

MySQL Installation Guide

Abstract

This is the MySQL Installation Guide from the MySQL 8.0 Reference Manual.

For legal information, see the [Legal Notices](#).

For help with using MySQL, please visit the [MySQL Forums](#), where you can discuss your issues with other MySQL users.

Document generated on: 2024-03-12 (revision: 78062)

Table of Contents

Preface and Legal Notices	v
1 Installing MySQL	1
2 General Installation Guidance	3
2.1 Supported Platforms	3
2.2 Which MySQL Version and Distribution to Install	3
2.3 How to Get MySQL	4
2.4 Verifying Package Integrity Using MD5 Checksums or GnuPG	4
2.4.1 Verifying the MD5 Checksum	5
2.4.2 Signature Checking Using GnuPG	5
2.4.3 Signature Checking Using Gpg4win for Windows	8
2.4.4 Signature Checking Using RPM	12
2.4.5 GPG Public Build Key for Archived Packages	12
2.5 Installation Layouts	21
2.6 Compiler-Specific Build Characteristics	22
3 Installing MySQL on Unix/Linux Using Generic Binaries	23
4 Installing MySQL from Source	27
4.1 Source Installation Methods	27
4.2 Source Installation Prerequisites	28
4.3 MySQL Layout for Source Installation	29
4.4 Installing MySQL Using a Standard Source Distribution	30
4.5 Installing MySQL Using a Development Source Tree	34
4.6 Configuring SSL Library Support	36
4.7 MySQL Source-Configuration Options	36
4.8 Dealing with Problems Compiling MySQL	70
4.9 MySQL Configuration and Third-Party Tools	71
4.10 Generating MySQL Doxygen Documentation Content	72
5 Installing MySQL on Microsoft Windows	75
5.1 MySQL Installation Layout on Microsoft Windows	78
5.2 Choosing an Installation Package	78
5.3 MySQL Installer for Windows	79
5.3.1 MySQL Installer Initial Setup	81
5.3.2 Setting Alternative Server Paths with MySQL Installer	85
5.3.3 Installation Workflows with MySQL Installer	86
5.3.4 MySQL Installer Product Catalog and Dashboard	95
5.3.5 MySQL Installer Console Reference	101
5.4 Installing MySQL on Microsoft Windows Using a <code>noinstall</code> ZIP Archive	111
5.4.1 Extracting the Install Archive	111
5.4.2 Creating an Option File	111
5.4.3 Selecting a MySQL Server Type	112
5.4.4 Initializing the Data Directory	113
5.4.5 Starting the Server for the First Time	113
5.4.6 Starting MySQL from the Windows Command Line	114
5.4.7 Customizing the PATH for MySQL Tools	115
5.4.8 Starting MySQL as a Windows Service	115
5.4.9 Testing The MySQL Installation	118
5.5 Troubleshooting a Microsoft Windows MySQL Server Installation	119
5.6 Windows Postinstallation Procedures	120
5.7 Windows Platform Restrictions	122
6 Installing MySQL on macOS	125
6.1 General Notes on Installing MySQL on macOS	125
6.2 Installing MySQL on macOS Using Native Packages	126

6.3 Installing and Using the MySQL Launch Daemon	132
6.4 Installing and Using the MySQL Preference Pane	135
7 Installing MySQL on Linux	141
7.1 Installing MySQL on Linux Using the MySQL Yum Repository	142
7.2 Installing MySQL on Linux Using the MySQL APT Repository	147
7.3 Installing MySQL on Linux Using the MySQL SLES Repository	147
7.4 Installing MySQL on Linux Using RPM Packages from Oracle	147
7.5 Installing MySQL on Linux Using Debian Packages from Oracle	152
7.6 Deploying MySQL on Linux with Docker Containers	153
7.6.1 Basic Steps for MySQL Server Deployment with Docker	154
7.6.2 More Topics on Deploying MySQL Server with Docker	159
7.6.3 Deploying MySQL on Windows and Other Non-Linux Platforms with Docker	166
7.7 Installing MySQL on Linux from the Native Software Repositories	166
7.8 Installing MySQL on Linux with Juju	169
7.9 Managing MySQL Server with systemd	169
8 Installing MySQL on Solaris	175
8.1 Installing MySQL on Solaris Using a Solaris PKG	176
9 Postinstallation Setup and Testing	179
9.1 Initializing the Data Directory	179
9.2 Starting the Server	185
9.2.1 Troubleshooting Problems Starting the MySQL Server	186
9.3 Testing the Server	188
9.4 Securing the Initial MySQL Account	190
9.5 Starting and Stopping MySQL Automatically	192
10 Upgrading MySQL	195
10.1 Before You Begin	195
10.2 Upgrade Paths	196
10.3 Upgrade Best Practices	197
10.4 What the MySQL Upgrade Process Upgrades	199
10.5 Changes in MySQL 8.0	203
10.6 Preparing Your Installation for Upgrade	222
10.7 Upgrading MySQL Binary or Package-based Installations on Unix/Linux	225
10.8 Upgrading MySQL with the MySQL Yum Repository	230
10.9 Upgrading MySQL with the MySQL APT Repository	232
10.10 Upgrading MySQL with the MySQL SLES Repository	232
10.11 Upgrading MySQL on Windows	232
10.12 Upgrading a Docker Installation of MySQL	234
10.13 Upgrade Troubleshooting	234
10.14 Rebuilding or Repairing Tables or Indexes	235
10.15 Copying MySQL Databases to Another Machine	236
11 Downgrading MySQL	239
12 Environment Variables	241
13 Perl Installation Notes	245
13.1 Installing Perl on Unix	245
13.2 Installing ActiveState Perl on Windows	246
13.3 Problems Using the Perl DBI/DBD Interface	246

Preface and Legal Notices

This is the MySQL Installation Guide from the MySQL 8.0 Reference Manual.

Licensing information—MySQL 8.0. This product may include third-party software, used under license. If you are using a *Commercial* release of MySQL 8.0, see the [MySQL 8.0 Commercial Release License Information User Manual](#) for licensing information, including licensing information relating to third-party software that may be included in this Commercial release. If you are using a *Community* release of MySQL 8.0, see the [MySQL 8.0 Community Release License Information User Manual](#) for licensing information, including licensing information relating to third-party software that may be included in this Community release.

Legal Notices

Copyright © 1997, 2024, Oracle and/or its affiliates.

License Restrictions

This software and related documentation are provided under a license agreement containing restrictions on use and disclosure and are protected by intellectual property laws. Except as expressly permitted in your license agreement or allowed by law, you may not use, copy, reproduce, translate, broadcast, modify, license, transmit, distribute, exhibit, perform, publish, or display any part, in any form, or by any means. Reverse engineering, disassembly, or decompilation of this software, unless required by law for interoperability, is prohibited.

Warranty Disclaimer

The information contained herein is subject to change without notice and is not warranted to be error-free. If you find any errors, please report them to us in writing.

Restricted Rights Notice

If this is software, software documentation, data (as defined in the Federal Acquisition Regulation), or related documentation that is delivered to the U.S. Government or anyone licensing it on behalf of the U.S. Government, then the following notice is applicable:

U.S. GOVERNMENT END USERS: Oracle programs (including any operating system, integrated software, any programs embedded, installed, or activated on delivered hardware, and modifications of such programs) and Oracle computer documentation or other Oracle data delivered to or accessed by U.S. Government end users are "commercial computer software," "commercial computer software documentation," or "limited rights data" pursuant to the applicable Federal Acquisition Regulation and agency-specific supplemental regulations. As such, the use, reproduction, duplication, release, display, disclosure, modification, preparation of derivative works, and/or adaptation of i) Oracle programs (including any operating system, integrated software, any programs embedded, installed, or activated on delivered hardware, and modifications of such programs), ii) Oracle computer documentation and/or iii) other Oracle data, is subject to the rights and limitations specified in the license contained in the applicable contract. The terms governing the U.S. Government's use of Oracle cloud services are defined by the applicable contract for such services. No other rights are granted to the U.S. Government.

Hazardous Applications Notice

This software or hardware is developed for general use in a variety of information management applications. It is not developed or intended for use in any inherently dangerous applications, including applications that may create a risk of personal injury. If you use this software or hardware in dangerous applications, then you shall be responsible to take all appropriate fail-safe, backup, redundancy, and other

measures to ensure its safe use. Oracle Corporation and its affiliates disclaim any liability for any damages caused by use of this software or hardware in dangerous applications.

Trademark Notice

Oracle, Java, MySQL, and NetSuite are registered trademarks of Oracle and/or its affiliates. Other names may be trademarks of their respective owners.

Intel and Intel Inside are trademarks or registered trademarks of Intel Corporation. All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. AMD, Epyc, and the AMD logo are trademarks or registered trademarks of Advanced Micro Devices. UNIX is a registered trademark of The Open Group.

Third-Party Content, Products, and Services Disclaimer

This software or hardware and documentation may provide access to or information about content, products, and services from third parties. Oracle Corporation and its affiliates are not responsible for and expressly disclaim all warranties of any kind with respect to third-party content, products, and services unless otherwise set forth in an applicable agreement between you and Oracle. Oracle Corporation and its affiliates will not be responsible for any loss, costs, or damages incurred due to your access to or use of third-party content, products, or services, except as set forth in an applicable agreement between you and Oracle.

Use of This Documentation

This documentation is NOT distributed under a GPL license. Use of this documentation is subject to the following terms:

You may create a printed copy of this documentation solely for your own personal use. Conversion to other formats is allowed as long as the actual content is not altered or edited in any way. You shall not publish or distribute this documentation in any form or on any media, except if you distribute the documentation in a manner similar to how Oracle disseminates it (that is, electronically for download on a Web site with the software) or on a CD-ROM or similar medium, provided however that the documentation is disseminated together with the software on the same medium. Any other use, such as any dissemination of printed copies or use of this documentation, in whole or in part, in another publication, requires the prior written consent from an authorized representative of Oracle. Oracle and/or its affiliates reserve any and all rights to this documentation not expressly granted above.

Documentation Accessibility

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at <http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc>.

Access to Oracle Support for Accessibility

Oracle customers that have purchased support have access to electronic support through My Oracle Support. For information, visit <http://www.oracle.com/pls/topic/lookup?ctx=acc&id=info> or visit <http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs> if you are hearing impaired.

Chapter 1 Installing MySQL

This chapter describes how to obtain and install MySQL. A summary of the procedure follows and later sections provide the details. If you plan to upgrade an existing version of MySQL to a newer version rather than install MySQL for the first time, see [Chapter 10, *Upgrading MySQL*](#), for information about upgrade procedures and about issues that you should consider before upgrading.

If you are interested in migrating to MySQL from another database system, see [MySQL 8.0 FAQ: Migration](#), which contains answers to some common questions concerning migration issues.

Installation of MySQL generally follows the steps outlined here:

1. **Determine whether MySQL runs and is supported on your platform.**

Please note that not all platforms are equally suitable for running MySQL, and that not all platforms on which MySQL is known to run are officially supported by Oracle Corporation. For information about those platforms that are officially supported, see <https://www.mysql.com/support/supportedplatforms/database.html> on the MySQL website.

2. **Choose which distribution to install.**

Several versions of MySQL are available, and most are available in several distribution formats. You can choose from pre-packaged distributions containing binary (precompiled) programs or source code. When in doubt, use a binary distribution. Oracle also provides access to the MySQL source code for those who want to see recent developments and test new code. To determine which version and type of distribution you should use, see [Section 2.2, “Which MySQL Version and Distribution to Install”](#).

3. **Choose which track to install.**

MySQL offers a bugfix track (such as MySQL 8.0), and an innovation track (today it's MySQL 8.3) and each track addresses different use cases. Both tracks are considered production-ready and include bug fixes, while innovation releases also include new features and potential for modified behavior.

A bugfix track upgrade includes point releases, such as MySQL 8.0.x upgrading to 8.0.y, while innovation track releases typically only have minor releases, such as MySQL 8.3.0 upgrading to 9.0.0. However, an innovation track does have the occasional point release.

4. **Download the distribution that you want to install.**

For instructions, see [Section 2.3, “How to Get MySQL”](#). To verify the integrity of the distribution, use the instructions in [Section 2.4, “Verifying Package Integrity Using MD5 Checksums or GnuPG”](#).

5. **Install the distribution.**

To install MySQL from a binary distribution, use the instructions in [Chapter 3, *Installing MySQL on Unix/Linux Using Generic Binaries*](#). Alternatively, use the [Secure Deployment Guide](#), which provides procedures for deploying a generic binary distribution of MySQL Enterprise Edition Server with features for managing the security of your MySQL installation.

To install MySQL from a source distribution or from the current development source tree, use the instructions in [Chapter 4, *Installing MySQL from Source*](#).

6. **Perform any necessary postinstallation setup.**

After installing MySQL, see [Chapter 9, *Postinstallation Setup and Testing*](#) for information about making sure the MySQL server is working properly. Also refer to the information provided in [Section 9.4,](#)

[“Securing the Initial MySQL Account”](#). This section describes how to secure the initial MySQL `root` user account, *which has no password* until you assign one. The section applies whether you install MySQL using a binary or source distribution.

7. If you want to run the MySQL benchmark scripts, Perl support for MySQL must be available. See [Chapter 13, *Perl Installation Notes*](#).

Instructions for installing MySQL on different platforms and environments is available on a platform by platform basis:

- **Unix, Linux**

For instructions on installing MySQL on most Linux and Unix platforms using a generic binary (for example, a `.tar.gz` package), see [Chapter 3, *Installing MySQL on Unix/Linux Using Generic Binaries*](#).

For information on building MySQL entirely from the source code distributions or the source code repositories, see [Chapter 4, *Installing MySQL from Source*](#)

For specific platform help on installation, configuration, and building from source see the corresponding platform section:

- Linux, including notes on distribution specific methods, see [Chapter 7, *Installing MySQL on Linux*](#).
- IBM AIX, see [Chapter 8, *Installing MySQL on Solaris*](#).

- **Microsoft Windows**

For instructions on installing MySQL on Microsoft Windows, using either the MySQL Installer or Zipped binary, see [Chapter 5, *Installing MySQL on Microsoft Windows*](#).

For details and instructions on building MySQL from source code using Microsoft Visual Studio, see [Chapter 4, *Installing MySQL from Source*](#).

- **macOS**

For installation on macOS, including using both the binary package and native PKG formats, see [Chapter 6, *Installing MySQL on macOS*](#).

For information on making use of an macOS Launch Daemon to automatically start and stop MySQL, see [Section 6.3, “Installing and Using the MySQL Launch Daemon”](#).

For information on the MySQL Preference Pane, see [Section 6.4, “Installing and Using the MySQL Preference Pane”](#).

Chapter 2 General Installation Guidance

Table of Contents

2.1 Supported Platforms	3
2.2 Which MySQL Version and Distribution to Install	3
2.3 How to Get MySQL	4
2.4 Verifying Package Integrity Using MD5 Checksums or GnuPG	4
2.4.1 Verifying the MD5 Checksum	5
2.4.2 Signature Checking Using GnuPG	5
2.4.3 Signature Checking Using Gpg4win for Windows	8
2.4.4 Signature Checking Using RPM	12
2.4.5 GPG Public Build Key for Archived Packages	12
2.5 Installation Layouts	21
2.6 Compiler-Specific Build Characteristics	22

The immediately following sections contain the information necessary to choose, download, and verify your distribution. The instructions in later sections of the chapter describe how to install the distribution that you choose. For binary distributions, see the instructions at [Chapter 3, Installing MySQL on Unix/Linux Using Generic Binaries](#) or the corresponding section for your platform if available. To build MySQL from source, use the instructions in [Chapter 4, Installing MySQL from Source](#).

2.1 Supported Platforms

MySQL platform support evolves over time; please refer to <https://www.mysql.com/support/supportedplatforms/database.html> for the latest updates.

2.2 Which MySQL Version and Distribution to Install

When preparing to install MySQL, decide which version and distribution format (binary or source) to use.

First, decide whether to install from a bugfix series like MySQL 8.0, or use an innovation release like MySQL 8.3. Both tracks include bug fixes while an innovation release includes the newest features. Both bugfix and innovation releases are meant for production use.

The naming scheme in MySQL 8.0 uses release names that consist of three numbers and an optional suffix (for example, **mysql-8.0.34**). The numbers within the release name are interpreted as follows:

- The first number (**8**) is the major version number.
- The second number (**0**) is the minor version number. Taken together, the major and minor numbers constitute the release series number. The series number describes the stable feature set.
- The third number (**34**) is the version number within the release series. This is incremented for each new bugfix release; for an innovation release, it will likely always be 0. For a bugfix series such as MySQL 8.0, the most recent version within the series is the best choice.

After choosing which MySQL version to install, decide which distribution format to install for your operating system. For most use cases, a binary distribution is the right choice. Binary distributions are available in native format for many platforms, such as RPM packages for Linux or DMG packages for macOS. Distributions are also available in more generic formats such as Zip archives or compressed `tar` files. On Windows, you can use [the MySQL Installer](#) to install a binary distribution.

Under some circumstances, it may be preferable to install MySQL from a source distribution:

- You want to install MySQL at some explicit location. The standard binary distributions are ready to run at any installation location, but you might require even more flexibility to place MySQL components where you want.
- You want to configure `mysqld` with features that might not be included in the standard binary distributions. Here is a list of the most common extra options used to ensure feature availability:
 - `-DWITH_LIBWRAP=1` for TCP wrappers support.
 - `-DWITH_ZLIB={system|bundled}` for features that depend on compression
 - `-DWITH_DEBUG=1` for debugging support

For additional information, see [Section 4.7, “MySQL Source-Configuration Options”](#).

- You want to configure `mysqld` without some features that are included in the standard binary distributions.
- You want to read or modify the C and C++ code that makes up MySQL. For this purpose, obtain a source distribution.
- Source distributions contain more tests and examples than binary distributions.

2.3 How to Get MySQL

Check our downloads page at <https://dev.mysql.com/downloads/> for information about the current version of MySQL and for downloading instructions.

For RPM-based Linux platforms that use Yum as their package management system, MySQL can be installed using the [MySQL Yum Repository](#). See [Section 7.1, “Installing MySQL on Linux Using the MySQL Yum Repository”](#) for details.

For Debian-based Linux platforms, MySQL can be installed using the [MySQL APT Repository](#). See [Section 7.2, “Installing MySQL on Linux Using the MySQL APT Repository”](#) for details.

For SUSE Linux Enterprise Server (SLES) platforms, MySQL can be installed using the [MySQL SLES Repository](#). See [Section 7.3, “Installing MySQL on Linux Using the MySQL SLES Repository”](#) for details.

To obtain the latest development source, see [Section 4.5, “Installing MySQL Using a Development Source Tree”](#).

2.4 Verifying Package Integrity Using MD5 Checksums or GnuPG

After downloading the MySQL package that suits your needs and before attempting to install it, make sure that it is intact and has not been tampered with. There are three means of integrity checking:

- MD5 checksums
- Cryptographic signatures using [GnuPG](#), the GNU Privacy Guard
- For RPM packages, the built-in RPM integrity verification mechanism

The following sections describe how to use these methods.

If you notice that the MD5 checksum or GPG signatures do not match, first try to download the respective package one more time, perhaps from another mirror site.

2.4.1 Verifying the MD5 Checksum

After you have downloaded a MySQL package, you should make sure that its MD5 checksum matches the one provided on the MySQL download pages. Each package has an individual checksum that you can verify against the package that you downloaded. The correct MD5 checksum is listed on the downloads page for each MySQL product; you should compare it against the MD5 checksum of the file (product) that you download.

Each operating system and setup offers its own version of tools for checking the MD5 checksum. Typically the command is named `md5sum`, or it may be named `md5`, and some operating systems do not ship it at all. On Linux, it is part of the **GNU Text Utilities** package, which is available for a wide range of platforms. You can also download the source code from <http://www.gnu.org/software/textutils/>. If you have OpenSSL installed, you can use the command `openssl md5 package_name` instead. A Windows implementation of the `md5` command line utility is available from <http://www.fourmilab.ch/md5/>. `winMd5Sum` is a graphical MD5 checking tool that can be obtained from <http://www.nullriver.com/index/products/winmd5sum>. Our Microsoft Windows examples assume the name `md5.exe`.

Linux and Microsoft Windows examples:

```
$> md5sum mysql-standard-8.0.36-linux-i686.tar.gz
aaab65abbec64d5e907dcd41b8699945  mysql-standard-8.0.36-linux-i686.tar.gz

$> md5.exe mysql-installer-community-8.0.36.msi
aaab65abbec64d5e907dcd41b8699945  mysql-installer-community-8.0.36.msi
```

You should verify that the resulting checksum (the string of hexadecimal digits) matches the one displayed on the download page immediately below the respective package.

Note

Make sure to verify the checksum of the *archive file* (for example, the `.zip`, `.tar.gz`, or `.msi` file) and not of the files that are contained inside of the archive. In other words, verify the file before extracting its contents.

2.4.2 Signature Checking Using GnuPG

Another method of verifying the integrity and authenticity of a package is to use cryptographic signatures. This is more reliable than using [MD5 checksums](#), but requires more work.

We sign MySQL downloadable packages with [GnuPG](#) (GNU Privacy Guard). [GnuPG](#) is an Open Source alternative to the well-known Pretty Good Privacy ([PGP](#)) by Phil Zimmermann. Most Linux distributions ship with [GnuPG](#) installed by default. Otherwise, see <http://www.gnupg.org/> for more information about [GnuPG](#) and how to obtain and install it.

To verify the signature for a specific package, you first need to obtain a copy of our public GPG build key, which you can download from <http://pgp.mit.edu/>. The key that you want to obtain is named `mysql-build@oss.oracle.com`. The keyID for MySQL 8.0.28 to 8.0.35 packages is `3A79BD29`. After obtaining this key, you should compare it with the key shown following, before using it verify MySQL packages. Alternatively, you can copy and paste the key directly from the text below.

Important

The `3A79BD29` key expires on 2023-12-14. A new replacement key (`A8D3785C`) will sign upcoming MySQL 8.0.36 and higher packages. Both keys are installed by

the MySQL repository setup packages released with MySQL 8.0.35, and both keys are also available at <https://repo.mysql.com/>.

Note

The following public GPG build key is for MySQL 8.0.28 to 8.0.35 packages. For the public GPG build key for earlier MySQL release packages (keyID [5072E1F5](#)), see [Section 2.4.5, “GPG Public Build Key for Archived Packages”](#).

```
-----BEGIN PGP PUBLIC KEY BLOCK-----
Version: SKS 1.1.6
Comment: Hostname: pgp.mit.edu
mQINBGG4urcBEACrbsRa7tSSyxSfFkB+KXSbNM9rxYqoB78u107skReefq4/+Y72TpDv1DZL
mdv/lK0IpLa3bnvsM9IE1trNLrfi+JES62kaQ6hePPgn2RqxyIirt2seSi3Z3n3j1Eg+mSdh
AvW+b+hFnqxo+TY0U+RBWdi4o00YzHefkYPSmNPdlxRPQBMv4GPTNfxERx6XvVSPcL1+jQ4R
2cQFBryNhIdBFIkOCosZjWhm+WnbURsLheBp7571qEYrpCufz77z1q2gEi+wtPHItfqsx3rz
xSRqatztMGYzPNUHNBjkr13npZtGW+kdN/xu980QLZxN+bZ88pNoOuzD6dKcpMJ0LkdUmTx5
z9ewiFiFbUDZ7PECom2g3veJrwr79CXDL1+39Hr8rDM2kDhSr9tAlPtNHVDcaYIGsSNIBc
YfLmt91133klHQHBDtWCNVtWJjg5YcLQJ9TxG9GQzgABPrm6NDdl1t9j7w1L7uwBvMB1wgp1r
RTPVfnUScd+025PEF+wTcBhfnzLtFj5xD7mNsmDmeHkF/sdFNOFAzTE1v2wq0ndYU60xbL6/
yl/Nipy7WiQjCG0m3WfKjVDTfs7/DXUqHFD0u4WMF9v+oqwpJXmAeGhQWZC/QhWtrjrNJ
AgwKpp263gDSdW70ekhrZsok1HJWx1SfxHJYCMFs2aH6ppzNsQARAQABtDZNeVNRtCBSZWxl
YXN1IEVU22luZWVyaW5nIDxtexNxbC1idWlsZEBvc3Mub3JhY2xlLmNvbT6JAlQEWEIAD4W
IQSfm+jXxYb1OEMLGcJGe5QtOnm9KQUCYbi6twIbAwUJA8JnAAULCQgHAgYVCgkICwIEFgID
AQIeAQIXgAAKCRBGe5QtOnm9KUeWd/992sS3lWLG0UQ6NoL7q0B4CerkqXtMzpjAKKg2jtBG
G3rKE1/OVAg1D8AwEK4LcC0407wohnh0HnIUbeDck5x20pgS5SplQpuXX1K9vPzHeL/WNTb9
8S3H2Mzj4o9obED6E5y2tTuPtMF8pC9TJ93LxbJLCHIKKwCAlcXud3GycRN72eqSqZfJGds
aeWLMfMhF6oe27d8XLoNjbyAxna/4jdWoTqmp8oT3bgv/TBco23NzqUSVFi+71jS1hHvcJu
oYJqaztGrAef/lWIGdfl/kLEh8IYx8OBNUoJh9mzCDlws83CBqoUdlzLNDdwmzu34Aw7xK1
4RAVinGFCpo/7EWOx6weyB/zqevUIIE89UABTEFoGih/hx2jdQV/NQnhtWTW0JH0hmPnaJBV
AJPYwAu082rx2pnZCxDATMn0elOkTue3PCmzHBF/GT6c65aQC4aojj0+Veh787Q1lQ9FrWbw
nTz+4fnZu/MBZtyLZ4JnsiWUS9eJ2V1g/A+RiIKu357QgylytLqLgYiWfzHF1YjdtbPYKjDa
ScnvtY8VO2Rktm7XiV4zKFKiaWp+vuVYpR0/7Adgnlj5Jt9lQQGOr+Z2VYx8SvBcC+by3XAt
YkRhtX5u4ML1VS3gcoWfDiWwCpvdK21EsXjQJxRr3dbSn0Havj4FJZX0QQ7Wzm6WLkCDQRh
uLq3ARAA6RYjqfC0YcLGKvHhoBnsX29vy9Wnly2JYpEnPUiB8X0VOyz5/Alv4Hqt14THkH+m
mMuhtndocQ2BkCCK508jWBvKS1S+Bd2esB45BDDmIhuX3ozu9Xza4ilFsPnLkQ0uMZJv30ls2
pXFmskhYyzmo6aOmH2536LdtPSlXtywfNV1HER69V/AHbrEzfoQkJ/qvPzELBOjfwjwDPDeP
iVgW9LhktzVzn/BjO7X1Jxw4PGcxJG6VapsXmM3t2fPN9eIHDUq8ocbHdJ4en8/bJDXZd9eb
QoILUuCG46hE3p6nTXfnPwSRnIRnsgCzeAz4rxDR4/Gv1XpZv5wqpL21XQ13nvZK1cv7J1IR
VdphK66De9GpVQVTqC102gqJUerdjGmXmyCA100ORqEPfKTrXz5YUGsWwPH+4xCuNQp0qmre
Rw3ghrH8potIr0iOVXFic5vJfBTgtcuEB6E6ulAN+3jqBGTaBML0jxg3Z5VC5HKVbpg2DbB
/wMrLwFHNAbzV5hj20s5Zmva0ySP1YHB26pAW8dwB38GBaQvfZq3ezM4cRAo/iJ/GsVE98dZ
EBO+Ml+0KYj+ZG+vyxzo20sweun7ZKT+9qZM90f6cQ3zqX6IfXZHHmQJBNv73mcZWNhDQOHs
4wBoq+FGQWNqLU9xaZxdXw80rlviDAwOy13EUTCvBTkAEQEAAyKCPAQYAQgAJhYhBIWb6NfF
huV4QwsZwkZ71C06eb0pBQJhuLq3AhsMBQkDwmCAA0JEEZ71C06eb0pSi8P/iy+dNnxrtie
Nn9vkkA7AmZ8RsvPXXVdCDSsL7UfhbS77r2L1qTa2aB3GAZUDIOXln511SxMeeLtOeguLME
V2Xi5km70rdtnja5SmWfc9fyExunXnsOhg6UG872At5CGEZU0c2Nt/hlGtOR3xxt30/Uwl+d
ErQPA4BUBw5K1T7OC6oPvt1KfF4bGZFloHgt2yE9YSNWZsTpe6XJSapemHZLPoXJLnhs3VBi
rWE31QS0bR15Az10/fg7ia65vQGMOCOTLpgChTbcZHTozeFqva4IEEgE4xN+6r8WtgSYeGGD
RmeMEVjPM9dzQObf+SvGd58u2z9f2agPK1H32c69RLoA0mHRE7Wkv4izeJUc5tumUY0e80jd
enZZjT3hjLh6tM+mrrp2oWnQIOed4LxUwldhMOj0rYXv6laLGL1FsW5eSke7ohBLcfBBTKnMC
BohROHy2E63WggfSDn3UYzfzqZ8cfbXetkXuLS/OM3MXbiNjg+ElYzjgWrkayu7yLakZx+mx6
sHPIJYm2hzkniMG29d5mGL7ZT9emP9b+CfqGUxoXJkjs0gnDl44bwGJ0dmIBu3aJVAaHODXy
Y/zdDMGjskfEYbNXCAy2FRZSE58tgTvPKD++Kd2KGp1MU2EIFT7JYfKhHAB5DGMkx92HUMid
sTSKHe+QnnnoFmu4gnmDU31i
=Xqbo
-----END PGP PUBLIC KEY BLOCK-----
```

To import the build key into your personal public GPG keyring, use `gpg --import`. For example, if you have saved the key in a file named `mysql_pubkey.asc`, the import command looks like this:

```
$> gpg --import mysql_pubkey.asc
gpg: key 3A79BD29: public key "MySQL Release Engineering
<mysql-build@oss.oracle.com>" imported
gpg: Total number processed: 1
```

```
gpg: imported: 1
```

You can also download the key from the public keyserver using the public key id, [3A79BD29](#):

```
$> gpg --recv-keys 3A79BD29
gpg: requesting key 3A79BD29 from hkp server keys.gnupg.net
gpg: key 3A79BD29: "MySQL Release Engineering <mysql-build@oss.oracle.com>"
1 new user ID
gpg: key 3A79BD29: "MySQL Release Engineering <mysql-build@oss.oracle.com>"
53 new signatures
gpg: no ultimately trusted keys found
gpg: Total number processed: 1
gpg: new user IDs: 1
gpg: new signatures: 53
```

If you want to import the key into your RPM configuration to validate RPM install packages, you should be able to import the key directly:

```
$> rpm --import mysql_pubkey.asc
```

If you experience problems or require RPM specific information, see [Section 2.4.4, "Signature Checking Using RPM"](#).

After you have downloaded and imported the public build key, download your desired MySQL package and the corresponding signature, which also is available from the download page. The signature file has the same name as the distribution file with an `.asc` extension, as shown by the examples in the following table.

Table 2.1 MySQL Package and Signature Files for Source files

File Type	File Name
Distribution file	<code>mysql-standard-8.0.36-linux-i686.tar.gz</code>
Signature file	<code>mysql-standard-8.0.36-linux-i686.tar.gz.asc</code>

Make sure that both files are stored in the same directory and then run the following command to verify the signature for the distribution file:

```
$> gpg --verify package_name.asc
```

If the downloaded package is valid, you should see a `Good signature` message similar to this:

```
$> gpg --verify mysql-standard-8.0.36-linux-i686.tar.gz.asc
gpg: Signature made Tue 01 Feb 2011 02:38:30 AM CST using DSA key ID 3A79BD29
gpg: Good signature from "MySQL Release Engineering <mysql-build@oss.oracle.com>"
```

The `Good signature` message indicates that the file signature is valid, when compared to the signature listed on our site. But you might also see warnings, like so:

```
$> gpg --verify mysql-standard-8.0.36-linux-i686.tar.gz.asc
gpg: Signature made Wed 23 Jan 2013 02:25:45 AM PST using DSA key ID 3A79BD29
gpg: checking the trustdb
gpg: no ultimately trusted keys found
gpg: Good signature from "MySQL Release Engineering <mysql-build@oss.oracle.com>"
gpg: WARNING: This key is not certified with a trusted signature!
gpg: There is no indication that the signature belongs to the owner.
Primary key fingerprint: A4A9 4068 76FC BD3C 4567 70C8 8C71 8D3B 5072 E1F5
```

That is normal, as they depend on your setup and configuration. Here are explanations for these warnings:

- *gpg: no ultimately trusted keys found*: This means that the specific key is not "ultimately trusted" by you or your web of trust, which is okay for the purposes of verifying file signatures.
- *WARNING: This key is not certified with a trusted signature! There is no indication that the signature belongs to the owner.*: This refers to your level of trust in your belief that you possess our real public key. This is a personal decision. Ideally, a MySQL developer would hand you the key in person, but more commonly, you downloaded it. Was the download tampered with? Probably not, but this decision is up to you. Setting up a web of trust is one method for trusting them.

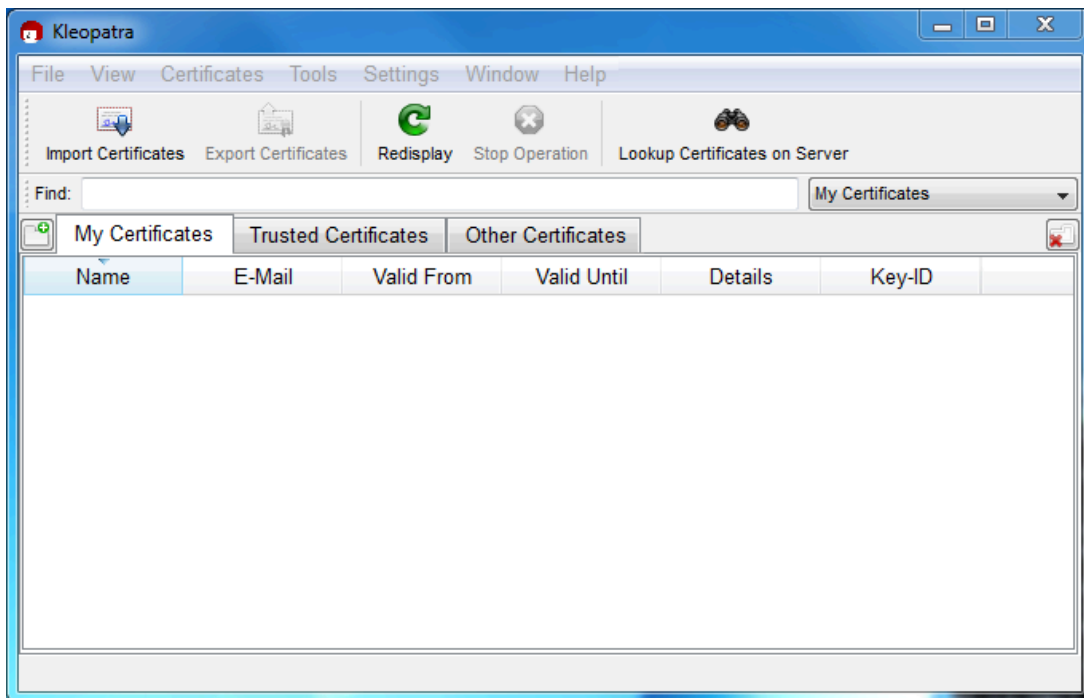
See the GPG documentation for more information on how to work with public keys.

2.4.3 Signature Checking Using Gpg4win for Windows

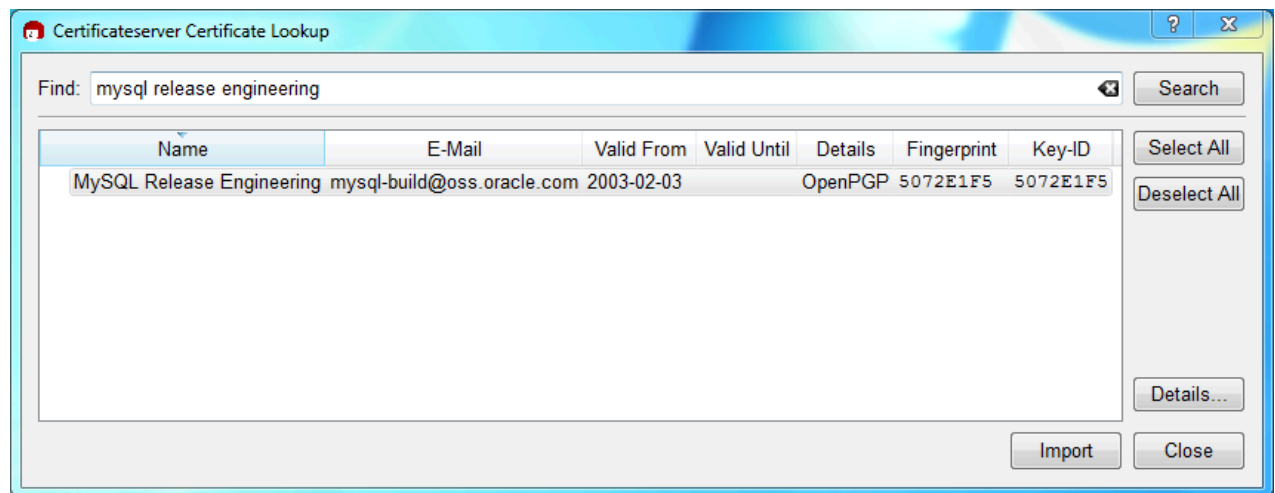
The [Section 2.4.2, "Signature Checking Using GnuPG"](#) section describes how to verify MySQL downloads using GPG. That guide also applies to Microsoft Windows, but another option is to use a GUI tool like [Gpg4win](#). You may use a different tool but our examples are based on Gpg4win, and utilize its bundled [Kleopatra](#) GUI.

Download and install Gpg4win, and then load Kleopatra. The dialog should look similar to:

Figure 2.1 Kleopatra: Initial Screen

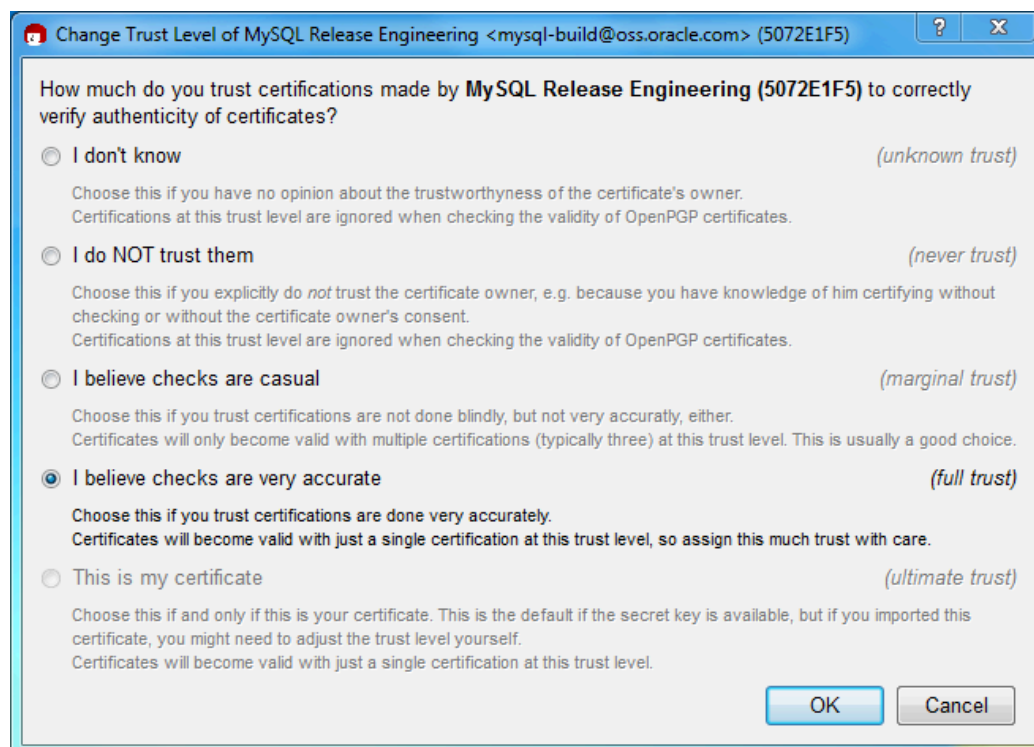


Next, add the MySQL Release Engineering certificate. Do this by clicking **File, Lookup Certificates on Server**. Type "Mysql Release Engineering" into the search box and press **Search**.

Figure 2.2 Kleopatra: Lookup Certificates on Server Wizard: Finding a Certificate

Select the "MySQL Release Engineering" certificate. The Fingerprint and Key-ID must be "3A79BD29" for MySQL 8.0.28 and higher or "5072E1F5" for MySQL 8.0.27 and earlier, or choose **Details...** to confirm the certificate is valid. Now, import it by clicking **Import**. When the import dialog is displayed, choose **Okay**, and this certificate should now be listed under the **Imported Certificates** tab.

Next, configure the trust level for our certificate. Select our certificate, then from the main menu select **Certificates, Change Owner Trust...** We suggest choosing **I believe checks are very accurate** for our certificate, as otherwise you might not be able to verify our signature. Select **I believe checks are very accurate** to enable "full trust" and then press **OK**.

Figure 2.3 Kleopatra: Change Trust level for MySQL Release Engineering

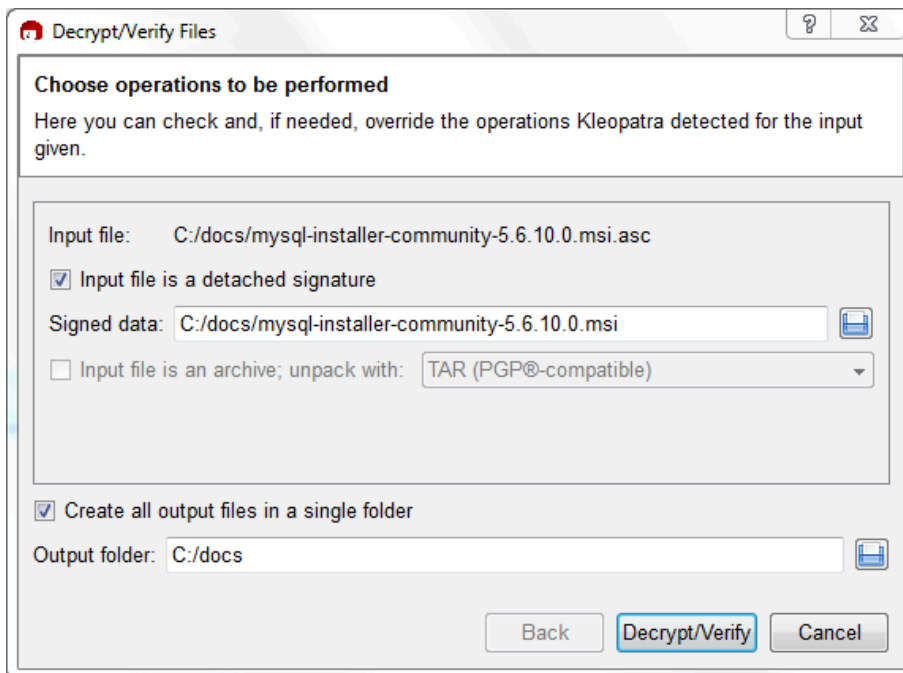
Next, verify the downloaded MySQL package file. This requires files for both the packaged file, and the signature. The signature file must have the same name as the packaged file but with an appended `.asc` extension, as shown by the example in the following table. The signature is linked to on the downloads page for each MySQL product. You must create the `.asc` file with this signature.

Table 2.2 MySQL Package and Signature Files for MySQL Installer for Microsoft Windows

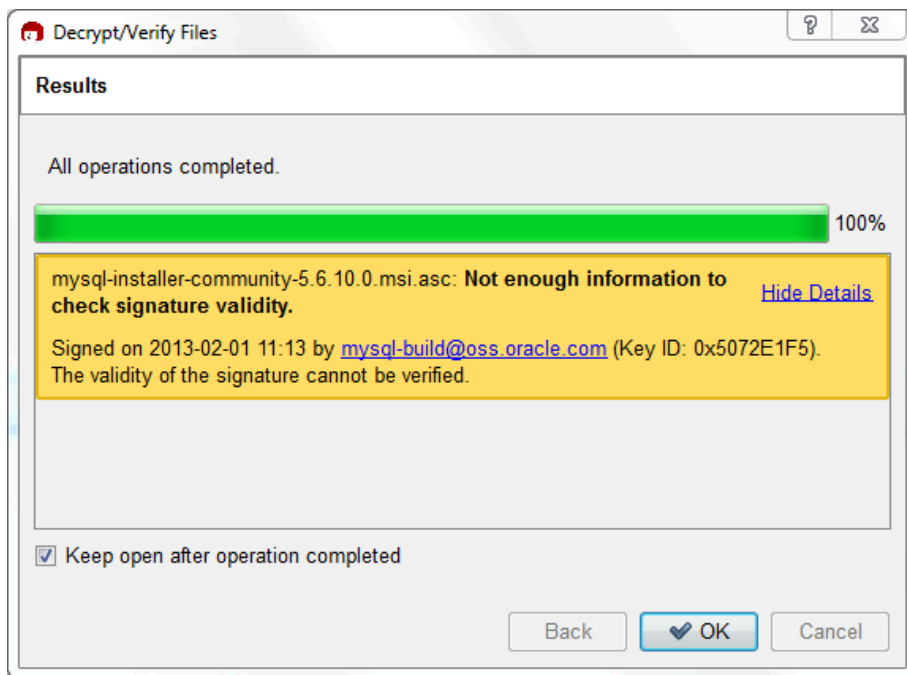
File Type	File Name
Distribution file	<code>mysql-installer-community-8.0.36.msi</code>
Signature file	<code>mysql-installer-community-8.0.36.msi.asc</code>

Make sure that both files are stored in the same directory and then run the following command to verify the signature for the distribution file. Either drag and drop the signature (`.asc`) file into Kleopatra, or load the dialog from **File, Decrypt/Verify Files...**, and then choose either the `.msi` or `.asc` file.

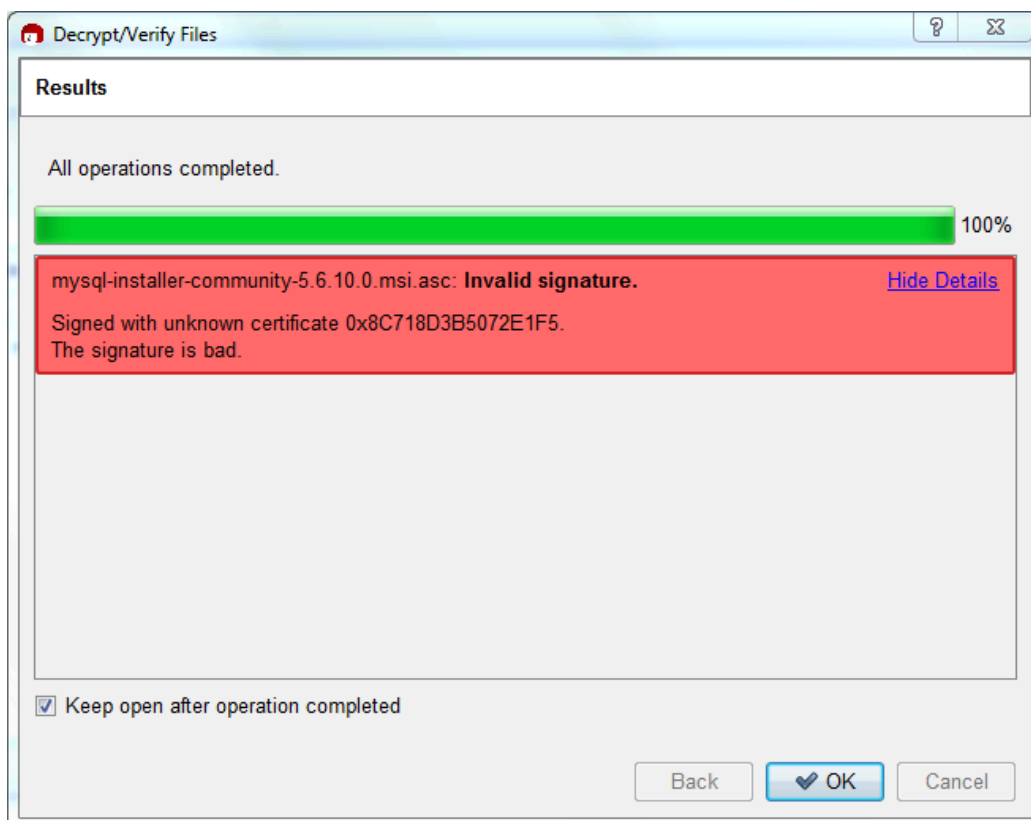
Figure 2.4 Kleopatra: The Decrypt and Verify Files Dialog



Click **Decrypt/Verify** to check the file. The two most common results look like the following figure; although the yellow warning may look problematic, the following means that the file check passed with success. You may now run this installer.

Figure 2.5 Kleopatra: the Decrypt and Verify Results Dialog: All operations completed

Seeing a red [The signature is bad](#) error means the file is invalid. Do not execute the MSI file if you see this error.

Figure 2.6 Kleopatra: the Decrypt and Verify Results Dialog: Bad

The [Section 2.4.2, “Signature Checking Using GnuPG”](#), section explains why you do not see a green `Good signature` result.

2.4.4 Signature Checking Using RPM

For RPM packages, there is no separate signature. RPM packages have a built-in GPG signature and MD5 checksum. You can verify a package by running the following command:

```
$> rpm --checksig package_name.rpm
```

Example:

```
$> rpm --checksig mysql-community-server-8.0.36-1.el8.x86_64.rpm
mysql-community-server-8.0.36-1.el8.x86_64.rpm: digests signatures OK
```

Note

If you are using RPM 4.1 and it complains about `(GPG) NOT OK (MISSING KEYS: GPG#3a79bd29)`, even though you have imported the MySQL public build key into your own GPG keyring, you need to import the key into the RPM keyring first. RPM 4.1 no longer uses your personal GPG keyring (or GPG itself). Rather, RPM maintains a separate keyring because it is a system-wide application and a user's GPG public keyring is a user-specific file. To import the MySQL public key into the RPM keyring, first obtain the key, then use `rpm --import` to import the key. For example:

```
$> gpg --export -a 3a79bd29 > 3a79bd29.asc
$> rpm --import 3a79bd29.asc
```

Alternatively, `rpm` also supports loading the key directly from a URL:

```
$> rpm --import https://repo.mysql.com/RPM-GPG-KEY-mysql-2022
```

You can also obtain the MySQL public key from this manual page: [Section 2.4.2, “Signature Checking Using GnuPG”](#).

2.4.5 GPG Public Build Key for Archived Packages

The following GPG public build key (keyID `5072E1F5`) can be used to verify the authenticity and integrity of MySQL 8.0.27 packages and earlier. For signature checking instructions, see [Section 2.4.2, “Signature Checking Using GnuPG”](#).

GPG Public Build Key for MySQL 8.0.27 Packages and Earlier

```
-----BEGIN PGP PUBLIC KEY BLOCK-----
Version: SKS 1.1.6
Comment: Hostname: gpg.mit.edu
mQGIBD4+owwRBAC14GIfUfCyEDSIEpVew3SAFUdJBtoQHH/nJKZyQT7h9bPlUWC3RODjQRey
CITRrdwyrKUGku2FmeVGwn2u2WmDMNABLnpprWpkBdCk96+OmSLN9brZfw2vOUgCmYv2hW0h
yDHuvYlQA/BThQoADgJ8AW6/0Lo7V1W9/8VuHP0gQwCgvzV3BqOxRznNCRxRxAuAuVztHRcE
AJooQKl+iSiunZMYDlWufeXfshc57S/+yeJkegNWhxwR9pRWArNYJdDRT+rf2RUe3vpquKN
QU/hnEIUHRQqYHo8gTxvxXNQc7fJYLVK2HtkrPbP72vwsEKMYhhr0eKCbtLGfls9krjj6sB
gACyP/Vb7hiPwxh6rDZ7ITnEkYpXBACmWpP8NJTKamEnPCia2ZoOHODANwpUkP43I7jsDmgt
obZX9qnrAXw+uNDIQJEXM6FSbi0LLtZciNlYsafwAPEOMDKpMqAK6IyisNtPvaLd8lH0bPAn
WqcyefepvrV0sxxqUEMcM3o7wwgfN83POkDasDbs3pjwPhxvHz6//62zQJ7Q2TXlTUUwgUmVs
ZWFZzZSBFbmdpbmVlcmVlZyA8bXlzcWwtYnVpbGRAB3NzLm9yYWNsZS5jb20+iEYEEBECAAYF
AllDBJ4ACgkQvcMmpx2w8a2MYQCgga9wXfwOe/52xg0RTkhsbDQhvdAAn30njwoLBhKdDBxk
hVmWZQvzdYYNiGYEEExECACYCGyMGCwkIBwMCBBUCCAMEFgIDAQIeAQIXgAUCtnc+KgUJE/sC
FQAKCRCMcY07UHLh9SbMAJ41l+qBz2BZNSGcZwwA6YbhGPC7FwCgp8z5TzIw4YQuL5NGJ/sy
0oSazqmIZgQTEQIAJgUCtnc9dglbIwUJEPPzpwYLCQgHAWIEFQIIAwQWAgMBAh4BAheAAAJ
EIXxjTtQcuHlUt4AoIKjhd7f0899d+7JFq3LD7zeeyI0AJ9Z+YyElHZSnzYi73brScilbIV6
sYhpBBMRAgApAhsjBgsJCACDAgQVAggDBBYCAwECHgECF4ACGQEFAlGUkToFCRU3IaoACgkQ
```

jHGNO1By4fWLQACfV6wP8ppZqMz2Z/gPZbPP7sDHE7EAn2kDdatXTZIR9pMgcN0cffltsX6
iGkEExECACkCgYMGcWkIBwMCBBUCCAMEFgIDAQIEAQIXgAIZAQUcUwHUZgUJGmbLywAKCRcM
cY07UHLh9V+DAKcJslgGwgVI/eut+5L+12v3ybl+ZgCcD7ZoA341HtoroV3U6xRD09fUgeqI
bAQTEQIALAIbIwIeAQIXgAIZAQLCQgHawIGFQoJCAIDBRYCAWEABQJYpXsIBQkeKt7NAAoJ
EIXxjTtQcuHlwrMANRGuZVbriMR077KTGAvhJF2uKJiPAJ9rCpXYFve2IdxST2i7w8nygefV
a4hsBBMRagAsAhsjAh4BAheAAhkBBgsJCacDagYVCgkIAGMFFgIDAQAFAlinBSAFCR4qyRQA
CgkQjHGNO1By4fVXBQCeOqVmlXfAWdq+QqATAtbZskN3HkYAnlT8LlIkTfREeVlKrQEAF7fg
6HrQiGwEExECACwCgYmCHgECF4ACGQEGCwKIBwMCBhUKCQgCAwUWAgMBAAUCXEBy+wUJ187e
5AAKCRcMcY07UHLh9RZPAJ9uvm0z1zfCN+DHxHvaoFLFjdVYTQCfborsC9tmeZyawhhogjeB
kZkorbyJARwEEAECAAYFALAS6+UACgkQ8aIC+GoXHivrWwf/dtLk/x+NC2VMDlg+vOeM0qgG
1lIhXZfiNsEisvvGaz4m8fSFRGe+lbvvfDoKRhxiGXU48RusjixzvBb6KTMuY6JpOVfz9Dj3
H9spYriHa+i6rYsXZIpOhfLiMnTy7NH20vYCyNZSS/ciIUACIfh/2NH8zNT5CNFluPNRs7H
sHzzz7pOlTjtTWiF4cq/Ij6Z6CNrmdj+SiMvjYN9u6sdeKGTontpycgD5HGKR+I7Nd/7v56y
haUe4FpuvsNXI8g86K9tI6MUFs8CUyy7Hj3kVBZOUUWVBM053knGdALSygQr50DA3jMGKV14Zn
Hje2RVWRmFtr5YwOwRTmXUSQPMLpBNiKbHAQQAQIABgUCU1B+vQAKCRAohbcD0zcc8dWwCACW
XXWDXICAWRUw+j3ph8dr9u3SItlJn3wBc7clpclKWpuLvTz7lGgz1VB0s8hH4xgkSA+zLz16
u56mpUzskF17f1I3Ac9GGpM40M5vmmR9hwldlHdzTgfbD+wkjlqgitNLoRcGdRf/+U7x09Gh
SS7Bf339sunIX6sMgXSC4L32D3zDjF5icGdb0k+j3lCrRmp853dGyA3ff9yUiBkxcKNawpi7
Vz3D2ddUpOF3BP+8NKpg4P2+srKgfFbd4HidcISQct3rY4vaTkEkLKG0nNA6U4r0YgOa7wIT
SsxFlntMMzaRg53QtK0+YkH0KuZR3GY8B7pi+tlgycyVR7mIFo7riQEcbBABAgAGBQJcSESc
AAoJENWpi/UwTWr2X/YH/0JLr/qBW7cDIx9admK5+vJpOul6U6SGzCkIlfK24j90kU0oJxDn
FVwc9tcxGtxK8n6AEC5G0FQzjuXeYQ1SAHXquZ9CeGjidmsrRLVKXwOicFZPBmfS9JBzdHa9
Wlb99NWH0ehWwnyIITVZ1KeBLbI7uoyXkvZgVp0Red37XWGgYEhT0JwAXnk4obH6djY3T/Hf
D70piuvFU7i64IRAqevUcaDppU/1QluDiOnViQ6MAki85Z+uoM6oJUZtwnqXDSYIPzRHctfx
Vdv3HS423RUvcfpmUGG94r7tTOSXhHS9rcs6lZLnKl84J0xzI5bWS/Fw+5h40Gpd4HTR/kiE
Xu2JARwEEAEIAAYFAlaBV3QACgkQRm7hv+CThQqT0wf9Ge3sRxxw+NIkLkKsHYBTktjY0yv49
48ja5s9awR0bzapKOMaluEgfwtkD8/NCgYeIVYyaZlYmS1FP51yAtuzdvZXAI0DAITyM4dlS
RCESjCCiZ028eIEcoem/j+UXrwo4+I7/abFhiSakzsFZ/eQHnsMnkJOLf8kug3vMXjSoiz+n
Tl4++fBK2mCVtULSftc877X8R7xUfOKYAGibny+RAi7E2JVTmtWfdtJagt3l5y60wTrL0M9d
3ZeEMdYLlPCmXrwZ4+u7oTNC26yLSbpL+weAReqH8jGsVlUmWWMXvkm+ixmrnN6WvSLqQ6K
P5jWnow9+KEHnNWB0aT4Iu8rYkBIgQQQAQIADAUCTndBLgUDABJ1AAAKCRCXELibyletFAnx
B/9t79Q72ap+hzawzKHAYk3j990FbB8uQDXyVdAM5Ay/Af0eyYSod9SBgpxyF1GL404dd7U
/uXwbZpAu5uEGxB/16Mq9EVPO5YxCR0ir7oqi6XG/qh+QJy/d3XG07ZbudvnLFylUE+tF8YU
Z5sm9lrnwPKYI2DIAObT0A7Pi9582YjB4YgNCxjrr6l909n4LHDNl174cNX0easl9zp4Zs
acGftJGorPEk+ChNCGKFNq/qR9Hn/ank29D8fzg6BLoa0ix8ZzZ25QPMI/+SF4xEp/07IoI4
dA+0m4iPz76B+ke0RTsgNRfVKjdz2fQ9214G9yWwNuLgcI3FBZTiYGi3iQEiBBABAgAMBQJO
iLYZBQMAEnUAAAJEJCQuJvKV618tkah/2hGrH40L3xRAP/CXEJHK30+L8y4+duBBQ8scRqn
XS28SLfdL8f/ENH+1wah9jhyMC+jmyRldd5ar3cC/s8AJRvOSDRfR5KvagvrDLrrF+i/vYDB
K5f6JQrryq0poupEuK0zTbLxolFX+CAq+3tQy8aY6+znItpiWhvK8ZoULYKV+Q063YyVWdBk
KadgELA6S08aQTGK7bJkyJ9xgbFBykcpUUBn0p4XZwzZ3jFgzwcMqRIYzbfTosVVLJ5HAB7B
u22AukPlsz9PZvd8X8nfmoJiWt15qtFOrxrKA+X5cZswzZ5H3jprDqOY6yA0Estu+8h1CPo
u50BmP7yKZxdXYqJASIEEAECaAwFAk6Z2dEFawASdQAACgkQlxC4m8pXrXwC8ggAgQXVkn5H
LtY50oXmh5D/KdphSKDM3Z9b/3MHZK5CwECQukaJlgxtyLWlHWyLOIhUkW6xHdmieoA8Yr9
J51rl1jopYuGZztzLSuQeSWR8190xnZVijKReVy2rDSxtv7PV5wR3gby72PmKWUw7UHFqtBr
JgA+h5ctfx1jXhIUtUZpDTStZAFgVmunDXoBNZtYYk/ffYlJ8KTjNmrqRcRbTurSy3dgGAAA
Z01DIR5KJrh3ikFFJfXz0QDoYochxqi4Xoc7o8uv19GUuvk5sKBT4b2ASF+JXAMRX0T7v8
Gralhn3CGGQGPZDN2ldm1Mzbi5oSETTUQ87nN4I7bXirYqYkBIgQQQAQIADAUCTqumAQUDABJ1
AAAKCRCXELibyletFmCHB/9/0733PXrdjkVlUjF7HKpdD8xy324oe5cRwDEVhsDj11AsPhLv
c37M3ucf2MV5BwGjjDypVRX3ht+1r9VsuR201ETkMu8zhdjxgTlZ931t/KDerU9sSJWOT33m
wEX7b50j3lhggq2Bc+qOUfSNR8TIOZ7E6P6GynxFzreS+QjHfpuFrg41FgV58YCEoMyKAvZg
CFzVSQa2QZ04uaUIbAhXqW+INkPdEl/nfv1UWdoe/t5d/BDELAT4HEbcJRGUn/GNRExOYw/I
AbauEOnmhNQS+oNgluSjlTFg6atK08XgXNfCp6sSVclSRTNKHSmntHEch/WULEOzsPUXWGW
VC40iQEiBBABAgAMBQJOvNkcBQMAEnUAAAJEJCQuJvKV618xSkh/izTt1ERQsgGcDUPqqvd
8exAk1mpsC7IOW+AYYtb0jIQOz7UkwUWVpr4R4siJXfzoZTYNqaYMLbencgHv25CE14PZnVN
xWDhDrhJ8X8Idxrlyh5FKt0CK53NT9yAsalcg/85oVqZeB0zECGWgsVtIc8JmTjvTsmFVrz
7F4hUOsrUchJmw0hfL9JirXtbpLY9VnaJXh9a8psnUCBrw3o05Zj8Pw/aaLdEBuK5mB/OSYo
vmJ0f/Bip+cUp10AnOyx0JzWNkQZWTmsVhxY6skBED4/+2ydv9TEoESw207t7c3Z7+stWcTK
RUG7TrqHPvFkr9U0FKnHeTeqPhc8rjUgfLaJASIEEAECaAwFAk70o7wFAwASdQAACgkQlxC4
m8pXrXzA3af/QjONvE3jme8h8SMLvlr6L11IuWpHyWwcvgakRjWuOjRrSVPghUAhJzEob4w
CzZ4ebRR8q7AazmOW5Fn1GoqtzrWxjrdBX3/vOdj0NvXqCFFtgmOSc4qz98+Lzuu8qQH9DEl
ZLyptv96tGZb5w82NtHFmu9LkKjAVYcDXqJ4USm90CApXqd+8lVOrWuM8NycgD0Ik3ZKZQXH
lDhJfZohNtqbWGMWdjgwkHoBSHesjZ/WarXEF0+oTLjZsbrymtGpPInsijHWD9QMOR55RwC
DtPW+JPPu5elLdaurjPOjjI6l0l8sNHekjmdZmRi0ZMyjprJITg4AG3yLU9zu+boCYkBiGQQ
AQ1ADAUCTV18vgUDABJ1AAAKCRCXELibyletFneIB/OWtd7SWBw8z61g5YwuG/mBcmLZVQFo
vGnJFeb+QlybEicqrUYJ3fIPj8Usc27dlwLP+6SU8BtldYjQ7p7CrQtaxG2SWYmNaJ50f6Eb
JpO/3lWSWiNegF3ycFonoz3yuWMwEdMXBa+NAVv/gUteLbmoeW+NwKSrYN30FYmkZe++vCkq
SYwlG0r9+19lFwKFvfK0jX1ZGk6GP27zTw49yopW9kFw/AUZXlwQHOYAL3gnsLpWz5LwiTyJ

GPG Public Build Key for Archived Packages

QkxAYYvdByZk4GjOi+HzqGSPspNIQEeUteXzfbPz0fWet64tudegYu/fn5QVLGS/WHfkuFkuo
gwnBfCcuTPEYcwGkuE/IZZEniQEiBBABAgAMBQJPBAkXBQMAEnUAAAOJEJcQuJvKV618AG8H
/0LLrlyM6osbLahOzcKmd//jSOZ2FIBXGKUmK8/onlu5sUcMmVVPnJuO/mHiFMbYFC655Di
rVUKlIZb6sdx2E/K+ZkZHPwF1BAaHUO/QGh3Zzc81VJg9KtFLAJkmQkc61VEF2MriaRlvlo
VpNr5Oiv2THOPgVxdV3goBL6EdAdgdwCvy23Z44vOp0QVNQt4aJKg2f49XO/Nl+Gd2mEr7wX
an9DZQq5zTU7uTRif3FlXHQ4bp8TWBK3Mu/sLlqZyTf3z7GH4w3QbwyA2CWkGgTGwQwyU8Fh
JQdrqXG10w0y6JusjJWdwTlfxA6Eia3wrSw2f8Rlu6V0k0ZhsMu3s7iJASIEEAECaAwFak8V
lNwFAwASdQAACgkQlxc4m8pXrXziJaf7Bn+4ul7NedLGKB4fWyKdVZARcys13kNUcIl2KDdu
j4rliaY3vXT+bnP7rdcpQRa13r+SdqM5uByROHNZ+014rVJIVAY+ahhk/ORmdJTSv79lJSkT
FuPzjYbKthqCsLIwa2XFHLBYSZuLvZMPL8k4rSMuI529XL48etlK7QNNVDtWmHUGY+XvPvPP
GOZwjmX7sHsrtEdkerjmcMughpVAnPyPsFe8ErQCOrPhDikZBSNcLur7zWj6m0+85eUTmcj8
luIik4wjp39tY3UrBisLzR9m4VrOd9AVw/JRoPDJFq6f4reQSOlBbD5yr7IyYtQSnTVMqxR4
4vnQcPqEcftTb4kBiGQQAQIADAUCTzltCWUDABJ1AAAKCRCXELibyletfaO9CACWRtSxOvve
/2KJASIEEAECaAwFak8V2xofAwASdQAACgkQlxc4m8pXrXzi9YUqGAsVc8HNwA7VKdBqsEvPJg
xVlm6Y+9JcqdQcA77qSMClc8n6oVf1RpI2yFnFUpjlmvJuW7iiX98tRO3QKWJIMjEPovgZcS
bhVhgKXIu87dtWwmcYhMsXBAyCzbsSaNWhOIpWKHuQ+rYRevD0xGD0013P7pocZJR850tM9e
5809bzdSRYZpFW5MkrD7Aity5GpD65xYmAkBwTjN4eNlp0nHVDsbVf4FsJve6JC6yzKOGFB
VU1TtAR2uPK6xxpn8ffzCNTAlvKXEM8Hgjjyq4LWSdDTBIEvuAgkz4T2eGJLXimhGpTXy7vz+
wnXQ9eAdArnfCgLfz8s/wmCoH4GJAFNlIkBiGQQAQIADAUCT2eddwUDABJ1AAAKCRCXELib
yletFfBEB/9RmWSSkUmPwib2EhHPuBL6Xti9NopLomj5MFzHcLtqoommKvpOUwrlxv0cZMej
ZenU3cWlAvvY287oJwmkFRFu9LJvILSGub9hxtQLhjd5qNaGRFLeJV8Y0Vtz+se2FWLPSvpj
mWFdfXppWQO/kIgVZoXcGJQRQWcetmLLgU9pxRcLASO/e5/wynFXmgSaJxWzWHhMvehvJTOq
siYWsQxgT/XawQTyJHkpYJoXx4KKXnocvc8+X3QkxAFfOHCwWhYI+7CN8znDqxYUx//PKfDG
2uN0JHPLza8rponN7c58Eo3WKRw0TKeSwOclcSufnFcrPenmlh2p70EvNRainiQEiBBAB
AgAMBQJPekdGBQMAEnUAAAOJEJcQuJvKV618YwoIAMn3uqSB4GelD61m0pIXJfOcC6BhCZvM
mV3xTp4ZJcDcQzjRV3rZrkt0DwyOVYpLzLgDgvrWjXjOzm0oblDvYHFA7DnGTGUSBLDX/xZ
5gRvDtkD6w8b/+r2/eQiSu7ey/riYwB6dm3GzKR7FEbIK6bEuPOUBwvV2tYkZRGTYqXq7NBL
uNv7c80GWhC/PqdvdhF4KAvL0PjVIGr5+mdXyviKqG7uvguYBDtDUMXlqgZpi+fb7EsBJYf
EkBR63jQqO04unqTlEXWds17gj+yp4IHbkJmEJMS8d2NIZMPb1lHmN+haTA73DwNkbVD1ata
qSLiFiGXRyZy87fikLVilJoJASIEEAECaAwFak+KdAUFAwASdQAACgkQlxc4m8pXrXwIUqGA
mmkFtxXv4kExFK+ShRwBYOglI/a6D3MbDkUHwn3Q8N58pYIqzlonRj/ZO8zme2rkMT1IZpdu
WgjBrvgWhmWCqWExngClj0Gv6ji8nlLzjjCkCZYwVzo2cQ8VodCRD5t0lilFul32XNqAk/br
U/dL5L1PZR4dV04kGBYir0xuziWdnNaydl9DguzPro+p7jy2RTyHD6d+VvL33iojA06WT+74
j+U1s3PnMNj3WixxdNGXANXWoGApjDAJfHIHeP1/JWLGX7tCeptNzWigJUUV665ik/QeN2go
2qHMSC4BRBAS4H2aw9Nd9raEb7fZliDmnMjlxSYierQo7q7kK2PdMYkBiGQQAQIADAUCT5xA
QQUDABJ1AAAKCRCXELibyletFOLsCADHzAnM10PtSWB0qasAr/9ioftqtKyxfdd/jmxUcOl
RUDjngNd4Gtmml7MS6jTjEjkGEC5/fxzB9uRXqm3WYLY3QVL+nLi/tHEcotivu2vqv4NGfUvW
CJfnJvEKBJr8sDGTcXxZQoYoAFBgTPlv9t4Rdo7asy37sMFR2ka4/kUlFDxYtFYFwWZCJpNL
hhw0MCI2StI/wIwTA/7TiFCNqHHAKAGeSzKVyKrPdJn8yt7Js2dm6t2NUOWXQ563S4s6JZdR
lXUV9oYh1v+gFAu57UHvinn6rdoXxgj3uoBmk9rWqJDNygnfwtflBcQXJnea+rMavGQWihx
eV40+BZPx9G61QEiBBABAgAMBQJPrg39BQMAEnUAAAOJEJcQuJvKV618M4YIAIp9yNCVLGta
URSthhmmgE/sMT5h2Uga6a3mXq8GbGa3/k4SGqv51bc6iLiLm2b0K8lu5m6nxqdZ8XNNMmY9
E+yYTjPsST7ci0xUzbAjKews63WlEUrj/1E2NEtvAjoS2gJB+ktxkn/9IHnqwrGogUofbw6T
hymURI+egyoDdBp91IQD8Uuq9lX+I+C1PPu+NCQyCtcAhQzh+8p7eJeQATEZe2aB1cdUWgqY
evEnYNNK8zv/X3OMYl67YyEgofKoSYKTqEuPHIITmkAfn0qVsBA4/VtLbzGVGyQECmbbA34s
51bMLrYeERF5DnSKcIa665srQ+pRCfJhz6VQXGsWlyWJASIEEAECaAwFak+/2VUFaWASdQAA
CgkQlxc4m8pXrXwDOAf+JEUUKLiQO+iqOLV+LvI09lU4ww7YfXcqz4B9yNG0e5Vprfs7nQ0P
tmf5dB7rJ6tNgkuHdoCb+w0/31pPEi7BFKXIoSgOz3f5dVKBG08GBSx+/G/TKSiTenov0PEU
7/DlwwmSgExmgmsQJEWTA3ylaVxc9EVC9x0Fi/czcNNlSpj5Qec7Ee9LoYX4snRLdx30L
lu9h9puZgm8b15FLemPUv/LdrRLDqG9j4m2dACS3TlN14cwiBAf/Nvxx3DEPOYTS6fwvKgLY
nHlOmKRCwLJ6ParpvdyjFUGWeCS7r4KoMCKY5tkvDof3FhggrQWgmzuPltBkTBQ7s4sGCNww
6okBiGQQAQIADAUCT9G1zwUDABJ1AAAKCRCXELibyletFdljB/9N01u6faG1D5xFZquz7Hw
EsSJwb/Ho9XJRC1mdX/Sq+ErOULSMz2FA9wDQCw6OGq0I3oLLwpdsr908+b0P82TodbAPU+ib
OsLUWtblAYUi5Nhg6WW4pKnuBObnKbTAmzlw+rvfUibfVFRBTyd2Muurlg5/kVUvW2qZw4BTg
Tx3rwFuZUJAlkwyvt3TUUrArOdKF+nLtVg3bn8EBKPx2GfKcFhASupOg4kHoKd0mf10Vt9Hh
KKuoBh1mdDdd6oaEHLK0QcTXHsUxZYViF022ycBWFgFtaoDMGzyUX010yFp/RVBT/jPXSBWtG
lctH+LGsKL4/hwz985CSp3qnCpaRpe3qiQEiBBABAgAMBQJP43EgBQMAEnUAAAOJEJcQuJvK

