MARTIN MARIETTA

MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2009
OAK RIDGE, TENNESSEE 37831

54-410

April 13, 1995

Mr. Thomas Hall
Division of Consumer Affairs
Occupational Safety and Health Administration
200 Constitution Avenue N. W.
Room N3649
Washington, D. C. 20210

OSHA
DOCKET OFFICER
DATE APR 13 1995
TIME

Dear Mr. Hall:

Comments on Regulation - 29 CFR Parts 1910, 1915, and 1926: Respiratory Protection

Enclosed are comments on Regulation, 29 CFR Parts 1910, 1915, and 1926: Respiratory Protection.

Comments were obtained from all Martin Marietta Energy Systems, Inc., Industrial Hygiene organizations, including union representation.

I feel that these comments will help achieve the necessary objectives for a safe environment of the employee and the company.

Thank you for the opportunity to comment. If you have any questions concerning these comments, please feel free to contact Mark Haskew at (615) 576-8588.

Sincerely,

M. E. Mitchell, Acting Manager
Compliance, Evaluation and Policy

MEM:GEB:PWF:ldd

Enclosures

54-410A

Respiratory Protection Standard Comments
April 14, 1995

(1) ISSUE: Clarify (a)(2) in regards to relationship to burden of cost to employer versus employee.

COMMENT: First sentence in (a)(2) needs to be redefined to clarify this relationship.

RESOLUTION: Respiratory protection shall be provided by the employer at no cost to the employee when such equipment is necessary to protect the health of the employee.

(2) ISSUE: If a respirator is used by an employee but its use is not required by OSHA standards or by the employer, and it is known as a "voluntary respirator" use situation, then the requirements of the proposed standard, although recommended, are to be mandatory.

COMMENT: Prior guidance from OSHA has required that such voluntary programs consist of :

1. Medical approval
2. Training of individuals
3. Fit test

RESOLUTION: Same standard that applies to mandatory issuance must apply to voluntary issuance.

(3) Definitions

ISSUE: National Institute of Occupational Safety & Health (NIOSH).

COMMENT: In definition of "Assigned Protection Factor" appearing in (b), NIOSH is not defined.

RESOLUTION: Revise definition to read, "Assigned protection factor....assigned by the National Institute for Occupational Safety and Health (NIOSH) to indicate...."

ISSUE: Atmosphere-supplying respirator definition.

COMMENT: The definition should be revised.

RESOLUTION: Use ANSI Z88.2.1992 stated below for atmosphere-supplying respirator. (with addition)

Atmosphere-supplying respirator means a class of respirators that supply a respirable atmosphere, independent of the workplace atmosphere. This includes self-contained breathing apparatus (SCBA) units.

ISSUE: **SUPPLIED AIR RESPIRATOR**

COMMENT: To be consistent with ANSI, terminology should be standardized. Atmosphere supply respirator is the same as supplied air respirator.

RESOLUTION: **Change "supplied air respirator" references throughout the standard to "atmosphere supply respirator" to be consistent.**

ISSUE: Better Definitions

COMMENT: To be consistent with ANSI definitions the following definitions should be either added or changed.

RESOLUTION:

Aerosol means particles, solid or liquid, suspended in air.

Canister or cartridge means a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

Demand respirator means an atmosphere-supplying respirator that admits respirable gas to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

Disposable respirator means a respirator for which maintenance is not intended and that is designed to be discarded after excessive resistance, sorbent exhaustion, physical damage, or end-of-service-life renders it unsuitable for use. Examples of this type of respirator are a disposable half-mask respirator or a disposable TYVEK supplied air hood. Please note, this is a "revised" definition.

Dust means an aerosol consisting of mechanically produced solid particles derived from the breaking up of larger particles. Dusts generally have a larger particle size when compared to fumes.

Fit factor means a quantitative measure of the fit of a particular respirator to a particular individual.

Fume means solid aerosols formed by condensation of a gas or vapor. Fumes generally have a smaller particle size when compared to dusts.

Gas means a fluid that has neither independent shape nor volume and tends to expand indefinitely.

Hazardous atmosphere means an atmosphere that contains a contaminant(s) in excess of the exposure limit or that is oxygen deficient.

Helmet means a hood that offers head protection against impact and penetration.

High-efficiency filter means a filter that removes from the air 99.97% or more of the aerosols having a diameter of 0.3*um*.

Hood means a respiratory inlet covering that completely covers the head and neck and may cover portions of the shoulders.

Loose-fitting facepiece means a respiratory inlet covering that is designed to form a partial seal with the face, does not cover the neck and shoulders, and may or may not offer head protection against impact and penetration.

Mist means an aerosol composed of liquid particles.

Negative-pressure respirator means a respirator in which the air pressure inside the respiratory inlet covering is negative during inhalation with respect to the ambient air pressure.

Occupational health professional means an individual whom, by experience and education, is competent at recognizing, evaluating, and controlling health hazards in the workplace.

Poor warning properties means a substance whose odor, taste, or irritation effects are not detectable or not persistent at concentrations at or below the exposure limit.

Positive pressure respirator means a respirator in which the pressure inside the respiratory inlet covering is normally positive with respect to the ambient air pressure.

Powered air-purifying respirator means an air-purifying respirator that uses a blower to force the ambient atmosphere through air-purifying elements to the inlet covering.

Qualitative fit test means a pass/fail fit test that relies on the subject's sensory response to detect the challenge agent.

Quantitative fit test means a fit test that uses an instrument to measure the challenge agent inside and outside the respirator.

Sorbent means a material that is contained in a cartridge or canister and removes specific gases and vapors from the inhaled air.

Supervisor means a person who has the responsibility of overseeing the work activities of one or more persons who must wear respirators.

Tight-fitting facepiece means a respiratory inlet covering that is designed to form a complete seal with the face. A half-facepiece (includes quarter masks, disposable masks, and masks with elastomeric facepieces) covers the nose and mouth; a full facepiece covers the nose, mouth, and eyes.

Vapor means the gaseous phase of matter that normally exists in a liquid or solid state at room temperature.

(4) ISSUE: **(c) Respiratory protection program-** (1) The employer in accordance with this section shall establish and implement a written respiratory protection program which shall.....

COMMENT: The employer should bare the expense of the entire respiratory protection program.

RESOLUTION: **(c) Respiratory protection program**-(1) The employer in accordance with this section shall establish and implement a written respiratory protection program, at no expense to the employee, which shall.....

(5) ISSUE: (d)(2) Where elastomeric facepiece respirators are to be used, the employer shall provide a selection of respirators from an assortment of at least three sizes for each type of facepiece and from at least two different manufacturers.

COMMENT: When facial dimensions are different and require more than one type of respirator, the employer could obtain respiratory protection equipment from one manufacturer that has more than one type of respirator to satisfy this need. To mandate each employer purchase, maintain, and segregate associated atmosphere-supplying respiratory protection equipment from more than one manufacturer is not cost effective. This alternative allows each user to select from two different types with three sizes respectfully, from one manufacturer.

RESOLUTION: (d)(2)Where elastomeric facepiece respirators are to be used, the employer shall provide a selection of respirators from either (i) or (ii).

(i) An assortment of at least three sizes for each type of facepiece and from at least two different manufacturers.

(ii) An assortment of at least three sizes for each type from at least two types from one manufacturer.

(6) ISSUE: (d)(8) Air-purifying respirators shall not be used for a hazardous chemical with poor or inadequate warning properties unless either:

(ii) The odor or irritation threshold is not in excess of three times the hazardous exposure level and there is no associated ceiling limit.

COMMENT: Three times the ceiling can lead to an exposure to the respirator wearer.

RESOLUTION: (d)(8)(ii) The odor or irritation...in excess of one-half the hazardous exposure level and there is no associated ceiling limit.

(7) ISSUE: (d)(9) In addition, in order to use an air-purifying respirator for hazardous chemicals with poor or inadequate warning properties, at least one of the following conditions must be met:

(d)(9)(i) The respirator has an end of service life indicator approved by NIOSH for use with the specific chemical, or....

COMMENT: Needs better clarity. The terminology would be more precise if the term cartridge was added.

RESOLUTION: (d)(9)(i) The respirator cartridge has an end of life.....

(8) ISSUE: (d)(9) selection of.....

COMMENT: Need to add an additional comment for clarity.

RESOLUTION: (d)(9)(iii) And in situations where air monitoring and actions as detailed in (d)(3) have been conducted and that Occupational Health Professional has determined that the potential occupational exposure is less than 1/10 of the hazardous exposure level negative pressure respirator can then be used.

(9) ISSUE: (e) Medical evaluation.

COMMENT: Delete current (e) and add Alternative 2 for (e) Medical evaluation. More inclusive, gives the physician more accurate information and reflects what hazards are present at the job site. Alternative 2 was reworded to clarify.

The proposed regulation for an employee required to wear a respirator for more than five hours during any work week was dropped. Any person wearing a respirator must be medically evaluated.

RESOLUTION: (e)Medical Evaluation.
(1) The employer shall provide a medical evaluation **prior to wearing a respirator, including single use dust masks.** The medical evaluation shall be performed by a licensed physician or by a health professional operating under the physicians supervision and shall include completion of a medical history and performance of a medical examination. **In addition the physician or equivalent is to assess facial conditions that may interfere with respirator fit, form, and function.** In advance of the medical evaluation the employer shall provide the examining professional with information concerning:

(i) The type of respiratory protection to be used;
(ii) The substances the employee will potentially be exposed to;
(iii) Description of the work effort required;
(iv) Duration and frequency of usage;
(v) The type of work performed, including any special responsibilities that affect the safety of others such as fire fighting or rescue work;
(vi) Any special environmental conditions (such as **temperature extremes** or confined space entry); and
(vii) Additional requirements for protective clothing and equipment.

(2) Upon completion of the examination, the employer shall obtain from the examining physician or the **health professional operating under the physicians supervision** a written opinion which states whether the employee is fit to wear a respirator and recommends any limitations on respirator use. A copy of this written opinion shall be provided to the examined employee.
(3) In case of new employees, employers may accept an already existing medical examination or written opinion from a physician provided it was conducted within a year of the date of employment, covered the same type of respirator under similar use conditions, and meets the requirements of (e)(1).
(4) The employer shall have the employee's medical status reviewed by, or under the supervision of, a licensed physician annually and at any time the employee experiences unusual difficulty breathing while being fitted for air while using a respirator. The employer shall have the responsible licensed physician provide a written opinion resulting from the review as required under (e)(2).

(10) ISSUE: (f) Fit Testing
(2) The employer shall ensure that an employee is fit tested prior to initial use of the respirator, whenever a different make or size respirator is used, and annually thereafter.....

COMMENT: To ensure personnel that are being fit tested are qualified to wear respirator and thus minimizing the possibility of injury while being fit tested.

RESOLUTION: (f)(2) The employer shall ensure that an employee is fit tested prior to initial use of the respirator, whenever a different make or size respirator is used, and annually thereafter unless otherwise specified by substance specific standards. The employer shall also ensure that an employee is medically approved prior to the respirator fit-test.

(11) ISSUE: (i) Supplied air quality and use

COMMENT: (i)(4)(iv) Breathing air lines should only be used to transport breathing air from a compressor/air bottle to the respirator wearer. Breathing air lines should not be cross connected with any nonrespirable gas or a process that uses breathing air. There have been documented cases within the Department of Energy Complex where such connections have introduced contaminants into breathing air lines.

RESOLUTION: **ADD(i)(4)(iv) Breathing air lines shall only be used to transport breathing air from a compressor/air cylinder to an end user. Breathing air lines shall not be connected to any process nor to a nonrespirable gas.**

(12) ISSUE: (k) Training

COMMENT: (k)(3) This new section is needed to ensure that the use of respiratory protection is performed in a correct manner.

RESOLUTION: (k) Training

(3) The employer shall provide a training program for personnel who supervise respirator wearers which include the following elements, and annually thereafter:

- (i) basic respiratory protection practices;
- (ii) nature and extent of respirator hazards to which persons under his/her supervision may be exposed;
- (iii) recognition and resolution of respirator use problems;
- (iv) principles and criteria for selecting respirators used by persons under his/her supervision;
- (v) training of respirator wearers;
- (vi) fitting and issuance of respirators;
- (vii) inspection of respirators;
- (viii) use of respirators, including monitoring of use;
- (ix) maintenance and storage of respirators;
- (x) regulations concerning respirator use.

(13) ISSUE: (k) Training

COMMENT: **ADD (k)(4)** To meet ANSI requirements

RESOLUTION: **(k)(4) The program administration training should be commensurate with the risk.**

(14) ISSUE: (k)Training

COMMENT: **ADD (k)(5)** Employees may use a SCBA on an infrequent basis and additional training would ensure that they are able to use such equipment in critical tasks when called upon.

RESOLUTION: **(k)(5) The employer shall provide a training program for employees who use self contained breathing apparatus in emergency situations on a semi-annual basis.**

(15) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

I. A. Minimum Criteria for a Valid Qualitative Fit Test

2. Test Agents.

(a) The test agent shall be relatively non-toxic.

COMMENT: The word "relatively" is not a definitive word. Better to delete.

RESOLUTION: Define **Toxic** : Any test agent should not exceed a concentrate of 1/2 the hazard exposure level.

(16) ISSUE: **Appendix A: Fit Testing Procedures (Mandatory)**
I. B. Validation Criteria for Qualitative Fit Tests
2.(b) The hoses of the test respirators shall be clamped shut and the new QLFT test administered. Immediately following the new QLFT method a QNFT shall be administered using the protocol established in section II.C. of Appendix A except that a strip chart recording of the test shall be made. The number of respirators test subject size population, exercises, sizes of respirators....

COMMENT: Needs better clarifying.

RESOLUTION: **I. B. Validation Criteria for Qualitative Fit Tests**

2.(b) The hoses of the test respirators shall be clamped shut and the new QLFT test administered. Immediately following the new QLFT method a QNFT shall be administered using the protocol established in section II.C. of Appendix A except that a strip chart recording or equivalent of the test shall be made. The number of respirators test subject size population.....

(17) ISSUE: **Appendix A: Fit Testing Procedures (Mandatory)**
I. C. Minimum Criteria for a Valid Particle Counting Quantitative Fit Test
2.(b) The concentration of the aerosol/gas shall not exceed an OSHA permissible exposure limit, the ACGIH threshold limit value,.....

COMMENT: Better clarity.

RESOLUTION: **I. C. Minimum Criteria for a Valid Particle Counting Quantitative Fit Test**
2.(b) The concentration of the aerosol/gas shall not exceed one half an OSHA permissible exposure limit value.....

(18) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)
I. C. Minimum Criteria for a Valid Particle Counting Quantitative Fit Test

COMMENT: Better clarity.

RESOLUTION: **ADD I. C. 3. Ambient PORTACOUNT Method- OSHA has already approved process.**

(19) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)
I. C. Minimum Criteria for a Valid Particle Counting Quantitative Fit Test

COMMENT: Better clarity.

RESOLUTION: **ADD I. C. 4. Pressure Differential Method - OSHA has been approved.**

(20) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)
I. D. 2. Means of establishing the accuracy across the full range of measurements shall include the following procedures:

(c) The numbers of respirators, test subject size population, exercises sizes....with respect to equipment between the **TWO** methods.

COMMENT: **To be consistent with requested changes in Appendix A I. C. 3. and 4.**

RESOLUTION: I. D. 2. Means of establishing the accuracy across the full range of measurements shall include the following procedures:

(c) The numbers of respirators, test subject size population, exercises sizes....with respect to equipment between the **FOUR** methods.

(21) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

I. E. Minimum Criteria for New Technology

6. Where test agents, aerosol or gases/vapors are used in a test environment the following shall apply:

(a) The test agents, concentration must be maintained below an established Permissible Exposure Limit (PEL)....

COMMENT: An action level needs to be established.

RESOLUTION: I. E. Minimum Criteria for New Technology

6. Where test agents, aerosol or gases/vapors are used in a test environment the following shall apply:

(a)The test agents, concentration must be maintained below **one half of** an established PEL....

(22) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

I. F. Validation for New Technological Methods of Determining Respirator Fit

2.(b) For any method....a QNFT shall be administered using the protocol established in section II of Appendix A except the strip chart recording of the test shall...

COMMENT: The employer may use computers.

RESOLUTION: I. F. Validation for New Technological Methods of Determining Respirator Fit

2.(b) For any method....a QNFT shall be administered using the protocol established in section II of Appendix A except the strip chart **or equivalent** recording of the test shall...

(23) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)
II. Current Fit Test Protocols
A. The employer shall include the following....

COMMENT: Ensure correlation with previous recommended actions.

This is being added at the first section in the series of steps.

RESOLUTION: II. Current Fit Test Protocols
A. The employer shall include the following...,
1. Prior to performing a fit-test the employer shall ensure the medical evaluation has been performed.

(24) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)
II. Current Fit Test Protocols
A. The employer shall include the following....

COMMENT: Better clarity.

RECOMMENDATION: Change to..
II. Current Fit Test Protocols
A. The employer shall include the following....
2. The test subject.....
3. Prior to the selection....

(25) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)
II. Current Fit Test Protocols
A. The employer shall include the following....

COMMENT: Better clarity.

RECOMMENDATION: **Delete 3.**
ADD: II. Current Fit Test Protocols
A. The employer shall include the following....
2. The test subject.....
3. Prior to the selection...
4. The test subject shall be.....

(26) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

II. Current Fit Test Protocols

A. The employer shall include the following.....

4. The test subject....

COMMENT: More definitive statement. Numbering system is based upon incorporation of # 23, #24, and #25.

RECOMMENDATION: II. Current Fit Test Protocols

A. The employer shall include the following....

5. The test subject shall be instructed to hold each **chosen** facepiece up to the face.....

(27) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

II. Current Fit Test Protocols

A. The employer shall include the following.....

6. The test subject....

COMMENT: More definitive statement. The numbering system is based on incorporation of comments #23,#24, #25 and #26.

RESOLUTION: II. Current Fit Test Protocols

A. The employer shall include the following....

6. The more comfortable facepieces are noted; the most comfortable mask is **donned or doffed one or more times** and worn at least....

(28) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

II. Current Fit Test Protocols

A. The employer shall include the following.....

7. The following criteria shall be used.....

NEW (c)
REVISE (d)
NEW (g)

COMMENT: More definitive statements. Numbering system is based on incorporation of comments #23, #24, #25 ,#26 and #27.

RESOLUTION: II. Current Fit Test Protocols

A. The employer shall include the following....

8. The following criteria shall be used.....

(c) any interference with the sealing surface
(d) fit across nose bridge **(if applicable)**
(g) fit test should mirror working conditions

(29) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

II. Current Fit Test Protocols

A. The employer shall include the following....

8. The test subject shall conduct the negative and positive pressure fit checks....

COMMENT: A positive pressure check cannot be performed on a loose fitting facepiece. Numbering system is based on incorporation of comments #23 - #28.

RESOLUTION: **Appendix A: Fit Testing Procedures (Mandatory)**
II. A. 9. The test subject shall conduct the negative and positive-pressure fit checks on **all types of tight-fitting respirators** as described in Appendix B or ANSI Z88.2-**1992**. Before conducting the negative or positive pressure test, the subject shall be told to seat the mask on the face by moving the head from side-to-side and up an down slowly while taking in a few slow deep breaths. Another facepiece shall be selected and retested if the test subject fails the fit check tests.

(30) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)
II. Current Fit Test Protocols
A. The employer shall include the following....
9 The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface ....

COMMENT: Better clarity. **Change Item 9 to Item 10**

RESOLUTION: 10. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface **without respect to gender (e.g. stubble beard)...**

(31) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)
II. Current Fit Test Protocols
A. The employer shall include the following....
11. If at any time within the first two weeks...

COMMENT: Any time a respirator becomes uncomfortable, the user should select a new facepiece and be retested. **Change Item 11 to 12.**

RESOLUTION: 12. The test subject shall be given the opportunity to select a different facepeice and to be retested if the respirator becomes uncomfortable.

(32) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

II. Current Fit Test Protocols

A. The employer shall include the following....

12. The employer shall maintain a record of the fit test administered to an employee. The record shall contain at least:.....

COMMENT: Better clarity. **Item 12 should be 13 with the additional items added.**

RESOLUTION: II. Current Fit Test Protocols

A. The employer shall include the following....

13. The employer shall maintain a record of the fit test administered to an employee. The record shall contain at least:.....

(f)approved protection factor
(g)NIOSH certification number
(h)fit test operator
(i)expiration of fit test

(33) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

II. Current Fit Test Protocols

A. The employer shall include the following....

14. Exercise regimen. Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject .....

COMMENT: **It should be optional for the fit-test wearer to wait five minutes before beginning fit-test. End user does not wait five minutes before starting to work when using a respirator. Item 13 should be 14.**

RESOLUTION: II. Current Fit Test Protocols

A. The employer shall include the following....

14. Exercise regimen. Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject's responsibilities during the test procedure. The description of the process shall include a description of the test exercises that the subject will be performing. **Deleted last sentence.**

(34) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

II. Current Fit Test Protocols

A. The employer shall include the following....

14. Test Exercises

(f) Grimace. The test subject shall grimace by smiling or frowning.

COMMENT: Reflects workplace conditions. **Item 14 should be 15.**

RESOLUTION: II. Current Fit Test Protocols

A. The employer shall include the following....

15. Test Exercises

(f) Grimace. The test subject shall grimace by smiling **AND** frowning.

(35) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

II. Current Fit Test Protocols

A. The employer shall include the following....

14.Test Exercises

(g) Bending over. The test subject shall bend at the waist as if he/she were to touch his/her toes.....

COMMENT: The last sentence is in violation with the American Disabilities Act. **Item 13 should be 14.**

RESOLUTION: II. Current Fit Test Protocols

A. The employer shall include the following....

15. Test Exercises

(g) Bending over. The test subject shall bend at the waist as if he/she were to touch his/her toes. **DELETE LAST SENTENCE.**

(36) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)
II. C. Quantitative Fit Test Protocol
(1) (b) ...calibrate equipment and....

COMMENT: Respirator Fit-Test personnel cannot calibrate certain quantitative fit-test devices on site, e.g., PORTACOUNT devices. These fit-test devices must be calibrated by the manufacturer.

RESOLUTION: Amend the above statement to read....are able to calibrate, if applicable, and perform tests properly...

(37) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)
II. C. Quantitative Fit Test (QNFT) Protocol

COMMENT: Proposed standard does not address specifics of PORTACOUNT or the Dynatech proposed protocol. Current protocol in Appendix A II. C. only addresses corn oil or sodium chloride.

RESOLUTION: Amend all places throughout Appendix A II. C. to permit use of the PORTACOUNT and Dynatech 2000 protocols as approved quantitative devices.

The PORTACOUNT measures respirator fit by comparing the concentration of microscopic particles outside the respirator to the concentration of particles that have leaked into the respirator. The ratio of these two concentrations is called a fit factor. The PORTACOUNT has two sample tubes, one samples the ambient air and the other attaches to the respirator and samples from inside it. A valve inside the PORTACOUNT switches from one tube to the other according to the sequence. The PROTACOUNT is based on a miniature, Continuous-flow Condensation Nucleus Counter (CNC). A CNC takes particles that are too small to be easily detected, grows them to a larger, easily detectable size, and then counts them. The PORTACOUNT grows sub micrometer particles to super micrometer alcohol droplets and then measures the concentration of the alcohol droplets. This makes the PORTACOUNT sensitive to particles having diameters as small as 0.02 micrometer, but insensitive to variations in particle size shape, composition, and refractive index. Thus, quantitative fit testing can be performed with virtually any aerosol, including ambient air.

(38) ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

II. C. 4. Procedural Requirements

(h) In order to successfully complete a QNFT three successful fit tests are required.

COMMENT: Three fit tests versus one fit test does not afford greater protection. Especially when proposed fit factors are 100 for half face respirators and 500 for full face respirators.

Attached data will show there is no difference statistically between the three individual tests an asbestos worker is required to do.

See Attachment A For Details

RESOLUTION: Appendix A.

II. C. 4. Procedural Requirements

(h) In order to successfully complete a QNFT, **ONE** successful fit test is required. The results of the fit test must exceed the minimum fit factor needed for the class of respirator (e.g. quarter facepiece)...

(39)ISSUE: Appendix A: Fit Testing Procedures (Mandatory)

II. C. 4. Procedural Requirements

(j) Interpretation of test results.

COMMENT: Three fit tests versus one fit test does not afford greater protection. Especially when proposed fit test factors are 100 for half face respirators and 500 for full face respirators.

RESOLUTION: Appendix A.

C. 4. Procedural Requirements

(j) Interpretation of test results. The fit factor established by the quantitative fit **test** shall be **the** fit factor value.

(40) ISSUE: 29 CFR 1910.1001 Asbestos
(g) (4) (ii) For each...either quantitative or qualitative face fit tests at the time of initial fitting and **at least every six months...**

COMMENT: Research shows that employee protection is not enhanced by having fit testing on a more frequent basis than once a year, i.e. in 29 CFR 1910.1018 (h)(3)(iii), 29 CFR 1910.1025 (f)(3)(ii), and 29 CFR 1910.1045 (h)(3)(ii)(B).

RESOLUTION: 29 CFR 1910.1001 Asbestos
(g) (4) (ii) For each...either a quantitative or qualitative face fit tests at the time of initial fitting and **annually thereafter.**

(41) ISSUE: 29 CFR 1910.1018 Inorganic Arsenic
(h)(3)(iii) For each ..either quantitative or qualitative face fit tests at the time of initial fitting and **at least semiannually thereafter...**

COMMENT: Research shows that employee protection is not enhanced by having fit testing on a more frequent basis than once a year. Also, this requirement should depend on number of employees.

RESOLUTION:: 29 CFR 1910.1018 Inorganic Arsenic
(h)(3)(iii)For each employee wearing negative pressure respirators or tight fitting positive pressure respirators, employers shall perform either quantitative or qualitative face fit tests at the time of initial fitting and **annually thereafter.**

(42) ISSUE: 29 CFR 1910.1025 Lead
(f)(3)(ii) Employers shall...either quantitative or qualitative face fit tests at the time of initial fitting and **at least every six months...**

COMMENT: Research shows that employee protection is not enhanced by having fit testing on a more frequent basis than once a year.

RESOLUTION: 29 CFR 1910.1025 Lead
(f)(3)(ii)For each employee wearing negative pressure respirators or tight fitting positive pressure respirators, employers shall perform either quantitative or qualitative face fit tests at the time of initial fitting and **annually thereafter.**

(43) ISSUE: 29 CFR 1910.1045 Acrylonitrile
(h)(3)(iii)(A)and (h)(3)(iii)(B)

COMMENT: Research shows that employee protection is not enhanced by having fit testing on a more frequent basis than once a year.

RESOLUTION: **Revised and renumbered** 29 CFR 1910.1045 Acrylonitrile
(h) (3)(iii)(A) For each employee wearing negative pressure respirators or tight fitting positive pressure respirators, employers shall perform either quantitative or qualitative face fit tests at the time of initial fitting and **annually thereafter.**

92-M-0527-02

Internal Correspondence

MARTIN MARIETTA

54-410B

MARTIN MARIETTA ENERGY SYSTEMS, INC.

May 27, 1992

J. L. Sherrill, 9106, MS-8023

Analysis of Three Plant Respirator Fit Data

Workers who may be exposed to hazardous materials are required to be fit for a respirator on a periodic basis, depending on the activity and risk of exposure. Since 1989 all three plants have tracked this respirator fit data electronically. Analysis of these data has provided insight into the respirator use complex wide. The data are non-normal; hence the mean makes a poor indicator of central tendency so the median has been used to make comparisons. We found that the plants did not have the same experiences with the same mask, that the MSA COMFO II generally provided the least protection, and that half masks in general provided less protection. Portacount performance is very uniform, but variability has been increasing since January 1991 probably due to better record keeping. Talking while using a mask reduces its effectiveness as suggested by the RR activity producing consistently lower fit factor estimates. Finally, the three consecutive fits required semiannually for asbestos workers are not statistically different. This implies that these measurements are redundant and do not enhance the worker's level of protection whatsoever.

