

In the Matter of

**CERTAIN DOUBLE-SIDED FLOPPY DISK
DRIVES AND COMPONENTS THEREOF**

Investigation No. 337-TA-215

USITC PUBLICATION 1860

MAY 1986



UNITED STATES INTERNATIONAL TRADE COMMISSION

COMMISSIONERS

Paula Stern, Chairwoman

Susan W. Liebeler, Vice Chairman

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David B. Rohr

Anne E. Brunsdale

**Address all communications to
Kenneth R. Mason, Secretary to the Commission
United States International Trade Commission
Washington, DC 20436**

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UNITED STATES INTERNATIONAL TRADE COMMISSION

Washington, DC 20436

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In the Matter of)

DOUBLE SIDED)

CERTAIN DOUBLE-SIDED FLOPPY DISK)
DRIVES AND COMPONENTS THEREOF.)

Investigation No. 337-TA-215

NOTICE OF COMMISSION DECISION ON REVIEW AFFIRMING
INITIAL DETERMINATION FINDING NO VIOLATION

AGENCY: U.S. International Trade Commission.

ACTION: The Commission has determined to affirm the presiding officer's initial determination finding no violation of section 337 of the Tariff Act of 1930, 19 U.S.C. § 1337, in investigation No. 337-TA-215.

SUMMARY: The Commission has determined on review to affirm the administrative law judge's (ALJ) initial determination (ID) finding no violation of section 337 in the above-captioned investigation. Although the Commission has affirmed the ALJ's finding of no violation, the Commission disagrees with portions of the ALJ's reasoning in the initial determination.

FOR FURTHER INFORMATION CONTACT: Marcia H. Sundeem, Esq., Office of the General Counsel, U.S. International Trade Commission, telephone 202-523-0350.

SUPPLEMENTARY INFORMATION: On December 6, 1984, Tandon Corporation (Tandon) filed a complaint and a motion for temporary relief under section 337. On January 22, 1985, the Commission instituted an investigation to determine whether there is a violation of section 337 in the unlawful importation or sale of certain double-sided floppy disk drives into the United States by reason of alleged infringement of the claims of U.S. Patent No. 4,151,573 (the '573 patent), the effect or tendency of which is to destroy or substantially injure an industry, efficiently and economically operated, in the United States.

The original respondents were: (1) Mitsubishi Electric Corporation, (2) Mitsubishi Electronics America, Inc., (3) TEAC Corporation, (4) TEAC Corporation of America (hereinafter collectively referred to as "TEAC"), (5) Sony Corporation, and (6) Sony Corporation of America (hereinafter collectively referred to as Sony). Mitsubishi is the only remaining respondent. On August 16, 1985, the Commission approved a settlement and

licensing agreement between the Sony respondents and Tandon. On November 5, 1985, the Commission approved a settlement and licensing agreement between the TEAC respondents and Tandon.

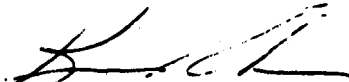
On May 29, 1985, the ALJ granted the complainant's motion for temporary relief after a hearing. On September 3, 1985, the Commission decided to affirm the ALJ's ID awarding temporary relief and awarded a limited temporary exclusion order barring entry of allegedly infringing drives manufactured by the respondents except under a bond of 25 percent.

On November 1, 1985, the ALJ issued an ID finding no violation of section 337. On December 19, 1985, the Commission determined to review portions of the ID (50 F.R. 52866). All parties submitted briefs on all issues under review. Sankyo Seiki Manufacturing Co., Ltd., filed a submission on the issue of remedy. No Government agency comments have been received.

The authority for the Commission's disposition of this matter is contained in section 337 of the Tariff Act of 1930 (19 U.S.C. § 1337) and in section 210.56 of the Commission's Rules of Practice and Procedure (49 F.R. 46123) (19 CFR § 210.56).

Copies of the Commission's action and order and all other non confidential documents filed in connection with this investigation are available for inspection during official business hours (8:45 a.m. to 5:15 p.m.) in the Office of the Secretary, U.S. International Trade Commission, 701 E Street NW., Washington, DC 20436, telephone 202-523-0161.

By order of the Commission.



Kenneth R. Mason
Secretary

Issued: January 31, 1986

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UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, DC 20436

OFFICE OF
DOCKET/USITC

In the Matter of)
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CERTAIN DOUBLE-SIDED FLOPPY DISK)
DRIVES AND COMPONENTS THEREOF)
)

Investigation No. 337-TA-215

COMMISSION ACTION AND ORDER

Background

On December 6, 1984, Tandon Corporation (Tandon) filed a complaint and a motion for temporary relief under section 337 of the Tariff Act of 1930. On January 22, 1985, the Commission instituted an investigation to determine whether there is a violation of section 337 in the unlawful importation or sale of certain double-sided floppy disk drives into the United States by reason of alleged infringement of the claims of U.S. Patent No. 4,151,573 (the '573 patent), the effect or tendency of which is to destroy or substantially injure an industry, efficiently and economically operated, in the United States.

The original respondents were: (1) Mitsubishi Electric Corporation, (2) Mitsubishi Electronics America, Inc. (hereinafter collectively referred to as "Mitsubishi"), (3) TEAC Corporation, (4) TEAC Corporation of America (hereinafter collectively referred to as "TEAC"), (5) Sony Corporation, and (6) Sony Corporation of America (hereinafter collectively referred to as "Sony").

On May 30, 1985, the administrative law judge (ALJ) issued an ID granting the complainant's motion for temporary relief. On July 2, 1985, the Commission determined to review the initial determination (ID) on the various issues (50 F.R. 28294).

On August 16, 1985, the Commission approved a settlement and licensing agreement between the Sony respondents and Tandon. On November 5, 1985, the Commission approved a settlement and licensing agreement between the TEAC respondents and Tandon. Mitsubishi is the only remaining respondent.

On September 3, 1985, the Commission decided to affirm the ALJ's ID awarding temporary relief. The Commission awarded a limited temporary exclusion order barring entry of allegedly infringing drives manufactured by the respondents except under a bond of 25 percent.

On November 1, 1985, the ALJ issued an ID finding no violation of section 337. The ALJ's decision is based on three findings. First, the double-sided floppy disk drives manufactured by Mitsubishi that are the subject of the investigation do not infringe the '573 patent. Second, the allegedly unfair acts of the respondents did not cause substantial injury to the domestic industry. Third, the allegedly unfair acts of the respondents have no tendency to substantially injure the domestic industry. On December 19, 1985, the Commission determined to review portions of the ID (50 F.R. 52866). All parties have submitted briefs on all issues under review, as well as on the

issues of remedy, bonding, and the public interest. Sankyo Seiki Manufacturing Co., Ltd. (Sankyo), filed a submission on the issue of remedy.

Action

Having considered the briefs of the parties, the Sankyo submission, and the record in this investigation, the Commission has determined to affirm the ALJ's ID finding no violation of section 337.

Order

Accordingly, it is hereby ORDERED THAT—

1. The administrative law judge's initial determination finding no violation of section 337 is affirmed;
2. The Secretary shall serve copies of this Commission Action and Order upon each party of record to this investigation and publish notice thereof in the Federal Register;

By order of the Commission.

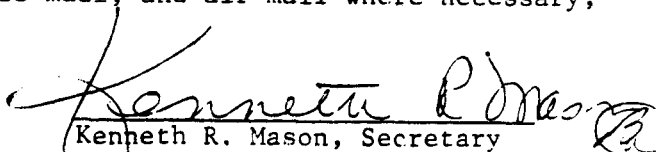


Kenneth R. Mason
Secretary

Issued: January 30, 1986

Certificate Of Service

I, Kenneth R. Mason, hereby certify that the attached NOTICE OF COMMISSION DECISION ON REVIEW AFFIRMING INITIAL DETERMINATION FINDING NO VIOLATION, was served upon Victoria L. Partner, Esq., and Robert D. Litowitz, Esq., and upon the following parties via first class mail, and air mail where necessary, on January 31, 1986.


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CERTIFICATE OF SERVICE - Page 2

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Kelly

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C. 20436

In the Matter of _____)
_____))
CERTAIN DOUBLE-SIDED FLOPPY DISK)
DRIVES AND COMPONENTS THEREOF)
_____)

Investigation No. 337-TA-215

VIEWS OF THE COMMISSION 1/ 2/

On December 19, 1985, the Commission determined to review the ID 3/ of the ALJ in Certain Double-Sided Floppy Disk Drives and Components Thereof, Inv. No. 337-TA-215. The ALJ issued the ID on November 1, 1985, and determined that there was no violation of section 337 of the Tariff Act of 1930 4/ on the basis that (1) the subject patent was not infringed by the subject articles, and (2) that the importation and/or sale of the subject articles do not have the effect or tendency to destroy or substantially injure the domestic industry.

We concur in the finding of no violation of section 337 on the basis that the subject patent is not infringed. Our determination that the subject

1/ Commissioners Eckes, Lodwick, and Rohr determine that the subject patent is not infringed and that this finding is dispositive in this investigation. They take no position on any other issue under review.

2/ Commissioner Brunsdale did not participate in this investigation.

3/ The following abbreviations are used in this opinion:

- ALJ = Administrative law judge;
- ID = Initial determination;
- CX = Complainant's exhibit;
- CPX = Complainant's physical exhibit;
- TR = Transcript of evidentiary hearing before the ALJ;
- MRX = Respondent Mitsubishi's exhibit;
- MRPX = Respondent Mitsubishi's physical exhibit;
- FF = Findings of fact.

4/ 19 U.S.C. § 1337.

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patent is not infringed is outcome determinative and, thus, we have not reached the other issues under review. 5/

Procedural History

On December 6, 1984, Tandon Corporation (Tandon) filed a complaint and a motion for temporary relief (Motion No. 215-1) under section 337 of the Tariff Act of 1930.

On the basis of Tandon's complaint, the Commission, on January 22, 1985, instituted this investigation to determine whether there is a violation of section 337 in the unlawful importation or sale of certain double-sided floppy disk drives into the United States by reason of alleged infringement of the claims of U.S. Patent No. 4,151,573 (the '573 patent), the effect or tendency of which is to destroy or substantially injure an industry, efficiently and economically operated, in the United States. 6/ The Commission did not institute on Tandon's allegations concerning prevention of the establishment of a domestic industry.

The original named respondents were: (1) Mitsubishi Electric Corporation, (2) Mitsubishi Electronics America, Inc. (hereinafter collectively referred to as Mitsubishi), (3) TEAC Corporation, (4) TEAC Corporation of America (hereinafter collectively referred to as TEAC), (5) Sony Corporation, and (6) Sony Corporation of America (hereinafter collectively referred to as Sony).

On May 29, 1985, the ALJ granted complainant's motion for temporary relief after a hearing. Respondents Sony, TEAC, and Mitsubishi and the Office of Unfair Import Investigations (OUII) filed petitions for review. On July 2,

5/ Chairwoman Stern and Vice Chairman Liebeler discuss the other issues under review. See their Additional Views, infra.

6/ 50 Fed. Reg. 4,276 (Jan. 30, 1985).

1985, the Commission determined to review the ID on temporary relief on the issues of patent validity, inequitable conduct, patent infringement, domestic industry, immediate and substantial harm, and the appropriateness of temporary relief. 7/

On September 3, 1985, the Commission affirmed the ALJ's initial determination awarding temporary relief. The Commission issued a limited temporary exclusion order barring entry into the United States of allegedly infringing drives manufactured by the respondents except under a bond of 25 percent. 8/

On August 16, 1985, the Commission approved a settlement and licensing agreement between the Sony respondents and Tandon. 9/ On November 5, 1985, the Commission approved a settlement and licensing agreement between the TEAC respondents and Tandon. 10/ Mitsubishi is the only remaining respondent.

On November 1, 1985, the ALJ issued an initial determination finding no violation of section 337. Tandon, Mitsubishi, and OUII filed petitions for review. On December 19, 1985, the Commission determined to review the following issues: 11/

- (1) whether the double-sided floppy disk drives that are the subject of the investigation infringe U.S. Patent No. 4,151,573;
- (2) whether the domestic industry is efficiently and economically operated;
- (3) whether the domestic industry includes the activities of complainant Tandon Corporation;

7/ 50 Fed. Reg. 28,294 (July 11, 1985).

8/ 50 Fed. Reg. 37,067 (Sept. 11, 1985).

9/ 50 Fed. Reg. 35,167 (Aug. 29, 1985).

10/ 50 Fed. Reg. 47,122 (Nov. 14, 1985).

11/ 50 Fed. Reg. 52,866 (Dec. 26, 1985).

- (4) whether the ALJ's reasoning that the domestic industry does not include 8-inch double-sided floppy disk drive manufacturing operations because 'the 8-inch drives only compete against similar sized drives as possible replacements in older systems for existing 8-inch drives, and affords no real market competition to 5-1/4 inch and 3-1/2 inch double-sided floppy disk drive products' (ID at 64-66) is legally erroneous in view of the decision of the Court of Appeals for the Federal Circuit in Bally/Midway Mfg. Co. v. U.S. International Trade Commission, 714 F.2d 1117 (Fed. Cir. 1983);
- (5) whether there is a sufficient causal nexus between the alleged unfair acts of the respondents and the substantial injury to the domestic industry; and,
- (6) whether the alleged unfair acts of the respondents have a tendency to substantially injure the domestic industry.

All parties filed briefs and reply briefs on the issues under review and on remedy, bonding, and the public interest.

Mitsubishi's Motion to Strike Portions of Tandon's Reply Brief

On January 9, 1986, respondent Mitsubishi filed a motion (Motion No. 215-63C) to strike Sections IIB, D, and E (in part) of Tandon's Reply Brief. According to Mitsubishi, Tandon's Reply Brief relies on deposition testimony which is not of record in the investigation. The depositions of all three of the inventors, Tandon, Hackney, and Applequist, were taken by respondents during the course of the investigation. Portions of the deposition of Mr. Tandon (MRPX 34C) were admitted into evidence with the remainder of the deposition being usable only to the limited extent of avoiding misimpressions of misleading statements. 12/ The deposition of Mr. Hackney (MRPX 36) was admitted into evidence in toto. 13/ The deposition of Mr. Applequist (CPX 34)

12/ TR 5328-31.

13/ TR 5332.

was not entered into evidence. Tandon filed an opposition to Mitsubishi's motion to strike on January 21, 1986.

Tandon argues that since the ALJ ruled that the entire deposition testimony of the inventors was available to Tandon to the extent that it was relevant to the portions of the depositions offered by Mitsubishi to avoid misimpressions or misleading statements that it is proper for Tandon to introduce such evidence before the Commission at this time.

Section 337 investigations are required by section 337(c) to be conducted "on the record after notice and an opportunity for a hearing in conformity with the provisions of subchapter II of chapter 5 of Title 5 [of the U.S. Code]." In reviewing the correctness of the ID on violation, the Commission is limited to the record certified to the Commission by the ALJ. ^{14/} Those portions of the deposition which were not entered into evidence before the ALJ are not part of the record certified to the Commission by the ALJ. The Commission, therefore, has not considered the portions of the deposition testimony of Tandon and Applequist which were not part of the record. Mitsubishi's motion is granted.

Parties

Tandon is a California corporation having its principal place of business at 20320 Prairie Street, Chatsworth, California 91311. It is the world's largest manufacturer of random access disk drives for microcomputer systems and the world's largest producer in the market of floppy disk drives.

Mitsubishi Electric Corporation is a Japanese company organized and existing under the laws of Japan with its principal place of business at

^{14/} Commission Rule 210.53 provides that the ALJ shall certify the record to the Commission.

2-3 Marunouchi 2-chome, Chiyoda-ku, Tokyo 100. Mitsubishi Electronics America, Inc., is a subsidiary of Mitsubishi Electric Corporation and has offices at 911 Knox Street, Torrance, California 90502.

The Articles Under Investigation and the Patented Invention

A. Background of the invention

The articles under investigation are double-sided floppy disk drives. Floppy disk drives are data storage systems that utilize a floppy disk as the magnetic storage surface. Floppy disks are made of limp material and have a magnetic coating.

The drives utilize transducers, also referred to as "heads," which "read/write" information from the disk. The transducers contain magnetic cores. In a double-sided floppy disk drive system the disk is sandwiched between two transducers. The transducers are mounted on supports. The transducers and supports are known as the head assembly. Contact between the transducers and the disk must be extremely close and the drive must deal with the undulations and waviness of the disk. If close contact between the disk and the transducer is not maintained, error in data transfer results. 15/ 16/

Floppy disks and drives come in three sizes--8-inch, 5-1/4 inch, and 3-1/2 inch--corresponding to the diameter of the disk. The trend in the disk drive industry is toward smaller drives. Although there is still a replacement market for 8-inch drives, they are practically obsolete. Currently 5-1/4 inch drives are the most widely sold size of drive. The 3-1/2 inch drive is projected to be a large seller in the near future. 17/

15/ For example, in the Mitsubishi drive a gap greater than 0.32 microns between the transducers and the disk produces unacceptable error. TR 2847.

16/ A more complete description of disk drive technology is in the ID at 13-15.

17/ ID at 145-47.

Double-sided floppy disk drives are manufactured in two heights: full height and half-height, full height drives being twice the height of half-height drives. Most double-sided disk drives sold today are half-height drives.

The '573 patent 18/ was issued to Sirjang Tandon, Alfred Hackney, and A. Applequist on April 24, 1979, and is currently assigned to Tandon Corporation. Tandon has granted licenses under the '573 patent to IBM, Control Data Corporation (CDC), Shugart Associates, and Texas Peripherals, Inc. (TP). The '573 patent discloses a data storage system that utilizes a head assembly for double-sided floppy disk drives.

Prior to the development of floppy disk drives, tape drives were commonly used. Tape drives transfer data from flexible tape by utilizing a non-gimballed transducer which forces the tape to wrap around the transducer. 19/ Another type of drive is the rigid disk drive. The rigid disk drive utilizes a transducer mounted on a gimbal or floating spring. 20/

Early floppy disk drives were single-sided disk drives, i.e., the drives had only one transducer. IBM developed one of the first single-sided floppy disk drives. 21/ IBM also worked on the development of double-sided drives. An early IBM double-sided floppy disk drive employed two gimballed transducers. In this early IBM drive both transducers were gimbal mounted and the transducers followed the movements of the disk. 22/ IBM and others

18/ The '573 patent is reproduced in the Appendix.

19/ ID at 31-32.

20/ Webster's Ninth New Collegiate Dictionary defines "gimbal" as a device that permits a body to freely incline in any direction or suspends it so that it will remain level when its support is tipped. See also FF 235N.

21/ FF 13-14C.

22/ CX 646 and CX 611 at 53.

experienced difficulties in the development of double-sided disk drives because of wear problems associated with the magnetic coating on the disk which diminished the accuracy of data storage and access.

The invention disclosed in the '573 patent overcame the problems associated with the prior art devices by utilizing an asymmetrical head assembly. 23/ The claimed invention combines rigid disk drive technology and tape drive technology. In the device disclosed in the '573 patent the lower transducer acts as a reference plane for the pliant disk and the upper transducer is gimbal mounted and is urged against the disk. 24/

Resolution of the patent infringement issue focuses on the amount of movement in the lower transducer. The upper (second) transducer is described in the '573 patent as being gimballed, or moveable, and the lower (first) transducer is described as "fixed" (claim 1), "relatively fixed" (claim 5), or "non-gimballed" (claim 12).

B. The Tandon and Mitsubishi drives

Tandon manufactures 8-inch, 5-1/4 inch, and 3-1/2 inch double-sided floppy disk drives. 25/ Tandon, however, is not commercially manufacturing 3-1/2 inch drives. Tandon's drives correspond to the preferred embodiment of the invention described and claimed in the '573 patent. The lower transducer used in the commercial Tandon device is a button head transducer and the upper transducer is gimbal mounted. 26/

23/ CX 601, col. 2, lines 48-60.

24/ Id.

25/ CPX 18-20 are head assemblies made by complainant according to the '573 patent.

26/ Tandon's Brief before the Commission at 27.

Mitsubishi manufactures and imports 8-inch, 5-1/4 inch, and 3-1/2 inch double-sided floppy disk drives. 27/ The Mitsubishi Mark I and Mark II series include a lower transducer mounted on a circular slotted sheet metal support element backed up by a load finger formed integrally with the plastic carriage, and an upper transducer mounted on a three ring gimbal spring. 28/ 29/

The Unfair Act--Patent Infringement

A. Literal infringement 30/

The ALJ concluded that the drives manufactured by Mitsubishi do not literally infringe the claims of the '573 patent. He based his conclusion on the Tandon commercial device itself, testimony of two of the inventors, testimony of various experts, the claims, and results of tests conducted by the parties.

We agree with the ALJ's conclusion that there is no literal infringement of the '573 patent. However, portions of the ALJ's analysis require clarification. Analysis of literal infringement is a two step process. First, the patented invention as described by the language of the claims must be defined. This is a question of law. Envirotech Corp. v. Al George, Inc., 730 F.2d 753, 221 U.S.P.Q. 473 (Fed. Cir. 1984). The second step is whether the accused device falls within the scope of the claims. This is a question of fact.

27/ Two models of 8-inch Mitsubishi drives are not alleged to infringe, Mitsubishi Model Nos. M2894 and M2896-6. FF 242.

28/ CX 693, TR 1564-65, FF 140.

29/ The structure of the Mitsubishi drives is described in detail in FF 135-45.

30/ The issue of the validity of the '573 patent is not on review before the Commission. The Commission has adopted the ID with respect to this issue.

The patented invention is defined by analyzing the language of each of the claims, the patent documents, including the file history, and experts' testimony. Autogiro Company of America v. United States, 384 F.2d 391, 155 U.S.P.Q. 697 (Ct. Cl. 1967), SSIH Equipment S.A. v. U.S. International Trade Commission, 718 F.2d 365, 218 U.S.P.Q. 678 (Fed. Cir. 1983).

The '573 patent has three independent claims: claims 1, 5, and 12. The portions of these claims that are in dispute involve the phrases used to explain the fixedness of the first (lower) transducer. Claim 1 specifies that the lower transducer is in a "fixed position in a direction normal to the plane of the media" Claim 12 is similar in that it specifies that the first transducer is "fixedly coupled to the carriage for bearing against a first side of the disc in an invariant position in a direction normal to the plane of the disc." 31/ Claim 5 specifies a "first non-gimballed transducer mounted on a first side of the media and having a relatively fixed position relative to the plane of the media." 32/

Tandon argues that claim 1 requires that the lower transducer is fixed in the Z-axis direction 33/ and that there is nothing in the claim restricting movement of the lower transducer along any other axis. With respect to claim 12, Tandon argues that the lower transducer is restricted in movement only in the Z-axis direction. 34/

Mitsubishi argues that all of the claims require that the lower transducer be secured to the carriage as firmly as possible and that the lower

31/ CX 601, col. 6, lines 52-53; col. 8, lines 23-26.

32/ Id. at col 7, lines 24-26.

33/ Z-axis movement is movement that is perpendicular to the plane of the disk.

34/ Tandon's Brief to the Commission at 23-26.

transducer is non-gimballed. According to Mitsubishi, the phrases "fixed" and "fixedly coupled" require that the lower transducer be secured as firmly as possible. This interpretation, according to Mitsubishi, is supported by the testimony of inventors Tandon and Hackney, ordinary usage of the terms in the industry, and the patent file history. 35/

Based on the patent documents and other evidence of record, we determine that claims 1 and 12 each require that the lower transducer does not move. This interpretation is fully supported by the record. The patent specification repeatedly emphasizes and explains that in the claimed invention the disk is deflected by the fixed transducer and at the same time confined against the fixed transducer (emphasis added). 36/ Thus, the lower "fixed" transducer of the claimed invention must be sufficiently secure so that the floppy disk may be forced against it, and close contact between the surface of the lower transducer and the disk is maintained.

The file history of the '573 patent supports the conclusion that claims 1 and 12 require that the lower transducer be securely fixed to the carriage so that it may act as a reference for the limp, pliant disk. 37/ In response to the first Office Action from the Patent Office, Tandon's patent attorney described the invention as having a "fixed transducer . . . in fixed

35/ Mitsubishi's Brief to the Commission at 43-48.

36/ CX 601, col. 2, lines 44-55, col. 5, lines 37-57.

37/ Consideration of the file history of a patent is relevant in defining the invention for purposes of literal infringement. *SSIH v. U.S. International Trade Commission*, 718 F.2d 365, 218 U.S.P.Q. 678 (Fed. Cir. 1983). Application of the doctrine of prosecution history estoppel, however, is improper to a literal infringement analysis. *Fromson v. Advance Offset Plate, Inc.*, 720 F.2d 1565, 1570, 219 U.S.P.Q. 1137, 1141 (Fed. Cir. 1983). Although the transition may be gradual between literal infringement by substantially identical structures and infringement by equivalent structures, the ALJ's use of prosecution history estoppel for purposes of claim interpretation is improper. *Builders Concrete v. Bremerton Concrete Products Co.*, 225 U.S.P.Q. 240, 241 (Fed. Cir. 1985).

position relative to the plane of the media." 38/ Similar remarks were made in response to the Final Office Action from the Patent Office: the invention was described as utilizing "one head that has an invariant position bearing against one side of the media without spring loading." 39/ No distinction was made between the different claims with respect to fixedness.

Mitsubishi's patent expert, Mr. Jessup, testified that:

the entire prosecution indicates that the first transducer must be fixed to its carriage by being secured, glued adhesively, or nailed as firmly as the art reasonably permits, and particularly in contrast to IBM and to its own (the claimed head) second head is not to be gimbaled. 40/

Experts in the field of disk drive technology testified that the term fixed as used in the industry means that the transducer is firmly secured to the carriage. Mitsubishi's technical expert, Mr. Lewis, testified as follows:

Q. In your opinion, does the term 'fixed' have a generally accepted meaning in the disk drive industry as applied to the mountings of recording heads?

A. Yes.

Q. And what is that meaning, sir.

A. A recording head that is fixed is a recording head that is designed to be not able to move. 41/

Based on this testimony, the phrases "fixed" and "fixedly coupled" as used in the industry mean that a fixed transducer does not move.

Two of the inventors of the device claimed in the '573 patent, Tandon and Hackney, also defined a "fixed" lower head in accordance with the definition of Mr. Lewis, i.e., the lower head does not move in any direction with respect to the carriage. 42/ In specifically explaining the term fixed, inventor Hackney testified that fixed meant "fixed in reference to the lower carriage,

38/ CX 611 at 28.

39/ Id. at 53.

40/ TR 4425. Also See TR 4464.

41/ TR 2870.

42/ MRPX 34C at 413-415 and MRPX 36 at 53-54.

such that it didn't move," and fixed as well as you could fix it so that it would not move. 43/ Neither Lewis, Tandon, or Hackney testified that fixed, as used in the industry at the time of the claimed invention, meant that a transducer was fixed in only the Z-axis direction or in a direction normal to the plane of the media. Tandon's argument that claims 1 and 12 refer only to fixed in the Z-axis direction is, therefore, not supported by the record.

Claim 5, the third independent claim, defines a device having a "first non-gimballed transducer mounted on a first side of the media and having a relatively fixed position relative to the plane of the media." 44/ Tandon argues that claim 5 emphasizes movement about the gimbal axis and says nothing about movement in the Z-axis direction. Mitsubishi argues that claim 5 is of the same scope as claims 1 and 12 with respect to the movement of the lower transducer.

For purposes of temporary relief the ALJ and the Commission determined that there was "reason to believe" that only claim 5 was literally infringed. This earlier determination was premised on the interpretation of the term "relatively" as permitting some movement of the lower transducer.

Additional and substantial evidence produced at the hearing on permanent relief by both parties establishes that the term "relatively" does not have a different meaning from the terms "fixed" and "fixedly coupled" as used in claims 1 and 12. Professor Chisum, Tandon's patent law expert, testified that the term "relatively" had "no major impact on the scope of the claim at all." 45/ Mitsubishi's patent expert testified similarly. 46/ Additionally, inventors Tandon and Hackney testified that the term "relatively fixed" has

43/ MRPX 36 at 53-54.

44/ CX 601, col. 7, lines 21-44.

45/ TR at 4373.

46/ Id. at 4459.

the same meaning as the term "fixed" used in the other claims. 47/ This testimony establishes that the scope of claim 5 with respect to the movement of the first transducer does not differ from the scope of claims 1 or 12.

Moreover, the term "non-gimballed" in claim 5 refers to a "fixed" transducer. The inventors testified that non-gimballed means that the head is to be fixed. 48/ During prosecution of the '573 patent non-gimballed was described as follows:

applicant's system utilizes one head that has an invariant position bearing against one side of the media without spring loading, and this head is non-gimballed. The other head is pivoted and gimballed. 49/

Therefore, based on the above evidence, we conclude that claims 1, 5, and 12 do not differ in scope with respect to the movement of the lower transducer. 50/

Finally, Tandon argues that the ALJ erred as a matter of law in considering the essence of the invention to be penetration of the lower head into the plane of the disk. 51/ Tandon is correct in stating that the entire invention must be evaluated, not merely the "heart" or "essence" of the invention. W.L. Gore & Associates, Inc. v. Garlock Inc., 721 F.2d 1540, 220 U.S.P.Q. 303, 309 (Fed. Cir. 1983). Although the ALJ used the term "essence," the overall discussion in the ID of the features of the invention make it clear that the ALJ did not consider merely the "essence" of the claimed invention.

47/ FF 235E.

48/ FF 235J.

49/ CX 611 at 53.

50/ We recognize that the doctrine of claim differentiation provides that claims are of differing scope. However, the amount of fixedness of the first transducer is but one element of the invention claimed in the '573 patent. There are numerous other elements claimed in claim 1, 5, and 12 and these result in the claims being of a differing scope.

51/ Tandon's Brief to the Commission at 38-40.

Under the second part of the infringement analysis for claims 1, 5, and 12, we conclude, as the ALJ did, that the drives manufactured by Mitsubishi do not literally infringe claims 1, 5 or 12. Tandon argues that the drives manufactured by Mitsubishi infringe because the gimbals on which the Mitsubishi lower heads are mounted are cosmetic. According to Tandon, the lower heads of the Mitsubishi drives behave as if they were fixed. We do not agree.

First, the lower or first transducer of the Mitsubishi drives moves significantly during operation of the drives. 52/ The first (lower) transducer and the upper transducer of the Mitsubishi drives are each mounted on a three ring gimbal spring which permits movement in the pitch, roll, and Z-axis directions. The 3-ring gimbals were developed by Mitsubishi in the early 1970's for use with rigid disk drives. 53/ The Mark I and Mark II drives, both 5-1/4 inch drives, have identical upper and lower gimbal springs. Mitsubishi's 3-1/2 inch drive also has two gimbal springs. Test results showed that the lower transducer of the Mitsubishi drives moved significantly during the "read/write" operation of the drive, and that the upper and lower transducers move together. 54/ 55/ 56/ These transducers, therefore, are neither "fixed," "fixedly coupled," or "relatively fixed," as required by claims 1, 12, and 5, respectively. Although Tandon argues that the lower gimbal is merely cosmetic, we conclude that the lower transducers

52/ FF 234A, FF 217, MRPX 42.

53/ TR 2842-43.

54/ FF 217-18.

55/ Tandon's insensitivity calculations do not account for the loading forces of the heads on the disk. ID at 39. Since these forces contribute to controlling disk movement, we have afforded greater weight to the tests conducted by Mitsubishi because those tests considered the loading forces.

56/ MRX 9 and MRPX 42. MRPX 42 is a videotape which illustrates the gimbaling action of the lower head of the Mitsubishi drives.

move and closely track the disk. Claims 1, 5, and 12 are not infringed, based on the above evidence.

Additionally, the first (lower) transducer of the Mitsubishi drive does not act as a fixed positional reference for the disk as expressly required by claim 1. 57/ Rather, the first transducer in the Mitsubishi drives follows the movements of the disk, i.e., the disk is not forced to conform to the first transducer. Thus, the drives of Mitsubishi also do not infringe claim 1 for this reason.

Tandon also argues that the ALJ erred as a matter of law because he substituted Tandon's commercial drives for the claims. 58/ It is legal error to compare the patentee's commercial product with the allegedly infringing product. Martin v. Barber, 225 U.S.P.Q. 233 (Fed. Cir. 1985). To the extent that the ALJ compared Tandon's drives to Mitsubishi's drives, this was error. Although the Commission's analysis uses data from tests which compare the movement of the lower transducers of the Tandon drives with the Mitsubishi drives, we have not based our determination on such a comparison. Rather, the test data establishes that the lower transducers of the Mitsubishi drives are not "fixed" as required by the claims.

B. Infringement: Doctrine of equivalents

The ALJ found that the drives manufactured by Mitsubishi do not infringe the claims of the '573 patent under the doctrine of equivalents. We agree with his conclusion. However, the ALJ did not discuss prosecution history estoppel in his analysis of infringement under the doctrine of equivalents,

57/ FF 243, 247.

58/ Tandon's Brief to the Commission at 32-38.

nor did he discuss a range of equivalents to which the '573 invention is entitled.

Analysis of infringement under the doctrine of equivalents is a tripartite test: do the accused devices (1) perform substantially the same function (2) in substantially the same way (3) to obtain the same result? Graver Tank & Manufacturing Co. v. Linde Air Products Co., 339 U.S. 605, 608, 85 U.S.P.Q. 328, 330 (1950). The Supreme Court described the doctrine as follows:

What constitutes equivalency must be determined against the context of the patent, the prior art, and the particular circumstances of the case Consideration must be given to the purpose for which an ingredient is used in a patent, the qualities it has when combined with the other ingredients, and the function which it is intended to perform

A finding of equivalence is a determination of fact. Proof can be made in any form: through testimony of experts or others versed in the technology; by documents, including texts and treatises; and of course, by the disclosures of the prior art. Id.

The doctrine is judicially created to do equity and is designed to protect inventors from unscrupulous copyists. Hughes Aircraft Co. v. United States, 717 F.2d 1351, 1361 (Fed. Cir. 1983). Kinzenbaw v. Deere & Co., 222 U.S.P.Q. 929 (Fed. Cir. 1984). Caterpillar Tractor Co. v. Berco, S.P.A., 714 F. 2d 1110, 1115, 219 U.S.P.Q. 185, 187 (Fed. Cir. 1983). The interplay between the doctrine of equivalents and prosecution history estoppel govern determination of infringement. Caterpillar Tractor Co.

Tandon argues that the Mitsubishi drives and the device claimed in the '573 patent are equivalent because they function in the same way--by removing large-scale variations of the disk during the read/write operation. The specific structure that accomplishes this is a head assembly having a

non-gimballed transducer and a gimballed transducer. According to Tandon, the claimed device is entitled to a range of equivalents broad enough to encompass the accused Mitsubishi device. 59/

The ALJ determined that the Mitsubishi drives, although performing the same function, do not perform it in substantially the same way. According to the ALJ, in the Tandon system data transfer is achieved by the loading force of the upper arm and penetration of the lower head into the plane of the the disk. The disk conforms to the lower head. 60/ In contrast, the Mitsubishi drives achieve data transfer by pitching and rolling synchronously. The transducers follow the movements of the pliant disk. 61/ This analysis is correct, but it does not include a discussion of prosecution history estoppel or a range of equivalents that was applicable to the claimed invention.

All patented inventions are entitled to a range of equivalents,

The breadth of the protection accorded under the doctrine is on a sliding scale depending on the nature of the invention. Pioneer patents are given the broadest protection, while small improvements are afforded fewer equivalents. Equivalency is determined in the context of the patent, prior art, and circumstances of the case.

John Zink v. National Airoil Burner Co., 613 F.2d 547,555, 205 U.S.P.Q. 494, 501 (5th Cir. 1980).

In view of the patent, the prior art and other evidence of record, we conclude that the claims of the '573 patent are not entitled to a range of equivalents broad enough to encompass the allegedly infringing drives which utilize two gimballed transducers. The patent specification describes the feature of the claimed invention as being "an asymmetrical system . . . in which the record element is deflected by the fixed transducer but confined

59/ Tandon's Brief to the Commission at 51.

60/ ID at 44.

61/ Id., FF 241B, 244B.

against the fixed transducer, despite perturbations in its movement by the more able transducer." 62/ Complainant's patent expert testified that an important aspect of the invention was that the lower head was fixed so that the media conformed to the head rather than the head following the pitching and rolling of the media as in the prior art. 63/

The arguments presented to the Patent Office during prosecution of the '573 patent reflect this basic concept of the invention. The claimed invention, as claimed in all of the independent claims, was described as having one gimballed, pivoted head and one fixed head which serves as a positional reference. 64/ These arguments were presented to the Patent Office to distinguish the claimed device from the device described by IBM in Reference R, 65/ which employed two gimballed heads. Tandon's patent attorney distinguished the claimed device from the device disclosed in Reference R by stating that: "[n]either of the two transducers of Reference R can be stated to be fixed in any fashion whatsoever, much less in the stated manner." 66/

Reference R, as described by Tandon, discloses a floppy disk drive having two gimballed heads which in operation "follow the deviations of the floppy disk from its nominal position." 67/ The transducers in the allegedly infringing drives also follow the deviations of the floppy disk. In contrast, Tandon argued to the Patent Office that the claimed device operates by forcing the floppy disk against "a reference surface defined by the fixed transducer." 68/ In view of these arguments, Tandon cannot now broaden its

62/ CX 601, col. 2, lines 48-52.

63/ FF 118.

64/ CX 611 at 53-54.

65/ CX 609.

66/ CX 611 at 28.

67/ CX 611 at 53.

68/ Id. at 54.

claimed invention under the doctrine of equivalents to encompass all asymmetrical double-sided floppy disk drives. 69/

Thus, we agree with the ALJ that there is no infringement under the doctrine of equivalents.

Conclusion

In summary, we have concluded that the double-sided floppy disk drives manufactured by respondent Mitsubishi, that are the subject of this investigation, do not infringe U.S. Patent No. 4,151,573. Our determination on this issue is dispositive of the investigation. Thus, there is no violation of section 337.

69/ Although claim 5 was amended after final rejection to add the term "relatively," this amendment was made to distinguish the claimed invention from Reference R, without adding new matter. CX 611. Thus, Tandon cannot argue that claim 5 is broad enough to include the drives manufactured by Mitsubishi.

ADDITIONAL VIEWS OF CHAIRWOMAN STERN ON DOMESTIC INDUSTRY AND INJURY

Domestic Industry

One of the most important issues in this investigation is the appropriate scope of the domestic industry. The question is the extent to which the Commission should consider in its analysis of domestic industry the research and development and other nonmanufacturing production-related activities that relate directly to the exploitation of the patent. Although the Commission has met this issue previously, 1/ in this investigation a different set of factual circumstances in a rapidly changing industry present the Commission with unexplored territory. In light of the significance of research and development in many high technology industries, and the certainty that this question will arise again in the future as more high technology cases are brought under section 337, I am compelled to reach it in these Additional Views. 2/

In this case, there is one patent at issue (the '573 patent). Three models of one product exploit this patent--the 8-inch, 5-1/4 inch, and 3-1/2 inch disk drive. The patent encompasses all drive sizes. All of the licensees produce all three drives within the United States. There is no question, then, of whether a "domestic industry" exists. However, Tandon, the complainant, domestically produces only two of the drives. Tandon conducts all of its research and development and engineering support relating to the patent within the United States. A question these facts present is thus

1/ See Certain Personal Computers and Components Thereof, 224 U.S.P.Q. 270, 284 (1984).

2/ Commissioners Eckes, Lodwick, and Rohr did not find it necessary to consider the remaining issues, once they determined that there was no patent infringement in this investigation.

whether the 5-1/4 inch drive produced by Tandon should be excluded from the domestic industry because it is manufactured offshore.

In many ways the dilemma this presents concerns the broader question of how the Commission implements the domestic industry requirement in section 337 within the context of our overriding concern for "the public health and welfare and the assurance of competitive conditions in the United States." ^{3/} One possible interpretation of "domestic industry" in this case would perhaps not allow the inclusion of all three products which exploit the patent, based on a reading that substantial manufacturing of each product line is mandatory to warrant its inclusion. An interpretation at the other extreme would not see the need for such activities as research and development to be tied to manufacturing within the United States at all.

It is my conclusion that Congress intended the Commission to balance both the public interest served by protecting intellectual property rights and that served by the entrepreneurial activity which results from a patent's exploitation. I have thus found that in this case it is appropriate to include research and development and other production-related activities within the scope of the domestic industry when there is simultaneous manufacture of products exploiting the patent.

A. Exclusion of 8-inch drives from the domestic industry

The ALJ determined the scope of the domestic industry by examining the domestic operations which are adversely affected by the alleged unfair methods of competition. He concluded that the domestic industry includes those

^{3/} Report of the Committee on Finance, United States Senate, for the Trade Reform Act of 1974, Report No. 93-1298, p. 197.

activities of Tandon and the domestic licensees in the United States dedicated to the manufacture, distribution, research and development, and sale for 5-1/4 inch and 3-1/2 inch double-sided floppy disk drives. ^{4/} He excluded the 8-inch drives from the domestic industry because Tandon admitted that the 8-inch drives manufactured by Mitsubishi do not infringe the '573 patent and there are little or no marketing opportunities remaining for 8-inch drives. The ALJ concluded that the 8-inch drives do not compete with the smaller sized drives.

The Commission has consistently defined the domestic industry in section 337 cases to be the domestic production of products covered by the intellectual property rights in question. In Certain Miniature, Battery Operated, All-Terrain, Wheeled Vehicles, Inv. No. 337-TA-122, USITC Pub. No. 1300 (1982) (Toy Trucks), and in Certain Products with Gremlin Character Depictions, Inv. No. 337-TA-201 (1986) (Gremlins), the Commission determined the domestic industry by evaluating "the nature and significance of complainant's business activities in the United States" which relate to the production of the patented, copyrighted, or trademarked products. In Gremlins the Commission determined that the use of competition between domestic production and imports to define the domestic industry is not the proper analysis of the domestic industry requirement of section 337. Thus, the ALJ's definition of the domestic industry in terms of competition between the domestically produced products and the imported products is contrary to Commission precedent as most recently announced in Gremlins. I determine that the domestic operations devoted to the production of 8-inch double-sided floppy disk drives are part of the domestic industry.

^{4/} ID at 65-97.

B. Does the domestic industry include the activities of Tandon

In Gremlins, the Commission, following its decision in Toy Trucks, defined the domestic industry as those activities which relate to complainant's domestic production of items exploiting the intellectual property right or rights. Production-related activities distinguish a domestic industry from an importer or an inventor. Gremlins at 5-11. Under Gremlins, manufacturing operations are clearly production-related activities which constitute a domestic industry. After reviewing the production-related activities of the domestic licensees and Tandon, I conclude that the domestic licensees and Tandon at the time the complaint was filed are a domestic industry under section 337. I have found one domestic industry that includes 8-inch, 5-1/4 inch and 3-1/2 inch double-sided floppy disk drives. 5/

The domestic licensees were manufacturing 5-1/4 inch and 3-1/2 inch drives in the United States at the time the complaint was filed. I also find that the domestic licensees and Tandon were manufacturing 8-inch drives at the time the complaint was filed.

With respect to the activities of Tandon, I determine that in light of the nature and significance of Tandon's activities in the United States, Tandon's production-related activities regarding its 8-inch, 5-1/4 inch, and 3-1/2 inch disk drives are part of the domestic industry.

As of April, 1985, Tandon manufactured all of its 8-inch drives in the United States at its Chatsworth, California, facility. 6/ 7/ With respect to

5/ The evidence of record, however, corresponds to each size of drive. Therefore, our analysis considers the activities of the domestic industry as they relate to each size of drive.

6/ FF 400B.

7/ Although the head assemblies for the Tandon 8-inch drives are manufactured offshore, the domestic industry has been defined as double-sided disk drives and the complete drives are manufactured in California.

Tandon's 5-1/4 inch drives, I determine that the production-related activities of Tandon, specifically, sustaining engineering and the U.S.-based research and development directly related to the exploitation of the '573 patent are part of the domestic industry. Similarly, Tandon's production-related activities regarding its 3-1/2 inch drives are part of the domestic industry. Tandon designed and completed the prototype engineering on its 3-1/2 inch drives at its Microtek facility in San Jose, California. 8/ Tandon has produced all of its 3-1/2 inch drives at its Microtek facility. Tandon is ready to commence production of 3-1/2 inch drives at Microtek as soon as it receives a production order.

Tandon's domestic activities are production-related activities as articulated in Gremlins and, thus, are part of the domestic industry under section 337. Activities such as research and development are also included within the scope of the domestic industry in this case in light of the nature of the domestic industry, the extent of manufacturing relating to the exploitation of the patent, and that such research and development exists in conjunction with the manufacture of the products which exploit the subject patent. See Certain Personal Computers, Inv. No. 337-TA-140 (1984).

Substantial Injury--Causation

The ALJ determined that, although the domestic industry was substantially injured, the allegedly unfair imports of respondent Mitsubishi were not a cause of such injury. I adopt the ID on this issue. In addition, the inclusion of the 8-inch drives within the domestic industry does not change

8/ FF 475.

the finding of no injury because the 8-inch drives manufactured by Mitsubishi are admittedly non-infringing and fairly traded. Thus, my analysis of injury involves only the effect or tendency of unfairly traded imports to substantially injure the domestic industry. These views are found in my joint opinion with the Vice Chairman.

ADDITIONAL VIEWS OF VICE CHAIRMAN LIEBELER

In addition to reviewing the patent issues, the Commission determined to review the following issues:

(1) whether the domestic industry includes the activities of complainant Tandon Corporation and whether 8-inch floppy disk drive manufacturing operations are part of the domestic industry; (2) whether there is a sufficient causal nexus between the alleged unfair acts of the respondents and the substantial injury to the domestic industry; (3) whether the domestic industry is efficiently and economically operated; and (4) whether the alleged unfair acts of the respondents have a tendency to substantially injure the domestic industry. I would answer all of these questions in the affirmative. My views on (3) efficient and economic operation and (4) tendency to injure are found in my joint¹ opinion with the Chairwoman.

I. Whether the domestic industry includes the activities of complainant Tandon Corporation and whether 8-inch floppy disk drive manufacturing operations are part of the domestic industry.

¹

See Additional Views of Chairwoman Stern and Vice Chairman Liebler which follow.

The Administrative Law Judge (ALJ) concluded that the domestic activities of Tandon Corporation are properly included within the domestic industry. I agree. Tandon's activities include manufacturing, and research and development. As I noted in Certain Gremlins Characters,² developmental activities are no less significant than actual³ manufacturing activities.

The ALJ concluded that 8-inch drives were not competitive with smaller drives and thus constituted a separate industry. I would reverse this determination. Although the issue of whether products compete is an important one in dumping and countervailing duty cases, such an analysis is irrelevant in Section 337 cases. Congress has indicated that the domestic industry generally consists of the domestic operations of the patent owner, his assignees and licensees devoted to exploitation of the intellectual property

²
337-TA-201, USITC Pub. No. ___ (1986) (Dissenting Views of Vice Chairman Liebeler).

³
The majority in Gremlins refers to "production-related activities." It would seem that without R&D there can be no production, so clearly such activity is production-related. Why R&D would be less production-related than the packaging of Rubik cubes is unclear. Cf. Cube Puzzles, Inv. No. 337-TA-112, USITC Pub. 1337 (1983).

right.⁴ Thus, the cross-elasticity of demand for the products exploiting a patent is irrelevant. "[T]he appropriate definition of a domestic industry would include all forms of exploitation of a domestic patent."⁵ Thus, all activities with respect to the 8-inch drives should be included within the domestic industry.

II. Whether there is a sufficient causal nexus between the alleged unfair acts of the respondents and the substantial injury to the domestic industry

The ALJ determined that "[t]he competitive acts of the Mitsubishi respondents were not a substantial cause of injury, especially since respondents' prices generally equaled or were above the market prices established either by complainant, its licensees, or non-respondents."⁶

⁴ H.R. Rep. No. 571, 93rd Cong., 1st Sess. 78 (1973).

⁵ Certain Rotary Wheel Printing Systems, Inv. No. 337-TA-185, USITC Pub. _____ (1985). See also Gremlins, at 11-14; Gremlins, at 18-20 (Dissenting Views of Vice Chairman Liebeler).

⁶ ID at 130.

There are two major problems with this analysis. First, section 337 does not require that the unfair acts be a substantial cause of injury. Thus, even if Tandon had significant quality problems that might have reduced its sales, Mitsubishi still would not be entitled to sell infringing drives.⁷

Second, the fact that imports sell for more than the domestic product does not mean that they are not in competition. If the infringer makes a better product or one with more frills, it may indeed sell at a higher price than the domestic product.⁸ Sales of the import still constitute either lost sales or lost royalties.

Complainant is the owner of the patent rights under the '573 patent and is, therefore, entitled to sell, license to sell, or prevent sales of devices that exploit the patent. Respondent has made substantial sales of devices that infringe the '573 patent.⁹ I would therefore find the requisite causal nexus¹⁰ to the injury has been shown to exist.

7

The lost sales analysis in the ID is faulty for this same reason. ID at 131-32.

8

See, e.g., J. Hirshleifer, Price Theory and Applications 116-17 (1976); F. Scherer, Industrial Market Structure and Economic Performance 60-61 (2d 1980).

VIEWS OF CHAIRWOMAN STERN AND VICE CHAIRMAN LIEBELER
ON EFFICIENT AND ECONOMIC OPERATION AND TENDENCY TO SUBSTANTIALLY INJURE

Efficient and Economic Operation

The ALJ recited the guidelines set forth by the Commission in past investigations with respect to efficient and economic operation, i.e., use of modern equipment and manufacturing facilities, investment in research and development, profitability of the relevant product line, substantial expenditures in advertising, promotion and development of consumer goodwill, and effective quality control programs. The ALJ found three factors to be controlling; (1) the quality of Tandon's drives, (2) the effect of Tandon's licensing policy on the domestic industry, and (3) Tandon's business structure vis-a-vis its offshore contractors. ^{1/} The ALJ also analyzed the operations of the domestic licensees. He concluded that the domestic industry was efficiently and economically operated.

We adopt the ID with respect to the first and third factors and we agree with the ALJ's conclusion that the domestic industry is efficiently and economically operated. We do not, however, adopt the ID with respect to the ALJ's consideration of licensing as a factor in the analysis of whether a domestic industry is efficiently and economically operated.

The ALJ found that Tandon's licensing policy generated competition from overseas suppliers, cost Tandon sales opportunities, and may in the long run contribute to Tandon's deteriorating market position. ^{2/}

OUII argues that the domestic industry's licensing agreements should not be considered in determining whether the domestic industry is efficiently and economically operated by the Commission. First, it is difficult to compare

^{1/} ID at 99-105.

^{2/} Id.

the profitability of a firm's long term operation in the presence and absence of licensing. Although, every patent licensing agreement in some sense diminishes a patentee's market position. license agreements increase the supply and, thus, have beneficial effects on the public. Second, judicial principles counsel against such harsh retrospective review of business decisions. The "business judgment rule" gives discretion to corporate directors when evaluating the prudence of business conduct.

We agree with the Commission Investigative Attorney and determine that licensing is not a factor in considering whether a domestic industry is efficiently and economically operated.

Tendency to Substantially Injure

The ALJ concluded that Mitsubishi's imports have no tendency to substantially injure the domestic industry that manufactures 3-1/2 inch and 5-1/4 inch double-sided floppy disk drives. His analysis focused on the tendency of the Mitsubishi imports to substantially injure Tandon, because Tandon is the only remaining major domestic manufacturer of the subject double-sided floppy disk drives. He premised his conclusion on Tandon's past poor quality reputation and presumed that it would continue into the future preventing Tandon from making sales. The ALJ also noted that Mitsubishi produces a high quality product. He, therefore, concluded that there is no tendency to substantially injure the domestic industry. We reverse this determination.

Analysis of tendency to substantially injure looks toward future injury; it is prospective. The Commission has traditionally examined such factors as whether the domestic industry experienced a loss of sales to the infringing imports; the trend in the imports' market share; underselling by the imports;

trends in domestic production, employment, profits, and pricing; opportunities to license the technology; foreign capacity; and the intent of the respondents to direct imports to the United States. ^{3/} In re Von Clemm, 229 F.2d 441 (CCPA 1955); Certain Recloseable Plastic Bags, Inv. No. 337-TA-22 (1977).

The Federal Circuit in Bally/Midway and the legislative history of section 337 describe tendency to substantially injure, [w]here unfair methods and acts have resulted in conceivable losses of sales, a tendency to substantially injure such industry has been established." House Comm. on Ways and Means, Trade Reform Act of 1973, H.R. Rep. No. 571, 93d Cong., 1st Sess. 78 (1973). Recently, the Federal Circuit elaborated on the tendency analysis, the "domestic industry must normally establish that the infringer holds, or threatens to hold, a significant share of the domestic market in the covered articles or has made a significant amount of sales of the articles." Textron, Inc. v. U.S. International Trade Commission, 753 F.2d 1019, 1029 (Fed. Cir. 1985).

The Commission investigative attorney argues, and we agree, that the existence of an unfair act is presumed in the tendency analysis. The ALJ, however, in his analysis treated Mitsubishi as a legitimate competitor. The correct analysis presumes an unfair act, i.e., that the Mitsubishi drives infringe the '573 patent. Against this background it is clear that the allegedly infringing imports of Mitsubishi have a tendency to injure the remaining domestic industry. For purposes of analysis, we will review the

^{3/} Vice Chairman Liebeler's views on what constitutes a tendency to substantially injure are fully set out in Certain Optical Waveguide Fibers, Inv. No. 337-TA-189, USITC Pub. 1754 (1985) (Vice Chairman Liebeler dissenting).

future effect the allegedly infringing imports will have on the 5-1/4 inch and 3-1/2 inch segments of the domestic industry. 4/

Mitsubishi currently holds a significant share of the U.S. market, approximately 7-8 percent for 5-1/4 inch drives and has the capacity to increase its market share. The domestic industry has experienced layoffs, decreased profits, decreased prices and the ultimate injury--destruction. These factors makes the domestic industry more vulnerable to future injury from unfairly traded imports. The domestic industry also has the capacity to meet the market demand. These factors combined with our evaluation of the 3-1/2 inch segment of the double-sided floppy disk drive market establish that the allegedly infringing 5-1/4 inch Mitsubishi drives have a tendency to substantially injure or destroy the domestic industry. 5/

The analysis of tendency to injure is prospective. There are several indications of future trends in the market. Substantial future sales in the market will be sales of 3-1/2 inch drives. [***] has recently entered into a large contract for 3-1/2 inch drives with Mitsubishi. [* * * *
* * * * *] Mitsubishi has the capacity and the intent to penetrate the U.S. market. Moreover, [* * * * *
* * * * *] The 3-1/2

4/ We have not considered the effect of imports of 8-inch drives because the 8-inch drives are admittedly noninfringing.

3/ We need not determine whether there would be a tendency to substantially injure the domestic industry if there were no domestic manufacture of 3-1/2 inch double-sided floppy disk drives. Our conclusion that the alleged unfair acts of Mitsubishi have a tendency to injure the domestic industry is based on an evaluation of the entire remaining domestic industry. We have not determined that there is a tendency of the allegedly unfair imports to substantially injure various segments of the domestic industry.

6/ ID at 147.

inch market will most likely be the future market where competition is stiffest and growth is the greatest.

As OUII emphasizes, the issue of quality differences is irrelevant if the respondent has committed unfair acts, and in the tendency analysis unfair acts must be presumed. The ALJ's consideration of Tandon's past quality problems in relation to Tandon's new 3-1/2 inch drive was error. Tandon's 3-1/2 inch drive is manufactured at a different facility from the one in which its 5-1/4 inch drives are manufactured. Several OEMs are considering Tandon's 3-1/2 inch drives. Considering the large potential for growth in the 3-1/2 inch segment of the double-sided floppy disk drive market, the intent of Mitsubishi to capture a significant market share in that segment of the market, and Mitsubishi's established position in the overall double-sided floppy disk drive market, we determine that the allegedly unfair acts of Mitsubishi have a tendency to substantially injure the domestic industry.

In summary, we have found that the imports in question do not infringe the '573 patent and there is, therefore, no violation of section 337. Assuming arguendo, however, that the patent at issue is infringed, we determine that the allegedly unfair acts of Mitsubishi in the importation or sale of double-sided floppy disk drives have the tendency to injure the domestic industry manufacturing double-sided floppy disk drives.

APPENDIX

[54] MAGNETIC RECORDING DEVICE FOR DOUBLE SIDED MEDIA

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[21] Appl. No.: 805,731

[22] Filed: Jan. 13, 1977

[51] Int. Cl. G11B 5/58

[52] U.S. Cl. 360/104; 360/130.1

[58] Field of Search 360/105, 104, 106, 75, 360/78, 133, 99, 130, 102-103

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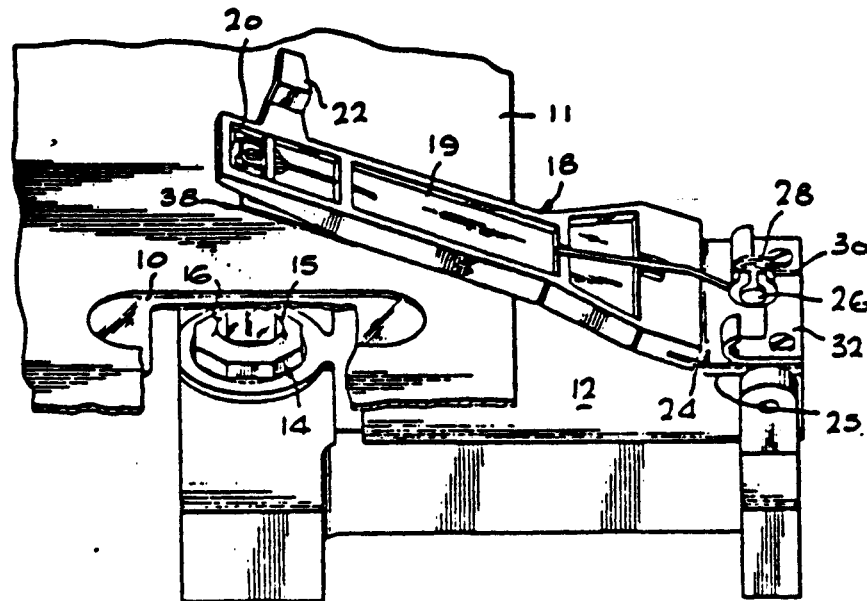
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[57] ABSTRACT

In a data storage system using a non-rigid magnetic storage surface, such as a floppy disc, and in which recording and reproduction are to be effected on both sides of the element by contact transducers, significant improvements over prior art devices are realized by employing a fixed transducer on one side of the element, and a movable transducer element on the opposite side. The movable transducer may be gimbal mounted on a pivoted spring-loaded arm of low mass and high stiffness to urge the magnetic storage surface against the fixed transducer with a light force. The force is adequate, together with a slight penetration of the fixed transducer into the plane of the disc, to correct deflections of the storage surface in directions transverse to its principal plane in the region between the transducers. Thus the transducers are maintained in operative relation for maximum flux interchange, but without introducing undue wear or requiring a long head settling time.

16 Claims, 5 Drawing Figures



MAGNETIC RECORDING DEVICE FOR DOUBLE SIDED MEDIA

BACKGROUND OF THE INVENTION

Subsequent to early work on disc and drum files for data processing systems, usage of contact recording was generally dropped as air bearing magnetic heads and associated support mechanisms were developed for "flying" a transducer at a small spacing from a magnetic recording surface, to permit intimate interaction between the transducer and the magnetic surface. Contact recording continued to be used in magnetic tape systems, for which multi-channel heads were typically employed. However, contact recording for disc media was revived with the introduction of the so-called "floppy" disc system, in which a thin pliant disc element contained within a cover jacket was used in combination with low cost accessing, transducing and control systems. Floppy disc systems have subsequently found widespread application not only in the program storage and entry applications for which they were originally intended, but also in a wide variety of data entry, storage and control applications. In the original systems, and since that time, the transducer structure generally comprises a single channel head with associated erase head, mounted in a transducer having a contact surface that is a segment of a spheroid or at least curved, the transducer itself being mounted in a carriage element that is accessed to different circumferential tracks on the floppy disc. On the opposite side of the disc from the transducer, and also in contact with the disc, is a pressure pad mounted adjacent the end of a spring-loaded arm, which is solenoid controllable so as to be free to exert pressure when data transfer operations are to take place.

Recently, however, the floppy disc industry has started to use both sides of the floppy disc for data transfer operations, the purpose primarily being to increase capacity. Thus only a single relatively low speed accessing mechanism continues to be employed, and the transducers on opposite sides of the element are in a generally opposed relation, with only a slight offset in the head gaps to avoid flux interaction. Because it is thought necessary to account for perturbations in movement of the flexible disc from its principal plane, recording heads and mounts are utilized that are essentially derived from the flying head technology. Specifically, a pair of small, identical slider heads are used, each mounted adjacent the end of a long resilient cantilevered head support, and mechanically urged together with a total force of approximately 8 grams. The concept is that as the flexible disc deviates from its principal plane, both of the heads tend to follow the actual position of the disc passing between them and permit contact recording without excessive wear or signal degradation. Accepted industry standards for functional specifications are 1,000,000 revolutions without substantial degradation in reproduced signal amplitude, and 3,000,000 revolutions without significant head wear.

There are, however, significant problems and limitations arising from the use of this double, symmetrical and very compliant head mechanism. The resilient mounts are relatively complex and must be precisely manufactured, and therefore are costly to manufacture and maintain. Furthermore, they require redesign, by each floppy disc manufacturer, of the carriage, head

support mechanisms and associated structure, because they have volumetric configurations incompatible with current structures. In addition, the head loading force and the mechanical configuration require that special provision be made to insure that the head does not constantly land at the same point and thereby cause undue wear. In addition, the long flexible columns used in the existing type of structure tend to bend in a slight S shape or shift differentially in response to perturbations in the disc surface position. This introduces both a degree of offset relative to the track center, reducing reproduced signal amplitude and tending to limit the positional accuracy which can be obtained, which in turn limits the track density which can be achieved. Furthermore, the two resiliently mounted heads do not settle quickly into operative relation, once landed on the disc, and this delay must be taken into account before data transfer operations can begin. Of great importance from the standpoint of the floppy disc systems manufacturer is the fact that he not only cannot use a portion of his existing inventory for heads and carriages, but must redesign a portion of his system for the new double sided configuration.

There are currently recognized both distinctions and similarities between contact and non-contact recording. In non-contact recording the purpose is to employ an aerodynamic effect to fly the transducer at given spacing above the record medium. This distance is decreasing as the art advances and some current systems use a little as 10-20 microinches, but a primary objective is to avoid contact or "head crash" during rotation. In contact recording a film of air is actually interposed between the head and the record medium during operation, but this is typically only a few microinches. In contact recording frictional contact and wear are inherent, and the head design must accommodate these factors. It can be seen, however, that in operative use both types use an air bearing effect and that the distinction is growing less clear as non-contact types fly at smaller heights and floppy discs are driven faster.

SUMMARY OF THE INVENTION

A device for effecting data recording and reproduction operations with each of the two sides of a pliant, non-rigid magnetic record element employs a fixed transducer on one side and a resilient element supporting a movable transducer on the other. An asymmetrical system is thus provided in which the record element is deflected by the fixed transducer but confined against the fixed transducer, despite perturbations in its movement, by the movable transducer. The movable transducer may be a smaller slider transducer that is mounted via a short length gimbal adjacent the end of a spring-loaded pivotable support arm. The arm mechanism urges the slider transducer and the intervening record element against the surface of the fixed transducer with a light force, although the fixed transducer is positioned to penetrate slightly into the nominal plane of the record element. The configuration of the spring-loaded arm mounting the slider transducer is compatible with the configuration of the mechanism ordinarily supporting a pressure pad, so that the structure is thus directly substitutable in the space available in the prior single sided system. The spring-loaded support arm has a high damping coefficient and effectively holds the flexible magnetic recording element against the fixed transducer, at a precise radial position, as well as correcting

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deflections of the record element, although wear is less than in existing double sided systems.

In a specific example of a construction in accordance with the invention, as used with a floppy disc system, a fixed transducer mounted on a conventional carriage 3 has a flat apex forming a contact surface and an annular spheroidal rim. By shaping the rounded rim after the flat apex is formed, wear is minimized due to the blending of the surfaces. A small slider head, at least no greater in area than the flat area of the fixed transducer, 10 is engageable against the opposite side of the floppy disc, to urge the disc against the fixed transducer, which is positioned to penetrate slightly into the plane of the disc. To maintain the operative relation on both sides, a torsion spring on a pivotable support arm is coupled to 15 the carriage. A load of less than about 20 grams is exerted at a central load point on the slider head, which is mounted in a short length gimbal mount so as to have freedom of movement in two directions relative to the plane of the disc. Lead wires coupled to the heads extend 20 along the load arm to the region of its pivot axis for making external electrical connection. This arrangement not only has a short settling time, but meets all specifications for wear and reproduced signal amplitudes, while permitting high positional accuracy.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the invention may be had by reference to the following description, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view, partially broken away, of the principal elements of a transducer system of recording on both sides of a flexible media, in which the accessing mechanism and associated parts of the system have been omitted for simplicity;

FIG. 2 is an enlarged perspective view of a portion of the arrangement of FIG. 1, showing further details of the slider head;

FIG. 3 is a side fragmentary view of the mechanism of FIGS. 1 and 2, showing the disposition of the heads and the flexible media during operation;

FIG. 4 is a plan view of the arrangement of FIG. 1; and

FIG. 5 is a side view, partially broken away, of the arrangement of FIGS. 1 and 4.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the Figures, the invention is described hereafter as it is structured for use with a floppy disc system, but inasmuch as such systems are widely used, only a fragment of the flexible disc 10 and its encompassing jacket cover 11 having an access slot through which the heads can come in contact with the disc, are shown for brevity and simplicity. Reference may be made to U.S. Pat. No. 3,879,757, and a number of other patents, for details of such features as the central hub and spindle means for gripping and rotating the flexible disc 10, the front cover which may be pivoted open to permit loading and unloading of the disc, and a lead screw or other type of radial accessing mechanism for driving the carriage 12 along the access opening in the disc cover 11 to a selected radial track position.

Adjacent the free end of the carriage 12 is mounted what is referred to as a fixed transducer, which may for example be of the type known as a "button head" transducer 14. Other types of transducers may be utilized inasmuch as a number of types are used with floppy disc

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systems, but they typically have a convex surface facing the disc 10. They generally employ a read/write head for a single track and adjacent trim erase heads, which need not be described in further detail. The fixed transducer 14 is positioned to penetrate or intercept the nominal plane of the disc 10 slightly (as best seen in FIG. 3). Whereas the typical button head 14 has a rounded top of approximately 2" radius for contact with a flexible disc, the apex of the button head, which principally contacts the disc 10 is a flat apex portion 15 of approximately 0.2" diameter. Preferably the head surface is first shaped flat, and a spheroidal convex rim 16 is then formed, to blend or smooth the intersection between the flat and curved surfaces so as to minimize wear. The rim 16 has a 2" radius of curvature in this example.

At the end of the carriage 12, spaced apart from the button head 14, is pivotally mounted a low mass, relatively stiff cantilevered upper support or load arm 18 having thinned areal sections 19 along its length for purposes of reducing weight without reducing rigidity. A small areal aperture 20 is also provided adjacent the free end of the upper load arm 18, within which aperture the magnetic heads and associated energizing coils are coextensively disposed. Also adjacent the free end is a landing control tab 22 engageable by a solenoid operated element (not shown) to permit automatic pivoting of the load arm 18 away from the button head 14, as in the position shown in FIG. 1, or to release the arm 18 to permit engagement or "landing" of the magnetic head on the flexible disc 10 as shown in FIG. 3.

The base end of the load arm 18 is coupled to the adjacent end of the carriage 12 by a light flexure spring 24 which permits pivoting movement away from the button head 14. The spring 24 engages a head load stop 25 at one position as seen in FIG. 5 to define the limit for movement in the direction toward the fixed transducer 14. A cylindrical mandrel 26 coupled to the carriage adjacent the pivot end of the load arm 18 is encompassed by a torsional load spring 28 having an elongated linear end running longitudinally against the body of the load arm 18, to spring load the arm 18 in the direction toward the fixed transducer 14. A keeper 32 on the end of the mandrel 26 maintains the load spring 28 in position, once mounted.

Adjacent the areal aperture 20 proximate the free end of the load arm 18, a tapered tab on the arm terminates in a load point 34 facing in the direction toward the fixed transducer 14. The load point 34 engages the central region of a small rectangular slider head 36 which comprises an abrasion resistant barium titanate pad having an embedded ferrite head and adjacent trim erase heads as previously described. The magnetic core elements and energizing windings (both shown only generally) are disposed on the opposite side from the disc 10 and coupled to the slider head 36. As best seen in FIG. 2, a central groove 38 is included on the underside of the slider head 36, parallel to the direction of relative motion between the disc 10 and the slider head 36, to permit air passage therebetween and to reduce air bearing effects at the speeds of revolution involved for the flexible disc 10 (nominally 360 rpm).

The slider head 36 is mounted at the end of a short length two axis gimbal spring 38 which comprises a base affixed at a radial spacing along the load arm 18 from the slider head 36, and includes a pair of elongated side arms 39, 40. Thus even though the slider head 36 remains in contact with the disc 10, and maintains the disc 10 against the fixed transducer 14 under normal

conditions of operation, it is also able to tilt to some extent about the load point 34 to compensate for major radial or circumferential deflections of the disc 10 from its nominal plane. Deflections can occur despite the fact that the disc 10 is confined within the jacket cover 11, because of the center drive arrangement, the pliant nature of the disc, and the frictional loads on the surface of the disc.

In a typical operation of the mechanism of FIGS. 1-5, the carriage 12 begins at a selected radial position or track relative to the recording surface of the disc 10, and is to be advanced or retracted along the radius intersecting the axis opening in the disc cover 11 to a different track position, for which purpose the accessing mechanism (not shown) is actuated in conventional fashion. Prior to data transfer, the solenoid actuated mechanism (also not shown) engaging the landing control tab 22 on the cantilevered upper load arm 18 is energized, permitting the torsional load spring 28 to urge the slider head 36 onto the facing surface of the disc 10. Thus the disc 10 is confined between the flat surface 15 of the fixed transducer 14 and facing surface of the slider head 36, and there is a slight penetration of the fixed transducer 14 into the plane of the disc, and concurrent curvature of the disc in the region encompassing the fixed transducer 14. Under a force of approximately 14 grams exerted by the torsional load spring 28 against the slider head 36, the facing surfaces of the button head 14 and the slider head 36 are held substantially parallel. Deflections of the disc 10 occurring prior to entry between the heads 14, 36 are corrected, so that recording or reproduction may take place with either surface of the disc 10. The recording gaps at the fixed transducer 14 and the slider head 36 are slightly displaced relative to each other along a radius of the disc 10, but the head gaps are essentially along the same radius, which also intersects the load point 34. The light force (typically less than approximately 20 grams) exerted via the load point 34 against the slider head 36 is sufficient to maintain both heads in close operative relation with the opposite sides of the disc 10, producing high reproduced signal amplitudes, and good recording. The slight wrapping of the pliant disc 10 about the surface of the fixed transducer 14 provides a part of the function of insuring close or contacting relation, and the remainder of the corrective action needed is supplied by the force of the slider transducer 36. Advantageously, the area of the face of the slider transducer 36 is smaller than the flat area 15 of the fixed transducer 14, but it is at least no greater. If there are large radial or circumferential, or both, deviations of the disc from its nominal plane, the gimbal spring 38 deflects by pivoting about the load point 34, so as to follow the contour of the disc 10. Normally, however, there is no such substantial or significant deviation of the disc 10 away from the flat surface 15 of the fixed transducer 14. Consequently, reproduced signal amplitude is maintained under all conditions of operation, even though the loading force is relatively low.

It will thus be appreciated by those skilled in the art that a significant factor is that the fixed transducer 14 provides a physical reference for the disc 10, and that the slider head 36, although lightly loaded against the disc 10, is held by a low mass load arm 18 having a high damping coefficient. The low force loading limits wear both on the contact surfaces of the transducers and on the facing surfaces of the disc, insuring a longer life if all other conditions are equal. In addition, positional accu-

racy is assured by the use of the fixed transducer 14 on the carriage and the slider head 36 on the stiff cantilevered load arm 18. The gimbal spring 38 has only relatively short length side arms 39, 40 and there is no tendency for these columnar elements to buckle or displace the slider head 36. Consequently, the device can readily be used in double density systems in which the number of tracks per inch is essentially doubled, and track offset effects are minimized.

Furthermore, the stiffness of the load arm, together with the light loading force, assures a very low abrasive effect at impact, which usually tends to occur within a limited region relative to an index position, and because of which special timing schemes have been required to be used with prior art systems in order to avoid excessive landing wear. The "settle" time of the heads, which denotes the time required for the heads to be assured of maintaining contact after initial impact, is substantially shortened and therefore the access time is on the average correspondingly reduced. The gimbal mechanism has adequate freedom of movement in two axes and thus can adjust in response to major deflections in the disc in either the radial or circumferential directions. Such advantages are achieved, in accordance with the instant example, by utilizing a load arm with a high damping coefficient and a short gimbal spring with small deflection. This arrangement provides a highly damped stiff gimbaling system. With a load arm of glass fiber-filled polycarbonate the mass of the arm is less than 3 grams.

It is of course significant that the mechanism disclosed is compatible with the envelope configurations of most prior art single sided recording systems for floppy disc drives. In consequence, the double head mechanism may be used as a direct substitute for head mechanisms in existing drives, merely by coupling to the accessing mechanism. The carriage can be the same as existing carriages, except for the additional provision of the pivot mount and the mount and support for the torsional load spring. Another advantage derives from the annular curved rim on the fixed transducer, which enables the disc to ramp over the fixed transducer when loading or unloading.

While a number of alternatives and modifications have been discussed above, it will be appreciated that the invention encompasses all forms and variations within the scope of the appended claims.

We claim:

1. A device for maintaining a pair of magnetic transducers in operative relation with both sides of a non-rigid planar magnetic recording media comprising:
 - a first transducer mounted relative to a first side of the media and having a fixed position in a direction normal to the plane of the media despite movement to different positions along the plane of the media, the first transducer being disposed in data transfer position relative to the media;
 - a support mechanism adjacent to the second side of the media in a region opposite the first transducer;
 - a second transducer coupled by gimbal support means to the support mechanism in opposition to the first transducer and movable toward and away from the plane of the media; and
 - means coupled to said support mechanism for urging said second transducer toward said first transducer and said media to maintain both transducers in operative relation with the intervening media with the first transducer serving as a fixed positional reference despite tendencies of the media to deviate

in position from its nominal plane and the second transducer matingly accommodating said tendencies by virtue of its gimbal support.

2. The invention as set forth in claim 1 above, wherein said first transducer has an at least partially curved surface facing the media, the media moves along a nominal plane in the region of the transducers, and the first transducer is positioned to partially intersect the nominal plane of the media.

3. The invention as set forth in claim 2 above, wherein said first transducer has a flat surface directly opposing the media and containing a non-magnetic gap region, and wherein the second transducer has an at least substantially flat surface directly opposing the media and containing a non-magnetic gap region.

4. The invention as set forth in claim 3 above, including in addition gimbal means coupled to said support mechanism and support said second transducer, and load point means coupled to said support mechanism and engaging said second transducer.

5. A device for maintaining a pair of magnetic transducers in operative relation with opposite sides of a non-rigid magnetic recording media comprising:

- a first non-gimballed transducer mounted on a first side of the media and having a relatively fixed position relative to the plane of the media in which the first transducer is in operative relationship with the first side of the media;
- a pivotable support arm having a pivot axis in fixed spatial relationship to the first transducer, and extending along the second side of the media to a region opposite the first transducer;
- a second transducer coupled by gimbal means to the support arm in opposition to the first transducer and being movable relative to the plane of the media and to the first transducer; and
- means coupled to said support arm for urging said second transducer and the media toward said first transducer with a force such that close operative relationship is maintained between each transducer and the associated side of the intervening media, with tendencies of the media to deviate from its nominal plane being compensated by the second transducer.

6. The invention as set forth in claim 5 above, wherein the force exerted by said second transducer is less than, approximately 20 grams.

7. The invention as set forth in claim 5 above, wherein in addition gimbal means couple the second transducer to the support arm, and means coupled to the support arm to engage a central region of the second transducer to provide a load point that is fixed relative to the arm, whereby the second transducer has two axes of freedom of movement relative to the load point.

8. The invention as set forth in claim 7 above, wherein said gimbal means comprises resilient means having a base portion coupled to said support arm, a terminal portion mounting said second transducer and a pair of relatively short resilient side arms coupling said

base and terminal portions, and wherein in addition said device includes a carriage coupled to support said first transducer and a flexure spring pivotally coupling the support arm at its pivot axis to the carriage.

9. The invention as set forth in claim 5 above, wherein the support arm has a high damping coefficient, and a mass of less than approximately 3 grams.

10. The invention as set forth in claim 9 above, wherein said means for urging said support arm comprises a torsional spring coupled to said support arm.

11. The invention as set forth in claim 5 above, wherein the first transducer has an outer annular portion that is curved and a flat interior portion, and wherein the second transducer has a flat contact surface with a groove therein that is substantially parallel to the direction of relative movement of the disc.

12. In a magnetic recording system in which a carriage support two magnetic heads is shifted radially relative to a center-driven pliant magnetic disc to provide data transfer with selectable record tracks on either side of the disc, to improvement comprising:

- a first transducer fixedly coupled to the carriage for bearing against a first side of the disc in an invariant position in a direction normal to the plane of the disc;

and means including a second gimbal mounted transducer movably coupled to the carriage for bearing against the second side of the disc in opposed relation to the first transducer, the second transducer being movable toward and away from the plane of the disc and the first transducer, said means including resilient means urging said second transducer toward said first transducer with sufficient force to maintain close operative relationship between both said transducers and the disc despite deviation of portions of the disc during movement thereof, with the second gimbal mounted transducer compensating tendencies of the pliant disc to deflect.

13. The invention as set forth in claim 12 above, wherein said first transducer is fixedly positioned perpendicular to the plane of the disc to penetrate the plane of the pliant disc.

14. The invention as set forth in claim 12 above, wherein said last mentioned means comprises a load arm and in addition short length gimbal means couple said second transducer to said load arm adjacent the end thereof.

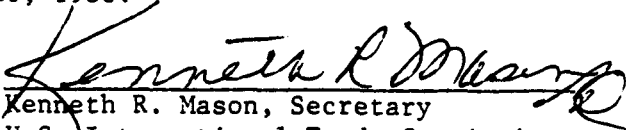
15. The invention as set forth in claim 14 above, wherein said load arm includes a load point member engaging said second transducer in a mid-region thereof.

16. The invention as set forth in claim 14 above, wherein said first transducer has a spheroidal rim and a flat apex surface facing the disc, and said second transducer has a flat surface contained within the area of the flat apex surface and including a central air relief groove.

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Certificate of Service

I, Kenneth R. Mason, hereby certify that the attached VIEWS OF THE COMMISSION, was served upon Victoria L. Partner, Esq., and Robert D. Litowitz, Esq., and upon the following parties via first class mail and air mail where necessary, on February 21, 1986.


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11-27-85 SOC
11-18-85

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

In the Matter of)
)
CERTAIN DOUBLE-SIDED FLOPPY)
DISK DRIVES AND COMPONENTS)
THEREFORE)

2-17-85
Investigation No. 337-TA-215
12-19-85

INITIAL DETERMINATION

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In the Matter of)
)
CERTAIN DOUBLE-SIDED FLOPPY)
DISK DRIVES AND COMPONENTS)
THEREOF)

Investigation No. 337-TA-215

INITIAL DETERMINATION

Sidney Harris, Administrative Law Judge

Pursuant to the Notice of Investigation (50 Fed. Reg. 4,276), this is the administrative law judge's Initial Determination in the Matter of Certain Double-Sided Floppy Disk Drives and Component. Thereof, U.S International Trade Commission Investigation No. 337-TA-215. 19 C.F.R. § 210.53(a).

The administrative law judge hereby determines that there is no violation of § 337 of the Tariff Act of 1930, as amended, in the importation of certain double-sided floppy disk drives and components thereof, or in their sale, by reason of infringement of U.S. Letters Patent No. 4,151,573, the effect of which is to destroy or substantially injure an industry, the tendency of which is to destroy or substantially injure an industry, which is efficiently and economically operated, in the United States.

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I. PROCEDURAL HISTORY

On December 6, 1984, Tandon Corporation, Chatsworth, California, filed a complaint and a motion for temporary relief under section 337 of the Tariff Act of 1930 (19 U.S.C. § 1337). Supplements to the complaint were filed on December 21 and 27, 1984, and January 7, 1985. The complaint, as supplemented, alleges unfair methods of competition and unfair acts in the importation of certain double-sided floppy disk drives and components thereof into the United States, or in their sale, by reason of alleged direct, induced, and contributory infringement of the claims of U.S. Letters Patent No. 4,151,573. The complaint further alleges that the effect or tendency of the unfair methods of competition and unfair acts is to destroy or substantially injure an efficiently and economically operated domestic industry and to prevent the establishment of a nascent sub-industry in the United States.

On January 22, 1985, the Commission ordered pursuant to 19 U.S.C. § 1337(b) that an investigation be instituted to determine whether there is a violation of 19 U.S.C. § 1337(a) with respect to the subject articles by reason of alleged direct, induced, and contributory infringement of the claims of U.S. Letters Patent No. 4,151,573 (the '573 patent), the effect or tendency of which is to destroy or substantially injure an industry, efficiently and economically operated, in the United States. Notice of Investigation, 50 Fed. Reg. 4,276 (Jan. 30, 1985). The Commission pursuant to 19 C.F.R. § 210.24(e) also forwarded to the Office of the Administrative Law Judges complainant's

motion for temporary relief under 19 U.S.C. §§ 1337(e) and (f) for an initial determination under 19 C.F.R. § 210.53(b). The notice of investigation and complaint were served on parties, interested Government agencies, and certain interested persons either by first-class mail or air mail on January 29, 1985.

The following persons were named as respondents in this investigation:

Mitsubishi Electric Corporation
2-3, Marunouchi 2-chome
Chiyoda-ku, Tokyo 100
Japan

TEAC Corporation
3-7-3, Naka-cho
Masashino, Tokyo 180
Japan

Sony Corporation
6-7-35, Kita-Shinagawa
Shinagawa-Ku, Tokyo 141
Japan

Mitsubishi Electronics America, Inc.
991 Knox Street
Torrance, California 90502

TEAC Corporation of America
7733 Telegraph Road
Montebello, California 90640

Sony Corporation of America
700 W. Artesia Boulevard
Compton, California 90220

The following entities, which were not named as respondents in this investigation, were also served with a copy of the notice of investigation, the complaint, and § 210.26 of the Commission's Rules of Practice and Procedure:

Alps Electric Co., Ltd.
1-7, Yukigawa Ohtsuka-cho
Ohta-ku, Tokyo 145
Japan

Fujitsu Ltd.
Furukawa Sogo Building
6-1, Marunouchi 2-chome
Chiyoda-ku, Tokyo 100
Japan

Matsushita Communication Industrial Co., Ltd.
4-3-1 Tsunashima-Higashi
Kohoku-ku, Yokohama 223
Japan

Matsushita Electric Industrial Co., Ltd.
1006, Kadoma
Kadoma City, Osaka 571
Japan

NEC Corporation
33-1 Shiba Gochome
Minato-ku, Tokyo 108
Japan

Ricoh Co., Ltd.
1-3-6 Naka-Magome
Ohta-ku, Tokyo 143
Japan

Tokyo Electric Co., Ltd.
14-10 1-chome Uchikanda
Chiyoda-ku, Tokyo 101
Japan

Toshiba Corporation
1-6, Uchisaiwaicho 1-chome
Chiyoda-ku, Tokyo 100
Japan

Victoria L. Partner, Esq., and Robert D. Litowitz, Esq., Unfair Import Investigations Division, were designated the Commission investigative attorneys. 50 Fed. Reg. 4,276 (Jan. 30, 1985). The Commission investigative attorney is a separate and independent party to this proceeding. 19 C.F.R. § 210.4(b).

