
THE HUB®

# SOFTWARE USER GUIDE

**Process Monitoring, Process Development, Mold Transfer, and Simulation Support**

RJG MOLD SMART

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Rev 10.1.0

# Contents

# Contents

## The Hub for Process Development 30

# Contents

# Introduction

Read, understand, and comply with all following instructions.

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## Privacy



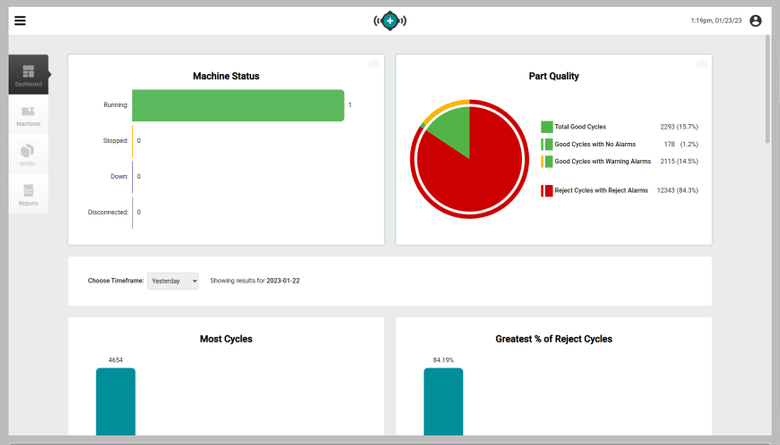
## Alerts

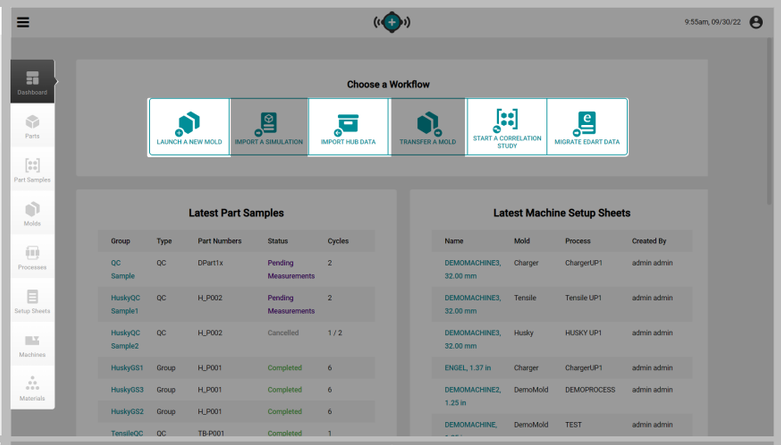
The following alert types are used as needed to further clarify or highlight information presented in this document:

**DEFINITION** *A definition or clarification of a term or terms used in the text.*

**NOTE** *A note provides additional information about a discussion topic.*

**CAUTION** *A caution is used to make the operator aware of conditions that can cause damage to equipment and/or injury to personnel.*










# Introduction (*continued*)

## The Hub Licensed Software Applications

The Hub software is available in different software application packages: The Hub for Process Monitoring; The Hub for Process Development, The Hub for Mold Transfer; The Hub for Simulation Import; and The Hub OPC UA Server. The features described in this guide include all available software application package features; some features may not be available depending upon license purchased.

## The Hub for Process Monitoring

The Hub for Process Monitoring provides the following:

- network-wide status overview
- job status overview
- quick-access graphs
- job reports

## The Hub for Process Development

The Hub for Process Analytics provides the following:

- Summary and detail reports of networked machines/molds
- Overall machine performance and status
- Mold settings
- Alarms or issues
- Historical CoPilot data backup
- Individual machine processes and trends

## The Hub for Mold Transfer

The Hub for Mold Transfer generates part processes with machine-independent values and setup sheets with machine-dependent values; launches new molds using specific mold/machine/process combinations, or transfers existing molds from a user-entered database of mold, machine, part, process, and material records.

## The Hub for Simulation Support

The Hub for Simulation Support provides import of Moldex3D, Moldflow simulation files and a database.

## The Hub OPC UA Server

The Hub® software Open Platform Communications Unified Architecture (OPC UA) server facilitates the transfer of RJG job information, summary variables, and alarm changes from The Hub software to a Manufacturing Execution System (MES) using Transmission Control Protocol (TCP) communication.

# Introduction (*continued*)

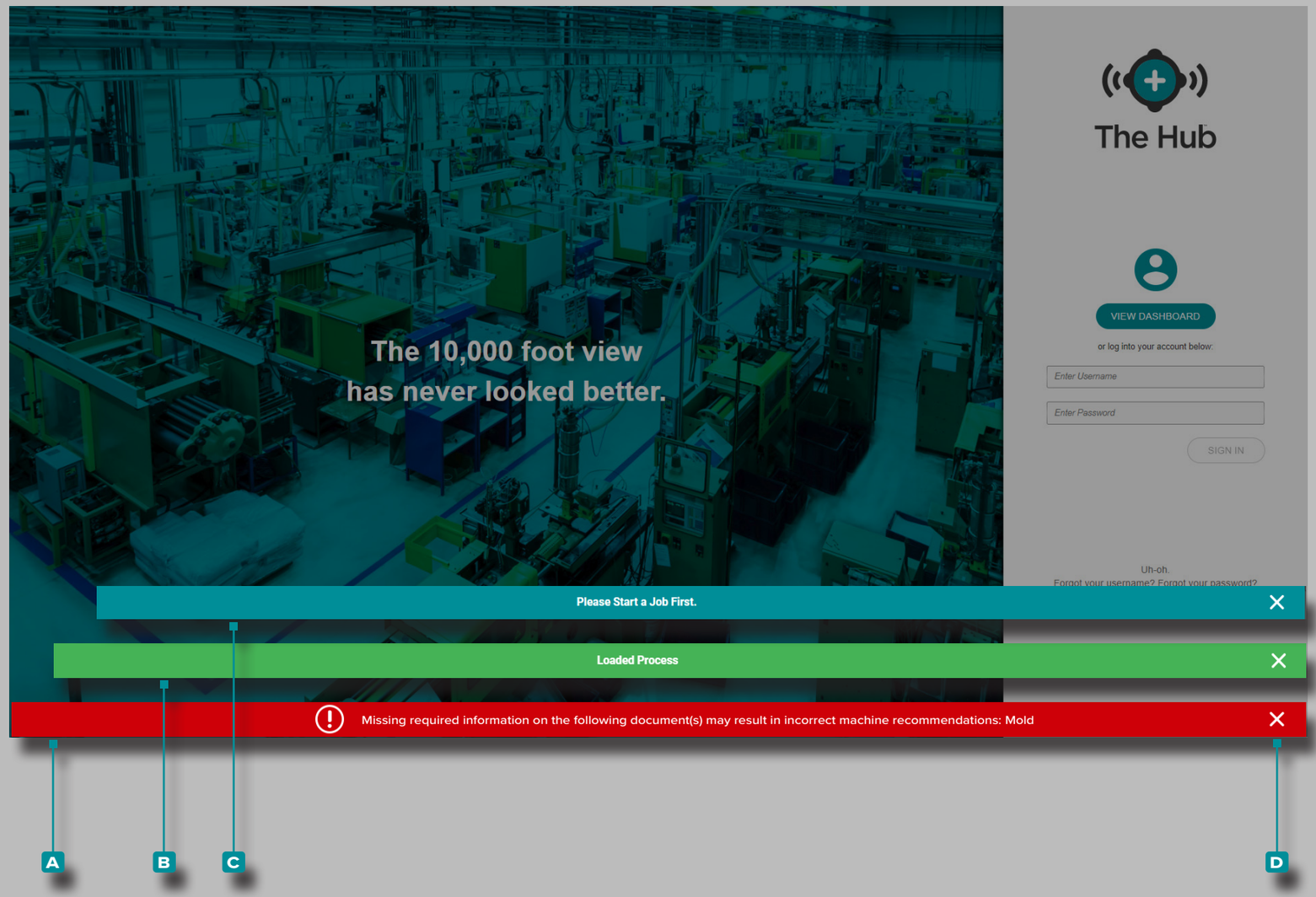
## Software Icons and Navigation

The following details commonly used icons and their functions in The Hub's software.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
|  | **Reload Page** | Click the object to reload The Hub Dashboard view. |  | **Expand Information** | Click the object to view full job information. |  | **Information** | Click the object to view job reports. |
|  | **Select Columns** | Click the object to view and select which column headings to display on the screen. |  | **Exit Window** | Click the object to exit an open window. |  | **Updating Connection** | Hover over the object to view the date/time of the latest connection update. |
|  | **Sort Column** | Click a table heading to sort the contents alphabetically or numerically, click again to change sorting by either ascending or descending order. |  | **Search** | Click the object, then enter a term to search the list of molds, machines, materials, parts, processes, and setup sheets. |  | **Connected/ Activated** | The object indicates a connection or activation status. |
|  | **Check Box** | Click the object to select or deselect. |  | **Filter by Keyword or Phrase** | Click in the field next to the object and enter a keyword or phrase by which to filter the records. |  | **Show Disconnected Machines** | Click the object to view disconnected machines and jobs. |

| | | | | | |
|---|---|---|---|---|---|
|  | **Settings** | Click the object to view available settings for the current item. |  | **Machines** | Click the object to view, create, or edit Machine records. |
|  | **Setup Sheets** | Click the object to view, create, or edit Setup Sheet records. |  | **User** | Tap the object to view user information. |
|  | **Molds** | Click the object to view, create, or edit Parts records. |  | **Compare Records** | Enables the selection of two records for comparison; refer to "Comparing Records" on page 32. |
|  | **Roles** | Tap the object to view role settings and permissions for users. |  | **Processes** | Click the object to view, create, or edit Process records. |
|  | **Launch a New Mold** | Click the object to Launch a New Mold. |  | **Devices** | Tap the object to view device information. |
|  | **Parts** | Click the object to view, create, or edit Parts records. |  | **Import a Simulation** | Click the object to Import a Simulation. |
|  | **Dashboard** | Click the object to view the Dashboard. |  | **Materials** | Click the object to view, create, or edit Material records. |
|  | **Transfer a Mold** | Click the object to Transfer a Mold. | | | |

# Introduction (*continued*)




## Software Notifications

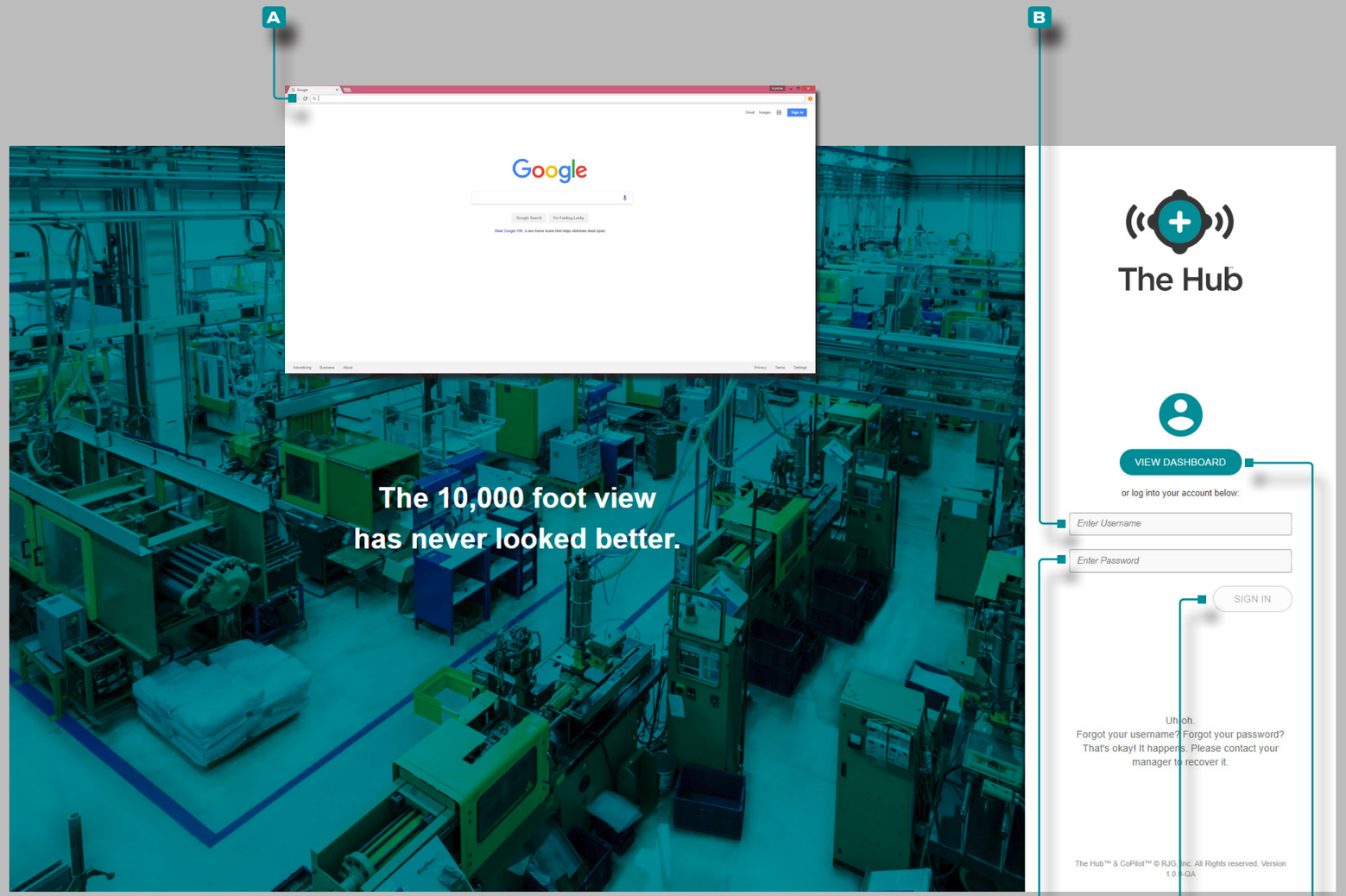
Software notifications appear across the bottom of the screen.

Error **A** notifications appear due to missing or incorrect information, or general software errors; *error notifications may be red or yellow, depending upon the required action's urgency*. Read the error to determine the error type and the corrective action required.

Success **B** notifications appear as a confirmation of any changes or commands that have been made in the software.

Information **C** notifications provide additional information for user assistance.

**Tap** the **D** exit icon to dismiss the notification from the screen.



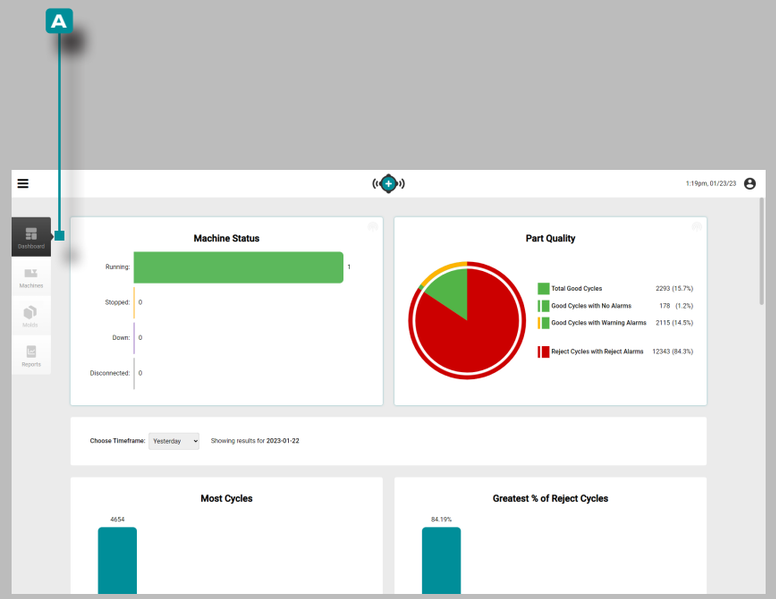

# Introduction (*continued*)

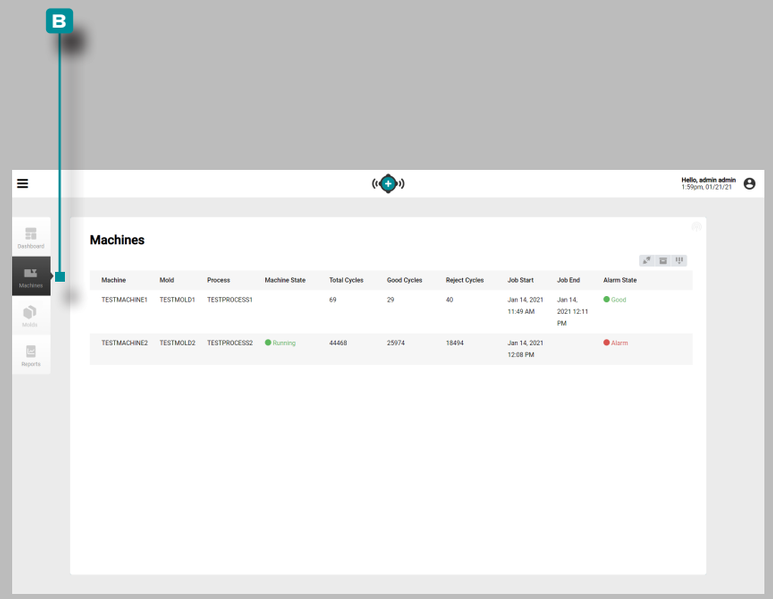
## User Login

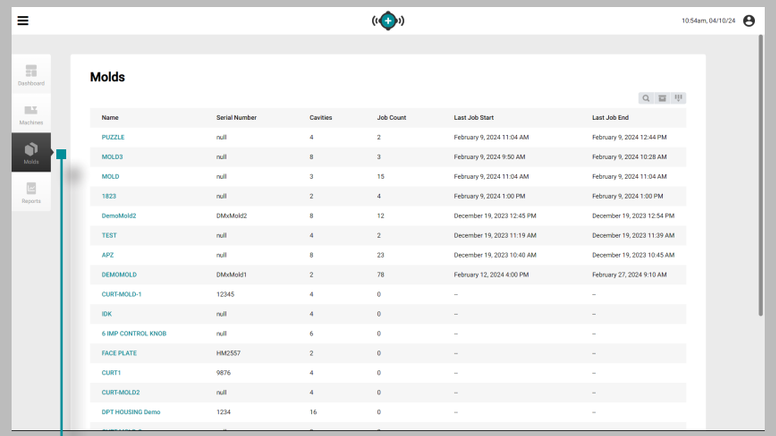
To view The Hub® software, open A Google Chrome and **enter** the assigned IP address or domain in the browser address bar.

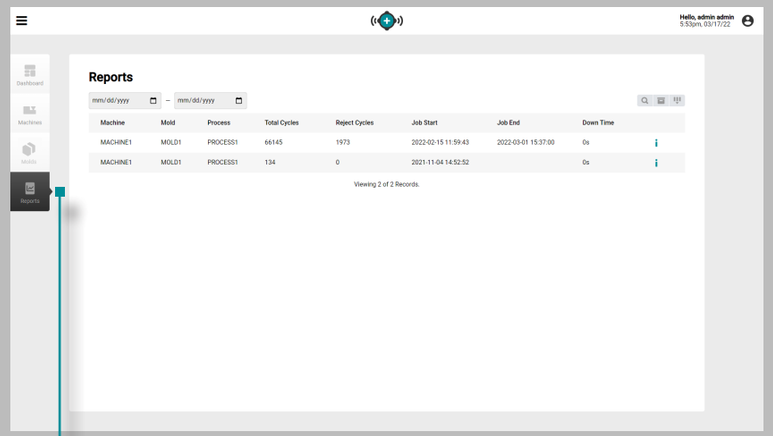
The Hub software requires users to log in with a username and password before use. **Enter** the assigned B username and C password, then **click** the D Sign In button to log in to the Hub.

Users without usernames and passwords may view the dashboard only; **click** the E View Dashboard button to view the Dashboard.




# The Hub for Process Monitoring

## Application Overview

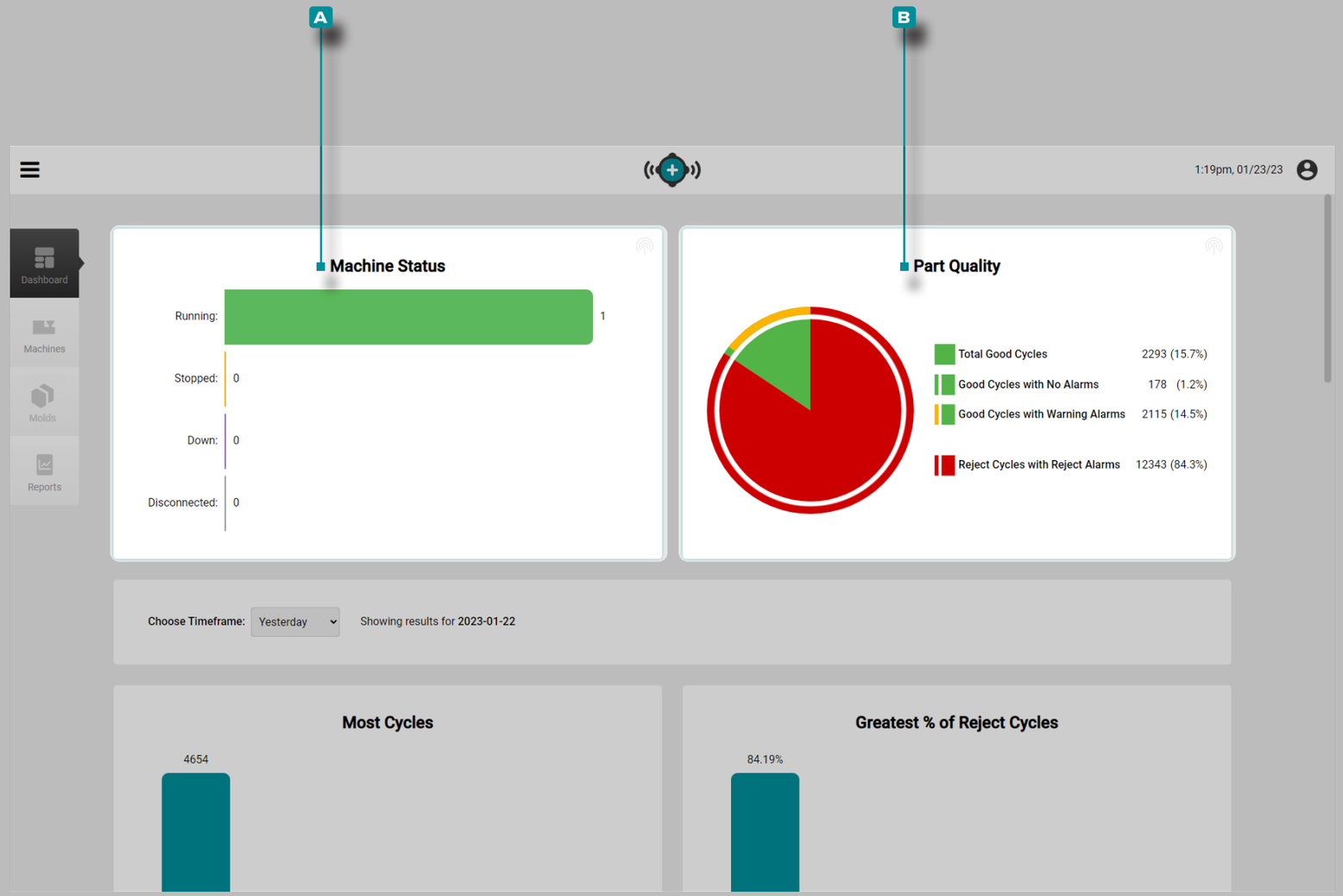
The Hub for Process Monitoring has three main pages, or views, where users can access data, view graphs and records, and generate reports.

The **A** Dashboard view provides an overall view of the machine status and part quality in the network, along with eight pre-populated, mini-reports, all displayed within a selectable time frame.

The **B** Machines view provides a detailed view of each machine and machine status in the network.

The **C** Molds view provides an overview of all jobs for each mold.

The **D** Reports view provides a record of jobs by machine.




# The Hub for Process Monitoring

## Dashboard

The Dashboard provides an overall view of machine status and part quality in the network in the A Machine Status Graph, B Part Quality Graph, and eight pre-populated tables that display the top five jobs within the selected time range in each category: Most Cycles, Greatest [Percent] % Reject Cycle, Most Alarms, Longest Down Time, Longest Run Time, Exceeded Cycle Time, Machine Out of Match, and Mold Out of Match.

The Dashboard A Machine Status Graph and B Part Quality Graph display job data from jobs that have been active within the past 24 hours.

### Machine Status Graph

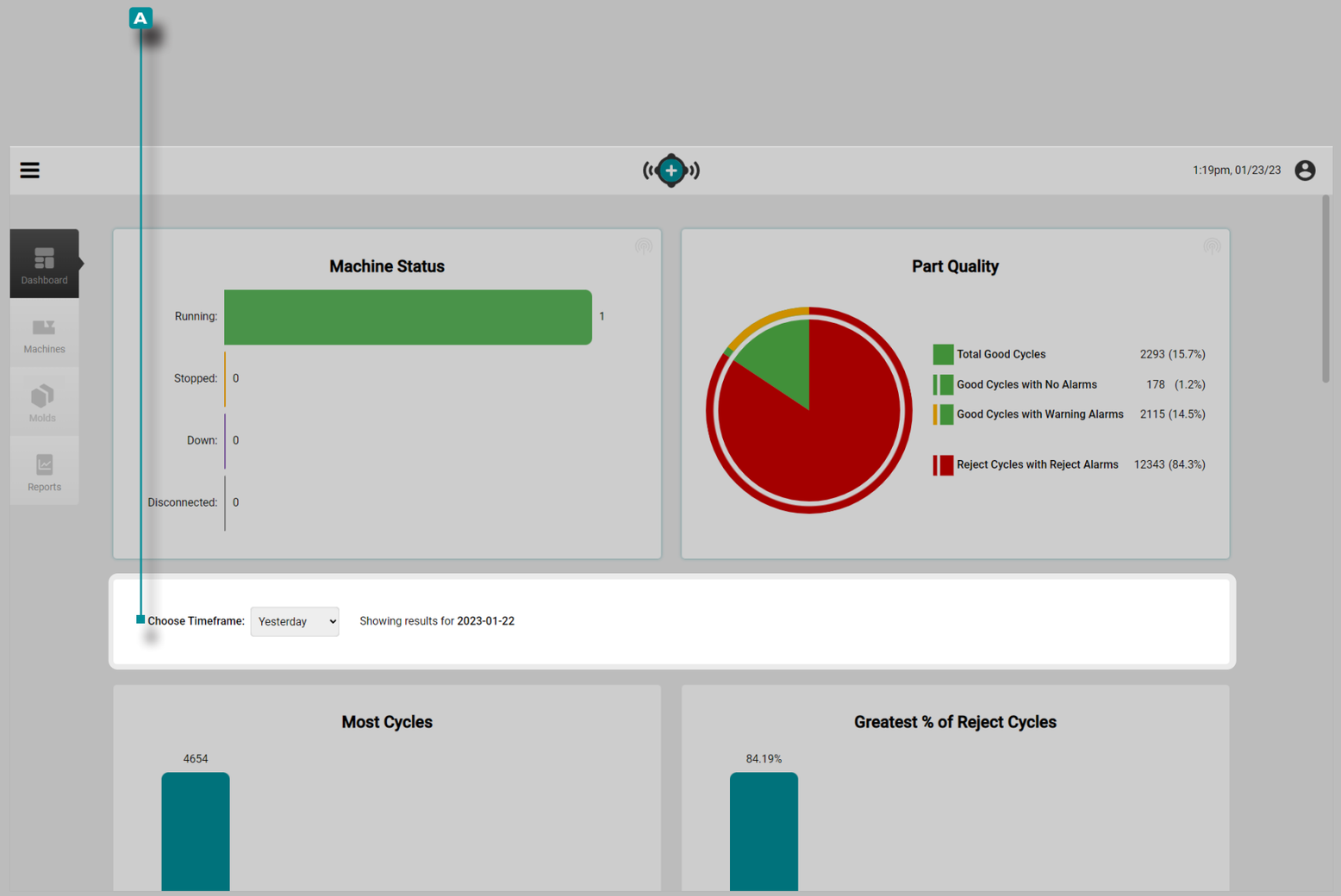
The A Machine Status Graph displays—in real-time—the number of running, stopped, disconnected, and down machines in the facility.

### Part Quality Graph

The B Part Quality Graph displays the number of good cycles, good cycles with no alarms, good cycles with warning alarms, and reject cycles with reject alarms from jobs that have been active within the past 24 hours.

**Hover** over the mouse pointer over the icon to view the Last Update date and time for either the Machine Status or Part Quality graph.

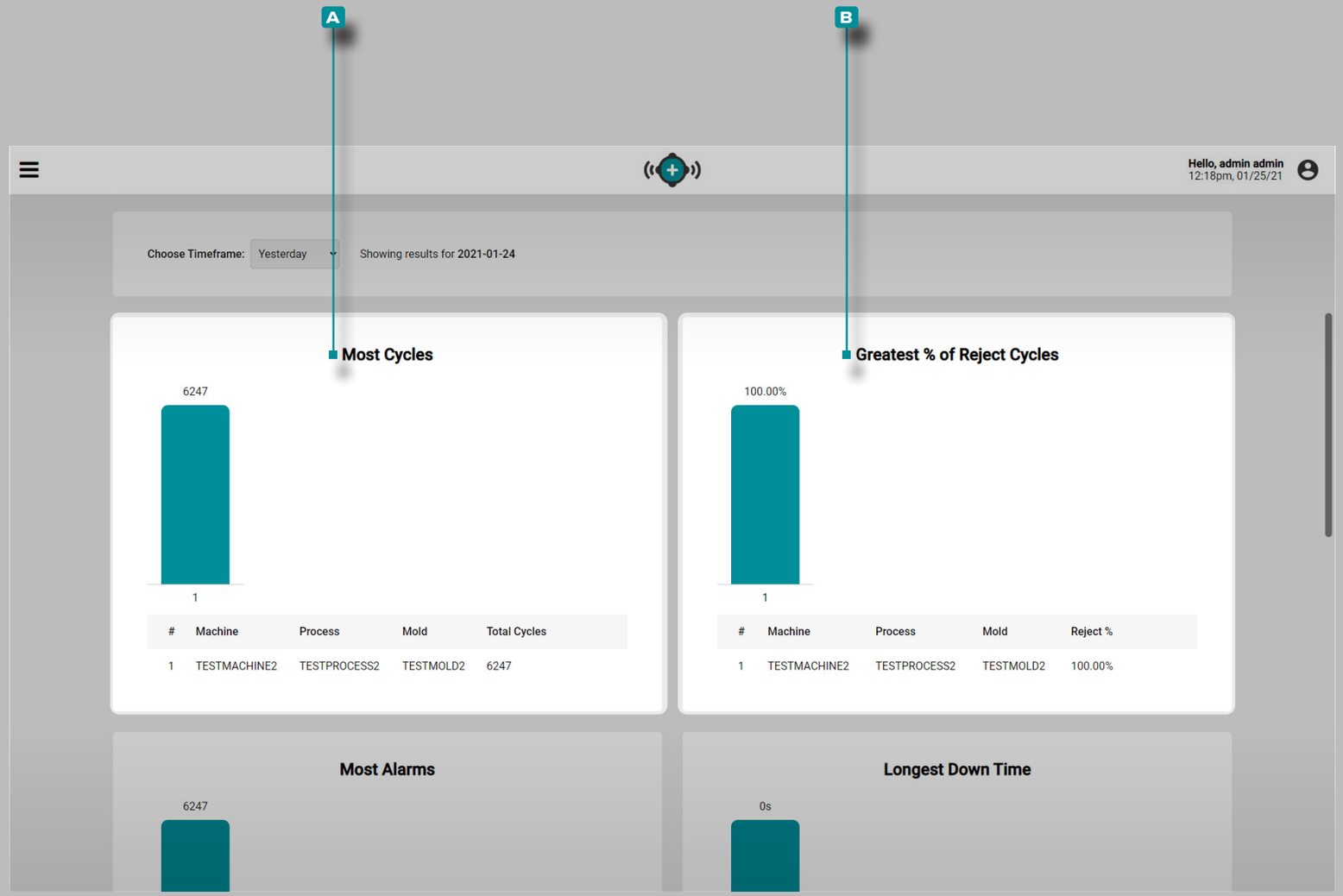
# The Hub for Process Monitoring




## Dashboard Tables

The Dashboard summary report tables display job data from jobs that have been active within the selected time range on the A Choose Timeframe: drop-down menu.

**Click** the A Choose Timeframe: drop-down menu to select Yesterday, Last Hour, Last 8 Hours, Last Week, or Last Month to view the data displayed *in the tables* below the graphs in that time range.




# The Hub for Process Monitoring

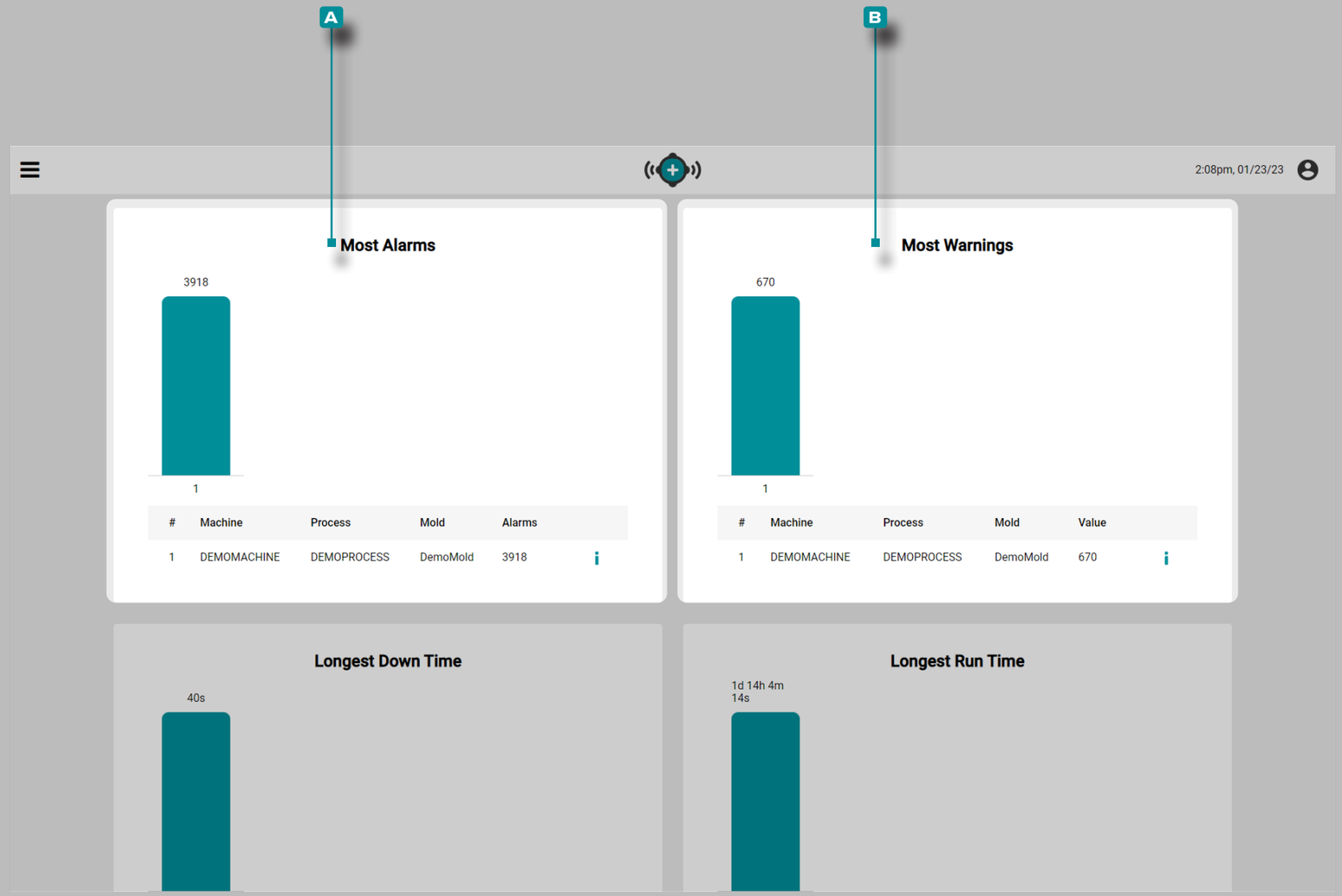
## (Dashboard Tables, *continued*)

### Most Cycles Table

The A Most Cycles table provides a table view of each job that has been active within the selected timeframe, and lists the machine name, process name, mold name, and total cycles.

### Greatest [Percent] % Reject Cycle Table

The B Greatest [Percent] % Reject Cycles table provides a table view of each job that has been active within the selected timeframe, and lists the machine name, process name, mold name, and reject [percent] % of each job.




# The Hub for Process Monitoring

## (Dashboard Tables, *continued*)

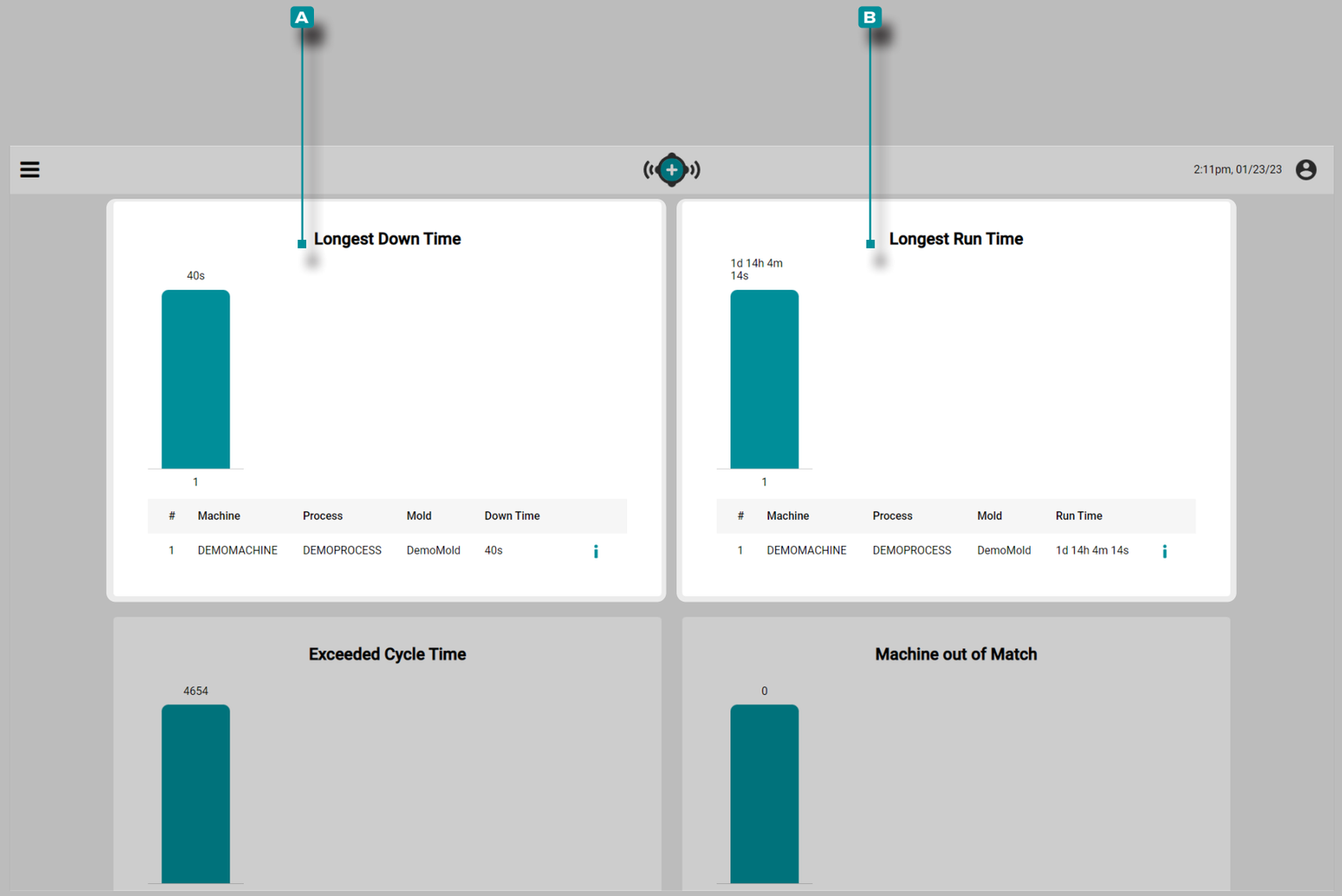
### Most Alarms Table

The **A** Most Alarms table provides a table view of each job that has been active within the selected timeframe, and lists the machine name, process name, mold name, and total alarms for each job.

### Most Warnings

The **B** Most Warnings table provides a table view of each job that has been active within the selected timeframe, and lists the machine name, process name, mold name, and warning alarms for each job.

# The Hub for Process Monitoring



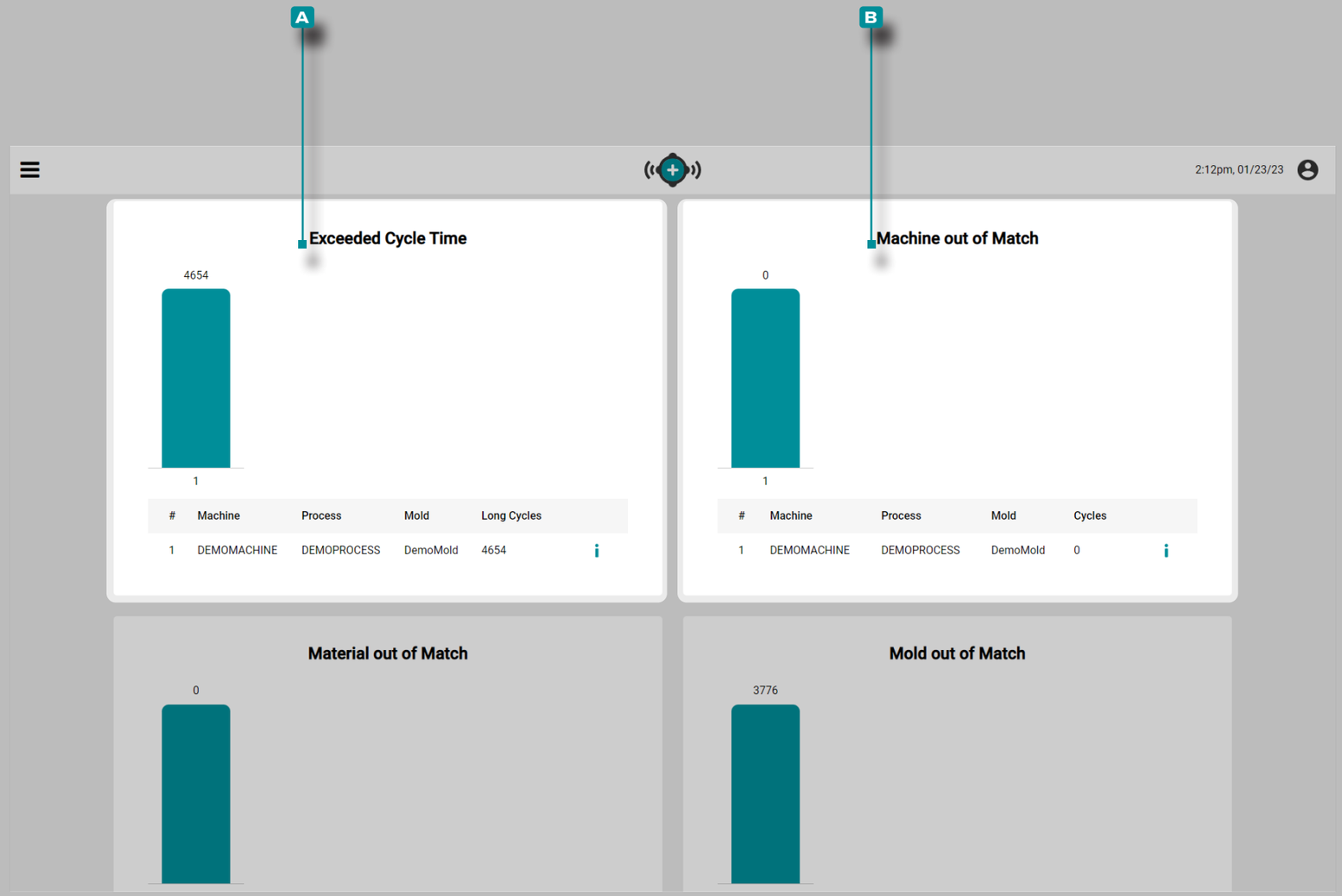

## Longest Down Time Table

The A Longest Down Time table provides a table view of each job that has been active within the past 24 hours, and lists the machine name, process name, mold name, and total down time.

📖 **DEFINITION** *is the length of time a machine is idle while a job is running. is the length of time a machine is down over the duration of a job, measured in hours, minutes, and seconds, or days.*

## Longest Run Time Table

The B Longest Run Time table provides a table view of each job that has been active within the selected timeframe, and lists the machine name, process name, mold name, and the longest run time for each job.




# The Hub for Process Monitoring

## (Dashboard Tables, *continued*)

### Exceeded Cycle Time Table

The A Exceeded Cycle Time table provides a table view of each job that has been active within the selected timeframe, and lists the machine name, process name, mold name, and the number of long cycles (cycles which exceeded the cycle time) for each job.

### Machine Out of Match Table

The B Machine Out of Match table provides a table view of each job that has been active within the selected timeframe, and lists the machine name, process name, mold name, and total out-of-match machine cycles for each job.


# The Hub for Process Monitoring

## (Dashboard Tables, *continued*)

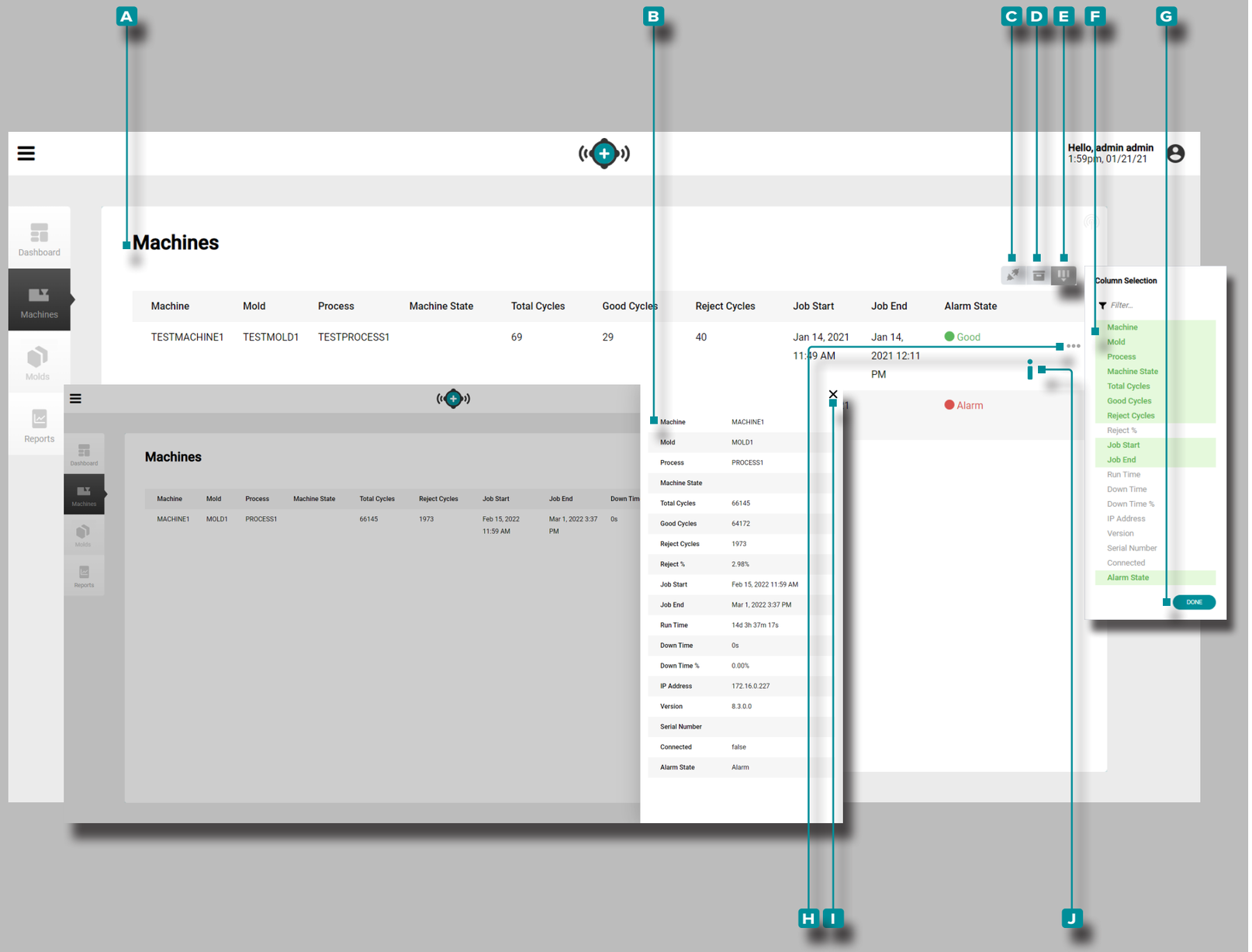
### Material Out of Match Table

The B Material Out of Match table provides a table view of each job that has been active within the selected timeframe, and lists the machine name, process name, mold name, and total out-of-match material cycles for each job.

### Mold Out of Match Table

The B Mold Out of Match table provides a table view of each job that has been active within the selected timeframe, and lists the machine name, process name, mold name, and total out-of-match mold cycles for each job.

# The Hub for Process Monitoring




## Machines

The A Machines view provides details of each machine in the network, and a B detailed machines view.

The Machines view displays running machines by default; to view all networked machines including stopped, down, or disconnected machine, **Click** the C connected machines icon to display all networked machines.

The Machines view can displays the following machine, mold, and job variables:

- Alarm State
- Connected (Yes/No)
- Custom Fields
- Down Time
- Down Time Percent (%)
- Good Cycles
- IP Address
- Job Start
- Job End
- Machine Match
- Machine Name
- Machine State
- Material Match
- Mold Match
- Mold Name
- Out of Match Cycles
- Process Name
- Reject Percent (%)
- Reject Cycles
- Run Time
- Serial Number
- Template
- Total Cycles
- Warning Cycles
- Version

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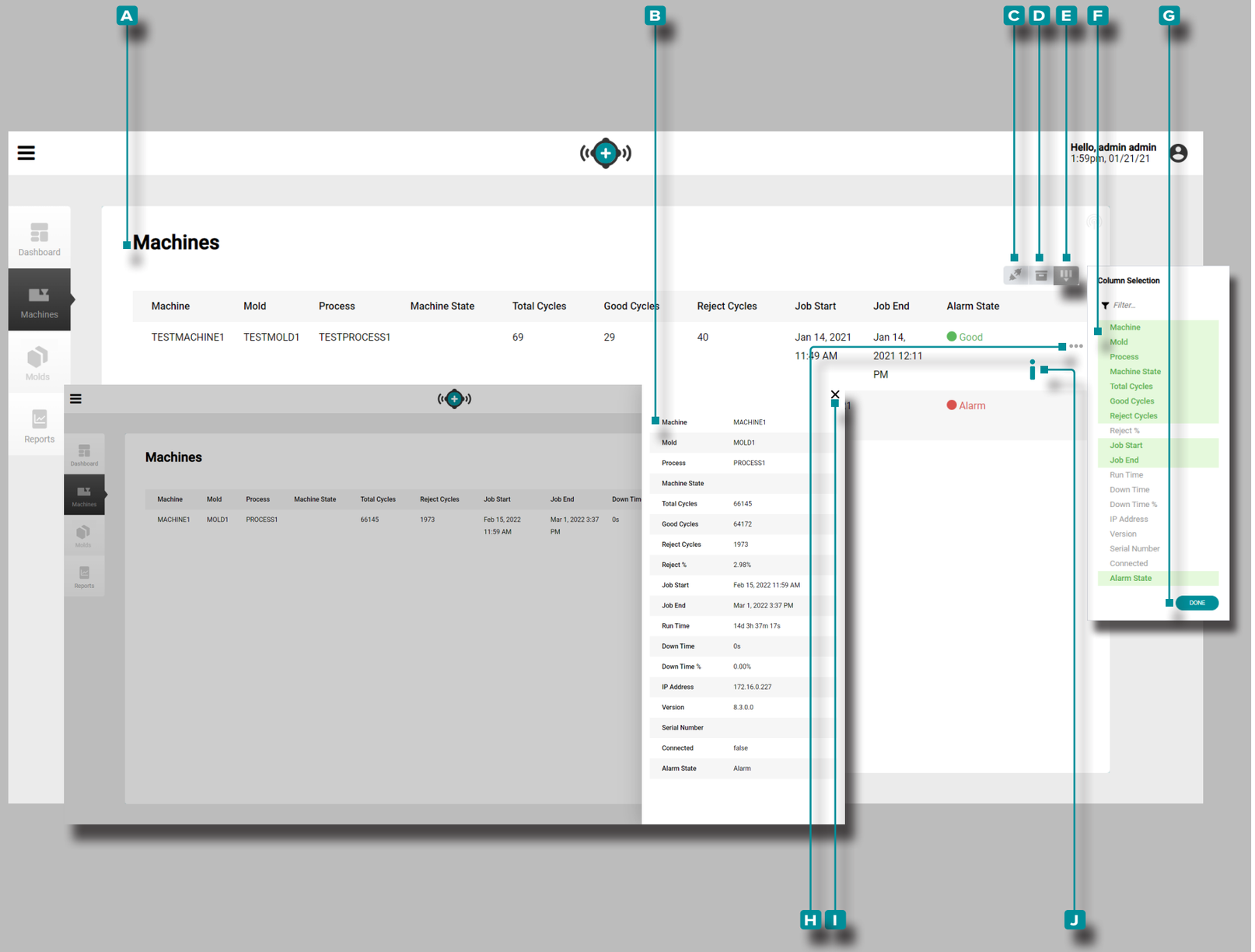


# The Hub for Process Monitoring

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**Click** the D archived records button to view records that have been archived.

**Click** E Select Columns to choose the displayed F variables. **Click** the G DONE button to save changes and exit the Select Columns pop-up window.

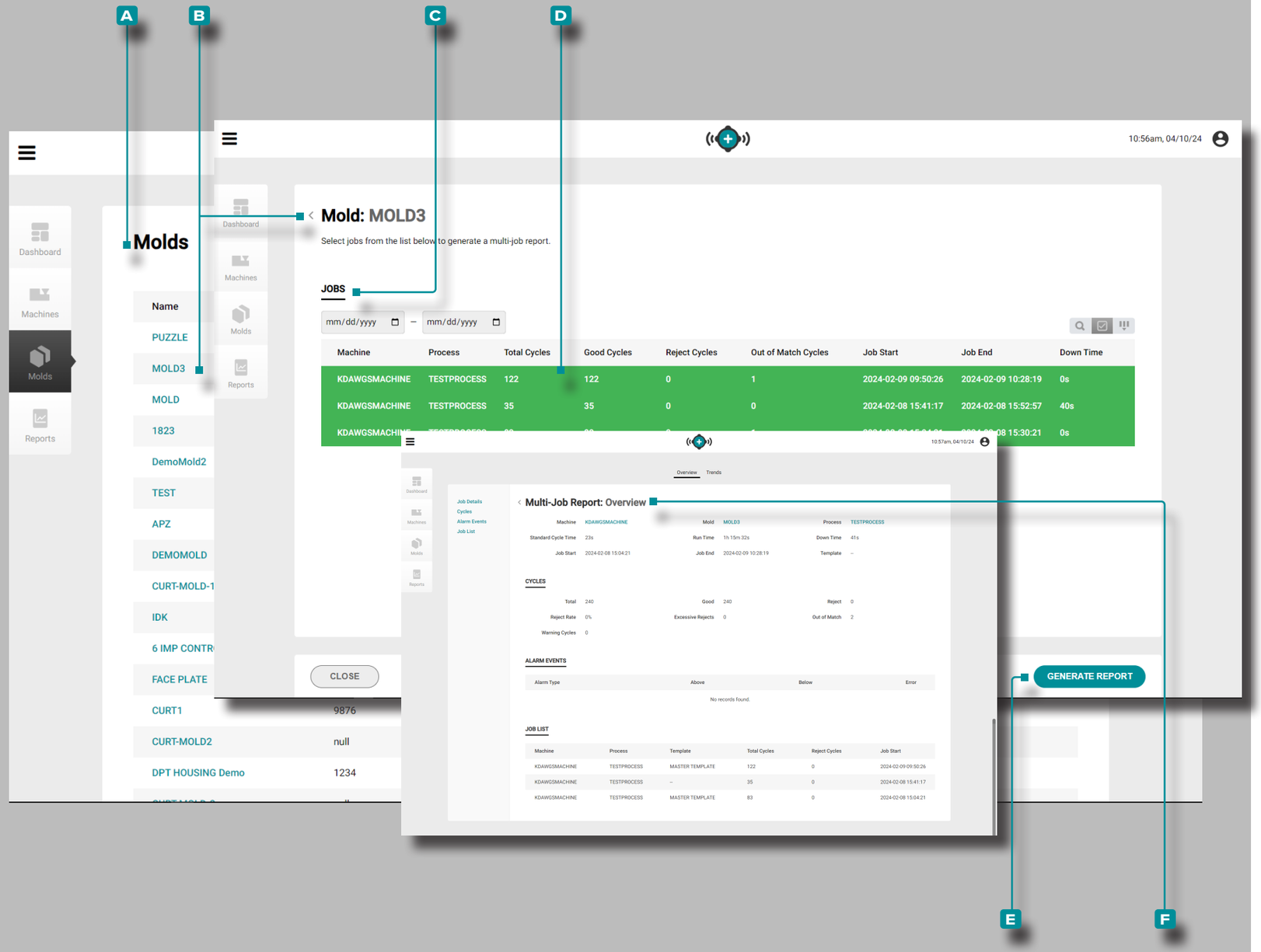
## Detailed Machine View

The Detailed Machine View displays all of the machine, mold, and job variables in a single slide-out window.

**Click** the H expand information icon next to the machine name/row to view the slide-out detailed machine view; click the I exit icon to close the slide-out detailed machine view.

**Click** the J information icon next to the machine name/row to open the job overview report.

# The Hub for Process Monitoring




## Molds

The A Molds view provides an overview of all jobs for each mold; from the molds view select multiple jobs ran with the mold to overview of the jobs.

**Click** on a B mold name to select the mold.

## Jobs

The C Jobs view provides an overview of all jobs associated with the selected mold. **Click** on D job names to select multiple jobs ran on the mold, then **click** the E Generate Report button to view a F Multiple Jobs Overview of all the selected jobs for the mold.

## Multi[ple]-Jobs Report

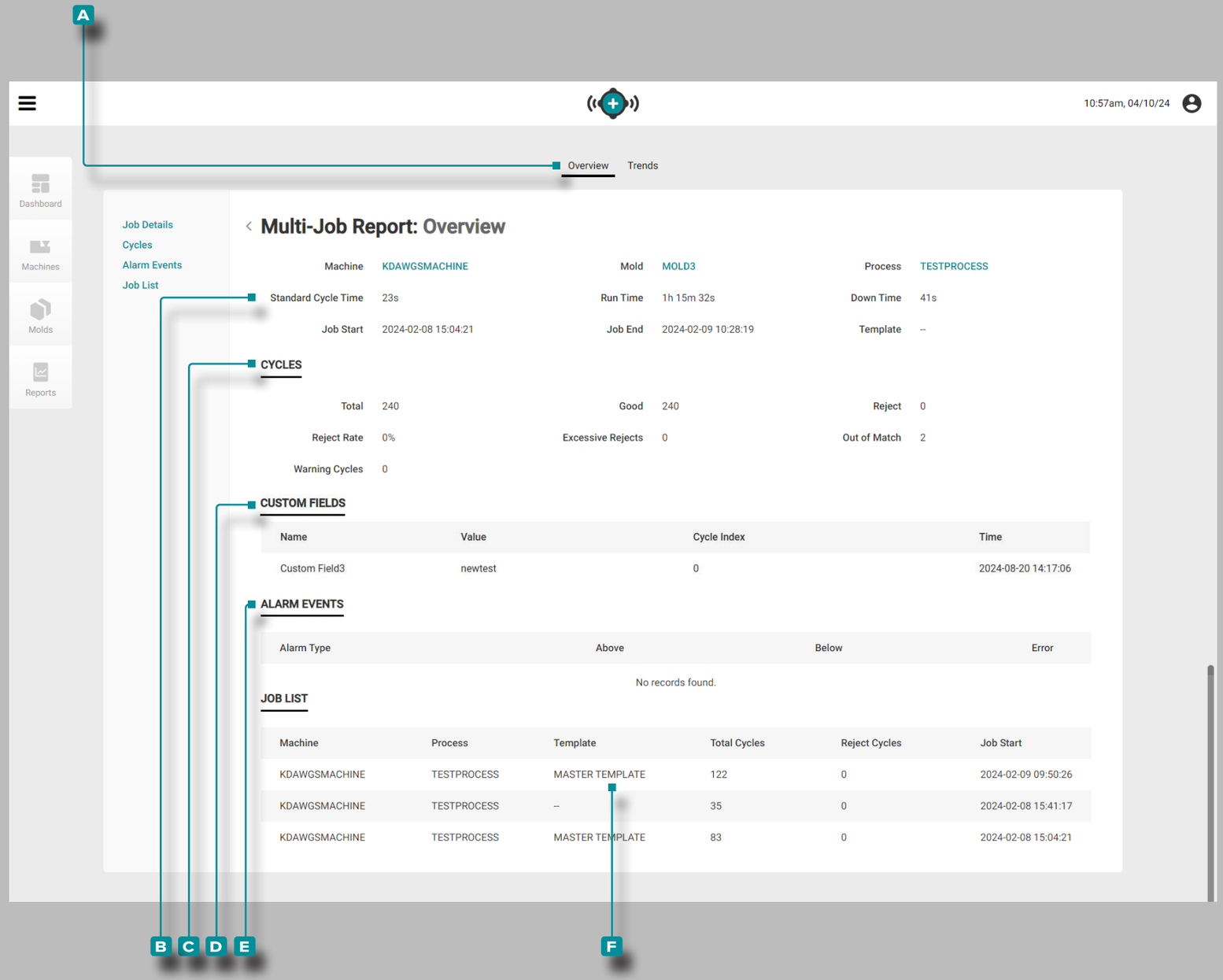
The Multi[ple]-Jobs Report for multiple jobs displays the following:

- combined jobs cycle values,
- combined jobs alarm events, and
- combined jobs summary graph data trends.