DETAILS

I received 20,792 records containing information about the respirator fits conducted between January 1, 1988, and April 15, 1992, at K-25, X-10, and Y-12. The data files are not completely compatible since X-10 does not enter portacount identifiers or sequence numbers for asbestos worker fits; but for the major portion of this analysis, the data were sufficiently compatible to be comparable.

The attached Table 1 summarizes the date ranges and frequency counts for the individual fits at each site. A further breakdown is shown in the frequency charts in the attached Figure 1. Y-12 has conducted more fits per year than other sites since 1990 with their total in 1991 exceeding the sum of the frequencies at the other sites.

The data were analyzed in groups according to plant, mask, and mask size. PROC UNIVARIATE in the SAS system was used. The data were identified as from a non-normal distribution with the means severely effected by a few high values. After some investigation of the fit factor using PROC CAPABILITY in the SAS system, it was apparent that the data did not follow any known distribution. The attached Table 2 presents the frequencies for mask, mask type, and mask size groupings by plant. The attached Table 3 presents the means for these groupings, and the attached Table 4 presents the medians. The mean is the algebraic average and in this case is a poor indicator of central tendency. The median is the value at the 50th percentile, or in other words, the middle value. It is the best indicator of centrality for the data. Cells with N less than ten have too few observations to provide valid conclusions.

The attached Figure 2.1 shows the medians by plant and mask for all half masks. The attached Figure 2.2 shows the medians by plant and mask for all full masks. A large value implies a better fit, a low one, a poorer fit. From these figures we can deduce that the MSA COMFO II half mask performed uniformly poorly in all fits. These values were not below acceptable values, just much lower than other masks. Y-12 had low performance on all half mask fits as compared to the other sites. The full mask fits seemed to be more variable but tended to be a factor of ten' higher than the half mask medians.

The attached Figures 3.1 and 3.2 show similar information but include a shape function to identify when frequencies are less than 10, between 10 and 100, and over 100. This is useful in identifying which groupings provide data from which valid conclusions can be made. As you can see in Figure 3.2, the full mask groups with the very large medians are both too small to make any conclusion from that data. Mask size appears to be a significant factor for all full masks and the Survivair. The pattern for the Survivair appears to indicate that more care needs to be taken in fitting the mask size. Large and small masks appear to be better fit, while the medium size appears to have a less good fit. From Figure 3.2 it appears K-25 and Y-12 have had similar experience fitting the Ultraview. From Figure 3.1 the fit experience on the Survivair varies greatly from plant to plant.

The attached Figures 4.1 and 4.2 display the medians in plant, mask, mask type, and year groupings. Here the size of the symbol indicates the number of observations in each group. In general we can conclude that our year-to-year performance at all sites is not erratic. The only exception to this is at Y-12 where the ULTRAVIEW fits for 1992, 1991, and 1990 are much better than the fits in 1989 and 1988.

The attached Figure 5 helps evaluate the effect of glasses on the medians of the plant and mask groupings. Glasses are evaluated for full mask fits only, and the indication is that the fit is not affected by the person wearing glasses.

The attached Figure 6 is a block chart showing the population breakdown within the mask and plant groupings. The intervals are logarithmic and show missing data as well. Much of the 1988 data is simply demographics of who was fit, without a fit factor being determined. This chart corresponds to Table 2 frequencies, but the intervals are of actual fit factors, not means or medians. This gives you an idea of the population distribution. If the shaded areas within the blocks were of uniform size, the data would be exponential; as you can see, it is not.

The attached Figures 7.1 to 7.15 show plots of the fit factor for each plant and mask grouping by date. Each day's result is connected and the mean marked with a bar. As you can see, in most cases, a single high fit factor reading can tremendously effect the daily mean. It is apparent from the plots that we are missing X-10 data from September 1990 through January 1991. It appears that at Y-12 the Survivair and Ultraview fits have been yielding larger fit factors since August 1990. The data appear to be much more variable in that time span as well.

The attached Table 5 and Figures 8.1 to 8.3 provide summary information on the nine activities an individual being fit is asked to perform. When activity made a difference in the fit factor, it appears that RR always produced the lowest factor; no other activity seemed to have a predictable effect. Most of the half masks were much less affected than the full masks. K-25 and Y-12 data had similar patterns; X-10 appeared to be more random. Although there are variations among the medians of the activities because of the large variation within each activity, they are not statistically different.

The attached Tables 6 and 7 and Figures 9.1 to 9.2 and 10.1 to 10.14 depict the portacount performance. Only K-25 and Y-12 track which portacount machine was used for a particular fit test. In general, portacounts performed very uniformly by mask as shown in Table 6 and in Figures 9.1 and 9.2. Also to be noted is that there are two models, the 8010 and the newer 8020. Table 7 gives comparisons over all masks and by mask. K-25 has only 8010s and only three designated portacounts. At Y-12 considerable confusion has taken place in the identification of the new model 8020s. Old portacount identifications have been used with the new portacount machines; hence any discussion about portacount machines will be biased with these data. Figures 10.1 to 10.10 show when changes began taking place. The 8020s tend to be somewhat less variable but not sufficient to make them statistically different at the 95 percent level. As we compile a larger historical sample and rigidly control the portacount identification, we should be able to define any differences as they arise.

A particular subgroup of the data is sufficiently important to warrant discussion. That is the data compiled on asbestos workers. The attached Figure 11.1 shows the relationships between the first, second, and third fits, as designated by sequence number, that comprise an asbestos worker's fit test. Once again, I caution you that only the medium and large balloons are used to draw conclusions. There is no statistical difference between these fit factor medians grouped by sequence number. Figure 11.2 shows similar data, with sequence numbers assigned for data in the database where records were entered without sequence number. Here the first fit appears to generally produce the smallest fit factor. The major exception is the Y-12 Ultraview where the rule appears to be broken. These fit factor medians are, however, not statistically different, and the additional tests are redundant. This subgroup of information is dealt with separately in another communication.

In summary, the three plant respirator fit data are non-normal, and the median is the best measure of central tendency. The P95-P5 range is be best indicator of dispersion. The half masks performed significantly worse than the full masks. Plant, mask type, mask size, and mask are all significant in classification of fit factors into groups. The wearing of glasses has little or no effect on full mask fit factors. The reading activity (RR) in the test produces the lowest fit factor value. Portacounts were very uniform in performance, but variability on all are increasing since January 1991. Finally, there appears to be no difference statistically between the three individual tests an asbestos worker is required to do.

Please contact me if you have any questions or comments.

Laura A. Johnson

Laura A. Johnson, 9119, MS-8234 (4-1935) - RC

Attachments

cc w/att: M. H. Burnett
R. S. Leete
M. W. Sherrill
File-LAJ

+OUTPUT

Command ——>

THREE PLANT RESPIRATOR FIT DATA 1

DATE RANGES IN DATA BY PLANT

12:16 Thursday, April 30, 1992

OBS	PLANT	_TYPE_	_FREQ_	N	MIN	MAX
1		0	20792	20792	06JAN88	13APR92
2	K	1	6045	6045	04OCT89	07FEB92
3	X	1	4371	4371	25APR89	26FEB92
4	Y	1	10376	10376	06JAN88	13APR92

TABLE 1

TABLE 2

THREE PLANT RESPIRATOR FIT DATA 09:07 Thursday, Apri

			TOTAL FITTINGS			
			PLANT			
			K	X	Y	ALL
MMASK	MTYPE	MSIZE				
MSA COMFO ELITE	HALF	LARGE	4	.	447	451
		MEDIUM	9	3	919	931
		SMALL	1	.	82	83
		ALL	14	3	1448	1465
MSA COMFO II	HALF	MSIZE				
		LARGE	386	458	744	1588
		MEDIUM	1382	884	2775	5041
		SMALL	53	32	95	180
		ALL	1821	1374	3614	6809
MSA ULTRATWIN	FULL	MSIZE				
		LARGE	.	446	.	446
		MEDIUM	4	1064	8	1076
		SMALL	3	113	1	117
		ALL	7	1623	9	1639
MSA ULTRAVUE	FULL	MSIZE				
		LARGE	494	2	530	1026
		MEDIUM	3329	14	3772	7115
		SMALL	244	1	657	902
		ALL	4067	17	4959	9043

TABLE 2. (continued)

THREE PLANT RESPIRATOR FIT DATA (CONTINUED) 09:07 Thursday, April 30, 1992

			TOTAL FITTINGS			
			PLANT			
			K	X	Y	ALL
MMASK	MTYPE					
SURVIVAIR	HALF	MSIZE				
		LARGE	23	16	44	83
		MEDIUM	84	81	181	346
		SMALL	29	56	120	205
		ALL	136	153	345	634

TABLE 3

THREE PLANT RESPIRATOR FIT DATA 09:07 Thursday, Apri

			PLANT							
			K		X		Y		ALI	
			N	MEAN	N	MEAN	N	MEAN	N	M
MMASK	MTYPE	MSIZE								
MSA COMFO ELITE	HALF	LARGE	4	8713	.	.	447	3743	451	
		MEDIUM	9	4419	3	8562	919	4925	931	
		SMALL	1	398	.	.	82	2295	83	
MSA COMFO II	HALF	LARGE	386	10048	458	8021	744	2334	1588	
		MEDIUM	1382	11523	884	2693	2775	6189	5041	
		SMALL	53	1294	32	2493	95	3514	180	
MSA ULTRAT-WIN	FULL	LARGE	.	.	446	9539	.	.	446	
		MEDIUM	4	35304	1064	9594	8	16088	1076	
		SMALL	3	9044	113	10417	1	282	117	
MSA ULTRAV-UE	FULL	LARGE	494	17711	2	25448	530	16559	1026	
		MEDIUM	3329	21717	14	8485	3772	20908	7115	
		SMALL	244	15359	1	2346	657	16597	902	
SURVIV-AIR	HALF	LARGE	23	12338	16	30760	44	4496	83	
		MEDIUM	84	6799	81	9868	181	5232	346	
		SMALL	29	8235	56	17887	120	2691	205	

TABLE 4.

THREE PLANT RESPIRATOR FIT DATA 1

15:45 Tuesday, May 19, 1992

			PLANT					
			K		K	X		X
			N Median	Median	RANGE	N Median	Median	RANGE
Mask	Type	MSIZE						
MSA COMFO ELITE	HALF	LARGE	4	5,656	2,849	.	.	.
		MEDIUM	9	1,246	2,364	3	5,858	1,518
		SMALL	1	398	0	.	.	.
MSA COMFO II	HALF	LARGE	386	532	2,988	458	201	1,332
		MEDIUM	1382	470	2,634	884	244	2,493
		SMALL	53	371	959	32	180	2,355
MSA ULTRAT-WIN	FULL	LARGE	.	.	.	446	5,178	5,046
		MEDIUM	4	29,171	6,174	1064	5,180	4,714
		SMALL	3	9,163	154	113	6,166	6,705
MSA ULTRAV-UE	FULL	LARGE	494	11,028	9,432	2	25,448	1,098
		MEDIUM	3329	11,247	10,441	14	3,301	8,331
		SMALL	244	7,972	8,250	1	2,346	0
SURVIV-AIR	HALF	LARGE	23	3,392	8,793	16	7,609	16,645
		MEDIUM	84	1,386	4,285	81	3,228	7,206
		SMALL	29	3,298	7,238	56	7,655	11,425

(CONTINUED)

TABLE 4. (continued)

THREE PLANT RESPIRATOR FIT DATA

15:45 Tuesday, May 19,

			PLANT Y N Median	PLANT Y Median	PLANT Y RANGE
Mask	Type	MSIZE			
MSA COMFO ELITE	HALF	LARGE	447	641	2,420
		MEDIUM	919	631	2,833
		SMALL	82	545	1,867
MSA COMFO II	HALF	LARGE	744	262	722
		MEDIUM	2775	420	1,924
		SMALL	95	259	850
MSA ULTRAT-WIN	FULL	LARGE	.	.	.
		MEDIUM	8	7,922	8,106
		SMALL	1	282	0
MSA ULTRAV-UE	FULL	LARGE	530	10,152	8,692
		MEDIUM	3772	12,488	10,989
		SMALL	657	9,228	9,805
SURVIV-AIR	HALF	LARGE	44	1,034	3,119
		MEDIUM	181	930	3,219
		SMALL	120	655	1,894

TABLE 5

THREE PLANT RESPIRATOR FIT DATA 09:07 Thursday, April 30, 1992

PLANT K

	Actions FF								
	fF		BN		BD		TH		ND
	N	MEDIAN	N	MEDIAN	N	MEDIAN	N	MEDIAN	N
Mask									
MSA COMFO ELITE	14	2,636	14	3,490	14	3,000	14	2,990	
MSA COMFO II	1821	479	1821	441	1821	454	1821	526	18
MSA ULTRATWIN	7	22,916	7	41,100	7	26,200	7	20,800	
MSA ULTRAVUE	4067	11,060	4067	12,200	4067	10,500	4067	14,300	40
SURVIVAIR	136	2,327	136	1,695	136	2,115	136	1,955	1

(CONTINUED)
PLANT K

	Actions FF								
	ND	RR		GM		BO		JP	
	MEDIAN	N	MEDIAN	N	MEDIAN	N	MEDIAN	N	MED
Mask									
MSA COMFO ELITE	4,465	14	1,580	14	526	14	2,835	14	3,
MSA COMFO II	531	1821	450	1821	380	1821	412	1821	
MSA ULTRATWIN	45,300	7	5,600	7	8,420	7	15,500	7	22,
MSA ULTRAVUE	15,100	4067	5,600	4067	8,760	4067	7,600	4067	10,
SURVIVAIR	2,750	136	1,385	136	376	136	1,005	136	1,

(CONTINUED)

TABLE 5. (continued)

PLANT K

	Actions FF	
	BN9	
	N	MEDIAN
Mask		
MSA COMFO ELITE	14	6,595
MSA COMFO II	1821	477
MSA ULTRATWIN	7	16,400
MSA ULTRAVUE	4067	12,700
SURVIVAIR	136	2,645

TABLE 5. (continued)

THREE PLANT RESPIRATOR FIT DATA 09:07 Thursday, April 30, 1992

PLANT X

	Actions FF								
	fF		BN		BD		TH		ND
	N	MEDIAN	N	MEDIAN	N	MEDIAN	N	MEDIAN	N
Mask									
MSA COMFO ELITE	3	5,858	3	10,200	3	12,600	3	7,590	
MSA COMFO II	1374	228	1373	202	1373	216	1373	228	13
MSA ULTRATWIN	1623	5,270	1623	3,120	1623	3,800	1623	4,520	16
MSA ULTRAVUE	17	3,710	17	6,220	17	3,970	17	5,200	
SURVIVAIR	153	5,601	153	3,550	153	3,710	153	3,640	1

(CONTINUED)
PLANT X

	Actions FF								
	ND	RR		GM		BO		JP	
	MEDIAN	N	MEDIAN	N	MEDIAN	N	MEDIAN	N	MED
Mask									
MSA COMFO ELITE	2,510	3	1,970	3	3,210	3	6,220	3	3,
MSA COMFO II	226	1373	229	1373	176	1373	194	1373	
MSA ULTRATWIN	5,150	1623	2,680	1623	3,050	1623	3,720	1623	5,
MSA ULTRAVUE	3,880	17	1,990	17	4,950	17	1,240	17	1,
SURVIVAIR	4,800	153	1,960	153	1,880	153	3,590	153	3,

(CONTINUED)

TABLE 5. (continued)

PLANT X

	Actions FF BN9	
	N	MEDIAN
Mask		
MSA COMFO ELITE	3	10,100
MSA COMFO II	1373	216
MSA ULTRATWIN	1624	5,680
MSA ULTRAVUE	17	3,270
SURVIVAIR	153	4,140

TABLE 5. (continued)

THREE PLANT RESPIRATOR FIT DATA 09:07 Thursday, April 30, 1992

PLANT Y

	Actions FF								
	fF		BN		BD		TH		ND
	N	MEDIAN	N	MEDIAN	N	MEDIAN	N	MEDIAN	N
Mask									
MSA COMFO ELITE	1448	626	1448	715	1448	758	1448	823	14
MSA COMFO II	3614	370	3614	408	3614	424	3614	459	36
MSA ULTRATWIN	9	6,914	9	14,200	9	12,300	9	9,360	
MSA ULTRAVUE	4959	11,760	4959	23,000	4959	13,900	4959	22,400	49
SURVIVAIR	345	872	345	3,180	345	3,350	345	4,470	3

(CONTINUED)
PLANT Y

	Actions FF								
	ND	RR		GM		BO		JP	
	MEDIAN	N	MEDIAN	N	MEDIAN	N	MEDIAN	N	MED
Mask									
MSA COMFO ELITE	845	1448	740	1448	625	1448	611	1448	
MSA COMFO II	446	3614	384	3614	353	3614	356	3614	
MSA ULTRATWIN	11,400	9	10,000	9	8,480	9	7,130	9	9,
MSA ULTRAVUE	23,000	4959	9,310	4959	12,800	4959	11,700	4959	12,
SURVIVAIR	5,390	346	928	346	937	345	1,360	345	1,

(CONTINUED)

TABLE 5. (continued)

PLANT Y

	Actions FF	
	BN9	
	N	MEDIAN
Mask		
MSA COMFO ELITE	1448	805
MSA COMFO II	3614	430
MSA ULTRATWIN	9	10,700
MSA ULTRAVUE	4959	23,800
SURVIVAIR	345	4,660

TABLE 6

THREE PLANT RESPIRATOR FIT DATA 09:48 Monday, May 4, 1992

			PLANT			
			K		Y	
			N	MEDIAN	N	MEDIAN
MODEL	Mask	PC_ID				
8010	MSA COMFO ELITE	1	1	20,316	203	639
		2	.	.	194	599
		3	7	3,989	152	561
		5	.	.	110	437
		6	.	.	21	590
		7	.	.	258	720
		8	.	.	216	718
		XXXXX	.	.	27	898
	MSA COMFO II	1	95	516	410	483
		2	148	652	431	413
		3	227	848	292	435
		5	.	.	193	354
		6	.	.	67	365
		7	.	.	285	501
		8	.	.	254	496
		XXXXX	.	.	39	262
	MSA ULTRATWIN	1	4	9,305	.	.
		2	2	46,359	3	5,942
		3	.	.	3	6,914
		5	.	.	1	34,646

(CONTINUED)

TABLE 6. (continued)

THREE PLANT RESPIRATOR FIT DATA 09:48 Monday,

			PLANT			
			K		Y	
			N	MEDIAN	N	MEDIAN
MODEL	Mask	PC_ID				
8010	MSA ULTRATWIN	6	.	.	1	51,961
	MSA ULTRAVUE	1	212	9,438	570	15,826
		2	339	10,822	558	16,756
		3	498	9,518	430	15,483
		5	.	.	269	12,707
		6	.	.	73	19,747
		7	.	.	633	16,556
		8	.	.	606	12,148
		XXXXX	.	.	107	10,145
	SURVIVAIR	1	7	430	14	1,855
		2	9	1,711	16	981
		3	19	1,320	11	1,896
		5	.	.	9	1,532
		6	.	.	1	10,282
		7	.	.	17	4,479
		8	.	.	26	1,642
		XXXXX	.	.	3	639
8020	MSA COMFO ELITE	1	.	.	5	574
		10	.	.	32	1,033
		11	.	.	98	585

(CONTINUED)

TABLE 6. (continued)

THREE PLANT RESPIRATOR FIT DATA 09:48 Monday, May 4, 1992

			PLANT			
			K		Y	
			N	MEDIAN	N	MEDIAN
MODEL	Mask	PC_ID				
8020	MSA COMFO ELITE	12	.	.	62	533
		2	.	.	1	797
		3	.	.	6	735
		5	.	.	11	525
		7	.	.	27	505
		9	.	.	6	1,278
		XXXXX	.	.	19	578
	MSA COMFO II	1	.	.	12	878
		10	.	.	29	1,069
		11	.	.	79	290
		12	.	.	51	318
		2	.	.	4	24,676
		3	.	.	9	980
		5	.	.	7	403
		7	.	.	27	706
		9	.	.	2	540
		XXXXX	.	.	18	1,354
	MSA ULTRAVUE	1	.	.	18	4,425
		10	.	.	72	11,956
		11	.	.	210	11,547

(CONTINUED)

TABLE 6. (continued)

THREE PLANT RESPIRATOR FIT DATA 09:48 Monday, 1

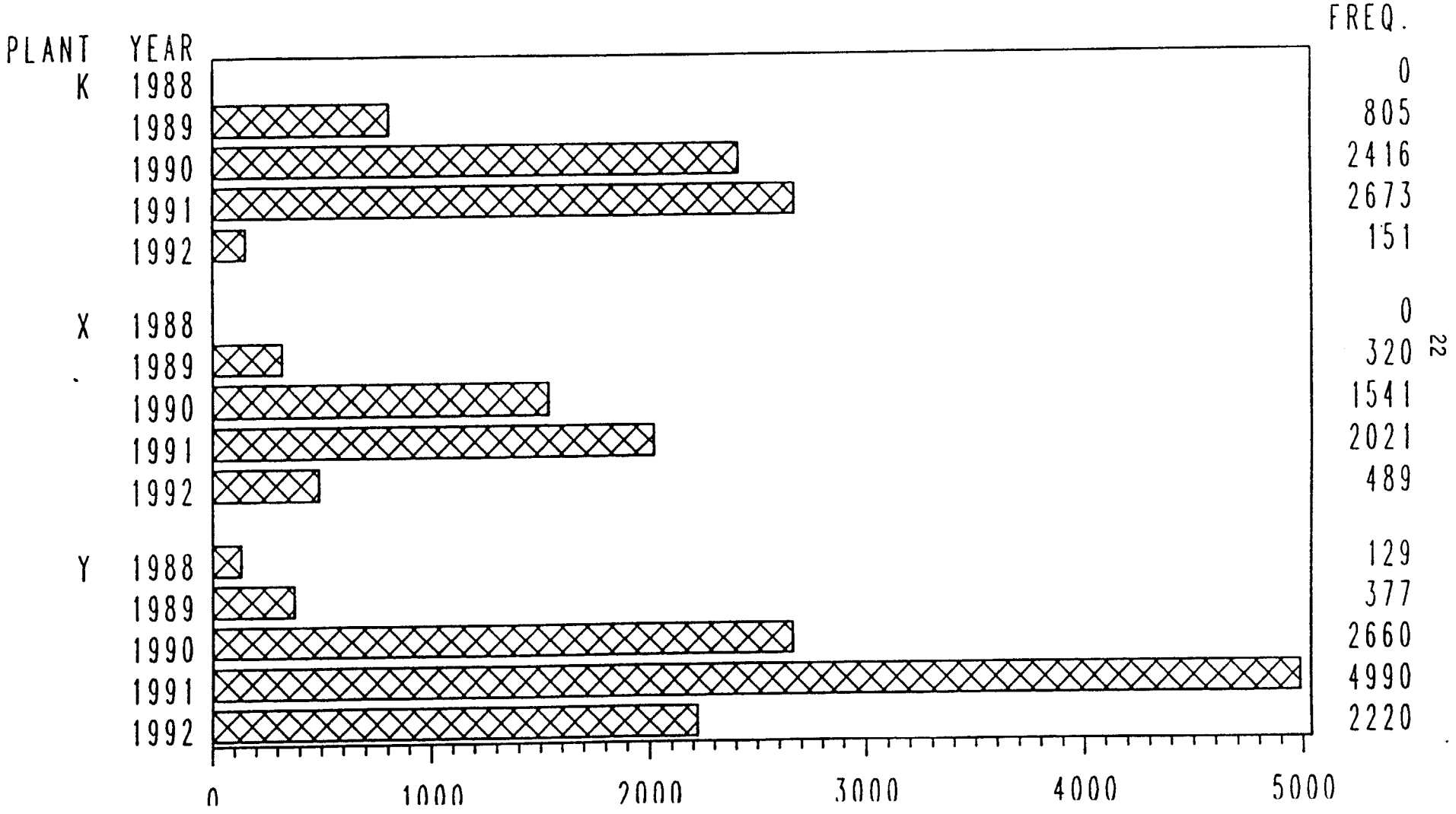
			PLANT			
			K		Y	
			N	MEDIAN	N	MEDIAN
MODEL	Mask	PC_ID				
8020	MSA ULTRAVUE	12	.	.	187	9,146
		2	.	.	4	15,539
		3	.	.	13	4,584
		4	.	.	3	6,970
		5	.	.	23	5,649
		7	.	.	68	10,116
		9	.	.	6	5,293
		XXXXX	.	.	41	10,671
	SURVIVAIR	1	.	.	1	975
		10	.	.	4	1,864
		11	.	.	13	640
		12	.	.	8	762
		5	.	.	3	460
		7	.	.	1	55,000
		9	.	.	3	624
		XXXXX	.	.	2	28,903

		PLANT					
		K		X		Y	
		N	MEDIAN	N	MEDIAN	N	MEDIAN
MODEL	Mask						
8010	ALL	6045	6,978	3170	1,869	9190	2,813
	MSA COMFO ELITE	14	2,636	3	5,858	1181	627
	MSA COMFO II	1821	479	1374	228	3376	364
	MSA ULTRATWIN	7	22,916	1623	5,270	9	6,914
	MSA ULTRAVUE	4067	11,060	17	3,710	4314	12,110
	SURVIVAIR	136	2,326	153	5,601	310	873
8020	ALL	.	.	.	.	1185	4,462
	MSA COMFO ELITE	.	.	.	.	267	618
	MSA COMFO II	.	.	.	.	238	446
	MSA ULTRAVUE	.	.	.	.	645	9,355
	SURVIVAIR	.	.	.	.	35	809