Chief Administrative Law Judge Janet D. Saxon designated Administrative Law Judge Sidney Harris to preside over this investigation.

On February 21, 1985, the Mitsubishi respondents filed a motion for summary determination under 19 C.F.R. § 210.50. Motion No. 215-2. The Mitsubishi respondents asserted that they had not at any time been involved in the manufacture, importation, distribution, or sale of any products which infringe the '573 patent and have not violated § 337. Responses to Motion 215-2 were due on March 6, 1985, and the Mitsubishi respondents rebuttal was due on March 11, 1985. Prelim. Conf. Tr. 12-13, 48-51. A decision on the motion for summary determination was postponed by the administrative law judge until after the hearing on temporary relief. Preh. Conf. Tr. 7.

A Preliminary Conference was held in this investigation on February 22, 1985. Appearances were made on behalf of complainant Tandon, all respondents, and the Commission investigative attorney. The prehearing and hearing schedule for the temporary relief phase of this investigation was set at this time. Order No. 3 (Feb. 25, 1985).

On March 14, 1985, the Sony respondents filed a motion for partial summary determination in this investigation. Motion No. 215-6. Rule 210.50(a) states that motions for summary determination by any party "must be filed at least thirty (30) days before the date fixed for any hearing provided for in section 210.41." The hearing on complainant's motion for temporary relief was scheduled to begin on April 8, 1985. Respondent's motion for summary determination, therefore, was filed less than 30 days before this hearing. The administrative law judge invoked the 30-day provision in order to avoid undue hardship to, and conserve the resources of, the parties and the Commission in this investigation and did not consider Sony's motion. Order No. 6 (Mar. 15, 1985).

A Prehearing Conference on complainant's motion for temporary relief was held on April 8, 1985. Appearances were noted for the record by complainant Tandon, respondents Mitsubishi Electric Corporation (MELCO), Mitsubishi Electronics America (MELA), TEAC Corporation (TEAC Japan), TEAC Corporation of America (TCA), Sony Corporation (Sony), and Sony Corporation of America (SONAM), and the Commission investigative attorney. The Hearing in the matter of Certain Double-Sided Floppy Disk Drives and Components Thereof commenced immediately after the prehearing conference. The hearing concluded on April 19, 1985.

On April 29, 1985, the administrative law judge sua sponte reconsidered the TEAC respondents application to subpoena Mr. Bogucki to testify at the hearing on temporary relief and his order granting the motion to quash this subpoena. The administrative law judge under 19 C.F.R. § 210.53(g) decided to reopen the record to take the testimony of Mr. Bogucki on matters listed in the original subpoena signed by the judge on April 3, 1985. Order No. 14 (Apr. 29, 1985). The testimony of Mr. Bogucki was taken on May 3, 1985.

Closing arguments on complainant's motion for temporary relief were held on May 6, 1985.

On May 30, 1985, the administrative law judge determined that there was reason to believe that a violation of § 337 of the Tariff Act of 1930, as amended, existed in the importation of certain double-sided floppy disk drives and components thereof, or in their sale, by reason of infringement of U.S. Letters Patent No. 4,151,573, the effect or tendency of which was to destroy or substantially injure an industry, efficiently and economically operated, in the United States. The administrative law judge then found that complainant's

motion for temporary relief should be granted based upon a consideration of the factors set forth in 19 C.F.R. § 210.24(e). Certain Double-Sided Floppy Disk Drives, Initial Determination, Inv. No. 337-TA-215.

On July 2, 1985, the Commission issued a notice of its decision to review the administrative law judge's initial determination awarding temporary relief under § 337. The Commission decided to review all issues set forth in the Initial Determination except for the issues of (1) invalidity of the '573 patent by reason of anticipation under 35 U.S.C. § 102(g), obviousness under 35 U.S.C. § 103, or misjoinder of inventors, (2) efficient and economic operation, and (3) importation and sale. The Commission stated that it would focus its review on (1) the definition of domestic industry, (2) the reason to believe standard of patent infringement in the temporary relief phase of an investigation, and (3) the appropriateness of temporary relief. 50 Fed. Reg. 28,294 (July 11, 1985).

On July 8, 1985, Tandon and the Sony respondents filed a joint motion to terminate this investigation as to the Sony respondents on the basis of a settlement agreement and a license agreement. Motion No. 215-32. Complainant granted the Sony Corporation a license under all claims of the '573 patent to make, have made, lease, use, and/or sell or otherwise dispose of 3-1/2 inch double-sided floppy disk drives covered by the claims of the patent throughout the world. Respondents agreed to a royalty arrangement with complainant and granted Tandon an option to enter into a license agreement with Sony as to certain patents relating to a micro-floppy disk system. On July 19, 1985, the administrative law judge issued an Initial Determination terminating this investigation as to respondents Sony Corporation and Sony Corporation of

America. Order No. 20; see Notice, 50 Fed. Reg. 31,053 (July 31, 1985). The Commission on August 20, 1985, issued its decision not to review this Initial Determination. 50 Fed. Reg. 35,167 (Aug. 29, 1985).

A Prehearing Conference was held before Administrative Law Judge Sidney Harris on August 19, 1985. Appearances were noted for the record by complainant Tandon, the Mitsubishi and TEAC respondents, and the Commission investigative attorney. The Hearing in the Matter of Certain Double-Sided Floppy Disk Drives and Components Thereof commenced immediately after the Prehearing Conference. The Hearing concluded on August 30, 1985.

On August 16, 1985, Sankyo Seiki Mfg. Co., Ltd., and Sankyo Seiki (America) Inc. and Epson America, Inc., Epson Corporation, and Sunritz Ltd. filed Motion No. 215-51 and Motion No. 215-52, respectively, to intervene for the limited purpose of opposing complainant's proffer of evidence. The interveners assert that they have had no actual notice of this investigation, and first became aware of it when the Commission investigative attorney telephoned them less than one week prior to the commencement of the hearing in this matter and informed them that complainant planned to introduce evidence relating to their products during the hearing. On August 23, 1985, the administrative law judge filed an Initial Determination permitting the nonrespondents to intervene for the limited purpose of cross-examining the one witness who will testify concerning their products and to adduce evidence showing their products are not closely similar or identical to respondents' products. Order No. 24. On September 26, 1985, the Commission reviewed and reversed this Initial Determination. The Commission also determined to exclude the evidence offered by complainant which relates to the products of nonrespondents. 50 Fed. Reg. 40,242 (Oct. 2, 1985).

On August 19, 1985, Tandon and the TEAC respondents filed a joint motion to terminate this investigation as to the TEAC respondents on the basis of a settlement agreement and a license agreement. Motion No. 215-54. Complainant granted TEAC Corporation a license under all claims of the '573 patent to make, have made, use, sell, or lease 5-1/4 inch and 3-1/2 inch double-sided floppy disk drives covered by the claims of the patent throughout the world. Respondents agreed to a royalty agreement with complainant. On October 2, 1985, the administrative law judge issued an Initial Determination terminating this investigation as to respondents TEAC Corporation and TEAC Corporation of America. Order No. 25; see Notice, 50 Fed. Reg. 41,228 (Oct. 9, 1985).

On September 4, 1985, the Commission determined to affirm the administrative law judge's Initial Determination recommending temporary relief. The Commission temporarily excluded from entry into the United States double-sided floppy disk drives and components thereof manufactured by or on behalf of the Mitsubishi or TEAC respondents, except under bond in the amount of 25 percent of the entered value of such articles. 50 Fed. Reg. 37,067 (Sept. 11, 1985).

On August 26, 1985, complainant Tandon filed a motion to amend the pleadings under 19 C.F.R. § 210.22(c) to conform to proof by adding the allegation that the Mitsubishi respondents engage in unfair methods of competition and unfair acts in the importation of certain double-sided floppy disk drives and components thereof into the United States, or in their sale, by reason of alleged predatory pricing. Motion Docket No. 215-57. Both the Mitsubishi respondents and the Commission investigative attorney filed

responses in opposition to this motion. Complainant on September 9, 1985, filed a motion for leave to respond to the opposition of respondents to Motion No. 215-57. Motion No. 215-58. Respondents also oppose this motion. Complainant's Motion No. 215-58 for leave to respond to respondents' opposition is hereby granted.

Tandon asserts that it first became aware of facts suggesting that respondents may be guilty of predatory pricing during the hearing on temporary relief. Tandon points specifically to the administrative law judge's finding that TEAC had sold at or below cost with respect to floppy disk drives sold to Tandy Corporation. Certain Double-Sided Floppy Disk Drives, TEO Initial Determination, 337-TA-215, at 106 (May 30, 1985). Complainant states that in response to this finding, and the administrative law judge's request that further evidence on this issue be presented at the hearing on permanent relief, it endeavored to gather pertinent information regarding respondents' manufacturing costs. Respondents did not object to complainant's discovery requests on the ground that predatory pricing is not an issue in this case, but responded to complainant's requests and initiated their own discovery with respect to this issue. Tandon adds that it was unable to request an amendment of the pleadings prior to the hearing on permanent relief because of the late date in which it received responses to its discovery requests and the need to review the documents, most of which were written in Japanese, and translate the pertinent ones into English. Finally, complainant concludes that the issue of predatory pricing should be treated in all respects as if it had been raised in the pleadings and notice of investigation because: (1) the requested amendment to conform to proof is permitted by the Commission's rules

and is in the interests of justice; (2) the Mitsubishi respondents will not be prejudiced by this amendment because they were aware of the existence of this issue since the Initial Determination on temporary relief and have responded to discovery with regard to it; and (3) the parties to this proceeding have voluntarily litigated this issue during the hearing on permanent relief.

The Mitsubishi respondents argue that Tandon's motion should be denied for the following reasons: First, Rule 210.22(c) does not permit complainant to amend the pleadings to add completely new unfair acts. Second, the allegation that respondents participated in predatory pricing is not reasonably within the scope of the complaint and notice of investigation. Third, respondents never consented to the presentation of evidence to prove the additional alleged unfair act of predatory pricing. Finally, complainant's attempt to change the nature of this case is untimely, and granting this request would prejudice respondents.

Rule 210.22(c) allows parties to amend the pleadings and notice of investigation "[w]hen issues not raised by the pleadings or notice of investigation, but reasonably within the scope of the pleadings and notice, are considered during the taking of evidence by express or implied consent of the parties." The record demonstrates that the Mitsubishi respondents did not consent to an amendment of the pleadings and notice in this investigation to include the alleged unfair act of predatory pricing.

Complainant states that it first learned of facts suggesting that respondents may be guilty of predatory pricing when the administrative law judge's in the initial determination on temporary relief found that TEAC had sold at or below cost with respect to floppy disk drives sold to Tandy

Corporation. The administrative law judge made no reference in this finding to the existence of a possible unfair act of predatory pricing; rather, those facts were referred to in order to determine whether complainant had established a reason to believe that respondents' activities have the effect or tendency to substantially injure a domestic industry. In this context, the administrative law judge requested the parties to submit further evidence with regard to "the full panoply of market factors that may have or will contribute to the injury of the domestic industry . . . to better define the substantiality of the effect or tendency of respondents' activities to injure the industry." Double-Sided Floppy Disk Drives, *supra*, at 106.

The record indicates that there was no consent to investigate whether respondents had engaged in predatory pricing as an unfair act. For example, complainant's reference to predatory pricing in its prehearing brief is included in its discussion of injury. Such a reference indicates that complainant gave no notice of its intention to amend the pleadings and notice in this investigation during the taking of evidence to include by express or implied consent of the parties an additional unfair act. Tandon, PEO Prehearing Brief 20-21 (Aug. 9, 1985).

The fact that the Mitsubishi respondents answered complainant's discovery requests as to the subject of predatory pricing, initiated their own discovery requests relevant to this issue, and proceeded to address it at the hearing on permanent relief, similarly fails to express or imply consent to consider this issue as an unfair act. The issue of effect or tendency to substantially injure the domestic industry involves questions of whether respondents sold above or below market prices, initiated or reacted to market price cuts. To

consider the prudent actions of respondents in addressing these questions in their discovery requests as consent to amend the pleadings and notice to incorporate a new unfair act would unduly prejudice their right to prepare and defend their case. There was simply no consent to include the issue of predatory pricing as an unfair act in this investigation.

Finally, it does not appear that a major change of this nature can be made through a motion to amend the pleadings, particularly at this late stage in the investigation. It is for the Commission to decide the scope of its investigations, and consequently an allegation of this nature should be included only after Commission institution, or through an initial determination based on a timely motion to amend that is adopted by the Commission. For the above reasons, complainant's Motion No. 215-57 to amend the pleadings is denied.

This Initial Determination is based on the entire record of this proceeding. Proposed findings not herein adopted, either in form or in substance, are either specifically dealt with in this Initial Determination, or are rejected as not being supported by the evidence or as involving immaterial matters.

The findings of fact include references to supporting evidentiary items in the record. Such references are intended to serve as guides to the depositions, exhibits, and testimony supporting the findings of fact; they do not necessarily represent complete summaries of the evidence supporting each finding. Some of the findings of fact are contained only in the opinion.

The following abbreviations are used in this Initial Determination:

- CX - Complainant's Exhibit (followed by its number and the referenced page(s)).
- CRX - Complainant's Rebuttal Exhibit
- CPX - Complainant's Physical Exhibit
- MRX - Mitsubishi Respondent Exhibit
- MRPX - Mitsubishi Respondent Physical Exhibit
- SRX - Sony Respondent Exhibit
- SRPX - Sony Respondent Physical Exhibit
- TRX - TEAC Respondent Exhibit
- TRPX - TEAC Respondent Physical Exhibit
- SX - Staff Counsel Exhibit
- SPX - Staff Counsel Physical Exhibit
- FF - Finding of Fact
- Tr. - Transcript

II. PATENT INFRINGEMENT

The unfair practice alleged in this investigation is patent infringement. Two elements must be present to demonstrate that respondents have engaged in patent infringement: (1) validity of the patent; and (2) infringement by respondents.

A. Patent Validity

1. Background of the '573 Patent.

U.S. Letters Patent 4,151,573 (referred to as the '573 patent or the Tandon patent), entitled "Magnetic Recording Device For Double Sided Media," was issued on April 24, 1979, and is assigned to complainant. CX 601. Three inventors are named: Mr. Sirjang I. Tandon, President of Tandon; Mr. Alfred Hackney; and Mr. A. Applequist. CX 601. The '573 patent describes claimed improvements over prior art products. Id. at cols. 1-2. The prior art referred to in the patent was embodied in the IBM 43 FD, the first double-sided disk drive marketed in the United States. See CX 609, 646.

IBM's advancement from a single-sided floppy disk drive to a double-sided drive, instantly doubling the capacity of the data storage devices used with computers, was a signal to the industry of the need to change to double-sided drives since IBM was the acknowledged leader in the computer

industry. Many firms simply followed IBM, galvanized into action by the Technical Disclosure Bulletin (CX 609) issued in December 1975 and the shipment of the double-sided floppy disk drives in June 1976 (FF 72) to develop their own double-sided drives in order to remain competitive with IBM. FF 23-27, 72A. IBM did not, and currently does not, sell floppy disk drives to other computer manufacturers. It manufactured the drives to incorporate them in its own computer systems. Rival computer companies purchased floppy disk drives from independent drive manufacturers to be incorporated into their computer systems. Floppy disk drive sales to such companies are known as OEM sales. FF 92, 302, 312.

IBM had also developed the first single-sided floppy disk drive which was an advance over the use of tape as a data storage device. FF 13-14C. Once the single-sided drive was well-established, IBM began working on double-sided drives in response to customer interest. FF 63. Difficulty was encountered in developing a double-sided drive which would accurately store and access data and, at the same time, not quickly wear out the magnetic coating of the disk and erase the data. CX 601, cols. 1-2; FF 36-37.

A key role in performing the storing and accessing functions for floppy disk drives (commonly referred to as read/write or data transfer function) is played by transducers, or read/write heads, which contain the magnetic cores. They are mounted on various supports and arms to enable the cores to maintain proper contact with the floppy disk and proper alignment with each other. The heads, the supports, and mountings are referred to as the head assembly. FF 18-19. Contact between the read/write heads and the disk (head compliance) must be incredibly close and stable. Comstock, Tr. 1451; Nathanson,

Tr. 1548. In the Mitsubishi drives, for example, a gap of greater than 0.32 microns (between 12 and 13 millionths of an inch or microinches) between the read/write cores and the disk produces unacceptable error in the storage or accessing of information from the disk. Hayashi, Tr. 2847. Stability of contact refers to proper alignment of the cores with each concentric track of the disk, which ensures that information is deposited or read onto or from the proper location. ^{1/}

The floppy disk is made of very pliant, limp, droopy material which undulates in rotation. "Wrinkles" also occur as a result of being clamped by the hub mechanism. FF 35, 164. The envelope gives it a certain amount of stiffness and permits the disk to be handled. The disk is also subject to variations in its width as a result of manufacturing imperfections and of being clamped upon loading of the heads against the disk (startup) and during read/write operations. These imperfections and deviations from the perfect plane of the disk are significant enough to cause error in the read/write operations if not compensated for in the design of the head assembly; yet, the range of motions involved is "unimaginably small." Comstock, Tr. 1548.

Respondents argue that the patent was anticipated, that it is obvious, and, that with deceptive intent, some of the inventors were omitted.

^{1/} The disk has a series of concentric tracks, which distinguishes it from the single continuous track of an ordinary phonograph record, and is encased in a paper envelope or jacket, from which it is not meant to be removed. The envelope has an opening at the center so that the disk can fit on a center spindle and hub. In addition, there is a radial slot in the envelope on opposing sides to permit the heads to come into contact with each of the concentric tracks as the disk rotates. The read/write heads can be positioned to access any location on any track of the disk during rotation (or operation) through a mechanism which moves the heads along the radial track defined by the envelope slot.

2. Anticipation -- 35 U.S.C. § 102(g).

It has been alleged that the '573 patent is invalid under 35 U.S.C. § 102(g) because the invention had already been made and used in the United States before the priority date of the suit patent by IBM.^{1a/}

Under 35 U.S.C. § 102(g), a person shall be entitled to a patent unless

before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of the one who was first to conceive and last to reduce to practice, from a time prior to conception by the others.

Unlike § 102(a), under which prior knowledge and use must be public when the patented invention is made, prior invention under § 102(g) "requires only that the invention be complete, that is, conceived and reduced to practice, and not abandoned, suppressed or concealed." International Glass Co., Inc. v. United States, 159 U.S.P.Q. 434, 440 (Ct. Cl. 1968) (citations omitted).

Although § 102(g) usually arises in priority disputes in Patent and Trademark Office (PTO) interference proceedings, "it may also be an appropriate defense to patent validity in infringement litigation where a patent application was never filed by the prior inventor." Id.

In the present case, it is claimed that the '573 patent was conceived and reduced to practice by IBM well before the time the application which matured into the '573 patent was filed. For purposes of this discussion, the date

^{1a/} Anticipation under 35 U.S.C. § 102(a) and (e) is also alleged by respondents. PEO Brief, at 3-7. The argument is that the IBM system was in fact asymmetrical (although it claimed not to be), like the Tandon system. This anticipation argument is insubstantial and is rejected. FF 110B. These arguments are relevant to infringement and discussed in that section below.

of Tandon's invention is deemed to be the date of filing the patent application, June 13, 1977. FF 16. Cosden Oil & Chemical Co. v. American Hoechst Corp., 214 U.S.P.Q. 244 (D. Del. 1982). The record is clear that IBM's early work on double-sided floppy disk drives occurred during 1973-1974. FF 51, 57. At that time, IBM tested three different types of head configuration in its disk drives. In the first type of drive, both heads were fixed, in that neither was designed to tilt or move towards or away from the disk in operation. In the course of testing, IBM was unable to obtain satisfactory results and decided not to pursue this design for commercial production. FF 58-60. However, a patent was obtained on this configuration. FF 60.

Another design tested by IBM utilized one fixed head and one gimbaled head. FF 61. Testing on a prototype of this drive occurred in late 1973. IBM was not satisfied with the performance of this second configuration in stress testing, and in January 1974 terminated further development of this design. FF 62-63. This design was never embodied in a commercially available product, its existence was known only within IBM, and no patent application was ever filed on this concept. FF 64, 66. Later, at the earliest in 1975 or 1976, IBM developed a precision writer strictly for in-house use which utilized a head configuration in which one head was fixed and the other gimbaled. This involved immobilizing the lower head of the 43 FD. FF 67-68.

In the third approach developed by IBM, both heads were gimbaled. FF 71-72. Based on successful testing of this configuration, further development work was done, the design was utilized in IBM's 43 FD drives, which were commercially produced, and a patent was applied for and obtained. FF 69-72.

The foregoing facts suggest that IBM actually conceived and tested a double-sided disk drive which embodied the same design and invention as that disclosed in the '573 patent. There is no dispute that IBM's activities occurred well before Tandon's.

In order for IBM's work on its type two head configuration to constitute an anticipating prior invention, it must be found that IBM reduced it to practice and did not abandon, conceal or suppress it. There has not been a sufficient showing that IBM reduced this concept to practice. The evidence indicates that IBM tested the concept for about four weeks, far less time than it spent on developing its type three design, and did not apply for a patent as it did for the two fixed head design. FF 62, 70. The IBM type two design appears to be more like preliminary experimentation, rather than reduction to practice. FF 62-65. For purposes of considering abandonment, concealment or suppression, however, a reduction to practice will be assumed.

Abandonment is irrelevant to this section unless it occurred before the time of the applicant's invention. Allen v. W.H. Brady Co., 184 U.S.P.Q. 385, 386 (7th Cir. 1974); Leesona Corp. v. Varta Batteries, Inc., 213 U.S.P.Q. 222, 250 (S.D.N.Y. 1981). In addition, "the concept of abandonment contemplates a voluntary decision by the original inventor to terminate any effort to practice his conception." Allen, 184 U.S.P.Q. at 386. Similarly, concealment or suppression must be intentional. Cosden Oil & Chemical, 214 U.S.P.Q. at 257.

Irrespective of a reduction to practice and an arguably successful use of an invention, it may be found to have been abandoned, suppressed or concealed in the absence of further steps taken within a reasonable time after the invention to make it publicly known. "Thus, failure to file a patent application . . .; to describe the invention in a publicly disseminated document . . .; or to use the invention publicly . . ., have been held to constitute abandonment, suppression or concealment." International Glass, 159 U.S.P.Q. at 441 (citations omitted). The measure of whether there has been abandonment, suppression or concealment by the first inventor is whether the public has gained any knowledge of his invention.

The true ground of the doctrine . . . lies in the policy and spirit of the patent laws and in the nature of the equity that arises in favor of him who gives the public the benefit of the knowledge of his invention, who expends his time, labor and money in discovering, perfecting, and patenting, in perfect good faith, that which he and all others have been led to believe has never been discovered, by reason of the indifference, supineness, or willful act of one who may, in fact, have discovered it long before.

Mason v. Hepburn, 13 App. D.C. 86 (D.C. Cir. 1898); see also Palmer and Taylor v. Dudzik, 178 U.S.P.Q. 608, 615 (C.C.P.A. 1973).

The facts relating to IBM's activities compel the conclusion that IBM voluntarily abandoned, suppressed and concealed its invention before the time of the same application which led to the '573 patent. At the time of its development work on double-sided floppy disk drives, IBM was pursuing three different design concepts. Problems were encountered with two of these designs, whereas the third showed promise. FF 58, 60-63, 69. As a result, IBM stopped development work on the first two designs, including the design that is claimed to anticipate the '573 patent, and did not disclose the latter

concept to the public. FF 60, 62, 64. When an article was published in 1981 which described IBM's work on floppy disk drives, the basic head design of its second approach was briefly discussed, together with an indication of the problems encountered. FF 63. To the extent that this may be considered a disclosure to the public, it occurred well after the date of the invention of the '573 patent.

It is noteworthy that of the three designs developed by IBM, the one design that is alleged to anticipate the suit patent is the only one for which IBM did not seek patent protection. FF 66. There is nothing on this record to suggest that IBM believed that its type two design was a patentable invention, or that it had priority over Tandon's claim. IBM's only use of this particular configuration occurred entirely in-house, and was clearly not publicly disclosed before June 1977. FF 64-68. The fact that IBM subsequently took a license from Tandon under the '573 patent (CX 62) further supports the conclusion that IBM voluntarily abandoned, suppressed and concealed this invention.

For the foregoing reasons, IBM's development work before 1977 did not anticipate the invention of the '573 patent because IBM willfully abandoned, canceled or suppressed its prior work.

3. Inventorship of the '573 Patent -- 35 U.S.C. § 116.

It is alleged that the invention of the '573 patent was first conceived at CalComp and that Tandon only participated in reducing it to practice. Thus, it is claimed that the suit patent is in error in failing to name Malcolm Smith, of CalComp, as an inventor, and that the coverage of the patent claims was misrepresented to CalComp in naming only Tandon employees as inventors with the deceptive intent to deprive CalComp of any ownership rights.

Non-joinder of a joint inventor may render a patent unenforceable. 1 D. Chisum, Patents §§ 2.02, 2.03 (1984). When a mistake is made in the joinder of inventors without deceptive intent, the mistake may be corrected under the remedial provisions of 35 U.S.C. § 256. Iowa State University Research Foundation, Inc. v. Sperry Rand Corp., 170 U.S.P.Q. 374 (4th Cir. 1971). However, the defense of improper joinder of inventors is a technical, and thus disfavored, defense. The party asserting such a defense bears the burden of proving such improper joinder by clear and convincing evidence. Certain Steel Rod Treating Apparatus and Components Thereof, Inv. No. 337-TA-97, 215 U.S.P.Q. 237, 255 (1981); see also Certain Fluidized Supporting Apparatus and Components Thereof, Inv. No. 337-TA-182/188, ID at 105-07, CD at 8 (1984).

During 1976 and 1977 California Computer Products, Inc. (CalComp), was an OEM supplier of single-sided disk drives. FF 91. When IBM announced its double-sided floppy disk drives in 1976, CalComp sought to enter the double-sided disk drive market as quickly as possible so that its OEM customers could remain competitive with IBM. FF 92. Since CalComp did not

have the technical capability to develop a double-sided floppy disk drive, it entered into a contract with Tandon Magnetics (predecessor of Tandon) to design the double-sided heads. FF 93-94.

Initially, it was the expressed view of Tandon and CalComp that IBM's preeminent position in the market would require CalComp to develop an IBM compatible disk drive. As a result, Tandon's original proposal to CalComp was to reverse engineer the IBM double-sided disk drive. FF 95. Preliminary work on the reverse engineered IBM drive revealed that the head assembly would not fit in CalComp's existing single-sided drive carriage. Therefore, for a variety of reasons, CalComp preferred to develop a double-sided disk drive that could be adapted to its single-sided drive. FF 96-97. Tandon expressed resistance to this approach, and attempted to dissuade CalComp from following it, though Tandon at the same time had decided to adapt the single-sided drive design for use in a double-sided drive. Hackney Dep., MRPX 36, at 28-38. In agreeing to develop the reverse engineered IBM drive and the modified CalComp drive in parallel (FF 98-100), Tandon apparently did not disclose to CalComp that it was in any event proceeding with the latter approach.^{1b/}

The essential controversy relating to CalComp's relations with Tandon concerns the participation of Mr. Malcolm Smith in the double-sided drive project.^{1c/} Mr. Smith was the mechanical engineer at CalComp's Small Disk Operations and served as liaison between Tandon and CalComp on this project and monitored and tested the prototype developed at Tandon. FF 94.

^{1b/} Tandon built the IBM design head assembly for Control Data, but this design was unsuccessful. Hackney Dep., MRPX 36, at 29, 56.

^{1c/} An additional controversy may relate to ownership rights to the '573 patent. FF 102-06. However, this matter does not appear to relate to the question of patent validity.

When Tandon delayed the development of the modified CalComp drive, Mr. Smith made a crude model of the modified CalComp drive, using a single-sided drive, in an effort to persuade Tandon to commence development of this design. In Mr. Smith's view, this model was not really acceptable, although it showed some ability to read and write because it destroyed the medium. FF 97, 99.

After Mr. Smith prepared the model, Tandon produced a prototype of this modified CalComp design, and preliminary testing gave very encouraging results. FF 100. Subsequent work at Tandon apparently concentrated on this modified CalComp design, with Mr. Smith in frequent attendance, with the objective of having the new double-sided drive ready for the NCC show in June 1977. This drive was incorporated in CalComp's product and was shown at the NCC show. According to Mr. Smith, the drive worked better than IBM's drive. FF 94, 101.

It was not until about September 1977 that Mr. Meyer, director of CalComp's Small Disk Operations, discovered that Tandon had filed a patent application on the double-sided floppy disk drive that had been developed as a result of the CalComp/Tandon development project. Mr. Meyer felt that Mr. Smith should be named as an inventor and that CalComp's name should be associated with the patent. The CalComp-Tandon agreement provided that the head and flexure designs were proprietary to Tandon and, among other things, that the carriage arm was proprietary to CalComp. FF 102-04. Mr. Meyer's concerns apparently were satisfied by Mr. Tandon's representation that the patent would only cover the head and the suspension flexure (FF 94, 102-104, 106), but in fact the patent application and patent were not so limited. The facts may indicate a basis for contract dispute between CalComp, or its successor, and Tandon, but do not show that any inventors have been omitted.

In Mr. Meyer's view, the agreements between Tandon and CalComp divided the ownership of different components of the double-sided disk drive between Tandon and CalComp, and Tandon patented more than it owned.^{2/} FF 102-06. This may be so, but Mr. Smith does not claim to have been one of the inventors.^{3/}

Mr. Smith's testimony indicates that in developing the modified CalComp double-sided head, Tandon prepared many of the technical drawings, particularly those related to the head assembly. The only drawings provided by CalComp covered the carriage and the upper arm. FF 102, 105. In Figure 1 of the '573 patent, the only part of that drawing "derived" from CalComp are the "bosses" or protuberances on the carriage, which is not a critical part of or central to the invention. FF 105. Mr. Smith also testified that he had prepared a crude model of the modified CalComp design. Although this model appears to have prompted Tandon to accede to CalComp's wishes with respect to adapting the single-sided drive to double-sided use, Mr. Smith made quite clear that his crude model did not work. Smith, Tr. 2244-45; FF 99.

^{2/} Mr. Meyer sought the advice of CalComp's patent committee and was told that the concept was unpatentable. FF 107.

^{3/} At the hearing on temporary relief, both Mr. Meyer and Mr. Smith testified about the CalComp/Tandon double-sided floppy disk drive project, which ultimately produced the double-sided drive that is the subject of the '573 patent. During the course of Mr. Meyer's testimony, particularly on cross-examination, it became clear that although he had very definite opinions about the nature of CalComp/Tandon relations, his memory of the timing and sequence of events was unclear. In addition, Mr. Meyer frequently disclaimed a clear memory of certain events on the basis that he was not directly involved. On balance, I have found Mr. Smith's testimony appears more definite on the sequence and timing of events, and I have relied more on his testimony for this purpose.

Although Mr. Meyer felt that Mr. Smith should have been named as an inventor, there is no indication that Mr. Smith challenged the patent. Mr. Smith filed a declaration with the PTO supporting Tandon's patent application.^{3a/} FF 108. As the chief mechanical engineer for CalComp and as liaison between CalComp and Tandon, Mr. Smith was in a better position than Mr. Meyer to know about the the capabilities of his crude model and the development of the double-sided disk drive that matured into the '573 patent. The word of the inventors is normally accepted as to who are the actual inventors. Brader, Cavitt, and Gipson v. Schaeffer, 193 U.S.P.Q. 627, 631 (PTO BPI 1976). In view of Mr. Smith's close connection with this project, his view of inventorship is the most reliable.

On the basis of the foregoing, I find that there is no improper joinder of inventors.^{3b/}

^{3a/} During the hearing on permanent relief, it was disclosed that Mr. Smith was an employee of Tandon for two to three years, including the period when he filed the declaration. Tandon Dep., MRPX 34, at 341-42; Hackney Dep., MRPX 36, at 34. In the declaration, Mr. Smith depicted himself as one experienced in the industry and listed his various employers but did not include Tandon. CX 611, at 40. This fact was also not disclosed in Mr. Smith's testimony during the TEO hearing. Mr. Meulners also filed a declaration in support of the patent and did not disclose the fact he was currently employed by Tandon. Tandon Dep., MRPX 34C, at 380-81, ; CX 611, at 34.

^{3b/} The issues of inequitable conduct by reason of failure to disclose the Parken Patent during the Tandon patent application and whether the Parken patent anticipates claim 1 of the Tandon patent were considered in the initial determination concerning temporary relief. These issues were reviewed and the rejection of them affirmed by the Commission. TEO ID at 22-26; Comm'n TEO Opn. at 6-11, (Oct. 11, 1985). No additional evidence or argument on these issues were offered in the hearing concerning permanent relief. The TEO Initial Determination and Commission Opinion regarding this issue are incorporated herein by reference.

4. Obviousness -- 35 U.S.C. § 103.

Respondents claim that the Tandon patent is invalid as obvious in light of the prior existing single-sided floppy disk drives, the prior IBM work on its type two design, and the CalComp model produced by Mr. Smith. Respondents argue it was obvious to modify the pressure pad arm of the single-sided drive to carry the second head.

Under 35 U.S.C. § 103, a patent may not be obtained if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. The test for obviousness, established by the Supreme Court in Graham v. John Deere & Co., 383 U.S. 1, 148 U.S.P.Q. 95-99 (1966), involves a determination of: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims at issue; and (3) the level of ordinary skill in the art.

The patent in suit and the prior art applied to its claims by the PTO offers a convenient starting point for ascertaining the scope and content of the prior art. See Orthopedic Equipment Co., Inc. v. United States, 702 F.2d 1005, 217 U.S.P.Q. 193, 196 (Fed. Cir. 1983). The prior art cited by the examiner consisted primarily of single-sided drives and reference R, the IBM double-sided drive. CX 611, at 24-25, 45-49. The examiner twice rejected the Tandon patent application as obvious. However, in doing so he relied upon the prior IBM double-sided device, and not the prior single-sided art. Id. Until the IBM device was disclosed in 1975 (CX 609), the industry relied solely on single-sided floppy disk drives. The single-sided floppy disk drive technology had been based upon the technology of prior reel-to-reel tape

drives as magnetic data storage devices. Stoddard, Tr. 4491-506. Technology for deploying magnetic heads on both sides of a floppy disk for effective data transfer was unknown until the IBM drive.

It was obvious to IBM to experiment with or investigate adding a second head on a gimbal spring and to retain the fixed head contained in the single-headed drive, as it was to CalComp. It was not obvious, however, that of the three methods it did investigate, this was one that could be made to work. Indeed, IBM after some experimentation thought so little of the asymmetrical configuration that no data was collected and no patent application was filed, although such a patent was filed on the two fixed-headed design despite the fact IBM chose not to commercialize it. Further, CalComp's suggestion that Tandon investigate whether a double-headed drive could be made so it could utilize its inventory and tooling for the single-headed drive, goes no further than to show that the approach of modifying the single-sided drive to substitute an upper transducer for the pressure pad arm is one that should be investigated. Mr. Smith, the CalComp engineer, does not claim to have reduced such a device to practice or made it work. Smith, Tr. 2294. His model was extremely crude and appears to be of the two fixed headed design made for the purpose of inducing Tandon to accelerate work on adapting its single-sided drive to double-sided operation. Smith, Tr. 2292-95.

Shugart, a subsidiary of Xerox Corp., followed the IBM design of two gimbal heads, and when it examined disk drives incorporating the '573 patent design, Shugart initially rejected this design because in the view of its engineers, it would not work. FF 73A, 77-79, 84-85A.

Mr. Stoddard has testified that the skill in the art was high, that he was a person skilled in the art, and that if he had been requested to design a double-sided floppy disk drive head assembly by modifying the existing single-sided drive, it would have been obvious to him to modify the arm carrying the pressure pad opposite the lower fixed head by substituting a gimbal mounted transducer. Stoddard, Tr. 4538-45, 4552. No one had requested Mr. Stoddard to design such a head assembly and, of course, he did not do so.

As the Court of Appeals for the Federal Circuit (CAFC) has noted, the question of nonobviousness is a simple one to ask but difficult to answer. CAFC precedent instructs that the proper analysis of the nonobviousness question begins with the presumption that the person of ordinary skill in the art at the time of the patentee's invention is presumed to have before him all of the relevant prior art. The next inquiry is whether, armed with this information, it would have been nonobvious to this person of ordinary skill in the art to coordinate the teachings of the prior art elements in the same manner as the claims in suit. Orthopedic Equipment, 217 U.S.P.Q. at 199. The CAFC has cautioned that the strong temptation to rely on hindsight in evaluating obviousness must be resisted:

It is wrong to use the patent in suit as a guide through the maze of prior art references in the right way so as to achieve the result of the claims in suit. Monday morning quarterbacking is quite improper when resolving the question of nonobviousness in a court of law.

Id.

It is conceded that technically the '573 patent design is different, and perhaps is radically different than the IBM design which was before the examiner. FF 110A, 235A-35B. Respondents' obviousness argument is based primarily on the prior single-sided disk drive art.

In hindsight, it appears that the conception embodied in the '573 patent did not involve a flash of inventive genius, but rather a belief that this design would work, and sufficient effort and ingenuity to make it work. See Hackney Dep., MRPX 36, at 12-23, 30-44. On the basis of the prior art--the single-side floppy disk drive developed by IBM--it occurred to IBM to try all three types of possible arrangements--two fixed-headed, two gimbal headed, and one fixed head and one gimbal head--to develop a double sided drive. Yet, it discarded the one-fixed head, one gimbal head design. It also occurred to Calcomp to investigate modification of its single-sided drive by replacing the pressure pad on the opposite side of the single fixed head with another head. Mr. Smith did not know if his crude model would work; he constructed it to prod Tandon to investigate. Shugart also did not believe this design would work.

There is no doubt that Mr. Stoddard is highly skilled in the art. "What might appear to be obvious to one skilled in the art may well be shown to be nonobvious subject matter by a clear showing of obstacles which the art had theretofore found insurmountable." In re Harris and McCane, 51 CCPA, 139 U.S.P.Q. 292, 295, cited in Rosenberg, Patent Law Fundamentals, § 9.02 (2d ed. 1984). To Shugart, a leading floppy disk drive manufacturer at the time, the obstacles were insurmountable, and led to its taking a license from Tandon. FF 86-86A, 87. In view of Shugart's belief at the time that such a design would not work, in view of IBM's failure to seek patent protection on its type two conception when it sought such protection on its type one and three designs, the evidence does not show that use of the one fixed head, one gimbaled head configuration for a double-sided floppy disk drive was obvious. In these circumstances, and in view of the presumption of validity

(35 U.S.C. § 282), it is difficult to accept Mr. Stoddard's ex post facto opinion as a basis for invalidating the '573 patent. This hindsight opinion is what the Supreme Court has instructed us to avoid.

Thus, although the level of skill in the art was high, many of the leaders in the field either did not believe it would work, or could not reduce the '573 patent to practice. What is obvious is that at the time of the patent application, the structure embodied in the '573 patent was not the way any of the leading manufacturers in the industry would or could construct a functioning double-headed floppy disk drive. The IBM approach was the only successful implementation of a double-sided drive in the industry, and the industry considered the IBM approach the only practical system. Comstock, Tr. 1511.

In Graham, the Supreme Court stated that secondary considerations such as commercial success and long-felt and unsolved needs might be utilized in addition to the three major criteria established by 35 U.S.C. § 103. 383 U.S. at 17-18. The Court reasoned that such indicia of obviousness may be more susceptible to judicial scrutiny since they are objective evidence based on motivational or economical inferences rather than technical facts based on subjective testimony of patent experts. This, the Court reasoned, would guard against the temptation to determine obviousness based on hindsight. 383 U.S. at 36.

That others have failed to develop the product in light of such a demand for it tends to show nonobviousness of the patented product. Reeves Instrument Corp. v. Beckman Instruments, Inc., 170 U.S.P.Q. 74 (9th Cir. 1971). Evidence of commercial success is "extremely strong and is entitled to great weight." Simmons Fastener Corp. v. Illinois Tool Works, Inc., 222 U.S.P.Q. 747, 744 (Fed. Cir. 1984). If it were obvious others would have

developed the product. See In re Fielder, 176 U.S.P.Q. 500 (C.C.P.A. 1973). Acceptance of a license by a substantial portion of the competitors in the market, as is true in this investigation, has also been regarded as commercial acquiescence supporting patentability. See, e.g., Stratoflex, Inc. v. Aeroquip Corp., 218 U.S.P.Q. 871 (Fed. Cir. 1983). The rationale for the use of commercial acquiescence is that companies would not normally act contrary to their economic interests unless they are convinced of the patent's validity. Chisum, § 5.05[3]. Because of the negligible amount and the lack of royalty paid by Shugart and IBM, respectively, the Tandon licenses alone may not provide strong evidence of the patent's nonobviousness, but the huge commercial success of the product defined in the '573 patent, and the number and quality of licensees, is strong evidence of industry acceptance and nonobviousness.

Based upon the above examination of the scope and content of the prior art and the differences between the prior art and the '573 patent, as well as the secondary considerations, the '573 patent is nonobvious.

For the reasons given above, the '573 patent is valid.

B. Patent Infringement

The '573 patent contains 16 claims, of which three (claims 1, 5, and 12) are independent. CX 601. It represents a mixture of two technologies used in earlier data storage devices; namely, the penetrating head of the tape drive and the air bearing head of the hard or rigid disk drive. Brown, Tr. 2522.

Tape, a very pliant or limp material, is transformed into a flat stable surface in a tape drive when the data transfer head penetrates the plane of the tape, such that the tape wraps itself around the head resulting in close

head to tape contact to enable accurate data transfer. The wrapping action provides contact over an area rather than a point and assures intimate contact even if there is slight misalignment between tape and magnetic core.

Stoddard, Tr. 4888-89; FF 235C. The transducer of a rigid disk drive is suspended on a gimbal spring so that it can move up or down, or pitch or roll in accordance with the tiny imperfections of the disk. This permits the disk and head to always maintain the same relationship for data transfer. The head in a rigid disk drive floats on a microscopically thin cushion of air so it will not abrade the disk and erase the stored data.

In the device defined by the '573 patent, the lower head maintains a similar relationship with the pliant, limp, floppy disk as the tape head did with the tape. The penetration of the lower head into the plane of the limp disk results in similar wrapping action as in a tape drive (Stoddard, Tr. 4495; CX 601, col. 5, lines 43-47) and creates a flat stable surface for the upper head to slide against.^{4/} The gimbal mounted upper head relates to the floppy disk as the gimbal mounted head does with the rigid disk. Brown, Tr. 2522-23.

In the Tandon system,^{5/} the lower head is not intended to move in normal operation. Tandon Dep., MRPX 34, at 414-15. The Tandon philosophy is to let the lower head set the reference plane for the disk. The reference plane is a

^{4/} Prior single-sided drives utilized spherical heads (Tandon Dep., MRPX 34, at 360; Stoddard Tr. 4538), but the Tandon patent specification described a flat lower head (CX 601, col. 4, lines 7-11), which appears necessary to the Tandon type head assembly. Tandon Dep., MRPX 34, at 184-85, 377; Stoddard, Tr. 4543-45.

^{5/} The Tandon system refers to the three independent claims of the '573 patent that were grouped together by Tandon patent counsel in making the amendments which resulted in the patent. CX 611, at 53; FF 229, 235D-35M.

relatively constant non-moving plane, a stable platform which makes head to disk compliance for the upper gimbal mounted head easier. Tandon Dep., MRPX 34, at 472-73. As the heads are moved to the various radial tracks of the disk, the penetration of the lower head and wrapping action of the pliant disk, transform the disk into a rigid surface at the area where the lower head penetrates. FF 228.

The '573 patent purports to be an improvement upon the prior IBM double-sided disk drive. FF 235-35B. The IBM device contained two transducers, one on either side of the disk, which were gimbal mounted and during operation permitted at least two degrees of freedom, pitch and roll. The transducers in turn were mounted upon arms that pivot towards or away from the floppy disk during the load or unload phase. CX 646; CX 611, at 53. The claim language relied upon to distinguish the prior IBM device, and which forms the basis of the infringement allegations, is as follows:

Claim 1 of the '573 patent specifying that the first (or lower) transducer has "a fixed position in a direction normal to the plane of the media," and that the first transducer serves "as a fixed positional reference despite tendencies of the media to deviate in position from its nominal plane."

Claim 5 specifies "a first non-gimbaled transducer . . . having a relatively fixed position relative to the plane of the media."

Claim 12 specifies a lower transducer "fixedly coupled . . . in an invariant position in a direction normal to the plane of the disc."^{6/}

In the accused Mitsubishi drives (except for one model), the lower heads are gimbal mounted, but have a load finger or backup device underneath them which has two effects on the movement of the lower transducer: It restricts the lower head from Z-axis motion away from the disk (Stoddard, Tr. 4568-69),^{7/} but on the other hand promotes pitching and rolling motion by serving as a fulcrum about which the head rotates and tilts. Tandon Dep., MRPX 34C, at 150; Hayashi, Tr. 4280.^{7a/} The Mitsubishi fixed lower head backup member can be seen at CX 693, photos 21 and 22. The various Mitsubishi models are the same or similar for our purposes (FF 135-45), except for one model which does not have the fixed backup member but has a heavier, more

^{6/} Mitsubishi argues that its products do not infringe these claims, and moreover that certain of its devices--the Mark II, M3, M2893 and M2894-4/5--also do not infringe because there is a different "means . . . urging [the] second transducer toward [the] first transducer and [the] media to maintain both transducers in operative relations with the . . . media," then as provided for in each of the independent claims of the '537 patent. Mitsubishi PEO Brief at 30. Little evidence other than conflicting opinions of experts (Lewis, Tr. 4618-19; Comstock, Tr. 5243-44) has been produced on the point, which has been raised relatively late in the proceeding. In view of the paucity of evidence concerning the question whether the Mitsubishi means is actually the same or an equivalent, and because it is not a dispositive issue (in view of the infringement findings), no determination has been made on this issue.

^{7/} Z-axis direction movement refers to movement of the head towards and away from the disk. It is also referred to as translational movement.

^{7a/} The IBM double-sided drive also had load points backing up the gimbals on which the heads were mounted. Stoddard, Tr. 4525-27.

restrictive spring on the lower head than on the upper head (FF 144), and some other models which have two springs on the lower head and one on the upper.

Comstock, Tr. 1835-36.^{8/}

Tandon argues that the gimbals on which the Mitsubishi lower heads are mounted are cosmetic, and that in operation these heads behave as if they are "fixed." Although the backup devices restrict translational movement of the lower heads away from the disk beyond a certain point (Stoddard, Tr. 4568-69), Mitsubishi claims that in operation, the lower heads of its devices move substantially and that its system is like the symmetrical IBM system.

Hayashi, Tr. 2843.

Tandon and Mitsubishi have conducted various tests purporting to measure head and disk movement and other factors relating to the patent claims. The significance of the test results is the subject of substantial dispute between the parties. Tandon's view is that since the offending Mitsubishi drives are asymmetrical like the Tandon drives, and since the lower heads move a small amount as compared to the amount of movement in a disk (away from its perfect plane) when not restrained by the heads, the lower heads function as if they are fixed and non-gimbaled. Mitsubishi argues that the lower heads in its drives exhibit much greater movement than the critical angles and distances necessary for maintenance of head to disk compliance, and therefore the gimbal mountings of its lower heads are functional (not cosmetic) and not "fixed," "fixedly coupled," or "non-gimbaled."

^{8/} Some Mitsubishi models are admittedly not infringing. Tandon TEO Brief at 62. The evidence produced at the PEO hearing regarding these models was insubstantial and did not establish infringement of these models, even if complainant's infringement views are accepted.

The patent specification describes the "tendencies of the media to deviate in position from its nominal plane." CX 601, col. 6, lines 67-68, to col. 7, line 1.^{9/} The nominal plane of the floppy disk is the "mythical perfect plane" of the disk if the heads were not there and if there were no disk imperfections or undulations caused by the clamping of the disk by the hub. Lewis, Tr. 2990; Comstock, Tr. 1516; FF 237. The patent thus makes it clear, and all parties are in agreement, that the head design of a floppy disk drive must deal successfully with the movements of the disk away from its perfect plane, or head to disk compliance will not be satisfactory, resulting in unacceptable errors in data transfer.

Mr. Nathanson tested disk drives of the respondents as well as the drives of Tandon and the IBM double-sided drive, which exemplified the most recent prior art relied upon by the examiner. FF 146-202.^{10/} The Nathanson tests measured free disk motion unconstrained by the heads, 2-axis, pitching and rolling of the lower heads, and compared the movement of the lower head to the movement of the disk in an equation, the result of which was called the degree of insensitivity of the lower head. Nathanson also measured the spring rates of each of the heads and the disk in various drives to measure the flexibility or stiffness of the various parts of the system.

^{9/} The same or closely similar language is in each of the independent claims.

^{10/} The technical experts called to testify by complainant and respondents have praised the test setup, instrumentation, accuracy and reliability of the Nathanson test results. The one apparent exception is Mitsubishi's claim that there was error in the measurement of the pitch angle in operation of the lower head of its Mark I model. No retest of this measurement has been made by complainant although it was suggested in the TEO initial determination that it do so. Respondents have presented evidence showing that it is an error or aberration. FF 224.

Mitsubishi conducted tests which compared the head compliance in Mitsubishi and Tandon drives, measured the spring rates of the lower heads in these drives, the degree of movement of the lower heads upon loading and in operation, and the effect of the operation of the lower heads upon removal of the upper head. FF 203-24.

There is general agreement among all the technical experts that there are two types of disk movements away from the nominal plane of the disk, and that these movements exert "substantial" forces on the heads while in operation; large scale waviness, sometimes referred to as undulations, and small scale movements such as manufacturing imperfections and variations in the thickness of the media. Brown, Tr. 2628, 2630; Hayashi, Tr. 2848-49; Lewis, Tr. 2892. In each of the systems, the two heads and the disk make up a sandwich. Each head plays a role in providing close and stable head to disk compliance. Comstock, Tr. 1552; Lewis, Tr. 2887; Brown, Tr. 2523.

The heads are loaded upon the disk through arms and springs, cooperating with the head mountings to bring the transducers into data transfer relationship with the disk. Stoddard, Tr. 4526-27; Tandon Dep., MRPX 34, at 428-29; Hackney Dep., MRPX 36, at 24. The '573 patent specification makes clear that these loading forces are separate from the force exerted by the fixed positional reference: "The slight wrapping of the pliant disc about the surface of the fixed transducer provides a part the function of insuring close or contacting relation, and the remainder of the cor[r]ective action needed is supplied by the force of the slider transducer." (Emphasis added.) CX 601, col. 5, lines 43-47; see Tandon Dep., MRPX 34, at 182-183. The load arm is an important part of the design. Hackney Dep., MRPX 36, at 116-18. The loading forces of the arms transmitted into the disk through the heads play a more significant role in dealing with unwanted disk movement than the penetrating

lower head. Comstock, Tr. 5246-47. These loading forces eliminate the large scale waviness of the disk. Hayashi, Tr. 4282; FF 221. After the large scale movements are eliminated, the heads can either iron out the small scale variations in the disk, or move in response to disk motion to accommodate these variations.

With this background in mind, we should now consider the questions of infringement literally and under the doctrine of equivalents.

1. Literal Infringement.

The term "fixed" in claim 1 and "fixedly coupled" in claim 12, based on the way the terms are used in the patent and in light of the testimony of the meaning of such terms in the industry, indicate that these terms mean the lower head was not designed to move in response to the forces it would likely encounter in a floppy disk drive. Lewis, Tr. 2919. FF 230, 232-33. According to two of the inventors, a fixed lower head means that the lower head not move in any direction with respect to the carriage. Hackney Dep., MRPX 36, at 31, 54; Tandon Dep., MRPX 34, at 414-15, 417-19. The independent claims of the '573 patent describe the structure or relationship of the various elements when they are in "data transfer" position (claim 12) or in "operative" relationship (claims 1 and 5).

Complainant's spring rate tests show that the mountings of the lower heads in the Mitsubishi drives are asymmetrical, that is, the lower heads are less flexibly mounted than the upper heads. FF 165, 173, 201. In this general respect, the Mitsubishi drives are like the Tandon system and unlike the IBM system in which the head mountings and arms are virtually symmetrical. The upper and lower gimbals in almost all the Mitsubishi drives are identical,

like the IBM system, but the backup load point or finger limits travel in the lower head, whereas the backup elements of the upper head are much more flexible. FF 138, 176; CX 716, at 37. Asymmetry, however, does not necessarily show that the Mitsubishi lower heads are fixed or non-gimbaled, or that the lower heads provide a positional reference for the disk.

Complainant relies on the insensitivity calculations to prove that the Mitsubishi lower heads are fixed or non-gimbaled as they function in a floppy disk drive. The insensitivity calculations compare movement of the lower head and movement of the free disk to arrive at a conclusion concerning the degree of lower head fixedness. See, e.g., FF 165-69. However, these calculations are flawed in that they leave out the loading force of the heads on the media, which is exerted by the force of the upper arm spring through the upper transducer against the disk and lower transducer. FF 110A, 221. See Opn., at 37-38. These forces affect the disk more significantly than penetration of a lower fixed head. Comstock, Tr. 5247. Although these forces play a significant role in controlling disk movement, they are not included in Nathanson's insensitivity calculations.^{10a/}

On the other hand, Mitsubishi's tests show significant movement in the Mitsubishi lower heads. Significant movement means more than a half minute of pitch motion arc (Lewis, Tr. 2901), or sufficient translational motion to affect the reliability and accuracy of data transfer. FF 234. The lower

^{10a/} Further, the insensitivity calculations produce wide variations in results depending upon where the measurement is made, which casts further doubt on the validity of the formulas as a method of determining whether the lower head in a particular disk drive is "fixed." FF 202, 240, 240A. The mere presence of the lower head in the Tandon drive under the point of measurement also reduces disk movement over 90 percent. FF 220.

heads of the Mitsubishi drives move up and down and tilt to a significant extent in operation. FF 210, 213, 215-16, 234A; MRPX 42 (a videotape graphically depicting through magnification the gimbaling action in comparison to the Tandon drive based on data recorded in MRX 92). The movement of the upper and lower Mitsubishi heads are virtually symmetrical or synchronous in pitching and rolling motion. MRPX 46-47; MRX 44. Consequently, the gimbals supporting the Mitsubishi lower heads are not "cosmetic" disguises for the purpose of avoiding the patent; these heads move significantly and are not "fixed," "fixedly coupled," or non-gimbaled.

Of the independent claims, claim 5 is the only one that provides the "non-gimbaled" lower head has "a relatively fixed position relative to movements of the plane of the media," (Emphasis added.) In the initial determination concerning temporary relief, this language was relied upon to differentiate claim 5 from claims 1 and 12 in that it appeared to include within its scope a lower head that could move to some extent. Double-Sided Floppy Disk Drives, TEO ID at 40-42. While the literal language appears to support the view that it means "somewhat fixed" (Lewis, Tr. 2921-22), it was added as an amendment while the application which led to the '573 patent was under final rejection; thus, its scope must be interpreted in accordance with the patent office history to determine whether complainant is estopped from claiming the full breadth of the term.

Whenever the doctrine of file history estoppel is evoked, a close examination must be made not only as to what was surrendered by the patentee, but also the reason for such a surrender. Bayer Aktiengesellschaft v. Duphar Int'l Research, 222 U.S.P.Q. 649, 653 (Fed. Cir. 1984); Ziegler v. Phillips Petroleum Co., 177 U.S.P.Q. 481, 489 (5th Cir. 1973), cert. denied, 414 U.S. 1079 (1973). Close examination of the prosecution history of the '573 patent

determines "not only what was surrendered, but also the reason for such a surrender" (Bayer, 177 U.S.P.Q. at 653). Attorneys arguments to secure issuance of the patent can limit the scope of the claims. Hughes Aircraft Co. v. United States, 717 F.2d, 1351, 1362, 219 U.S.P.Q. 473, 481 (Fed. Cir. 1983); Coleco Industries, Inc. v. U.S.I.T.C., 573 F.2d, 1247, 1257, 197 U.S.P.Q. 472, 480 (C.C.P.A. 1978); In the Matter of Certain Rotary Wheel Printing Systems, Inv. No. 337-TA-185, at 37 (Aug. 1985).

The patent was twice rejected by the examiner as anticipated by reason primarily of reference R, the IBM Technical Disclosure Bulletin. CX 611, at 23-25, 44-49. The patent application was under final rejection when additional amendments were submitted after an August 3, 1978, interview to distinguish reference R concerning "the definition of fixedness of the heads and the significant relationships." Id., at 53. The term "relatively fixed" in claim 5 was included for the first time in these amendments to distinguish reference R without "the addition of new matter." Id. Further, in connection with the final amendments, and in distinguishing reference R, it was stated that "applicant's system utilizes one head that has an invariant position bearing against one side of the media without spring loading, and this head is non-gimbaled." Id. Thus, the term "relatively fixed" lower head in claim 5 cannot be interpreted so as to inject new or additional matter into the claims, and it further must be interpreted to be limited to a structure which is "invariant" against the disk without "gimbaling" or "spring loading."

Professor Chisum, complainant's patent law expert, has stated that insertion of the term "relatively" before "fixed" in claim 5 had no "major impact on the scope of the claim at all." Chisum, Tr. 4373. The examiner had

considered similar language in claims 1 and 12 and "consistently interpreted it as not being sufficient to define the invention" in view of reference R; thus, simply adding "relatively" before fixed in claim 5 would not "change that interpretation." Id., at 4373-74. Mr. Jessup, respondents' patent law expert, is of the view that addition of the term "relatively" before "fixed" in claim 5 is "redundant." Jessup, Tr. 4459. The views of both experts, although differently stated, are in basic agreement: Both state that "relatively" before "fixed" had no substantial effect on the scope of claim 5.^{11/} They are correct. Since the amendments specifically were represented not to include "new matter" and since applicants sought to show that the lower head in the claims as amended were fixed in a way that the heads in reference R were not fixed, that is, one head has an "invariant position bearing against one side of the media without spring loading" and "non-gimbaled" as opposed to the two pivoted, gimbaled heads in reference R, the addition of the word "relatively" in claim 5 before "fixed" is superfluous.

Thus, in light of the arguments made by applicants patent counsel in order to secure issuance of the patent while under final rejection, complainant is estopped from contending that the term "relatively" expands the scope of claim 5 to include a lower head that moves in response to the forces normally encountered in the operation of a floppy disk drive.

^{11/} Moreover, one of the inventors, Mr. Tandon, states that "relatively fixed" in claim 5 does not have any meaning different from "fixed" in claims 1 and 12. Tandon Dep., MRPX 34, at 613-14. Another inventor, Mr. Hackney, specifically states that a gimbaled lower head is not part of the invention. Hackney Dep., MRPX 36, at 45.

Since it has been shown in the discussion above that respondents' gimbal mounted lower heads move, and pitch and roll significantly, complainant has failed to establish that the Mitsubishi disk drives literally infringe claims 1, 5, and 12 of the '573 patent.

2. Doctrine of Equivalents.

Respondents argue that essentially no range of equivalents should be afforded the Tandon patent claims because of the limiting amendments and attorneys arguments made while the application was under final rejection. Specifically, respondents argue that because of the attorney's arguments in attempting to distinguish reference R, the examiner's principal prior art reference, a gimbaled or spring loaded lower head is not within the patent claims. CX 611, at 53; Jessup, Tr. 4469. Complainant takes the position that any patent is entitled to a fair range of equivalents and that although the lower heads of the Mitsubishi devices are mounted on gimbal springs, if they are sufficiently fixed so that they function as positional references in floppy disk drives, they are within the independent claims. Chisum, Tr. 4383. If the Mitsubishi devices perform substantially the same function in substantially the same way to obtain the same result, then they are equivalent to the device defined in the '573 patent. See Graver Tank & Mfg. Co. v. Linde Air Products, 339 U.S. 605, 608, 85 U.S.P.Q. 328 (1950); Perkin-Elmer Corp. v. Computervision Corp., 732 F.2d 888, 900, 221 U.S.P.Q. 669, -679 (Fed. Cir. 1984). The result or function is to provide accurate and effective data transfer, which is provided by the drives or all parties. Mitsubishi argues that its devices do not perform this function in the same way as in the Tandon system.

Complainant cannot regain through the doctrine of equivalents what has been surrendered in order to obtain the patent. As shown above, much has been surrendered, but nevertheless we should examine the claims and the alleged infringing devices under the doctrine of equivalents to determine if the Mitsubishi gimbal mounted lower heads function as a positional reference for the disk.

The heads in the Mitsubishi drives in operation pitch and roll synchronously. FF 217-19, 223. Although the backup member in the Mitsubishi drives restrict Z-axis movement away from the disk, the role of this element is in providing a backup for the loading force of the heads. FF 110A, 221; Stoddard, Tr. 4565-69.

In the Tandon system, data transfer is achieved by the loading force of the upper arm and by penetration of the lower head into the plane of the disk. The disk thus takes the shape of the lower head, while that portion of the disk resting on top of the head assumes the characteristics of a hard disk. Tandon Dep., MRPX 34, at 472-74. The Tandon system radically differed from the IBM system in transforming the unstable, limp floppy disk into a media that assumed the characteristics of a rigid, hard disk. Meulners Aff., CX 611, ¶ 6b; Tandon Dep., MRPX 34, at 477. The limp, floppy disk in the area directly above the Tandon lower head, becomes a rigid, stable platform, and permits the upper Tandon gimbal mounted head to pitch and roll in accordance with the upper disk surface thickness variations. Tandon Dep., MRPX 34, at 473-75. In the Tandon system, the positional reference is achieved through a penetration of a flat lower head at least as large as the upper head, and preferably larger (Hackney Dep., MRPX 36, at 41; Stoddard, Tr. 4543-45), into the plane of the disk to a greater extent than in prior single-sided systems. FF 228-29, 235.

Mr. Nathanson, one of complainant's technical witnesses measured the extent of penetration of the lower heads of various drives into the plane of the disk. The penetration of the Tandon drive is 274 ten thousands of an inch, as compared to 51 ten-thousands of an inch for the Mitsubishi drive. CX 716, at 34-35.^{12/} The penetration of the Tandon drive is about five times greater than the penetration of the Mitsubishi drives.^{13/} The prior standard for penetration in single-sided drives, and for actual penetration in the IBM 43 FD drive, is about 10 ten-thousands of an inch. Stoddard, Tr. 4505-27.^{14/} In the Mitsubishi devices, were it not for the loading force of the upper head, the disk would tend to fly off the lower head producing unacceptable signals. This is not true of the Tandon drives which exemplify the patent. FF 224. The movement of the lower head in the

^{12/} The penetration of the Mitsubishi drives is alleged to be geometrical only in that, because there is a space or rubber spring between the load point and the lower gimbal, the disk moves the lower head down. Lewis, Tr. 4621-25; Stoddard, Tr. 4566-69. The Mitsubishi lower head is more resilient than the Tandon lower head and can be moved by the disk until it hits the supporting load point. FF 140, 143, 177, 206.

^{13/} Complainant refers to other measurements for penetration of Mitsubishi Model M4851A-3 as .0143 and Model MF 535 as .0071. CX 782 at 17, 49. These are references to the laboratory notebook of Tandon employees and are not part of the testimony of Mr. Nathanson, who supervised the tests. In his witness statement (CX 716), Mr. Nathanson referred to the Mitsubishi Model No. 4851 and to the measurement of penetration as .0051. There is no explanation why the additional penetration measurements in the laboratory notebooks were not in the witness statement, but since they were not, they were not subject to cross-examination, and thus are raw data and less reliable. In any event, the penetration referred to in the notebooks is substantially less than measured in the Tandon Model 100-2A, which exemplifies the patent claims.

^{14/} The IBM patent which embodies the technology of the IBM 43 FD does not refer to penetration and speaks of the symmetrical relationship of the heads to the disk. FF 110B.

Mitsubishi drives varies substantially depending upon the brand of disk used. FF 222. These facts tend to show that the penetration of the lower head in the Mitsubishi devices is not sufficient to establish a physical reference for the disk.

There is not sufficient proof that in the Mitsubishi drives the small scale variations are dealt with by penetration of the lower head sufficient to press out the small scale variations. On the contrary, the Mitsubishi drives deal with the small scale variations in the disk by permitting both heads to pitch, roll, and move to accommodate these variations. FF 226-27. Upon loading of the heads, only the small scale movements are left, to which the Mitsubishi heads react like the heads in the old IBM drive. Lewis, Tr. 2891-92, 2907-08. Thus, the lower heads in the Mitsubishi drives do not function as a "fixed positional reference" pressing out the small scale disk variations.

Therefore, the Mitsubishi drives do not infringe the claims of the '573 patent under the doctrine of equivalents because data transfer is achieved in a different way than in the Tandon system.

For the reasons stated above, the accused Mitsubishi floppy disk drives do not infringe any of the claims of the '573 patent.

III. IMPORTATION AND SALE

To invoke the subject matter jurisdiction of the Commission and to support a finding that a violation of § 337 exists, complainant must establish that the accused product has been imported and/or sold in the United States.

MELCO is a Japanese corporation which manufactures and sells double-sided floppy disk drives in the United States through its U.S. subsidiary, MELA. FF 268-69. MELCO manufactures and sells into the United States 3-1/2 inch and 5-1/4 inch double-sided floppy disk drives alleged to infringe the '573 patent. FF 273-75. MELA performs quality assurance, service and repair functions, and application engineering support in the United States on disk drives which it distributes. FF 280-84. From October 1982 to September 1983, C* the Mitsubishi respondents shipped double-sided disk drives to the C United States, of which about percent were 5-1/4 inch disk drives. About of these disk drives were 8 inch drives which do not infringe the '573 patent. FF 270. From October 1983 to September 1984, the Mitsubishi C respondents shipped double-sided floppy disk drives to the United C States. Of this total, about were double-sided 3-1/2 inch disk drives, C about were 5-1/4 inch disk drives, and about were 8 inch disk drives. FF 271. From October 1984 to December 1984, the Mitsubishi C respondents shipped double-sided floppy disk drives to the United C States. Of this total, about were double-sided 3-1/2 inch disk C drives, were 5-1/4 inch disk drives, and were 8 inch disk drives. FF 272. The 8 inch drives shipped to the United States from October 1983 to December 1984 do not infringe the '573 patent. FF 272.

*C = Confidential

The evidence of record establishes that Mitsubishi respondents have imported into or sold in the United States double-sided floppy disk drives.

On July 24, 1985, the Mitsubishi respondents identified for the first time the following floppy disk drives: (1) 5-1/4 inch half-height models--MF 501, MF 503, MF 504, MF 505, MF 501A, MF 503A, MF 504A, MF 505A; (2) 3-1/2 inch half-height models--MF 353A, MF 354A, MF 355A; and (3) 3-1/2 inch 41mm height model--MF 353. Mitsubishi, Supplemental Answers to Tandon's First Set of Interrogatories, No. 1. Three of these models were produced to Tandon on July 30, 1985. Tandon, PEO Reply Brief at 28. An additional three floppy disk drive models, MX 1, MF 354, and MF 355, were identified by respondents at the deposition of Mr. Foster on August 6, 1985. Foster Dep., CX 573, at 52-54, 109-10. The late date on which respondents identified these disk drives, together with the complexity of the subject matter involved, precluded complainant from conducting adequate discovery relative to whether these models are infringing. To include these models in this investigation would unduly prejudice complainant's interests. For this reason, the above 14 floppy disk drive models should not be considered by the Commission in its determination of whether or not there exists a violation of § 337 with regard to the subject matter of this investigation.

IV. DOMESTIC INDUSTRY

The Commission has customarily defined the domestic industry in patent-based investigations as the domestic operations of the patent owner and its licensees devoted to the exploitation of the patent. Certain Methods for Extruding Plastic Tubing, Inv. No. 337-TA-110, 218 U.S.P.Q. 348 (1982); Certain Slide Fastener Stringers and Machines and Components Thereof, Inv. No. 337-TA-85, 216 U.S.P.Q. 907 (1981); see H.R. Rep. No. 93-571, 93 Cong., 1st Sess. 78 (1973). The domestic industry is not limited to manufacturing per se but may encompass distribution, research and development, and sales. Certain Personal Computers, Inv. No. 337-TA-140, 224 U.S.P.Q. 270 (1984); Plastic Tubing, supra. The Commission does not adhere to any rigid formula in determining the scope of the domestic industry as it is not precisely defined in the statute, but will examine each case in light of the realities of the marketplace. Slide Fastener Stringers, supra; Certain Apparatus for the Continuous Production of Copper Rod, Inv. No. 337-TA-52, 206 U.S.P.Q. 138 (1979).

A. Domestic Industry Definition: Double-Sided Floppy Disk Drives

Tandon was incorporated in California in February 1976. FF 366. Tandon developed and filed a patent application for its double-sided head assembly in 1977. FF 368. During its first year of operations, Tandon established itself as a leading manufacturer of flexible disk drive recording heads (including its patented double-sided head) and captured approximately 80 percent of the total floppy disk drive market for head assemblies. FF 367. Tandon in 1979

introduced its 5-1/4 inch double-sided floppy disk drive product line, and by 1982 had become the largest independent manufacturer of floppy disk drives sold to OEMs. FF 396. For fiscal year 1984, complainant's net sales of head assemblies totaled units; its net sales of disk drives totaled units. FF 371.

Respondents assert that the domestic industry in a patent-based investigation is limited to the article covered by the claims of the patent. Respondents conclude that the claims of the '573 patent are limited to head assemblies, do not include floppy disk drives, and that the domestic industry should be strictly defined by the domestic activities of the patentee and its licensees devoted to the production and sale of head assemblies. Mitsubishi PEO Brief, at 44-46 (Sept. 16, 1985).

Complainant asserts that the specifications and claims of of the '573 patent are directed to a double-sided floppy disk drive or magnetic recording system. Tandon-TEO Brief, at 31-33, 46-48 (Apr. 29, 1985); Tandon PEO Brief, at 49-51 (Sept. 16, 1985). Based on this premise, complainant concludes that Tandon and its licensees constitute a domestic industry. Tandon PEO Brief, at 32-46; Tandon PEO Reply Brief, at 2-4 (Sept 23, 1985).

The Commission investigative attorney, while taking the position that the invention disclosed by the '573 patent is a transducer or magnetic head assembly, agrees with the administrative law judge's earlier determination that the precise coverage of the patent is not a controlling factor in this case. Staff PEO Brief, at 11 (Sept. 17, 1985). The staff attorney supports the administrative law judge's decision that the domestic industry is defined by the domestic activities of complainant and its licensees devoted to

manufacture, distribution, research and development, and sale of double-sided floppy disk drives covered by the claims of the '573 patent. Staff PEO Brief, at 17-18 (Sept. 17, 1985).

The claims of the '573 patent are directed to head assemblies. Opn., at 13-46. The administrative law judge in his initial determination concerning the question of temporary relief, however, found that the domestic industry in this investigation incorporated the domestic activities of the patentee and its licensees devoted to the manufacture, distribution, research and development, and sale of double-sided floppy disk drives. TEO Initial Determination, Inv. No. 337-TA-215, at 53. The current arguments of the Mitsubishi respondents on this point are similar to those raised by respondents at the early stages of this proceeding, and fail to persuade the administrative law judge to alter his original conclusion.

Respondents rely on the Court of Appeals decision in Schaper Manufacturing Co. v. U.S. Int'l Trade Comm'n, 219 U.S.P.Q. 665 (Fed. Cir. 1983), and the cases cited therein, to assert that "the relevant domestic 'industry' [in a § 337 investigation] extends only to articles which come within the claims of the patent relied on." See 219 U.S.P.Q. at 667. The Commission's decisions in Certain Apparatus for Production of Copper Rod, 206 U.S.P.Q. 138 (1979), and Certain Slide Fastener Stringers and Machines, 216 U.S.P.Q. 907 (1981), hold that the Commission is not bound by any rigid formula in defining a domestic industry, but will evaluate each case in light of the realities of the marketplace. 206 U.S.P.Q. at 161; 216 U.S.P.Q. at 916. An in depth analysis of Schaper demonstrates that the court's decision is consistent with Copper Rod and Slide Fastener Stringers and does not create, as suggested by respondents, a rigid industry formula for patent-based investigations.

Schaper Manufacturing Co. was engaged in developing, manufacturing, and marketing of toy products. Complainant had been granted an exclusive license to manufacture, use, and sell toy vehicles under U.S. Letters Patent No. 4,306,375. Complainant arranged for the manufacture of these vehicles in Hong Kong. 219 U.S.P.Q. at 666-67. The court agreed with the Commission's decision that a portion of complainant's business activities relating to production of accessories for the toy vehicles, all of which occurred in the United States, could not be considered part of any domestic toy vehicle industry as that term is defined under § 337. The court held that it was a well-settled, longstanding rule that, "[i]n cases under §337 involving United States article patents, the relevant domestic 'industry' extends only to articles which come within the claims of the patent relied on." 219 U.S.P.Q. at 667. The court then applied the facts of the case to this rule:

Appellants' complaint alleged infringement of the '375 patent, which covers only the Stomper toy vehicles. The fact that the existence of the accessories derives from the toy vehicles does not make their domestic production by Schaper . . . a part of a toy vehicles industry in this action under section 337. The accessories are not a necessary part of the vehicles, nor are they integral to them. Most of the appellants' vehicles are sold without the accessories; the latter do not come within the claims of the '375 patent; nor do they have the claimed product configuration of the Stomper toy vehicle. The Commission could rightly conclude from these facts that "the Stomper accessories cannot be part of any domestic industry in this investigation." (Footnotes deleted.)

219 U.S.P.Q. at 667-68.

The court in Schaper did not rely simply upon an industry definition derived from the claims of the '375 patent to hold that complainant did not constitute an industry in the United States within the meaning of § 337. It found that it was the nature and extent of complainant's domestic activities in the United States that were insufficient to constitute a domestic

industry. 219 U.S.P.Q. at 669; see Certain Portable Electronic Calculators, 337-TA-198, at 91-95 (1985). While the court agreed with the Commission's decisions in Certain Airtight Cast Iron Stoves, 215 U.S.P.Q. 963 (1981), and Certain Airless Paint Spray Pumps, 216 U.S.P.Q. 465 (1981), that the servicing and installation activities of a complainant within the United States may meet the domestic industry requirement under § 337, it distinguished these cases in Schaper because the Commission did not err in its finding that "Schaper's activities in the United States are too minimal to be considered an 'industry' under section 337." (Emphasis added.) 219 U.S.P.Q. at 669. Consistent with the Commission's decision in Copper Rod and Slide Fastener Stringers, the court recognized that the domestic industry in patent-based investigations may encompass a broader definition than the article covered by the claims of a patent.

Respondents assert that the "market realities exception" has been invoked in cases involving patented, manufactured articles only when the patented product is not an article of commerce. Mitsubishi PEO Brief, at 45. Respondents, however, fail to recognize that the market realities test is not an isolated exception to the definition of a domestic industry, but is taken into account in each § 337 investigation.

A head assembly can be sold as a separate article of commerce. Tandon was originally established as a manufacturer of flexible disk drive recording heads and did not introduce its 5-1/4 inch double-sided floppy disk drive product line until 1979. FF 365-66, 396. A small portion of Tandon's sales in fiscal year 1984 involves the sale of recording heads directly to customers. FF 371. At the same time, the head assembly is a necessary and

integral part of the floppy disk drive. A floppy disk drive functions to store and transfer data, and it is the heads within the head assembly that perform the read/write function. 15/

The Commission in Certain Personal Computers and Components Thereof, USITC Pub. No. 1504, 224 U.S.P.Q. 270 (1984), held that if the intellectual property right involved in the investigation is an essential component of an article, the industry should be defined in terms of the complete article and not just the intellectual property right. USITC Pub. No. 1504, at 41. The Commission found that one copyright at issue, a computer program known as the Autostart ROM, was used every time the personal computer was used. The Commission did not make similar findings with respect to the other intellectual property rights at issue. The Commission also made no finding whether the copyrighted software or the patented technology were articles of commerce separate from the personal computer, but held that the actual article of commerce involved in the investigation was the complete personal computer and defined the domestic industry as those portions of complainant's activities devoted to certain personal computers. USITC Pub. No. 1504, at 41-42.

15/ Complainant conducted a value-added analysis for double-sided head assemblies used in the TM 65, TM 100, TM 101, and TM 848 disk drives. Based on this analysis, value-added ranged from percent for TM 65 head assemblies to percent for TM 101 head assemblies in April-June 1985. Most of the domestic value-added came from domestic material costs. FF 395A-95F. Because double-sided disk drives, rather than double-sided head assemblies, properly define the industry, it is not necessary to analyze the head assembly value-added analysis.

Respondents assert that the Commission's decision in Certain Modular Structural Systems, Inv. No. 337-TA-164, USITC Pub. 1668 (1984), considers Personal Computers as a mere exception and that the definition of a domestic industry is limited to complainant's intellectual property right. Mitsubishi TEO Reply Brief, at 14 n. 14 (May 3, 1985). This view is incorrect.

After determining that the investigation in the matter of Modular Structural Systems should be terminated for mootness, the Commission reiterated its longstanding practice of defining the domestic industry by the exploitation of the intellectual property right at issue. USITC Pub. 1668, at 8, 12. The Commission underscored that a domestic industry was not to be defined according to a rigid formula; "In certain circumstances, the realities of the marketplace require a modification of that principle." USITC Pub. 1668, at 12. The Commission gave as an example an instance in which a patented article is not itself the actual article of commerce, but is physically incorporated in an article of commerce, and cited Personal Computers as an authority from which such a proposition might follow. USITC Pub. 1668, at 12 n. 40. The Commission held that the industry in the investigation should be defined in terms of the patented article, FSD's # 600 connector, because the record clearly showed that the connector was not only a separate article of commerce, but the actual article of commerce at issue. USITC Pub. 1668, at 9-12, 12-15. Thus, Personal Computers cannot be read simply as a unique exception or as an aberration.

The patented article in this investigation may be in and of itself an article of commerce, but unlike the articles at issue in Modular Structural Systems, head assemblies are not the actual articles of commerce at issue when

viewed according to the competitive realities of the marketplace. In Modular Structural Systems, respondents exported connectors to the United States. Complainant also typically sold connectors. USITC Pub. 1668, at 8-11. The Commission thus determined that the industry should be defined in terms of the patented connector, rather than the complete modular structural system.

In this case, the actual article involved in competition is double-sided floppy disk drives. It is the importation and sale of respondent's double-sided floppy disk drives, rather than head assemblies, that compete directly with the domestic activities of the patentee and its licensees. FF 256-57, 268-69, 285. Complainant's net sales of disk drives for fiscal year 1984 totaled units, while its net sales of head assemblies equaled only a small fraction of its sales of drives, or units. FF 371. Finally, the head assembly is the most significant part of a floppy disk drive. It insures intimate and stable head to disk contact necessary for accurate data transfer, and without it, this critical function could not be performed.

Based upon the foregoing discussion, the domestic industry in this investigation is defined by the domestic activities of the patentee and its licensees devoted to the manufacture, distribution, research and development, and sale of double-sided floppy disk drives.

B. The Adversely Affected Domestic Operations

Tandon currently manufactures the following patented double-sided floppy disk drives: (1) the TM 100, a 5-1/4 inch full-height floppy disk drive; (2) the TM 65, a direct drive 5-1/4 inch half-height floppy disk drive; (3) the TM 848, a direct drive 8 inch half-height floppy disk drive; (4) the TM 50, a belt-driven 5-1/4 inch half-height floppy disk drive; and (5) the TM 101, a modification of the TM 100. FF 398. Tandon is currently utilizing its patented technology to develop a half-height, 3-1/2 inch double-sided floppy disk drive. FF 475-90. Tandon has produced evaluation units of this drive for sale to potential customers. FF 481, 487A, 488C.

The patented double-sided floppy disk drives manufactured by Tandon licensees at the time the complaint was filed in this investigation include: (1) Texas Peripherals TM 65-2, a direct drive 5-1/4 inch half-height floppy disk drive; (2) Control Data Model No. 9409 and No. 9409-T, 5-1/4 inch full-height floppy disk drives; (3) Control Data Model No. 9428 and No. 9429, 5-1/4 inch half-height floppy disk drives; (4) Shugart Model No. SA-850, an 8 inch floppy disk drive; (5) Shugart Model No. SA-450, a 5-1/4 inch floppy disk drive; and (6) Shugart Model SA-350, a 3-1/2 inch floppy disk drive. See FF 345A, 505-06, 513A. Complainant asserts that all of the double-sided floppy disk drives of Tandon and its licensees which incorporate the claims of the '573 patent comprise the domestic industry in this investigation.

Though a complainant may incorporate the patented technology in a number of products, all of the products may not necessarily be included in the domestic industry for purposes of § 337. The industry consists of those domestic operations which are adversely affected by the alleged unfair methods

of competition or unfair acts. Certain Heavy-Duty Staple Gun Tackers, Inv. No. 337-TA-137, Initial Determination, at 66-68 (1983), adopted by Commission, 49 Fed. Reg. 668 (Jan. 5, 1984); Certain Drill Point Screws for Drywall Construction, Inv. No. 337-TA-116, USITC Pub. 1365, at 11-15 (1983); Certain Headboxes and Papermaking Machine, Inv. No. 337-TA-82, USITC Pub. 1138, at 27-29 (1981).

All floppy disk drives perform essentially the same storage and retrieval functions; therefore, from both a technical and a broad economic perspective, all floppy disk drives are potential substitutes for one another. FF 543. The economic concept of floppy disk drive substitutes incorporates, but at the same time goes beyond, technical possibilities of substitution. Not only must it be technically possible to substitute one floppy disk drive product for another, but the marketplace must perceive the products as substitutes. FF 544. Competition for the principal floppy disk drive configurations has come from newer floppy disk drives offering increased capacity, smaller size, and/or lower price. FF 545.

In 1976, the state of the art for floppy disk drives was the 8 inch drive. FF 548. Sales of 8 inch double-sided disk drives in the United States continued to outnumber sales of 5-1/4 inch double-sided disk drives both in 1980 and 1981. FF 552. In 1982, a customer asked Tandon for a quote on both the 5-1/4 inch and 8 inch disk drives. Tandon has received a number of similar requests for quotes since that time. FF 553. Tandon currently offers its full repertoire of disk drives, including the 8 inch drive, to customers who are designing new computer systems, but there is no evidence of any new computer systems that use the 8 inch disk drive. FF 554-59.

