

# Automated Tape Library

## Barcode Label Technical Brief



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Automated Tape Library - Barcode Label Technical Brief

TT0006 Revision 3.0

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## Summary

Date	Revision	Description
April, 2005	1.0	Initial Release
December, 2006	2.0	Updates include: <ul style="list-style-type: none"><li>• New tape drive and label support</li></ul>
—	2.5	Engineering Updates
May, 2010	3.0	Updates include: <ul style="list-style-type: none"><li>• New labels and descriptions</li><li>• LTO5</li></ul>

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# Introduction

This document describes the barcode labels used for cartridge tapes in Oracle's StorageTek Automated Cartridge Systems (ACS), also known as tape libraries.

## Scan Engine

StorageTek libraries such as the SL8500, SL3000, and SL500 use a charge couple device-(CCD) based scan engine that is integrated into the cartridge gripping mechanism of the robot for reading the barcode on tape cartridge labels.

This scan engine uses an LED light source to project a thin strip of light onto the barcode portion of the label. The white portions of the barcode reflect back an image to a lens that collects and focuses the pattern on to a multi-pixel CCD imager.

This CCD imager uses the same technology as those of digital cameras except this imager uses a single row of sensors instead of the multiple row sensors used in digital cameras. In essence, the CCD imager provides a very narrow picture that cuts across the bars in the barcode creating a digitized signal.

Because the Library scan engine uses a light source that illuminates the label, anything that causes a reflection back into the lens could blind the CCD imager and cause barcode read problems. That is why the scan engine is mounted at an angle to the labels and targets to avoid any direct reflection problems.

### **Important:**

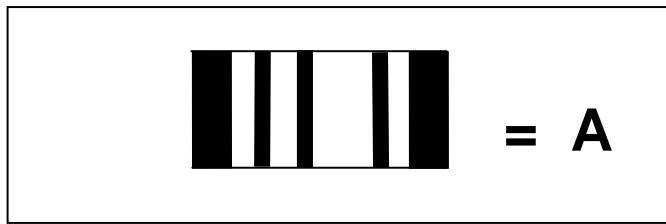
The SL8500, SL3000, and SL500 libraries *do not* use a laser scanner. Laser scanner barcode readers scan a laser dot across the barcode that detects and reflects back amplitude. These scanners use a very thin beam of light, (the laser) and require laser light emission warnings and to indicate where the laser beam originates.

## Barcode Standard

StorageTek libraries use labels based on the **Code 39** barcode standard<sup>1</sup>. This standard uses discrete barcodes, which means that a fixed pattern of bars represents a single character.

Each character is made up of 9 bars—5 black bars and 4 white bars—3 of which are wider than the others. This is the reason for the name Code 39 and why some people refer to it as the *3 of 9 Code*.

*For example:* The figure below represents the letter A using 6 six narrow bars and 3 wide bars (two black and one white).



**Figure 1:** Code 39 Barcode Standard and the Letter A

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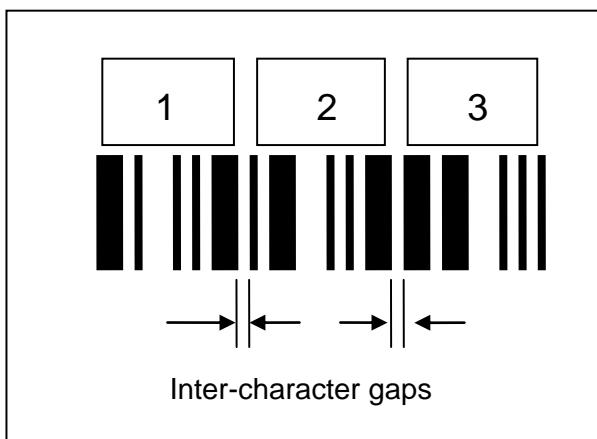
1) All StorageTek mixed-media libraries follow these guidelines.

## Label Design

The Code 39 standard supports 36 unique alpha-numeric characters—the letters A through Z and the numbers 0 through 9—for use in making customer labels, note that no lower case letters are used.

This standard also supports seven special characters ( - . \$ / + % \* ), which are not part of the customer label.

When multiple characters are arranged together as a label or volume serial number (VOLSER), a single, narrow white bar or space, is placed between the individual character barcodes. This space is called the Inter-character Gap.



**Figure 2:** Inter-character Gaps

For the decode algorithms to function properly, a delimiter or *start* and *stop* character is needed to bind the actual barcode label characters together. This character is the asterisk “\*”, one of the seven special characters.

