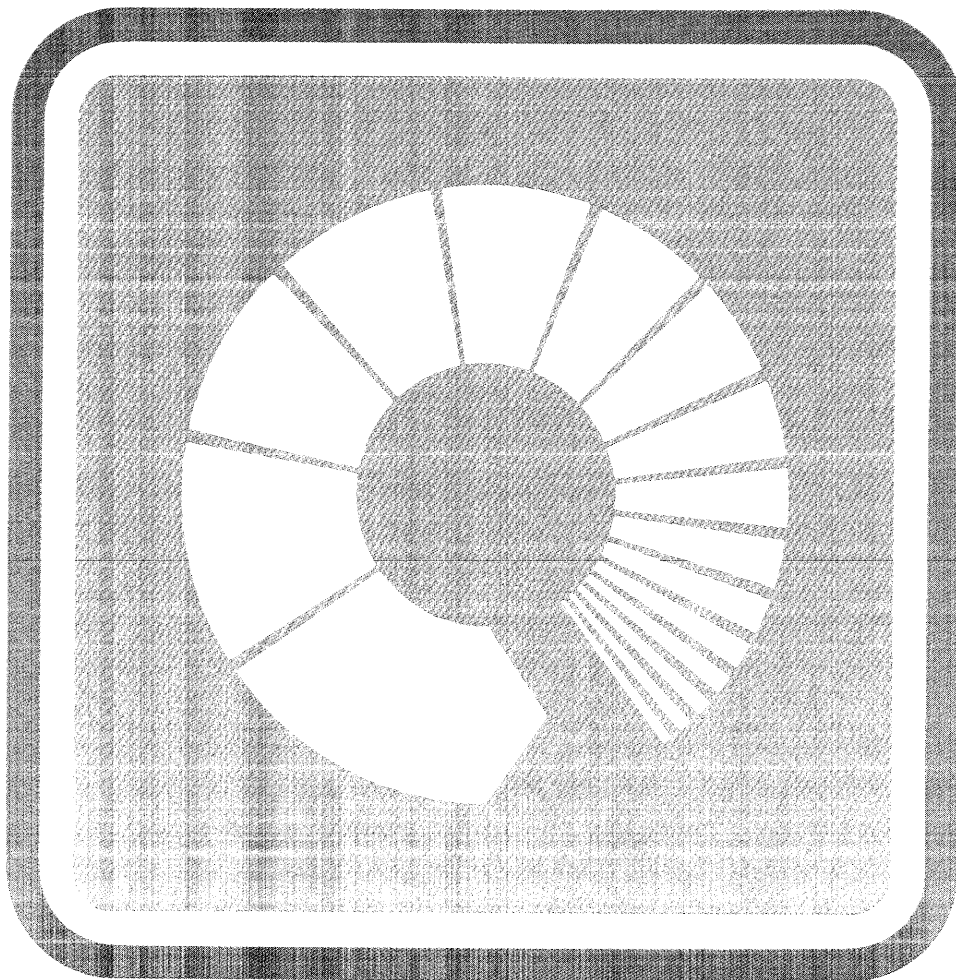


7906

DISC DRIVE

USER'S MANUAL



CERTIFICATION

Products, materials, parts, and services furnished on this order have been provided in accordance with all applicable Hewlett-Packard specifications. Actual inspection and test data pertaining to this order is on file and available for examination.

Hewlett-Packard's calibration measurements are traceable to the National Bureau of Standards to the extent allowed by the Bureau's calibration facilities.

The Hewlett-Packard Quality Program satisfies the requirements of MIL-Q-9858, MIL-I-45208, and MIL-C-45662.



7906

DISC DRIVE

USER'S MANUAL

Printed: MAR 1980

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P.O. Box 39, Boise, Idaho, U.S.A.

