Hitachi Virtual Storage Platform 5000 Series

Hitachi Virtual Storage Platform E Series

SVOS RF 9.8.6

Hitachi Volume Shredder User Guide

The Volume Shredder software product enables you to completely erase data on volumes on your storage system for security purposes.

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Preface

The Volume Shredder software product enables you to completely erase data on volumes on your storage system for security purposes.

Please read this document carefully to understand how to use this product, and maintain a copy for reference purposes.

Intended audience

This document is intended for system administrators, Hitachi Vantara representatives, and authorized service providers who install, configure, and operate the Hitachi storage systems.

Readers of this document should be familiar with the following:

- Data processing and RAID storage systems and their basic functions.
- The *Hardware Guide* for your storage system model.
- The Hitachi Device Manager - Storage Navigator software.
- Data protection and security practices in enterprise storage environments, including data retention, archival, and shredding.

Product version

This document revision applies to the following product versions:

- VSP 5000 series: 90-09-01 or later
- VSP E series: 93-07-01 or later
- SVOS RF 9.8.6 or later

Release notes

Read the release notes before installing and using this product. They may contain requirements or restrictions that are not fully described in this document or updates or corrections to this document. Release notes are available on the Hitachi Vantara Support Website: https://knowledge.hitachivantara.com/Documents.

Changes in this revision

- Corrected shredding times for VSP E series.

Document conventions

This document uses the following typographic conventions:

Convention	Description
Bold	▪ Indicates text in a window, including window titles, menus, menu options, buttons, fields, and labels. Example: Click **OK**. ▪ Indicates emphasized words in list items.
Italic	▪ Indicates a document title or emphasized words in text. ▪ Indicates a variable, which is a placeholder for actual text provided by the user or for output by the system. Example: `pairdisplay -g group` (For exceptions to this convention for variables, see the entry for angle brackets.)
`Monospace`	Indicates text that is displayed on screen or entered by the user. Example: `pairdisplay -g oradb`
< > angle brackets	Indicates variables in the following scenarios: ▪ Variables are not clearly separated from the surrounding text or from other variables. Example: `Status-<report-name><file-version>.csv` ▪ Variables in headings.
[ ] square brackets	Indicates optional values. Example: [a | b] indicates that you can choose a, b, or nothing.
{ } braces	Indicates required or expected values. Example: { a | b } indicates that you must choose either a or b.
| vertical bar	Indicates that you have a choice between two or more options or arguments. Examples: [a | b] indicates that you can choose a, b, or nothing. { a | b } indicates that you must choose either a or b.

This document uses the following icons to draw attention to information:

Icon	Label	Description
	Note	Calls attention to additional information.
	Tip	Provides helpful information, guidelines, or suggestions for performing tasks more effectively.
	Important	Highlights information that is essential to the completion of a task.
	Caution	Warns the user of adverse conditions and/or consequences (for example, disruptive operations, data loss, or a system crash).
	CAUTION	Warns the user of a hazardous situation that, if not avoided, could result in major or minor injury.
	WARNING	Warns the user of a hazardous situation which, if not avoided, could result in death or serious injury.

Conventions for storage capacity values

Physical storage capacity values (for example, disk drive capacity) are calculated based on the following values:

Physical capacity unit	Value
1 kilobyte (KB)	1,000 (10^3) bytes
1 megabyte (MB)	1,000 KB or $1{,}000^2$ bytes
1 gigabyte (GB)	1,000 MB or $1{,}000^3$ bytes
1 terabyte (TB)	1,000 GB or $1{,}000^4$ bytes
1 petabyte (PB)	1,000 TB or $1{,}000^5$ bytes
1 exabyte (EB)	1,000 PB or $1{,}000^6$ bytes

Logical capacity values (for example, logical device capacity, cache memory capacity) are calculated based on the following values:

Logical capacity unit	Value
1 block	512 bytes
1 cylinder	Mainframe: 870 KB Open-systems: ▪ OPEN-V: 960 KB ▪ Others: 720 KB
1 KB	1,024 (2^{10}) bytes
1 MB	1,024 KB or $1{,}024^2$ bytes
1 GB	1,024 MB or $1{,}024^3$ bytes
1 TB	1,024 GB or $1{,}024^4$ bytes
1 PB	1,024 TB or $1{,}024^5$ bytes
1 EB	1,024 PB or $1{,}024^6$ bytes

Accessing product documentation

Product user documentation is available on the Hitachi Vantara Support Website: https://knowledge.hitachivantara.com/Documents. Check this site for the most current documentation, including important updates that may have been made after the release of the product.

Getting help

The Hitachi Vantara Support Website is the destination for technical support of products and solutions sold by Hitachi Vantara. To contact technical support, log on to the Hitachi Vantara Support Website for contact information: https://support.hitachivantara.com/en_us/contact-us.html.

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Comments

Please send comments to doc.comments@hitachivantara.com. Include the document title and number, including the revision level (for example, -07), and refer to specific sections and paragraphs whenever possible. All comments become the property of Hitachi Vantara LLC.

Thank you!

Chapter 1: Overview of Hitachi Volume Shredder

This chapter provides an overview of Volume Shredder operations.

Data security practices and Volume Shredder

The Volume Shredder software enables you to securely erase data on volumes by overwriting existing data to prevent restoration of the erased data. For example, when the user of a volume changes, you may want to purge the data stored by the previous user before giving access to the new user. This method of erasing data by overwriting it with dummy data is referred to as shredding.

Because of the way data is written on the drives, overwriting data once or twice might not be enough to ensure that the data cannot be restored. The best practice is to overwrite data at least three times with dummy data. Volume Shredder allows you to specify the number of times the data is overwritten, enabling you to ensure compliance with applicable requirements (for example, DoD5220.22-M).

Note: Complete data erasure can be guaranteed only for hard disk drives (HDDs). For flash drives (SSDs, SCMs, and FMDs), complete data erasure (overwriting all cells including overprovisioned cells) cannot be guaranteed. For information about data erasure for flash drives (for example, cryptographic erasure, data eradication services), contact customer support.

Supported volume types

You can use Volume Shredder to shred volumes on both open-systems and mainframe systems, including logical devices (LDEVs) and custom volumes (CVs) of all emulation types. External volumes and Dynamic Provisioning virtual volumes can also be shredded. When a shredding operation is performed on an unused virtual volume for Dynamic Provisioning, no dummy data is written to the volume.

