Office of the Director of National Intelligence

STONESOUP

Securely Taking On Software of Uncertain Provenance

Intelligence Advanced Research Projects Activity

IARPA

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STONESOUP
Phase 3 Test and Evaluation Report
24 December 2014

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EXECUTIVE SUMMARY

BACKGROUND

The Intelligence Advanced Research Projects Activity (IARPA) STONESOUP (Securely Taking On New Executable Software Of Uncertain Provenance) program was a 51-month effort consisting of three phases. Phase 1 included a base period of 18 months along with a 3-month extension period, Phase 2 covered a period of 15 months, and Phase 3 was an optional period of 15 months. Continuing into the option period depended on Performer performance and Test & Evaluation (T&E) performance, the availability of funding and IARPA priorities.

The goal of STONESOUP Phase 3 program was to eliminate the effects of vulnerabilities in software applications by (a) extending the scope and capability of approaches for analysis, confinement, and diversification; (b) addressing a wide range of security vulnerabilities within the same framework; and (c) integrating approaches to leverage the strengths and weaknesses of each. The advance sought was to provide comprehensive, automated techniques for vulnerability reduction in software of uncertain provenance. Planned to be executed in three phases over 51 months, the program completed test and evaluation of Phase 3 progress during July-November 2014.

Phase 3 performers were those that made significant progress in Phase 2 as measured by the program metrics and those that understood and contributed to the goals of the STONESOUP program. Performers that offered only minor enhancements to the current state of the art were not invited to continue with the program.

Three performer teams were selected to enter into Phase 3. The primes for the three teams and the names of their developmental tools are:

- Columbia University – MINESTRONE
- GrammaTech, Incorporated – PEASOUP
- Kestrel Institute – VIBRANCE

The STONESOUP Broad Agency Announcement (BAA) specified the program's intent to address eight weakness classes in three software languages. **Table ES-1** shows the combinations chosen in Phase 3 by software class.

Table ES-1 Weakness Classes Mapped to Language and Common Weakness Enumerations

Weakness Class	# CWEs	
	Java	C/Binary
Number Handling	8	9
Tainted Data	4	N/A
Error Handling	8	N/A
Resource Drain	8	11
Injection	6	4
Concurrency Handling	15	16
Memory Corruption	N/A	17
Null Pointer Error	N/A	1

In order to quantitatively evaluate the tools' performance, at the beginning of Phase three, a team consisting of TASC, Ponte Technologies (PonteTec), Information Systems Worldwide (i_SW), and Lawrence Livermore National Laboratory selected suitable software applications and injected a target weakness to be rendered unexploitable during Phase 3.

In Phase 3, one evaluation metric was the scalability of each proposed technology with respect to handling larger code bases, determined by a Source Lines of Code (SLOC) count.

Methods for counting lines of code are inherently controversial—a perfect method does not exist. For STONESOUP, physical lines of code, not counting whitespace or comment-only lines, were used.

Evaluation related to code size were accomplished progressively as STONESOUP moved through its different phases. The maximum code size of a test case increased for each phase:

- For Phase 1, test cases used Base Programs (a.k.a., base test programs) up to 10,000 lines of code.
- For Phase 2, test cases used Base Programs up to 100,000 lines of code.
- For Phase 3, test cases used Base Programs with up to 2,200,000 lines of code (note: Test and Evaluation [T&E] chose base programs for Phase 3 to achieve an average of 500,000 lines of code).

The T&E team ran each test case under two conditions – one with no STONESOUP tool present (e.g., Stage-One) and one with the performer-developed mitigation tool under evaluation present (e.g., Stage-Two). The test cases are a bundle, a compressed archive file, which includes, among other things, the complete base program source code, including any necessary libraries and build instructions, for an application with an identified target weakness.

