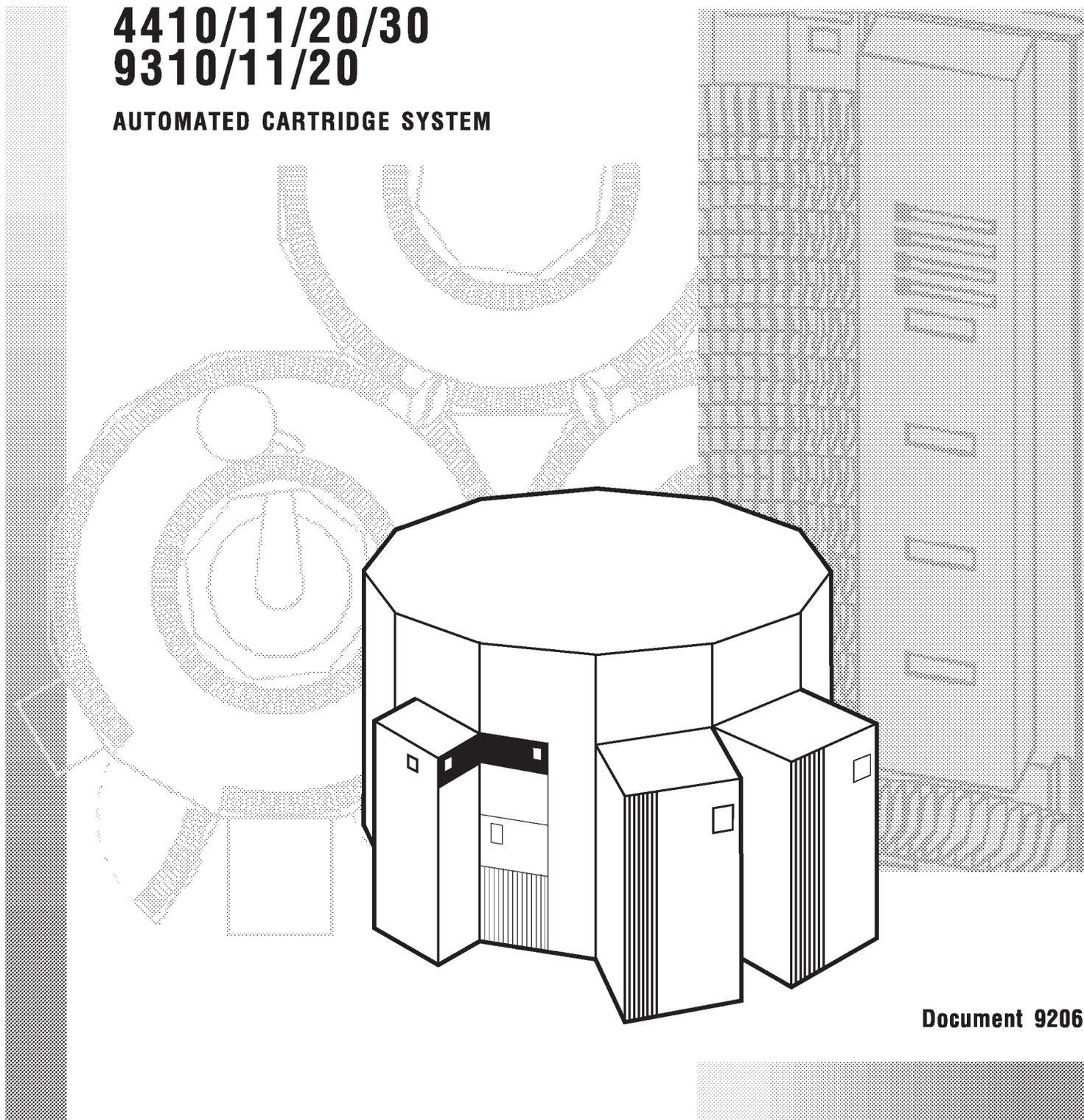


# StorageTek

## HARDWARE OPERATOR'S GUIDE

### 4410/11/20/30 9310/11/20

#### AUTOMATED CARTRIDGE SYSTEM



Document 9206

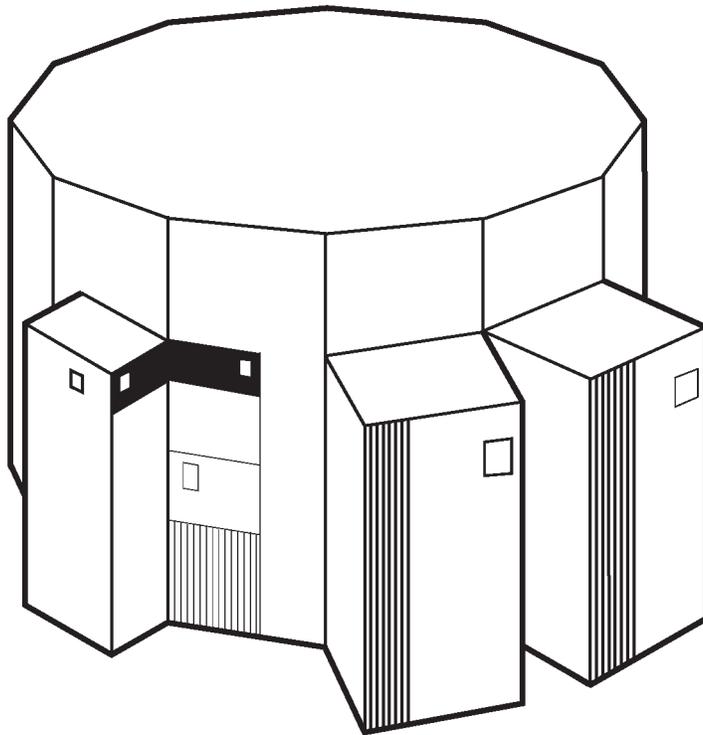


# StorageTek

## HARDWARE OPERATOR'S GUIDE

**4410/11/20/30**  
**9310/11/20**

**AUTOMATED CARTRIDGE SYSTEM**



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# Notices

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The following is the compliance statement from the Federal Communications Commission:

**Note:** This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his or her own expense.

Some of the cables used to connect peripherals must be shielded and grounded as described in the installation manual. Operation of this equipment with the required cables that are not shielded and correctly grounded may result in interference to radio or TV reception.

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# About This Guide

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This guide describes how to operate the Storage Technology Corporation 4410/11/20/30 and 9310/11/20 Automated Cartridge System (ACS). Most of the information is hardware-oriented. For specific software commands and console messages, refer to your software operator's guide. For specific cartridge subsystem information, refer to your cartridge subsystem publications.

This guide is intended primarily for data center operators. System programmers and administrators also might find information contained in this guide useful. This guide can be read entirely; however, it is more important that you familiarize yourself with the overall organization and location of various information for reference purposes.

This guide is divided into four chapters and one appendix:

- Chapter 1, "[General Information](#)" provides a basic overview of the ACS, including descriptions of system hardware components, discussions of operating modes, and safety features.
- Chapter 2, "[Controls and Indicators](#)" shows the location of control panels and indicators in the ACS and the functions associated with them.
- Chapter 3, "[Operating an ACS](#)" describes the basic procedures to operate the ACS.
- Chapter 4, "[Obtaining StorageTek Maintenance Support](#)" describes how to contact Customer Support for assistance if the LSM has a hardware or software problem.
- Appendix A, "[Cartridge Tape Information](#)" lists the basic requirements for cartridges and describes how to prepare and maintain cartridges.

A [glossary](#) of relevant terms/abbreviations and an index are located after Appendix A. A [Reader's Comment Form](#) at the back of the guide is for communicating suggestions or requests for change. We encourage and appreciate reader feedback.

## ■ Alert Messages

This guide contains alert messages that must be read carefully and followed:

- Note** Provides additional information that might be of special interest. A note can point out exceptions to rules or procedures. A note usually, but not always, follows the information to which it relates.
- Caution** Informs the user of conditions that might result in damage to hardware, corruption of customer data or application software, or long-term health hazard to people. A caution always precedes the information to which it relates.
- Warning** Alerts the user to conditions that might result in injury or death. A warning always precedes the information to which it relates.

## ■ Messages d'alerte

Ce manuel contient des messages d'alerte qu'il est nécessaire de lire attentivement et de respecter :

- Une **remarque** fournit des informations supplémentaires sur l'utilisation d'un programme, d'une unité périphérique ou d'un système. Une remarque succède en général à l'intervention dont il est question.
- Un message d'**avertissement** fait part d'une information importante qui permet d'éviter d'endommager un programme, une unité périphérique ou un système. Un message d'avertissement précède l'intervention dont il est question.
- Un message d'**attention** fait part d'une information importante qui permet d'éviter de porter un préjudice éventuel à tout individu. Un message d'attention précède l'intervention dont il est question.

## ■ Warnungshinweise

Dieses Handbuch enthält Warnungshinweise, die genau gelesen und beachtet werden müssen:

**Hinweise** liefern zusätzliche Informationen über den Gebrauch eines Programms, Gerätes oder Systems. Ein Hinweis folgt im allgemeinen der Handlung, auf die er sich bezieht.

**Vorsichtshinweise** liefern wichtige Informationen zur Vermeidung möglicher Schäden an einem Programm, Gerät oder System. Ein Vorsichtshinweis geht der Handlung voraus, auf die er sich bezieht.

**Warnungen** liefern wichtige Informationen zur Vermeidung möglicher Verletzungen. Eine Warnung geht der Handlung voraus, auf die sie sich bezieht.

## ■ Messaggi di avviso

Questa guida contiene messaggi di avviso che devono essere letti e seguiti attentamente:

Una **Nota** fornisce addizionali informazioni sull'uso di un programma, dispositivo o sistema. In genere questo tipo di messaggio segue l'azione a cui si riferisce.

Un messaggio di **Attenzione** fornisce importanti informazioni per evitare possibili danni a un programma, dispositivo o sistema. Questo tipo di messaggio precede l'azione a cui si riferisce.

Un **Avvertenza** fornisce importanti informazioni per evitare possibili danni a una persona. Questo tipo di messaggio precede l'azione a cui si riferisce.

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## ■ Related Publications

The following list contains the names and order numbers of publications that provide additional information about the LSM, the cartridge subsystems, cartridge tapes.

### LSM Publications

*9360 LSM Hardware Operator's Guide* 9871

### Cartridge Drive Publications

*4480/4780 Operator's Guide* 95688

*4490 Operator's Guide* 9600

*4791 Operator's Guide* 9786

*9490 Operator's Guide* 9634

*9840 User's Reference Manual* 95739

*SD-3 Operator's Guide* 9787

### Software Publications

*Operator's Guide (HSC MVS/XA-ESA Implementation)* 4044265XX

*System Programmer's Guide (HSC MVS/XA-ESA Implementation)* 4044266XX

*Operator's Reference Summary (HSC MVS/XA-ESA Implementation)* 4044306XX

*HSC Messages and Codes* 4044267XX

*Operator's Guide (HSC VM Implementation)* 4044292XX

*Operator's Reference Summary (HSC VM Implementation)* 4044509XX

*System Programmer's Guide (HSC VM Implementation)* 4044293XX

*SCP Messages and Codes* 4044294XX

*4400 Automated Cartridge System UNIX-Based Library Server System Administrator's Guide* 404340601

*4400 Automated Cartridge System UNIX-Based Library Server System Programmer's Guide* 404340701

*4400 Automated Cartridge System UNIX-Based Library Server System Programmer's Guide* 404340701

\* Some ACSLS, Solaris, and AIX documentation may also be obtained at the following Internet website:

[http://www.stortek.com/StorageTek/doc/acsls/acsls\\_documentation.shtml](http://www.stortek.com/StorageTek/doc/acsls/acsls_documentation.shtml)

**ANSI Publications**

*American National Standard Magnetic Tape and Cartridge for Information Interchange* ACS X3B5

**IBM Publications**

*Care and Handling of the IBM Magnetic Tape Cartridge* GA32-0047

*Tape and Cartridge Requirements for the IBM 3480 Tape Drive* GA32-0048

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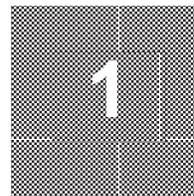
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# General Information

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This chapter provides a general description of the automated cartridge system (ACS) components and features, and presents a high-level explanation of how the ACS interacts with the operating system.

The following topics are discussed:

- System components
- Controlling software modes
- Library storage module (LSM) operating modes
- LSM safety features

**WARNING:**

**Under no circumstances should anyone other than an authorized customer services engineer remove any covers from any component of an ACS.**

**By doing so, you might injure yourself, damage a component, and void any warranty on the unit.**

**ATTENTION :**

**Seul un technicien agréé du service client est autorisé à ouvrir un composant quelconque du ACS (Automated Cartridge System [Système automatisé à cartouches]).**

**Dans le cas contraire, il y a risques de blessures, d'endommagement d'un composant et d'annulation de toute garantie existante sur le matériel.**

**WARNUNG:**

**Die Abdeckungen der ACS-Komponenten dürfen nur von zugelassenen Servicetechnikern entfernt werden.**

**Gegenteiliges Handeln kann zu Verletzungen, Beschädigungen einer Komponente und zur Nichtigkeitmachung der Gerätegarantie führen.**

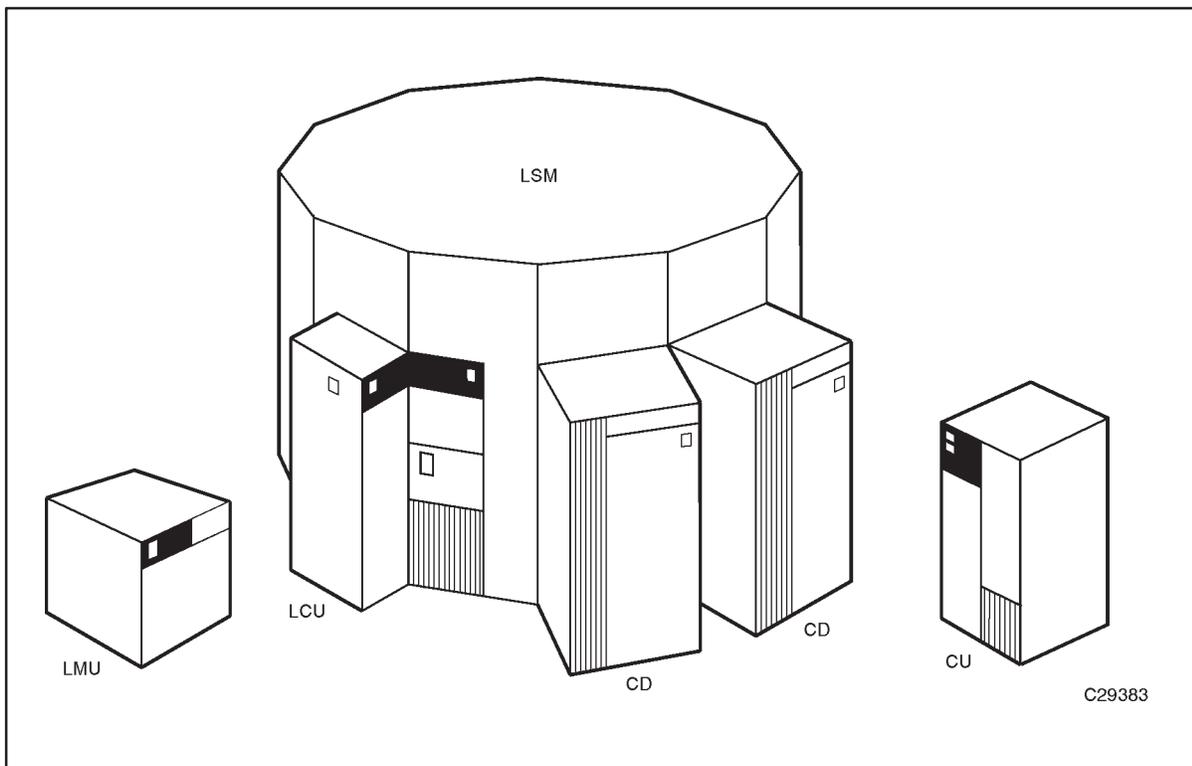
**AVVERTENZA:**

**Solamente un tecnico autorizzato del servizio assistenza può rimuovere i coperchi dei componenti di un ACS in qualsiasi circostanza.**

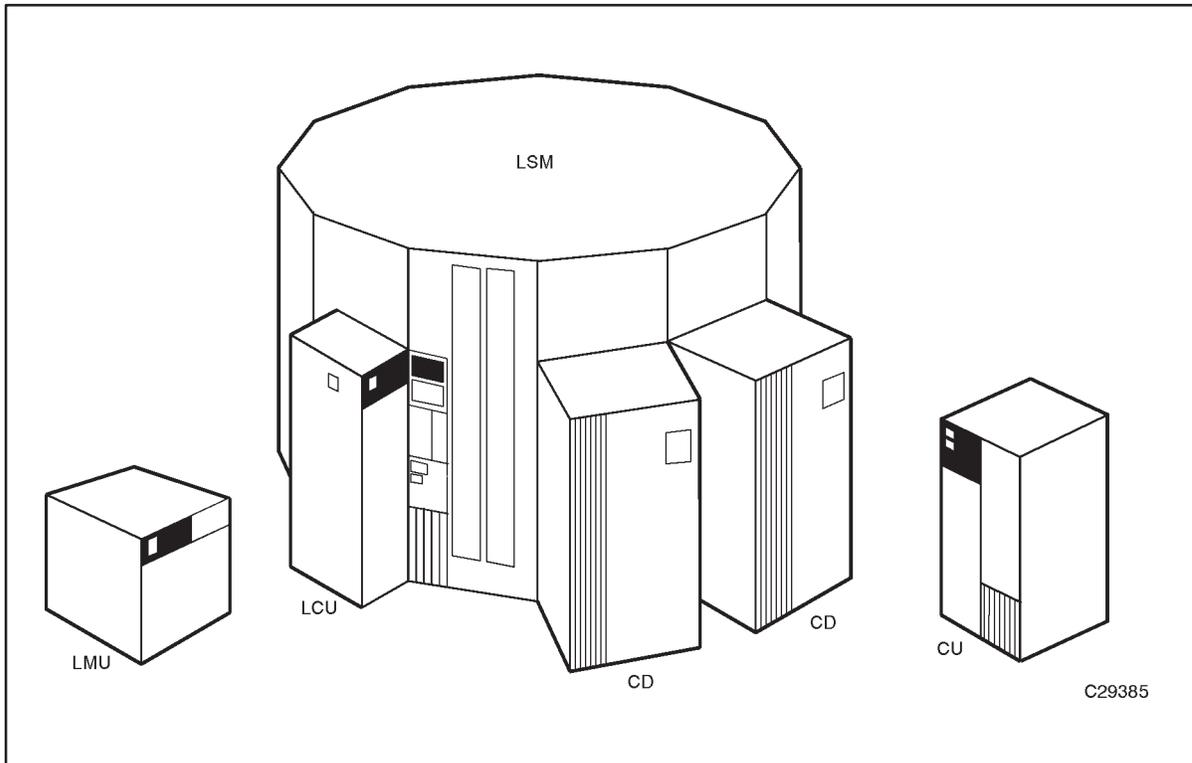
**Se i coperchi sono rimossi da altri, ne possono risultare infortuni, danni a componenti e l'annullamento di eventuali garanzie dell'unità.**

## ■ System Components

StorageTek's ACS, also called the library, is a fully automated storage and retrieval system for cartridge tapes. The following pages describe the system components. Figure 1-1 shows an ACS with the 21-cell cartridge access port (CAP) door; [Figure 1-2](#) shows an ACS with the 80-cell CAP door and one cell priority CAP (PCAP).



**Figure 1-1. ACS Hardware with 21-Cell Cartridge Access Port**



**Figure 1-2. ACS Hardware with 80-Cell Cartridge Access Port**

## Controlling Software

The controlling software is the overall manager of the library, the interface between the operating system and each ACS. It intercepts or receives mount/dismount messages, translates them into move requests, and routes them to the library management unit (LMU).

## Library Management Unit

The LMU is the interface between the controlling software and the library control unit (LCU). A single LMU manages from 1 to 16 LSMs. It can receive mount and dismount requests from as many as 16 hosts. When a mount request is received, the LMU sends commands to the LCU attached to the correct LSM.

## Library Control Unit

An LCU is attached to each LSM. When the LCU receives a request from the LMU, the LCU microprocessor commands the LSM robot to:

1. Move to the location of the cartridge.
2. Make sure that the cartridge is correct by reading the VOLSER label.
3. Retrieve the cartridge from the cell location.
4. Move the cartridge to the specified destination cell.
5. Place the cartridge into the transport, pass-thru port (PTP), cartridge exchange mechanism (CEM), CAP, or PCAP.

## Library Storage Module

The LSM is a 12-sided structure containing a free-standing, vision-assisted robot, and storage for up to 6,000 cartridges. From one to four CDs (2 to 16 transports) can be attached to the exterior of an LSM, allowing the robot to insert cartridges into the transports. [Figure 1-3](#) shows a top view of the 4410 LSM. [Figure 1-4](#) shows a top view of the 9310 LSM.

Up to 16 LSMs can be interconnected. Cartridges can be passed from one LSM to another through a CEM/PTP in the walls of adjacent LSMs. If a cartridge is in one LSM and the assigned transport is attached to another LSM, the robot retrieving the cartridge from its home cell places it into a CEM/PTP. The robot in the adjacent LSM retrieves the cartridge from the CEM/PTP and mounts it in the assigned transport, or places it into another CEM/PTP to continue passing the cartridge to the destination LSM.

When a mount is requested:

1. The servo system moves the robot fingers to within 0.65 cm (0.25 in.) of the center of the cell location.
2. A solid-state camera vision system fine-positions the robot fingers.
3. The camera makes sure that the VOLSER label on the cartridge is correct.
4. The robot retrieves the cartridge from the cell.
5. The robot moves to the specified transport and mounts the cartridge.

When a dismount is requested, the robot removes the cartridge from the transport and either:

- Returns the cartridge to the source cell if pass-thru operations were not required to mount the volume.
- Places the cartridge in an available cell in the robot LSM if pass-thru operations were required to mount the volume. (Normally, pass-thru

operations are not performed to place a cartridge in a storage cell after it has been dismantled, as long as an available cell exists in the LSM.)

- If specifically directed to return the cartridge to its original home cell location, the robot places the cartridge into the CEM/PTP cell to begin passing it back to the original LSM.

Each LSM has an access door in the outer wall for human access to the interior. The access door contains at least one CAP and might contain a PCAP.

## Cartridge Access Port

The CAP and PCAP allow the operator to enter and eject cartridges without interrupting automated operations in the LSM. The standard 21-cell CAP allows up to 21 cartridges to be loaded into or removed from the LSM without the operator entering the LSM.

The enhanced 80-cell CAP allows up to 80 cartridges to be loaded into or removed from the LSM without the operator entering the LSM. This CAP consists of two doors, each holding 40 cartridges, and a PCAP. The cartridges can be placed into magazines holding 10 cartridges each, and the entire magazine can be placed into the CAP. The PCAP allows one cartridge to be entered or ejected.

## Cartridge Subsystem

The cartridge subsystem consists of:

- 4xxx cartridge drives (CDs) that attach to the LSM, and control units (CUs). The CD contains two or four transports, where tape cartridges are placed for read or write operations. The CU is the controller/interface between the CDs and input/output channels. *The 4xxx transports require 3480-type cartridges.*
- 9490 cartridge drives (CDs) that attach to the LSM and contain two or four controller transport units (CTU). Each CTU has a transport. *The 9490 transports require 3480-type cartridges.*
- SD-3 cartridge drives (CDs) that attach to the LSM and contain one to four controller transport units (CTU). Each CTU has a transport. *The SD-3 transports require helical scan cartridges.*
- 9840 cartridge drives (CDs) that attach to the LSM. One to ten independent drive units might be installed on an LSM wall. *9840 drives require their unique cartridges.*

Refer to your [cartridge subsystem publications](#) for specific information concerning CDs, CUs, CTUs, and 9840 drives.

The ExtendedStore™ LSM does not have attached CDs, because it is only used for storing cartridges. It is connected with CEMS/PTPs to LSMs that have attached CDs.

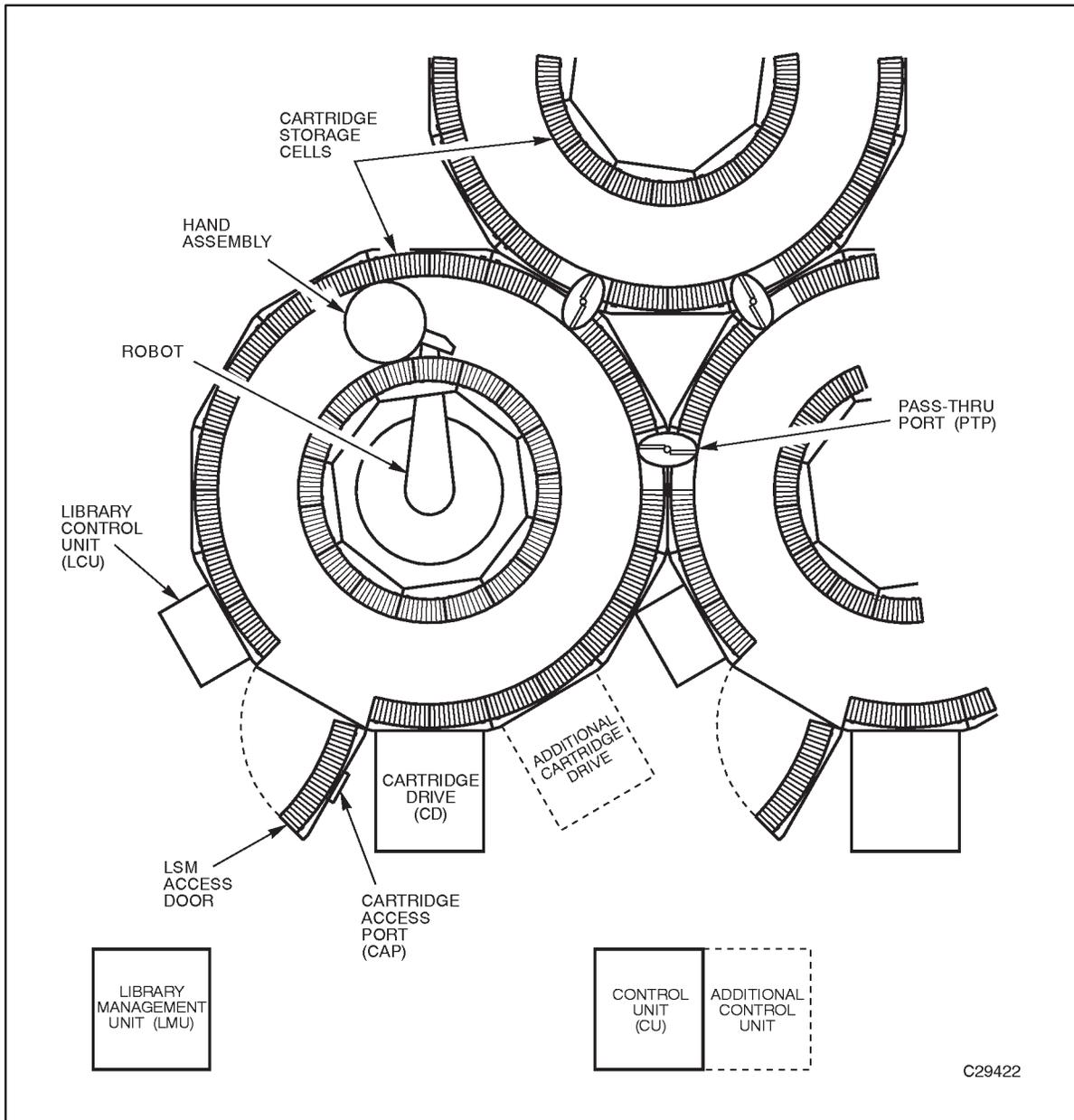
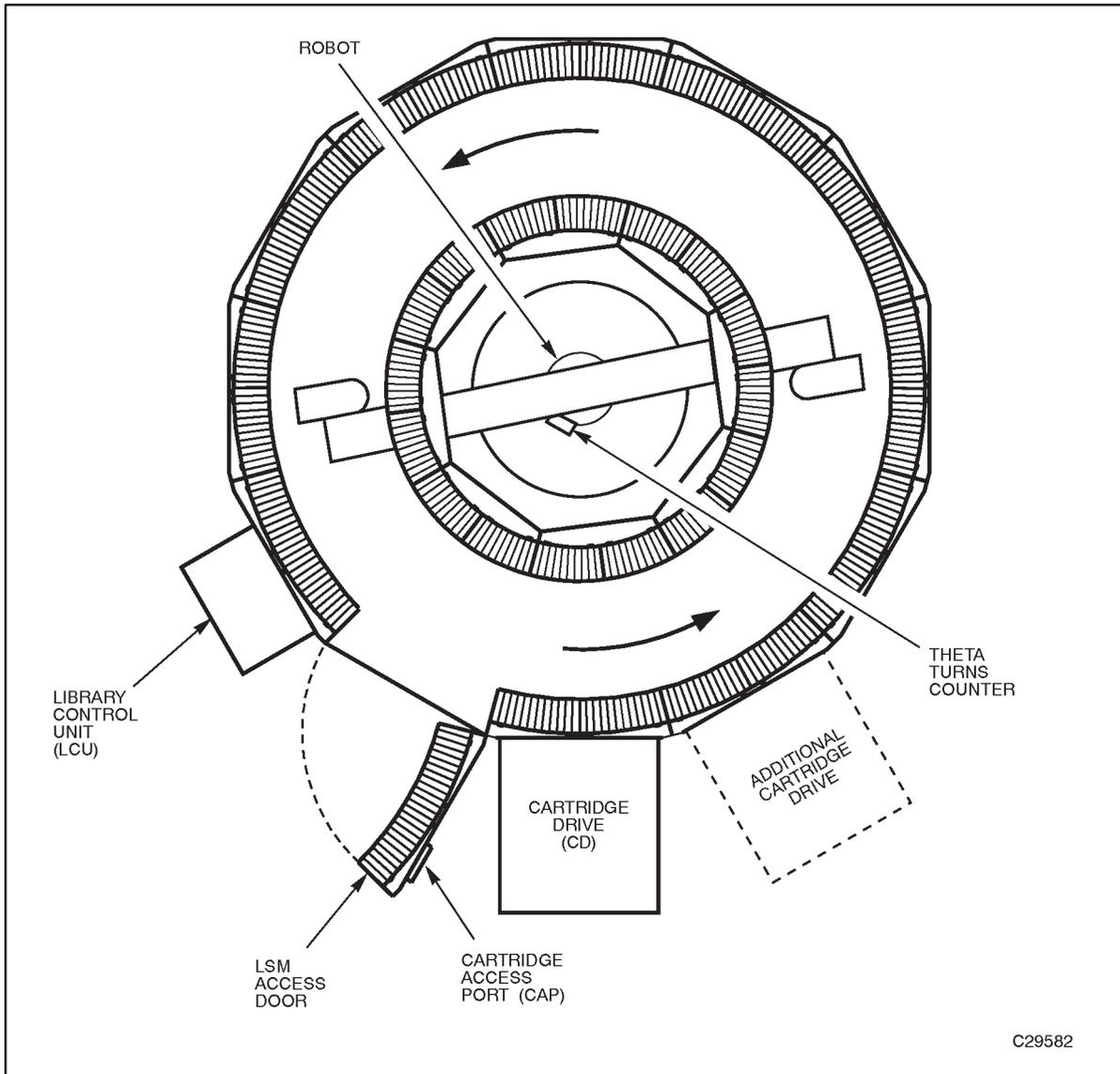


Figure 1-3. 4410 Library Storage Module—Top View



**Figure 1-4. 9310 Library Storage Module—Top View**

## ■ Controlling Software Modes

The terms “connected mode” and “disconnected mode” refer to the relationship between the controlling software and an ACS. An ACS may be connected to one host while being disconnected from another. A single host may be attached to several ACSs, some of which are connected to the controlling software, and some of which are disconnected from it.

If your system supports a dual LMU configuration, the ACS can be in a condition referred to as “standby mode.” Two LMUs exist in a dual LMU

configuration: one master and one standby. If the master LMU stops functioning, the standby LMU becomes the master and takes over the functions.

## Connected Mode

Controlling software is connected to an ACS when both of the following conditions are true:

- The controlling software is executing on that particular host.
- The host and the ACS are communicating with a minimum of one station on-line to the ACS (a station is the connection between the host and the LMU).

While the controlling software is connected to the ACS, messages from the host are routed to the ACS, which automates the mounts and dismounts.

## Disconnected Mode

Controlling software is disconnected from an ACS when both of the following conditions are true:

- The controlling software is executing on that particular host.
- The host and the ACS are not communicating (no stations are on-line to the ACS from that particular host).

In disconnected mode, no automated tape activity can occur for this host using this ACS.

In a multiple-host environment, however, since the ACS is still capable of automated operations, you can semi-automate mounts and dismounts by issuing software commands from a connected host's console. As the mount and dismount messages are displayed on the disconnected host's console, you can issue software mount and dismount commands from the connected host's console to direct the LSM robots to perform the mounts and dismounts.

## Standby Mode

The controlling software is connected to an ACS in standby mode when the following conditions are true:

- The dual LMU feature has been installed.
- No stations are on-line to the master LMU.
- At least one station is on-line to the standby LMU.

In standby mode, the controlling software intercepts mount and dismount messages and accepts operator cartridge movement commands. The controlling software cannot send requests to the master LMU, since no stations are on-line. The operator can resolve this situation by issuing the switch

command, causing the standby LMU to become the master LMU. When the standby LMU has assumed master LMU functionality, the controlling software sends all the pending (or saved) LMU requests to the new master LMU.

## ■ LSM Operating Modes

An LSM operating mode is the way in which an LSM and all the controlling software attached to it interact. The two operating modes are automatic and manual. Automatic mode is the normal operating mode of an LSM. An LSM is either in automatic mode to all hosts or in manual mode to all hosts.

### Automatic Mode

An LSM operating in automatic mode does not require operator intervention to mount, dismount, swap, or pass a cartridge. When the LSM is in automatic mode, the operator can use console commands or batch utility processing to enter or eject cartridges through the CAP.

### Manual Mode

An LSM operating in manual mode cannot perform any automated operations. The operator must manually mount and dismount cartridges.

## ■ LSM Safety Features

Unless otherwise noted, the following items are standard safety features on the LSM.

- **LSM Safety Interlocks**—If the access door to the LSM is opened, electrical interlocks remove power from the robot to prevent injury to someone.
- **LSM Entrance Safety Sign**—Just inside the access door to the LSM, a lit panel mounted on the ceiling directs an operator to enter when the electrical interlocks remove power to the robot, and all safety procedures have been followed.
- **Prevention of LSM Access Door Closing**—By following simple safety procedures (refer to "[Entering the LSM](#)" in Chapter 3), someone inside the LSM can prevent anyone outside the LSM from closing the LSM access door.
- **LSM Emergency Power Off (EPO) Switch**—Pressing a large, bright red knob on the inside of the LSM access door activates an EPO switch that turns off AC power to the LCU/LSM. This extra safety feature is provided in case anyone outside the LSM locks the access door when someone else is inside.

- **LSM Fire Detection**—In the rare case of fire in the LSM, sensors start an immediate subsystem shutdown (EPO).
- **Internal Fire Suppression System Ports**—The LSM contains ports to which the user may connect a fire suppression system. This system, as well as its controls and sensors, is supplied by a third party vendor at the customer's request. Additional information can be supplied by a StorageTek Marketing Representative.
- **Theta Obstruction Search**—During initialization, the robot theta arm moves slowly through its full range of motion. In this mode, current is limited and the mechanism can be stopped by hand. If any physical obstruction prevents the arm from moving for more than a few seconds, the arm shuts down and an error is posted. If motion is disturbed only for a moment, the mechanism continues to sweep, but posts an error at the end of initialization, without going into normal move mode.

À moins qu'il en soit précisé autrement, les points suivants constituent des dispositifs de sécurité standard du LSM (Library Storage Module [Module d'archivage]).

- **Verrouillage de sécurité du LSM** – En cas d'ouverture de la porte d'accès au LSM, un verrouillage électrique permet de mettre le robot hors tension pour éviter toute blessure.
- **Signal de sécurité d'entrée du LSM** – À l'entrée du LSM, un affichage lumineux monté sur le plafond indique à l'opérateur s'il peut entrer, une fois le robot hors tension et les procédures de sécurité respectées.
- **Prévention contre la fermeture de la porte d'accès au LSM** – Tout individu à l'intérieur du LSM peut interdire la fermeture de la porte d'accès au LSM depuis l'extérieur, simplement en suivant les procédures de sécurité appropriées (« [Entrer dans le LSM](#) »).
- **Commutateur EPO** (Emergency Power Off [mise hors tension en cas d'urgence]) du LSM – Appuyer sur le gros bouton rouge vif situé à l'intérieur de la porte d'accès au LSM ([illustration 2-7](#)) active le commutateur EPO qui permet de couper le courant alternatif du LCU/LSM. Ce dispositif de sécurité supplémentaire est utile lorsqu'une personne à l'extérieur du LSM verrouille la porte d'accès alors qu'une autre personne se trouve encore à l'intérieur.
- **Détection incendie du LSM** – Dans le cas, rare, où un incendie se déclenche dans le LSM, les détecteurs déclenchent immédiatement un arrêt d'urgence du sous-système (EPO).
- **Ports du système interne d'extinction d'incendie** – Il existe dans le LSM des ports sur lesquels l'utilisateur peut brancher un système d'extinction d'incendie. Ce système, ainsi que ses systèmes de contrôle et de détection, sont fournis par un distributeur tiers, à la demande du client. Il est possible d'obtenir des informations complémentaires auprès du représentant commercial de StorageTek.