The market for 8 inch disk drives is flat, but replacement sales opportunities exist for customers who still use an 8 inch disk drive in their system. FF 555. Tandon estimates the 8 inch disk drive market at several hundred thousand drives per year, and expects to compete with Mitsubishi and one or two other Japanese companies for this business. FF 554. Over the long term, however, the 8 inch disk drive is not expected to be an important factor in the marketplace. FF 555-56. The decline in the 8 inch drive market is attributed to a general industry trend toward the use of smaller, less expensive components, the use by IBM and Apple of 5-1/4 inch and 3-1/2 inch formats, and the wealth of software available for the 5-1/4 inch disk drives. FF 555-57.

A prototype of the 5-1/4 inch disk drive was unofficially shown by Shugart to certain companies in about April 1976. Shugart later introduced the 5-1/4 inch drive at a trade show in May 1976. FF 305. At first, sales of the 5-1/4 inch single-sided floppy disk drive were slow due to an industry reaction of disbelief because IBM was using 8 inch drives and the product was not IBM-compatible. FF 307. The initial market expansion for 5-1/4 inch disk drives was also hindered by a software shortage. FF 561. The 5-1/4 inch floppy disk drive began to sell in 1977-1978 with the growth of the personal computer market (FF 307) and became a critical factor in the marketplace in 1978-1979 when IBM began its initial use of the 5-1/4 inch drive (FF 560). The first year in which double-sided 5-1/4 inch floppy disk drives outsold double-sided 8 inch disk drives was 1982. FF 547. The 5-1/4 inch double-sided disk drive is expected to dominate the floppy disk drive market at least through 1987. FF 547.

The first 3-1/2 inch single-sided floppy disk drive (micro-floppy) was introduced in June 1981 at a computer trade show. FF 562. At first there was no standard size for the micro-floppy disk drive, and diameters for the product ranged from 3.4 inches to 3.9 inches. FF 565. An industry standards committee was formed in May 1982, and a standard micro-floppy disk size of 3-1/2 inches was agreed to approximately a year later. FF 566. The first U.S. shipment of micro-floppy disk drives took place in 1982 when 9,000 units were sold. In 1983, 269,000 units were sold. Estimated sales for 1984 are 1,064,000 units. FF 563. Most of these drives have been single-sided. FF 563. Shugart introduced a single-sided 3-1/2 inch disk drive in April 1983 and a double-sided 3-1/2 inch floppy disk drive in October 1983. FF 567. In 1983, Shugart sold evaluation units of the double-sided 3-1/2 inch disk drive to approximately 15 to 20 accounts. FF 568.

The most intense competition between different diameter disk drives occurs at the early design or product planning stage of the personal computer. FF 546. A "marketing window" is created as the OEM, in the process of designing a new computer system, considers vendors and evaluates and tests disk drives. FF 604.

In terms of media (disk) interchangeability, a 3-1/2 inch double-sided disk drive cannot be made compatible with a 5-1/4 inch double-sided disk drive. FF 573. The electrical interfacing between 3-1/2 inch and 5-1/4 inch disk drives is the same, however, for those devices quoted as being compatible. FF 576. Some Japanese 3-1/2 inch disk drive manufacturers advertise their product as being compatible with 5-1/4 inch disk drives. FF 577. Given the industry trend toward the use of smaller and less expensive

components, the possibility exists at the design stage for the substitution of 3-1/2 inch double-sided disk drives for 5-1/4 inch disk drives. With respect to new computer systems, Compaq has switched its computer from a 5-1/4 inch drive to a 3-1/2 inch drive, and IBM may have a 3-1/2 inch drive in its new generation PC. FF 596A.

The effect of IBM not having introduced a 3-1/2 inch disk drive computer in the United States up to this time, has been to limit the market for this drive, especially among the OEMs considered to be "IBM followers."

FF 599-600. In addition, software availability has limited the market for 3-1/2 inch computers and disk drives; there are currently 170-175 software programs available on 3-1/2 inch diskettes compared to approximately 10,000 software programs available on 5-1/4 inch diskettes. FF 597. If IBM enters the United States market with a computer using 3-1/2 inch drives, and recent events indicate that IBM may be preparing to do so, it is likely that other OEM's would follow with similar computers systems. FF 600; CX 877. Thus, the future market for 3-1/2 inch disk drives, and their viability as a substitute at the design stage for 5-1/4 inch disk drives, is largely dependent on IBM's decision with respect to the introduction of a 3-1/2 inch disk drive computer and the speed at which IBM and the industry develop 3-1/2 inch software. See CX 877.

Once the design stage of the computer is completed, competition tends to be limited to disk drives having the same diameters and dimensions. FF 546. The most critical factors affecting the compatibility of technically different floppy disk drives include: (1) media interchangeability; (2) physical interchangeability; (3) use of the same set of signals; and (4) use of the same set of connectors with the same output. FF 570-71. Less critical

factors of compatibility include interchangeability of spare parts, timing of input signals, and power usage differentials. FF 570.

For example, with regard to media interchangeability, a 5-1/4 inch floppy disk cannot be placed in an 8 inch disk drive (FF 572); a 3-1/2 inch double-sided floppy disk drive cannot be made compatible with a 5-1/4 inch double-sided disk drive (FF 573). If data stored on a 5-1/4 inch drive is to be transferred to a 3-1/2 inch drive, the data would have to be regenerated, a laborious process. FF 575. The change from a 5-1/4 inch drive to a 3-1/2 inch drive in an existing system would also be difficult because it would involve substantial design changes, including size, wiring, and plugs. FF 587. Therefore, to switch an existing computer system from the incumbent floppy disk drive supplier to a new supplier, or from one disk drive diameter to another diameter, may involve substantial costs.

Some Japanese 3-1/2 inch floppy disk drive manufacturers, however, advertise their product as being compatible with 5-1/4 inch drives. FF 577. Also, an OEM could potentially substitute a 3-1/2 inch drive in the space formerly occupied by a 5-1/4 inch drive the same way some OEMs replaced full-height 5-1/4 inch drives with half-height 5-1/4 inch drives (i.e., by keeping the larger bezel). FF 583. The probability of substituting 3-1/2 inch drives for 5-1/4 inch drives in an existing product is less than the substitution of half-height for full-height drives because the 3-1/2 inch drive differs from the 5-1/4 inch drive in its basic physical configuration. Still, if the 3-1/2 inch disk drive is priced lower than the 5-1/4 inch disk drive, substitution may be made. FF 584; see FF 589A.. The computer systems sold by OEMs are evolving rapidly. To remain competitive, an OEM producer

must bring into the market a new system with the latest advances as soon as possible or risk falling behind. FF 610. If the market moves toward a smaller 3-1/2 disk drive computer as a result of IBM's future introduction of a 3-1/2 inch computer, the cost of not introducing a 3-1/2 inch disk drive computer in terms of lost market share may outweigh any conversion costs.

Another industry trend is the move from full-height to half-height disk drives. In the spring 1982 NCC show, only Shugart showed a half-height product; however, in the fall 1982 Comdex show, half-height disk drives were displayed by Tandon, Shugart, and CDC, as well as by 12 to 15 Japanese suppliers. FF 591-92. In many cases, customers switched from full-height disk drives to half-height drives while keeping the full-height bezel because of lower price associated with the half-height drive. FF 589-89A. The half-height disk drive allowed miniaturization and took advantage of the availability of 5-1/4 inch software. FF 595. In January 1983, IBM discontinued its purchase of full-height disk drives from Tandon, but agreed to purchase newer products such as fast-access Winchester disk drives and half-height 5-1/4 inch flexible disk drives. FF 593. Contra FF 693A. There exists a wide and broad-based industry trend toward higher capacity, half-height 5-1/4 inch flexible disk drives. FF 594.

All floppy disk drives are technical substitutes in the sense that they perform the same function. The degree of economic substitutability between disk drives of different sizes, or from different suppliers, differs depending on factors such as the planning stage of the computer's development and the relative costs to switch. The costs of switching from an incumbent supplier and/or a particular disk drive size are clearly greater once the OEM is past

the initial planning stage. The costs of not switching may include an inability to take advantage of the lower price of a substitute disk drive or the loss of market share if a substitute disk drive is widely accepted in the market.

The degree of substitutability between the different size disk drives is relatively high at the design stage for a new computer. This conclusion is qualified, however, by the fact that the market has effectively determined that the 8 inch floppy disk drive is a relic (i.e., since 1982, no new computer system has been designed with an 8 inch drive) and many large OEMs have already passed the design stage for 5-1/4 inch floppy disk drive computers and selected vendors for their products. See FF 640K-40L. The degree of substitutability between different size disk drives after the computer design stage is relatively limited. Clearly an 8 inch drive cannot be substituted for drives in a system designed for 5-1/4 inch or 3-1/2 inch drives. There is constant competitive pressure on OEMs to upgrade their systems, and to reevaluate the use of smaller diameter disk drives and different suppliers, thereby creating only limited substitution in the post-design stage period. Evidence of this is especially evident in the pressure to switch from full-height to half-height disk drives and in the uncertainty involved in the future market for 3-1/2 inch floppy disk drive computers.

Respondents import into or sell in the United States 5-1/4 inch and 3-1/2 inch floppy disk drive products that directly compete with specific disk drives of complainant and its licensees. Tandon's TM 848 is also in competition with Mitsubishi (and one or two other Japanese companies) for Shugart's 8 inch disk drive accounts. FF 554. The 8 inch drives shipped by the Mitsubishi respondents to the United States from October

1982 to December 1984, however, do not infringe the '573 patent. FF 270, 272. Also, no OEM has designed a new computer system utilizing an 8 inch drive since 1982. While there is a degree of substitutability between the 8 inch and smaller drives, the 8 inch drive only competes against similar sized drives as possible replacements in older systems for existing 8 inch drives, and affords no real market competition to 5-1/4 inch and 3-1/2 inch double-sided floppy disk drive products. See Headboxes and Papermaking Machine, supra.

In conclusion, the domestic industry in this investigation is restricted to the 5-1/4 inch and 3-1/2 inch double-sided floppy disk drives of Tandon and its domestic licensees which incorporate the claims of the '573 patent.

C. Complainant and Its Licensees

The proper date for determining whether the domestic activities of complainant constitute an industry entitled to protection under § 337 is the date on which the complaint is filed. Bally/Midway Mfg. Co. v. U.S. Int'l Trade Comm'n, 219 U.S.P.Q. 97, 100 (Fed. Cir. 1983). Tandon filed the complaint in this matter on December 6, 1984. 50 Fed. Reg. 4276 (Jan. 30, 1985). Therefore, the domestic industry will be defined as of that date. Deterioration of the domestic industry during Commission proceedings does not undermine the conclusion that the business constituted an industry at the time the complaint was filed. Bally/Midway, 219 U.S.P.Q. at 101-02.

1. Tandon.

a. Offshore operations.

Since its formation, Tandon has contracted with offshore manufacturing facilities in India for high volume production of labor intensive components and various completed products. FF 372, 456. The companies located in India include Tandon Magnetics (India) Pvt., Ltd. (TMI), which assembles recording heads and certain labor intensive disk drive sub-assemblies; Tandon Motors Pvt., Ltd. (TMM), which manufactures precision stepper motors used in Tandon's flexible and rigid disk drives; Barnala Electronics, which manufactures harness assemblies for use in Tandon's disk drives; Tancom Electronics, which manufactures rigid disk drive record heads; and Eastern Peripherals Pvt., Ltd., which manufactures completed half-height 48 TPI 5-1/4 inch floppy disk drives. FF 457. Tandon arranged for the assembly of TM 50, TM 65, and TM 100 overseas only after initial production problems were identified and design changes made in response thereto. Tandon has provided to the overseas operations the drawings, specifications, manufacturing assembly instructions, test equipment, test procedures, and related documentation from which the drives could be assembled and tested. FF 457A.

The manufacture of head assemblies was the first component moved overseas by complainant because of the relatively large amount of labor involved in the manufacture of this component. FF 374. Tandon first contracted with TMI in June 1978 for the assembly and testing of certain ferrite recording head and disk drive products. FF 375. On December 1, 1980, Tandon and TMI entered into a contract in which conditions were established to govern TMI's assembly and testing in Bombay, India, of these products. The contract is due to expire on December 1, 1985. FF 376, 458.

The specific services to be performed by TMI, and the dates of the performance, is to be determined according to the purchase orders issued by Tandon during the contractual period. Each purchase order specifies the dates upon which the assembly is to be completed and shipped to Tandon and the price. FF 377. For each purchase order issued, Tandon pays TMI a fee calculated by Tandon according to the quantity of units purchased, Tandon's determination of the amount of labor required to perform the service, a joint determination of the hourly labor rate, and a joint determination of operating expenses other than labor costs. FF 378. Tandon provides TMI with all equipment, material, and know-how; TMI provides reasonably sufficient structural facilities and a skilled labor force. FF 380. All property, materials, know-how, and other proprietary rights furnished to TMI by Tandon remain the property of Tandon. FF 381. Tandon pays all costs of shipment from TMI and all duties. FF 382.

The transactions between Tandon and the companies located in India are coordinated and effected through Tandon Associates, Inc., which acts on behalf of the various Indian companies. Tandon Associates invoices Tandon for the products and services performed by these companies at prices reflecting a mark-up for its services. FF 460. Tandon Associates is a separate company from complainant. FF 387.

Tandon Singapore Ltd., a wholly-owned subsidiary of Tandon located in Singapore, manufactures the TM 100, the TM 101, and certain Winchester disk drives. FF 465. In April 1985, Tandon Singapore produced approximately 150,000 units of the TM 100 a month. FF 467. Approximately 149,000 of the TM 100s were double-sided floppy disk drives, of which units were shipped

to Tandon's facility at Chatsworth, California. FF 467, 469. Approximately 129,000 of the TM 100s were quality-tested in Singapore, then drop-shipped directly to IBM. FF 470.

Head assemblies for the following Tandon double-sided floppy disk drives are assembled offshore and subject to quality control in India: TM 50, TM 65-2, TM 65-4, TM 100-2, TM 100-4, TM 101-4, and TM 848. FF 385-86. Tandon does not currently manufacture commercial quantities of head assemblies in the United States. FF 389. Any production of head assemblies in the United States by Tandon is limited to engineering and development programs and small initial production runs of less than 100 units. FF 390.

Tandon's offshore and domestic manufacture of floppy disk drives by model number as of fiscal year 1984 (October 1, 1983, through September 30, 1984) was as follows:

	<u>Model</u>	<u>Offshore Units</u>	<u>Domestic Units</u>	<u>Total</u>
C	TM 50			
C	TM 55/55D			
C	TM 65			
C	TM 100			
C	TM 101			
C	TM 848			

The above figures reflect production of both single-sided and double-sided floppy disk drives. FF 401. In fiscal year 1984, however, approximately 95 percent of Tandon's total floppy disk drive business involved double-sided drives (FF 399).

For the period July 1984 to June 1985, Tandon's manufacture of double-sided floppy disk drives was as follows:

	<u>Model</u>	<u>Offshore Units</u>	<u>Domestic Units</u>	<u>Total</u>
C	TM 65			
C	TM 100			
C	TM 101			

FF 402A. The TM 50 is not included in this list because it was determined that during this period it was predominantly a single-sided product. FF 411; Mitchell, Tr. 3254. The TM 55/55D is a double-sided product, but production of this product had virtually ceased prior to December 6, 1984. Huenemeier, Dep., MRPX 52, at 62. The TM 848 is an 8 inch drive and thus not considered part of the domestic industry in this investigation. Opn. at 64-65. Therefore, those domestic activities of complainant dedicated to the production of the TM 50, TM 55/55D, or TM 848 will not be considered part of the domestic industry as defined in this investigation.

b. TM 65, TM 100, TM 101.

The existence of a domestic industry must be determined according to an assessment of the nature and significance of the activities carried out in the United States in connection with the product. Certain Miniature, Battery-Operated, All-Terrain Wheeled Vehicles, Inv. No. 337-TA-122 (1982), aff'd sub nom. Schaper, 219 U.S.P.Q. 665. One method to assess the nature and significance of domestic activities is to determine the value added to the product by domestic activities as a percentage of the product's total value.

Certain Cube Puzzles, Inv. No. 337-TA-112, 219 U.S.P.Q. 322, 334-35 (1982).

This type of evaluation is important because it helps to determine whether complainant's domestic activities differ in kind from the activities that would normally be performed by an importer. Schaper, 219 U.S.P.Q. at 669.

A three-part value-added analysis for TM 65-2L, TM 100, and TM 101 floppy disk drives produced by Tandon follows. The first analysis is based on quarterly data for the period from July 1984 to June 1985. FF 404A-04C.

	<u>Time Period</u>	<u>U.S. Mfg. and Domestic Content</u>	<u>Total Cost</u>
C	4Q 1984	\$	\$
C	1Q 1985		
C	2Q 1985		
C	3Q 1985		

FF 404D-04E.

The second analysis estimates the percentage of total product cost for the TM 65-2L, TM 100, and TM 101 attributable to domestic manufacturing and materials content:

	<u>July-Sept 1984</u>	<u>Oct-Dec 1984</u>	<u>Jan-March 1985</u>	<u>April-June 1985</u>
C	TM 65 :	8	8	8
C	TM 100:			
C	TM 101:			

FF 404JJ.

The final analysis estimates the unit costs of production for the TM 65-2L, TM 100, and TM 101 for April-June 1985 and represents current activity and costs:

	TM 65		TM 100		TM 101	
	<u>\$/unit</u>	<u>percent</u>	<u>\$/unit</u>	<u>percent</u>	<u>\$/unit</u>	<u>percent</u>
C <u>U.S. Mfg Cost</u> :						
C Engineering						
C Technical Support						
C Operational G&A						
C Labor						
C Material Support						
C Labor Support						
C TOTAL						
C <u>Material Cost</u> :						
C Foreign						
C Domestic						
C TOTAL						
C <u>U.S. Non-Mfg</u> :						
C Marketing						
C Mkting-Related G&A						
C TOTAL						
C <u>Foreign assembly:</u>						
C <u>Other</u> :						
C Freight						
C Customs						
C Material Variance						
C TOTAL						
C <u>TOTAL COST</u> :						

FF 404KK; see FF 404F-04II.

The Commission has never determined the exact percentage of domestic value-added required to constitute a domestic industry under § 337. E.g., Certain Cube Puzzles, Inv. No. 337-TA-112, 219 U.S.P.Q. 322 (1982) (domestic industry based on 50 percent value added); Certain Papermaking Machine Forming

Sections, Inv. No. 337-TA-147 (1984) (domestic industry based on 30 percent value added). Because of the differing circumstances for each investigation, the Commission has also never precisely defined those industry components which constitute domestic value-added, but rather relies on an evaluation of the nature and extent of complainant's domestic activities in the United States (see Schaper, 219 U.S.P.Q. at 669) minus those activities normally performed by an importer, including customs and components of transportation, marketing, and general and administrative activities.

Complainant modified the value-added analysis it conducted at the temporary relief stage of this investigation by excluding costs associated with all marketing activities (except technical support) and general and administrative expenses related to marketing salaries and the credit department. Mitchell, CX 836, at 6. Complainant has thus defined domestic value-added in this investigation as the percentage of total cost derived from U.S. manufacturing costs and domestic material content.

The cost of U.S.-produced components (domestic material) purchased by Tandon should be included in the U.S. value added, especially since material costs constitute a large portion of the total cost of floppy disk drive production. FF 404AA. The inclusion of U.S.-produced components is also supported by the fact that when Tandon re-imports completed disk drives from India after assembly, the value of U.S. components in the drives qualifies for special tariff consideration. FF 404Y.

The largest single component of U.S. manufacturing costs is operational general and administrative expenses (G&A). Tandon considers less than one percent of G&A to be related to import activities and deducted this percentage

from overall G&A. FF 404I. Tandon Associates performs many of the administrative activities related to the importation of disk drives, and these costs are not included in the domestic value-added calculation. See FF 404J-04K. It would appear that a larger portion of Tandon's G&A expenses should have been allocated to import-related activities, however, given the importance of imported disk drives in Tandon's overall sales. Therefore, while there exist certain G&A expenses typically not performed by an importer and properly included in a domestic value-added analysis, there remain questions concerning Tandon's allocation methods for G&A. See, e.g., FF 404M.

The percentage of value-added calculated by Tandon varies quarter by quarter, unit by unit. The average percentage domestic value-added for the TM 65 floppy disk drive during the period July 1984 through June 1985 is C percent; for the TM 100, C percent; and for the TM 101, C percent. See FF 404JJ. If G&A expenses are excluded from the value-added, these C figures decline to C percent for the TM 65; C percent for the TM 100; C and C percent for the TM 101. The actual domestic value-added lies somewhere between these two calculations.

The Mitsubishi respondents argue that a substantial portion of Tandon's U.S. manufacturing costs consist of activities performed by a typical importer of head assemblies and disk drives; that is, an importer of floppy disk drives must perform quality control and assurance activities, maintain engineering facilities, and conduct service and repair activities. Respondents conclude that such activities, because they are also performed by an importer, do not support the existence of a domestic industry. Mitsubishi, PEO Brief, at 46-49.

Respondents' argument misreads Commission precedent. The fact that activities performed by complainant within the United States are also performed by respondent within the United States, does not require the Commission to disregard these activities when formulating its definition of a domestic industry. It is the nature and extent of complainant's activities in the United States that defines the relevant domestic industry (Opn. at 51-56). That is, an analysis of domestic value-added should not incorporate activities usually performed by an importer, and while the Commission may look to a respondent's activities to assist in its determination of whether an activity is one normally performed by an importer, the fact that respondent performs the activity does not ipso facto define it as usual import-related activity. To make such a finding, for example, would require the Commission to delete from its consideration of domestic industry all activities performed by complainant within the United States, even though complainant does not engage in offshore activities, simply because respondent also performs such activities within the United States.

The above analysis leaves serious questions as to whether the amount of domestic value added by Tandon to its floppy disk drives is sufficient to constitute a domestic industry. A value-added analysis, however, is recognized as "simply one factor in considering the nature and significance of a party's relevant activities in the United States. It is not necessarily dispositive [as to this issue]." Certain Fluidized Supporting Apparatus, Inv. No. 337-TA-182/188, at 15 (1984). The addition of the following factors to the value-added analysis demonstrates that the activities of Tandon in the United States are substantial enough to constitute a domestic industry in this investigation.

c. Domestic activities.

Tandon in fiscal year 1984 leased 515,000 square feet of building space for its principal executive offices and domestic manufacturing operations at Chatsworth, Simi Valley, Thousand Oaks, San Jose, and Santa Clara, California. FF 438. As of April 1985, the buildings leased by Tandon in the United States occupied square feet. FF 439. Tandon's facility at Simi Valley is not involved in the assembly of floppy disk drives, but its operations do include the assembly of printed circuit boards used in floppy disk drive production and its employees provide support production for Tandon models made offshore. FF 400E, 440. The Santa Clara facility also is not involved in the production of floppy disk drives, but its research and development may have assisted Microtek with regard to the 3-1/2 inch floppy disk drive product. FF 441-42. The Thousand Oaks facility houses the Voyager Division of Tandon which makes computer systems and subsystems. FF 443.

The Chatsworth facility occupies square feet of building space. Approximately individuals are employed by Tandon at Chatsworth in activities relating to the manufacture, marketing, administration, and research and development of floppy disk drives. FF 444-44A.

All research and development concerning Tandon floppy disk drives, with the exception of the 3-1/2 inch disk drive, is done in the United States at the Chatsworth facility. The research and development facility occupies square feet of building space and employs engineers, technicians, five document control individuals, and nine drafting individuals. FF 447. In

C fiscal year 1984, Tandon expended \$ on research and development, or
C approximately percent of the cost value for its floppy disk drives.
C Product research and development expenses increased by percent in fiscal
C year 1983 and percent in fiscal year 1984, while remaining essentially
constant as a portion of net sales. FF 448A; see FF 448. During the period
from January 1984 to present, the following double-sided head development
programs were conducted in Chatsworth: TM 35, TM 65-8, TM 75-2, TM 75-8,
TM 304, TM 306, TM 308, and TM 309. FF 425A.

The research and development associated with, and the engineering
prototype units and pilot production for, the TM 50, TM 65, TM 100, and
TM 101, had been conducted in the United States, but was completed prior to
December 1984. FF 449-51. Problems that may be associated with the
continuous production of floppy disk drives, however, require technical
evaluation by manufacturing engineers, or sustaining engineering. Virtually
all sustaining engineering activities are performed in the United States.
There are also ongoing efforts to improve the production process by both
enhancing the quality of the product and reducing costs. FF 428, 428B, 453.
C Approximately to individuals perform sustaining engineering activities
at Tandon. FF 428A.

For all head assemblies assembled in Chatsworth, or at one of Tandon's
offshore assembly plants, Tandon's Chatsworth facility performs a number of
engineering functions: The design of all double-sided head assemblies is
conducted in Chatsworth. The Drafting Department takes engineering sketches
and turns them into standard approved vellums. They also update all documents

as required through engineering change orders. Tandon's Chatsworth model shop fabricates initial prototypes and assist in fabrication of assembly tooling. FF 423A. Tandon's "advanced head production" section includes engineers who supervise initial production of new heads and head assemblies. Tandon currently has to people in this section, and in December 1984, Tandon had about to people in this section. FF 423B. The design of all tooling used to fabricate piece parts is conducted by Chatsworth engineering personnel. The design of all assembly tooling and the fabrication of such tooling is also conducted in Chatsworth. FF 423C. Finally, Manufacturing Engineering develops, debugs, and documents all manufacturing assembly instructions for use by assembly personnel. Engineering personnel located in Chatsworth approve all first article reports and any new vendors that may be developed during the life of the product. In the event that technical problems arise, these individuals are dispatched to offshore assembly plants to spearhead the corrective action process. FF 423D.

Tandon is currently developing the TM 300 series of 3-1/2 inch double-sided floppy disk drives (TM 304, TM 306, and TM 308) at its Microtek subsidiary located in San Jose, California. FF 475; see FF 475A. Microtek occupies square feet of manufacturing space, and is starting to occupy an additional square feet adjacent to its present facility, and employs approximately individuals in the design and development of the TM 300 series. FF 477-77A. Tandon has completed development of a one megabyte 3-1/2 inch micro-floppy disk drive, built engineering evaluation models of this drive, and proceeded into preproduction. Tandon has fully tooled the product and has produced preproduction models that it has evaluated and which

customers are evaluating. FF 488A; see FF 476. Microtek has sold evaluation units of the TM 304 and TM 306 to customers. FF 481, 487A.

Microtek has acquired tooling for the manufacture of the TM 300 series disk drive and intends to commence production at its San Jose facility as soon as an order for commercial production has been received. FF 477-78. To commence production, however, Microtek would have to order parts, hire and train workers in the assembly of the disk drive, and set up quality control procedures. FF 482-82A. It would take from 90 to 120 days for Microtek to achieve production of 10,000 units per month of the TM 300 series floppy disk drive. FF 483. The Microtek facility has the capacity to produce 20,000 to 30,000 drives per month. FF 485. Once Microtek achieved production of 10,000 units per month, its facilities would employ 100 to 250 workers, of which 50 percent would be involved in the direct production of the drive while the remaining individuals would be engineering and support personnel. FF 484. Microtek at this time has not received any production orders for 3-1/2 inch floppy disk drives and has no plans to manufacture these drives for inventory purposes (FF 486); however, if production orders are received, initial production of the drives would commence (FF 488-88D). Tandon incurred expenses of \$875,000 for fiscal years 1984 and 1985 with respect to Microtek's development of the 3-1/2 inch double-sided technology. FF 476A; see FF 480.

The Chatsworth facility as of December 6, 1984, has provided the following quality services for all head assemblies assembled in Chatsworth or at one of Tandon's offshore assembly plants: Quality engineers support the procurement cycle by assisting in vendor surveys. Chatsworth quality engineers also are responsible for developing detailed receiving inspection and in-process

inspection procedures. Quality engineers working with engineering representatives approve the disposition of all discrepant material and coordinate and approve vendor corrective action programs. Quality control personnel perform incoming inspections on 100 percent of the lots of material received as well as perform all first article inspections. FF 462A; see FF 462B.

Servicing and repair of Tandon's disk drives, with the exception of TM 100 disk drives under warranty, are performed at Chatsworth or elsewhere in the United States by subcontractors under Tandon's control. The service and repair for Tandon disk drives sold to which are out-of-warranty is handled in Chatsworth or elsewhere in the United States. In December 1984, Tandon's Chatsworth facility had a staff of approximately employees for service and repair. FF 471-71A.

Based upon the above evidence, the activities of Tandon in the United States dedicated to the manufacture, distribution, research and development, and sale of double-sided 5-1/4 inch and 3-1/2 inch floppy disk drives constitute part of the domestic industry in this investigation.

2. Texas Peripherals.

Texas Peripherals (TP) is a joint venture owned equally by Tandy Corporation and complainant. Tandon became a member of this joint venture in January 1984. FF 493. Tandon and Tandy each own equal interests in TP, and revenues and profits are divided equally between the two companies. FF 494. The initial cost to Tandon for joining the joint venture was the contribution

of Tandon's half-height flexible disk technology and a cash payment of \$1.9 million. FF 496. In fiscal year 1984, Tandon was allocated \$808,416 in profit from the TP venture. FF 494.

TP was formed for the purpose of manufacturing disk drives in the United States for sale either to Tandy or Tandon. FF 495. TP facilities consisted of approximately 87,000 square feet of manufacturing and commercial space. FF 497. As of December 1984, TP manufactured at its facilities in Fort Worth, Texas, the TM 100-1, a full-height single-sided floppy disk drive, the TM 65-1, a half-height 5-1/4 inch single-sided disk drive, and the TM 65-2, a half-height 5-1/4 inch double-sided disk drive. FF 503. TP purchases all of its head assemblies for the TM 65-2 from Tandon. FF 392.

On April 25, 1984, the projected production of TP floppy disk drives for October 1984 was 27,117; for November 1984, 43,450; and for December 1984, 39,430. Of those drives planned for production in October 1984, 1000 were to be half-height double-sided floppy disk drives; in November 1984, 32,350 were to be half-height double-sided floppy disk drives; and in December 1984, 28,230 were to be half-height double-sided floppy disk drives. TP forecasted continued growth of its floppy disk drive production such that by February-March-April 1985, TP planned to ship 68,652 drives a month, 50,052 of which would be half-height double-sided floppy disk drives. This projection was based upon the forecasted requirements of Tandy and Tandon. FF 764. In the spring of 1984, the joint venture committee authorized \$300,000 for tooling in which to set up TP. FF 766.

On May 15, 1984, TP delivered working samples of the TM 65-2 to various Tandy divisions, including Tandy Advanced Products, Tandy Home Computer, Tandy Computer Assy., Tandy Systems Design, and Computer Product Engineering. This

drive was assembled at TP from a kit supplied by Tandon and did not incorporate any components procured or tooled by TP. FF 767. On June 15, June 16, and July 15, 1984, TP scheduled the delivery of preproduction samples of the TM 65-2 to Tandy Home Computer, Tandy Computer Assy., Tandy Systems Design, and Tandy Advanced Products. Some of these preproduction samples were later delivered to the various Tandy divisions in late June, July, or August 1984. The preproduction samples were more representative of TP's production units and contained some degree of TP's configurations. FF 768.

TP's profit plan for fiscal 1985 indicated that production of the half-height 5-1/4 inch double-sided disk drive was scheduled to begin October 1984. By May 23, 1985, production of this floppy disk drive was expected to reach 30,000 units per month. This level of production was less than originally anticipated because Tandy had decided to continue to use the full-height product in its Model 4 computer instead of switching to a half-height product. FE 769.

As of September 1984, \$264,300 of the equipment budget had been committed to vendors to fabricate the tooling for the TM 65 product. TP planned to have its tooling in place by December 1984. The commitments to vendors for tooling were made in expectation of volume business for the TM 65 from Tandy. FF 770. As of September 19, 1984, TP's production line was capable of producing the quantities needed to achieve its financial objectives.

TP commenced production of the TM 65-2 in late 1984. FF 505. Most of the TM 65-2s were assembled from kits supplied by Tandon. FF 506. TP received a purchase order on October 9, 1984, from Tandy Home Computer for 6,000 TM 65-2

floppy disk drive. FF 508. The order was scheduled for delivery as follows: 1,000 by November 15, 1984; 2,000 by December 15, 1984; and 3,000 by January 15, 1985. FF 775. TP failed to meet its production schedule for this order: TP delivered the first 50 units for qualification testing in November 1984. FF 776. TP only delivered 50 of the 1000 floppy disk drives requested by Tandy Home Computers for November 1984 because of problems encountered with the drives. TP decided that it would be best to deliver just 50 units in order to identify problems, make modifications, and allow customer evaluation of the drives; TP could then correct these problems for future shipments. FF 777. TP's next delivery of 400 units did not take place until the first days of January 1985. TP hoped that the units would become qualified at that time and that it could pick up production quickly and complete the orders by February and March 1985. FF 776. To date, TP has shipped 450 double-sided floppy disk drives to Tandy. FF 509.

As of April 15, 1985, TP employed 350 persons. During April 1985, TP planned to lay off approximately 25 to 50 employees. In May 1985, TP planned to lay off an additional 75 to 100 employees. Those employees left at TP would continue to produce current orders of the TM 65-1 until July 1985, at which time they would be laid off. FF 498, 806.

After the announcement of the initial determination with respect to Tandon's motion for temporary relief, Tandon and Tandy discussed the future of TP and explored the immediate requirements of both Tandy and Tandon for the TM 65-2 double-sided drive. Tandy advised Tandon that its purchase order commitments to other vendors were more than adequate to supply all of its

needs for this type of product through November 1985. Similarly, since Tandon has not yet been able to penetrate the 5-1/4 inch half-height double-sided disk drive market, Tandon itself had no immediate need for this product from TP. FF 509A. In order to preserve TP's production capacity to the fullest extent possible, Tandon proposed that Tandy and Tandon each procure 5,000 drives per month from TP for the months of July, August, and September 1985. FF 509B. Shortly after presenting this proposal, Tandon was notified by Tandy that, because it had no need for 5-1/4 inch half-height double-sided disk drives before December 1985, Tandy was unwilling to order 5,000 units per month from TP for the months of July, August, and September 1985. FF 509C.

Tandon authorized a unilateral commitment to purchase TM 65-2 drives from TP for three months starting at approximately 2,000 units per month. This proposal was submitted to TP and Tandy by letter dated June 28, 1985.

FF 509D. On July 10, 1985, the TP joint venture committee met to discuss the future of TP. Mr. Hochman presented a projected profit and loss plan based upon Tandon's offer to procure 2,000 units per month from TP. Assuming that Tandon purchased such drives at \$90 per unit and provided TP with Tandon's refurbishing business, it was estimated that TP would suffer losses of \$101,000 in the months of August, September, and October 1985. FF 509E.

While Tandon and Tandy both agreed that it was desirable to preserve the ability of TP to manufacture TM 65-2s if either Tandon or Tandy should have a need for such product in the future as a result of this proceeding, Tandy did not agree that it was necessary to keep TP's manufacturing facility in operation for that purpose. Moreover, Tandy was desirous of using the TP Fort Worth facility for other purposes. Tandy was only willing to agree to the

continued operation of TP if Tandon absorbed all of the losses in excess of the costs of storing TP's production equipment, estimated to be \$18,000 per month. Tandy believed that reactivating production with stored equipment would not take any longer than ramping up from limited production in the interim, and TP should therefore cease production pending further developments. FF 509F.

After the July 10, 1985, meeting, Tandon's management reviewed the continued operation of TP. Since Tandon was unwilling to absorb any operating losses in excess of \$18,000 per month, even if Tandon purchased TM 65s from TP at a price of \$90 per unit (a price at which Tandon would suffer additional losses), Tandon decided that it was unwilling to absorb such losses unilaterally. Tandon concluded that it had no choice but to acquiesce in Tandy's proposal that TP's production equipment be stored pending the ruling of the Commission on permanent relief. FF 509G.

TP, as of April 1985, has never produced production quantities of the TM 65-2 (i.e., an order of 15,000 drives a month of any one type of drive). FF 509H. TP, however, has assembled in its plant approximately 1500 TM 65-2 floppy disk drives. FF 796. TP has not produced any commercial quantities of double-sided 5-1/4 inch disk drives since April 1985 (FF 509I), but as of December 1984, TP had produced approximately to units of the TM 100, a full-height single-sided floppy disk drive, and units of the TM 65-1, a half-height 5-1/4 inch single-sided disk drive. The mechanical parts of the TM 65-1, except for the head assembly, are the same as those found in the TM 65-2. FF 797. TP could have produced on a double shift TM 65-2 double-sided floppy disk drives a month. FF 798.

3. Control Data Corporation/Magnetic Peripherals.

Control Data Corporation (CDC) was granted a license by Tandon on September 30, 1984, to manufacture and sell disk drives under the '573 patent. FF 513. The license agreement resulted from a claim by Tandon that the drives manufactured by Magnetic Peripherals, Inc. (MPI), a partially-owned subsidiary of CDC, were covered by the '573 patent. FF 723; see FF 513A. Some, if not all, of the head assemblies used by CDC in its double-sided floppy disk drives produced in the United States are manufactured by Lafe, which is located in Taiwan or Korea. FF 393.

MPI is located in Oklahoma City, Oklahoma, and manufactures disk drives for sale by CDC to the OEM market. FF 511. As of 1983, the Oklahoma City facility occupied approximately 100,000 square feet of building space. FF 523.

The floppy disk drive market was relatively stable until mid-1984. At that time the market became unstable and prices dropped an average of \$10 per unit per month. FF 696, 739. Based upon CDC's cost of production in the United States, CDC in the third quarter of 1984 started to question whether it should stay in the floppy disk drive business and made the decision to move production of drives offshore. FF 525. As of April 1985, CDC continued to
C assemble and test approximately to percent of its requirements for
half-height 5-1/4 inch double-sided floppy disk drives at its Oklahoma City
facility. FF 520A, 526. The estimated maximum production capacity at CDC's
C Oklahoma City facility is drives per year, or approximately to
C units a month. It would take CDC at least three months to produce at
this level; the necessary tooling is in place, but CDC has laid off or
furloughed a number of its personnel. FF 518, 527, 741.

C CDC in 1983 shipped \$ worth of floppy disk drives or
C units. FF 729. CDC by December 30, 1984 had shipped \$ worth of
C floppy disk drives or units. FF 730. CDC as of December 30, 1984,
C had firm purchase orders for 1985 of floppy disk drive units and had
C projected a high probability sales forecast for 1985 of units.
FF 731. Most of the above floppy disk drives are 5-1/4 inch half-height or
C full-height drives. The old 8 inch products constitute about percent of
CDC's sales. Of the 5-1/4 inch full-height products, 90 percent plus are
double-sided configurations; of the 5-1/4 inch half-height products, almost
all are double-sided configurations. FF 514-15.

In 1983, CDC/MPI employed approximately 350 individuals at its Oklahoma
City facility. In 1984, the number of employees involved in the floppy disk
drive business increased to between 650 to 675 individuals. The closing of
CDC's Oklahoma City facility, however, has been ongoing since the third
quarter of 1984. In October 1984, CDC laid off 450 individuals from its
Oklahoma City facility. In February 1985, CDC made its final announcement
with respect to the termination of employees at its Oklahoma City facility.
FF 521, 750; see FF 527A-27C. On April 15, 1985, CDC laid off approximately
150 employees at its Oklahoma City floppy disk drive facility, leaving 75
employees primarily engaged in continuation and support engineering with
respect to the overseas assembly of drives and CDC's customers. FF 521A.

As of April 1985, CDC had research and development facilities in Oklahoma
City, Oklahoma, and Minneapolis, Minnesota. FF 528A. In 1984, CDC expended
C approximately \$ million for research and development for floppy disk
drives, including research and development for its 5-1/4 inch 1.6

megabyte drive and its 3-1/2 inch drives. All such research and development took place in the United States, and virtually all such expenses relate to double-sided drives. FF 528B.

Drawings, specifications, manufacturing assembly instructions, and technical support for disk drives manufactured overseas for CDC originate from the Oklahoma City facility. FF 529. The engineering prototypes and evaluation units for the 5-1/4 inch double-sided full-height and half-height floppy disk drives manufactured by CDC/MPI were developed and tested in the United States. FF 529A. The preproduction units and initial production units of the CDC/MPI full-height and half-height 5-1/4 inch floppy disk drives were assembled and tested in the United States. FF 529B. As of April 1985, manufacturing engineering and sustaining engineering for all 5-1/4 inch double-sided disk drive products marketed by CDC were performed in Oklahoma City. FF 529C. As of April 1985, engineering field change and design changes to solve production problems for all 5-1/4 inch floppy disk drive products currently offered by CDC were performed in Oklahoma City. FF 529D. As of April 1985, technical support and supervision for all overseas manufacture of CDC drives comes from Oklahoma City. FF 529E.

In 1984 and continuing into 1985, CDC's Oklahoma City facility procured all materials used in the foreign assembly of its floppy disk drives with the exception of head assemblies. FF 529F. CDC's Oklahoma City's facility was responsible for evaluating and selecting vendors for assembly materials, providing drawings and specifications generated in the United States for the materials to such vendors, and insuring that the materials actually provided conformed to specifications. FF 529G. During 1984 and continuing into

C 1985, over percent of the total material cost of CDC's 5-1/4 inch half-height floppy disk drives that were assembled offshore was attributable to materials produced from domestic sources. In addition, CDC conducted substantial domestic activities in connection with the manufacture of its drives that were assembled offshore, including research and development, design engineering, manufacturing and support engineering, material procurement, testing, and overhead and general and administrative costs in connection with such activities. FF 529H. Approximately percent of the materials used to assemble drives offshore is currently procured by CDC in the United States; however, with the exception of initial vendor qualification, testing of incoming parts takes place at the manufacturing site. FF 530.

Those disk drives that are manufactured offshore are tested offshore, though quality control for these products also is conducted at Oklahoma City through a sampling process. FF 531. As of April 1985, all 5-1/4 inch double-sided disk drives which are currently being manufactured offshore for CDC are received in Oklahoma City and tested. The drives are certified to meet vendor specifications. CDC tests the 5-1/4 inch drives manufactured abroad to comply with UL requirements and CSA certification. FF 532A. CDC customer liaison, application and engineering support, and service and repair for disk drives produced both offshore and in the United States is based in the United States. FF 533.

CDC's remaining production facility for floppy disk drives in Oklahoma City, as well as its capital equipment, including production and test equipment, are used in the production of floppy disk drives at that facility.

c FF 527D. CDC has an inventory of disk drives and has a commitment with
C an offshore supplier to build units. CDC is obligation to pay for the
C offshore assembly of approximately floppy disk drives over the
C remainder of 1985, of which over percent are double-sided 5-1/4 inch
half-height drives. CDC would go into domestic production only if there is
increased demand for quantities beyond those specified in its contracts with
foreign suppliers. FF 542, 734-34B. CDC has not yet commenced any efforts to
liquidate its Oklahoma City facility or the production and test equipment at
that facility and has not yet decided when to commence such liquidation. FF
527E.

4. Shugart.

Shugart Associates was formed in the mid-1970s by Allen Shugart and several key employees who had worked together at IBM and Memorex on disk drive designs. FF 299. Shugart was granted a license by Tandon on July 1, 1980, to manufacture and sell disk drives under the '573 patent. FF 3. By the end of 1981, Shugart employed 2,700 individuals and had annual sales of approximately \$198 million. FF 324. The company was located in Sunnyvale and Roseville, California, and Nogales, Mexico (400 employees). FF 300, 344.

Shugart's annual sales for 1983 was \$240 million dollars. At that time, Shugart was the world's second largest manufacturer of floppy disk drives behind Tandon. FF 339. Shugart first became profitable in July 1975. FF 340. Shugart's total annual revenues in succeeding years was \$18 million in 1977, \$34 million in 1978, \$70 million in 1979, \$134 million in 1980, and \$198 million in 1981. FF 302A. In fiscal year 1983, Shugart sold

C approximately drives and had sales volume of \$ million. At least
7 \$ million of this was attributable to Shugart's total floppy disk drive
C products, of which \$ to \$ million constituted double-sided floppy disk
drive sales. FF 344E. In January 1984, Shugart was a viable floppy disk
drive company. At that time, Shugart was selling everything it could make in
its floppy disk drive production facilities, and Shugart's United States
factories were running double shifts to meet customer demand. FF 344F. The
extreme competitive environment at the end of 1983, however, caused a
substantial erosion in Shugart's profitability. The first time Shugart saw
this rapid erosion was in 1983. Shugart recorded an operating loss in January
1984. FF 340.

On January 15, 1984, Shugart employed 2,600 people in the United States
and 600 in Mexico and occupied about 490,000 square feet of space at Roseville
and Sunnyvale, California. FF 344. By December 6, 1984, Shugart had
experienced several layoffs, and its employment force had been reduced to
1,600 to 1,700 employees, 400 of whom were in Mexico. As of December 6, 1984,
800 of the 1,200 United States employees were devoted to floppy disk drive
production, manufacture, engineering, design, sales, service, and marketing.
All of Shugart's United States manufacturing facilities were still intact with
C a joint capacity of to floppy disk drive products per month.
At this time, Shugart was running a reduced, one shift per day operation in
each of the two facilities. FF 344. In January 1985, Xerox formally
announced the closing of Shugart at a time when it still employed 1,400
individuals. FF 346.

Shugart's Roseville facility had a production capacity for 50,000 to 60,000 disk drives per month and manufactured both 8 inch and 5-1/4 inch double-sided floppy disk drives. As of December 6, 1984, there were 150 to 200 people located at the Roseville facility for production and manufacturing of double-sided floppy disk drives. FF 344A. Shugart's Sunnyvale facility had a production capacity for to double-sided disk drives per month and manufactured 3-1/2 inch, 5-1/4 inch, and 8 inch double-sided floppy disk drives. As of December 6, 1984, there were 200 to 400 people located at the Sunnyvale facility for the manufacture of double-sided floppy disk drives. Another 200 people located at the Sunnyvale production facility produced printed circuit boards to be used in double-sided floppy disk drives. FF 344B. Shortly after December 1984, Shugart closed the Roseville plant, leaving only the Sunnyvale plant in operation in the United States. Shugart remains in the double-sided floppy disk drive business to the extent it continues to manufacture its 8 inch double-sided product, the SA-850. FF 345E.

In January 1984, all research and development, engineering support, marketing and sales, testing, and servicing for Shugart products manufactured in the United States was performed at Shugart's United States facilities.

FF 344C. In January 1984, Shugart employed some people for floppy disk drive research alone. At least two-thirds of this research and development group were dedicated to the development of the "Sabre" product, which was to be a low cost double-sided disk drive manufactured in the United States using robotics. FF 344D. In December 1984, all research and development and other

support activities for United States-produced products were being performed in the United States. Additionally, United States support activities for the disk drives purchased from Matsushita were performed in the United States. Printed circuit boards were manufactured in the United States for all of Shugart-produced double-sided floppy disk drives, and lot testing was being performed in the United States for those drives received from Japan. As of December 1984, Shugart's research and development program equaled approximately seven percent of Shugart's gross sales. FF 345B. As of December 6, 1984, approximately people were left in the Shugart's quality organization for double-sided floppy disk drives. FF 345D.

In December 1984, Shugart was manufacturing approximately to double-sided floppy disk drives in the United States, and was receiving to units and selling to double-sided floppy disk drives produced in Japan by Matsushita for Shugart. FF 345. Shugart's backlog order summary for December 1984 indicated sales of SA-350s, SA-450s, and SA-850s, for a total of approximately double-sided floppy disk drives to be manufactured in the United States. The same document indicated orders for delivery in December 1984 for to Shugart disk drive Models SA-455 and SA-465 assembled for Shugart in Japan by Matsushita. (The SA-850, an 8 inch drive, and the SA-455 and SA-465, half-height 5-1/4 inch drives, are not properly considered part of the domestic industry. Opn. at 64-65, 94. Shugart sold over \$ worth of double-sided disk drives in December 1984. FF 345A.

Shugart manufactured a 3-1/2 inch double-sided floppy disk drive at Sunnyvale, California, in 1982. FF 347. Following a meeting in May 1982 with Dysan Corporation's president, Shugart formed a venture group to pursue the

design and development of the 3-1/2 inch drive. A small company environment was created, and the best engineers from Shugart were picked for the engineering organization. The project used high-volume automated lines for production. FF 348.

Single-sided 3-1/2 inch drives were introduced into the marketplace in April 1983. FF 349. In October 1983, a double-sided version of the 3-1/2 inch drive was introduced. The double-sided 3-1/2 inch drive employed Tandon's patented technology. FF 350. Evaluation sales were made of the 3-1/2 inch double-sided disk drives to 15-20 accounts, including Apple Computer, Wang, Convergent Technologies, Nixdorf, and Honeywell-Bull. FF 351. Approximately 2000 to 3000 double-sided Shugart 3-1/2 inch drives were sold in 1983. FF 352. On December 6, 1984, Shugart had plant capacity for 100,000 3-1/2 inch double-sided floppy disk drives per year located in Sunnyvale, California. FF 353.

On December 19, 1983, after examining economic studies concerning what would be required to make the business fully profitable, Xerox concluded that it could no longer support Shugart. As of January 1, 1984, Shugart's annual reported sales for fiscal year 1983 was \$240 million. Xerox concluded that even given substantial investments, Shugart could not be made profitable within the next 12 to 18 months. FF 343. Production of the 3-1/2 inch double-sided floppy disk drive ceased in approximately February 1985, except
C for the fulfillment of the existing commitments to for production of

C approximately more double-sided units. FF 353A. In January 1985, Xerox formally announced the closing of Shugart's 5-1/4 inch and 3-1/2 inch floppy disk drive operation. Shugart's 5-1/4 inch business was sold to Matsushita in February 1985, including the extensive inventory that had built up over the previous quarters. FF 353B.

In the first quarter of 1984, Shugart sold double-sided floppy disk drives assembled for it under Tandon's patent license by Matsushita of Japan. These drives were half-height models and were designated as the SA-455 and SA-465. FF 344H. Complainant has failed to submit sufficient evidence to permit the conclusion that the SA-455 and SA-465 should be considered part of the domestic industry. See FF 344I-44J.

5. IBM.

In August 1984, IBM commenced the manufacture of 5-1/4 inch double-sided floppy disk drives in Boulder, Colorado. IBM has continued manufacturing such disk drives from that time until the present. FF 542A. The IBM drive is covered by claims 1, 5, and 12 of the '573 patent. FF 542B.

The disk drives manufactured by IBM were for use in IBM's personal computer and also in other IBM small computers and display products. IBM commenced such manufacture for the purpose of supplying in substantial part its own internal needs for such disk drives in lieu of purchasing them from outside vendors. FF 542C. IBM initially decided to manufacture double-sided floppy disk drives commencing in August 1984 because it thought it would be a profitable venture. IBM had only planned to use the drives for internal production purposes and never planned to sell the drives in the marketplace.

FF 542D. The IBM Boulder double-sided 5-1/4 inch floppy disk drive manufacturing facility features fully automated subassembly and alignment operations, manual final assembly operations, and semi-automated final tests and packaging. Robots are used, including the IBM 7545 and internally developed "pick and place" robots. FF 542F. IBM employs statistical process control techniques for quality control and quality assurance activities. Production yields are targeted at 100 percent. FF 542G.

During the period from August 1, 1984, through June 30, 1985, IBM produced the following quantities of floppy disk drives:

<u>Period</u>	<u>Quantity</u>
3rd Quarter 1984	7,150
4th Quarter 1984	932
1st Quarter 1985	4,168
2nd Quarter 1985	5,552

The 7,150 drives produced in the third quarter of 1984 were full-height 5-1/4 inch double-sided drives. The drives produced thereafter were all half-height 5-1/4 inch double-sided floppy disk drives of 1.2 megabytes formatted. FF 542H.

The head assemblies used in IBM's 5-1/4 inch full-height double-sided floppy disk drives are assembled in Hong Kong . The head assemblies used in IBM's 5-1/4 inch half-height double-sided floppy disk drive are assembled in Korea . FF 542T. The head assemblies were made in accordance with drawings and specifications provided by IBM. These head assemblies were procured by IBM purchasing personnel in the United States using normal procurement procedures. Once selected, the vendor's

product was qualified by an onsite review of its process. Product testing was performed by domestic IBM employees. In some instances, IBM has provided final test equipment for use by the vendor. FF 542I.

subject their head assemblies to quality control before shipping them to IBM. IBM does not subject the imported head assemblies to quality control, but receives them directly into stock. FF 542X.

IBM procures the printed circuit board, two motors, and a number of minor parts for use in its head assemblies from offshore suppliers. Approximately 75 percent of the material costs of the completed printed circuit boards, the completed motors, and the completed head assembly is procured from offshore suppliers. Materials cost comprises 80 percent of the total production cost of the IBM disk drive. FF 542J.

In December 1984, IBM employed about 10 individuals who were directly involved in the manufacture and assembly of its 5-1/4 inch double-sided floppy disk drives, including assemblers and a manufacturing manager, and 37 employees indirectly involved. Now there are 32 employees directly involved in the manufacturing process and 37 employees indirectly involved. FF 542S.

IBM Boulder will continue to manufacture 5-1/4 inch double-sided disk drives until current commitments are met, at which time IBM plans to discontinue such manufacture. IBM plans to continue to purchase complete head assemblies from a foreign source for these drives during such time. Completion of the current commitments is expected around July 1986. FF 542K. The reason IBM plans to cease the manufacture of disk drives is that management has decided that internal manufacture of 5-1/4 inch disk drives is not financially attractive and that there are adequate supplies available in

the marketplace. IBM management has therefore decided to purchase such drives, other than the aforementioned commitments, from outside sources rather than to make them internally. IBM made the decision to cease production of the disk drives in late July 1985. FF 542L.

6. Conclusion.

As of December 6, 1984, the date on which the complaint was filed in this investigation, the domestic activities of Tandon and its licensees, Texas Peripherals, Control Data Corporation, Shugart, and IBM, devoted to the manufacture, distribution, research and development, and sale of double-sided 5-1/4 inch and 3-1/2 inch floppy disk drives constitute a domestic industry for purposes of § 337. Cessation or limitation of domestic activities during Commission proceedings does not undermine the conclusion that these activities constituted an industry at the time the complaint was filed.

V. EFFICIENT AND ECONOMIC OPERATION

In order to prevail under § 337, a complainant must establish that the domestic industry is efficiently and economically operated. The guidelines set forth by the Commission to assess whether a domestic industry is efficiently and economically operated include: (1) use of modern equipment and manufacturing facilities; (2) investment in research and development; (3) profitability of the relevant product line; (4) substantial expenditures in advertising, promotion, and development of consumer goodwill; and (5) effective quality control programs. E.g., Certain Methods for Extruding Plastic Tubing, Inv. No. 337-TA-110, 218 U.S.P.Q. 348 (1982); Certain Coin Operated Audio Visual Games and Components Thereof, Inv. No. 337-TA-105, 216 U.S.P.Q. 1106 (1982); Certain Slide Fastener Stringers and Machines and Components Thereof, Inv. No. 337-TA-85, 216 U.S.P.Q. 907 (1981).

A. Tandon

There are three important areas of exploration with respect to the question of Tandon's efficient and economic operation. The first issue relates to the quality of the disk drives manufactured by Tandon both before and after the complaint was filed. The second relates to the effect of Tandon's licensing policy on the domestic industry. The third relates to Tandon's business structure vis-a-vis its offshore contractors and Tandon Associates.

1. Quality.

a. Pre-December 1984.

In 1982, Tandon became the largest independent (i.e., non-captive) manufacturer of floppy disk drives sold to OEMs. FF 612. At that time, Tandon's success was largely dependent on sales of full-height disk drives, which dominated the market. FF 596. Tandon commenced production of belt-driven half-height disk drives (TM 50, TM 55) in the fall of 1982. FF 640A. Due to production problems with these models, and the recognition that the market desired direct-drive half-height disk drives, Tandon decided to modify these models to incorporate a direct drive motor. FF 640B-40D.

Tandon's problems with quality during the 1982-1984 period can be traced to its failure to develop a commercially viable direct-drive disk drive until late 1984, and its reliance on the problem-ridden TM 50 and TM 55 models in the interim. FF 640E-40J, 640M, 642-43, 647-49, 651-52, 656, 660, 661, 662, 663A-63C, 664, 665; see Opn. at 126-30. Tandon's reputation was further tarnished by its inability to deliver purchase orders of half-height disk drives to certain customers during this period. FF 640H, 653, 657, 658-59, 663, 664. Tandon's quality problems during the 1983-1984 period in part explains Tandon's current lack of success with sales of its TM 65 after it finally became available in late 1984, as some customers have refused to evaluate the TM 65 because of quality problems with earlier Tandon models. FF 640R, 658, 661.

Tandon endeavored to explain away the quality problems its customers encountered by attributing rejects to correlation problems between Tandon and its customers, or problems at the OEMs themselves. Tandon PEO Reply Brief, at 11-12 (Sept. 23, 1985). It is evident that a portion of rejected Tandon

disk drives would have been due to differences in technical testing procedures among Tandon and its customers, or to problems at OEM customers rather than at Tandon. FF 643, 646, 650. However, this does not offset the evidence of record that OEMs were experiencing unusually high reject rates with Tandon disk drives during 1983-1984, especially when compared to the low reject rates experienced at some OEMs when they switched to other suppliers. FF 663, 663C, 663M, 663P.

b. Post December 1984.

Tandon developed a half-height disk drive, the TM 65, that became commercially available to the market in August or September 1984. FF 640K. To date, Tandon has not been successful in marketing the TM 65 model. FF 640N-40P. There are several factors which may explain Tandon's lack of success in 1985 with respect to the TM 65.

First, Tandon's problems with the quality and availability of its double-sided disk drives during 1982-1984 damaged its reputation in the marketplace. FF 640H, 640M, 640R, 658, 661. At least five former customers that had quality problems with Tandon disk drives now are neither purchasing commercial quantities, nor evaluating Tandon double-sided disk drives. FF 643, 649, 656, 659, 663.

Second, when Tandon's half-height 5-1/4 inch disk drive became available in 1984, a large portion of the primary-supplier marketing window for the 1.0 megabyte TM 65 was closed. FF 640K, 640L; Opn., at 126-30. Although the marketing window for 1.6 megabyte disk drives opened during 1985, Tandon sold only of these drives in the first half of 1985 and had only on order in June 1985. Huenemeier, CX 835, at 2.

Finally, the possibility exists that the TM 65 is itself suffering from quality deficiencies. Given the problems experienced by Tandon with the quality of its disk drives through the end of 1984, the burden of proof is on Tandon to show that it has corrected the quality problems associated with its earlier half-height 5-1/4 inch disk drives and turned the situation around with its TM 65. Some evidence suggests that the quality of the TM 65 is good, while other evidence suggests that quality problems persist. FF 640P, 640S-40U; MRX 49C, at 41054; MRX 105C, at 52510, 52566-67, 52585.

There is no doubt that Tandon's poor quality reputation persisted in the marketplace long after the complaint was filed. The evidence of poor quality produced by respondents placed the burden of going forward with evidence of good quality on Tandon. Tandon presented no current customer of the TM 65 as a witness to verify the quality of this drive or to demonstrate that quality is no longer a problem. Because of the small number of TM 65s sold to date, the evidence concerning the TM 65 quality is inconclusive. An overall evaluation of the evidence leads to the conclusion, however, that Tandon suffers from a poor quality reputation in the marketplace.

2. Licensing Policy.

Tandon's licensing policy has allowed major foreign and domestic competitors to use Tandon's double-sided head assembly technology in their disk drives, and has allowed potential customers to purchase double-sided disk drives incorporating the '573 patent technology from a number of Tandon's competitors. FF 666H. While Tandon's licensing policy has generated revenue for itself, it has also generated increased competition, particularly from foreign companies.

Tandon's licensing of Shugart in 1980 had the effect of allowing Shugart to market Matsushita-produced double-sided disk drives in the United States starting in 1983. FF 666H-66I. The record shows that Shugart/Matsushita aggressively priced their products during 1983-1984. FF 666N-66R, 666T, 666X, 666AA; CX 546, at 524617, 524636, 524654, 524690, 525471, 525482, 525776. In February 1985, a portion of Shugart's disk drive operations was sold to Matsushita. FF 666L. In the same month, Tandon gave Matsushita the right to make, have made, use and sell double-sided floppy disk drives incorporating the '573 patent anywhere in the world. FF 666M. Tandon subsequently faced price competition directly from Matsushita during 1985. FF 666K, 666N, 666T, 666V, 666W, 666BB, 666DD, 666FF; CX 551. Tandon has recently entered into license agreements with TEAC and Sony. FF 9-12.

With respect to the licensing of potential customers, Tandon licensed Hewlett-Packard (H-P) in 1980 and IBM in 1984. FF 666H. These license agreements gave H-P and IBM the right to make, have made, use, and sell double-sided disk drives utilizing the '573 patent, and in effect gave a license to any supplier from whom they purchased floppy disk drives. FF 666II, 666KK. H-P decided to use a 3-1/2 inch disk drive rather than a 5-1/4 inch disk drive in a new computer model, and since the beginning of 1985 has purchased 3-1/2 inch disk drives from Sony. FF 666JJ. Mitsubishi recently disclosed that it has contracted to sell 250,000 double-sided 3-1/2 inch disk drives to IBM, with production to begin in the spring of 1986. FF 666LL.

Tandon's licensing policy has thus generated competition from overseas suppliers that has led and will lead to additional price pressure in the double-sided disk drive market. Tandon's licensing policy may also have cost itself sales opportunities at two large potential customers, H-P and IBM. It cannot be determined whether these business decisions show that Tandon is inefficient and uneconomic. In the short run Tandon benefited from substantial license payments and technology exchange, but in the long run it appears that Tandon's licensing policy contributed to its deteriorating market position.

3. Business Structure.

All of Tandon's 5-1/4 inch double-sided disk drives are assembled offshore, either at its Singapore subsidiary or by contract at Eastern Peripherals in India. Huenemeier, Tr. 436, 449-50; Mitchell, Tr. 3247-48. Because the large portion of Singapore-produced disk drives are shipped directly from the Tandon subsidiary to IBM in Singapore, this analysis will focus on the business relationship between Tandon and its Indian operations. FF 467, 469-70.

Tandon contracts with various Indian companies for the assembly or purchase of disk drive components used by Tandon or for completed 5-1/4 inch disk drives. Only Eastern Peripherals assembles completed disk drives. FF 628-30. Tandon believes it benefits in terms of material and assembly costs by assembling disk drives overseas rather than in the United States. FF 630.

Tandon Associates is located in the United States and coordinates the contract assembly and purchase transactions between Tandon and the Indian contract companies. FF 631-31K. Tandon Associates is independent of Tandon. FF 632. The principal purpose of purchasing disk drives through Tandon Associates, rather than directly from the Indian contractors, is to

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. FF 632A.

It is likely that the addition of one more layer in the procurement process (i.e., Tandon Associates) has led to certain inefficiencies and additional costs that would not be present if Tandon dealt directly with the Indian companies. For example, Tandon Associates adds a markup and certain additional charges for the drives it imports from India when it sells these disk drives to Tandon. FF 631F, 631I.

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. Mitchell, Tr. 3275.

Finally, it is possible that by dealing with the Indian contractors through Tandon Associates rather than directly, Tandon has less than optimal control over the production process in India, which may explain in part some of the past quality problems Tandon has had with its Indian-produced disk drives.

Tandon's decision to lower costs through cheaper overseas labor rather than through automation may also explain in part the quality problems it has had with its Indian-produced disk drives. One of the main advantages of automated production methods is that less material is wasted and reject rates are lower. Malmgren, Tr. 5052-54, 5057.

The imposition of the extra layer in the procurement process may have been necessary to protect Tandon from . Overseas assembly was probably also necessary to lower costs, though there is little information of record to ascertain the costs and benefits to Tandon of pursuing lower costs through offshore assembly as opposed to automation. Therefore, although Tandon's business structure with respect to its decision to move overseas and utilize the services of Tandon Associates may have added certain inefficiencies and additional costs, this is not sufficient in and of itself to reach a determination that Tandon is uneconomic and inefficient.

4. Conclusion--Tandon.

Based on certain measures, such as R&D expenditures, profitability, and employee benefits, Tandon appeared to be an efficient and economic operation during 1983 and 1984. FF 615, 619, 625-27A. However, the record also shows that during this same period, Tandon's success was predominantly the result of its reliance on sales of full-height disk drives. In 1984, Tandon on its full-height disk drives, but in both 1983 and 1984 it on its half-height 5-1/4 inch disk drives. FF 615D-15E. The ability to supply the market with a quality product is critical for success. Therefore, Tandon's significant problems with the quality of its half-height 5-1/4 inch disk drives during the period January 1983 to December 1984 resulted in a reputation for poor quality in the period December 6, 1984, to date.

B. Texas Peripherals

A determination with respect to the efficient and economic operation of Texas Peripherals (TP) is complicated because TP was a joint venture owned by Tandon and Tandy. The joint venture agreement placed certain restrictions on TP's double-sided disk drive materials procurement and sales alternatives. FF 666MM.

Since purchase orders from Tandon and Tandy were only for one month's supply at a time, TP had a difficult time negotiating favorable pricing for larger quantities of raw materials. FF 668A. In addition,

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. FF 667B. Finally, as of December 1984, most of the parts received by TP from Tandon were not standard, so that every drive produced by TP had to be "custom built" to insure quality and reliability to Tandy. TP experienced for head assemblies received from Tandon and for completed TP drives shipped to Tandy. FF 667E-67G.

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Under the joint venture, TP could sell only to Tandon or Tandy unless given permission to sell to a third party. FF 795. Therefore, TP was restricted in terms of the market it could pursue, and this in turn restricted its ability to produce in the volumes necessary for efficient operation.

TP never really got the double-sided portion of its business off the ground, producing a total of only double-sided disk drives. FF 796. The record shows that TP's problems with the quality of its double-sided disk drives were largely attributable to lack of support from Tandon. These

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quality problems delayed TP's qualification at Tandy, which in turn contributed to the fact that TP never produced commercial quantities of double-sided disk drives. TP's equipment is FF 509A-09G, 806G.

TP had successfully produced single-sided disk drives for years before Tandon joined the joint venture. CX 722; Huenemeier, Tr. 301. As of April 15, 1985, TP had outstanding purchase orders for TM 100s and TM 65-1s, both single-sided products. The TM 65-1 is mechanically the same as the TM 65-2, except for the double-sided head assembly supplied by Tandon. FF 797. Therefore, TP was efficiently and economically operated, because TP's problems with respect to double-sided disk drives are attributable to lack of support from its joint venture owners, rather than to the internal operation of TP itself. See Opn. at 79-84.

C. Shugart

Shugart's double-sided disk drive product lines experienced continued and sustained profits until the end of the second quarter of 1984, when its 3-1/2 inch floppy disk drive business substantially deteriorated and the 5-1/4 inch double-sided disk drive market experienced a significant drop in product pricing. FF 669I. Shugart had installed a new equipment and a progressive assembly line, which used automated testing equipment, for its 3-1/2 inch product line. Neun, CX 821, at 10. Shugart had traditionally expended approximately percent of its gross sales on research and development. FF 668F. As of December 6, 1984, Shugart had an employee benefit package which included life insurance, health insurance, dental insurance, vision care, and pension and bonus plans. FF 668D.

Shugart failed to develop its own half-height 5-1/4 inch double-sided disk drive, and instead contracted with Matsushita in 1983 for a supply of half-height drives. FF 669H. Shugart's failure to develop half-height disk drives does not lead to a determination that Shugart was inefficient and uneconomic. Once Shugart reached the conclusion that it could not develop a commercially viable half-height product, it made a business decision to purchase half-height disk drives offshore at a price it believed would enable it to earn a profit on sales. FF 330, 332-34.

Shugart was efficiently and economically operated. See Opn. at 89-94.

D. CDC

In 1983, CDC had approximately a 20 percent share of the full-height 5-1/4 inch floppy disk drive business and a minimal percentage of the half-height 5-1/4 inch disk drive business. In 1984, CDC's share of the half-height 5-1/4 inch disk drive business had grown to about 10 percent, but by April 1985, its market share had fallen to two percent. FF 669. During the period 1980 to 1983, CDC realized profits each year from the floppy disk drive business. FF 669A.

C In 1984, CDC expended approximately million for research and development for floppy disk drives. All R&D took place in the United States, and virtually all of it related to double-sided disk drives. FF 669B. In 1984, CDC decided to move most of its floppy disk drive business offshore
C because the cost of production in the Far East was about to per unit less than in the United States. FF 669C.

CDC was efficiently and economically operated. See Opn. at 85-89.

E. IBM

IBM, on an ongoing basis, engages in research and development at its Boulder, Colorado, facility in connection with the products it manufactures for the purposes of designing new products and improving the designs and features of its current products. Such research and development activities have included research and development activities with respect to IBM's 5-1/4 inch double-sided floppy disk drives and the components used in such drives, including the head assemblies. FF 688H.

The IBM employee benefits program provides protection, security, and opportunity. IBM intends to maintain an average level of pay that is higher than the average level for similar skills in other companies with which IBM competes for employees and with which it competes in the marketplace, thus assuring that IBM rates will be competitive. IBM management believes that its wage rates have been competitive to date. FF 689I.

IBM was efficiently and economically operated. See Opn. at 94-97.

F. Conclusion

The difficulties experienced by the domestic industry during 1983-1985 were primarily the result of a rapid shift in the market demand from full-height to half-height 5-1/4 inch drives, and the inability of the United States industry to develop and successfully market a domestically produced half-height 5-1/4 inch double-sided drive. See Opn. at 110-12, 125-36. A rapid price decline also took place in the market as a result of several factors, including the market entry of numerous double-sided floppy disk drive suppliers and the downturn in the computer industry. Given the severity and rapidity of the market change and price decrease, it would be difficult to conclude that the failure of U.S. disk drive producers to sufficiently cut costs while attempting to restructure their produce lines constitutes inefficient and uneconomic operation. Indeed, Tandon and CDC reacted to competitive price pressures by moving assembly to lower-cost offshore operations, and Shugart opted to enter into a purchase agreement with a Japanese supplier.

With the exception of Tandon's operations during 1983-1984, and the effect that the poor quality of Tandon's half-height 5-1/4 inch disk drives had on Tandon's reputation during 1985, the firms within the domestic industry as of December 6, 1984, were efficiently and economically operated. Therefore, the domestic industry as defined under § 337 is as a whole efficiently and economically operated.



VI. INJURY

As a final element in a § 337 investigation, complainant must show that respondents' unfair methods of competition and unfair acts have the effect or tendency to destroy or substantially injure the domestic industry. 19 U.S.C. § 1337(a). Injury requires proof separate and independent from evidence of an unfair act. Complainant must establish a causal relationship between respondents' unfair acts and the injury suffered as a result of such acts.

A. Overview: The 1982-1985 Domestic Floppy Disk Drive Market

The United States market for computers and double-sided floppy disk drives exhibited significant growth beginning in 1981 and continuing through 1983. Sales of double-sided disk drives in the United States increased from 350,000 drives in 1980 to 3,951,000 drives in 1983. FF 670. Double-sided 5-1/4 inch disk drives experienced the most significant growth in 1983 sales, increasing from 804,000 units sold in 1982 to 3,496,000 units sold in 1983. FF 670. This overall sales increase was reflected in sales by individual companies: Tandon's sales of double-sided disk drives increased from 498,000 drives in 1982 to 1,084,600 drives in 1983. FF 682. Shugart's sales increased from 78,900 drives to 215,900 drives over the same period. FF 683. CDC's sales increased from 81,600 to 421,800 drives. Micro Peripheral's sales increased from 65,900 drives to 401,200 drives. FF 683-85.

The estimated market price for 5-1/4 inch full-height double-sided floppy disk drives in mid-1983 was \$150 to \$200 per drive and for 5-1/4 inch half-height double-sided disk drives, \$125 to \$135 per drive. FF 694-95. By

the end of 1983, prices for half-height disk drives closed at about \$117 per unit. FF 677, 691J, 696A, 697. In 1984, declines in the price of disk drives were attributable to at least three factors: (1) the emergence of numerous foreign manufacturers in Japan and elsewhere; (2) a rapid and broad-based industry trend toward lower-priced, half-height 5-1/4 inch floppy disk drives; and (3) intense price competition in the personal computer industry and corresponding price pressure on disk drive suppliers from OEM firms.

The burgeoning competition from Japanese disk drive suppliers is partly the result of a mid-1981 request for quote (RFQ) by Nippon Telephone and Telegraph (NTT) for 100,000 to 500,000 half-height double-sided floppy disk drives. FF 671-77. The RFQ, which was one of the largest orders in the world, required that successful recipients demonstrate some production capacity. NTT limited its request, however, to 15-20 Japanese companies at a time when only TEAC, Mitsubishi, and Matsushita had sufficient disk drive capacity. No United States companies were requested to quote. FF 672-74. Matsushita, which held a licensing agreement with Shugart, warned Shugart that the NTT RFQ would generate excess capacity in the Japanese disk drive market and result in sales of Japanese disk drives to the United States. FF 675. Matsushita informed Shugart that Japan's Ministry of International Trade and Industry had decided that computer peripherals, including floppy disk drives, would be an important area of endeavor for Japanese industry in the 1980s. FF 676. Shugart first faced price competition from Japanese companies in Europe in mid-1983, then in the United States in late 1983. FF 677.

The market trend in floppy disk drive demand may be broadly characterized as heading towards smaller size, higher capacity drives. Product life cycles are also relatively short. FF 692A-92B, 697. From 1982 to 1983, the market for double-sided floppy disk drives changed structurally from full-height to

half-height drives. The half-height version of the 5-1/4 inch double-sided disk drive increased its world market share from 24.8 percent in 1982 to 54.7 percent in 1983. FF 691. Both Tandon and Shugart experienced significant difficulties during this period and through 1984 in developing and marketing a half-height disk drive and failed to capitalize on the shift from full-height to half-height drives. FF 692-93. Shugart never successfully developed a competitive half-height product and finally had to contract with Matsushita to provide it with a supply of half-height disk drives. FF 693. Tandon did not have a viable half-height disk drive available until mid to late 1984. FF 640A-40Q, 692, 835A, 836, 843A-43K. As a consequence, U.S. producers, while capturing 96 percent of the world market increase in 5-1/4 inch full-height disk drive sales between 1982 and 1983, captured only 16 percent of the increase in the world market for 5-1/4 inch half-height disk drive sales during this same time period. FF 691A. Japanese suppliers entered the floppy disk drive market primarily as suppliers of half-height drives and captured large and increasing shares of the half-height market in 1983 and 1984. FF 691A. Therefore, with the passage of time, domestic floppy disk drive suppliers necessarily lost their share of the 5-1/4 inch double-sided drive market as OEMs shifted from full-height to half-height products.

The floppy disk drive market was relatively price stable until mid-1984. The market then became unstable as disk drive prices dropped an average of \$10 per unit each month. FF 696. By the end of 1984, prices for full-height 5-1/4 inch double-sided disk drives ranged between \$85 and \$95 per unit. By April 1985, prices for this product ranged between \$65 and \$85 per unit. FF 694. Prices for half-height 5-1/4 inch double-sided disk drives equaled \$85 per drive at the end of 1984. FF 695. Prices continued to decline such

that current prices for 5-1/4 inch half-height disk drives to major customers are as low as \$55 per drive for sales of 48 TPI, 0.5 megabyte drives.

C FF 691G, 691I. (

C .) Price erosion is alleged to be a major factor in Tandon's and Shugart's decreased profitability. FF 678, 811.

Currently, there are between 25 and 50 suppliers of floppy disk drives, many supplying disk drives produced in Japan. One market analyst estimated that 10 suppliers could satisfy today's market demand. FF 691E-91F. The oversupply of disk drives during a period of reduced demand has contributed to the overall price decrease in the double-sided disk drive market.

B. Substantial Injury

Several factors are relevant to a determination of substantial injury to a domestic industry, including, but not limited to: (1) lost and declining sales; (2) volume of imports and capacity to increase imports; (3) loss of market share; (4) lost customers; (5) decreased employment; (6) decreased production and profitability; (7) underselling; and (8) excess domestic capacity. E.g., Certain Vertical Milling Machines, Inv. No. 337-TA-133 (1984); Certain Drill Point Screws for Drywall Construction, Inv. No. 337-TA-115 (1983); Spring Assemblies, 216 U.S.P.Q. at 242-45; Certain Roller Units, Inv. No. 337-TA-44, 208 U.S.P.Q. 141, 144 (1979).

1. Injury to Complainant and Its Licensees.

a. Tandon.

Tandon's net income earned on its overall operations increased from about \$1.5 million in fiscal year 1980 to about \$29.4 million in fiscal year 1984. FF 807. The ratios of net income to net sales for these fiscal years, however, remained essentially constant: 1980--7.6%; 1981--8.3%; 1982--10.5%; 1983--7.8%; and 1984--7.3%. FF 808. Tandon's net income decreased substantially as it suffered its first losses beginning the third quarter 1984. The ratio of net income to net sales for calendar year 1984 and first quarter 1985 are as follows: 1Q 1984--9.9%; 2Q 1984--7.6%; 3Q 1984--(7.6%) (parenthesis indicate loss); 4Q 1984--(17.0%); 1Q 1985 (32.6%). FF 810; see FF 809.

A total of approximately 3,353,200 double-sided 5-1/4 inch disk drives were sold in the United States in 1983. Tandon sold double-sided drives, or percent of the 1983 market. Virtually all of Tandon's sales of 5-1/4 inch floppy disk drives consisted of full-height units, and Tandon was the leading 5-1/4 inch full-height manufacturer. Tandon's 1983 market share for half-height drives, however, was virtually nil. FF 398A.

Between 1983 and 1984, Tandon's sales of double-sided floppy disk drives decreased from units to units. FF 812-13. During 1984, Tandon's sales of double-sided floppy disk drives decreased from units in the first half of the year to units in the second half of the

C year. FF 814. Approximately percent of Tandon's total floppy disk drive
C business in fiscal year 1984 was double-sided; however, Tandon sold only
C double-sided half-height 5-1/4 inch floppy disk drives during this
C period after it had projected sales of units. FF 399-99A, 814B. In
C the period July 1984 to June 1985, Tandon sold only about half-height
C 5-1/4 inch double-sided disk drives, and Tandon estimates that it will sell
C only during the period of September through December 1985. FF 814A.
C For the fiscal year which ended September 30, 1985, Tandon originally
C projected sales of its 5-1/4 inch half-height double-sided floppy disk drives
C equal to \$, including projected sales of units through the
C first three quarters. As a result of sales below projections, this figure was
C revised downward in February 1985 to units. Tandon has failed to meet
C this lower estimate, shipping approximately units in the first three
C quarters of fiscal year 1985. FF 814C. Tandon has not been able to penetrate
C the half-height 5-1/4 inch double-sided floppy disk drive market to any
C significant degree. FF 814A-14C.

Between January 1984 and January 1985, Tandon laid off 1,450 employees
from its domestic floppy disk drive division. FF 815C. Part of this decline
is attributed to the restructure of Tandon's manufacturing operations to
emphasize offshore production of mature product lines. FF 815; see
FF 815A-15B. In December 1984 and January 1985, Tandon terminated 197 United
States employees (Engineering--22; Production--170; and Purchasing--5). The
engineers were laid off because Tandon's expenditures were not appropriate for
the amount of profits being generated. FF 815D. From January 1985 through
July 1985, Tandon laid off 167 employees in the flexible disk drive and head

division. Tandon's decrease in personnel between January and July 1985 is attributable to erosion in the demand for Tandon floppy disk drives. FF 815E. In May 1985, Tandon vacated and sublet a substantial portion of its plant facilities because the employee layoffs left Tandon with substantial excess space. FF 815F.

b. Texas Peripherals.

Texas Peripherals (TP) is a joint venture owned equally by Tandy Corporation and complainant. TP was formed for the purpose of manufacturing disk drives in the United States for sale either to Tandy or Tandon. Tandon became a member of this joint venture in January 1984. FF 760-61.

On April 25, 1984, TP's projected production of half-height double-sided floppy disk drives was 1,000 units for October 1984, 32,350 units for November 1984, and 28,230 for December 1984. TP forecasted continued growth of its floppy disk drive production such that by February-March-April 1985, TP planned to ship 68,652 drives a month, 50,052 of which would be half-height, double-sided floppy disk drives. FF 764. The projected average selling price for the half-height, double-sided drive was \$86 per unit. FF 765.

TP's profit plan for fiscal year 1985 indicated that production of the half-height 5-1/4 inch double-sided disk drive was scheduled to begin October 1984 so that by May 23, 1985, production of this floppy disk drive was expected to reach 30,000 units per month. This level of production was less than originally anticipated because Tandy had decided to continue to use a full-height product in one of its computers instead of switching to a half-height product, but volume buying of 30,000 units per month was

sufficient to achieve reduced costs for the TP floppy disk drive. FF 771-73.
As of September 1984, \$264,300 of the budget for tooling had been committed to
vendors to fabricate the tooling for the TM 65 product. FF 770.

C On October 9, 1984, TP received an order for 6,000 units of the TM 65-2
C floppy disk drive from Tandy Home Computers. FF 775. TP

C . FF 776; see FF 776-81. Tandy Home

C Computers also

C FF 782.

C per unit. FF 788.

C By February 1985, however, TP would have needed to qualify its product at \$
per unit in order to get a purchase order from Tandy Home Computers. Both

C TEAC and had competed with TP for the Tandy Home Computers' business, and

TEAC had proposed a modified version of its double-sided floppy disk drive for

C \$ per unit. FF 789.

C As of February 12, 1985, the lowest projected total cost for the TM 65 was

C somewhere in the \$ to \$ price range for an order of full-height and

half-height floppy disk drives per month. At this price, TP's profits on the

C sale of floppy disk drives would be between and percent, with an

C average end of the year net profit before taxes of less than percent.

C Even at this optimistic figure, TP would have been required to sell at \$

C above the TEAC price. Such a profit level was

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C . FF 790. The

C recommendation was made that Tandy Home Computers

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. The intangible benefit of proximity to the customer base no longer appeared to be a viable condition for maintaining a manufacturing facility devoted to the half-height drive. FF 791.

Tandy Home Computers canceled its order with TP for 6,000 units of the TM 65-2 floppy disk drive in March 1985. FF 793. If TP had been price competitive with respect to the other floppy disk drive vendors, the qualification process for its drives would have continued. FF 792. Tandy Home Computers has awarded some of its double-sided floppy disk drive business to . FF 793.

TP assembled in its plant approximately 15,000 TM 65-2 floppy disk drives. As such, TP never produced a "production quantity" of the TM 65-2, that is, an order of 15,000 drives a month of any one type. FF 796. However, as of December 1984, TP had produced units of the TM 65-1, a half-height 5-1/4 inch single-sided disk drive and as of April 15, 1985, had outstanding purchase orders for TM 65-1s. Except for the head assembly, the mechanical parts of the TM 65-1 are the same as those found in the TM 65-2. FF 797. Therefore, it is not unreasonable to postulate that TP, given additional time, could have produced TM 65-2 double-sided floppy disk drives a month. FF 798; see FF 792.

As of April 15, 1985, TP employed 350 persons. During the month of April 1985, TP planned to lay off approximately 25 to 50 employees. In May 1985, TP planned to lay off an additional 75 to 100 employees. Those employees left at TP were suppose to continue production of current orders for the TM 65-1 until July 1985, at which time they were to be laid off. FF 498, 806. TP has stopped production of floppy disk drives and has no plans to resume

production. FF 806A. The Texas Peripherals' Joint Venture Committee recently concluded that TP's production equipment would be stored pending the Commission's ruling on permanent relief. FF 509A-09G, 806D.

c. Control Data Corporation.

