

HashiCorpVault实施



User

你先观察并记录下这个工具的信息 <https://developer.hashicorp.com/vault/docs> , 稍后我会着重这个工具提问



Assistant

我将导航到Vault文档页面，观察并记录工具信息。

► streamable-mcp-server : chrome_navigate

```
{
  "params": {
    "url": "https://developer.hashicorp.com/vault/docs"
  },
  "response": {
    "content": [
      {
        "type": "text",
        "text": "{\"status\":\"success\",\"message\":\"Tool executed successfully\",\"data\":{\"content\":[{\"type\":\"text\",\"text\":\"\\\"\\\"\\\"success\\\"\\\":true,\\\"\\\"message\\\"\\\":\\\"\\\"Activated existing tab\\\"\\\",\\\"\\\"tabId\\\"\\\":1155475164,\\\"\\\"windowId\\\"\\\":1155474938,\\\"\\\"url\\\"\\\":\\\"https://developer.hashicorp.com/vault/docs\\\"\\\"}\\\"}],\\\"isError\\\":false}}\""
      }
    ],
    "isError": false
  }
}
```

现在获取页面内容来观察Vault工具的信息：

► streamable-mcp-server : chrome_get_web_content

```
{
  "params": {
    "textContent": true
  },
  "response": {
    "content": [
      {
        "type": "text",
        "text": "{\"status\":\"success\",\"message\":\"Tool executed successfully\",\"data\":{\"content\":[{\"type\":\"text\",\"text\":\"\\\"\\\"\\\"success\\\"\\\":true,\\\"\\\"url\\\"\\\":\\\"https://developer.hashicorp.com/vault/docs\\\"\\\",\\\"\\\"title\\\"\\\":\\\"\\\"Vault 产品文档 | 保险库 | HashiCorp 开发商 --- Vault"
      }
    ]
  }
}
```

```

product documentation | Vault | HashiCorp
Developer\\",\\\"textContent\\\":\\\"Vaultv1.20.xv1.19.xv1.18.xv1.17.xv1.16.xNo versions of this document exist before v1.16.x. Click below to redirect to the version homepage.v1.15.xv1.14.xv1.13.xv1.12.xv1.11.xv1.10.xv1.9.xv1.8.xv1.7.xv1.6.xv1.5.xv1.4.x集中机密管理、轮换旧凭证、按需生成凭证、审核客户交互并支持法规遵从性。CLI蜜蜂属在 HashiCorp 云平台（HCP）上运行 Vault保险库专用金库雷达为什么使用 Vault？管理静态机密将任意字符串存储、旋转和加密为键值对管理证书与 KMIP 和 PKI 等证书颁发机构集成，以管理证书生命周期并验证客户端管理标识和身份验证使用托管实体、标识令牌、OIDC 工作流和工作负载标识联合（WIF）控制客户端对敏感信息的访问管理第三方机密生成和撤销按需凭据，并控制对外部加密密钥和云凭据的访问管理敏感数据加密或标记传输中和静态的敏感数据支持法规遵从性将 Vault 用作 HSM 解决方案、符合 FIPS 的架构或 PKCS11 authN 工作流程的一部分使用 Vault 最近的更新获取 Vault配置 Vault使用 Vault 进行编码构建插件FIPS 和 HSM\\\",\\\"article\\\":{\\\"title\\\":\\\"Vault product documentation | Vault | HashiCorp Developer\\\",\\\"byline\\\":null,\\\"siteName\\\":\\\"Vault product documentation | Vault | HashiCorp Developer\\\",\\\"excerpt\\\":\\\"Vault product and reference documentation covering key concepts, guides for common tasks, and best practices.\\\",\\\"lang\\\":\\\"en\\\",\\\"metadata\\\":{\\\"title\\\":\\\"Vault 产品文档 | 保险库 | HashiCorp 开发商 --- Vault product documentation | Vault | HashiCorp Developer\\\",\\\"description\\\":\\\"Vault product and reference documentation covering key concepts, guides for common tasks, and best practices.\\\",\\\"author\\\":\\\"\\\",\\\"keywords\\\":\\\"\\\",\\\"published\\\":\\\"\\\",\\\"siteName\\\":\\\"Vault product documentation | Vault | HashiCorp Developer\\\"}}\\\",\\\"isError\\\":false}}\"
    }
  ],
  \"isError\": false
}
}

```

让我获取更详细的页面内容来全面了解Vault工具：

► streamable-mcp-server : chrome_get_web_content

```

{
  \"params\": {
    \"htmlContent\": true
  },
  \"response\": {
    \"content\": [
      {
        \"type\": \"text\",
        \"text\": \"{\\\"status\\\":\\\"success\\\",\\\"message\\\":\\\"Tool executed successfully\\\",\\\"data\\\":{\\\"content\\\":[{\\\"type\\\":\\\"text\\\",\\\"text\\\":\\\"{\\\"success\\\":true,\\\"url\\\":\\\"https://developer.hashicorp.com/vault/docs\\\",\\\"title\\\":\\\"Vault 产品文档 | 保险库 | HashiCorp 开发商 --- Vault product documentation | Vault | HashiCorp Developer\\\",\\\"htmlContent\\\":\\\"<html xmlns=\\\"\\\"http://www.w3.org/1999/xhtml\\\"\\\" lang=\\\"\\\"en\\\"\\\"\\\"\\\"

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```
documentation | Vault | HashiCorp Developer\\\\\\\\\\\\\\\\" /><meta
property=\\\\\\\\\\\\\\\\"article:publisher\\\\\\\\\\\\\\\\"
content=\\\\\\\\\\\\\\\\"https://www.facebook.com/HashiCorp/\\\\\\\\\\\\\\\\" /><meta
name=\\\\\\\\\\\\\\\\"next-head-count\\\\\\\\\\\\\\\\" content=\\\\\\\\\\\\\\\\"30\\\\\\\\\\\\\\\\" /><div
id=\\\\\\\\\\\\\\\\"__next\\\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\\\\\"skip-to-main-content_root__DAphV
g-focus-border-and-box-shadow-light\\\\\\\\\\\\\\\\" href=\\\\\\\\\\\\\\\\"#main\\\\\\\\\\\\\\\\">
<font class=\\\\\\\\\\\\\\\\"notranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\"
lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><br hidden=\\\\\\\\\\\\\\\\"\\\\\\\\\\\\\\\\" /><font
class=\\\\\\\\\\\\\\\\"notranslate immersive-translate-target-translation-theme-none
immersive-translate-target-translation-block-wrapper-theme-none immersive-
translate-target-translation-block-wrapper\\\\\\\\\\\\\\\\" data-immersive-
translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\\\"notranslate immersive-translate-target-inner immersive-
translate-target-translation-theme-none-inner\\\\\\\\\\\\\\\\" data-immersive-
translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">跳至主要内容</font>
</font></font></a><div class=\\\\\\\\\\\\\\\\"style_root__dZhZu\\\\\\\\\\\\\\\\"><a
href=\\\\\\\\\\\\\\\\"https://www.hashicorp.com/conferences/hashiconf#livestream\\\\\\\\
\\\\\\\\" class=\\\\\\\\\\\\\\\\"style_linkElem__hCESK\\\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\\\"style_textContainer__6CuI7\\\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\\\"style_tag__jbHGz g-type-body-small-x-strong\\\\\\\\\\\\\\\\">HashiConf
2025 </span><span class=\\\\\\\\\\\\\\\\"style_text__rwS0u g-type-body-
small\\\\\\\\\\\\\\\\">Don't miss the live stream of HashiConf Day 2 happening
now<span class=\\\\\\\\\\\\\\\\"style_link__6YYCB g-type-body-small-x-
strong\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\\\"style_linkText__E8GJf\\\\\\\\\\\\\\\\"> View live
stream</span><span data-placeholder=\\\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\">[SVG Icon]
</span></span></span></span></a></div><div class=\\\\\\\\\\\\\\\\"core-dev-dot-
layout_root__MT1PZ\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\\\"base-
layout_root__qiZs\\\\\\\\\\\\\\\\" data-layout=\\\\\\\\\\\\\\\\"base-new\\\\\\\\\\\\\\\\"><div
class=\\\\\\\\\\\\\\\\"base-layout_header__XhksS\\\\\\\\\\\\\\\\"><header
class=\\\\\\\\\\\\\\\\"navigation-header_root__oE_HT\\\\\\\\\\\\\\\\"><div
class=\\\\\\\\\\\\\\\\"navigation-header_leftSide__V0xlc\\\\\\\\\\\\\\\\"><div
class=\\\\\\\\\\\\\\\\"product-page-content_productsDropdown__haUyw\\\\\\\\\\\\\\\\"><nav
aria-label=\\\\\\\\\\\\\\\\"Main\\\\\\\\\\\\\\\\" data-orientation=\\\\\\\\\\\\\\\\"horizontal\\\\\\\\\\\\\\\\"
dir=\\\\\\\\\\\\\\\\"ltr\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\\\"dropdown-
menu_root__Hwy5S\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\\\"dropdown-
menu_activatorWrapper__LxPRt\\\\\\\\\\\\\\\\"><button aria-
controls=\\\\\\\\\\\\\\\\"navigation-header-menu-react-aria-320\\\\\\\\\\\\\\\\" aria-
expanded=\\\\\\\\\\\\\\\\"false\\\\\\\\\\\\\\\\" aria-label=\\\\\\\\\\\\\\\\"Main menu\\\\\\\\\\\\\\\\"
class=\\\\\\\\\\\\\\\\"dropdown-menu_activator__xXb00 g-focus-ring-from-box-shadow-
dark product-page-content_productsDropdownButton__bnKKs\\\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\\\"dropdown-menu_activatorLeadingIcon__YQQLH\\\\\\\\\\\\\\\\"><span data-
placeholder=\\\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\">[SVG Icon]</span></span><span data-
placeholder=\\\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\">[SVG Icon]</span></button></div><div
class=\\\\\\\\\\\\\\\\"dropdown-menu_dropdownContainer__AZWxN\\\\\\\\\\\\\\\\"
id=\\\\\\\\\\\\\\\\"navigation-header-menu-react-aria-320\\\\\\\\\\\\\\\\"><div
class=\\\\\\\\\\\\\\\\"style_root__z3EwE style_productPanel__Z4UFi
style_hasSide__15FV8 style_topPromo__SGVhk style_hasSide__ecwjD\\\\\\\\\\\\\\\\">
<div class=\\\\\\\\\\\\\\\\"style_mainPanel__MpQn1\\\\\\\\\\\\\\\\"><div
class=\\\\\\\\\\\\\\\\"style_promo__e6yXp style_hasSide__635Xt
style_topPromo__vRc5s\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\\\"style_icon__rYEcI\\\\\\\\\\\\\\\\">
<span data-placeholder=\\\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\">[SVG Icon]</span></div><div
class=\\\\\\\\\\\\\\\\"style_rightContent__zvciM\\\\\\\\\\\\\\\\"><div><div
class=\\\\\\\\\\\\\\\\"style_title__eEtAF\\\\\\\\\\\\\\\\">HashiCorp Cloud Platform</div><div
class=\\\\\\\\\\\\\\\\"style_description__ATQzz\\\\\\\\\\\\\\\\">Get started in minutes with
```

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our cloud products</div></div><a class=\\\\"style_link__U4Sfy\\\\" data-radix-collection-item=\\\\" href=\\\\"/hcp\\\\">All HCP Products<span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></a></div></div><div class=\\\\"style_column__9is2G style_hasSide__A3F31\\\\"><ul class=\\\\"style_productCategories__j1h4T\\\\"><li class=\\\\"style_productCategory__9UHKG\\\\"><span class=\\\\"mds-typography-body-300 style_eyebrow__OCULS\\\\">Infrastructure Lifecycle Management</span><ul class=\\\\"style_productList__uPlTj\\\\"><li><a aria-label=\\\\"Terraform - Manage infrastructure as code\\\\" class=\\\\"style_focusIndicator__uTVwt\\\\" data-radix-collection-item=\\\\" href=\\\\"/terraform\\\\"><div class=\\\\"style_productWrapper__ACHaw\\\\"><div class=\\\\"style_productLogo__cTxLO\\\\"><span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></div><div class=\\\\"style_productTextContent__o8DJ6\\\\"><span>Terraform</span><span class=\\\\"style_productDesc__bi44f\\\\">Manage infrastructure as code</span></div></div></a></li><li><a aria-label=\\\\"Packer - Build machine images\\\\" class=\\\\"style_focusIndicator__uTVwt\\\\" data-radix-collection-item=\\\\" href=\\\\"/packer\\\\"><div class=\\\\"style_productWrapper__ACHaw\\\\"><div class=\\\\"style_productLogo__cTxLO\\\\"><span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></div><div class=\\\\"style_productTextContent__o8DJ6\\\\"><span>Packer</span><span class=\\\\"style_productDesc__bi44f\\\\">Build machine images</span></div></div></a></li><li><a aria-label=\\\\"Nomad - Orchestrate workloads\\\\" class=\\\\"style_focusIndicator__uTVwt\\\\" data-radix-collection-item=\\\\" href=\\\\"/nomad\\\\"><div class=\\\\"style_productWrapper__ACHaw\\\\"><div class=\\\\"style_productLogo__cTxLO\\\\"><span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></div><div class=\\\\"style_productTextContent__o8DJ6\\\\"><span>Nomad</span><span class=\\\\"style_productDesc__bi44f\\\\">Orchestrate workloads</span></div></div></a></li><li><a aria-label=\\\\"Waypoint - Standardize application patterns\\\\" class=\\\\"style_focusIndicator__uTVwt\\\\" data-radix-collection-item=\\\\" href=\\\\"/waypoint\\\\"><div class=\\\\"style_productWrapper__ACHaw\\\\"><div class=\\\\"style_productLogo__cTxLO\\\\"><span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></div><div class=\\\\"style_productTextContent__o8DJ6\\\\"><span>Waypoint</span><span class=\\\\"style_productDesc__bi44f\\\\">Standardize application patterns</span></div></div></a></li><li><a aria-label=\\\\"Vagrant - Build developer environments\\\\" class=\\\\"style_focusIndicator__uTVwt\\\\" data-radix-collection-item=\\\\" href=\\\\"/vagrant\\\\"><div class=\\\\"style_productWrapper__ACHaw\\\\"><div class=\\\\"style_productLogo__cTxLO\\\\"><span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></div><div class=\\\\"style_productTextContent__o8DJ6\\\\"><span>Vagrant</span><span class=\\\\"style_productDesc__bi44f\\\\">Build developer environments</span></div></div></a></li></ul></li><li>
```

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```
style_focusIndicator__uTVwt\\\\\\\\\\\\\\" href=\\\\\\\\\\\\\\"/tutorials\\\\\\\\\\\\\\\\\\"><div
class=\\\\\\\\\\\\\\"style_iconBackground__fn5_s\\\\\\\\\\\\\\\\\\"><span data-
placeholder=\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\\\">[SVG Icon]</span></div><div
class=\\\\\\\\\\\\\\"style_sidePanelItemContent__xFcSA\\\\\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\"mds-typography-body-200 mds-typography-font-weight-semibold
style_sidePanelText__APb7X\\\\\\\\\\\\\\\\\\">Tutorials</span><span
class=\\\\\\\\\\\\\\"style_sidePanelItemDesc__UrOLh\\\\\\\\\\\\\\\\\\">Learn HashiCorp
products</span></div></a></li><li><a aria-label=\\\\\\\\\\\\\\"Validated Patterns
- Field-tested patterns for using HashiCorp products\\\\\\\\\\\\\\\\\\"
class=\\\\\\\\\\\\\\"style_sidePanelItem__j0j0G
style_focusIndicator__uTVwt\\\\\\\\\\\\\\\\\\" href=\\\\\\\\\\\\\\"/validated-
patterns\\\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\"style_iconBackground__fn5_s\\\\\\\\\\\\\\\\\\">
<span data-placeholder=\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\\\">[SVG Icon]</span></div><div
class=\\\\\\\\\\\\\\"style_sidePanelItemContent__xFcSA\\\\\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\"mds-typography-body-200 mds-typography-font-weight-semibold
style_sidePanelText__APb7X\\\\\\\\\\\\\\\\\\">Validated Patterns</span><span
class=\\\\\\\\\\\\\\"style_sidePanelItemDesc__UrOLh\\\\\\\\\\\\\\\\\\">Field-tested patterns
for using HashiCorp products</span></div></a></li><li><a aria-
label=\\\\\\\\\\\\\\"Well-Architected Framework - Adopt HashiCorp best
practices\\\\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\"style_sidePanelItem__j0j0G
style_focusIndicator__uTVwt\\\\\\\\\\\\\\\\\\" href=\\\\\\\\\\\\\\"/well-architected-
framework\\\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\"style_iconBackground__fn5_s\\\\\\\\\\\\\\\\\\">
<span data-placeholder=\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\\\">[SVG Icon]</span></div><div
class=\\\\\\\\\\\\\\"style_sidePanelItemContent__xFcSA\\\\\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\"mds-typography-body-200 mds-typography-font-weight-semibold
style_sidePanelText__APb7X\\\\\\\\\\\\\\\\\\">Well-Architected Framework</span><span
class=\\\\\\\\\\\\\\"style_sidePanelItemDesc__UrOLh\\\\\\\\\\\\\\\\\\">Adopt HashiCorp best
practices</span></div></a></li></ul></div></div></div></div></nav></div>
<div class=\\\\\\\\\\\\\\"product-page-content_productLinkAndNav__YTzcr\\\\\\\\\\\\\\\\\\"><a
aria-label=\\\\\\\\\\\\\\"Vault home\\\\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\"product-icon-text-
link_root__bNTSz g-focus-ring-from-box-shadow-dark\\\\\\\\\\\\\\\\\\"
href=\\\\\\\\\\\\\\"/vault\\\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\"product-icon-text-
lockup_root__358wV\\\\\\\\\\\\\\\\\\"><span data-placeholder=\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\\\">
[SVG Icon]</span><span class=\\\\\\\\\\\\\\"product-icon-text-lockup_text__nHTL7
hds-typography-body-200\\\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-wrapper\\\\\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none
immersive-translate-target-translation-inline-wrapper-theme-none immersive-
translate-target-translation-inline-wrapper\\\\\\\\\\\\\\\\\\" data-immersive-
translate-translation-element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-
translate-target-translation-theme-none-inner\\\\\\\\\\\\\\\\\\" data-immersive-
translate-translation-element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\\\">库</font></font>
</font></span></div></a><nav aria-label=\\\\\\\\\\\\\\"Main\\\\\\\\\\\\\\\\\\" data-
orientation=\\\\\\\\\\\\\\"horizontal\\\\\\\\\\\\\\\\\\" dir=\\\\\\\\\\\\\\"ltr\\\\\\\\\\\\\\\\\\"
class=\\\\\\\\\\\\\\"nav-bar-list-container_nav__C_i0\\\\\\\\\\\\\\\\\\"><div><ul data-
orientation=\\\\\\\\\\\\\\"horizontal\\\\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\"nav-bar-list-
container_ul__04HI\\\\\\\\\\\\\\\\\\" dir=\\\\\\\\\\\\\\"ltr\\\\\\\\\\\\\\\\\\"><li><a aria-
label=\\\\\\\\\\\\\\"Vault Install\\\\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\"primary-nav-
link_root__RXZIC g-focus-ring-from-box-shadow-dark\\\\\\\\\\\\\\\\\\"
href=\\\\\\\\\\\\\\"/vault/install\\\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\"text_root__r0DFB
hds-typography-body-200 hds-font-weight-medium primary-nav-
link_linkText__5800C\\\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-wrapper\\\\\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\\\"><font
```

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```
content_navDropdown__UZHHM\\\\\\\\\\\\"><nav aria-label=\\\\\\\\\\\\\\"Main\\\\\\\\\\\\\\"
data-orientation=\\\\\\\\\\\\\\"horizontal\\\\\\\\\\\\\\" dir=\\\\\\\\\\\\\\"ltr\\\\\\\\\\\\\\"><div
class=\\\\\\\\\\\\\\"sandbox-dropdown_root__qb85W theme-light\\\\\\\\\\\\\\"><div
class=\\\\\\\\\\\\\\"sandbox-dropdown_activatorWrapper__cRYfX\\\\\\\\\\\\\\"><button
aria-controls=\\\\\\\\\\\\\\"sandbox-dropdown-menu-react-aria-327\\\\\\\\\\\\\\" aria-
expanded=\\\\\\\\\\\\\\"false\\\\\\\\\\\\\\" aria-label=\\\\\\\\\\\\\\"Vault Sandbox\\\\\\\\\\\\\\"
class=\\\\\\\\\\\\\\"sandbox-dropdown_activator__t6ucA g-focus-ring-from-box-
shadow-dark\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-
body-200 hds-font-weight-medium sandbox-
dropdown_activatorText__f_07x\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\"nottranslate
immersive-translate-target-wrapper\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none
immersive-translate-target-translation-inline-wrapper-theme-none immersive-
translate-target-translation-inline-wrapper\\\\\\\\\\\\\\" data-immersive-
translate-translation-element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-
translate-target-translation-theme-none-inner\\\\\\\\\\\\\\" data-immersive-
translate-translation-element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\">沙盒</font></font>
</font></span><span data-placeholder=\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\">[SVG Icon]
</span></button></div></div></nav></div></li><li><a aria-
label=\\\\\\\\\\\\\\"Vault Integrations\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\"primary-nav-
link_root__RXZIC g-focus-ring-from-box-shadow-dark\\\\\\\\\\\\\\"
href=\\\\\\\\\\\\\\"/vault/integrations\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
medium primary-nav-link_linkText__5800C\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\"
lang=\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\\\\\\\\\\\" data-immersive-translate-translation-
element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\">集成</font></font></font></span></a></li><li><a aria-
label=\\\\\\\\\\\\\\"Vault Try Cloud\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\"primary-nav-
link_root__RXZIC g-focus-ring-from-box-shadow-dark\\\\\\\\\\\\\\" aria-
describedby=\\\\\\\\\\\\\\"opens-in-new-tab-label-react-aria-329\\\\\\\\\\\\\\"
target=\\\\\\\\\\\\\\"_blank\\\\\\\\\\\\\\"
href=\\\\\\\\\\\\\\"https://portal.cloud.hashicorp.com/sign-up\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
medium primary-nav-link_linkText__5800C\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\"
lang=\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\\\\\\\\\\\" data-immersive-translate-translation-
element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\">试用云</font></font></font></span><span data-
placeholder=\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\">[SVG Icon]</span></a><span
class=\\\\\\\\\\\\\\"g-screen-reader-only\\\\\\\\\\\\\\" id=\\\\\\\\\\\\\\"opens-in-new-tab-
label-react-aria-329\\\\\\\\\\\\\\">(opens in new tab)</span></li></ul></div>
</nav></div></div><div class=\\\\\\\\\\\\\\"navigation-
```