- Détecteur d'obstruction Thêta – Au moment de l'initialisation, le bras du robot Thêta se déplace lentement sur toute sa sphère d'action. Avec ce mode, l'intensité du courant est limitée et il est possible d'interrompre manuellement le mécanisme. Si un obstacle physique empêche le bras de se déplacer pendant quelques secondes, le robot s'arrête et enregistre un message d'erreur. Si le mouvement est interrompu pendant à peine quelques secondes, le mécanisme continue son balayage tout en enregistrant un message d'erreur à la fin de l'initialisation et en ne rebasculant pas en mode mouvement normal.

Soweit nichts angegeben ist, verfügt das LSM über folgende Standardsicherheitsvorrichtungen.

- LSM Sicherheitssperren – Bei Öffnung der Eingangstür zum LSM wird der Strom zum Roboter automatisch gesperrt, um Verletzungen zu verhindern.
- [Sicherheitsschild am LSM – Eingang](#) – Direkt hinter der Eingangstür zum LSM weist ein erleuchtetes Feld an der Decke den Bediener darauf hin, erst einzutreten, wenn die elektrischen Sperren die Stromzufuhr zum Roboter abgeschaltet haben und alle Sicherheitsvorkehrungen beachtet wurden.
- Verhinderung eines Schließens der LSM-Eingangstür – Durch Beachtung einiger einfacher Vorsichtsmaßnahmen (["Betreten des LSM"](#)) kann jemand im Innern des LSM verhindern, daß jemand außerhalb des LSM die Eingangstür zum LSM schließt.
- [Notausschalter am LSM](#) – Durch Drücken eines großen, hellroten Schalters innen an der LSM-Eingangstür ([Abb. 2-7](#)) wird eine Notausschaltung aktiviert, die den Wechselstrom zum LCU/LSM abschaltet. Diese besondere Sicherheitsvorrichtung ist für den Fall vorgesehen, daß jemand außerhalb des LSM die Eingangstür zum LSM schließt, während sich noch jemand im Innern aufhält.
- Feuermelder am LSM – Für den seltenen Fall, daß es im LSM zu einem Feuer kommen sollte, bewirken Sensoren eine sofortige Abschaltung des Subsystems (Notaus).
- Interne Feuerlöschanschlüsse – Das LSM verfügt über Anschlüsse, an die der Benutzer ein Feuerlöschsystem anschließen kann. Dieses System samt Steuerungen und Sensoren wird von Drittparteien auf Wunsch des Kunden geliefert. Weitere diesbezügliche Auskünfte sind von einem StorageTek-Marketingvertreter erhältlich.
- Theta-Hinderniserkennung – Während der Initialisierung bewegt sich der Roboterarm langsam durch seinen gesamten Bewegungsbereich. In diesem Modus ist die Stromzufuhr beschränkt, und der Mechanismus kann von Hand gestoppt werden. Falls ein Hindernis den Arm mehrere Sekunden lang an seiner Bewegung hindert, schaltet der Arm ab, und es wird eine Fehlermeldung angezeigt. Wird die Bewegung

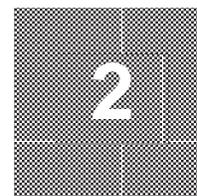
nur momentan behindert, setzt der Arm seine Bewegung fort, aber am Ende der Initialisierung erscheint eine Fehlermeldung, und der normale Bewegungsmodus wird nicht eingeleitet.

A meno che altrimenti indicato, i seguenti articoli sono caratteristiche di sicurezza in dotazione sull'LSM (Library Storage Module o Modulo archiviazione libreria).

- Blocco di sicurezza dell'LSM – Se la porta d'accesso dell'LSM è aperta, il blocco elettrico stacca l'alimentazione al robot per prevenire infortuni.
- [Indicazione di sicurezza per l'ingresso nell'LSM](#) – All'interno della porta d'accesso dell'LSM, un pannello luminoso montato sul soffitto segnala all'operatore di entrare quando il blocco elettrico stacca l'alimentazione al robot, e tutte le procedure di sicurezza sono state seguite.
- Prevenzione della chiusura della porta d'accesso dell'LSM – Seguendo semplici procedure di sicurezza ("[Ingresso nell'LSM](#)"), chi si trova all'interno dell'LSM può impedire che la porta d'accesso dell'LSM venga chiusa dal di fuori.
- [Interruttore di spegnimento di emergenza \(EPO\) dell'LSM](#) – Premendo una grossa manopola rosso vivo all'interno della porta d'accesso dell'LSM ([Figura 2-7](#)) si attiva un interruttore che disinserisce l'alimentazione in corrente alternata dell'LCU/LSM. Questa addizionale funzione di sicurezza serve nel caso che la porta d'accesso venga bloccata dall'esterno quando qualcuno si trova all'interno dell'LSM.
- Rilevatore di incendio LSM – Nel raro caso di un incendio nell'LSM, i sensori avviano un immediato spegnimento del sottosistema (EPO).
- Aperture per sistemi antincendio – L'LSM contiene aperture a cui l'utente può collegare un sistema antincendio. Questo sistema viene fornito, unitamente ai relativi controlli e sensori, da un altro produttore dietro richiesta del cliente. Si possono richiedere ulteriori informazioni a un rappresentante del reparto marketing di StorageTek.
- Ricerca ostruzioni Theta – Durante l'inizializzazione, il braccio theta del robot si sposta lentamente in tutti i suoi movimenti. In questa modalità, la corrente è limitata e il meccanismo può essere fermato con una mano. Se ostruzioni fisiche impediscono al braccio di muoversi per alcuni secondi, il braccio si spegne e viene visualizzato un messaggio d'errore. Se il movimento viene disturbato solo momentaneamente, il meccanismo continua l'azione, ma viene visualizzato un messaggio alla fine dell'inizializzazione, e il sistema non passa alla modalità di movimento normale.

# Controls and Indicators

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This chapter describes the location and functions of control panels, indicators, and emergency power off (EPO) switches for the ACS hardware components. The LMU and LCU each contain an operator panel.

Components that function as a unit (for example, the LCU and the LSM), are described together in the same section. The following topics are discussed:

- LMU operator panel
- LCU/LSM operator panel
- Standard CAP control panel
- Enhanced CAP display panel
- Emergency power off switch—inside LSM
- 4xxx Cartridge Subsystem controls and indicators

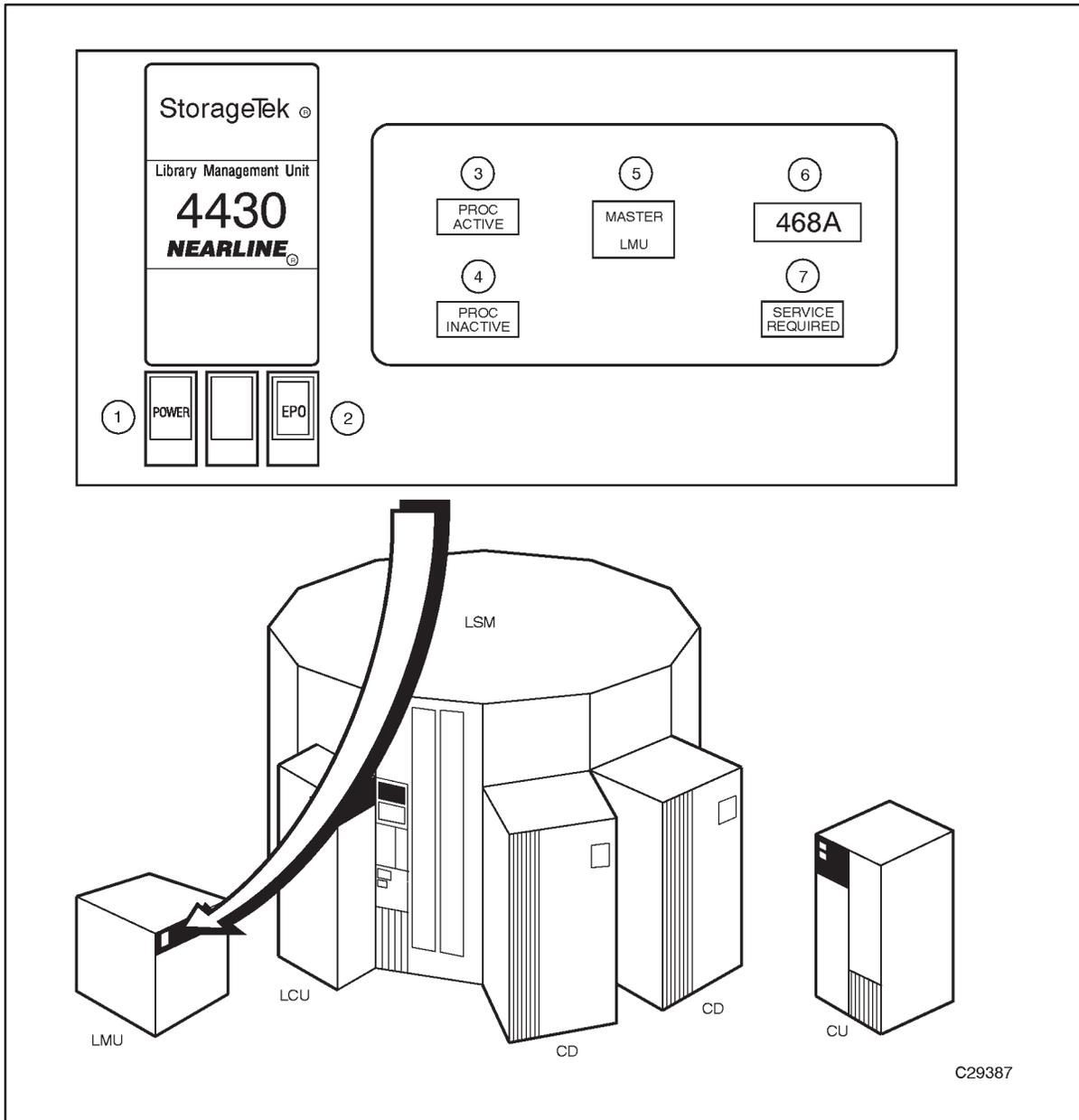
**Note:** Refer to the appropriate [Cartridge Drive manual](#) for information concerning 9490, SD-3, and 9840 operations.

## ■ LMU Operator Panel

The LMU operator panel contains power on/off switches and indicators to monitor the operation of the LMU. [Table 2-1](#) lists and describes each numbered item and [Figure 2-1](#) shows this panel.

<b>Item<sup>1</sup></b>	<b>Label</b>	<b>Type</b>	<b>Function</b>
1	1/0 (on older units)	Rocker switch with indicator (on older units)  Push-button switch (on newer units)	<b>Switch:</b> Applies DC power to the LMU when it is set to the “1” position and starts a controlled power down when it is set to the “0” position.  <b>Indicator:</b> On when +5 VDC power is applied to LMUs.
2	EPO	Momentary switch	Emergency power off (EPO). The EPO switch turns off all power from the LMU. <b>Use this switch only in an emergency; the EPO switch can be reset only by a CSE.</b>
	EPO (Mise hors tension en cas d’urgence)	Commutateur à action temporaire	Mise hors tension en cas d’urgence. Le commutateur de mise hors tension en cas d’urgence coupe le courant du LMU. <b>N’utiliser ce commutateur qu’en cas d’urgence ; seul un CSE peut rétablir le commutateur EPO.</b>
	Notausschalter	Momentschalter	Notausschalter. Der Notausschalter schaltet den gesamten Strom von der LMU ab. <b>Diesen Schalter nur im Notfall verwenden. Er kann nur von einem Servicetechniker zurückgesetzt werden.</b>
	EPO	Interruttore temporaneo	Spegnimento d’emergenza. L’interruttore EPO stacca l’alimentazione all’LMU. <b>Usare questo interruttore solamente in caso di emergenza; l’interruttore EPO può essere riarmato solamente da un tecnico autorizzato del servizio assistenza.</b>
3	PROC ACTIVE	Indicator	Indicates that the processor is operating.
4	PROC INACTIVE	Indicator	Indicates that the processor is not operating.
5	MASTER <sup>2</sup> LMU	Indicator	On when the LMU is the master LMU in a dual LMU configuration. Blinks briefly when LMU is the standby LMU in a dual LMU configuration, polls the master LMU.
6		Alphanumeric display	Displays four-character error codes, LMU modes.
7	SERVICE REQUIRED	Indicator	On when the CSE is needed. Indicates that the processor has detected an error in the LMU that requires CSE attention. The LMU might or might not continue to operate.

<sup>1</sup> Numbers match item numbers in Figure 2-1.  
<sup>2</sup> Applies to dual LMU systems.



**Figure 2-1. LMU Operator Panel**

## ■ LCU/LSM Operator Panel

The LCU/LSM operator panel is on the LCU. Table 2–2 lists and describes each numbered item and [Figure 2–2](#) shows this panel .

<b>Item<sup>1</sup></b>	<b>Label</b>	<b>Type</b>	<b>Function</b>
1	1/0 (on older units)	Rocker switch/Indicator (on older units)  Push-button switch only (on newer units)	<b>Switch:</b> Set the switch to “1” to turn on DC power and start wake up procedures. Set it to “0” to turn off DC power to the LSM after all in-process commands are completed.  <b>Indicator:</b> On when DC power is applied to the LSM.
2	EPO  EPO (Mise hors tension en cas d’urgence)  Notausschalter	Momentary switch  Commutateur à action temporaire  Momentschalter	Emergency power off. Press this momentary switch to immediately remove all power from the LCU and LSM and end all activity in progress within the LSM.  <b>Use this switch only in an emergency; the EPO switch can be reset only by a CSE.</b>  Another EPO switch is inside the LSM.  Mise hors tension en cas d’urgence.Appuyer sur ce commutateur à action temporaire pour couper immédiatement le courant dans le LCU et LSM et interrompre toute activité en cours dans le LSM.  <b>N’utiliser ce commutateur qu’en cas d’urgence; seul un CSE peut rétablir le commutateur EPO.</b>  Il existe un autre commutateur EPO dans le LSM.  Notausschalter.Durch Betätigung dieses Momentschalters wird sofort der gesamte Strom von der LCU und dem LSM getrennt und alle laufenden Aktivitäten im LSM werden abgebrochen.  <b>Diesen Schalter nur im Notfall verwenden. Er kann nur von einem Servicetechniker zurückgesetzt werden.</b>  Ein weiterer Notausschalter befindet sich im Innern des LSM.

<sup>1</sup> Numbers match item numbers in Figure 2–2.

<b>Table 2-2. LCU/LSM Operator Panel</b>			
<b>Item<sup>1</sup></b>	<b>Label</b>	<b>Type</b>	<b>Function</b>
2	EPO	Interruttore temporaneo	<p>Spegnimento d'emergenza. Premendo questo interruttore temporaneo si disinserisce immediatamente l'alimentazione dell'LCU e LSM e si interrompono tutte le attività in corso all'interno dell'LSM.</p> <p><b>Usare questo interruttore solamente in caso di emergenza; l'interruttore EPO può essere riarmato solamente da un tecnico autorizzato del servizio assistenza.</b></p> <p>Un altro interruttore EPO è posto all'interno dell'LSM.</p>
3	ONLINE	Indicator	On if LSM is on-line.
4	OFFLINE	Indicator	On if LSM is off-line.
5	MAINT MODE	Indicator	On in maintenance mode. Maintenance mode is an LSM state in which diagnostic routines can run. The only way to put an LSM into maintenance mode is with a software switch turned on from either a 392X diagnostic device or the Central Support Remote Center, or during power on for wake-up diagnostics.

<sup>1</sup> Numbers match item numbers in Figure 2-2.

<b>Table 2-2. LCU/LSM Operator Panel</b>			
<b>Item<sup>1</sup></b>	<b>Label</b>	<b>Type</b>	<b>Function</b>
6	LSM ACTIVE	Indicator	On when the robot is moving.  <b>WARNING</b> <b>Do not assume the LSM is safe to enter even if this indicator is not on. To prevent any possibility of being injured by the robot, follow the safety procedures discussed in “Entering the LSM” in Chapter 3.</b>
	LSM EN FONCTION	Indicateur	Allumé lorsque le robot se déplace.  <b>ATTENTION :</b> <b>Même si l’indicateur n’est pas allumé, il est possible que l’entrée dans le LSM ne puisse pas se faire en toute sécurité. Pour éviter d’être blessé par le robot, suivre les procédures de sécurité présentées au paragraphe « Entrer dans le LSM ».</b>
	LSM AKTIV	Anzeige	Eingeschaltet, während sich der Roboter bewegt.  <b>WARNUNG:</b> <b>Niemals annehmen, daß es sicher ist, das LSM zu betreten, selbst wenn diese Anzeige nicht leuchtet. Zur Vermeidung von Verletzungen durch den Roboter, die Sicherheitshinweise unter “Betreten des LSM” beachten.</b>
	LSM ATTIVO	Indicatore	Acceso quando il robot è in movimento.  <b>AVVERTENZA:</b> <b>Anche se questo indicatore è spento, non pensare di poter entrare in tutta sicurezza nell’LSM. Per prevenire la possibilità di infortuni causati dal robot, seguire le procedure di sicurezza descritte nella sezione “Ingresso nell’LSM”.</b>
7	PROC INACTIVE	Indicator	On if processor failure is detected.
8	PROC ACTIVE	Indicator	On if processor is functioning.
<sup>1</sup> Numbers match item numbers in Figure 2-2.			

<b>Table 2-2. ICU/LSM Operator Panel</b>			
<b>Item<sup>1</sup></b>	<b>Label</b>	<b>Type</b>	<b>Function</b>
9	SMOKE DETECT	Indicator	Indicates that the overhead smoke detectors have been tripped (causing emergency power off).
10		Alphanumeric display	<p>Displays status error codes.</p> <p>During initialization, it displays interim status codes for initialization, calibration, CEM/pass-thru ports, and playgrounds.</p> <p>During normal operation, this display is blank.</p> <p>When the SERVICE REQUIRED indicator is on, this display shows an error code that points to the cause of the problem. If a failure generates more than one error code, only the first error code is displayed. If possible, the software saves any undisplayed error codes for a CSE to retrieve.</p>
11	SERVICE REQUIRED	Indicator	On when LSM needs service. The alphanumeric display indicates the correct error code.

<sup>1</sup> Numbers match item numbers in Figure 2-2.

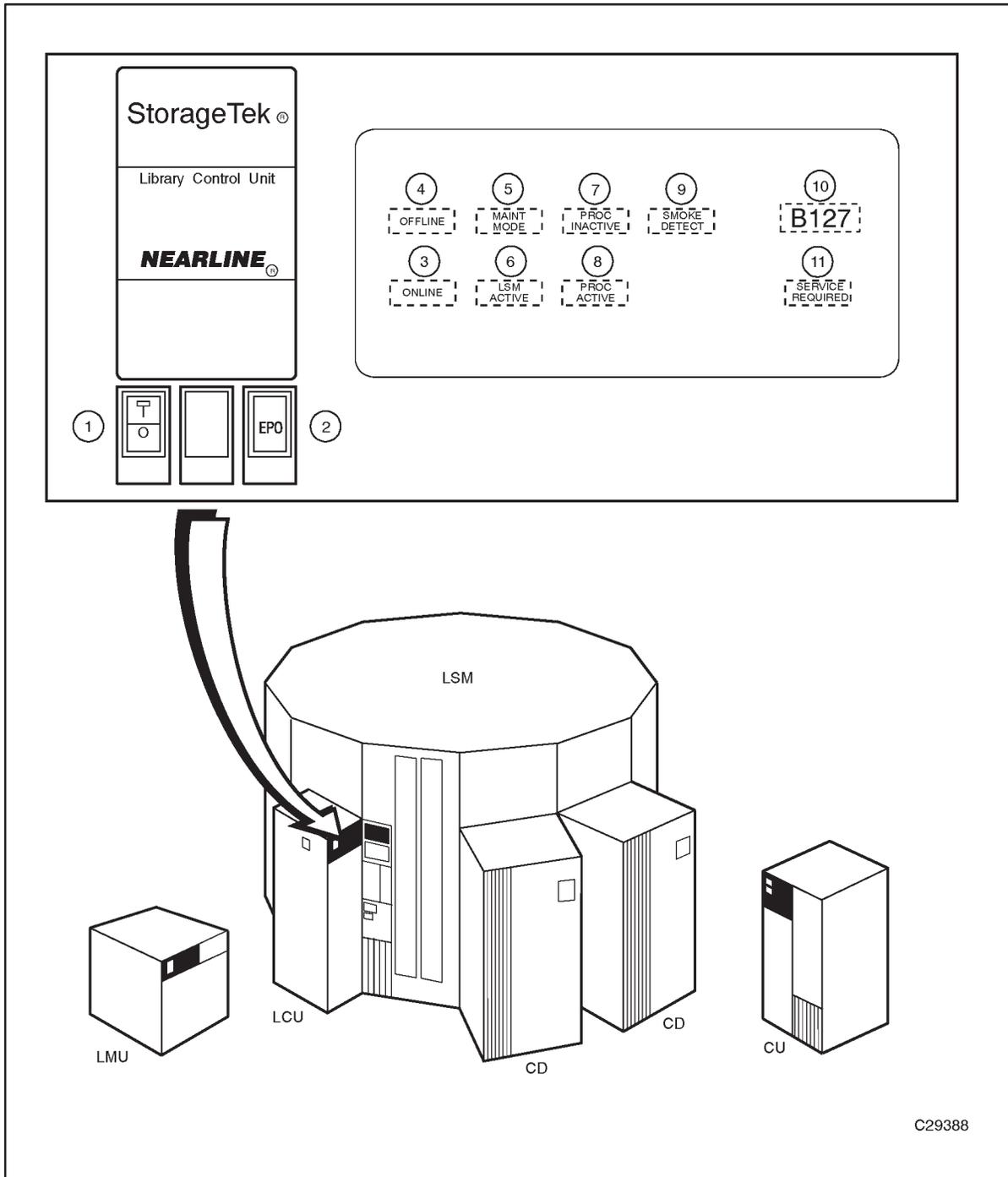


Figure 2-2. LCU/LSM Operator Panel

## ■ Standard CAP Control Panel

The standard CAP contains 21 cells, allowing up to 21 cartridges to be entered into or ejected from the library without anyone having to enter the LSM. The control panel located above the CAP on the LSM access door contains three indicators that provide CAP status information. Table 2-3 lists and describes each numbered item and [Figure 2-3](#) shows this panel.

<b>Item<sup>1</sup></b>	<b>Label</b>	<b>Type</b>	<b>Function</b>
1	CAP LOCKED	Indicator	On when the CAP door may not be opened.
2	CAP ENTER	Indicator	On when the cartridge enter operation is in progress.  When this indicator is on and the CAP LOCKED indicator is <i>not</i> on, the CAP door may be opened and cartridges inserted.
3	CAP EJECT	Indicator	On when a cartridge eject operation is in progress.  When this indicator is on and the CAP LOCKED indicator is <i>not</i> on, the CAP door may be opened and cartridges removed.

<sup>1</sup> Item numbers correspond to item numbers in [Figure 2-3](#).

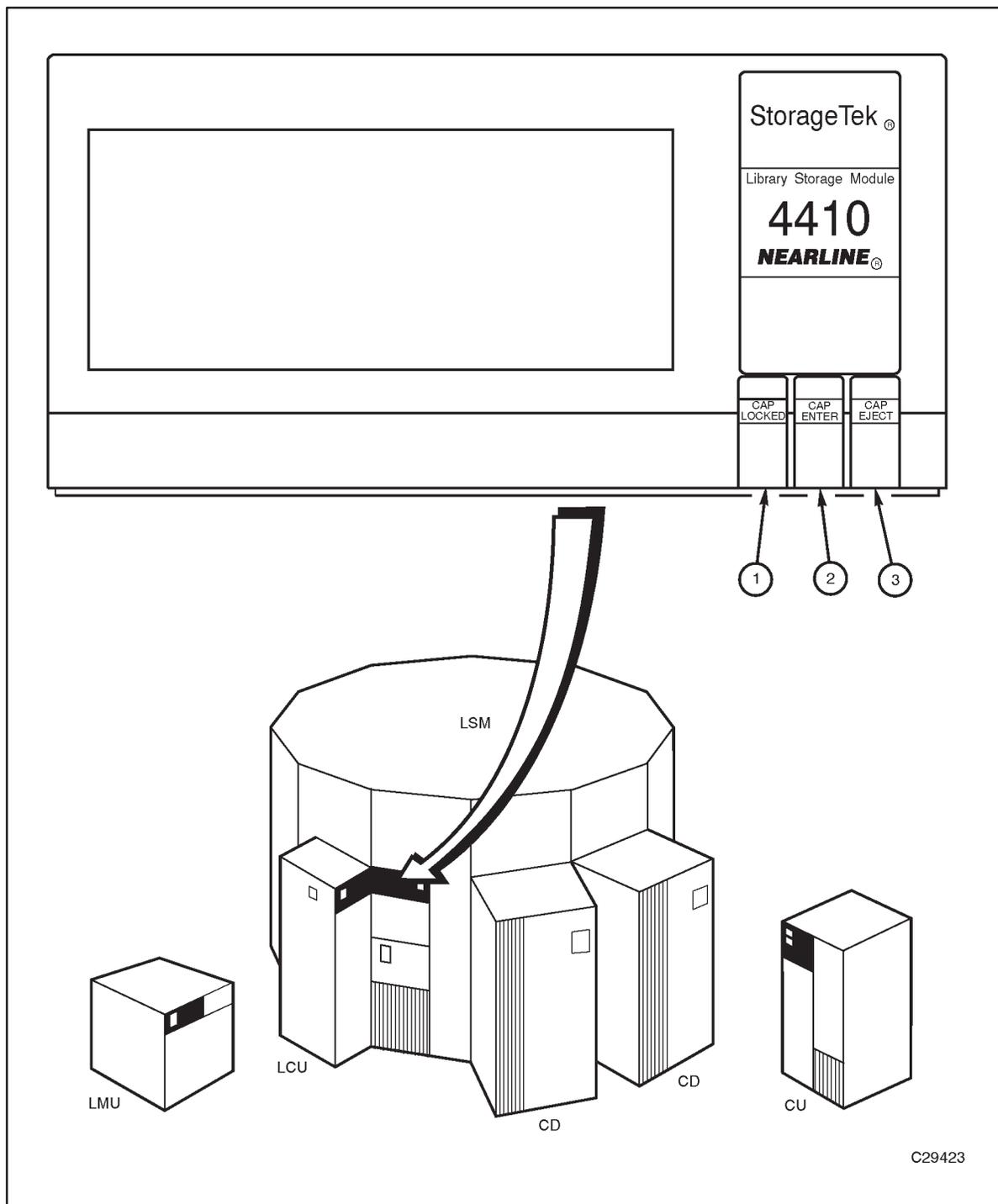


Figure 2-3. Standard CAP Control Panel

## ■ Enhanced CAP Display Panel

The enhanced CAP contains 81 cells, allowing up to 81 cartridges to be entered into or ejected from the library without anyone having to enter the LSM.

The CAP consists of a one-cell priority CAP (PCAP) and two doors containing 40 cells each.

The display panel located above the PCAP on the LSM access door displays CAP and PCAP status, number and location of cartridges in the CAPs, and error messages.

The panel is divided into three sections—PCAP on the left, CAP 1 in the middle, and CAP 0 on the right.

The upper portion of each section shows requests for operator intervention and error messages. Data messages, such as Load Cartridges and Remove Cartridges, are displayed in reverse screen color. During the idle state of the PCAP, the StorageTek logo and 4410 Nearline is displayed.

The middle portion of each section shows CAP status, such as LOCKED, ENTER, and EJECT.

The lower portion of each section shows CAP access interrupt status, such as DOOR OPEN, and number of cartridges in the device.

The LED push-button switch on the left-hand side below the PCAP display allows the operator to restore the display if it has been blanked. When the CAP or PCAP has been inactive for 10 minutes, the display will blank and the green LED in the switch will light. The display remains blanked until the switch is depressed, a host request for CAP interaction occurs, or a CAP/PCAP door open or close is sensed.

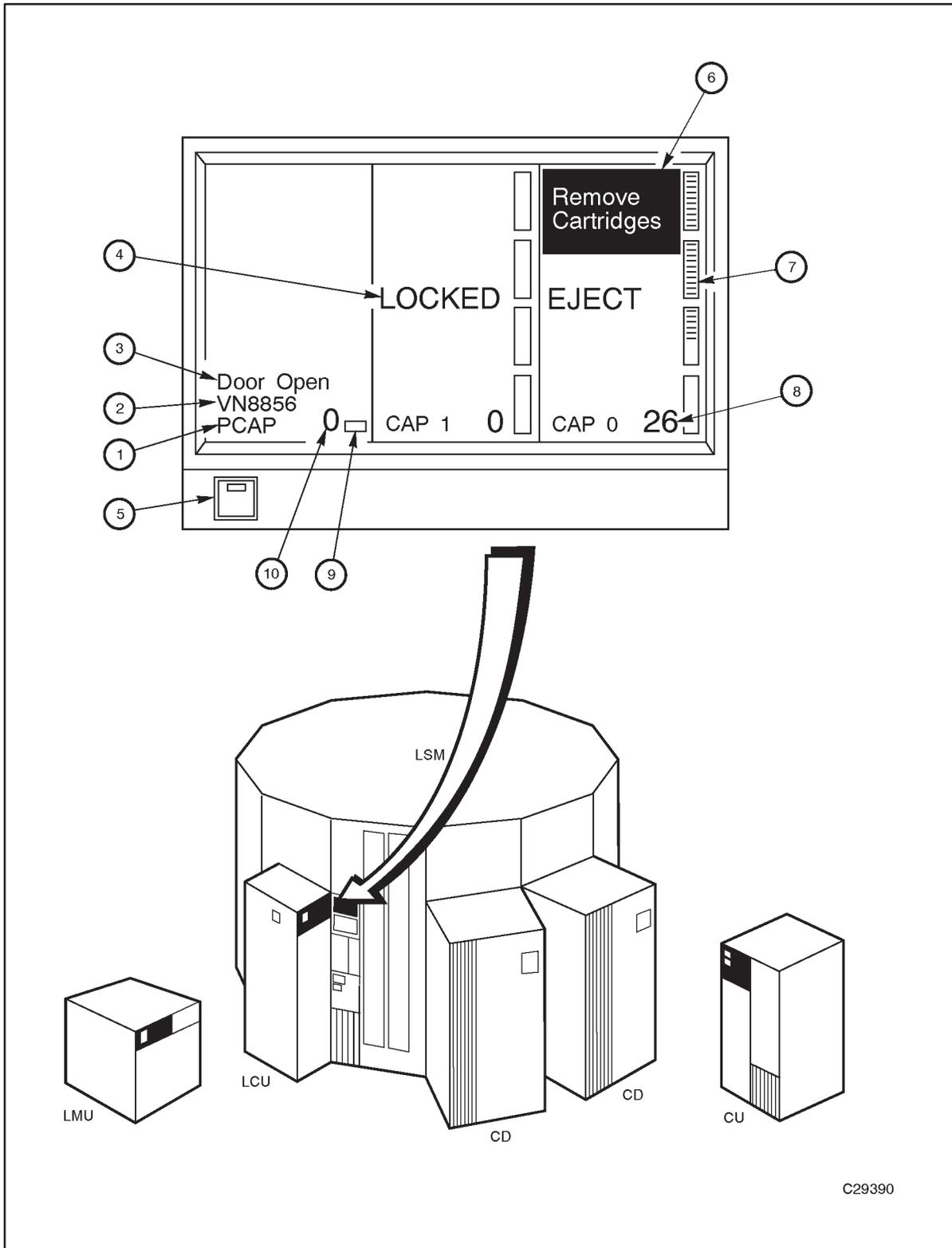
The LED switch is enabled with LMU microcode Release 3.4. For microcode releases prior to Release 3.4, one of two conditions exist:

- On earlier display panels, the display dims and displays reverse video.
- On later display panels, the display goes to reverse video but does not dim.

After Release 3.4, all displays will blank. In the absence of a switch, the display returns if a door open/close sense occurs or a host request for CAP/PCAP interaction occurs.

[Table 2-4](#) lists and describes each numbered item and [Figure 2-4](#) shows this panel.

<b>Table 2-4. Enhanced CAP Display Panel</b>		
<b>Item<sup>1</sup></b>	<b>Category</b>	<b>Function</b>
1	Device	PCAP, CAP 1, CAP 0
2	VOLSER	With certain software, VOLSER of cartridge in PCAP
3	Status	CAP access interrupt (Door Open)
4	Status	LOCKED, ENTER, EJECT
5	Switch/Indicator	<b>Switch:</b> Restores display when blanked. <b>Indicator:</b> Lights when display is blanked.
6	Message	Operator intervention required, error messages
7	Rectangular boxes with horizontal lines	Rectangular boxes show number and location of magazines (0-3) in the device. Horizontal lines within the boxes show cartridges being entered or ejected. If the magazines are not placed correctly in the device, an error message appears at the top of the device section.
8	Number	Number of cartridges in the CAP (0-40)
9	Box	Horizontal line means a cartridge is in the PCAP
10	Number	1 means a cartridge is in the PCAP; 0 means PCAP is empty.
<sup>1</sup> Item numbers correspond to item numbers in Figure 2-4.		



C29390

**Figure 2-4. Enhanced CAP Display Panel**

## ■ Emergency Power Off Switch—Inside LSM

### **WARNING:**

**The LSM safety system is not foolproof. Use extreme caution before you close the access door to make sure that no one is inside. Make a visual inspection for people or other obstructions just before you close the access door.**

It is remotely possible that someone could become trapped inside the LSM. For this reason, there is a large red EPO push-button switch on the inside of the LSM access door to immediately shut down the LSM. Pressing this switch turns off power from all moving parts of the robot. [Figure 2-5](#) shows the location of this switch on the standard CAP. On the enhanced CAP, the switch has the same location, next to the access door latch.

## ■ Commutateur de mise hors tension en cas d'urgence (EPO) du LSM – A l'intérieur du LSM

### **ATTENTION :**

**Le système de sécurité du LSM n'est pas à l'abri d'un dérèglement. Fermer la porte d'accès avec une extrême prudence et bien vérifier que personne n'est resté à l'intérieur. Avant de fermer la porte d'accès, procéder à un examen visuel à la recherche de personnes ou d'autres obstacles.**

Il est extrêmement rare mais possible qu'une personne puisse rester bloquée à l'intérieur du LSM. C'est pourquoi il existe un gros bouton rouge EPO à l'intérieur de la porte d'accès qui permet d'arrêter immédiatement le LSM. Appuyer sur ce commutateur coupe le courant de tous les éléments mobiles du robot. [L'illustration 2-5](#) indique l'emplacement du commutateur sur un CAP standard. Sur les CAP plus sophistiqués, le commutateur est au même endroit, près du système de verrouillage de la porte.

