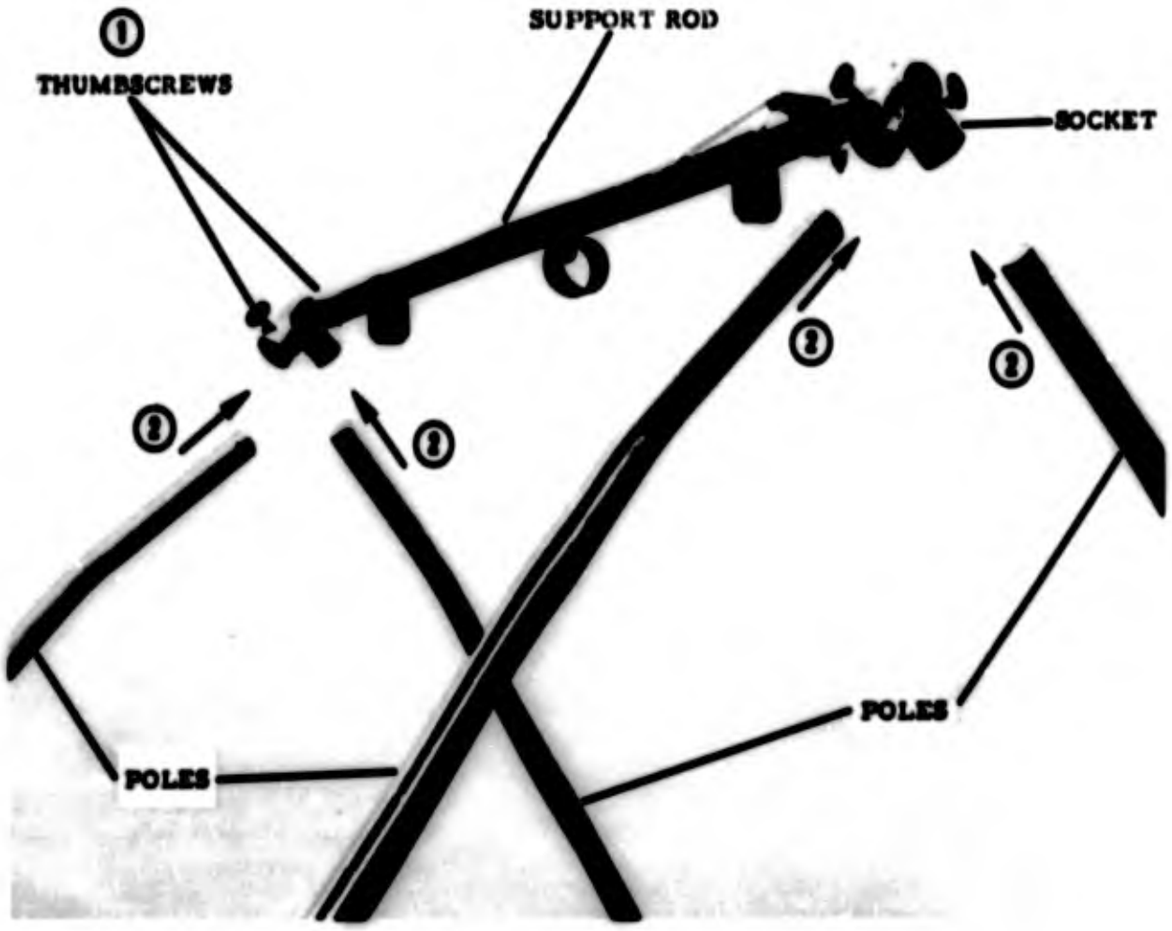
A-FRAME INSTRUCTIONS - SEE PAGE 39, FOR DOORWAY INSTRUCTIONS

ASSEMBLED A-FRAMES

The A-Frame Ventilator can be assembled with one Flap Section

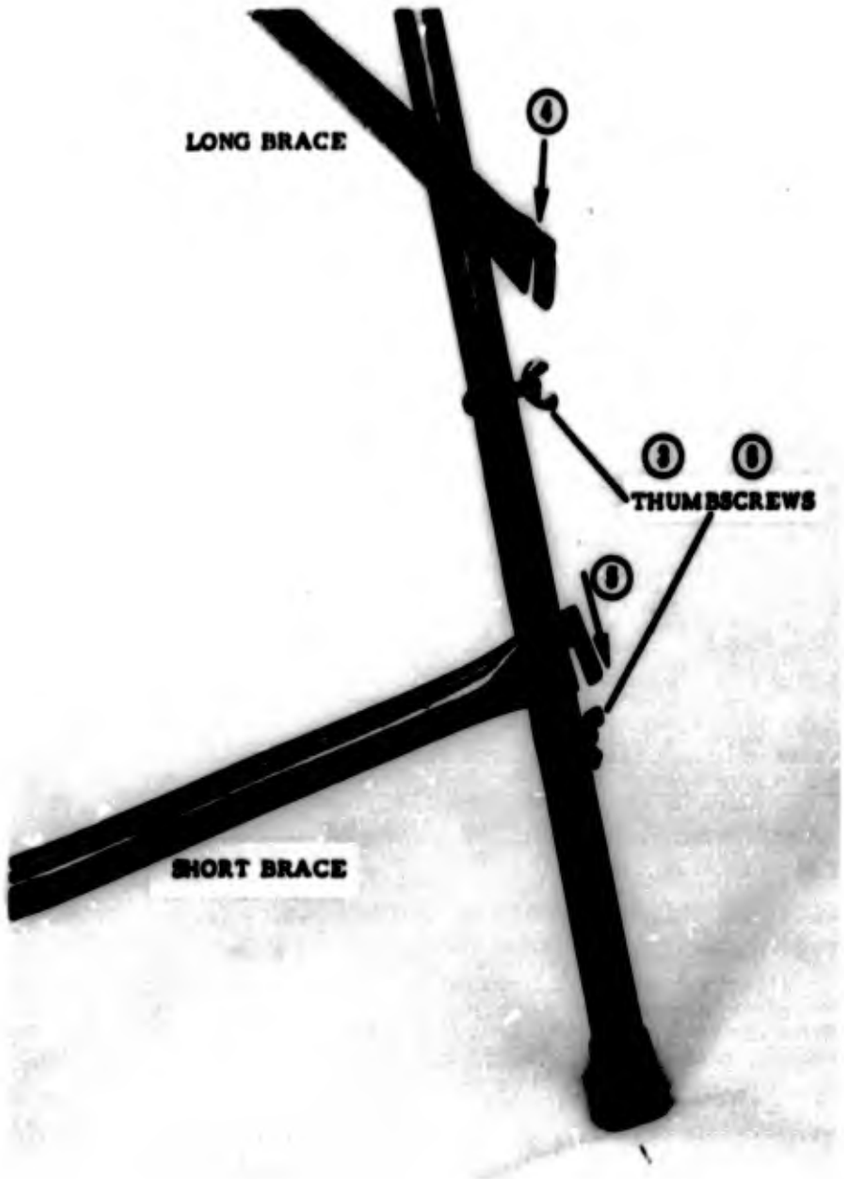
and,

if needed, the other section can be attached.



Step 1 - **Loosen but <u>DO NOT REMOVE</u> 4 thumbscrews on sockets (at ends of support rod).**

Step 2 - **Insert all 4 poles into sockets so that arches point upward. Turn thumbscrews LOOSELY, DO NOT TIGHTEN.**

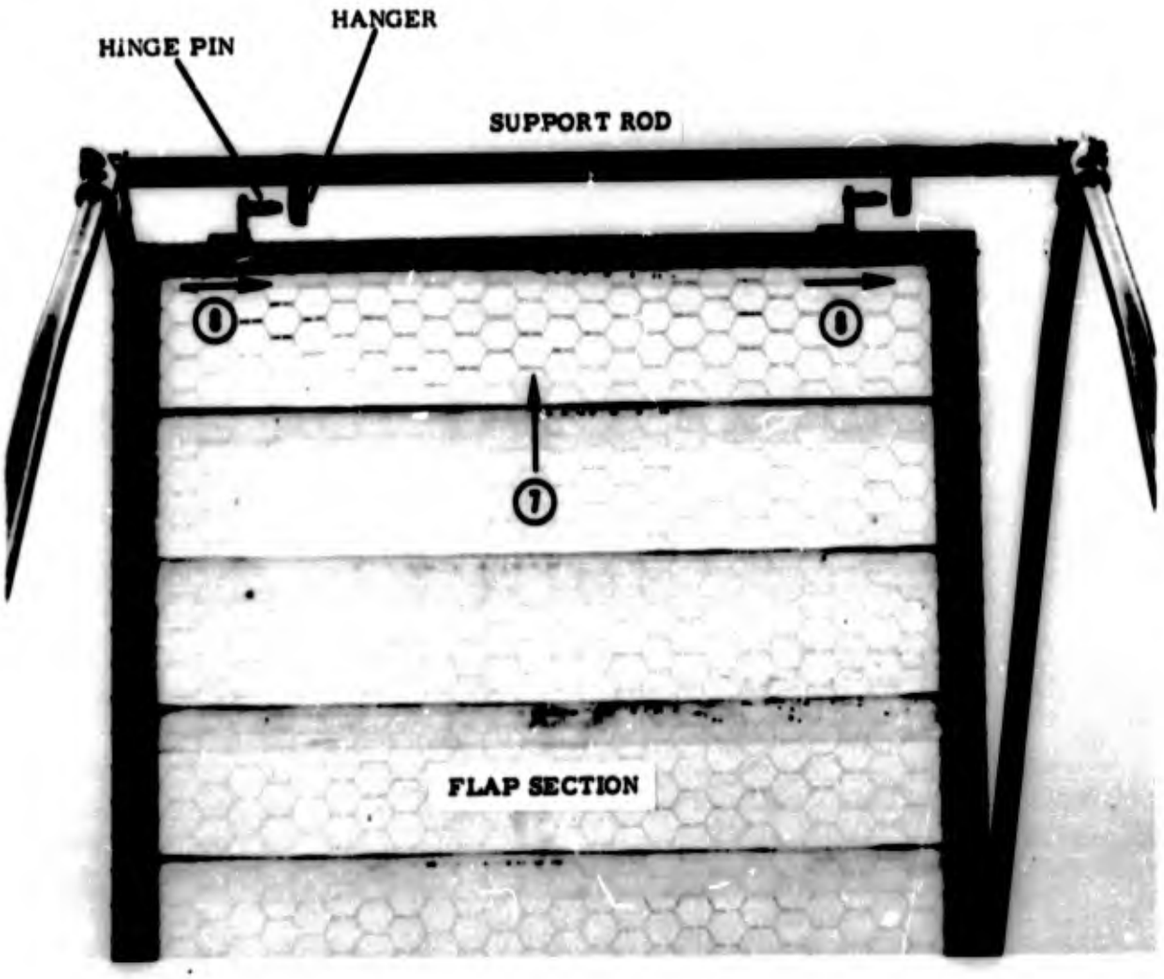


Step 3 - Loosen all 8 thumbscrews at bottom of all 4 poles.

Step 4 - Hook ends of long braces over thumbscrews, and turn thumbscrews LOOSELY, DO NOT TIGHTEN.

Step 5 - Hook ends of short braces over thumbscrews, and turn thumbscrews LOOSELY, DO NOT TIGHTEN.

Step 6 - NOW, TIGHTEN all 8 thumbscrews at bottom of 4 poles, and then TIGHTEN thumbscrews on support rod sockets.



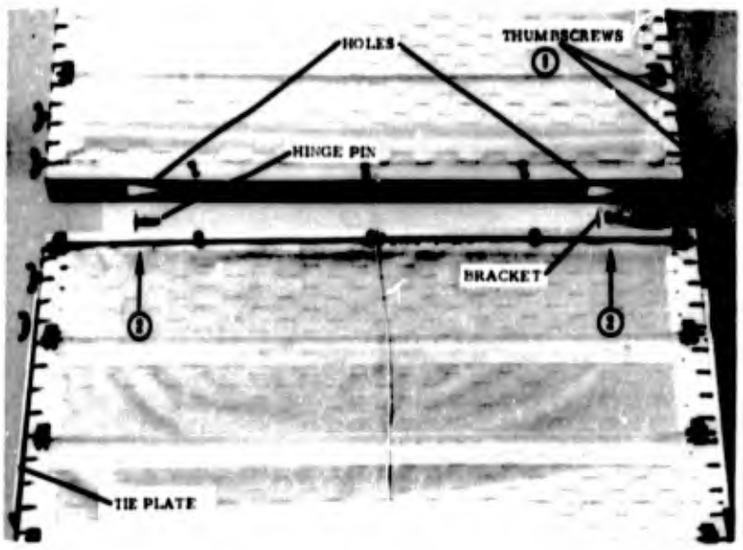
IF BOTH FLAP SECTIONS WILL BE USED ON THE A-FRAME, FIRST ATTACH THE SECTION WITHOUT THE SLOTTED METAL PLATES ON THE SIDES OF THE FLAP SECTION (AT THE TOP). OTHERWISE, USE ANY SECTION.

Step 7 - With plastic flaps on same side of support rod as minimum swing indicator, lift Flap Section so that hinge pins fit into holes in hangers.

Step 8 - Push Flap Section to the right until hinge pins snap through hangers.

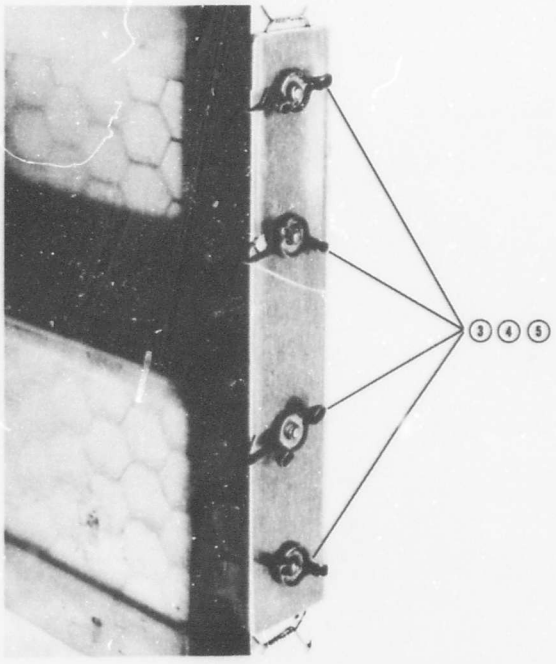
Step 9 - Attach pull cord through hole at bottom of Flap Section.

The A-Frame Ventilator with one Flap Section is now assembled. Continue reading if the second Flap Section will be attached. BE SURE TO READ THE OPERATING INSTRUCTIONS ON PAGE 38 IN ANY CASE!



Step 1 - Loosen 4 thumbscrews at bottom of attached Flap Section, and loosen 4 thumbscrews which hold two tie plates to other Flap Section.

Step 2 - Lift unattached Flap Section so that brackets and hinge pins fit through triangle-shaped holes in bottom of attached Flap Section.



Step 3 - Pull both tie plates away from Flap Section, and swing them upward so that slots in tie plates hook over thumbscrews.