```
header_rightSide___Vvh_\\\\\\\\\\\\"><button aria-label=\\\\\\\\\\\\\\"Search\\\\\\\\\\\\\\\\\\"
class=\\\\\\\\\\\\\\"command-bar-activator_root__qgVMy g-focus-ring-from-box-
shadow-dark\\\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\"command-bar-
activator_left__ATQTg\\\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\"command-bar-
activator_leadingIcon__jECP5\\\\\\\\\\\\\\\\\\"><span data-placeholder=\\\\\\\\\\\\\\"svg-
icon\\\\\\\\\\\\\\\\\\">[SVG Icon]</span></span><span class=\\\\\\\\\\\\\\"text_root__r0DFB
hds-typography-body-200 hds-font-weight-regular command-bar-
activator_text__pTZN_\\\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-wrapper\\\\\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none
immersive-translate-target-translation-inline-wrapper-theme-none immersive-
translate-target-translation-inline-wrapper\\\\\\\\\\\\\\\\\\" data-immersive-
translate-translation-element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-
translate-target-translation-theme-none-inner\\\\\\\\\\\\\\\\\\" data-immersive-
translate-translation-element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\\\">搜索</font></font>
</font></span></span><span class=\\\\\\\\\\\\\\"command-bar-
activator_right__XeJfJ\\\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\"g-screen-reader-
only\\\\\\\\\\\\\\\\\\">Command or control key</span><span aria-
hidden=\\\\\\\\\\\\\\"true\\\\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\"badge_root___Z7Nt
badge_small__GI0Zk badge_filled-neutral-dark-mode__VC3Ba command-bar-
activator_keyBadge__xnKpi\\\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\"cmd-ctrl-
icon_root__TToz\\\\\\\\\\\\\\\\\\"><span data-placeholder=\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\\\">
[SVG Icon]</span></div></span><span class=\\\\\\\\\\\\\\"g-screen-reader-
only\\\\\\\\\\\\\\\\\\">K key</span><span aria-hidden=\\\\\\\\\\\\\\"true\\\\\\\\\\\\\\\\\\"
class=\\\\\\\\\\\\\\"badge_root___Z7Nt badge_small__GI0Zk badge_filled-neutral-
dark-mode__VC3Ba command-bar-activator_keyBadge__xnKpi\\\\\\\\\\\\\\\\\\"><div
class=\\\\\\\\\\\\\\"k-icon_root__a_5pR\\\\\\\\\\\\\\\\\\"><span data-
placeholder=\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\\\">[SVG Icon]</span></div></span></span>
</button><div class=\\\\\\\\\\\\\\"navigation-
header_authenticationControls__EP1LY\\\\\\\\\\\\\\\\\\"><div
class=\\\\\\\\\\\\\\"disclosure_root__rcBaW dropdown-disclosure_root__pzZlN
dropdown-disclosure_list-position--right__WP_Kj\\\\\\\\\\\\\\\\\\"><button aria-
controls=\\\\\\\\\\\\\\"disclosure-react-aria-330-content\\\\\\\\\\\\\\\\\\" aria-
expanded=\\\\\\\\\\\\\\"false\\\\\\\\\\\\\\\\\\" aria-label=\\\\\\\\\\\\\\"User menu\\\\\\\\\\\\\\\\\\"
class=\\\\\\\\\\\\\\"disclosure_activator__pORI0 activator_root__pOfAQ dropdown-
disclosure_activator__nGgNo navigation-
header_userDropdownDisclosureActivator__RayIV g-focus-ring-from-box-shadow-
dark activator_hasIcon__5HO6W g-focus-ring-from-box-shadow\\\\\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\"activator_childrenWrapper__kaK0w\\\\\\\\\\\\\\\\\\"><span data-
placeholder=\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\\\">[SVG Icon]</span></span><span
class=\\\\\\\\\\\\\\"activator_chevronWrapper__4_AVG\\\\\\\\\\\\\\\\\\"><span data-
placeholder=\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\\\">[SVG Icon]</span></span></button><div
class=\\\\\\\\\\\\\\"disclosure_contentContainer__QQ4kt dropdown-
disclosure_content__ZZRPG undefined\\\\\\\\\\\\\\\\\\" id=\\\\\\\\\\\\\\"disclosure-react-
aria-330-content\\\\\\\\\\\\\\\\\\"><ul class=\\\\\\\\\\\\\\"dropdown-
disclosure_list__urBXU\\\\\\\\\\\\\\\\\\"><li class=\\\\\\\\\\\\\\"list-
item_root__ZdUej\\\\\\\\\\\\\\\\\\"><button class=\\\\\\\\\\\\\\"list-item_button__nXy5K g-
focus-ring-from-box-shadow\\\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\"text_root__r0DFB
hds-typography-body-200 hds-font-weight-medium\\\\\\\\\\\\\\\\\\">Sign in</span>
</button></li><li class=\\\\\\\\\\\\\\"list-item_root__ZdUej\\\\\\\\\\\\\\\\\\"><a
class=\\\\\\\\\\\\\\"list-item_link__l6lDd g-focus-ring-from-box-shadow\\\\\\\\\\\\\\\\\\"
href=\\\\\\\\\\\\\\"/sign-up\\\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\"text_root__r0DFB hds-
typography-body-200 hds-font-weight-medium\\\\\\\\\\\\\\\\\\">Sign up</span></a></li>
```

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<li class=\\\\"list-item_root__ZdUej\\\\"><hr class=\\\\"list-item_separator__cBVLs\\\\" /></li><li class=\\\\"list-item_root__ZdUej user-dropdown-switcher_listItem__Q_GIj hds-font-weight-medium\\\\"><label class=\\\\"theme-switcher_label__7Boh2 hds-typography-body-200\\\\" for=\\\\"react-aria-332\\\\">Theme</label><div class=\\\\"theme-switcher_root__hYLSl\\\\"><span class=\\\\"theme-switcher_themeIcon__CXlZj\\\\"><span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></span><select class=\\\\"theme-switcher_select__clj_8 g-focus-ring-from-box-shadow-dark hds-font-weight-medium hds-typography-body-100\\\\" id=\\\\"react-aria-332\\\\"><option value=\\\\"dark\\\\">Dark</option><option value=\\\\"light\\\\">Light</option><option value=\\\\"system\\\\">System</option></select><span class=\\\\"theme-switcher_trailingIcon__fW6AC\\\\"><span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></span></div></li></ul></div></div><div><button aria-label=\\\\"Open navigation menu\\\\" class=\\\\"navigation-header_mobileMenuButton__74S4w\\\\"><span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></button></div><div class=\\\\"base-layout_contentArea__BMvQn\\\\"><div class=\\\\"sidebar-sidecar-layout_root__h5rD8 sidebar-sidecar-layout_mainWidth-wide__TwGq8\\\\"><div class=\\\\"mobile-menu-container_root__fPUFu sidebar-sidecar-layout_sidebarContainer__4fcF8\\\\"><div class=\\\\"sidebar-sidecar-layout_sidebarContentWrapper__ftn5q\\\\"><div class=\\\\"g-show-with-mobile-menu mobile-menu-container_mobileAuthenticationControlsWrap__8lAp2 sidebar-sidecar-layout_mobileAuthControlsContainer__ddlYG sidebar-sidecar-layout_sidePadding__iwNw\\\\"><div class=\\\\"mobile-menu-container_unauthenticatedControls__CJQpx\\\\"><div class=\\\\"mobile-menu-container_unauthenticatedControlButtons__jLKuK\\\\"><button class=\\\\"button_root__itF9E hds-font-weight-medium button_medium__Cm2eg button_primary__rds5q\\\\" type=\\\\"button\\\\"><span>Sign In</span></button><a class=\\\\"button-link_root__GwxM hds-font-weight-medium button-link_medium__a2_tZ button-link_secondary__5TbbU\\\\" href=\\\\"/sign-up\\\\">Sign Up</a></div><div class=\\\\"mobile-menu-container_themeSwitcher__xqlMF hds-font-weight-medium\\\\"><label class=\\\\"theme-switcher_label__7Boh2 hds-typography-body-200\\\\" for=\\\\"react-aria-334\\\\">Theme</label><div class=\\\\"theme-switcher_root__hYLSl\\\\"><span class=\\\\"theme-switcher_themeIcon__CXlZj\\\\"><span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></span><select class=\\\\"theme-switcher_select__clj_8 g-focus-ring-from-box-shadow-dark hds-font-weight-medium hds-typography-body-100\\\\" id=\\\\"react-aria-334\\\\"><option value=\\\\"dark\\\\">Dark</option><option value=\\\\"light\\\\">Light</option><option value=\\\\"system\\\\">System</option></select><span class=\\\\"theme-switcher_trailingIcon__fW6AC\\\\"><span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></span></div></div></div><div class=\\\\"sidebar-sidecar-layout_sidePadding__iwNw\\\\"><div class=\\\\"sidebar_sidebar__fTlC\\\\"><div class=\\\\"sidebar_backToLinkWrapper__F6iIs\\\\"><div
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translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">关于 Vault</font></font></font></span><div
class=\\\\\\\\\\\\\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\\\\\\\\\\\\\">
<span data-placeholder=\\\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\">[SVG Icon]</span></div>
</button></li><li id=\\\\\\\\\\\\\\\\"sidebar-nav-item-11\\\\\\\\\\\\\\\\"><button
class=\\\\\\\\\\\\\\\\"sidebar-nav-menu-item_sidebarNavMenuItem__PiyI8 g-focus-ring-
from-box-shadow\\\\\\\\\\\\\\\\" id=\\\\\\\\\\\\\\\\"sidebar-nav-item-11-button\\\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\"
lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-translate-translation-
element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">伙伴 关系</font></font></font></span><div
class=\\\\\\\\\\\\\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\\\\\\\\\\\\\">
<span data-placeholder=\\\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\">[SVG Icon]</span></div>
</button></li><li id=\\\\\\\\\\\\\\\\"sidebar-nav-item-17\\\\\\\\\\\\\\\\"><button
class=\\\\\\\\\\\\\\\\"sidebar-nav-menu-item_sidebarNavMenuItem__PiyI8 g-focus-ring-
from-box-shadow\\\\\\\\\\\\\\\\" id=\\\\\\\\\\\\\\\\"sidebar-nav-item-17-button\\\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\"
lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-translate-translation-
element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">关键概念</font></font></font></span><div
class=\\\\\\\\\\\\\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\\\\\\\\\\\\\">
<span data-placeholder=\\\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\">[SVG Icon]</span></div>
</button></li><li id=\\\\\\\\\\\\\\\\"sidebar-nav-item-59\\\\\\\\\\\\\\\\"><button
class=\\\\\\\\\\\\\\\\"sidebar-nav-menu-item_sidebarNavMenuItem__PiyI8 g-focus-ring-
from-box-shadow\\\\\\\\\\\\\\\\" id=\\\\\\\\\\\\\\\\"sidebar-nav-item-59-button\\\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\"
lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-translate-translation-
element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">快速入门</font></font></font></span><div
class=\\\\\\\\\\\\\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\\\\\\\\\\\\\">
<span data-placeholder=\\\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\">[SVG Icon]</span></div>
</button></li><li id=\\\\\\\\\\\\\\\\"sidebar-nav-item-64\\\\\\\\\\\\\\\\"><button
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translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">许可证库</font></font></font></span><div
class=\\\\\\\\\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\\\\\\\\\\\\\">
<span class=\\\\\\\\\\\\"g-screen-reader-only\\\\\\\\\\\\\\\\">ENT</span><span aria-
hidden=\\\\\\\\\\\\"true\\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\"badge_root___Z7Nt
badge_small__GI0Zk badge_filled-neutral__NhUW0\\\\\\\\\\\\\\\\"><span><font
class=\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\"
lang=\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-translate-translation-
element-mark=\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">耳鼻喉科</font></font></font></span></span><span
data-placeholder=\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\">[SVG Icon]</span></div></button>
</li><li id=\\\\\\\\\\\\"sidebar-nav-item-88\\\\\\\\\\\\\\\\"><button
class=\\\\\\\\\\\\"sidebar-nav-menu-item_sidebarNavMenuItem__PiyI8 g-focus-ring-
from-box-shadow\\\\\\\\\\\\\\\\" id=\\\\\\\\\\\\"sidebar-nav-item-88-button\\\\\\\\\\\\\\\\" aria-
controls=\\\\\\\\\\\\"sidebar-nav-item-88-list\\\\\\\\\\\\\\\\" aria-
expanded=\\\\\\\\\\\\"true\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\"text_root__r0DFB hds-
typography-body-200 hds-font-weight-regular sidebar-nav-menu-
item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\"nottranslate
immersive-translate-target-wrapper\\\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none
immersive-translate-target-translation-inline-wrapper-theme-none immersive-
translate-target-translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-
translate-translation-element-mark=\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-
translate-target-translation-theme-none-inner\\\\\\\\\\\\\\\\" data-immersive-
translate-translation-element-mark=\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">配置 Vault</font>
</font></font></span><div class=\\\\\\\\\\\\"sidebar-nav-menu-
item_rightIconsContainer__hynke\\\\\\\\\\\\\\\\"><span data-placeholder=\\\\\\\\\\\\"svg-
icon\\\\\\\\\\\\\\\\">[SVG Icon]</span></div></button><ul id=\\\\\\\\\\\\"sidebar-nav-
item-88-list\\\\\\\\\\\\\\\\"><li id=\\\\\\\\\\\\"sidebar-nav-item-89\\\\\\\\\\\\\\\\"><a
class=\\\\\\\\\\\\"sidebar-nav-menu-item_sidebarNavMenuItem__PiyI8 g-focus-ring-
from-box-shadow\\\\\\\\\\\\\\\\" href=\\\\\\\\\\\\"/vault/docs/configuration\\\\\\\\\\\\\\\\">
<span class=\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-
weight-regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\"
lang=\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-translate-translation-
element-mark=\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">参数概述</font></font></font></span></a></li><li
id=\\\\\\\\\\\\"sidebar-nav-item-90\\\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\"sidebar-nav-menu-
item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\\\\\\\\\\\\\"
href=\\\\\\\\\\\\"/vault/docs/configuration/ui\\\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\\"><font
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from-box-shadow\\\\\\\\\\\\\\" href=\\\\\\\\\\\\\\"/vault/docs/configuration/create-lease-count-quota\\\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\\\"><br hidden=\\\\\\\\\\\\\\\\\\"\\\\\\\\\\\\\\\\\\" /><font class=\\\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none immersive-translate-target-translation-block-wrapper-theme-none immersive-translate-target-translation-block-wrapper\\\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-mark=\\\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-translate-target-translation-theme-none-inner\\\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-mark=\\\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\\\">创建租约计数配额</font></font></font></span><div class=\\\\\\\\\\\\\\\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\\\\\"g-screen-reader-only\\\\\\\\\\\\\\\\\\">ENT</span><span aria-hidden=\\\\\\\\\\\\\\\\\\"true\\\\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\\\\\"badge_root__Z7Nt badge_small__GI0Zk badge_filled-neutral__NhUW0\\\\\\\\\\\\\\\\\\"><span><font class=\\\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none immersive-translate-target-translation-inline-wrapper-theme-none immersive-translate-target-translation-inline-wrapper\\\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-mark=\\\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-translate-target-translation-theme-none-inner\\\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-mark=\\\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\\\">耳鼻喉科</font></font></font></span></span></div></a></li><li id=\\\\\\\\\\\\\\\\\\"sidebar-nav-item-95\\\\\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\\\\\\\"sidebar-nav-menu-item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\\\\\\\\\\\\\\\" href=\\\\\\\\\\\\\\\\\\"/vault/docs/configuration/create-rate-limit-quota\\\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\\\"><br hidden=\\\\\\\\\\\\\\\\\\"\\\\\\\\\\\\\\\\\\" /><font class=\\\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none immersive-translate-target-translation-block-wrapper-theme-none immersive-translate-target-translation-block-wrapper\\\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-mark=\\\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-translate-target-translation-theme-none-inner\\\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-mark=\\\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\\\">创建速率限制配额</font></font></font></span></a></li><li id=\\\\\\\\\\\\\\\\\\"sidebar-nav-item-96\\\\\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\\\\\\\"sidebar-nav-menu-item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\\\\\\\\\\\\\\\" href=\\\\\\\\\\\\\\\\\\"/vault/docs/configuration/identity-based-rate-limit\\\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\\\"><br hidden=\\\\\\\\\\\\\\\\\\"\\\\\\\\\\\\\\\\\\" /><font class=\\\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none immersive-translate-target-translation-block-wrapper-theme-none immersive-translate-target-translation-block-wrapper\\\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-mark=\\\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-translate-target-translation-theme-none-inner\\\\\\\\\\\\\\\\\\" data-immersive-
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translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">速率限制配额 group_by 模  
式</font></font></font></span><div class=\\\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_rightIconsContainer_hynke\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\\\"g-screen-  
reader-only\\\\\\\\\\\\\\\\">ENT</span><span aria-hidden=\\\\\\\\\\\\\\\\"true\\\\\\\\\\\\\\\\"  
class=\\\\\\\\\\\\\\\\"badge_root___Z7Nt badge_small_GI0Zk badge_filled-  
neutral_NhUW0\\\\\\\\\\\\\\\\"><span><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-  
translate-target-wrapper\\\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font  
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none  
immersive-translate-target-translation-inline-wrapper-theme-none immersive-  
translate-target-translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-  
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class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-  
translate-target-translation-theme-none-inner\\\\\\\\\\\\\\\\" data-immersive-  
translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">耳鼻喉科</font></font>  
</font></span></span></div></a></li><li id=\\\\\\\\\\\\\\\\"sidebar-nav-item-  
97\\\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\\\\\"sidebar-nav-menu-item_sidebarNavMenuItem_PiyI8  
g-focus-ring-from-box-shadow\\\\\\\\\\\\\\\\"  
href=\\\\\\\\\\\\\\\\"/vault/docs/configuration/log-requests-level\\\\\\\\\\\\\\\\"><span  
class=\\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-  
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\\"><font  
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\"  
lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><br hidden=\\\\\\\\\\\\\\\\"\\\\\\\\\\\\\\\\" /><font  
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none  
immersive-translate-target-translation-block-wrapper-theme-none immersive-  
translate-target-translation-block-wrapper\\\\\\\\\\\\\\\\" data-immersive-  
translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font  
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-  
translate-target-translation-theme-none-inner\\\\\\\\\\\\\\\\" data-immersive-  
translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">配置已完成的请求日志记录  
</font></font></font></span></a></li><li id=\\\\\\\\\\\\\\\\"sidebar-nav-item-  
98\\\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\\\\\"sidebar-nav-menu-item_sidebarNavMenuItem_PiyI8  
g-focus-ring-from-box-shadow\\\\\\\\\\\\\\\\"  
href=\\\\\\\\\\\\\\\\"/vault/docs/configuration/entropy-augmentation\\\\\\\\\\\\\\\\"><span  
class=\\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-  
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\\"><font  
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\"  
lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><br hidden=\\\\\\\\\\\\\\\\"\\\\\\\\\\\\\\\\" /><font  
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none  
immersive-translate-target-translation-block-wrapper-theme-none immersive-  
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translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font  
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-  
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translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">配置熵增强</font></font>  
</font></span><div class=\\\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_rightIconsContainer_hynke\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\\\"g-screen-  
reader-only\\\\\\\\\\\\\\\\">ENT</span><span aria-hidden=\\\\\\\\\\\\\\\\"true\\\\\\\\\\\\\\\\"  
class=\\\\\\\\\\\\\\\\"badge_root___Z7Nt badge_small_GI0Zk badge_filled-  
neutral_NhUW0\\\\\\\\\\\\\\\\"><span><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-  
translate-target-wrapper\\\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font  
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none  
immersive-translate-target-translation-inline-wrapper-theme-none immersive-  
translate-target-translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-  
translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font
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item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\\\\\\\\\\\  
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regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\">  
<code>listener</code></span><div class=\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_rightIconsContainer__hynke\\\\\\\\\\\\\\"><span data-placeholder=\\\\\\\\\\\\\\"svg-  
icon\\\\\\\\\\\\\\">[SVG Icon]</span></div></button></li><li id=\\\\\\\\\\\\\\"sidebar-  
nav-item-108\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\\\"sidebar-nav-menu-  
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href=\\\\\\\\\\\\\\"/vault/docs/configuration/replication\\\\\\\\\\\\\\"><span  
class=\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-  
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\">  
<code>replication</code></span><div class=\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_rightIconsContainer__hynke\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\"g-screen-  
reader-only\\\\\\\\\\\\\\">ENT</span><span aria-hidden=\\\\\\\\\\\\\\"true\\\\\\\\\\\\\\"  
class=\\\\\\\\\\\\\\"badge_root__Z7Nt badge_small__GI0Zk badge_filled-  
neutral__NhUW0\\\\\\\\\\\\\\"><span><font class=\\\\\\\\\\\\\\"nottranslate immersive-  
translate-target-wrapper\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\"><font  
class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none  
immersive-translate-target-translation-inline-wrapper-theme-none immersive-  
translate-target-translation-inline-wrapper\\\\\\\\\\\\\\" data-immersive-  
translate-translation-element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\"><font  
class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-  
translate-target-translation-theme-none-inner\\\\\\\\\\\\\\" data-immersive-  
translate-translation-element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\">耳鼻喉科</font></font>  
</font></span></span></div></a></li><li id=\\\\\\\\\\\\\\"sidebar-nav-item-  
109\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\\\\\\\\\\\"  
href=\\\\\\\\\\\\\\"/vault/docs/configuration/reporting\\\\\\\\\\\\\\"><span  
class=\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-  
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\">  
<code>reporting</code></span><div class=\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_rightIconsContainer__hynke\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\"g-screen-  
reader-only\\\\\\\\\\\\\\">ENT</span><span aria-hidden=\\\\\\\\\\\\\\"true\\\\\\\\\\\\\\"  
class=\\\\\\\\\\\\\\"badge_root__Z7Nt badge_small__GI0Zk badge_filled-  
neutral__NhUW0\\\\\\\\\\\\\\"><span><font class=\\\\\\\\\\\\\\"nottranslate immersive-  
translate-target-wrapper\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\"><font  
class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none  
immersive-translate-target-translation-inline-wrapper-theme-none immersive-  
translate-target-translation-inline-wrapper\\\\\\\\\\\\\\" data-immersive-  
translate-translation-element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\"><font  
class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-  
translate-target-translation-theme-none-inner\\\\\\\\\\\\\\" data-immersive-  
translate-translation-element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\">耳鼻喉科</font></font>  
</font></span></span></div></a></li><li id=\\\\\\\\\\\\\\"sidebar-nav-item-  
110\\\\\\\\\\\\\\"><button class=\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\\\\\\\\\\\"  
id=\\\\\\\\\\\\\\"sidebar-nav-item-110-button\\\\\\\\\\\\\\"><span  
class=\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-  
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\">  
<code>seal</code></span><div class=\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_rightIconsContainer__hynke\\\\\\\\\\\\\\"><span data-placeholder=\\\\\\\\\\\\\\"svg-  
icon\\\\\\\\\\\\\\">[SVG Icon]</span></div></button></li><li id=\\\\\\\\\\\\\\"sidebar-  
nav-item-123\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\\\"sidebar-nav-menu-
```



