



DynaLog File Viewer Reference Guide

Millennium 52-leaf MLC
Millennium 80-leaf MLC
Millennium 120-leaf MLC
HD120 MLC
MARK-Series 52-leaf MLC
MARK-Series 80-leaf MLC
Saturne 80-leaf MLC
BrainLAB m3

CE 0086

ISO 13485
REGISTERED

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Abstract	<p><i>DynaLog File Viewer Reference Guide</i> provides reference information and procedures for using the DynaLog File Viewer, version 8.X.</p> <p>This publication is the English-language original.</p>
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Chapter 1 Introduction

Introduction

This reference guide describes *DynaLog files* and how to use DynaLog File Viewer, version 8.X (DFV), a program that analyzes data in DynaLog files and displays the data in graphical formats.

DynaLog File Viewer Reference Guide is written for physicists who want to statistically evaluate leaf positions and the beam state of the Clinac during a dynamic treatment using a MARK-Series MLC or a Millennium MLC (this includes the HD120 MLC).

This guide uses the term MARK-Series to indicate all pre-Millennium MLCs including MLC, Standard MLC, CR-MLC, and MARK-Series MLC.

Before you begin using DynaLog File Viewer, you should be familiar with the Microsoft Windows operating environment and have basic knowledge of the MLC software.

Visual Cues

This publication uses the following visual cues to help you find information:



WARNING: A warning describes actions or conditions that can result in serious injury or death.



CAUTION: A caution describes hazardous actions or conditions that can result in minor or moderate injury.



NOTICE: A notice describes actions or conditions that can result in damage to equipment or loss of data.



Note: A note describes information that may pertain to only some conditions, readers, or sites.



Tip: A tip describes useful but optional information such as a shortcut, reminder, or suggestion, to help get optimal performance from the equipment or software.

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DynaLog File

A DynaLog file is a record of the actual dose fraction (dose dynamic) or gantry angle (arc dynamic) versus actual MLC leaf positions from either a *dynamic treatment* or a segmental treatment, encoded in UTF-8 format. A dynamic treatment is a treatment during which the MLC leaves, collimator, or gantry move while the beam is on and both the dose rate and the speed of the leaves are continually adjusted by the control system.

The DynaLog data is taken every 50 ms by the MLC controller. The recording continues until the dynamic treatment is completed or terminated. Starting with MLC version 8.0, DynaLog file information is collected for the entire treatment, and no time limit is imposed. Autosave is only accomplished if automatic DynaLog logging was started prior to treatment.

The MLC controller stores the DynaLog data in a temporary memory buffer. Each time you load a new dynamic treatment, the MLC controller overwrites the DynaLog data from the previous treatment. As a result, the DynaLog data for the finished treatment is no longer retrievable. To prevent losing data from your dynamic treatment, save the DynaLog files after each field or turn on the autosave feature of DynaLog files.

DynaLog File Size

The DynaLog file size is dependent upon the elapsed treatment time. Thus, the longer the dynamic treatment lasts, the larger the DynaLog file size.

File size might become a consideration on the MARK-Series MLC, where the file needs to be transferred from the controller using floppy disks or flash drive.

If the file becomes too large, you can use a file-compression utility to reduce its size so that it fits on the floppy disk. One popular compression tool is PKZIP, available from the PKWARE web site at <http://www.pkware.com>. Another alternative is the public domain compression tool Zip from the Info-ZIP Group, which you can find in the ZipTool directory on the DFV installation CD-ROM. For more information about using this utility, see [Compress DynaLog Files](#) on page 44.

DynaLog File Viewer Description

DynaLog File Viewer is a utility program that allows you to view data from DynaLog files in graphical formats. A standard text editor such as WordPad or Notepad cannot be used to view DynaLog files. DynaLog File Viewer takes the data from the DynaLog files and converts the data into tables and plots. DynaLog files are viewed by using one of the following formats:

- Error Histogram—shows information for all leaf position deviations. DynaLog File Viewer creates a histogram with a tally of the number of leaf position deviations within each bin. This plot is broken into 0.05 cm bins spanning a total range from 0–1.00 cm. The plot has a zero deviation bin for deviations less than 0.005 cm and an *above maximum* bin for deviations greater than 1.00 cm. The error histogram bin boundaries represent position deviations at the isocenter plane.
- Error RMS—shows the calculated root mean square (RMS) value for leaf deviations. DynaLog File Viewer calculates RMS values for leaf position deviations of individual leaves using the following formula:

$$\text{LeafError RMS} = \sqrt{\frac{\sum_{t=1}^n (\text{LeafPlanPos}_t - \text{LeafActualPos}_t)^2}{n}}$$

where:

- t = data sample index
- n = total number of samples



Note: DynaLog files contain all leaf positions, but a leaf is included in the RMS calculations only if it or the opposing leaf moves during the treatment.

- Beam Hold Off plot—shows when and how often the beam hold-off is asserted during the dynamic treatment. This plot can be used as a tool to ensure that the system is operating correctly.
- Beam On plot—shows when and how often the beam is on during the dynamic treatment.

For examples of each of the data tables and plots, as well as instructions on how to use DynaLog File Viewer, see Chapter 3.

Chapter 2 Generating DynaLog Files

Generate DynaLog Files

The MARK-Series MLC and Millennium MLC controllers operate in different software environments; therefore, the procedure for generating DynaLog files for each type of controller is different. This chapter provides step-by-step instructions for generating DynaLog files for the MARK-Series MLC and the Millennium MLC.

Generate and Save DynaLog Files for a MARK-Series MLC

To generate DynaLog files for a MARK-Series MLC, perform the following steps:

1. Close the patient file on the MLC workstation.
2. Type F on the MLC controller keyboard.

The MLC controller prompts you to type a letter that represents the disk drive where you want to save the DynaLog files for both carriages.

3. To save the DynaLog files, perform one of the following:
 - Type A to save the DynaLog files onto a floppy disk.
 - Type letter of the flash drive location to save the DynaLog files onto a flash drive.
 - Type C to save the DynaLog files to the hard disk drive.



Note: DynaLog files saved to the hard disk drive are stored in the MLC controller directory and are not accessible while the MLC controller is in use. To access the files, exit the MLC controller.

Once you have specified the drive where the DynaLog files are to be saved, the MLC controller writes dynaloga.001 for carriage A and dynalogb.001 for carriage B to the designated drive. The MLC controller automatically increases the file extension number (for example, .002, .003, .004 and so forth), each time new DynaLog files are generated.

If the DynaLog files are saved to a hard disk drive, to copy them onto a floppy disk or flash drive, type one of the following commands at the MS-DOS prompt:

- `copy dynaloga.### X: dynaloga.##`
- `copy dynalogb.### X: dynalogb.##`

where ### is the appropriate three-digit extension and X is the appropriate floppy disk or flash drive location.

Generate and Save DynaLog Files for a Millennium MLC

The Millennium MLC controller operates in a VxWorks® environment. Serial communication, using HyperTerminal, needs to be set up to communicate with the MLC controller, and an Ethernet connection is required to transfer DynaLog files to the workstation.



Note: *DynaLog files may contain patient Personal Health Information (PHI).*

Use one of the following methods to generate DynaLog files for the Millennium MLC:

- Enter a command to save the DynaLog files for only the dynamic treatment just completed.
or
- Enter a command to make the MLC controller automatically save the DynaLog files after the completion of each dynamic treatment. There are two possible ways to automatically save DynaLog files:
 - Enter a command at HyperTerminal that turns on the autosave only for the current session.
 - Modify the appropriate startup.* file to turn on autosave permanently.



Note: *The Millennium MLC controller automatically names the file when generating new DynaLog files. The name is based on the patient's information and time of treatment. However, the MLC workstation replaces following characters in the DynaLog file name with an underscore _:*

- < (less than)
- > (greater than)
- : (colon)
- " (double quote)
- / (forward slash)
- \ (backslash)
- | (vertical bar or pipe)
- ? (question mark)
- * (asterisk)

To enable the system to generate and save DynaLogs automatically, in the HyperTerminal at the VxWorks prompt, type the command: diagAutoDynalogs 1

To turn off this feature, type the command: diagAutoDynalogs 0

When this feature is enabled, as soon as a dynamic MLC treatment finishes, the controller writes those treatment DynaLog files to the DynaLogs folder subdirectory within the default FTP root directory on the MLC workstation. For example:

```
\Oncology\MLC\Controller\exec\DynaLogs\
```

Unlike manually-generated DynaLog files, the controller assigns unique file names to the automatically generated DynaLog files. The Revision B MLC controller names the files using the following convention:

CYYYYMMDDHHNNSS_<Patient ID>.dlg

where the values are as follows:

C	A or B for the MLC carriage (leaf bank)
YYYY	4-digit year
MM	2-digit month
DD	2-digit day of the month
HH	24-hour clock time stamp
NN	minutes time stamp
SS	seconds time stamp
<Patient ID>	The Patient ID

Chapter 3 DynaLog File Viewer Procedures

Start DynaLog File Viewer

DynaLog File Viewer opens, saves, and displays the DynaLog files in data tables and plots.

To start DynaLog File Viewer:

- Double-click the **DynaLog File Viewer** icon on the desktop.
or
- From the Windows **Start** menu, select **Programs > MLC Utilities > DynaLog File Viewer**.