## ■ Notausschalter – Im Innern des LSM

### **WARNUNG:**

**Das Sicherheitssystem des LSM ist nicht narrensicher. Vor dem Schließen der Eingangstür stets nachsehen, ob sich noch Personen oder Hindernisse im Innern befinden.**

Es kann jedoch u. U. vorkommen, daß jemand im LSM eingeschlossen ist. Aus diesem Grund befindet sich innen im LSM an der Eingangstür ein großer, roter Notausschalter, um das LSM sofort abzuschalten. Durch Drücken dieses Schalters wird der Strom zu allen beweglichen Teilen des Roboters

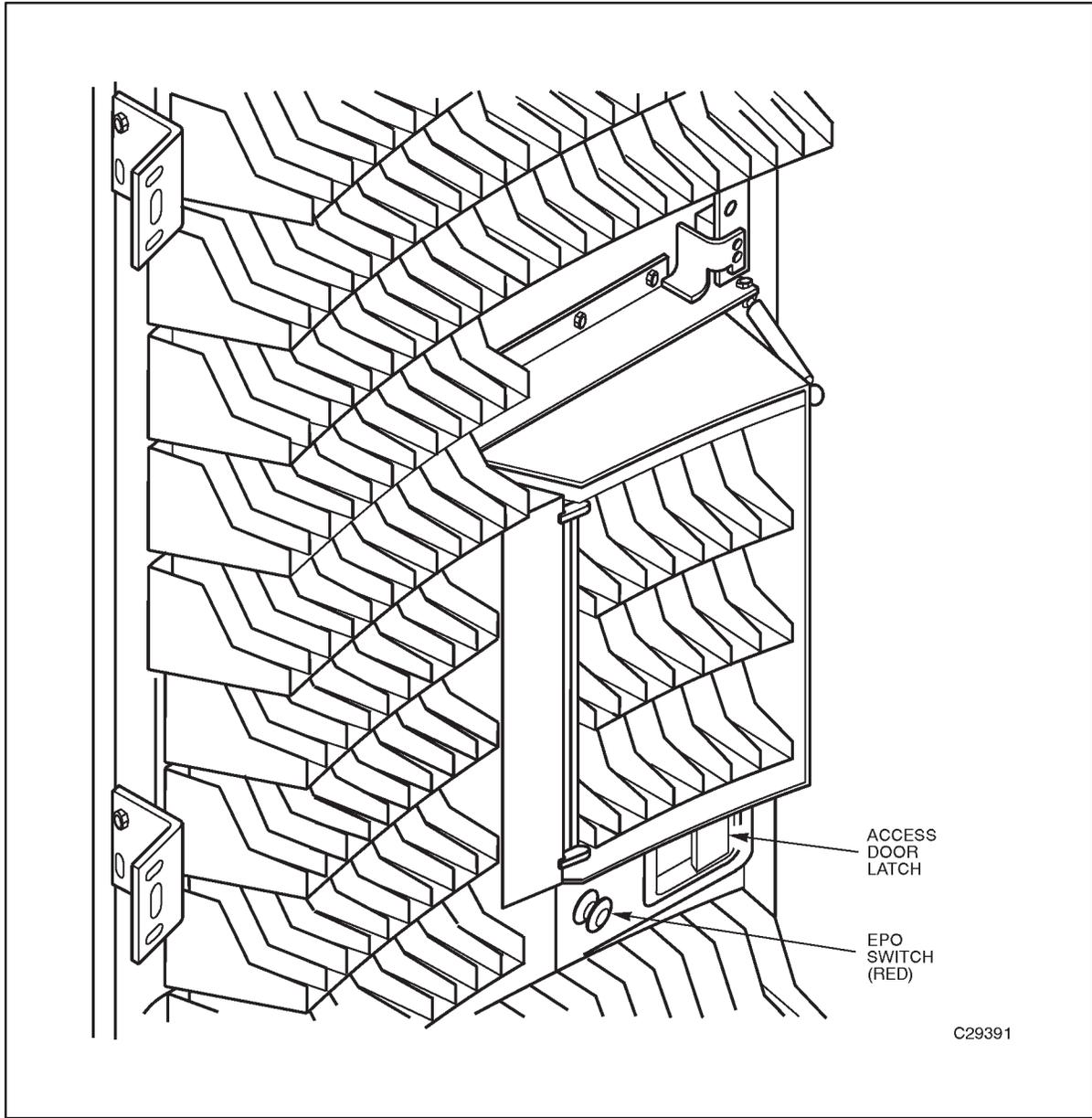
ausgeschaltet. [Abbildung 2-5](#) zeigt den Anbringungsort dieses Schalters am Standard-CAP. Am erweiterten CAP befindet sich der Schalter am selben Ort, neben dem Türriegel.

## ■ Interruttore di spegnimento d'emergenza (EPO) – dentro l'LSM

### **AVVERTENZA:**

**Il sistema di sicurezza dell'LSM non è infallibile. Si raccomanda particolare prudenza prima di chiudere la porta d'accesso nel verificare che non vi sia nessuno all'interno. Controllare che non vi siano persone o altre ostruzioni immediatamente prima di chiudere la porta d'accesso.**

Esiste una seppur remota possibilità che qualcuno possa rimanere intrappolato dentro l'LSM. Per questo motivo, c'è un grande pulsante rosso EPO all'interno della porta d'accesso dell'LSM per spegnere immediatamente l'LSM. Premendo questo pulsante si disinserisce l'alimentazione di tutte le parti mobili del robot. [La figura 2-5](#) mostra l'ubicazione di questo interruttore sul pannello standard di accesso alla cartuccia. Sul pannello avanzato, l'interruttore si trova nella stessa posizione, accanto al fermo della porta d'accesso.



**Figure 2-5. Emergency Power Off (EPO) Switch—Inside LSM**

## ■ 4xxx Cartridge Subsystem Controls, Indicators

The following pages describe the 4xxx Cartridge Subsystem panels. Refer to the [9490](#), [SD-3](#) and [9840 publications](#) for information on panels used for those units.

### Emergency Power Off (EPO) Switch

**CAUTION:**

**Use this switch only in an emergency. Pressing the EPO switch starts an uncontrolled power off. You might lose data and cause system problems. Only a CSE can restore power to the subsystem after this switch is pushed.**

A red EPO switch is mounted on the front cover of the control unit (CU). Pressing this switch immediately removes all power from the AC and DC power supplies, and from the attached CDs.

### Commutateur de mise hors tension en cas d'urgence (EPO)

**ATTENTION :**

**N'utiliser ce commutateur qu'en cas d'urgence. Appuyer sur ce commutateur EPO déclenche une coupure incontrôlable. Il se peut qu'elle génère des pertes d'information et des problèmes systèmes. Une fois le commutateur enclenché, seul un CSE est en mesure de rétablir le courant dans le sous-système.**

Un commutateur EPO rouge est placé à l'avant de l'unité de contrôle (CU). Appuyer sur ce commutateur coupe immédiatement le courant des blocs d'alimentation en courant alternatif et continu et des CD ( Cartridge drive [Unités de cartouches]) solidaires.

### Notausschalter

**VORSICHT:**

**Diesen Schalter nur im Notfall verwenden. Drücken des Notausschalters bewirkt eine unkontrollierte Stromabschaltung. Es können Daten verlorengehen und Probleme mit dem System verursacht werden. Nur ein Servicetechniker kann die Stromzufuhr zum Subsystem wiederherstellen, wenn der Notausschalter betätigt wurde.**

Ein roter Notausschalter befindet sich an der Vorderseite der Steuereinheit (CU). Durch Drücken dieses Schalters wird die Wechsel- und Gleichstromversorgung und der Strom von den angeschlossenen Plattenlaufwerken (CDs) unterbrochen.

## Interruttore di spegnimento d'emergenza (EPO)

### **ATTENZIONE:**

**Usare questo interruttore solamente in caso di emergenza. Premendo l'interruttore EPO si avvia lo spegnimento incontrollato. Si possono perdere dati e causare problemi al sistema. Solamente un tecnico autorizzato del servizio assistenza può ripristinare l'alimentazione del sottosistema quando viene premuto questo interruttore.**

Un interruttore EPO rosso è montato sul coperchio anteriore dell'unità di controllo (CU).

Premendo questo interruttore si disinserisce immediatamente l'alimentazione dagli alimentatori in corrente alternata e continua, e dalle unità a cartuccia collegate.

## Control Unit Operator Panel

Refer to your subsystem operator's guide for CU operator panel information.

## 4xxx Cartridge Drive Operator Panel—Outside LSM

An operator panel on the back of the CD contains switches that control the transport. [Table 2-5](#) lists and describes each numbered item and [Figure 2-6](#) shows this panel.

**Table 2-5. 4xxx CD Operator Panel—Outside LSM**

<b>Item<sup>1</sup></b>	<b>Label</b>	<b>Type</b>	<b>Function</b>
1	OFFLINE	Momentary switch	Changes the state of the machine from on-line to off-line, or vice versa. Before pressing it for an off-line state, place the unit off-line from the console. After pressing it for an on-line state, place the unit on-line at the console.
2	OFFLINE	Yellow LED	When the OFFLINE switch is pressed, this yellow LED flashes until the transport changes state. If this LED is continuously on, the transport is off-line; if it is not on, the transport is on-line.
3	WTM	Momentary switch	Requests the CU to write a tape mark on the tape in the transport. The transport must be off-line and ready.
4	WTM	Green LED	When the WTM switch is pressed, the green LED remains on until a tape mark is written on the tape in the matching transport.

<sup>1</sup> Numbers match item numbers in Figure 2-6.

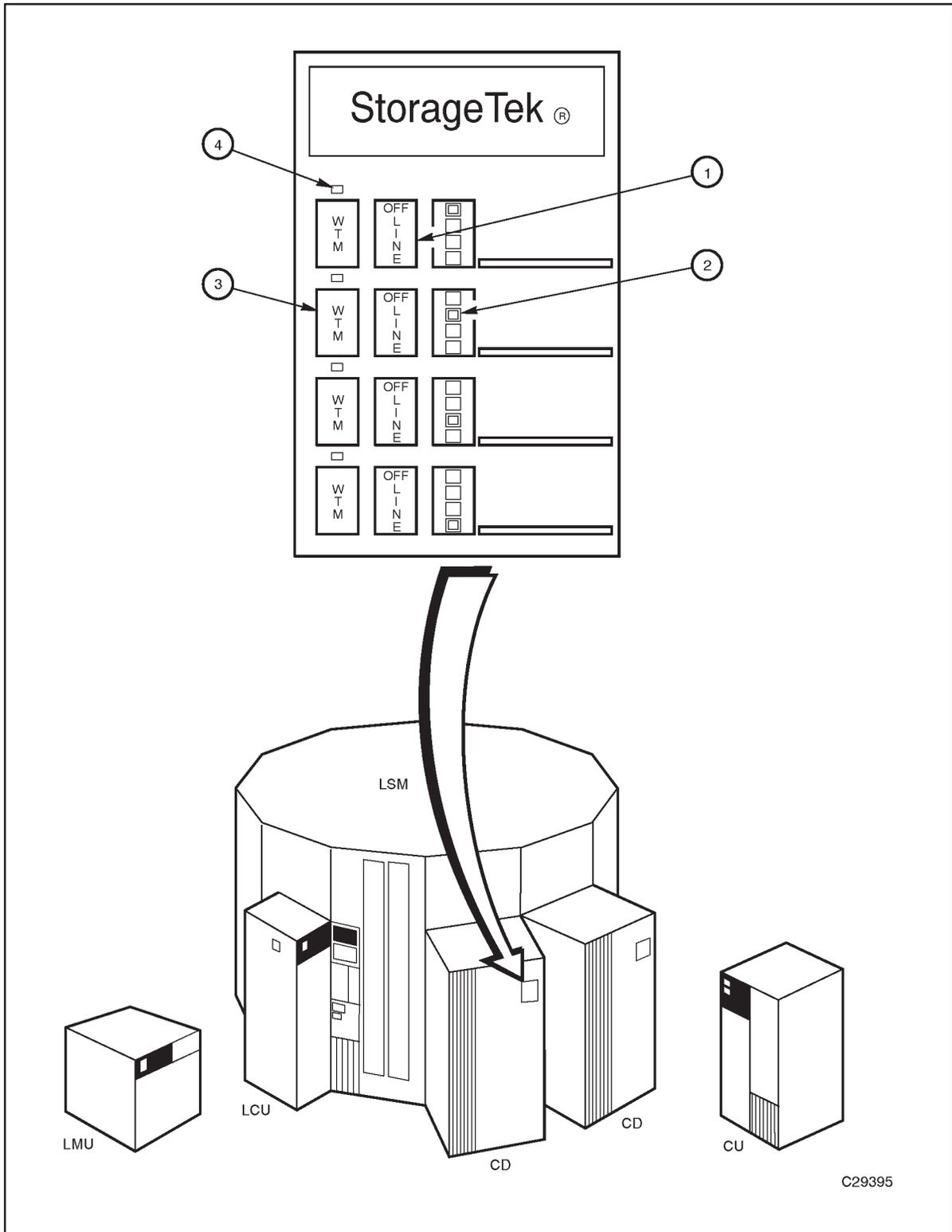


Figure 2-6. 4xxx CD Operator Panel—Outside LSM

## 4xxx Cartridge Drive Operator Panel—Inside LSM

Each CD attached to the LSM includes a manual mode operator display panel and a control panel. These two panels are accessible only from inside the LSM and are operative only during manual cartridge operation. [Table 2-6](#) lists and describes each numbered item and [Figure 2-7](#) shows these panels.

The display panels for the transports are mounted above the top transport on the air box cover. In units that use the DD cards (rather than the DDM card), the top display corresponds to the top transport, the bottom display to the lowest transport, etc. In units that use the DDM card, the upper left corner of the display corresponds to transport 0, the upper right corner to transport 1, the lower left corner to transport 2, and the lower right corner to transport 3.

During normal operation, the display is blanked. The control panel is located to the right of the transport opening and mounted on the air box for each of the installed transports.

<b>Item<sup>1</sup></b>	<b>Label</b>	<b>Type</b>	<b>Function</b>
1	SELECT	Green light bar	When on, transport is selected by the CU.
2	OPERATOR	Red light bar	When on, operator intervention is needed.
3	OFFLINE	Yellow light bar	When on, the transport is off-line.
4		10-character display	Presents host and transport state messages.
5	REWIND	Momentary switch	<p>Press (if Ready/Not-ready switch is in Not-ready position) to rewind tape to BOT. Press again and hold down for several seconds to reset any hold off-load and unblanks display.</p> <p>In a manual mode LSM, press this switch and the UNLOAD switch for two seconds to change the intensity of the transport message display. Refer to “Resetting the Transport Display” in Chapter 3.</p>
6	UNLOAD	Momentary switch	<p>Rewinds tape to BOT and ejects cartridge for removal by operator, if Ready/Not-ready switch is in Not-ready position.</p> <p>In a manual mode LSM, press this switch and the REWIND switch for two seconds to change the intensity of the transport message display. Refer to “Resetting the Transport Display” in Chapter 3.</p>
7	READY	<p>Momentary switch</p> <p>Green LED</p>	<p><b>Switch:</b> Press this switch to set and reset the Ready Enable switch. When Ready switch is set, transport can read and write data from and to tape, and Rewind and Unload push buttons are disabled.</p> <p>When the ready state is not set, either the transport is prevented from becoming ready, or, if it is ready, it exits the ready state when it finishes the record it is processing.</p> <p><b>Indicator:</b> On when Ready switch is in Ready position.</p>
<p><sup>1</sup> Numbers match item numbers in Figure 2-7</p> <p><sup>2</sup> Make sure that the READY indicator is on for each transport before exiting the LSM to return the system to automatic mode.</p>			

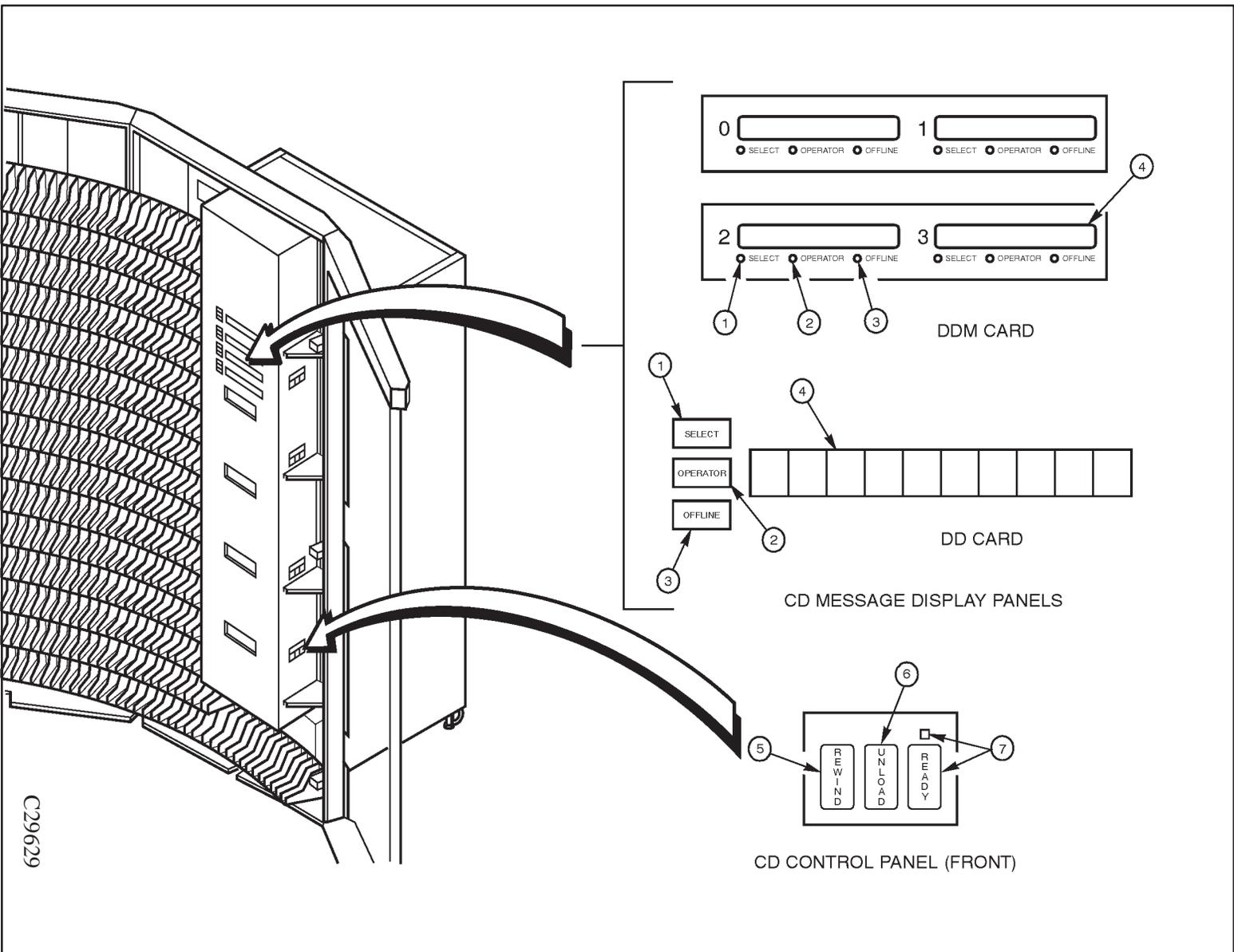


Figure 2-7. 4xxxx CD Message Display and Operator Panels—Inside ISM

## Transport Condition Messages

The message display shows transport condition changes. [Table 2-7](#) lists these messages and meanings.

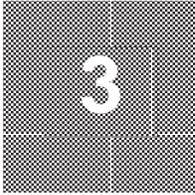
## Check Code Messages

When the subsystem detects a hardware error in the transport, a check code message appears in the message display. The format of the check code message is “CHK\_XXXX,” where XXXX is a hexadecimal error code. For most check codes, record it and place a service call. Tell the CSE the error/check code.

<b>Message</b>	<b>Description</b>
CHK XXXX	Transport detected fault symptom code 'XXXX'.
*CLEAN*	Clean the transport with a cleaning cartridge.
*CLEANING*	Cleaning cartridge is loaded and running.
CLOSE DOOR	Operator must close the door.
DOWNLOAD n	Functional code must be downloaded to transport ('n' is the transport number 0-3).
E.O.T.	Logical end of taped has been reached.
*ERASING*	Data security erase is being performed.
FUNCTIONAL	Transport is initializing functional code download from the CU.
LOADING	Cartridge is being loaded.
LOCATING	Transport is searching for a sector.
NT READY F	Transport is not ready and the cartridge is file protected.
NT READY U	Transport is not ready and the cartridge is not file protected.
P.E.O.T.	Transport is at the physical end of tape.
READY	Transport is ready.
READY F	Transport is ready and the cartridge is file protected.
READY U	Transport is ready and the cartridge is not file protected.
REWINDING	Transport is rewinding.
RWD *CLEAN	Request for a cleaning cartridge occurs while another cartridge is rewinding.
*SELFTTEST*	Transport is running boot PROM diagnostics.
StorageTek	IPL is complete.
TEST DONE	Transport has successfully completed servo diagnostics and is waiting for functional code to be downloaded from the CU.
TESTING n	Transport is running servo diagnostics on transport 'n'.
UNLOADING	Transport is unloading.
-WTM FAIL-	Request to write a tape mark failed (switch is on the back of the CD). Place a service call.
*	Transport is unloaded.

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# Operating an ACS



3

This chapter describes the procedures for operating an ACS:

- LSM automatic mode
- LSM manual mode
- Returning the LSM to automatic mode
- LMU operation
- LCU/LSM operation
- Cartridge subsystem operation
- Loading a functional diskette (IPL)

**WARNING:**

**Under no circumstances should anyone other than an authorized customer services engineer remove any covers from any component of an ACS. By doing so, you might injure yourself, damage a component, and void any warranty on the unit.**

**ATTENTION :**

**Seul un technicien agréé du service client est autorisé à ouvrir un composant quelconque du ACS. Dans le cas contraire, il y a risques de blessures, d'endommagement d'un composant et d'annulation de toute garantie existante sur le matériel.**

**WARNUNG:**

**Die Abdeckungen der ACS-Komponenten dürfen nur von zugelassenen Servicetechnikern entfernt werden. Gegenteiliges Handeln kann zu Verletzungen, Beschädigungen einer Komponente und zur Nichtigkeitmachung der Gerätegarantie führen.**

**AVVERTENZA:**

**Solamente un tecnico autorizzato del servizio assistenza può rimuovere i coperchi dei componenti di un ACS in qualsiasi circostanza. Se i coperchi sono rimossi da altri, ne possono risultare infortuni, danni a componenti e l'annullamento di eventuali garanzie dell'unità.**

## ■ LSM Automatic Mode

When an LSM is online, it is in automatic mode. This means that the robot can mount and dismount cartridges in the cartridge drive, retrieve cartridges and store them in the wall cells of the LSM, and retrieve and eject cartridges through the CAP and PCAP. In other words, the robot can perform all operations that take place inside the LSM, without help from the operator.

The most common functions that an operator must perform when an LSM is in automatic mode are:

- Inserting cartridges into the LSM through a cartridge access port (CAP) or priority CAP (PCAP)
- Retrieving cartridges from the LSM through a CAP/PCAP
- Entering a cartridge when the eject routine is in progress

## CAP and PCAP Modes

When an LSM is in automatic mode, the CAPs and PCAP can be in either auto-mode or manual mode.

When the CAP is in auto-mode, it is unlocked unless it is currently being used to enter cartridges. The operator can enter cartridges into an auto-mode CAP without using commands.

When the CAP is in manual mode, it is locked and must be unlocked by the host or by an operator command to enter or eject cartridges. When the host wants to use the CAP, a message on the console instructs the operator to place a cartridge into the CAP or remove one. An operator who wants to use the CAP must issue the appropriate command to start the entering or the ejecting activity.

## Entering Cartridges into CAP in Auto-mode

To enter a cartridge into the CAP:

1. Look at the indicator or display to make sure that the CAP is not locked.
2. Unlatch and open the CAP and insert the cartridge into the proper slot.
3. Close the CAP door. Make sure that the latch catches.

## Entering Cartridges through Standard CAP, Manual Mode

Use the enter command to enter cartridges into an automatic mode LSM when a CAP is in manual mode. Each enter command lets you specify one CAP in one LSM. Refer to your software manual for the command syntax and console messages.

1. Type the enter command at the console.
2. The CAP ENTER indicator on the CAP panel turns on.
3. A message appears on the console.
4. The CAP LOCKED indicator turns off.
5. The CAP door unlocks.

**CAUTION:**

**Make sure that the CAP LOCKED indicator is off before opening the CAP.**

**WARNING:**

**To prevent contact with the robot and possible injury to yourself, do not try to reach beyond the CAP into the LSM.**

**ATTENTION :**

**Avant d'ouvrir le CAP, vérifiez que l'indicateur « CAP FERMÉ » n'est pas allumé.**

**ATTENTION :**

**Pour éviter de heurter le robot et éviter d'être blessé, ne pas essayer d'aller au-delà du CAP dans le LSM.**

**VORSICHT:**

**Prüfen, ob die Anzeige CAP LOCKED aus ist, bevor das CAP geöffnet wird.**

**WARNUNG:**

**Um eine Berührung des Roboters und mögliche Verletzungen zu verhindern, nicht versuchen, hinter das CAP in das LSM zu reichen.**

**ATTENZIONE:**

**Accertarsi che l'indicatore PANNELLO BLOCCATO sia spento prima di aprire il pannello.**

**AVVERTENZA:**

**Per evitare il contatto con il robot e possibili lesioni, non tentare di allungare le braccia nell'LSM oltre il CAP.**

6. Open the CAP door by pressing the CAP latch (Figure 3-1).

**CAUTION:**

**Do not skip any cells in a given row. The robot stops scanning the CAP cells when it finds the first empty cell. Cartridges that are placed after an empty cell are not entered.**

7. Place the cartridges into the CAP cells (Figure 3-2). Insert the cartridges so that the customer label is on the left, and the VOLSER label faces toward you.

Fill the top row of storage cells from left to right, then the middle row from left to right, and then the bottom row, until you have inserted all the cartridges or filled up the CAP.

**CAUTION:**

**Do not slam the CAP door. The robot cannot recover cartridges that fall on the floor.**

8. Close the CAP door.
9. The CAP LOCKED indicator on the CAP panel turns on.

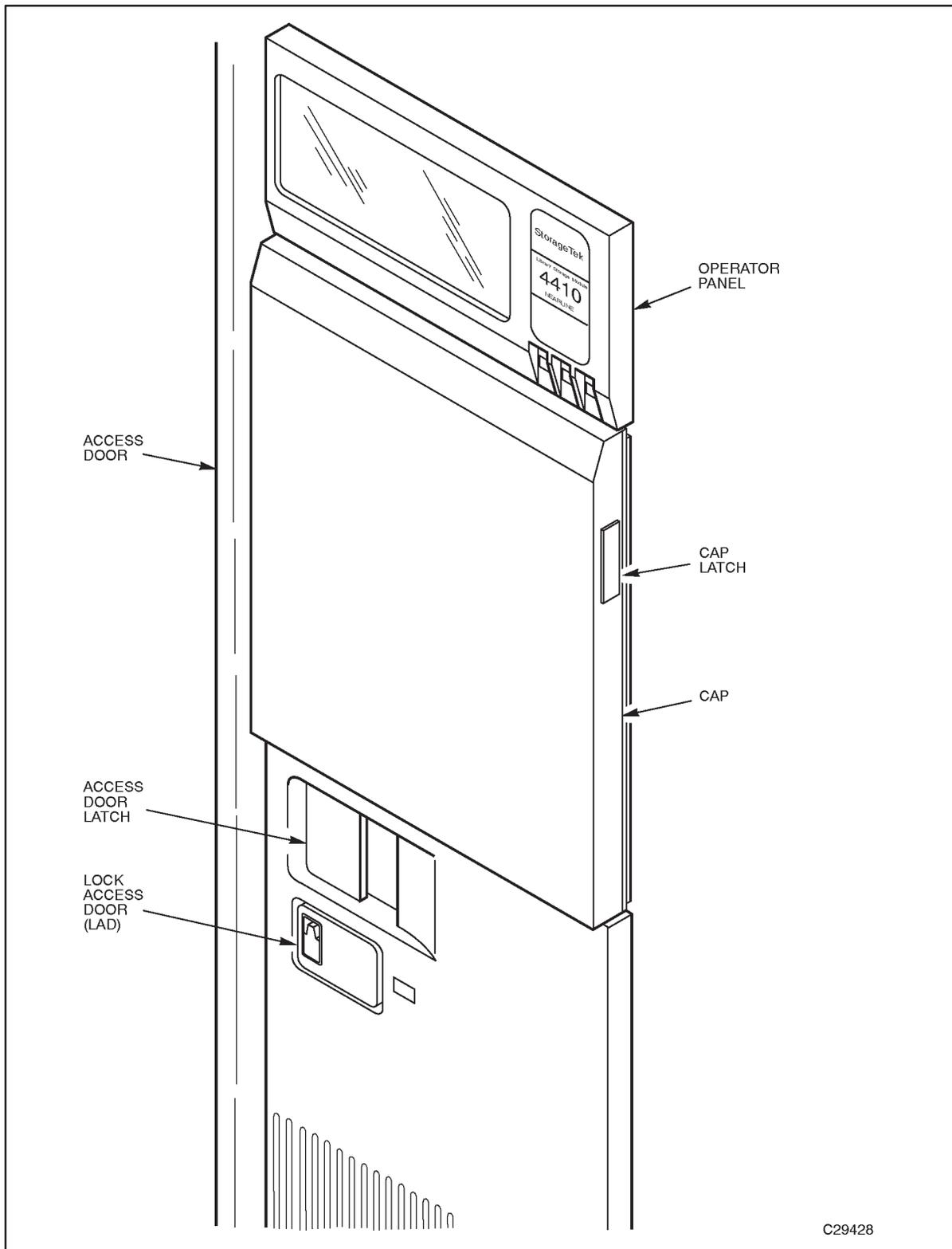
**Note:** The CAP ENTER indicator remains lit until the enter operation is ended by the operator.

10. The robot scans the CAP and stores all cartridges with readable labels inside the LSM. Cartridges with unreadable labels are left in the CAP.

**CAUTION:**

**Make sure that the CAP LOCKED indicator is off before opening the CAP.**

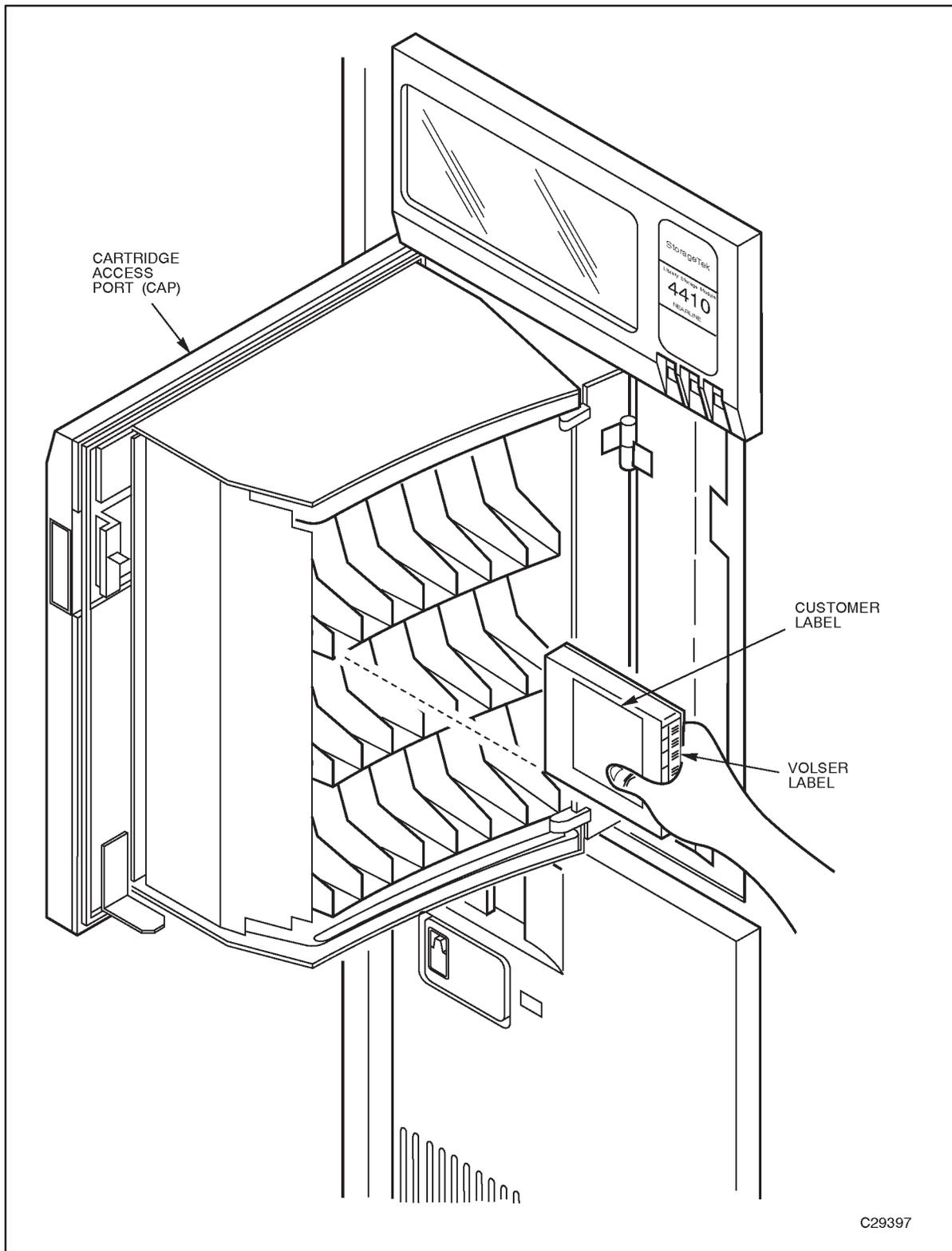
11. The CAP unlocks when the robot has removed all readable cartridges from the CAP. Open the CAP.
12. If any cartridges were not accepted by the robot, an HSC message to this effect is displayed on the console.
13. If more cartridges must be placed in the CAP, repeat steps 7 through 12 as often as necessary.
14. Close the empty CAP. The CAP returns to an enter state.



**Figure 3-1. Standard Cartridge Access Port—Closed**

**To discontinue this operation:**

15. At the console, type the command to drain the CAP and make it available for other work. Refer to the HSC operator guide.
16. The CAP ENTER indicator turns off.
17. Remove any cartridges that are left in the CAP.
18. Close the CAP door. The CAP LOCKED indicator turns on.



**Figure 3-2. Standard Cartridge Access Port—Opened**

## Entering Cartridges through Enhanced CAP, Manual Mode

Use the enter command to enter cartridges into an automatic mode LSM when a CAP is in manual mode. Each enter command lets you specify one CAP in one LSM. Refer to your [software manual](#) for the command syntax and console messages.

1. Type the enter command at the console. Refer to the [HSC operator guide](#).
2. ENTER and Load Cartridges appears on the display.
3. A message appears on the console.
4. The CAP door unlocks.

**CAUTION:**

**Make sure that ENTER appears on the display before opening the CAP.**

**WARNING:**

**To prevent contact with the robot, do not try to reach beyond the CAP into the LSM.**

**ATTENTION :**

**Pour éviter de heurter le robot, ne pas essayer d'aller au-delà du CAP dans le LSM.**

**WARNUNG:**

**Um eine Berührung des Roboters und mögliche Verletzungen zu verhindern, nicht versuchen, hinter das CAP in das LSM zu reichen.**

**AVVERTENZA:**

**Per evitare il contatto con il robot, non tentare di allungare le braccia nell'LSM oltre il CAP.**

5. Open the CAP door by pulling down on the paddle handle CAP latch ([Figure 3-3](#)).
6. Place the cartridges into the magazine cells as in [Figure 3-4](#). Insert the cartridges so that the customer label is on top and the VOLSER label is facing you.

You may put cartridges into the magazines while the magazines are in the CAP, *or*

You may remove the magazines from the CAP, insert cartridges into the magazines, then replace the cartridge-filled magazines into the CAP.

Regardless of which method you use, you must make sure that two conditions are met before you close the CAP door:

- All magazine positions in both CAPs must be occupied by magazines. If a magazine from either CAP is missing, the robot will not service the CAP.
- The top cartridge slot in the top magazine of the open CAP must be occupied, and there must be no empty slots between the top and bottom cartridges. The robot scans down, starting at the topmost slot, and stops scanning at the first empty slot it encounters.

**CAUTION:**

**Do not slam the door. The robot cannot retrieve cartridges if they fall out of the CAP onto the floor.**

7. Close the CAP door.
8. LOCKED appears on the display.

If operating in Paired CAP mode, both CAP doors must be opened and closed every time the CAP is unlocked.