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PREFACE

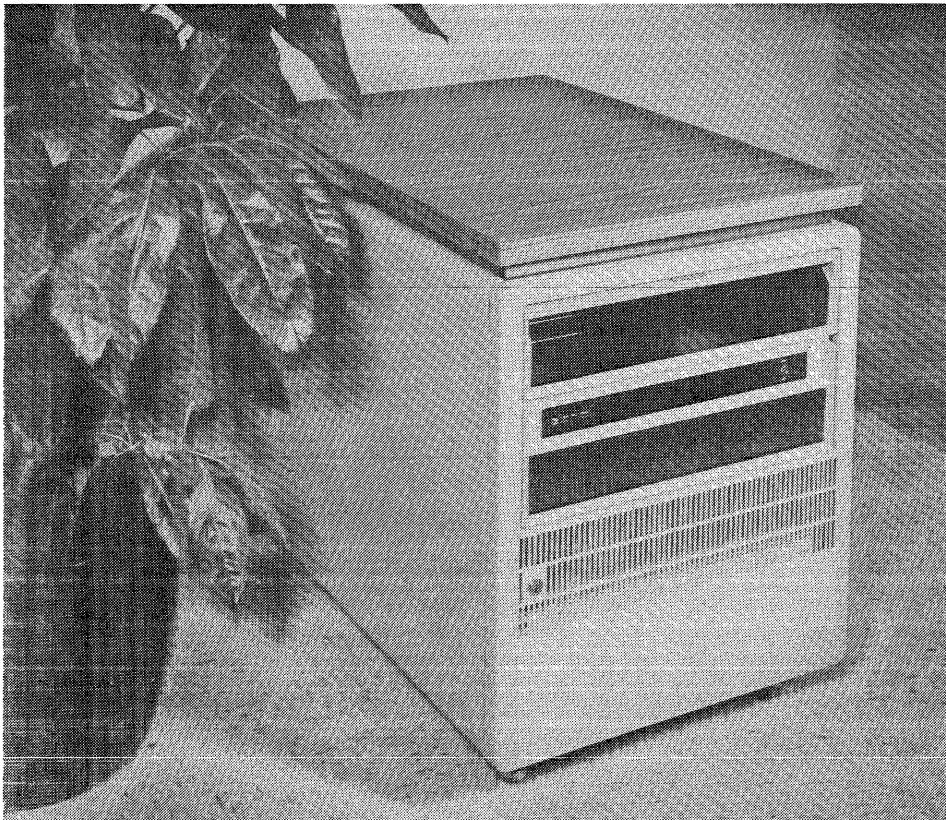
This manual contains general information pertaining to the operation of the HP 7906 Disc Drive, one of a family of disc storage drives. Hewlett-Packard's disc manufacturing experience includes more than 21,000 customer shipments. Engineering and manufacturing excellence have been emphasized in the HP tradition to ensure that the entire disc drive family exhibit the performance, reliability, and serviceability that have established HP products as a marketplace standard. Complete service is offered for the disc drive from 172 Hewlett-Packard service offices around the world.

NOTICE

The information contained in this document is subject to change without notice.

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HP 7906 Disc Drive

ABOUT HEWLETT-PACKARD



Hewlett-Packard began as a small company in 1939 in Palo Alto, California. William Hewlett and David Packard, two Stanford University graduate engineers, built their first product, a resistance-capacity audio oscillator, with an original investment of \$538. This oscillator was easier to use, more stable, and less expensive than others available at the time. The first sale was to a Walt Disney Studios engineer who was impressed enough by the oscillator to order eight to be used in filming the movie "Fantasia."

With this modest start, the company grew in its first ten years from annual sales of \$5,000 to \$2 million and a total of 200 employees. By 1959, an expanding product line of electronic test and measurement instruments produced sales of \$50 million and employment exceeded 2,000.

In the 1960's the demand for increasingly sophisticated electronic equipment led to the development of the first Hewlett-Packard minicomputer and the first Hewlett-Packard desktop calculator. These products were designed to interface easily with test and measurement instruments and thus make measuring more efficient and accurate. By the end of the 60's decade, the total corporate sales were more than \$336 million.

Through continued growth in the 1970's, Hewlett-Packard today is a major manufacturer of electronic equipment for measurement and computation and is rapidly becoming the world's leading manufacturer of minicomputer and calculator based mass storage devices. Noted for design excellence and superb reliability, over 21,000 disc drives have been shipped to date. The company now employs over 44,000 people throughout the world, with annual sales in excess of one billion dollars.

INTRODUCING THE 7906

GENERAL DESCRIPTION

The HP 7906 Disc Drive is a high-performance, random-access, mass-storage device designed for use as a peripheral unit with small- and medium-size systems. The disc drive has a combination fixed disc and a front-loading, removable disc cartridge.

All HP 7906's contain a sophisticated fault detection system which senses abnormal drive conditions and indicates the fault through a group of four light-emitting diode indicators on the control printed-circuit assembly. This advanced serviceability feature facilitates troubleshooting and reduces time to diagnose and repair failures.

In addition, HP 7906's which contain an integrated controller have a self-test feature which further facilitates troubleshooting.

DISC MEDIA

The HP 12940A Formatted Disc Cartridge is uniquely and individually tested and certified to meet Hewlett-Packard's stringent requirements for error-rate performance, mechanical balance, and surface flatness. Because of the unique interdependence of the disc drive and the disc cartridge, Hewlett-Packard's published specifications, disc drive performance, and reliability can only be assured when using the HP 12940A Disc Cartridge. For the above reasons, if the HP 7906 Disc Drive is operated using a disc cartridge other than the HP 12940A Disc Cartridge and damage occurs as a result, Hewlett-Packard will *not* be responsible for the repair or the resulting damage under either warranty or an HP service contract.

Extensive testing of the HP 7906 Disc Drive in conjunction with the HP 12940A Disc Cartridge has ensured the best possible disc media error performance and interchangeability of disc cartridges between HP 7906 Disc Drives (operating within the performance specifications and within environmental limits) throughout the warranty period of the disc drive.

The disc media consists of two magnetic-oxide-coated discs. Both surfaces of the cartridge disc and the bottom surface of the fixed disc are data surfaces. The top surface of the fixed disc is used to store servo information which controls positioning of the read/write heads. There are 411 cylinders available for information storage. Each cylinder consists of four tracks, one on each surface of the cartridge disc and two on the lower surface of the fixed disc. When formatted, each data track is subdivided into 48 data sectors. Each data sector is capable of storing up to 128 words of data. A data word consists of 16 bits of information.