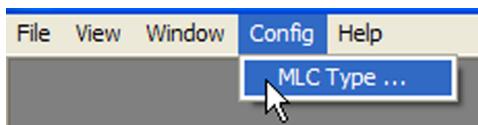
The first time DynaLog File Viewer is opened, the Configuration dialog box opens, allowing you to choose which MLC calculations are to be used, and what file format is to be used from the list of available formats (see [Set the DynaLog File Interpretation](#) on page 14).

After the first time, when the program opens, the Open dialog box for the current configuration opens (see [Millennium DynaLog Files](#) on page 16 and [Classic DynaLog Files](#) on page 18).

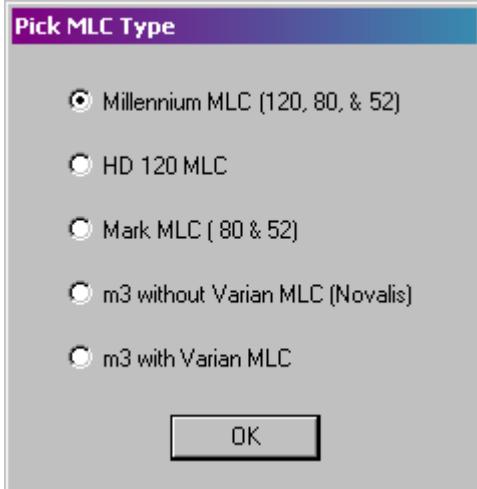
Set the DynaLog File Interpretation

The MLC type you specify determines the types of files you can open and how the data is interpreted by which MLC type you specify:

- When you start DynaLog File Viewer for the first time, you are prompted to select an MLC type.
- You can also change the MLC type at any time by selecting MLC Type from the Config menu.



The Pick MLC Type dialog box opens so that you can select the MLC type.



The five choices represent the eight supported MLC configurations. Each configuration uses different correction factors and calculation sets:

- Millennium MLC (120, 80, & 52)
 - Millennium 120-leaf MLC
 - Millennium 80-leaf MLC
 - Millennium 52-leaf MLC
- HD 120 MLC
- Mark MLC (80 & 52)
 - MARK-Series 80-leaf MLC
 - MARK-Series 52-leaf MLC
- m3 without Varian MLC (Novalis)
- m3 with Varian MLC



Note: *The same data yields different results when different configuration settings are selected. Therefore, you should ensure that you select the configuration that is used to collect your data.*

You can open either Millennium DynaLog files or Classic files. For more information, see [Millennium DynaLog Files](#) on page 16 and [Classic DynaLog Files](#) on page 18.

Open DynaLog Files

From the File menu, DynaLog File Viewer can open either Millennium DynaLog files or Classic files.



Note: You can only open Millennium DynaLog files if you have the MLC type set to Millennium MLC (see [Set the DynaLog File Interpretation](#) on page 14).

Millennium DynaLog Files

When you start the Dynalog File Viewer program, the Open Dynalog File for Carriage A window [Figure 1](#) opens.

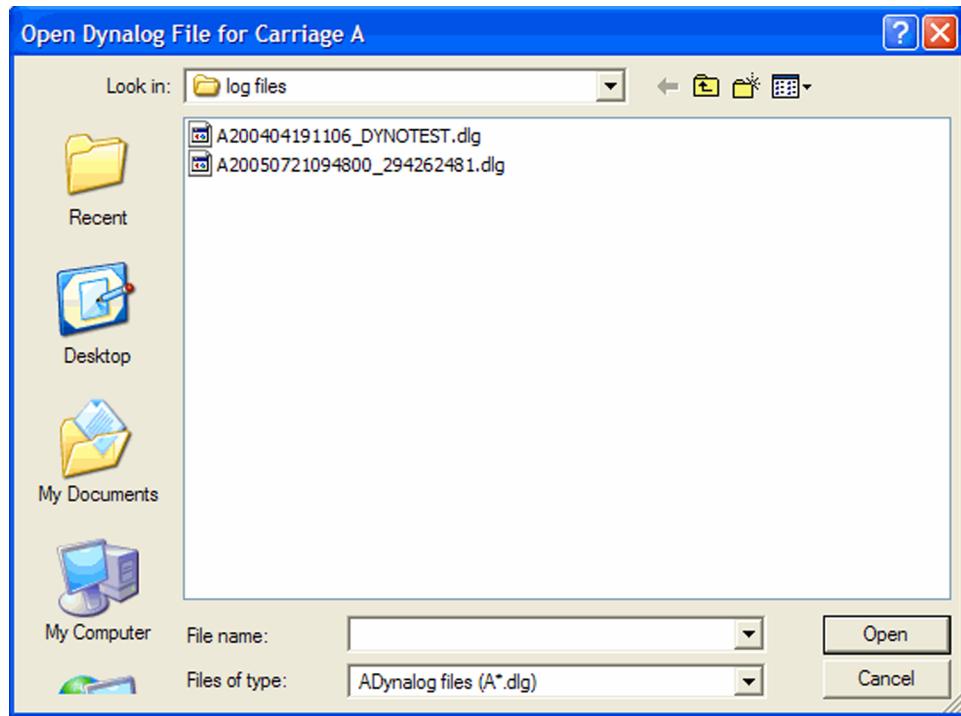
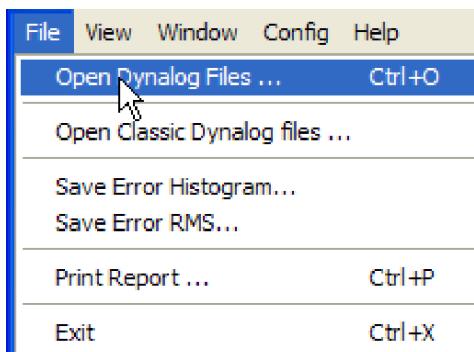


Figure 1 Open DynaLog File for Carriage A Window

At other times, you can display this window from the File menu.

To open a Millennium DynaLog file, perform the following steps:

1. From the **File** menu, select **Open Dynalog Files**.



The Open Dynalog File for Carriage A window appears (see [Figure 1 Open DynaLog File for Carriage A Window](#) on page 16). If the desired file is not available, use the folder navigation buttons in the window to navigate to the directory containing the desired file.

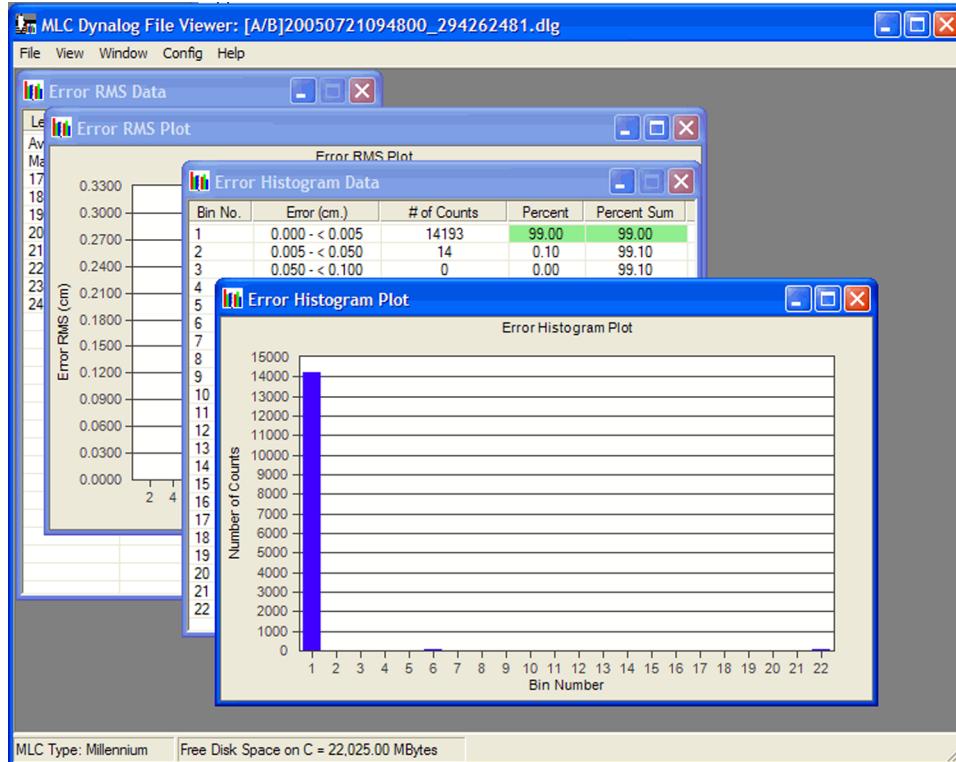
2. Select the file for carriage A (for example, A20050721094800_294262481.dlg).
3. Click **Open**.

The program opens the files for Carriage A and Carriage B. The file name for Carriage B is automatically assumed to be the same as that for Carriage A, with a B prefix instead of an A.



Note: To open a file, both the A and B files must be present in the same folder.

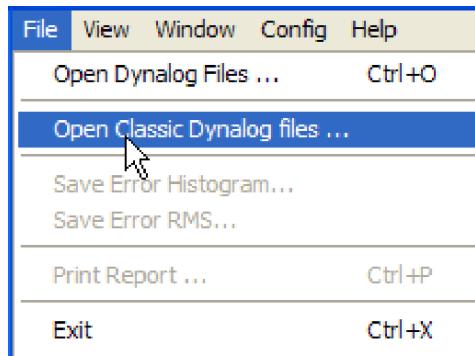
The program automatically generates the data tables and plots for both the error RMS and the error histogram data and displays them in the main window.