Control Data Corporation (CDC) was granted a license by Tandon on September 30, 1984, to manufacture and sell disk drives under the '573 patent. FF 722. CDC's industry position in 1983 approximated 20 percent of the full-height floppy disk drive market and a minimal percentage of the half-height floppy disk drive market. FF 725. CDC's industry position in 1984 approximated 20 percent of the full-height floppy disk drive market and 10 percent of the half-height floppy disk drive market. FF 726. CDC's current industry position approximates more than 20 percent of the full-height disk drive market and two percent of the half-height floppy disk drive market. FF 727. Most of CDC's floppy disk drives were 5-1/4 inch half-height or full-height drives. The old 8 inch drives constituted about percent of sales. percent of the full-height and almost all of the half-height 5-1/4 inch drives were double-sided. FF 732.

In 1983, CDC shipped about \$ worth of floppy disk drives or units. FF 729. CDC's five-year manufacturing plan prepared in late 1983 forecasted its 1984 requirements for 5-1/4 inch half-height disk drives at units and 1985 requirements as units. FF 733. This forecast underestimated CDC's 1984 requirements because by December 30, 1984, CDC had shipped units or about \$ worth of disk drives. FF 730. Also by December 30, 1984, CDC had firm 1985 purchase orders for

C floppy disk drives and had projected a high probability sales forecast
C of units. FF 731. By April 1985, however, CDC had to reduce its
D projected 1985 sales to about units even though it had already made a
C commitment to its offshore supplier to build floppy disk drives.
FF 734. CDC is obligated to pay for the offshore assembly of approximately
C floppy disk drives for the remainder of 1985, of which over percent
are double-sided 5-1/4 inch half-height floppy disk drives. FF 734A. CDC is
obligated to accept delivery of these units whether or not it has resale
orders from OEM customers. FF 734B.

Based upon CDC's cost of production in the United States, CDC in the third
quarter of 1984 started to question whether it should stay in the floppy disk
drive business and decided in September 1984 to move production of disk drives
offshore. FF 739, 751. In October 1984, CDC laid off 450 individuals from
its Oklahoma City facility. FF 750. In April 1985, as the result of CDC's
decision to phase out its domestic operations, CDC laid off an additional 150
employees. FF 751. CDC as of April 1985 continued to assemble and test
C approximately to percent of its requirements for half-height 5-1/4 inch
double-sided floppy disk drives at its Oklahoma City facility. FF 740. If
CDC does not resume floppy disk drive production at its Oklahoma City
facility, the facility, as well as equipment used there, will probably be
sold. FF 759E.

C In 1984, CDC experienced a write-down and operating loss of \$ million in
its floppy disk drive business. FF 748. As of April 1985, CDC was operating
C its 5-1/4 inch floppy disk drive business at a loss of \$ million a month.
FF 747. Based upon monthly analyses beginning in the fourth quarter of 1984,

C CDC decided in February 1985 that

C . CDC's position on this

C subject remained the same in August 1985. FF 749, 759G.

C

C . FF 759E. CDC's decision

C

C

C

. FF 759F-59H.

d. Shugart.

Shugart was formed in the mid-1970's by Allen Shugart and several key employees who had worked together at IBM and Memorex on disk drive designs. FF 702. By January 1976, Shugart was a single-product company with sales of \$1.5 million to \$3.0 million in 1975 and actual sales of \$9.0 million for 1976. The single product was an 8 inch single-sided floppy disk drive, which sold for \$400 to \$500 per unit. FF 703. Shugart was acquired by Xerox Corporation on December 16, 1977. FF 315. Shugart was granted a license by Tandon on July 1, 1980, to manufacture and sell disk drives under the '573 patent. FF 3.

By the end of 1981, Shugart employed 2,700 individuals (300 in Mexico) and had annual sales of approximately \$198 million. FF 704. In 1981, Shugart announced a full-height 5-1/4 inch double-sided disk drive of its own design. At the spring 1982 National Computer Conference, Shugart was the only company that displayed a half-height product. At the fall 1982 Comdex show, Shugart, Tandon, and CDC, as well as 12 to 15 Japanese companies, also showed half-height disk drives. FF 706.

Shugart never entered into commercial production of its own half-height disk drives because it could not develop a model which was cost effective relative to market prices. FF 330, 332-34. Shugart charted the price declines of 1983 and concluded that the decline had a very negative long-term impact. Shugart considered several economic alternatives to recover from the erosion in profits, including setting up an offshore production facility in either Singapore, Taiwan, or South Korea. FF 715. Shugart task forces in mid to late 1982 recommended the immediate establishment of a production facility in Singapore. Shugart was unable to receive management's approval for the establishment of this facility. FF 716. Shugart turned to its Japanese licensee, Matsushita, and entered into a purchase agreement for half-height double-sided floppy disk drives with prices ranging from \$124 to under \$100 depending upon the quantity ordered. FF 708. The extreme competitive environment at the end of 1983, however, caused Shugart's profitability to erode substantially, and Shugart suffered an operating loss in January 1984. FF 713.

In 1983, Shugart was the world's second largest manufacturer of floppy disk drives next to Tandon with an annual fiscal 1983 sales volume of \$240 million. FF 714. On December 19, 1983, Xerox, after examining economic studies concerning the steps needed to make Shugart fully profitable, concluded that Shugart could not be made profitable within the next 12 to 18 months even with substantial investments. FF 717. Xerox decided that it could no longer support Shugart. FF 717. In February 1985, Shugart's assets with respect to the 5-1/4 inch business were sold to Matsushita, including the extensive inventory that had been built up over the previous quarters.

FF 720. Production of Shugart's 3-1/2 inch double-sided disk drive operation ceased in February 1985, except for the fulfillment of existing commitments to C IBM for production of approximately double-sided units. FF 720A.

By October 1983, Shugart employed 3,600 individuals, of whom all but 550 individuals were employed in the United States. In October 1983, Shugart for the first time had to lay off 7-1/2 percent of its work force. FF 712. As of January 15, 1984, Shugart employed 2,600 people in the United States and 600 in Mexico, but by December 6, 1984, Shugart had to lay off more workers, reducing the number of its employees to 1,600-1,700 individuals, 400 of whom were employed in Mexico. FF 718. In January 1985, Xerox formally announced the closing of Shugart at a time when it employed 1,400 individuals. FF 720.

e. IBM.

In August 1984, IBM commenced production of 5-1/4 inch double-sided floppy disk drives in Boulder, Colorado. IBM has continued manufacturing disk drives from that time until the present. FF 542A. The IBM drive is covered by the claims of the '573 patent. FF 542B.

In December 1984, IBM employed about 10 individuals who were directly involved in the manufacture and assembly of its 5-1/4 inch double-sided floppy disk drives, including assemblers and a manufacturing manager, and 37 employees indirectly involved. Now there are 32 employees directly involved in the manufacturing process and 37 employees indirectly involved. FF 542S.

The disk drives manufactured by IBM are for use in IBM's personal computer and also in other IBM small computers and display products. IBM commenced such manufacture for the purpose of supplying its own internal needs for such disk drives in lieu of purchasing from outside vendors. FF 542C. IBM

initially decided to manufacture double-sided floppy disk drives because it thought it would be a profitable venture. IBM had only planned to use the drives for internal production purposes and never planned to sell the drives in the marketplace. FF 542D.

IBM Boulder will continue to manufacture 5-1/4 inch double-sided disk drives until current commitments are met, at which time IBM plans to discontinue such manufacture. Completion of the current commitments is expected around July 1986. FF 542K. The reason IBM plans to cease the manufacture of disk drives is that management has decided that internal manufacture of 5-1/4 inch disk drives is not financially attractive and that there are adequate supplies available in the marketplace. IBM made the decision to cease production of the disk drives in late July 1985 even though C it estimated that it could manufacture a volume of disk drives at a C cost of \$ to \$ unit and make an acceptable profit at this price. FF 542L, 542N, 542R. The decision to discontinue production of the IBM manufactured disk drives was based upon considerations of resource allocations rather than cost effectiveness of the project. FF 542M.

In order to show a violation of § 337 has occurred, complainant must demonstrate a causal relationship between respondents' unfair acts and the injury suffered as a result of such acts in the importation of the product. A discussion of the facts relating to whether such a causal relationship exists in this investigation follows.

2. Causation.

Section 337(a) states in part that it is unlawful for an owner, importer, consignee, or agent of either, to participate in (1) unfair methods of competition and unfair acts, (2) in the importation of articles into the United States, or in their sale, (3) the effect or tendency of which is to destroy or substantially injure an industry, efficiently and economically operated, in the United States, or to prevent the establishment of such an industry. 19 U.S.C. § 1337(a). All elements of § 337 must be established if complainant is to prevail; however, the existence of each element is not sufficient evidence of a violation of § 337 where one element is not related to another. See generally Certain Centrifugal Trash Pumps, 337-TA-43, at 9 (1979). The unfair methods of competition or unfair acts must be in the importation or sale of the subject articles such that the combination of these two elements destroys or substantially injures a domestic industry. The fact that a respondent imports the articles in question into the United States does not result in a violation of § 337 if the importation of that article is not a substantial cause of the injury. See Certain Floppy Disk Drives and Components Thereof, Initial Determination, Inv. No. 337-TA-203, at 51-54 (1985) (extensive review of the legislative history of § 337 supports this conclusion) (hereinafter referred to as Floppy I).

The critical question is whether a causal nexus exists between the injury found and the floppy disk drives imported by the Mitsubishi respondents. This question is complicated by the existence of numerous non-respondents, foreign licensees, and settled respondents that compete in the marketplace.

FF 618B-618C, 666J-666BB, 666HH, 691F-691H, 691K, 699-700A, 744, 756, 823-35, 863-70, 875-78, 898-906. See Vertical Milling Machines, 223 U.S.P.Q. 332;

Drill Point Screws, USITC Pub. No. 1365. There is also evidence that Shugart and Tandon both lost sales and market share because of their inability to supply high-quality or state of the art disk drives in response to market demand (FF 331-34, 640A-40Q, 835A-36, 843A-43J), and a broad consensus exists that qualitative factors, as well as competitive price, are critical for retaining floppy disk drive customers (FF 610, 637-39A). Market share gains by imports because of a broad based shift in consumer demand that complainant is unable to meet, may be considered in a causation analysis. See Certain Large Video Matrix Display Systems, Inv. No. 337-TA-75, USITC Pub. 1158, at 25; Centrifugal Trash Pumps, USITC Pub. 943, at 20-21 (Concurring Opinion of Vice Chairman Alberger).

a. Changes in the Marketplace.

From 1982 to 1983, the market for double-sided floppy disk drives changed structurally from full-height to half-height drives. Opn. at 110-13. Floppy I, FF 39.^{15/} The half-height drives introduced by Tandon were the TM 50 (primarily a single-sided, low performance, low cost, 48 TPI half-height drive) and the TM 55 (a double-sided, high performance, 96 TPI half-height that used essentially the same mechanics as the TM 50). Both drives are belt-driven or indirect drives. FF 640A; Floppy I, FF 39-40.

In the latter part of 1982 and the first part of 1983, Tandon was receiving substantial orders from its customers for its half-height, belt-driven drives. Tandon experienced substantial difficulty in manufacturing a trouble-free TM 50. Greater difficulty was being experienced with respect to the TM 55. Floppy I, FF 41. Tandon also became aware of the need for a half-height direct drive 5-1/4 inch disk drive around September or

^{15/} The evidence that supports the findings in Floppy I is also evidence of record in this investigation.

October 1982, and found by December 1982 that most customers insisted on direct drive floppy disk drives. FF 640C-40D. In the fall of 1982, Tandon assigned one of its employees, Philip Tomasi, to solve problems associated with the TM 50 and TM 55. Mr. Tomasi commenced work to modify or redesign the TM 55 to accommodate a direct drive motor. Floppy I, FF 42. Tandon expected to have a new direct drive floppy disk drive available for production in February or March 1983 (FF 640E), but because of an alleged theft of trade secrets (Floppy I, Opn. at 22-26), Tandon lost important lead time in its development of a direct drive product (see FF 640F).

There is a period of time during which the marketing of a new product is most opportune. The opportunity is sometimes referred to as a marketing window and is characterized by customers who, shopping for the first time, are open-minded and select a vendor in an impartial way. Floppy I, FF 55. The marketing window of opportunity for half-height 5 1/4 inch floppy disk drives opened in the summer of 1982 and broadened in the fall of 1982. Floppy I, FF 56-57. During the fall of 1982 and continuing into 1983, computer manufacturers evaluated half-height 5-1/4 inch floppy disk drives and selected their vendors based upon their assessment of the quality and performance of the disk drives and the perceived ability of the manufacturer to produce, deliver, and support the disk drives on a reliable long-term basis. Floppy I, FF 58. Very little of the customer base for half-height, direct drive floppy disk drives was eliminated due to the efforts of competitors in September-October-November 1982. Approximately 20 percent of the market for this product disappeared during the spring of 1983. During June-July-August 1983, another 10 to 20 percent of the market disappeared, and during

September-October-November 1983, another 10 to 20 percent disappeared.

Floppy I, FF 59. As major companies qualified and selected their vendors for half-height floppy disk drives, the marketing window began to close in early 1983 and was substantially closed by mid-1984. Of the customer base for this product perceived by Tandon in September 1982, only 10 or 20 percent of this base was available by August 1984. Floppy I, FF 62.

During 1982, 1983, and into 1984, Tandon was unable to deliver specified quantities of functioning half-height drives to many of its existing customers due to production problems. As a result, Tandon suffered many order cancellations. Tandon attributes \$ million in losses to its inability to deliver specified quantities of functioning half-height disk drives to customers. Tandon attributes a loss of \$ million in prospective business opportunities to its inability to deliver functioning disk drives to customers on a timely basis. FF 640H. Tandon tried to retain customers through sales of its TM 50 and TM 55 disk drives, including the TM 55D, a direct drive version of the TM 55, and promises of a future improved product, the TM 65. Because the TM 55 did not work adequately and the TM 65 lagged behind in development, Tandon lost customers. FF 640I; see Floppy I, FF 52. By August 1984, the TM 65 was available to customers, but only about 10 to 20 percent of the original customer base for direct drive half-height drives as perceived by Tandon in September 1982 was available. FF 640K. The TM 65 was not selected by several OEM manufacturers because, by the time it was available, competing half-height drives had already been evaluated and qualified. FF 640L. Also,

the inability of Tandon to deliver commercial quantities of functioning half-height drives during the period 1982-1984 seriously damaged Tandon's reputation. FF 640M; see Opn. at 99-101.

The evidence set forth both in the Floppy I and Floppy II investigations demonstrates that the shift in consumer product demand is a major cause of the injury to the domestic industry at issue. Complainant's argument to the contrary is severely undermined because a number of complainant's witnesses modified their testimony as to the exact cause of injury depending upon whether they testified in Floppy I or Floppy II.^{16/} For example, Tandon in

C Floppy II alleged that lost sales to _____ and _____ resulted from competition with respondents; however, in Floppy I the same lost sales of identical quantity and price were attributed by Tandon to its inability to deliver functioning half-height disk drives to these customers. C FF 835-35A, 836. Also, eight out of the _____ lost sales that Tandon attributes to respondents occurred prior to April 1984 (FF 835-42; Edwards, CX 818, at 5-7), when Tandon was unable to deliver an acceptable product. Tandon's inability to deliver functioning direct drive 5-1/4 inch half-height floppy disk drives in 1983-1984 and the poor quality of the drives which were shipped to customers, together with the fact that only 10 to 20 percent of the primary

^{16/} On the last day of the hearing on permanent relief, the administrative law judge inquired as to why evidence of record in Floppy I, relevant to the issues of this case, had not been placed by either party on the record of this investigation. The administrative law judge learned that respondents in a February 1985 request for production of documents had indeed requested judicial records, transcripts, notes and testimony. Complainant at that time objected to the relevancy of this request. The objection was overruled by the administrative law judge, and the documents were produced shortly after the complainant was ordered to do so in the last day of hearing. Tr. 5236-42, 5310-18.

customers for this market remained when Tandon's product became fully available in late 1984, combined to cause substantial injury to Tandon. The competitive acts of the Mitsubishi respondents were not a substantial cause of injury, especially since respondents' prices generally equaled or were above the market prices established either by complainant, its licensees, or non-respondents. FF 640M, 640Q-40R; see FF 680; 681C; CX 546, CX 551, CX 554, CX 562, MRX 49, at 40982, 40984, 41054, 41098.

Shugart's profitability was also significantly influenced by the structural change in the double-sided floppy disk drive market from full-height to half-height drives. Once Shugart placed Tandon's patented technology in its disk drives, it developed a successful and highly profitable full-height disk drive product line. FF 316-25. After Shugart learned about future competition, Shugart immediately started developing two new half-height products, Model A and Model B, and set a goal to develop a half-height disk drive that could be sold profitably at about \$140 to \$160. FF 330.

Shugart was the only company to display a half-height product at the spring 1982 National Computer Conference, but by the fall 1982 Comdex show, double-sided half-height drives were displayed by Shugart, Tandon, CDC, as well as 12-15 Japanese suppliers. FF 331. As a result of the Comdex show, Shugart increased the pressure on the Model A and Model B groups to meet cost targets and set the products for high volume manufacturing. The goal was to produce the drive at one to ten million units a year and to be extremely competitive in the \$140-\$150 price range. FF 332. As 1983 progressed, Shugart was unable to produce a price competitive half-height, double-sided floppy disk drive and dropped plans for commercial production of Model A

and Model B. Shugart turned to its Japanese licensee, Matsushita, and entered into a purchase agreement for half-height, double-sided drives (SA-455 and SA-465) at prices ranging from \$124 to under \$100 depending upon the quantity ordered. FF 334. Shugart's sales of disk drives produced by Matsushita are not encompassed within the domestic industry definition (see Opn. at 94), and its alleged loss of sales of Matsushita-produced disk drives are not properly considered part of the injury analysis.

b. Lost Sales.

While it is undisputed that Mitsubishi holds market share in the United States, it must also be shown that Mitsubishi's sales directly resulted in lost sales to complainant or its licensees. The evidence of direct loss of sales is especially important when there exists non-respondent competitors in the market. Drill Point Screws, USITC Pub. 1365, at 20-22; Vertical Milling Machines, 223 U.S.P.Q. 332.

The companies named by Tandon, Shugart, CDC, and TP in their allegations of lost sales correspond closely with MELA's customers (see FF 711-11A, 711C, 711E, 711H, 742-43, 745, 788-90, 835A-38, 841).^{17/} The competitive conditions facing some of MELA's major customers in the United States in 1984

C ^{17/} Sales of double-sided floppy disk drives models M4851, M4852, M4853, M4854, and M4855 accounted for approximately percent of MELA's peripheral sales in January-June 1985. Compare CX 534 with CX 535. See Foster, Tr. 4846; Foster Dep., CX 574, at 189-90.

(FF 688B) and in January-June 1985 (FF 688C) supports the above conclusion that Mitsubishi gained this business primarily because of the failure of the domestic industry to respond to changes in market demand.

C i. In 1984, CDC sold primarily full-height, double-sided
C disk drives to Ousley, Tr. 671. CDC's role as a new products vendor
C for was terminated in the third quarter of 1984, however, even though
C CDC had quoted prices to in the low \$ Ousley, Tr. 672. FF 742.
C CDC is still a vendor with Ousley, Tr. 672. CDC considers to
be a lost sale. FF 742-43.

C In January-June 1985, was MELA's largest single customer for
computer peripherals, accounting for 50 percent of MELA's peripheral sales.
C CX 535. Jack Sellers, , left
C Tandy for in April 1984. FF 663D. Mr. Sellers recommended to
quality and purchasing officials that they change to the Mitsubishi disk drive
based upon his experience with Mitsubishi disk drives at Tandy. FF 663F.
Mr. Sellers also experienced quality and delivery problems with respect to
Tandon's double-sided floppy disk drives during his tenure at Tandy. FF 663A.

C MELA's sales history report shows that it sold full-height
C 5-1/4 inch disk drives to at a price of \$ during September-October
C 1984. CX 434, at 504243-44; CX 872, at 1; Foster, Tr. 4795-96. was
C willing to pay a \$ premium to MELA for delivery of disk drives in
C August 1984. CX 856, at 517177-78. currently uses a half-height
5-1/4 inch Mitsubishi disk drive. FF 663F.

C In April 1985, CDC attempted, but failed, to regain the half-height
C business, by quoting prices as low as \$ to \$ per unit. FF 743.
C During the period January-June 1985, MELA's lowest price to was \$
per unit. CX 534, CX 872, at 1-2. Tandon currently is not a qualified disk
C drive supplier at . FF 663G.

C The evidence does not support the assertion that purchased the
C Mitsubishi disk drives because of low price. MELA's selling price to
in 1984 and 1985 was above the market price and above the quoted prices of
MELA's domestic competitors. Based on Mr. Sellers' favorable experience with
C Mitsubishi drives, decision to purchase Mitsubishi drives at his
recommendation appears to be the result of quality, rather than price,
factors. FF 663C.

C ii. In January-June 1985,
C was MELA's third largest customer, accounting for
percent of MELA's peripheral sales. CX 535. Both Tandon and Shugart consider
C a lost sale. FF , 836.

Tandon's allegation involves the cancellation in July 1983 of orders for
C the TM 55 worth \$. The record strongly supports the view, and Tandon
C has in fact stated, that cancelled this order because Tandon was unable to
solve its production problems and deliver specified quantities of functioning
C half-height disk drives. FF 836; see also FF 637-40J. is not currently
purchasing commercial quantities from, or evaluating, Tandon double-sided disk
drives. Tandon Response to Mitsubishi Requests for Admissions Nos. 136-37.
C The Mitsubishi disk drives purchased by were priced higher than the Tandon
disk drives. Tjon, Tr. 2030.

C Shugart's allegation relates to its attempt to sell double-sided
C 96 TPI disk drives to during the second and third quarters of 1984.
C FF 711-11A. The evidence indicates that Shugart must have offered its
C SA-465 disk drives, since in 1984 used a half-height disk drive in its
system. These drives are produced for Shugart by Matsushita, as Shugart
dropped its own development of half-height disk drives in 1983 and contracted
to purchase double-sided half-height floppy disk drives from Matsushita for
less than \$100 to \$124. FF 334, 344B; Tjon, Tr. 2027. During the second and
third quarters of 1984, Mitsubishi sold double-sided, half-height disk drives
C to for prices ranging from \$ to \$. CX 434; CX 872. Shugart's
sales of disk drives produced by Matsushita are not encompassed within the
industry definition, and its alleged loss of sales of Matsushita-produced disk
drives are not properly considered part of the injury analysis. In any event,
price does not seem to be a factor in this example, because the Mitsubishi
prices were above the Shugart/Matsushita prices.

C iii. . In January-June 1985, was
C MELA's fourth largest customer, accounting for percent of MELA's computer
C peripheral sales. CX 535. Tandon, Shugart, and CDC all consider a lost
sale. FF 711E, 745, 843G; Edwards, CX 818, at 6.

C In 1983, requested a Tandon quote for 72,000 TM 65s to be delivered
C over a two-year period. Tandon quoted a price of \$ per drive, but
because the TM 65 was not available and the customer desired a direct disk
drive, this sale was not made. Mr. Abraham was informed that a two-year
C contract for 72,000 drives was given to Matsushita and Shugart for \$ a
C drive. FF 843G. On January 25, 1985, Tandon quoted \$ to \$ per

C drive to for its TM 65-8 (1.6 megabyte) and \$ to \$ for its
C TM 65-2 (0.5 megabyte). Complainant was informed by that Tandon's
competition was offering lower prices. Edwards, CX 818, at 6.

C In March-April 1985, Mitsubishi supplied with disk drives (0.5
C megabyte) at \$ per unit. MRX 48, at 41720; CX 534, at 527208. In June
C 1985, Mitsubishi supplied with disk drives (0.5 megabyte) at \$
C per unit. CX 534, at 527208. According to Mr. Foster, the \$ price
C reduction to was due to a buildup of drives in MELA's inventory. The
inventory buildup resulted from MELA's importation of drives in the first half
C of 1985 based on early 1985 projected requirements, which never
materialized. Because the drives had a unique PC board designed specifically
C for , the drives would otherwise have to be retrofitted should MELA hope to
e sell them to other customers. FF 666V. told MELA that Matsushita, with
C whom MELA shared the business, had quoted a \$ or \$ price for its
drives, and that Mitsubishi had to be competitive in order to participate in
C the total order for about drives. FF 666W.

C Shugart maintains that as late as April-May 1984, when first started
C purchasing disk drives from Mitsubishi, it had percent of the
business. Shugart asserts that it had to lower its price to hold a share of
C the account. Neun, CX 821, at 12. In competing against Mitsubishi for
sales to this account, however, Shugart would have to market the half-height
disk drives produced for Shugart by Matsushita. As discussed above, these
lost sales allegations are not considered part of the injury analysis.

In the third quarter of 1984, CDC attempted to solicit orders for half-height floppy disk drives from at \$ to \$ per unit. CDC was unsuccessful in its bid, being told that there were three or four vendors offering prices from \$ to \$ per unit. FF 745. In the third quarter of 1984, Mitsubishi's prices to ranged from \$ to \$ per unit. CX 872; CX 434. In April 1985, CDC was told that it would have to bid less than \$ to obtain business. FF 745. In April 1985, Mitsubishi's price to was \$. CX 872; CX 534.

Both Mitsubishi and Matsushita disk drives are sold to , and it appears that may be playing these two suppliers against each other to obtain the most favorable price. Cf. Opn. at 110-13. The record also shows that Mitsubishi prices were above prices maintained it could get from alternative suppliers.

iv. . In January-June 1985, was MELA's second largest customer, accounting for percent of MELA's peripheral sales. CX 535. Tandon's alleged lost sale to respondents involves the purchase by of double-sided floppy disk drives from Mitsubishi in October 1983. FF 837. Tandon did not produce commercial quantities of a viable half-height disk drive until late 1984; therefore, this lost sales allegation lacks credibility. is not currently purchasing commercial quantities from, or evaluating, Tandon double-sided disk drives. Tandon Response to Mitsubishi Requests for Admissions Nos. 180-81.

v. . In January-June 1985, was MELA's 16th largest customer, accounting for about percent of MELA's peripheral sales. CX 535. Both Tandon and Shugart consider a lost sale. FF 711D, 842.

C Tandon's allegation involves purchase in June 1983 of Mitsubishi's
5-1/2 inch disk drives. By its own admission, Tandon experienced severe
problems supplying half-height drives to the marketplace in June 1983. Opn.
C at 126-30. Thus, this lost sale allegation is without foundation. is
not currently purchasing commercial quantities from, or evaluating, Tandon
double-sided disk drives. Tandon Response to Mitsubishi Requests for
Admissions Nos. 150-51.

C Shugart's allegation involves purchase of to drives
per year from Mitsubishi in the second quarter of 1984. FF 711D. Since
Shugart's sales of half-height products were exclusively Matsushita-produced
drives, this lost sale is not considered part of the injury analysis.

C vi. Tandon, Shugart, and TP all consider a lost sale.
FF 711H, 764-96, 835-35A. Tandon's lost sale allegation refers to
C cancellation of an August-November 1983 order for TM 55s worth \$. The
C evidence indicates, however, that canceled this order because Tandon was
unable to solve its production problems and deliver a specified quantity of
functioning half-height disk drives. FF 835A. Tandon's second alleged lost
C sale of a account concerns competition from TEAC, a settled respondent.
FF 835.

C Shugart's lost sale allegations refer to purchase of to
C Mitsubishi disk drives (96 TPI) in the second quarter of 1984 and
C to half-height Mitsubishi disk drives (48 and 96 TPI) in the
fall of 1984. As discussed above, the Shugart half-height disk drives were
produced by Matsushita and are not considered part of the injury analysis. In
addition, internal Mitsubishi documents indicate that MELA lowered its price
to that of its competitors', including Shugart, Matsushita, and TEAC, during
this period to obtain the sale. CX 855.

TP's alleged lost sale refers primarily to sales of the TM 65-2, a 48 TPI
C disk drive, which TP was developing for sale to Tandon and
C . FF . The record indicates that TP's primary
C competition for floppy disk drive sales to was TEAC, and that
decision to discontinue purchasing from TP was due to qualification and
delivery problems exacerbated by the lower-priced TEAC drive. Opn. at 116-19.

Finally, the record indicates that Mitsubishi's 1984-1985 sales to
of almost exclusively 96 TPI disk drives were at prices higher than its
competitors, including Matsushita, a Tandon licensee. TRX 66-67; CX 434;
CX 534; CX 855; CX 872.

C vii. . This alleged lost sale involves an attempt
C by Tandon to obtain business from .
C In June 1985, Tandon quoted a price range for its floppy disk drives
C from \$ to \$ per unit. Tandon was informed that Mitsubishi, TEAC,
and Toshiba had offered substantially lower prices. CX 818, at 6. Tandon has
not provided, however, any additional evidence concerning whether Mitsubishi
actually obtained this sale. Mr. Foster of MELA testified that MELA may have
C given evaluation units of its double-sided disk drives to (Foster,
Tr. 4894), but MELA's sales report for the period January-June 1985 does not
C reflect any sales to (CX 535).^{18/}

^{18/} Other customers referred to by Tandon as lost sales to Mitsubishi concern the period prior to August 1984, a time when Tandon was unable to supply commercial quantities of viable direct-drive, half-height disk drives to the market. See FF 837, 841-43F, 843H-43J, 637-40P; Opn. at 126-30. Other customers referred to by Shugart as lost sales to Mitsubishi concern competition between Mitsubishi's half-height disk drives and Shugart's SA-455 and SA-465 disk drives, both of which are produced by Matsushita. Only Shugart's full-height floppy disk drives are included within the domestic industry; therefore, lost sales of Matsushita-produced half-height drives are not relevant to an injury determination. Opn. at 94.

The above evidence supports the conclusion that sales of double-sided floppy disk drives by the Mitsubishi respondents' did not directly result in loss of sales to the domestic industry. There is also little evidence that the Mitsubishi respondents gained their market share in the United States because of low price; rather, the record supports the view that complainant, as well as non-respondents, settled respondents, and Tandon's licensees, especially Matsushita, were more price aggressive.^{18a/} See FF 666K, 666N, 666Q-66HH. Respondents appeared to react more to the lower prices set by competitors. FF 666K-66HH, 983-86. The fact that customers were willing to pay a premium for Mitsubishi disk drives also indicates the existence of qualitative advantages in purchasing these drives.^{19/}

There is no evidence of record that the activities of respondents injured TP. The record indicates that TP's primary competition for floppy disk drive sales to _____ was _____, and that _____ decision to discontinue purchasing from TP was due to qualification and delivery problems exacerbated by the lower-priced _____ drive. Opn. at _____.

Finally, there is no evidence of record that the activities of respondents injured IBM.

C ^{18a/} In late 1984, Mitsubishi (Japan) would not meet _____ purchase price objectives due to Mitsubishi's own cost constraints. Matsushita/Panasonic currently supply _____ flexible disk drive requirements. FF 666Q-66T.

^{19/} Findings of fact concerning Mitsubishi's attempts to beat Shugart with price (as well as with quality and support) relate to competition with Matsushita-produced drives, rather than U.S.-produced drives. Moreover, these facts do not necessarily show that Mitsubishi quoted lower prices than Shugart/Matsushita drives. FF 711F-11G.

in the marketplace. The decision to discontinue production of the IBM manufactured disk drives was based upon considerations of resource allocation rather than cost effectiveness of the project. Opn. at 123-24.

For the foregoing reasons, the administrative law judge finds that the alleged unfair methods of competition and unfair acts of respondents in the importation of double-sided floppy disk drives into the United States, or in their sale, do not substantially injure the domestic industry.

C. Tendency to Substantially Injure

When an assessment of the market in the presence of the accused imported products demonstrates relevant conditions or circumstances from which probable future injury can be inferred, a tendency to substantially injure the domestic industry has been shown. Certain Combination Locks, Recommended Determination, Inv. No. 337-TA-47, at 24 (1979). Relevant conditions or circumstances may include foreign cost advantage and production capacity, ability of the imported product to undersell complainant's product, or substantial manufacturing capacity combined with the intention to penetrate the United States market. Certain Methods for Extruding Plastic Tubing, Inv. No. 337-TA-110, U.S.P.Q. 348 (1982); Reclosable Plastic Bags, Inv. No. 337-TA-22 (1977); Panty Hose, Tariff Comm'n Pub. No. 471 (1972). The legislative history of § 337 indicates that "[w]here unfair methods and acts have resulted in conceivable loss of sales, a tendency to substantially injure such industry has been established." H.R. Rep. 93-571, 93 Cong., 1st Sess. 78 (1973), citing, In re Von Clemm, 108 U.S.P.Q. 371 (C.C.P.A. 1955); see also Bally/Midway Mfg. Co. v. U.S. Int'l Trade Comm'n, 219 U.S.P.Q. 97, 102 (C.A.F.C. 1983).

The market factors discussed under "substantial injury" will continue to affect the domestic industry. As major companies qualified and selected vendors for half-height 5-1/4 inch double-sided floppy disk drives, the marketing window for this product substantially closed by mid-1984 such that only 10 or 20 percent of the customer base was available by August 1984. Once an OEM selects a floppy disk drive vendor for one of its products, there are certain factors that weigh against changing the vendor for the product. For example, OEMs spend a substantial amount of time and effort to evaluate a vendor and its product, and a change in vendors may require retraining of personnel and customers and alterations in sales manuals and software. Additionally, OEMs tend to enter into long-term contracts. FF 846.

Part of the 5-1/4 inch drive market will experience a resurgence as OEMs evaluate and qualify higher capacity disk drives, but the central focus for the future of this market will be competition between firms as replacement suppliers and as second-source vendors. See FF 913-15. It is likely that the market trend towards smaller size, higher-capacity drives will continue. The marketing window for 3-1/2 inch double-sided disk drives will probably broaden in the near future, even though this market has not yet grown at the rate expected because IBM has not yet introduced in the United States a computer utilizing this drive and the market has not yet created a large amount of software. FF 597-99; see FF 848, 850, 854, 855A, 856, 856B, 858C.

1. The 5-1/4 Inch Double-Sided Floppy Disk Drive Market.

The Mitsubishi respondents have the ability and intent to continue to sell 5-1/4 inch double-sided floppy disk drives in the United States' market. FF 849, 883-84, 889, 892. Factors discussed above and in the section on "substantial injury," however, suggest that respondents' imports do not have the tendency to substantially injure the domestic industry. Opn. at 126-31.

Tandon eliminated itself from a large portion of the 5-1/4 inch market when it failed to have available half-height disk drives during the initial qualification period in 1982-1984. FF 640H-40L, 640Q. The fact that Tandon's reputation was seriously damaged by its inability to deliver commercial quantities of functioning half-height drives during this period (FF 640M; see Opn. at 99-101), will continue to hamper Tandon in its efforts to market its disk drives. Tandon and its licensees history of lost sales is the result of the failure to supply quality disk drives with the technical features demanded by the marketplace. Opn. at 110-13, 116-21, 126-31. Lost sales to an OEM are significant not only because of the particular customer lost, but also because of the probable loss of future sales opportunities with the OEM. FF 847.

Mitsubishi's past success in the 5-1/4 inch disk drive market has been the result of its ability to offer high-quality, technologically-advanced disk drives. There is little evidence that respondents gained their market share in the United States because of low price (Opn. at 131-39), and the fact that customers were willing to pay a premium for Mitsubishi disk drives indicates the existence of qualitative advantages in purchasing these drives (See Opn. at 139). Mitsubishi disk drives are generally higher priced than disk drives supplied by Tandon's foreign licensees and non-respondents. FF 666K, 666N, 666Q-66DD, 666HH; see MRX 49, at 40982, 40984, 41054, 41098; CX 546; CX 551; CX 554; CX 562.

Mitsubishi's ability to undersell Tandon in the marketplace is a function of Mitsubishi's and Tandon's relative costs of production. Unit cost information by different models for Mitsubishi double-sided disk drives is not available in the record. IBM estimated that it could profitably produce 1.2

C megabyte floppy disk drives for \$ to \$ per unit for annual
C production quantities of units. FF 542N. Based on the IBM's
assessment of the trade press, Japanese disk drive producers are at least as
sophisticated as IBM. Fenstermaker, Tr. 3573. Therefore, the IBM cost can be
used as a reasonable proxy for costs of production in Japan.

Tandon's costs are a function of negotiating a price from Tandon
Associates, which is separate from Tandon and acts on behalf of Eastern
Peripherals. Huenemeier, CX 835, at 29. For small production quantities,
C Tandon Associates currently sells TM 65-2s to Tandon for \$. Tandon
negotiates price with Tandon Associates based on projections of its
requirements over the next three or four months. Huenemeier, Tr. 3674. If
Tandon purchases more than its projected requirements, it would renegotiate
the price with Tandon Associates. Huenemeier, Tr. 3675. Tandon has not
estimated what price it would be able to negotiate from Tandon Associates for
C quantities of to units, although the price would be lower based
on lower production costs for higher-volume production. Huenemeier,
Tr. 3673-74; see, Huenemeier, CX 835, at 30; Fenstermaker, Tr. 3570, 3583.

Because of Tandon's low production volumes to date for half-height drives,
it is difficult to determine what Tandon's cost would be at higher production
quantities. However, it is apparent that Tandon's costs would decrease
C because of lower unit overhead costs. Mr. Huenemeier believes that
C
Huenemeier, CX 835, at 30. Mr. Fenstermaker of IBM estimated that unit
C production costs would increase by \$ to \$ for production volume
C decreases of roughly units when operating in the to

unit range. When operating at lower volumes, unit cost changes would be even greater. FF 542Q; Fenstermaker, Tr. 3583-85. Based on the indeterminacy of Tandon's potential costs at higher production volumes, and the evidence that Tandon's units costs could decrease substantially at higher production volumes, it is difficult to determine whether Mitsubishi will be able to undersell Tandon because of a relative cost advantage.

Currently, a number of potential customers will not consider Tandon disk drives because of past quality problems. Complainant also lost a number of prospective business opportunities because potential customers evaluated and qualified competitors' drives when Tandon drives were not available. FF 640H, 640K-40L, 640Q-40R; MRX 49, at 40991, 41104; Opn. at 126-38. Other customers, however, have recently evaluated Tandon's TM 65. See FF 640P, 640S-640U, 849-49A, 850A-50B, 853, 855, 855B, 856-56A. These facts demonstrate that if Tandon is successful in improving the quality of its product, it may be able to gain market share.

The constant competitive demands on OEMs to upgrade their systems have increased the pressure to reevaluate different diameter disk drives and different suppliers, thereby increasing the possibility of substitution in the post-design stage period for computers. Tandon's future success or failure will depend on its ability to offer high-quality disk drives technically comparable with competitive market drives. Although price is always an important variable for a potential purchaser, it has not been the critical variable with respect to competition between the domestic industry and the Mitsubishi respondents. Tandon thus can price higher than the market price levels set by its licensees and nonrespondents, and remain price-competitive with Mitsubishi.

2. The 3-1/2 Inch Double-Sided Floppy Disk Drive Market.

The Mitsubishi respondents have demonstrated the capacity, ability, and willingness to compete in the 3-1/2 inch market. FF 883A, 883G-83H, 883J, 883M. And while the marketing window for primary suppliers of half-height 5-1/4 inch double-sided floppy disk drive market has substantially closed, the marketing window for primary suppliers of 3-1/2 inch double-sided drives is at the early stages of development. This market has not grown at the rate expected, but IBM's recent decision to purchase a large number of 3-1/2 inch disk drives from Mitsubishi beginning the spring of 1986 demonstrates this market's future growth potential.

To date, sales of 3-1/2 inch double-sided floppy disk drives have accounted for only a small portion of the Mitsubishi respondents sales of disk drives in the United States. FF 883B. For example, MELA's largest new account for 1985 is with _____ for _____ to _____ double-sided 3-1/2 inch disk drives at the proposed July-December 1985 price of \$ _____. FF 883G-83H. For the period July-December 1985, MELA forecasted sales of _____ double-sided 3-1/2 inch disk drives in the United States, though approximately _____ of these sales are to _____, and may be considered part of the injury analysis only with respect to respondents' perceived production capacity. FF 883G; see FF 883F. Respondents also forecast substantial sales of 3-1/2 inch disk drives for the period January-June 1986. FF 883M. MELA's estimated prices for these sales range from \$ _____ to \$ _____. FF 883G. Mitsubishi recently won a contract to supply IBM with 250,000 units of a new model 3-1/2 inch disk drive (MF 355, 2.0 megabyte) shown during the July 1985 National Computer Conference Show. FF 883K.

Tandon has developed 3-1/2 inch double-sided disk drives (1.0 megabyte) at its Microtek facility, and has shipped evaluation units to potential

C customers, including . FF 476-81, 487-87A, 488A, 488C-88D, 848, 850, 856, 856A, 858C-58D; see Opn. at 77-78. Tandon does not currently have a full-scale production line in place for these products, but can proceed to a production capacity of 10,000 drives per month in 90 to 120 days. FF 482-86, 488, 488B.^{20/} The market's perception concerning the poor quality of Tandon 5-1/4 inch disk drives may be an impediment to Tandon's potential success with the 3-1/2 inch drive market. However, because this market is in the evaluation stage, OEMs will be more willing to evaluate and qualify various suppliers. Cf. FF 858C-58D, 911.

There have been few sales of 3-1/2 inch disk drives by Mitsubishi in the domestic market. Thus, it is difficult to determine respondents' pricing strategy regarding this product.^{21/} Respondents' assessment of the tradeoff between higher short term profit (higher price) and market share will affect

C ^{20/} Microtek is currently working on development of a
C . FF 475A-75B. Tandon's lack of full-scale production facilities in place may detract from its ability to sell the 3-1/2 inch drive.

^{21/} Cost of production is also difficult to estimate in the early stages of the 3-1/2 inch drive.

its decision with respect to pricing strategy. FF 883L. The evidence suggests that Mitsubishi may be willing to take a short-term loss for sales of 3-1/2 inch floppy disk drives in order to gain a foothold in the market, then offset this loss with 5-1/4 inch disk drive profits. FF 897A.

Sony, a settled respondent and licensee of complainant, is expected to be a major factor in the supply of 3-1/2 inch drives. FF 858E, 898-99. Like Mitsubishi, Sony may be expected to price in a manner which would ensure a foothold in this burgeoning segment of the industry.^{22/} TEAC, also a settled respondent and licensee of complainant, is expected to be a major supplier of 3-1/2 inch drives. FF 858E, 863, 868. TEAC has generally followed an aggressive price policy with respect to its double-sided disk drives. FF 699, 700, 772, 789-90, 860-62, 875; see Opn. at 117-18. Mitsubishi's most recent sale of 3-1/2 inch drives have been at relatively high prices. FF 883G-83H. There is no evidence of the price levels in the sales to IBM, or of Tandon's offering prices of this product.

^{22/} Sony's presence in the U.S. market has been primarily with respect to 3-1/2 inch disk drives. FF 898-901.

It is too early to tell which firms will establish the market price levels, but it is expected that complainant's foreign licensees will play a major role in this process. The evidence does not justify a finding that Mitsubishi's pricing practices regarding this product will be any different than with regard to the 5-1/4 inch product. There is thus no sufficient evidence to establish that Mitsubishi will underprice the domestic industry for the 3-1/2 inch product.

The intervening factors discussed in substantial injury play the same role in tendency toward substantial injury. In light of these factors and those discussed above, competition by the Mitsubishi respondents is not likely to be a substantial factor in any future loss of sales to the domestic industry. For the foregoing reasons, the alleged unfair methods of competition and unfair acts of respondents in the importation of double-sided floppy disk drives into the United States, or in their sale, do not have a tendency to substantially injure the domestic industry.

FINDINGS OF FACT

I. JURISDICTION

1. The United States International Trade Commission, pursuant to section 337 of the Tariff Act of 1930, as amended, has jurisdiction over the subject matter of this investigation, because the alleged unfair acts and unfair methods of competition involve importation and sale of articles alleged to infringe complainant's U.S. Letters Patent No. 4,151,573 (the '573 patent). Notice of Investigation, 50 Fed. Reg. 4,276 (Jan. 30, 1985).

II. THE PARTIES

A. Complainant and Interested Persons

2. Tandon Corporation is a California Corporation having its principal place of business at 20320 Prairie Street, Chatsworth, California 91311. Founded in 1975, it is the world's largest manufacturer of random access disk drives for microcomputer systems and the world's largest producer in the market of floppy disk drives. These systems include word processors, personal computers, and small business computers. Complaint, ¶ 3, 4; SRX 172, Tandon's Response to Sony's Request for Admission, Nos. 86, 87 (Feb. 11, 1985).

3. Shugart Associates, a subsidiary of Xerox Corporation, is located at 475 Oakmead Parkway, Sunnyvale, California 94086. Shugart is a licensee of Tandon's U.S. Letters Patent No. 4,151,573 (the '573 patent) as of July 1, 1980. Complaint, ¶ 59; CX 616.

4. Control Data Corporation (CDC) is headquartered at 8100-34th Avenue, South Minneapolis, Minnesota 55420. CDC was granted a license on September 30, 1984, to manufacture and sell disk drives under the '573 patent. Complaint, ¶ 64; CX 620; Ousley, Tr. 629.

5. Magnetic Peripherals, Inc. (MPI), is a partially-owned subsidiary of Control Data Corporation, and headquartered at 8100-34th Avenue, South Minneapolis, Minnesota 55420. MPI was granted a license on September 30, 1984, to manufacture and sell disk drives under the '573 patent. CDC is a 67 percent majority owner of MPI; part owners of MPI include Honeywell, Sperry, and Bull. Complaint, ¶¶ 59, 62; Ousley, Tr. 627-29; CX 620.

6. Texas Peripherals, Inc. (TP), located at 3131 W. Bolt Street, Fort Worth, Texas 76110, is a joint venture of Tandon and Tandy Electronics. Under the joint venture agreement, TP has a non-exclusive license under the '573 patent to manufacture and sell TP's products. Complaint, ¶ 63; CX 722, at 7.

6A. International Business Machines (IBM), a New York corporation located in Armonk, New York, is a licensee of Tandon's U.S. Letters Patent No. 4,151,573 as of January 1, 1984. Complaint, ¶ 65.

7. Mitsubishi Electric Corporation (MELCO) is a Japanese company organized and existing under the laws of Japan. MELCO's principal place of business is located at 2-3 Marunouchi 2-chome, Chiyoda-ku, Tokyo 100. MELCO designs, manufactures, and sells double-sided floppy disk drives for importation into the United States. Complaint, ¶ 14(a); CX 401.

8. Mitsubishi Electronics America, Inc. (MELA), with offices at 911 Knox Street, Torrance, California 90502, is a domestic company and a subsidiary of MELCO. MELA imports, sells, and distributes within the United States double-sided floppy disk drives manufactured by MELCO. MELA and MELCO will be referred to collectively as Mitsubishi. Complaint, ¶ 14(b); CX 401, 404.

9. TEAC Corporation (TEAC Japan), a settled respondent, is a Japanese company organized and existing under the laws of Japan. TEAC Japan's principal place of business is located at 3-7-3 Naka-cho, Musashino, Tokyo 180. TEAC Japan designs, manufactures, and sells double-sided floppy disk drives for importation into the United States. Complaint, ¶ 14(c); CX 1; Order No. 25 (Oct. 2, 1985).

10. TEAC Corporation of America (TCA), a settled respondent with offices at 7733 Telegraph Road, Montebello, California 90640, is a domestic company and a subsidiary of TEAC Japan. TCA imports, sells, and distributes within the United States double-sided floppy disk drives. TEAC Japan and TCA will be collectively referred to as TEAC. Complaint, ¶ 14(d); CX 1; Order No. 25 (Oct. 2, 1985).

11. Sony Corporation (Sony), a settled respondent, is a Japanese company organized and existing under the laws of Japan. Sony's principal place of business is located at 6-7-35, Kita-shinagawa, Shinagawa-ku, Tokyo 141. Sony designs, manufactures, and sells double-sided floppy disk drives for importation into the United States. Complaint, ¶ 14(e); CX 203, 204; Order No. 20 (July 19, 1985).

12. Sony Corporation of America (SONAM), a settled respondent with offices at Sony Drive, Park Ridge, New Jersey 07656, is a domestic company and a subsidiary of Sony. SONAM imports, sells, and distributes within the United States double-sided floppy disk drives. Sony and SONAM will be collectively referred to as Sony. Complaint, ¶ 14(f); Mergerline Dep., CX 252, Tr. 40; CX 203, 204; Order No. 20 (July 19, 1985).

III. UNFAIR METHODS OF COMPETITION

A. Background of the Invention.

13. In 1964, the state-of-the-art drive was reel-to-reel tape drive. Sollman, Tr. 10-11.

14. In 1964 or 1965, the industry pursued an information storage product called a magnetic card random access memory device. Sollman, Tr. 12. IBM also was working on a new storage device called a disk drive, using a rigid disk 30 inches in diameter. Sollman, Tr. 13-15.

14A. The development of the floppy disk drive began in 1968 at IBM. The first floppy disk drive, the IBM Model 23 FD, was a read-only, single-sided machine used for program loading and included a spherical, stainless steel transducer or head on one side of the disk, a spring-loaded pressure pad on the other side of the disk opposite the head, a carriage for supporting these parts, and a carriage drive mechanism for moving the head along a radius of the disk to access the concentric data tracks. Dalziel, CX 822, ¶ 4; CX 601, col. 1, lines 15-36; CX 643.

14B. The IBM Model 23 FD is shown and described in U.S. Letters Patent No. 3,678,481 (Dalziel et al.) filed March 13, 1970. Dalziel, CX 822, ¶ 4; CX 643.

14C. In conjunction with the 23 FD disk drive, IBM developed the first floppy disk drive in which a Mylar recording disk was enclosed in a square jacket or envelope with head and pressure pad access slots and central openings for receiving the drive hub and positioning cone. Both this "diskette" and the single-sided floppy drive became worldwide standards. Dalziel, CX 822, ¶ 4; CX 643.

15. About in 1972 a floppy disk drive was being developed by 15 to 20 different companies in the United States. Sollman, Tr. 31; see id., 23.

16. U.S. Letters Patent No. 4,151,573 (the '573 patent) issued on April 24, 1979, from Application Serial No. 805,731 (the '731 application) filed June 13, 1977, and names Sirjang L. Tandon, Alfred C. Hackney, and Roy A. Applequist as the joint inventors. The patent is entitled, "Magnetic Recording Device for Double-Sided Media." CX 601; see CX 611.

17. Single-sided floppy disk drive systems were in use prior to the advent of double-sided floppy drives. The single-sided drives employ a single transducer for contacting the disk. On the opposite side from the transducer, and also in contact with the disk, was a felt pressure pad to press the disk against the transducer. CX 601, col. 1, lines 20-36; CX 643.

18. The double-sided floppy disk drive described in the '573 patent includes in part a dual read/write head or transducer assembly for transferring data to and from the floppy disk, a central hub and spindle for gripping and rotating the disk, a front cover which may be pivoted open to permit insertion and removal of the disk, and a mechanism for positioning the transducer assembly to a selected radial track position. The floppy disk is enclosed within a protective cover jacket having access slots through which the transducers can come into contact with the opposed surfaces of the disk. CX 601, col. 3, lines 49-63.

19. With reference to the specification and drawings of the '573 patent which describe and show an exemplary form of the patent, there is included a read/write transducer assembly comprising generally a carriage, a lower or first transducer (also called the side ϕ transducer) for

transferring data to and from one side of the disk, and an upper or second transducer (also called the side 1 transducer) which opposes the lower transducer and transfers data to and from the other side of the disk. CX 601.

20. The lower side 0 transducer is mounted on the carriage while the upper side 1 transducer is mounted on a support arm that is coupled to the carriage by a flexure spring which serves as a pivot for the support arm. CX 601.

21. A torsional spring loads the support arm towards the carriage thereby urging the upper side 1 transducer towards the disk and the opposed lower side 0 transducer. CX 601.

22. The upper head is mounted at the end of a short length gimbal spring that permits the upper transducer to pitch and roll in response to the tendencies of the disk to deflect. CX 601.

23. In November 1976, IBM introduced the world's first double-sided floppy disk drive. Sollman, Tr. 60-61.

24. The diskettes for the IBM double-sided disk drive were coated on both sides. The disk drive placed two heads, one on each side of the diskette, in contact or near-contact with the diskette. The heads were both cantilevered and the diskette would flow between them. Sollman, Tr. 61-62.

25. Mr. James T. Engh, director of the double-sided floppy disk drive program at IBM, summarized the double-sided floppy development work at IBM in an article entitled "The IBM Diskette and Diskette Drive" published in the September 1981, IBM Journal of Research and Development. Engh, Tr. 902, 916; CX 664.

26. The IBM double-sided head assembly is described in the '573 patent under the "Background of the Invention." That description, in pertinent part, states:

Recently, however, the floppy disc industry has started to use both sides of the floppy disc for data transfer operations, the purpose primarily being to increase capacity. Thus only a single relatively low speed accessing mechanism continues to be employed, and the transducers on opposite sides of the element are in a generally opposed relation, with only a slight offset in the head gaps to avoid flux interaction. Because it is thought necessary to account for perturbations in movement of the flexible disc from its principal plane, recording heads and mounts are utilized that are essentially derived from the flying head technology. Specifically, a pair of small identical slider heads are used, each mounted adjacent the end of a long resilient cantilevered head support, and mechanically urged together with a total force of approximately 8 grams. The concept is that as the flexible disc deviates from its principal plane, both of the heads tend to follow the actual position of the disc passing between them and permit contact recording without excessive wear or signal degradation.

CX 601, col. 1, lines 37-57.

27. At the time of the invention of the '573 patent, the IBM approach was considered by those in the industry to be the only practical approach to achieving double-sided floppy disk recording and reproduction. Comstock, Tr. 1510-11.

28. In the Tandon patent, the IBM double-sided head assembly was described as having significant deficiencies:

There are, however, significant problems and limitations arising from the use of this double, symmetrical and very compliant head mechanism. The resilient mounts are relatively complex and must be precisely manufactured, and therefore are costly to manufacture and maintain. Furthermore, they require redesign, by each floppy disc manufacturer, of the carriage, head support mechanisms and associated structure, because [sic] they have volumetric configurations incompatible with current structures. In addition, the head loading force and the mechanical configuration require that special provision be made

to insure that the head does not constantly land at the same point and thereby cause undue wear. In addition, the long flexible columns used in the existing type of structure tend to bend in a slight S shape or shift differentially in response to perturbations in the disc surface position. This introduces both a degree of offset relative to the track center, reducing reproduced signal amplitude and tending to limit the positional accuracy which can be obtained, which in turn limits the track density which can be achieved. Furthermore, the two resiliently mounted heads do not settle quickly into operative relation, once landed on the disc, and this delay must be taken into account before data transfer operations can begin. Of great importance from the standpoint of the floppy disc systems manufacturer is the fact that he not only cannot use a portion of his existing inventory for heads and carriages, but must redesign a portion of his system for the new double-sided configuration.

CX 601, col. 1, line 62 to col. 2, line 24.

29. The IBM approach was also the subject of the declarations of two engineers filed in support of the '573 patent. According to these declarations, the IBM product was, among other things, subject to positioning errors and "column buckling," and was complex and difficult to manufacture. Muelners Decl., CX 611 (Feb. 28, 1978); Smith Decl., CX 611 (Feb. 28, 1978).

30. The difficulties encountered by IBM in the manufacture of the IBM double-sided transducer assembly are described in IBM U.S. Letters Patent No. 4,263,630. This patent indicates that special fabrication techniques had to be adopted by IBM to assure that the transducer suspensions were precisely symmetrical and that they would bear against the disk with uniform forces. CX 651.

31. IBM U.S. Letters Patent No. 4,202,020 relates to a control system for randomizing the loading and unloading of the IBM double-sided floppy disk drive transducer assembly to overcome the media wear problems caused by the IBM transducer assembly. CX 649.

32. The device embodied in the Tandon patent solved the problems encountered by the IBM double-sided disk drive by providing an asymmetrical transducer assembly in which one of the transducers is used as a fixed positional reference for the floppy disk. Comstock, Tr. 394; CX 601, col. 2, lines 44-52.

33. The essence of the '573 patent is that the lower or side β head is in a fixed position with respect to the nominal plan of the disk so that it provides a reference surface for the pliant disk. Comstock, Tr. 1494.

34. The invention described by the '573 patent is substantially simpler, less costly, easier to maintain, and more stable and reliable in operation than the IBM-type two-sided transducer structure and solved the "column buckling" problem. Smith, Tr. 2316; Muelner Decl., CX 611, ¶ 6 (Feb. 28, 1978); Smith Decl., CX 611, ¶ 6 (Feb. 28, 1978).

35. The disk is very pliant and limp, and acts almost like a tape. The envelop gives the disk support. Comstock, Tr. 1583.

36. The following excerpt from Electronic News, July 10, 1979, states:

Some Firms Drop IBM 2-sided Floppy Head Design

Magnetic head problems that have severely impacted sales of double-sided floppy disc drives ... have forced several OEM vendors to turn to a head design different from IBM's, long-considered the defacto industry standard.

CalComp, Pertec and Siemens are among the firms that have stopped using the IBM head design and have begun using the design developed jointly by Tandon Magnetics and CalComp. These firms claimed the IBM design, which uses two floating heads [to] read and record data is less efficient and more expensive to make.

* * *

Industry observers have said the media wear problem has been the main reason double-sided sales have not been anywhere near what experts had expected. Suppliers admitted being at least nine months behind schedule for double-sided.

The Tandon design incorporates a fixed head for reading and recording on the bottom of the diskette and a floating head at the top of the diskette. Its supporters claim that even if the problems in the IBM have been solved the Tandon head is still the more attractive alternative.

* * *

Terry J. Hardie, Product Sales Manager at CDC, said the primary problems with the IBM design have been during the loading and unloading of the heads. He said because of the design the heads continuously loaded and unloaded at the same spot on the diskette, causing quick media wear.

Mr. Hardie said CDC has attempted to solve the problem by softening the force which is required to load and unload.

CX 640.

37. The following excerpt from an article appearing in Systems International, April 1980, and entitled "Mini-Floppy Disk Drives," states:

The double-sided r/w head for floppy disc drives was first introduced by IBM and soon taken up by other companies. It was a dual flexure head by which is meant that both sides of the r/w head moved when it was loaded on the floppy disc The idea behind using a dual flexure head was its apparent ability to allow each head to follow closely the contours of the media on both sides of the floppy disc. Tests indicated that early designs did not meet the 'tap-tap' test, wherein the head is repeatedly loaded on the same spot on the rotating disc. The highly dual flexure head had the tendency not to land flat: sharp edges of the head would cut into the mylar of the disc. In addition, when the head made contact with the media it would rebound several times before settling. Tap-tap tests were showing media damage after a short period of operation. A more successful design was later introduced by Tandon Magnetics. This company designed a single flexure head . . . which after some final refinements worked well and eliminated the severe media wear of the dual flexure head. Many double sided disc vendors today utilize Tandon.

CX 633, at 44.

B. Independent Claims 1, 5, and 12 of the '573 Patent

38. Claims 1, 5, and 12, which comprise the independent claims of the '573 patent, read as follows:

1. A device for maintaining a pair of magnetic transducers in operative relation with both sides of a non-rigid planar magnetic recording media comprising:

- a first transducer mounted relative to a first side of the media and having a fixed position in a direction normal to the plane of the media despite movement to different positions along the plane of the media, the first transducer being disposed in data transfer position relative to the media;
- a support mechanism adjacent to the second side of the media in a region opposite the first transducer;
- a second transducer coupled by gimbal support means to the support mechanism in opposition to the first transducer and movable toward and away from the plane of the media; and means coupled to said support mechanism for urging said second transducer toward said first transducer and said media to maintain both transducer in operative relation with the intervening media with the first transducer serving as a fixed positional reference despite tendencies of the media to deviate in position from its nominal plane and the second transducer matingly accommodating said tendencies by virtue of its gimbal support.

5. A device for maintaining a pair of magnetic transducers in operative relation with opposite sides of a non-rigid magnetic recording media comprising:

- a first non-gimbaled transducer mounted on a first side of the media and having a relatively fixed position relative to the plane of the media in which the first transducer is in operative relationship with the first side of the media;
- a pivotable support arm having a pivot axis in fixed spatial relationship to the first transducer, and extending along the second side of the media to a region opposite the first transducer;
- a second transducer coupled by gimbal means to the support arm in opposition to the first transducer and being movable relative to the plane of the media and to the first transducer; and

means coupled to said support arm for urging said second transducer and the media toward said first transducer with a force such that close operative relationship is maintained between each transducer and the associated side of the intervening media, with tendencies of the media to deviate from its nominal plan being compensated by the second transducer.

12. In a magnetic recording system in which a carriage supporting two magnetic heads is shifted radially relative to a center-driven pliant magnetic disc to provide data transfer with selectable record tracks on either side of the selectable record tracks on either side of the disc, [the] improvement comprising:

a first transducer fixedly coupled to the carriage for bearing against a first side of the disc in an invariant position in a direction normal to the plane of the disc; and means including a second gimbal mounted transducer movably coupled to the carriage for bearing against the second side of the disc in opposed relation to the first transducer, the second transducer being movable toward and away from the plane of the disc and the first transducer, said means including resilient means urging said second transducer toward said first transducer with sufficient force to maintain close operative relationship between both said transducers and the disc despite deviation of portions of the disc during movement thereof, with the second gimbal mounted transducer compensating tendencies of the pliant disc to deflect.

CX 601, cols. 6-8.

39. The '573 patent refers to a head assembly to be used in a floppy disk drive "system." Column 3 of the specification, starting on line 49, for simplicity, refers to another patent for further details about the disk drive system such as the hub and the spindle. Comstock, Tr. 1503.

40. Intentionally Left Blank.

41. Claim 5 provides that the first or side β head shall be "non-gimbaled." A gimbal is a spring which permits various angular deviations, that is, pitch and roll type motions. Comstock, Tr. 1514-15.

41A. The flexure on which the upper head is mounted in the Mitsubishi Mark I drive is a gimbal spring. The upper and lower flexure elements are identical. Casual visual observation of the lower head mounting indicates that the lower flexure is a gimbal spring. In operation, the upper head exhibits behavior in pitch and roll closely conforming to that of the lower head. Comstock, Tr. 1781-82.

42. Claim 12 relates to a magnetic recording "system" in which the improvement comprises a first transducer (side Ø) that is fixedly coupled to the carriage and bears against the first side of the disk in an invariant position in a direction normal to the plane of the disk, and a second transducer (side 1) which is gimbal-mounted and moveably coupled to the carriage. Comstock, Tr. 1500-02.

43. Intentionally Left Blank.

44. During the prosecution of the '573 patent application before the U.S. Patent and Trademark Office, the examiner rejected claims 1, 5, and 12 as originally presented, principally because of an IBM Technical Disclosure Bulletin (Reference R) (CX 609) which generally depicts the transducer assembly of the IBM double-sided disk drive. Comstock, Tr. 1510-11; CX 611; CX 609.

45. Column 1, lines 37 et seq., of the '573 patent, describes the type of design generally described in CX 609 in which both heads are floating relatively free. Comstock, Tr. 1513.

46. The patent examiner considered the IBM double-sided floppy disk drive and its transducer assembly, as represented by the description thereof in the application that issued as the '573 patent and in the cited IBM Technical Disclosure Bulletin, as the most relevant prior art. Comstock, Tr. 1507-11, 1513, 1526; CX 611.

47. Reference R (CX 609) shows an approach to achieving double-sided operation in which both of the recording heads were permitted to float quite freely and to follow the undulations of the disk. This approach contrasts with the approach exemplified by the '573 patent where one of the heads is fixed and serves as a positional reference for the disk. Comstock, Tr. 1512.

48. There is a dramatic difference in the basic philosophy of the design reflected in Reference R and the subject matter of the Tandon patent. Comstock, Tr. 1512.

49. The IBM double-sided floppy disk drive is also the subject of: (1) IBM Patent No. 4,089,029 issued to Castrodale et al.; (2) an article entitled "The IBM Diskette and Diskette Drive," by James T. Engh, published September 1981 in the IBM Journal of Research and Development; and (3) a manual entitled "IBM 5114 Diskette Maintenance Information Manual." CX 625; CX 646; CX 664.

50. The examiner issued the '573 patent after amendments to claims 1, 5, and 12 were filed while the the '573 patent application was under final rejection. CX 611.

C. Development of Double-Sided Floppy Disk Drives by IBM

51. In 1971, IBM was developing a single-sided floppy disk drive for use with 8 inch diameter single-sided flexible disks. This project was known as the 33 FD. IBM announced the product which incorporated the 33 FD in the fall of 1972, and the product was first delivered in spring 1973. The drive of the 33 FD was a single read/write head. Engh, Tr. 904-05.

52. In the 33 FD disk drive, the head carriage assembly was mounted on a lead screw. The lead screw was driven by a motor so that as the screw rotated, the head could move across the disk within a certain limit. The pressure arm opposite the head was operated by a solenoid mechanism. When the disk was dropped into the unit, the pressure arm would go forward and exert slight pressure against the disk so that the read/write head would be in intimate contact with the disk. The head was fixed in relation to the nominal plane in which the disk would rotate. Engh, Tr. 913-15; SRPX 17, 20.

53. SRPX 20 is a head carriage assembly used in the IBM 33 FD flexible disk drive. SRPX 21 is a head button of the kind contained in SRPX 20. The sensitive element in the head button is the narrow black stripe down the center of the head button that is surrounded by the white material. Engh, Tr. 907-08.

54. Opposite the head button on SRPX 20 is a small red pressure pad. Engh, Tr. 909.

55. The head button on the 33 FD is in intimate contact with the disk, and when electric signals are sent to the head button through an assembly of wires, reading and writing take place on the disk. Engh, Tr. 913.

56. In the 33 FD, the read/write head was fixed in relation to the nominal plane of the disk and would not have any gimbaling, roll, pitch or Z-axis movement. Engh, Tr. 914-15.

57. As a result of the favorable response to the 33 FD, IBM customers suggested that IBM improve the performance and capacity of the disk drive and the diskette. Accordingly, IBM began a project to develop a successor to the 33 FD, which was known as the 43 FD. Preliminary planning and discussions for this project began in 1972, and in the latter half of 1973 hardware analysis and studies were begun on the 43 FD project. Engh, Tr. 915-16.

58. During the development process for the 43 FD, IBM considered different types of head configurations. The first type of head design (hereafter "type one") consisted of two fixed heads. In this embodiment, both heads were rigidly affixed and separated by a fixed space so that a diskette could be dropped between the heads in the fixed space. The heads were mounted on an assembly that pivoted so that one head could be brought into the plane of the disk, into contact with the disk, or rotated out and the other head brought into contact with the plane of the disk. Engh, Tr. 916-18.

59. Tests were conducted at IBM on a prototype of the head assembly of the type one disk drive. Before proceeding to production on this design, it would have to satisfactorily pass the stress test. The stress test utilized "non-nominal" disks, which is a disk that has been bent or crimped, or whose envelope is flexed. The stress test was used as a go/no-go test. Engh, Tr. 932-34.

60. The stress tests on the type one head assembly were unacceptable because satisfactory head-to-disk compliance could not be obtained. Any irregularities in the diskette caused excessive bounce and unsatisfactory wear on the medium. As a result of this unsatisfactory outcome, the decision was made not to pursue this particular head design. Nevertheless, IBM did obtain a patent on the type one design. Engh, Tr. 932, 934-36; CX 603; CX 664, at 706.

61. A second configuration considered by IBM for its 43 FD disk drive consisted of a modification of the existing 33 FD drive (hereafter "type two"). In this design, the pressure pad arm of the 33 FD drive was replaced with a second head which was mounted in a position where the pressure pad was mounted so that the head would come into contact with the other side of the disk. Thus, one head was fixed and the other head was movable into the plane of the disk. The construction of the movable head allowed it to roll and pitch. The model of the type two head configuration was built in late 1973 or early 1974. Engh, Tr. 918, 926-27.

62. A model of the type two head assembly was made for purposes of testing in about November-December 1973. This head configuration was also subjected to stress testing with non-nominal disks to determine whether the concept showed enough promise to proceed with further testing of the entire drive mechanism. The results were not satisfactory, and further work on this design ceased in January 1974. The tests were conducted over a period of about four weeks. It was determined that the type two approach suffered the same head compliance problems as were encountered with the type one design. Engh, Tr. 939-44; Castrodale, Tr. 971, 974; CX 739.

63. In the IBM report authored by Mr. Engh, entitled "The IBM Diskette and Diskette Drive," published in 1981, the following description of the type two design was provided:

The next approach used one head rigidly mounted and the second head on a flexible suspension. The second head closed on the disk, and the suspension system provided a pressure on the disk and a resilience to absorb disk irregularities. Again, a stable compliance was not achieved. The principal problem was the unpredictability of disk dynamic movements over a wide range of environments with a variety of diskettes.

CX. 664, at 706.

64. The work done on the type two approach was not disclosed outside IBM, and within IBM only those with a need to know were aware of this approach. There is no indication that any test data was accumulated or maintained about the type two design, and no technical disclosure bulletin was ever issued on this design. In addition, IBM never commercially marketed a product which embodied the type two design. Engh, Tr. 939-40, 942-45, 948; Castrodale, Tr. 974-77.

65. The type two head assembly model was also tested with normal disks, that is, disks manufactured to meet IBM specifications and tolerances. The test results with the normal disks on the type two design were acceptable. Castrodale, Tr. 956.

66. IBM did not file a patent application on the type two design configuration. Castrodale, Tr. 976.

67. In about 1975 or 1976, after the 43 FD disk drive went into production, IBM needed to create stress disks. It was necessary to write these disks with enhanced precision. To accomplish this, IBM engineers immobilized one of the heads of the type three disk drive (see FF 69-71,

infra) so as to minimize the offtrack contribution allowed by gimbaling. This in-house disk writer thus utilized the type two head design concept.

Castrodale, Tr. 978-80.

68. The test disk writer was used exclusively in-house at IBM, and none of the test disks were commercially sold or used in public. Castrodale, Tr. 978, 981-82.

69. At about the same time that IBM engineers were working on the type one and type two head configurations, they were also developing a prototype and doing experimental work on the type three design. As a result of the early successes shown with this third alternative, it was decided to direct the most effort to developing this design. The type three design was ultimately used in the 43 FD disk drive which was commercially introduced in 1976. Engh, Tr. 929-30, 944.

69A. The IBM engineers turned to rigid disk technology in search of a solution to the problems encountered with the type one and type two approaches. CX 664, at 706.

70. Development work on the type three design began in about January 1974. Although IBM's existing Winchester technology was used as a primary reference point for the type three head configuration, this project required a significant amount of further development over the next two years before it reached the point of commercialization. The type three design was embodied in IBM's 43 FD and was first commercially available in January 1976. Engh, Tr. 946-47.

71. A patent was obtained on the type three disk drive, U.S. Letters Patent No. 4,089,029 (Castrodale), entitled "Data Storage Apparatus Using a Flexible Magnetic Disk." The abstract of the patent describes the type three configuration as follows:

A data storage apparatus having a thin flexible disk with magnetic recording surfaces on both faces and a carriage embracing the disk and carrying a pair of transducers in contact with opposite faces of the disk. Each of the transducers is mounted on a relatively weak gimbal spring. Relative rigid load arms bear on dimples located at the centers of the transducers to form universal joint connections with the transducers. The gimbal springs and universal joint connections allow the transducers to pitch and roll with wobbling movements of the flexible disk without movement of the load arms. The load arms are mounted on relatively stiff gimbal spring portions for applying a predetermined force to the transducers holding them in engagement with the disk while allowing yielding movement of the transducers in directions normal to the disk engaging faces of the transducers.

Castrodale, Tr. 980; CX 646.

72. IBM's first double-sided floppy disk drive, 8 inch, model 43 FD, was introduced in March or April of 1976 and was first shipped in June 1976. It used a type three modification, viz., each head mounted in a flexible suspension. Engh, Tr. 919, 930, 946.

72A. The nature of the floppy disk drive industry circa 1976 and today is that the industry follows IBM. Thus, the industry reaction to IBM's introduction of the Model 43 FD was that the next generation of disk drives was to be double-sided. Sollman, Tr. 62-63; Stoddard, Tr. 4538.

72B. The difficulties encountered by IBM in the manufacture of the IBM double-sided transducer assembly are described in IBM U.S. Letters Patent No. 4,263,630. This patent indicates that special fabrication techniques had

to be adopted by IBM to assure that the transducer suspensions were precisely symmetrical and that they would bear against the disk with uniform forces. CX 651.

72C. IBM U.S. Letters Patent No. 4,202,020 relates to a control system for randomizing the loading and unloading of the IBM double-sided floppy disk drive transducer assembly to overcome the media wear problems caused by the IBM transducer assembly. CX 649.

72D. IBM also sought to prevent damage to the read/write heads, their suspensions and the recording media in the IBM double-sided drive by electronically controlling the loading and unloading movements of the heads, as described in the IBM Technical Disclosure Bulletin (Vol. 18, No. 77, Dec. 1975, at 2246-47). CX 609.

D. Shugart

73. Shugart sold a single-sided 8 inch floppy disk drive with a fixed read/write head cemented into the carriage from September 1973 until after the announcement of the first double-sided floppy disk drive by IBM in 1976. Sollman, Tr. 37-38, 202-03.

73A. The designers of the IBM single-sided floppy disk drive and diskette worked together at Shugart Associates, which pioneered the development of the "mini-floppy," that is, the 5-1/4 inch single-sided floppy disk drive. The best selling single-sided 8 inch floppy disk drive in 1975 was Shugart's Model SA-800. Dalziel, Tr. 4285; Dalziel, CX 822, ¶ 6.

74. In July-August 1976, Shugart endeavored to take a leadership position in the floppy disk drive industry and decided to attempt doubling the capacity of its products. Three different approaches were considered:

(1) write more bits around each track; (2) write narrower tracks to put more tracks around the disk; and (3) utilize both sides of the disk (double-sided recording). Sollman, Tr. 58-59. Shugart decided to pursue the double-track density approach. Sollman, Tr. 60.

75. In November 1976, IBM introduced the first double-sided floppy disk drive. The disk drive was part of a Model 360-1 bank terminal controller. Sollman, Tr. 60; see FF 72.

76. The diskettes for the IBM double-sided disk drive was coated on both sides. The disk drive placed two heads, one on each side of the diskette, in contact or near-contact with the diskettes. The heads were cantilevered and the diskettes would flow between them. Sollman, Tr. 61-62.

77. Shugart, like others in the industry, decided to design its own double-sided disk drive. Shugart overnight gave up the double-track density approach and informed its major OEM customers of its decision. Sollman, Tr. 64.

78. A program was initiated at Shugart to design a double-sided floppy disk drive to be designated the SA-850. Sollman, Tr. 63-64; Dalziel, Tr. 4286.

79. The double-sided design program received highest priority with all Shugart resources devoted to the project. Fifteen to 20 engineers were originally assigned to the project, and this number increased to 80 engineers at one point. Sollman, Tr. 65-66.

80. Considerable Shugart research facilities at Sunnyvale, California, were also devoted to the design effort, as well as those of Xerox' Palo Alto facility, subsequent to December 16, 1977, when Xerox Corporation purchased Shugart. Sollman, Tr. 66-67.

80A. Shugart followed the IBM approach because initial evaluations appeared to indicate that it was a good solution to the problem of recording on both sides of a floppy disk. Shugart initially had a lot of confidence in IBM's approach. Dalziel, Tr. 4385-86, 4294.

81. Shugart officially introduced a double-sided disk drive product, the SA-850, in April 1977 and started shipments in June 1977. In the fall of 1977, customers began to return the product because the magnetic head structures used were beginning to strip the oxides off the diskettes, which destroyed the customer's information. Sollman, Tr. 67, 68.

82. Shugart engaged in a highly intensive crash effort to solve the design problems associated with its double-sided product. Approximately 10- different designs were tried over a number of years. Sollman, Tr. 67-68. Approximately \$4.0 to \$5.0 million was expended by Shugart on the design. Sollman, Tr. 68.

83. Shugart's competitors were experiencing similar results in their pursuit of both IBM-type and non-IBM-type head designs--media wear problems and unsatisfactory product. Sollman, Tr. 69.

83A. Despite these efforts, Shugart never totally solved the problems encountered with the IBM approach. Dalziel, Tr. 4286.

83B. Mr. Dalziel studied the deficiencies of the IBM approach as they were observed in the SA-850 and summarized his findings and analysis in an interoffice memo dated August 4, 1978, and entitled "SA850 Head/Media Interface, Observations & Experimental Results" (CX 822, Ex. C). One of the problems was pitch resonance, a self-excited vibration inherent in the design. Another was radial spacing offset of the read/write cores of the

heads which is affected by the roll angle of the sliders. Yet another problem was the manufacturing cost resulting principally from the need to have balanced head loading provided by the flexures. Thus, production yields were low. Mr. Dalziel concluded that even setting aside manufacturability or cost problems, the IBM-type design was only marginally acceptable for 48 tracks per inch and unacceptable for high-track densities. Another conclusion that he drew was that the low mass of the head sliders and the very low axial, pitch and roll stiffnesses of the flexures which allowed good compliance and very little wear in rigid disk, Winchester-type drives, was technology mistakenly applied to flexible disk, load/unload, contact recording. Since friction is unavoidable in contact recording, the low stiffness flexure supporting the slider head resulted in a dynamically unstable assembly. CX 822, at 12.

84. One competitor, CalComp, advertised that it had a successful double-sided floppy disk drive product. Sollman, Tr. 69.

85. Shugart purchased three CalComp disk drives for testing by its engineers. The engineers discovered that the CalComp disk drives employed a head assembly manufactured by Tandon Magnetics of Chatsworth, California, and that the drives worked well with a wide range of media. Sollman, Tr. 70-71.

85A. Engineers at Shugart were skeptical of the Tandon design and did not believe it would perform adequately. Dalziel, CX 822, ¶ 14.

86. The Shugart engineering department considered the CalComp drive to be a very interesting product, but because they believed they were close to a breakthrough on their own design, the engineering department preferred to continue their efforts. Sollman, Tr. 71-72.

86A. Because of Shugart's experience with single-sided floppy disk drive technology, its engineers did not believe that it was possible to get adequate compliance between the heads and the disk and still get acceptable wear characteristics on both sides with the Tandon approach, which used a fixed head in combination with a flexure mounted head. Dalziel, CX 822, ¶ 14.

87. After further Shugart design efforts failed, Shugart's President prevailed on Shugart management to begin patent licensing discussions with Tandon Corporation. Sollman, Tr. 73. The licensing negotiations were successful, and a license agreement was signed between Tandon and Shugart which embodied the Tandon patented technology. Sollman, Tr. 74.

88. A license agreement for the technology incorporated in the '573 patent was signed by Tandon and Shugart on July 1, 1980. Sollman, Tr. 74; CX 616.

89. Shugart placed the Tandon patented technology in its disk drive products and the SA-850 became a successful and highly profitable product. The technology was also added to the 5-1/4 inch disk drive, the SA-450. Sollman, Tr. 74-75.

90. Shugart does not know why it could not solve the double-sided floppy disk drive problem. "I think today that is probably one of the largest corporate enigmas that remains. We threw everything at that design. In fact, we even had designs identical to Tandon's that were there earlier in our attempts, and we couldn't make those work either." Sollman, Tr. 75.

E. CalComp.

91. Prior to 1976, California Computer Products, Inc. (CalComp) was manufacturing single-sided floppy disk drives. These were 8 inch drives that were similar to the IBM 23 FD and 33 FD single-sided drives. CalComp's single-sided disk drive had a single read/write head that was fixed in relation to the nominal plane of the disk, and did not have any provision for pitch or roll or Z-axis movement. On the other side of the disk there was a head pressure pad arm that was mounted so as to move toward and away from the head on side β . Smith, Tr. 2282-84; Meyer, Tr. 2061-63; SRPX 20.

92. When IBM announced its 8 inch double-sided floppy disk drive in 1976, CalComp decided to develop its own double-sided floppy disk drive to remain competitive in the market. CalComp's original plan was to enter the market with a reverse engineered IBM-type double-sided drive. Smith, Tr. 2284-85; Meyer, Tr. 2066-68.

93. In 1976, CalComp did not have the technical capability to design a double-sided floppy disk drive in-house, and thus entered into an agreement with Tandon Magnetics to design the heads. Meyer, Tr. 2068; Smith, Tr. 2285, 2313.

94. A group was formed at CalComp in September-October 1976 to develop this double-sided floppy disk drive which was known as the Small Disk Operation. Mr. Henry Meyer was the director of this program. Mr. Malcolm Smith was responsible for the mechanical engineering aspects of the program, and served as a liaison with Tandon Magnetics. In his capacity as liaison with Tandon, Mr. Smith made frequent visits to Tandon's facilities, ranging from about once per week in the early phases of the program to daily at later stages of development. Mr. Smith's function was, in part, to evaluate the test data developed by Tandon. Meyer, Tr. 2068-69; Smith, Tr. 2286, 2288-89.

95. When the Tandon/CalComp double-sided disk drive development program began in about October 1976, Tandon was proceeding with a reverse-engineered IBM approach. At this point, it was felt by CalComp that market acceptance for their double-sided drives depended on following the IBM design. Smith, Tr. 2285, 2291-92, 2314-15; Meyer, Tr. 2076-78; SRX 29.

96. After CalComp received preliminary sketches and a sample carriage of the IBM-type double-sided drive from Tandon, it was determined that this drive would not fit the existing carriage of CalComp's single-sided drive. CalComp preferred to adapt the new double-sided drive to its single-sided carriage so as to avoid having to change the configuration of the chassis and be able to use the existing head load solenoid, stepper motor, and lead screw arrangement. CalComp felt it was in its best interest to adapt their single-sided drive because its largest customer, DEC, had a license with CalComp that it intended to exercise. It would have been necessary for CalComp to engage in a long approval cycle before being allowed to change the design. Smith, Tr. 2286-87; Meyer, Tr. 2079-80.

97. To adapt the single-sided drive to a double-sided head configuration, CalComp's engineers proposed investigation of a design wherein it would not be necessary to alter the bottom head. This involved redesigning the load arm of the single-sided drive which had the pressure pad. The movable upper arm would be replaced by a different arm which would have a gimbaled flexure and a head. Smith, Tr. 2287; Meyer, Tr. 2081.

98. When CalComp evaluated the pros and cons of the IBM approach and modification of their existing drive, they felt that it would be best to proceed with both designs in parallel. In about October 1976, CalComp requested Tandon to work on both design concepts concurrently. Meyer, Tr. 2081-82.

99. Tandon reported that modification of the CalComp single-sided drive was delayed. To speed the development of the modified CalComp design, Mr. Smith in late November 1976 made a very crude model of the modified design at CalComp and discussed the design with Mr. Tandon. Mr. Smith's preliminary testing of this model showed some ability to read and write, but it destroyed the medium. Smith, Tr. 2292-94.

100. In February 1977, CalComp received from Tandon a model of the single-sided CalComp drive modified to be double-sided. Tests conducted on this model at CalComp gave very good results. At a meeting of CalComp and Tandon personnel held in March 1977, CalComp expressed its strong preference to proceed with the modified CalComp single-sided design. Although Mr. Tandon expressed his view that this was not a wise decision, Tandon did proceed to modify CalComp's single-sided drive to make it double-sided. Smith, Tr. 2296-98.