V618UEEIALr7RNQkNw1qo7E4bUpWJjopiD00IvynA0r5Eo0r83VX5YYlAfuoMzBGg6ffKiCs
drHjEh45aIguu8crQ7p2tLU0OzKYiFFKbZdsT/yliYRu4n28eHdv8VMKGZIA7t0ONIpLYPd2
9pjyVKy4MOo91NfwXM5+tcIzbYL9g+DuhQbYDmy8TVv7KKyY/gqZU1YB6kS49lycQw8WCine
FoeD1fb6AP9uOMFivqn2QCAhjXueKC01M200jR0wu7jdojN50Jgeo6U0eIHTj20Qmzn8wYG
MX2o+1ybSTjjHIp3X8ldYx01Sa3AqwKEBclLdg5yIyAjHq2phRod2s/gjqRwT+uJASIEEAEC
AAwFAk/1PVUFAwAsdQAACgkQlxC4m8pXrXwn3AgAjWUh3l1xsQcXo8pdF7XniUSlqnmKYxT+
UZOP71lxeav/yjY+gwyZvf8TWT4RlRp5IGg6aNLwLaDB3lcXBGuXAAANGUr+kbLewviHnCY3Z
+PWiuusle+ofjbs8tFAr3LN3Abj70dME7GOhLypLP2mXIoAlnMDJ0AyrKx5EeA2jS8zCWCu
zii0j4ZwUZAESXchpS09V9Q86YiPtp+ikV0hmYgZpIXRNcHOpXnVYEW/95MFwi4gpG+VoN57
kWBXv6csfac04BEIu9X/7y40LbNuvzcinnHa0Pde5RnRlBEPQBBZyst2YZviWTFsbG8K2xok
dotdZDabvrRGMhRzBUwQEokBigQQAQIADAUCUAZhawUDABJ1AAAKCRCXELibyletfdJUCAC+
68SXRk4aSeJy6W+4cS6xs//7YYIGDqpX4gSlWltMIKCIWNhHkZqxKnWClnmvgGhw6VsZ2N0k
YdOnIrzEPWL7qp1ZRIe1GDY85dRXNw0SxaGGi7A8s6J9yZPAAPtvpMS/cv1JO+IveFaBRHbI
RRndS3QgZVXq48RH20lHep3o7c964WTB/41oZPJ7iOKgsDLdpjC1kJRfO9iY0s/3QrjL7nJq
5ml4uYl6rbqaIoL8lC7iyc0UKU9sZGMCPV7H0oOIAy206A3hYSruytOtiC1PnfVZjh14ek2C
g+Uc+4B8LQf5Lpha4xub9xvp1X5Gt3wiPrMzcH89yOaxhR8490+0iQEiBBABAGAMBQJQGC19
BQMAEnUAAAOJEJCQuJvKV618CbcIAJXCdbUt96B3xGYghOx+cUb+X8zcy9lyNV8QC2xjd9Mr
02LJTQHfJfQ9Td6LfuorB7nQHOqJK1/lWE28t9t1H7I+i7ujYwA/fwardRzqCulNXrgFEiQK
ZFaDjRyYm0jWG/sA3/Rq2CMBNhbEccTDuZ8VvRdm0xMPpyavP8D2dM9WBkPHoik4yAIIlVkr
hWmr0Up0JhRoelfeyqcN/6ClUgeRMIyBYthA55fk2X5+CerommlpDfJlJFQOv64VSzS68NG8
j9yf66uuL3bB00dzOMW6Yq/P9wskCDlMbYm/UnHfB5wAuxWpDeAvt/u+vU4xqqEjkUQGP03b
0v1xl79maSuJASIEEGEKAawFAlWg3HIFgweGH4AACgkQSjPs1SbI/ESPUQf/Z6Htrj7wDWU8
vLYv3Fw23ZuJ8t8U/akSNwbq6UGgwqke+5MKClfPk90ekzu5Q6N78XUII3Qg8HnfdTU0ihYg
qd3AlQm2CGZHEz5xoxR1jJziRCbb1J7qEw8N/KzBcTkHB4+ag6bjFY9U4f9xu3TjPIu7F2V
BklAX+cmDo8yZpJdnP4ro0Yabbg0Q9xzvaK/7pFRz+vL/u/lxW7ie7n6vXTiaYlXnIt5xAXX
dwfLYmWeAgdc9KXFN1t4lfuqrETtNCHme+JI+B2Tz2gHmMVLHiDV59eLC0uU/uVsOXEd26ib
JC4f3KqY9kxuQm325kNzxnmxiwMPCVzsEh7lsYp+OokBMwQQAQgAHRYhBADTXowDFGileoOk
6kPAYq+7WPawBQJasiYMAAOJEEPAyq+7WPawox0H/i96nkg1ID6lux+i20cOhVZylNJ770Vv
0zfEXddWRN/675uMVjLLiD/WfnDpw6ow6NM7vfEwmbvolqeFF7rWWTPLM57uZfTk73un3fbaL
JiDZyrUSTQKK/yhGAZmwulOQq7XBm+u8G9UcFi4XQuoc5I/v/lUgbxXBADlxlzfzpkIDwOaB
s23RDiMcWZGcosUkYHxlm8scU0tRANVLQ/PHgtt1U13x2PLzrdQm3YUDKUJ9+yn02jN2sYwt
laSohj4UbLnq6pI4CXWZR7XWQs+NX7P3R359FDtw7OhYKoVuIkrFZ1jY0i3wQgw1/Sm2DAg9
3lsZDVC/avEUa0o+VuJuvJ+JATMEEAIEAB0WlQQGFx4znGT7HFjpuwT3iPLiBOWZfAUCXJ7Q
KwAKQ3iPLiBOWZfGoXB/wN0P3m27fy/6UXT10Ua3H+24ueUdLipsvR82TwefnwkhlrbggE
0Em7ZuhZkzv7j856gv/tOekYYqWGg1CLalD3y371LAGqltjY3k/g2RWLxLXNdZgXEyFvaNQA
oQa9aC2Q7FOyEMwVkkXrGa4MML7IBkrtMds9QPKtfipachPf6tQOFc12zHRjXmZi0eRwyQue
0sLLiJZPn7N8bBAJyZ9IJEpkhNrKS+9J5D1Refj++DwBKDh04kQXZFEZzhxcungQW5oMBQgr
uW2hULTLeIEV+C516OnwWJoz6XKJP0Jp8PY0b08pGgToGIYHkoX2x64yoROuZasFDv7sFGX6
7QxyiQEZBBABCAAdFiEENOMfMPATUAXIzAoiOmODCOrwFAlv/EJIAcGkQoiOmODCOrwG
uAf+IVXpob2S3UQzWJLSQyWG0wQ51go4IBVpHv6hKuhDFj47YdUbyWO+cGgnbjc7FVz54PUM
PIdxImGHElNHH+DNR8hvvAi+YpnqqdT3g+OgZ6XoYevret5B2b5fRgN1/HWUjaJ/n5g6SMsC
+3DrmdMu1FEDnKv/lHwQvOQXKt/U2rXELILOmVdMavRJEwkrk2SVwbdeass2EInZVsmWL+ot
9dU5hrkmLa16iHUoK6zF6Wa1loi7UU2kgUF2DnyZG/5AumsNhx608EAs1zEdn8wibXL48vq
Z4Ue9Gvmokdlq/r/4BMUDf1qLEZHBkbaklK1zXxl7uMiW3ZlCqpg5HgwYkBMwQQAQgAHRYh
BBTHGHD/tHbAjaF4NhhRZPE15/iCBQJZ+o/oAAoJEBhrZPE15/iCyfMH/3YP3ND8jFqIwkmG
JaITHP9GhAQda73g7BFirBHeL033tcLtUbEHXvnIZzulo7jju9oQBjQvgGgI15AgH1m7lHaD
iAL3VmuUFZ4wys7SODHvSZUWlaPLEdOoLkeiG9J6elu0d/xWZmj86IaHMHrUEmlitMoo0m+U
MwVNLFNZrAjcn82DiS6s0A52tOlPq/jR4v9AYfMZSnd1MLm/CZaZpWq6aqm7ef7CDfsUvU
w7VsL3pls+Jgo6+8RwQ1W2Lgt5ORthvpjPKE1z0qgDpoXTkPoi8M20taD5UZbpByzMZPJXXr
+LBrRbs48IcPVHx8sxHMH1HsQCIXHDGItNSaJlqJATMEEAIEAB0WlQQazDqcUxAL9VrKN9zD
LyvJ+reoRgUCW4YZiAAKCRDDLvYvJ+reoRptWCACoIgFrvhbr3clWVq16LJ8UmQLk/6uFFZPN
CiR6ZbvzOd+a3gk1G8AhDEW2zoNhFg9+I7yqUBGqn+B1nDZ6psyu8d5EoRUFtm3PghqEccy5
KixqoPxBTquzkGkbN8PDLUY5KvpTOLLlYZxlHszShw4roPsU4rxZtxyu98sSW0cm47VPr069p
91p9rCoHY8Fng7r3w28tVfvLuZ1SK4jtykIvw+M/pVBk9rQVCAJ0JjkaHkTOpkHqsVBYhtu7
mzsXfkQZkeuxdNx6X1fMrbjOfzH0GYTT8Knn75Ljhr3hozrsL4Kz4J9gsLHCjkD5XKzLwCFK
R6UhhZzr7uhufbqZiYtLiQEZBBABCAAdFiEELLeCvUfxyJI8qMqHHSVPZ6Jn8NcFaltZjFMA
CgkQHSPVZ6Jn8NfKSGgApk065wFrqx2uqkZKfJGw2mdsGeDVjGq9tMKUWeYVxTNxjiYly8Dc
/jr0S3AU6q7X7tAAcmvaXoBfW3xEIXMSH73GeinVG7wnlab6GKPDRKJzXfJ88rF07pX8R1pc
ZH+eikiFsn9bcnEycH82bonS7dzyoo6yg2zBqNtSmWYLDg2hcoTw4UHApWdX6+n99m3Vz0Q0
8ThQI9hqpUYGvP5qyYahFf+39HSViof+Kq5KKhvSoiS9NzFzYZ0ZszYt+2joZUpAM6XqtEGu
TMzXHkE+/V4yI3hIsVhNkXKgDrqjwA+UmTlR4/gBoiRhZ8r4mn1gYI08darQmkppf9MEbcDz
U4kBMwQQAQgAHRYhBC1hIxvZohEBMIEUf5vAD7YfFmHCBQJcns2XAAoJEJvAD7YfFmHCC0UH
/R8c5xy96ntPI2u6hwn5i0BGD/2IdO+VdnBUneyE4k9t2fXKDRtq6LAR2PAD0OehSe4qiR6hw
ldaC8yiyg+zgpZusbCLGxbsBdYEGMwTIEFsa8DyPMANpJ0XLkGGf8oC7+6RuAjuVlm6DRlurr
U93/QIG6M2SNsmnPgSZWYV4Y5/G7Xxyj0Fc3gNjjjGGP61CBR01W6rgNpn35sZ9GYCZcG1QA
GGrT8mSVoUhPgPCXKz2dZDzsmDhn7rULB6bXcsHiC/nW/wFBpoVOIFixND0rb1SYyJzPdPtO
K6S+o+ancZct8ed/4fUJPBqRbsuFS1SKzvJfPXjHGTZBitqQE7h57SJATMEEAIEAB0WlQQt

9h/1MHY0zPQ0K+NHN096zf003AUCXK2H5QAKCRBHN096zf0030JtB/wKbQN4IjVnkmWxSaBc
JABRu/WSbNjoTo/auJV6IRUBpwr130izMw239w5suuWxlphjPq3PdglBaKKeQNdeRoitudUjd
hydON1cq2wh90073wU2GHeZLi48MopUNksrhHfd/XWV//0LcSpERSqIBVIUi+8DHwFvpCzCz
zIRg9lOcQmEtJAFFUtkF9FEeZg02NPO3fEwkjKDeJYUib+mD9BllyxhU8apUx/c2zaFGQOCr
Ml1N/gHztAWdcIadK/tujqRWR4wnJ0+ny/HP+bWd18+YjhcWzUQ8FytG+DA3oylQld0w0emt
qfn0zqiFkJQdG0M4qtItJYEHYlYpG2yoQHcCiQEzBBABCAADFiEERVx3frY8Ya00hcAGjZrN
vi2vIgUfAlnScGAACgkQjZrNvi2vIgW5IQf8DKjeOHF9ChDcb4T0luJjiaUu6lxewSRD7iwd
6MjCsaxgMifTD7Bzvdem4finoOul2YAPt1LfIfvtVrtGG97R/Wvs3yji9NSzXkDGue7/IIi
4dKlCkKviJg7G6A8+MGXaQTW8i0ePI/44IyG5yogKjno7L4h0f3WguGzmCRUJcgYm23IsaTh
Pvdq39ARyHalrk0hXZ+OqsYBr1w7KLyPrbPA3N+/2RkMz6m+T8ZksOrEdF/90nCRky4Wbg4
SJqWQNNsmfgT0rQL2Qvne598FKmltrTJuwBtIrSeuL/dbKt+hkLgnRjnmTAsyPaf0gXvMtfU
P9goQMWD+A2BU/bXJokBMwQQAQgAHRyHbFBGh7ZZZpG0pg7f1ToXvZveJ/LBQJblegAAoJ
EFT0XvZveJ/LS0YH/jpcVprMEGnq1C0mYG2MLRqeK4T8Y6UnHE2ZBPc125P4QcQfhgUJ98m4
0B5UkzljreFr9Zebk3pE8r4NBsamlJvi8sGbZONTsX4D3oW9ks0eicK0cTZJgtX5RmSNFh63
+EHbqTneK/NTQIuqRSCoufQCOH6QY1PVsICBlFZUPMfuxRlO7EwHKNiHPVBZNlM7AXxdjCMU
kXvda8V14kActblw7NWxWxo5q4hkQ2K3FsmBWxvz+YBhJ8FnRjdzWNUoWveggOD6u4H7GuOg
kCyXnlfVnbCyJWSXQT9polJRnIAJMatykcYVLNS/IS65U+KlcmShcF+Gil9BuGyckbRuNaSJ
ATMEAEIAB0WlQRh2+o6RdTFb7cS1WLG3d+zE2Q5m7gUCWdJutAAKCRc3d+zE2Q5m7rgJB/9k
c+prmrnjsg/Lt6d90LqYoavvIeFkAoDhhWgQeEOADlwgyHIpS6qoMKgvBlvda2r0bmk1kUL2
xQaidj36wB5yJHauOnFX+3ZJ6QCYUaeoWtqO2ROHvTiuyUdVKC5NtKaHpM1/lP/jl1ZRWay
idggH7EnwDMT+900x0D02n5J29Vp9uP0lGtMVSVSiJCCG0xwNBgNiXX1BpZbN4bRm5F8DAGiN
v4Z169QZFWbpbj8wFVJ/rV4ouvCFPlutVEAuIlKpAj35joXDFJhMvPpnPj84iocGqYPZHKR6j
a90+o8dZw3hXObFowjcxJsJuQUTVkpUhzqr6kEulampaQ8OGpXCZHiQEzBBABCAADFiEEZ/mr
TQXqCZjglXUWgzhTfF02evsFAltbmWkACgkQgzhtKKq2evsdrAgAubfuG1vWX3TTG/VYrFM
laS1Roc034ePoJHK5rLT00/TnnnObw38kJM1juyu4Ebfou+ZAlspiWgHad62R1B29Kys/6uC
qG2Jvbf716da4oLXelYd9eb+IKVEiSb2yfbSltLLB0c/kBdcHUP6Alzz0HV811HWj1Wx8cFU
MV7aAQoOfnNBbnNWLNXLYGHh47/Qmjife5V8r6UJZGsyv/1hP4JHSQ2nqcM8Vfj+K+HEuu
nnxzgWacQXP/0IhI1VwoWhsJlHW+4kwW02DDopdBfLTzCtzcDokfBcCg8hsmC4Jpxww5eHm
saY3eIB32keCpikvOGwdGDBRH7+da8knzokBMwQQAQgAHRyHBG4VA/IlW5kLV/VchhLcHkBr
mersBQJAX4N4AAoJEBLcHkBrmersksUH/3M0cypXBnyGI1/yE576MDa0G1xJvciup0ELeyhj
48Y7IAR7XiQdtiPt8t1IiPFf8iaw56vJw5H6UKraOcJZHOHLSwDr5gAWJgMqnq1FX/DxVKif
USt81KX0tHN6t6oMESgm2jRkvcWjh6PvEZ1IARxZG4IjErErqWIIjUJR86xzkLyhRVtKUL/Yk
uN11013Alsd/0CGUAnjrluUUXypadtNr7/qsBx8dG6B/VMLWToEDEon76b8BzL/Cqr0eRyg
Qz6KWi3hmsK+mE4+2VoDgWuHquM900uS9Z+7LUws24mX5QE7fz+AT9F5pthJQzN9BTvgGc
kpI2sz3PNvzBL5WJATMEAEIAB0WlQR00X0/mB27LBoNhwQL60sMns+mzQUCWoyYfgAKCRAL
60sMns+mzYgnB/9y+G1B/9tGDC+9pitnVtCL2yCHGpGAg+TKhQsabXzZqfyykTgzCHhVqRQc
XH2z5NSGR0Io+kbGMUuQCaen60lcORVxYIuivZekJOAG+9kiqWRbyTv4aR6zvh805wCyEhhyi
ifi65PM7y9ld6i22qtT/JoDnFkP5Ri6Af/fz9iaIaluQKJCU5xY1Lt/BorGlrGvX5KiZD8xc
AijJRATZ0CJ21gbxISSxELAfH42KzGAVJw/0hARRMk1/eK0HVDpD47mcmC5h/O/HlwPYi0hn
xB+6/nuwwtRgMDBufNV0StU43njxCYmGI9/Ilz5Vs+zhz8ypw/xCr1U7aAPZQdSSsfEViQEz
BBABCAADFiEEelR8OpStCJs7bhrK1TniJxBsvzsFAlv+8d0ACgkQ1TniJxBsvzsiFwf/a3lt
OuSrFs4M03YVp6LoCM6CwZfvcFl+6B0TAurOiCja9lsNmbusSx0ad7bZy6/kHDXH/eqomXeu
04hkxxBvGK3gZt7iQsr9vsUSbbJnc1zMyOZKlhdXAOLOskttqtPs6hiJ9kUHFGZe47V3c77G
GMqj/akLU5PtkzhK7+JbbASW0iK60aXCZ5nAbW1zTQLgJnYr1k4b920rzGe8ndTzGmSJIGnb
YvuD9ZI40DZRWVf1tXqCY643AXFY0ohRxxj54uHnMLYhc0I65u2ZGWRiTI0g/en5E8i7WoejA
/sR0+cYs711iJwlNRwfqmmJWRGREEHcJ3N52k3X7ayq3qmr3K4kBMwQQAQgAHRyHBJSRYHFB
cqf4Tl2vze+YN4Ly8sn+BQJae/KHAAoJEE+YN4Ly8sn+5ckH/juc2h7bC40GMRhcZBLAG2vW
WEMTc8dar9ZyJYXzR25W1/Cz/JXgJgMjSrE6m9ptycpvWc6IRlrQM/IqG+ywYFPwNp3PYsc0
1N33yC15W7DPRDTtJE+9yUbsY9FeYraV4ghxiBxD1cDwtd7DFNGNRvBDH7yQHmXBW0K8x6yX
Mwllgj2/MvdFUKmz8Lku94OmrbDOi83cnaJUNbN15Wle7hWAIRAlt3P1VusjV/XyzxvcSffB
mt3CgBCyK9CnyEr27CVkhZ8pcabITx9afMd1UTEii90+qzgcJwcR46bJPZBdavMt56kVCeC0
kG440300k+OahKXzw4YspZM0046gYRKJATMEAEIAB0WlQSm5fcyEkLUw6FcN0ZJlMjHNZ28
bgUCTXJMCQAKCRBJlMjHNZ28bsgCB/96PlBUdsKgnh/RpmPB+piQf60g+97L4fxHuQbzKoe
UNCSWNF7saVa5VaPxbV/9jDCTPZI5vBtNjebXtkmLoWFSZaXCyb49SiJfvrSRaEX5QSqIRd4
3KMuo7nAvbPVYtMChCO/glt3riF2icC6pgvmNZWm5Nu4pkLzRmQv8U33BAKL7EYIjZZaC/9h
o4Sh4l/gLNItoXmDsD34sJwBLvEilpQOalxNJ4kfQSRD/8ufakE5wfSie/s04w/2Cp7RD9H0
Vld+7FwP0lHQ3XJjONvOzj6uVdwCC5fcmcbXbb2bbJ/xe4YVL3xmwWz5m2w+kBSpaZ6VHNocB
8S20mIIPpr70iQEzBBABCAADFiEEp6WxZJrn5Z0o967I/htVRVZtQSYFAlqnkGEACgkQ/htV
RVZtQSYV2AF97F7LUI8lqOYyZuX6skNf5rNSew+7i5NsiNpQzZmdscJh9eJzyLrePLp7q
9HUohMF/Fc0SgbdTKSbWfSIdXkeaQ2twPj4rPlxxYBc00Y0OX4fNVA50/pTI9nxIVQCDTlj1
/WlY+fnj88lCkAKWoRjITaotjFmYt+gbJMBn3MMYf0V0DeIRozV7//NdKzFXKmJ3fsCDGXXF
CVWM1Fn3M91o1fh3FSgKd+0sexUDn5afwWCqjGgiXDsE7fEdwsbnz1rDzWvuqCoZyIh1RXQf
QVbiakpzfvtdytC3Vo672KzpZ9d69Adhfn2ydAYxL/Xuvk9pWdeBNF4T+HfS9Z30BokBMwQQ
AQgAHRyHBjPCF6TGRucA13q1lkfneVsJZHBQJawgLRaAoJEF1kfkneVsJZHGNSIAIaSJ3gf
tBtf0WLxYIo5zhNclXonfgUUNjGrXHm5NxoI4Eulpx9dQYCY++whMFbXpZQTgFAUq8q342EZ
raLCWwALZEZmkZjv+FX6bk8sgqZESpUOLJAiqpobKpaawOQ7LS+XW00SchH1oLFAgDyBeIDZ
N/LitLiDkJelxpDQdtUHawksqMChIaBe60B5xvmlNkhnrmM1p+e3LUd4j+XxAcCdY5LSqV

GPG Public Build Key for Archived Packages

```
hcZ/byxfNoXETsQyUH01Tu8Fdypmk0zYUgZK2kGwXs1fOGj5m0M5nfUuVWq5C5mWtOI6ZngT
LPJ32tRW526KIXXZMTc0PzrQqQvTFHEWRLdc3MAOIlgumHzSE9fgIBjvzBUvs665ChAVE7p2
BU6nxt1c4D0juwXWECVmlqL0HKjC5xvml112QhseV7Da341I0k5TcLRcomkbkv8IhcCI5g08
lgUqlYwZAMfliEnJt4zRPVSPyYKa4sfPuIz1PYxXB01lGEpuE5UKJ941d+BJu04alQJ6jKz2
DudH/Vg/1L7YJNALV2cHKsis2z9JBArg/AsFGN139XqoOatJ8yDs+FtSylt12ulwaT33TqJ0
nHZ8nuAfyUmpdG74RC0twbv94EvCebmqVg2lJlxcxaRdU0ZiSDZJNbXjcgVA4gvIRCYbadl9
OTHPTKUyR0Z2hN1LUKVoLmWkps04J2D1T5wXgcSH5DfdToMd88RGhkhH7YkCMwQQAQgAHRYh
BH+P4y2Z05oUXOVHZQXCWLGt3v4UBQJhrDYPAAoJEAXCWLgt3v4Uh2oQAMS3sK0MentPE+gu
71Li9rMbD/305nlAxBJLX4MzLi2xPl648YV5nq9WMMt6qyp+OVwDXefneYNMgfU2/uu/Wi/o
XTHBJuU361mfZhrWPj2h/vtfgDIYG2wio0DNJyaUQwLEi6ggPm0AHhKS4td69R+7qyQsbUIa
BFgoytxFzxDb5o2hicEOXa573m4myfAdCx5ucYfq+jlXJW9Gw7ERnFlv9xQDXiuryXWFRdv
U0OWzVPu9T0gPkcG8NABwqxs280c7n9A19HM2FtDAKD0LIcm/I4ZEhFVqvG6Hj966+FeuICw
OaefFhthOoi3yc0+pkjlIePz/TmnsplTvvZOXH+6XEMPPPRQpvf5IZKJyrvuzoU8vkXY2h/
gJHi9HiSIIQ/BVEpvp6UjXvIbNPLK31I188qx9EfT/tv434w1ZpC6V1FzE2LtxyNcj/+OUvj
9hKOJ71KOVpsnBbGiWg809s4sCIZ/IFLWAKOJgxAEK/GcRkkkCqGNx7HA+coteNHqXLa/Lb
2/r8gGn6KH9YhQootsGghsSsY+6CW5TM5E+FhSRJU7MFHRpA94N7Hn6OFUK2OXtHyRhxE867
R+ChJaZxbtoQvVnV2Rv9yoZrBki3RoQ6/6/fcnRlx2moTMYg7K8AMMv7ZCfaP6AjpOjTVnMV
CpNy1Ao7smOzLafKbbeXiQiZBBABCAAdFiEEjy2YV7IZJ8NHv36cSrDCiwqTaaEFAMf9XbsA
CgkQSRDCiwqTaaFUGw//WSU022Csa60I6VN8yJQmf0wCo9sieWDXCdHZ+CB0+gu0I3EMYR2a
gL8lqCd6M79fpP8DiLK0Jvn9mhXCsJyJtJQUsuNi5kQ/O9gwarRsr7EjJ7R8u8lpSh9YpLMS
yN6XXfoa4Qy5H0w9idJdb3owKAXSjuRdi/hUEXja8TWliYwrfwiVDQi/aCoLZ4b9p6SfGR3Y
gE8UIZLZtdWgsPJHkvdvntTpI4fwMsadBfa2f+m4Wq2CAU5KSfYsVpKawSQ1osdUZUK7g+Ui
jy//ad7eZ+Bac75blHs7ua2iif8Sc7MC55ZM5ldkv+01qJ7td5vOCT1LKJg5PKKUC7YTTh9U
PH1ERJ/SwCHNCS1xhLvU02VRO1PN9H1QkPnEMBOobpmYkNqYLBfFwioJ31iltpYY0IUX5qBM
5UkwygqMsdYrL+2ozIYc+/A8KUnZXozOAG9LP8gBE5jBJSikbqsi9Fumf7Q63++g4ojcYpOZ
F92X6kQMGqBvkvs8UajR5f/n6QH0je4XFPj4141VM/PPfZSShNGd00i41+KwozICnQ1+fhwh
N0VG4eALSJ6XQEEfJ18PrBRS3sdC7OvEMLevEC8ojsQeZEl1CLelqAUoEcmgmXjs0DaJn2tt
qNYYUxUcFOyCfznzgWL679C9FVp+Dag9jzDMKsqWo/Lt3IDNF19ZUc93WJAjMEEAkAB0WIQSC
p1WCWP+FB0H/9bX9bbut3FAu7gUCW8ygHQAKCRB9bbut3FAu7mOad/9QJ1MiyKvw9rYqTvkU
OSDSL8u8g6NP5R9ozgGZegInZ/NzT8u5emYccflnLlFvRQZPnt7YIH4+h25CCGQ5HxZUGENx
ndeUg4dm3B10A8hxxv+abEM9VYDGqSiVf6z1xObvENOpMgmlmFdDi909d6jFFy4Hd6/BWejbU
4M3kfuD39RxaTlOEWfqvTvf4GKiLqM71glNB8WrTqxt2t/Mo2h6UPCF7/wPF/idMABkEn0ye
blWDCAZVxxAQETfNo129hPb2qxPGoCWGw24ySpGrM5We4Nd3bbdGItSZ0mATNM1+m9FY9j30
vpePFCzzYGZ+23EcpXmU1EJdXVsR0LnlglJLuQ9HpwWehve0d7/cIzKn7a0fqqe7bmVSPyxWL3m
yTA4FwdbrebBr2y7ixlXZ6WtX/rqTvo2HTDfLLe0ZwMbbfAtOFX0M01PtXTLMJAl5w1G8Nj8
bthwDn4KVfYOpqPt70Xc/GLYNLzcyYQXX5e8Uskmg40OH5cQV5OFEG8qpxTg53wANDdxXGzs
NUqe84Qkoyk75nWzVfsi00/OhTzmfiC48esXcs0kTrkSPRfChtSMoYPmHfV3dTF17ifjz5a
C2SL22R+RokWuzGxxpvaEQAWIYct6izfla+CjnXPD2Jw3yDC/Oeg68XYiSrbeFdCRzQbs9YP
ipUFilHuCiNZeg3rFL2N2JodXg2LGORJz1RKazT7uAfRr5z7W1FtDtNeVNRTCBOYWNrYwDl
IHNpZ25pbmcga2V5ICh3d3cubXlzcWwuY29tKSA8YnVpbGRABx1zcWwuY29tPohGBBARAgAG
BQI/rO0vAAoJEK/FI0h4g3QP9pYaoNtSISDDAAU2HafyAYLLD/yUC4hKAJ0czMsBLbo0M/xP
aJ60x9Q5Hmw2uIhGBBARAgAGBQI/tEN3AAoJEIWWr6swc05mxsManRag9X61YgulkbfBiQDk
u4czTd9pAJ4q5W8KZ0+2ujTrePN55NdWtnXj4YhGBBARAgAGBQJDW7PqAAoJEIvYLM8wuUtc
f3QAnRCyqF0CpMTdIGc7bd05I7CIMhTAJ0UTGx001d/VwvdDiKWj45N2tNbYIhGBBARAgAG
BQJEgG8nAAoJEAssGHlMQ+blg3AAn0LFZPlxoiExchVUNyEf91re86gTAKDYbKP3F/FVH7Ng
c8T77xkt8vuUPYhGBBARAgAGBQJFMJ7XAAoJEDiOJeizQZWMhYAmwXMOYCIotEUwybHTYri
Q3LvzT6hAJ4kqvYk2i44BR2W2os1FPGq7FQgeYhGBBARAgAGBQJFoANrAAoJELvbtOQbsCq+
m48AN2u2SuJv15k9PEsrIOAxKGZyuC/VAKC1oB7mIN+cG2WMfmVE4ffHYhlP5ohGBBARAgAG
BQJE8TMMaAoJEPZJxPRgk1MMcNEAoIm2pP0sIcVh9Yo0YYGAgORrTOL3AJwIbcy+e8HMNSoN
V5u51RnrVKie34hMBBARAgAMBQJBgcsBBYMGItmLAAoJEBhZ0B9ne6HsQo0AnA/LCTQ3P5kv
JvDhg1DsFVTfnJxpA49WFjg/kIcaN5iPlJfabaITZI3H4hMBBARAgAMBQJBgcs0BYMGItlY
AAoJEIHC9+viE7aSiImANRVTVVafMXvJhV6D5uHfWeeD046TAJ4kjpW2bHyd6DjCymq+BdED
z63axohMBBARAgAMBQJBgctiBYMGItkqAAoJEGtw7Nldw/RzCaoAmwWM6+Rj1z14D/PIys5n
W48Hq13hAJ0blObthv96g+7oUy9Uj09Uh41lF4hMBBARAgAMBQJB0JmKBYMF1BFoAAoJEH01
ygrBKafCYlUAoIblr5D6qMLMpm01krHk3MNbX5b5AJ4vryx5fw6iJctC5GwJ+Y8ytXab34hM
BBARAgAMBQJCKlu6BYMFEujsAAoJEOYbpIkV67mr8xMAoJMy+UJC0sqXMPsXh3BUSDcmfFS+
AJ9+Z15LpoOnAidTT/K9iODXGVik6ohMBBIRAgAMBQJAKlk6BYMHektSAAoJEDyhHzSU+vhh
```


JlWAnA/gOdW0Thj080+dFtdbpKuImfXJAJ0TL53QKp92EzscSZs491D2YkoEqohMBBIRAgAM
BQJAPfQ6BYMHZqnSAAoJEPLXXGPjngWcst8AoLQ3MJWqtMNHDbLxSyzXhFGHURU8AJ4ukRzf
NjQElQH00ZM2WnCVNZOUihMBBIRAgAMBQJBDGqEBYMGlp0IAAoJEDnKK/Q9aopf/N0AniE2
fcCK01wDIwusQGVLC+JvnnWbAKDDoUSEYUnn5qzRbrzWW5zBno/Nb4hMBBIRAgAMBQJCGKU0
BYMFI/9YAAoJEAQNWIV8g5+o4yQAnA9QOFLV5POCddyUMqB/fnctu09eAJ4sJbLKP/Z3SAiT
pKrNo+XZRXauqIhMBBIRAgAMBQI+PqPRBYMJZgC7AAoJEElQ4SqqcPhyJOEAnImxHijft00b
KXvucSo/pECUmpaiAJ41M9MRVj5VcdH/KN/KjRtW6tHFPYhMBBIRAgAMBQI+QoIDBYMJYiKJ
AAoJELblzU3GuiQ/lpEAOIhpp6BozKI8p6eaabzF5MLJH58pAKCu/ROOfK8JEG2aLos+5zEY
rB/LsohMBBIRAgAMBQI+TU2EBYMJVlcIAAoJEC27dr+t1MkzBQwAoJU+RuTVSn+TI+uWxUpT
82/ds5NkAJ9bnNodffYMMK7GyMiv/TzifiTD+4hMBBIRAgAMBQJb14B2BYMFzSQWAAoJEGbv
28jNgv0+P7wAn13uu8YkhfNMJHwDpK2/qM/4AQAJ40drnKW2qJ5EEIJwtXpwapgrzWiYhM
BBIRAgAMBQJCGIEOBYMFjCN+AAoJEHbBAXyiMW6ho04An0Ith3Kx5/sixbjZR9aEjoePGTNK
AJ94SldLiESaYaJx2lGILD9bbVoHQYhdBBIRAgAdBQI+PqMMBQkZJgGABQsHCgMEAXUDAGMW
AgECF4AACGkQJHGNO1By4fVxjgCeKVTBNefwxq1A6IbRr9s/Gu8r+AIAniKdIl1FhOduUKH
AVprO3s8XerMiF0EExECABOFakeslLQFCQ0wWKgFCwKAwQDFQMCAxYCAQIXgAAKCRCMcY07
UHLh9a6SAJ9/PgZQSPNeQ6LvVVzCALEBJObt7QCffgs+vWP18JutdZc7XiawgAN9vmmIXQQT
EQIAHQUCR6yUzWUJDTBYqAULBwoDBAMVawIDFgIBaheAAoJEIxxjTtQcuHldCoAoLC6RtsD
9K3N7NOxcp3PYOzH2oqzAKCFHn0jSgxk7E8by3sh+Ay8yVv0BYhdBBIRAgAdBQsHCgMEAXUD
AGMWAgECF4AFakeuSEFCQ0ufRUACgkQJHGNO1By4fUdtwCFRNcucXikBMy7tE2BbfwEYTLB
TFAAnifQGbkmcARVS7nqauGhelED/vdgiF0EExECAB0FCwKAwQDFQMCAxYCAQIXgAUCS3Au
ZQUJEPpyWQAKCRCMcY07UHLh9aA+AKCHDKOBKBrGb8tOg9BIub3LFhMvHQCeIOotlhHHULs
TIXAUrD8+ubIeZaIZQQTEQIAHQUCPJ6jDAUJCWYBgAULBwoDBAMVawIDFgIBaheAAABIEIxx
jTtQcuH1B2VHUECAAQFxfjgCeKVTBNefwxq1A6IbRr9s/Gu8r+AIAniKdIl1FhOduUKHAVpr
O3s8XerMiGUEEXECAB0FakeslLQFCQ0wWKgFCwKAwQDFQMCAxYCAQIXgAASCRCMcY07UHLh
9Qdlr1BHAAEBRpIA38+B1BI815Dou9VXMIAsQE4G3tAJ9+Cz69Y/Xwm611lzteJrCAA32+
aYh1BBMRAgAdBQsHCgMEAXUDAGMWAgECF4AFaktwL8oFCRDz86cAEgdlr1BHAAEBRCRCMcy07
UHLh9bDbAJ4mKWARqsvx4TJ8N1hPJF2otJkeSgCEmVJ1jxmD+Jd4SscjSvTgFG6Q1WC1bwQw
EQIAlUUCTnc9rSgdIGJ1aWxkQG15c3FsLmNvbSB3aWxsIHN0b3Agd29ya2luZyBzb29uAAoJ
E1xxjTtQcuH1tT0An3EMrSjEkUv29OX05JkLiVfQrODPAJwkTLlycnLPv15pGMvSzav8JyWN
3Ih7BDARAgA7BQJCDzX1NB0AT29wcy4uLiBzaG91bGQgaGF2ZSBiZWVuIGxvY2FsISBJJ20g
KnNvKiBzdHVwaWQuLi4ACgkQOcor9D1qil/vRwCdFo08f66oKLiUEAqzlf9iDlPozEEAn2Eg
vCYLCCHjfGosrkrU3WK5NFVgiI8EMBECAE8FAKvVAl9IHQBtaG91bGQgaGF2ZSBiZWVuIGEG
bg9jYwWgc21nbmF0dXJ1LCBvciBzb21ldGhpbmcgLSBXVEYgd2FzIEkgdGhpbmtpbmc/AAoJ
EDnKK/Q9aopf/PSAn3BVqK0alJeF0xPSVLR90PsRlmmGAJ44oisY7T13NjbPgZal8W32fbqg
bIkBHAQSAQIABgUCS8iIAWAKCRDc9Osew28OLx5CB/91LHRH0qWjPPyIrv3DTQ06x2gljQ1r
Q1MWZNuoEdfRcmgbrZxdiBzf5Mmd36liFiLmDIGLEX8vyT+Q9U/Nf1bRh/AKfK0x9PDSINWY
bE6zCI2PNKjSWFarzr+cQvFqGXQCEILVcU1HDxZlir1nWpRccnasMBFp52+koc6PNFjQ13
HpHbM3IcPhaaV8JD3ANyFYS410C/S4etDQdX37GruVb9Dcv9Xkc5TS2KjDIBsEs89isHrH2+
3Z1xdLsE7Lix9DwLxZAND9oiuThJAGK/pYJb+hyLLuloCg85ZX81/ZLqEOKy155xuTvCq1
tSPmSUObCuWAH+OagBdYSduxiQEiBBABAgAMBQJJKmigBQMAEnUAAaAJEJCQuJvKV618U4wI
AKk/45VnuUf9w1j7fvdzGwDIjT9Lk9dLQAGB13gEVZEVYqtYF5cEZzyx18c7NUTCTNX3qLId
ul114A4CQDg5U9bUwwUKAUfGLaz380mtKtM9V9A4f19H2Gfsdumr8RPDQihfUUqju+d0ycd
mcUScj48Nctx0xhCCWNjOFPERHi9hJRQ7x6RKyFTLjM5ftdInHCo9S+mzyqz90+iMgX68Mm
+AVgdXSC9L6yGnw6H97GD28oRMGWBtZsmCyqf9I3YutH8mGXRot3QbSJD7/AeZVh1BQwVoJn
CT8Eolpc/OYZKRRndElthrX0yjuFwTeOzvqeHlgzEW/FtOCBW7iR0WSJASIEEAECaAwFAkoz
TogFAwASdQAACgkQ1xC4m8pXrXwXiAf+Ked6Mgd98YyTyNiLHh11PulboCnKgJ430jLzKfgv
7ytVCulxMfKrrWRw3fA9Lc19mzNQX/So/o/ywsk0nUG2sfEs5FiMk+aC957Ic/MDagmXqKap
ZROJbzbZ/KNj9rPCG9kXPGA9sUn6vk39nnv4hr130tNKpM0fMxRhpcNoCrN14rs/QTpdRpp
7KBuNaMetDU7R70jMDL4qT+BcCmYMIYw4dIV7tmaC0VxtcszZcVckxSigRMPZHwxSx37GdCx
9/+TqlA4vGL6NQsXZKv+Kqa+WTqBngOl6YGO6FxdixELiNRpflmafz6h8XgYXFGpehjuX1n
60Iz0BffuWbpl4kBiGQQAQIADAUCSkRyCgUDABJ1AAAKCRCLibyletfPaaB/9FCSmYwz7m
vz0fHZ01EAYeLnCS290XGW89o4FYTBw0PB0ulygyqj2TMCK68RCNU2KFs/bXbHeS+dZitMA
fSaULYi7LJuCCmrDM5SX5aLSj6+TxkDQDR1K1ZE3y6qd4Kx3VeeN7Wu+oLj/3Jjbbe0uYcq
+/PniRra9f0Z0neTeXZ7CGTVBIsKs1CnKBTR26MZMOom2eTRZwGFUX1PzuW/dbZ4Z0+J6Xmd
Tm2td7OYYWPbV3noblKUrxyjtGtO3ip3Oe3zSCWHUFMAaEuXOMw8tN51wy6ybcPVAH0hoiBw
b3iCFJ/20QqaZEno6edYzkqf0pwvrcTmiPb+Vj0fnjBjiQEiBBABAgAMBQJKVj5HBQMAEnUA
AAoJEJCQuJvKV61845AH/R3IkGIGOB/7x3fiOgKOS0uFljDxysiM8FV06BfXbFpRgFMZxah
NFUDKCDN98MDkFbd5S5aGkvhaHS7PVwQ8/BIYJaJeUG3AXmrpFV/c9kYn1+YW5OQ9E7tKu51
5U0j1Y/weNtC04u6Rh/nrp6CvMBH2nvhSBZ+2k02auqtFohuK6+wUHGiXt5EK8RAKs3Sf6n
kP2EJUHzy1Q8ec5YDiaV24AVkPFBZMCKpD3Z+seIGrL4zUkV7PPY4zd9g340qj8JvtN4AD/
Z1vBLuJLixcQdt9aieOySA9DAVgHbe2wVS4zi5nBURsmD5u96CUOWNK1sOV+ACTdIv/T5qSU
VweJASIEEAECaAwFAkpoCoQFAwASdQAACgkQ1xC4m8pXrXysfQf+IJyIPhTphk0kGPQY3v9e
3znW30VahyZx0L6Q25eeQWGMVeTF1U4JThUEYzgYGip8i9qBsFPJ9XgOL5bxTgV7/WOK7eX8
e+qXHB3A2QYbrM0GfZKN3BCKba++HmvJXU58tf+aBCB00Bg+rPn6QUNSPibu4tp65TaPVPSV
HjNTTICXu3sneHB+okJcc5z1ubme8nAytKb6x0JM/keNSXAev2ZN7zG5m+Pqw7/DQ/gCogzG
ML1bulP2rSh8YpJPC3vAVuHTmxsbhRBg4l7j5KiHf4qMBRvZry+YiHhwpf2p8JbCGF141+H
UD1VMeGeXnNo/9SO+dC2OGuf8WrV4FIpxIkBiGQQAQIADAUCSknCuGUDABJ1AAAKCRCLib

yletfBjrcACDd/zvoveoNlNiUUBazelcGXwaxSvUMSRouQNkxkoMzfA+aFpYFHWEdfLqndp
oJTIkgkESd5f0DJT26oLFekLvX3mpzfGz8l39KzDMLi6+7MtG7DnA3kvfViuZBNDwqoTS6hH
KcGa0MJDgzZQqJ9Ke/7T7eY+HzktUBLjzUY2kv5VV8Ji0p6xY27jT73xiDov00ZbBFN+xBtx
2iRmjJgnPtjt/zU5sLiv9fU0A+Pb53gBT+mXMNX2tsG07Kmuz7vfJR5ydoY7guyB3XlvUK9y
AmCWlGq67ERG934SujZFikO/oZUrWrrQu2jj5v8B7xwtcCFCdpZAIrAbD4BTglvPiQEiBBAB
AgAMBQJkjl+9BQMAEnUAAAJEJcQuJvKV6l8DTwH/3DzIl1zwr6TTtTfTBH9FSDdhvaUEPKC
bLT3WZwZIHREaLEENcQ85cGoYoBeJXVBIwBczZUpGy4pqFjYcWQ9vKfM2Nt1Nrs+v9tKc+9G
ECH0Y1a+9GDYqnepcN20/3HLASCEpXfWqhVe0lG+lupGgqYfMgTG9RByTkMzVXB9ER5gijGC
zjTf1YAOFUx2eBBLYa3w/ZzPT+nwRmEUaDpfwq06UPrzMZuho17SGPZUNz4lZ4p2NF8Td9bk
hOiJ3+gORRohbq0HdarDvSDoP/aGsQltfeF5p0KEcpIHx5B05H1twIkOGFTxyx3nTWqauEJy
2a+Wl5ZB10hB2TqWAE9Z54KJASIEEAECaAwFAkqgEkcFAWASdQAACgkQlxC4m8pXrXwyXwf/
UPzz+D+n19JWlvha7laUxuDMZMQCKTcEjFCu4QVZlRqcBFPoz0Tt74/X75QdmxZizqXlE6lbf
EsbVjL2Mt5zJedSlvbSbrmn4hV4pHzr08dbflZkNXl05g8ZlpsqQ7VyUt5YtWCn0tGNn4B5
Eb6WMeqxQteujV3B7AtMH+CD0ja+A2/pOrHIpqScz8aupksBMCrYghoT+7/qXNEVkjNmCu2N
mHxfv6dL5Xy/0iJjie2umStu8WtFRTpYmnv2gEhbCdb/zHfVg6lGgTBjQv9MvBVGRxnJfD4l
NqlucsadD+UM7WjV3v5VuN2r9KD9wocd/s22ELCRA2wKccvR/nWBkIkBiGQQAQIADAUCSqqG
AAUDABJlAAAKCRCXELibyletfaT8B/9cPhH8DlHoiv+cK8rAJMOMzQvQyY4BwsRrakyCvlg
7/yvMs74anynSouf0LgsXADQ29Hmrpf+zC5E5/jPGWNK8lX2VBVoB8nZkMSAnkZfOw+mWu9I
Aj2NLcsvt9JYnMAq5R7RrIrHsDQ2DIYxRgaE/5CVEVry9YQEj18A13/SyYoB4FWpDI4fRfUW
JbUJrYmfg0p+4zL0YS9F1lUhsHUu+g1Wlc83N54ozIlv0l3HUwVayzII4E/YNrIkpoAo+o8R
z9g6M6jCg3mwn+OfiZVJO++VOiguJF5KzoZIIICMXE3t5hL87Kroi7UkNwm+YHw3ZaLEBm0B
WAXw4DsJZcpViQEiBBABAgAMBQJkuceJBQMAEnUAAAJEJcQuJvKV6l88KEH/24QK2LVl142
4Wx3T9G4bJFRWWuEkTpYJw6ss72lqus9t7BsoGaNLMHQZKAlca9wLTqY826q4nv9anEqwWZ
+Dl8Kte+UAMUq2BFTL0EvOMJ6ilZyE8cUFVb1+09tpBWJJS7t3z00uMMmznGuHzSm4MgCnGhA
sOgiuHdPWSlnHnqNJA/SB6UVQxtcDOaqQLlIvhd2HVqrOBrtER3td/YgLo6HSxXpXtZ8DBa2
NYQYSwAdlqJAPLbnBsLXwbCswuIDMZv8BjWUNBEJkOmoV5CXxhPrP5kxWvyBvsIhTk8ph2
GIh/ZRVNDAsChbuUlEJBACpwaMrCgwJpTl7/KTgeZVSJASIEEAECaAwFAkreCMYFAWASdQAA
CgkQlxC4m8pXrXyOQqf7BvRm/3PvFCCksyJBW4EVBW7z/PS/kBK6bIE9Q7f7QlXfICGGUIPa
rufXWbV+G4a3Z8LfaEKJTOTvNePfguwpFjneUZn1CG+oVSlAfddvYhAsgkLhQqMbaNJlJly4D/
H3xvCna/s7Teufud0JLXoLBedFXeB5Cg2KlEoxINqMo+lm/VGJmbykwqoRvxZLDfnbFag5zG
59+OWw4TC8nz1lQYIBn22YiWRk5zsCJA400+KL1vwBiFDrREhALQc/YBJKYrRX3ZV4U/EeYD
KB0NCBklW1tXGCEE3uhM0S5VFclj7Pq58ECuntH5xOy+KMNFljiQwvWfbaFTJvcjFQS+OplX
b4kBiGQQAQIADAUCS86VAUDABJlAAAKCRCXELibyletfgS8CACTeI2BmKs24GF80JewTOQI
cvhncdV7hKZ0ltnPNBBdv6qT3iX2Gva10iYhI5Eg30jt/hKFJTMlFYZyI1peFodGjv7Lk5l
u7zaNBvTlPBCP+eJspi6rGpSuhtMSb405jPclRBmbY+w9wctLyZflzG+s1Sdw8adcRXQNFqr
vVlZYOMu2S8FunqLfxpjewiFiDPzAzmBwZMoO2PLCYFhwV6Eh2jO33OGbvBmyHNFZBFx5F/+
kiyeT47MEhrfhytJ6Z0dpXtX8HvbvzPzCDLOI80W6rPTG76KW06ziZrJ8lYCa6a7D0lY7BYy
W2HoxzYcuumjRkGF4nqK4Mw+wefCp0H/iQEiBBABAgAMBQJLAF3aBQMAEnUAAAJEJcQuJvK
V6l8/qOH/ibXDQg2BmqlLoT4H+ezXjPgDg8aiuz6f4xibTmrO+L4ScMX+zK0KZVwp6Kau28
Nx+gO0oAUW8mNxd+c10ZaY+7RIkxEvkooKksArBmZT+xrE6CgHlAs3D4Mc+14nfd0aZaUbe
iobWvXlXl27MELcWyeMlgbeNoucc473JddvmHSRRM5F9Qp28CvWDEXYghq11aoha08+cei
pvzyu030TwtJuA0qhefOHZAvFrRli99ML8xzF1Z0vBct+36SuYxDXyIhksd7aG9Us0lW6W5Si
JyT4cDyI0JDhbnZ0ntzWYKcKMZMxf8w3jW4sfQL0prhHrARqqPiU8OTUH/VNX5CJASIEEAEC
AAwFAksRgasFAwASdQAACgkQlxC4m8pXrXydogf/a3lofmYfMoE3p9SgQt/v28iy00j9A1Lm
qKwEhJkxkf/X/Qa7pafGQ9J90JQkxYKMxydWPspTbDFMccZWkBK132vZp9Q3FHKpndPDLK2S
25miTReeAAQNgMMFLeyy7ZHi5YsKwLbKxcSo7/m0jlitNYlmt94imFNpg/mHGsy6O+rLeQTA
opuIzP3VwN6ItL5gIFxqWpmf/V0Xh/vxTwLqJ66vECD8vyHrHblUzgiXHgyYbZPxAa2SRRd3
4V38phaZ/QsTkss+Sd/QeHChWyU9d6KengWwcr/nDO+K/hhnm05Oqz02Upwyxrgi6484HQUN
/Smf44VBsSDlDBjaAKjMr4kBiGQQAQIADAUCSNN1AUDABJlAAAKCRCXELibyletfcWiB/9c
EZtdFVcsxpE3hJzM6PBPf+1QKUJorVe/7MqNEb3TMWFgBxyOfvD7uMpCjYOrqq5AbUQfZfj9
K7qmqzWUMuoYceGIlbDmHFBjWtmaF0BiyHaobgY/9RbdCNcbtZrW34feiW9aDZyvCoLHEVkcCC
QACSv3FwdYVvKRB5eihvpwJk5tpScdIA12YLqzmVTFdhrZuYvtDdQHjgoLM08B9s9kok7D2T
SpveVzXXPH68Z3JkVubhHT7cs+n+9PRvcaVJtsX2VTUY5eFVqmGuAUUvrvp2aN8cKQ+mVcCQR
VV1ht9o8YB5925MUx2VJm10y0nkBQUmZyzMEOVGkuU/G+pVrRmmAiQEiBBABAgAMBQJLJyaS
BQMAEnUAAAJEJcQuJvKV6l8eU0IAKnVh6ymId9C3ZqVyxwTnOB8RMQceJzwCLqk2RT0dPhN
5ZwUcQN7lCp9hymMutC8FdKRR/ESK21vJF2/576Pln4fIeOIbycBAEvqrL14epATj53uBizo
NOTuwblKximFERuW3MP4XiFUJB0tPws2vR5UU3t6GoQJjWNoIbz9DK2L6X/Qz3Tb9if6bPSK
U6JRlYn3Hos9ogg21vWCxgMTKUuPAYhmYjSvkqH3BihXi+c17MVvE7W5GJbQHuoJo+MgSxu04
4qnvdH2pf4Mzc10xcl0hJxeffNyeiY2bzdI2yCaCtmW0lCWlSc2oiE0zw60lD4hY5XmC2q1
MLsKB5VNXXGJASIEEAECaAwFAks4Ze4FAwASdQAACgkQlxC4m8pXrXyWXggAon2abiNvRzx9
7364Mjx4l1FvM1tVebzNbOkDwZS1ABqTDGgq/ffZA/VZrU+h2eL97cQyGxJEQ5kkm/vliobE
ZEFMT0pv9WMzfidqzhdKdcpbbxdaErIjD5fBACKdjazAUeH7zce2v+bBN0l9LZoRiXbNugG9
38lKJ2E4ZTYffvftl/e4RzOgqR9VD/A5MzxXFbCVharHbeT8OwZy40z2UDaDsZHSnKoG1WN
posf2HTMBPNcsOSY/hIBRWnXnzdyOkWt7laeLnmNleUEwzk4J7GnlambPIctOdoEURimsaey
TkLZGejKnwi/PqARYDWlFsReKNHD753ZMViUnAsq2IkBiGQQAQIADAUCS0oyJwUDABJlAAAK
CRCXELibyletGodCAC5hjmXwquHSb8ZL0RifIL3j3iU6U7qLk1TQKkTqgELfUzeF9f8NuNR
txLmzNk1T7YI9iji6NAtnuy43v610MbqlkV8x69qNP360wv408wXxet0s5ViZuVOZJAY075c

```

YRhopgfmhkh4hbkAoKCLaJ0R0WUEEsDHsqj8XLJuGRREURy8TJWaB/cotXsgijf99gt+giw
In8tyb3+WVIUHWfw2+Drpd3nfcMqge054PePJ0oBWWjaar+wgC/76Se286IHcYMrml/Adnvx
ZaIKmxZmkTmDMcFmNvjRYSKBGjQ9Uu7dws7SMSbbd34f8Jt9nyuRqMcl4INAXthWY/S3Sdil
iQEiBBABAGAMBQJLW/5mBQMAEnUAAoJEJcQuJvKV618L8IAKq3Z0QHzaOoz5wnvj51YG8
nZoW5RG7Hob3mL1D9b+FTTzaIxsLf7STagPwKtM57rU/7ehHIuO/9QQNQ3Mudw17Ziwd015X
7iG8/Af1Wnc6bXfTz18IplRuqyVc0qQeJZhT7MBpk1cS4ZGZHPQdtAh4Aw5YXihrbbq6jV7j
CzUmFz4XcT8CKJHIUGoFR0vTmFqlAt2K1lmwGMh2IEamPOJ0wsTbBfZbhmKB03RToEjIipGZ
M+NtKS/NL2RJYWZ+FCCcEMoRgmlVmATWw3natgLWwN4Z6K4rGXONWi/0wyFgxZpmjdHmjXa
Igz8EroVsLbnaV/8yG7cgK5e6M0Fk1iJASIEEAECAAwFAktIfgFAwASdQAACgkQ1xC4m8pX
rXyR3QgAksvAMfQC+ACUEWSVAlepDFR1xI45UwBa2UeBY7Kj0OCiZlkgREvx20IOv1gExyPl
zNxDeqmYsl2mleEoH6QlXaJRd8MxIVfAnjAt8izwU2dfDwflTTWgGQYf8q7qeAv1XC34yNge
0JaTd1C55Qpmc051f2ojMsAi36bBJO4Dr59jhVYidJQADS/d7FpAzn1hH9SGUg6ekYb2jxCS
rvt0wRtMyk6YGts4xEHCN0wC9VTobaXo9xvsqhtUK44Gdvptq1cBFX8byzD6fN8nXp+v8qh
t1PYDqb4muqTh2UXXi1WmtvPXo7kkZQ8CvI3YbZ10F1IDLT20VJWFZaJYL2fzyokCIgQQAQIA
DAUCQYHLhQWDBiLZBwAKCRCq4+bOZqFEaKgveACCERnaHGyUYa0wETjj6DLEXsqeOiXad4i9
aBQxnd35GugcFofC/nCY4XcnCMMEnmdQ9ofUuU30BJ6BNJIBeUsAabgLoobP/3KEaiCIiyh
HYU5jarpZAh+Zopgs30cl1mQ1tIaS69iJxrgTLodkAsAJAeEUWTPq9fHFFZC1eGBysyfWg4
biJz/zclI+qyTbFA5g6tRoixTo8ko7QhY2AA5UGeg+83Hdb6akC04Z2QRErxKAqrphHzj8Xp
jVosQAdAi/qVKQeNKR0LJ+iq6+YesmcWGFzeb87dGNweVFDJIGA0qY27pTb21ExYjsRFN4Cb
13NfodAbMtOxcAWZ7jAPCxAPlHUG++mHMrhQXEToznBFE4nbnC7vOBNGWdjUgXcpkUCkop4b
17BFpR+k8ZtYLS8S8p2LLz4uAeCcSm2/msJxT7rC/FvoH8428oHincgs2ICo9z0/UD4Hmm000
+SszdVkiIjinyOVWb400zkAlnnhEZ3o6hAHcREIsBgPwEYVTj/9ZdC0AO44Nj9cU7awaqgt
rnwvfr/o4V2g18bLSkl1tZU27/29HeuOeFGj1Fe0YrDd/aRNsxbyb2028H4sG1CVZmC5uKliQ
BDiSyA7Q0bbdofCWOqzm5twlpKWnY8Oe0ub9XP5p/sVfck4FceWFHwv+/PC9RzSL331Q6vM2
wIkCIgQTAQIADAUCQp8KHAWDBQWacAAKCRDYwgoJWiRXzyE+D/9uc7z6fIsalfOYoLN60ajA
bQbI/uRKBfugyZ5RoAtusn9Z2rAtn61WrFhu4uCSJtFNlny2RERg40f56pTghKrD+YEt+Nz
e6+FKQ5AbGIdFsR/2bUk+ZZRSt83e14Lcb6ii/fJfzkoIox9ltkifQxqY7Tvk4noKu4oLSc8
Olwsf/y0B9sYUUCmUfcng58DEmGie9ovUslmyt5NPnveXxp5UeaRc5Rqt9tK2B4A+7/cqEN
rdZJbAMsunt2+2fkYiRunAFPKPBdJBsYlsxeL/A9aKe0viKEXQdAWqdNZKNCi8rd/oOP99/9
lMbFudAbX6nL2DSb1OG2Z7NWEqgIAzjmpwYYPCKeVz5Q8R+if9/fe5+STY/550aI33fJ2H3v
+U435VjYqbrerWe36xJitcJeqUzW71fQtXi1CTEl3w2ch7VF5oj/QyjabLnAlHgSlkSi6p7B
y5C2MnbCH1CfPnIinPhFoRcRGPjJe9nFwGs+QblvS/Chzc2WX3s/2SWm4gEUKRX4zsAJ5ocy
fa/vkxChSxK/erWlCPf/J1T70+i5waXDN/E3enSet/WL7h94pQKpjz8OdGL4JSBHUAAGA+a+
dknqnPF0KMKLhJrgV+L7084FhbmAP7PXm3xmiMPriXf+el5fZZequQoIagf8rdRHHhRjXqgI
0HNknkaOqs8dtrkCDQQ+PqMdEAgA7+GJfxbMdY4wslPnjH9rF4N2qfWsen/lxaZoJYc3a6M0
2WCnH16ahT2/tBK2w1QI4YfTeR47gCvtgb6O1JHffOo2HfLmRDRiRjd1DTCHqeyX7CHhcgHj
/dNRlW22015QFecmV9U0Vhp3aFfWC4Ujfs3LU+hkAWZe7zaD5cH9J7yv/6xuZVw411x0h4Uq
sTcWmu0iM1BzELqX1DY7LwoPEb/O9Rkbf4fmLe11EzIaCa4PqARXQZc4dhSinMt6K3X4BrRs
KTFozBu74F47D8I1bf5vSYHbuE5p/1oDznkg/p8kW+3FxuWrycciqFtCnz215yyX39LXfn1
LzKUb/F5GwADBQf+Lwqqa8CGRrfsOAJxim63CHfty5mUc5rUSnTs1GYEIOCR1BeQauyPZbPD
sDD9MZ12aSafanFvvFG6Llx9xkU7tzq+vKLoWkm4u5xf3vn55VjnSdlaQ9eQnUcXiL4cnBGo
TbOWI39EcyzsgslzBdC++mpjCQTcA7p6JUVsP6oAB3FQWg54tuUo0Ec8bsM8b3Ev42LmuQT5N
dKHGwHsXTpt10klk4bQk40aJhSiylBMahpT27jWjJlMiJc+IWJ0mghkKHt926s/ymfdf5Hkd
Q1cyvzs5tryVI3Fy78XeSYfQvuuwqp2H139pXGEkg0n6KdUOetdZWhe70YGNPwlyjWJT1IhM
BBgRAGAMBQI+PqMdBQkJZgGAAAJEIXxjTtQcuH17p4An3r1QpVC9yhnW2cSAjq+kr72GX0e
AJ4295k16NxyEuFApmr1+0uUq/SlSyhMBBgRAGAMBQJHrJT8BQkNMFjFAAJEIXxjTtQcuH1
pc4An0I965H3JY2GTrizp+dCezxbhexaAJ48FhocFYvfHztgeUWb6aPvgQZHT4hUBBgRAGAM
BQI+PqMdBQkJZgGAABIJEIXxjTtQcuH1B2VHUECAAQHungCfevVCLUL3KGdbZxICOr6SvvYZ
fR4Anjb3mSxo3FgS4UCmavX7S5Sr9KWxiFQEGBECAAwFAk53Pe0FCRP7AbgAEgd1r1BHAAEB
CRCMcy07UHLh9RSbAJSFivb5sESf8vYE5yfd1n9AVa6FEwCgpWAIWbl9p1DcB+L5RCUBw6mG
uck=
=yia9
-----END PGP PUBLIC KEY BLOCK-----

```

2.5 Installation Layouts

The installation layout differs for different installation types (for example, native packages, binary tarballs, and source tarballs), which can lead to confusion when managing different systems or using different installation sources. The individual layouts are given in the corresponding installation type or platform chapter, as described following. Note that the layout of installations from vendors other than Oracle may differ from these layouts.

- [Section 5.1, “MySQL Installation Layout on Microsoft Windows”](#)
- [Section 4.3, “MySQL Layout for Source Installation”](#)

- [Table 3.1, “MySQL Installation Layout for Generic Unix/Linux Binary Package”](#)
- [Table 7.5, “MySQL Installation Layout for Linux RPM Packages from the MySQL Developer Zone”](#)
- [Table 6.1, “MySQL Installation Layout on macOS”](#)

2.6 Compiler-Specific Build Characteristics

In some cases, the compiler used to build MySQL affects the features available for use. The notes in this section apply for binary distributions provided by Oracle Corporation or that you compile yourself from source.

`icc` (Intel C++ Compiler) Builds

A server built with `icc` has these characteristics:

- SSL support is not included.

Chapter 3 Installing MySQL on Unix/Linux Using Generic Binaries

Oracle provides a set of binary distributions of MySQL. These include generic binary distributions in the form of compressed `tar` files (files with a `.tar.xz` extension) for a number of platforms, and binaries in platform-specific package formats for selected platforms.

This section covers the installation of MySQL from a compressed `tar` file binary distribution on Unix/Linux platforms. For Linux-generic binary distribution installation instructions with a focus on MySQL security features, refer to the [Secure Deployment Guide](#). For other platform-specific binary package formats, see the other platform-specific sections in this manual. For example, for Windows distributions, see [Chapter 5, Installing MySQL on Microsoft Windows](#). See [Section 2.3, “How to Get MySQL”](#) on how to obtain MySQL in different distribution formats.

MySQL compressed `tar` file binary distributions have names of the form `mysql-VERSION-OS.tar.xz`, where `VERSION` is a number (for example, `8.0.36`), and `OS` indicates the type of operating system for which the distribution is intended (for example, `pc-linux-i686` or `winx64`).

There is also a “minimal install” version of the MySQL compressed `tar` file for the Linux generic binary distribution, which has a name of the form `mysql-VERSION-OS-GLIBCVER-ARCH-minimal.tar.xz`. The minimal install distribution excludes debug binaries and is stripped of debug symbols, making it significantly smaller than the regular binary distribution. If you choose to install the minimal install distribution, remember to adjust for the difference in file name format in the instructions that follow.

Warnings

- If you have previously installed MySQL using your operating system native package management system, such as Yum or APT, you may experience problems installing using a native binary. Make sure your previous MySQL installation has been removed entirely (using your package management system), and that any additional files, such as old versions of your data files, have also been removed. You should also check for configuration files such as `/etc/my.cnf` or the `/etc/mysql` directory and delete them.

For information about replacing third-party packages with official MySQL packages, see the related [APT guide](#) or [Yum guide](#).

- MySQL has a dependency on the `libaio` library. Data directory initialization and subsequent server startup steps fail if this library is not installed locally. If necessary, install it using the appropriate package manager. For example, on Yum-based systems:

```
$> yum search libaio # search for info
$> yum install libaio # install library
```

Or, on APT-based systems:

```
$> apt-cache search libaio # search for info
$> apt-get install libaio1 # install library
```

- **Oracle Linux 8 / Red Hat 8 (EL8):** These platforms by default do not install the file `/lib64/libtinfo.so.5`, which is required by the MySQL client `bin/mysql` for packages `mysql-VERSION-el7-x86_64.tar.gz` and `mysql-VERSION-linux-glibc2.12-x86_64.tar.xz`. To work around this issue, install the `ncurses-compat-libs` package:

```
$> yum install ncurses-compat-libs
```

To install a compressed `tar` file binary distribution, unpack it at the installation location you choose (typically `/usr/local/mysql`). This creates the directories shown in the following table.

Table 3.1 MySQL Installation Layout for Generic Unix/Linux Binary Package

Directory	Contents of Directory
<code>bin</code>	<code>mysqld</code> server, client and utility programs
<code>docs</code>	MySQL manual in Info format
<code>man</code>	Unix manual pages
<code>include</code>	Include (header) files
<code>lib</code>	Libraries
<code>share</code>	Error messages, dictionary, and SQL for database installation
<code>support-files</code>	Miscellaneous support files

Debug versions of the `mysqld` binary are available as `mysqld-debug`. To compile your own debug version of MySQL from a source distribution, use the appropriate configuration options to enable debugging support. See [Chapter 4, Installing MySQL from Source](#).

To install and use a MySQL binary distribution, the command sequence looks like this:

```
$> groupadd mysql
$> useradd -r -g mysql -s /bin/false mysql
$> cd /usr/local
$> tar xvf /path/to/mysql-VERSION-OS.tar.xz
$> ln -s full-path-to-mysql-VERSION-OS mysql
$> cd mysql
$> mkdir mysql-files
$> chown mysql:mysql mysql-files
$> chmod 750 mysql-files
$> bin/mysqld --initialize --user=mysql
$> bin/mysql_ssl_rsa_setup
$> bin/mysqld_safe --user=mysql &
# Next command is optional
$> cp support-files/mysql.server /etc/init.d/mysql.server
```

Note

This procedure assumes that you have `root` (administrator) access to your system. Alternatively, you can prefix each command using the `sudo` (Linux) or `pfexec` (Solaris) command.

The `mysql-files` directory provides a convenient location to use as the value for the `secure_file_priv` system variable, which limits import and export operations to a specific directory. See [Server System Variables](#).

A more detailed version of the preceding description for installing a binary distribution follows.

Create a mysql User and Group

If your system does not already have a user and group to use for running `mysqld`, you may need to create them. The following commands add the `mysql` group and the `mysql` user. You might want to call the user and group something else instead of `mysql`. If so, substitute the appropriate name in the following

instructions. The syntax for `useradd` and `groupadd` may differ slightly on different versions of Unix/Linux, or they may have different names such as `adduser` and `addgroup`.

```
$> groupadd mysql
$> useradd -r -g mysql -s /bin/false mysql
```

Note

Because the user is required only for ownership purposes, not login purposes, the `useradd` command uses the `-r` and `-s /bin/false` options to create a user that does not have login permissions to your server host. Omit these options if your `useradd` does not support them.

Obtain and Unpack the Distribution

Pick the directory under which you want to unpack the distribution and change location into it. The example here unpacks the distribution under `/usr/local`. The instructions, therefore, assume that you have permission to create files and directories in `/usr/local`. If that directory is protected, you must perform the installation as `root`.

```
$> cd /usr/local
```

Obtain a distribution file using the instructions in [Section 2.3, “How to Get MySQL”](#). For a given release, binary distributions for all platforms are built from the same MySQL source distribution.

Unpack the distribution, which creates the installation directory. `tar` can uncompress and unpack the distribution if it has `z` option support:

```
$> tar xvf /path/to/mysql-VERSION-OS.tar.xz
```

The `tar` command creates a directory named `mysql-VERSION-OS`.

To install MySQL from a compressed `tar` file binary distribution, your system must have GNU `xz Utils` to uncompress the distribution and a reasonable `tar` to unpack it.

Note

The compression algorithm changed from Gzip to XZ in MySQL Server 8.0.12; and the generic binary's file extension changed from `.tar.gz` to `.tar.xz`.

GNU `tar` is known to work. The standard `tar` provided with some operating systems is not able to unpack the long file names in the MySQL distribution. You should download and install GNU `tar`, or if available, use a preinstalled version of GNU `tar`. Usually this is available as `gnutar`, `gtar`, or as `tar` within a GNU or Free Software directory, such as `/usr/sfw/bin` or `/usr/local/bin`. GNU `tar` is available from <http://www.gnu.org/software/tar/>.

If your `tar` does not support the `xz` format then use the `xz` command to unpack the distribution and `tar` to unpack it. Replace the preceding `tar` command with the following alternative command to uncompress and extract the distribution:

```
$> xz -dc /path/to/mysql-VERSION-OS.tar.xz | tar x
```

Next, create a symbolic link to the installation directory created by `tar`:

```
$> ln -s full-path-to-mysql-VERSION-OS mysql
```

The `ln` command makes a symbolic link to the installation directory. This enables you to refer more easily to it as `/usr/local/mysql`. To avoid having to type the path name of client programs always when you are working with MySQL, you can add the `/usr/local/mysql/bin` directory to your `PATH` variable:

```
$> export PATH=$PATH:/usr/local/mysql/bin
```

Perform Postinstallation Setup

The remainder of the installation process involves setting distribution ownership and access permissions, initializing the data directory, starting the MySQL server, and setting up the configuration file. For instructions, see [Chapter 9, *Postinstallation Setup and Testing*](#).

Chapter 4 Installing MySQL from Source

Table of Contents

4.1 Source Installation Methods	27
4.2 Source Installation Prerequisites	28
4.3 MySQL Layout for Source Installation	29
4.4 Installing MySQL Using a Standard Source Distribution	30
4.5 Installing MySQL Using a Development Source Tree	34
4.6 Configuring SSL Library Support	36
4.7 MySQL Source-Configuration Options	36
4.8 Dealing with Problems Compiling MySQL	70
4.9 MySQL Configuration and Third-Party Tools	71
4.10 Generating MySQL Doxygen Documentation Content	72

Building MySQL from the source code enables you to customize build parameters, compiler optimizations, and installation location. For a list of systems on which MySQL is known to run, see <https://www.mysql.com/support/supportedplatforms/database.html>.

Before you proceed with an installation from source, check whether Oracle produces a precompiled binary distribution for your platform and whether it works for you. We put a great deal of effort into ensuring that our binaries are built with the best possible options for optimal performance. Instructions for installing binary distributions are available in [Chapter 3, Installing MySQL on Unix/Linux Using Generic Binaries](#).

If you are interested in building MySQL from a source distribution using build options the same as or similar to those use by Oracle to produce binary distributions on your platform, obtain a binary distribution, unpack it, and look in the `docs/INFO_BIN` file, which contains information about how that MySQL distribution was configured and compiled.

Warning

Building MySQL with nonstandard options may lead to reduced functionality, performance, or security.

The MySQL source code contains internal documentation written using Doxygen. The generated Doxygen content is available at <https://dev.mysql.com/doc/index-other.html>. It is also possible to generate this content locally from a MySQL source distribution using the instructions at [Section 4.10, “Generating MySQL Doxygen Documentation Content”](#).

4.1 Source Installation Methods

There are two methods for installing MySQL from source:

- Use a standard MySQL source distribution. To obtain a standard distribution, see [Section 2.3, “How to Get MySQL”](#). For instructions on building from a standard distribution, see [Section 4.4, “Installing MySQL Using a Standard Source Distribution”](#).

Standard distributions are available as compressed `tar` files, Zip archives, or RPM packages. Distribution files have names of the form `mysql-VERSION.tar.gz`, `mysql-VERSION.zip`, or `mysql-VERSION.rpm`, where `VERSION` is a number like `8.0.36`. File names for source distributions

can be distinguished from those for precompiled binary distributions in that source distribution names are generic and include no platform name, whereas binary distribution names include a platform name indicating the type of system for which the distribution is intended (for example, `pc-linux-i686` or `winx64`).

- Use a MySQL development tree. For information on building from one of the development trees, see [Section 4.5, “Installing MySQL Using a Development Source Tree”](#).

4.2 Source Installation Prerequisites

Installation of MySQL from source requires several development tools. Some of these tools are needed no matter whether you use a standard source distribution or a development source tree. Other tool requirements depend on which installation method you use.

To install MySQL from source, the following system requirements must be satisfied, regardless of installation method:

- `CMake`, which is used as the build framework on all platforms. `CMake` can be downloaded from <http://www.cmake.org>.
- A good `make` program. Although some platforms come with their own `make` implementations, it is highly recommended that you use GNU `make` 3.75 or later. It may already be available on your system as `gmake`. GNU `make` is available from <http://www.gnu.org/software/make/>.

On Unix-like systems, including Linux, you can check your system's version of `make` like this:

```
$> make --version
GNU Make 4.2.1
```

- As of MySQL 8.0.26, MySQL 8.0 source code permits use of C++17 features. To enable the necessary level of C++17 support across all supported platforms, the following minimum compiler versions apply:
 - Linux: GCC 10 or Clang 5
 - macOS: XCode 10
 - Solaris: GCC 10
 - Windows: Visual Studio 2019
- The MySQL C API requires a C++ or C99 compiler to compile.
- An SSL library is required for support of encrypted connections, entropy for random number generation, and other encryption-related operations. By default, the build uses the OpenSSL library installed on the host system. To specify the library explicitly, use the `WITH_SSL` option when you invoke `CMake`. For additional information, see [Section 4.6, “Configuring SSL Library Support”](#).
- The Boost C++ libraries are required to build MySQL (but not to use it). MySQL compilation requires a particular Boost version. Typically, that is the current Boost version, but if a specific MySQL source distribution requires a different version, the configuration process stops with a message indicating the Boost version that it requires. To obtain Boost and its installation instructions, visit [the official Boost web site](#). After Boost is installed, tell the build system where the Boost files are placed according to the value set for the `WITH_BOOST` option when you invoke `CMake`. For example:

```
cmake . -DWITH_BOOST=/usr/local/boost_version_number
```

Adjust the path as necessary to match your installation.

- The [ncurses](#) library.
- Sufficient free memory. If you encounter build errors such as [internal compiler error](#) when compiling large source files, it may be that you have too little memory. If compiling on a virtual machine, try increasing the memory allocation.
- Perl is needed if you intend to run test scripts. Most Unix-like systems include Perl. For Windows, you can use [ActiveState Perl](#). or [Strawberry Perl](#).

To install MySQL from a standard source distribution, one of the following tools is required to unpack the distribution file:

- For a [.tar.gz](#) compressed [tar](#) file: GNU [gunzip](#) to uncompress the distribution and a reasonable [tar](#) to unpack it. If your [tar](#) program supports the [z](#) option, it can both uncompress and unpack the file.

GNU [tar](#) is known to work. The standard [tar](#) provided with some operating systems is not able to unpack the long file names in the MySQL distribution. You should download and install GNU [tar](#), or if available, use a preinstalled version of GNU tar. Usually this is available as [gnutar](#), [gtar](#), or as [tar](#) within a GNU or Free Software directory, such as [/usr/sfw/bin](#) or [/usr/local/bin](#). GNU [tar](#) is available from <https://www.gnu.org/software/tar/>.

- For a [.zip](#) Zip archive: [WinZip](#) or another tool that can read [.zip](#) files.
- For an [.rpm](#) RPM package: The [rpmbuild](#) program used to build the distribution unpacks it.

To install MySQL from a development source tree, the following additional tools are required:

- The Git revision control system is required to obtain the development source code. [GitHub Help](#) provides instructions for downloading and installing Git on different platforms.
- [bison](#) 2.1 or later, available from <http://www.gnu.org/software/bison/>. (Version 1 is no longer supported.) Use the latest version of [bison](#) where possible; if you experience problems, upgrade to a later version, rather than revert to an earlier one.

[bison](#) is available from <http://www.gnu.org/software/bison/>. [bison](#) for Windows can be downloaded from <http://gnuwin32.sourceforge.net/packages/bison.htm>. Download the package labeled “Complete package, excluding sources”. On Windows, the default location for [bison](#) is the [C:\Program Files\GnuWin32](#) directory. Some utilities may fail to find [bison](#) because of the space in the directory name. Also, Visual Studio may simply hang if there are spaces in the path. You can resolve these problems by installing into a directory that does not contain a space (for example [C:\GnuWin32](#)).

- On Solaris Express, [m4](#) must be installed in addition to [bison](#). [m4](#) is available from <http://www.gnu.org/software/m4/>.

Note

If you have to install any programs, modify your [PATH](#) environment variable to include any directories in which the programs are located. See [Setting Environment Variables](#).

If you run into problems and need to file a bug report, please use the instructions in [How to Report Bugs or Problems](#).

4.3 MySQL Layout for Source Installation

By default, when you install MySQL after compiling it from source, the installation step installs files under [/usr/local/mysql](#). The component locations under the installation directory are the same as for binary

distributions. See [Table 3.1, “MySQL Installation Layout for Generic Unix/Linux Binary Package”](#), and [Section 5.1, “MySQL Installation Layout on Microsoft Windows”](#). To configure installation locations different from the defaults, use the options described at [Section 4.7, “MySQL Source-Configuration Options”](#).

4.4 Installing MySQL Using a Standard Source Distribution

To install MySQL from a standard source distribution:

1. Verify that your system satisfies the tool requirements listed at [Section 4.2, “Source Installation Prerequisites”](#).
2. Obtain a distribution file using the instructions in [Section 2.3, “How to Get MySQL”](#).
3. Configure, build, and install the distribution using the instructions in this section.
4. Perform postinstallation procedures using the instructions in [Chapter 9, *Postinstallation Setup and Testing*](#).

MySQL uses [CMake](#) as the build framework on all platforms. The instructions given here should enable you to produce a working installation. For additional information on using [CMake](#) to build MySQL, see [How to Build MySQL Server with CMake](#).

If you start from a source RPM, use the following command to make a binary RPM that you can install. If you do not have `rpmbuild`, use `rpm` instead.

```
$> rpmbuild --rebuild --clean MySQL-VERSION.src.rpm
```

The result is one or more binary RPM packages that you install as indicated in [Section 7.4, “Installing MySQL on Linux Using RPM Packages from Oracle”](#).

The sequence for installation from a compressed `tar` file or Zip archive source distribution is similar to the process for installing from a generic binary distribution (see [Chapter 3, *Installing MySQL on Unix/Linux Using Generic Binaries*](#)), except that it is used on all platforms and includes steps to configure and compile the distribution. For example, with a compressed `tar` file source distribution on Unix, the basic installation command sequence looks like this:

```
# Preconfiguration setup
$> groupadd mysql
$> useradd -r -g mysql -s /bin/false mysql
# Beginning of source-build specific instructions
$> tar zxvf mysql-VERSION.tar.gz
$> cd mysql-VERSION
$> mkdir bld
$> cd bld
$> cmake ..
$> make
$> make install
# End of source-build specific instructions
# Postinstallation setup
$> cd /usr/local/mysql
$> mkdir mysql-files
$> chown mysql:mysql mysql-files
$> chmod 750 mysql-files
$> bin/mysqld --initialize --user=mysql
$> bin/mysql_ssl_rsa_setup
$> bin/mysqld_safe --user=mysql &
# Next command is optional
$> cp support-files/mysql.server /etc/init.d/mysql.server
```

A more detailed version of the source-build specific instructions is shown following.

Note

The procedure shown here does not set up any passwords for MySQL accounts. After following the procedure, proceed to [Chapter 9, *Postinstallation Setup and Testing*](#), for postinstallation setup and testing.

- [Perform Preconfiguration Setup](#)
- [Obtain and Unpack the Distribution](#)
- [Configure the Distribution](#)
- [Build the Distribution](#)
- [Install the Distribution](#)
- [Perform Postinstallation Setup](#)

Perform Preconfiguration Setup

On Unix, set up the `mysql` user that owns the database directory and that should be used to run and execute the MySQL server, and the group to which this user belongs. For details, see [Create a mysql User and Group](#). Then perform the following steps as the `mysql` user, except as noted.

Obtain and Unpack the Distribution

Pick the directory under which you want to unpack the distribution and change location into it.

Obtain a distribution file using the instructions in [Section 2.3, “How to Get MySQL”](#).

Unpack the distribution into the current directory:

- To unpack a compressed `tar` file, `tar` can decompress and unpack the distribution if it has `z` option support:

```
$> tar zxvf mysql-VERSION.tar.gz
```

If your `tar` does not have `z` option support, use `gunzip` to decompress the distribution and `tar` to unpack it:

```
$> gunzip < mysql-VERSION.tar.gz | tar xvf -
```

Alternatively, `CMake` can decompress and unpack the distribution:

```
$> cmake -E tar zxvf mysql-VERSION.tar.gz
```

- To unpack a Zip archive, use [WinZip](#) or another tool that can read `.zip` files.

Unpacking the distribution file creates a directory named `mysql-VERSION`.

Configure the Distribution

Change location into the top-level directory of the unpacked distribution:

```
$> cd mysql-VERSION
```

Build outside of the source tree to keep the tree clean. If the top-level source directory is named `mysql-src` under your current working directory, you can build in a directory named `build` at the same level. Create the directory and go there:

```
$> mkdir bld
$> cd bld
```

Configure the build directory. The minimum configuration command includes no options to override configuration defaults:

```
$> cmake ../mysql-src
```

The build directory need not be outside the source tree. For example, you can build in a directory named `build` under the top-level source tree. To do this, starting with `mysql-src` as your current working directory, create the directory `build` and then go there:

```
$> mkdir build
$> cd build
```

Configure the build directory. The minimum configuration command includes no options to override configuration defaults:

```
$> cmake ..
```

If you have multiple source trees at the same level (for example, to build multiple versions of MySQL), the second strategy can be advantageous. The first strategy places all build directories at the same level, which requires that you choose a unique name for each. With the second strategy, you can use the same name for the build directory within each source tree. The following instructions assume this second strategy.

On Windows, specify the development environment. For example, the following commands configure MySQL for 32-bit or 64-bit builds, respectively:

```
$> cmake .. -G "Visual Studio 12 2013"
$> cmake .. -G "Visual Studio 12 2013 Win64"
```

On macOS, to use the Xcode IDE:

```
$> cmake .. -G Xcode
```

When you run `Cmake`, you might want to add options to the command line. Here are some examples:

- `-DBUILD_CONFIG=mysql_release`: Configure the source with the same build options used by Oracle to produce binary distributions for official MySQL releases.
- `-DCMAKE_INSTALL_PREFIX=dir_name`: Configure the distribution for installation under a particular location.
- `-DCPACK_MONOLITHIC_INSTALL=1`: Cause `make package` to generate a single installation file rather than multiple files.
- `-DWITH_DEBUG=1`: Build the distribution with debugging support.