9. The robot scans the CAP and stores all cartridges with readable labels inside the LSM.

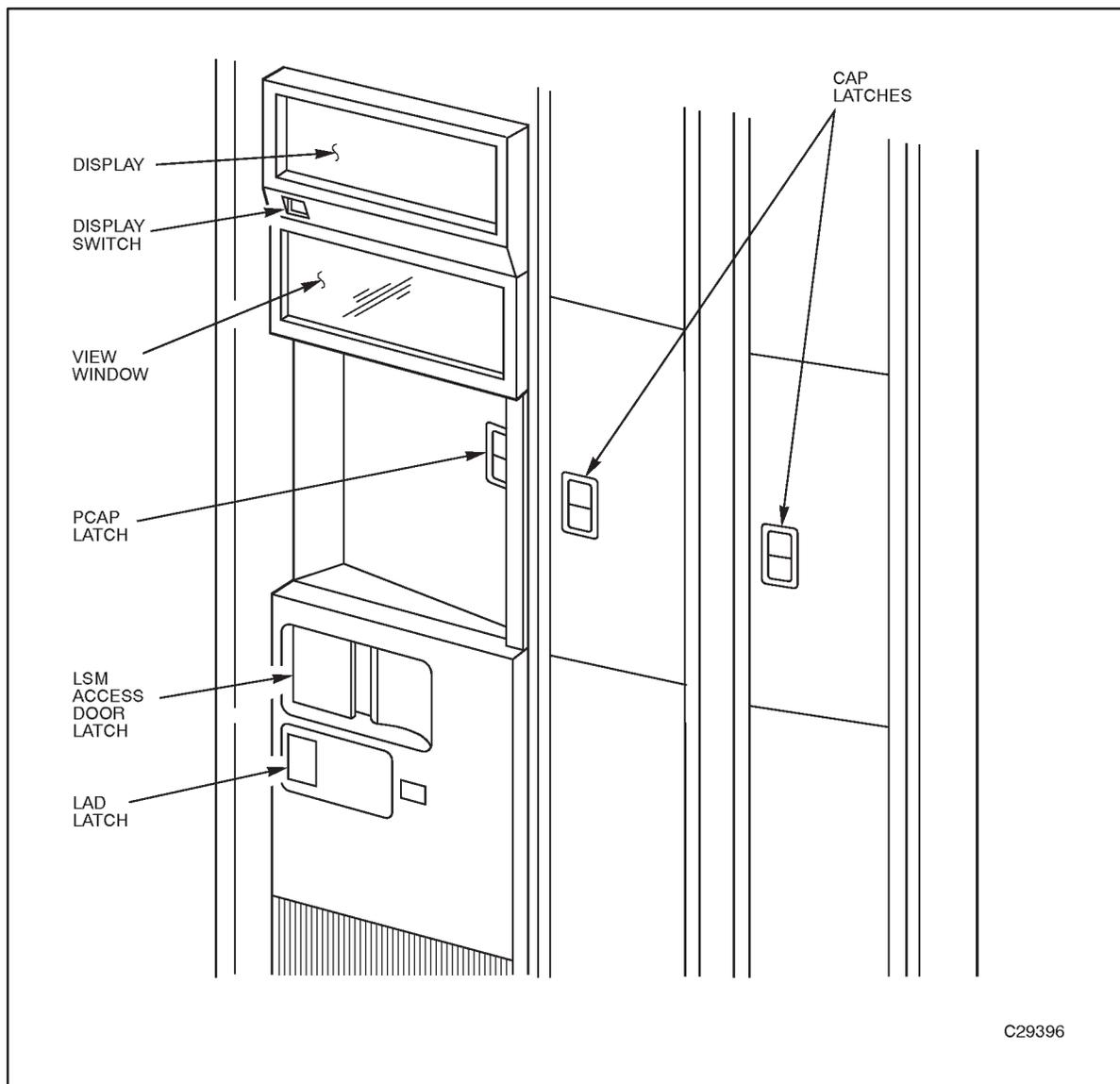
**CAUTION:**

**Make sure that ENTER appears on the display before opening the CAP.**

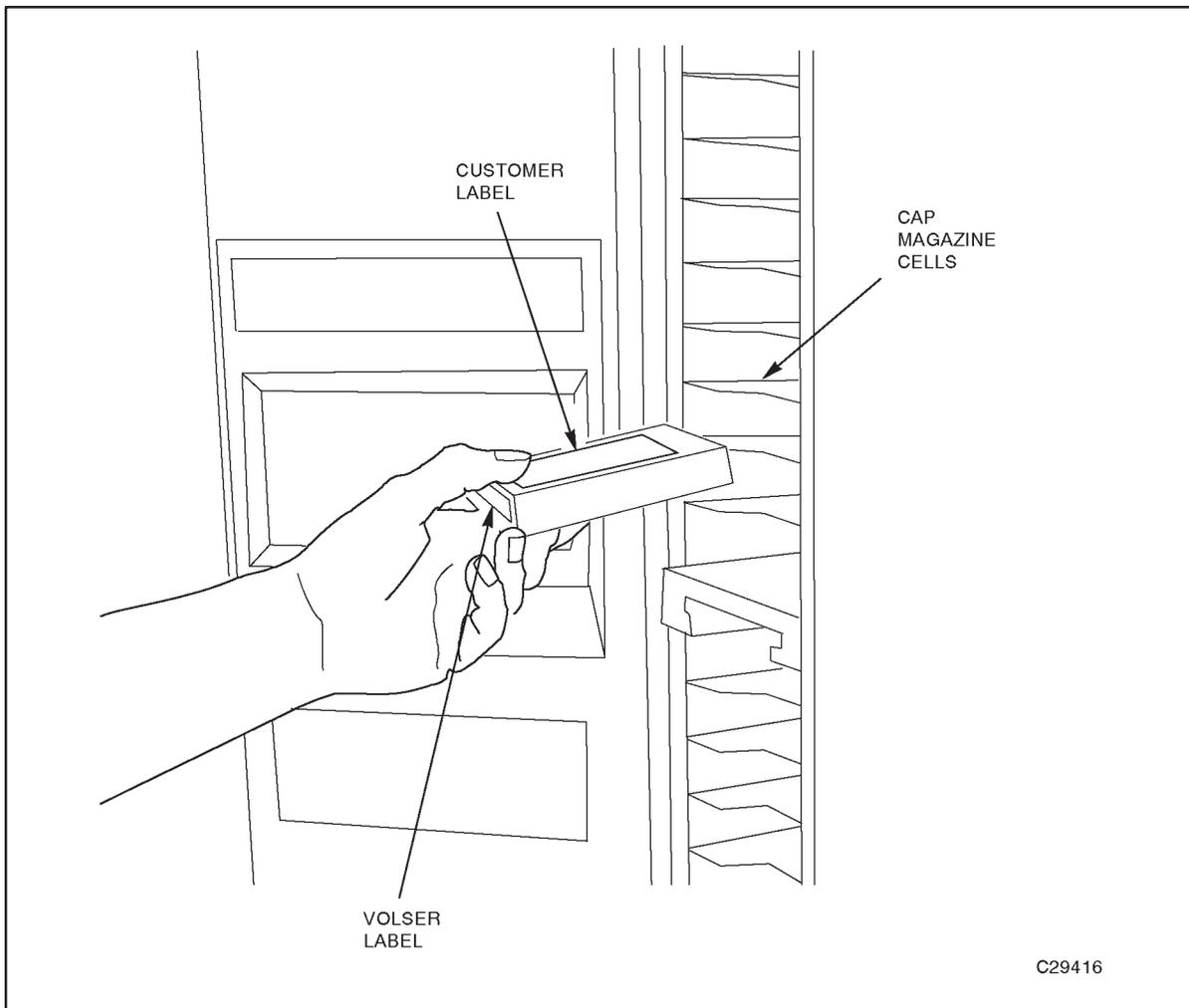
10. The CAP unlocks when the robot has removed all readable cartridges from the CAP. Open the CAP.
11. If Remove Cartridges appears on the display, remove any cartridges that were not accepted by the robot.
12. If more cartridges must be placed in the CAP, repeat steps 6 through 11, as many times as necessary.
13. Close the empty CAP. The CAP returns to an empty state.

**To discontinue this operation:**

14. At the console, type the command to drain the CAP and make it available for other work.
15. Remove any cartridges left in the CAP.
16. Close the CAP door. LOCKED appears on the display.



**Figure 3-3. Enhanced Cartridge Access Port—Closed**



**Figure 3-4. Enhanced Cartridge Access Port—Opened**

## Entering Cartridges into the LSM through the PCAP

The PCAP is located on the enhanced access door. The following pages describe how to enter cartridges into the LSM through the PCAP.

### When PCAP is in Auto-mode

When the PCAP is in auto-mode:

1. Look at the indicator or display to make sure that the PCAP is not locked.
2. Unlatch and open the PCAP door (Figure 3-3).
3. Insert the cartridge into the PCAP slot with the customer label on top and the VOLSER label facing you. (Figure 3-5).
4. Close the PCAP door.

### When PCAP is in Manual Mode

Use the enter command to enter cartridges into a PCAP when it is in manual mode.

1. Type the enter command at the console. Refer to the HSC operator guide.
2. ENTER and Load Cartridges appears on the display.
3. A message appears on the console.
4. The PCAP door unlocks.

**CAUTION:**

**Make sure that ENTER appears on the display before opening the PCAP.**

**WARNING:**

**To prevent contact with the robot and possible injury to yourself, do not try to reach beyond the PCAP into the LSM.**

**ATTENTION :**

**Pour éviter de heurter le robot et éviter d'être blessé, ne pas essayer d'aller au-delà du PCAP dans le LSM.**

**WARNUNG:**

**Um eine Berührung des Roboters und mögliche Verletzungen zu verhindern, nicht versuchen, hinter das CAP in das LSM zu reichen.**

**AVVERTENZA:**

**Per evitare il contatto con il robot e possibili lesioni, non tentare di allungare le braccia nell'LSM oltre il PCAP.**

5. Open the PCAP door by pulling down on the paddle handle PCAP latch (Figure 3-3).
6. Place the cartridges into the PCAP cell (Figure 3-4). Insert the cartridge so that the customer label is on top and the VOLSER is facing you.

**CAUTION:**

**Do not slam the door. The robot cannot retrieve a cartridge if it falls out of the PCAP onto the floor.**

7. Close the PCAP door.
8. LOCKED appears on the display.
9. The robot scans the PCAP and stores the cartridge if its label is readable.

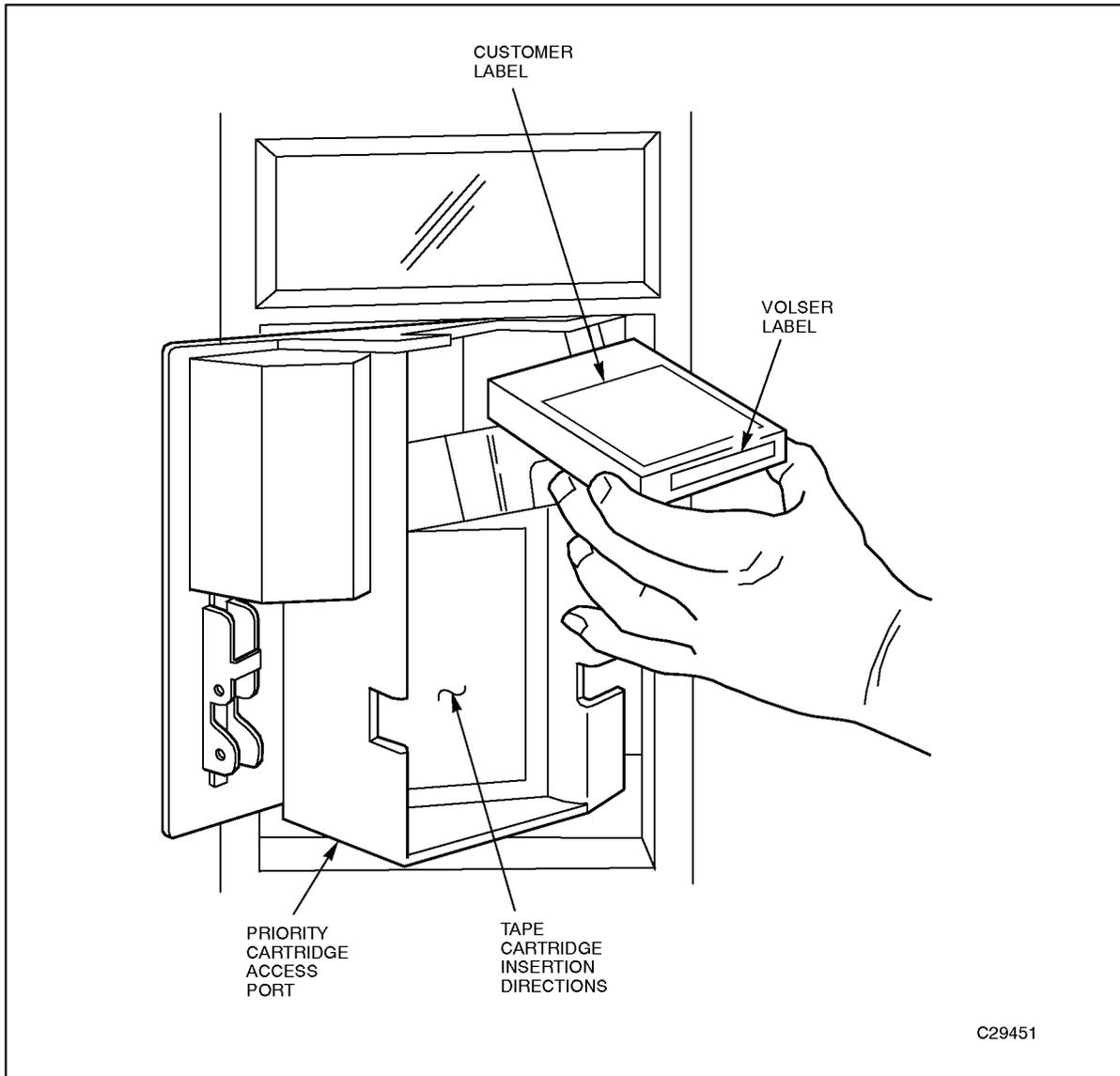
**CAUTION:**

**Make sure that ENTER appears on the display before opening the PCAP.**

10. The PCAP unlocks when the robot has removed the cartridge from the PCAP. Open the PCAP.
11. If Remove Cartridges appears on the display, remove the cartridge that was not accepted by the robot.
12. If more cartridges must be placed in the PCAP, repeat steps 6 through 11 as many times as necessary.
13. Close the empty PCAP. The PCAP returns to an empty state.

**To discontinue this operation:**

14. At the console, type the command to drain the PCAP and make it available for other work.
15. Remove any cartridge left in the PCAP.
16. Close the PCAP door. LOCKED appears on the display.



**Figure 3-5. Priority Cartridge Access Port—Opened**

## Ejecting Cartridges through a Standard CAP in Manual Mode

Use the eject command to eject cartridges from an LSM. Refer to your software manual for the command syntax and console messages.

1. Type the eject command at the console.
2. The CAP EJECT indicator on the CAP panel turns on.

3. The robot places cartridges into the CAP until all specified cartridges are in the CAP or all CAP cells are filled.
4. A message appears on the console.
5. The CAP LOCKED indicator turns off.

**CAUTION:**

**Make sure that the CAP LOCKED indicator is off before opening the CAP.**

6. Open the CAP door.
7. Remove all cartridges. *Do not leave cartridges in the CAP.*
8. Close the CAP door.
9. If more cartridges need to be ejected, the robot continues filling the CAP. Wait until the CAP door is unlocked and repeat steps 6 through 8.

The eject operation ends automatically when all specified cartridges have been ejected.

## Ejecting Cartridges through an Enhanced CAP

Use the eject command to eject cartridges from an LSM. Refer to your software manual for the command syntax and console messages.

1. Type the eject command at the console.
2. LOCKED appears on the display, if it is not already there.
3. The robot places cartridges into the CAP until all specified cartridges are in the CAP or all CAP cells are filled. The rectangular boxes on the display represent the magazines, and the horizontal lines within the boxes represent the cartridges in the magazine slots. The number at the bottom of the display increments as cartridges are added to the CAP.
4. REMOVE CARTRIDGES appears on the console.
5. EJECT replaces LOCKED on the display.

**CAUTION:**

**Make sure that EJECT appears on the display before opening the CAP.**

6. Open the CAP door.
7. Remove all cartridges, either by removing the cartridges from the magazines inside the CAP, or by removing the magazines from the CAP and taking the cartridges from the magazines outside of the CAP. Do not leave cartridges in the CAP, or Remove Cartridges will appear on the display. If the magazines were removed, replace them with empty magazines. Make sure that at least one magazine (the bottom one) is in the CAP.

8. Close the CAP door. LOCKED replaces EJECT and REMOVE CARTRIDGES on the display.

If the CAPs are operating in Paired CAP mode, both CAP doors must be opened and closed every time the CAP is unlocked.

9. If more cartridges need to be ejected, the robot continues filling the CAP. Wait until the CAP door is unlocked and repeat steps 6 through 8.

The eject operation ends automatically when all specified cartridges have been ejected.

## Ejecting Cartridges through the PCAP

The PCAP is located on the enhanced access door. A cartridge is ejected from a PCAP when a message appears on the operator console to eject the cartridge. Use the eject command to eject cartridges from an LSM. Refer to your software manual for the command syntax and console messages.

1. Type the eject command at the console.
2. LOCKED appears on the display, if it is not already there.
3. The robot places a cartridge into the CAP.
4. REMOVE CARTRIDGE appears on the console.
5. EJECT replaces LOCKED on the display.

### **CAUTION:**

**Make sure that EJECT appears on the display before opening the CAP.**

6. Open the PCAP door.
7. Remove the cartridge from the PCAP slot.
8. Close the PCAP door. LOCKED replaces EJECT and REMOVE CARTRIDGES on the display.
9. If more cartridges need to be ejected, the robot continues filling the PCAP. Wait until the PCAP door is unlocked and repeat steps 6 through 8.

The eject operation ends automatically when all specified cartridges have been ejected.

## ■ LSM Manual Mode

When the LSM is in manual mode, the robot is disabled, and the operator must enter the LSM to mount and dismount cartridges in the cartridge drives. Manual operations include:

- Determining that the LSM is not in automatic mode

- Placing the LSM in manual mode
- Entering the LSM
- Moving the robot
- Removing a cartridge from the robot fingers
- Resetting the transport display
- Locating a cartridge in the LSM
- Mounting a cartridge
- Dismounting a cartridge

## Determining LSM is Not in Automatic Mode

The following conditions indicate when an LSM is not functioning in automatic mode:

- The LSM access door is open.
- The robot does not automatically mount and dismount cartridges.
- A console message informs the operator that an LSM is not ready, indicating a problem has been detected in the LSM. The message identifies the LSM and provides a code for the failure.

## Displaying LSM Status

If you suspect that the LSM is not functioning in automatic mode, type the command at the system console to display the status of the LSM. Refer to your software manual for the command syntax and console messages. The status display indicates if the LSM is not functioning in automatic mode.

## Dual LMU Environment

ACS requests cannot effectively be automated if all stations are offline to the LMU, or if all online station paths are not working. In a dual LMU environment, if all online station paths to the master LMU are not working, use the switch command to move the work load to the standby LMU.

## Placing the LSM in Manual Mode

Refer to your software manual for the command syntax and console messages to place the LSM in manual mode. The LSM remains in manual mode until a command is given to place the LSM online.

## Making sure the LSM is Offline

If you do not see a console message indicating that the LSM is offline, type the command to display the LSM status.

**Note:** Placing the LSM offline does not cause the cartridge drives (CDs) in the affected LSM to become offline.

## Entering the LSM

### WARNING:

- Do not enter the LSM until you are thoroughly familiar with this procedure.
- Refer to [Figure 3-7](#) or [Figure 3-8](#) and familiarize yourself with the access door and its components.
- Do not attempt to override any of the electrical or mechanical safety devices in this machine.
- Do not enter the LSM without informing someone in the immediate area.
- *Never* shut the LSM door when leaving without first making sure the LSM is unoccupied. Look around the inside of the LSM, and then ask in a loud voice if anyone is inside.

## Entrer Dans Le LSM

### ATTENTION :

- Ne pas entrer dans le LSM avant d'être parfaitement familiarisé avec cette procédure.
- Se reporter à [l'illustration 3-7](#) et [l'illustration 3-8](#) et se familiariser avec la porte d'accès et ses composants.
- Ne pas tenter de neutraliser les dispositifs de sécurité électriques ou mécaniques de cette machine.
- Ne pas entrer dans le LSM sans en informer une personne à proximité.
- Ne jamais fermer le LSM sans avoir auparavant vérifié que le LSM était vide. Regarder à l'intérieur du LSM puis demander à voix haute si quelqu'un s'y trouve.

## Betreten des LSM

### WARNUNG:

- Das LSM erst betreten, wenn dieses Verfahren genau bekannt ist.

- **Abbildung 3-7 bzw. Abbildung 3-8** ansehen, um sich mit der Eingangstür und ihren Komponenten vertraut zu machen.
- **Niemals versuchen, die elektrischen oder mechanischen Sicherheitseinrichtungen dieser Maschine zu umgehen.**
- **Das LSM nie betreten, ohne vorher jemanden in unmittelbarer Nähe informiert zu haben.**
- **Niemals die LSM-Eingangstür schließen, ohne vorher geprüft zu haben, ob das LSM leer ist. Das Innere des LSM absuchen und laut fragen, ob sich noch jemand darin aufhält.**

## Ingresso nell'LSM

### AVVERTENZA:

- **Non entrare nell'LSM se non si conosce bene questa procedura.**
- **Vedere la Figura 3-7 o la Figura 3-8 per acquisire dimestichezza con la porta d'accesso e i suoi componenti.**
- **Non tentare di ignorare i dispositivi di sicurezza meccanici o elettrici di questa macchina.**
- **Non entrare nell'LSM senza informarne qualcuno nell'area circostante.**
- **Non chiudere mai la porta dell'LSM quando si esce senza prima verificare che l'LSM non sia occupato. Guardarsi intorno all'interno dell'LSM e quindi chiedere ad alta voce se c'è nessuno.**

When you begin the procedure to enter the LSM, the LED warning sign next to the lock access door (LAD) displays the words DO NOT OPEN.

Refer to your software manual for the command syntax and console messages and do the following:

1. If the LSM is online, place the LSM offline to all host CPUs. The DO NOT OPEN warning display turns off and the robot stops. This finishes all outstanding library requests.
2. Wait for the message confirming the LSM is offline. If the LSM does not come offline, enter the command to display the status of the ACS.
3. Wait for the outstanding processes to complete or type the command to force the LSM offline to all host CPUs.
4. Open the LAD and expose the door lock (Figure 3-9). Opening the LAD activates a switch, automatically causing a software interrupt and stopping the robot.
5. Insert the key and unlock the access door.

6. Pull the paddle handle to activate the opening mechanism and open the access door. At this time, several things happen:
  - a. The locking pins activate the Door-Seated (ajar) switch.
  - b. After 2 degrees of door rotation, power to the robot is turned off.
  - c. Two serial interlock switches are deactivated in the circuit that powers the robot rotation.
  - d. The Door Has-Been-Opened (HBO) switch is activated, causing an interrupt to software.
  - e. The Safety Sign switch activates the DO NOT ENTER sign inside the library ([Figure 3-6](#)).
7. Return the key lock to the locked position, remove the key, and close the LAD. This causes the sign inside the LSM to display SAFE TO ENTER, turns on the lights inside the LSM, jams the locking pins outward to prevent anyone from closing the door, and activates safety switches.
8. Put the key in your pocket so that no one can close the door while you are inside, and enter the LSM.

In the unlikely event that someone becomes locked inside and the system begins to start up, lights flash for 30 seconds before the robot starts to move. This provides enough time and light to find the door and open it using the interior latch, or to push the emergency power off (EPO) switch located next to the interior latch. Either of these actions stops any further power up.

The inside door latch always allows someone to exit, regardless of the position of the exterior key.

**WARNING:**

**This system is not foolproof and cannot detect all obstructions.**

**ATTENTION :**

**Le système n'est pas à l'abri d'un dérèglement et ne peut pas détecter tous les types d'obstacles.**

**WARNING:**

**Das System ist nicht narrensicher und kann nicht alle Hindernisse erkennen.**

**AVVERTENZA:**

**Il sistema non è sicuro al cento per cento e non può rilevare tutte le ostruzioni.**

In addition, when the robot becomes powered, the theta arm slowly sweeps the interior of the LSM, searching for any obstruction (such as a tool box or oscilloscope). In this mode, current is limited and the theta arm can be

stopped by hand. If any physical obstruction prevents the theta arm from moving for more than a few seconds, the theta arm shuts down and an error is posted. If motion is disturbed only for a moment, the theta arm continues to sweep, but posts an error at the end of initialization, without going into normal move mode.

**Note:** You may make as many LSM keys as you wish. Record the key number and store it in a safe place. Order copies from Illinois Lock Company (refer to the key package located inside the access door or call 312-537-1800). An experienced locksmith can open the lock.

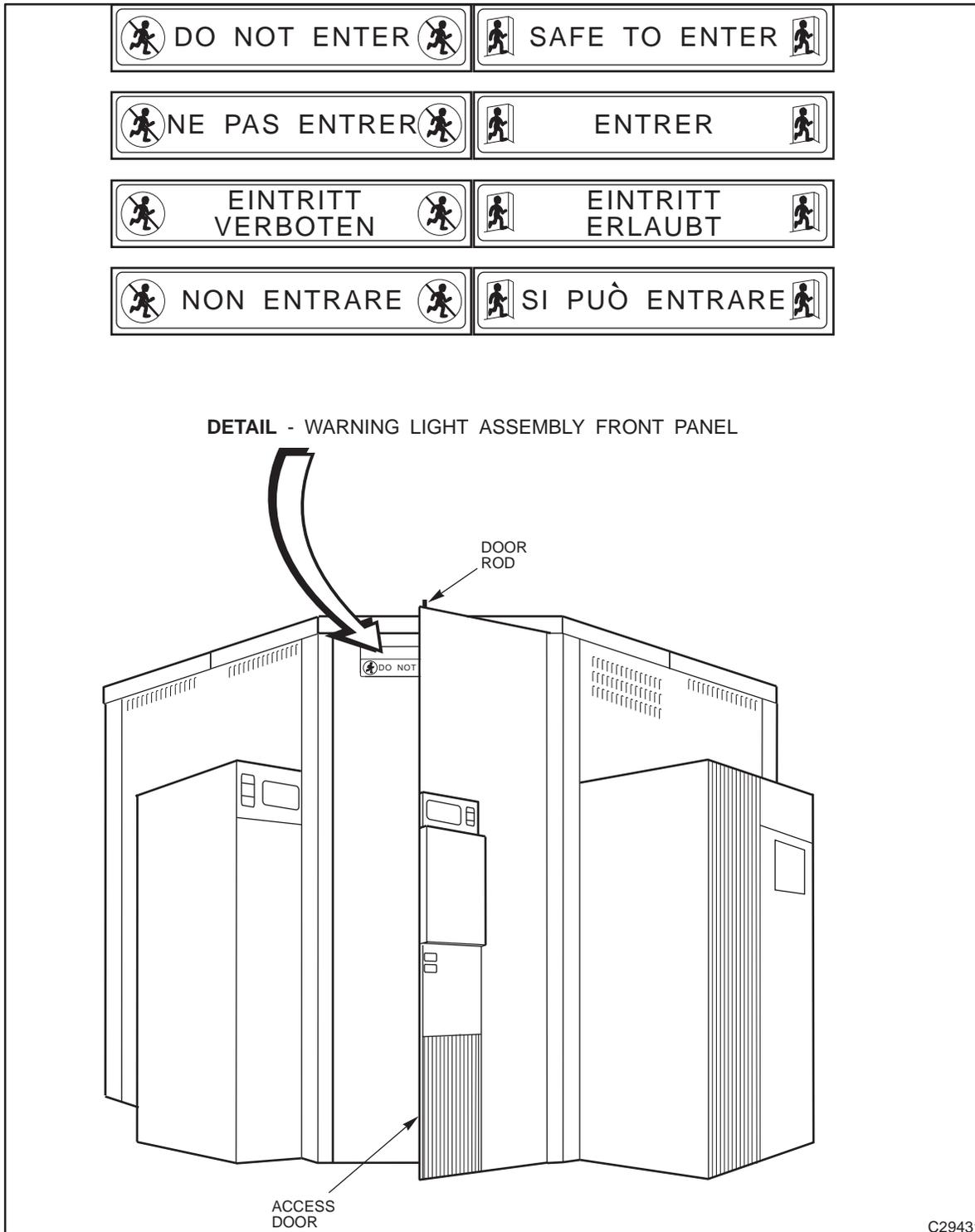
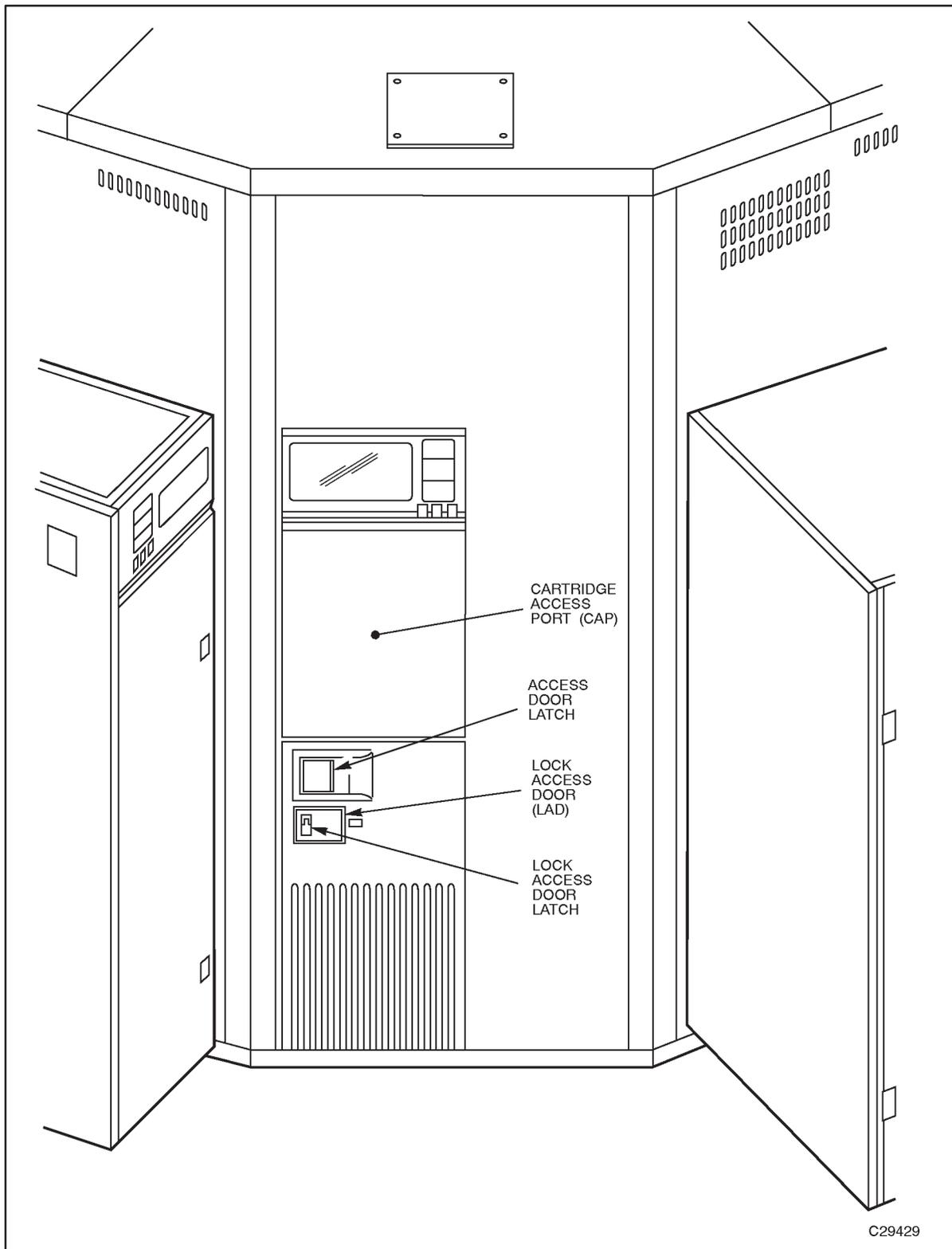
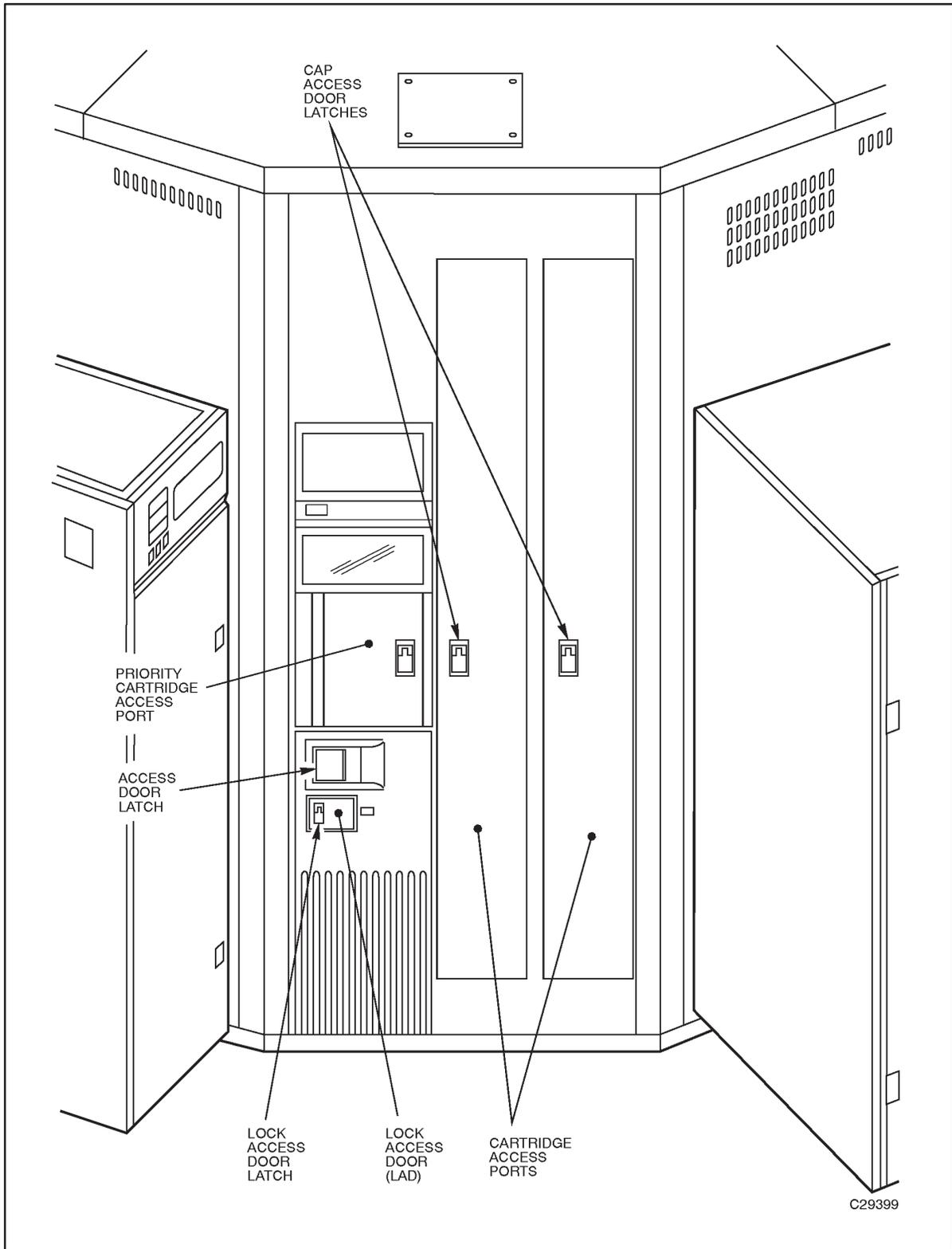


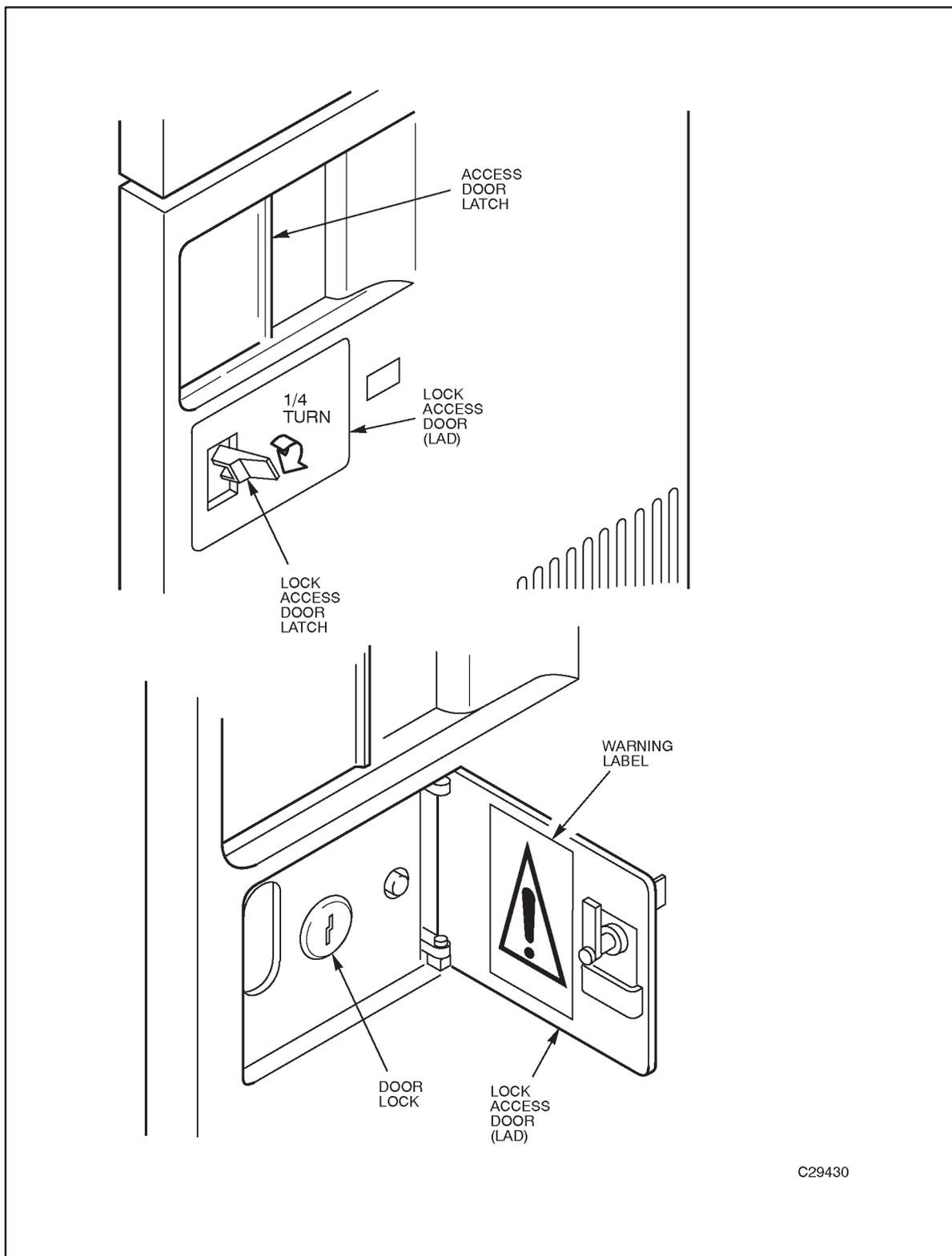
Figure 3-6. LSM Warning Light



**Figure 3-7. Standard LSM Access Door—Outside View**



**Figure 3-8. Enhanced LSM Access Door—Outside View**



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**Figure 3-9. LSM Access Door Latch and Door Lock Cover**

## Moving the Robot

You might need to move the robot to make it easier to retrieve cartridges from the LSM and manually load/unload those cartridges into the cartridge drive transports. The amount of movement is dictated by the location of the cartridge in the LSM and the location of the cartridge drive transport into which it is to be loaded/unloaded.