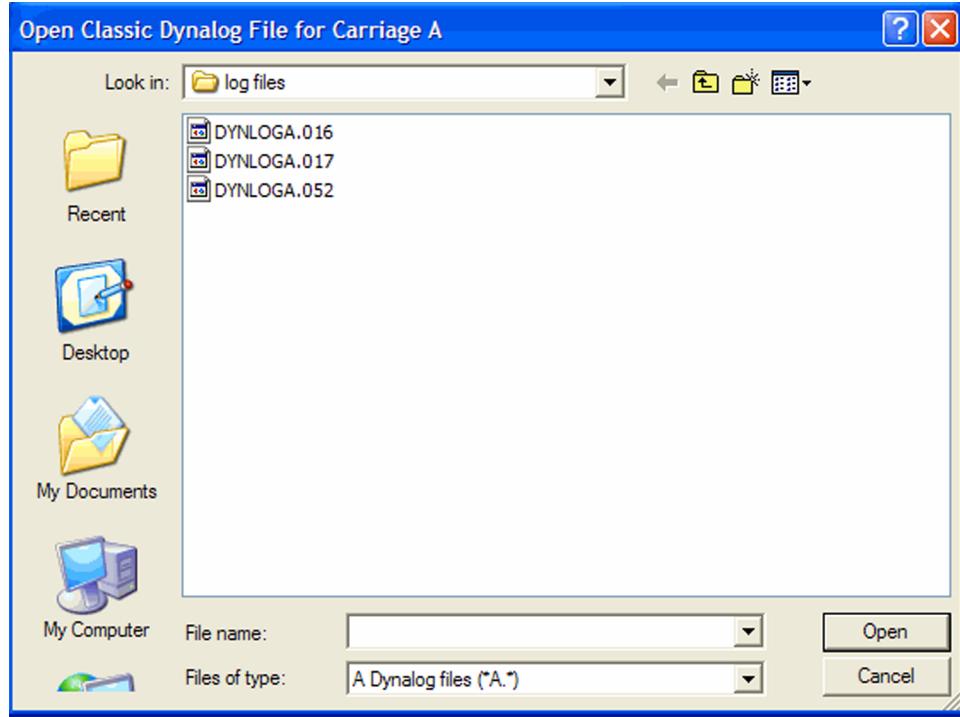
Classic DynaLog Files

Classic DynaLog Files are generated by Mark-series MLC models. To open a Classic DynaLog file, perform the following steps:

1. From the **File** menu, select **Open Classic Dynalog Files**.



The Open Classic Dynalog File for Carriage A window appears.



If the desired file is not available, use the folder navigation buttons in the window to navigate to the directory containing the desired file.

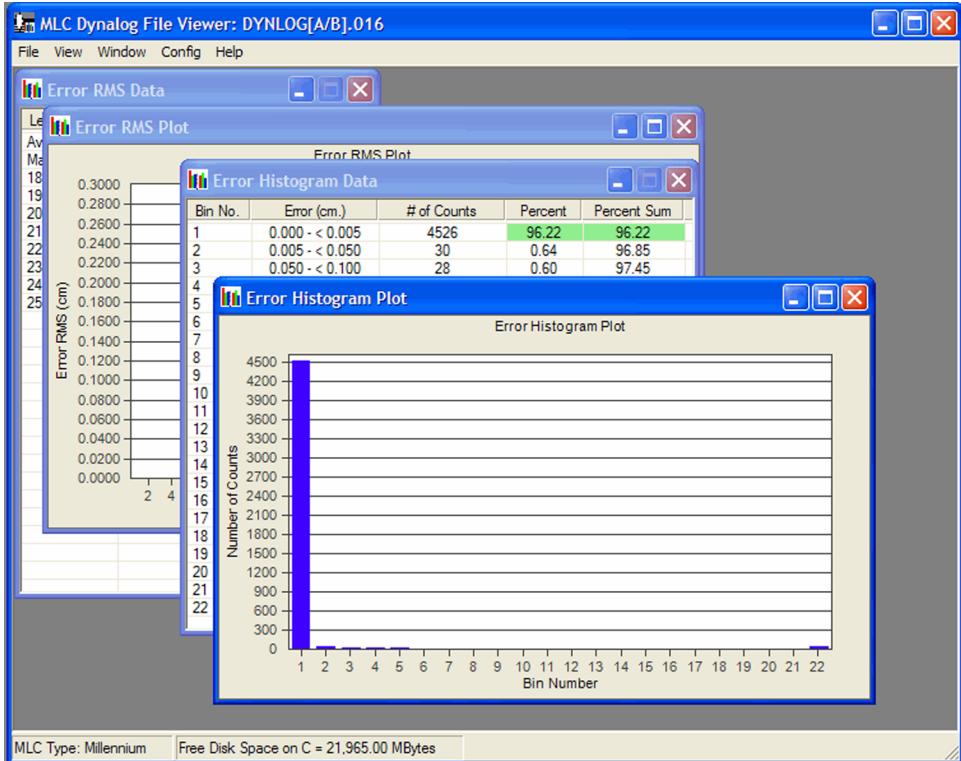
2. Select the file for carriage A (for example, DYNALOGA . 015).
3. Click **Open**.

The program opens the files for Carriage A and Carriage B. The file name for Carriage B is automatically assumed to be the same as that for Carriage A, with the last letter of the file name being B instead of A.

Note: To open a file, both the A and B files must be present in the same folder.



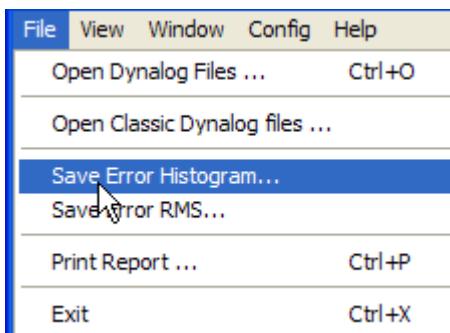
The program automatically generates the data tables and plots for both the error RMS and the error histogram data and displays them in the main window.



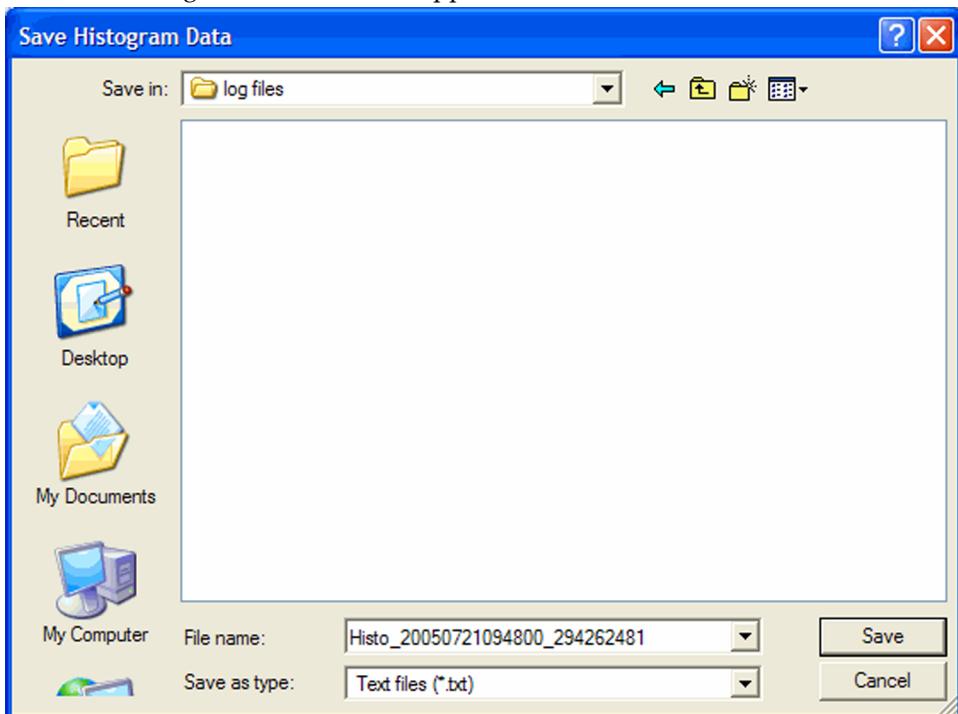
Save DynaLog Analysis Results

To save the error histogram data table, perform the following steps:

1. From the **File** menu, select **Save Error Histogram**.



The Save Histogram Data window appears.



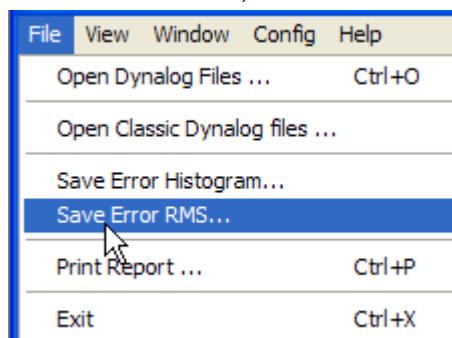
2. Accept the default file name or type a new file name for the error histogram data table in the **File name** text box.
3. Click **Save**.