You cannot use Volume Shredder to shred the following types of volumes:

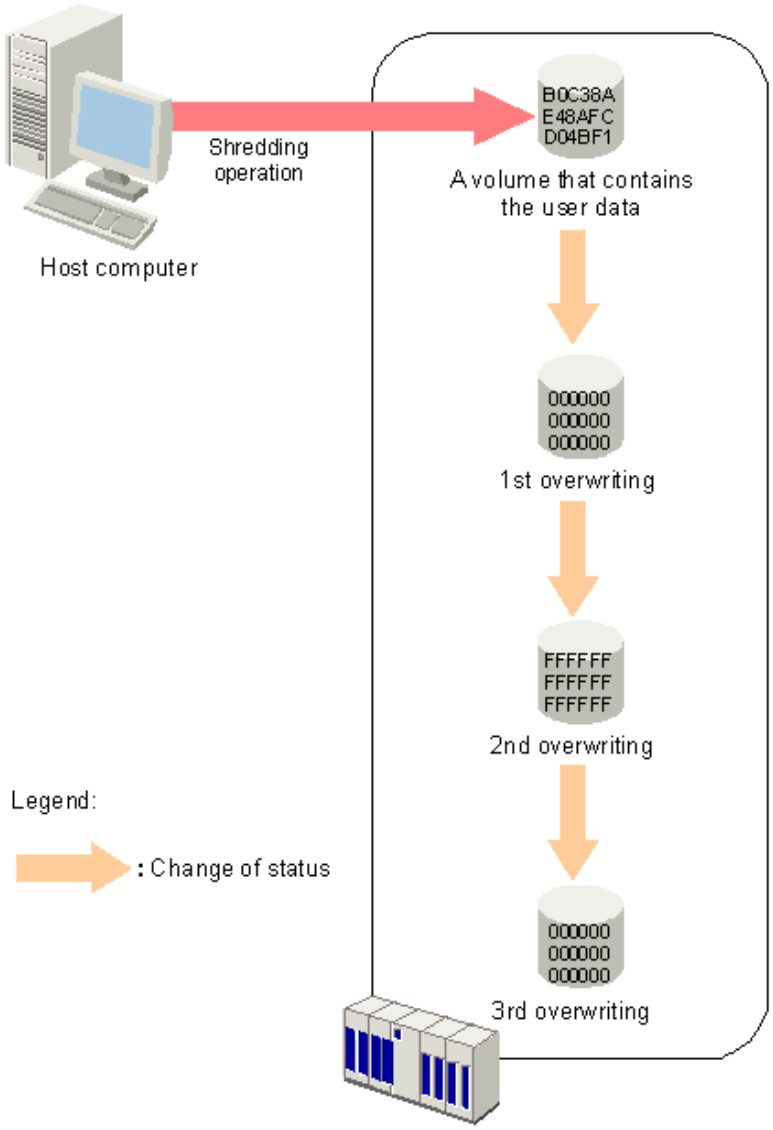
- Pool volumes
- Virtual volumes for Thin Image
- Journal volumes
- Volumes that are not write-enabled (access attribute is not read/write)
- FlashCopy® TSE-VOL

- Virtual volume with ALU attribute
- Volumes for which accelerated compression is enabled
- Virtual volumes for which the capacity saving function is enabled
- Deduplication system data volumes
- Volumes belonging to parity groups under dynamic sparing
- Volumes belonging to parity groups under correction access
- Volumes belonging to parity groups under copy back

Volume Shredder functions

The following figure shows user data that is being overwritten three times (default value for number of overwrites). Volume Shredder overwrites data using the following dummy data values:

- The first overwrite is 00.
- The second overwrite is FF.
- The third overwrite is 00.



You can configure Volume Shredder to overwrite data from three to eight times, and each time the system overwrites the data you can configure the dummy data to be any hexadecimal number from 0 to FFFF.

After the system finishes overwriting data, you can view the results in the user interface or, if configured, you can open the compressed results files.

We recommend that you execute the shredding function at times of day when the host I/O load is lowest. If the number of LDEVs to be shredded is large, shredding operations might affect host I/O operations.

Note that, while the shredding function is being executed, maintenance operations cannot be performed on a drive to which the volume to be shredded belongs.

Shredding times

The standard required time for shredding (without host I/Os) differs depending on the drive type. For details, see the following sections.

- Standard required time for hard disk drives (on page 14)
- Standard required time for SSDs (with SAS interface) (on page 16)
- Standard required time for SSDs (with NVMe interface) (on page 19)
- Standard required time for SCMs (on page 21)
- Standard required time for FMDs (on page 21)

In these sections, the tables assume the use of OPEN-V volumes with drive type DKxxx-JxxxSS/KxxxSS/HxxxSS. The same standard times also apply to shredding encrypted drives.

Since each volume is overwritten three times with dummy data by default, Volume Shredder requires three times the time listed in the tables. If the number of overwrites has been changed, use the following formula to calculate the time required for shredding:

```
(time required for shredding) = [time for one overwrite (standard required time)] x
(number of overwrites (n))
```

When host I/Os are performed, the required shredding time is at least six times that of when no host I/Os are performed. If a DKxxx-HxxxSS data drive is used for creating a parity group on an encrypted data drive, the time required for shredding that parity group is the maximum time listed.

Notes on shredding times

- In these sections, the tables also assume the following conditions:
  - For VSP 5000 series, 8 DKBs/DKBNs are mounted per system.
  - Shredding is performed on one ECC group.
  - The assumed number of LDEVs is the maximum number of LDEVs that is allowed per ECC group when each LDEV has 100 GB of capacity. If each LDEV does not have 100 GB of capacity, the required time might be longer than the time in the tables.
- If there is heavy I/O load on a parity group (including a parity group not to be shredded), the shredding operation might fail. If this occurs, lower the I/O load, and then perform a shredding operation again.
- If the volumes to be shredded belong to drives of mixed types or mixed configurations, the longest required times associated with the drive type or drive configuration apply to all volumes. Thus, mixed types and configurations take more time for the volumes to become available for use than when the drive type and drive configuration are the same. When you add drives or change drive configurations, you should arrange the drives into those with the same standard required times, and then add drives starting with those volume types requiring the least shredding time.
- When the emulation type for mainframe is selected for the LDEV, Fibre Channel connectivity for mainframe is required. When the emulation type for open systems is selected, a channel for open systems is required.

- Complete data erasure can be guaranteed only for disk drives. For information about complete data erasure for flash drives and SCMs, contact customer support.
- For an SSD with NVMe interface, the required shredding time might be a quarter or less than the value in the relevant table, depending on the internal state of the SSD.

Standard required time for hard disk drives

The following tables show the standard required times for shredding for HDDs (DKxxx-JxxxSS/KxxxSS/HxxxSS disk drives).

For VSP 5000 series:

Rotation per minute	RAID level		Standard required time*
10K rpm	RAID 1	2D+2D	140 minutes
	RAID 5	3D+1P	90 minutes
		7D+1P	40 minutes
	RAID 6	6D+2P	45 minutes
		14D+2P	20 minutes
7.2K rpm	RAID 1	2D+2D	175 minutes
	RAID 5	3D+1P	115 minutes
		7D+1P	55 minutes
	RAID 6	6D+2P	65 minutes
		14D+2P	30 minutes
*Drive capacity is assumed to be 1 TB.			