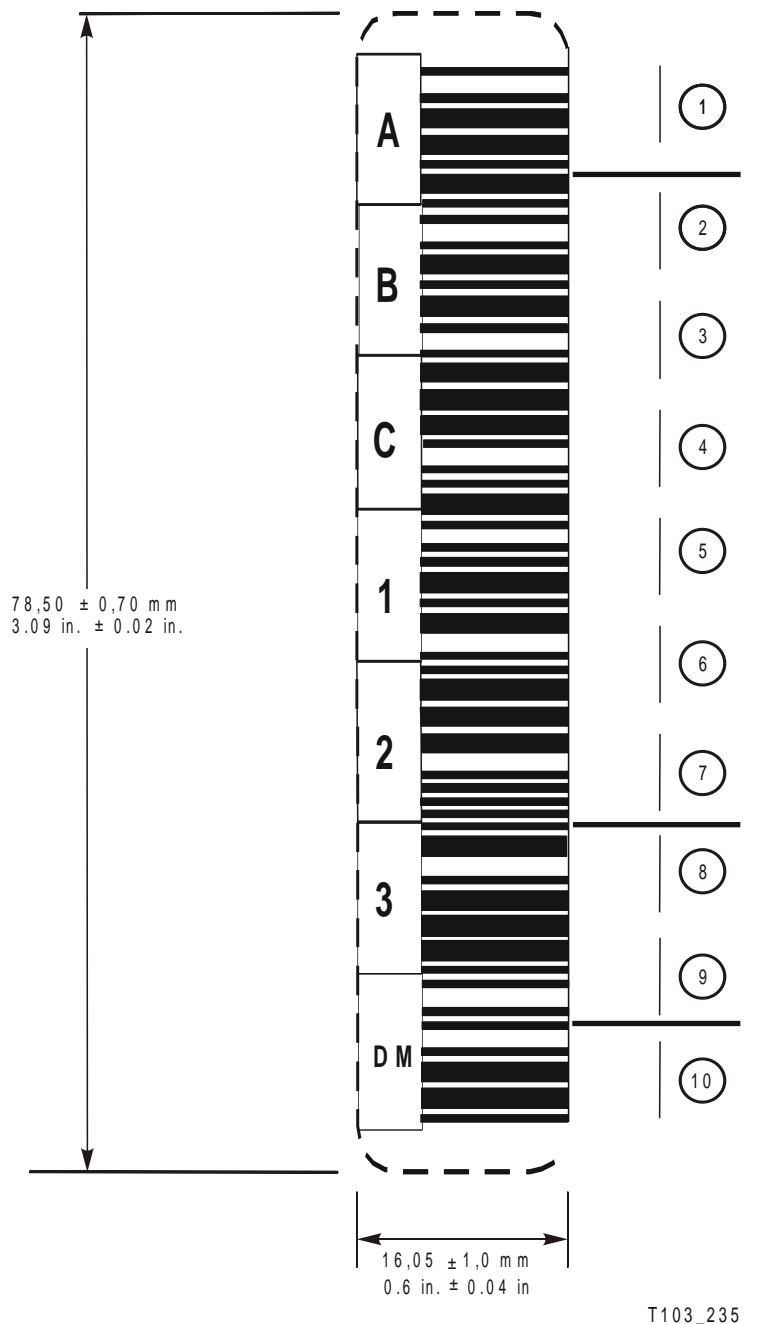
The asterisk should never be used inside a barcode as part of the customer-defined characters. Barcode algorithms only decode the characters *between* the asterisks; they ignore characters *outside* the asterisks.

*For example:*

Actual Barcode Label	After Decoding	Comments
*ABC123*	ABC123	Good label
*ABC*23*	ABC	Misplaced stop character
*ABC5678	Unreadable	No stop character detected

The StorageTek T-Series tape drive style labels made by Tri-optic , use a \$ as the *start* and *stop* character. The \$ is another of the seven special characters and should not be used as part of the customer label.

The figure on the next page illustrates the barcode, inter-character gaps, and the start and stop characters of a standard label.



**Figure 3:** Barcode Placement Standards

For more information, refer to the following specifications:

- AIM Uniform Symbology Specification USS-39
- ANSI MH10.8M-1993 ANSI Code 39 Barcode Specification

## Media ID Labels

The media ID label is the way a particular type of tape cartridge is identified by the library.