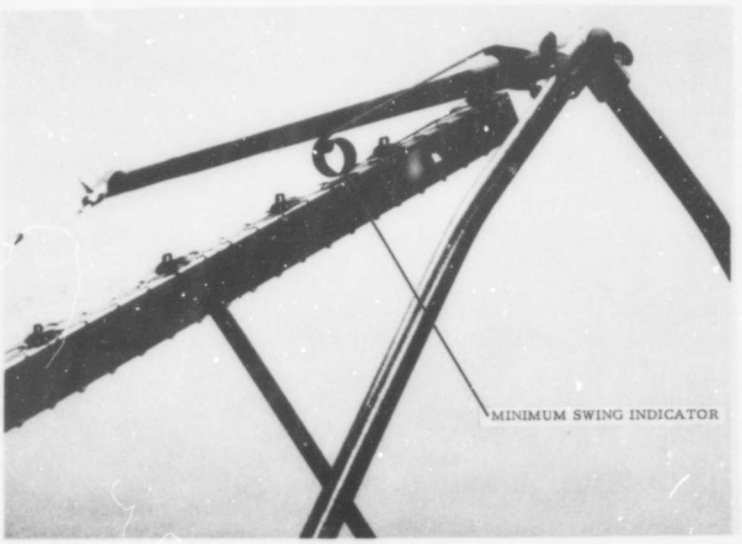
Step 4 - Turn all 8 thumbscrews LOOSELY and check for a rigid connection between both Flap Sections.

Step 5 - NOW, TIGHTEN all 8 thumbscrews.

The A-Frame Ventilator with both Flap Sections is now fully assembled.

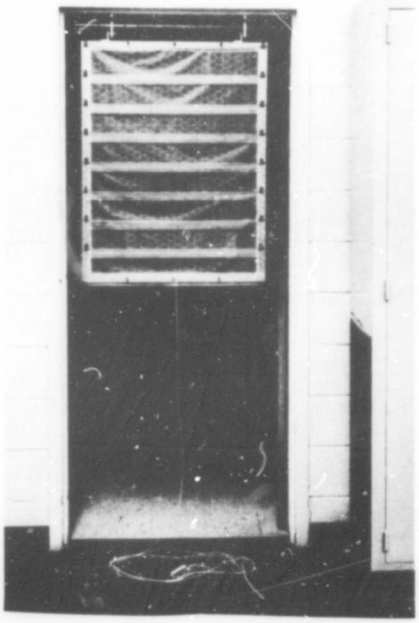
NOW READ THE OPERATING INSTRUCTIONS.

Operating the A-FRAME VENTILATOR



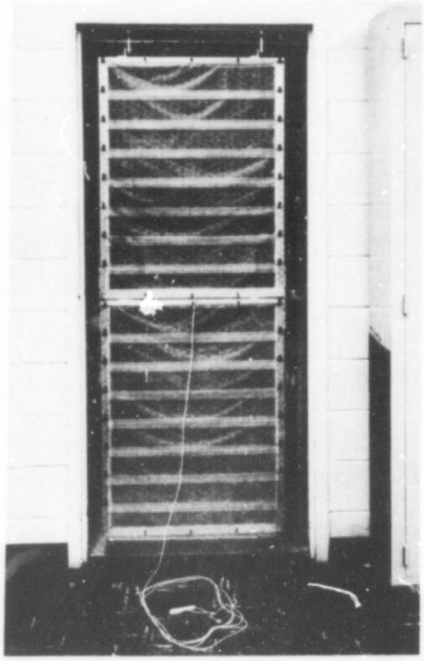
The A-Frame is operated by pulling the pull cord as the Flap Section swings toward the operator. EACH TIME IT IS PULLED, THE FLAP SECTION MUST TOUCH THE MINIMUM SWING INDICATOR. Keep a constant rhythm as the Flap Section(s) swings.

DOORWAY INSTRUCTIONS

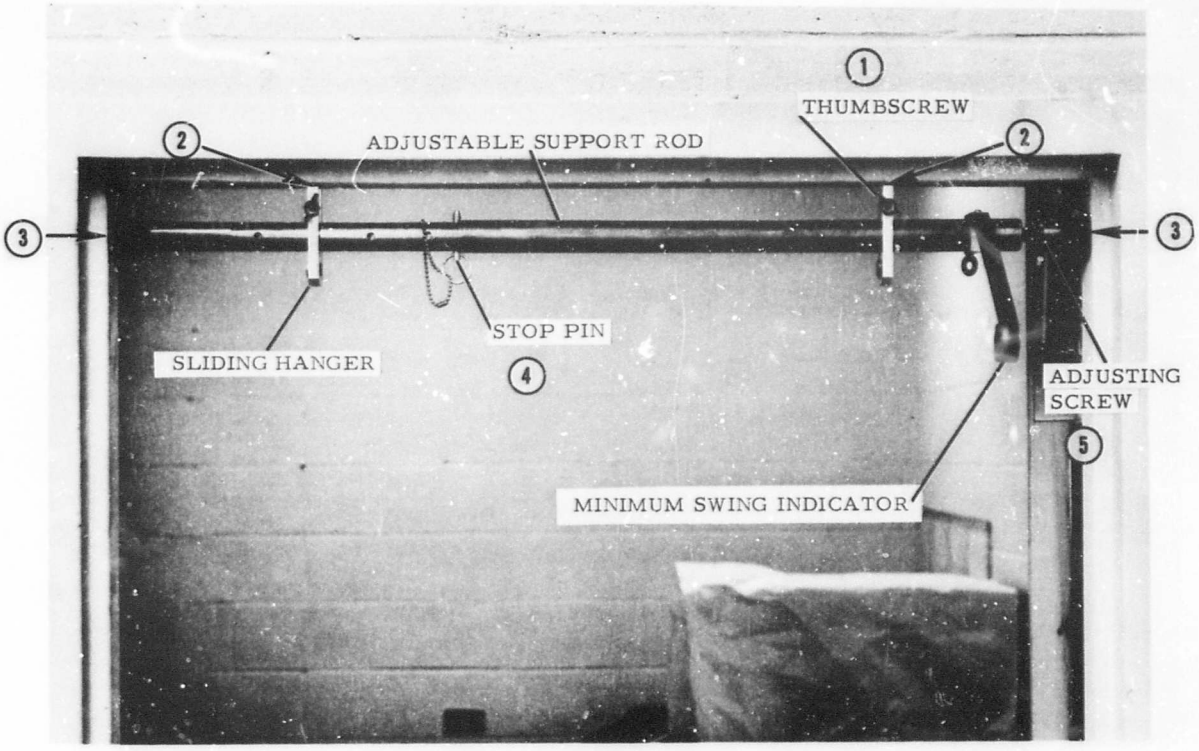


The Doorway Ventilator can be assembled with one Flap Section

ASSEMBLED DOORWAY VENTILATORS



and, if needed, the other section can be attached.



WHEN ASSEMBLING DOORWAY VENTILATOR, MINIMUM SWING INDICATOR AND ADJUSTING SCREW MUST BE AT RIGHT SIDE OF DOORWAY.

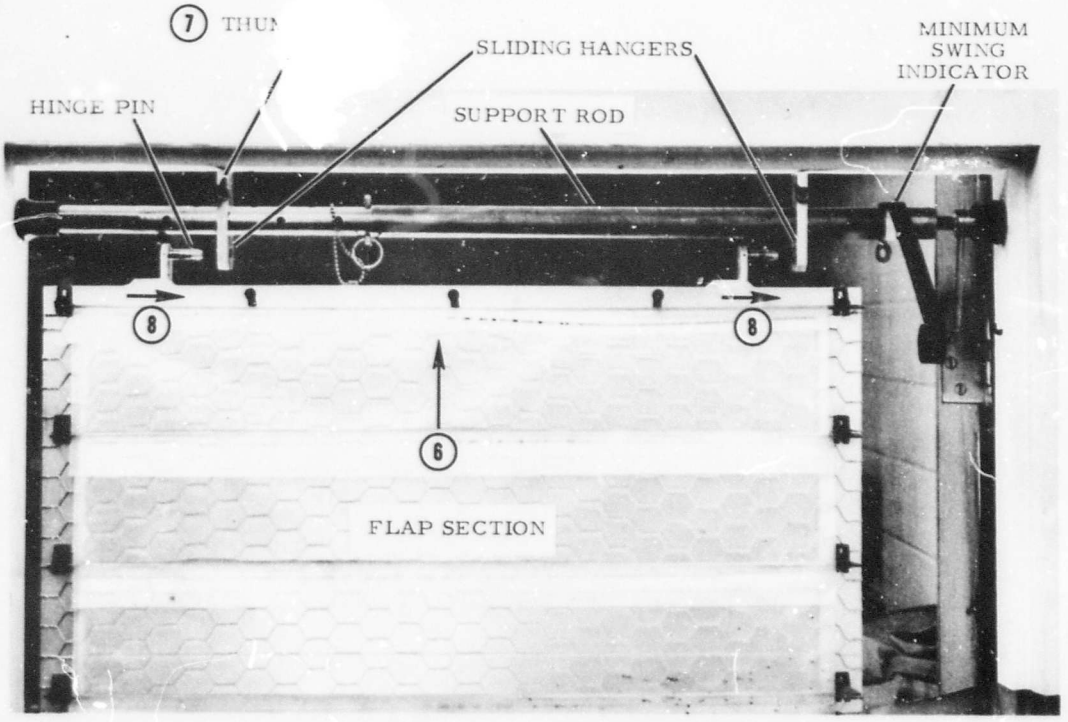
Step 1 - Loosen thumbscrews in sliding hangers so hangers can slide freely.

Step 2 - Lift adjustable support rod to top of doorway until sliding hangers tough top of doorway.

Step 3 - Pull adjustable support rod apart until both rubber ends are against door frame.

Step 4 - Insert stop pin in exposed hole nearest to larger tube.

Step 5 - Turn adjusting screw until support rod is firmly in position.



IF BOTH FLAP SECTIONS WILL BE USED ON THE DOORWAY VENTILATOR, FIRST ATTACH THE SECTION WITHOUT THE SLOTTED METAL PLATES ON THE SIDES OF THE FLAP SECTION (AT THE TOP). OTHERWISE, USE ANY SECTION.

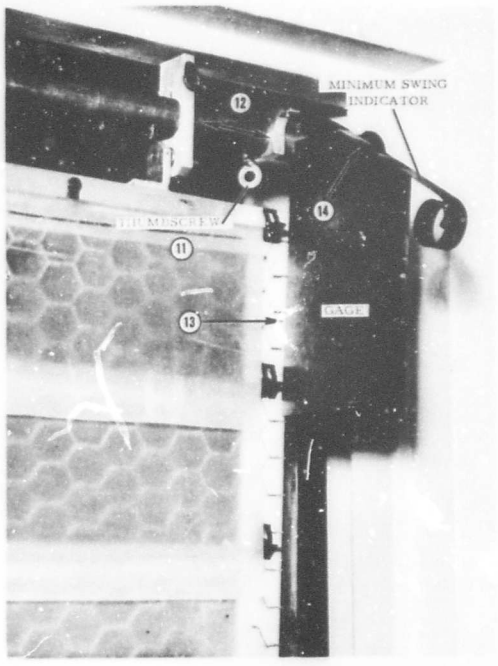
Step 6 - With plastic flaps on same side of adjustable support rod as minimum swing indicator, lift Flap Section to level of sliding hangers and slide hangers along support rod to positions which will allow the Flap Section to swing freely.

Step 7 - TIGHTEN thumbscrews.

Step 8 - Push Flap Section to the right until hinge pins snap through hangers.

Step 9 - Attach pull cord through hole at bottom of Flap Section.

Step 10 - Slowly swing Flap Section and check for clearance.



THE MINIMUM SWING INDICATOR MUST BE ADJUSTED AS FOLLOWS:

Step 11 - Loosen thumbscrew on minimum swing indicator until it is just able to slide along support rod.

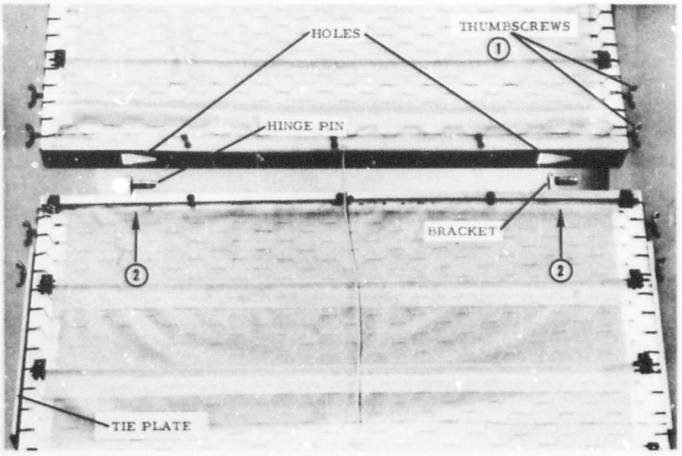
Step 12 - Slide indicator until it is in line with frame of Flap Section.

Step 13 - Place back of gage against front of Flap Section, and turn indicator until it touches slanting edge of gage. Now, TIGHTEN thumbscrew.

Step 14 - Slowly swing Flap Section and check for contact with indicator.

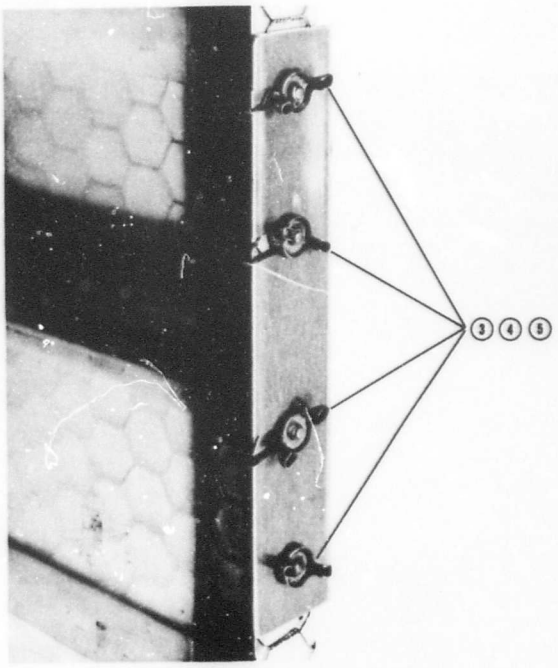
The Doorway Ventilator with one Flap Section is now assembled.

Continue reading if the second Flap Section will be attached. BE SURE TO READ THE OPERATING INSTRUCTIONS ON PAGE 45 IN ANY CASE!



Step 1 - Loosen 4 thumbscrews at bottom of attached Flap Section, and loosen 4 thumbscrews which hold two tie plates to other Flap Section.

Step 2 - Lift unattached Flap Section so that brackets and hinge pins fit through triangle-shaped holes in bottom of attached Flap Section.



Step 3 - Pull both tie plates away from Flap Section, and swing them upward so that slots in tie plates hook over thumbscrews.

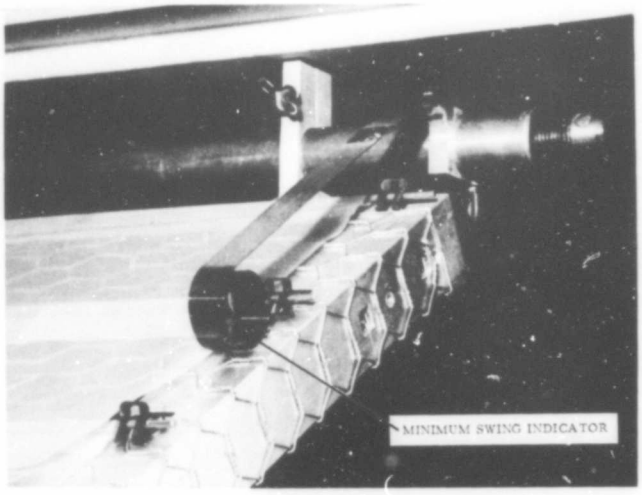
Step 4 - Turn all 8 thumbscrews LOOSELY and check for a rigid connection between both Flap Sections.

Step 5 - NOW, TIGHTEN all 8 thumbscrews.

The Doorway Ventilator with both Flap Sections is now fully assembled.