The following pages describe how to rotate, raise, and lower the robot, and how to remove a cartridge from the robot fingers.

### WARNING:

- Do not enter the LSM until you are familiar with the procedure described in **"Entering the LSM."**
- Do not enter the LSM or move any of its robotics mechanisms if you have any reason to suspect they are enabled.

### ATTENTION :

- Ne pas entrer dans le LSM avant d'être familiarisé avec les procédures décrites dans le paragraphe « **Entrer dans le LSM** ».
- Ne pas entrer dans le LSM ou ne déplacer aucun des mécanismes de robotique, dans le cas où ces derniers semblent défectueux.

### WARNUNG:

- Das LSM erst betreten, wenn das unter **"Betreten des LSM"** beschriebene Verfahren bekannt ist.
- Das LSM nicht betreten und keinen der Robotermechanismen bewegen, wenn der Verdacht besteht, daß diese aktiviert sind.

### AVVERTENZA:

- Non entrare nell'LSM se non si conosce bene la procedura descritta nella sezione **"Ingresso nell'LSM"**.
- Non entrare nell'LSM o muovere i meccanismi robotici se si ha motivo di sospettare che siano abilitati.

### CAUTION:

- Do not touch any shiny polished surfaces. Body oils can destroy the lubrication on these surfaces.
- Do not touch any lubricated parts.
- Push or pull the robotics carriage only as shown in the following figures.

- **The robot should move freely. Do not force the robot if movement is restricted.**

## **Raising and Lowering the Robot**

### **WARNING:**

**Using extreme caution, make sure that your hand is placed at a point where no electrical parts are exposed.**

### **ATTENTION :**

**Faire preuve de prudence et s'assurer que les mains ne touchent pas les composants électriques apparents.**

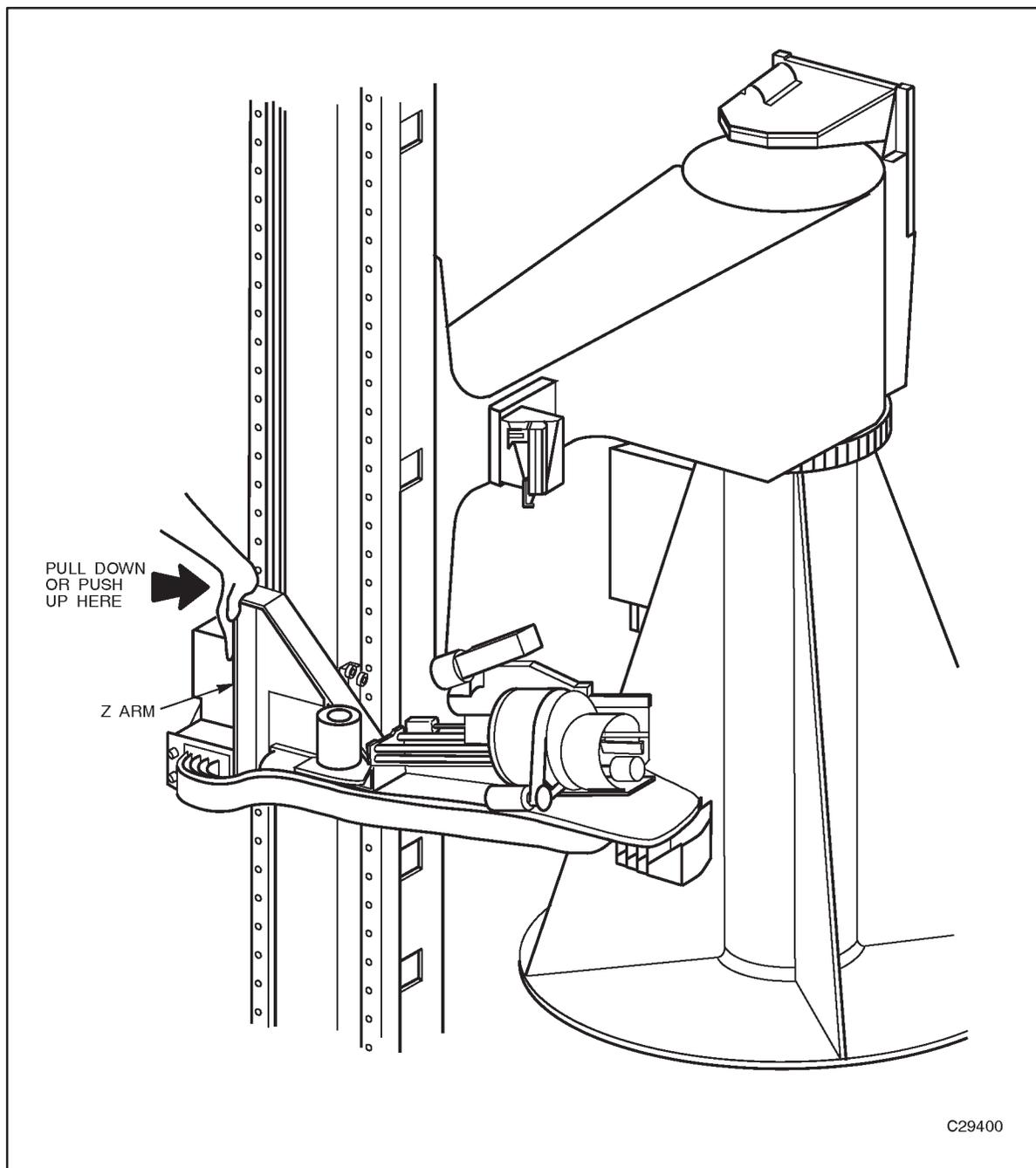
### **WARNUNG:**

**Mit besonderer Vorsicht sicherstellen, daß die Hand nicht an einer Stelle aufliegt, wo stromführende Teile freiliegen.**

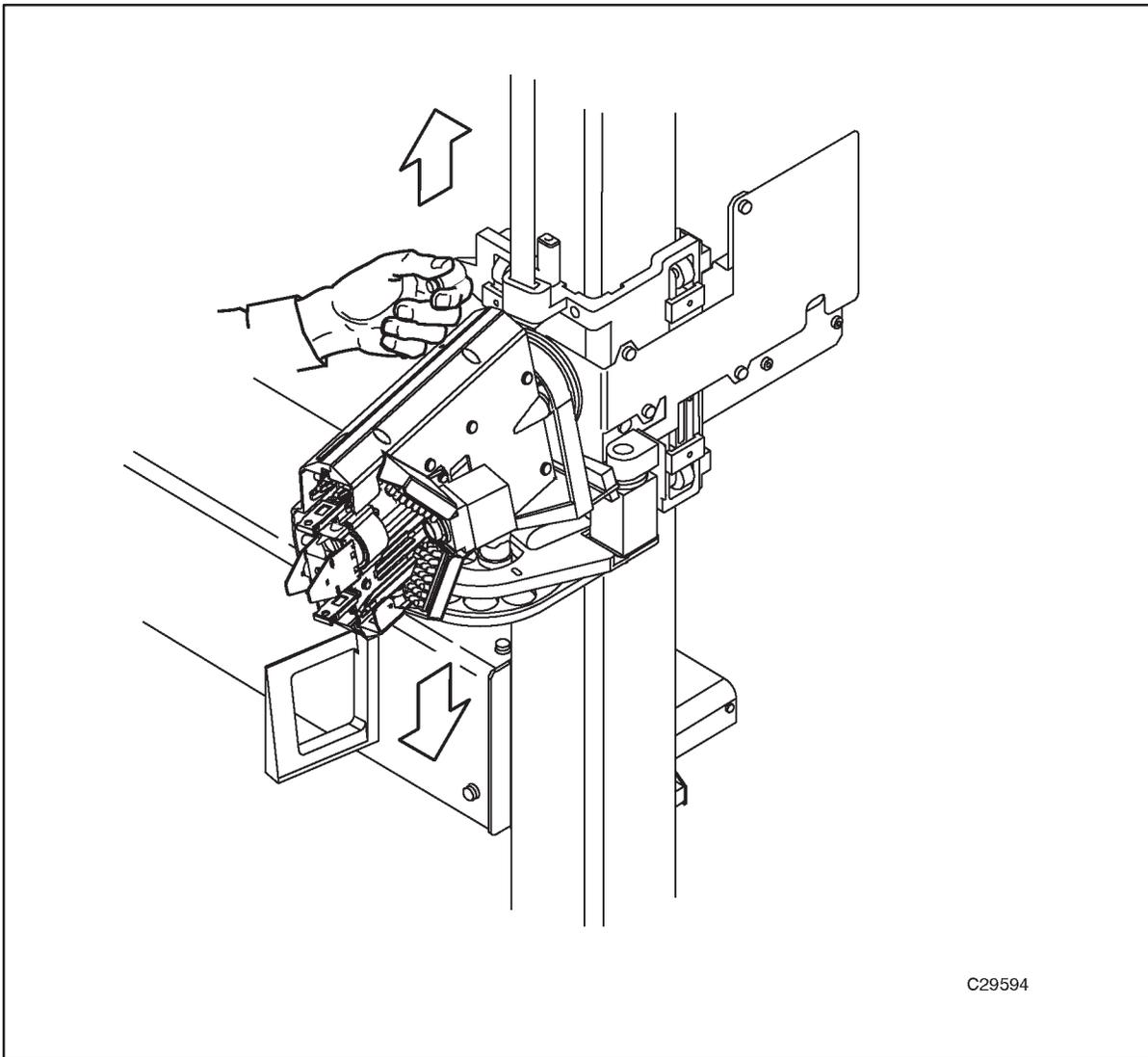
### **AVVERTENZA:**

**Facendo particolare attenzione, verificare non vi siano parti elettriche esposte nei punti in cui si appoggiano le mani.**

If you need to raise or lower the robot, **gently** pull down or push up by placing your hand under the Z arm as shown in [Figure 3-10](#) for the 4410 LSM or [Figure 3-11](#) for the 9310 LSM.



**Figure 3-10. Raising and Lowering the 4410 Robot**



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**Figure 3-11. Raising and Lowering the 9310 Robot**

## Rotating the Robot

**CAUTION:**

**If you meet resistance when pushing or pulling the robot, do not force the robot; the arm probably has touched a stopping mechanism. Move the robot in the opposite direction.**

If you need to rotate the robot, gently push or pull by placing your hand above the calibration assembly and at the point where the theta arm joins the Z channel, as shown in [Figure 3-12](#) for the 4410 LSM or [Figure 3-16](#) for the 9310 LSM.

Restrictions on robot movement described in the following steps apply to the leadscrew driven Z channel machines, due to the design of the theta stop. Check the location of the robot and move the robot as described in the appropriate step.

- If the robot has stopped directly across (180 degrees) from the access door, pull the robot from the left side of the LSM (counterclockwise). Do not pass the access door. Refer to [Figure 3-13](#).
- If the robot has stopped on the left side of the LSM and is less than 180 degrees from the access door, pull the robot from the left side of the LSM (counterclockwise). Do not pass the access door. Refer to [Figure 3-14](#).
- If the robot has stopped on the right side of the LSM and is less than 180 degrees from the access door, pull the robot from the right side of the LSM (clockwise). Do not pass the access door. Refer to [Figure 3-15](#). The robot contains a braking assembly which prevents continuous rotation. The allowable range is roughly  $\pm 240$  degrees.

**WARNING:**

**Before you close the LSM access door, look inside the LSM and ask in a loud voice to determine whether anyone is inside the LSM.**

**ATTENTION :**

**Avant de fermer la porte d'accès du LSM, regarder à l'intérieur puis demander à voix haute si quelqu'un s'y trouve.**

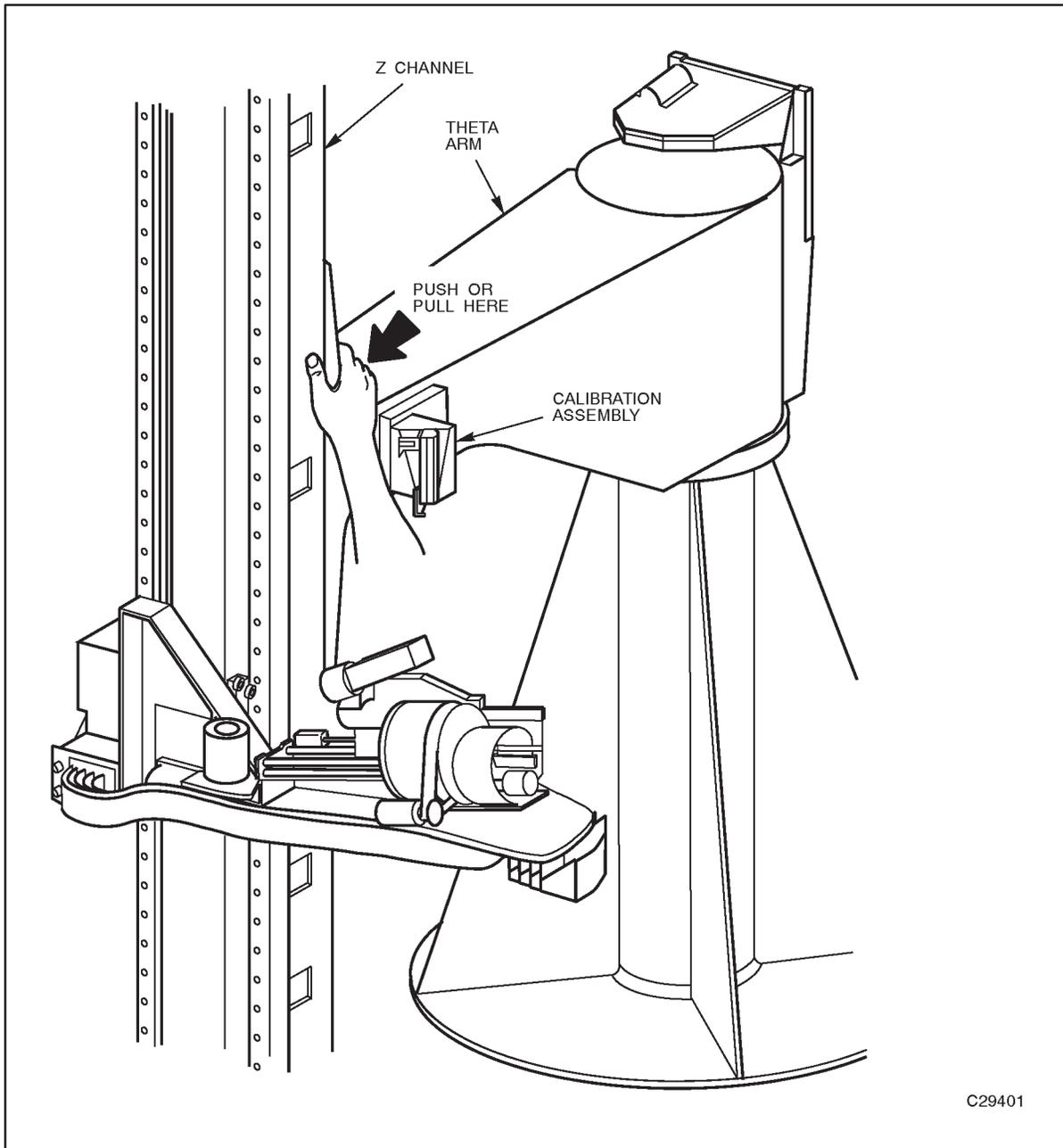
**WARNUNG:**

**Vor dem Schließen der Eingangstür zum LSM im Innern nachsehen und laut fragen, ob sich noch jemand darin aufhält.**

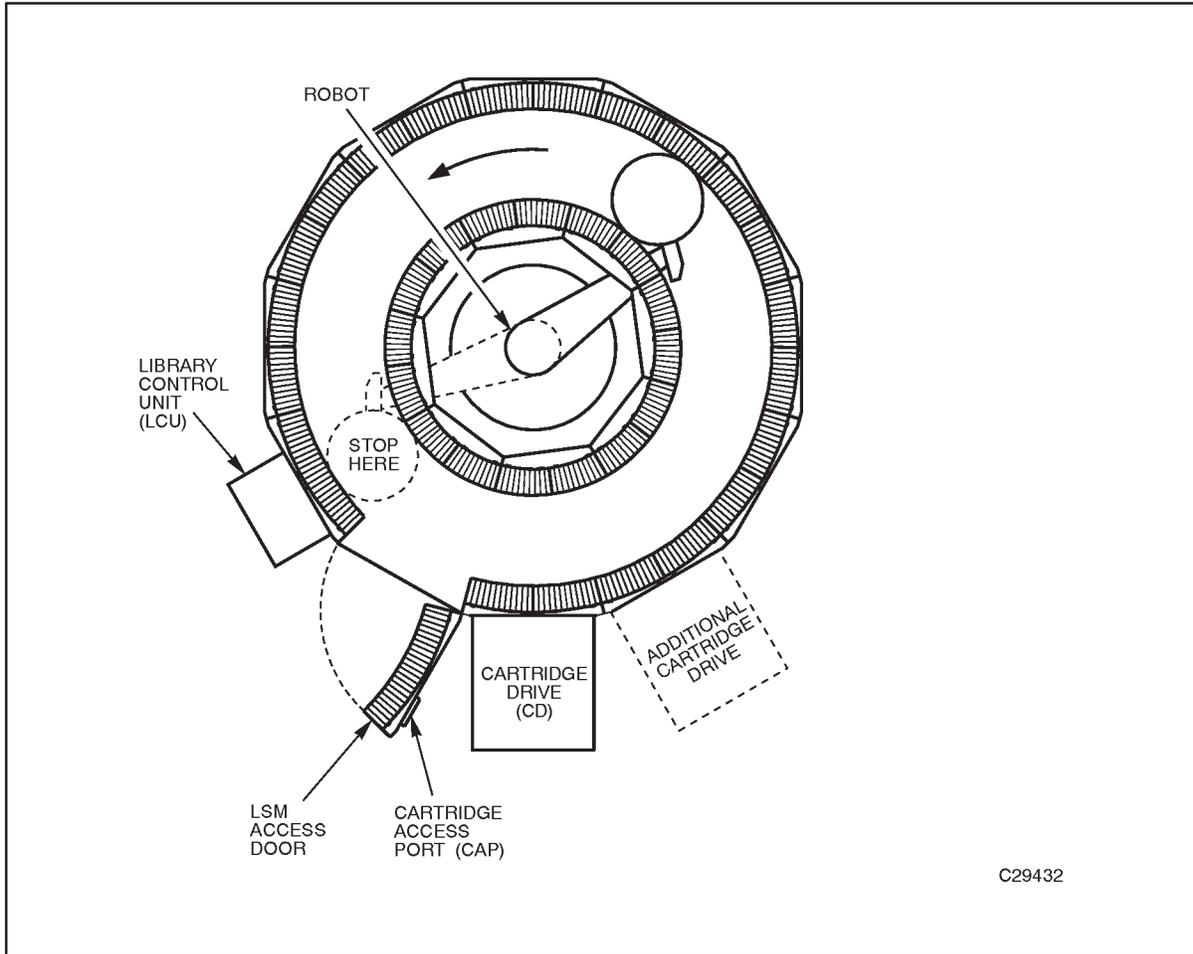
**AVVERTENZA:**

**Prima di chiudere la porta d'accesso, guardare all'interno dell'LSM e chiedere ad alta voce se c'è qualcuno.**

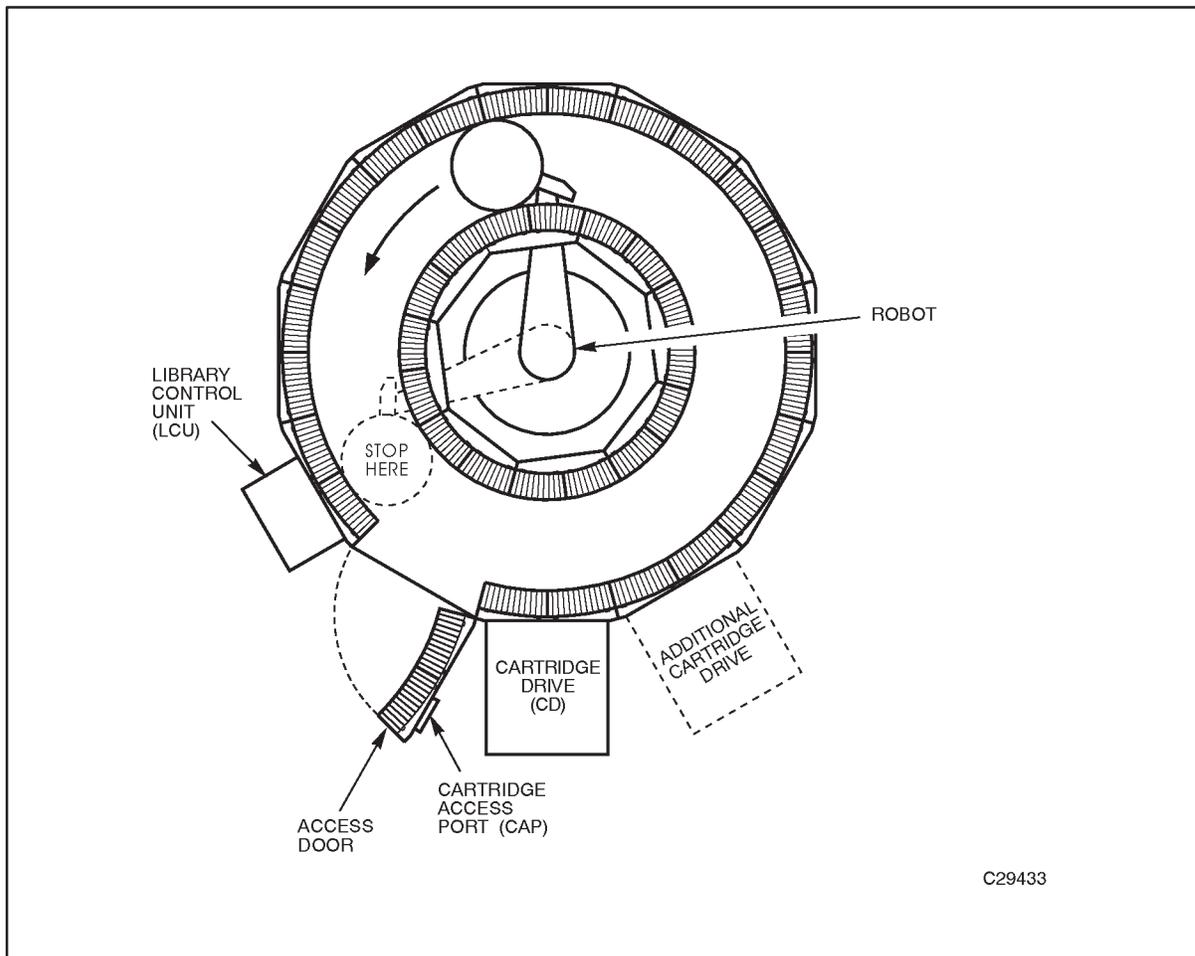
**CAUTION:**  
Make sure that the robot is not resting against the mechanical stop.  
Make certain no extra material (manuals, eyeglasses, tools) are left inside. These objects would cause the robot to stop and could damage the robot.



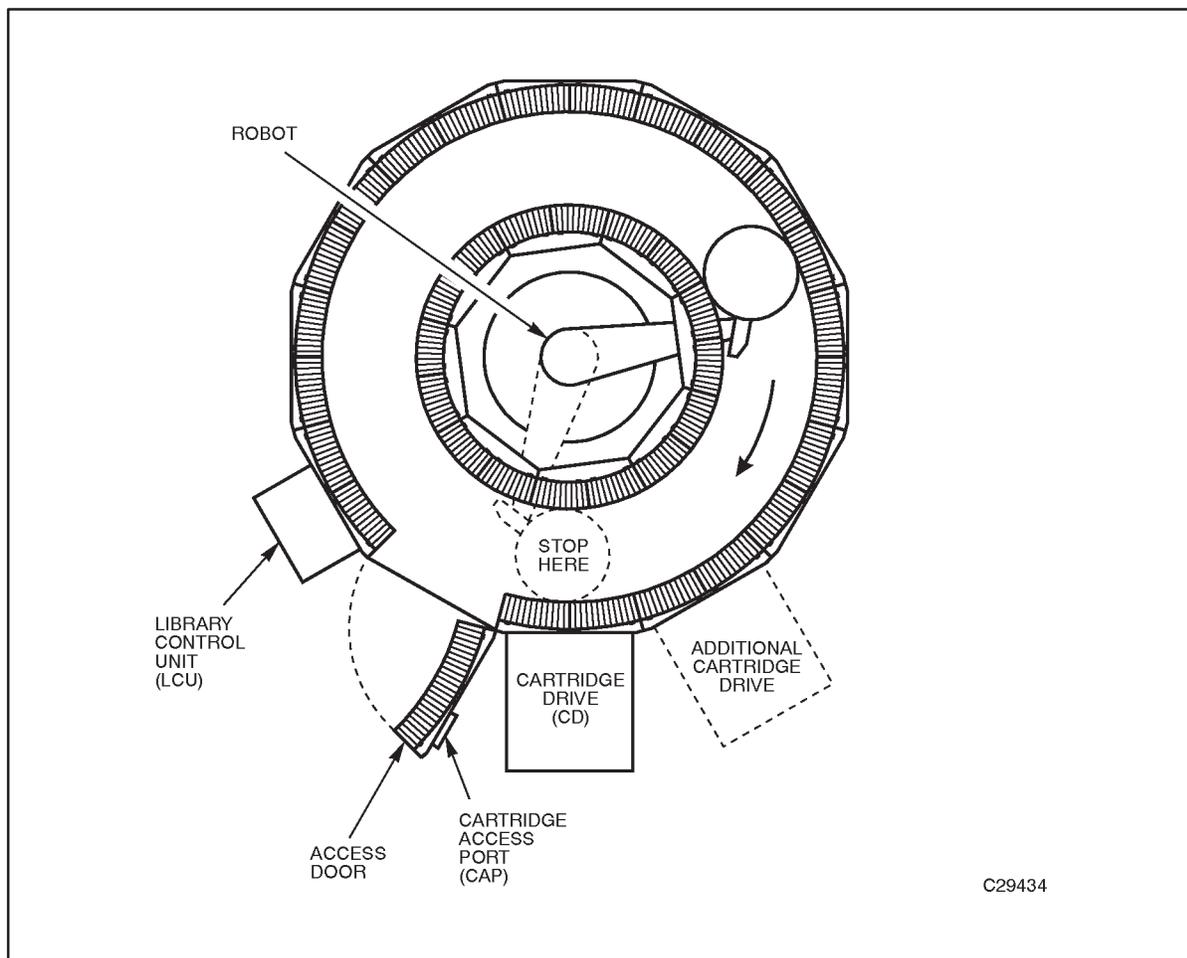
**Figure 3-12. Rotating the 4410 Robot**



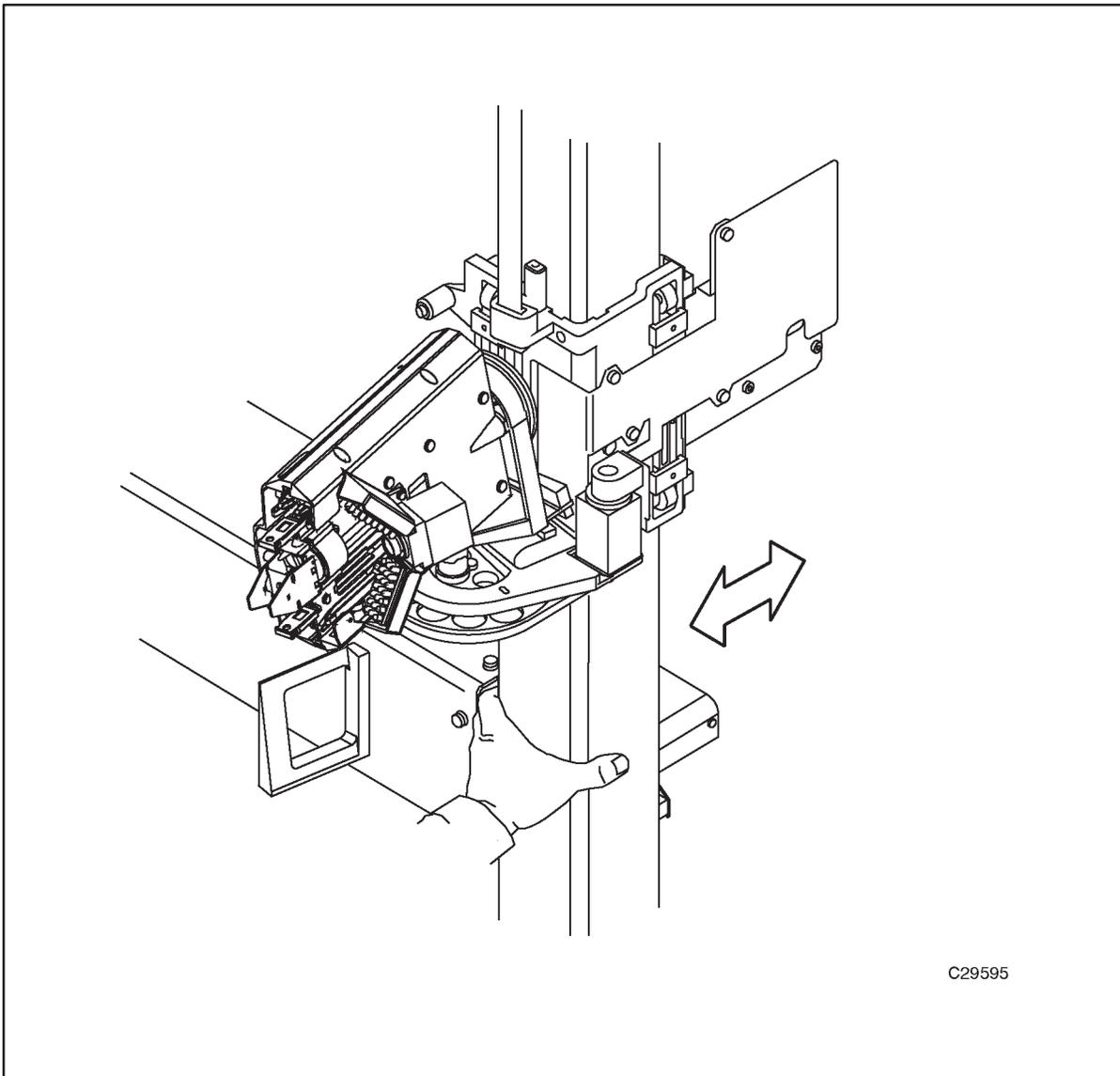
**Figure 3-13. Rotating the 4410 Robot 180 Degrees**



**Figure 3-14. Rotating the 4410 Robot Counterclockwise**



**Figure 3-15. Rotating the 4410 Robot Clockwise**



C29595

**Figure 3-16. Rotating the 9310 Robot**

## Removing a Cartridge from 4410 Robot Fingers

### WARNING:

Do not enter the LSM until you are familiar with the procedure described in "[Entering the LSM](#)." Do not enter the LSM or move any of its robotics mechanism if you have any reason to suspect it is enabled.

### ATTENTION :

Ne pas entrer dans le LSM avant d'être familiarisé avec les procédures décrites dans le paragraphe « [Entrer dans le LSM](#) ». Ne pas entrer dans le LSM ou ne déplacer aucun des mécanismes de robotique, dans le cas où ces derniers semblent défectueux.

### WARNUNG:

Das LSM erst betreten, wenn das unter "[Betreten des LSM](#)" beschriebene Verfahren bekannt ist. Das LSM nicht betreten und keinen der Robotermechanismen bewegen, wenn der Verdacht besteht, daß diese aktiviert sind.

### AVVERTENZA:

Non entrare nell'LSM se non si conosce bene la procedura descritta nella sezione "[Ingresso nell'LSM](#)". Non entrare nell'LSM o muovere i meccanismi robotici se si ha motivo di sospettare che siano abilitati.

### CAUTION:

- Be extremely careful when you remove a cartridge from the robot fingers (gripper assembly). Perform the following procedure exactly. In particular, do not bend the fingers; use the knob on the stepper motor to release the grip. Failure to do so causes mechanical damage to the finger mechanism.
- Do not touch any shiny polished surfaces. Body oils can destroy the lubrication on these surfaces.
- Do not touch any lubricated parts.
- Do not push or pull the cartridge, fingers, plunger, camera or any other part of the reach function mechanism except as shown in the following figures.

To remove a cartridge from the 4410 robot fingers:

1. Rotate the reach function mechanism counterclockwise so that the cartridge and fingers are in the horizontal position as shown in [Figure 3-17](#).
2. To extend the gripper assembly forward, grasp the cartridge with the left hand and pull gently, until the gripper assembly has extended to its maximum length as shown in [Figure 3-18](#).
3. Grasp the gripper assembly with the right hand, then hold it in the extended position as shown in [Figure 3-18](#).
4. Grasp the fingers with the left hand and hold that position.
5. Turn the gripper motor dial counterclockwise to release the cartridge from the fingers as shown in [Figure 3-19](#).
6. Remove the cartridge.