The Multi[ple]-Jobs Report for multiple jobs does not display the following:

- audit report,
- statistics report,
- quality report, or
- work orders.

# The Hub for Process Monitoring




Multi[ple]-Jobs Report: Overview

The A Multi[ple] Jobs Report: Overview provides machine, process, mold, and job information including B Job Details, C Cycles count, D Custom Fields, E Alarm Events, and F Job List.

All values displayed in the Multi[ple]-Jobs Report: Overview are the combined total for the selected jobs.

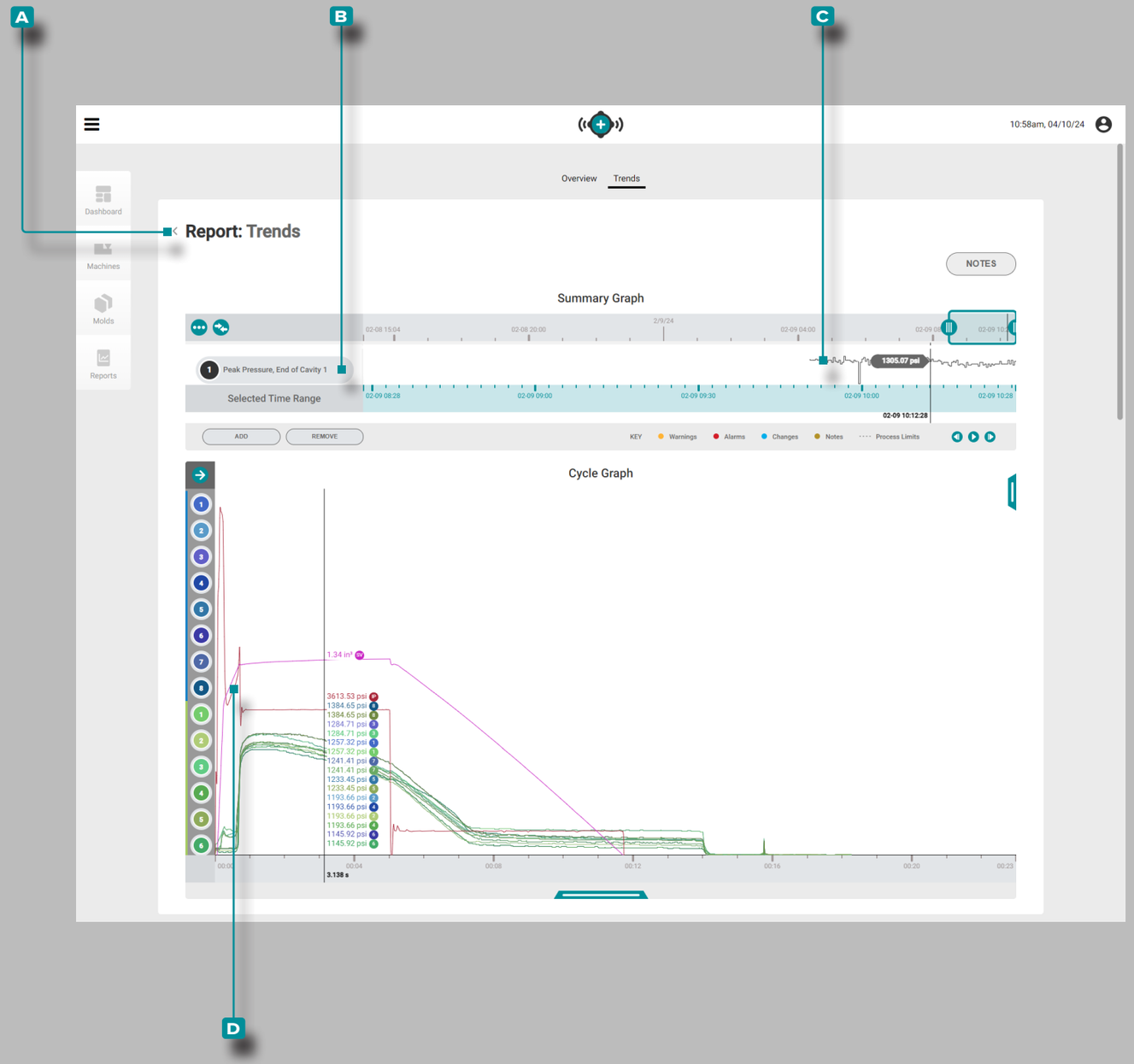
The B Job Details displays the machine, mold, process, and template names, as well as total run time, job start date/time, and job end date/time.

The C Cycles count displays the number of total, good, reject, and out of match cycles in the job, along with the reject rate (%) percent, excessive rejects count, and out of match count.

The D Custom Fields displays the job's custom fields.

The E Alarm Events displays the job's alarm state (no alarm/alarm), total alarms, and any alarms by type with the above or below values.

The F Job List displays selected jobs at the bottom of the report.




# The Hub for Process Monitoring

## Multi[ple]-Jobs Report: Trends

The A Multi[ple] Jobs Report: Trends provides summary and cycle graphs. The summary graph provides the selection and graphical display of B job cycle data types over the length of the job which form C trends, and additionally highlights alarm conditions which occurred.

The trends are formed by cycle summary values; a single data point represents a cycle. Data points are displayed together, creating a curve and allowing the viewing of trends.

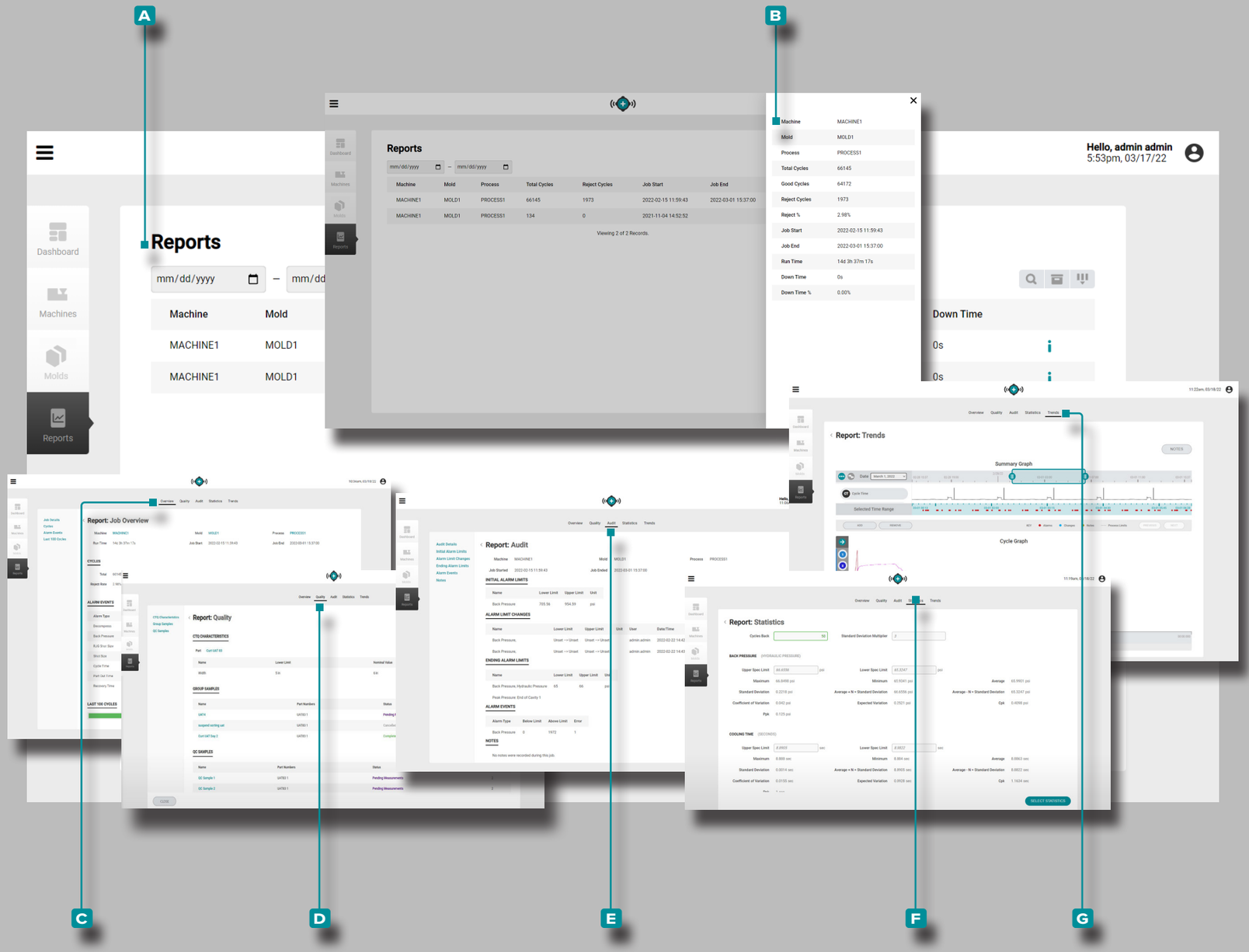
The cycle graph provides the selection and graphical display of D job cycle curves. Each D job cycle curve provides Lynx device input, machine sequence, or cavity pressure/ temperature sensor cycle data to view or print on the cycle graph.

The type and number of B job cycle data types C trends and D job cycle curves available depends upon connected machine and equipment.

Additionally, users may export multiple jobs from the summary graph (multiple .csv files contained in a .zip folder); the export will start at the start date/time of the first job and end at the end date/time of the last job. The user may select whether to export the selected trends or all trends, and whether to include part measurements.

For all summary and cycle graph controls, and for job exports, refer to page 21–page 29.

# The Hub for Process Monitoring




## Reports

The **A** Reports view provides a customizable view of machine, mold, and process details of each networked machine, a **B** detailed reports view, and access to **C** Job Overview, **D** Quality, **E** Audit, **F** Statistics, and **G** Trends reports for each job.

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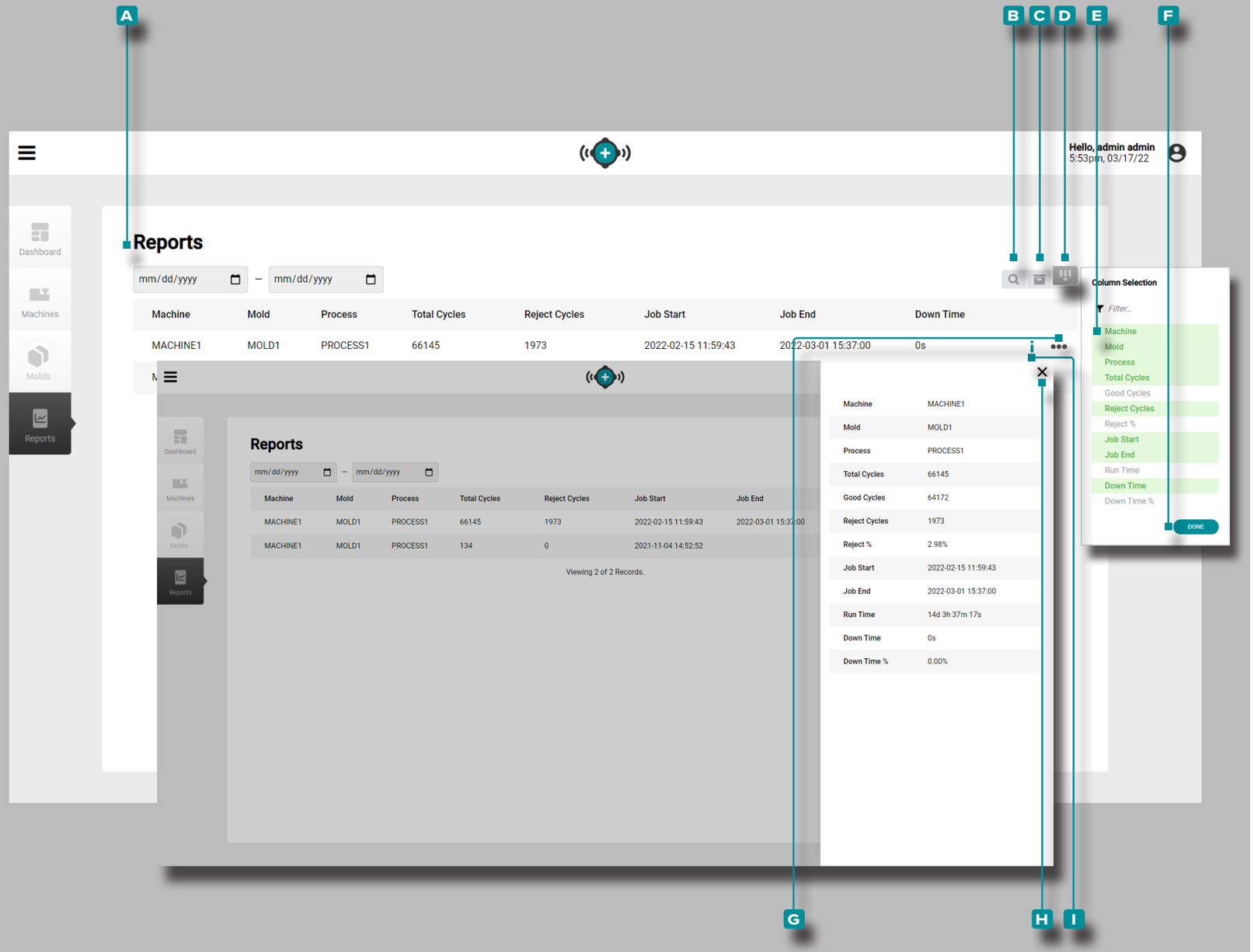


# The Hub for Process Monitoring

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## (Reports, *continued*)

The A Reports view displays the following machine, mold, and job variables:

- Machine Name
- Mold Name
- Process Name
- Total Cycles
- Good Cycles
- Reject Cycles
- Reject Percent (%)
- Warning Cycles
- Out of Match Cycles
- Template
- Job Start
- Job  End
- Run Time
- Down Time
- Down Time Percent (%)
- Custom Fields

**Click** the B search icon to enter/search for a word or phrase among the reports.

**Click** the C archive icon to display archived reports in the listed reports.

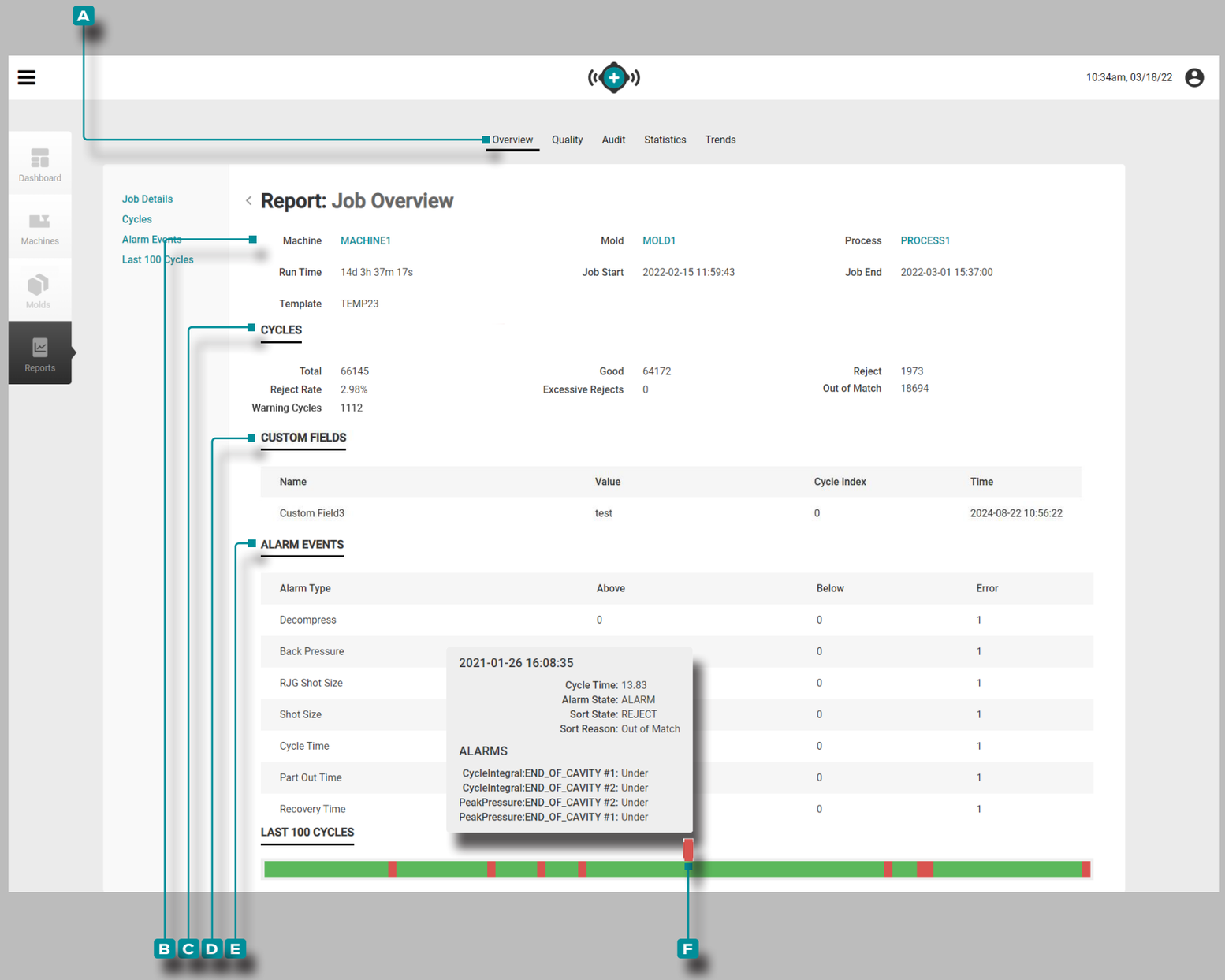
**Click** D Select Columns to choose the displayed E variables. **Click** the F DONE button to save changes and exit the Select Columns pop-up window.

### Detailed Report View

The Detailed Report View displays all of the 12 machine, mold, and job variables in a single slide-out window.

**Click** the G expand information icon next to the machine name/row to view the slide-out detailed machine view; click the H exit icon to close the slide-out detailed machine view.

**Click** the I information icon next to the machine name/row to open the job overview report (refer to "Reports: Job Overview" on page 16 for more information).




# The Hub for Process Monitoring

## Reports: Job Overview

The **A** Job Overview report provides machine, process, mold, and job information including **B** Job Information, **C** Cycles count, **D** Custom Fields, and **E** Alarm Events the **F** History bar.

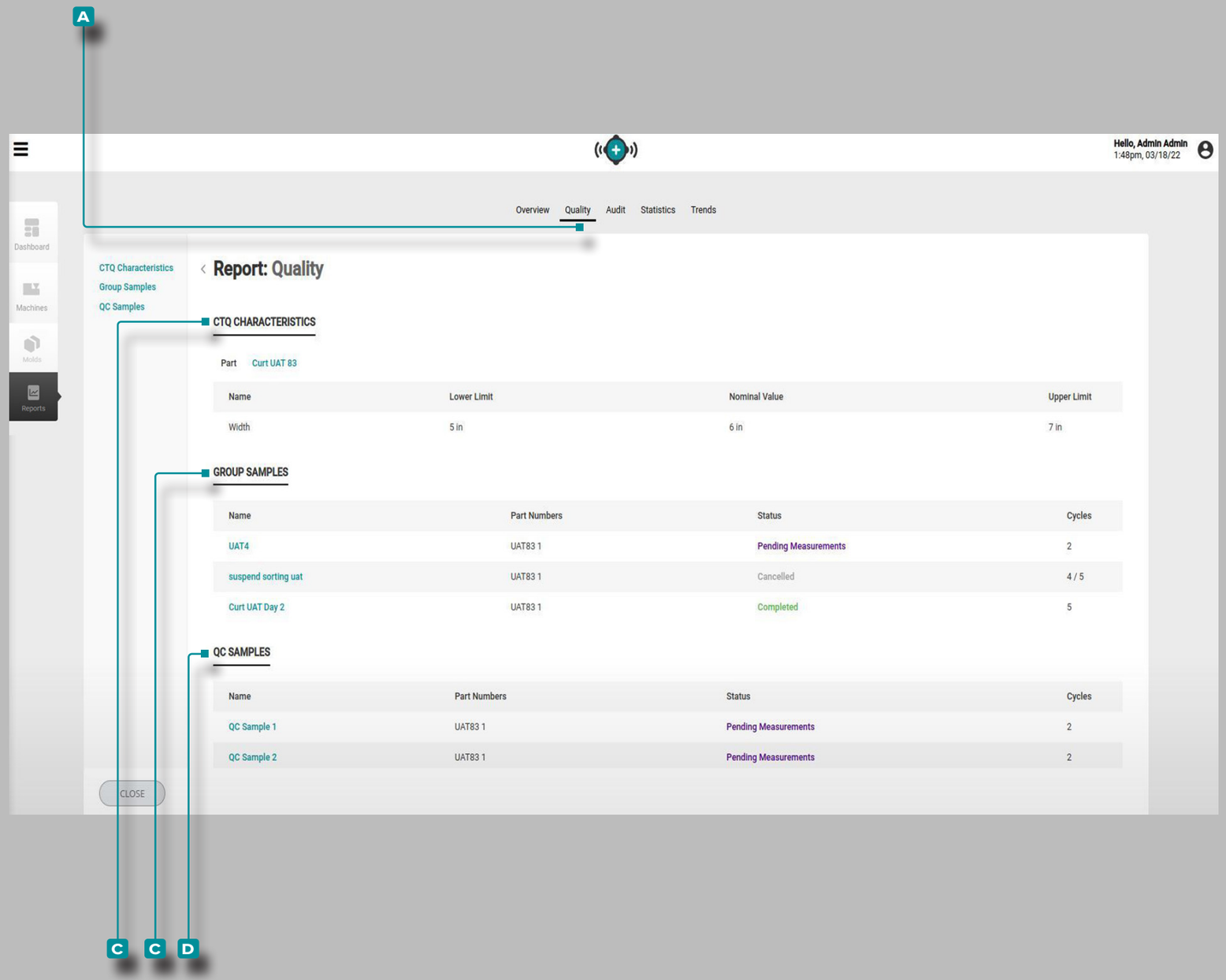
The **B** Job Information displays the machine, mold, process, and template names, as well as total run time, job start date/time, and job end date/time.

The **C** Cycles count displays the number of total, good, reject, and out of match cycles in the job, along with the reject rate (%) percent, excessive rejects count, and out of match count.

The **D** Custom Fields displays the job's custom fields.

The **E** Alarm Events displays the job's alarm state (no alarm/alarm), total alarms, and any alarms by type with the above or below values.

**Mouse over** the Job Details **F** History bar to view cycle details including cycle start date and time, cycle time (length of cycle), cycle alarm/warning state, cycle sort state, and alarm occurrences.




# The Hub for Process Monitoring

Reports: Quality

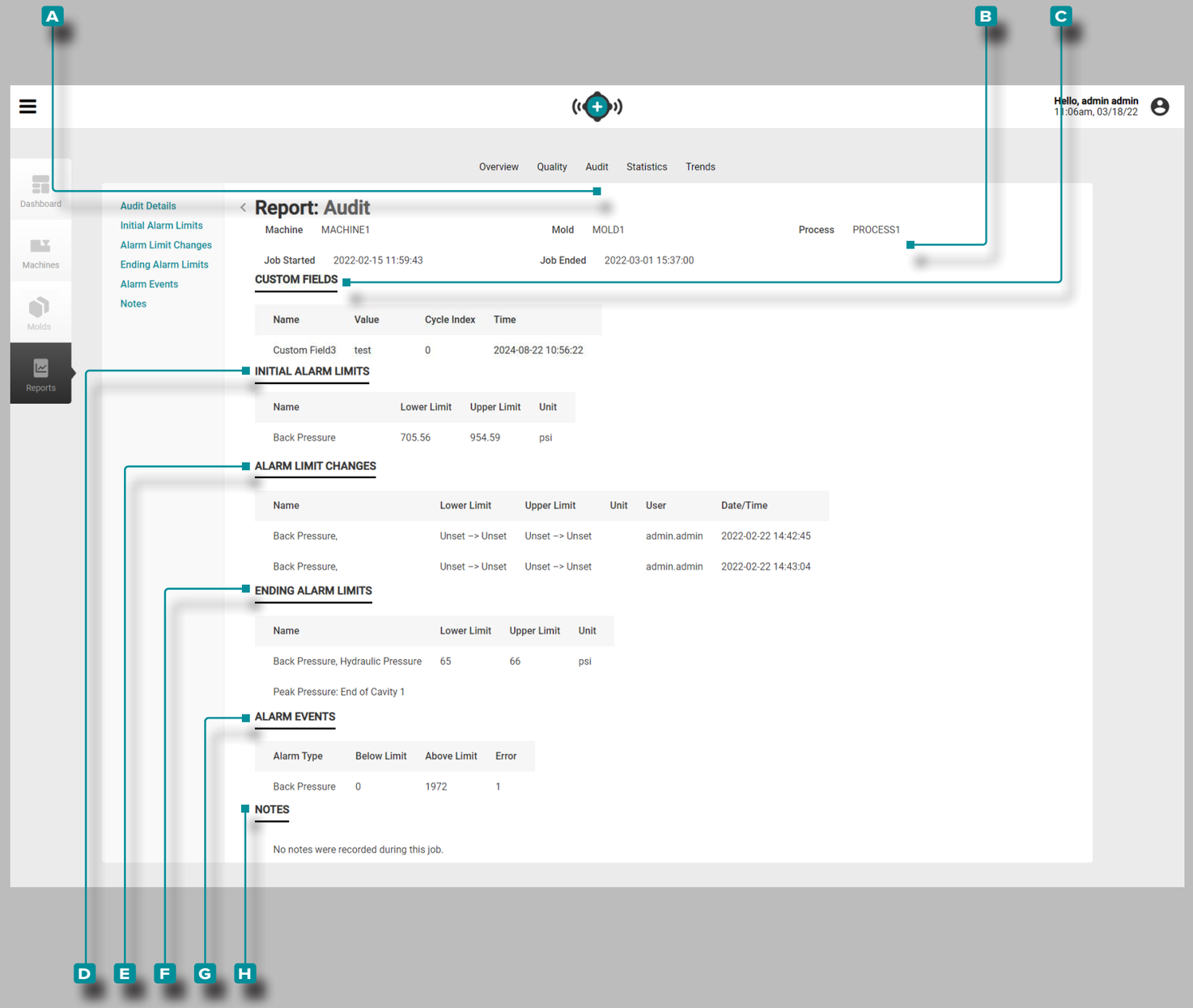
The **A** Quality report provides **B** CTQ Characteristics, **C** Group Samples, and **D** QC Samples for the related job.

The **B** CTQ Characteristics displays the related part and any CTQs for the part.

The **C** Group Samples displays group samples taken during the job, including name, part numbers, status, and number of cycles.

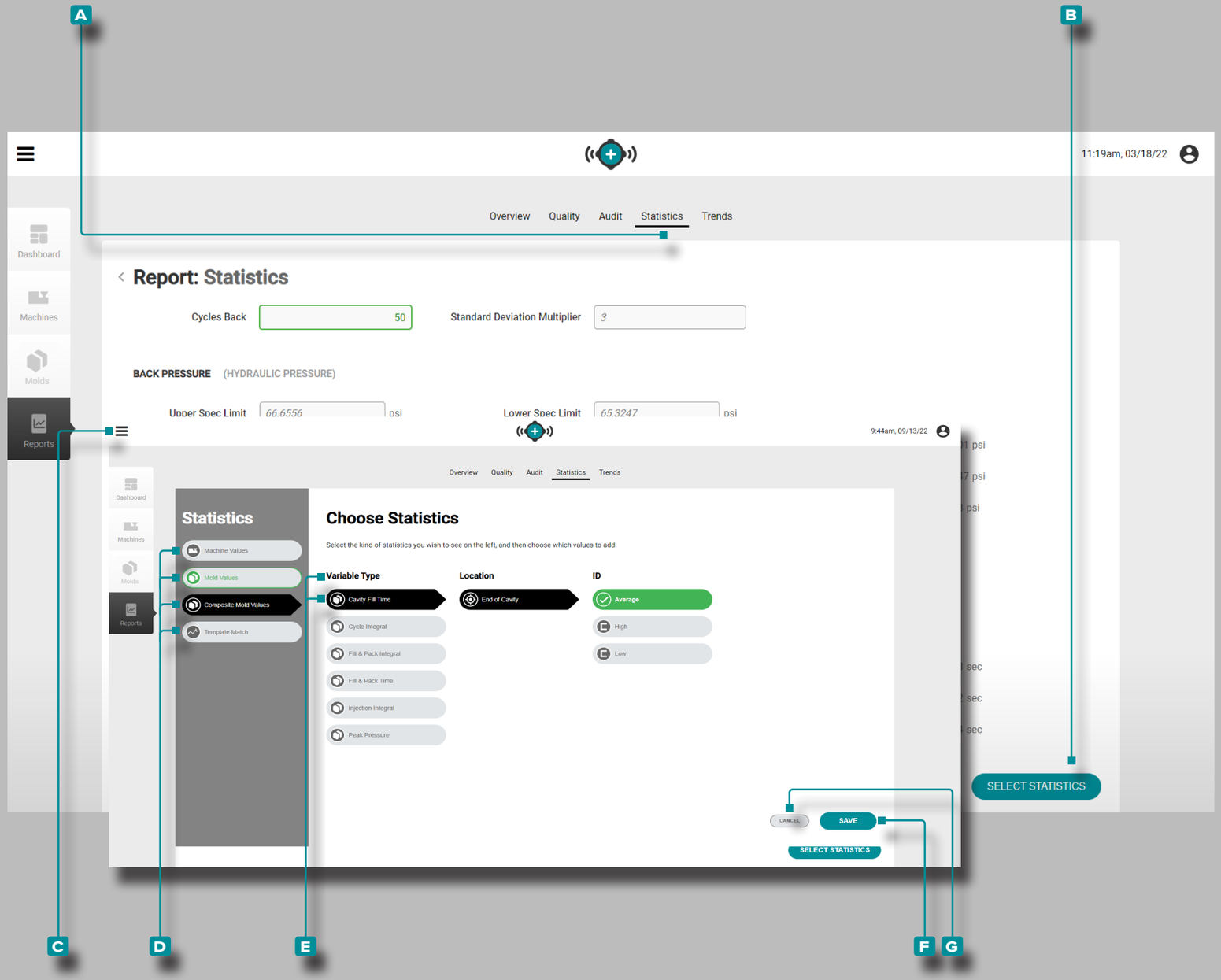
The **D** QC Samples displays QC samples taken during the job, including name, part numbers, status, and number of cycles.

# The Hub for Process Monitoring




## Reports: Audit

The A Audit report provides B Job Information including information entered at setup; any C Custom Fields used for the job; D Initial Alarm Limits including lower and upper limits which were entered for alarms at setup; E Alarm Limit Changes made during the job; F Ending Alarm Limits including lower and upper limits from the job; G Alarm Events which occurred during the job; and H Notes entered during the job (including any process match assistance advice notes entered on the CoPilot system). If a process change number was entered with a note, it will appear in the H Notes section.




# The Hub for Process Monitoring

Reports: Statistics

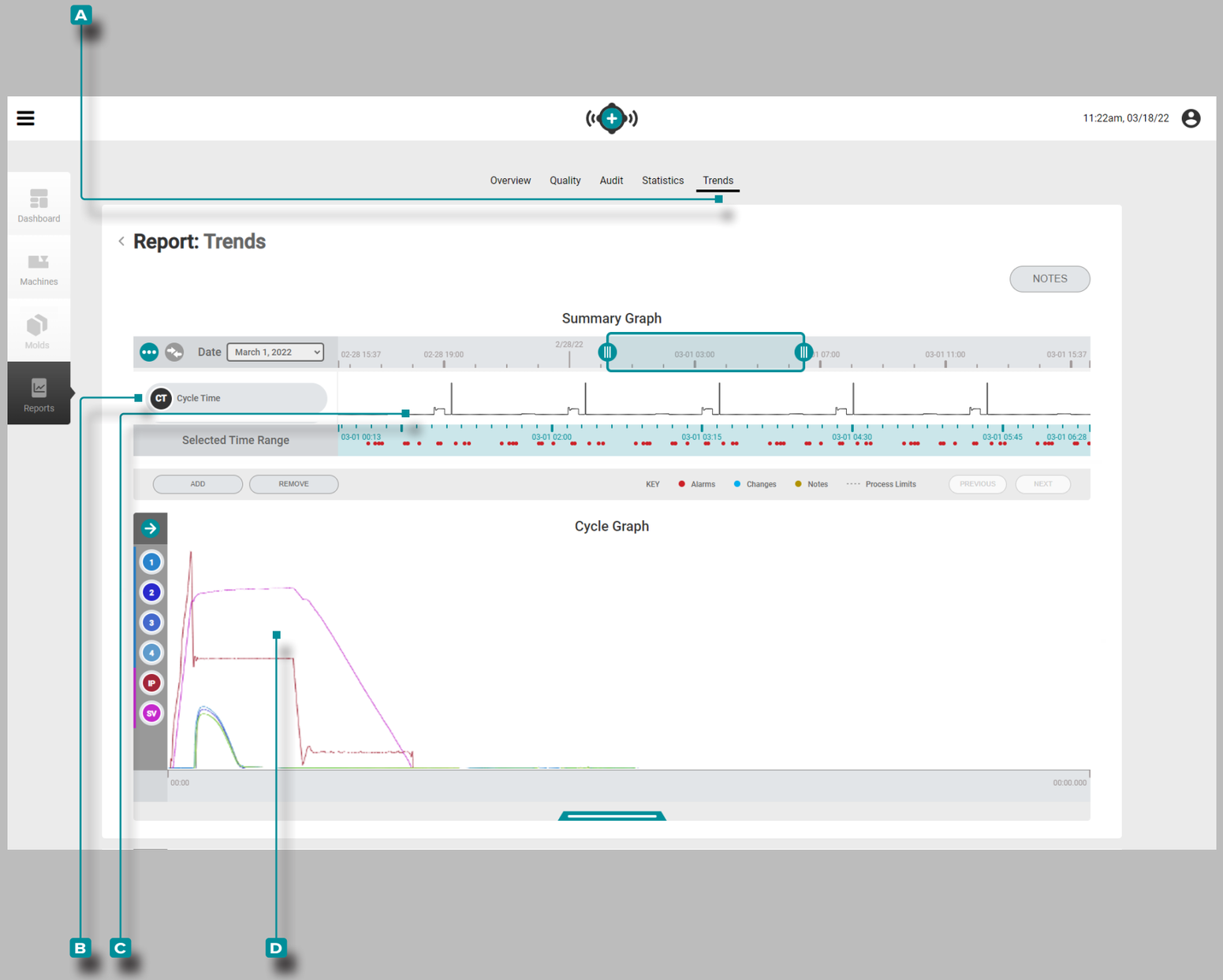
The A Statistics report provides a selection and viewing of up to 26 machine or mold variable values with up to 12 statistics displayed for each value.

**Click** the B select statistics button to view the C choose statistics window; **click** a D statistic values type (machine, mold, composite mold, or template values), then **click** to select each desired E variable type, location, Quantity, and ID (if necessary), then **click** the F SAVE button to save the selections, or the G cancel button to cancel the selections.

If desired, **enter** the number of cycles back from the total cycles from which data will be retrieved; a standard deviation multiplier is automatically entered, but also may be changed.

The following statistics are displayed beneath each chosen statistic variable type:

- Upper Spec Limit
- Lower Spec Limit
- Maximum
- Minimum
- Average
- Standard Deviation
- Average + N * Standard Deviation
- Average - N * Standard Deviation
- Coefficient of Variation
- Expected Variation
- Cpk (process capability measurement)
- Ppk (process performance index).




# The Hub for Process Monitoring

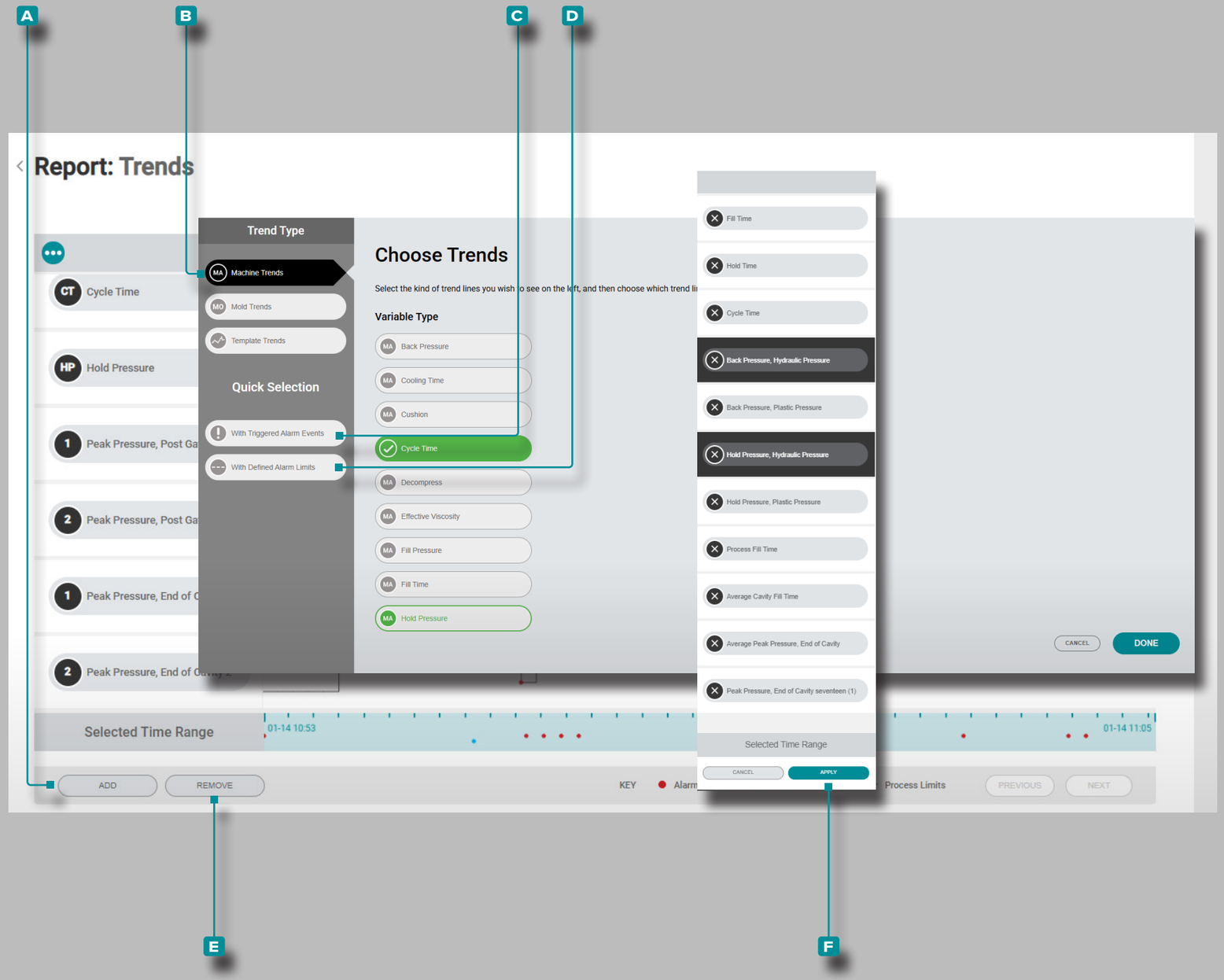
## Reports: Trends

The A trends report provides summary and cycle graphs. The summary graph provides the selection and graphical display of B job cycle data types over the length of the job which form C trends, and additionally highlights alarm conditions which occurred.

The trends are formed by cycle summary values; a single data point represents a cycle. Data points are displayed together, creating a curve and allowing the viewing of trends.

The cycle graph provides the selection and graphical display of D job cycle curves. Each D job cycle curve provides Lynx device input, machine sequence, or cavity pressure/ temperature sensor cycle data to view or print on the cycle graph.

The type and number of B job cycle data types C trends and D job cycle curves available depends upon connected machine and equipment.




# The Hub for Process Monitoring

## Add or Remove Summary Graph Trends

### Add Summary Graph Trends

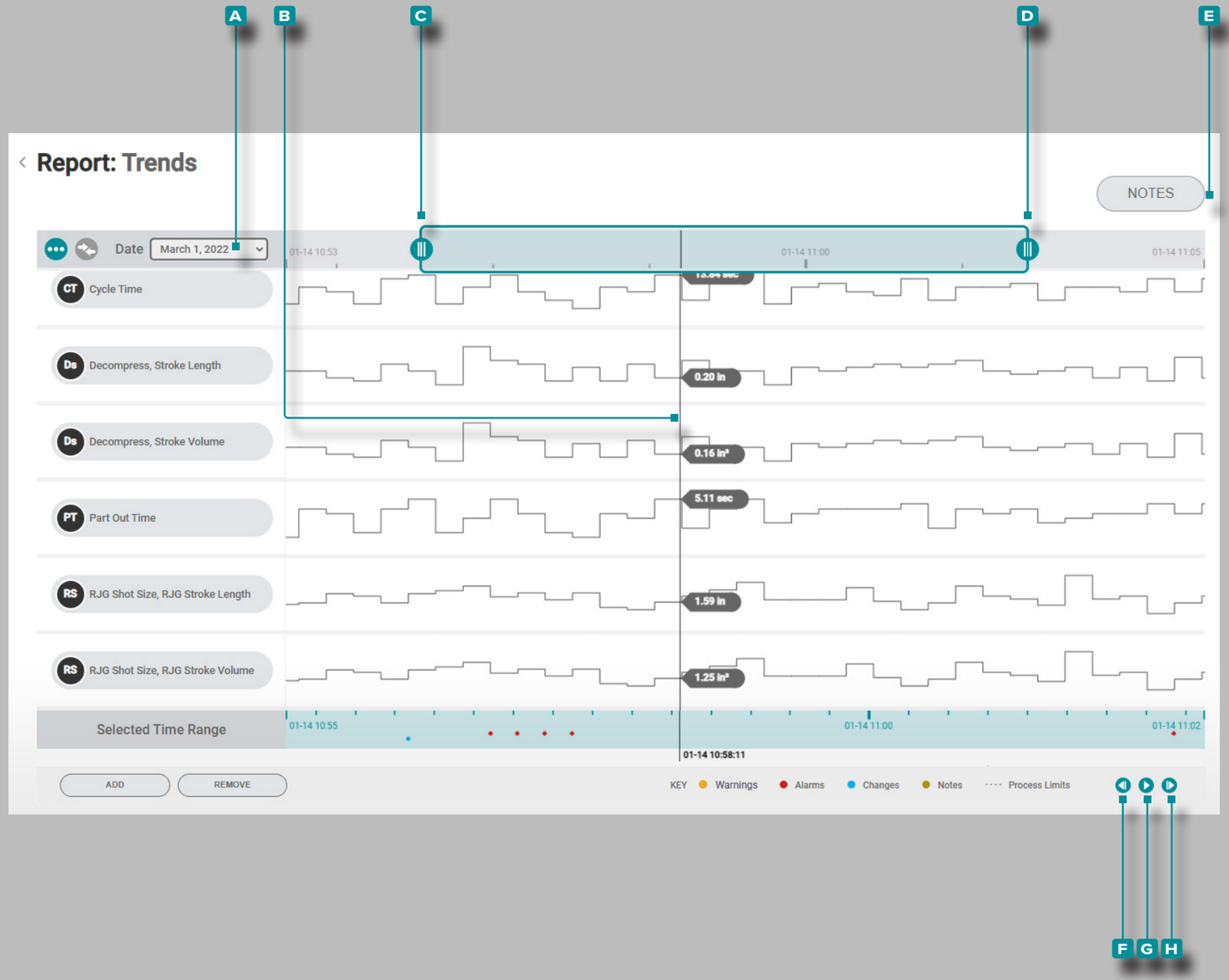
To select and view additional Trends, **click** the A add button, then **click** B machine trends, mold trends, composite mold trends, or template trends. **click** the desired trend variable type from the list and then **click** done; the selected trend(s) will be added to the summary graph.

### Add Summary Graph Trends with Alarms or Limits

To view trends with alarm or limits, **click** the C with triggered alarm events or D with defined alarm limits buttons. The affected trends will display—alarms are denoted on the trend line by a red dot.

### Remove Summary Graph Trends

To remove Trends, **click** the E remove button, **click** to select a trend or trends, and then **click** the F apply button to dismiss the trend(s).




# The Hub for Process Monitoring

## Summary Graph Trend Controls

### Select Date

**Click** on the drop-down menu, then **click** to select a A date to view data for a specific day.

### Select a Data Point/Show Cursor

**Click** and **hold** on a B data point within the graph to view the cursor, which provides the selected cycle's summary-data point-specific details.

### Zoom In or Out

Trends are automatically scaled to show the entire job. **Click**, **hold**, and **drag** the C & D graph bars to zoom to or select a desired time period within the job.

**Click**, **hold**, and **drag** between the selected time range between the graph bars to move the zoom area to a different time period.

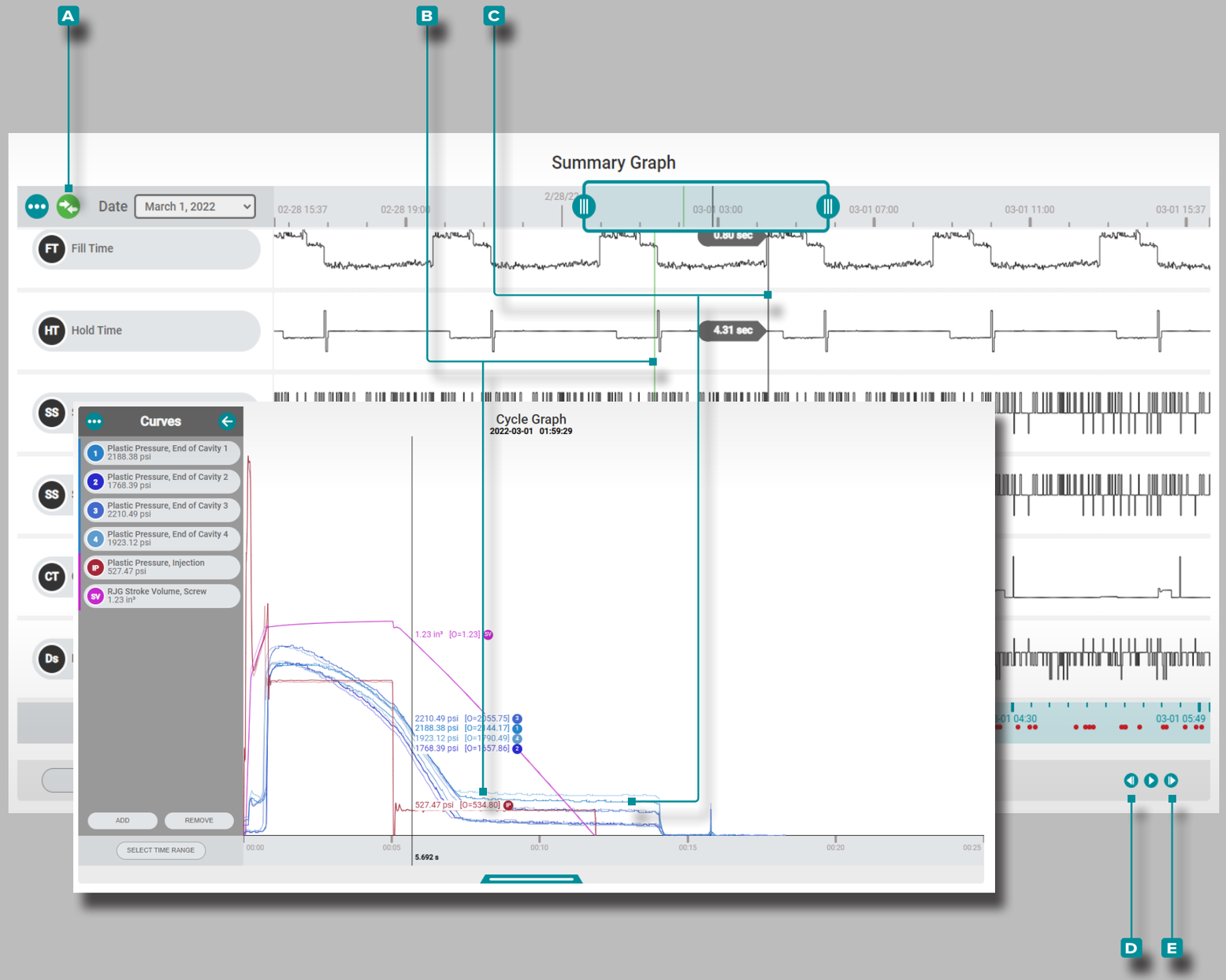
### Notes

**Click** the E NOTES button to display any notes entered during the job (including any process match assistance advice notes entered on the CoPilot system).

### Pan Through Cycles, or Play Cycle-by-Cycle

**Click** the F previous button to view the previous cycle, the G play button to play through the date until the job end, or the H next button to view the next cycle. The cursor must be selected for these functions to work.

**Click**, **hold**, and **drag** on the summary graph to pan left or right on the graph.




# The Hub for Process Monitoring

## Comparing Summary Graph Cycles (Comparing Cycles on Cycle Graph)

Two cycles from the Summary Graph can be selected for comparison and displayed on the current Cycle Graph.

### Select Cycle for Display/Comparison

**Click** and **hold** on a data point on the Summary Graph to display the selected cycle and cursor on the cycle graph; the A compare icon will be teal. **If no cycle is selected for overlay on the Summary Graph, the compare icon will be grey**. **Tap** the A compare icon, then **click** and **hold** on another data point to overlay the selected Summary Graph cycles on the Cycle Graph; the A compare icon will be green.

### Cycle Graph Comparison Cycle Display and Behavior

The B comparison cycle appears on the summary graph as a green line, and on the cycle graph as lighter-tinted curves than the C currently-selected cycle's curves. The Cycle Graph will display the curves for the C currently-selected cycle (cursor/comparison cycle) and B comparison cycle from the Summary Graph. **The comparison cycle will remain displayed on the cycle graph until it is cleared.**

### Select a Different Cycle for Comparison and Overlay

To select a different cycle to compare on the cycle graph, use the D PREVIOUS or E NEXT buttons to navigate to the desired cycle, OR **click**, hold, and drag the cursor to the desired cycle. The Cycle Graph will update automatically.

To select a different cycle to compare on the cycle graph, remove the current comparison cycle (see below: "Clear a Comparison Cycle"), then select a new cycle for comparison (see above "Select Cycle for Display/Comparison").

### Clear a Comparison Cycle

To remove a comparison cycle, **click** the A compare icon; the icon will be teal.


## Overlaying Summary Graph Cycles (Overlaying Cycles on Cycle Graph)

Multiple cycles from the Summary Graph can be overlaid and displayed on the Cycle Graph.

### Select and Display Overlay Cycles

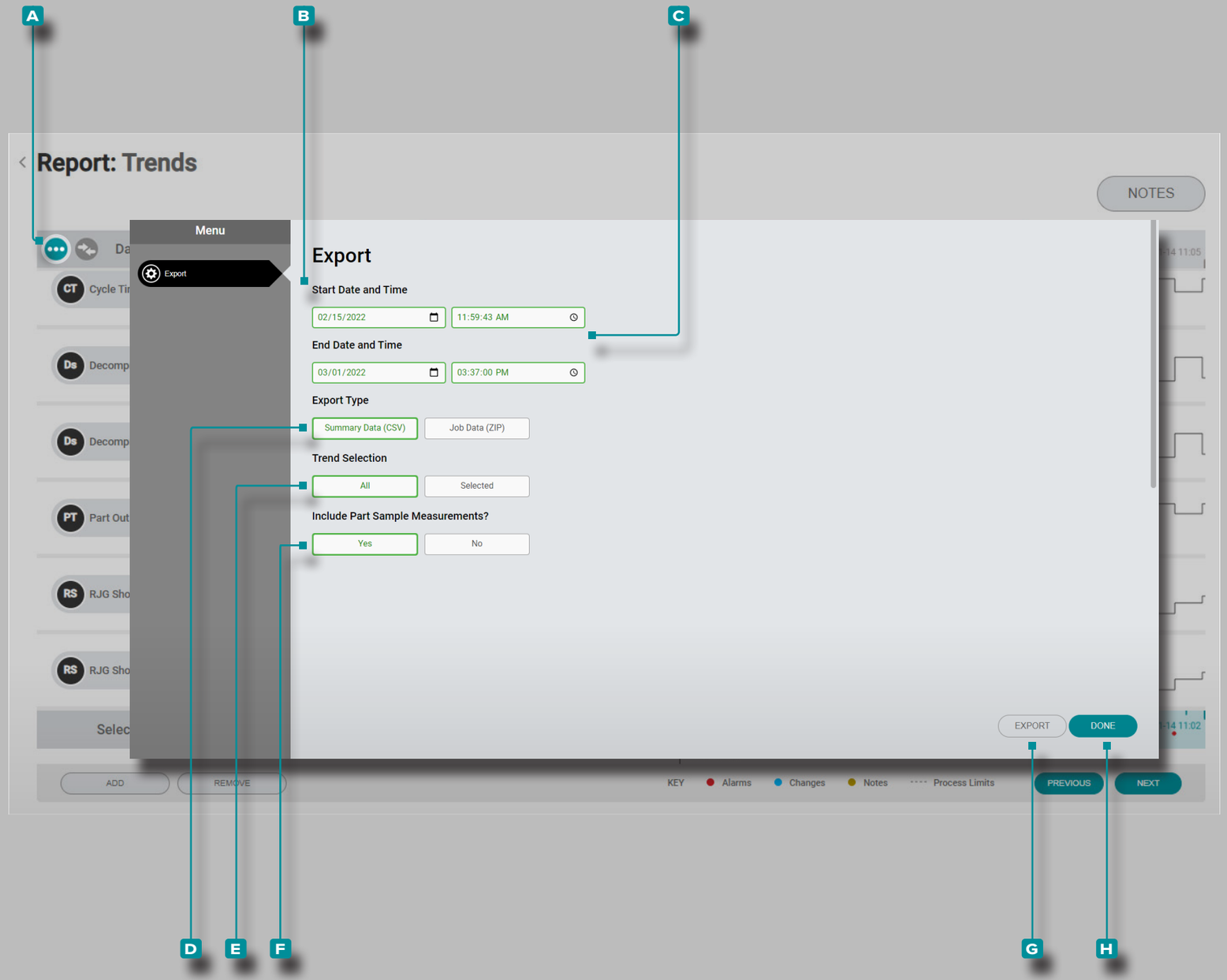
**Click** and **hold** on a data point on the Summary Graph to display the cursor on Summary Graph and the selected cycle on the cycle graph.

On the Cycle Graph, **tap**, hold, and drag the **A** Quick Actions menu slider to the left, then **click** the **B** SHOW OVERLAYS button.

Use the Summary Graph **C** previous button to overlay preceding cycles, the **D** play button to automatically overlay subsequent cycles, or **E** next button to overlay subsequent cycles on the Cycle Graph. The Cycle Graph will update automatically.

### Clear Overlay Cycles

To remove overlay cycles, **tap** the **F** HIDE OVERLAYS button on the Cycle Graph **A** Quick Actions menu.




# The Hub for Process Monitoring

## Export Summary Graph Trends

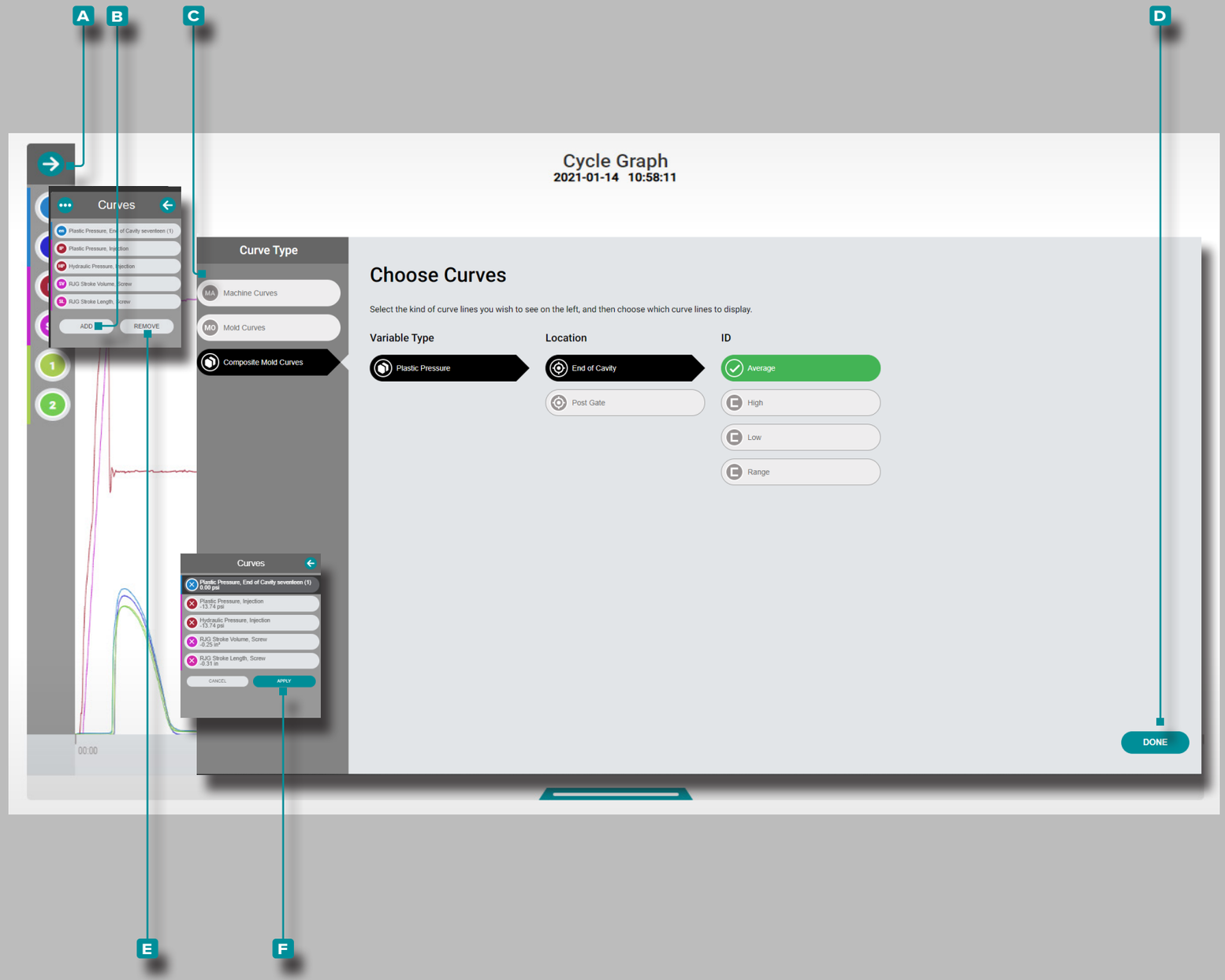
Summary Graph trends can be exported to a comma-separated values (.csv) file which includes timestamp, date/time, trend value, and any notes entered for the selected trend(s).

**Click** on the A summary graph menu button; the summary graph trends export window will appear.

Select a B Start Date and Time and an C End Date and Time, then **click** to select an export type—either D Summary Data (.csv) or Job Data (.zip), then **click** to select which E trends to export—all available curves or only the currently selected curves, and then **click** to select whether to include F part sample measurements.

**Click** the G EXPORT button to generate a downloadable .csv file.

**Click** the H DONE button when done to exit the window.




# The Hub for Process Monitoring

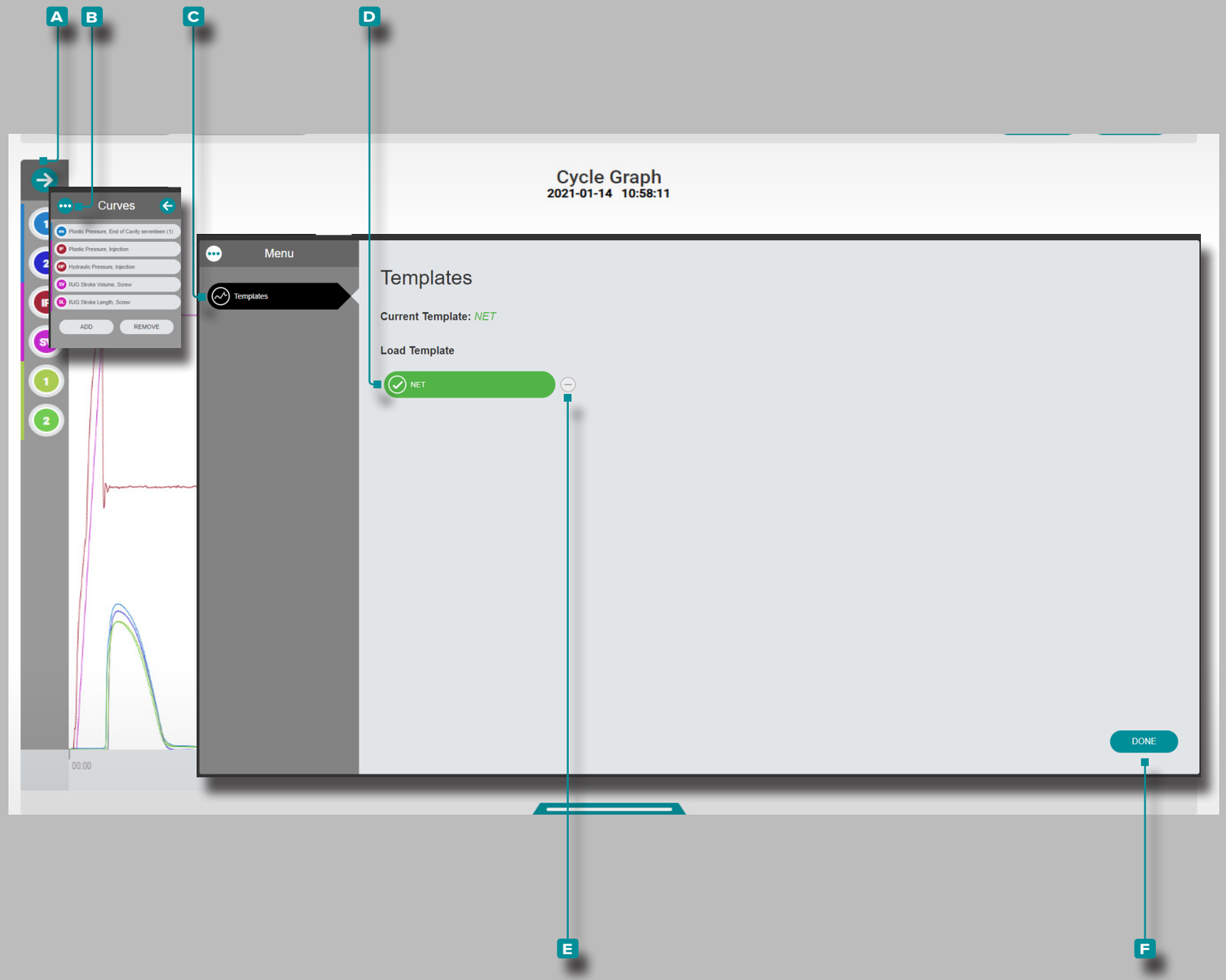
## Add or Remove Cycle Graph Curves

### Add Cycle Graph Curves

To select and view additional cycle curves, **click** the A expand arrow to view the curve menu, **click** the B Add button, then **click** C machine curves, mold curves, or composite mold curves. **Click** the desired curve variable type from the list, and location and ID (if necessary) and then click D DONE; the selected curve(s) will be added to the cycle graph.