To make sure that the correct media type is installed in the correct tape drive in an *Any Cartridge, Any Slot<sup>TM</sup>* library, a method to identify the type of media was needed. The use of media ID labels allows a single library or library complex to mix drive types and media types.

The first tape cartridges to use the media ID in StorageTek libraries was the StorageTek Timberline 9490 Extended tapes called "E-Carts." Since that time mixed-media libraries have always required tapes to include a media ID label.

Enterprise class cartridge tapes were the first to have a special recess molded into the cartridge to accept a unique single character label. Currently, almost all of the 36 alpha-numeric characters have been assigned different media-type IDs to date.

*For example:*

Digital Linear Tape (DLT) labels for StorageTek libraries were designed to include a *seventh* character to represent the media ID. This seven character label became unique to DLT and Super DLT (SDLT) tapes.

Linear Tape-Open (LTO) labels were designed to be an *eight*-character label which includes the six-character customer-defined label plus a domain type (seventh character) and the media ID (eighth character).

The addition of a domain type with the media ID now allows the library to more accurately represent how the information is reported to the host—where the domain type represents the tape technology (for example LTO) and the media ID represents the version of that technology (for example generation 1, 2, 3, 4 or 5).

## Media Label Requirements

StorageTek modular library systems support three types of tape drives and media formats:

- Super Digital Linear Tape drives (SDLT 600) and DLT-S4
- Linear Tape-Open (LTO) Generation 2, 3, 4 and 5 tape drives
- StorageTek T-Series (T9840x, T9940x, and T10000x)

Using Figure 4 as an example, the following describes the requirements for the media label:

- **T9x40 Series Labels:**

These tape cartridges require a **six plus one**-character label.

The six-character customer label can be printed only by Tri-Optic Corporation, American Eagle Systems / Wrightline, or Imation Corporation for use in StorageTek libraries. These labels have a unique barcode format based on the Code 39 barcode that use a unique start stop character, then the single media ID character; thus the six-plus-one format.

- **T10000 Series Labels:**

These tape cartridges require an **eight**-character label.

This label includes a six character customer defined volume serial number or the cartridge's function, such as diagnostic (DG) or cleaning (CLN). The other two characters identify the media domain or tape technology, and the media ID.

- LTO Labels:**

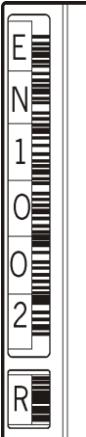
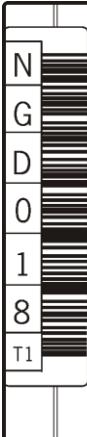
LTO tape cartridges require an **eight**-character label.

Like the T10000, this label includes a six character customer defined volume serial number or the cartridge's function, such as diagnostic (DG) or cleaning (CLN). The other two characters identify the media domain or tape technology, and the media ID or version of that particular technology.

- DLT/SDLT Labels:**

These tape cartridges require a **seven**-character label.

The six character label version does not indicate the media type and is *not compatible* with the SL8500 library. The seven character label has a small identifier below the sixth character for the media ID or version.

T9x40 Six-plus-one label	T10000 Eight-characters	LTO Eight-characters	SDLT Seven-characters
 T104_057	 T104_053	 T104_051	 T104_050
<b>T9940 cartridge:</b> P = T9940 Data W = Cleaning  <b>T9840 cartridge:</b> R = T9840 Data U = Cleaning Y = T9840D Cleaning  Implied domain = 00	<b>T10000 cartridge:</b> T1 = T10000 Data TS = T10000 Data Sport CT = Cleaning CL = Universal cleaning	<b>LTO data cartridge:</b> LT = Gen 3 WORM LU = Gen 4 WORM LV = Gen 5 WORM L5 = Gen 5 (1.5 TB) L4 = Gen 4 (800GB) L3 = Gen 3 (400 GB) L2 = Gen 2 (200 GB) L1 = Gen 1 (100 GB) CU = Universal cleaning	<b>DLTtape cartridge:</b> B = DLT1 C = DLTtape III D = DLTtape IV E = DLTtape III-XT  <b>SDLTTape cartridge:</b> S = Super DLTtape I 2 = Super DLTtape II 4 = DLT-S4  Implied domain = 01 S4 = DLT- S4

**Figure 4:** Tape Cartridge Label Requirements for Different Types of Media

## Cleaning and Diagnostic Labels

Cleaning and diagnostic cartridges require different labels to distinguish them from data cartridges. As the name implies, cleaning cartridges clean the tape path and read/write heads of the tape drives.

