



VWorks Automation Control 14.1

Functional Design Specification

Notices

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1 Introduction

This chapter provides an introduction to this document and the VWorks 14.1 software.

The topics are:

- [“About this document” on page 2](#)
- [“Software overview” on page 3](#)
- [“Supported devices” on page 4](#)
- [“User information access” on page 5](#)

About this document

VWorks Automation Control 14.1 is integrated with OpenLab ECM XT 2.6, which is described in the [OpenLab Server 2.6/OpenLab ECM XT 2.6 Functional Design Specification](#). This VWorks software 14.1 specification provides descriptions of the core functions provided by VWorks software 14.1. For step-by-step instructions on how to configure and use VWorks software 14.1, see the documents provided in the VWorks 14 Knowledge Base. The primary documents are listed in the following table. For details on how to access these guides, see “[User information access](#)” on page 5.

Figure Documents supporting VWorks and devices that use VWorks

Product	Document
VWorks Automation Control	VWorks Automation Control installation Guide
	VWorks Plus Configuration and Administration Guide
	VWorks Standard Configuration and Administration Guide
	VWorks Plus Quick Reference
	VWorks Standard Quick Reference
	VWorks Automation Control Setup Guide
	VWorks Automation Control User Guide
BenchCel Microplate Handler	VWorks Quick Guide for Protocol Authors
	BenchCel Microplate Handler User Guide
	BenchCel Quick Guide
Bravo Platform	Bravo Platform Safety and Installation Guide
	Bravo Platform Unpacking Guide
	Bravo Platform Quick Guide
	Bravo Platform User Guide
Centrifuge with Loader	Microplate Centrifuge User Guide
	Microplate Centrifuge Quick Guide
	Microplate Centrifuge Unpacking Guide
	Microfuge Centrifuge with Loader User Guide
	Microfuge Centrifuge with Loader Quick Guide
	Microfuge Loader Unpacking Guide
Microplate Labeler	Microplate Labeler User Guide
	Microplate Labeler Quick Guide
Microscan Bar Code Reader	Microscan Barcode Reader Device Driver Guide

Product	Document
Labware MiniHub	Labware MiniHub Safety and Installation Guide
	Labware MiniHub User Guide
	Labware MiniHub Quick Guide
PlateLoc Sealer	PlateLoc Sealer User Guide
	PlateLoc Sealer Quick Guide
Pump Module	Pump Module and Accessories User Guide
BioTek Liquid Handlers	BioTek Liquid Handler Device Driver Guide
BioTek Reader	BioTek Gen5 Reader Device Driver Guide

Software overview

VWorks 14.1 runs on a single computer and controls standalone automation devices or integrated automation devices in a laboratory automation workstation. The software is available as compliance-enabled and standard editions, VWorks Plus and VWorks Standard respectively. VWorks Plus supports compliance with Part 11 of Title 21 of the Code of Federal Regulations (21 CFR Part 11).

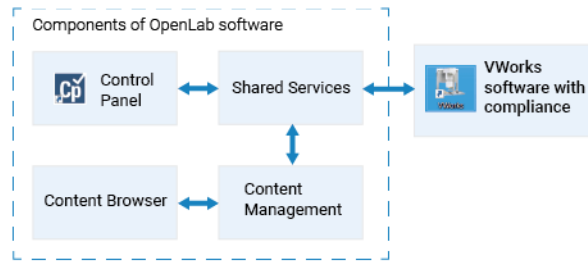
Software development process and validation

The Agilent Declaration of Software Quality shipped with each software package documents the software development and testing steps executed as part of the development cycle. The development process is registered to the ISO 9001 quality standard.

Major components

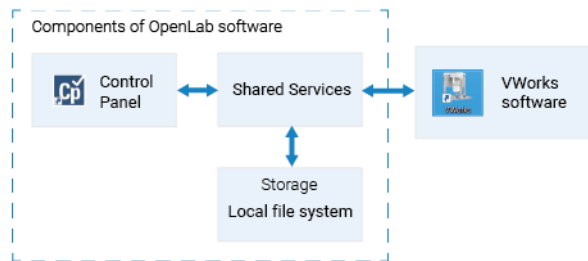
- **OpenLab for VWorks.** The VWorks software is integrated with the OpenLab Control Panel and Shared Services. Control Panel is the user interface for Shared Services, which are set of administrative services. An administrator uses Control Panel to configure VWorks user access, software licenses, storage, e-signature levels, and audit trail settings.
 - *VWorks Plus.* Uses Content Management to store VWorks files, records of interest, and audit trails. The files are stored in a predefined VWorks Project folder in the Content Management repository. A system administrator can use the Content Browser to view and edit the project structure and contents. See the following figure for the relationship between these components.

Figure VWorks Plus edition architecture



- *VWorks Standard*. Uses the local file system. Shared Services stores the files in a predefined VWorks Project folder. See the following figure for the relationship between these components.

Figure VWorks Standard edition architecture



- **VWorks components.** The VWorks software provides the instrument control tools for Agilent automation devices. Based on a user's role and privileges, users can create and run protocols on the automation devices.

VWorks Plus features

VWorks Plus provides the following features to enable compliance with the FDA rules and guidelines of 21 CFR Part 11 and similar rules:

- *Data security.* Physical protection of data by limiting access to the system and preventing unauthorized access.
- *Data Integrity.* Protecting raw data and metadata and preventing these from unauthorized modification, and linking raw data and results to reproduce the original results at any time, for example, in an audit situation, and document each new result copy.
- *Audit traceability.* Documenting who did what to the results and when.

For details, see "[Compliance](#)" on page 53.

Supported devices

The VWorks 14.1 software supports a variety of Agilent automation devices in standalone mode or in a BenchCel workstation configuration.

See "[VWorks Plugins](#)" on page 65 for more information about VWorks supported devices.

User information access

The user information is available in the following locations:

- *Knowledge base*. The help system for the Automation Solutions products is available from:
 - Help menu within the VWorks software: **Select Help > Knowledge Base** or press F1.
 - From the Windows desktop: **Select Start > All Apps > Agilent Technologies > VWorks Knowledge Base**.
- *Context-sensitive help*. Clicking the Context Help button on the VWorks toolbar converts the pointer to a question mark and enables you to select specific areas or icons in the main window to open a relevant topic or document.
- *PDF files*. The PDF files of the user guides are installed with the VWorks software (C:\Program Files (x86)\Agilent Technologies\VWorks\UserGuides) and are available in the VWorks Knowledge Base.
- *Website*. You can search the online VWorks Knowledge Base or download the latest version of any PDF file from the Agilent website at www.agilent.com/chem/askb.

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2 Network and computer requirements

This chapter provides an overview of network and computer requirements for VWorks 14.1 software.

The topics are:

- “Computer requirements” on page 8
- “Domain requirements” on page 8
- “Firewall settings” on page 8

Computer requirements

See the [VWorks 14.1 Site Preparation Checklist](#) for the computer hardware requirements.

Domain requirements

With domain-based authentication individual machines must always be able to communicate with domain components, not just to login but also to receive authorization for many routine functions.

Firewall settings

For communication to transpire, some ports in the firewall must be accessible to the OpenLab components. See [OpenLab Server 2.6/OpenLab ECM XT 2.6 Functional Design Specification](#) for more information.

3 Installation

This chapter provides the functional design specification of VWorks 14.1 software installation.

The topics are:

- “OpenLab for VWorks installer” on page 10
- “VWorks 14.1 installer” on page 10
- “Software Verification Tool” on page 10
- “Bravo IQOQ” on page 11
- “Licensing” on page 11

OpenLab for VWorks installer

The OpenLab for VWorks installer is a wizard that installs and configures the following required software tools and components:

- *Control Panel and Shared Services*. These components of the OpenLab software control the user access and storage for the VWorks software. The installer places a Control Panel shortcut icon on the Windows desktop.
- *Content Browser and Content Management (VWorks Plus only)*. Shared Services stores VWorks files in Content Management, which is a secure storage repository. Content Browser enables viewing and managing Content Management.
- *Agilent Software Verification Tool*. Agilent support providers may use this tool to verify the software installation. See [“Software Verification Tool” on page 10](#) for more information.

VWorks 14.1 installer

The VWorks 14.1 installer is a wizard that installs:

- *VWorks software*.
- *Bravo IQOQ Test Utilities*. Authorized Agilent support providers may use these utilities to perform qualification on the corresponding Agilent device.

The VWorks installer automatically does the following:

- Enables projects in OpenLab Control Panel and creates the VWorks Project and standard folder structure and adds default instrument and application objects in the OpenLab Control Panel.
- Publishes VWorks user roles and groups.
- Publishes all standard labware entires, labware classes, and liquid classes.

Software Verification Tool

The Agilent Software Verification Tool is installed with each Agilent software component. This utility has a reference file providing an index of the files required for a proper installation. The utility checks the reference list against the files installed, their locations and revisions, including operating system files with specific dependencies.

This test is typically performed at installation and can be performed at any time to verify the file level integrity of the software installed on each computer in the installation. Test reports can be printed or saved to files.

The tool can be used to verify a successful installation of a new version or patch. This does not replace the Installation Qualification (IQ) service, which is delivered by an authorized Agilent service provider.

Bravo IQOQ

To qualify the accuracy of Bravo liquid handling, the customer can order Bravo qualification services from Agilent. The Bravo IQOQ service requires a reagent kit in addition to the software and is performed by an Agilent field specialist.

Licensing

VWorks requires a license to run the software and the license can be published on the OpenLab Control Panel.

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4 Software interface

This topic provides the functional design specification of VWorks 14.1 software interface.

The topics are:

- “OpenLab Control Panel interface” on page 14
- “VWorks interface” on page 14

OpenLab Control Panel interface

See the [OpenLab Server 2.6/OpenLab ECM XT 2.6 Functional Design Specification](#).

VWorks interface

Main window interface

The VWorks main window consists of menus and menu commands, toolbars, tabbed areas, and a status bar. The content of each of these items can change depending on whether you are viewing a device file, protocol, or form.

Terminology	Description
Title bar	Displays the name of the window.
Menus	Lists menu commands.
Toolbars	Displays button commands.
Work area	Displays device files, protocols, or forms.
Log and progress area	Displays the Main Log, Pipette Log, Time Constraint Log, Progress, and Runset Manager. You use these tabs primarily to monitor various aspects of the run and to set up multiple protocol runs in a sequence.
Status bar	Displays the state of the software.

Device file interface

Terminology	Description
Available Devices area	Displays the following tabs: <ul style="list-style-type: none"> • Available devices. The list of devices you can add to the device file. • Workspace. The list of protocols, forms, and device files that are currently open. • Available Macros. The list of macros created to expedite the protocol writing process.