For VSP E590, VSP E790, VSP E1090:

Rotation per minute	Drive capacity	RAID level		Standard required time (minutes)*
				VSP E590, VSP E790, VSP E1090
10K rpm	2.4 TB	RAID 1	2D+2D	(VSP E590, VSP E790) 130 (VSP E1090) 115
		RAID 5	3D+1P	(VSP E590, VSP E790) 80 (VSP E1090) 75

Rotation per minute	Drive capacity	RAID level		Standard required time (minutes)*
				VSP E590, VSP E790, VSP E1090
			4D+1P	(VSP E590, VSP E790) 60 (VSP E1090) 55
			6D+1P	(VSP E590, VSP E790) 40 (VSP E1090) 35
			7D+1P	(VSP E590, VSP E790) 35 (VSP E1090) 30
		RAID 6	6D+2P	(VSP E590, VSP E790) 40 (VSP E1090) 35
			12D+2P	(VSP E590, VSP E790) 25 (VSP E1090) 20
			14D+2P	(VSP E590, VSP E790) 20 (VSP E1090) 15
7.2K rpm	6.0 TB	RAID 1	2D+2D	170
		RAID 5	3D+1P	105
			4D+1P	80
			6D+1P	50
			7D+1P	45
		RAID 6	6D+2P	50
			12D+2P	25
			14D+2P	25
	10.0 TB	RAID 1	2D+2D	155
		RAID 5	3D+1P	95
			4D+1P	70
			6D+1P	45
			7D+1P	40
		RAID 6	6D+2P	45

Rotation per minute	Drive capacity	RAID level		Standard required time (minutes)*
				VSP E590, VSP E790, VSP E1090
			12D+2P	25
			14D+2P	20
	14.0 TB	RAID 1	2D+2D	145
		RAID 5	3D+1P	90
			4D+1P	65
			6D+1P	45
			7D+1P	40
		RAID 6	6D+2P	45
			12D+2P	25
			14D+2P	20
	18.0 TB	RAID 1	2D+2D	150
		RAID 5	3D+1P	95
			4D+1P	70
			6D+1P	45
			7D+1P	40
		RAID 6	6D+2P	45
			12D+2P	25
			14D+2P	20
* The standard required time per TB in a parity group				

Standard required time for SSDs (with SAS interface)

The following tables show the standard required times for shredding for SSDs (with SAS interface).

For VSP 5000 series:

RAID level		Standard required time*
RAID 1	2D+2D	20 minutes
RAID 5	3D+1P	15 minutes
	7D+1P	10 minutes
RAID 6	6D+2P	10 minutes
	14D+2P	5 minutes
* Flash drive capacity is assumed to be 1 TB.		

For VSP E590, VSP E790, VSP E1090:

Drive capacity	RAID level		Standard required time (minute)*
			VSP E590, VSP E790, VSP E1090
1.9 TB	RAID 1	2D+2D	10
	RAID 5	3D+1P	(VSP E590, VSP E790) 10 (VSP E1090) 5
		4D+1P	5
		6D+1P	5
		7D+1P	5
	RAID 6	6D+2P	5
		12D+2P	5
		14D+2P	5
3.8 TB	RAID 1	2D+2D	(VSP E590, VSP E790) 10 (VSP E1090) 15
	RAID 5	3D+1P	10
		4D+1P	(VSP E590, VSP E790) 5 (VSP E1090) 10
		6D+1P	5
		7D+1P	5
	RAID 6	6D+2P	(VSP E590, VSP E790) 5 (VSP E1090) 10

Drive capacity	RAID level		Standard required time (minute)*
			VSP E590, VSP E790, VSP E1090
		12D+2P	5
		14D+2P	5
7.6 TB	RAID 1	2D+2D	(VSP E590, VSP E790) 10 (VSP E1090) 15
	RAID 5	3D+1P	10
		4D+1P	(VSP E590, VSP E790) 5 (VSP E1090) 10
		6D+1P	5
		7D+1P	5
	RAID 6	6D+2P	(VSP E590, VSP E790) 5 (VSP E1090) 10
		12D+2P	5
		14D+2P	5
15.0 TB	RAID 1	2D+2D	10
	RAID 5	3D+1P	10
		4D+1P	5
		6D+1P	5
		7D+1P	5
	RAID 6	6D+2P	5
		12D+2P	5
		14D+2P	5
30.0 TB	RAID 1	2D+2D	10
	RAID 5	3D+1P	(VSP E590, VSP E790) 5 (VSP E1090) 10
		4D+1P	5
		6D+1P	5
		7D+1P	5

Drive capacity	RAID level		Standard required time (minute)*
			VSP E590, VSP E790, VSP E1090
	RAID 6	6D+2P	5
		12D+2P	5
		14D+2P	5
* The standard required time per TB in a parity group.			

Standard required time for SSDs (with NVMe interface)

The following table shows the standard required times for shredding for SSDs (with NVMe interface).

For VSP 5000 series:

RAID level		Standard required time*	
		1.9 TB to 15 TB	30 TB
RAID 1	2D+2D	10 minutes	4 minutes
RAID 5	3D+1P	10 minutes	3 minutes
	7D+1P	5 minutes	2 minutes
RAID 6	6D+2P	10 minutes	2 minutes
	14D+2P	5 minutes	2 minutes
* Flash drive capacity is assumed to be 1 TB.			

For VSP E series:

Drive capacity	RAID level		Standard required time (minutes)*		
			VSP E590, VSP E790	VSP E990	VSP E1090
1.9 TB	RAID 1	2D+2D	10	10	10
	RAID 5	3D+1P	5	10	10
		4D+1P	5	10	5
		6D+1P	5	10	5

Drive capacity	RAID level		Standard required time (minutes)*		
			VSP E590, VSP E790	VSP E990	VSP E1090
		7D+1P	5	10	5
	RAID 6	6D+2P	5	10	5
		12D+2P	5	10	5
		14D+2P	5	10	5
3.8 TB	RAID 1	2D+2D	10	10	10
	RAID 5	3D+1P	5	10	10
		4D+1P	5	10	5
		6D+1P	5	10	5
		7D+1P	5	10	5
	RAID 6	6D+2P	5	10	5
		12D+2P	5	10	5
		14D+2P	5	10	5
7.6 TB	RAID 1	2D+2D	10	10	10
	RAID 5	3D+1P	5	10	10
		4D+1P	5	10	5
		6D+1P	5	10	5
		7D+1P	5	10	5
	RAID 6	6D+2P	5	10	5
		12D+2P	5	10	5
		14D+2P	5	10	5
15 TB	RAID 1	2D+2D	10	10	10
	RAID 5	3D+1P	5	10	10
		4D+1P	5	10	5
		6D+1P	5	10	5
		7D+1P	5	10	5
	RAID 6	6D+2P	5	10	5

Drive capacity	RAID level		Standard required time (minutes)*		
			VSP E590, VSP E790	VSP E990	VSP E1090
		12D+2P	5	10	5
		14D+2P	5	10	5
30 TB	RAID 1	2D+2D	5	5	5
	RAID 5	3D+1P	5	5	5
		4D+1P	5	5	5
		6D+1P	5	5	5
		7D+1P	5	5	5
	RAID 6	6D+2P	5	5	5
		12D+2P	5	5	5
		14D+2P	5	5	5
* The standard required time per TB in a parity group.					

Standard required time for SCMs

The following table shows the standard required times for shredding for SCMs.

RAID level		Standard required time*
		VSP 5000 series
RAID 1	2D+2D	5 minutes
RAID 5	3D+1P	4 minutes
	7D+1P	2 minutes
RAID 6	6D+2P	2 minutes
	14D+2P	2 minutes
*SCM capacity is assumed to be 1 TB.		

Standard required time for FMDs

(VSP 5000 series) The following table shows the standard required times for shredding for FMDs.

RAID level		Standard required time*
RAID 1	2D+2D	20 minutes
RAID 5	3D+1P	10 minutes
	7D+1P	10 minutes
RAID 6	6D+2P	10 minutes
	14D+2P	10 minutes
*FMD capacity is assumed to be 1 TB.		

Chapter 2: Volume Shredder operations

This chapter describes and provides instructions for performing Hitachi Volume Shredder operations.