Ultimately, the Phase 3 test corpus comprised a total of 9876 test cases distributed roughly across the 12 software-weakness suites chosen by the software class. In order to run these thousands of test cases and maintain the program schedule, the T&E team used Amazon Web Services (AWS) virtual machine instances (i.e., cloud technology). The T&E team leveraged AWS to execute test cases across as many as 277 independent virtual machines simultaneously. In total 449,150 hours (over 51 years) of compute time was used between April and December 2014 – at a cost of approximately $230,000.

RESULTS

This table summarizes the BAA Goals and the overall Phase 3 Results.

Table ES-2 Overall Phase 3 Results

Metric	Target	Phase 1 Goal	Phase 2 Goal	Phase 3 Goal	Phase 3 Results
% Test Cases Successfully Processed	Software Class A (Java)	100%	100%	100%	99.6%
	Software Class B (C, C++)	90%	90%	90%	99.8%
	Software Class C (x86 Binary Executables)	75%	75%	75%	100%
% Seeded Vulnerabilities Rendered Unexploitable (of successful Test Cases) With No Altered Functionality	First 2 Weakness Classes	75%	90%	95%	Columbia = 28.8% GrammaTech = 39.8% Kestrel = 82.0%
	Second 2 Weakness Classes	N/A	80%	95%	Columbia = 22.0% GrammaTech = 55.8% Kestrel =78.3%
	Final 2 Weakness Classes	N/A	N/A	90%	Columbia = 14.3% GrammaTech = 27.1% Kestrel =75.3%
% Increase in Running Time	All	N/A	N/A	10%	Columbia=472.7% GrammaTech=18.5% Kestrel =11%

PERCENTAGE OF SUBMITTED TEST CASES SUCCESSFULLY PROCESSED:

- Columbia (C) successfully processed 2623 out of 2623 test cases – 100 %
- GrammaTech (Binary) successfully processed 1954 out of 1958 test cases – 99.8 %
- Kestrel (Java) successfully processed 2755 out of 2766 test cases – 99.6 %.

PERCENTAGE OF SEEDED VULNERABILITIES RENDERED UNEXPLOITABLE:

- Columbia passed 571 out of 2,623 test cases for a passing rate of 21.8% +1.4/-1.3% at a 0.90 confidence level.
- GrammaTech passed 818 out of 1,954 test cases for a success rate of 41.9% +/- 1.8% at a 0.90 confidence level.
- Kestrel passed 2166 out of 2,755 test cases for a success rate of 78.6% +/- 1.3% at a 0.90 confidence level.

RESULTS BY PHASE EACH WEAKNESS CLASS WAS INTRODUCED

Table ES-3 summarizes the overall performance of weaknesses introduced in each phase and how each performer fared when these weakness classes were tested in Phase 3.

Table ES-3 Overall Results of Weaknesses Introduced Per Phase

Phase/Performer	Total Test Cases	Passed	% Passed
Introduced Phase 1	**2503**	**1289**	**51.5%**
Columbia	902	260	28.8%
GrammaTech	660	257	38.9%
Kestrel	941	772	82.0%
Introduced Phase 2	**2501**	**1317**	**52.7%**
Columbia	846	186	22.0%
GrammaTech	733	409	55.8%
Kestrel	922	722	78.3%
Introduced Phase 3	**2328**	**949**	**40.8%**
Columbia	875	125	14.3%
GrammaTech	561	152	27.1%
Kestrel	892	672	75.3%
Grand Total	**7332**	**3555**	**48.5%**

Figure ES-1 illustrates the phase each weakness class was introduced for each performer, and how each technology performed when these weakness classes were tested in Phase 3. For example, the Command Injection weakness class was introduced for VIBRANCE (Kestrel) in Phase 1, and in Phase 3, 85.7% of the test cases passed. For PEASOUP the Command Injection weakness class was introduced in Phase 1, and passed 64.0% of the test cases. For

MINESTRONE the Command Injection weakness class was introduced in Phase 3 and it passed 22.7% of those test cases in Phase 3.