ENVIRONMENTAL CONSIDERATIONS

TEMPERATURE

Although the HP 7906 Disc Drive has been designed and manufactured to operate over a wide range of environmental conditions, it is important to use the disc drive within the limits specified in table 1 to ensure disc cartridge interchangeability.

Table 1. Temperature/Humidity Considerations

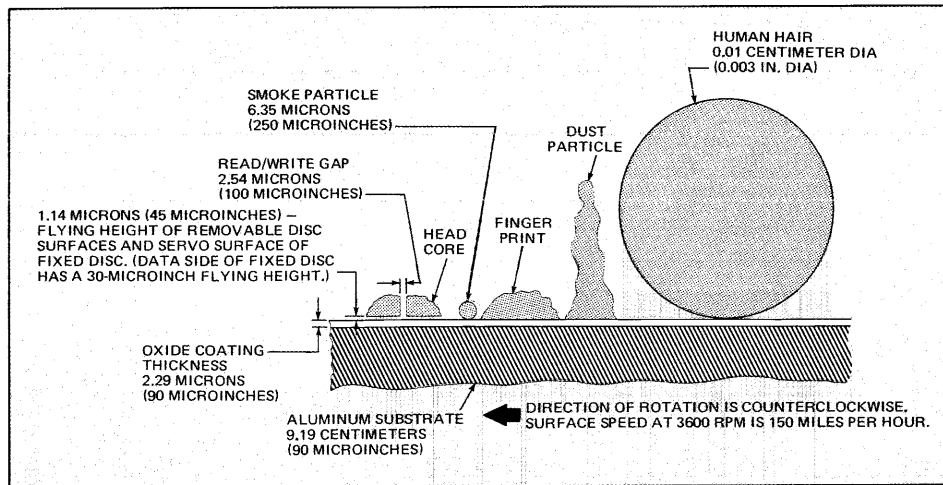
AMBIENT TEMPERATURE	
Operating:	10°C to 40°C (50°F to 104°F) rate of temperature change not to exceed 10°C (18°F)/hour
Non-Operating:	-40°C to 65°C (-40°F to 149°F) rate of temperature change not to exceed 20°C (36°F)/hour
RELATIVE HUMIDITY	
Operating:	8% to 80% with maximum wet bulb temperature not to exceed 25.6°C (78°F), non-condensing
Non-Operating:	5% to 95%
Note:	The disc drive must not be turned on if there are signs of moisture condensation in or on the disc drive.
ALTITUDE	
Operating:	Sea level to 4 572 m (15,000 ft)
Non-Operating:	304.8 m (1,000 ft) below sea level to 15 240 m (50,000 ft)

The temperature of the disc cartridge with respect to the disc drive must be within $\pm 3^{\circ}\text{C}$ ($\pm 5.4^{\circ}\text{F}$) of each other to ensure optimum performance. If the waiting time is not critical and disc cartridges are stored in another area, the temperature of the storage area should be maintained between -15°C and 60°C (5°F and 140°F) with the relative humidity between 0 and 95 percent. If the temperature and relative humidity of the storage area are different than the operating area, the disc cartridges must be allowed 2 hours for environmental stabilization when brought into the operating area.

CLEANLINESS

Shown on the following page are the critical elements involved in the disc read/write process, i.e., the read/write gap, the flying height of the heads, and the thickness of the oxide coating on the disc surfaces. The flying height is an average value due to the surface irregularities of both heads and disc. Also shown are various types of contaminants and their size relationships. A contaminant particle hard enough and of the right size may scratch either the oxide coating or the head surface. Even if not hard enough to scratch, it may be large enough to increase the head disc spacing, thereby causing data errors. Therefore, to prevent potential damage or data losses, it is extremely important to maintain the cleanliness of the air within the disc drive.

Air entering the disc drive passes through a prefilter, which traps the larger contaminant particles, and then through an absolute filter, which traps 99 percent of all contaminants down to 0.3 micron in size. By trapping the larger particles, the prefilter extends the life of the more costly absolute filter. To ensure that clean air will be present, the air flow through the filters must be checked on a regularly scheduled basis. The preventive maintenance schedule requires that the absolute filter output air pressure be measured every six months when the disc drive is operated in a clean environment. When the disc drive is operated in a severe environment, such as one in which unusual amounts of dust, smoke, moisture, oil vapor, or other foreign matter are present, the absolute filter output air pressure should be measured more frequently. Refer this measurement and any filter replacement to service-trained personnel.



Head/Media Critical Elements

STORAGE

Special considerations must be taken for storage of disc cartridges. It is highly desirable to have disc cartridges stored in environmental surroundings that are nearly identical with those of the operating area. Storing disc cartridges in the same area where the disc drive is located will avoid the waiting time for disc drive and disc cartridge temperature equalization.

Disc cartridges should always be stored in a clean, dust-free area and should not be stacked more than two high when lying flat. It is advisable to provide storage cabinets with shelves adjusted to the appropriate height. Disc cartridges should not come in contact with any magnetic material and should not be stored directly on top of the disc drive. A magnetic field with an intensity greater than 50 oersteds near a disc cartridge can cause loss of information.

ACCESSORIES

The following accessories may be ordered with the disc drive or separately from your local Hewlett-Packard Sales and Service Office. A list of HP Sales and Service Offices is provided at the back of this manual.