101. The double-sided floppy disk drive that CalComp ultimately marketed was a modification of its single-sided drive. This model performed better than the IBM double-sided drive because it did not destroy the medium as rapidly as the IBM design and was not subject to column buckling, as was the IBM design. In addition, the CalComp double-sided drive was less expensive than IBM's drive. Smith, Tr. 2298-300; SRPX 10.

102. In order to manufacture the CalComp double-sided drive, it was necessary to prepare design drawings. The drawings for the button head, the upper head, the gimbal flexure, and the critical locating dimensions for the upper and lower heads were prepared by Tandon. The drawings for the carriage and the upper arm were provided by CalComp. The method of attaching the head assembly to the carriage was initially proposed by CalComp, but was later modified by Tandon. Smith, Tr. 2300-02.

103. Under the terms of Tandon's proposal to CalComp for development of the double-sided floppy disk drive, Tandon stated that the head and flexure design were proprietary to Tandon. The design and development of the carriage and associated hardware was stated to be proprietary to CalComp. SRX 29.

104. In the Attachment to the CalComp "letter of authorization" from Meyer to Tandon, dated November 15, 1976, the three phases of the double-sided floppy disk drive development project were defined. In addition, CalComp agreed to treat as proprietary to Tandon the tool design for Tandon's head fabrication techniques. At the end of Phase II of the project, CalComp would own the carriage and drive design, including the tooling, and specifically the carriage arm and the carriage-arm-to-carriage interface. Tandon would own the slider and the suspension flexure. SRX 43.

105. Figure 1 of the '573 patent depicts the embodiment as it was exhibited in the CalComp carriage. The CalComp carriage is different from others in the market in that the boss, which was used to mount the guide shaft into the drive, is fairly massive in the head area, while the boss at the rear of the carriage is relatively narrow. Smith, Tr. 2305-07; CX 601.

106. In about September 1977, Mr. Meyer learned that Tandon had filed a patent application on the CalComp double-sided floppy disk drive design. Initially, Mr. Meyer was annoyed to hear that the application had been filed, and apparently felt that Mr. Smith should be named as one of the inventors, and that CalComp's name should be associated with the patent. Mr. Meyer's concern about the propriety of Tandon's patent application was apparently allayed by Mr. Tandon's representation that the patent would cover only the head and the suspension flexure rather than the entire assembly. Meyer, Tr. 2225-28; SRX 79.

107. In about March 1977, CalComp considered whether it was interested in obtaining a patent on the new double-sided drive configuration. The design was submitted to CalComp's patent committee. It was the opinion of the patent committee that the design probably was not patentable. Meyer, Tr. 2139-41.

108. In February 1978, Mr. Smith filed a declaration in the PTO in support of Tandon's patent application. Smith, Tr. 2326-27; Smith Decl., CX 611, (Mar. 6, 1978).

109. The device embodied in the Tandon patent solved the problems encountered by the IBM double-sided disk drive by providing an asymmetrical transducer assembly in which one of the transducers is used as a fixed positional reference for the floppy disk. Comstock, Tr. 394; CX 601, col. 2, lines 44-52.

109A. In the IBM double-sided disk drive, the head supporting flexures were very long and flimsy so that head alignment was very difficult; it was significantly more difficult to align for higher track densities. One of the

problems addressed by the inventors was that in the IBM design any deformation in the disk caused the heads to go off track, that is, off the centerline of the track, because of the flimsy nature of the head mounting flexures. This problem was resolved by the Tandon invention and provided the capability of going to higher track densities. Tandon, CPX 31, at 390-91.

110. The essence of the '573 patent is that the lower or side β head is in a fixed position with respect to the nominal plan of the disk so that it provides a reference surface for the pliant disk through penetration by the lower head into the plane of the media. Comstock, Tr. 1494; Tandon Dep., at 356, 413-14, MRPX 34C.

110A. The claimed data transfer relationship is not synonymous with penetration of the side β head into the nominal plane of the disk. Penetration is not the only factor involved in the read/write relationship. The loading force of the transducers on the disk is probably more significant than penetration in that these forces deal with the large scale waviness of the disk. Comstock, Tr. 5246-47; Hayashi, Tr. 4282.

110B. Mr. Stoddard, one of Mitsubishi's technical experts, testified that in the prior art IBM Model 43 FD double-sided floppy disk drive, described in U.S. Letters Patent No. 4,089,029 (Castrodale), one of the heads penetrates the nominal plane of the disk. Stoddard, Tr. 4525, 4528-29. The '029 patent, however, states in part:

Advantageously, the mountings for the transducers 150 and 152 allow the flat bearing surfaces 150a and 152a of the transducers to run in contact with the magnetic disk 20 with no penetration of either of the transducers 150 and 152 in the disk 20 and with the compliance of the transducers 150 and 152 to the disk 20 being constant. This result is attained particularly since the transducer surfaces 150a and 152a, which are of the same size and shape, are located exactly opposite each other and in register with each other except for the thickness of the disk 20 between them. Since the disk 20 is thin and flexible, it may be expected to wobble in directions X, Y and Z (see FIG. 14); and the two transducers 150 and 152 together move in these directions with the spacing between the transducers 150 and 152 remaining the same and equal to the thickness of the disk 20. In this connection, the relatively rigid load arms 182 and 186 acting under the spring influence of the spring portions 176b and 184b maintain the desired loading of the transducers 150 and 152 on the disk 20 and against each other while yielding in a direction Z with the warping of the disk 20 in this direction Z. The springs 176 and 184 and particularly the spring portions 176d, 176e, and 176f for the transducer 150 and the spring portions 184d, 184e and 184f for the transducer 152 function to allow an easy pivoting of the transducers 150 and 152 in the direction X and Y to maintain the transducer surfaces 150a and 152a in firm contact with the surfaces of the disk 20 as the disk 20 wobbles either radially of the disk or circumferentially of the disk. No resistance to the pitching and rolling of the transducers is provided by the relatively rigid load arms 182 and 186, since the transducers pivot about the dimples 176h and 184h acting as pivot points and acting as universal joints with the load arm portions 182g and 186g. With the disclosed construction, because of the intimate, regular compliance of the transducers to the disk, the potential for high bit density is present. Also, due to the relatively low spring rate of the springs 176 and 184 functioning as gimbal springs as above mentioned and also due to the fact that there is no disk penetration by the transducers 150 and 152, and load forces applied onto the transducers 150 and 152 by the load arms 182 and 186 by reason of the deflected spring portions 176b and 184b may be kept to a minimum; and good transducer and disk wear life are thus characteristics of the disclosed apparatus.

CX 646, cols. 12, 11, 7-53 (emphasis added).

111. The invention described by the '573 patent is substantially simpler, less costly, easier to maintain, and more stable and reliable in operation than the IBM-type two-sided transducer structure. Smith, Tr. 2316; Muelner Decl., CX 611, ¶ 6 (Feb. 28, 1978); Smith Decl., CX 611, ¶ 6 (Feb. 28, 1978).

112. At the time the Tandon design of the '573 patent (CX 601) became known to the floppy disk drive industry, there was initial resistance toward utilizing the Tandon design. Stoddard, Tr. 4547.

112A. Many disk drive manufacturers eventually stopped using the IBM approach and adopted the Tandon approach. CX 633; CX 640.

113. There came a time when the Tandon design of the '573 patent was accepted in the floppy disk drive industry. Stoddard, Tr. 4550.

113A. IBM became a major purchaser of patented drives from Tandon, and continues to buy such products from Tandon. Huenemeier, CX 835, at 21.

113B. In 1984, Tandon and its licensee, CDC, alone sold more than \$ worth of double-sided floppy disk drive covered by the '573 patent. Serge, CX 717, CX 730.

114. The claims of the '573 patent are directed to the normal, read/write operation of the claimed system in which both transducers are in contact and in data transfer relationship with the disk. Comstock, Tr. 1948-49; CX 601.

115. Claim 12 of the '573 patent is a Jepson-type claim. Thus, it would read on a magnetic recording system improved in the manner that is specified in the elements following the phrase "the improvement comprising." Chisum, Tr. 4308, 4311; Jessup, Tr. 4438, 4442.

116. The meaning of the phrase "magnetic recording system" in claim 12 is to be equated with a floppy disk drive in view of the specification of the '573 patent. Chisum, Tr. 4311, 4314.

117. The '573 patent includes a comprehensive description of a floppy disk drive "system" in column 3 of the specification, starting on line 49, and for simplicity, that portion of the patent refers to another patent for further details such as the hub, the spindle and so forth. Comstock, Tr. 1503; CX 601.

118. An important aspect of the '573 patent (CX 601) is that the lower head must be "fixed" so that the media tends to conform to the head rather than the head following any pitching and rolling of the media, as was the case with the IBM prior art device (CX 609, CPX 16). Chisum, Tr. 4361.

119. The word "gimbal" as used in the patent specification relates to the ability of the device to tilt to some extent about a load point to compensate for major radial or circumferential deflections of the disk from its nominal plane, otherwise known as pitch and roll. Chisum, Tr. 4331.

120. Patent examiners conceive it as their obligation to give a claim the broadest interpretation conceivable during the pendency of a patent application. Jessup, Tr. 4404.

121. It was the examiner's view in his first Office Action that the language of claim 1 was very broad and would read on the principal prior art reference, the IBM Technical Disclosure Bulletin (CX 609). Jessup, Tr. 4407-08.

122. On page 5 of the second amendment, the attorney was emphasizing that in the device as claimed, unlike the principal prior art device of the IBM Technical Disclosure Bulletin (CX 609), one of the heads serves as a positional reference while in the IBM device neither of the heads serves as a positional reference. Chisum, Tr. 4328.

123.-129. Intentionally Left Blank.

G. Coverage of the Tandon Double-Sided Floppy Disk Drives by the '573 Patent.

130. The Tandon Model Nos. TM 50, TM 55, TM 65, TM 100, TM 101, TM 306, and TM 848 are covered by at least claims 1, 5, and 12 of the '573 patent. Comstock, Tr. 1534-36.

131. The CDC Model Nos. 9409, 9428, and 9429 are covered by at least claims 1, 5, and 12 of the '573 patent. Comstock, Tr. 1536; CPX 21-25.

132. The Tandon Model Nos. TM 65 and TM 100 sold by TP are covered by at least claims 1, 5, and 12 of the '573 patent. Comstock, Tr. 1534-36.

132A. The 5-1/4 inch double-sided floppy disk drive manufactured by IBM in Boulder, Colorado, since August 1984, is covered by claims 1, 5, and 12 of the '573 patent. Fenstermaker, CX 859, at 1; Comstock, Tr. 4145.

H. The Accused Products.

133.-134. Intentionally Left Blank.

135. The various Mitsubishi (MELCO) double-sided disk drive transducer assemblies are described in Exhibit MRX 27, the written witness statement of Toshikazu Hayashi, and are shown in a series of sketches attached to that statement. Hayashi, MRX 27.

136. There are several models of double-sided flexible disk drives manufactured by MELCO. The double-sided disk drives manufactured by MELCO and exported to the United States include four 8 inch disk drive models (M2893, M2894-4/5, M2894-6, and M2896-6), three 5-1/4 inch series of drives designated Mark I, Mark II, and M3 series and comprising 13 models (Mark I Models: M4851, M4852, M4853, M4854, and M4855; Mark II Models: M4851-1 or -3, M4853-1 or -3, M4854-1 or -3, and M4855-1; and M3 Models: M4851A-3), and one 3-1/2 inch disk drive, Model MF 353. Hayashi, MRX 27, ¶ 5; MRX 92.

137. The Mitsubishi double-sided floppy disk drives include the Mark I Series, the Mark II Series, the M3 Series, all comprising 5-1/4 inch drives, the MF 353 3-1/2 inch drive, and four 8 inch double-sided disk drive models. Hayashi, MRX 27.

138. All 12 models of the Mark I and Mark II Series (which includes the Model M4851 which was tested by Tandon) have identical gimbals on which the upper and lower transducers are mounted. Comstock, Tr. 1572, 1574; CX 615, ¶ 6; Hayashi, MRX 27, ¶¶ 23-25, Figs. 5, 6, 8-10.

139. The flexure on which the upper head is mounted in the Mitsubishi Mark I drive is a gimbal spring. The upper and lower flexure elements are identical. Comstock, Tr. 1781, 1782.

140. The Mitsubishi Mark I and Mark II Series, as exemplified by the M4851 tested by Tandon, includes a lower transducer mounted on a circular slotted sheet metal support element backed up by a load finger formed integrally with the plastic carriage. A rubber pad is disposed between the load finger and the lower surface of the sheet metal support. CX 693, photos 19, 20, 21; Hayashi MRX 27, ¶¶ 15-21, 23-25, Fig. 8; Comstock, Tr. 1564-65, 1568-69, 1592-93, 1782, 1790.

141. The upper head of the Mitsubishi Mark I and Mark II Series is mounted on a gimbal spring which in turn is carried by a support arm pivotally coupled to the carriage. CX 693, photos 19, 22; Hayashi, MRX 27, ¶ 17; Comstock, Tr. 1781.

142. The disk drive Models M4852, M4853, M4854 and M4855 of the Mark I series differ in some respects from the M4851 model in their overall disk drive structures and circuit board configurations, and there are some differences in slider and core dimensions; however, the basic construction of the carriage and magnetic head assemblies of these other models are the same as the above-described Model M4851. Hayashi, MRX 27, ¶ 21.

143. The Mitsubishi M3 Series has a transducer assembly identical to that of the Mark I/Mark II Series, except that the pad between the load finger and the lower transducer support has been omitted, leaving a gap of 20-80 micrometers between those two elements, and the lower head support is a "single ring" construction to provide a greater spring constant about the roll axis. Hayashi, MRX 27, ¶ 27, Fig. 15.

144. In the Mitsubishi Model MF 353, the lower transducer is mounted on a sheet metal spring element having a thickness 60 percent greater than the spring element mounting the upper head (0.16 mm vs. 0.10 mm). No load fingers are employed in this design. Hayashi, MRX 27 ¶¶ 31, 32, Figs. 16-19.

145. In the Mitsubishi Models M2893 and M2894-4/5 8 inch drives, the lower transducer is mounted on two, parallel flexure elements with a load point in between. The upper transducer is mounted on a single flexure element; no load point is used behind this element. Hayashi, MRX 27, Figs. 1d-1f, 2c, 2d.

I. Infringement

1. Tandon Tests.

146. Tests were conducted at Tandon on certain of the respondent's, complainant's, and IBM's double-sided floppy disk drives. The tests were conducted under the supervision of Mr. Marshall Nathanson, Tandon's Senior Staff Engineer. Nathanson, Tr. 1309, 1476, 4023-25, 4027-28; Nathanson, CX 716, ¶ 1-3; Nathanson, CX 817, ¶ 78; Nathanson, CRX 8, ¶ 106.

147. Mr. Nathanson formulated the tests, decided what data would be required, and established test procedure protocols to assure the reliability and accuracy of the tests, the data, and the results. Nathanson, Tr. 1413, 1476.

148. A preliminary survey was made to determine the test and calibration procedures, instrumentation ranges, how to mount the test probes, and so forth. Nathanson, Tr. 1473-74; Nathanson, CX 716, ¶ 4.

149. All of the data obtained from the preliminary survey were recorded in Exhibit TRX 13, a first data notebook. Nathanson, Tr. 1473-74; TRX 13; Nathanson, CX 716, ¶ 4.

150. Various measurements were made of the displacement of the transducers along the Z-axis and about the pitch and roll axes due to the forces imposed on the transducers by the rotating disk. Nathanson, CX 716, ¶ 14, 16, 18, 21, 22.

151. Generally, the Tandon tests directed by Mr. Nathanson measured the motions or displacements of the transducers and a sample floppy disk, as well as the stiffnesses or spring rates of those components. Nathanson, CX 716, ¶ 13, 15, 17, 19, 20, 22.

152. An attempt was made to measure the degree to which heads move due to the influence of disks, and the degree to which heads restrain disk movement. To do this, the disk motion that exists in the absence of heads was measured and compared to movement in the presence of heads. Nathanson, Tr. 1470.

153. The motion and spring rate measurements were used in formulae devised by Mr. Nathanson. Nathanson, Tr. 1413, 1470; CX 716, ¶¶ 14, 16, 18, 21, 22, 43, 50, 56, 63.

154. The Tandon tests, and their relationship to the claims of the '573 patent, consisted of the following:

- (a) Disk and transducer motions and spring rates along the Z-axis, that is, in a direction normal or perpendicular to the plane of the disk. CX 716, ¶¶ 13, 15, 38-50;
- (b) Disk and transducer motions and spring rates about the pitch axis. CX 716, ¶¶ 17, 52, 54-63; and
- (c) Transducer motion about the roll axis (because of instrumentation limitations, disk motion about the roll axis could not be measured) and disk and transducer spring rates about the roll axis.

CX 716, ¶¶ 19, 22, 53-73.

155. The first series of tests was conducted at Tandon during the periods of September 4-25, 1984, and September 29 to November 2, 1984. The data from these tests were recorded in three data notebooks (Nos. 2-4) (CX 622-24). The methodology used and the results of these tests were reported in Mr. Nathanson's first witness statement (CX 716). Nathanson, CX 716, ¶ 30.

156. A second series of tests was conducted at Tandon during the period July 8-29, 1985, and on August 5, 1985. The data from these tests were recorded in four data notebooks (Nos. 6-9) (CX 780-82, CRX 7). The methodology used and the results of these tests were reported in Mr. Nathanson's second and third witness statements (CX 817, CRX 8). Nathanson, Tr. 4025-28; Nathanson, CX 817, ¶¶ 27, 79, 86; Nathanson, CRX 8, ¶ 106.

157. The Nathanson test equipment, the basic set-up, and the approaches to accumulate data that he used were excellent. Brown, Tr. 2602-03.

158. The first series of tests were conducted at Tandon on two samples of each of the following production double-sided floppy disk drive models:

- (a) Mitsubishi Model M4851 5-1/4 inch floppy disk drive (CPX 11A, CPX 11B).
- (b) TEAC Model FD-54B-02-U 5-1/4 inch floppy disk drive (CPX 10A, CPX 10B).
- (c) Sony Model OA-D32W-10 3-1/2 inch floppy disk drive (CPX 12A, CPX 12B).
- (d) Tandon Model TM 100-2A 5-1/4 inch floppy disk drive (CPX 23).
- (e) Tandon Model TM 848E 8 inch floppy disk drive (CPX 22).
- (f) IBM Model 53 FD 8 inch floppy disk drive. (CPX 16, CPX 17).

Nathanson, Tr. 1312, 1316-18; Nathanson, CX 716, ¶¶ 17, 26, 27.

159. The first series of tests consisted of Z-axis disk and transducer motion measurements; Z-axis disk and transducer spring rate measurement; measurements of pitch and roll motions of the disk and transducers; and measurements of the pitch and roll spring rates of the disk and transducers. Nathanson, CX 716, ¶¶ 13-22.

160. For measuring the transducer and disk motions and spring rates, the Tandon tests utilized a variety of sensitive instrumentation and measuring techniques, including capacitance and photonic probes, load cells, and laser beam technology. Nathanson, CX 716.

161. There are two advantages in having made two types of measurements, that is, motion measurements (with the disk drive in operation) and spring rate measurements. In the operation of the disk drive, all three elements--the two heads and the disk sandwiched in between--tend to move together so that it is difficult to sort out the influence of the various elements. In contrast, the spring rate measurements can be made on each of the elements independently to get additional insight as to how much each element is contributing to the overall result that is observed during the normal operation of the disk drive. Comstock, Tr. 1528-30.

162. The floppy disk used with disk drives are very pliant and can be strongly influenced by small forces. Clamping of the disk by the hub of the spindle drive can send wrinkles through the disk and those wrinkles can be different from one clamping to another. Accordingly, when the disk is inserted and clamped, one may see a wide range of variation in the disk waviness. The disk was inserted in the drive and clamped. All measurements were made without changing that clamping of the disk so that all measurements on a particular machine were related to the fixed clamped condition of the disk. Comstock, Tr. 1582-83.

163. For purposes of the Tandon tests, a single representative, off-the-shelf disk was used for all dynamic tests of each of the three different size drives. Nathanson, Tr. 1436; Nathanson, CX 716, ¶ 137.

164. For example, the same disk, a standard production disk not selected for any particular characteristics, was used for all of the 5-1/4 inch floppy disk drives tests conducted by Mr. Nathanson. The disk was not taken out of the drive during any testing. It was clamped into position, all the tests involving that disk were run, and it was not removed from the drive until that testing had been completed. Comstock, Tr. 1954.

165. The Tandon Z-axis data purport to show that each of the floppy disk drives tested, with the notable exception of the IBM drive, are asymmetric. The IBM drive is symmetric.

Table I

Z-Axis Disk and Transducer Motion Data

	Mitsubishi	TEAC	Sony	Tandon 5-1/4	Tandon 8	IBM
A (microinches)	1300	2714	4200	2317	2500	5200
B (microinches)	29	155	20	17	59	3139
I (%)	97.8	94.3	99.5	99.3	97.6	39.6

Table II

Z-Axis Disk and Transducer Spring Rate Data

	Mitsubishi	TEAC	Sony	Tandon 5-1/4	Tandon 8	IBM
K_{ho} (gms/in)	20,000	18,000	72,000	164,000	60,000	50
K_{hl} (gms/in)	200	167	200	200	200	50
K_d (gms/in)	50	50	100	50	66.7	120
I (%)	99.75	99.73	99.86	99.97	99.89	45.45

Comstock, Tr. 1950-51; Nathanson, CX 716, 11 43, 50.

166. In Table I, "A" is the measured disk Z-axis motion or displacement, "B" is the side β transducer Z-axis displacement, and "I" is the calculated degree of insensitivity of the side β transducer to the applied Z-axis displacement of the disk. Nathanson, CX 716, ¶ 43.

167. In Table I, "I" was calculated as follows:

$$I = (1-B/A) \times 100$$

Nathanson, CX 716, ¶ 43.

168. In Table II, K_{ho} , K_{hl} , and K_d are, respectively, the measured Z-axis spring rates of the β transducer and its mounting structure, the side l transducer and its mounting structure, and the floppy disk. "I" is the calculated degree of sensitivity of the transducer to being displaced along the Z-axis by the disk. Nathanson, CX 716, ¶ 50.

169. In Table II, "I" was calculated as follows:

$$I = [1 - (K_d / (K_d + K_{ho} + K_{hl}))] \times 100$$

Nathanson, CX 716, ¶ 50.

170. According to Tandon's technical expert, the data in Tables I and II show that the Mitsubishi, TEAC, Sony, and Tandon drives have an asymmetrical transducer assembly construction. Comstock, Tr. 1950-52.

171. The conclusion reached in FF 170 is in contrast to the prior art IBM double-sided floppy disk drive in which both of the transducers tend to follow or comply with the waviness or undulations of the disk. Comstock, Tr. 1950-52.

172. The measurements of disk pitch motion (P_d), side β transducer pitch motion (P_h), and side β transducer roll motion (R_h), as compiled by Nathanson, are shown in Table III, below, for each of the six disk drives tested. Table III also shows Nathanson's calculations of insensitivity ("I," in %).

197. Table V shows both instantaneous peak-to-peak and centerline peak-to-peak displacement or motion measurements. The instantaneous peak-to-peak measurements include all components of electronic noise, common mode vibrations not cancelled by automatic carriage motion subtraction, and any high frequency vibrations caused by transducer resonance. The centerline peak-to-peak measurement method removes or subtracts such noises and vibration modes from the instantaneous peak-to-peak motion signals. The frequency spectrum of the transducer, carriage and disk motions were recorded with and without the side 1 transducer in contact with the disk, to aid in demonstrating transducer-induced resonance. These measurements are shown in data notebook 9, Exhibit CRX 7. Nathanson, CX 817, ¶ 96; Nathanson, CRX 7; CRX 8.

198. With respect to the track accessibility for making displacement measurements at multiple radii, there were limitations in most of the disk drives that did not permit access to anything except mid-radius. In the Tandon and IBM disk drives, it was possible to make measurements over a somewhat greater range of radii so those measurements were made and reported. Comstock, Tr. 4123-25; Nathanson, CX 817, Table I.

199. Table VI, below, shows "free" disk displacement and side 0 transducer displacement, both in microinches, as measured at tracks 17 and 22 in the Tandon drive and at tracks 42 and 62 in the IBM drive. Table VI shows both instantaneous peak-to-peak and centerline peak-to-peak measurements. Nathanson, CX 817, Table I.

196. Table V, below, shows measurements of disk Z-axis displacement ("A" in microinches) and side β transducer Z-axis displacement ("B" in microinches) for each of two disk samples at approximately mid-radius tracks for all of the test drives except the Mitsubishi MF 353. Nathanson, CX 817, Table II.

TABLE V

Z-Axis Disk and Transducer Displacements at Mid-Radius Tracks

DRIVE MAKE	MITSUB	MITSUB	TANDON	IBM
MODEL NO.	M4851	M4851A-3	TM 100-2A	53 FD
SERIAL NO.	15031	A006001	S4461808	41961
<u>Instantaneous Peak-To-Peak Displacements</u>				
Disk displ. (A) 1st disk	4,333	3,333	1,300	6,467
Transducer displ. (B) 1st disk	90	107	27	5,167
Insensitivity (%) 1st disk	97.9	96.8	97.9	20.1
Disk displ. (A) 2nd disk	1,300	2,867	1,400	3,867
Transducer displ. (B) 2nd disk	50	177	40	3,633
Insensitivity (%) 2nd disk	96.2	93.8	97.1	6.1
Average Insensitivity (%)	97.1	95.3	97.5	13.1
<u>Centerline Peak-To-Peak Displacements</u>				
Disk displ. (A) 1st disk	4,267	3,000	1,100	5,533
Transducer displ. (B) 1st disk	70	70	7	4,933
Insensitivity (%) 1st disk	98.6	97.9	99.4	10.8
Disk displ. (A) 2nd disk	1,233	2,800	1,333	3,200
Transducer displ. (B) 2nd disk	17	57	13	2,967
Insensitivity (%) 2nd disk	98.6	98.0	99.0	7.3
Average Insensitivity (%)	98.5	98.0	99.2	9.1
1st disk identification	DL101	DL101	DL103	3M201
2nd disk identification	3M101	3M101	3M101	MX201
Test radius	TRK 17	TRK 18	TRK 20	TRK 40

Nathanson, CX 817, Table II.

helpful to know the frequency of the vibration so that the source of the vibration can be traced back to particular elements in the system. Comstock, Tr. 4101-03.

191. The resonance phenomenon applies to all floppy disk drives generally. Comstock, Tr. 4103.

192. For purposes of the second series of tests, transducer 2-axis motion has been presented using both the average centerline peak-to-peak method and the instantaneous peak-to-peak method. This permits the data to be seen from both perspectives. However, the results are not substantially affected by the method used. Comstock, Tr. 4106-07; CX 817, Tables 1, 2.

193. In the measurement of spring rates in the second series of tests, in light of the testimony at the hearing on temporary relief, the carriages were removed from the disk drives and clamped in a vice so as to get a measurement of spring rate that was free from the influence of the spring rates of the carriage guide rods. Comstock, Tr. 4104.

194. The measurement of the side 1 transducer mounting spring rate was improved for purposes of the second series of tests by measuring in compression rather than in tension. Comstock, Tr. 4104-05.

195. None of these changes in measurement technique had any material effect on the conclusions relating to the asymmetry of the system or the question of whether one transducer was mounted more rigidly than the other transducer, or the question of the side β transducer being significantly stiffer than the disk. Nor did these changes in measurements technique affect the computed values of insensitivity, "I," which fell in the same ranges found as a result of the first series of tests. None of the refinements in testing technique really altered any of those conclusions. Comstock, Tr. 4105.

186. Although the correction for chassis motion made in the first series of tests is probably scientifically more sound, the testimony during the hearing on temporary relief was directed toward the issue of carriage motion. Thus, in the second series of tests, Mr. Nathanson corrected for carriage motion, and in that respect produced a set of data that would be enhanced over the prior set of data. Comstock, Tr. 4097-98.

187. None of these changes (see FF 181-86) significantly influenced the final conclusions. Comstock, Tr. 4098.

188. The second series of tests made use of a spectrum analyzer which permitted the recording of not only the actual motion traces but also the frequency spectrum of the various signals that might be present in those motion signals. That instrument operates on the principle of a fast Fourier transform mathematical method for determining frequency distributions or spectra and it provided further information about the performance of the test drives. Comstock, Tr. 4098.

189. Furthermore, in the second series of tests, an automatic output plotter-printer was used that generated the charts that are shown in the exhibits as opposed to taking a Polaroid photograph of an oscilloscope screen. The use of the plotter-printer both speeded up the process and provided a larger scale plot which was easier to work with than a relatively small Polaroid photograph. Comstock, Tr. 4099.

190. In a floppy disk drive, it is important to avoid resonance because it can affect the alignment of the transducer and track and can influence the wear of the disk. In tracking down these resonances, it is

tests are reported in three data notebooks, Nos. 6, 7, and 8, identified as CX 780, CX 781, and CX 782, respectively, and in the "Second Witness Statement of Marshall Nathanson," CX 817. Nathanson, Tr. 4025-26; Nathanson, CX 817, 11 79, 86.

182. The second series of tests also included measurements of the resonance characteristics of the transducer/disk combinations in the Mitsubishi Models M4851 and M4851A-3. Nathanson, Tr. 4026; Comstock, Tr. 4135-38; Nathanson, CRX 7; CRX 8.

183. In conducting the additional tests, Mr. Nathanson expanded the scope of the tests in several respects. For example, a more elaborate job of measuring the spring rate of the disk at five different radial locations was performed. Also, two sample disks were used in this round of testing rather than one disk. Comstock, Tr. 4095.

184. Another way in which the later series of tests differed from the earlier series was that the disk drives were tested both before and after modification to determine whether chassis modifications had any influence on the measurements. Comstock, Tr. 4096.

185. The second series of tests was further enhanced in adopting an improved instrumentation set-up, not in terms of the accuracy of the measurements, but in terms of conducting a simultaneous measurement of carriage motion and disk or transducer motion and then performing an automatic electronic subtraction of the carriage motion from either the disk or transducer motion whereby an automatic correction was obtained of whatever carriage motion that might have been present. Comstock, Tr. 4096.

177. In the Mitsubishi drives having a load point, upon loading of the upper transducer arm against the disk, the lower transducer moves into contact with the load point, which accounts for the very high stiffness measurements. Comstock, Tr. 5260-62.

178. In the Mitsubishi drive, the spring rate in the Z-axis direction of the upper transducer assembly is very much less than that of the lower transducer assembly. Comstock, Tr. 5261-62.

179. In the IBM double-sided floppy disk drive Model 53 FD, both heads are mounted in a highly flexible manner in accordance with the principal outlined in CX 609, and the test data reveals that in the IBM drive the heads tend to follow the movements of the disk to a very high degree. Comstock, Tr. 1524.

180. The second series of tests were conducted on the following double-sided disk drive samples:

Manufacturer	Model No.	Serial No.	Exhibit No.
(a) Mitsubishi	M4851 (5-1/4)	15031	CPX 11A
(b) Mitsubishi	M4851A-3 (5-1/4)	A006001	CPX 11C
(c) Mitsubishi	MF 353 (3-1/2)	G30001083	CPX 11D
(d) Tandon	TM 100-2A (5-1/4)	S4461808	CPX 35
(e) IBM	53 FD (8)	41961	CPX 16A

Nathanson, Tr. 4023-26; Nathanson, CX 817, ¶ 74.

181. The second series of tests included measurements of Z-axis transducer and disk displacements, and Z-axis transducer and disk spring rates for all of the above drives (FF 180). The measurements and data from these

Roll Spring Rate Data

<u>Drive Make</u>	<u>Head 0</u> <u>Spring Rate</u> (gm-in/rad)	<u>Head 1</u> <u>Spring Rate</u> (gm-in/rad)	<u>Head System</u> <u>Spring Rate</u> (gm-in/rad)	<u>Disk</u> <u>Spring Rate</u> (gm-in/rad)	<u>Head</u> <u>Pitch</u> <u>Invariance</u>
Mitsubishi	24.42	24.45	48.87	14.77	76.79
TEAC	1,135	2.07	1,137.07	14.77	98.72
Sony	44,445	4.82	44,449.82	14.77	99.96
Tandon 5-1/4"	126,316	5.71	126,331.7	14.77	99.99
Tandon 8"	126,316	7.07	126,323	14.77	99.99
IBM 8"	4.05	4.05	8.1	14.77	35.42

CX 716, ¶ 63.

174. The value of "I" in Table II was calculated using the following formula:

$$I = (1 - P_h/P_d) \times 100$$

Nathanson, CX 716, ¶ 56.

175. The value of "I" in Table IV was calculated using the following formula:

$$I = [1 - K_d/(K_d + K_{ho} + K_{hl})] \times 100$$

Nathanson, CX 716, ¶ 63.

176. In the Mitsubishi Model M4851, although the circular flexure elements mounting the upper and lower transducers are the same, the lower transducer flexure is supported from below by a load point that greatly increases the stiffness in the direction perpendicular to the plane of the disk. The measured spring rates of 18,000 to 22,000 grams per inch in the Z-axis direction for those lower flexure supports is much stiffer than the spring rate of the disk. Comstock, Tr. 5259-60.

Table III

Disk and Transducer Pitch and Roll Displacements

	Mitsubishi	TEAC	Sony	Tandon 5-1/4	Tandon 8	IBM
P_d (arc-mins)	13.56	12.33	16.10	13.07	15.39	27.82
P_h (arc-mins)	0.15	0.69	0.15	0.30	0.45	22.62
I (%)	98.9	94.4	99.1	97.7	97.1	18.7
R_h (arc-mins)	0.60	0.15	0.15	0.30	0.45	18.17

173. In Table IV, below, there is shown for each of the subject floppy disk drives, the measured pitch and roll spring rates of the disk (K_d), the side 1 transducer (K_{h1}), and the side 0 transducer (K_{h0}). Table IV also shows Nathanson's calculation of insensitivity ("I," in %). Nathanson, CX 716, ¶ 63.

Table IV

Pitch Spring Rate Data

<u>Drive Make</u>	<u>Head 0 Spring Rate (gm-in/rad)</u>	<u>Head 1 Spring Rate (gm-in/rad)</u>	<u>Head System Spring Rate (gm-in/rad)</u>	<u>Disk Spring Rate (gm-in/rad)</u>	<u>Head Syst Pitch Invarian</u>
Mitsubishi	28.92	28.53	57.45	17.75	76.40
TEAC	56.81	3.09	59.90	17.75	77.14
Sony	44,445	7.63	44,452.63	17.75	99.96
Tandon 5-1/4"	126,316	15.57	126,332	17.75	99.99
Tandon 8"	120,000	15.20	120,015	17.75	99.99
IBM 8"	5.52	5.52	11.04	17.75	38.35

TABLE VI

Z-Axis Transducer and Disk Displacements at Accessible Tracks

	TANDON TRK 17	TANDON TRK 22	IBM TRK 42	IBM TRK 62
<u>Instantaneous Peak-To-Peak Displacements</u>				
Disk displacement (microinches)	2,467	3,4334	4,267	5,800
Transducer displ. (microinches)	33	40	3,166	4,400
Insensitivity (%)	98.7	98.8	25.8	24.1
<u>Centerline Peak-To-Peak Displacements</u>				
Disk displacement (microinches)	2,333	3,367	4,033	5,533
Transducer displ. (microinches)	10	27	2,267	3,733
Insensitivity (%)	99.6	99.2	43.8	32.5
Tandon test disk identification	= 3M#101			
IBM test disk identification	= 3M#201			

Nathanson, CX 817, Table I.

200. No transducer or disk displacement tests were conducted on the Mitsubishi Model MF 353 3-1/2 inch drive because probe access to side \emptyset was obstructed by the spindle motor and a circuit board. The circuit board mounts LSI integrated circuit components which could not be removed and relocated without adversely affecting the drive. Nathanson, CX 817, ¶ 95.

201. In Table VII, below, there is shown for each of the subject floppy disk drives the measured spring rates, in grams per inch, of the side \emptyset transducer and its mounting structure (K_{h0}), the side 1 transducer and its mounting structure (K_{h1}) and the floppy disk both at the inner radius (K_{di}) and at the outer radius (K_{do}). Table VII also shows for each drive the insensitivity (I, in %) of the transducers to being displaced along the Z-axis by the disk, both at the inner radius and at the outer radius. The values of "I" were calculated using the following equation:

$$I = [1 - (K_d/K_{h0} + K_{h1} + K_d)] \times 100$$

Nathanson, CX 817, ¶ 99; Nathanson, CX 817, Table III.

TABLE VII

Z-Axis Spring Rate Data

	Mitsu M4851	Mitsur M4851A-3	Mitsu MF 353	Tandon TM 100-2	IBM 53 FD
Kh0 (lower head)	22000	9241	4815	166667	50
Kh1 (upper head)	172	650	97.3	199.4	50
Kdi (inner radius)	167	484	350	833	364
Kdo (outer radius)	113	433	50	652	59
Insensitivity (I.D.)	99.3	95.3	93.3	99.5	21.6
Insensitivity (O.D.)	99.5	95.8	99.0	99.6	66.7

Nathanson, CX 817, Table III.

202. The spring rates of the side ϕ or lower transducers and their mounting structures in the Mitsubishi drives range from 4,815 to 22,000 grams per inch, compared to disk spring rates ranging from 50 to 484 grams per inch and side 1 (upper) transducer spring rates of from 97.3 to 650 grams per inch. These figures yielded calculated insensitivities of 93.3 percent to 99.5 percent for the Mitsubishi drives. In contrast, the IBM drive exhibited insensitivities ranging from 21.6 percent at the inner track radius to 66.7 percent at the outer track radius. Nathanson, CX 817, Table III.

2. Mitsubishi Tests

203. Mitsubishi conducted certain tests in which transducer and media motions, as well as transducer spring rates, were measured. MRX 10; MRX 43; MRX 44; MRX 47; MRX 93.

204. According to Mr. Hayashi, one of Mitsubishi technical experts, the media motion measured in the Mitsubishi tests with the head carriage assembly positioned at track 00 and the side 1 transducer retracted was "quite similar" to that measured in the Tandon tests. Hayashi, Tr. 4243-44.

205. The spring rate test data submitted by Mitsubishi also tend to support the tests conducted at Tandon in that the agreement between measurements was very good. Comstock, Tr. 1594-95.

206. Mitsubishi measured a lower head spring rate in the Tandon TM 100-2A of about two million grams per inch as opposed to 164,000 grams per inch measured by Tandon. Comstock, Tr. 1594-95.

207. The Mitsubishi M3 Series 5-1/4 inch double-sided disk drive; the MF 353 3-1/2 inch double-sided disk drive; and the Models M2893 and M2984-4/5 8 inch double-sided disk drives all have--like the M4851 and the other Mark I and Mark II Series models--an asymmetrical head assembly construction. Comstock, CX 615, ¶ 16.

208. Based on the Hayashi witness statement, MRX 27, the Mitsubishi Model M4851 tested by Tandon fairly represents the Mitsubishi Mark I, Mark II, and M3 Series, the MF 353 and the two 8 inch models mentioned above. Each of these Mitsubishi drives uses an asymmetrical transducer system in which one of the transducers is more stiffly mounted than the other. Comstock, CX 615, ¶ 17.

209. The Mitsubishi tests were conducted by MELCO employees acting under the direction and supervision of Mr. Toshikazu Hayashi. Many of the test reports based upon those tests have been admitted into evidence as MRX 1, 3, 5, 7, 10, 12, and 43-47. Additionally, several videotapes were prepared in a similar fashion, were played in open court, and were admitted as MRX 9 and MRX 42. Hayashi, MRX 27A, ¶ 9; Hayashi, MRX 92, ¶¶ 30-35.

209A. In the Hayashi tests, head motions were measured at different times than media motions, with the head motions being measured before the media motions. Those measurements were made on different days. Hayashi, Tr. 4273.

210. The modulation test reported in MRX 1 (entitled "Comparison Test of the Modulation of the Tandon and Mitsubishi Drives") compares the degree of head compliance of the head to the media for Tandon and Mitsubishi systems. Lack of good head compliance, that is, an unacceptably large spacing between the read/write gap of the head and the magnetic recording media, can be gauged by observing the ratio of the minimum readback amplitude to the average maximum readback amplitude ("minimum amplitude ratio"). In the Mitsubishi drives, a spacing of 0.32 microns is the maximum acceptable spacing and corresponds to a minimum amplitude ratio of 80 percent. MRX 1, ¶¶ 1, 8; Hayashi, Tr. 2847, 2852-55.

211. The head support mechanism of the Mitsubishi drive, wherein both the lower (S_0) and upper (S_1) heads are mounted by gimbal springs, enables the heads to satisfactorily comply with deflections in the media. MRX 1, at 7-8; Hayashi, Tr. 2852-55.

212. The spring rate test of the lower (S_0) head in the Z-axis direction indicates that spring rate is 2,100,000 grams/inch for the Tandon TM 100-2 tested, compared with an average of 21,000 grams/inch for the two Mitsubishi M4851 drives tested. The Z-axis spring rate for the S_0 heads is 100 times greater in the Tandon system than in the Mitsubishi system. These results are obtained when the spring constant of the S_0 head itself is measured and the effects of movement of other parts of the drive are eliminated. MRX 3, at 1 et. seq.

213. The Mitsubishi drives showed Z-axis movement during loading in excess of 64 times greater movement than in the Tandon system. The smallest Z-axis movement in the Mitsubishi systems was 16.6 microns, well in excess of the critical dimension of 0.32 microns. All of the measured pitch and roll angles were at least 35 times greater in the Mitsubishi system than in the Tandon system. MRX 5, at 6; Hayashi, Tr. 2858-60; Lewis, Tr. 2901.

213A. Pitch and movement of the heads during the operative read/write operation is demonstrated by the various laser tests in which a laser beam is reflected off of a lightweight reflective surface placed on the head. Movement of the carriage, the lower (S_0) head and the lower (S_0) and upper (S_1) heads, were measured. Multiple tests were conducted utilizing various recording media. MRX 7, at 1 et. seq.

214. The laser test results reported in MRX 7 and partially displayed in the videotape (MRX 9) demonstrate that the pitch and roll movement of the lower (S_0) head of the Tandon system was on the same order as the size of the movement of the carriage, 0.5mm. The Mitsubishi lower (S_0) head movement reported ranged up to 8.1 minutes for the pitch direction and up to 2.6' for the roll direction. MRX 7, at 7-10; MRX 9.

214A. The laser test videotape demonstrated the motion of the upper (S_1) and lower (S_0) heads simultaneously for some tests. The tests on the Mitsubishi devices demonstrated that both the upper (S_1) and lower (S_0) heads move a comparable and significant amount during the operation of the drives. The Tandon drives did not exhibit comparable or significant movement during the operation of those drives. MRX 9.

215. The pitch, roll, and Z-axis movements of the upper (S_1) and lower (S_0) head of the Mitsubishi and Tandon systems during read/write operation are described in the test report MRX 10 and MRX 43. In the M4851 Mark I Mitsubishi drives tested, the Z-axis displacement of the read/write gap ranged from 0.71 microns to 1.14 microns. In the Mark II, M3, MF353, and M2896-63 drives tested, the Z-axis displacement of the head center ranged from 0.23 microns to over 6.9 microns. Though these distances are small in an absolute sense, they are large in comparison to the critical dimension of 0.32 microns. Pitching and rolling angles varied from 0.38' to 2.38' in the Mark I. In the Mark II, M3, MF353 and M2896-6 drives, these angles varied from 0.32' to 10.0'. This shows that the lower (S_0) head in the Mitsubishi system follows the small deviations of the media. MRX 10, at 1, et seq.; Hayashi, Tr. 2862-65.

216. During the loading and unloading operations, the lower head of the Mitsubishi drive moves in the Z-axis direction as well as in pitch and roll. Hayashi, Tr. 2855. As an example, the lower head of a Mitsubishi Mark I 5-1/4 inch drive moved 16.6 micrometers (664 microinches) during loading, several hundred times more than the lower head movement in the Tandon 5-1/4 inch drive. This movement of the Mitsubishi lower head is about 50

times that of the critical spacing of 0.32 micrometers. Similarly, there were very large differences between the movement of the Mitsubishi lower head in pitch and roll and their corresponding movements in the Tandon device. In substance, the Tandon lower head did not move at all during loading and unloading, while the Mitsubishi head moved a significant amount in all three directions. Hayashi, Tr. 2858, 5859; MRX 5.

217. The lower head of the Mitsubishi drive also moved significantly in pitch, roll, and Z-axis direction during the read/write operation of the drive. MRX 7; MRX 9. The read/write gap of the Mitsubishi drive moved on the order of 1.13 micrometers during the read/write operation, more than four times the critical 0.32 micrometers referred to above. Hayashi, Tr. 2862; MRX 10. The movements in pitch and roll of both the upper and lower heads in the Mitsubishi drive were virtually identical, the heads moving in a synchronous manner. Hayashi, Tr. 2864; MRPX 20, 21.

218. The movement of the upper and lower heads of both Tandon and Mitsubishi drives were presented at both the hearing on temporary relief and the hearing on permanent relief in the form of graphical test data depicting head motion in the Z-axis direction, and in pitch and roll. MRX 10; MRX 43. In order to present this data in a format would more clearly demonstrate the amount and correlation of head movement, videotape MRX 42 was prepared. The images on the videotape were generated through computer animation and represented the actual head movement of a Mitsubishi M4852 Mark I drive and a Tandon TM 100-2 drive. The head motions shown represent the actual head motion of physical drives. The source of the data used to generate the images is presented in Hayashi WS, MRX 92, ¶ 26. Because of the imperceptible size

of the head movements, to permit visual presentation in a video format, the pitch, roll, and Z-axis movements were multiplied 1000 times for both drives. Hayashi, MRX 92, ¶ 27; Hayashi, Tr. 4227-35.

219. The videotape MRX 42 demonstrates that the upper and lower heads in the Mitsubishi Mark I drive pitch and roll synchronously. In contrast, the heads in the Tandon drive move asynchronously. Hayashi, Tr. 4234.

220. Measurements of media motion near mid-radius position were measured and reported in MRX 44. The test measured the amount of disk movement near mid-radius with the upper head off-loaded from the disk with the lower head in two positions at track $\beta\beta$ and near mid-radius underneath the disk measurement location. In this way, the effect of the lower head on the disk could be determined. In the Mitsubishi drive tested, the presence of the lower head had minimal effect on the amount of disk fluctuation. The presence of the lower head reduced the disk fluctuations from 51 microns (approximately 2040 microinches) to 49 microns (approximately 1960 microinches). In the Tandon system measured, the mere presence of the lower head reduced the mid-radius disk fluctuations by over 90 percent. The media movement in the Tandon drive was reduced from 21 microns (approximately 840 microinches) to 1.4 microns (56 microinches) merely by the presence of the upper head. Hayashi, Tr. 4242-46.

221. Tests were conducted in which the motion of the media was measured at the points where it entered and exited the head area. The results of these tests are reported in MRX 44. This data demonstrates that a light loading force can eliminate the large-scale waviness of the media. Hayashi, Tr. 4248; MRX 44.

222. The amount of Z-axis, pitch and roll motions for various media were measured for a Mitsubishi M4851 Mark I drive and a Tandon TM 100-2 drive. For each drive, three different diskettes (one each from three manufacturers) were used. The test results are displayed at page 18 of MRX 43. The results show that the degree of movement in the lower head of the Tandon drive does not vary for the various media. In contrast, in the Mitsubishi drive, the degree of movement of the lower head varied by over a factor of 3:2 depending upon the type of media used. In the Tandon drive, it is the upper head alone which responds to the thickness variations and fluctuations of the media. In the Mitsubishi drive, both heads cooperate to accommodate the thickness variations and fluctuations of the media. MRX 43; Hayashi, Tr. 4249-50.

223. The motion of the upper and lower heads of Mitsubishi drives were measured and the results presented in MRX 43 and MRX 45. The pitch and roll motions of the upper and lower heads in the tested drives were virtually synchronous. The heads pitch and roll together to accommodate the thickness variations and fluctuations of the media. MRX 43; Lewis, Tr. 4606-07.

224. Tests were conducted to determine the effect of the upper head being loaded on and off the disk. The test results are reported in MRX 96. In the Tandon drive, the presence or absence of the upper head had very little effect on the read/write signal amplitude of the lower head. Thus, the mere presence of the lower head alone is sufficient due to the significant penetration to result in good head to media contact. In the Mitsubishi drives, the presence of both the upper and lower head was essential to

achieving acceptable read/write signal amplitude. The presence of the lower head alone is insufficient to provide a reference for the disk such that the disk may be read. Lewis, Tr. 4582-92.

225. MELCO has been involved with the design and manufacture of magnetic data storage systems for use in computers for over 25 years. Starting in 1957, MELCO designed and manufactured its first system which was a magnetic drum data storage system. In the early 1960s, MELCO joined in the design and manufacture of rigid disk drive units. The MELCO M811 rigid disk became the best seller in Japan. MELCO manufactured the majority of its key parts in-house, such as the plated disk, spindle motors and heads for the disk drive. In the early 1970s, MELCO developed cartridge drive systems which were used in office computer systems. Again, this system became a best seller in Japan. MELCO was a leader in developing "ramp head loading technology." MELCO was one of the earliest designers and manufacturers of flexible disk drive systems for computer systems, the first units being designed in 1973 and 1974. Since that time, the line of MELCO flexible disk drives, as well as other types of drives, has grown. Hayashi, MRX 27-A, ¶ 4.

226. The Mitsubishi double gimbal design, which is employed in all of the Mitsubishi drives in issue, employs the principle of having the heads follow the small scale deviations in the media. The heads do not control these small but significant deviations, but rather follow those deviations through their gimbal mount. This approach is to be contrasted with the Tandon system, which attempts to "iron out" or eliminate these small scale deviations. These two philosophies constitute fundamentally different solutions to the problem of small scale waviness. Hayashi, Tr. 2849-50.

227. The intent of the Mitsubishi design is to permit both heads to move significant amounts in the Z-axis direction and in pitch and roll.

Hayashi, Tr. 2843-44.

228. The Tandon '573 patent is directed to an improvement in a head carriage assembly for use in connection with a double-sided flexible disk drive. Penetration is utilized in order to obtain control over the media, to ensure good contact between the head and the flexible media, and to iron out the large scale fluctuations in the media. CX 611, Prosecution History at 37; Meulners Decl., CX 611, ¶ 6a; Chisum, Tr. 4343, 4367-68; Lewis, Tr. 4571-72. Control over the flexible media is accomplished by penetrating the plane of the disk in greater magnitude than was done in the prior art systems, thus providing a stable repeatable head media platform analogous to rigid disk technology. The lower fixed head irons out the fluctuations of the media, thereby providing essentially a flat surface similar to a rigid disk for the upper head to ride on. CX 611, at 37; Meulners Decl., CX 611, ¶ 6a; Tandon Dep., at 473, MRPX 34C.

229. Control over the media is accomplished by penetrating the nominal plane of the disk in a relatively large magnitude, thus deriving a stable repeatable head media platform analogous to rigid disk technology. The result is to utilize the slider-head gimbaling action to complete a three-piece invariant structure comprising: (1) the lower, non-gimbaled, non-spring loaded, invariant head; (2) the media; and (3) the gimbaling upper head. This platform action of the media-head contact is forced and becomes the chief principle by which the Tandon design radically differs from the IBM design. CX 611, at 37-38, 41; Meulners Decl., CX 611, Smith Decl., CX 611; Jessup, Tr. 4412-14.

230. The intention in the Tandon design is that the lower head not move, that it not pitch and roll. Hackney Dep., at 31, MRPX 36C.

231. The Tandon patent does not include a double-sided disk drive in which: (1) the lower head is gimbaled; (2) the upper head is fixed; or (3) both the upper and lower heads are gimbaled. Hackney Dep., at 44-45, MRPX 36C.

232. The degree of fixedness of the first transducer required by claims 1, 5, and 12 is that the head had to be designed to not move in response to forces it would likely encounter in a floppy disk drive. Lewis, Tr. 2919; TEO ID at 39; Tandon Dep., at 180, 413-15, 417-18, 440. The lower head should be secured as firmly as the art reasonably permits. Jessup, Tr. 4425, 4464.

233. In the disk drive industry, the term "fixed," as applied to the mounting of recorded heads, means that the recording head is designed to be not able to move under the forces of the disk. Lewis, Tr. 2870; Brown, Tr. 2640; TEO ID at 39; Hackney Dep., at 42, 122, MRPX 36C.

234. It is very important that a flexible disk drive establish good head compliance, that is, good contact between the heads and the media or, to state the converse, that the spacing between the read/write gap of the head and the media be kept to zero or a minimum value. Hayashi, Tr. 2844. As that spacing increases, the readback signal amplitude ratio decreases. When that ratio drops off to 80 percent of its maximum value, the operation of the drive is no longer satisfactory. In the Mitsubishi drive, the 80 percent figure is reached when the spacing between the gap and the media is about 0.32 micrometers or 12 microinches. Hayashi, Tr. 2847. Thus, while the spacings

involved in the operation of a flexible disk drive are very small in an absolute sense, they are of critical importance to its proper operation.

Hayashi, Tr. 2848; Comstock, Tr. 1548.

234A. The lower heads in the Mitsubishi drives all move a significant amount in the Z-axis direction, both during the loading and unloading phase, as well as during the read/write operation. Hayashi, Tr. 2855, 2857-59, 2862-63; MRX 5, 10.

3. Interpretations and Scope of Tandon Patent Claims.

235. The Tandon '573 patent is directed to an improvement in a head carriage assembly for use in connection with a double-sided flexible disk drive. The patent represents a mixture of two magnetic storage technologies -- a penetrating head type system from tape drives and single-sided flexible disk drive systems and the air bearing head of the hard or rigid disk drive. Brown, Tr. 2522. Penetration is utilized in order to obtain control over the media, to ensure good contact between the head and the flexible media, and to iron out the large scale fluctuations in the media. CX 611, at 37; Meulners Decl., CX 611, ¶ 6a; Chisum, Tr. 4343, 4367-68; Lewis, Tr. 4571-72. Control over the flexible media is accomplished by penetrating the plane of the disk in greater magnitude than was done in the prior art systems, thus providing a stable repeatable head media platform analogous to rigid disk technology. The lower fixed head irons out the fluctuations of the media, thereby providing essentially a flat surface similar to a rigid disk for the upper head to ride on. CX 611; at 37; Meulners Decl., ¶ 6a; Tandon Dep., at 473.

235A. One of the perceived deficiencies or problems with the prior art IBM double-sided disk drive was that the resilient mounts were relatively complex and had to be precisely manufactured and, therefore, were costly to manufacture and maintain. CX 601, col. 1, lines 62-67. In contrast to the IBM system, the Tandon system is one that is simpler to fabricate and has fewer parts. CX 611, at 29, Amendment of March 1, 1978, at 4. This simplicity of fabrication derives from the fact that the first transducer is not gimbaled, is not spring-loaded, and is securely attached to the carriage. Jessup, Tr. 4410.

235B. One of the perceived deficiencies with the prior art IBM approach to double-sided recording in a flexible disk drive was that the flexible media was unstable in the pitch and roll directions. One of the "significant deficiencies" with the IBM approach was that the flexible media is not stable relative to the pitch and roll attitude of the heads. CX 611, at 41; Smith Decl., ¶ 5b. Additionally, variations especially in roll cause the recording gaps of the head structures to move away from each other radially, causing significant loss of radial positioning accuracy. This loss of radial positioning accuracy can cause, especially for disk interchange, the heads to respond to recorded data on tracks adjacent to the track of interest, a major source of data transfer error. CX 611, at 36; Meulners Decl., at 3.

235C. The Tandon design requires that the lower invariant head provide a reference plane, as opposed to a reference point, for the media. This invariantly positioned lower head provides a stable, repeatable plane over which the flexible media is drawn. This reference plane irons out the large scale fluctuations in the media, thereby presenting a surface to the upper

gimbaled head essentially analogous to the media in the rigid disk field. Jessup, Tr. 4414; CX 611; Comstock, Tr. 4118-19; Tandon Dep., at 413-14, 417-18, 436, 463, 476, MRPX 34C; Hackney Dep., at 114-15, MRPX 36C.

235D. The terms "fixed," "relatively fixed," and "fixedly coupled" used in claims 1, 5, and 12 of the Tandon patent all require the same degree of fixedness of the lower or first transducer. Jessup, Tr. 4424. No argument was made in the prosecution history which indicates that any of the claims was to differ as to the requisite degree of fixedness. Chisum, Tr. 4375.

235E. The term "fixed" as it is used in claim 1 does not have a different meaning than the term "relatively fixed position" in claim 5. Tandon Dep., at 613, MRPX 36C; Hackney Dep., MRPX 36C.

235F. The degree of fixedness of the first transducer required by claims 1, 5, and 12 is that the head had to be designed to not move in response to forces it would likely encounter in a floppy disk drive. Lewis, Tr. 2919; Tandon Dep., at 180, 413-15, 417-18, 440. The lower head should be secured as firmly as the art reasonably permits. Jessup, Tr. 4425, 4464.

235G. In the disk drive industry, the term "fixed," as applied to the mounting of recording heads, means that the recording head is designed not to move under the forces of the disk. Lewis, Tr. 2870; Brown, Tr. 2640; TEO ID at 39; Hackney Dep., at 42, 122, MRPX 36C.

235H. The phrase "relatively fixed" as used in claim 5 of the '573 patent does not qualify the requisite degree of fixedness of the first transducer nor does it mean "somewhat fixed." The appropriate term of art in drafting the patent claim to indicate a certain degree of flexibility or a

certain degree of tolerance is "substantially." Jessup, Tr. 4426.

Additionally, since "relatively" was added to claim 5 while under final Amendment, if "relatively" meant "somewhat," that amendment would have broadened the claim which was professed not to be the intention of the applicant. Chisum, Tr. 4374; CX 611, at 53, Amendment of Aug. 3, 1978, at 4. There is no indication in the prosecution history that the applicant was trying to broaden the meaning of the term "fixed" by the amendment. Chisum, Tr. 4375.

235I. The term "invariant" as used in claim 12 of the Tandon '573 patent means that the first transducer "doesn't move, does not vary in the direction normal to the plane of the disk." Tandon Dep., at 614, MRPX 34C. An "invariant" transducer may move a little bit since nothing is one-hundred percent fixed; however, for all practical purposes, it does not move. The head also does not move to any significant degree. Tandon Dep., at 750-51, MRPX 34C.

235J. "Non-gimbaled" as used in the context of the Tandon '573 patent refers to a device which is not gimbaled; a gimbaled device is one that is free to move around various rotational axes. Chisum, Tr. 4330-31.

"Non-gimbaled" means a head does not move in pitch and roll when subject to forces put on it. Tandon Dep., at 437, 610, MRPX 34C. A "non-gimbaled" head is intended to be fixed and non-movable. Hackney Dep., at 169, MRPX 36C. Claim 5 expressly requires that the first transducer be "non-gimbaled." All of the claims of the Tandon '573 patent require that the first transducer be "non-gimbaled," as it is an essential characteristics of an invariant transducer. Jessup, Tr. 4468.

235K. The limitation that the first transducer be "non-gimbaled" is the important limitation in claim 5. Chisum, Tr. 4330-31.

235L. A "non-gimbaled button type head" is a head that, in operation, does not gimbal to accommodate any motion of the media, but the media establishes the button head as a reference. Tandon Dep., at 475, MRPX 34C.

235M. In the disk drive industry, the term "gimbaled," as applied to the mounting of recording heads, means a suspension system for the recording head that allows the head to pitch and roll. Lewis, Tr. 2871; Brown, Tr. 2649; Hackney Dep., at 22-23, MRPX 34C.

235N. A "gimbal spring" is an elastic structure which allows one, two or three degrees of freedom of angular displacement. Siegel, Tr. 4704. The term "gimbal" includes a single-axis gimbal. Tandon Dep., at 672, MRPX 34C; Hackney Dep., at 227, MRPX 36C.

235P. Mr. Tandon testified that the presence of a load point in the Tandon design does not prevent gimbaling, but rather is to provide gimbaling. The presence of a load point does not make the transducer fixed, but makes it gimbaled. Tandon Dep., at 669-70, MRPX 34C. Indeed, the presence of a pivot point promotes gimbaling. Tandon Dep., at 429, MRPX 34C.

235Q. Invariance of the first transducer in a direction normal to the plane of the media requires that the first transducer not move in the pitch and roll directions since the offset of the head gap from the load point results in the conversion of pitch and roll motion into motion in a direction normal to the plane of the disk. Lewis, Tr. 2886.

236. A "positional reference" within the meaning of the Tandon patent refers to a plane, which the disk is to be referenced to. A positional reference establishes a plane for the disk. Tandon Dep., at 436, 466, 552-53, 613, MRPX 36C.

236A. A head carriage for a double-sided flexible disk drive in which the upper head pitches and rolls in order to maintain contact or good compliance with the media, and in which the lower head pitches and rolls to essentially a similar degree as does the upper head, clearly does not infringe any claims of the Tandon '573 patent. Chisum, Tr. 4368.

236B. While under final rejection, claim 1 was amended to require that the first transducer, which has a fixed position in a direction normal to the plane of the media, further serve the function of serving as a "fixed positional reference." This was a further limitation on the claim. Jessup, Tr. 4420. In order to infringe claim 1, both the required structure of a fixed first transducer, as well as the required function, must be present. Claims 5 and 12 do not refer to either a "positional reference" or a "fixed positional reference." CX 611, at 50-51; Chisum, Tr. 4351.

236C. While under final rejection, all of the claims were amended to expressly limit the claims to systems in which it was the second transducer which accommodated, via its gimbal structure, the fluctuations and thickness variations of the media. CX 611, at 51-52, Amendments of Aug. 3, 1978. It is this second transducer which is "movable in the direction toward and away from the pliant disk and the fixed head." CX 611, at 54, Amendment of Aug. 3, 1978, at 5. It is this transducer which, in the Tandon design, is intended to pitch, roll, and move in the Z-axis direction to accommodate media fluctuations and thickness variations. Jessup, Tr. 4422-23.

237. As used in the claims of the Tandon patent, the term "nominal plane" is used to mean the average plane occupied by the disk after it has been sandwiched by the heads; that is, after the heads have been loaded and the drive is ready to read or write. Lewis, Tr. 2874; Comstock, Tr. 1791-93.

237A. In each of claims 1, 5, and 12, the tendencies of the disk or media to deviate referred to are those deviations or deflections that take place after the disk is sandwiched between the heads and the drive is ready for read/write operation. Lewis, Tr. 2877, 2879, 2882; Comstock, Tr. 1791-94.

238. None of the claims of the Tandon patent cover a system in which the first transducer employs a spring-loaded head. A spring-loaded head is one in which, if the slider is in an operating position against the disk surface and then that disk surface were to be removed and the opposing head to be removed also, then that transducer would fall forward under the expansion of a spring member, and no other members or mass moving along with that device. Jessup, Tr. 4434; Nathanson, Tr. 4063.

238A. A double-sided drive in which the first transducer employs spring-loading is not within the scope of the claims of the Tandon '573 patent. Jessup, Tr. 4434; CX 611, at 53, Amendment of Aug. 3, 1978, at 3.

239. All of the claims require that the force which causes the heads to sandwich the media be the force which urges the upper arm towards the media. For example, claim 1 requires "means coupled to said support mechanism for urging said second transducer toward said first transducer and said media to maintain both transducers in operative relation with the intervening media." CX 611.

239A. All of the claims as originally filed required that the first transducer be in a "fixed position relative to the plane of the media," or "fixedly coupled to the carriage." CX 611, at 14-18. There was a "misunderstanding" between the Examiner and the applicant as to the scope of the claims as originally filed; the Examiner giving the claims a "very, very broad" scope which read on the prior art reference R. Chisum, Tr. 4325. Despite applicant's argument that "neither of the two transducers of reference R can be stated to be fixed in any fashion whatsoever, much less in the stated manner" (CX 611, at 28), the Examiner persisted in his rejection that claims 1, 5, and 12 were clearly anticipated by reference R. CX 611, at 45. While under final rejection, the applicant narrowed all of the claims by both amendment and argument. Jessup, Tr. 4423-24, 4433-34; CX 611, at 50-54. In the remarks admittedly directed to "the definition of fixedness of the heads and the significant relationships," applicant's distinguished reference R by stating that "[i]n contrast, applicants' system utilizes one head that has an invariant position bearing against one side of the media without spring loading, and this head is non-gimbaled." CX 611, at 53.

240. The measured value of "insensitivity" varies depending upon where the disk is measured. Yet the patent gives no guidance as to where the "insensitivity" should be measured. In one case, the "insensitivity" of one disk drive varied from 21.6 percent to 66.7 percent depending upon where the disk was measured. This shows a swing of over 40 percent in "insensitivity" simply by moving the position where the disk is probed. Comstock, Tr. 4191-92.

240A. The measured value of "insensitivity" for a disk drive depends upon the particular disk that is used and the method of measurement. Comstock, Tr. 4195.

241. The Mitsubishi head carriage assemblies perform the data transfer function in quite a different way than is taught or suggested by the Tandon patent or prosecution history. The principal differences are: First, the lower head in all of the Mitsubishi drives is not fixed. The lower head is, by design and intent, a gimbaling device. Second, the lower head of the Mitsubishi drives fails to provide a reference plane for the media. The lower head pitches and rolls to a similar degree as does the upper head. Lewis, Tr. 4618-19.

241A. The gimbaled lower head in the accused Mitsubishi devices is not the functional equivalent of the invariantly fixed and non-gimbaled lower head of the claimed Tandon design. The movable lower head, in conjunction with the upper gimbaled head, permits sympathetic motion with respect to the essentially free disk undulations that Mr. Nathanson measured. The lower head thereby imposes less constraint on the media. In contrast, the first transducer in the claimed Tandon system is designed to iron out these undulations and provide a stable reference platform for the flexible media. The upper head in the claimed Tandon system is presented with a globally flat media essentially like that of a rigid disk. Additionally, the first transducer in the Mitsubishi system can deal on a local basis with thickness variations and anomalies of the lower surface of the disk, while the upper head deals with the anomalies and thickness variations of the upper head. In contrast, in the Tandon system the first transducer is designed not to respond to even the local anomalies or thickness variations of the lower side of the disk. It is the second gimbaled transducer alone in the claimed Tandon system which is intended to account for all thickness fluctuations and local anomalies. Lewis, Tr. 4607, 4609-10; CX 622, PH at 50-54.

241B. The accused Mitsubishi devices do not accomplish substantially the same thing in substantially the same way, to achieve substantially the same result. The Mitsubishi devices follow the small scale deviations in the media, whereas the Tandon system is designed to "iron out" or eliminate those variations. Hayashi, Tr. 2849-50; Lewis, Tr. 2887.

242. The Mitsubishi 8 inch flexible disk drives denominated M2849 and M2896-6 do not infringe any of the claims of the patent in suit. Comstock, Tr. 1837-39. Mr. Hackney concluded that the M2896 drive appears not to be within the scope of his invention. Hackney Dep., 179, MRPX 36C.

243. The Mitsubishi Mark I, Mark II, and M3 5-1/4 inch and MF 353 3-1/2 inch disk drives do not have a lower head having a fixed position in a direction normal to the plane of the media, nor do the lower heads serve as a fixed positional reference for the media. On the contrary, the lower heads are mounted on gimbal springs which allows them to pitch and roll and move in the Z-axis direction. Lewis, Tr. 2886, 4594; Siegel, Tr. 4707-08; Hayashi, MRX 27, ¶¶ 15-22; MRX 43.

244. The gimbaling action and operation of the lower head in the Mitsubishi devices is significant in relationship to the critical aspect of maintaining intimate contact between the head and the medium. Lewis, Tr. 4604. All of the tests that were performed by Mitsubishi and Mr. Lewis measuring the amount of lower head pitch and roll movement in the Mark I drive showed movements in excess of one minute and up to 19.15 minutes of arc. MRX 43, at 18. Two out of the three measurements conducted by Tandon were consistent with this conclusion; one measurement on an M4853 drive showing

pitch of 3.2 minutes of arc and one showing 1.05 minutes of arc. MRX 71, Bates No. 028239; Nathanson Notebook No. 2, at 35. The measurement reported in the Witness Statement of Marshall Nathanson of pitch movement of less than 0.15 minutes of arc is erroneous or an aberration. Lewis, Tr. 4606-07.

244A. The lower head in the Mitsubishi design gimbals in operation more than the upper gimballed head in the Tandon design. For example, in the comparison between a Mitsubishi M4851 Mark I drive and a Tandon TM 101-2 drive, the following results were obtained using identical flexible disks:

Media	Pitch Angle		Roll Angle	
	Tandon Upper	MELCO Lower	Tandon Upper	MELCO Lower
Maxell	0.61'	3.75'	0.86'	2.98'
3M	0.73'	7.18'	0.74'	1.93'
Datalife	1.87'	19.15'	1.46'	9.80'

The laser beam tests conducted independently by Martyn Lewis corroborate the fact that the Mitsubishi lower head gimbals more than the Tandon upper head. MRX 43, at 18; Lewis, Tr. 4603.

244B. In the Mitsubishi Mark I 5-1/4 inch disk drives, the tendencies of the media to deviate in position from its nominal plane are accommodated by the gimbal mounted upper and lower heads acting in concert. Lewis, Tr. 2887.

244C. The lower heads of the Mark I, Mark II, M3 and MF 353 drives move significantly. They do not function to provide a fixed positional reference for the media. Lewis, Tr. 2887.

244D. In the Mark I, Mark II, M3 and MF 353 drives, the media controls the heads during the read/write operation. Lewis, Tr. 2888; Hayashi, Tr. 2849, 2850.

245. The lower heads in the Mitsubishi M4851, Mark I, Mark II, M3 and MF 353 drives are spring-loaded. Nathanson, Tr. 4064.

245A. The upper and lower heads in the Mitsubishi M4851, Mark I, Mark II, M3 and MF 353 drives pitch and roll together essentially synchronously. Hayashi, Tr. 4234; Comstock, Tr. 1815.

246. None of the accused Mitsubishi devices have a first transducer mounted relative to a first side of the media and having a fixed position in a direction normal to the plane of the media as required in claim 1 of the patent in suit. Lewis, Tr. 2886-88; MRX 3; MRX 5; MRX 7; MRX 9; MRX 10; Hayashi, Tr. 2858-60, 2861, 2864; Hayashi, MRX 27, ¶¶ 6-33.

247. In none of the accused Mitsubishi drives does the first transducer serve as a fixed positional reference as that term is used in the patent in suite and required in claim 1. Lewis, Tr. 2886, 2888; MRX 3; MRX 5; MRX 7; MRX 9; MRX 10; Hayashi, Tr. 2858-60, 2861, 2864; Hayashi, MRX 27, ¶¶ 6-33.

248. When the upper head is loaded onto the lower head in the accused Mitsubishi drive, the lower head moves down under the force of the upper head. When the upper head is removed, the lower head moves up into the position it occupied before the upper head and disk were loaded. The amount of downward movement of the various Mitsubishi heads is as follows:

<u>Drive</u>	<u>Tandon Measurement</u>	<u>Mitsubishi Measurement</u>
M4851, Mark I	1,400	664
Mark II	---	792
M3	1,750	1,700
MF 353	5,400	

(All distances are reported in microinches.) Accordingly, all of the lower heads of the Mitsubishi drive as reported here are spring-loaded. MRX 5, Nathanson Notebook 8, at 30, 31, 57.

249. None of the accused Mitsubishi devices have a pivotable support arm having a pivot axis in fixed spatial relationship to the first transducer as required by claim 5 of the patent in suit. Brown, Tr. 2530; Lewis, Tr. 2886; MRX 3; MRX 5; MRX 7; MRX 9; MRX 10; Hayashi, Tr. 2858-60, 2861, 2864; Hayashi, MRX 27, ¶¶ 6-33.

250. None of the Mitsubishi drives contain a first transducer fixedly coupled to the carriage for bearing against a first side of the disk in an invariant position in a direction normal to the plane of the disk as required by claim 12 of the patent in suit. Lewis, Tr. 2886-88; MRX 3; MRX 5; MRX 7; MRX 9; MRX 10; Hayashi, Tr. 2858-60, 2861, 2864; Hayashi, MRX 27, ¶¶ 6-33.

251. The IBM 43 FD double-sided floppy disk drive was first sold in 1976 and constitutes a prior art reference for the purposes of determining the validity of the Tandon '573 patent under 35 U.S.C. §§ 102 and 103.

252. In 1976, a person of ordinary skill in the art of floppy disk drive design would be one who was an engineer having a lot of experience in magnetic recording, including experience in flexible disk drive design. Stoddard, Tr. 4539.

253. In a double-sided floppy disk drive, if the lower head is fixed, the upper head has to be gimbaled. Comstock, Tr. 4179.

254. In October 1976, after his arrival at Tandon Corporation, Mr. Hackney met Mr. Applequist, a second named co-inventor, for the first time. At their very first meeting, they agreed that the IBM-type design was the wrong approach for double-sided floppy disk drive. Mr. Tandon was present at this meeting. They decided to use existing single-sided floppy disk drive hardware to develop a double-sided floppy disk drive. They chose to use a single-sided device made by General Computer Systems. This device had a button head rigidly mounted to the carriage by epoxy. This device also used a load arm with a pressure pad. Messrs. Hackney and Applequist recognized that using the basic configuration of an existing single-sided drive would allow manufacturers to convert to double-sided drives quickly and easily. At this first meeting, Mr. Applequist suggested putting a gimbaled head on the upper arm in place of the pressure pad. It was agreed by all three co-inventors that a flat bottom head should be used. Hackney Dep., at 11-17, 35-38, MRPX 36C.

255. Mr. Hackney testified that the "invention" of the Tandon '573 patent is the adoption of a single-sided carriage and configuration to a double-sided recording technique, utilizing a fixed lower head and a gimbaled upper head. Hackney Dep., at 43-44, MRPX 36C.

IV. IMPORTATION AND SALE

256.-267. Intentionally Left Blank.

268. Mitsubishi Electric Corporation (MELCO) is a Japanese corporation which designs and manufactures double-sided floppy disk drives for importation into the United States. CX 447, at 45; CX 401;

269. Mitsubishi Electronics America, Inc. (MELA), is a subsidiary of MELCO, which imports sells and distributes double-sided floppy disk drives manufactured by MELCO. CX 447, at 45; CX 401.

C 270. From October 1982 to September 1983, Mitsubishi shipped
C double-sided disk drives to the United States, of which about percent were
C 5-1/4 inch disk drives. About of these disk drives were 8 inch drives
not alleged to have infringed the '573 patent. CX 690, Interrogatory No. 7.

C 271. From October 1983 to September 1984, double-sided,
floppy disk drives were shipped by Mitsubishi to the United States. Of this
C total, about were double-sided 3-1/2 inch disk drives, about were
C 5-1/4 inch disk drives, and about were 8 inch disk drives. The 8 inch
drives did not infringe the '573 patent. CX 690, Interrogatory No. 7.

C 272. From October 1984 to December 1984, double-sided,
floppy disk drives were shipped by Mitsubishi to the United States. Of this
C total, about were double-sided 3-1/2 inch disk drives, were 5-1/4
C inch disk drives, and were 8 inch disk drives. The 8 inch drives did
not infringe the '573 patent. CX 690, Interrogatory No. 7.

273. Mitsubishi manufactures, imports into, and sells in the United States the following models of double-sided floppy disk drives: MF 353, M4851, M4851-1, M4851-3, M4851A-3, M4852, M4853, M4853-1, M4853-3, M4854, M4854-1, M4854-3, M4855, M4855-1, M2893, M2894-6, M2896-6, M2894-4/5. CX 687, Interrogatory No. 1 (Feb. 15, 1985); CX 689, Interrogatory No. 1 (Feb. 22, 1985).

274. Mitsubishi Model MF 353 is a 3-1/2 inch double-sided floppy disk drive. CX 405; CX 689, Interrogatory No. 1.

275. Mitsubishi Models M4851, M4951-1, M4851-3, M4852, M4853, M4853-1, M4853-3, M4854-1, M4854-3, M4855, and M4855-1 are 5-1/4 inch double-sided floppy disk drives. CX 404; CX 689, Interrogatory No. 1.

276. Mitsubishi Models M2893, M2894-6, M2896-6, and M2894-4/5 are 8 inch double-sided disk drives. CX 403; CX 689, Interrogatory No. 1.

277. Mitsubishi Model M4851-A is known as a "M3" drive and represents a third generation of the original M4851. Foster Dep., CX 447, at 97; CX 689, Interrogatory No. 1.

278. MELA sells double-sided floppy disk drives through its own direct sales force and a network of regional distributors. CX 688, Interrogatory No. 12.

279. MELA has warehousing facilities in Torrance and Compton, California. Foster Dep., CX 447, at 67, 69.

280. MELA performs quality assurance procedures on disk drives received from MELCO for sale in the United States. MRX 41(C), ¶ 4; Foster, Tr. 2926.

281. Mitsubishi America performs service and repair in the United States on drives it distributes. MRX 41(C), ¶ 4; CX 447, at 31, 78.

C 282. On a new Mitsubishi product, percent of the product may
undergo quality assurance testing by MELA in the United States. On mature
C product lines, the testing may be reduced to percent. CX 447, at 75-76.

283. Usually, Mitsubishi disk drive repairs are effected by MELA in
the United States. CX 447, at 77-79.

284. MELA performs application engineering support in the United
States with respect to floppy disk drives manufactured by MELCO. CX 447, at
40.

285.-298. Intentionally Left Blank.

V. DOMESTIC INDUSTRY

A. Shugart and General Marketplace Background

299. Shugart Associates was formed in the mid-1970s by Allen Shugart and several key employees who had worked together at IBM and Memorex on disk drive designs. Sollman, Tr. 36-40. In 1976, Shugart had 50 to 60 employees, 25 of whom were engineers formerly from IBM and Memorex. Sollman, Tr. 39.

300. Shugart was located in Sunnyvale, California. Sollman, Tr. 39.

301. By January 1976, Shugart was a single-product company with sales of \$1.5 million to \$3.0 million in 1975 and projected sales of \$6.0 million for 1976. Actual 1976 sales were \$9.0 million. The single product was an 8 inch single-sided floppy disk drive selling for \$400 to \$500.

Sollman, Tr. 37-38, 42.

302. The Shugart 8 inch floppy disk drive was competitive with other floppy diskette drives in the marketplace. "But the one thing that they all tried to maintain was IBM compatibility, so any OEM customer could be secure in his belief that IBM written diskettes could be read and updated on that product." Sollman, Tr. 38-39.

302A. Shugart's total annual revenues in succeeding years was \$18 million in 1977, \$34 million in 1978, \$70 million in 1979, \$134 million in 1980, and \$198 million in 1981. Sollman, Tr. 57, 75.

303. Shugart, together with Dyson Corporation and Information Terminals Corporation, developed the first 5-1/4 inch disk drive. Sollman, Tr. 47-50. The dimensions were the result of efforts to design a disk drive

at the request of Dr. Wang, Chairman of Wang Laboratories, who desired a smaller disk drive for a desk-top system which was to be a precursor to the personal computer. Sollman, Tr. 42-44, 48-49.

304. In 1976, Wang Laboratories was a \$200 million-a-year corporation making a word processing unit costing \$30,000. The system used a tape drive storage system. Dr. Wang's vision was to use a tape diskette unit in a desk-top product that would sell for approximately \$10,000. Sollman, Tr. 44-45.

305. A prototype of the 5-1/4 inch disk drive was shown unofficially to certain companies about April 1976, then later at a trade show in May 1976. Sollman, Tr. 47-52.

306. The first shipment of the 5-1/4 inch single-sided disk drive to Wang Laboratories occurred in August 1976. Sollman, Tr. 53-54.

307. At first, sales of the 5-1/4 inch single-sided disk drive were slow due to an industry reaction of disbelief since IBM was using 8 inch disk drives and the product was not IBM compatible. Sollman, Tr. 53-54. However, with the growth of the personal computer market in 1977-1978, the 5-1/4 inch disk drive began to sell. Sollman, Tr. 54.

308. By 1977, at the time of the development of the 5-1/4 inch floppy disk drive, the state of the art in technology of floppy disk drives was the Shugart SA-800, a single-sided floppy disk drive with 8000 kilobyte capacity. Sollman, Tr. 55-56.

309. In July-August 1976, Shugart endeavored to take a leadership position in the floppy disk drive industry and decided to attempt doubling the capacity of its products. Three different approaches were considered:

(1) write more bits around each track; (2) write narrower tracks to put more

tracks around the disk; and (3) utilize both sides of the disk (double-sided recording). Sollman, Tr. 58-59. Shugart decided to pursue the double-track density approach. Sollman, Tr. 60.

310. In November 1976, IBM introduced the first double-sided floppy disk drive. The disk drive was part of a Model 360-1 bank terminal controller. Sollman, Tr. 60; see FF 72.

311. The diskettes for the IBM double-sided disk drive was coated on both sides. The disk drive placed two heads, one on each side of the diskette, in contact or near-contact with the diskettes. The heads were cantilevered and the diskettes would flow between them. Sollman, Tr. 61-62. The industry reaction was that IBM had just informed the industry that the next generation of disk drives was to be double-sided. Sollman, Tr. 63.

312. Shugart, like others in the industry, decided to design its own double-sided disk drive. Shugart overnight gave up the double-track density approach and informed its major OEM customers of its decision. Sollman, Tr. 64.

313. A program was initiated at Shugart to design a double-sided disk drive. "[W]e [Shugart] believed that we were a leading supplier of OEM products and to allow our customers to compete effectively with IBM we would have to allow their systems to interchange information with the IBM systems. To do anything other than that would take ourselves right out of the marketplace." Sollman, Tr. 64.

314. The double-sided design program received highest priority with all Shugart resources devoted to the project. Fifteen to twenty engineers were originally assigned to the project, and this number increased to 80 engineers at one point. Sollman, Tr. 65-66.

315. Considerable Shugart research facilities at Sunnyvale, California, were also devoted to the design effort, as well as those of Xerox' Palo Alto facility, subsequent to December 16, 1977, when Xerox Corporation purchased Shugart. Sollman, Tr. 66-67.

316. Shugart officially introduced a double-sided disk drive product, the SA-850, in April 1977 and started shipments in June 1977. In the fall of 1977, customers began to return the product because the magnetic head structures used were beginning to strip the oxides off the diskettes, which destroyed the customer's information. Sollman, Tr. 67, 68.

317. Shugart engaged in a highly intensive crash effort to solve the design problems associated with its double-sided product. Approximately 10 different designs were tried over a number of years. Sollman, Tr. 67-68. Approximately \$4 to \$5 million was expended by Shugart on the design. Sollman, Tr. 68.

318. Shugart's competitors were experiencing similar results in their pursuits of both IBM-type and non-IBM-type head designs--media wear problems and unsatisfactory product. Sollman, Tr. 68-69.

319. One competitor, CalComp, advertised that it had a successful double-sided floppy disk drive product. Sollman, Tr. 69.

320. Shugart purchased three CalComp disk drives for testing by its engineers. The engineers discovered that the CalComp disk drives employed a head assembly manufactured by Tandon Magnetics of Chatsworth, California, and that the drives worked well with a wide range of media. Sollman, Tr. 70-71.

321. The Shugart engineering department considered the CalComp drive to be a very interesting product, but because they believed they were close to a breakthrough on their own design, the engineering department preferred to put all their efforts in this design. Sollman, Tr. 71-72.