### Remove Cycle Graph Curves

To remove cycle curves, **click** the A expand arrow to view the curve menu, **click** the E remove button, **click** to select a curve, and then **click** the F apply button to dismiss the selected curve.




# The Hub for Process Monitoring

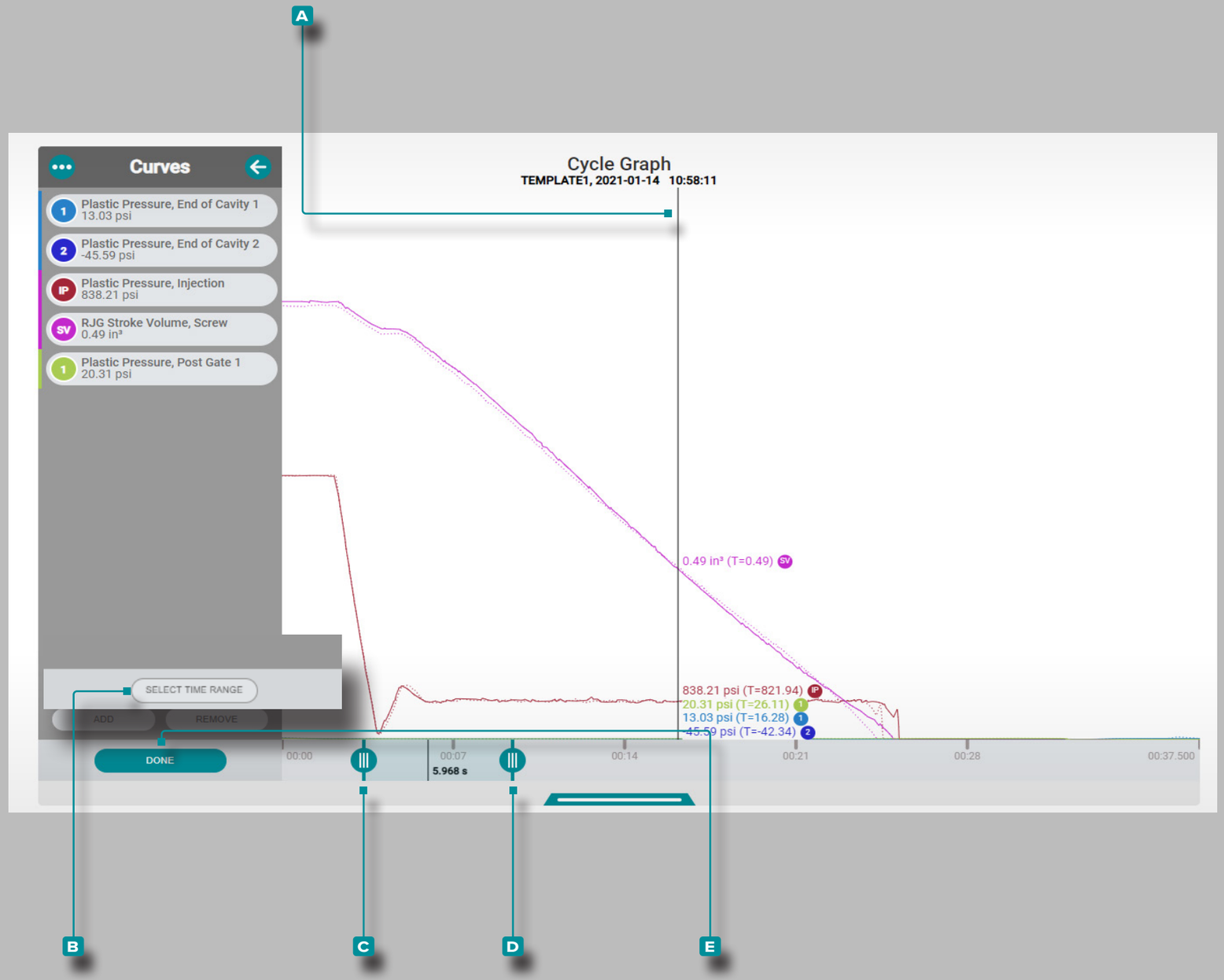
## Add or Remove Cycle Graph Curve Template

### Add Cycle Graph Curve Template

To select and view a cycle curve template, **click** the A expand arrow to view the curve menu, **click** the B menu button, then **click** the C Templates button; **click** the desired D template. **Click** the F DONE button; the selected template curve(s) will be added to the cycle graph as dotted lines.

### Remove Cycle Graph Curve Template

To remove a cycle curve template, **click** the A expand arrow to view the curve menu, **click** the B menu button, then **click** the C Templates button. **Click** the E remove button to deselect/remove a template from view on the cycle graph. **Click** the F DONE button.




## Cycle Graph Controls

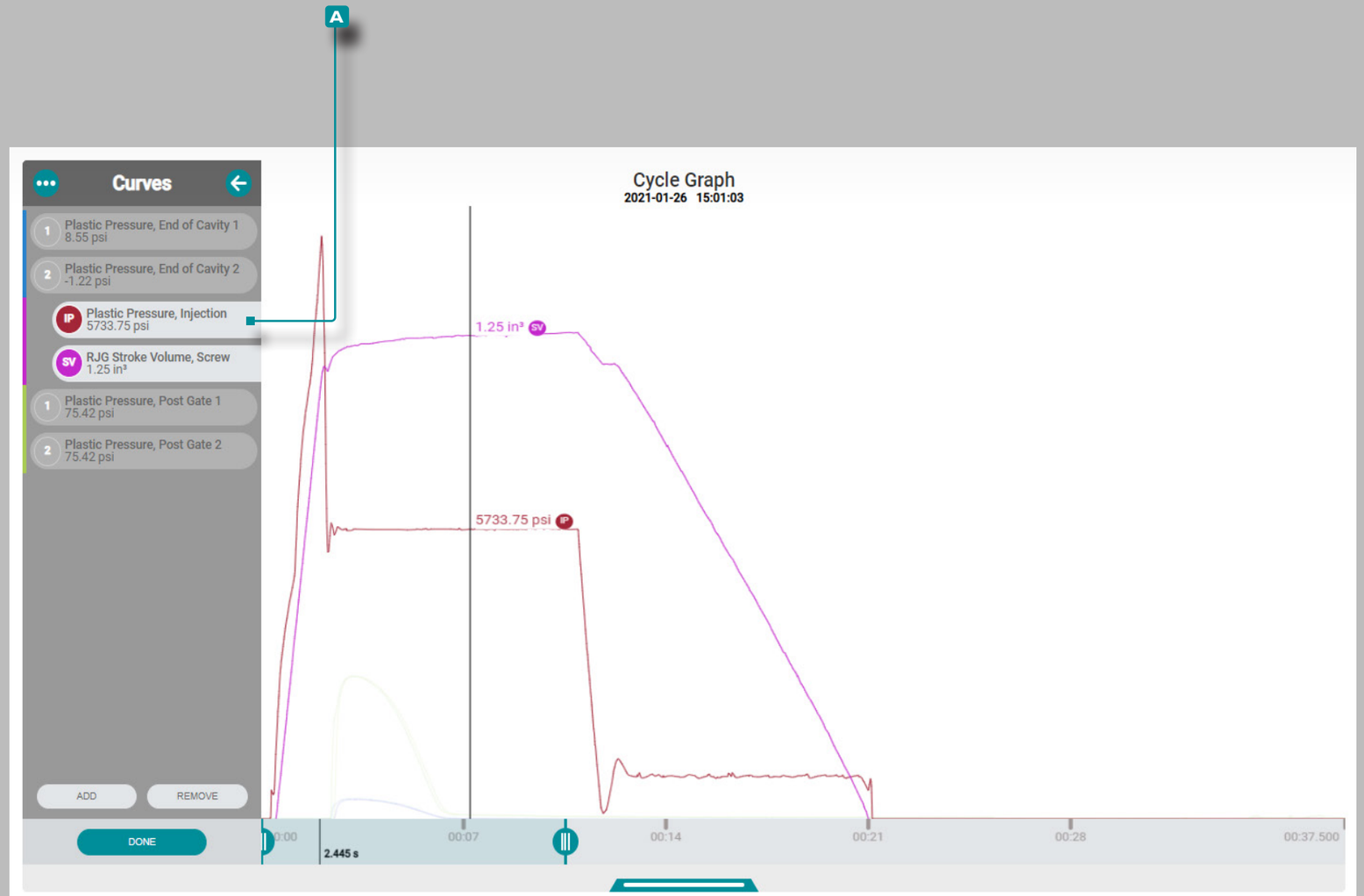
### Select a Data Point/Show Cursor

**With a cycle selected on the Summary Graph, click** and **hold** on the cycle graph to view the A cursor and cycle data values (refer to "Summary Graph Trend Controls" "Select a Data Point/Show Cursor" on page 22). **Click**, **hold**, and **drag** on the cycle graph to drag the cursor left or right on the graph.

### Zoom In or Out

Cycle curves are automatically scaled to show the entire job. **Click** the B select time range button, then **click**, **hold**, and **drag** the C & D graph bars to zoom to or select a desired time period within the job.

**Click**, **hold**, and **drag** between the graph bars to move the zoom area to a different time period, and **click** E DONE to apply the changes.




(Cycle Graph Controls, *continued*)

Pan Through Cycles, or Play Cycle-by-Cycle

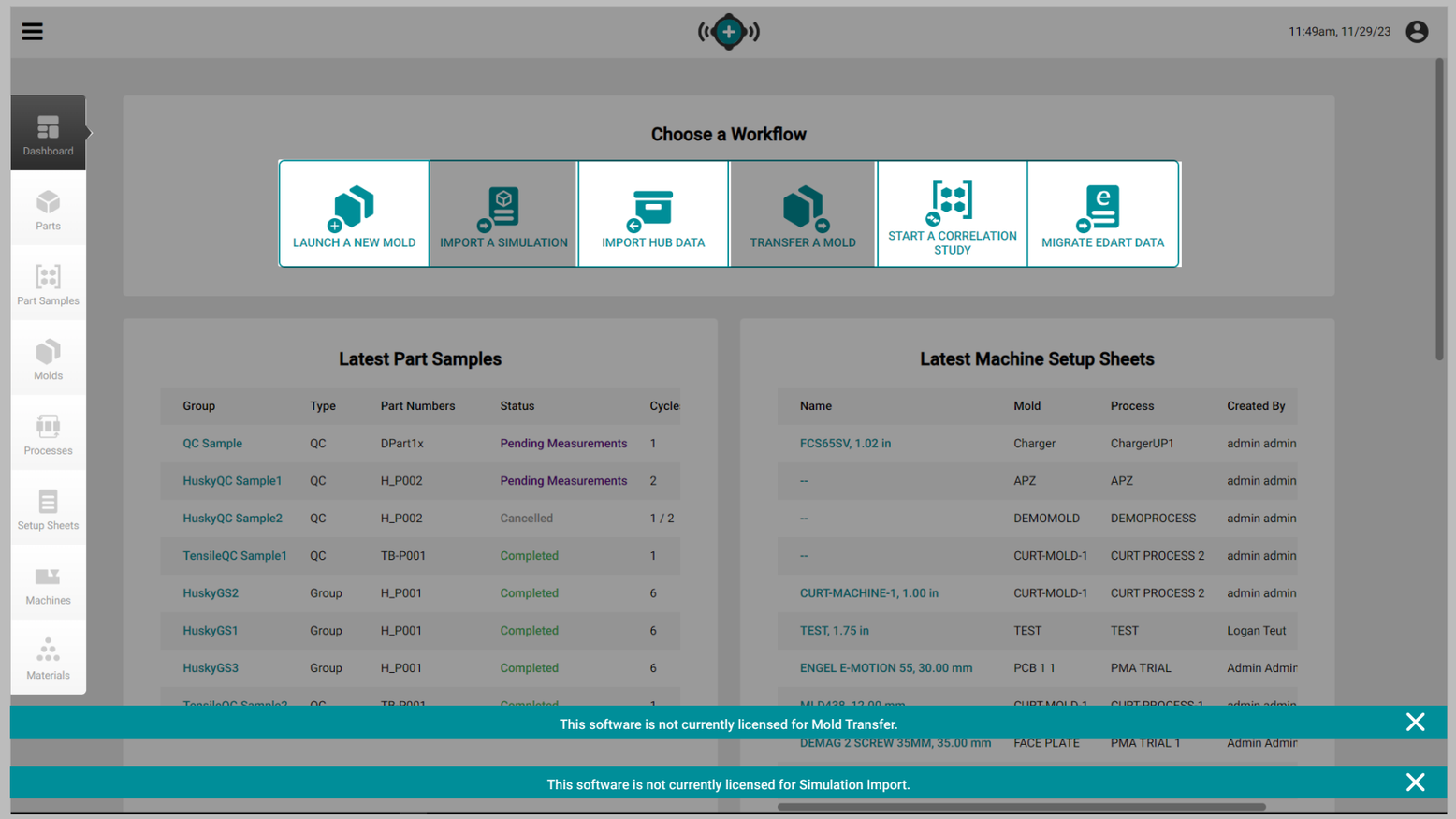
**Click** the NEXT button **on the Summary Graph** to play through the data until the job end, or the PREVIOUS button **on the Summary Graph** to play through the date until the job start (refer to "Summary Graph Trend Controls" "Add Summary Graph Trends" "Pan Through Cycles, or Play Cycle-by-Cycle" on page 22).

Highlight a Curve or Curves

**Click** and **hold** on a A curve label to temporarily highlight that curve on the graph while other visible curves are faded until the curve label is released ***OR***

**Click**, **hold,** and **drag** a A curve label **to the right** to highlight that curve on the graph while other visible curves are faded until the curve label is dragged back to the original, in-line position.

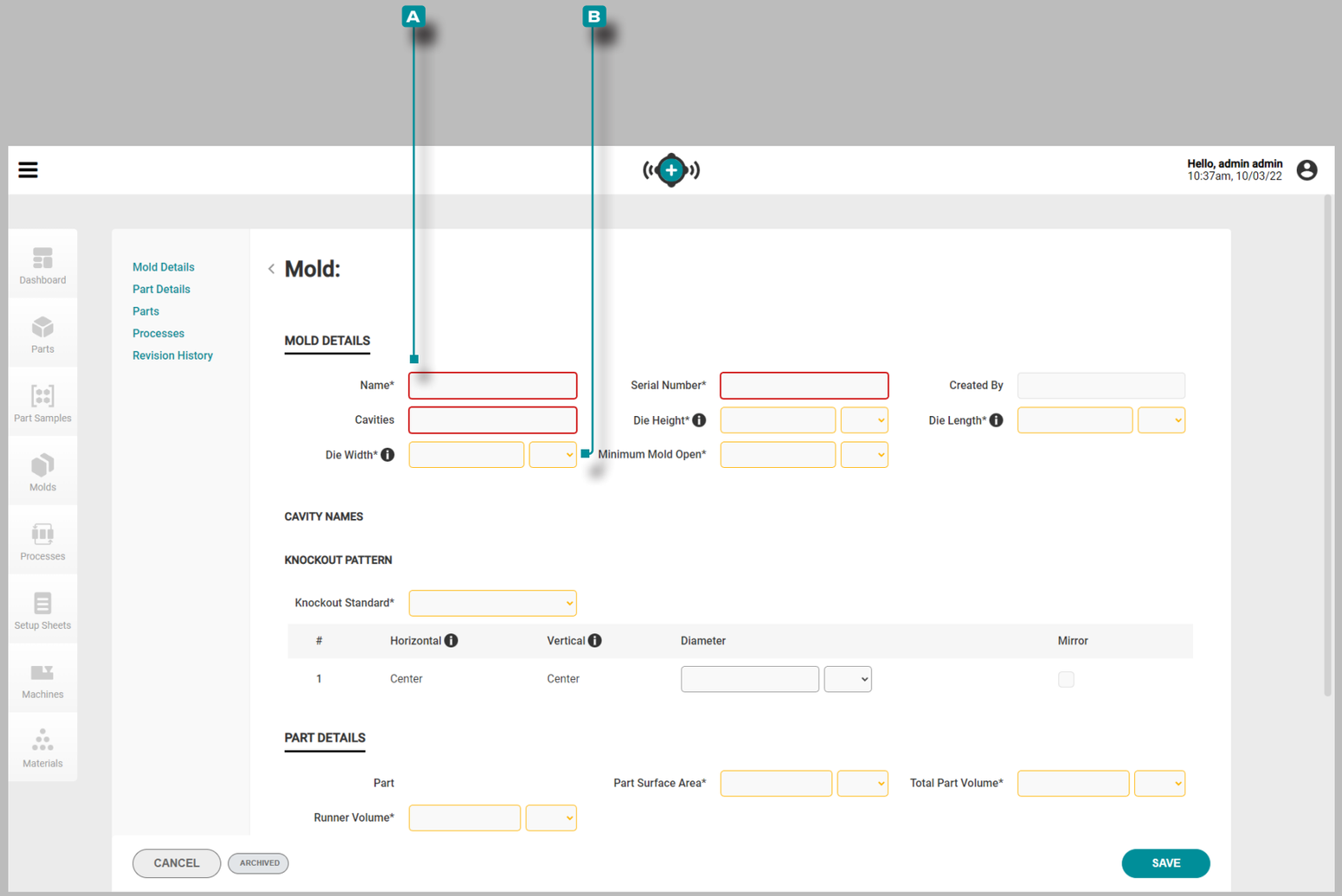
# The Hub for Process Development




## Application Overview

The Hub for Process Development provides a user-entered database of part, part sample, mold, process, setup sheet, machine, and material records, and allows users to import job data or perform correlation studies. The Hub for Process Development dashboard additionally provides access to The Hub for Mold Transfer and The Hub for Simulation Support tools; these tools will only function if the correct licenses are applied to the software.

Click on the corresponding menu button to view The Hub for Process Development dashboard to import job data, view or add records for part, part sample, mold, process, setup sheet, machine, and material records, start a correlation study, launch a new mold or transfer a mold, and import a simulation.

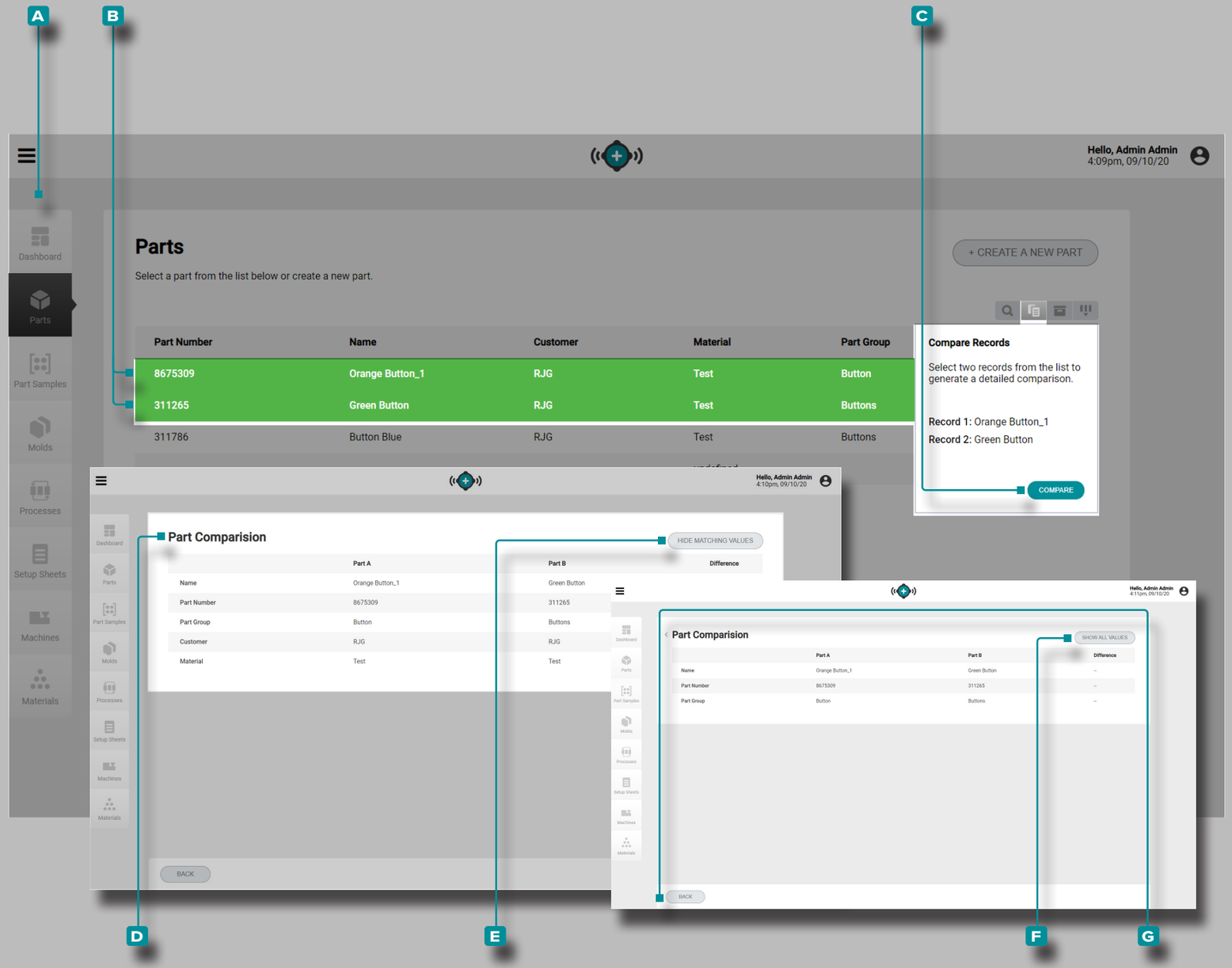



# The Hub for Process Development

## Creating Records

A record can be created without entering the items that are required for use with the process transfer “Launch a New Mold” or “Transfer a Mold” tools in order for the machine/mold fitment to be determined; refer to each record section in this guide for items that are required to satisfy mold transfer requirements for these tools.

**Fields required for record creation A are outlined in red.**
**Fields required for mold transfer B are outlined in yellow.**

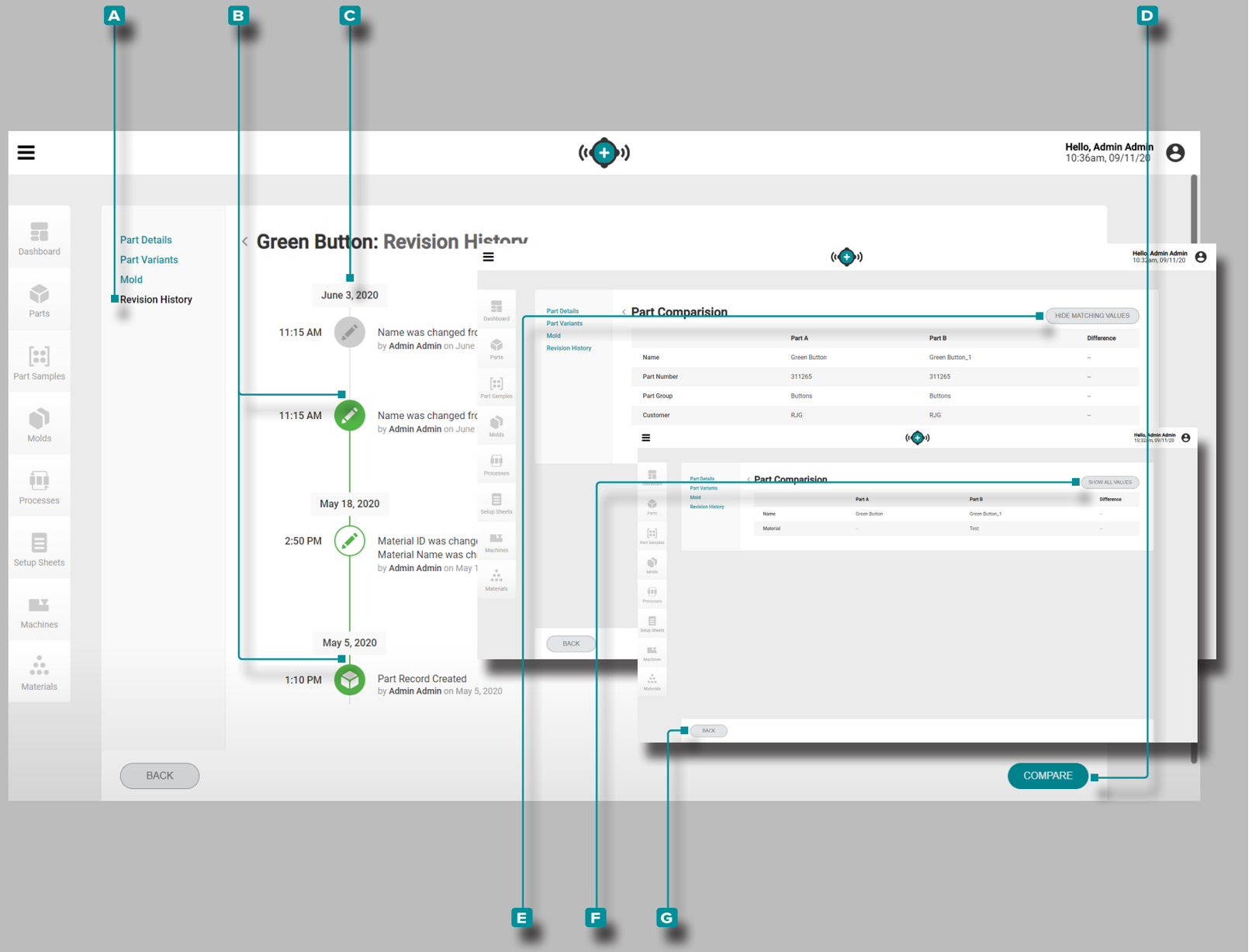



# The Hub for Process Development

## Comparing Records

Each records page (parts, molds, processes, setup sheets, machines, and materials) provides a list of records with the ability to compare two records. A comparison of two records shows a side-by-side comparison of each record's information, with the option of hiding matching values to quickly identify differences between the records.

Navigate to a records page (parts, molds, processes, setup sheets, machines, or materials); **click** the A compare button, then **click** on B two records to select which two to compare, then **click** the C COMPARE button. The D compare records page will display both records' information beside one another; to hide all matching information/values the records share, **click** the E HIDE MATCHING VALUES button. To view all information after hiding matching values, **click** the F SHOW ALL VALUES button. When done comparing records, **click** the G BACK button to return to the records page.



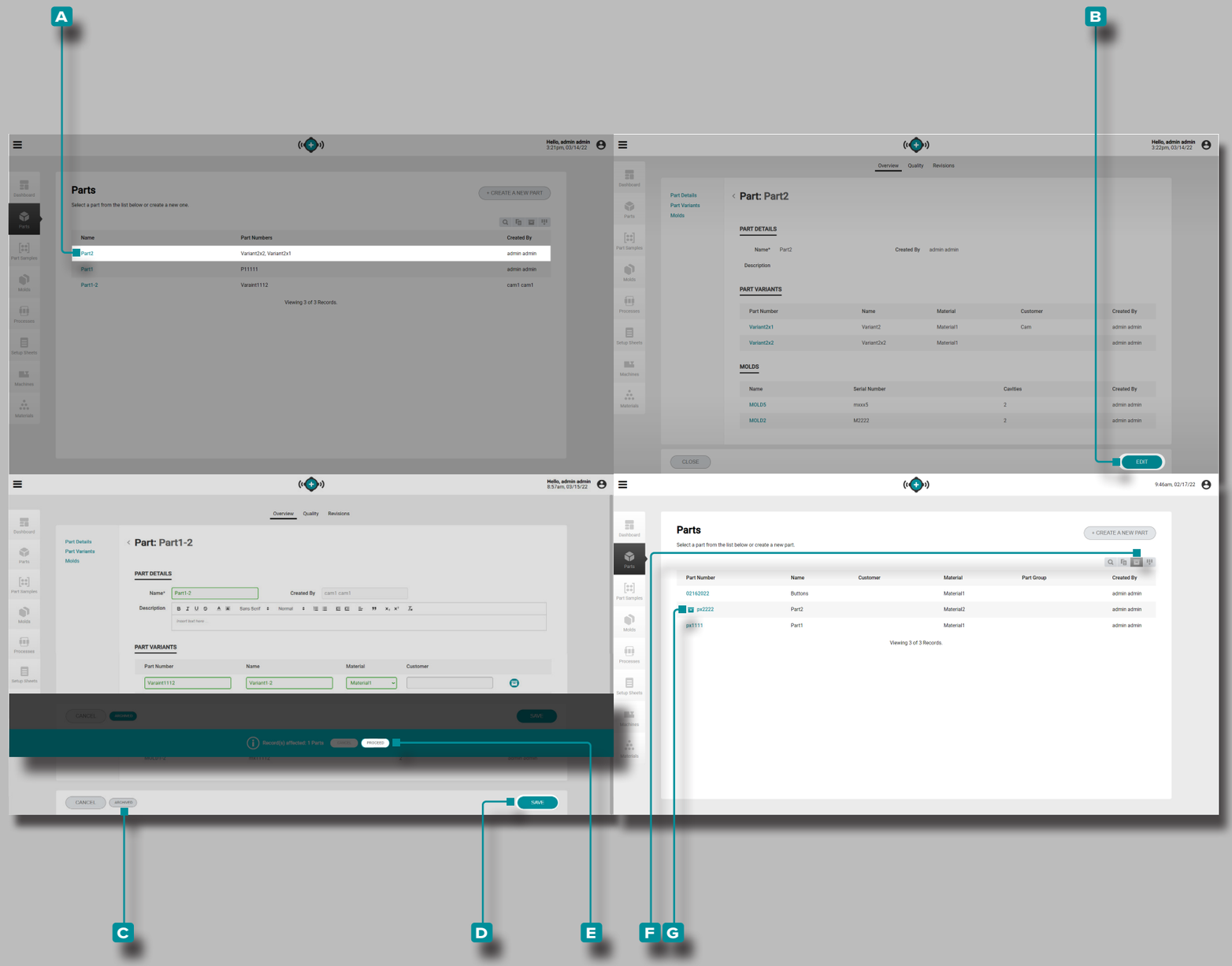

# The Hub for Process Development

## Comparing Record Revision History

Each record type provides a record revision history within the record. The revision history displays when the record was created, and each change made to the record since creation. Revision versions of each record can be compared easily using the compare records function.

While viewing a record, **click** A Revision History to view the revision history for that record (for part records, select the “Revisions” tab, then select Revisions History; refer to "Revision History" on page 40) . **Click** any two B icons next to a date and time along the C revision history timeline to select for comparison the two selected dates/times; **click** the D COMPARE button to view the side-by-side comparison.

The comparison page will display both date/time revision history records’ information beside one another; to hide all matching information/values the records share, **click** the E HIDE MATCHING VALUES button. To view all information after hiding matching values, **click** the F SHOW ALL VALUES button. When done comparing records, **click** the G BACK button to return to the record’s revision history page.




# The Hub for Process Development

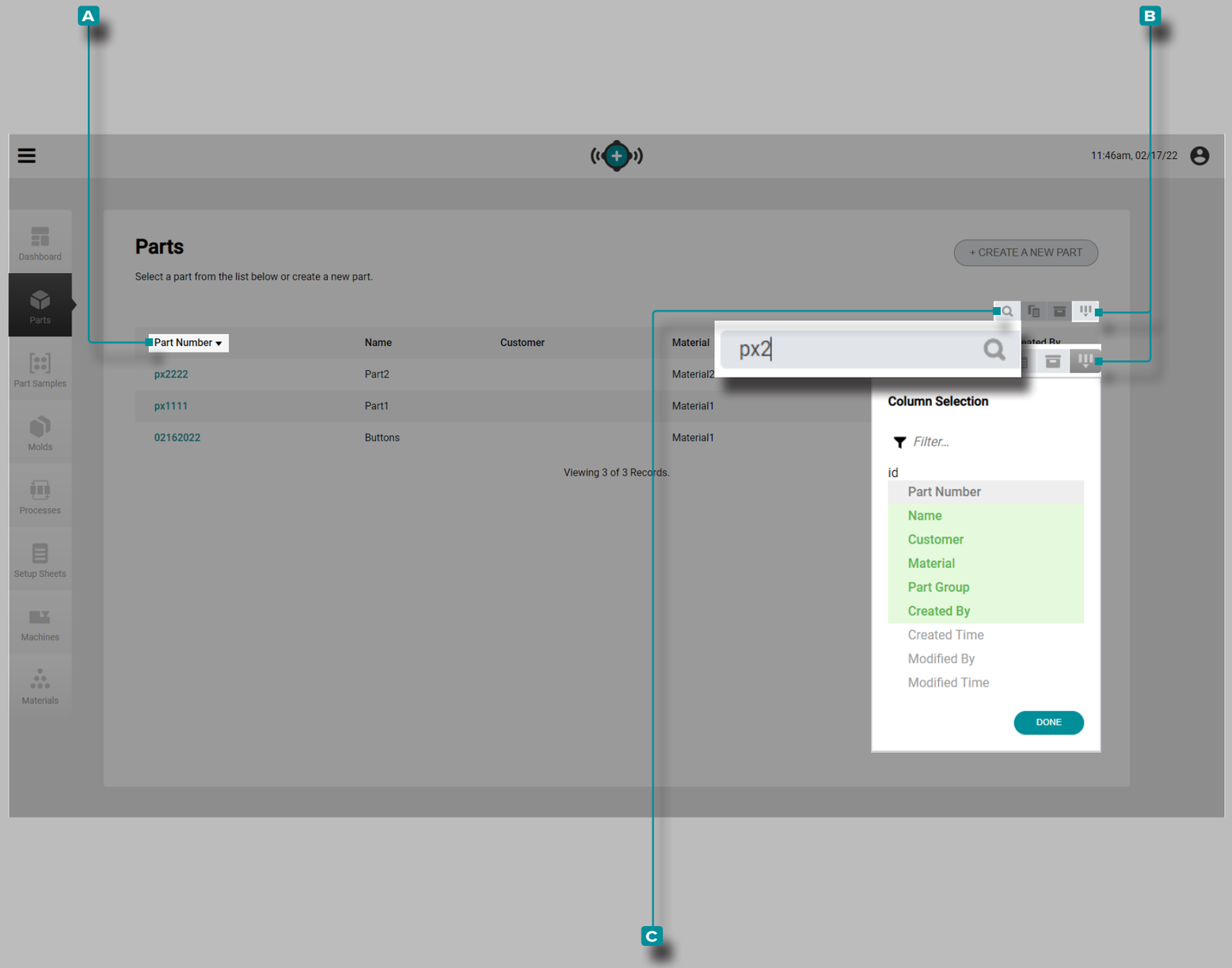
## Archiving Records

Parts, molds, processes, setup sheets, machines, and materials records can be archived so that the record will be unavailable to use on connected CoPilot systems.

Navigate to a records page (parts, molds, processes, setup sheets, machines, or materials); **click** a **A** record name/ number to select it and view the record details; then **click** the **B** edit button, and then **click** the **C** ARCHIVED button to archive or un-archive the record. **Click** the **D** SAVE button to complete the archival.

A user notification will appear in order to confirm the archive of the selected record; if other records are affected by the archival, the affected record information will be included in the notification. **Click** the **E** PROCEED button to confirm record archival.

By default, archived records will be hidden from the listed records. To view archived records, **click** the **F** view archived records button to view all records, including archived records. Archived records will have an **G** archived records icon next to the record name/number in the record list.




# The Hub for Process Development

## Sorting and Searching Records

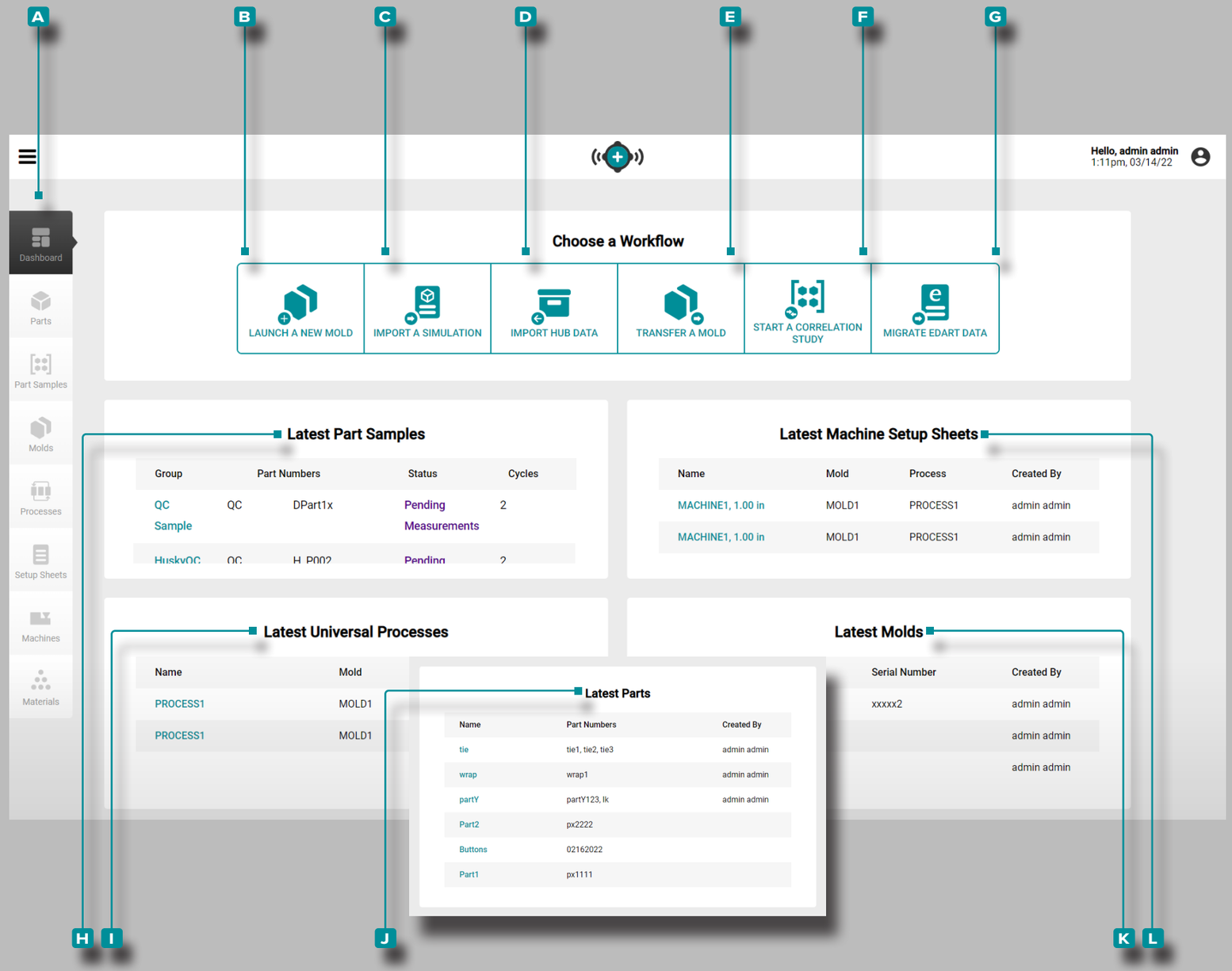
### Sorting Records

Each records page (parts, molds, processes, setup sheets, machines, and materials) can be sorted using the column headings. **Click** a A column heading to sort the records in ascending order; **click** the column heading a second time to sort the records in descending order. A triangle is displayed next to the column that is sorted. If the triangle point is facing up, the column is being sorted in ascending order; if the triangle point is facing down, the column in being sorted in descending order.

Select which columns and corresponding record information are visible; **click** the B column selection button, then **click** to select/deselect columns to display on the records page. Selected column headings are highlighted in green.

### Searching Records

Each records page (parts, molds, processes, setup sheets, machines, and materials) can be searched using alphanumeric text. **Click** the C search icon, then **enter** the text by which to search. Any matching records will be displayed, while any un-matching records will be hidden until the search is cleared and exited.




# The Hub for Process Development

## Dashboard

The A Dashboard provides a quick view of the top ten latest machine setup sheets, universal processes, molds, and parts, along with access to the launch a new mold, import a simulation, import job data, transfer a mold, and start a correlation study functions.

### Launch a New Mold

If licensed, use the B Launch a New Mold tool to launch a new mold by entering part and mold records, selecting (or entering) a compatible machine, and generating a setup sheet and a process (refer to "Launch a New Mold" on page 82).

### Import a Simulation

If licensed, use the C Import a Simulation tool to import a mold simulation file (refer to "Import a Simulation" on page 86).

### Import Job Data

Use the D Import Job Data tool to import job data from another The Hub software instance (refer to "Import Hub Data" on page 67).

### Transfer a Mold

If licensed, use the E Transfer a Mold tool to transfer an existing mold from one machine to another by selecting part, mold, and process records, selecting a compatible machine, and generating a setup sheet (refer to "Transfer a Mold" on page 84).

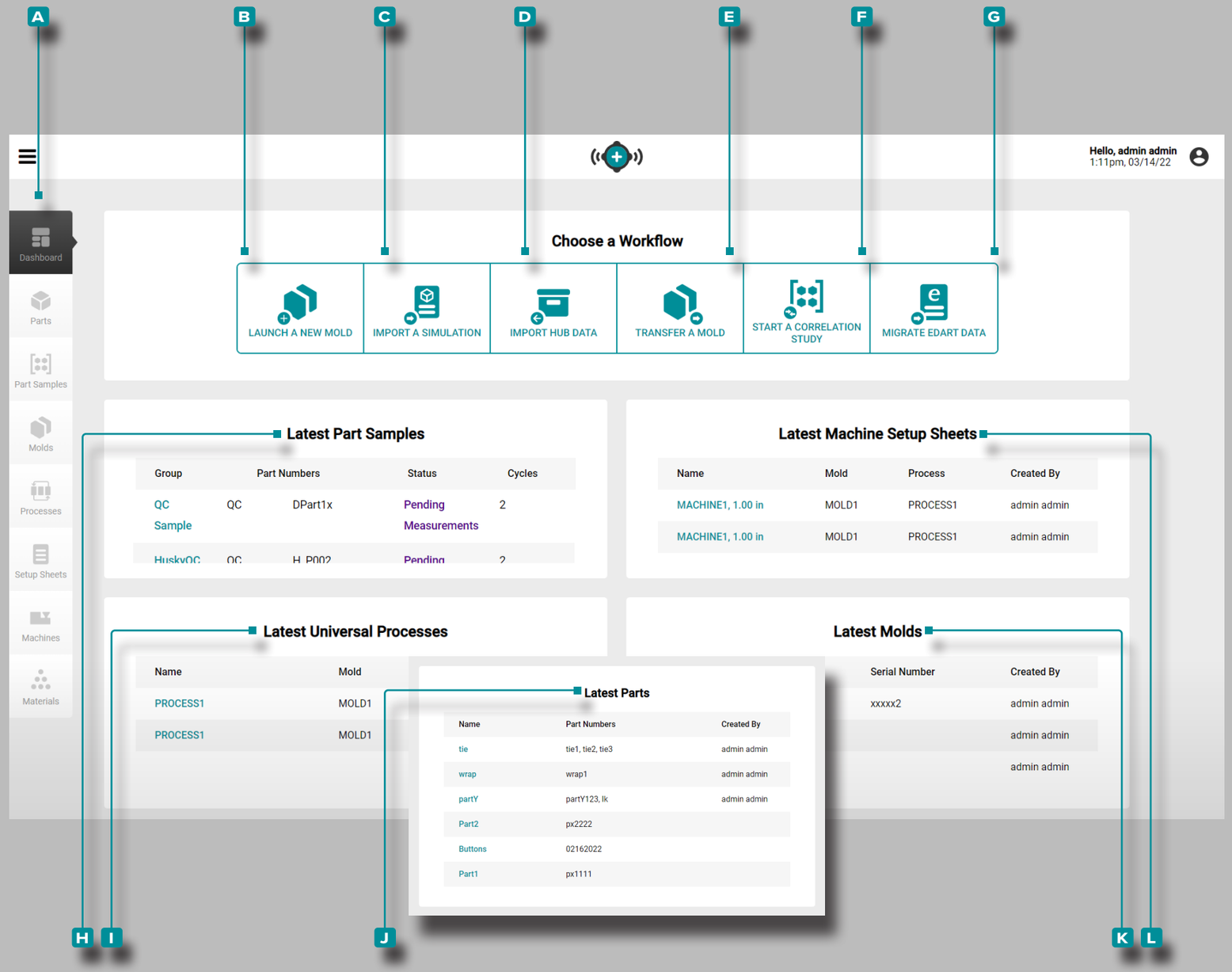
### Start a Correlation Study

Use the F Start a Correlation Study tool to find correlations between parts and process data by selecting part samples with completed critical-to-quality (CTQ) measurements with the same mold from different processes (refer to "Start a Correlation Study" on page 68).

### Migrate eDART Data

Use the G Migrate eDART Data tool to import eDART configurations into The Hub software for use with CoPilot systems (refer to "Start a Correlation Study" on page 68).

***(continued on next page)***




# The Hub for Process Development

*(continued from previous page)*

## Latest Part Samples

The **H** Latest Part Samples displays the 10 most recent part samples with group, part numbers, status, and number of cycles.

## Latest Universal Processes

The **I** Latest Universal Processes displays the 10 most recent universal processes with name, mold, cycle time, and created by username.

## Latest Parts

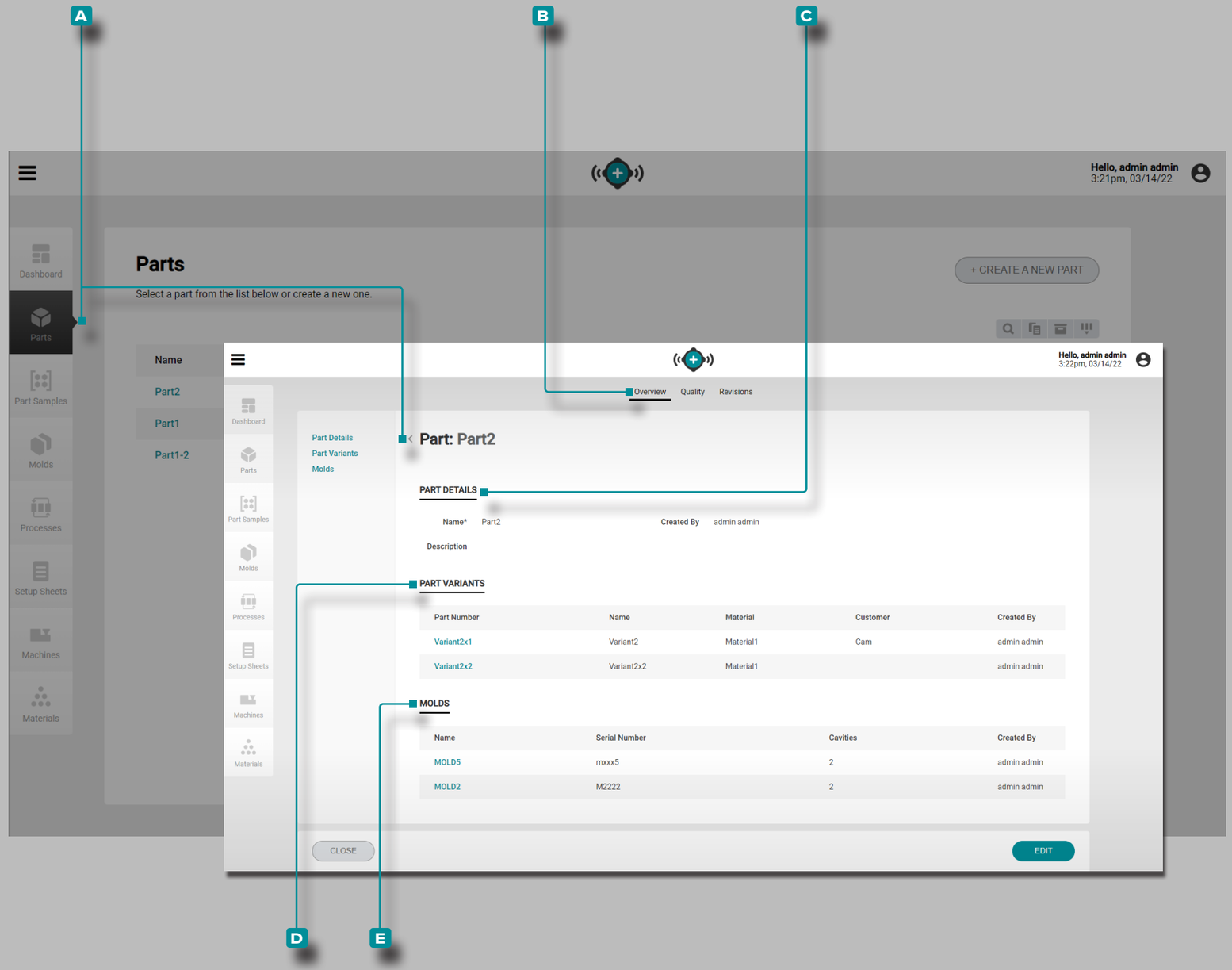
The **J** Latest Parts displays the 10 most recent parts by name, customer, and created by username.

## Latest Machine Setup Sheets

The **K** Latest Machine Setup Sheets displays the 10 most recent machine setup sheets with name, mold, process, and the created by username.

## Latest Molds

The **L** Latest Molds displays the 10 most recent molds with name, cavities, and created by username.




# The Hub for Process Development

## Parts

### Part Records

Part records A are entered and shown on the Parts page. **Click** on a part number to view part overview, quality, and revision history information. Part records A can also be compared to one another using the compare records feature; refer to "Comparing Records" on page 32 for information on comparing records.

### Overview

The A Part records B Overview tab provides the part details, part variants, and associated molds.

### Part Details

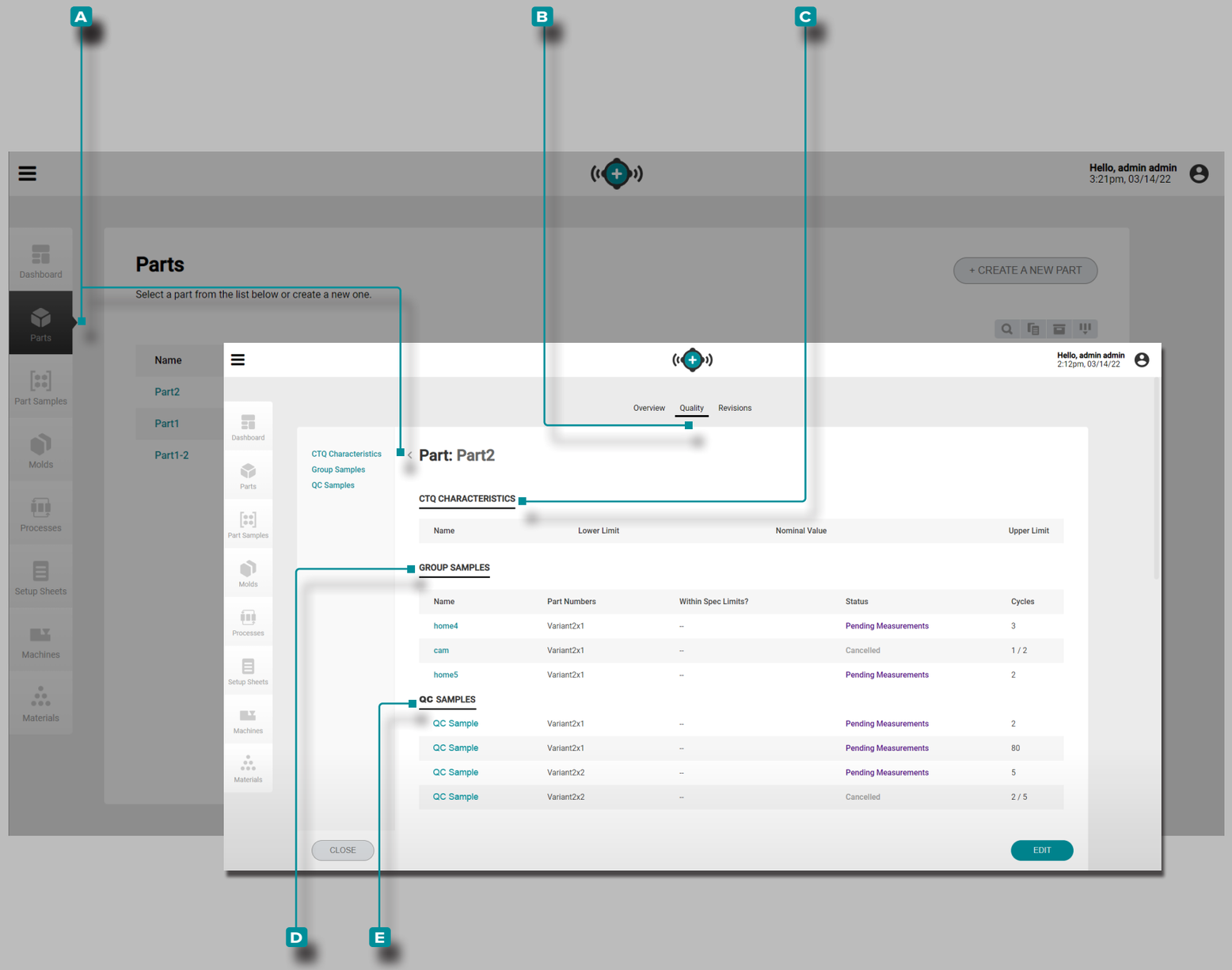
Part Details C contains the part name, who the part was created by, and a description (if entered).

### Part Variants

Part Variants D includes the part number, name, material, customer, and who the part was created by of any part variants. Part variants are created to associate parts made from the same mold but with different materials/customers/processes, and to associate part measurements with any samples taken of the part variant.

### Molds

The E Molds section displays the associated mold(s) for the part; for more information on mold record associations, refer to "Molds" on page 46.




# The Hub for Process Development

(Part Records, *continued*)

## Quality

The A Part records B Quality tab provides any critical-to-quality (CTQ) characteristics, group samples, and quality control (QC) samples for the selected part.

## CTQ Characteristics

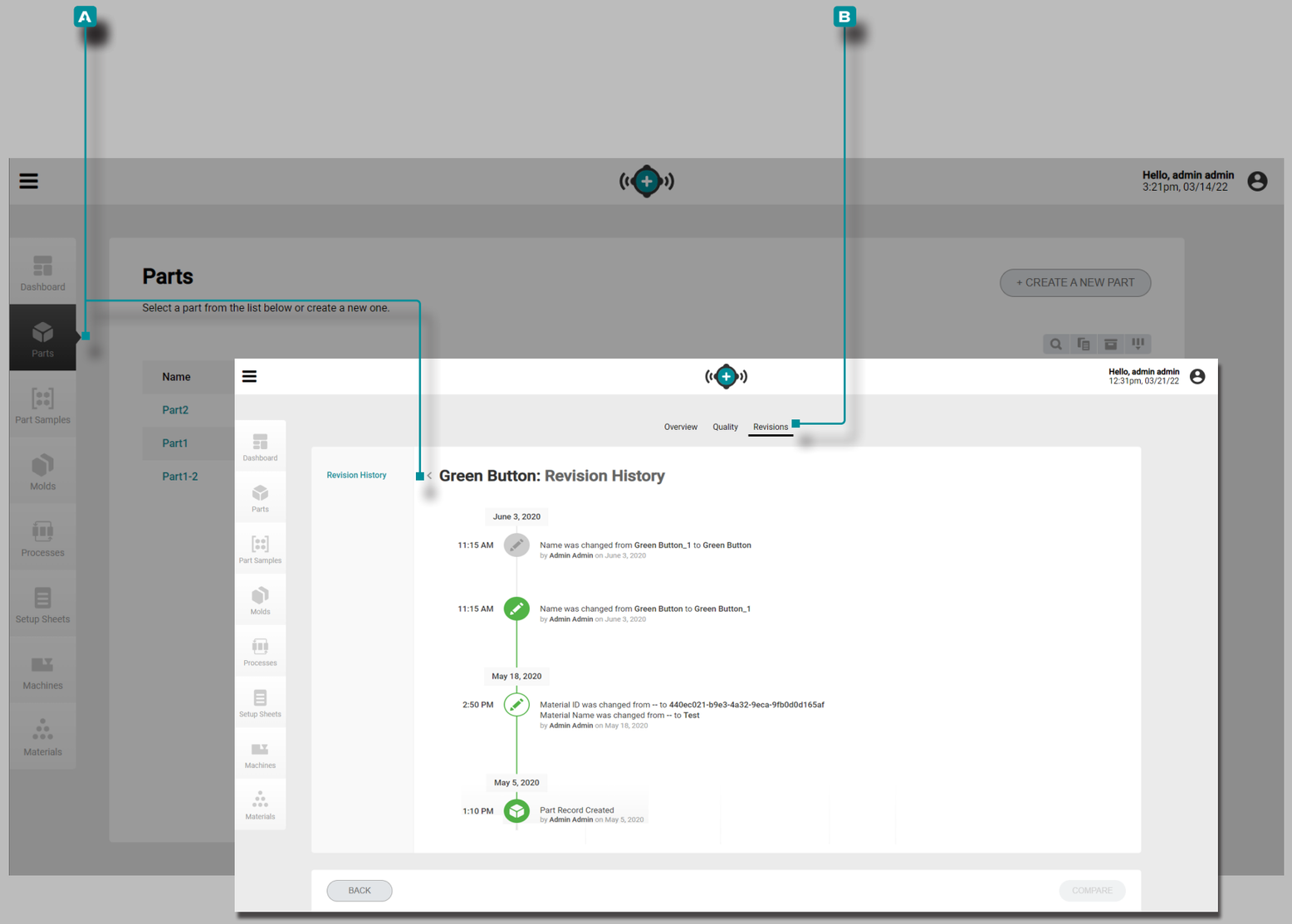
CTQ Characteristics C contains the CTQ name, lower limit, nominal value, and upper limit. The entered CTQ values will be used when part measurements are entered for part samples (refer to "Edit a Part Record: CTQ Characteristics" on page 43 and "Enter Part Measurements" on page 45).

## Group Samples

Group Samples D for the selected part are displayed in list form. Group Samples D includes the group sample name, associated part number (variant), if the sample is within specified limits (yes/no), status (completed/canceled/pending measurements), and (number of) cycles.

## QC Samples

QC Samples E for the selected part are displayed in list form. QC Samples E includes the sample name, associated part number (variant), if the sample is within specified limits (yes/no), status (completed/canceled/pending measurements), and (number of) cycles.



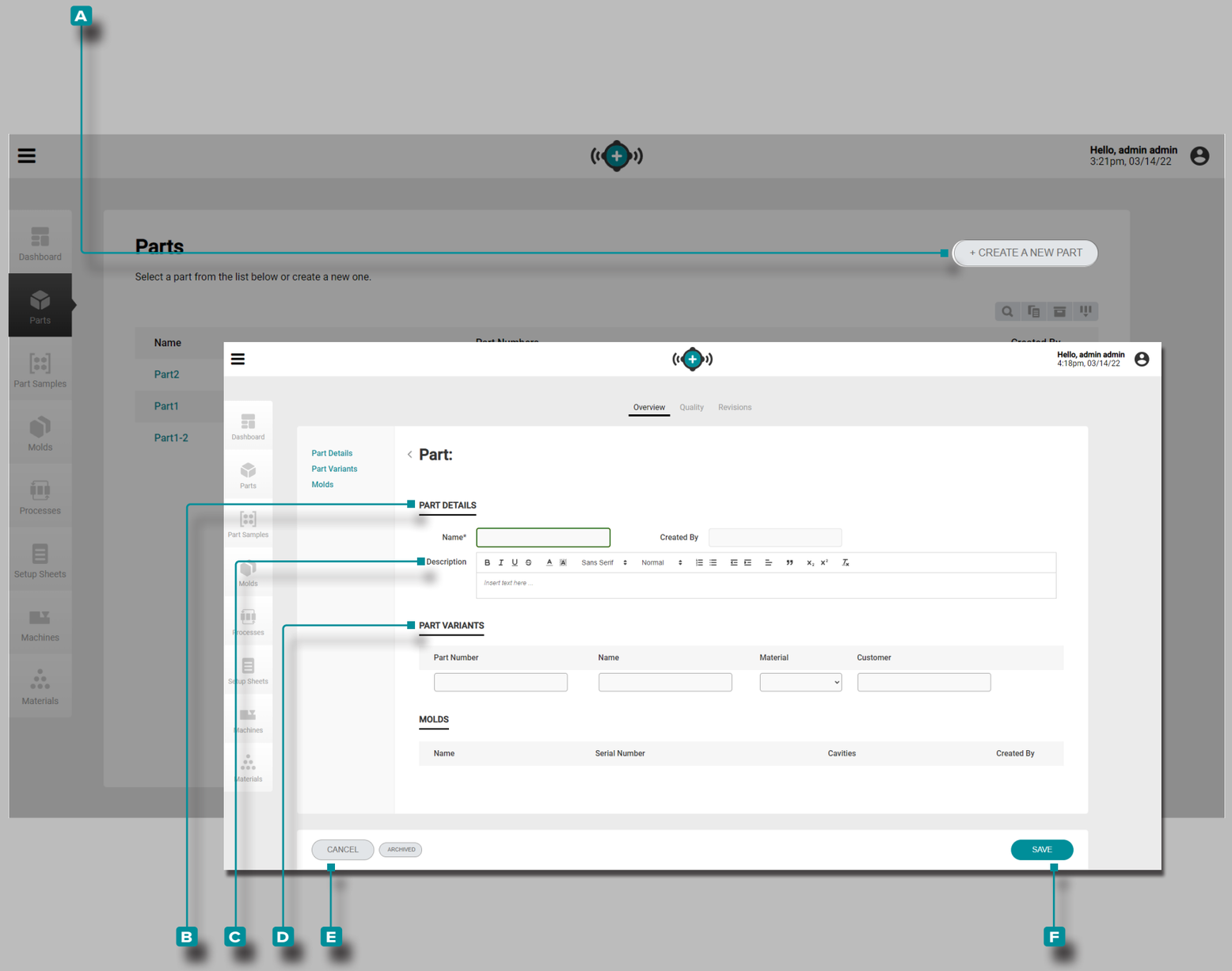

(Part Records, *continued*)

Revisions

Revision History

The A Part records B Revision History tab is a log of user-initiated actions that occur within the software, providing a record of each user action related to the record while logged in. **Click** on the B Revision History heading to view the part record revision history. Refer to "Comparing Record Revision History" on page 33 for information on comparing record revisions.