HP Model No.	Description
HP 10631B	HP-IB Interface Cable (2 m) (6.55 ft)
HP 12904A	Slide Mounting Kit
HP 12940A	Formatted Disc Cartridge
HP 13013B	Multi-Unit Cable (3.66 m) (12 ft)
HP 13013B-001	Multi-Unit Cable (1.83 m) (6 ft)
HP 13013B-002	Multi-Unit Cable (5.49 m) (18 ft)
HP 13013B-003	Multi-Unit Cable (2.44 m) (8 ft)
HP 13213B	Data Cable (3.05 m) (10 ft)
HP 13213B-001	Data Cable (7.62 m) (25 ft)
HP 13213B-002	Data Cable (15.24 m) (50 ft)
HP 13213B-003	Data Cable (22.86 m) (75 ft)
HP 13213B-004	Data Cable (1.83m) (6 ft)

SUPPORTING DOCUMENTATION

The following documentation may be ordered from a Hewlett-Packard Sales and Service Office. Sales and Service Offices are listed at the back of this manual.

- *HP 7906 Disc Drive Installation Manual*, part no. 07906-90902.
- *HP 7906 Disc Drive Service Manual*, part no. 07906-90903.

USING THE 7906

OPERATING PRECAUTIONS

WARNING

The disc drive does not contain operator-serviceable parts. To prevent electrical shock, refer all installation and maintenance activities to service-trained personnel.

The operator should observe the following precautions when operating the disc drive:

- The disc drive has a strong magnetic field; do not wear a wrist watch when working near the top rear of the disc drive.
- Do not place magnetic media on top of the disc drive.
- Observe all warning and caution labels affixed to the disc drive.
- In normal operation the heads “fly” over the disc surfaces on a thin cushion of air. Dust or other contaminants between the head and the disc can cause the head to contact the disc and possibly damage the disc and/or the head. Operate the disc drive in a clean area to minimize the chance of this malfunction occurring.
- If head and disc contact should occur as described above, do not attempt to retrieve data by placing the potentially damaged disc cartridge in another drive. Also, do not place another disc cartridge in this drive until the drive and disc cartridge have been checked by service-trained personnel.

OPERATING PROCEDURES

The following paragraphs provide the basic operating procedures for the disc drive. Included is a procedure for startup, changing a disc cartridge, changing logical unit identification, shutdown, and responding to disc drive faults.

STARTUP PROCEDURE

To operate the disc drive, proceed as follows:

- a. Set the RUN/STOP switch to the STOP position.
- b. Push in on the bottom edge of the control panel access door to open it.
- c. Set the DISC PROTECT switches as desired.
- d. Set the FORMAT switch as desired.
- e. Set the UNIT SELECT switch to correspond to the desired disc drive logical unit address (Hewlett-Packard Interface Bus device address for disc drives with an integrated controller) which will permit proper operation with the system.

- f. Set the POWER switch (at rear of disc drive) to the 1 (or on) position. (On earlier versions of the HP 7906, a POWER/OFF switch is located on the operator control panel behind the control panel access door.) Observe that the Unit Select Identification and DOOR UNLOCKED indicators light.
- g. Close the control panel access door.
- h. Open the cartridge access door by pulling out and down on its recessed upper edge.

CAUTION

If head and disc contact should occur, as described under OPERATING PRECAUTIONS, do not attempt to retrieve data by placing the potentially damaged disc cartridge in another drive. Also, do not place another disc cartridge in this drive until the drive and disc cartridge have been checked by service-trained personnel.

- i. Carefully insert an HP 12940A Formatted Disc Cartridge, access-door end first, until it is seated fully.
- j. Close the cartridge access door.
- k. Set the RUN/STOP switch to RUN. The DOOR UNLOCKED indicator will go out and after the startup sequence is complete (one minute or less) the DRIVE READY indicator will light. The DRIVE FAULT indicator will light only if a malfunction occurs. Also, for disc drives with an integrated controller, the SELF TEST FAILED indicator will blink while the self test is running and light steady if the disc drive fails the self test.

CHANGING A DISC CARTRIDGE

To change a disc cartridge, proceed as follows:

- a. If the disc drive is operating, set the RUN/STOP switch to STOP. The DRIVE READY indicator will go out immediately.
- b. Allow the spindle to halt (30 seconds or less). The DOOR UNLOCKED indicator will light indicating that the cartridge access door may be opened.
- c. Open the cartridge access door by pulling out and down on its recessed upper edge.
- d. Firmly grasp the disc cartridge and slowly pull it straight out.
- e. Carefully insert the new disc cartridge, access-door end first, until it is seated fully. Use only an HP 12940A Formatted Disc Cartridge.
- f. Close the cartridge access door.
- g. Set the RUN/STOP switch to RUN to resume operation.

CHANGING LOGICAL UNIT IDENTIFICATION

To change the logical unit identification of the disc drive, proceed as follows:

- a. If the disc drive is operating, set the RUN/STOP switch to STOP. The DRIVE READY indicator will go out immediately.

- b. Push in on the bottom edge of the control panel access door to open it.
- c. Set the UNIT SELECT switch to correspond to the desired disc drive logical unit address (Hewlett-Packard Interface Bus device address for disc drives with an integrated controller) which will permit proper operation with the system.
- d. Close the control panel access door.
- e. Set the RUN/STOP switch to RUN to resume operation.