For a more extensive list of options, see [Section 4.7, “MySQL Source-Configuration Options”](#).

To list the configuration options, use one of the following commands:

```
$> cmake .. -L # overview
$> cmake .. -LH # overview with help text
$> cmake .. -LAH # all params with help text
$> ccmake .. # interactive display
```

If `CMake` fails, you might need to reconfigure by running it again with different options. If you do reconfigure, take note of the following:

- If `CMake` is run after it has previously been run, it may use information that was gathered during its previous invocation. This information is stored in `CMakeCache.txt`. When `CMake` starts, it looks for that file and reads its contents if it exists, on the assumption that the information is still correct. That assumption is invalid when you reconfigure.
- Each time you run `CMake`, you must run `make` again to recompile. However, you may want to remove old object files from previous builds first because they were compiled using different configuration options.

To prevent old object files or configuration information from being used, run these commands in the build directory on Unix before re-running `CMake`:

```
$> make clean
$> rm CMakeCache.txt
```

Or, on Windows:

```
$> devenv MySQL.sln /clean
$> del CMakeCache.txt
```

Before asking on the [MySQL Community Slack](#), check the files in the `CMakeFiles` directory for useful information about the failure. To file a bug report, please use the instructions in [How to Report Bugs or Problems](#).

Build the Distribution

On Unix:

```
$> make
$> make VERBOSE=1
```

The second command sets `VERBOSE` to show the commands for each compiled source.

Use `gmake` instead on systems where you are using GNU `make` and it has been installed as `gmake`.

On Windows:

```
$> devenv MySQL.sln /build RelWithDebInfo
```

If you have gotten to the compilation stage, but the distribution does not build, see [Section 4.8, “Dealing with Problems Compiling MySQL”](#), for help. If that does not solve the problem, please enter it into our bugs database using the instructions given in [How to Report Bugs or Problems](#). If you have installed the latest versions of the required tools, and they crash trying to process our configuration files, please report that also. However, if you get a `command not found` error or a similar problem for required tools, do not report it. Instead, make sure that all the required tools are installed and that your `PATH` variable is set correctly so that your shell can find them.

Install the Distribution

On Unix:

```
$> make install
```

This installs the files under the configured installation directory (by default, `/usr/local/mysql`). You might need to run the command as `root`.

To install in a specific directory, add a `DESTDIR` parameter to the command line:

```
$> make install DESTDIR="/opt/mysql"
```

Alternatively, generate installation package files that you can install where you like:


```
$> make package
```

This operation produces one or more `.tar.gz` files that can be installed like generic binary distribution packages. See [Chapter 3, *Installing MySQL on Unix/Linux Using Generic Binaries*](#). If you run `CMake` with `-DCPACK_MONOLITHIC_INSTALL=1`, the operation produces a single file. Otherwise, it produces multiple files.

On Windows, generate the data directory, then create a `.zip` archive installation package:

```
$> devenv MySQL.sln /build RelWithDebInfo /project initial_database
$> devenv MySQL.sln /build RelWithDebInfo /project package
```

You can install the resulting `.zip` archive where you like. See [Section 5.4, “Installing MySQL on Microsoft Windows Using a `noinstall` ZIP Archive”](#).

Perform Postinstallation Setup

The remainder of the installation process involves setting up the configuration file, creating the core databases, and starting the MySQL server. For instructions, see [Chapter 9, *Postinstallation Setup and Testing*](#).

Note

The accounts that are listed in the MySQL grant tables initially have no passwords. After starting the server, you should set up passwords for them using the instructions in [Chapter 9, *Postinstallation Setup and Testing*](#).

4.5 Installing MySQL Using a Development Source Tree

This section describes how to install MySQL from the latest development source code, which is hosted on [GitHub](#). To obtain the MySQL Server source code from this repository hosting service, you can set up a local MySQL Git repository.

On [GitHub](#), MySQL Server and other MySQL projects are found on the [MySQL](#) page. The MySQL Server project is a single repository that contains branches for several MySQL series.

- [Prerequisites for Installing from Development Source](#)
- [Setting Up a MySQL Git Repository](#)

Prerequisites for Installing from Development Source

To install MySQL from a development source tree, your system must satisfy the tool requirements listed at [Section 4.2, “Source Installation Prerequisites”](#).

Setting Up a MySQL Git Repository

To set up a MySQL Git repository on your machine:

1. Clone the MySQL Git repository to your machine. The following command clones the MySQL Git repository to a directory named `mysql-server`. The initial download may take some time to complete, depending on the speed of your connection.

```
$> git clone https://github.com/mysql/mysql-server.git
Cloning into 'mysql-server'...
remote: Counting objects: 1198513, done.
remote: Total 1198513 (delta 0), reused 0 (delta 0), pack-reused 1198513
Receiving objects: 100% (1198513/1198513), 1.01 GiB | 7.44 MiB/s, done.
Resolving deltas: 100% (993200/993200), done.
```



```
Checking connectivity... done.
Checking out files: 100% (25510/25510), done.
```

2. When the clone operation completes, the contents of your local MySQL Git repository appear similar to the following:

```
~> cd mysql-server
~/mysql-server> ls
client          extra           mysys           storage
cmake           include         packaging       strings
CMakeLists.txt  INSTALL        plugin          support-files
components      libbinlogevents README          testclients
config.h.cmake  libchangestreams router          unittest
configure.cmake libmysql        run_doxyxygen.cmake utilities
Docs           libservices     scripts         VERSION
Doxyfile-ignored LICENSE        share          vio
Doxyfile.in     man            sql            win
doxygen_resources mysql-test     sql-common
```

3. Use the `git branch -r` command to view the remote tracking branches for the MySQL repository.

```
~/mysql-server> git branch -r
origin/5.7
origin/8.0
origin/HEAD -> origin/trunk
origin/cluster-7.4
origin/cluster-7.5
origin/cluster-7.6
origin/trunk
```

4. To view the branch that is checked out in your local repository, issue the `git branch` command. When you clone the MySQL Git repository, the latest MySQL branch is checked out automatically. The asterisk identifies the active branch.

```
~/mysql-server$ git branch
* trunk
```

5. To check out an earlier MySQL branch, run the `git checkout` command, specifying the branch name. For example, to check out the MySQL 5.7 branch:

```
~/mysql-server$ git checkout 5.7
Checking out files: 100% (9600/9600), done.
Branch 5.7 set up to track remote branch 5.7 from origin.
Switched to a new branch '5.7'
```

6. To obtain changes made after your initial setup of the MySQL Git repository, switch to the branch you want to update and issue the `git pull` command:

```
~/mysql-server$ git checkout 8.0
~/mysql-server$ git pull
```

To examine the commit history, use the `git log` command:

```
~/mysql-server$ git log
```

You can also browse commit history and source code on the GitHub [MySQL](#) site.

If you see changes or code that you have a question about, ask on [MySQL Community Slack](#).

7. After you have cloned the MySQL Git repository and have checked out the branch you want to build, you can build MySQL Server from the source code. Instructions are provided in [Section 4.4, “Installing MySQL Using a Standard Source Distribution”](#), except that you skip the part about obtaining and unpacking the distribution.

Be careful about installing a build from a distribution source tree on a production machine. The installation command may overwrite your live release installation. If you already have MySQL installed and do not want to overwrite it, run `CMake` with values for the `CMAKE_INSTALL_PREFIX`, `MYSQL_TCP_PORT`, and `MYSQL_UNIX_ADDR` options different from those used by your production server. For additional information about preventing multiple servers from interfering with each other, see [Running Multiple MySQL Instances on One Machine](#).

Play hard with your new installation. For example, try to make new features crash. Start by running `make test`. See [The MySQL Test Suite](#).

4.6 Configuring SSL Library Support

An SSL library is required for support of encrypted connections, entropy for random number generation, and other encryption-related operations.

If you compile MySQL from a source distribution, `CMake` configures the distribution to use the installed OpenSSL library by default.

To compile using OpenSSL, use this procedure:

1. Ensure that OpenSSL 1.0.1 or newer is installed on your system. If the installed OpenSSL version is older than 1.0.1, `CMake` produces an error at MySQL configuration time. If it is necessary to obtain OpenSSL, visit <http://www.openssl.org>.
2. The `WITH_SSL` `CMake` option determines which SSL library to use for compiling MySQL (see [Section 4.7, “MySQL Source-Configuration Options”](#)). The default is `-DWITH_SSL=system`, which uses OpenSSL. To make this explicit, specify that option. For example:

```
cmake . -DWITH_SSL=system
```

That command configures the distribution to use the installed OpenSSL library. Alternatively, to explicitly specify the path name to the OpenSSL installation, use the following syntax. This can be useful if you have multiple versions of OpenSSL installed, to prevent `CMake` from choosing the wrong one:

```
cmake . -DWITH_SSL=path_name
```

Alternative OpenSSL system packages are supported as of MySQL 8.0.30 by using `WITH_SSL=openssl11` on EL7 or `WITH_SSL=openssl13` on EL8. Authentication plugins, such as LDAP and Kerberos, are disabled since they do not support these alternative versions of OpenSSL.

3. Compile and install the distribution.

To check whether a `mysqld` server supports encrypted connections, examine the value of the `have_ssl` system variable:

```
mysql> SHOW VARIABLES LIKE 'have_ssl';
+-----+-----+
| Variable_name | Value |
+-----+-----+
| have_ssl      | YES   |
+-----+-----+
```

If the value is `YES`, the server supports encrypted connections. If the value is `DISABLED`, the server is capable of supporting encrypted connections but was not started with the appropriate `--ssl-xxx` options to enable encrypted connections to be used; see [Configuring MySQL to Use Encrypted Connections](#).

4.7 MySQL Source-Configuration Options

The `CMake` program provides a great deal of control over how you configure a MySQL source distribution. Typically, you do this using options on the `CMake` command line. For information about options supported by `CMake`, run either of these commands in the top-level source directory:

```
$> cmake . -LH
$> ccmake .
```

You can also affect `CMake` using certain environment variables. See [Chapter 12, Environment Variables](#).

For boolean options, the value may be specified as `1` or `ON` to enable the option, or as `0` or `OFF` to disable the option.

Many options configure compile-time defaults that can be overridden at server startup. For example, the `CMAKE_INSTALL_PREFIX`, `MYSQL_TCP_PORT`, and `MYSQL_UNIX_ADDR` options that configure the default installation base directory location, TCP/IP port number, and Unix socket file can be changed at server startup with the `--basedir`, `--port`, and `--socket` options for `mysqld`. Where applicable, configuration option descriptions indicate the corresponding `mysqld` startup option.

The following sections provide more information about `CMake` options.

- [CMake Option Reference](#)
- [General Options](#)
- [Installation Layout Options](#)
- [Storage Engine Options](#)
- [Feature Options](#)
- [Compiler Flags](#)
- [CMake Options for Compiling NDB Cluster](#)

CMake Option Reference

The following table shows the available `CMake` options. In the `Default` column, `PREFIX` stands for the value of the `CMAKE_INSTALL_PREFIX` option, which specifies the installation base directory. This value is used as the parent location for several of the installation subdirectories.

Table 4.1 MySQL Source-Configuration Option Reference (CMake)

Formats	Description	Default	Introduced	Removed
<code>ADD_GDB_INDEX</code>	Whether to enable generation of <code>.gdb_index</code> section in binaries		8.0.18	
<code>BUILD_CONFIG</code>	Use same build options as official releases			
<code>BUNDLE_RUNTIME_LIBS</code>	Bundle runtime libraries with server MSI and Zip packages for Windows	<code>OFF</code>		
<code>CMAKE_BUILD_TYPE</code>	Type of build to produce	<code>RelWithDebInfo</code>		

Formats	Description	Default	Introduced	Removed
<code>CMAKE_CXX_FLAGS</code>	Flags for C++ Compiler			
<code>CMAKE_C_FLAGS</code>	Flags for C Compiler			
<code>CMAKE_INSTALL_PREFIX</code>	Installation base directory	<code>/usr/local/mysql</code>		
<code>COMPILATION_COMMENT</code>	Comment about compilation environment			
<code>COMPILATION_COMMENT_USE_MYSQLD</code>	Comment about compilation environment for use by mysqld		8.0.14	
<code>COMPRESS_DEBUG_SYMBOLS</code>	Compress debug sections of binary executables	<code>OFF</code>	8.0.22	
<code>CPACK_MONOLITHIC_BUILD</code>	Whether package build produces single file	<code>OFF</code>		
<code>DEFAULT_CHARSET</code>	The default server character set	<code>utf8mb4</code>		
<code>DEFAULT_COLLATION</code>	The default server collation	<code>utf8mb4_0900_ai_ci</code>		
<code>DISABLE_PSI_COND</code>	Exclude Performance Schema condition instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_DATA</code>	Exclude the performance schema data lock instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_ERROR</code>	Exclude the performance schema server error instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_FILE</code>	Exclude Performance Schema file instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_IDLE</code>	Exclude Performance Schema idle instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_MEMORY</code>	Exclude Performance Schema memory instrumentation	<code>OFF</code>		

Formats	Description	Default	Introduced	Removed
<code>DISABLE_PSI_METADATA</code>	Exclude Performance Schema metadata instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_MUTEX</code>	Exclude Performance Schema mutex instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_PS</code>	Exclude the performance schema prepared statements	<code>OFF</code>		
<code>DISABLE_PSI_RWLOCK</code>	Exclude Performance Schema rwlock instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_SOCKET</code>	Exclude Performance Schema socket instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_SP</code>	Exclude Performance Schema stored program instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_STAGE</code>	Exclude Performance Schema stage instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_STATEMENT</code>	Exclude Performance Schema statement instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_STATEMENT_DIGEST</code>	Exclude Performance Schema statements_digest instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_TABLE</code>	Exclude Performance Schema table instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_THREAD</code>	Exclude the performance schema thread instrumentation	<code>OFF</code>		
<code>DISABLE_PSI_TRANSACTION</code>	Exclude the performance	<code>OFF</code>		

Formats	Description	Default	Introduced	Removed
	schema transaction instrumentation			
<code>DISABLE_SHARED</code>	Do not build shared libraries, compile position-dependent code	<code>OFF</code>		8.0.18
<code>DOWNLOAD_BOOST</code>	Whether to download the Boost library	<code>OFF</code>		
<code>DOWNLOAD_BOOST_TIMEOUT</code>	Timeout in seconds for downloading the Boost library	600		
<code>ENABLED_LOCAL_INNO</code>	Whether to enable LOCAL for LOAD DATA	<code>OFF</code>		
<code>ENABLED_PROFILING</code>	Whether to enable query profiling code	<code>ON</code>		
<code>ENABLE_DOWNLOADS</code>	Whether to download optional files	<code>OFF</code>		8.0.26
<code>ENABLE_EXPERIMENTAL_VARIABLES</code>	Whether to enable experimental InnoDB system variables	<code>OFF</code>		
<code>ENABLE_GCOV</code>	Whether to include gcov support			
<code>ENABLE_GPROF</code>	Enable gprof (optimized Linux builds only)	<code>OFF</code>		
<code>FORCE_COLORED_OUTPUT</code>	Whether to colorize compiler output	<code>OFF</code>	8.0.33	
<code>FORCE_INSOURCE_BUILD</code>	Whether to force an in-source build	<code>OFF</code>	8.0.14	
<code>FORCE_UNSUPPORTED_COMPILER</code>	Whether to permit unsupported compilers	<code>OFF</code>		
<code>FPROFILE_GENERATE</code>	Whether to generate profile guided optimization data	<code>OFF</code>	8.0.19	
<code>FPROFILE_USE</code>	Whether to use profile guided optimization data	<code>OFF</code>	8.0.19	
<code>HAVE_PSI_MEMORY</code>	Enable performance schema memory tracing module for	<code>OFF</code>	8.0.26	

Formats	Description	Default	Introduced	Removed
	memory allocation functions used in dynamic storage of over-aligned types			
<code>IGNORE_AIO_CHECK</code>	With <code>-DBUILD_CONFIG=mysql_release</code> , ignore libaio check	<code>OFF</code>		
<code>INSTALL_BINDIR</code>	User executables directory	<code>PREFIX/bin</code>		
<code>INSTALL_DOCDIR</code>	Documentation directory	<code>PREFIX/docs</code>		
<code>INSTALL_DOCREADMEDIR</code>	README file directory	<code>PREFIX</code>		
<code>INSTALL_INCLUDEDIR</code>	Header file directory	<code>PREFIX/include</code>		
<code>INSTALL_INFODIR</code>	Info file directory	<code>PREFIX/docs</code>		
<code>INSTALL_LAYOUT</code>	Select predefined installation layout	<code>STANDALONE</code>		
<code>INSTALL_LIBDIR</code>	Library file directory	<code>PREFIX/lib</code>		
<code>INSTALL_MANDIR</code>	Manual page directory	<code>PREFIX/man</code>		
<code>INSTALL_MYSQLKEYRINGDIR</code>	Directory for keyring_file plugin data file	platform specific		
<code>INSTALL_MYSQLSHARED</code>	Shared data directory	<code>PREFIX/share</code>		
<code>INSTALL_MYSQLTESTDIR</code>	mysql-test directory	<code>PREFIX/mysql-test</code>		
<code>INSTALL_PKGCONFIGDIR</code>	Directory for mysqlclient.pc pkg-config file	<code>INSTALL_LIBDIR/pkgconfig</code>		
<code>INSTALL_PLUGINDIR</code>	Plugin directory	<code>PREFIX/lib/plugin</code>		
<code>INSTALL_PRIV_LIBDIR</code>	Installation private library directory		8.0.18	
<code>INSTALL_SBINDIR</code>	Server executable directory	<code>PREFIX/bin</code>		
<code>INSTALL_SECURE_FILE_PRIV</code>	secure_file_priv default value	platform specific		
<code>INSTALL_SHAREDIR</code>	local/mysql.m4 installation directory	<code>PREFIX/share</code>		
<code>INSTALL_STATIC_LIBDIR</code>	Whether to install static libraries	<code>ON</code>		
<code>INSTALL_SUPPORTDIR</code>	Extra support files directory	<code>PREFIX/support-files</code>		

Formats	Description	Default	Introduced	Removed
<code>LINK_RANDOMIZE</code>	Whether to randomize order of symbols in mysql binary	<code>OFF</code>		
<code>LINK_RANDOMIZE_SEED</code>	Seed value for <code>LINK_RANDOMIZE</code> option	<code>mysql</code>		
<code>MAX_INDEXES</code>	Maximum indexes per table	<code>64</code>		
<code>MEMCACHED_HOME</code>	Path to memcached; obsolete	<code>[none]</code>		8.0.23
<code>MSVC_CPPCHECK</code>	Enable MSVC code analysis.	<code>OFF</code>	8.0.33	
<code>MUTEX_TYPE</code>	InnoDB mutex type	<code>event</code>		
<code>MYSQLX_TCP_PORT</code>	TCP/IP port number used by X Plugin	<code>33060</code>		
<code>MYSQLX_UNIX_ADDR</code>	Unix socket file used by X Plugin	<code>/tmp/mysqlx.sock</code>		
<code>MYSQL_DATADIR</code>	Data directory			
<code>MYSQL_MAINTAINER_ENV</code>	Whether to enable MySQL maintainer-specific development environment	<code>OFF</code>		
<code>MYSQL_PROJECT_NAME</code>	Windows/macOS project name	<code>MySQL</code>		
<code>MYSQL_TCP_PORT</code>	TCP/IP port number	<code>3306</code>		
<code>MYSQL_UNIX_ADDR</code>	Unix socket file	<code>/tmp/mysql.sock</code>		
<code>NDB_UTILS_LINK_DYNAMIC</code>	Cause NDB tools to be dynamically linked to ndbclient		8.0.22	
<code>ODBC_INCLUDES</code>	ODBC includes directory			
<code>ODBC_LIB_DIR</code>	ODBC library directory			
<code>OPTIMIZER_TRACE</code>	Whether to support optimizer tracing			
<code>OPTIMIZE_SANITIZER_BUILDS</code>	Whether to optimize sanitizer builds	<code>ON</code>	8.0.34	
<code>REPRODUCIBLE_BUILDS</code>	Take extra care to create a build result independent of build location and time			

Formats	Description	Default	Introduced	Removed
<code>SHOW_SUPPRESSED_WARNINGS</code>	Whether to show suppressed compiler warnings and not fail with -Werror.	OFF	8.0.30	
<code>SYSCONFDIR</code>	Option file directory			
<code>SYSTEMD_PID_DIR</code>	Directory for PID file under systemd	<code>/var/run/mysqld</code>		
<code>SYSTEMD_SERVICE</code>	Name of MySQL service under systemd	<code>mysqld</code>		
<code>TMPDIR</code>	tmpdir default value			
<code>USE_LD_GOLD</code>	Whether to use GNU gold linker	ON		8.0.31
<code>USE_LD_LLD</code>	Whether to use LLVM lld linker	ON	8.0.16	
<code>WIN_DEBUG_NO_INLINE</code>	Whether to disable function inlining	OFF		
<code>WITHOUT_SERVER</code>	Do not build the server	OFF		
<code>WITHOUT_xxx_STORAGE_ENGINE</code>	Exclude storage engine xxx from build			
<code>WITH_ANT</code>	Path to Ant for building GCS Java wrapper			
<code>WITH_ASAN</code>	Enable AddressSanitizer	OFF		
<code>WITH_ASAN_SCOPE</code>	Enable AddressSanitizer - fsanitize-address-use-after-scope Clang flag	OFF		
<code>WITH_AUTHENTICATION_PLUGINS</code>	Enabled automatically if any corresponding server authentication plugins are built		8.0.26	
<code>WITH_AUTHENTICATION_LDAP</code>	Whether to report error if LDAP authentication plugins cannot be built	OFF		

Formats	Description	Default	Introduced	Removed
<code>WITH_AUTHENTICATION</code>	Build PAM authentication plugin	<code>OFF</code>		
<code>WITH_AWS_SDK</code>	Location of Amazon Web Services software development kit			
<code>WITH_BOOST</code>	The location of the Boost library sources			
<code>WITH_BUILD_ID</code>	On Linux systems, generate a unique build ID	<code>ON</code>	8.0.31	
<code>WITH_BUNDLED_LIBEVENT</code>	Use bundled libevent when building ndbmcache; obsolete	<code>ON</code>		8.0.23
<code>WITH_BUNDLED_MEMCACHED</code>	Use bundled memcached when building ndbmcache; obsolete	<code>ON</code>		8.0.23
<code>WITH_CLASSPATH</code>	Classpath to use when building MySQL Cluster Connector for Java. Default is an empty string.			
<code>WITH_CLIENT_PROTOCOL</code>	Build client-side protocol tracing framework	<code>ON</code>		
<code>WITH_CURL</code>	Location of curl library			
<code>WITH_DEBUG</code>	Whether to include debugging support	<code>OFF</code>		
<code>WITH_DEFAULT_COMPILER_OPTIONS</code>	Whether to use default compiler options	<code>ON</code>		
<code>WITH_DEFAULT_FEATURES</code>	Whether to use default feature set	<code>ON</code>		8.0.22
<code>WITH_DEVELOPER_ENTITLEMENT</code>	Whether to add the 'get-task-allow' entitlement to all executables on macOS to generate a core dump in	<code>OFF</code>	8.0.30	

Formats	Description	Default	Introduced	Removed
	the event of an unexpected server halt			
<code>WITH_EDITLINE</code>	Which libedit/editline library to use	<code>bundled</code>		
<code>WITH_ERROR_INJECTION</code>	Enable error injection in the NDB storage engine. Should not be used for building binaries intended for production.	<code>OFF</code>		
<code>WITH_FIDO</code>	Type of FIDO library support	<code>bundled</code>	8.0.27	
<code>WITH_GMOCK</code>	Path to googlemock distribution			8.0.26
<code>WITH_ICU</code>	Type of ICU support	<code>bundled</code>		
<code>WITH_INNO_DB_EXTRA_DEBUGGING</code>	Whether to include extra debugging support for InnoDB.	<code>OFF</code>		
<code>WITH_INNO_DB_MEMCACHED_SHARED_LIBRARIES</code>	Whether to generate memcached shared libraries.	<code>OFF</code>		
<code>WITH_JEMALLOC</code>	Whether to link with -ljemalloc	<code>OFF</code>	8.0.16	
<code>WITH_KEYRING_TEST</code>	Build the keyring test program	<code>OFF</code>		
<code>WITH_LIBEVENT</code>	Which libevent library to use	<code>bundled</code>		
<code>WITH_LIBWRAP</code>	Whether to include libwrap (TCP wrappers) support	<code>OFF</code>		
<code>WITH_LOCK_ORDER_TOOLS</code>	Whether to enable LOCK_ORDER tooling	<code>OFF</code>	8.0.17	
<code>WITH_LSAN</code>	Whether to run LeakSanitizer, without AddressSanitizer	<code>OFF</code>	8.0.16	
<code>WITH_LTO</code>	Enable link-time optimizer	<code>OFF</code>	8.0.13	
<code>WITH_LZ4</code>	Type of LZ4 library support	<code>bundled</code>		

Formats	Description	Default	Introduced	Removed
<code>WITH_LZMA</code>	Type of LZMA library support	<code>bundled</code>		8.0.16
<code>WITH_MECAB</code>	Compiles MeCab			
<code>WITH_MSAN</code>	Enable MemorySanitizer	<code>OFF</code>		
<code>WITH_MSVCRT_DEBUG</code>	Enable Visual Studio CRT memory leak tracing	<code>OFF</code>		
<code>WITH_MYSQLX</code>	Whether to disable X Protocol	<code>ON</code>		
<code>WITH_NDB</code>	Build MySQL NDB Cluster	<code>OFF</code>	8.0.31	
<code>WITH_NDBAPI_EXAMPLES</code>	Build API example programs	<code>OFF</code>		
<code>WITH_NDBCLUSTER</code>	Build the NDB storage engine	<code>OFF</code>		
<code>WITH_NDBCLUSTER_FOR_INTERNAL_USE</code>	For internal use, may not work as expected in all circumstances; users should employ <code>WITH_NDBCLUSTER</code> instead	<code>ON</code>		
<code>WITH_NDBMTD</code>	Build multithreaded data node.	<code>ON</code>		
<code>WITH_NDB_DEBUG</code>	Produce a debug build for testing or troubleshooting.	<code>OFF</code>		
<code>WITH_NDB_JAVA</code>	Enable building of Java and ClusterJ support. Enabled by default. Supported in MySQL Cluster only.	<code>ON</code>		
<code>WITH_NDB_PORT</code>	Default port used by a management server built with this option. If this option was not used to build it, the management server's default port is 1186.	<code>[none]</code>		
<code>WITH_NDB_TEST</code>	Include NDB API test programs.	<code>OFF</code>		

Formats	Description	Default	Introduced	Removed
<code>WITH_NUMA</code>	Set NUMA memory allocation policy			
<code>WITH_PACKAGE_FLAGS</code>	For flags typically used for RPM/DEB packages, whether to add them to standalone builds on those platforms		8.0.26	
<code>WITH_PLUGIN_NDBCLUSTER</code>	For internal use; may not work as expected in all circumstances. Users should employ <code>WITH_NDBCLUSTER</code> or <code>WITH_NDB</code> instead		8.0.13	8.0.31
<code>WITH_PROTOBUF</code>	Which Protocol Buffers package to use	<code>bundled</code>		
<code>WITH_RAPID</code>	Whether to build rapid development cycle plugins	<code>ON</code>		
<code>WITH_RAPIDJSON</code>	Type of RapidJSON support	<code>bundled</code>	8.0.13	
<code>WITH_RE2</code>	Type of RE2 library support	<code>bundled</code>		8.0.18
<code>WITH_ROUTER</code>	Whether to build MySQL Router	<code>ON</code>	8.0.16	
<code>WITH_SSL</code>	Type of SSL support	<code>system</code>		
<code>WITH_SYSTEMD</code>	Enable installation of systemd support files	<code>OFF</code>		
<code>WITH_SYSTEMD_DEBUG</code>	Enable additional systemd debug information	<code>OFF</code>	8.0.22	
<code>WITH_SYSTEM_LIBS</code>	Set system value of library options not set explicitly	<code>OFF</code>		
<code>WITH_TCMALLOC</code>	Whether to link with <code>-ltcmalloc</code>	<code>OFF</code>	8.0.22	
<code>WITH_TEST_TRACE_PLUGIN</code>	Build test protocol trace plugin	<code>OFF</code>		
<code>WITH_TSAN</code>	Enable ThreadSanitizer	<code>OFF</code>		

Formats	Description	Default	Introduced	Removed
<code>WITH_UBSAN</code>	Enable Undefined Behavior Sanitizer	<code>OFF</code>		
<code>WITH_UNIT_TESTS</code>	Compile MySQL with unit tests	<code>ON</code>		
<code>WITH_UNIXODBC</code>	Enable unixODBC support	<code>OFF</code>		
<code>WITH_VALGRIND</code>	Whether to compile in Valgrind header files	<code>OFF</code>		
<code>WITH_WIN_JEMALLOC</code>	Path to directory containing jemalloc.dll		8.0.29	
<code>WITH_ZLIB</code>	Type of zlib support	<code>bundled</code>		
<code>WITH_ZSTD</code>	Type of zstd support	<code>bundled</code>	8.0.18	
<code>WITH_xxx_STORAGE_ENGINE</code>	Compile storage engine xxx statically into server			

General Options

- `-DBUILD_CONFIG=mysql_release`

This option configures a source distribution with the same build options used by Oracle to produce binary distributions for official MySQL releases.

- `-DWITH_BUILD_ID=bool`

On Linux systems, generates a unique build ID which is used as the value of the `build_id` system variable and written to the MySQL server log on startup. Set this option to `OFF` to disable this feature.

Added in MySQL 8.0.31, this option has no effect on platforms other than Linux.

- `-DBUNDLE_RUNTIME_LIBRARIES=bool`

Whether to bundle runtime libraries with server MSI and Zip packages for Windows.

- `-DCMAKE_BUILD_TYPE=type`

The type of build to produce:

- `RelWithDebInfo`: Enable optimizations and generate debugging information. This is the default MySQL build type.
- `Release`: Enable optimizations but omit debugging information to reduce the build size. This build type was added in MySQL 8.0.13.
- `Debug`: Disable optimizations and generate debugging information. This build type is also used if the `WITH_DEBUG` option is enabled. That is, `-DWITH_DEBUG=1` has the same effect as `-DCMAKE_BUILD_TYPE=Debug`.

The option values `None` and `MinSizeRel` are not supported.

- `-DCPACK_MONOLITHIC_INSTALL=bool`

This option affects whether the `make package` operation produces multiple installation package files or a single file. If disabled, the operation produces multiple installation package files, which may be useful if you want to install only a subset of a full MySQL installation. If enabled, it produces a single file for installing everything.

- `-DFORCE_INSOURCE_BUILD=bool`

Defines whether to force an in-source build. Out-of-source builds are recommended, as they permit multiple builds from the same source, and cleanup can be performed quickly by removing the build directory. To force an in-source build, invoke `CMake` with `-DFORCE_INSOURCE_BUILD=ON`.

- `-DFORCE_COLORED_OUTPUT=bool`

Defines whether to enable colorized compiler output for `gcc` and `clang` when compiling on the command line. Defaults to `OFF`.

Installation Layout Options

The `CMAKE_INSTALL_PREFIX` option indicates the base installation directory. Other options with names of the form `INSTALL_xxx` that indicate component locations are interpreted relative to the prefix and their values are relative pathnames. Their values should not include the prefix.

- `-DCMAKE_INSTALL_PREFIX=dir_name`

The installation base directory.

This value can be set at server startup using the `--basedir` option.

- `-DINSTALL_BINDIR=dir_name`

Where to install user programs.

- `-DINSTALL_DOCDIR=dir_name`

Where to install documentation.

- `-DINSTALL_DOCREADMEDIR=dir_name`

Where to install `README` files.

- `-DINSTALL_INCLUDEDIR=dir_name`

Where to install header files.

- `-DINSTALL_INFODIR=dir_name`

Where to install Info files.

- `-DINSTALL_LAYOUT=name`

Select a predefined installation layout:

- `STANDALONE`: Same layout as used for `.tar.gz` and `.zip` packages. This is the default.
- `RPM`: Layout similar to RPM packages.
- `SVR4`: Solaris package layout.

- [DEB](#): DEB package layout (experimental).

You can select a predefined layout but modify individual component installation locations by specifying other options. For example:

```
cmake . -DINSTALL_LAYOUT=SVR4 -DMYSQL_DATADIR=/var/mysql/data
```

The `INSTALL_LAYOUT` value determines the default value of the `secure_file_priv`, `keyring_encrypted_file_data`, and `keyring_file_data` system variables. See the descriptions of those variables in [Server System Variables](#), and [Keyring System Variables](#).

- `-DINSTALL_LIBDIR=dir_name`

Where to install library files.

- `-DINSTALL_MANDIR=dir_name`

Where to install manual pages.

- `-DINSTALL_MYSQLKEYRINGDIR=dir_path`

The default directory to use as the location of the `keyring_file` plugin data file. The default value is platform specific and depends on the value of the `INSTALL_LAYOUT` CMake option; see the description of the `keyring_file_data` system variable in [Server System Variables](#).

- `-DINSTALL_MYSQLSHAREDIR=dir_name`

Where to install shared data files.

- `-DINSTALL_MYSQLTESTDIR=dir_name`

Where to install the `mysql-test` directory. To suppress installation of this directory, explicitly set the option to the empty value (`-DINSTALL_MYSQLTESTDIR=`).

- `-DINSTALL_PKGCONFIGDIR=dir_name`

The directory in which to install the `mysqlclient.pc` file for use by `pkg-config`. The default value is `INSTALL_LIBDIR/pkgconfig`, unless `INSTALL_LIBDIR` ends with `/mysql`, in which case that is removed first.

- `-DINSTALL_PLUGINDIR=dir_name`

The location of the plugin directory.

This value can be set at server startup with the `--plugin_dir` option.

- `-DINSTALL_PRIV_LIBDIR=dir_name`

The location of the dynamic library directory.

Default location. For RPM builds, this is `/usr/lib64/mysql/private/`, for DEB it is `/usr/lib/mysql/private/`, and for TAR it is `lib/private/`.

Protobuf. Because this is a private location, the loader (such as `ld-linux.so` on Linux) may not find the `libprotobuf.so` files without help. To guide the loader, `RPATH=$ORIGIN/./$INSTALL_PRIV_LIBDIR` is added to `mysqld` and `mysqlxtest`. This works for most cases but when using the [Resource Group](#) feature, `mysqld` is `setsuid`, and the loader ignores any `RPATH` which contains `$ORIGIN`. To overcome this, an explicit full path to the directory is set in the DEB and RPM

versions of `mysqld`, since the target destination is known. For tarball installs, patching of `mysqld` with a tool like `patchelf` is required.

This option was added in MySQL 8.0.18.

- `-DINSTALL_SBINDIR=dir_name`

Where to install the `mysqld` server.

- `-DINSTALL_SECURE_FILE_PRIVDIR=dir_name`

The default value for the `secure_file_priv` system variable. The default value is platform specific and depends on the value of the `INSTALL_LAYOUT CMake` option; see the description of the `secure_file_priv` system variable in [Server System Variables](#).

- `-DINSTALL_SHAREDIR=dir_name`

Where to install `aclocal/mysql.m4`.

- `-DINSTALL_STATIC_LIBRARIES=bool`

Whether to install static libraries. The default is `ON`. If set to `OFF`, these library files are not installed: `libmysqlclient.a`, `libmysqldservices.a`.

- `-DINSTALL_SUPPORTFILESDIR=dir_name`

Where to install extra support files.

- `-DLINK_RANDOMIZE=bool`

Whether to randomize the order of symbols in the `mysqld` binary. The default is `OFF`. This option should be enabled only for debugging purposes.

- `-DLINK_RANDOMIZE_SEED=val`

Seed value for the `LINK_RANDOMIZE` option. The value is a string. The default is `mysql`, an arbitrary choice.

- `-DMYSQL_DATADIR=dir_name`

The location of the MySQL data directory.

This value can be set at server startup with the `--datadir` option.

- `-DODBC_INCLUDES=dir_name`

The location of the ODBC includes directory, which may be used while configuring Connector/ODBC.

- `-DODBC_LIB_DIR=dir_name`

The location of the ODBC library directory, which may be used while configuring Connector/ODBC.

- `-DSYSCONFDIR=dir_name`

The default `my.cnf` option file directory.

This location cannot be set at server startup, but you can start the server with a given option file using the `--defaults-file=file_name` option, where `file_name` is the full path name to the file.

- `-DSYSTEMD_PID_DIR=dir_name`

The name of the directory in which to create the PID file when MySQL is managed by systemd. The default is `/var/run/mysqld`; this might be changed implicitly according to the `INSTALL_LAYOUT` value.

This option is ignored unless `WITH_SYSTEMD` is enabled.

- `-DSYSTEMD_SERVICE_NAME=name`

The name of the MySQL service to use when MySQL is managed by `systemd`. The default is `mysqld`; this might be changed implicitly according to the `INSTALL_LAYOUT` value.

This option is ignored unless `WITH_SYSTEMD` is enabled.

- `-DTMPDIR=dir_name`

The default location to use for the `tmpdir` system variable. If unspecified, the value defaults to `P_tmpdir` in `<stdio.h>`.

Storage Engine Options

Storage engines are built as plugins. You can build a plugin as a static module (compiled into the server) or a dynamic module (built as a dynamic library that must be installed into the server using the `INSTALL_PLUGIN` statement or the `--plugin-load` option before it can be used). Some plugins might not support static or dynamic building.

The `InnoDB`, `MyISAM`, `MERGE`, `MEMORY`, and `CSV` engines are mandatory (always compiled into the server) and need not be installed explicitly.

To compile a storage engine statically into the server, use `-DWITH_engine_STORAGE_ENGINE=1`. Some permissible `engine` values are `ARCHIVE`, `BLACKHOLE`, `EXAMPLE`, and `FEDERATED`. Examples:

```
-DWITH_ARCHIVE_STORAGE_ENGINE=1
-DWITH_BLACKHOLE_STORAGE_ENGINE=1
```

To build MySQL with support for NDB Cluster, use the `WITH_NDB` option. (*NDB 8.0.30 and earlier: Use `WITH_NDBCLUSTER`.*)

Note

It is not possible to compile without Performance Schema support. If it is desired to compile without particular types of instrumentation, that can be done with the following `CMake` options:

```
DISABLE_PSI_COND
DISABLE_PSI_DATA_LOCK
DISABLE_PSI_ERROR
DISABLE_PSI_FILE
DISABLE_PSI_IDLE
DISABLE_PSI_MEMORY
DISABLE_PSI_METADATA
DISABLE_PSI_MUTEX
DISABLE_PSI_PS
DISABLE_PSI_RWLOCK
DISABLE_PSI_SOCKET
DISABLE_PSI_SP
DISABLE_PSI_STAGE
DISABLE_PSI_STATEMENT
DISABLE_PSI_STATEMENT_DIGEST
DISABLE_PSI_TABLE
```

```
DISABLE_PSI_THREAD  
DISABLE_PSI_TRANSACTION
```

For example, to compile without mutex instrumentation, configure MySQL using `-DDISABLE_PSI_MUTEX=1`.

To exclude a storage engine from the build, use `-DWITH_engine_STORAGE_ENGINE=0`. Examples:

```
-DWITH_ARCHIVE_STORAGE_ENGINE=0  
-DWITH_EXAMPLE_STORAGE_ENGINE=0  
-DWITH_FEDERATED_STORAGE_ENGINE=0
```

It is also possible to exclude a storage engine from the build using `-DWITHOUT_engine_STORAGE_ENGINE=1` (but `-DWITH_engine_STORAGE_ENGINE=0` is preferred). Examples:

```
-DWITHOUT_ARCHIVE_STORAGE_ENGINE=1  
-DWITHOUT_EXAMPLE_STORAGE_ENGINE=1  
-DWITHOUT_FEDERATED_STORAGE_ENGINE=1
```

If neither `-DWITH_engine_STORAGE_ENGINE` nor `-DWITHOUT_engine_STORAGE_ENGINE` are specified for a given storage engine, the engine is built as a shared module, or excluded if it cannot be built as a shared module.

Feature Options

- `-DADD_GDB_INDEX=bool`

This option determines whether to enable generation of a `.gdb_index` section in binaries, which makes loading them in a debugger faster. The option is disabled by default. `lld` linker is used, and is disabled by It has no effect if a linker other than `lld` or GNU `gold` is used.

This option was added in MySQL 8.0.18.

- `-DCOMPILATION_COMMENT=string`

A descriptive comment about the compilation environment. As of MySQL 8.0.14, `mysqld` uses `COMPILATION_COMMENT_SERVER`. Other programs continue to use `COMPILATION_COMMENT`.

- `-DCOMPRESS_DEBUG_SECTIONS=bool`

Whether to compress the debug sections of binary executables (Linux only). Compressing executable debug sections saves space at the cost of extra CPU time during the build process.

The default is `OFF`. If this option is not set explicitly but the `COMPRESS_DEBUG_SECTIONS` environment variable is set, the option takes its value from that variable.

This option was added in MySQL 8.0.22.

- `-DCOMPILATION_COMMENT_SERVER=string`

A descriptive comment about the compilation environment for use by `mysqld` (for example, to set the `version_comment` system variable). This option was added in MySQL 8.0.14. Prior to 8.0.14, the server uses `COMPILATION_COMMENT`.

- `-DDEFAULT_CHARSET=charset_name`

The server character set. By default, MySQL uses the `utf8mb4` character set.

`charset_name` may be one of `binary`, `armscii8`, `ascii`, `big5`, `cp1250`, `cp1251`, `cp1256`, `cp1257`, `cp850`, `cp852`, `cp866`, `cp932`, `dec8`, `eucjpms`, `euckr`, `gb2312`, `gbk`, `geostd8`, `greek`, `hebrew`, `hp8`, `keybcs2`, `koi8r`, `koi8u`, `latin1`, `latin2`, `latin5`, `latin7`, `macce`, `macroman`, `sjis`, `swe7`, `tis620`, `ucs2`, `ujis`, `utf8mb3`, `utf8mb4`, `utf16`, `utf16le`, `utf32`.

This value can be set at server startup with the `--character-set-server` option.

- `-DDEFAULT_COLLATION=collation_name`

The server collation. By default, MySQL uses `utf8mb4_0900_ai_ci`. Use the `SHOW COLLATION` statement to determine which collations are available for each character set.

This value can be set at server startup with the `--collation_server` option.

- `-DDISABLE_PSI_COND=bool`

Whether to exclude the Performance Schema condition instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_FILE=bool`

Whether to exclude the Performance Schema file instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_IDLE=bool`

Whether to exclude the Performance Schema idle instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_MEMORY=bool`

Whether to exclude the Performance Schema memory instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_METADATA=bool`

Whether to exclude the Performance Schema metadata instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_MUTEX=bool`

Whether to exclude the Performance Schema mutex instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_RWLOCK=bool`

Whether to exclude the Performance Schema rlock instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_SOCKET=bool`

Whether to exclude the Performance Schema socket instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_SP=bool`

Whether to exclude the Performance Schema stored program instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_STAGE=bool`

Whether to exclude the Performance Schema stage instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_STATEMENT=bool`

Whether to exclude the Performance Schema statement instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_STATEMENT_DIGEST=bool`

Whether to exclude the Performance Schema statement digest instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_TABLE=bool`

Whether to exclude the Performance Schema table instrumentation. The default is `OFF` (include).

- `-DDISABLE_SHARED=bool`

Whether to disable building build shared libraries and compile position-dependent code. The default is `OFF` (compile position-independent code).

This option is unused, and was removed in MySQL 8.0.18.

- `-DDISABLE_PSI_PS=bool`

Exclude the Performance Schema prepared statements instances instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_THREAD=bool`

Exclude the Performance Schema thread instrumentation. The default is `OFF` (include).

Only disable threads when building without any instrumentation, because other instrumentations have a dependency on threads.

- `-DDISABLE_PSI_TRANSACTION=bool`

Exclude the Performance Schema transaction instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_DATA_LOCK=bool`

Exclude the performance schema data lock instrumentation. The default is `OFF` (include).

- `-DDISABLE_PSI_ERROR=bool`

Exclude the performance schema server error instrumentation. The default is `OFF` (include).

- `-DDOWNLOAD_BOOST=bool`

Whether to download the Boost library. The default is `OFF`.

See the `WITH_BOOST` option for additional discussion about using Boost.

- `-DDOWNLOAD_BOOST_TIMEOUT=seconds`

The timeout in seconds for downloading the Boost library. The default is 600 seconds.

See the `WITH_BOOST` option for additional discussion about using Boost.

- `-DENABLE_DOWNLOADS=bool`

Whether to download optional files. For example, with this option enabled, [CMake](#) downloads the Google Test distribution that is used by the test suite to run unit tests, or Ant and JUnit, required for building the GCS Java wrapper.

As of MySQL 8.0.26, MySQL source distributions bundle the Google Test source code used to run unit tests. Consequently, as of that version the `WITH_GMOCK` and `ENABLE_DOWNLOADS` [CMake](#) options are removed and are ignored if specified.

- `-DENABLE_EXPERIMENTAL_SYSVARS=bool`

Whether to enable experimental [InnoDB](#) system variables. Experimental system variables are intended for those engaged in MySQL development, should only be used in a development or test environment, and may be removed without notice in a future MySQL release. For information about experimental system variables, refer to `/storage/innobase/handler/ha_innodb.cc` in the MySQL source tree. Experimental system variables can be identified by searching for “`PLUGIN_VAR_EXPERIMENTAL`”.

- `-DWITHOUT_SERVER=bool`

Whether to build without MySQL Server. The default is OFF, which does build the server.

This is considered an experimental option; it is preferred to build with the server.

- `-DENABLE_GCOV=bool`

Whether to include [gcov](#) support (Linux only).

- `-DENABLE_GPROF=bool`

Whether to enable [gprof](#) (optimized Linux builds only).

- `-DENABLED_LOCAL_INFILE=bool`

This option controls the compiled-in default [LOCAL](#) capability for the MySQL client library. Clients that make no explicit arrangements therefore have [LOCAL](#) capability disabled or enabled according to the `ENABLED_LOCAL_INFILE` setting specified at MySQL build time.

By default, the client library in MySQL binary distributions is compiled with `ENABLED_LOCAL_INFILE` disabled. If you compile MySQL from source, configure it with `ENABLED_LOCAL_INFILE` disabled or enabled based on whether clients that make no explicit arrangements should have [LOCAL](#) capability disabled or enabled, respectively.

`ENABLED_LOCAL_INFILE` controls the default for client-side [LOCAL](#) capability. For the server, the `local_infile` system variable controls server-side [LOCAL](#) capability. To explicitly cause the server to refuse or permit `LOAD DATA LOCAL` statements (regardless of how client programs and libraries are configured at build time or runtime), start `mysqld` with `--local-infile` disabled or enabled, respectively. `local_infile` can also be set at runtime. See [Security Considerations for LOAD DATA LOCAL](#).

- `-DENABLED_PROFILING=bool`

Whether to enable query profiling code (for the `SHOW PROFILE` and `SHOW PROFILES` statements).

- `-DFORCE_UNSUPPORTED_COMPILER=bool`

By default, [CMake](#) checks for minimum versions of [supported compilers](#); to disable this check, use `-DFORCE_UNSUPPORTED_COMPILER=ON`.

- `-DSHOW_SUPPRESSED_COMPILER_WARNINGS=bool`

Show suppressed compiler warnings, and do so without failing with `-Werror`. Defaults to `OFF`.

This option was added in MySQL 8.0.30.

- `-DFPROFILE_GENERATE=bool`

Whether to generate profile guided optimization (PGO) data. This option is available for experimenting with PGO with GCC. See `cmake/fprofile.cmake` in the MySQL source distribution for information about using `FPROFILE_GENERATE` and `FPROFILE_USE`. These options have been tested with GCC 8 and 9.

This option was added in MySQL 8.0.19.

- `-DFPROFILE_USE=bool`

Whether to use profile guided optimization (PGO) data. This option is available for experimenting with PGO with GCC. See the `cmake/fprofile.cmake` file in a MySQL source distribution for information about using `FPROFILE_GENERATE` and `FPROFILE_USE`. These options have been tested with GCC 8 and 9.

Enabling `FPROFILE_USE` also enables `WITH_LTO`.

This option was added in MySQL 8.0.19.

- `-DHAVE_PSI_MEMORY_INTERFACE=bool`

Whether to enable the performance schema memory tracing module for memory allocation functions (`ut::aligned_name` library functions) used in dynamic storage of over-aligned types.

- `-DIGNORE_AIO_CHECK=bool`

If the `-DBUILD_CONFIG=mysql_release` option is given on Linux, the `libaio` library must be linked in by default. If you do not have `libaio` or do not want to install it, you can suppress the check for it by specifying `-DIGNORE_AIO_CHECK=1`.

- `-DMAX_INDEXES=num`

The maximum number of indexes per table. The default is 64. The maximum is 255. Values smaller than 64 are ignored and the default of 64 is used.

- `-DMYSQL_MAINTAINER_MODE=bool`

Whether to enable a MySQL maintainer-specific development environment. If enabled, this option causes compiler warnings to become errors.

- `-DWITH_DEVELOPER_ENTITLEMENTS=bool`

Whether to add the `get-task-allow` entitlement to all executables to generate a core dump in the event of an unexpected server halt.

On macOS 11+, core dumps are limited to processes with the `com.apple.security.get-task-allow` entitlement, which this CMake option enables. The entitlement allows other processes to attach and read/modify the processes memory, and allows `--core-file` to function as expected.

This option was added in MySQL 8.0.30.

- `-DMUTEX_TYPE=type`

The mutex type used by [InnoDB](#). Options include:

- [event](#): Use event mutexes. This is the default value and the original [InnoDB](#) mutex implementation.
- [sys](#): Use POSIX mutexes on UNIX systems. Use [CRITICAL_SECTION](#) objects on Windows, if available.
- [futex](#): Use Linux futexes instead of condition variables to schedule waiting threads.
- [-DMYSQLX_TCP_PORT=port_num](#)

The port number on which X Plugin listens for TCP/IP connections. The default is 33060.

This value can be set at server startup with the [mysqlx_port](#) system variable.

- [-DMYSQLX_UNIX_ADDR=file_name](#)

The Unix socket file path on which the server listens for X Plugin socket connections. This must be an absolute path name. The default is [/tmp/mysqlx.sock](#).

This value can be set at server startup with the [mysqlx_port](#) system variable.

- [-DMYSQL_PROJECT_NAME=name](#)

For Windows or macOS, the project name to incorporate into the project file name.

- [-DMYSQL_TCP_PORT=port_num](#)

The port number on which the server listens for TCP/IP connections. The default is 3306.

This value can be set at server startup with the [--port](#) option.

- [-DMYSQL_UNIX_ADDR=file_name](#)

The Unix socket file path on which the server listens for socket connections. This must be an absolute path name. The default is [/tmp/mysql.sock](#).

This value can be set at server startup with the [--socket](#) option.

- [-DOPTIMIZER_TRACE=bool](#)

Whether to support optimizer tracing. See [MySQL Internals: Tracing the Optimizer](#).

- [-DREPRODUCIBLE_BUILD=bool](#)

For builds on Linux systems, this option controls whether to take extra care to create a build result independent of build location and time.

This option was added in MySQL 8.0.11. As of MySQL 8.0.12, it defaults to [ON](#) for [RelWithDebInfo](#) builds.

- [-DUSE_LD_GOLD=bool](#)

GNU [gold](#) linker support was removed in MySQL 8.0.31; this CMake option was also removed.

[CMake](#) causes the build process to link with the GNU [gold](#) linker if it is available and not explicitly disabled. To disable use of this linker, specify the [-DUSE_LD_GOLD=OFF](#) option.

- [-DUSE_LD_LLD=bool](#)

`CMake` causes the build process to link using the LLVM `lld` linker for Clang if it is available and not explicitly disabled. To disable use of this linker, specify the `-DUSE_LD_LLD=OFF` option.

This option was added in MySQL 8.0.16.

- `-DWIN_DEBUG_NO_INLINE=bool`

Whether to disable function inlining on Windows. The default is `OFF` (inlining enabled).

- `-DWITH_ANT=path_name`

Set the path to Ant, required when building GCS Java wrapper. Set `WITH_ANT` to the path of a directory where the Ant tarball or unpacked archive is saved. When `WITH_ANT` is not set, or is set with the special value `system`, the build process assumes a binary `ant` exists in `$PATH`.

- `-DWITH_ASAN=bool`

Whether to enable the AddressSanitizer, for compilers that support it. The default is `OFF`.

- `-DWITH_ASAN_SCOPE=bool`

Whether to enable the AddressSanitizer `-fsanitize-address-use-after-scope` Clang flag for use-after-scope detection. The default is off. To use this option, `-DWITH_ASAN` must also be enabled.

- `-DWITH_AUTHENTICATION_CLIENT_PLUGINS=bool`

This option is enabled automatically if any corresponding server authentication plugins are built. Its value thus depends on other `CMake` options and it should not be set explicitly.

This option was added in MySQL 8.0.26.

- `-DWITH_AUTHENTICATION_LDAP=bool`

Whether to report an error if the LDAP authentication plugins cannot be built:

- If this option is disabled (the default), the LDAP plugins are built if the required header files and libraries are found. If they are not, `CMake` displays a note about it.
- If this option is enabled, a failure to find the required header file and libraries causes `CMake` to produce an error, preventing the server from being built.

For information about LDAP authentication, see [LDAP Pluggable Authentication](#).

- `-DWITH_AUTHENTICATION_PAM=bool`

Whether to build the PAM authentication plugin, for source trees that include this plugin. (See [PAM Pluggable Authentication](#).) If this option is specified and the plugin cannot be compiled, the build fails.

- `-DWITH_AWS_SDK=path_name`

The location of the Amazon Web Services software development kit.

- `-DWITH_BOOST=path_name`

The Boost library is required to build MySQL. These CMake options enable control over the library source location, and whether to download it automatically:

- `-DWITH_BOOST=path_name` specifies the Boost library directory location. It is also possible to specify the Boost location by setting the `BOOST_ROOT` or `WITH_BOOST` environment variable.

`-DWITH_BOOST=system` is also permitted and indicates that the correct version of Boost is installed on the compilation host in the standard location. In this case, the installed version of Boost is used rather than any version included with a MySQL source distribution.

- `-DDOWNLOAD_BOOST=bool` specifies whether to download the Boost source if it is not present in the specified location. The default is `OFF`.
- `-DDOWNLOAD_BOOST_TIMEOUT=seconds` the timeout in seconds for downloading the Boost library. The default is 600 seconds.

For example, if you normally build MySQL placing the object output in the `bld` subdirectory of your MySQL source tree, you can build with Boost like this:

```
mkdir bld
cd bld
cmake .. -DDOWNLOAD_BOOST=ON -DWITH_BOOST=$HOME/my_boost
```

This causes Boost to be downloaded into the `my_boost` directory under your home directory. If the required Boost version is already there, no download is done. If the required Boost version changes, the newer version is downloaded.

If Boost is already installed locally and your compiler finds the Boost header files on its own, it may not be necessary to specify the preceding CMake options. However, if the version of Boost required by MySQL changes and the locally installed version has not been upgraded, you may have build problems. Using the CMake options should give you a successful build.

With the above settings that allow Boost download into a specified location, when the required Boost version changes, you need to remove the `bld` folder, recreate it, and perform the `cmake` step again. Otherwise, the new Boost version might not get downloaded, and compilation might fail.

- `-DWITH_CLIENT_PROTOCOL_TRACING=bool`

Whether to build the client-side protocol tracing framework into the client library. By default, this option is enabled.

For information about writing protocol trace client plugins, see [Writing Protocol Trace Plugins](#).

See also the `WITH_TEST_TRACE_PLUGIN` option.

- `-DWITH_CURL=curl_type`

The location of the `curl` library. `curl_type` can be `system` (use the system `curl` library) or a path name to the `curl` library.

- `-DWITH_DEBUG=bool`

Whether to include debugging support.

Configuring MySQL with debugging support enables you to use the `--debug="d,parser_debug"` option when you start the server. This causes the Bison parser that is used to process SQL statements

to dump a parser trace to the server's standard error output. Typically, this output is written to the error log.

Sync debug checking for the [InnoDB](#) storage engine is defined under [UNIV_DEBUG](#) and is available when debugging support is compiled in using the [WITH_DEBUG](#) option. When debugging support is compiled in, the [innodb_sync_debug](#) configuration option can be used to enable or disable [InnoDB](#) sync debug checking.

Enabling [WITH_DEBUG](#) also enables Debug Sync. This facility is used for testing and debugging. When compiled in, Debug Sync is disabled by default at runtime. To enable it, start `mysqld` with the `--debug-sync-timeout=N` option, where *N* is a timeout value greater than 0. (The default value is 0, which disables Debug Sync.) *N* becomes the default timeout for individual synchronization points.

Sync debug checking for the [InnoDB](#) storage engine is available when debugging support is compiled in using the [WITH_DEBUG](#) option.

For a description of the Debug Sync facility and how to use synchronization points, see [MySQL Internals: Test Synchronization](#).

- `-DWITH_DEFAULT_FEATURE_SET=bool`

Whether to use the flags from `cmake/build_configurations/feature_set.cmake`. This option was removed in MySQL 8.0.22.

- `-DWITH_EDITLINE=value`

Which `libedit/editline` library to use. The permitted values are `bundled` (the default) and `system`.

- `-DWITH_FIDO=fido_type`

The `authentication_fido` authentication plugin is implemented using a FIDO library (see [FIDO Pluggable Authentication](#)). The `WITH_FIDO` option indicates the source of FIDO support:

- `bundled`: Use the FIDO library bundled with the distribution. This is the default.

As of MySQL 8.0.30, MySQL includes `fido2` version 1.8.0. (Prior releases used `fido2` 1.5.0).

- `system`: Use the system FIDO library.

`WITH_FIDO` is disabled (set to `none`) if all authentication plugins are disabled.

This option was added in MySQL 8.0.27.

- `-DWITH_GMOCK=path_name`

The path to the googletest distribution, for use with Google Test-based unit tests. The option value is the path to the distribution zip file. Alternatively, set the `WITH_GMOCK` environment variable to the path name. It is also possible to use `-DENABLE_DOWNLOADS=1`, so that CMake downloads the distribution from GitHub.

If you build MySQL without the Google Test unit tests (by configuring without `WITH_GMOCK`), CMake displays a message indicating how to download it.

As of MySQL 8.0.26, MySQL source distributions bundle the Google Test source code. Consequently, as of that version, the `WITH_GMOCK` and `ENABLE_DOWNLOADS` CMake options are removed and are ignored if specified.

- `-DWITH_ICU={icu_type|path_name}`

MySQL uses International Components for Unicode (ICU) to support regular expression operations. The `WITH_ICU` option indicates the type of ICU support to include or the path name to the ICU installation to use.

- `icu_type` can be one of the following values:
 - `bundled`: Use the ICU library bundled with the distribution. This is the default, and is the only supported option for Windows.
 - `system`: Use the system ICU library.
- `path_name` is the path name to the ICU installation to use. This can be preferable to using the `icu_type` value of `system` because it can prevent CMake from detecting and using an older or incorrect ICU version installed on the system. (Another permitted way to do the same thing is to set `WITH_ICU` to `system` and set the `CMAKE_PREFIX_PATH` option to `path_name`.)

- `-DWITH_INNODB_EXTRA_DEBUG=bool`

Whether to include extra InnoDB debugging support.

Enabling `WITH_INNODB_EXTRA_DEBUG` turns on extra InnoDB debug checks. This option can only be enabled when `WITH_DEBUG` is enabled.

- `-DWITH_INNODB_MEMCACHED=bool`

Whether to generate memcached shared libraries (`libmemcached.so` and `innodb_engine.so`).

- `-DWITH_JEMALLOC=bool`

Whether to link with `-ljemalloc`. If enabled, built-in `malloc()`, `calloc()`, `realloc()`, and `free()` routines are disabled. The default is `OFF`.

`WITH_JEMALLOC` and `WITH_TCMALLOC` are mutually exclusive.

This option was added in MySQL 8.0.16.

- `-DWITH_WIN_JEMALLOC=string`

On Windows, pass in a path to a directory containing `jemalloc.dll` to enable jemalloc functionality. The build system copies `jemalloc.dll` to the same directory as `mysqld.exe` and/or `mysqld-debug.exe` and utilizes it for memory management operations. Standard memory functions are used if `jemalloc.dll` is not found or does not export the required functions. An INFORMATION level log message records whether or not jemalloc is found and used.

This option is enabled for official MySQL binaries for Windows.

This option was added in MySQL 8.0.29.

- `-DWITH_KEYRING_TEST=bool`

Whether to build the test program that accompanies the `keyring_file` plugin. The default is `OFF`. Test file source code is located in the `plugin/keyring/keyring-test` directory.

- `-DWITH_LIBEVENT=string`

Which `libevent` library to use. Permitted values are `bundled` (default) and `system`. Prior to MySQL 8.0.21, if you specify `system`, the system `libevent` library is used if present, and an error occurs

otherwise. In MySQL 8.0.21 and later, if `system` is specified and no system `libevent` library can be found, an error occurs regardless, and the bundled `libevent` is not used.

The `libevent` library is required by InnoDB memcached, X Plugin, and MySQL Router.

- `-DWITH_LIBWRAP=bool`

Whether to include `libwrap` (TCP wrappers) support.

- `-DWITH_LOCK_ORDER=bool`

Whether to enable `LOCK_ORDER` tooling. By default, this option is disabled and server builds contain no tooling. If tooling is enabled, the `LOCK_ORDER` tool is available and can be used as described in [The LOCK_ORDER Tool](#).

Note

With the `WITH_LOCK_ORDER` option enabled, MySQL builds require the `flex` program.

This option was added in MySQL 8.0.17.

- `-DWITH_LSAN=bool`

Whether to run LeakSanitizer, without AddressSanitizer. The default is `OFF`.

This option was added in MySQL 8.0.16.

- `-DWITH_LTO=bool`

Whether to enable the link-time optimizer, if the compiler supports it. The default is `OFF` unless `FPROFILE_USE` is enabled.

This option was added in MySQL 8.0.13.

- `-DWITH_LZ4=lz4_type`

The `WITH_LZ4` option indicates the source of `zlib` support:

- `bundled`: Use the `lz4` library bundled with the distribution. This is the default.
- `system`: Use the system `lz4` library. If `WITH_LZ4` is set to this value, the `lz4_decompress` utility is not built. In this case, the system `lz4` command can be used instead.
- `-DWITH_LZMA=lzma_type`

The type of LZMA library support to include. `lzma_type` can be one of the following values:

- `bundled`: Use the LZMA library bundled with the distribution. This is the default.
- `system`: Use the system LZMA library.

This option was removed in MySQL 8.0.16.

- `-DWITH_MECAB={disabled|system|path_name}`

Use this option to compile the MeCab parser. If you have installed MeCab to its default installation directory, set `-DWITH_MECAB=system`. The `system` option applies to MeCab installations performed from source or from binaries using a native package management utility. If you installed MeCab to a

custom installation directory, specify the path to the MeCab installation, for example, `-DWITH_MECAB=/opt/mecab`. If the `system` option does not work, specifying the MeCab installation path should work in all cases.

For related information, see [MeCab Full-Text Parser Plugin](#).

- `-DWITH_MSAN=bool`

Whether to enable MemorySanitizer, for compilers that support it. The default is off.

For this option to have an effect if enabled, all libraries linked to MySQL must also have been compiled with the option enabled.

- `-DWITH_MSRTC_DEBUG=bool`

Whether to enable Visual Studio CRT memory leak tracing. The default is `OFF`.

- `-DMSVC_CPPCHECK=bool`

Whether to enable MSVC code analysis. The default is `OFF`.

- `-DWITH_MYSQLX=bool`

Whether to build with support for X Plugin. The default is `ON`. See [Using MySQL as a Document Store](#).

- `-DWITH_NUMA=bool`

Explicitly set the NUMA memory allocation policy. `CMake` sets the default `WITH_NUMA` value based on whether the current platform has `NUMA` support. For platforms without `NUMA` support, `CMake` behaves as follows:

- With no `NUMA` option (the normal case), `CMake` continues normally, producing only this warning:
`NUMA library missing or required version not available.`
- With `-DWITH_NUMA=ON`, `CMake` aborts with this error: `NUMA library missing or required version not available.`
- `-DWITH_PACKAGE_FLAGS=bool`

For flags typically used for RPM and Debian packages, whether to add them to standalone builds on those platforms. The default is `ON` for nondebug builds.

This option was added in MySQL 8.0.26.

- `-DWITH_PROTOBUF=protobuf_type`

Which Protocol Buffers package to use. `protobuf_type` can be one of the following values:

- `bundled`: Use the package bundled with the distribution. This is the default. Optionally use `INSTALL_PRIV_LIBDIR` to modify the dynamic Protobuf library directory.
- `system`: Use the package installed on the system.

Other values are ignored, with a fallback to `bundled`.

- `-DWITH_RAPID=bool`

Whether to build the rapid development cycle plugins. When enabled, a `rapid` directory is created in the build tree containing these plugins. When disabled, no `rapid` directory is created in the build tree.

The default is `ON`, unless the `rapid` directory is removed from the source tree, in which case the default becomes `OFF`.

- `-DWITH_RAPIDJSON=rapidjson_type`

The type of RapidJSON library support to include. `rapidjson_type` can be one of the following values:

- `bundled`: Use the RapidJSON library bundled with the distribution. This is the default.
- `system`: Use the system RapidJSON library. Version 1.1.0 or later is required.

This option was added in MySQL 8.0.13.

- `-DWITH_RE2=re2_type`

The type of RE2 library support to include. `re2_type` can be one of the following values:

- `bundled`: Use the RE2 library bundled with the distribution. This is the default.
- `system`: Use the system RE2 library.

As of MySQL 8.0.18, MySQL no longer uses the RE2 library, and this option has been removed.

- `-DWITH_ROUTER=bool`

Whether to build MySQL Router. The default is `ON`.

This option was added in MySQL 8.0.16.

- `-DWITH_SSL={ssl_type|path_name}`

For support of encrypted connections, entropy for random number generation, and other encryption-related operations, MySQL must be built using an SSL library. This option specifies which SSL library to use.

- `ssl_type` can be one of the following values:

- `system`: Use the system OpenSSL library. This is the default.

On macOS and Windows, using `system` configures MySQL to build as if CMake was invoked with `path_name` points to a manually installed OpenSSL library. This is because they do not have system SSL libraries. On macOS, `brew install openssl` installs to `/usr/local/opt/openssl` so that `system` can find it. On Windows, it checks `%ProgramFiles%/OpenSSL`, `%ProgramFiles%/OpenSSL-Win32`, `%ProgramFiles%/OpenSSL-Win64`, `C:/OpenSSL`, `C:/OpenSSL-Win32`, and `C:/OpenSSL-Win64`.

- `yes`: This is a synonym for `system`.
- `opensslversion`: (MySQL 8.0.30 and later:) Use an alternate OpenSSL system package such as `openssl11` on EL7, or `openssl3` on EL8.

Authentication plugins, such as LDAP and Kerberos, are disabled as they do not support these alternative versions of OpenSSL.

- `path_name` is the path name to the OpenSSL installation to use. This can be preferable to using the `ssl_type` value of `system` because it can prevent CMake from detecting and using an older or incorrect OpenSSL version installed on the system. (Another permitted way to do the same thing is to set `WITH_SSL` to `system` and set the `CMAKE_PREFIX_PATH` option to `path_name`.)

For additional information about configuring the SSL library, see [Section 4.6, “Configuring SSL Library Support”](#).

- `-DWITH_SYSTEMD=bool`

Whether to enable installation of `systemd` support files. By default, this option is disabled. When enabled, `systemd` support files are installed, and scripts such as `mysqld_safe` and the System V initialization script are not installed. On platforms where `systemd` is not available, enabling `WITH_SYSTEMD` results in an error from CMake.

For more information about using `systemd`, see [Section 7.9, “Managing MySQL Server with systemd”](#). That section also includes information about specifying options otherwise specified in `[mysqld_safe]` option groups. Because `mysqld_safe` is not installed when `systemd` is used, such options must be specified another way.

- `-DWITH_SYSTEM_LIBS=bool`

This option serves as an “umbrella” option to set the `system` value of any of the following CMake options that are not set explicitly: `WITH_CURL`, `WITH_EDITLINE`, `WITH_FIDO`, `WITH_ICU`, `WITH_LIBEVENT`, `WITH_LZ4`, `WITH_LZMA`, `WITH_PROTOBUF`, `WITH_RE2`, `WITH_SSL`, `WITH_ZSTD`.

`WITH_ZLIB` was included here prior MySQL 8.0.30.

- `-DWITH_SYSTEMD_DEBUG=bool`

Whether to produce additional `systemd` debugging information, for platforms on which `systemd` is used to run MySQL. The default is `OFF`.

This option was added in MySQL 8.0.22.

- `-DWITH_TCMALLOC=bool`

Whether to link with `-ltcmalloc`. If enabled, built-in `malloc()`, `calloc()`, `realloc()`, and `free()` routines are disabled. The default is `OFF`.

`WITH_TCMALLOC` and `WITH_JEMALLOC` are mutually exclusive.

This option was added in MySQL 8.0.22.

- `-DWITH_TEST_TRACE_PLUGIN=bool`

Whether to build the test protocol trace client plugin (see [Using the Test Protocol Trace Plugin](#)). By default, this option is disabled. Enabling this option has no effect unless the `WITH_CLIENT_PROTOCOL_TRACING` option is enabled. If MySQL is configured with both options enabled, the `libmysqlclient` client library is built with the test protocol trace plugin built in, and all the standard MySQL clients load the plugin. However, even when the test plugin is enabled, it has no effect by default. Control over the plugin is afforded using environment variables; see [Using the Test Protocol Trace Plugin](#).

Note

Do *not* enable the `WITH_TEST_TRACE_PLUGIN` option if you want to use your own protocol trace plugins because only one such plugin can be loaded at a time and an error occurs for attempts to load a second one. If you have already built MySQL with the test protocol trace plugin enabled to see how it works, you must rebuild MySQL without it before you can use your own plugins.

For information about writing trace plugins, see [Writing Protocol Trace Plugins](#).

- `-DWITH_TSAN=bool`

Whether to enable the ThreadSanitizer, for compilers that support it. The default is off.

- `-DWITH_UBSAN=bool`

Whether to enable the Undefined Behavior Sanitizer, for compilers that support it. The default is off.

- `-DWITH_UNIT_TESTS={ON|OFF}`

If enabled, compile MySQL with unit tests. The default is `ON` unless the server is not being compiled.

- `-DWITH_UNIXODBC=1`

Enables unixODBC support, for Connector/ODBC.

- `-DWITH_VALGRIND=bool`

Whether to compile in the Valgrind header files, which exposes the Valgrind API to MySQL code. The default is `OFF`.

To generate a Valgrind-aware debug build, `-DWITH_VALGRIND=1` normally is combined with `-DWITH_DEBUG=1`. See [Building Debug Configurations](#).

- `-DWITH_ZLIB=zlib_type`

Some features require that the server be built with compression library support, such as the `COMPRESS()` and `UNCOMPRESS()` functions, and compression of the client/server protocol. The `WITH_ZLIB` option indicates the source of `zlib` support:

In MySQL 8.0.32 and later, the minimum supported version of `zlib` is 1.2.13.

- `bundled`: Use the `zlib` library bundled with the distribution. This is the default.
- `system`: Use the system `zlib` library. If `WITH_ZLIB` is set to this value, the `zlib_decompress` utility is not built. In this case, the system `openssl zlib` command can be used instead.
- `-DWITH_ZSTD=zstd_type`

Connection compression using the `zstd` algorithm (see [Connection Compression Control](#)) requires that the server be built with `zstd` library support. The `WITH_ZSTD` option indicates the source of `zstd` support:

- `bundled`: Use the `zstd` library bundled with the distribution. This is the default.
- `system`: Use the system `zstd` library.

This option was added in MySQL 8.0.18.

Compiler Flags

- `-DCMAKE_C_FLAGS="flags"`

Flags for the C compiler.

- `-DCMAKE_CXX_FLAGS="flags"`

Flags for the C++ compiler.

- `-DWITH_DEFAULT_COMPILER_OPTIONS=bool`

Whether to use the flags from `cmake/build_configurations/compiler_options.cmake`.

Note

All optimization flags are carefully chosen and tested by the MySQL build team. Overriding them can lead to unexpected results and is done at your own risk.

- `-DOPTIMIZE_SANITIZER_BUILDS=bool`

Whether to add `-O1 -fno-inline` to sanitizer builds. The default is `ON`.

To specify your own C and C++ compiler flags, for flags that do not affect optimization, use the `CMAKE_C_FLAGS` and `CMAKE_CXX_FLAGS` CMake options.

When providing your own compiler flags, you might want to specify `CMAKE_BUILD_TYPE` as well.

For example, to create a 32-bit release build on a 64-bit Linux machine, do this:

```
$> mkdir build
$> cd build
$> cmake .. -DCMAKE_C_FLAGS=-m32 \
  -DCMAKE_CXX_FLAGS=-m32 \
  -DCMAKE_BUILD_TYPE=RelWithDebInfo
```

If you set flags that affect optimization (`-Onumber`), you must set the `CMAKE_C_FLAGS_build_type` and/or `CMAKE_CXX_FLAGS_build_type` options, where `build_type` corresponds to the `CMAKE_BUILD_TYPE` value. To specify a different optimization for the default build type (`RelWithDebInfo`) set the `CMAKE_C_FLAGS_RELWITHDEBINFO` and `CMAKE_CXX_FLAGS_RELWITHDEBINFO` options. For example, to compile on Linux with `-O3` and with debug symbols, do this:

```
$> cmake .. -DCMAKE_C_FLAGS_RELWITHDEBINFO="-O3 -g" \
  -DCMAKE_CXX_FLAGS_RELWITHDEBINFO="-O3 -g"
```

CMake Options for Compiling NDB Cluster

The following options are for use when building the MySQL sources with NDB Cluster support.

- `-DMEMCACHED_HOME=dir_name`

NDB support for memcached was removed in NDB 8.0.23; thus, this option is no longer supported for building NDB in this or later versions.

- `-DNDB_UTILS_LINK_DYNAMIC={ON|OFF}`

Controls whether NDB utilities such as `ndb_drop_table` are linked with `ndbclient` statically (`OFF`) or dynamically (`ON`); `OFF` (static linking) is the default. Normally static linking is used when building these to avoid problems with `LD_LIBRARY_PATH`, or when multiple versions of `ndbclient` are installed. This option is intended for creating Docker images and possibly other cases in which the target environment is subject to precise control and it is desirable to reduce image size.

Added in NDB 8.0.22.

- `-DWITH_BUNDLED_LIBEVENT={ON|OFF}`

NDB support for memcached was removed in NDB 8.0.23; thus, this option is no longer supported for building NDB in this or later versions.

- `-DWITH_BUNDLED_MEMCACHED={ON|OFF}`

NDB support for memcached was removed in NDB 8.0.23; thus, this option is no longer supported for building NDB in this or later versions.

- `-DWITH_CLASSPATH=path`

Sets the classpath for building MySQL NDB Cluster Connector for Java. The default is empty. This option is ignored if `-DWITH_NDB_JAVA=OFF` is used.

- `-DWITH_ERROR_INSERT={ON|OFF}`

Enables error injection in the NDB kernel. For testing only; not intended for use in building production binaries. The default is `OFF`.

- `-DWITH_NDB={ON|OFF}`

Build MySQL NDB Cluster; build the NDB plugin and all NDB Cluster programs.

Added in NDB 8.0.31.

- `-DWITH_NDBAPI_EXAMPLES={ON|OFF}`

Build NDB API example programs in `storage/ndb/ndbapi-examples/`. See [NDB API Examples](#), for information about these.

- `-DWITH_NDBCLUSTER_STORAGE_ENGINE={ON|OFF}`

NDB 8.0.30 and earlier. For internal use only; may not always work as expected. To build with NDB support, use `WITH_NDBCLUSTER` instead.

NDB 8.0.31 and later. Controls (only) whether the `ndbcluster` plugin is included in the build; `WITH_NDB` enables this option automatically, so it is recommended that you use `WITH_NDB` instead.

- `-DWITH_NDBCLUSTER={ON|OFF}`

Build and link in support for the NDB storage engine in `mysqld`.

This option is deprecated as of NDB 8.0.31, and subject to eventual removal; use `WITH_NDB` instead.

- `-DWITH_NDBMTD={ON|OFF}`

Build the multithreaded data node executable `ndbmt.d`. The default is `ON`.

- `-DWITH_NDB_DEBUG={ON|OFF}`

Enable building the debug versions of the NDB Cluster binaries. This is `OFF` by default.

- `-DWITH_NDB_JAVA={ON|OFF}`

Enable building NDB Cluster with Java support, including support for ClusterJ (see [MySQL NDB Cluster Connector for Java](#)).

This option is `ON` by default. If you do not wish to compile NDB Cluster with Java support, you must disable it explicitly by specifying `-DWITH_NDB_JAVA=OFF` when running `CMake`. Otherwise, if Java cannot be found, configuration of the build fails.

- `-DWITH_NDB_PORT=port`

Causes the NDB Cluster management server (`ndb_mgmd`) that is built to use this `port` by default. If this option is unset, the resulting management server tries to use port 1186 by default.

- `-DWITH_NDB_TEST={ON|OFF}`

If enabled, include a set of NDB API test programs. The default is `OFF`.

- `-DWITH_PLUGIN_NDBCLUSTER={ON|OFF}`

For internal use only; may not always work as expected. This option was removed in NDB 8.0.31; use `WITH_NDB` instead to build MySQL NDB Cluster. (*NDB 8.0.30 and earlier: Use `WITH_NDBCLUSTER`.*)

4.8 Dealing with Problems Compiling MySQL

The solution to many problems involves reconfiguring. If you do reconfigure, take note of the following:

- If `CMake` is run after it has previously been run, it may use information that was gathered during its previous invocation. This information is stored in `CMakeCache.txt`. When `CMake` starts, it looks for that file and reads its contents if it exists, on the assumption that the information is still correct. That assumption is invalid when you reconfigure.
- Each time you run `CMake`, you must run `make` again to recompile. However, you may want to remove old object files from previous builds first because they were compiled using different configuration options.

To prevent old object files or configuration information from being used, run the following commands before re-running `CMake`:

On Unix:

```
$> make clean
$> rm CMakeCache.txt
```

On Windows:

```
$> devenv MySQL.sln /clean
$> del CMakeCache.txt
```

If you build outside of the source tree, remove and recreate your build directory before re-running `CMake`. For instructions on building outside of the source tree, see [How to Build MySQL Server with CMake](#).