Terminology	Description
Device file area	<p>Displays the list of devices that are added to the device file. The area also allows you to:</p> <ul style="list-style-type: none"> • Initialize all devices • Initialize selected devices • Close selected devices • Delete selected devices • Open the diagnostic software of the selected device
Device properties area	<p>Displays the properties you can set for the selected device in the device file.</p>

Protocol interface

Terminology	Description
Available tasks area	<p>Displays the following tabs:</p> <ul style="list-style-type: none"> • Available Tasks. The list of tasks you can add to a protocol. The list of tasks can vary, depending on the devices added in the device file and the process or subprocess selected. • Workspace. The list of protocols, forms, and device files that are currently open.
Protocol area	<p>Displays the following:</p> <ul style="list-style-type: none"> • Startup Protocol. Contains tasks that must be run before the main protocol starts. • Main Protocol. Contains tasks of the protocol. • Cleanup Protocol. Contains tasks that must be run after the main protocol finishes. • Protocol Options. References the device file and contains additional information associated with the protocol. <p>An open VWorks form will display in the Protocol and Task Parameters areas. If the form displays in full screen mode, the entire form fills the VWorks window.</p>

Terminology	Description
Task Parameters area	<p>Displays one or more of the following, depending on the task selected:</p> <ul style="list-style-type: none">• Task Parameters. Contains parameters associated with the selected process plate or task.• Custom Parameters. Allows you to create variables to be used by the selected task. Might also contain parameters or options associated with the task.• Device Selection. Contains the list of devices that will perform the selected task. Also allows you to set up a pool of devices for the same task to increase throughput and backup devices in case the primary devices are in an error state.• Advanced Settings. Allows you to add JavaScript to change the task parameters or pass information to and from an external database during a protocol run.

Labware Editor

The Labware Editor is a window that you open from the Tools menu in the VWorks window. Users with VWorks technician or VWorks administrator privileges can use this tool to manage the labware definitions. The Labware Editor has two tabbed pages:

- *Labware Entries.* Provides tools for creating and editing labware definitions.
- *Labware Classes.* Provides tools for creating and editing labware classes and the labware entries for each class.

For more details, see [“Labware Editor” on page 29](#).

Liquid Library Editor

The Liquid Library Editor is a tabbed window that opens from the Tools menu in the VWorks window. The Liquid Library Editor provides tools for users with VWorks technician or VWorks administrator privileges to enter values for properties that affect pipetting speed, accuracy, and precision.

Pipette Technique Editor

The Pipette Technique Editor is used to define any number of pipette techniques. After you create a technique, it becomes available for the liquid-handling tasks in the Bravo Subprocess.

Inventory Editor

The Inventory Editor is a tabbed window that opens from the VWorks Tools menu only if a connection to the inventory database is established. The inventory database maintains a list of labware located in long-term labware storage devices. You use the VWorks Inventory Editor to access the data in the inventory database.

Experiment Editor

The Experiments Editor is a window that opens from the VWorks Tools menu only if a connection to the Experiments database is established. The Experiments Editor and database enables the tracking of parameter settings involved in preparing a microplate for downstream analysis. The protocol and form must be associated with an experiment ID and include parameters tagged to be tracked automatically.

Form Designer

The Form Designer is opened from the File > New or File > Open menu in the VWorks window. The Form Editor is opened from the VWorks Tools menu. The Form Designer/Form Editor provides tools for users with VWorks technician or VWorks administrator privileges to create and edit VWorks forms. A form is a customized user interface that enables operators to run an associated VWorks protocol. A VWorks user who creates protocols can design forms to simplify the operator duties when it comes time to run the associated protocols.

Error Library

The Error Library window opens from the VWorks Tools menu. The error-handling library contains a collection of automatic responses to specific error messages developed by the user.

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5 OpenLab for VWorks

This chapter provides the functional design specification of the OpenLab component of the VWorks 14.1 software.

The topics are:

- “OpenLab Control Panel” on page 20
- “Control Panel activity log and administrative reports” on page 21
- “Control Panel settings published by VWorks installer” on page 21
- “Content Browser” on page 23
- “OpenLab for VWorks tools” on page 23

OpenLab Control Panel

Configuration requirements

In order to run VWorks 14.1, the software must first be configured using OpenLab Control Panel. The VWorks user must have project and instrument privileges to log in to VWorks 14.1.

The OpenLab Control Panel functions are divided into views, which are selected through view buttons in the lower left pane of the application's user interface.

The views are:

- *Instruments*. This view specifies the instrument settings. For VWorks 14.1, the *instrument* is essentially the computer that is running the VWorks software.
- *Projects*. This view specifies the VWorks project settings, including the project name and who has project access privileges. For VWorks Plus, the project settings also include the audit comment and e-signature settings.
- *Administration*. This view provides access to administration functions such as authentication, security, user access and so forth.

Administration settings

The following describes the settings required to configure VWorks 14.1.

Authentication

VWorks 14.1 supports Internal or Windows Domain as authentication providers.

Security Policy

Internal authentication. You can set all policy parameters in the Control Panel.

Windows Domain authentication. You set only the inactivity time in the Control Panel. All other parameters are defined by the Windows operating system.

Users, groups, and roles

VWorks software publishes the required VWorks Groups and Roles.

For more information on users, groups, and roles, see the [VWorks Plus Configuration and Administration Guide](#) and the [VWorks Standard Configuration and Administration Guide](#).

email server

If you want to allow the VWorks software to send email notifications, for example, when a run error occurs, the Control Panel must be connected to an email server.

- The computer running the VWorks software must be able to communicate with your outgoing email server (SMTP server). The email server settings must be configured in the Control Panel.
- After connecting to an email server in the Control Panel, you must also enable email notifications in the VWorks Options dialog box. For details, see the [VWorks Automation Control User Guide](#).

Control Panel activity log and administrative reports

System Activity Log

Note: For information on activity logs in the VWorks software, see “VWorks logs” on [page 49](#).

The System Activity Log contains information on the various events associated with Shared Services.

For the VWorks software, only the following types of events are recorded:

- System
- Instrument
- Project Management
- User
- Group
- Security
- License

The messages can come from other Shared Services components, such as the user management, system messages, or event messages.

Administrative Reports view

In the Administrative Reports view, you can export various XML or PDF reports related to the OpenLab for VWorks system configuration, including:

- **Instruments Report.** For VWorks 14.1, typically, only one instrument is configured per workstation.
- **Projects Report.** Provides detailed information about configuration and access privileges for a project or projects for the VWorks workstation.
- **Roles and Privileges Report.** Describes all roles defined on the system, including details of all privileges included in each role.
- **System Report.** Provides a consolidated view of the system, which includes all information about the instrument controller, instrument, projects, roles, users, and groups.
- **User's and Group's Role Assignment Report.** Provides an overview of all users and groups with their assigned roles.

Control Panel settings published by VWorks installer

Project settings

VWorks project

The following VWorks project is configured automatically during the VWorks software installation:

```
/VWorks Projects/VWorks
```

The VWorks project folder stores the labware entries, liquid classes, pipetting techniques, device files, protocols, forms, runsets, and other miscellaneous files for your protocols.

Additional projects can be created and configured for different users running different workflows.

Audit trail settings

Available in VWorks Plus only. The VWorks software prompts for an audit comment when a user changes a record of interest. The audit comment settings are specified in the Workstation tab of the Projects view in the OpenLab Control Panel.

Signature settings

Available in VWorks Plus only. VWorks uses the OpenLab electronic signature service. The signature settings are configured as part of the Project settings. For details, see the [VWorks Plus Configuration and Administration Guide](#).

Before the E-Signatures feature is available for VWorks use, a connection to the VWorks E-Signatures database (PostgreSQL) must be established in the VWorks Options dialog. For details, see the [VWorks Automation Control Setup Guide](#).

Control Panel instrument settings

For VWorks 14.1, the *instrument* is created by default when the software is installed. Typically, only one *instrument* is configured in Control Panel for VWorks Plus and VWorks Standard. The *instrument* is basically the computer that controls the automation device or devices. For details on configuring the VWorks devices, see [“VWorks Plugins” on page 65](#).

For VWorks 14.1, the *instrument* has the following properties:

Property	Description
Name	By default, the software uses the computer name. You can type a different name for the instrument.
Application	VWorks Workstation (This value is fixed.)
Instrument controller	Computer name (This value is fixed.)
Instrument type	VWorksInstrDriver
Default project	By default, the VWorks project is selected.

The Configure Instrument button in the ribbon opens the VWorks Instrument Configuration dialog box where you can enter a name for the Workstation Folder, which stores the VWorks global option settings, the device profiles, the log activity files, and so forth that are specific to this VWorks *workstation*. By default, the software creates a folder titled, Workstation.

Content Browser

Overview

VWorks Plus only. The OpenLab Content Browser enables viewing and editing of the VWorks project. Login privileges for Content Browser are configured in the Control Panel. For a detailed description of the features, see the Help available in the Content Browser.

VWorks implementation

A VWorks user with appropriate privileges can use Content Browser to:

- Edit the VWorks project structure, including creating or uploading files and folders
- Restore records

The Sign File feature in Content Browser is not supported in the VWorks software. To ensure proper tracking of signatures for VWorks records, only the VWorks e-signatures feature should be used.

OpenLab for VWorks tools

Shared Services Maintenance utility

The Shared Services Maintenance utility is automatically installed with VWorks 14.1.

- Backup and Restore tab. For VWorks Standard, this tab provides a means for backing up and storing the Shared Services data. This tab does not apply to VWorks Plus.
- Windows Domain tab

In the Shared Services Maintenance utility, the Windows Domain tab is relevant if you use Windows domain authentication to identify your VWorks 14.1 users.

OpenLab for VWorks must be given access to the server where these credentials are stored. In the Windows Domain tab, you specify or change the credentials that OpenLab for VWorks will use to access your Windows domain server.

- Server Settings tab. VWorks 14.1 typically has only the connection to the local computer.

Backup and Restore utilities

For VWorks Plus, the Backup and Restore utilities provide a means for backing up and restoring the following:

- Configuration file
- Databases for Shared Services, Content Management, and Data Repository
- Solr indexes
- Content and Archive storage locations
- Alfresco cache

5 OpenLab for VWorks

OpenLab for VWorks tools

- Certificate server
- e-signatures for completed record-state transitions and closed experiment IDs

In addition to running the Backup/Restore utilities, you must also backup/restore the following databases, which are not included:

- VWorks Inventory database. You can export the inventory database to create a backup copy.
- VWorks Experiments database. You can export all experiment IDs to a backup file (.expTags file) and make a backup copy of any archived experiment ID files.

6 VWorks specifications

This chapter provides the VWorks 14.1 software functional design specification.

The topics are:

- “Software overview” on page 26
- “Relationship of components in VWorks software” on page 27
- “Labware Editor” on page 29
- “Liquid Library Editor” on page 29
- “Pipette Technique Editor” on page 30
- “Inventory Editor” on page 30
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- “Macro Library” on page 48
- “Exporting and importing” on page 48
- “VWorks Backup Manager” on page 49
- “VWorks logs” on page 49

Software overview

Features available for VWorks Standard and VWorks Plus

Features	Description
Define labware	You create labware definitions that describe the labware you will use during protocol runs.
Define liquid classes	<i>Bravo Platform only.</i> You use a liquid class to describe the liquid-handling properties for a task in a protocol.
Manage inventory	<i>Storage devices only.</i> For devices such as the Labware MiniHub, the Inventory Editor helps you track barcodes and labware as you move them into and out of storage or incubation.
Track experiments	You can set up an experiments database and use experiment IDs to track the parameter settings for a given application run.
Set up devices	You define any devices used in a protocol in a VWorks device file.
Create protocols	Protocols determine the sequence of tasks to be automated in a run. For example, you can use a protocol to apply barcode labels to 100 microplates.
Create forms	A form provides a simplified interface for running a protocol, which can be helpful for users who have limited or infrequent experience with the VWorks software.
Create pipetting techniques	<i>Bravo Platform only.</i> You can create pipetting techniques that describe the pipetting methods.
Run, pause, monitor, and stop protocols	You can start, pause, monitor, and stop a protocol run from the controlling computer.