SHUTDOWN PROCEDURE

To shut down the disc drive, proceed as follows:

- a. Set the RUN/STOP switch to STOP. The DRIVE READY indicator will go out immediately.
- b. Allow the spindle to halt (30 seconds or less). The DOOR UNLOCKED indicator will light indicating that the cartridge access door may be opened and the cartridge removed, if desired.
- c. Set the POWER switch (at rear of disc drive) to the 0 (or off) position. (On earlier versions of the HP 7906, a POWER/OFF switch is located on the operator control panel behind the control panel access door.) The Unit Select Identification and DOOR UNLOCKED indicators will go out.

RESPONDING TO DISC DRIVE FAULTS

Disc drive faults must be referred to your local Hewlett-Packard Customer Engineer or to other service-trained personnel. Conditions which define drive faults are as follows:

- a. No DRIVE READY indication one minute or less (could be longer if the temperature of the cartridge and disc drive are not within $\pm 3^{\circ}\text{C}$) after setting the RUN/STOP switch to RUN. This indicates that the disc drive has not reached operational status.
- b. DRIVE FAULT indicator lights at any time.
- c. For disc drives with an integrated controller, the SELF TEST FAILED indicator lights steady at any time.

Authorized operator responses when the disc drive appears to be malfunctioning are as follows:

- a. If the DRIVE FAULT indicator is not lighted, set the RUN/STOP switch to STOP. Check for errors, such as an incorrect logical unit/device address, or an improperly seated disc cartridge.
- b. For disc drives with an integrated controller, if the SELF TEST FAILED indicator light blinks continuously check that the OP/SERVICE switch on the self-test panel at the rear of the disc drive is at the OP position.
- c. Report all observed disc drive faults to the supervising operator.

OPERATOR PANEL

DRIVE READY

Lights to indicate that the startup sequence is complete and the disc drive is ready for operation.

RUN/STOP

When set to RUN, the startup sequence is initiated. After the startup sequence is complete, the heads will be loaded at cylinder zero and the DRIVE READY indicator will light.

When set to STOP, the shut-down sequence is initiated. After the disc has stopped rotating the DOOR UNLOCKED indicator will light to indicate that the disc cartridge may be removed.

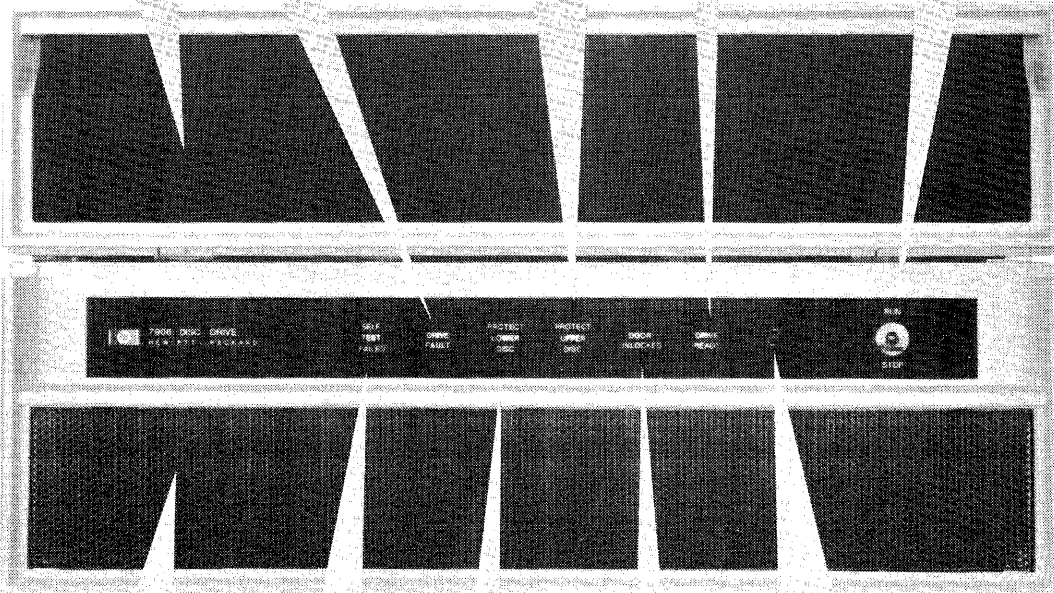
DRIVE FAULT

Lights in the event a malfunction occurs in the disc drive.

PROTECT UPPER DISC

Lights whenever the UPPER DISC PROTECT switch is activated. When lighted, it indicates that both data surfaces on the upper (removable) disc are protected from any write operations.

CARTRIDGE ACCESS DOOR



CONTROL PANEL ACCESS DOOR

SELF TEST FAILED

Lights steady whenever a disc drive with an integrated controller fails the self test.

PROTECT LOWER DISC

Lights whenever the LOWER DISC PROTECT switch is activated. When lighted, it indicates that the data surface on the lower (fixed) disc is protected from any write operations.

The Unit Select Identification Indicator displays the selected logical unit address of the disc drive (HP-IB device address for disc drives with integrated controller). When the disc drive is selected (unable to respond to the self-test START switch for disc drives with integrated controller), a light-emitting diode is lighted in the upper corner of this indicator.

