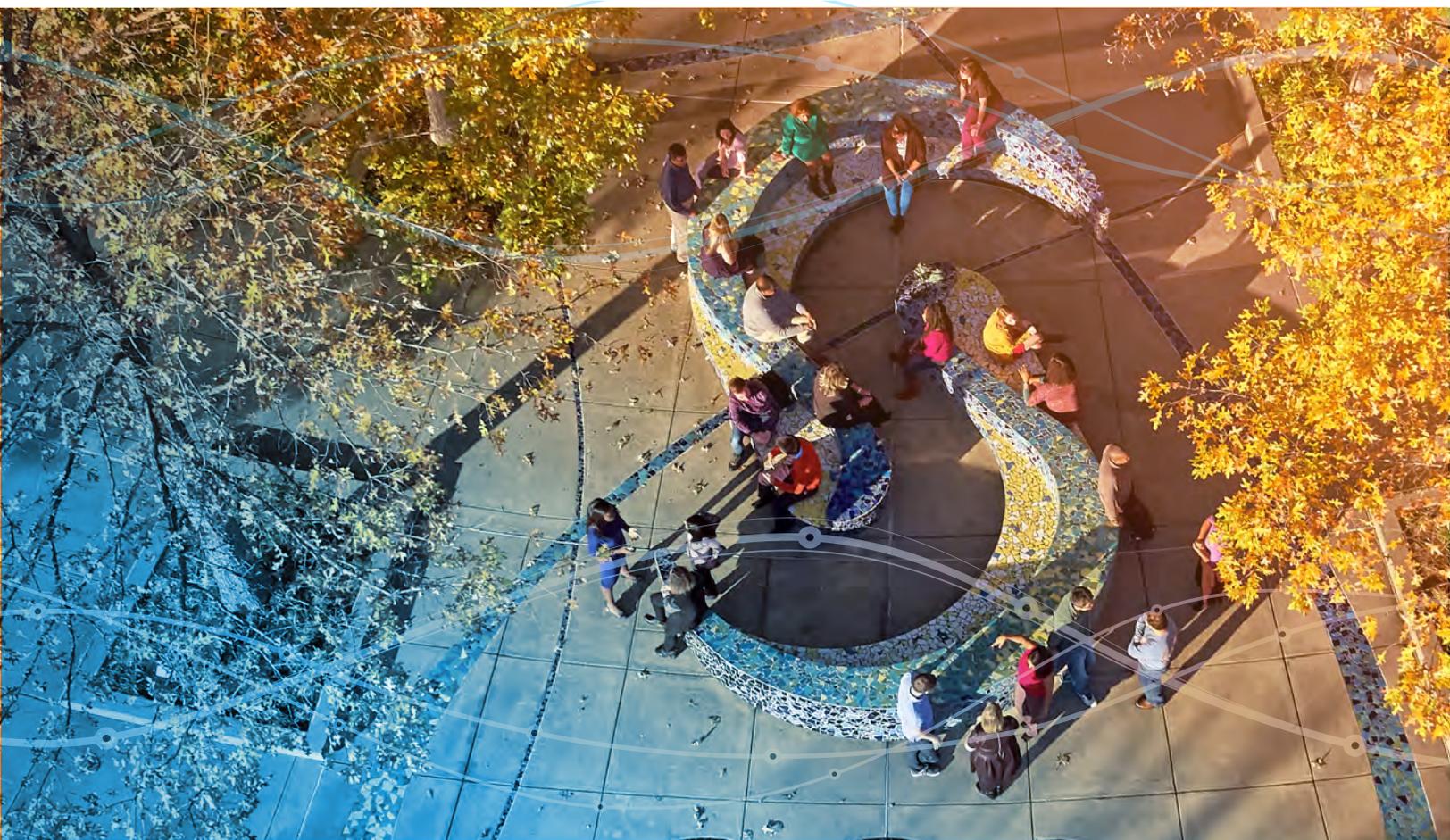# The Quality Imperative:
SAS Institute's Commitment to Quality

A corporate statement of SAS' commitment to product quality, service quality, and customer satisfaction

Appendix 3: Installation and Operation Qualification for SAS® 9.4

Appendix 3: Installation and Operation Qualification for SAS® 9.4

SAS 9.4 includes three qualification tools, the SAS Installation Qualification Tool (SAS IQ), the SAS Operational Qualification Tool (SAS OQ), and the SAS Deployment Tester, to help customers verify installation and test the operation of SAS at their sites. These tools provide a consistent, repeatable process for verifying the initial installation and future updates to SAS while also providing a framework for running customer-written tests. Output of SAS IQ and SAS OQ includes a data file that contains the test results and output formatting options. SAS Deployment Tester generates an online report of the success of each test run.