NOW READ THE OPERATING INSTRUCTIONS.

Operating the DOORWAY VENTILATOR



The Doorway Ventilator is operated by pulling the pull cord as the Flap Section swings toward the operator. EACH TIME IT IS PULLED, THE FLAP SECTION MUST TOUCH THE MINIMUM SWING INDICATOR. Keep a constant rhythm as the Flap Section(s) swings.

APPENDIX B

LIMITED COORDINATION

MILITARY SPECIFICATION

ONE-OPERATOR AND TWO-OPERATOR BICYCLE VENTILATOR KIT

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LIMITED COORDINATION

MILITARY SPECIFICATION

ONE-OPERATOR AND TWO-OPERATOR BICYCLE VENTILATOR KIT

This limited coordination military specification has been prepared by the Office of Civil Defense based upon currently available technical information, but it has not been approved for promulgation as a coordinated military specification. It is subject to modification. However, pending its promulgation as a coordinated military specification, it may be used in procurement.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers the fabrication, assembly, performance, and packaging of a pedal-operated portable ventilation fan and removable plastic ducting, for use in fallout shelters.

1.2 Classification. Pedal-operated ventilation kits shall be of two types:

Type 1 - One-operator bicycle ventilator kit (see Figure 1).
Type 2 - Two-operator bicycle ventilator kit (see Figure 2).

2. APPLICABLE SPECIFICATIONS, STANDARDS, DRAWINGS AND OTHER PUBLICATIONS

2.1 Specifications and Standards. The following specifications and standards of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

L-P-378	Plastic Film (Polyethylene, Thin Gage)
GGG-S-278	Shears and Scissors
PPP-B-636	Box, Fiberboard
PPP-B-001163	Box, Corrugated Fiberboard, High Compression Strength, Weather-resistant, Wax-resin Impregnated
PPP-T-45	Tape, Gummed, Paper, Reinforced
PPP-T-60	Tape, Pressure Sensitive, Adhesive, Waterproof, for Packaging
PPP-T-76	Tape, Pressure-sensitive Adhesive Paper, (for Carton Sealing)
TT-E-529	Enamel, Alkyd, Semi-gloss

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Military

MIL-A-101	Adhesive, Water-resistant, for Sealing Fiberboard Boxes
MIL-B-131	Barrier Material, Water Vaporproof, Flexible
MIL-L-8937	Lubricant, Solid Film, Heat Cured
MIL-P-116	Preservation, Methods of

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-171	Finishing of Metal and Wood Surfaces

Federal

FED.STD. No. 129	Marking for Shipment and Storage
FED.STD. No. 595	Colors

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Atlanta, Chicago, Kansas City, Mo.; Dallas, Denver, San Francisco, Los Angeles, Seattle and Washington, D. C. Copies of the military specifications and standards required by contractors in connection with specific procurement functions should be obtained form the procuring agency or as directed by the contracting officer.)

2.2 Drawings.

2.2.1 One-operator Bicycle Ventilator Kit, 30" Fan.

1477R-1000	One-operator Bicycle Ventilator, Assembly of
" R-1001	Frame
" E-1002	Shroud, Fan
" C-1003	Handle Bar, Assembly of
" B-1004	Stem, Saddle
" B-1005	Hanger, Crank
" B-1006	Lock Screw, Handle Bar
" E-1007	Frame, Sub-assembly
" B-1008	Sprocket, Fan Shaft
" B-1009	Shaft, Fan
" D-1010	Guard, Fan
" C-1011	Drive Sprocket
" A-1012	Wood Lattice

2.2.2 Two-operator Bicycle Ventilator Kit, 30" Fan.

1477R-5000	Two-operator Bicycle Ventilator, Assembly of
" R-5010	Frame, Assembly of
" C-5011	Support Legs
" C-5012	Horizontal Tie
" B-5013	Handle Adaptor
" B-5014	Hanger, Crank
" B-5015	Foot, Support
" B-5016	Vertical End Support
" A-5017	Locking Screw
" D-5020	Shroud, Fan
" C-5030	Handle Bar, Assembly of
" C-5050	Drive Sprocket
" B-5060	Sprocket, Fan Shaft
" B-5070	Shaft, Fan
" B-5080	Guard, Fan
" B-5090	Stem Saddle Support
" A-5095	Wood Lattice

2.3 Other Publications. The following publications, of the issue in effect on date of invitation for bids, form a part of this specification:

Air Moving and Conditioning Association, Inc.

Publication: AMCA Standard 210
Test Code for Air Moving Devices

(Copies of AMCA publications may be obtained from the Air Moving and Conditioning Association, Inc., 30 West University Drive, Arlington Heights, Illinois, 60004.)

3. REQUIREMENTS

3.1 Drawings. Unless otherwise specified herein, the materials and assembly thereof shall be as shown on the drawings (see 2.2); however, minor changes will be allowed. Any minor change or substitute of materials must not affect the rigidity of the unit and the performance requirements specified herein and must be approved by the contracting officer. Drawings are furnished for contractor guidance and informational purposes only, to illustrate details of the required equipment. While every precaution has been taken to assure their accuracy, the contractor is responsible for dimensional adequacy and accurate fits for proper equipment assembly, alignment, and operation.

3.1.1 Contents of a Complete One-operator Bicycle Ventilator Kit:

(a) One-operator bicycle ventilator, complete
(b) One roll 30-inch diameter ducting 50 ft. long
(c) One roll duct tape 2" wide 30 yds. long
(d) One pair 4-inch scissors
(e) Tube, 1-1/2 ounces, lubricating oil
(f) Instruction booklets (3 copies)

3.1.2 Contents of a Complete Two-operator Bicycle Ventilator Kit:

(a) Two-operator bicycle ventilator, complete
(b) One roll of 30-inch diameter ducting, 50 ft. long
(c) One roll of duct tape 2 inches wide 30 yds. long
(d) One pair 4-inch scissors
(e) Tube, 1-1/2 ounces, lubricating oil
(f) Instruction booklets (3 copies)

3.1.3 Metal Fabrication. Metal used in the fabrication of the equipment shall be free from kinks. The straightening of material shall be done by methods that will not cause injury to the metal. Shearing and chipping shall be done neatly and accurately. Corners shall be square and true.

3.1.4 Machine Work. Tolerance and gages for metal fits shall conform to the limitations specified herein and otherwise to the standards of best commercial practice. Finished contact and bearing surfaces shall be true and exact. Adequate gages shall be utilized to assure proper joint fit, interchangeability, alignment, chain tension, and fan concentricity with respect to the shroud.

3.1.5 Bolted Connections. Bolt holes shall be accurately punched or drilled and shall have the burrs removed. All bolts, screws and nuts shall be tight.

3.1.6 Welding. The surfaces of parts to be welded shall be free from rust, scale, paint, grease and other foreign matter. Welds shall develop adequate strength in the parts connected.

3.1.7 Heat Treatment. As specified on drawings.

3.1.8 Painting and Finishing. Major units and subassemblies shall be painted or finished as specified herein or on drawings.

3.2 Fan. The fan diameter shall be 30.00$\pm$ 0.05 inches, the leading and trailing edges shall be in line within 0.11 inches and shall be statically balanced within 0.16 ounce-inches. The fan rotation shall be clockwise (facing air discharge), and the leading edge shall be from 1/8 to 1/4 inch from the air discharge side of the shroud such that the fan does not project beyond the shroud.

3.3 Transmission. The ratio of fan shaft speed to pedal speed shall be 8.73/1.0 for the one-operator unit and 10.71/1.0 for the two-operator unit. The chain shall be American Standards Association No. 35. All chains shall be endless riveted.

3.4 Saddle. The seat shall have full three point spring suspension, and shall be a minimum of 9 inches long and 9-3/4 inches wide. The top shall be vinyl covered, rubber padded. The seat clamp shall be 7/8 inch dia. and the nut shall be hexagon, 9/16 across the flats. The saddle shall be finished by the standard methods of the manufacturer.

3.5 Accessories.

3.5.1 Instructions. Each ventilation kit (both one and two-operator) shall include three copies (3) of assembly and operating instructions. This publication will be furnished by the Office of Civil Defense at the time of the contract award.

3.5.2 Duct, Polyethylene. One roll polyethylene tubing, 50 feet long and of 4 mil thickness with a flat dimension of 48 inches conforming to Type II, Grade C Finish 1 of Specification L-P-378 shall be supplied with each ventilator unit.

3.5.3 Tape. One roll of pressure-sensitive tape, 2 inches wide by 30 yards in length shall be furnished with each unit. The tape shall conform to Specification PPP-T-60, Type III, Class 1.

3.5.4 Lubricant. One and one-half (1-1/2) ounces of SAE20 lube oil in a clear plastic container shall be furnished with each unit. The container shall be approximately 1 inch by 4-5/8 inches, and shall have a blind dispenser tip head.

3.5.5 Scissors. Contractor will furnish one 4-inch, blunt point scissors with each unit. Scissors shall be in accordance with Federal Specification GGG-S-278, Type II, Class 3, Style A and/or Style B, Size 4.

3.6 Lubrication at Assembly. The crank bearings shall be permanently lubricated with a lubricant formulated with a non-soap, organic-type thickener (di-amide-carbonyl) such as American Oil Company "RYKON" Grease No. 2. The grease shall be suitable for long shelf life stability without further lubrication during use.

3.7 Finish and Color. All parts shall be free from burrs, roughness, and rust. The subassembles and assemblies, except the sprockets, fan shaft and fan guard, shall be finished as follows unless otherwise noted herein or on the drawings:

Cleaning - Finish 4.2 of MIL-STD-171.
Surface Treatment - Finish 5.3.1.3 of MIL-STD-171.
Prime - Finish 5.2 of MIL-STD-171.
Finish - One coat, semi-gloss white untinted, Number 27875 of FED-STD-595, Enamel, Alkyd certified to equal or exceed the performance requirements of Federal Specification TT-E-529.

The sprockets and fan shaft shall be finished as follows:

Cleaning - Finish 4.1 of MIL-STD-171.
Surface Treatment - Finish 5.3.1.3 of MIL-STD-171.
Finish - Solid film lubricant qualified under MIL-L-8937.

The fan guard shall be finished as follows:

Zinc plate as per 1.9.1.2 of MIL-STD-171.

3.8 Marking. The bicycle ventilator assembly shall have a metal plate affixed that is stamped as shown in Figure 3 for the one-operator unit and Figure 4 for the two-operator unit.

3.9 Workmanship. All materials used in the unit shall be of good commercial quality, entirely suitable for the purpose intended. The units, including all accessories, shall be constructed and finished in a thoroughly workmanlike manner. Particular attention shall be given to neatness and thoroughness of machining, fitting of parts, welding, riveting and marking of assemblies. Visual defects will be cause for rejection.

3.10 Preproduction Sample. When specified in the contract or order (see 6.2) before production is commenced, a sample machine shall be submitted or made available to the contracting officer or his authorized representative for approval in accordance with 4.2. The approval of the preproduction sample authorizes the commencement of production, but does not relieve the supplier of responsibility for compliance with all applicable provisions of this specification. The preproduction sample shall be manufactured in the same facilities to be used for the manufacture of the production items.

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection Responsibility. The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Preproduction Sample Inspection. When a preproduction sample is required (see 3.10), it shall be examined in accordance with applicable paragraphs of Section 3 and Section 4 (with laboratory tests at the contractor's expense). Tests shall be required for the fan and transmission used in the preproduction model, if these components are different than the prototype components suggested for use in 4.7 or on drawings 1477-1000 and 1477-5000.

4.3 Production Inspection.

4.3.1 Performance. The inspector shall ascertain that the units meet the performance requirements specified herein.

4.3.2 Workmanship. The units shall be inspected for rigidity, chain tension, alignment, interference of components, finish, color (see 3.7) and marking (see 3.8).

4.3.3 Packing and Marking. The inspector shall ascertain that the packing and marking of the containers conform to this specification.

4.4 Tests. If there is any change or substitution in the fan-shroud assembly, or transmission, other than the prototype components suggested for use in 4.7 or on Drawings 1477-1000 and 1477-5000, then performance tests for these items shall be required.

4.4.1 Fan Assembly Performance. The fan-shroud assembly shall be tested per AMCA-STD-210 at 480 RPM for the one-operator unit(Figure 5), and 590 RPM for the two-operator unit (Figure 6).

4.4.2 Packaging. Cleanliness, leakage, and heat seal tests are required per Specification MIL-P-116, Table 3.

4.5 Quality Conformance Inspection.

4.5.1 Lot. A lot shall consist of one day's production or all units offered for acceptance at one time.

4.5.2 Sampling.

4.5.2.1 Sampling for Examination. Sampling for examination shall be in accordance with MIL-STD-105. For major defects the AQL shall be 2.5 percent defective units, at inspection Level II. For minor defects, the AQL shall be 6.5 percent at inspection Level I (or S_2 for standards parts). Each minor characteristic shall be considered separately for acceptance of the lot.

4.5.2.2 Sampling for Tests. Sampling for tests shall be in accordance with standard MIL-STD-105 at inspection Level II. The AQL shall be 1.0 percent defective.

4.5.3 Examination. Each unit selected in accordance with 4.5.2.1 shall be examined for defects listed in Table I. Any sample having one or more defects shall be considered a defective unit.

Table I

CLASSIFICATION OF DEFECTS

Category	Defect
Major	
101	Packaging not acceptable; equipment could be damaged or small parts lost.

102	Package marking not as specified.
103	Welds not acceptable.
104	Chain too tight; will not fit sprockets.
105	Components or hardware - including technical publication - missing.
106	Handle bars will not fit into socket.
107	Incorrect number of teeth in the sprockets.

Minor

201	Material not as specified.
202	Dimensions not as specified.
203	Metal fabrication not suitable.
204	Workmanship not acceptable.
205	Finish not as specified or acceptable.
206	Drive chain too loose.

4.5.4 Function Tests. Samples selected in accordance with 4.5.2.2 shall be tested as specified herein. Any sample failing to pass any test shall be considered a defective unit.

4.5.4.1 Assemble the bicycle unit and operate at the normal pedalling rate of 55 RPM. Check for the following defects:

(a) Chain too loose
(b) Sprockets out of line
(c) Fan hitting the shroud
(d) Fan hitting the fan guard
(e) Loose parts
(f) Bearings too loose
(g) Bearings too tight.

4.6 Inspection of Preparation for Delivery. The contents, preservation, packing, and marking shall be inspected to determine compliance with the requirements of Section 5 of this specification.

4.7 Fan. The fan shall be equal to and interchangeable with the Torrington Manufacturing Company, Fan Number R-3020-4. Any substitution shall meet or exceed performance requirements stated in 3.2.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging of the bicycle ventilator and accessories (see 3.1.1 and 3.1.2).

5.1.1 The following preservation procedures in conformance with MIL-P-116 shall be effected.

5.1.1.1 Duct. The polyethylene tubing shall be wound on a substantial core with an approximate outside diameter of 3 inches and approximately 48-1/4 inches in length. The ducting shall be suitably restrained from unwinding with masking tape.

5.1.1.1.1 Duct, Packaging. The roll of ducting shall be packed in a Style FPF, Type CF, Domestic Class, 125 pound bursting strength, fiberboard box fabricated and closed in conformance with Specification PPP-B-636. Approximate inside dimensions shall be 48-1/2 inches long by 4-3/8 inches wide by 4-3/8 inches deep. The box shall be closed with gummed paper tape 2 inches wide conforming to Specification PPP-T-76 or PPP-T-45. The contents of the box will be stenciled (3/4" letters) on one panel of the box (see 5.2.1).