DOOR UNLOCKED

Lights whenever the RUN/STOP switch is set to STOP, the spindle has stopped and the door lock solenoid is energized. The cartridge access door may now be opened. It also lights when the RUN/STOP switch is set to RUN and the cartridge access door is not closed.

CONTROL PANEL

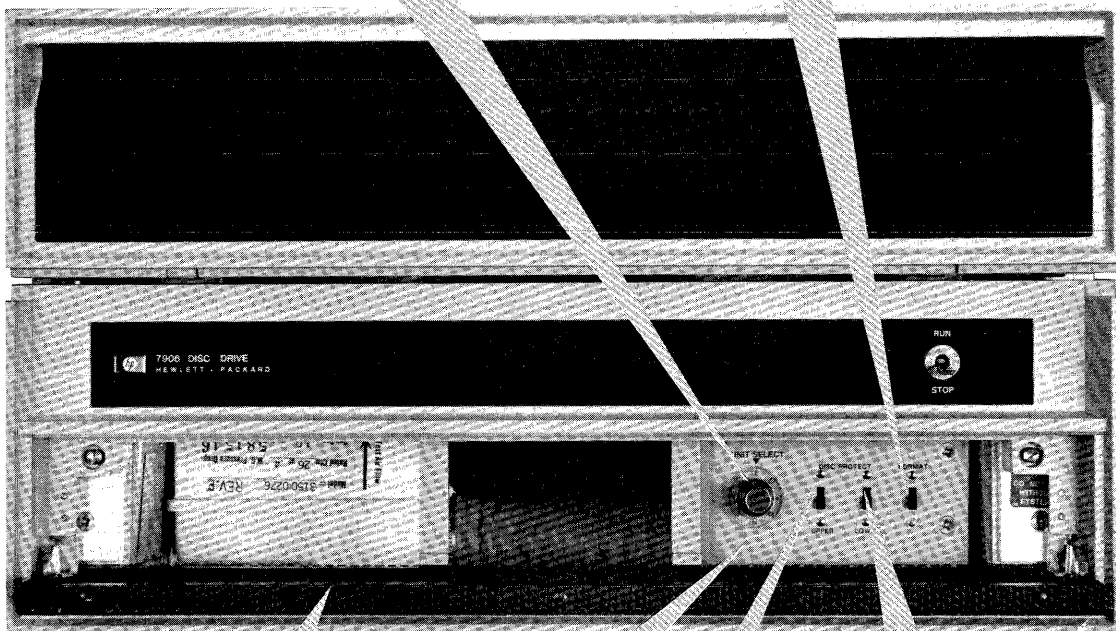
UNIT SELECT

Selects the logical unit address of the disc drive (HP-IB device address for disc drives with an integrated controller). The Unit Select Identification indicator will correspond to the switch setting.

FORMAT

When set to the alter position (up or ●), the contents of the sector address field can be changed. This position is used to initialize an unrecorded disc or to selectively set protected track status bits in the sector address field.

When set to the protected position, the contents of the sector address field cannot be altered.



**CONTROL PANEL
ACCESS DOOR (OPEN)**

**OPERATOR
CONTROL PANEL***

UPPER DISC PROTECT

When set to the protected position (up or ●), the data recorded on both surfaces of the upper disc is protected from any write operations. The PROTECT UPPER DISC indicator will light to indicate that the data protection feature is activated.

When set to the unprotected position, the data recorded on both surfaces of the upper disc is not protected from any write operations and therefore it is subject to change.

LOWER DISC PROTECT

When set to the protected position (up or ●), the data recorded on the data surface of the lower disc is protected from any write operations. The PROTECT LOWER DISC indicator will light to indicate that the data protection feature is activated.

When set to the unprotected position, the data recorded on the data surface of the lower disc is not protected from any write operations and therefore it is subject to change.

* Earlier versions of the HP 7906 have POWER/OFF switch and fuse F1 on the operator control panel.

REAR PANEL

F2

This 8-ampere, 250-volt, slo-blo secondary fuse (part no. 2110-0383) provides overload protection for the -36 Vdc power supply.

F3

This 8-ampere, 250-volt, slo-blo secondary fuse (part no. 2110-0383) provides overload protection for the +36 Vdc power supply.