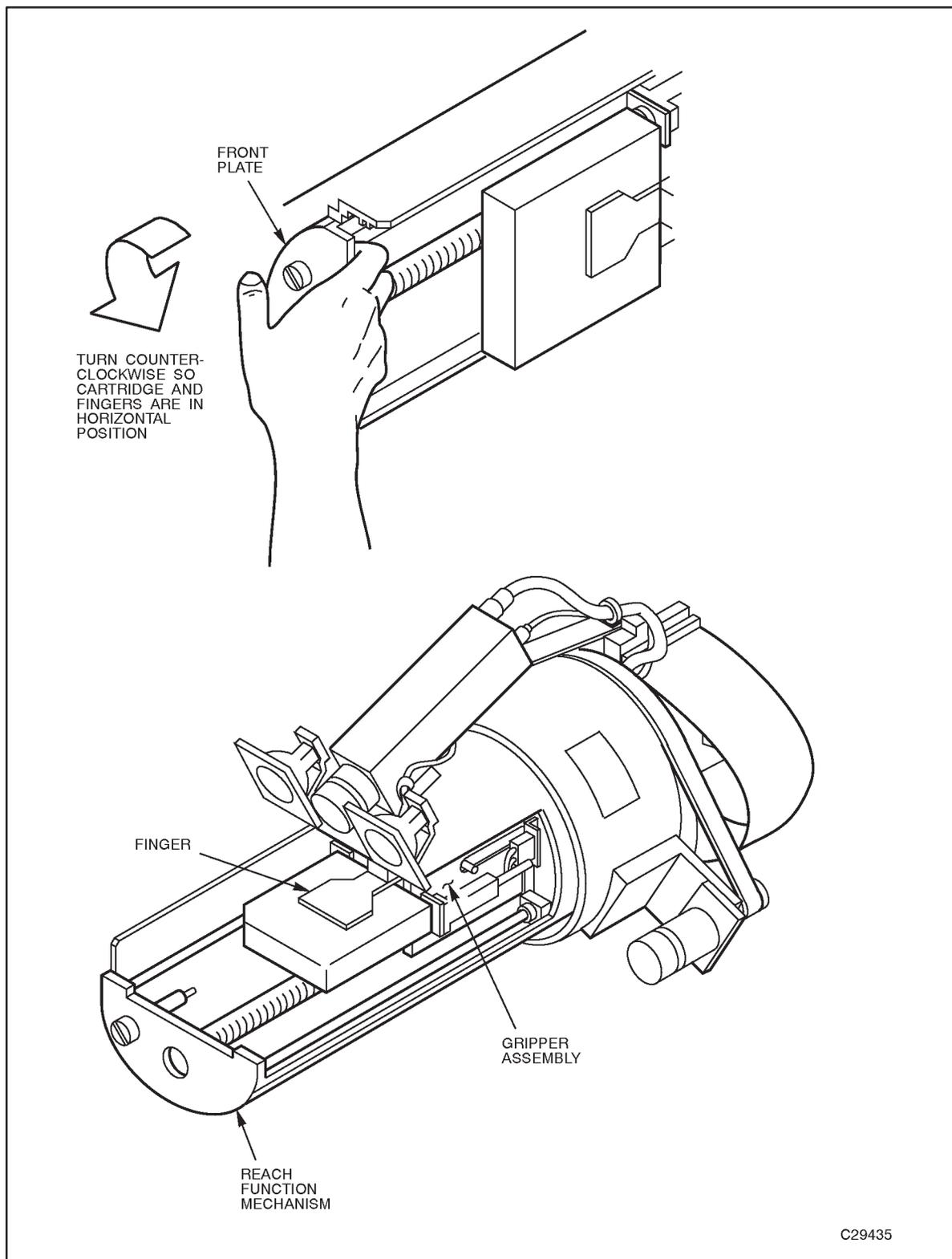
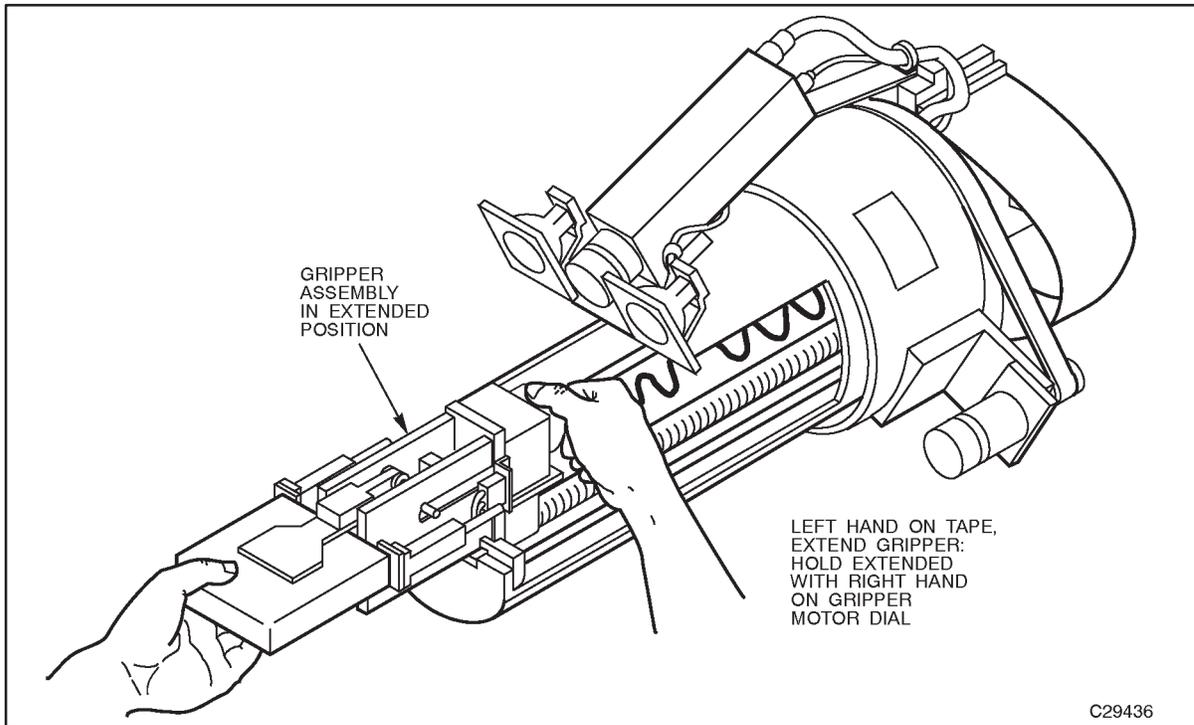
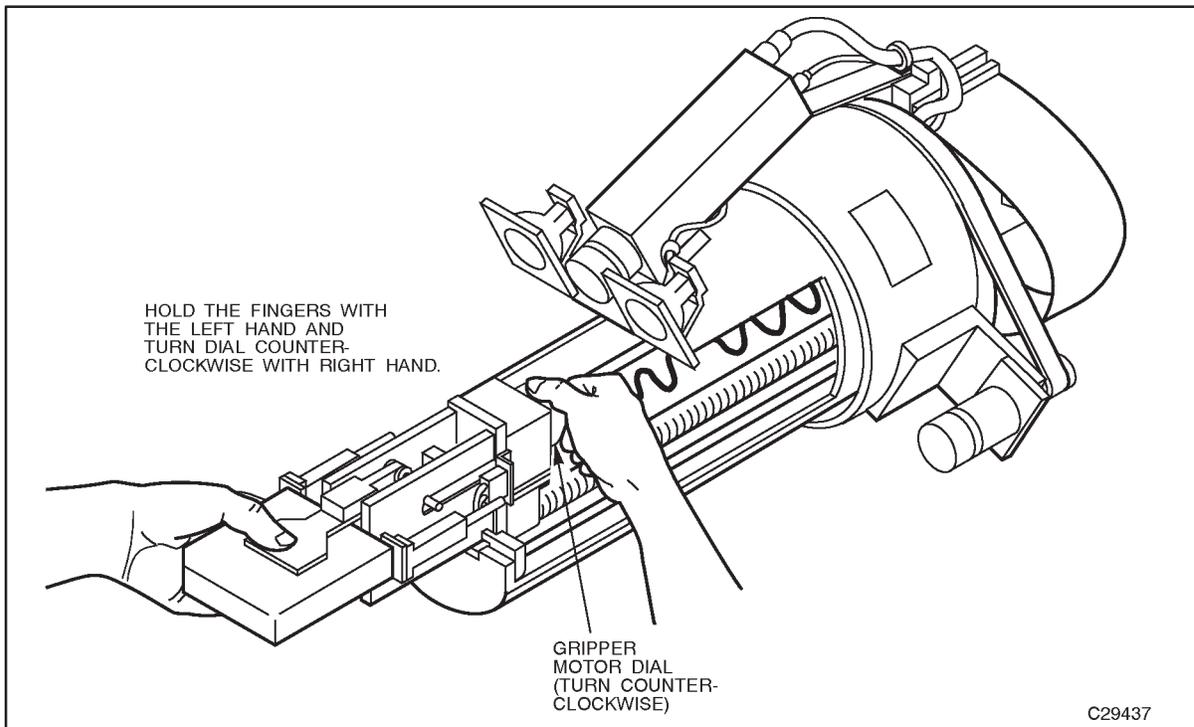


Figure 3-17. Turning the 4410 Reach Function Mechanism



**Figure 3-18. Extending the Gripper Assembly**



**Figure 3-19. Turning the Gripper Motor Dial**

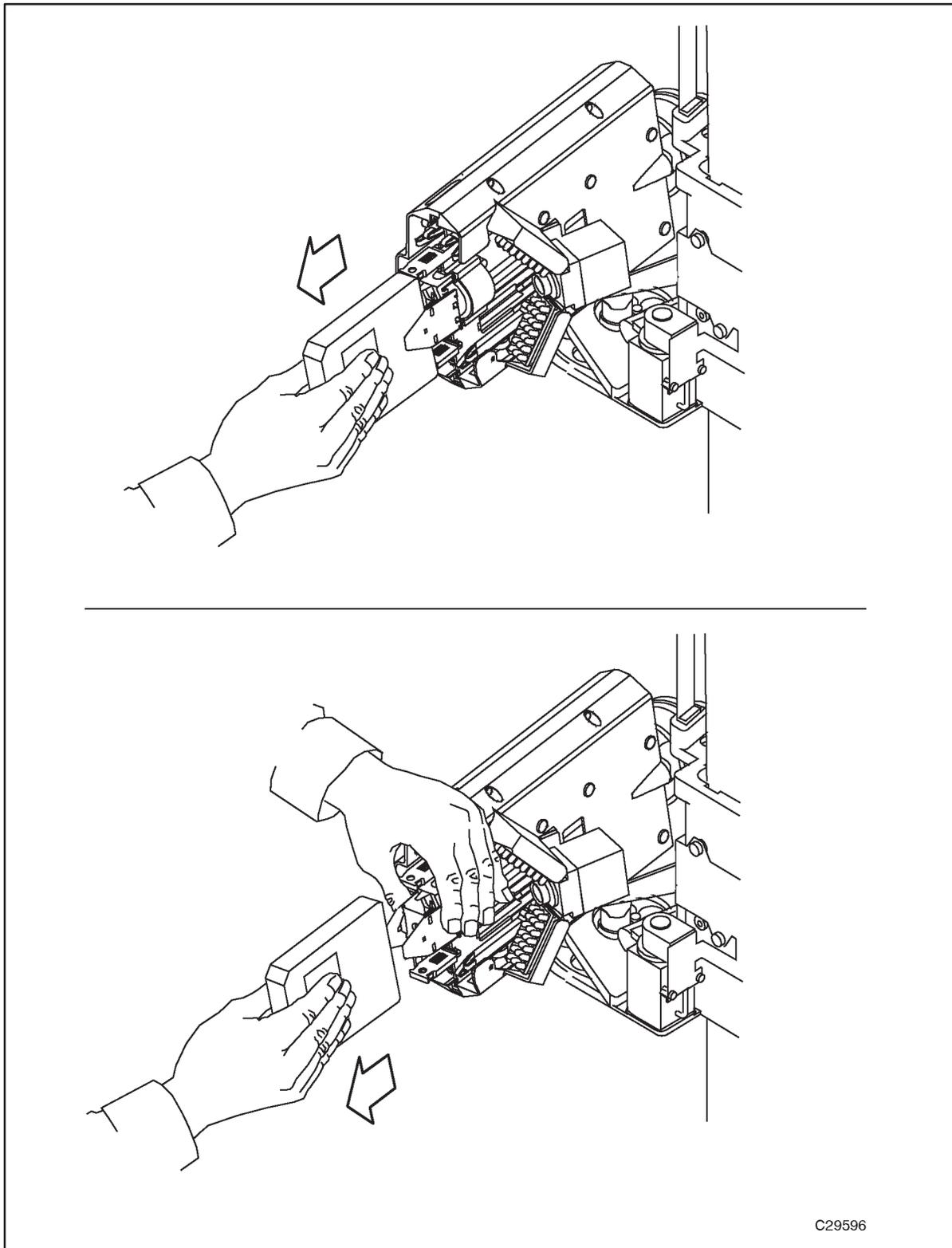
## Removing a Cartridge from 9310 Robot Fingers

**CAUTION:**

**Be extremely careful when removing a cartridge from the robot fingers (gripper assembly). Perform the following procedure exactly to avoid damaging the equipment.**

To remove a cartridge from the 9310 robot fingers:

1. Raise or lower the robot by using the wrist stop as shown in [Figure 3-11](#) until the robot is waist high.
2. Extend the gripper by grasping the cartridge and gently pulling until the gripper is fully extended as shown in [Figure 3-20](#).
3. Gently squeeze the back of the top and bottom fingers until the tension on the cartridge is removed.
4. Remove the cartridge and release the pressure applied to the fingers.



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**Figure 3-20. Removing a Cartridge from the 9310 Robot Fingers**

## Resetting the 4xxx Transport Display

At the beginning of manual mode operation, each transport is in a Hold Off Load condition. In this condition, the message display panel above the transport is blank and the transport does not load if a cartridge is mounted. This condition must be cleared before you can mount cartridges manually.

**Note:** A resetting of the display is not required for the 9840 Cartridge Drive.

To reactivate the transport display and clear the Hold Off Load condition, do the following (Figure 3-21).

1. If the transport contains an unloaded cartridge, dismount the cartridge and remove it from the LSM.

**WARNING:**

**Empty transports perform elevator motions during wakeups. Stay clear of the cartridge insertion opening until the display becomes active.**

**Before inserting a cartridge into a transport in a manual mode LSM, make sure that either StorageTek, an asterisk, or the volume/cell location information appears on the transport display panel.**

**ATTENTION :**

**Un mécanisme d'entraînement vide déclenche des mouvements de l'élévateur lors de l'activation. S'éloigner de l'ouverture d'insertion des cartouches jusqu'à ce que le panneau d'affichage soit actif.**

**Avant d'introduire une cartouche dans le mécanisme d'entraînement en mode manuel, vérifier que StorageTek, un astérisque ou le volume/localisation de la cellule apparaît sur le panneau d'affichage du mécanisme d'entraînement.**

**WARNING:**

**Leere Transportteile führen während der Initialisierung Hehebewegungen aus. Von der Kassetteneinführung fernbleiben, bis die Anzeige aktiviert ist.**

**Vor dem Einlegen einer Kassette in ein Transportteil eines manuell betriebenen LSM sicherstellen, daß entweder Storage Tek, ein Sternchen oder die Mengen/Zellenort-Daten auf dem Anzeigefeld des Transportteils erscheinen.**

**AVVERTENZA**

**I trasportatori vuoti effettuano movimenti di elevazione durante i test automatici. Stare lontano dall'apertura di inserimento della cartuccia fino a quando il display non diventa attivo.**

**Prima di inserire una cartuccia in un trasportatore in un LSM a modalità manuale, accertarsi che sul pannello del display del trasportatore siano visualizzati StorageTek, o un asterisco, o le informazioni relative al volume/cella.**

2. When the transport is empty and the READY indicator is lit, hold down the REWIND switch for about 4 seconds. This resets the message display and clears Hold Off Load condition. Repeat this step for every nonbusy transport that does not have an active display.

**Note:** Allocated transports display the cartridge VOLSER and the cell location. An asterisk is displayed if the transport is not allocated to a mount request.

When an unallocated transport is properly reset, the display appears as follows:

								*	
--	--	--	--	--	--	--	--	---	--

## Controlling Transport Display Intensity

**Note:** The 9840 Cartridge Drive display has no intensity adjustment.

The REWIND and UNLOAD switches are used to control the intensity of the message display. As you hold down these two switches at the same time, the display dims to the next level of intensity every 2 seconds (100 percent, 50 percent, 25 percent, and off), continuing to cycle until the switches are released. The brightness remains at the level existing when the two switches are released. The drive must be in the READY state for these switches to function in this way.

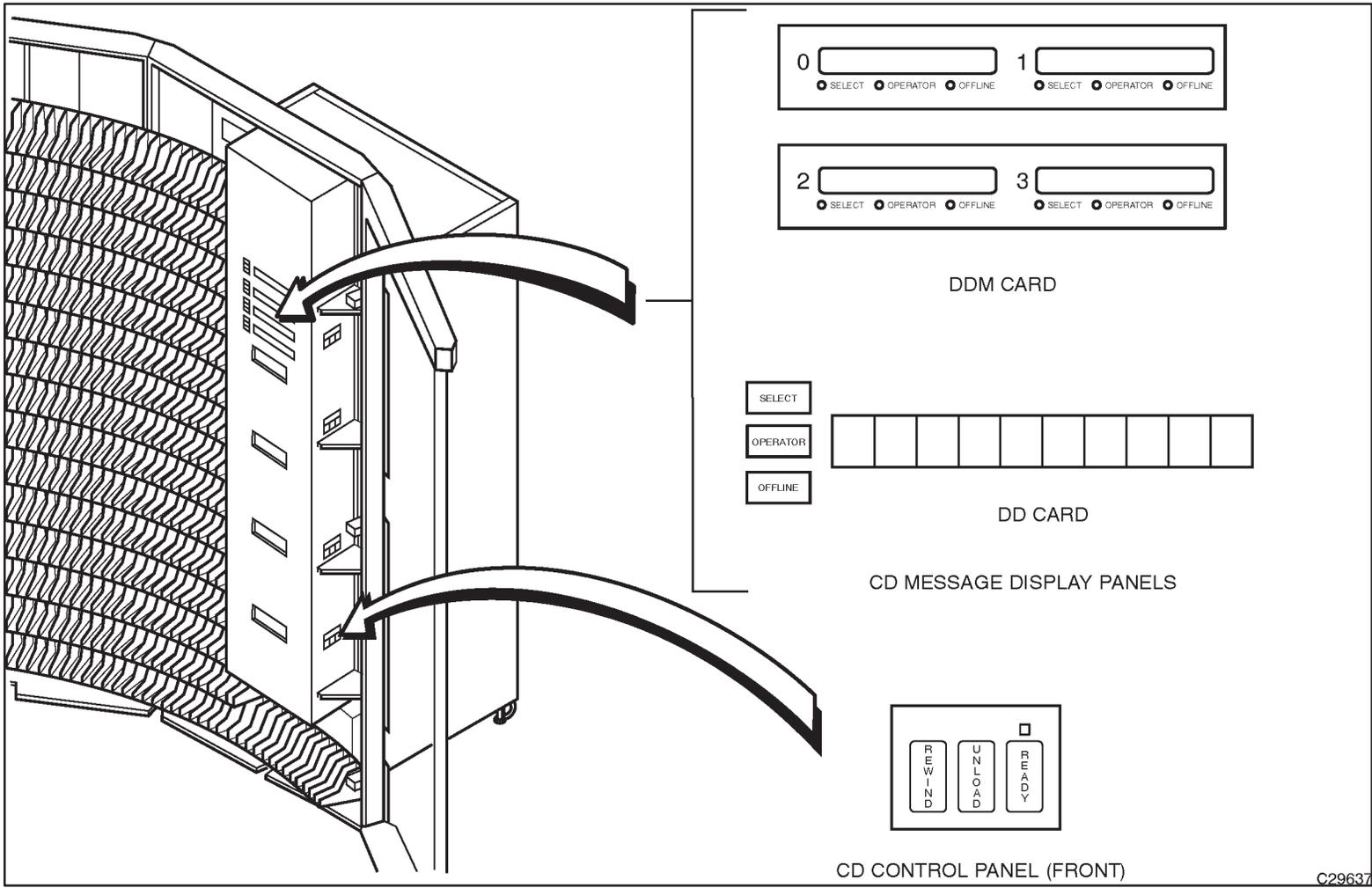


Figure 3-21. 4xxx CD Message Display and Operator Panels—Inside LSM

## Locating a Cartridge in the LSM

The cartridge VOLSER and cell location are provided in a console message and on the transport display panel.

### Cartridge Location in the Console Message

The console message provides the VOLSER and cell location of the cartridge, and the address of the transport allocated for the mount. Before entering the LSM, write down the VOLSER, cell location, and transport address.

Figure 3-22 through Figure 3-27 show how panels, rows, and columns are numbered. The panel type associated with a particular panel applies only to this example. Panels 1 through 9 may be configured differently in your environment.

### Cartridge Location on Message Display Panel

Inside a manual mode LSM, the transport display panel switches back and forth between the VOLSER and cell location of the requested cartridge. The VOLSER appears as seven characters: the six-character volume serial number prefixed with an M, indicating the transport is awaiting the mount.

The cell location appears in the following format:

	<i>l</i>	<i>l</i>	<i>p</i>	<i>p</i>	<i>r</i>	<i>r</i>	<i>c</i>	<i>c</i>	
--	----------	----------	----------	----------	----------	----------	----------	----------	--

where:

*ll* calls out an LSM.

*pp* calls out an LSM panel.

*rr* calls out a row in the panel.

*cc* calls out a column in the row.

An example of the location displayed is:

	0	1	0	7	1	1	1	5	
--	---	---	---	---	---	---	---	---	--

In the example, the cartridge is located in LSM 01, panel 07, row 11, column 15.

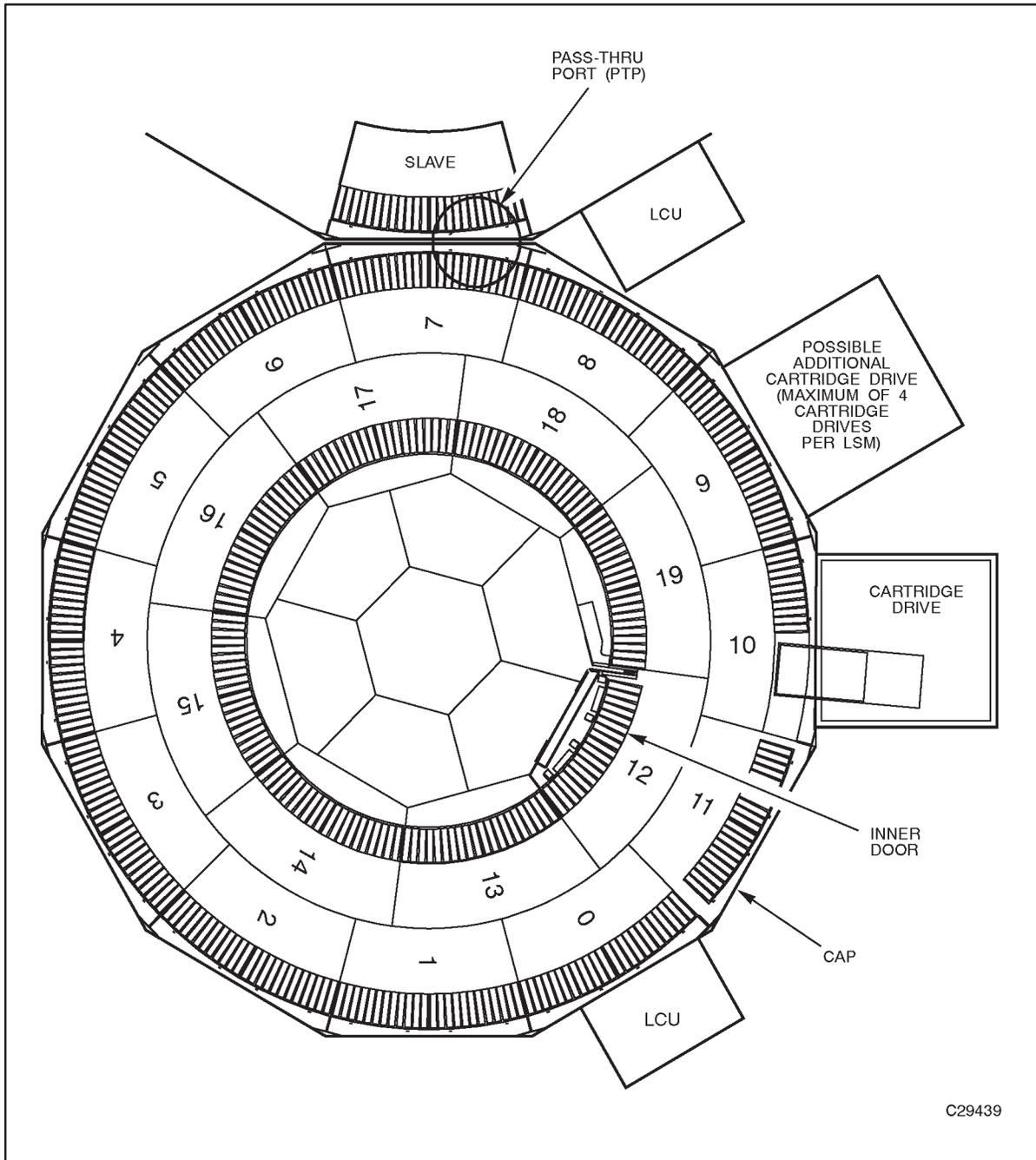


Figure 3-22. Cartridge Locations

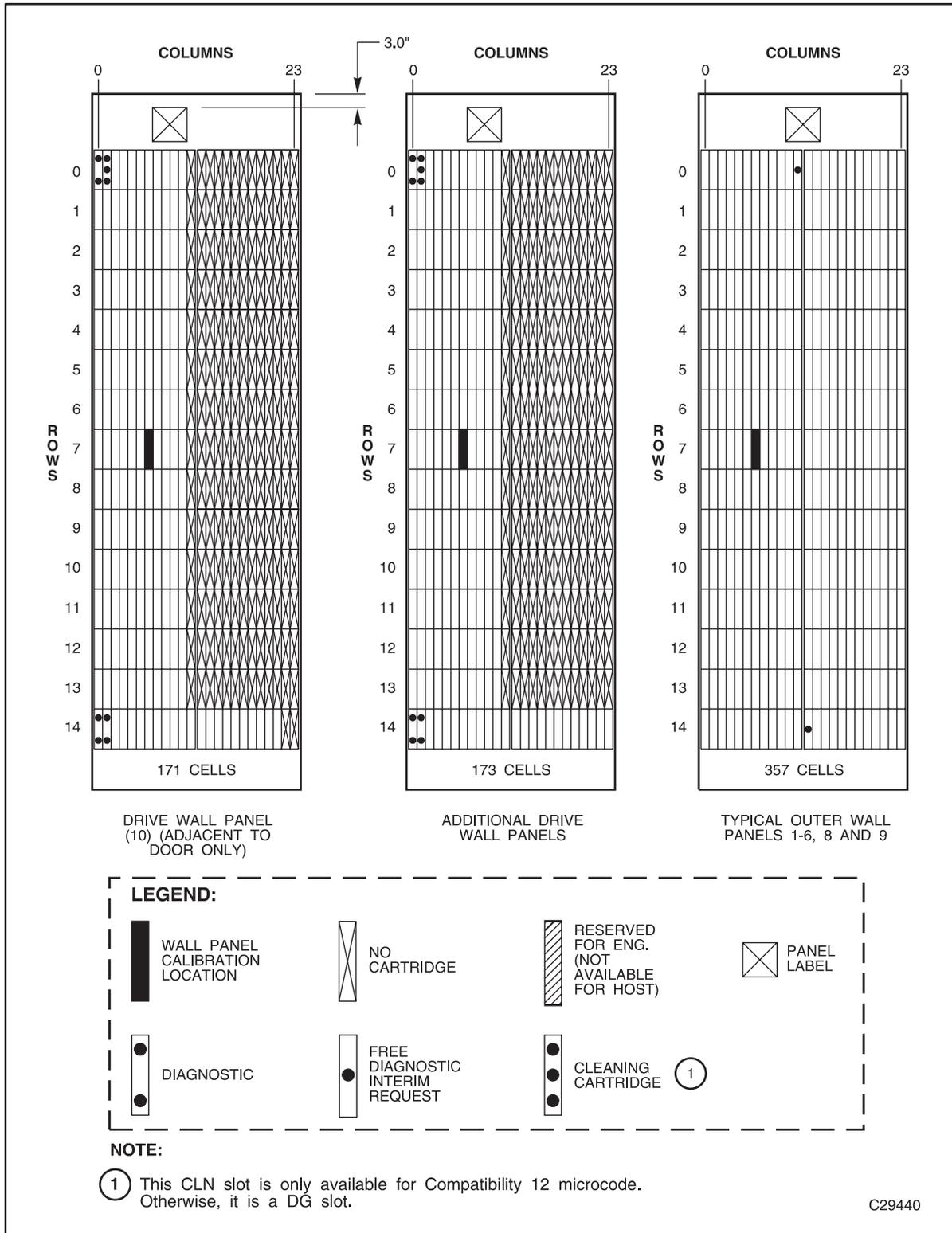


Figure 3-23. Cartridge Locations

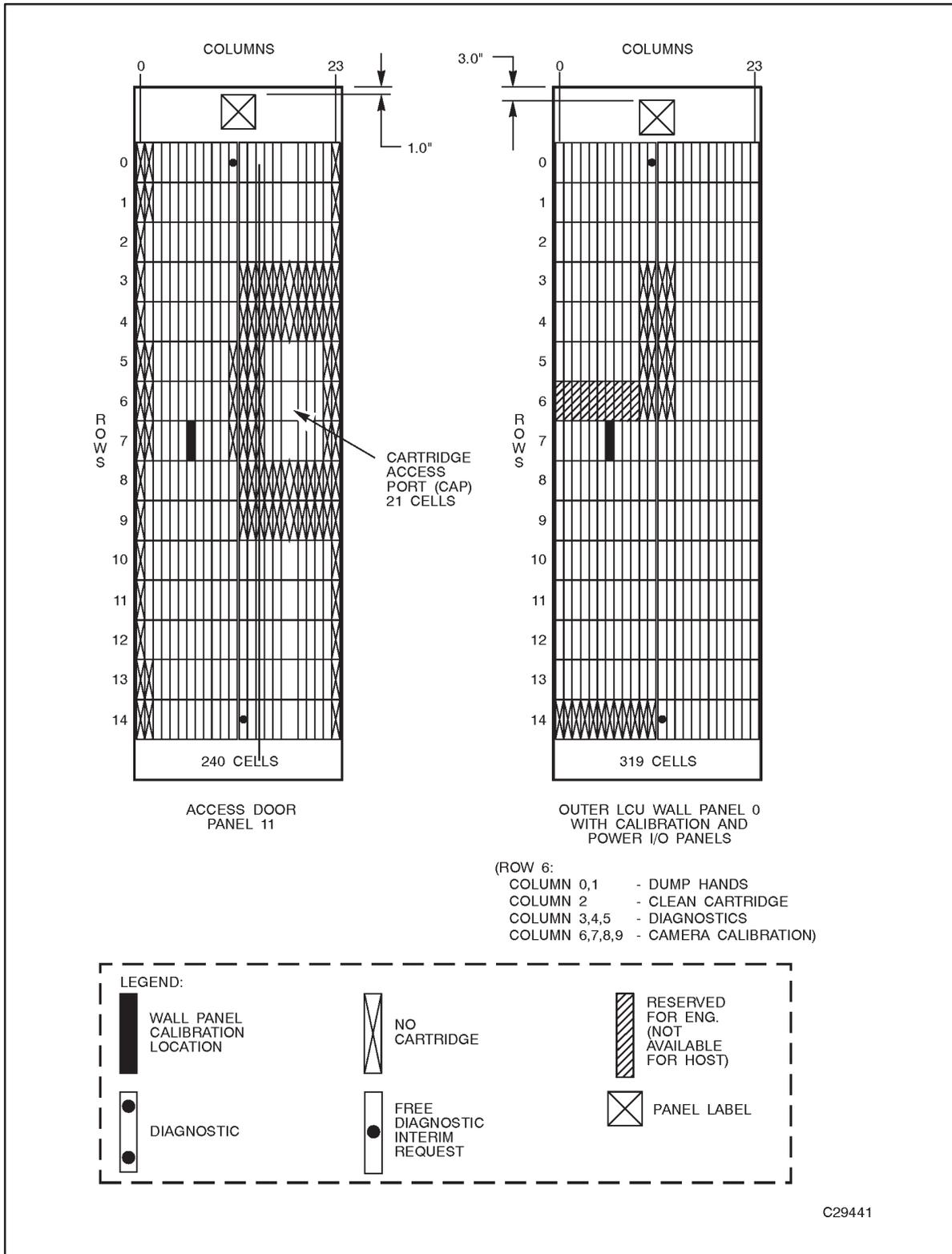


Figure 3-24. Cartridge Locations

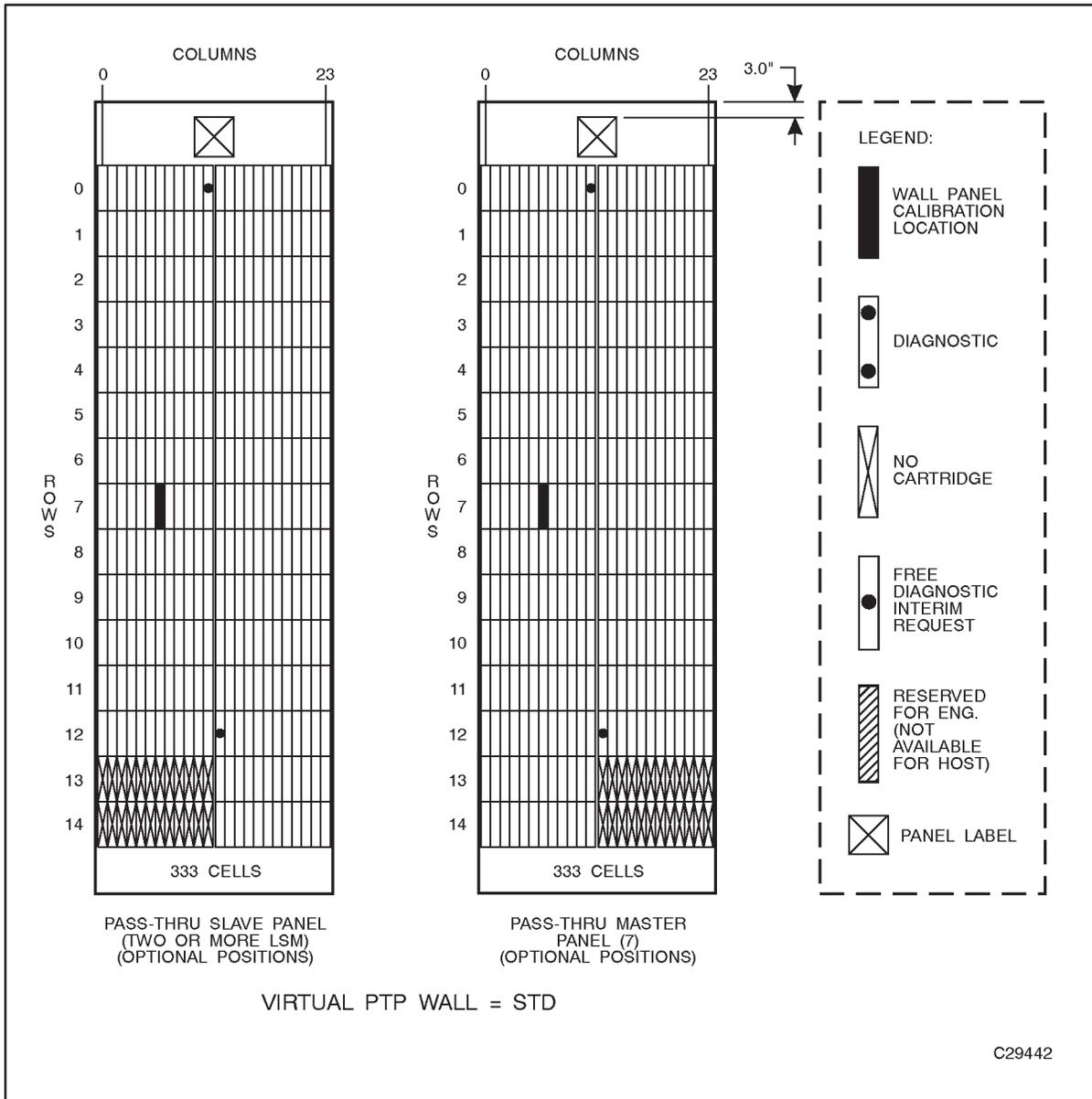


Figure 3-25. Cartridge Locations

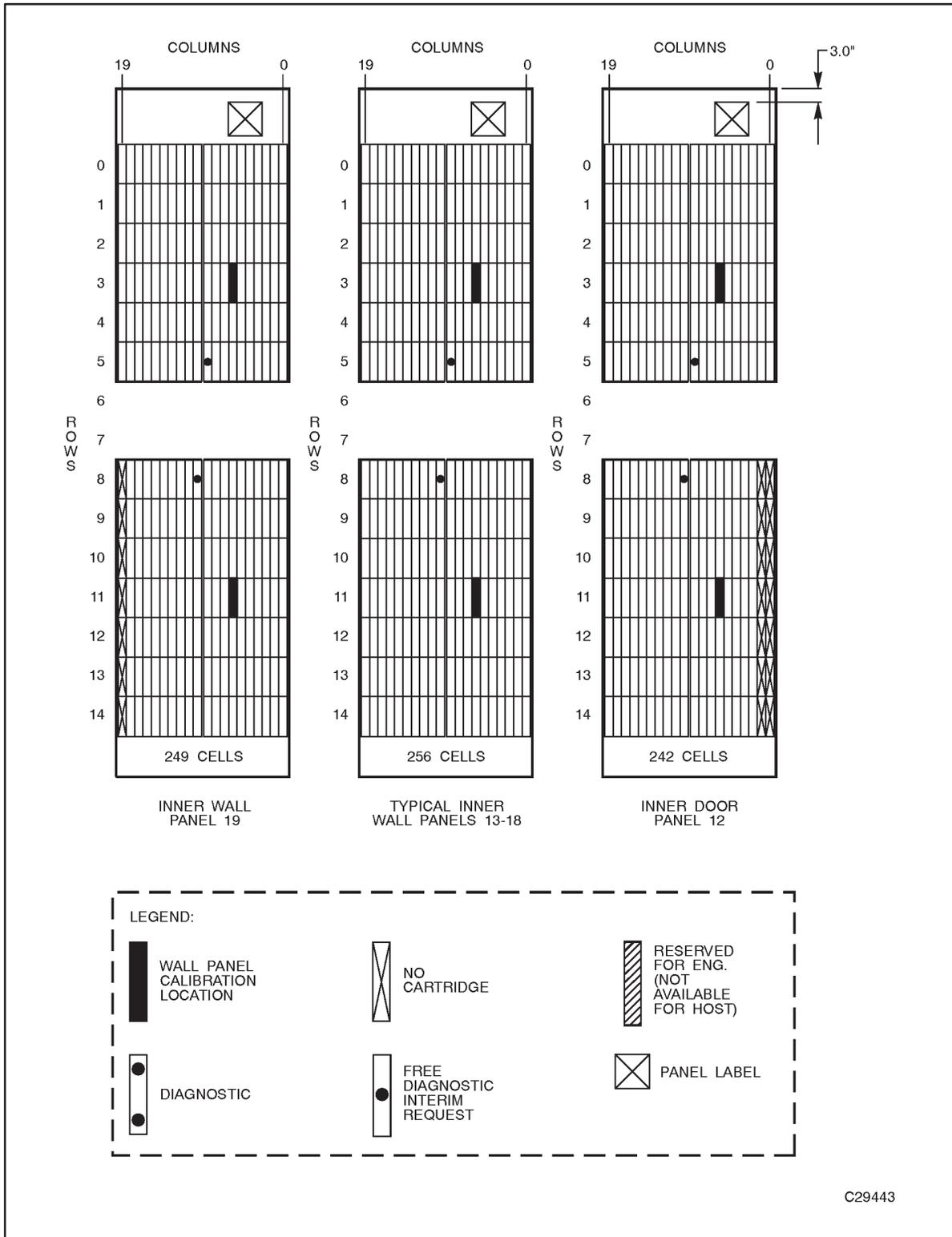
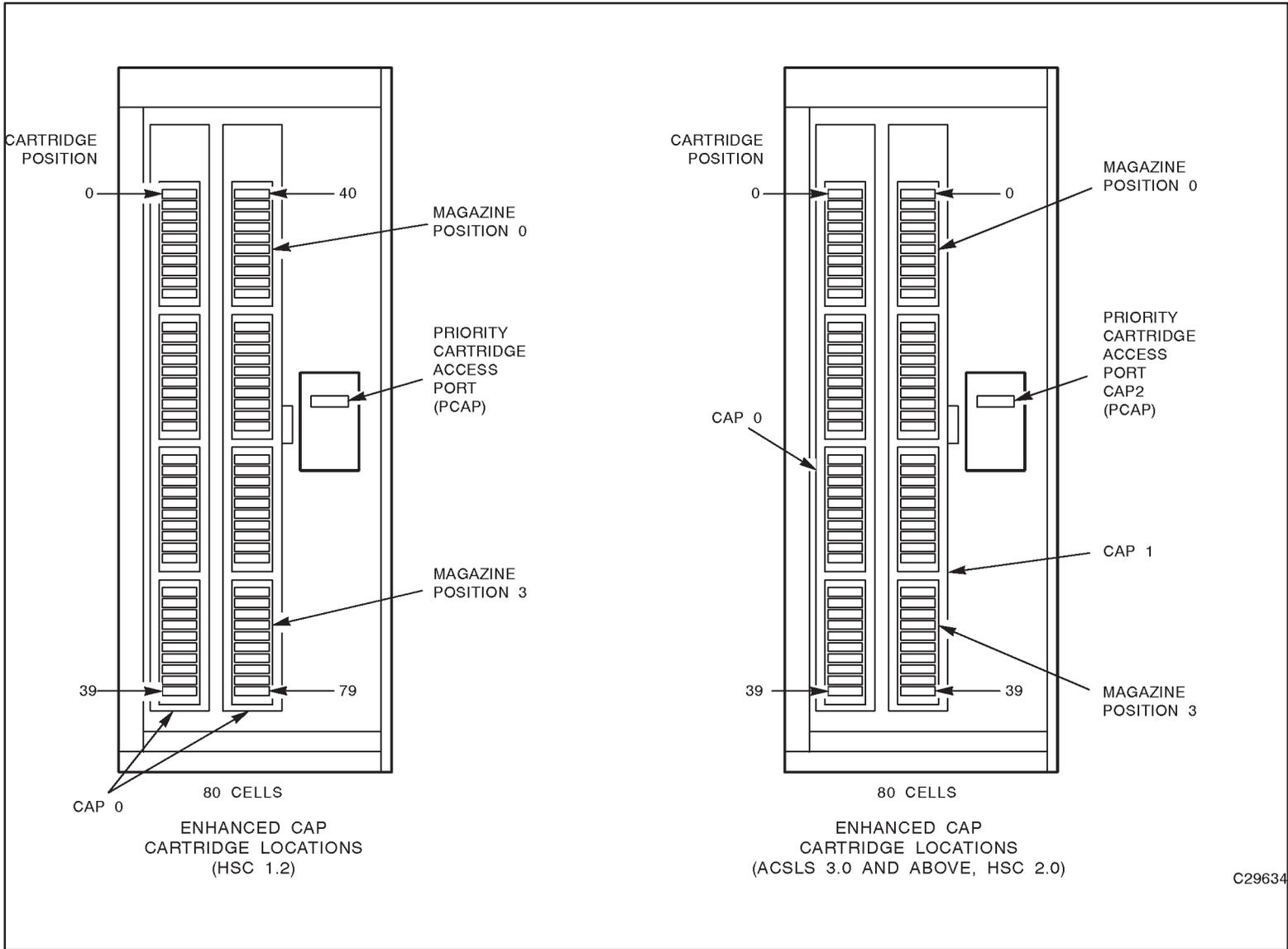


Figure 3-26. Cartridge Locations

Figure 3-27. CAP Cartridge Locations



## Mounting a Cartridge

When the operating system sends a mount request for a volume residing in a manual mode LSM, the transport display shows the location of the cartridge.