5.1.1.2 Tape. The roll of tape (see 3.5.3) shall be packaged in conformance with method 1A-8 of MIL-P-116.

5.1.1.4 Oil. The lubricating oil contained in the plastic tube (see 3.5.4) shall be packaged in conformance with method 1C-3 of MIL-P-116.

5.1.1.5 Packing of Small Accessories. The small accessories, duct tape, scissors, and lubricating oil shall be packed in a Style RSC, Type CF, Domestic Class, 125 pound bursting strength, fiberboard box fabricated to commercial standards. This box shall be closed with gummed paper tape. The approximate inside dimensions shall be 6-1/2 inches long, 6-1/2 inches wide and 3-1/2 inches deep. The packing order shall be as follows: The roll of duct tape shall be placed in the box and covered with a fiberboard divider 6-3/8 inches by 6-3/8 inches of the same material as the box. On the divider the packets containing the scissors and lubrcating oil shall be placed and the box closed with tape (see 5.1.1.1.1). The contents of the box shall be stenciled (1/2"letters) on one panel of the box (see 5.2.1).

5.1.1.6 Instruction Booklet. The (3) copies of the instruction booklet (see 3.5.1) shall be packaged in conformance with method 1C-3 of MIL-P-116. The message and its placement on the waterproof bag is shown in Figure 7.

5.1.2 Interior Box Containing the One-operator Ventilator Kit. The one-operator ventilator kit shall be packed in a Style FOL, Type CF, Domestic Class, 200 pound bursting strength, fiberboard box fabricated and closed in conformance with Specification PPP-B-636. The approximate inside dimensions shall be 59-1/4 inches long, 17-1/4 inches wide, 37-1/4 inches deep. The top flaps of the box shall be closed with reinforced gummed paper tape 3 inches wide conforming to Specification PPP-T-45. The bottom flaps are to be closed with metal staples. The inside bottom of the box shall have a wooden lattice of 1/4 inch thick lumber inserted on which the bicycle ventilator will stand. Additional cushioning, padding and inner packing forms shall be included at the suggestion of the box manufacturer. The wood lattice and inner packing forms shall be fabricated to reflect the best commercial practice to prevent damage to the packaged item.

5.1.2.1 Interior Box Containing the Two-operator Ventilator Kit. The two-operator ventilator kit shall be packed in a Style FOL, Type CF, Domestic Class, 200 pound bursting strength, fiberboard box fabricated and closed in conformance with Specification PPP-B-636. The approximate inside dimensions shall be 81-3/4 inches long, 17-1/4 inches wide, 38-3/4 inches deep. The top flaps shall be closed with reinforced gummed paper tape 3 inches wide conforming to Specification PPP-T-45. The bottom flaps shall be closed with metal staples. The bottom of the box shall have a wood lattice of 1/4 inch lumber inserted on which the bicycle ventilator shall stand. Additional cushioning, padding and inner packing forms shall be included at the suggestion of the box manufacturer. The wood lattice and inner packing forms shall be fabricated to reflect the best commercial practice to prevent damage to the packaged item.

5.1.2.2 Interior Box Packing for the One-operator and the Two-operator Ventilator Kits. The box containing the plastic duct (see 5.1.1.1.1) shall be securely taped with glass fiber reinforced plastic tape to the wood lattice. The wood lattice shall be placed into the interior box (see 5.1.2 and 5.1.2.1). The box containing the small accessories (see 5.1.1.5) shall be taped with reinforced plastic tape to the frame of the bicycle. The packet containing the instruction booklets (see 5.1.1.6) shall be taped securely to the bicycle saddle with 1 inch wide masking tape. The bicycle ventilator shall be inserted into the box and any inner forms, blocking or padding shall be installed around the unit. The box shall be closed as per 5.1.2.1.

5.1.2.3 Barrier Bag. The packed interior boxes of either the one or two-operator ventilator units shall be enclosed in a close fitting heat sealed bag fabricated from barrier material conforming to Specification MIL-B-131.

5.1.2.4 Exterior Container for the One-operator Ventilator Kit. The bagged interior box shall be packed in a Style FOL, Type CF, Domestic Class, 275 pound bursting strength, fiberboard box, wax-resin impregnated in conformance with Federal Specification PPP-B-001163. The approximate inside dimensions shall be 59-3/4 inches long, 17-3/4 inches wide and 37-3/4 inches deep. Exterior box markings and messages as they are to appear on the box are shown in Figure 8.

5.1.2.5 Exterior Container for the Two-operator Ventilator Kit. The bagged interior box shall be packed in a Style FOL, Type CF, Domestic Class, 275 pound bursting strength, fiberboard box, wax-resin impregnated in conformance with Federal Specification PPP-B-001163. The approximate inside dimensions shall be 82-1/4 inches long, 17-3/4 inches wide, and 39-1/4 inches deep. Exterior box markings and messages as they are to appear on the box are shown in Figure 9.

5.1.2.6 Closure. The flaps of the box specified in 5.1.2.4 and 5.1.2.5 shall be securely sealed with water resistant adhesive conforming to MIL-A-101. In addition the seam shall be sealed by the application of 3 inch minimum width pressure-sensitive tape in conformance with Specification PPP-T-76. The strip of tape shall overlap the side panel a minimum of 6 inches on each panel.

5.2 Marking of Containers.

5.2.1 Marking of Intermediate Boxes. The intermediate boxes containing the plastic duct (see 5.1.1.1.1) and small accessories (see 5.1.1.5) shall be marked on one panel with a listing of the contents.

5.2.2 Marking of Exterior Box Containing the One-operator Ventilator Kit. The marking shall be as per Figure 8. The lettering shall be in yellow and in Gothic style.

5.2.3 Marking of Exterior Box Containing the Two-operator Ventilator Kit. The marking shall be as per Figure 9. The lettering shall be in yellow and in Gothic style.

6. NOTES

6.1 Intended Use. Bicycle ventilator kits are intended for use in identified fallout shelters to provide the ncessary ventilation air to maintain thermal and atmospheric control of the shelter's environment during a national emergency. The units can be pedal operated by the shelterees.

6.2 Ordering Data. Procurement documents should specify the following:

(a) Title, number and date of this Specification.
(b) Number of assemblies required.
(c) Contact point for Instruction Manuals. (See 3.5.1)
(d) Listing of serial numbers. (See 3.8)
(e) When preproduction sample is required. (See 3.10)

Notice. When Government drawings, specifications, or other data are used for any purpose other than in accordance with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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Office of Civil Defense

Preparing Activity:

Office of Civil Defense

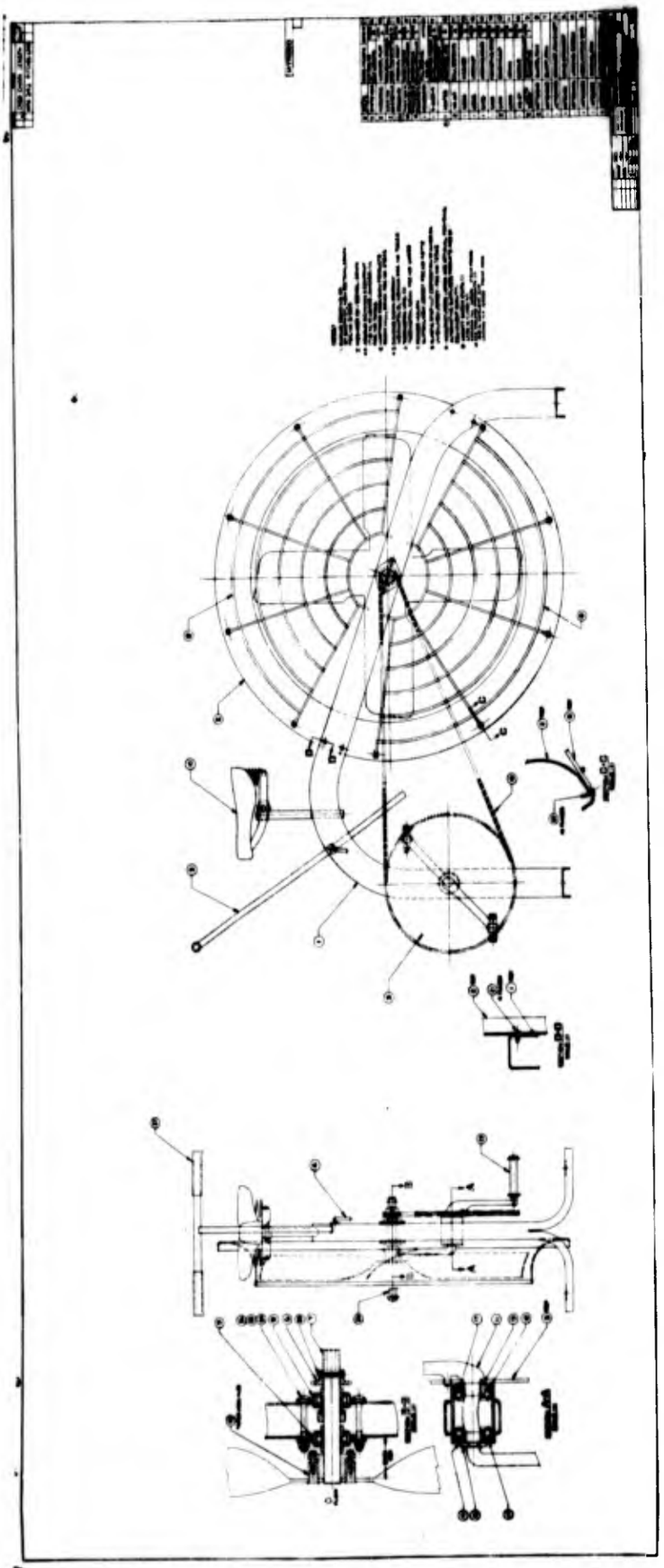

Figure 1 ONE-OPERATOR BICYCLE VENTILATOR KIT

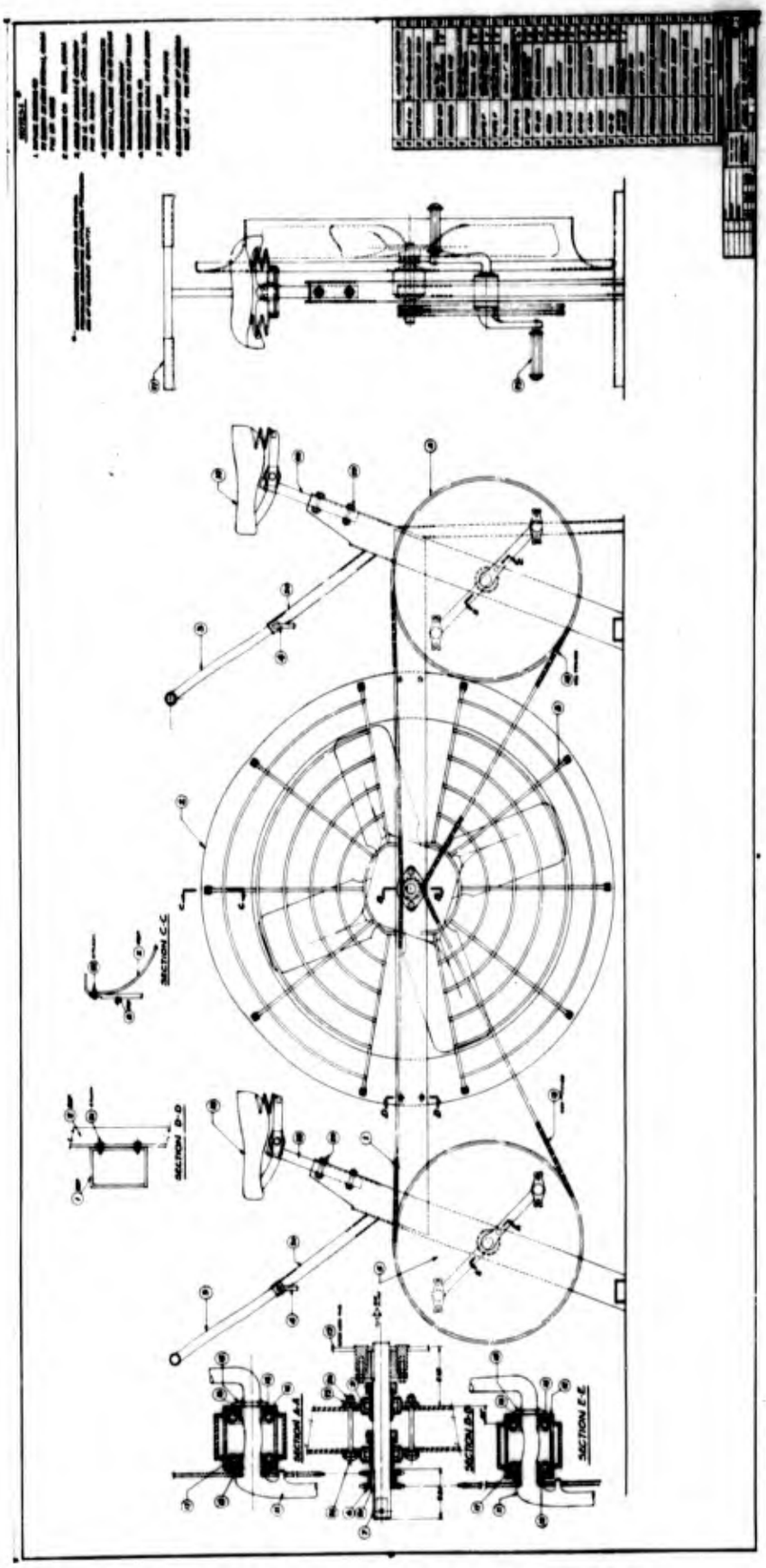

Figure 2 TWO-OPERATOR BICYCLE VENTILATOR KIT

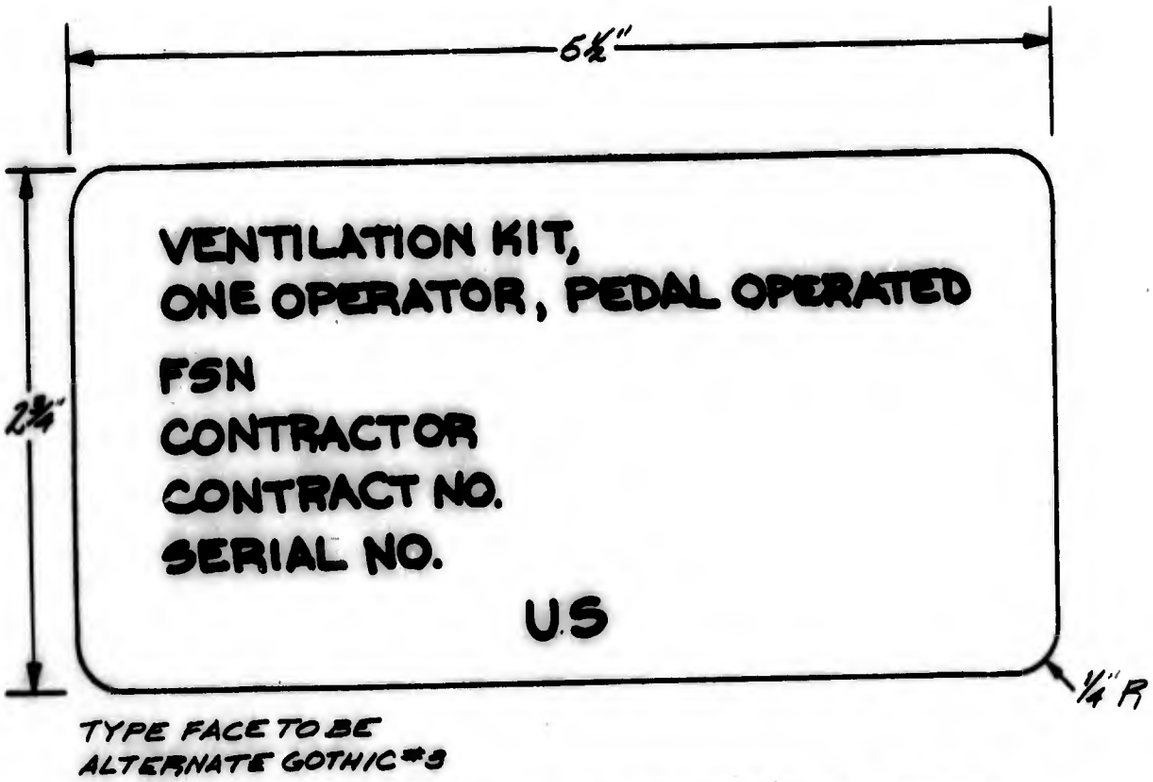

Figure 3 IDENTIFICATION PLATE, BICYCLE VENTILATOR KIT, ONE-OPERATOR

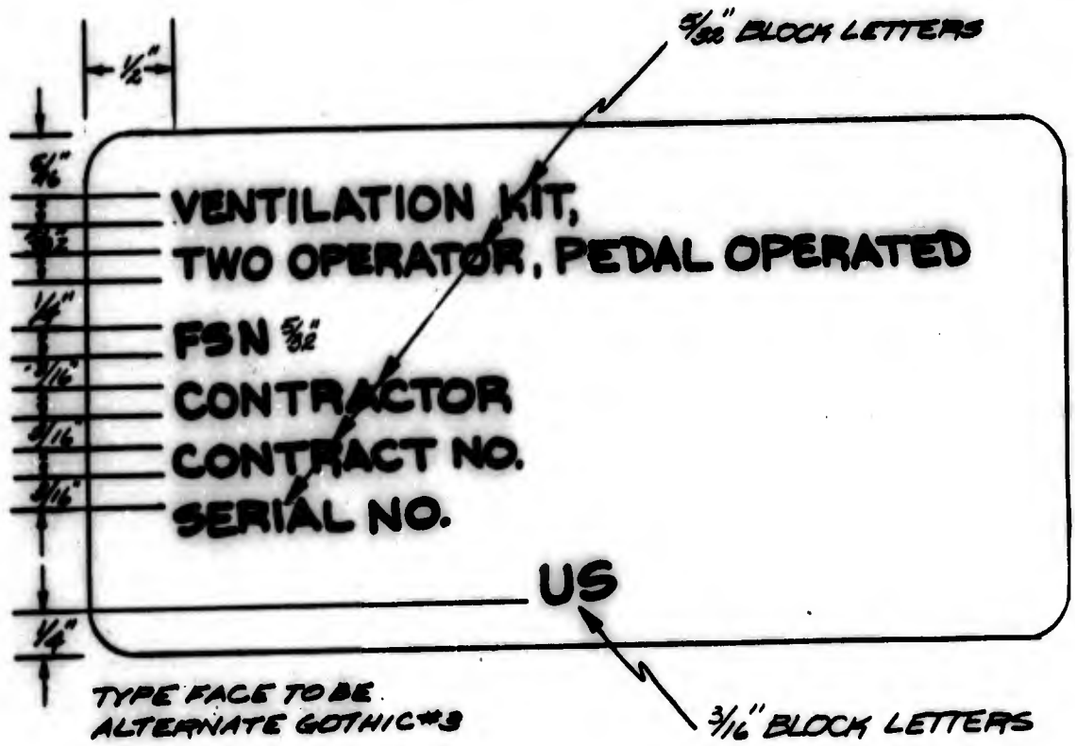

Figure 4 IDENTIFICATION PLATE, BICYCLE VENTILATOR KIT, TWO-OPERATOR

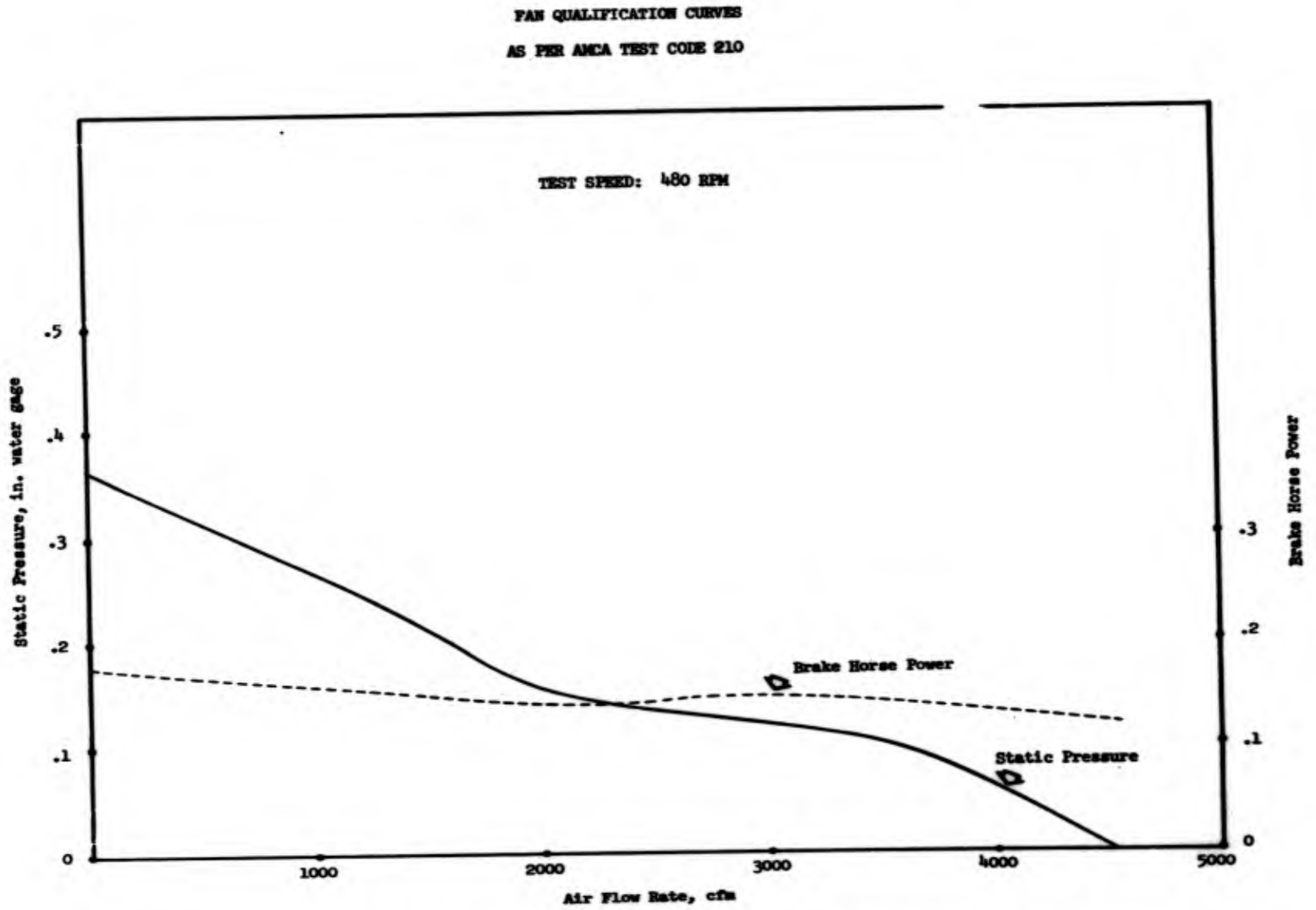

Figure 5 FAN QUALIFICATION CURVES, ONE-OPERATOR UNIT

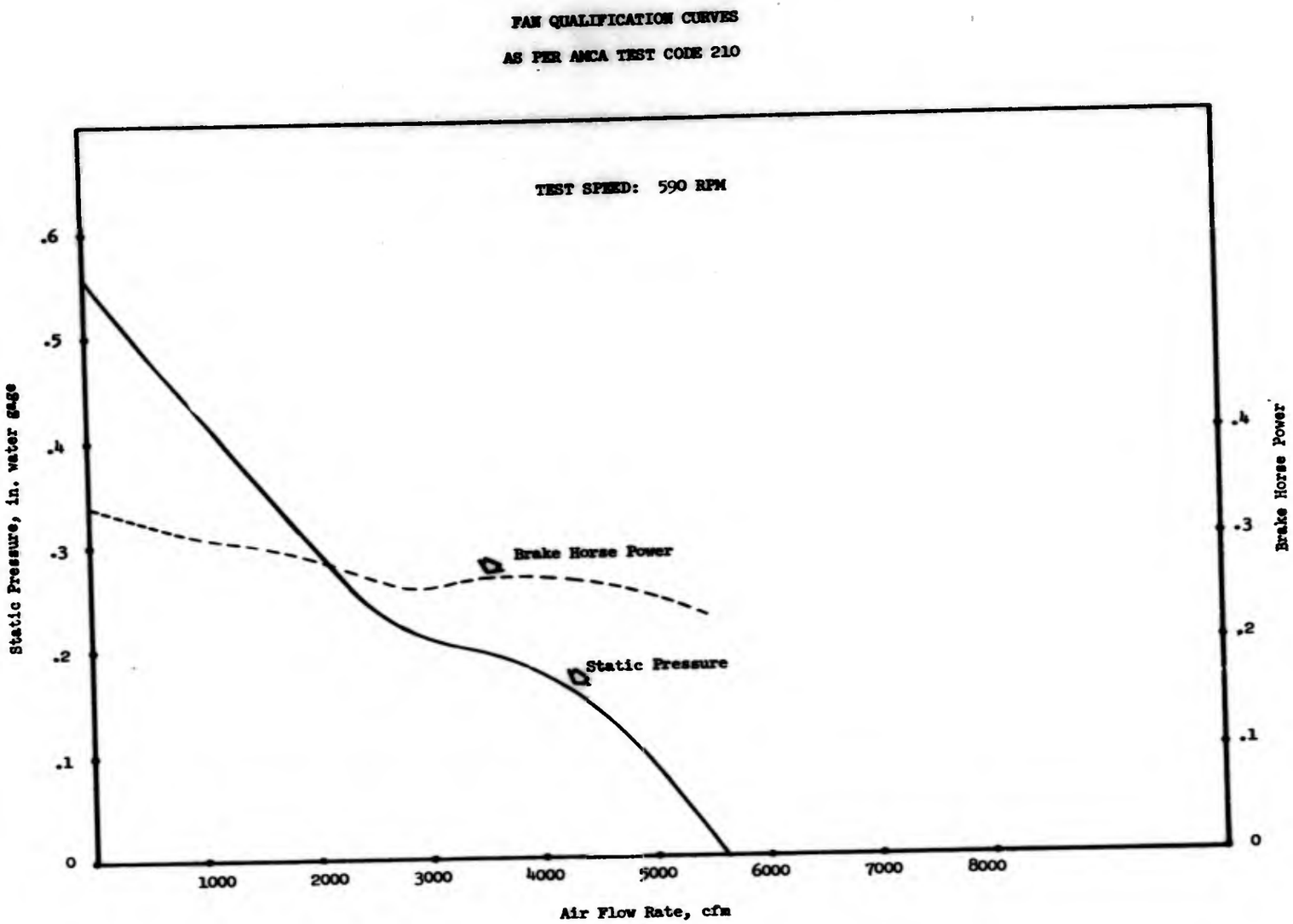

Figure 6 FAN QUALIFICATION CURVES,
TWO-OPERATOR UNIT

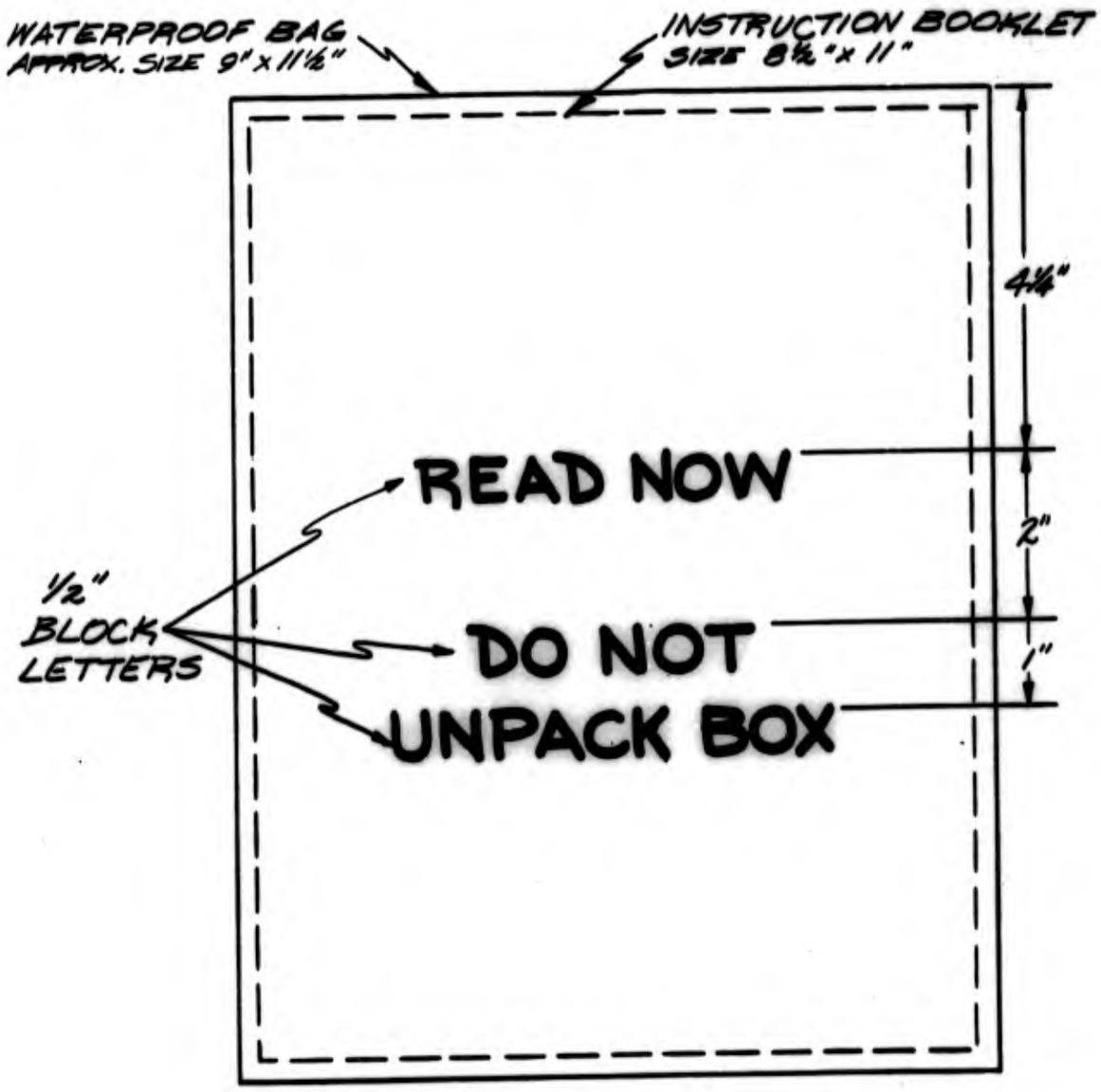

Figure 7 MESSAGE MARKING ON WATERPROOF INSTRUCTION BOOKLET BAG

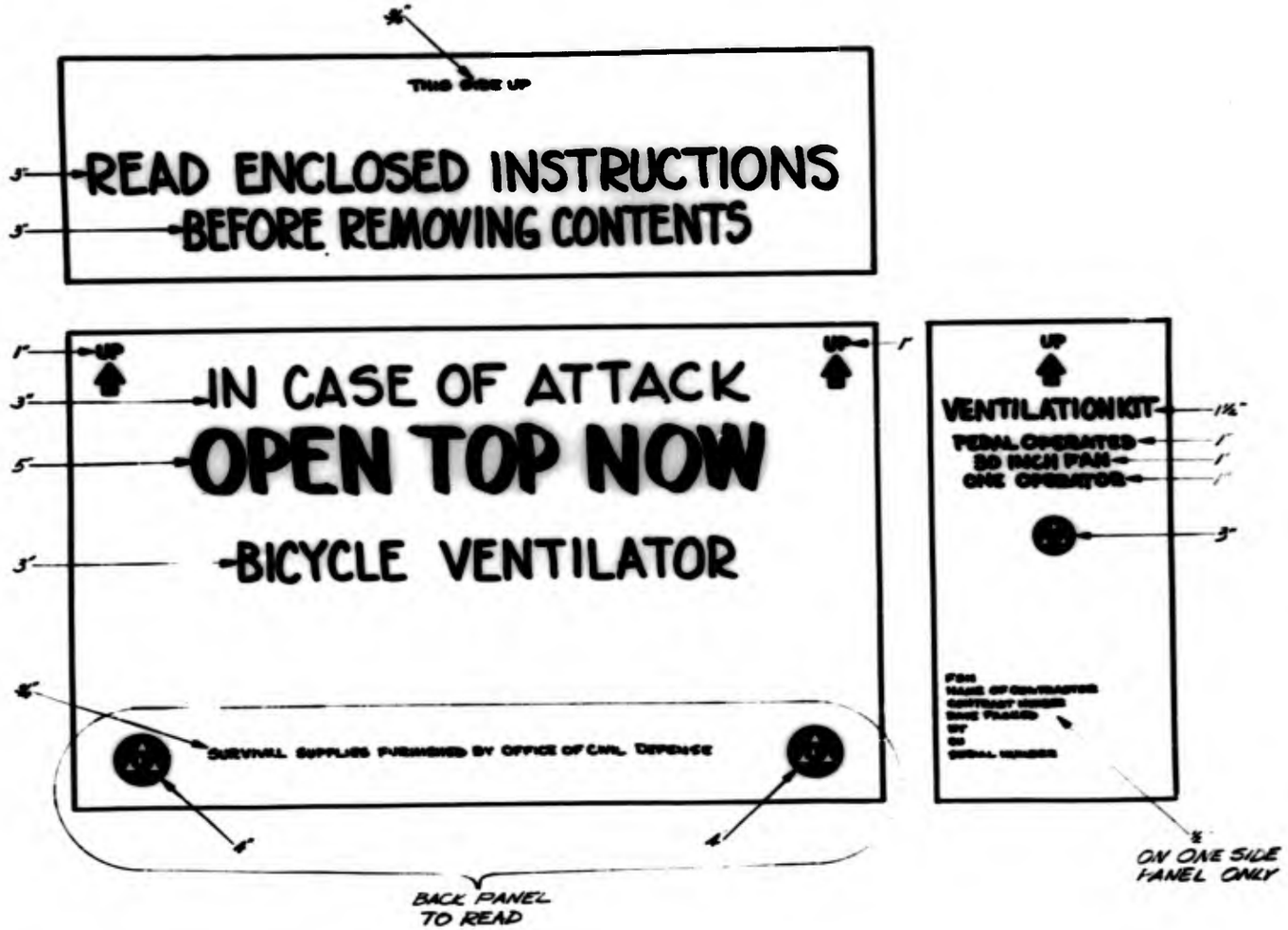

Figure 8 EXTERIOR BOX MARKINGS, BICYCLE VENTILATOR KIT, ONE-OPERATOR

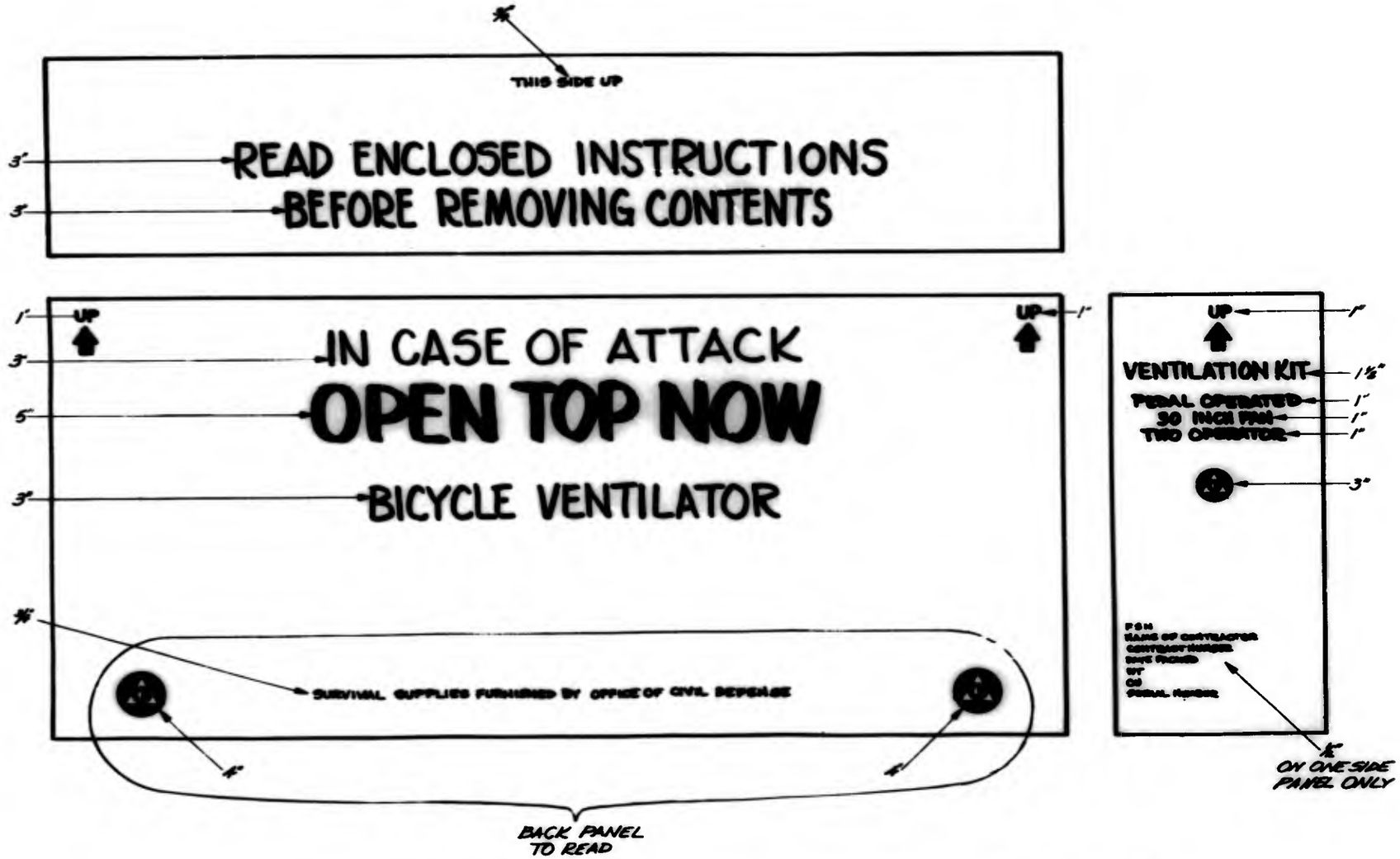

Figure 9 EXTERIOR BOX MARKINGS, BICYCLE VENTILATOR KIT, TWO-OPERATOR

APPENDIX C

LIMITED COORDINATION

MILITARY SPECIFICATION

KEARNY PUMP VENTILATOR KIT

LIMITED COORDINATION

MILITARY SPECIFICATION

KEARNY PUMP VENTILATOR KIT

This limited coordination military specification has been prepared by the Office of Civil Defense based upon currently available technical information, but it has not been approved for promulgation as a coordinated military specification. It is subject to modification. However, pending its promulgation as a coordinated military specification, it may be used in procurement.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers the fabrication, assembly, performance and packaging of a complete ventilator kit for use in fallout shelters. (See Figures 1, 2 and 3)

1.2 Classification. Kearny pump ventilator systems as used in fallout shelters shall be of the following types as specified.

Type I: Ventilation systems using a Kearny pump ventilator assembled to an adjustable doorway support bar.

Type II: Ventilation systems using a Kearny pump ventilator assembled to a portable A-frame support.

2. APPLICABLE SPECIFICATIONS, STANDARDS, DRAWINGS AND OTHER PUBLICATIONS

2.1 Specifications and Standards. The following specifications and standards of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

L-P-378	Plastic Film (Polyethylene, Thin Gage)
QQ-P-416	Plating, Cadmium, Electrodeposited
UU-P-268	Paper, Kraft Wrapping
PPP-B-636	Box, Fiberboard
PPP-B-001163	Box, Corrugated Fiberboard, High Compression Strength, Weather-resistant, Wax-resin Impregnated
PPP-T-45	Tape, Gummed, Paper, Reinforced
PPP-T-76	Tape, Pressure-sensitive Adhesive Paper, (for Carton Sealing)

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Military

MIL-A-101	Adhesive, Water-resistant, for Sealing Fiberboard Boxes
MIL-B-131	Barrier Material, Water Vaporproof, Flexible
MIL-C-5541	Chemical Films and Chemical Film Materials for Aluminum and Aluminum Alloys
MIL-L-8937	Lubricant, Solid Film, Heat Cured
MIL-P-116	Preservation, Methods of

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-171	Finishing of Metal and Wood Surfaces

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Atlanta, Chicago, Kansas City, Mo.; Dallas, Denver, San Francisco, Los Angeles, Seattle and Washington, D. C. Copies of the military specifications and standards required by contractors in connection with specific procurement functions should be obtained from the procuring agency or as directed by the contracting officer.)

2.2 Drawings.

2.2.1 Doorway Kearny Support Bar.

1477D-2000	Doorway Kearny Support Bar, Assembly
" C-2010	Doorway Kearny Support Tubes
" C-2020	Doorway Kearny Support Components
" B-2030	Bearing Support, Outer Tube
" B-2031	Bearing Support, Inner Tube
" B-2040	Doorway Kearny Support, Subassembly
" A-2050	Crutch Tip
" A-2051	Crutch Tip (Modified)

2.2.2 A-frame (Kearny Pump Support).

1477J-4000	A-frame, Assembly
" D-4001	A-frame Legs and Brace
" D-4002	A-frame Components
" B-4005	Slip-on Fitting
" C-4006	Top Support, Subassembly

2.2.3 Kearny Pump.

1477E-3000	Kearny Pump Frame, Assembly of
" D-3010	Kearny Pump Frame, Top Section
" D-3015	Kearny Pump Frame, Bottom Section

1477C-3020	Kearny Pump	Flap Components
" C-3030	Kearny Pump	Components
" A-3035	Kearny Pump	Hinge Pins
" B-3040	Kearny Pump	Tie Plate, Left Hand
" B-3041	Kearny Pump	Tie Plate, Right Hand
" B-3042	Kearny Pump	Pull Cord

(Copies of drawings required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 Drawings. Unless otherwise specified herein, the materials and assembly thereof shall be as shown on the drawings (see Figures 1, 2 and 3); however, minor changes will be allowed. Any minor change or substitution of materials must not affect the rigidity of the unit or the performance requirements specified herein and must be approved by the contracting officer. Drawings are furnished for contractor guidance and information purposes only, to illustrate details of the required equipment. While every precaution has been taken to assure their accuracy, the contractor is responsible for dimensional adequacy and accurate fits for proper equipment assembly, alignment, and operation.