TABLE 7

THREE PLANT RESPIRATOR FIT DATA

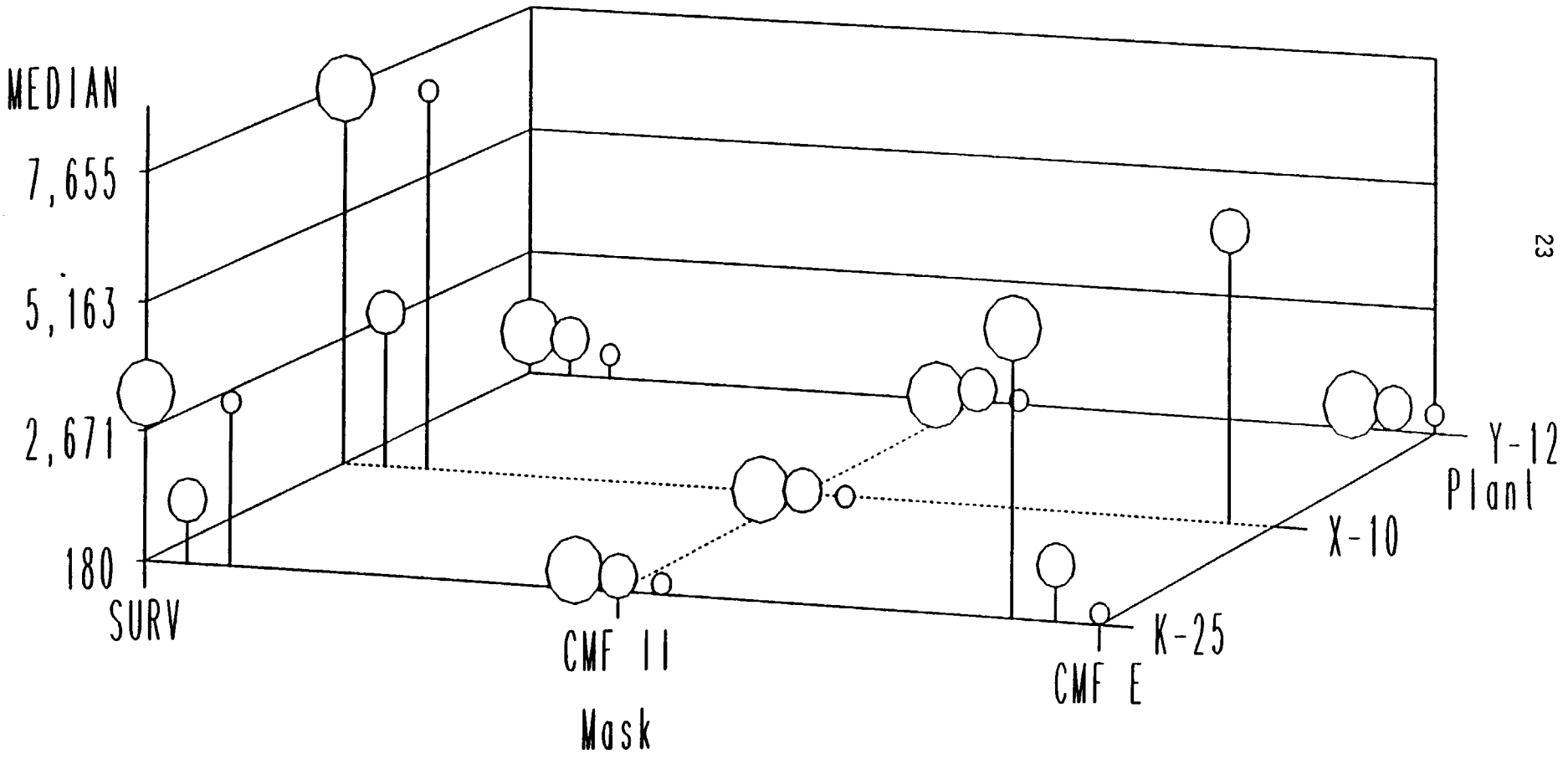
FREQUENCY BY YEAR



Three Plant Respirator Fit Data

Comparison of Medians

Mask Type=HALF

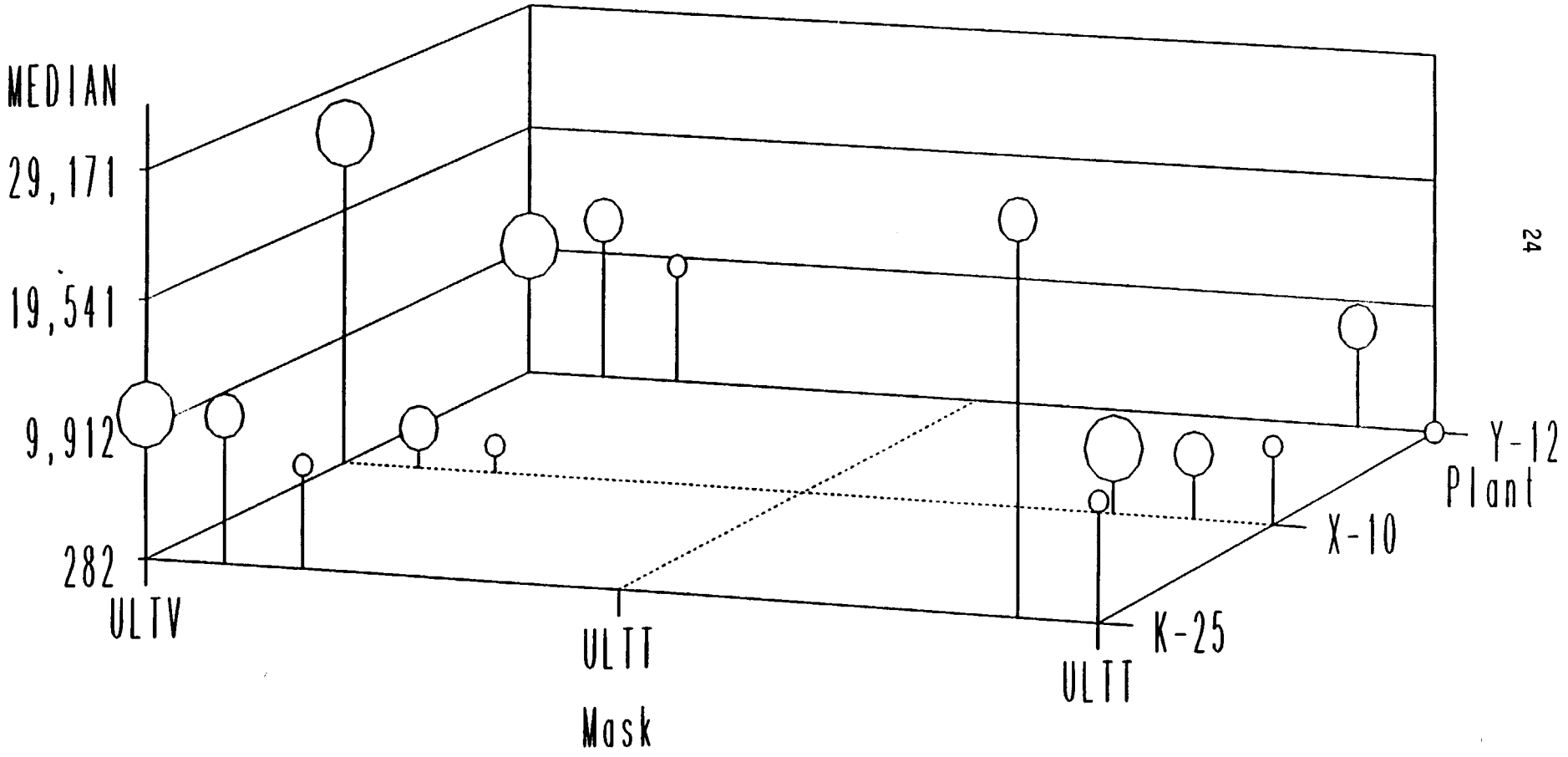


Size of Balloon is Size of Mask

Three Plant Respirator Fit Data

Comparison of Medians

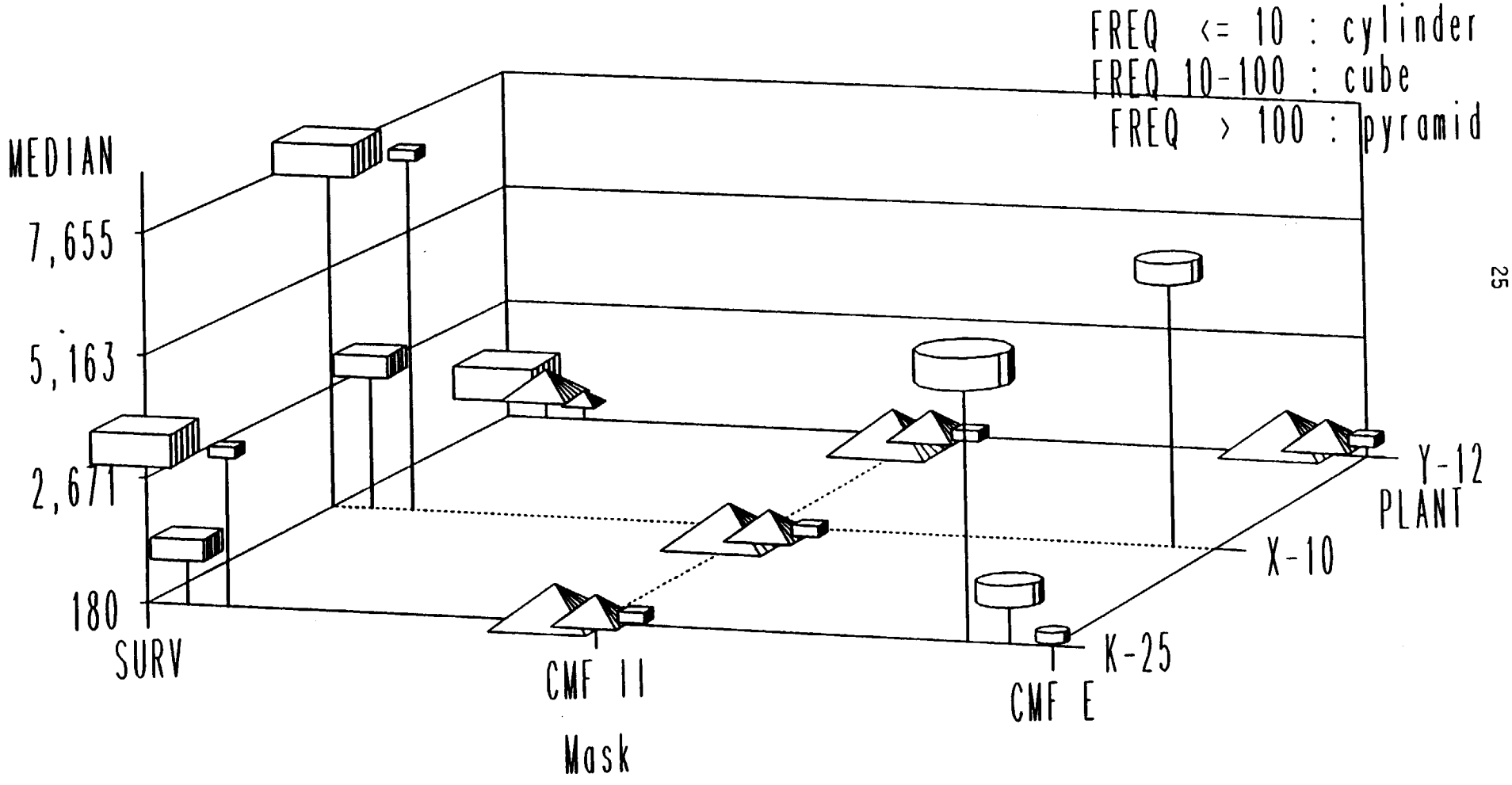
Mask Type=FULL



Three Plant Respirator Fit Data

Comparison of Medians

Mask Type:=HALF

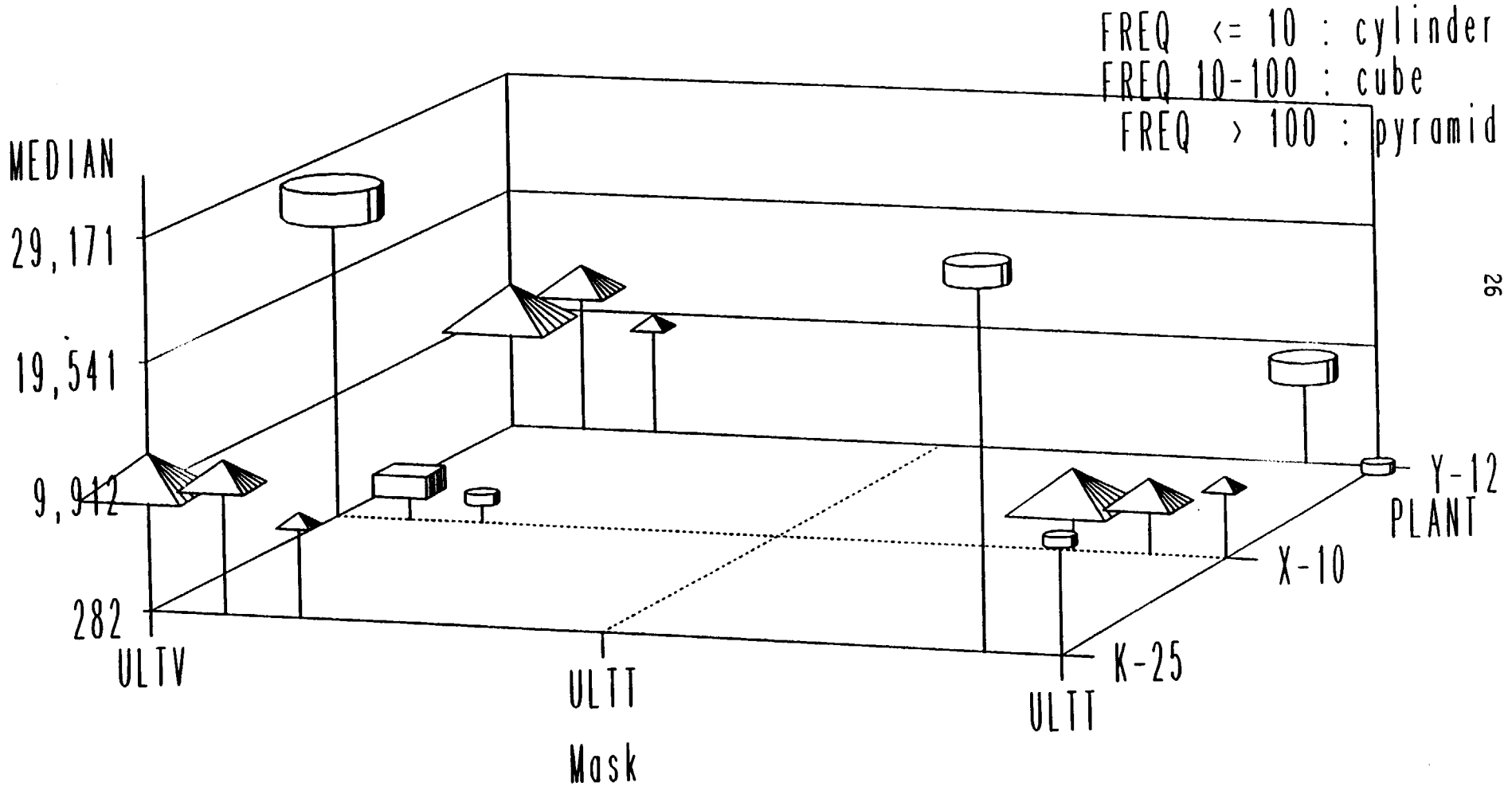


Size of figure is size of mask

Three Plant Respirator Fit Data

Comparison of Medians

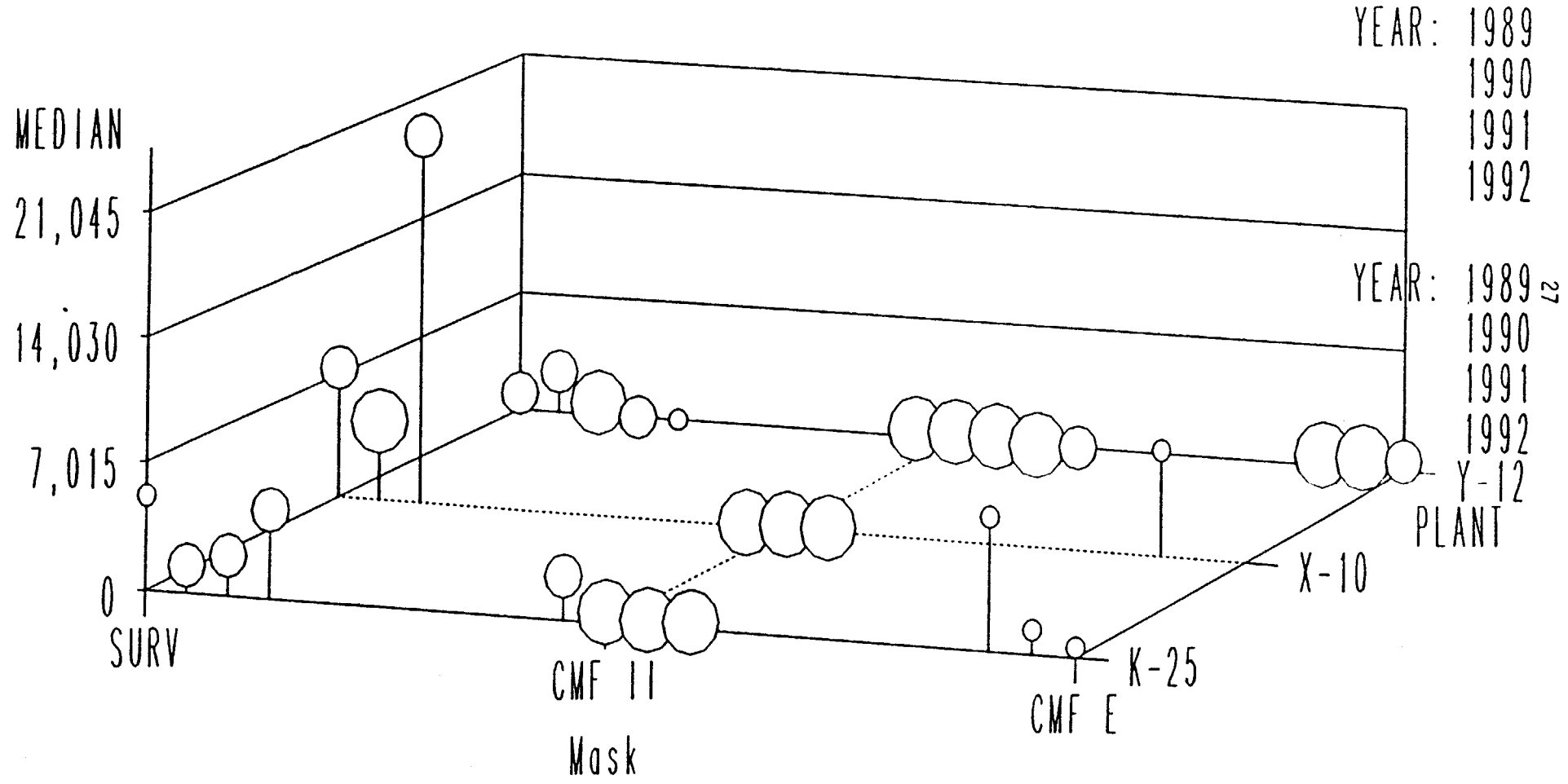
Mask Type:=FULL



Three Plant Respirator Fit Data

Comparison of Medians

Mask Type:=HALF



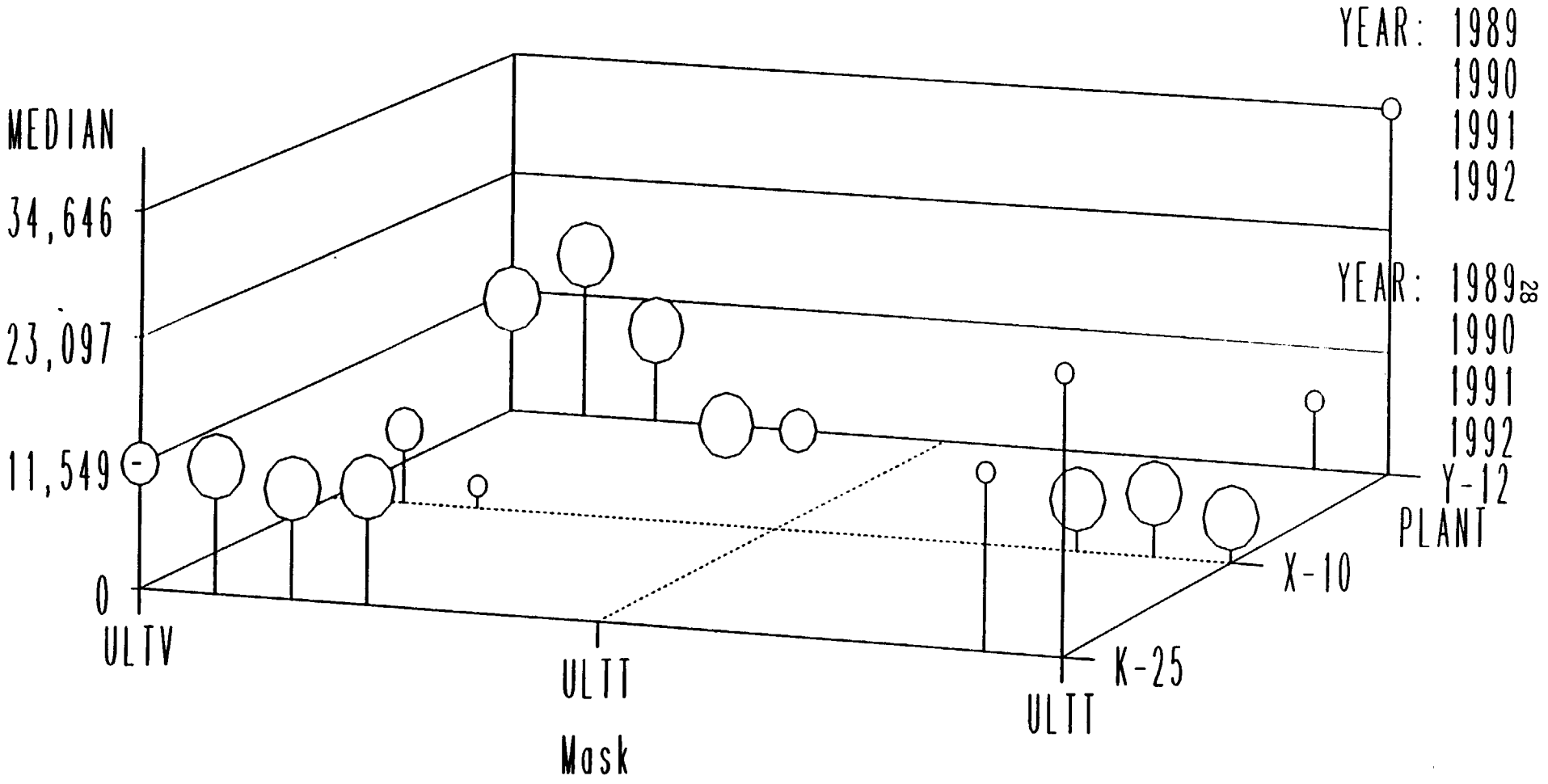
Balloon size denotes frequency
Small c=10
Med 10<N<100