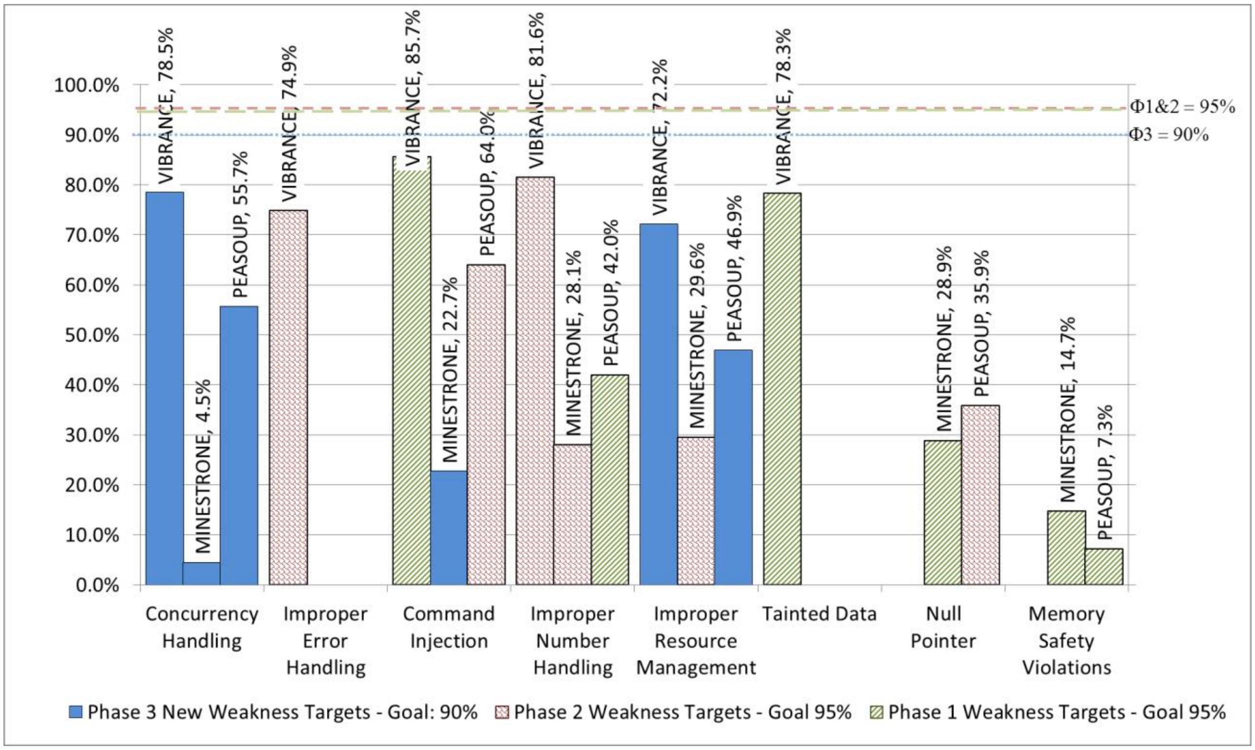

Figure ES-1 Overall Results of Weakness Classes Introduced Per Phase

PERCENTAGE INCREASE IN PERFORMANCE EXECUTION TIME:

- ▶ The overall average increase in processing time for Columbia’s MINESTRONE was 472.7%
- ▶ The overall average increase in processing time for GrammaTech’s PEASOUP was 18.5%
- ▶ The overall average increase in processing time for Kestrel’s VIBRANCE was 11%

OBSERVATIONS

Percentage Of Submitted Test Cases Successfully Processed: Kestrel came close to meeting the goal of 100% test cases processed only skipping 11 out of 2766 test cases. Columbia and GrammaTech exceeded processing goals.