322. After further Shugart design efforts failed, Shugart's President prevailed on Shugart management to begin patent licensing discussions with Tandon Corporation. Sollman, Tr. 73. The licensing negotiations were successful, and a license agreement was signed between Tandon and Shugart which embodied the Tandon patented technology. Sollman, Tr. 74; CX 616.

323. Shugart placed the Tandon patented technology in its disk drive products and the SA-850 became a successful and highly profitable product. The technology was also added to the 5-1/4 inch disk drive, the SA-450. Sollman, Tr. 74-75.

324. By the end of 1981, Shugart employed 2,700 individuals and had annual sales of approximately \$198 million. The company was located in Sunnyvale and Roseville, California, and Nogales, Mexico (300 employees). Sollman, Tr. 75-76.

325. In 1981, Shugart announced a full-height 5-1/4 inch double-track density version and double-sided version of its own design. After Shugart began to sell these products, it began to notice pricing competition from Tandon, Control Data, and Japanese companies. Shugart was principally concerned about the competition from Control Data and secondarily, from Tandon. Sollman, Tr. 76-77.

326. Sometime in 1981 or 1982, Shugart became concerned about competition from Japanese companies. Sollman, Tr. 77. That is, in mid-1981, Nippon Telephone & Telegraph (NTT) had announced that it would award a major contract for 100,000 to 500,000 floppy disk drives, which would have been the largest order in the world outside of IBM. Sollman, Tr. 78. NTT invited 15 to 20 Japanese companies to bid on a "half-height" double-sided mini-floppy disk drive having a 1.6 megabyte capacity. No American companies were invited to bid. Sollman, Tr. 79, 80.

327. One condition for bidding on the NTT contract was that a company demonstrate production capability. At the time of the request for bid, only two or three Japanese companies (TEAC, Matsushita, and perhaps Mitsubishi) had production facilities, and the remainder were newcomers to the industry. Sollman, Tr. 79-80.

328. Shugart was forewarned in mid-1981 of the consequences of the NTT bid by its Japanese licensee Matsushita Communications, Inc. Matsushita told Shugart that the Japanese market would not be large enough to sustain the production of these 15-20 companies and that these companies could be expected to begin selling their products in the United States. Sollman, Tr. 80-81; see id., Tr. 77-78, 84-85.

329. The Shugart-Matsushita license agreement dated back to 1975 when trade barriers in Japan were 22-1/2 percent. Shugart judged that it would be impossible to break the trade barrier and licensed Matsushita to manufacture and sell Shugart's technology in Japan. Matsushita was not permitted to sell its products in the United States. Sollman, Tr. 81.

330. After the Matsushita warning about future competition from Japan, Shugart immediately started developing two new products, Model A and Model B (half-height). This type of product was currently selling in the marketplace for \$250 in moderate OEM volumes. Shugart set as a goal to come up with a half-height disk drive that could be sold profitably at about \$140 to \$160. Sollman, Tr. 82, 83-84, 86.

331. At the spring 1982 National Computer Conference, Shugart was the only company that displayed a half-height product. At the fall 1982 Comdex show, Shugart, Tandon, and Control Data showed half-height double-sided floppy disk drives. Twelve to fifteen Japanese suppliers also showed their half-height products. Sollman, Tr. 87.

332. As a result of the 1982 Comdex show, Shugart increased the pressure on the Model A and Model B groups to meet cost targets and to get the products set for high-volume manufacturing. The goal was to run a product at the 1-10 million a year level and to be extremely competitive in the \$140-\$150 range. Sollman, Tr. 92-93.

333. In April 1983, Shugart assessed the market conditions in Europe and saw extreme price competition at key and vital accounts from five or six Japanese manufacturers. Shugart also saw lower price bidding in the United States from Japanese half-height products. Sollman, Tr. 93-95.

334. As 1983 progressed, price erosion in half-height drives brought prices down into the \$120 range, and Shugart dropped its Model A and Model B programs. Sollman, Tr. 93-95. Shugart turned to its Japanese licensee, Matsushita, and entered into a purchase agreement for half-height double-sided

floppy disk drives with prices ranging from \$124 to under \$100 depending upon the quantity ordered. Sollman, Tr. 97. The Matsushita manufactured products were known as the SA-455 and SA-465. Sollman, Tr. 96-97.

335. In 1983, Shugart found itself in head-to-head competition with Japanese products at virtually every major United States and European account. Sollman, Tr. 97-98. "The outcome was that we had to adjust all of our pricing substantially downward yet again with severe price erosions and then profit erosions that had to naturally follow." Sollman, Tr. 98.

336.-337. Intentionally Left Blank.

338. In October 1983, Shugart experienced its first layoff. Shugart had grown to 3,600 employees, all but 550 of whom were located in the United States. The October layoff equaled 7-1/2 percent of the work force. Sollman, Tr. 99.

339. Shugart's annual sales for 1983 was \$240 million dollars. At that time, Shugart was the world's second largest manufacturer of floppy disk drives behind Tandon. Sollman, Tr. 100-01.

340. Shugart first became profitable in July 1975. The extreme competitive environment at the end of 1983 caused Shugart's profitability to erode substantially. The first time Shugart saw a rapid erosion of its profitability was in 1983 such that in January 1984, it suffered an operating loss. Sollman, Tr. 101.

341. Shugart had charted the price declines of 1983 and concluded that the decline had a very negative long-term impact. Sollman, Tr. 101. Shugart considered several economic alternatives to recover from the erosion in profits, including setting up an offshore production facility in either Singapore, Taiwan, or South Korea. Sollman, Tr. 101-02.

342. Shugart task forces in mid to late 1982 recommended the late establishment of a production facility in Singapore. Shugart was able to receive management's approval. Shugart needed the approval of Fuji-Xerox, a Japanese joint venture owned by Shugart's parent corporation Xerox and Fuji-Foto Films, before any manufacturing could take place in that part of the world. Shugart never received the approval of Fuji-Xerox. Sollman, Tr. 103-04.

343. On December 19, 1983, after examining economic studies as well as what would be required to make the business fully profitable, Xerox concluded that it could no longer support Shugart. As of January 1, 1984, Shugart's annual reported sales for fiscal year 1983 was \$240 million. Xerox concluded that even given substantial investments, Shugart could not be made profitable within the next 12 to 18 months. Sollman, Tr. 104-06, 107.

344. On January 15, 1984, Shugart employed 2,600 people in the United States and 600 in Mexico and occupied about 490,000 square feet of space at Roseville and Sunnyvale, California. By December 6, 1984, Shugart had experienced several more layoffs, and its employment force had been reduced to 1,600 to 1,700 employees, 400 of whom were in Mexico. Sollman, Tr. 109, 111-12. As of December 6, 1984, of the 1,200 United States employees, at least two-thirds, about 800, were devoted to floppy disk drive production, manufacture, engineering, design, sales, service, and marketing. All of Shugart's United States manufacturing facilities were still intact with a joint capacity of to floppy disk drive products per month. At this time, Shugart was running a reduced, one shift per day operation in each of the two facilities. Neun, CX 821, at 7.

C 344A. Shugart's Roseville facility had a production capacity for to disk drives per month and manufactured both 8 inch and 5-1/4 inch double-sided floppy disk drives. Neun, CX 821, at 4. As of December 6, 1984, there were 150 to 200 people located at the Roseville facility for production and manufacturing of double-sided floppy disk drives. Neun, Tr. 3396.

C 344B. Shugart's Sunnyvale facility had a production capacity for to double-sided disk drives per month and manufactured 3-1/2 inch, 5-1/4 inch, and 8 inch double-sided floppy disk drives. All of Shugart's United States-produced double-sided disk drives (Model Nos. SA-350, 450, 460, 850, 851, and 860) utilized Tandon's '573 patent technology under the Shugart-Tandon license agreement. However, none of these model's were half-height, a product which Shugart never produced. As of December 6, 1984, there were 200 to 400 people located at the Sunnyvale facility for the manufacture of double-sided floppy disk drives. Another 200 people located at the Sunnyvale production facility for produced printed circuit boards to be used in double-sided floppy disk drives. Neun, Tr. 3395-97; Sollman, Tr. 223, 264-65.

344C. In January 1984, all research and development, engineering support, marketing and sales, testing, and servicing for Shugart products manufactured in the United States was performed at Shugart's United States facilities. Neun, CX 821, at 4.

C 344D. In January 1984, Shugart employed some people for floppy disk drive research alone. At least two-thirds of this research and development group were dedicated to the development of the "Sabre" product, which was to be a low cost double-sided disk drive manufactured in the United States using robotics. Neun, CX 821, at 3.

C 344E. In fiscal year 1983, Shugart sold approximately drives and had sales volume of \$ million. At least \$ million of this was C attributable to Shugart's total floppy disk drive products, of which \$ to C \$ million constituted double-sided floppy disk drive sales. Neun, CX 821, at 3.

344F. In January 1984, Shugart was a viable floppy disk drive company. At that time, Shugart was selling everything it could make in its floppy disk drive production facilities, and Shugart's United States factories were running double shifts to meet customer demand. Neun, CX 821, at 3.

344G. Between 1976 and January 1984, Shugart sold the following double-sided disk drives: SA-850 (8 inch, full-height); SA-450 (5-1/4 inch, full-height, 48 TPI); SA-460 (5-1/4 inch, full-height, 96 TPI); SA860 (8 inch, half-height, 48 TPI); SA-455 (5-1/4 inch, half-height, 48 TPI); SA-465 (5-1/4 inch, half-height, 96 TPI); SA-350 (3-1/2 inch). The SA-450 and SA-460 were eventually discontinued to be replaced by the SA-455 and SA-465 series. Sollman, Tr. 264-65; see Neun, Tr. 3417-20.

344H. In the first quarter of 1984, Shugart sold double-sided floppy disk drives assembled for it under Tandon's patent license by Matsushita of Japan. Neun, Tr. 3403. These drives were half-height models and were designated as the SA-455 and SA-465. Neun, Tr. 3391-93; Neun, CX 821, at 4.

344I. Research and development for the SA-455 and SA-465 was done jointly by Matsushita in Japan and by Shugart in the United States (approximately 10 United States Shugart personnel). With respect to these half-height drives, all product support was performed in the United States, including incoming lot quality inspection, repair, support and servicing engineering and marketing and sales. Shugart expended about \$ on an annual basis in conjunction with these activities. Neun, Tr. 3403-04, 3458-63; Neun, CX 821, at 4-5.

344J. In December 1984, approximately 30 employees at Shugart were dedicated to operational aspects of bringing the Matsushita drives into the United States; other employees lent support to the imported products in the areas of sales, marketing, transportation and storage, and administrative and technical support. Neun, Tr. 3458-60. Approximately 17 Shugart employees were engaged in technical aspects of importation such as quality control, sustaining engineering, and research. Neun, Tr. 3460-61.

345. In December 1984, Shugart was manufacturing approximately to double-sided floppy disk drives in the United States, and was receiving to units and selling to double-sided floppy disk drives produced in Japan by Matsushita for Shugart. All of these disk drives employed the licensed Tandon technology. Neun, CX 821, at 8; see Neun, Tr. 3391-92; Sollman, Tr. 113.

345A. By December 1984, Shugart's backlog order summary (CX-863) indicated sales of SA-350s, SA-450s, and SA-850s for a total of approximately double-sided floppy disk drives to be manufactured in the United States. The same document indicates orders for delivery in

C December 1984 for to Shugart disk drive Models SA-455 and SA-465
assembled for Shugart in Japan by Matsushita. These drives were also
C manufactured by Shugart under Tandon's license. Shugart sold over \$
million worth of double-sided disk drives in December 1984. Neun,
Tr. 3402-04; CX 863.

345B. In December 1984, all research and development and other support
activities for United States-produced products were being performed in the
United States. Additionally, United States support activities for the disk
drives purchased from Matsushita were performed in the United States. Printed
circuit boards were manufactured in the United States for all of
Shugart-produced double-sided floppy disk drives, and lot testing was being
performed in the United States for those drives received from Japan. As of
December 1984, Shugart's reserach and development program equaled
approximately seven percent of Shugart's gross sales. Neun, Tr. 3399-401,
3403-04; Neun, CX 821, at 8, 11.

345C. In the December 1984 time frame, the assembly of 8 inch
double-sided disk drives was in the process of being transferred to Mexico,
although all other functions, including printed circuit board production and
some head assembly production remained in the United States. Additional
support activity also continued in the United States. These included all
continuing, maintenance, and manufacturing engineering, research and
development, and lot testing of the drives. Finally, all planning, inventory
control, and material services were fully controlled at the Sunnyvale
facility. The SA-850 parts were "kitted" at Sunnyvale and sent to Mexico for
assembly. After assembly, the SA-850 drive was quality inspected at
Sunnyvale. Neun, Tr. 3397-98, 3413-14; Neun, CX 821, at 9; FF 344B.

345D. As of December 6, 1984, approximately 40 people were left in the Shugart's quality organization for double-sided floppy disk drives. Neun, Tr. 3399.

345E. Shortly after December 1984, Shugart closed the Roseville plant, leaving only the Sunnyvale plant in operation in the United States. Shugart remains in the double-sided floppy disk drive business to the extent it continues to manufacture its 8 inch double-sided product, the SA-850. The SA-850 is being assembled in Nogales, Mexico, but all technical support and quality assurance work is performed in Sunnyvale. Neun, Tr. 3413; Neun, CX 821, at 8-9.

345F. Models SA-455 and SA-465 were not manufactured by Shugart (Sollman, Tr. 266); that is, Shugart never manufactured a 5-1/4 inch half-height double-sided floppy disk drive. Rather, Shugart made a strategic decision to resell 5-1/4 inch half-height drives made in Japan by Matsushita. Under the terms of Shugart's license with Tandon, Shugart was permitted to sell drives covered by the '573 patent that were manufactured by other companies for Shugart. Sollman, Tr. 237-38; CX 616, at 5-6.

346. Intentionally Left Blank.

347. Shugart manufactured a 3-1/2 inch double-sided floppy disk drive at Sunnyvale, California, in 1982. Sollman, Tr. 113-14, 116-17.

348. Following a meeting in May 1982 with Dysan Corporation's president, Shugart formed a venture group to pursue the design and development of the 3-1/2 inch drive. Sollman, Tr. 116-18, 119. A small company environment was created, and the best engineers from Shugart were picked for

the engineering organization. The project was located at Sunnyvale, California, and used for production, high-volume automated lines. Sollman, Tr. 119-20.

349. Single-sided 3-1/2 inch drives were introduced into the marketplace in April 1983. Sollman, Tr. 120-21.

350. In October 1983, a double-sided version of the 3-1/2 inch drive was introduced. Sollman, Tr. 121. The double-sided 3-1/2 inch drive employed Tandon's patented technology. Sollman, Tr. 120, 121.

351. Evaluation sales were made of the 3-1/2 inch double-sided disk drives to 15-20 accounts, including Apple Computer, Wang, Convergent Technologies, Nixdorf, and Honeywell-Bull. Sollman, Tr. 123-24.

352. Approximately 2000-3000 double-sided Shugart 3-1/2 inch drives were sold in 1983. Sollman, Tr. 125.

353. On December 6, 1984, Shugart had plant capacity for 100,000 3-1/2 inch double-sided floppy disk drives per year located in Sunnyvale, California. Sollman, Tr. 126-27.

353A. Production of the 3-1/2 inch double-sided floppy disk drive ceased in approximately February 1985, except for the fulfillment of the existing commitments to IBM for production of approximately more double-sided units. Neun, CX 821, at 9.

353B. In January 1985, Xerox formally announced the closing of Shugart's 5-1/4 inch and 3-1/2 inch floppy disk drive operation. Shugart's 5-1/4 inch business was sold to Matsushita in February 1985, including the extensive inventory that had built up over the previous quarters. Neun, CX 821, at 8-9; Sollman, Tr. 111.

354. At the time of the fall 1982 Comdex show, there were nine United States manufacturers of double-sided floppy disk drives: Qume, Shugart, Control Data, Remex, MFE Corporation, Siemens, Micropolis, Micro Peripherals, and Tandon. Sollman, Tr. 88-90; CX 678, at DT 11-11, DT 13-13.

355. Qume is not profitable. Qume went offshore to Taiwan in November 1982 although some modest United States production remains. With IBM's termination of the IBM PCjr contract, Qume may not be able to continue in the marketplace. Qume is not a Tandon licensee. Sollman, Tr. 131-32; CX 616-21, 696.

356. Shugart has essentially closed its doors. Sollman, Tr. 132.

357. Control Data Corporation recently laid off 950 employees and is planning to move production offshore. Sollman, Tr. 132.

358. Remex went out of business in 1983. Remex is not a Tandon licensee. Sollman, Tr. 132; CX 616-21, 696.

359. MFE Corporation went out of business in 1983. MFE Corporation is not a Tandon licensee. Sollman, Tr. 132; CX 616-21, 696.

360. Siemens went out of business in late 1983 or early 1984. Siemens is not a Tandon licensee. Sollman, Tr. 132-33; CX 616-21, 696.

361. Micropolis is still in business as a corporation but withdrew from the floppy disk business in 1984. Micropolis is not a Tandon licensee. Sollman, Tr. 133-34; CX 616-21, 696.

362. Micro Peripherals went out the business in mid-1984. Sollman, Tr. 134.

363. Tandon is currently the remaining strong domestic participant in the double-sided floppy disk drive market. Sollman, Tr. 134.

364. A total of 25 floppy disk drive manufacturers were headquartered in the United States as of December 1982 and December 1983. By December 1984, there were only 20 floppy disk drive manufacturers in the United States. During 1984, seven manufacturers of floppy disk drives in the United States ceased production, went into bankruptcy, or were sold to foreign corporations, including Amlyn, Hi-Tech Peripherals, Micropolis Corp., Remex, Tabor, and World Storage Technology. Additionally, in February 1984, Xerox Corporation, which owned Shugart, sold its 5-1/4 inch floppy disk drive line to Matsushita. CX 677-79; Haldi, CX 711, at 40.

B. Tandon -- Head Assemblies

365. In 1975, Tandon first sold floppy disk drive heads and head assemblies to disk drive manufacturers. TRX 48, at 040634.

366. Tandon was incorporated in California in February 1976. During its first year of operations, the company established itself as a leading manufacturer of flexible disk drive recording head assemblies. CX 666, at 1.

367. In 1976, Tandon captured about 80 percent of the total floppy disk drive head assembly market. TRX 48.

368. In 1977, Tandon developed and patented its first double-sided head assembly. CX 665, at 018632.

369. From 1977 to 1981 Tandon sold head assemblies and components for head assemblies. Huenemeier, Tr. 426-28.

370. Tandon continued to sell recording heads directly to customers in fiscal year 1984. CX 666, at 22.

371. In fiscal year 1984, Tandon's net unit sales of head assemblies
C totaled , while its net unit sales of disk drives totaled .
CX 709.

371A. Tandon purchased double-sided head assemblies for use in 5-1/4
C inch disk drives from of California in 1982,
1983, and 1984. MRX 104C, at 019152-54, 019170, 019207-14.

371B. On March 29, 1984, the shipment schedule for double-sided head
C assemblies for the TM 65 from called for units to be
shipped between then and the end of 1984. MRX 104C, at 0191152.

372. Since its formation, Tandon has utilized offshore manufacturing
in India on a contract basis for high volume production of labor intensive
components and various completed products. CX 666, at 2.

373. In 1979, some Tandon head assemblies were assembled in India.
MRX 31, at 24378-79.

374. The manufacture of head assemblies was the first component
moved by Tandon overseas because of the relatively large amount of nonskilled
labor involved in manufacture of this component. S. Tandon Dep., TRX 26B, at
221.

375. Beginning about June 1978, Tandon had contracted with Tandon
Magnetics (India) Pvt., Ltd. (TMI), for the assembly and testing of certain
ferrite recording head and disk drive products at TMI's facilities in the
Santa Cruz Export Processing Zone, Bombay, India. TRX 47.

C 376. , Tandon contracted with TMI concerning
conditions governing TMI's assembly and testing in Bombay, India, of certain
ferrite recording heads and disk drives for Tandon. The Tandon/TMI contract
C is due to terminate on . TRX 47, at 022892-94, 022900.

377. The specific services to be performed by TMI under the Tandon/TMI contract, and the dates of such performance, is determined pursuant to purchase orders issued by Tandon during the term of the contract. According to the terms of the contract, in each purchase order the date desired by Tandon for completed assembly and shipment to Tandon is specified, as is the price information. TRX 47, at 022893.

378. According to the Tandon/TMI contract, for each purchase order issued by Tandon to TMI, Tandon

. TRX 47, at 022895.

379. According to the Tandon/TMI contract,

. TRX 47, at 022899.

380. According to the Tandon/TMI contract, Tandon provides TMI with all equipment, material, and know-how, and TMI provides reasonably sufficient structural facilities and a skilled labor force (with regard to the performance of the specified services). TRX 47, at 022896.

381. According to the Tandon/TMI contract,

. TRX 47, at 022896.

382. According to the Tandon/TMI contract,

. TRX 47, at 022898.

383. Mr. Huenemeier was unaware whether Tandon had any suppliers of double-sided floppy disk drive head assemblies other than TMI from December 1984 to the present. Huenemeier, Tr. 464.

384. In 1984, Tandon listed the Indian facility as the only Tandon facility producing head assemblies. TRX 48, at 040636-37.

385. Head assemblies for the following double-sided floppy disk drives of Tandon are assembled offshore in India and subject to quality control in India: TM 50, TM 65-2, TM 65-4, TM 100-2, TM 100-4, TM 101-4, and TM 848. Huenemeier, Tr. 437-39, 446-48, 474-75, 497, 509, 522, 3607-08; Huenemeier, CX 836, at 10-11; Elsner, Tr. 2339-40.

386. The head assemblies used in the Tandon TM 848-2 are bought from TMI by Tandon Associates in India, and Tandon obtains them from Tandon Associates. Huenemeier, Tr. 438, 441-42.

387. Tandon Associates is a separate entity from Tandon Corporation and provides the service of being the representative of all the contract facilities in India. Huenemeier, Tr. 442.

C 388. The head assemblies for all TM 848s produced in October-December 1984 were assembled in India. Huenemeier, Tr. 437, 509.

388A. In January 1982, Tandon commenced operations in Singapore through Tandon (S) Pte. Ltd., a wholly-owned subsidiary. Tandon subsequently commenced and continued a geographic restructuring of its manufacturing operations, emphasizing high-volume manufacturing of products offshore. Tandon's Singapore operations, which include the manufacture of both flexible and rigid disk drives, subsystems, printed circuit boards and chassis, currently represents the major portion of Tandon's manufacturing operations. CX 666, at 2; see MRX 31.

389. Tandon does not currently assemble commercial quantities of head assemblies double-sided flexible disk drives in the United States.

Huenemeier, Tr. 798-99, 3607-08.

390. Any manufacture in the United States by Tandon of head assemblies is limited to engineering and development programs, and small initial production runs of less than 100 units. Huenemeier, Tr. 799.

391. The head assemblies for Texas Peripherals' TM 65-1 and TM 65-2 came from . The head assemblies for Texas Peripherals' TM 100 came from C . Hochman, Tr. 1633. C

392. Texas Peripherals procured all of its double-sided head assemblies from TMI through Tandon. Huenemeier, Tr. 474-75.

393. Lafa, a supplier of head assemblies located in Taiwan or Korea, probably supplies all head assemblies for MPI. Ousley, Tr. 697-98.

394. Through 1984, Shugart obtained 60 percent of its head assemblies from Mexico. Sollman, Tr. 199, 201.

395. The license agreement between Tandon and Matsushita specified that, except for spare parts and repair purposes, Matsushita can sell only patented head assemblies incorporated in a completed disk drive. TRX 55, at 027632.

395A. Marika Mitchell of Tandon calculated the domestic content of Tandon's head assemblies produced offshore. Mitchell, CX 836, at 1.

395B. Based on Ms. Mitchell's analysis, Tandon's expenditures for U.S. manufacturing activity and domestic content of materials for head assemblies for the TM 65, TM 100, TM 101, and TM 848 for the fourth quarter of fiscal year 1984 (July-September 1984) and the first three quarters of fiscal year 1985 (October 1984-June 1985) are as follows:

C
C
C
C

<u>Time Period</u>	<u>U.S. Mfg. and Domestic Content</u>	<u>Total Cost</u>
4Q 1984	\$.	\$
1Q 1985		
2Q 1985		
3Q 1985		

Mitchell, CX 836, Head Schedule 5; Mitchell, Tr. 3235-37.

395C. Tandon's corporate expenses (corporate engineering, marketing, and G&A) were allocated to head assemblies by: (1) multiplying each corporate expense by the ratio of floppy disk drive products revenue over total corporate revenue; (2) multiplying the result of the allocation in #1 by the ratio of direct material head assembly cost to direct material disk drive cost; and (3) dividing the result of #2 by head assembly units to arrive at a head assembly unit cost for each corporate expense. Mitchell, Tr. 3309-12, 3316-17; Mitchell, CX 836, at 12, Head Schedules 1-4D.

395D. The divisional engineering expenses for head assemblies could be segregated out, and the unit cost for this expense was arrived at by dividing the head assembly engineering cost by the number of head assemblies. These expenses are separate from the engineering expenses for the floppy disk drive division. Mitchell, Tr. 3314-16.

395E. Based on Ms. Mitchell's analysis, unit costs of production for head assemblies for the TM 65 and TM 100, are broken out as follows for April-June 1985:

	<u>TM 65</u>		<u>TM 100</u>	
	<u>\$/unit</u>	<u>percent</u>	<u>\$/unit</u>	<u>percent</u>

U.S. Mfg. Cost:

C Engineering
 C Technical Support
 C Operational G&A
 C Labor
 C Material Support
 C Labor Support
 C Total Mfg.

Material Cost:

C Foreign
 C Domestic
 C Total

U.S. Non-Mfg.:

C Marketing
 C Marketing-related G&A
 C Total

C Foreign assembly

Other:

C Freight
 C Customs
 C Material variance
 C Total

C TOTAL COST:

Mitchell, CX 836, at Head Schedules 4A-4B.

395F. Based on Ms. Mitchell's analysis, unit costs of production for head assemblies for the TM 65 and TM 100, are broken out as follows for April-June 1985:

	<u>TM 101</u>		<u>TM 848</u>	
	<u>\$/unit</u>	<u>percent</u>	<u>\$/unit</u>	<u>percent</u>
	<u>U.S. Mfg. Cost:</u>			
C				
	Engineering			
C				
	Technical Support			
C				
	Operational G&A			
C				
	Labor			
C				
	Material Support			
C				
	Labor Support			
C				
	Total Mfg.			
	<u>Material Cost:</u>			
C				
	Foreign			
C				
	Domestic			
C				
	Total			
	<u>U.S. Non-Mfg.:</u>			
C				
	Marketing			
C				
	Marketing-related G&A			
C				
	Total			
C				
	<u>Foreign assembly</u>			
	<u>Other:</u>			
C				
	Freight			
C				
	Customs			
C				
	Material variance			
C				
	Total			
C				
	<u>TOTAL COST:</u>			

Mitchell, CX 836, at Head Schedules 4C-4D.

C. Tandon -- Disk Drives

396. Tandon began manufacturing complete double-sided floppy disk drives in 1979. By 1982, Tandon had become the largest independent (not including production for captive use) manufacturer of floppy disk drives sold to OEMs. Complaint, ¶ 12(h); CX 678, Table 5.

396A. After being initially funded by its founders and private investors, Tandon received proceeds through public sales of securities amounting to:

	<u>Date</u>	<u>Amount</u>
C	2/81	\$
C	11/81	\$
C	11/82	\$

Mitchell, CX 836, at 13; CX 665, at 28.

397. Tandon's net sales for fiscal years 1982, 1983, and 1984 were \$150,490,000; \$303,369,000; and \$400,792,000, respectively. For the same years, floppy disk drives accounted for 89 percent, 82 percent, and 80 percent of its net sales. CX 666, at 2, 29.

398. Tandon currently produces the following models of double-sided floppy disk drives: the TM 50, a 5-1/4 inch half-height belt-driven floppy disk drive; the TM 65 and TM 75, 5-1/4 inch half-height, direct drive floppy disk drives; the TM 848, an 8 inch, half-height direct drive floppy disk drive; the TM 100, a 5-1/4 inch full-height floppy disk drive; and the TM 101, a modification of the TM 100. Huenemeier, CX 722, at 5.

398A. A total of approximately 3,353,200 5-1/4 inch double-sided disk drives were sold in the United States in 1983. Tandon sold double-sided drives, or percent of the 1983 market. Virtually all of Tandon's sales of 5-1/4 inch floppy disk drives consisted of full-height units, and Tandon was the leading 5-1/4 inch full-height manufacturer. Tandon's market share in half-height drives in 1983 was Huenemeier, CX 835, at 3.

C 399. In fiscal year 1984, approximately percent of Tandon's total floppy disk drive business was double-sided. Serge, CX 717, at 2.

C 399A. Tandon sold double-sided half-height 5-1/4 inch floppy disk drives in 1984. Huenemeier, CX 835, at 3.

400. Commencing in 1981 and through December 1984, Tandon performed all steps necessary for the manufacture of double-sided head assemblies used in the TM 848, including the installation of two coils inside both the button and slider, the mounting of the upper arm to the carriage, the mechanical flexure, the optical alignment of each resulting subassembly, the mounting of the upper arm to the carriage, the mechanical alignment of the upper and lower heads, the installation of the cables on the upper and lower heads, and the final testing and alignment of the head assembly. Huenemeier, CX 835, at 10-11. In fiscal year 1984, Tandon's net sales of TM 848s was \$. CX 709; Serge, CX 717, at 3.

400A. In calendar year 1983, approximately 78.5 percent of all TM 848s produced were double-sided. CX 679, at DT11-9, DT12-11; Haldi, CX 711, at 33.

C 400B. As late as April 1985, all TM 848s are manufactured in the United States at the Chatsworth, California facility where square feet were devoted to TM 848 production (which includes both one-sided and two-sided versions). As late as April 1985, full-time employees at an annual salary rate of about \$ supported the manufacture of from to TM 848 units per month, accounting for approximately \$ per month revenue. All quality control and quality assurance, all associated research and development, product support, servicing, marketing, and sales is performed in the United States. Haldi, CX 711, at 33; Huenemeier, CX 722, at 7.

C 400C. During the period July 1984 to June 1985, Tandon sold
C TM 848s, accounting for \$ million in sales. Mitchell, CX 836, at 5.

400D. As of August 1985, approximately 105 workers were devoted to the production of the TM 848. Huenemeier, Tr. 3683.

400E. As late as April 1985, printed circuit boards for the TM 848 and the dual-sided TM 65-2L were stuffed and tested in Tandon's facility in Simi Valley, California. Employees at the Simi Valley facility also provided support production for Tandon models made offshore. As late as April 1985,
C approximately full-time employees and square feet of space at Simi
Valley were involved in floppy disk drive production. Haldi, CX 711, at 33.

400F. During the first quarter of fiscal year 1985, Tandon was producing TM 848 double-sided head assemblies both at Chatsworth, California,
C and offshore. Tandon made head assemblies at Chatsworth, and had final
C assembly of head assemblies completed offshore. During the second quarter of fiscal 1985, there was virtually no such production in the United States. Huenemeier, Tr. 3608; Huenemeier, CX 835, at 11.

400G. As to head assemblies for double-sided drives other than the TM 848, Tandon has performed some manufacturing operations in the United States and contracted with Tandon Magnetics (India) Pvt., Ltd. (TMI), in India to provide labor necessary to do final assembly of the head assembly. Huenemeier, CX 835, at 11.

401. Tandon's offshore and domestic manufacture for fiscal year 1984, ending September 30, 1984, by model number is as follows:

	<u>Model</u>	<u>Offshore Units</u>	<u>Domestic Units</u>	<u>Total</u>
C	TM 50			
C	TM 55/55D			
C	TM 65			
C	TM 100			
C	TM 101			
C	TM 848			

These figures reflect manufacture of both single- and double-sided disk drives. Serge, CX 717, at 3-4; Serge, Tr. 871.

402. For the first quarter of fiscal 1985 (October-December 1984) Tandon produced TM 100s in Singapore, TM 50s and TM 65s in India, and TM 848s in the United States. SRX 176, at 5.

402A. For the period July 1984 to June 1985, Tandon's manufacture of floppy disk drives was as follows:

	<u>Model</u>	<u>Offshore Units</u>	<u>Domestic Units</u>	<u>Total</u>
C	TM 65			
C	TM 100			
C	TM 101			
C	TM 848			

Mitchell, CX 836, at 7.

402B. The TM 100s assembled onshore are believed to have been assembled prior to December 6, 1984. Mitchell, Tr. 3247-48.

403. Anthony Francis Serge is the corporate costs control manager of Tandon Corporation, and has been employed by Tandon since February 1982. Serge, CX 717, at 1-2.

403A. Marika E. Mitchell is the Controller-Domestic Operations of Tandon Corporation and has been employed by Tandon since March 1983.

Mitchell, CX 836, at 1, 3.

403B. Dr. Malmgren defined value-added as the difference between the cost of materials acquired and the sales price. Malmgren, CPX 56, at 94.

404. Mr. Serge conducted a value-added analysis for Tandon-produced floppy disk drives that relied on profit and loss statements, bills of material, other cost related reports, and shipping records. Serge, CX 717; Serge, Tr. 859-59.

404A. Ms. Mitchell conducted a value-added analysis which updated and modified the Serge analysis, relying on more recent cost data, and excluding certain activities from the value-added which an importer would also incur. Mitchell, CX 836, at 6.

404B. Ms. Mitchell's value-added analysis was by quarter for the period July 1984 to June 1985, and focused on the TM 65, TM 100, and TM 101 Tandon disk drives. Mitchell, CX 836, Drive Schedules 1 to 5.

404C. The TM-65 schedules in Marika Mitchell's witness statement reflect the TM 65-2L product, which is Tandon's 48 TPI double-sided product. Huenemeier, Tr. 3609.

404D. Based on Ms. Mitchell's analysis, Tandon's expenditures for U.S. manufacturing activity and domestic content of materials for the TM 65, TM 100, and TM 101 for the fourth quarter of fiscal year 1984 (July-September 1984) and the first three quarters of fiscal year 1985 (October 1984-June 1985) are as follows:

C
C
C
C

<u>Time Period</u>	<u>U.S. Mfg. and Domestic Content</u>	<u>Total Cost</u>
4Q 1984	\$	\$
1Q 1985		
2Q 1985		
3Q 1985		

Mitchell, CX 836, at 2

404E. The cost figures in 404D for U.S. manufacturing and domestic content were computed for the TM 65, TM 100, and TM 101 and do not include any of the U.S. manufacturing costs and domestic content of Tandon's manufacture of its TM 848 product in Chatsworth. Mitchell, Tr. at 3330-30.

404F. Tandon's corporate expenses (corporate engineering, marketing, technical support, corporate GS&A) were allocated to floppy disk drives by using the percentage of revenue generated by floppy disk drive products over total corporate revenue. The unit cost per disk drive for corporate expenses was then calculated by dividing the corporate expense allocated to floppy disk drives by the total units of disk drives. Mitchell, CX 836, at 6, Drive Schedules 1-3.

404G. Ms. Mitchell's method for allocating corporate expenses to disk drives included corporate expenses that also could be further allocated to head assemblies, because she assumed that in every disk drive was contained a head assembly. Mitchell, Tr. 3313.

404H. Ms. Mitchell assumed that the unit engineering costs, technical support costs, and operational G&A costs were the same for the TM 65, TM 100 and TM 101. Mitchell, Tr. 3285; Mitchell, CX 836, Drive Schedules 4A-4C.

404Q. Material costs for U.S. manufacture are reflected in the indented bill of materials. The costed indented bill of materials specifies the parts and their associated costs that are necessary in the production of the product. Foreign material costs are derived from invoices (India) or from standard material transfer price from Tandon's Singapore subsidiary. Mitchell, CX 836, at 11.

404R. Tandon does not keep records that reflect research and development expenses for each model. Tandon costs R&D expenses as they are incurred rather than amortizing them. Mitchell, Tr. 3265.

404S. Between July-September 1984 and October-December 1984, Tandon transferred all of the R&D functions that had been in corporate engineering to divisional engineering. Mitchell, Tr. 3259-61.

404T. The R&D for the TM 100, TM 101, TM 65, TM 50, and TM 848 had been completed by December 6, 1984. Most R&D for a floppy disk drive product is performed before it is ever produced commercially. Huememeier, Tr. 444-45, 498-99; Neun, Tr. 3451.

404U. The engineering costs used in the Mitchell value-added analysis do not include R&D expenses for the Tandon TM 300 project, which is performed by another Tandon division. Mitchell, Tr. 3329-30.

404V. Three to four percent of the cost value of Tandon's floppy disk drives represents R&D costs. Huenemeier, Tr. 491-93.

404W. In analyzing the cost structures for the TM 100, TM 101, and TM 65, Ms. Mitchell used the following cost categories: (1) U.S. manufacturing; (2) U.S. non-manufacturing; (3) offshore assembly; and (4) material. Mitchell, CX 836, at 9.

404X. The domestic value-added in the Mitchell analysis includes U.S. manufacturing costs and the domestic content of material costs. U.S. manufacturing costs include engineering, technical support, operational G&A (i.e., G&A not including marketing V.P. salary or burden and excluding the credit department expenses), labor, material support, and labor support. Mitchell, CX 836, at 9.

404Y. According to Dr. Malmgren, the value of parts manufactured and purchased in the United States would on balance be included in the U.S. value-added, but each case would have to be analyzed on an individual basis. Dr. Malmgren cited a section of U.S. law regarding imports of products that have been exported from the U.S., processed abroad, and then returned to the United States. Malmgren, CPX 56, at 96-97.

404Z. In Mr. Block's analysis of U.S. component suppliers, he included as U.S. suppliers only those whose material qualified as U.S.-origin under rules established by the U.S. Customs Service. Block, CX 819, at 5; Block, Tr. 3717-19.

404AA. Tandon takes advantage of duty drawback provisions of United States law for the domestic component value of the disk drives it imports. Mitchell, Tr. 3332.

404BB. According to Dr. Magrath, production costs include the costs of procuring components or raw materials. Magrath, Tr. 3776.

C 404CC. Material costs accounted for approximately percent to percent of the total cost of Tandon's double-sided disk drives in April-June 1985. Mitchell, CX 836, Drive Schedules 4A-4C.

404DD. Mr. Block of Tandon calculated Tandon's Floppy Disk Drive Division's United States materials purchases for floppy disk drives for the period October 1, 1984, to June 30, 1985, from a Tandon computer printout of its revenue paid to flexible disk drive vendors. Mr. Block excluded from this printout all foreign suppliers, intra-company transfers, suppliers of services and freight companies. The remaining figures represented Tandon's purchases of United States material over this period of \$ million. Block, CX 819, at 3, 6.

404EE. Over the October 1, 1984, to June 30, 1985, period, United States materials were also procured by Tandon Pte. Ltd. () and by the Tandon Printed Circuit Board Assembly Division (printed circuit boards for the TM 50, TM 65, and TM 848). Purchases of these items totaled \$ million. For motors, and for PCB's used only in the TM 65 and TM 848, purchases totaled \$3.4 million. Block, CX 819, at 6, Ex. D.

404FF. The motors purchased from are shipped directly to Singapore. Block, Tr. 3710-11.

404GG. In order to obtain the proportion of domestic content of materials in the TM 65, TM 100, and TM 101, Ms. Mitchell took the ratio of United States-origin materials (from the Block witness statement) to total materials cost for the period July 1984 to June 1985. Based on this calculation, Ms. Mitchell applied a constant percentage of to total material cost to estimate the domestic content of material for each model. Mitchell, Tr. 3302; Mitchell, CX 836, Drive Schedules 4A-4C.

404HH. Ms. Mitchell included United States-origin materials for the United States-produced TM 848 and for single-sided disk drives in calculating the percentage domestic content for the TM 65, TM 100, and TM 101. Mitchell, Tr. 3301.

404II. The labor content of assembling a disk drive is about 1/2 hour. TRX 105E, at 119.

404JJ. According to Ms. Mitchell, the offshore assembly costs used in the value-added analysis include offshore assembly, offshore overhead and profit, and Tandon Associates' overhead and profit. Mitchell, Tr. 3293-99.

C 404KK. For the TM 65 disk drive, the labor content of \$ per disk drive in January-June 1985 consists of packaging, removing the drives out of a four-package container and putting them into a single-package container. For C the two earlier quarters, the labor costs of \$ and \$ per disk drive related to specific testing and inspection of drives being imported. Currently, all testing and inspection of the TM 65 disk drive is performed in India. Mitchell, Tr. 3288-89; Mitchell, CX 836, at Drive Schedule 4A.

404LL. Tandon estimates that for the four quarters listed below, the percentage of total product cost for the TM 65, TM 100, and TM 101 attributable to United States manufacturing and domestic content of materials as follows:

	July-Sept. <u>1984</u>	Oct.-Dec. <u>1984</u>	Jan.-Mar. <u>1985</u>	April-June <u>1985</u>
C TM 65	%	%	%	%
C TM 100				
C TM 101				

Mitchell, CX 836, at 2, 8, Drive Schedule 5.

404MM. Based on Ms. Mitchell's analysis, unit costs of production for the TM 65, TM 100, and TM 101 are broken out as follows for April-June 1985:

	<u>TM 65</u>		<u>TM 100</u>		<u>TM 101</u>	
	<u>\$/unit</u>	<u>percent</u>	<u>\$/unit</u>	<u>percent</u>	<u>\$/unit</u>	<u>percent</u>
<u>U.S. Mfg. Cost:</u>						
C Engineering						
C Technical Support						
C Operational G&A						
C Labor						
C Material Support						
C Labor Support						
C Total Mfg.						
 <u>Material Cost:</u>						
C Foreign						
C Domestic						
C Total						
 <u>U.S. Non-Mfg.:</u>						
C Marketing						
C Marketing-related G&A						
C Total						
 C <u>Foreign assembly</u>						
 <u>Other:</u>						
C Freight						
C Customs						
C Material variance						
C Total						
 C <u>TOTAL COST:</u>						

Mitchell, CX 836, Drive Schedules 4A-4C.

405. Mr. Serge's value-added analysis was based on April-June 1984 data, but Mr. Serge testified that the information is representative of current activity and costs. Serge, Tr. 862, 864.

406. With the exception of the TM 100, Tandon's records for floppy disk drives do not separate single-sided and double-sided drives. Serge, Tr. 858.

407. Based on Mr. Serge's analysis, the following costs and percentages of total product cost are attributable to the activities performed by Tandon in the United States:

	<u>TM 50</u>		<u>TM 65</u>	
	<u>\$/unit</u>	<u>percent</u>	<u>\$/unit</u>	<u>percent</u>
	<u>Material:</u>			
C	Labor Value-Added			
C	Material Variance			
C	Material Support			
C	Labor Support			
	<u>Engineering:</u>			
C	Corporate			
C	Divisional			
	<u>Marketing:</u>			
C	Corporate			
	<u>General & Admin:</u>			
C	Corporate			
C	Divisional			
C	<u>Customs:</u>			
	<u>Foreign Value-Added:</u>			
C	Singapore			
C	India			
C	<u>TOTAL COST:</u>			

Serge, CX 717, at attachments A-1 to D-1.

408. Based on Mr. Serge's analysis, the following costs and percentages of total product cost are attributable to the activities performed by Tandon in the United States:

	<u>TM 100</u>		<u>TM 101</u>	
	<u>\$/unit</u>	<u>percent</u>	<u>\$/unit</u>	<u>percent</u>

Material:

C Labor Value-Added
 C Material Variance
 C Material Support
 C Labor Support

Engineering:

C Corporate
 C Divisional

Marketing:

C Corporate

General & Admin:

C Corporate
 C Divisional

Customs:

Foreign Value-Added:

C Singapore
 C India

TOTAL COST:

Serge, CX 717, at attachments A-1 to D-1.

409. Mr. Serge considered that based on his analysis, value-added in
 C the United States accounted for percent, percent, percent,
 C and percent of the production costs for the TM 50, TM 65, TM 100, and
 TM 101 floppy disk drives, respectively. Serge, CX 717, at 5

410. Based on a Tandon Corporation income statement of November
 C 1984, United States costs in April-June 1983 accounted for percent of the
 combined production cost of TM 100s and TM 101s. In July-September 1984, this
 C percentage fell to percent. CX 709.

411. Tandon's cost data for the TM 50 are based upon schedules which refer to the single-sided TM 50 floppy disk drive because during fiscal year 1984, the TM 50 was predominantly a single-sided product. Serge, Tr. 869-70.

412. Cost data for the TM 100 represent both single-sided and double-sided drives. Cost data for the TM 65 and TM 101 represent double-sided drives only. Serge, Tr. 878-79.

413. The components of material costs include the per unit labor cost for testing and packing in the United States ("Labor value added"), customs duties (for the TM 100 and TM 101 only), material variance (for the TM 100 and TM 101 only), material support overhead (for the TM 50 and 65 only), and labor support overhead. Serge, CX 717, at 6.

414. According to Dr. Haldi, "burn-in" testing of disk drives at Tandon involved placing disk drives on racks and plugging them in. This test involved no extensive manual labor and lasted about four hours. Haldi, Tr. 1181-83.

415. For the TM 50, United States labor costs for testing and packing accounted for percent of the total unit cost of production, while for the TM 65, TM 100, and TM 101, these costs accounted for percent, percent, and percent, respectively, of the total unit cost of production. Serge, CX 717, attachments B-1, B-2, D-1, D-2, A-1, A-2, C-1, C-2.

416. For the TM 100 and TM 101, customs duties accounted for percent and percent, respectively, of the total unit cost of production. Serge, CX 717, attachments A-1, C-1.

417. Material variance represents those components, parts, or supplies that are necessary in the operation due to shrinkage, scrapping, or damage of the product, that are generated through the inspection and quality assurance of imported disk drives. Serge, Tr. 885-86.

C 418. Material variance accounted for percent of the total unit
C cost of production for the TM 100, and percent of the total unit cost of
production for the TM 101. Serge, CX 717, attachments, A-1, C-1.

419. Material overhead (support) represents costs for receiving, inspection, and planning groups as a function of disk drives as they enter Tandon. This cost is included in Tandon's inventory costs. Serge, Tr. 885; see Mitchell, CX 836, at 10.

C 4 percent of the total unit cost and for the TM 65, percent of
the total unit cost. Serge, CX 717, attachments B-1, D-1.

421. Labor overhead (support) represents administrative, supervisory, quality control, quality assurance, quality engineering, and product support costs. Serge, Tr. 886; Mitchell, CX 836, at 11.

C 422. Labor overhead costs were allocated equally between the four
C product lines at \$ per unit. This represents percent, percent,
C percent, and percent, respectively, of the total unit cost of the
TM 50, TM 65, TM 100, and TM 101 disk drives, respectively. Serge, CX 717,
attachments B-1, D-1, A-1, C-1.

423. Unit engineering costs were calculated on both the corporate and divisional levels. Corporate unit engineering costs were calculated by multiplying total corporate engineering costs by an "effort" variable of , which represents the percentage of floppy disk drives to total product shipped

by Tandon in April-June 1984. The engineering cost attributed to floppy disk drives was then divided by the total number of disk drives sold in April-June 1984 to arrive at a per unit corporate engineering cost. Corporate engineering costs include research and development (R&D) costs. Serge, Tr. 872-74, 887, 897-98, 985; CX 717, at 7.

423A. For all head assemblies assembled in Chatsworth or at one of Tandon's offshore assembly plants, Tandon's Chatsworth facility performs a number of engineering functions. The design of all double-sided head assemblies is conducted in Chatsworth. The Drafting Department at Chatsworth takes engineering sketches and turns them into standard approved vellums, drawn to scale using accepted drafting procedures. They also update all documents as required through engineering change orders. Tandon's Chatsworth model shop is used to fabricate initial prototypes and assist in fabrication of assembly tooling. Huenemeier, CX 835, at 10-12.

423B. Tandon's "advanced head production" section at Chatsworth includes engineers who supervise initial production of new heads and head assemblies. Currently, Tandon has to people in this section. In December 1984, Tandon had about to people in this section. Huenemeier, Tr. 3657; Huenemeier, CX 835, at 12.

423C. The design of all tooling used to fabricate piece parts is conducted by Chatsworth engineering personnel. The design of all assembly tooling and the fabrication of such tooling is conducted in Chatsworth. Huenemeier, CX 835, at 10, 12.

423D. Manufacturing Engineering, located in Chatsworth, develops, debugs, and documents all manufacturing assembly instructions for use by assembly personnel. Engineering personnel, located in Chatsworth, approve all

first article reports and any new vendors that may be developed during the life of the product. In the event that technical problems arise, Chatsworth engineering personnel are dispatched to offshore assembly plants to spearhead the corrective action process. Huenemeier, CX 835, at 10, 12.

424. Of the \$16.3 million spent on research and development by Tandon in fiscal year 1984, \$7.5 million was spent on floppy disk drive R&D. Haldi, Tr. 1223.

425. Mr. Serge testified that the R&D costs he used in his value added analysis did not include R&D for non-floppy disk products, although R&D for media manufacturing, pleated media manufacturing, or Winchester subsystem development may have been included in the R&D allocated to floppy disk drives. Serge, Tr. 990-93.

425A. During the period from January 1984 to present, the following double-sided head development programs were conducted in Chatsworth: TM 35, TM 65-8, TM 75-2, TM 75-8, TM 304, TM 306, TM 308, TM 309, and TM 100 (a high-capacity 5 megabyte half-height floppy disk drive). Huenemeier, CX 835, at 12.

C 426. For each product line, the unit engineering cost was \$.
C This represents percent, percent, percent, and percent of the total unit cost of the TM 50, TM 65, TM 100, and TM 101 disk drives, respectively. Serge, CX 717, attachments B-1, D-1, A-1, C-1.

427. In addition to corporate-wide engineering functions, each of the operating divisions maintains its own engineering staff, which includes sustaining engineering for the products developed by that division. See FF 453. Total "divisional" engineering costs are multiplied by the effort

C variable of , and then divided by the total number of floppy disks sold, to arrive at a divisional unit engineering cost. Serge, Tr. 872-73; Serge, CX 717, at 7.

428. Sustaining engineering is a continuing engineering process to handle problems that come up on existing products. Serge, Tr. 874; see FF 453.

428A. Approximately 12-13 persons perform sustaining engineering activities at Tandon. Huenemeier, Tr. 3687-88.

428B. There is a correlation between volume of production and sustaining engineering activity. Higher volumes of production involve more sources of components, which leads to more problems and consequently more sustaining engineering. Huenemeier, Tr. 3688-89.

429. For each product line, the divisional unit engineering cost was \$, and represents percent, percent, percent, and percent of the total unit cost of the TM 50, TM 65, TM 100, and TM 101 disk drives, respectively. Serge, CX 717, attachments B-1, D-1, A-1, C-1.

430. Engineering is a stand-alone department, and engineering costs are separate from labor support costs. Serge, Tr. 886-87.

C 431. The marketing unit cost is based on an allocation of total corporate marketing costs to floppy disk drives based on the effort variable. This cost is then divided by the total number of floppy disk drives to arrive at a unit marketing cost. Serge, Tr. 887-88; Serge, CX 717, at 7.

432. Marketing costs include salaries, commissions expenses, advertising, technical or engineering support provided by the marketing group (product specs), technical documentation, and departmental overhead associated with marketing and product support operations. Serge, Tr. 880.

C 433. For each product line, the unit marketing cost was \$, and
C represents percent, percent, percent, and percent of the total
unit cost of the TM 50, TM 65, TM 100, and TM 101 disk drives, respectively.
Serge, CX 717, attachments B-1, D-1, A-1, C-1.

433A. All of the marketing for Tandon's double-sided disk drives,
including those assembled offshore, for customers located in the United States
is handled by Tandon's sales and marketing personnel who are officed in the
United States. In addition, Tandon's United States marketing and sales
organization performs substantial marketing and sales effort with respect to
customers located in other countries. Huenemeier, CX 722, at 18.

434. General and administrative costs are broken out between
corporate and divisional general and administrative costs. These costs are
C calculated by application of the effort variable of to total general
administrative costs. Unit costs are then calculated by dividing these costs
by the number of disk drives. Serge, Tr. 887; Serge, CX 717, at 7.

435. General and administrative costs encompass the executive
offices and officers, the finance departments, the personnel and payroll
departments, as well as the operational management that may fall within the
division as opposed to the executive levels. Serge, Tr. 881.

436. For each product line, the corporate general administrative
C unit cost was \$, and represents percent, percent, percent,
C and percent of the total unit cost of the TM 50, TM 65, TM 100, and TM 101
floppy disk drives, respectively. Serge, CX 717, attachments B-1, D-1, A-1,
C-1.

437. For each product line, the divisional general administrative unit cost was \$, and represents percent, percent, percent, and percent, respectively, of the total unit cost of the TM 50, TM 65, TM 100, and TM 101 floppy disk drives. Serge, CX 717, attachments B-1, D-1, A-1, C-1.

437A. The procurement of parts used in the assembly of the TM 100, TM 65, and TM 50 overseas is in part handled in the United States. Huenemeier, CX 722, at 16.

437B. Tandon procures components for head assemblies from Chatsworth, California, for all head assemblies assembled in Chatsworth or Bombay. The procurement process involves identifying and surveying potential vendors, negotiating initial pricing, and obtaining first article approval. The Chatsworth purchasing people place the actual purchase orders with the vendors. As material is received in Chatsworth, it is inspected and disposed of if found discrepant. Material is then stocked and either issued to the Chatsworth production facility or packaged for shipment to one of Tandon's offshore assembly plants. The processing of invoices, credit memoranda, and other documentation necessary to deal with the vendors is done at Chatsworth. As of December 6, 1984, all of these procurement steps were performed in Chatsworth. Huenemeier, CX 835, at 13.

437C. As to parts procured in the United States, Tandon has performed appropriate inspection and testing in Chatsworth where such parts are received to control the quality of that material. For this purpose, Tandon maintains appropriate test equipment in Chatsworth, much of which is designed by Tandon in the United States for the purpose of ensuring the desired quality of the incoming material. Huenemeier, CX 722, at 16.

C 437D. Approximately or Tandon employees are involved in vendor identification and vendor surveys with respect to the procurement of materials and components that are incorporated into Tandon's double-sided disk drives. MRX 59, at 8-9.

438. In fiscal year 1984, Tandon leased buildings for its principal executive offices and domestic manufacturing operations in Chatsworth, Simi Valley, Thousand Oaks, San Jose, and Santa Clara, California, that occupied 515,000 square feet. CX 666, at 18.

439. In April 1985, Tandon's leased buildings in the United States occupy 448,000 square feet. Huenemeier, CX 722, at 2.

440. In April 1985, Tandon's facility at Simi Valley was not involved in the assembly of floppy disk drives, but has a Winchester disk drive facility, a printed circuit board assembly operation, and some warehouse space. Printed circuit boards are used in floppy disk drive production. Huenemeier, Tr. 429.

441. Tandon's facility at Santa Clara is not involved in the production of floppy disk drives. Huenemeier, Tr. 432-33.

442. The research and development group at Santa Clara is primarily involved in R&D for Winchester disk drives, but may have been assisting Microtek (see FF 475-92) in its endeavors with regard to the 3-1/2 inch product. Huenemeier, Tr. 491.

443. Tandon's facility at Thousand Oaks houses the Voyager Division. The Voyager Division is responsible for the design and manufacture of Tandon computer systems and subsystems that incorporate Tandon's floppy and rigid disk drives, which are sold by OEMs under the OEM's name. Huenemeier, Tr. 430-31.

444. As late as April 1985, Tandon's Chatsworth facility occupied seven leased buildings occupying approximately 351,000 square feet. Approximately 270 employees at Chatsworth are devoted to floppy disk drive manufacture and related activities, such as marketing, administration, and research and development. Elsner, CPX 33, Interrogatory No. 4; CPX 33 at 189-90; see also Huenemeier, CX 722, at 12.

444A. Prior to January 1984 and through the spring of 1985, Tandon's facilities involved in the manufacturing activities of head and head assemblies for use in double-sided disk drives were located in Building 1 at 9333 Oso Avenue, Chatsworth, California, which had 20,080 square feet of space. Since the spring of 1985, the various manufacturing functions being performed have been done in Chatsworth, California, at three separate buildings: Building 4 at 9423 Oso Avenue, with 15,035 square feet; Building 3 at 20320 Prairie Street, with 76,610 square feet; and Building 5 at 20310 Plummer Street, with 46,440 square feet. Huenemeier, CX 835, at 15.

445. Of the 351,000 square feet and 270 employees devoted to floppy disk drive manufacturing at Chatsworth in April 1985, manufacturing facilities for the TM 848 occupy about 45,000 square feet and employ 237 employees. Elsner, CPX 33, at 191.

446. In the remaining 306,000 square feet, about 200 employees are engaged in warehousing, administration, finance, and other corporate-related functions. Elsner, CPX 33, at 191-92.

446A. At the Chatsworth facility, the procurement process, which surveys vendors and negotiates pricing, etc., has approximately four employees. Huenemeier, Tr. 3661.

446B. At the Chatsworth facility, the detailed planning of components and piece parts employs about four individuals. Huenemeier, Tr. 3661.

446C. The division that receives and inspects materials at Chatsworth has approximately 12 employees. Huenemeier, Tr. 3661-62.

446D. As of January 1984, those Tandon United States employees involved in manufacturing activities related to head assemblies numbered approximately ; and as of December 6, 1984, numbered approximately ; and today, number approximately . The above numbers include engineering personnel devoted to heads, which broken down include: As of January 1984, approximately employees; as of December 6, 1984, employees; and today, employees. Huenemeier, CX 835, at 15-16.

447. With the exception of development of the 3-1/2 inch disk drive, all research and development for Tandon's floppy disk drives is done in the United States at Tandon's Chatsworth facility. The Tandon's Chatsworth R&D facility includes approximately square feet of building space, offices, two full-test and evaluation laboratories, and as of April 1985, engineers, technicians, document control individuals, and drafting employees. Huenemeier, CX 722, at 10.

448. R&D expenses accounted for 5.0 percent of net sales in fiscal 1983 and 4.0 percent in fiscal 1984. CX 666, at 23.

448A. In fiscal year 1984, Tandon expended \$16,269,000 on research and development or approximately 3-4 percent of the cost value for its floppy disk drives. Product research and development expenses increased by 127 percent in fiscal year 1983 and 18 percent in fiscal year 1984, while remaining essentially constant as a portion of net sales. Huenemeier, CX 722, at 10-11; CX 666, at 29.

449. All R&D and engineering in connection with the original design of Tandon's TM 100s and TM 101s (assembled in Singapore and at TP), TM 50s (assembled in India), and TM 65 (assembled in India and at TP), has been conducted in the United States. All drawings and specifications defining the product as a result of such R&D and engineering were prepared in the United States. All engineering prototypes were assembled and tested in the United States to insure that the design met the product objectives. Huenemeier, CX 722, at 12-13.

450. The R&D and the production of engineering prototype units and pilot production for the TM 100s, TM 101s, TM 65s, and TM 50s had been completed by December 6, 1984. Huenemeier, Tr. 498-99.

451. The development of the double-sided TM 100 took place between 1978 and 1979. Huenemeier, Tr. 443.

452. The development of the TM 848 double-sided disk drive took place in the 1980 to 1981 time frame. Huenemeier, Tr. 444.

453. After a product is in production, production problems are occasionally confronted which require technical evaluation and solution. This evaluation is customarily performed by manufacturing engineers and is referred to as "sustaining engineering." In addition, after a product is in production, there are ongoing efforts to improve the manufacturing process both in terms of enhancing the quality of the product and in reducing costs. With respect to Tandon's floppy disk drives produced overseas, all or virtually all of such sustaining engineering has been and continues to be performed by Tandon in the United States. Huenemeier, CX 722, at 15-16.

454. According to complainant's economic expert, R&D activities in the flexible disk drive industry take place at a pace that is independent of current production, and they take place at a site that is removed from current production. R&D activities tend to be of a non-recurring nature, where production tends to be a highly repetitive flow process down an assembly line. Haldi, Tr. 1272.

454A. Tandon's engineering activities regarding heads and head assemblies during the first fiscal quarter of 1985 included the development of head assemblies for the TM 65-8, the TM 300, and the TM 75.

455. Primarily as a result of Tandon's restructuring of its manufacturing operations to emphasize offshore production of mature product lines, Tandon's employment in the United States during fiscal year 1984 decreased to 1,605 as of December 1, from a level of 3,300 a year earlier. Employment in Singapore increased from 2,500 to 2,997 over the same period. CX 666, at 18.

456. Tandon contracts with various companies in India for the assembly or purchase of component used by Tandon in its final products and for the purchase of complete half-height 48 TPI 5-1/4 inch flexible disk drives. CX 666, at 11.

457. The Indian companies include Tandon Magnetics (India) Pvt., Ltd. (TMI), which assembles recording heads and certain labor-intensive disk drive sub-assemblies; Tandon Motors Pvt., Ltd. (TMM), which manufactures precision stepper motors used in Tandon's flexible and rigid disk drives; Barnala Electronics (Barnala), which manufactures harness assemblies for use in Tandon's disk drives; Tancom Electronics (Tancom), which manufactures rigid

disk drive recording heads; and Eastern Peripherals Pvt., Ltd. (Eastern Peripherals), which manufactures completed half-height 48 TPI 5-1/4 inch flexible disk drives. CX 666, at 11.

457A. It was only after the initial production problems were identified and design changes made in response thereto that Tandon arranged for the assembly of TM 100, TM 65, and TM 50 overseas. In connection with such overseas assembly, Tandon has provided to the overseas operations the drawings, specifications, manufacturing assembly instructions, test equipment, test procedures and related documentation from which the drives could be assembled and tested. Huenemeier, CX 722, at 13-15.

458. TMI provides contract assembly services to Tandon pursuant to an agreement under which Tandon provides TMI with the raw materials and know-how required for the assembly of recording heads and disk drive subassemblies, and TMI uses its best efforts to perform all assembly operation requested by Tandon. This agreement will continue to December 1, 1985, at which time it may be extended by mutual agreement or terminated by either party. CX 666, at 11-12.

459. Finished products and components are purchased directly by Tandon from TMM, Barnala, Tancom, and Eastern Peripherals pursuant to standard purchase orders placed by Tandon, and there are no long-term purchase commitments from Tandon to any of the Indian companies. CX 666, at 12.

460. The contract assembly and purchase transactions between Tandon and the Indian companies are coordinated and effected through Tandon Associates, Inc., which acts on behalf of the various Indian companies and

directly invoices Tandon at prices reflecting a mark-up for the services of Tandon Associates for the products and services of the Indian companies. CX 666, at 12.

C 461. The Indian companies manufacture approximately to
C TM 50s a month, of which about are offered for sale in the United States. Prior to January 1985, all TM 50s shipped to the United States were inspected at Chatsworth. In January 1985, the disk drives were subjected to standard 105(d) evaluation, which includes testing the first 100 drives received in each shipment and then 80 of the next 1,000 drives selected randomly. If 10 percent of this selected group fails the testing, then the entire shipment is pulled for re-examination. Huenemeier, CX 722, at 9-10.

462. The 105(d) evaluation of Indian-assembled disk drives at Chatsworth was made in conjunction with the successful implementation of certain inspection criteria in Bombay as of January 1985. Huenemeier, Tr. 490.

462A. For all head assemblies assembled in Chatsworth or at one of Tandon's offshore assembly plants, the Chatsworth facility has provided the following quality services: Quality engineers support the procurement cycle by assisting in vendor surveys. Chatsworth quality engineers are also responsible for developing detailed receiving inspection and in-process inspection procedures. Quality engineers working with engineering representatives approve the disposition of all discrepant material and coordinate and approve vendor corrective action programs. Quality control personnel working in receiving inspection perform incoming inspections on 100 percent of the lots of material received as well as perform all first article inspections. As of December 6, 1984, all these quality activities were performed in Chatsworth. Huenemeier, CX 835, at 13-14.

462B. During late 1984, some of the TM 848 double-sided head assemblies were assembled overseas. With respect to all such head assemblies which have been assembled offshore from January 1984 to the present, 100 percent inspection and testing is performed in Chatsworth. With respect to any head assemblies assembled overseas which require rework, all such rework is performed in Chatsworth by Tandon. Tandon performed each of these activities in Chatsworth, California, as of December 6, 1984. Huenemeier, CX 835, at 10-14.

463. Quality control on Tandon's TM 65-4, TM 65-2, and TM 50 is performed by Eastern Peripherals in India, the sole place of manufacture. Huenemeier, Tr. 450-51.

463A. When Tandon's disk drives, including those assembled overseas, are sold to customers, it is sometimes necessary to consult with the customer to answer technical questions about the product and its interface with the system in which it is installed. This consulting with Tandon's customer base is handled by technical personnel in the United States for United States customers who purchased Tandon's disk drives, including those assembled overseas. Huenemeier, CX 722, at 17.

464. Eastern Peripherals has produced half-height flexible disk drives of the single- and double-sided variety in the quantities of 60,000 to 80,000 per month. Huenemeier, Tr. 784.

464A. With respect to each of Tandon's disk drive models assembled overseas, Tandon conducts reliability testing in Chatsworth. This reliability testing is performed on samples for all of the disk drives manufactured by Tandon and includes testing for burn-in, long-term reliability, as well as

shake, vibration, and drive tests. These tests are performed not only on a routine basis with respect to Tandon's existing designs, but are also performed with respect to disk drives containing recent design changes to ensure that those design changes have not inadvertently caused long-term reliability problems. Huenemeier, CX 722, at 17.

464B. All customer liaison and application engineering support with respect to the use of Tandon's drives in their systems is provided to the customer by the quality assurance group at Tandon in Chatsworth. Huenemeier, CX 722, at 17.

465. Tandon's wholly-owned subsidiary in Singapore is Tandon Singapore Ltd. This subsidiary manufactures the TM 100, the TM 101, and certain Winchester disk drives. Huenemeier, CX 722, at 6.

466. Double-sided TM 100s are assembled only in Singapore. Huenemeier, Tr. 449.

467. Tandon Singapore Ltd. currently produces about TM 100s a month, of which units are shipped to Chatsworth. Huenemeier, CX 722, at 10.

467A. The capacity of the Tandon Singapore facility for manufacturing double-sided floppy disk drives is in the neighborhood of 200,000 drives per month or 10,000 drives per day. Abraham, Tr. 1137.

468. All of the TM 100s that are shipped to Chatsworth from Singapore are subjected to quality control at Singapore, and then subjected to 105(d) sample testing at Chatsworth. Huenemeier, Tr. 473.

469. As of April 1985, 149,000 of the 150,000 TM 100s produced in Singapore are double-sided. Huenemeier, Tr. 490.

470. As of April 1985, approximately 129,000 of the 150,000 TM 100s produced in Singapore are quality-tested in Singapore and then drop-shipped directly to IBM in Singapore. Huenemeier, Tr. 490-91.

471. All warranty repairs and service on the TM 100 units drop shipped to IBM in Singapore are currently performed in Singapore. Huenemeier, CX 722, at 18.

471A. Servicing and repair of Tandon's disk drives, both warranty repair and out-of-warranty repair, are performed at Chatsworth or elsewhere in the United States by Tandon's subcontractors under Tandon's control. With the exception of TM 100 disk drives assembled in Singapore and drop shipped to IBM, such service and repair has always been performed in the United States. The service and repair for Tandon disk drives sold to IBM which are out-of-warranty has always been handled in Chatsworth or elsewhere in the United States. In December 1984, Tandon's Chatsworth facility had a full-service staff of approximately employees for service and repair. Huenemeier, CX 722, at 18.

472. Tandon is currently working on a 5-1/4 inch half-height double-sided flexible disk drive, the . Tandon has a purchase order from for units. Huenemeier, Tr. 295-96.

472A. The is currently in the evaluation stages . Edwards, Tr. 3759; Edwards, CX 818, at 4.

472B. product development began in late 1984 and has continued since that time. There have been to Tandon engineers involved with the development. Huenemeier, Tr. 295.

473. Tandon intends to manufacture the . The development work has taken place in the United States. Huenemeier, Tr. 297.

C 474. The
Edwards, Tr. 3759; Edwards, CX 818, at 4.

C 474A. Tandon purchased over \$ from United States suppliers
relating to its floppy disk drive parts requirements since January 1984.
Block, CX 819 at 2.

C 474B. Tandon purchased \$ of flexible disk drive materials
C from United States suppliers during Tandon's fiscal year 1984 and \$
from United States suppliers during the first three quarters of fiscal years
1985. Block, CX 819, at 5, 7.

474C. The costs of flexible drive components Tandon purchased from
United States suppliers show that purchases over the past seven quarters, since
January 1, 1984, have been as follows:

	<u>Time Period</u>	<u>Amount</u>
C	1Q, 2Q, 3Q FY 1984	\$
C	4Q FY 1984	\$
C	1Q, 2Q, 3Q FY 1985	\$
C	FY 1984 and 1Q, 2Q 3Q FY 1985	\$

Block, CX 819, at 7, Ex. E.

474D. Tandon has purchased other components for heads and head
assemblies from United States' vendors. Such components consist of five
conductor black cable, flex cables, back bars, back bar clips, gimbal
flexures, round shields, insulation pads, plastic insert pins, rectangle
shields, arms, flex arms, sleeving, connectors, terminal pins, button
 housings, epoxy, plastic carriages, compression springs, spring housings,

476. Tandon has completed its engineering prototype activities on the TM 306 and preproduction involving 50-100 units of TM 304s and TM 306s has started at Microtek for the purpose of providing samples to Tandon's marketing organization. Huenemeier, Tr. 289.

476A. Tandon's double-sided engineering expenses incurred by its Microtek subsidiary was \$875,000 in fiscal years 1984 and 1985. Huenemeier, Tr. 3608-09.

C 477. Tandon's Microtek subsidiary occupies square feet of
C manufacturing space and employs about persons with respect to the design and development of the TM 300 series of 3-1/2 inch double-sided disk drives. Microtek has acquired tooling for the manufacture of these drives and intends to commence production in San Jose, California, as soon as an order of commercial production has been received. Huenemeier, CX 722, at 26.

C 477A. Microtek is starting to occupy an additional square feet adjacent to its present facility. Dalziel, Tr. 4290-91.

478. Microtek has acquired tooling for the purpose of commercial production of the TM 304 and TM 306. The cost of this tooling was \$400,000. Production tooling comprises the various molds and jigs that are used to fabricate the piece parts that are used in the assembly of the flexible disk drive. Huenemeier, Tr. 289-90.

479. Tooling purchased by Microtek for the 3-1/2 inch double-sided floppy disk drive would be located at vendors who would supply various parts for which they are tooled, including the chassis and other parts. Haldif, Tr. 1212-13.

480. For research and development regarding the TM 300 series,
C Tandon has spent anywhere from \$ to \$, and has employed from
C to employees, primarily engineers. Huenemeier, Tr. 294.

481. Microtek has sold evaluation units of its TM 304 and TM 306 to
customers. Abraham, Tr. 1019.

482. In order for Microtek to commence production of 3-1/2 inch disk
drives in commercial quantities, parts would have to be ordered into
production from Microtek's vendors, workers would have to be hired and trained
to commence assembly of the parts into a disk drive, and quality control
inspection and testing procedures would have to be set up. This process would
take 90 to 120 days. Haldi, Tr. 1275-76; Huenemeier, Tr. 3679.

482A. There is no assembly line in place at the present time at
Microtek capable of producing the TM 300 series. Huenemeier, Tr. 3678.

483. It would take 90 to 120 days to achieve volumes in the 10,000
unit per month range for TM 300 series drives at Microtek. Huenemeier,
Tr. 291; Haldi, Tr. 1196.

484. Production at Microtek at the 10,000 unit per month level would
employ 100 to 250 workers, with about 50 percent being direct production
personnel and the remaining being engineering and support personnel.
Huenemeier, Tr. 292-93.

485. According to Mr. Huenemeier, the Microtek facility has the
capacity to produce 20,000 to 30,000 3-1/2 inch flexible disk drives per
month. Huenemeier, Tr. 292.

486. Currently, Microtek has no production orders for 3-1/2 floppy
disk drives, and has no plans to produce these drives for inventory purposes.
Huenemeier, Tr. 752; Huenemeier, CX 835, at 9.

487. Orders are being solicited by Microtek for double-sided 3-1/2 inch disk drives. Huenemeier, Tr. 753.

487A. Since May 30, 1985, Tandon has forwarded 3-1/2 inch double-sided evaluation drives manufactured in San Jose, California, at its Microtek subsidiary to _____, where evaluation is ongoing. Edwards, CX 818, at 3.

488. If production orders are received at Microtek for the 3-1/2 inch disk drive, initial production would be at Microtek. Huenemeier, Tr. 753.

488A. Tandon has now completed development of the one megabyte 3-1/2 inch micro-floppy disk drive, built engineering evaluation models of this drive, and proceeded into preproduction. Tandon has fully tooled the product and had produced preproduction models that it has evaluated and that it is having customers evaluate. Dalziel, Tr. 4290.

C 488B. Tandon has

C . MRX 59, at 12.

488C. Tandon has produced approximately 100 drives during its preproduction TM 300 run. Huenemeier, Tr. 3630; CX 845.

488D. Tandon has delivered evaluation units of the TM 300 series to various customers for evaluation. Huenemeier, CX 835, at 8.

488E. Microtek still has its tooling for the manufacture of these drives in production quantities and still intends to commence production of the same in San Jose, California, as soon as an order for commercial production has been received. Huenemeier, CX 835, at 8-9.

489. Based on initial expectations of large-volume orders, Microtek had plans to move production of the TM 306 offshore in late 1984. Huenemeier, Tr. 754. Tandon has no plans at present to assemble the TM 300 series

products offshore, and any future decision whether to do so will depend upon the relative costs and efficiencies of assembling domestically or offshore. Huenemeier, CX 835, at 9.

490. Microtek may determine to move manufacture of its 3-1/2 inch disk drive offshore if demand conditions warrant such a move. Haldi, Tr. 1246-47.

491. Microtek currently produces Winchester disk drives which it sells to the OEM market. Huenemeier, Tr. 433, 756.

492. The TM 35 (another 3-1/2 inch drive that Tandon had been developing) never went into production because the TM 35 program was scrapped in favor of a program that would meet the specifications of IBM. The TM 308 was designed to meet IBM requirements. Huenemeier, Tr. 457-58.

E. Texas Peripherals

493. Effective January 1, 1984, Tandon entered into a joint venture agreement with Tandy Corporation for the joint ownership and operation of Texas Peripherals (TP), a Fort Worth, Texas manufacturer of full-height, 5-1/4 inch flexible disk drives. CX 666, at 14; CX 619.

494. Tandon and Tandy each own equal interests in TP, and revenues and profits are divided equally between Tandon and Tandy. In fiscal year 1984, Tandon was allocated \$808,416 in profit from the TP venture. CX 666, at 14.

495. The joint venture agreement provides that TP will sell its products exclusively to Tandy and Tandon unless otherwise agreed to by Tandy and Tandon. During fiscal year 1984, substantially all production of TP was purchased by Tandy. CX 666, at 14.

496. The initial cost to Tandon for joining the joint venture was the contribution of Tandon's half-height flexible disk technology, as well as a payment of approximately \$1.9 million. Huenemeier, Tr. 302.

497. TP facilities consisted of approximately 87,000 square feet of manufacturing and commercial space. CX 666, at 14.

498. In April 1985, approximately 350 to 360 persons were employed by TP. Hochman, Tr. 1648; CX 666, at 14.

499. The current representatives of the TP joint venture committee are Herschel Hochman, the general manager of TP; Dr. Patterson, a vice president of Tandy; Jim Mortenson, a vice president of Tandy; Steven Huenemeier, Tandon; and Dennis Trafecanty, a vice president of Tandon. Huenemeier, Tr. 299.

500. During 1982 and 1983, TP manufactured a full-height 5-1/4 inch single-sided drive called the TM 100-1, as well as an 8 inch flexible disk product. Huenemeier, Tr. 300.

501. Tandy had received a license from Tandon to produce a single-sided TM 100, and that license was used for TM 100-1 production at TP during 1982-1983. Huenemeier, Tr. 300.

502. From 1982 to 1983, approximately 20,000 to 25,000 single-sided TM 100s per month were manufactured by TP for sale to Tandy. Huenemeier, Tr. 301.

502A. TP's capacity to produce double-sided floppy disk drives was per month on a double shift. Hochman, Tr. 1628.

503. Since December 1984, TP has been assembling single-sided TM 100s, and single- and double-sided TM 63s. Hochman, Tr. 1632.

504. From January to December 1984, TP produced single-sided TM 100s. Huenemeier, CX 722, at 8.

505. In late 1984, TP commenced production of 5-1/4 inch half-height double-sided floppy disk drives referred to as the TM 65. TP assembled approximately double-sided TM 65s. Huenemeier, CX 722, at 8; Huenemeier, Tr. 1614.

506. Most of the TM 65-2 double-sided disk drives produced by TP were . The cost of the was approximately \$ per unit. Some TM 65-2 drives were manufactured , but the percentage of drives produced from is unknown. Hochman, Tr. 1613-14.

506A. Texas Peripherals procured all of its double-sided head assemblies used in the TM 65-2 from Tandon, which in turn procures them from TMI. Huenemeier Tr. 474-75; Hochman, Tr. 1633.

507. Tandon purchased single-sided and double-sided TM 65s from TP for evaluation. Huenemeier, Tr. 779; Huenemeier, CX 722, at 8.

508. TP received a purchase order from Tandy Home Computer dated October 9, 1984, for 6,000 TM 65-2 double-sided floppy disk drives. These disk drives were to be delivered over a three month period commencing in October or November of 1984. CX 707; Huenemeier, Tr. 361-62;

509. To date, TP has shipped 450 double-sided disk drives to Tandy. Huenemeier, CX 722, at 8.

509A. After the announcement of the Initial Determination with respect to Tandon's motion for temporary relief, Tandon and Tandy discussed the future of TP. The immediate requirements of both Tandy and Tandon for the TM 65-2

double-sided drive were explored. Tandy advised Tandon that its purchase order commitments to other vendors were more than adequate to supply all of its needs for this type of product through November 1985. Similarly, since Tandon has not yet been able to penetrate the 5-1/4 inch half-height double-sided disk drive marketplace, Tandon itself had no immediate need for this product from TP. Huenemeier, CX 835, at 18.

509B. In order to preserve to the fullest extent possible the production capacity of TP, Tandon proposed that Tandy and Tandon each procure 5,000 drives per month from TP for the months of July, August, and September of 1985. Huenemeier, CX 835, at 19; CX 760.

509C. Shortly after presenting this proposal, Tandon was notified by Tandy that, because it had no need for 5-1/4 inch half-height double-sided disk drives before December 1985, it was unwilling to order 5,000 units per month from TP for the months of July, August, and September 1985. Huenemeier, CX 835, at 19.

509D. Tandon authorized a unilateral commitment to purchase TM 65-2 drives from TP for these three months starting at approximately 2,000 units per month. This proposal was submitted to TP and Tandy by letter dated June 28, 1985. Huenemeier, CX 835, at 19; CX 758.

509E. On July 10, 1985, the TP joint venture committee met to discuss the future of TP. Mr. Hochman presented a projected profit and loss plan based upon Tandon's offer to procure 2,000 units per month from TP. Assuming that Tandon purchased such drives at \$90 per unit and provided TP with Tandon's refurbishing business, it was estimated that TP would suffer losses of \$101,000 in the months of August, September, and October 1985. Huenemeier, CX 835, at 19-20; CX 759.

509F. While Tandon and Tandy both agreed that it was desirable to preserve the ability of TP to manufacture TM 65-2s if either Tandon or Tandy should have a need for such product in the future as a result of the Commission proceeding, Tandy did not agree that it was necessary to keep TP's manufacturing facility in operation for that purpose. Moreover, Tandy was desirous of using the TP Fort Worth facility for other purposes. Tandy was only willing to agree to the continued operation of TP if Tandon absorbed all of the losses in excess of the costs of storing TP's production equipment, estimated to be \$18,000 per month. Tandy believed that reactivating production with stored equipment would not take any longer than ramping up from limited production in the interim and that TP should therefore cease production pending further developments. Huenemeier, CX 835, at 20.

509G. After the July 10, 1985, meeting, Tandon's management reviewed the continued operation of TP. Since Tandy was unwilling to absorb any operating losses in excess of \$18,000 per month, even if Tandon purchased TM 65s from TP at a price of \$90 per unit--a price at which Tandon would suffer additional losses--Tandon decided that it was unwilling to absorb such losses unilaterally. Tandon concluded that it had no choice but to acquiesce in Tandy's proposal that TP's production equipment be stored pending the ruling of the Commission after the hearing on permanent relief. Huenemeier, CX 835, at 21; CX 761.

509H. TP, as of April 1965, has not produced production quantities of the TM 65-2, i.e., an order of 15,000 drives a month of any one type of drive. Hochman, Tr. 1628.

509I. TP has not produced any commercial quantities of double-sided 5-1/4 inch disk drives since April 1985. Huenemeier, Tr. 3630.

F. Control Data Corporation/Magnetic Peripherals

510. Control Data Corporation (CDC) is a majority (67%) owner of Magnetic Peripherals, Inc. (MPI). The other owners of MPI are Honeywell, Sperry, and Bull. Flexible disk drives are produced by the subsidiary, MPI. Ousley, Tr. 629, 691.

511. MPI manufactures disk drives solely for CDC for sale to the OEM market. Ousley, Tr. 631.

512. CDC has a license from Tandon with respect to Tandon's patent on double-sided disk drives. Ousley, Tr. 632; CX 620.

513. CDC became a Tandon licensee on September 30, 1984. Ousley, Tr. 702; CX 620.

513A. The \$1.0 million license fee that CDC paid to Tandon with respect to the '573 patent license was based in part upon the amount of CDC's past sales for double-sided floppy disk drives, including sales of Model Nos. 9409, 9409-T, 9428, and 9429. Ousley, Tr. 3338.

514. Approximately 90 percent of the 5-1/4 inch full height disk drive production in 1983 and 1984 was double-sided. Virtually all of the 5-1/4 inch half-height product was double-sided in 1984. Ousley, Tr. 649-50.

515. The 8 inch double-sided floppy disk drive product line accounted for about percent of CDC/MPI orders in 1984. Ousley, Tr. 649.

516. In 1983, CDC/MPI had approximately 20 percent of the full-height disk drive market and a minimal share of the half-height market. Ousley, Tr. 633.

1985, CDC/MPI employed approximately 100 to 150 persons in the floppy disk drive business in the United States, of which 25 were involved in research and development. Ousley, Tr. 641-43.

C 521A. On April 15, 1985, CDC laid off approximately employees at its Oklahoma City floppy disk drive facility, leaving 75 employees primarily engaged in continuation and support engineering with respect to the overseas assembly of drives and CDC's customers. Ousley, CX 820, at 2-3.

522. CDC/MPI currently sells 5-1/4 inch full-height floppy disk drives (No. 9409) and 5-1/4 inch half-height floppy disk drives (Nos. 9428 and 9429). Ousley, Tr. 629; CX 728.

523. In 1983, CDC/MPI 's Oklahoma City facilities covered approximately 100,000 square feet, which was devoted to manufacturing. Ousley, Tr. 642.

524. CDC/MPI's decision to move some of its facilities offshore occurred in late September 1984. Implementation of this decision occurred in October 1984, when 450 employees were terminated. Ousley, Tr. 691-92.