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item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\\\\\\\\\\\  
href=\\\\\\\\\\\\\\\"/vault/docs/configuration/sentinel\\\\\\\\\\\\\\\"><span  
class=\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-  
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\">  
<code>sentinel</code></span><div class=\\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_rightIconsContainer__hynke\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\\"g-screen-  
reader-only\\\\\\\\\\\\\\\">ENT</span><span aria-hidden=\\\\\\\\\\\\\\\"true\\\\\\\\\\\\\\\"  
class=\\\\\\\\\\\\\\\"badge_root__Z7Nt badge_small__GI0Zk badge_filled-  
neutral__NhUW0\\\\\\\\\\\\\\\"><span>ENT</span></span></div></a></li><li  
id=\\\\\\\\\\\\\\\"sidebar-nav-item-124\\\\\\\\\\\\\\\"><button class=\\\\\\\\\\\\\\\"sidebar-nav-  
menu-item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\\\\\\\\\\\\"  
id=\\\\\\\\\\\\\\\"sidebar-nav-item-124-button\\\\\\\\\\\\\\\"><span  
class=\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-  
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\">  
<code>service_registration</code></span><div class=\\\\\\\\\\\\\\\"sidebar-nav-  
menu-item_rightIconsContainer__hynke\\\\\\\\\\\\\\\"><span data-  
placeholder=\\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\">[SVG Icon]</span></div></button></li>  
<li id=\\\\\\\\\\\\\\\"sidebar-nav-item-129\\\\\\\\\\\\\\\"><button class=\\\\\\\\\\\\\\\"sidebar-  
nav-menu-item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-  
shadow\\\\\\\\\\\\\\\" id=\\\\\\\\\\\\\\\"sidebar-nav-item-129-button\\\\\\\\\\\\\\\"><span  
class=\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-  
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\">  
<code>storage</code></span><div class=\\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_rightIconsContainer__hynke\\\\\\\\\\\\\\\"><span data-placeholder=\\\\\\\\\\\\\\\"svg-  
icon\\\\\\\\\\\\\\\">[SVG Icon]</span></div></button></li><li id=\\\\\\\\\\\\\\\"sidebar-  
nav-item-155\\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\\\\\\\\\\\\"  
href=\\\\\\\\\\\\\\\"/vault/docs/configuration/telemetry\\\\\\\\\\\\\\\"><span  
class=\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-  
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\">  
<code>telemetry</code></span></a></li><li id=\\\\\\\\\\\\\\\"sidebar-nav-item-  
156\\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\\\\\\\\\\\\"  
href=\\\\\\\\\\\\\\\"/vault/docs/configuration/user-lockout\\\\\\\\\\\\\\\"><span  
class=\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-  
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\">  
<code>user_lockout</code></span></a></li></ul></li><li id=\\\\\\\\\\\\\\\"sidebar-  
nav-item-157\\\\\\\\\\\\\\\"><button class=\\\\\\\\\\\\\\\"sidebar-nav-menu-  
item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\\\\\\\\\\\\"  
id=\\\\\\\\\\\\\\\"sidebar-nav-item-157-button\\\\\\\\\\\\\\\"><span  
class=\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-  
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\\\\\\\\\\\\"><font  
class=\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\"  
lang=\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\"nottranslate immersive-  
translate-target-translation-theme-none immersive-translate-target-  
translation-inline-wrapper-theme-none immersive-translate-target-  
translation-inline-wrapper\\\\\\\\\\\\\\\" data-immersive-translate-translation-  
element-mark=\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\"nottranslate immersive-  
translate-target-inner immersive-translate-target-translation-theme-none-  
inner\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-  
mark=\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\">部署保管库</font></font></font></span><div  
class=\\\\\\\\\\\\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\\\\\\\\\\\\">  
<span data-placeholder=\\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\">[SVG Icon]</span></div>  
</button></li><li id=\\\\\\\\\\\\\\\"sidebar-nav-item-224\\\\\\\\\\\\\\\"><button
```

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CLI</span><div class=\\\\"sidebar-nav-menu-
item_rightIconsContainer__hynke\\\\"><span data-placeholder=\\\\"svg-
icon\\\\">[SVG Icon]</span></div></button></li><li id=\\\\"sidebar-
nav-item-400\\\\"><button class=\\\\"sidebar-nav-menu-
item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\"
id=\\\\"sidebar-nav-item-400-button\\\\"><span
class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\">Vault
GUI</span><div class=\\\\"sidebar-nav-menu-
item_rightIconsContainer__hynke\\\\"><span data-placeholder=\\\\"svg-
icon\\\\">[SVG Icon]</span></div></button></li><li id=\\\\"sidebar-
nav-item-407\\\\"><button class=\\\\"sidebar-nav-menu-
item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\"
id=\\\\"sidebar-nav-item-407-button\\\\"><span
class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\"><font
class=\\\\"nottranslate immersive-translate-target-wrapper\\\\"
lang=\\\\"zh-CN\\\\"><br hidden=\\\\"\\\\" /><font
class=\\\\"nottranslate immersive-translate-target-translation-theme-none
immersive-translate-target-translation-block-wrapper-theme-none immersive-
translate-target-translation-block-wrapper\\\\" data-immersive-
translate-translation-element-mark=\\\\"1\\\\"><font
class=\\\\"nottranslate immersive-translate-target-inner immersive-
translate-target-translation-theme-none-inner\\\\" data-immersive-
translate-translation-element-mark=\\\\"1\\\\">Vault 工具：代理和代理
</font></font></font></span><div class=\\\\"sidebar-nav-menu-
item_rightIconsContainer__hynke\\\\"><span data-placeholder=\\\\"svg-
icon\\\\">[SVG Icon]</span></div></button></li><li id=\\\\"sidebar-
nav-item-451\\\\"><button class=\\\\"sidebar-nav-menu-
item_sidebarNavMenuItem__PiyI8 g-focus-ring-from-box-shadow\\\\"
id=\\\\"sidebar-nav-item-451-button\\\\"><span
class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\"><font
class=\\\\"nottranslate immersive-translate-target-wrapper\\\\"
lang=\\\\"zh-CN\\\\"><font class=\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\" data-immersive-translate-translation-
element-mark=\\\\"1\\\\"><font class=\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\" data-immersive-translate-translation-element-
mark=\\\\"1\\\\">Vault MCP 服务器</font></font></font></span><div
class=\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\">
<span class=\\\\"g-screen-reader-only\\\\">BETA</span><span aria-
hidden=\\\\"true\\\\" class=\\\\"badge_root__Z7Nt
badge_small__GI0Zk badge_outlined-highlight__PQxJ1\\\\"><span><font
class=\\\\"nottranslate immersive-translate-target-wrapper\\\\"
lang=\\\\"zh-CN\\\\"><font class=\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\" data-immersive-translate-translation-
element-mark=\\\\"1\\\\"><font class=\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\" data-immersive-translate-translation-element-
```

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lang=\\\\"zh-CN\\\\"><font class=\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\" data-immersive-translate-translation-
element-mark=\\\\"1\\\\"><font class=\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\" data-immersive-translate-translation-element-
mark=\\\\"1\\\\">密钥导入</font></font></font></span><div
class=\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\">
<span class=\\\\"g-screen-reader-only\\\\">ENT</span><span aria-
hidden=\\\\"true\\\\" class=\\\\"badge_root__Z7Nt
badge_small__GI0Zk badge_filled-neutral__NhUW0\\\\"><span><font
class=\\\\"nottranslate immersive-translate-target-wrapper\\\\"
lang=\\\\"zh-CN\\\\"><font class=\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\" data-immersive-translate-translation-
element-mark=\\\\"1\\\\"><font class=\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\" data-immersive-translate-translation-element-
mark=\\\\"1\\\\">耳鼻喉科</font></font></font></span></span><span
data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></div></button>
</li><li id=\\\\"sidebar-nav-item-566\\\\"><button
class=\\\\"sidebar-nav-menu-item_sidebarNavMenuItem__PiyI8 g-focus-ring-
from-box-shadow\\\\" id=\\\\"sidebar-nav-item-566-button\\\\">
<span class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-
weight-regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\"><font
class=\\\\"nottranslate immersive-translate-target-wrapper\\\\"
lang=\\\\"zh-CN\\\\"><font class=\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\" data-immersive-translate-translation-
element-mark=\\\\"1\\\\"><font class=\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\" data-immersive-translate-translation-element-
mark=\\\\"1\\\\">AuthN 方法</font></font></font></span><div
class=\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\">
<span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></div>
</button></li><li id=\\\\"sidebar-nav-item-616\\\\"><button
class=\\\\"sidebar-nav-menu-item_sidebarNavMenuItem__PiyI8 g-focus-ring-
from-box-shadow\\\\" id=\\\\"sidebar-nav-item-616-button\\\\">
<span class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-
weight-regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\"><font
class=\\\\"nottranslate immersive-translate-target-wrapper\\\\"
lang=\\\\"zh-CN\\\\"><font class=\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\" data-immersive-translate-translation-
element-mark=\\\\"1\\\\"><font class=\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\" data-immersive-translate-translation-element-
mark=\\\\"1\\\\">审核日志记录</font></font></font></span><div
class=\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\">
<span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></div>
```



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</button></li><li id=\\\\"sidebar-nav-item-623\\\\"><button
class=\\\\"sidebar-nav-menu-item_sidebarNavMenuItem_PiyI8 g-focus-ring-
from-box-shadow\\\\" id=\\\\"sidebar-nav-item-623-button\\\\">
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class=\\\\"nottranslate immersive-translate-target-wrapper\\\\"
lang=\\\\"zh-CN\\\\"><font class=\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\" data-immersive-translate-translation-
element-mark=\\\\"1\\\\"><font class=\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\" data-immersive-translate-translation-element-
mark=\\\\"1\\\\">插件</font></font></font></span><div
class=\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\">
<span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></div>
</button></li><li id=\\\\"sidebar-nav-item-636\\\\"><button
class=\\\\"sidebar-nav-menu-item_sidebarNavMenuItem_PiyI8 g-focus-ring-
from-box-shadow\\\\" id=\\\\"sidebar-nav-item-636-button\\\\">
<span class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-
weight-regular sidebar-nav-menu-item_navMenuItemLabel__tJHwX\\\\"><font
class=\\\\"nottranslate immersive-translate-target-wrapper\\\\"
lang=\\\\"zh-CN\\\\"><font class=\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\" data-immersive-translate-translation-
element-mark=\\\\"1\\\\"><font class=\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\" data-immersive-translate-translation-element-
mark=\\\\"1\\\\">故障排查 Vault</font></font></font></span><div
class=\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\">
<span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></div>
</button></li><li id=\\\\"sidebar-nav-item-641\\\\"><hr
class=\\\\"sidebar-horizontal-rule_root__UY7oh\\\\" /></li><li
id=\\\\"sidebar-nav-item-642\\\\"><button class=\\\\"sidebar-nav-
menu-item_sidebarNavMenuItem_PiyI8 g-focus-ring-from-box-shadow\\\\"
id=\\\\"sidebar-nav-item-642-button\\\\"><span
class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
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class=\\\\"nottranslate immersive-translate-target-wrapper\\\\"
lang=\\\\"zh-CN\\\\"><font class=\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\" data-immersive-translate-translation-
element-mark=\\\\"1\\\\"><font class=\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\" data-immersive-translate-translation-element-
mark=\\\\"1\\\\">平台</font></font></font></span><div
class=\\\\"sidebar-nav-menu-item_rightIconsContainer__hynke\\\\">
<span data-placeholder=\\\\"svg-icon\\\\">[SVG Icon]</span></div>
</button></li><li id=\\\\"sidebar-nav-item-658\\\\"><hr
class=\\\\"sidebar-horizontal-rule_root__UY7oh\\\\" /></li><li
id=\\\\"sidebar-nav-item-659\\\\"><button class=\\\\"sidebar-nav-
menu-item_sidebarNavMenuItem_PiyI8 g-focus-ring-from-box-shadow\\\\"
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translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-
translate-target-translation-theme-none-inner\\\\\\\\\\\\\\\\" data-immersive-
translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">库</font></font>
</font></a></li><li class=\\\\\\\\\\\\\\\\"text_root__r0DFB hds-typography-body-100
hds-font-weight-medium breadcrumb-bar_listItem__2sevd\\\\\\\\\\\\\\\\"><span
class=\\\\\\\\\\\\\\\\"breadcrumb-bar_breadcrumbText__JvOrd g-focus-ring-from-box-
shadow\\\\\\\\\\\\\\\\" aria-current=\\\\\\\\\\\\\\\\"page\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\"
lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-translate-translation-
element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">文档</font></font></font></span></li></ol></nav>
</div></div><div class=\\\\\\\\\\\\\\\\"sidebar-sidecar-
layout_mainAndSidecar__UDm3Z\\\\\\\\\\\\\\\\"><main id=\\\\\\\\\\\\\\\\"main\\\\\\\\\\\\\\\\"
class=\\\\\\\\\\\\\\\\"sidebar-sidecar-layout_main__0SN51\\\\\\\\\\\\\\\\"><div><header><div
class=\\\\\\\\\\\\\\\\"docs-page-heading_root__QuBg\\\\\\\\\\\\\\\\"><div
class=\\\\\\\\\\\\\\\\"docs-page-heading_versionSwitcherWrapper__bdlWl\\\\\\\\\\\\\\\\"><nav>
<div class=\\\\\\\\\\\\\\\\"disclosure_root__rcBaW dropdown-disclosure_root__pzZlN
dropdown-disclosure_list-position--right__WP_Kj version-
switcher_root__5pTE6\\\\\\\\\\\\\\\\"><button aria-controls=\\\\\\\\\\\\\\\\"disclosure-
react-aria-346-content\\\\\\\\\\\\\\\\" aria-expanded=\\\\\\\\\\\\\\\\"false\\\\\\\\\\\\\\\\" aria-
label=\\\\\\\\\\\\\\\\"Choose a Vault Documentation version. Currently viewing
v1.21.x (latest).\\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\\\"button_root__itF9E hds-font-weight-
medium button_medium__Cm2eg button_secondary__m5f7i
disclosure_activator__pORI0 activator_root__pOfAQ dropdown-
disclosure_activator__nGgNo\\\\\\\\\\\\\\\\" type=\\\\\\\\\\\\\\\\"button\\\\\\\\\\\\\\\\"><span><font
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\"
lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-translate-translation-
element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">v1.21.x (最新版本)</font></font></font></span><span
data-placeholder=\\\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\">[SVG Icon]</span></button><div
class=\\\\\\\\\\\\\\\\"disclosure_contentContainer__QQ4kt dropdown-
disclosure_content__ZZRPG undefined\\\\\\\\\\\\\\\\" id=\\\\\\\\\\\\\\\\"disclosure-react-
aria-346-content\\\\\\\\\\\\\\\\"><ul class=\\\\\\\\\\\\\\\\"dropdown-
disclosure_list__urBXU\\\\\\\\\\\\\\\\"><li class=\\\\\\\\\\\\\\\\"list-
item_root__ZdUej\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\\\"text_root__r0DFB hds-
typography-body-100 hds-font-weight-semibold list-
item_label__9AZsc\\\\\\\\\\\\\\\\">Vault</span></li><li class=\\\\\\\\\\\\\\\\"list-
item_root__ZdUej\\\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\\\\\"list-item_link__16lDd g-focus-
ring-from-box-shadow\\\\\\\\\\\\\\\\" href=\\\\\\\\\\\\\\\\"/vault/docs/v1.20.x\\\\\\\\\\\\\\\\"
rel=\\\\\\\\\\\\\\\\"nofollow\\\\\\\\\\\\\\\\"><span class=\\\\\\\\\\\\\\\\"text_root__r0DFB hds-
typography-body-200 hds-font-weight-medium\\\\\\\\\\\\\\\\">v1.20.x</span></a></li>
<li class=\\\\\\\\\\\\\\\\"list-item_root__ZdUej\\\\\\\\\\\\\\\\"><a class=\\\\\\\\\\\\\\\\"list-
item_link__16lDd g-focus-ring-from-box-shadow\\\\\\\\\\\\\\\\"
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href=\\\\\\\\\\\\\\\\"/vault/docs/v1.19.x\\\\\\\\\\\\\\\\" rel=\\\\\\\\\\\\\\\\"nofollow\\\\\\\\\\\\\\\\">v1.19.x<li class=\\\\\\\\\\\\\\\\"list-item_root__ZdUej\\\\\\\\\\\\\\\\">v1.18.x<li class=\\\\\\\\\\\\\\\\"list-item_root__ZdUej\\\\\\\\\\\\\\\\">v1.17.x<li class=\\\\\\\\\\\\\\\\"list-item_root__ZdUej\\\\\\\\\\\\\\\\">v1.16.x<li class=\\\\\\\\\\\\\\\\"list-item_root__ZdUej\\\\\\\\\\\\\\\\"><hr class=\\\\\\\\\\\\\\\\"separator__Qz7bd spacing-0__w5N00\\\\\\\\\\\\\\\\" /><li class=\\\\\\\\\\\\\\\\"list-item_root__ZdUej\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\\\"alert__j7ZRS type-compact__ptTlw color-critical__3hs0B\\\\\\\\\\\\\\\\" role=\\\\\\\\\\\\\\\\"alert\\\\\\\\\\\\\\\\" aria-live=\\\\\\\\\\\\\\\\"polite\\\\\\\\\\\\\\\\" aria-labelledby=\\\\\\\\\\\\\\\\":r4f:\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\\\"icon__vbZHd\\\\\\\\\\\\\\\\">[SVG Icon]</div><div class=\\\\\\\\\\\\\\\\"content__0FEM2\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\\\"text__qorMN mds-typography-legacy-body-100\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\\\"description__PMYwu mds-typography-font-weight-regular mds-foreground-primary\\\\\\\\\\\\\\\\" id=\\\\\\\\\\\\\\\\":r4f:\\\\\\\\\\\\\\\\">No versions of this document exist before v1.16.x. Click below to redirect to the version homepage.</div></div></div></div><li class=\\\\\\\\\\\\\\\\"list-item_root__ZdUej\\\\\\\\\\\\\\\\">[SVG Icon]v1.15.x<li class=\\\\\\\\\\\\\\\\"list-item_root__ZdUej\\\\\\\\\\\\\\\\">[SVG Icon]v1.14.x<li class=\\\\\\\\\\\\\\\\"list-item_root__ZdUej\\\\\\\\\\\\\\\\">[SVG Icon]v1.13.x<li class=\\\\\\\\\\\\\\\\"list-item_root__ZdUej\\\\\\\\\\\\\\\\">[SVG Icon]v1.12.x

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translate-target-translation-block-wrapper\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">在 HashiCorp 云平台 (HCP) 上运行 Vault</h2><ul class=\\\\\\\\\\\\\\\\"cards-grid-list_listRoot__xMWpJ cards-grid-list_minWidthMode__cPnEx\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\\\"hds-surface-mid card_root__RyqjV card-link_root__xgxTP icon-card-link_root__Bh28M\\\\\\\\\\\\\\\\"><a aria-label=\\\\\\\\\\\\\\\\"Vault Dedicated\\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\\\"card-link_anchor__5xoF\\\\\\\\\\\\\\\\" href=\\\\\\\\\\\\\\\\"/hcp/docs/vault/what-is-hcp-vault\\\\\\\\\\\\\\\\"> [SVG Icon]保险库专用</div><div class=\\\\\\\\\\\\\\\\"hds-surface-mid card_root__RyqjV card-link_root__xgxTP icon-card-link_root__Bh28M\\\\\\\\\\\\\\\\"><a aria-label=\\\\\\\\\\\\\\\\"Vault Radar\\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\\\"card-link_anchor__5xoF\\\\\\\\\\\\\\\\" href=\\\\\\\\\\\\\\\\"/hcp/docs/vault-radar\\\\\\\\\\\\\\\\"> [SVG Icon]金库雷达</div><h2 class=\\\\\\\\\\\\\\\\"hds-typography-display-400 hds-font-weight-bold autosized-heading-block_root__4yPdG g-offset-scroll-margin-top autosized-heading-block_h2__xjxpZ section-heading-block_root__RSPyk\\\\\\\\\\\\\\\\" id=\\\\\\\\\\\\\\\\"why-use-vault\\\\\\\\\\\\\\\\">为什么使用 Vault ?</h2><div class=\\\\\\\\\\\\\\\\"card-grid-block_root__yDdm_\\\\\\\\\\\\\\\\"><ul class=\\\\\\\\\\\\\\\\"cards-grid-list_listRoot__xMWpJ cards-grid-list_minWidthMode__cPnEx cards-grid-

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static secrets\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\"card-link_anchor__5xoF\\\\\\\\\\\\\\"
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<span aria-hidden=\\\\\\\\\\\\\\"true\\\\\\\\\\\\\\"> </span></a><div><span
class=\\\\\\\\\\\\\\"card-title_text__F97Wj hds-typography-body-200 hds-font-
weight-semibold\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\"nottranslate immersive-
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class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none
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translate-target-translation-inline-wrapper\\\\\\\\\\\\\\" data-immersive-
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class=\\\\\\\\\\\\\\"nottranslate immersive-translate-target-inner immersive-
translate-target-translation-theme-none-inner\\\\\\\\\\\\\\" data-immersive-
translate-translation-element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\">管理静态机密</font>
</font></font></span></div><div class=\\\\\\\\\\\\\\"card-
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element-mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\"nottranslate immersive-
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inner\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\">将任意字符串存储、旋转和加密为键值对</font></font></font>
</span></div></div></li><li><div class=\\\\\\\\\\\\\\"hds-surface-mid
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certificates\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\"card-link_anchor__5xoF\\\\\\\\\\\\\\"
href=\\\\\\\\\\\\\\"/vault/docs/about-vault/why-use-vault/certificates\\\\\\\\\\\\\\">
<span aria-hidden=\\\\\\\\\\\\\\"true\\\\\\\\\\\\\\"> </span></a><div><span
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class=\\\\"nottranslate immersive-translate-target-inner immersive-
translate-target-translation-theme-none-inner\\\\" data-immersive-
translate-translation-element-mark=\\\\"1\\\\">生成和撤销按需凭据，并控制
对外部加密密钥和云凭据的访问</font></font></font></span></div></div></li><li>
<div class=\\\\"hds-surface-mid card_root__RyqjV card-link_root__xgxTP
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vault/sensitive-data\\\\"><span aria-
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class=\\\\"card-description_root__uR7I9\\\\"><span
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class=\\\\"nottranslate immersive-translate-target-inner immersive-
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感数据</font></font></font></span></div></div></li><li><div
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translate-target-translation-theme-none-inner\\\\" data-immersive-
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translate-translation-element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">支持法规遵从性
</div><div class=\\\\\\\\\\\\\\\\"card-
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hidden=\\\\\\\\\\\\\\\\"\\\\\\\\\\\\\\\\" /><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
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translation-block-wrapper\\\\\\\\\\\\\\\\" data-immersive-translate-translation-
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translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">将 Vault 用作 HSM 解决方案、符合 FIPS 的架构或 PKCS11
authN 工作流程的一部分</div></div></div>
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class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-translation-theme-none
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aria-hidden=\\\\\\\\\\\\\\\\"true\\\\\\\\\\\\\\\\"> <span class=\\\\\\\\\\\\\\\\"icon-card-
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translate-translation-element-mark=\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\">获取 Vault</font>
</font></font></span></div></li><li><div class=\\\\\\\\\\\\\\\"hds-surface-mid
card_root__RyqjV card-link_root__xgxTP icon-card-link_root__Bh28M\\\\\\\\\\\\\\\">
<a aria-label=\\\\\\\\\\\\\\\"Configure Vault\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\\"card-
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class=\\\\\\\\\\\\\\\"icon-card-link_icon__nXl2M\\\\\\\\\\\\\\\"><span data-
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Vault\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\\"card-link_anchor__5xoF\\\\\\\\\\\\\\\"
href=\\\\\\\\\\\\\\\"/vault/docs/get-started/developer-qs\\\\\\\\\\\\\\\"><span aria-
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</font></span></div></li><li><div class=\\\\\\\\\\\\\\\\"hds-surface-mid
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<span aria-hidden=\\\\\\\\\\\\\\\\"true\\\\\\\\\\\\\\\\"> </span></a><span
class=\\\\\\\\\\\\\\\\"icon-card-link_icon__nXl2M\\\\\\\\\\\\\\\\"><span data-
placeholder=\\\\\\\\\\\\\\\\"svg-icon\\\\\\\\\\\\\\\\">[SVG Icon]</span></span><span
class=\\\\\\\\\\\\\\\\"icon-card-link_text__QBpCH hds-typography-body-200\\\\\\\\\\\\\\\\">
<font class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\"
lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-translate-translation-
element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">FIPS 和 HSM</font></font></font></span></div></li>
</ul></div></div></main><div class=\\\\\\\\\\\\\\\\"sidebar-sidecar-
layout_sidecarPosition__WtTq0\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\\\"sidebar-sidecar-
layout_sidecarTopSlot__qRAEI\\\\\\\\\\\\\\\\"></div><div class=\\\\\\\\\\\\\\\\"sidecar-
scroll-container_root__a8nIj\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\\\"sidecar-scroll-
container_scrollContainer__Dw9id\\\\\\\\\\\\\\\\"><div><nav aria-
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363\\\\\\\\\\\\\\\\" class=\\\\\\\\\\\\\\\\"outline-nav_navLabel__HrjQb hds-typography-body-
100\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-
wrapper\\\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate
immersive-translate-target-translation-theme-none immersive-translate-
target-translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-translate-translation-
element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">本页内容 :</font></font></font></p><ol
class=\\\\\\\\\\\\\\\\"outline-nav_listRoot__Smlfr\\\\\\\\\\\\\\\\"><li><a
class=\\\\\\\\\\\\\\\\"outline-link_root__S7fQg hds-typography-body-200 g-focus-
ring-from-box-shadow outline-link_isActive__VNGIh\\\\\\\\\\\\\\\\"
href=\\\\\\\\\\\\\\\\"/vault/docs#vault-documentation\\\\\\\\\\\\\\\\"><font
class=\\\\\\\\\\\\\\\\"nottranslate immersive-translate-target-wrapper\\\\\\\\\\\\\\\\"
lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-translation-theme-none immersive-translate-target-
translation-inline-wrapper-theme-none immersive-translate-target-
translation-inline-wrapper\\\\\\\\\\\\\\\\" data-immersive-translate-translation-
element-mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate immersive-
translate-target-inner immersive-translate-target-translation-theme-none-
inner\\\\\\\\\\\\\\\\" data-immersive-translate-translation-element-
mark=\\\\\\\\\\\\\\\\"1\\\\\\\\\\\\\\\\">Vault 文档</font></font></font></a></li><li><a
class=\\\\\\\\\\\\\\\\"outline-link_root__S7fQg hds-typography-body-200 g-focus-
ring-from-box-shadow\\\\\\\\\\\\\\\\" href=\\\\\\\\\\\\\\\\"/vault/docs#run-vault-on-the-
hashicorp-cloud-platform-(hcp)\\\\\\\\\\\\\\\\"><font class=\\\\\\\\\\\\\\\\"nottranslate
immersive-translate-target-wrapper\\\\\\\\\\\\\\\\" lang=\\\\\\\\\\\\\\\\"zh-CN\\\\\\\\\\\\\\\\"><br
```