**NOTE** *Revision History is visible only to the users designated with administrator and process engineer roles.*




# The Hub for Process Development

## Create a New Part Record

**Click** the A CREATE A NEW PART button on the parts records page.

**Enter** B Part Details Name (**this is a required field**); the Created By field will automatically populate with the current user's name).

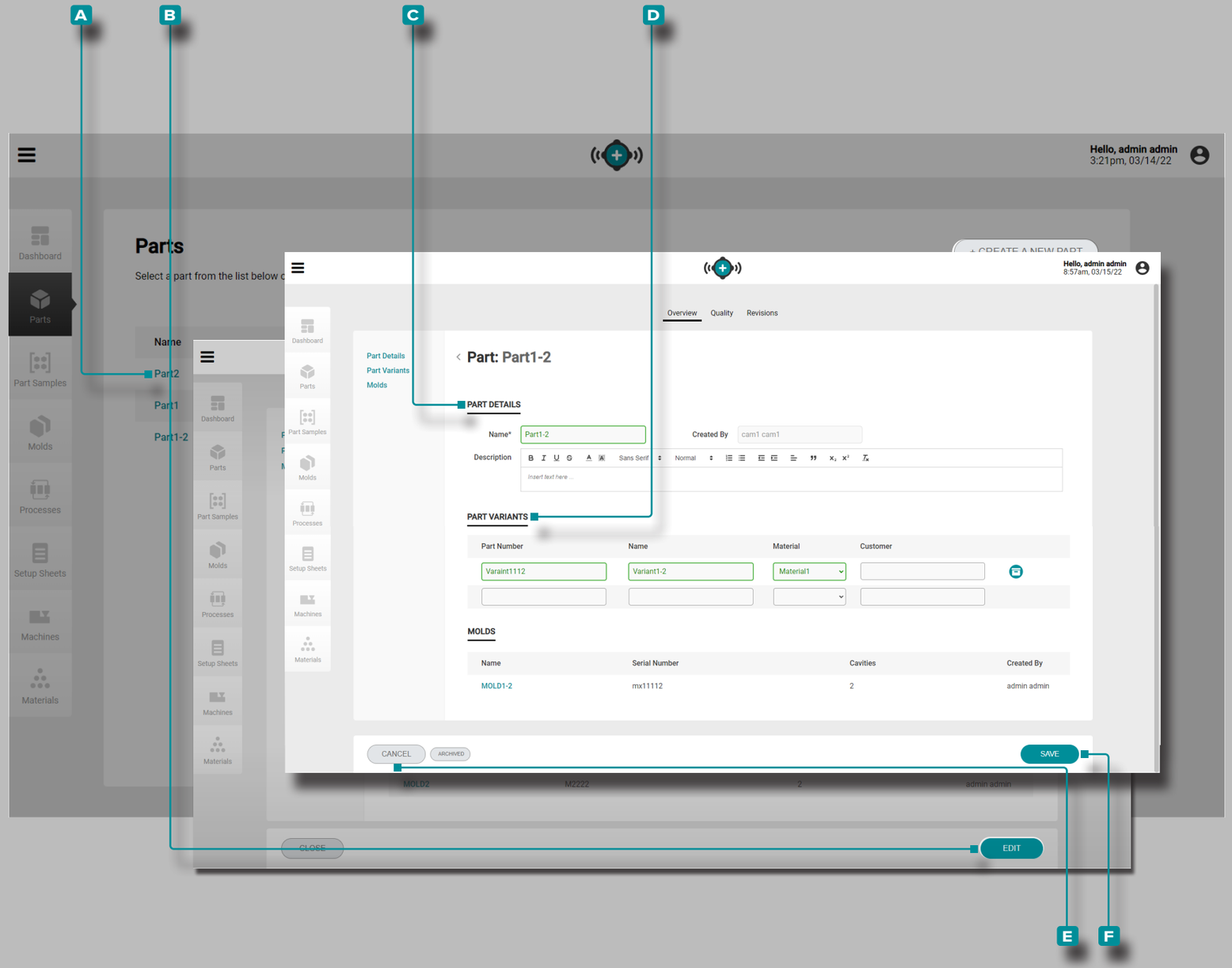
Optionally, **enter a part** C description.

Optionally, **enter** D Part Variants for the part (part variants can be created from the part record at any time as long as the part record has not been archived); refer to "Part Variants" on page 38.

Information for D Part Variants include Part Number, Name, Material, and Customer, and are optional. However, if a part variant is entered, then the Part Number, Name, and Material are required—the Customer field is optional.

The Molds section will be blank; parts and mold can be associated when a new mold is launched or when a mold is transfered (when a setup sheet and process is created).

**Click** the F SAVE button to save the part record, or the E CANCEL button to exit without saving the record.




# The Hub for Process Development

## Edit a Part Record Overview

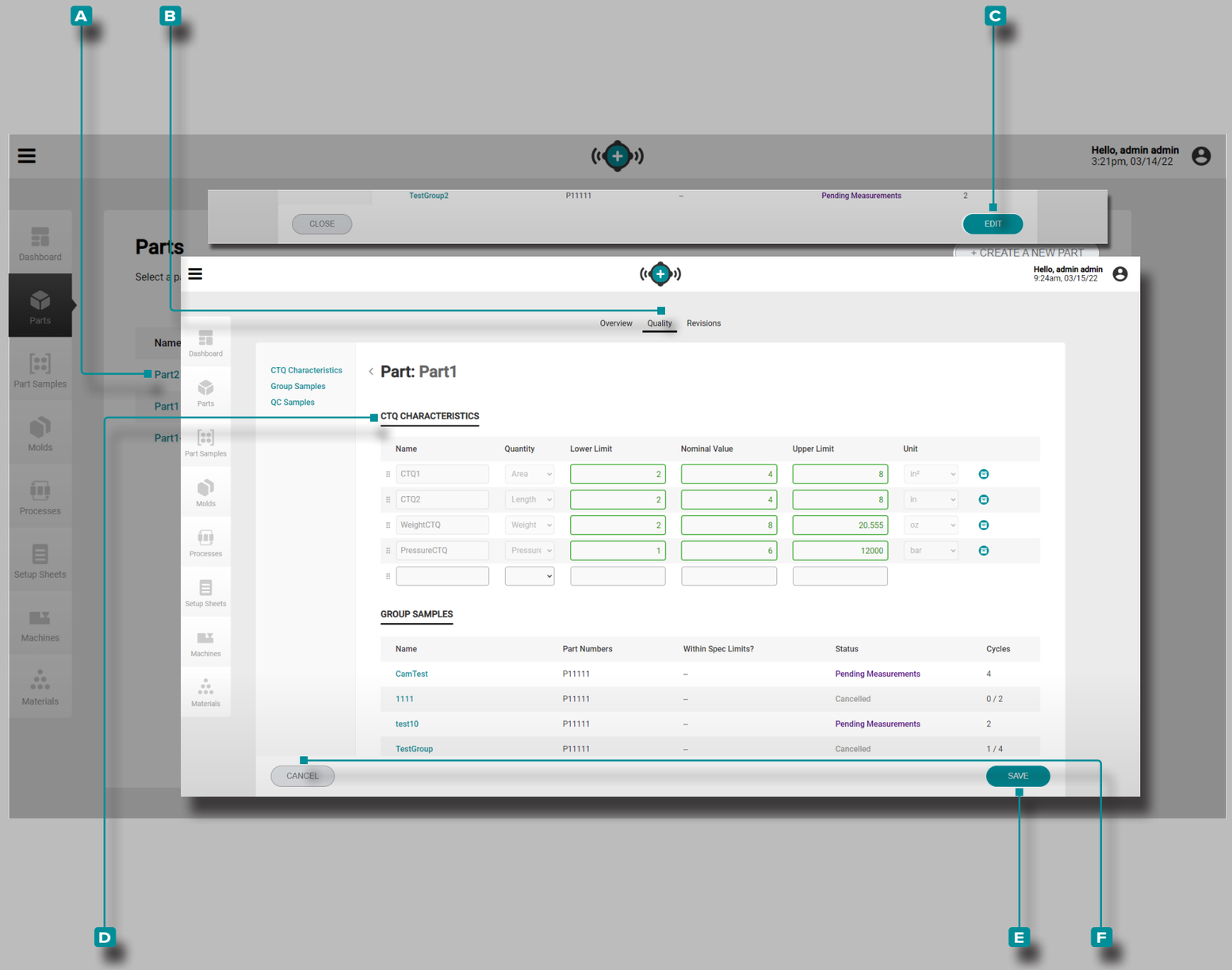
**Click** the A part number on the Parts records page to view the part record. **Click** the B EDIT button to edit the overview part details.

Edit the C part details (Name, Number, Group, Material, or Customer; the Created By field will automatically populate with the current user's name).

Edit or add a D part variant (Part Number, Name, Material, or Customer.

Mold associations cannot be edited.

**Click** the F SAVE button to save the part record, or the E CANCEL button to exit without saving the record.




## Edit a Part Record: CTQ Characteristics

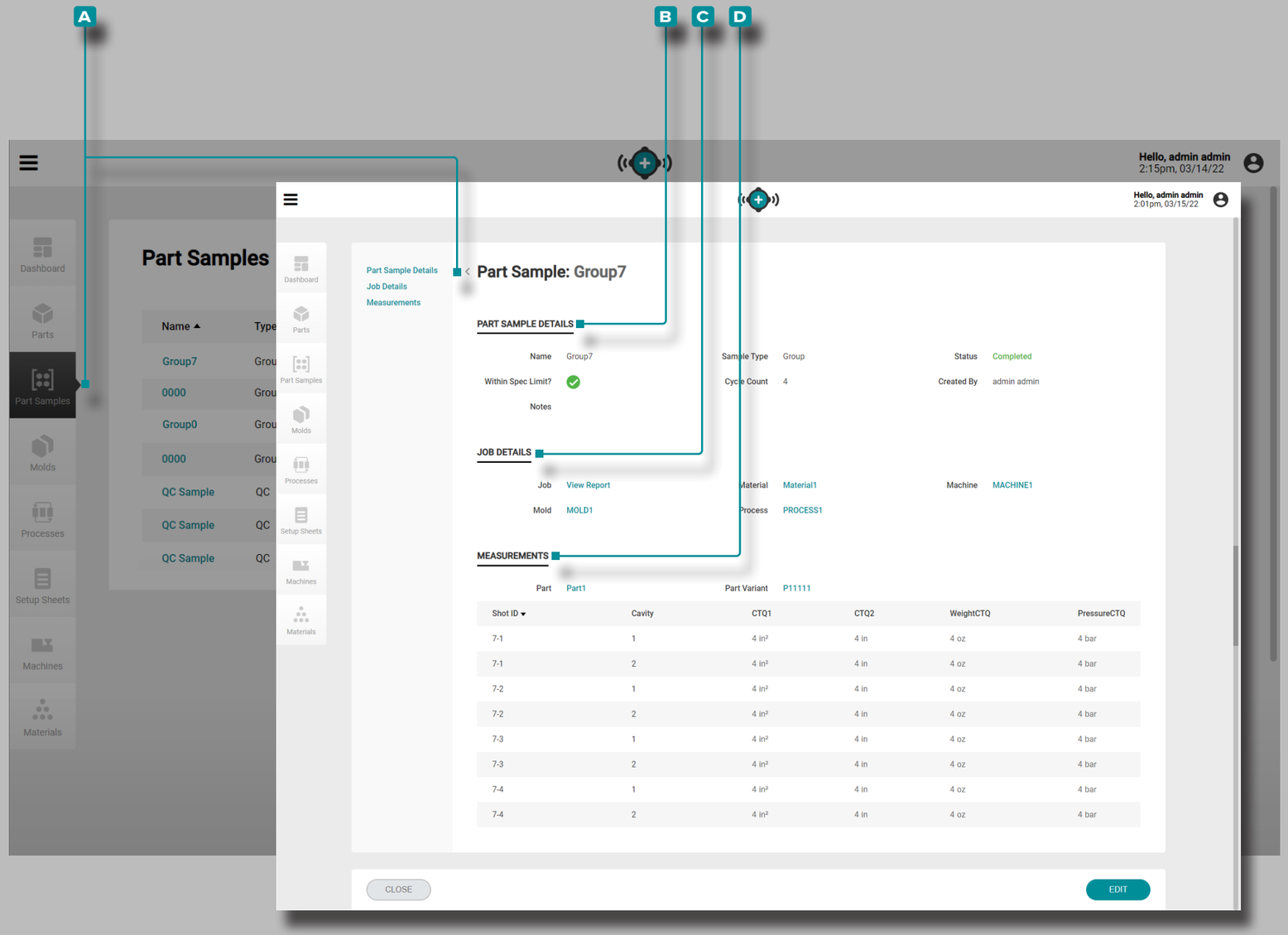
**Click** the A part number on the Parts records page to view the part record. **Click** the B Quality tab at the top of the part record view the CTQ Characteristics.

**Click** the C EDIT button to edit the D CTQ Characteristics.

Edit the D CTQ Characteristics (Name, Lower Limit, Nominal Value, or Upper Limit).

Group Samples and QC Samples cannot be edited from this page; refer to "Part Samples" on page 44

**Click** the E SAVE button to save the part record, or the F CANCEL button to exit without saving the record.




# The Hub for Process Development

## Part Samples

### Part Sample Records

Part sample records **A** that were collected from CoPilot systems are shown on the Part Samples page. **Click** on a part sample name to view details, associated job details, and measurements. Once a part sample is complete, measurements can be added to the record. Refer to X.

### Part Sample Details

Part Sample Details **B** contains the information entered when a part sample record was created, including name, sample type, status, if the part sample is withing the specified limits, cycle count, notes, and created by.

Part samples are designated either as a group sample or a QC sample when they are created. Group Samples are typically used during process development with a new mold. QC Samples are typically taken after process development, when a part is in production.

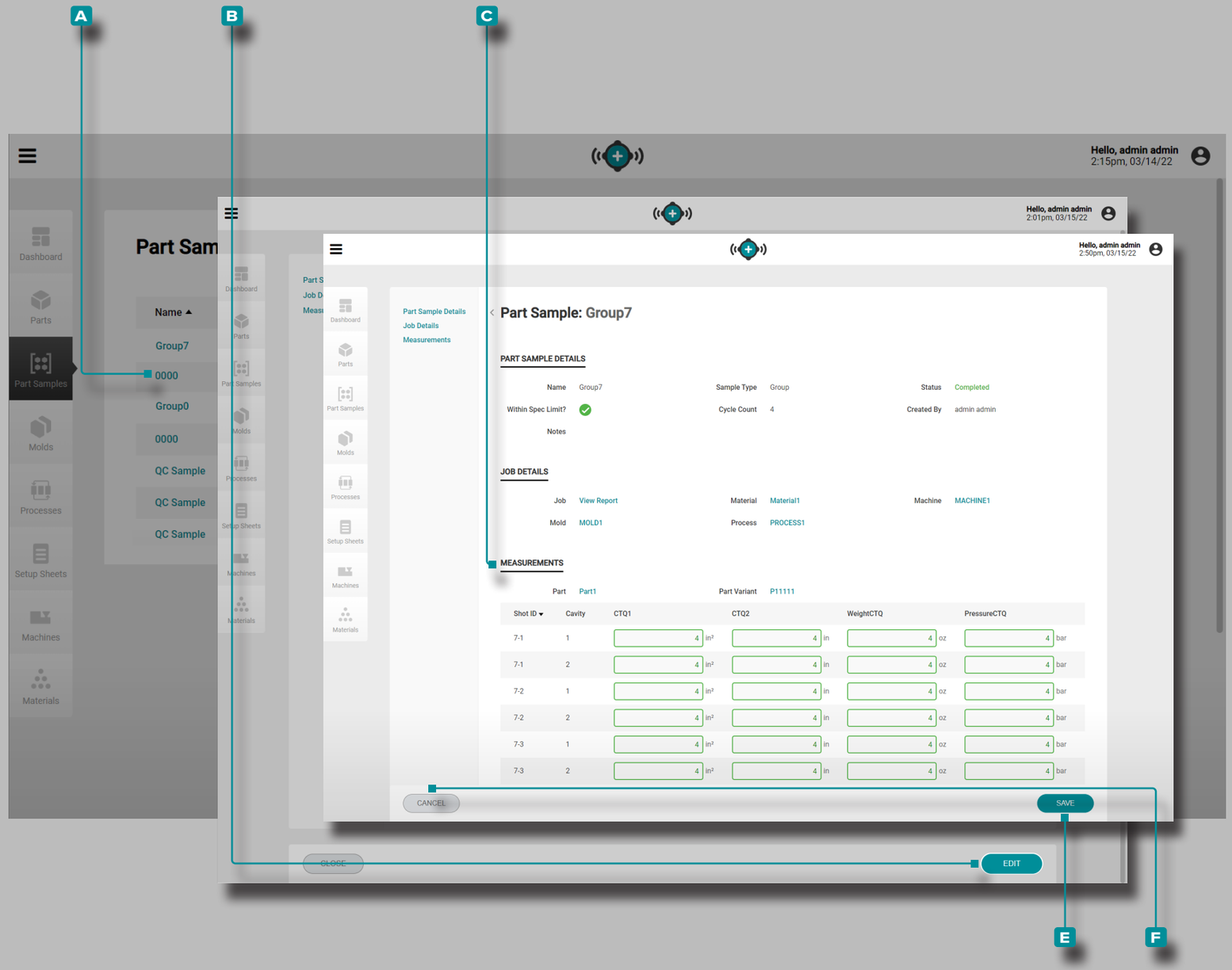
### Job Details

The **C** Job Details section will display the associated Job, Material, Machine, Mold, and Process for the sample. **Click** on a Job, Material, Machine, Mold, or Process name to view the associated record.

### Measurements

The **D** Measurements section will display the associated Shot ID, Cavity, and any entered CTQ characteristics assigned to the part and part variant for the sample. Refer to "Create a New Part Record" on page 41 for information on creating parts and "Edit a Part Record: CTQ Characteristics" on page 43 for information on entering CTQ characteristics.

# The Hub for Process Development



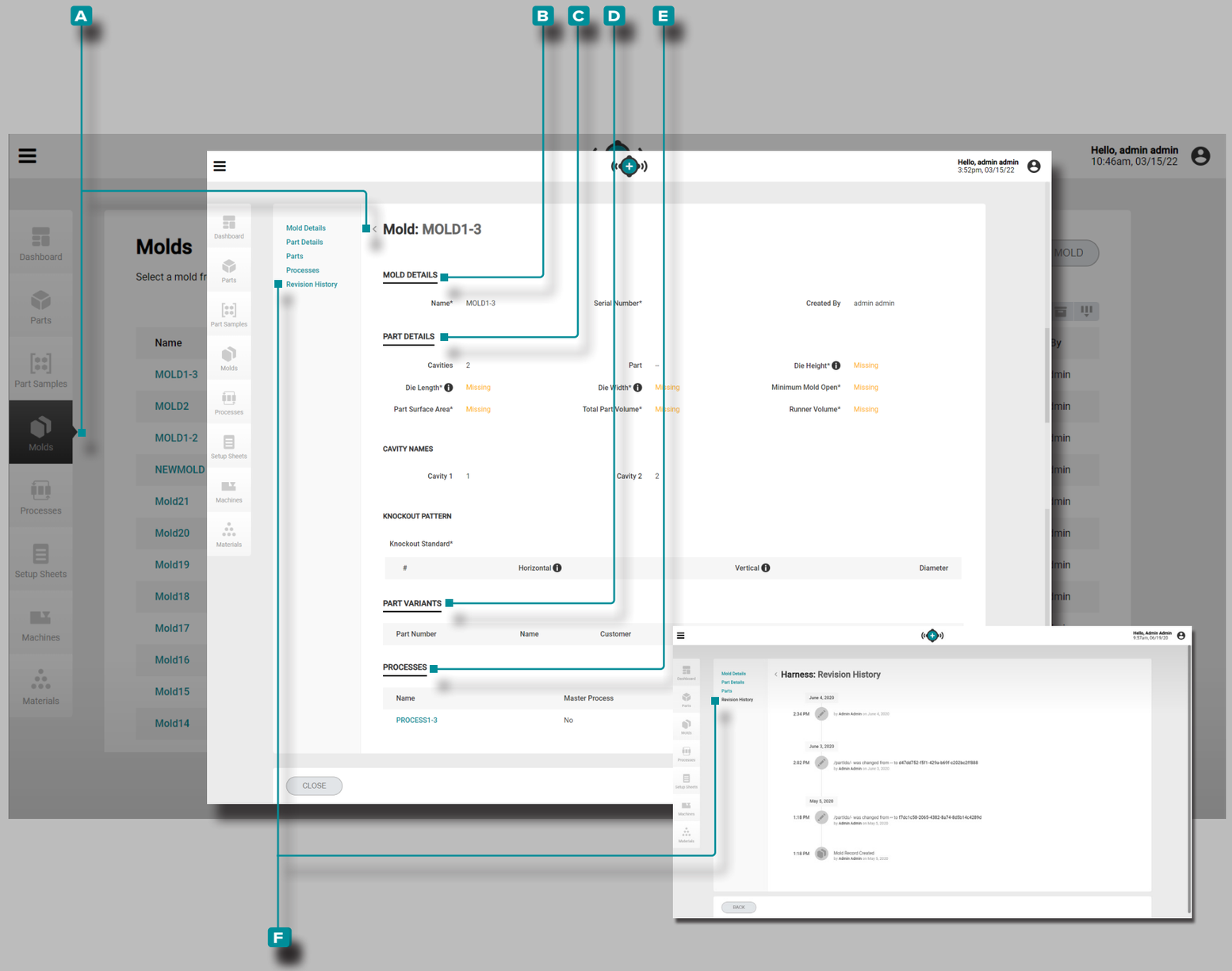

## Enter Part Measurements

**Click** the **A** part sample name on the Part Samples records page to view the part sample record.

**Click** the **B** EDIT button to add **C** Measurements.

**Enter** the part **C** Measurements.

**Click** the **E** SAVE button to save the part record, or the **F** CANCEL button to exit without saving the record.




# The Hub for Process Development

## Molds

### Mold Records

Mold records **A** are shown on the Molds page. **Click** on a mold name to view mold details, associated part details, associated part variants, associated processes, and revision history. Mold records **A** can also be compared to one another using the compare records feature; refer to "Comparing Records" on page 32 for information on comparing records.

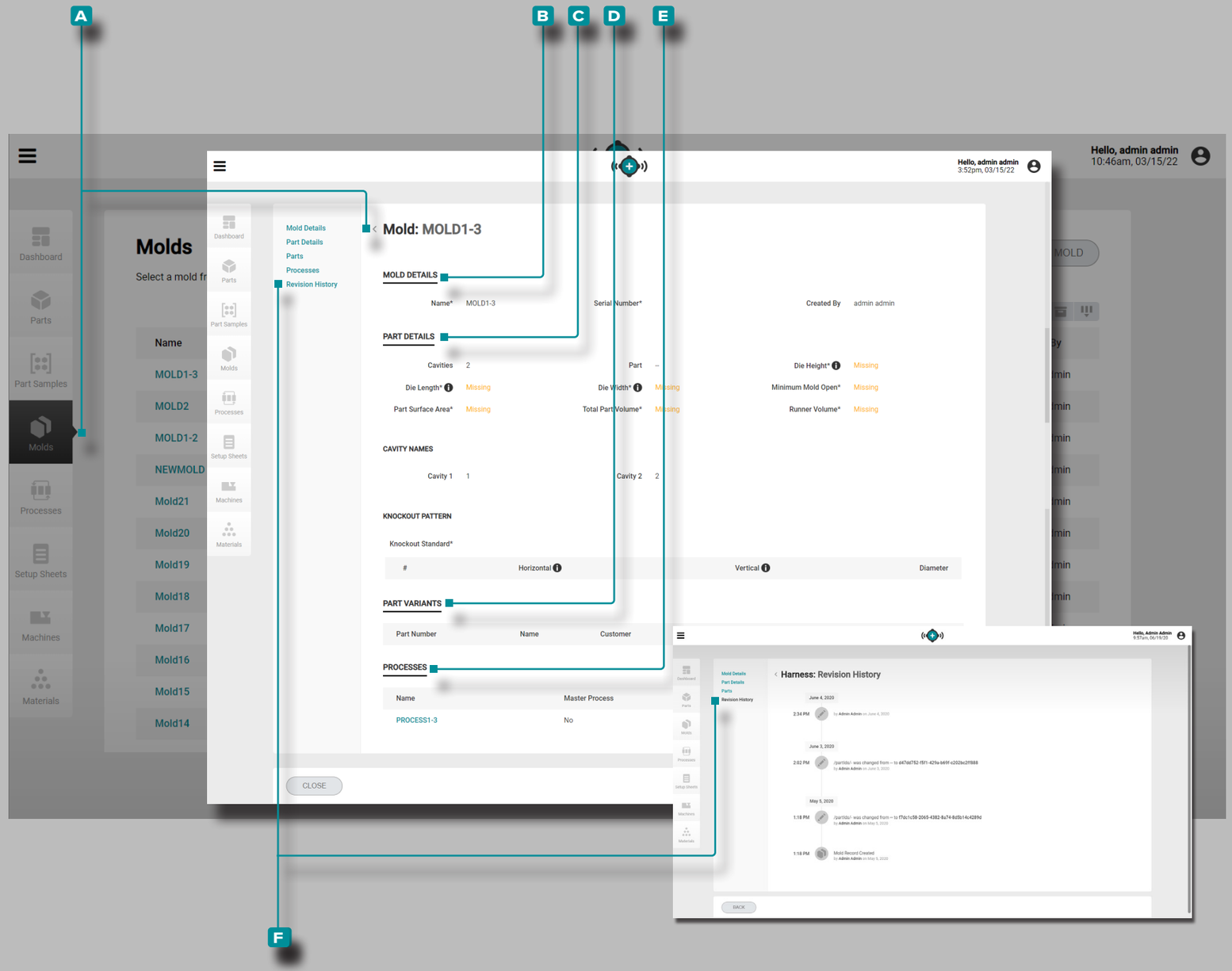
### Mold Details

Mold Details **B** contains the information entered when a mold record was created, including mold name, serial number, and created by.

### Part Details

Part Details **C** contains the physical part information entered when a mold record was created, including number of cavities, knockout standard, die height, die length, die width, minimum mold open, part surface area, part volume, and runner volume. If included, part details also displays cavity names and knockout pattern information.

***(continued on next page)***




# The Hub for Process Development

***(continued from previous page)***

## Part Variants

The **D** Part Variants section will display the associated part(s) for the mold. When a mold record is created or edited, an existing part record(s) can be selected to create the part/mold association; refer to "Create a New Mold Record" on page 48 or "Edit a Mold Record" on page 49 for information on associating a part and mold.

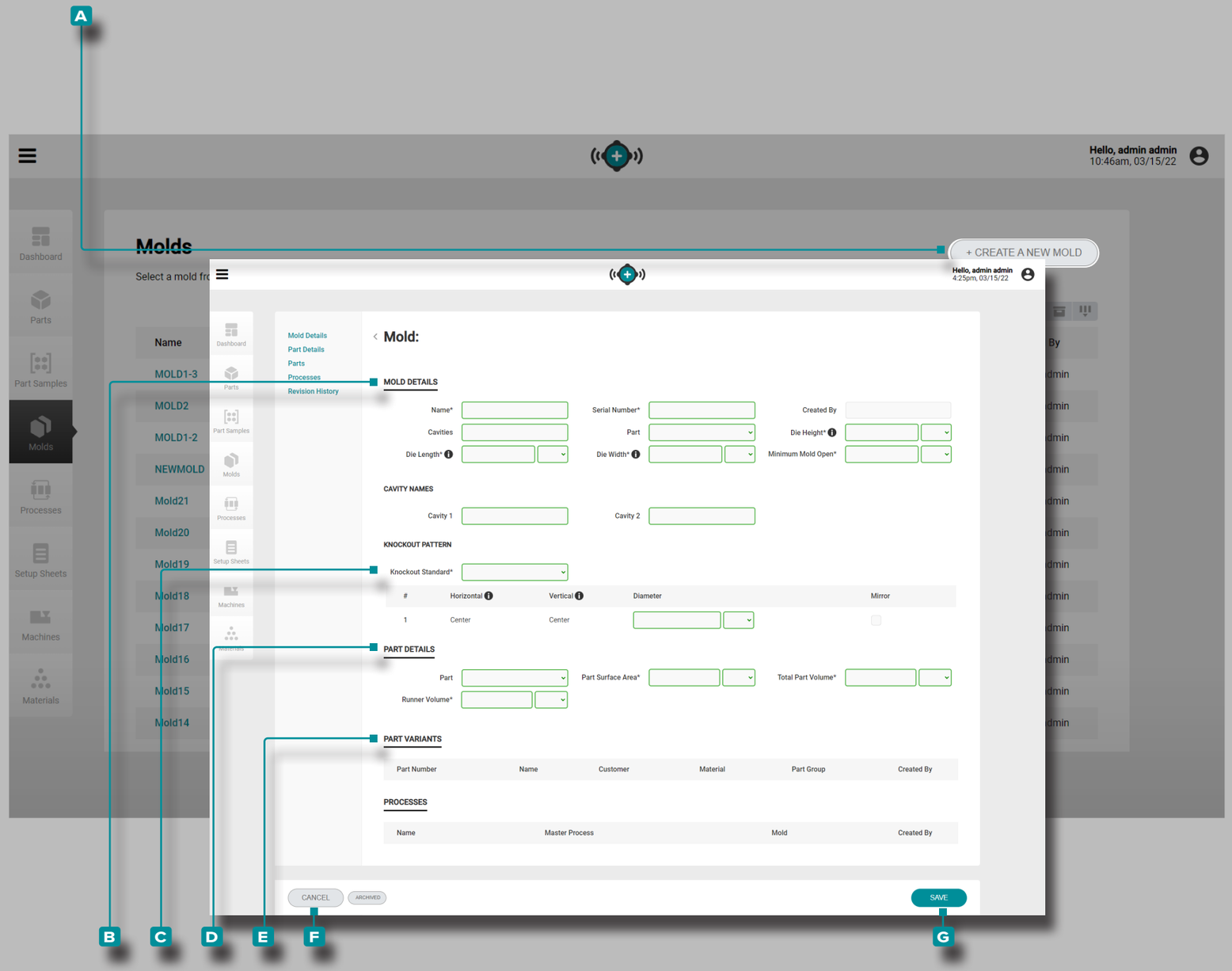
## Processes

The **E** Processes section will display the associated process(es) for the mold. When a setup sheet is created, molds are associated with a process(es); refer to "Launch a New Mold" on page 82 or "Transfer a Mold" on page 84.

## Revision History

The **F** Revision History is a log of user-initiated actions that occur within the software, providing a record of each user action related to the record while logged in. **Click** on the **F** Revision History heading to view the mold record revision history. Refer to "Comparing Record Revision History" on page 33 for information on comparing record revisions.

**ⓘ NOTE** *Revision History is visible only to the users designated with administrator and process engineer roles.*




# The Hub for Process Development

## Create a New Mold Record

**Click** the A CREATE A NEW MOLD button on the Molds records page.

**Enter** the B mold details (name, serial number, number of cavities, part, die height, die length, die width, minimum mold open (**these are required fields**); the Created By field will automatically populate with the current user's name).

The appropriate number of cavity names fields will appear after the number of cavities field is completed. Optionally, **enter** cavity names; the fields are automatically filled using numbers and do not require editing if no names are used.

**Click** the C knockout standard drop-down menu to select Euromap, SPI, or Center for the mold Knockout Pattern; **enter** the horizontal, vertical, and center dimensions where applicable. If the knockout is symmetrically-located, select the mirror check box to automatically duplicate the mirrored knockout of the mold.

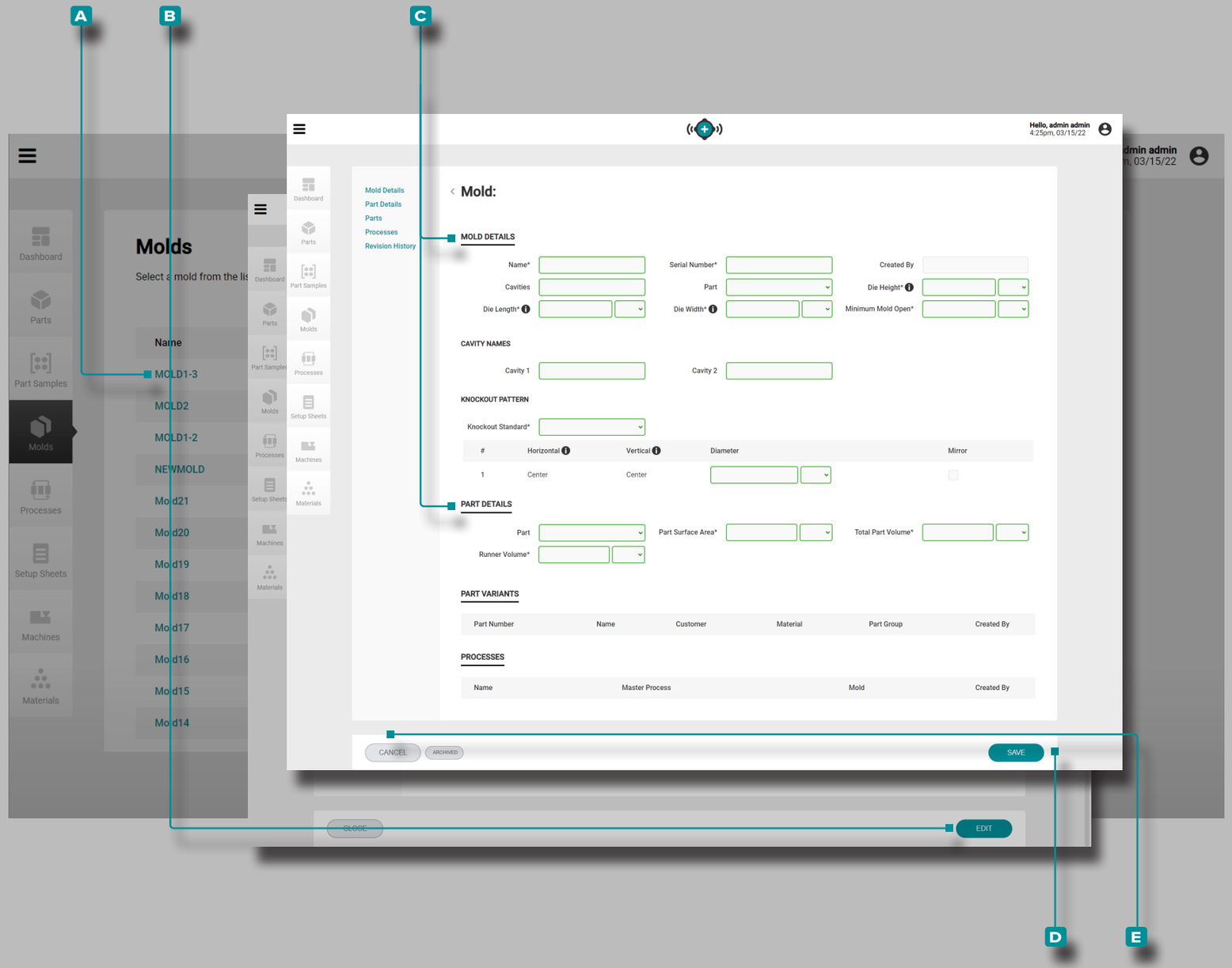
**Enter** the physical D part details (part surface area, part volume, and runner volume (**these fields—*except number of cavities*—are required for process transfer features**).

**A part must be selected in order for part/part variants to be associated with the mold, and enable use of the part sample feature**s.

**Click** on a E part or parts to associate a part record with the mold record.

**Click** the G SAVE button to save the part record, or the F CANCEL button to exit without saving the record.

# The Hub for Process Development

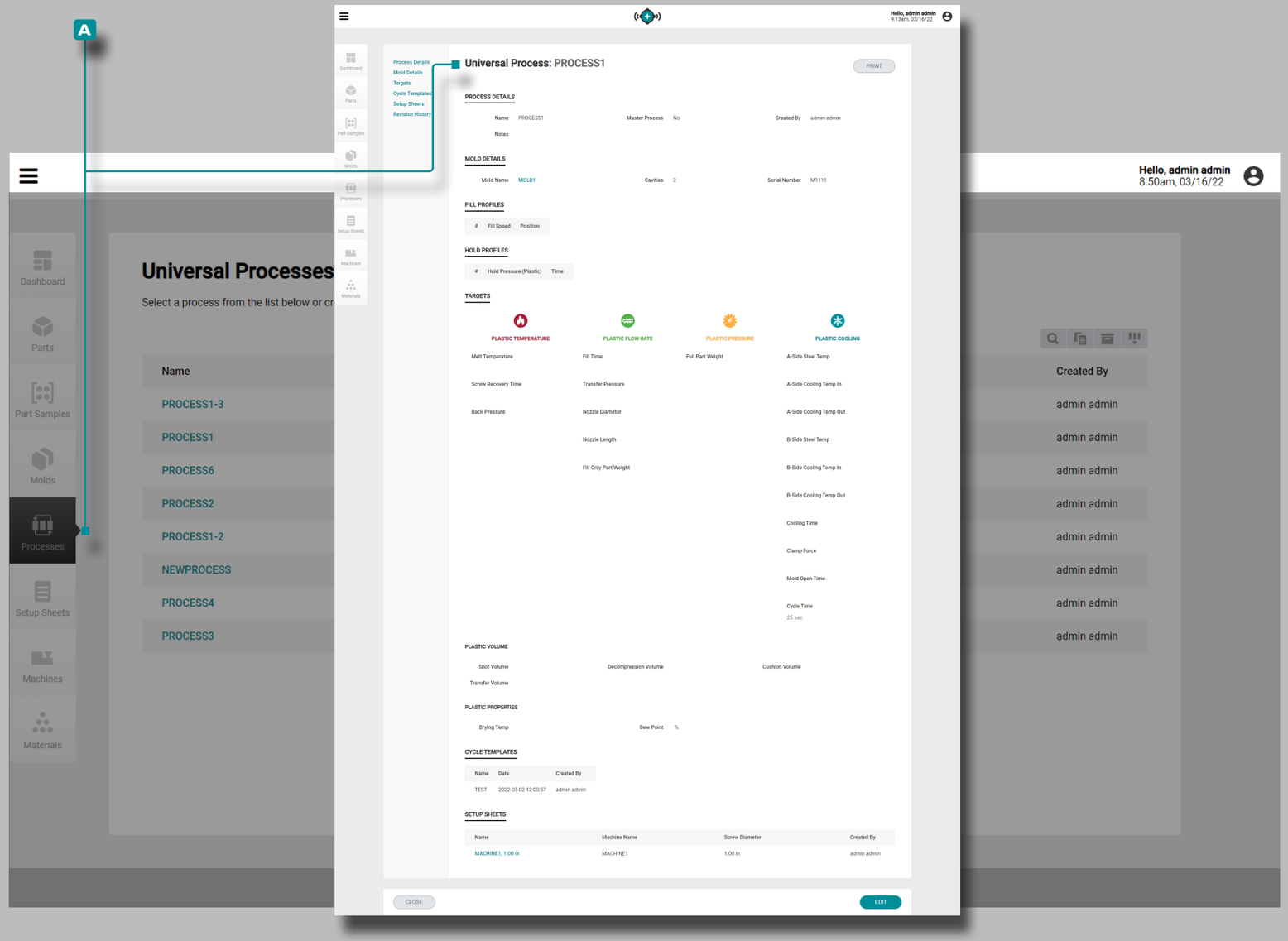



## Edit a Mold Record

**Click** the A mold name to view the mold record on the Molds records page. **Click** the B EDIT button to edit the mold details.

Edit the C mold details, physical part details.

**Click** the D SAVE button to save the mold record, or the E CANCEL button to exit without saving the record.




# The Hub for Process Development

## Processes

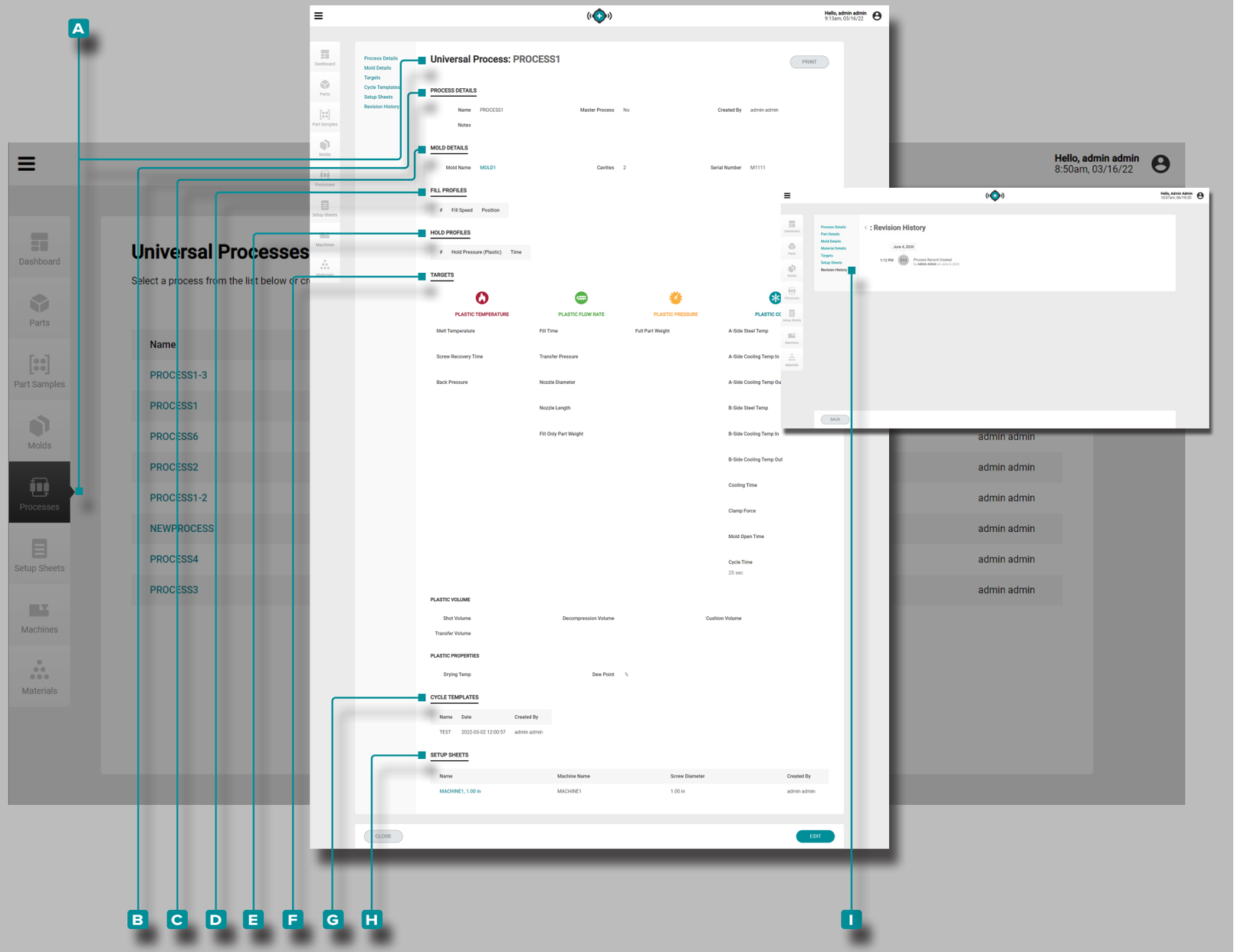
### Process Records

Process records contain machine-independent variables; therefore, processes are created and saved for use across machines *provided the machine is compatible with the selected mold and process requirements*. Additionally, **processes are only generated using the "Launch a New Mold" feature**—once a process is generated for a new mold launch, it can be selected later for use with the "Transfer a Mold" feature.

**ⓘ NOTE** *Process record variables are entered and displayed in volumetric units and plastic pressure units.*

Process records **A** are shown on the Processes page. **Click** on a process record to view Process Details, associated Mold Details, associated Material Details, Fill Profiles, Hold Profiles, process Targets, associated Setup Sheets, and Revision History. Process records **A** can also be compared to one another using the compare records feature; refer to "Comparing Records" on page 32 for information on comparing records.

***(continued on next page)***




# The Hub for Process Development

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## Process Details

Process Details **B** contains the process name, which is automatically generated by the system from the part number and mold name, if the process has been marked as the “Master Process, created by, and notes.

## Mold Details

Mold Details **C** contains the associated mold record’s details (refer to "Mold Records" on page 46 for information on mold records).

## Fill Profiles

Fill Profiles **D** are created when a process is created or generated; fill profiles include number, speed, and position values.

## Hold Profiles

Hold Profiles **E** are created when a process is created or generated; hold profiles include number, hold pressure (plastic), and time values.

## Targets

Targets **F** are created when a process is created or generated; targets include plastic: volume, temperature, flow, pressure, and cooling-related values.

## Cycle Templates

Cycle Templates **G** contains the associated cycle template(s) for the process.

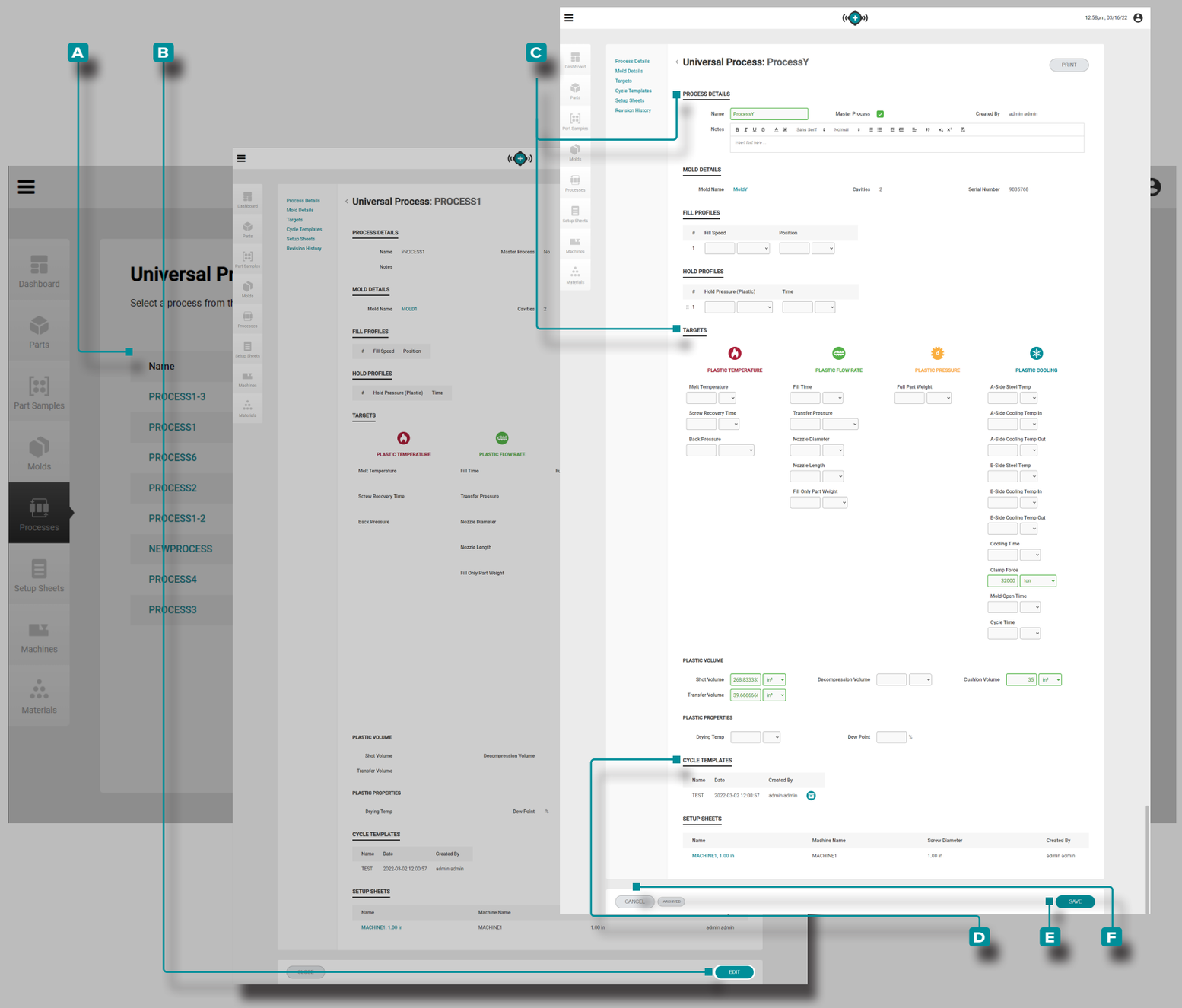
## Setup Sheets

Setup Sheets **H** contains the associated setup sheets (refer to "Setup Sheet Records" on page 54 for information on setup sheet records).

## Revision History

The **I** Revision History is a log of user-initiated actions that occur within the software, providing a record of each user action related to the record while logged in. **Click** on the **I** Revision History heading to view the process record revision history. Refer to "Comparing Record Revision History" on page 33 for information on comparing record revisions.

**ⓘ NOTE** *Revision History is visible only to the users designated with administrator and process engineer roles.*




# The Hub for Process Development

## Create a New Process Record

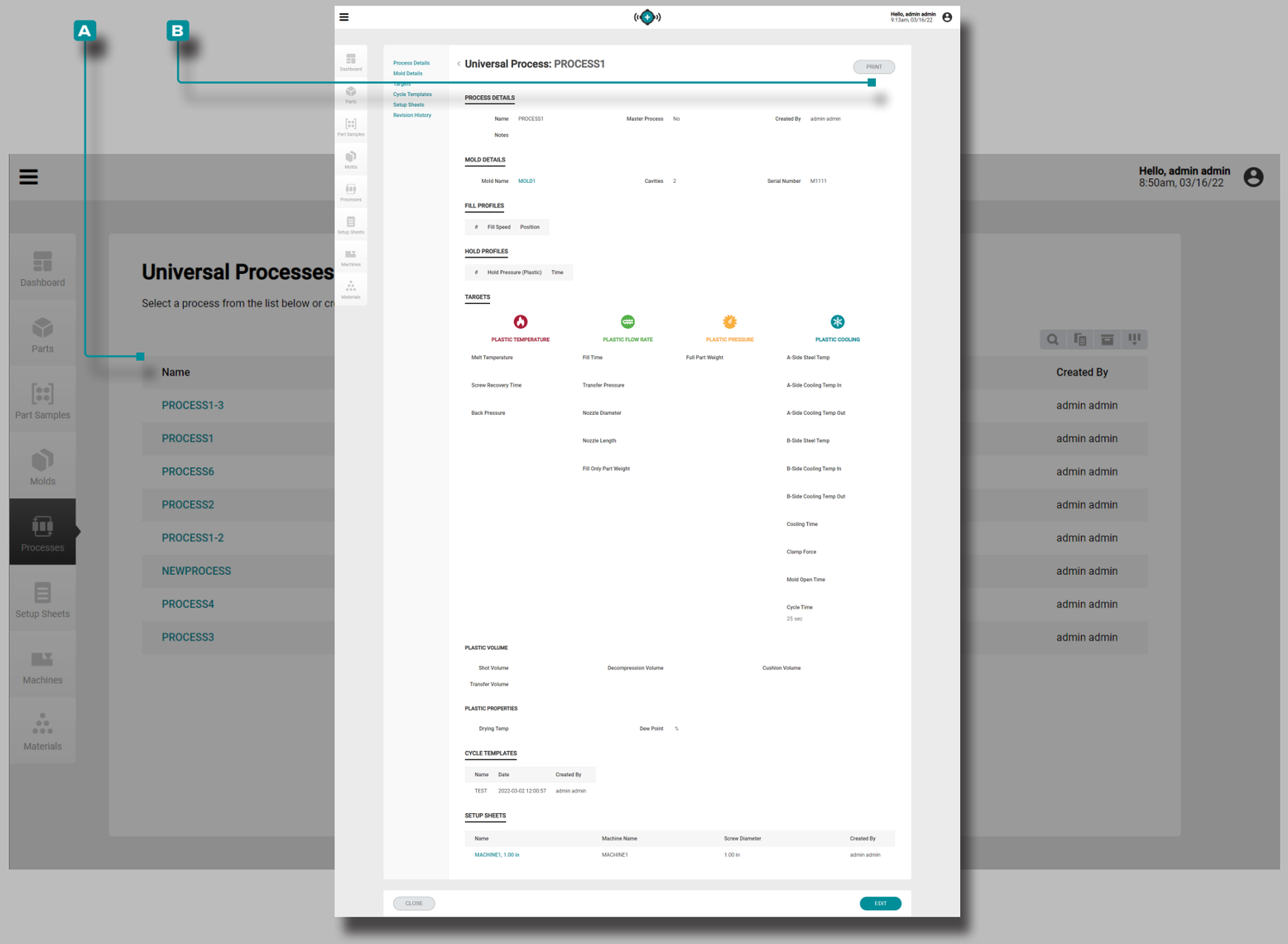
Process records are created only through the Launch a New Mold tool located on the dashboard; refer to "Launch a New Mold" on page 82 for information on the Launch a New Mold tool.

## Edit a Process Record

**Click** the **A** process name to view the process record on the Processes records page. **Click** the **B** EDIT button to edit the process record.

Edit the **C** process details or targets, or archive/un-archive **D** cycle templates. Other process record items (associated molds and setup sheets) cannot be edited from the processes page and must be edited from the individual molds or setup sheets records pages.

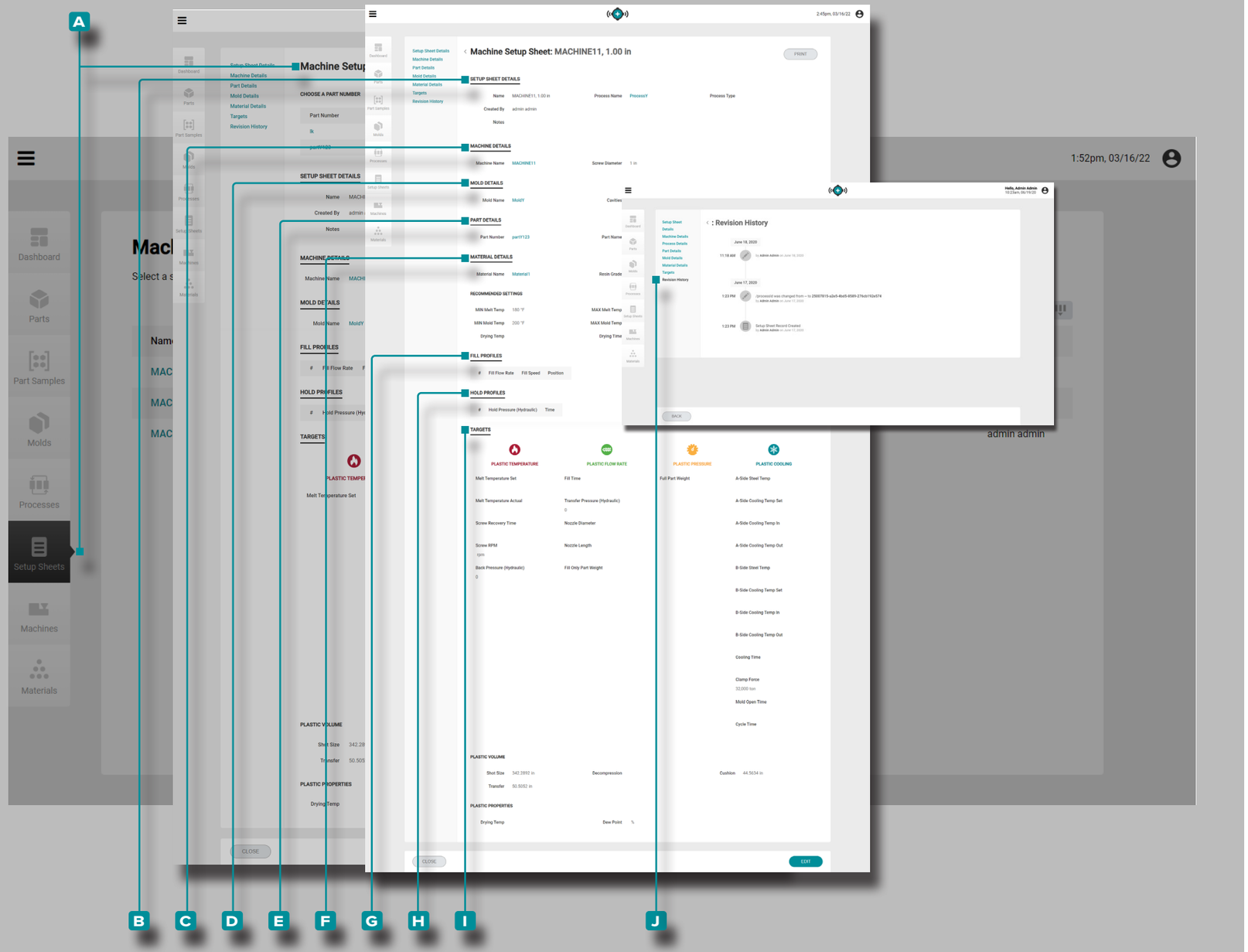
**Click** the **E** SAVE button to save the process record, or the **F** CANCEL button to exit without saving the record.




# The Hub for Process Development

## Print Process Record

**Click** the A process name to view the process record on the Processes records page. **Click** the B PRINT button to print the process record.




# The Hub for Process Development

## Setup Sheets

### Setup Sheet Records

Setup sheets include specific, machine-dependent values that are used *only* with a specific part-mold-machine-process combination and therefore are generated by the “Launch a New Mold” or “Transfer a Mold” features only after all other records are created/selected. **Setup Sheets are mold-specific**.

**ⓘ NOTE** *Setup sheet record variables can be displayed/entered in volume or linear units, and plastic pressure or hydraulic pressure units.*

Setup sheet **A** records are shown on the Setup Sheets page. **Click** on a setup sheet record name, then **click** on a part variant (if applicable) to view Setup Sheet Details, Machine Details, associated Part Details, associated Mold Details, associated Material Details including recommended settings, process Targets, and Revision History. Setup sheet records **A** can also be compared to one another using the compare records feature; refer to "Comparing Records" on page 32 for information on comparing records.

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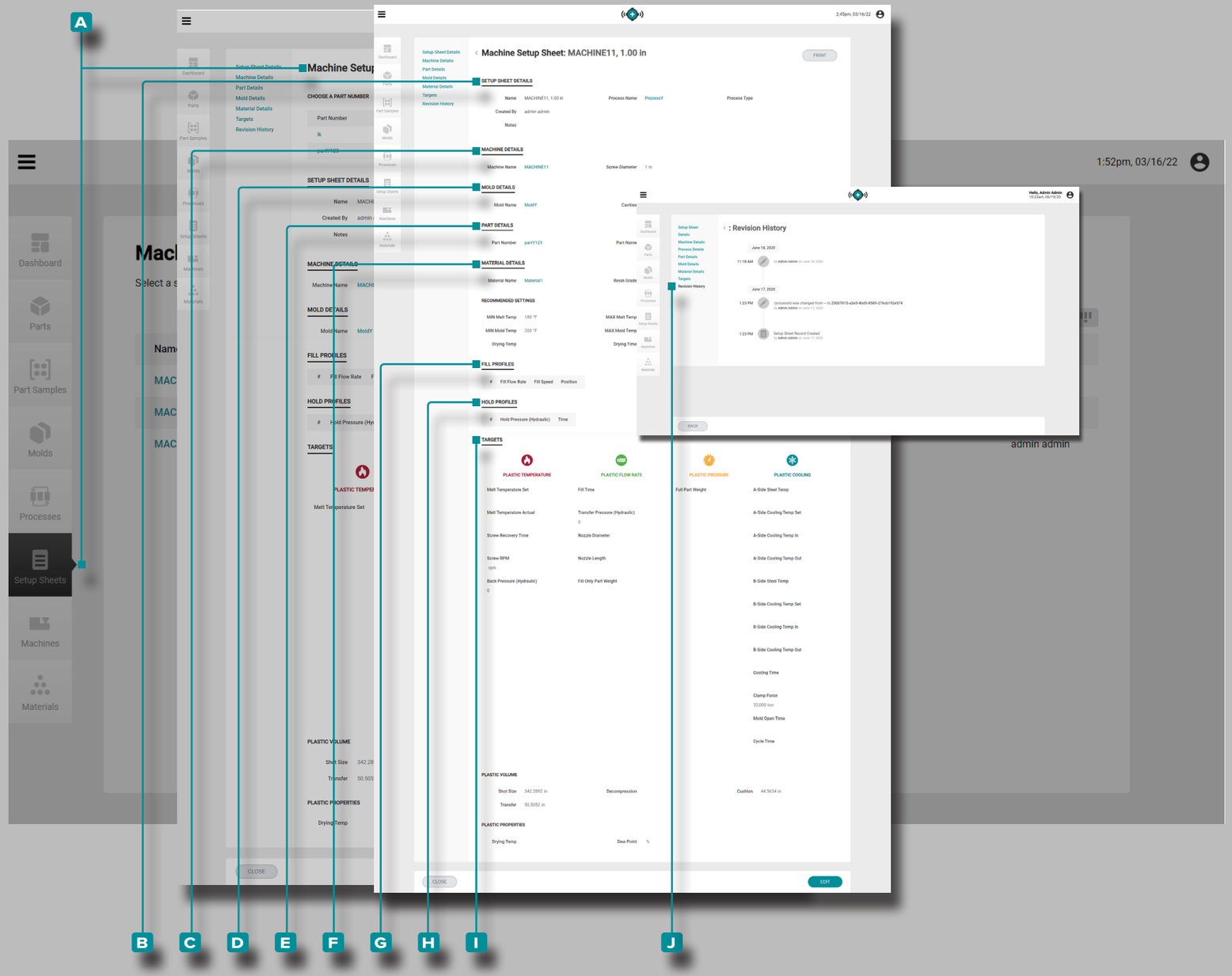


# The Hub for Process Development

***(continued from previous page)***

Setup Sheet Details

Setup Sheet Details **B** contains the setup sheet name, the associated process record name, process type, and created by.