The error histogram data file is an ASCII text file that contains the same data as

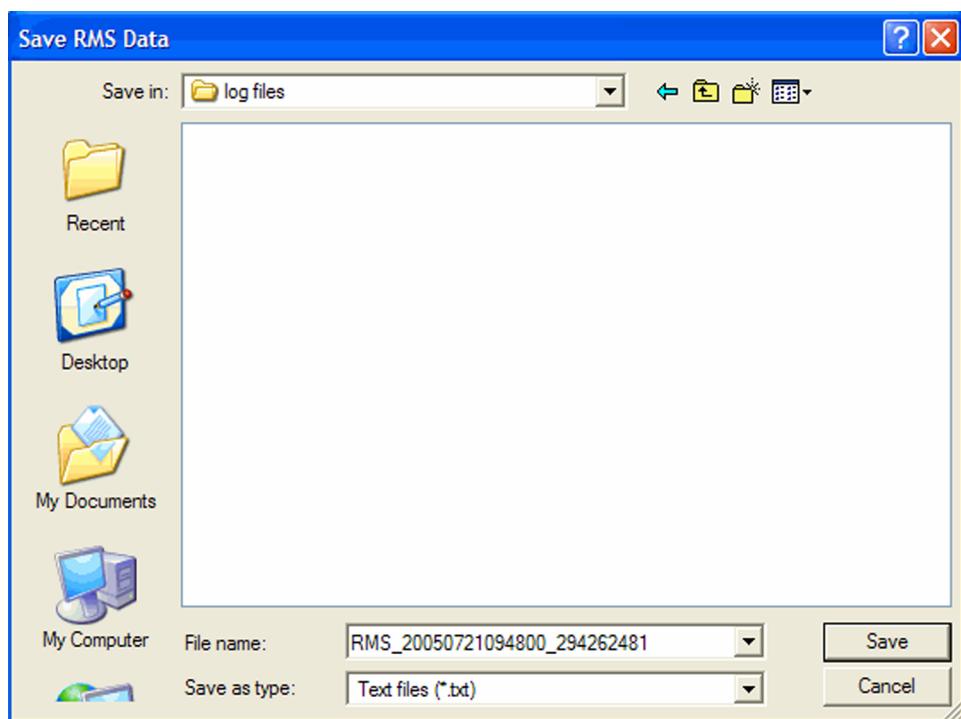
the Error Histogram Data window, described in [Error Histogram](#) on page 23.

To save the error RMS data, perform the following steps:

1. From the **File** menu, select **Save Error RMS**.



The Save RMS Data window appears.



2. Accept the default file name or type a new file name for the error RMS data table in the **File name** text box.
3. Click **Save**.

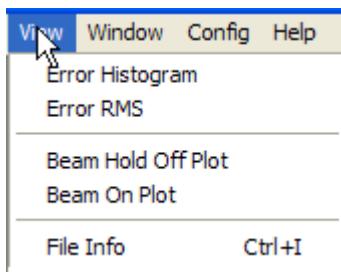
The program saves the error RMS file and closes the window.

The error RMS data file is an ASCII text file that contains the same data as the Error RMS Data window, described in [Error RMS](#) on page 26.

View DynaLog Data in Graphical Formats

To view the tables and plots for the DynaLog data:

- From the **View** menu, select the desired data tables and plots.



When selecting either Error Histogram or Error RMS from the View menu, DFV displays both the data table and the plot in the main window. For clarity, this reference guide shows the data tables and plots in individual figures.

Error Histogram

To view the error histogram data:

- From the **View** menu, select **Error Histogram**.
- From the **Window** menu, select either **Error Histogram Data** or **Error Histogram Plot**.

DynaLog File Viewer opens both the Error Histogram Data ([Figure 2](#) on page 24) and the Error Histogram Plot windows ([Figure 4](#) on page 26).

The Error Histogram Data table has five columns.

Bin No.	Error (cm.)	# of Counts	Percent	Percent Sum
1	0.000 - < 0.005	9069	27.86	27.86
2	0.005 - < 0.050	20336	62.47	90.33
3	0.050 - < 0.100	2965	9.11	99.44
4	0.100 - < 0.150	136	0.42	99.86
5	0.150 - < 0.200	46	0.14	100.00
6	0.200 - < 0.250	0	0.00	100.00
7	0.250 - < 0.300	0	0.00	100.00
8	0.300 - < 0.350	0	0.00	100.00
9	0.350 - < 0.400	0	0.00	100.00
10	0.400 - < 0.450	0	0.00	100.00
11	0.450 - < 0.500	0	0.00	100.00
12	0.500 - < 0.550	0	0.00	100.00
13	0.550 - < 0.600	0	0.00	100.00
14	0.600 - < 0.650	0	0.00	100.00
15	0.650 - < 0.700	0	0.00	100.00
16	0.700 - < 0.750	0	0.00	100.00
17	0.750 - < 0.800	0	0.00	100.00
18	0.800 - < 0.850	0	0.00	100.00
19	0.850 - < 0.900	0	0.00	100.00
20	0.900 - < 0.950	0	0.00	100.00
21	0.950 - < 1.000	0	0.00	100.00
22	1 and above	0	0.00	100.00

- 1. Bin number
- 2. Range of leaf deviation for that bin at the isocenter plane
- 3. Number of samples in that bin
- 4. Percentage of the total sample count in that bin
- 5. Summation of the percentage in that bin

Figure 2 Error Histogram Data Window

The last column contains the cumulative sum of the percentages in the fourth column. If the sum of the percentages reaches 95% within the first 8 rows, then the Percent and Percent Sum columns of the row that crosses the 95% threshold, and all the previous rows, are shaded green.

If the sum of the percentages does not reach 95% in the first 8 rows, then the first 8 rows are shaded green, and the subsequent rows are shaded red up to the row that reaches the 95% mark.

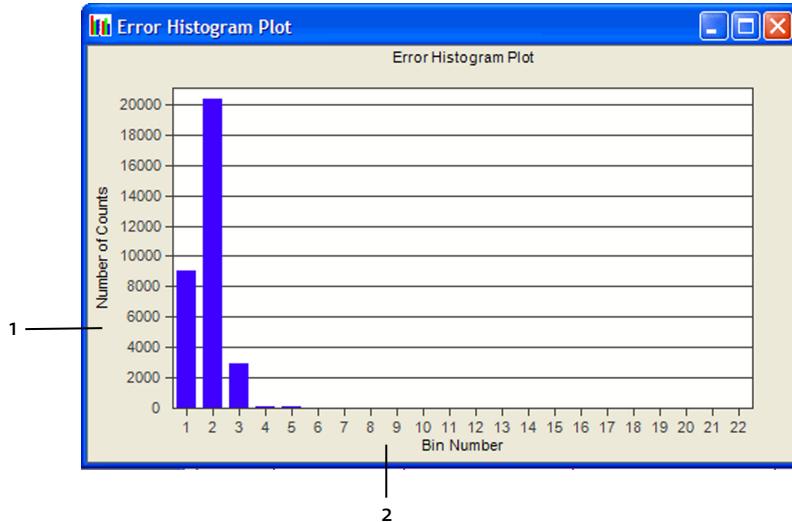
If there is a non-zero # of Counts value for bin 22, then that value is shaded yellow (see [Figure 3](#)).

Error Histogram Data					
Bin No.	Error (cm.)	# of Counts	Percent	Percent Sum	
1	0.000 - < 0.005	14193	99.00	99.00	
2	0.005 - < 0.050	14	0.10	99.10	
3	0.050 - < 0.100	0	0.00	99.10	
4	0.100 - < 0.150	0	0.00	99.10	
5	0.150 - < 0.200	0	0.00	99.10	
6	0.200 - < 0.250	34	0.24	99.34	
7	0.250 - < 0.300	15	0.10	99.44	
8	0.300 - < 0.350	0	0.00	99.44	
9	0.350 - < 0.400	0	0.00	99.44	
10	0.400 - < 0.450	0	0.00	99.44	
11	0.450 - < 0.500	13	0.09	99.53	
12	0.500 - < 0.550	9	0.06	99.60	
13	0.550 - < 0.600	0	0.00	99.60	
14	0.600 - < 0.650	0	0.00	99.60	
15	0.650 - < 0.700	0	0.00	99.60	
16	0.700 - < 0.750	11	0.08	99.67	
17	0.750 - < 0.800	9	0.06	99.73	
18	0.800 - < 0.850	0	0.00	99.73	
19	0.850 - < 0.900	0	0.00	99.73	
20	0.900 - < 0.950	0	0.00	99.73	
21	0.950 - < 1.000	5	0.03	99.77	
22	1 and above	33	0.23	100.00	

Figure 3 Error Histogram Data with Shading for Bin 22

The specifications that determine pass or fail (red or green) are set to match the current Varian specification, and cannot be altered by the user.

The Error Histogram Plot provides a graphical representation of the Error Histogram Data values.



1. Y-axis represents sample count
2. X-axis represents bin number

Figure 4 Error Histogram Plot Window

Error RMS

To view the error RMS data:

- Select **Error RMS** from the **View** menu.

DFV displays both the Error RMS Data ([Figure 5](#)) and the Error RMS Plot ([Figure 6](#)) windows.