Workflow for shredding

Use the following workflow to shred volumes using Volume Shredder:

1. Verify that the current shredding status for the volume is Normal. See Viewing shredding status with the Logical Devices window (on page 30).
2. Block the volume. See Blocking a volume (on page 23).
3. Calculate the number of overwrite passes. See Calculating the number of overwrite passes for flash drives or SCMs (on page 25) or Calculating the number of overwrite passes for FMDs (on page 26).
4. Define the shredding conditions. See Defining shredding conditions (on page 27).
5. Shred volumes. See Shredding a volume (on page 28) or Shredding volumes in parity groups (on page 29).

   If you need to stop a shredding operation, see Stopping a shredding operation from HDvM - SN Tasks window (on page 30).
6. Check the shredding results in the results file. See Viewing shredding results in the compressed files (on page 33).

Blocking a volume

Before you begin

- Review information related to the following topics in the *Provisioning Guide* for your storage system:
  - Blocking LDEVs
  - Selecting logical devices
  - Selecting internal or external parity groups
- You must have the Storage Administrator (Provisioning) role to perform this task.

Procedure

1. Perform one of the following, depending on the location of the volume, to display the volume you want to block:
   - To display the **LDEVs** tab, in the **Storage Systems** tree, select **Parity Groups**, **Internal**, or **External**, and then select the parity group that contains the volume you want to block.
   - To display the **LDEVs** tab, in the **Storage Systems** tree, select **Logical Devices**.
   - To display the **Virtual Volumes** tab, in the **Storage Systems** tree, select **Pools**, and then select the pool that contains the virtual volume you want to block.
2. Confirm the current status of the volume you want to block by viewing the **Status** column of the table.
   - If the volume is already blocked, **Blocked** appears in the status column.
   - If the volume is not blocked, a status other than **Blocked** appears in the status column.
3. Select the volume you want to block, click **More Actions**, and then select **Block LDEVs**. The **Block LDEVs** window opens.
4. Note the settings in the **Block LDEVs** window, enter a unique task name or accept the default name, and then click **Apply**.
   If **Go to tasks window for status** is selected, the **Tasks** window will open.

Blocking volumes in a parity group

Before you begin

- Review information related to the following topics in the *Provisioning Guide* for your storage system:
  - Blocking LDEVs
  - Selecting logical devices
  - Selecting internal or external parity groups
- You must have the Storage Administrator (Provisioning) role to perform this task.

Procedure

1. Display the **Parity Groups** tab by choosing one of the following steps, depending on the location of the parity group:
   - In the **Storage Systems** tree, select **Parity Groups**.
   - In the **Storage Systems** tree, select **Parity Groups**, and then select **Internal** or **External**.

2. Confirm the current status of the volumes you want to block by viewing the **LDEV Status** column of the table.
   - If the volume is already blocked, **Blocked** appears in the status column.
   - If the volume is not blocked, a status other than **Blocked** appears in the status column.
3. Select the parity group you want to block, click **More Actions**, and then select **Block LDEVs**. The **Block LDEVs** window opens.
4. Note the settings in the **Block LDEVs** window, enter a unique task name or accept the default name, and then click **Apply**.
   If **Go to tasks window for status** is selected, the **Tasks** window will open.

Calculating the number of overwrite passes for flash drives or SCMs

Because of the way space is allocated in flash drives or SCMs, the dummy data that is used to overwrite the volume must exceed the capacity of the target volume. Therefore, before you shred a volume on flash drives or SCMs, you need to calculate the number of times the system must overwrite the volume with dummy data.

Before you begin

You must have the Storage Administrator (Provisioning) role to perform this task.

Procedure

1. Select an LDEV on the **LDEVs** tab in the **Logical Devices** window, and write down its capacity and the number of data drives in its parity group (for example, 3 drives for RAID5-3D+1P, 6 drives for RAID6-6D+2P).
2. Use the following formula to calculate the number of times to overwrite the selected LDEV:

   n = [(*drive-capacity* × *number-of-data-drives-in-parity-group*) × 2] / *LDEV-capacity*

   Example: The capacity of the flash drive or SCM is 400 GB, the RAID configuration is 3D+1P, and the LDEV capacity is 440 GB.

   ```
   [(400 x 3) x 2 ] / 440 = 5.45 = six times
   ```

   Round up the value (5.45) to the nearest whole number. You need to overwrite the LDEV six times.

Example of shredding data on flash drives or SCMs

In this sample configuration, the capacity of the flash drive or SCM is 400 GB, the RAID configuration is 3D+1P, and the LDEV capacity is 440 GB.

Procedure

1. Calculate the number of shredding operations.

   ```
   [(400 × 3) × 2] / 440 = 5.45 = six times
   ```

   Round up the value (5.45) to the nearest whole number. You need to overwrite the data six times.

2. Define the shredding settings.

   Refer to Defining shredding conditions (on page 27), enter the dummy data **00** in the text box and add a row to the **Data Pattern (User Setting)** list (add rows for performing the shredding operation six times).

3. Erase the volume data.

   Refer to Defining shredding conditions (on page 27) and execute the shredding operation.

4. Repeat steps 2 and 3 using the dummy data **FF.**

5. Repeat steps 2 and 3 using the dummy data **00.**

Calculating the number of overwrite passes for FMDs

Because of the way space is allocated in FMDs, the dummy data that is used to overwrite the volume must exceed the capacity of the target volume. Therefore, before you shred a volume on FMDs, you need to calculate the number of times the system must overwrite the volume with dummy data.

Before you begin

You must have the Storage Administrator (Provisioning) role to perform this task.

Procedure

1. Select an LDEV on the **LDEVs** tab in the **Logical Devices** window, and write down its capacity and the number of data drives in its parity group (for example, 3 drives for RAID5-3D+1P, 6 drives for RAID6-6D+2P).

2. Use the following formula to calculate the number of times to overwrite the selected LDEV:

   n = [(*drive-capacity* × *number-of-data-drives-in-parity-group*) × 2] / *LDEV-capacity*

   Example: The capacity of the FMD is 1,600 GB, the RAID configuration is 3D+1P, and the LDEV capacity is 880 GB.

   ```
   [(1,600 x 3) x 2] / 880 = 10.9 = 11 times
   ```

   Round up the value (10.9) to the nearest whole number. You need to overwrite the LDEV 11 times.

   You can write dummy data up to eight times in one shredding operation. To write dummy data nine or more times, perform the shredding operation for the volume as many times as required.

Example of shredding data on FMDs

This example assumes that the capacity of the FMD is 1,600 GB, the RAID configuration is 3D+1P, and the LDEV capacity is 880 GB.

Procedure

1. Calculate the number of times to overwrite the data:
   `[(1,600 x 3) x 2] / 880 = 10.9 = 11 times`

   Round up the value (10.9) to the nearest whole number. You need to overwrite the data 11 times.
2. Define the shredding settings.

   Refer to Defining shredding conditions (on page 27), select the **Data Pattern (User Setting)** list and **Random Data**, then click **Add** eight times.
3. Erase the volume data.
   Refer to Defining shredding conditions (on page 27) for procedures on erasing the volume data.
4. Repeat steps 2 and 3, three more times, clicking **Add** three times.

Defining shredding conditions

Configure data overwrite patterns and the number of overwrite passes in the Shredding Data Pattern window. By default the number of overwrite passes is three; but you can change this number from three to up to eight times. The system keeps user-specified settings while the Shred LDEVs window is open.

Before you begin

You must have the Storage Administrator (Provisioning) role to perform this task.