Machine Details

Machine Details **C** contains the associated machine name, and the machine's screw diameter.

Part Details

Part Details **D** contains the associated part record's details (refer to "Part Records" on page 38 for information on part records).

Mold Details

Mold Details **E** contains the associated mold record's details (refer to "Mold Records" on page 46 for information on mold records).

Material Details

Material Details **F** contains the associated material record's details (refer to "Material Records" on page 64 for information on material records).

Fill Profiles

Fill Profiles **G** contains any fill profiles added to the setup sheet.

Hold Profiles

Hold Profiles **H** contains any hold profiles added to the setup sheet.

Targets

Targets **I** are created when a process is created or generated; targets include plastic: volume, temperature, flow, pressure, and cooling-related values.

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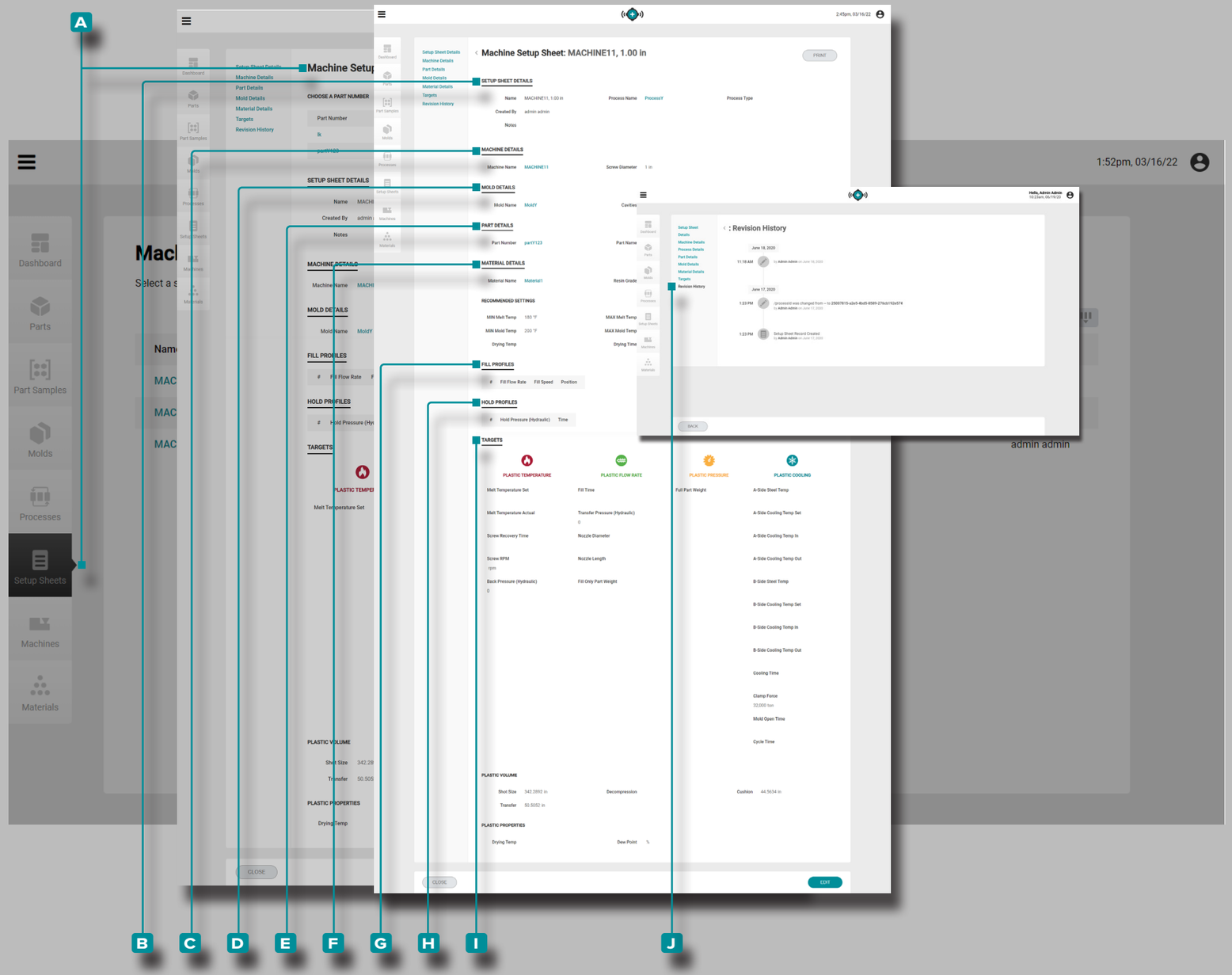


# The Hub for Process Development

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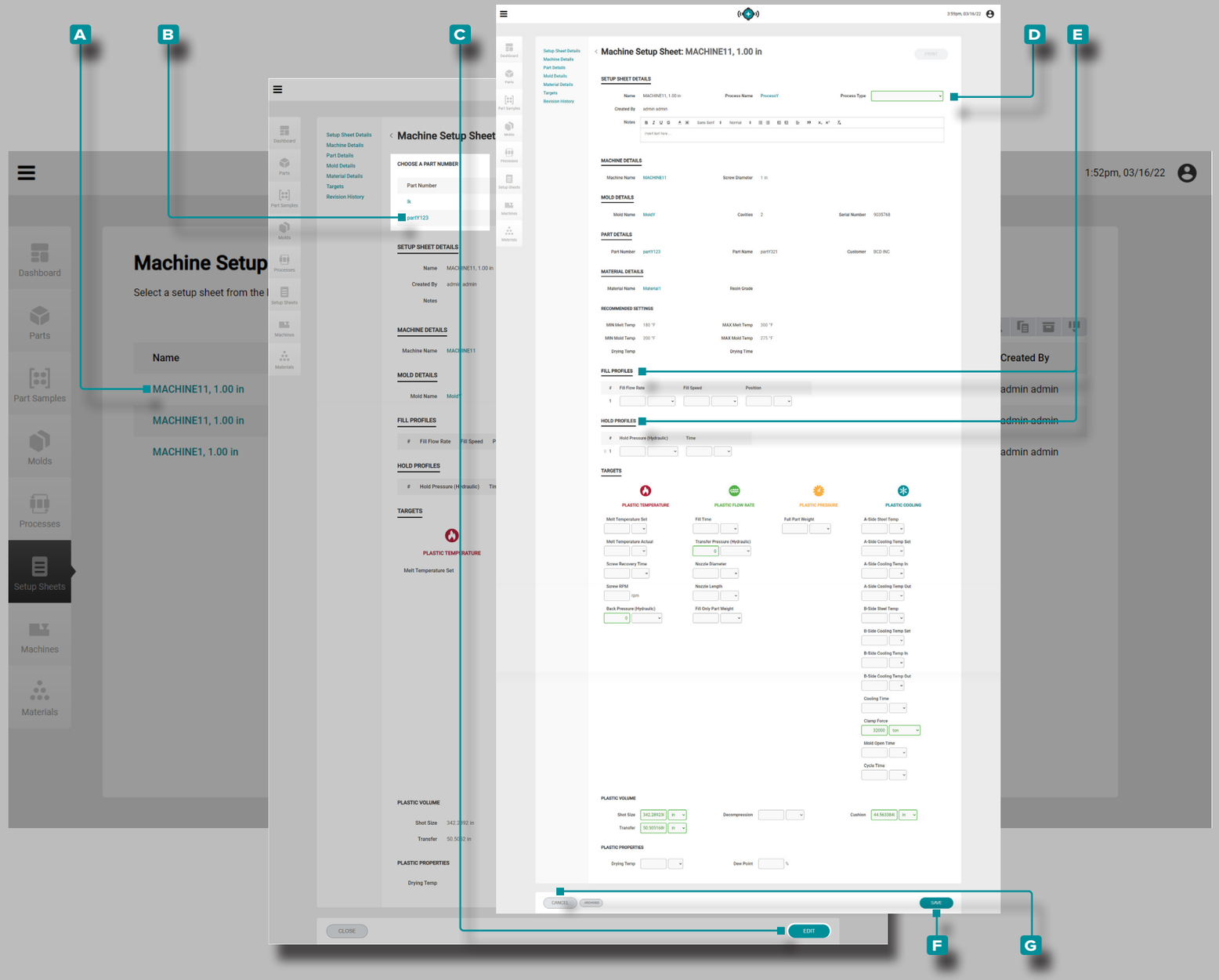
## Revision History

The J Revision History is a log of user-initiated actions that occur within the software, providing a record of each user action related to the record while logged in. **Click** on the J Revision History heading to view the setup sheet record revision history. Refer to "Comparing Record Revision History" on page 33 for information on comparing record revisions.

**NOTE** *Revision History is visible only to the users designated with administrator and process engineer roles.*




# The Hub for Process Development

## Create a New Setup Sheet Record

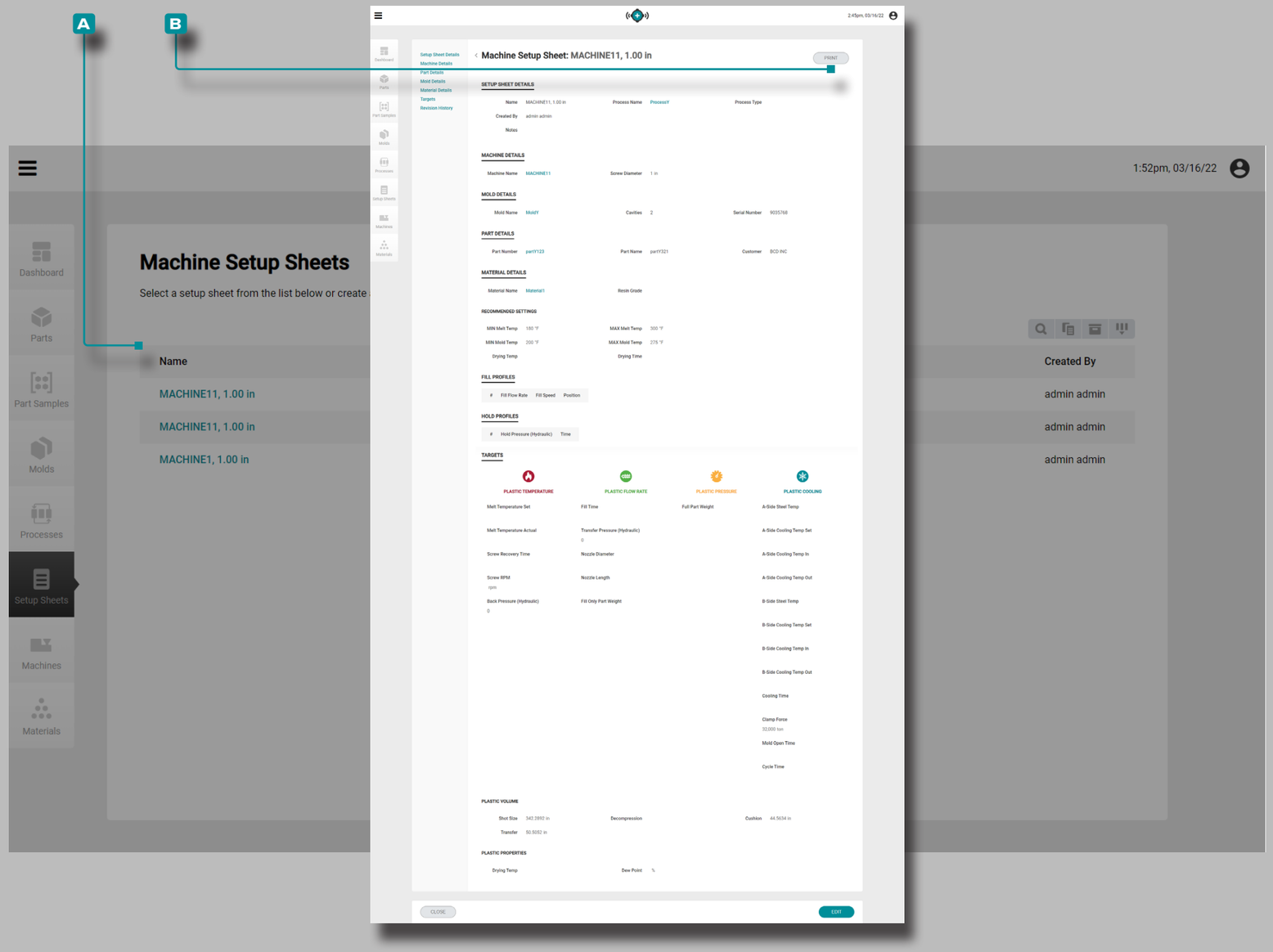
Setup Sheet records are created only through the Launch a New Mold or Transfer a Mold tools located on the dashboard; refer to "Launch a New Mold" on page 82 for information on the Launch a New Mold tool or "Transfer a Mold" on page 84 for information on the Transfer a Mold tool.

## Edit a Setup Sheet Record

**Click** the **A** setup sheet name to view the setup sheet record on the Setup Sheets records page. Optionally, **click** to select a **B** part variant to edit the setup sheet record for that variant. **Click** the **C** EDIT button to edit the setup sheet record.

Edit the **D** process type, **E** fill and/or hold profiles, or targets. Other process record items (associated parts, associated molds, materials, and processes) cannot be edited from the setup sheets page and must be edited from the individual parts, molds, materials, or processes records pages.

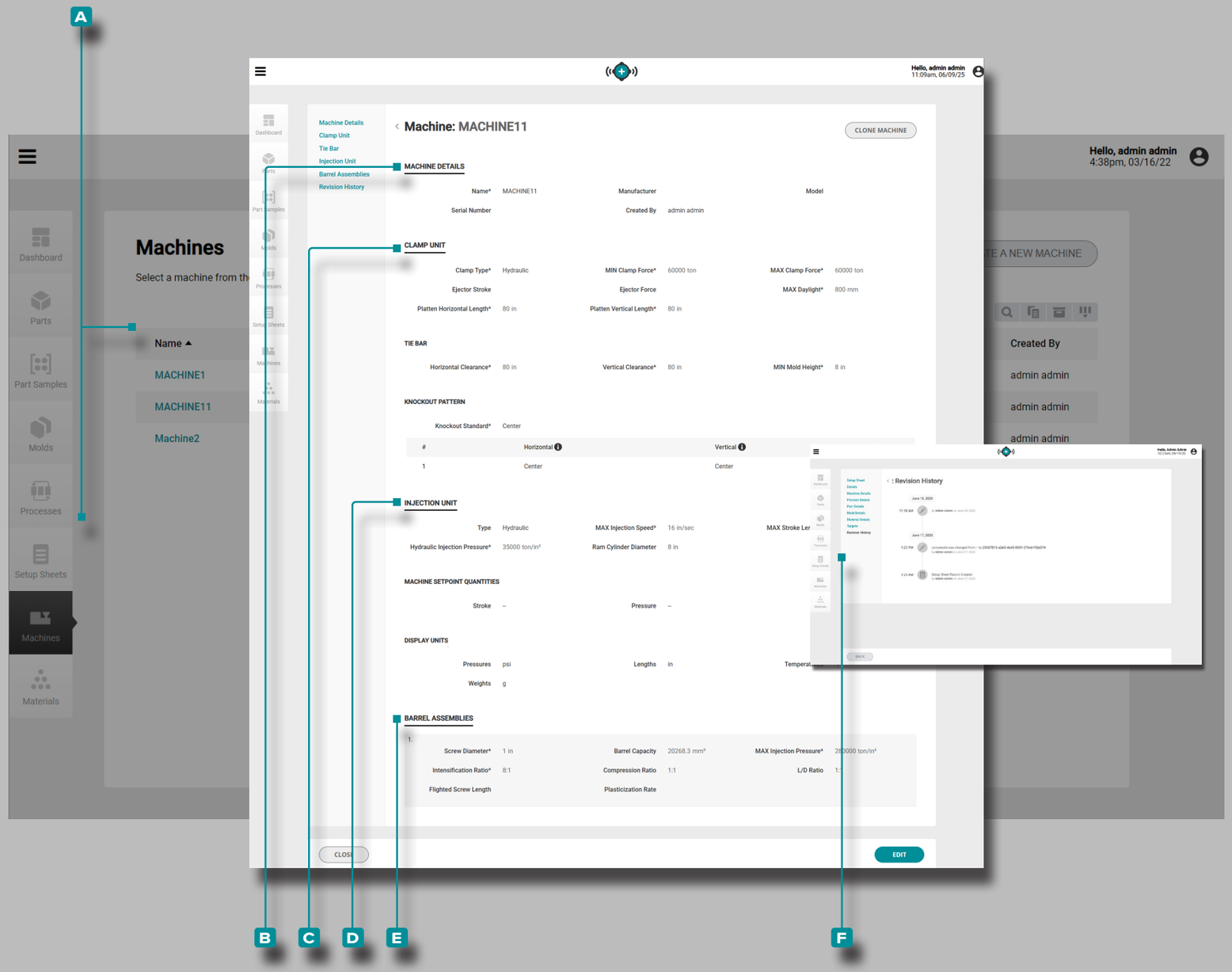
**Click** the **F** SAVE button to save the setup sheet record, or the **G** CANCEL button to exit without saving the record.




# The Hub for Process Development

## Print Setup Sheet Record

**Click** the A setup sheet name to view the setup sheet record on the Setup Sheets records page. **Click** the B PRINT button to print the setup sheet record.




# The Hub for Process Development

## Machines

### Machine Records

Machine Records **A** are shown on the Machines page. **Click** on a machine name to view Machine Details, Clamp Unit, Tie Bar dimensions, Injection Unit, barrel assemblies, and revision history. Machine Records **A** can also be compared to one another using the compare records feature; refer to "Comparing Records" on page 32 for information on comparing records.

### Machine Details

Machine Details **B** contains the machine name, manufacturer, model, and serial number, and created by.

### Clamp Unit

Clamp Unit **C** details include the clamp unit's physical details, including tie bar and knockout pattern information.

### Injection Unit

Injection Unit **D** details include the injection unit's physical details, including machine setpoint quantities and display units.

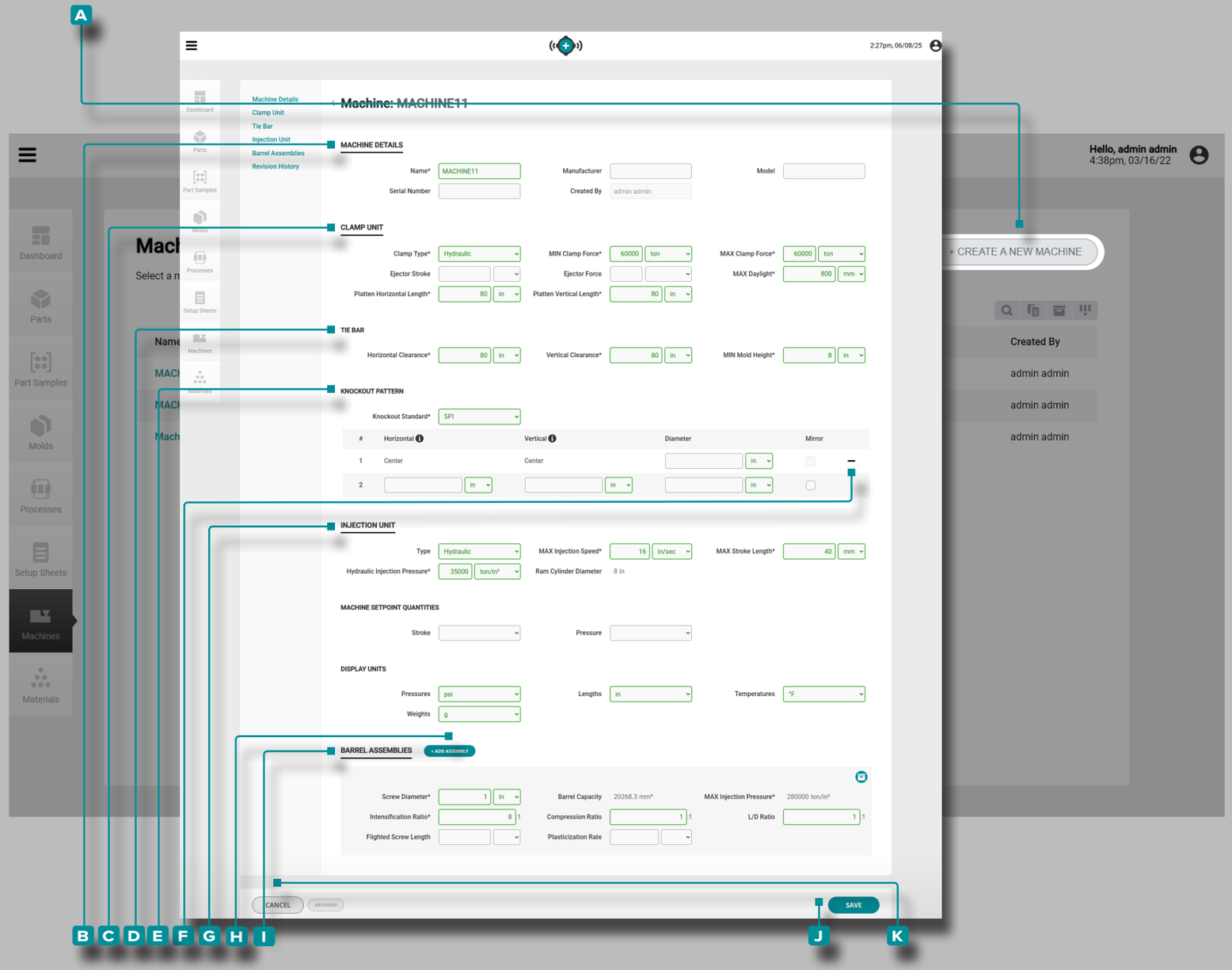
### Barrel Assemblies

Barrel Assemblies **E** includes the available barrel assemblies which can be used in the injection molding machine.

### Revision History

The **F** Revision History is a log of user-initiated actions that occur within the software, providing a record of each user action related to the record while logged in. **Click** on the **F** Revision History heading to view the machine record revision history. Refer to "Comparing Record Revision History" on page 33 for information on comparing record revisions.

**NOTE** *Revision History is visible only to the users designated with administrator and process engineer roles.*




# The Hub for Process Development

Create a New Machine Record

**Click** the A CREATE A NEW MACHINE button on the Machines records page.

**Enter** the B machine details (machine name (**this is a required field**), manufacturer, model, and serial number; the created by field will automatically populate with the current user's name).

**Enter** the physical C clamp unit details (clamp type*, opening stroke*, minimum and maximum clamp force*, ejector stroke, ejector force, and platten horizontal and vertical lengths*).

**Enter** the physical D tie bar details (horizontal and vertical clearance*, and maximum and minimum mold height*).

**Click** the E knockout pattern drop-down menu and select a mold knockout pattern* (euromap, SPI, or center).

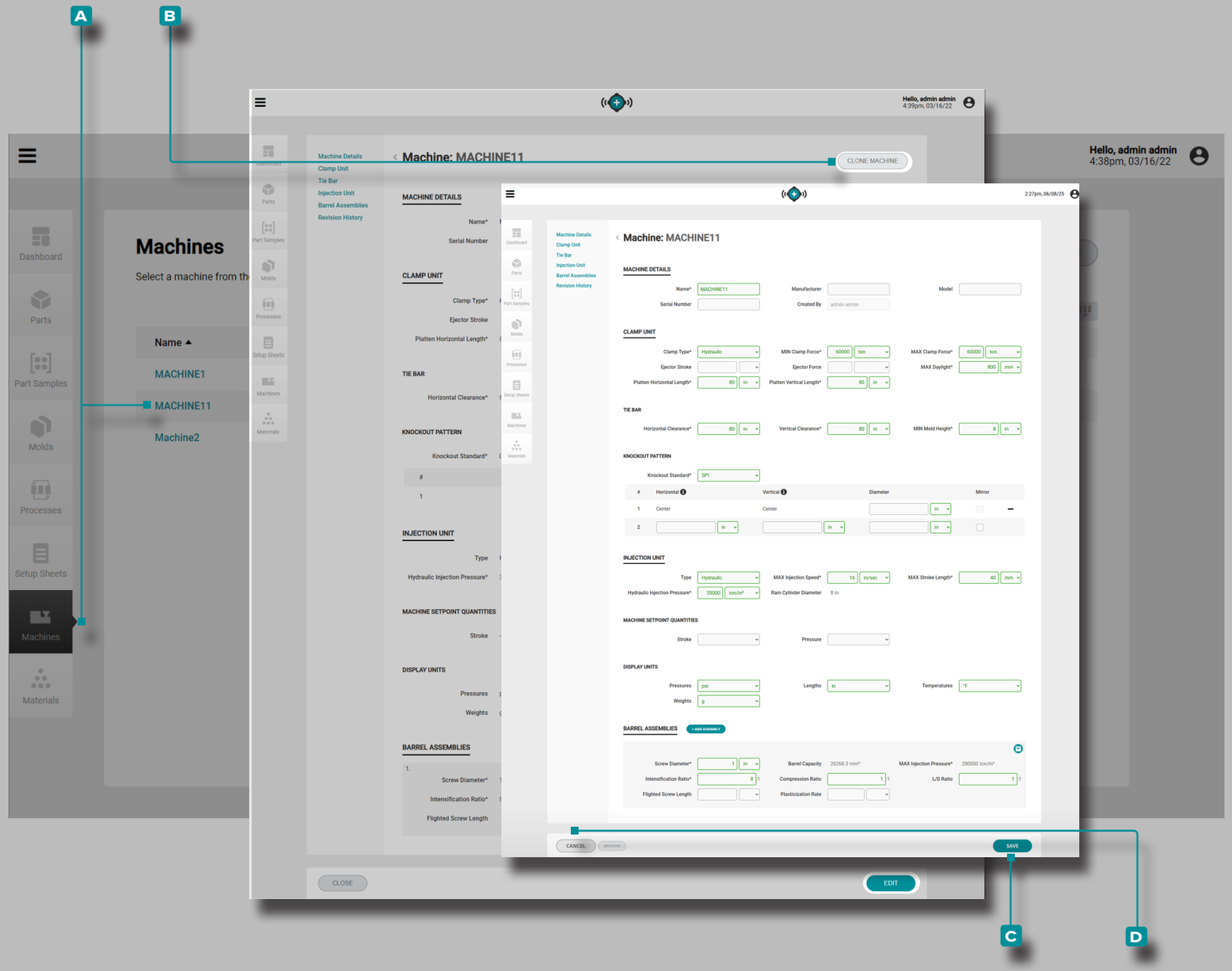
**Enter** the E knockout pattern details (horizontal, vertical, and center). If the knockout is symmetrically-located, select the mirror check box to duplicate the mirrored knockout. To remove a knockout pattern, **click** the F minus button; center knockouts can only be removed when euromap or SPI are selected.

**Enter** the physical G injection unit details (type, maximum injection speed*, and maximum stroke length*. **select** the machine setpoint quantities (linear or volumetric) and display units for pressures, lengths, temperatures, and weights.

**Click** the H +ADD ASSEMBLY to add and **enter** the physical I barrel assembly details (screw diameter*, maximum injection pressure*, compression ratio, L/D ratio, flighted screw length, and plastication rate).

**Click** the J SAVE button to save the machine record, or the K CANCEL button to exit without saving the record.

*THESE FIELDS ARE REQUIRED FOR PROCESS TRANSFER FEATURES.




# The Hub for Process Development

## Clone a Machine

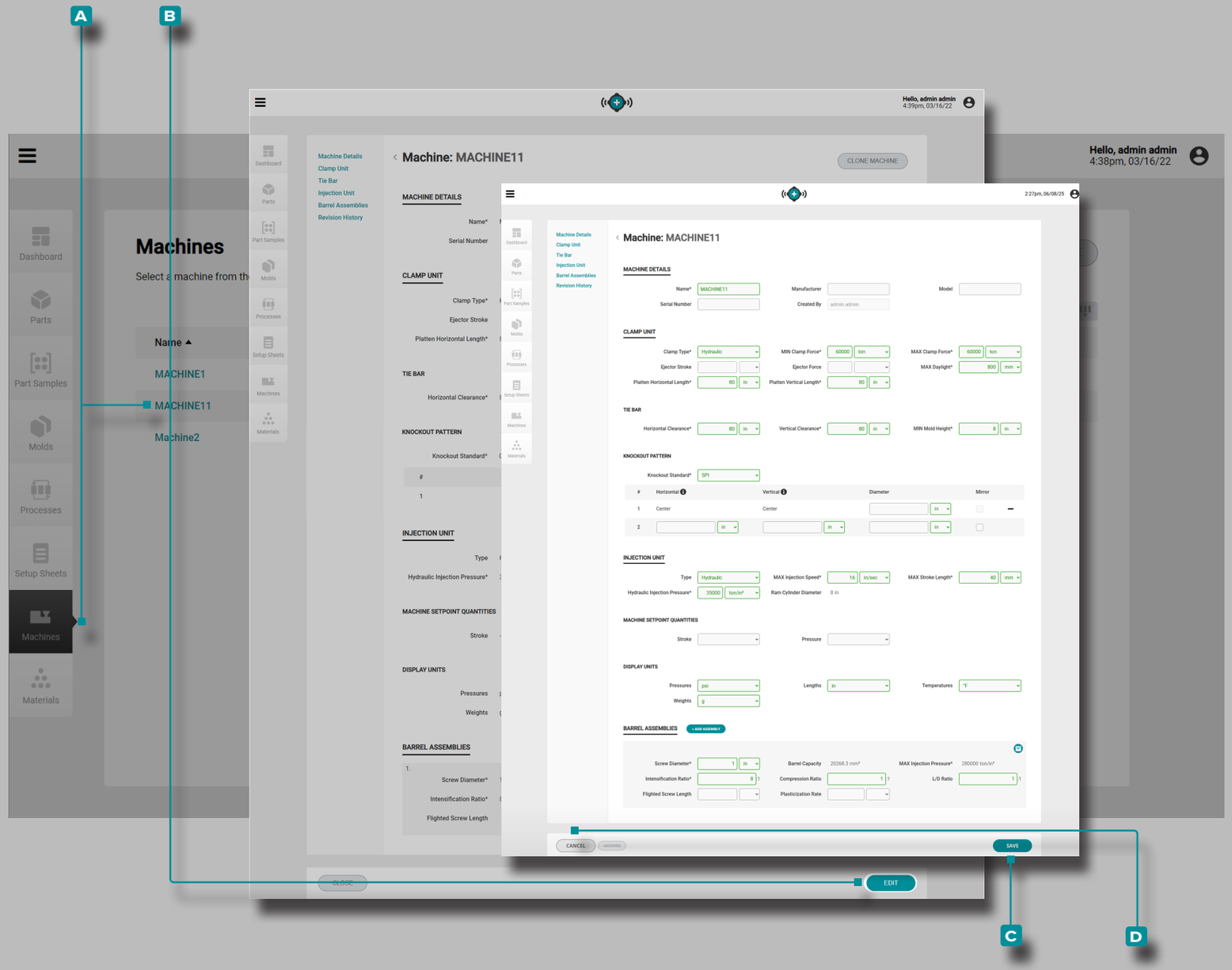
If there are multiple of the same model machine from a manufacturer, machines can quickly be cloned to quickly create machine records.

**Click** the **A** machine name to view the machine record on the Machines records page. **Click** the **B** CLONE MACHINE button to edit the machine details.

**Enter a new machine name (this is required).**

If necessary, edit the machine details, physical clamp unit details, tie bar details, physical injection unit details, barrel assemblies, or select/deselect a barrel assembly to associate/disassociate a barrel assembly record with the machine record.

**Click** the **C** SAVE button to save the machine record, or the **D** CANCEL button to exit without saving the record.



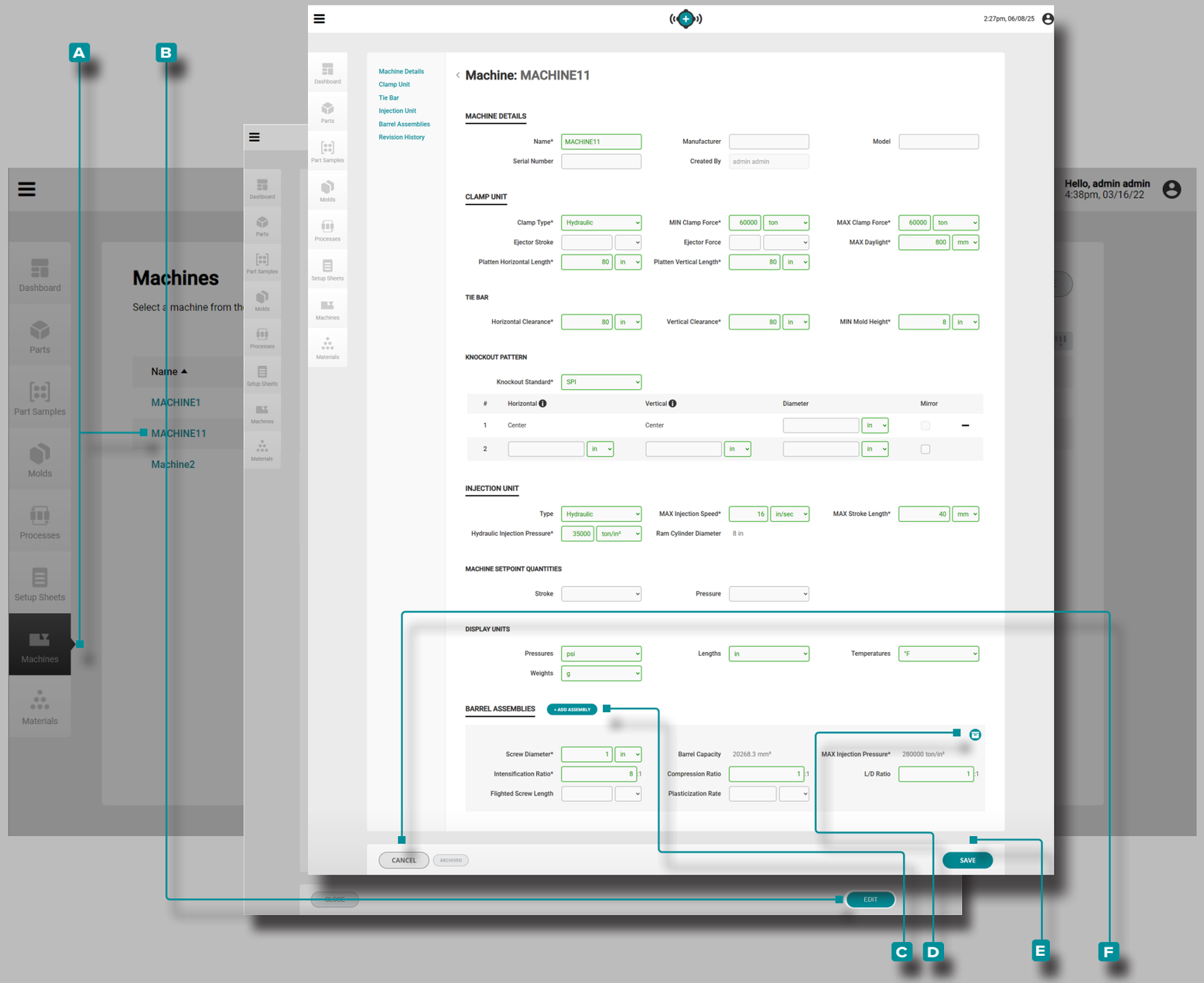

# The Hub for Process Development

## Edit a Machine Record

**Click** the A machine name to view the machine record on the Machines records page. **Click** the B EDIT button to edit the machine details.

Edit the machine details, physical clamp unit details, tie bar details, physical injection unit details, barrel assemblies, or select/deselect a barrel assembly to associate/disassociate a barrel assembly record with the machine record.

**Click** the C SAVE button to save the machine record, or the D CANCEL button to exit without saving the record.




# The Hub for Process Development

Add or Archive a Barrel Assembly

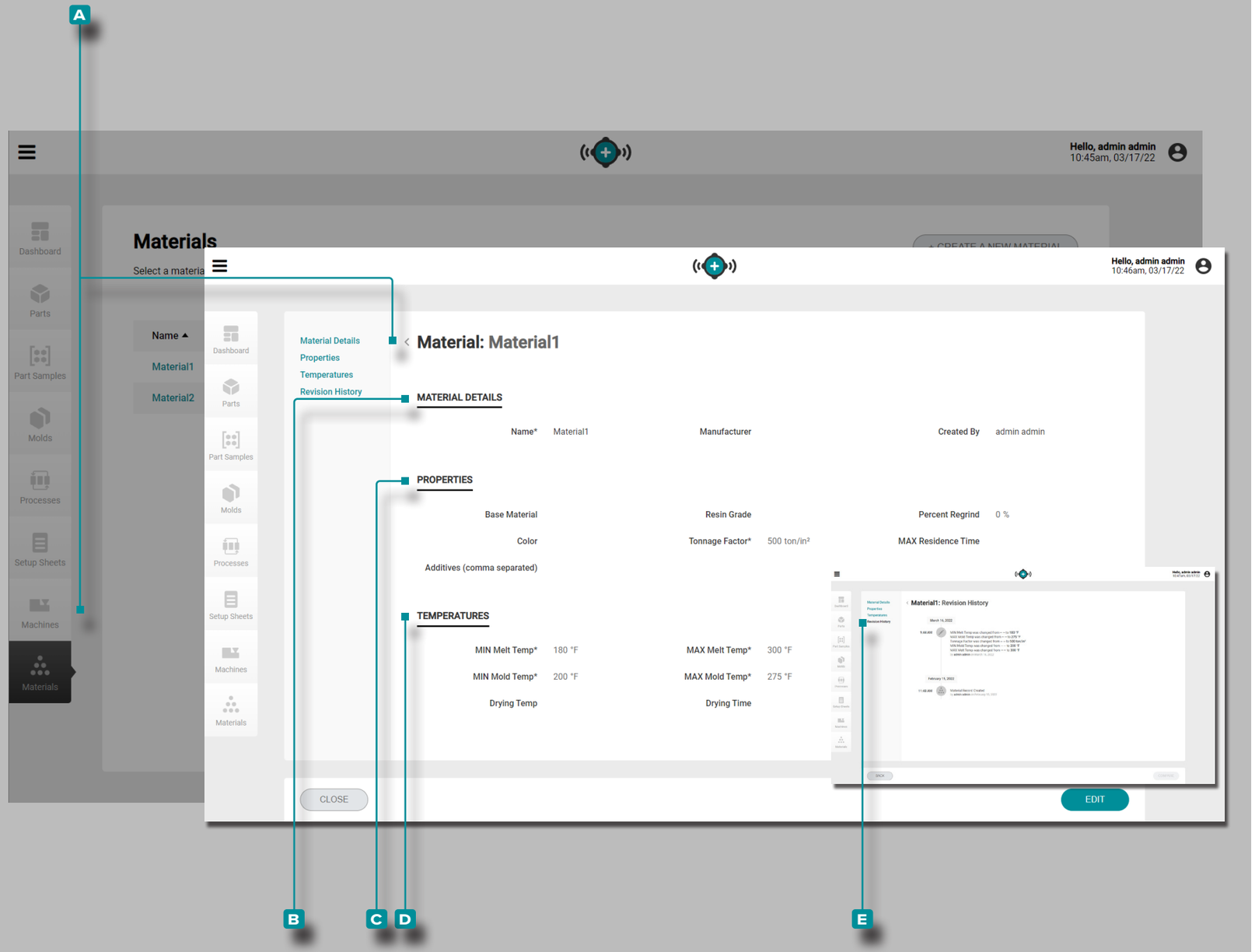
**Click** the **A** machine name to view the machine record On the Machines records page. **Click** the **B** EDIT button to edit the machine details.

**Click** the **C** ADD ASSEMBLY button next to the Barrel Assemblies heading; **enter** the barrel assembly details (**all barrel assembly fields are required for process transfer features**).

***OR***

**Click** the **D** Archive button in the upper right-hand corner of a barrel assembly to archive (or un–archive) the assembly. Archiving a barrel assembly saves the assembly for future use, but enables another barrel assembly to be used with the machine.

**Click** the **E** SAVE button to save the machine record, or the **F** CANCEL button to exit without saving the record.




# The Hub for Process Development

## Materials

### Material Records

Material records **A** are shown on the Materials page. **Click** on a material name to view Material Details, properties, temperatures, and revision history. Material records **A** can also be compared to one another using the compare records feature; refer to "Comparing Records" on page 32 for information on comparing records.

### Material Details

Material Details **B** contains the material name, manufacturer, and created by.

### Properties

Material Properties **C** contains the material physical properties (resin grade, percent regrind, color, tonnage, maximum residence time, additives (additives entered must be separated by commas)).

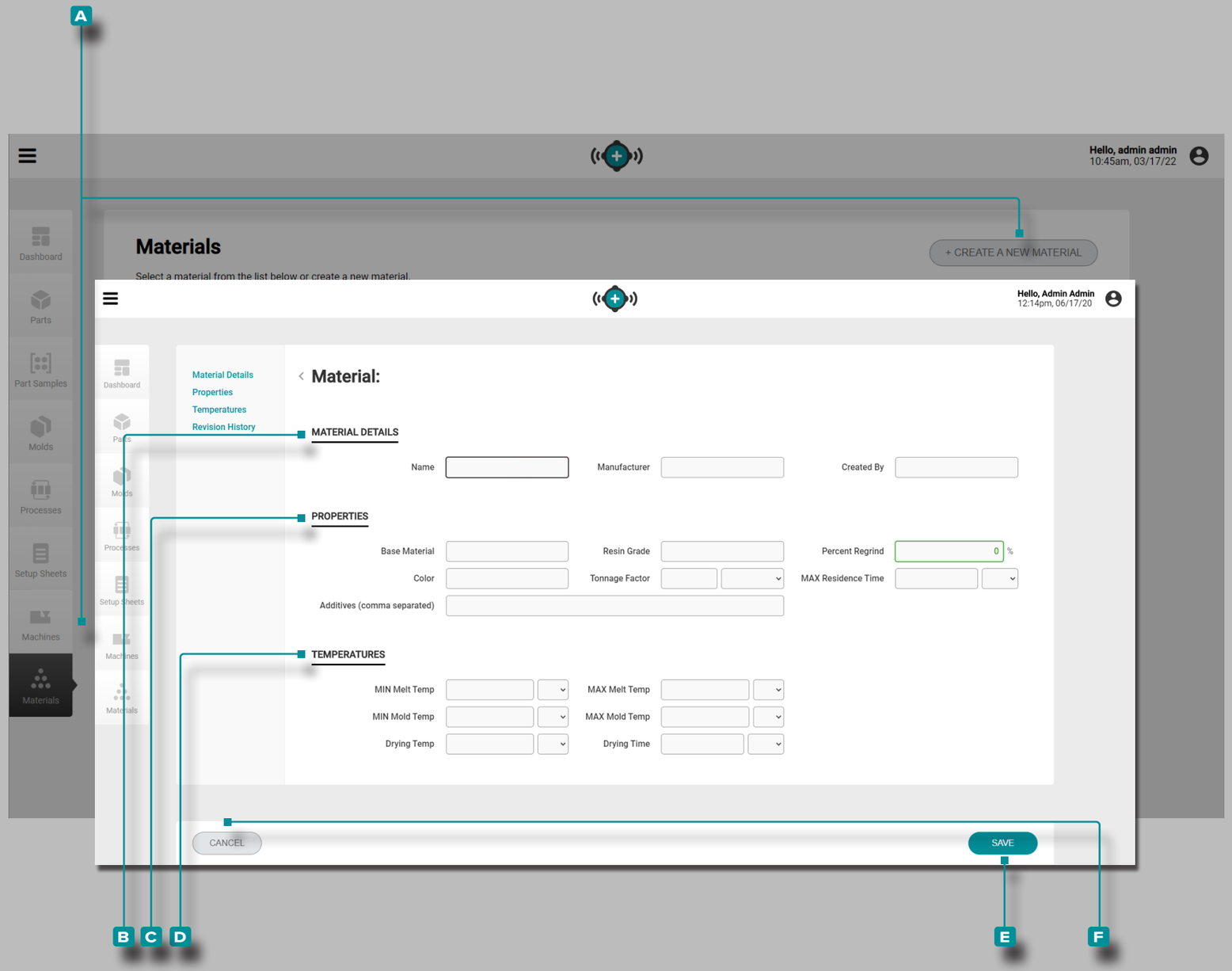
### Temperatures

Material Temperatures **D** contains the processing temperature information (minimum melt temperature, maximum melt temperature, minimum mold temperature, maximum mold temperature, drying temperature, and drying time).

### Revision History

The **E** Revision History is a log of user-initiated actions that occur within the software, providing a record of each user action related to the record while logged in. **Click** on the **E** Revision History heading to view the material record revision history. Refer to "Comparing Record Revision History" on page 33 for information on comparing record revisions.

**NOTE** *Revision History is visible only to the users designated with administrator and process engineer roles.*




# The Hub for Process Development

## Create a New Material Record

**Click** the **A** CREATE A NEW MATERIAL button on the Materials records page.

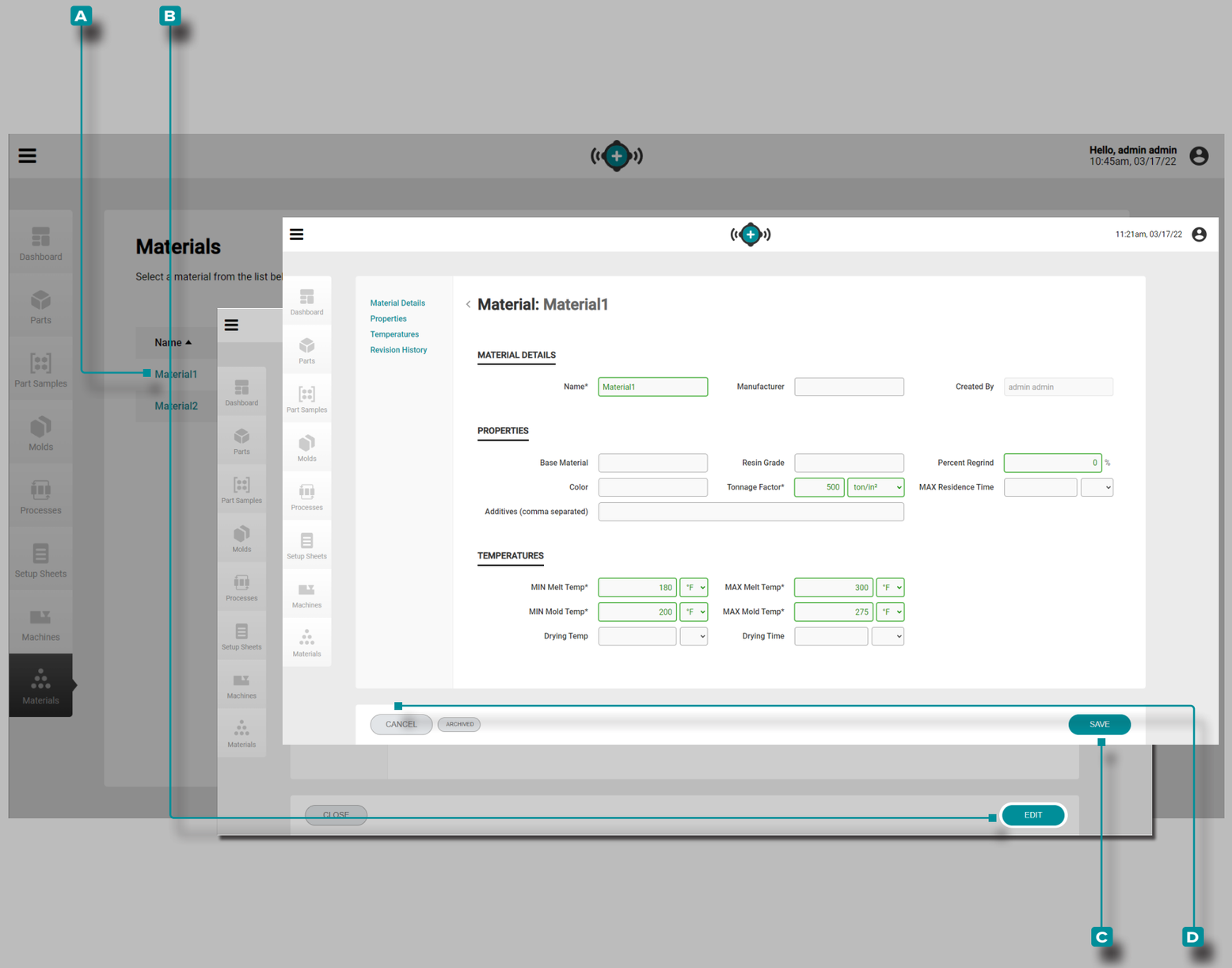
**Enter** the **B** material details (material name (**this is a required field**) and manufacturer; the created by field will automatically populate with the current user's name).

**Enter** the **C** material properties (base material, resin grade, percent regrind, color, tonnage factor (**this fields is required for process transfer features**), maximum residence time, and additives (additives entered must be separated by commas)).

**Enter** the **D** material temperatures information (minimum melt temperature, maximum melt temperature, minimum mold temperature, maximum mold temperature (**these fields are required for process transfer features**), and drying temperature and drying time).

**Click** the **E** SAVE button to save the material record, or the **F** CANCEL button to exit without saving the record.

# The Hub for Process Development

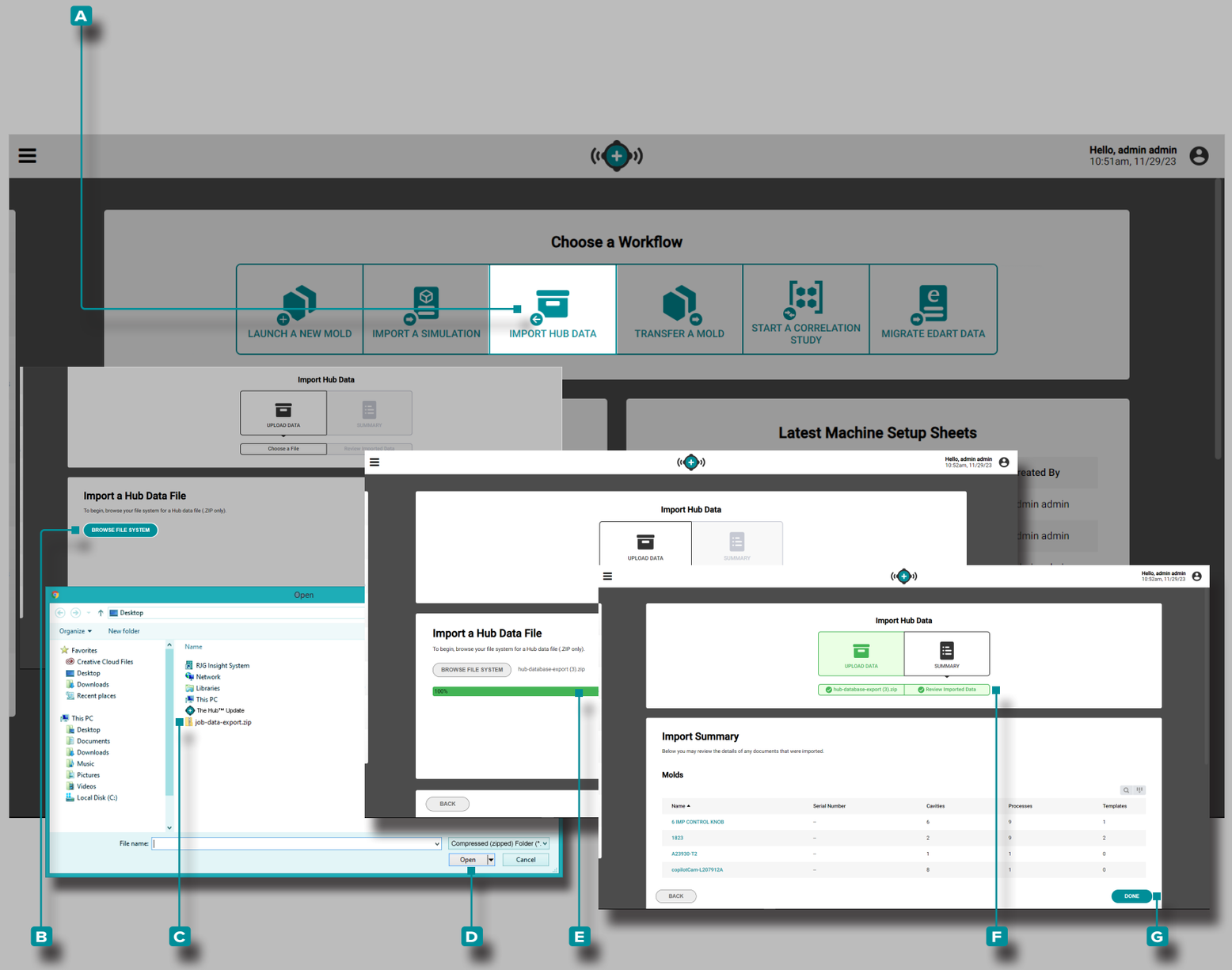



## Edit a Material Record

**Click** the A material name to view the material record on the Materials records page. **Click** the B EDIT button to edit the material details.

Edit the material details, material properties, or material temperatures information.

**Click** the C SAVE button to save the material record, or the D CANCEL button to exit without saving the record.




# The Hub for Process Development

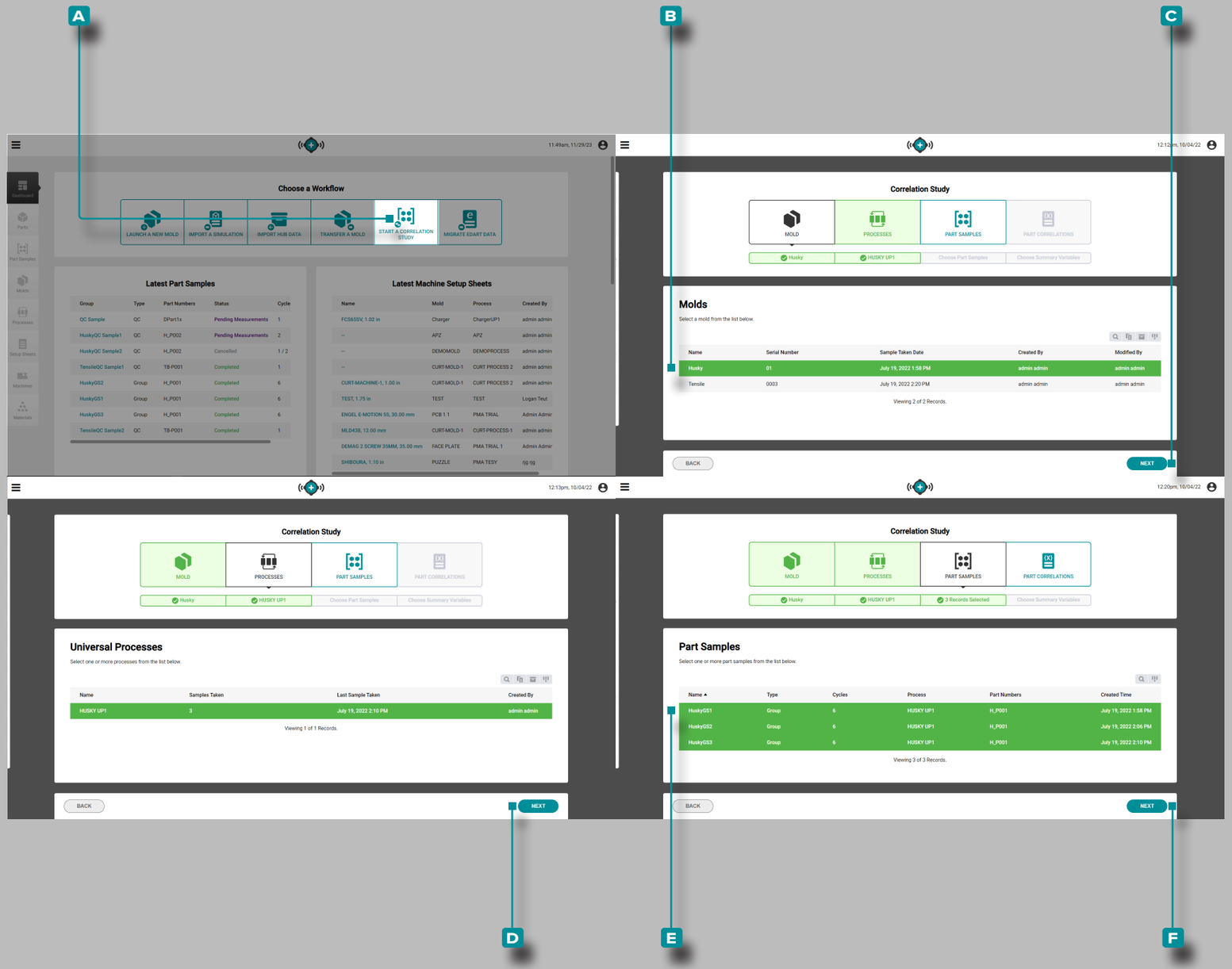
## Import Hub Data

The Import Hub Data tool allows the import of The Hub or job data from another The Hub software instance. Refer to "Data Import, Export, Backup, and Archival" on page 112 in the Appendix for complete information on imported and exported job data, and backup and archival of The Hub software.

**Click** the **A** Import Hub Data button on the Dashboard.

**Click** the **B** BROWSE FILE SYSTEM button to open the file browser, then locate and **click** the **C** .zip file to import, then **click** the **D** Open button.

If the data import is successful, a **E** green status bar will temporarily appear on the Import Job Data page. A **F** Summary of the data that was imported will then be displayed. **Click** the **F** DONE button to exit the import data function.




# The Hub for Process Development

## Start a Correlation Study

The Start a Correlation Study tool identifies correlations between physical part characteristics and process data by the comparison of part samples with completed CTQ measurements from the same mold to the process data gathered during sample taking.

**ⓘ NOTE** *Only part samples with CTQ measurements completed can be selected for use with the Start a Correlation Study tool.*

Most physical characteristics of injection molded parts can be correlated to in-cavity variables displayed and recorded by the CoPilot system and The Hub software. Determining part-to-data correlations is accomplished by finding and changing cavity variables in order to change parts through planned experiments. Refer to "Finding Part Quality/Process Data Correlations with the CoPilot System and The Hub Software" on page 114 and "Choosing Alarm Settings with the CoPilot System and The Hub Software" on page 118 for more information on planning experiments and finding part correlations with the CoPilot system and The Hub software.

**Click** the **A** Start a Correlation Study button on the Dashboard.

**Click** to select the desired **B** Mold from the list of molds with associated, completed part samples. **Click** the **C** NEXT button to continue.

Once a mold is selected, the associated process will automatically be selected. **Click** the **D** NEXT button to continue.

**Click** to select the desired **E** Part Sample(s) from the list. **Click** the **F** NEXT button to continue.

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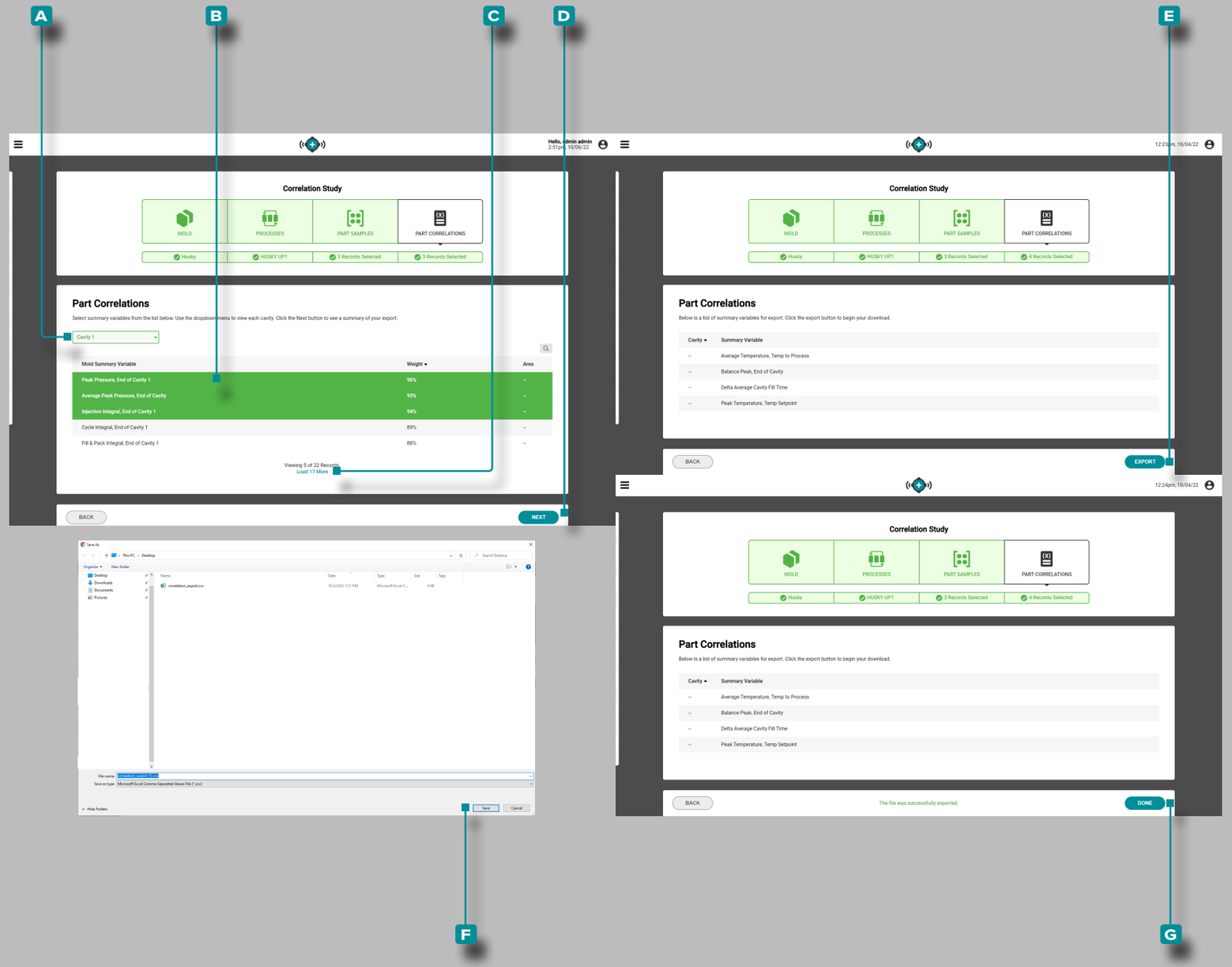


# The Hub for Process Development

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**Click** to select the desired **A** Cavity location from the drop-down list.