The first row of the Error RMS Data table shows the average RMS error for the moving leaves on carriage A and carriage B. The second row shows the maximum RMS error for the leaves on carriage A and carriage B. The green shading indicates the larger maximum of the two. If the maximum value is greater than the acceptance specification, then the value is shaded red instead of green.

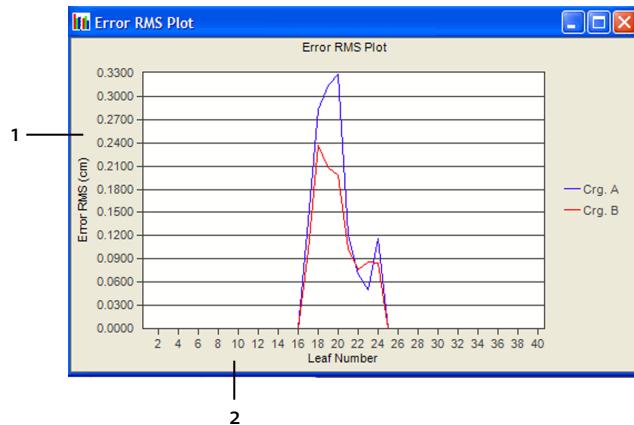
The remaining rows represent the RMS error for each individual leaf. All error values are in units of centimeters at the treatment plane. Leaf pairs that do not move during the course of the treatment are not included in the RMS calculations.

The screenshot shows a Windows application window titled "Error RMS Data". The window contains a table with three columns: "Leaf No.", "Crg A.", and "Crg. B.". The "Leaf No." column lists leaf numbers from 17 to 24. The "Crg A." column contains values 0.140, 0.283, 0.315, 0.329, 0.121, 0.070, 0.050, and 0.116. The "Crg. B." column contains values 0.101, 0.237, 0.208, 0.198, 0.103, 0.075, 0.086, and 0.085. The row for "Average" has a value of 0.178 for Crg A. and 0.137 for Crg. B. The maximum value in the Crg A. column is highlighted in green.

Leaf No.	Crg A.	Crg. B.
Average	0.178	0.137
Maximum	0.329	0.237
17	0.140	0.101
18	0.283	0.237
19	0.315	0.208
20	0.329	0.198
21	0.121	0.103
22	0.070	0.075
23	0.050	0.086
24	0.116	0.085

1. Leaf number
2. RMS error for carriage A
3. RMS error for carriage B

Figure 5 Error RMS Data Window

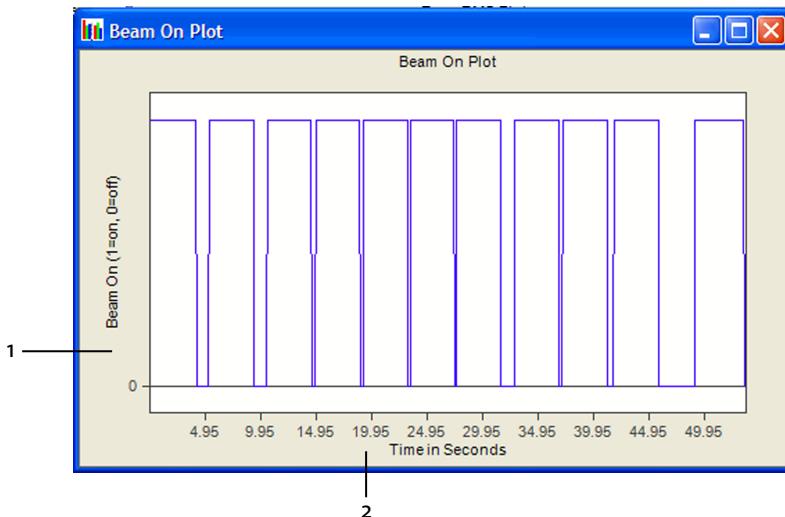


1. Y-axis represents RMS error
2. X-axis represents leaf number

Figure 6 Error RMS Plot Window

Beam On Plot

- To view the Beam On Plot, select **Beam On Plot** from the **View** menu.
The Beam On Plot window appears.



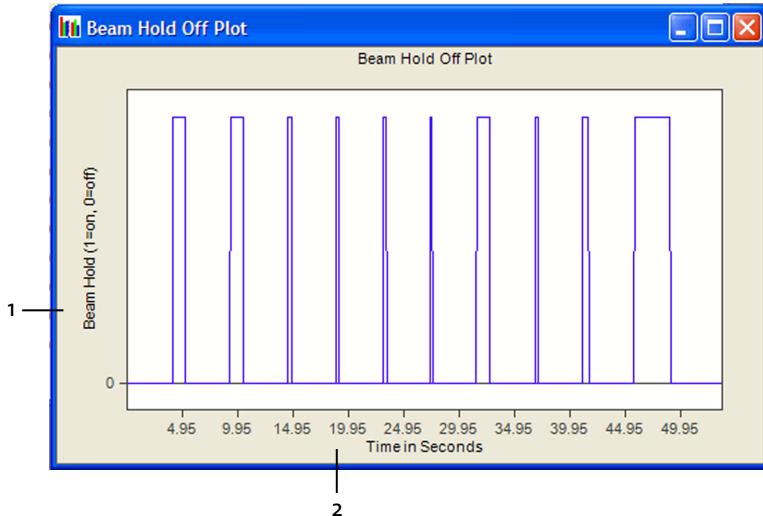
- Y-axis represents beam on
- X-axis represents time

Figure 7 Beam On Plot

Figure 7 shows the state of the beam during the dynamic treatment as a function of time. The X-axis represents time; the Y-axis has a 0 or 1 value. A 1 represents the state in which the beam is on, and 0 represents the state in which the beam is off.

Beam Hold Off Plot

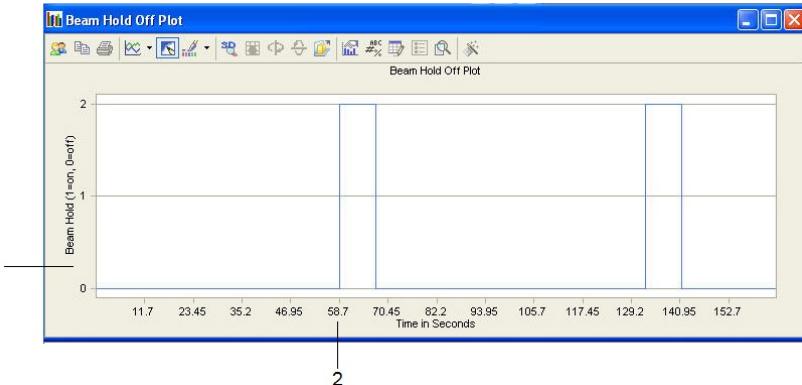
- To view the Beam Hold Off Plot, select **Beam Hold Off Plot** from the **View** menu.
The Beam Hold Off Plot window appears.



1. Y-axis represents beam hold-off
2. X-axis represents time

Figure 8 Beam Hold Off Plot for Dynamic Treatment

Figure 8 shows the state of the beam hold-off during the dynamic treatment as a function of time. The Y-axis can have a value of 0 or 1. A 1 represents the state in which the beam hold-off is on (X-ray off), and 0 represents the state in which the beam hold-off is off (X-ray on). The X-axis represents time.



1. Y-axis represents beam hold-off
2. X-axis represents time

Figure 9 Beam Hold Off Plot for LFIMRT

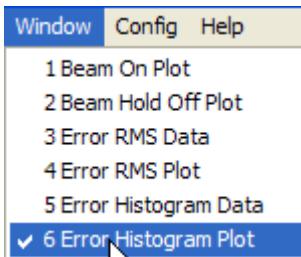
[Figure 9](#) shows the state of the beam hold-off during the LFIMRT treatment as a function of time. The Y-axis can have a value of 0 or 2. A 2 represents the state in which the beam hold-off is on (X-ray off), and 0 represents the state in which the beam hold-off is off (X-ray on). The X-axis represents time.

Arrange DynaLog File Graphical Formats

When several data tables and plots are open, you can specify which data table or plot appears in the front by clicking on the window or by using the Window menu.

To bring the data table or plot to the front:

- Click in the window of the desired DynaLog file information.
or
- From the **Window** menu, select the desired DynaLog file information.



The Window menu displays only the open data tables and plots. Data tables and plots are numbered in the order in which they were opened.

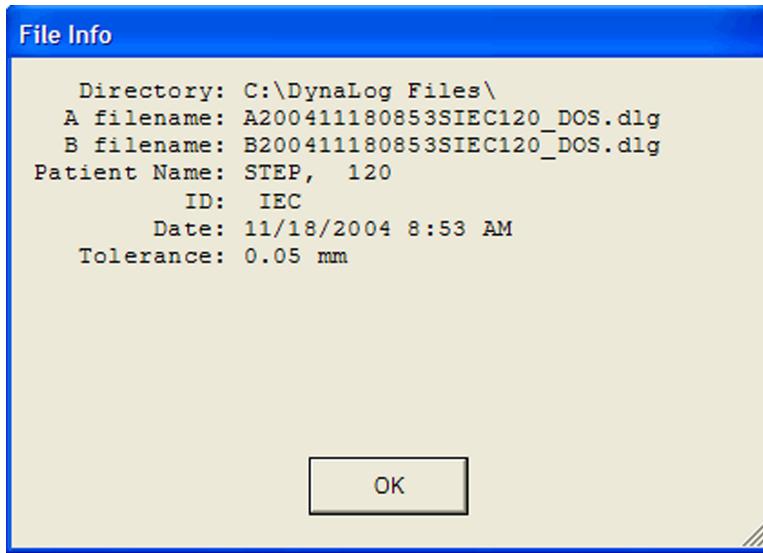


Note: In order to bring a specific data table or plot to the front, the data table or plot must be active and must appear in the main DynaLog File Viewer window.