Procedure

1. In the **Storage Systems** tree, select **Logical Devices** to display the **LDEVs** tab.
2. Select a blocked volume, click **More Actions**, and then select **Shred LDEVs** to open the **Shred LDEVs** window.
3. Click **Edit Data Pattern**. The **Edit Shredding Data Pattern** window opens.
4. To use the default pattern, click **Default Pattern (00-FF-00)**.

   To specify custom settings, click **Data Pattern (User Setting)** and specify the data pattern as follows:

   Caution: For FMDs, make sure you select **Random Data** as the specified **Data Pattern**.

   a. To add a random data pass, select **Random Data**, and click **Add**. A random data pass is added in the **Data Pattern (User Setting)** table.

b. To define a data pattern, click **Define Data**, enter the number that you want to use as dummy data in the text box, and click **Add**. You can enter a hexadecimal number of up to four digits (0 to FFFF). The data pattern is added in the **Data Pattern (User Setting)** table.

> **Caution:** You should enter three or more numbers to use as dummy data. If you overwrite data with less than three numbers, some or all data might be recoverable.

c. If you make a mistake, click **Clear** and re-enter the desired numbers.

5. When the data pattern is correct (default or user-defined), click **OK** to save your settings and close the **Edit Shredding Data Pattern** window.
6. Click **Cancel** to close the **Shred LDEVs** window.

Shredding a volume

Before you begin

You must have the Storage Administrator (Provisioning) role to perform this task.

Procedure

1. Choose one of the following steps, depending on the location of the volume:
   - To display the **LDEVs** tab, in the **Storage Systems** tree, select **Logical Devices**, or select **Parity Groups**, **Internal**, or **External** and then select the parity group that contains the volume you want to shred.
   - To display the **Virtual Volumes** tab, in the **Storage Systems** tree, select **Pools**, and then select the pool that contains the virtual volume you want to shred.
2. Select the volume you want to shred and confirm the current status of the volume by viewing the **Status** column of the table.
   - If the volume is already blocked, **Blocked** appears in the status column.
   - If the volume is not blocked, a status other than **Blocked** appears in the status column. In this case, you need to block the volume before you can shred it. See Blocking a volume (on page 23).
3. Click **More Actions** > **Shred LDEVs**.
4. To save the shredding results to a file, click **Set Data Output** (you can output the shredding results of up to three volumes). If you don't want to save the results to a file, click **Cancel Data Output**.
5. Click **Finish**.
6. Verify the settings in the **Shred LDEVs** window.

   When the settings are correct, enter a unique task name or accept the default name, and click **Apply**.

   If **Go to tasks window for status** is selected, the **Tasks** window will open.

7. Check the operation results.
   - If there is no volume specified to save the shredding results to a file, check the operation results in the **Tasks** window. For details, see Viewing shredding results with the Tasks window (on page 32).
   - If there is at least one volume specified to save the shredding results to a file, check the operation results in the shredding result file. For details, see Viewing shredding results in the compressed files (on page 33).

   After the shredding operation is completed, the volume status automatically changes from **Blocked** to **Normal**.

Shredding volumes in parity groups

Before you begin

You must have the Storage Administrator (Provisioning) role to perform this task.

Procedure

1. Display the **Parity Groups** tab by choosing one of the following steps, depending on the location of the parity group:
   - In the **Storage Systems** tree, select **Parity Groups**.
   - In the **Storage Systems** tree, select **Parity Groups**, and then select **Internal** or **External**.
2. Select the parity group you want to shred and confirm the current status by viewing the **Status** column of the table.
   - If the parity group is already blocked, **Blocked** appears in the status column.
   - If the parity group is not blocked, a status other than **Blocked** appears in the status column. In this case, you need to block the parity group before you can shred it. See Blocking volumes in a parity group (on page 24).
3. Click **More Actions** > **Shred LDEVs**.
4. To save the shredding results to a file, click **Set Data Output** (you can output the shredding results of up to three volumes). If you don't want to save the results to a file, click **Cancel Data Output**.
5. Click **Finish**.
6. Verify the settings in the **Shred LDEVs** window.

   When the settings are correct, enter a unique task name or accept the default name, and click **Apply**.

   If **Go to tasks window for status** is selected, the **Tasks** window will open.

7. Check the operation results.
   - If there is no volume specified to save the shredding results to a file, check the operation results in the **Tasks** window. For details, see Viewing shredding results with the Tasks window (on page 32).
   - If there is at least one volume specified to save the shredding results to a file, check the operation results in the shredding result file. For details, see Viewing shredding results in the compressed files (on page 33).

   After the shredding operation is completed, the volume status automatically changes from **Blocked** to **Normal**.

Viewing shredding status with the Tasks window

You can verify the progress of shredding operations using either the Tasks window or the Logical Devices window. For details about using the Logical Devices window, see Viewing shredding status with the Logical Devices window (on page 30).

Procedure

1. In the **Storage Systems** tree, select **Tasks**.
2. Verify the shredding status in the **Tasks** window. For detailed information, click the task name in the **Task Name** column to open the **Task Properties** window.

   For more information, see the *Managing tasks* section in the *System Administrator Guide* for your storage system.

Viewing shredding status with the Logical Devices window

You can verify the progress of shredding operations using either the Logical Devices window or the Tasks window.

Procedure

1. In the **Storage Systems** tree, click **Logical Devices**.
2. Verify the shredding progress in the **Logical Devices** window. When the volume shredding is in progress, the **Status** column displays **Shredding**.

   For details about the **Logical Devices** window, see the *Provisioning Guide* for your storage system.

Stopping a shredding operation from HDvM - SN Tasks window

You can stop the volume shredding process.

Caution: If you stop the shredding process, you cannot restart the process. Data integrity of the volume is not guaranteed.

For VSP E series: You can interrupt the shredding process by using one of following:

- Tasks window
- The menu in Interrupt Shredding Task window.

For a faster response, use the Tasks window to stop the shredding operation.

Tip: For VSP E series: The shredding tasks cannot be interrupted if either of the following two conditions exist:

- Status of the shredding task is Failed.
- Format/Shredding Task Status is Shredding on the Parity Groups window or Logical Devices window.

In this case, perform the interrupt operation from Interrupt Shredding Task window.

Before you begin

You must have the Storage Administrator (Provisioning) role to perform this task.

Procedure

1. In the **Storage Systems** tree, select **Tasks**.
2. Click the task name of the desired task in the **Task Name** column.
   The **Task Properties** window opens.
3. Click **Abort** in the **Shredding Data pattern** field.
4. Verify the displayed settings and click **Yes**.
   The shredding process stops.
5. Click **Close** in the **Task Properties** window.

Stopping a shredding operation from HDvM - SN Interrupt Shredding Task window

You can stop the volume shredding process from the Interrupt Shredding Task window.

Caution: If you stop the shredding process, you cannot restart the process. Data integrity of the volume is not guaranteed.

Note: We recommend to use the Tasks window to stop the shredding operation if you want faster response.

Before you begin

You must have the Storage Administrator (Provisioning) role to perform this task.