On some systems, warnings may occur due to differences in system include files. The following list describes other problems that have been found to occur most often when compiling MySQL:

- To define which C and C++ compilers to use, you can define the `CC` and `CXX` environment variables. For example:

```
$> CC=gcc
$> CXX=g++
$> export CC CXX
```

While this can be done on the command line, as just shown, you may prefer to define these values in a build script, in which case the `export` command is not needed.

To specify your own C and C++ compiler flags, use the `CMAKE_C_FLAGS` and `CMAKE_CXX_FLAGS` CMake options. See [Compiler Flags](#).

To see what flags you might need to specify, invoke `mysql_config` with the `--cflags` and `--cxxflags` options.

- To see what commands are executed during the compile stage, after using CMake to configure MySQL, run `make VERBOSE=1` rather than just `make`.
- If compilation fails, check whether the `MYSQL_MAINTAINER_MODE` option is enabled. This mode causes compiler warnings to become errors, so disabling it may enable compilation to proceed.
- If your compile fails with errors such as any of the following, you must upgrade your version of `make` to GNU `make`:

```
make: Fatal error in reader: Makefile, line 18:
Badly formed macro assignment
```

Or:

```
make: file `Makefile' line 18: Must be a separator (:
```

Or:

```
pthread.h: No such file or directory
```

Solaris and FreeBSD are known to have troublesome `make` programs.

GNU `make` 3.75 is known to work.

- The `sql_yacc.cc` file is generated from `sql_yacc.yy`. Normally, the build process does not need to create `sql_yacc.cc` because MySQL comes with a pregenerated copy. However, if you do need to re-create it, you might encounter this error:

```
"sql_yacc.yy", line xxx fatal: default action causes potential...
```

This is a sign that your version of `yacc` is deficient. You probably need to install a recent version of `bison` (the GNU version of `yacc`) and use that instead.

Versions of `bison` older than 1.75 may report this error:

```
sql_yacc.yy:#####: fatal error: maximum table size (32767) exceeded
```

The maximum table size is not actually exceeded; the error is caused by bugs in older versions of `bison`.

For information about acquiring or updating tools, see the system requirements in [Chapter 4, Installing MySQL from Source](#).

4.9 MySQL Configuration and Third-Party Tools

Third-party tools that need to determine the MySQL version from the MySQL source can read the `MYSQL_VERSION` file in the top-level source directory. The file lists the pieces of the version separately. For example, if the version is MySQL 8.0.36, the file looks like this:

```

MYSQL_VERSION_MAJOR=8
MYSQL_VERSION_MINOR=0
MYSQL_VERSION_PATCH=36
MYSQL_VERSION_EXTRA=
MYSQL_VERSION_STABILITY="LTS"

```

Note

In MySQL 5.7 and earlier, this file was named `VERSION`.

To construct a five-digit number from the version components, use this formula:

```

MYSQL_VERSION_MAJOR*10000 + MYSQL_VERSION_MINOR*100 + MYSQL_VERSION_PATCH

```

4.10 Generating MySQL Doxygen Documentation Content

The MySQL source code contains internal documentation written using Doxygen. The generated Doxygen content is available at <https://dev.mysql.com/doc/index-other.html>. It is also possible to generate this content locally from a MySQL source distribution using the following procedure:

1. Install `doxygen` 1.9.2 or later. Distributions are available here at <http://www.doxygen.nl/>.

After installing `doxygen`, verify the version number:

```

$> doxygen --version
1.9.2

```

2. Install `PlantUML`.

When you install PlantUML on Windows (tested on Windows 10), you must run it at least once as administrator so it creates the registry keys. Open an administrator console and run this command:

```

$> java -jar path-to-plantuml.jar

```

The command should open a GUI window and return no errors on the console.

3. Set the `PLANTUML_JAR_PATH` environment to the location where you installed PlantUML. For example:

```

$> export PLANTUML_JAR_PATH=path-to-plantuml.jar

```

4. Install the `Graphviz` `dot` command.

After installing Graphviz, verify `dot` availability. For example:

```

$> which dot
/usr/bin/dot
$> dot -V
dot - graphviz version 2.40.1 (20161225.0304)

```

5. Change location to the top-level directory of your MySQL source distribution and do the following:

First, execute `cmake`:

```

$> cd mysql-source-directory
$> mkdir build
$> cd build
$> cmake ..

```

Next, generate the `doxygen` documentation:

```
$> make doxygen
```

Inspect the error log, which is available in the `doxyerror.log` file in the top-level directory. Assuming that the build executed successfully, view the generated output using a browser. For example:

```
$> firefox doxygen/html/index.html
```

Chapter 5 Installing MySQL on Microsoft Windows

Table of Contents

5.1 MySQL Installation Layout on Microsoft Windows	78
5.2 Choosing an Installation Package	78
5.3 MySQL Installer for Windows	79
5.3.1 MySQL Installer Initial Setup	81
5.3.2 Setting Alternative Server Paths with MySQL Installer	85
5.3.3 Installation Workflows with MySQL Installer	86
5.3.4 MySQL Installer Product Catalog and Dashboard	95
5.3.5 MySQL Installer Console Reference	101
5.4 Installing MySQL on Microsoft Windows Using a <code>noinstall</code> ZIP Archive	111
5.4.1 Extracting the Install Archive	111
5.4.2 Creating an Option File	111
5.4.3 Selecting a MySQL Server Type	112
5.4.4 Initializing the Data Directory	113
5.4.5 Starting the Server for the First Time	113
5.4.6 Starting MySQL from the Windows Command Line	114
5.4.7 Customizing the PATH for MySQL Tools	115
5.4.8 Starting MySQL as a Windows Service	115
5.4.9 Testing The MySQL Installation	118
5.5 Troubleshooting a Microsoft Windows MySQL Server Installation	119
5.6 Windows Postinstallation Procedures	120
5.7 Windows Platform Restrictions	122

Important

MySQL 8.0 Server requires the Microsoft Visual C++ 2019 Redistributable Package to run on Windows platforms. Users should make sure the package has been installed on the system before installing the server. The package is available at the [Microsoft Download Center](https://www.microsoft.com/download/details.aspx?id=53349). Additionally, MySQL debug binaries require Visual Studio 2019 to be installed.

MySQL is available for Microsoft Windows 64-bit operating systems only. For supported Windows platform information, see <https://www.mysql.com/support/supportedplatforms/database.html>.

There are different methods to install MySQL on Microsoft Windows.

MySQL Installer Method

The simplest and recommended method is to download MySQL Installer (for Windows) and let it install and configure a specific version of MySQL Server as follows:

1. Download MySQL Installer from <https://dev.mysql.com/downloads/installer/> and execute it.

Note

Unlike the standard MySQL Installer, the smaller `web-community` version does not bundle any MySQL applications, but downloads only the MySQL products you choose to install.

2. Determine the setup type to use for the initial installation of MySQL products. For example:

- **Developer Default:** Provides a setup type that includes the selected version of MySQL Server and other MySQL tools related to MySQL development, such as MySQL Workbench.
 - **Server Only:** Provides a setup for the selected version of MySQL Server without other products.
 - **Custom:** Enables you to select any version of MySQL Server and other MySQL products.
3. Install the server instance (and products) and then begin the server configuration by following the onscreen instructions. For more information about each individual step, see [Section 5.3.3.1, “MySQL Server Configuration with MySQL Installer”](#).

MySQL is now installed. If you configured MySQL as a service, then Windows automatically starts the MySQL server every time you restart the system. Also, this process installs the MySQL Installer application on the local host, which you can use later to upgrade or reconfigure MySQL server.

Note

If you installed MySQL Workbench on your system, consider using it to check your new MySQL server connection. By default, the program automatically start after installing MySQL.

Additional Installation Information

It is possible to run MySQL as a standard application or as a Windows service. By using a service, you can monitor and control the operation of the server through the standard Windows service management tools. For more information, see [Section 5.4.8, “Starting MySQL as a Windows Service”](#).

To accommodate the `RESTART` statement, the MySQL server forks when run as a service or standalone, to enable a monitor process to supervise the server process. In this case, there are two `mysqld` processes. If `RESTART` capability is not required, the server can be started with the `--no-monitor` option. See [RESTART Statement](#).

Generally, you should install MySQL on Windows using an account that has administrator rights. Otherwise, you may encounter problems with certain operations such as editing the `PATH` environment variable or accessing the [Service Control Manager](#). When installed, MySQL does not need to be executed using a user with Administrator privileges.

For a list of limitations on the use of MySQL on the Windows platform, see [Section 5.7, “Windows Platform Restrictions”](#).

In addition to the MySQL Server package, you may need or want additional components to use MySQL with your application or development environment. These include, but are not limited to:

- To connect to the MySQL server using ODBC, you must have a Connector/ODBC driver. For more information, including installation and configuration instructions, see [MySQL Connector/ODBC Developer Guide](#).

Note

MySQL Installer installs and configures Connector/ODBC for you.

- To use MySQL server with .NET applications, you must have the Connector/.NET driver. For more information, including installation and configuration instructions, see [MySQL Connector/.NET Developer Guide](#).

Note

MySQL Installer installs and configures MySQL Connector/NET for you.

MySQL distributions for Windows can be downloaded from <https://dev.mysql.com/downloads/>. See [Section 2.3, “How to Get MySQL”](#).

MySQL for Windows is available in several distribution formats, detailed here. Generally speaking, you should use MySQL Installer. It contains more features and MySQL products than the older MSI, is simpler to use than the compressed file, and you need no additional tools to get MySQL up and running. MySQL Installer automatically installs MySQL Server and additional MySQL products, creates an options file, starts the server, and enables you to create default user accounts. For more information on choosing a package, see [Section 5.2, “Choosing an Installation Package”](#).

- A MySQL Installer distribution includes MySQL Server and additional MySQL products including MySQL Workbench, and MySQL for Visual Studio. MySQL Installer can also be used to upgrade these products in the future (see <https://dev.mysql.com/doc/mysql-compat-matrix/en/>).

For instructions on installing MySQL using MySQL Installer, see [Section 5.3, “MySQL Installer for Windows”](#).

- The standard binary distribution (packaged as a compressed file) contains all of the necessary files that you unpack into your chosen location. This package contains all of the files in the full Windows MSI Installer package, but does not include an installation program.

For instructions on installing MySQL using the compressed file, see [Section 5.4, “Installing MySQL on Microsoft Windows Using a `noinstall` ZIP Archive”](#).

- The source distribution format contains all the code and support files for building the executables using the Visual Studio compiler system.

For instructions on building MySQL from source on Windows, see [Chapter 4, *Installing MySQL from Source*](#).

MySQL on Windows Considerations

- **Large Table Support**

If you need tables with a size larger than 4GB, install MySQL on an NTFS or newer file system. Do not forget to use `MAX_ROWS` and `AVG_ROW_LENGTH` when you create tables. See [CREATE TABLE Statement](#).

- **MySQL and Virus Checking Software**

Virus-scanning software such as Norton/Symantec Anti-Virus on directories containing MySQL data and temporary tables can cause issues, both in terms of the performance of MySQL and the virus-scanning software misidentifying the contents of the files as containing spam. This is due to the fingerprinting mechanism used by the virus-scanning software, and the way in which MySQL rapidly updates different files, which may be identified as a potential security risk.

After installing MySQL Server, it is recommended that you disable virus scanning on the main directory (`datadir`) used to store your MySQL table data. There is usually a system built into the virus-scanning software to enable specific directories to be ignored.

In addition, by default, MySQL creates temporary files in the standard Windows temporary directory. To prevent the temporary files also being scanned, configure a separate temporary directory for

MySQL temporary files and add this directory to the virus scanning exclusion list. To do this, add a configuration option for the `tmpdir` parameter to your `my.ini` configuration file. For more information, see [Section 5.4.2, “Creating an Option File”](#).

5.1 MySQL Installation Layout on Microsoft Windows

For MySQL 8.0 on Windows, the default installation directory is `C:\Program Files\MySQL\MySQL Server 8.0` for installations performed with MySQL Installer. If you use the ZIP archive method to install MySQL, you may prefer to install in `C:\mysql`. However, the layout of the subdirectories remains the same.

All of the files are located within this parent directory, using the structure shown in the following table.

Table 5.1 Default MySQL Installation Layout for Microsoft Windows

Directory	Contents of Directory	Notes
<code>bin</code>	<code>mysqld</code> server, client and utility programs	
<code>%PROGRAMDATA%\MySQL\MySQL Server 8.0\</code>	Log files, databases	The Windows system variable <code>%PROGRAMDATA%</code> defaults to <code>C:\ProgramData</code> .
<code>docs</code>	Release documentation	With MySQL Installer, use the <code>Modify</code> operation to select this optional folder.
<code>include</code>	Include (header) files	
<code>lib</code>	Libraries	
<code>share</code>	Miscellaneous support files, including error messages, character set files, sample configuration files, SQL for database installation	

5.2 Choosing an Installation Package

For MySQL 8.0, there are multiple installation package formats to choose from when installing MySQL on Windows. The package formats described in this section are:

- [MySQL Installer](#)
- [MySQL noinstall ZIP Archives](#)
- [MySQL Docker Images](#)

Program Database (PDB) files (with file name extension `pdb`) provide information for debugging your MySQL installation in the event of a problem. These files are included in ZIP Archive distributions (but not MSI distributions) of MySQL.

MySQL Installer

This package has a file name similar to `mysql-installer-community-8.0.36.0.msi` or `mysql-installer-commercial-8.0.36.0.msi`, and utilizes MSIs to install MySQL server and other products automatically. MySQL Installer downloads and applies updates to itself, and to each of the installed products. It also configures the installed MySQL server (including a sandbox InnoDB cluster test setup) and MySQL Router. MySQL Installer is recommended for most users.

MySQL Installer can install and manage (add, modify, upgrade, and remove) many other MySQL products, including:

- Applications – MySQL Workbench, MySQL for Visual Studio, MySQL Shell, and MySQL Router (see <https://dev.mysql.com/doc/mysql-compat-matrix/en/>)
- Connectors – MySQL Connector/C++, MySQL Connector/NET, Connector/ODBC, MySQL Connector/Python, MySQL Connector/J, MySQL Connector/Node.js
- Documentation – MySQL Manual (PDF format), samples and examples

MySQL Installer operates on all MySQL supported versions of Windows (see <https://www.mysql.com/support/supportedplatforms/database.html>).

Note

Because MySQL Installer is not a native component of Microsoft Windows and depends on .NET, it does not work with minimal installation options like the Server Core version of Windows Server.

For instructions on how to install MySQL using MySQL Installer, see [Section 5.3, “MySQL Installer for Windows”](#).

MySQL noinstall ZIP Archives

These packages contain the files found in the complete MySQL Server installation package, with the exception of the GUI. This format does not include an automated installer, and must be manually installed and configured.

The `noinstall` ZIP archives are split into two separate compressed files. The main package is named `mysql-VERSION-winx64.zip`. This contains the components needed to use MySQL on your system. The optional MySQL test suite, MySQL benchmark suite, and debugging binaries/information components (including PDB files) are in a separate compressed file named `mysql-VERSION-winx64-debug-test.zip`.

If you choose to install a `noinstall` ZIP archive, see [Section 5.4, “Installing MySQL on Microsoft Windows Using a noinstall ZIP Archive”](#).

MySQL Docker Images

For information on using the MySQL Docker images provided by Oracle on Windows platform, see [Section 7.6.3, “Deploying MySQL on Windows and Other Non-Linux Platforms with Docker”](#).

Warning

The MySQL Docker images provided by Oracle are built specifically for Linux platforms. Other platforms are not supported, and users running the MySQL Docker images from Oracle on them are doing so at their own risk.

5.3 MySQL Installer for Windows

MySQL Installer is a standalone application designed to ease the complexity of installing and configuring MySQL products that run on Microsoft Windows. It is downloaded with and supports the following MySQL products:

- MySQL Servers

MySQL Installer can install and manage multiple, separate MySQL server instances on the same host at the same time. For example, MySQL Installer can install, configure, and upgrade separate instances of MySQL 5.7 and MySQL 8.0 on the same host. MySQL Installer does not permit server upgrades between major and minor version numbers, but does permit upgrades within a release series (such as 8.0.21 to 8.0.22).

Note

MySQL Installer cannot install both *Community* and *Commercial* releases of MySQL server on the same host. If you require both releases on the same host, consider using the [ZIP archive](#) distribution to install one of the releases.

- MySQL Applications

MySQL Workbench, MySQL Shell, and MySQL Router.

- MySQL Connectors (up to MySQL 8.0.33)

MySQL Connector/NET, MySQL Connector/Python, MySQL Connector/ODBC, MySQL Connector/J, and MySQL Connector/C++. To install MySQL Connector/Node.js, see <https://dev.mysql.com/downloads/connector/nodejs/>.

Note

To install newer MySQL connectors, visit <https://dev.mysql.com/downloads/>.

Installation Requirements

MySQL Installer requires Microsoft .NET Framework 4.5.2 or later. If this version is not installed on the host computer, you can download it by visiting the [Microsoft website](#).

To invoke MySQL Installer after a successful installation:

1. Right-click Windows Start, select **Run**, and then click **Browse**. Navigate to `Program Files (x86) > MySQL > MySQL Installer for Windows` to open the program folder.
2. Select one of the following files:
 - `MySQLInstaller.exe` to open the graphical application.
 - `MySQLInstallerConsole.exe` to open the command-line application.
3. Click **Open** and then click **OK** in the Run window. If you are prompted to allow the application to make changes to the device, select **Yes**.

Each time you invoke MySQL Installer, the initialization process looks for the presence of an internet connection and prompts you to enable offline mode if it finds no internet access (and offline mode is disabled). Select **Yes** to run MySQL Installer without internet-connection capabilities. MySQL product availability is limited to only those products currently in the product cache when you enable offline mode. To download MySQL products, click the offline mode **Disable** quick action shown on the dashboard.

An internet connection is required to download a manifest containing metadata for the latest MySQL products that are not part of a full bundle. MySQL Installer attempts to download the manifest when you start the application for the first time and then periodically in configurable intervals (see [MySQL Installer options](#)). Alternatively, you can retrieve an updated manifest manually by clicking **Catalog** in the [MySQL Installer dashboard](#).

Note

If the first-time or subsequent manifest download is unsuccessful, an error is logged and you may have limited access to MySQL products during your session. MySQL Installer attempts to download the manifest with each startup until the initial manifest structure is updated. For help finding a product, see [Locating Products to Install](#).

MySQL Installer Community Release

Download software from <https://dev.mysql.com/downloads/installer/> to install the Community release of all MySQL products for Windows. Select one of the following MySQL Installer package options:

- *Web*: Contains MySQL Installer and configuration files only. The web package option downloads only the MySQL products you select to install, but it requires an internet connection for each download. The size of this file is approximately 2 MB. The file name has the form `mysql-installer-community-web-VERSION.N.msi` in which `VERSION` is the MySQL server version number such as 8.0 and `N` is the package number, which begins at 0.
- *Full or Current Bundle*: Bundles all of the MySQL products for Windows (including the MySQL server). The file size is over 300 MB, and the name has the form `mysql-installer-community-VERSION.N.msi` in which `VERSION` is the MySQL Server version number such as 8.0 and `N` is the package number, which begins at 0.

MySQL Installer Commercial Release

Download software from <https://edelivery.oracle.com/> to install the Commercial release (Standard or Enterprise Edition) of MySQL products for Windows. If you are logged in to your My Oracle Support (MOS) account, the Commercial release includes all of the current and previous GA versions available in the Community release, but it excludes development-milestone versions. When you are not logged in, you see only the list of bundled products that you downloaded already.

The Commercial release also includes the following products:

- Workbench SE/EE
- MySQL Enterprise Backup
- MySQL Enterprise Firewall

The Commercial release integrates with your MOS account. For knowledge-base content and patches, see [My Oracle Support](#).

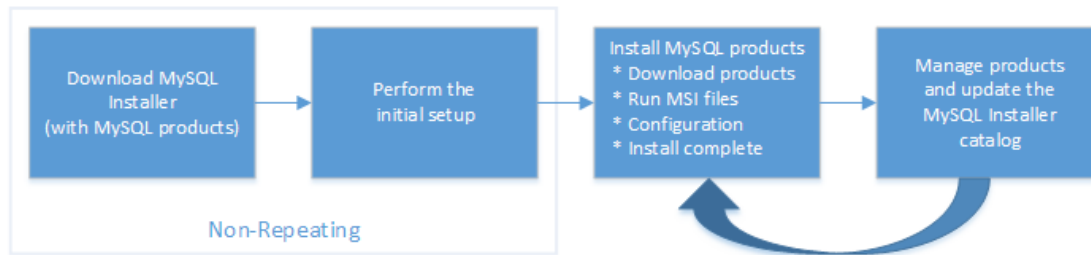
5.3.1 MySQL Installer Initial Setup

- [Choosing a Setup Type](#)
- [Path Conflicts](#)
- [Check Requirements](#)
- [MySQL Installer Configuration Files](#)

When you download MySQL Installer for the first time, a setup wizard guides you through the initial installation of MySQL products. As the following figure shows, the initial setup is a one-time activity in the

overall process. MySQL Installer detects existing MySQL products installed on the host during its initial setup and adds them to the list of products to be managed.

Figure 5.1 MySQL Installer Process Overview



MySQL Installer extracts configuration files (described later) to the hard drive of the host during the initial setup. Although MySQL Installer is a 32-bit application, it can install both 32-bit and 64-bit binaries.

The initial setup adds a link to the Start menu under the **MySQL** folder group. Click **Start, MySQL, and MySQL Installer - [Community | Commercial]** to open the community or commercial release of the graphical tool.

Choosing a Setup Type

During the initial setup, you are prompted to select the MySQL products to be installed on the host. One alternative is to use a predetermined setup type that matches your setup requirements. By default, both GA and pre-release products are included in the download and installation with the **Client only** and **Full** setup types. Select the **Only install GA products** option to restrict the product set to include GA products only when using these setup types.

Note

Commercial-only MySQL products, such as MySQL Enterprise Backup, are available to select and install if you are using the Commercial version of MySQL Installer (see [MySQL Installer Commercial Release](#)).

Choosing one of the following setup types determines the initial installation only and does not limit your ability to install or update MySQL products for Windows later:

- **Server only:** Only install the MySQL server. This setup type installs the general availability (GA) or development release server that you selected when you downloaded MySQL Installer. It uses the default installation and data paths.
- **Client only:** Only install the most recent MySQL applications (such as MySQL Shell, MySQL Router, and MySQL Workbench). This setup type excludes MySQL server or the client programs typically bundled with the server, such as `mysql` or `mysqladmin`.
- **Full:** Install all available MySQL products, excluding MySQL connectors.
- **Custom:** The custom setup type enables you to filter and select individual MySQL products from the [MySQL Installer catalog](#).

Note

For MySQL Server versions 8.0.20 (and earlier) and MySQL 5.7 (all versions), the account you use to run MySQL Installer may not have adequate permission

to install the server data files and this can interrupt the installation because the `ExecSecureObjects` MSI action cannot be executed. To proceed, deselect the **Server data files** feature before attempting to install the server again. For help, see [Product Features To Install](#)).

The **Server data files** check box was removed from the feature tree for MySQL Server 8.0.21 (and higher).

Use the [Custom](#) setup type to install:

- A product or product version that is not available from the usual download locations. The catalog contains all product releases, including the other releases between pre-release (or development) and GA.
- An instance of MySQL server using an alternative installation path, data path, or both. For instructions on how to adjust the paths, see [Section 5.3.2, “Setting Alternative Server Paths with MySQL Installer”](#).
- Two or more MySQL server versions on the same host at the same time (for example, 5.7 and 8.0).
- A specific combination of products and features not offered as a predetermine setup type. For example, you can install a single product, such as MySQL Workbench, instead of installing all client applications for Windows.

Path Conflicts

When the default installation or data folder (required by MySQL server) for a product to be installed already exists on the host, the wizard displays the **Path Conflict** step to identify each conflict and enable you to take action to avoid having files in the existing folder overwritten by the new installation. You see this step in the initial setup only when MySQL Installer detects a conflict.

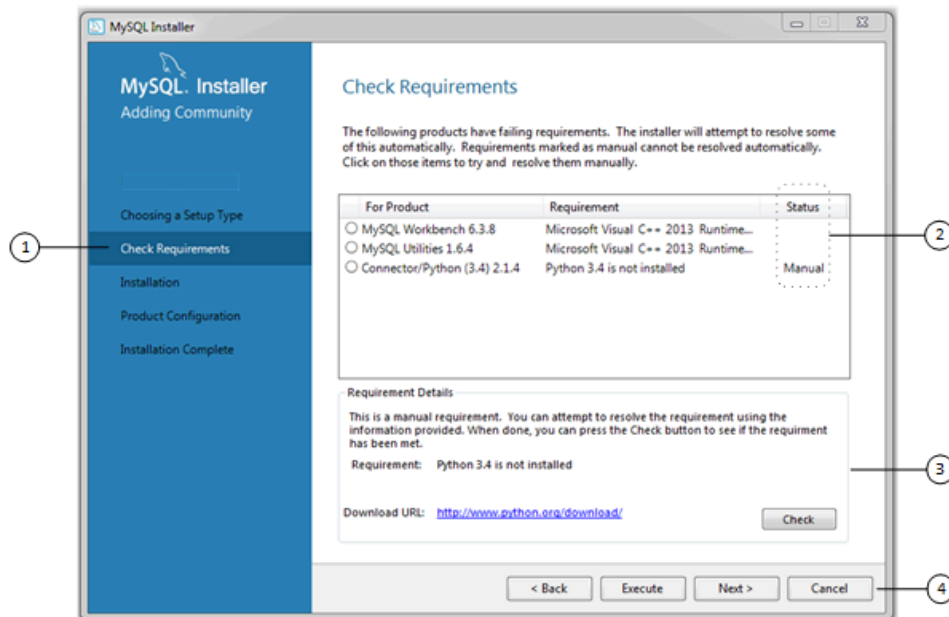
To resolve the path conflict, do one of the following:

- Select a product from the list to display the conflict options. A warning symbol indicates which path is in conflict. Use the browse button to choose a new path and then click **Next**.
- Click **Back** to choose a different setup type or product version, if applicable. The [Custom](#) setup type enables you to select individual product versions.
- Click **Next** to ignore the conflict and overwrite files in the existing folder.
- Delete the existing product. Click **Cancel** to stop the initial setup and close MySQL Installer. Open MySQL Installer again from the Start menu and delete the installed product from the host using the Delete operation from the [MySQL Installer dashboard](#).

Check Requirements

MySQL Installer uses entries in the `package-rules.xml` file to determine whether the prerequisite software for each product is installed on the host. When the requirements check fails, MySQL Installer displays the **Check Requirements** step to help you update the host. Requirements are evaluated each time you download a new product (or version) for installation. The following figure identifies and describes the key areas of this step.

Figure 5.2 Check Requirements



Description of Check Requirements Elements

- Shows the current step in the initial setup. Steps in this list may change slightly depending on the products already installed on the host, the availability of prerequisite software, and the products to be installed on the host.
- Lists all pending installation requirements by product and indicates the status as follows:
 - A blank space in the **Status** column means that MySQL Installer can attempt to download and install the required software for you.
 - The word *Manual* in the **Status** column means that you must satisfy the requirement manually. Select each product in the list to see its requirement details.
- Describes the requirement in detail to assist you with each manual resolution. When possible, a download URL is provided. After you download and install the required software, click **Check** to verify that the requirement has been met.
- Provides the following set operations to proceed:
 - Back** – Return to the previous step. This action enables you to select a different the setup type.
 - Execute** – Have MySQL Installer attempt to download and install the required software for all items without a manual status. Manual requirements are resolved by you and verified by clicking **Check**.
 - Next** – Do not execute the request to apply the requirements automatically and proceed to the installation without including the products that fail the check requirements step.
 - Cancel** – Stop the installation of MySQL products. Because MySQL Installer is already installed, the initial setup begins again when you open MySQL Installer from the Start menu and click **Add** from the dashboard. For a description of the available management operations, see [Product Catalog](#).

MySQL Installer Configuration Files

All MySQL Installer files are located within the `C:\Program Files (x86)` and `C:\ProgramData` folders. The following table describes the files and folders that define MySQL Installer as a standalone application.

Note

Installed MySQL products are neither altered nor removed when you update or uninstall MySQL Installer.

Table 5.2 MySQL Installer Configuration Files

File or Folder	Description	Folder Hierarchy
MySQL Installer for Windows	This folder contains all of the files needed to run MySQL Installer and <code>MySQLInstallerConsole.exe</code> , a command-line program with similar functionality.	<code>C:\Program Files (x86)</code>
Templates	The <code>Templates</code> folder has one file for each version of MySQL server. Template files contain keys and formulas to calculate some values dynamically.	<code>C:\ProgramData\MySQL\MySQL Installer for Windows\Manifest</code>
<code>package-rules.xml</code>	This file contains the prerequisites for every product to be installed.	<code>C:\ProgramData\MySQL\MySQL Installer for Windows\Manifest</code>
<code>products.xml</code>	The <code>products</code> file (or product catalog) contains a list of all products available for download.	<code>C:\ProgramData\MySQL\MySQL Installer for Windows\Manifest</code>
Product Cache	The <code>Product Cache</code> folder contains all standalone <code>.msi</code> files bundled with the full package or downloaded afterward.	<code>C:\ProgramData\MySQL\MySQL Installer for Windows</code>

5.3.2 Setting Alternative Server Paths with MySQL Installer

You can change the default installation path, the data path, or both when you install MySQL server. After you have installed the server, the paths cannot be altered without removing and reinstalling the server instance.

Note

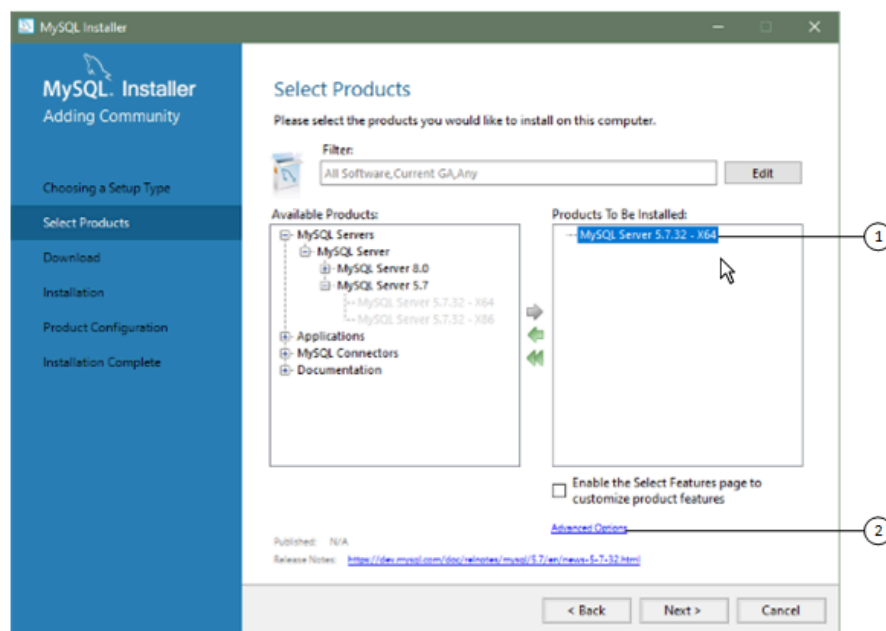
Starting with MySQL Installer 1.4.39, if you move the data directory of an installed server manually, MySQL Installer identifies the change and can process a reconfiguration operation without errors.

To change paths for MySQL server

1. Identify the MySQL server to change and enable the **Advanced Options** link as follows:
 - a. Navigate to the **Select Products** page by doing one of the following:
 - i. If this is an **initial setup** of MySQL Installer, select the **Custom** setup type and click **Next**.

- ii. If MySQL Installer is installed on your computer, click **Add** from the dashboard.
 - b. Click **Edit** to apply a filter on the product list shown in **Available Products** (see [Locating Products to Install](#)).
 - c. With the server instance selected, use the arrow to move the selected server to the **Products To Be Installed** list.
 - d. Click the server to select it. When you select the server, the **Advanced Options** link is enabled below the list of products to be installed (see the following figure).
2. Click **Advanced Options** to open a dialog box where you can enter alternative path names. After the path names are validated, click **Next** to continue with the configuration steps.

Figure 5.3 Change MySQL Server Path



5.3.3 Installation Workflows with MySQL Installer

MySQL Installer provides a wizard-like tool to install and configure new MySQL products for Windows. Unlike the initial setup, which runs only once, MySQL Installer invokes the wizard each time you download or install a new product. For first-time installations, the steps of the initial setup proceed directly into the steps of the installation. For assistance with product selection, see [Locating Products to Install](#).

Note

Full permissions are granted to the user executing MySQL Installer to all generated files, such as `my.ini`. This does not apply to files and directories for specific products, such as the MySQL server data directory in `%ProgramData%` that is owned by `SYSTEM`.

Products installed and configured on a host follow a general pattern that might require your input during the various steps. If you attempt to install a product that is incompatible with the existing MySQL server version (or a version selected for upgrade), you are alerted about the possible mismatch.

MySQL Installer provides the following sequence of actions that apply to different workflows:

- **Select Products.** If you selected the [Custom](#) setup type during the initial setup or clicked **Add** from the [MySQL Installer dashboard](#), MySQL Installer includes this action in the sidebar. From this page, you can apply a filter to modify the Available Products list and then select one or more products to move (using arrow keys) to the Products To Be Installed list.

Select the check box on this page to activate the Select Features action where you can customize the products features after the product is downloaded.

- **Download.** If you installed the full (not web) MySQL Installer package, all [.msi](#) files were loaded to the [Product Cache](#) folder during the initial setup and are not downloaded again. Otherwise, click **Execute** to begin the download. The status of each product changes from [Ready to Download](#), to [Downloading](#), and then to [Downloaded](#).

To retry a single unsuccessful download, click the **Try Again** link.

To retry all unsuccessful downloads, click **Try All**.

- **Select Features To Install (disabled by default).** After MySQL Installer downloads a product's [.msi](#) file, you can customize the features if you enabled the optional check box previously during the Select Products action.

To customize product features after the installation, click **Modify** in the [MySQL Installer dashboard](#).

- **Installation.** The status of each product in the list changes from [Ready to Install](#), to [Installing](#), and lastly to [Complete](#). During the process, click **Show Details** to view the installation actions.

If you cancel the installation at this point, the products are installed, but the server (if installed) is not yet configured. To restart the server configuration, open MySQL Installer from the Start menu and click **Reconfigure** next to the appropriate server in the dashboard.

- **Product configuration.** This step applies to MySQL Server, MySQL Router, and samples only. The status for each item in the list should indicate [Ready to Configure](#). Click **Next** to start the configuration wizard for all items in the list. The configuration options presented during this step are specific to the version of database or router that you selected to install.

Click **Execute** to begin applying the configuration options or click **Back** (repeatedly) to return to each configuration page.

- **Installation complete.** This step finalizes the installation for products that do not require configuration. It enables you to copy the log to a clipboard and to start certain applications, such as MySQL Workbench and MySQL Shell. Click **Finish** to open the [MySQL Installer dashboard](#).

5.3.3.1 MySQL Server Configuration with MySQL Installer

MySQL Installer performs the initial configuration of the MySQL server. For example:

- It creates the configuration file ([my.ini](#)) that is used to configure the MySQL server. The values written to this file are influenced by choices you make during the installation process. Some definitions are host dependent. For example, `query_cache` is enabled if the host has fewer than three cores.

Note

Query cache was deprecated in MySQL 5.7 and removed in MySQL 8.0 (and later).

- By default, a Windows service for the MySQL server is added.

- Provides default installation and data paths for MySQL server. For instructions on how to change the default paths, see [Section 5.3.2, “Setting Alternative Server Paths with MySQL Installer”](#).
- It can optionally create MySQL server user accounts with configurable permissions based on general roles, such as DB Administrator, DB Designer, and Backup Admin. It optionally creates a Windows user named `MysqSys` with limited privileges, which would then run the MySQL Server.

User accounts may also be added and configured in MySQL Workbench.

- Checking **Show Advanced Options** enables additional **Logging Options** to be set. This includes defining custom file paths for the error log, general log, slow query log (including the configuration of seconds it requires to execute a query), and the binary log.

During the configuration process, click **Next** to proceed to the next step or **Back** to return to the previous step. Click **Execute** at the final step to apply the server configuration.

The sections that follow describe the server configuration options that apply to MySQL server on Windows. The server version you installed will determine which steps and options you can configure. Configuring MySQL server may include some or all of the steps.

Type and Networking

- Server Configuration Type

Choose the MySQL server configuration type that describes your setup. This setting defines the amount of system resources (memory) to assign to your MySQL server instance.


- **Development:** A computer that hosts many other applications, and typically this is your personal workstation. This setting configures MySQL to use the least amount of memory.
- **Server:** Several other applications are expected to run on this computer, such as a web server. The Server setting configures MySQL to use a medium amount of memory.
- **Dedicated:** A computer that is dedicated to running the MySQL server. Because no other major applications run on this server, this setting configures MySQL to use the majority of available memory.
- **Manual**

Prevents MySQL Installer from attempting to optimize the server installation, and instead, sets the default values to the server variables included in the `my.ini` configuration file. With the **Manual** type selected, MySQL Installer uses the default value of 16M for the `tmp_table_size` variable assignment.

- Connectivity

Connectivity options control how the connection to MySQL is made. Options include:

- **TCP/IP:** This option is selected by default. You may disable TCP/IP Networking to permit local host connections only. With the TCP/IP connection option selected, you can modify the following items:
 - **Port** for classic MySQL protocol connections. The default value is `3306`.
 - **X Protocol Port** shown when configuring MySQL 8.0 server only. The default value is `33060`
 - **Open Windows Firewall port for network access**, which is selected by default for TCP/IP connections.

If a port number is in use already, you will see the information icon () next to the default value and **Next** is disabled until you provide a new port number.

- **Named Pipe:** Enable and define the pipe name, similar to setting the `named_pipe` system variable. The default name is `MySQL`.

When you select **Named Pipe** connectivity, and then proceed to the next step, you are prompted to set the level of access control granted to client software on named-pipe connections. Some clients require only minimum access control for communication, while other clients require full access to the named pipe.

You can set the level of access control based on the Windows user (or users) running the client as follows:

- **Minimum access to all users (RECOMMENDED).** This level is enabled by default because it is the most secure.
- **Full access to members of a local group.** If the minimum-access option is too restrictive for the client software, use this option to reduce the number of users who have full access on the named pipe. The group must be established on Windows before you can select it from the list. Membership in this group should be limited and managed. Windows requires a newly added member to first log out and then log in again to join a local group.
- **Full access to all users (NOT RECOMMENDED).** This option is less secure and should be set only when other safeguards are implemented.
- **Shared Memory:** Enable and define the memory name, similar to setting the `shared_memory` system variable. The default name is `MySQL`.
- **Advanced Configuration**

Check **Show Advanced and Logging Options** to set custom logging and advanced options in later steps. The Logging Options step enables you to define custom file paths for the error log, general log, slow query log (including the configuration of seconds it requires to execute a query), and the binary log. The Advanced Options step enables you to set the unique server ID required when binary logging is enabled in a replication topology.

- **MySQL Enterprise Firewall (Enterprise Edition only)**

The **Enable MySQL Enterprise Firewall** check box is deselected by default. Select this option to enable a security list that offers protection against certain types of attacks. Additional post-installation configuration is required (see [MySQL Enterprise Firewall](#)).

Important

There is an issue for MySQL 8.0.19 that prevents the server from starting if MySQL Enterprise Firewall is selected during the server configuration steps. If the server startup operation fails, click **Cancel** to end the configuration process and return to the dashboard. You must uninstall the server.

The workaround is to run MySQL Installer without MySQL Enterprise Firewall selected. (That is, do not select the **Enable MySQL Enterprise Firewall** check box.) Then install MySQL Enterprise Firewall afterward using the instructions for manual installation (see [Installing or Uninstalling MySQL Enterprise Firewall](#)).

Authentication Method

The **Authentication Method** step is visible only during the installation or upgrade of MySQL 8.0.4 or higher. It introduces a choice between two server-side authentication options. The MySQL user accounts that you create in the next step will use the authentication method that you select in this step.

MySQL 8.0 connectors and community drivers that use `libmysqlclient` 8.0 now support the `caching_sha2_password` default authentication plugin. However, if you are unable to update your clients and applications to support this new authentication method, you can configure the MySQL server to use `mysql_native_password` for legacy authentication. For more information about the implications of this change, see [caching_sha2_password as the Preferred Authentication Plugin](#).

If you are installing or upgrading to MySQL 8.0.4 or higher, select one of the following authentication methods:

- Use Strong Password Encryption for Authentication (RECOMMENDED)

MySQL 8.0 supports a new authentication based on improved, stronger SHA256-based password methods. It is recommended that all new MySQL server installations use this method going forward.

Important

The `caching_sha2_password` authentication plugin on the server requires new versions of connectors and clients, which add support for the new MySQL 8.0 default authentication.

- Use Legacy Authentication Method (Retain MySQL 5.x Compatibility)


Using the old MySQL 5.x legacy authentication method should be considered only in the following cases:

- Applications cannot be updated to use MySQL 8.0 connectors and drivers.
- Recompilation of an existing application is not feasible.
- An updated, language-specific connector or driver is not available yet.

Accounts and Roles

- Root Account Password

Assigning a root password is required and you will be asked for it when performing other MySQL Installer operations. Password strength is evaluated when you repeat the password in the box provided. For descriptive information regarding password requirements or status, move your mouse pointer over

the information icon () when it appears.

- MySQL User Accounts (Optional)

Click **Add User** or **Edit User** to create or modify MySQL user accounts with predefined roles. Next, enter the required account credentials:

- **User Name:** MySQL user names can be up to 32 characters long.
- **Host:** Select `localhost` for local connections only or `<All Hosts (%)>` when remote connections to the server are required.

- **Role:** Each predefined role, such as `DB Admin`, is configured with its own set of privileges. For example, the `DB Admin` role has more privileges than the `DB Designer` role. The **Role** drop-down list contains a description of each role.
- **Password:** Password strength assessment is performed while you type the password. Passwords must be confirmed. MySQL permits a blank or empty password (considered to be insecure).

MySQL Installer Commercial Release Only: MySQL Enterprise Edition for Windows, a commercial product, also supports an authentication method that performs external authentication on Windows. Accounts authenticated by the Windows operating system can access the MySQL server without providing an additional password.

To create a new MySQL account that uses Windows authentication, enter the user name and then select a value for **Host** and **Role**. Click **Windows** authentication to enable the `authentication_windows` plugin. In the Windows Security Tokens area, enter a token for each Windows user (or group) who can authenticate with the MySQL user name. MySQL accounts can include security tokens for both local Windows users and Windows users that belong to a domain. Multiple security tokens are separated by the semicolon character (`;`) and use the following format for local and domain accounts:

- Local account

Enter the simple Windows user name as the security token for each local user or group; for example, `finley;jeffrey;admin`.

- Domain account

Use standard Windows syntax (`domain\domainuser`) or MySQL syntax (`domain\domainuser`) to enter Windows domain users and groups.

For domain accounts, you may need to use the credentials of an administrator within the domain if the account running MySQL Installer lacks the permissions to query the Active Directory. If this is the case, select **Validate Active Directory users with** to activate the domain administrator credentials.

Windows authentication permits you to test all of the security tokens each time you add or modify a token. Click **Test Security Tokens** to validate (or revalidate) each token. Invalid tokens generate a descriptive error message along with a red `x` icon and red token text. When all tokens resolve as valid (green text without an `x` icon), you can click **OK** to save the changes.

Windows Service

On the Windows platform, MySQL server can run as a named service managed by the operating system and be configured to start up automatically when Windows starts. Alternatively, you can configure MySQL server to run as an executable program that requires manual configuration.

- **Configure MySQL server as a Windows service** (Selected by default.)

When the default configuration option is selected, you can also select the following:

- **Start the MySQL Server at System Startup**

When selected (default), the service startup type is set to Automatic; otherwise, the startup type is set to Manual.

- **Run Windows Service as**

When **Standard System Account** is selected (default), the service logs on as Network Service.

The **Custom User** option must have privileges to log on to Microsoft Windows as a service. The **Next** button will be disabled until this user is configured with the required privileges.

A custom user account is configured in Windows by searching for "local security policy" in the Start menu. In the Local Security Policy window, select **Local Policies, User Rights Assignment**, and then **Log On As A Service** to open the property dialog. Click **Add User or Group** to add the custom user and then click **OK** in each dialog to save the changes.

- Deselect the Windows Service option.

Server File Permissions

Optionally, permissions set on the folders and files located at `C:\ProgramData\MySQL\MySQL Server 8.0\Data` can be managed during the server configuration operation. You have the following options:

- MySQL Installer can configure the folders and files with full control granted exclusively to the user running the Windows service, if applicable, and to the Administrators group.

All other groups and users are denied access. This is the default option.

- Have MySQL Installer use a configuration option similar to the one just described, but also have MySQL Installer show which users could have full control.

You are then able to decide if a group or user should be given full control. If not, you can move the qualified members from this list to a second list that restricts all access.

- Have MySQL Installer skip making file-permission changes during the configuration operation.

If you select this option, you are responsible for securing the `Data` folder and its related files manually after the server configuration finishes.

Logging Options

This step is available if the **Show Advanced Configuration** check box was selected during the **Type and Networking** step. To enable this step now, click **Back** to return to the **Type and Networking** step and select the check box.

Advanced configuration options are related to the following MySQL log files:

- [Error Log](#)
- [General Log](#)
- [Slow Query Log](#)
- [Bin Log](#)

Note

The binary log is enabled by default for MySQL 5.7 and higher.

Advanced Options

This step is available if the **Show Advanced Configuration** check box was selected during the **Type and Networking** step. To enable this step now, click **Back** to return to the **Type and Networking** step and select the check box.

The advanced-configuration options include:

- **Server ID**

Set the unique identifier used in a replication topology. If binary logging is enabled, you must specify a server ID. The default ID value depends on the server version. For more information, see the description of the `server_id` system variable.

- **Table Names Case**

You can set the following options during the initial and subsequent configuration the server. For the MySQL 8.0 release series, these options apply only to the initial configuration of the server.

- **Lower Case**

Sets the `lower_case_table_names` option value to 1 (default), in which table names are stored in lowercase on disk and comparisons are not case-sensitive.

- **Preserve Given Case**

Sets the `lower_case_table_names` option value to 2, in which table names are stored as given but compared in lowercase.

Apply Server Configuration

All configuration settings are applied to the MySQL server when you click **Execute**. Use the **Configuration Steps** tab to follow the progress of each action; the icon for each toggles from white to green (with a check mark) on success. Otherwise, the process stops and displays an error message if an individual action times out. Click the **Log** tab to view the log.

When the installation completes successfully and you click **Finish**, MySQL Installer and the installed MySQL products are added to the Microsoft Windows Start menu under the `MySQL` group. Opening MySQL Installer loads the `dashboard` where installed MySQL products are listed and other MySQL Installer operations are available.

5.3.3.2 MySQL Router Configuration with MySQL Installer

MySQL Installer downloads and installs a suite of tools for developing and managing business-critical applications on Windows. The suite consists of applications, connectors, documentation, and samples.

During the `initial setup`, choose any predetermined setup type, except `Server only`, to install the latest GA version of the tools. Use the `Custom` setup type to install an individual tool or specific version. If MySQL Installer is installed on the host already, use the **Add** operation to select and install tools from the MySQL Installer dashboard.

MySQL Router Configuration

MySQL Installer provides a configuration wizard that can bootstrap an installed instance of MySQL Router 8.0 to direct traffic between MySQL applications and an InnoDB Cluster. When configured, MySQL Router runs as a local Windows service.

Note

You are prompted to configure MySQL Router after the initial installation and when you reconfigure an installed router explicitly. In contrast, the upgrade operation does not require or prompt you to configure the upgraded product.

To configure MySQL Router, do the following:

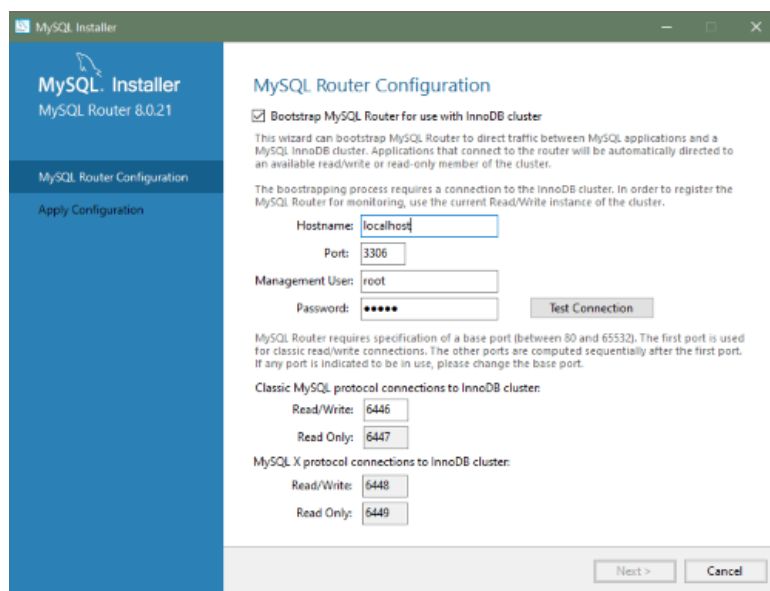
1. Set up InnoDB Cluster.
2. Using MySQL Installer, download and install the MySQL Router application. After the installation finishes, the configuration wizard prompts you for information. Select the **Configure MySQL Router for InnoDB Cluster** check box to begin the configuration and provide the following configuration values:

- **Hostname:** Host name of the primary (seed) server in the InnoDB Cluster (`localhost` by default).
- **Port:** The port number of the primary (seed) server in the InnoDB Cluster (`3306` by default).
- **Management User:** An administrative user with root-level privileges.
- **Password:** The password for the management user.
- **Classic MySQL protocol connections to InnoDB Cluster**

Read/Write: Set the first base port number to one that is unused (between 80 and 65532) and the wizard will select the remaining ports for you.

The figure that follows shows an example of the MySQL Router configuration page, with the first base port number specified as 6446 and the remaining ports set by the wizard to 6447, 6448, and 6449.

Figure 5.4 MySQL Router Configuration



3. Click **Next** and then **Execute** to apply the configuration. Click **Finish** to close MySQL Installer or return to the [MySQL Installer dashboard](#).

After configuring MySQL Router, the root account exists in the user table as `root@localhost` (local) only, instead of `root@%` (remote). Regardless of where the router and client are located, even if both are located on the same host as the seed server, any connection that passes through the router is viewed by server as being remote, not local. As a result, a connection made to the server using the local host (see the example that follows), does not authenticate.

```
$> \c root@localhost:6446
```

5.3.4 MySQL Installer Product Catalog and Dashboard

This section describes the MySQL Installer product catalog, the dashboard, and other actions related to product selection and upgrades.

- [Product Catalog](#)
- [MySQL Installer Dashboard](#)
- [Locating Products to Install](#)
- [Upgrading MySQL Server](#)
- [Removing MySQL Server](#)
- [Upgrading MySQL Installer](#)

Product Catalog

The product catalog stores the complete list of released MySQL products for Microsoft Windows that are available to download from [MySQL Downloads](#). By default, and when an Internet connection is present, MySQL Installer attempts to update the catalog at startup every seven days. You can also update the catalog manually from the dashboard (described later).

An up-to-date catalog performs the following actions:

- Populates the **Available Products** pane of the Select Products page. This step appears when you select:
 - The [Custom](#) setup type during the [initial setup](#).
 - The **Add** operation from the dashboard.
- Identifies when product updates are available for the installed products listed in the dashboard.

The catalog includes all development releases (Pre-Release), general releases (Current GA), and minor releases (Other Releases). Products in the catalog will vary somewhat, depending on the MySQL Installer release that you download.

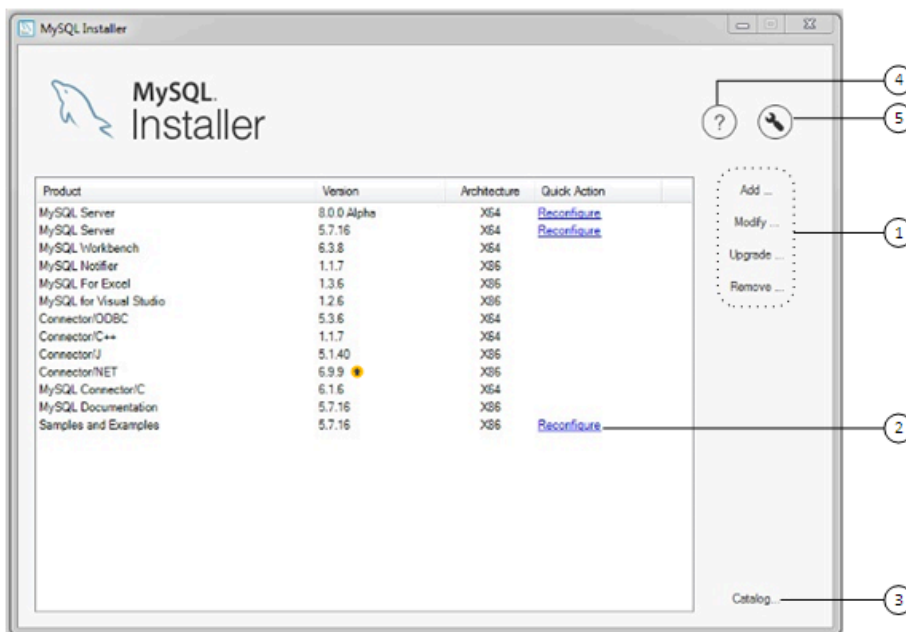
MySQL Installer Dashboard

The MySQL Installer dashboard is the default view that you see when you start MySQL Installer after the [initial setup](#) finishes. If you closed MySQL Installer before the setup was finished, MySQL Installer resumes the initial setup before it displays the dashboard.

Note

Products covered under Oracle Lifetime Sustaining Support, if installed, may appear in the dashboard. These products, such as MySQL for Excel and MySQL Notifier, can be modified or removed only.

Figure 5.5 MySQL Installer Dashboard Elements



Description of MySQL Installer Dashboard Elements

1. MySQL Installer dashboard operations provide a variety of actions that apply to installed products or products listed in the catalog. To initiate the following operations, first click the operation link and then select the product or products to manage:

- **Add:** This operation opens the Select Products page. From there you can adjust the filter, select one or more products to download (as needed), and begin the installation. For hints about using the filter, see [Locating Products to Install](#).

Use the directional arrows to move each product from the **Available Products** column to the **Products To Be Installed** column. To enable the Product Features page where you can customize features, click the related check box (disabled by default).

Note

For MySQL Server versions 8.0.20 (and earlier) and MySQL 5.7 (all versions), the account you use to run MySQL Installer may not have adequate permission to install the server data files and this can interrupt the installation because the `ExecSecureObjects` MSI action cannot be executed. To proceed, deselect the **Server data files** feature before attempting to install the server again.

The **Server data files** check box was removed from the feature tree for MySQL Server 8.0.21 (or higher).

- **Modify:** Use this operation to add or remove the features associated with installed products. Features that you can modify vary in complexity by product. When the **Program Shortcut** check box is selected, the product appears in the Start menu under the [MySQL](#) group.
- **Upgrade:** This operation loads the Select Products to Upgrade page and populates it with all the upgrade candidates. An installed product can have more than one upgrade version and the operation

requires a current product catalog. MySQL Installer upgrades all of the selected products in one action. Click **Show Details** to view the actions performed by MySQL Installer.

- **Remove:** This operation opens the Remove Products page and populates it with the MySQL products installed on the host. Select the MySQL products you want to remove (uninstall) and then click **Execute** to begin the removal process. During the operation, an indicator shows the number of steps that are executed as a percentage of all steps.


To select products to remove, do one of the following:

- Select the check box for one or more products.
 - Select the **Product** check box to select all products.
2. The **Reconfigure** link in the Quick Action column next to each installed server loads the current configuration values for the server and then cycles through all configuration steps enabling you to change the options and values. You must provide credentials with root privileges to reconfigure these items. Click the **Log** tab to show the output of each configuration step performed by MySQL Installer.

On completion, MySQL Installer stops the server, applies the configuration changes, and restarts the server for you. For a description of each configuration option, see [Section 5.3.3.1, “MySQL Server Configuration with MySQL Installer”](#). Installed [Samples and Examples](#) associated with a specific MySQL server version can also be reconfigured to apply new feature settings, if any.


3. The **Catalog** link enables you to download the latest catalog of MySQL products manually and then to integrate those product changes with MySQL Installer. The catalog-download action does not perform an upgrade of the products already installed on the host. Instead, it returns to the dashboard and adds an arrow icon to the Version column for each installed product that has a newer version. Use the **Upgrade** operation to install the newer product version.

You can also use the **Catalog** link to display the current change history of each product without downloading the new catalog. Select the **Do not update at this time** check box to view the change history only.

4. The MySQL Installer About icon () shows the current version of MySQL Installer and general information about MySQL. The version number is located above the **Back** button.

Tip


Always include this version number when reporting a problem with MySQL Installer.

In addition to the About MySQL information () , you can also select the following icons from the side panel:

- License icon () for MySQL Installer.

This product may include third-party software, used under license. If you are using a Commercial release of MySQL Installer, the icon opens the MySQL Installer Commercial License Information User Manual for licensing information, including licensing information relating to third-party software that may be included in this Commercial release. If you are using a Community release of MySQL Installer, the icon opens the MySQL Installer Community License Information User Manual for licensing information, including licensing information relating to third-party software that may be included in this Community release.


- Resource links icon () to the latest MySQL product documentation, blogs, webinars, and more.

5. The MySQL Installer Options icon () includes the following tabs:

- **General:** Enables or disables the Offline mode option. If selected, this option configures MySQL Installer to run without depending on internet-connection capabilities. When running MySQL Installer in offline mode, you see a warning together with a **Disable** quick action on the dashboard. The warning serves to remind you that running MySQL Installer in offline mode prevents you from downloading the latest MySQL products and product catalog updates. Offline mode persists until you disable the option.

At startup, MySQL Installer determines whether an internet connection is present, and, if not, prompts you to enable offline mode to resume working without a connection.

- **Product Catalog:** Manages the automatic catalog updates. By default, MySQL Installer checks for catalog updates at startup every seven days. When new products or product versions are available,

MySQL Installer adds them to the catalog and then inserts an arrow icon () next to the version number of installed products listed in the dashboard.

Use the product catalog option to enable or disable automatic updates and to reset the number of days between automatic catalog downloads. At startup, MySQL Installer uses the number of days you set to determine whether a download should be attempted. This action is repeated during next startup if MySQL Installer encounters an error downloading the catalog.

- **Connectivity Settings:** Several operations performed by MySQL Installer require internet access. This option enables you to use a default value to validate the connection or to use a different URL, one selected from a list or added by you manually. With the **Manual** option selected, new URLs can be added and all URLs in the list can be moved or deleted. When the **Automatic** option is selected, MySQL Installer attempts to connect to each default URL in the list (in order) until a connection is made. If no connection can be made, it raises an error.
- **Proxy:** MySQL Installer provides multiple proxy modes that enable you to download MySQL products, updates, or even the product catalog in most network environments. The mode are:

- **No proxy**

Select this mode to prevent MySQL Installer from looking for system settings. This mode disables any proxy settings.

- **Automatic**

Select this mode to have MySQL Installer look for system settings and to use those settings if found, or to use no proxy if nothing is found. This mode is the default.

- **Manual**

Select this mode to have MySQL Installer use your authentication details to configuration proxy access to the internet. Specifically:

- A proxy-server address (<http://address-to-server>) and port number
- A user name and password for authentication

Locating Products to Install

MySQL products in the catalog are listed by category: MySQL Servers, Applications, MySQL Connectors, and Documentation. Only the latest GA versions appear in the **Available Products** pane by default. If you are looking for a pre-release or older version of a product, it may not be visible in the default list.

Note

Keep the product catalog up-to-date. Click **Catalog** on the MySQL Installer dashboard to download the latest manifest.

To change the default product list, click **Add** in the dashboard to open the Select Products page, and then click **Edit** to open the dialog box shown in the figure that follows. Modify the settings and then click **Filter**.

Figure 5.6 Filter Available Products

The screenshot shows a dialog box titled 'Filter Available Products'. It has the following controls:

- Text:** A text input field.
- Category:** A dropdown menu currently set to 'All Software'.
- Maturity:** A dropdown menu currently set to 'Current GA'.
- Already Downloaded:** A checkbox that is currently unchecked.
- Architecture:** Three radio buttons: 'Any' (selected), '32-bit', and '64-bit'.
- Filter:** A button at the bottom right.

Reset one or more of the following fields to modify the list of available products:

- **Text:** Filter by text.
- **Category:** All Software (default), MySQL Servers, Applications, MySQL Connectors, or Documentation (for samples and documentation).
- **Maturity:** Current Bundle (appears initially with the full package only), Pre-Release, Current GA, or Other Releases. If you see a warning, confirm that you have the most recent product manifest by clicking **Catalog** on the MySQL Installer dashboard. If MySQL Installer is unable to download the manifest, the range of products you see is limited to bundled products, standalone product MSIs located in the [Product Cache](#) folder already, or both.

Note

The Commercial release of MySQL Installer does not display any MySQL products when you select the Pre-Release maturity filter. Products in development are available from the Community release of MySQL Installer only.

- **Already Downloaded** (the check box is deselected by default). Permits you to view and manage downloaded products only.
- **Architecture:** Any (default), 32-bit, or 64-bit.

Upgrading MySQL Server

Important server upgrade conditions:

- MySQL Installer does not permit server upgrades between major release versions or minor release versions, but does permit upgrades within a release series, such as an upgrade from 5.7.18 to 5.7.19.

- Upgrades between milestone releases (or from a milestone release to a GA release) are not supported. Significant development changes take place in milestone releases and you may encounter compatibility issues or problems starting the server.
- For upgrades to MySQL 8.0.16 server and higher, a check box enables you to skip the upgrade check and process for system tables, while checking and processing data dictionary tables normally. MySQL Installer does not prompt you with the check box when the previous server upgrade was skipped or when the server was configured as a sandbox InnoDB Cluster. This behavior represents a change in how MySQL Server performs an upgrade (see [Section 10.4, “What the MySQL Upgrade Process Upgrades”](#)) and it alters the sequence of steps that MySQL Installer applies to the configuration process.

If you select **Skip system tables upgrade check and process. (Not recommended)**, MySQL Installer starts the upgraded server with the `--upgrade=MINIMAL` server option, which upgrades the data dictionary only. If you stop and then restart the server without the `--upgrade=MINIMAL` option, the server upgrades the system tables automatically, if needed.

The following information appears in the **Log** tab and log file after the upgrade configuration (with system tables skipped) is complete:

```
WARNING: The system tables upgrade was skipped after upgrading MySQL Server. The
server will be started now with the --upgrade=MINIMAL option, but then each
time the server is started it will attempt to upgrade the system tables, unless
you modify the Windows service (command line) to add --upgrade=MINIMAL to bypass
the upgrade.

FOR THE BEST RESULTS: Run mysqld.exe --upgrade=FORCE on the command line to upgrade
the system tables manually.
```

To choose a new server version:

1. Click **Upgrade**. Confirm that the check box next to product name in the **Upgradeable Products** pane has a check mark. Deselect the products that you do not intend to upgrade at this time.

Note

For server milestone releases in the same release series, MySQL Installer deselects the server upgrade and displays a warning to indicate that the upgrade is not supported, identifies the risks of continuing, and provides a summary of the steps to perform a logical upgrade manually. You can reselect server upgrade at your own risk. For instructions on how to perform a logical upgrade with a milestone release, see [Logical Upgrade](#).

2. Click a product in the list to highlight it. This action populates the **Upgradeable Versions** pane with the details of each available version for the selected product: version number, published date, and a [Changes](#) link to open the release notes for that version.

Removing MySQL Server


To remove a local MySQL server:

1. Determine whether the local data directory should be removed. If you retain the data directory, another server installation can reuse the data. This option is enabled by default (removes the data directory).
2. Click **Execute** to begin uninstalling the local server. Note that all products that you selected to remove are also uninstalled at this time.
3. (Optional) Click the **Log** tab to display the current actions performed by MySQL Installer.

Upgrading MySQL Installer

MySQL Installer remains installed on your computer, and like other software, MySQL Installer can be upgraded from the previous version. In some cases, other MySQL software may require that you upgrade MySQL Installer for compatibility. This section describes how to identify the current version of MySQL Installer and how to upgrade MySQL Installer manually.

To locate the installed version of MySQL Installer:

1. Start MySQL Installer from the search menu. The MySQL Installer dashboard opens.
2. Click the MySQL Installer About icon (). The version number is located above the **Back** button.

To initiate an on-demand upgrade of MySQL Installer:

1. Connect the computer with MySQL Installer installed to the internet.
2. Start MySQL Installer from the search menu. The MySQL Installer dashboard opens.
3. Click **Catalog** on the bottom of the dashboard to open the Update Catalog window.
4. Click **Execute** to begin the process. If the installed version of MySQL Installer can be upgraded, you will be prompted to start the upgrade.
5. Click **Next** to review all changes to the catalog and then click **Finish** to return to the dashboard.
6. Verify the (new) installed version of MySQL Installer (see the previous procedure).

5.3.5 MySQL Installer Console Reference

`MySQLInstallerConsole.exe` provides command-line functionality that is similar to MySQL Installer. This reference includes:

- [MySQL Product Names](#)
- [Command Syntax](#)
- [Command Actions](#)

The console is installed when MySQL Installer is initially executed and then available within the `MySQL Installer for Windows` directory. By default, the directory location is `C:\Program Files (x86)\MySQL\MySQL Installer for Windows`. You must run the console as administrator.

To use the console:

1. Open a command prompt with administrative privileges by selecting **Windows System** from **Start**, then right-click **Command Prompt**, select **More**, and select **Run as administrator**.
2. From the command line, optionally change the directory to where the `MySQLInstallerConsole.exe` command is located. For example, to use the default installation location:

```
cd Program Files (x86)\MySQL\MySQL Installer for Windows
```

3. Type `MySQLInstallerConsole.exe` (or `mysqlinstallerconsole`) followed by a command action to perform a task. For example, to show the console's help:

```
MySQLInstallerConsole.exe --help
```

```
===== Start Initialization =====  
MySQL Installer is running in Community mode
```

```

Attempting to update manifest.
Initializing product requirements.
Loading product catalog.
Checking for product packages in the bundle.
Categorizing product catalog.
Finding all installed packages.
Your product catalog was last updated at 23/08/2022 12:41:05 p. m.
Your product catalog has version number 671.
===== End Initialization =====

The following actions are available:

Configure - Configures one or more of your installed programs.
Help       - Provides list of available command actions.
Install    - Installs and configures one or more available MySQL programs.
List       - Lists all available MySQL products.
Modify     - Modifies the features of installed products.
Remove     - Removes one or more products from your system.
Set        - Configures the general options of MySQL Installer.
Status     - Shows the status of all installed products.
Update     - Updates the current product catalog.
Upgrade    - Upgrades one or more of your installed programs.

The basic syntax for using MySQL Installer command actions. Brackets denote optional entities.
Curly braces denote a list of possible entities.

...

```

MySQL Product Names

Many of the `MySQLInstallerConsole` command actions accept one or more abbreviated phrases that can match a MySQL product (or products) in the catalog. The current set of valid short phrases for use with commands is shown in the following table.

Note

Starting with MySQL Installer 1.6.7 (8.0.34), the `install`, `list`, and `upgrade` command options no longer apply to MySQL for Visual Studio (now EOL), MySQL Connector/NET, MySQL Connector/ODBC, MySQL Connector/C++, MySQL Connector/Python, and MySQL Connector/J. To install newer MySQL connectors, visit <https://dev.mysql.com/downloads/>.

Table 5.3 MySQL Product Phrases for use with the `MySQLInstallerConsole.exe` command

Phrase	MySQL Product
<code>server</code>	MySQL Server
<code>workbench</code>	MySQL Workbench
<code>shell</code>	MySQL Shell
<code>visual</code>	MySQL for Visual Studio
<code>router</code>	MySQL Router
<code>backup</code>	MySQL Enterprise Backup (requires the commercial release)
<code>net</code>	MySQL Connector/NET
<code>odbc</code>	MySQL Connector/ODBC
<code>c++</code>	MySQL Connector/C++
<code>python</code>	MySQL Connector/Python

Phrase	MySQL Product
<code>j</code>	MySQL Connector/J
<code>documentation</code>	MySQL Server Documentation
<code>samples</code>	MySQL Samples (sakila and world databases)

Command Syntax

The `MySQLInstallerConsole.exe` command can be issued with or without the file extension (`.exe`) and the command is not case-sensitive.

```
mysqlinstallerconsole[.exe] [[--]action] [action_blocks_list] [options_list]
```

Description:

action

One of the permitted operational actions. If omitted, the default action is equivalent to the `--status` action. Using the `--` prefix is optional for all actions.

Possible actions are: `--configure`, `--help`, `--install`, `--list`, `--modify`, `--remove`, `--set`, `--status`, `--update`, and `--upgrade`.

action_blocks_list

A list of blocks in which each represents a different item depending on the selected action. Blocks are separated by commas.

The `--remove` and `--upgrade` actions permit specifying an asterisk character (*) to indicate all products. If the * character is detected at the start of this block, it is assumed all products are to be processed and the remainder of the block is ignored.

Syntax: `*|action_block[,action_block][,action_block]...`

action_block: Contains a product selector followed by an indefinite number of argument blocks that behave differently depending on the selected action (see [Command Actions](#)).

options_list

Zero or more options with possible values separated by spaces. See [Command Actions](#) to identify the options permitted for the corresponding action.

Syntax: `option_value_pair[option_value_pair][option_value_pair]...`

option_value_pair: A single option (for example, `--silent`) or a tuple of a key and a corresponding value with an options prefix. The key-value pair is in the form of `--key[=value]`.

Command Actions

`MySQLInstallerConsole.exe` supports the following command actions:

Note

Configuration block (or *arguments_block*) values that contain a colon character (:) must be wrapped in quotation marks. For example, `install_dir="C:\MySQL\MySQL Server 8.0"`.

- `[--]configure [product1]:[configuration_argument]=[value], [product2]:[configuration_argument]=[value], [...]`

Configures one or more MySQL products on your system. Multiple `configuration_argument=value` pairs can be configured for each product.

Options:

<code>--continue</code>	Continues processing the next product when an error is caught while processing the action blocks containing arguments for each product. If not specified the whole operation is aborted in case of an error.
<code>--help</code>	Shows the options and available arguments for the corresponding action. If present the action is not executed, only the help is shown, so other action-related options are ignored as well.
<code>--show-settings</code>	Displays the available options for the selected product by passing in the product name after <code>--show-settings</code> .
<code>--silent</code>	Disables confirmation prompts.

Examples:

```
MySQLInstallerConsole --configure --show-settings server
```

```
mysqlinstallerconsole.exe --configure server:port=3307
```

- `[--]help`

Displays a help message with usage examples and then exits. Pass in an additional command action to receive help specific to that action.

Options:

<code>--action=[action]</code>	Shows the help for a specific action. Same as using the <code>--help</code> option with an action. Permitted values are: <code>all</code> , <code>configure</code> , <code>help</code> (default), <code>install</code> , <code>list</code> , <code>modify</code> , <code>remove</code> , <code>status</code> , <code>update</code> , <code>upgrade</code> , and <code>set</code> .
<code>--help</code>	Shows the options and available arguments for the corresponding action. If present the action is not executed, only the help is shown, so other action-related options are ignored as well.

Examples:

```
MySQLInstallerConsole help
```

```
MySQLInstallerConsole help --action=install
```

- `[--]install [product1]:[features]:[config block]:[config block], [product2]:[config block], [...]`

Installs one or more MySQL products on your system. If pre-release products are available, both GA and pre-release products are installed when the value of the `--type` option value is `Client` or `Full`.

Use the `--only_ga_products` option to restrict the product set to GA products only when using these setup types.

Description:

<code>[product]</code>	Each product can be specified by a product phrase with or without a semicolon-separated version qualifier. Passing in a product keyword alone selects the latest version of the product. If multiple architectures are available for that version of the product, the command returns the first one in the manifest list for interactive confirmation. Alternatively, you can pass in the exact version and architecture (<code>x86</code> or <code>x64</code>) after the product keyword using the <code>--silent</code> option.
<code>[features]</code>	All features associated with a MySQL product are installed by default. The feature block is a semicolon-separated list of features or an asterisk character (*) that selects all features. To remove a feature, use the <code>modify</code> command.
<code>[config block]</code>	<p>One or more configuration blocks can be specified. Each configuration block is a semicolon-separated list of key-value pairs. A block can include either a <code>config</code> or <code>user</code> type key; <code>config</code> is the default type if one is not defined.</p> <p>Configuration block values that contain a colon character (:) must be wrapped in quotation marks. For example, <code>installdir="C:\MySQL\MySQL Server 8.0"</code>. Only one configuration type block can be defined for each product. A user block should be defined for each user to be created during the product installation.</p>

Note

The `user` type key is not supported when a product is being reconfigured.

Options:

<code>--auto-handle-prereqs</code>	If present, MySQL Installer attempts to download and install some software prerequisites, not currently present, that can be resolved with minimal intervention. If the <code>--silent</code> option is not present, you are presented with installation pages for each prerequisite. If the <code>--auto-handle-prereqs</code> options is omitted, packages with missing prerequisites are not installed.
<code>--continue</code>	Continues processing the next product when an error is caught while processing the action blocks containing arguments for each product. If not specified the whole operation is aborted in case of an error.
<code>--help</code>	Shows the options and available arguments for the corresponding action. If present the action is not executed, only the help is shown, so other action-related options are ignored as well.
<code>--mos-password=password</code>	Sets the My Oracle Support (MOS) user's password for commercial versions of the MySQL Installer.

<code>--mos-user=user_name</code>	Specifies the My Oracle Support (MOS) user name for access to the commercial version of MySQL Installer. If not present, only the products in the bundle, if any, are available to be installed.
<code>--only-ga-products</code>	Restricts the product set to include GA products only.
<code>--setup-type=setup_type</code>	<p>Installs a predefined set of software. The setup type can be one of the following:</p> <ul style="list-style-type: none">• <code>Server</code>: Installs a single MySQL server• <code>Client</code>: Installs client programs and libraries (excludes MySQL connectors)• <code>Full</code>: Installs everything (excludes MySQL connectors)• <code>Custom</code>: Installs user-selected products. This is the default option.

Note

Non-custom setup types are valid only when no other MySQL products are installed.

<code>--show-settings</code>	Displays the available options for the selected product, by passing in the product name after <code>-showsettings</code> .
<code>--silent</code>	Disable confirmation prompts.

Examples:

```
mysqlinstallerconsole.exe --install j;8.0.29, net;8.0.28 --silent
```

```
MySQLInstallerConsole install server;8.0.30:*:port=3307;server_id=2:type=user;user=foo
```

An example that passes in additional configuration blocks, separated by ^ to fit:

```
MySQLInstallerConsole --install server;8.0.30;x64:*:type=config;open_win_firewall=true; ^  
general_log=true;bin_log=true;server_id=3306;tcp_ip=true;port=3306;root_passwd=pass; ^  
install_dir="C:\MySQL\MySQL Server 8.0":type=user;user_name=foo;password=bar;role=DBManager
```


- `[--]list`

When this action is used without options, it activates an interactive list from which all of the available MySQL products can be searched. Enter `MySQLInstallerConsole --list` and specify a substring to search.

Options:

<code>--all</code>	Lists all available products. If this option is used, all other options are ignored.
<code>--arch=architecture</code>	Lists that contain the specified architecture. Permitted values are: <code>x86</code> , <code>x64</code> , and <code>any</code> (default). This option can be combined with the <code>--name</code> and <code>--version</code> options.
<code>--help</code>	Shows the options and available arguments for the corresponding action. If present the action is not executed, only the help is shown, so other action-related options are ignored as well.
<code>--name=package_name</code>	Lists products that contain the specified name (see product phrase), This option can be combined with the <code>--version</code> and <code>--arch</code> options.
<code>--version=version</code>	Lists products that contain the specified version, such as 8.0 or 5.7. This option can be combined with the <code>--name</code> and <code>--arch</code> options.

Examples:

```
MySQLInstallerConsole --list --name=net --version=8.0
```

- `[--]modify [product1:-removelist|+addlist], [product2:-removelist|+addlist] [...]`

Modifies or displays features of a previously installed MySQL product. To display the features of a product, append the product keyword to the command, for example:

```
MySQLInstallerConsole --modify server
```

Options:

<code>--help</code>	Shows the options and available arguments for the corresponding action. If present the action is not executed, only the help is shown, so other action-related options are ignored as well.
<code>--silent</code>	Disable confirmation prompts.

Examples:

```
MySQLInstallerConsole --modify server:+documentation
```

```
MySQLInstallerConsole modify server:-debug
```

- `[--]remove [product1], [product2] [...]`

Removes one or more products from your system. An asterisk character (*) can be passed in to remove all MySQL products with one command.

Options:

<code>--continue</code>	Continue the operation even if an error occurs.
<code>--help</code>	Shows the options and available arguments for the corresponding action. If present the action is not executed, only the help is shown, so other action-related options are ignored as well.
<code>--keep-datadir</code>	Skips the removal of the data directory when removing MySQL Server products.
<code>--silent</code>	Disable confirmation prompts.

Examples:

```
mysqlinstallerconsole.exe remove *
```

```
MySQLInstallerConsole --remove server --continue
```

- `[--]set`

Sets one or more configurable options that affect how the MySQL Installer program connects to the internet and whether the automatic products-catalog updates feature is activated.

Options:

<code>--catalog-update=bool_value</code>	Enables (<code>true</code> , default) or disables (<code>false</code>) the automatic products catalog update. This option requires an active connection to the internet.
<code>--catalog-update-days=int_value</code>	Accepts an integer between 1 (default) and 365 to indicate the number of days between checks for a new catalog update when MySQL Installer is started. If <code>--catalog-update</code> is <code>false</code> , this option is ignored.
<code>--connection-validation=validation_type</code>	Sets how MySQL Installer performs the check for an internet connection. Permitted values are <code>automatic</code> (default) and <code>manual</code> .
<code>--connection-validation-urls=url_list</code>	A double-quote enclosed and comma-separated string that defines the list of URLs to use for checking the internet connection when <code>--connection-validation</code> is set to <code>manual</code> . Checks are made in

the same order provided. If the first URL fails, the next URL in the list is used and so on.

`--offline-
mode=bool_value`

Enables MySQL Installer to run with or without internet capabilities. Valid modes are:

- `True` to enable offline mode (run without an internet connection).
- `False` (default) to disable offline mode (run with an internet connection). Set this mode before downloading the product catalog or any products to install.