Diagnostic cartridges are for service representatives to run read and write tests on the tape drive. In general, these tapes are standard data cartridges with a special diagnostic label.

The first three alphanumeric characters in the label sequence determine the type of cartridge being used.

### For Enterprise Systems

[ CLNnnn ], where:

"CLN" is the cleaning cartridge identifier, "nnn" is a sequence of numbers (such as CLN000 to CLN999).

The T10000, 9840/9940 and SDLT cleaning labels do not include the fourth character drive type identifier due to legacy software issues.

### For Other Systems

[ CLNvnn ], where:

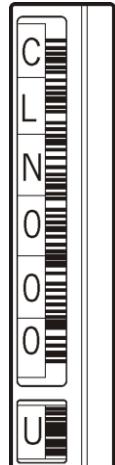
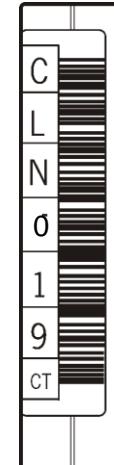
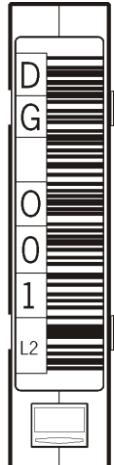
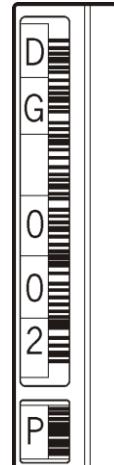
"CLN" is the cleaning cartridge identifier, "v" is the drive type identifier, such as CLNUxx for a Universal cleaning cartridge, "nn" is a sequence of numbers (for example: CLNU00 to CLNU99).

Note: First generation LTO Ultrium cleaning cartridge labels also used a media id type for "v" that coincided with the drive type prior to the universal cleaning cartridge.

### For Diagnostic Cartridges

[ DG{space}nnn ], where “DG{space}” is the diagnostic cartridge identifier, and “nnn” is a sequence of numbers (such as DG 001, and DG 019).

Diagnostic cartridge labels also require the unique media ID type that coincides with the drive type.

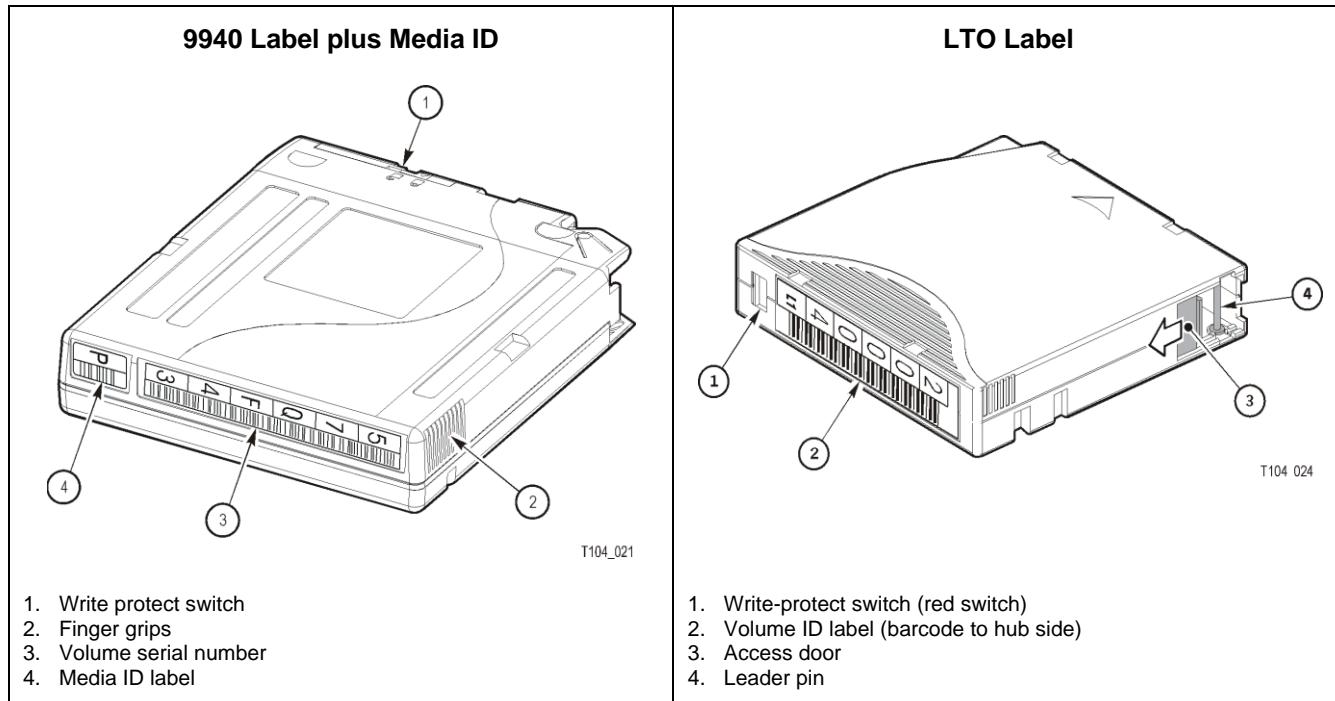
Cleaning Cartridge Labels			Diagnostic Cartridge Labels			
						