To mount a cartridge:

**WARNING:**

**Do not enter the LSM until you are familiar with the procedure described in "[Entering the LSM](#)."**

**ATTENTION :**

**Ne pas entrer dans le LSM avant d'être familiarisé avec les procédures décrites dans le paragraphe « [Entrer dans le LSM](#) ».**

**WARNUNG:**

**Das LSM erst betreten, wenn das unter "[Betreten des LSM](#)" beschriebene Verfahren bekannt ist.**

**AVVERTENZA:**

**Non entrare nell'LSM se non si conosce bene la procedura descritta nella sezione "[Ingresso nell'LSM](#)".**

1. Enter the LSM.
2. Write down the VOLSER and cell location of the requested volume, and the address of the assigned transport shown in the message.
3. Reset the transport display if it is not active (refer to "[Resetting the Transport Display](#)" for instructions).
4. Locate the cartridge and remove it from the cell location.
5. Inspect the cartridge for damage (refer to "[Inspecting a Cartridge](#)").

**WARNING:**

**Keep fingers out of the transport when mounting a cartridge; the elevator lowers automatically.**

**ATTENTION :**

**Lors du montage des cartouches, éloigner les mains du mécanisme d'entraînement ; l'élévateur descend automatiquement.**

**WARNUNG:**

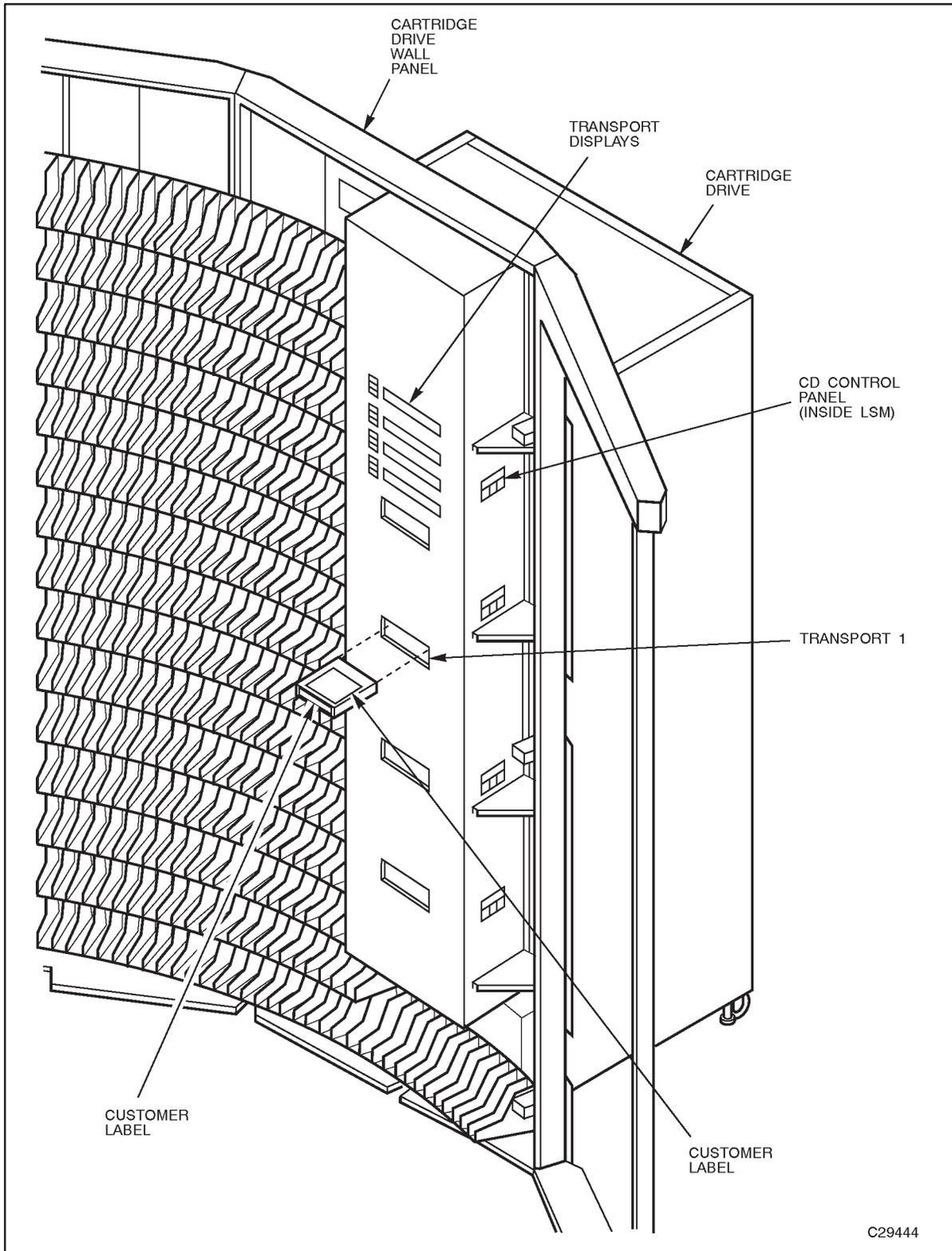
**Beim Montieren einer Kassette nicht mit den Fingern in die Transportteile fassen; die Hebevorrichtung senkt sich automatisch.**

**AVVERTENZA:**

**Quando si monta una cartuccia, tenere le dita fuori dal trasportatore; l'elevatore si abbassa automaticamente.**

6. Verify that the transport READY LED is lit, then insert the cartridge as shown in [Figure 3-28](#).

**Note:** If the transport does not load the cartridge, verify that the elevator is down, and press the REWIND switch to activate the transport.



**Figure 3-28. Inserting a Cartridge into Transport**

## Dismounting a Cartridge

To dismount a cartridge:

**WARNING:**

Do not enter the LSM until you are familiar with the procedure described in "[Entering the LSM](#)."

**ATTENTION :**

Ne pas entrer dans le LSM avant d'être familiarisé avec les procédures décrites dans le paragraphe « [Entrer dans le LSM](#) ».

**WARNUNG:**

Das LSM erst betreten, wenn das unter "[Betreten des LSM](#)" beschriebene Verfahren bekannt ist.

**AVVERTENZA:**

Non entrare nell'LSM se non si conosce bene la procedura descritta nella sezione "[Ingresso nell'LSM](#)".

1. Enter the LSM and go to the desired transport.
2. Press the READY switch.

This places the ready switch in the NOT READY position.

3. Press the UNLOAD switch.

This causes the transport to rewind and unload the cartridge.

4. Remove the cartridge from the transport and the LSM.
5. Store the cartridge outside the LSM.
6. Place the READY switch in the READY position.

The READY LED comes on when this action is performed. The transport is ready for automated operations.

## ■ Returning to Automatic Mode

The following pages describe how to return the LSM to automatic mode:

- Making the transports ready
- Exiting the LSM
- Placing the LSM in automatic mode
- Entering cartridges removed during manual mode

## Making the Transports Ready

All the transports must be in a READY condition before you close the LSM access door and place the LSM in automatic mode.

1. Check the READY indicator above the READY switch on the CD operator panel for every transport.
2. If this indicator is lit, do nothing to the corresponding transport.
3. If this indicator is not lit, press the READY switch until indicator turns on.

## Exiting the LSM

Before you leave the LSM, make sure that no tools or foreign objects are left, and no cartridges are outside the cartridge cells. Make sure that nothing is lying on the top portion (the ledge) of the bottom inner wall. Then:

1. Step outside the LSM.

### **WARNING:**

**Before you close the LSM access door, look inside the LSM and ask in a loud voice to determine whether anyone is inside the LSM.**

### **ATTENTION :**

**Avant de fermer la porte d'accès du LSM, regarder à l'intérieur puis demander à voix haute si quelqu'un s'y trouve.**

### **WARNUNG:**

**Vor dem Schließen der Eingangstür zum LSM im Innern nachsehen und laut fragen, ob sich noch jemand darin aufhält.**

### **AVVERTENZA:**

**Prima di chiudere la porta d'accesso, guardare all'interno dell'LSM e chiedere ad alta voce se c'è qualcuno.**

2. If necessary, close the CAP door.
3. Remove all cartridges from the CAP and store them outside the LSM.
4. Open the LAD, insert the key in the lock, and turn the key to the unlocked position.

### **CAUTION:**

**Do not slam the door. You could damage the door, or cause cartridges to fall onto the floor. The robot cannot recover cartridges that fall onto the floor.**

5. Pull the latch handle and **gently** close the door, pushing on both top and bottom until it clicks shut.
6. Turn the key to the locked position.
7. Remove the key from the lock and close the LAD. The LSM automatically performs a quick initialization procedure.

## Placing the LSM in Automatic Mode

Type the command at the console to place the LSM online to all host CPUs. Refer to your software manual for the command syntax and console messages.

## Entering Cartridges Removed During Manual Mode

To return the cartridges to the LSM that were removed while the LSM was in manual mode:

- After placing the LSM online to all host CPUs, enter the cartridges through the CAP, as described in "[Enter Cartridges through a Standard CAP in Manual Mode](#)" or "[Enter Cartridges through an Enhanced CAP in Manual Mode](#)."
- Before you exit the LSM, place all cartridges into the storage cells of **one panel**, and audit that panel.
- Before you leave the LSM, place the cartridges in empty cells at random on several different panels, and audit the entire LSM (or at least all panels with added cartridges).

## ■ LMU Operation

The LMU responds to mount and dismount requests from the host through the library software and passes each request to the desired LSM, which performs the physical action requested. The following pages describe the operator procedures for stand-alone LMU and dual LMU configurations. Emergency power off procedures are the same for both configurations.

Refer to "[LMU Controls and Indicators](#)" on page 2-1 for explanations of LMU control panels. Refer to your [software manual](#) for the command syntax and console messages.

## Operating an LMU—Stand-alone Configuration

The following sections describe how to operate a stand-alone LMU.

## Powering On/IPLing an LMU

To power on a stand-alone LMU:

- Press the power switch on the LMU operator panel. (On older models, press the switch to the "1" position, and the indicator in the switch turns on. If it does not, call a CSE to restore power.)

## Displaying LMU Status

Type the command to display LMU status. The command lists:

- Current status of the ACS
- Current status of the LMU
- On-line, offline or standby status of each LMU station

## Powering Off an LMU

To power off a stand-alone LMU:

1. Place all stations offline to all software.

**Note:** Leaving stations online when you power off an LMU causes I/O error messages to be displayed on the console.

2. Press the power switch on the LMU operator panel. (On older models, press to "0" and the indicator light in the switch turns off).

**Note:** In a dual LMU environment, powering off the master LMU starts an LMU switch causing the standby LMU to become the master LMU. See ["Powering Off an LMU – Dual LMU Environment"](#) for more information.

## Operating an LMU—Dual LMU Configuration

The following sections describe how to operate dual LMUs.

### Dual LMU Operation Overview

Dual LMU configurations provide a backup LMU which can take over if the active (master) LMU fails. Both LMUs are capable of being the master but only one can be the master at a given moment. The LMUs regularly check the status of each other over the local area network (LAN).

The software directs all input/output to the master LMU. All stations may be placed online to both LMUs when you start the software. The stations to the current master LMU come fully online, and the stations to the current standby LMU come up as standby.

**Note:** It is recommended that you place two stations online to each LMU from each host. An automatic LMU switch only occurs in response to a failure in the master LMU. Path failures do not start an LMU switch.

The requirements for a fully functional dual LMU configuration are:

- LMU microcode software level 2.3 or higher
- Correct operating software level (refer to your software manual)
- Both LMUs powered on (one serves as the master, and the other as the standby)
- At least one station online to each LMU from each host. On-line stations to a standby LMU are called standby stations.

If the above conditions are met, automatic LMU switch can occur if a failure is detected in the master LMU.

The switch command can be used to manually switch the master LMU functionality to the standby LMU. You may give the switch command even if no LMU internal errors are present.

**Note:** When typing the switch command, remember that all hosts connected to the dual LMU ACS are affected by a switch of the master LMU functionality. Enter operations must be restarted after an LMU switch.

## Powering On/IPLing an LMU—Dual LMU Configuration

When an LMU is powered on in a dual LMU environment, it places itself in a standby status and then checks for an active master LMU. If an active master LMU exists, the LMU remains available as the standby LMU. If an active master LMU does not exist, the LMU becomes the master LMU.

If both LMUs are powered on at about the same time, the first to complete IPL assumes the role of master. If you prefer to call out one LMU as the master, power it on first and wait for it to complete IPL before powering on the second LMU. The following procedure describes this type of dual LMU power on:

1. Load the functional diskettes into the top floppy drives for both LMUs. Refer to "[Loading a Functional Diskette \(IPL\)](#)" for instructions on loading a functional diskette.

**Note:**

- a. Both LMUs must be loaded with the same version of LMU microcode.
- b. The correct CSE-loaded hardware configuration must be on each LMU floppy disk.

2. Press the power switch on the operator panel of one LMU. (On older models, press the switch to the "1" position, and the indicator in the switch turns on. If it does not, call a CSE to restore power.) Upon IPL completion, the MASTER indicator turns on.
3. Power on the second LMU by repeating the above step on the operator panel of the second LMU. The MASTER indicator light blinks briefly on the standby LMU as it polls the master LMU to make sure that it is working.

If both LMUs power on successfully, the console message shows that the dual LMU is configured, which LMU is master, and that the standby is ready.

**Note:** If a series of highlighted messages is displayed, indicating first one LMU, then the other is master, refer to the software manual for dual LMU recovery procedures.

## Displaying Dual LMU Status

To determine the status of the dual LMU, enter the command to display the ACS status. The command response lists:

- Current status of the ACS
- Current status of the dual LMU configuration
- Master LMU
- Standby LMU
- On-line, offline or standby status of each dual LMU station
- Software/LMU compatibility levels

## LMU Switch Overview

The master LMU functionality can be switched in the following ways:

- The switch is automatic due to a self-detected failure or power supply problem in the master LMU.
- The operator starts the switch.
- The IPL switch on the master LMU is pressed.
- The master LMU is powered off.

## Consequences of an LMU Switch

When an LMU switch occurs, console messages track the changing status of the master and standby LMUs.

When a switch occurs in a dual LMU environment, the software questions the LMUs to determine the current status of each station. The status of each station is kept as online, offline, standby, pending online, pending offline, or

pending force offline. Use the command to display the ACS status to determine the status of each station, as well as the status of each LMU.

## Performing Automatic LMU Switch

LMU microcode software detects, reports, and reacts to LMU failures as necessary to keep the ACS working. You have no control over the timing of an automatic LMU switch; therefore, some work might be in process within the LMU. When the standby LMU takes over as master, it notifies the software of its status and sends the LMU ready signal. The software reads the recovery information provided by the new master LMU concerning in-transit cartridges within the various LSMs in the ACS.

The software:

1. Marks completed the queued requests, reflecting the current locations of in-transit cartridges
2. Sends all incomplete requests to the new master LMU
3. Marks cartridges as errant when requests cannot be completed successfully

**Note:** You might need to restart enter and eject operations after an LMU switch.

## Performing Operator-Started LMU Switch

Before you start an LMU switch while some stations are communicating, decide if the need to switch LMUs is immediate, or if processing can be completed before making the switch. If the need to switch LMUs is not critical, wait until the LSMs are relatively idle.

Start an LMU switch by typing the switch command. The command is routed through the standby LMU to the disconnected master LMU, causing it to IPL. The following sequence of events occurs:

1. The software sends the switch message.
2. The standby LMU becomes the master LMU and the MASTER indicator turns on.
3. On-line LSMs perform quick-init.
4. As each LSM becomes ready, the software sends a message.
5. If the old master LMU completes IPL successfully, it becomes the standby LMU.

If the switch command is given while processing is active, cartridges might be in-transit in various LSMs. Recovery procedures occur automatically as described in "[Performing Automatic LMU Switch](#)." Upon receiving the LMU

ready signal, the software waits for the LSMs to complete a quick init and then re-drives the requests building up on the queue.

## Powering Off an LMU—Dual LMU Configuration

To power off the master LMU:

1. Place at least one station online to the standby LMU. The station is on standby.
2. Press the power switch on the operator panel of the master LMU. (On older models, press to "0" and the indicator light in the switch turns off.) This starts an LMU switch. Messages appear on operator consoles indicating the changing status of the LMUs.
3. Make sure that the MASTER indicator turns on as the standby LMU becomes the new master LMU.

A message is displayed if the standby LMU successfully assumes the role of master LMU.

All LSMs go through quick-init and recovery procedures.

All LMU requests except enter requests are re-driven. Enter operations must be restarted.

**Note:** Enter operations end when a master LMU is powered off. Other LMU and robotics operations recover and complete once the standby LMU becomes the new master LMU.

No special precautions are necessary to power off the standby LMU; just press the DC power switch on the standby LMU operator panel. Messages appear on operator consoles indicating which LMU is the master LMU and the changing status of the standby LMU.

## Powering Off an LMU—Emergency

To power off the LMU in an emergency, press the EPO switch on the LMU operator panel. Call a CSE to restore power to an LMU that has been powered down by the EPO switch.

In a dual LMU environment, powering off the master LMU starts an LMU switch. If the standby LMU is powered on and at least one station is online to the standby LMU, the standby LMU becomes the master LMU.

## ■ LCU/LSM Operation

Redundant LANs provide the communication link between the LMU and the LCU. The LCU provides power to the LSM and interprets message commands

to the LSM from the LMU. The following sections describe the operator procedures for the LCU/LSM.

Refer to "[LCU/LSM Controls and Indicators](#)" for explanations of all control panels. Refer to your software manual for console messages.

## Powering On an LCU/LSM

To power on an LCU/LSM, press the power switch on the LCU operator panel. (On older models, press the switch to the "1" position, and the indicator in the switch turns on. If it does not, call a CSE to restore power.)

## Loading Functional Code—LCU/LSM

The functional code for the LCU is downloaded from the LMU. This code download can only occur when:

- The LMU is powered up,
- A functional diskette is in floppy drive 1 of the LMU, and
- The LMU is communicating with the LSM.

After the LCU is powered on, the functional code can be downloaded from the LMU by powering the LCU/LSM off and then on again. Code download and LCU/LSM initialization can take 10 to 25 minutes.

## Powering Off an LCU/LSM

To power off an LCU/LSM:

1. Take the LSM offline from all host CPUs.

**Note:** Error messages are given if the LCU/LSM are powered off while the LSM is online.

2. Press the power switch on the LCU operator panel. (On older models, press the switch to the "0" position, and the indicator in the switch turns off.)

## Powering Off an LCU/LSM—Emergency

To power off the LCU/LSM in an emergency, press the EPO switch on the LCU operator panel. This immediately removes power to the robot and to the LCU.

An EPO switch is also inside the LSM. It is a large red button below the CAP on the panel inside the LSM access door.

Call a CSE to restore power to an LCU/LSM that has been powered down by either EPO switch.

## ■ Cartridge Subsystem Operation

The procedure for cleaning a transport tape path with a cleaning cartridge is described in “[Cleaning a Transport Tape Path](#).” The procedure for loading a functional diskette is described in “[Loading a Functional Diskette \(IPL\)](#).” For other subsystem operations, refer to your [cartridge subsystem operator’s guide](#).

### Cleaning the Transport Tape Path

When a library transport has passed a certain amount of tape media across the read/write heads, it informs the LMU, which broadcasts a “drive needs cleaning” notification to all connected hosts. The software responds to this by either scheduling an automatic cleaning for the transport, or by notifying the operator with a console message.

Refer to your [software manual](#) for command syntax and console messages. Clean the transport tape path at least once a week even without a message.

To clean the transport tape path:

1. Enter the LSM following the procedures described in “[LSM Manual Mode Procedures](#)” for placing the LSM in manual mode, entering the LSM, and resetting the transport displays.
2. Mount a nonlibrary cleaning cartridge in the transport.
3. Dismount the cartridge when it is unloaded.
4. Update the cartridge usage by shading the appropriate number of circles, squares on the label to match the number of cleaning cycles done with that cartridge.
5. Remove the cartridge from the LSM.

### Cleaning Cartridges

Cleaning cartridges have a unique 3-character alphanumeric prefix in their VOLSER (default is “CLN”). Cartridges with that prefix make up pools of cleaning cartridges in each LSM. Cleaning cartridges cannot be used as scratch cartridges or initialized by software utilities.

#### **CAUTION:**

**Do not re-enter a cleaning cartridge that has been ejected from the library. When you enter a cleaning cartridge, the software considers it to be new and sets the usage counter to zero.**

When a transport requires cleaning, the software selects a cartridge from the pool of cleaning cartridges in the LSM that contains the transport (or from the closest LSM that has cleaning cartridges). If no cleaning cartridges exist in the ACS, the operator is prompted to mount a cleaning cartridge. It is recommended to have one cleaning cartridge in the ACS for each transport.

When a cleaning cartridge is used a defined number of times, it is automatically ejected from the library, and the operator is notified by a console message. Open the specified CAP, remove the ejected cleaning cartridge, and dispose of it.

## ■ Loading a Functional Diskette (IPL)

If a functional diskette is in the floppy drive when an LMU, LCU, or CU is powered up, the program on the diskette is loaded into memory.

If a functional diskette is not in the floppy drive, insert it (see ["Inserting a Functional Diskette into a Floppy Drive"](#)).

In a dual LMU environment, both functional diskettes in both LMUs should contain the same level of microcode - Release 2.3 or higher. An error message appears on the operator console if different levels of microcode are loaded into the two LMUs.

**Note:** While the CU is loading from the functional diskette, the indicator in the IPL switch remains lit and the 4-digit display shows changing alphanumeric characters. When the loading process is complete, the IPL indicator turns off, and the 4-digit display becomes blank. If the loading is unsuccessful, the IPL indicator remains lit, and the 4-digit display shows a hexadecimal error code.

## Inserting a Functional Diskette into a Floppy Drive

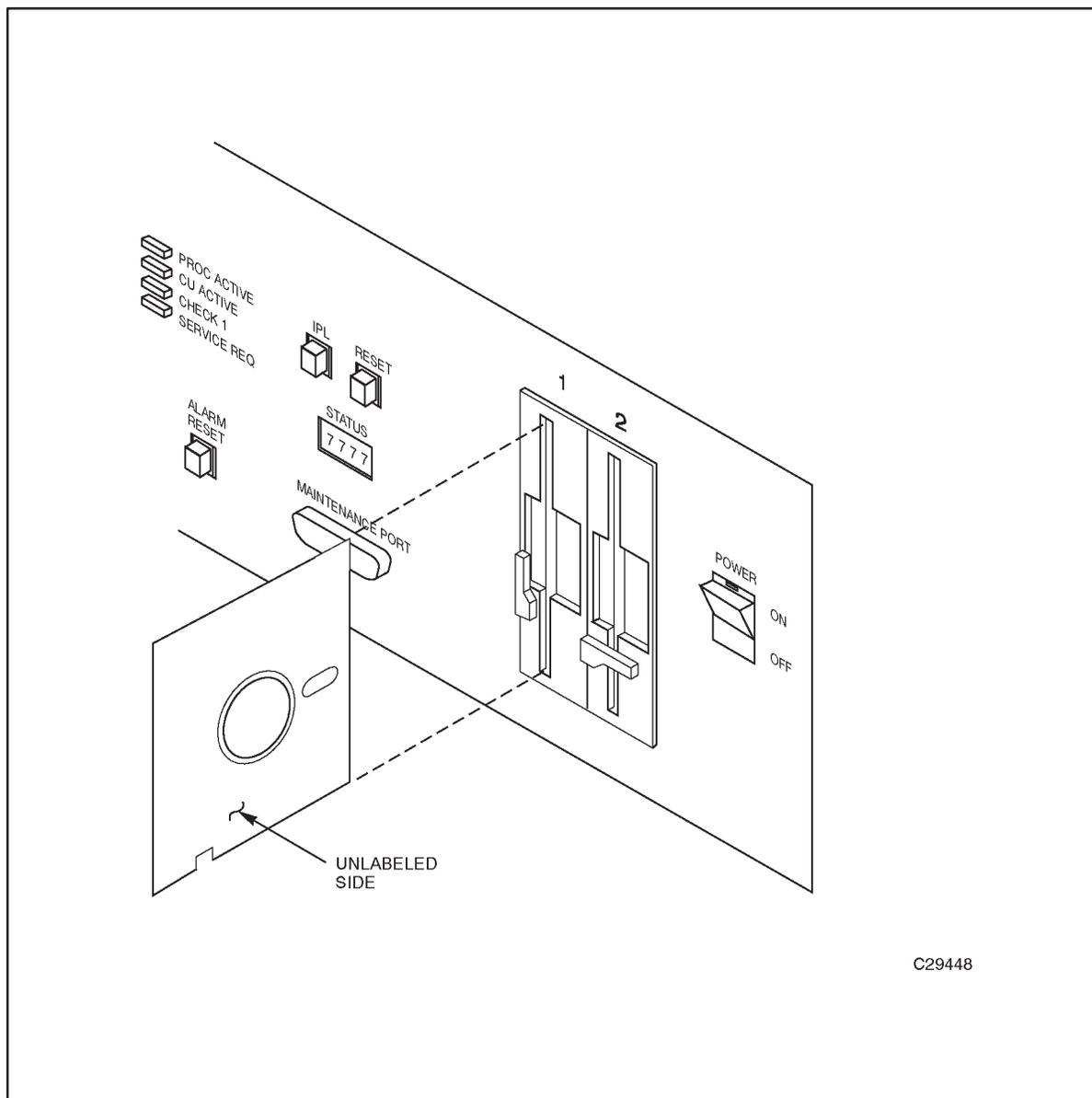
To insert a functional diskette into a floppy drive:

1. Make sure that the lever at the entry slot of the drive is rotated as far as it will go counterclockwise.
2. Insert the diskette into the drive as shown in [Figure 3-29](#).

### **CAUTION:**

**Do not push against the diskette if there is any resistance. Damage might occur to the diskette, the floppy drive, or both.**

3. Push the diskette in until it is completely in the floppy drive.
4. Rotate the lever one-quarter turn clockwise.



C29448

Figure 3-29. Inserting Functional Diskette Into Floppy Drive

# Obtaining Maintenance Support

## 4

This chapter describes what to do if problems occur with the ACS. In some cases, you might be able to correct the problem. In other cases, you must contact your service representative, as described in this chapter.

When the problem is caused by cartridge tapes, refer to [Appendix A](#). When the problem is caused by drives, refer to your drive operator's guide.

Most of the time, a fault symptom code (FSC) will appear on the LSM operator panel display. Write down the information on the display and give the information to your customer representative or to the staff at Customer Support. Write down the FSC as soon as it appears to retain a history of what happened.

## ■ Customer Support

Customer Support is available 24 hours a day, seven days a week, to customers with StorageTek maintenance contracts and to StorageTek customer services engineers (CSEs).

## ■ Customer Initiated Maintenance

Customer Initiated Maintenance begins with a telephone call from a customer to the StorageTek CS. The customer receives immediate attention from StorageTek personnel to record problem information and send a CSE to correct the problem.

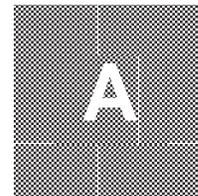
To contact the CS about a problem:

1. Use the telephone to call the StorageTek central dispatcher at  
**☎ 1-800-525-0369**.
2. Tell the central dispatcher why you are calling. The central dispatcher will ask several questions and send a CSE. If you have answers to the following questions when placing a service call, the process is much smoother and faster:
  - Site location number \_\_\_\_\_
  - Account name \_\_\_\_\_
  - Equipment model number \_\_\_\_\_

- Contact name \_\_\_\_\_
- Telephone number \_\_\_\_\_
- Problem description \_\_\_\_\_
- Urgency of problem \_\_\_\_\_

# Cartridge Tape Information

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This appendix lists basic requirements for cartridges, and describes how to prepare and maintain cartridges.

## ■ 3480 and Helical Scan Cartridge Specifications

The LSM uses cartridges that meet the specifications defined in the ANSI publication, *American National Standard Magnetic Tape and Cartridge for Information Interchange, ACS X3B5*.

3480 Nad helical scan cartridges must meet the following requirements:

- Cartridges
  - 10.16 cm x 12.7 cm x 2.54 cm (4 in. x 5 in. x 1 in.)
  - Integrated thumbwheel for 3480, slide switch for helical scan
- Media
  - Chromium dioxide for 3480, ferromagnetic for helical scan
  - 1.27 cm (0.5 in.) wide
  - 165 m (541 ft) long minimum for 3480, 91 m (299 ft) for helical scan
  - No beginning of tape/end of tape reflective markers
- Volume serial number (VOLSER) label
  - Valid characters are A-Z, 0-9, # (crosshatch), or trailing blanks.
  - Leading blanks are not allowed.

Colored cartridges are approved only if the measured reflection density is greater than 1.20, as obtained with an X-Rite 404G color reflection densitometer. For more information about colored cartridges, contact your StorageTek Marketing representative.

Measurements are:

<b>Bandwidth:</b>	ANSI Status T Wideband (380 to 780 nanometers)
<b>Measuring range:</b>	Density (0.00–2.50) D
<b>Accuracy:</b>	± 0.02 D
<b>Repeatability:</b>	± 0.01 D
<b>Aperture diameter:</b>	3.4 mm

## ■ 9840 Cartridge Specifications

Specifications for 9840 cartridges are listed in the table below.

<b>Characteristics</b>	<b>Values</b>
Cartridge type STK1R	270 m (885.82 ft), 8 microns
Cartridge type STK1S	Not available
Cartridge type STK1T	Not available
Cartridge type STK1U	Cleaning cartridge
Dimensions	125 x 109 x 24.5 mm (4.92 x 4.29 x 0.968 in.)
Data compression	LZ-1 Enhanced
Media life	10 year minimum
Data error rates (including those caused by media defects)	Uncorrected Bit Error Rate (BTE) = 1 in 10 <sup>18</sup> bytes

## ■ Preparing Cartridges

The following sections describe how to handle and inspect a cartridge, apply labels, and set the file protect selector or write protect switch,

### Handling a Cartridge

Improper handling of cartridges can result in a loss of data or damage to a machine component.

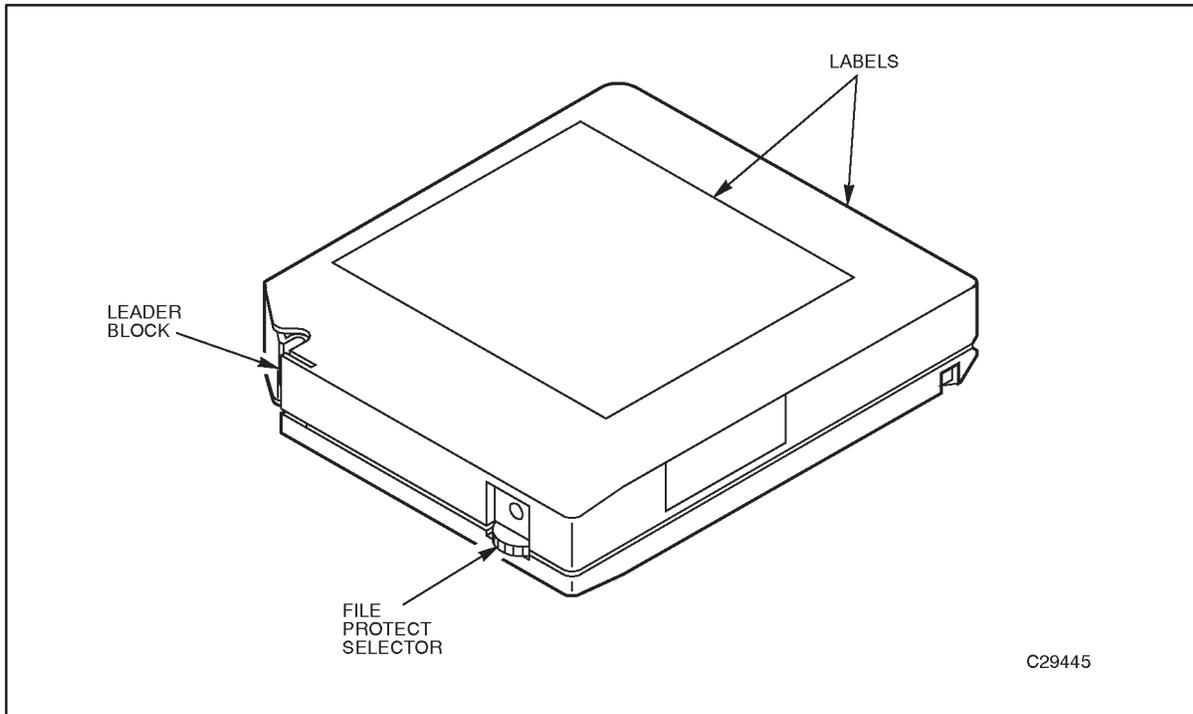
To handle a cartridge correctly:

- Do not carry several cartridges loosely in a container. The leader blocks can snag on other cartridges and become unlatched.
- Make sure that the leader block is latched every time you pick up a cartridge.
- Keep cartridges *clean*.
- Inspect a cartridge before each use and *never* put a damaged cartridge into a drive or LSM.
- Never release a leader block and pull tape from a cartridge.
- Never open a cartridge.
- Do not handle tape that is outside the cartridge; the tape edge might be damaged.
- Do not expose the tape or cartridge to direct sunlight or moisture.
- Do not expose a recorded cartridge to magnetic fields; this might destroy data on the tape.