`--proxy-mode`

Specifies the proxy mode. Valid modes are:

- `Automatic` to automatically identify the proxy based on the system settings.
- `None` to ensure that no proxy is configured.
- `Manual` to set the proxy details manually (`--proxy-server`, `--proxy-port`, `--proxy-username`, `--proxy-password`).

`--proxy-password`

The password used to authenticate to the proxy server.

`--proxy-port`

The port used for the proxy server.

`--proxy-server`

The URL that point to the proxy server.

`--proxy-username`

The user name used to authenticate to the proxy server.

`--reset-defaults`

Resets the MySQL Installer options associated with the `--set` action to the default values.

Examples:

```
MySQLIntallerConsole.exe set --reset-defaults
```

```
mysqlintallerconsole.exe --set --catalog-update=false
```

```
MySQLIntallerConsole --set --catalog-update-days=3
```

```
mysqlintallerconsole --set --connection-validation=manual  
--connection-validation-urls="https://www.bing.com,http://www.google.com"
```

- `[--]status`

Provides a quick overview of the MySQL products that are installed on the system. Information includes product name and version, architecture, date installed, and install location.

Options:

`--help`

Shows the options and available arguments for the corresponding action. If present the action is not executed, only the help is shown, so other action-related options are ignored as well.

Examples:

```
MySQLInstallerConsole status
```

- `[--]update`

Downloads the latest MySQL product catalog to your system. On success, the catalog is applied the next time either `MySQLInstaller` or `MySQLInstallerConsole.exe` is executed.

MySQL Installer automatically checks for product catalog updates when it is started if `n` days have passed since the last check. Starting with MySQL Installer 1.6.4, the default value is 1 day. Previously, the default value was 7 days.

Options:

<code>--help</code>	Shows the options and available arguments for the corresponding action. If present the action is not executed, only the help is shown, so other action-related options are ignored as well.
---------------------	---

Examples:

```
MySQLInstallerConsole update
```

- `[--]upgrade [product1:version], [product2:version] [...]`

Upgrades one or more products on your system. The following characters are permitted for this action:

<code>*</code>	Pass in <code>*</code> to upgrade all products to the latest version, or pass in specific products.
<code>!</code>	Pass in <code>!</code> as a version number to upgrade the MySQL product to its latest version.

Options:

<code>--continue</code>	Continue the operation even if an error occurs.
<code>--help</code>	Shows the options and available arguments for the corresponding action. If present the action is not executed, only the help is shown, so other action-related options are ignored as well.
<code>--mos-password=password</code>	Sets the My Oracle Support (MOS) user's password for commercial versions of the MySQL Installer.
<code>--mos-user=user_name</code>	Specifies the My Oracle Support (MOS) user name for access to the commercial version of MySQL Installer. If not present, only the products in the bundle, if any, are available to be installed.
<code>--silent</code>	Disable confirmation prompts.

Examples:

```
MySQLInstallerConsole upgrade *
```

```
MySQLInstallerConsole upgrade workbench:8.0.31
```

```
MySQLInstallerConsole upgrade workbench:!
```

```
MySQLInstallerConsole --upgrade server:8.0.30:!, j:8.0.29:!
```

5.4 Installing MySQL on Microsoft Windows Using a `noinstall` ZIP Archive

Users who are installing from the `noinstall` package can use the instructions in this section to manually install MySQL. The process for installing MySQL from a ZIP Archive package is as follows:

1. Extract the main archive to the desired install directory
Optional: also extract the debug-test archive if you plan to execute the MySQL benchmark and test suite
2. Create an option file
3. Choose a MySQL server type
4. Initialize MySQL
5. Start the MySQL server
6. Secure the default user accounts

This process is described in the sections that follow.

5.4.1 Extracting the Install Archive

To install MySQL manually, do the following:

1. If you are upgrading from a previous version please refer to [Section 10.11, “Upgrading MySQL on Windows”](#), before beginning the upgrade process.
2. Make sure that you are logged in as a user with administrator privileges.
3. Choose an installation location. Traditionally, the MySQL server is installed in `C:\mysql`. If you do not install MySQL at `C:\mysql`, you must specify the path to the install directory during startup or in an option file. See [Section 5.4.2, “Creating an Option File”](#).

Note

The MySQL Installer installs MySQL under `C:\Program Files\MySQL`.

4. Extract the install archive to the chosen installation location using your preferred file-compression tool. Some tools may extract the archive to a folder within your chosen installation location. If this occurs, you can move the contents of the subfolder into the chosen installation location.

5.4.2 Creating an Option File

If you need to specify startup options when you run the server, you can indicate them on the command line or place them in an option file. For options that are used every time the server starts, you may find it most convenient to use an option file to specify your MySQL configuration. This is particularly true under the following circumstances:

- The installation or data directory locations are different from the default locations (`C:\Program Files\MySQL\MySQL Server 8.0` and `C:\Program Files\MySQL\MySQL Server 8.0\data`).
- You need to tune the server settings, such as memory, cache, or InnoDB configuration information.

When the MySQL server starts on Windows, it looks for option files in several locations, such as the Windows directory, `C:\`, and the MySQL installation directory (for the full list of locations, see [Using Option](#)

Files). The Windows directory typically is named something like `C:\WINDOWS`. You can determine its exact location from the value of the `WINDIR` environment variable using the following command:

```
C:\> echo %WINDIR%
```

MySQL looks for options in each location first in the `my.ini` file, and then in the `my.cnf` file. However, to avoid confusion, it is best if you use only one file. If your PC uses a boot loader where `C:` is not the boot drive, your only option is to use the `my.ini` file. Whichever option file you use, it must be a plain text file.

Note

When using the MySQL Installer to install MySQL Server, it creates the `my.ini` at the default location, and the user executing MySQL Installer is granted full permissions to this new `my.ini` file.

In other words, be sure that the MySQL Server user has permission to read the `my.ini` file.

You can also make use of the example option files included with your MySQL distribution; see [Server Configuration Defaults](#).

An option file can be created and modified with any text editor, such as Notepad. For example, if MySQL is installed in `E:\mysql` and the data directory is in `E:\mydata\data`, you can create an option file containing a `[mysqld]` section to specify values for the `basedir` and `datadir` options:

```
[mysqld]
# set basedir to your installation path
basedir=E:/mysql
# set datadir to the location of your data directory
datadir=E:/mydata/data
```

Microsoft Windows path names are specified in option files using (forward) slashes rather than backslashes. If you do use backslashes, double them:

```
[mysqld]
# set basedir to your installation path
basedir=E:\\mysql
# set datadir to the location of your data directory
datadir=E:\\mydata\\data
```

The rules for use of backslash in option file values are given in [Using Option Files](#).

The ZIP archive does not include a `data` directory. To initialize a MySQL installation by creating the data directory and populating the tables in the mysql system database, initialize MySQL using either `--initialize` or `--initialize-insecure`. For additional information, see [Section 9.1, "Initializing the Data Directory"](#).

If you would like to use a data directory in a different location, you should copy the entire contents of the `data` directory to the new location. For example, if you want to use `E:\mydata` as the data directory instead, you must do two things:

1. Move the entire `data` directory and all of its contents from the default location (for example `C:\Program Files\MySQL\MySQL Server 8.0\data`) to `E:\mydata`.
2. Use a `--datadir` option to specify the new data directory location each time you start the server.

5.4.3 Selecting a MySQL Server Type

The following table shows the available servers for Windows in MySQL 8.0.

Binary	Description
<code>mysqld</code>	Optimized binary with named-pipe support
<code>mysqld-debug</code>	Like <code>mysqld</code> , but compiled with full debugging and automatic memory allocation checking

All of the preceding binaries are optimized for modern Intel processors, but should work on any Intel i386-class or higher processor.

Each of the servers in a distribution support the same set of storage engines. The `SHOW ENGINES` statement displays which engines a given server supports.

All Windows MySQL 8.0 servers have support for symbolic linking of database directories.

MySQL supports TCP/IP on all Windows platforms. MySQL servers on Windows also support named pipes, if you start the server with the `named_pipe` system variable enabled. It is necessary to enable this variable explicitly because some users have experienced problems with shutting down the MySQL server when named pipes were used. The default is to use TCP/IP regardless of platform because named pipes are slower than TCP/IP in many Windows configurations.

5.4.4 Initializing the Data Directory

If you installed MySQL using the `noinstall` package, no data directory is included. To initialize the data directory, use the instructions at [Section 9.1, “Initializing the Data Directory”](#).

5.4.5 Starting the Server for the First Time

This section gives a general overview of starting the MySQL server. The following sections provide more specific information for starting the MySQL server from the command line or as a Windows service.

The information here applies primarily if you installed MySQL using the `noinstall` version, or if you wish to configure and test MySQL manually rather than with the MySQL Installer.

The examples in these sections assume that MySQL is installed under the default location of `C:\Program Files\MySQL\MySQL Server 8.0`. Adjust the path names shown in the examples if you have MySQL installed in a different location.

Clients have two options. They can use TCP/IP, or they can use a named pipe if the server supports named-pipe connections.

MySQL for Windows also supports shared-memory connections if the server is started with the `shared_memory` system variable enabled. Clients can connect through shared memory by using the `--protocol=MEMORY` option.

For information about which server binary to run, see [Section 5.4.3, “Selecting a MySQL Server Type”](#).

Testing is best done from a command prompt in a console window (or “DOS window”). In this way you can have the server display status messages in the window where they are easy to see. If something is wrong with your configuration, these messages make it easier for you to identify and fix any problems.

Note

The database must be initialized before MySQL can be started. For additional information about the initialization process, see [Section 9.1, “Initializing the Data Directory”](#).

To start the server, enter this command:

```
C:\> "C:\Program Files\MySQL\MySQL Server 8.0\bin\mysqld" --console
```

You should see messages similar to those following as it starts (the path names and sizes may differ). The `ready for connections` messages indicate that the server is ready to service client connections.

```
[Server] C:\mysql\bin\mysqld.exe (mysqld 8.0.30) starting as process 21236
[InnoDB] InnoDB initialization has started.
[InnoDB] InnoDB initialization has ended.
[Server] CA certificate ca.pem is self signed.
[Server] Channel mysql_main configured to support TLS.
Encrypted connections are now supported for this channel.
[Server] X Plugin ready for connections. Bind-address: '::' port: 33060
[Server] C:\mysql\bin\mysqld.exe: ready for connections.
Version: '8.0.30' socket: '' port: 3306 MySQL Community Server - GPL.
```

You can now open a new console window in which to run client programs.

If you omit the `--console` option, the server writes diagnostic output to the error log in the data directory (`C:\Program Files\MySQL\MySQL Server 8.0\data` by default). The error log is the file with the `.err` extension, and may be set using the `--log-error` option.

Note

The initial `root` account in the MySQL grant tables has no password. After starting the server, you should set up a password for it using the instructions in [Section 9.4](#), “Securing the Initial MySQL Account”.

5.4.6 Starting MySQL from the Windows Command Line

The MySQL server can be started manually from the command line. This can be done on any version of Windows.

To start the `mysqld` server from the command line, you should start a console window (or “DOS window”) and enter this command:

```
C:\> "C:\Program Files\MySQL\MySQL Server 8.0\bin\mysqld"
```

The path to `mysqld` may vary depending on the install location of MySQL on your system.

You can stop the MySQL server by executing this command:

```
C:\> "C:\Program Files\MySQL\MySQL Server 8.0\bin\mysqladmin" -u root shutdown
```

Note

If the MySQL `root` user account has a password, you need to invoke `mysqladmin` with the `-p` option and supply the password when prompted.

This command invokes the MySQL administrative utility `mysqladmin` to connect to the server and tell it to shut down. The command connects as the MySQL `root` user, which is the default administrative account in the MySQL grant system.

Note

Users in the MySQL grant system are wholly independent from any operating system users under Microsoft Windows.

If `mysqld` doesn't start, check the error log to see whether the server wrote any messages there to indicate the cause of the problem. By default, the error log is located in the `C:\Program Files\MySQL\MySQL Server 8.0\data` directory. It is the file with a suffix of `.err`, or may be specified by passing in the `--`

`log-error` option. Alternatively, you can try to start the server with the `--console` option; in this case, the server may display some useful information on the screen to help solve the problem.

The last option is to start `mysqld` with the `--standalone` and `--debug` options. In this case, `mysqld` writes a log file `C:\mysqld.trace` that should contain the reason why `mysqld` doesn't start. See [The DBUG Package](#).

Use `mysqld --verbose --help` to display all the options that `mysqld` supports.

5.4.7 Customizing the PATH for MySQL Tools

Warning

You must exercise great care when editing your system `PATH` by hand; accidental deletion or modification of any portion of the existing `PATH` value can leave you with a malfunctioning or even unusable system.

To make it easier to invoke MySQL programs, you can add the path name of the MySQL `bin` directory to your Windows system `PATH` environment variable:

- On the Windows desktop, right-click the **My Computer** icon, and select **Properties**.
- Next select the **Advanced** tab from the **System Properties** menu that appears, and click the **Environment Variables** button.
- Under **System Variables**, select **Path**, and then click the **Edit** button. The **Edit System Variable** dialogue should appear.
- Place your cursor at the end of the text appearing in the space marked **Variable Value**. (Use the **End** key to ensure that your cursor is positioned at the very end of the text in this space.) Then enter the complete path name of your MySQL `bin` directory (for example, `C:\Program Files\MySQL\MySQL Server 8.0\bin`)

Note

There must be a semicolon separating this path from any values present in this field.

Dismiss this dialogue, and each dialogue in turn, by clicking **OK** until all of the dialogues that were opened have been dismissed. The new `PATH` value should now be available to any new command shell you open, allowing you to invoke any MySQL executable program by typing its name at the DOS prompt from any directory on the system, without having to supply the path. This includes the servers, the `mysql` client, and all MySQL command-line utilities such as `mysqladmin` and `mysqldump`.

You should not add the MySQL `bin` directory to your Windows `PATH` if you are running multiple MySQL servers on the same machine.

5.4.8 Starting MySQL as a Windows Service

On Windows, the recommended way to run MySQL is to install it as a Windows service, so that MySQL starts and stops automatically when Windows starts and stops. A MySQL server installed as a service can also be controlled from the command line using `NET` commands, or with the graphical `Services` utility. Generally, to install MySQL as a Windows service you should be logged in using an account that has administrator rights.

The `Services` utility (the Windows `Service Control Manager`) can be found in the Windows Control Panel. To avoid conflicts, it is advisable to close the `Services` utility while performing server installation or removal operations from the command line.

Installing the service

Before installing MySQL as a Windows service, you should first stop the current server if it is running by using the following command:

```
C:\> "C:\Program Files\MySQL\MySQL Server 8.0\bin\mysqladmin"  
      -u root shutdown
```

Note

If the MySQL `root` user account has a password, you need to invoke `mysqladmin` with the `-p` option and supply the password when prompted.

This command invokes the MySQL administrative utility `mysqladmin` to connect to the server and tell it to shut down. The command connects as the MySQL `root` user, which is the default administrative account in the MySQL grant system.

Note

Users in the MySQL grant system are wholly independent from any operating system users under Windows.

Install the server as a service using this command:

```
C:\> "C:\Program Files\MySQL\MySQL Server 8.0\bin\mysqld" --install
```

The service-installation command does not start the server. Instructions for that are given later in this section.

To make it easier to invoke MySQL programs, you can add the path name of the MySQL `bin` directory to your Windows system `PATH` environment variable:

- On the Windows desktop, right-click the **My Computer** icon, and select **Properties**.
- Next select the **Advanced** tab from the **System Properties** menu that appears, and click the **Environment Variables** button.
- Under **System Variables**, select **Path**, and then click the **Edit** button. The **Edit System Variable** dialogue should appear.
- Place your cursor at the end of the text appearing in the space marked **Variable Value**. (Use the **End** key to ensure that your cursor is positioned at the very end of the text in this space.) Then enter the complete path name of your MySQL `bin` directory (for example, `C:\Program Files\MySQL\MySQL Server 8.0\bin`), and there should be a semicolon separating this path from any values present in this field. Dismiss this dialogue, and each dialogue in turn, by clicking **OK** until all of the dialogues that were opened have been dismissed. You should now be able to invoke any MySQL executable program by typing its name at the DOS prompt from any directory on the system, without having to supply the path. This includes the servers, the `mysql` client, and all MySQL command-line utilities such as `mysqladmin` and `mysqldump`.

You should not add the MySQL `bin` directory to your Windows `PATH` if you are running multiple MySQL servers on the same machine.

Warning

You must exercise great care when editing your system `PATH` by hand; accidental deletion or modification of any portion of the existing `PATH` value can leave you with a malfunctioning or even unusable system.

The following additional arguments can be used when installing the service:

- You can specify a service name immediately following the `--install` option. The default service name is `MySQL`.
- If a service name is given, it can be followed by a single option. By convention, this should be `--defaults-file=file_name` to specify the name of an option file from which the server should read options when it starts.

The use of a single option other than `--defaults-file` is possible but discouraged. `--defaults-file` is more flexible because it enables you to specify multiple startup options for the server by placing them in the named option file.

- You can also specify a `--local-service` option following the service name. This causes the server to run using the `LocalService` Windows account that has limited system privileges. If both `--defaults-file` and `--local-service` are given following the service name, they can be in any order.

For a MySQL server that is installed as a Windows service, the following rules determine the service name and option files that the server uses:

- If the service-installation command specifies no service name or the default service name (`MySQL`) following the `--install` option, the server uses the service name of `MySQL` and reads options from the `[mysqld]` group in the standard option files.
- If the service-installation command specifies a service name other than `MySQL` following the `--install` option, the server uses that service name. It reads options from the `[mysqld]` group and the group that has the same name as the service in the standard option files. This enables you to use the `[mysqld]` group for options that should be used by all MySQL services, and an option group with the service name for use by the server installed with that service name.
- If the service-installation command specifies a `--defaults-file` option after the service name, the server reads options the same way as described in the previous item, except that it reads options only from the named file and ignores the standard option files.

As a more complex example, consider the following command:

```
C:\> "C:\Program Files\MySQL\MySQL Server 8.0\bin\mysqld"  
      --install MySQL --defaults-file=C:\my-opts.cnf
```

Here, the default service name (`MySQL`) is given after the `--install` option. If no `--defaults-file` option had been given, this command would have the effect of causing the server to read the `[mysqld]` group from the standard option files. However, because the `--defaults-file` option is present, the server reads options from the `[mysqld]` option group, and only from the named file.

Note

On Windows, if the server is started with the `--defaults-file` and `--install` options, `--install` must be first. Otherwise, `mysqld.exe` attempts to start the MySQL server.

You can also specify options as Start parameters in the Windows `Services` utility before you start the MySQL service.

Finally, before trying to start the MySQL service, make sure the user variables `%TEMP%` and `%TMP%` (and also `%TMPDIR%`, if it has ever been set) for the operating system user who is to run the service are pointing to a folder to which the user has write access. The default user for running the MySQL service is `LocalSystem`, and the default value for its `%TEMP%` and `%TMP%` is `C:\Windows\Temp`, a directory

`LocalSystem` has write access to by default. However, if there are any changes to that default setup (for example, changes to the user who runs the service or to the mentioned user variables, or the `--tmpdir` option has been used to put the temporary directory somewhere else), the MySQL service might fail to run because write access to the temporary directory has not been granted to the proper user.

Starting the service

After a MySQL server instance has been installed as a service, Windows starts the service automatically whenever Windows starts. The service also can be started immediately from the `Services` utility, or by using an `sc start mysqld_service_name` or `NET START mysqld_service_name` command. `SC` and `NET` commands are not case-sensitive.

When run as a service, `mysqld` has no access to a console window, so no messages can be seen there. If `mysqld` does not start, check the error log to see whether the server wrote any messages there to indicate the cause of the problem. The error log is located in the MySQL data directory (for example, `C:\Program Files\MySQL\MySQL Server 8.0\data`). It is the file with a suffix of `.err`.

When a MySQL server has been installed as a service, and the service is running, Windows stops the service automatically when Windows shuts down. The server also can be stopped manually using the `Services` utility, the `sc stop mysqld_service_name` command, the `NET STOP mysqld_service_name` command, or the `mysqladmin shutdown` command.

You also have the choice of installing the server as a manual service if you do not wish for the service to be started automatically during the boot process. To do this, use the `--install-manual` option rather than the `--install` option:

```
C:\> "C:\Program Files\MySQL\MySQL Server 8.0\bin\mysqld" --install-manual
```

Removing the service

To remove a server that is installed as a service, first stop it if it is running by executing `SC STOP mysqld_service_name` or `NET STOP mysqld_service_name`. Then use `SC DELETE mysqld_service_name` to remove it:

```
C:\> SC DELETE mysql
```

Alternatively, use the `mysqld --remove` option to remove the service.

```
C:\> "C:\Program Files\MySQL\MySQL Server 8.0\bin\mysqld" --remove
```

If `mysqld` is not running as a service, you can start it from the command line. For instructions, see [Section 5.4.6, “Starting MySQL from the Windows Command Line”](#).

If you encounter difficulties during installation, see [Section 5.5, “Troubleshooting a Microsoft Windows MySQL Server Installation”](#).

For more information about stopping or removing a Windows service, see [Starting Multiple MySQL Instances as Windows Services](#).

5.4.9 Testing The MySQL Installation

You can test whether the MySQL server is working by executing any of the following commands:

```
C:\> "C:\Program Files\MySQL\MySQL Server 8.0\bin\mysqlshow"
C:\> "C:\Program Files\MySQL\MySQL Server 8.0\bin\mysqlshow" -u root mysql
C:\> "C:\Program Files\MySQL\MySQL Server 8.0\bin\mysqladmin" version status proc
C:\> "C:\Program Files\MySQL\MySQL Server 8.0\bin\mysql" test
```

If `mysqld` is slow to respond to TCP/IP connections from client programs, there is probably a problem with your DNS. In this case, start `mysqld` with the `skip_name_resolve` system variable enabled and

use only `localhost` and IP addresses in the `Host` column of the MySQL grant tables. (Be sure that an account exists that specifies an IP address or you may not be able to connect.)

You can force a MySQL client to use a named-pipe connection rather than TCP/IP by specifying the `--pipe` or `--protocol=PIPE` option, or by specifying `.` (period) as the host name. Use the `--socket` option to specify the name of the pipe if you do not want to use the default pipe name.

If you have set a password for the `root` account, deleted the anonymous account, or created a new user account, then to connect to the MySQL server you must use the appropriate `-u` and `-p` options with the commands shown previously. See [Connecting to the MySQL Server Using Command Options](#).

For more information about `mysqlshow`, see [mysqlshow — Display Database, Table, and Column Information](#).

5.5 Troubleshooting a Microsoft Windows MySQL Server Installation

When installing and running MySQL for the first time, you may encounter certain errors that prevent the MySQL server from starting. This section helps you diagnose and correct some of these errors.

Your first resource when troubleshooting server issues is the [error log](#). The MySQL server uses the error log to record information relevant to the error that prevents the server from starting. The error log is located in the [data directory](#) specified in your `my.ini` file. The default data directory location is `C:\Program Files\MySQL\MySQL Server 8.0\data`, or `C:\ProgramData\Mysql` on Windows 7 and Windows Server 2008. The `C:\ProgramData` directory is hidden by default. You need to change your folder options to see the directory and contents. For more information on the error log and understanding the content, see [The Error Log](#).

For information regarding possible errors, also consult the console messages displayed when the MySQL service is starting. Use the `SC START mysql_d_service_name` or `NET START mysql_d_service_name` command from the command line after installing `mysqld` as a service to see any error messages regarding the starting of the MySQL server as a service. See [Section 5.4.8, “Starting MySQL as a Windows Service”](#).

The following examples show other common error messages you might encounter when installing MySQL and starting the server for the first time:

- If the MySQL server cannot find the `mysql` privileges database or other critical files, it displays these messages:

```
System error 1067 has occurred.
Fatal error: Can't open and lock privilege tables:
Table 'mysql.user' doesn't exist
```

These messages often occur when the MySQL base or data directories are installed in different locations than the default locations (`C:\Program Files\MySQL\MySQL Server 8.0` and `C:\Program Files\MySQL\MySQL Server 8.0\data`, respectively).

This situation can occur when MySQL is upgraded and installed to a new location, but the configuration file is not updated to reflect the new location. In addition, old and new configuration files might conflict. Be sure to delete or rename any old configuration files when upgrading MySQL.

If you have installed MySQL to a directory other than `C:\Program Files\MySQL\MySQL Server 8.0`, ensure that the MySQL server is aware of this through the use of a configuration (`my.ini`) file. Put the `my.ini` file in your Windows directory, typically `C:\WINDOWS`. To determine its exact location from the value of the `WINDIR` environment variable, issue the following command from the command prompt:

```
C:\> echo %WINDIR%
```

You can create or modify an option file with any text editor, such as Notepad. For example, if MySQL is installed in `E:\mysql` and the data directory is `D:\MySQLdata`, you can create the option file and set up a `[mysqld]` section to specify values for the `basedir` and `datadir` options:

```
[mysqld]
# set basedir to your installation path
basedir=E:/mysql
# set datadir to the location of your data directory
datadir=D:/MySQLdata
```

Microsoft Windows path names are specified in option files using (forward) slashes rather than backslashes. If you do use backslashes, double them:

```
[mysqld]
# set basedir to your installation path
basedir=C:\\Program Files\\MySQL\\MySQL Server 8.0
# set datadir to the location of your data directory
datadir=D:\\MySQLdata
```

The rules for use of backslash in option file values are given in [Using Option Files](#).

If you change the `datadir` value in your MySQL configuration file, you must move the contents of the existing MySQL data directory before restarting the MySQL server.

See [Section 5.4.2, “Creating an Option File”](#).

- If you reinstall or upgrade MySQL without first stopping and removing the existing MySQL service and install MySQL using the MySQL Installer, you might see this error:

```
Error: Cannot create Windows service for MySql. Error: 0
```

This occurs when the Configuration Wizard tries to install the service and finds an existing service with the same name.

One solution to this problem is to choose a service name other than `mysql` when using the configuration wizard. This enables the new service to be installed correctly, but leaves the outdated service in place. Although this is harmless, it is best to remove old services that are no longer in use.

To permanently remove the old `mysql` service, execute the following command as a user with administrative privileges, on the command line:

```
C:\> SC DELETE mysql
[SC] DeleteService SUCCESS
```

If the `sc` utility is not available for your version of Windows, download the `delsrv` utility from <http://www.microsoft.com/windows2000/techinfo/reskit/tools/existing/delsrv-o.asp> and use the `delsrv mysql` syntax.

5.6 Windows Postinstallation Procedures

GUI tools exist that perform most of the tasks described in this section, including:

- **MySQL Installer:** Used to install and upgrade MySQL products.
- **MySQL Workbench:** Manages the MySQL server and edits SQL statements.

If necessary, initialize the data directory and create the MySQL grant tables. Windows installation operations performed by MySQL Installer initialize the data directory automatically. For installation from

a ZIP Archive package, initialize the data directory as described at [Section 9.1, “Initializing the Data Directory”](#).

Regarding passwords, if you installed MySQL using the MySQL Installer, you may have already assigned a password to the initial `root` account. (See [Section 5.3, “MySQL Installer for Windows”](#).) Otherwise, use the password-assignment procedure given in [Section 9.4, “Securing the Initial MySQL Account”](#).

Before assigning a password, you might want to try running some client programs to make sure that you can connect to the server and that it is operating properly. Make sure that the server is running (see [Section 5.4.5, “Starting the Server for the First Time”](#)). You can also set up a MySQL service that runs automatically when Windows starts (see [Section 5.4.8, “Starting MySQL as a Windows Service”](#)).

These instructions assume that your current location is the MySQL installation directory and that it has a `bin` subdirectory containing the MySQL programs used here. If that is not true, adjust the command path names accordingly.

If you installed MySQL using MySQL Installer (see [Section 5.3, “MySQL Installer for Windows”](#)), the default installation directory is `C:\Program Files\MySQL\MySQL Server 8.0`:

```
C:\> cd "C:\Program Files\MySQL\MySQL Server 8.0"
```

A common installation location for installation from a ZIP archive is `C:\mysql`:

```
C:\> cd C:\mysql
```

Alternatively, add the `bin` directory to your `PATH` environment variable setting. That enables your command interpreter to find MySQL programs properly, so that you can run a program by typing only its name, not its path name. See [Section 5.4.7, “Customizing the PATH for MySQL Tools”](#).

With the server running, issue the following commands to verify that you can retrieve information from the server. The output should be similar to that shown here.

Use `mysqlshow` to see what databases exist:

```
C:\> bin\mysqlshow
+-----+
| Databases |
+-----+
| information_schema |
| mysql |
| performance_schema |
| sys |
+-----+
```

The list of installed databases may vary, but always includes at least `mysql` and `information_schema`.

The preceding command (and commands for other MySQL programs such as `mysql`) may not work if the correct MySQL account does not exist. For example, the program may fail with an error, or you may not be able to view all databases. If you install MySQL using MySQL Installer, the `root` user is created automatically with the password you supplied. In this case, you should use the `-u root` and `-p` options. (You must use those options if you have already secured the initial MySQL accounts.) With `-p`, the client program prompts for the `root` password. For example:

```
C:\> bin\mysqlshow -u root -p
Enter password: (enter root password here)
+-----+
| Databases |
+-----+
| information_schema |
| mysql |
| performance_schema |
| sys |
+-----+
```

If you specify a database name, `mysqlshow` displays a list of the tables within the database:

```
C:\> bin\mysqlshow mysql
Database: mysql
+-----+
|          Tables          |
+-----+
| columns_priv             |
| component                |
| db                       |
| default_roles            |
| engine_cost              |
| func                     |
| general_log              |
| global_grants            |
| gtid_executed            |
| help_category            |
| help_keyword             |
| help_relation            |
| help_topic               |
| innodb_index_stats       |
| innodb_table_stats       |
| ndb_binlog_index         |
| password_history         |
| plugin                   |
| procs_priv               |
| proxies_priv             |
| role_edges               |
| server_cost              |
| servers                  |
| slave_master_info        |
| slave_relay_log_info     |
| slave_worker_info       |
| slow_log                 |
| tables_priv              |
| time_zone                |
| time_zone_leap_second   |
| time_zone_name           |
| time_zone_transition     |
| time_zone_transition_type|
| user                     |
+-----+
```

Use the `mysql` program to select information from a table in the `mysql` database:

```
C:\> bin\mysql -e "SELECT User, Host, plugin FROM mysql.user" mysql
+-----+
| User | Host      | plugin                |
+-----+
| root | localhost | caching_sha2_password |
+-----+
```

For more information about `mysql` and `mysqlshow`, see [mysql — The MySQL Command-Line Client](#), and [mysqlshow — Display Database, Table, and Column Information](#).

5.7 Windows Platform Restrictions

The following restrictions apply to use of MySQL on the Windows platform:

- **Process memory**

On Windows 32-bit platforms, it is not possible by default to use more than 2GB of RAM within a single process, including MySQL. This is because the physical address limit on Windows 32-bit is 4GB and

the default setting within Windows is to split the virtual address space between kernel (2GB) and user/applications (2GB).

Some versions of Windows have a boot time setting to enable larger applications by reducing the kernel application. Alternatively, to use more than 2GB, use a 64-bit version of Windows.

- **File system aliases**

When using `MyISAM` tables, you cannot use aliases within Windows link to the data files on another volume and then link back to the main MySQL `datadir` location.

This facility is often used to move the data and index files to a RAID or other fast solution.

- **Limited number of ports**

Windows systems have about 4,000 ports available for client connections, and after a connection on a port closes, it takes two to four minutes before the port can be reused. In situations where clients connect to and disconnect from the server at a high rate, it is possible for all available ports to be used up before closed ports become available again. If this happens, the MySQL server appears to be unresponsive even though it is running. Ports may be used by other applications running on the machine as well, in which case the number of ports available to MySQL is lower.

For more information about this problem, see <https://support.microsoft.com/kb/196271>.

- **DATA DIRECTORY and INDEX DIRECTORY**

The `DATA DIRECTORY` clause of the `CREATE TABLE` statement is supported on Windows for `InnoDB` tables only, as described in [Creating Tables Externally](#). For `MyISAM` and other storage engines, the `DATA DIRECTORY` and `INDEX DIRECTORY` clauses for `CREATE TABLE` are ignored on Windows and any other platforms with a nonfunctional `realpath()` call.

- **DROP DATABASE**

You cannot drop a database that is in use by another session.

- **Case-insensitive names**

File names are not case-sensitive on Windows, so MySQL database and table names are also not case-sensitive on Windows. The only restriction is that database and table names must be specified using the same case throughout a given statement. See [Identifier Case Sensitivity](#).

- **Directory and file names**

On Windows, MySQL Server supports only directory and file names that are compatible with the current ANSI code pages. For example, the following Japanese directory name does not work in the Western locale (code page 1252):

```
datadir="C:/私たちのプロジェクトのデータ"
```

The same limitation applies to directory and file names referred to in SQL statements, such as the data file path name in `LOAD DATA`.

- **The \ path name separator character**

Path name components in Windows are separated by the \ character, which is also the escape character in MySQL. If you are using `LOAD DATA` or `SELECT ... INTO OUTFILE`, use Unix-style file names with / characters:

```
mysql> LOAD DATA INFILE 'C:/tmp/skr.txt' INTO TABLE skr;  
mysql> SELECT * INTO OUTFILE 'C:/tmp/skr.txt' FROM skr;
```

Alternatively, you must double the \ character:

```
mysql> LOAD DATA INFILE 'C:\\tmp\\skr.txt' INTO TABLE skr;  
mysql> SELECT * INTO OUTFILE 'C:\\tmp\\skr.txt' FROM skr;
```

- **Problems with pipes**

Pipes do not work reliably from the Windows command-line prompt. If the pipe includes the character `^Z` / `CHAR(24)`, Windows thinks that it has encountered end-of-file and aborts the program.

This is mainly a problem when you try to apply a binary log as follows:

```
C:\> mysqlbinlog binary_log_file | mysql --user=root
```

If you have a problem applying the log and suspect that it is because of a `^Z` / `CHAR(24)` character, you can use the following workaround:

```
C:\> mysqlbinlog binary_log_file --result-file=/tmp/bin.sql  
C:\> mysql --user=root --execute "source /tmp/bin.sql"
```

The latter command also can be used to reliably read any SQL file that may contain binary data.

Chapter 6 Installing MySQL on macOS

Table of Contents

6.1 General Notes on Installing MySQL on macOS	125
6.2 Installing MySQL on macOS Using Native Packages	126
6.3 Installing and Using the MySQL Launch Daemon	132
6.4 Installing and Using the MySQL Preference Pane	135

For a list of macOS versions that the MySQL server supports, see <https://www.mysql.com/support/supportedplatforms/database.html>.

MySQL for macOS is available in a number of different forms:

- **Native Package Installer**, which uses the native macOS installer (DMG) to walk you through the installation of MySQL. For more information, see [Section 6.2, “Installing MySQL on macOS Using Native Packages”](#). You can use the package installer with macOS. The user you use to perform the installation must have administrator privileges.
- **Compressed TAR archive**, which uses a file packaged using the Unix `tar` and `gzip` commands. To use this method, you need to open a [Terminal](#) window. You do not need administrator privileges using this method; you can install the MySQL server anywhere using this method. For more information on using this method, you can use the generic instructions for using a tarball, [Chapter 3, Installing MySQL on Unix/Linux Using Generic Binaries](#).

In addition to the core installation, the Package Installer also includes [Section 6.3, “Installing and Using the MySQL Launch Daemon”](#) and [Section 6.4, “Installing and Using the MySQL Preference Pane”](#) to simplify the management of your installation.

For additional information on using MySQL on macOS, see [Section 6.1, “General Notes on Installing MySQL on macOS”](#).

6.1 General Notes on Installing MySQL on macOS

You should keep the following issues and notes in mind:

- **Other MySQL installations:** The installation procedure does not recognize MySQL installations by package managers such as Homebrew. The installation and upgrade process is for MySQL packages provided by us. If other installations are present, then consider stopping them before executing this installer to avoid port conflicts.

Homebrew: For example, if you installed MySQL Server using Homebrew to its default location then the MySQL installer installs to a different location and won't upgrade the version from Homebrew. In this scenario you would end up with multiple MySQL installations that, by default, attempt to use the same ports. Stop the other MySQL Server instances before running this installer, such as executing `brew services stop mysql` to stop the Homebrew's MySQL service.

- **Launchd:** A launchd daemon is installed that alters MySQL configuration options. Consider editing it if needed, see the documentation below for additional information. Also, macOS 10.10 removed startup item support in favor of launchd daemons. The optional MySQL preference pane under macOS **System Preferences** uses the launchd daemon.
- **Users:** You may need (or want) to create a specific `mysql` user to own the MySQL directory and data. You can do this through the [Directory Utility](#), and the `mysql` user should already exist. For use

in single user mode, an entry for `_mysql` (note the underscore prefix) should already exist within the system `/etc/passwd` file.

- **Data:** Because the MySQL package installer installs the MySQL contents into a version and platform specific directory, you can use this to upgrade and migrate your database between versions. You need either to copy the `data` directory from the old version to the new version, or to specify an alternative `datadir` value to set location of the data directory. By default, the MySQL directories are installed under `/usr/local/`.
- **Aliases:** You might want to add aliases to your shell's resource file to make it easier to access commonly used programs such as `mysql` and `mysqladmin` from the command line. The syntax for `bash` is:

```
alias mysql=/usr/local/mysql/bin/mysql
alias mysqladmin=/usr/local/mysql/bin/mysqladmin
```

For `tcsh`, use:

```
alias mysql /usr/local/mysql/bin/mysql
alias mysqladmin /usr/local/mysql/bin/mysqladmin
```

Even better, add `/usr/local/mysql/bin` to your `PATH` environment variable. You can do this by modifying the appropriate startup file for your shell. For more information, see [Invoking MySQL Programs](#).

- **Removing:** After you have copied over the MySQL database files from the previous installation and have successfully started the new server, you should consider removing the old installation files to save disk space. Additionally, you should also remove older versions of the Package Receipt directories located in `/Library/Receipts/mysql-VERSION.pkg`.

6.2 Installing MySQL on macOS Using Native Packages

The package is located inside a disk image (`.dmg`) file that you first need to mount by double-clicking its icon in the Finder. It should then mount the image and display its contents.

Note

Before proceeding with the installation, be sure to stop all running MySQL server instances by using either the MySQL Manager Application (on macOS Server), the preference pane, or `mysqladmin shutdown` on the command line.

To install MySQL using the package installer:

1. Download the disk image (`.dmg`) file (the community version is available [here](#)) that contains the MySQL package installer. Double-click the file to mount the disk image and see its contents.

Double-click the MySQL installer package from the disk. It is named according to the version of MySQL you have downloaded. For example, for MySQL server 8.0.36 it might be named `mysql-8.0.36-macos-10.13-x86_64.pkg`.

2. The initial wizard introduction screen references the MySQL server version to install. Click **Continue** to begin the installation.

The MySQL community edition shows a copy of the relevant GNU General Public License. Click **Continue** and then **Agree** to continue.

3. From the **Installation Type** page you can either click **Install** to execute the installation wizard using all defaults, click **Customize** to alter which components to install (MySQL server, MySQL Test, Preference Pane, Launchd Support -- all but MySQL Test are enabled by default).

Note

Although the **Change Install Location** option is visible, the installation location cannot be changed.

Figure 6.1 MySQL Package Installer Wizard: Installation Type

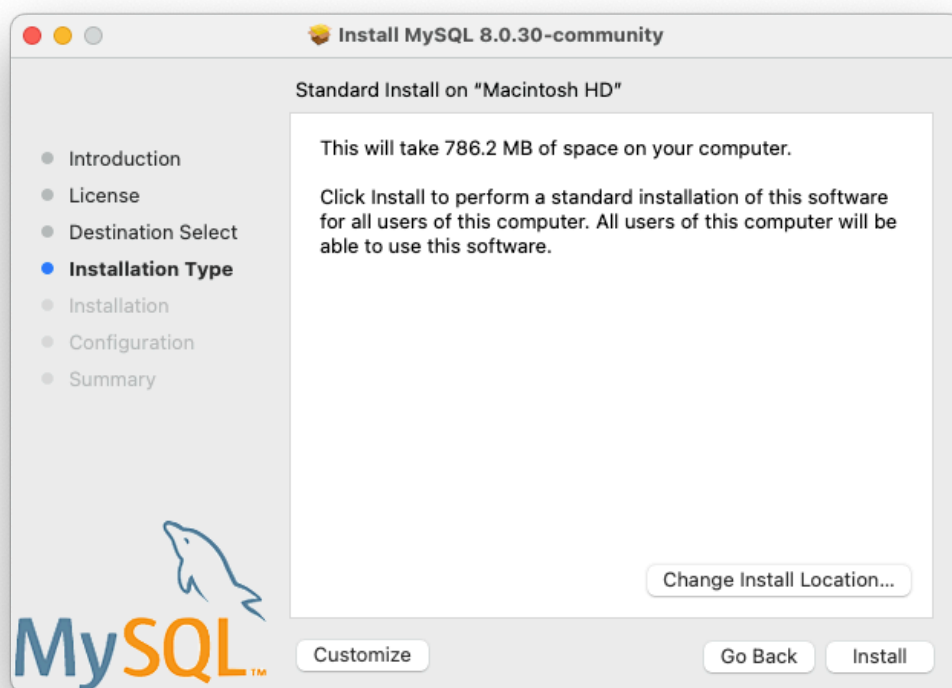
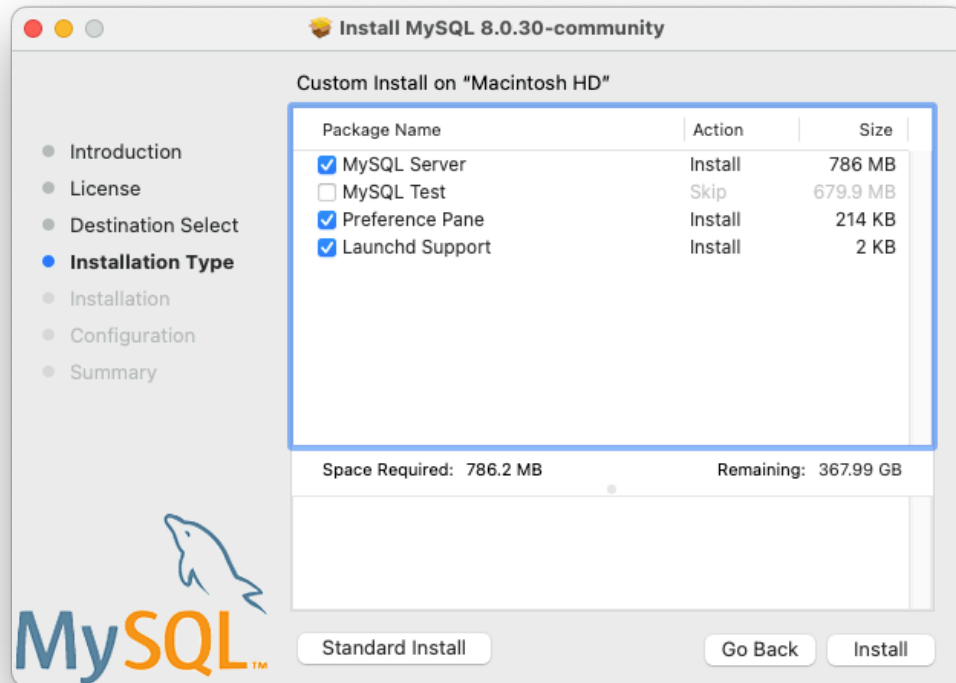
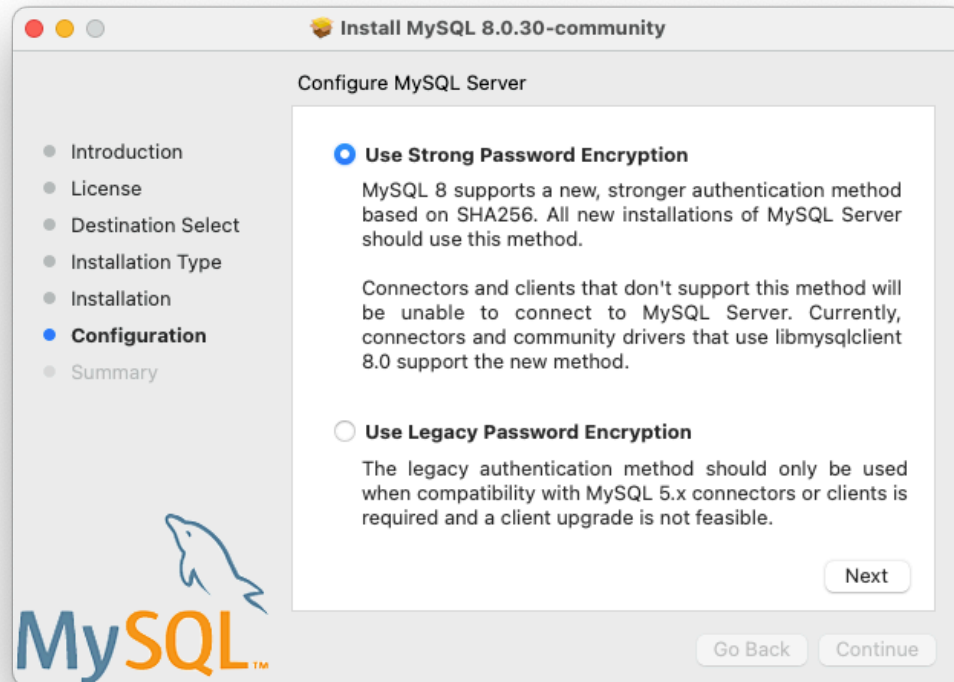


Figure 6.2 MySQL Package Installer Wizard: Customize

4. Click **Install** to install MySQL Server. The installation process ends here if upgrading a current MySQL Server installation, otherwise follow the wizard's additional configuration steps for your new MySQL Server installation.
5. After a successful new MySQL Server installation, complete the configuration steps by choosing the default encryption type for passwords, define the root password, and also enable (or disable) MySQL server at startup.

6. The default MySQL 8.0 password mechanism is `caching_sha2_password` (Strong), and this step allows you to change it to `mysql_native_password` (Legacy).

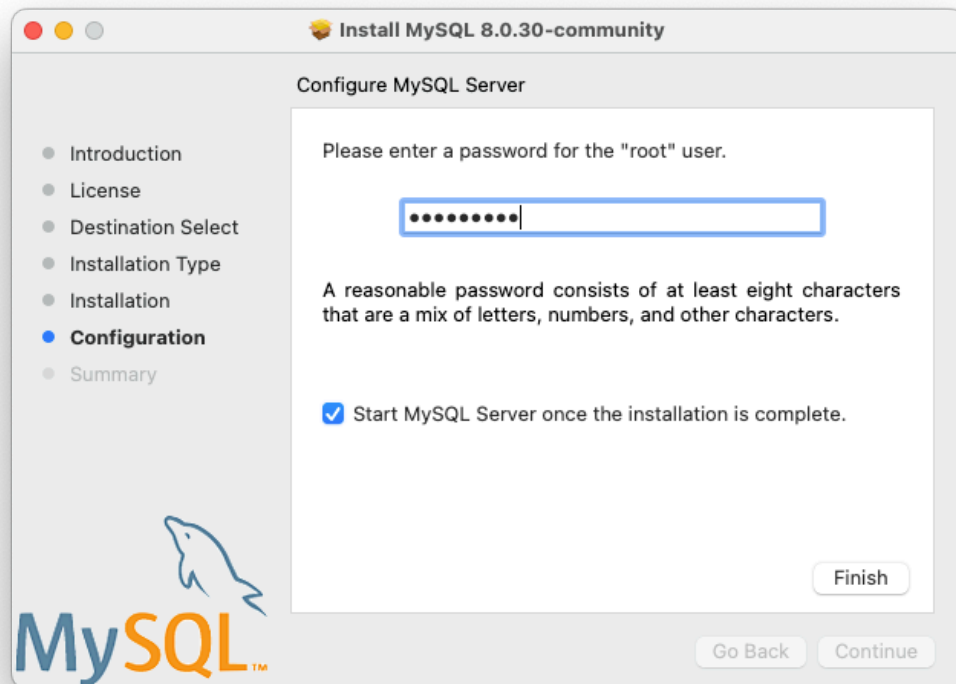
Figure 6.3 MySQL Package Installer Wizard: Choose a Password Encryption Type



Choosing the legacy password mechanism alters the generated launchd file to set `--default_authentication_plugin=mysql_native_password` under `ProgramArguments`. Choosing strong password encryption does not set `--default_authentication_plugin` because the default MySQL Server value is used, which is `caching_sha2_password`.

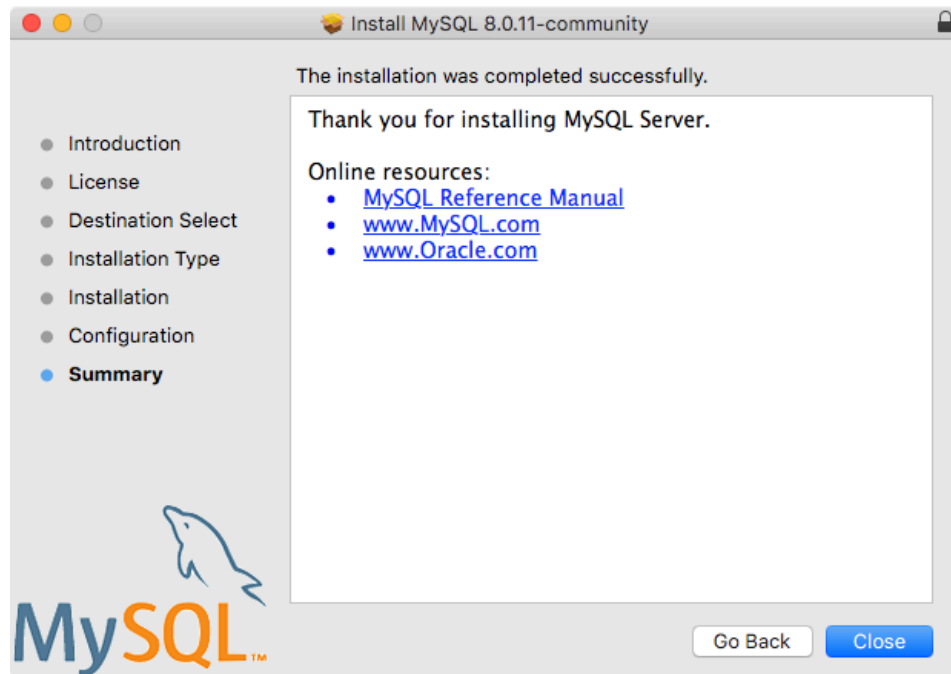
7. Define a password for the root user, and also toggle whether MySQL Server should start after the configuration step is complete.

Figure 6.4 MySQL Package Installer Wizard: Define Root Password



8. **Summary** is the final step and references a successful and complete MySQL Server installation. **Close** the wizard.

Figure 6.5 MySQL Package Installer Wizard: Summary



MySQL server is now installed. If you chose to not start MySQL, then use either `launchctl` from the command line or start MySQL by clicking "Start" using the MySQL preference pane. For additional information, see [Section 6.3, "Installing and Using the MySQL Launch Daemon"](#), and [Section 6.4, "Installing and Using the MySQL Preference Pane"](#). Use the MySQL Preference Pane or `launchd` to configure MySQL to automatically start at bootup.

When installing using the package installer, the files are installed into a directory within `/usr/local` matching the name of the installation version and platform. For example, the installer file `mysql-8.0.36-macos10.15-x86_64.dmg` installs MySQL into `/usr/local/mysql-8.0.36-macos10.15-x86_64/` with a symlink to `/usr/local/mysql`. The following table shows the layout of this MySQL installation directory.

Note

The macOS installation process does not create nor install a sample `my.cnf` MySQL configuration file.

Table 6.1 MySQL Installation Layout on macOS

Directory	Contents of Directory
<code>bin</code>	<code>mysqld</code> server, client and utility programs
<code>data</code>	Log files, databases, where <code>/usr/local/mysql/data/mysqld.local.err</code> is the default error log
<code>docs</code>	Helper documents, like the Release Notes and build information
<code>include</code>	Include (header) files

Directory	Contents of Directory
<code>lib</code>	Libraries
<code>man</code>	Unix manual pages
<code>mysql-test</code>	MySQL test suite ('MySQL Test' is disabled by default during the installation process when using the installer package (DMG))
<code>share</code>	Miscellaneous support files, including error messages, <code>dictionary.txt</code> , and rewriter SQL
<code>support-files</code>	Support scripts, such as <code>mysqld_multi.server</code> , <code>mysql.server</code> , and <code>mysql-log-rotate</code> .
<code>/tmp/mysql.sock</code>	Location of the MySQL Unix socket

6.3 Installing and Using the MySQL Launch Daemon

macOS uses launch daemons to automatically start, stop, and manage processes and applications such as MySQL.

By default, the installation package (DMG) on macOS installs a launchd file named `/Library/LaunchDaemons/com.oracle.oss.mysql.mysqld.plist` that contains a plist definition similar to:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple Computer//DTD PLIST 1.0//EN" "http://www.apple.com/DTDs/PropertyList-1.0.dtd"
<plist version="1.0">
<dict>
  <key>Label</key>          <string>com.oracle.oss.mysql.mysqld</string>
  <key>ProcessType</key>    <string>Interactive</string>
  <key>Disabled</key>       <false/>
  <key>RunAtLoad</key>      <true/>
  <key>KeepAlive</key>      <true/>
  <key>SessionCreate</key>  <true/>
  <key>LaunchOnlyOnce</key> <false/>
  <key>UserName</key>       <string>_mysql</string>
  <key>GroupName</key>     <string>_mysql</string>
  <key>ExitTimeOut</key>    <integer>600</integer>
  <key>Program</key>       <string>/usr/local/mysql/bin/mysqld</string>
  <key>ProgramArguments</key>
    <array>
      <string>/usr/local/mysql/bin/mysqld</string>
      <string>--user=_mysql</string>
      <string>--basedir=/usr/local/mysql</string>
      <string>--datadir=/usr/local/mysql/data</string>
      <string>--plugin-dir=/usr/local/mysql/lib/plugin</string>
      <string>--log-error=/usr/local/mysql/data/mysqld.local.err</string>
      <string>--pid-file=/usr/local/mysql/data/mysqld.local.pid</string>
      <string>--keyring-file-data=/usr/local/mysql/keyring/keyring</string>
      <string>--early-plugin-load=keyring_file=keyring_file.so</string>
    </array>
  <key>WorkingDirectory</key> <string>/usr/local/mysql</string>
</dict>
</plist>
```

Note

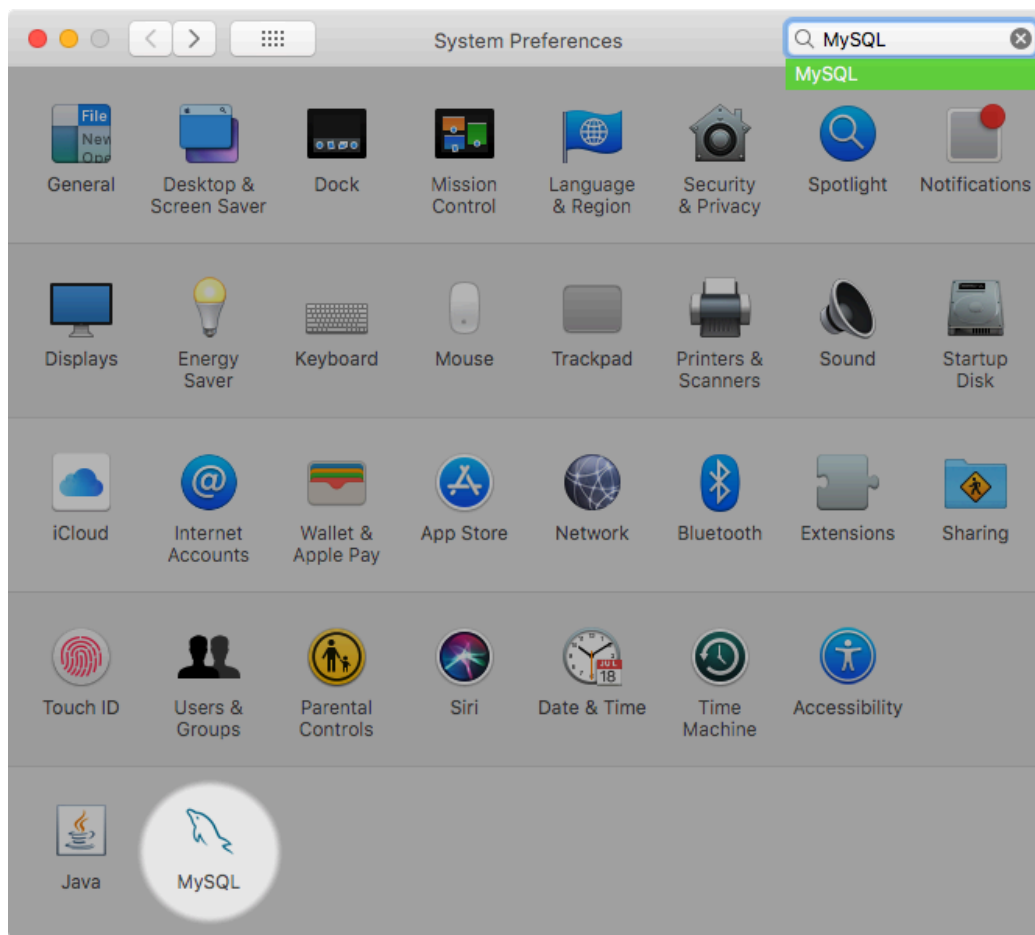
Some users report that adding a plist DOCTYPE declaration causes the launchd operation to fail, despite it passing the lint check. We suspect it's a copy-

n-paste error. The md5 checksum of a file containing the above snippet is `d925f05f6d1b6ee5ce5451b596d6baed`.

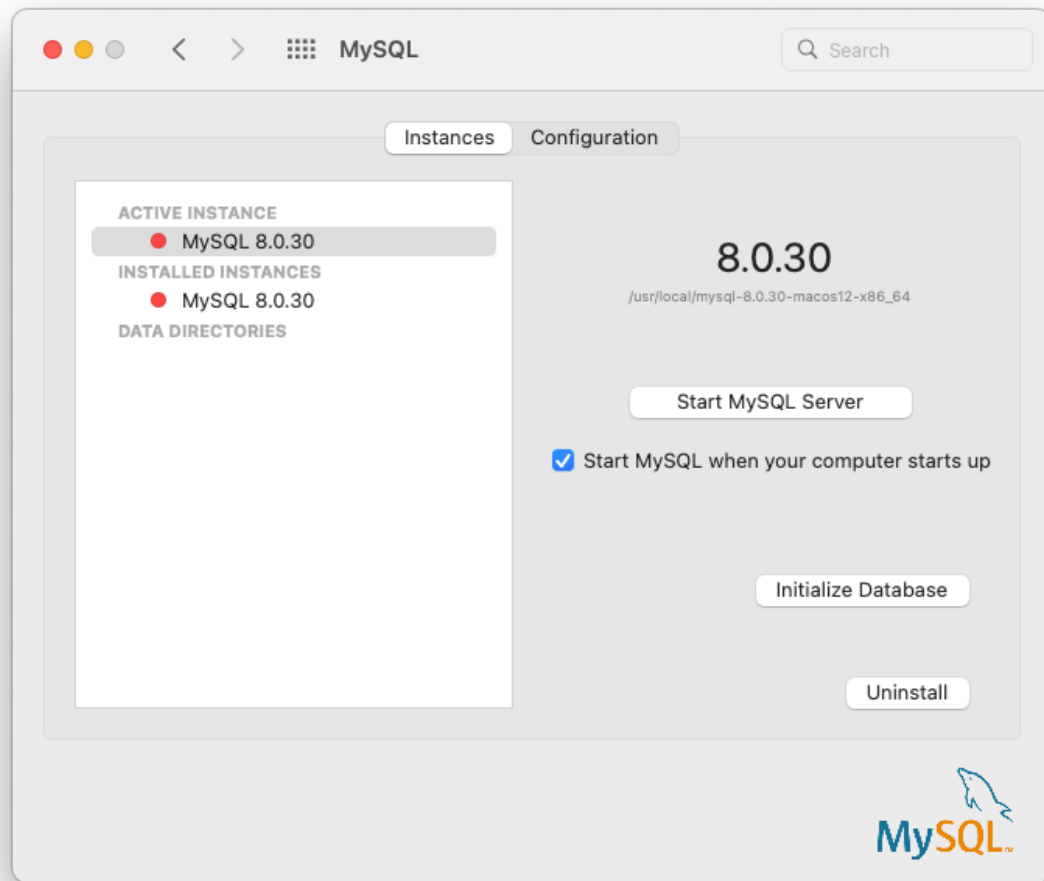
To enable the launchd service, you can either:

- Open macOS system preferences and select the MySQL preference panel, and then execute **Start MySQL Server**.

Figure 6.6 MySQL Preference Pane: Location



The **Instances** page includes an option to start or stop MySQL, and **Initialize Database** recreates the `data/` directory. **Uninstall** uninstalls MySQL Server and optionally the MySQL preference panel and launchd information.

Figure 6.7 MySQL Preference Pane: Instances

- Or, manually load the launchd file.

```
$> cd /Library/LaunchDaemons
$> sudo launchctl load -F com.oracle.oss.mysql.mysqld.plist
```

- To configure MySQL to automatically start at bootup, you can:

```
$> sudo launchctl load -w com.oracle.oss.mysql.mysqld.plist
```

Note

When upgrading MySQL server, the launchd installation process removes the old startup items that were installed with MySQL server 5.7.7 and below.

Upgrading also replaces your existing launchd file named `com.oracle.oss.mysql.mysqld.plist`.

Additional launchd related information:

- The plist entries override `my.cnf` entries, because they are passed in as command line arguments. For additional information about passing in program options, see [Specifying Program Options](#).
- The **ProgramArguments** section defines the command line options that are passed into the program, which is the `mysqld` binary in this case.
- The default plist definition is written with less sophisticated use cases in mind. For more complicated setups, you may want to remove some of the arguments and instead rely on a MySQL configuration file, such as `my.cnf`.
- If you edit the plist file, then uncheck the installer option when reinstalling or upgrading MySQL. Otherwise, your edited plist file is overwritten, and all edits are lost.

Because the default plist definition defines several **ProgramArguments**, you might remove most of these arguments and instead rely upon your `my.cnf` MySQL configuration file to define them. For example:

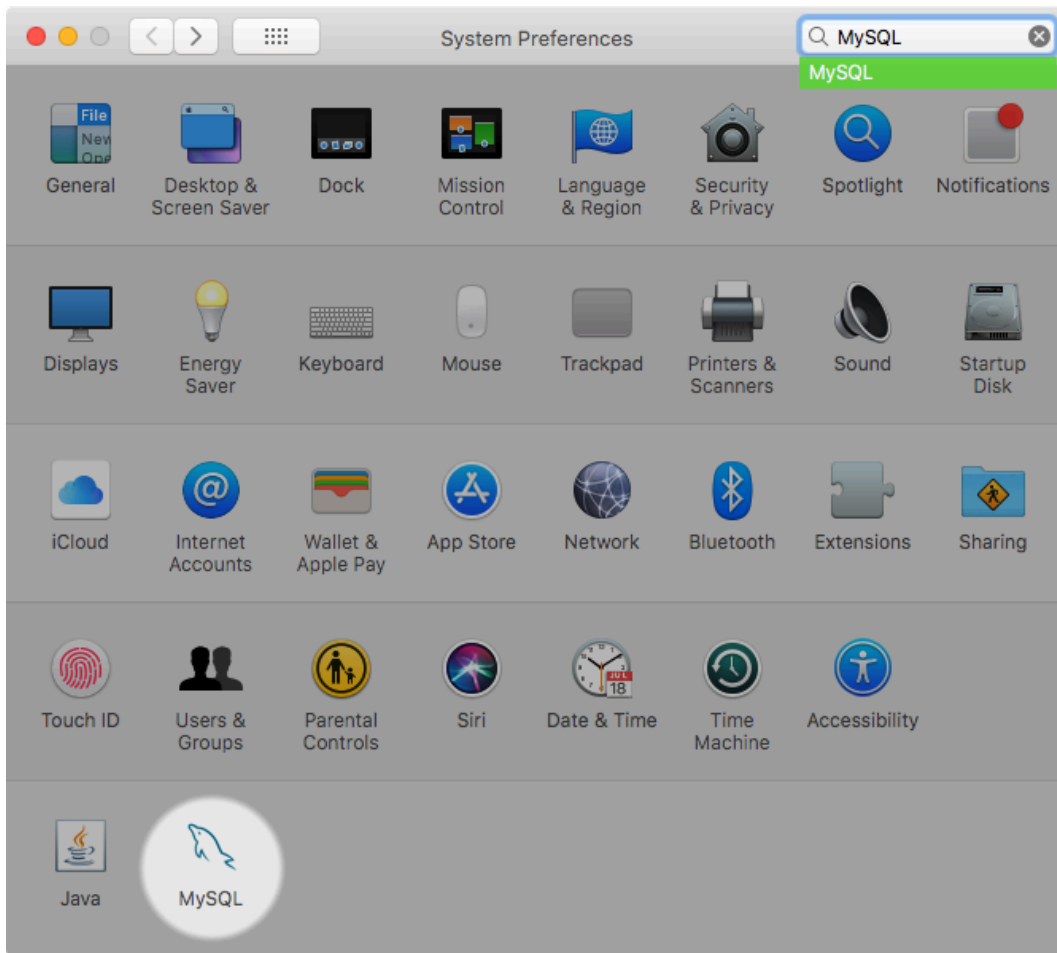
```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple Computer/DTD PLIST 1.0//EN" "http://www.apple.com/DTDs/PropertyList-1.0.0.dtd">
<plist version="1.0">
<dict>
  <key>Label</key>                <string>com.oracle.oss.mysql.mysqld</string>
  <key>ProcessType</key>          <string>Interactive</string>
  <key>Disabled</key>             <false/>
  <key>RunAtLoad</key>            <true/>
  <key>KeepAlive</key>            <true/>
  <key>SessionCreate</key>        <true/>
  <key>LaunchOnlyOnce</key>       <false/>
  <key>UserName</key>             <string>_mysql</string>
  <key>GroupName</key>           <string>_mysql</string>
  <key>ExitTimeOut</key>          <integer>600</integer>
  <key>Program</key>              <string>/usr/local/mysql/bin/mysqld</string>
  <key>ProgramArguments</key>
    <array>
      <string>/usr/local/mysql/bin/mysqld</string>
      <string>--user=_mysql</string>
      <string>--basedir=/usr/local/mysql</string>
      <string>--datadir=/usr/local/mysql/data</string>
      <string>--plugin-dir=/usr/local/mysql/lib/plugin</string>
      <string>--log-error=/usr/local/mysql/data/mysqld.local.err</string>
      <string>--pid-file=/usr/local/mysql/data/mysqld.local.pid</string>
      <string>--keyring-file-data=/usr/local/mysql/keyring/keyring</string>
      <string>--early-plugin-load=keyring_file=keyring_file.so</string>
    </array>
  <key>WorkingDirectory</key>    <string>/usr/local/mysql</string>
</dict>
</plist>
```

In this case, the `basedir`, `datadir`, `plugin_dir`, `log_error`, `pid_file`, `keyring_file_data`, and `--early-plugin-load` options were removed from the default plist `ProgramArguments` definition, which you might have defined in `my.cnf` instead.

6.4 Installing and Using the MySQL Preference Pane

The MySQL Installation Package includes a MySQL preference pane that enables you to start, stop, and control automated startup during boot of your MySQL installation.

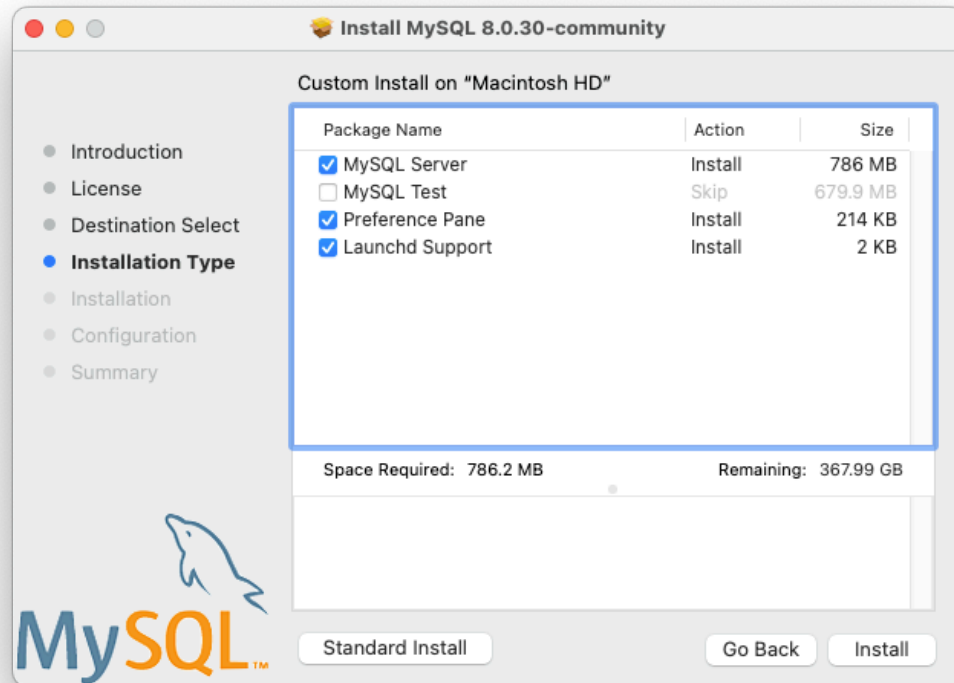
This preference pane is installed by default, and is listed under your system's *System Preferences* window.

Figure 6.8 MySQL Preference Pane: Location

The MySQL preference pane is installed with the same DMG file that installs MySQL Server. Typically it is installed with MySQL Server but it can be installed by itself too.

To install the MySQL preference pane:

1. Go through the process of installing the MySQL server, as described in the documentation at [Section 6.2, "Installing MySQL on macOS Using Native Packages"](#).
2. Click **Customize** at the **Installation Type** step. The "Preference Pane" option is listed there and enabled by default; make sure it is not deselected. The other options, such as MySQL Server, can be selected or deselected.

Figure 6.9 MySQL Package Installer Wizard: Customize

3. Complete the installation process.

Note

The MySQL preference pane only starts and stops MySQL installation installed from the MySQL package installation that have been installed in the default location.

Once the MySQL preference pane has been installed, you can control your MySQL server instance using this preference pane.

The **Instances** page includes an option to start or stop MySQL, and **Initialize Database** recreates the `data/` directory. **Uninstall** uninstalls MySQL Server and optionally the MySQL preference panel and launchd information.

Figure 6.10 MySQL Preference Pane: Instances

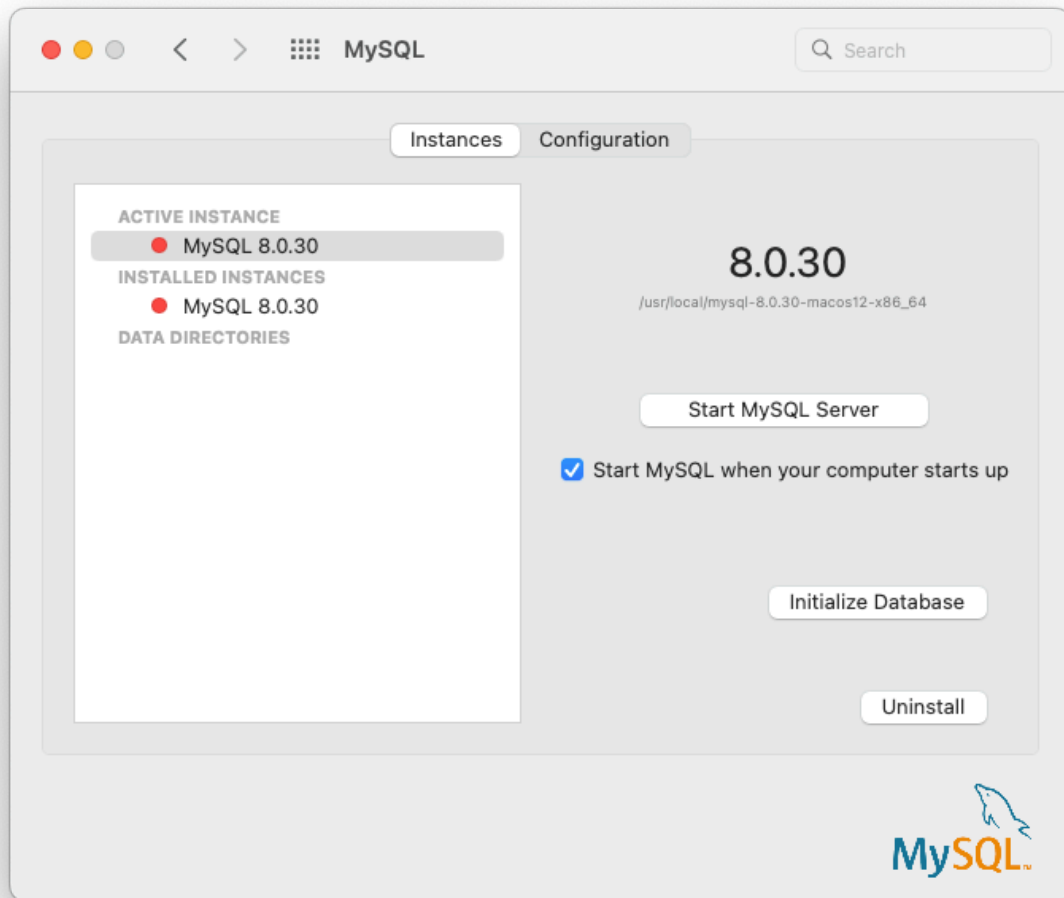
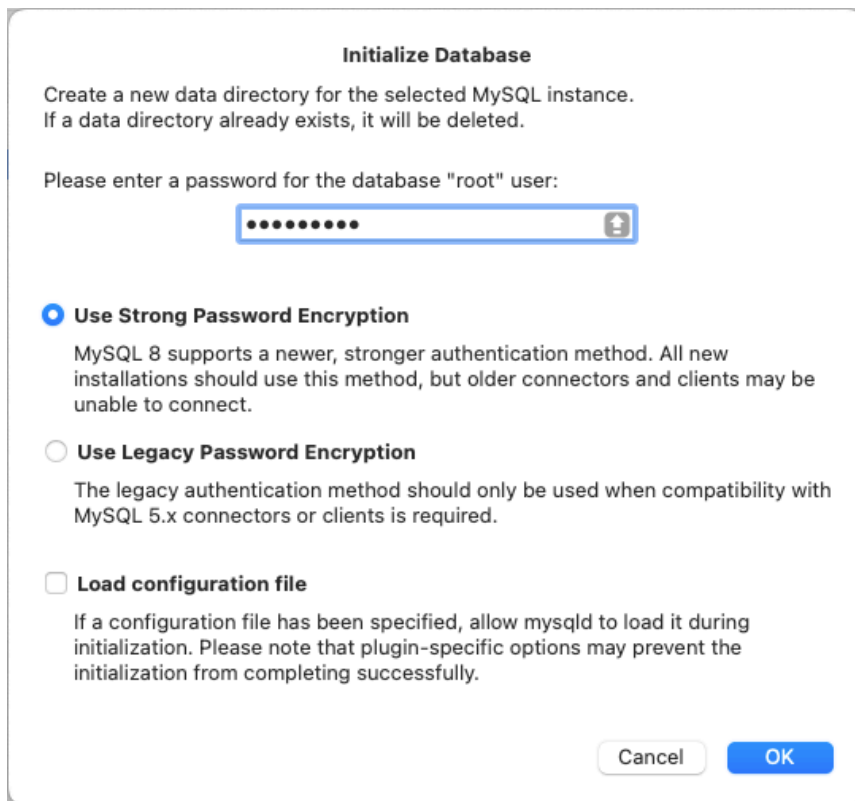


Figure 6.11 MySQL Preference Pane: Initialize Database

Initialize Database

Create a new data directory for the selected MySQL instance.
If a data directory already exists, it will be deleted.

Please enter a password for the database "root" user:

••••••••

☒ **Use Strong Password Encryption**

MySQL 8 supports a newer, stronger authentication method. All new installations should use this method, but older connectors and clients may be unable to connect.

☐ **Use Legacy Password Encryption**

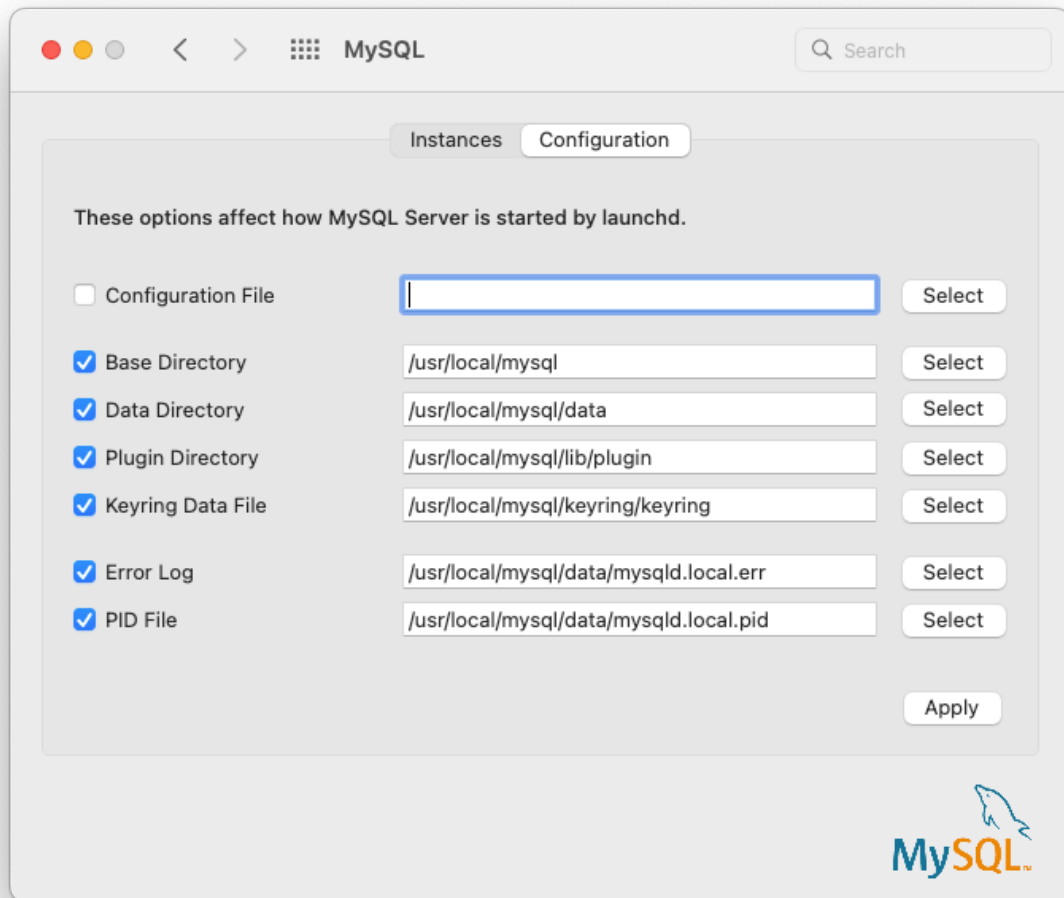
The legacy authentication method should only be used when compatibility with MySQL 5.x connectors or clients is required.

☐ **Load configuration file**

If a configuration file has been specified, allow mysqld to load it during initialization. Please note that plugin-specific options may prevent the initialization from completing successfully.

Cancel OK

The **Configuration** page shows MySQL Server options including the path to the MySQL configuration file.

Figure 6.12 MySQL Preference Pane: Configuration

The MySQL Preference Pane shows the current status of the MySQL server, showing **stopped** (in red) if the server is not running and **running** (in green) if the server has already been started. The preference pane also shows the current setting for whether the MySQL server has been set to start automatically.

Chapter 7 Installing MySQL on Linux

Table of Contents

7.1 Installing MySQL on Linux Using the MySQL Yum Repository	142
7.2 Installing MySQL on Linux Using the MySQL APT Repository	147
7.3 Installing MySQL on Linux Using the MySQL SLES Repository	147
7.4 Installing MySQL on Linux Using RPM Packages from Oracle	147
7.5 Installing MySQL on Linux Using Debian Packages from Oracle	152
7.6 Deploying MySQL on Linux with Docker Containers	153
7.6.1 Basic Steps for MySQL Server Deployment with Docker	154
7.6.2 More Topics on Deploying MySQL Server with Docker	159
7.6.3 Deploying MySQL on Windows and Other Non-Linux Platforms with Docker	166
7.7 Installing MySQL on Linux from the Native Software Repositories	166
7.8 Installing MySQL on Linux with Juju	169
7.9 Managing MySQL Server with systemd	169

Linux supports a number of different solutions for installing MySQL. We recommend that you use one of the distributions from Oracle, for which several methods for installation are available:

Table 7.1 Linux Installation Methods and Information

Type	Setup Method	Additional Information
Apt	Enable the MySQL Apt repository	Documentation
Yum	Enable the MySQL Yum repository	Documentation
Zypper	Enable the MySQL SLES repository	Documentation
RPM	Download a specific package	Documentation
DEB	Download a specific package	Documentation
Generic	Download a generic package	Documentation
Source	Compile from source	Documentation
Docker	Use the Oracle Container Registry . You can also use My Oracle Support for the MySQL Enterprise Edition.	Documentation
Oracle Unbreakable Linux Network	Use ULN channels	Documentation

As an alternative, you can use the package manager on your system to automatically download and install MySQL with packages from the native software repositories of your Linux distribution. These native packages are often several versions behind the currently available release. You are also normally unable to install innovation releases, since these are not usually made available in the native repositories. For more information on using the native package installers, see [Section 7.7, “Installing MySQL on Linux from the Native Software Repositories”](#).

Note

For many Linux installations, you want to set up MySQL to be started automatically when your machine starts. Many of the native package installations perform this

operation for you, but for source, binary and RPM solutions you may need to set this up separately. The required script, `mysql.server`, can be found in the `support-files` directory under the MySQL installation directory or in a MySQL source tree. You can install it as `/etc/init.d/mysql` for automatic MySQL startup and shutdown. See [mysql.server — MySQL Server Startup Script](#).

7.1 Installing MySQL on Linux Using the MySQL Yum Repository

The [MySQL Yum repository](#) for Oracle Linux, Red Hat Enterprise Linux, CentOS, and Fedora provides RPM packages for installing the MySQL server, client, MySQL Workbench, MySQL Utilities, MySQL Router, MySQL Shell, Connector/ODBC, Connector/Python and so on (not all packages are available for all the distributions; see [Installing Additional MySQL Products and Components with Yum](#) for details).

Before You Start

As a popular, open-source software, MySQL, in its original or re-packaged form, is widely installed on many systems from various sources, including different software download sites, software repositories, and so on. The following instructions assume that MySQL is not already installed on your system using a third-party-distributed RPM package; if that is not the case, follow the instructions given in [Section 10.8, “Upgrading MySQL with the MySQL Yum Repository”](#) or [Replacing a Third-Party Distribution of MySQL Using the MySQL Yum Repository](#).

Note

Repository setup RPM file names begin with `mysql80-community` to highlight the default active MySQL subrepository, which is MySQL 8.0 today. They also install subrepositories for the MySQL innovation track, which allows installing and upgrading the MySQL 8.3 innovation release.

Steps for a Fresh Installation of MySQL

Follow the steps below to install the latest GA version of MySQL with the MySQL Yum repository:

Adding¹the MySQL Yum Repository

First, add the MySQL Yum repository to your system's repository list. This is a one-time operation, which can be performed by installing an RPM provided by MySQL. Follow these steps:

- Go to the Download MySQL Yum Repository page (<https://dev.mysql.com/downloads/repo/yum/>) in the MySQL Developer Zone.
- Select and download the release package for your platform.
- Install the downloaded release package with the following command, replacing `platform-and-version-specific-package-name` with the name of the downloaded RPM package:

```
$> sudo yum install platform-and-version-specific-package-name.rpm
```

For an EL6-based system, the command is in the form of:

```
$> sudo yum install mysql80-community-release-el6-{version-number}.noarch.rpm
```

For an EL7-based system:

```
$> sudo yum install mysql80-community-release-el7-{version-number}.noarch.rpm
```

For an EL8-based system:

```
$> sudo yum install mysql80-community-release-el8-{version-number}.noarch.rpm
```

For an EL9-based system:

```
$> sudo yum install mysql80-community-release-el9-{version-number}.noarch.rpm
```

For Fedora 37:

```
$> sudo dnf install mysql80-community-release-fc37-{version-number}.noarch.rpm
```

For Fedora 38:

```
$> sudo dnf install mysql80-community-release-fc38-{version-number}.noarch.rpm
```

For Fedora 39:

```
$> sudo dnf install mysql80-community-release-fc39-{version-number}.noarch.rpm
```

The installation command adds the MySQL Yum repository to your system's repository list and downloads the GnuPG key to check the integrity of the software packages. See [Section 2.4.2, “Signature Checking Using GnuPG”](#) for details on GnuPG key checking.

You can check that the MySQL Yum repository has been successfully added by the following command (for dnf-enabled systems, replace `yum` in the command with `dnf`):

```
$> yum repolist enabled | grep "mysql.*-community.*"
```

Note

Once the MySQL Yum repository is enabled on your system, any system-wide update by the `yum update` command (or `dnf upgrade` for dnf-enabled systems) upgrades MySQL packages on your system and replaces any native third-party packages, if Yum finds replacements for them in the MySQL Yum repository; see [Section 10.8, “Upgrading MySQL with the MySQL Yum Repository”](#), for a discussion on some possible effects of that on your system, see [Upgrading the Shared Client Libraries](#).

Selecting a Release Series

When using the MySQL Yum repository, the latest GA series (currently MySQL 8.0) is selected for installation by default. If this is what you want, you can skip to the next step, [Installing MySQL](#).

Within the MySQL Yum repository, different release series of the MySQL Community Server are hosted in different subrepositories. The subrepository for the latest GA series (currently MySQL 8.0) is enabled by default, and the subrepositories for all other series (for example, the MySQL 8.0 series) are disabled by default. Use this command to see all the subrepositories in the MySQL Yum repository, and see which of them are enabled or disabled (for dnf-enabled systems, replace `yum` in the command with `dnf`):

```
$> yum repolist all | grep mysql
```

To install the latest release from the latest GA series, no configuration is needed. To install the latest release from a specific series other than the latest GA series, disable the subrepository for the latest GA series and enable the subrepository for the specific series before running the installation command.

If your platform supports `yum-config-manager`, you can do that by issuing these commands, which disable the subrepository for the 5.7 series and enable the one for the 8.0 series:

```
$> sudo yum-config-manager --disable mysql57-community
$> sudo yum-config-manager --enable mysql80-community
```

For dnf-enabled platforms:

```
$> sudo dnf config-manager --disable mysql57-community
$> sudo dnf config-manager --enable mysql80-community
```

Besides using `yum-config-manager` or the `dnf config-manager` command, you can also select a release series by editing manually the `/etc/yum.repos.d/mysql-community.repo` file. This is a typical entry for a release series' subrepository in the file:

```
[mysql57-community]
name=MySQL 5.7 Community Server
baseurl=http://repo.mysql.com/yum/mysql-5.7-community/el/6/$basearch/
enabled=1
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-mysql-2022
        file:///etc/pki/rpm-gpg/RPM-GPG-KEY-mysql
```

Find the entry for the subrepository you want to configure, and edit the `enabled` option. Specify `enabled=0` to disable a subrepository, or `enabled=1` to enable a subrepository. For example, to install MySQL 8.0, make sure you have `enabled=0` for the above subrepository entry for MySQL 5.7, and have `enabled=1` for the entry for the 8.0 series:

```
# Enable to use MySQL 8.0
[mysql80-community]
name=MySQL 8.0 Community Server
baseurl=http://repo.mysql.com/yum/mysql-8.0-community/el/6/$basearch/
enabled=1
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/RPM-GPG-KEY-mysql-2022
        file:///etc/pki/rpm-gpg/RPM-GPG-KEY-mysql
```

You should only enable subrepository for one release series at any time. When subrepositories for more than one release series are enabled, Yum uses the latest series.

Verify that the correct subrepositories have been enabled and disabled by running the following command and checking its output (for dnf-enabled systems, replace `yum` in the command with `dnf`):

```
$> yum repolist enabled | grep mysql
```

Disabling the Default MySQL Module

(EL8 systems only) EL8-based systems such as RHEL8 and Oracle Linux 8 include a MySQL module that is enabled by default. Unless this module is disabled, it masks packages provided by MySQL repositories. To disable the included module and make the MySQL repository packages visible, use the following command (for dnf-enabled systems, replace `yum` in the command with `dnf`):

```
$> sudo yum module disable mysql
```

Installing MySQL

Install MySQL by the following command (for dnf-enabled systems, replace `yum` in the command with `dnf`):

```
$> sudo yum install mysql-community-server
```

This installs the package for MySQL server (`mysql-community-server`) and also packages for the components required to run the server, including packages for the client (`mysql-community-client`), the common error messages and character sets for client and server (`mysql-community-common`), and the shared client libraries (`mysql-community-libs`).

Starting the MySQL Server

Start the MySQL server with the following command:

```
$> systemctl start mysqld
```

You can check the status of the MySQL server with the following command:

```
$> systemctl status mysqld
```

If the operating system is systemd enabled, standard `systemctl` (or alternatively, `service` with the arguments reversed) commands such as `stop`, `start`, `status`, and `restart` should be used to manage the MySQL server service. The `mysqld` service is enabled by default, and it starts at system reboot. See [Section 7.9, “Managing MySQL Server with systemd”](#) for additional information.

At the initial start up of the server, the following happens, given that the data directory of the server is empty:

- The server is initialized.
- SSL certificate and key files are generated in the data directory.
- `validate_password` is installed and enabled.
- A superuser account `'root'@'localhost'` is created. A password for the superuser is set and stored in the error log file. To reveal it, use the following command:

```
$> sudo grep 'temporary password' /var/log/mysqld.log
```

Change the root password as soon as possible by logging in with the generated, temporary password and set a custom password for the superuser account:

```
$> mysql -uroot -p
```

```
mysql> ALTER USER 'root'@'localhost' IDENTIFIED BY 'MyNewPass4!';
```

Note

`validate_password` is installed by default. The default password policy implemented by `validate_password` requires that passwords contain at least one uppercase letter, one lowercase letter, one digit, and one special character, and that the total password length is at least 8 characters.

For more information on the postinstallation procedures, see [Chapter 9, Postinstallation Setup and Testing](#).

Note

Compatibility Information for EL7-based platforms: The following RPM packages from the native software repositories of the platforms are incompatible with the package from the MySQL Yum repository that installs the MySQL server. Once you have installed MySQL using the MySQL Yum repository, you cannot install these packages (and vice versa).

- akonadi-mysql

Installing Additional MySQL Products and Components with Yum

You can use Yum to install and manage individual components of MySQL. Some of these components are hosted in sub-repositories of the MySQL Yum repository: for example, the MySQL Connectors are to be found in the MySQL Connectors Community sub-repository, and the MySQL Workbench in MySQL Tools Community. You can use the following command to list the packages for all the MySQL components available for your platform from the MySQL Yum repository (for dnf-enabled systems, replace `yum` in the command with `dnf`):

```
$> sudo yum --disablerepo=* --enablerepo='mysql*-community*' list available
```

Install any packages of your choice with the following command, replacing `package-name` with name of the package (for dnf-enabled systems, replace `yum` in the command with `dnf`):

```
$> sudo yum install package-name
```

For example, to install MySQL Workbench on Fedora:

```
$> sudo dnf install mysql-workbench-community
```

To install the shared client libraries (for dnf-enabled systems, replace `yum` in the command with `dnf`):

```
$> sudo yum install mysql-community-libs
```

Platform Specific Notes

ARM Support

ARM 64-bit (aarch64) is supported on Oracle Linux 7 and requires the Oracle Linux 7 Software Collections Repository (`ol7_software_collections`). For example, to install the server:

```
$> yum-config-manager --enable ol7_software_collections
$> yum install mysql-community-server
```

Note

ARM 64-bit (aarch64) is supported on Oracle Linux 7 as of MySQL 8.0.12.

Known Limitation

The 8.0.12 release requires you to adjust the `libstdc++7` path by executing `ln -s /opt/oracle/oracle-armtoolset-1/root/usr/lib64 /usr/lib64/gcc7` after executing the `yum install` step.

Updating MySQL with Yum

Besides installation, you can also perform updates for MySQL products and components using the MySQL Yum repository. See [Section 10.8, “Upgrading MySQL with the MySQL Yum Repository”](#) for details.

7.2 Installing MySQL on Linux Using the MySQL APT Repository

The MySQL APT repository provides [deb](#) packages for installing and managing the MySQL server, client, and other components on the current Debian and Ubuntu releases.

Instructions for using the MySQL APT Repository are available in [A Quick Guide to Using the MySQL APT Repository](#).

7.3 Installing MySQL on Linux Using the MySQL SLES Repository

The MySQL SLES repository provides RPM packages for installing and managing the MySQL server, client, and other components on SUSE Enterprise Linux Server.

Instructions for using the MySQL SLES repository are available in [A Quick Guide to Using the MySQL SLES Repository](#).

7.4 Installing MySQL on Linux Using RPM Packages from Oracle

The recommended way to install MySQL on RPM-based Linux distributions is by using the RPM packages provided by Oracle. There are two sources for obtaining them, for the Community Edition of MySQL:

- From the MySQL software repositories:
 - The MySQL Yum repository (see [Section 7.1, “Installing MySQL on Linux Using the MySQL Yum Repository”](#) for details).
 - The MySQL SLES repository (see [Section 7.3, “Installing MySQL on Linux Using the MySQL SLES Repository”](#) for details).
- From the [Download MySQL Community Server](#) page in the [MySQL Developer Zone](#).

Note

RPM distributions of MySQL are also provided by other vendors. Be aware that they may differ from those built by Oracle in features, capabilities, and conventions (including communication setup), and that the installation instructions in this manual do not necessarily apply to them. The vendor's instructions should be consulted instead.

MySQL RPM Packages

Table 7.2 RPM Packages for MySQL Community Edition

Package Name	Summary
mysql-community-client	MySQL client applications and tools
mysql-community-client-plugins	Shared plugins for MySQL client applications
mysql-community-common	Common files for server and client libraries
mysql-community-devel	Development header files and libraries for MySQL database client applications
mysql-community-embedded-compat	MySQL server as an embedded library with compatibility for applications using version 18 of the library

Package Name	Summary
<code>mysql-community-icu-data-files</code>	MySQL packaging of ICU data files needed by MySQL regular expressions
<code>mysql-community-libs</code>	Shared libraries for MySQL database client applications
<code>mysql-community-libs-compat</code>	Shared compatibility libraries for previous MySQL installations; only present if previous MySQL versions are supported by the platform
<code>mysql-community-server</code>	Database server and related tools
<code>mysql-community-server-debug</code>	Debug server and plugin binaries
<code>mysql-community-test</code>	Test suite for the MySQL server
<code>mysql-community</code>	The source code RPM looks similar to <code>mysql-community-8.0.36-1.el7.src.rpm</code> , depending on selected OS
Additional *debuginfo* RPMs	There are several <code>debuginfo</code> packages: <code>mysql-community-client-debuginfo</code> , <code>mysql-community-libs-debuginfo</code> , <code>mysql-community-server-debuginfo</code> , <code>mysql-community-server-debuginfo</code> , and <code>mysql-community-test-debuginfo</code> .

Table 7.3 RPM Packages for the MySQL Enterprise Edition

Package Name	Summary
<code>mysql-commercial-backup</code>	MySQL Enterprise Backup (added in 8.0.11)
<code>mysql-commercial-client</code>	MySQL client applications and tools
<code>mysql-commercial-client-plugins</code>	Shared plugins for MySQL client applications
<code>mysql-commercial-common</code>	Common files for server and client libraries
<code>mysql-commercial-devel</code>	Development header files and libraries for MySQL database client applications
<code>mysql-commercial-embedded-compat</code>	MySQL server as an embedded library with compatibility for applications using version 18 of the library
<code>mysql-commercial-icu-data-files</code>	MySQL packaging of ICU data files needed by MySQL regular expressions
<code>mysql-commercial-libs</code>	Shared libraries for MySQL database client applications
<code>mysql-commercial-libs-compat</code>	Shared compatibility libraries for previous MySQL installations; only present if previous MySQL versions are supported by the platform. The version of the libraries matches the version of the libraries installed by default by the distribution you are using.
<code>mysql-commercial-server</code>	Database server and related tools
<code>mysql-commercial-test</code>	Test suite for the MySQL server
Additional *debuginfo* RPMs	There are several <code>debuginfo</code> packages: <code>mysql-commercial-client-debuginfo</code> , <code>mysql-commercial-libs-debuginfo</code> , <code>mysql-commercial-server-debuginfo</code> , and <code>mysql-commercial-test-debuginfo</code> .

Package Name	Summary
	debuginfo mysql-commercial-server-debuginfo, and mysql-commercial-test-debuginfo.

The full names for the RPMs have the following syntax:

```
packagename-version-distribution-arch.rpm
```

The *distribution* and *arch* values indicate the Linux distribution and the processor type for which the package was built. See the table below for lists of the distribution identifiers:

Table 7.4 MySQL Linux RPM Package Distribution Identifiers

Distribution Value	Intended Use
el{ <i>version</i> } where { <i>version</i> } is the major Enterprise Linux version, such as <i>el8</i>	EL6 (8.0), EL7, EL8, and EL9-based platforms (for example, the corresponding versions of Oracle Linux, Red Hat Enterprise Linux, and CentOS)
fc{ <i>version</i> } where { <i>version</i> } is the major Fedora version, such as <i>fc37</i>	Fedora 38 and 39
<i>sles12</i>	SUSE Linux Enterprise Server 12

To see all files in an RPM package (for example, *mysql-community-server*), use the following command:

```
$> rpm -qpl mysql-community-server-version-distribution-arch.rpm
```

The discussion in the rest of this section applies only to an installation process using the RPM packages directly downloaded from Oracle, instead of through a MySQL repository.

Dependency relationships exist among some of the packages. If you plan to install many of the packages, you may wish to download the RPM bundle *tar* file instead, which contains all the RPM packages listed above, so that you need not download them separately.

In most cases, you need to install the *mysql-community-server*, *mysql-community-client*, *mysql-community-client-plugins*, *mysql-community-libs*, *mysql-community-icu-data-files*, *mysql-community-common*, and *mysql-community-libs-compat* packages to get a functional, standard MySQL installation. To perform such a standard, basic installation, go to the folder that contains all those packages (and, preferably, no other RPM packages with similar names), and issue the following command:

```
$> sudo yum install mysql-community-{server,client,client-plugins,icu-data-files,common,libs}-*
```

Replace *yum* with *zypper* for SLES, and with *dnf* for Fedora.

While it is much preferable to use a high-level package management tool like *yum* to install the packages, users who prefer direct *rpm* commands can replace the *yum install* command with the *rpm -Uvh* command; however, using *rpm -Uvh* instead makes the installation process more prone to failure, due to potential dependency issues the installation process might run into.

To install only the client programs, you can skip *mysql-community-server* in your list of packages to install; issue the following command:

```
$> sudo yum install mysql-community-{client,client-plugins,common,libs}-*
```

Replace *yum* with *zypper* for SLES, and with *dnf* for Fedora.

A standard installation of MySQL using the RPM packages result in files and resources created under the system directories, shown in the following table.

Table 7.5 MySQL Installation Layout for Linux RPM Packages from the MySQL Developer Zone

Files or Resources	Location
Client programs and scripts	<code>/usr/bin</code>
<code>mysqld</code> server	<code>/usr/sbin</code>
Configuration file	<code>/etc/my.cnf</code>
Data directory	<code>/var/lib/mysql</code>
Error log file	For RHEL, Oracle Linux, CentOS or Fedora platforms: <code>/var/log/mysqld.log</code> For SLES: <code>/var/log/mysql/mysqld.log</code>
Value of <code>secure_file_priv</code>	<code>/var/lib/mysql-files</code>
System V init script	For RHEL, Oracle Linux, CentOS or Fedora platforms: <code>/etc/init.d/mysqld</code> For SLES: <code>/etc/init.d/mysql</code>
Systemd service	For RHEL, Oracle Linux, CentOS or Fedora platforms: <code>mysqld</code> For SLES: <code>mysql</code>
Pid file	<code>/var/run/mysql/mysqld.pid</code>
Socket	<code>/var/lib/mysql/mysql.sock</code>
Keyring directory	<code>/var/lib/mysql-keyring</code>
Unix manual pages	<code>/usr/share/man</code>
Include (header) files	<code>/usr/include/mysql</code>
Libraries	<code>/usr/lib/mysql</code>
Miscellaneous support files (for example, error messages, and character set files)	<code>/usr/share/mysql</code>

The installation also creates a user named `mysql` and a group named `mysql` on the system.

Notes

- The `mysql` user is created using the `-r` and `-s /bin/false` options of the `useradd` command, so that it does not have login permissions to your server host (see [Creating the mysql User and Group](#) for details). To switch to the `mysql` user on your OS, use the `--shell=/bin/bash` option for the `su` command:

```
su - mysql --shell=/bin/bash
```

- Installation of previous versions of MySQL using older packages might have created a configuration file named `/usr/my.cnf`. It is highly recommended that you examine the contents of the file and migrate the desired settings inside to the file `/etc/my.cnf` file, then remove `/usr/my.cnf`.

MySQL is NOT automatically started at the end of the installation process. For Red Hat Enterprise Linux, Oracle Linux, CentOS, and Fedora systems, use the following command to start MySQL:

```
$> systemctl start mysqld
```

For SLES systems, the command is the same, but the service name is different:

```
$> systemctl start mysql
```

If the operating system is systemd enabled, standard `systemctl` (or alternatively, `service` with the arguments reversed) commands such as `stop`, `start`, `status`, and `restart` should be used to manage the MySQL server service. The `mysqld` service is enabled by default, and it starts at system reboot. Notice that certain things might work differently on systemd platforms: for example, changing the location of the data directory might cause issues. See [Section 7.9, “Managing MySQL Server with systemd”](#) for additional information.

During an upgrade installation using RPM and DEB packages, if the MySQL server is running when the upgrade occurs then the MySQL server is stopped, the upgrade occurs, and the MySQL server is restarted. One exception: if the edition also changes during an upgrade (such as community to commercial, or vice-versa), then MySQL server is not restarted.

At the initial start up of the server, the following happens, given that the data directory of the server is empty:

- The server is initialized.
- An SSL certificate and key files are generated in the data directory.
- `validate_password` is installed and enabled.
- A superuser account `'root'@'localhost'` is created. A password for the superuser is set and stored in the error log file. To reveal it, use the following command for RHEL, Oracle Linux, CentOS, and Fedora systems:

```
$> sudo grep 'temporary password' /var/log/mysqld.log
```

Use the following command for SLES systems:

```
$> sudo grep 'temporary password' /var/log/mysql/mysqld.log
```

The next step is to log in with the generated, temporary password and set a custom password for the superuser account:

```
$> mysql -uroot -p
```

```
mysql> ALTER USER 'root'@'localhost' IDENTIFIED BY 'MyNewPass4!';
```

Note

`validate_password` is installed by default. The default password policy implemented by `validate_password` requires that passwords contain at least one uppercase letter, one lowercase letter, one digit, and one special character, and that the total password length is at least 8 characters.

If something goes wrong during installation, you might find debug information in the error log file `/var/log/mysqld.log`.

For some Linux distributions, it might be necessary to increase the limit on number of file descriptors available to `mysqld`. See [File Not Found and Similar Errors](#)

Installing Client Libraries from Multiple MySQL Versions. It is possible to install multiple client library versions, such as for the case that you want to maintain compatibility with older applications linked against previous libraries. To install an older client library, use the `--oldpackage` option with `rpm`. For example,

to install `mysql-community-libs-5.5` on an EL6 system that has `libmysqlclient.21` from MySQL 8.0, use a command like this:

```
$> rpm --oldpackage -ivh mysql-community-libs-5.5.50-2.el6.x86_64.rpm
```

Debug Package. A special variant of MySQL Server compiled with the [debug package](#) has been included in the server RPM packages. It performs debugging and memory allocation checks and produces a trace file when the server is running. To use that debug version, start MySQL with `/usr/sbin/mysqld-debug`, instead of starting it as a service or with `/usr/sbin/mysqld`. See [The DBUG Package](#) for the debug options you can use.

Note

The default plugin directory for debug builds changed from `/usr/lib64/mysql/plugin` to `/usr/lib64/mysql/plugin/debug` in MySQL 8.0.4. Previously, it was necessary to change `plugin_dir` to `/usr/lib64/mysql/plugin/debug` for debug builds.

Rebuilding RPMs from source SRPMs. Source code SRPM packages for MySQL are available for download. They can be used as-is to rebuild the MySQL RPMs with the standard `rpmbuild` tool chain.

7.5 Installing MySQL on Linux Using Debian Packages from Oracle

Oracle provides Debian packages for installing MySQL on Debian or Debian-like Linux systems. The packages are available through two different channels:

- The [MySQL APT Repository](#). This is the preferred method for installing MySQL on Debian-like systems, as it provides a simple and convenient way to install and update MySQL products. For details, see [Section 7.2, “Installing MySQL on Linux Using the MySQL APT Repository”](#).
- The [MySQL Developer Zone's Download Area](#). For details, see [Section 2.3, “How to Get MySQL”](#). The following are some information on the Debian packages available there and the instructions for installing them:
 - Various Debian packages are provided in the MySQL Developer Zone for installing different components of MySQL on the current Debian and Ubuntu platforms. The preferred method is to use the tarball bundle, which contains the packages needed for a basic setup of MySQL. The tarball bundles have names in the format of `mysql-server_MVER-DVER_CPU.deb-bundle.tar`. *MVER* is the MySQL version and *DVER* is the Linux distribution version. The *CPU* value indicates the processor type or family for which the package is built, as shown in the following table:

Table 7.6 MySQL Debian and Ubuntu Installation Packages CPU Identifiers

<i>CPU</i> Value	Intended Processor Type or Family
<code>i386</code>	Pentium processor or better, 32 bit
<code>amd64</code>	64-bit x86 processor

- After downloading the tarball, unpack it with the following command:

```
$> tar -xvf mysql-server_MVER-DVER_CPU.deb-bundle.tar
```

- You may need to install the `libaio` library if it is not already present on your system:

```
$> sudo apt-get install libaio1
```

- Preconfigure the MySQL server package with the following command:

```
$> sudo dpkg-preconfigure mysql-community-server_*.deb
```

You are asked to provide a password for the root user for your MySQL installation. You might also be asked other questions regarding the installation.

Important

Make sure you remember the root password you set. Users who want to set a password later can leave the **password** field blank in the dialogue box and just press **OK**; in that case, root access to the server is authenticated using the [MySQL Socket Peer-Credential Authentication Plugin](#) for connections using a Unix socket file. You can set the root password later using [mysql_secure_installation](#).

- For a basic installation of the MySQL server, install the database common files package, the client package, the client metapackage, the server package, and the server metapackage (in that order); you can do that with a single command:

```
$> sudo dpkg -i mysql-{common,community-client-plugins,community-client-core,community-client,client,c
```

There are also packages with [server-core](#) and [client-core](#) in the package names. These contain binaries only and are installed automatically by the standard packages. Installing them by themselves does not result in a functioning MySQL setup.

If you are being warned of unmet dependencies by [dpkg](#) (such as [libmecab2](#)), you can fix them using [apt-get](#):

```
sudo apt-get -f install
```

Here are where the files are installed on the system:

- All configuration files (like [my.cnf](#)) are under [/etc/mysql](#)
- All binaries, libraries, headers, etc., are under [/usr/bin](#) and [/usr/sbin](#)
- The data directory is under [/var/lib/mysql](#)

Note

Debian distributions of MySQL are also provided by other vendors. Be aware that they may differ from those built by Oracle in features, capabilities, and conventions (including communication setup), and that the instructions in this manual do not necessarily apply to installing them. The vendor's instructions should be consulted instead.

7.6 Deploying MySQL on Linux with Docker Containers

This section explains how to deploy MySQL Server using Docker containers.

While the [docker](#) client is used in the following instructions for demonstration purposes, in general, the MySQL container images provided by Oracle work with any container tools that are compliant with the [OCI 1.0 specification](#).

Warning

Before deploying MySQL with Docker containers, make sure you understand the security risks of running containers and mitigate them properly.

7.6.1 Basic Steps for MySQL Server Deployment with Docker

Warning

The MySQL Docker images maintained by the MySQL team are built specifically for Linux platforms. Other platforms are not supported, and users using these MySQL Docker images on them are doing so at their own risk. See [the discussion here](#) for some known limitations for running these containers on non-Linux operating systems.

- [Downloading a MySQL Server Docker Image](#)
- [Starting a MySQL Server Instance](#)
- [Connecting to MySQL Server from within the Container](#)
- [Container Shell Access](#)
- [Stopping and Deleting a MySQL Container](#)
- [Upgrading a MySQL Server Container](#)
- [More Topics on Deploying MySQL Server with Docker](#)

Downloading a MySQL Server Docker Image

Important

For users of MySQL Enterprise Edition: A subscription is required to use the Docker images for MySQL Enterprise Edition. Subscriptions work by a Bring Your Own License model; see [How to Buy MySQL Products and Services](#) for details.

Downloading the server image in a separate step is not strictly necessary; however, performing this step before you create your Docker container ensures your local image is up to date. To download the MySQL Community Edition image from the [Oracle Container Registry \(OCR\)](#), run this command:

```
docker pull container-registry.oracle.com/mysql/community-server:tag
```

The `tag` is the label for the image version you want to pull (for example, `5.7`, `8.0`, or `latest`). If `:tag` is omitted, the `latest` label is used, and the image for the latest GA version of MySQL Community Server is downloaded.

To download the MySQL Enterprise Edition image from the OCR, you need to first accept the license agreement on the OCR and log in to the container repository with your Docker client. Follow these steps:

- Visit the OCR at <https://container-registry.oracle.com/> and choose **MySQL**.
- Under the list of MySQL repositories, choose `enterprise-server`.
- If you have not signed in to the OCR yet, click the **Sign in** button on the right of the page, and then enter your Oracle account credentials when prompted to.
- Follow the instructions on the right of the page to accept the license agreement.
- Log in to the OCR with your container client using, for example, the `docker login` command:

```
# docker login container-registry.oracle.com
Username: Oracle-Account-ID
```



```
Password: password
Login successful.
```

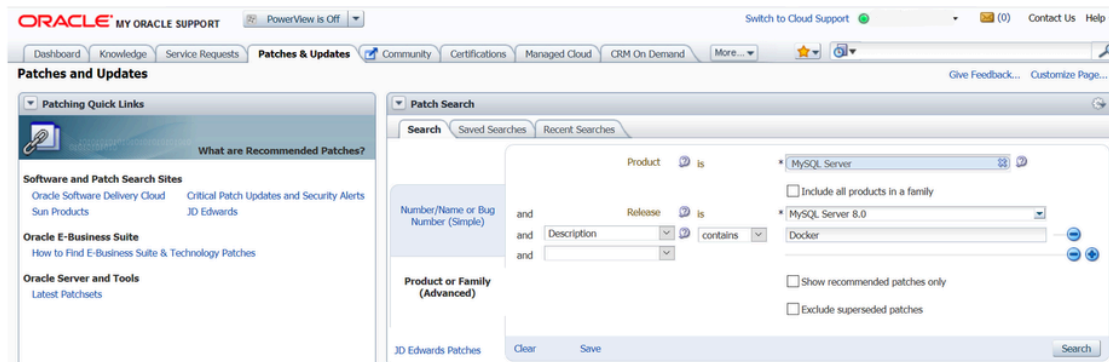
Download the Docker image for MySQL Enterprise Edition from the OCR with this command:

```
docker pull container-registry.oracle.com/mysql/enterprise-server:tag
```

To download the MySQL Enterprise Edition image from [My Oracle Support](#) website, go onto the website, sign in to your Oracle account, and perform these steps once you are on the landing page:

- Select the **Patches and Updates** tab.
- Go to the **Patch Search** region and, on the **Search** tab, switch to the **Product or Family (Advanced)** subtab.
- Enter “MySQL Server” for the **Product** field, and the desired version number in the **Release** field.
- Use the dropdowns for additional filters to select **Description—contains**, and enter “Docker” in the text field.

The following figure shows the search settings for the MySQL Enterprise Edition image for MySQL Server 8.0:



- Click the **Search** button and, from the result list, select the version you want, and click the **Download** button.
- In the **File Download** dialogue box that appears, click and download the **.zip** file for the Docker image.

Unzip the downloaded **.zip** archive to obtain the tarball inside (`mysql-enterprise-server-version.tar`), and then load the image by running this command:

```
docker load -i mysql-enterprise-server-version.tar
```

You can list downloaded Docker images with this command:

```
$> docker images
REPOSITORY                                TAG      IMAGE ID      CREATED      SIZE
container-registry.oracle.com/mysql/community-server  latest  1d9c2219ff69  2 months ago  496MB
```

Starting a MySQL Server Instance

To start a new Docker container for a MySQL Server, use the following command:

```
docker run --name=container_name --restart on-failure -d image_name:tag
```

`image_name` is the name of the image to be used to start the container; see [Downloading a MySQL Server Docker Image](#) for more information.

The `--name` option, for supplying a custom name for your server container, is optional; if no container name is supplied, a random one is generated.

The `--restart` option is for configuring the [restart policy](#) for your container; it should be set to the value `on-failure`, to enable support for server restart within a client session (which happens, for example, when the `RESTART` statement is executed by a client or during the [configuration of an InnoDB cluster instance](#)). With the support for restart enabled, issuing a restart within a client session causes the server and the container to stop and then restart. *Support for server restart is available for MySQL 8.0.21 and later.*

For example, to start a new Docker container for the MySQL Community Server, use this command:

```
docker run --name=mysql11 --restart on-failure -d container-registry.oracle.com/mysql/community-server:latest
```

To start a new Docker container for the MySQL Enterprise Server with a Docker image downloaded from the OCR, use this command:

```
docker run --name=mysql11 --restart on-failure -d container-registry.oracle.com/mysql/enterprise-server:latest
```

To start a new Docker container for the MySQL Enterprise Server with a Docker image downloaded from My Oracle Support, use this command:

```
docker run --name=mysql11 --restart on-failure -d mysql/enterprise-server:latest
```

If the Docker image of the specified name and tag has not been downloaded by an earlier `docker pull` or `docker run` command, the image is now downloaded. Initialization for the container begins, and the container appears in the list of running containers when you run the `docker ps` command. For example:

```
$> docker ps
```

CONTAINER ID	IMAGE	COMMAND	CREATED
4cd4129b3211	container-registry.oracle.com/mysql/community-server:latest	"/entrypoint.sh mysql..."	8 seconds ago

The container initialization might take some time. When the server is ready for use, the [STATUS](#) of the container in the output of the `docker ps` command changes from `(health: starting)` to `(healthy)`.

The `-d` option used in the `docker run` command above makes the container run in the background. Use this command to monitor the output from the container:

```
docker logs mysql11
```

Once initialization is finished, the command's output is going to contain the random password generated for the root user; check the password with, for example, this command:

```
$> docker logs mysql11 2>&1 | grep GENERATED
GENERATED ROOT PASSWORD: Axegh3kAJyDLaRuBemecis&EShOs
```

Connecting to MySQL Server from within the Container

Once the server is ready, you can run the `mysql` client within the MySQL Server container you just started, and connect it to the MySQL Server. Use the `docker exec -it` command to start a `mysql` client inside the Docker container you have started, like the following:

```
docker exec -it mysql11 mysql -uroot -p
```

When asked, enter the generated root password (see the last step in [Starting a MySQL Server Instance](#) above on how to find the password). Because the `MYSQL_ONETIME_PASSWORD` option is true by default,

after you have connected a `mysql` client to the server, you must reset the server root password by issuing this statement:

```
mysql> ALTER USER 'root'@'localhost' IDENTIFIED BY 'password';
```

Substitute `password` with the password of your choice. Once the password is reset, the server is ready for use.

Container Shell Access

To have shell access to your MySQL Server container, use the `docker exec -it` command to start a bash shell inside the container:

```
$> docker exec -it mysql1 bash
bash-4.2#
```

You can then run Linux commands inside the container. For example, to view contents in the server's data directory inside the container, use this command:

```
bash-4.2# ls /var/lib/mysql
auto.cnf      ca.pem      client-key.pem  ib_logfile0  ibdata1  mysql      mysql.sock.lock  private_key.p
ca-key.pem    client-cert.pem  ib_buffer_pool  ib_logfile1  ibtmp1   mysql.sock  performance_schema  public_l
```

Stopping and Deleting a MySQL Container

To stop the MySQL Server container we have created, use this command:

```
docker stop mysql1
```

`docker stop` sends a SIGTERM signal to the `mysqld` process, so that the server is shut down gracefully.

Also notice that when the main process of a container (`mysqld` in the case of a MySQL Server container) is stopped, the Docker container stops automatically.

To start the MySQL Server container again:

```
docker start mysql1
```

To stop and start again the MySQL Server container with a single command:

```
docker restart mysql1
```

To delete the MySQL container, stop it first, and then use the `docker rm` command:

```
docker stop mysql1
```

```
docker rm mysql1
```

If you want the [Docker volume for the server's data directory](#) to be deleted at the same time, add the `-v` option to the `docker rm` command.

Upgrading a MySQL Server Container

Important

- Before performing any upgrade to MySQL, follow carefully the instructions in [Chapter 10, Upgrading MySQL](#). Among other instructions discussed there, it is especially important to back up your database before the upgrade.

- The instructions in this section require that the server's data and configuration have been persisted on the host. See [Persisting Data and Configuration Changes](#) for details.

Follow these steps to upgrade a Docker installation of MySQL 5.7 to 8.0:

- Stop the MySQL 5.7 server (container name is `mysql57` in this example):

```
docker stop mysql57
```

- Download the MySQL 8.0 Server Docker image. See instructions in [Downloading a MySQL Server Docker Image](#). Make sure you use the right tag for MySQL 8.0.
- Start a new MySQL 8.0 Docker container (named `mysql80` in this example) with the old server data and configuration (with proper modifications if needed—see [Chapter 10, Upgrading MySQL](#)) that have been persisted on the host (by [bind-mounting](#) in this example). For the MySQL Community Server, run this command:

```
docker run --name=mysql80 \
  --mount type=bind,src=/path-on-host-machine/my.cnf,dst=/etc/my.cnf \
  --mount type=bind,src=/path-on-host-machine/datadir,dst=/var/lib/mysql \
  -d container-registry.oracle.com/mysql/community-server:8.0
```

If needed, adjust `container-registry.oracle.com/mysql/community-server` to the correct image name—for example, replace it with `container-registry.oracle.com/mysql/enterprise-server` for MySQL Enterprise Edition images downloaded from the OCR, or `mysql/enterprise-server` for MySQL Enterprise Edition images downloaded from My Oracle Support.

- Wait for the server to finish startup. You can check the status of the server using the `docker ps` command (see [Starting a MySQL Server Instance](#) for how to do that).

Follow the same steps for upgrading within the 8.0 series (that is, from release 8.0.x to 8.0.y): stop the original container, and start a new one with a newer image on the old server data and configuration. If you used the `8.0` or the `latest` tag when starting your original container and there is now a new MySQL 8.0 release you want to upgrade to it, you must first pull the image for the new release with the command:

```
docker pull container-registry.oracle.com/mysql/community-server:8.0
```

You can then upgrade by starting a *new* container with the same tag on the old data and configuration (adjust the image name if you are using the MySQL Enterprise Edition; see [Downloading a MySQL Server Docker Image](#)):

```
docker run --name=mysql80new \
  --mount type=bind,src=/path-on-host-machine/my.cnf,dst=/etc/my.cnf \
  --mount type=bind,src=/path-on-host-machine/datadir,dst=/var/lib/mysql \
  -d container-registry.oracle.com/mysql/community-server:8.0
```

Note

For MySQL 8.0.15 and earlier: You need to complete the upgrade process by running the `mysql_upgrade` utility in the MySQL 8.0 Server container (the step is *not* required for MySQL 8.0.16 and later):

- `docker exec -it mysql80 mysql_upgrade -uroot -p`

When prompted, enter the root password for your old server.

- Finish the upgrade by restarting the new container:

```
docker restart mysql80
```

More Topics on Deploying MySQL Server with Docker

For more topics on deploying MySQL Server with Docker like server configuration, persisting data and configuration, server error log, and container environment variables, see [Section 7.6.2, “More Topics on Deploying MySQL Server with Docker”](#).

7.6.2 More Topics on Deploying MySQL Server with Docker

Note

Most of the following sample commands have `container-registry.oracle.com/mysql/community-server` as the Docker image being used (like with the `docker pull` and `docker run` commands); change that if your image is from another repository—for example, replace it with `container-registry.oracle.com/mysql/enterprise-server` for MySQL Enterprise Edition images downloaded from the Oracle Container Registry (OCR), or `mysql/enterprise-server` for MySQL Enterprise Edition images downloaded from [My Oracle Support](#).

- [The Optimized MySQL Installation for Docker](#)
- [Configuring the MySQL Server](#)
- [Persisting Data and Configuration Changes](#)
- [Running Additional Initialization Scripts](#)
- [Connect to MySQL from an Application in Another Docker Container](#)
- [Server Error Log](#)
- [Using MySQL Enterprise Backup with Docker](#)
- [Using mysqldump with Docker](#)
- [Known Issues](#)
- [Docker Environment Variables](#)

The Optimized MySQL Installation for Docker

Docker images for MySQL are optimized for code size, which means they only include crucial components that are expected to be relevant for the majority of users who run MySQL instances in Docker containers. A MySQL Docker installation is different from a common, non-Docker installation in the following aspects:

- Only a limited number of binaries are included.
- All binaries are stripped; they contain no debug information.

Warning

Any software updates or installations users perform to the Docker container (including those for MySQL components) may conflict with the optimized MySQL installation created by the Docker image. Oracle does not provide support for MySQL products running in such an altered container, or a container created from an altered Docker image.

Configuring the MySQL Server

When you start the MySQL Docker container, you can pass configuration options to the server through the `docker run` command. For example:

```
docker run --name mysql1 -d container-registry.oracle.com/mysql/community-server:tag --character-set-server=utf8mb4
```

The command starts the MySQL Server with `utf8mb4` as the default character set and `utf8mb4_col` as the default collation for databases.

Another way to configure the MySQL Server is to prepare a configuration file and mount it at the location of the server configuration file inside the container. See [Persisting Data and Configuration Changes](#) for details.

Persisting Data and Configuration Changes

Docker containers are in principle ephemeral, and any data or configuration are expected to be lost if the container is deleted or corrupted (see discussions [here](#)). [Docker volumes](#) provides a mechanism to persist data created inside a Docker container. At its initialization, the MySQL Server container creates a Docker volume for the server data directory. The JSON output from the `docker inspect` command on the container includes a `Mount` key, whose value provides information on the data directory volume:

```
$> docker inspect mysql1
...
  "Mounts": [
    {
      "Type": "volume",
      "Name": "4f2d463cfc4bdd4baebcb098c97d7da3337195ed2c6572bc0b89f7e845d27652",
      "Source": "/var/lib/docker/volumes/4f2d463cfc4bdd4baebcb098c97d7da3337195ed2c6572bc0b89f7e845d27652/_data",
      "Destination": "/var/lib/mysql",
      "Driver": "local",
      "Mode": "",
      "RW": true,
      "Propagation": ""
    }
  ],
  ...
```

The output shows that the source directory `/var/lib/docker/volumes/4f2d463cfc4bdd4baebcb098c97d7da3337195ed2c6572bc0b89f7e845d27652/_data`, in which data is persisted on the host, has been mounted at `/var/lib/mysql`, the server data directory inside the container.

Another way to preserve data is to [bind-mount](#) a host directory using the `--mount` option when creating the container. The same technique can be used to persist the configuration of the server. The following command creates a MySQL Server container and bind-mounts both the data directory and the server configuration file:

```
docker run --name=mysql1 \
--mount type=bind,src=/path-on-host-machine/my.cnf,dst=/etc/my.cnf \
--mount type=bind,src=/path-on-host-machine/datadir,dst=/var/lib/mysql \
-d container-registry.oracle.com/mysql/community-server:tag
```

The command mounts `path-on-host-machine/my.cnf` at `/etc/my.cnf` (the server configuration file inside the container), and `path-on-host-machine/datadir` at `/var/lib/mysql` (the data directory inside the container). The following conditions must be met for the bind-mounting to work:

- The configuration file `path-on-host-machine/my.cnf` must already exist, and it must contain the specification for starting the server by the user `mysql`:

```
[mysqld]
```

```
user=mysql
```

You can also include other server configuration options in the file.

- The data directory `path-on-host-machine/datadir` must already exist. For server initialization to happen, the directory must be empty. You can also mount a directory prepopulated with data and start the server with it; however, you must make sure you start the Docker container with the same configuration as the server that created the data, and any host files or directories required are mounted when starting the container.

Running Additional Initialization Scripts

If there are any `.sh` or `.sql` scripts you want to run on the database immediately after it has been created, you can put them into a host directory and then mount the directory at `/docker-entrypoint-initdb.d/` inside the container. For example:

```
docker run --name=mysql1 \  
--mount type=bind,src=/path-on-host-machine/scripts/,dst=/docker-entrypoint-initdb.d/ \  
-d container-registry.oracle.com/mysql/community-server:tag
```

Connect to MySQL from an Application in Another Docker Container

By setting up a Docker network, you can allow multiple Docker containers to communicate with each other, so that a client application in another Docker container can access the MySQL Server in the server container. First, create a Docker network:

```
docker network create my-custom-net
```

Then, when you are creating and starting the server and the client containers, use the `--network` option to put them on network you created. For example:

```
docker run --name=mysql1 --network=my-custom-net -d container-registry.oracle.com/mysql/community-server
```

```
docker run --name=myapp1 --network=my-custom-net -d myapp
```

The `myapp1` container can then connect to the `mysql1` container with the `mysql1` hostname and vice versa, as Docker automatically sets up a DNS for the given container names. In the following example, we run the `mysql` client from inside the `myapp1` container to connect to host `mysql1` in its own container:

```
docker exec -it myapp1 mysql --host=mysql1 --user=myuser --password
```

For other networking techniques for containers, see the [Docker container networking](#) section in the Docker Documentation.

Server Error Log

When the MySQL Server is first started with your server container, a [server error log](#) is NOT generated if either of the following conditions is true:

- A server configuration file from the host has been mounted, but the file does not contain the system variable `log_error` (see [Persisting Data and Configuration Changes](#) on bind-mounting a server configuration file).
- A server configuration file from the host has not been mounted, but the Docker environment variable `MYSQL_LOG_CONSOLE` is `true` (which is the variable's default state for MySQL 8.0 server containers). The MySQL Server's error log is then redirected to `stderr`, so that the error log goes into the Docker container's log and is viewable using the `docker logs mysqld-container` command.

To make MySQL Server generate an error log when either of the two conditions is true, use the `--log-error` option to [configure the server](#) to generate the error log at a specific location inside the container.

To persist the error log, mount a host file at the location of the error log inside the container as explained in [Persisting Data and Configuration Changes](#). However, you must make sure your MySQL Server inside its container has write access to the mounted host file.

Using MySQL Enterprise Backup with Docker

[MySQL Enterprise Backup](#) is a commercially-licensed backup utility for MySQL Server, available with [MySQL Enterprise Edition](#). MySQL Enterprise Backup is included in the Docker installation of MySQL Enterprise Edition.

In the following example, we assume that you already have a MySQL Server running in a Docker container (see [Section 7.6.1, “Basic Steps for MySQL Server Deployment with Docker”](#) on how to start a MySQL Server instance with Docker). For MySQL Enterprise Backup to back up the MySQL Server, it must have access to the server's data directory. This can be achieved by, for example, [bind-mounting a host directory on the data directory of the MySQL Server](#) when you start the server:

```
docker run --name=mysqlserver \
--mount type=bind,src=/path-on-host-machine/datadir/,dst=/var/lib/mysql \
-d mysql/enterprise-server:8.0
```

With this command, the MySQL Server is started with a Docker image of the MySQL Enterprise Edition, and the host directory `/path-on-host-machine/datadir/` has been mounted onto the server's data directory (`/var/lib/mysql`) inside the server container. We also assume that, after the server has been started, the required privileges have also been set up for MySQL Enterprise Backup to access the server (see [Grant MySQL Privileges to Backup Administrator](#), for details). Use the following steps to back up and restore a MySQL Server instance.

To back up a MySQL Server instance running in a Docker container using MySQL Enterprise Backup with Docker, follow the steps listed here:

1. On the same host where the MySQL Server container is running, start another container with an image of MySQL Enterprise Edition to perform a back up with the MySQL Enterprise Backup command `backup-to-image`. Provide access to the server's data directory using the bind mount we created in the last step. Also, mount a host directory (`/path-on-host-machine/backups/` in this example) onto the storage folder for backups in the container (`/data/backups` in the example) to persist the backups we are creating. Here is a sample command for this step, in which MySQL Enterprise Backup is started with a Docker image downloaded from [My Oracle Support](#):

```
$> docker run \
--mount type=bind,src=/path-on-host-machine/datadir/,dst=/var/lib/mysql \
--mount type=bind,src=/path-on-host-machine/backups/,dst=/data/backups \
--rm mysql/enterprise-server:8.0 \
mysqlbackup -umysqlbackup -ppassword --backup-dir=/tmp/backup-tmp --with-timestamp \
--backup-image=/data/backups/db.mbi backup-to-image
[Entrypoint] MySQL Docker Image 8.0.11-1.1.5
MySQL Enterprise Backup version 8.0.11 Linux-4.1.12-61.1.16.el7uek.x86_64-x86_64 [2018-04-08 07:06:45]
Copyright (c) 2003, 2018, Oracle and/or its affiliates. All Rights Reserved.
180921 17:27:25 MAIN      INFO: A thread created with Id '140594390935680'
180921 17:27:25 MAIN      INFO: Starting with following command line ...
...
-----
Parameters Summary
-----
Start LSN          : 29615616
End LSN            : 29651854
-----
mysqlbackup completed OK!
```

It is important to check the end of the output by `mysqlbackup` to make sure the backup has been completed successfully.

- The container exits once the backup job is finished and, with the `--rm` option used to start it, it is removed after it exits. An image backup has been created, and can be found in the host directory mounted in the last step for storing backups, as shown here:

```
$> ls /tmp/backups
db.mbi
```

To restore a MySQL Server instance in a Docker container using MySQL Enterprise Backup with Docker, follow the steps listed here:

- Stop the MySQL Server container, which also stops the MySQL Server running inside:

```
docker stop mysqlserver
```

- On the host, delete all contents in the bind mount for the MySQL Server data directory:

```
rm -rf /path-on-host-machine/datadir/*
```

- Start a container with an image of MySQL Enterprise Edition to perform the restore with the MySQL Enterprise Backup command `copy-back-and-apply-log`. Bind-mount the server's data directory and the storage folder for the backups, like what we did when we backed up the server:

```
$> docker run \
--mount type=bind,src=/path-on-host-machine/datadir/,dst=/var/lib/mysql \
--mount type=bind,src=/path-on-host-machine/backups/,dst=/data/backups \
--rm mysql/enterprise-server:8.0 \
mysqlbackup --backup-dir=/tmp/backup-tmp --with-timestamp \
--datadir=/var/lib/mysql --backup-image=/data/backups/db.mbi copy-back-and-apply-log
[Entrypoint] MySQL Docker Image 8.0.11-1.1.5
MySQL Enterprise Backup version 8.0.11 Linux-4.1.12-61.1.16.el7uek.x86_64-x86_64 [2018-04-08 07:06:45]
Copyright (c) 2003, 2018, Oracle and/or its affiliates. All Rights Reserved.
180921 22:06:52 MAIN      INFO: A thread created with Id '139768047519872'
180921 22:06:52 MAIN      INFO: Starting with following command line ...
...
180921 22:06:52 PCR1      INFO: We were able to parse ibbackup_logfile up to
lsn 29680612.
180921 22:06:52 PCR1      INFO: Last MySQL binlog file position 0 155, file name binlog.000003
180921 22:06:52 PCR1      INFO: The first data file is '/var/lib/mysql/ibdata1'
and the new created log files are at '/var/lib/mysql'
180921 22:06:52 MAIN      INFO: No Keyring file to process.
180921 22:06:52 MAIN      INFO: Apply-log operation completed successfully.
180921 22:06:52 MAIN      INFO: Full Backup has been restored successfully.
mysqlbackup completed OK! with 3 warnings
```

The container exits once the backup job is finished and, with the `--rm` option used when starting it, it is removed after it exits.

- Restart the server container, which also restarts the restored server, using the following command:

```
docker restart mysqlserver
```

Or, start a new MySQL Server on the restored data directory, as shown here:

```
docker run --name=mysqlserver2 \
--mount type=bind,src=/path-on-host-machine/datadir/,dst=/var/lib/mysql \
-d mysql/enterprise-server:8.0
```

Log on to the server to check that the server is running with the restored data.

Using `mysqldump` with Docker

Besides using MySQL Enterprise Backup to back up a MySQL Server running in a Docker container, you can perform a logical backup of your server by using the `mysqldump` utility, run inside a Docker container.

The following instructions assume that you already have a MySQL Server running in a Docker container and, when the container was first started, a host directory `/path-on-host-machine/datadir/` has been mounted onto the server's data directory `/var/lib/mysql` (see [bind-mounting a host directory on the data directory of the MySQL Server](#) for details), which contains the Unix socket file by which `mysqldump` and `mysql` can connect to the server. We also assume that, after the server has been started, a user with the proper privileges (`admin` in this example) has been created, with which `mysqldump` can access the server. Use the following steps to back up and restore MySQL Server data:

Backing up MySQL Server data using `mysqldump` with Docker.

1. On the same host where the MySQL Server container is running, start another container with an image of MySQL Server to perform a backup with the `mysqldump` utility (see documentation of the utility for its functionality, options, and limitations). Provide access to the server's data directory by bind mounting `/path-on-host-machine/datadir/`. Also, mount a host directory (`/path-on-host-machine/backups/` in this example) onto a storage folder for backups inside the container (`/data/backups` is used in this example) to persist the backups you are creating. Here is a sample command for backing up all databases on the server using this setup:

```
$> docker run --entrypoint "/bin/sh" \
--mount type=bind,src=/path-on-host-machine/datadir/,dst=/var/lib/mysql \
--mount type=bind,src=/path-on-host-machine/backups/,dst=/data/backups \
--rm container-registry.oracle.com/mysql/community-server:8.0 \
-c "mysqldump -uadmin --password='password' --all-databases > /data/backups/all-databases.sql"
```

In the command, the `--entrypoint` option is used so that the system shell is invoked after the container is started, and the `-c` option is used to specify the `mysqldump` command to be run in the shell, whose output is redirected to the file `all-databases.sql` in the backup directory.

2. The container exits once the backup job is finished and, with the `--rm` option used to start it, it is removed after it exits. A logical backup been created, and can be found in the host directory mounted for storing the backup, as shown here:

```
$> ls /path-on-host-machine/backups/
all-databases.sql
```

Restoring MySQL Server data using `mysqldump` with Docker.

1. Make sure you have a MySQL Server running in a container, onto which you want your backed-up data to be restored.
2. Start a container with an image of MySQL Server to perform the restore with a `mysql` client. Bind-mount the server's data directory, as well as the storage folder that contains your backup:

```
$> docker run \
--mount type=bind,src=/path-on-host-machine/datadir/,dst=/var/lib/mysql \
--mount type=bind,src=/path-on-host-machine/backups/,dst=/data/backups \
--rm container-registry.oracle.com/mysql/community-server:8.0 \
mysql -uadmin --password='password' -e "source /data/backups/all-databases.sql"
```

The container exits once the backup job is finished and, with the `--rm` option used when starting it, it is removed after it exits.

3. Log on to the server to check that the restored data is now on the server.

Known Issues

- When using the server system variable `audit_log_file` to configure the audit log file name, use the `loose` option modifier with it; otherwise, Docker cannot start the server.

Docker Environment Variables

When you create a MySQL Server container, you can configure the MySQL instance by using the `--env` option (short form `-e`) and specifying one or more environment variables. No server initialization is performed if the mounted data directory is not empty, in which case setting any of these variables has no effect (see [Persisting Data and Configuration Changes](#)), and no existing contents of the directory, including server settings, are modified during container startup.

Environment variables which can be used to configure a MySQL instance are listed here:

- The boolean variables including `MYSQL_RANDOM_ROOT_PASSWORD`, `MYSQL_ONETIME_PASSWORD`, `MYSQL_ALLOW_EMPTY_PASSWORD`, and `MYSQL_LOG_CONSOLE` are made true by setting them with any strings of nonzero lengths. Therefore, setting them to, for example, "0", "false", or "no" does not make them false, but actually makes them true. This is a known issue.
- `MYSQL_RANDOM_ROOT_PASSWORD`: When this variable is true (which is its default state, unless `MYSQL_ROOT_PASSWORD` is set or `MYSQL_ALLOW_EMPTY_PASSWORD` is set to true), a random password for the server's root user is generated when the Docker container is started. The password is printed to `stdout` of the container and can be found by looking at the container's log (see [Starting a MySQL Server Instance](#)).
- `MYSQL_ONETIME_PASSWORD`: When the variable is true (which is its default state, unless `MYSQL_ROOT_PASSWORD` is set or `MYSQL_ALLOW_EMPTY_PASSWORD` is set to true), the root user's password is set as expired and must be changed before MySQL can be used normally.
- `MYSQL_DATABASE`: This variable allows you to specify the name of a database to be created on image startup. If a user name and a password are supplied with `MYSQL_USER` and `MYSQL_PASSWORD`, the user is created and granted superuser access to this database (corresponding to `GRANT ALL`). The specified database is created by a `CREATE DATABASE IF NOT EXIST` statement, so that the variable has no effect if the database already exists.
- `MYSQL_USER`, `MYSQL_PASSWORD`: These variables are used in conjunction to create a user and set that user's password, and the user is granted superuser permissions for the database specified by the `MYSQL_DATABASE` variable. Both `MYSQL_USER` and `MYSQL_PASSWORD` are required for a user to be created—if any of the two variables is not set, the other is ignored. If both variables are set but `MYSQL_DATABASE` is not, the user is created without any privileges.

Note

There is no need to use this mechanism to create the root superuser, which is created by default with the password set by either one of the mechanisms discussed in the descriptions for `MYSQL_ROOT_PASSWORD` and `MYSQL_RANDOM_ROOT_PASSWORD`, unless `MYSQL_ALLOW_EMPTY_PASSWORD` is true.

- `MYSQL_ROOT_HOST`: By default, MySQL creates the `'root'@'localhost'` account. This account can only be connected to from inside the container as described in [Connecting to MySQL Server from within the Container](#). To allow root connections from other hosts, set this environment variable. For example, the value `172.17.0.1`, which is the default Docker gateway IP, allows connections from the host machine that runs the container. The option accepts only one entry, but wildcards are allowed (for example, `MYSQL_ROOT_HOST=172.*.*.*` or `MYSQL_ROOT_HOST=%`).
- `MYSQL_LOG_CONSOLE`: When the variable is true (which is its default state for MySQL 8.0 server containers), the MySQL Server's error log is redirected to `stderr`, so that the error log goes into the Docker container's log and is viewable using the `docker logs mysqld-container` command.

Note

The variable has no effect if a server configuration file from the host has been mounted (see [Persisting Data and Configuration Changes](#) on bind-mounting a configuration file).

- `MYSQL_ROOT_PASSWORD`: This variable specifies a password that is set for the MySQL root account.

Warning

Setting the MySQL root user password on the command line is insecure. As an alternative to specifying the password explicitly, you can set the variable with a container file path for a password file, and then mount a file from your host that contains the password at the container file path. This is still not very secure, as the location of the password file is still exposed. It is preferable to use the default settings of `MYSQL_RANDOM_ROOT_PASSWORD` and `MYSQL_ONETIME_PASSWORD` both being true.

- `MYSQL_ALLOW_EMPTY_PASSWORD`. Set it to true to allow the container to be started with a blank password for the root user.

Warning

Setting this variable to true is insecure, because it is going to leave your MySQL instance completely unprotected, allowing anyone to gain complete superuser access. It is preferable to use the default settings of `MYSQL_RANDOM_ROOT_PASSWORD` and `MYSQL_ONETIME_PASSWORD` both being true.

7.6.3 Deploying MySQL on Windows and Other Non-Linux Platforms with Docker

Warning

The MySQL Docker images provided by Oracle are built specifically for Linux platforms. Other platforms are not supported, and users running the MySQL Docker images from Oracle on them are doing so at their own risk. This section discusses some known issues for the images when used on non-Linux platforms.

Known Issues for using the MySQL Server Docker images from Oracle on Windows include:

- If you are bind-mounting on the container's MySQL data directory (see [Persisting Data and Configuration Changes](#) for details), you have to set the location of the server socket file with the `--socket` option to somewhere outside of the MySQL data directory; otherwise, the server fails to start. This is because the way Docker for Windows handles file mounting does not allow a host file from being bind-mounted on the socket file.

7.7 Installing MySQL on Linux from the Native Software Repositories

Many Linux distributions include a version of the MySQL server, client tools, and development components in their native software repositories and can be installed with the platforms' standard package management systems. This section provides basic instructions for installing MySQL using those package management systems.

Important

Native packages are often several versions behind the currently available release. You are also normally unable to install development milestone releases (DMRs), since these are not usually made available in the native repositories. Before proceeding, we recommend that you check out the other installation options described in [Chapter 7, Installing MySQL on Linux](#).

Distribution specific instructions are shown below:

- **Red Hat Linux, Fedora, CentOS**

Note

For a number of Linux distributions, you can install MySQL using the MySQL Yum repository instead of the platform's native software repository. See [Section 7.1, "Installing MySQL on Linux Using the MySQL Yum Repository"](#) for details.

For Red Hat and similar distributions, the MySQL distribution is divided into a number of separate packages, `mysql` for the client tools, `mysql-server` for the server and associated tools, and `mysql-libs` for the libraries. The libraries are required if you want to provide connectivity from different languages and environments such as Perl, Python and others.

To install, use the `yum` command to specify the packages that you want to install. For example:

```
#> yum install mysql mysql-server mysql-libs mysql-server
Loaded plugins: presto, refresh-packagekit
Setting up Install Process
Resolving Dependencies
--> Running transaction check
---> Package mysql.x86_64 0:5.1.48-2.fc13 set to be updated
---> Package mysql-libs.x86_64 0:5.1.48-2.fc13 set to be updated
---> Package mysql-server.x86_64 0:5.1.48-2.fc13 set to be updated
--> Processing Dependency: perl-DBD-MySQL for package: mysql-server-5.1.48-2.fc13.x86_64
--> Running transaction check
---> Package perl-DBD-MySQL.x86_64 0:4.017-1.fc13 set to be updated
--> Finished Dependency Resolution
Dependencies Resolved

=====
Package                Arch          Version           Repository        Size
=====
Installing:
mysql                  x86_64        5.1.48-2.fc13     updates           889 k
mysql-libs              x86_64        5.1.48-2.fc13     updates           1.2 M
mysql-server            x86_64        5.1.48-2.fc13     updates           8.1 M
Installing for dependencies:
perl-DBD-MySQL          x86_64        4.017-1.fc13      updates           136 k
Transaction Summary
=====
Install      4 Package(s)
Upgrade      0 Package(s)
Total download size: 10 M
Installed size: 30 M
Is this ok [y/N]: y
Downloading Packages:
Setting up and reading Presto delta metadata
Processing delta metadata
Package(s) data still to download: 10 M
(1/4): mysql-5.1.48-2.fc13.x86_64.rpm | 889 kB    00:04
(2/4): mysql-libs-5.1.48-2.fc13.x86_64.rpm | 1.2 MB    00:06
(3/4): mysql-server-5.1.48-2.fc13.x86_64.rpm | 8.1 MB    00:40
(4/4): perl-DBD-MySQL-4.017-1.fc13.x86_64.rpm | 136 kB    00:00
```

```

-----
Total                                     201 kB/s | 10 MB      00:52
Running rpm_check_debug
Running Transaction Test
Transaction Test Succeeded
Running Transaction
  Installing      : mysql-libs-5.1.48-2.fc13.x86_64                1/4
  Installing      : mysql-5.1.48-2.fc13.x86_64                    2/4
  Installing      : perl-DBD-MySQL-4.017-1.fc13.x86_64             3/4
  Installing      : mysql-server-5.1.48-2.fc13.x86_64              4/4
Installed:
  mysql.x86_64 0:5.1.48-2.fc13          mysql-libs.x86_64 0:5.1.48-2.fc13
  mysql-server.x86_64 0:5.1.48-2.fc13
Dependency Installed:
  perl-DBD-MySQL.x86_64 0:4.017-1.fc13
Complete!

```

MySQL and the MySQL server should now be installed. A sample configuration file is installed into `/etc/my.cnf`. To start the MySQL server use `systemctl`:

```
$> systemctl start mysqld
```

The database tables are automatically created for you, if they do not already exist. You should, however, run `mysql_secure_installation` to set the root passwords on your server.

- **Debian, Ubuntu, Kubuntu**

Note

For supported Debian and Ubuntu versions, MySQL can be installed using the [MySQL APT Repository](#) instead of the platform's native software repository. See [Section 7.2, "Installing MySQL on Linux Using the MySQL APT Repository"](#) for details.

On Debian and related distributions, there are two packages for MySQL in their software repositories, `mysql-client` and `mysql-server`, for the client and server components respectively. You should specify an explicit version, for example `mysql-client-5.1`, to ensure that you install the version of MySQL that you want.

To download and install, including any dependencies, use the `apt-get` command, specifying the packages that you want to install.

Note

Before installing, make sure that you update your `apt-get` index files to ensure you are downloading the latest available version.

Note

The `apt-get` command installs a number of packages, including the MySQL server, in order to provide the typical tools and application environment. This can

mean that you install a large number of packages in addition to the main MySQL package.

During installation, the initial database is created, and you are prompted for the MySQL root password (and confirmation). A configuration file is created in `/etc/mysql/my.cnf`. An init script is created in `/etc/init.d/mysql`.

The server should already be started. You can manually start and stop the server using:

```
#> service mysql [start|stop]
```

The service is automatically added to the 2, 3 and 4 run levels, with stop scripts in the single, shutdown and restart levels.

7.8 Installing MySQL on Linux with Juju

The Juju deployment framework supports easy installation and configuration of MySQL servers. For instructions, see <https://jujucharms.com/mysql/>.

7.9 Managing MySQL Server with systemd

If you install MySQL using an RPM or Debian package on the following Linux platforms, server startup and shutdown is managed by systemd:

- RPM package platforms:
 - Enterprise Linux variants version 7 and higher
 - SUSE Linux Enterprise Server 12 and higher
 - Fedora 29 and higher
- Debian family platforms:
 - Debian platforms
 - Ubuntu platforms

If you install MySQL from a generic binary distribution on a platform that uses systemd, you can manually configure systemd support for MySQL following the instructions provided in the post-installation setup section of the [MySQL 8.0 Secure Deployment Guide](#).

If you install MySQL from a source distribution on a platform that uses systemd, obtain systemd support for MySQL by configuring the distribution using the `-DWITH_SYSTEMD=1` CMake option. See [Section 4.7, “MySQL Source-Configuration Options”](#).

The following discussion covers these topics:

- [Overview of systemd](#)
- [Configuring systemd for MySQL](#)
- [Configuring Multiple MySQL Instances Using systemd](#)
- [Migrating from mysqld_safe to systemd](#)

Note

On platforms for which systemd support for MySQL is installed, scripts such as `mysqld_safe` and the System V initialization script are unnecessary and are not installed. For example, `mysqld_safe` can handle server restarts, but systemd provides the same capability, and does so in a manner consistent with management of other services rather than by using an application-specific program.

One implication of the non-use of `mysqld_safe` on platforms that use systemd for server management is that use of `[mysqld_safe]` or `[safe_mysqld]` sections in option files is not supported and might lead to unexpected behavior.

Because systemd has the capability of managing multiple MySQL instances on platforms for which systemd support for MySQL is installed, `mysqld_multi` and `mysqld_multi.server` are unnecessary and are not installed.

Overview of systemd

systemd provides automatic MySQL server startup and shutdown. It also enables manual server management using the `systemctl` command. For example:

```
$> systemctl {start/stop/restart/status} mysqld
```

Alternatively, use the `service` command (with the arguments reversed), which is compatible with System V systems:

```
$> service mysqld {start/stop/restart/status}
```

Note

For the `systemctl` command (and the alternative `service` command), if the MySQL service name is not `mysqld` then use the appropriate name. For example, use `mysql` rather than `mysqld` on Debian-based and SLES systems.

Support for systemd includes these files:

- `mysqld.service` (RPM platforms), `mysql.service` (Debian platforms): systemd service unit configuration file, with details about the MySQL service.
- `mysqld@.service` (RPM platforms), `mysql@.service` (Debian platforms): Like `mysqld.service` or `mysql.service`, but used for managing multiple MySQL instances.
- `mysqld.tmpfiles.d`: File containing information to support the `tmpfiles` feature. This file is installed under the name `mysql.conf`.
- `mysqld_pre_systemd` (RPM platforms), `mysql-system-start` (Debian platforms): Support script for the unit file. This script assists in creating the error log file only if the log location matches a pattern (`/var/log/mysql*.log` for RPM platforms, `/var/log/mysql/*.log` for Debian platforms). In other cases, the error log directory must be writable or the error log must be present and writable for the user running the `mysqld` process.

Configuring systemd for MySQL

To add or change systemd options for MySQL, these methods are available:

- Use a localized systemd configuration file.

- Arrange for systemd to set environment variables for the MySQL server process.
- Set the `MYSQLD_OPTS` systemd variable.

To use a localized systemd configuration file, create the `/etc/systemd/system/mysqld.service.d` directory if it does not exist. In that directory, create a file that contains a `[Service]` section listing the desired settings. For example:

```
[Service]
LimitNOFILE=max_open_files
Nice=nice_level
LimitCore=core_file_limit
Environment="LD_PRELOAD=/path/to/malloc/library"
Environment="TZ=time_zone_setting"
```

The discussion here uses `override.conf` as the name of this file. Newer versions of systemd support the following command, which opens an editor and permits you to edit the file:

```
systemctl edit mysqld # RPM platforms
systemctl edit mysql  # Debian platforms
```

Whenever you create or change `override.conf`, reload the systemd configuration, then tell systemd to restart the MySQL service:

```
systemctl daemon-reload
systemctl restart mysqld # RPM platforms
systemctl restart mysql  # Debian platforms
```

With systemd, the `override.conf` configuration method must be used for certain parameters, rather than settings in a `[mysqld]`, `[mysqld_safe]`, or `[safe_mysqld]` group in a MySQL option file:

- For some parameters, `override.conf` must be used because systemd itself must know their values and it cannot read MySQL option files to get them.
- Parameters that specify values otherwise settable only using options known to `mysqld_safe` must be specified using systemd because there is no corresponding `mysqld` parameter.

For additional information about using systemd rather than `mysqld_safe`, see [Migrating from mysqld_safe to systemd](#).

You can set the following parameters in `override.conf`:

- To set the number of file descriptors available to the MySQL server, use `LimitNOFILE` in `override.conf` rather than the `open_files_limit` system variable for `mysqld` or `--open-files-limit` option for `mysqld_safe`.
- To set the maximum core file size, use `LimitCore` in `override.conf` rather than the `--core-file-size` option for `mysqld_safe`.
- To set the scheduling priority for the MySQL server, use `Nice` in `override.conf` rather than the `--nice` option for `mysqld_safe`.

Some MySQL parameters are configured using environment variables:

- `LD_PRELOAD`: Set this variable if the MySQL server should use a specific memory-allocation library.
- `NOTIFY_SOCKET`: This environment variable specifies the socket that `mysqld` uses to communicate notification of startup completion and service status change with systemd. It is set by systemd when the `mysqld` service is started. The `mysqld` service reads the variable setting and writes to the defined location.

In MySQL 8.0, `mysqld` uses the `Type=notify` process startup type. (`Type=forking` was used in MySQL 5.7.) With `Type=notify`, systemd automatically configures a socket file and exports the path to the `NOTIFY_SOCKET` environment variable.

- `TZ`: Set this variable to specify the default time zone for the server.

There are multiple ways to specify environment variable values for use by the MySQL server process managed by systemd:

- Use `Environment` lines in the `override.conf` file. For the syntax, see the example in the preceding discussion that describes how to use this file.
- Specify the values in the `/etc/sysconfig/mysql` file (create the file if it does not exist). Assign values using the following syntax:

```
LD_PRELOAD=/path/to/malloc/library
TZ=time_zone_setting
```

After modifying `/etc/sysconfig/mysql`, restart the server to make the changes effective:

```
systemctl restart mysqld # RPM platforms
systemctl restart mysql  # Debian platforms
```

To specify options for `mysqld` without modifying systemd configuration files directly, set or unset the `MYSQLD_OPTS` systemd variable. For example:

```
systemctl set-environment MYQSLD_OPTS="--general_log=1"
systemctl unset-environment MYQSLD_OPTS
```

`MYSQLD_OPTS` can also be set in the `/etc/sysconfig/mysql` file.

After modifying the systemd environment, restart the server to make the changes effective:

```
systemctl restart mysqld # RPM platforms
systemctl restart mysql  # Debian platforms
```

For platforms that use systemd, the data directory is initialized if empty at server startup. This might be a problem if the data directory is a remote mount that has temporarily disappeared: The mount point would appear to be an empty data directory, which then would be initialized as a new data directory. To suppress this automatic initialization behavior, specify the following line in the `/etc/sysconfig/mysql` file (create the file if it does not exist):

```
NO_INIT=true
```

Configuring Multiple MySQL Instances Using systemd

This section describes how to configure systemd for multiple instances of MySQL.

Note

Because systemd has the capability of managing multiple MySQL instances on platforms for which systemd support is installed, `mysqld_multi` and `mysqld_multi.server` are unnecessary and are not installed.

To use multiple-instance capability, modify the `my.cnf` option file to include configuration of key options for each instance. These file locations are typical:

- `/etc/my.cnf` or `/etc/mysql/my.cnf` (RPM platforms)

- `/etc/mysql/mysql.conf.d/mysqld.cnf` (Debian platforms)

For example, to manage two instances named `replica01` and `replica02`, add something like this to the option file:

RPM platforms:

```
[mysqld@replica01]
datadir=/var/lib/mysql-replica01
socket=/var/lib/mysql-replica01/mysql.sock
port=3307
log-error=/var/log/mysqld-replica01.log
[mysqld@replica02]
datadir=/var/lib/mysql-replica02
socket=/var/lib/mysql-replica02/mysql.sock
port=3308
log-error=/var/log/mysqld-replica02.log
```

Debian platforms:

```
[mysqld@replica01]
datadir=/var/lib/mysql-replica01
socket=/var/lib/mysql-replica01/mysql.sock
port=3307
log-error=/var/log/mysql/replica01.log
[mysqld@replica02]
datadir=/var/lib/mysql-replica02
socket=/var/lib/mysql-replica02/mysql.sock
port=3308
log-error=/var/log/mysql/replica02.log
```

The replica names shown here use `@` as the delimiter because that is the only delimiter supported by `systemd`.

Instances then are managed by normal `systemd` commands, such as:

```
systemctl start mysqld@replica01
systemctl start mysqld@replica02
```

To enable instances to run at boot time, do this:

```
systemctl enable mysqld@replica01
systemctl enable mysqld@replica02
```

Use of wildcards is also supported. For example, this command displays the status of all replica instances:

```
systemctl status 'mysqld@replica*'
```

For management of multiple MySQL instances on the same machine, `systemd` automatically uses a different unit file:

- `mysqld@.service` rather than `mysqld.service` (RPM platforms)
- `mysql@.service` rather than `mysql.service` (Debian platforms)

In the unit file, `%I` and `%i` reference the parameter passed in after the `@` marker and are used to manage the specific instance. For a command such as this:

```
systemctl start mysqld@replica01
```

`systemd` starts the server using a command such as this:

```
mysqld --defaults-group-suffix=%I ...
```

The result is that the `[server]`, `[mysqld]`, and `[mysqld@replica01]` option groups are read and used for that instance of the service.

Note

On Debian platforms, AppArmor prevents the server from reading or writing `/var/lib/mysql-replica*`, or anything other than the default locations. To address this, you must customize or disable the profile in `/etc/apparmor.d/usr.sbin.mysqld`.

Note

On Debian platforms, the packaging scripts for MySQL uninstallation cannot currently handle `mysqld@` instances. Before removing or upgrading the package, you must stop any extra instances manually first.

Migrating from mysqld_safe to systemd

Because `mysqld_safe` is not installed on platforms that use systemd to manage MySQL, options previously specified for that program (for example, in an `[mysqld_safe]` or `[safe_mysqld]` option group) must be specified another way:

- Some `mysqld_safe` options are also understood by `mysqld` and can be moved from the `[mysqld_safe]` or `[safe_mysqld]` option group to the `[mysqld]` group. This does *not* include `--pid-file`, `--open-files-limit`, or `--nice`. To specify those options, use the `override.conf` systemd file, described previously.

Note

On systemd platforms, use of `[mysqld_safe]` and `[safe_mysqld]` option groups is not supported and may lead to unexpected behavior.

- For some `mysqld_safe` options, there are alternative `mysqld` procedures. For example, the `mysqld_safe` option for enabling `syslog` logging is `--syslog`, which is deprecated. To write error log output to the system log, use the instructions at [Error Logging to the System Log](#).
- `mysqld_safe` options not understood by `mysqld` can be specified in `override.conf` or environment variables. For example, with `mysqld_safe`, if the server should use a specific memory allocation library, this is specified using the `--malloc-lib` option. For installations that manage the server with systemd, arrange to set the `LD_PRELOAD` environment variable instead, as described previously.

Chapter 8 Installing MySQL on Solaris

Table of Contents

8.1 Installing MySQL on Solaris Using a Solaris PKG	176
---	-----

Note

MySQL 8.0 supports Solaris 11.4 and higher

MySQL on Solaris is available in a number of different formats.

- For information on installing using the native Solaris PKG format, see [Section 8.1, “Installing MySQL on Solaris Using a Solaris PKG”](#).
- To use a standard `tar` binary installation, use the notes provided in [Chapter 3, *Installing MySQL on Unix/Linux Using Generic Binaries*](#). Check the notes and hints at the end of this section for Solaris specific notes that you may need before or after installation.

Note

MySQL 5.7 has a dependency on the Oracle Developer Studio Runtime Libraries; but this does not apply to MySQL 8.0.

To obtain a binary MySQL distribution for Solaris in tarball or PKG format, <https://dev.mysql.com/downloads/mysql/8.0.html>.

Additional notes to be aware of when installing and using MySQL on Solaris:

- If you want to use MySQL with the `mysql` user and group, use the `groupadd` and `useradd` commands:

```
groupadd mysql
useradd -g mysql -s /bin/false mysql
```

- If you install MySQL using a binary tarball distribution on Solaris, because the Solaris `tar` cannot handle long file names, use GNU `tar` (`gtar`) to unpack the distribution. If you do not have GNU `tar` on your system, install it with the following command:

```
pkg install archiver/gnu-tar
```

- You should mount any file systems on which you intend to store `InnoDB` files with the `forcedirectio` option. (By default mounting is done without this option.) Failing to do so causes a significant drop in performance when using the `InnoDB` storage engine on this platform.
- If you would like MySQL to start automatically, you can copy `support-files/mysql.server` to `/etc/init.d` and create a symbolic link to it named `/etc/rc3.d/S99mysql.server`.
- If too many processes try to connect very rapidly to `mysqld`, you should see this error in the MySQL log:

```
Error in accept: Protocol error
```

You might try starting the server with the `--back_log=50` option as a workaround for this.

- To configure the generation of core files on Solaris you should use the `coreadm` command. Because of the security implications of generating a core on a `setuid()` application, by default, Solaris does not

support core files on `setuid()` programs. However, you can modify this behavior using `coreadm`. If you enable `setuid()` core files for the current user, they are generated using mode 600 and are owned by the superuser.

8.1 Installing MySQL on Solaris Using a Solaris PKG

You can install MySQL on Solaris using a binary package of the native Solaris PKG format instead of the binary tarball distribution.

Note

MySQL 5.7 has a dependency on the Oracle Developer Studio Runtime Libraries; but this does not apply to MySQL 8.0.

To use this package, download the corresponding `mysql-VERSION-solaris11-PLATFORM.pkg.gz` file, then uncompress it. For example:

```
$> gunzip mysql-8.0.36-solaris11-x86_64.pkg.gz
```

To install a new package, use `pkgadd` and follow the onscreen prompts. You must have root privileges to perform this operation:

```
$> pkgadd -d mysql-8.0.36-solaris11-x86_64.pkg
The following packages are available:
  1  mysql      MySQL Community Server (GPL)
                        (i86pc) 8.0.36
Select package(s) you wish to process (or 'all' to process
all packages). (default: all) [?,??,q]:
```

The PKG installer installs all of the files and tools needed, and then initializes your database if one does not exist. To complete the installation, you should set the root password for MySQL as provided in the instructions at the end of the installation. Alternatively, you can run the `mysql_secure_installation` script that comes with the installation.

By default, the PKG package installs MySQL under the root path `/opt/mysql`. You can change only the installation root path when using `pkgadd`, which can be used to install MySQL in a different Solaris zone. If you need to install in a specific directory, use a binary `tar` file distribution.

The `pkg` installer copies a suitable startup script for MySQL into `/etc/init.d/mysql`. To enable MySQL to startup and shutdown automatically, you should create a link between this file and the init script directories. For example, to ensure safe startup and shutdown of MySQL you could use the following commands to add the right links:

```
$> ln /etc/init.d/mysql /etc/rc3.d/S91mysql
$> ln /etc/init.d/mysql /etc/rc0.d/K02mysql
```

To remove MySQL, the installed package name is `mysql`. You can use this in combination with the `pkgrm` command to remove the installation.

To upgrade when using the Solaris package file format, you must remove the existing installation before installing the updated package. Removal of the package does not delete the existing database information, only the server, binaries and support files. The typical upgrade sequence is therefore:

```
$> mysqladmin shutdown
$> pkgrm mysql
$> pkgadd -d mysql-8.0.36-solaris11-x86_64.pkg
$> mysql_safe &
$> mysql_upgrade # prior to MySQL 8.0.16 only
```

You should check the notes in [Chapter 10, *Upgrading MySQL*](#) before performing any upgrade.

Chapter 9 Postinstallation Setup and Testing

Table of Contents

9.1 Initializing the Data Directory	179
9.2 Starting the Server	185
9.2.1 Troubleshooting Problems Starting the MySQL Server	186
9.3 Testing the Server	188
9.4 Securing the Initial MySQL Account	190
9.5 Starting and Stopping MySQL Automatically	192

This section discusses tasks that you should perform after installing MySQL:

- If necessary, initialize the data directory and create the MySQL grant tables. For some MySQL installation methods, data directory initialization may be done for you automatically:
 - Windows installation operations performed by MySQL Installer.
 - Installation on Linux using a server RPM or Debian distribution from Oracle.
 - Installation using the native packaging system on many platforms, including Debian Linux, Ubuntu Linux, Gentoo Linux, and others.
 - Installation on macOS using a DMG distribution.

For other platforms and installation types, you must initialize the data directory manually. These include installation from generic binary and source distributions on Unix and Unix-like system, and installation from a ZIP Archive package on Windows. For instructions, see [Section 9.1, “Initializing the Data Directory”](#).

- Start the server and make sure that it can be accessed. For instructions, see [Section 9.2, “Starting the Server”](#), and [Section 9.3, “Testing the Server”](#).
- Assign passwords to the initial `root` account in the grant tables, if that was not already done during data directory initialization. Passwords prevent unauthorized access to the MySQL server. For instructions, see [Section 9.4, “Securing the Initial MySQL Account”](#).
- Optionally, arrange for the server to start and stop automatically when your system starts and stops. For instructions, see [Section 9.5, “Starting and Stopping MySQL Automatically”](#).
- Optionally, populate time zone tables to enable recognition of named time zones. For instructions, see [MySQL Server Time Zone Support](#).

When you are ready to create additional user accounts, you can find information on the MySQL access control system and account management in [Access Control and Account Management](#).

9.1 Initializing the Data Directory

After MySQL is installed, the data directory must be initialized, including the tables in the `mysql` system schema:

- For some MySQL installation methods, data directory initialization is automatic, as described in [Chapter 9, Postinstallation Setup and Testing](#).

- For other installation methods, you must initialize the data directory manually. These include installation from generic binary and source distributions on Unix and Unix-like systems, and installation from a ZIP Archive package on Windows.

This section describes how to initialize the data directory manually for MySQL installation methods for which data directory initialization is not automatic. For some suggested commands that enable testing whether the server is accessible and working properly, see [Section 9.3, “Testing the Server”](#).

Note

In MySQL 8.0, the default authentication plugin has changed from `mysql_native_password` to `caching_sha2_password`, and the `'root'@'localhost'` administrative account uses `caching_sha2_password` by default. If you prefer that the `root` account use the previous default authentication plugin (`mysql_native_password`), see [caching_sha2_password and the root Administrative Account](#).

- [Data Directory Initialization Overview](#)
- [Data Directory Initialization Procedure](#)
- [Server Actions During Data Directory Initialization](#)
- [Post-Initialization root Password Assignment](#)

Data Directory Initialization Overview

In the examples shown here, the server is intended to run under the user ID of the `mysql` login account. Either create the account if it does not exist (see [Create a mysql User and Group](#)), or substitute the name of a different existing login account that you plan to use for running the server.

1. Change location to the top-level directory of your MySQL installation, which is typically `/usr/local/mysql` (adjust the path name for your system as necessary):

```
cd /usr/local/mysql
```

Within this directory you can find several files and subdirectories, including the `bin` subdirectory that contains the server, as well as client and utility programs.

2. The `secure_file_priv` system variable limits import and export operations to a specific directory. Create a directory whose location can be specified as the value of that variable:

```
mkdir mysql-files
```

Grant directory user and group ownership to the `mysql` user and `mysql` group, and set the directory permissions appropriately:

```
chown mysql:mysql mysql-files
chmod 750 mysql-files
```

3. Use the server to initialize the data directory, including the `mysql` schema containing the initial MySQL grant tables that determine how users are permitted to connect to the server. For example:

```
bin/mysqld --initialize --user=mysql
```

For important information about the command, especially regarding command options you might use, see [Data Directory Initialization Procedure](#). For details about how the server performs initialization, see [Server Actions During Data Directory Initialization](#).

Typically, data directory initialization need be done only after you first install MySQL. (For upgrades to an existing installation, perform the upgrade procedure instead; see [Chapter 10, Upgrading MySQL](#).) However, the command that initializes the data directory does not overwrite any existing `mysql` schema tables, so it is safe to run in any circumstances.

4. If you want to deploy the server with automatic support for secure connections, use the `mysql_ssl_rsa_setup` utility to create default SSL and RSA files:

```
bin/mysql_ssl_rsa_setup
```

For more information, see [mysql_ssl_rsa_setup — Create SSL/RSA Files](#).

Note

The `mysql_ssl_rsa_setup` utility is deprecated as of MySQL 8.0.34.

5. In the absence of any option files, the server starts with its default settings. (See [Server Configuration Defaults](#).) To explicitly specify options that the MySQL server should use at startup, put them in an option file such as `/etc/my.cnf` or `/etc/mysql/my.cnf`. (See [Using Option Files](#).) For example, you can use an option file to set the `secure_file_priv` system variable.
6. To arrange for MySQL to start without manual intervention at system boot time, see [Section 9.5, “Starting and Stopping MySQL Automatically”](#).
7. Data directory initialization creates time zone tables in the `mysql` schema but does not populate them. To do so, use the instructions in [MySQL Server Time Zone Support](#).

Data Directory Initialization Procedure

Change location to the top-level directory of your MySQL installation, which is typically `/usr/local/mysql` (adjust the path name for your system as necessary):

```
cd /usr/local/mysql
```

To initialize the data directory, invoke `mysqld` with the `--initialize` or `--initialize-insecure` option, depending on whether you want the server to generate a random initial password for the `'root'@'localhost'` account, or to create that account with no password:

- Use `--initialize` for “secure by default” installation (that is, including generation of a random initial `root` password). In this case, the password is marked as expired and you must choose a new one.
- With `--initialize-insecure`, no `root` password is generated. This is insecure; it is assumed that you intend to assign a password to the account in a timely fashion before putting the server into production use.

For instructions on assigning a new `'root'@'localhost'` password, see [Post-Initialization root Password Assignment](#).

Note

The server writes any messages (including any initial password) to its standard error output. This may be redirected to the error log, so look there if you do not see the messages on your screen. For information about the error log, including where it is located, see [The Error Log](#).

On Windows, use the `--console` option to direct messages to the console.

On Unix and Unix-like systems, it is important for the database directories and files to be owned by the `mysql` login account so that the server has read and write access to them when you run it later. To ensure this, start `mysqld` from the system `root` account and include the `--user` option as shown here:

```
bin/mysqld --initialize --user=mysql
bin/mysqld --initialize-insecure --user=mysql
```

Alternatively, execute `mysqld` while logged in as `mysql`, in which case you can omit the `--user` option from the command.

On Windows, use one of these commands:

```
bin\mysqld --initialize --console
bin\mysqld --initialize-insecure --console
```

Note

Data directory initialization might fail if required system libraries are missing. For example, you might see an error like this:

```
bin/mysqld: error while loading shared libraries:
libnuma.so.1: cannot open shared object file:
No such file or directory
```

If this happens, you must install the missing libraries manually or with your system's package manager. Then retry the data directory initialization command.

It might be necessary to specify other options such as `--basedir` or `--datadir` if `mysqld` cannot identify the correct locations for the installation directory or data directory. For example (enter the command on a single line):

```
bin/mysqld --initialize --user=mysql
--basedir=/opt/mysql/mysql
--datadir=/opt/mysql/mysql/data
```

Alternatively, put the relevant option settings in an option file and pass the name of that file to `mysqld`. For Unix and Unix-like systems, suppose that the option file name is `/opt/mysql/mysql/etc/my.cnf`. Put these lines in the file:

```
[mysqld]
basedir=/opt/mysql/mysql
datadir=/opt/mysql/mysql/data
```

Then invoke `mysqld` as follows (enter the command on a single line, with the `--defaults-file` option first):

```
bin/mysqld --defaults-file=/opt/mysql/mysql/etc/my.cnf
--initialize --user=mysql
```

On Windows, suppose that `C:\my.ini` contains these lines:

```
[mysqld]
basedir=C:\Program Files\MySQL\MySQL Server 8.0
datadir=D:\MySQLdata
```

Then invoke `mysqld` as follows (again, you should enter the command on a single line, with the `--defaults-file` option first):

```
bin\mysqld --defaults-file=C:\my.ini
--initialize --console
```

Important

When initializing the data directory, you should not specify any options other than those used for setting directory locations such as `--basedir` or `--datadir`, and the `--user` option if needed. Options to be employed by the MySQL server during normal use can be set when restarting it following initialization. See the description of the `--initialize` option for further information.

Server Actions During Data Directory Initialization

Note

The data directory initialization sequence performed by the server does not substitute for the actions performed by `mysql_secure_installation` and `mysql_ssl_rsa_setup`. See [mysql_secure_installation — Improve MySQL Installation Security](#), and [mysql_ssl_rsa_setup — Create SSL/RSA Files](#).

When invoked with the `--initialize` or `--initialize-insecure` option, `mysqld` performs the following actions during the data directory initialization sequence:

1. The server checks for the existence of the data directory as follows:
 - If no data directory exists, the server creates it.
 - If the data directory exists but is not empty (that is, it contains files or subdirectories), the server exits after producing an error message:

```
[ERROR] --initialize specified but the data directory exists. Aborting.
```

In this case, remove or rename the data directory and try again.

An existing data directory is permitted to be nonempty if every entry has a name that begins with a period (.).

2. Within the data directory, the server creates the `mysql` system schema and its tables, including the data dictionary tables, grant tables, time zone tables, and server-side help tables. See [The mysql System Schema](#).
3. The server initializes the `system tablespace` and related data structures needed to manage `InnoDB` tables.

Note

After `mysqld` sets up the `InnoDB system tablespace`, certain changes to tablespace characteristics require setting up a whole new `instance`. Qualifying changes include the file name of the first file in the system tablespace and the number of undo logs. If you do not want to use the default values, make sure that the settings for the `innodb_data_file_path` and `innodb_log_file_size` configuration parameters are in place in the MySQL [configuration file](#) *before* running `mysqld`. Also make sure to specify as necessary other parameters that affect the creation and location of `InnoDB` files, such as `innodb_data_home_dir` and `innodb_log_group_home_dir`.

If those options are in your configuration file but that file is not in a location that MySQL reads by default, specify the file location using the `--defaults-extra-file` option when you run `mysqld`.

- The server creates a `'root'@'localhost'` superuser account and other reserved accounts (see [Reserved Accounts](#)). Some reserved accounts are locked and cannot be used by clients, but `'root'@'localhost'` is intended for administrative use and you should assign it a password.

Server actions with respect to a password for the `'root'@'localhost'` account depend on how you invoke it:

- With `--initialize` but not `--initialize-insecure`, the server generates a random password, marks it as expired, and writes a message displaying the password:

```
[Warning] A temporary password is generated for root@localhost:
iTag*AfrH5ej
```

- With `--initialize-insecure`, (either with or without `--initialize` because `--initialize-insecure` implies `--initialize`), the server does not generate a password or mark it expired, and writes a warning message:

```
[Warning] root@localhost is created with an empty password ! Please
consider switching off the --initialize-insecure option.
```

For instructions on assigning a new `'root'@'localhost'` password, see [Post-Initialization root Password Assignment](#).

- The server populates the server-side help tables used for the `HELP` statement (see [HELP Statement](#)). The server does not populate the time zone tables. To do so manually, see [MySQL Server Time Zone Support](#).
- If the `init_file` system variable was given to name a file of SQL statements, the server executes the statements in the file. This option enables you to perform custom bootstrapping sequences.

When the server operates in bootstrap mode, some functionality is unavailable that limits the statements permitted in the file. These include statements that relate to account management (such as `CREATE USER` or `GRANT`), replication, and global transaction identifiers.

- The server exits.

Post-Initialization root Password Assignment

After you initialize the data directory by starting the server with `--initialize` or `--initialize-insecure`, start the server normally (that is, without either of those options) and assign the `'root'@'localhost'` account a new password:

- Start the server. For instructions, see [Section 9.2, “Starting the Server”](#).
- Connect to the server:
 - If you used `--initialize` but not `--initialize-insecure` to initialize the data directory, connect to the server as `root`:

```
mysql -u root -p
```

Then, at the password prompt, enter the random password that the server generated during the initialization sequence:

```
Enter password: (enter the random root password here)
```

Look in the server error log if you do not know this password.

- If you used `--initialize-insecure` to initialize the data directory, connect to the server as `root` without a password:

```
mysql -u root --skip-password
```

3. After connecting, use an `ALTER USER` statement to assign a new `root` password:

```
ALTER USER 'root'@'localhost' IDENTIFIED BY 'root-password';
```

See also [Section 9.4, “Securing the Initial MySQL Account”](#).

Note

Attempts to connect to the host `127.0.0.1` normally resolve to the `localhost` account. However, this fails if the server is run with `skip_name_resolve` enabled. If you plan to do that, make sure that an account exists that can accept a connection. For example, to be able to connect as `root` using `--host=127.0.0.1` or `--host=:1`, create these accounts:

```
CREATE USER 'root'@'127.0.0.1' IDENTIFIED BY 'root-password';
CREATE USER 'root'@':1' IDENTIFIED BY 'root-password';
```

It is possible to put those statements in a file to be executed using the `init_file` system variable, as discussed in [Server Actions During Data Directory Initialization](#).

9.2 Starting the Server

This section describes how to start the server on Unix and Unix-like systems. (For Windows, see [Section 5.4.5, “Starting the Server for the First Time”](#).) For some suggested commands that you can use to test whether the server is accessible and working properly, see [Section 9.3, “Testing the Server”](#).

Start the MySQL server like this if your installation includes `mysqld_safe`:

```
$> bin/mysqld_safe --user=mysql &
```

Note

For Linux systems on which MySQL is installed using RPM packages, server startup and shutdown is managed using `systemd` rather than `mysqld_safe`, and `mysqld_safe` is not installed. See [Section 7.9, “Managing MySQL Server with systemd”](#).

Start the server like this if your installation includes `systemd` support:

```
$> systemctl start mysqld
```

Substitute the appropriate service name if it differs from `mysqld` (for example, `mysql` on SLES systems).

It is important that the MySQL server be run using an unprivileged (non-`root`) login account. To ensure this, run `mysqld_safe` as `root` and include the `--user` option as shown. Otherwise, you should execute the program while logged in as `mysql`, in which case you can omit the `--user` option from the command.

For further instructions for running MySQL as an unprivileged user, see [How to Run MySQL as a Normal User](#).

If the command fails immediately and prints `mysqld ended`, look for information in the error log (which by default is the `host_name.err` file in the data directory).

If the server is unable to access the data directory it starts or read the grant tables in the `mysql` schema, it writes a message to its error log. Such problems can occur if you neglected to create the grant tables by initializing the data directory before proceeding to this step, or if you ran the command that initializes the data directory without the `--user` option. Remove the `data` directory and run the command with the `--user` option.

If you have other problems starting the server, see [Section 9.2.1, “Troubleshooting Problems Starting the MySQL Server”](#). For more information about `mysqld_safe`, see [mysqld_safe — MySQL Server Startup Script](#). For more information about systemd support, see [Section 7.9, “Managing MySQL Server with systemd”](#).

9.2.1 Troubleshooting Problems Starting the MySQL Server

This section provides troubleshooting suggestions for problems starting the server. For additional suggestions for Windows systems, see [Section 5.5, “Troubleshooting a Microsoft Windows MySQL Server Installation”](#).

If you have problems starting the server, here are some things to try:

- Check the [error log](#) to see why the server does not start. Log files are located in the [data directory](#) (typically `C:\Program Files\MySQL\MySQL Server 8.0\data` on Windows, `/usr/local/mysql/data` for a Unix/Linux binary distribution, and `/usr/local/var` for a Unix/Linux source distribution). Look in the data directory for files with names of the form `host_name.err` and `host_name.log`, where `host_name` is the name of your server host. Then examine the last few lines of these files. Use `tail` to display them:

```
$> tail host_name.err
$> tail host_name.log
```

- Specify any special options needed by the storage engines you are using. You can create a `my.cnf` file and specify startup options for the engines that you plan to use. If you are going to use storage engines that support transactional tables ([InnoDB](#), [NDB](#)), be sure that you have them configured the way you want before starting the server. If you are using [InnoDB](#) tables, see [InnoDB Configuration](#) for guidelines and [InnoDB Startup Options and System Variables](#) for option syntax.

Although storage engines use default values for options that you omit, Oracle recommends that you review the available options and specify explicit values for any options whose defaults are not appropriate for your installation.

- Make sure that the server knows where to find the [data directory](#). The `mysqld` server uses this directory as its current directory. This is where it expects to find databases and where it expects to write log files. The server also writes the pid (process ID) file in the data directory.

The default data directory location is hardcoded when the server is compiled. To determine what the default path settings are, invoke `mysqld` with the `--verbose` and `--help` options. If the data directory is located somewhere else on your system, specify that location with the `--datadir` option to `mysqld` or `mysqld_safe`, on the command line or in an option file. Otherwise, the server does not work properly. As an alternative to the `--datadir` option, you can specify `mysqld` the location of the base directory under which MySQL is installed with the `--basedir`, and `mysqld` looks for the `data` directory there.

To check the effect of specifying path options, invoke `mysqld` with those options followed by the `--verbose` and `--help` options. For example, if you change location to the directory where `mysqld` is installed and then run the following command, it shows the effect of starting the server with a base directory of `/usr/local`:

```
$> ./mysqld --basedir=/usr/local --verbose --help
```


You can specify other options such as `--datadir` as well, but `--verbose` and `--help` must be the last options.

Once you determine the path settings you want, start the server without `--verbose` and `--help`.

If `mysqld` is currently running, you can find out what path settings it is using by executing this command:

```
$> mysqladmin variables
```

Or:

```
$> mysqladmin -h host_name variables
```

`host_name` is the name of the MySQL server host.

- Make sure that the server can access the [data directory](#). The ownership and permissions of the data directory and its contents must allow the server to read and modify them.

If you get `Errcode 13` (which means `Permission denied`) when starting `mysqld`, this means that the privileges of the data directory or its contents do not permit server access. In this case, you change the permissions for the involved files and directories so that the server has the right to use them. You can also start the server as `root`, but this raises security issues and should be avoided.

Change location to the data directory and check the ownership of the data directory and its contents to make sure the server has access. For example, if the data directory is `/usr/local/mysql/var`, use this command:

```
$> ls -la /usr/local/mysql/var
```

If the data directory or its files or subdirectories are not owned by the login account that you use for running the server, change their ownership to that account. If the account is named `mysql`, use these commands:

```
$> chown -R mysql /usr/local/mysql/var
$> chgrp -R mysql /usr/local/mysql/var
```

Even with correct ownership, MySQL might fail to start up if there is other security software running on your system that manages application access to various parts of the file system. In this case, reconfigure that software to enable `mysqld` to access the directories it uses during normal operation.

- Verify that the network interfaces the server wants to use are available.

If either of the following errors occur, it means that some other program (perhaps another `mysqld` server) is using the TCP/IP port or Unix socket file that `mysqld` is trying to use:

```
Can't start server: Bind on TCP/IP port: Address already in use
Can't start server: Bind on unix socket...
```

Use `ps` to determine whether you have another `mysqld` server running. If so, shut down the server before starting `mysqld` again. (If another server is running, and you really want to run multiple servers, you can find information about how to do so in [Running Multiple MySQL Instances on One Machine](#).)

If no other server is running, execute the command `telnet your_host_name tcp_ip_port_number`. (The default MySQL port number is 3306.) Then press Enter a couple of times. If you do not get an error message like `telnet: Unable to connect to remote host: Connection refused`, some other program is using the TCP/IP port that `mysqld` is trying to use. Track down what program this is and disable it, or tell `mysqld` to listen to a different port with the `--`

`port` option. In this case, specify the same non-default port number for client programs when connecting to the server using TCP/IP.

Another reason the port might be inaccessible is that you have a firewall running that blocks connections to it. If so, modify the firewall settings to permit access to the port.

If the server starts but you cannot connect to it, make sure that you have an entry in `/etc/hosts` that looks like this:

```
127.0.0.1    localhost
```

- If you cannot get `mysqld` to start, try to make a trace file to find the problem by using the `--debug` option. See [The DEBUG Package](#).

9.3 Testing the Server

After the data directory is initialized and you have started the server, perform some simple tests to make sure that it works satisfactorily. This section assumes that your current location is the MySQL installation directory and that it has a `bin` subdirectory containing the MySQL programs used here. If that is not true, adjust the command path names accordingly.

Alternatively, add the `bin` directory to your `PATH` environment variable setting. That enables your shell (command interpreter) to find MySQL programs properly, so that you can run a program by typing only its name, not its path name. See [Setting Environment Variables](#).

Use `mysqladmin` to verify that the server is running. The following commands provide simple tests to check whether the server is up and responding to connections:

```
$> bin/mysqladmin version
$> bin/mysqladmin variables
```

If you cannot connect to the server, specify a `-u root` option to connect as `root`. If you have assigned a password for the `root` account already, you'll also need to specify `-p` on the command line and enter the password when prompted. For example:

```
$> bin/mysqladmin -u root -p version
Enter password: (enter root password here)
```

The output from `mysqladmin version` varies slightly depending on your platform and version of MySQL, but should be similar to that shown here:

```
$> bin/mysqladmin version
mysqladmin Ver 14.12 Distrib 8.0.36, for pc-linux-gnu on i686
...
Server version          8.0.36
Protocol version        10
Connection              Localhost via UNIX socket
UNIX socket             /var/lib/mysql/mysql.sock
Uptime:                 14 days 5 hours 5 min 21 sec
Threads: 1 Questions: 366 Slow queries: 0
Opens: 0 Flush tables: 1 Open tables: 19
Queries per second avg: 0.000
```

To see what else you can do with `mysqladmin`, invoke it with the `--help` option.

Verify that you can shut down the server (include a `-p` option if the `root` account has a password already):

```
$> bin/mysqladmin -u root shutdown
```

Verify that you can start the server again. Do this by using `mysqld_safe` or by invoking `mysqld` directly. For example:

```
$> bin/mysqld_safe --user=mysql &
```

If `mysqld_safe` fails, see [Section 9.2.1, “Troubleshooting Problems Starting the MySQL Server”](#).

Run some simple tests to verify that you can retrieve information from the server. The output should be similar to that shown here.

Use `mysqlshow` to see what databases exist:

```
$> bin/mysqlshow
+-----+
| Databases |
+-----+
| information_schema |
| mysql |
| performance_schema |
| sys |
+-----+
```

The list of installed databases may vary, but always includes at least `mysql` and `information_schema`.

If you specify a database name, `mysqlshow` displays a list of the tables within the database:

```
$> bin/mysqlshow mysql
Database: mysql
+-----+
| Tables |
+-----+
| columns_priv |
| component |
| db |
| default_roles |
| engine_cost |
| func |
| general_log |
| global_grants |
| gtid_executed |
| help_category |
| help_keyword |
| help_relation |
| help_topic |
| innodb_index_stats |
| innodb_table_stats |
| ndb_binlog_index |
| password_history |
| plugin |
| procs_priv |
| proxies_priv |
| role_edges |
| server_cost |
| servers |
| slave_master_info |
| slave_relay_log_info |
| slave_worker_info |
| slow_log |
| tables_priv |
| time_zone |
| time_zone_leap_second |
| time_zone_name |
| time_zone_transition |
| time_zone_transition_type |
| user |
+-----+
```

Use the `mysql` program to select information from a table in the `mysql` schema:

```
$> bin/mysql -e "SELECT User, Host, plugin FROM mysql.user" mysql
```

User	Host	plugin
root	localhost	caching_sha2_password

At this point, your server is running and you can access it. To tighten security if you have not yet assigned a password to the initial account, follow the instructions in [Section 9.4, “Securing the Initial MySQL Account”](#).

For more information about `mysql`, `mysqladmin`, and `mysqlshow`, see [mysql — The MySQL Command-Line Client](#), [mysqladmin — A MySQL Server Administration Program](#), and [mysqlshow — Display Database, Table, and Column Information](#).

9.4 Securing the Initial MySQL Account

The MySQL installation process involves initializing the data directory, including the grant tables in the `mysql` system schema that define MySQL accounts. For details, see [Section 9.1, “Initializing the Data Directory”](#).

This section describes how to assign a password to the initial `root` account created during the MySQL installation procedure, if you have not already done so.

Note

Alternative means for performing the process described in this section:

- On Windows, you can perform the process during installation with MySQL Installer (see [Section 5.3, “MySQL Installer for Windows”](#)).
- On all platforms, the MySQL distribution includes `mysql_secure_installation`, a command-line utility that automates much of the process of securing a MySQL installation.
- On all platforms, MySQL Workbench is available and offers the ability to manage user accounts (see [MySQL Workbench](#)).

A password may already be assigned to the initial account under these circumstances:

- On Windows, installations performed using MySQL Installer give you the option of assigning a password.
- Installation using the macOS installer generates an initial random password, which the installer displays to the user in a dialog box.
- Installation using RPM packages generates an initial random password, which is written to the server error log.
- Installations using Debian packages give you the option of assigning a password.
- For data directory initialization performed manually using `mysqld --initialize`, `mysqld` generates an initial random password, marks it expired, and writes it to the server error log. See [Section 9.1, “Initializing the Data Directory”](#).

The `mysql.user` grant table defines the initial MySQL user account and its access privileges. Installation of MySQL creates only a `'root'@'localhost'` superuser account that has all privileges and can do anything. If the `root` account has an empty password, your MySQL installation is unprotected: Anyone can connect to the MySQL server as `root` *without a password* and be granted all privileges.

The 'root'@'localhost' account also has a row in the `mysql.proxies_priv` table that enables granting the `PROXY` privilege for ' '@' ', that is, for all users and all hosts. This enables `root` to set up proxy users, as well as to delegate to other accounts the authority to set up proxy users. See [Proxy Users](#).

To assign a password for the initial MySQL `root` account, use the following procedure. Replace `root-password` in the examples with the password that you want to use.

Start the server if it is not running. For instructions, see [Section 9.2, “Starting the Server”](#).

The initial `root` account may or may not have a password. Choose whichever of the following procedures applies:

- If the `root` account exists with an initial random password that has been expired, connect to the server as `root` using that password, then choose a new password. This is the case if the data directory was initialized using `mysqld --initialize`, either manually or using an installer that does not give you the option of specifying a password during the install operation. Because the password exists, you must use it to connect to the server. But because the password is expired, you cannot use the account for any purpose other than to choose a new password, until you do choose one.

1. If you do not know the initial random password, look in the server error log.

2. Connect to the server as `root` using the password:

```
$> mysql -u root -p
Enter password: (enter the random root password here)
```

3. Choose a new password to replace the random password:

```
mysql> ALTER USER 'root'@'localhost' IDENTIFIED BY 'root-password';
```

- If the `root` account exists but has no password, connect to the server as `root` using no password, then assign a password. This is the case if you initialized the data directory using `mysqld --initialize-insecure`.

1. Connect to the server as `root` using no password:

```
$> mysql -u root --skip-password
```

2. Assign a password:

```
mysql> ALTER USER 'root'@'localhost' IDENTIFIED BY 'root-password';
```

After assigning the `root` account a password, you must supply that password whenever you connect to the server using the account. For example, to connect to the server using the `mysql` client, use this command:

```
$> mysql -u root -p
Enter password: (enter root password here)
```

To shut down the server with `mysqladmin`, use this command:

```
$> mysqladmin -u root -p shutdown
Enter password: (enter root password here)
```

Note

For additional information about setting passwords, see [Assigning Account Passwords](#). If you forget your `root` password after setting it, see [How to Reset the Root Password](#).

To set up additional accounts, see [Adding Accounts, Assigning Privileges, and Dropping Accounts](#).

9.5 Starting and Stopping MySQL Automatically

This section discusses methods for starting and stopping the MySQL server.

Generally, you start the `mysqld` server in one of these ways:

- Invoke `mysqld` directly. This works on any platform.
- On Windows, you can set up a MySQL service that runs automatically when Windows starts. See [Section 5.4.8, “Starting MySQL as a Windows Service”](#).
- On Unix and Unix-like systems, you can invoke `mysqld_safe`, which tries to determine the proper options for `mysqld` and then runs it with those options. See [mysqld_safe — MySQL Server Startup Script](#).
- On Linux systems that support `systemd`, you can use it to control the server. See [Section 7.9, “Managing MySQL Server with systemd”](#).
- On systems that use System V-style run directories (that is, `/etc/init.d` and run-level specific directories), invoke `mysql.server`. This script is used primarily at system startup and shutdown. It usually is installed under the name `mysql`. The `mysql.server` script starts the server by invoking `mysqld_safe`. See [mysql.server — MySQL Server Startup Script](#).
- On macOS, install a `launchd` daemon to enable automatic MySQL startup at system startup. The daemon starts the server by invoking `mysqld_safe`. For details, see [Section 6.3, “Installing and Using the MySQL Launch Daemon”](#). A MySQL Preference Pane also provides control for starting and stopping MySQL through the System Preferences. See [Section 6.4, “Installing and Using the MySQL Preference Pane”](#).
- On Solaris, use the service management framework (SMF) system to initiate and control MySQL startup.

`systemd`, the `mysqld_safe` and `mysql.server` scripts, Solaris SMF, and the macOS Startup Item (or MySQL Preference Pane) can be used to start the server manually, or automatically at system startup time. `systemd`, `mysql.server`, and the Startup Item also can be used to stop the server.

The following table shows which option groups the server and startup scripts read from option files.

Table 9.1 MySQL Startup Scripts and Supported Server Option Groups

Script	Option Groups
<code>mysqld</code>	<code>[mysqld]</code> , <code>[server]</code> , <code>[mysqld-major_version]</code>
<code>mysqld_safe</code>	<code>[mysqld]</code> , <code>[server]</code> , <code>[mysqld_safe]</code>
<code>mysql.server</code>	<code>[mysqld]</code> , <code>[mysql.server]</code> , <code>[server]</code>

`[mysqld-major_version]` means that groups with names like `[mysqld-5.7]` and `[mysqld-8.0]` are read by servers having versions 5.7.x, 8.0.x, and so forth. This feature can be used to specify options that can be read only by servers within a given release series.

For backward compatibility, `mysql.server` also reads the `[mysql_server]` group and `mysqld_safe` also reads the `[safe_mysqld]` group. To be current, you should update your option files to use the `[mysql.server]` and `[mysqld_safe]` groups instead.

For more information on MySQL configuration files and their structure and contents, see [Using Option Files](#).

Chapter 10 Upgrading MySQL

Table of Contents

10.1 Before You Begin	195
10.2 Upgrade Paths	196
10.3 Upgrade Best Practices	197
10.4 What the MySQL Upgrade Process Upgrades	199
10.5 Changes in MySQL 8.0	203
10.6 Preparing Your Installation for Upgrade	222
10.7 Upgrading MySQL Binary or Package-based Installations on Unix/Linux	225
10.8 Upgrading MySQL with the MySQL Yum Repository	230
10.9 Upgrading MySQL with the MySQL APT Repository	232
10.10 Upgrading MySQL with the MySQL SLES Repository	232
10.11 Upgrading MySQL on Windows	232
10.12 Upgrading a Docker Installation of MySQL	234
10.13 Upgrade Troubleshooting	234
10.14 Rebuilding or Repairing Tables or Indexes	235
10.15 Copying MySQL Databases to Another Machine	236

This chapter describes the steps to upgrade a MySQL installation.

Upgrading is a common procedure, as you pick up bug fixes within the same MySQL release series or significant features between major MySQL releases. You perform this procedure first on some test systems to make sure everything works smoothly, and then on the production systems.

Note

In the following discussion, MySQL commands that must be run using a MySQL account with administrative privileges include `-u root` on the command line to specify the MySQL `root` user. Commands that require a password for `root` also include a `-p` option. Because `-p` is followed by no option value, such commands prompt for the password. Type the password when prompted and press Enter.

SQL statements can be executed using the `mysql` command-line client (connect as `root` to ensure that you have the necessary privileges).

10.1 Before You Begin

Review the information in this section before upgrading. Perform any recommended actions.

- Understand what may occur during an upgrade. See [Section 10.4, “What the MySQL Upgrade Process Upgrades”](#).
- Protect your data by creating a backup. The backup should include the `mysql` system database, which contains the MySQL data dictionary tables and system tables. See [Database Backup Methods](#).

Important

Downgrade from MySQL 8.0 to MySQL 5.7, or from a MySQL 8.0 release to a previous MySQL 8.0 release, is not supported. The only supported alternative is to restore a backup taken *before* upgrading. It is therefore imperative that you back up your data before starting the upgrade process.

- Review [Section 10.2, “Upgrade Paths”](#) to ensure that your intended upgrade path is supported.
- Review [Section 10.5, “Changes in MySQL 8.0”](#) for changes that you should be aware of before upgrading. Some changes may require action.
- Review [What Is New in MySQL 8.0](#) for deprecated and removed features. An upgrade may require changes with respect to those features if you use any of them.
- Review [Server and Status Variables and Options Added, Deprecated, or Removed in MySQL 8.0](#). If you use deprecated or removed variables, an upgrade may require configuration changes.
- Review the [Release Notes](#) for information about fixes, changes, and new features.
- If you use replication, review [Upgrading a Replication Topology](#).
- Review [Section 10.3, “Upgrade Best Practices”](#) and plan accordingly.
- Upgrade procedures vary by platform and how the initial installation was performed. Use the procedure that applies to your current MySQL installation:
 - For binary and package-based installations on non-Windows platforms, refer to [Section 10.7, “Upgrading MySQL Binary or Package-based Installations on Unix/Linux”](#).

Note

For supported Linux distributions, the preferred method for upgrading package-based installations is to use the MySQL software repositories (MySQL Yum Repository, MySQL APT Repository, and MySQL SLES Repository).

- For installations on an Enterprise Linux platform or Fedora using the MySQL Yum Repository, refer to [Section 10.8, “Upgrading MySQL with the MySQL Yum Repository”](#).
- For installations on Ubuntu using the MySQL APT repository, refer to [Section 10.9, “Upgrading MySQL with the MySQL APT Repository”](#).
- For installations on SLES using the MySQL SLES repository, refer to [Section 10.10, “Upgrading MySQL with the MySQL SLES Repository”](#).
- For installations performed using Docker, refer to [Section 10.12, “Upgrading a Docker Installation of MySQL”](#).
- For installations on Windows, refer to [Section 10.11, “Upgrading MySQL on Windows”](#).
- If your MySQL installation contains a large amount of data that might take a long time to convert after an in-place upgrade, it may be useful to create a test instance for assessing the conversions that are required and the work involved to perform them. To create a test instance, make a copy of your MySQL instance that contains the `mysql` database and other databases without the data. Run the upgrade procedure on the test instance to assess the work involved to perform the actual data conversion.
- Rebuilding and reinstalling MySQL language interfaces is recommended when you install or upgrade to a new release of MySQL. This applies to MySQL interfaces such as PHP `mysql` extensions and the Perl `DBD::mysql` module.

10.2 Upgrade Paths

- Upgrade from MySQL 5.7 to 8.0 is supported. However, upgrade is only supported between General Availability (GA) releases. For MySQL 8.0, it is required that you upgrade from a MySQL 5.7 GA release (5.7.9 or higher). Upgrades from non-GA releases of MySQL 5.7 are not supported.

- Upgrading to the latest release is recommended before upgrading to the next version. For example, upgrade to the latest MySQL 5.7 release before upgrading to MySQL 8.0.
- Upgrade that skips versions is not supported. For example, upgrading directly from MySQL 5.6 to 8.0 is not supported.
- Once a release series reaches General Availability (GA) status, upgrade within the release series (from one GA version to another GA version) is supported. For example, upgrading from MySQL 8.0.x to 8.0.y is supported. (Upgrade involving development-status non-GA releases is not supported.) Skipping a release is also supported. For example, upgrading from MySQL 8.0.x to 8.0.z is supported. MySQL 8.0.11 is the first GA status release within the MySQL 8.0 release series.

10.3 Upgrade Best Practices

MySQL supports upgrading between minor versions (within an LTS series) and to the next major version (across an LTS series). Upgrading provides the latest features, performance, and security fixes.

To prepare and help ensure that your upgrade to the latest MySQL release is successful, we recommend the following best practices:

- [Decide on Major or Minor Version for Upgrade](#)
- [Decide on Upgrade Type](#)
- [Review Supported Platforms](#)
- [Understand MySQL Server Changes](#)
- [Run Upgrade Checker and Fix Incompatibilities](#)
- [Run Applications in a Test Environment](#)
- [Benchmark Applications and Workload Performance](#)
- [Run Both MySQL Versions in Parallel](#)
- [Run Final Test Upgrade](#)
- [Check MySQL Backup](#)
- [Upgrade Production Server](#)
- [Enterprise Support](#)

Decide on Major or Minor Version for Upgrade

The MySQL Release Model makes a distinction between LTS (Long Term Support) and Innovation Releases. LTS releases have 8+ years of support and are meant for production use. Innovation Releases provide users with the latest features and capabilities. Learn more about the [MySQL Release Model](#).

Performing a minor version upgrade is straightforward while major version upgrades require strategic planning and additional testing before the upgrade. This guide is especially useful for major version upgrades.

Decide on Upgrade Type

There are three main ways to upgrade MySQL, read the associated documentation to determine which type of upgrade is best suited for your situation.

- [An in-place upgrade](#): Replacing the MySQL Server packages.
- [A logical upgrade](#): exporting SQL from the old MySQL instance to the new.
- [A replication topology upgrade](#): account for each server's topology role.

Review Supported Platforms

If your current operating system is not supported by the new version of MySQL, then plan to upgrade the operating system as otherwise an in-place upgrade is not supported.

For a current list of supported platforms, see: <https://www.mysql.com/support/supportedplatforms/database.html>

Understand MySQL Server Changes

Each major version comes with new features, changes in behavior, deprecations, and removals. It is important to understand the impact of each of these to existing applications.

See: [Section 10.5, “Changes in MySQL 8.0”](#).

Run Upgrade Checker and Fix Incompatibilities

MySQL Shell's [Upgrade Checker Utility](#) detects incompatibilities between database versions that must be addressed before performing the upgrade. The `util.checkForServerUpgrade()` function verifies that MySQL server instances are ready to upgrade. Connect to the existing MySQL server and select the MySQL Server version you plan to upgrade to for the utility to report issues to address prior to an upgrade. These include incompatibilities in data types, storage engines, and so on.

You are ready to upgrade when the upgrade checking utility no longer reports any issues.

Run Applications in a Test Environment

After completing the upgrade checker's requirements, next test your applications on the new target MySQL server. Check for errors and warnings in the MySQL error log and application logs.

Benchmark Applications and Workload Performance

We recommend benchmarking your own applications and workloads by comparing how they perform using the previous and new versions of MySQL. Usually, newer MySQL versions add features and improve performance but there are cases where an upgrade might run slower for specific queries. Possible issues resulting in performance regressions:

- Prior server configuration is not optimal for newer version
- Changes to data types
- Additional storage required by Multi-byte character set support
- Storage engines changes
- Dropped or changed indexes
- Stronger encryption

- Stronger authentication
- SQL optimizer changes
- Newer version of MySQL require additional memory
- Physical or Virtual Hardware is slower - compute or storage

For related information and potential mitigation techniques, see [Valid Performance Regressions](#).

Run Both MySQL Versions in Parallel

To minimize risk, it is best keep the current system running while running the upgraded system in parallel.

Run Final Test Upgrade

Practice and do a run though prior to upgrading your production server. Thoroughly test the upgrade procedures before upgrading a production system.

Check MySQL Backup

Check that the full backup exists and is viable before performing the upgrade.

Upgrade Production Server

You are ready to complete the upgrade.

Enterprise Support

If you're a MySQL Enterprise Edition customer, you can also contact the MySQL Support Team experts with any questions you may have.

10.4 What the MySQL Upgrade Process Upgrades

Installing a new version of MySQL may require upgrading these parts of the existing installation:

- The `mysql` system schema, which contains tables that store information required by the MySQL server as it runs (see [The mysql System Schema](#)). `mysql` schema tables fall into two broad categories:
 - Data dictionary tables, which store database object metadata.
 - System tables (that is, the remaining non-data dictionary tables), which are used for other operational purposes.
- Other schemas, some of which are built in and may be considered “owned” by the server, and others which are not:
 - The `performance_schema`, `INFORMATION_SCHEMA`, `ndbinfo`, and `sys` schemas.
 - User schemas.

Two distinct version numbers are associated with parts of the installation that may require upgrading:

- The data dictionary version. This applies to the data dictionary tables.

- The server version, also known as the MySQL version. This applies to the system tables and objects in other schemas.

In both cases, the actual version applicable to the existing MySQL installation is stored in the data dictionary, and the current expected version is compiled into the new version of MySQL. When an actual version is lower than the current expected version, those parts of the installation associated with that version must be upgraded to the current version. If both versions indicate an upgrade is needed, the data dictionary upgrade must occur first.

As a reflection of the two distinct versions just mentioned, the upgrade occurs in two steps:

- Step 1: Data dictionary upgrade.

This step upgrades:

- The data dictionary tables in the `mysql` schema. If the actual data dictionary version is lower than the current expected version, the server creates data dictionary tables with updated definitions, copies persisted metadata to the new tables, atomically replaces the old tables with the new ones, and reinitializes the data dictionary.
 - The Performance Schema, `INFORMATION_SCHEMA`, and `ndbinfo`.
- Step 2: Server upgrade.

This step comprises all other upgrade tasks. If the server version of the existing MySQL installation is lower than that of the new installed MySQL version, everything else must be upgraded:

- The system tables in the `mysql` schema (the remaining non-data dictionary tables).
- The `sys` schema.
- User schemas.

The data dictionary upgrade (step 1) is the responsibility of the server, which performs this task as necessary at startup unless invoked with an option that prevents it from doing so. The option is `--upgrade=NONE` as of MySQL 8.0.16, `--no-dd-upgrade` prior to MySQL 8.0.16.

If the data dictionary is out of date but the server is prevented from upgrading it, the server does not run, and exits with an error instead. For example:

```
[ERROR] [MY-013381] [Server] Server shutting down because upgrade is
required, yet prohibited by the command line option '--upgrade=NONE'.
[ERROR] [MY-010334] [Server] Failed to initialize DD Storage Engine
[ERROR] [MY-010020] [Server] Data Dictionary initialization failed.
```

Some changes to the responsibility for step 2 occurred in MySQL 8.0.16:

- Prior to MySQL 8.0.16, `mysql_upgrade` upgrades the Performance Schema, the `INFORMATION_SCHEMA`, and the objects described in step 2. The DBA is expected to invoke `mysql_upgrade` manually after starting the server.
- As of MySQL 8.0.16, the server performs all tasks previously handled by `mysql_upgrade`. Although upgrading remains a two-step operation, the server performs them both, resulting in a simpler process.

Depending on the version of MySQL to which you are upgrading, the instructions in [In-Place Upgrade](#) and [Logical Upgrade](#) indicate whether the server performs all upgrade tasks or whether you must also invoke `mysql_upgrade` after server startup.

Note

Because the server upgrades the Performance Schema, `INFORMATION_SCHEMA`, and the objects described in step 2 as of MySQL 8.0.16, `mysql_upgrade` is unneeded and is deprecated as of that version; expect it to be removed in a future version of MySQL.

Most aspects of what occurs during step 2 are the same prior to and as of MySQL 8.0.16, although different command options may be needed to achieve a particular effect.

As of MySQL 8.0.16, the `--upgrade` server option controls whether and how the server performs an automatic upgrade at startup:

- With no option or with `--upgrade=AUTO`, the server upgrades anything it determines to be out of date (steps 1 and 2).
- With `--upgrade=NONE`, the server upgrades nothing (skips steps 1 and 2), but also exits with an error if the data dictionary must be upgraded. It is not possible to run the server with an out-of-date data dictionary; the server insists on either upgrading it or exiting.
- With `--upgrade=MINIMAL`, the server upgrades the data dictionary, the Performance Schema, and the `INFORMATION_SCHEMA`, if necessary (step 1). Note that following an upgrade with this option, Group Replication cannot be started, because system tables on which the replication internals depend are not updated, and reduced functionality might also be apparent in other areas.
- With `--upgrade=FORCE`, the server upgrades the data dictionary, the Performance Schema, and the `INFORMATION_SCHEMA`, if necessary (step 1), and forces an upgrade of everything else (step 2). Expect server startup to take longer with this option because the server checks all objects in all schemas.

`FORCE` is useful to force step 2 actions to be performed if the server thinks they are not necessary. One way that `FORCE` differs from `AUTO` is that with `FORCE`, the server re-creates system tables such as help tables or time zone tables if they are missing.

The following list shows upgrade commands prior to MySQL 8.0.16 and the equivalent commands for MySQL 8.0.16 and higher:

- Perform a normal upgrade (steps 1 and 2 as necessary):
 - Prior to MySQL 8.0.16: `mysqld` followed by `mysql_upgrade`
 - As of MySQL 8.0.16: `mysqld`
- Perform only step 1 as necessary:
 - Prior to MySQL 8.0.16: It is not possible to perform all upgrade tasks described in step 1 while excluding those described in step 2. However, you can avoid upgrading user schemas and the `sys` schema using `mysqld` followed by `mysql_upgrade` with the `--upgrade-system-tables` and `--skip-sys-schema` options.
 - As of MySQL 8.0.16: `mysqld --upgrade=MINIMAL`
- Perform step 1 as necessary, and force step 2:
 - Prior to MySQL 8.0.16: `mysqld` followed by `mysql_upgrade --force`
 - As of MySQL 8.0.16: `mysqld --upgrade=FORCE`

Prior to MySQL 8.0.16, certain `mysql_upgrade` options affect the actions it performs. The following table shows which server `--upgrade` option values to use as of MySQL 8.0.16 to achieve similar effects.

(These are not necessarily exact equivalents because a given `--upgrade` option value may have additional effects.)

mysql_upgrade Option	Server Option
<code>--skip-sys-schema</code>	<code>--upgrade=NONE</code> or <code>--upgrade=MINIMAL</code>
<code>--upgrade-system-tables</code>	<code>--upgrade=NONE</code> or <code>--upgrade=MINIMAL</code>
<code>--force</code>	<code>--upgrade=FORCE</code>

Additional notes about what occurs during upgrade step 2:

- Step 2 installs the `sys` schema if it is not installed, and upgrades it to the current version otherwise. An error occurs if a `sys` schema exists but has no `version` view, on the assumption that its absence indicates a user-created schema:

```
A sys schema exists with no sys.version view. If
you have a user created sys schema, this must be renamed for the
upgrade to succeed.
```

To upgrade in this case, remove or rename the existing `sys` schema first. Then perform the upgrade procedure again. (It may be necessary to force step 2.)

To prevent the `sys` schema check:

- As of MySQL 8.0.16: Start the server with the `--upgrade=NONE` or `--upgrade=MINIMAL` option.
- Prior to MySQL 8.0.16: Invoke `mysql_upgrade` with the `--skip-sys-schema` option.
- Step 2 upgrades the system tables to ensure that they have the current structure. This is true whether the server or `mysql_upgrade` performs the step. With respect to the content of the help tables and time zone tables, `mysql_upgrade` does not load either type of table, whereas the server loads the help tables, but not the time zone tables. (That is, prior to MySQL 8.0.16, the server loads the help tables only at data directory initialization time. As of MySQL 8.0.16, it loads the help tables at initialization and upgrade time.) The procedure for loading time zone tables is platform dependent and requires decision making by the DBA, so it cannot be done automatically.
- From MySQL 8.0.30, when Step 2 is upgrading the system tables in the `mysql` schema, the column order in the primary key of the `mysql.db`, `mysql.tables_priv`, `mysql.columns_priv` and `mysql.procs_priv` tables is changed to place the host name and user name columns together. Placing the host name and user name together means that index lookup can be used, which improves performance for `CREATE USER`, `DROP USER`, and `RENAME USER` statements, and for ACL checks for multiple users with multiple privileges. Dropping and re-creating the index is necessary and might take some time if the system has a large number of users and privileges.
- Step 2 processes all tables in all user schemas as necessary. Table checking might take a long time to complete. Each table is locked and therefore unavailable to other sessions while it is being processed. Check and repair operations can be time-consuming, particularly for large tables. Table checking uses the `FOR UPGRADE` option of the `CHECK TABLE` statement. For details about what this option entails, see [CHECK TABLE Statement](#).

To prevent table checking:

- As of MySQL 8.0.16: Start the server with the `--upgrade=NONE` or `--upgrade=MINIMAL` option.
- Prior to MySQL 8.0.16: Invoke `mysql_upgrade` with the `--upgrade-system-tables` option.

To force table checking:

- As of MySQL 8.0.16: Start the server with the `--upgrade=FORCE` option.
- Prior to MySQL 8.0.16: Invoke `mysql_upgrade` with the `--force` option.
- Step 2 saves the MySQL version number in a file named `mysql_upgrade_info` in the data directory.

To ignore the `mysql_upgrade_info` file and perform the check regardless:

- As of MySQL 8.0.16: Start the server with the `--upgrade=FORCE` option.
- Prior to MySQL 8.0.16: Invoke `mysql_upgrade` with the `--force` option.

Note

The `mysql_upgrade_info` file is deprecated; expect it to be removed in a future version of MySQL.

- Step 2 marks all checked and repaired tables with the current MySQL version number. This ensures that the next time upgrade checking occurs with the same version of the server, it can be determined whether there is any need to check or repair a given table again.

10.5 Changes in MySQL 8.0

Before upgrading to MySQL 8.0, review the changes described in this section to identify those that apply to your current MySQL installation and applications. Perform any recommended actions.

Changes marked as **Incompatible change** are incompatibilities with earlier versions of MySQL, and may require your attention *before upgrading*. Our aim is to avoid these changes, but occasionally they are necessary to correct problems that would be worse than an incompatibility between releases. If an upgrade issue applicable to your installation involves an incompatibility, follow the instructions given in the description.

- [Data Dictionary Changes](#)
- [caching_sha2_password as the Preferred Authentication Plugin](#)
- [Configuration Changes](#)
- [Server Changes](#)
- [InnoDB Changes](#)
- [SQL Changes](#)
- [Changed Server Defaults](#)
- [Valid Performance Regressions](#)

Data Dictionary Changes

MySQL Server 8.0 incorporates a global data dictionary containing information about database objects in transactional tables. In previous MySQL series, dictionary data was stored in metadata files and nontransactional system tables. As a result, the upgrade procedure requires that you verify the upgrade readiness of your installation by checking specific prerequisites. For more information, see [Section 10.6, “Preparing Your Installation for Upgrade”](#). A data dictionary-enabled server entails some general operational differences; see [Data Dictionary Usage Differences](#).

caching_sha2_password as the Preferred Authentication Plugin

The `caching_sha2_password` and `sha256_password` authentication plugins provide more secure password encryption than the `mysql_native_password` plugin, and `caching_sha2_password` provides better performance than `sha256_password`. Due to these superior security and performance characteristics of `caching_sha2_password`, it is as of MySQL 8.0 the preferred authentication plugin, and is also the default authentication plugin rather than `mysql_native_password`. This change affects both the server and the `libmysqlclient` client library:

- For the server, the default value of the `default_authentication_plugin` system variable changes from `mysql_native_password` to `caching_sha2_password`.

This change applies only to new accounts created after installing or upgrading to MySQL 8.0 or higher. For accounts already existing in an upgraded installation, their authentication plugin remains unchanged. Existing users who wish to switch to `caching_sha2_password` can do so using the `ALTER USER` statement:

```
ALTER USER user
  IDENTIFIED WITH caching_sha2_password
  BY 'password' ;
```

- The `libmysqlclient` library treats `caching_sha2_password` as the default authentication plugin rather than `mysql_native_password`.

The following sections discuss the implications of the more prominent role of `caching_sha2_password`:

- [caching_sha2_password Compatibility Issues and Solutions](#)
- [caching_sha2_password-Compatible Clients and Connectors](#)
- [caching_sha2_password and the root Administrative Account](#)
- [caching_sha2_password and Replication](#)

caching_sha2_password Compatibility Issues and Solutions

Important

If your MySQL installation must serve pre-8.0 clients and you encounter compatibility issues after upgrading to MySQL 8.0 or higher, the simplest way to address those issues and restore pre-8.0 compatibility is to reconfigure the server to revert to the previous default authentication plugin (`mysql_native_password`). For example, use these lines in the server option file:

```
[mysqld]
default_authentication_plugin=mysql_native_password
```

That setting enables pre-8.0 clients to connect to 8.0 servers until such time as the clients and connectors in use at your installation are upgraded to know about `caching_sha2_password`. However, the setting should be viewed as temporary, not as a long term or permanent solution, because it causes new accounts created with the setting in effect to forego the improved authentication security provided by `caching_sha2_password`.

The use of `caching_sha2_password` offers more secure password hashing than `mysql_native_password` (and consequent improved client connection authentication). However, it also has compatibility implications that may affect existing MySQL installations:

- Clients and connectors that have not been updated to know about `caching_sha2_password` may have trouble connecting to a MySQL 8.0 server configured with `caching_sha2_password` as the default authentication plugin, even to use accounts that do not authenticate with `caching_sha2_password`. This issue occurs because the server specifies the name of its default authentication plugin to clients. If a client or connector is based on a client/server protocol implementation that does not gracefully handle an unrecognized default authentication plugin, it may fail with an error such as one of these:

```
Authentication plugin 'caching_sha2_password' is not supported
```

```
Authentication plugin 'caching_sha2_password' cannot be loaded:
dlopen(/usr/local/mysql/lib/plugin/caching_sha2_password.so, 2):
image not found
```

```
Warning: mysqli_connect(): The server requested authentication
method unknown to the client [caching_sha2_password]
```

For information about writing connectors to gracefully handle requests from the server for unknown default authentication plugins, see [Authentication Plugin Connector-Writing Considerations](#).

- Clients that use an account that authenticates with `caching_sha2_password` must use either a secure connection (made using TCP using TLS/SSL credentials, a Unix socket file, or shared memory), or an unencrypted connection that supports password exchange using an RSA key pair. This security requirement does not apply to `mysql_native_password`, so the switch to `caching_sha2_password` may require additional configuration (see [Caching SHA-2 Pluggable Authentication](#)). However, client connections in MySQL 8.0 prefer use of TLS/SSL by default, so clients that already conform to that preference may need no additional configuration.
- Clients and connectors that have not been updated to know about `caching_sha2_password` *cannot* connect to accounts that authenticate with `caching_sha2_password` because they do not recognize this plugin as valid. (This is a particular instance of how client/server authentication plugin compatibility requirements apply, as discussed at [Authentication Plugin Client/Server Compatibility](#).) To work around this issue, relink clients against `libmysqlclient` from MySQL 8.0 or higher, or obtain an updated connector that recognizes `caching_sha2_password`.
- Because `caching_sha2_password` is also now the default authentication plugin in the `libmysqlclient` client library, authentication requires an extra round trip in the client/server protocol for connections from MySQL 8.0 clients to accounts that use `mysql_native_password` (the previous default authentication plugin), unless the client program is invoked with a `--default-auth=mysql_native_password` option.

The `libmysqlclient` client library for pre-8.0 MySQL versions is able to connect to MySQL 8.0 servers (except for accounts that authenticate with `caching_sha2_password`). That means pre-8.0 clients based on `libmysqlclient` should also be able to connect. Examples:

- Standard MySQL clients such as `mysql` and `mysqladmin` are `libmysqlclient`-based.
- The `DBD::mysql` driver for Perl DBI is `libmysqlclient`-based.
- MySQL Connector/Python has a C Extension module that is `libmysqlclient`-based. To use it, include the `use_pure=False` option at connect time.

When an existing MySQL 8.0 installation is upgraded to MySQL 8.0.4 or higher, some older `libmysqlclient`-based clients may “automatically” upgrade if they are dynamically linked, because they use the new client library installed by the upgrade. For example, if the `DBD::mysql` driver for Perl DBI uses dynamic linking, it can use the `libmysqlclient` in place after an upgrade to MySQL 8.0.4 or higher, with this result:

- Prior to the upgrade, DBI scripts that use `DBD::mysql` can connect to a MySQL 8.0 server, except for accounts that authenticate with `caching_sha2_password`.
- After the upgrade, the same scripts become able to use `caching_sha2_password` accounts as well.

However, the preceding results occur because `libmysqlclient` instances from MySQL 8.0 installations prior to 8.0.4 are binary compatible: They both use a shared library major version number of 21. For clients linked to `libmysqlclient` from MySQL 5.7 or older, they link to a shared library with a different version number that is not binary compatible. In this case, the client must be recompiled against `libmysqlclient` from 8.0.4 or higher for full compatibility with MySQL 8.0 servers and `caching_sha2_password` accounts.

MySQL Connector/J 5.1 through 8.0.8 is able to connect to MySQL 8.0 servers, except for accounts that authenticate with `caching_sha2_password`. (Connector/J 8.0.9 or higher is required to connect to `caching_sha2_password` accounts.)

Clients that use an implementation of the client/server protocol other than `libmysqlclient` may need to be upgraded to a newer version that understands the new authentication plugin. For example, in PHP, MySQL connectivity usually is based on `mysqlnd`, which currently does not know about `caching_sha2_password`. Until an updated version of `mysqlnd` is available, the way to enable PHP clients to connect to MySQL 8.0 is to reconfigure the server to revert to `mysql_native_password` as the default authentication plugin, as previously discussed.

If a client or connector supports an option to explicitly specify a default authentication plugin, use it to name a plugin other than `caching_sha2_password`. Examples:

- Some MySQL clients support a `--default-auth` option. (Standard MySQL clients such as `mysql` and `mysqladmin` support this option but can successfully connect to 8.0 servers without it. However, other clients may support a similar option. If so, it is worth trying it.)
- Programs that use the `libmysqlclient` C API can call the `mysql_options()` function with the `MYSQL_DEFAULT_AUTH` option.
- MySQL Connector/Python scripts that use the native Python implementation of the client/server protocol can specify the `auth_plugin` connection option. (Alternatively, use the Connector/Python C Extension, which is able to connect to MySQL 8.0 servers without the need for `auth_plugin`.)

caching_sha2_password-Compatible Clients and Connectors

If a client or connector is available that has been updated to know about `caching_sha2_password`, using it is the best way to ensure compatibility when connecting to a MySQL 8.0 server configured with `caching_sha2_password` as the default authentication plugin.

These clients and connectors have been upgraded to support `caching_sha2_password`:

- The `libmysqlclient` client library in MySQL 8.0 (8.0.4 or higher). Standard MySQL clients such as `mysql` and `mysqladmin` are `libmysqlclient`-based, so they are compatible as well.
- The `libmysqlclient` client library in MySQL 5.7 (5.7.23 or higher). Standard MySQL clients such as `mysql` and `mysqladmin` are `libmysqlclient`-based, so they are compatible as well.
- MySQL Connector/C++ 1.1.11 or higher or 8.0.7 or higher.
- MySQL Connector/J 8.0.9 or higher.
- MySQL Connector/NET 8.0.10 or higher (through the classic MySQL protocol).
- MySQL Connector/Node.js 8.0.9 or higher.

- PHP: the X DevAPI PHP extension (mysql_xdevapi) supports `caching_sha2_password`.

PHP: the PDO_MySQL and ext/mysql extensions do not support `caching_sha2_password`. In addition, when used with PHP versions before 7.1.16 and PHP 7.2 before 7.2.4, they fail to connect with `default_authentication_plugin=caching_sha2_password` even if `caching_sha2_password` is not used.

caching_sha2_password and the root Administrative Account

For upgrades to MySQL 8.0, the authentication plugin existing accounts remains unchanged, including the plugin for the `'root'@'localhost'` administrative account.

For new MySQL 8.0 installations, when you initialize the data directory (using the instructions at [Section 9.1, “Initializing the Data Directory”](#)), the `'root'@'localhost'` account is created, and that account uses `caching_sha2_password` by default. To connect to the server following data directory initialization, you must therefore use a client or connector that supports `caching_sha2_password`. If you can do this but prefer that the `root` account use `mysql_native_password` after installation, install MySQL and initialize the data directory as you normally would. Then connect to the server as `root` and use `ALTER USER` as follows to change the account authentication plugin and password:

```
ALTER USER 'root'@'localhost'  
  IDENTIFIED WITH mysql_native_password  
  BY 'password';
```

If the client or connector that you use does not yet support `caching_sha2_password`, you can use a modified data directory-initialization procedure that associates the `root` account with `mysql_native_password` as soon as the account is created. To do so, use either of these techniques:

- Supply a `--default-authentication-plugin=mysql_native_password` option along with `--initialize` or `--initialize-insecure`.
- Set `default_authentication_plugin` to `mysql_native_password` in an option file, and name that option file using a `--defaults-file` option along with `--initialize` or `--initialize-insecure`. (In this case, if you continue to use that option file for subsequent server startups, new accounts are created with `mysql_native_password` rather than `caching_sha2_password` unless you remove the `default_authentication_plugin` setting from the option file.)

caching_sha2_password and Replication

In replication scenarios for which all servers have been upgraded to MySQL 8.0.4 or higher, replica connections to source servers can use accounts that authenticate with `caching_sha2_password`. For such connections, the same requirement applies as for other clients that use accounts that authenticate with `caching_sha2_password`: Use a secure connection or RSA-based password exchange.

To connect to a `caching_sha2_password` account for source/replica replication:

- Use any of the following `CHANGE MASTER TO` options:

```
MASTER_SSL = 1  
GET_MASTER_PUBLIC_KEY = 1  
MASTER_PUBLIC_KEY_PATH='path to RSA public key file'
```

- Alternatively, you can use the RSA public key-related options if the required keys are supplied at server startup.

To connect to a `caching_sha2_password` account for Group Replication:

- For MySQL built using OpenSSL, set any of the following system variables:

```
SET GLOBAL group_replication_recovery_use_ssl = ON;  
SET GLOBAL group_replication_recovery_get_public_key = 1;  
SET GLOBAL group_replication_recovery_public_key_path = 'path to RSA public key file';
```

- Alternatively, you can use the RSA public key-related options if the required keys are supplied at server startup.

Configuration Changes

- **Incompatible change:** A MySQL storage engine is now responsible for providing its own partitioning handler, and the MySQL server no longer provides generic partitioning support. [InnoDB](#) and [NDB](#) are the only storage engines that provide a native partitioning handler that is supported in MySQL 8.0. A partitioned table using any other storage engine must be altered—either to convert it to [InnoDB](#) or [NDB](#), or to remove its partitioning—*before* upgrading the server, else it cannot be used afterwards.

For information about converting [MyISAM](#) tables to [InnoDB](#), see [Converting Tables from MyISAM to InnoDB](#).

A table creation statement that would result in a partitioned table using a storage engine without such support fails with an error ([ER_CHECK_NOT_IMPLEMENTED](#)) in MySQL 8.0. If you import databases from a dump file created in MySQL 5.7 (or earlier) using [mysqldump](#) into a MySQL 8.0 server, you must make sure that any statements creating partitioned tables do not also specify an unsupported storage engine, either by removing any references to partitioning, or by specifying the storage engine as [InnoDB](#) or allowing it to be set as [InnoDB](#) by default.

Note

The procedure given at [Section 10.6, “Preparing Your Installation for Upgrade”](#), describes how to identify partitioned tables that must be altered before upgrading to MySQL 8.0.

See [Partitioning Limitations Relating to Storage Engines](#), for further information.

- **Incompatible change:** Several server error codes are not used and have been removed (for a list, see [Features Removed in MySQL 8.0](#)). Applications that test specifically for any of them should be updated.
- **Important change:** The default character set has changed from [latin1](#) to [utf8mb4](#). These system variables are affected:
 - The default value of the [character_set_server](#) and [character_set_database](#) system variables has changed from [latin1](#) to [utf8mb4](#).
 - The default value of the [collation_server](#) and [collation_database](#) system variables has changed from [latin1_swedish_ci](#) to [utf8mb4_0900_ai_ci](#).

As a result, the default character set and collation for new objects differ from previously unless an explicit character set and collation are specified. This includes databases and objects within them, such as tables, views, and stored programs. Assuming that the previous defaults were used, one way to preserve them is to start the server with these lines in the [my.cnf](#) file:

```
[mysqld]  
character_set_server=latin1  
collation_server=latin1_swedish_ci
```

In a replicated setting, when upgrading from MySQL 5.7 to 8.0, it is advisable to change the default character set back to the character set used in MySQL 5.7 before upgrading. After the upgrade is completed, the default character set can be changed to [utf8mb4](#).

In addition, you should be aware that MySQL 8.0 enforces checks on permitted characters in a given character set which MySQL 5.7 does not; this is a known issue. This means that, prior to attempting to upgrade, you should ensure that no comments contain characters that are not defined for the character set in use. You can fix this in either of two ways:

- Change the character set to one that includes the character or characters in question.
- Remove the offending character or characters.

The preceding applies to table, file, and index comments.

- **Incompatible change:** As of MySQL 8.0.11, it is prohibited to start the server with a `lower_case_table_names` setting that is different from the setting used when the server was initialized. The restriction is necessary because collations used by various data dictionary table fields are based on the `lower_case_table_names` setting that was defined when the server was initialized, and restarting the server with a different setting would introduce inconsistencies with respect to how identifiers are ordered and compared.

Server Changes

- In MySQL 8.0.11, several deprecated features related to account management have been removed, such as use of the `GRANT` statement to modify nonprivilege characteristics of user accounts, the `NO_AUTO_CREATE_USER` SQL mode, the `PASSWORD()` function, and the `old_passwords` system variable.

Replication from MySQL 5.7 to 8.0 of statements that refer to these removed features can cause replication failure. Applications that use any of the removed features should be revised to avoid them and use alternatives when possible, as described in [Features Removed in MySQL 8.0](#).

To avoid a startup failure on MySQL 8.0, remove any instance of `NO_AUTO_CREATE_USER` from `sql_mode` system variable settings in MySQL option files.

Loading a dump file that includes the `NO_AUTO_CREATE_USER` SQL mode in stored program definitions into a MySQL 8.0 server causes a failure. As of MySQL 5.7.24 and MySQL 8.0.13, `mysqldump` removes `NO_AUTO_CREATE_USER` from stored program definitions. Dump files created with an earlier version of `mysqldump` must be modified manually to remove instances of `NO_AUTO_CREATE_USER`.

- In MySQL 8.0.11, these deprecated compatibility SQL modes were removed: `DB2`, `MAXDB`, `MSSQL`, `MYSQL323`, `MYSQL40`, `ORACLE`, `POSTGRES`, `NO_FIELD_OPTIONS`, `NO_KEY_OPTIONS`, `NO_TABLE_OPTIONS`. They can no longer be assigned to the `sql_mode` system variable or used as permitted values for the `mysqldump --compatible` option.

Removal of `MAXDB` means that the `TIMESTAMP` data type for `CREATE TABLE` or `ALTER TABLE` is no longer treated as `DATETIME`.

Replication from MySQL 5.7 to 8.0 of statements that refer to the removed SQL modes can cause replication failure. This includes replication of `CREATE` statements for stored programs (stored procedures and functions, triggers, and events) that are executed while the current `sql_mode` value includes any of the removed modes. Applications that use any of the removed modes should be revised to avoid them.

- The text of many MySQL 8.0 error messages has been revised and improved to provide more and better information than in MySQL 5.7. If your application depends on specific content or formatting of error messages, you should test these and be prepared to update the application accordingly prior to performing an upgrade.

- As of MySQL 8.0.3, spatial data types permit an [SRID](#) attribute, to explicitly indicate the spatial reference system (SRS) for values stored in the column. See [Spatial Data Types](#).

A spatial column with an explicit [SRID](#) attribute is SRID-restricted: The column takes only values with that ID, and [SPATIAL](#) indexes on the column become subject to use by the optimizer. The optimizer ignores [SPATIAL](#) indexes on spatial columns with no [SRID](#) attribute. See [SPATIAL Index Optimization](#). If you want the optimizer to consider [SPATIAL](#) indexes on spatial columns that are not SRID-restricted, each such column should be modified:

- Verify that all values within the column have the same SRID. To determine the SRIDs contained in a geometry column *col_name*, use the following query:

```
SELECT DISTINCT ST_SRID(col_name) FROM tbl_name;
```

If the query returns more than one row, the column contains a mix of SRIDs. In that case, modify its contents so all values have the same SRID.

- Redefine the column to have an explicit [SRID](#) attribute.
- Recreate the [SPATIAL](#) index.
- Several spatial functions were removed in MySQL 8.0.0 due to a spatial function namespace change that implemented an [ST_](#) prefix for functions that perform an exact operation, or an [MBR](#) prefix for functions that perform an operation based on minimum bounding rectangles. The use of removed spatial functions in generated column definitions could cause an upgrade failure. Before upgrading, run `mysqlcheck --check-upgrade` for removed spatial functions and replace any that you find with their [ST_](#) or [MBR](#) named replacements. For a list of removed spatial functions, refer to [Features Removed in MySQL 8.0](#).
- The [BACKUP_ADMIN](#) privilege is automatically granted to users with the [RELOAD](#) privilege when performing an in-place upgrade to MySQL 8.0.3 or higher.
- From MySQL 8.0.13, because of differences between row-based or mixed replication mode and statement-based replication mode in the way that temporary tables are handled, there are new restrictions on switching the binary logging format at runtime.
 - `SET @@SESSION.binlog_format` cannot be used if the session has any open temporary tables.
 - `SET @@global.binlog_format` and `SET @@persist.binlog_format` cannot be used if any replication channel has any open temporary tables. `SET @@persist_only.binlog_format` is allowed if replication channels have open temporary tables, because unlike `PERSIST`, `PERSIST_ONLY` does not modify the runtime global system variable value.
 - `SET @@global.binlog_format` and `SET @@persist.binlog_format` cannot be used if any replication channel applier is running. This is because the change only takes effect on a replication channel when its applier is restarted, at which time the replication channel might have open temporary tables. This behavior is more restrictive than before. `SET @@persist_only.binlog_format` is allowed if any replication channel applier is running.
- From MySQL 8.0.27, configuring a session setting for `internal_tmp_mem_storage_engine` requires the [SESSION_VARIABLES_ADMIN](#) or [SYSTEM_VARIABLES_ADMIN](#) privilege.
- As of MySQL 8.0.27, the clone plugin permits concurrent DDL operations on the donor MySQL Server instance while a cloning operation is in progress. Previously, a backup lock was held during the cloning operation, preventing concurrent DDL on the donor. To revert to the previous behavior of blocking concurrent DDL on the donor during a clone operation, enable the `clone_block_ddl` variable. See [Cloning and Concurrent DDL](#).

- From MySQL 8.0.30, error log components listed in the `log_error_services` value at startup are loaded implicitly early in the MySQL Server startup sequence. If you have previously installed loadable error log components using `INSTALL COMPONENT` and you list those components in a `log_error_services` setting that is read at startup (from an option file, for example), your configuration should be updated to avoid startup warnings. For more information, see [Error Log Configuration Methods](#).

InnoDB Changes

- `INFORMATION_SCHEMA` views based on InnoDB system tables were replaced by internal system views on data dictionary tables. Affected InnoDB `INFORMATION_SCHEMA` views were renamed:

Table 10.1 Renamed InnoDB Information Schema Views

Old Name	New Name
<code>INNODB_SYS_COLUMNS</code>	<code>INNODB_COLUMNS</code>
<code>INNODB_SYS_DATAFILES</code>	<code>INNODB_DATAFILES</code>
<code>INNODB_SYS_FIELDS</code>	<code>INNODB_FIELDS</code>
<code>INNODB_SYS_FOREIGN</code>	<code>INNODB_FOREIGN</code>
<code>INNODB_SYS_FOREIGN_COLS</code>	<code>INNODB_FOREIGN_COLS</code>
<code>INNODB_SYS_INDEXES</code>	<code>INNODB_INDEXES</code>
<code>INNODB_SYS_TABLES</code>	<code>INNODB_TABLES</code>
<code>INNODB_SYS_TABLESPACES</code>	<code>INNODB_TABLESPACES</code>
<code>INNODB_SYS_TABLESTATS</code>	<code>INNODB_TABLESTATS</code>
<code>INNODB_SYS_VIRTUAL</code>	<code>INNODB_VIRTUAL</code>

After upgrading to MySQL 8.0.3 or higher, update any scripts that reference previous InnoDB `INFORMATION_SCHEMA` view names.

- The [zlib library](#) version bundled with MySQL was raised from version 1.2.3 to version 1.2.11.

The `zlib compressBound()` function in `zlib 1.2.11` returns a slightly higher estimate of the buffer size required to compress a given length of bytes than it did in `zlib version 1.2.3`. The `compressBound()` function is called by InnoDB functions that determine the maximum row size permitted when creating compressed InnoDB tables or inserting and updating rows in compressed InnoDB tables. As a result, `CREATE TABLE ... ROW_FORMAT=COMPRESSED`, `INSERT`, and `UPDATE` operations with row sizes very close to the maximum row size that were successful in earlier releases could now fail. To avoid this issue, test `CREATE TABLE` statements for compressed InnoDB tables with large rows on a MySQL 8.0 test instance prior to upgrading.

- With the introduction of the `--innodb-directories` feature, the location of file-per-table and general tablespace files created with an absolute path or in a location outside of the data directory should be added to the `innodb_directories` argument value. Otherwise, InnoDB is not able to locate these files during recovery. To view tablespace file locations, query the Information Schema `FILES` table:

```
SELECT TABLESPACE_NAME, FILE_NAME FROM INFORMATION_SCHEMA.FILES \G
```

- Undo logs can no longer reside in the system tablespace. In MySQL 8.0, undo logs reside in two undo tablespaces by default. For more information, see [Undo Tablespaces](#).

When upgrading from MySQL 5.7 to MySQL 8.0, any undo tablespaces that exist in the MySQL 5.7 instance are removed and replaced by two new default undo tablespaces. Default undo

tablespaces are created in the location defined by the `innodb_undo_directory` variable. If the `innodb_undo_directory` variable is undefined, undo tablespaces are created in the data directory. Upgrade from MySQL 5.7 to MySQL 8.0 requires a slow shutdown which ensures that undo tablespaces in the MySQL 5.7 instance are empty, permitting them to be removed safely.

When upgrading to MySQL 8.0.14 or later from an earlier MySQL 8.0 release, undo tablespaces that exist in the pre-upgrade instance as a result of an `innodb_undo_tablespaces` setting greater than 2 are treated as user-defined undo tablespaces, which can be deactivated and dropped using `ALTER UNDO TABLESPACE` and `DROP UNDO TABLESPACE` syntax, respectively, after upgrading. Upgrade within the MySQL 8.0 release series may not always require a slow shutdown which means that existing undo tablespaces could contain undo logs. Therefore, existing undo tablespaces are not removed by the upgrade process.

- **Incompatible change:** As of MySQL 8.0.17, the `CREATE TABLESPACE ... ADD DATAFILE` clause does not permit circular directory references. For example, the circular directory reference (`/../`) in the following statement is not permitted:

```
CREATE TABLESPACE ts1 ADD DATAFILE ts1.ibd 'any_directory/../../ts1.ibd';
```

An exception to the restriction exists on Linux, where a circular directory reference is permitted if the preceding directory is a symbolic link. For example, the data file path in the example above is permitted if `any_directory` is a symbolic link. (It is still permitted for data file paths to begin with `'../'`.)

To avoid upgrade issues, remove any circular directory references from tablespace data file paths before upgrading to MySQL 8.0.17 or higher. To inspect tablespace paths, query the Information Schema `INNODB_DATAFILES` table.

- Due to a regression introduced in MySQL 8.0.14, in-place upgrade on a case-sensitive file system from MySQL 5.7 or a MySQL 8.0 release prior to MySQL 8.0.14 to MySQL 8.0.16 failed for instances with partitioned tables and `lower_case_table_names=1`. The failure was caused by a case mismatch issue related to partitioned table file names. The fix that introduced the regression was reverted, which permits upgrades to MySQL 8.0.17 from MySQL 5.7 or MySQL 8.0 releases prior to MySQL 8.0.14 to function as normal. However, the regression is still present in the MySQL 8.0.14, 8.0.15, and 8.0.16 releases.

In-place upgrade on a case-sensitive file system from MySQL 8.0.14, 8.0.15, or 8.0.16 to MySQL 8.0.17 fails with the following error when starting the server after upgrading binaries or packages to MySQL 8.0.17 if partitioned tables are present and `lower_case_table_names=1`:

```
Upgrading from server version version_number with
partitioned tables and lower_case_table_names == 1 on a case sensitive file
system may cause issues, and is therefore prohibited. To upgrade anyway, restart
the new server version with the command line option 'upgrade=FORCE'. When
upgrade is completed, please execute 'RENAME TABLE part_table_name
TO new_table_name; RENAME TABLE new_table_name
TO part_table_name;' for each of the partitioned tables.
Please see the documentation for further information.
```

If you encounter this error when upgrading to MySQL 8.0.17, perform the following workaround:

1. Restart the server with `--upgrade=force` to force the upgrade operation to proceed.
2. Identify partitioned table file names with lowercase partition name delimiters (`#p#` or `#sp#`):

```
mysql> SELECT FILE_NAME FROM INFORMATION_SCHEMA.FILES WHERE FILE_NAME LIKE '%#p#' OR FILE_NAME LIKE '%#s'
```

- For each file identified, rename the associated table using a temporary name, then rename the table back to its original name.