Display File Information

To display information about the current data files:

- Select the **File Info** option from the **View** menu.
The File Info data box opens and shows the File Info data.



Print DynaLog File Reports

To print DynaLog file reports:

1. Select **Print Reports** from the **File** menu.
2. In the standard Windows print dialog box, select the desired printer.
3. Click **OK**.

The Print Reports option prints a single report with file information, plus the data tables and charts from the windows that are open. This can include:

- Error Histogram Plot
- Error Histogram Data
- Error RMS Plot
- Error RMS Data
- Beam On Plot
- Beam Hold Off Plot

Close DynaLog Files

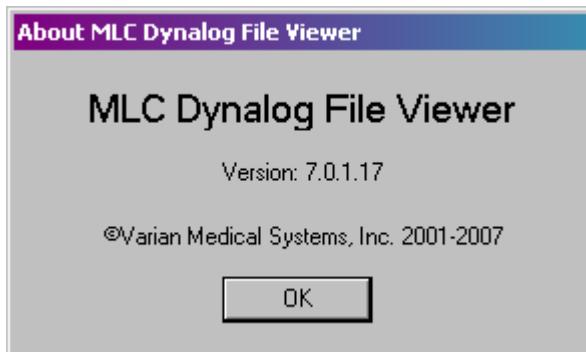
To close the DynaLog file tables and plots:

- Click the close button (X) in the upper right corner of the window.

Obtain DynaLog File Viewer Version Number

To display the DynaLog File Viewer version number:

- Select **About** from the **Help** menu.



Exit DynaLog File Viewer

To exit DynaLog File Viewer:

- Select **Exit** from the **File** menu.

Chapter 4 Interpret DynaLog Analysis Results

DynaLog File Viewer Analysis of Step-and-Shoot Treatments

In order to understand the statistical analyses performed by DynaLog File Viewer for step-and-shoot treatments, it is important to understand some details about how the leaves are instructed to move throughout the treatment, and how this information is recorded in the DynaLog files.

Varian dynamic MLC treatments are driven by MLC plan files, also known as *dva* files. MLC plan files are the instructions for the positioning of all MLC leaves throughout the treatment, and consist of a progressive sequence of dose fractions; associated with each dose fraction is an intended position for each leaf. Step-and-shoot treatments contain alternating *step* and *shoot* segments: the step segment instructs the leaves to move with no dose increase; the shoot segment instructs the dose fraction to increase with no leaf movement.

In each 50-ms control cycle, the Clinac reports the current dose fraction along with the actual position of each leaf. The MLC controller determines if the actual dose fraction has reached the next dose fraction listed in the MLC plan file. If so, the next dose fraction, along with a new set of leaf positions, is read from the MLC plan file; these positions then become the *new* expected leaf positions. At this *transition* point, the leaves are in the leaf positions associated with the former dose fraction—the *old* positions—but the MLC controller now expects them to be at the *new* positions. Often for the step-and-shoot technique, these position changes are large—on the order of millimeters or even centimeters—and they exceed the dynamic leaf tolerance. In this case, a beam hold-off is asserted.

At this instant in time, the following occurs:

- Leaf position deviations are equal to the distance between the current actual leaf positions (which were the *old* expected positions) and the newly calculated expected leaf positions.
- Beam hold-off has been asserted.
- Beam hold-off instruction has not yet been delivered to the Clinac, and so the beam is still on.

The DynaLog file record for this instance records the following:

- Beam hold-off = 1 (Yes) or = 2 (during LFIMRT carriage group transitions)
- Beam on = 1 (Yes)
- Actual leaf positions equal to the *old* positions

- Expected leaf positions equal to the *new* positions



Note: Even if the dynamic leaf tolerance is not exceeded, these transition values are still relatively large.

The DynaLog File Viewer includes all DynaLog file data points with beam on = 1 in its calculations, so these transition points are always included. As a result at each transition point, leaf deviation values equal to the intended incremental movement of the leaf—relatively large values—are included in the statistical calculations.

It is important to understand that during normal operation of the MLC, these transition-point deviations are always included in the statistical results calculated by the DynaLog File Viewer.

Relation Between Dynamic Tolerance and RMS Error

DynaLog data depend on the dynamic plan and the treatment setup.

Typically, DynaLog data include the following characteristics:

- Distinguishable correlation exists between the histogram distribution and the RMS error values for leaf position deviations. When the RMS error values are large, the histogram bin counts reflect this fact. For example, more tallies may be in bin ranges trending toward 1.0 cm. On the other hand, when the RMS error values are smaller, more tallies may be in bin ranges trending toward 0.0 cm.

Active leaves are those leaves that move during the delivery of the dynamic field.



Note: The number of RMS samples is derived from the summation of bin tallies and the number of active leaves, according to the following equation:

$$\text{Number of RMS Samples} = \frac{\text{Summation of Bin Samples}}{\text{Number of Active Leaves}}$$

- Smaller dynamic tolerance values result in lower RMS error values, whereas larger dynamic tolerance values result in higher RMS error values.
- Smaller dynamic tolerance values result in more frequent beam hold-offs.

Figure 10 on page 35 through Figure 18 on page 40 show results of the Error Histogram Values, Error RMS Values, and Beam Hold Off Plot windows of DynaLog files from treatments delivered using various total doses and dose rates.

[Figure 10](#) shows the Error Histogram Data window. The inset window shows quantitative leaf histogram data values split into bins, the number of tallies per bin, and the percentage of occurrences in each bin. The large window displays a graphical representation of the same data. This IMRT plan was delivered using 180 MU at a dose rate of 300 MU/min.

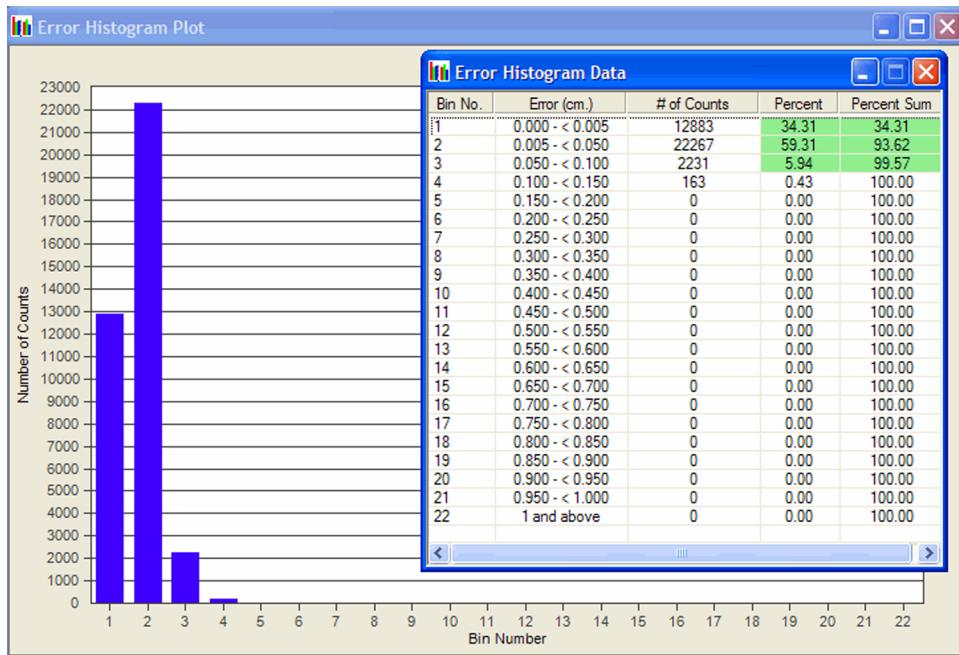


Figure 10 Error Histogram Data and Plot at 180 MU and 300 MU/min

[Figure 11](#) shows a plot of leaf RMS error values for the same treatment as used for Figure 10.

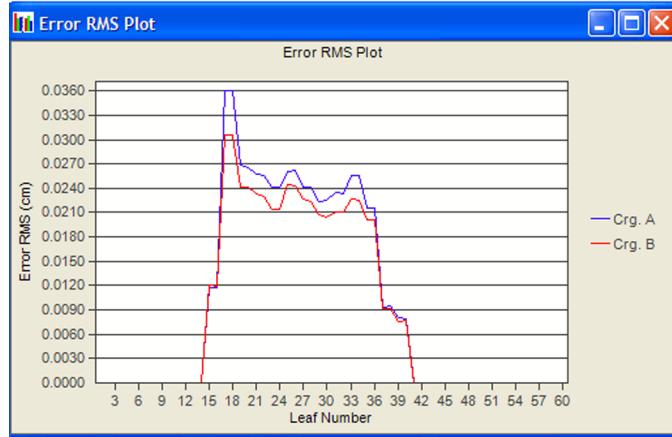


Figure 11 Error RMS Values Plot at 180 MU and 300 MU/Min

Figure 12 shows the Beam Hold Off plot for the same treatment. In this case, there were no beam hold-offs.