3.1.1 Contents of a Complete Kearny Pump Kit:

Box 'A'
(a) Kearny pump frame (2 sections)
(b) Doorway support bar
(c) Pull cords (2)
(d) Instruction booklets (3 copies)

Box 'B'
(a) A-frame
(b) Instruction booklets (3 copies)

3.1.2 Metal Fabrication. Metal used in the fabrication of the equipment shall be free from kinks. The straightening of material shall be done by methods that will not cause injury to the metal. Shearing and chipping shall be done neatly and accurately. Corners shall be square and true.

3.1.3 Machine Work. Tolerance and gages for metal fits shall conform to the limitations specified herein and otherwise to the standards of best commercial practice. Finished contact and bearing surfaces shall be true and exact. Adequate gages shall be utilized to assure proper bearing fit, interchangeability, alignment and squareness.

3.1.4 Bolted and Screwed Connections. Bolt holes shall be accurately punched or drilled and shall have the burrs removed. Tapped holes shall be tapped to class of fit specified on the drawing; all metal chips resulting from this operation shall be removed.

3.1.5 Welding. The surfaces of parts to be welded shall be free from rust, scale, paint, grease and other foreign matter. Welds shall develop adequate strength in the parts connected.

3.1.6 Finishing. Major units and subassemblies shall be finished as specified herein or on drawings.

3.2 Accessories.

3.2.1 Instructions. Each auxiliary ventilation kit shall be supplied with six (6) assembly and operating instructions booklets. This publication will be furnished by the Office of Civil Defense at the time of contract award.

3.3 Lubrication. All porous bronze bearings shall be impregnated with a high grade oxidation resistant mineral oil of SAE30 viscosity.

3.4 Finish.

3.4.1 A-Frame.

3.4.1.1 Steel Components. Cadmium plate, per Federal Specification QQ-P-416, Type I, Class C.

3.4.1.2 Aluminum Slip-on Fittings. Chemical conversion coat in accordance with MIL-C-5541A, Class 1.

3.4.2 Adjustable Doorway Support Bar.

3.4.2.1 Steel Components.

Cleaning - Finish 4.1 of MIL-STD-171.
Surface treatment - manganese phosphate coat per 5.3.1.3 of MIL-STD-171.
Finish - solid dry film lubricant qualified under MIL-L-8937.

3.4.2.2 Aluminum Bearing Support. Chemical conversion coat in accordance with MIL-C-5541A, Class 1.

3.4.3 Kearny Air Pump.

3.4.3.1 Steel Components. Cadmium plate, per Federal Specification QQ-P-416, Type I, Class C.

3.4.3.2 Netting. Commercial galvanize.

3.4.3.3 Aluminum Frames and Tie Plates. Chemical conversion coat in accordance with MIL-C-5541, Class 1.

3.5 Marking. Since the configuration of the items in this specification does not lend itself to marking, the identification of the items shall be made on the container in conformance with MIL-STD-129.

3.6 Workmanship. All materials used in the unit shall be of good commercial quality, entirely suitable for the purpose intended. The units shall be constructed and finished in a thoroughly workmanlike manner. Particular attention shall be given to neatness and thoroughness of machining, fitting of parts, welding, and marking of assemblies. Visual defects shall be cause for rejection.

3.7 Preproduction Sample. When specified in the contract or order before production is commenced, sample devices shall be submitted or made available to the contracting officer or his authorized representative for approval in accordance with 4.2. The approval of the preproduction sample authorizes the commencement of production, but does not relieve the supplier of responsibility for compliance with all applicable provisions of this specification. The preproduction sample shall be manufactured in the same facilities to be used for the manufacture of the production items.

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection Responsibility. The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Preproduction Sample Inspection. When a preproduction sample is required (see 3.12), it shall be examined in accordance with applicable paragraphs of Section 3 and Section 4 (with laboratory tests at the contractor's expense).

4.3 Production Inspection.

4.3.1 Performance. The inspector shall ascertain that the units meet the performance requirements specified herein.

4.3.2 Workmanship. The units shall be inspected for rigidity, alignment, interference of components, interchangeability of components, finish, color and marking.