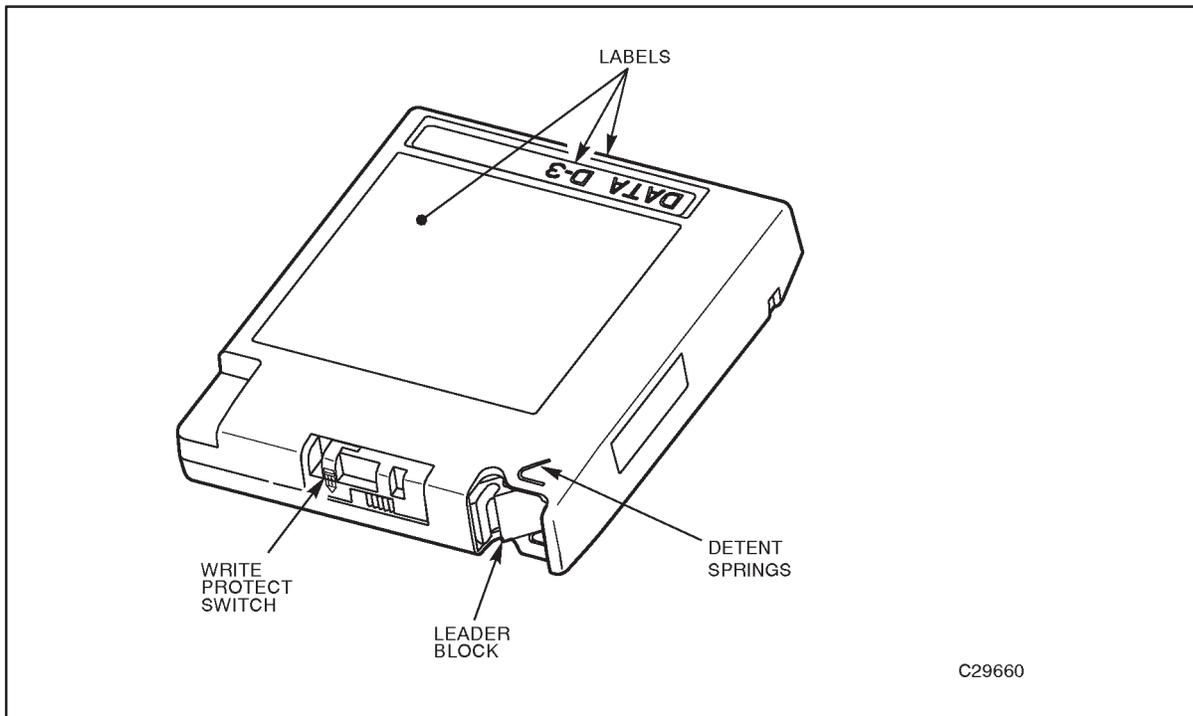
### Inspecting a Cartridge

A defective or dirty cartridge can damage a transport. Always inspect a cartridge before entering it into an LSM. See [Figure A-1](#) or [Figure A-2](#). Look for:

- Cracked or broken cartridge
- Broken leader block
- Broken leader block latch
- Damaged file-protect selector
- Liquid in the cartridge
- Labels not firmly attached or extending over the cartridge edge
- Any other obvious damage



**Figure A-1. Inspecting a 3480-type Cartridge**



**Figure A-2. Inspecting a Helical Scan Cartridge**

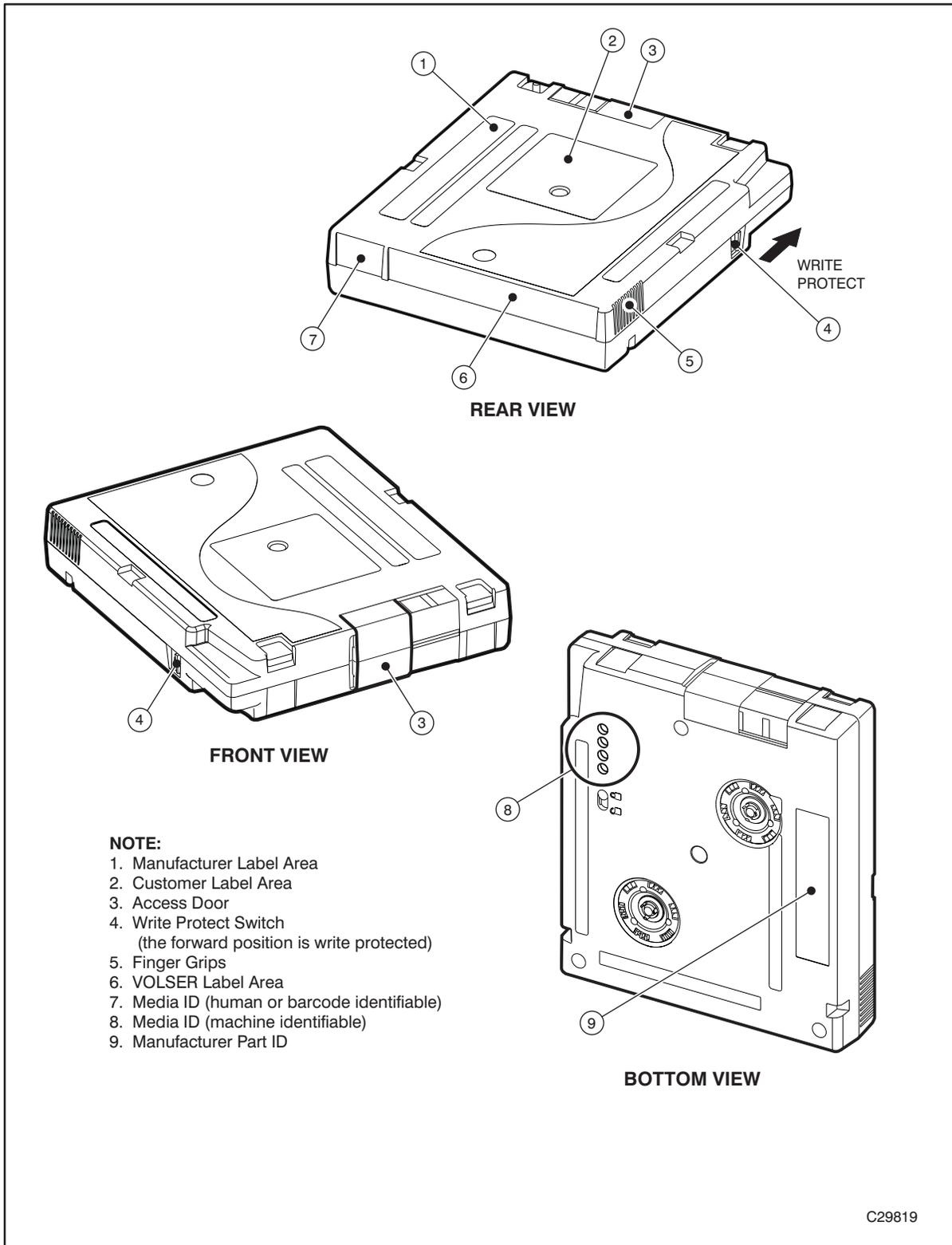


Figure A-3. 9840 Cartridge Components

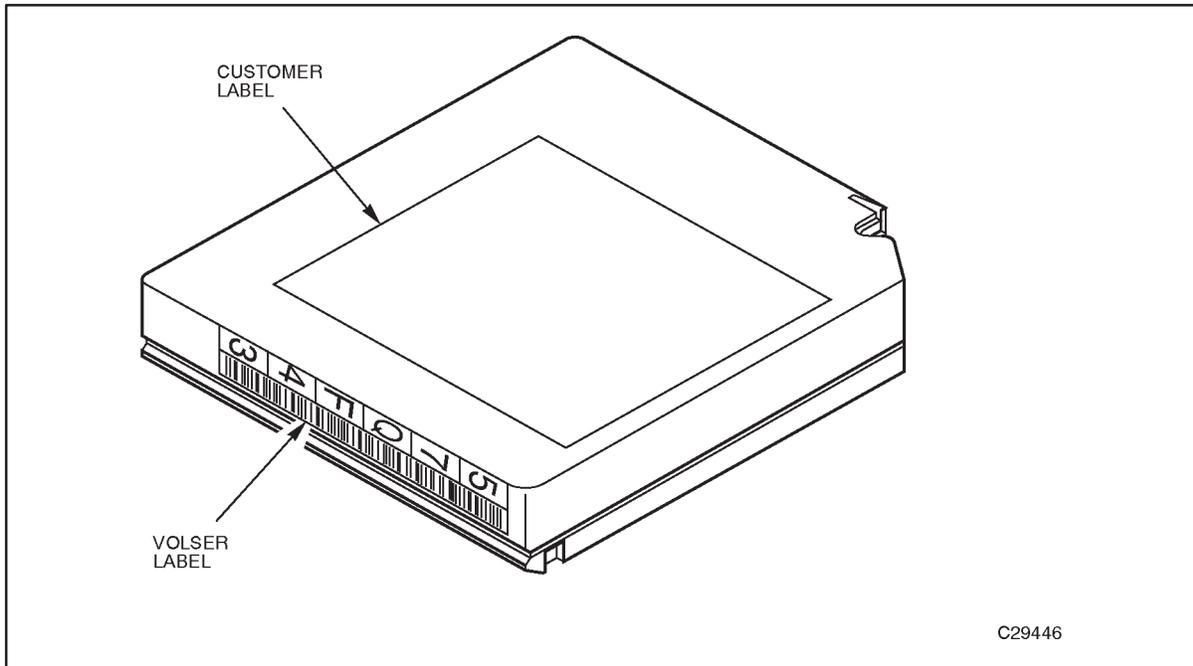


Figure A-4. Applying Labels on 3480-type Cartridges

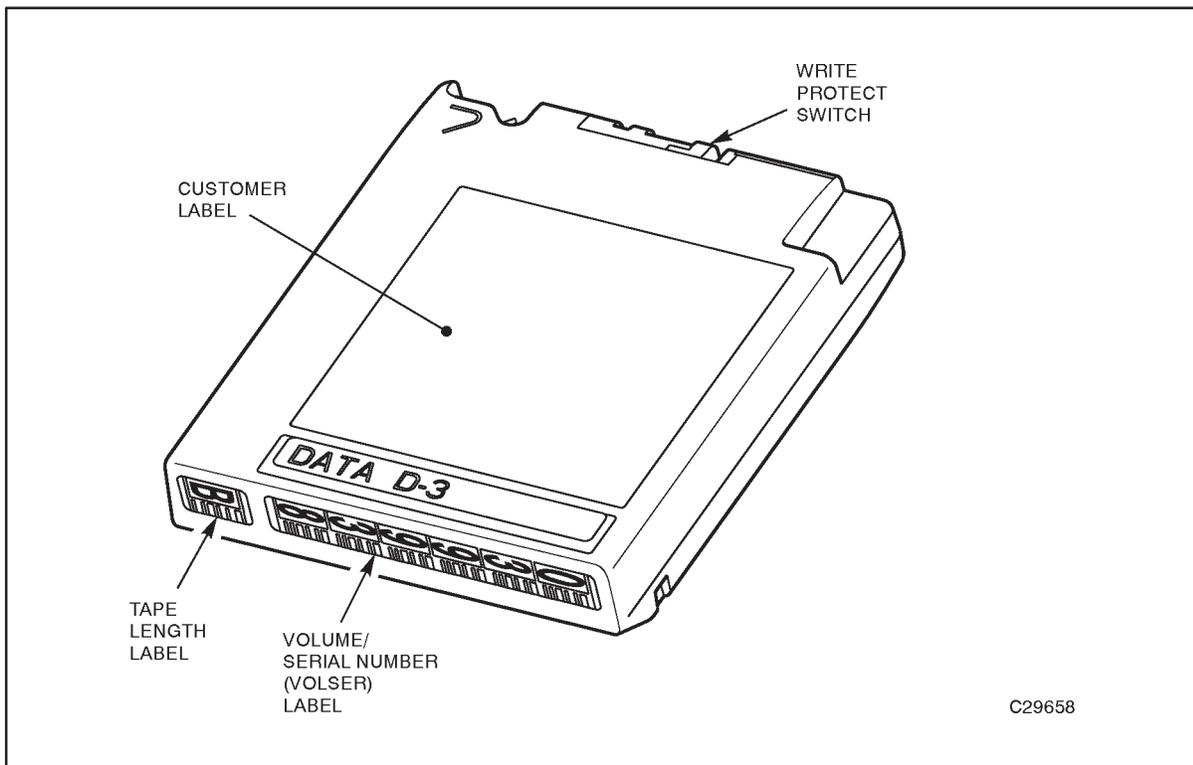


Figure A-5. Applying Labels on Helical Scan Cartridges

## Applying Labels on Cartridges

Cartridge labels reflect the cartridge media and usage. Cleaning cartridges have CLN in the VOLSER; diagnostic cartridges have DG in the VOLSER. Extended media cartridges have a label with an “E” that you will place next to the VOLSER, as described below.

The kinds of cartridge labels you might need to apply are:

- Customer
- VOLSER
- Extended media (enhanced tape)

Referring to [Figure A-4](#) or [Figure A-5](#), place the labels on the recessed areas provided on each cartridge:

1. Make sure that the cartridge has been at room temperature for at least 24 hours.
2. Clean the surface where the labels will be placed using a cleaning solution made for this purpose. See [“Cleaning the Cartridge Exterior.”](#)
3. Peel the backing from the VOLSER label.
4. Hold the cartridge so that the leader block is above the file protect selector and is facing away from you.
5. Position the label with the VOLSER characters to the left, so you can read them from top to bottom. Press into place.
6. If you are using an extended media (enhanced tape) cartridge, peel the backing from the “E” label and place the label in the recessed area to the left of the VOLSER. Press into place.
7. If your cartridge has no customer label, place the label in the area shown in [Figure A-4](#) or [Figure A-5](#) and press into place.

The labels must be within the indented area of the cartridge so that the edges of the label are parallel to the edges of the cartridge. The label should be close to the inside edge of the indented area but must *never* overlap the edge of this area.

### Notes:

1. Make sure that the labels are not placed elsewhere on the cartridge surface.
2. Make sure that the edges of the labels do not curl up; curling causes the cartridge to stick in the drive loader.
3. Use labels that do not leave a residue when removed.
4. Make sure that the label contains a VOLSER.

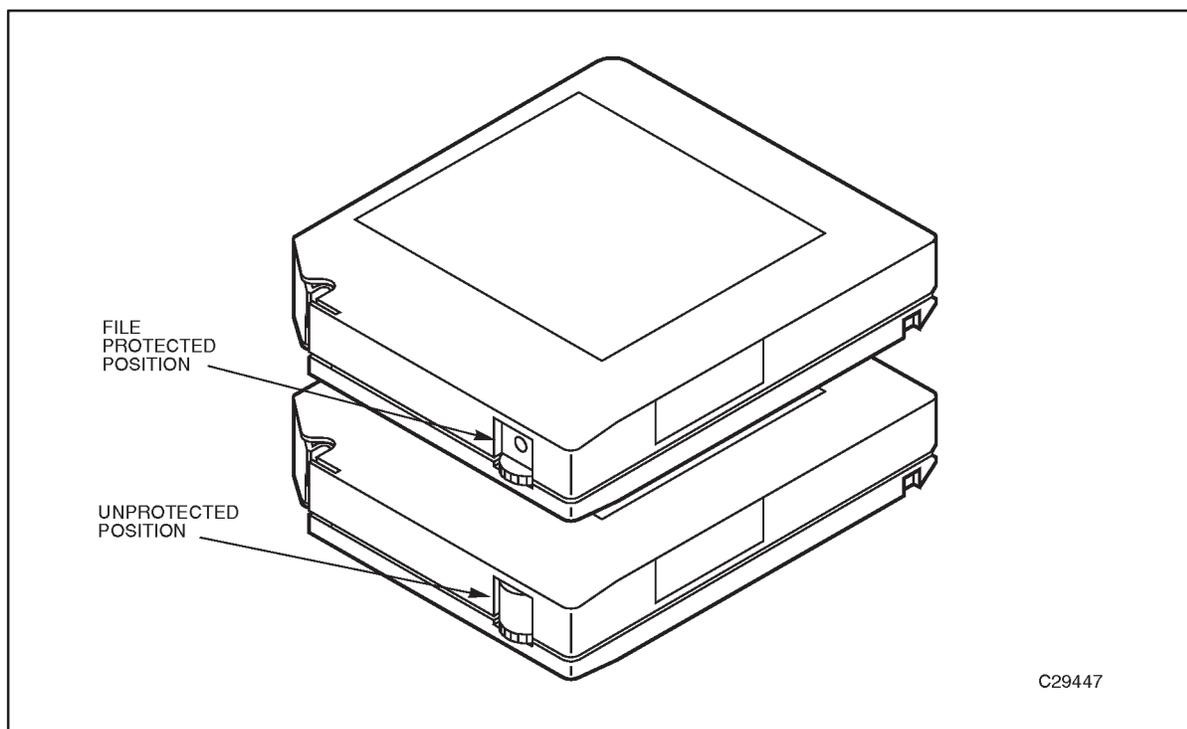
## Setting 3480-type File Protect Selector to Read/Write

You can set the file protect selector so that the cartridge is write-enabled. Refer to Figure A-6 and turn the thumbwheel on the side of the cartridge until the white dot or white padlock icon above the wheel disappears. In this position, the transport can write as well as read data. This setting is recommended when entering cartridges into the LSM.

**Note:** Some software has a feature called virtual thumbwheel, allowing read-only access to a cartridge that is not physically write-protected.

## Setting 3480-type File Protect Selector to Read-Only

You can set the file protect selector so that the cartridge is read-only (nothing can be written on the tape). Refer to Figure A-6 and turn the thumbwheel on the side of the cartridge until the white dot or white padlock icon in a dark background appears on the wheel. In this position, the transport can only read data from the tape and can not write data.



**Figure A-6. Setting the 3480-type File Protect Selector**

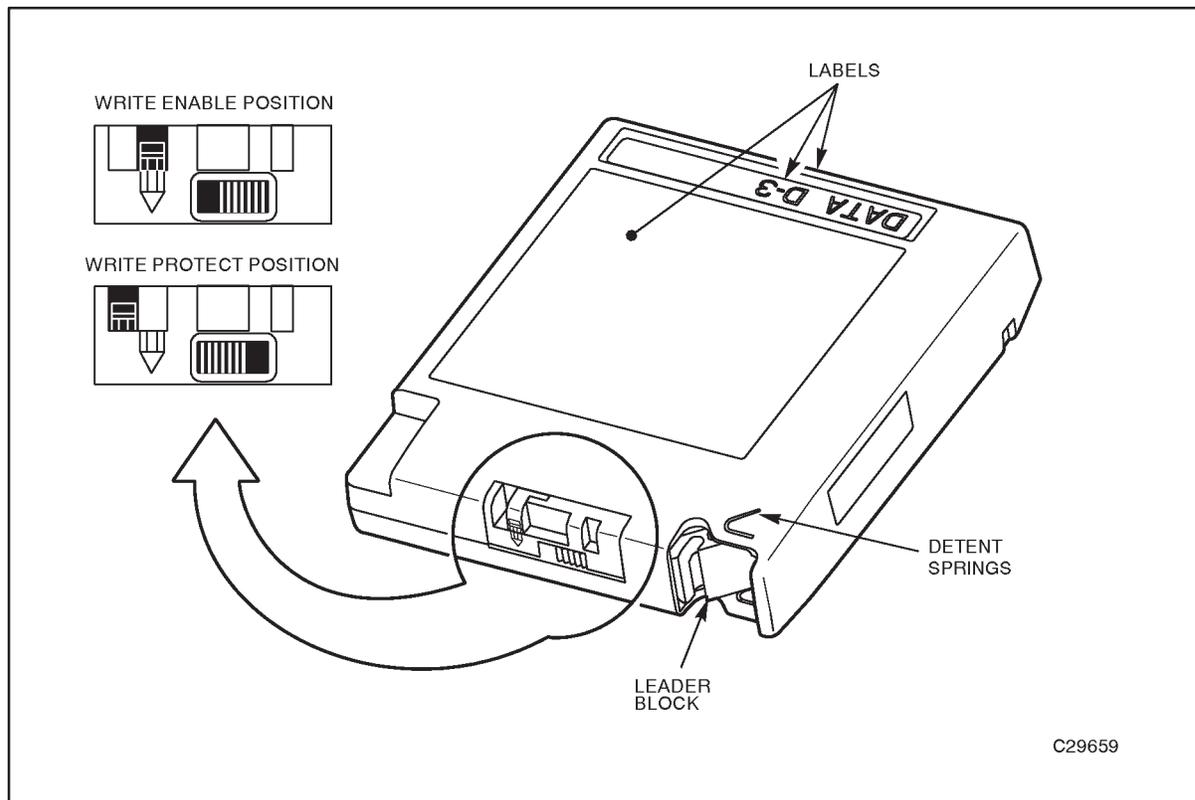
## Setting Helical Scan Write Protect Switch to Read-Only

You can set the write protect switch so that the cartridge is read-only (nothing can be written on the tape). Refer to Figure A-7 and slide the switch to the right so that the pencil icon is split. In this position, the drive can only read data from the tape and can not write data.

## Setting Helical Scan Write Protect Switch to Read/Write

You can set the write protect switch so that the cartridge is write-enabled. Refer to Figure A-7 and slide the switch to the left so that the pencil icon is joined. In this position, the drive can write as well as read data. This setting is recommended when entering cartridges into the LSM.

**Note:** Some software has a feature called virtual thumbwheel, allowing read-only access to a cartridge that is not physically write-protected.



**Figure A-7. Setting the Helical Scan Write Protect Switch**

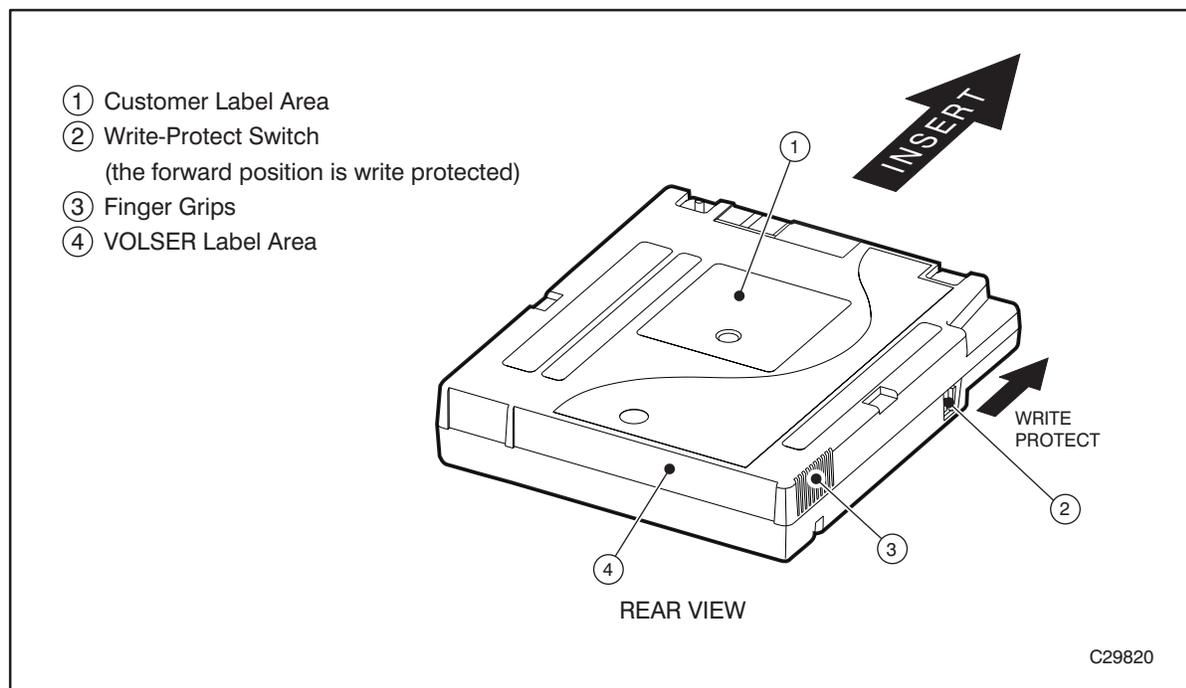
## Setting 9840 Write Protect Switch to Read-Only

You can set the 9840 write protect switch so that the cartridge is read-only (nothing can be written on the tape). Refer to Figure A-8 and slide the switch to the front of the cartridge. In this position, the drive can only read data from the tape and can not write data.

## Setting 9840 Write Protect Switch to Read/Write

You can set the 9840 write protect switch so that the cartridge is write-enabled. Refer to Figure A-8 and slide the switch to the rear of the cartridge. In this position, the drive can write as well as read data. This setting is recommended when entering cartridges into the LSM.

**Note:** Some software has a feature called virtual thumbwheel, allowing read-only access to a cartridge that is not physically write-protected.



**Figure A-8. Setting the 9840 Cartridge Write Protect Switch**

## ■ Maintaining Cartridges

The following sections list environmental specifications, describe how to store and clean cartridges, use cleaning cartridges, and repair a detached leader block.

### 3480-type Cartridge Environmental Specifications

The following specifications refer to the operating and storage environments for 3480-type cartridges:

Operating environment:

**Temperature** 15.6°– 32.2° C (60°– 90° F)

**Relative humidity** 20% – 80%

**Wet bulb temperature** 25.6° C (78° F) maximum

Cartridge storage environment:

**Temperature** 4.4°– 32.2° C (40°– 90° F)

**Relative humidity** 5% – 89%

**Wet bulb temperature** 26.7° C (80° F) maximum

### Helical Scan Cartridge Environmental Specifications

The following specifications refer to the operating and storage environments for helical scan cartridges:

Operating environment:

**Temperature** 15°– 27° C (59°– 81° F)

**Relative humidity** 30% – 60%

**Wet bulb temperature** 25° C (77° F) maximum

Cartridge storage environment:

**Temperature** 5°– 32° C (41°– 90° F)

**Relative humidity** 5% – 80%

**Wet bulb temperature** 26° C (80° F) maximum

## 9840 Cartridge Environmental Specifications

The following specifications refer to the operating and storage environments for 9840 cartridges:

Shipping (unrecorded) environment:

**Temperature** -23° – 49° C (-10° – 120° F)

**Relative humidity** 5% – 80%

**Wet bulb temperature** 26° C (78.8° F) maximum

Shipping (recorded) environment:

**Temperature** 4° – 40° C (40° – 104° F)

**Relative humidity** 5% – 80%

**Wet bulb temperature** 26° C (78.8° F) maximum

Operating environment:

**Temperature** 15.6° – 32.2° C (60° – 90° F)

**Relative humidity** 20% – 80%

**Wet bulb temperature** 26° C (78.8° F) maximum

Cartridge storage (non-archive) environment:

**Temperature** 5° – 32.2° C (41° – 90° F)

**Relative humidity** 5% – 80%

**Wet bulb temperature** 26° C (78° F) maximum

Cartridge storage (archive) environment:

**Temperature** 5° – 25.5° C (41° – 78° F)

**Relative humidity** 40% – 60%

**Wet bulb temperature** 26° C (78° F) maximum

## Storing Cartridges

When you store a cartridge:

- Do not take a cartridge out of its protective wrapping until you are ready to use it. Use the tear string, not a sharp instrument, to remove the wrapping.
- Store cartridges in a clean environment that duplicates the conditions of the room in which they are used.
- Before using a cartridge, make sure that it has been in its operating environment for at least 24 hours.

## Cleaning the Cartridge Exterior

**CAUTION:**

**Do not use certain solvents to remove labels or to clean cartridges because they can damage the cartridges. Do not use acetone, trichloroethane, toluene, xylene, benzene, ketone, methylethyl ketone, methylene chloride, ethyldichloride, esters, ethyl acetate, or similar chemicals.**

Wipe all dust, dirt, and moisture from the cartridge with a lint-free cloth.

Use StorageTek Tape Cleaner Wipes, PN 4046289-01 to clean the cartridges. These wipes are saturated with isopropyl alcohol. Do not let any solution touch the tape or get inside the cartridge.

## Using Cleaning Cartridges

Cleaning cartridges have a VOLSER prefix of DG CLN or CLNxxx. These cartridges can not be used as scratch cartridges or initialized by software utilities.

**CAUTION:**

**Do not re-enter a cleaning cartridge that has been ejected from an LSM. When you enter a cleaning cartridge, the software considers it to be new and sets the usage counter to zero.**

## **Repairing a Detached Leader Block**

When a tape is damaged, use a backup tape. If a 3480 or helical scan cartridge leader block is detached, the cartridge or tape has no obvious damage, and you have no backup tape, you may repair the leader block using a repair kit provided by your supplier. You can use the tape one time to copy the data onto another tape.

# Glossary

---

## Numerics

**9840** A cartridge drive that reads/writes to tapes; the housing for the tape contains supply and take-up reels.

## A

**ac** Alternating current.

**ACS** See automated cartridge system.

**automated cartridge system (ACS)** The library subsystem consisting of one or two LMUs, and from 1 to 16 attached LSMs.

**automatic mode** A relationship between an LSM and all attached hosts. LSMs operating in automatic mode handle cartridges without operator intervention. This is the normal operating mode of an LSM that has been placed on-line to all host CPUs.

## B

**beginning-of-tape (BOT)** The location on a tape where written data begins.

## C

**CAP** See cartridge access port.

**cartridge, 3480** The plastic housing around the tape. It is approximately 100 mm (4 in.) by 125 mm (5 in.) by 25 mm (1 in.). A plastic leader block is attached to the tape for automatic threading when loaded in a transport. The spine of the cartridge contains a label listing the VOLSER (tape volume serial number).

**cartridge, 9840** The plastic housing around the tape. It is approximately 109 mm (4.3 in.) by 125 mm (5 in.) by 25 mm (1 in.). The housing contains the tape and two reels for automatic threading when loaded in a transport. The spine of the cartridge contains a label listing the VOLSER (tape volume serial number).

**cartridge access port (CAP)** An assembly allowing an operator to enter/eject cartridges during automated operations. The CAP is located on the access door of an LSM. The standard CAP contains 21 cells. The enhanced CAP holds 80 cells plus a PCAP with one cell.

**cartridge drive (CD)** A device containing two or four cartridge transports with associated power and pneumatic supplies.

**CD** See cartridge drive.

**cell** A slot in the LSM that is used to store a tape cartridge.

**Central Support Remote Center (CSRC)** The remote diagnostic center at StorageTek. CSRC operators can access and test StorageTek systems and software, through telecommunications lines, from remote customer installations. Previously referred to as the Remote Diagnostic Center (RDC).

**channel** A device that connects the host and main storage with the input and output control units.

**channel command** A command received by a CU from a channel.

**connected mode** A relationship between a host and an ACS. In this mode, the host and an ACS are capable of communicating (at least one station to this ACS is on-line).

**control unit (CU)** A microprocessor-based unit situated logically between a host channel (or channels) and from 2 to 16 tape transports. It translates channel commands into tape transport commands, sends transport status to the channel(s), and passes data between the channel(s) and transport(s).

**controlling software** An ACS component that acts as the interface between the operating system and the rest of the automated library.

**cross-host recovery** The ability for one host to perform recovery for another host that has failed.

**CSE** customer services engineer

**CSRC** See Central Support Remote Center.

**CU** See control unit.

## D

**dc** Direct current.

**device number** A four-digit hexadecimal number that uniquely identifies a device attached to a processor.

**disconnected mode** A relationship between a host and an ACS. In this mode, the host and an ACS are not capable of communicating (there are no on-line stations to this ACS).

**dual LMU** A hardware/microcode software feature allowing a second LMU to take control when the first LMU fails.

## E

**emergency power off (EPO)** Pressing the EPO switch on the LMU Operator Panel immediately removes all power from the LMU. Pressing the EPO switch on the LCU Operator Panel or the EPO button on the access door inside the LSM immediately removes all power from the LCU and LSM.

**EOT** end-of-tape marker.

**EPO** See emergency power off.

## I

**ID** Identifier or identification.

**initial program load (IPL)** A process that activates a machine reset and loads system programs to prepare a computer system for operation. Processors having diagnostic programs activate these programs at IPL execution. Devices running microcode software usually reload the functional microcode software from a floppy diskette at IPL execution.

**intervention required** The operator needs to perform manual action.

**IPL** See initial program load.

## L

**LAN** See local area network.

**LCU** See library control unit.

**LED** See light emitting diode.

**library** An installation of one or more ACSs, attached cartridge drives, cartridges placed into the ACSs, host software that controls and manages the ACSs and associated cartridges, and the library control data set that describes the state of the ACSs.

**library control unit (LCU)** The portion of the LSM that controls the picking, mounting, dismounting, and replacing of cartridges.

**library management unit (LMU)** The portion of the ACS that manages from 1 to 16 LSMs and communicates with the host CPU.

**library storage module (LSM)** The portion of the ACS that provides the storage area for cartridges plus the robot necessary to move the cartridges. The term LSM often means the LCU and LSM combined.

**light emitting diode (LED)** An electronic device used mainly as an indicator on status panels to show equipment on/off conditions.

**LMU** See library management unit.

**local area network (LAN)** A computer network in which devices within the network can access each other for data transmission purposes. The LMU and attached LCUs are connected with a local area network.

**LSM** See library storage module.

**LSM number** A method used to identify an LSM. The first LSM listed in this parameter is 0 (hexadecimal), the second LSM listed is 1, and so forth, until all LSMs are identified (maximum number of 15 or hexadecimal F).

## M

**maintenance facility** Hardware contained in the CU and LMU that allows a CSE and the CSRC to run diagnostics, retrieve status, and communicate with respective units through their control panels.

**manual mode** A relationship between an LSM and all attached hosts. LSMs operating in manual mode have been placed off-line to all host CPUs and require human assistance to perform cartridge operations.

**master LMU** The LMU currently controlling the functional work of the ACS in a dual LMU configuration.

**modem** Modulator/demodulator. An electronic device that converts computer digital data to analog data for transmission over a telecommunications line (telephone line). At the receiving end, the modem performs the inverse function.

**monitor** A device that observes, records, and verifies selected system activities to determine significant departure from expected operation.

## O

**operating system (OS)** Software that controls the execution of programs to make overall system operation easier.

## P

**pass-thru port (PTP)** A mechanism that allows a cartridge to be passed from one LSM to another in a multiple LSM ACS.

**PCAP** See priority cartridge access port.

**priority cartridge access port** An assembly allowing an operator to enter/eject one cartridge during automated operations. The PCAP is located on the 80-cell CAP access door of an LSM.

**PTP** See pass-thru port.

## S

**standby** The status of a station that has been placed on-line but is connected to the standby LMU of a dual LMU ACS.

**standby LMU** The redundant LMU in a dual LMU configuration that is ready to take over functions if a master LMU fails or when the operator issues the switch command.

**station** A hardware path between the host computer and an LMU over which the controlling software and LMU send control information.

**switchover** The standby LMU becomes the master LMU.

## T

**transport** An electromechanical device capable of threading tape from a cartridge, moving the tape across a read/write head, and writing data onto or reading data from the tape.

## U

**utilities** Utility programs. The programs that allow an operator to manage the resources of the library and to monitor overall library performance.

## V

**VOLSER** Volume serial number. A six-character alphanumeric label used to identify a tape cartridge.

**volume** A data carrier that is mounted or dismounted as a unit. ( *See* cartridge).

## W

**write tape mark (WTM)** The operation performed to record a special magnetic mark on tape to identify a particular location.

**WTM** See write tape mark.

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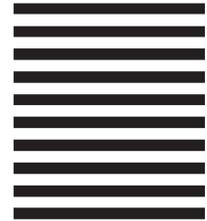


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