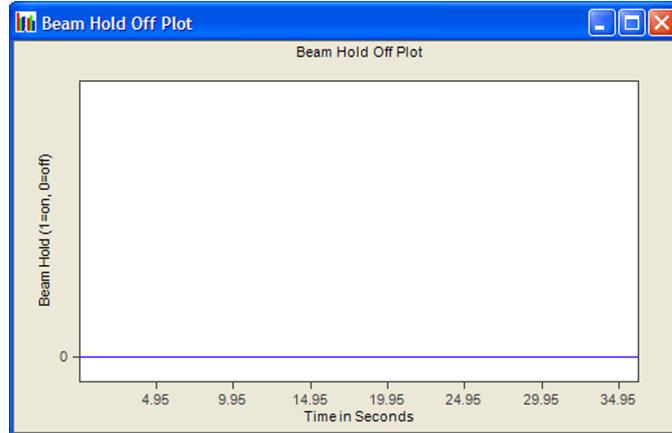


Figure 12 Beam Hold Off Plot at 180 MU and 300 MU/Min

Figure 13 shows the same display as shown in Figure 10 on page 35, except that the treatment represented in Figure 13 was delivered using a dose rate of 600 MU/min rather than 300 MU/min. The higher dose rate requires the leaves to move faster to maintain the desired dose versus position prescribed in the MLC plan file. Note the higher percentage of counts in the 0.005 cm–0.05 cm bin (72.69%) compared to the same bin shown in Figure 10 (59.31%).

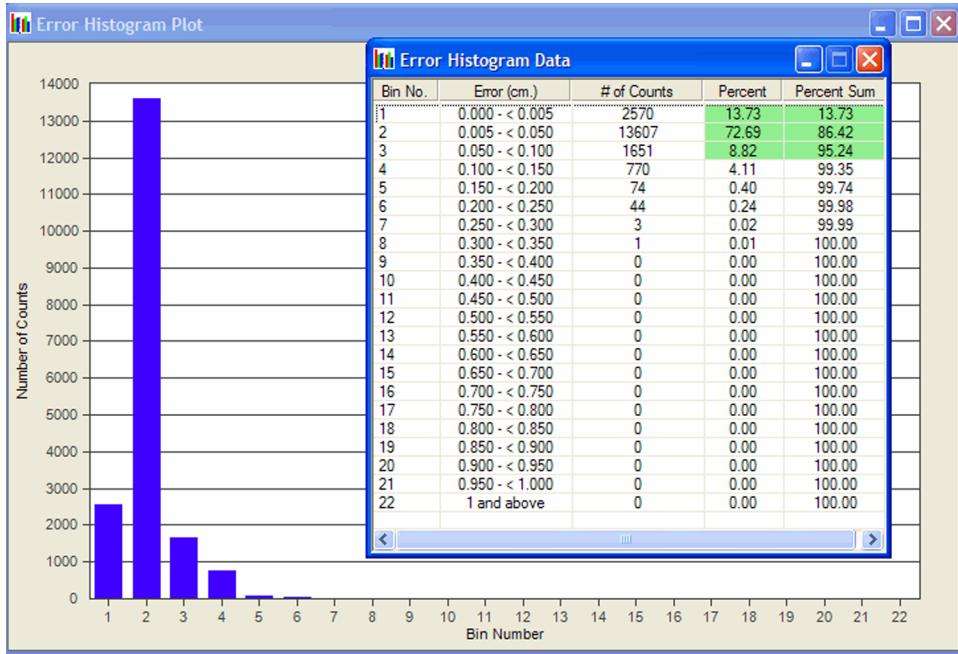


Figure 13 Error Histogram Data and Plot at 180 MU and 600 MU/Min

Figure 14 shows the plot of leaf RMS error values for the same treatment as used for Figure 13. Notice that the general shape of the curve is similar to Figure 11 on page 36, but the individual peak values have increased compared to the individual peak values in Figure 11.

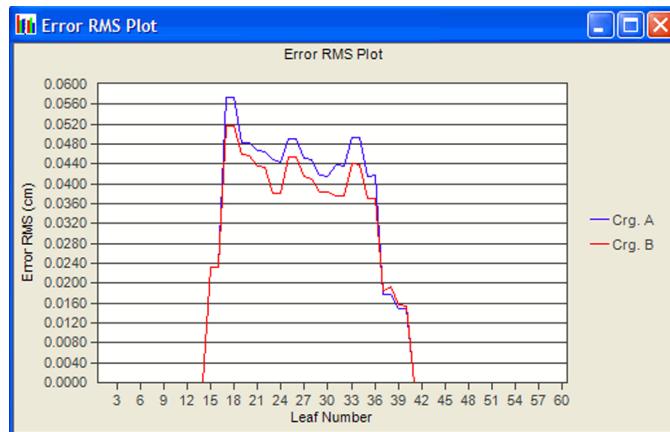


Figure 14 Error RMS Values Plot at 180 MU and 600 MU/Min

[Figure 15](#) shows the Beam Hold Off plot for the treatment delivered using 180 MU at 600 MU/min. This plan results in more beam hold-offs compared to [Figure 12](#) on page 36, because the beam needed to be paused while the leaves moved into the positions as prescribed in the MLC plan file.

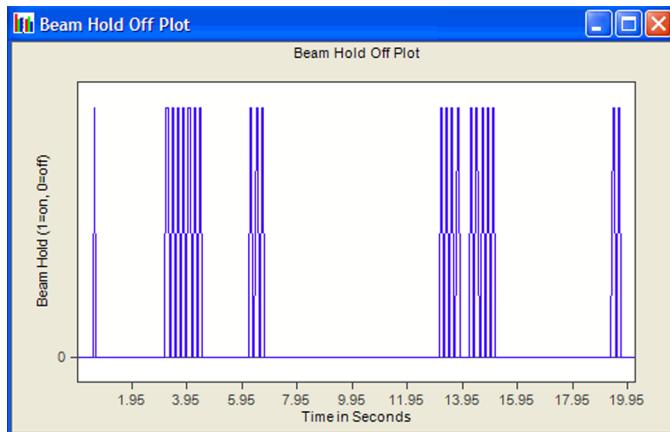


Figure 15 Beam Hold Off Plot at 180 MU and 600 MU/Min

[Figure 16](#) corresponds to [Figure 10](#) on page 35 except that [Figure 16](#) was generated with a total dose of 45 MU rather than 180 MU. The lower total dose requires the leaves to move at a faster speed to maintain the desired dose versus position prescribed in the MLC plan file. Note the slightly higher percentage of counts in the 0.005 cm–0.05 cm bin (63.35%) compared with the same bin shown in [Figure 10](#) (59.31%).

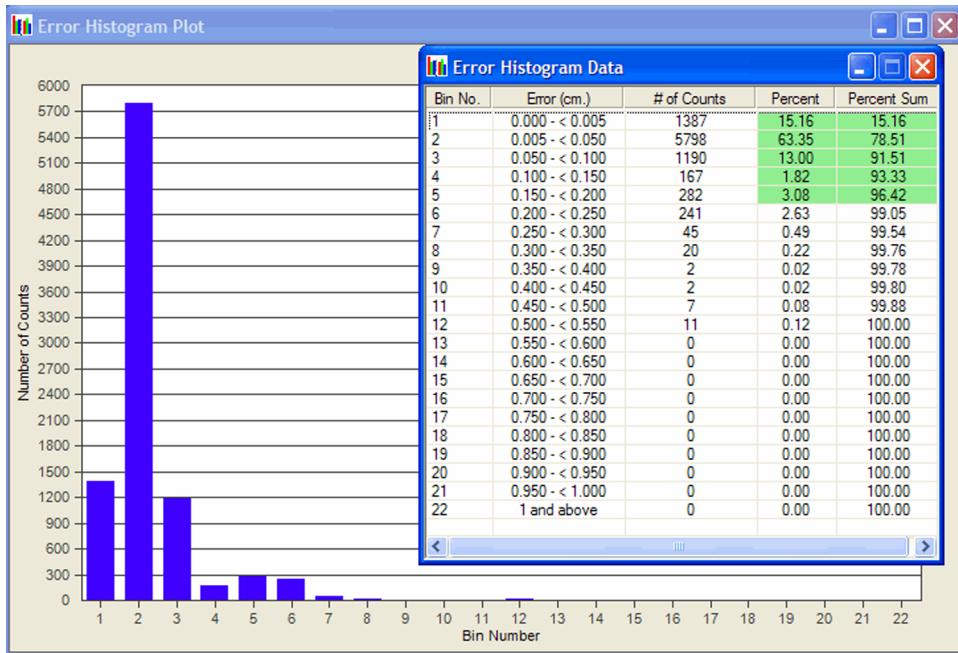


Figure 16 Error Histogram Data and Plot at 45 MU and 300 MU/Min

Figure 17 corresponds to Figure 11 on page 36 except that, while the general shape of the curve remains quite similar to the curve in Figure 11, the individual peak values have increased from over 0.036 cm in Figure 11 to a little over 0.11 cm in Figure 17.