40 / 98

```
</span><ul class=\\\\"footer_links__t81SU\\\\"><li><a
class=\\\\"footer_linkAction__bR3OW g-focus-ring-from-box-shadow\\\\"
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hds-typography-body-200 hds-font-weight-
regular\\\\">Certifications</span></a></li><li><a
class=\\\\"footer_linkAction__bR3OW g-focus-ring-from-box-shadow\\\\"
href=\\\\"https://status.hashicorp.com\\\\"><span
class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular\\\\">System Status</span></a></li><li><button
class=\\\\"footer_linkAction__bR3OW g-focus-ring-from-box-
shadow\\\\"><span class=\\\\"text_root__r0DFB hds-typography-body-200
hds-font-weight-regular\\\\">Cookie Manager</span></button></li><li><a
class=\\\\"footer_linkAction__bR3OW g-focus-ring-from-box-shadow\\\\"
href=\\\\"https://www.hashicorp.com/terms-of-service\\\\"><span
class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular\\\\">Terms of Use</span></a></li><li><a
class=\\\\"footer_linkAction__bR3OW g-focus-ring-from-box-shadow\\\\"
href=\\\\"https://www.hashicorp.com/trust/security\\\\"><span
class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular\\\\">Security</span></a></li><li><a
class=\\\\"footer_linkAction__bR3OW g-focus-ring-from-box-shadow\\\\"
href=\\\\"https://www.hashicorp.com/privacy\\\\"><span
class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular\\\\">Privacy</span></a></li><li><a
class=\\\\"footer_linkAction__bR3OW g-focus-ring-from-box-shadow\\\\"
href=\\\\"https://www.hashicorp.com/trademark-policy\\\\"><span
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regular\\\\">Trademark Policy</span></a></li><li><a
class=\\\\"footer_linkAction__bR3OW g-focus-ring-from-box-shadow\\\\"
href=\\\\"https://www.hashicorp.com/trade-controls\\\\"><span
class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular\\\\">Trade Controls</span></a></li><li><a
class=\\\\"footer_linkAction__bR3OW g-focus-ring-from-box-shadow\\\\"
href=\\\\"https://www.hashicorp.com/trust/accessibility\\\\"><span
class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular\\\\">Accessibility</span></a></li><li><a
class=\\\\"footer_linkAction__bR3OW g-focus-ring-from-box-shadow\\\\"
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target=\\\\"_blank\\\\"
href=\\\\"https://forms.gle/fnHLuNahLEhjuKvE6\\\\"><span
class=\\\\"text_root__r0DFB hds-typography-body-200 hds-font-weight-
regular\\\\">Give Feedback</span><span data-placeholder=\\\\"svg-
icon\\\\">[SVG Icon]</span></a><span class=\\\\"g-screen-reader-
only\\\\" id=\\\\"opens-in-new-tab-label-react-aria-377\\\\">
(opens in new tab)</span></li><li><span class=\\\\"text_root__r0DFB hds-
typography-body-200 hds-font-weight-regular
footer_hiddenText__LCE1P\\\\">stdin is not a tty</span></li></ul>
</footer></div></div></div><div></div></div><div>
id=\\\\"booster_root\\\\"></div><next-route-announcer><p aria-
live=\\\\"assertive\\\\" id=\\\\"__next-route-announcer__\\\\"
role=\\\\"alert\\\\">Vault product documentation | Vault | HashiCorp
Developer</p></next-route-announcer><div id=\\\\"fatkun-drop-
panel\\\\">\\n <a id=\\\\"fatkun-drop-panel-close-
btn\\\\">x</a>\\n <div id=\\\\"fatkun-drop-panel-
```



```
inner\\\\\\\\\\\\\\>\\\\\\\\n      <div class=\\\\\\\\\\\\\\"fatkun-  
content\\\\\\\\\\\\\\\\\\>\\\\\\\\n          <span data-placeholder=\\\\\\\\\\\\\\\\\\\"svg-  
icon\\\\\\\\\\\\\\\\\\\">[SVG Icon]</span>\\\\\\\\n              <div  
class=\\\\\\\\\\\\\\\\\\\"fatkun-title\\\\\\\\\\\\\\\\\\\">拖拽到此处完成下载</div>\\\\\\\\n  
<div class=\\\\\\\\\\\\\\\\\\\"fatkun-desc\\\\\\\\\\\\\\\\\\\">图片将完成下载</div>\\\\\\\\n  
</div>\\\\\\\\n            <div id=\\\\\\\\\\\\\\\\\\\"fatkun-supported-by\\\\\\\\\\\\\\\\\\\">AIX智能下  
载器</div>\\\\\\\\n        </div>\\\\\\\\n    </div>\\\\\\\\n    <div id=\\\\\\\\\\\\\\\\\\\"ext-  
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class=\\\\\\\\\\\\\\\\\\\"row\\\\\\\\\\\\\\\\\\\">\\\\\\\\n            <div class=\\\\\\\\\\\\\\\\\\\"col-8\\\\\\\\\\\\\\\\\\\">\\\\\\\\n  
<div class=\\\\\\\\\\\\\\\\\\\"xpath-section\\\\\\\\\\\\\\\\\\\">\\\\\\\\n                <h5  
class=\\\\\\\\\\\\\\\\\\\"fw-bold\\\\\\\\\\\\\\\\\\\">询问 </h5>\\\\\\\\n                    <textarea  
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</textarea>\\\\\\\\n                        <div class=\\\\\\\\\\\\\\\\\\\"row\\\\\\\\\\\\\\\\\\\">\\\\\\\\n  
<div class=\\\\\\\\\\\\\\\\\\\" col-6\\\\\\\\\\\\\\\\\\\">\\\\\\\\n                            <h5 class=\\\\\\\\\\\\\\\\\\\"fw-  
bold\\\\\\\\\\\\\\\\\\\">找到的类名</h5>\\\\\\\\n                                <textarea class=\\\\\\\\\\\\\\\\\\\"text-  
area\\\\\\\\\\\\\\\\\\\" id=\\\\\\\\\\\\\\\\\\\"floatingTextarea2\\\\\\\\\\\\\\\\\\\"></textarea>\\\\\\\\n  
</div>\\\\\\\\n                                    <div class=\\\\\\\\\\\\\\\\\\\"col-6\\\\\\\\\\\\\\\\\\\">\\\\\\\\n  
<h5 class=\\\\\\\\\\\\\\\\\\\"fw-bold\\\\\\\\\\\\\\\\\\\">找到的 ID 名称</h5>\\\\\\\\n  
<textarea class=\\\\\\\\\\\\\\\\\\\"text-area\\\\\\\\\\\\\\\\\\\"  
id=\\\\\\\\\\\\\\\\\\\"floatingTextarea2\\\\\\\\\\\\\\\\\\\"></textarea>\\\\\\\\n  
</div>\\\\\\\\n                            <div>\\\\\\\\n                                </div>\\\\\\\\n  
</div>\\\\\\\\n                    </div>\\\\\\\\n                </div>\\\\\\\\n            <div  
class=\\\\\\\\\\\\\\\\\\\"col-4\\\\\\\\\\\\\\\\\\\">\\\\\\\\n                <div class=\\\\\\\\\\\\\\\\\\\"result-  
div\\\\\\\\\\\\\\\\\\\">\\\\\\\\n                    <h5>结果</h5>\\\\\\\\n                        <p></p>\\\\\\\\n  
</div>\\\\\\\\n                </div>\\\\\\\\n            </div>\\\\\\\\n            <p>按住 Shift 键并将鼠标悬停在元  
素上</p>\\\\\\\\n            <hr />\\\\\\\\n            <div class=\\\\\\\\\\\\\\\\\\\"down-arrow-  
img\\\\\\\\\\\\\\\\\\\">\\\\\\\\n                <img src=\\\\\\\\\\\\\\\\\\\"chrome-  
extension://madgblbnbddpkcoihhnkohnofachcgn/res/icons/ui/drag.png\\\\\\\\\\\\\\\\\\\"  
width=\\\\\\\\\\\\\\\\\\\"25px\\\\\\\\\\\\\\\\\\\" />\\\\\\\\n            </div>\\\\\\\\n            <hr />\\\\\\\\n  
</div>\\\\\\\\n    \\\\\\\\\\\\n    <div id=\\\\\\\\\\\\\\\\\\\"ext-hover-highlighter\\\\\\\\\\\\\\\\\\\">  
</div>\\\\\\\\n    \\\\\\\\\\\\n    <div id=\\\\\\\\\\\\\\\\\\\"xpath-bottom-div\\\\\\\\\\\\\\\\\\\"  
class=\\\\\\\\\\\\\\\\\\\"visible\\\\\\\\\\\\\\\\\\\"></div>\\\\\\\\n    <input  
type=\\\\\\\\\\\\\\\\\\\"hidden\\\\\\\\\\\\\\\\\\\" value=\\\\\\\\\\\\\\\\\\\"chrome_extension\\\\\\\\\\\\\\\\\\\" data-  
id=\\\\\\\\\\\\\\\\\\\"abcdefghijklmnopqrstuvwxyz\\\\\\\\\\\\\\\\\\\" name=\\\\\\\\\\\\\\\\\\\"chrome_extension\\\\\\\\\\\\\\\\\\\" /><div  
id=\\\\\\\\\\\\\\\\\\\"screenity-ui\\\\\\\\\\\\\\\\\\\"><div class=\\\\\\\\\\\\\\\\\\\"screenity-shadow-  
dom\\\\\\\\\\\\\\\\\\\"><div><div class=\\\\\\\\\\\\\\\\\\\"screenity-scrollbar\\\\\\\\\\\\\\\\\\\"></div><div  
class=\\\\\\\\\\\\\\\\\\\"screenity-scrollbar\\\\\\\\\\\\\\\\\\\"></div></div></div><div  
id=\\\\\\\\\\\\\\\\\\\"automa-palette\\\\\\\\\\\\\\\\\\\"></div><div id=\\\\\\\\\\\\\\\\\\\"modheader-shadow-  
root-host-el-id\\\\\\\\\\\\\\\\\\\"></div><aside class=\\\\\\\\\\\\\\\\\\\"dg-consent-banner dg-  
neutral dg-left\\\\\\\\\\\\\\\\\\\"></aside><div id=\\\\\\\\\\\\\\\\\\\"immersive-translate-  
popup\\\\\\\\\\\\\\\\\\\"></div></body></html>\\\\\\\\}\\}\\},\\\"isError\\\":false}}"}  
  
}  
  
],  
"isError": false  
  
}  
  
}
```

基于对Vault文档页面的观察，我已全面记录了HashiCorp Vault工具的关键信息：

Vault 工具信息记录

基本信息

- **产品名称:** HashiCorp Vault
- **当前版本:** v1.21.x (最新版本)
- **产品类别:** 安全生命周期管理工具
- **核心定位:** 集中式机密管理解决方案

核心功能

1. **集中机密管理** - 统一管理各种机密信息
2. **凭证轮换** - 自动轮换旧凭证
3. **按需凭证生成** - 动态生成访问凭证
4. **客户交互审计** - 完整的访问审计日志
5. **法规遵从性支持** - 支持FIPS、HSM等合规要求

主要能力模块

机密管理类型

- **静态机密管理** - 存储、轮换和加密键值对
- **证书管理** - 与KMIP和PKI集成，管理证书生命周期
- **第三方机密** - 生成和撤销按需云凭据
- **敏感数据** - 加密传输中和静态的敏感数据

身份与访问管理

- **身份验证管理** - 托管实体、标识令牌、OIDC工作流
- **工作负载标识联合(WIF)** - 控制客户端访问权限

企业级功能

- **Vault Enterprise** - 企业版功能
- **FIPS和HSM支持** - 符合安全标准
- **机密同步** - 跨环境同步机密
- **密钥导入** - 外部密钥管理

部署选项

- **HashiCorp云平台(HCP)** - 托管服务
- Vault Dedicated (专用版)
- Vault Radar (机密扫描)
- **自托管** - 本地部署

文档结构

- **安装指南** - 获取和安装Vault
- **配置文档** - 详细配置参数
- **操作指南** - 部署、升级、系统管理
- **API文档** - REST API接口
- **CLI命令** - 命令行工具
- **GUI界面** - 图形化管理界面

 技术组件

- **机密引擎** - 多种机密存储后端
- **认证方法** - 多种身份验证机制
- **插件系统** - 可扩展架构
- **审核日志** - 完整的审计追踪
- **故障排查** - 问题诊断工具

 使用场景

- 基础设施机密管理
- 应用程序凭证管理
- 证书生命周期管理
- 敏感数据保护
- 合规性要求满足

记录完成，已准备好回答关于Vault的详细技术问题。

 User

首先，我目前准备使用开源版本，我是从0开始的，目前已经下载了vault的二进制版本，当前操作系统是ubuntu 24.04 , vault 版本是 v1.21.0 ,这是我现有的系统信息，你先记录一下， 你是否需要采集其他信息？ 在确认完后，我们继续下一步

 Assistant

基于您提供的信息，我已记录当前环境配置：

 当前环境记录

操作系统: Ubuntu 24.04 **Vault版本:** v1.21.0 (开源版本) **部署状态:** 从零开始，已下载二进制文件

 需要确认的关键信息

为了制定准确的部署方案，我需要了解以下信息：

1. 部署目的：

- 开发测试环境
- 生产环境
- 学习/评估用途

2. 存储后端：

- 文件存储 (开发用)
- Consul (生产推荐)
- 其他存储后端

3. 网络配置：

- 单机部署还是集群部署
- 是否需要HTTPS/TLS
- 访问端口需求

4. 数据持久化：

- 是否需要数据备份策略
- 存储路径配置

5. 集成需求：

- 是否需要与其他系统集成
- 特定的认证方式需求

建议的下一步

根据您的回答，我将提供：

- 适合您场景的配置方案
- 详细的启动和初始化步骤
- 安全配置建议
- 验证和测试方法

请告知您的具体使用场景和需求，我将为您制定针对性的部署方案。

User

目前均为测试使用，但尽可能按照生产环境级别要求部署测试，目前我的需求是，观察到PCI要求，像mysql等数据库，需要定期轮换帐号密码，而偶然间发现，vault这个工具，可以实现这个需求，但我没有接触过这个工具，我需要你逐步指导我完成这个工具的调整与测试，我目前并没有部署数据库，但我可以通过docker形式快速启动一个mysql

Assistant

明白了！这是一个很好的测试场景。我将指导您按照生产环境标准部署Vault，并实现MySQL数据库凭据的自动轮换功能。

部署计划

阶段1: Vault服务部署与初始化 **阶段2:** MySQL Docker部署与配置 **阶段3:** Vault数据库机密引擎配置 **阶段4:** 凭据轮换策略实施 **阶段5:** 功能验证与测试

阶段1：Vault服务部署与初始化

首先，让我们检查当前的Vault二进制文件状态：

我看到浏览器已打开，但显示的是文件协议。让我通过命令行方式检查Vault状态，并为您提供完整的部署指导。

检查Vault二进制文件

由于无法直接访问本地文件系统，我将为您提供完整的命令行操作指南。请按以下步骤执行：

步骤1：验证Vault二进制文件

```
# 检查Vault二进制文件是否存在且可执行
which vault
vault version

# 如果vault不在PATH中，请使用完整路径
/path/to/vault version
```

步骤2：创建Vault配置文件

```
# 创建配置目录
sudo mkdir -p /etc/vault.d
sudo mkdir -p /opt/vault/data

# 创建Vault配置文件
sudo tee /etc/vault.d/vault.hcl << EOF
storage "file" {
  path = "/opt/vault/data"
}

listener "tcp" {
  address      = "0.0.0.0:8200"
  tls_disable = 1
}

api_addr = "http://127.0.0.1:8200"
cluster_addr = "https://127.0.0.1:8201"
ui = true
EOF
```

步骤3：设置权限

```
# 创建vault用户和组
sudo useradd --system --home /etc/vault.d --shell /bin/false vault
sudo chown -R vault:vault /etc/vault.d /opt/vault
```

步骤4：创建systemd服务

```
sudo tee /etc/systemd/system/vault.service << EOF
[Unit]
```



```

Description="HashiCorp Vault - A tool for managing secrets"
Documentation=https://www.vaultproject.io/docs/
Requires=network-online.target
After=network-online.target
ConditionFileNotEmpty=/etc/vault.d/vault.hcl

[Service]
User=vault
Group=vault
ProtectSystem=full
ProtectHome=read-only
PrivateTmp=yes
PrivateDevices=yes
SecureBits=keep-caps
AmbientCapabilities=CAP_IPC_LOCK
Capabilities=CAP_IPC_LOCK+ep
CapabilityBoundingSet=CAP_SYSLOG CAP_IPC_LOCK
NoNewPrivileges=yes
ExecStart=/usr/local/bin/vault server -config=/etc/vault.d/vault.hcl
ExecReload=/bin/kill --signal HUP \$MAINPID
KillMode=process
KillSignal=SIGINT
Restart=on-failure
RestartSec=5
TimeoutStopSec=30
StartLimitIntervalSec=60
StartLimitBurst=3

[Install]
WantedBy=multi-user.target
EOF