Background

Originally, these tools were conceived as testing tools to assist with the internal testing of the installation processes. However, the feature set has been broadened to allow distribution to customers. The SAS Qualification Tools (SAS IQ and SAS OQ) that are delivered to customers are the same tools that are used in the testing and qualification of the SAS®9 installation software. SAS Deployment Tester was designed to test the complex configuration of the SAS 9.4 Intelligence Platform, although any of the SAS OQ tests or customer-written tests can be run using this tool.

Customer Considerations

The SAS Installation Qualification tool (SAS IQ) assists regulated customers in demonstrating compliance and qualifying the installation. SAS IQ can be used as part of the installation process, as an interim check on the state of the SAS System, and as an automated tool to maintain an audit history. The SAS Operational Qualification tool (SAS OQ) also assists in demonstrating compliance and includes tests that are designed to be included in operational qualification. SAS OQ can be used as part of the initial qualification process and as an automated tool to maintain a history when changes are made to the SAS installation. SAS Deployment Tester runs SAS OQ tests and tests for SAS 9.4 Intelligence Platform.

SAS customers need to install SAS on appropriate hardware and software according to the installation instructions. When running SAS®9 or later, customers should run the SAS IQ and SAS OQ tests after installation. Customers should then write procedures that document how SAS is used at their site. Any systems that they have built using SAS might need to be validated with each new SAS release. Many companies do this by running the programs at the earlier release, and then running the tests at the new release and comparing results.

SAS Professional Services and Delivery can provide support to customers, including drug sponsors and contract research organizations, on validation efforts. Consultants take steps such as these:

• Gather user and functional requirements and prepare validation documentation inclusive of validation plans, test protocols, and test scripts.

• Install and configure SAS software according to the instructions and alert notes that are delivered by SAS as part of the software shipment.

• Execute IQ, OQ, and Performance Qualification (PQ) according to approved plans and test scripts.

- Provide knowledge transfer to IT staff and end users on the above, recommending formal SAS training where needed.
- Provide project management for all the above activities.

Operation

The testing process for the installation of SAS 9.4 has three phases. The first phase is the initial installation process on the target platforms. The second phase is the execution of the SAS Installation Qualification Tool (SAS IQ). The third phase is the execution of the SAS Operational Qualification Tool (SAS OQ) or SAS Deployment Tester.

Phase 1

During this phase, SAS is installed at the customer site. Customers should follow the installation instructions provided in their packages—or see the online instructions provided on the SAS Install Center (**http://support.sas.com/documentation/installcenter/**).

Phase 2

SAS IQ assists you in demonstrating that the SAS System has been installed and maintained to the manufacturer's specifications. SAS IQ verifies the integrity of each file in SAS®9 and provides the customer a set of reports detailing the results. To execute SAS IQ, follow the instructions in **http://support.sas.com/documentation/installcenter/en/ ikinstqualtoolug/66614/PDF/default/qualification_tools_guide.pdf**.

Phase 3

SAS OQ assists you in demonstrating that the SAS System is operational. SAS OQ uses SAS programs provided by the component development groups and will execute, process, and report the program results. To execute SAS OQ, follow the instructions in **http://support.sas.com/documentation/installcenter/en/ikinstqualtoolug/66614/PDF/ default/qualification_tools_guide.pdf**.

SAS Deployment Tester is a diagnostic tool used for assessing a SAS 9.4 Intelligence Platform deployment. After an installation or upgrade, you can use SAS Deployment Tester to ensure that your SAS software and critical server components have been installed and configured correctly. To learn more about the SAS Deployment Tester, including prerequisites for use, how to add tests, and how to use the Deployment Tester, see **https:// go.documentation.sas.com/doc/en/bicdc/9.4/bisag/ n1c1m0fm7gxs54n104kqx33wqgo7.htm**.