T104_055	T104_057	T104_059	T104_054	T104_056	T104_058	T104_060
LTO	9840	T10000	SDLT	LTO	9940	T10000

## Labeling Media

Today, most tape cartridges have a recessed area on the back of the cartridge designed specifically for attaching the label.

**Important:**

Labels for one technology and format should never be placed on a tape cartridge using a different technology and format. The library might load that cartridge into an incompatible tape drive. This could cause damage to the tape drive and tape cartridge.



**Figure 5: Labeling Media**

**Guidelines for applying the labels include:**

- Inspect and clean the cartridge before you apply any labels (if necessary). Wipe all dust, dirt, and moisture from the cartridge using a lint-free cloth; use a valid cleaning solution (such as isopropyl alcohol) to clean the cartridge.
- Apply the labels within the recess on a cartridge as straight as possible. Labels applied at an angle will have a narrower valid reading area and will reduce barcode reading margins.
- With the hub side down, apply the label with the barcode on the lower portion of the label as shown in the following figure. (With the cartridge sitting on the hub side while viewing the label, the barcode will be below the human-readable characters.)
- There might also be a recessed area on the top of the cartridge. This area is intended for a customerusable label. Write on customer labels with a marker that does not smear.
- Replace the existing label rather than changing the writing on it.
- Apply a new label to the cartridge instead of placing one label on top of the other.
- Do *not* write on a barcode label.
- Do not use sharp instruments to seat or remove a label.

## T-Series Tape Cartridge Labels

The SL8500, SL3000, and SL500 libraries will not read T-Series tape cartridges with only the media ID label or with only the volume ID label. *Reading both labels is required.*

Also, StorageTek recommends the newer, taller barcode labels for the T-Series tape cartridges. These labels (with their taller height) improve the readability margin of the scan engine.

*Examples:*



**Figure 6: T-Series Media Labels**

## Upside-Down Detection

Upside-down detection is based on the read direction of the label and the position of the label within the scan engine's field of view.

Handling and installing cartridges correctly is very important and must be emphasized to operators. Especially, inserting a T-Series cartridge upside down—this can cause damage to the robot and to the cartridge.

## LTO and DLT Cartridges

For upside-down LTO and DLT cartridges, the label can be recognized and may be placed into a cartridge slot. However, when the library tries to load the cartridge into a drive, the:

- Drive does not allow the upside-down cartridge to be inserted,
- Cartridge is returned to its original slot, and
- Drive posts a load error message to the host.

The operator should verify if there is an upside-down condition by exporting the cartridge through the CAP.

## T-Series Cartridges

**Caution:** *Equipment and cartridge damage.* An upside-down T-Series cartridge does not seat (fit) correctly into the slots and can cause damage to the robot and the cartridge.

Make sure the customer is aware of the problems this can cause.

## Non-labeled Cartridges

Non-labeled cartridges are *not* supported in StorageTek libraries. If a non-labeled cartridge is left inside the library and a software audit is started, the cartridges are exported.

## Unreadable Labels

The barcode reader tries to read a label at five different positions in front of a cartridge slot. If all these attempts fail, the robot moves the reader in an “up scan” across the slot, then a “down scan” across the slot and repeats this sequence three times before the robot posts an error that the label is unreadable.