~~Size of figure is size of mask~~

Three Plant Respirator Fit Data

Comparison of Medians

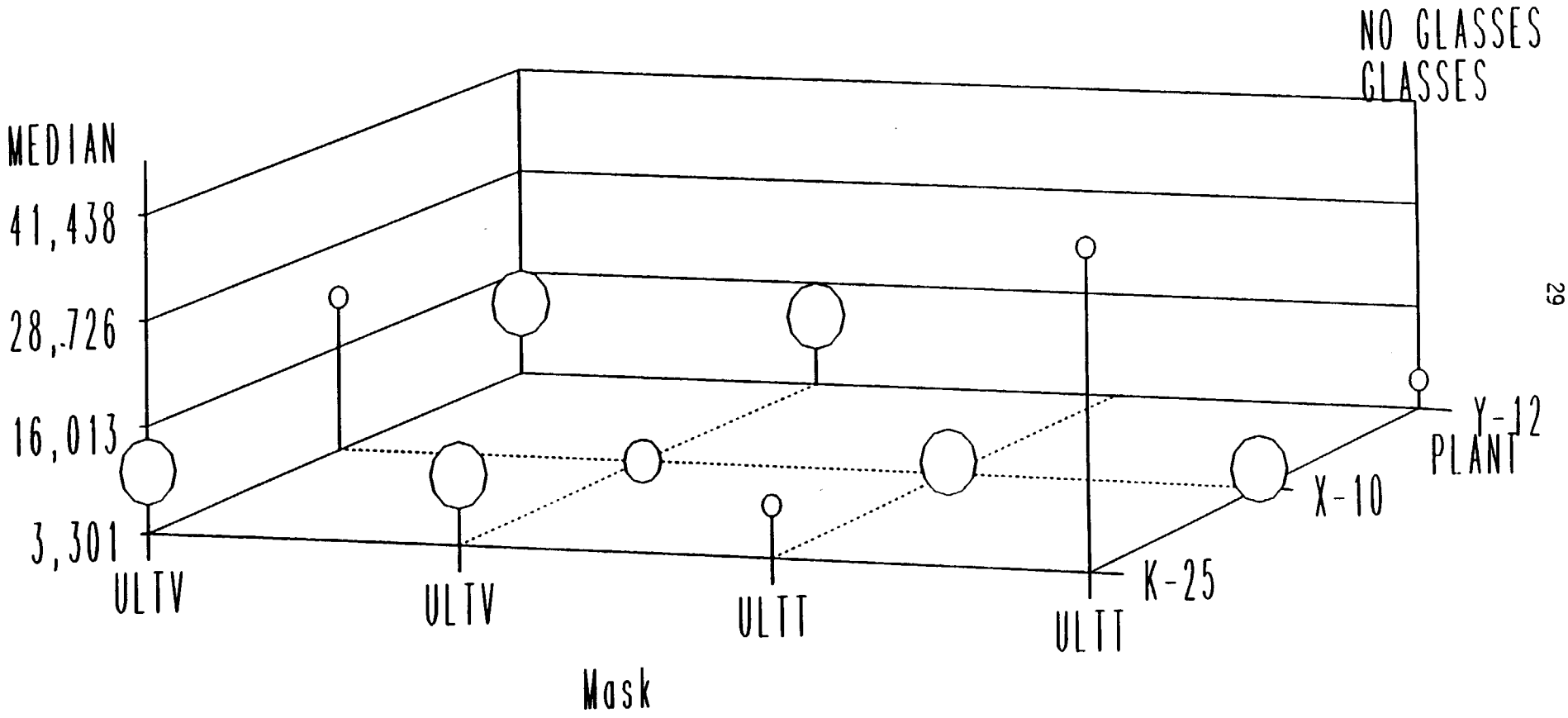
Mask Type:=FULL



Three Plant Respirator Fit Data

Comparison of Fit Factor Medians

Full Masks Only

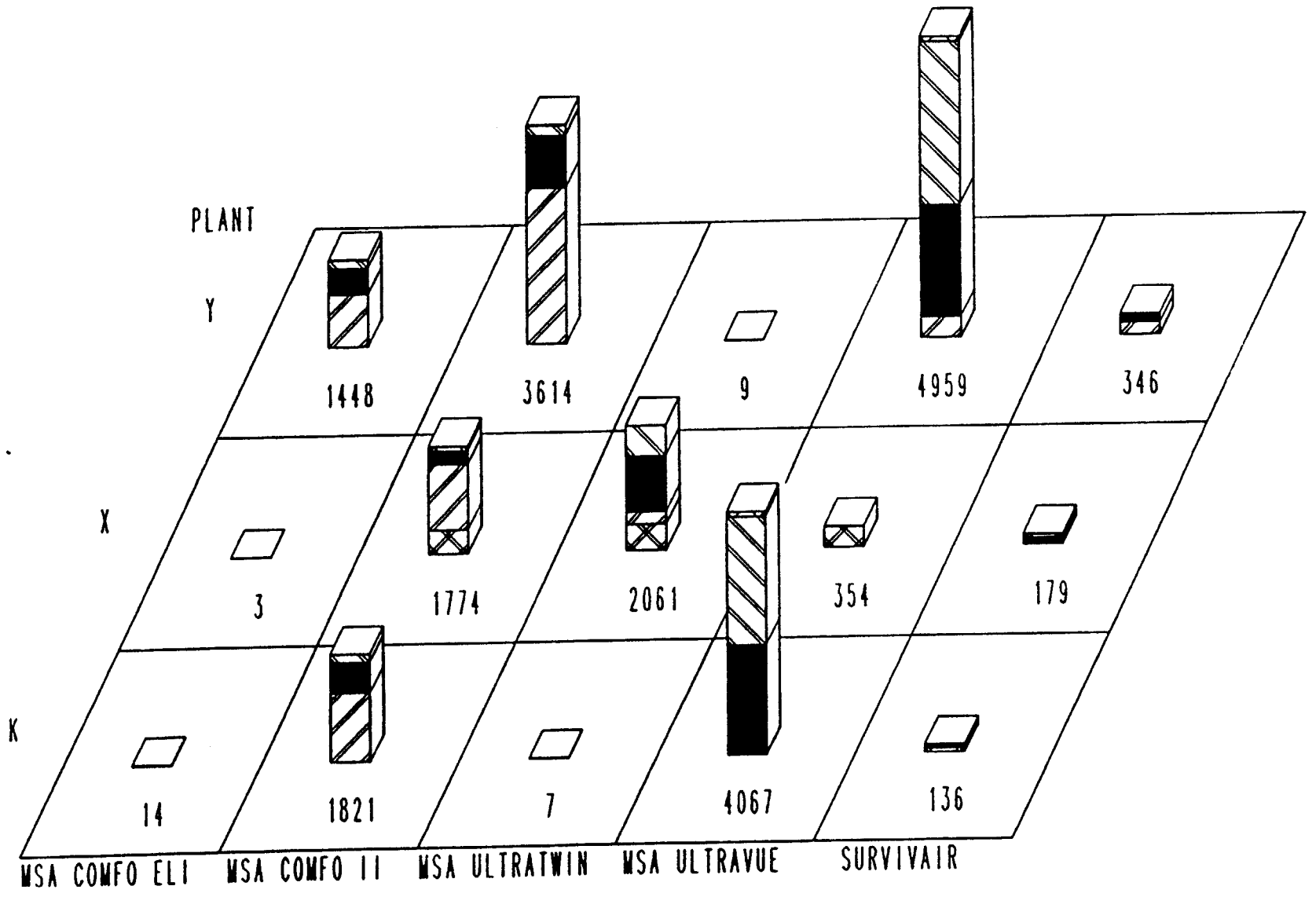


Balloon size denotes frequency
SMALL : N<=10
MEDIUM: 10<N<100
LARGE : N>=100

FIGURE 5

THREE PLANT RESPIRATOR FIT DATA

ALL WORKERS



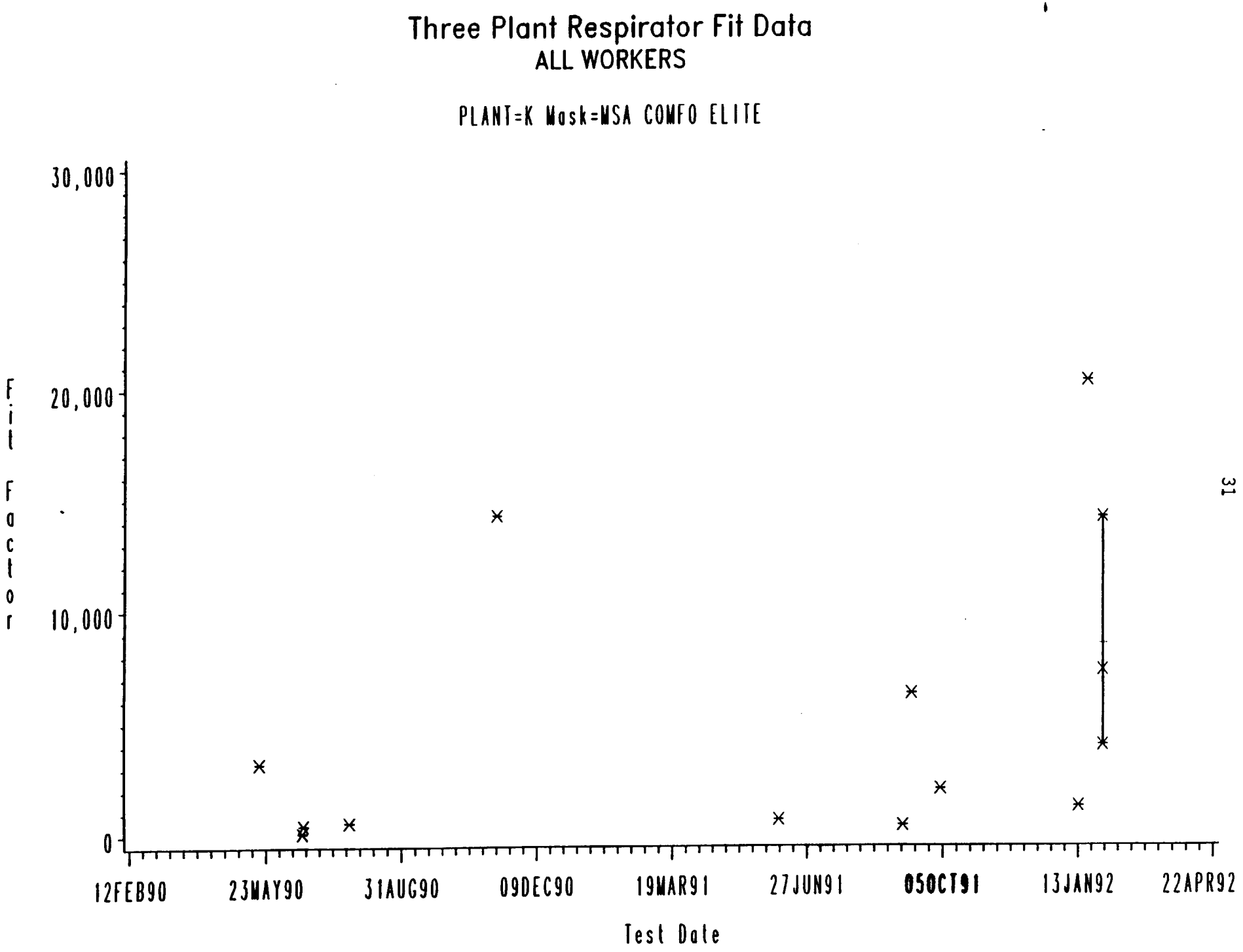
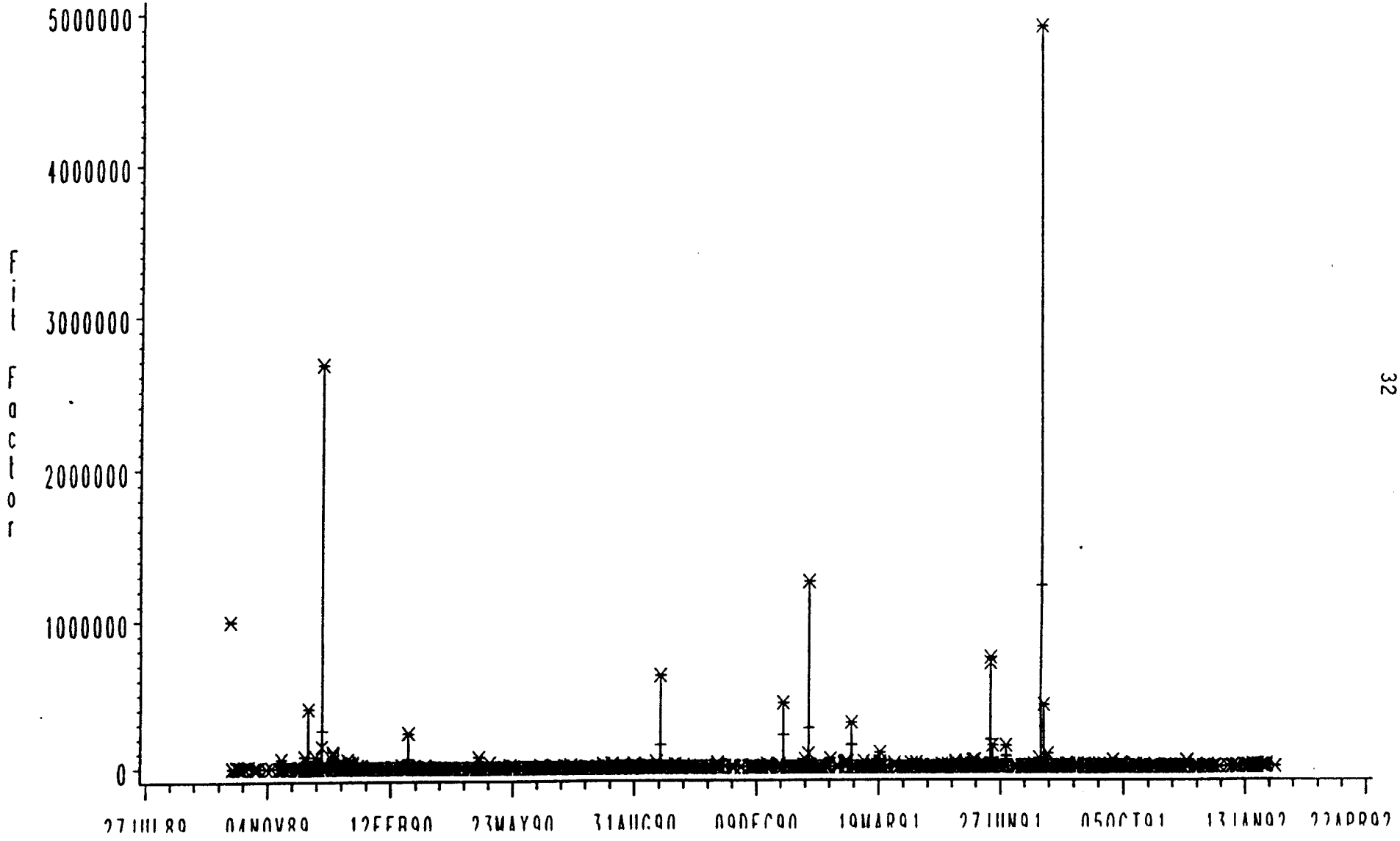

Three Plant Respirator Fit Data
ALL WORKERS
PLANT=K Mask=MSA COMFO ELITE
30,000
20,000
10,000
0
Fit Factor
12FEB90
23MAY90
31AUG90
09DEC90
19MAR91
27JUN91
05OCT91
13JAN92
22APR92
Test Date

FIGURE 7.1

Three Plant Respirator Fit Data
ALL WORKERS

PLANT=K Mask=MSA COMFO II



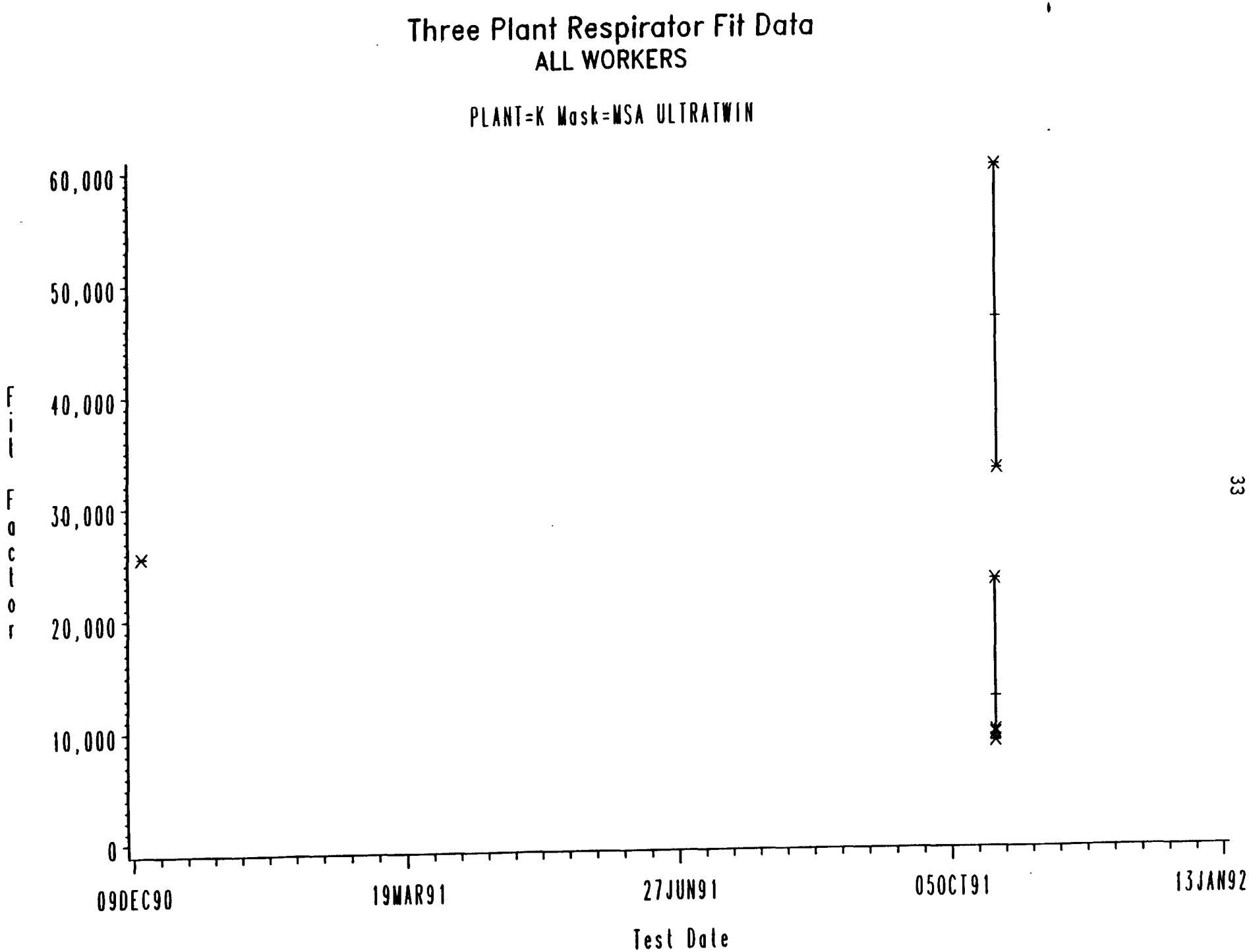
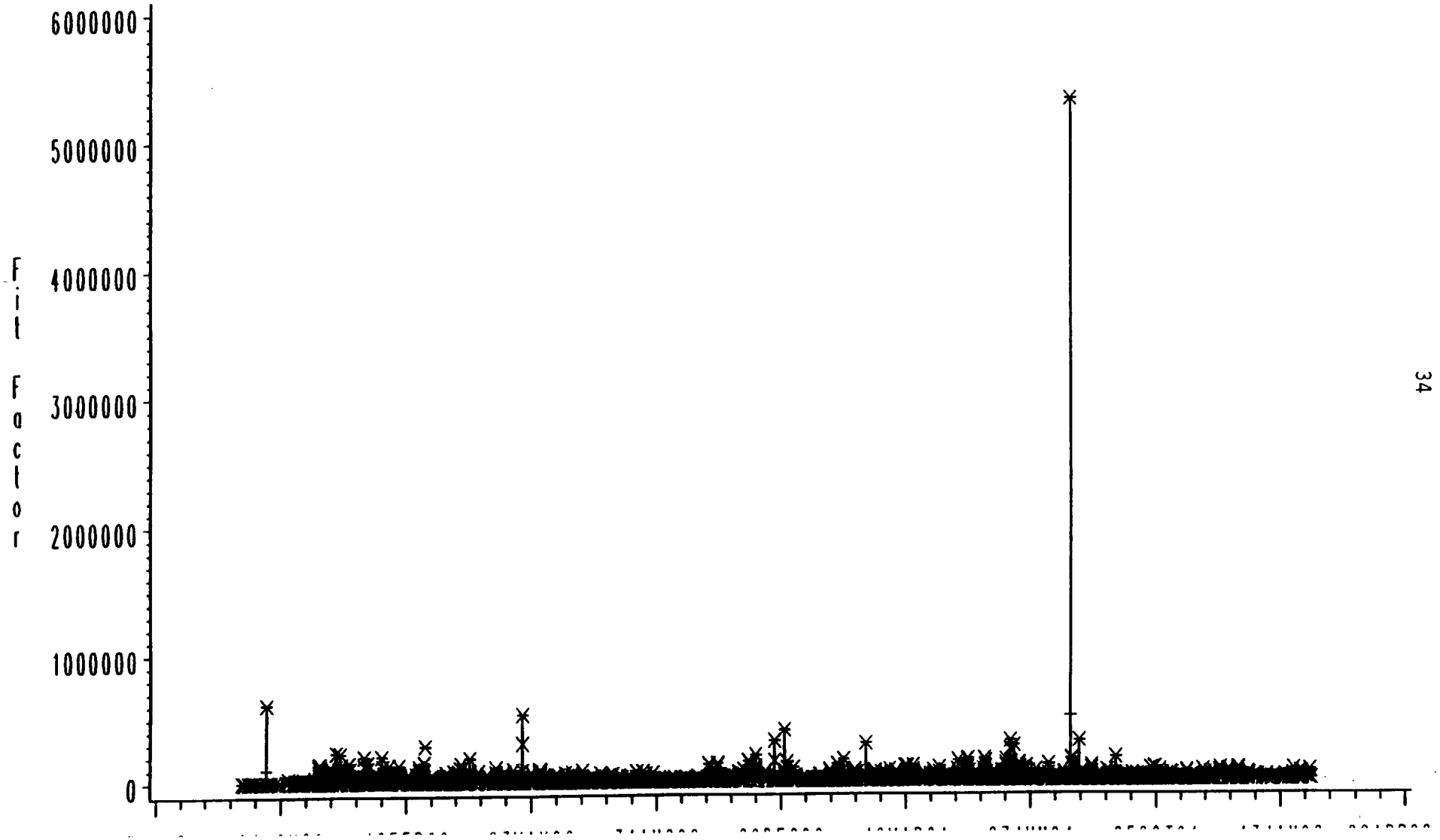

Three Plant Respirator Fit Data
ALL WORKERS
PLANT=K Mask=MSA ULTRATWIN
Fit Factor
60,000
50,000
40,000
30,000
20,000
10,000
0
09DEC90
19MAR91
27JUN91
05OCT91
13JAN92
Test Date

FIGURE 7.3

Three Plant Respirator Fit Data
ALL WORKERS

PLANT=K Mask=MSA ULTRAVUE



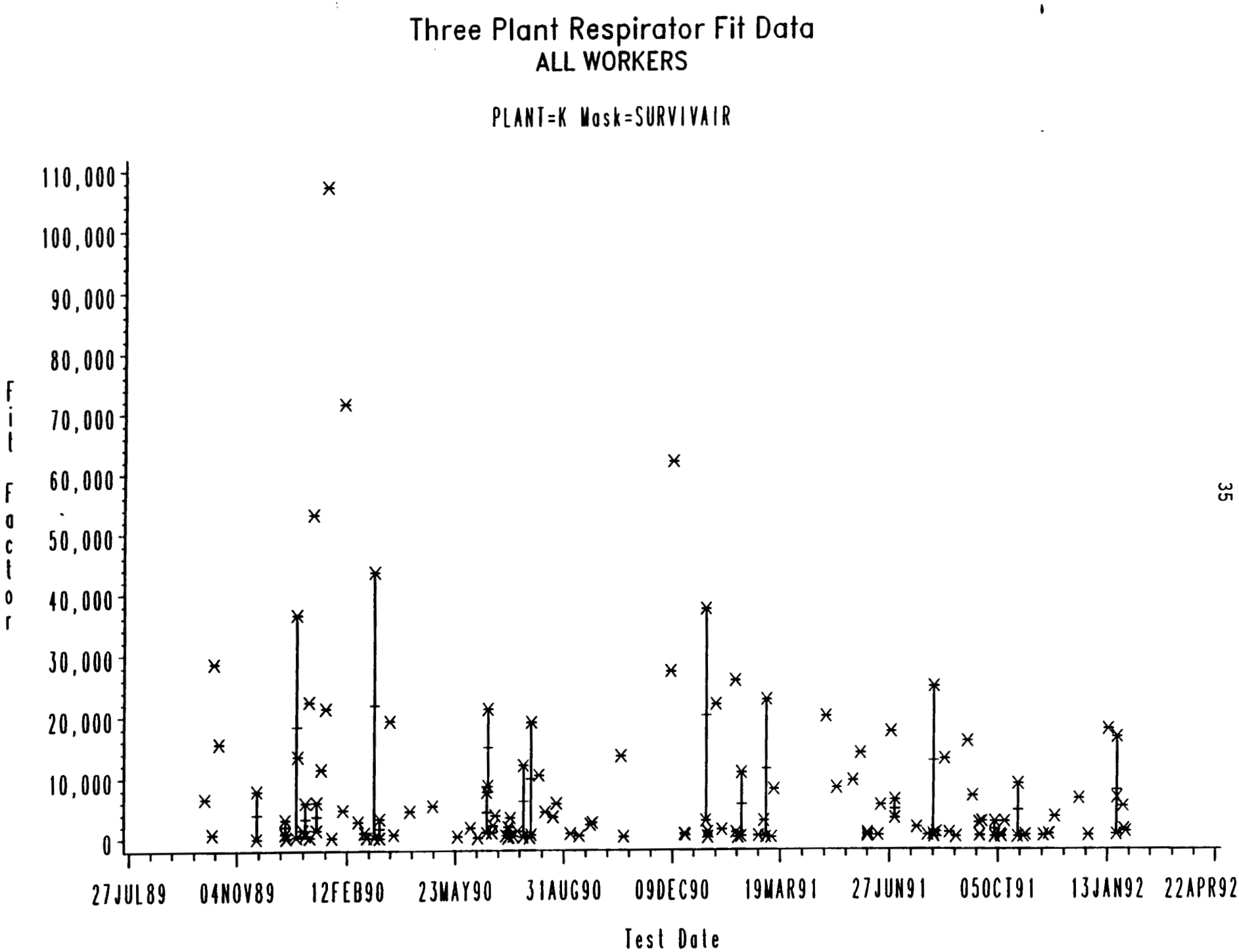
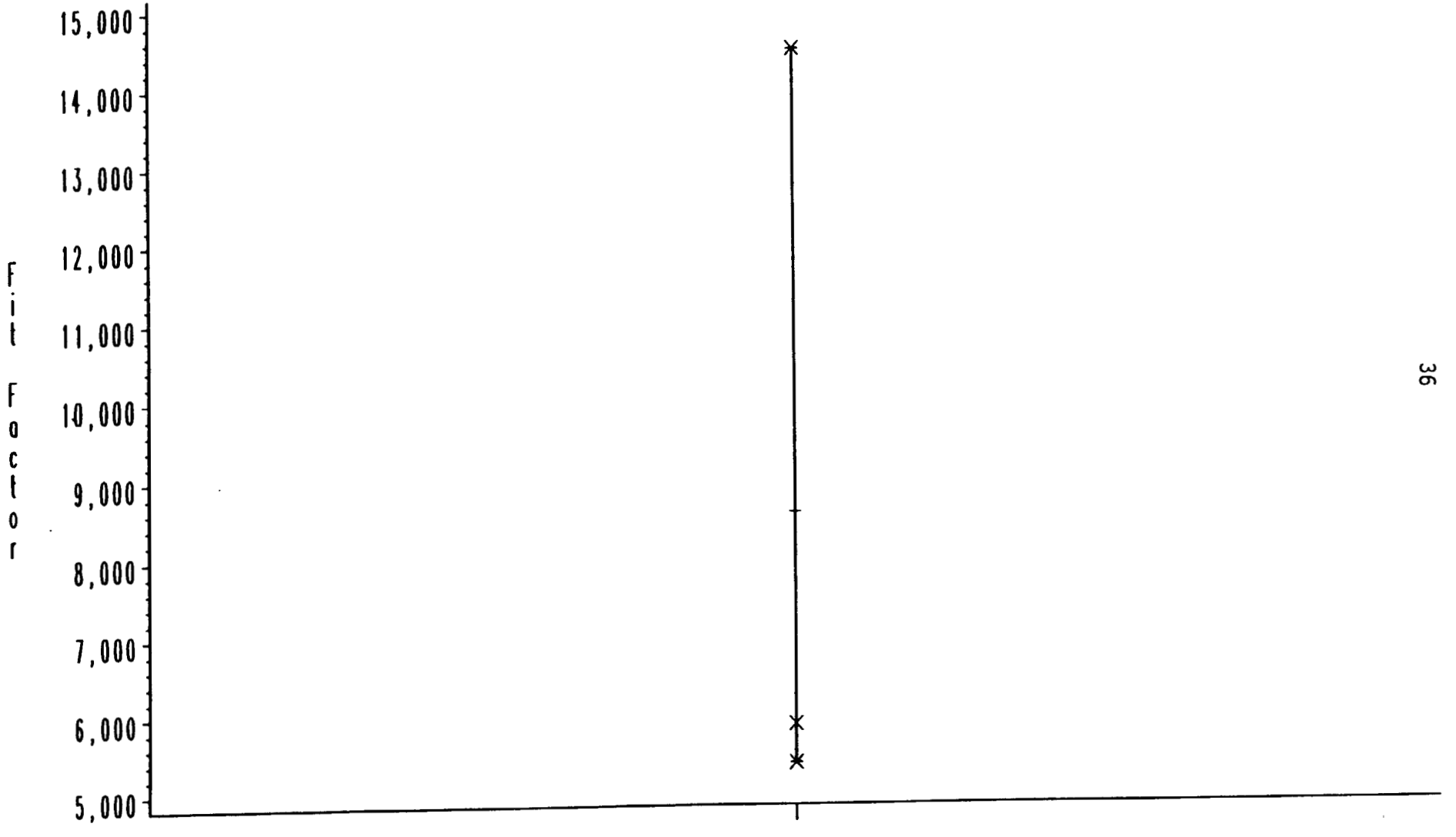

Three Plant Respirator Fit Data
ALL WORKERS
PLANT=K Mask=SURVIVAIR
Fit Factor
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
27JUL89
04NOV89
12FEB90
23MAY90
31AUG90
09DEC90
19MAR91
27JUN91
05OCT91
13JAN92
22APR92
Test Date