4.3.3 Packing and Marking. The inspector shall ascertain that the packing and marking of the containers conform to this specification.

4.3.4 Packaging. Cleanliness, leakage, and heat seal tests are required per MIL-P-116, Table 3.

4.5 Quality Conformance Inspection.

4.5.1 Lot. A lot shall consist of one day's production or all units offered for acceptance at one time.

4.5.2 Sampling.

4.5.2.1 Sampling for Examination. Sampling for examination shall be in accordance with MIL-STD-105. For major defects the AQL shall be 2.5 percent defective units, at inspection Level II. For minor defects, the AQL shall be 6.5 percent at inspection Level I (or S_2 for standard parts). Each minor characteristic shall be considered separately for acceptance of the lot.

4.5.2.2 Sampling for Tests. Sampling for tests shall be in accordance with MIL-STD-105, at inspection Level II. The AQL shall be 1.0 percent defective.

4.5.3 Examination. Each unit selected in accordance with 4.5.2.1 shall be examined for defects listed in Table I. Any unit having one or more major defects shall be considered a defective unit.

Table I

CLASSIFICATION OF DEFECTS

Category	Defect
Major	
101	Packaging not acceptable; equipment could be damaged or small parts lost.
102	Package marking not as specified.
103	Hinge pins not properly lined up on the Kearny pump.
104	Bearing supports not properly positioned on the Kearny pump.
105	Bearing supports will not slide over tubes on the adjustable doorway bar.
106	Tube will not telescope on the adjustable doorway support bar.
107	Bearing supports incorrectly positioned on the A-frame, preventing proper attachment of the Kearny pump.
108	Components or hardware missing, including the assembly and operating instructions booklet.
109	Welds not acceptable.

Minor

201	Material not as specified.
202	Dimensions not as specified.
203	Metal fabrication not suitable.
204	Fasteners and pins not as specified.
205	Workmanship not acceptable.
206	Finish not as specified or acceptable.
207	Preservation not as specified.

4.5.4 Functional Tests. Samples selected in accordance with 4.5.2.2 shall be tested as specified herein. Any sample failing to pass any test shall be considered a defective unit.

4.5.4.1 Kearny Pump.

4.5.4.1.1 Assemble top and bottom sections together using tie plates.

4.5.4.1.2 Install a top and bottom section into a fixture which will serve to indicate the correct alignment of the hinge pins.

4.5.4.2 Doorway Support Bar.

4.5.4.2.1 Install the doorway support bar in the minimum and maximum door openings as specified on print 1477D-2000, to check overall dimensions.

4.5.4.2.2 Slide each bearing support along the length of the tubes to check for free sliding fit.

4.5.4.3 A-frame.

(a) Assemble A-frame to check for ease of assembly.

(b) Install a Kearny pump previously checked on the fixture (see 4.5.4.2.2) into the A-frame and operate, swinging the Kearny beyond the legs of the A-frame. Check for bearing support alignment on the A-frame top piece, rigidity of the A-frame, interference if any between the legs of the A-frame and the swinging Kearny pump.

4.6 Inspection of Preparation for Delivery. The preservation, packaging, packing and marking shall be inspected to determine compliance with the requirements of Section 5 of this specification.

5. PREPARATION FOR DELIVERY

5.1 Preservation and packaging of adjustable doorway support bar, A-frame, and Kearny pump and accessories.

5.1.1 The following preservation procedures in conformance with MIL-P-116 shall be effected.

5.1.1.1 Intermediate packing of accessories for adjustable doorway bar, A-frame, Kearny pump.

5.1.1.1.1 Assembly and Operating Instructions. The assembly and operating instructions booklets, 6 copies (see 3.2.1), shall be preserved and packaged, 3 copies per packet, per method 1C-3 of MIL-P-116. The transparent heat sealed bag shall be fabricated from material conforming to Federal Specification L-P-378 (see 5.1.1.3 and 5.1.1.4). The message and its placement on the plastic bag is shown in Figure 4.

5.1.1.1.2 Kearny Pump, Pull Cords (Two). The pull cords (2 per package) shall be preserved and packaged per method 1C-3 of MIL-P-116. The transparent heat sealed bag shall be fabricated from material conforming to Federal Specification L-P-378 (see 5.1.1.4).

5.1.1.2 Doorway Support Bar. The doorway support bar shall be packed in a Style FPF, Type CF, Domestic Class, 125 pound bursting strength, fiberboard box fabricated and closed in conformance with Federal Specification PPP-B-636. Approximate inside dimensions shall be 30-1/4 inches long by 4-3/4 inches wide by 2 inches deep. The box shall be closed with gummed paper tape 3 inches wide conforming to Federal Specification PPP-T-76 or PPP-T-45. The contents of the box shall be stenciled (1/2" letters) on one of the large panels of the box.

5.1.1.3 A-frame, Interior Box. The A-frame shall be packed in conformance with method 1A-14 of MIL-P-116. The interior box shall be Style FOL, Type CF, Domestic Class, 125 pound bursting strength, fiberboard box fabricated and closed in conformance with Federal Specification PPP-B-636. Approximate inside dimensions shall be 5 inches long by 5 inches wide by 95 inches deep. The box shall be closed by gummed paper tape 3 inches wide conforming to Federal Specification PPP-T-76 or PPP-T-45. Part No. 1477C-4006, top support, subassembly shall be wrapped in Kraft wrapping paper conforming to Federal Specification UU-P-268 with ends of wrap secured with masking tape. Any additional cushioning, padding, or dunnage will be included to reflect best commercial practice to prevent damage of the packaged item. A packet of the assembly and operating instructions (3 copies) (see 5.1.1.1.1) shall be placed in the box in such manner as to prevent damage to the booklets when removing the A-frame from the box.

5.1.1.3.1 Barrier Bag. The packed interior box shall be enclosed in a close-fitting heat-sealed bag fabricated from barrier material conforming to MIL-B-131, Class 1.

5.1.1.3.2 Exterior Container. The bagged interior box shall be packed in a Style RSC box. The body joint shall be secured with adhesive to conform with best commercial practice. Approximate inside dimensions shall be 5-1/2 inches long by 5-1/2 inches wide by 96 inches deep. The corrugated fiberboard shall be wax and/or resin impregnated Type CF, 200 pound grade in conformance with Federal Specification PPP-B-001163. Exterior box markings are shown in Figure 5 (see 5.2.1).

5.1.1.3.3 Closure. The flaps of the box specified in 5.1.1.3.2 shall be securely sealed with water resistant adhesive conforming to MIL-A-101. In addition, the center seams shall be sealed by the application of 3 inch minimum width pressure sensitive tape in conformance with Federal Specification PPP-T-76. The strip of tape shall overlap the side panel a minimum of 6 inches on each panel.

5.1.1.4 Kearny Pump Interior Container. The Kearny pump shall be packed in conformance with method 1A-14 of MIL-P-116. The interior box shall be Style FOL, Type CF, Domestic Class, 125 pound bursting strength, fiberboard box fabricated and closed in conformance with Federal Specification PPP-B-636. Approximate inside dimensions shall be 30-3/4 inches long, 5 inches wide and 41 inches deep. The box shall be closed by gummed paper tape 3 inches wide conforming to Federal Specification PPP-T-76 or PPP-T-45. The two Kearny pump frames shall be packed face to face with appropriate inner packing forms on the face and sides of the Kearny frames to separate them and protect the hinge wires and clips and prevent wrinkling or creasing of the plastic flaps. The Kearny pump (one top and one bottom section) shall be inserted into the packing box with the bearing support lugs toward the top. The pull cord packet shall be placed on top of the Kearny pump sections between the bearing support lugs. The packet of the assembly and operating instructions (3 copies) shall be securely wrapped and taped to the doorway support bar container (see 5.1.1.2). This shall be placed in the box on top of the Kearny pump. The placement of the doorway support bar box shall be such, so that the instruction booklets are instantly visible when the top flaps of the interior container are opened.

5.1.1.4.1 Barrier Bag. The packed interior box shall be enclosed in a close fitting heat sealed bag fabricated from barrier material conforming to MIL-B-131, Class 1.

5.1.1.4.2 Exterior Container. The bagged interior box shall be packed in a Style FOL box. The body joint shall be secured with adhesive conforming to the best commercial practice. The approximate inside dimensions shall be 31-1/4 inches long, 5-1/2 inches wide, and 42 inches deep. The corrugated fiberboard shall be wax and/or resin impregnated Type CF, 250 pound grade in conformance with Federal Specification PPP-B-001163. Exterior box markings are shown in Figure 6 (see 5.2.1).

5.1.1.4.3 Closure. The flaps of the box specified in 5.1.1.4.2 shall be securely sealed with water resistant adhesive conforming to MIL-A-101.

5.2 Marking of Exterior Boxes.

5.2.1 The box containing the A-frame shall be marked as per Figure 5. The lettering shall be in yellow and of Gothic style.

5.2.2 The box containing the Kearny pump and the doorway support bar shall be marked as per Figure 6. The lettering shall be in yellow and of Gothic style.

6. NOTES

6.1 Intended Use. Kearny pump ventilator kits are intended for use in identified fallout shelters to distribute the ventilation air to maintain thermal and atmospheric control of the shelter's environment during a national emergency.

6.2 Ordering Data. Procurement documents should specify the following:

(a) Title, number and date of this specification
(b) Number of assemblies required
(c) Contact point for the assembly and operating instruction booklet (3.2.1)
(d) When preproduction sample is required (3.7).

Notice. When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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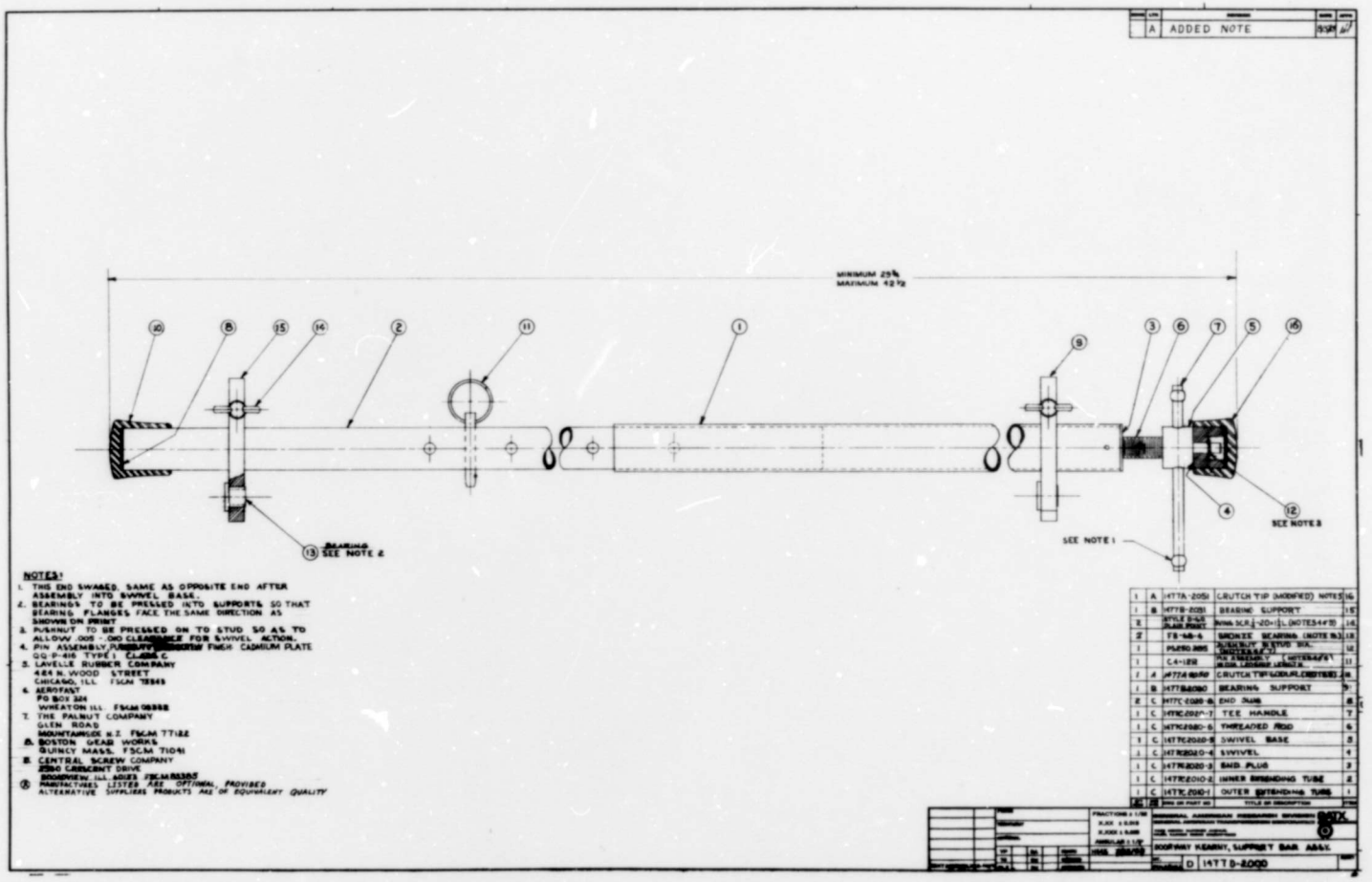