Percentage Of Seeded Vulnerabilities Rendered Unexploitable: The Phase 3 goal for seeded vulnerabilities rendered unexploitable was 90%. None of the performers met that goal overall, however Kestrel surpassed that goal for four out of six of the base programs tested, however, when evaluated by weakness class the results fell below the goal.

Percentage Increase In Execution Time: The goal for acceptable increase in execution time was 10%. None of the performers met that goal, however Kestrel came closest at 11%.

ACKNOWLEDGMENTS

Members of the TASC-led Test and Evaluation (T&E) team who contributed to the STONESOUP test and evaluation activity during Phase 3 were:

TASC Inc.

- Jim Wedertz (T&E Lead)
- David Carrott, PhD
- James "Chip" Hughes
- Vern Milholen
- Sherrill Neese
- James "JT" Thomas
- Ray Williams

Information Systems Worldwide (i_SW)

- Peggy Bates (IV&V Lead)
- Aryeh Berkowitz
- Jenn Casler
- Jeffery Gross
- Robert Pierce

Ponte Technologies (PonteTec)

- Paul Cohen
- Brian Green
- Michael Heber
- Ted Hesselroth
- Geoffrey MacGill (Test Data Generation Lead)
- Tyler Montier
- Bruce Potter (PonteTec CTO)
- Dalton Schaadt
- Zachary Simonetti (TEXAS Lead)
- Ben Smith
- Tim Webster
- Sasha Wood
- Joseph Zelanis

Independent Consultant

- Jeff Foster, PhD (IV&V)

Members of the test case generation team from **Lawrence Livermore National Laboratory (LLNL)** who worked in expanding the ROSE compiler framework were:

- Dan Quinlan, PhD (ROSE Lead)
- Markus Schordan, PhD
- Justin Too
- Robb Matzke

Members from **Rice University** who assisted LLNL in expanding the ROSE compiler were:

- Phillipe Charles, PhD
- Vivek Sarkar, PhD

The MITRE Corporation during their tenure as Lead Test and Evaluation Coordinator managed the Phase 2 source documents, which the Phase 3 Test and Evaluation team utilized in developing some of the Phase 2 documentation.

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1.0 Introduction

The Securely Taking On New Executable Software Of Uncertain Provenance (STONESOUP) program was a 51-month Intelligence Advanced Research Projects Activity (IARPA) program that aimed to eliminate the effects of vulnerabilities in software applications. The STONESOUP program relied on a test and evaluation activity to help determine whether a proposed technology is making progress toward program goals. **Table 1-1** shows the significant T&E events that occurred during Phase 3.

This section summarizes the information from the following document(s), and it is recommended that the reader reference this documentation for more information:

- Test and Evaluation Plan (T&E Plan)

Table 1-1 Significant Events

Event	Date(s)
Kick-Off Meeting for STONESOUP Phase 3 with Performers at Joint Principal Investigator Meeting (Baltimore MD)	11-12 Dec 2013
Performer Site Visits	18 Feb – 27 Mar 2014
Test & Evaluation eXecution & Analysis System (TEXAS) Version 1.0	13-May-2014
Performers' Integration Testing with TEXAS	1-13 May 2014
Dry Run 1	14-17 May 2014
TEXAS Version 2.0	14-Jul-2014
Performers' Integration Testing with TEXAS	15-27 Jul 2014
Dry Run 2	28 Jul – 1 Aug 2014
Performer Site Visits	18-28 Aug 2014
TEXAS Version 3.0	23-Sep-2014
Performers' Integration Testing with TEXAS	11-23 Sep 2014
Dry Run 3	24 Sep – 3 Oct 2014
TEXAS Version 4.0 (Final)	18-Oct-2014
Manual Testing to check for altered functionality	1-31 Oct 2014
Final Test Case Generation	22 Sep – 7 Nov 2014
Performers' Integration Testing with TEXAS	19-31 Oct 2014
Final Test & Evaluation	3-30 Nov 2014
Present preliminary Final T&E results to Performers at Joint Principal Investigator Meeting (Charlottesville VA)	19-20 Nov 2014
Package NIST Technology Transition materials	31-Dec-2014
Final Test & Evaluation Report	31-Dec-2014