Content

The content of the testing tools is generated within the R&D community. During the weekly build process, a data file is created that contains the md5sum values for each file that is used by SAS IQ for each target platform. These values are validated over the course of weekly testing by several testing groups in R&D. The test cases and test tables used by SAS OQ and SAS Deployment Tester are developed by the testing groups that are responsible for the SAS®9 component. The tables and tests are executed and validated on all target platforms during weekly testing by several testing groups in R&D.

Verification of Test Results

Customers can create new tests that fit their unique needs. A test can be constructed in several ways. There are general approaches to determining the result of a test:

- Human verification
- Programmatic verification
- Self-verification

Human verification of a test is the least efficient of the approaches. This method requires that a person visually inspect the results of a test including the SAS log, the SAS output, and the return code from the SAS application. It is time-consuming and very repetitive work to go over the same text files again and again. This can lead to incorrect results interpretation after just a few iterations.

Programmatic verification means that a test program, such as a SAS program, cannot reliably determine its own result status, so it needs additional programs that run after it is completed to help determine the result.

Filtering and comparing with a benchmark is a classic and common example of programmatic verification. When this method is used, the output file is filtered to remove non-deterministic data, of which the current date and time are good examples. Then the filtered version of the output file is compared against a benchmark file in a byte-by-byte manner. If the filtered output file matches the benchmark, then the test is deemed to have passed. Otherwise, the test has failed. Benchmarks are problematic in that they require frequent maintenance, host-specific versions, and filtering, which could result in test failures that are not real. These failures require that resources be allocated to analyze the differences and decide whether there is a problem with the program being tested, whether a new benchmark needs to be created, or whether some addition or change to the filter needs to be made. However, programmatic verification is very reliable and requires no special programming skills other than filtering to create the filtered output file.

The self-verification approach means writing a test program that can reliably determine whether the feature being tested worked and then reporting that through a simple return code. Self-verification avoids all the problems of benchmarking and produces very reliable, durable, low-maintenance test ware, but it does require additional, up-front investment and programming skills. Tests must be carefully written to make sure that passing results are accurate.

SAS has put a lot of effort into writing as many as possible of the supplied SAS OQ tests in a self-verifying format. We suggest that users follow our example and try to do the same. Here are some suggestions, tips, and best practices.

Every SAS DATA step, procedure, and global statement should set the value of at least one of the automatic SAS macro variables from this list: SYSERR, SYSRC, SYSLIBRC, SYSFILRC, SYSLCKRC, and SYSINFO. Users should check these macro variables in their test programs at every opportunity.

PROC COMPARE can be used effectively to validate many procedures. Any procedure that can produce a SAS data set as output can be reliably validated by directly constructing a SAS data set with the variables and values that are expected to be generated. Users can execute a simple DATA step with DATALINES input to accomplish this or any number of straightforward DATA step techniques. Then they can use PROC COMPARE to verify that the procedure-generated data set matches the one that they've created by hand. The result can be quickly checked by looking at the SYSINFO macro variable.

Other Notes

Customers often need to establish a baseline for their tests in a prior SAS release and then verify the results in a new SAS release. The SAS OQ provides a clear migration path for customers who are concerned about moving to a new release of SAS.

Both SAS IQ and SAS OQ are supported for the Windows and UNIX operating environments in SAS®9. SAS IQ and SAS OQ can be used only with files that are provided through the normal R&D delivery process for SAS®9 and later. For example, hot fixes applied by using the normal R&D install process are verified regardless of the delivery mechanism. Files that use post-processing methods, such as ZIP or TAR archives, cannot be verified.

Release Information
The version of this paper is January 2022.

Unless otherwise indicated, this document relates only to SAS 9.4, SAS Viya, and the products that are available with SAS 9.4 and SAS Viya. It also relates to services from the date of this paper forward. Quality processes are continually evolving. Therefore, SAS reserves the right to modify the processes described in this document at any time. If you are using SAS 9.4 and SAS Viya and have questions about processes in those releases, send email to **qualitypaper@sas.com.**

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