C 525. The decision to move offshore was based on an unstable market situation in the last half of 1984, when CDC/MPI

C . CDC/MPI believed that it could produce approximately
C \$ to \$ cheaper offshore on a per unit basis (\$ in the United States
C compared to \$ offshore). Ousley, Tr. 666-67.

C 526. CDC/MPI continues to assemble and test about to percent of its drives in Oklahoma City. This volume will not likely move offshore because it is made up of drives that have special requirements. Ousley, Tr. 668, 3384-86.

527. In April 1985, CDC/MPI had capacity in Oklahoma City to produce
C to half-height drives per month. It would require to
C months to reach production at that level. Overseas capacity is units
C annually (per month). CDC/MPI inventories as of April 1985 were
units. Ousley, Tr. 666-70.

527A. On January 1, 1983, CDC's floppy disk drive division had
C employees: management employees; professional engineers; technical
C non-degree employees; clerical employees; craftsmen; and line
C operation employees. Ousley, CX 820, at 5-6.

527B. On January 1, 1984, CDC's floppy disk drive division had
C employees: management employees; professional engineers; technical
C non-degree employees; clerical employees; craftsmen; and line
C operation employees. Ousley, CX 820, at 6.

527C. At the end of 1984, the total number of CDC's floppy disk drive
C employees was about . Ousley, CX 820, at 6.

527D. CDC

C
C
C
C . Ousley, CX 820, at 3.

527E. CDC has

C
C . Ousley, CX 820, at 3.

528. CDC/MPI contracts with foreign suppliers for its offshore disk
drive requirements and is currently purchasing from its foreign supplier at
C \$ or \$ per month. Ousley, Tr. 668-71.

528A. As of April 1985, CDC had research and development facilities in Oklahoma City, Oklahoma, as well as Minneapolis, Minnesota. Ousley, Tr. 634.

528B. In 1984, CDC expended approximately \$ million for research and development for floppy disk drives, including research and development for its 5-1/4 inch 1.6 megabyte drive and its 3-1/2 inch drives. All such research and development took place in the United States and virtually all such expenses relate to double-sided drives. Ousley, CX 820, at 4.

529. Drawings, specifications, manufacturing assembly instructions, and technical support for disk drives manufactured overseas for CDC/MPI come from CDC/MPI in Oklahoma City. Ousley, Tr. 636-37; Ousley, CX 820, at 7.

529A. The engineering prototypes and evaluation units for the 5-1/4 inch double-sided full-height and half-height floppy disk drives manufactured by MPI were developed and tested in the United States. Ousley, Tr. 634-35.

529B. The preproduction units and initial production units of the MPI full-height and half-height 5-1/4 inch floppy disk drives were assembled and tested in the United States. Ousley, Tr. 635,

529C. As of April 1985, all manufacturing engineering and sustaining engineering for all 5-1/4 inch double-sided disk drive products marketed by CDC was performed in Oklahoma City, Oklahoma. Ousley, Tr. 635.

529D. As of April 1985, engineering field change and design changes to solve production problems for all 5-1/4 inch floppy disk drive products currently offered by CDC was performed in Oklahoma City, Oklahoma. Ousley, Tr. 635-36.

529E. As of April 1985, technical support and supervision for all overseas manufacture of CDC drives comes from Oklahoma City, Oklahoma. Ousley, Tr. 636-37.

529F. In 1984 and continuing into 1985, CDC's Oklahoma City facility

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. Ousley, CX 820, at 6.

529G. CDC's Oklahoma City's facility was responsible for the evaluation and selection of vendors for the assembly materials, providing drawings and specifications generated by CDC in the United States to such vendors for the materials, and insuring that the materials actually provided and conformed to specifications. Ousley, CX 820, at 6-7.

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529H. During 1984 and continuing into 1985, over percent of the total material cost of CDC's 5-1/4 inch half-height floppy disk drives that were assembled offshore was attributable to materials produced from domestic sources. In addition, CDC conducted substantial domestic activities in connection with the manufacture of its drives that were assembled offshore, including research and development, design engineering, manufacturing and support engineering, material procurement overhead, testing, and overhead and general and administrative costs in connection with such activities. Ousley, CX 820, at 7.

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530. Approximately percent of the materials used to assemble drives offshore are currently procured by CDC/MPI in the United States. With the exception of initial qualification of a vendor, testing of incoming parts takes place at the manufacturing site. Ousley, Tr. 637-40, 3371.

531. The disk drives that are manufactured offshore are also tested offshore, and quality control for drives produced offshore takes place in Oklahoma city through a sampling process. Ousley, Tr. 638-39, 699-700.

532. The CDC/MPI activities in connection with identifying and selecting test equipment for quality control takes place in the United States. Ousley, Tr. 636.

532A. As of April 1985, all 5-1/4 inch double-sided disk drives which are currently being manufactured offshore for CDC are received in Oklahoma City and tested. The drives are certified to meet the specifications which were negotiated with the vendor. CDC tests the 5-1/4 inch drives manufactured abroad to comply with UL requirements and CSA certification. Ousley, Tr. 638-41, 3379-80.

533. CDC/MPI customer liaison, application and engineering support, and service and repair are based in the United States for disk drives produced offshore and in the United States. Ousley, Tr. 638-39.

534. From the third quarter of 1984 up to the present, CDC's double-sided head assemblies have been assembled offshore. Ousley, CX 820, at 7. Lafe, located in Korea, supplies all the head assemblies for CDC/MPI's double-sided disk drives. Ousley, Tr. 698.

C 535. In April 1985, CDC/MPI had parts on hand to build units
C for 1985, but has firm orders for approximately percent of this total. The
C forecast for 1985 sales is about units. Ousley, Tr. 651-52.

536. CDC/MPI attempted to develop a 3-1/2 inch, double-sided floppy disk drive, starting in 1983. CDC/MPI initially planned to produce this drive in Oklahoma City, but shelved the product in the fourth quarter of 1984 because of low market prices. Ousley, Tr. 679-81, 700.

537. A rough prototype of the 3-1/2 inch drive may have been shown to customers, but nothing was actually given to a customer. Ousley, Tr. 729.

538. The CDC/MPI 3-1/2 inch floppy disk drive was of a design that worked from a technical standpoint. Ousley, Tr. 682.

C 539. If market conditions improved and CDC/MPI
C on the 3-1/2 inch disk drive, CDC/MPI would consider resuming
the 3-1/2 inch disk drive project. Ousley, Tr. 682.

540. CDC/MPI has explored 1.6 megabyte drives, which were in the
prototype stage in the fourth quarter of 1984. This product will not be
C pursued because . Ousley, Tr. 686.

541. Production of the 1.6 megabyte drive would have been in
Oklahoma City and then most likely moved to the Far East for contract
production. Ousley, Tr. 687.

C 542. CDC/MPI has an inventory of disk drives and has a
C commitment with an offshore supplier to purchase units. If CDC/MPI
C does not purchase the units, it will incur some penalty. CDC/MPI
C would go into domestic production
C . Ousley, Tr. 709-10.

G. IBM

542A. In August 1984, IBM commenced the manufacture of 5-1/4 inch
double-sided floppy disk drives in Boulder, Colorado. IBM has continued
manufacturing such disk drives from that time until the present.
Fenstermaker, CX 859, at 1.

542B. The IBM drive (CPX 54) is covered by claims 1, 5, and 12 of the '573 patent. Comstock, Tr. 4145.

542C. The disk drives manufactured by IBM were for use in IBM's personal computer and also in other IBM small computers and display products. IBM commenced such manufacture for the purpose of supplying in substantial part its own internal needs for such disk drives in lieu of purchasing them from outside vendors. Fenstermaker, CX 859, at 1-2; Fenstermaker, Tr. 3566.

542D. IBM initially decided to manufacture double-sided floppy disk drives commencing in August 1984 because it thought it would be a profitable venture. IBM had only planned to use the drives for internal production purposes and never planned to sell the drives in the marketplace. Fenstermaker, Tr. 3567-68.

542E. The double-sided head assemblies incorporated in the IBM drives contained two heads, one fixed on the head carriage assembly and the other mounted on a hinged arm which pivoted. Fenstermaker, CX 859, at 2.

542F. The IBM Boulder double-sided 5-1/4 inch floppy disk drive manufacturing facility features fully automated subassembly and alignment operations, manual final assembly operations, and semi-automated final tests and packaging. Robots are used, including the IBM 7545 and internally developed "pick and place" robots. Fenstermaker, CX 859, at 3-4.

542G. IBM employs statistical process control techniques for quality control and quality assurance activities. Production yields are targeted at 100 percent. Fenstermaker, CX 859, at 4.

542H. During the period from August 1, 1984, through June 30, 1985, IBM produced the following quantities of floppy disk drives:

<u>Period</u>	<u>Quantity</u>
3rd Quarter 1984	7,150
4th Quarter 1984	932
1st Quarter 1985	4,168
2nd Quarter 1985	5,552

Fenstermaker, CX 859, at 2. The 7,150 drives produced in the third quarter of 1984 were full-height 5-1/4 inch double-sided drives. The drives produced thereafter were all half-height 5-1/4 inch double-sided floppy disk drives of 1.2 megabytes formatted. Fenstermaker, Tr. 3554-55; CX 866; see CX 868-69.

542I. The double-sided head assemblies used in the IBM disk drives were assembled offshore. The head assemblies were made in accordance with drawings and specifications provided by IBM. These head assemblies were procured by IBM purchasing personnel in the United States using normal procurement procedures. Once selected, the vendor's product was qualified by an onsite review of its process. Product testing was performed by domestic IBM employees. IBM has provided final test equipment for use by the vendor in some instances. Fenstermaker, CX 859, at 2-3.

542J. IBM procures the printed circuit board, two motors, and a number of minor parts for use in its head assemblies from offshore suppliers. Approximately 75 percent of the material costs of the completed printed circuit boards, the completed motors, and the completed head assembly is procured from offshore suppliers. Fenstermaker, Tr. 3563-64. Materials cost comprises 80 percent of the total production cost of the IBM disk drive. Fenstermaker, Tr. 3565.

542K. IBM Boulder will continue to manufacture 5-1/4 inch double-sided disk drives until current commitments are met, at which time IBM plans to discontinue such manufacture. IBM plans to continue to purchase complete head

assemblies from a foreign source for these drives during such time. Completion of the current commitments is expected around July 1986. Fenstermaker, CX 859, at 3.

542L. The reason IBM plans to cease the manufacture of disk drives is that management has decided that internal manufacture of 5-1/4 inch disk drives is not financially attractive and that there are adequate supplies available in the marketplace. IBM management has therefore decided to purchase such drives, other than the aforementioned commitments, from outside sources rather than to make them internally. Fenstermaker, CX 859, at 3; Fenstermaker, Tr. 3577. IBM made the decision to cease production of the disk drives in late July 1965. Fenstermaker, Tr. 3567.

542M. The decision to discontinue production of the IBM manufactured disk drives was based upon considerations of resource allocation rather than cost effectiveness of the project. Fenstermaker, Tr. 3583, 3588.

542N. Once IBM had reached economies of scale in its production of disk drives, IBM planned to produce half-height 1.2 megabyte 5-1/4 inch double-sided floppy disk drives in Boulder, Colorado, at a projected average cost of \$ to \$ for a volume exceeding units a year. The average cost for production of the full-height drive in Boulder was about \$175. Fenstermaker, Tr. 3569-71, 3581-82, 3584-86.

542P. IBM planned to achieve economies of scale by utilizing fully automated production line techniques, including use of robotics. IBM thought that the use of these techniques reduced the cost of producing the drives more than a labor intensive style operation. Fenstermaker, Tr. 3571-72.

542Q. If IBM reduced the number of disk drives produced at a cost per unit of \$ to \$ for a volume exceeding units a year, the estimated cost per unit would increase about to dollars for the first 100,000 reduction of unit production, then accelerate for each additional 100,000 unit reduction. The increase in cost per unit based on a reduction in total unit production is caused by the requirement to cover fixed costs. Fenstermaker, Tr. 3583-85.

542R. When IBM estimated that it could manufacture a volume of disk drives at a cost of \$ to \$ unit, it also investigated the market price for disk drives and concluded that it could make an acceptable profit at this price. Fenstermaker, Tr. 3586.

542S. In December 1984, IBM employed about 10 individuals who were directly involved in the manufacture and assembly of its 5-1/4 inch double-sided floppy disk drives, including assemblers and a manufacturing manager, and 37 employees indirectly involved. Now there are 32 employees directly involved in the manufacturing process and 37 employees indirectly involved. Fenstermaker, Tr. 3552; Fenstermaker, CX 859, at 3; CX 867.

542T. The head assemblies used in IBM's 5-1/4 inch full-height double-sided floppy disk drives are assembled in Hong Kong. The head assemblies used in IBM's 5-1/4 inch half-height double-sided floppy disk drive are assembled in Korea. Fenstermaker, Tr. 3562-63.

542U. The price paid by IBM for the assembly of full-height 5-1/4 inch head assemblies in Hong Kong is \$30 plus an additional \$5 burden. Fenstermaker, Tr. 3559.

552V. The price paid by IBM for the assembly of half-height 5-1/4 inch head assemblies in Korea is \$25 plus an additional \$5 burden. Fenstermaker, Tr. 3559-60.

C 542W. IBM drew up specifications for the head assemblies and left it to and to research and develop the product. Fenstermaker, Tr. 3562-63.

C 542X. and subject their head assemblies to quality control before shipping them to IBM. IBM does not subject the imported head assemblies to quality control, but receives them directly into stock. Fenstermaker, Tr. 3561-62.

H. Substitution

543. All floppy disk drives perform essentially the same storage and retrieval functions for small computers, which means that from both a technical and broad economic perspective all floppy disk drives are potential substitutes for one another. Haldi, CX 711, at 48; see CX 666, at 14.

544. The economic concept of substitutes not only includes but goes beyond technical and engineering possibilities of substitution. Not only must it be technically possible to substitute one product for another, but the purchaser must also regard the products as substitutes for each other. Haldi, CX 711, at 48.

545. Competition for the principal floppy drive configurations has come from newer floppy drives offering more capacity, smaller size, or lower price. CX 679, at SUM-16.

546. Disk drives of different diameters compete most intensely at the early design or product planning stage. At other times, competition tends to be limited to disk drives having the same diameter. Haldi, CX 711, at 52; see Sollman, Tr. 211-12; Abraham, Tr. 1087-89; Ousley, Tr. 718.

547. The following table shows United States sales of disk drives by size from 1980 to 1983, and forecasted shipments for 1984 and 1985:

Shipments of Floppy Disk Drives to United States
Destinations by All Manufacturers, Domestic and Foreign

(Thousands of Units)

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984(E)</u>	<u>1985(E)</u>
ADD FDD'S	1,258	2,336	3,394	8,169	11,662	15,138
8-INCH						
Single-Side	464	517	449	216	146	73
Two Sides	<u>221</u>	<u>269</u>	<u>401</u>	<u>455</u>	<u>414</u>	<u>346</u>
Total	<u>685</u>	<u>786</u>	<u>850</u>	<u>672</u>	<u>560</u>	<u>419</u>
5.25 INCH						
Single-Side	444	1,287	1,731	3,732	3,840	3,839
Two Sides	<u>129</u>	<u>264</u>	<u>804</u>	<u>3,496</u>	<u>6,198</u>	<u>8,457</u>
Total	<u>573</u>	<u>1,550</u>	<u>2,535</u>	<u>7,228</u>	<u>10,038</u>	<u>12,296</u>
MICRO-FLOPPIES	--	--	9	269	1,064	2,423

Haldi, CX 711, at 27.

548. In 1976, the "state of the art" was an 8 inch floppy disk drive incorporated in the Wang desk top computer system. Sollman, Tr. 44.

549. The first shipment of the 5-1/4 inch single-sided disk drive occurred in August 1976. Sollman, Tr. 53-54.

550. At first, sales of the 5-1/4 inch disk drive were slow since IBM was using 8 inch disk drives. Sollman, Tr. 53-54.

551. With the explosion of the personal computer market in 1977-1978, the 5-1/4 inch disk drive began to sell. Sollman, Tr. 54.

552. In both 1980 and 1981, sales of 8 inch double-sided disk drives outnumbered sales of 5-1/4 inch double-sided disk drives in the United States. CX 711, at 27.

553. In 1982, a Tandon customer asked for a quote for both 5-1/4 inch and 8 inch disk drives, and similar request for quotes have subsequently occurred. Abraham, Tr. 1126-27.

554. Tandon seeks customers for the TM 848, including customers that plan to go out of the 8 inch drive computer because of Shugart's exit from the 8 inch disk drive market. The 8 inch drive business is estimated at several hundred thousand drives per year, and Tandon expects to compete with Mitsubishi and one or two other Japanese companies for that business. Abraham, Tr. 1127-30.

555. The market for double-sided 8 inch disk drives is flat. Although there is no new business for the 8 inch drive, there are continuing opportunities with established customers. The marketing window for 8 inch disk drives is closing due in part to the increase in demand for smaller disk drives. This shift in consumer preference is a long term factor. Abraham, Tr. 1068-69; see MRX 51, at Bates No. 530745.

556. Dr. Haldi did not include 8 inch disk drives in his analysis because he believed that only 3-1/2 inch and 5-1/4 inch disk drives were being imported, and because the 8 inch disk drive is gradually falling out of the marketplace as an important factor. Haldi was aware of no new computer products that are incorporating the 8 inch disk drive. Haldi, Tr. 1232.

557. The 8 inch disk drive market has declined because of the wealth of software available for 5-1/4 inch and 3-1/2 inch disk drives, and the use by IBM and Apple of 5-1/4 and 3-1/2 inch formats. Haldi, Tr. 1237-38.

558. OEMs initially considered all sizes of drives when designing a new product. For example, in 1982, OEMs considered whether to use an 8 inch drive or a smaller drive, but many settled on a 5-1/4 inch disk drive. Abraham, Tr. 1088.

559. Tandon offers its full repertoire of disk drives, including the 8 inch disk drive, to customers designing a new computer system. However, Mr. Abraham could not remember the last time a new computer system used an 8 inch drive. Few customers currently ask for and consider the 8 inch drive for a new computer system. Abraham, Tr. 1130-32.

560. Only in 1978 or 1979 did the smaller size of the disk drive become a critical factor, and this was due to IBM's initial use of a 5-1/4 inch disk drive at that time. Sollman, Tr. 205-06.

561. When the market initially began to expand for 5-1/4 inch disk drives, there was a 5-1/4 inch software shortage. Langer, Tr. 2442.

562. Mr. Sollman first saw a single-sided 3-1/2 inch disk drive (the "micro-floppy") in June 1981 at the NCC show. It was produced by Sony. Sollman, Tr. 114.

563. Disk/Trend Report reported the first United States shipment of micro-floppy disk drives in 1982, when 9,000 units were sold. In 1983, 269,000 units were sold, and Disk/Trend's estimate for 1984 sales is 1,064,000 units. CX 711, at 27.

564. In 1983, only 3.8 percent of total sales of 3-1/2 inch disk drives were double-sided. In 1984, this percentage was estimated at 23.9 percent. CX 679, at DT15-9.

565. Initially, there was no standard size for micro-floppy disk drives, and diameters ranged from 3.4 inches to 3.9 inches. The time frame was April 1982. Sollman, Tr. 116.

566. An industry standards committee was formed in approximately May 1982, and a standard micro-floppy disk size (3-1/2 inches) was agreed to a year later. Sollman, Tr. 118.

567. Shugart introduced a single-sided 3-1/2 inch floppy disk drive in April 1983 and a double-sided 3-1/2 inch disk drive in October 1983. Sollman, Tr. 121.

568. In 1983, Shugart sold evaluation units of the double-sided 3-1/2 inch disk drive to approximately 15 to 20 accounts. Sollman, Tr. 123-24.

569. Sony began to offer in the United States its Slimline double-sided micro-floppy disk drive in the third quarter of 1984. CX 208, at 3.

570. The factors most critical for affecting interchangeability of disk drives are: (1) interchangeability of media from one drive to another; (2) physical interchangeability of one drive for another; (3) whether different disk drives use the same set of signals; and (4) whether different disk drives use the same set of connectors with the same output. Other less critical factors include the interchangeability of spare parts, the timing of input signals, and power usage differentials. Sollman, Tr. 262-63. Other types of compatibility are the disk drive's rotational speed and its track-to-track access time. Sollman, Tr. 22.

571. The major incompatibility between disk drives is in the size (diameter) of the diskette (media) which the disk drives use. Abraham, Tr. 1143-46.

572. A 5-1/4 inch disk cannot be placed in an 8 inch drive. Abraham, Tr. 1090.

573. In terms of media interchange compatibility, a 3-1/2 inch double-sided disk drive cannot be made compatible with a 5-1/4 inch double-sided disk drive. Sollman, Tr. 219.

574. Diskettes are interchangeable between drives of different makes if the diameters of the drives are the same. Abraham, Tr. 1018.

575. In order for data stored on a 5-1/4 inch disk to be transferred to a 3-1/2 inch disk, the data would have to be regenerated, which is a laborious process. Abraham, Tr. 1091-92.

576. Electrical interfacing between 3-1/2 inch and 5-1/4 inch drives is the same for those devices that are quoted as being compatible. Abraham, Tr. 1145.

577. Some Japanese 3-1/2 inch disk drive manufacturers advertise their product as being compatible with 5-1/4 inch disk drives. CX 247.

578. The Sony OA-D32W is a 3-1/2 inch double-sided floppy disk drive that is interface compatible with an 8 inch disk drive. Mergentime, CX 252, at 78; CX 205, at 750569.

579. The significance of interface compatibility between an 8 inch and a 3-1/2 inch drive is that less redesigning would be required to convert an 8 inch computer system into a 3-1/2 inch computer system. Mergentime, CX 252, at 79-80.

580. Mr. Abraham of Tandon is not aware of a situation where an OEM has replaced an 8 inch drive with a 3-1/2 inch drive. An OEM would unlikely replace a TM 848 (8 inch drive) or TM 100 (5-1/4 inch drive) with a TM 304 or TM 306 (3-1/2 inch drives) in an existing system because of diskette (media) incompatibility. Abraham, Tr. 1016-18.

581. Competition between 3-1/2 inch and 5-1/4 inch drives takes place primarily in the procurement of new products. Ousley, Tr. 718.

582. If a new product is a small desk top or portable computer, customers want the smallest, and smallest is best in many cases. OEMs would want to evaluate 3-1/2 inch products for their next generation of machines, even though the current generation machine may be using a 5-1/4 inch disk drive. Ousley, Tr. 718.

583. An OEM could potentially substitute a 3-1/2 inch drive in the space formerly occupied by a 5-1/4 inch drive the way OEMs replaced full-height 5-1/4 inch drives with half-height 5-1/4 inch drives, that is, by keeping the larger bezel. Ousley, Tr. 718-19.

584. In an existing product, the probability of substitution of 3-1/2 inch drives for 5-1/4 inch drives is less than the substitution of half-height for full-height 5-1/4 inch drives, because the 3-1/2 inch drive differs more in terms of length and width. However, if the 3-1/2 inch disk drive is priced lower than the 5-1/4 inch disk drive, this substitution may be made. Ousley, Tr. 719-20.

585. Media incompatibility complicates the substitutability issue between 3-1/2 inch and 5-1/4 inch disk drives. Ousley, Tr. 720-21.

586. Mr. Ousley was not aware of any cases where CDC had bid on an OEM contract with a 5-1/4 inch disk drive and lost the business to a 3-1/2 inch disk drive. Ousley, Tr. 721.

587. According to Mr. Langer of SONAM, the change from a 5-1/4 inch disk drive to a 3-1/2 inch disk drive would be difficult because it would involve substantial design changes, including size, wiring, and plugs. Langer, Tr. 2416.

588. For several years, all 8 inch and 5-1/4 inch full-height disk drives were 3-1/2 inches high. In 1981, Tandon introduced its first 8 inch disk drive which was only 1-3/4 inches high, the half-height disk drive. Half-height drives are expected to replace full-height drives in many of the most widely distributed microcomputer products within the next two years. CX 670, at DT13-7, DT13-11; CX 679, at DT14-4; Haldi, CX 711, at 18A-18B.

589. In many cases, because of a lower price, customers switched from full-height drives to half-height drives, keeping the full-height bezel. Ousley, Tr. 719.

589A. The general decline in full-height disk drive prices resulted from price pressures created by half-height drives competing against full-height drives. Ousley, Tr. 3372.

590. TEAC's half-height disk drives competed against full-height disk drives for sales to

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Brehme, CX 48, at 185-90.

591. In the Spring 1982 NCC show, only Shugart showed a half-height product, which it had developed with Matsushita. Sollman, Tr. 87.

592. In the Fall 1982 Comdex show, half-height disk drives were shown by Tandon, Shugart, and CDC, as well as by 12 to 15 Japanese suppliers. Sollman, Tr. 87.

593. In January 1983, IBM had discontinued purchasing full-height disk drives from Tandon and agreed to purchase newer products such as fast-access Winchester disk drives and half-height 5-1/4 inch flexible disk drives for use in microcomputer products. CX 667, at 11.

593A. Based upon recent negotiations with IBM, Tandon estimates that it will produce approximately 40,000 TM 100-2 double-sided disk drives for IBM for at least the next several months from August 1985. Huenemeier, CX 835, at 5.

594. There exists a rapid and broad-based industry trend toward half-height 5-1/4 inch flexible disk drives and higher capacity Winchester disk drives. This trend has resulted in significant and immediate price erosion in earlier models of full-height flexible disk drives. CX 667, at 12.

595. The half-height disk drive allowed miniaturization and at the same time took advantage of the availability of 5-1/4 inch software. Langer, Tr. 2415.

596. The following table shows sales of full-height and half-height double-sided disk drives, by disk drive diameter, for 1980 through 1983, and forecasted sales for 1984 and 1985:

Shipments of Floppy Disk Drives World-Wide,
By Diameter and Height

(in Thousands of Units)

	<u>1982</u>	<u>1983</u>	<u>1984 (E)</u>	<u>1985 (E)</u>
8-INCH DRIVE				
full-height	286.2	241.9	192.4	142.6
half-height	195.3	436.1	491.8	454.9
5-1/4 INCH				
full-height	955.1	2,572.5	2,732.8	2,252.8
half-height	314.3	3,107.3	6,189.2	10,132.1

CX 679, at DT12-10, DT14-13; CX 678, at DT11-10, DT13-13.

596A. With respect to new computer systems, Compaq has switched from a 5-1/4 inch disk drive to a 3-1/2 inch disk drive, and IBM has indicated that it will have a 3-1/2 inch disk drive in its new generation PC. Ousley, Tr. 721.

597. The 3-1/2 inch disk drive is typically sold in a desk top or portable computer, but this market has been disappointing in 1985. Software availability has been a problem for the 3-1/2 inch computer market--there are currently about 170-175 software programs available on 3-1/2 inch diskettes, whereas there are about 10,000 software programs available on 5-1/4 inch diskettes. Langer, Tr. 2409-12.

598. According to Mr. Langer of SONAM, it would take nine years for availability of 3-1/2 inch software to match that of 5-1/2 inch software, but this time frame depends on IBM's decision with respect to introduction of a 3-1/2 inch computer, as well as 3-1/2 inch software development. Langer, Tr. 2461-63.

599. The effect of IBM not having introduced a 3-1/2 inch drive computer is that there is practically no market for 3-1/2 inch disk drives. Langer, Tr. 2418-19.

600. If IBM enters the market with a 3-1/2 inch computer, it is likely that other OEMs would follow with 3-1/2 inch machines. Langer, Tr. 2442.

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601. Sony's 3-1/2 inch disk drive has a

. Langer, Tr. 2425-29.

602. According to Mr. Sollman, disk drives have become more like commodity items, where pricing plays a greater role than it did five years ago. Sollman, Tr. 210.

603. Although evaluation of a disk drive by an OEM normally takes from three to six months, if the OEM is using a standard type drive, evaluation may not even be necessary. Sollman, Tr. 249-50.

604. A "marketing window" exists when an OEM is in the process of designing a new computer system. The window is open when vendors are being considered and when drives are being evaluated and tested. Once a vendor is chosen, the marketing window is generally closed. Abraham, Tr. 1056-58.

605. Once a vendor is chosen, it is more difficult for another vendor to compete successfully for future business because:

- (1) OEMs spend a substantial amount of time and effort to evaluate a vendor's product from technical and marketing standpoints.
- (2) The effort and expense needed to change the product support, including training of personnel and customers, sales manuals, software, and spare parts, substantially prohibits an OEM from changing vendors.
- (3) Economies of scale suggests that it is in the interest of the OEM to enter a long term relationship with a vendor because the price is generally lower for larger quantities purchased.
- (4) Vendor loyalty frequently influences an OEM to maintain a relationship with a particular vendor whose service has been satisfactory.

Abraham, CX 714, at 3-4.

606. For a customer to switch suppliers, the economic reasons for switching must be stronger than the four reasons (FF 605) a customer has not to switch. Abraham, Tr. 1106-07.

607. The marketing window would open if the selected vendor could not deliver the drives. Reasons for not supplying a drive to a customer would be non-payment by the customer, or customer dissatisfaction with the vendor caused by quality problems with the disk drives or delivery problems by the vendor. Abraham, Tr. 1060-62.

608. The marketing window for double-sided 3-1/2 inch disk drives is currently wide open. Abraham, Tr. 1067.

609. The marketing window for double-sided, higher capacity 5-1/4 inch disk drives is wide open with respect to mid to late 1985. Abraham, Tr. 1067.

610. The computer systems sold by OEMs are evolving rapidly, and to remain competitive, an OEM producer must bring into the market a new system with the latest advances as soon as possible, or risk falling behind. Abraham, Tr. 1109-10.

611. For a disk drive to be considered a viable economic substitute and a second supply source, it must meet the technical specifications of the primary source disk drive as well as look like the primary source drive. Haldi, CX 711, at 52.

611A. Costs associated with switching disk drive suppliers include reevaluating disk drives, restocking inventory, and changing product support and software. Abraham, Tr. 1103; Abraham, CX 714, at 3; see Tjon, Tr. 2033.

611B. Although OEMs generally cannot readily interchange floppy disk drives from different manufacturers during production, OEMs can readily substitute drives of other manufacturers during the design and evaluation phases of producing a new computer model. Haldi, Tr. 1304-05; Haldi, CX 711, at 75-86.

VI. ECONOMIC AND EFFICIENT OPERATION

A. Tandon--General

612. In 1982, Tandon became the largest independent (i.e., noncaptive) manufacturer of floppy disk drives sold to OEMs. Haldi, CX 711, at 39.

613. In early 1985, Tandon was the world's largest manufacturer in the market of random access disk drives for micro-computer systems. SRX 172, Tandon Response to Admission No. 86 (Feb. 12, 1985).

614. In early 1985, Tandon was the world's largest producer in the market for floppy disk drives. SRX 172, Tandon Response to Admission No. 87 (Feb. 12, 1985).

615. Tandon's net income and growth rate of net income are as follows:

	<u>Fiscal Year</u>	<u>Net Income</u>	<u>% Increase over Previous Year</u>
C	1981	\$	%
C	1982	\$	%
C	1983	\$	%
C	1984	\$	%

Haldi, CX 711, at 39.

615A. After being initially funded by its founders and private investors, Tandon received proceeds of public sales of securities amounting to:

	<u>Date</u>	<u>Amount</u>
C	2/81	\$
C	11/81	
C	11/82	

Mitchell, CX 836, at 13.

C 615B.

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. Huenemeier, Tr. 3636.

C

615C. Tandon on its 8 inch double-sided floppy disk drive. Huenemeier, Tr. 3636-37.

C

615D. In 1984, Tandon on its 5-1/4 inch full-height disk drives. Huenemeier, Tr. 3637.

C

615E. In 1983 and 1984, Tandon in its 5-1/4 inch half-height disk drives. In 1983, the half-height 5 1/4 inch product would have been the TM 50 and TM 55 models, which were sold in small quantities as an introduction of the product line. The new half-height 5-1/4 inch drives, the TM 65s are . Huenemeier, Tr. 3636-38.

616. "Tandon's product philosophy of maximum vertical integration has paid off handsomely, by providing some of the lowest costs in the industry and a high level of control over the firm's ability to grow with demand." CX 678, at MFGR-11 (Dec. 1983).

617. For full-height disk drives, Tandon had obtained and retained major accounts for companies with advanced technological knowledge and high performance requirements, including IBM, AT&T, and Tandy. For example, in fiscal year 1984, IBM accounted for approximately 58 percent of Tandon's net sales. IBM has followed the practice of placing orders providing for deliveries over periods not exceeding six months. As of August 1985, Tandon

C was not selling production quantities of double-sided disk drives to .
Haldi, CX 711, at 39; CX 666, at 8; Tandon Response to Mitsubishi Requests for
Admissions, Response No. 126.

618. Tandon tests all raw materials and components prior to
manufacture and runs mechanical, integrity, and reliability tests on completed
floppy disk drives. Haldi, CX 711, at 43.

619. Tandon's research and development expenditures as a percentage
of net sales for the last five fiscal years are as follows: FY 1980 - 4.2%;
FY 1981 - 5.3%; FY 1982 - 4.0%; FY 1983 - 4.5%; and FY 1984 - 4.1%. CX 666,
at 20; Haldi, CX 711, at 43.

620. Approximately \$7.5 million of the \$16.3 million spent by Tandon
in fiscal year 1984 for research and development is attributable to research
and development on floppy disk drives. Haldi, Tr. 1223; see CX 666, at 29.

C 621. Tandon has expended approximately \$ to \$ on the
research and development of the TM 300 series floppy disk drive. Huenemeier,
Tr. 294.

C 622. For fiscal year 1982 through fiscal year 1984, Tandon spent
\$ on marketing and sales for all its products. Haldi, CX 711, at
43-44.

623. Since 1982, Tandon has participated in the following major
industry expositions: June 1982 - National Computer Conference (NCC);
September 1982 - Peripheral Equipment Expo; November 1982 - Comdex; April
1983 - Comdex; May 1983 - NCC; November 1983 - Comdex; July 1984 - NCC; and
November 1984 - Comdex. Haldi, CX 711, at 44.

624. Tandon employees are eligible for disability insurance under the state plan administered by the State of California. CX 670.

625. Tandon provides its full-time employees with Term Life Insurance equal to one year's adjusted pay, Dental Expense Insurance (no cost for employee but contribution required for dependent coverage), and Accidental Death and Dismemberment Insurance. CX 671.

626. Tandon provides its full-time employees the opportunity to join the Performance Plus Savings Plan whereby they may have up to six percent of their pre-tax wages deducted from their paychecks and invested in the plan. Such investments are matched by Tandon (100 percent up to four percent of pre-tax wages, then 50 percent thereafter to six percent) and will vest with the employee at a rate of 25 percent after two years of service, 50 percent after three years, 75 percent after four years, and 100 percent after five years. CX 672.

627. Tandon employees have the option of participating in the following health care plans: Kaiser Foundation Health Plan; INA Health Plan of California; and Maxicare Health Plan. CX 673; CX 674; CX 675.

627A. Tandon provides education expense reimbursement programs for all employees. Huenemeier, Tr. 3692.

B. Tandon--Business Structure

628. Tandon contracts with various companies in India for the assembly or purchase of components used by Tandon in its final products or for the purchase of complete half-height 48 TPI 5-1/4 inch flexible disk drives. CX 666, at 11.

629. The Indian companies include Tandon Magnetics (India) Pvt., Ltd. (TMI), which assembles recording heads and certain labor-intensive disk drive sub-assemblies; Tandon Motors Pvt., Ltd. (TMM), which manufactures precision stepper motors used in Tandon's flexible and rigid disk drives; Barnala Electronics (Barnala), which manufactures harness assemblies for use in Tandon's disk drives; Tancom Electronics (Tancom), which manufactures rigid disk drive recording heads; and Eastern Peripherals Pvt., Ltd. (Eastern Peripherals), which manufactures completed half-height 48 TPI 5-1/4 inch flexible disk drives. CX 666, at 11.

629A. Of the Indian companies, only Eastern Peripherals, Inc. assembles Tandon's 5-1/4 inch half-height disk drives. MPRX 54C, at 34.

630. Tandon believes that the termination of its present relationship with any of the Indian companies would result in increased costs of procurement or manufacture of the component parts and finished drives they supply. CX 666, at 13.

631. The contract assembly and purchase transactions between Tandon and the Indian companies are coordinated and effected through Tandon Associates, Inc., which acts on behalf of the various Indian companies. Tandon Associates directly invoices Tandon Corporation for the products and services of the Indian companies at prices reflecting a mark-up for the services of Tandon Associates. CX 666, at 12.

631A. Tandon Associates coordinates all the movement of material from the United States to India and the material back from India to the United States, coordinates the technical interface between Tandon Corporation and Eastern Peripheral, and pays all the duties and freight for products imported from India. J. Tandon Dep., MRPX 54C, at 39.

C 631B. The typical sequence
C begins by Tandon
C then issues its own purchase order for the
C drives . J. Tandon Dep., MRPX 54C, at 69.

C 631C. After receiving a
C issues purchase orders to
C for whatever components it will not procure directly. then
C typically issues its purchase order for these parts to Tandon. J. Tandon
C Dep., MRPX 54C, at 69-70.

C 631D.
C
C
C
C
C . J. Tandon Dep., MRPX
C 54C, at 47-48, 51, 54, 70-72, 81, 83.

C 631E. Fewer than Tandon employees maintain Tandon's purchase
C parts book. Tandon, Response to Mitsubishi Requests for Admissions, No. 59.

C 631F. When itself procures
C , it imposes a service charge of
C . This charge is included in the finished
C disk drive price
C . J. Tandon Dep., MRPX 54C, at 81-82.

C 631G.
C
C . J. Tandon Dep.,
C MRPX 54C, at 97.

632. Tandon Associates is separate from Tandon Corporation and provides the service of being the representative for all of the contract facilities in India. Tandon Corporation personnel therefore only deal with one entity in the United States, and do not coordinate the activities of the separate companies in India. Huenemeier, Tr. 442.

632A. The principal purpose of purchasing disk drives through Tandon Associates is

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J. Tandon Dep., MPRX 54C, at 38-39.

633. Sirjang Lal Tandon is the President, and a director and principal shareholder, of Tandon Corporation. CX 666, at 12.

634. Tandon Associates is a California corporation owned by Jawahar Lal Tandon, a brother of Sirjang Lal Tandon. CX 666, at 12.

635. All of the Indian companies are owned and controlled directly or indirectly by the family of Manohar Lal Tandon, who is a brother of Sirjang Lal Tandon. CX 666, at 12.

636. Sirjang Lal Tandon is not a shareholder, officer, or director of Tandon Associates or any of the Indian companies. CX 666, at 12.

C. Tandon--Quality and Delivery

637. Quality and product support are important factors in a company's ability to sell disk drives and maintain an OEM as a customer. Haldi, Tr. 1220; Huenemeier, Tr. 734.

638. Since the marketplace for computers is very competitive, quality problems with computers can harm an OEMs business. Abraham, Tr. 1107.

639. Quality or delivery problems can overcome any existing advantage a disk drive producer has by virtue of being the existing OEM supplier and cause the OEM to seek another supplier. Abraham, Tr. 1029, 1061-62, 1071-72.

639A. The relative percentage of product returned by customers affects that customer's opinion of a floppy disk drive supplier. Foster, Tr. 4857-58.

639B. According to Dr. Malmgren, some customers that left Tandon due to quality problems will not go back to Tandon. Malmgren, Tr. 5044-45.

640. It is vital to an OEM that the supplier of disk drives keep to the delivery schedule, otherwise the OEM may have difficulty remaining competitive. Abraham, Tr. 1109-10.

640A. Tandon commenced production of the TM 50, a half-height 5-1/4 inch floppy disk drive in the fall of 1982. The TM 50 is a low-cost, low-performance, belt-driven drive intended for the home computer market. The TM 55 is a high performance belt-driven disk drive aimed at the higher performance personal computer market. Abraham, MRX 117C, at 1-2.

640B. During the fall of 1982, Tandon experienced production problems with the TM 50 and TM 55. In view of these problems, Tandon decided to initiate a total new design incorporating a direct-drive motor to reduce cost and improve the half-height product in its manufacturability. Abraham, MRX 117C, at 2.

640C. Tandon became aware of the need for a half-height direct-drive 5-1/4 inch disk drive around September or October of 1982. At that time and continuing into 1983, the window of opportunity was wide open for that product. Abraham Dep., MRPX 49C, at 110, 112-13; Abraham, MRX 117C, at 11.

640D. The customers that did not state a strong preference for direct-drive floppy disk drives were in the minority in September 1982. By December 1982, even these customers insisted on direct-drive floppy disk drives. Abraham Dep., MRPX 49C, at 113; see MRX 59, Tandon's Responses to Request for Admissions, No. 42 at 16.

640E. Tandon expected to have a new direct-drive available for production in February or March of 1983. Abraham, MRX 117C, at 2.

640F. Tandon lost a year in lead time in production of its half-height direct-drive floppy disk drives. The Tandon TM 55A direct-drive was expected to go into production in May/June 1983, but the replacement direct-drive half-height, the TM 65, did not start into large scale production until mid to late 1984. Barmache, MRX 121C, at 32.

640G. The Tandon TM 55D direct-drive was available in September 1983. However, it was not available in any substantial quantity and had a very limited ability to penetrate the market. Abraham Dep., MRPX 49C, Vol. 3, at 127.

640H. During 1982, 1983, and into 1984, Tandon was unable to deliver specified quantities of functioning half-height drives to many of its existing customers due to production problems. As a result, Tandon suffered many order cancellations. Tandon attributes \$ million in losses to its inability to deliver specified quantities of functioning half-height disk drives to

C customers. Tandon attributed a loss of \$ million in prospective business opportunities to its inability to deliver functioning disk drives to customers on a timely basis. Abraham, MRX 117C, at 4-6, 8-9; see MRX 48C, at 27701, 26092; MRX 49C, at 441076, 41031, 41095, 40968, 40970-71, 40974, 41041-43, 41039, 41103, 41109.

640I. The marketing window for half-height floppy disk drives began to close in 1983 and was substantially closed by mid-1984, if not sooner. Abraham, MRX 117C, at 11.

640J. Prior to the introduction of the TM 65, Tandon tried to retain customers with its TM 50 and TM 55 disk drives and the promise of a future improved product. Because the TM 55 did not work adequately and the TM 65 was far behind in development, some customers were lost, including

C . J. Tandon Dep., MPRX 53C, at 426-27.

640K. By August 1984, when the TM 65 was available to the customer, approximately to percent of the original customer base for direct-drive half-height drives that Tandon had perceived in September 1982 was available. However, due to possibilities of being a second source or a replacement source, the customer base available to Tandon in the 12 months following August 1984 was probably in excess of this to percent estimate. Abraham Dep., MRPX 49C, Vol. 3, at 128-31.

640L. The TM 65 was not selected by several OEM manufacturers because by the time it was available, competing half-height drives had already been evaluated and qualified and were being procured by such manufacturers. MRX 59, Tandon's Responses to Request for Admissions, No. 39, at 15.

640M. The inability of Tandon to deliver commercial quantities of functioning half-height drives during 1982 and into 1984 seriously damaged Tandon's reputation. Abraham, MRX 117C, at 9.

640N. Tandon sold 16,904 double-sided half-height 5-1/4 inch disk drives in 1984. Huenemeier, CX 835, at 3.

640P. During the period October 1984 through June 1985, Tandon shipped 13,315 TM 65-2 units (excluding shipments of 2,950 units to Tandon GmbH (West Germany) which have not been sold), of which 392 or less than 3 percent have been returned for repair through July 31, 1985. Huenemeier, CX 835, at 2.

640Q. As of December 1984, Tandon believed that "future" sales of the TM 65 had been lost to Tandy, Convergent Technologies, Olivetti, and Compaq, because of these customers' perception that Tandon would not be able to respond quickly to production changes or fast start-up production rates. This perception was based on the absence of demonstrated production capacity at Tandon, due to the late market entry of the TM 65 relative to other competitors. Abraham, MRPX 49C, Vol. III, 99-101.

640R. Tandon's poor image for quality has hampered its efforts to sell and qualify the TM 65 in 1984-1985 for sales to Exxon Office Systems, Telex Computer Products, Scientific MicroSystems, Heath/Zenith, Apollo Computer, and Sperry Univac. MRX 105C, at 53504; MRX 49C, at 41097, 41062; MRX 48C, at 41702, 41720-22, 26481; MRX 103C, at 52719.

640S. AT&T is considering Tandon's double-sided floppy disk drive. In early 1985, AT&T visited the Bombay facility of Tandon's contract assembler, Eastern Peripherals, and delivered to Tandon its evaluation report as a result of that visit. Huenemeier, Tr. 5190-92; CX 766.

C 640T. The facility was rated "adequate" in nine
C categories by , with ratings of "adequate with recommended change" or
"marginal" in three categories. The one marginal rating related to the
C documentation of quality control. The facility received an
overall rating of adequate. CX 766, at 3.

C 640U. According to Mr. Huenemeier, has a three rating system,
with "adequate" being the highest, "marginal" being the second highest, and
"inadequate" or "unacceptable" being the lowest rating. Huenemeier, Tr. 5193.

640V. According to Dr. Malmgren, producers who have gone to a high
degree of automation, such as Japan, and those heading in that direction seem
to be having better results with quality than those who rely on heavy labor.
Malmgren Dep., CPX 56, at 90-92; Malmgren, Tr. at 5053-54.

640W. According to Alan Shugart, founder of Shugart Associates,
keeping production in the United States by automating is not feasible because
product life cycles are too short to justify investing in the equipment.
TRX 105-D, at 44.

640X. Lower labor costs are one reason for manufacturing abroad. But
lower component prices abroad are more important, since there is only about
half an hour of labor involved in assembling each drive. TRX 105-E, at 119.

641. Convergent Technologies buys components, disk drives, and high
technology things, in order to integrate them into computer systems for resale
to OEMs. Tjon, Tr. 2026.

642. In 1982, Convergent designed a new computer system, the "next
generation" or N-GEN. Tandon was originally intended to source the
double-sided floppy disk drives for this system because of the price and
availability of the drive. Tjon, Tr. 2027-28.

643. Convergent ultimately did not use Tandon drives because it found that the Tandon drive did not meet the requirements and allow Convergent to ship the quality levels it wanted. Some of the problems Convergent had with Tandon's drives originated with Convergent rather than Tandon. On August 21, 1985, Convergent was not purchasing commercial quantities or evaluating Tandon double-sided disk drives. Tjon, Tr. 2037-39; Tandon Responses to Mitsubishi Requests for Admissions Nos. 135-36.

644. Kaypro specializes in test instrumentation. Anjard, Tr. 1977. In the fall of 1982, Kaypro developed a transportable computer called the Kaypro-2. It had two floppy drives that were 5-1/4 inch single-sided, 48 TPI. Anjard, Tr. 1978.

645. Kaypro purchased the drives for the Kaypro-2 and the Kaypro-4, which used a full-height 5-1/4 inch double-sided floppy disk drive, from Tandon primarily because of availability and price. Anjard, Tr. 1978.

646. Kaypro began encountering field problems with the Tandon drives. It received complaints from end users as well as dealers. Anjard, Tr. 1979. The complaints received concerned the failure of the drive to function when the disk is put into the drive and general read-write faults. Anjard, Tr. 1979-80. Tandon advised Kaypro that the problems arose because Kaypro did not know how to interface the drive in the computer. Anjard, Tr. 1981.

647. In the spring of 1983, Kaypro generated a new computer, the Kaypro-10. The new system was to have a half-height double-sided drive. Kaypro decided to use a Tandon drive primarily because of cost and availability. Anjard, Tr. 1982-83. Tandon assured Kaypro that it could meet Kaypro's 2.5 percent maximum reject rate. Anjard, Tr. 1985.

648. In the summer of 1983, Kaypro experienced major reject problems with the Tandon drives. Kaypro claims a fallout rate of 60 percent going into production. In addition, Kaypro received reports of a 50 percent failure in the field. Anjard, Tr. 1986, 1990. Kaypro's dealers informed Kaypro that if it continued to supply Tandon drives, their affiliation with Kaypro would be terminated. Anjard, Tr. 1991.

649. In January 1984, Kaypro terminated its purchases from Tandon. Anjard, Tr. 1992. In April 1985, Kaypro had four suppliers: Toshiba; Shugart (Matsushita); Mitsubishi; and Epson. Anjard, Tr. 1993. The total reject rate for these vendors is under two percent. As of August 21, 1985, Kaypro was not purchasing commercial quantities or evaluating Tandon double-sided disk drives. Anjard, Tr. 2001; Tandon Responses to Mitsubishi Requests for Admissions Nos. 120-21.

650. Environmental conditions were endemic at Kaypro. It failed to develop clean areas. Anjard, Tr. 2002. Also, one or two million dollars of inventory was lost and never accounted for because of lack of an in-out control system. Anjard, Tr. 2004.

651. An article in the July 9, 1984, edition of the Computer Systems News quotes Donald Sinsabaugh, managing director of Swergold, Chefitz & Sinsabaugh, as follows:

"The company [Tandon] has a lot of work to do over the next 12 months to recover from its problems. . . . Number one, they are suffering a loss of market share in floppies to the Japanese, and number two, they have had manufacturing problems that have led to a lower-quality product. The quality issue is important because it has led, in some cases, to a return of product to Tandon and the buildup of excessively high inventory levels.

They have got to solve those major problems before they can be a long-term, viable competitor."

MRX 26, at 501254.

652. An article in the July 9, 1984, edition of the Computer Systems News quotes Michael Murphy of the California Technology Stock Letter as follows:

"At some point, Japanese vendors will come in with low-cost, high-quality products Tandon has the low cost; they have to get their quality up. Their increasing use of overseas manufacturing is a big plus for them, because they save a bundle of money sourcing components offshore, and they can afford to throw a whole lot of bodies at improving quality, if they need to. They paid all their dues in terms of design work and manufacturing from a cost side, and now they'll probably get the quality improving from here."

MRX 26, at 501254.

653. A Tandon memo dated January 10, 1984, summarizes discussions held between Tandon and Tandy Advanced. The discussion centered on the TM 50-1 and TM 55-2 floppy disk drives. "The major problem here is that Tandon has lost credibility because we have continued to fall far short of the promised shipments. Tandy has indicated that if we are able to ship in the area of 15,000 drives per month, we could restore that credibility."

MRX 25.3, at 027814; TRX 39B.

654.-655. Intentionally Left Blank.

656. A Tandon Customer Contact Report with Lanier Business Products Inc. for February 24, 1984, indicated that in the past, "

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." The report concluded that Tandon could possibly sell Lanier the TM 252. As of August 21, 1985,

MRX 25.2, at 026307; Tandon Responses to Mitsubishi Requests for Admissions Nos. 138-39.

661. A Tandon memo dated June 4, 1984, summarizes discussions held between Tandon and Sperry Univac. The memo indicates that Sperry Univac would not discuss the TM 65-4, TM 848E-2, TM 503, and TM 703

. Sperry Univac did discuss Tandon's TM 252. MRX 25.3, at 026481; TRX 43C.

662. A Tandon Customer Contact Report with Engram Assoc. for June 28, 1984, details with the TM 848-2. TRX 43B.

663. A Tandon Customer Contact Report with S.C.I. for September 4, 1984, indicated that S.C.I.

. Qume developed problems, so S.C.I. went to Mitsubishi. "

. MRX 25.2, at 026472; Tandon Responses to Mitsubishi Requests for Admissions Nos. 103-04.

663A. Mr. Sellers experienced quality and delivery problems with Tandon's double-sided floppy disk drives during 1982-1984 while general business manager of Tandy Business Products. Problems were encountered with head alignment, basic mechanics, and severe noise. Despite these problems, Tandy had a lot of allegiance to Tandon due to its price competitiveness and the perception that Tandon was working hard to solve the problems. Sellers, Tr. 4940-47.

663B. In the spring of 1983, Tandy solicited bids for 5-1/4 inch half-height double-sided disk drives to be used in its Tandy 2000 computer. Tandy's engineering department recommended three suppliers, including Mitsubishi and TEAC. Tandon's drive was not included on the list because it did not meet certain design parameters. However, Tandon got the order based on its representations that it could fix the design problems over time, one problem being that the drive was belt-driven. Tandon's disk drive was lower priced than the TEAC or Mitsubishi drives. Sellers, Tr. 4947-50.

663C. Tandy had problems with interference between the first shipment of 500 to 1,000 Tandon disk drives and the video monitor. This problem was never solved, and Tandy subsequently purchased disk drives from Mitsubishi at a slightly higher price. The reject rate for Mitsubishi disk drives was less than one percent. Sellers, Tr. 4950-53, 4962, 4995.

663D. The Tandy 2000 computer was still using the Mitsubishi disk drive when Mr. Sellers left Tandy for Compaq in April 1984. Mr. Sellers is currently the vice president of manufacturing at Compaq. Sellers, Tr. 4933, 4953.

663E. While at Tandy, Mr. Sellers never had any involvement evaluating the Tandon TM 65 disk drive. Sellers, Tr. 5001-02.

663F. When he transferred to Compaq in April 1984, Mr. Sellers recommended to the quality and purchasing people that they change to the Mitsubishi disk drive. Compaq currently uses a Mitsubishi half-height, 5-1/4 inch double-sided disk drive. Sellers, Tr. 4954.

663G. Tandon is not currently a qualified disk drive supplier for Compaq. Sellers, Tr. 4954.

663H. Mr. Jablonski is Vice President of Production Engineering and Quality Control at Compucorp. Jablonski, Tr. 3477-78.

663I. In 1980, Compucorp chose Tandon as a source of 5-1/4 inch, double-sided disk drives (TM 100-4) for its 600 series computer. The Tandon disk drive was chosen because of availability.

663J. The Tandon disk drive did not perform adequately in the 600 series computer, with a reject rate of over 50 percent. Compucorp also experienced problems in the field with Tandon disk drives. Jablonski, Tr. 3479-86.

663K. In early 1983, Compucorp introduced its series 300 computer into the market and chose 5-1/4 inch disk drives from Micro Peripherals Inc. Jablonski, Tr. 3486-87.

663L. Because the MPI disk drives performed very poorly, Compucorp quickly qualified Tandon's new TM 101-4 and the Mitsubishi 5-1/4 inch disk drive in the summer of 1983. Jablonski, Tr. 3486-87.

663M. Compucorp purchased disk drives from both Mitsubishi and Tandon. The Mitsubishi disk drives performed well but Compucorp experienced delivery and quality problems with Tandon disk drives in 1983. Jablonski, Tr. 3487-95; MRX 107C; MRX 108C.

663N. In February 1984, Compucorp issued an engineering change request which related to existing Tandon 101-4 disk drives in Compucorp systems. Because of media wear problems with Tandon disk drives in systems in certain regions, this request required the testing and reworking of Tandon drives. Jablonski, Tr. 3495-3500; MRX 109C; MRX 110C.

666A. The reputation of a disk drive supplier for providing a reliable and uninterrupted delivery of a product is a primary concern in an OEM's selection of a supplier. Foster, MRX 41C, ¶ 8.

666B. One reason that the reputation is very important is that the drives must often be customized to accommodate the unique specifications of a particular OEM customer. Foster, MRX 41C, ¶ 8. Customizing a drive to suit a particular OEM often ties the OEM to a particular drive supplier and requires an investment in time and preparation on the part of the OEM and/or the supplier. Foster, Tr. 2929, 2932.

666C. In addition to the customizing which is done to the exterior of a disk drive in order to suit a particular OEM, OEMs frequently have specific performance requirements which further limit the selection of available disk drive suppliers. MRX 41C, ¶ 9.

666D. Selection of a particular disk drive supplier frequently follows an evaluation period which may extend over a period of six months. Drives that are not qualified by an OEM during this period are generally eliminated from consideration by the OEM for use in the computer system for which the evaluation was conducted. From these remaining qualified suppliers, the OEM selects a primary source of the disk drives. It is not unusual for there to be only one supplier of the disk drives qualified for a particular computer system (Foster, MRX 41C, ¶ 10), though an OEM often qualifies more than one disk drive manufacturer (Foster, Tr. 2934). Some OEMs have a second supply source for their drives. Foster, Tr. 2934.

666E. The evaluation of disk drives by an OEM normally takes three to six months. If the disk drive is a "commodity-type" disk drive, an evaluation may not even be necessary. Sollman, Tr. 251-53.

666F. In view of the evaluation procedure and the customization undertaken by the OEM and the disk drive supplier, the ability of the supplier to deliver the product on time and without significant interruption is a primary concern of the OEM. Foster, MRX 41C, ¶ 11.

666G. Implicit in the selection of a supplier for a customized drive is the fact that the OEM frequently cannot substitute "standard" disk drives of another supplier in the event the supply of disk drives is interrupted. Foster, MRX 41C, ¶ 11.

D. Tandon--Licensing Policy

666H. Tandon presently has license agreements relating to its floppy disk drives under the '573 patent with the following companies: Shugart (July 1, 1980); Hewlett Packard Co. (February 1, 1980); Microperipherals, Inc. (October 29, 1982); CDC (September 30, 1984); Magnetic Peripherals, Inc. (subsidiary of CDC) (September 30, 1984); IBM (January 1, 1984); Matsushita (February 1985); TEAC; and Sony. CX 616-19; CX 696; CX 767; Huenemeier, CX 722, at 12; Order No. 25 (Oct. 2, 1985); Order No. 20 (July 19, 1985).

666I. In 1983, because of its inability to manufacture cost-effective half-height disk drives, Shugart entered into a purchase agreement for half-height drives with Matsushita. These products were 5-1/4 half-height drives, the SA-455 and SA-465. Sollman, Tr. 96-97.

C 666J. In December 1984, approximately double-sided disk drives were produced by Matsushita for sale by Shugart in the United States. These sales would have been licensed under the Tandon patent. CX 863; Neun, Tr. 3403.

C 666K. In January 1985, was quoting a delivered price of
C \$ for its 5-1/4 inch 48 TPI disk drive (for sales to A&A/Tandy), compared
C to a price of \$ for the drive. In the same month, Mitsubishi's
lowest price was \$77.50 for sales of its 48 TPI drive to Compaq. TRX 66;
CX 872; CX 534.

666L. At the end of February 1985, a portion of the Shugart business
was sold to Matsushita. Neun, Tr. 3408.

666M. In February 1985, Tandon and Matsushita entered into a license
agreement giving Matsushita the right to make, have made, use and sell
double-sided floppy disk drives incorporating the '573 patent anywhere in the
C world. Tandon received \$ million () for
granting the license to Matsushita. CX 696.

666N. In March 1985, an internal Tandy memorandum referred to
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C . At that time,
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C . Prices from and were \$ and \$, respectively.
TRX 69.

C 666P. Tandy decided to
C
C
TRX 70.

C 666Q. price objectives presented to Mitsubishi in October 1984
C (for 1985 purchases) ranged from \$ per drive (f.o.b. Japan) for the first
C quarter of 1985 for units, to \$ per drive for the fourth quarter of
C 1985 for units. These prices related to the M4851 5-1/4 inch
half-height drive (0.5 megabyte). CX 856, at 5199939; Foster Tr. 4873.

C 666R. MELCO told MELA National Sales Manager, Mr. Foster, that MELCO'S
C costs would not permit it to meet price objectives. Foster, Tr.
4909-11, 4920-21.

C 666S. In November 1984, Tandon offered its TM 65-2, a 5-1/4
C inch half-height disk drive (48 TPI) for \$. According to Tandon, that
C price was \$ below the market price. MRX 103, at 27775.

C 666T. Today, Matsushita/Panasonic supplies Wang's flexible disk drive
requirements; previously, Shugart supplied Wang. Foster, Tr. 4762.

C 666U. In May-June 1985, Mitsubishi's price to for Model 4853
C (5-1/4 half-height, 96 TPI) drives ranged from \$ to \$. The price
C that Matsushita quoted for the same requirement ranged from \$ to
C \$. Foster, Tr. 4780-82; CX 534, at 527219.

C 666V. According to Mr. Foster, the price reduction to
C from \$ to \$ between May and June 1985 was due to a buildup of drives
in MELA's inventory. The inventory buildup resulted from MELA's importation
of drives in the first half of 1985 based on projected requirements given by
C in early 1985, which never materialized. Because the drives in
C inventory had a unique PC board specifically for , the drives
C would have had to have been retrofitted for re-sale to other customers.
is MELA's fourth largest customer. CX 535, at 530799; Foster, Tr. 4771-73,
4856.

C 666BB. In March 1985, prices to for the 5-1/4 inch, 1.6 megabyte,
C disk drives (including Mitsubishi) had declined to \$, with one of the
C companies offering drives to at this price being Matsushita. The
C market price for 0.5 megabyte disk drives had declined to \$. CX 855, at
517925, 517927; Foster Tr., at 4843-14.

C 666CC. In July 1985, Mitsubishi's price schedule for its M4854-3S (a
C lower cost 1.6 megabyte) was offered to for \$ (ex-go-down
C Tokyo, \$, delivered). The price schedule for the 0.5 megabyte
C drive was \$ (ex-go-down-Tokyo, \$, delivered). CX 849;
Foster, Tr. 4776.

C 666DD. reduced the price of floppy disk drives offered to
Tandy because of excess inventory. Chidambaram, Tr. 1728-29.

C 666EE. is MELA's largest customer, currently representing
percent or more of Mitsubishi's total U.S. sales. Foster, Tr. 4737.

C 666FF. MELA is currently supplying with two 5-1/4 inch
half-height disk drives, the M4851 (0.5 megabyte) and the M4854 (1.5 megabyte,
96 TPI). Matsushita is the only other vendor that has been qualified by
C to provide it with 48 TPI, 0.5 megabyte disk drives. is
currently in the process of evaluating disk drives from other suppliers.
Foster, Tr. 4738-39.

C 666GG. is currently evaluating Tandon double-sided disk drives.
MRX 59, Tandon's Response to Request to Request for Admissions No. 130, at 50;
Edwards, Tr. at 3726.

C 666HH. Mitsubishi lost as a customer when Shugart undercut
C Mitsubishi's prices by \$ to \$ a drive to salvage its excess inventory.
Foster, Tr. 4762, 4872; see also, Neun, Tr. 3473.

666II. The license agreement between Hewlett-Packard (H-P) and Tandon gave H-P the right to make, have made (except by Shugart), use, and sell double-sided disk drives utilizing the '573 patent. CX 617, at 3.

666JJ. H-P informed Tandon that it decided to incorporate a 3-1/2 inch single-sided drive, rather than a 5-1/4 inch drive, in a new computer model, and that it planned to procure such drives from Sony. Since the beginning of 1985, H-P has been purchasing double-sided 3-1/2 inch disk drives from Sony. These are licensed sales. Abraham, CX 714, at 12; CX 617.

666KK. Pursuant to the Tandon-IBM License Agreement, Tandon gave IBM the right to make, have made, use, lease, sell and otherwise transfer Tandon Licensed Products. CX 621, at 7-8.

666LL. MELCO Japan has recently disclosed that it has a contract to supply IBM with 250,000 3-1/2 inch floppy disk drives, with production to begin in the spring of 1986. These are licensed sales. CX 877; CX 621.

E. Texas Peripherals

666MM. Texas Peripherals (TP) is jointly owned and operated by Tandon and Tandy Corporation. CX 666, at 14; CX 619.

666NN. Texas Peripherals was allowed to sell disk drives only to Tandon and Tandy unless otherwise agreed to by Tandon and Tandy. CX 666, at 14.

666PP. TP's employees receive wage rates competitive with those paid in the Ft. Worth area, and in addition, a package of fringe benefits identical to those of Tandy Corporation, which include partially paid medical insurance, a life insurance plan, a retirement plan, and a partially paid stock purchase plan. Haldi, CX 711, at 45.

C 667F. In January 1985, TP
C
C . TRX 74; TRX 75; TRX 76.
C 667G. In its fourth trial production shipment to
C . TRX 77.

F. Shugart

668. In 1983, Shugart was the second largest floppy disk drive manufacturer in the world behind Tandon. Sollman, Tr. 100-01.

668A. Annual sales at Shugart at the end of 1983 were approximately \$240 million. Sollman, Tr. 100-01.

668B. In 1983, Shugart abandoned its program to develop half-height 5-1/4 inch double-sided disk drives. It turned to its Japanese licensee, Matsushita, and entered into a purchase agreement for half-height double sided disk drives. Sollman, Tr. 93-97.

668C. Shugart's double-sided floppy disk drive lines had experienced continued and sustained profits throughout the entire history of the floppy disk drive division until the end of the second quarter of 1984 when the 3-1/2 inch floppy disk drive business had deteriorated substantially and pricing had dropped significantly in the marketplace with respect to 5-1/4 inch double-sided disk drives. Neun, CX 821, at 10; Sollman, Tr. 101.

668D. According to Mr. Neun, as of December 6, 1984, Shugart had an employee benefit package which included life insurance, health insurance, dental insurance, vision care, and pension and bonus plans. Neun, CX 821, at 9-10; Neun, Tr. 3411; CX 865.

C 668E. Shugart paid wages that varied from the to percentile of the industry norm. Neun, CX 821, at 10.

C 668F. Shugart expended approximately percent of its gross sales on its research and development program. Neun, CX 821, at 11.

G. CDC

669. In 1983, CDC had approximately a 20 percent share of the full-height 5-1/4 inch floppy disk drive business and a minimal percentage of the half-height 5-1/4 inch disk drive business. In 1984, CDC had approximately a 20 percent share of the full-height 5-1/4 inch floppy disk drive business and a 10 percent share of the half-height 5-1/4 inch disk drive business. At the present time, CDC has increased its share of the full-height business, but only has a 2 percent share of the half-height business. Ousley, Tr. 633-34.

669A. During the period 1980 to 1983, CDC realized profits each year from the floppy disk drive business. Ousley, CX 820, at 8.

C 669B. In 1984, CDC expended approximately \$ million for research and development for floppy disk drive, including R&D for its 5-1/4 inch 1.6 megabyte drive and its 3-1/2 inch drives. All of such R&D took place in the United States and virtually all of such R&D related to double-sided disk drives. Oulsey, CX 820, at 4.

C 669C. In 1984 CDC decided to move the majority of its floppy disk drive production offshore, because CDC could produce drives in the Far East at approximately \$ /unit less than in the United States. Ousley, Tr. 665-66.

669D. In Mr. Ousley's opinion, CDC's employee and fringe benefits for its employees in the floppy disk drive area are at least commensurate with those which are customarily provided by computer peripheral companies to their employees. Ousley, CX 820, at 8.

H. IBM

669E. IBM, on an ongoing basis, engages in research and development at its Boulder, Colorado, facility in connection with the products it manufactures for the purposes of designing new products and improving the designs and features of its current products. Such research and development activities have included research and development activities with respect to IBM's 5-1/4 inch double-sided floppy disk drives and the components used in such drives, including the head assemblies. Fenstermaker, CX 859, at 4.

669F. The IBM employee benefits program provides protection, security, and opportunity, and is one of the finest in the industry. IBM intends to maintain an average level of pay that is higher than the average level for similar skills in other companies with which IBM competes for employees and with which it competes in the marketplace, thus assuring that IBM rates will be competitive. IBM management believes that its wage rates have been competitive to date. Fenstermaker, CX 859, at 4-5.

VII. INJURY

A. General

670. Sales of double-sided floppy disk drives increased steadily from 350,000 units in 1980 to 3,951,000 units in 1983. The growth was most significant for sales of 5-1/4 inch double-sided disk drives, which increased from 804,000 drives in 1982 to 3,496,000 drives in 1983. CX 711, at 27.

671. In mid-1981, Mr. Sollman of Shugart was informed by its license agreement partner Matsushita that a major contract award for floppy disk drives would be made by Nippon Telephone and Telegraph (NTT). Sollman, Tr. 78

672. In mid-1981, NTT informed the vendor community in Japan about a potential request for quote (RFQ) of between 100,000 and 500,000 half-height double-sided disk drives. This would have been the largest order in the world outside an IBM order. Sollman, Tr. 78-79.

673. Fifteen to 20 Japanese companies were requested by NTT to bid on this contract, and at that time only TEAC, Matsushita, and Mitsubishi had floppy disk drive production capacity. The other companies were newcomers. No United States companies were requested to quote. Sollman, Tr. 79-80.

674. The RFQ required the successful recipients to demonstrate a production capacity of some magnitude. Sollman, Tr. 79.

675. Matsushita warned Shugart that the result of the NTT request for quote would be to generate excess capacity in the Japanese market and sales of Japanese disk drives in the United States. Sollman, Tr. 80.

676. Shugart was also informed by Matsushita that MITI had decided in 1981 that computer peripherals, including floppy disk drives, would be an important area of endeavor for Japan in the 1980s. Sollman, Tr. 84-85.

677. Shugart first faced price competition from five or six Japanese companies in Europe in mid-1983--TEAC and Mitsubishi were predominant. Price competition in the United States was not that severe at that time, although price competition from Japan became more intense at the end of 1983, when prices closed at \$117. Sollman, Tr. 94-95.

678. According to Mr. Sollman of Shugart, price declines contributed substantially to Shugart's deteriorating profits in 1983. Sollman, Tr. 269-71.

679. In January 1985, a TCA gross profit report showed that TCA was selling floppy disk drives to A&A International (the international purchasing arm of Tandy (TRX 28, at 2)) at a unit price of \$ and a unit cost of \$. CX 16, at 252250.

680. In a Tandy memo, TEAC was quoted as saying that their August 1984 selling price of \$ delivered was a "rockbottom " price which barely covered their cost of production, and TEAC would be able to shade prices no further until the introduction of their "VA" version disk drive. CX 741, at 2986.

681. Mr. Brehme of TCA believed that Mitsubishi is not making a profit. The basis for this belief is the reported existence of an oversupply of Mitsubishi disk drives in Japan. Brehme, Tr. 2754-55, 2766, 2768-69.

681A. In reaching his conclusion concerning the oversupply of Mitsubishi disk drives, Mr. Brehme relied on Mr. Osawa's witness statement. However, Mr. Osawa in his witness statement referred to Matsushita, not Mitsubishi, as having an oversupply of 50,000 drives in the United States as of March 1985. Brehme, Tr. 2754-55; Osawa, TRX 28, at 8.

681B. The value of Shugart's inventories of Matsushita drives as of
C December 1984 exceeded \$ million. Quantities of Matsushita disk drives held
C by Shugart in December 1984 were SA-455s, and to
SA-465s. Neun, Tr. 3438-39.

681C. In 1985, Shugart began selling Matsushita disk drives for
whatever the market would bring. Neun, Tr. 3473-74.

682. Tandon's sales of double-sided disk drives increased from
498,800 drives in 1982 to 1,084,600 drives in 1983. CX 678, at DT11-11,
DT13-13; CX 679, at DT12-11, DT14-15.

683. Shugart's sales of double-sided disk drives increased from
78,900 drives in 1982 to 215,900 drives in 1983. CX 678, at DT11-11, DT13-13;
CX 679, at DT12-11, DT14-15.

684. CDC's sales of double-sided disk drives increased from 81,600
drives in 1982 to 421,800 drives in 1983. CX 678, at DT11-11, DT13-13;
CX 679, at DT12-11, DT14-15.

685. Micro Peripheral's sales of double-sided disk drives increased
from 65,900 drives in 1982 to 401,200 drives in 1983. CX 678, at DT11-11,
DT13-13; CX 679, at DT12-11, DT14-15.

686. In 1982, Tandon and its present licensees held 76.0 percent of
the United States OEM market for 5-1/4 inch and 8 inch double-sided disk
drives. The Mitsubishi respondents held 11.5 percent of the 8 inch market and
3.1 percent of the 5-1/4 inch market. The TEAC respondents held 2.4 percent
of the 5-1/4 inch market only. CX 678, at DT11-11, DT13-13.

690. In 1983, Tandon and its licensees held 55.6 percent of the United States OEM market for 5-1/4 inch double-sided disk drives. The Mitsubishi respondents held 12.2 percent of this market and the TEAC respondents held 9.3 percent. All of the 26.0 percentage point drop in Tandon's and its licensees' market share between 1982 and 1983 was at the expense of Tandon, while Tandon's licensees expanded their market share. CX 678, at DT13-13; CX 679, at DT14-15.

690A. In 1983, Tandon was the leading 5-1/4 inch full-height manufacturer. That is, Tandon sold 5-1/4 inch double-sided drives, or of the market, virtually all of which were full-height drives. Huenemeier, CX 835, at 2-3.

691. From 1982 to 1983, the half-height disk drive increased its worldwide share of the 5-1/4 inch double-sided disk drive market from 24.8 percent to 54.7 percent. Total world OEM sales of the 5-1/4 inch double-sided disk drive increased from 1,269,400 units in 1982 to 5,679,800 units in 1983, with most of this increase attributable to half-height drives. CX 678, at DT13-11; CX 679, at DT14-13.

691A. From 1982 to 1983 world market sales of 5-1/4 inch half-height double-sided floppy disk drives increased from 314,300 units to 3,107,000 units. Non-U.S. suppliers (Japan accounting for about 90 percent of non-U.S. suppliers of full and half-height 5-1/4 inch drives) captured approximately 83 percent of this increase while U.S. suppliers captured 16 percent. By contrast, U.S. suppliers captured 96 percent of the the 1,617,400 unit increase in 5-1/4 inch full-height double-sided disk drive shipments over the same period. CX 678, at DT13-11, DT 13-13; CX 679, at DT 679, at DT14-13, DT14-15.

691B. The year 1982 was the last year full-size drives held the majority of unit shipments. In 1983, half-height drives accounted for 57.6 percent of 1983 worldwide unit shipments. CX 679, at DT 14-6.

691C. In 1984, approximately 4.8 million units of double-sided 5-1/4 inch double-sided floppy disk drives were sold in the North American market. MRX 51, at 20.

691D. In 1984, there were still sales of full-height 5-1/4 inch double-sided disk drives in the United States for use in, for example, the IBM PC and XT computers. CX 679, at DT 14-5, 14-6, MRX 51, at 23.

691E. In 1984, 53 percent of the North American flexible disk drive business was attributed to sales of 5-1/4 inch double-sided drive. MRX 51, at 9.

691F. The 5-1/4 inch flexible disk drive market is characterized by extreme production overcapacity, especially in Japan. In this market, 50 suppliers provide more than 400 models, while eight to ten of these suppliers could satisfy world demand. MRX 51, at 22.

691G. Domestic producers estimate that there exists 20 to 35 Japanese companies competing in the U.S. floppy disk drive industry. MRPX 52C, Vol IV, at 325; Ousley, Tr. 712; Edwards, Tr. 3747-48.

691H. The record establishes that these nonrespondent companies have imported and sold the following models into the United States:

Canon	-	5-1/4" - Model MDD 211
Epson	-	5-1/4" - Model SD 521
	-	3-1/2" - Model SMD 140
Hitachi	-	5-1/4" - Model HFD505B
Hitachi	-	3" - Model HFD305D
JVC	-	5-1/4" - Model MDP-2
NEC	-	5-1/4" - Model FD1055
Okidata	-	5-1/4" - Model GM330511
Phillips	-	5-1/4" - Model X3132
Qume	-	5-1/4" - Model 142
Sankyo	-	3" - Model FDC355-Da
Sumitomo	-	5-1/4" - Model FDA5200B
TEC	-	5-1/4" - Model FB-503
Toshiba	-	5-1/4" - Model FDD5401E
World Storage Tech	-	5-1/4" - Model FDD-212--504
YE Data	-	5-1/4" - Model YD-380

CX 757, at 3, 21, 31, 35, 47-61, 67, 80, 85, 95, 107, 116, 122, 131, 136, 149.

691I. Business and technology trends indicate that price erosion in the 5-1/4 inch flexible disk drive market will continue into the \$60 to \$70 range on large contracts. MRX 51, at 23; see Edwards, Tr. 3747-48.

691J. The 1985 Dataquest Report concludes that pricing on the flexible disk drive market is based on lowest-cost producers economies of scale and that offshore manufacturing is essential for all United States' producers. MRX 51, at 39.

691K. In March 1985, Shugart was offering disk drives at prices of \$ to \$ in order to move product and maintain contact with their customers. The price offered by competitors at this time was in the . Neun, Tr. 3408-09.

691L. In April 1985, disk drive prices were expected to fall an additional 15 to 20 percent over the following year. Brehme, Tr. 2703.

691M. According to Mr. Neun, a price of \$ is actively being quoted today to such major accounts as . Neun, Tr. 3409.

692. According to Tandon, it was late in entering the half-height 5-1/4 inch floppy disk drive market in part due to the theft of trade secrets by its own employees. Haldi, Tr. 1302-03.

692A. The floppy disk drive market is characterized by short product life cycles. Malmgren Dep., at 13, 86.

692B. The trend in floppy disk drive market demand can be broadly characterized as toward smaller and higher capacity floppy disk drives. CX 667, at 12; CX 679, at SUM-16.

693. Shugart endeavored to develop 5-1/4 inch half-height disk drives (Models A and B), but in 1983 decided to market Matsushita-produced 5-1/4 inch half-height disk drives (Models SA-455, SA-465) in the United States because the price from Matsushita was lower than Shugart's own estimated cost of production. Sollman, Tr. 82-83, 268-69.

694. CDC's estimate of the prevailing market prices for full-height 5-1/4 inch double-sided disk drives ranged from \$ to \$ per unit in mid-1983; for mid-1984, between \$ and \$ per unit; for the end of 1984, between \$ to \$ per unit. In April 1985, prices on normal bids ranged between \$ to \$ per unit. Ousley, Tr. 652-53.

695. CDC's estimate of the prevailing market prices for half-height 5-1/4 inch double-sided floppy disk drives for the summer of 1984 ranged from \$ to \$ per unit; for the fall of 1984, under \$ per unit; at the end of 1984, \$ per unit. In April 1985, prices for any substantial new procurement were in the \$ per unit range. Ousley, Tr. 653-54.

696. The floppy disk drive market was relatively stable until mid-1984. At that time the market became unstable and prices dropped an average of \$ per unit per month. Ousley, Tr. 666-67.

696A. According to Tandon's financial statement, Tandon was able to lower its manufacturing costs in 1983 due in large part to its manufacturing operations in Singapore and India. This enabled it to meet the market demand for low-priced disk drives. CX 665, at 13.

697. According to Tandon's financial statements, floppy disk price declines in fiscal 1984 were attributable to at least three factors: (1) intense price competition in the personal computer industry and corresponding price pressure on disk drive suppliers; (2) the emergence of numerous foreign manufacturers in Japan and elsewhere; and (3) a rapid and broad-based industry trend toward (lower-priced) half-height 5-1/4 inch floppy disk drives. CX 666, at 22; CX 667, at 12.

C 698. TCA tries to sell at a price that is percent above its base cost (f.o.b. Japan price, freight, and customs). Brehme, Tr. 2715.

699. In 1984, TEAC Japan dropped its disk drive prices to TCA three times, and TCA's United States price dropped accordingly. Brehme, Tr. 2715-16.

700. Since December 1984, TEAC prices have decreased by from 30 to 40 percent. Brehme, Tr. 2711.

C 700A. In 1985, Matsushita, TEC, Epson, TEAC, Mitsubishi, and Alps have
C quoted factory prices in Japan ranging from the high \$ s to the mid-\$ for
C 5-1/4 inch half-height double-sided drives in the quantity range. The
amount to be added to these prices to obtain a delivered United States price
C would be roughly \$ or less. Chidambaram, Tr. 1713-16.

B. Shugart

701. Shugart Associates, a subsidiary of Xerox Corporation, is located at 475 Oakmead Parkway, Sunnyvale, California 94086. Shugart is a licensee of Tandon's U.S. Letters Patent No. 4,151,573 (the '573 patent) as of July 1, 1980. Complaint, ¶ 59; CX 616.

702. Shugart was formed in the mid-1970s by Allen Shugart and several key employees who had worked together at IBM and Memorex on disk drive designs. Sollman, Tr. 36-40. In 1976, Shugart had 50 to 60 employees. Sollman, Tr. 39.

703. By January 1976, Shugart was a single-product company with sales of \$1.5 million to \$3.0 million in 1975 and projected sales of \$6.0 million for 1976. Actual 1976 sales were \$9.0 million. The single product was an 8 inch single-sided floppy disk drive selling for \$400 to \$500. Sollman, Tr. 37-38, 42.

704. By the end of 1981, Shugart employed 2,700 individuals and had annual sales of approximately \$198 million. The company was located in Sunnyvale and Roseville, California, and Nogales, Mexico (300 employees). Sollman, Tr. 75-76.

705. In 1981, Shugart announced a full-height 5-1/4 inch double-track density version and double-sided version of its own design. After Shugart began to sell these products, it began to notice some pricing competition from Tandon, Control Data, and Japanese companies. Shugart was principally concerned about the competition from Control Data and secondarily, from Tandon. Sollman, Tr. 76-77.

706. At the spring 1982 National Computer Conference, Shugart was the only company that displayed a half-height product. At the fall 1982 Comdex show, Shugart, Tandon, and Control Data showed half-height double-sided floppy disk drives. Twelve to fifteen Japanese suppliers also showed their half-height products. Sollman, Tr. 87.

707. In April 1983, Shugart assessed the market conditions in Europe and saw extreme price competition at key and vital accounts from five or six Japanese manufacturers. Shugart also saw lower price bidding in the United States from Japanese half-height products. Sollman, Tr. 93-95.

708. As 1983 progressed, price erosion in half-height drives brought prices down into the \$120 range. Sollman, Tr. 93-95. Shugart turned to its Japanese licensee, Matsushita, and entered into a purchase agreement for half-height double-sided floppy disk drives with prices ranging from \$124 to under \$100 depending upon the quantity ordered. Sollman, Tr. 97.

709. In 1983, Shugart found itself in head-to-head competition with Japanese products at virtually every major United States and European account. Sollman, Tr. 97-98. "The outcome was that we had to adjust all of our pricing substantially downward yet again with severe price erosions and then profit erosions that had to naturally follow." Sollman, Tr. 98.

710. Shugart lost a NCR bid to TEAC; Shugart bid \$125, TEAC bid \$112. The contract was for 200,000 units per year. Sollman, Tr. 98.

711. Shugart lost a Convergent Technologies bid to Mitsubishi for 100,000 drives per year. Sollman, Tr. 98-99.

C 711A. Mr. Neun stated that Shugart lost the
account to Mitsubishi for 250,000 96 tpi double-sided drives per year during
the second and third quarters of 1984. Shugart sales personnel were informed
C by that no matter how aggressive Shugart's pricing was over this
time period, Mitsubishi's pricing was always lower. After repeated attempts
to land this account, Shugart failed. According to Mr. Neun, pricing was a
key reason. Neun, CX 821, at 11.

C 711B. In June 1983, MELA and Shugart competed for sales of floppy disk
drives to the . MELA obtained the account. Foster Dep.,
CX 447, at 319.

C 711C. Mr. Neun stated that Shugart lost the account in the
C second quarter of 1984 to Mitsubishi. The account was for 20,000 to
30,000 disk drives per year. According to Mr. Neun, pricing was a key
reason. Neun, CX 821, at 12.

C 711D. Mr. Neun stated that Shugart lost the account for
20,000 to 30,000 disk drives per year to Mitsubishi in the second quarter of
1984. According to Mr. Neun, pricing was a key reason. Neun, CX 821, at 12.
C (Shugart began selling a 1.6 megabyte product, the SA-475, to at the
beginning of 1985. Neun, Tr. 3429.)