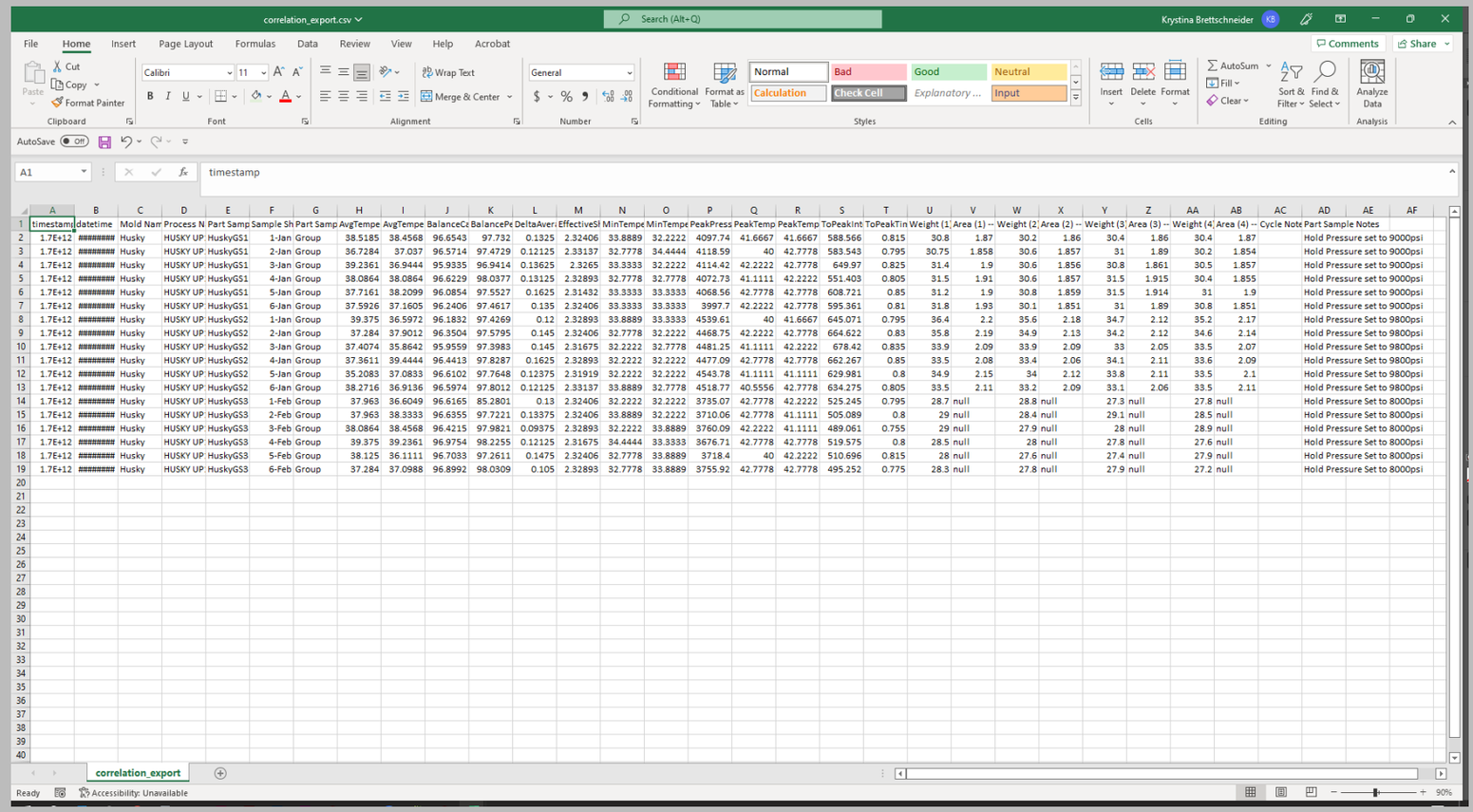
**Click** to select the desired **B** Mold Summary Variable(s) from the list. **Variables with correlations ≥90% show the highest correlation and are good choice for setting alarms.** If a correlation cannot be calculated (due to a sensor disconnection during sampling or other error), the variable correlation percent will be missing; ? will be displayed instead. To expand the mold summary variable list, **click** **C** Load (x) More.

**CAUTION** *RJG, Inc. does not recommend using Machine Summary Variables for correlation.*

**Click** the **D** NEXT button to continue.

**Click** the **E** EXPORT button to create a downloadable .csv file. A file explorer window will open; select a name a location for the file, and then **click** **F** Save to save the file.

**Click** the **G** DONE button to exit.

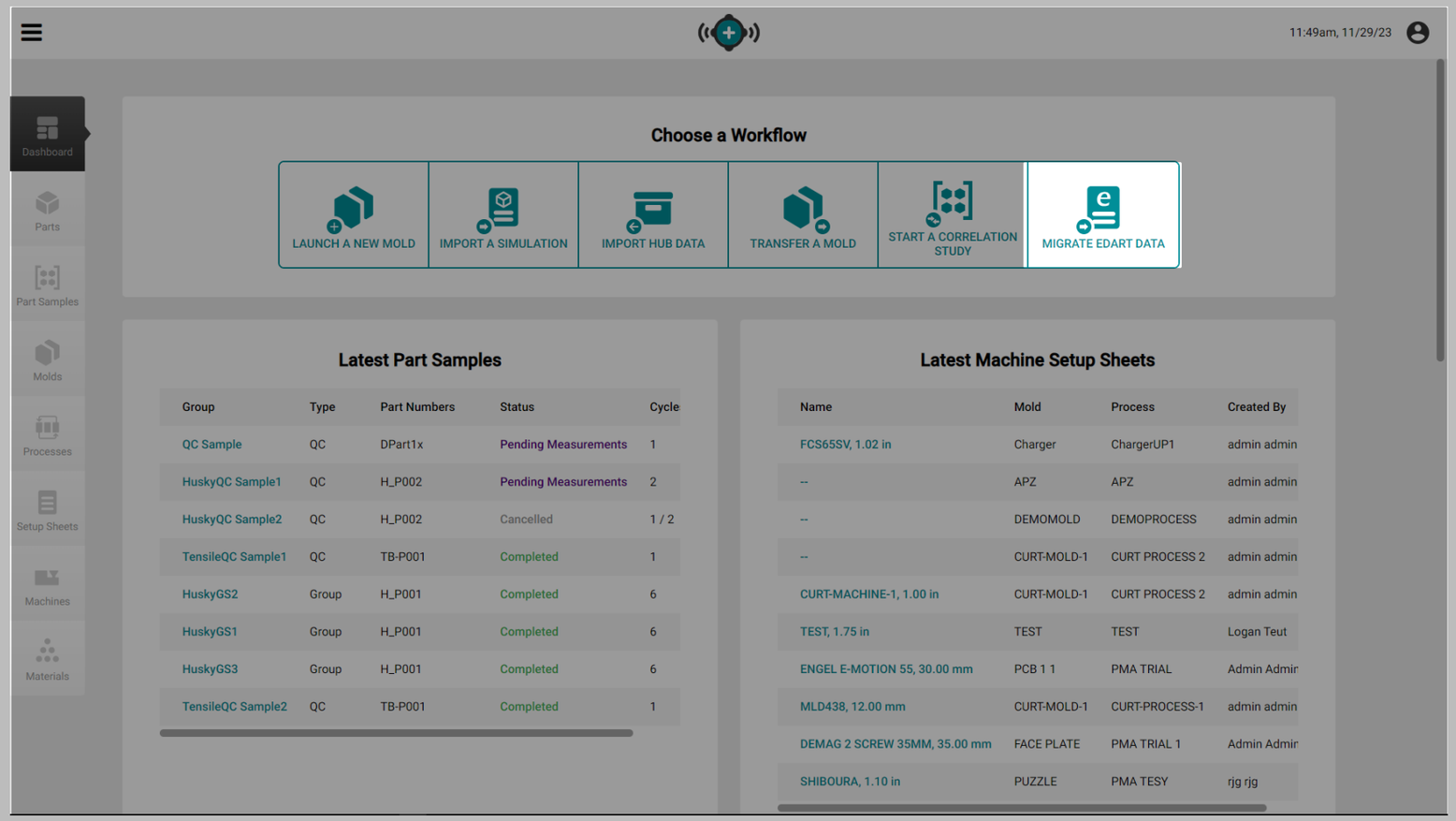



# The Hub for Process Development

The .csv file contains the selected, exported mold summary variable data and the following columns:

- Timestamp
- Date and Time
- Mold Name
- Process Name
- Part Sample Name
- Sample Shot ID
- Part Sample Time
- Cycle Notes
- Part Sample Notes

From the exported mold summary variable correlation data, alarm settings can be made using the lowest and highest settings used during part sample testing. Refer to "Finding Part Quality/Process Data Correlations with the CoPilot System and The Hub Software" on page 114 and "Choosing Alarm Settings with the CoPilot System and The Hub Software" on page 118 for more information on planning experiments and finding part correlations with the CoPilot system and The Hub software.




# The Hub for Process Development

## Migrate eDART Data

The Migrate eDART Data feature enables users to convert and migrate the following:

- Mold Sensor Configurations,
- Process Templates, and
- Process Setups

from eDART systems to The Hub software, for use with the CoPilot systems.

The Migrate eDART Data feature ***does not currently support*** the conversion or migration of the following:

- Machine Configurations,
- Alarm Settings,
- V→P Settings, or
- Valve Gate Settings

from eDART systems to The Hub software/CoPilot system.

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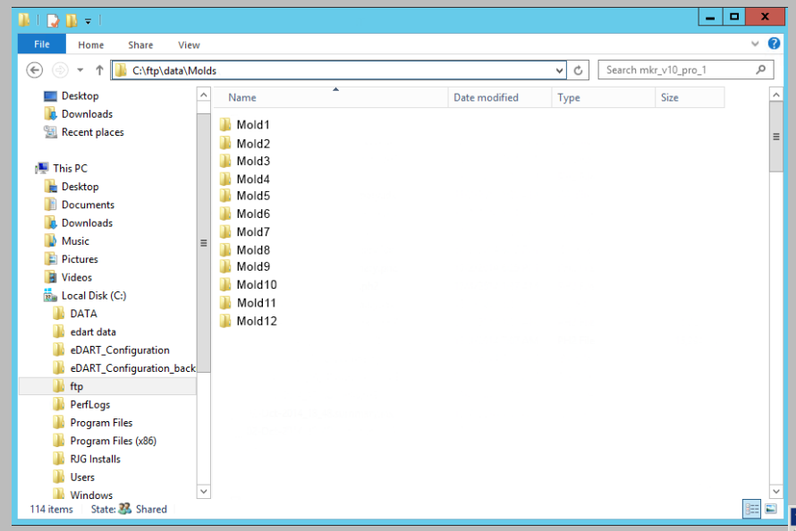


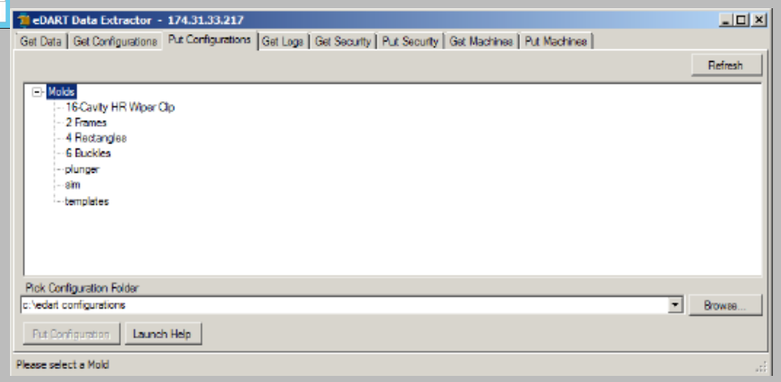


# The Hub for Process Development

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## Get eDART Configuration Files

An eDART configuration file in .zip format is required to migrate data to The Hub system. There are two methods of retrieving eDART configurations files: through the eDART Data Manager (EDM), or through the eDART Data Extractor.

### Extract Configuration Files from eDART Data Manager (EDM)

1. From a networked, connected computer, locate the eDART data folder.
   c:\eDART_Configurations_Groups\Group Name\Molds
2. Locate the \Molds folder.
3. Copy the \Molds folder to desktop.
4. Compress the \Molds folder to a .zip file.
   (Right click the folder, then click "Send to", and then click "Compressed (zipped) folder".)
5. File is ready for upload to The Hub Migrate eDART Data tool.

### Extract Configuration Files from the eDART Data Extractor

1. From a networked, connected computer, open the eDART Data Extractor.
2. Select the Get Configurations tab.
3. Select a Mold.
4. Select a Save Folder.
5. Select Get Configuration.
6. Compress the  folder to a .zip file.
   (Right click the folder, then click "Send to", and then click "Compressed (zipped) folder".)
7. File is ready for upload to The Hub Migrate eDART Data tool.

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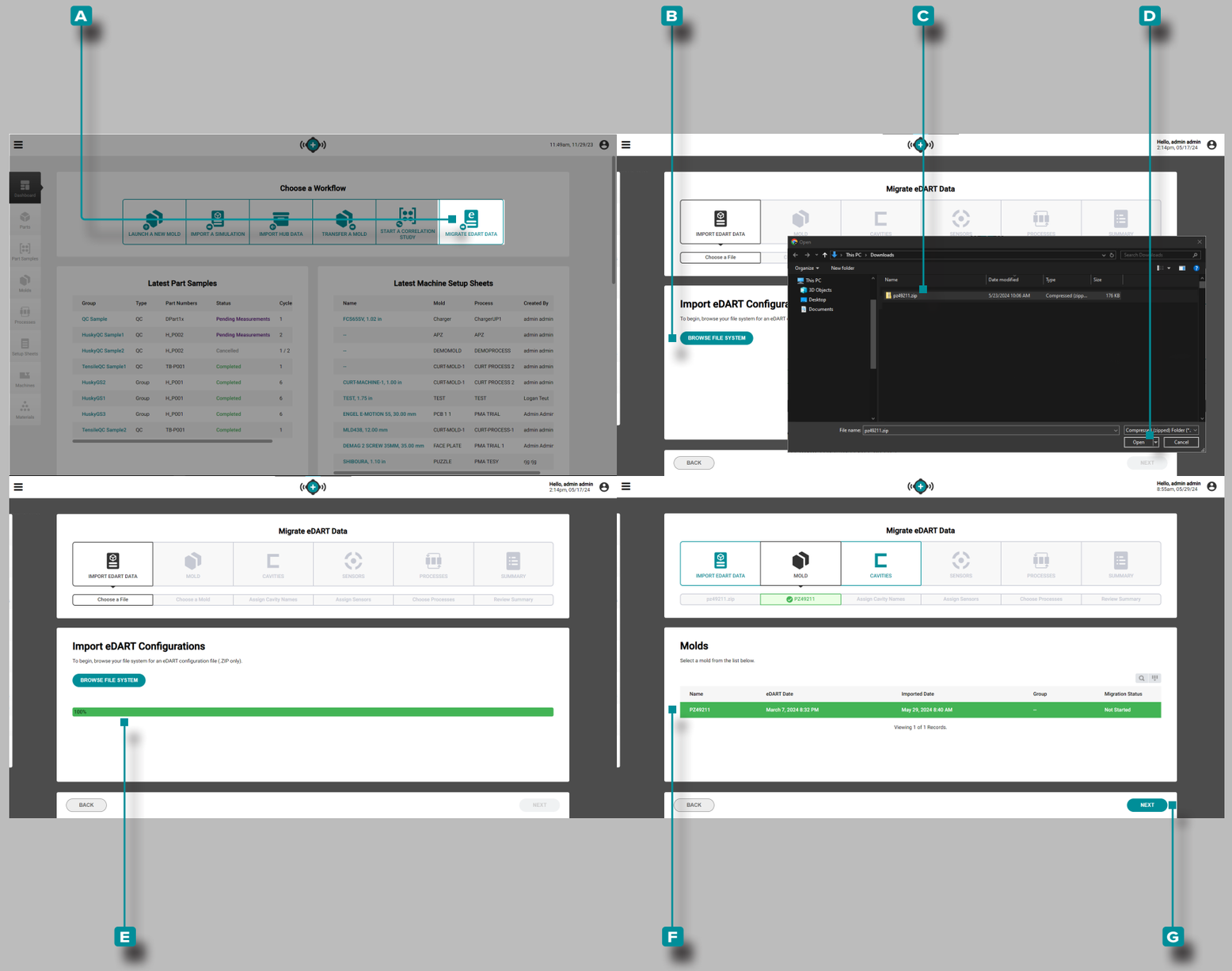


# The Hub for Process Development

***(continued from previous page)***

**Click** the **A** Migrate eDART Data button from the Process Development Dashboard.

## Import eDART Configurations

**Click** the **B** Browse File System button on the Migrate eDART Data, Import eDART Data page. Navigate to the desired **C** eDART data .zip file in the file explorer window, and **click** to select it. **Click** the **D** Open button.

**NOTE** *The Hub software Migrate eDART Data feature accepts only eDART data files that are in .zip format.*

A **E** File Upload Progress Bar will display file upload progress on the Migrate eDART Data, Import eDART Data page; once the file is uploaded, the Migrate eDART Data feature will automatically navigate to the next step: Molds.

## Molds

**Click** a **F** Mold from the Mold list to select it for migration.
**Click** the **G** Next button to continue migration of the selected mold.

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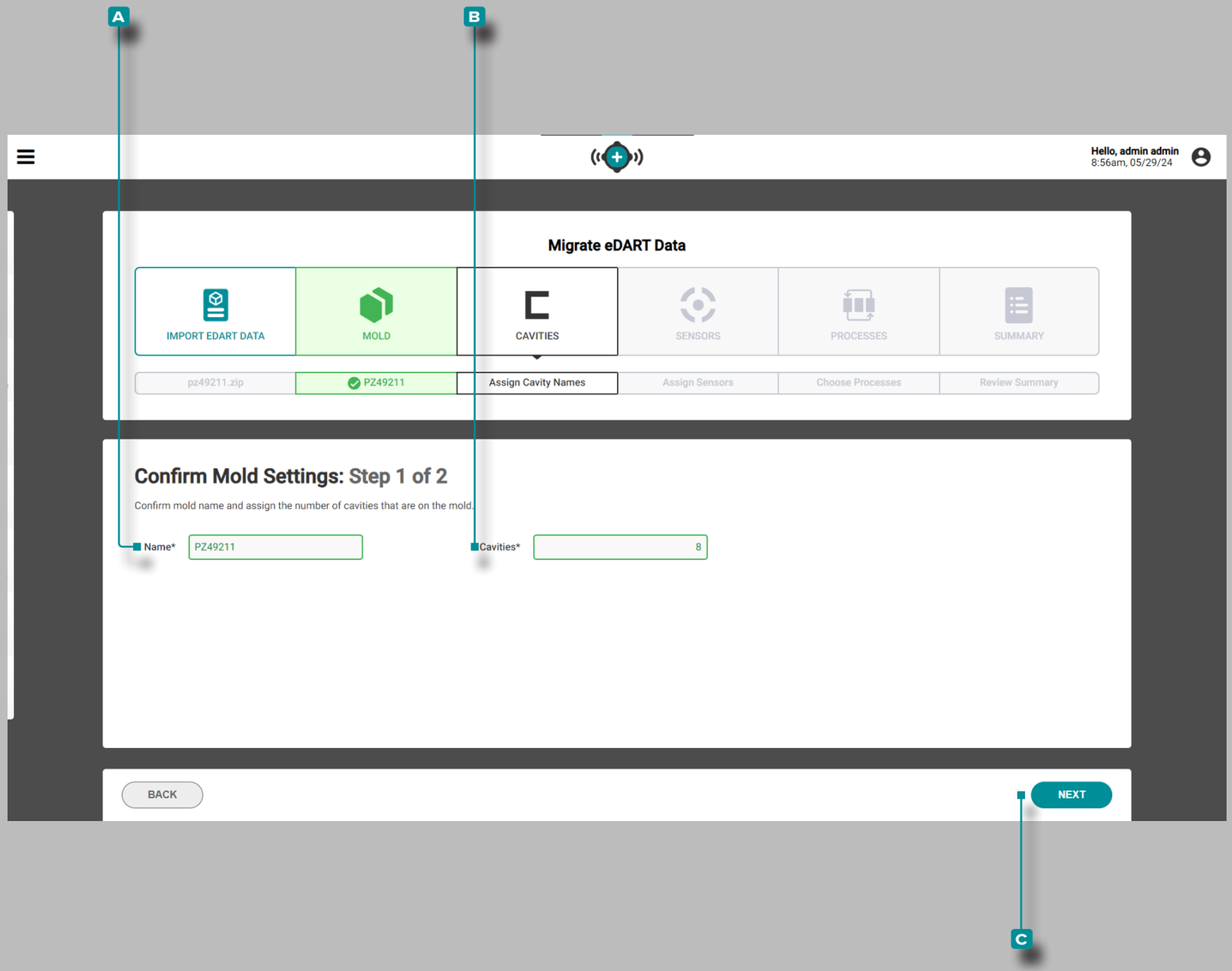


# The Hub for Process Development

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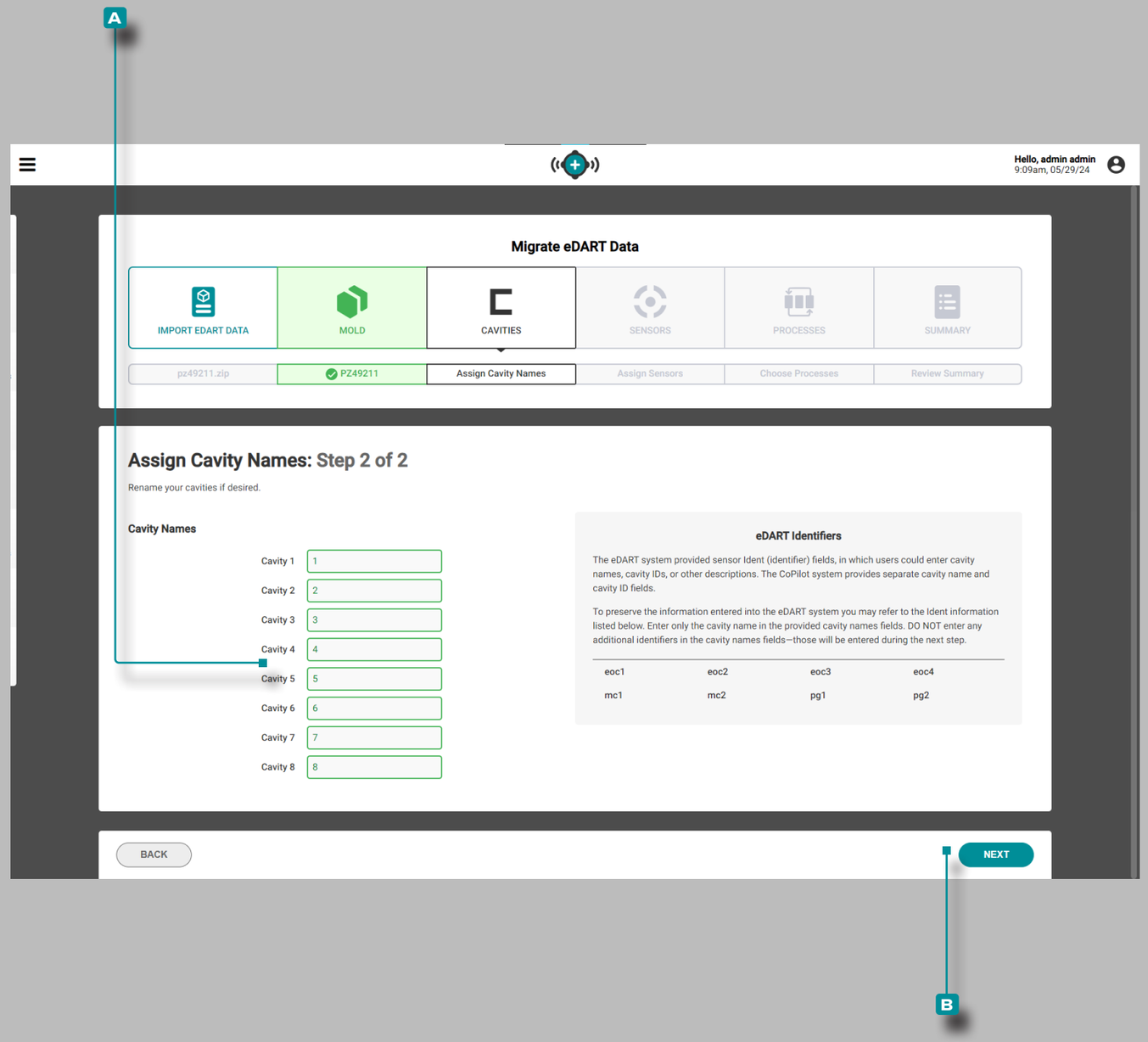
Confirm Mold Settings: Step 1 of 2

**Optionally, click** the A Name field to **enter** a mold name.

**Click** the B Cavities field to **enter** the number of cavities in the mold; **the number of cavities in the mold is required**. **Click** the C Next button to continue migration of the selected mold.

*(continued on next page)*




# The Hub for Process Development

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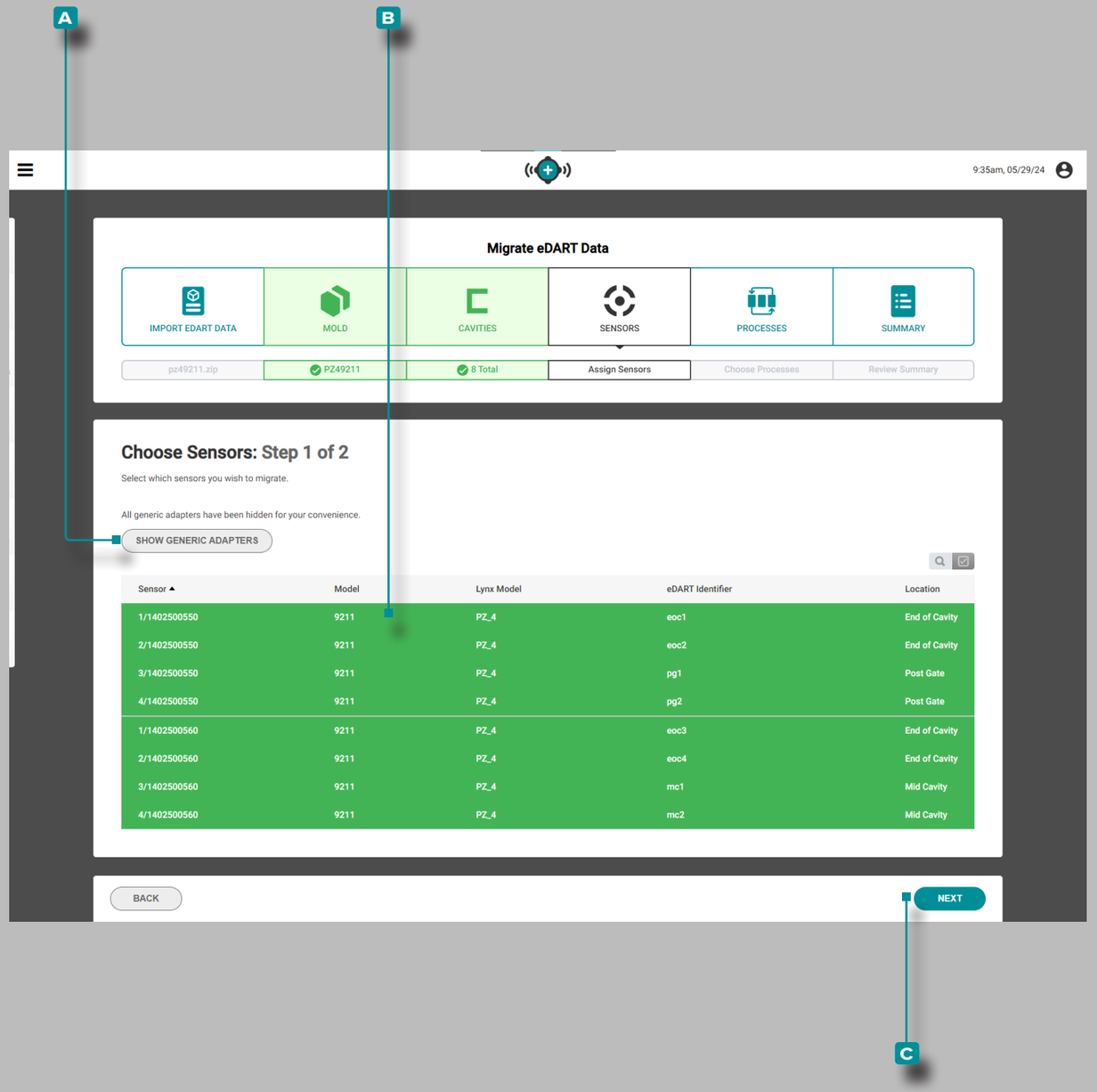
## Assign Cavity Names: Step 2 of 2

The eDART system provided sensor identifier fields, in which cavity names, cavity IDs, or other descriptions such as End-of-Cavity (eoc), Mid-Cavity(mid), or Post-Gate (pg) could be entered. The CoPilot system provides separate cavity name and cavity ID fields; use the provided eDART Identifiers as a reference while entering cavity names.

A list of cavities is populated**; click** each **A** Cavity field and **enter** a cavity name for each name; **the cavity names are required. DO NOT enter any sensor "idents" (identifiers) in the cavity name fields.**

**Click** the **B** Next button to continue migration of the selected mold.

***(continued on next page)***




# The Hub for Process Development

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## Choose Sensors: Step 1 of 2

A list of sensors is populated; the list includes the sensor serial number, model, Lynx [Adapter] Model, eDART Identifier, and Location. **Click** the **A** Show/Hide Generic Adapters button to show or hide any generic Lynx adapters.

**Click** anywhere on a **B** sensor row to select a sensor for migration; selected sensor rows will be highlighted green. **Click** the **C** NEXT button to continue migration.

## Generic Adapters

Generic adapters are generally the adapter which is mounted outside the mold and connected to the sensors through the plate adapter located on the of the mold; for example, piezoelectric sensors are connected directly to the PZ-4 sensor plate, and the sensor plate is connected to the generic adapter PZ/LX4F-S-ID.

Both adapters will display sensor configurations, ***however***, the plate adapter located on the mold will display the necessary mold-related sensors while the generic adapter may be used across multiple molds and show unnecessary configurations. Generic adapters are automatically hidden by default.

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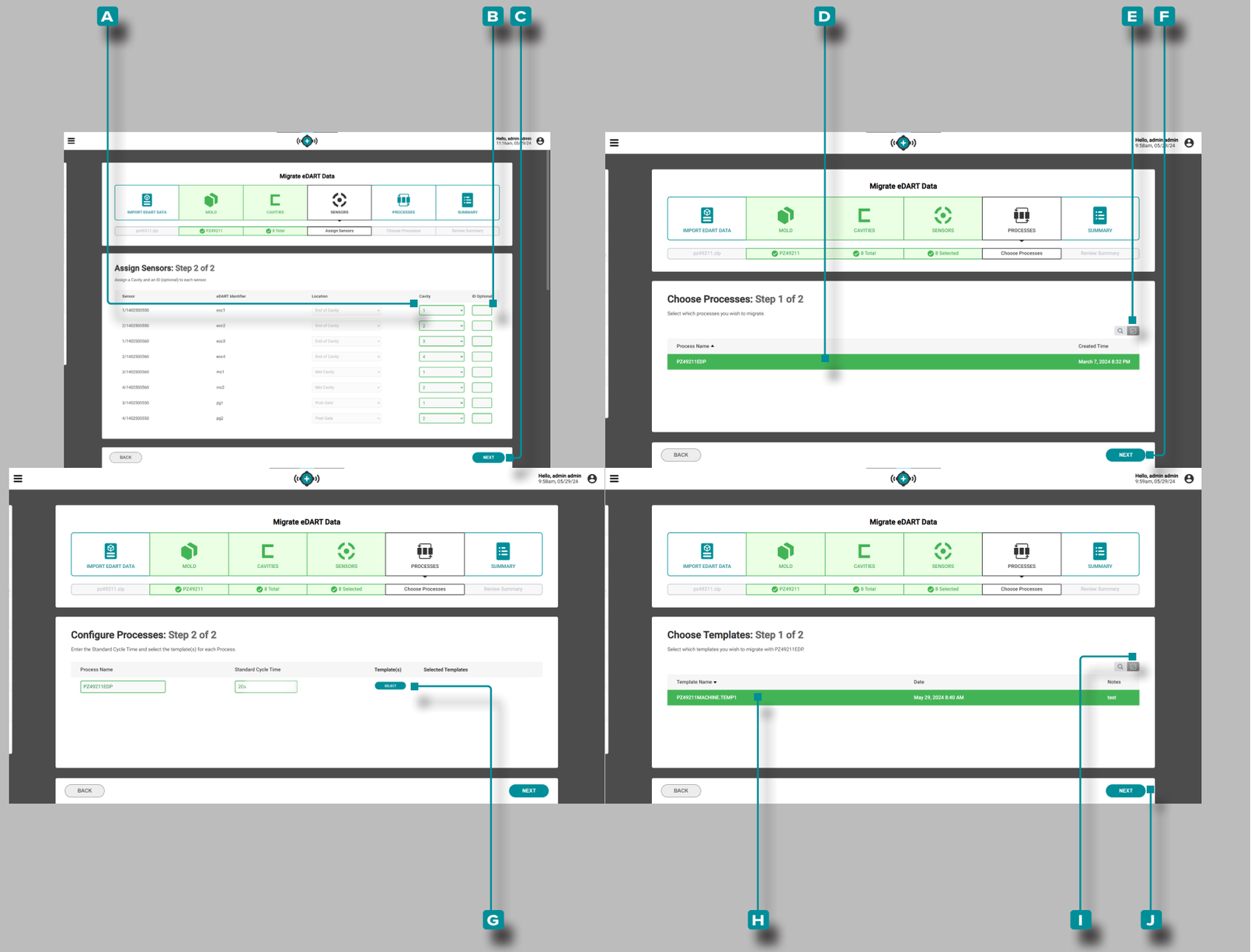


# The Hub for Process Development

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## Assign Sensors: Step 2 of 2

For each sensor, **click** the **A** Cavity dropdown to select and assign a cavity name for the sensor.

**Optionally, enter** the an **B** ID (sensor identifier); the eDART identifiers are listed for reference. **Click** the **C** Next button to continue to process migration.

## Choose Processes: Step 1 of 2

**Click** anywhere on a **D** process row to select a process for migration; selected process rows will be highlighted green, or **optionally, click** the **E** select all button to select all available processes. **Click** the **F** NEXT button to continue migration.

## Configure Processes: Step 2 of 2

**Optionally, enter** a different process name or standard cycle time in the associated fields.

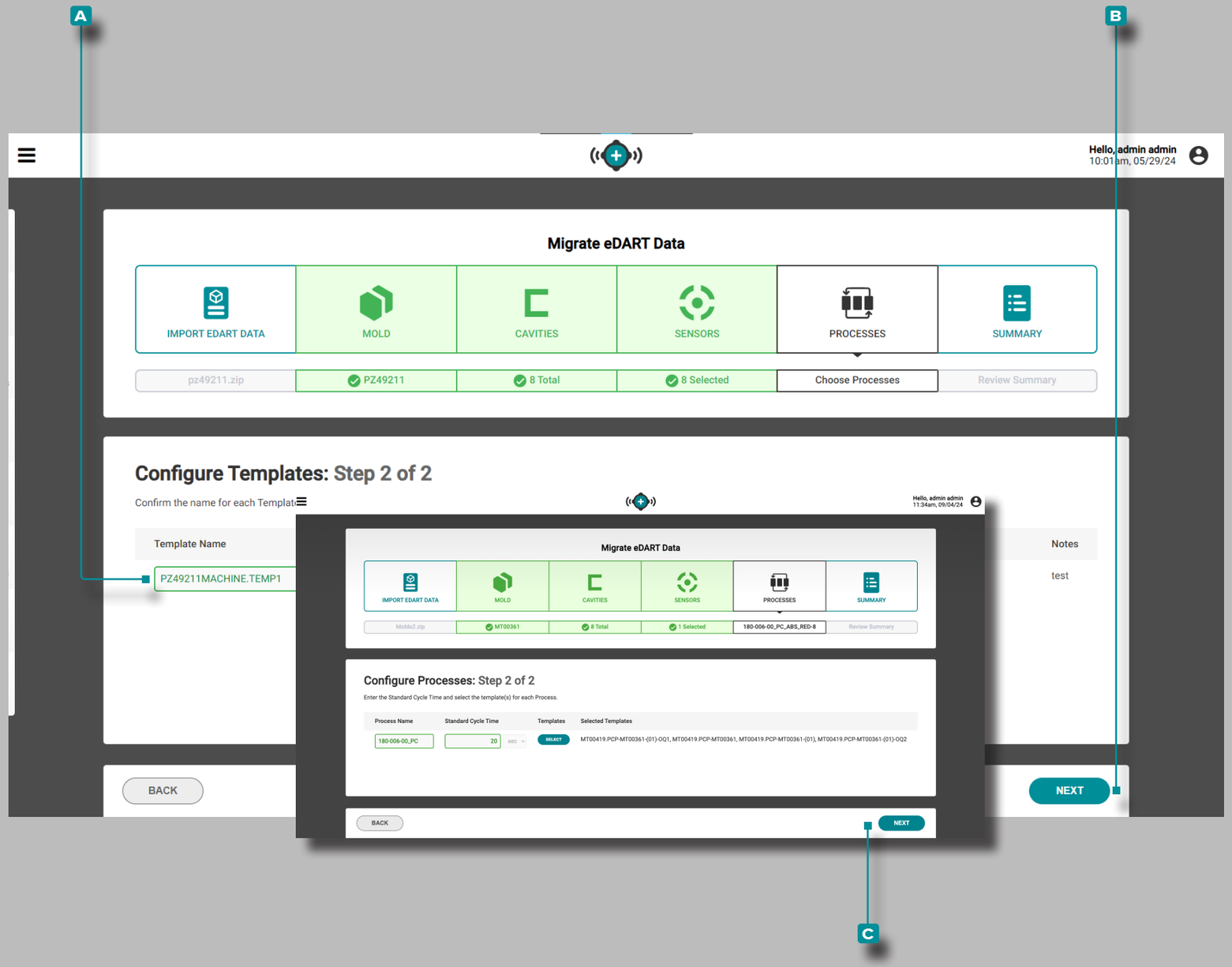
## Choose Templates: Step 1 of 2

**Click** the **G** SELECT button to view and add process templates.

**Click** anywhere on a **H** template row to select a template for migration; selected template rows will be highlighted green, or **optionally, click** the **I** select all button to select all available templates. **Click** the **J** NEXT button to continue migration.

***(continued on next page)***

# The Hub for Process Development

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Configure Templates: Step 2 of 2

**Optionally, click** to **enter** a different A template name in the associated field. **Click** the B NEXT button to add the template to the process.

Configure Processes: Step 2 of 2

**Click** the C NEXT button to complete process migration.

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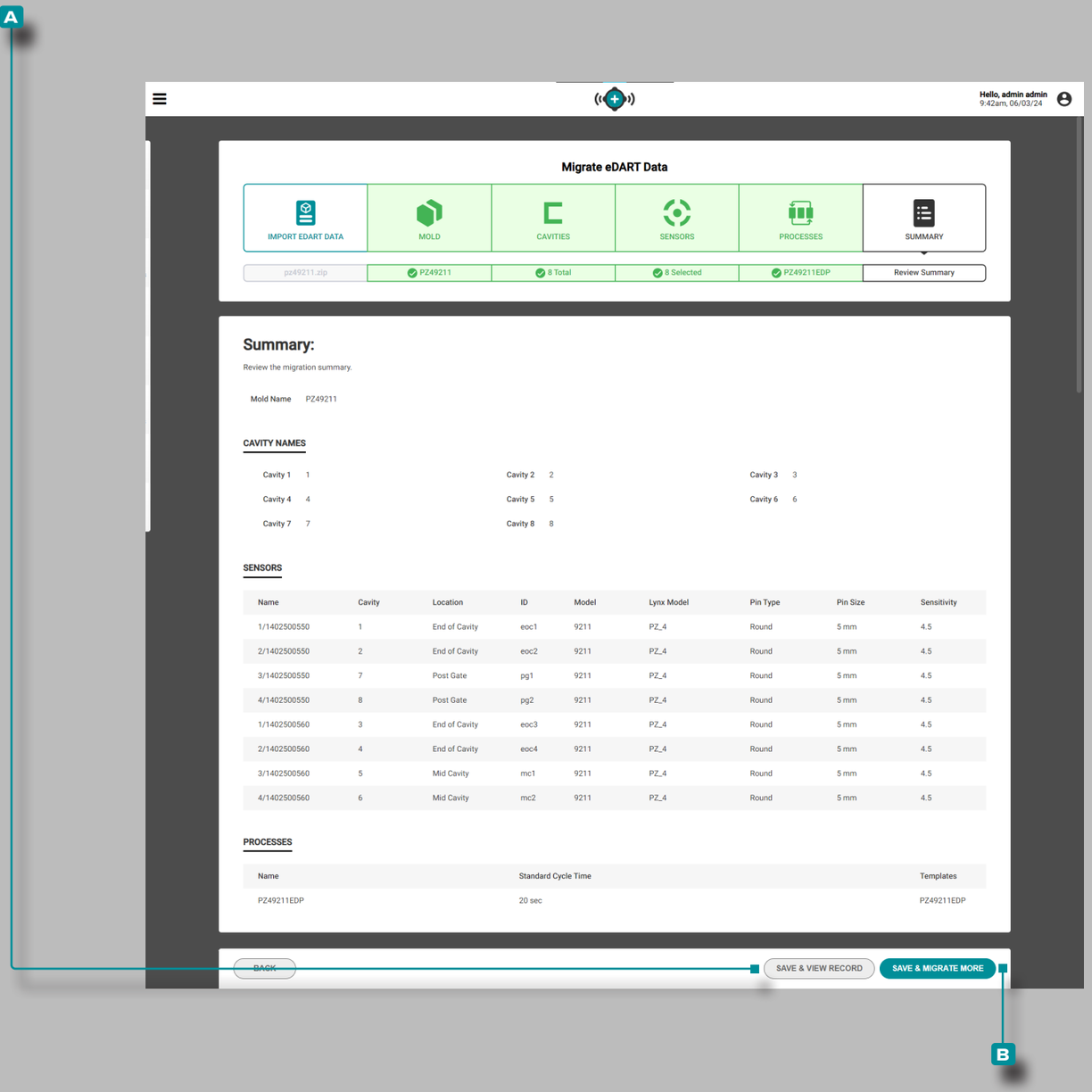


# The Hub for Process Development

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## Summary

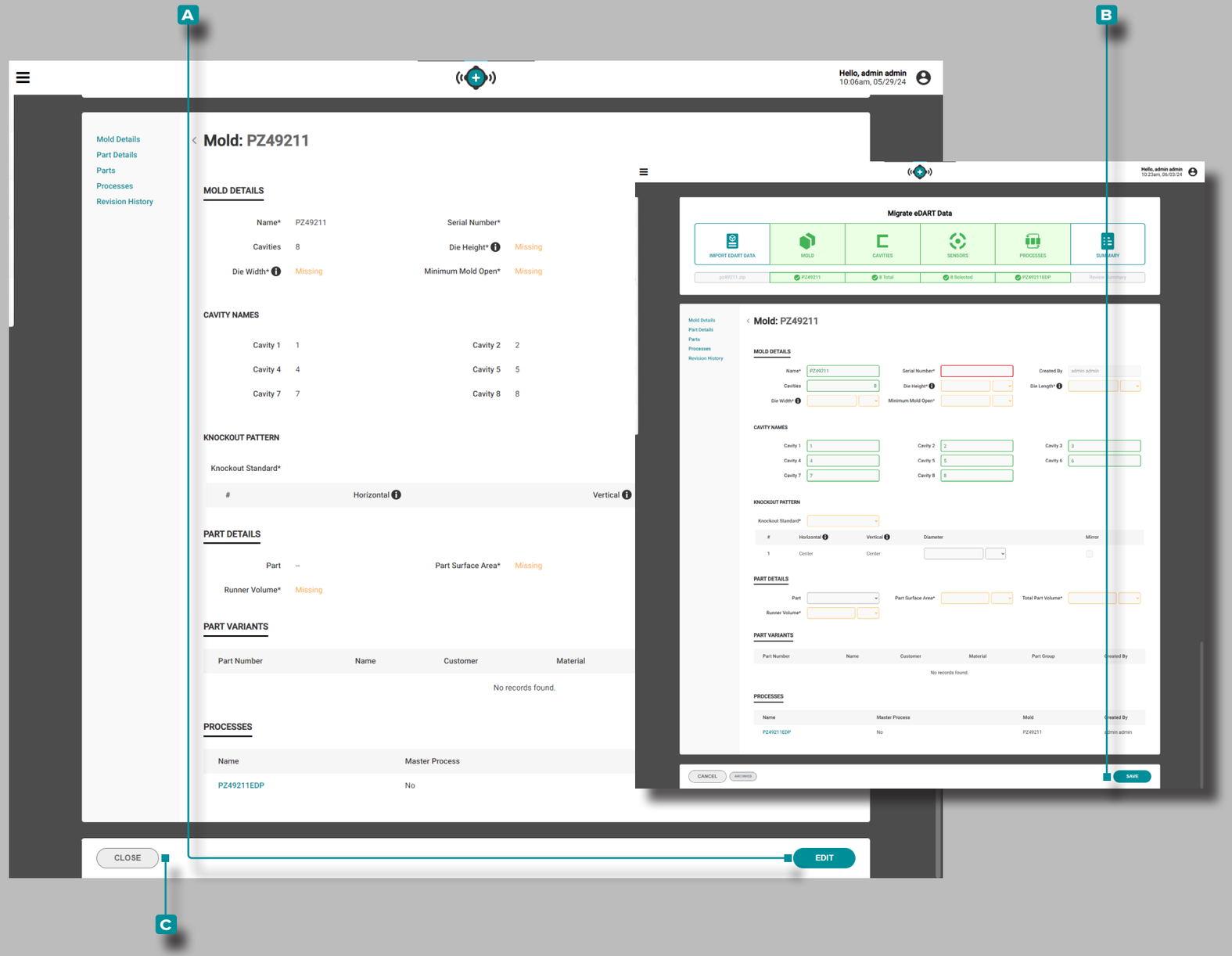
The Summary provides a review of the migrated eDART data including mold name, cavity names, sensors, processes, and templates.

**Click** the **A** SAVE & VIEW RECORD button to complete the migration process and edit the current record data,

OR

**click** the **B** SAVE & MIGRATE MORE button to save the migrated data and continue migrating additional eDART system data.

***(continued on next page)***




# The Hub for Process Development

***(continued from previous page)***

## Save and View Record

The migrated record view provides a review of the migrated eDART data including mold details, cavity names, knockout pattern, part details, part variants, and processes.

**Click** the **A** EDIT button to complete the record with any missing data. Once editing is complete, **click** the **B** SAVE button to save any changes. **Click** the **C** CLOSE button to close the record and return to the Migrate eDART Data workflow.

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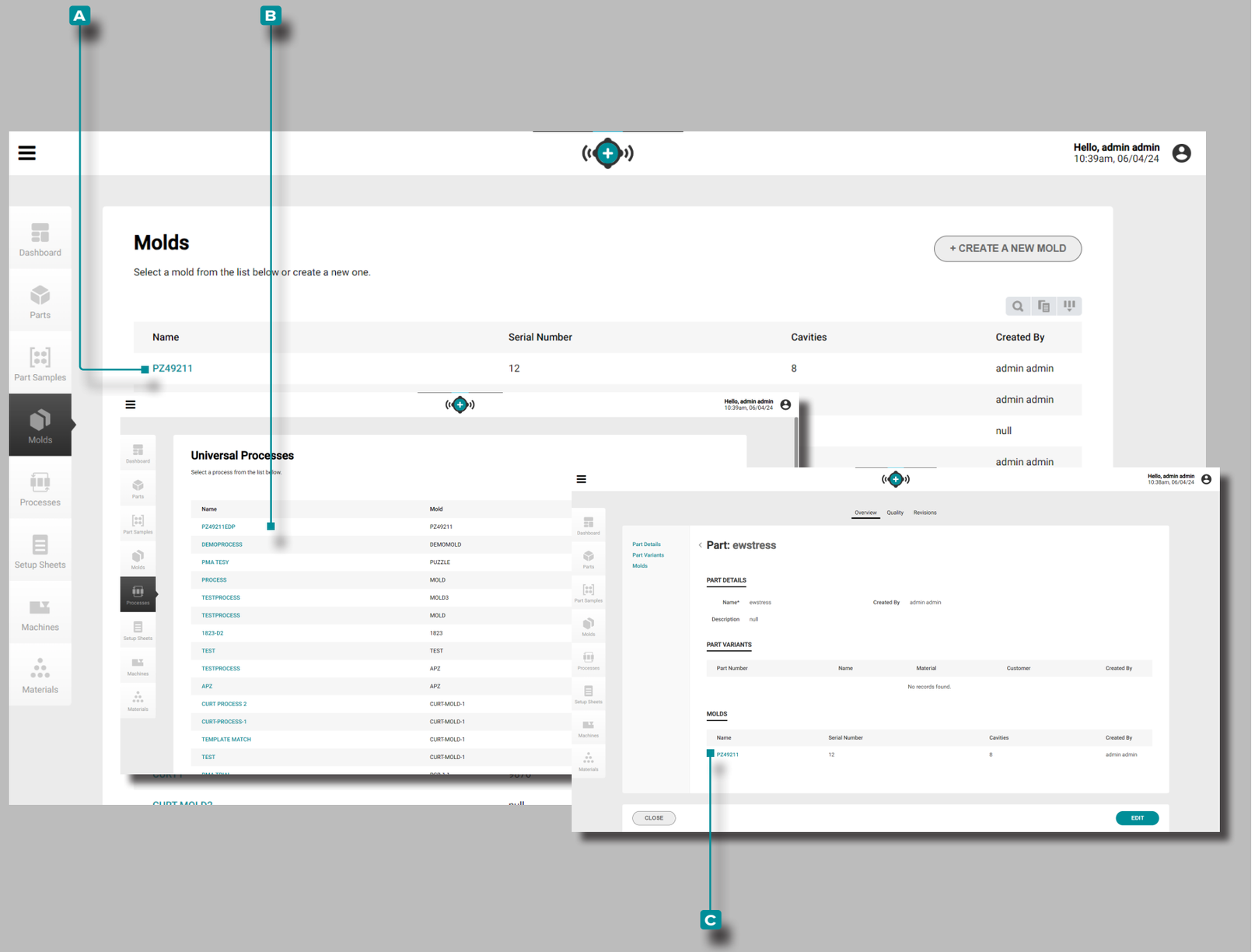


# The Hub for Process Development

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## Viewing Migrated eDART Data on The Hub

The migrated eDART data can be viewed on The Hub software for Process Development A Molds and B Processes views. The migrated mold is also displayed on any corresponding C Parts view.

## Viewing Migrated eDART Data on the CoPilot System

The migrated eDART data Molds, Processes, and Parts can be selected for use in networked, connected CoPIlot systems. When a migrated mold is selected in the CoPilot system, the associated, migrated process is also selected.

When the job is started, the user is able to load the process template from the Cycle Graph. With a process template and template summary variables selected the following can be viewed:

- imported template cycle curves can be displayed on the Cycle Graph.
- imported template summary data will be visible for all machine, mold, and composite variables when viewing the Previous Cycle Values widget.
- imported template summary data will be visible for all machine, mold, and composite variables when viewing the Alarm Settings widget.
- imported template summary data will be visible for all machine, mold, and composite variables when viewing the Template Match widget.


# The Hub for Mold Transfer

## Application Overview

The Hub for Mold Transfer, when licensed, is available on The Hub for Process Development dashboard.

The Hub for Mold Transfer generates part processes with machine-independent values and setup sheets with machine-dependent values for specific mold/machine/process combinations to launch new molds or transfer existing molds from the user-entered database of mold, machine, part, process, and material records.

## Launch a New Mold

The Launch a New Mold tool generates a process with machine-independent values and a setup sheet for a job based on the selected part, part variant, mold, and machine.

**ⓘ NOTE** *Only part, mold, and machine records with the necessary, required fields completed can be selected for use with the Launch a New Mold tool due to mold/machine fitment requirements.*

**Click** the **A** Launch a New Mold button on the Dashboard.

**Click** on a **B** row to select a part, or click the **C** CREATE A NEW PART BUTTON, then **click** the **D** NEXT button. **If a new part was created, at least one part variant must also have been created in order to continue.**

Depending upon the selected part and the part associations, the part variant and/or the mold may automatically be assigned. If the part variant or mold are not assigned, **click** to select the correct **E** part variant, then **click** the **F** NEXT button; **click** to select the correct **G** mold then **click** the **H** NEXT button.

If a new part and part variant(s) was created, click the **I** CREATE A NEW MOLD button, and create a new mold record to continue.

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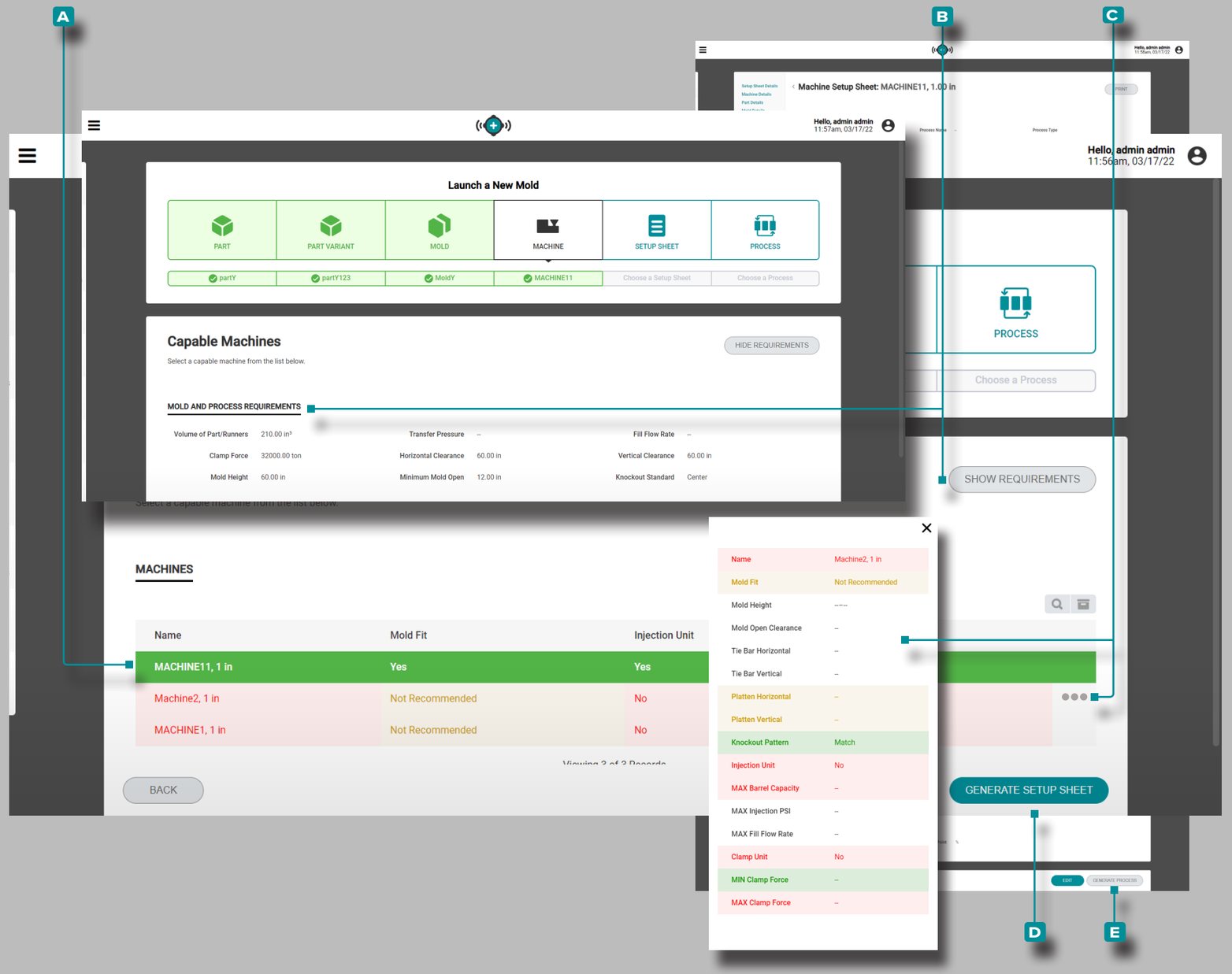



# The Hub for Mold Transfer

***(continued from previous page)***

**Click** on a A row to select a compatible machine. Machine compatibility is shown using the following colors:

- green indicates that one or more of a machine's capabilities is compatible and can provide the necessary process requirements;
- yellow indicates that one or more of a machine's capabilities may not be compatible with the current process requirements;
- red indicates that one or more of a machine's capabilities are not capable of providing the necessary process requirements.

Refer to the Appendix section"Mold Launch, Mold Transfer, and Simulation Support Machine Compatibility" on page 109 for complete information on machine compatibility requirements.

Optionally, **click** the B SHOW/HIDE REQUIREMENTS button to view/hide mold and process requirements to compare them with listed machines.

Optionally, hover over the right-hand side of a machine row, then **click** on the C information icon to view complete machine information.

**Click** the D GENERATE SETUP SHEET button to generate a setup sheet.

**Click** the E GENERATE PROCESS button on the setup sheet to generate a process.

# The Hub for Mold Transfer


## Transfer a Mold

The Transfer a Mold tool generates a setup sheet of machine-dependent values for a job based on the selected part, mold, process, and machine.

**ⓘ NOTE** *Only part, mold, process, and machine records with the necessary, required fields completed can be selected for use with the Transfer a Mold tool due to mold/machine fitment requirements.*

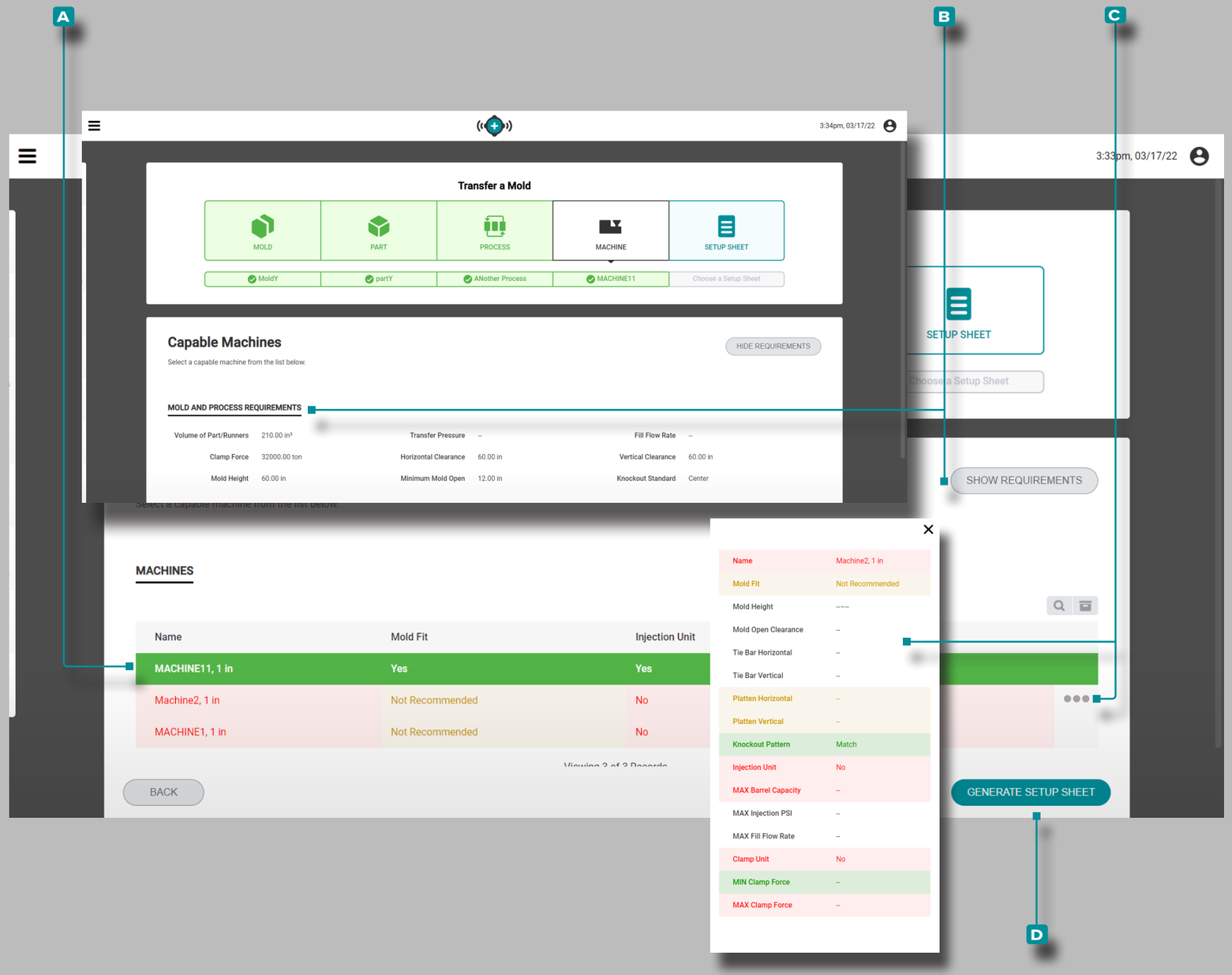
**Click** the **A** Transfer a Mold button on the Dashboard.

**Click** on a **B** row to select a mold, then **click** the **C** NEXT button.

If the selected mold has an existing part record associated, the part will be automatically selected, otherwise **click** on a **D** row to select a part, then **click** the **E** NEXT button.