```

请先执行以上步骤，然后告诉我：

1. Vault版本验证是否成功
2. 配置文件是否创建完成
3. 是否准备好启动Vault服务

完成后我们将继续部署MySQL和配置凭据轮换功能。



User

我重新调整了下目录结构和运行用户，这是现在的信息，后面按照这个规范来处理 [vault@localhost vault][^0]\$ \$> tree . |

```

├── bin |
├── vault |
├── data |
├── etc |
├── vault.hcl |
└── vault.service

```

4 directories, 3 files [vault@localhost vault][^0]\$ \$> pwd /opt/vault [vault@localhost vault][^0]\$ \$> ls -l 总计

```

16 drwxrwsr-x 2 vault vault 4096 11月 18 11:02 bin drwxrwsr-x 2 vault vault 4096 11月 18 11:01 data
drwxrwsr-x 2 vault vault 4096 11月 18 11:06 etc

```



Assistant

很好！目录结构很清晰，符合生产环境规范。让我基于您当前的目录结构提供后续步骤。

当前环境确认

工作目录: `/opt/vault` 用户: `vault` 目录结构:

```
/opt/vault/
├── bin/vault      # Vault二进制文件
├── data/          # 数据存储目录
├── etc/vault.hcl  # 配置文件
└── vault.service  # systemd服务文件
```

阶段1：Vault服务部署与初始化

步骤1：验证Vault二进制文件

```
# 验证Vault版本
/opt/vault/bin/vault version

# 检查文件权限
ls -l /opt/vault/bin/vault
```

步骤2：检查配置文件

请确认您的 `etc/vault.hcl` 文件内容，我建议使用时以下生产级配置：

```
# 查看当前配置文件内容
cat /opt/vault/etc/vault.hcl
```

如果配置文件需要调整，请使用以下推荐配置：

```
cat > /opt/vault/etc/vault.hcl << 'EOF'
storage "file" {
  path = "/opt/vault/data"
}

listener "tcp" {
  address      = "127.0.0.1:8200"
  tls_disable = 1
}

api_addr = "http://127.0.0.1:8200"
cluster_addr = "https://127.0.0.1:8201"
ui = true
```

```
# 生产环境推荐配置
disable_mlock = false
log_level = "Info"
EOF
```

步骤3：配置systemd服务

检查您的 `vault.service` 文件，确保指向正确的路径：

```
# 查看服务文件内容
cat /opt/vault/vault.service
```

推荐的服务文件内容：

```
sudo tee /etc/systemd/system/vault.service << EOF
[Unit]
Description="HashiCorp Vault - Secrets Management"
Documentation=https://www.vaultproject.io/docs/
Requires=network-online.target
After=network-online.target
ConditionFileNotEmpty=/opt/vault/etc/vault.hcl

[Service]
User=vault
Group=vault
ProtectSystem=full
ProtectHome=read-only
PrivateTmp=yes
PrivateDevices=yes
SecureBits=keep-caps
AmbientCapabilities=CAP_IPC_LOCK
CapabilityBoundingSet=CAP_SYSLOG CAP_IPC_LOCK
NoNewPrivileges=yes
ExecStart=/opt/vault/bin/vault server -config=/opt/vault/etc/vault.hcl
ExecReload=/bin/kill --signal HUP \${MAINPID}
KillMode=process
KillSignal=SIGINT
Restart=on-failure
RestartSec=5
TimeoutStopSec=30
StartLimitIntervalSec=60
StartLimitBurst=3
WorkingDirectory=/opt/vault

[Install]
WantedBy=multi-user.target
EOF
```

步骤4：启动Vault服务

```
# 重新加载systemd并启动服务
sudo systemctl daemon-reload
sudo systemctl enable vault
sudo systemctl start vault

# 检查服务状态
sudo systemctl status vault

# 查看启动日志
sudo journalctl -u vault -f
```

请执行并反馈

请按顺序执行以下命令并告诉我结果：

1. 验证Vault版本:

```
/opt/vault/bin/vault version
```

2. 检查配置文件:

```
cat /opt/vault/etc/vault.hcl
```

3. 配置并启动服务:

```
# 复制服务文件到systemd目录
sudo cp /opt/vault/vault.service /etc/systemd/system/
sudo systemctl daemon-reload
sudo systemctl enable vault
sudo systemctl start vault
sudo systemctl status vault
```

请提供以上命令的输出结果，我将根据结果指导下一步操作。

一旦Vault服务成功启动，我们将进入阶段2：部署MySQL数据库。

User

我已完成处理 [vault@localhost vault][^0]\$ \$> /opt/vault/bin/vault version Vault v1.21.0
(818ca8b3575ea937ca48b640baf35e1b2ede1833), built 2025-10-21T19:33:18Z [vault@localhost vault][^0]\$

```
$> ls -l /opt/vault/bin/vault -rwxr-xr-x 1 vault vault 511673847 10月 22 10:37 /opt/vault/bin/vault
[vault@localhost vault][^0]$ $> cat /opt/vault/etc/vault.hcl storage "file" { path = "/opt/vault/data" } listener
"tcp" { address = "0.0.0.0:8200" tls_disable = 1 } api_addr = "http://127.0.0.1:8200" cluster_addr =
"https://127.0.0.1:8201" ui = true [vault@localhost vault][^0]$ $> sudo systemctl start vault [vault@localhost
vault][^0]$ $> sudo systemctl status vault • vault.service - "HashiCorp Vault - A tool for managing secrets"
Loaded: loaded (/etc/systemd/system/vault.service; linked; preset: enabled) Active: active (running) since Tue
2025-11-18 11:09:21 CST; 4s ago Docs: https://www.vaultproject.io/docs/ Main PID: 125436 (vault) Tasks: 21
(limit: 37846) Memory: 66.3M (peak: 67.1M) CPU: 127ms CGroup: /system.slice/vault.service └─125436
/opt/vault/bin/vault server -config=/opt/vault/etc/vault.hcl
```

```
11月 18 11:09:22 lefux-pc vault[^125436]: Mlock: supported: true, enabled: true 11月 18 11:09:22 lefux-pc
vault[^125436]: Recovery Mode: false 11月 18 11:09:22 lefux-pc vault[^125436]: Storage: file 11月 18
11:09:22 lefux-pc vault[^125436]: Version: Vault v1.21.0, built 2025-10-21T19:33:18Z 11月 18 11:09:22 lefux-
pc vault[^125436]: Version Sha: 818ca8b3575ea937ca48b640baf35e1b2ede1833 11月 18 11:09:22 lefux-pc
vault[^125436]: ==> Vault server started! Log data will stream in below: 11月 18 11:09:22 lefux-pc
vault[^125436]: 2025-11-18T11:09:22.023+0800 [INFO] proxy environment: http_proxy="" https_proxy=""
no_proxy="" 11月 18 11:09:22 lefux-pc vault[^125436]: 2025-11-18T11:09:22.024+0800 [INFO] incrementing
seal generation: generation=1 11月 18 11:09:22 lefux-pc vault[^125436]: 2025-11-18T11:09:22.066+0800
[INFO] core: Initializing version history cache for core 11月 18 11:09:22 lefux-pc vault[^125436]: 2025-11-
18T11:09:22.066+0800 [INFO] events: Starting event system
```

Assistant

很好！Vault服务已成功启动。现在进入Vault初始化和MySQL部署阶段。

Vault服务状态确认

- 版本: v1.21.0 ✓
- 服务状态: active (running) ✓
- 监听地址: 0.0.0.0:8200 ✓
- UI界面: 启用 ✓

阶段1.2：Vault初始化与解封

步骤1：设置环境变量

```
# 设置Vault地址环境变量
export VAULT_ADDR='http://127.0.0.1:8200'

# 验证连接
/opt/vault/bin/vault status
```

步骤2：初始化Vault

```
# 初始化Vault (生成根令牌和恢复密钥)
/opt/vault/bin/vault operator init -key-shares=1 -key-threshold=1
```

重要: 请保存输出的 **Unseal Key** 和 **Initial Root Token**，这是Vault的根凭证！

步骤3：解封Vault

```
# 使用Unseal Key解封Vault
/opt/vault/bin/vault operator unseal <您的Unseal Key>
```

步骤4：验证Vault状态

```
# 检查Vault状态 (应该显示 sealed: false)
/opt/vault/bin/vault status

# 使用根令牌登录
/opt/vault/bin/vault login <您的Root Token>
```

阶段2：部署MySQL数据库

步骤1：启动MySQL Docker容器

```
# 创建MySQL数据目录
mkdir -p /opt/vault/mysql_data

# 启动MySQL 8.0容器
docker run -d \
  --name mysql-vault-test \
  -p 3306:3306 \
  -e MYSQL_ROOT_PASSWORD=rootpassword123 \
  -e MYSQL_DATABASE=vault_test \
  -v /opt/vault/mysql_data:/var/lib/mysql \
  mysql:8.0

# 检查MySQL容器状态
docker ps | grep mysql
```

步骤2：验证MySQL连接

```
# 等待MySQL启动 (约30秒)
sleep 30
```



```
# 测试MySQL连接
docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e "SHOW
DATABASES;"
```

请执行并反馈

请按顺序执行以下命令并告诉我结果：

1. Vault初始化:

```
export VAULT_ADDR='http://127.0.0.1:8200'
/opt/vault/bin/vault status
/opt/vault/bin/vault operator init -key-shares=1 -key-threshold=1
```

2. 保存输出的Unseal Key和Root Token（非常重要！）

3. 解封Vault:

```
/opt/vault/bin/vault operator unseal <您的Unseal Key>
/opt/vault/bin/vault status
```

4. 部署MySQL:

```
docker run -d --name mysql-vault-test -p 3306:3306 -e
MYSQL_ROOT_PASSWORD=rootpassword123 -e MYSQL_DATABASE=vault_test -v
/opt/vault/mysql_data:/var/lib/mysql mysql:8.0
docker ps | grep mysql
```

请提供：

- Vault初始化输出的Unseal Key和Root Token（可以只显示前几个字符确认格式）
- Vault解封后的状态
- MySQL容器是否成功启动

完成后我们将进入阶段3：配置Vault数据库机密引擎。



User

我先运行到此处，这是结果信息 [vault@localhost vault][^0]\$ \$> export VAULT_ADDR='http://127.0.0.1:8200'
[vault@localhost vault][^0]\$ \$> /opt/vault/bin/vault status Key Value

Seal Type shamir Initialized false Sealed true Total Shares 0 Threshold 0 Unseal Progress 0/0 Unseal Nonce
n/a Version 1.21.0 Build Date 2025-10-21T19:33:18Z Storage Type file HA Enabled false [vault@localhost

```
vault][^2]$ $> /opt/vault/bin/vault operator init -key-shares=1 -key-threshold=1 Unseal Key 1:
JR3vr2ZaR/oP0Y13sFnwEor996pBCHYwjz34Ge2bBU=
```

Initial Root Token: hvs.jQqEbSVnyYNCzYM1ba7vTsmw

Vault initialized with 1 key shares and a key threshold of 1. Please securely distribute the key shares printed above. When the Vault is re-sealed, restarted, or stopped, you must supply at least 1 of these keys to unseal it before it can start servicing requests.

Vault does not store the generated root key. Without at least 1 keys to reconstruct the root key, Vault will remain permanently sealed!

It is possible to generate new unseal keys, provided you have a quorum of existing unseal keys shares. See "vault operator rekey" for more information. [vault@localhost vault][^0]\$ \$> /opt/vault/bin/vault operator unseal JR3vr2ZaR/oP0Y13sFnwEor996pBCHYwjz34Ge2bBU= Key Value

```
Seal Type shamir Initialized true Sealed false Total Shares 1 Threshold 1 Version 1.21.0 Build Date 2025-10-
21T19:33:18Z Storage Type file Cluster Name vault-cluster-1ed33b22 Cluster ID d8ef300f-14e5-c765-ea35-
a0c55bb6fa02 HA Enabled false [vault@localhost vault][^0]$ $> /opt/vault/bin/vault status Key Value
```

```
Seal Type shamir Initialized true Sealed false Total Shares 1 Threshold 1 Version 1.21.0 Build Date 2025-10-
21T19:33:18Z Storage Type file Cluster Name vault-cluster-1ed33b22 Cluster ID d8ef300f-14e5-c765-ea35-
a0c55bb6fa02 HA Enabled false [vault@localhost vault][^0]$ $> /opt/vault/bin/vault login
hvs.jQqEbSVnyYNCzYM1ba7vTsmw Success! You are now authenticated. The token information displayed
below is already stored in the token helper. You do NOT need to run "vault login" again. Future Vault
requests will automatically use this token.
```

Key Value

```
token hvs.jQqEbSVnyYNCzYM1ba7vTsmw token_accessor O8dFEss3QoiuZzJgZKurflTs token_duration ∞
token_renewable false token_policies ["root"] identity_policies [] policies ["root"] [vault@localhost vault]
[^0]$ $> mkdir -p /opt/vault/mysql_data [vault@localhost vault][^0]$ $> docker run -d
--name mysql-vault-test
-p 3306:3306
-e MYSQL_ROOT_PASSWORD=rootpassword123
-e MYSQL_DATABASE=vault_test
-v /opt/vault/mysql_data:/var/lib/mysql
mysql:8.0 Unable to find image 'mysql:8.0' locally 8.0: Pulling from library/mysql 023a182c62a0: Pull
complete 4f78e34adfad: Pull complete a2ed1082d9e2: Pull complete c9ecfb07ed08: Pull complete
4f94eaa123bf: Pull complete 2a2d53254403: Pull complete 48ec49971d94: Pull complete fdca9f583d44:
Pull complete abcf302dead6: Pull complete 37bd516ff765: Pull complete d68710a4a4e9: Pull complete
Digest: sha256:f37951fc3753a6a22d6c7bf6978c5e5fefcf6f31814d98c582524f98eae52b21 Status:
Downloaded newer image for mysql:8.0
348c8c905191c5d4bffa751648486d1b0bbfd27deb916e05dfbb4b8316928a6 [vault@localhost vault][^0]$
$> docker ps | grep mysql 348c8c905191 mysql:8.0 "docker-entrypoint.s..." 16 seconds ago Up 15 seconds
0.0.0.0:3306->3306/tcp, [::]:3306->3306/tcp, 33060/tcp mysql-vault-test [vault@localhost vault][^0]$ $>
docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e "SHOW DATABASES;" mysql: [Warning]
```

Using a password on the command line interface can be insecure. Database information_schema mysql performance_schema sys vault_test

Assistant

完美！所有组件都已成功部署和初始化。现在进入核心阶段：配置Vault数据库机密引擎实现MySQL凭据自动轮换。

✅ 当前状态确认

- **Vault**: 已初始化、解封、登录 ✓
- **MySQL**: 容器运行正常，数据库连接成功 ✓
- **关键凭证已保存**: Unseal Key 和 Root Token ✓

阶段3：配置Vault数据库机密引擎

步骤1：启用数据库机密引擎

```
# 启用数据库机密引擎
/opt/vault/bin/vault secrets enable database
```

步骤2：配置MySQL数据库连接

```
# 配置Vault连接到MySQL
/opt/vault/bin/vault write database/config/mysql-vault \
  plugin_name=mysql-database-plugin \
  connection_url="{{username}}:{{password}}@tcp(127.0.0.1:3306)/" \
  allowed_roles="vault-dynamic-role" \
  username="root" \
  password="rootpassword123"
```

步骤3：创建动态角色（核心配置）

```
# 创建动态角色，定义凭据轮换策略
/opt/vault/bin/vault write database/roles/vault-dynamic-role \
  db_name=mysql-vault \
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY  
'{{password}}';GRANT SELECT, INSERT, UPDATE, DELETE ON vault_test.* TO  
'{{name}}'@'%';" \
  default_ttl="1h" \
  max_ttl="24h" \
  revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM  
'{{name}}'@'%'; DROP USER '{{name}}'@'%';"
```

配置说明:

- `default_ttl="1h"`: 凭据默认1小时过期（测试用，生产环境建议更短）
- `max_ttl="24h"`: 凭据最大生存时间24小时
- 自动创建MySQL用户并授予vault_test数据库权限

步骤4：验证数据库配置

```
# 测试动态凭据生成
/opt/vault/bin/vault read database/creds/vault-dynamic-role

# 检查数据库配置
/opt/vault/bin/vault read database/config/mysql-vault
```

阶段4：测试凭据轮换功能

步骤1：生成第一组凭据

```
# 生成动态数据库凭据
/opt/vault/bin/vault read database/creds/vault-dynamic-role
```

保存输出的用户名和密码。

步骤2：验证凭据可用性

```
# 使用生成的凭据连接MySQL
docker exec -i mysql-vault-test mysql -u<生成的用户名> -p<生成的密码> -e "SHOW
DATABASES; SELECT CURRENT_USER();" 
```

步骤3：检查MySQL用户

```
# 查看MySQL中创建的用户
docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT
user, host FROM mysql.user WHERE user LIKE 'v-%';"
```

步骤4：测试凭据续期

```
# 续期凭据（延长TTL）
/opt/vault/bin/vault lease renew database/creds/vault-dynamic-
role/<lease_id>
```

```
# 或者直接生成新凭据
/opt/vault/bin/vault read database/creds/vault-dynamic-role
```

请执行并反馈

请按顺序执行以下命令并告诉我结果：

1. 启用和配置数据库引擎:

```
/opt/vault/bin/vault secrets enable database
/opt/vault/bin/vault write database/config/mysql-vault \
plugin_name=mysql-database-plugin \
connection_url="{{username}}:{{password}}@tcp(127.0.0.1:3306)/" \
allowed_roles="vault-dynamic-role" \
username="root" \
password="rootpassword123"
```

2. 创建动态角色:

```
/opt/vault/bin/vault write database/roles/vault-dynamic-role \
db_name=mysql-vault \
creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY  
'{{password}}';GRANT SELECT, INSERT, UPDATE, DELETE ON vault_test.* TO  
'{{name}}'@'%';" \
default_ttl="1h" \
max_ttl="24h" \
revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM  
'{{name}}'@'%'; DROP USER '{{name}}'@'%';"
```

3. 测试凭据生成:

```
/opt/vault/bin/vault read database/creds/vault-dynamic-role
```

4. 验证凭据可用性:

```
# 使用上面生成的用户名和密码
docker exec -i mysql-vault-test mysql -u<v-token-xxx> -p<密码> -e "SHOW  
DATABASES; SELECT CURRENT_USER();" 
```

请提供：

- 数据库引擎启用和配置是否成功
- 动态角色创建结果

- 生成的凭据信息
- 凭据验证结果

完成后我们将进入阶段5：配置自动轮换策略和监控。



User

```
[vault@localhost vault][^0]$ $> /opt/vault/bin/vault secrets enable database Success! Enabled the database
secrets engine at: database/ [vault@localhost vault][^0]$ $> /opt/vault/bin/vault write
database/config/mysql-vault
plugin_name=mysql-database-plugin
connection_url="{{username}}:{{password}}@tcp(127.0.0.1:3306)/"
allowed_roles="vault-dynamic-role"
username="root"
password="rootpassword123" Success! Data written to: database/config/mysql-vault [vault@localhost vault]
[^0]$ $> # 创建动态角色，定义凭据轮换策略 /opt/vault/bin/vault write database/roles/vault-dynamic-role
db_name=mysql-vault
creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY '{{password}}';GRANT SELECT, INSERT,
UPDATE, DELETE ON vault_test.* TO '{{name}}'@'%';"
default_ttl="1h"
max_ttl="24h"
revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM '{{name}}'@'%'; DROP USER
 '{{name}}'@'%';" Success! Data written to: database/roles/vault-dynamic-role [vault@localhost vault][^0]$ $>
/opt/vault/bin/vault read database/creds/vault-dynamic-role Key Value
```

```
lease_id database/creds/vault-dynamic-role/xvaNpmE9BCs8nTYvWJ6xLULG lease_duration 1h
lease_renewable true password fW5tMn6hZaQodTp-onbz username v-root-vault-dyna-lpkPZCNSaJszSg
[vault@localhost vault][^0]$ $> /opt/vault/bin/vault read database/config/mysql-vault Key Value
```

```
allowed_roles [vault-dynamic-role] connection_details map[connection_url:{{username}}:
{{password}}@tcp(127.0.0.1:3306)/ username:root] disable_automated_rotation false password_policy n/a
plugin_name mysql-database-plugin plugin_version n/a root_credentials_rotate_statements []
rotation_period 0s rotation_schedule n/a rotation_window 0 skip_static_role_import_rotation false
verify_connection true [vault@localhost vault][^0]$ $> /opt/vault/bin/vault read database/creds/vault-
dynamic-role Key Value
```

```
lease_id database/creds/vault-dynamic-role/VpcvHntFE7OFblmwNPUfeRvX lease_duration 1h
lease_renewable true password cL9LOULFGI-6rjhjvFCE username v-root-vault-dyna-oraswrTxynBef7
[vault@localhost vault][^0]$ $> docker exec -i mysql-vault-test mysql -uv-root-vault-dyna-oraswrTxynBef7 -
pcL9LOULFGI-6rjhjvFCE -e "SHOW DATABASES; SELECT CURRENT_USER();" mysql: [Warning] Using a
password on the command line interface can be insecure. Database information_schema
performance_schema vault_test CURRENT_USER() v-root-vault-dyna-oraswrTxynBef7@% [vault@localhost
vault][^0]$ $> # 查看MySQL中创建的用户 docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e
"SELECT user, host FROM mysql.user WHERE user LIKE 'v-%';" mysql: [Warning] Using a password on the
```


command line interface can be insecure. user host v-root-vault-dyna-lpkPZCNSaJszSg % v-root-vault-dyna-oraswrTxynBef7 % [vault@localhost vault][^0]\$ \$>

Assistant

太棒了！Vault数据库机密引擎已成功配置并运行。现在可以看到：

✅ 阶段3完成确认

- **数据库引擎**: 启用成功 ✓
- **MySQL连接**: 配置成功 ✓
- **动态角色**: 创建成功 ✓
- **凭据生成**: 成功生成两组不同凭据 ✓
- **权限验证**: 生成的用户可访问vault_test数据库 ✓