FIGURE 7.5

Three Plant Respirator Fit Data
ALL WORKERS

PLANT=X Mask=MSA COMFO ELITE



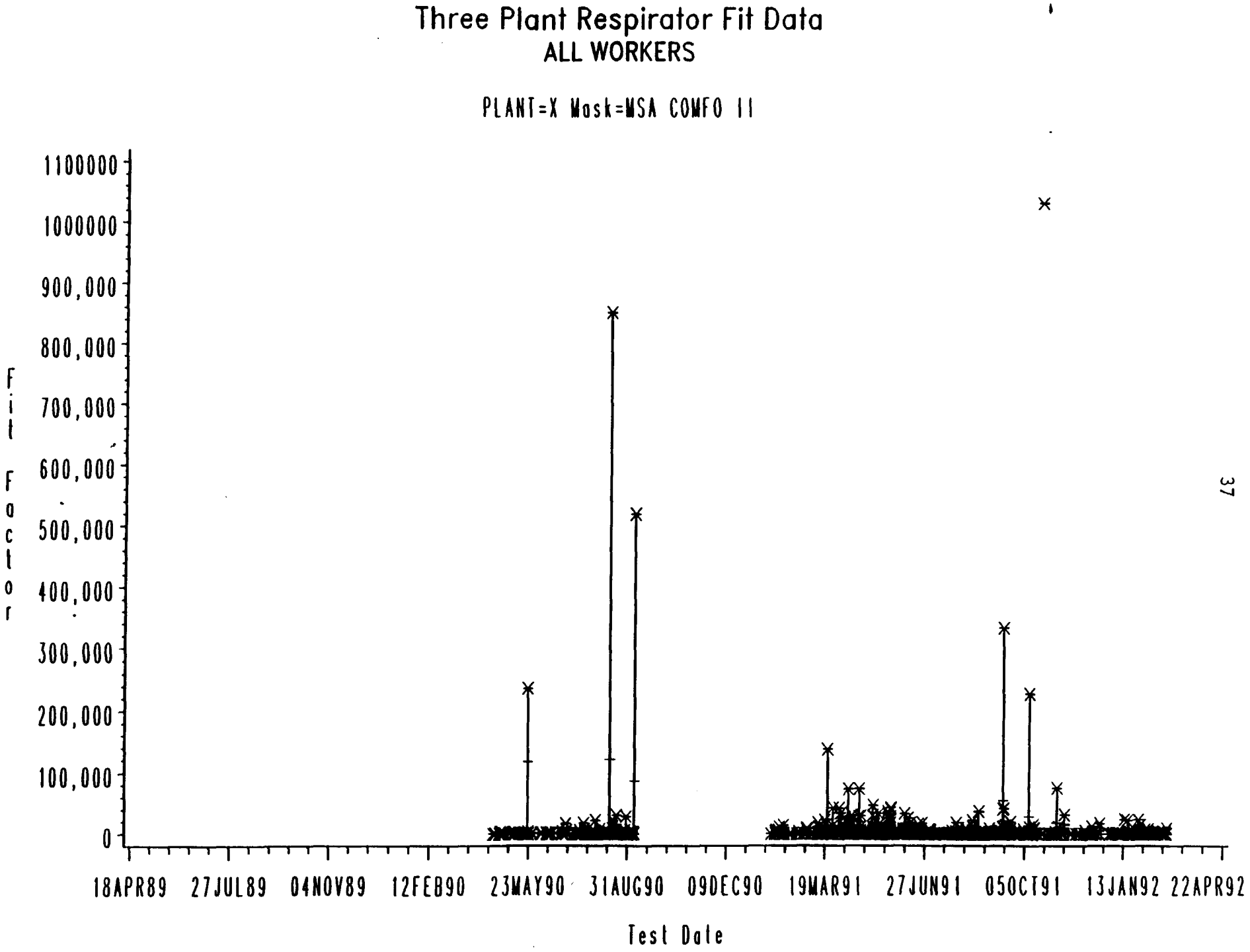
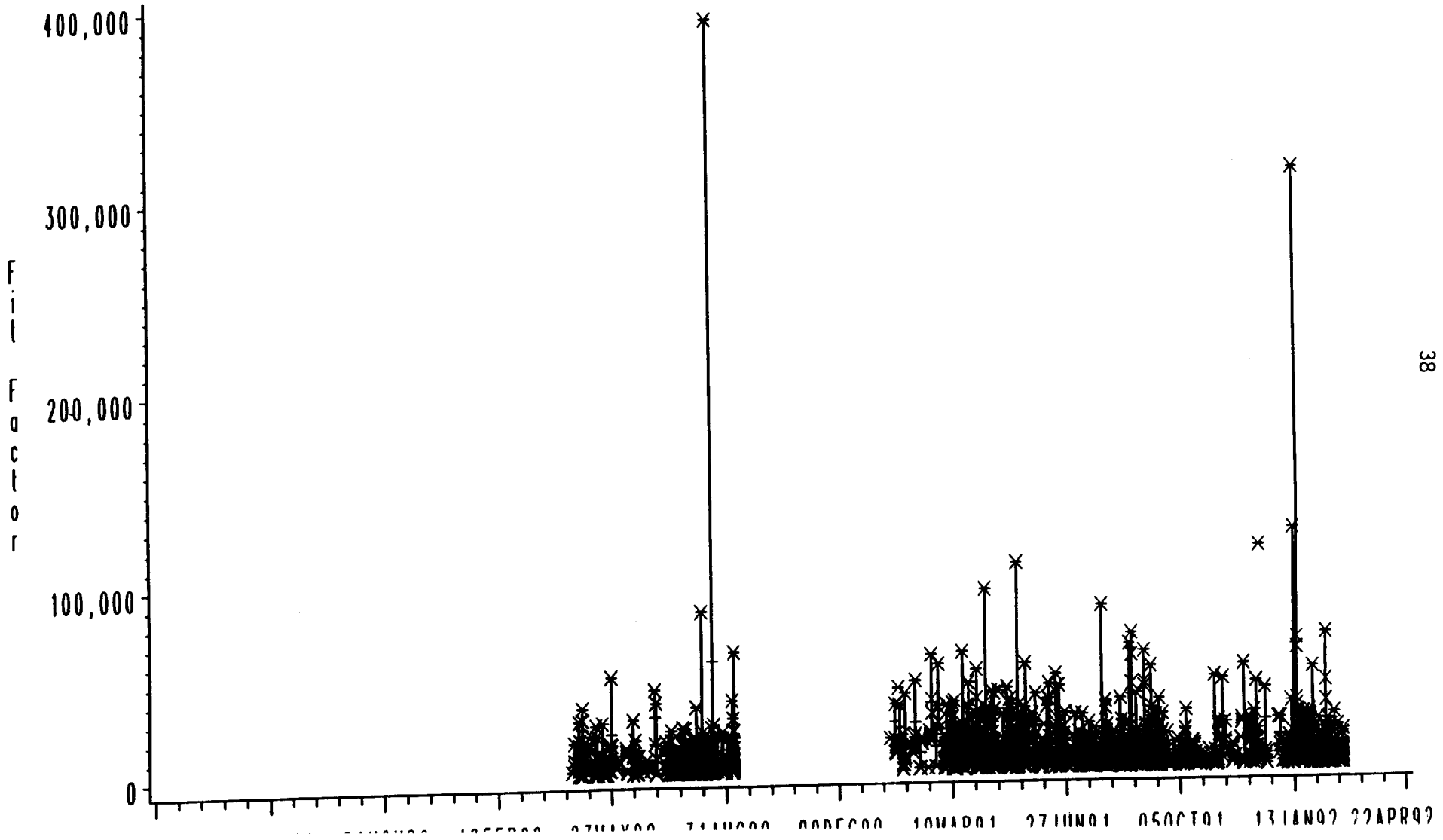

Three Plant Respirator Fit Data
ALL WORKERS
PLANT=X Mask=MSA COMFO II
Fit Factor
1100000
1000000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
18APR89
27JUL89
04NOV89
12FEB90
23MAY90
31AUG90
09DEC90
19MAR91
27JUN91
05OCT91
13JAN92
22APR92
Test Date

FIGURE 7.7

Three Plant Respirator Fit Data
ALL WORKERS

PLANT=X Mask=MSA ULTRATWIN



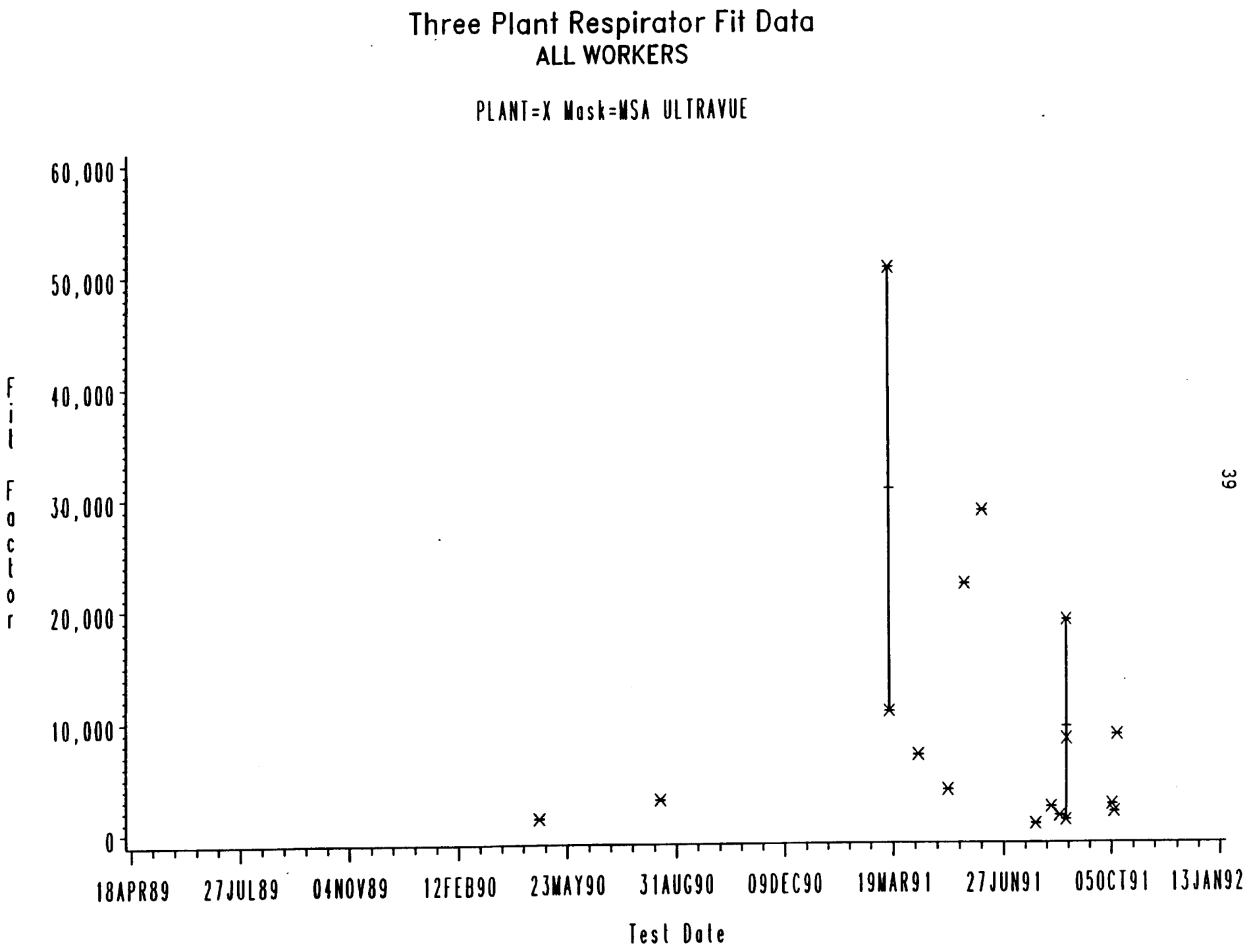
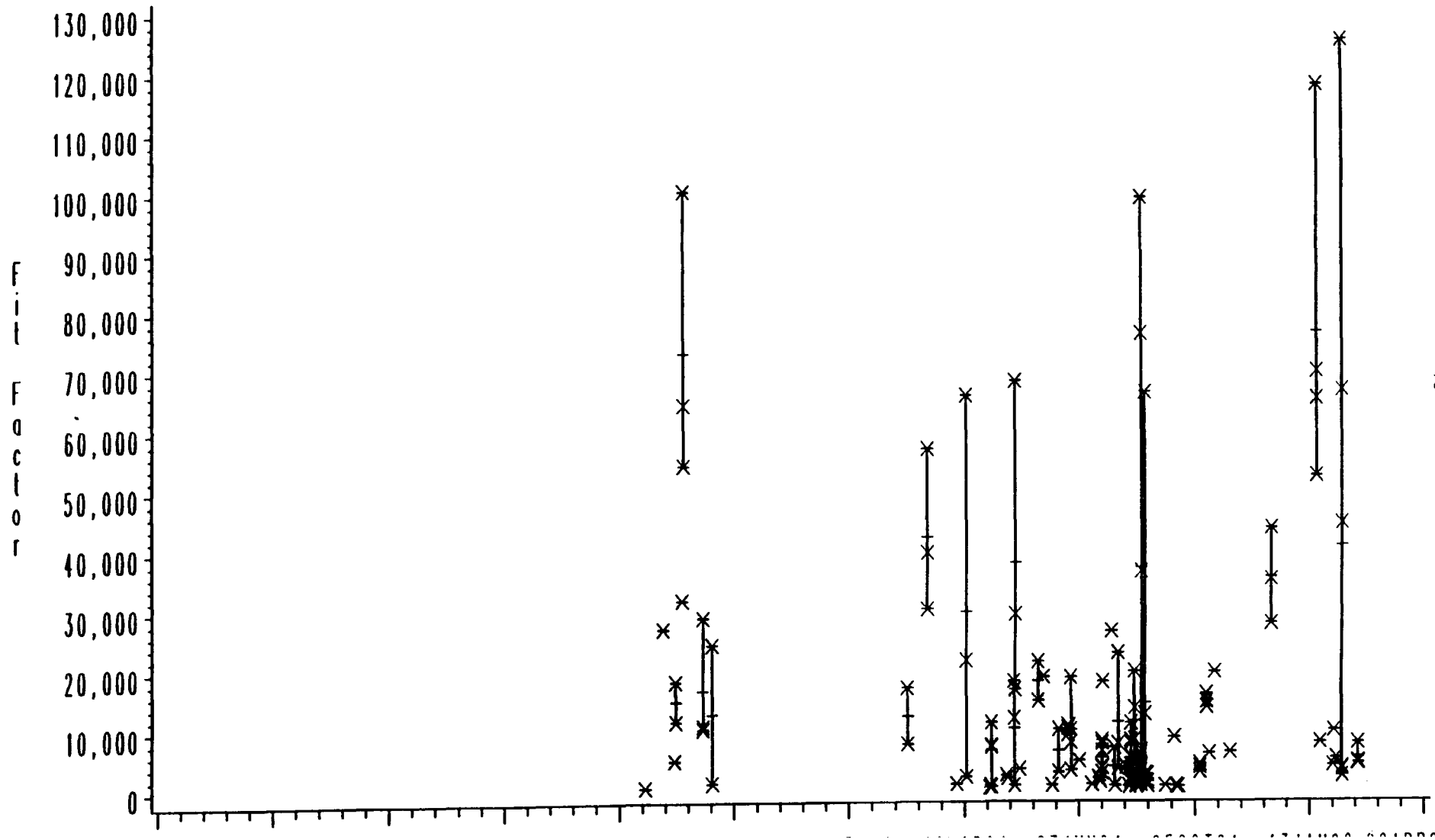

Three Plant Respirator Fit Data
ALL WORKERS
PLANT=X Mask=MSA ULTRAVUE
Fit Factor
60,000
50,000
40,000
30,000
20,000
10,000
0
18APR89
27JUL89
04NOV89
12FEB90
23MAY90
31AUG90
09DEC90
19MAR91
27JUN91
05OCT91
13JAN92
Test Date

FIGURE 7.9

Three Plant Respirator Fit Data
ALL WORKERS

PLANT=X Mask=SURVIVAIR



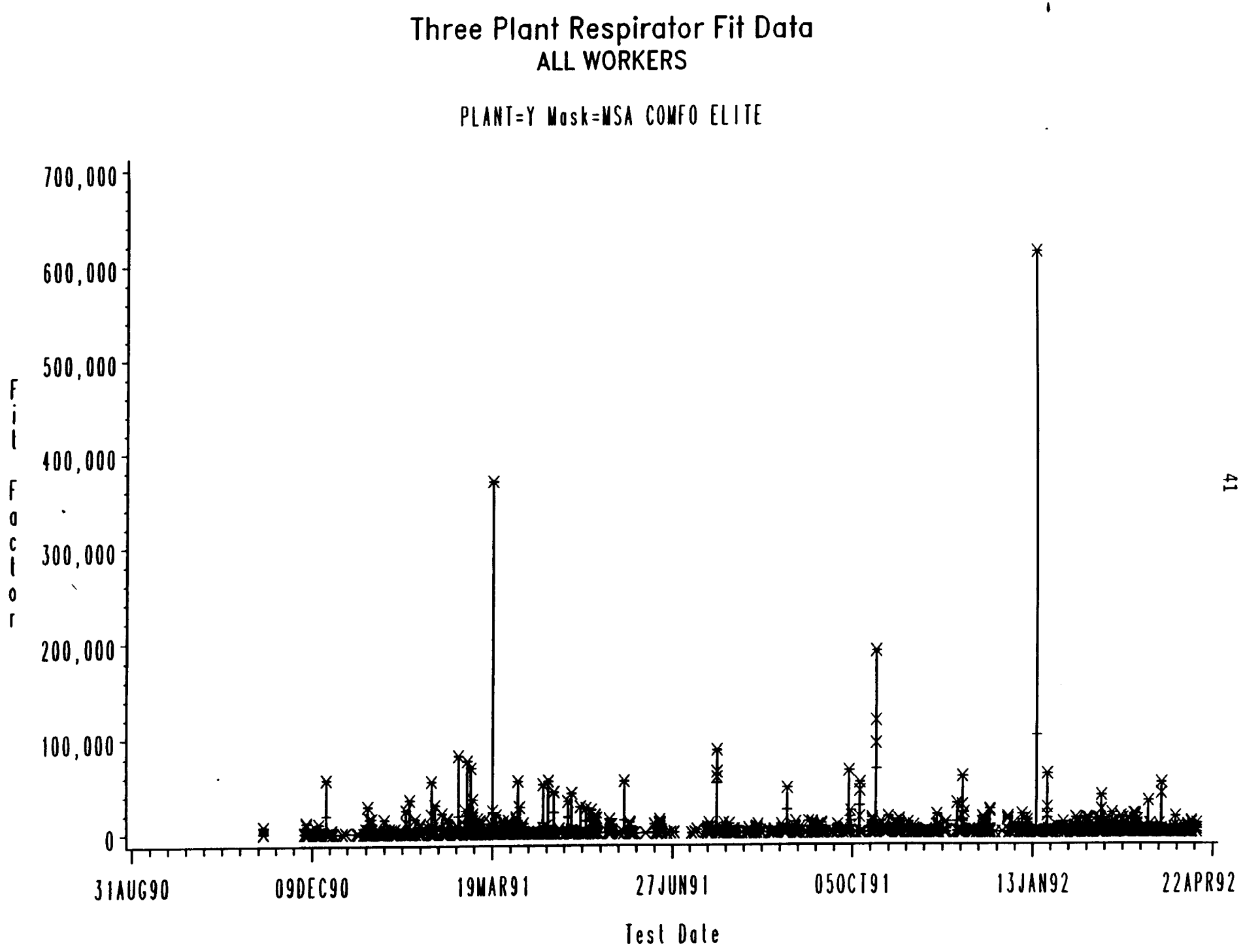
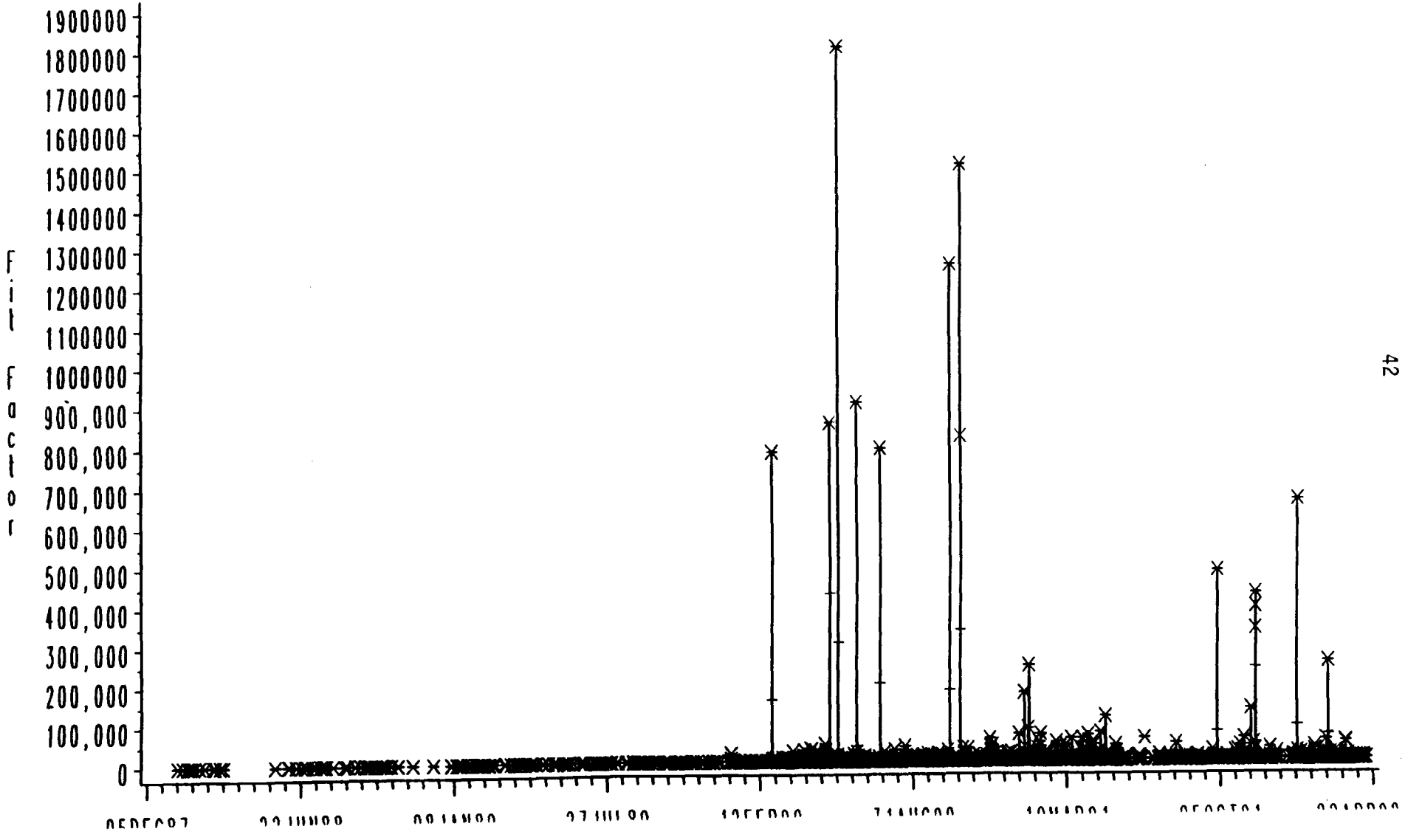

Three Plant Respirator Fit Data
ALL WORKERS
PLANT=Y Mask=MSA COMFO ELITE
Fit Factor
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
31AUG90
09DEC90
19MAR91
27JUN91
05OCT91
13JAN92
22APR92
Test Date

FIGURE 7.11

Three Plant Respirator Fit Data
ALL WORKERS

PLANT=Y Mask=MSA COMFO II



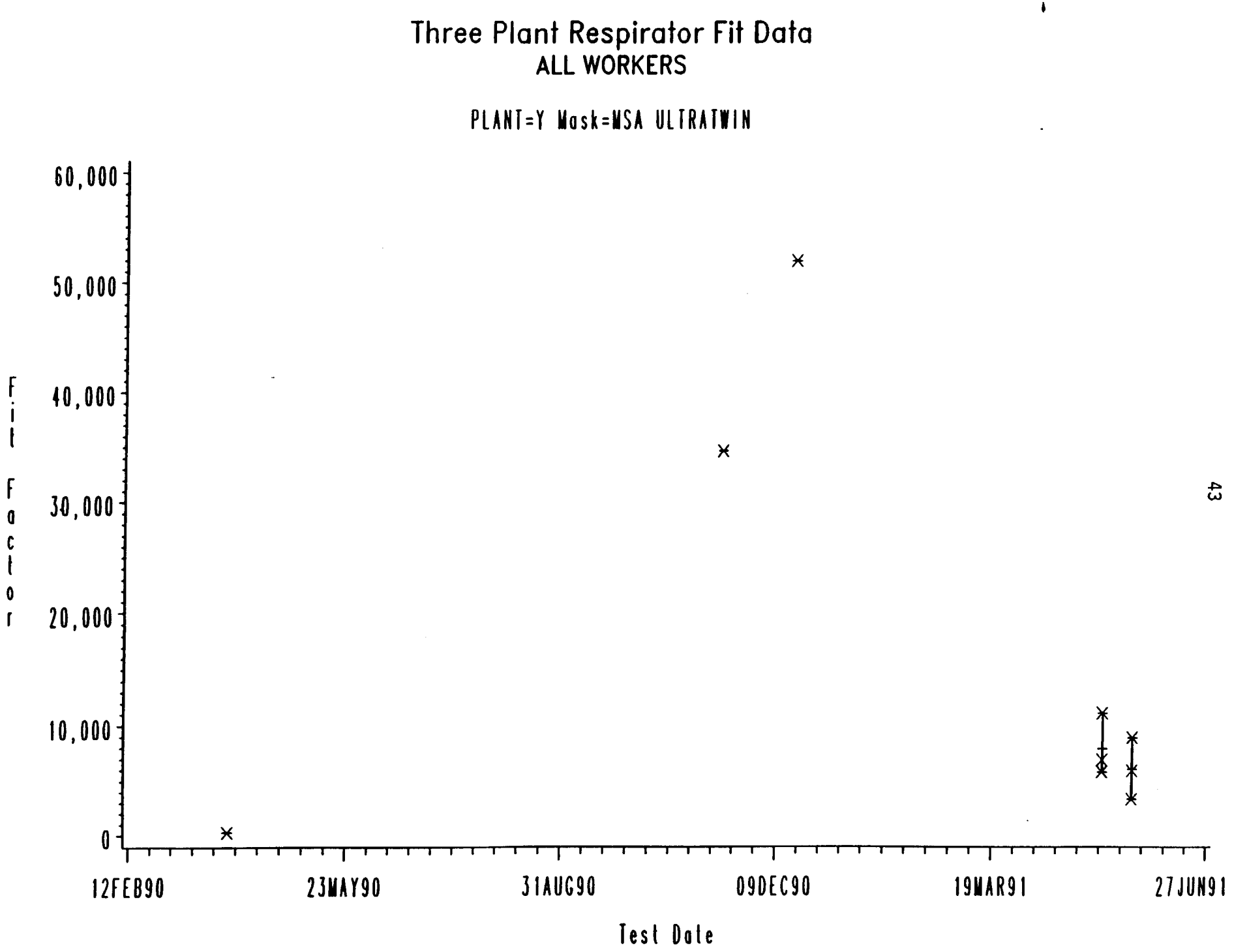
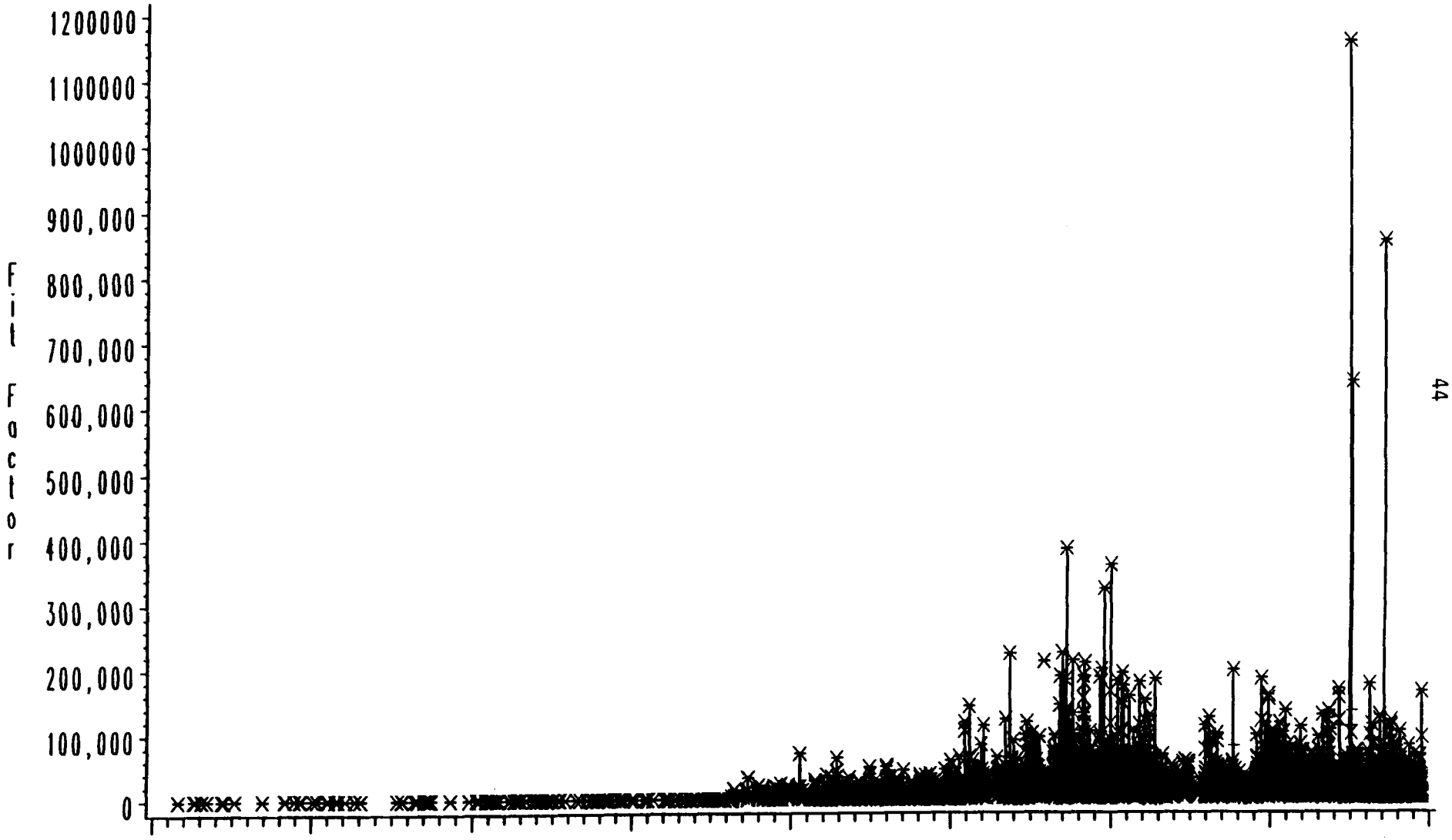