The VWorks software uses dynamic scheduling to run the tasks in a protocol. The scheduler determines which task to run next based on the availability of resources moment-by-moment, to reduce idle time during a protocol. This causes the software to re-determine the sequence of task execution every time a protocol is run. As a result, run times can vary for a given protocol. However, you can specify a time interval between two dependent tasks using the Time Constraints feature.








Relationship of components in VWorks software

The VWorks software uses different components (files and databases) to run protocols. It is important to understand the relationships between each of the components in the software. Changing settings or options in one component will affect one or more of the other components.

Component descriptions



The following table lists and describes the primary VWorks software components.

Note: VWorks treats these as records of interest. For details on records of interest, see ["Records of interest" on page 56](#).

Component	Description	File extension	Opening this component loads...
Global settings			
	A file that contains a collection of labware properties that the VWorks software uses to handle a labware type in the automation system.	.xml	Labware definitions
	A file used by the Hit Pick Replication task that specifies the dispense pattern in destination microplates.	.xml	Dispense information in destination microplates
	A file that contains pipetting settings for different liquid types.	.xml	Liquid class information
	A file that specifies the x- and y-axis offset when pipetting.	.xml	Pipette x- and y-axis offset information
Device-related files			
	A file that contains: <ul style="list-style-type: none"> The list of devices the software will communicate with and control Configuration information of each device Communication settings (profile) 	.dev	<ul style="list-style-type: none"> Device profile Teachpoint file (BenchCel device)
	A file that contains a collection of settings that the VWorks software uses to control a specific device.	.xml	Teachpoints or teachpoint file (applicable to some devices such as the BenchCel device)
	A device-dependent file that contains your teachpoint settings.	.xml	Teachpoint definitions
Protocol-related files			

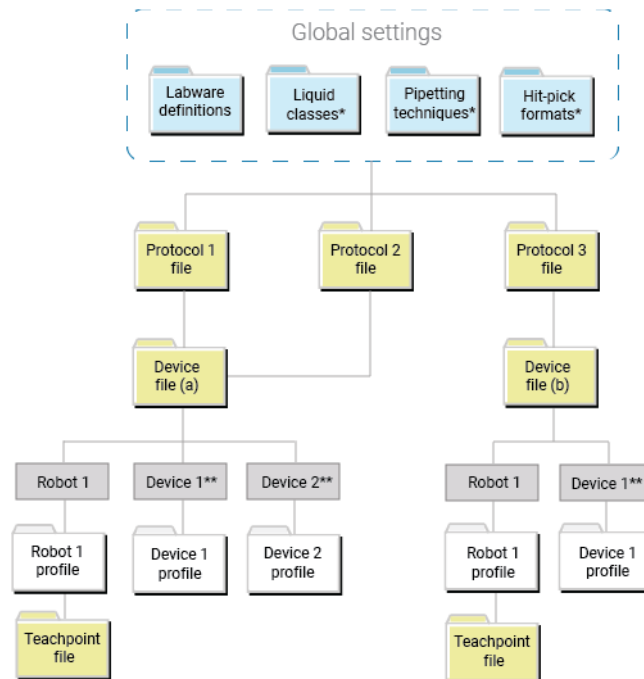
6 VWorks specifications

Relationship of components in VWorks software

Component	Description	File extension	Opening this component loads...
	A file that contains instructions for performing a run.	.pro	<ul style="list-style-type: none"> VWorks software (if it is not already open) Device file VWorks form (if configured in Protocol Options)
	A simplified user-interface that can be linked to a protocol for operators to use when running the protocol.	.VWForm	VWorks form and associated protocol

Relationships of VWorks components

- Labware definitions are used by all protocols.
- Liquid classes, pipetting techniques, and hit-pick formats are used by protocols containing liquid-handling tasks. In particular, hit-pick formats are used by the Hit Pick Replication task.
- Each protocol references a single device file that contains one or more devices.
- More than one protocol can reference the same device file.
- Each device (or robot) references a single device profile.
- Some devices, such as the BenchCel device, reference a single teachpoint file.



* Liquid-handling tasks only

** Individual device, not a device type

Miscellaneous files

Files created in software other than the VWorks software, such as barcode input files (.bar, .csv, or .txt), hitpick input files (.csv), inventory files (.sql), JavaScript files (.js), and so forth, must be imported into Shared Services storage before the files are available for use in the VWorks software.

Labware Editor

The Labware Editor enables you to create labware definitions. Each labware definition consists of a labware entry and clabware class. VWorks administrator or technician roles are required to use the Labware Editor.

Some common labware and some Agilent labware comes already defined in the VWorks software. However, these labware definitions will still require some fine-tuning for each particular system.

For a detailed description of the Labware Editor, refer to the [VWorks Automation Control 14.1 Setup Guide](#).

Labware entry

A labware entry is the collection of properties or parameter values that describe a specific type of labware. This information is used by the VWorks software to command the robot and other devices to do tasks based on the information in the definition. Each labware entry is saved as an .xml file in Shared Services storage.

VWorks Plus only. The labware entries are records of interest. The software automatically logs audit trails for the labware entries that are in the In Validation and Released states. Optionally, the software can log audit trails for these records while they are In Development. You cannot edit or delete labware entries that have transitioned to the Released state.

Labware classes

Labware classes are sets of labware entries, grouped so they are easier to manage than many individual labware entries. Each labware class is saved as an .xml file in Shared Services storage.

Labware classes are used in combination with the device manager to restrict which types of labware can be used on which devices during a protocol run.

VWorks Plus only. The labware classes are records of interest for which the software automatically logs audit trails. These records are exempt from transitioning through development states.

Liquid Library Editor

The Liquid Library Editor provides tools for users with technician or administrator privileges to enter values for properties that affect pipetting speed, accuracy, and precision.

Default liquid library entries are installed with the VWorks software.

You use the Liquid Library to fine-tune the volume aspirated or dispensed by your Bravo Platform.

The values entered into the Liquid Library Editor can be saved as a collection, known as a liquid class.

For a detailed description of the Liquid Library Editor, see the [VWorks Automation Control Setup Guide](#).

How liquid classes are stored

Each liquid class is saved as an .xml file in Shared Services storage.

VWorks Plus only. The liquid classes are records of interest. The software automatically logs audit trails for liquid classes that are in the In Validation and Released states. Optionally, the software can log audit trails for these records while they are in the In Development state.

Calibrating the Bravo Platform

The Liquid Library Editor also has an equation editor that can be used to calibrate the Bravo Platform.

Pipette Technique Editor

You can define a pipette technique to use different pipetting methods. Different applications can benefit from different pipetting methods. For example, in multiplexed microplates, dispensing at an offset from the well center can improve distribution of the fluid. In cell-based assays, moving the pipette to the side of the wells minimizes the removal of the cells from the center or reading area of the well.

You use the Pipette Technique Editor to define any number of pipette techniques. After you create a technique, it becomes available for the following liquid-handling tasks in the Bravo Subprocess:

- Aspirate
- Dispense
- Mix
- Pin Tool

You create, edit, and manage (copy, rename, delete) pipette techniques in the Pipette Technique Editor dialog box accessible in the task parameters area of a task or from the Tools menu in the main VWorks window.

Shared Services saves each pipette technique as an XML file in a VWorks Projects folder, for example, /VWorks Projects/VWorks/Pipetting/Techniques.

VWorks Plus only. Pipette techniques are records of interest. The software automatically logs audit trails for pipette techniques that are in the In Validation and Released states. Optionally, the software can log audit trails for these records while they are in the In Development state.

Inventory Editor

The Inventory Editor is for use with long-term labware storage in the Labware MiniHub.

Labware inventory management

The inventory management system allows long-term tracking of microplates because barcode data is stored in a database (MySQL database). Before the Inventory Editor is available for use, a connection to the inventory database is required. For details on how to connect to the database and use the Inventory Editor, see the [VWorks Automation Control 14.1 Setup Guide](#).

Information that is stored

The Inventory database maintains a list of labware located in long-term labware storage devices. Each labware entry in the database includes the following information:

- Device in which the labware is located
- Cassette and slot location of the labware
- Names of the location and plate groups to which it belongs
- Labware type
- Any north-side, south-side, east-side, and west-side barcodes
- Volume of the wells in the labware

VWorks Plus only. The inventory database is a record of interest (.sql) that is exempt from record state changes. VWorks logs an audit trail for this file.

How to access data in the Inventory database

You use the VWorks Inventory Editor to add or remove labware data in the inventory database.

The list of labware in the database is automatically updated every time the robot moves a labware into or out of a storage device.

You can back up the inventory database by exporting it to an SQL file.

The VWorks Backup Manager enables back up of VWorks labware definitions, liquid classes, and pipetting techniques in addition to the Inventory database.

Experiments Editor

Experiment IDs and Experiment database overview

Experiment IDs defined

An experiment ID is a database record that captures the steps executed and the settings used during each run of a protocol. Any errors that may have occurred during a run are also recorded. An experiment ID can be used to record the steps performed and settings used during the course of a sample prep workflow.

You use the Experiments Editor to create experiment IDs, which are stored in the Experiments database, and to generate experiment ID reports (.pdf file).

Prerequisites

The Experiments Editor uses a PostgreSQL database, which is installed with the VWorks software. Before the Experiments Editor is available for use, a connection to the VWorks Experiments database must be established.

How the data is recorded

The Experiments Editor feature is designed for use with VWorks forms. VWorks forms have built-in features that expedite how the form's author tags the data to be tracked. The data tags in the form determine which data to record for a selected experiment ID for the protocol being run. A pair of Step Started/Completed tasks specify each task or task sequence in the protocol to be recorded.

Alternatively, if you know how to write programs in JavaScript or have a basic understanding of programming, you can use the built-in object in the VWorks JavaScript interpreter instead of using VWorks forms.

Experiment ID status changes

An experiment ID has the following status transitions:

- Not yet used. Automatically assigned to a newly created experiment ID.
- Open. Automatically assigned to an experiment ID that has been associated with a protocol run.
- Closed. A closed experiment ID cannot be used for additional runs, and it cannot be reopened.
- Archived.

For VWorks Plus, the VWorks Administrator role is required to close an experiment ID. An experiment ID report is automatically uploaded to Content Management when an experiment ID is closed. If the E-Signature feature is configured, the specified signatures must be completed before the experiment ID closes.

Exporting and importing experiment IDs

You can export active experiment IDs from the Experiments database to files in the local file system. You can export the data for individual or multiple experiment IDs to a single file. The exported data does not include archived experiment IDs.

When importing any previously exported experiment IDs, the software performs tamper detection to verify that no changes were made to the exported experiment ID files.

You should periodically export the data for all active experiment IDs to create a backup copy of the database. You can import the backup copy to recover the experiment ID data in case the data become damaged or lost.

You can import the experiment IDs from a previously saved *.expTags file, for example as part of a data recovery process. However, you cannot import an experiment ID if it already exists in the Experiments database.

Device files

To communicate with and control the robot and integrated devices, the VWorks software uses a device file that contains the following information:

- List of devices the software will communicate with and control
- Device type of each device (for example, the robot in the lab automation system and any integrated device)
- Configuration information of each device (for example, approach height, allowed or prohibited labware, barcode reader access, and so on)

- A link to the communication settings (profile) required for communication between the devices and the VWorks software

You provide the device information in the VWorks window. The device information is stored in a device (.dev) file.

The available devices are listed in the **Available Devices** area of the VWorks window. The **Device File** area provides the interface to create a device file. See [“VWorks Plugins” on page 65](#) for more information on Agilent automation devices.