**Click** on a **F** row to select a process (of machine-independent values), then **click** the **G** NEXT button.

***(continued on next page)***




# The Hub for Mold Transfer

***(continued from previous page)***

**Click** on a A row to select a compatible machine. Machine compatibility is shown using the following colors:

- green indicates that one or more of a machine's capabilities is compatible and can provide the necessary process requirements;
- yellow indicates that one or more of a machine's capabilities may not be compatible with the current process requirements;
- red indicates that one or more of a machine's capabilities are not capable of providing the necessary process requirements.

Refer to the Appendix section"Mold Launch, Mold Transfer, and Simulation Support Machine Compatibility" on page 109 for complete information on machine compatibility requirements.

Optionally, **click** the B SHOW/HIDE REQUIREMENTS button to view/hide mold and process requirements to compare them with listed machines.

Optionally, hover over the right-hand side of a machine row, then **click** on the C information icon to view complete machine information.

**Click** the D GENERATE SETUP SHEET button to generate a setup sheet.


# The Hub for Simulation Support

## Application Overview

The Hub for Simulation Support, when licensed, is available on The Hub for Process Development dashboard. The Hub for Simulation Import allows mold flow simulation files to be uploaded to The Hub software.

## Import a Simulation

The Import a Simulation tool generates a setup sheet of machine-dependent values for a job based on the imported simulation file (Moldex3D files only) and selected part, mold, process, and machine.

**Click** the **A** Import a Simulation button on the Dashboard.

**Click** the **B** BROWSE FILE SYSTEM button, select the simulation file (.zip) from the window, then **click** the **C** Open button. The simulation file will be uploaded; **click** the **D** NEXT button to continue.

**Click** on a **E** row to select a part, or create a new part, then **click** the **F** NEXT button.

**Click** on a **G** row to select a mold, complete the required mold fields, or create a new mold, then **click** the **H** NEXT button.

Select a process setup or complete the process setup and then **click** the **L** NEXT/SAVE button.

**Click** on a **I** row to select a compatible machine. Machine compatibility is shown using the following colors:

- green indicates that one or more of a machine's capabilities is compatible and can provide the necessary process requirements;
- yellow indicates that one or more of a machine's capabilities may not be compatible with the current process requirements;
- red indicates that one or more of a machine's capabilities are not capable of providing the necessary process requirements.

Refer to the Appendix section"Mold Launch, Mold Transfer, and Simulation Support Machine Compatibility" on page 109 for complete information on machine compatibility requirements.

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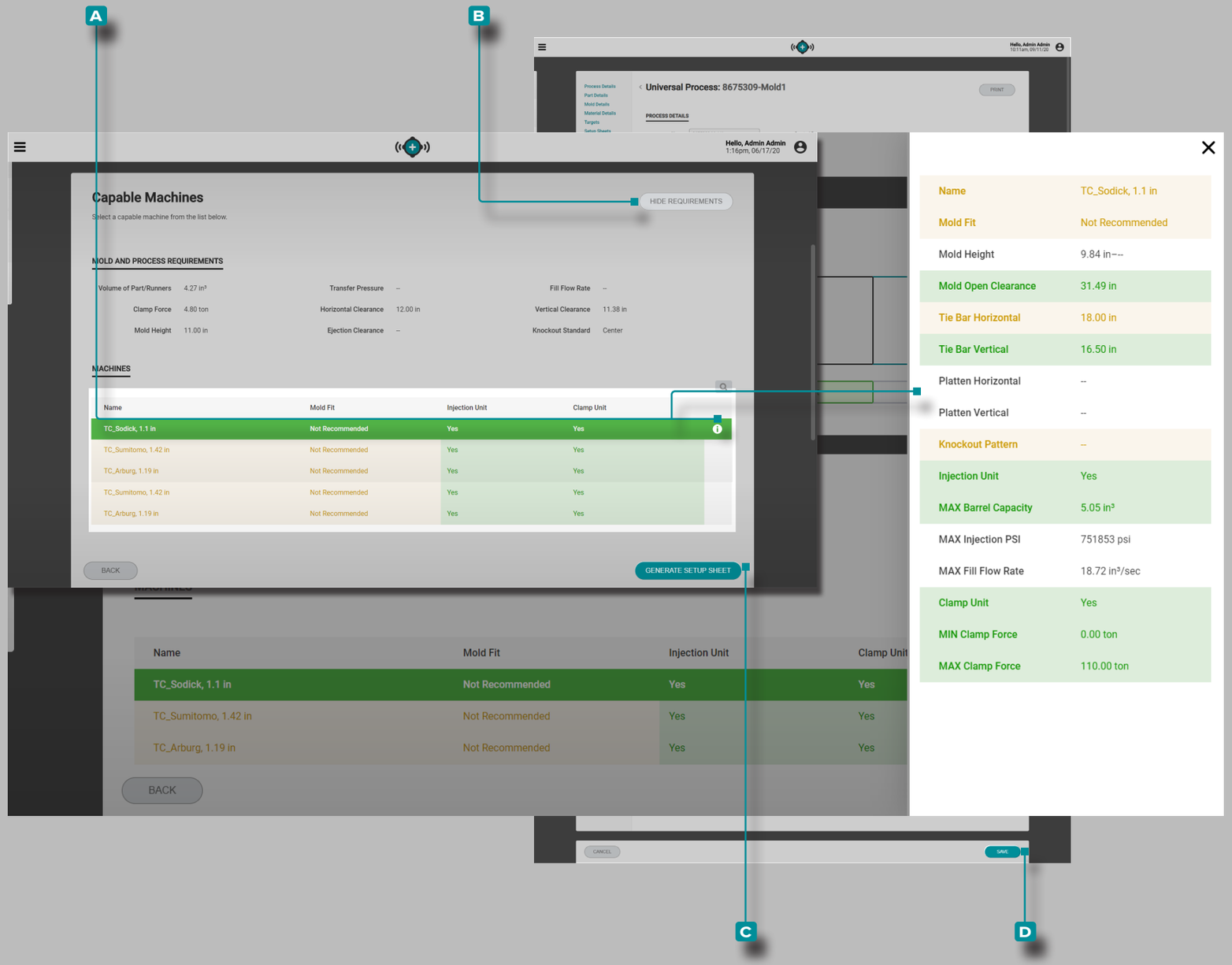


# The Hub for Simulation Support

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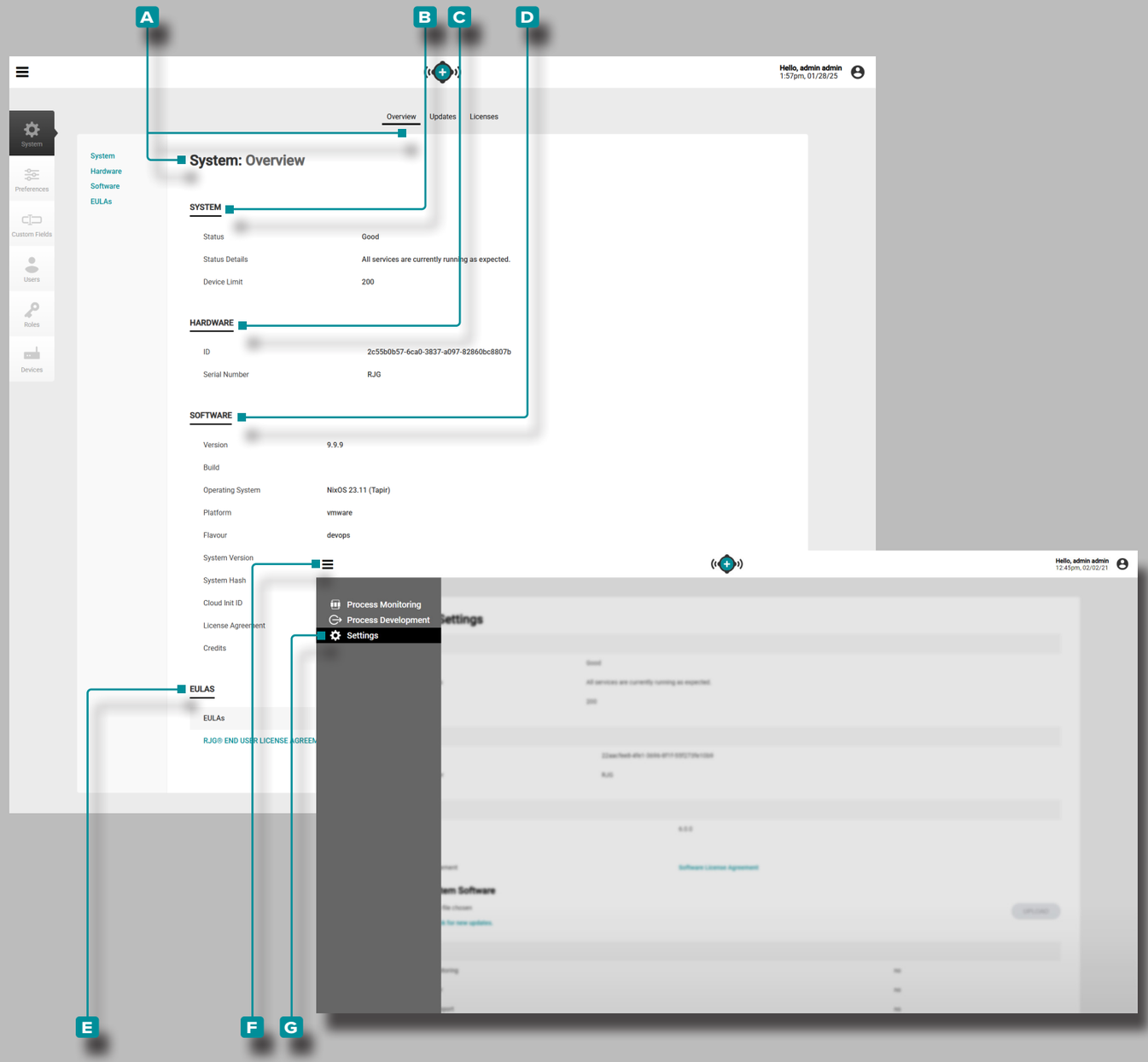
Optionally, hover over the right-hand side of a machine row, then **click** on the **A** information icon to view complete machine information, **AND/OR**

**Click** the **B** SHOW/HIDE REQUIREMENTS button to view/hide mold and process requirements to compare them with listed machines.

**Click** the **C** GENERATE SETUP SHEET button to generate a setup sheet.

**Click** the **D** SAVE button to save the setup sheet.




# Settings

## System Settings: Overview

The Hub **A** System Settings: Overview includes **B** System, **C** Hardware, **D** Software, and **E** End User License Agreement (EULA) information.

**Click** the **F** menu icon from any page, then **click** **G** Settings to access overview, updates, and licenses information.

### System

The System Settings **B** System information provides the system status, status details, and device limit.

### Hardware

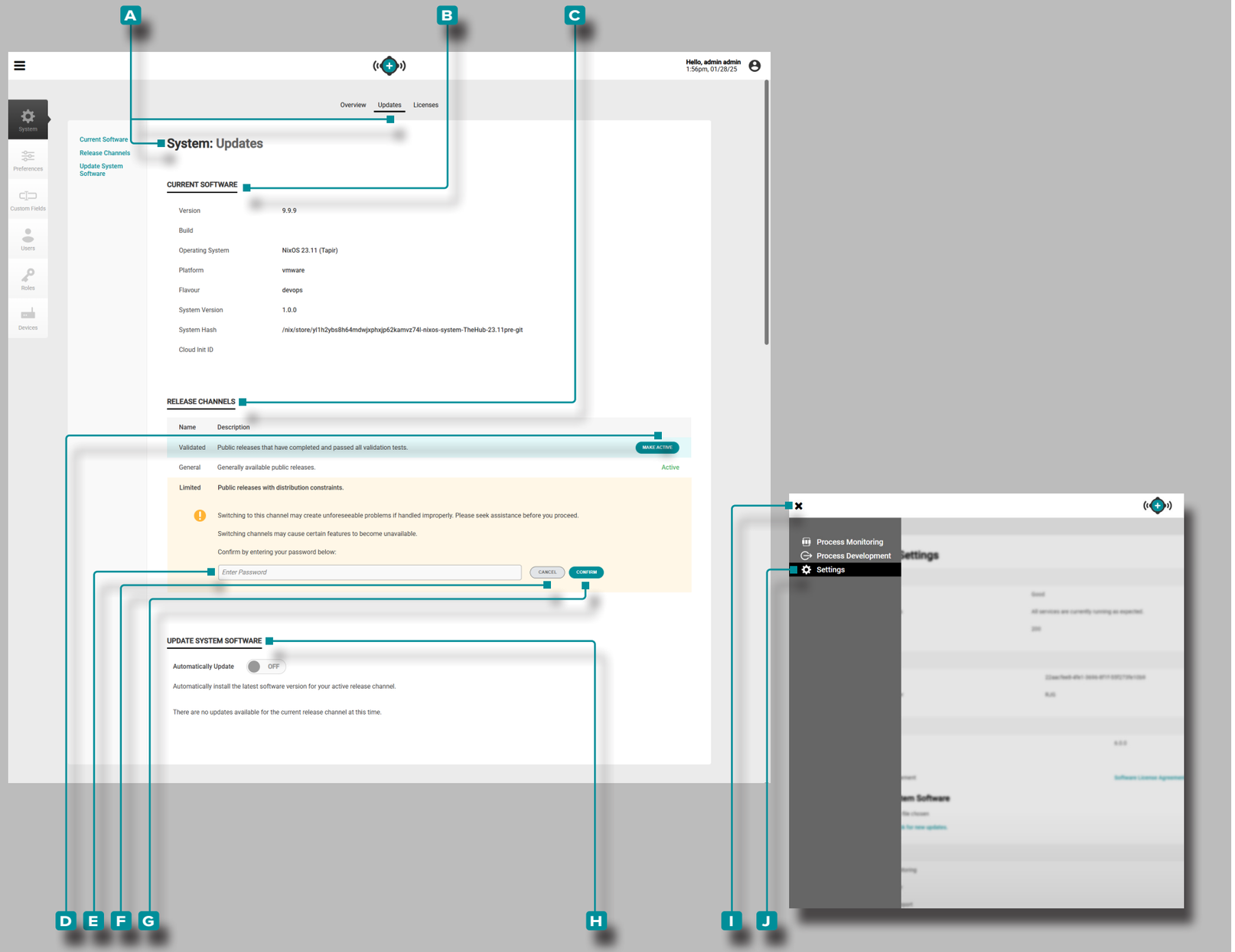
The System Settings **C** Hardware information provides the hardware identification code and serial number.

### Software

The System Settings **D** Software information includes version number, build number, operating system (Debian or NixOS), platform, system hash, cloud init ID (if NixOS), software license agreement, and credits (open source licenses).

### End User License Agreements (EULAs)

The **E** EULA information provides a PDF of the RJG® End User License Agreement for The Hub® software..




# Settings (*continued*)

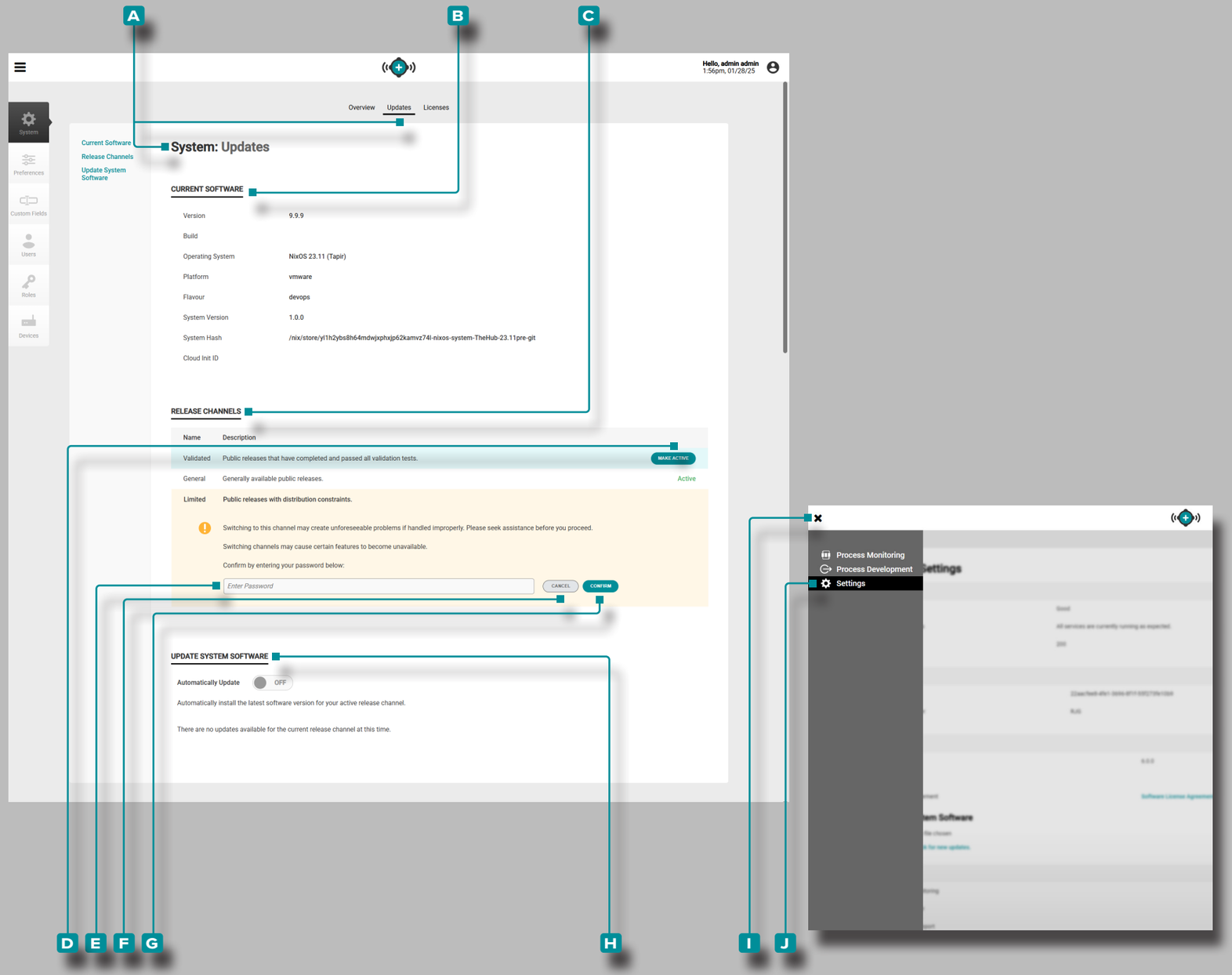
## System Settings: Updates

The Hub **A** System Settings: Updates includes **B** Current Software, **C** Release Channels (NixOS systems only), and **H** Update System Software. **Click** the **I** menu icon from any page, then **click** **J** Settings to access **A** System Settings: Updates information.

## Current Software

The Updates **B** Current Software information provides the version, build, operating system (Debian or NixOS), platform, flavor, system version, system health, and cloud init ID (if running a NixOS system).

***(continued on next page)***




# Settings (*continued*)

## System Settings: Updates *(continued from previous page)*

### Release Channels (NixOS Systems Only)

The Updates C Release Channels—only visible if running a NixOS system—provides the user selection of Limited, General, or Validated releases. **Click** the I menu icon from any page, then **click** J Settings to access H Update System Software information and C Release Channels.

#### Limited Release

A Limited release has passed all testing, but contains a breaking change (a change that may cause other parts to fail) that must be managed carefully.

#### General Release

A General release is a typical release, available to the general public.

#### Validated Release

A Validated release is a release that has been tested and completed medical validation.

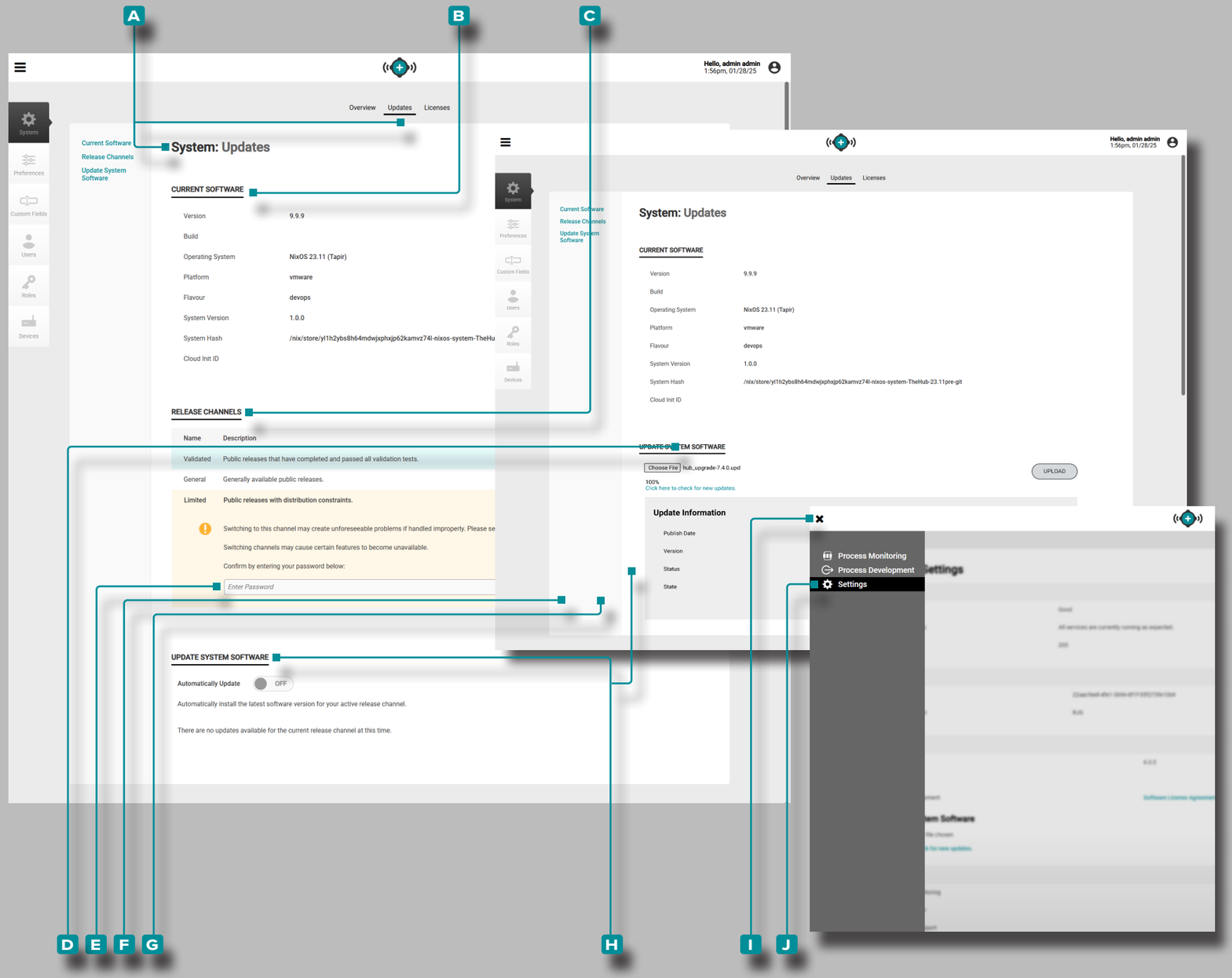
The currently-selected release channel will be designated by an "Active" marking within the release channel's table row. To select a different release channel, hover over the desired release channel row, then **click** the D Make Active button.

**CAUTION** *Switching to a limited release channel may create unforseeable problems; request assistance before proceeding. Switching to a different release channel may cause certain features to become unavailable.*

**Click** the E password field to **enter** the password assigned to the user account, then click G CONFIRM button to confirm the change, or click the F CANCEL button to discard any changes.

***(continued on next page)***

# Settings (*continued*)



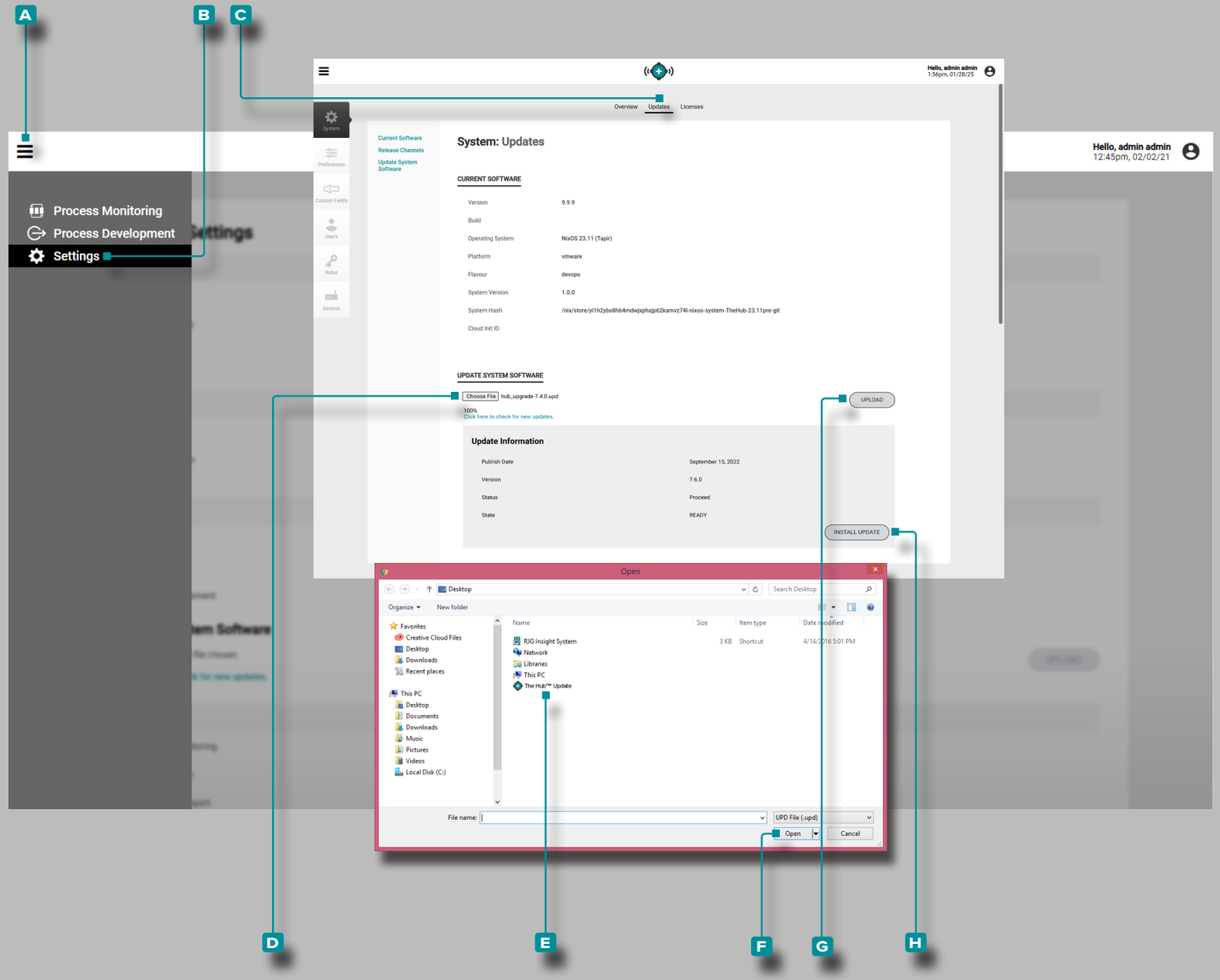

## System Settings: Updates *(continued from previous page)*

### Update System Software

The System Settings H Update System Software provides the software update functions for Debian and NixOS system users. **Click** the I menu icon from any page, then **click** J Settings to access H Update System Software information.

Refer to "Updating a Debian System" on page 92 or "Updating a NixOS System" on page 93 for Debian and NixOS system updates.

# Settings (*continued*)




## Updating a Debian System

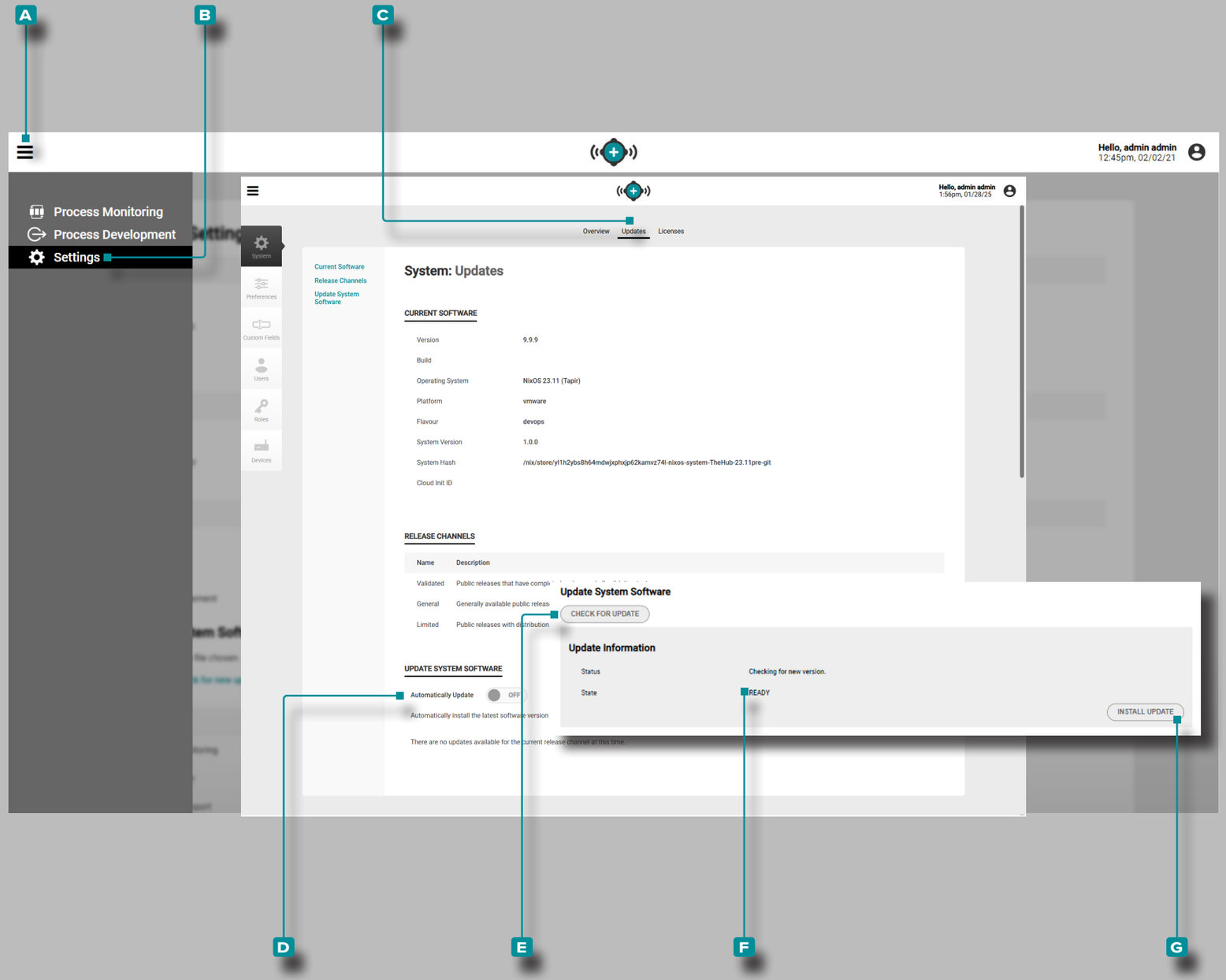
A Debian system The Hub software can be updated directly from System Settings. Update The Hub software as necessary for the latest bug fixes and new features.

**CAUTION** *DO NOT skip update versions; DO NOT apply a newer update if an older update is available—i. e. applying v7.2 update to a v7.0 system versus applying v7.1 update to a v7.0 system, then applying the v7.2 update. Refer to the RJG website to ensure that the correct update is applied to the CoPilot system. Failure to comply may result in errors or issues in the CoPilot software and The Hub system.*

**Download software update files from www.rjginc.com.**

**Click** the **A** menu icon, **click** **B** Settings, then **click** the **C** Updates tab heading. **Click** the **D** Choose File button under the "Update System Software" heading to browse for an update file.

Select the **E** update file (.UPD) from the window, then **click** the **F** Open button. **Click** the **G** UPLOAD button; once the upload is complete, then **click** the **H** INSTALL UPDATE button. Allow the system to update; when the update is complete, refresh the page (press F5 on the keyboard) and confirm that The Hub software version is updated.




# Settings (*continued*)

## Updating a NixOS System

A NixOS system The Hub software (one that runs on a Virtual Appliance (VA)) can be updated directly from System Settings. Update The Hub software as necessary for the latest bug fixes and new features.

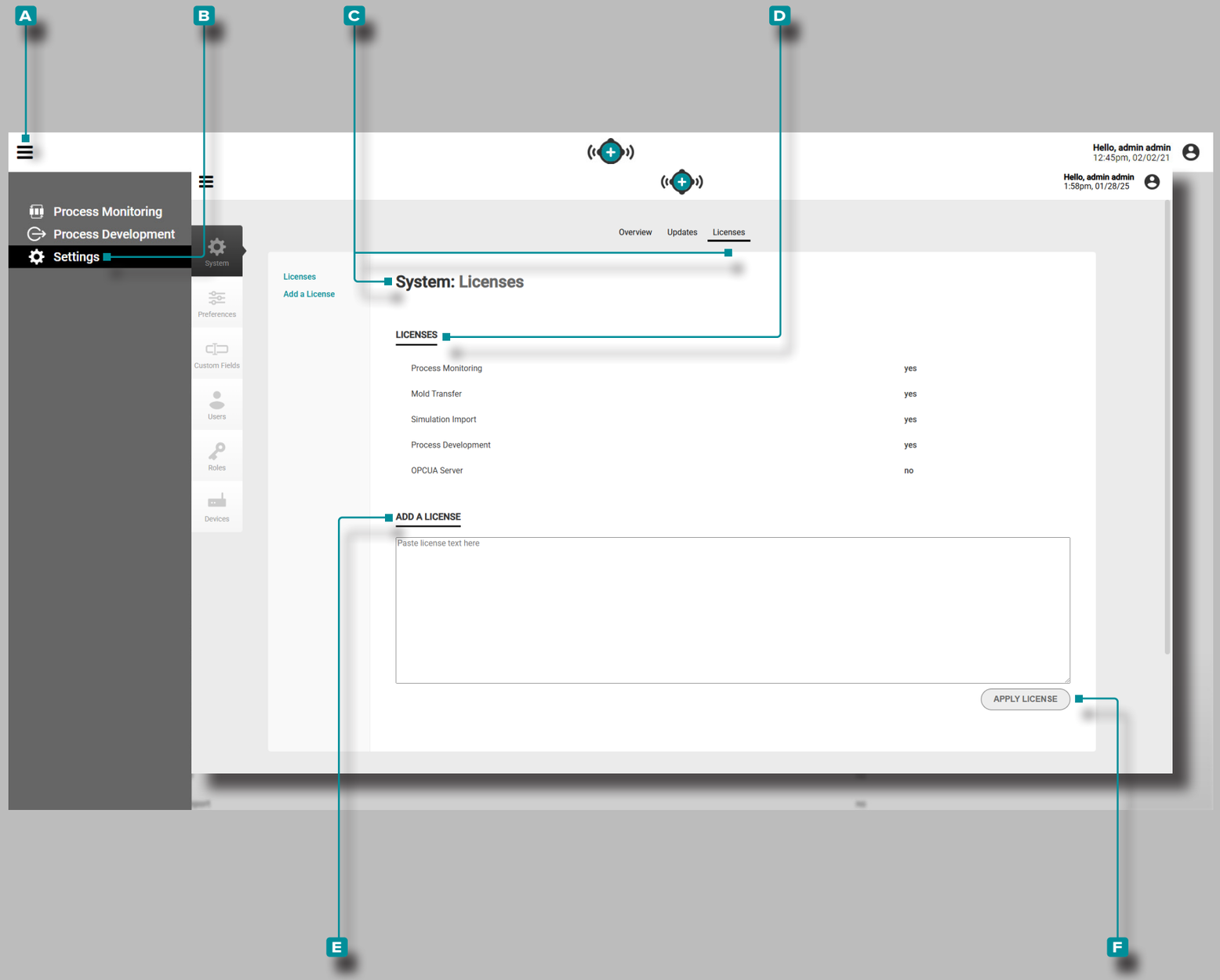
**CAUTION** *DO NOT skip update versions; DO NOT apply a newer update if an older update is available—i. e. applying v7.2 update to a v7.0 system versus applying v7.1 update to a v7.0 system, then applying the v7.2 update. Refer to the RJG website to ensure that the correct update is applied to the CoPilot system. Failure to comply may result in errors or issues in the CoPilot software and The Hub system.*

**NOTE** *A user must be logged in to perform a system update.*

Updates will be automatically applied if the Automatically Update option is selected to ON, any updates that are published for the currently-selected release channel will be applied without user intervention.

**Click** the **A** menu icon, **click** **B** Settings, then **click** the **C** Updates tab heading. The **D** Automatically Update slider must be selected to ON for updates to be automatically applied.

Alternatively, **click** the **E** CHECK FOR UPDATE button to browse for an update file. If an update is available, and a **F** READY state is displayed, **click** the **G** INSTALL UPDATE button. Allow the system to update; when the update is complete, refresh the page (press F5 on the keyboard) and confirm that The Hub software version is updated.




# Settings (*continued*)

## System Settings: Licenses

The Hub C System Settings: Licenses includes D Licenses status and the E Add a License function. The software must be licensed for use with CoPilot systems. Some features may not be available to core-only licensed users.

**Click** the A menu icon from any page, then **click** B Settings to access overview, updates, and licenses information.

## Licenses

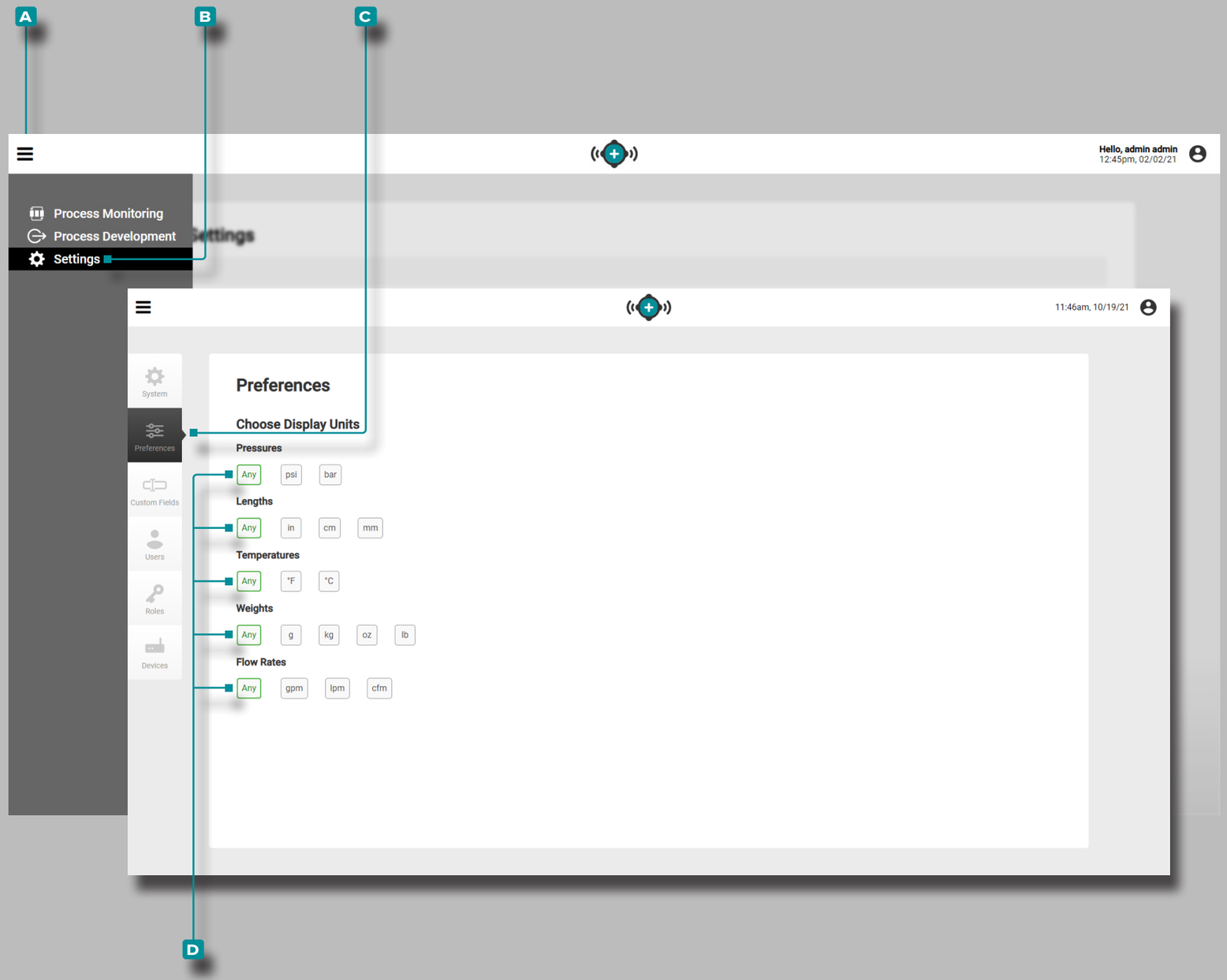
The System Settings D Licenses displays which licenses are active on the system, including: process monitoring, mold transfer, simulation support, process development, and OPC UA server.

## Add a License

The C System Settings: Licenses provides an E Add a License.

**Click** the A menu icon, **click** B Settings, and then **click** C Licenses.

**Copy** (Ctrl+C) and **Paste** (Ctrl+V) the license text into the E Add a License field; **click** the F Apply License button to apply the license.




# Settings (*continued*)

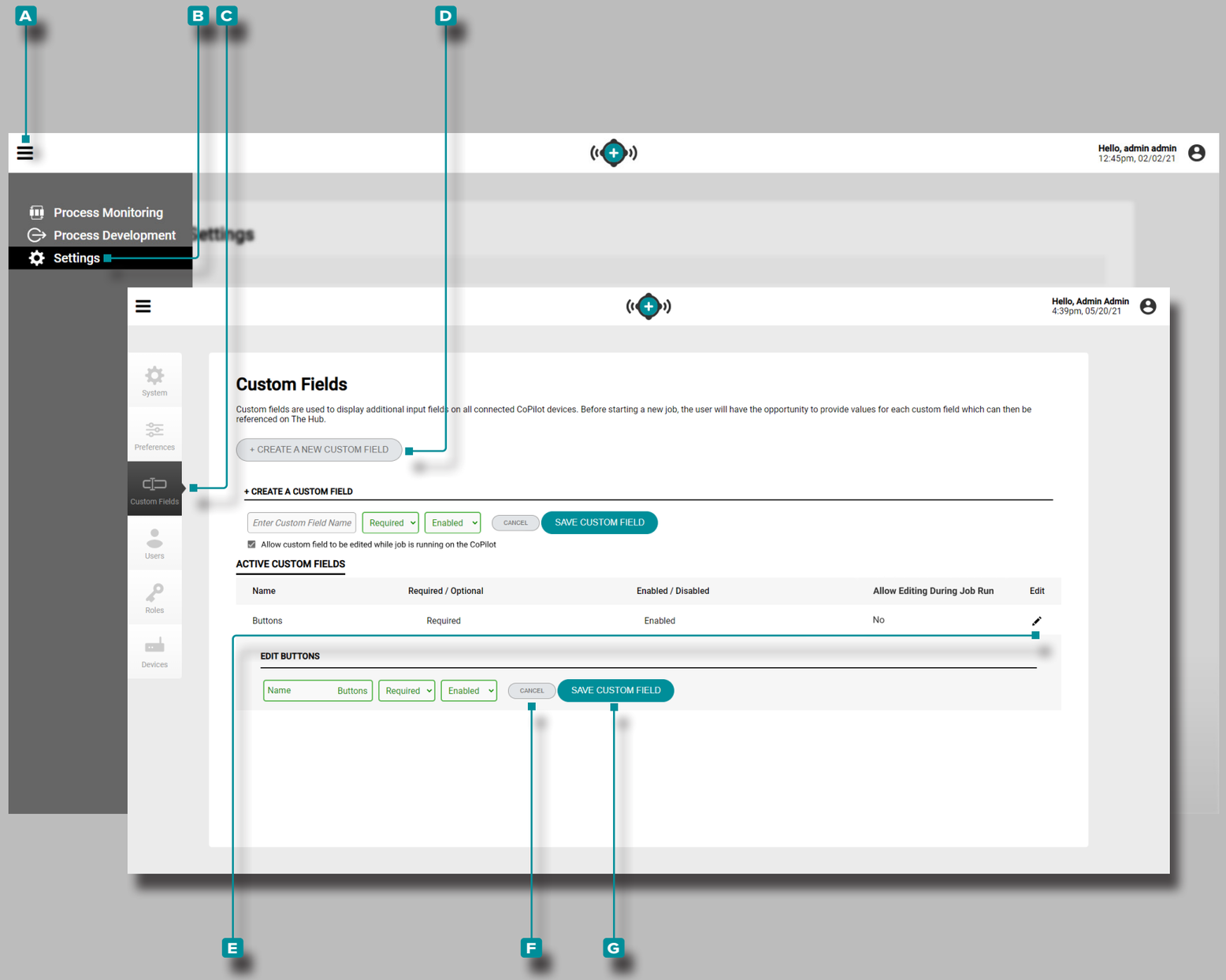
## Preferences

Manage display units of measurement for The Hub and CoPilot softwares from the Preferences view.

## Choose Display Units

Users can select the desired display units of measurement for pressures, lengths, temperatures, weights, and flow rates in The Hub and CoPilot softwares.

**Click** the A menu icon, then **click** B Settings, then **click** C Preferences. Under each category, **click** to select the desired D display units of measurement.




# Settings (*continued*)

## Custom Fields

Manage, add, or edit custom fields for The Hub and CoPilot softwares from the Custom Fields view.

**NOTE** *There is a limit of three (3) custom fields that can be displayed on the CoPilot system during a job.*

### Create a New Custom Field

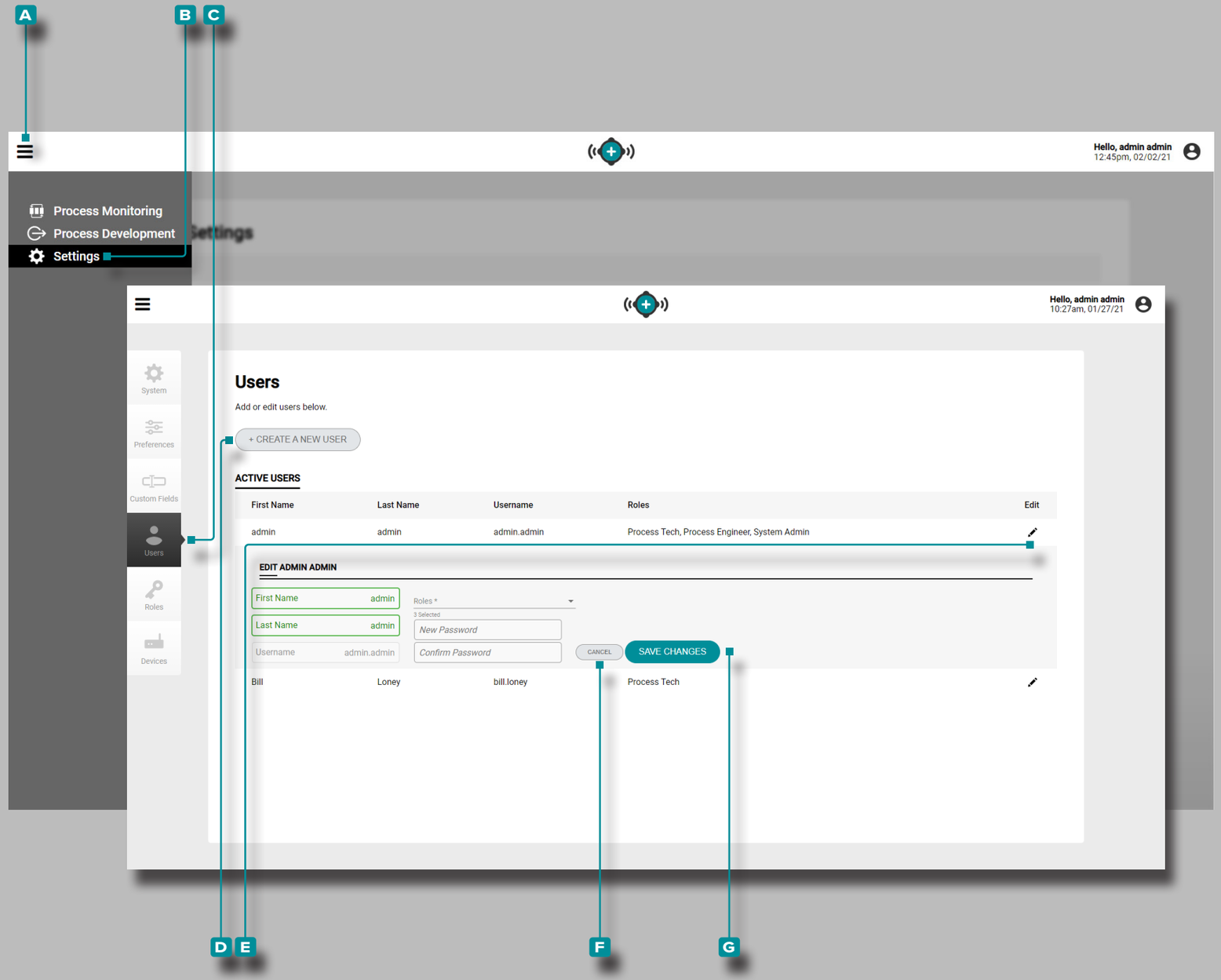
**Click** the **A** menu icon, then **click** **B** Settings, then **click** **C** Custom Fields.

**Click** the **D** Create a New Custom Field button to add a new custom field to the system; **enter** the required information and select if the field is required or optional, and enabled or disabled for the custom field from the drop-down menus.

### Edit an Existing Custom Field

**Click** the **A** menu icon, then **click** **B** Settings, then **click** **C** Custom Fields.

**Click** the **E** edit icon next an existing user to edit the custom field; **click** the **F** Cancel button to discard any changes or, **click** the **G** Save Changes button to save any changes.




# Settings (*continued*)

## Users

Manage, add, or edit users for The Hub and CoPilot softwares from the Users view.

### Create a New User

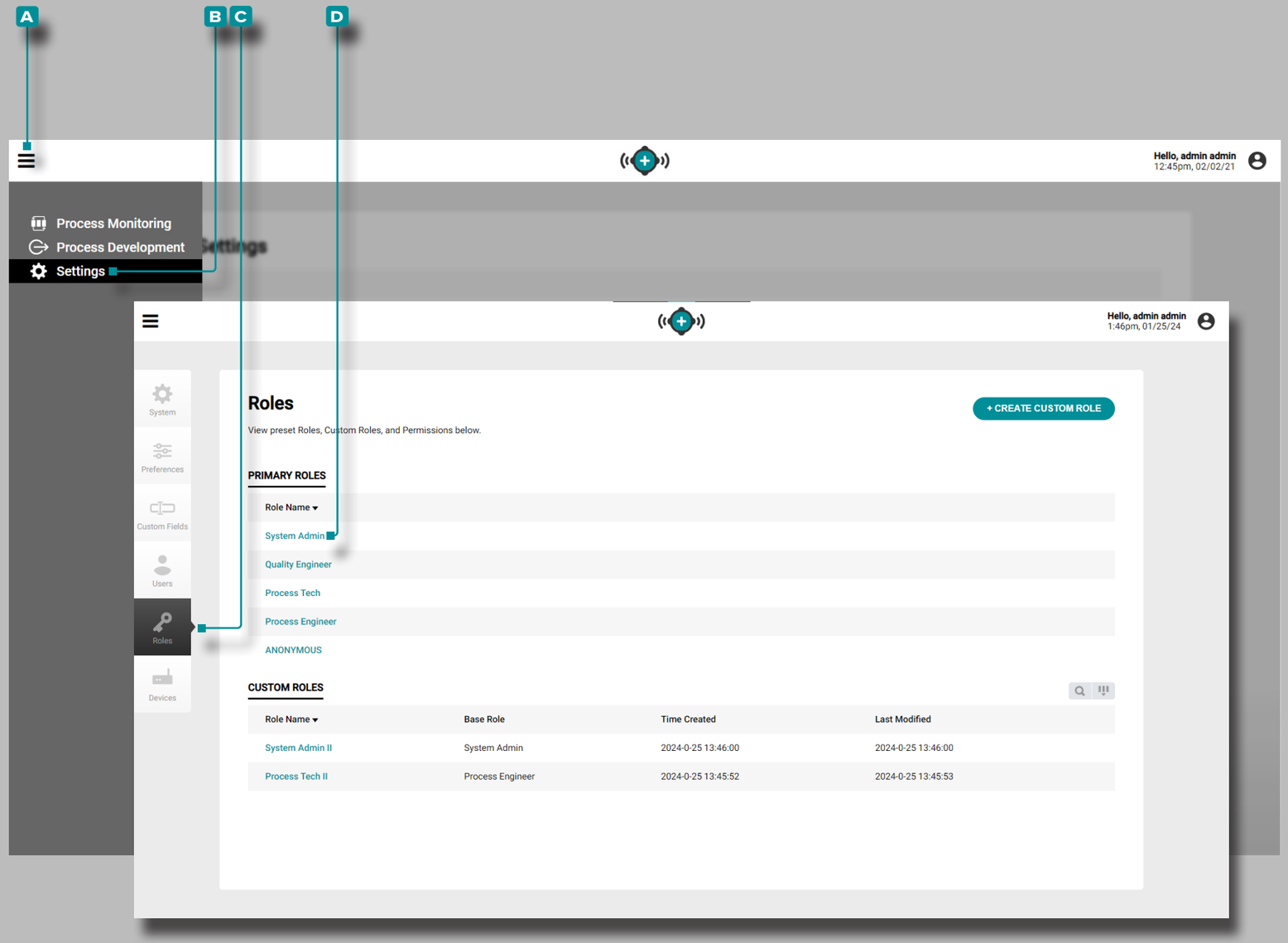
**Click** the A menu icon, then **click** B Settings, then **click** C Users.

**Click** the D Create a New User button to add a new user to the system; **enter** the required user information and select a role for the user from the drop-down menu.

### Edit an Existing User

**Click** the A menu icon, then **click** B Settings, then **click** C Users.

**Click** the E edit icon next an existing user to edit the user account; **click** the F Cancel button to discard any changes or, **click** the G Save Changes button to save any changes.




# Settings (*continued*)

## Roles

Manage, view, create, or edit user roles for The Hub and CoPilot softwares from the Role List.

**Click** the A menu icon, then **click** B Settings, then **click** C Roles. **Click** the D Role Name to view associated permissions for each Role.

## Primary Roles

The pre-defined roles System Admin, Process Tech, Process Engineer, and QC Engineer include permissions for creating, reading (viewing), editing, deleting, or other actions for each function in The Hub and CoPilot software. Primary Role Permissions

## Custom Roles

Custom Roles can be created in The Hub including permissions for creating, reading (viewing), editing, deleting, or other actions for each function in The Hub software and CoPilot system. Refer to "Create Custom User Roles" on page 102 and "Edit Custom User Roles" on page 103 for more information on custom roles.

## Permissions

Permissions are divided into three categories: Global Permissions, The Hub Permissions, and CoPilot Permissions; refer to "Global Role Permissions" on page 99, "The Hub Software Role Permissions" on page 100, and "CoPilot System Role Permissions" on page 101.

# Settings (*continued*)

## Global Role Permissions

Global permissions are any actions that can take place in either The Hub software or the CoPilot system. The table below displays the shared permissible actions for each preset role for The Hub software and CoPilot system.

| FUNCTION | QUALITY ENGINEER | SYSTEM ADMIN | PROCESS ENGINEER | ANONYMOUS | PROCESS TECHNICIAN |
|---|---|---|---|---|---|
| Advice | Read | Read | Read, Allow | Read | Read |
| Job Valve Gate Configuration | | Read | Read, Edit | Read | Read |
| Machine Setup | Read | Read | Create, Read, Edit, Delete | Read | Read |
| Material Setup | Read | | Create, Read, Edit, Delete | Read | Read |
| Mold Setup | Read | Read | Create, Read, Edit, Delete | Read | Read |
| Notes | | | Create, Read, Edit | | Read, Edit |
| Part Parents | Create, Read, Edit | Read | Create, Read, Edit | Read | Read |
| Part Samples | Read | Read | Read | Read | Read |
| Part Setup | Create, Read, Edit, Delete | | Create, Read, Edit, Delete | Read | Read |
| Process Setup | Read | | Create, Read, Edit, Delete | Read | Read |
| Sensor Lists | Read | Read | Read | Read | Read |
| Set Template | | | Allow | | Read |
| Submit Help Request | | Allow | Allow | | Allow |
| System Diagnostics | | Read | Read | Read | Read |
| System Settings | Read | Read, Edit | Read, Edit | Read | Read |
| System Timezone | Read | Read | Read | Read | Read |
| Template Match | Read | Read | Read, Edit | Read | Read |
| Templates | Read | Read | Create, Read, Edit, Delete | Read | Read |
| V2P | Read | Read | Read, Edit | Read | Read |

# Settings (*continued*)

The Hub Software Role Permissions

The Hub permissions are any actions that can take place in The Hub software. The table below displays the permissible actions for each preset role in The Hub software.

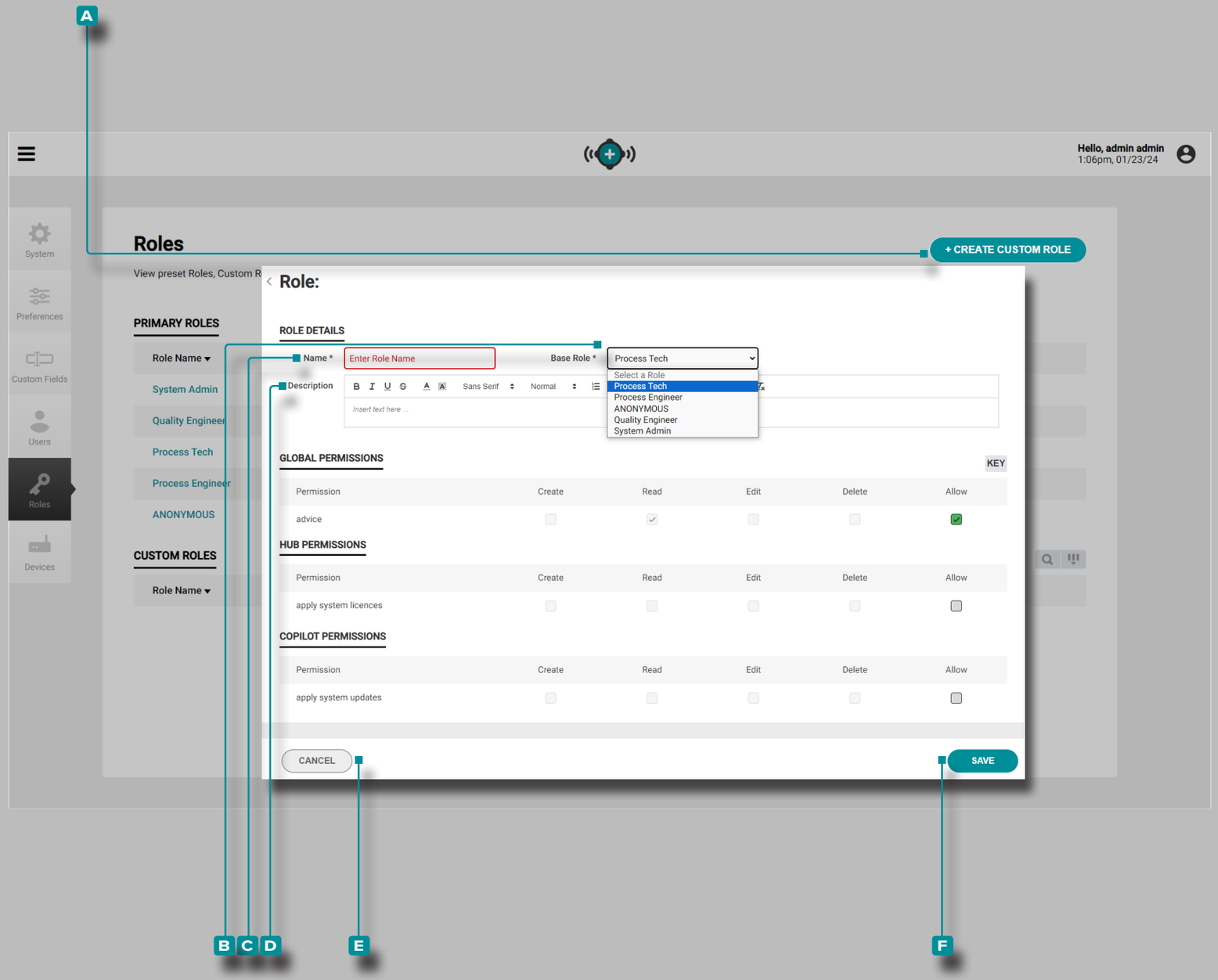
| FUNCTION | QUALITY ENGINEER | SYSTEM ADMIN | PROCESS ENGINEER | ANONYMOUS | PROCESS TECHNICIAN |
|---|---|---|---|---|---|
| Apply System Licenses | | Allow | | | |
| Apply System Updates | | Allow | | | |
| Configurations | Read | Read, Edit | Read, Edit | Read | Read |
| Critical to Quality Characteristics | Edit | | Edit | | |
| Custom Fields | Read | Create, Read, Edit | Read | Read | Read |
| Disable eDARTs | | Allow | | | |
| Disable Users | | Allow | | | |
| eDARTS | | Read | Read | | Read |
| EULA Acknowledgments | | Create | | | |
| Job Cycle Graphs | Read | Read | Read | Read | Read |
| Job Trends | Read | Read | Read | Read | Read |
| Jobs | Read | Read | Read | Read | Read |
| Jobs Summary | Read | Read | Read | Read | Read |
| Measurements | Edit | | Edit | | |
| User Roles | | Create, Read, Edit, Delete | | | |
| Users | | Create, Read, Edit | | | |

# Settings (*continued*)

CoPilot System Role Permissions

CoPilot permissions are any actions that can take place in the CoPilot system. The table below displays the permissible actions for each preset role in the CoPilot system software.

| FUNCTION | QUALITY ENGINEER | SYSTEM ADMIN | PROCESS ENGINEER | ANONYMOUS | PROCESS TECHNICIAN |
|---|---|---|---|---|---|
| Apply System Updates | | Allow | | | |
| Clear Excessive Rejects | | | Allow | | Allow |
| Configurations | Read | Create, Read, Edit | Create, Read, Edit | Read | Read |
| Cycle Advice | | | Read | | Read |
| Display Units | Read | Read, Edit | Read, Edit | Read | Read, Edit |
| Enable Injection | | | Allow | Read | Allow |
| Job | Read | Read | Read, Edit | Read | Read, Edit |
| Offline Override | | | Allow | | Read |
| Previous Cycle | Read | Read | Read | Read | Read |
| Raw Data Viewer | | Read | Read | Read | |
| Set Screw Bottom | | | Allow | | Allow |
| Sorting Options | | | Read, Edit | | Read |
| Start/Stop Job | | | Allow | | Allow |
| System Logs | | Read | Read | | Read |
| Toggle Outputs | | | Allow | | Allow |
| Toggle Part Samples | Allow | | Allow | | Allow |
| Toggle Sequencer | | Allow | Allow | | Allow |
| Zero Hydraulic Pressure | | | Allow | | Allow |




# Settings (*continued*)

## Create Custom User Roles

**ⓘ NOTE** *Only users with a designated Admin role within the software have the required permission to create custom roles.*

**ⓘ NOTE** *Up to ten (10) custom roles may be created within The Hub software by an Admin user.*

Custom Roles are created by selecting an existing base role and adapting it to create the desired permissioned role.