Three Plant Respirator Fit Data
ALL WORKERS
PLANT=Y Mask=MSA ULTRATWIN
60,000
50,000
40,000
30,000
20,000
10,000
0
Fit Factor
12FEB90
23MAY90
31AUG90
09DEC90
19MAR91
27JUN91
Test Date

FIGURE 7.13

Three Plant Respirator Fit Data
ALL WORKERS

PLANT=Y Mask=MSA ULTRAVUE



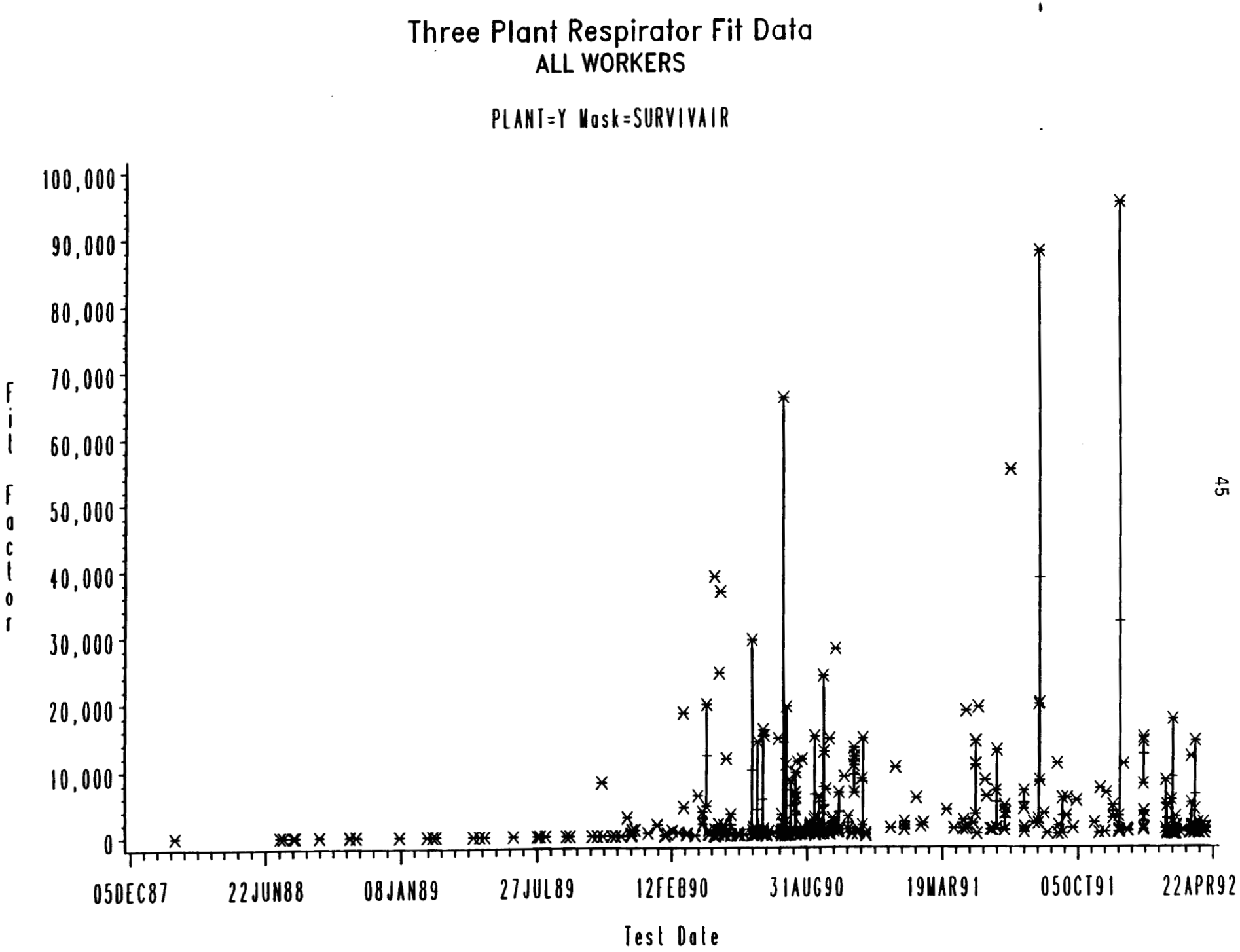
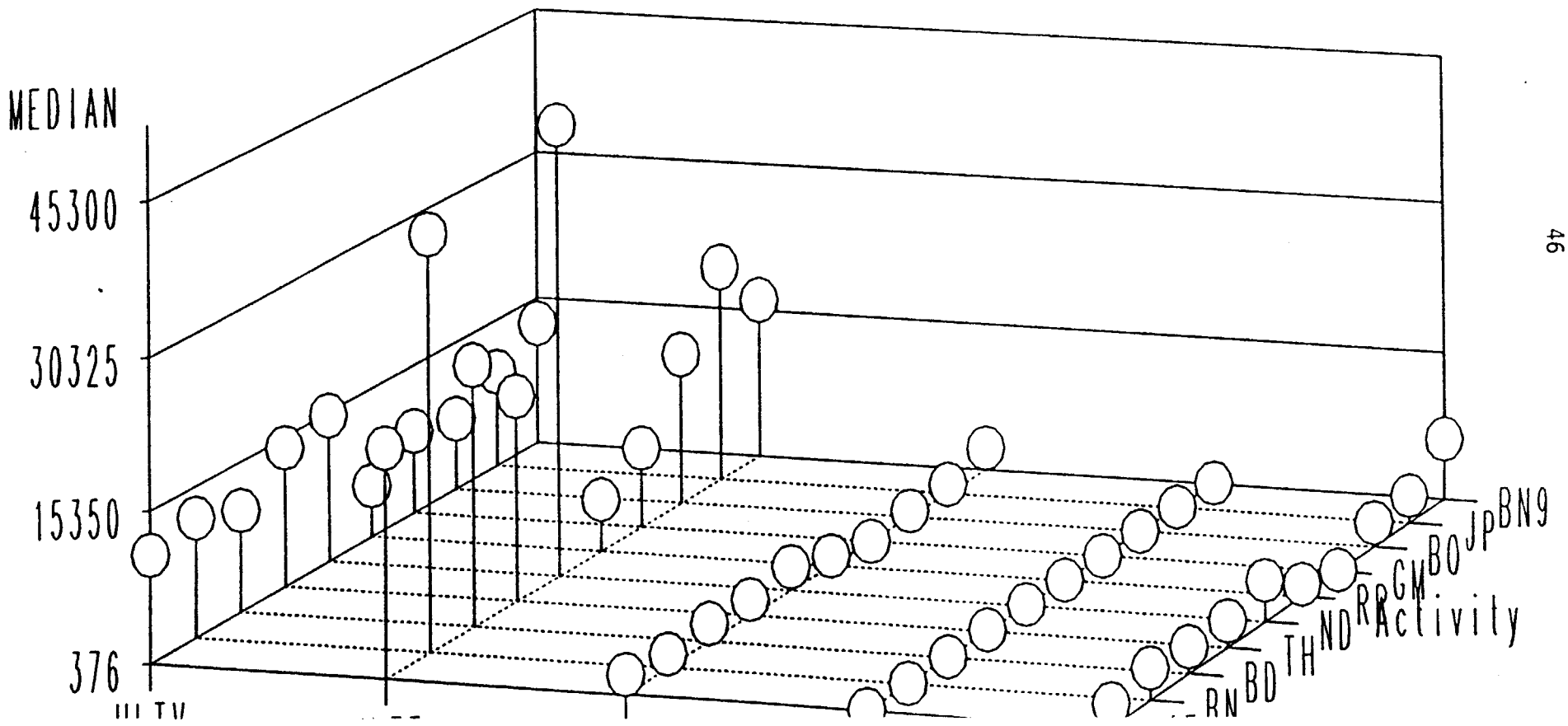

Three Plant Respirator Fit Data
ALL WORKERS
PLANT=Y Mask=SURVIVAIR
Fit Factor
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
05DEC87
22JUN88
08JAN89
27JUL89
12FEB90
31AUG90
19MAR91
05OCT91
22APR92
Test Date

FIGURE 7.15

Three Plant Respirator Fit Data

Comparison of Medians

PLANT=K



Three Plant Respirator Fit Data
Comparison of Medians
PLANT=X

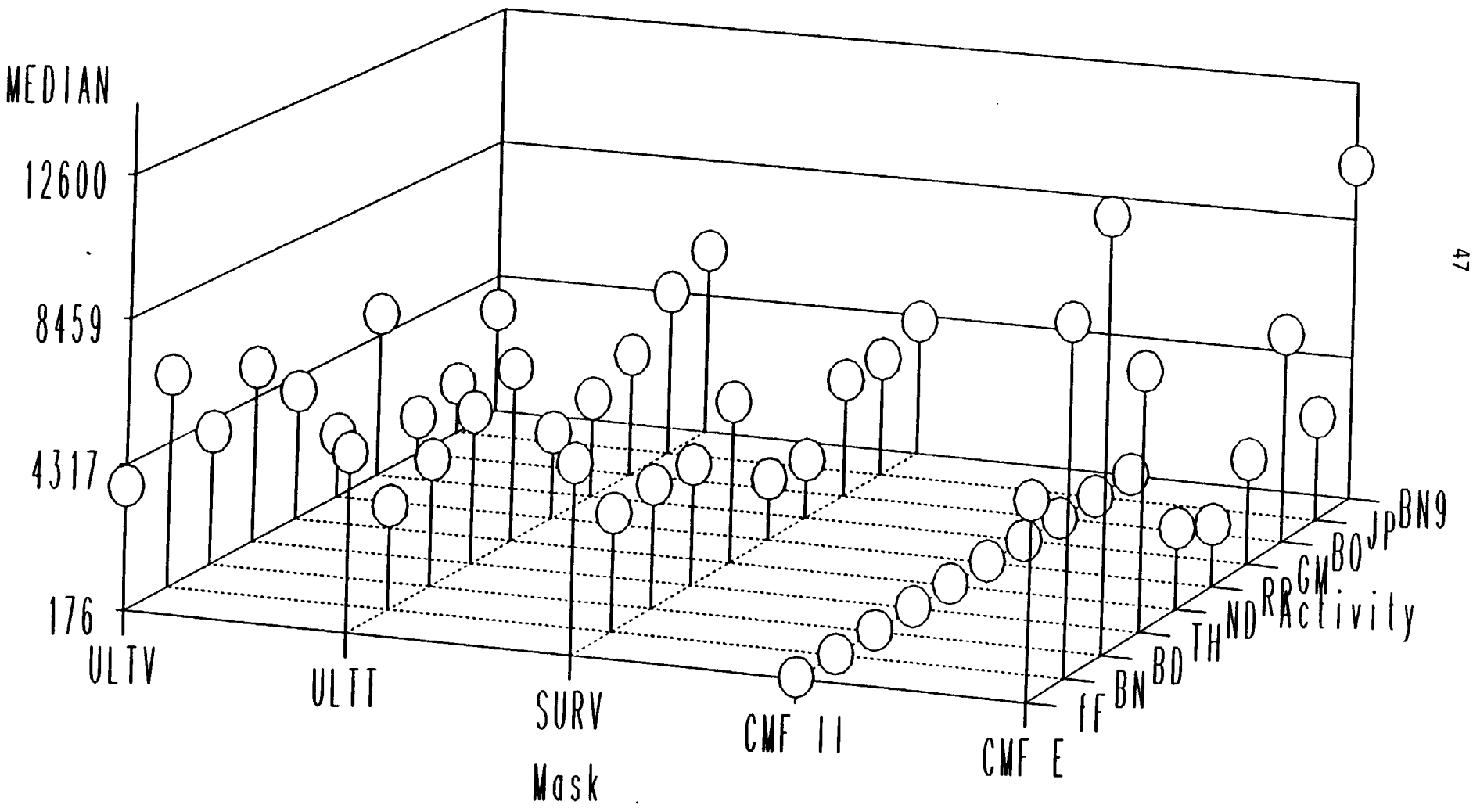
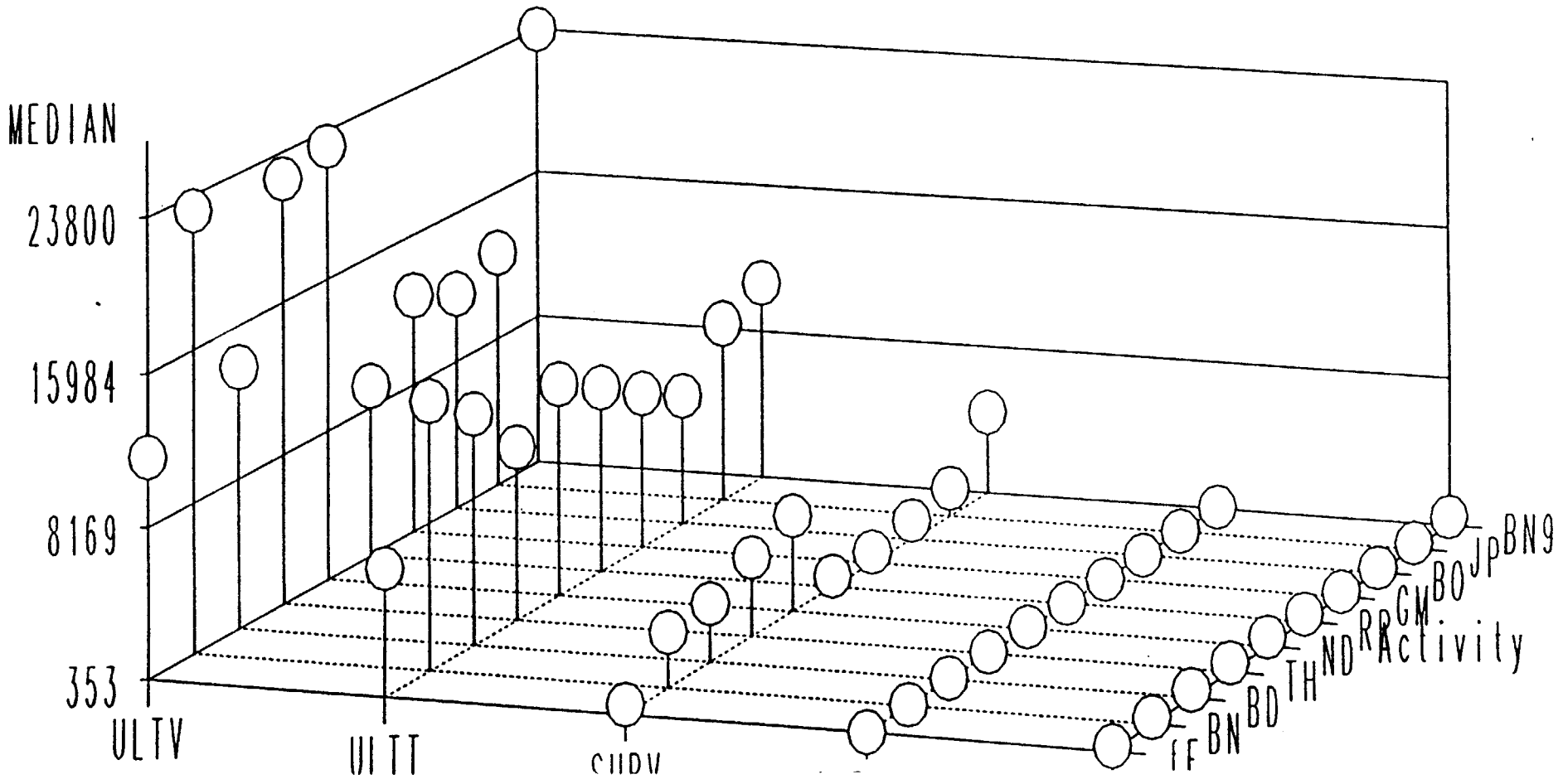


FIGURE 8.2

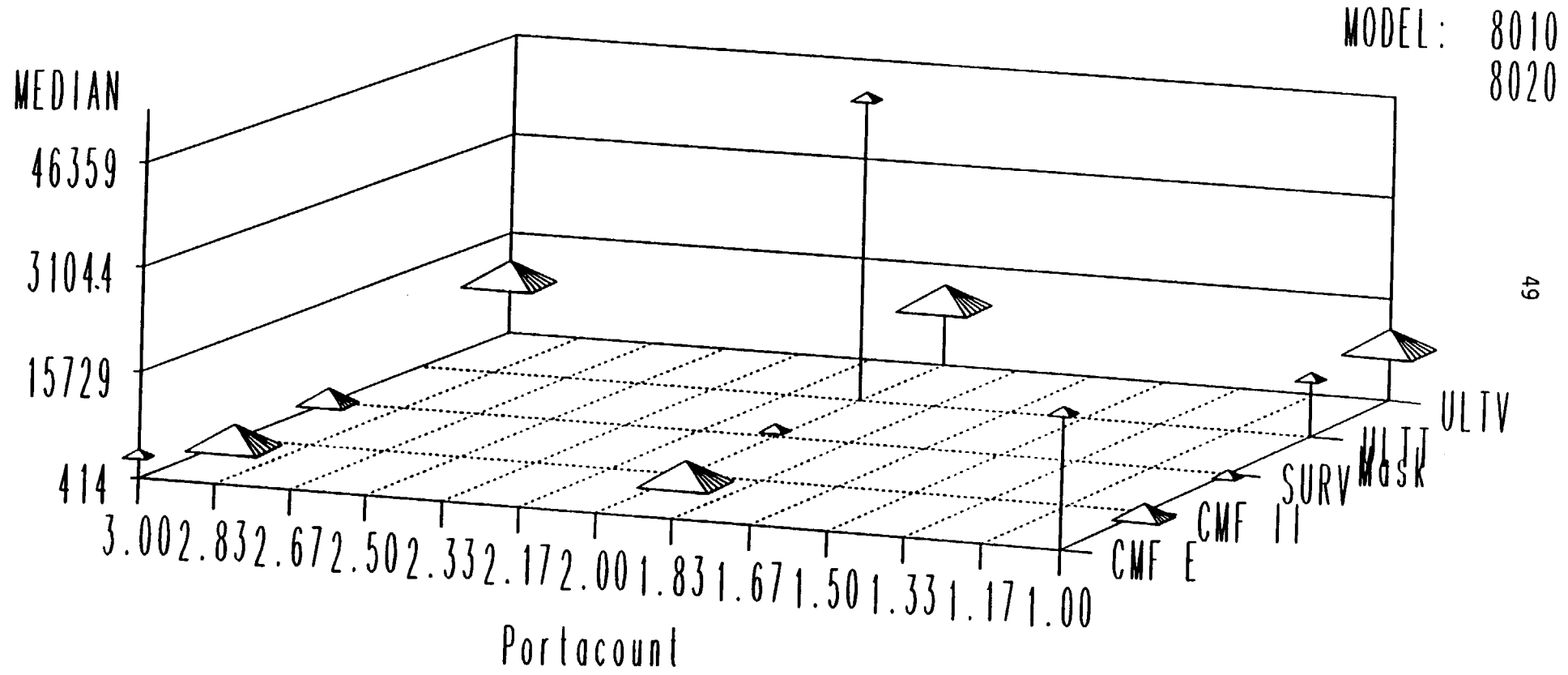
Three Plant Respirator Fit Data

Comparison of Medians

PLANT=Y



Three Plant Respirator Fit Data
Comparison of Medians
PLANT=K



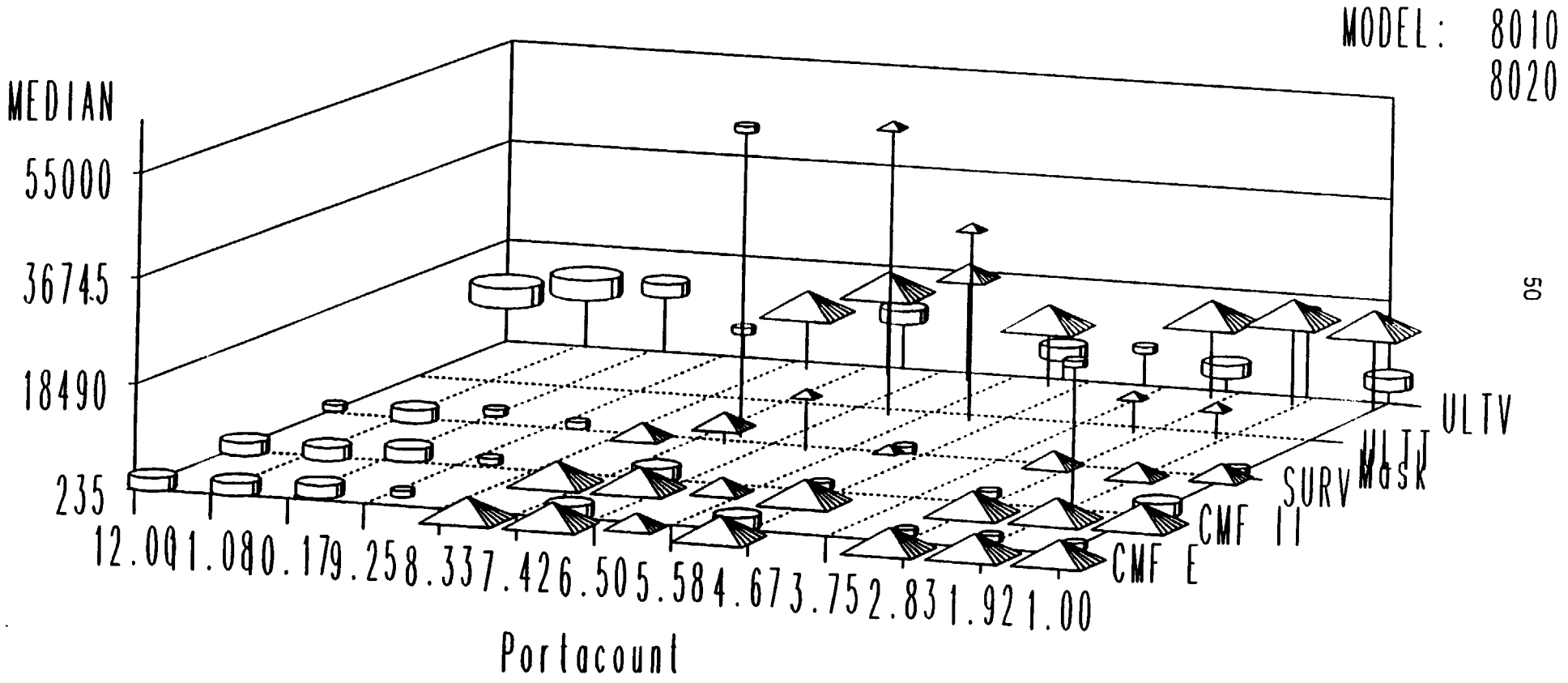
Symbol size denotes frequency
SMALL : N<=10
MEDIUM: 10<N<100
LARGE : N>=100