VWorks protocols

Protocol components

The VWorks software enables you to create protocols that automate laboratory tasks. A protocol consists of one or more processes. Each process consists of one or more tasks.

Protocols

A protocol is a schedule of tasks to be performed by a standalone device or devices integrated in the lab automation system. The purpose of a protocol is to process or perform tasks on labware.

Protocols appear in the Protocol area of the VWorks window.

Processes

A process is a sequence of tasks that are performed on a particular labware or a group of labware. A process is represented by a lane with white background in the Protocol area.

Each process lane starts with a microplate icon. The icon typically represents the labware or group of labware that you are processing. The labware is called the process plate.

A process lane can also be used as a control to initiate other processes in the protocol.

Plate instances

When a process plate icon represents a group of labware, each labware in the group is called a plate instance. For example, if you have 10 microplates that need to be processed as the Source Plate, then microplate 1 is Source Plate instance 1, microplate 2 is Source Plate instance 2, microplate 3 is Source Plate instance 3, and so on.

Subprocesses

A subprocess is a sequence of tasks performed as a subroutine within a protocol. A subprocess is performed by a single device type, such as the Bravo device.

Subprocesses are represented by a subprocess icon in the protocol.

Tasks

A task is an operation performed on one or more labware, and is represented by an icon in the protocol. It has associated parameters that are set in the Task Parameters area.

Macros

A VWorks macro is a collection of protocol tasks and associated task parameters grouped together in an abbreviated form. You can insert the macro easily at other places within the same protocol or throughout other protocols where the same task

sequence is required. A macro eliminates the need to recreate a repeated task sequence within the same protocols or subsequent protocols that you write. Therefore, protocol writing can be easier, faster, and less error-prone.

Runsets

A runset is a collection of protocol runs that can be scheduled in advance to be performed without operator intervention.

The following table provides an overview of how the Runset Manager works.

Step	Task
1	You add the protocols to a runset and specify the schedule for each protocol, or you can open an existing runset.
2	The Runset Manager determines the most efficient way to run the protocols based on the following: <ul style="list-style-type: none"> • The specified run start times. • Any specified run priorities. • Whether the protocols share the same device file. • Whether the protocol rules permit simultaneous runs.
3	The Runset Manager opens and compiles each protocol before running it the specified number of times.
4	The Runset Manager repeats step 3 for each protocol in the runset.

VWorks Plus treats protocols as records of interest that transition through record stages. The protocol files are stored in Content Management.

Running a protocol

The steps for running a protocol are summarized in the following table.

Table Workflow for running a protocol.

Step	Task	Description
1	Turn on the devices that will be used in the protocol and prepare them for operation.	Instructions are in the individual device user guides.
2	Login to VWorks software.	Launch VWorks and sign in through the OpenLab Control Panel
3	Open a form or protocol.	In the VWorks window, select Open File and select the form or protocol you wish to run.

Step	Task	Description
4	Set the general and view options.	<p>Global options include:</p> <ul style="list-style-type: none"> • Directories and file paths <ul style="list-style-type: none"> – View file paths under Tools > Options > Directories and Paths. – Set file paths for Error library and Macro library. • General options <ul style="list-style-type: none"> – Select Tools > Options. – Set or select options. – Set View Options.
5	Set error-handling options.	<p>VWorks automated error handling includes:</p> <ul style="list-style-type: none"> • View under Tools > Options > Error Handling area. • <i>Error library</i>. A collection of automatic responses to specific error messages. You select the error library file path and select the Enable error library option in the Options dialog box. • <i>Error-handling options</i>. You set general error-handling options during setup or the first time a protocol is run in the software.
6	Set up email notification.	<p>You can specify that the VWorks software send you an email or text message when a run error occurs. Setting up email notification also enables bug reporting.</p> <p>Alternatively, you can configure VWorks to post online messages on Twitter.</p> <p>The following are required for the email notification to work:</p> <ul style="list-style-type: none"> • The VWorks computer must be connected to a network with internet access. • The outgoing email server must be set up on the system's computer. • In the Email Setup area of the Options dialog box, specify the email preferences and parameters. <p>The VWorks software can automatically notify you about system status via email and online message postings.</p> <p><i>About setting up automatic online notification.</i> The online posting feature can notify you about various system events, such as errors, deadlocks, and protocol and process starts and finishes. You can receive the online notification on any device where you can access a Twitter account.</p>

Step	Task	Description
7	Start the protocol run.	<p>When you start a run, you have the option of scheduling the protocol to run immediately or at a future date and time. In addition, you can specify that the protocol start while another is still running.</p> <p>When you schedule multiple runs:</p> <ul style="list-style-type: none"> You can start a run while existing protocols are already running or are scheduled to run. Protocols that are running simultaneously can share devices. The priority of device use is specified in the device selection area when you set the task parameters. You can manage a set of runs using the Runset Manager.
8	Create and manage runsets.	<p>Select File > New > Runset :</p> <ul style="list-style-type: none"> Add protocols to the runset. Configure the following for the runset: <ul style="list-style-type: none"> Number of times to run the protocol Run start time Priority of runs Starting barcode, if using Notes about the protocol
9	Monitor, pause, or stop the runs.	<p>In the VWorks window, select View > Progress. The Progress tab appears at the bottom of the window and displays the following:</p> <ul style="list-style-type: none"> Overall progress <p>Displays a progress bar to indicate how far along the system is in all running protocols.</p> Running protocols <p>Contains the list of protocols that are currently running.</p> Display <p>Based on your selection in the Overall progress area, shows an aspect of the overall run progress.</p> <p>You can display a Gantt chart for one or more protocols while they are running, or for one or more open protocols have been run in the current VWorks session since they were opened.</p> <p>While a protocol is running, you can visually monitor the progress in real-time in the Gantt Chart dialog box. In addition, you have the option of displaying the progress by instance or device.</p> <p>Run information displayed in the Gantt Chart format enables you to monitor resource usage during the run. Too much spacing (time) between tasks might indicate poor device usage or potential bottlenecks.</p>
10	Pause the run.	<p>You can pause runs using one of the following methods:</p> <ul style="list-style-type: none"> Pause all runs Pause selected runs in a runset
11	Stop the run.	<p>To stop a run in an emergency, use the hardware Emergency Stop button. See the device user guide for the procedure.</p>

Protocol tasks

Protocol tasks can be divided into the following types of tasks:

- Microplate handling
- Microplate storage
- Liquid-handling
- Scheduling

Microplate-handling tasks

Microplate-handling tasks are used with Agilent Automation Devices to move labware into, within, and out of the Automation Workstation.

The microplate-handling tasks and their description are listed in the following table.

Table Microplate-handling tasks and their description

Task	Description	Available for
Centrifuge Process	indicates the start of a protocol subroutine that employs the Microplate Centrifuge. Within the subprocess, the software automatically adds the Centrifuge task to spin microplates according to the task parameter settings.	Centrifuge and Centrifuge with Loader
CentrifugeAuto	The CentrifugeAuto task can be used with the Microplate Centrifuge and Centrifuge with Loader devices to spin microplates according to the task parameter settings. The CentrifugeAuto task enables you to spin one microplate with a counterweight or spin two microplates from a protocol process, at the same time. Counterweights can be placed manually or robotically.	Centrifuge and Centrifuge with Loader
Configure Static Labware	Available only in the Startup protocol, the Configure Static Labware task allows you to assign static labware to locations on a device. The labware will remain at these locations during the protocol. <i>Note:</i> You can also configure static labware in the device subprocess task in the main protocol. Configure labware in the device subprocess if you want to override the labware configuration in the startup protocol. Configure labware in a Startup Protocol if the labware configuration will be used in all the Main Protocol subprocesses. In general, you configure static labware before the first task in a protocol. If you have multiple processes in the protocol, configure the labware once before the first task of the first process.	Any device
Delid	The Delid task removes lids from microplates. You can use the Delid task to remove and discard a lid, or you can pair it with the Relid task to retain the removed lid and later place the lid back on the microplate. <i>Note:</i> You can only delid process plates and configured labware. You cannot delid static labware	BenchCel Microplate Handler or Bravo Platform

6 VWorks specifications

VWorks protocols

Task	Description	Available for
Dismount	The Dismount task removes labware, such as a filter microplate, from the top of an elution microplate or reservoir that is resting on a platepad. Always paired with a Mount task, the Dismount task uses information that is specified in the Mount task.	Platepad
Incubate	The Incubate task moves labware to a location, leaves it there for a specified time period, and then moves it from the location. The number of labware that can be incubated simultaneously is limited by the number of locations that are available for holding labware.	Platepad
Mount	The Mount task places a labware, such as a filter microplate, on top of a collection microplate or reservoir that is resting on a platepad. The Mount task works with the Wait For task and is paired with the Dismount task. The Mount task becomes available when you add a Platepad device in the device file. The task can be used only in the Main Protocol.	Platepad
Move to Location (Agilent Bravo)	The Move to Location (Agilent Bravo) task moves the pipette head to a safe distance above a specified deck location. The safe distance is set in the Bravo profile. Typically, this task is used in Startup and Cleanup Protocols to move the pipette head out of the way.	Bravo Platform
Place Plate	The Place Plate task moves labware to a specified location. If the location has a barcode reader installed, the Place Plate task moves the labware to the location and reads the barcode.	Any device
Print and Apply	The Print and Apply task allows you to: <ul style="list-style-type: none">• Specify the contents to be printed on a microplate label.• Print the specified contents on a label.• Apply the label to a labware.	Microplate Labeler
Relid	The Relid task places lids on the microplates.	BenchCel Microplate Handler or Bravo Platform
Reserve Location	The Reserve Location task reserves a location on the Bravo Platform for a specified length of time. The task is typically used to incubate a microplate at that location.	Bravo Platform
Rotate Stage (Agilent Microplate Labeler)	The Rotate Stage (Agilent Microplate Labeler) task rotates the Microplate Labeler stage 180°. You use this task to change the orientation of microplates in preparation for label applications.	Microplate Labeler
Seal (Agilent PlateLoc)	The Seal (Agilent PlateLoc) task seals microplates using the PlateLoc Sealer.	PlateLoc Sealer

Task	Description	Available for
Waste	If your automation system includes a trash container or hole, you can use the Waste task to move a lid or labware to the trash container or hole.	Waste Bin
Run Experiment (BioTek Gen5 Reader)	The Run Experiment (BioTek Gen5 Reader) task runs the specified experiment on the BioTek Reader.	BioTek Gen5 Readers
Create Experiment (BioTek Gen5 Reader)	The Create Experiment (BioTek Gen5 Reader) task enables you to set up an experiment to run on the BioTek Reader.	
Wait for Temperature (BioTek Gen5 Reader)	The Wait for Temperature (BioTek Gen5 Reader) task couples with the Set Temperature task. It pauses the VWorks protocol until the specified BioTek Reader's incubator reaches target temperature.	
Set Temperature (BioTek Gen5 Reader)	The Set Temperature (BioTek Gen5 Reader) task preheats the BioTek Gen5 Reader for incubated reads where the Gen5 Experiment contains a Set Temperature command in the acquisition procedure.	

Microplate storage tasks

Microplate storage tasks are used when there is a storage database configured in the VWorks software.

The microplate-storage tasks and their description are listed in the following table.