F4

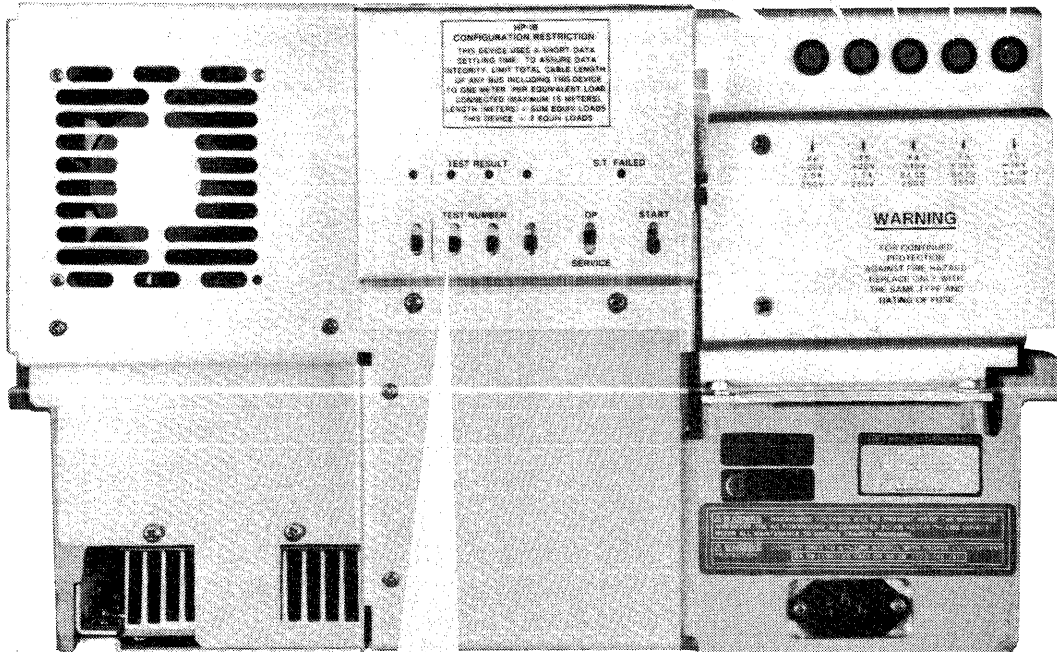
This 8-ampere, 250-volt secondary fuse (part no. 2110-0342) provides overload protection for the +10 Vdc unregulated (+5 Vdc regulated) power supply.

F5

This 1.5-ampere, 250-volt secondary fuse (part no. 2110-0043) provides overload protection for the +20 Vdc unregulated (+12 Vdc regulated) power supply.

F6

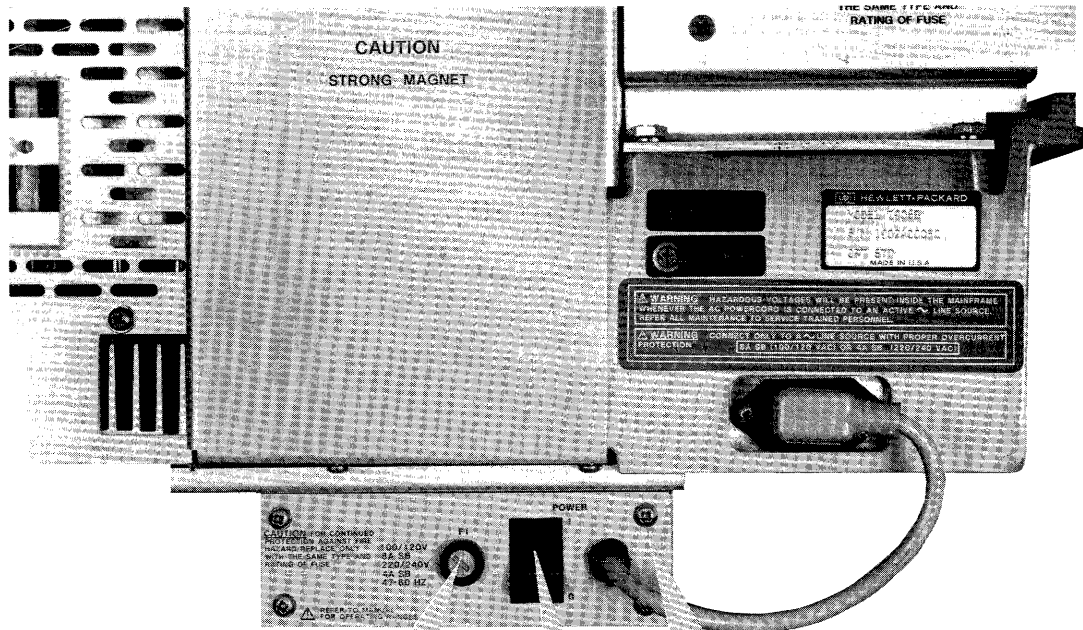
This 1.5-ampere, 250-volt secondary fuse (part no. 2110-0043) provides overload protection for the -20 Vdc unregulated (-12 Vdc regulated) power supply.



SELF TEST PANEL

Only on disc drives with an integrated controller. A servicing aid for troubleshooting the integrated controller and disc drive. Automatically performs a self-test routine whenever power is turned on, whenever the RUN/STOP switch is set to RUN, by system command, or by activating the self-test panel START switch.

POWER PANEL



F1*

Provides protection from an ac power overload. The current and voltage ratings and the HP part numbers of the required fuse are listed below.