1.1 Program Background

Many recently developed source and object code scanners, both research and commercial, have demonstrated that they can find thousands of security vulnerabilities, including null pointer errors, buffer overflows, race conditions, format string vulnerabilities, and others. However, in detecting these issues today's tools often produce a large number of false positives – trouble reports that do not actually correspond to vulnerabilities. To reduce the rate of false positive reports to an acceptable level, tools typically discard reports that algorithms indicate are relatively unlikely to cause trouble – consequently introducing false negatives (vulnerabilities that should be reported, but are not).

Finally, these tools are designed for software developers to use. They produce error reports that are typically understandable only to programmers, and remediating a detected problem usually requires modifying the program source code, which is not a task end users can easily undertake.

While source and object code analysis tools have been making great strides, two other complementary technologies have also been advancing: approaches to confine security vulnerabilities, and approaches to diversify software to make unknown vulnerabilities harder to exploit.

Confinement refers to any mechanisms that are put in place to mitigate known vulnerabilities and prevent those vulnerabilities from being exploited at run time. Since confinement typically occurs at run time, it can be much more precise than source or object code analysis. At the time a confinement mechanism is invoked, information is available about the current execution environment that is difficult or impossible to pre-compute, and the confinement mechanism can use this information to pinpoint the violation and determine an appropriate course of action. In contrast, source and object code analysis is typically concerned with preventing problems in all possible runs, so it must be more conservative in its analysis. Yet confinement leaves vulnerabilities latent at run-time, and being forced to choose between fail-stop and failure oblivious behaviors is not ideal.

Diversification is another approach to dealing with security vulnerabilities, which means changing the way a program executes or changing the state of the program in order to make it much harder for an attacker to take advantage of a vulnerability. For many kinds of attacks to succeed, the attacker needs to determine the relative or absolute memory locations of, for example, the stack or heap for the current context, or the locations of shared library routines that the attacker may want to call. If these locations are name fixed values or easily predicted across many different computers, an attacker can afford to invest significant resources in determining those locations. Some diversification strategies seek to alter the memory structure of programs so that even if the attacker finds an exploitable vulnerability in one system, it will be difficult to determine how to exploit the same vulnerability on a different computer, on the same machine after a reboot, or potentially even in a different process running the same application on the same machine.

Analysis, confinement, and diversification methods have made major advances in recent years, and all three have shown effectiveness in reducing vulnerabilities in practice. However, these techniques are still limited in their scope and operate in stovepipes. For example, one tool might address buffer overflows, and an independent tool might address format-string vulnerabilities. Finally, these techniques are typically used independently, and they do not interoperate. For example, vulnerabilities that are missed by a code analysis tool will likely remain in the code, subject neither to confinement nor to diversification. The result is that even if analysis, confinement, and diversification are used together to address a number of vulnerabilities, the result is a patchwork with many holes in it, and the ultimate benefit is hard to characterize.

STONESOUP seeks solutions that substantially reduce vulnerability to malicious exploitation of software flaws by:

- Extending the scope and capability of approaches for analysis, confinement, and diversification;
- Addressing a wide range of security vulnerabilities within the same framework; and
- Integrating analysis, confinement, and diversification to leverage the strengths and weaknesses of each approach.

The major advance sought is to provide comprehensive, automated techniques for vulnerability reduction in software of uncertain provenance.

1.2 Program Schedule

The STONESOUP program was a 51-month effort consisting of three consecutive phases, where the test and evaluation activity ran throughout each phase of the program:

- Phase 1 was a base period of 21 months
- Phase 2 followed for a period of 15 months
- Phase 3 was an optional period of 15 months

Continuation of each performer into the option years depended upon the potential of their proposed technology, the availability of funding, and IARPA priorities.