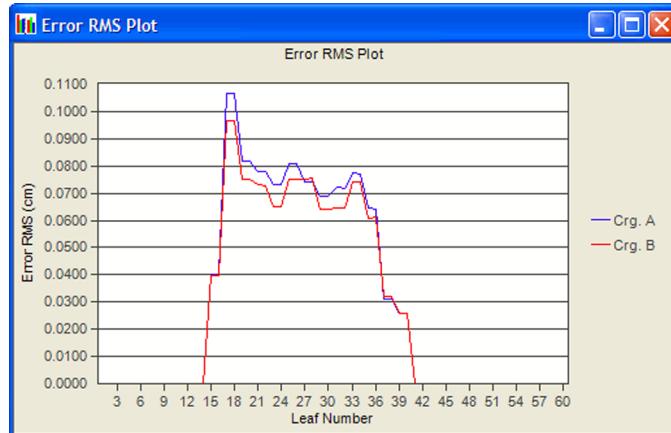


Figure 17 Error RMS Values Plot at 45 MU and 300 MU/Min

[Figure 18](#) corresponds to [Figure 12](#) on page 36 and [Figure 15](#) on page 38 except that the total dose and/or dose rate was reduced. Notice the larger number of beam hold-offs in this plot compared to the beam hold-offs in [Figure 15](#). This is what is expected when the treatment conditions are changed so that the time allowed for the leaf movements is reduced from 0.30 minutes at 600 MU/min and 180 MU total dose to 0.15 minutes at 300 MU/min and 45 MU total dose.

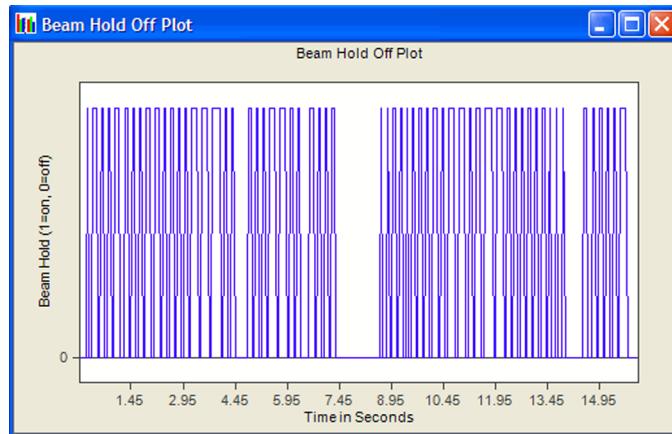


Figure 18 Beam Hold Off Plot at 45 MU and 300 MU/Min

Appendix A DynaLog File Contents

File Naming Convention

The MLC controller names the files using the following convention:

CYYYYMMDDHHNNSS_<Patient ID>.dlg

where:

C	A or B for the MLC carriage (leaf bank)
YYYY	4-digit year
MM	2-digit month
DD	2-digit day of the month
HH	24-hour clock time stamp
NN	minutes time stamp
SS	seconds time stamp
<Patient ID>	The Patient ID



Note: The Millennium MLC controller automatically names the file when generating new DynaLog files. The name is based on the patient's information and time of treatment. However, the MLC workstation replaces following characters in the DynaLog file name with an underscore _:

- < (less than)
- > (greater than)
- : (colon)
- " (double quote)
- / (forward slash)
- \ (backslash)
- | (vertical bar or pipe)
- ? (question mark)
- * (asterisk)

File Header

The file header consists of 6 lines with the following meanings:

Line	Format	Description
1	B	Letter indicating version
2	<Lastname>,<Firstname>,<ID>	Patient information, up to 25 characters
3	<PlanUID>,<Beam Number> or <Plan filename>	Treat 6.5 or greater or Standalone ^a
4	<long>	Tolerance
5	<long>	Number of leaves in MLC
6	<long>	Clinac Scale 0 = Varian scale 1 = IEC scale (IEC 60601-2-1 only)



Note: The IEC 61217 scale is not available for DynaLog files.

-
- a. The logic for determining the third line is as follows: If the Field Serial number is zero and the PlanUID is non-zero, it is assumed to be Treat 6.5 or greater. If both the Field Serial number and the PlanUID are zero, the filename is used. If the filename is an empty string, a blank line is written.
-

File Content

Each line of the DynaLog file contains the following:

Column	Format	Description
1	<long>	Current dose fraction or current gantry rotation
2	<long>	Previous segment number (starting with zero)
3	<long>	Beam hold-off state 2 = LFIMRT carriage group transitions 1 = MLC beam hold-off signal asserted 0 = MLC beam hold-off signal not asserted



Note: For RapidArc and conformal arc plans, dose fraction information is displayed only if you remove the # character preceding the diagUseRapidArcDynamalogFormat command in the MLC controller startup script. In all other cases, gantry rotation in tenths of a degree is displayed if you retain the # character preceding the diagUseRapidArcDynamalogFormat command.

Column	Format	Description
4	<long>	Beam on state 1 = Clinac beam is on 0 = beam is off
5	<long>	Previous segment dose index or previous segment gantry angle
6	<long>	Next segment dose index or next segment gantry angle
7	<long>	Gantry rotation in 10th of a degree
8	<long>	Collimator rotation in 10th of a degree
9	<long>	Upper Y1 jaw position in mm in the isoplane
10	<long>	Upper Y2 jaw position in mm in the isoplane
11	<long>	Lower X1 jaw position in mm in the isoplane
12	<long>	Lower X2 jaw position in mm in the isoplane
13	<long>	Carriage expected position in 100th of a mm
14	<long>	Carriage actual position in 100th of a mm
The remaining columns contain the following values for each leaf in the carriage. (nLeaf = 0, 1, 2, and so on)		
4*nLeaf + 15	<long>	Expected position
4*nLeaf + 16	<long>	Actual position
4*nLeaf + 17	<long>	Previous field position
4*nLeaf + 18	<long>	Next field position



Note:

- All dose fractions range from 0 to 25000.
- All gantry and collimator angles are recorded in tenths of degrees, Varian scale.
- All jaws are recorded in millimeters in the isoplane.
- All carriage and leaf positions are recorded in hundredths of millimeters, in the leaf (physical) plane. Zero is at the centerline. Positive means retracted. Negative means extended across the centerline.

Appendix B Compressing DynaLog Files

Compress DynaLog Files

Zip is a file compression utility that reduces a file size. Zip typically compresses DynaLog files to approximately 10% of their original size. UnZip is the counterpart to Zip—it decompresses zipped files. Zip and UnZip are public domain programs from the Info-ZIP Group. Info-ZIP software (Zip, UnZip and related utilities) is freeware and can be obtained as either source code or executables from the Internet.

This appendix provides instructions on how to use the Zip and UnZip utilities to compress and restore DynaLog files. For more detailed instructions on the use of these programs, including descriptions of features that are not described here, refer to the complete program documentation, included in zip files in the `ZipTool\Distribution` directory of the DFV installation CD-ROM.



Note: *These procedures apply only for a MARK-Series MLC controller. Because Millennium MLC DynaLog files do not need to be transferred to floppy disks or flash drives, this process does not apply to Millennium MLC controllers.*

Install Zip and Unzip

The files `Zip.exe` and `UnZip.exe` are located in the `ZipTool` directory on the DFV installation CD-ROM.

To install the Zip and Unzip files, perform the following steps:

1. Copy `UnZip.exe` to `C:\` on the computer on which the DynaLog files are to be analyzed.
2. Copy `Zip.exe` to `C:\` on the MLC controller computer. (If the controller does not have a CD-ROM drive, transfer this file using a floppy disk or flash drive.)

Zip DynaLog Files



Note: *Zipping DynaLog files can only be done when the MARK-Series MLC controller computer is not running the MARK-Series MLC controller software.*

To zip DynaLog files directly to a floppy disk or flash drive on a MARK-Series MLC controller computer, perform the following steps:

1. If the MARK-Series MLC controller software is running, exit that program by typing E.
2. Insert the floppy disk or flash drive into the appropriate drive.
3. Change the current directory to the directory containing the desired DynaLog files to compress.
4. At the DOS prompt, type the zip command using the following syntax:

```
C:\zip <zipfilename> <file list>
```

```
C:\zip a:dlogs dynloga.001
```

compresses dynloga.001 to a file named dlogs.zip on the A: drive.

```
C:\zip a:dlog1 dynloga.001 dynlogb.001
```

compresses dynloga.001 and dynlogb.001 to a file named dlog1.zip on the A: drive.

The normal DOS wildcard characters apply.

```
C:\zip dlogall dynlog?.*
```

compresses all files matching this wildcard template to a file named dlogall.zip in the current directory. Depending on the number and size of the original DynaLog files in this example, if dlogall.zip fits onto a floppy disk or flash drive, it can be copied to the floppy disk or flash drive using one of the normal DOS commands.

Unzip DynaLog Files

Once the zip files are copied to the destination computer containing UnZip.exe, the DynaLog files from the zip files can be retrieved. UnZip is a DOS program, so these steps must be executed in a command prompt window.

To retrieve the DynaLog files from the zip files, perform the following steps:

1. Change the current directory to the directory containing the desired zip files to decompress.
2. At the DOS prompt, type the unzip command using the following syntax:

```
C:\unzip <zipfilename>
```

The .zip extension to the zip file name is optional. UnZip extracts all the files that had been compressed into the specified zip file, restoring each to the current directory with its original file name.

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