Table Microplate-storage tasks and their description

Task	Description	Available for
clearinventory	The clearInventory task deletes all labware data from the inventory database. Use this task to clear the inventory at the desired point in the protocol.	Any device
Downstack	The Downstack task moves labware as follows: <ul style="list-style-type: none"> Out of the bottom of stacking devices such as the BenchCel Microplate Handler Off of the top of a stack of labware at a Bravo deck location 	Bravo Platform and BenchCel Microplate Handler
exportDatabase	The exportDatabase task exports all data in the inventory database to the specified location. You can use this task to create a backup copy of the inventory database at the desired point in the protocol.	Any device
importCsvToInventory	The importCsvToInventory task imports labware data in the specified CSV file into the inventory database.	Any device
Load	The Load task instructs a robot to move a defined set of labware into a storage device.	Labware MiniHub

Task	Description	Available for
Reorder	The Reorder task collects and incubates labware in a stack and then reverses the order of the labware in a second stack.	Bravo Platform and BenchCel Microplate Handler
Scan Stack	The Scan Stack task scans a specified Bravo deck location to confirm the presence or absence of labware and determine the height of the stack. You must add one Scan Stack task for each Downstack or Upstack task, and at least two Scan Stack tasks for each Reorder task in the Bravo Subprocess.	Bravo Platform
Storage Incubate	The Storage Incubate task moves a defined set of labware into a storage device, leaves it there for a specified time period, and then moves it out of the storage device.	Labware MiniHub
Unload	The Unload task instructs a robot to move a defined set of labware out of a storage device.	Labware MiniHub
Upstack	The Upstack task moves labware as follows: <ul style="list-style-type: none"> • Into the bottom of stacking devices such as the BenchCel Microplate Handler • Onto the top of a stack of labware at a Bravo deck location 	Bravo Platform and BenchCel Microplate Handler

Liquid-handling tasks

Liquid-handling tasks include all tasks associated with the Bravo liquid handler and executed within Agilent Automation Workstation protocols. They are carried out in a Sub-Process of a protocol.

The liquid-handling tasks and their description are listed in the following table.

Table Liquid-handling tasks and their description

Task	Description
SubProcess (Agilent Bravo)	The Subprocess (Agilent Bravo) task indicates the start of a protocol subroutine that employs the Bravo Platform. Within the subprocess, you can add tasks that are unique to the device.
Aspirate	The Aspirate (Agilent Bravo) task draws liquid from a microplate or reservoir.
AM Aspirate (Agilent Bravo)	The AM Aspirate (Agilent Bravo) task is designed for aspirating fluids through AssayMAP Bravo cartridges that are mounted on the Bravo 96AM Head.
AM Dispense (Agilent Bravo)	The AM Dispense (Agilent Bravo) task is designed for dispensing fluids through AssayMAP Bravo cartridges that are mounted on the Bravo 96AM Head.
AM Mix (Agilent Bravo)	The AM Mix (Agilent Bravo) task is designed for aspirating and dispensing fluids through AssayMAP Bravo cartridges that are mounted on the Bravo 96AM Head.

Task	Description
AM Cartridges Off (Agilent Bravo)	The AM Cartridges Off (Agilent Bravo) task removes the AssayMAP Bravo cartridges from the Bravo 96AM Head. The task is available only if the device profile specifies the Bravo 96AM Head. You can use the AM Cartridges Off task while the head's syringes contain liquid, and then subsequently dispense the liquid using the syringe probes.
AM Cartridges On (Agilent Bravo)	The AM Cartridges On (Agilent Bravo) task presses cartridges on a Bravo 96AM Head. The task is available only if the profile specifies the Bravo 96AM Head. You can use the AM Cartridges On (Bravo) task while the head's syringes are empty or contain liquid.
AM Wash Syringes (Agilent Bravo)	The AM Wash Syringes (Agilent Bravo) task enables the following types of washes using the Bravo 96AM Head: <ul style="list-style-type: none"> • Internal washing of the Bravo 96AM Head syringes • External washing of the syringe probes • External washing of the AssayMAP Bravo cartridges while mounted on the probes
Assemble Vacuum (Agilent Bravo)	The Assemble Vacuum task directs the robot to pick up the Vacuum Filtration Station components from designated deck locations and stack them in the order you specify. The task is used in conjunction with the following tasks: <ul style="list-style-type: none"> • Disassemble Vacuum • Move and Filter Plate • Pipette Under Vacuum Collar • Toggle Vacuum
Dilute to Final Volume (Agilent Bravo)	The Dilute to Final Volume (Agilent Bravo) task allows you to transfer liquid from a reagent labware to a destination microplate. The task is available only if you specified dilution series parameters within the Format Wizard in the Hit Pick Replication task.
Disassemble Vacuum (Agilent Bravo)	The Disassemble Vacuum (Agilent Bravo) task directs the robot to remove components from the Vacuum Filtration Station and place them back at the locations specified in the Assemble Vacuum task. If a filter plate was placed on top of the station, the Disassemble Vacuum task directs the robot to move the microplate to a specified location before disassembly.
Dispense (Agilent Bravo)	The Dispense (Agilent Bravo) task dispenses liquid into a microplate, reservoir, or tubes in a tube rack.
Dispense to Waste (Agilent Bravo)	The Dispense to Waste (Agilent Bravo) task moves the pipettes by a horizontal offset and then dispenses used fluid in between the chimneys in the MicroWash Reservoir. The software calculates the horizontal offset automatically based on the labware definition for the MicroWash Reservoir (also known as the Tip Wash Station).
Hit Pick Replication (Agilent Bravo)	The Hit Pick Replication (Agilent Bravo) task allows you to: <ul style="list-style-type: none"> • Hit pick, or transfer contents, from selected wells in a source microplate to a destination microplate. • Replicate a microplate by transferring contents from a source microplate into multiple destination microplates.

6 VWorks specifications

VWorks protocols

Task	Description
Initialize Axis (Agilent Bravo)	The Initialize Axis (Agilent Bravo) task allows any one of the six Bravo axes (motors) to be initialized (homed) during a protocol run.
Mix (Agilent Bravo)	The Mix (Agilent Bravo) task aspirates and dispenses liquid multiple times to mix it. The task allows you to specify different well-bottom distances for the aspirate and dispense actions.
Move and Filter Plate (Agilent Bravo)	The Move and Filter Plate task moves a specified filter plate from its current location to the Vacuum Filtration Station and then turns on and turns off the vacuum.
Pin Tool (Agilent Bravo)	The Pin Tool (Agilent Bravo) task can be used to perform low-volume transfers of a fixed volume using a pin tool. You can use the Pin Tool task repeatedly in a protocol subprocess to perform all the pin-tool-related steps, such as: <ul style="list-style-type: none">• Pin Tool—Adsorb• Pin Tool—Dispense• Pin Tool—Wash• Pin Tool—Blot• Pin Tool—Mix
Pipette Under Collar Begin and End (Agilent Bravo)	If the assembled Vacuum Filtration Station includes the filter plate, and you want to pipette into the filter plate that is underneath the collar, a pair of Pipette Under Collar tasks (Begin and End) are required. <ul style="list-style-type: none">• Pipette Under Collar Begin (Agilent Bravo). Prepares the Bravo device for pipetting in a microplate that sits under the collar of the Vacuum Filtration Station.• Pipette Under Collar End (Agilent Bravo). Resets the Bravo device after pipetting under the Vacuum Filtration Station collar to prepare for subsequent tasks in the Bravo Subprocess.
Pump Reagent (Agilent Bravo)	The Pump Reagent (Agilent Bravo) task fills or empties an Auto Fill Station (wash station) by pumping for a specified number of seconds or until the percent of maximum tared weight is reached. If the reservoir is on a Weigh Station, the pump stops fluid flow when the target weight is reached. Otherwise, gravity drain is used to empty the reservoir.
Serial Dilution (Agilent Bravo)	The Serial Dilution (Agilent Bravo) task allows you to set up serial dilution in a microplate using a single task. You use the Serial Dilution wizard to set up the task parameters. The end result is a sequence of Aspirate, Dispense, and optional Mix tasks that produce a linear or non-linear concentration gradient in selected wells.
Set Head Mode (Agilent Bravo)	The Set Head Mode (Agilent Bravo) task specifies the channels (or barrels) in the pipette head to be used for pipetting. You can select an $m \times n$ array of channels (barrels) for one of the following configurations: <ul style="list-style-type: none">• All of the pipette channels• The first or last full column or row of pipette channels• Multiple full columns or rows of pipette channels• The first or last partial column or row of pipette channels• Multiple partial columns or rows of pipette channels• A single pipette barrel at the corner of the pipette head

Task	Description
Set Temperature (Agilent Bravo)	The Set Temperature (Agilent Bravo) task sets or turns off the target temperature for a Heating Shaking Station accessory while a specific labware is on the station.
Set Temperature - Position ((Agilent Bravo)	The Set Temperature - Position (Agilent Bravo) task sets or turns off the target temperature for a Heating Shaking Station accessory, without regard to which labware is on the station.
Shake (Agilent Bravo)	The Shake (Agilent Bravo) task instructs the Orbital Shaking Station to shake.
Shake Plate (Agilent Bravo)	The Shake Plate (Agilent Bravo) task instructs a Heating Shaking Station accessory to shake.
Tips Off (Agilent Bravo)	The Tips Off (Agilent Bravo) task ejects disposable pipette tips from the liquid-handling heads that are compatible with disposable tips.
Tips On (Agilent Bravo)	The Tips On (Agilent Bravo) task presses disposable pipette tips onto the liquid-handling head. The task is not for use with fixed-tip pipette heads.
Toggle Vacuum (Agilent Bravo)	The Toggle Vacuum (Agilent Bravo) task turns on and turns off the vacuum in a Vacuum Filtration Station.
Wash Tips (Agilent Bravo)	The Wash Tips (Agilent Bravo) task washes pipette tips using a number of aspirate and dispense actions.
Run (BioTek Liquid Handler)	The Run BioTek Liquid Handler task runs the specified BioTek liquid-handler protocol on a BioTek liquid-handling device.

Scheduling tasks

Scheduling tasks are used to manage the timing, order, and parameters of tasks and processes of a protocol.

The scheduling tasks and their description are listed in the following table.

Table Scheduling tasks and their description

Task	Description	Available for
Define Plate Set	The Define Plate Set task allows you to create an array variable to represent a group of process plates that will be processed using the same tasks in a looping routine. You can reference the plate set using the Location, plate parameter in a task.	Any device
Defince Variables	<p>The Define Variables task allows you to create variables and assign initial values. You can reference the variables in a task.</p> <p>You can use the Define Variables task with the Loop and Loop End tasks. The Loop tasks allow you to specify the starting variable value, how frequently the value will increment or decrement, and the amount by which the value will increment or decrement.</p>	
Change Instance	The Change Instance task allows you to change a plate instance within a loop. For example, you can use the Change Instance task within the Loop and Loop End tasks to aspirate from one source microplate and dispense into different instances of a destination microplate.	
Group Begin and Group End	<p>The Group Begin and Group End tasks are used together to:</p> <ul style="list-style-type: none"> • Group a number of tasks within a subprocess. • Constrain the grouped tasks to run in the specified sequence. • Prevent downstream tasks from starting until the grouped tasks are finished. <p>If the tasks are not grouped, the software will determine the fastest task sequence based on available resources.</p> <p>During the protocol run, the software will make sure the labware needed by the grouped tasks are on the device locations before running the first task in the group. In addition, while the grouped tasks are running, only the microplates required by the grouped tasks will be allowed to be moved onto, off of, or within the device.</p> <p>Use the Group Begin and Group End tasks if you want to control the sequence of liquid-handling tasks to make sure each microplate is handled the same way in the same sequence.</p>	Bravo Platform

Task	Description	Available for
JavaScript	The JavaScript task runs the specified JavaScript at the desired point in the protocol. Typically, you use the JavaScript task to run a program that is independent of any task.	Any device
Loop and Loop End	The Loop and Loop End tasks are used together to repeat a set of tasks that are within the two tasks.	
Print	The Print task prints barcode labels using the Microplate Labeler. The task does not apply labels to labware. Use this task if you want to print labels and manually apply the labels to labware such as tubes or other containers.	Microplate Labeler (standalone only)
Process Control	The Process Control task is used to initiate a specific process within the same protocol based on an upstream condition or the type of labware entering the process.	Any device
Signal	The Signal task permits another process that is currently in the wait state to continue to the next task. The wait state is from the Wait For task in the other process.	
Spawn Process	The Spawn Process task is used to initiate another process within the same protocol. For example, to reduce evaporation, you can use Process Control task to deliver a certain labware into the system only when they are ready to be processed. You can also use the Process Control task with JavaScript code to use operator-supplied information to initiate a new process or funnel incoming labware into a different process depending on the barcode.	
User Message	The User Message task: <ul style="list-style-type: none"> Displays reminder messages. For example, the message can remind the operator to change pipette heads, empty the waste container, empty a reservoir, or replace labware. Prompts operators for variable values. The protocol run is paused until the operator clicks Continue, or supplies the requested variable value and clicks Continue.	
Wait For	In a multi-process protocol, the Wait For task pauses the process that contains the task and waits for the go-ahead signal from another process before continuing to the next task. The go-ahead signal comes from the Signal task in the other process.	