**Click** the **A** +Create Custom Role icon, then **click** to select the desired **B** Base Role to adapt in the drop-down menu.

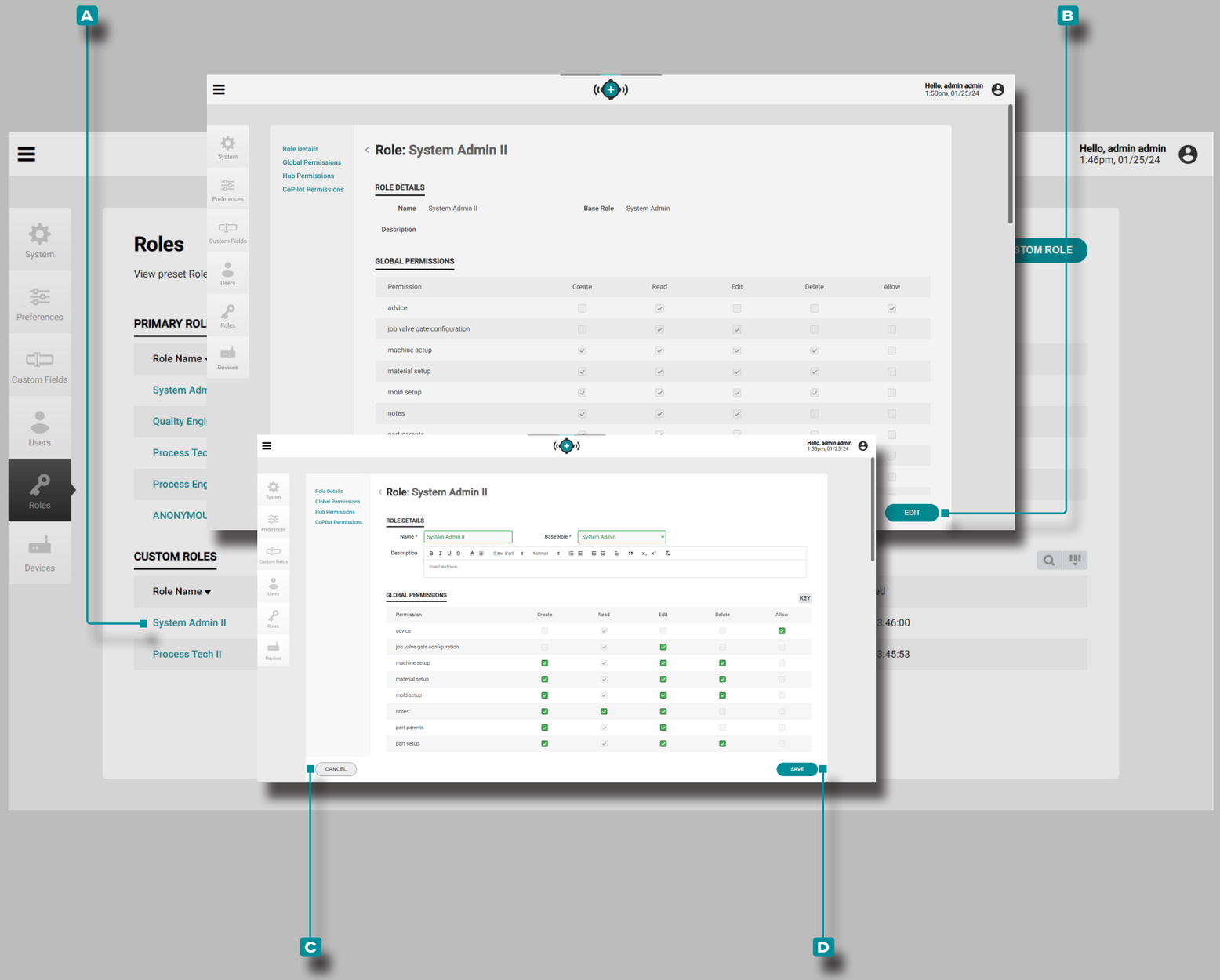
**Click** the **C** name field and **enter** the desired role name. The name can be up to 25 characters, and no duplicate names are permitted.

**Enter** a description in the **D** Description field if desired. A description is not required, and there is no character limit.

Some Global, The Hub, and CoPilot permissions are assigned or prohibited depending on the selected Base Role. If a permission is prohibited to change for the Base Role, it cannot be selected/deselected for the custom role; prohibited permissions checkboxes are greyed out . Permissions that are required are displayed in a grey checkbox with a charcoal check mark ; required permissions cannot be deselected.

Permissions that are adaptable from the base role permissions are displayed in a green checkbox with a black check mark ; permissions that are not part of the base role, but can be assigned during role customization are displayed in a grey checkbox until selected, and then are displayed in a green checkbox with a white check mark .

**Click** to select or deselect the desired Global, The Hub, and/or CoPilot permissions for the custom role. **Click** the **E** CANCEL button to cancel any changes, or **click** the **F** SAVE button to save the Custom Role.




# Settings (*continued*)

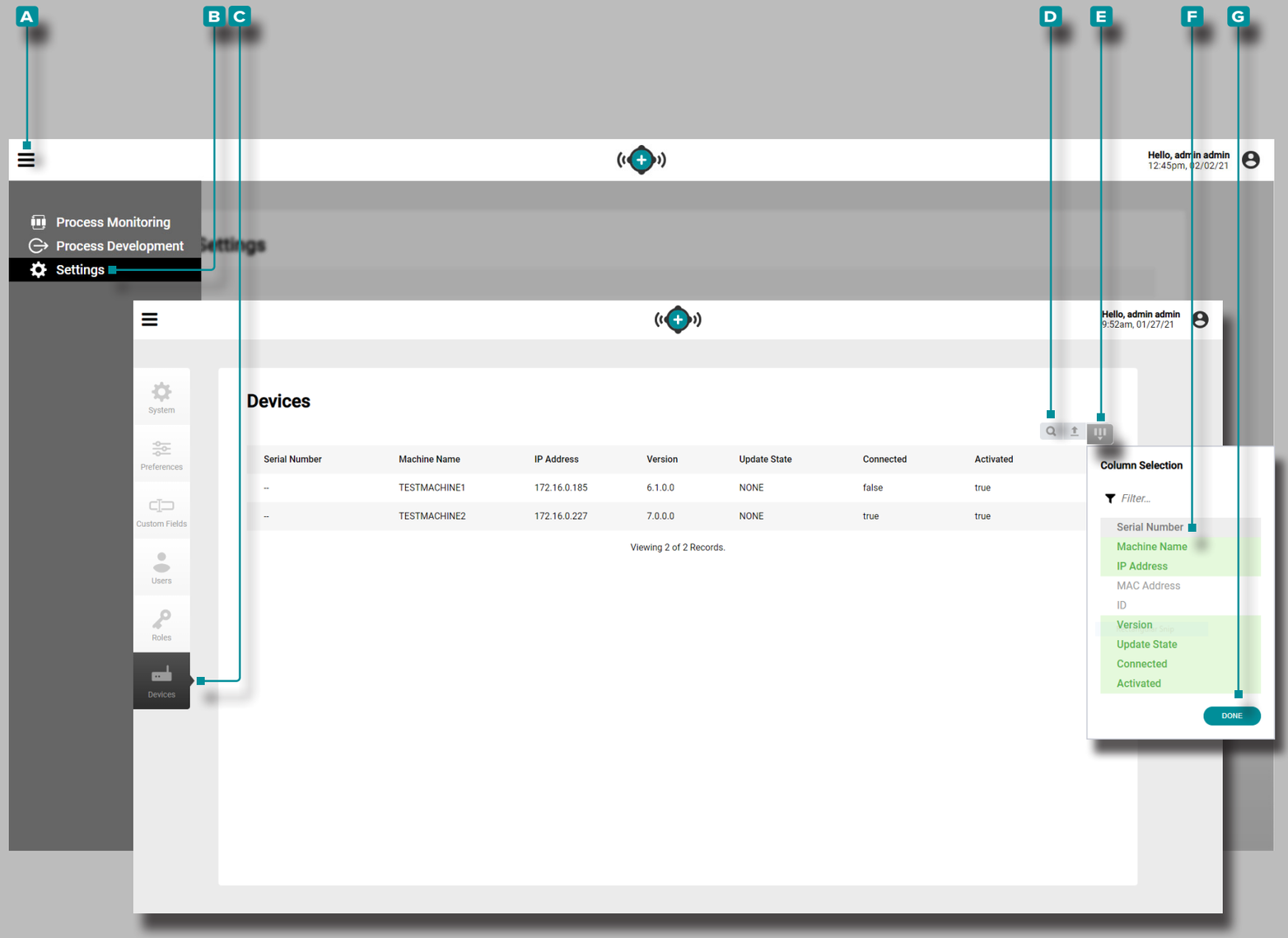
## Edit Custom User Roles

Custom Roles can be edited to include or exclude global, The Hub software, and/or CoPilot system permissions.

**Click** the **A** Custom Role to edit, then **click** to the **B** EDIT button. Edit the Name, ⓘBase Role, or permissions as desired.

ⓘ **NOTE** *If the Base Role is changed, permissions applied to the custom role previously will be deleted.*

**Click** the **C** CANCEL button to cancel any changes, or **click** the **D** SAVE button to save the changes to the Custom Role.




# Settings (*continued*)

## Devices

The Devices view provides details of each CoPilot system in the network including serial number.

The Devices view can displays up to 9 of the following device variables:

- Serial Number
- Machine Name
- IP Address
- MAC Address
- ID
- Version
- Update State
- Connected
- Activated

**Click** the **A** menu icon, then **click** **B** Settings, then **click** **C** Devices to view CoPilot system network information.

**Click** the **D** search icon to enter/search for a word or phrase among the devices.

**Click** **E** Select Columns to choose the displayed **F** variables. **Click** the **G** DONE button to save changes and exit the Select Columns pop-up window.

# Settings (*continued*)

## CoPilot Systems Updates

The connected CoPilot systems can be updated directly from The Hub, from the Devices page. Update the connected CoPilot systems as necessary for the latest bug fixes and new features.

**CAUTION** *DO NOT skip update versions; DO NOT apply a newer update if an older update is available—i. e. applying v7.2 update to a v7.0 system versus applying v7.1 update to a v7.0 system, then applying the v7.2 update. Refer to the RJG website to ensure that the correct update is applied to the CoPilot system. Failure to comply may result in errors or issues in the CoPilot software and The Hub system.*

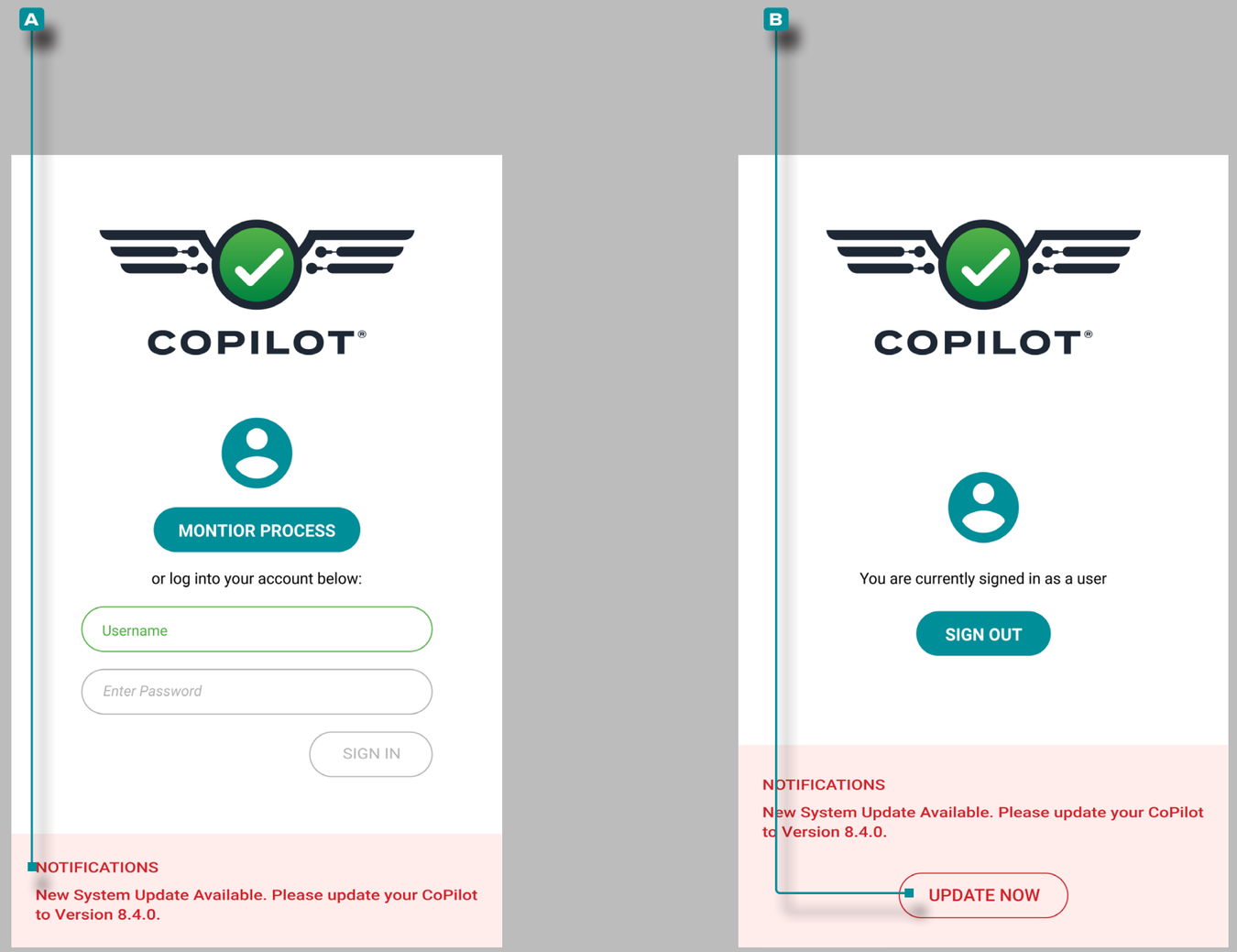
**Click** the **A** menu icon, then **click** **B** Settings, then **click** **C** Devices to view CoPilot system network information.

**Click** the **D** Update Devices button, and then **click** on the desired **E** CoPilot devices in the list to select or deselect them for update; the selected rows (devices) will turn green. **Click** the **F** UPDATE button to continue with the update

**Click** the **G** pencil icon on the slideout window, then click the **H** Choose File button. Select the update file (.UPD) from the window, then **click** the **I** Open button. **Click** the **J** UPLOAD button; wait for the upload to complete, then **click** the **K** SEND UPDATE button.

Once the status displays “Transfer Complete Success”, the update will be available on the selected CoPilot systems.

***(continued on next page)***




# Settings (*continued*)

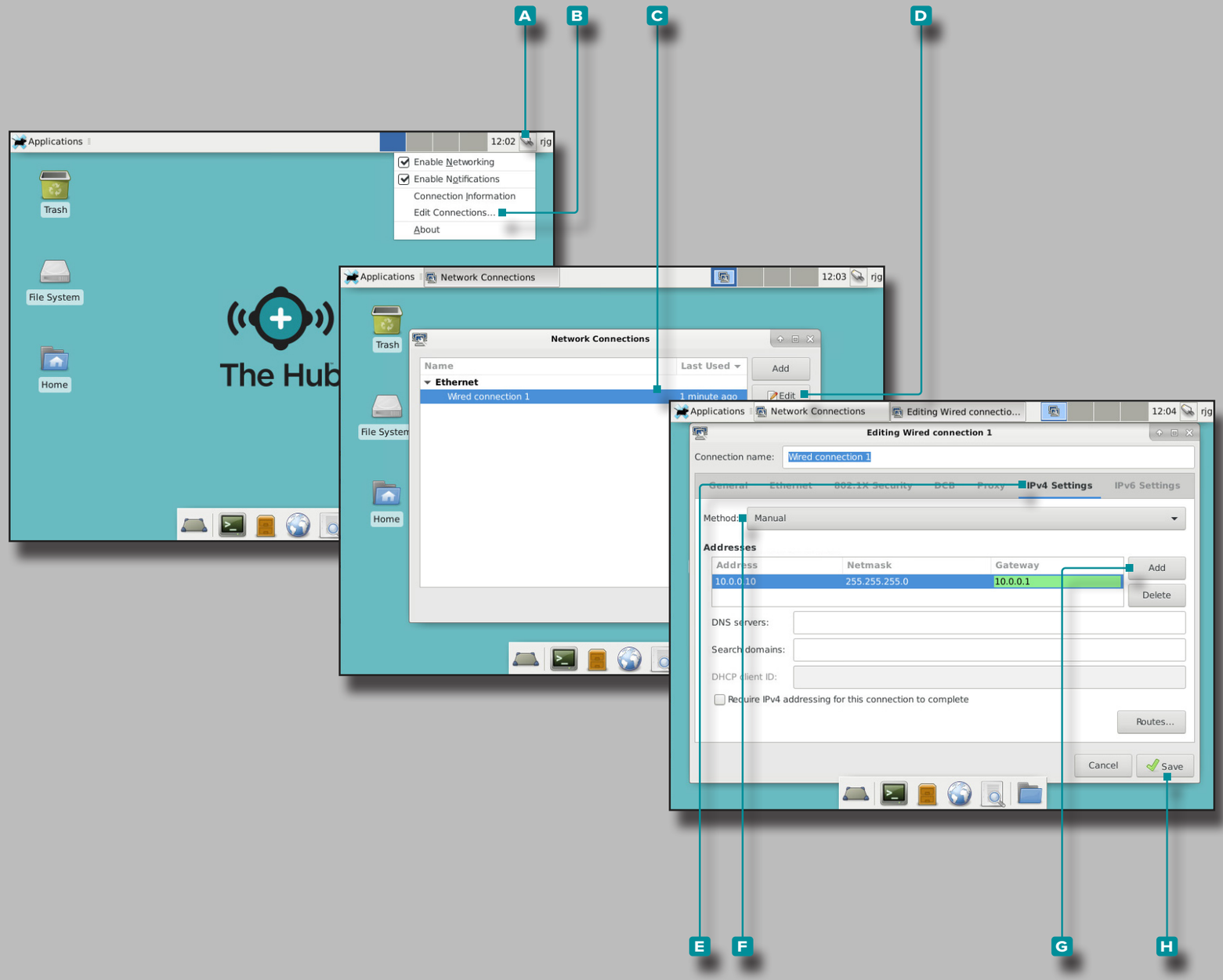
***(continued from previous page)***

The CoPilot systems that received the update will display an A update notification on the login screen. To complete the updates, sign in to each CoPilot system, then select the B UPDATE NOW button on each CoPilot system's login screen.

**CAUTION** *Each CoPilot system must be rebooted after updates are installed. Ensure the machine is stopped before rebooting each CoPilot system.*

To ensure the CoPilot update has installed successfully, refresh the Devices page on The Hub to view the current CoPilot system software version.

# Settings (*continued*)




## The Hub IP Address

The Hub IP address is preset at RJG, Inc (10.0.0.10 (IP Address) 255.255.255.0 (Subnet Mask)). The Hub Server IP address must be set in each CoPilot system configuration.

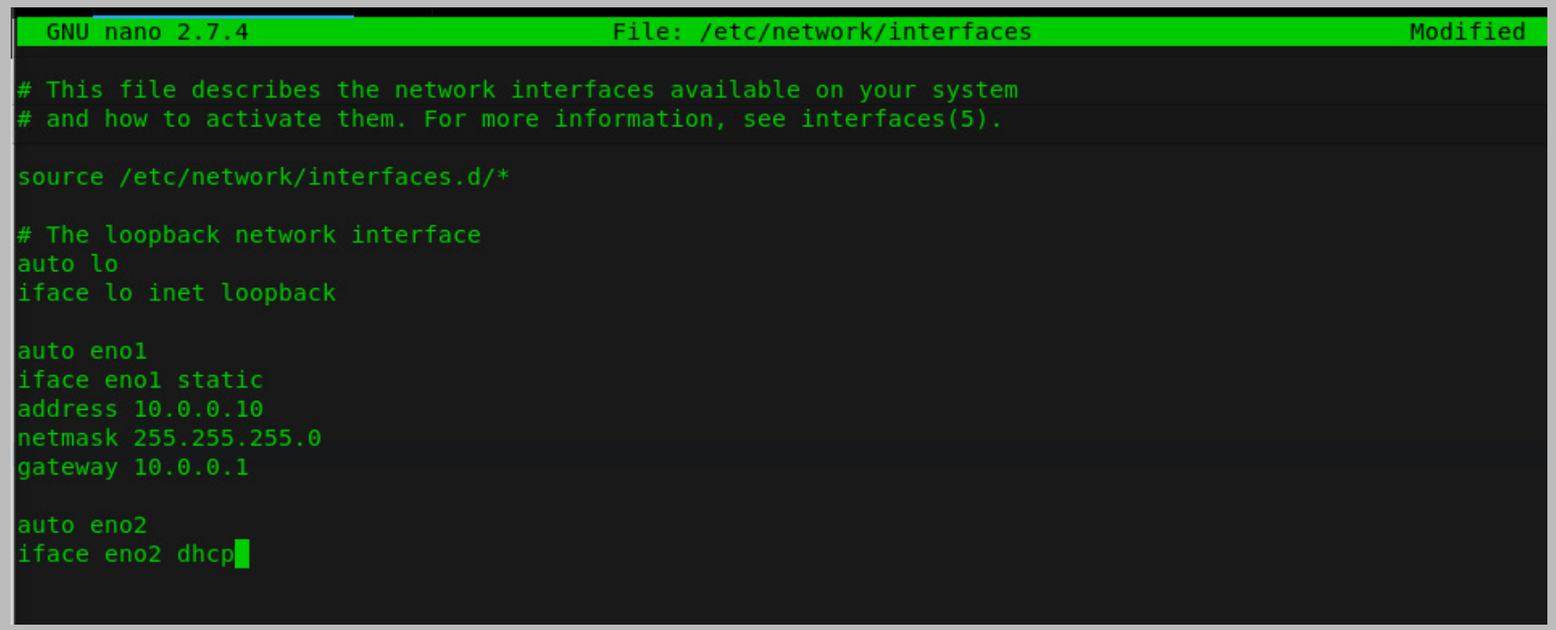
If a The Hub system network with assigned IP address exists, The Hub IP address may be changed to match the current CoPilot systems configuration; the change can be made through the graphical user interface (GUI, preferred method) or by command prompt. Read and follow all instructions to change The Hub IP address, if desired.

### Change by GUI

1. Log in to The Hub server.
2. **Click** the **A** network connection icon next to the username “rjg”, then **click** **B** Edit connections.
3. **Click** the **C** wired connection, then **click** **D** edit.
4. **Click** **E** IPv4 Settings, then **click** the **F** desired connection method; enter the Address, Netmask, and Gateway desired.

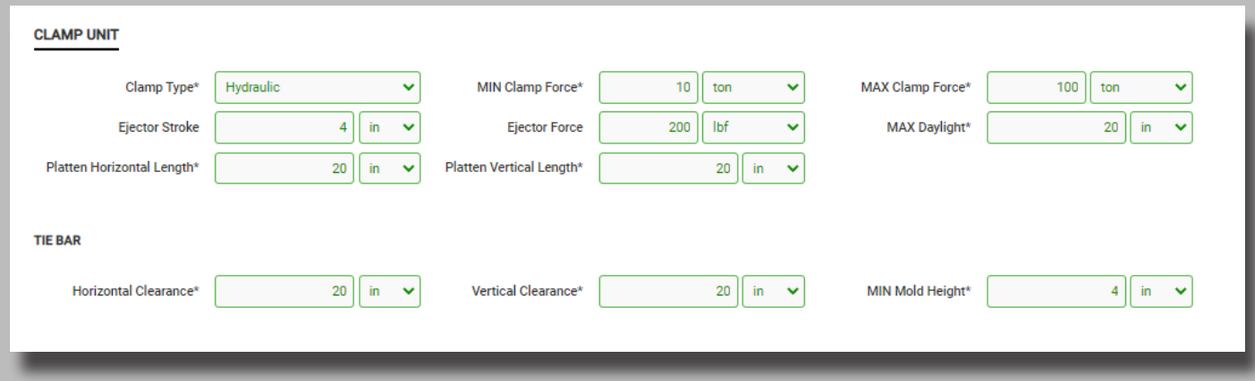
   If setting a static address, select **F** Manual and then **click** **G** add and enter the Address, Netmask, and Gateway options with the appropriate address.
5. **Click** the **H** save button to save and exit.

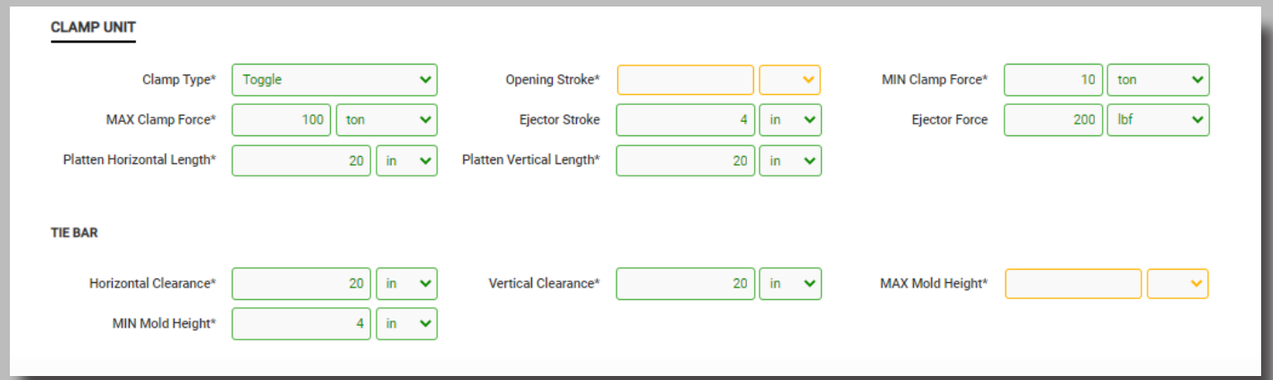
# Settings (*continued*)




Change by Command Prompt

1. Log in to The Hub application server.
2. At prompt rjg@TheHub: **enter** sudo nano /etc/network/interfaces and return/enter on the keyboard.
3. **Enter** the Address, Netmask, and Gateway desired.




# Appendix

## Mold Launch, Mold Transfer, and Simulation Support Machine Compatibility

The Launch a New Mold, Transfer a Mold, and Simulation Support tools provide a list of recommended machines for use with the selected mold based on the following user-entered machine and mold information:

- Mold Fit (vertical and horizontal tie bar dimensions, vertical and horizontal platen dimensions, minimum and maximum mold height, ejection clearance, and maximum platen daylight dimension)
- Clamp Force (process vs. machine maximum clamp force)
- Injection Rate (process vs. machine maximum flow rate)
- Injection Pressure (process vs. machine maximum injection pressure)
- Injection Capacity (process shot volume vs. machine maximum barrel capacity)

Machine compatibility is shown using the following colors:

- green indicates that one or more of a machine's capabilities is compatible and can provide the necessary process requirements;
- yellow indicates that one or more of a machine's capabilities may not be compatible with the current process requirements;
- red indicates that one or more of a machine's capabilities are not capable of providing the necessary process requirements.

The following tables detail the requirements that determine a mold and machine's compatibility/color code.

# Appendix (*continued*)

Mold Fit

| NOT COMPATIBLE/RED | NOT RECOMMENDED/YELLOW | COMPATIBLE/GREEN |
|---|---|---|
| Mold Length is greater than Machine's Tie Bar Vertical Length | Mold Length is less than 2/3 of Machine's Tie Bar Vertical Dimension | Mold and Machine are Compatible |
| Mold Width is greater than Machine's Tie Bar Horizontal Dimension | | |
| Mold Length is greater than Machine's Vertical Platen Length | | |
| Mold Width is greater than the Machines Horizontal Platen Dimension | | |
| Mold Height is less than Toggle Machine's Minimum Mold Height | Mold Width is less than 2/3 of Machine's Tie Bar Horizontal Dimension | |
| Mold Height is greater than Toggle Machine's Maximum Mold Height | | |
| Mold Ejection Clearance is greater than Machine's Clamp Stroke | | |
| Mold Die Height plus Mold Ejection Clearance is greater than Machine's Maximum Platen Day Light Dimension | | |

# Appendix (*continued*)

Clamp Force

| NOT COMPATIBLE/RED | NOT RECOMMENDED/YELLOW | COMPATIBLE/GREEN |
|---|---|---|
| Process Clamp Force is greater than Machine's Maximum Clamp Force | Process Clamp Force is greater th an 80% of Machine's Maximum Clamp Force | Mold and Machine are Compatible |
| | Process Clamp Force is less than Machine's Minimum Clamp Force | |

Injection Rate

| NOT COMPATIBLE/RED | NOT RECOMMENDED/YELLOW | COMPATIBLE/GREEN |
|---|---|---|
| Process Flow Rate is greater than Machine's Maximum Flow Rate | Process Flow Rate is greater than 80% of Machine's Maximum Flow Rate | Mold and Machine are Compatible |

Injection Pressure

| NOT COMPATIBLE/RED | NOT RECOMMENDED/YELLOW | COMPATIBLE/GREEN |
|---|---|---|
| Process Injection Pressure is greater than Machine's Maximum Injection Pressure | Process Injection Pressure is greater than 80% of Machine's Maximum Injection Pressure | Mold and Machine are Compatible |

Injection Capacity

| NOT COMPATIBLE/RED | NOT RECOMMENDED/YELLOW | COMPATIBLE/GREEN |
|---|---|---|
| Process Shot Volume is greater than 90% of Machine's Maximum Barrel Capacity | Process Shot Volume is greater than 80% of Machine's Maximum Barrel Capacity | Mold and Machine are Compatible |
| Process Shot Volume is less than 10% of Machine's Maximum Barrel Capacity | | |

# Appendix (*continued*)

## Data Import, Export, Backup, and Archival

### Overview

Users are able to move data from one The Hub system (or Copilot system) to another The Hub system, in order to send data to RJG Customer Support, OEM customers, or transferring data between plants, or mold tryout.

### File Format

Data for import, export, and backup is provided in the ZIP file format. The ZIP file format is space-efficient and allows random data access. From the ZIP file format, data is then contained in cbor data structures. This makes the data self-describing to some extent, while still being space-efficient and compatible with current data structures.

### Data Structure

The data structure is as follows:

- Job
- ChangeLogs
- JobAlarms
- JobLegend
- Notes
- Cycle
  - 0
  - 1
  - ...
- CycleData
  - 0
  - 1
  - ...
- SummaryData
  - SummaryVaribleX
  - SummaryVaribleY
  - ...
- Entities
  - Machine
  - Mold
  - Process
  - SetupSheet
  - Templates
  - EntityRevisions

### Imported Data

When a job is imported, the job data is written to disk. The job document is inserted into the database with a reference to the job file on the disk. Job data is accessed from the file instead of reading it out of the database. Entity documents can also be optionally imported, depending on the application.

### Data Access

Job documents will always be queried from the database. The only time that a job document will be read from a data file is when importing a job file. Other job data will be accessed from the data file if it is present, or from the database if it has not already been written.

If a secondary backup location has been set and the primary data file has been deleted, it will read from the secondary file instead. If the data has been removed from the database and the data file deleted, an error will be returned to notify the user to contact their network administrator to retrieve the data from the archival system. The data must then be imported to access the job data. The user will use the Data Import tool to import the data into the Hub.

### Data Backup and Archival

Data backup should be in place and used in the event of hardware failure or data loss/corruption, while data archival is intended for long-term retention.

### Data Backup

Data can be imported to The Hub system in the form of a backup file in order to restore The Hub data, or to review previously-backed-up data. When a job is complete, all relevant job data is collected and stored to disk in this file format. The job document is updated with a reference to the file on disk, which is a user-configurable location.

### Data Archival

Archived data is intended for long-term data retention. When a job is complete, all relevant job data is collected and stored to disk in this file format. The job document is updated with a reference to the file on disk, which is a user-configurable location.

### Data Retention and Cleanup

The user can configure two settings for data retention and cleanup. The first is how long that data stays in the database. This will potentially affect some queries that can be done on the data. For instance, any query that queried cycles across jobs would only work if the data was in the database. Queries on jobs will work. When a job is over the data retention date, the cycle and summary data are removed from the database and the job document is updated so that the data is no longer in the database. The job document will be retained for future access.

The second user setting is the amount of free space to reserve on the system. If there is not enough free space it will delete job data files until there is enough free space. The Hub software will not monitor or cleanup data if a secondary data location is configured. The user must ensure that there is enough space to backup data. The system must be configured with enough space to store data in the database for the retention period, and to store the data files long enough for the archival system to complete backup.

# Appendix (*continued*)

## Data Backup and Archival Implementation and Configuration

There are multiple ways that a user can configure backup and archival depending on infrastructure. Data can be stored in a folder that is shared and the location can be monitored by an external system which archives the data to a separate location.

- A backup service can be ran on The Hub that is responsible for archiving data to another location.
- A network file system (NFS) or storage area network (SAN) share can be mounted on The Hub system, and a secondary backup location can be configured for The Hub system to archive data.

## Background and Default Configuration

The user can expect the job reference information (historical run information, configuration information, and the reference to the specific ZIP file, etc.) to remain in the database but it will no longer store the historical job run data, which is generally the larger subset of data, in the database; this will be stored in the ZIP file that the job run will create; this allows the the Postgres database to be maintained without it ballooning in size.

- (Default location: /opt/rjg/datafiles)

During The Hub system's installation, the app.properties file is created, mapping out the default Postgres database settings. The Data Backup configuration is also automatically generated inside of the app.properties file and can be modified by the IT Administrator to customize the Data Backup feature to the organization's needs.

- The app.properties file is located in the ESM Jetty directory. (/opt/rjg/esm-jetty/config/app.properties)

An example of the Data Backup default configuration is shown here:

postgres.address=127.0.0.1
postgres.port=5432
postgres.user=postgres
postgres.password=postgres
#backup.primaryPath=/mnt/sdb
#backup.secondaryPath=/mnt/nfs
#backup.reserveSpace=1000000000
#backup.databaseExpire=180

## Data Backup Switches and Configuration

To change the default Data Backup configuration on The Hub, uncomment and modify the necessary configuration switches in the default configuration file.

An example of the new default configuration with Data Backup is shown, here:

#backup.primaryPath=/mnt/sdb
#backup.secondaryPath=/mnt/nfs
#backup.reserveSpace=1000000000 #1GB of file space
#backup.databaseExpire=180 #180 days

- **backup.primaryPath**: This is the primary data backup storage location should a user change away from /opt/rjg/datafiles
- **backup.secondaryPath**: This is the secondary, or archive, data backup storage location. (The primaryPath copies the data to the secondaryPath and is often used as something like an external thumb drive, HDD, etc.)
- **backup.reserveSpace**: This is the space reserved, in bytes, for updates and running data to be allocated on the system. (The default is 1GB of data)
- **backup.databaseExpire**: This is the number of days before job data is removed from the database. (The default is 180 days)

**Customers will contact Customer Support for implementation.**

ⓘ **NOTE** *If the default configuration is left untouched but the user specifies the secondaryPath, the data will be defaulted to /opt/rjg/datafiles while the /opt/rjg/esm-jetty/config/app.properties secondaryPath mapped location will receive the backed-up copy.*

ⓘ **NOTE** *When the primaryPath and secondaryPath are set, the data inside of the primaryPath is automatically copied to the secondaryPath location.*

ⓘ **NOTE** *When the backup.reserveSpace is exceeded, the system will delete the larger and newest files, first.*

## Overview

Most characteristics of injection molded parts can be predicted or "correlated" to in-cavity variables. Correlations between part quality characteristics and in-cavity variable can be found by determining which characteristics are important, which variables can be used to change the part and how, doing an experiment (part sampling), and measuring the parts.

There are three basic levels of part quality characteristic problems:

- **Level One**—Characteristics that can be seen without measurement.
  **Part Quality Characteristic Problems**: short shots, flash and some sinks.
- **Level Two**—Characteristics that usually do not destroy the part in the measurement, but are not visible.
  **Part Quality Characteristic Problems**: dimensions, weight, warp, balance, and others.
- **Level Three**—Characteristics that usually require destructive testing.
- **Part Quality Characteristic Problems**: strength (tensile, compressive, impact), chemical resistance, and others.

Part quality characteristic problems can be controlled by the in-cavity variables—or "Four Plastics Variables"—melt temperature, flow rate, pressure, and cooling (rate and time).

## Planning a Part Quality Characteristic to Process Data Correlation Experiment

ⓘ **NOTE** *Plenty of literature and courses exist on designed experiments that may be more efficient or advanced techniques than those described in the following text.*

**1.** Choose Important Part Quality Characteristics

Level one part quality characteristics can and often are remedied simpy by stabilizing a process and setting alarms above and below the average for peaks or integrals. Level two and three part quality characteristics are less obvious and require a correlation study.

**2.** Determine Measurement of Part Quality Characteristics

Ensure that measurement equipment and techniques are accurate and repeatable. The results of a "Gage Repeatability Study" will ensure measurements will be valid. The resolution and accuracy must exceed the tolerance requirements by a minimum factor of 3. Find a way to assign numeric inputs to each (for example, how much chemical resistance is necessary). If parts require any post-molding stabilization, make sure it is repeatable.

Test the measurement plan on some parts to verify it works, and to determine how much time it takes.

**3.** Determine which Plastic Variables Affect the Chosen Part Quality Characteristics

- Dimensions
  Pressure (usually seen in cycle integrals, or sometimes pressure drop); or sometimes cooling rate and time in semi-crystalline.
  Melt temperature and mold temperature are important in crystalline materials. Flow orientation affects dimensions in glass filled materials (affected by gate sequencing).
  Back pressure and screw design can also affect glass-filled materials by cutting up the fibers.
- Weight
  Pressure including packing, and then discharge after pack, or at end of hold (not controlled).
- Warp
  Cooling rate, pressure (static pressure loss)—gate sealed or not (or amount of seal), and temperature.
- Texture
  Flow (cavity fill times) during the first part of pressure (fill and pack times and integrals).
- Crystallinity (and properties affected by it)
  Cooling, melt temperature, and mold temperature.
- Level 3 Part Quality Characteristic
  Contact material supplier for many level 3 part quality characteristics (impact resistance, etc).

Time constraints can limit the number of variables chosen, so pick those most likely to work. If correlations are weak but show promise, then run another study to zero-in on the important variables.

**4.** Know and Maintain the Process

RJG, Inc. recommends that a DECOUPLED MOLDING® process is used, whether DECOUPLED MOLDING® I, DECOUPLED MOLDING® II, or DECOUPLED MOLDING® III. It is also important to know if there is gate seal or gate discharge. Know the process and maintain it throughout the testing phase and beyond.

**5.** Determine Test Level and Number

Usually two test levels are sufficient: “Low” and “High”. A “Medium” level may be needed if the correlation is expected to not be a straight line (something with a “bow” in it), or just as an additional measure.

**6.** Machine Adjustment for In-Cavity Variable Adjustment

**It is difficult or even impossible to adjust anything on the machine in order to affect only one plastic variable at a time.**

Plastics Variables are interdependent in various degrees. For example, if fill time is increased, but the mold opens at the same time in the cycle, then it will result in decreased cooling time for the last area of the part to fill. Therefore, though it is not standard practice in Design of Experiments to change more than one variable at a time, it might be necessary to change two machine variables in order to effectively change just one plastics variable.

Beware of “orthogonal arrays” on machine variables, as it can result in changing all plastic variables on every run. Suppose flow rate was the variable to be changed; faster flow rates tend to fill the part farther due to compression. To achieve the same fill-only part, both fill speed and the V→P1 and V→P2 position (DECOUPLED MOLDING III) on the machine (or transfer position for DECOUPLED II) in order to change the flow rate—without affecting the pressurization portion of the cycle at the same time.

This concept applies particularly to transfer position (DECOUPLED MOLDING II) or slow-down position (DECOUPLED MOLDING III). When changing fill speeds, always go back to a short shot and make adjustments to the in-cavity position (by weight) to match the value discovered on shorts before changing the speed.

Another key objective is to not destroy the process by changing things that modify the essential elements of DECOUPLED MOLDING (if that is the process setup). Otherwise, if the process is excessively “coupled”, several or all plastics variables could be changing with change to one machine setting.

**7.** How Much to Change Each Value

Choose melt temperature and mold temperature based on manufacturer’s recommendations for molding, for final part quality (for eample, final part working temperature in semi-crystalline materials), or simulation. For variables such as flow rate and pressure, if unsure what limits to set, use the steps in "Sampling Parts to Make Correlation Data", "6. Choose Process Limits" on page 116 set the limits. These are done once the process is running. Simulations can also be used to suggest limits.

**8.** Assign a Name to Each Sample Group

A sample “group” is a sample of parts with the same settings. For each chosen plastics variable (for example, mold temperature) there may be two groups, making four sample groups total, shown as follows:

- Group 1: pressure (high) at temperature 1
- Group 2: pressure (low) at temperature 1
- Group 3: pressure (high) at temperature 2
- Group 4: pressure (low) at temperature 2

It is useful to name the runs using the level and the variable, for example: “High P” for “High Pressure”, or “High P/Low T” for “High Pressure, Low Temperature”. It is common practice to write the number or letter on the physical parts and also keep a reference document that lists them.

**9.** Order the Group Samples By Execution of the Experiment

For example: It takes quite some time to change a melt temperature by adjusting the barrel temperatures. Try to do all pressure and flow group changes first, then change the melt and do pressure or flow at the lower temperature. This will save much more time than changing temperature at each group. Start with faster speeds, higher pressures. Start with lower temperatures. It takes longer to go down than up.

**10.** Determine the Number of Samples per Group Sample

It is beneficial to take extra samples for each group if the time is available (for example, fairly fast cycle times); all of the samples may not need to be measured, but the samples will be at hand if needed. For longer cycle times, take at least two to three samples in a group.

## Sampling Parts to Make Correlation Data

Before starting, ensure the following is/are in order:

- Decide how the parts will be labeled. Ensure that labeling does not interfere with the part characteristics or later measurements (markings obscuring a feature or deforming the part).
- Collect supplies—markers, bags, tags, and other materials.
- Plan part handling, especially with fast cycles and hot runners. Have a place for each group, and lay the bags out in order.
- Plan to stabilize the parts after molding) in the way it will be done during production (cooling, or other processes).

**1.** Start the process using standard techniques (DECOUPLED MOLDING I, DECOUPLED MOLDING II, DECOUPLED MOLDING III, or other).

**2.** Stabilize the process in fully-automatic.

**3.** Set the fill volume on the CoPilot system at the slow-down to pack (DECOUPLED MOLDING III), or transfer (DECOUPLED MOLDING I).
This will provide accurate records for fill speed/flow rate and viscosity, as well as other variables.

**4.** Choose the sensor and pressure level that represents a full cavity.
Usually, this is 1,000 psi at the end of the cavity, but if sensors are only at Post Gate or Mid Cavity, then change the sensor location and level as appropriate to create good data for cavity fill time and balance.

**5.** Choose the sensor and percent of peak that represents a fully-packed cavity.
If all sensors are Post Gate, then the default Post Gate is acceptable. If sensors are Mid Cavity or End of Cavity, then change the sensor location as appropriate. If the pressure curves have very gradually rising tops lower the percentage for pack to ensure it does not pick up 98% at the wrong point.

**6.** Choose Process Limits

If not already chosen, determine the limits by adjusting the process as described below. This is only necessary if it is unknown how much variation the process can handle without becoming unstable or exceeding the capabilities of the machine. It is not necessary to use the maximum limits in order to get good correlation.

**A.** Build a centered process that can withstand reasonable variation in the values chosen above.

**B.** Save a template for the centered process.

This helps to ensure that the process is stabilized between runs.

**C.** Change the settings until one or more of the following occurs:

- Parts are visually unacceptable (short, flash, blush, etc.)
- Anything causes cycle breaks, such as nozzle drool (mold protect), parts sticking, or difficulty ejecting.
- Speeds or pressures exceed the machine's capability (for example, pressure limiting fill or pack), or the capability of any machines on which the process is expected to run.
- The machine ceases to perform as instructed (for example, will not control speed or pressure, nozzle leaks).
- The process is no longer robust (for example, not decoupled—fill is so fast that the flow front reaches the end of the cavity before slow-down) or stable due to low viscosity from slow fill rates.

**D.** Choose levels just inside these limits to have the widest possible window for testing. However, from experience it may be known that certain values of cavity variables are unacceptable—if so, then narrow the limits accordingly.

**E.** Record the chosen setting levels with each sample group as defined in "Planning a Part Quality Characteristic to Process Data Correlation Experiment", "7. How Much to Change Each Value" and "8. Assign a Name to Each Sample Group" on page 115. Record each limit for each control parameter (machine, temperature, V→P transfer etc.) that will be changing.

**F.** Return the process to the centered process and ensure that the data matches the template from "**6.** Choose Process Limits", "**B.** Save a template for the centered process." on page 116.

**7.** On the CoPilot system, perform the following:

**A.** Create a note on the Summary Graph.
Include the purpose, equipment in use (machine, cooler, etc.), initial machine settings, and similar part sample settings.

**B.** Check for stability on the Summary Graph; effective viscosity/fill, cavity pressure integrals, mold temperature minimums, screw run time, cycle time, and average value/back pressure are useful data to check. The machine or auxiliaries can cause instabilities that can affect the results—look for trends or cycling in the data.

**C.** On the Part Sample widget, enter the name of the group (this would be the short name that you created in "Planning a Part Quality Characteristic to Process Data Correlation Experiment", "8. Assign a Name to Each Sample Group" on page 115). Enter details in the notes area.

**D.** Start the group sample. Do not save parts until instructed by the part sample widget. Always dump any accumulated parts until "Take Next Sample" is displayed. If the "Reject Samples" switch is on with a part diverter, then all sampled parts will go into the reject chute.

**E.** Do not press “Cancel Samples” unless the Part Sample widget was mistakenly started. Wait until all part samples are completed.

**8.** Bag, number, or label the sample parts in each group with the sample number and group name.

**ⓘ NOTE** *Do not stop the press between samples. It must run continuously to retain stability.*

**9.** Optionally, return the process to the centered process before changing settings for the next run. Check the template to ensure it matches the one saved in "Planning a Part Quality Characteristic to Process Data Correlation Experiment", "6. Choose Process Limits", "B. Save a template for the centered process." on page 116 to prevent changes that would affect the experiment.

**10.** Adjust the process for the next run, and repeat steps 7.C.–9. Repeat for each sample group.

## Evaluate the Data

**1.** Record Part Sample Measurements
Measure the part samples and record the measurements in the part sample record on The Hub software (refer to "Enter Part Measurements" on page 45).

**2.** Find Correlations and Set Alarms
Refer to "Start a Correlation Study" on page 36.

**ⓘ NOTE** *If all of the measured parts fall within specification then the alarm limits can be set to the values of the in-cavity variables discovered in "Planning a Part Quality Characteristic to Process Data Correlation Experiment", "6. Choose Process Limits" when limits were set for the experiment.*

**3.** Adjust the Process
After alarms are set, adjust the process up and down to ensure that bad parts are sorted properly.

# Choosing Alarm Settings with the CoPilot System and The Hub Software

## Overview

The CoPilot system monitors process data using in-mold and machine sensors and machine sequence inputs. Alarms and sorting actions can be set for parts which fall outside of the alarm limits (high/above and low/below) in process data. The following describes alarms, alarm limits, and setting alarm limits to detect bad parts.

## Choosing Alarms

The CoPilot calculates values using cycle data and sequence input information over time—called summary values—and displays them on the Summary Graph (the Summary Graph can display multiple summary values per sensor). The Summary values include a type category (for example, sequence time) and a location category (such as Fill time). Choose which summary values to set alarms on the CoPilot system.

**1.** Alarms for Quality Issues

Determine what types of quality issues to detect using alarms. Different cavity pressure values do a good job of checking for different quality issues. For example, “Peak, Cavity Pressure” works better for predicting flash, while “Process Time, Fill and Pack Time” (the time it took to fill and pack the part out) works better for predicting surface texture, especially in filled materials. To test whether or not a value predicts part quality, refer to "Finding Part Quality/Process Data Correlations with the CoPilot System and The Hub Software" on page 114.

Once the quality issues to be monitored are determined, use the tables in "Summary Values for Settings Alarms" on page 121 to choose the summary values on which to set alarms.

**2.** Quantity of Alarms

Determine criticial to quality (CTQ) part characteristics and difficultly in maintaining part quality. In simple applications, only one set or more of alarms may be needed; in difficult applications, more alarms may be needed—as many as six or seven. To satisfy multiple quality issues (such as dimensions and texture), additional alarms will be needed. In general, minimize the number of alarms initially, then add more later if trouble catching problems persists. Using too many alarms can cause false alarms and confusion, especially if there is a lack of experience using alarms.

**3.** Alarm/Sensor Location

**In general, the best place to monitor (set alarms) is at the end-of-cavity** (this may not be true if a potential problem is far from the end-of-cavity).

In most cases, place the sensor in or near the area of influence. This is the area where the last material is flowing through the part at the end of the filling stage. To find the area of influence, run a clear or natural colored material, and then switch to a dark or colored material. On the first shot with the new material, the path that it makes will be the area of influence. Sometimes a sensor will not fit in that area; if not, get as close as possible to that area, and stay out of regions that stop flowing very early in the filling process.

If there are multiple sensors, it is okay to put alarms on all of the sensors.

## Choosing Alarm Limits

The following are three different approaches on how to choose alarm levels.

- **Approach 1:** Estimate Alarm Limits Settings and Adjust as Necessary

  How it works: Rough estimates are used at process start, and then refined during normal production.

  Advantages: This is the simplest approach for setting alarm limits.

  Disadvantages: This may be the slowest, least-accurate approach, unless it is used in conjunction with approaches 2 or 3.

- **Approach 2:** Alarm Limits for When Parts May Be Different than Before

  How it Works: A stable process is chosen, and alarm limits are set to activate when the process changes significantly.

  Advantages: This approach keeps process capability high.

  Disadvantages: This approach does not sort good parts from bad.

- **Approach 3:** Alarm Limits When the Parts are Probably Bad

  How it Works: An experiment is ran to determine what alarm levels will sort good/bad parts.

  Advantages: This approach prevents bad parts from being shipped.

  Disadvantages: This approach does not catch process shifts until bad parts are being produced.

### Approach 1: Estimate Alarm Settings and Adjust as Necessary

Establish preliminary rough estimates of alarm limits and refine them during normal production. This approach does not allow alarms to be quickly stable unless either Approaches #2 or #3 are used in conjunction. Otherwise, it will take a while before alarms are optimized. During production, monitor parts that are rejected and adjust the alarms according to the analysis of the parts.

Perform the following steps:

**1.** Establish Preliminary Alarm Limits

Set preliminary alarms on each summary value; choose arbitrary alarm values. Generally, it is better to set the alarms tight and gradually loosen them than to set them loose and gradually tighten them.

**2.** Monitor Alarm Parts During Production

Periodically check the Reject bin for alarm parts. When parts are found in the Reject bin, inspect them (either all or a relatively large sampling).

Determine which summary values caused the alarms—these summary values are the ones that will be changed—use the following to adjust alarms:

- If none of the parts are bad, widen the alarms that were triggered the most.
- If a few of the parts are bad, widen the alarms that were triggered.
- If many of the parts are bad, tighten all the alarms slightly.
- If most of the parts are bad, tighten all the alarms considerably.
- If the result is somewhere between few and many bad parts, do not change the alarms.

Any time bad parts get into the Good bin, tighten all the alarms.

- If a few bad parts get into the good parts bin, tighten the alarms slightly.
- If many bad parts get into the good parts bin, tighten the alarms considerably.

Keep adjusting the alarms until few alarm parts are bad, and no bad parts get into the good parts bin. Ideally, no bad parts are sorted into the good parts bin, even if a few good parts are sorted into the bad parts bin.

### Approach 2: Alarm Limits for When Parts may be Different than Before

A stable process is chosen, and alarm limits are set to activate when the process changes significantly. This approach keeps process capability high, but does not sort good parts from bad.

Perform the following steps:

**1.** Select Data from a Stable Process

Allow the process to stabilize; in most cases, this will take anywhere from 15 minutes to 1 hour. Watch the summary graph to see when stabilization occurs. Let the process run until there are at least 100 or more datapoints. There must not be any “outlying” datapoints—anything that is above or below the normal process.

Zoom in on the data in the stable region.

**2.** Set an Alarm on the First Summary Value

Choose the first summary value to set an alarm on (refer to "Summary Values for Settings Alarms" on page 121). Open the Alarm Settings widet on the CoPilot system, and follow the instructions found in the CoPilot System Software User Guide to set alarms using sigma. The Alarm Setting widget automatically defaults to 4.5 σ (sigma), but can be changed.

**3.** Repeat for Each Summary Value to Set Alarms On

Set alarms to catch any parts when the process changes considerably from normal range. To catch any small variations, set alarms with a smaller window to +/- 3 σ.

## Approach 3: Alarm Limits When the Parts are Probably Bad

**1.** Plan the Experiment

ⓘ **NOTE** *Select one quality characteristic to focus the experiment on, and only two or three cavity pressure values.*

Determine which machine setting will have the largest effect on the quality of the part (for example, part measurements). In many cases, this is hold pressure. This the 'experimental factor'; other common factors include fill speed, mold temperature, or melt temperature.

Determine which summary values to use for alarms (refer to "Summary Values for Settings Alarms" on page 121).

**2.** Run the Experiment

With the process running stably, adjust the experimental factor (machine setting) until the parts are no longer acceptable.

Observe and record the values for the cavity pressure values that will be used for alarms; these values will be the lower alarm points.

Repeat the previous step, but adjust the experimental factor in the opposite direction. Observe and record the values for the cavity pressure values that will be used for alarms; these values will be the upper alarm points.

**3.** Enter Alarm Settings into the CoPilot System Software.

The alarms should be conservative—a little tighter than the initial alarm points. Bring each of the alarm points in about 1/3 of the way to the centered process. While a few good parts may still get to the bad parts bin, be sure that no bad parts make it into the good parts bin.

Follow the instructions for entering alarm settings described in detail in Approach 1; the only difference being that the high and low alarm settings are entered manually.

Following this approach, alarms will reject parts that are likely bad, but the alarms are likely conservative. Some good parts may be sent the the bad parts bin, but no bad parts will enter the good parts bin.

Optionally, once alarms are set, verify the parts by adjusting the process until alarms occur on the high and low ends. Check/measure/inspect the parts to verify how close the desired dimensions/other characteristics are to the specification limit.

ⓘ **NOTE** *This is the simplified approach to setting alarms. RJG, Inc. offers in-depth classes for systematic injection molding including molding strategies, design strategies, part troubleshooting, and process & production management.*

## Setting Alarm Limits

Refer to the CoPilot System Software User Guide for instructions on setting alarms in the CoPilot system software.

## Summary Values for Settings Alarms

Once the quality issues to be monitored are determined, use the following tables to choose the summary values on which to set alarms. Each table contains values to use for cavity pressure (preferred) and hydraulic and stroke (if cavity pressure is not available). The summary values are ranked in order of preference in each table (first listed is usually the best at predicting part quality).

### Detecting Short Shots

#### Cavity Pressure

- Peak, EOC (low alarm)
- Peak, PG
- Peak, MID
- Cycle Integral, EOC (low alarm)
- Cycle Integral, PG
- Cycle Integral, MID
- Fill and Pack Time (high alarm)

#### Hydraulic and Stroke

- Peak, Shot Volume (± 6 σ)
- Cycle Integral, Shot Volume (± 6 σ)
- Effective Viscosity, Fill (high alarm)

### Detecting Sinks

#### Cavity Pressure

- Peak, EOC (low alarm)
- Cycle Integral, EOC (low alarm)
- Cycle Integral, PG
- Fill and Pack Time (high alarm)

#### Hydraulic and Stroke

- Peak, Shot Volume (± 6 σ)
- Cycle Integral, Shot Volume (± 6 σ)
- Effective Viscosity, Fill (high alarm)

### Detecting Flash

#### Cavity Pressure

- Peak, Any Cavity Sensor
- Fill and Pack Time (low alarm)

#### Hydraulic and Stroke

- Peak, Shot Volume (± 6 σ)
- Cycle Integral, Shot Volume (± 6 σ)
- Effective Viscosity, Fill (low alarm)

### Detecting Texture

#### Cavity Pressure

- Fill and Pack Time (low alarm)
- Pack Rate
- Cavity Fill Time
- Peak, Any Cavity Sensor

#### Hydraulic and Stroke

- Value at Fill→Pack Transfer, Volume
- Value at Pack→Hold Transfer, Volume
- Effective Viscosity, Fill
- Peak, Shot Volume (± 6 σ)
- Cycle Integral, Shot Volume (± 6 σ)

### Detecting Dimensions

#### Cavity Pressure

- Cycle Integral, EOC
- Cycle Integral, PG
- Peak, Cavity Pressure
- Injection Integral, Cavity Pressure

#### Hydraulic and Stroke

- Peak, Shot Volume (± 6 σ)
- Cycle Integral, Shot Volume (± 6 σ)
- Effective Viscosity, Fill (high alarm)
- Peak, Hydraulic Injection
- Value at Pack→Hold Transfer, Injection Pressure
- Value at Fill→Pack Transfer, Injection Pressure or Shot Volume

### Detecting Check Ring Leakage

#### Cavity Pressure

- Process Time, Cavity Fill
- Fill and Pack Time (high alarm)

#### Hydraulic and Stroke

- Peak, Shot Volume
- Cycle Integral, Shot Volume

### Detecting Thin Wall Part Characteristics (other than texture)

#### Cavity Pressure

- Fill and Pack Integral, EOC
- Fill and Pack Integral, other Cavity Pressure
- Peak, EOC
- Fill and Pack Time

#### Hydraulic and Stroke

- Peak, Shot Volume (± 6 σ)
- Effective Viscosity, Fill
- Fill and Pack Integral, Shot Volume (± 6 σ)
- Value at Pack→Hold Transfer, Injection Pressure or Shot Volume
- Value at Fill→Pack Transfer, Injection Pressure or Shot Volume

### Detecting Stresses and Molecular Orientation

#### Cavity Pressure

- Fill and Pack Time
- Cavity Fill Time
- Fill Shear Rate at Transfer
- Static or Dynamic Pressure Loss, PG to EOC
- Static or Dynamic Pressure Loss, Injection to PG

#### Hydraulic and Stroke

- Fill Time
- Value at Pack→Hold Transfer, Shot Volume

# Finding Alarm Settings with the CoPilot System and The Hub Software (continued)

## Detecting Blocked Cavities

### Cavity Pressure

- Range, PG Peak
- Range, EOC Peak
- Cavity Fill Time

### Hydraulic and Stroke

- Peak, Shot Volume (± 6 σ)
- Cycle Integral, Shot Volume

## Detecting Mold Balance

### Cavity Pressure

- Balance, Cavity Fill Time
- Balance, Cavity Pack Time
- Balance, EOC
- Balance, other Cavity Peak

### Hydraulic and Stroke

- Not Applicable

## Detecting Crystallinity

### Cavity Pressure

- Cooling Rate, any Cavity Sensor
- Cycle Integral, any Cavity Sensor

### Hydraulic and Stroke

- Average Value, Mold Surface Temperature

## Detecting Core Deflection

### Cavity Pressure

- Peak, Core Deflection
- Cycle Integral, Core Deflection

### Hydraulic and Stroke

- Effective Viscosity, Fill
- Fill Time

## Detecting Warp

### Cavity Pressure

- Cooling Rate, any Cavity Sensor
- Gate Seal, PG
- Static or Dynamic Pressure Loss, PG to EOC
- Fill and Pack Time
- Cavity Fill Time

### Hydraulic and Stroke

- Fill Time
- Pack Time
- Injection Forward Time

## Detecting Mixing Consistency

### Cavity Pressure

- Not Applicable

### Hydraulic and Stroke

- Average Value, Back Pressure
- Screw Run Time

## Detecting Viscosity Changes

### Cavity Pressure

- Static or Dynamic Pressure Loss, PG to EOC
- Static or Dynamic Pressure Loss, Injection to PG
- Value at Fill→Pack Transfer, PG

### Hydraulic and Stroke

- Effective Viscosity, Fill
- Screw Run Time

## Detecting Gate Seal

### Cavity Pressure

- Gate Seal, PG

### Hydraulic and Stroke

- Injection Forward Time

## Detecting Machine Operation Consistency

### Cavity Pressure

- Not Applicable

### Hydraulic and Stroke

- Fill Time
- Cycle Time

## Detecting Setup Consistency

### Cavity Pressure

- Cycle Integral, any Cavity Sensor

### Hydraulic and Stroke

- Fill Time
- Injection Forward Time
- Cycle Time
- Screw Run Time
- Value at Fill→Pack Transfer, Volume
- Average Value, Hold Pressure
- Average Value, Back Pressure
- Average Value, Fill Flow Rate
- Average Value, Pack Flow Rate
- Decompression, Shot Volume

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