C 711E. The account, where Shugart also had had 100 percent
of the business as late as April-May of 1984, started purchasing drives from
C Mitsubishi. According to Mr. Neun, used the Mitsubishi lower
prices as a lever to drive the Shugart prices down. Neun, CX 821, at 12.
C Shugart, by lowering its prices, was able to retain the account.
Neun, Tr. 3430-31.

711F. On August 15, 1984, a Mitsubishi account/prospect review noted
C that MELA " " to obtain the 0.5
C megabyte (M4851) floppy disk drive business from Corona Data Systems. "
C
C . " CX 546, Bates
No. 526483.

711G. In August 1984, a MELA account/prospect review noted that MELA's
C strategy should be " " to obtain floppy
C disk drive business from . CX 547, Bates No. 524565.

711H. In the second quarter of 1984, Shugart lost the account
C for 96 tpi double-sided disk drives for approximately to disk
C drives per month to Mitsubishi. According to Mr. Neun, price was a key
reason. Neun, CX 821, at 11. Shugart lost a second sale to Mitsubishi for
C the account for to 48 tpi and 96 tpi half-height
drives in the fall of 1984. Neun, Tr. 3412-13.

712. In October 1983, Shugart experienced its first layoff. Shugart
had grown to 3,600 employees, all but 550 of whom were located in the United
States. The October layoff equaled 7-1/2 percent of the work force. Sollman,
Tr. 99.

713. Shugart's annual sales for 1983 was \$240 million dollars. At
that time, Shugart was the world's second largest manufacturer of floppy disk
drives behind Tandon. Sollman, Tr. 100-01.

714. The extreme competitive environment at the end of 1983 caused
Shugart's profitability to erode substantially. Shugart first became

profitable in July 1975. The first time Shugart saw a rapid erosion of its profitability was in 1983. In January 1984, it suffered an operating loss. Sollman, Tr. 101; Neun, CX 821, at 10.

715. Shugart had charted the price declines of 1983 and concluded that the decline had a very negative long-term impact. Sollman, Tr. 101. Shugart considered several economic alternatives to recover from the erosion in profits, including setting up an offshore production facility in either Singapore, Taiwan, or South Korea. Sollman, Tr. 101-02.

716. Shugart task forces in mid to late 1982 recommended the immediate establishment of a production facility in Singapore. Shugart, however, was unable to receive management's approval for the establishment of this facility. That is, Shugart needed the approval of Fuji-Xerox, a Japanese joint venture owned by Shugart's parent corporation Xerox and Fuji-Foto Films, before any manufacturing could take place in that part of the world. Shugart never received the approval of Fuji-Xerox. Sollman, Tr. 103-04.

716A. In the first quarter of 1984, with the Japanese competition beginning to take its toll in the marketplace, Shugart sold everything it could make and experienced a book to build ratio of . This was due to Shugart's success over the years in obtaining ongoing contracts for major OEMs and industry recognition of the quality of Shugart's double-sided floppy disk drive products. Neun, CX 821, at 5.

716B. Over the next three quarters of 1984, the Shugart floppy disk drive business was to change dramatically. By the second quarter of 1984, disk drive prices started to decrease due to a softening in the marketplace

and an increase in foreign competition, particularly from TEAC and Mitsubishi, according to Mr. Neun. Price-cutting became commonplace, with TEAC leading the price-cutting during this timeframe. Neun, CX 821, at 5.

716C. Sales personnel at Shugart were amazed at the pricing done by TEAC and Mitsubishi. Shugart simply could not compete, notwithstanding the recognized quality of their product. Shugart's margins declined and layoffs continued. There were numerous layoffs in the second, third, and fourth quarters of 1984. Neun, CX 821, at 6.

716D. By the time the fourth quarter of 1984 began, Shugart's floppy disk drive business was struggling. The summer season had been soft, which caused even further price-cutting by TEAC, Mitsubishi, and other foreign competitors, according to Mr. Neun. Neun, CX 821, at 6.

716E. Around December 6, 1984, TEAC and Mitsubishi prices, and those of other Japanese competitors, had been cut to the \$ to \$ range, which came close to Shugart's actual cost of production, according to Mr. Neun. It became clear that Shugart could not continue to compete in that kind of marketplace. Neun, CX 821, at 7.

717. On December 19, 1983, after examining studies regarding the economic climate as well as what would be required to make the business fully profitable, Xerox concluded that it could no longer support Shugart. As of January 1, 1984, Shugart's annual reported sales for fiscal year 1983 was \$240 million. Xerox concluded that even with substantial investments, there would be no way to make Shugart profitable within the next 12 to 18 months. Sollman, Tr. 104-06, 107.

718. On January 15, 1984, Shugart employed 2,600 people in the United States and 600 in Mexico and occupied about 490,000 square feet of space at Roseville and Sunnyvale, California. By December 6, 1984, Shugart had experienced several more layoffs, and its employment force had been reduced to 1,600 to 1,700 employees, 400 of whom were in Mexico. Sollman, Tr. 109, 111-12.

719. Shugart was still manufacturing double-sided floppy disk drives in the United States on December 6, 1984, including 8 inch and 3-1/2 inch products. Sollman, Tr. 113.

720. In January 1985, Xerox formally announced the closing of Shugart's 5-1/4 inch and 3-1/2 inch floppy disk drive operation at a time when it still employed 1,400 individuals. Its announcement coincided with Xerox' 1984 earning statement. As for the assets of the Shugart floppy disk drive business, the 5-1/4 inch business was sold to Matsushita in February 1985, including the extensive inventory that had built up over the previous quarters. Neun, CX 821, at 8-9; Sollman, Tr. 113.

720A. Production of Shugart's 3-1/2 inch double-sided floppy disk drive operation ceased in approximately February 1985, except for the fulfillment of existing commitments to for production of approximately double-sided units. Neun, CX 821, at 9.

721. Xerox has already sold or is in the process of selling the various parts of Shugart's domestic facilities. Sollman, Tr. 113.

C. Control Data Corporation

722. Control Data Corporation (CDC) was granted a license on September 30, 1984, to manufacture and sell disk drives under the '573 patent. Complaint, ¶ 64; CX 620; Ousley, Tr. 629, 632-33.

723. Magnetic Peripherals, Inc. (MPI), is a partially-owned subsidiary of Control Data Corporation. MPI was granted a license on September 30, 1984, to manufacture and sell disk drives under the '573 patent. The license agreement resulted from a claim by Tandon that the drives manufactured by MPI were covered by the '573 patent. Complaint, ¶¶ 59, 62; CX 620; see Ousley, Tr. 627-29, 632-33.

724. CDC's subsidiary MPI manufactures flexible disk drives. CDC as a parent company of MPI does not manufacture flexible disk drives. Ousley, Tr. 691. Some, if not all, of the head assemblies used by CDC in its double-sided floppy disk drives produced in the United States are manufactured by Lafa, which is located in Taiwan or Korea. Ousley, Tr. 698.

725. CDC's industry position in 1983 approximated 20 percent of the full-height floppy disk drive market and a minimal percentage of the half-height floppy disk drive market. Ousley, Tr. 633.

726. CDC's industry position in 1984 approximated 20 percent of the full-height floppy disk drive market and 10 percent of the half-height floppy disk drive market. Ousley, Tr. 633.

727. CDC's current industry position approximates more than 20 percent of the full-height disk drive market and two percent of the half-height floppy disk drive market. Ousley, Tr. 633-34.

728. CDC's industry position in the total disk drive market, which includes Winchester and floppy disk drives, was 40 percent for 1983 and 27 percent for 1984. Ousley, Tr. 634.

C 729. CDC in 1983 shipped \$ worth of floppy disk drives or
C units. Ousley, Tr. 645, 647; CX 729-30.

C 730. CDC by December 30, 1984, had shipped \$ worth of
C floppy disk drives or units. Ousley, Tr. 645-46, 648; CX 729-30.

731. CDC, as of December 30, 1984, had firm purchase orders for 1985 of 79,000 floppy disk drive units and had projected a high probability sales
C forecast for 1985 of units. A high probability order is defined as an order CDC can make a definite commitment and order parts. New prospects and new business are not reflected in this number. Ousley, Tr. 648-49; CX 730.

732. The numbers recited in FF 725-31 cover 5-1/4 inch full-height and 5-1/4 inch half-height products. Of the 5-1/4 inch full-height products,
C percent plus are double-sided configurations; of the 5-1/4 inch half-height products, almost all are double-sided configurations. The old 8 inch products
C constitute maybe percent of the numbers. Ousley, Tr. 649-50.

733. CDC's five-year manufacturing plan prepared in late 1983 forecasted its 1984 requirements for 5-1/4 inch half-height floppy disk drives
C as units and 1985 requirements as units. Ousley,
Tr. 650-51; CX 731.

734. In April 1985, CDC was committed to have its offshore supplier
C build floppy disk drives, but only had orders for percent of that
number. At that time, CDC was projecting sales in 1985 on the order of
C units. Ousley, Tr. 652, 709-10.

734A. CDC is obligated to pay for the offshore assembly of
C approximately floppy disk drives over the remainder of 1985, of which
C over percent are double-sided 5-1/4 inch half-height floppy disk drives.
C CDC must pay between \$ and \$ for these disk drives. Ousley, Tr.
671, 709; Ousley, CX 820, at 3.

C 734B. The units are to be delivered at the rate of
C approximately units per month over the remainder of 1985. CDC is
obligated to accept delivery of these units whether or not it has orders from
OEM customers for their resale. Ousley, Tr. 3388; Ousley, CX 820, at 3.

735. CDC's estimate of the prevailing market prices for full-height
5-1/4 inch double-sided floppy disk drives for mid-1983 averaged between \$150
to \$200 per unit; for mid-1984, between \$105 to \$115 per unit; for the end of
1984, between \$85 to \$95 per unit. In April 1985, prices on normal bids
ranged between \$65 to \$85 per unit, though CDC has heard a low bid of \$52.
Ousley, Tr. 652-53.

736. CDC's estimate of the prevailing market prices for half-height
5-1/4 inch double-sided floppy disk drives for the summer of 1984 ranged from
\$125 to \$135 per unit; the fall of 1984, under \$100 per unit; end of 1984, \$85
per unit. Current prices for any substantial new procurement are in the \$60
per unit range. Ousley, Tr. 653-54.

737. In late 1983, CDC based on the existing market conditions
projected that the 1984 prices for its Model Nos. 9298 and 9299 half-height
C 5-1/4 inch double-sided floppy disk drives would be \$ per unit and \$ per
C unit, respectively, and the 1985 prices, \$ per unit and \$ per unit,
respectively. Ousley, Tr. 656-57; CX 732.

738. On April 4, 1984, CDC defined its major competition in the half-height 5-1/4 inch double-sided floppy disk drive market as follows:

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Shugart

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Japanese

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C

Tandon

CX 733.

739. The floppy disk drive market was relatively stable until mid-1984. At that time the market became unstable and prices dropped an average of \$10 per unit per month. Based upon CDC's cost of production in the United States, CDC in the third quarter of 1984

and made the decision to move production of drives offshore. Ousley, Tr. 666-68.

740. As of April 1985, CDC continued to assemble and test approximately to percent of its requirements for half-height 5-1/4 inch double-sided floppy disk drives at its Oklahoma City facility. Ousley, Tr. 668.

741. As of April 1985, the estimated maximum production capacity at CDC's Oklahoma City facility was _____ drives per year, or approximately _____ to _____ units a month. It would take CDC at least _____ months to produce at this level. The necessary tooling is in place, but CDC has laid off or furloughed a number of its personnel. Ousley, Tr. 669.

742. _____ was and is a CDC OEM customer for some flexible and numerous rigid drives. CDC has an ongoing business relationship with _____ and is trying to keep that business. CDC ceased being a vendor for half-height product in the mid or third quarter 1984; "we were not able to give them a price that they felt they could live with due to other competitive prices." CDC thinks that Mitsubishi received _____ business at this time. Ousley, Tr. 671-72.

743. CDC has attempted to gain back _____ half-height double-sided floppy disk drive business. Before April 1985, CDC quoted prices as low as \$ _____ to \$ _____ per unit, but was unable to secure _____ business. CDC believes that Mitsubishi is currently supplying _____ with this product. Ousley, Tr. 673, 727-29.

744. In 1984, CDC supplied _____ approximately 50,000 to _____ full-height floppy disk drives at a cost of \$ _____ per unit. Prices for half-height floppy disk drives forced CDC to reduce its prices for full-height drives. _____, however, elected to switch from full-height to half-height drives and canceled its business with CDC. _____ now obtains half-height floppy disk drives from Panasonic (i.e., Matsushita). Ousley, Tr. 674-75.

745. In the third quarter of 1984, CDC attempted to solicit from
C its business for half-height floppy disk drives. CDC at
C this time was quoting prices for half-height drives at \$ to \$ per unit.
CDC was unsuccessful in its bid for this business and is unsure who finally
received this order, but was told that there were three or four vendors whose
C price bids ranged from \$ to \$ per unit. CDC was informed within two weeks
of the hearing on temporary relief in this investigation that to obtain
C business, it would have to bid less than \$ per unit. CDC was told
C that several vendors could quote such prices to , including .
Ousley, Tr. 675-76.

746. CDC has a national agreement with two distributors, and
C . CDC distributed through these companies almost all of its disk
C products and tape products. CDC's contracts with its distributors are for a
short time period and the distributors have the privilege of returning
C products to CDC if they are unable to sell them. and compete in
a market where there are 10 to 15 major domestic distributors. This market is
very price sensitive. In April 1985, CDC sold its half-height product to its
C distributors at \$ per unit. Other distributors purchased drives in the \$
per unit range, and CDC was under pressure to reduce its prices to obtain
business. In April 1985, a major national distribution competitor of
C , which was offered prices for floppy disk drives in the \$ per unit
range, used a TEAC drive. Ousley, Tr. 676-77.

747. In April 1985, CDC was operating its 5-1/4 inch floppy disk
C drive business at a loss of \$. Ousley, Tr. 682-83.

748. CDC experienced a writedown and operating loss in its flexible
C disk drive business last year of \$. Ousley, Tr. 683.

749. Based upon monthly analyses beginning in the fourth quarter of 1984, CDC in its February 1985 financial review decided that unless market conditions improved,

. Ousley, Tr. 683.

749A. As a result of CDC's inability to offer prices sufficiently competitive with those being offered by the Japanese competitors, CDC continued to lose market share to the Japanese competitors and

. Ousley, CX 820, at 2.

750. The closing of CDC's Oklahoma City facility has been ongoing since the third quarter of 1984. In October 1984, CDC laid off 450 individuals from its Oklahoma City facility. In February 1985, CDC made its final announcement with respect to the termination of employees at its Oklahoma City facility. "The final termination of the employees in Oklahoma City associated with flexible [disk drives] will take place within the next few weeks." Ousley, Tr. 683-84, 692 (Apr. 10, 1985).

751. As of April 1985, the total production of CDC floppy disk drives has moved offshore. Ousley, Tr. 684 (Apr. 10, 1985). The only activity that continues in the United States is engineering, ongoing tests, product support, and any limited customer-unique specification work. Approximately 75 CDC employees will be associated with this group after April 15, 1985. CDC needed to lay off an additional 150 employees in order to reach the 75 person level. Ousley, Tr. 684-85, 723. The decision to begin moving CDC's production facilities offshore was made in September 1984. Ousley, Tr. 691-92.

751A. As a result of CDC's decision in February 1985, approximately 150 CDC employees at the Oklahoma City floppy disk drive facility were terminated on April 15, 1985, leaving 75 employees. Ousley, CX 820, at 2-3.

752. After the termination of employees by CDC, the production line at the Oklahoma City facility will be effectively phased down. CDC will attempt either to use the production line at other locations within CDC or to sell the line. CDC hopes to dispose of the production line as quickly as possible. Ousley, Tr. 688-89 (Apr. 10, 1985).

C 753. CDC has made the decision to
C based on current market conditions. "If those market conditions were
to reverse rapidly, then we have the plant, the people and the process in
place to stay in the business. . . . I think given that the foreign
C competition that we have seen is the major reason
C if that were to stop, then we would have an opportunity to
C ." Ousley, Tr. 689-90.

754. The only reason that CDC would go into domestic production at this time is if there was an increased demand over its current contracts with foreign suppliers. See FF 734, 749. While there would still remain a price differential with respect to the production of floppy disk drives in the United States vis-a-vis the contract supplier, should an exclusion order be issued in this case, the price differential would not be that great. CDC would be expected to manufacture wherever the cost would be lowest for the corporation: "We would . . . start up most likely our 1.6 [megabyte half-height 5-1/4 inch floppy disk drive] and potentially 3-1/2 inch line in Oklahoma City. And there again . . . at some point in time transfer that over to the Far East, if the cost were still less." Ousley, Tr. 710-11.

755. "Our [CDC's] stated corporate position from the chairman of our board is that we would prefer to manufacture domestically. So at some point in time if that cost difference makes it such that we aren't prudent businessmen, we would go offshore, but that is not strictly dollars and cents." Ousley, Tr. 711-12.

756. There are currently 30 to 35 foreign manufacturers for double-sided floppy disk drives. Ousley, Tr. 712. TEAC is a very formidable competitor and ranks in the top five of these foreign manufacturers. CDC does not see Mitsubishi in as many places as it does TEAC, but Mitsubishi is somewhere in the top ten of the foreign manufacturers. "Sony we do not see very often other than as it relates to 3-1/2 inch, which is all futures basically at this point in time." Ousley, Tr. 715-16, 717.

757.-758. Intentionally Left Blank.

759. CDC's domestic cost for the manufacture of the Models 9428 and 9429 in late 1984 and 1985 was \$ to over \$. And as of August 1985, CDC's cost of manufacturing double-sided half-height 5-1/4 inch floppy disk drives offshore is higher than the selling prices prevailing in the market. Ousley, Tr. 3358-60.

759A. Since April 1985, CDC has continued its efforts to market floppy disk drives. In its recent marketing activities, CDC has encountered greater difficulty in obtaining orders than in the past because of the lower prices being offered by Japanese disk drive manufacturers. Ousley, CX 820, at 5.

759B. CDC has been informed with increasing frequency by potential customers that they would require prices of \$ or \$ in order for CDC to be considered as a source, based upon the availability of drives from other manufactures at those prices. Ousley, CX 820, at 5.

759C. CDC has been forced by current market conditions to reduce its
C prices on new contracts to the \$ to \$ range in order to liquidate its
C current inventory. In order for CDC to realize a percent profit it
C would have to sell its drives at percent above the \$ price. Ousley,
Tr. 3365, 3367, 3388-89; Ousley, CX 820, at 5.

759D. CDC is currently selling and delivering approximately to
C double-sided drives per month, and the rate of sales of CDC's
C double-sided floppy disk drives is continuing to decline. Ousley, CX 820, at
3-4.

759E. At present, CDC is still suffering significant operating losses
in regard to its floppy disk drive business. Ousley, CX 820, at 4. If CDC
does not resume floppy disk drive production at its Oklahoma City facility,
C . Ousley,
Tr. 3361.

759F. In order to make a reasonable profit, and therefore reconsider
C , CDC would have to realize a
C gross profit in the range of percent. Prices would have to be at least
C percent higher than \$ for CDC to stay in the floppy disk drive business,
C assuming that CDC today could make such drives at a cost of \$. Ousley,
Tr. 3364-66.

759G. If there is no improvement in market conditions, CDC
C
C . CDC's decision
C is based upon the fact that it does not appear that

C CDC can at a profit despite its efforts to take all
steps to reduce costs sufficiently to enable it to compete at a profit.
Ousley, CX 820, at 8.

C 759H. CDC has invested of dollars in its floppy disk
drive business. This includes its investment in its Oklahoma City facility
and research and development and engineering at that facility, but does not
include marketing or advertising costs. CDC has lost or will lose virtually

C
C . Ousley, CX 820, at 4; Ousley, Tr. 3363.

C 759I. In Mr. Ousley's opinion, CDC would reconsider its decision
C if market conditions changed
sufficiently so that it appeared that CDC could realize a reasonable profit by
C continuing to . Ousley, CX 820, at 4-5.

D. Texas Peripherals

760. Texas Peripherals (TP) is a joint venture owned equally by
Tandy Corporation and Tandon. Tandon became a member of this joint venture in
January 1984, and supplied its licensed technology to TP. CX 619; Huenemeier,
Tr. 299, 302.

761. TP was formed for the purpose of manufacturing disk drives in
the United States for sale either to Tandy or Tandon. Huenemeier, CX 722, at
7-8; see Huenemeier, Tr. 303, 304; Hochman, Tr. 1691; CX 619, Art. IX, § 9.01.

762. As of December 1984, TP manufactured at its facilities in Fort Worth, Texas, the TM 100-1, a full-height single-sided floppy disk drive, the TM 65-1, a half-height 5-1/4 inch single-sided disk drive, and the TM 65-2, a half-height 5-1/4 inch double-sided disk drive. Hochman, Tr. 1631-32; see CX 666, at 14.

763. TP purchases all of its head assemblies for the TM 65-2 from Tandon. Hochman, Tr. 1633.

764. On April 25, 1984, the projected production of TP floppy disk drives for October 1984 was 27,117; for November 1984, 43,450; and for December 1984, 39,430. Of those drives planned for production in October 1984, 1,000 would be half-height double-sided floppy disk drives; in November 1984, 32,350 would be half-height double-sided floppy disk drives; and in December 1984, 28,230 would be half-height double-sided floppy disk drives. TP forecasted continued growth of its floppy disk drive production such that by February-March-April 1985, TP planned to ship 68,652 drives a month, 50,052 of which would be half-height double-sided floppy disk drives. CX 727, at Bates No. 028560. This projection was based upon the forecasted requirements of Tandy and Tandon (though in this forecast the Tandon-required drives were minimal). Huenemeier, Tr. 312-14, 319-20; see, e.g., CX 727, at Bates Nos. 028549-50.

765. On April 25, 1984, the projected average selling price for TP's half-height double-sided floppy disk drive was \$86 per unit. Huenemeier, Tr. 315-16; CX 727, at Bates No. 028560. In spring 1984, TP submitted bids for this product to the various Tandy divisions. Huenemeier, Tr. 316-17. At this time, \$86 per unit was considered a competitive bid for this type of product. Huenemeier, Tr. 317; see id., Tr. 308.

766. In the spring of 1984, the joint venture committee authorized \$300,000 for tooling in which to set up TP. Huenemeier, Tr. 321; CX 706, at 2.

767. On May 15, 1984, TP delivered working samples of the TM 65-2 to various Tandy divisions, including Tandy Advanced Products, Tandy Home Computer, Tandy Computer Assy., Tandy Systems Design, and CPE (Computer Product Engineering). Huenemeier, Tr. 317-18; CX 727, at Bates No. 028549. This drive was assembled at TP from a kit supplied by Tandon and did not incorporate any components procured or tooled by TP. Huenemeier, Tr. 318; Hochman, Tr. 1644-45.

768. On June 15, June 16, and July 15, 1984, TP scheduled the delivery of preproduction samples of the TM 65-2 to Tandy Home Computer, Tandy Computer Assy., Tandy Systems Design, and Tandy Advanced Products. Only some of these preproduction samples were later delivered to the various Tandy divisions in late June, July, or August 1984. The preproduction samples were more representative of TP's production units and contained some degree of TP's configurations. Huenemeier, Tr. 318-19; CX 727, at Bates No. 028549.

769. TP's profit plan for fiscal year 1985 indicated that production of the half-height 5-1/4 inch double-sided disk drive was scheduled to begin October 1984. By May 23, 1985, production of this floppy disk drive was expected to reach 30,000 units per month. This level of production was less than originally anticipated (see FF 764) because Tandy had decided to continue to use the full-height product in its model 4 computer instead of switching to a half-height product. Huenemeier, Tr. 305, 322-24; CX 727, at Bates. No. 028572.

770. As of September 1984, \$264,300 of the budget for tooling had been committed to vendors to fabricate the tooling for the TM 65 product (see FF 766). TP planned to have its tooling in place by December 1984. The commitments to vendors for tooling were made in expectation of volume business for the TM 65 from Tandy. Huenemeier, Tr. 321-22; CX 706, at 2; see CX 727, at Bates No. 028568.

771. As of September 19, 1984, TP's production line was capable of producing the quantities needed to achieve its financial objectives (see FF 764). "The plant capacity was shown to range from 30,000 drives per month in December [1984] to better than 50,000 as we approach March [1985]. We are not capacity limited." CX 727, at Bates Nos. 028566, 028568; see Huenemeier, Tr. 324-25.

772. The minutes of the September 19, 1984, joint venture committee meeting indicate that a major topic of discussion was the strategy by which Tandy, Tandon, and TP would be able to compete in the marketplace with the new floppy disk drive. "The TEAC \$77 drive has been the driving force by which we seem to be measuring all of our future pricing. . . . Steve Huenemeier [representing Tandon] has been looking at these costs together with Texas Peripherals and felt that the ultimate objective should be a drive with a material cost under \$50. If this goal is met, then we should easily be able to compete." CX 727, at Bates No. 028569; see Huenemeier, Tr. 325-27; Hochman, Tr. 1676.

773. As of September 19, 1984, volume buying was considered a necessary condition to achieve the reduced costs for the TP floppy disk drive. "Jim Mortensen [representing Tandy] will be exploring the avenues to

encourage Tandy to make these types of commitments [sic]." An order of 30,000 units per month was considered necessary to procure material in the volumes required to get a \$50 per unit material cost. CX 727, at Bates Nos. 028569, 028571; Huenemeier, Tr. 327.

774. A Product Evaluation Request/Report on TP's half-height 5-1/4 inch double-sided disk drive was received by TP from the Computer Product Engineering division of Tandy in early October 1984. (The report is dated August 19, 1984, and October 3, 1984.) This report concluded, "This drive is equal or better than the TEAC Drive. It will hold alignment longer, and handle shipping better due to the cast chassis. . . . This drive is acceptable." Hochman, Tr. 1655-59; CX 727, at Bates No. 028599-604.

775. TP on October 9, 1984, received an order for 6,000 units of the TM 65-2 floppy disk drives from Tandy Home Computers, a division of Tandy. The order was scheduled for delivery as follows: 1,000 by November 15, 1984; 2,000 by December 15, 1984; and 3,000 by January 15, 1985. Hochman, Tr. 1614, 1616, 1659; CX 727, at Bates No. 028608; see Huenemeier, Tr. 361-62.

C 776. TP

C : TP delivered the first 50 units for qualification testing in November 1984. TP's next delivery of 400 units did not take place until the first days of January 1985. TP hoped that the units would become qualified at that time and that it could pick up production quickly and complete the orders by February and March 1985. Hochman, Tr. 1614-15; see Huenemeier, Tr. 363-65.

C 777. TP only delivered of the floppy disk drives requested
by Tandy Home Computers for November 1984 because of problems encountered with
C the drives. TP decided that it would be best to deliver only units in
order to identify problems, make modifications, and allow customer evaluation
of the drives. TP could then correct these problems for future shipments.
"[T]he slippage in schedule was agreed upon by the customer on the basis that
C he was getting sufficient drives from to support his operations. But we
knew there would come a time when we had to get this thing going, to get it
delivered, and that time was going to be somewhere in the May-June time
frame." Hochman, Tr. 1647.

778. The units delivered by TP to Tandy Home Computer were not
qualified because the customer considered the product as not meeting its
qualifications and its expectations as to quality. The initial report on the
C first drives sent to Tandy Home Computer in November 1984 gave a breakdown
on the quality issues and the technical problems the customer found in the
C drive. Some of the problems identified were due to

C . These problems associated with the drive were
corrected in the next group sent. Tandy Home Computer found additional
problems with the second group of drives with respect to two areas: (1)
incoming quality; and (2) reliability. Hochman, Tr. 1615-17, 1660-67; see
id., Tr. 1648-50; CX 727, at Bates Nos. 028586-87.

C 779. As of February 1985, TP had progressed in solving many of the
quality problems associated with its floppy disk drives. "

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.” Hochman,

Tr. 1618-19; see id., Tr. 1666-67.

780. The only major problem that remained as to TP's floppy disk drives concerned a soft error problem. A soft error increases the time it takes the computer to recover data. The soft error rate displayed by the units manufactured by TP were in excess of what TP's competition was displaying under the same circumstances. Hochman, Tr. 1619; Huenemeier, Tr. 365-68; CX 727, at Bates No. 028591; see Patterson, Tr. 1751.

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781. TP would have been able to solve

. Hochman, Tr. 1623, 1624; see id., Tr. 1618-21; Huenemeier, Tr. 368, 369.

C
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782. To date,

. Hochman, Tr. 1650 (Apr. 15, 1985).

783. At the February 1985 joint venture committee meeting, the discussion as to the quality problems with TP's disk drive units was considered secondary to the main issue of whether TP had the ability to compete in the market in terms of the cost of its product. Hochman, Tr. 1622-23, 1625-26; CX 727, at Bates Nos. 028591-92; see Huenemeier, Tr. 369-70.

784. TP's cost of production at the time it stopped its half-height double-sided floppy disk drive program was \$. "The cost on that unit has to be qualified because those units came from kits that were supplied from Tandon" Hochman, Tr. 1613.

785. TP was not able to obtain the cost reductions necessary within the time frame required by Tandy Corporation. "Tandy issues orders on a periodic basis We bid, as do other outside vendors, and as such when our bid goes in if it is not competitive, . . . Tandy reserves the right to purchase from outside sources." TP has not been competitive in its bid for Tandy's orders of a half-height double-sided floppy disk drive product. Hochman, Tr. 1610-11.

786. TP's selling price at the time it halted production of its half-height double-sided floppy disk drive program was \$. Hochman, Tr. 1613.

787. Tandy Home Computers indicated in October 1984, when it first placed its order with TP for half-height 5-1/4 inch double-sided disk drives, that there would be follow up orders at \$ per unit if TP could get its drive qualified. Hochman, Tr. 1624-25.

788. If Tandy Home Computers TP's TM 65-2 units, TP planned to reduced the sales price per unit from \$ to \$. Hochman, Tr. 1617.

789. By February 1985, TP needed to qualify its product at a price of \$ per unit in order to get a purchase order from Tandy Home Computers. "[We had received written notice that the present version at that moment in time was \$ and change and that there was another version coming on board for \$ and change." Both TEAC and competed with TP for the Tandy Home

Computers' business. TEAC had proposed a modified version of its double-sided
C floppy disk drive for \$ per unit. Hochman, Tr. 1611, 1625-28, 1676-83;
CX 740; see CX 727, at Bates No. 028591; Huenemeier, Tr. 370-71.

790. As of February 12, 1985, the lowest projected total cost for
C the TM 65 was somewhere in the \$ to \$ price range for an order of
total full-height and half-height floppy disk drives per month. Hochman,
Tr. 1671-73, 1675-76; CX 727, at Bates No. 028596. At this price, TP's
C profits on the sale of floppy disk drives would be between and
percent, with an average end of the year net profit before taxes of less than
C percent. Hochman, Tr. 1673, 1683-84; CX 727, at Bates Nos. 028591,
028598; see Huenemeier, Tr. 372-73. "It was also noted that even this
C optimistic figure would require that Texas Peripherals still sell at \$
C above the TEAC price assuming the \$ unit to be real." CX 727, at Bates No.
028591. Such a profit level was unacceptable with respect to the letter of
the joint venture agreement, which stated that TP had to produce to the
C competitive market price or no less than cost plus percent. Hochman,
1673-74; CX 619, Art. IX, § 9.01.

791. The recommendation was made at the February 1985 joint venture
C committee meeting that

C . Hochman, Tr. 1634, 1682-83. "Texas Peripherals' low volume cannot
C compete with producers of high volume. Everyone agreed that intangible
benefit of proximity to the customer base may no longer be a viable condition
C for maintaining a manufacturing facility devoted to the Slimline [half-height]

C drive.

C .” CX 727, at Bates No.
028592; see Huenemeier, Tr. 371-73, 375, 376-77, 379.

792. If TP had been price competitive with respect to the other floppy disk drive vendors, the qualification process for its drives would have continued. Patterson, Tr. 1753, 1760-61.

793. It became apparent as of February 1985, that Tandy Home
C Computers' planned to cancel its order with TP for units of the TM 65-2
floppy disk drive. The order was finally cancelled in March 1985. Hochman,
Tr. 1617-18, 1634-35. Tandy Home Computers has awarded some of its
C double-sided floppy disk drive business to . Hochman, Tr. 1636; see id.,
Tr. 1636-38.

C 794. TP planned to
C . Hochman, Tr. 1608; Huenemeier, Tr. 389.

C 795. TP . TP cannot
supply the product at the required cost: "We are not competitive with outside
sources." Hochman, Tr. 1608, 1610. TP is unable to sell products to any
customer other than Tandy or Tandon unless the two venturers agree to such a
sale. CX 619, Art. IX, § 9.01; Huenemeier, CX 722, at 7-8; see FF 761.

C 796. TP assembled in its plant approximately TM 65-2 floppy
disk drives. TP never produced a "production quantity" of the TM 65-2, that
C is, an order of drives a month of any one type. Hochman, Tr. 1614,
1628.

C 797. As of December 1984, TP had produced approximately to
C units of the TM 100, a full-height single-sided floppy disk drive, and
C units of the TM 65-1, a half-height 5-1/4 inch single-sided disk

C drive. As of April 15, 1985, TP had outstanding purchase orders for
C TM 100s and TM 65-1s. Except for the head assembly, the mechanical
parts of the TM 65-1 are the same as those found in the TM 65-2. Hochman,
Tr. 1632-33, 1669.

C 798. TP could produce on double shift TM 65-2 double-sided
floppy disk drives a month. Hochman, Tr. 1628; FF 764.

799. As of February 25, 1985, TP's shutdown schedule for March 1985
provides as follows:

C
C
C
C

C
C

C
C

C
C

SX 6(C), No. 1031.

800. As of February 25, 1985, TP's shutdown schedule for May 1985
provides as follows:

C
C
C
C

C
C

C

SX 6(C), No. 1031.

801. As of February 25, 1985, TP's shutdown schedule for July 1985 provides as follows:

C

C

SX 6(C), No. 1031.

802. As of February 25, 1985, TP's shutdown schedule for August 1985, , provides as follows:

C

C

C

C

C

C

C

C

SX 6(C), No. 1031.

803. TP for the most part is proceeding on time with its shutdown schedule. Hochman, Tr. 1638-39.

804. TP received its last order for production of the TM 100, a full-height single-sided floppy disk drive, in February 1985. Hochman, Tr. 1639-40. TP received its last order for production of the TM 65-1, a half-height 5-1/4 inch single-sided disk drive, in the two weeks prior to the hearing on temporary relief. Hochman, Tr. 1640.

C

805.

C

. Hochman,

Tr. 1693. TP is scheduled to complete production on the last order for the

C

TM 65-1s

. Hochman, Tr. 1640.

806. As of April 15, 1985, TP employed 350 persons. During the month of April 1985, TP planned to lay off approximately 25 to 50 employees. In May 1985, TP planned to lay off an additional 75 to 100 employees. Those employees left at TP will continue to produce current orders of the TM 65-1 until July 1985, at which time those remaining individuals were to be laid off. Hochman, Tr. 1692-93; see Huenemeier, Tr. 388.

806A. TP has stopped production of floppy disk drives and
. Hochman, Tr. 1608, 1611, 1613.

806B. The sales price of the TP's TM 65-2 was \$ per unit at the time
. Hochman, Tr. 1613.

806C. TP has not produced any commercial quantities of double-sided disk drives 5-1/4 inch disk drives since the hearing on temporary relief. Huenemeier, Tr. 3630, CX 845.

806D. The Texas Peripherals Joint Venture Committee recently concluded that Texas Peripherals' production equipment would be stored pending the ruling of the Commission. Huenemeier, CX 835, at 19-21.

E. Tandon

1. General.

807. Selected Tandon income statement data (including subsidiary operations) for each of the past five fiscal years ended September 28, are as follows:

Five Years Ending September 28

	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Net Sales	\$22,761	\$54,152	\$150,490	\$303,369	\$400,792
Cost of Sales	<u>16,617</u>	<u>37,567</u>	<u>105,262</u>	<u>219,822</u>	<u>311,106</u>
Gross Profit	6,144	16,585	45,228	83,547	89,686
Product Research & Development	960	2,870	6,042	13,741	16,269
Selling, General & Administrative Expenses . .	2,124	5,735	13,798	36,830	30,113
Interest & Other Expenses .	228	707	289	1,262	2,568
Interest Income	---	(817)	(3,268)	(4,644)	(1,315)
Income before provision for income taxes	<u>2,832</u>	<u>8,090</u>	<u>28,367</u>	<u>36,358</u>	<u>42,051</u>
Provision for Income Taxes.	<u>1,325</u>	<u>3,585</u>	<u>12,632</u>	<u>12,700</u>	<u>12,615</u>
Net Income	<u>1,507</u>	<u>4,505</u>	<u>15,735</u>	<u>23,658</u>	<u>29,436</u>

CX 666, at 20.

808. For Tandon and its subsidiaries, the ratios of net income to net sales for each of the fiscal years 1980 through 1984 are as follows:

<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
7.6%	8.3%	10.5%	7.8%	7.3%

CX 666, at 20.

809. A summary of Tandon's quarterly operating results for calendar year 1984 and first quarter 1985 is as follows:

	<u>March 30, 1984</u>	<u>June 29, 1984</u>	<u>September 28, 1984</u>	<u>December 28, 1984</u>	<u>March 29, 1985</u>
Net Sales	\$105,672	\$106,257	\$95,808	\$90,664	\$61,126
Gross Profit	27,378	27,764	8,838	(7,410)	(14,515)
Income Before Income Taxes	16,057	16,024	(4,349)	(21,963)	(28,440)
Net Income (loss)	10,437	10,416	(724)	(15,374)	(19,910)

CX 666, at 44; CX 667, at 4.

810. For Tandon and its subsidiaries, the ratios of net income to net sales for each of the quarters in calendar year 1984 and the first quarter of 1985 are as follows:

	<u>1Q 1984</u>	<u>2Q 1984</u>	<u>3Q 1984</u>	<u>4Q 1984</u>	<u>1Q 1985</u>
(loss)	9.9%	9.8%	(7.6%)	(17.0%)	(32.6%)

CX 666, at 44; CX 667, at 4.

811. Price erosion is a factor in Tandon's decreasing profitability. CX 666, at 22; Haldi, Tr. 1291-92.

812. In 1983, Tandon's sales volume of double-sided floppy disk drives was units, CX 702.

813. In 1984, Tandon's sales volume of double-sided floppy disk drives was units. CX 702.

814. During 1984, Tandon's sales of double-sided floppy disk drives decreased from units in the first half of the year to units in the second half of the year. CX 702.

814A. Tandon has not yet been able to penetrate the 5-1/4 inch half-height floppy disk drive market to any significant degree. During the period from July 1, 1984, through June 30, 1985, Tandon sold only TM 65-2Ls, TM 65-4s, and TM 65-8s. Tandon estimates that it will be producing less than 5-1/4 inch half-height double-sided floppy disk drives during the months of September through December 1985. Huenemeier, CX 835, at 2-3, 5.

814B. For the fiscal year ended September 30, 1984, Tandon projected sales of half-height 5-1/4 inch double-sided floppy disk drives. Tandon sold units during this period. Huenemeier, CX 835, at 3-4.

814C. For the fiscal year ended September 30, 1985, Tandon originally
C projected sales of \$ half-height 5-1/4 inch double-sided floppy disk
C drives, including projected sales of units through the first three
quarters. As a result of sales below projections, this figure was revised
C downward in February 1985 to units. Tandon has failed to meet this
C lower estimate, shipping approximately units in the first three
quarters of fiscal year 1985. Huenemeier, CX 835, at 4.

814D. According to Mr. Edwards, since May 30, 1985, the TM 65 has
C passed evaluation and been qualified at the following users:

C
C

Mr. Sellers of Compaq stated that Tandon has not been qualified at Compaq.
The TM 65 has also passed evaluation and been qualified at the following
C distributors:

C . Edwards, CX 818, at 2; Sellers, Tr. 4954.

C 814E. Since May 30, 1985,
C have also requested evaluation units of the TM 65-8. Edwards, CX 818,
at 2.

814F. Eastern Peripherals' current direct costs of producing the
C TM 65-2, including materials and labor, is \$, which yields a cost,
C including freight and duty, landed in the United States of \$. Tandon is
C currently paying Tandon Associates \$ for such drives. Huenemeier,
CX 835, at 7, 29-30.

815. From fiscal year 1983 to fiscal year 1984, United States employment at Tandon dropped from 3,300 persons to 1,605 persons. Tandon attributes this decline primarily "to restructuring of its manufacturing operations to emphasize offshore production of mature product lines." CX 666, at 18.

815A. In Tandon's flexible disk drive and head division, employment declined from 1,782 persons in January 1984 to 549 persons in July 1984. CX 870.

815B. In Tandon's flexible disk drive and head division, employment declined from 549 persons in July 1984 to 165 persons in July 1985. CX 870.

815C. Tandon laid off 1,450 employees of the floppy disk drive division between January 1984 and January 1985. Huenemeier, Tr. 3614-15; CX 870.

815D. In December 1984 and January 1985, Tandon terminated 197 United States employees:

	<u>Department</u>	<u>No. Terminated</u>
C	Engineering	
C	Production	
C	Purchasing	

Huenemeier, CX 835, at 5. The engineers were laid off because Tandon's expenditures were not appropriate for the amount of profits being generated. Huenemeier, Tr. 3684.

815E. From January 1985 through July 1985, Tandon laid off 167 employees in the flexible disk drive and head division. Tandon's decrease in personnel between January and July 1985 is attributable to erosion in the demand for Tandon floppy disk drives. CX 870; Huenemeier, Tr. 3701.

815F. In May 1985, Tandon vacated and sublet its Building No. 1, which
C had square feet of space, in an effort to reduce its operating losses.
C At the same time and for the same reason, Tandon sublet Building No. 2 with
C square feet. Tandon is currently in the process of closing its
engineering building (Building No. 4 with square feet), its personnel
C building (Building No. 5 with square feet), and its marketing building
C (Building No. 6 with square feet). These buildings are being closed
because the employee layoffs have left Tandon with substantial excess space.
The operations in these buildings will be consolidated in Tandon's Building
C No. 3, which has square feet of space. Huenemeier, CX 835, at 6-7.

816. In 1982, Tandon had a 60.5 percent market share of the United States 5-1/4 inch double-sided disk drive market. Mitsubishi and TEAC had a combined market share of 5.5 percent. CX 678, at DT13-13.

817. In 1983, Tandon had a 30.5 percent market share of the United States 5-1/4 inch double-sided disk drive market. Mitsubishi and TEAC had a combined market share of 21.5 percent. CX 679, at DT14-15.

818. In 1982, Tandon had a 23.8 percent market share of the United States 8 inch double-sided disk drive market. Mitsubishi had a 11.5 percent market share. CX 678, at DT11-11.

819. In 1983, Tandon had a 20.7 percent market share of the United States 8 inch double-sided disk drive market. Mitsubishi had an 11.2 percent market share. CX 679, at DT12-11.

820. In fiscal year 1984, Mitsubishi and TEAC sold in the United
C States and disk drives, respectively. CX 694; CX 690.

C 821. In October-December 1984, Mitsubishi and TEAC sold and
C disk drives, respectively. CX 690; CX 694.

C 821A. Tandon sold only evaluation units of its half-height drives to
IBM in fiscal year 1984. Huenemeier, Tr. 3629-30.

C 822. As of April 1985, Tandon had received a purchase order from
C for TM 75s. Prior to that order, Tandon had no major order for
half-height 5-1/4 inch disk drives. Huenemeier, Tr. 296; Haldi, Tr. 1269.

C 822A. is currently evaluating the Tandon TM 75, and no purchase
orders had actually been placed with Tandon as of August 1985. Edwards, CX
C 818, at 4.

C 823. In June 1984, , placed an order
C for double-sided disk drives with TEAC. was a prior customer of
TM 100s and had evaluated the TM 65-2 and TM 65-4 for a proposed purchase of
C minimum units over 12 months. Abraham, CX 714, at 6.

C 824. , selected TEAC for a
C double-sided floppy disk order. was a prior Tandon TM 100 customer
C and evaluated the TM 65, but decided to place its order with TEAC for to
C units over a 12-month period. Abraham, CX 714, at 6.

C 825. In November 1984, , placed an
C order with TEAC for to double-sided 5-1/4 inch floppy disk drive
C units per year starting November 1984. had evaluated the TM 65.
Abraham, CX 714, at 7.

C 826. , selected TEAC as vendor
C for to double-sided floppy disk drives per year over Tandon's
TM 65. Abraham, CX 714, at 7.

C 827. In June 1984,
C , gave TEAC an order for to floppy disk drives
per year. Other competitors for this account included Mitsubishi and
C Shugart. evaluated Tandon's TM 65-2L. Abraham, CX 714, at 7.
C 828. In 1983,
C ordered to double-sided floppy disk drives from TEAC. Tandon
had sought this business. Abraham, CX 714, at 7-8.
C 829. In October 1982,
C gave TEAC an order for approximately double-sided floppy disk drives
per year. Abraham, CX 714, at 5.
C 830. In October 1983,
C selected TEAC for an order of approximately double sided floppy disk
drives per year. Abraham, CX 714, at 5.
C 831. In September 1983,
C gave an order of to double-sided disk drives to
TEAC. Abraham, CX 714, at 5-6.
C 832. In June 1983, gave an order to TEAC for
double-sided floppy disk drives per year. Abraham, CX 714.
C 833. In September 1983, , gave an
C order to TEAC. In October 1984, gave TEAC an order for
double-sided floppy disk drives per month. Abraham, CX 714, at 8.
C 834. In November 1984,
C , gave TEAC an order for double-sided 5-1/4 inch floppy
disk drives over three years. Abraham, CX 714, at 8.

C 835. In October 1984, canceled an order for
C approximately TM 65-2L disk drives after delivery of units and
C awarded the balance of drives to TEAC and Mitsubishi. CX 714, at 5, 9.

C 835A. had previously canceled an order for TM 55s initially
C issued on August 12, September 6, and November 1, 1983, with \$ million of
C product still on order from Tandon in October and November 1983.
canceled this order because Tandon was unable to solve its production problems
and deliver a specified quantity of functioning half-height disk drives.
Abraham, MRX 117C, at 2-6.

C 836. , canceled a
C July 29, 1983, order for TM 55s with \$ of product still on order from
C Tandon and switched to Mitsubishi. Abraham, CX 714, at 9.

C canceled this order because Tandon was unable to solve its
C production problems and deliver a specified quantity of functioning
half-height disk drives. Abraham, MRX 117C, at 2-5; see MRX 48M.

C 837. In October 1983,
C , gave Mitsubishi an order for double-sided floppy disk
drives. Abraham, CX 714, at 9.

C 837A. In October 1982, Mitsubishi obtained part of a sale of
double-sided floppy disk drives to . Abraham, CX 714, at 5, 9.
Contra MRX 48JJJ, at 026875, 027733-34.

C 837B. In September, 1983, Mitsubishi obtained part of a sale of
C double-sided floppy disk drives to . Abraham, CX 714,
at 5, 9.

C 838. In April 1983,
C , awarded Mitsubishi an order for double-sided floppy disk
drives per year. Abraham, CX 714, at 10.

C 839. In October 1984, , selected
C Mitsubishi for an order of double-sided floppy disk drives per year.
C had evaluated Tandon's TM 65-8. Other competitors included TEAC.
Abraham, CX 714, at 10.

C 840. On October 1984,
C selected Mitsubishi for an order of approximately drives per year.
C had evaluated Tandon's TM 65-2L. Other competitors for this order
included TEAC and Shugart. Abraham, CX 714, at 10-11. Contra MRX 48BBB, at
026472.

C 841. In November 1983,
C , gave Mitsubishi an order for double-sided 5-1/4 inch floppy disk
drives. Abraham, CX 714, at 10-11.

C 842. In June 1983,
gave Mitsubishi an order for 5-1/4 inch double-sided disk drives. Abraham,
CX 714, at 11.

843. Tandon bid on each of the orders contained in FF 823 to 842.
Abraham, Tr. 1142-43.

C 843A. In May 1983, canceled an order for TM 50s
C initially issued on January 3, 13, and 25, 1983, with \$ million of product
C still on order from Tandon. canceled this order because Tandon was
unable to solve its production problems and deliver a specified quantity of
functioning half-height disk drives. Abraham, MRX 117C, at 2-5.

C 843B. In late 1983, canceled an order for TM 50s
C initially issued on September 30, 1983, with \$ million of product still on
C order from Tandon. canceled this order because Tandon was
unable to solve its production problems and deliver a specified quantity of
functioning half-height disk drives. Abraham, MRX 117C, at 2-5.

C 843C. In April 1984, canceled an order for TM 65s
C initially issued on July 21, 1983, with \$ million of product still on order
C from Tandon. canceled this order because Tandon was unable to
solve its production problems and deliver a specified quantity of functioning
half-height disk drives. Abraham, MRX 117C, at 2-5.

C 843D. In May 1984, canceled an order for TM 55Ds
C initially issued on October 31, 1983, with \$ million of product still on
C order from Tandon. canceled this order because Tandon was
unable to solve its production problems and deliver a specified quantity of
functioning half-height disk drives. Abraham, MRX 117C, at 2-5.

C 843E. MELA, since March 1985, may have shipped approximately to
C 1.6 megabyte Model M4854 floppy disk drives to . Foster, Dep.,
C CX 574, at 264-65. had previously canceled a March 18, 1983, order for
C TM 50s with \$ million of product still on order from Tandon in early 1984.
C canceled this order because Tandon was unable to solve its production
problems and deliver a specified quantity of functioning half-height disk
drives. Abraham, MRX 117C, at 2-5.

C 843F. On or about June 29, 1983, requested a
C quote from Tandon for TM 55s for delivery over a two-year period, for
C which Tandon quoted a price of \$ per drive for a total of \$ million.

Tandon was unable to land this business opportunity as a result of its inability to deliver functioning evaluation drives on a timely basis and its inability to demonstrate that it could deliver large quantities of TM 55s on a reliable basis. Mr. Abraham understood that TEAC and Mitsubishi ultimately received this business. Abraham, MRX 117C, at 6.

C 843G. In the spring of 1983, requested a quote from Tandon
C for TM 55-2s and TM 55-4s for delivery over a two-year period,
C for which Tandon quoted a price of \$ and \$, respectively, per drive for
C a total of \$ million. Tandon was unable to land this business opportunity
C as a result of its inability to deliver functioning evaluation drives on a
timely basis and its inability to demonstrate that it could deliver large
quantities of TM 55s on a reliable basis. Mr. Abraham was informed that
Toshiba obtained this business for the same price quoted by Tandon. Abraham,
MRX 117C, at 6-7.

C 843H. In 1983, requested a quote from Tandon for
C TM 65s for delivery over a two-year period, for which Tandon quoted a price of
C \$ per drive for a total of \$ million. Since the TM 65 was not available
C and the customer desired a direct drive, this sale was not made. Mr. Abraham
C was informed that a two-year contract for drives was given to
C Matsushita and Shugart for \$ per drive. Abraham, MRX 117C, at 7.

C 843I. In 1983, requested a quote from Tandon for
C TM 65s for delivery over a two-year period, for which Tandon quoted a price of
C \$ per drive for a total of \$ million. Since the TM 65 was not available
C soon enough and the customer desired a direct drive, this sale was not made.
C Mr. Abraham understood that a two-year contract for drives was given to
TEAC for \$145 per drive. Abraham, MRX 117C, at 7.

C 843J. In the summer of 1983, requested a quote from Tandon for
C TM 65s for delivery over a one-year period, for which Tandon quoted a
C price of \$ per drive for a total of \$ million. Because of technical
problems with the product, this sale was not made. Mr. Abraham was informed
C that Acorn ordered drives from TEAC and Mitsubishi. Abraham,
MRX 117C, at 8.

C 843K. In 1983, ICL requested a quote from Tandon for TM 65s for
C delivery over a one-year period, for which Tandon quoted a price of \$ per
C drive for a total of \$ million. Because Tandon could not deliver either
the TM 65 or the TM 55 as an interim product pending completion of the TM 65,
C this sale was not made. Mr. Abraham understood that ordered drives
C from TEAC at \$ per drive. Abraham, MRX 117C, at 7-8.

C 843L. MELA currently sells 1.0 megabyte, Model M4853 floppy disk
C drives to in very low quantities. Foster Dep., CX 574, at 292.

C 843M. MELA competed with Tandon for sales of 5-1/4 inch disk drives to
C . Matsushita obtained the account. Foster Dep.,
CX 573, at 29.

C 843N. MELA competed with Tandon for sales of 8 inch floppy disk drives
C to . Mitsubishi obtained the account at a higher price per
unit than Tandon charged. Foster Dep., CX 573, at 31.

C 843P. MELA competed with Tandon for sales of 5-1/4 inch floppy disk
C drives to . Mitsubishi obtained the account at a \$ to \$
premium over Tandon's price. Foster Dep., CX 573, at 31.

C 843Q. MELA competed with Tandon for sales of 5-1/4 inch 1.0 megabyte
C floppy disk drives to Mitsubishi obtained the account.
Foster Dep., CX 447, at 311; Foster Dep., CX 574, at 234-35.

843R. MELA currently is competing with Tandon for sales of 1.6 megabyte floppy disk drives and possibly 0.5 megabyte and 1.0 megabyte floppy disk drives to . A vendor has not yet been chosen. Tandon's price is lower than the Mitsubishi price. Foster Dep., CX 574, at 268-69.

843S. In February 1984, Tandon and MELA competed for sales of 5-1/4 inch half-height floppy disk drives to , a computer company in northern California. Foster Dep., CX 447, at 323-24.

843T. In early 1984, MELA, Tandon, Shugart, CDC, Qume, Ricoh, and Phillips competed for sales of floppy disk drives to . Foster Dep., CX 447, at 324-25.

843U. Tandon has competed with MELA for sales of 1.6 megabyte, half-height 5-1/4 inch double-sided floppy disk drives to . Foster Dep., CX 574, at 249-51.

843V. Tandon has competed with MELA, Shugart, TEC, TEAC, and MPI for sales of 5-1/4 inch floppy disk drives to . Foster Dep., CX 447, at 320.

843W. MELA competed for sales of 0.5 megabyte floppy disk drives with TEAC and Shugart at . Tandon was the supplier at that time. CX 546, Bates No. 524635.

843X. MELA competed with Tandon, TEAC, and Shugart for sales of floppy disk drives to . Foster, Dep., CX 447, at 289.

843Y. In July 1982, MELA competed with Tandon and Shugart for sales of floppy disk drives to , a subsidiary of . was experiencing delivery problems with Tandon at that time. Foster Dep., CX 447, at 308; MRX 4811, at 027202.

843Z. MELA competed with Tandon, Shugart, and Alps in February 1983
C for sales of floppy disk drives to . Foster Dep., CX 447, at 311-12.

843AA. MELA competed with Shugart, TEAC, Tandon, Remex, and Seagate for
C sales of floppy disk drives to . later went
bankrupt. Foster Dep., CX 447, at 315-16.

843BB. In April 1983, MELA and Tandon competed for sales of floppy disk
C drives to , a computer company in northern California. MELA obtained the
account. Foster Dep., CX 447, at 316-17.

843CC. MELA has competed with Tandon for sales of the 1.0 megabyte
C 5-1/4 inch floppy disk drive to . Tandon was initially
C awarded the account because of its lower price. later
awarded the account to MELA because of quality deficiencies in Tandon's
product. Foster Dep., CX 447, at 270-72.

843DD. MELA has competed with Tandon for sales of 1.6 megabyte, floppy
C disk drives to . MELA received a premium price above that quoted by
other companies because of the performance of its product. Foster Dep.,
CX 574, at 237-40.

843EE. MELA has competed with Tandon, TEAC, NEC, and Hitachi for sales
C of 5-1/4 inch floppy disk drives to . MELA's price was in
C the area of \$. There were several companies offering prices below what
MELA's contract stated. Foster Dep., CX 574, at 233-35.

843FF. Through April 1984, Tandon suffered order cancellations in
C excess of \$ million as a result of its inability to solve its production
problems and deliver a specified quantity of functioning half-height disk
drives. Abraham, MRX 117C, at 2-4.

843GG. Based upon Mr. Abraham's knowledge and familiarity with Tandon's business opportunities in 1983 and continuing in 1984 with respect to the TM 50 and TM 55 as well as a half-height direct drive disk drive product, Tandon lost over \$ million in business opportunities because of its inability to deliver functioning products to potential customers on a timely basis. Abraham, MRX 117C, at 6.

843HH. TEAC sells disk drives to A&A Japan, the Japanese office of A&A International, a purchasing arm of Tandy. Osawa, TRX 28, at 2-3.

843II. A&A Japan acquires title in Japan to the drives and subsequently exports them to the United States to A&A International. Accordingly, TEAC sells drives to A&A Japan at the f.o.b. Tokyo price. Osawa, TRX 28, at 3.

843JJ. Sometimes drives are sold by TEAC's United States subsidiary, TCA, to A&A International in the United States. However, nearly all disk drives which are sold directly to A&A Japan are from TEAC Japan. Osawa, TRX 28, at 3.

843KK. As of April 1985, the lowest price offered by TEAC to A&A Japan for the double-sided floppy disk drives being sought has been \$ f.o.b. Tokyo. Osawa, TRX 28, at 7. Lately, A&A has applied further pressure on TEAC to lower its quoted price of \$. Osawa, TRX 28, at 7.

843LL. Because Radio Shack is committed to purchasing double-sided floppy disk drives at \$ f.o.b. California in June, A&A stated that TEAC's failure to meet its competitor's price might result in no orders by A&A for TEAC drives as of June and July 1985. Osawa, TRX 28, at 8.

2. Future Sales.

844. The period of time during which the marketing of a new product is most opportune is frequently referred to as the "marketing window." This window opens when a demand for a new product is identified. Once an OEM has selected its vendor(s) for a particular product, the window of opportunity associated with that product has substantially closed. Abraham, CX 714, at 2; Abraham, Tr. 1057-58.

844A. The marketing window for 5-1/4 inch double-sided, half-height, high capacity floppy disk drives is currently open. Abraham, Tr. 1067.

844B. It is expected that several major computer OEMs will soon announce next-generation computer products with 3-1/2 inch disk drives. Haldi, CX 711, at 74.

844C. The initial OEM orders for 3-1/2 inch disk drives will be crucial in determining future market position among floppy disk drive manufacturers. Those floppy disk drive manufacturers that fail to achieve initial OEM orders while the window is open will tend to be relegated to a niche position in the market, and could even be forced to leave the market altogether. Haldi, CX 711, at 74.

844D. The move by IBM to offer a computer with 1.6 megabyte, double-sided 5-1/4 inch disk drives has opened another important window of opportunity for floppy disk drive manufacturers. Haldi, CX 711, at 74-75.

844E. The desire to introduce new computer models by the fall of 1985 may lead many computer OEMs to place critical initial orders for disk drives between May and July 1985. Placement of such orders will cause important windows of opportunities to close. Haldi, CX 711, at 76.

844F. Many important windows of opportunities that are now open could begin closing as early as May, June, or July 1985. Haldi, CX 711, at 76-77.

845. The marketing window can reopen if the selected vendor can not deliver the disk drive. Abraham, Tr. 1059-62.

846. Once an OEM selects a floppy disk drive vendor for one of the OEM's products, there are certain factors which may weigh against changing the vendor for the product. For example, OEMs spend a substantial amount of time and effort to evaluate a vendor and its product, and a change in vendors may require retraining of personnel and customers and changes in sales manuals and software. Additionally, OEMs tend to enter into long-term contracts. Abraham, CX 714, at 2-4.

847. Lost sales to a given OEM may be significant not only because of the particular contract lost, but also because of potential sales opportunities for future business with that OEM. Abraham, CX 714, at 4.

847A. Tandon remains in competition with Sony, TEAC, and Mitsubishi for several major accounts which will be awarded during the next few months. Abraham, CX 714, ¶ 17.

C 848. is scheduled to select a vendor
C in May 1985 for an order of 3-1/2 inch double-sided floppy disk drives
C per year. Tandon is seeking to sell its TM 304. Abraham, CX 714, at 5;
Langer Dep., CX 254, at 71-72.

C 849. is also seeking a vendor on a 1.6 megabyte, 5-1/4 inch
double-sided drive. Tandon is seeking to sell its TM 65-8 there and is in
head-to-head competition with TEAC and Mitsubishi. Abraham, CX 714, at 15.

C 849A. The opportunities are still pending. Tandon has been
requested to send additional evaluation units with regard to the 1.6 megabyte,
C 5-1/4 inch drive. has experienced an internal problem with its
temperature chamber equipment which delayed the completion of testing.
Edwards, CX 818, at 3.

C 850. , is scheduled to select
C a vendor in August 1985 for to 3-1/2 inch double-sided floppy
disk drives. Tandon is seeking to sell its TM 308 (1 MB) and TM 309 (1.6 MB)
drives and is in head-to-head competition with TEAC. Abraham, CX 714, at 16.

850A. Tandon is in competition with Mitsubishi for an order with
C regarding 1.6 megabyte, 5-1/4 inch drives. Foster Dep., CX 447,
Tr. 365-69.

C 850B. The matter remains pending. Additionally, has
requested since the hearing on temporary relief that Tandon supply TM 65-8s
for evaluation. The pending competition is Mitsubishi and TEAC. The order is
C believed to be in the magnitude of to pieces over a 24-month
C period. has given initial acceptance of the first TM 65-8s evaluated
and has since ordered eight additional ones. Edwards, CX 818, at 3-4;
Edwards, Tr. 3728-29.

851. Tandon was in head-to-head competition with TEAC and Mitsubishi
C at , for an order for 1.0
megabyte, 5-1/4 inch double-sided floppy disk drives. Tandon was seeking to
C sell its TM 65-8. Abraham, CX 714, at 16. The qualification
is now completed. Tandon has been selected as an alternative choice. The
primary choice was either TEAC, Mitsubishi, or Toshiba. Edwards, CX 818, at 4.

852. Tandon is in head-to-head competition with TEAC for an order
C from , for 3-1/2 inch double-sided floppy disk
drives. Vendor selection is scheduled for April 1985 (1 MB) and October 1985
C (1.6 MB). The quantity of 1 megabyte drives involved is per year by
C 1986. Tandon is seeking to sell its TM 308 (developed to specifications
for 1.0 MB) and TM 309 (1.6 MB). Abraham, CX 714, at 16; see Foster Dep.,
CX 447, at 373-74. Selection of a 3-1/2 inch product appears to be on hold.
Edwards, CX 818, at 4.

C 853. , is also seeking a vendor for 1.6
megabyte, 5-1/4 inch double-sided floppy disk drives, as a second source to
C . Tandon is in competition with Mitsubishi for a contract.
C Approximately units will be ordered and vendor selection is scheduled
for about July 1985. Tandon is offering its TM 75-8. Abraham, CX 714, at 17;
Foster Dep., CX 447, at 371-75. Tandon's TM 75 is currently in the evaluation
stages. Edwards, CX 818, at 4.

C 854. is seeking a vendor for
3-1/2 inch double-sided drives at several locations and has a vendor selection
C date of October 1985, for a quantity of per year for its
C , operation . Vendor selection is scheduled for
C October 1985 for an order of drives per year for its
C operation . Tandon is seeking to sell its TM 304 and
TM 309 drives. Abraham, CX 714, at 16, 17.

855. , is seeking a vendor for a 1.0 megabyte, 5-1/4 inch double-sided floppy disk drive. Tandon is in head-to-head competition with Mitsubishi for an order of drives per year there starting June 1985 with vendor selection in May 1985. Abraham, CX 714, at 17, 18; Foster Dep., CX 447, at 376.

855A. The 3-1/2 inch product is currently being evaluated by on an ongoing basis. With regard to the 5-1/4 inch product, the Tandon disk drive is presently well along in the evaluation stage and qualification is expected. Vendor selection will occur in October 1985. Qualification of the TM 65 has occurred at all stages except shock and vibration, which is currently ongoing. Edwards, CX 818, at 4.

855B. Tandon initially quoted \$ to with respect to to TM 65-4 units. Tandon was advised by that this quote was not even close to the competition. Tandon was informed that Mitsubishi, TEAC, and Toshiba were all offering substantially lower prices. Accordingly, on June 27, 1985, Tandon quoted \$ to \$ for to units to and was advised that this quotation as well was higher than the prices quoted by Mitsubishi, TEAC, and Toshiba. Edwards, CX 818, at 5.

856. Tandon is in head-to-head competition with TEAC and Mitsubishi at . A vendor start date of August 1985 is schedule there for an order of double-sided 3-1/2 inch and 5-1/4 inch floppy disk drives per year. Tandon is seeking to sell its TM 308 (1 MB), TM 65-8 (1.6 MB), and TM 64-2L (0.5 MB) drives. Abraham, CX 714, at 18; Foster Dep., CX 447, at 378-79.

C 856A. On January 25, 1985, Tandon quoted \$ to \$ to
C for to units of its TM 65-8D, a double-sided 5-1/4 inch floppy
C disk drive, 1.6 megabyte. Tandon also quoted \$ to \$ to for
C to units of its TM 65-2, a 0.5 megabyte double-sided disk
C drive. Tandon has been informed by that its competition was
offering prices lower than Tandon's. Mr. Edwards knows that Mitsubishi is
C currently supplying with double-sided floppy disk drives and
believes that TEAC is also. Edwards, CX 818, at 6.

C 856B. is currently talking to Tandon about long-range
opportunities. Edwards, Tr. 3732-35; see Edwards, CX 818, at 5.

C 856C. Tandon is in competition with Mitsubishi for a contract offered
C by , for
double-sided 3-1/2 inch floppy disk drives per year. The vendor selection
date is May 1985. Langer Dep., CX 554, Tr. 382-83; Abraham, CX 714, ¶ 17.

857. As of April 1985, MELA has had discussions the past six months
with Commodore concerning the potential sale of drives to that company.
Foster, Tr. 304.

858. MELA continues to meet with Wang with the hope of doing
business with it. Foster, Tr. 399.

C 858A. On June 25, 1985, Tandon quoted \$ to for units
C of TM 65-2L double-sided floppy disk drive. This quote was made to
C after Tandon was informed that Mitsubishi was quoting a price below
C Tandon's list price of \$ for its comparable double-sided disk drive for this
quantity of units, but did not indicate how much lower Mitsubishi's quote
was. Edwards, CX 818, at 5; Edward, Tr. 3737-43; see Foster, Tr. 4742..

858B. Included in TEAC's customer list are the following companies:
Apple Computer; A&A Consumer Pro. Laboratories; Billings Research
International; Burroughs Corp.; Control Data Corp.; Convergence; Dysan Corp.;
IBM; Magnetic Peripherals; Memorex; Micro Peripherals; Qume Corp.; Sperry
Univac; Tandy Advanced Products; Tandy Home Computers; Texas Instruments; Wang
Laboratories, Inc. CX 17.

858C. A number of major OEMs, including IBM, are thought to be in the
process of designing new computer models which will incorporate 3-1/2 inch
C micro-floppy disk drives. is expected to
C select a double-sided micro-floppy vendor in May 1985; is expected to
C choose a supplier by August 1985; and the plant in , is
thought to have a vendor selection date set for April 1985 and October 1985.
C The order is expected to be for units per year, and the combined
C orders are expected to be for units per year. Abraham,
CX 714, at 15-16.

858D. Tandon is seeking to sell its 3-1/2 inch double-sided floppy
C disk drive to major OEM accounts such as . Abraham,
CX 714.

858E. have solicited the same accounts for which Tandon
C has solicited 3-1/2 inch micro-floppy disk drive orders. ;
Brehme, CX 48, at 195-96, 305.

859.-861. Intentionally Left Blank.

862. In 1985, Matsushita, TEC, Epson, TEAC, Mitsubishi, and Alps
C quoted factory prices in Japan ranging from the high \$ s to the mid-\$ for
half-height 5-1/4 inch double-sided drives in the 100,000 quantity range. The
amount to be added to these prices to obtain a delivered United States price
would be roughly \$9 or less. Chidambaram, Tr. 1713-16.

863. In a document dated January 11, 1985, TCA listed 30 major OEM
C "target accounts" for fiscal 1985, including
C . Brehme, Tr. 2709; CX 18, at 250927.

864. TEAC double-sided disk drives compete against those of Tandon,
Texas Peripherals, Control Data Corporation, and Shugart. Brehme, Tr. 2745,
2766; CX 48, at 185-90, 197-204.

865. TEAC Japan's forecast for TCA's sales in fiscal year 1985 was
C units per month. CX 18, at 250925; Brehme, Tr. 2707-08.

866. TCA's own forecast for its sales in fiscal year 1985 was
units per month. CX 18, at 250925; Brehme, Tr. 2707-08.

867. Based on a September 1984 report, TEAC has plans for total
production of its FD-53/54/55 series double-sided 5-1/4 inch disk drives of
C units in 1985, of which units were reserved for export,
C and units (including sales by TCA) were targeted for the United
States. CX 8, at Bates No. 251230; Beckerman Dep., CX 49, at 103-08; Haldi,
CX 711, at 57.

868. TEAC is presently competing for 3-1/2 inch double-sided disk
drive sales at major United States OEMs. Brehme, Tr. 2767.

869. TEAC distributes disk drives in the United States in approximately the following percentages: percent to retail distribution type customers; percent to the middle tier of industrial type customers; and percent to large OEMs. TCA sells to percent of total TEAC sales in the United States. Brehme, Tr. 2772-74.

870. The OEM sales are the most important to TEAC because the retail distribution sales are dependent to some extent on the OEM sales. Also, sales to the retail distribution and industrial customers are somewhat cyclical and unpredictable. Brehme, Tr. 2772-73.

871.-882. Intentionally Left Blank.

F. Mitsubishi

1. General.

882A. Mitsubishi officially introduced the 96 TPI, 1.0 megabyte disk drive in early 1982, and introduced the 96 TPI, 1.6 megabyte disk drive in August 1982. These two products have constituted a significant portion of Mitsubishi's computer peripheral business in the United States. Foster, Tr. 4734.

882B. MELA secured just about every account for its 1.0 megabyte disk drive in the 1983 time frame. Mitsubishi was six to twelve months ahead of all other disk drive manufacturers with the high capacity disk drive. Initially, Mitsubishi lost business by not marketing a 48 TPI disk drive, because that was where the greatest portion of the disk drive market was shifting in 1982, due to IBM's announcement of a PC-type product. Foster, Tr. 4735.

883. Mitsubishi has production facilities in Japan with a capacity of approximately products and carriage assemblies per month. CX 690, Interrogatory No. 11.

883A. MELCO's capacity to produce 3-1/2 inch floppy disk drives in Japan is drives per month. Foster, Tr. 4919.

883B. Mitsubishi first sold 3-1/2 inch disk drives (MF 353) in the United States during the period October 1983 to March 1984. However, the quantity sold in that period was small. During the period April 1984 to December 1984, Mitsubishi sold approximately 3-1/2 inch double-sided disk drives in the United States, out of total double-sided disk drive sales of about thousand units. CX 690, Interrogatory No. 7, at 3.

883C. MELA has issued purchase orders for Model 353A 3-1/2 inch double-sided disk drives. This is a new model introduced by MELCO. Some of these disk drives will be shipped to customers as evaluation units. Foster, Tr. 4817, 4825-26; MRX 112; MRX 113A.

883D. Intentionally Left Blank.

883E. Although MELA supports inquiries from domestically, also has a foreign buying office, and procures disk drives directly from Japanese manufacturers. Foster, Tr. 4918.

883F. Orders had been placed by directly with MELCO for 3-1/2 inch double-sided disk drives for use by . The volumes would be for 5,000 disk drives per year initially, and a best case of to disk drives purchased over a five or six year period. purchases from Mitsubishi would be covered by the . Foster, Tr. 4918-19; CX 621, at 7-8; see also, CX 537, at 530726.

883G. For the period July-December 1985, MELA forecasted sales of
C 3-1/2 inch disk drives in the United States (forecast date of July 5,
C 1985). Approximately of these sales were accounted for by .
C Proposed prices ranged from \$ for sales to to \$ for sales to
Sun Electric. CX 536.

C 883H. was MELA's largest new account in 1985, purchasing
C 3-1/2 inch double-sided disk drives (MF 353). Foster, Tr.
4791.

C 883I. For the period April 1985 to September 1985, MELA had proposed
C pricing to MELCO for the MF 353 disk drive of \$ in April-May 1985 and
C \$ in July-September 1985 (c.i.f. Los Angeles). The accepted price was
C \$. CX 557.

C 883J. In June 1985, MELA listed , as a
significant opportunity for the MF 353A (new 3-1/2 inch double-sided), and
C and as significant opportunities for the the MF 353 (3-1/2 inch
double-sided). CX 537, at 530728.

883K. In August 1985, MELCO disclosed that it had a contract to
supply IBM with 250,000 3-1/2 inch floppy disk drives, with production to
begin in the spring of 1986. This drive is the MF 355, a 2.0 megabyte disk
drive, which Mitsubishi had announced at the July 1985 National Computer
Conference. CX 877.

C 883L. The tradeoff between short term profit and market share is a
CX 537, at 530725.

883M. For the period January-June, 1986, Mitsubishi has forecasted sales of 3-1/2 inch disk drives, with the largest customer being . CX 536.

884. Mitsubishi's monthly production of double-sided disk drives during fiscal year 1984 was approximately units per month. CX 690, Interrogatory No. 11; see CX 690, Interrogatory No. 7, at 3.

885. Mitsubishi's double-sided disk drives compete with double-sided disk drives sold by Tandon, Shugart, and Control Data Corporation. Foster, CX 447, at 308-27.

886. There was a percent surplus of production capacities at Mitsubishi's Koriyama Works. CX 690, Interrogatory No. 11.

887. Mitsubishi's inventory of floppy disk drives at its Koriyama Works in December 1984 was disk drives, of which were 5-1/4 inch disk drives. In March 1984, the inventory level was units. CX 690, at attachment 4.

888. Intentionally Left Blank.

889. In a report dated January 14, 1985, MELA projected disk drive sales of \$ in 1985, and \$ in 1986. Of the 1985 forecast, \$ was for 5-1/4 inch disk drives, \$ was for 3-1/2 inch disk drives, and \$ was for 8 inch disk drives. CX 470, at 512106.

890. With the exception of 8 inch double-sided disk drives, Mitsubishi devotes employees and square meters to manufacture and production of double-sided floppy disk drives. This activity takes place in Koriyama Works in Japan. Manufacture of 8 inch double-sided disk drives is done under Mitsubishi's technical guidance in OA Research Institute, Ltd., which is a subcontract factory of Mitsubishi. CX 690, Interrogatory No. 9.

891. All research and development for Mitsubishi's double-sided floppy disk drives is carried out in Japan. Foster Dep., CX 447, at 47; CX 688, Interrogatory No. 9.

892. Mitsubishi is currently considering new double-sided disk drive products for sale in the United States. One is a _____ inch double-sided floppy disk drive with a _____. Also under discussion is a _____ inch double-sided disk drive and additional models of a _____ inch double-sided disk drive. Foster Dep., CX 447, at 140-49.

893. MELCO devotes _____ employees and _____ square meters to research and development of double-sided floppy disk drives. This activity takes place in Japan. CX 690, Interrogatory No. 9.

894. Design engineering for Mitsubishi's double-sided floppy disk drives occurs in Japan. Foster Dep., CX 447, at 48.

895. Product engineering for Mitsubishi's double-sided floppy disk drives occurs in Japan. Foster Dep., CX 447, at 48.

896. Primary quality control for Mitsubishi's double-sided floppy disk drives occurs in Japan. Foster Dep., CX 447, at 63-64.

897. MELCO devotes _____ employees and _____ square meters to marketing, distribution, sales, and warehousing of double-sided floppy disk drives. CX 690, Interrogatory No. 9.

897A. Mitsubishi stated that with respect to the 3-1/2 inch floppy disk drive market,

. It planned to

C
C

. Mitsubishi believed that

in the market for

3-1/2 inch floppy disk drives. CX 856, at 520022.

898. In September 1984, SONAM forecast sales in February 1985 of 800 3-1/2 inch disk drives, of which 480 were single-sided and 320 were double-sided disk drives. CX 240.

899. SONAM has placed with potential customers approximately 10 full-height OA-D33Ws, 80 half-height MP-F51Ws, and 50 half-height MP-F52Ws evaluation units one megabyte, 3-1/2 inch disk drives. CX 202, Interrogatory No. 7; CX 692, at 4; Mergentime Dep., CX 252, Vol. I, at 119-20.

900. Intentionally Left Blank.

901. Sony introduced a 5-1/4 inch plug-compatible version of its 3-1/2 inch double-sided floppy disk drive (OA-D33W), which was advertised as being capable of replacing standard mini-floppy drives without any interfacing problems. The double-sided version was scheduled to be available in early 1985, but was never produced in commercial quantities. CX 210; Mergentime Dep., CX 252, Vol. I, at 119-20.

902.-978. Intentionally Left Blank.

2. Mitsubishi Pricing Strategy.

C
C

979. MELA is a customer of MELCO, and

. Foster, Tr. 4899-4900.

980. According to Mr. Foster of MELA, MELA's approach to pricing is
C as follows:

C
C
C
C
C

. Foster, Tr. 4784-89.

981. According to Dr. Magrath, Mitsubishi is staying in the floppy disk drive market at all costs, by pricing competitively and disregarding its own production costs, contrary to common business practice. Dr. Magrath relied on CX 855 and CX 856 to support his theory concerning Mitsubishi's pricing policy. Magrath, Tr. 3990.

982. According to Dr. Magrath, if over the long run a company is uncompetitive in price in a certain product line, common business sense would dictate that the company should drop the product line. Magrath, Tr. 3988.

983. Exhibit CX 855 is a series of internal MELA/MELCO letters discussing Mitsubishi pricing during the ten month period ending in March
C 1985, primarily for sales to . On seven occasions during this
C period, Mitsubishi referenced the lower prices of competitors (including
C) in analyzing its own pricing
C strategy for . CX 855, at 517778, 517779, 517783, 517796, 517797,
517849, 517864, 517889, 517927.

984. Exhibit CX 856 is a series of internal MELA/MELCO letters
C concerning Mitsubishi pricing to certain U.S. customers ().
C On occasions, MELCO referenced its production cost and/or profit margin

C as . The relationship
between production quantity and cost was also cited. CX 856, at 520011,
520019-21, 520026.

985. Mitsubishi spent months qualifying to obtain a contract for
C double-sided floppy disk drives from in mid to late 1984. Although
C qualified, MELA did not obtain any business from because MELA could not
C meet price requirements. This was one account where a lower price
C requested , due to cost constraints at
C . Foster, Tr. 4802-03, 4909-10, 4921-22; CX 856, at 519939.

C 986. Mr. Foster estimates that MELA has
C
C
C . Foster, Tr.
4909-10.

C 987. One specific instance where was
C for a sale to . This was justified by the
C which would result from the increase in
production volume. Foster, Tr. 4912, 4919-20.

CONCLUSIONS OF LAW

1. The U.S. International Trade Commission has jurisdiction over unfair methods of competition and unfair acts in the importation into or sale in the United States of products the effect or tendency of which is to destroy or substantially injure an industry, efficiently and economically operated, in the United States. 19 U.S.C. § 1337.

2. The Commission has subject matter jurisdiction over the double-sided floppy disk drives and components thereof at issue in this investigation that have been imported into or sold in the United States. FF 1.

3. U.S. Letters Patent No. 4,151,573 is valid. Opn., at 13-31.

4. Patent infringement is an unfair act or method of competition under 19 U.S.C. § 1337. In re Von Clemm, 108 U.S.P.Q. 371 (C.C.P.A. 1955).

5. The double-sided floppy disk drives of the Mitsubishi respondents considered in this investigation do not infringe the claims of the '573 patent. Opn., at 31-46.

6. The Mitsubishi respondents have imported into and sold in the United States certain double-sided floppy disk drives. Opn., at 47-48.

7. The domestic industry in this investigation is defined by the domestic activities of the patentee and its licensees devoted to the manufacture, distribution, research and development, and sale of 5-1/4 inch and 3-1/2 inch double-sided floppy disk drives. Opn., at 49-65.

8. The domestic operations of complainant and its licensees devoted to the manufacture, distribution, research and development, and sale of 5-1/4 inch and 3-1/2 inch double-sided floppy disk drives constitute a domestic industry for purposes of § 337. Opn., at 65-97.

9. The domestic industry at issue in this investigation is efficiently and economically operated. Opn., at 98-109.

10. The alleged unfair methods of competition and unfair acts of respondents in the importation of double-sided floppy disk drive into the United States, or in their sale, do not have the effect or tendency to substantially injure the domestic industry at issue in this investigation. Opn., at 110-48.

11. There is no violation of § 337 of the Tariff Act of 1930, as amended, in the importation of certain double-sided floppy disk drives and components thereof, or in their sale, by reason of infringement of U.S. Letters Patent No. 4,151,573, the effect or tendency of which is to destroy or substantially injure an industry, efficiently and economically operated, in the United States. Conclusions of Law 3-10.

INITIAL DETERMINATION AND ORDER

Based on the foregoing opinion, findings of fact, conclusions of law, and the record as a whole, and having considered all pleadings and arguments as well as proposed findings of fact and conclusions of law, it is the administrative law judge's INITIAL DETERMINATION that no violation of § 337 exists in the importation of certain double-sided floppy disk drives and components thereof, or in their sale, by reason of infringement of U.S. Letters Patent No. 4,151,573, the effect or tendency of which is to destroy or substantially injure an industry, efficiently and economically operated, in the United States.

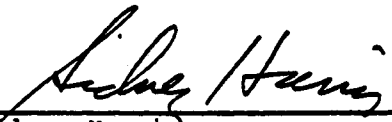
In accordance with Rule 210.44(b), all material found to be confidential by the administrative law judge under Rule 210.6(a) is to be given in camera treatment for five years from the termination date of this investigation.

The Secretary is instructed to serve a public version of this Initial Determination upon all parties of record and the confidential version upon counsel for complainant Tandon Corporation and respondents Mitsubishi Electric Corporation and Mitsubishi Electronics America, Inc., who are signatories to the protective order issued by the administrative law judge on January 30, 1985, and the Commission Investigative attorney. To expedite service of the public version, counsel is hereby ordered to serve on the administrative law judge by no later than November 12, 1985, a copy of this Initial Determination with those sections considered by the party to be confidential bracketed in red ink.

This Initial Determination shall become the determination of the Commission 45 days after its date of service unless the Commission within those 45 days shall have ordered review of this Initial Determination, or certain issues herein, pursuant to Rules 210.54(b) or 210.55. 19 C.F.R. § 210.53(h).

Any party to this investigation may request a review by the Commission of this Initial Determination by filing with the Secretary a petition for review, except that a party who has defaulted may not petition for review of any issue regarding which the party is in default. A petition of review shall be filed within ten (10) days after the service of this Initial Determination.

19 C.F.R. § 210.54(a).

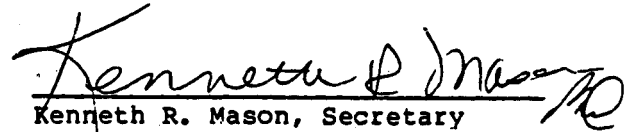


Sidney Harris
Administrative Law Judge

Issued: November 1, 1985

CERTIFICATE OF SERVICE

I, Kenneth R. Mason, hereby certify that the attached Initial Determination (Public Version) was served upon Victoria L. Partner, Esq., Robert D. Litowitz, Esq., and upon the following parties via first class mail, and air mail where necessary, on November 27, 1985.



Kenneth R. Mason, Secretary
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