6 VWorks specifications

VWorks forms

Task	Description	Available for
Wait for User (Agilent Bravo) <i>Note:</i> This task is available for a Bravo Platform that is equipped with a legacy pendant that has a Go button.	<p>The Wait For User (Agilent Bravo) task pauses the protocol and waits until the operator presses the go button on the pendant. When the operator presses the go button, the protocol resumes.</p> <p>You use the Wait For User task if you want to perform a task manually at the desired point in the protocol. For example, you can use the Wait For User task to pause the run so that you can manually replace a microplate on the deck. When you are finished, you press the go button on the pendant.</p> <p><i>Note:</i> Alternatively, you can use the User Message task to insert a pause in a protocol. Use the User Message task instead of the Wait For User task if you have easier access to the computer than the pendant during a run</p>	Bravo Platform
Step Started/Step Completed	<p>The Step Started/Completed task requires a connection to the Experiments database.</p> <p>The Step Started/Completed task is used to mark a given Step (task sequence) in a protocol as having been started or having completed. Steps are used to track which tags are relevant to a given application run, and which have not had the underlying part of the protocol executed yet.</p>	Protocols with a connection to the Experiments database

VWorks forms

A form provides a simplified interface, which can be helpful for users who have limited or infrequent experience with the VWorks software. VWorks administrator or technician access is required to create protocol forms.

Form designer overview

The Form Designer window has four primary areas:

Area	Description
Available Controls	The control palette, which includes three categories from which to select controls and indicators.
Form Canvas	<p>The work area where the form's author arranges the form controls while viewing a representation of the form. Three buttons are included in this area by default: Run Protocol, Pause, and Full Screen on/off.</p> <p>As you drag controls into position in the Form Canvas, invisible grid lines assist with the alignment based on the controls that are already in the form.</p>
Control Properties	The properties associated with a control that is currently selected in the Form Canvas.

Area	Description
Form Properties	The properties that apply to the entire form, such as the background color and the context for JavaScript variables that are used in the form.

Available controls overview

The Available Controls area of the Form Designer window contains the following areas, each of which provides different types of controls that you can use in your form design:

Area	Description
Available Controls	The control palette, which includes three categories from which to select controls and indicators.
General Controls area	Most of the controls in the General Controls area can be assigned a JavaScript variable. By assigning a JavaScript variable, you can allow form users to edit task parameter values or enable the display of runtime data. The JavaScript variable must be assigned in both the control properties and in the corresponding task parameter in the protocol.
Specialized Buttons area	The Specialized Buttons area contains button controls that are already programmed to perform commands that are currently available elsewhere in the VWorks window, such as Run Protocol and Pause.
Specialized Display Controls area	The controls in the Specialized Display Controls area display data that is not drawn from a JavaScript variable. These controls include Elapsed Time, Overall Progress, and Experiment ID.

Error library

About the Error Library

If you are a VWorks administrator or technician, you can use an error library to:

- Display or hide certain error messages during a protocol run. Hiding minor errors reduces the number of interruptions in the protocol run.
- Automate error recovery responses for selected errors to reduce the number of manual interventions in a protocol run.
- Track the frequency of certain errors for troubleshooting, establishing standard automated recovery responses, or quality-control reporting.

You can add error messages to the error library to set up display options and automated responses. When you initialize a device or run a protocol and an error dialog box opens, click **Add to Error Library** to add the displayed error message to the error library.

Enabling the Error Library

In the Error Handlers tab of the Error Library tool, you can set the parameters to identify the error handlers. An error handler is a set of conditions that define a specific response to an error. For details, see the [VWorks Automation Control 14.1 User Guide](#).

Viewing and tracking error occurrences

You can view all the errors that have occurred during the protocol run that have not yet been assigned an error handler. The error library records the frequency of their occurrences and other information to help you determine whether you want to add them to the library and what automated response to specify.

The list of errors can be sorted by a given parameter by clicking the corresponding column heading in the dialog box.

Macro Library

About macro libraries

A macro library is a collection of VWorks task macros (see ["Protocol components" on page 33](#) for a definition of a task). Each macro is an abbreviated grouping of task sequences that you can reuse when creating protocols.

Creating and using a macro library

If you are a VWorks administrator or technician, you can create a Macro Library (.mlb file) and have the macros displayed and available when creating a protocol.

Multiple macro libraries can be created but only one macro library is used in a VWorks session.

Macro libraries can be managed like other protocol-associated records.

Exporting and importing

You can export and import protocols and their associated records to transport protocols between computers, back up and recover protocols and associated files, and to facilitate troubleshooting problems with protocols and other files when seeking assistance from Agilent Technical Support.

VWorks files you can export

You can export or import the following:

- Protocol file
- Form file
- Runset file
- Device file, including the device profile and teachpoint file

- Macros used in the exported protocol or the entire macro library (.mlb file)
- Labware definitions
- Liquid classes
- Pipette techniques
- Hit-picking files
- Plate map files
- Barcode files
- Error library
- JSWrapper task files
- Log files

You can also export and import inventory data files. See [“Inventory Editor” on page 30](#).

Exporting protocols and associated records

You can export files from Shared Services storage if you have administrator, technician, or operator privileges.

VWorks Plus only. The software performs tamper detection on the files selected for export and prevents you from exporting a file that is corrupted or has been modified outside of the VWorks software.

Importing protocols and associated records

VWorks Plus only. If the imported .vzp file was exported from VWorks 14.0 or later, the software does the following:

- Performs tamper detection on the imported file before parsing the file contents. If the software detects that the file is corrupted or has been modified outside of VWorks 14.0 or later, an error message appears and you cannot import the file.
- Prevents you from overwriting a protocol file of the same name if the file is in the validation or released state. In this case, you can import the file only if you rename it.

VWorks Backup Manager

You use the Backup Manager to back up and restore the Inventory databases, labware definitions and liquid classes, and pipette techniques. The Backup Manager stores the backup in a .vbk file.

VWorks logs

You cannot edit or delete log entries within the VWorks software, and you cannot change the storage location for the log files. However, you can download copies of the log files from Shared Services storage to a location of your choice.

Types of logs

Main Log

The Main Log contains all of the actions that occur within the VWorks software, including changes to device profiles in the diagnostics software. The main log contents are listed in the following table.

Table Main Log contents

Column name	Description
Timestamp	Time and date of the event or error.
Class	Type of event or error message: <ul style="list-style-type: none"> • Info • Event • Error • Warning
Device	Device at which the event or error occurred.
Location	Location where the event or error occurred.
Process	Name of the protocol process and subprocess that is running.
Task	Task at which the event or error occurred.
Description	Description of the action that is being recorded.
File name	Name and location of the protocol file.
Session ID	Login session number.

Pipette Log

The Pipette Log contains all pipetting events and error information. The pipette log contents are listed in the following table.

Table Pipette Log contents

Column name	Description
Timestamp	Time and date of the pipetting event or error.
Class	Type of event or error message: <ul style="list-style-type: none"> • Event • Transfer
Session ID	Login session number.
Device	Device at which the event or error occurred.
Volume	The volume of liquid transferred.
Aspirate Location	The location at which the Aspirate task occurred.

Column name	Description
Aspirate Selection	The wells from which the fluid was drawn for the Aspirate task.
Dispense Location	The location at which the Dispense task occurred.
Dispense Selection	The wells into which the fluid was dispensed.
Location	Location where the event or error occurred.
Description	Description of the action that is being recorded.
File name	Name and location of the protocol file.

Time Constraints Log

The Time Constraints Log contains all the information about time-limited task events and errors. The Time Constraints Log contents are listed in the following table.

Table Time Constraints Log contents

Column name	Description
Timestamp	Time and date of the event or error.
Class	Type of event or error message: <ul style="list-style-type: none"> • Info • Event • Error • Warning
Session ID	Login session number.
Start Process	The name of the protocol process or subprocess that contains the first of the two dependent tasks.
End Process	The name of the protocol process or subprocess that contains the second of the two dependent tasks.
End Task	The task number that identifies the second of the two dependent tasks.
Target Interval	The time specified in the Edit Time Constraints dialog box.
Allowed Deviation	The time tolerance specified in the Edit Time Constraints dialog box.
Actual Interval	The length of time of the first task during the run.
Actual Deviation	The difference between the Target interval and the Actual interval.
Error	The result of the following: Actual deviation – Allowed deviation If the result is less than 0, Error is set to 0.

Column name	Description
Description	Description of the action that is being recorded.
File name	Name and location of the protocol file.

Device mini-logs

The diagnostics software for each device plugin includes a mini-log that records changes to the device profile. This activity is saved in the Main Log in VWorks.

Viewing the logs

You can view the VWorks logs in the following ways:

- *VWorks window.* You can display the logs for the current VWorks session in the VWorks window.
- *VWorks log files.* You can display the contents of log files from previous VWorks sessions in the following ways:
 - *View a downloaded copy of the log file.* If you are a VWorks administrator or technician, you can use the Log Management command to save a copy of a log file to a location of your choice. You can use a text editor, such as Notepad, to view the copy of the log file.
 - *View a log file in the Content Browser.* Available only for VWorks Plus, an administrator can use the browser to view files in the Content Management repository.

Validating and saving a copy of a log file

The Log Management tool enables you to validate and save a copy of a log file.

- **Save As.** The software validates the selected file to determine if it has been altered or corrupted.
 - If the validation is successful, the Save Old Log File As dialog box opens and allows you to save a copy.
 - If the validation is not successful, an error message appears and the save as procedure is aborted.
- **Validate.** The software validates the selected file to determine if it has been altered or corrupted.

The software checks the log file and displays a message that explains whether the validation is successful.



7 Compliance

This chapter provides the functional design specification for the compliance component of VWorks 14.1 software.

The topics are:

- “VWorks features that support 21 CFR Part 11” on page 54
- “Audit trail content and options” on page 55
- “Records of interest” on page 56
- “E-Signatures in VWorks” on page 60
- “Tamper detection in VWorks” on page 61

VWorks features that support 21 CFR Part 11

The FDA rules and guidelines for compliant electronic records and computerized systems require secure data handling. The following table lists the applicable VWorks Plus features.