Procedure

1. Open the **Interrupt Shredding Task** window by any of the following ways:
   - Using the **Logical Devices** window

     Perform either of the following operations:
     - In the **Storage Systems** tree, select **Logical Devices** to display the **LDEVs** tab. Then, click **More Actions > Interrupt LDEV Task > Interrupt Shredding Task**.
     - On the **Actions** menu, click **Logical Device > Interrupt Shredding Task**.
   - Using the **Parity Groups** window

     Perform either of the following operations:
     - In the **Storage Systems** tree, select **Parity Groups** to display the **Parity Groups** tab. Then, click **More Actions > Interrupt Shredding Task**.
     - On the **Actions** menu, click **Logical Device > Interrupt Shredding Task**.
2. Verify the displayed settings, and then click **Apply**.
   The shredding process stops.

   Note: If the shredding operation being performed is interrupted, the end times of following tasks in the **Tasks** window differ:
   - End time of the shredding task being performed.
   - End time of the task for the interruption of shredding.

     The time difference above is approximately 10 minutes.

     To determine whether the shredding task is finished or not, confirm the status of the task. If **Status** is Completed or Failed, the shredding task is finished.

Viewing shredding results with the Tasks window

Use the Tasks window to verify the results of the shredding operation.

Note: If there is at least one volume specified to save the shredding results to a file, you can check the operation results in the shredding result file. For details, see Viewing shredding results in the compressed files (on page 33).

Procedure

1. In the **Storage Systems** tree, select **Tasks**.
2. Click the task name of the desired task in the **Task Name** column.
3. In the **Task Properties** window, view the **Result** column in the **Shredding Data Pattern** table.

Check the contents to verify whether all the overwriting operations have been completed normally. If an overwriting pass is not completed normally, it means the shredding was not successful. If shredding fails, try shredding the volume again. If shredding fails again, contact customer support to resolve the error. If the storage system experiences a power outage during the shredding process, one of the following error messages will appear:

- **Shredding operation canceled**
- **Shredding operation failed**

4. Click **Close** to close the **Task Properties** window.

The following table lists and describes the Volume Shredder status messages that are displayed in the shredding results.

Status	Description
--	The shredding operation was not performed.
Shredding operation Normal.	The shredding operation was successful.
Writing.	The shredding operation is in progress.
Shredding operation not executed.	The shredding operation did not occur as specified.
Shredding operation canceled.	The shredding operation was canceled, or power to the system was interrupted.
Shredding operation Failed.	The shredding operation was not successful, or power to the system was interrupted.
Shredding data transfer error.	The system could not write the shredding results to a file.
Shredding data verify error.	An error was detected in the file containing the shredding results.
No-data assigned.	When you shred an unused Dynamic Provisioning virtual volume, no dummy data is written to the volume. In this case the status of the shredding operation in the shredding results file is **No-data assigned**.

Viewing shredding results in the compressed files

If there is at least one volume specified to save the shredding results to a file, you can save the shredding results as a compressed file on the computer. The following procedure shows how to view the shredding results in the file.

Before you begin

You must have the Storage Administrator (Provisioning) role to perform this task.

Procedure

1. Display the Device Manager - Storage Navigator main window.
2. On the menu bar, select **Reports** > **Shredding Report**, and then click either **Download Latest Report** to download the latest result file or **Download Other Reports** to download the past ten times result files.
   When the preparation for download is complete, a message appears.
3. Click **OK**.
4. Specify the folder in which to download the file.
5. Click **Save**.
   Compressed files are downloaded.
6. Decompress the file. The binary file showing the results of shredding, the text file showing the contents of shredding operation, and its result are output.
7. Check the shredding results in the decompressed files. For details, see Understanding shredding results in compressed files (on page 34).

Understanding shredding results in compressed files

When you open the compressed file, you see binary and text files that contain shredding results.

- The name of the binary file indicates LDKC, CU, and LDEV numbers of the shredded volumes, and the number of times the system wrote dummy data to the volumes. For example, if a binary file is named `00-01-11-03.bin`, the LDKC number is 00, the CU number is 01, and the LDEV number is 11. The filename also indicates that the system wrote dummy data to that volume three times. A binary file contains the first 512 bytes of data of a shredded volume (LDEV).
- The file name of a text file appears as follows:

  `shred_`*`finish-time-of-shredding-operation`*`.txt`

The compressed file is saved with the time zone setting of the SVP. If the compressed file is decompressed on the computer, the time stamp of the decompressed file appears with the time zone setting of the computer. The time stamp of the decompressed file might be different from the actual finish time of the shredding operation.

In the text file, you can check whether the shredding operation ended normally. The following shows example contents of the text file:

```
DKC S/N: 90406
Day/Time started: 2019/02/21,10:04:09
Day/Time ended: 2019/02/21,10:05:11
```

```
WR Data Pattern: 0x00-0xFF-0x00
Result: Normal (No data assigned-No data assigned-No data assigned)
LDEVs:
0x00:0x40:0x01
0x00:0x50:0x01
0x00:0x60:0x01
0x00:0x80:0x01
0x00:0x90:0x01
0x00:0xA0:0x01
0x00:0xF0:0x01
0x00:0xFE:0x01
0x00:0xFE:0xF1
```

How to check shredding results

Check the status output after “Result:” and before the parentheses. If the shredding operation normally ended, “Normal” is output. If the shredding operation failed, “Failed” is output. When “Failed” is output, retry the shredding operation. If the shredding operation still fails, contact customer support.

Each of the statuses in the parentheses after "Result:" indicates the termination status of each system operation that wrote dummy data to the volumes. In the preceding example, the system wrote dummy data to the volumes three times. The following table lists and describes individual statuses.

Termination status in the parentheses	Description
Normal	The shredding operation normally ended.
No data assigned	The shredding operation was executed on an unused DP-VOL. In this case, the system did not write dummy data on unused DP-VOLs. However, if the volumes to be shredded included the following volumes, the system wrote dummy data to these volumes: ▪ DP-VOLs being used ▪ Regular internal volumes ▪ External volumes
Not executed	The shredding operation was not executed with the specified parameters.
Canceled	The shredding operation was interrupted.
Failed	The shredding operation abnormally ended.

Termination status in the parentheses	Description
Data verify error	An abnormality was found while the file containing shredding results was being verified.
Data transfer error	Outputting shredding results to a file failed.