1.3 Key Stakeholders

This section describes the key stakeholders involved in the STONESOUP test and evaluation activity and outlines the roles and responsibilities of each.

1.3.1 Program Team

The program team had ultimate authority over the test and evaluation activity and was responsible for making final decisions about whether a performer's proposed technology satisfied the metrics (refer to Section 3.1) defined in the Broad Agency Announcement (BAA).

Program team responsibilities were performed by IARPA, which also ran the overall STONESOUP program.

1.3.2 Test and Evaluation Team

The test and evaluation (T&E) team was led by TASC to conduct system engineering, software development and manage all testing activities. The Test Case Generation and TEXAS development teams, led by Ponte Technologies (PonteTec), included generating and evaluating each test case to be used during the STONESOUP T&E activity and development of TEXAS. Additionally, members of the Test Case Generation team from Lawrence Livermore National Laboratory (LLNL) worked in expanding the ROSE compiler framework. The last member of the T&E team, the Independent Validation and Verification team, led by Information Systems Worldwide (i_SW), provided an objective assessment of both the weakness algorithmic variants created to simulate CWEs and the test cases after they have been injected with the variants.

1.3.3 Performers

Three performers participated in Phase 3 of the STONESOUP program:

- Columbia University
  - Primary Investigator: Salvatore Stolfo, PhD
  - Subcontractor: Symantec: Shabnam Abouyhadarel, Azzedine Benameur, Nathan Evans, Matthew Elder
- GrammaTech, Inc.
  - Primary Investigator: David Melski, PhD
  - Subcontractor: Raytheon: William Ella, David Hyde, Brian Mastropietro
- Kestrel Institute
  - Co-Primary Investigator: Alessandro Coglio, PhD
  - Co-Primary Investigator: Henny Sipma
  - Team Partner: Massachusetts Institute of Technology (MIT)

In addition to developing its proposed technology, each performer was responsible for supporting the test and evaluation activity as defined in the STONESOUP Rules of Engagement.

Previous project phases included participants from:

- George Mason University
  - Walter "Andy" Powell
  - Mohamed Elsabagh, Dan Fleck, Angelos Stavrou

1.4 Document Structure

This document is structured to provide a complete description of the Phase 3 T&E activity of the STONESOUP program.

- **Section 2.0** describes the methodology that was used to test and evaluate the performer's proposed technologies. This section goes into greater detail on a number of the individual components of the methodology including the metrics that were used, the evaluation process, the dry runs that were held to prepare for the evaluation, and presents any observations to improve the methodology in a future phase.
- **Section 3.0** describes the use of Amazon Web Services.
- **Section 4.0** describes the automated testing application that was developed specifically for the test and evaluation activity to execute the large number of test cases called for by the testing methodology.
- **Section 5.0** describes the test corpus that was created for Phase 3 of the STONESOUP program. This section reviews the generation process, analyzes the generated corpus to determine how complete it is, and presents any observations to improve the test corpus in a future phase.
- **Section 6.0** describes the test case framework system, which prepares a template for the test host including summaries of the approach to generate the test cases and approach to creating virtual machine base images.
- **Section 7.0** describes the Independent Verification and Validation effort.
- **Section 8.0** presents the results of the testing and the related evaluation of each proposed technology.
- **Section 9.0** gives an overall summary of the test and evaluation activity.

1.5 Related Documents and Software Articles

More detailed information on many of the topics discussed in this report appears in the deliverable documents listed in **Table 1-2**.

Table 1-2 Test and Evaluation Activity Documents

Document	Release Date	Purpose
IARPA Broad Agency Announcement IARPA-BAA-09-08	16-Sep-2009	Describes the goals of the STONESOUP program.
STONESOUP Phase 2 Test and Evaluation Final Report	13-Sep-2013	Detailed review of the test and evaluation activity for STONESOUP Phase 2 with results and analyses of testing conducted during evaluation of four proposed technologies.
STONESOUP Test Case Generation Plan, Version 2.1 (Phase 2)	21-Nov-2012	Guides the test generation team during test case development in creating test cases for Phase 2 and defines the criteria for test cases to be generated. After generated test cases are submitted to the T&E team and upon verification, they are added to the overall collection of test cases.