```
mysql> RENAME TABLE table_name TO temporary_table_name;
mysql> RENAME TABLE temporary_table_name TO table_name;
```

- Verify that there are no partitioned table file names lowercase partition name delimiters (an empty result set should be returned).

```
mysql> SELECT FILE_NAME FROM INFORMATION_SCHEMA.FILES WHERE FILE_NAME LIKE '%#p#%' OR FILE_NAME LIKE
Empty set (0.00 sec)
```

- Run `ANALYZE TABLE` on each renamed table to update the optimizer statistics in the `mysql.innodb_index_stats` and `mysql.innodb_table_stats` tables.

Because of the regression still present in the MySQL 8.0.14, 8.0.15, and 8.0.16 releases, importing partitioned tables from MySQL 8.0.14, 8.0.15, or 8.0.16 to MySQL 8.0.17 is not supported on case-sensitive file systems where `lower_case_table_names=1`. Attempting to do so results in a “Tablespace is missing for table” error.

- MySQL uses delimiter strings when constructing tablespace names and file names for table partitions. A “#p#” delimiter string precedes partition names, and an “#sp#” delimiter string precedes subpartition names, as shown:

```
schema_name.table_name#p#partition_name#sp#subpartition_name
table_name#p#partition_name#sp#subpartition_name.ibd
```

Historically, delimiter strings have been uppercase (#P# and #SP#) on case-sensitive file systems such as Linux, and lowercase (#p# and #sp#) on case-insensitive file systems such as Windows. As of MySQL 8.0.19, delimiter strings are lowercase on all file systems. This change prevents issues when migrating data directories between case-sensitive and case-insensitive file systems. Uppercase delimiter strings are no longer used.

Additionally, partition tablespace names and file names generated based on user-specified partition or subpartition names, which can be specified in uppercase or lowercase, are now generated (and stored internally) in lowercase regardless of the `lower_case_table_names` setting to ensure case-insensitivity. For example, if a table partition is created with the name `PART_1`, the tablespace name and file name are generated in lowercase:

```
schema_name.table_name#p#part_1
table_name#p#part_1.ibd
```

During upgrade, MySQL checks and modifies if necessary:

- Partition file names on disk and in the data dictionary to ensure lowercase delimiters and partition names.
- Partition metadata in the data dictionary for related issues introduced by previous bug fixes.
- InnoDB statistics data for related issues introduced by previous bug fixes.

During tablespace import operations, partition tablespace file names on disk are checked and modified if necessary to ensure lowercase delimiters and partition names.

- As of MySQL 8.0.21, a warning is written to the error log at startup or when upgrading from MySQL 5.7 if tablespace data files are found to reside in unknown directories. Known directories are those defined by the `datadir`, `innodb_data_home_dir`, and `innodb_directories` variables. To make a directory

known, add it to the `innodb_directories` setting. Making directories known ensures that data files can be found during recovery. For more information, see [Tablespace Discovery During Crash Recovery](#).

- **Important change:** From MySQL 8.0.30, the `innodb_redo_log_capacity` variable controls the amount of disk space occupied by redo log files. With this change, the default number of redo log files and their location has also changed. From MySQL 8.0.30, InnoDB maintains 32 redo log files in the `#innodb_redo` directory in the data directory. Previously, InnoDB created two redo log files in the data directory by default, and the number and size of redo log files were controlled by the `innodb_log_files_in_group` and `innodb_log_file_size` variables. These two variables are now deprecated.

When the `innodb_redo_log_capacity` setting is defined, `innodb_log_files_in_group` and `innodb_log_file_size` settings are ignored; otherwise, those settings are used to compute the `innodb_redo_log_capacity` setting (`innodb_log_files_in_group * innodb_log_file_size = innodb_redo_log_capacity`). If none of those variables are set, redo log capacity is set to the `innodb_redo_log_capacity` default value, which is 104857600 bytes (100MB).

As is generally required for any upgrade, this change requires a clean shutdown before upgrading.

For more information about this feature, see [Redo Log](#).

- Before MySQL 5.7.35, there was no size limitation for indexes in tables with redundant or compact row format. As of MySQL 5.7.35, the limit is 767 bytes. An upgrade from a MySQL version before 5.7.35 to MySQL 8.0 can produce inaccessible tables. If a table with redundant or compact row format has an index larger than 767 bytes, drop the index and re-create it before an upgrade to MySQL 8.0. The error message is:

```
mysql> ERROR 1709 (HY000): Index column size too large. The maximum column size is 767 bytes.
```

SQL Changes

- **Incompatible change:** As of MySQL 8.0.13, the deprecated `ASC` or `DESC` qualifiers for `GROUP BY` clauses have been removed. Queries that previously relied on `GROUP BY` sorting may produce results that differ from previous MySQL versions. To produce a given sort order, provide an `ORDER BY` clause.

Queries and stored program definitions from MySQL 8.0.12 or lower that use `ASC` or `DESC` qualifiers for `GROUP BY` clauses should be amended. Otherwise, upgrading to MySQL 8.0.13 or higher may fail, as may replicating to MySQL 8.0.13 or higher replica servers.

- Some keywords may be reserved in MySQL 8.0 that were not reserved in MySQL 5.7. See [Keywords and Reserved Words](#). This can cause words previously used as identifiers to become illegal. To fix affected statements, use identifier quoting. See [Schema Object Names](#).
- After upgrading, it is recommended that you test optimizer hints specified in application code to ensure that the hints are still required to achieve the desired optimization strategy. Optimizer enhancements can sometimes render certain optimizer hints unnecessary. In some cases, an unnecessary optimizer hint may even be counterproductive.
- **Incompatible change:** In MySQL 5.7, specifying a `FOREIGN KEY` definition for an InnoDB table without a `CONSTRAINT symbol` clause, or specifying the `CONSTRAINT` keyword without a `symbol`, causes InnoDB to use a generated constraint name. That behavior changed in MySQL 8.0, with InnoDB using the `FOREIGN KEY index_name` value instead of a generated name. Because constraint names must be unique per schema (database), the change caused errors due to foreign key index names that were not unique per schema. To avoid such errors, the new constraint naming behavior has been reverted in MySQL 8.0.16, and InnoDB once again uses a generated constraint name.

For consistency with InnoDB, NDB releases based on MySQL 8.0.16 or higher use a generated constraint name if the `CONSTRAINT symbol` clause is not specified, or the `CONSTRAINT` keyword is specified without a `symbol`. NDB releases based on MySQL 5.7 and earlier MySQL 8.0 releases used the `FOREIGN KEY index_name` value.

The changes described above may introduce incompatibilities for applications that depend on the previous foreign key constraint naming behavior.

- The handling of system variable values by MySQL flow control functions such as `IFNULL()` and `CASE()` changed in MySQL 8.0.22; system variable values are now handled as column values of the same character and collation, rather than as constants. Some queries using these functions with system variables that were previously successful may subsequently be rejected with `Illegal mix of collations`. In such cases, cast the system variable to the correct character set and collation.
- **Incompatible change:** MySQL 8.0.28 fixes an issue in previous MySQL 8.0 releases whereby the `CONVERT()` function sometimes allowed invalid casts of `BINARY` values to nonbinary character sets. Applications which may have relied on this behavior should be checked and if necessary modified prior to upgrade.

In particular, where `CONVERT()` was used as part of an expression for an indexed generated column, the change in the function's behavior may result in index corruption following an upgrade to MySQL 8.0.28. You can prevent this from happening by following these steps:

1. Prior to performing the upgrade, correct any invalid input data.
2. Drop and then re-create the index.

You can also force a table rebuild using `ALTER TABLE table FORCE`, instead.

3. Upgrade the MySQL software.

If you cannot validate the input data beforehand, you should not re-create the index or rebuild the table until after you perform the upgrade to MySQL 8.0.28.

Changed Server Defaults

MySQL 8.0 comes with improved defaults, aiming at the best out of the box experience possible. These changes are driven by the fact that technology is advancing (machines have more CPUs, use SSDs and so on), more data is being stored, MySQL is evolving (InnoDB, Group Replication, AdminAPI), and so on. The following table summarizes the defaults which have been changed to provide the best MySQL experience for the majority of users.

Option/Parameter	Old Default	New Default
<i>Server changes</i>		
<code>character_set_server</code>	latin1	utf8mb4
<code>collation_server</code>	latin1_swedish_ci	utf8mb4_0900_ai_ci
<code>explicit_defaults_for_timestamp</code>	OFF	ON
<code>optimizer_trace_max_mem_size</code>	16KB	1MB
<code>validate_password_check_user_name</code>	OFF	ON
<code>back_log</code>	-1 (autosize) changed from : <code>back_log = 50 + (max_connections / 5)</code>	-1 (autosize) changed to : <code>back_log = max_connections</code>

Option/Parameter	Old Default	New Default
<code>max_allowed_packet</code>	4194304 (4MB)	67108864 (64MB)
<code>max_error_count</code>	64	1024
<code>event_scheduler</code>	OFF	ON
<code>table_open_cache</code>	2000	4000
<code>log_error_verbosity</code>	3 (Notes)	2 (Warning)
<code>local_infile</code>	ON (5.7)	OFF
<i>InnoDB changes</i>		
<code>innodb_undo_tablespaces</code>	0	2
<code>innodb_undo_log_truncate</code>	OFF	ON
<code>innodb_flush_method</code>	NULL	fsync (Unix), unbuffered (Windows)
<code>innodb_autoinc_lock_mode</code>	1 (consecutive)	2 (interleaved)
<code>innodb_flush_neighbors</code>	1 (enable)	0 (disable)
<code>innodb_max_dirty_pages_pct</code>	1 (%)	10 (%)
<code>innodb_max_dirty_pages_pct</code>	75 (%)	90 (%)
<i>Performance Schema changes</i>		
<code>performance-schema-instrument='wait/lock/metadata/sql/%=ON'</code>	OFF	ON
<code>performance-schema-instrument='memory/%=COUNTED'</code>	OFF	COUNTED
<code>performance-schema-consumer-events-transactions-current=ON</code>	OFF	ON
<code>performance-schema-consumer-events-transactions-history=ON</code>	OFF	ON
<code>performance-schema-instrument='transaction%=ON'</code>	OFF	ON
<i>Replication changes</i>		
<code>log_bin</code>	OFF	ON
<code>server_id</code>	0	1
<code>log-slave-updates</code>	OFF	ON
<code>expire_logs_days</code>	0	30
<code>master-info-repository</code>	FILE	TABLE
<code>relay-log-info-repository</code>	FILE	TABLE
<code>transaction-write-set-extraction</code>	OFF	XXHASH64
<code>slave_rows_search_algorithm</code>	INDEX_SCAN, TABLE_SCAN	INDEX_SCAN, HASH_SCAN

Option/Parameter	Old Default	New Default
<code>slave_pending_jobs_size_max</code>	16M	128M
<code>gtid_executed_compression_period</code>	1000	0
<i>Group Replication changes</i>		
<code>group_replication_autorejoin_tries</code>	0	3
<code>group_replication_exit_status</code>	ABORT_SERVER	READ_ONLY
<code>group_replication_member_expel_timeout</code>	0	5

For more information about options or variables which have been added, see [Option and Variable Changes for MySQL 8.0](#), in the *MySQL Server Version Reference*.

The following sections explain the changes to defaults and any impact they might have on your deployment.

Server Defaults

- The default value of the `character_set_server` system variable and command line option `--character-set-server` changed from `latin1` to `utf8mb4`. This is the server's default character set. At this time, UTF8MB4 is the dominant character encoding for the web, and this change makes life easier for the vast majority of MySQL users. The upgrade from 5.7 to 8.0 does not change the character set for any existing database objects, but, unless you set `character_set_server` explicitly (either back to the previous value, or to a new one), a new schema uses `utf8mb4` by default. We recommend that you move to `utf8mb4` whenever possible.
- The default value of the `collation_server` system variable and command line argument `--collation-server` changed from `latin1_swedish_ci` to `utf8mb4_0900_ai_ci`. This is the server's default collation, the ordering of characters in a character set. There is a link between collations and character sets as each character set comes with a list of possible collations. The upgrade from 5.7 to 8.0 does not change any collation for any existing database objects, but takes effect for new objects.
- The default value of the `explicit_defaults_for_timestamp` system variable changed from `OFF` (MySQL legacy behavior) to `ON` (SQL standard behavior). This option was originally introduced in 5.6 and was `OFF` in 5.6 and 5.7.
- The default value of the `optimizer_trace_max_mem_size` system variable changed from `16KB` to `1MB`. The old default caused the optimizer trace to be truncated for any non-trivial query. This change ensures useful optimizer traces for most queries.
- The default value of the `validate_password_check_user_name` system variable changed from `OFF` to `ON`. This means that when the `validate_password` plugin is enabled, by default it now rejects passwords that match the current session user name.
- The autosize algorithm for the `back_log` system variable has changed. The value for autosize (-1) is now set to the value of `max_connections`, which is bigger than the calculated by `50 + (max_connections / 5)`. The `back_log` queues up incoming IP connect requests in situations where the server is not able to keep up with incoming requests. In the worst case, with `max_connections` number of clients trying to reconnect at the same time, for example after a network failure, they can all be buffered and reject-retry loops are avoided.
- The default value of the `max_allowed_packet` system variable changed from `4194304` (4M) to `67108864` (64M). The main advantage with this larger default is less chance of receiving errors about an insert or query being larger than `max_allowed_packet`. It should be as big as the largest [The BLOB and TEXT Types](#) you want to use. To revert to the previous behavior, set `max_allowed_packet=4194304`.

- The default value of the `max_error_count` system variable changed from 64 to 1024. This ensures that MySQL handles a larger number of warnings, such as an UPDATE statement that touches 1000s of rows and many of them give conversion warnings. It is common for many tools to batch updates, to help reduce replication lag. External tools such as pt-online-schema-change defaults to 1000, and gh-ost defaults to 100. MySQL 8.0 covers full error history for these two use cases. There are no static allocations, so this change only affects memory consumption for statements that generate lots of warnings.
- The default value of the `event_scheduler` system variable changed from OFF to ON. In other words, the event scheduler is enabled by default. This is an enabler for new features in SYS, for example “kill idle transactions”.
- The default value of the `table_open_cache` system variable changed from 2000 to 4000. This is a minor change which increases session concurrency on table access.
- The default value of the `log_error_verbosity` system variable changed from 3 (Notes) to 2 (Warning). The purpose is to make the MySQL 8.0 error log less verbose by default.

InnoDB Defaults

- **Incompatible change** The default value of the `innodb_undo_tablespaces` system variable changed from 0 to 2. This configures the number of undo tablespaces used by InnoDB. In MySQL 8.0 the minimum value for `innodb_undo_tablespaces` is 2 and rollback segments cannot be created in the system tablespace anymore. Thus, this is a case where you cannot revert back to 5.7 behavior. The purpose of this change is to be able to auto-truncate Undo logs (see next item), reclaiming disk space used by (occasional) long transactions such as a `mysqldump`.
- The default value of the `innodb_undo_log_truncate` system variable changed from OFF to ON. When enabled, undo tablespaces that exceed the threshold value defined by `innodb_max_undo_log_size` are marked for truncation. Only undo tablespaces can be truncated. Truncating undo logs that reside in the system tablespace is not supported. An upgrade from 5.7 to 8.0 automatically converts your system to use undo tablespaces, using the system tablespace is not an option in 8.0.
- The default value of the `innodb_flush_method` system variable changed from NULL to `fsync` on Unix-like systems and from NULL to `unbuffered` on Windows systems. This is more of a terminology and option cleanup without any tangible impact. For Unix this is just a documentation change as the default was `fsync` also in 5.7 (the default NULL meant `fsync`). Similarly on Windows, `innodb_flush_method` default NULL meant `async_unbuffered` in 5.7, and is replaced by default `unbuffered` in 8.0, which in combination with the existing default `innodb_use_native_aio=ON` has the same effect.
- **Incompatible change** The default value of the `innodb_autoinc_lock_mode` system variable changed from 1 (consecutive) to 2 (interleaved). The change to interleaved lock mode as the default setting reflects the change from statement-based to row-based replication as the default replication type, which occurred in MySQL 5.7. *Statement-based replication* requires the consecutive auto-increment lock mode to ensure that auto-increment values are assigned in a predictable and repeatable order for a given sequence of SQL statements, whereas *row-based replication* is not sensitive to the execution order of SQL statements. Thus, this change is known to be incompatible with statement based replication, and may break some applications or user-generated test suites that depend on sequential auto increment. The previous default can be restored by setting `innodb_autoinc_lock_mode=1`;
- The default value of the `innodb_flush_neighbors` system variable changes from 1 (enable) to 0 (disable). This is done because fast IO (SSDs) is now the default for deployment. We expect that for the majority of users, this results in a small performance gain. Users who are using slower hard drives may see a performance loss, and are encouraged to revert to the previous defaults by setting `innodb_flush_neighbors=1`.

- The default value of the `innodb_max_dirty_pages_pct_lwm` system variable changed from 0 (%) to 10 (%). With `innodb_max_dirty_pages_pct_lwm=10`, InnoDB increases its flushing activity when >10% of the buffer pool contains modified ('dirty') pages. The purpose of this change is to trade off peak throughput slightly, in exchange for more consistent performance.
- The default value of the `innodb_max_dirty_pages_pct` system variable changed from 75 (%) to 90 (%). This change combines with the change to `innodb_max_dirty_pages_pct_lwm` and together they ensure a smooth InnoDB flushing behavior, avoiding flushing bursts. To revert to the previous behavior, set `innodb_max_dirty_pages_pct=75` and `innodb_max_dirty_pages_pct_lwm=0`.

Performance Schema Defaults

- Performance Schema Meta Data Locking (MDL) instrumentation is turned on by default. The compiled default for `performance-schema-instrument='wait/lock/metadata/sql/%=ON'` changed from `OFF` to `ON`. This is an enabler for adding MDL oriented views in SYS.
- Performance Schema Memory instrumentation is turned on by default. The compiled default for `performance-schema-instrument='memory/%=COUNTED'` changed from `OFF` to `COUNTED`. This is important because the accounting is incorrect if instrumentation is enabled after server start, and you could get a negative balance from missing an allocation, but catching a free.
- Performance Schema Transaction instrumentation is turned on by default. The compiled default for `performance-schema-consumer-events-transactions-current=ON`, `performance-schema-consumer-events-transactions-history=ON`, and `performance-schema-instrument='transaction%=ON'` changed from `OFF` to `ON`.

Replication Defaults

- The default value of the `log_bin` system variable changed from `OFF` to `ON`. In other words, binary logging is enabled by default. Nearly all production installations have the binary log enabled as it is used for replication and point-in-time recovery. Thus, by enabling binary log by default we eliminate one configuration step, enabling it later requires a `mysqld` restart. Enabling it by default also provides better test coverage and it becomes easier to spot performance regressions. Remember to also set `server_id` (see following change). The 8.0 default behavior is as if you issued `./mysqld --log-bin --server-id=1`. If you are on 8.0 and want 5.7 behavior you can issue `./mysqld --skip-log-bin --server-id=0`.
- The default value of the `server_id` system variable changed from 0 to 1 (combines with the change to `log_bin=ON`). The server can be started with this default ID, but in practice you must set the `server-id` according to the replication infrastructure being deployed, to avoid having duplicate server ids.
- The default value of the `log_slave_updates` system variable changed from `OFF` to `ON`. This causes a replica to log replicated events into its own binary log. This option is required for Group Replication, and also ensures correct behavior in various replication chain setups, which have become the norm today.
- The default value of the `expire_logs_days` system variable changed from 0 to 30. The new default 30 causes `mysqld` to periodically purge unused binary logs that are older than 30 days. This change helps prevent excessive amounts of disk space being wasted on binary logs that are no longer needed for replication or recovery purposes. The old value of 0 disables any automatic binary log purges.
- The default value of the `master_info_repository` and `relay_log_info_repository` system variables change from `FILE` to `TABLE`. Thus in 8.0, replication metadata is stored in InnoDB by default. This increases reliability to try and achieve crash safe replication by default.
- The default value of the `transaction-write-set-extraction` system variable changed from `OFF` to `XXHASH64`. This change enables transaction write sets by default. By using Transaction Write Sets, the source has to do slightly more work to generate the write sets, but the result is helpful in conflict

detection. This is a requirement for Group Replication and the new default makes it easy to enable binary log writeset parallelization on the source to speed up replication.

- The default value of the `slave_rows_search_algorithms` system variable changed from `INDEX_SCAN, TABLE_SCAN` to `INDEX_SCAN, HASH_SCAN`. This change speeds up row-based replication by reducing the number of table scans the replica applier has to do to apply the changes to a table without a primary key.
- The default value of the `slave_pending_jobs_size_max` system variable changed from `16M` to `128M`. This change increases the amount of memory available to multithreaded replicas.
- The default value of the `gtid_executed_compression_period` system variable changed from `1000` to `0`. This change ensures that compression of the `mysql.gtid_executed` table only occurs implicitly as required.

Group Replication Defaults

- The default value of `group_replication_autorejoin_tries` changed from `0` to `3`, which means that automatic rejoin is enabled by default. This system variable specifies the number of tries that a member makes to automatically rejoin the group if it is expelled, or if it is unable to contact a majority of the group before the `group_replication_unreachable_majority_timeout` setting is reached.
- The default value of `group_replication_exit_state_action` changed from `ABORT_SERVER` to `READ_ONLY`. This means that when a member exits the group, for example after a network failure, the instance becomes read-only, rather than being shut down.
- The default value of `group_replication_member_expel_timeout` changed from `0` to `5`, meaning that a member suspected of having lost contact with the group is liable for expulsion 5 seconds after the 5-second detection period.

Most of these defaults are reasonably good for both development and production environments. There is one exception to this, we decided to keep the new option called `innodb_dedicated_server` set to `OFF` although we recommend it to be `ON` for production environments. The reason for defaulting to `OFF` is that it causes shared environments such as developer laptops to become unusable, because it takes *all* the memory it can find.

For production environments we recommend setting `innodb_dedicated_server` to `ON`. When set to `ON` the following InnoDB variables (if not specified explicitly) are autoscaled based on the available memory `innodb_buffer_pool_size`, `innodb_log_file_size`, and `innodb_flush_method`. See [Enabling Automatic Configuration for a Dedicated MySQL Server](#).

Although the new defaults are the best configuration choices for most use cases, there are special cases, as well as legacy reasons for using existing 5.7 configuration choices. For example, some people prefer to upgrade to 8.0 with as few changes to their applications or operational environment as possible. We recommend to evaluate all the new defaults and use as many as you can. Most new defaults can be tested in 5.7, so you can validate the new defaults in 5.7 production before upgrading to 8.0. For the few defaults where you need your old 5.7 value, set the corresponding configuration variable or startup option in your operational environment.

MySQL 8.0 has the Performance Schema `variables_info` table, which shows for each system variable the source from which it was most recently set, as well as its range of values. This provides SQL access to all there is to know about a configuration variable and its values.

Valid Performance Regressions

Performance regressions are expected between MySQL versions 5.7 and 8.0. MySQL 8.0 has more features, changes default values, is more robust, and adds security functionality and additional diagnostic

information. Listed here are valid reasons for regressions between these versions which includes potential mediation options. This is not an exhaustive list.

Changes related to default values changing between MySQL versions 5.7 and 8.0:

- [Binary logs](#) are disabled by default in 5.7, and enabled by default in 8.0.

Mediation: Disable binary logging by specifying the `--skip-log-bin` or `--disable-log-bin` option at startup.

- The default character set changed from `latin1` to `utf8mb4` in 8.0. While `utf8mb4` performs significantly better in 8.0 than it did in 5.7, `latin1` is faster than `utf8mb4`.

Mediation: Use `latin1` in 8.0 if `utf8mb4` is not needed.

[Transactional Data Dictionary](#) (atomic DDL) was introduced in 8.0.

- This increases robustness/reliability at the expense of DDL performance (CREATE / DROP intensive loads), but it should not impact the DML load (SELECT / INSERT / UPDATE / DELETE).

Mediation: None

The more modern [TLS ciphers/algorithms](#) used as of 5.7.28 has an effect when TLS (SSL) is enabled (the default):

- Before MySQL 5.7.28, MySQL uses the yaSSL library for the community edition and OpenSSL for the enterprise edition.

As of MySQL 5.7.28, MySQL only uses OpenSSL with its stronger TLS ciphers, which are more costly in terms of performance.

Upgrading to MySQL 8.0 from MySQL 5.7.28 or earlier can cause a TLS performance regression.

Mediation: None (if TLS is required for security reasons)

[Performance Schema \(PFS\)](#) instrumentation is much wider in 8.0 than in 5.7:

- PFS cannot be compiled out in MySQL 8.0 but it can be turned off. Some performance schema instrumentation will still exist even when turned off, but overhead will be smaller.

Mediation: Set `performance_schema = OFF` in 8.0, or turn off performance schema instrumentation at finer granularity if some but not all PFS functionality is needed.

Truncating undo tablespaces is enabled by default in 8.0 which can significantly impact performance:

- Historically InnoDB stored undo logs in the system tablespace but there was no way to reclaim space used by undo log. The system tablespace would only grow and not shrink, and this inspired feature requests to remedy this.

MySQL 8.0 moved the undo log to separate tablespaces which allows both manual and automatic undo log truncation.

However, auto-truncation has a permanent performance overhead and it can potentially cause stalls.

Mediation: Set `innodb_undo_log_truncate = OFF` in 8.0, and manually truncate undo logs as needed. For related information, see [Truncating Undo Tablespaces](#).

The character classes `[[:alpha:]]` or `[[:digit:]]` do not perform as well with regular expression functions such as `REGEXP()` and `RLIKE()` in MySQL 8.0 as they did in MySQL 5.7. This is due to the

replacement in MySQL 8.0 of the Spencer regular expression library with the ICU library, which uses UTF-16 internally.

Mediation: In place of `[[:alpha:]]`, use `[a-zA-Z]`; in place of `[[:digit:]]`, use `[0-9]`.

10.6 Preparing Your Installation for Upgrade

Before upgrading to the latest MySQL 8.0 release, ensure the upgrade readiness of your current MySQL 5.7 or MySQL 8.0 server instance by performing the preliminary checks described below. The upgrade process may fail otherwise.

Tip

Consider using the [MySQL Shell upgrade checker utility](#) that enables you to verify whether MySQL server instances are ready for upgrade. You can select a target MySQL Server release to which you plan to upgrade, ranging from the MySQL Server 8.0.11 up to the MySQL Server release number that matches the current MySQL Shell release number. The upgrade checker utility carries out the automated checks that are relevant for the specified target release, and advises you of further relevant checks that you should make manually. The upgrade checker works for all GA releases of MySQL 5.7, 8.0, and 8.3. Installation instructions for MySQL Shell can be found [here](#).

Preliminary checks:

1. The following issues must not be present:

- There must be no tables that use obsolete data types or functions.

In-place upgrade to MySQL 8.0 is not supported if tables contain old temporal columns in pre-5.6.4 format (`TIME`, `DATETIME`, and `TIMESTAMP` columns without support for fractional seconds precision). If your tables still use the old temporal column format, upgrade them using `REPAIR TABLE` before attempting an in-place upgrade to MySQL 8.0. For more information, see [Server Changes](#), in [MySQL 5.7 Reference Manual](#).

- There must be no orphan `.frm` files.
- Triggers must not have a missing or empty definer or an invalid creation context (indicated by the `character_set_client`, `collation_connection`, `Database Collation` attributes displayed by `SHOW TRIGGERS` or the `INFORMATION_SCHEMA TRIGGERS` table). Any such triggers must be dumped and restored to fix the issue.

To check for these issues, execute this command:

```
mysqlcheck -u root -p --all-databases --check-upgrade
```

If `mysqlcheck` reports any errors, correct the issues.

2. There must be no partitioned tables that use a storage engine that does not have native partitioning support. To identify such tables, execute this query:

```
SELECT TABLE_SCHEMA, TABLE_NAME
FROM INFORMATION_SCHEMA.TABLES
WHERE ENGINE NOT IN ('innodb', 'ndbcluster')
AND CREATE_OPTIONS LIKE '%partitioned%';
```

Any table reported by the query must be altered to use `InnoDB` or be made nonpartitioned. To change a table storage engine to `InnoDB`, execute this statement:

```
ALTER TABLE table_name ENGINE = INNODB;
```

For information about converting [MyISAM](#) tables to [InnoDB](#), see [Converting Tables from MyISAM to InnoDB](#).

To make a partitioned table nonpartitioned, execute this statement:

```
ALTER TABLE table_name REMOVE PARTITIONING;
```

3. Some keywords may be reserved in MySQL 8.0 that were not reserved previously. See [Keywords and Reserved Words](#). This can cause words previously used as identifiers to become illegal. To fix affected statements, use identifier quoting. See [Schema Object Names](#).
4. There must be no tables in the MySQL 5.7 `mysql` system database that have the same name as a table used by the MySQL 8.0 data dictionary. To identify tables with those names, execute this query:

```
SELECT TABLE_SCHEMA, TABLE_NAME
FROM INFORMATION_SCHEMA.TABLES
WHERE LOWER(TABLE_SCHEMA) = 'mysql'
and LOWER(TABLE_NAME) IN
(
'catalogs',
'character_sets',
'check_constraints',
'collations',
'column_statistics',
'column_type_elements',
'columns',
'dd_properties',
'events',
'foreign_key_column_usage',
'foreign_keys',
'index_column_usage',
'index_partitions',
'index_stats',
'indexes',
'parameter_type_elements',
'parameters',
'resource_groups',
'routines',
'schemata',
'st_spatial_reference_systems',
'table_partition_values',
'table_partitions',
'table_stats',
'tables',
'tablespace_files',
'tablespace_spaces',
'triggers',
'view_routine_usage',
'view_table_usage'
);
```

Any tables reported by the query must be dropped or renamed (use `RENAME TABLE`). This may also entail changes to applications that use the affected tables.

5. There must be no tables that have foreign key constraint names longer than 64 characters. Use this query to identify tables with constraint names that are too long:

```
SELECT TABLE_SCHEMA, TABLE_NAME
FROM INFORMATION_SCHEMA.TABLES
WHERE TABLE_NAME IN
    (SELECT LEFT(SUBSTR(ID,INSTR(ID,'/')+1),
```

```
INSTR(SUBSTR(ID, INSTR(ID, '/') + 1), '_ibfk_') - 1)
FROM INFORMATION_SCHEMA.INNODB_SYS_FOREIGN
WHERE CHAR_LENGTH(SUBSTR(ID, INSTR(ID, '/') + 1)) > 64);
```

For a table with a constraint name that exceeds 64 characters, drop the constraint and add it back with constraint name that does not exceed 64 characters (use [ALTER TABLE](#)).

6. There must be no obsolete SQL modes defined by [sql_mode](#) system variable. Attempting to use an obsolete SQL mode prevents MySQL 8.0 from starting. Applications that use obsolete SQL modes should be revised to avoid them. For information about SQL modes removed in MySQL 8.0, see [Server Changes](#).
7. There must be no views with explicitly defined columns names that exceed 64 characters (views with column names up to 255 characters were permitted in MySQL 5.7). To avoid upgrade errors, such views should be altered before upgrading. Currently, the only method of identify views with column names that exceed 64 characters is to inspect the view definition using [SHOW CREATE VIEW](#). You can also inspect view definitions by querying the Information Schema [VIEWS](#) table.
8. There must be no tables or stored procedures with individual [ENUM](#) or [SET](#) column elements that exceed 255 characters or 1020 bytes in length. Prior to MySQL 8.0, the maximum combined length of [ENUM](#) or [SET](#) column elements was 64K. In MySQL 8.0, the maximum character length of an individual [ENUM](#) or [SET](#) column element is 255 characters, and the maximum byte length is 1020 bytes. (The 1020 byte limit supports multibyte character sets). Before upgrading to MySQL 8.0, modify any [ENUM](#) or [SET](#) column elements that exceed the new limits. Failing to do so causes the upgrade to fail with an error.
9. Before upgrading to MySQL 8.0.13 or higher, there must be no table partitions that reside in shared [InnoDB](#) tablespaces, which include the system tablespace and general tablespaces. Identify table partitions in shared tablespaces by querying [INFORMATION_SCHEMA](#):

If upgrading from MySQL 5.7, run this query:

```
SELECT DISTINCT NAME, SPACE, SPACE_TYPE FROM INFORMATION_SCHEMA.INNODB_SYS_TABLES
WHERE NAME LIKE '%#P#%' AND SPACE_TYPE NOT LIKE 'Single';
```

If upgrading from an earlier MySQL 8.0 release, run this query:

```
SELECT DISTINCT NAME, SPACE, SPACE_TYPE FROM INFORMATION_SCHEMA.INNODB_TABLES
WHERE NAME LIKE '%#P#%' AND SPACE_TYPE NOT LIKE 'Single';
```

Move table partitions from shared tablespaces to file-per-table tablespaces using [ALTER TABLE ... REORGANIZE PARTITION](#):

```
ALTER TABLE table_name REORGANIZE PARTITION partition_name
INTO (partition_definition TABLESPACE=innodb_file_per_table);
```

10. There must be no queries and stored program definitions from MySQL 8.0.12 or lower that use [ASC](#) or [DESC](#) qualifiers for [GROUP BY](#) clauses. Otherwise, upgrading to MySQL 8.0.13 or higher may fail, as may replicating to MySQL 8.0.13 or higher replica servers. For additional details, see [SQL Changes](#).

11. Your MySQL 5.7 installation must not use features that are not supported by MySQL 8.0. Any changes here are necessarily installation specific, but the following example illustrates the kind of thing to look for:

Some server startup options and system variables have been removed in MySQL 8.0. See [Features Removed in MySQL 8.0](#), and [Server and Status Variables and Options Added, Deprecated, or Removed in MySQL 8.0](#). If you use any of these, an upgrade requires configuration changes.

Example: Because the data dictionary provides information about database objects, the server no longer checks directory names in the data directory to find databases. Consequently, the `--ignore-db-dir` option is extraneous and has been removed. To handle this, remove any instances of `--ignore-db-dir` from your startup configuration. In addition, remove or move the named data directory subdirectories before upgrading to MySQL 8.0. (Alternatively, let the 8.0 server add those directories to the data dictionary as databases, then remove each of those databases using `DROP DATABASE.`)

12. If you intend to change the `lower_case_table_names` setting to 1 at upgrade time, ensure that schema and table names are lowercase before upgrading. Otherwise, a failure could occur due to a schema or table name lettercase mismatch. You can use the following queries to check for schema and table names containing uppercase characters:

```
mysql> select TABLE_NAME, if(sha(TABLE_NAME) !=sha(lower(TABLE_NAME)), 'Yes', 'No') as UpperCase from information
```

As of MySQL 8.0.19, if `lower_case_table_names=1`, table and schema names are checked by the upgrade process to ensure that all characters are lowercase. If table or schema names are found to contain uppercase characters, the upgrade process fails with an error.

Note

Changing the `lower_case_table_names` setting at upgrade time is not recommended.

If upgrade to MySQL 8.0 fails due to any of the issues outlined above, the server reverts all changes to the data directory. In this case, remove all redo log files and restart the MySQL 5.7 server on the existing data directory to address the errors. The redo log files (`ib_logfile*`) reside in the MySQL data directory by default. After the errors are fixed, perform a slow shutdown (by setting `innodb_fast_shutdown=0`) before attempting the upgrade again.

10.7 Upgrading MySQL Binary or Package-based Installations on Unix/Linux

This section describes how to upgrade MySQL binary and package-based installations on Unix/Linux. In-place and logical upgrade methods are described.

- [In-Place Upgrade](#)
- [Logical Upgrade](#)
- [MySQL Cluster Upgrade](#)

In-Place Upgrade

An in-place upgrade involves shutting down the old MySQL server, replacing the old MySQL binaries or packages with the new ones, restarting MySQL on the existing data directory, and upgrading any

remaining parts of the existing installation that require upgrading. For details about what may need upgrading, see [Section 10.4, “What the MySQL Upgrade Process Upgrades”](#).

Note

If you are upgrading an installation originally produced by installing multiple RPM packages, upgrade all the packages, not just some. For example, if you previously installed the server and client RPMs, do not upgrade just the server RPM.

For some Linux platforms, MySQL installation from RPM or Debian packages includes systemd support for managing MySQL server startup and shutdown. On these platforms, `mysqld_safe` is not installed. In such cases, use systemd for server startup and shutdown instead of the methods used in the following instructions. See [Section 7.9, “Managing MySQL Server with systemd”](#).

For upgrades to MySQL Cluster installations, see also [MySQL Cluster Upgrade](#).

To perform an in-place upgrade:

1. Review the information in [Section 10.1, “Before You Begin”](#).
2. Ensure the upgrade readiness of your installation by completing the preliminary checks in [Section 10.6, “Preparing Your Installation for Upgrade”](#).
3. If you use XA transactions with [InnoDB](#), run `XA RECOVER` before upgrading to check for uncommitted XA transactions. If results are returned, either commit or rollback the XA transactions by issuing an `XA COMMIT` or `XA ROLLBACK` statement.
4. If you are upgrading from MySQL 5.7.11 or earlier to MySQL 8.0, and there are encrypted [InnoDB](#) tablespaces, rotate the keyring master key by executing this statement:

```
ALTER INSTANCE ROTATE INNODB MASTER KEY;
```

5. If you normally run your MySQL server configured with `innodb_fast_shutdown` set to 2 (cold shutdown), configure it to perform a fast or slow shutdown by executing either of these statements:

```
SET GLOBAL innodb_fast_shutdown = 1; -- fast shutdown
SET GLOBAL innodb_fast_shutdown = 0; -- slow shutdown
```

With a fast or slow shutdown, [InnoDB](#) leaves its undo logs and data files in a state that can be dealt with in case of file format differences between releases.

6. Shut down the old MySQL server. For example:

```
mysqladmin -u root -p shutdown
```

7. Upgrade the MySQL binaries or packages. If upgrading a binary installation, unpack the new MySQL binary distribution package. See [Obtain and Unpack the Distribution](#). For package-based installations, install the new packages.
8. Start the MySQL 8.0 server, using the existing data directory. For example:

```
mysqld_safe --user=mysql --datadir=/path/to/existing-datadir &
```

If there are encrypted [InnoDB](#) tablespaces, use the `--early-plugin-load` option to load the keyring plugin.

When you start the MySQL 8.0 server, it automatically detects whether data dictionary tables are present. If not, the server creates them in the data directory, populates them with metadata, and then proceeds with its normal startup sequence. During this process, the server upgrades metadata for

all database objects, including databases, tablespaces, system and user tables, views, and stored programs (stored procedures and functions, triggers, and Event Scheduler events). The server also removes files that previously were used for metadata storage. For example, after upgrading from MySQL 5.7 to MySQL 8.0, you may notice that tables no longer have `.frm` files.

If this step fails, the server reverts all changes to the data directory. In this case, you should remove all redo log files, start your MySQL 5.7 server on the same data directory, and fix the cause of any errors. Then perform another slow shutdown of the 5.7 server and start the MySQL 8.0 server to try again.

9. In the previous step, the server upgrades the data dictionary as necessary. Now it is necessary to perform any remaining upgrade operations:
 - As of MySQL 8.0.16, the server does so as part of the previous step, making any changes required in the `mysql` system database between MySQL 5.7 and MySQL 8.0, so that you can take advantage of new privileges or capabilities. It also brings the Performance Schema, `INFORMATION_SCHEMA`, and `sys` databases up to date for MySQL 8.0, and examines all user databases for incompatibilities with the current version of MySQL.
 - Prior to MySQL 8.0.16, the server upgrades only the data dictionary in the previous step. After the MySQL 8.0 server starts successfully, execute `mysql_upgrade` to perform the remaining upgrade tasks:

```
mysql_upgrade -u root -p
```

Then shut down and restart the MySQL server to ensure that any changes made to the system tables take effect. For example:

```
mysqldadmin -u root -p shutdown  
mysqld_safe --user=mysql --datadir=/path/to/existing-datadir &
```

The first time you start the MySQL 8.0 server (in an earlier step), you may notice messages in the error log regarding nonupgraded tables. If `mysql_upgrade` has been run successfully, there should be no such messages the second time you start the server.

Note

The upgrade process does not upgrade the contents of the time zone tables. For upgrade instructions, see [MySQL Server Time Zone Support](#).

If the upgrade process uses `mysql_upgrade` (that is, prior to MySQL 8.0.16), the process does not upgrade the contents of the help tables, either. For upgrade instructions in that case, see [Server-Side Help Support](#).

Logical Upgrade

A logical upgrade involves exporting SQL from the old MySQL instance using a backup or export utility such as `mysqldump` or `mysqlpump`, installing the new MySQL server, and applying the SQL to your new MySQL instance. For details about what may need upgrading, see [Section 10.4, “What the MySQL Upgrade Process Upgrades”](#).

Note

For some Linux platforms, MySQL installation from RPM or Debian packages includes `systemd` support for managing MySQL server startup and shutdown. On these platforms, `mysqld_safe` is not installed. In such cases, use `systemd` for server startup and shutdown instead of the methods used in the following instructions. See [Section 7.9, “Managing MySQL Server with systemd”](#).

Warning

Applying SQL extracted from a previous MySQL release to a new MySQL release may result in errors due to incompatibilities introduced by new, changed, deprecated, or removed features and capabilities. Consequently, SQL extracted from a previous MySQL release may require modification to enable a logical upgrade.

To identify incompatibilities before upgrading to the latest MySQL 8.0 release, perform the steps described in [Section 10.6, “Preparing Your Installation for Upgrade”](#).

To perform a logical upgrade:

1. Review the information in [Section 10.1, “Before You Begin”](#).
2. Export your existing data from the previous MySQL installation:

```
mysqldump -u root -p
--add-drop-table --routines --events
--all-databases --force > data-for-upgrade.sql
```

Note

Use the `--routines` and `--events` options with `mysqldump` (as shown above) if your databases include stored programs. The `--all-databases` option includes all databases in the dump, including the `mysql` database that holds the system tables.

Important

If you have tables that contain generated columns, use the `mysqldump` utility provided with MySQL 5.7.9 or higher to create your dump files. The `mysqldump` utility provided in earlier releases uses incorrect syntax for generated column definitions (Bug #20769542). You can use the Information Schema `COLUMNS` table to identify tables with generated columns.

3. Shut down the old MySQL server. For example:

```
mysqladmin -u root -p shutdown
```

4. Install MySQL 8.0. For installation instructions, see [Chapter 1, *Installing MySQL*](#).
5. Initialize a new data directory, as described in [Section 9.1, “Initializing the Data Directory”](#). For example:

```
mysqld --initialize --datadir=/path/to/8.0-datadir
```

Copy the temporary '`root`'@'`localhost`' password displayed to your screen or written to your error log for later use.

6. Start the MySQL 8.0 server, using the new data directory. For example:

```
mysqld_safe --user=mysql --datadir=/path/to/8.0-datadir &
```

7. Reset the `root` password:

```
$> mysql -u root -p
Enter password: **** <- enter temporary root password
```

```
mysql> ALTER USER USER() IDENTIFIED BY 'your new password';
```

8. Load the previously created dump file into the new MySQL server. For example:

```
mysql -u root -p --force < data-for-upgrade.sql
```

Note

It is not recommended to load a dump file when GTIDs are enabled on the server (`gtid_mode=ON`), if your dump file includes system tables. `mysqldump` issues DML instructions for the system tables which use the non-transactional MyISAM storage engine, and this combination is not permitted when GTIDs are enabled. Also be aware that loading a dump file from a server with GTIDs enabled, into another server with GTIDs enabled, causes different transaction identifiers to be generated.

9. Perform any remaining upgrade operations:

- In MySQL 8.0.16 and higher, shut down the server, then restart it with the `--upgrade=FORCE` option to perform the remaining upgrade tasks:

```
mysqladmin -u root -p shutdown
mysqld_safe --user=mysql --datadir=/path/to/8.0-datadir --upgrade=FORCE &
```

Upon restart with `--upgrade=FORCE`, the server makes any changes required in the `mysql` system schema between MySQL 5.7 and MySQL 8.0, so that you can take advantage of new privileges or capabilities. It also brings the Performance Schema, `INFORMATION_SCHEMA`, and `sys` schema up to date for MySQL 8.0, and examines all user schemas for incompatibilities with the current version of MySQL.

- Prior to MySQL 8.0.16, execute `mysql_upgrade` to perform the remaining upgrade tasks:

```
mysql_upgrade -u root -p
```

Then shut down and restart the MySQL server to ensure that any changes made to the system tables take effect. For example:

```
mysqladmin -u root -p shutdown
mysqld_safe --user=mysql --datadir=/path/to/8.0-datadir &
```

Note

The upgrade process does not upgrade the contents of the time zone tables. For upgrade instructions, see [MySQL Server Time Zone Support](#).

If the upgrade process uses `mysql_upgrade` (that is, prior to MySQL 8.0.16), the process does not upgrade the contents of the help tables, either. For upgrade instructions in that case, see [Server-Side Help Support](#).

Note

Loading a dump file that contains a MySQL 5.7 `mysql` schema re-creates two tables that are no longer used: `event` and `proc`. (The corresponding MySQL 8.0 tables are `events` and `routines`, both of which are data dictionary tables and are protected.) After you are satisfied that the upgrade was successful, you can remove the `event` and `proc` tables by executing these SQL statements:

```
DROP TABLE mysql.event;  
DROP TABLE mysql.proc;
```

MySQL Cluster Upgrade

The information in this section is an adjunct to the in-place upgrade procedure described in [In-Place Upgrade](#), for use if you are upgrading MySQL Cluster.

As of MySQL 8.0.16, a MySQL Cluster upgrade can be performed as a regular rolling upgrade, following the usual three ordered steps:

1. Upgrade MGM nodes.
2. Upgrade data nodes one at a time.
3. Upgrade API nodes one at a time (including MySQL servers).

The way to upgrade each of the nodes remains almost the same as prior to MySQL 8.0.16 because there is a separation between upgrading the data dictionary and upgrading the system tables. There are two steps to upgrading each individual `mysqld`:

1. Import the data dictionary.

Start the new server with the `--upgrade=MINIMAL` option to upgrade the data dictionary but not the system tables. This is essentially the same as the pre-MySQL 8.0.16 action of starting the server and not invoking `mysql_upgrade`.

The MySQL server must be connected to `NDB` for this phase to complete. If any `NDB` or `NDBINFO` tables exist, and the server cannot connect to the cluster, it exits with an error message:

```
Failed to Populate DD tables.
```

2. Upgrade the system tables.

Prior to MySQL 8.0.16, the DBA invokes the `mysql_upgrade` client to upgrade the system tables. As of MySQL 8.0.16, the server performs this action: To upgrade the system tables, restart each individual `mysqld` without the `--upgrade=MINIMAL` option.

10.8 Upgrading MySQL with the MySQL Yum Repository

For supported Yum-based platforms (see [Section 7.1](#), “Installing MySQL on Linux Using the MySQL Yum Repository”, for a list), you can perform an in-place upgrade for MySQL (that is, replacing the old version and then running the new version using the old data files) with the MySQL Yum repository.

Notes

- Before performing any update to MySQL, follow carefully the instructions in [Chapter 10, Upgrading MySQL](#). Among other instructions discussed there, it is especially important to back up your database before the update.
- The following instructions assume you have installed MySQL with the MySQL Yum repository or with an RPM package directly downloaded from [MySQL Developer Zone's MySQL Download page](#); if that is not the case, following the instructions in [Replacing a Third-Party Distribution of MySQL Using the MySQL Yum Repository](#).

Selecting a Target Series

By default, the MySQL Yum repository updates MySQL to the latest version in the release series you have chosen during installation (see [Selecting a Release Series](#) for details), which means, for example, a 5.7.x installation is *not* updated to a 8.0.x release automatically. To update to another release series, you must first disable the subrepository for the series that has been selected (by default, or by yourself) and enable the subrepository for your target series. To do that, see the general instructions given in [Selecting a Release Series](#). For upgrading from MySQL 5.7 to 8.0, perform the *reverse* of the steps illustrated in [Selecting a Release Series](#), disabling the subrepository for the MySQL 5.7 series and enabling that for the MySQL 8.0 series.

As a general rule, to upgrade from one release series to another, go to the next series rather than skipping a series. For example, if you are currently running MySQL 5.6 and wish to upgrade to 8.0, upgrade to MySQL 5.7 first before upgrading to 8.0.

Important

For important information about upgrading from MySQL 5.7 to 8.0, see [Upgrading from MySQL 5.7 to 8.0](#).

Upgrading MySQL

Upgrade MySQL and its components by the following command, for platforms that are not dnf-enabled:

```
sudo yum update mysql-server
```

For platforms that are dnf-enabled:

```
sudo dnf upgrade mysql-server
```

Alternatively, you can update MySQL by telling Yum to update everything on your system, which might take considerably more time. For platforms that are not dnf-enabled:

```
sudo yum update
```

For platforms that are dnf-enabled:

```
sudo dnf upgrade
```

Restarting MySQL

The MySQL server always restarts after an update by Yum. Prior to MySQL 8.0.16, run [mysql_upgrade](#) after the server restarts to check and possibly resolve any incompatibilities between the old data and the upgraded software. [mysql_upgrade](#) also performs other functions; for details, see [mysql_upgrade — Check and Upgrade MySQL Tables](#). As of MySQL 8.0.16, this step is not required, as the server performs all tasks previously handled by [mysql_upgrade](#).

You can also update only a specific component. Use the following command to list all the installed packages for the MySQL components (for dnf-enabled systems, replace [yum](#) in the command with [dnf](#)):

```
sudo yum list installed | grep "^mysql"
```

After identifying the package name of the component of your choice, update the package with the following command, replacing [package-name](#) with the name of the package. For platforms that are not dnf-enabled:

```
sudo yum update package-name
```

For dnf-enabled platforms:

```
sudo dnf upgrade package-name
```

Upgrading the Shared Client Libraries

After updating MySQL using the Yum repository, applications compiled with older versions of the shared client libraries should continue to work.

If you recompile applications and dynamically link them with the updated libraries: As typical with new versions of shared libraries where there are differences or additions in symbol versioning between the newer and older libraries (for example, between the newer, standard 8.0 shared client libraries and some older—prior or variant—versions of the shared libraries shipped natively by the Linux distributions' software repositories, or from some other sources), any applications compiled using the updated, newer shared libraries require those updated libraries on systems where the applications are deployed. As expected, if those libraries are not in place, the applications requiring the shared libraries fail. For this reason, be sure to deploy the packages for the shared libraries from MySQL on those systems. To do this, add the MySQL Yum repository to the systems (see [Adding the MySQL Yum Repository](#)) and install the latest shared libraries using the instructions given in [Installing Additional MySQL Products and Components with Yum](#).

10.9 Upgrading MySQL with the MySQL APT Repository

On Debian and Ubuntu platforms, to perform an in-place upgrade of MySQL and its components, use the MySQL APT repository. See [Upgrading MySQL with the MySQL APT Repository](#) in [A Quick Guide to Using the MySQL APT Repository](#).

10.10 Upgrading MySQL with the MySQL SLES Repository

On the SUSE Linux Enterprise Server (SLES) platform, to perform an in-place upgrade of MySQL and its components, use the MySQL SLES repository. See [Upgrading MySQL with the MySQL SLES Repository](#) in [A Quick Guide to Using the MySQL SLES Repository](#).

10.11 Upgrading MySQL on Windows

There are two approaches for upgrading MySQL on Windows:

- [Using MySQL Installer](#)
- [Using the Windows ZIP archive distribution](#)

The approach you select depends on how the existing installation was performed. Before proceeding, review [Chapter 10, Upgrading MySQL](#) for additional information on upgrading MySQL that is not specific to Windows.

Note

Whichever approach you choose, always back up your current MySQL installation before performing an upgrade. See [Database Backup Methods](#).

Upgrades between non-GA releases (or from a non-GA release to a GA release) are not supported. Significant development changes take place in non-GA releases and you may encounter compatibility issues or problems starting the server.

Note

MySQL Installer does not support upgrades between *Community* releases and *Commercial* releases. If you require this type of upgrade, perform it using the [ZIP archive](#) approach.

Upgrading MySQL with MySQL Installer

Performing an upgrade with MySQL Installer is the best approach when the current server installation was performed with it and the upgrade is within the current release series. MySQL Installer does not support upgrades between release series, such as from 5.7 to 8.0, and it does not provide an upgrade indicator to prompt you to upgrade. For instructions on upgrading between release series, see [Upgrading MySQL Using the Windows ZIP Distribution](#).

To perform an upgrade using MySQL Installer:

1. Start MySQL Installer.
2. From the dashboard, click **Catalog** to download the latest changes to the catalog. The installed server can be upgraded only if the dashboard displays an arrow next to the version number of the server.
3. Click **Upgrade**. All products that have a newer version now appear in a list.

Note

MySQL Installer deselects the server upgrade option for milestone releases (Pre-Release) in the same release series. In addition, it displays a warning to indicate that the upgrade is not supported, identifies the risks of continuing, and provides a summary of the steps to perform an upgrade manually. You can reselect server upgrade and proceed at your own risk.

4. Deselect all but the MySQL server product, unless you intend to upgrade other products at this time, and click **Next**.
5. Click **Execute** to start the download. When the download finishes, click **Next** to begin the upgrade operation.

Upgrades to MySQL 8.0.16 and higher may show an option to skip the upgrade check and process for system tables. For more information about this option, see [Important server upgrade conditions](#).

6. Configure the server.

Upgrading MySQL Using the Windows ZIP Distribution

To perform an upgrade using the Windows ZIP archive distribution:

1. Download the latest Windows ZIP Archive distribution of MySQL from <https://dev.mysql.com/downloads/>.
2. If the server is running, stop it. If the server is installed as a service, stop the service with the following command from the command prompt:

```
C:\> SC STOP mysql_d_service_name
```

Alternatively, use `NET STOP mysql_d_service_name`.

If you are not running the MySQL server as a service, use `mysqladmin` to stop it. For example, before upgrading from MySQL 5.7 to 8.0, use `mysqladmin` from MySQL 5.7 as follows:

```
C:\> "C:\Program Files\MySQL\MySQL Server 5.7\bin\mysqladmin" -u root shutdown
```

Note

If the MySQL `root` user account has a password, invoke `mysqladmin` with the `-p` option and enter the password when prompted.

3. Extract the ZIP archive. You may either overwrite your existing MySQL installation (usually located at `C:\mysql`), or install it into a different directory, such as `C:\mysql8`. Overwriting the existing installation is recommended.
4. Restart the server. For example, use the `SC START mysql_d_service_name` or `NET START mysql_d_service_name` command if you run MySQL as a service, or invoke `mysqld` directly otherwise.
5. Prior to MySQL 8.0.16, run `mysql_upgrade` as Administrator to check your tables, attempt to repair them if necessary, and update your grant tables if they have changed so that you can take advantage of any new capabilities. See [mysql_upgrade — Check and Upgrade MySQL Tables](#). As of MySQL 8.0.16, this step is not required, as the server performs all tasks previously handled by `mysql_upgrade`.
6. If you encounter errors, see [Section 5.5, “Troubleshooting a Microsoft Windows MySQL Server Installation”](#).

10.12 Upgrading a Docker Installation of MySQL

To upgrade a Docker installation of MySQL, refer to [Upgrading a MySQL Server Container](#).

10.13 Upgrade Troubleshooting

- A schema mismatch in a MySQL 5.7 instance between the `.frm` file of a table and the `InnoDB` data dictionary can cause an upgrade to MySQL 8.0 to fail. Such mismatches may be due to `.frm` file corruption. To address this issue, dump and restore affected tables before attempting the upgrade again.
- If problems occur, such as that the new `mysqld` server does not start, verify that you do not have an old `my.cnf` file from your previous installation. You can check this with the `--print-defaults` option (for example, `mysqld --print-defaults`). If this command displays anything other than the program name, you have an active `my.cnf` file that affects server or client operation.
- If, after an upgrade, you experience problems with compiled client programs, such as `Commands out of sync` or unexpected core dumps, you probably have used old header or library files when compiling your programs. In this case, check the date for your `mysql.h` file and `libmysqlclient.a` library to verify that they are from the new MySQL distribution. If not, recompile your programs with the new headers and libraries. Recompilation might also be necessary for programs compiled against the shared client library if the library major version number has changed (for example, from `libmysqlclient.so.20` to `libmysqlclient.so.21`).
- If you have created a loadable function with a given name and upgrade MySQL to a version that implements a new built-in function with the same name, the loadable function becomes inaccessible. To correct this, use `DROP FUNCTION` to drop the loadable function, and then use `CREATE FUNCTION` to re-create the loadable function with a different nonconflicting name. The same is true if the new version of

MySQL implements a built-in function with the same name as an existing stored function. See [Function Name Parsing and Resolution](#), for the rules describing how the server interprets references to different kinds of functions.

- If upgrade to MySQL 8.0 fails due to any of the issues outlined in [Section 10.6, “Preparing Your Installation for Upgrade”](#), the server reverts all changes to the data directory. In this case, remove all redo log files and restart the MySQL 5.7 server on the existing data directory to address the errors. The redo log files (`ib_logfile*`) reside in the MySQL data directory by default. After the errors are fixed, perform a slow shutdown (by setting `innodb_fast_shutdown=0`) before attempting the upgrade again.

10.14 Rebuilding or Repairing Tables or Indexes

This section describes how to rebuild or repair tables or indexes, which may be necessitated by:

- Changes to how MySQL handles data types or character sets. For example, an error in a collation might have been corrected, necessitating a table rebuild to update the indexes for character columns that use the collation.
- Required table repairs or upgrades reported by `CHECK TABLE`, `mysqlcheck`, or `mysql_upgrade`.

Methods for rebuilding a table include:

- [Dump and Reload Method](#)
- [ALTER TABLE Method](#)
- [REPAIR TABLE Method](#)

Dump and Reload Method

If you are rebuilding tables because a different version of MySQL cannot handle them after a binary (in-place) upgrade or downgrade, you must use the dump-and-reload method. Dump the tables *before* upgrading or downgrading using your original version of MySQL. Then reload the tables *after* upgrading or downgrading.

If you use the dump-and-reload method of rebuilding tables only for the purpose of rebuilding indexes, you can perform the dump either before or after upgrading or downgrading. Reloading still must be done afterward.

If you need to rebuild an `InnoDB` table because a `CHECK TABLE` operation indicates that a table upgrade is required, use `mysqldump` to create a dump file and `mysql` to reload the file. If the `CHECK TABLE` operation indicates that there is a corruption or causes `InnoDB` to fail, refer to [Forcing InnoDB Recovery](#) for information about using the `innodb_force_recovery` option to restart `InnoDB`. To understand the type of problem that `CHECK TABLE` may be encountering, refer to the `InnoDB` notes in [CHECK TABLE Statement](#).

To rebuild a table by dumping and reloading it, use `mysqldump` to create a dump file and `mysql` to reload the file:

```
mysqldump db_name t1 > dump.sql
mysql db_name < dump.sql
```

To rebuild all the tables in a single database, specify the database name without any following table name:

```
mysqldump db_name > dump.sql
mysql db_name < dump.sql
```

To rebuild all tables in all databases, use the `--all-databases` option:

```
mysqldump --all-databases > dump.sql
mysql < dump.sql
```

ALTER TABLE Method

To rebuild a table with `ALTER TABLE`, use a “null” alteration; that is, an `ALTER TABLE` statement that “changes” the table to use the storage engine that it already has. For example, if `t1` is an `InnoDB` table, use this statement:

```
ALTER TABLE t1 ENGINE = InnoDB;
```

If you are not sure which storage engine to specify in the `ALTER TABLE` statement, use `SHOW CREATE TABLE` to display the table definition.

REPAIR TABLE Method

The `REPAIR TABLE` method is only applicable to `MyISAM`, `ARCHIVE`, and `CSV` tables.

You can use `REPAIR TABLE` if the table checking operation indicates that there is a corruption or that an upgrade is required. For example, to repair a `MyISAM` table, use this statement:

```
REPAIR TABLE t1;
```

`mysqlcheck --repair` provides command-line access to the `REPAIR TABLE` statement. This can be a more convenient means of repairing tables because you can use the `--databases` or `--all-databases` option to repair all tables in specific databases or all databases, respectively:

```
mysqlcheck --repair --databases db_name ...
mysqlcheck --repair --all-databases
```

10.15 Copying MySQL Databases to Another Machine

In cases where you need to transfer databases between different architectures, you can use `mysqldump` to create a file containing SQL statements. You can then transfer the file to the other machine and feed it as input to the `mysql` client.

Use `mysqldump --help` to see what options are available.

Note

If GTIDs are in use on the server where you create the dump (`gtid_mode=ON`), by default, `mysqldump` includes the contents of the `gtid_executed` set in the dump to transfer these to the new machine. The results of this can vary depending on the MySQL Server versions involved. Check the description for `mysqldump's --set-gtid-purged` option to find what happens with the versions you are using, and how to change the behavior if the outcome of the default behavior is not suitable for your situation.

The easiest (although not the fastest) way to move a database between two machines is to run the following commands on the machine on which the database is located:

```
mysqladmin -h 'other_hostname' create db_name
mysqldump db_name | mysql -h 'other_hostname' db_name
```

If you want to copy a database from a remote machine over a slow network, you can use these commands:

```
mysqladmin create db_name
mysqldump -h 'other_hostname' --compress db_name | mysql db_name
```

You can also store the dump in a file, transfer the file to the target machine, and then load the file into the database there. For example, you can dump a database to a compressed file on the source machine like this:

```
mysqldump --quick db_name | gzip > db_name.gz
```

Transfer the file containing the database contents to the target machine and run these commands there:

```
mysqladmin create db_name
gunzip < db_name.gz | mysql db_name
```

You can also use `mysqldump` and `mysqlimport` to transfer the database. For large tables, this is much faster than simply using `mysqldump`. In the following commands, `DUMPDIR` represents the full path name of the directory you use to store the output from `mysqldump`.

First, create the directory for the output files and dump the database:

```
mkdir DUMPDIR
mysqldump --tab=DUMPDIR
db_name
```

Then transfer the files in the `DUMPDIR` directory to some corresponding directory on the target machine and load the files into MySQL there:

```
mysqladmin create db_name          # create database
cat DUMPDIR/*.sql | mysql db_name  # create tables in database
mysqlimport db_name
DUMPDIR/*.txt                     # load data into tables
```

Do not forget to copy the `mysql` database because that is where the grant tables are stored. You might have to run commands as the MySQL `root` user on the new machine until you have the `mysql` database in place.

After you import the `mysql` database on the new machine, execute `mysqladmin flush-privileges` so that the server reloads the grant table information.

Chapter 11 Downgrading MySQL

Downgrade from MySQL 8.0 to MySQL 5.7, or from a MySQL 8.0 release to a previous MySQL 8.0 release, is not supported. The only supported alternative is to restore a backup taken *before* upgrading. It is therefore imperative that you back up your data before starting the upgrade process.

Chapter 12 Environment Variables

This section lists environment variables that are used directly or indirectly by MySQL. Most of these can also be found in other places in this manual.

Options on the command line take precedence over values specified in option files and environment variables, and values in option files take precedence over values in environment variables. In many cases, it is preferable to use an option file instead of environment variables to modify the behavior of MySQL. See [Using Option Files](#).

Variable	Description
<code>AUTHENTICATION_KERBEROS_CLIENT_LOG</code>	Kerberos authentication logging level.
<code>AUTHENTICATION_LDAP_CLIENT_LOG</code>	Client-side LDAP authentication logging level.
<code>AUTHENTICATION_PAM_LOG</code>	PAM authentication plugin debug logging settings.
<code>CC</code>	The name of your C compiler (for running CMake).
<code>CXX</code>	The name of your C++ compiler (for running CMake).
<code>CC</code>	The name of your C compiler (for running CMake).
<code>DBI_USER</code>	The default user name for Perl DBI.
<code>DBI_TRACE</code>	Trace options for Perl DBI.
<code>HOME</code>	The default path for the <code>mysql</code> history file is <code>\$HOME/.mysql_history</code> .
<code>LD_RUN_PATH</code>	Used to specify the location of <code>libmysqlclient.so</code> .
<code>LIBMYSQL_ENABLE_CLEARTEXT_PLUGIN</code>	Enable <code>mysql_clear_password</code> authentication plugin; see Client-Side Cleartext Pluggable Authentication .
<code>LIBMYSQL_PLUGIN_DIR</code>	Directory in which to look for client plugins.
<code>LIBMYSQL_PLUGINS</code>	Client plugins to preload.
<code>MYSQL_DEBUG</code>	Debug trace options when debugging.
<code>MYSQL_GROUP_SUFFIX</code>	Option group suffix value (like specifying <code>--defaults-group-suffix</code>).
<code>MYSQL_HISTFILE</code>	The path to the <code>mysql</code> history file. If this variable is set, its value overrides the default for <code>\$HOME/.mysql_history</code> .
<code>MYSQL_HISTIGNORE</code>	Patterns specifying statements that <code>mysql</code> should not log to <code>\$HOME/.mysql_history</code> , or <code>syslog</code> if <code>--syslog</code> is given.
<code>MYSQL_HOME</code>	The path to the directory in which the server-specific <code>my.cnf</code> file resides.
<code>MYSQL_HOST</code>	The default host name used by the <code>mysql</code> command-line client.
<code>MYSQL_OPENSSL_UDF_DH_BITS_THRESHOLD</code>	Maximum key length for <code>create_dh_parameters()</code> . See MySQL Enterprise Encryption Usage and Examples .

Variable	Description
<code>MYSQL_OPENSSL_UDF_DSA_BITS_THRESHOLD</code>	Maximum DSA key length for <code>create_asymmetric_priv_key()</code> . See MySQL Enterprise Encryption Usage and Examples .
<code>MYSQL_OPENSSL_UDF_RSA_BITS_THRESHOLD</code>	Maximum RSA key length for <code>create_asymmetric_priv_key()</code> . See MySQL Enterprise Encryption Usage and Examples .
<code>MYSQL_PS1</code>	The command prompt to use in the <code>mysql</code> command-line client.
<code>MYSQL_PWD</code>	The default password when connecting to <code>mysqld</code> . Using this is insecure. See note following table.
<code>MYSQL_TCP_PORT</code>	The default TCP/IP port number.
<code>MYSQL_TEST_LOGIN_FILE</code>	The name of the <code>.mylogin.cnf</code> login path file.
<code>MYSQL_TEST_TRACE_CRASH</code>	Whether the test protocol trace plugin crashes clients. See note following table.
<code>MYSQL_TEST_TRACE_DEBUG</code>	Whether the test protocol trace plugin produces output. See note following table.
<code>MYSQL_UNIX_PORT</code>	The default Unix socket file name; used for connections to <code>localhost</code> .
<code>MYSQLX_TCP_PORT</code>	The X Plugin default TCP/IP port number.
<code>MYSQLX_UNIX_PORT</code>	The X Plugin default Unix socket file name; used for connections to <code>localhost</code> .
<code>NOTIFY_SOCKET</code>	Socket used by <code>mysqld</code> to communicate with <code>systemd</code> .
<code>PATH</code>	Used by the shell to find MySQL programs.
<code>PKG_CONFIG_PATH</code>	Location of <code>mysqlclient.pc</code> <code>pkg-config</code> file. See note following table.
<code>TMPDIR</code>	The directory in which temporary files are created.
<code>TZ</code>	This should be set to your local time zone. See Time Zone Problems .
<code>UMASK</code>	The user-file creation mode when creating files. See note following table.
<code>UMASK_DIR</code>	The user-directory creation mode when creating directories. See note following table.
<code>USER</code>	The default user name on Windows when connecting to <code>mysqld</code> .

For information about the `mysql` history file, see [mysql Client Logging](#).

Use of `MYSQL_PWD` to specify a MySQL password must be considered *extremely insecure* and should not be used. Some versions of `ps` include an option to display the environment of running processes. On some systems, if you set `MYSQL_PWD`, your password is exposed to any other user who runs `ps`. Even on systems without such a version of `ps`, it is unwise to assume that there are no other methods by which users can examine process environments.

`MYSQL_PWD` is deprecated as of MySQL 8.0; expect it to be removed in a future version of MySQL.

`MYSQL_TEST_LOGIN_FILE` is the path name of the login path file (the file created by `mysql_config_editor`). If not set, the default value is `%APPDATA%\MySQL\mylogin.cnf` directory on Windows and `$HOME/.mylogin.cnf` on non-Windows systems. See [mysql_config_editor — MySQL Configuration Utility](#).

The `MYSQL_TEST_TRACE_DEBUG` and `MYSQL_TEST_TRACE_CRASH` variables control the test protocol trace client plugin, if MySQL is built with that plugin enabled. For more information, see [Using the Test Protocol Trace Plugin](#).

The default `UMASK` and `UMASK_DIR` values are `0640` and `0750`, respectively. MySQL assumes that the value for `UMASK` or `UMASK_DIR` is in octal if it starts with a zero. For example, setting `UMASK=0600` is equivalent to `UMASK=384` because `0600` octal is `384` decimal.

The `UMASK` and `UMASK_DIR` variables, despite their names, are used as modes, not masks:

- If `UMASK` is set, `mysqld` uses `($UMASK | 0600)` as the mode for file creation, so that newly created files have a mode in the range from `0600` to `0666` (all values octal).
- If `UMASK_DIR` is set, `mysqld` uses `($UMASK_DIR | 0700)` as the base mode for directory creation, which then is AND-ed with `~(~$UMASK & 0666)`, so that newly created directories have a mode in the range from `0700` to `0777` (all values octal). The AND operation may remove read and write permissions from the directory mode, but not execute permissions.

See also [Problems with File Permissions](#).

It may be necessary to set `PKG_CONFIG_PATH` if you use `pkg-config` for building MySQL programs. See [Building C API Client Programs Using pkg-config](#).

Chapter 13 Perl Installation Notes

Table of Contents

13.1 Installing Perl on Unix	245
13.2 Installing ActiveState Perl on Windows	246
13.3 Problems Using the Perl DBI/DBD Interface	246

The Perl `DBI` module provides a generic interface for database access. You can write a `DBI` script that works with many different database engines without change. To use `DBI`, you must install the `DBI` module, as well as a DataBase Driver (DBD) module for each type of database server you want to access. For MySQL, this driver is the `DBD::mysql` module.

Note

Perl support is not included with MySQL distributions. You can obtain the necessary modules from <http://search.cpan.org> for Unix, or by using the ActiveState `ppm` program on Windows. The following sections describe how to do this.

The `DBI/DBD` interface requires Perl 5.6.0, and 5.6.1 or later is preferred. `DBI` *does not work* if you have an older version of Perl. You should use `DBD::mysql` 4.009 or higher. Although earlier versions are available, they do not support the full functionality of MySQL 8.0.

13.1 Installing Perl on Unix

MySQL Perl support requires that you have installed MySQL client programming support (libraries and header files). Most installation methods install the necessary files. If you install MySQL from RPM files on Linux, be sure to install the developer RPM as well. The client programs are in the client RPM, but client programming support is in the developer RPM.

The files you need for Perl support can be obtained from the CPAN (Comprehensive Perl Archive Network) at <http://search.cpan.org>.

The easiest way to install Perl modules on Unix is to use the `CPAN` module. For example:

```
$> perl -MCPAN -e shell
cpan> install DBI
cpan> install DBD::mysql
```

The `DBD::mysql` installation runs a number of tests. These tests attempt to connect to the local MySQL server using the default user name and password. (The default user name is your login name on Unix, and `ODBC` on Windows. The default password is “no password.”) If you cannot connect to the server with those values (for example, if your account has a password), the tests fail. You can use `force install DBD::mysql` to ignore the failed tests.

`DBI` requires the `Data::Dumper` module. It may be installed; if not, you should install it before installing `DBI`.

It is also possible to download the module distributions in the form of compressed `tar` archives and build the modules manually. For example, to unpack and build a `DBI` distribution, use a procedure such as this:

1. Unpack the distribution into the current directory:

```
$> gunzip < DBI-VERSION.tar.gz | tar xvf -
```

This command creates a directory named `DBI-VERSION`.

2. Change location into the top-level directory of the unpacked distribution:

```
$> cd DBI-VERSION
```

3. Build the distribution and compile everything:

```
$> perl Makefile.PL
$> make
$> make test
$> make install
```

The `make test` command is important because it verifies that the module is working. Note that when you run that command during the `DBD:mysql` installation to exercise the interface code, the MySQL server must be running or the test fails.

It is a good idea to rebuild and reinstall the `DBD:mysql` distribution whenever you install a new release of MySQL. This ensures that the latest versions of the MySQL client libraries are installed correctly.

If you do not have access rights to install Perl modules in the system directory or if you want to install local Perl modules, the following reference may be useful: <http://learn.perl.org/faq/perlfaq8.html#How-do-I-keep-my-own-module-library-directory->

13.2 Installing ActiveState Perl on Windows

On Windows, you should do the following to install the MySQL `DBD` module with ActiveState Perl:

1. Get ActiveState Perl from <http://www.activestate.com/Products/ActivePerl/> and install it.
2. Open a console window.
3. If necessary, set the `HTTP_proxy` variable. For example, you might try a setting like this:

```
C:\> set HTTP_proxy=my.proxy.com:3128
```

4. Start the PPM program:

```
C:\> C:\perl\bin\ppm.pl
```

5. If you have not previously done so, install `DBI`:

```
ppm> install DBI
```

6. If this succeeds, run the following command:

```
ppm> install DBD-mysql
```

This procedure should work with ActiveState Perl 5.6 or higher.

If you cannot get the procedure to work, you should install the ODBC driver instead and connect to the MySQL server through ODBC:

```
use DBI;
$dbh= DBI->connect("DBI:ODBC:$dsn",$user,$password) ||
die "Got error $DBI::errstr when connecting to $dsn\n";
```

13.3 Problems Using the Perl DBI/DBD Interface

If Perl reports that it cannot find the `../mysql/mysql.so` module, the problem is probably that Perl cannot locate the `libmysqlclient.so` shared library. You should be able to fix this problem by one of the following methods:

- Copy `libmysqlclient.so` to the directory where your other shared libraries are located (probably `/usr/lib` or `/lib`).
- Modify the `-L` options used to compile `DBD:mysql` to reflect the actual location of `libmysqlclient.so`.
- On Linux, you can add the path name of the directory where `libmysqlclient.so` is located to the `/etc/ld.so.conf` file.
- Add the path name of the directory where `libmysqlclient.so` is located to the `LD_RUN_PATH` environment variable. Some systems use `LD_LIBRARY_PATH` instead.

Note that you may also need to modify the `-L` options if there are other libraries that the linker fails to find. For example, if the linker cannot find `libc` because it is in `/lib` and the link command specifies `-L/usr/lib`, change the `-L` option to `-L/lib` or add `-L/lib` to the existing link command.

If you get the following errors from `DBD:mysql`, you are probably using `gcc` (or using an old binary compiled with `gcc`):

```
/usr/bin/perl: can't resolve symbol '__moddi3'
/usr/bin/perl: can't resolve symbol '__divdi3'
```

Add `-L/usr/lib/gcc-lib/... -lgcc` to the link command when the `mysql.so` library gets built (check the output from `make` for `mysql.so` when you compile the Perl client). The `-L` option should specify the path name of the directory where `libgcc.a` is located on your system.

Another cause of this problem may be that Perl and MySQL are not both compiled with `gcc`. In this case, you can solve the mismatch by compiling both with `gcc`.