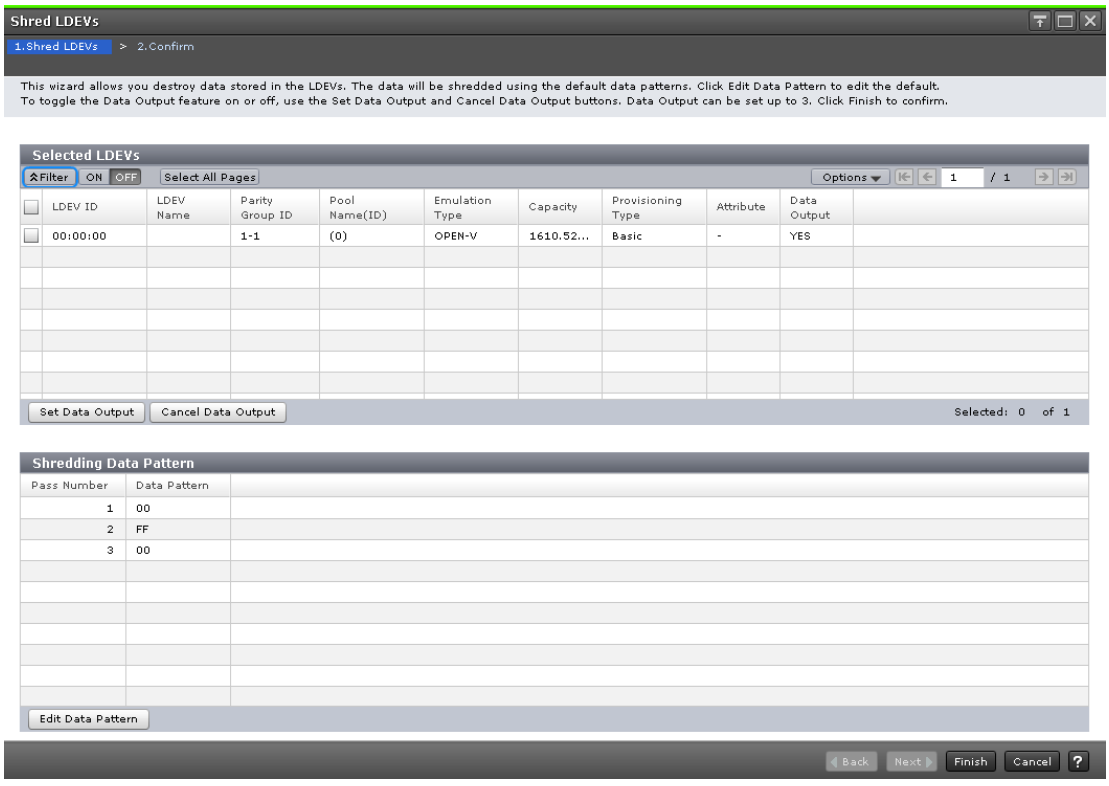
Chapter 3: Volume Shredder GUI reference

This section describes the Device Manager - Storage Navigator windows for Volume Shredder.

Shred LDEVs wizard

Shred LDEVs window

Use the Shred LDEVs window to select the volumes (LDEVs) to be shredded, configure the shredding operations (number of overwrite passes, data patterns), and enable/disable the output of shredding results to files.



Selected LDEVs table in the Shred LDEVs window

Item	Description
LDEV ID	ID of the selected LDEV. The ID is a combination of the logical disk controller (LDKC) number, control unit (CU) number, and LDEV number.
LDEV Name	Name of the selected LDEV.
Parity Group ID	Parity group number (for example, 1-1) of the selected LDEV.
Pool Name(ID)	Pool volume (pool-VOL) name and ID.
Emulation Type	VSP 5000 series: Emulation type of the selected LDEV.
Capacity	Capacity of the selected LDEV. To change the capacity unit, select Option > Capacity Unit.
Provisioning Type	Provisioning type of the selected LDEV: ▪ Basic: Internal volume ▪ External: External volume ▪ DP: Virtual volume of Dynamic Provisioning
Attribute	The following LDEV attributes are displayed: ▪ Command device: The volume has the command device attribute. ▪ ESE: ESE-VOL ▪ SLU: The volume has the SLU attribute. ▪ Data Direct Mapping: The volume has the data direct map attribute. ▪ (-): The volume does not have an attribute.
Data Output	**YES**: The results of the shredding operation will be saved in a file. **NO**: The results of the shredding operation will be not saved in a file.

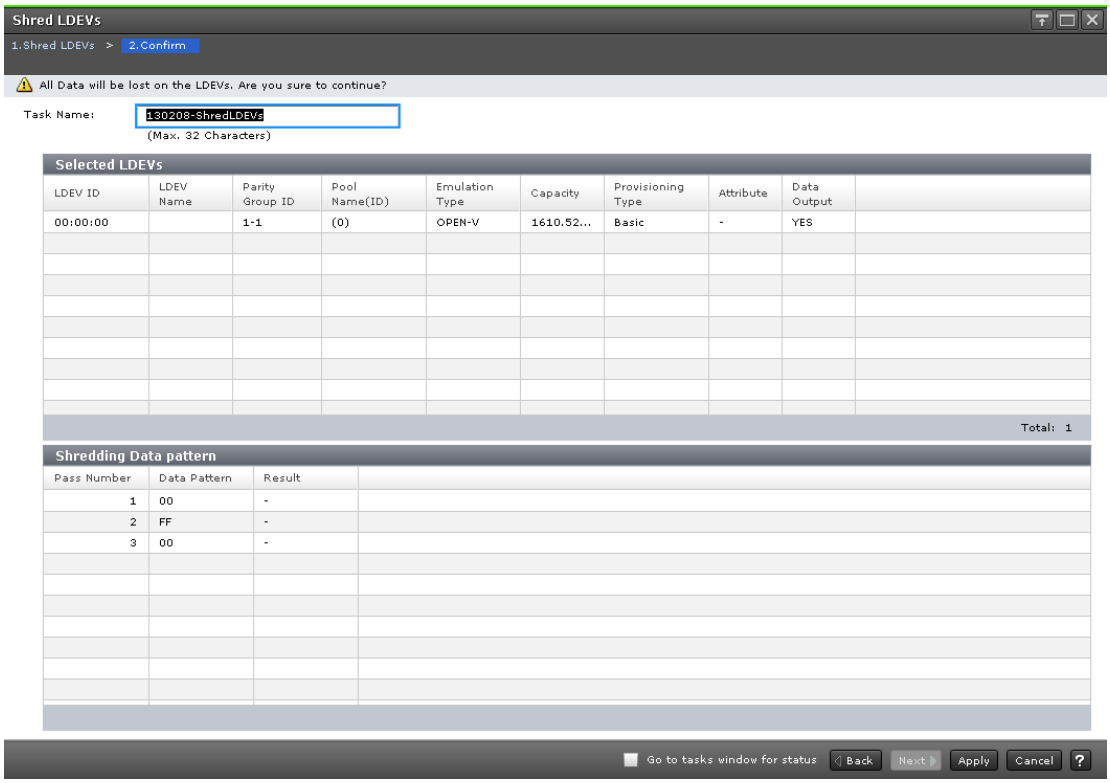
Item	Description
Set Data Output	If this button is selected, Yes appears in the Data Output column. If the data output setting is enabled, the results of the shredding operation will be saved in a file. Results can be saved for up to three volumes.
Cancel Data Output	If this button is selected, No appears in the Data Output column. If the data output setting is disabled, the results of the shredding operation will be not saved in a file.

Shredding Data Pattern table in the Shred LDEVs window

Item	Description
Pass Number	Order of the overwrite pass.
Data Pattern	Dummy data pattern for the overwrite pass.
Edit Data Pattern	Click to open the Edit Shredding Data Pattern dialog box, which allows you to change the data pattern setting.

Shred LDEVs wizard Confirm window

Use the Confirm window to review the information for the volume shredding operations and start the shredding task. When you are ready to start the specified volume shredding operations, enter a unique name for the shredding task, and then click Apply to start the shredding operations.



Selected LDEVs table in the Confirm window

Item	Description
LDEV ID	ID of the LDEV to be shredded. The ID is a combination of the logical disk controller (LDKC) number, control unit (CU) number, and LDEV number.
LDEV Name	Name of the LDEV to be shredded.
Parity Group ID	Parity group number (for example, 1-1) of the LDEV to be shredded.
Pool Name(ID)	Pool volume (pool-VOL) name and ID.
Emulation Type	VSP 5000 series: Emulation type of the LDEV to be shredded.
Capacity	Capacity of the LDEV to be shredded. To change the capacity unit, select Option > Capacity Unit.