Figure 1 DOORWAY KEARNY SUPPORT BAR

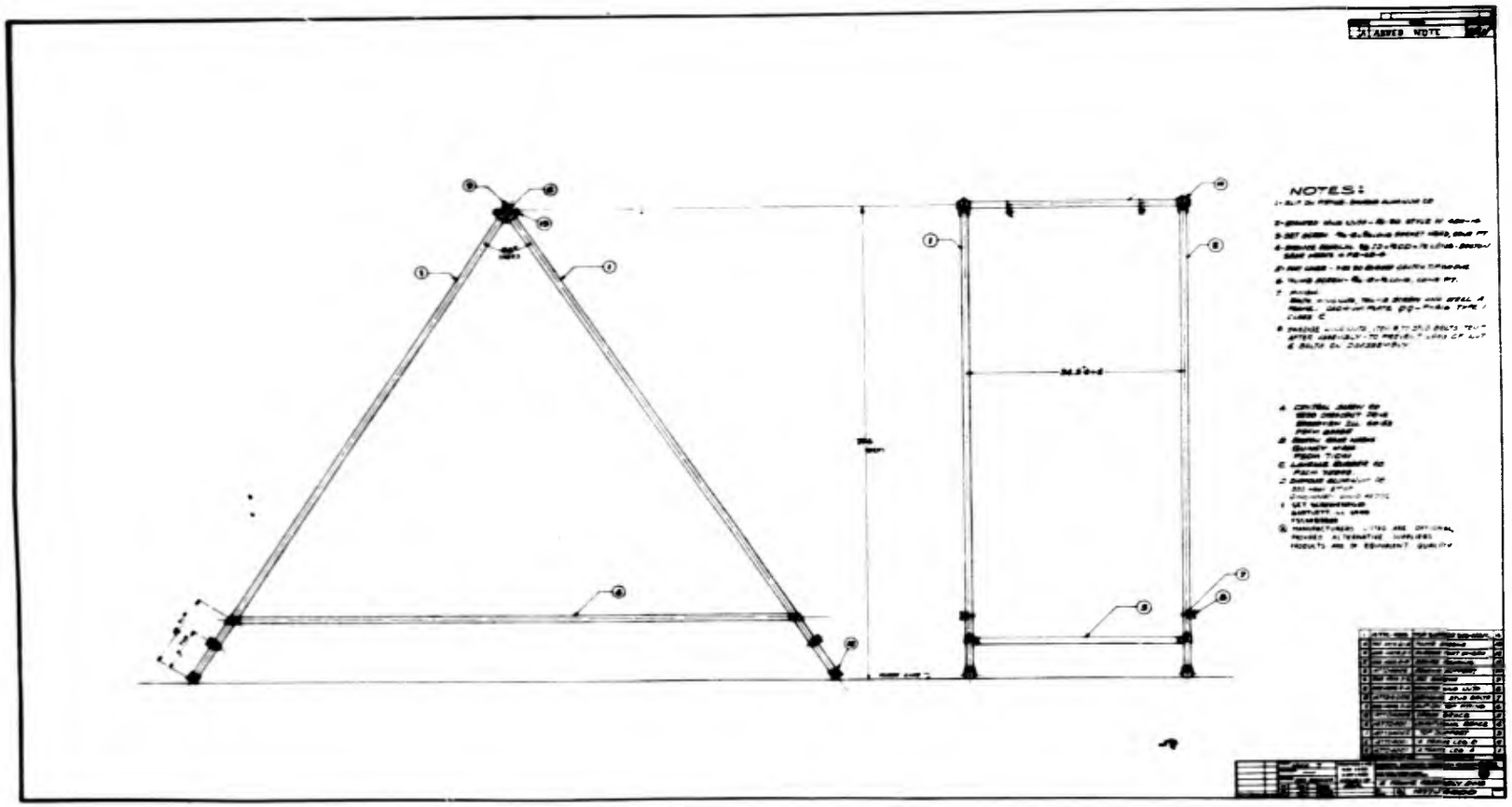

Figure 2 **A-FRAME**

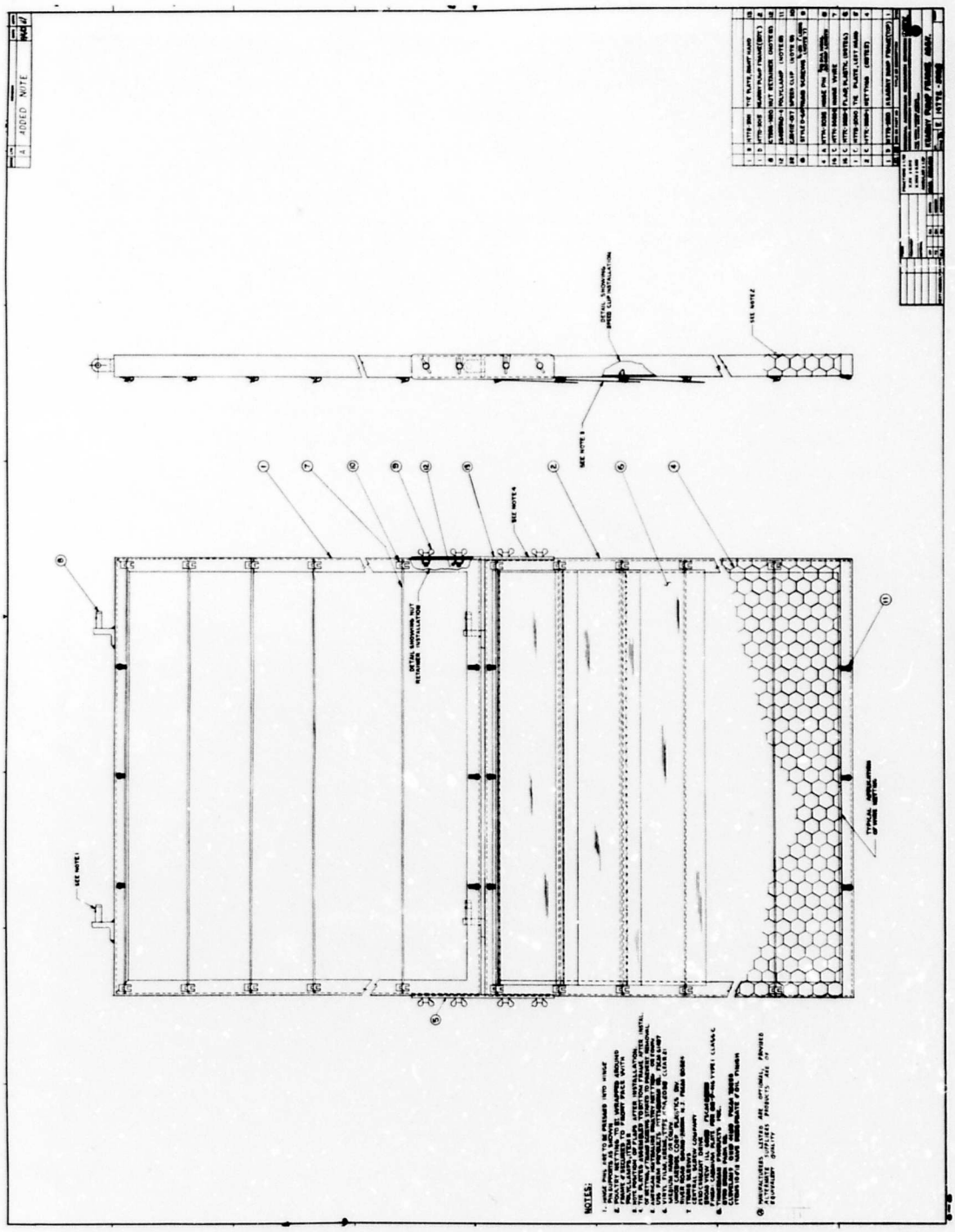

Figure 3 KEARNY PUMP FRAME

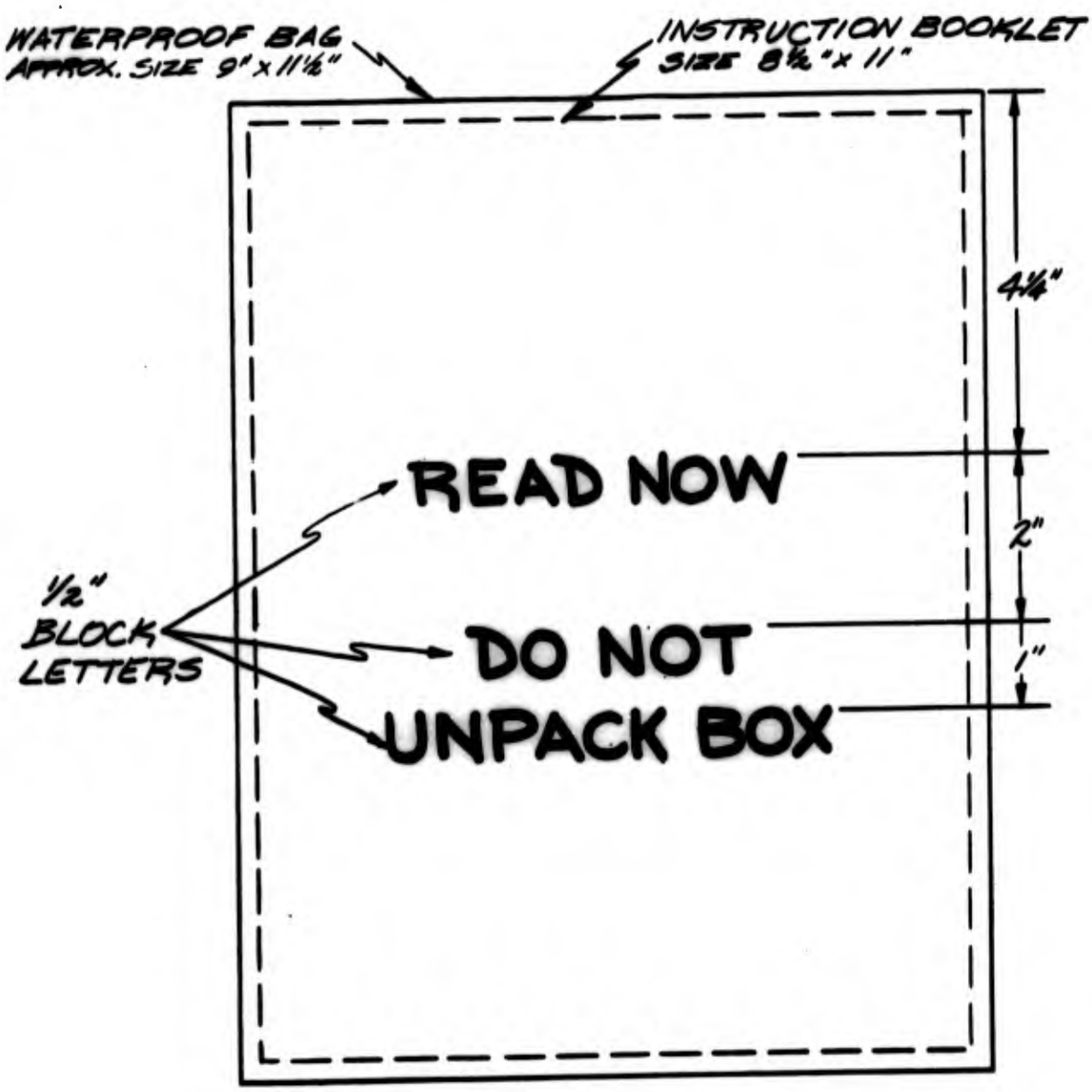

Figure 4 MESSAGE MARKING ON PLASTIC BAG

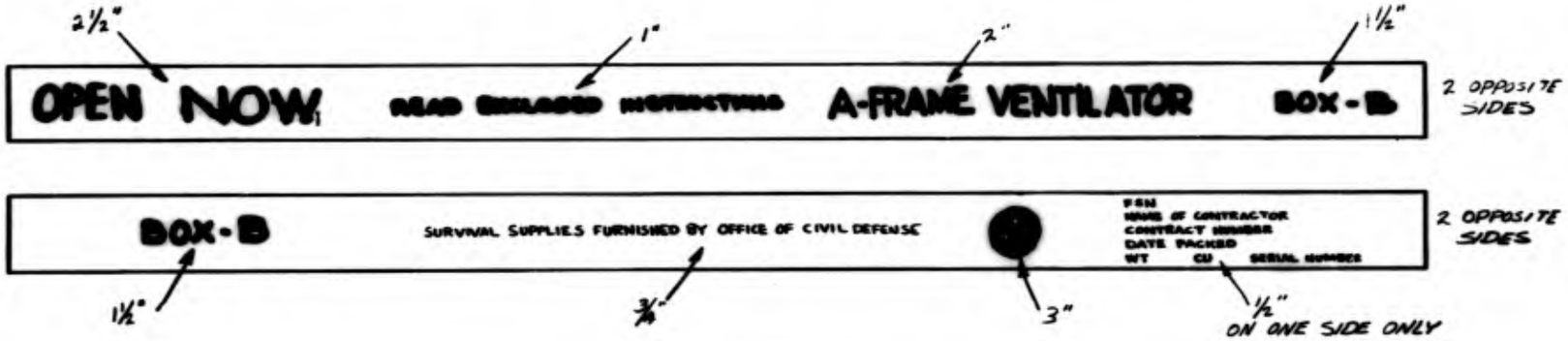

Figure 5 EXTERIOR BOX MARKINGS, A-FRAME

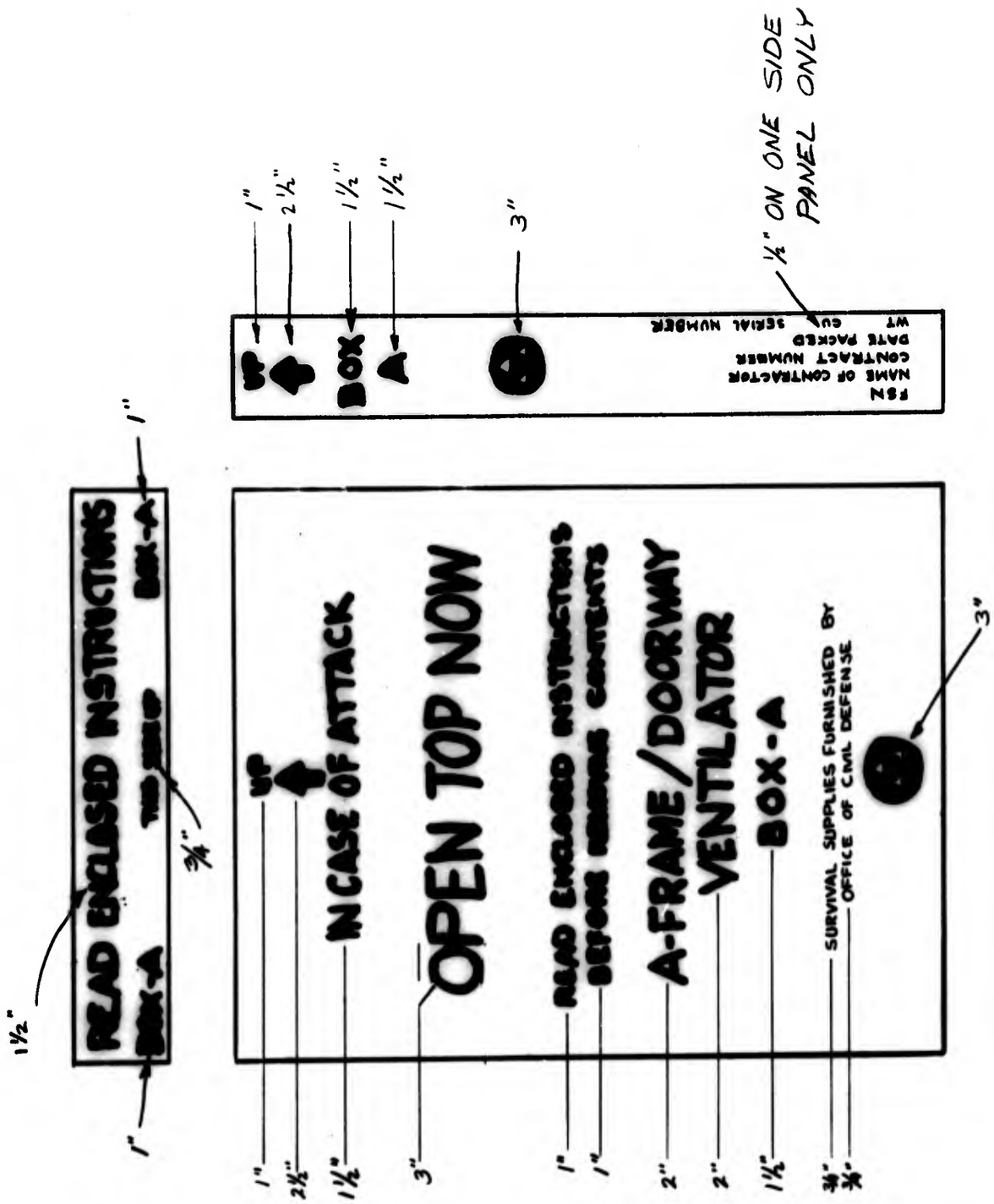

Figure 6 EXTERIOR BOX MARKINGS, KEARNY PUMP

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13. ABSTRACT

The report describes the development of three types of ventilator kits for use in OCD fallout shelters: a one-operator bicycle ventilator kit, a two-operator bicycle ventilator kit and a Kearny pump kit. The bicycle ventilators are pedal driven and employ 30" dia. fans and 30" dia. exhaust ducts. The Kearny pump is arm driven. The report also describes the effects of blast tests - peak overpressure 4 psi - on these kits. Operating instructions and military specifications for the kits are included.

DD FORM 1 NOV 68 1473 REPLACES DD FORM 1473, 1 JAN 68, WHICH IS OBSOLETE FOR ARMY USE.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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VENTILATION						
WEAPONS EFFECTS						