FIGURE 9.1

Three Plant Respirator Fit Data

Comparison of Medians

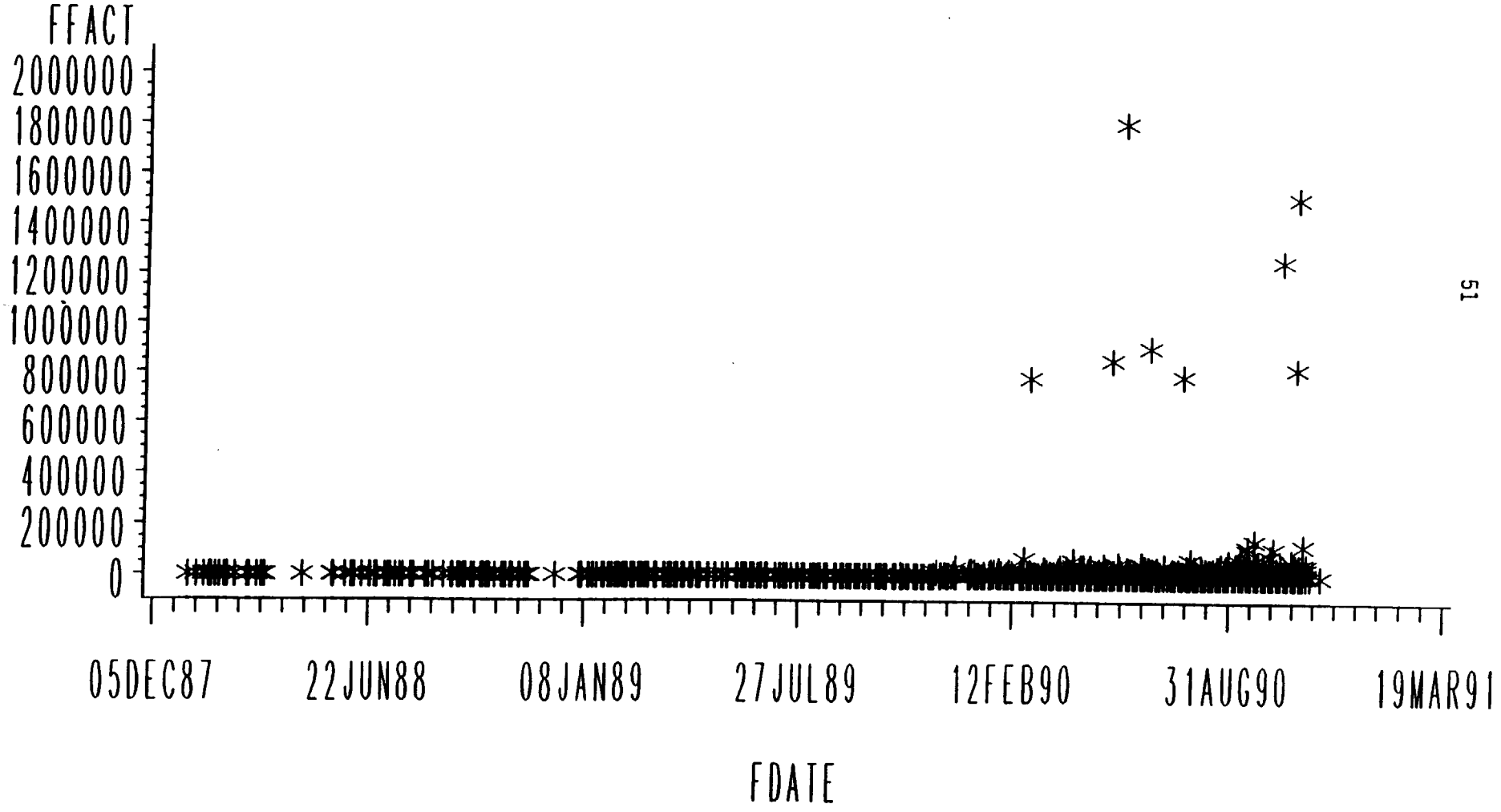
PLANT=Y



Symbol size denotes frequency

THREE PLANT RESPIRATOR FIT DATA

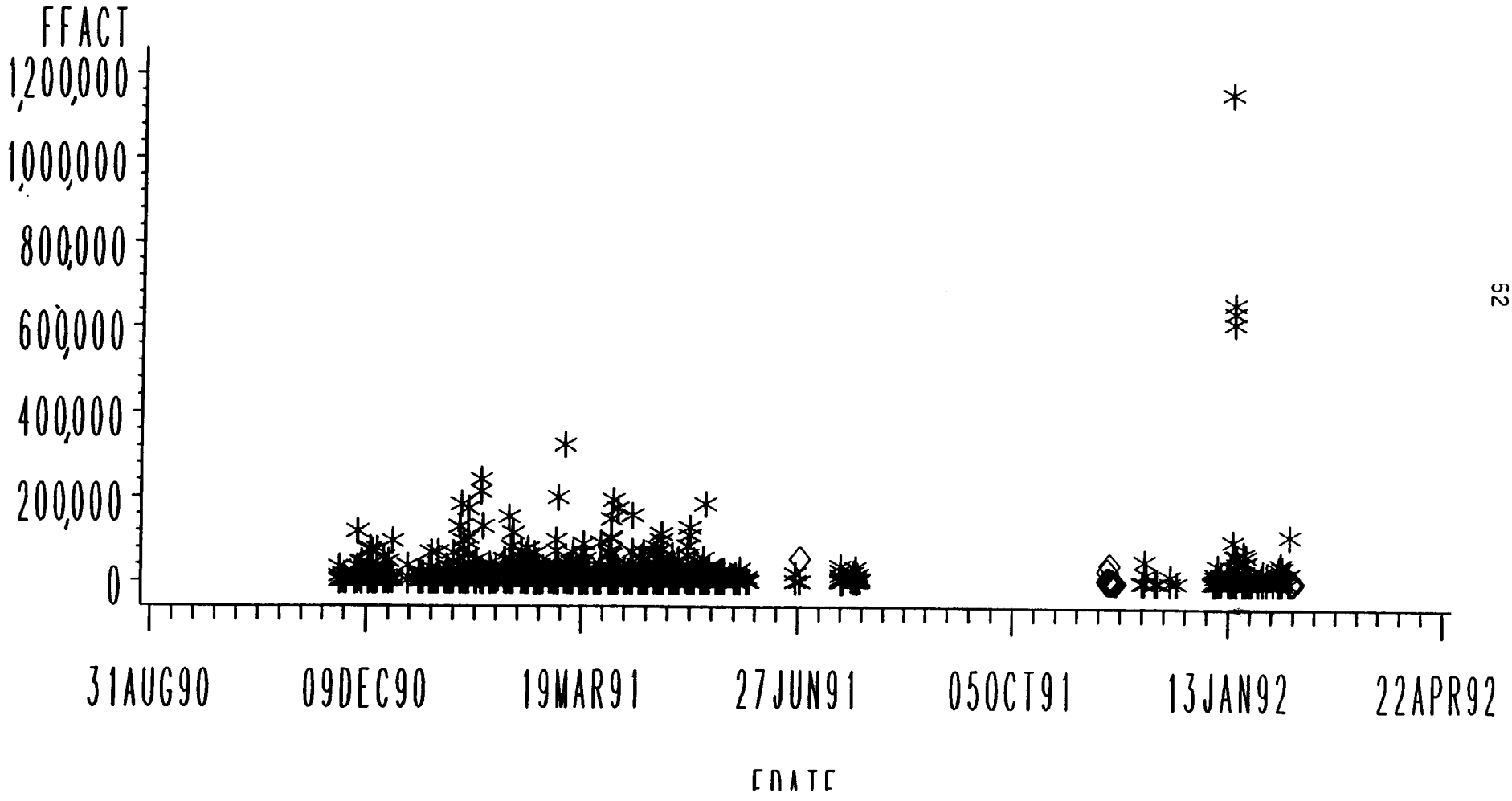
Portacount Performance
PLANT=Y PC_ID=' '