Table Features that support 21 CFR Part 11

Feature	Description
Authentication, security, and user management	Prevent unauthorized access and unauthorized modification of records of interest. The Control Panel enables management of users, groups, roles, and privileges.
Content Management	Provides secure storage with access control.
Control Panel system activity log	Records events that occur during a Control Panel session, for example, logging in, updates to users, groups, or roles, updates to licenses, and so forth.
Backup and restore procedures for the software and Content Management.	Provide procedures required for disaster recovery planning.
VWorks activity logs	Record events that occur during a VWorks session. The logs include the Main log, Pipette log, and Time Constraints log. The Diagnostics software for each device displays a profile activity log, which is also stored in the Main Log.
Audit trails and reports	Provides traceability for records of interest, documenting who did what and when. An audit file is logged for each record of interest.
Record state tracking	Provides control of records that transition through development, validation and released states to ensure record integrity and traceability. The software also increments the version of a record of interest each time a change is saved.
Electronic signatures	Enables e-signatures allowing users to sign off on a record before transitioning it to the next record state and to close an experiment ID.
Tamper detection	Detects corrupted records and records that have been modified externally from VWorks Plus.
Exporting and importing protocols	Provides a means to export protocols and associated components to an archive file (.vzp) that can be used to transport protocols between computers, back up and recover protocols, and facilitate troubleshooting problems with protocols and other files when seeking assistance from Agilent Technical Support.

Feature	Description
Backup and Restore features	<p>Provides a means to backup and restore the following files from an archive file (.vbk).</p> <ul style="list-style-type: none"> • Labware entries • Labware classes • Liquid classes • Pipetting techniques • Database file (.sql) for labware inventory

Audit trail content and options

VWorks Plus logs audit trails for files that are considered to be records of interest (ROI). Each record is stored in the Content Management Repository and includes its audit trail and a checksum file. The software uses the checksum file for tamper detection.

The audit trail contains the following for each change to a record of interest.

Table Audit trail contents

Column	Description
Local Time	The local date and time of a change to the record of interest.
UTC Time	The UTC date and time of a change to the record of interest.
Computer name	The name of the computer on which audit trail is generated.
Software Version	The version and build of the VWorks software running on the computer listed above.
User	The user name of the logged-in user who made the change to the record of interest.
State of ROI	<p>The development state of the record of interest:</p> <ul style="list-style-type: none"> • Released, In Validation, or, if applicable, In Development. Logging an audit trail for records in the development state is optional. • Pending. A record that is pending one or more esignatures. • Exempt. For details, see “Records exempt from state changes” on page 57.
Description	A software-generated description of what the changes were.
Audit Comment	<p>A comment (reason for the change) that the user entered in the Audit Comment dialog box for this change.</p> <p>Whenever a record for which the software has logged an audit trail is modified, the Audit Comment dialog box opens and requires the user to enter a comment before saving the record. Comments are restricted to 256 characters.</p>

Audit trail options

By default, the VWorks software is not configured to log audit trails for records that are in development. If you want to log audit trails for records in development, you can use the options in the Options dialog box to set your preferences.

The audit trail options are described in the following table.

Table Audit trail options

Column	Description
Log audit trail for records of interest that are in development state	The option to maintain an audit trail for development state records. You cannot delete records for which VWorks logs an audit trail.
Automatically change the state of dependent records	The option to automate record state changes for dependent records when you change the state of a record of interest.
Prompt user with a list of device profiles when running a protocol in RELEASED state	The option to list all the referenced device profiles that are in the validation state when running a protocol that is in the released state, or when running a protocol that references a device file that is in the released state.

Audit trail reports

Audit reports can be generated for any audit trail of a record of interest. The software performs tamper detection on any record selected for the audit trail report. A report cannot be generated for a record if the software detects tampering or corruption of that file.

Records of interest

VWorks has two categories for records of interest:

- 1 Records that are subject to development state changes
- 2 Records exempt from state changes

Records that are subject to development state changes

Records of interest can exist in any of the following four state stages:

- **In Development.** By default, the software does not create an audit trail log for records in development. However, the software includes an option to log the audit trail entries for In Development records.
- **In Validation.** An audit trail is logged for In Validation records. Such records may be modified but not deleted. The Audit Comment dialog appears any time you modify and save a record in this state.
- **Released.** The software prevents any changes to records that are in the Released state. If you attempt to save a change for a released record, a message appears stating This record is released and cannot be changed.

Records exempt from state changes

VWorks logs all the audit trail entries for an exempt record of interest starting from the creation of the file. The Audit Comment dialog appears any time you modify and save a record of interest that is exempt from record states.

Table Records of interest that are exempt from record state changes

Record of interest (file extension)	Description
VWorksOptions (.xml)	A global options file that specifies parameter settings that apply to all the protocols on the computer running VWorks Plus. The software logs an audit trail for this record, starting with the creation of the record and tracks any subsequent changes.
Labware class (.xml)**	A file that lists a collection of labware entries that can be used with a given device, for example, Uses Standard Platepad or Uses Filter Platepad.
Teachpoint file (.xml)	A device-dependent file that contains your teachpoint settings, for example, a BenchCel teachpoint file.
Miscellaneous files that are imported into the Content Management Repository. The software logs an audit trail for the following records after they are imported into the Repository.	
Barcode files (.bar, .csv, or .txt)	An input file for specifying the barcodes to apply to a microplate.
Excel files (.xlsx, .xls, or .xlsm)	A utility for calculating volume requirements or for creating a method used by the AssayMAP Protein Sample Prep Workbench.
Gantt chart files (.gnt)	An input file used by the Hit Pick Replication task. The file contains information about the source microplate and specifies the dispense pattern in destination microplates.
Hitpick input files (.csv)	An input file used by the Hit Pick Replication task. The file contains information about the source microplate and specifies the dispense pattern in destination microplates.
Image files (.jpg, .png, .bmp, or .ico)	A labware inventory database file.
Experiments database files (.expTags)	Archived files and exported files that contain experiment data in XML format. The software saves these files to the local file system, not Shared Services storage.
JavaScript (.js)	A text file that contains JavaScript code that is used to execute instructions, for example, in a protocol task. The JS Wrapper task uses a JavaScript task file (.js).

VWorks records that transition through states

The following table lists the records of interest (ROI) that are tracked based on their development state. Changes to this type of record:

- **In Development.** Changes may be logged to an audit trail depending on the setting in the Options dialog box.

- **In Validation.** Changes are always logged to an audit trail.
- **Released.** No changes are permitted.

Table Records of interest that are tracked based on their development state

Record of interest (file extension)	Description
Device file (.dev)	A file that contains: <ul style="list-style-type: none"> • The list of devices the software will communicate with and control • Configuration information of each device • Communication settings (profile)
Device profile (.xml)	A file that contains a collection of settings that the VWorks software uses to communicate with a specific device, for example, the Bravo Platform. Although profiles can transition from the In Development state to the In Validation state, these records cannot transition to the Released state. This exception is necessary because adjustments to the teachpoints for a given device may be required if the instrument is moved to another location or if a hardware collision occurs. A teachpoint adjustment would result in an update to the device profile.
Error library (.elb)	A file that contains a collection of automated error responses.
Form file (.VWform)	A file that provides a simplified user interface for running a protocol.
Hit pick format (.xml)	A file that is used by hit picking protocols to specify the destination well pattern and a few other items.
Labware entry (.xml)	A file that contains a collection of labware properties that the VWorks software uses to handle a given labware type in the automation system. <i>Note:</i> Each labware entry is assigned to a labware class or classes. Labware classes are exempt from record state changes, but labware entries in the released state cannot be removed from a labware class.
Liquid class (.xml)	A file that specifies pipetting settings, set up for different liquid types.
Macro library (.mlb)	A file that contains a collection of macros. A macro is a collection of protocol tasks in an abbreviated form that you can insert at various places within the same protocol or throughout other protocols where the same task sequence is required.
Pipette technique (.xml)	A file that specifies the x- and y-axis offset when pipetting.
Protocol file (.pro)	A file that contains instructions for performing a run.
Runset file (.rst)	A file that specifies a collection of protocol runs that can be scheduled in advance to be performed without operator intervention.

Record of interest editing

Each record of interest that transitions through the record states has different limits on editing or deleting files, as described in the following table.

Table Editing options in different record states

Record state	Description	Editing of record allowed?
In Development	The VWorks software assigns this state to new records. By default, the software does not log an audit trail records in development.	Administrator or VWorks technician may edit files. Only administrator can delete files.
Pending	The VWorks software assigns this state to a record that is awaiting one of more e-signatures before transitioning to the next state.	No editing or deleting allowed.
In Validation	A VWorks administrator or technician can change the record state from In Development to In Validation. The software logs an audit trail for all In Validation records.	VWorks administrator or technician may edit but cannot delete these files.
Released	A VWorks administrator or technician can change the record state from In Validation to Released. The software logs an audit trail for all Released records.	No editing or deleting allowed.

Protocols and record-state dependencies

A VWorks protocol has dependencies on other records of interest, such as a device file, labware entries, and so forth. To run a protocol successfully, the dependent records must have a state equal to or greater than the protocol. For example, if you attempt to run a released protocol with labware entries that are still in validation, an error message appears and you must abort the protocol.

The following table lists record states permitted for dependent records at each development state of the protocol.

State of the protocol	State of the dependent records
In Development	Any of the 3 record states
In Validation	In Validation or Released only
Released	Released only

Labware classes and teachpoint files (BenchCel) are exempt from record state changes.

Device profiles cannot transition to the released state, because teachpoint adjustments may be required if a device is moved to another location or if a hardware collision occurs.

Prerequisites of record state changes

- VWorks Technician privileges or greater are required to change the state of the record.
- If e-signatures are enabled, all specified e-signature levels must be completed to transition a record.
- You cannot change a record's state if it references other records that are at a lower state.

For example, if you are transitioning a protocol from In Development to In Validation, the labware entries must have a state of at least In Validation. In this case, you can either:

- Manually change the state of each dependent record before transitioning the protocol.
- Select the option for the software to change the state of dependent records automatically.

E-Signatures in VWorks

Signature levels specify the users or user groups that may sign records and the order in which the users may sign. An administrator initially configures the signature levels in OpenLab Control Panel. For details, see the [VWorks Plus Configuration and Administration Guide](#).

Prerequisites

The OpenLab electronic signature service uses a PostgreSQL database, which is installed with the VWorks software. Before the E-Signatures feature is available for VWorks use, a connection to the VWorks E-Signatures database must also be established.

Records that can be signed

The VWorks software can prompt for a signature in the following cases.

Record type	E-signature requirements
Records of interest that transition through record states	E-signatures are required to transition a record from <ul style="list-style-type: none">• In Development to In Validation• In Validation to Released If the user who initiates the transition has the credentials to sign at this stage, a dialog box opens and provides this option.
Experiment IDs	E-signatures are required when an experiment ID is closed.

E-Signature contents

E-Signatures store the following information.

Table E-Signature record contents

Column	Description
Level	The numeric signature level. Up to 5 levels may be configured, where 5 is the highest level signature.
Level Name	The level name assigned by the administrator.
Signed By	The full user name and (user login).
Local Time	The datetime stamp in local time.
UTC Time	The datetime stamp in UTC time.
Meaning	The meaning of the signature level.
Comment	The comment entered by the user when signing.
Is valid?	True indicates that a signature was posted successfully. False indicates previously posted signatures that were revoked.