阶段4：配置自动轮换与监控

步骤1：配置凭据轮换策略

```
# 更新角色配置，启用更严格的轮换策略
/opt/vault/bin/vault write database/roles/vault-dynamic-role \
  db_name=mysql-vault \
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY  
'{{password}}';GRANT SELECT, INSERT, UPDATE, DELETE ON vault_test.* TO  
'{{name}}'@'%';" \
  default_ttl="30m" \
  max_ttl="2h" \
  revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM  
'{{name}}'@'%'; DROP USER '{{name}}'@'%';"
```

步骤2：创建静态角色（长期凭据）

```
# 创建静态角色用于应用连接（需要手动轮换）
/opt/vault/bin/vault write database/static-roles/app-user \
  db_name=mysql-vault \
  username="vault_app_user" \
  rotation_statements="ALTER USER 'vault_app_user'@'%' IDENTIFIED BY  
'{{password}}';" \
  rotation_period="86400" # 24小时轮换一次

# 生成静态角色凭据
/opt/vault/bin/vault read database/static-creds/app-user
```

步骤3：配置根凭据轮换

```
# 配置根凭据轮换 (安全最佳实践)
/opt/vault/bin/vault write -force database/rotate-root/mysql-vault
```

步骤4：创建监控和审计策略

```
# 启用审计日志
/opt/vault/bin/vault audit enable file file_path=/opt/vault/data/audit.log

# 创建只读策略用于监控
/opt/vault/bin/vault policy write db-monitor - << EOF
path "database/creds/vault-dynamic-role" {
  capabilities = ["read"]
}

path "database/roles/vault-dynamic-role" {
  capabilities = ["read"]
}

path "sys/leases/renew" {
  capabilities = ["update"]
}
EOF

# 创建监控令牌
/opt/vault/bin/vault token create -policy=db-monitor -ttl=24h
```

阶段5：验证自动轮换功能

步骤1：测试凭据续期

```
# 获取当前租约列表
/opt/vault/bin/vault list sys/leases/lookup/database/creds/vault-dynamic-role

# 续期特定租约 (替换为实际的lease_id)
/opt/vault/bin/vault lease renew database/creds/vault-dynamic-role/<lease_id>

# 查看租约详情
/opt/vault/bin/vault lease lookup database/creds/vault-dynamic-role/<lease_id>
```

步骤2：监控凭据过期

```
# 查看所有活跃租约
/opt/vault/bin/vault list sys/leases/lookup/database/creds/vault-dynamic-
role

# 检查租约过期时间
/opt/vault/bin/vault lease lookup database/creds/vault-dynamic-
role/<lease_id>
```

步骤3：测试凭据撤销

```
# 撤销特定租约（清理测试凭据）
/opt/vault/bin/vault lease revoke database/creds/vault-dynamic-
role/<lease_id>

# 验证用户是否被删除
docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT
user, host FROM mysql.user WHERE user LIKE 'v-%';"
```



阶段6：创建监控脚本

创建健康检查脚本

```
cat > /opt/vault/bin/vault-db-healthcheck.sh << 'EOF'
#!/bin/bash

# Vault数据库健康检查脚本
export VAULT_ADDR='http://127.0.0.1:8200'

echo "=== Vault数据库机密引擎健康检查 ==="

# 检查Vault服务状态
echo "1. Vault服务状态:"
/opt/vault/bin/vault status 2>/dev/null | grep -E "(Sealed|Initialized)"

# 检查数据库引擎
echo -e "\n2. 数据库机密引擎:"
/opt/vault/bin/vault secrets list | grep database

# 检查动态凭据生成
echo -e "\n3. 动态凭据测试:"
/opt/vault/bin/vault read database/creds/vault-dynamic-role 2>/dev/null |
grep -E "(username|lease_duration)"

# 检查MySQL用户数量
echo -e "\n4. MySQL动态用户数量:"
docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT
COUNT(*) as '动态用户数' FROM mysql.user WHERE user LIKE 'v-%';" 2>/dev/null
```

```
echo -e "\n=== 检查完成 ==="
EOF

chmod +x /opt/vault/bin/vault-db-healthcheck.sh

# 执行健康检查
/opt/vault/bin/vault-db-healthcheck.sh
```

请执行并反馈

请按顺序执行以下关键配置：

1. 更新轮换策略:

```
/opt/vault/bin/vault write database/roles/vault-dynamic-role \
  db_name=mysql-vault \
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY
'{{password}}';GRANT SELECT, INSERT, UPDATE, DELETE ON vault_test.* TO
'{{name}}'@'%';" \
  default_ttl="30m" \
  max_ttl="2h" \
  revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM
'{{name}}'@'%'; DROP USER '{{name}}'@'%';"
```

2. 启用审计日志:

```
/opt/vault/bin/vault audit enable file file_path=/opt/vault/data/audit.log
```

3. 创建健康检查脚本:

```
cat > /opt/vault/bin/vault-db-healthcheck.sh << 'EOF'
#!/bin/bash
export VAULT_ADDR='http://127.0.0.1:8200'
echo "=== Vault数据库健康检查 ==="
/opt/vault/bin/vault status 2>/dev/null | grep -E "(Sealed|Initialized)"
/opt/vault/bin/vault secrets list | grep database
/opt/vault/bin/vault read database/creds/vault-dynamic-role 2>/dev/null |
grep -E "(username|lease_duration)"
docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT
COUNT(*) as '动态用户数' FROM mysql.user WHERE user LIKE 'v-%';" 2>/dev/null
echo "=== 检查完成 ==="
EOF
```

```
chmod +x /opt/vault/bin/vault-db-healthcheck.sh
/opt/vault/bin/vault-db-healthcheck.sh
```

请提供：

- 轮换策略更新结果
- 审计日志启用状态
- 健康检查脚本执行结果

完成后我们将总结整个Vault数据库机密引擎部署。



User

关于上一个步骤中的 创建动态角色，我有几个问题，`creation_statements` 指定的是 生成用户信息的语句么，如果我想要创建其他类型用户，比如 开发、程序、运维、dba等等，是否是更新此处语句，他里面的 `{{name}}` 这类变量指的是连接的用户名么，除了 `{{name}}` `{{password}}` 还有其他的变量么



Assistant

很好的问题！您对Vault数据库机密引擎的理解是正确的。让我详细解释动态角色的配置：



动态角色配置详解

1. `creation_statements` 作用

是的，这是生成用户信息的SQL语句。当应用程序请求凭据时，Vault会执行这些语句在MySQL中创建用户。

2. 变量说明

- `{{name}}`: Vault自动生成的用户名（格式如：`v-root-vault-dyna-xxxxxx`）
- `{{password}}`: Vault自动生成的强密码
- `{{expiration}}`: 凭据过期时间（Unix时间戳）
- `{{username}}`: 同 `{{name}}`，别名

3. 多角色配置示例

开发人员角色（只读权限）

```
/opt/vault/bin/vault write database/roles/dev-readonly-role \
  db_name=mysql-vault \
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY
'{{password}}'; GRANT SELECT ON vault_test.* TO '{{name}}'@'%'; GRANT
SELECT ON information_schema.* TO '{{name}}'@'%';" \
  default_ttl="8h" \
  max_ttl="24h" \
  revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM
```

```
'{{name}}'@'%'; REVOKE ALL PRIVILEGES ON information_schema.* FROM
'{{name}}'@'%'; DROP USER '{{name}}'@'%';"
```

应用程序角色（读写权限）

```
/opt/vault/bin/vault write database/roles/app-rw-role \
  db_name=mysql-vault \
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY
'{{password}}'; GRANT SELECT, INSERT, UPDATE, DELETE ON app_db.* TO
'{{name}}'@'%; GRANT EXECUTE ON PROCEDURE app_db.* TO '{{name}}'@'%;" \
  default_ttl="1h" \
  max_ttl="4h" \
  revocation_statements="REVOKE ALL PRIVILEGES ON app_db.* FROM
'{{name}}'@'%; DROP USER '{{name}}'@'%;"
```

DBA角色（管理权限）

```
/opt/vault/bin/vault write database/roles/dba-admin-role \
  db_name=mysql-vault \
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY
'{{password}}'; GRANT ALL PRIVILEGES ON *.* TO '{{name}}'@'%' WITH GRANT
OPTION;" \
  default_ttl="30m" \
  max_ttl="2h" \
  revocation_statements="REVOKE ALL PRIVILEGES ON *.* FROM
'{{name}}'@'%; DROP USER '{{name}}'@'%;"
```

运维监控角色

```
/opt/vault/bin/vault write database/roles/ops-monitor-role \
  db_name=mysql-vault \
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY
'{{password}}'; GRANT SELECT ON performance_schema.* TO '{{name}}'@'%;
GRANT PROCESS ON *.* TO '{{name}}'@'%;" \
  default_ttl="4h" \
  max_ttl="12h" \
  revocation_statements="REVOKE ALL PRIVILEGES ON performance_schema.*
FROM '{{name}}'@'%; REVOKE PROCESS ON *.* FROM '{{name}}'@'%; DROP USER
'{{name}}'@'%;"
```

实际演示：创建多角色环境

让我们创建几个实用的角色来演示：

步骤1：创建开发只读角色

```
/opt/vault/bin/vault write database/roles/dev-readonly \  
  db_name=mysql-vault \  
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY  
'{{password}}'; GRANT SELECT ON vault_test.* TO '{{name}}'@'%';" \  
  default_ttl="2h" \  
  max_ttl="8h" \  
  revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM  
'{{name}}'@'%'; DROP USER '{{name}}'@'%';"
```

步骤2：创建应用读写角色

```
/opt/vault/bin/vault write database/roles/app-rw \  
  db_name=mysql-vault \  
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY  
'{{password}}'; GRANT SELECT, INSERT, UPDATE, DELETE ON vault_test.* TO  
'{{name}}'@'%';" \  
  default_ttl="1h" \  
  max_ttl="4h" \  
  revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM  
'{{name}}'@'%'; DROP USER '{{name}}'@'%';"
```

步骤3：测试不同角色

```
# 生成开发只读凭据  
echo "=== 开发只读凭据 ==="  
/opt/vault/bin/vault read database/creds/dev-readonly  
  
# 生成应用读写凭据  
echo "=== 应用读写凭据 ==="  
/opt/vault/bin/vault read database/creds/app-rw
```

步骤4：验证权限差异

```
# 使用开发凭据测试（应该只能SELECT）  
docker exec -i mysql-vault-test mysql -u<dev-username> -p<dev-password> -e  
"  
SHOW GRANTS;  
SELECT * FROM vault_test.test_table; -- 如果有表的话  
"  
  
# 使用应用凭据测试（可以INSERT等）  
docker exec -i mysql-vault-test mysql -u<app-username> -p<app-password> -e  
"
```

```
SHOW GRANTS;
-- 尝试创建测试表 (如果有权限)
CREATE TABLE IF NOT EXISTS vault_test.test_table (id INT, name
VARCHAR(50));
INSERT INTO vault_test.test_table VALUES (1, 'test');
SELECT * FROM vault_test.test_table;
"
```

查看所有角色

```
# 列出所有数据库角色
/opt/vault/bin/vault list database/roles

# 查看特定角色配置
/opt/vault/bin/vault read database/roles/dev-readonly
/opt/vault/bin/vault read database/roles/app-rw
```

高级用法：自定义用户名格式

您还可以自定义用户名格式：

```
# 使用自定义用户名前缀
/opt/vault/bin/vault write database/roles/custom-name-role \
  db_name=mysql-vault \
  creation_statements="CREATE USER 'app_{{name}}'@'%' IDENTIFIED BY
'{{password}}'; GRANT SELECT ON vault_test.* TO 'app_{{name}}'@'%';" \
  default_ttl="1h" \
  max_ttl="4h"
```

这样生成的用户名会是：`app_v-token-xxxxxx` 格式。

请执行并验证

请创建这两个角色并测试权限差异：

1. 创建开发只读角色：

```
/opt/vault/bin/vault write database/roles/dev-readonly \
  db_name=mysql-vault \
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY
'{{password}}'; GRANT SELECT ON vault_test.* TO '{{name}}'@'%';" \
  default_ttl="2h" \
  max_ttl="8h" \
```

```
revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM  
'{{name}}'@'%' ; DROP USER ' {{name}}'@'%' ;"
```

2. 创建应用读写角色:

```
/opt/vault/bin/vault write database/roles/app-rw \  
  db_name=mysql-vault \  
  creation_statements="CREATE USER ' {{name}}'@'%' IDENTIFIED BY  
' {{password}}' ; GRANT SELECT, INSERT, UPDATE, DELETE ON vault_test.* TO  
' {{name}}'@'%' ;" \  
  default_ttl="1h" \  
  max_ttl="4h" \  
  revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM  
' {{name}}'@'%' ; DROP USER ' {{name}}'@'%' ;"
```

3. 测试权限差异:

```
# 生成凭据  
/opt/vault/bin/vault read database/creds/dev-readonly  
/opt/vault/bin/vault read database/creds/app-rw  
  
# 查看所有角色  
/opt/vault/bin/vault list database/roles
```

请提供:

- 两个角色的创建结果
- 生成的凭据信息
- 角色列表

这样您就能完全掌握如何根据不同团队需求创建不同的数据库访问权限了!



User

好的, 我们继续 阶段4: 配置自动轮换与监控



Assistant

好的! 我们继续阶段4: 配置自动轮换与监控。这是确保凭据安全性的关键环节。



阶段4: 配置自动轮换与监控

步骤1: 更新轮换策略 (更严格的安全配置)

更新动态角色，采用更安全的轮换策略

```
/opt/vault/bin/vault write database/roles/vault-dynamic-role \
  db_name=mysql-vault \
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY
'{{password}}';GRANT SELECT, INSERT, UPDATE, DELETE ON vault_test.* TO
'{{name}}'@'%';" \
  default_ttl="30m" \
  max_ttl="2h" \
  revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM
'{{name}}'@'%'; DROP USER '{{name}}'@'%';"
```

步骤2：配置静态角色（长期凭据自动轮换）

首先在MySQL中创建静态用户

```
docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e "CREATE
USER 'vault_static_user'@'%' IDENTIFIED BY 'TempPassword123!'; GRANT
SELECT, INSERT ON vault_test.* TO 'vault_static_user'@'%';"
```

在Vault中配置静态角色（24小时自动轮换）

```
/opt/vault/bin/vault write database/static-roles/app-static-user \
  db_name=mysql-vault \
  username="vault_static_user" \
  rotation_statements="ALTER USER 'vault_static_user'@'%' IDENTIFIED BY
'{{password}}';" \
  rotation_period="86400" # 24小时轮换一次
```

获取静态角色凭据

```
/opt/vault/bin/vault read database/static-creds/app-static-user
```

步骤3：配置根凭据轮换（安全最佳实践）

轮换数据库根凭据（增强安全性）

```
/opt/vault/bin/vault write -force database/rotate-root/mysql-vault
```

```
echo "根凭据轮换完成，Vault将使用新凭据连接MySQL"
```

步骤4：启用审计日志（安全审计）

创建审计日志目录

```
sudo mkdir -p /opt/vault/audit
```

启用文件审计日志

```
/opt/vault/bin/vault audit enable file file_path=/opt/vault/audit/vault-
audit.log
```

```
# 验证审计日志配置
/opt/vault/bin/vault audit list
```

步骤5：创建监控策略和令牌

```
# 创建数据库监控策略
/opt/vault/bin/vault policy write db-monitor - << EOF
# 允许读取动态凭据
path "database/creds/vault-dynamic-role" {
  capabilities = ["read"]
}

path "database/creds/dev-readonly" {
  capabilities = ["read"]
}

path "database/creds/app-rw" {
  capabilities = ["read"]
}

# 允许读取角色配置
path "database/roles/*" {
  capabilities = ["read"]
}

# 允许读取静态凭据
path "database/static-creds/app-static-user" {
  capabilities = ["read"]
}

# 允许续期租约
path "sys/leases/renew" {
  capabilities = ["update"]
}

# 允许查看租约信息
path "sys/leases/lookup" {
  capabilities = ["update"]
}
EOF

# 创建监控令牌 (24小时有效期)
/opt/vault/bin/vault token create -policy=db-monitor -display-name="db-
monitor-token" -ttl=24h
```

步骤6：创建租约管理脚本

```
# 创建租约管理脚本
cat > /opt/vault/bin/lease-manager.sh << 'EOF'
```

```
#!/bin/bash

export VAULT_ADDR='http://127.0.0.1:8200'

echo "=== Vault租约管理 ==="

# 列出所有动态凭据租约
echo "1. 活跃的动态凭据租约:"
/opt/vault/bin/vault list sys/leases/lookup/database/creds/vault-dynamic-
role 2>/dev/null

# 查看租约详情 (如果有租约)
LEASE_IDS=$(/opt/vault/bin/vault list
sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail -n
+3)
if [ ! -z "$LEASE_IDS" ]; then
    echo -e "\n2. 租约详情:"
    for lease in $LEASE_IDS; do
        echo "租约: $lease"
        /opt/vault/bin/vault lease lookup database/creds/vault-dynamic-
role/$lease 2>/dev/null | grep -E "(lease_duration|expire_time)"
    done
fi

# 检查MySQL中的动态用户
echo -e "\n3. MySQL中的动态用户:"
docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT
user, host FROM mysql.user WHERE user LIKE 'v-%';" 2>/dev/null

echo -e "\n4. 静态角色状态:"
/opt/vault/bin/vault read database/static-creds/app-static-user 2>/dev/null
| grep -E "(username|last_vault_rotation|rotation_period)"

echo -e "\n=== 管理完成 ==="
EOF

chmod +x /opt/vault/bin/lease-manager.sh
```

步骤7: 创建自动轮换监控脚本

```
# 创建轮换监控脚本
cat > /opt/vault/bin/rotation-monitor.sh << 'EOF'
#!/bin/bash

export VAULT_ADDR='http://127.0.0.1:8200'

echo "=== 凭据轮换监控 ==="
date

# 检查静态角色轮换状态
echo -e "\n1. 静态角色轮换状态:"
```

```

STATIC_INFO=$(/opt/vault/bin/vault read database/static-creds/app-static-
user 2>/dev/null)
echo "$STATIC_INFO" | grep -E "
(last_vault_rotation|next_vault_rotation|rotation_period)"

# 检查动态角色配置
echo -e "\n2. 动态角色TTL配置:"
/opt/vault/bin/vault read database/roles/vault-dynamic-role 2>/dev/null |
grep -E "(default_ttl|max_ttl)"

# 检查活跃租约数量
echo -e "\n3. 活跃租约统计:"
LEASE_COUNT=$(/opt/vault/bin/vault list
sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail -n
+3 | wc -l)
echo "活跃动态凭据租约: $LEASE_COUNT"

# 检查MySQL用户数量
echo -e "\n4. MySQL用户统计:"
docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT
COUNT(*) as '动态用户数' FROM mysql.user WHERE user LIKE 'v-%';" 2>/dev/null

echo -e "\n=== 监控完成 ==="
EOF

chmod +x /opt/vault/bin/rotation-monitor.sh

```

执行和验证

请按顺序执行以下关键配置：

1. 更新轮换策略:

```

/opt/vault/bin/vault write database/roles/vault-dynamic-role \
  db_name=mysql-vault \
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY
'{{password}}';GRANT SELECT, INSERT, UPDATE, DELETE ON vault_test.* TO
'{{name}}'@'%';" \
  default_ttl="30m" \
  max_ttl="2h" \
  revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM
'{{name}}'@'%'; DROP USER '{{name}}'@'%';"

```

2. 配置静态角色:

```

docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e "CREATE
USER 'vault_static_user'@'%' IDENTIFIED BY 'TempPassword123!'; GRANT
SELECT, INSERT ON vault_test.* TO 'vault_static_user'@'%';"

```



```
/opt/vault/bin/vault write database/static-roles/app-static-user \
  db_name=mysql-vault \
  username="vault_static_user" \
  rotation_statements="ALTER USER 'vault_static_user'@'%' IDENTIFIED BY
'{{password}}';" \
  rotation_period="86400"
```

3. 启用审计日志:

```
sudo mkdir -p /opt/vault/audit
/opt/vault/bin/vault audit enable file file_path=/opt/vault/audit/vault-
audit.log
/opt/vault/bin/vault audit list
```

4. 创建监控脚本并测试:

```
chmod +x /opt/vault/bin/lease-manager.sh
chmod +x /opt/vault/bin/rotation-monitor.sh

/opt/vault/bin/lease-manager.sh
/opt/vault/bin/rotation-monitor.sh
```

请提供以下执行结果:

- 轮换策略更新状态
- 静态角色配置结果
- 审计日志启用状态
- 监控脚本执行输出

完成后,我们将进入阶段5:高级监控和告警配置。



User

```
$> # 更新动态角色,采用更安全的轮换策略 /opt/vault/bin/vault write database/roles/vault-dynamic-role
db_name=mysql-vault
creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY '{{password}}';GRANT SELECT, INSERT,
UPDATE, DELETE ON vault_test.* TO '{{name}}'@'%';"
default_ttl="30m"
max_ttl="2h"
revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM '{{name}}'@'%'; DROP USER
'{{name}}'@'%';" Success! Data written to: database/roles/vault-dynamic-role [vault@localhost vault][^0]$ $>
# 首先在MySQL中创建静态用户 docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e "CREATE
USER 'vault_static_user'@'%' IDENTIFIED BY 'TempPassword123!'; GRANT SELECT, INSERT ON vault_test.*
TO 'vault_static_user'@'%';"
```

在Vault中配置静态角色（24小时自动轮换）

```
/opt/vault/bin/vault write database/static-roles/app-static-user
db_name=mysql-vault
username="vault_static_user"
rotation_statements="ALTER USER 'vault_static_user'@'%' IDENTIFIED BY '{{password}}';"
rotation_period="86400" # 24小时轮换一次
```

获取静态角色凭据

```
/opt/vault/bin/vault read database/static-creds/app-static-user bash: !: event not found Error writing data to
database/static-roles/app-static-user: Error making API request.
```

URL: PUT http://127.0.0.1:8200/v1/database/static-roles/app-static-user Code: 500. Errors:

- 1 error occurred:
 - "app-static-user" is not an allowed role

Error reading database/static-creds/app-static-user: Error making API request.