SOURCE VOLTAGE	REQUIRED RATING	HP PART NUMBER
100 Vac	8A SB*, 250V	2110-0383
120 Vac	8A SB*, 250V	2110-0383
220 Vac	4A SB*, 250V	2110-0365
240 Vac	4A SB*, 250V	2110-0365

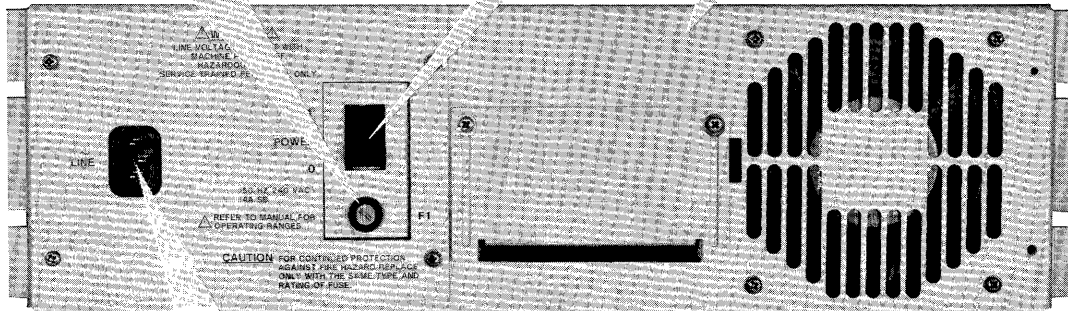
* The SB indicates that a slo-blo fuse must be used.

Power panel for disc drives mounted in a cabinet other than a low profile cabinet.

POWER*

Controls the application of ac power to the disc drive power supplies and blower motor. Power "on" condition is with the switch in the 1 position. The 1 and 0 indications correspond to international symbology currently in use.

Power panel for disc drives in a low profile cabinet.



This three terminal power line connector provides the means to connect an ac power source to the disc drive.

* On earlier versions of the HP 7906, the POWER switch and fuse F1 are located on the operator control panel behind the control panel access door.

SPECIFICATIONS

Rotation

Speed: 3600 RPM
Average rotational delay: 8.33 ms

Data transfer rate

Bits/second: 7,500,000
Kilobytes/second: 937.5

Data Capacity

Item	Data Bits Per	Data Bytes Per	Sectors Per	Tracks Per
Byte	8			
Words	16	2		
Sector	2,048	256		
Track*	98,304	12,288	48	
Fixed Disc	78,643,200	9,830,400	38,400	800
Cartridge	78,643,200	9,830,400	38,400	800
Drive	157,286,400	19,660,800	76,800	1,600

* Six additional spare tracks/surface are not included in capacity table.

Safety

7906MR Master Drive, 7906SR Add-On Drive, and 7906HR ICD Drive components are UL recognized and CSA certified, except for Option 015.

7906M Master Drive, 7906S Add-On Drive, and 7906H ICD Drive are UL listed and CSA certified, except for Option 015.

7906M Master Drive and 7906S Add-On Drive having the power switch at the rear of the drive and 7906H ICD Drive have been designed to comply with the German VDE safety standard VDE-0730.

No other certification is implied.

Temperature

Operating: +10° to +40°C (50° to 104°F),
rate of change not to exceed 10°C (18°F)/hr
Non-operating: -40° to +65°C (-40° to +149°F),
rate of change not to exceed 20°C (36°F)/hr

Relative humidity

Operating: 8% to 80%
Non-operating: 5% to 95%

Heat dissipation

7906M Master Drive: 720 watts (2458 Btu/hr)
7906S Add-On Drive: 510 watts (1741 Btu/hr)
7906H ICD Drive: 520 watts (1776 Btu/hr)
7906MR Master Drive: 690 watts (2355 Btu/hr)
7906SR Add-On Drive: 480 watts (1638 Btu/hr)
7906HR ICD Drive: 490 watts (1673 Btu/hr)

Altitude

Operating: Sea level to 4,572 m (15,000 ft)
Non-operating: 304.8 m (1,000 ft) below sea level
to 15,240 m (50,000 ft)

Power requirements

100/120/220/240V, +5% - 10%, 47.5 to 66 Hz, single phase.

7906M Master Drive: 720W/7.6A max @ 120 Vac
7906S Add-On Drive: 510W/5.45A max @ 120 Vac
7906H ICD Drive: 520W/5.5A max @ 120 Vac
7906MR Master Drive: 690W/7.35A max @ 120 Vac
7906SR Add-On Drive: 480W/5.2A max @ 120 Vac
7906HR ICD Drive: 490W/5.4A max @ 120 Vac

Note: For 7906M/MR with option 100,
add 35W/0.55A max @ 120 Vac.

Seek time

Track-to-track: 5 ms
Average random: 25 ms
Full stroke (typical over 400 tracks): 45 ms

Tilt

Continues to operate up to ±20 degrees about either horizontal axis.

Dimensions

7906M Master Drive, 7906S Add-On Drive, and 7906H ICD Drive in Low Profile Cabinet

Height: 71.8 cm (28.25 in.)
Width: 55.3 cm (21.78 in.)
Depth: 79.1 cm (31.13 in.)

7906 Drive (for 7906MR/SR/HR)

Height: 40.0 cm (15.75 in.)
Panel Width: 48.0 cm (18.9 in.)
Width Behind Panel: 44.1 cm (17.38 in.)
Depth Behind Panel: 71.1 cm (28 in.)

Net weight

7906M Master Drive in Low Profile Cabinet: 154 kg (340 lb)
7906S Add-On Drive in Low Profile Cabinet: 138 kg (303 lb)
7906H ICD Drive in Low Profile Cabinet: 138.9 kg (305 lb)
7906MR Master Drive: 87.2 kg (192 lb)
7906SR Add-On Drive: 73.5 kg (162 lb)
7906HR ICD Drive: 74.4 kg (164 lb)