MODEL *** 8010

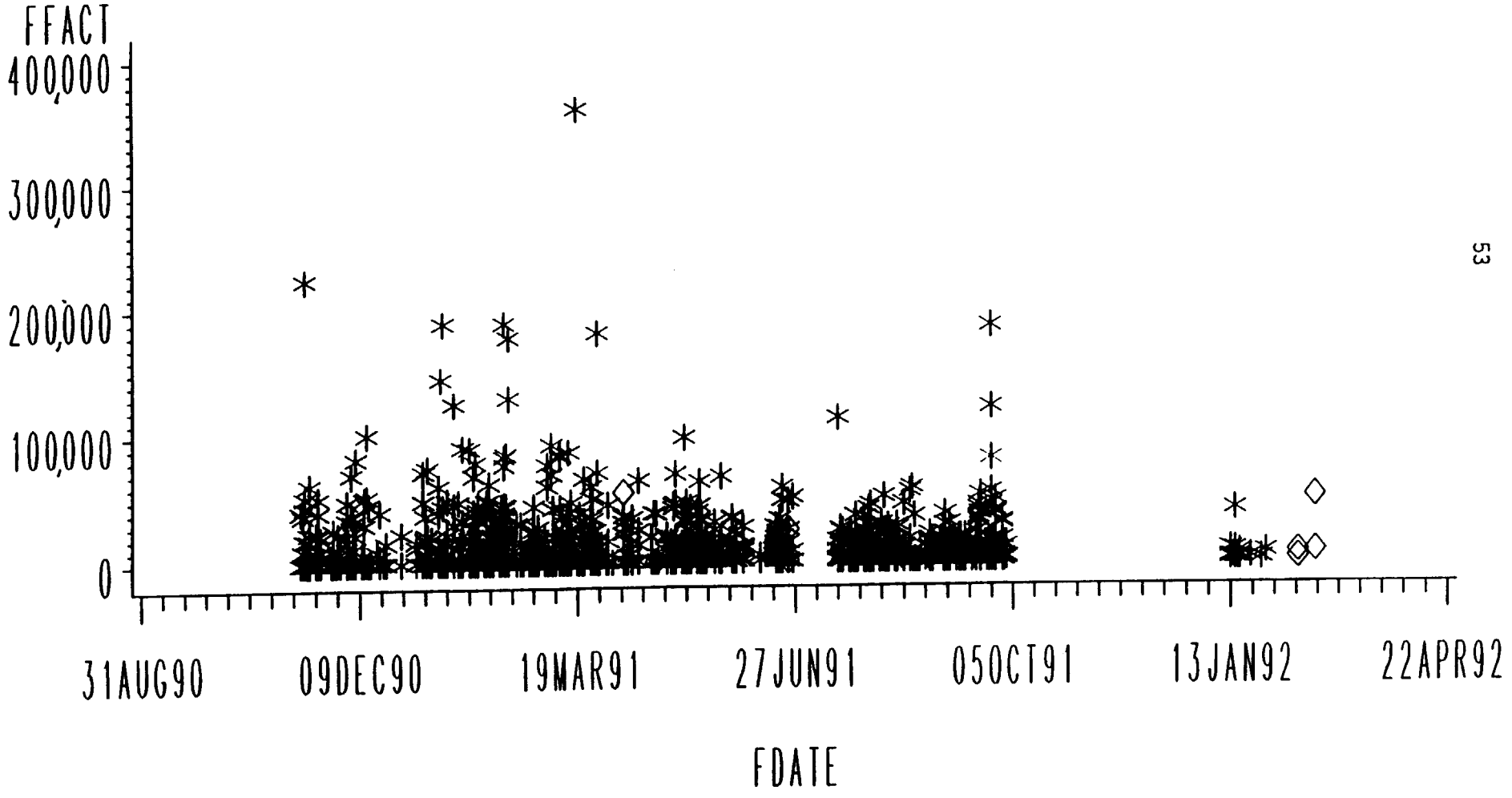
THREE PLANT RESPIRATOR FIT DATA

Portacount Performance
PLANT=Y PC_ID=1



THREE PLANT RESPIRATOR FIT DATA

Portacount Performance
PLANT=Y PC_ID=2

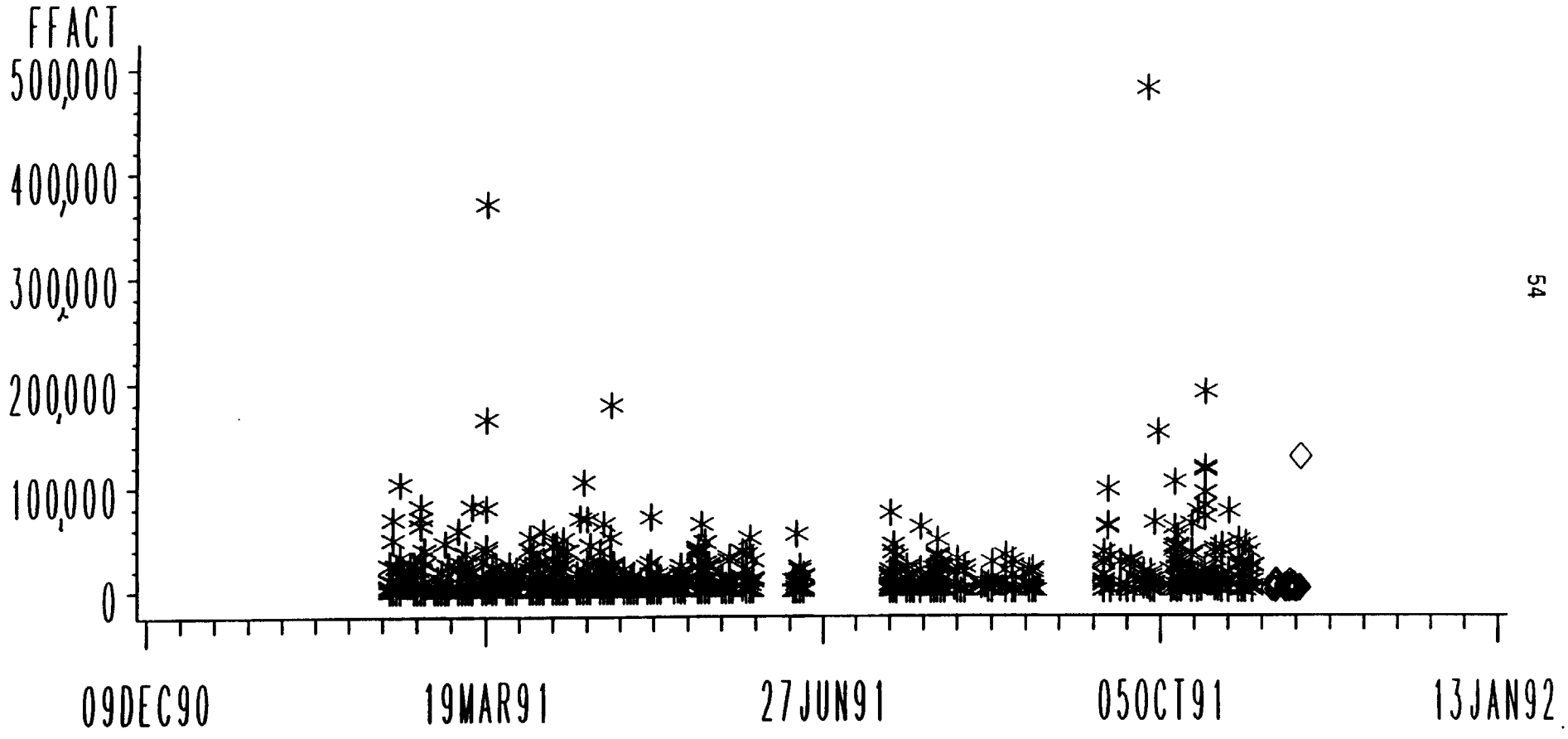


MODEL *** 8010 ◇◇◇ 8020

FIGURE 10-2

THREE PLANT RESPIRATOR FIT DATA

Portacount Performance
PLANT=Y PC_ID=3



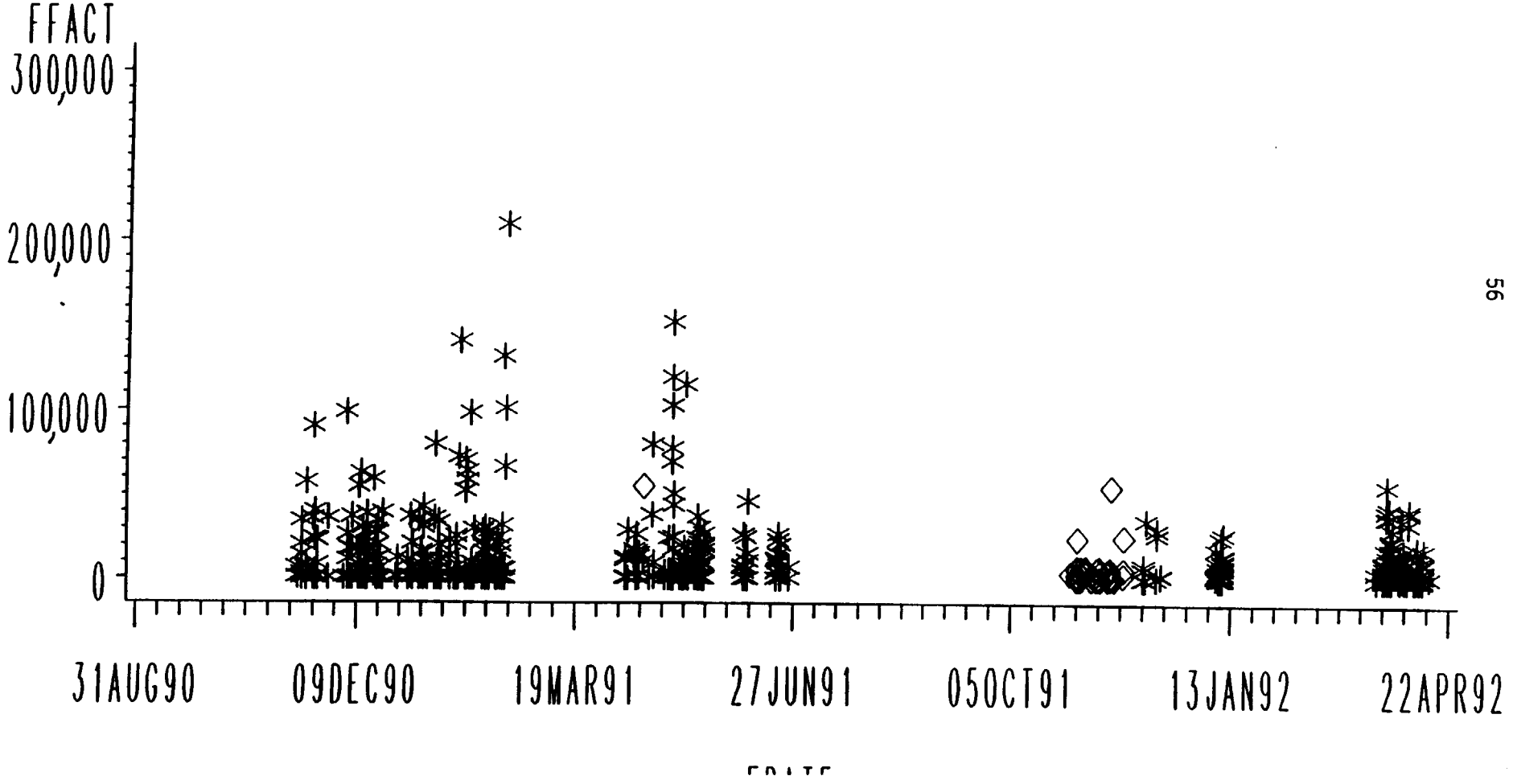
THREE PLANT RESPIRATOR FIT DATA

Portacount Performance
PLANT=Y PC_ID=4

MODEL *** 8020

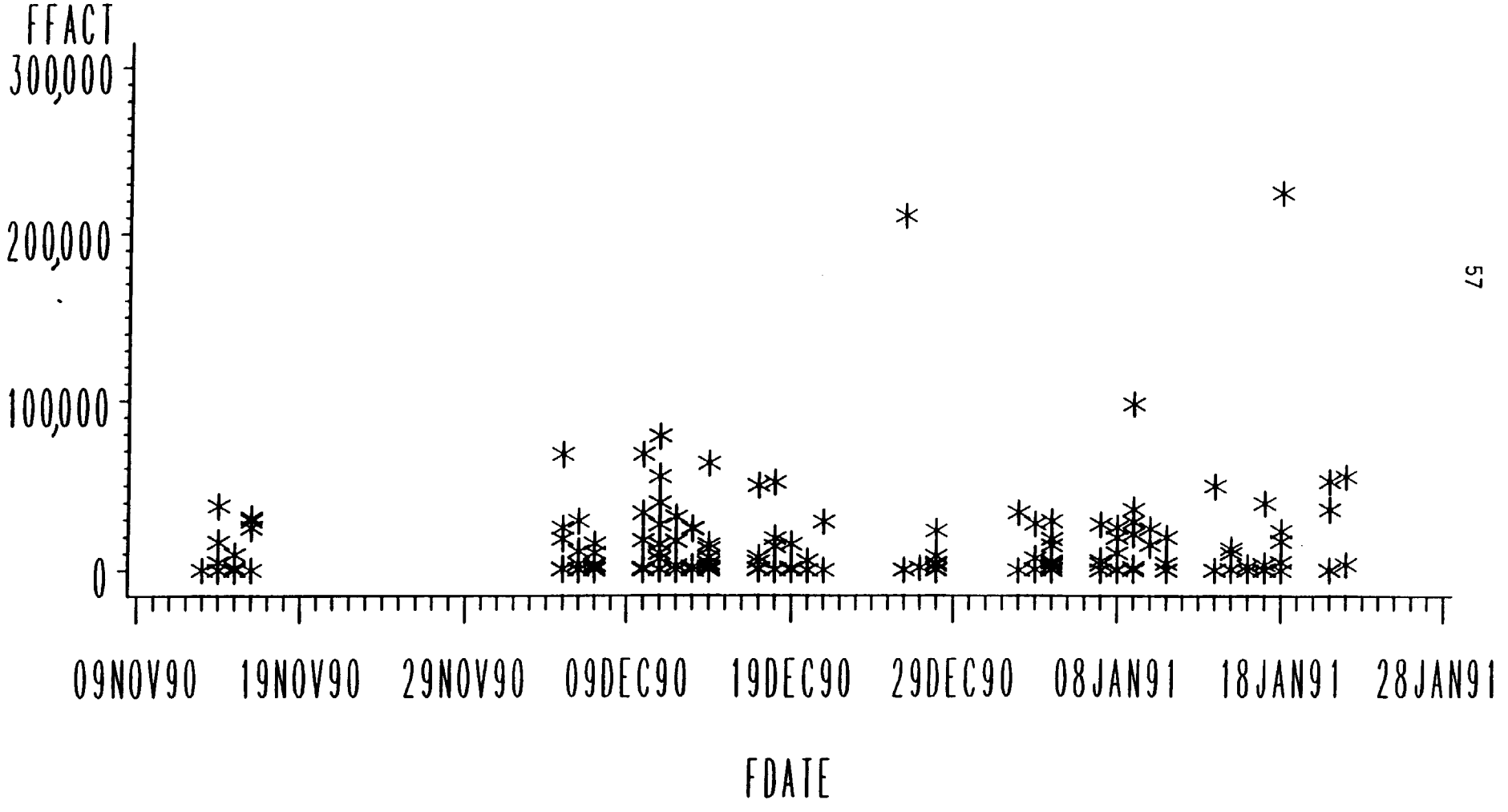
THREE PLANT RESPIRATOR FIT DATA

Portacount Performance
PLANT=Y PC_ID=5



THREE PLANT RESPIRATOR FIT DATA

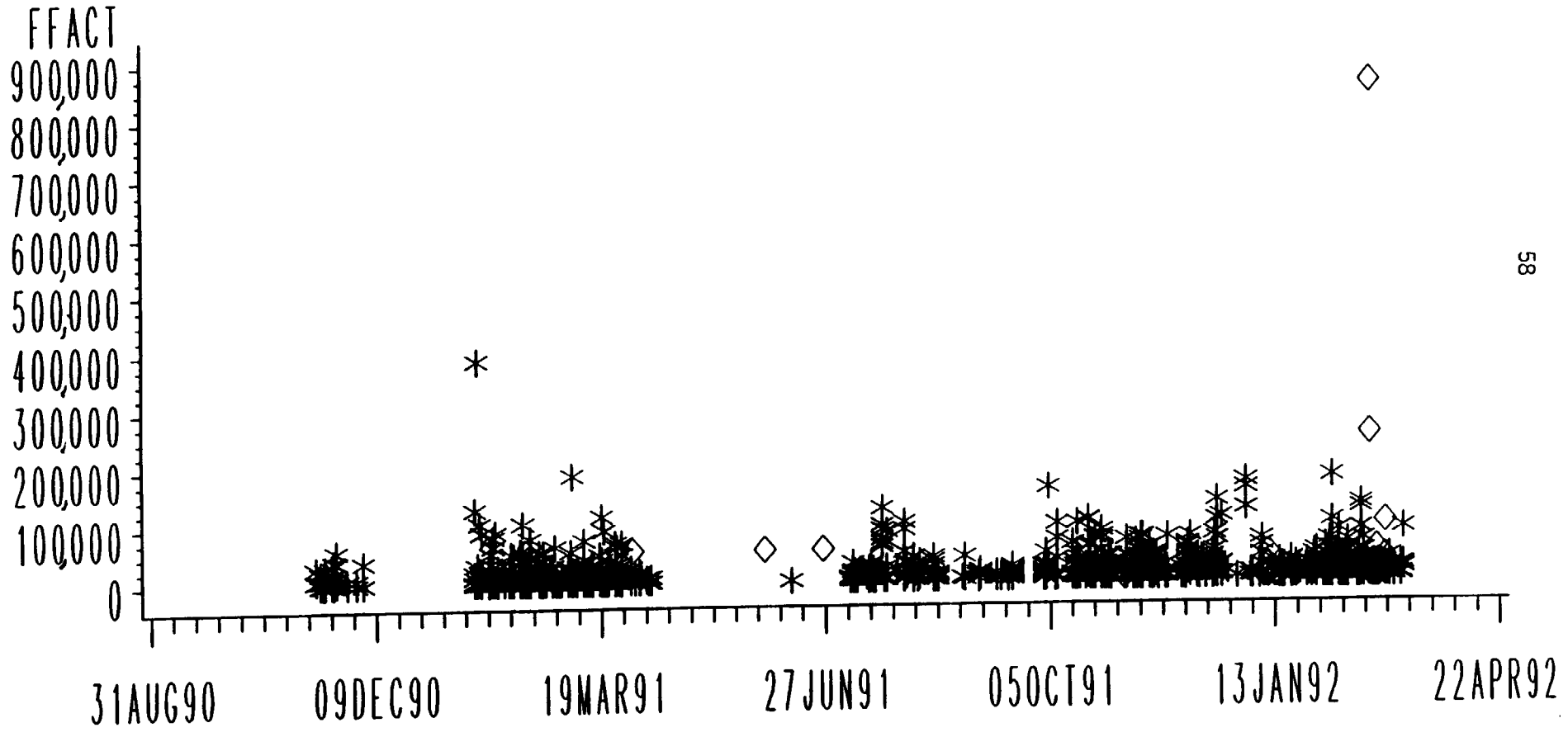
Portacount Performance
PLANT=Y PC_ID=6



MODEL *** 8010

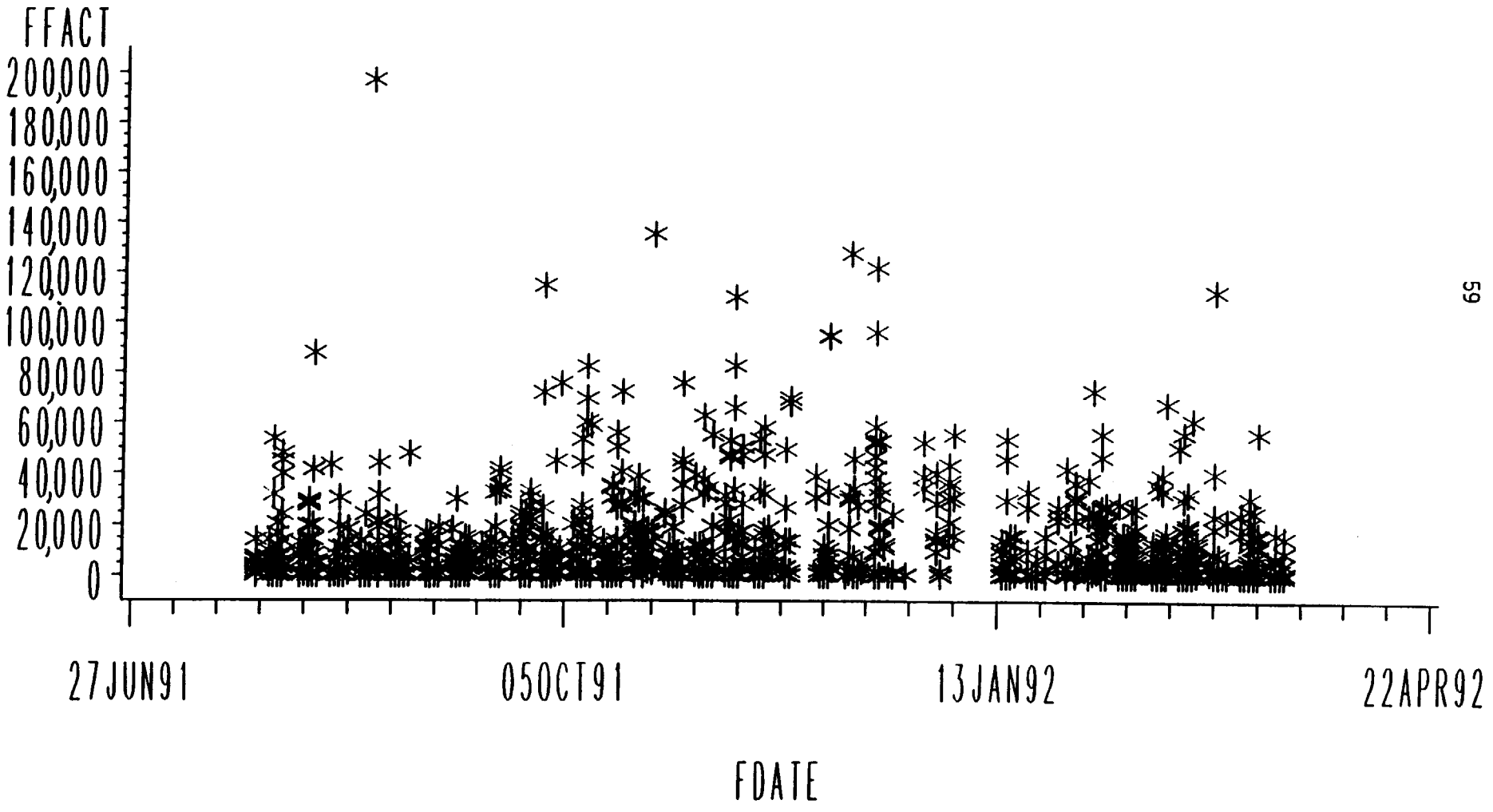
THREE PLANT RESPIRATOR FIT DATA

Portacount Performance
PLANT=Y PC_ID=7



THREE PLANT RESPIRATOR FIT DATA

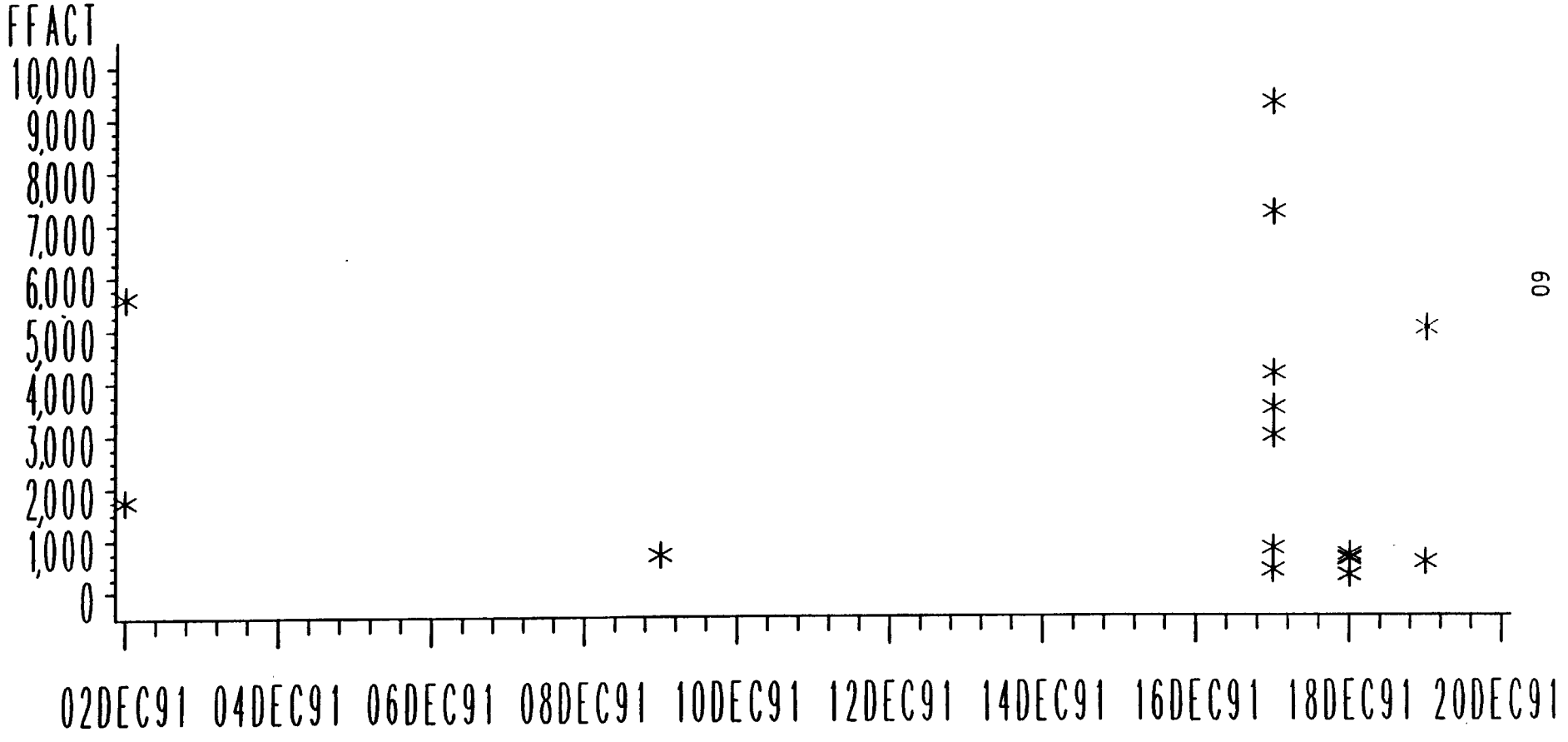
Portacount Performance
PLANT=Y PC_ID=8



MODEL *** 8010

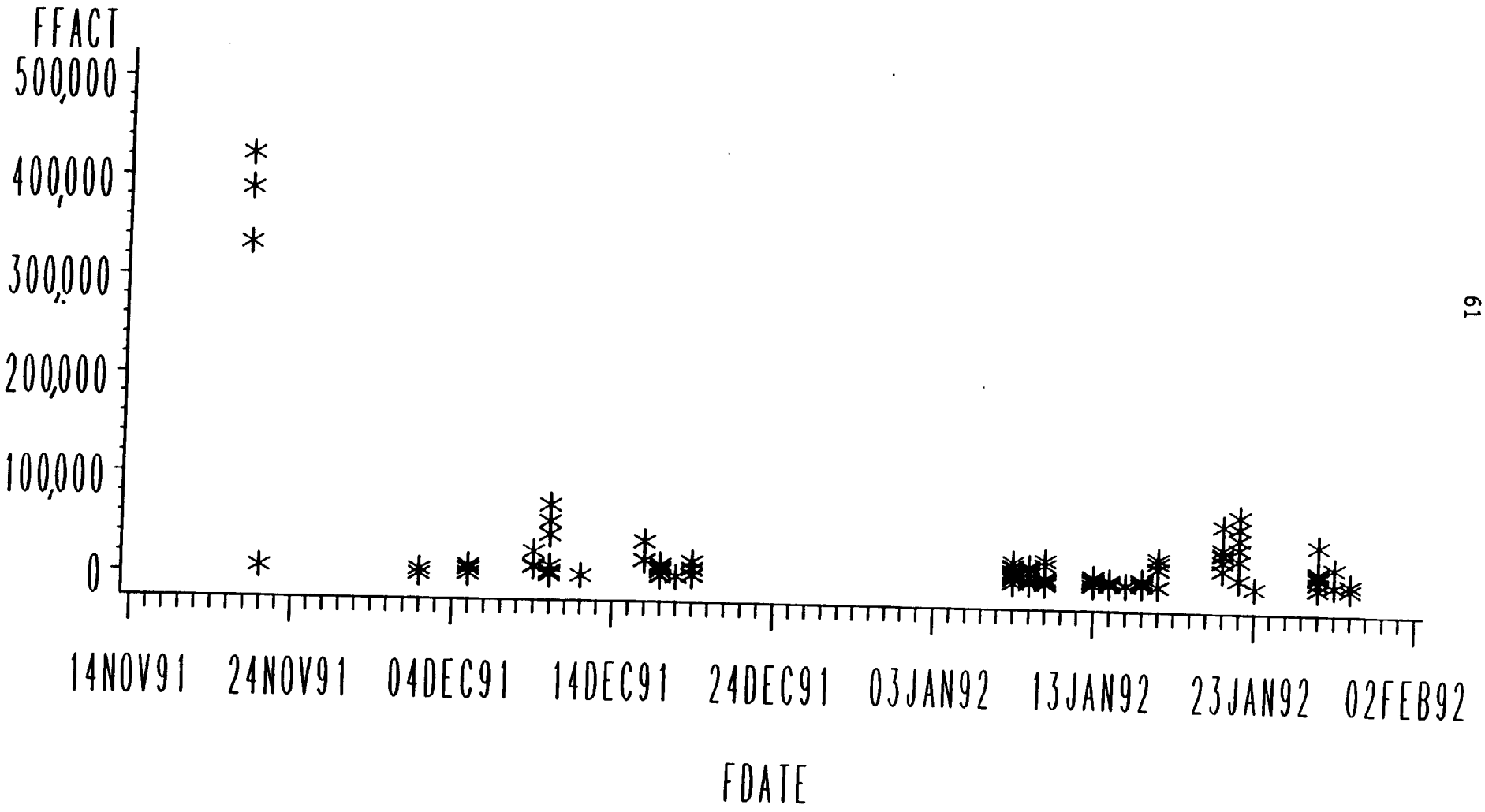
THREE PLANT RESPIRATOR FIT DATA

Portacount Performance
PLANT=Y PC_ID=9



THREE PLANT RESPIRATOR FIT DATA

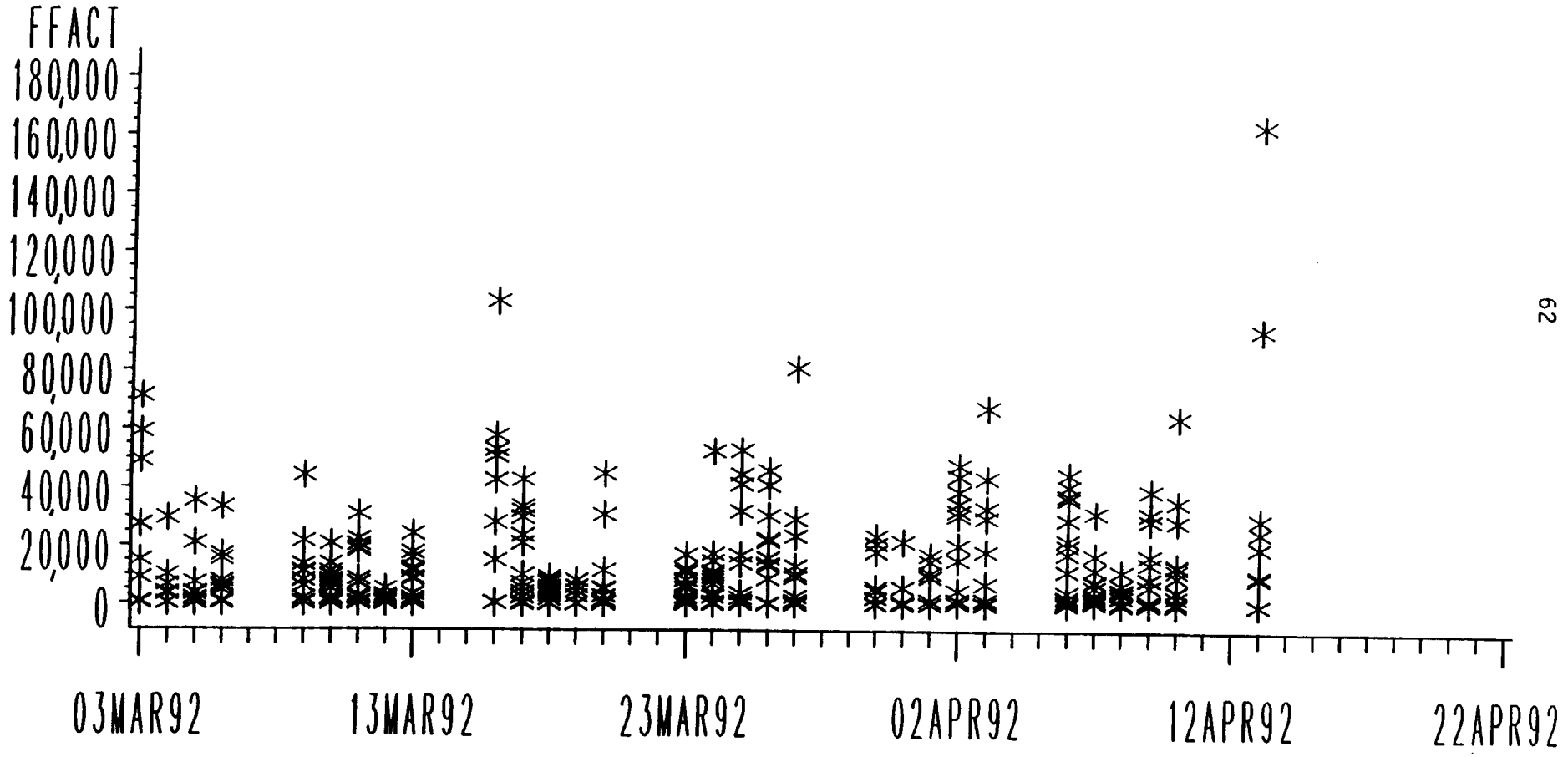
Portacount Performance
PLANT=Y PC_ID=10



MODEL *** 8020

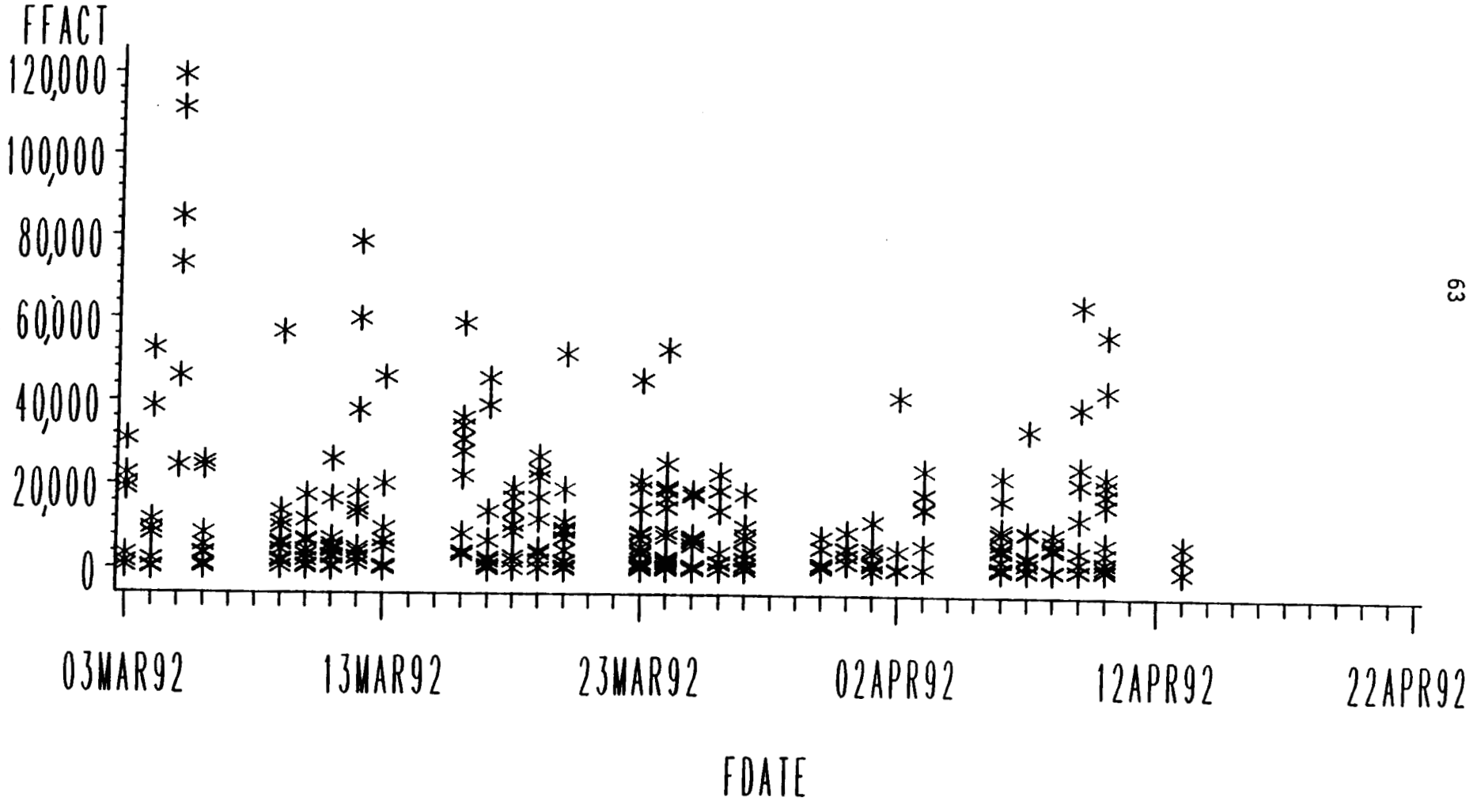
THREE PLANT RESPIRATOR FIT DATA

Portacount Performance
PLANT=Y PC_ID=11



THREE PLANT RESPIRATOR FIT DATA

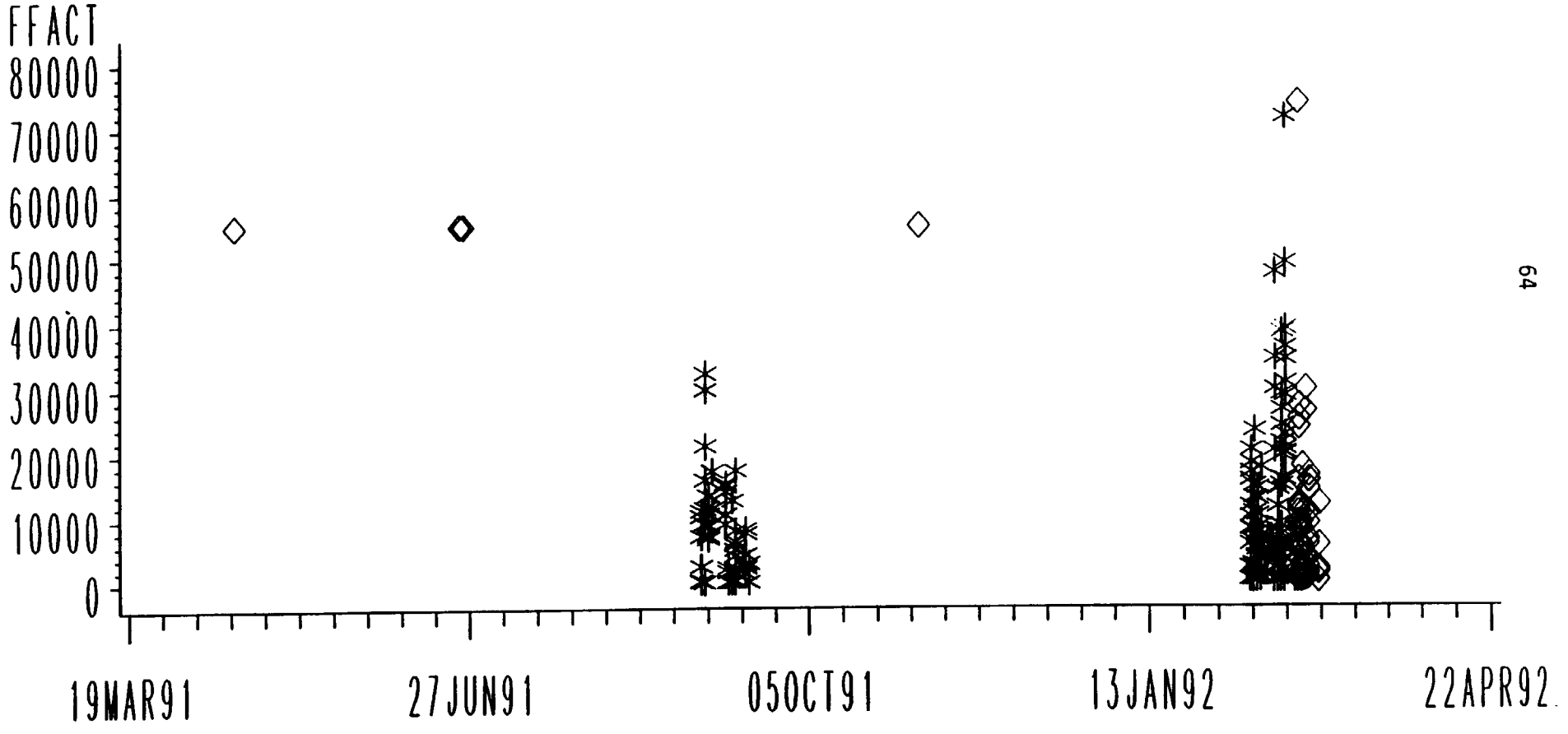
Portacount Performance
PLANT=Y PC_ID=12



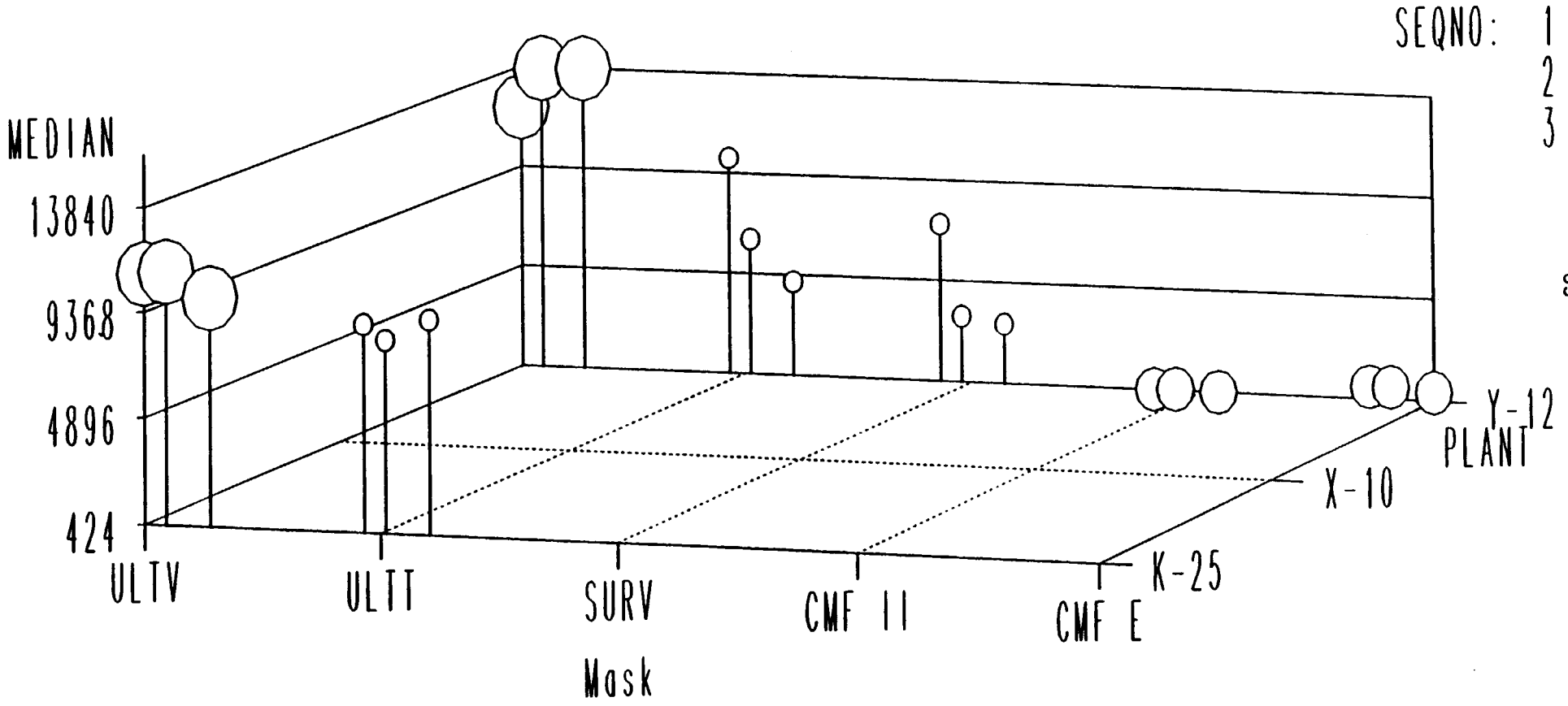
MODEL *** 8020

THREE PLANT RESPIRATOR FIT DATA

Portacount Performance
PLANT=Y PC_ID=XXXXX



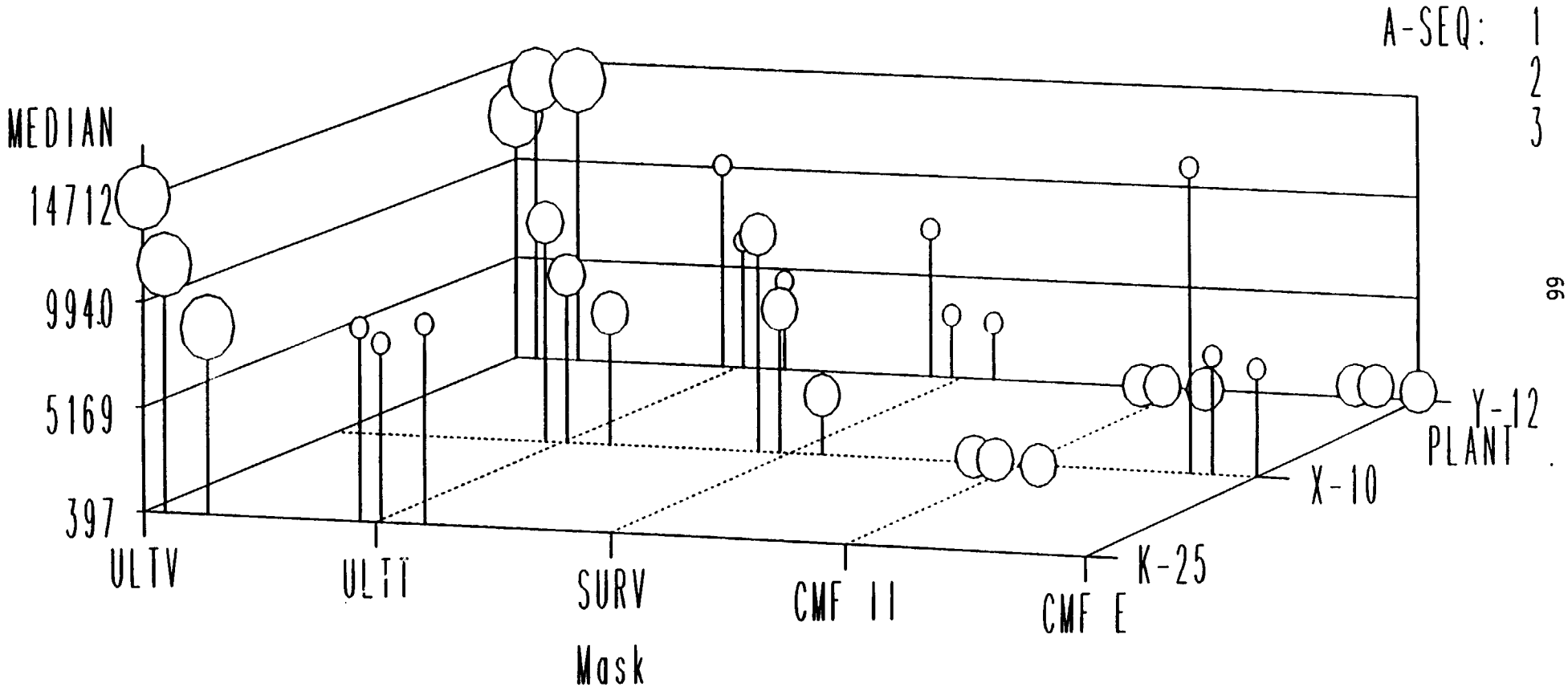
Three Plant Respirator Fit Data
Comparison of Fit Factor Medians
ASBESTOS WORKERS



Balloon size denotes frequency
SMALL : N<=10
MEDIUM: 10<N<100
LARGE : N>=100

FIGURE 11.1

Three Plant Respirator Fit Data
Comparison of Fit Factor Medians
ASBESTOS WORKERS – Assigned Sequence Numbers



'n size denotes frequency