Item	Description
Provisioning Type	Provisioning type of the LDEV to be shredded: ▪ Basic: Internal volume ▪ External: External volume ▪ DP: Virtual volume of Dynamic Provisioning
Attribute	The following LDEV attributes are displayed: ▪ Command device: The volume has the command device attribute. ▪ ESE: ESE-VOL ▪ SLU: The volume has the SLU attribute. ▪ Data Direct Mapping: The volume has the data direct map attribute. ▪ (-): The volume does not have any attribute.
Data Output	YES: The results of the shredding operation will be saved in a file. NO: The results of the shredding operation will be not saved in a file.

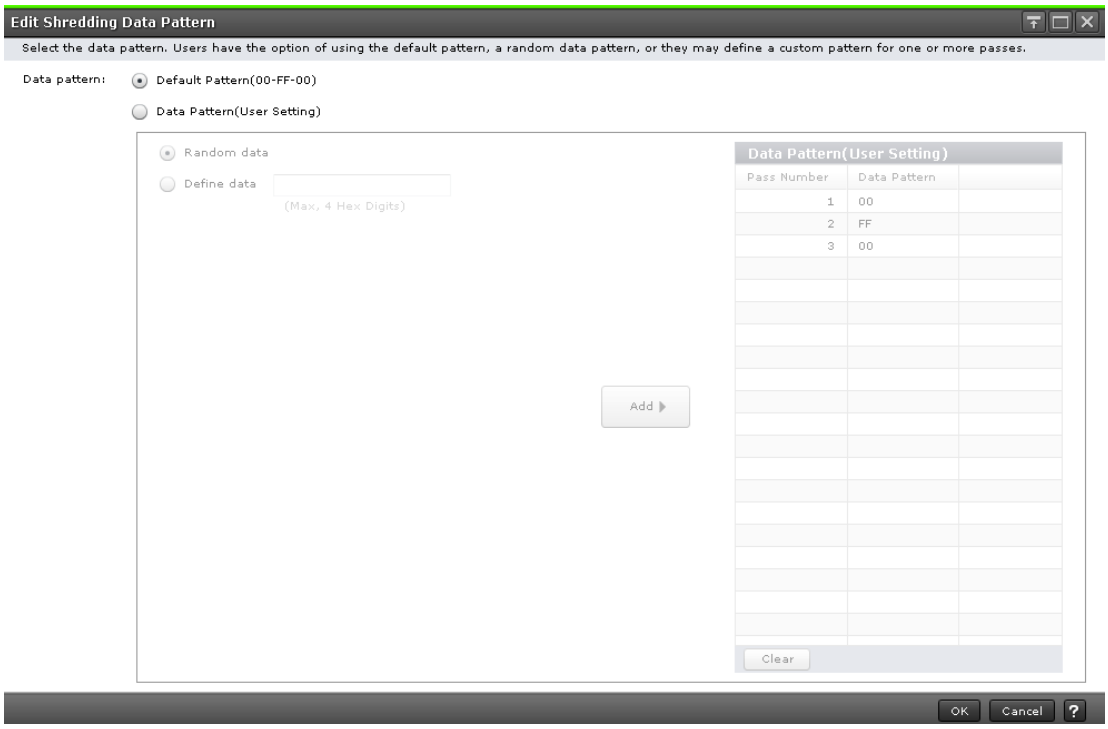
Shredding Data Pattern table in the Confirm window

Item	Description
Pass Number	Order of the overwrite pass.
Data Pattern	Dummy data pattern for the overwrite pass.

Item	Description
Result	Results of the shredding operations: ▪ -: The system did not overwrite the volume. ▪ Shredding operation Normal: The system successfully overwrote the volume. ▪ Writing: The system is overwriting the volume now. ▪ Shredding operation not executed: The system did not overwrite the volume as configured. ▪ Shredding operation canceled: The system or user cancelled the overwrite request. ▪ Shredding operation Failed: The overwrite process ended unsuccessfully. ▪ Shredding data transfer error: The results could not be written to a file. ▪ Shredding data verify error: An error was detected while verifying the file containing the result. ▪ No-data assigned: The Dynamic Provisioning virtual volume was unused; no dummy data was written to the volume. However, if the following volumes are included in the shredding volumes, the dummy data is written to volumes: Used Dynamic Provisioning virtual volumes, Internal volumes with normal status, and External volumes.

Edit Shredding Data Pattern window

Use the Edit Shredding Data Pattern window to configure the volume shredding settings, including number of overwrite passes and dummy data patterns.



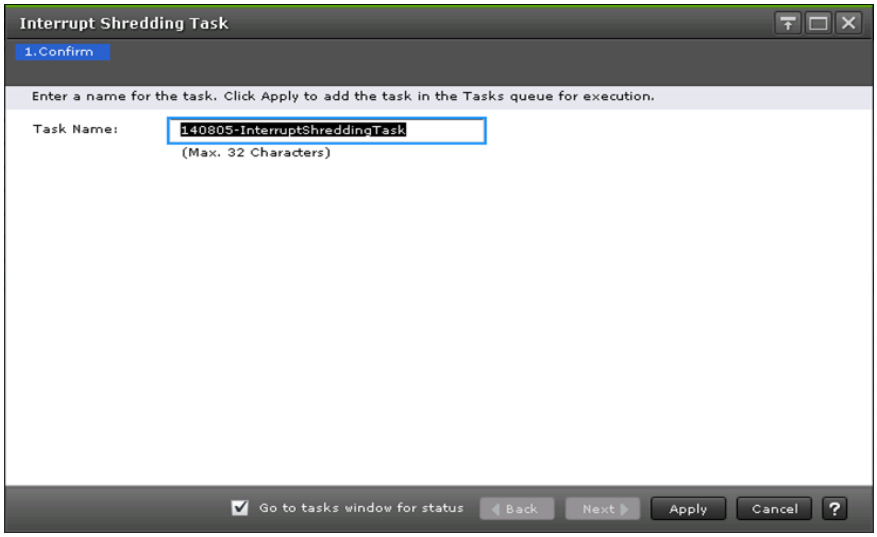
Item	Description
Data Pattern	Type of data pattern: default data pattern or custom. ▪ Default Pattern(00-FF-00): Three passes with the following dummy data patterns: "00" for the first pass, "FF" for the second pass, and "00" for the third pass. ▪ Data Pattern(User Setting): Selected to define the number of passes and the data pattern for each pass.
Random Data	Volume Shredder selects a 4-digit hexadecimal number at random to be used as the dummy data pattern for the pass.
Define Data	Enter a hexadecimal number (from 0 to FFFF) to be used as the dummy data for the user-defined pass.
Add	Adds the user-defined data pattern to the Data Pattern(User Setting) table. This button is available only when you select Data Pattern(User Setting) for the Data pattern type.

Data Pattern (User Setting) table in the Edit Shredding Data Pattern window

Item	Description
Pass Number	Order of the overwrite pass.
Data Pattern	Dummy data pattern for the overwrite pass.
Clear	Clears the values (other than 00) in the bottom row of the Data Pattern(User Setting) table.

Interrupt Shredding Task window

Use the Interrupt Shredding Task window to stop shredding tasks.



Item	Description
Task Name	Enter the task name to be interrupted. A task name can be up to 32 ASCII characters (letters, numerals and symbols). The alphabet characters are case-sensitive.

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