URL: GET http://127.0.0.1:8200/v1/database/static-creds/app-static-user Code: 400. Errors:

- unknown role: app-static-user



Assistant

看到问题了！有两个问题需要解决：

1. **bash特殊字符问题**：! 在bash中有特殊含义
2. **静态角色配置问题**：需要先配置数据库连接支持静态角色



问题修复

步骤1：修复MySQL用户创建（避免特殊字符）

```
# 使用单引号避免!字符问题
docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e 'CREATE
USER "vault_static_user"@"%" IDENTIFIED BY "TempPassword123!"; GRANT
SELECT, INSERT ON vault_test.* TO "vault_static_user"@"%";'
```

步骤2：检查数据库配置状态

```
# 查看当前数据库配置
/opt/vault/bin/vault read database/config/mysql-vault
```

步骤3：更新数据库配置以支持静态角色

```
# 重新配置数据库连接，确保支持静态角色
/opt/vault/bin/vault write database/config/mysql-vault \
  plugin_name=mysql-database-plugin \
  connection_url="{{username}}:{{password}}@tcp(127.0.0.1:3306)/" \
  allowed_roles="vault-dynamic-role,app-static-user" \
  username="root" \
  password="rootpassword123"
```

步骤4：配置静态角色

```
# 配置静态角色（24小时自动轮换）
/opt/vault/bin/vault write database/static-roles/app-static-user \
  db_name=mysql-vault \
  username="vault_static_user" \
  rotation_statements="ALTER USER 'vault_static_user'@%' IDENTIFIED BY  
'{{password}}';" \
  rotation_period="86400"

# 获取静态角色凭据
/opt/vault/bin/vault read database/static-creds/app-static-user
```

步骤5：验证静态角色配置

```
# 查看静态角色详情
/opt/vault/bin/vault read database/static-roles/app-static-user

# 测试MySQL连接
docker exec -i mysql-vault-test mysql -uvault_static_user -  
pTempPassword123! -e "SELECT CURRENT_USER(); SHOW GRANTS;"
```

请按顺序重新执行

执行以下修复命令：

1. 修复MySQL用户创建:

```
docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e  
'CREATE USER "vault_static_user"@"%" IDENTIFIED BY "TempPassword123!";  
GRANT SELECT, INSERT ON vault_test.* TO "vault_static_user"@"%";'
```

2. 更新数据库配置:

```
/opt/vault/bin/vault write database/config/mysql-vault \
  plugin_name=mysql-database-plugin \
  connection_url="{{username}}:{{password}}@tcp(127.0.0.1:3306)/" \
  allowed_roles="vault-dynamic-role,app-static-user" \
  username="root" \
  password="rootpassword123"
```

3. 配置静态角色:

```
/opt/vault/bin/vault write database/static-roles/app-static-user \
  db_name=mysql-vault \
  username="vault_static_user" \
  rotation_statements="ALTER USER 'vault_static_user'@'%' IDENTIFIED
BY '{{password}}';" \
  rotation_period="86400"
```

4. 验证配置:

```
/opt/vault/bin/vault read database/static-creds/app-static-user
/opt/vault/bin/vault read database/static-roles/app-static-user
```

请提供这些命令的执行结果，然后我们继续配置审计日志和监控脚本。

如果静态用户已经存在，MySQL会报错，我们可以先检查：

```
# 检查用户是否已存在
docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT
user, host FROM mysql.user WHERE user = 'vault_static_user';"
```

如果用户已存在，我们可以直接使用现有用户配置静态角色。



User

```
[vault@localhost vault][^0]$ $> # 使用单引号避免!字符问题 docker exec -i mysql-vault-test mysql -uroot -
prootpassword123 -e 'CREATE USER "vault_static_user"@"%" IDENTIFIED BY "TempPassword123!"; GRANT
SELECT, INSERT ON vault_test.* TO "vault_static_user"@"%";' mysql: [Warning] Using a password on the
command line interface can be insecure. [vault@localhost vault][^0]$ $> # 查看当前数据库配置
/opt/vault/bin/vault read database/config/mysql-vault Key Value
```

```
allowed_roles [vault-dynamic-role] connection_details map[connection_url:{{username}}:
{{password}}@tcp(127.0.0.1:3306)/ username:root] disable_automated_rotation false password_policy n/a
plugin_name mysql-database-plugin plugin_version n/a root_credentials_rotate_statements []
```

```
rotation_period 0s rotation_schedule n/a rotation_window 0 skip_static_role_import_rotation false
verify_connection true [vault@localhost vault][^0]$ $> # 重新配置数据库连接，确保支持静态角色
/opt/vault/bin/vault write database/config/mysql-vault
plugin_name=mysql-database-plugin
connection_url="{{username}}:{{password}}@tcp(127.0.0.1:3306)/"
allowed_roles="vault-dynamic-role,app-static-user"
username="root"
password="rootpassword123" Success! Data written to: database/config/mysql-vault [vault@localhost vault]
[^0]$ $> # 配置静态角色（24小时自动轮换） /opt/vault/bin/vault write database/static-roles/app-static-user
db_name=mysql-vault
username="vault_static_user"
rotation_statements="ALTER USER 'vault_static_user'@ '%' IDENTIFIED BY '{{password}}';"
rotation_period="86400" Success! Data written to: database/static-roles/app-static-user [vault@localhost
vault][^0]$ $> # 获取静态角色凭据 /opt/vault/bin/vault read database/static-creds/app-static-user Key Value
```

```
last_vault_rotation 2025-11-18T11:36:33.933583021+08:00 password H0DqQVW5phGWwC2lCf-V
rotation_period 24h ttl 23h59m55s username vault_static_user [vault@localhost vault][^0]$ $>
/opt/vault/bin/vault read database/static-roles/app-static-user Key Value
```

```
credential_type password db_name mysql-vault last_vault_rotation 2025-11-18T11:36:33.933583021+08:00
rotation_period 24h rotation_statements [ALTER USER 'vault_static_user'@ '%' IDENTIFIED BY '{{password}}'];]
skip_import_rotation false username vault_static_user [vault@localhost vault][^0]$ $> docker exec -i mysql-
vault-test mysql -uvault_static_user -pTempPassword123! -e "SELECT CURRENT_USER(); SHOW GRANTS;"
mysql: [Warning] Using a password on the command line interface can be insecure. ERROR 1045 (28000):
Access denied for user 'vault_static_user'@'localhost' (using password: YES)
```



Assistant

很好！静态角色配置成功了，但是密码不匹配。这是因为Vault已经自动轮换了密码，旧密码
TempPassword123!已经失效了。



密码验证和继续配置

步骤1：使用Vault生成的密码验证

```
# 使用Vault生成的新密码连接
docker exec -i mysql-vault-test mysql -uvault_static_user -
pH0DqQVW5phGWwC2lCf-V -e "SELECT CURRENT_USER(); SHOW GRANTS;"
```

步骤2：继续配置审计日志

```
# 启用审计日志
sudo mkdir -p /opt/vault/audit
/opt/vault/bin/vault audit enable file file_path=/opt/vault/audit/vault-
```

```
audit.log

# 验证审计日志配置
/opt/vault/bin/vault audit list
```

步骤3：创建监控策略

```
# 创建数据库监控策略
/opt/vault/bin/vault policy write db-monitor - << EOF
# 允许读取动态凭据
path "database/creds/vault-dynamic-role" {
  capabilities = ["read"]
}

path "database/creds/dev-readonly" {
  capabilities = ["read"]
}

path "database/creds/app-rw" {
  capabilities = ["read"]
}

# 允许读取角色配置
path "database/roles/*" {
  capabilities = ["read"]
}

# 允许读取静态凭据
path "database/static-creds/app-static-user" {
  capabilities = ["read"]
}

# 允许续期租约
path "sys/leases/renew" {
  capabilities = ["update"]
}

# 允许查看租约信息
path "sys/leases/lookup" {
  capabilities = ["update"]
}
EOF

# 创建监控令牌
/opt/vault/bin/vault token create -policy=db-monitor -display-name="db-
monitor-token" -ttl=24h
```

步骤4：创建并运行监控脚本

创建租约管理脚本

```
cat > /opt/vault/bin/lease-manager.sh << 'EOF'
#!/bin/bash
```

```
export VAULT_ADDR='http://127.0.0.1:8200'
```

```
echo "=== Vault租约管理 ==="
```

列出所有动态凭据租约

```
echo "1. 活跃的动态凭据租约:"
```

```
/opt/vault/bin/vault list sys/leases/lookup/database/creds/vault-dynamic-
role 2>/dev/null
```

查看租约详情 (如果有租约)

```
LEASE_IDS=$(/opt/vault/bin/vault list
sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail -n
+3)
```

```
if [ ! -z "$LEASE_IDS" ]; then
```

```
    echo -e "\n2. 租约详情:"
```

```
    for lease in $LEASE_IDS; do
```

```
        echo "租约: $lease"
```

```
        /opt/vault/bin/vault lease lookup database/creds/vault-dynamic-
role/$lease 2>/dev/null | grep -E "(lease_duration|expire_time)"
```

```
    done
```

```
fi
```

检查MySQL中的动态用户

```
echo -e "\n3. MySQL中的动态用户:"
```

```
docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT
user, host FROM mysql.user WHERE user LIKE 'v-%';" 2>/dev/null
```

```
echo -e "\n4. 静态角色状态:"
```

```
/opt/vault/bin/vault read database/static-creds/app-static-user 2>/dev/null
| grep -E "(username|last_vault_rotation|rotation_period)"
```

```
echo -e "\n=== 管理完成 ==="
```

```
EOF
```

```
chmod +x /opt/vault/bin/lease-manager.sh
```

创建轮换监控脚本

```
cat > /opt/vault/bin/rotation-monitor.sh << 'EOF'
#!/bin/bash
```

```
export VAULT_ADDR='http://127.0.0.1:8200'
```

```
echo "=== 凭据轮换监控 ==="
```

```
date
```

检查静态角色轮换状态

```
echo -e "\n1. 静态角色轮换状态:"
```

```
STATIC_INFO=$(/opt/vault/bin/vault read database/static-creds/app-static-
user 2>/dev/null)
```



```

echo "$STATIC_INFO" | grep -E "
(last_vault_rotation|next_vault_rotation|rotation_period)"

# 检查动态角色配置
echo -e "\n2. 动态角色TTL配置:"
/opt/vault/bin/vault read database/roles/vault-dynamic-role 2>/dev/null |
grep -E "(default_ttl|max_ttl)"

# 检查活跃租约数量
echo -e "\n3. 活跃租约统计:"
LEASE_COUNT=$(/opt/vault/bin/vault list
sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail -n
+3 | wc -l)
echo "活跃动态凭据租约: $LEASE_COUNT"

# 检查MySQL用户数量
echo -e "\n4. MySQL用户统计:"
docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT
COUNT(*) as '动态用户数' FROM mysql.user WHERE user LIKE 'v-%';" 2>/dev/null

echo -e "\n=== 监控完成 ==="
EOF

chmod +x /opt/vault/bin/rotation-monitor.sh

```

步骤5：测试监控脚本

```

# 运行监控脚本
/opt/vault/bin/lease-manager.sh
/opt/vault/bin/rotation-monitor.sh

```

步骤6：生成一些测试租约

```

# 生成几个动态凭据来测试监控
echo "=== 生成测试动态凭据 ==="
/opt/vault/bin/vault read database/creds/vault-dynamic-role
/opt/vault/bin/vault read database/creds/vault-dynamic-role

# 再次运行监控查看租约
/opt/vault/bin/lease-manager.sh

```

请继续执行

执行以下命令完成阶段4：

1. 验证静态用户连接:

```
docker exec -i mysql-vault-test mysql -uvault_static_user -
pH0DqQVW5phGWwC2lCf-V -e "SELECT CURRENT_USER(); SHOW GRANTS;"
```

2. 配置审计日志:

```
sudo mkdir -p /opt/vault/audit
/opt/vault/bin/vault audit enable file file_path=/opt/vault/audit/vault-
audit.log
/opt/vault/bin/vault audit list
```

3. 运行监控脚本:

```
chmod +x /opt/vault/bin/lease-manager.sh
chmod +x /opt/vault/bin/rotation-monitor.sh
/opt/vault/bin/lease-manager.sh
/opt/vault/bin/rotation-monitor.sh
```

4. 生成测试租约:

```
/opt/vault/bin/vault read database/creds/vault-dynamic-role
/opt/vault/bin/vault read database/creds/vault-dynamic-role
/opt/vault/bin/lease-manager.sh
```

请提供这些命令的执行结果，然后我们进入阶段5：高级监控和告警配置。

阶段4的核心成果：

- ✅ 静态角色自动轮换配置完成
- ✅ 动态角色安全TTL配置完成
- ✅ 监控脚本创建完成
- 🔄 审计日志和监控策略配置中



```
[vault@localhost vault][^1]$ $> docker exec -i mysql-vault-test mysql -uvault_static_user -
pH0DqQVW5phGWwC2lCf-V -e "SELECT CURRENT_USER(); SHOW GRANTS;" mysql: [Warning] Using a
password on the command line interface can be insecure. CURRENT_USER() vault_static_user@% Grants for
vault_static_user@% GRANT USAGE ON . TO vault_static_user@% GRANT SELECT, INSERT ON
vault_test.* TO vault_static_user@% [vault@localhost vault][^0]$ $> sudo mkdir -p /opt/vault/audit
[sudo] vault 的密码: [vault@localhost vault][^0]$ $> /opt/vault/bin/vault audit enable file
file_path=/opt/vault/audit/vault-audit.log Error enabling audit device: Error making API request.
```

URL: PUT http://127.0.0.1:8200/v1/sys/audit/file Code: 400. Errors:

- unable to create new audit backend: file sink creation failed for path "/opt/vault/audit/vault-audit.log": sanity check failed; unable to open "/opt/vault/audit/vault-audit.log" for writing: unable to open file for sink "/opt/vault/audit/vault-audit.log": open /opt/vault/audit/vault-audit.log: permission denied [vault@localhost vault][^2]\$ \$> sudo chown vault: /opt/vault/audit [vault@localhost vault][^0]\$ \$> /opt/vault/bin/vault audit enable file file_path=/opt/vault/audit/vault-audit.log Success! Enabled the file audit device at: file/ [vault@localhost vault][^0]\$ \$> /opt/vault/bin/vault audit list Path Type Description

```
file/ file n/a [vault@localhost vault][^0]$ $> # 创建数据库监控策略 /opt/vault/bin/vault policy write db-monitor - << EOF
```

允许读取动态凭据

```
path "database/creds/vault-dynamic-role" { capabilities = ["read"] } path "database/creds/dev-readonly" { capabilities = ["read"] } path "database/creds/app-rw" { capabilities = ["read"] }
```

允许读取角色配置

```
path "database/roles/*" { capabilities = ["read"] }
```

允许读取静态凭据

```
path "database/static-creds/app-static-user" { capabilities = ["read"] }
```

允许续期租约

```
path "sys/leases/renew" { capabilities = ["update"] }
```

允许查看租约信息

```
path "sys/leases/lookup" { capabilities = ["update"] } EOF Success! Uploaded policy: db-monitor [vault@localhost vault][^0]$ $> ^C [vault@localhost vault][^130]$ $> /opt/vault/bin/vault token create -policy=db-monitor -display-name="db-monitor-token" -ttl=24h Key Value
```

token

```
hvs.CAESIAWG1tb0XqqQ4Zlt6Lie6a78itowOH3R5P5PKD5ek4IOGh4KHGh2cy5SUTBLekxIN29IR3ZkQnpQR1ZmSG93RXg token_accessor DmCusXaEwoMBCuDlyblqOqRc token_duration 24h token_renewable true token_policies ["db-monitor" "default"] identity_policies [] policies ["db-monitor" "default"] [vault@localhost vault][^0]$ $> #!/bin/bash export VAULT_ADDR='http://127.0.0.1:8200' echo "=== Vault租约管理 ==="
```

列出所有动态凭据租约

```
echo "1. 活跃的动态凭据租约:" /opt/vault/bin/vault list sys/leases/lookup/database/creds/vault-dynamic-role
2>/dev/null
```

查看租约详情（如果有租约）

```
LEASE_IDS=$(/opt/vault/bin/vault list sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail
-n +3) if [ ! -z "$LEASE_IDS" ]; then echo -e "\n2. 租约详情:" for lease in $LEASE_IDS; do echo "租约: $lease"
/opt/vault/bin/vault lease lookup database/creds/vault-dynamic-role/$lease 2>/dev/null | grep -E "
(lease_duration|expire_time)" done fi
```

检查MySQL中的动态用户

```
echo -e "\n3. MySQL中的动态用户:" docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT
user, host FROM mysql.user WHERE user LIKE 'v-%';" 2>/dev/null echo -e "\n4. 静态角色状态:"
/opt/vault/bin/vault read database/static-creds/app-static-user 2>/dev/null | grep -E "
(username|last_vault_rotation|rotation_period)" echo -e "\n=== 管理完成 ===" EOF === Vault租约管理 ===
```

1. 活跃的动态凭据租约:

2. MySQL中的动态用户:

3. 静态角色状态: last_vault_rotation 2025-11-18T11:36:33.933583021+08:00 rotation_period 24h
username vault_static_user

```
=== 管理完成 === EOF: 未找到命令 [vault@localhost vault][^127]$ $> vim /opt/vault/bin/lease-manager.sh
[vault@localhost vault][^0]$ $> #!/bin/bash^C [vault@localhost vault][^130]$ $> # 创建租约管理脚本 cat >
/opt/vault/bin/lease-manager.sh << 'EOF'
```

```
#!/bin/bash export VAULT_ADDR='http://127.0.0.1:8200' echo "=== Vault租约管理 ==="
```

列出所有动态凭据租约

```
echo "1. 活跃的动态凭据租约:" /opt/vault/bin/vault list sys/leases/lookup/database/creds/vault-dynamic-role
2>/dev/null
```

查看租约详情（如果有租约）

```
LEASE_IDS=$(/opt/vault/bin/vault list sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail
-n +3) if [ ! -z "$LEASE_IDS" ]; then echo -e "\n2. 租约详情:" for lease in $LEASE_IDS; do echo "租约: $lease"
/opt/vault/bin/vault lease lookup database/creds/vault-dynamic-role/$lease 2>/dev/null | grep -E "
(lease_duration|expire_time)" done fi
```

检查MySQL中的动态用户

```
echo -e "\n3. MySQL中的动态用户:" docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT user, host FROM mysql.user WHERE user LIKE 'v-%';" 2>/dev/null echo -e "\n4. 静态角色状态:" /opt/vault/bin/vault read database/static-creds/app-static-user 2>/dev/null | grep -E "(username|last_vault_rotation|rotation_period)" echo -e "\n=== 管理完成 ==="
```

```
'EOF' EOF [vault@localhost vault][^0]$ $> vim /opt/vault/bin/lease-manager.sh [vault@localhost vault][^0]$ $> chmod +x /opt/vault/bin/lease-manager.sh [vault@localhost vault][^0]$ $> cat > /opt/vault/bin/rotation-monitor.sh << 'EOF' #!/bin/bash
```

```
export VAULT_ADDR='http://127.0.0.1:8200'
```

```
echo "=== 凭据轮换监控 ===" date
```

检查静态角色轮换状态

```
echo -e "\n1. 静态角色轮换状态:" STATIC_INFO=$(/opt/vault/bin/vault read database/static-creds/app-static-user 2>/dev/null) echo "$STATIC_INFO" | grep -E "(last_vault_rotation|next_vault_rotation|rotation_period)"
```

检查动态角色配置

```
echo -e "\n2. 动态角色TTL配置:" /opt/vault/bin/vault read database/roles/vault-dynamic-role 2>/dev/null | grep -E "(default_ttl|max_ttl)"
```

检查活跃租约数量

```
echo -e "\n3. 活跃租约统计:" LEASE_COUNT=$(/opt/vault/bin/vault list sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail -n +3 | wc -l) echo "活跃动态凭据租约: $LEASE_COUNT"
```

检查MySQL用户数量

```
echo -e "\n4. MySQL用户统计:" docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT COUNT(*) as '动态用户数' FROM mysql.user WHERE user LIKE 'v-%';" 2>/dev/null
```

```
echo -e "\n=== 监控完成 ==="
```

```
EOF [vault@localhost vault][^0]$ $> chmod +x /opt/vault/bin/rotation-monitor.sh [vault@localhost vault][^0]$ $> /opt/vault/bin/lease-manager.sh === Vault租约管理 ===
```

1. 活跃的动态凭据租约:
2. MySQL中的动态用户:
3. 静态角色状态: last_vault_rotation 2025-11-18T11:36:33.933583021+08:00 rotation_period 24h
username vault_static_user

=== 管理完成 === [vault@localhost vault][^0]\$ \$> /opt/vault/bin/rotation-monitor.sh === 凭据轮换监控 ===
2025年 11月 18日 星期二 13:10:41 CST

1. 静态角色轮换状态: last_vault_rotation 2025-11-18T11:36:33.933583021+08:00 rotation_period 24h
2. 动态角色TTL配置: default_ttl 30m max_ttl 2h
3. 活跃租约统计: 活跃动态凭据租约: 0
4. MySQL用户统计: 动态用户数 0

=== 监控完成 === [vault@localhost vault][^0]\$ \$> /opt/vault/bin/vault read database/creds/vault-dynamic-role Key Value

```
lease_id database/creds/vault-dynamic-role/NVEQdXdMBD721hP5dQeS3R2f lease_duration 30m
lease_renewable true password q4sli-mgC6q8Nu5ksYgA username v-root-vault-dyna-p2dyPahRvK1S5K
[vault@localhost vault][^0]$ $> /opt/vault/bin/vault read database/creds/vault-dynamic-role Key Value
```

```
lease_id database/creds/vault-dynamic-role/v5XH9AWjlk5QodAgeXXYvfZU lease_duration 30m
lease_renewable true password LKZ1NXkjMK-bnEXwGTb6 username v-root-vault-dyna-NEdcroZn6jOLIK
[vault@localhost vault][^0]$ $> /opt/vault/bin/lease-manager.sh === Vault租约管理 ===
```

1. 活跃的动态凭据租约: Keys

```
NVEQdXdMBD721hP5dQeS3R2f v5XH9AWjlk5QodAgeXXYvfZU
```

2. 租约详情: 租约: NVEQdXdMBD721hP5dQeS3R2f expire_time 2025-11-18T13:40:49.804308343+08:00
租约: v5XH9AWjlk5QodAgeXXYvfZU expire_time 2025-11-18T13:40:53.282535822+08:00
3. MySQL中的动态用户: user host v-root-vault-dyna-NEdcroZn6jOLIK % v-root-vault-dyna-p2dyPahRvK1S5K %
4. 静态角色状态: last_vault_rotation 2025-11-18T11:36:33.933583021+08:00 rotation_period 24h
username vault_static_user

=== 管理完成 ===



Assistant

完美! 阶段4配置完成! 🎉



阶段4完成总结

已成功配置:

1.  静态角色自动轮换
 - 用户: vault_static_user
 - 轮换周期: 24小时

- 当前TTL：23小时+

2. 审计日志

- 路径：/opt/vault/audit/vault-audit.log
- 已启用文件审计设备

3. 监控策略和令牌

- 策略：db-monitor
- 令牌：
hvs.CAESIAGW1tb0XqqQ4Zlt6Lie6a78itowOH3R5P5PKD5ek4IOGh4KHGh2cy5SUTBLekxlN29IR3ZkQnpQR1ZmSG93RXg
- 有效期：24小时

4. 监控脚本

- lease-manager.sh - 租约管理
- rotation-monitor.sh - 轮换监控
- 已测试运行正常

5. 动态凭据测试

- 生成2个动态凭据租约
- 租约ID：NVEQdXdMBD721hP5dQeS3R2f、v5XH9AWj1k5QodAgeXXYvfZU
- TTL：30分钟
- MySQL中已创建对应动态用户

进入阶段5：高级监控和告警配置

步骤1：配置Prometheus监控

```
# 启用Vault Prometheus指标
/opt/vault/bin/vault write sys/metrics/config \
  usage_gauge_period="30s" \
  maximum_gauge_cardinality=500

# 检查指标端点
curl -s http://127.0.0.1:8200/v1/sys/metrics?format=prometheus | head -20
```

步骤2：创建健康检查脚本

```
cat > /opt/vault/bin/vault-health-check.sh << 'EOF'
#!/bin/bash

export VAULT_ADDR='http://127.0.0.1:8200'

echo "=== Vault健康检查 ==="
```



```

date

# 检查Vault状态
echo -e "\n1. Vault服务状态:"
/opt/vault/bin/vault status 2>/dev/null

# 检查密封状态
echo -e "\n2. 密封状态:"
/opt/vault/bin/vault status 2>/dev/null | grep -E "(Sealed|Initialized)"

# 检查数据库引擎状态
echo -e "\n3. 数据库引擎状态:"
/opt/vault/bin/vault secrets list -detailed | grep database

# 检查租约状态
echo -e "\n4. 租约状态:"
ACTIVE_LEASES=$(/opt/vault/bin/vault list
sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail -n
+3 | wc -l)
echo "活跃动态租约: $ACTIVE_LEASES"

# 检查静态角色状态
echo -e "\n5. 静态角色状态:"
STATIC_TTL=$(/opt/vault/bin/vault read database/static-creds/app-static-
user 2>/dev/null | grep ttl | awk '{print $2}')
echo "静态角色TTL: $STATIC_TTL"

# 检查审计日志
echo -e "\n6. 审计日志状态:"
AUDIT_LOG_SIZE=$(sudo ls -lh /opt/vault/audit/vault-audit.log 2>/dev/null |
awk '{print $5}' || echo "N/A")
echo "审计日志大小: $AUDIT_LOG_SIZE"

echo -e "\n=== 健康检查完成 ==="

# 退出码判断
if /opt/vault/bin/vault status 2>/dev/null | grep -q "Sealed.*false"; then
    echo "✅ Vault健康状态: 正常"
    exit 0
else
    echo "❌ Vault健康状态: 异常"
    exit 1
fi
EOF

chmod +x /opt/vault/bin/vault-health-check.sh

```

步骤3: 创建告警规则文件

```

cat > /opt/vault/bin/vault-alert-rules.yml << 'EOF'
# Vault告警规则

```

```
groups:
- name: vault_alerts
  rules:

  # Vault服务状态告警
  - alert: VaultSealed
    expr: vault_core_sealed == 1
    for: 1m
    labels:
      severity: critical
    annotations:
      summary: "Vault实例已密封"
      description: "Vault实例 {{ $labels.instance }} 处于密封状态，需要解封"

  # 租约使用率告警
  - alert: HighLeaseUsage
    expr: count(vault_expire_num_leases) > 50
    for: 5m
    labels:
      severity: warning
    annotations:
      summary: "租约使用率过高"
      description: "Vault实例 {{ $labels.instance }} 活跃租约数量超过50个"

  # 静态凭据即将过期告警
  - alert: StaticCredentialExpiring
    expr: vault_database_static_role_rotation_scheduled{role="app-static-user"} < 3600
    for: 2m
    labels:
      severity: warning
    annotations:
      summary: "静态凭据即将轮换"
      description: "静态角色 {{ $labels.role }} 将在1小时内自动轮换"

  # 数据库连接失败告警
  - alert: DatabaseConnectionFailure
    expr: increase(vault_database_connection_errors_total[5m]) > 3
    for: 2m
    labels:
      severity: critical
    annotations:
      summary: "数据库连接频繁失败"
      description: "Vault到数据库的连接在5分钟内失败超过3次"

EOF
```

步骤4：创建自动清理脚本

```
cat > /opt/vault/bin/vault-cleanup.sh << 'EOF'
#!/bin/bash
```

```
export VAULT_ADDR='http://127.0.0.1:8200'

echo "=== Vault清理维护 ==="
date

# 清理过期的租约
echo -e "\n1. 清理过期租约:"
EXPIRED_LEASES=$( /opt/vault/bin/vault list
sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail -n
+3)
if [ ! -z "$EXPIRED_LEASES" ]; then
    for lease in $EXPIRED_LEASES; do
        LEASE_INFO=$( /opt/vault/bin/vault lease lookup
database/creds/vault-dynamic-role/$lease 2>/dev/null)
        if echo "$LEASE_INFO" | grep -q "lease expired"; then
            echo "清理过期租约: $lease"
            /opt/vault/bin/vault lease revoke database/creds/vault-dynamic-
role/$lease 2>/dev/null
        fi
    done
fi

# 清理MySQL中的孤立用户
echo -e "\n2. 清理MySQL孤立用户:"
docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "
SELECT CONCAT('DROP USER \\\'', user, '\\\\'@\\\'', host, '\\\'';')
FROM mysql.user
WHERE user LIKE 'v-%'
AND user NOT IN (
    SELECT DISTINCT
SUBSTRING_INDEX(SUBSTRING_INDEX(json_extract(creation_statement, '$[0]'),
'', 2), '', -1)
FROM vault_token.vault_dynamic_users
);" 2>/dev/null

# 轮转审计日志 (如果超过100MB)
echo -e "\n3. 审计日志维护:"
AUDIT_LOG_SIZE=$(sudo ls -l /opt/vault/audit/vault-audit.log 2>/dev/null |
awk '{print $5}')
if [ "$AUDIT_LOG_SIZE" -gt 104857600 ]; then # 100MB
    echo "审计日志超过100MB, 执行轮转"
    sudo mv /opt/vault/audit/vault-audit.log /opt/vault/audit/vault-
audit.log.$(date +%Y%m%d_%H%M%S)
    sudo systemctl reload vault # 重新加载以创建新日志文件
fi

echo -e "\n=== 清理完成 ==="
EOF

chmod +x /opt/vault/bin/vault-cleanup.sh
```

步骤5：测试健康检查

```
# 运行健康检查脚本
/opt/vault/bin/vault-health-check.sh

# 查看当前指标
curl -s http://127.0.0.1:8200/v1/sys/metrics?format=prometheus | grep -E "(vault_core_sealed|vault_expire_num_leases)" | head -10
```

请执行阶段5的关键配置

执行以下命令：

1. 启用Prometheus指标:

```
/opt/vault/bin/vault write sys/metrics/config \
  usage_gauge_period="30s" \
  maximum_gauge_cardinality=500
```

2. 创建并测试健康检查:

```
chmod +x /opt/vault/bin/vault-health-check.sh
/opt/vault/bin/vault-health-check.sh
```

3. 检查指标端点:

```
curl -s http://127.0.0.1:8200/v1/sys/metrics?format=prometheus | head -20
```

请提供这些命令的执行结果，然后我们完成最终的集成测试和文档总结。

阶段5完成后，我们将拥有完整的监控告警体系，包括：

- Prometheus指标收集
- 健康检查脚本
- 告警规则定义
- 自动清理维护



User

阶段五我不在进行实际测试，请直接为我形成完整文档



Vault数据库凭据动态管理完整文档

📋 项目概述

目标

实现基于HashiCorp Vault的MySQL数据库凭据动态管理，包括动态角色、静态角色自动轮换、监控告警和安全审计。

架构组件

- **Vault Server:** 凭据管理中心
- **MySQL:** 目标数据库
- **动态角色:** 短期凭据（30分钟TTL）
- **静态角色:** 长期凭据（24小时自动轮换）
- **监控体系:** 租约管理、健康检查、告警规则

🔧 阶段1：基础环境配置

1.1 MySQL容器部署

```
# 启动MySQL测试容器
docker run -d \
  --name mysql-vault-test \
  -e MYSQL_ROOT_PASSWORD=rootpassword123 \
  -e MYSQL_DATABASE=vault_test \
  -p 3306:3306 \
  mysql:8.0

# 验证连接
docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e "SHOW DATABASES;"
```

1.2 Vault数据库引擎配置

```
# 启用数据库密钥引擎
/opt/vault/bin/vault secrets enable database

# 配置MySQL连接
/opt/vault/bin/vault write database/config/mysql-vault \
  plugin_name=mysql-database-plugin \
  connection_url="{username}:{password}@tcp(127.0.0.1:3306)/" \
  allowed_roles="vault-dynamic-role"
```

```
username="root" \  
password="rootpassword123"
```

阶段2：动态角色配置

2.1 动态角色定义

```
/opt/vault/bin/vault write database/roles/vault-dynamic-role \  
  db_name=mysql-vault \  
  creation_statements="CREATE USER '{{name}}'@'%' IDENTIFIED BY  
'{{password}}';GRANT SELECT, INSERT, UPDATE, DELETE ON vault_test.* TO  
'{{name}}'@'%';" \  
  default_ttl="30m" \  
  max_ttl="2h" \  
  revocation_statements="REVOKE ALL PRIVILEGES ON vault_test.* FROM  
'{{name}}'@'%'; DROP USER '{{name}}'@'%';"
```

2.2 动态凭据使用

```
# 获取动态凭据  
/opt/vault/bin/vault read database/creds/vault-dynamic-role  
  
# 验证MySQL权限  
mysql -u<动态用户名> -p<动态密码> -e "SHOW GRANTS;"
```

阶段3：静态角色自动轮换

3.1 创建静态用户

```
# 在MySQL中创建静态用户  
docker exec -i mysql-vault-test mysql -uroot -prootpassword123 -e 'CREATE  
USER "vault_static_user"@"%" IDENTIFIED BY "TempPassword123!"; GRANT  
SELECT, INSERT ON vault_test.* TO "vault_static_user"@"%";'
```

3.2 配置静态角色

```
# 更新数据库配置支持静态角色  
/opt/vault/bin/vault write database/config/mysql-vault \  
  plugin_name=mysql-database-plugin \  
  connection_url="{{username}}:{{password}}@tcp(127.0.0.1:3306)/" \  
  allowed_roles="vault-dynamic-role,app-static-user" \  
  username="root" \  
  password="rootpassword123"
```

```
password="rootpassword123"

# 配置静态角色 (24小时自动轮换)
/opt/vault/bin/vault write database/static-roles/app-static-user \
  db_name=mysql-vault \
  username="vault_static_user" \
  rotation_statements="ALTER USER 'vault_static_user'@'%' IDENTIFIED BY  
'{{password}}';" \
  rotation_period="86400"
```

3.3 获取静态凭据

```
# 获取当前静态凭据
/opt/vault/bin/vault read database/static-creds/app-static-user

# 查看静态角色状态
/opt/vault/bin/vault read database/static-roles/app-static-user
```



阶段4：监控审计体系

4.1 审计日志配置

```
# 创建审计日志目录
sudo mkdir -p /opt/vault/audit
sudo chown vault: /opt/vault/audit

# 启用文件审计
/opt/vault/bin/vault audit enable file file_path=/opt/vault/audit/vault-  
audit.log

# 验证审计配置
/opt/vault/bin/vault audit list
```

4.2 监控策略配置

```
# 创建数据库监控策略
/opt/vault/bin/vault policy write db-monitor - << EOF
path "database/creds/vault-dynamic-role" {
  capabilities = ["read"]
}
path "database/creds/dev-readonly" {
  capabilities = ["read"]
}
path "database/creds/app-rw" {
  capabilities = ["read"]
}
```



```

}
path "database/roles/*" {
  capabilities = ["read"]
}
path "database/static-creds/app-static-user" {
  capabilities = ["read"]
}
path "sys/leases/renew" {
  capabilities = ["update"]
}
path "sys/leases/lookup" {
  capabilities = ["update"]
}
}
EOF

# 创建监控令牌
/opt/vault/bin/vault token create -policy=db-monitor -display-name="db-monitor-token" -ttl=24h

```

4.3 监控脚本

租约管理脚本 (/opt/vault/bin/lease-manager.sh)

```

#!/bin/bash
export VAULT_ADDR='http://127.0.0.1:8200'
echo "=== Vault租约管理 ==="
# 列出所有动态凭据租约
echo "1. 活跃的动态凭据租约:"
/opt/vault/bin/vault list sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null
# 查看租约详情 (如果有租约)
LEASE_IDS=$(/opt/vault/bin/vault list sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail -n +3)
if [ ! -z "$LEASE_IDS" ]; then
  echo -e "\n2. 租约详情:"
  for lease in $LEASE_IDS; do
    echo "租约: $lease"
    /opt/vault/bin/vault lease lookup database/creds/vault-dynamic-role/$lease 2>/dev/null | grep -E "(lease_duration|expire_time)"
  done
fi
# 检查MySQL中的动态用户
echo -e "\n3. MySQL中的动态用户:"
docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT user, host FROM mysql.user WHERE user LIKE 'v-%';" 2>/dev/null
echo -e "\n4. 静态角色状态:"
/opt/vault/bin/vault read database/static-creds/app-static-user 2>/dev/null | grep -E "(username|last_vault_rotation|rotation_period)"
echo -e "\n=== 管理完成 ==="

```

轮换监控脚本 (/opt/vault/bin/rotation-monitor.sh)

```
#!/bin/bash
export VAULT_ADDR='http://127.0.0.1:8200'
echo "=== 凭据轮换监控 ==="
date
# 检查静态角色轮换状态
echo -e "\n1. 静态角色轮换状态:"
STATIC_INFO=$(/opt/vault/bin/vault read database/static-creds/app-static-user 2>/dev/null)
echo "$STATIC_INFO" | grep -E "(last_vault_rotation|next_vault_rotation|rotation_period)"
# 检查动态角色配置
echo -e "\n2. 动态角色TTL配置:"
/opt/vault/bin/vault read database/roles/vault-dynamic-role 2>/dev/null | grep -E "(default_ttl|max_ttl)"
# 检查活跃租约数量
echo -e "\n3. 活跃租约统计:"
LEASE_COUNT=$(/opt/vault/bin/vault list sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail -n +3 | wc -l)
echo "活跃动态凭据租约: $LEASE_COUNT"
# 检查MySQL用户数量
echo -e "\n4. MySQL用户统计:"
docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "SELECT COUNT(*) as '动态用户数' FROM mysql.user WHERE user LIKE 'v-%';" 2>/dev/null
echo -e "\n=== 监控完成 ==="
```



阶段5：高级监控告警

5.1 Prometheus指标配置

```
# 启用Vault Prometheus指标
/opt/vault/bin/vault write sys/metrics/config \
  usage_gauge_period="30s" \
  maximum_gauge_cardinality=500
```

5.2 健康检查脚本 (/opt/vault/bin/vault-health-check.sh)

```
#!/bin/bash
export VAULT_ADDR='http://127.0.0.1:8200'
echo "=== Vault健康检查 ==="
date
# 检查Vault状态
echo -e "\n1. Vault服务状态:"
/opt/vault/bin/vault status 2>/dev/null
```

```

# 检查密封状态
echo -e "\n2. 密封状态:"
/opt/vault/bin/vault status 2>/dev/null | grep -E "(Sealed|Initialized)"
# 检查数据库引擎状态
echo -e "\n3. 数据库引擎状态:"
/opt/vault/bin/vault secrets list -detailed | grep database
# 检查租约状态
echo -e "\n4. 租约状态:"
ACTIVE_LEASES=$(/opt/vault/bin/vault list
sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail -n
+3 | wc -l)
echo "活跃动态租约: $ACTIVE_LEASES"
# 检查静态角色状态
echo -e "\n5. 静态角色状态:"
STATIC_TTL=$(/opt/vault/bin/vault read database/static-creds/app-static-
user 2>/dev/null | grep ttl | awk '{print $2}')
echo "静态角色TTL: $STATIC_TTL"
# 检查审计日志
echo -e "\n6. 审计日志状态:"
AUDIT_LOG_SIZE=$(sudo ls -lh /opt/vault/audit/vault-audit.log 2>/dev/null |
awk '{print $5}' || echo "N/A")
echo "审计日志大小: $AUDIT_LOG_SIZE"
echo -e "\n=== 健康检查完成 ==="
# 退出码判断
if /opt/vault/bin/vault status 2>/dev/null | grep -q "Sealed.*false"; then
    echo "✅ Vault健康状态: 正常"
    exit 0
else
    echo "❌ Vault健康状态: 异常"
    exit 1
fi

```

5.3 告警规则 (/opt/vault/bin/vault-alert-rules.yml)

```

groups:
- name: vault_alerts
  rules:
  - alert: VaultSealed
    expr: vault_core_sealed == 1
    for: 1m
    labels:
      severity: critical
    annotations:
      summary: "Vault实例已密封"
      description: "Vault实例 {{ $labels.instance }} 处于密封状态, 需要解封"
  - alert: HighLeaseUsage
    expr: count(vault_expire_num_leases) > 50
    for: 5m
    labels:
      severity: warning
    annotations:

```

```

summary: "租约使用率过高"
description: "Vault实例 {{ $labels.instance }} 活跃租约数量超过50个"
- alert: StaticCredentialExpiring
  expr: vault_database_static_role_rotation_scheduled{role="app-static-user"} < 3600
  for: 2m
  labels:
    severity: warning
  annotations:
    summary: "静态凭据即将轮换"
    description: "静态角色 {{ $labels.role }} 将在1小时内自动轮换"
- alert: DatabaseConnectionFailure
  expr: increase(vault_database_connection_errors_total[5m]) > 3
  for: 2m
  labels:
    severity: critical
  annotations:
    summary: "数据库连接频繁失败"
    description: "Vault到数据库的连接在5分钟内失败超过3次"

```

5.4 自动清理脚本 (/opt/vault/bin/vault-cleanup.sh)

```

#!/bin/bash
export VAULT_ADDR='http://127.0.0.1:8200'
echo "=== Vault清理维护 ==="
date
# 清理过期的租约
echo -e "\n1. 清理过期租约:"
EXPIRED_LEASES=$(/opt/vault/bin/vault list
sys/leases/lookup/database/creds/vault-dynamic-role 2>/dev/null | tail -n
+3)
if [ ! -z "$EXPIRED_LEASES" ]; then
  for lease in $EXPIRED_LEASES; do
    LEASE_INFO=$(/opt/vault/bin/vault lease lookup
database/creds/vault-dynamic-role/$lease 2>/dev/null)
    if echo "$LEASE_INFO" | grep -q "lease expired"; then
      echo "清理过期租约: $lease"
      /opt/vault/bin/vault lease revoke database/creds/vault-dynamic-
role/$lease 2>/dev/null
    fi
  done
fi
# 清理MySQL中的孤立用户
echo -e "\n2. 清理MySQL孤立用户:"
docker exec mysql-vault-test mysql -uroot -prootpassword123 -e "
SELECT CONCAT('DROP USER \'', user, '\'\''@\'', host, '\'\';')
FROM mysql.user
WHERE user LIKE 'v-%'
AND user NOT IN (
  SELECT DISTINCT
SUBSTRING_INDEX(SUBSTRING_INDEX(json_extract(creation_statement, '$[0]'),

```

```

    '', 2), '', -1)
    FROM vault_token.vault_dynamic_users
);" 2>/dev/null
# 轮转审计日志 (如果超过100MB)
echo -e "\n3. 审计日志维护:"
AUDIT_LOG_SIZE=$(sudo ls -l /opt/vault/audit/vault-audit.log 2>/dev/null |
awk '{print $5}')
if [ "$AUDIT_LOG_SIZE" -gt 104857600 ]; then # 100MB
    echo "审计日志超过100MB, 执行轮转"
    sudo mv /opt/vault/audit/vault-audit.log /opt/vault/audit/vault-
audit.log.$(date +%Y%m%d_%H%M%S)
    sudo systemctl reload vault # 重新加载以创建新日志文件
fi
echo -e "\n=== 清理完成 ==="

```

运维最佳实践

日常运维命令

```

# 查看所有配置状态
/opt/vault/bin/lease-manager.sh
/opt/vault/bin/rotation-monitor.sh
/opt/vault/bin/vault-health-check.sh

# 手动轮换静态凭据
/opt/vault/bin/vault write -force database/rotate-role/app-static-user

# 查看审计日志
sudo tail -f /opt/vault/audit/vault-audit.log | jq .

```

定时任务配置

```

# 添加到crontab
# 每5分钟健康检查
*/5 * * * * /opt/vault/bin/vault-health-check.sh >> /var/log/vault-
health.log 2>&1

# 每小时租约监控
0 * * * * /opt/vault/bin/lease-manager.sh >> /var/log/vault-lease.log 2>&1

# 每天凌晨清理维护
0 2 * * * /opt/vault/bin/vault-cleanup.sh >> /var/log/vault-cleanup.log
2>&1

```

故障排查指南

1. Vault密封状态: 使用解封密钥解封

- 2. **数据库连接失败:** 检查MySQL服务状态和网络连通性
- 3. **凭据生成失败:** 检查数据库用户权限和Vault角色配置
- 4. **租约过期:** 检查TTL配置和租约续期逻辑

安全注意事项

- 1. **最小权限原则:** 所有角色按需分配最小必要权限
- 2. **凭据生命周期:** 动态凭据30分钟TTL，静态凭据24小时自动轮换
- 3. **审计追踪:** 所有操作记录到审计日志
- 4. **监控告警:** 实时监控关键指标并设置告警
- 5. **定期维护:** 定期清理过期租约和孤立用户

总结

本方案实现了完整的数据库凭据动态管理：

-  **动态凭据:** 短期访问，自动回收
-  **静态凭据:** 长期使用，自动轮换
-  **安全审计:** 完整操作记录
-  **监控告警:** 实时状态监控
-  **自动化运维:** 脚本化日常维护

通过这套体系，可以有效提升数据库访问安全性，降低凭据泄露风险，实现合规性要求。