## Cartridge Label Care

The following is a list of Do's

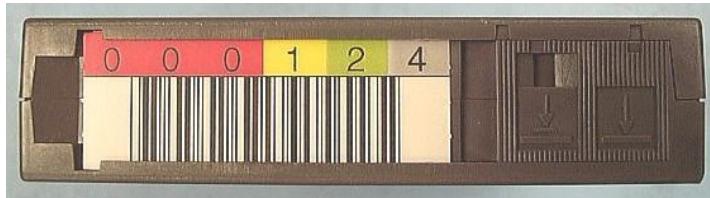
- Keep the barcode intact
- Apply the label within a year of purchase to ensure the adhesive is still good
- Make sure that the cartridge surface is clean before you apply the label
- Make sure that the labels are applied and aligned with no rotation, twists or turns
- Make sure that the labels are completely stuck to the cartridge
- Apply labels in the correct orientation
- Use only 9840/9940 labels from Tri-optic, American Eagle/Writeliner or Imation

The following is a list of Don'ts:

- Put any kind of tape across the barcode label
- Mark on or damage the barcode label
- Curl the label up the edge of the label recess
- Apply labels crookedly within the label recess
- Apply a second label on top of a previous label—remove the first label completely
- Re-use labels after they have been removed from a cartridge
- Put the wrong label type on a cartridge
- Apply the 9840/9940 single-character media ID label crookedly

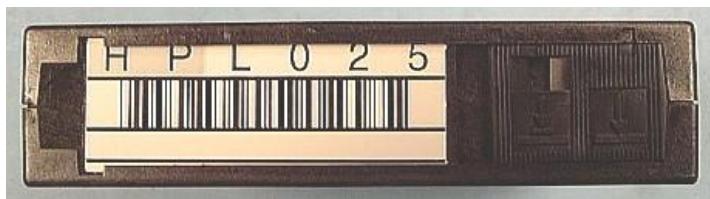
## Unsupported Label Types

The following are some examples of unsupported labels:



Tall barcode six-character DLT labels.

These labels do not indicate which type of DLT media it is.



Short barcode six-character DLT labels.

These labels do not indicate which type of DLT media it is.



Unique barcode six-character DLT label.

These labels do not indicate which type of DLT media it is.



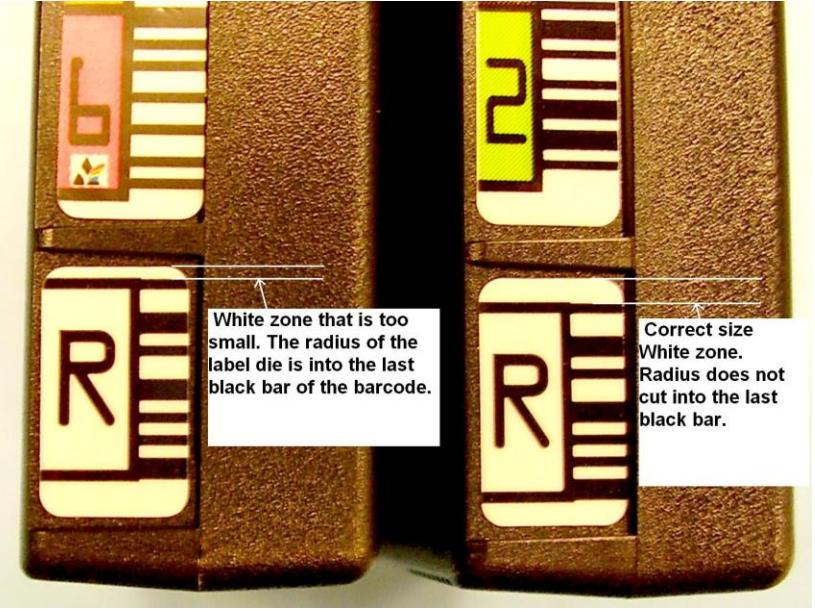
Qualstar-style LTO label with eight customer characters and a checksum.

This label does not indicate which type of LTO media the cartridge is.

The barcode is also on the wrong side of the human readable characters.

## Problem Labels

The following are some examples of problem labels:

 <p>White zone that is too small. The radius of the label die is into the last black bar of the barcode.</p> <p>Correct size White zone. Radius does not cut into the last black bar.</p>	<p>Media ID labels need to have the correct size <i>quiet zone</i> above and below the barcode.</p> <p>If the quiet zone is too small, the scan engine can misread the media ID character when it is viewing the lower part of the barcode.</p>
	<p>If the media ID label is rotated one direction and the six-character label is rotated in the opposite direction, the area is too small to read.</p>
	<p>If the media ID label is shifted up and the six-character label is shifted in the opposite direction, the area is too small to read.</p>



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