Tamper detection in VWorks

Tamper detection verifies the data integrity of records of interest. The feature detects corrupted records and records that have been modified outside of the VWorks software.

Examples of tampering include:

- Deleting any file from a record of interest archive (.roiZip) in Content Management.
Note: All records of interest are stored in an .roiZip archive that includes the audit trail file and a checksum file.
- Modifying parameter values in any file outside of the VWorks software.
- Changing the structure of an .xml file, such as removing any closing or opening XML tag.

If the software detects tampering, an error message advises you that the file cannot be loaded and to contact the VWorks administrator to try to recover the file. In this case, the VWorks administrator can restore a backup copy or use the Content Browser to recover a previous version of the record. For details, see Guides for VWorks Plus edition.

When does tamper detection occur

The Vworks software performs tamper detection for the following actions:

Table When tamper detection occurs

Action	Description
Starting the VWorks software and logging in	Checks the VWorks Options.xml file for tampering as well as any files referenced in VWorks Options, for example ErrorLibrary.elb or MacroLibrary.mlb files.
Using the Tamper Detection command	Checks the records of interest stored in the Content Management Repository to verify the data integrity.

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Tamper detection in VWorks

Action	Description
Opening a record of interest	Checks the record for data integrity before opening the file.
Performing a protocol run	Checks the protocol when the protocol is compiled. During a run, tamper detection occurs at the point in the run when a task parameter value is set by a script or variable and the task actually executes.
Importing a VWorks protocol archive (.vzp file)	Checks the .vzp archive contents if the .vzp was created in VWorks version 14 or later.
Importing or restoring experiments in the Experiments Editor	Checks an experiment file that was archived or exported before allowing you to restore or import the file.
Importing an Inventory database file (.sql)	Checks the file that was exported before allowing you to import the file.
Using VWorks Backup and Restore (.vbk file)	Checks the selected files during: <ul style="list-style-type: none">• <i>Backup</i>. An error message lists any corrupted records and provides the option to continue the backup for clean records only.• <i>Restore</i>. A Restore operation cannot proceed if the backup (.vbk file) is corrupted or has been tampered.
Generating an audit trail report	Checks the selected record of interest, and generates the audit trail report if the record has not been corrupted or tampered.

Tamper detection responses when opening a record of interest

When you open a record of interest, the software checks the given record for data integrity before loading it. If a record is corrupted or has been tampered, the response can vary depending on the file, as the following table shows. To resolve the problem, an administrator can use the Content Browser to restore a previous, clean version of a record.

Table VWorks response to a corrupted or tampered record

Type of record	VWorks response if record is corrupted or has been tampered
A single record of interest, for example, a device file or labware entry	A message states that the file has been corrupted or modified outside of the VWorks software and cannot be loaded.

Type of record	VWorks response if record is corrupted or has been tampered
A record of interest that references or contains other records	<p>The software response depends on the record type, for example:</p> <ul style="list-style-type: none"> • <i>Runset that includes a corrupted protocol.</i> A message lists the corrupted record and states that the runset cannot be loaded. • <i>Protocol that references a corrupted record.</i> A message lists the corrupted record and states that the record cannot be loaded. • <i>Form that references a corrupted record.</i> The form loads successfully, but the corrupted record (for example, protocol, device file, or runset) cannot be loaded. • <i>Labware class that contains a corrupted labware entry.</i> The labware class loads successfully, but the corrupted labware entry cannot be loaded.
VWorks Options.xml file (Options dialog box)	<p>The software response depends on the issue:</p> <ul style="list-style-type: none"> • If the VWorksOptions.xml file is corrupted or tampered, an error message states that the VWorks software must close. In this case, an administrator can use the Content Browser to restore a clean backup copy of the file or a previous version of the file. • If a file referenced by VWorks Options, such as the error library or macro library, is corrupted or missing an error message states that the file cannot be loaded. • If the VWorks Options.xml file is missing, an error message opens and advises that the software will load the default values for VWorks Options. <p>An administrator can click Tools > Options, and then verify the settings in the Options dialog box.</p>
Error library or macro library	A message states that the file has been corrupted or modified outside of the VWorks software and cannot be loaded.

Restoring records

An administrator can restore records in the following ways:

- Rollback the version of a selected record to a previous clean version in the Content Browser.
- Restore records from a clean backup copy.

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Tamper detection in VWorks

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8 VWorks Plugins

This chapter provides an overview of the devices supported by VWorks 14.1 software.

The topics are:

- “Devices supported by VWorks” on page 66
- “Bravo Platform” on page 66
- “BioTek Liquid Handler” on page 68
- “BenchCel Microplate Handler” on page 68
- “Centrifuge with Loader” on page 68
- “Microplate Labeler” on page 68
- “BioTek Gen5 Reader” on page 68
- “Microscan Barcode Reader (Mirrored Barcode Reader)” on page 69
- “Labware MiniHub” on page 69
- “PlateLoc Sealer” on page 69

Devices supported by VWorks

Device Plugins

The VWorks software uses device plugins to communicate with and control Agilent specific devices. A device can be a robot, an instrument, or a location in the lab automation system that can hold a piece of labware.

When you start the VWorks software, the icons of the plugins for the supported devices are listed in the Available Devices area of the window.

Device type	Description
Labware-handling devices	<ul style="list-style-type: none">• Agilent BenchCel• Agilent Centrifuge• Agilent Centrifuge Loader• Agilent Labware MiniHub• Agilent Microplate Labeler• Agilent Microscan Barcode Reader (Mirrored Barcode Reader)• Agilent PlateLoc
Liquid-handling devices	<ul style="list-style-type: none">• Agilent Bravo• BioTek Liquid Handler (VWorks 14.1 and later)
Microplate readers	BioTek Gen5 Reader (VWorks 14.1 and later)
Phantom devices	Virtual devices that permit the manual movement of labware during a protocol run: <ul style="list-style-type: none">• Agilent Phantom Human Robot• Agilent Phantom Stacker
Location devices	Devices where you can place a piece of labware: <ul style="list-style-type: none">• Platepad (installed outside of Bravo Platform)• Waste Bin
Devices for manufacturing use only	<ul style="list-style-type: none">• Agilent Generic I/O Module• Agilent Generic RS-232 Device

Bravo Platform

The Bravo Platform is a versatile liquid handler with a nine plate-location deck that is suitable for handling 96-well, 384-well, and 1536-well microplates (plates). The platform uses interchangeable liquid-handling heads. It can also be equipped with a gripper that enables automatic microplate pickup and placement.

To ensure pipetting accuracy, Bravo IQOQ is available for purchase. See [“Bravo IQOQ” on page 11](#).

The Bravo Platform can be used in the following ways:

- As a single device controlled by a computer
- Integrated with other devices in a lab automation system

For example, when used as a single device, it can be placed in a laminar flow hood for use with cell-based applications or handling potentially hazardous materials.

As an integrated device in a lab automation system, it can be used to prepare microplates for high-throughput screening or other automated process.

The Bravo Platform can be accompanied by a multitude of accessories some of which are listed in the table below. For a complete list of all available accessories and more detailed information, see the [Bravo Platform User Guide](#).

Table Some of the accessories available for the Bravo Platform

Accessory	Description
Autofilling accessories	<p>Consists of the following:</p> <ul style="list-style-type: none"> • Pump Module • Auto Filling Reservoir, Tip Wash Station, or Open Wash Tray • Weigh Station (optional) <p>The pump module has two peristaltic pumps, one that pumps the fresh source fluid into a reservoir, and a second one that pumps the waste fluid from the reservoir. Optionally, you can use the Pump Module with an Agilent Weigh Station to provide precise liquid- level control for an autofilling reservoir or wash station.</p>
Peltier Thermal Station	Uses Peltier technology to provide temperature control uniformly across a microplate. The station uses the Inheco Single TEC Control (STC) or Multi TEC Control (MTC).
Heating Shaking Station	Provides heating and fluid mixing across a microplate. The station uses the Inheco Single TEC Control (STC) or Multi TEC Control (MTC).
Orbital Shaking Station	Mixes labware contents using a shaking motion.
Vacuum Filtration Station	Uses vacuum to filter the contents of a microplate.
Filter Plate Holder	Provides a location for a filter plate while awaiting assembly of the Vacuum Filtration Station and when disassembling the station.
Thermal Station	Uses a fluid-filled thermal block to provide temperature control uniformly across a microplate.

BioTek Liquid Handler

The BioTek Liquid Handler plugin can be used with various models of BioTek liquid handlers. For a list, see the BioTek Liquid Handler Device Guide for your VWorks version.

BenchCel Microplate Handler

The BenchCel Microplate Handler is a microplate-processing automation device that:

- Stores stacks of labware (microplates, tip boxes, and tube racks) to be processed during a protocol run.
- Moves labware to and from integrated devices such as the Bravo Platform, PlateLoc Thermal Microplate Sealer, or Microplate Labeler for processing.

Centrifuge with Loader

The Agilent Microplate Centrifuge with Loader consists of an automated centrifuge and a robotic microplate handler:

- The Centrifuge has two buckets, each capable of carrying a single microplate, filter plate, or lidded microplate.
- The Loader has a plate stage and a gripper that enables microplate placement by a robotic arm in your automation system. After the robot places a microplate onto the Loader plate stage, the gripper picks up the microplate and moves it into the Centrifuge.

The Centrifuge with Loader is intended to be integrated with a robotic lab automation system.

Microplate Labeler

The Microplate Labeler prints labels and applies them to labware.

You can create and apply the same or a different label on up to four sides of a microplate. Each label can include up to six fields, including a barcode field and human-readable text fields.

A Microplate Labeler can be used in the following configurations:

- Integrated in a BenchCel workstation
- As a standalone device
- Integrated with a third-party lab automation system

BioTek Gen5 Reader

The BioTek Gen5 Reader plugin can be used with various models of BioTek Gen5 readers. For a list, see the BioTek Gen5 Reader Device Guide for your VWorks version.

VWorks Plus 14.1 requires BioTek Gen5 Reader protocols and experiment files to be stored on local drive in visible Windows directories. Gen5 protocols and experiments can be copied to a more secured location once data acquisition and processing is complete.

Microscan Barcode Reader (Mirrored Barcode Reader)

The Microscan Barcode Reader scans barcode labels affixed to a side of a piece of labware.

When used on a Bravo Platform, the Microscan Barcode Reader consists of a platepad with a barcode reader sensor head and a mirror. The Microscan Barcode Reader can be installed in place of a platepad at any deck location and is designed to scan barcodes on the east or west side of microplates.

Labware MiniHub

The Labware MiniHub is a rotating random-access labware storage device. Up to four labware can be placed on each shelf. Spacing blocks, also called spacers, can be added or removed to adjust the distance between shelves, accommodating different labware types (microplates, tip boxes, or tube racks).

The Labware MiniHub is designed to be configured with the BenchCel Microplate Handler.

PlateLoc Sealer

The PlateLoc Sealer applies a sealing material on top of microplates to seal individual wells.

The PlateLoc Sealer can be used as a standalone device or in a robotic lab automation system.

The Gas-Purging PlateLoc uses argon gas to displace air, containing moisture and oxygen, in the microplate immediately before the sealing begins. Because argon is inert, it does not react with the microplate contents. The microplate contents can be protected from hydration and oxidation for up to 24 hours.

In This Guide

This guide provides functional design specifications for VWorks 14.1 including:

- Software interface
- Software components
- Instrument control specifications
- Compliance features
- VWorks plugins

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