Document	Release Date	Purpose
IARPA STONESOUP Phase 3 Dry Run 1 Evaluation Report, Version 1.1	12-Dec-2014	Evaluation of Dry Run 1 and demonstration of the TEXAS Client software via a command line interface (CLI), manually executing single test cases without automated scoring. Evaluation of the performers' and the TEXAS Client's support for the draft test API. Evaluation of performers' ability to perform regular regression testing of their technologies on special dedicated developmental subnetworks provided for this purpose. Evaluation of all other components of the TEXAS system that will be demonstrated as a Rehearsal-of-Concept (ROC) drill, i.e., as a table top exercise with each procedure or network message described in sequence.
IARPA STONESOUP Phase 3 Rehearsal of Concept (ROC) Drill Hosting	22-May-2014	Table top exercise for Dry Run 1 for each performer with each procedure or network message described in sequence.
IARPA STONESOUP Phase 3 Dry Run 2 Evaluation Report, Version 1.1	12-Dec-2014	Evaluation of Dry Run 2 with the goals, system structure, dry run process, test corpus and results of the dry run activity.
IARPA STONESOUP Phase 3 Dry Run 3 Evaluation Report, Version 1.1	12-Dec-2014	Documents the goals, system overview of TEXAS, process, test corpus, results and lessons learned of Dry Run 3 activity. This report also describes the way ahead for Final T&E.
IARPA STONESOUP Phase 3 Rules of Engagement - Dry Run 1, Version 1.4	12-Dec-2014	Prior to each dry run evaluation, a rules of engagement report shall be prepared documenting what each performer is expected to provide at the dry run and how the dry run will be conducted.
IARPA STONESOUP Phase 3 Rules of Engagement - Dry Run 2, Version 1.1	12-Dec-2014	Prior to each dry run evaluation, a rules of engagement report shall be prepared documenting what each performer is expected to provide at the dry run and how the dry run will be conducted.
IARPA STONESOUP Phase 3 Rules of Engagement - Dry Run 3, Version 1.1	12-Dec-2014	Prior to each dry run evaluation, a rules of engagement report shall be prepared documenting what each performer is expected to provide at the dry run and how the dry run will be conducted.
IARPA STONESOUP Phase 3 Rules of Engagement, Version 4.0	12-Dec-2014	Defines the test system concept of operations, the system interfaces that the performers must support, and any other information that a Performer would need to interact with the testing system.
IARPA STONESOUP Phase 3 Test Generation Report, Version 1.0	12-Dec-2014	Documents results of the test generation team in creating fault injection based test cases for Phase 3, the criteria for test cases to be generated, and the format of test meta-data.
IARPA STONESOUP Phase 3 Test & Evaluation eXecution and Analysis System (TEXAS) Collaboration User Guide, Version 1.1	12-Dec-2014	Describes the procedures and expectations of each participant for sharing information with the mechanism and conventions to facilitate group interactions.
IARPA STONESOUP Phase 3 Test & Evaluation eXecution and Analysis System (TEXAS) Command Line Interface (CLI) Users Guide, Version 4.0	22-Oct-2014	Describes Command Line Interface (CLI) to support the two major testing stages (i.e. Stage 1 and Stage 2) and the three major testing workflows (i.e. Analyze, Execute, and Score) within each stage. Allow a test engineer or performer technology developer to run the analyze or execute commands, and receive immediate feedback in regards to the results and score, if performing an execution workflow.

Document	Release Date	Purpose
IARPA STONESOUP Phase 3 Test & Evaluation eXecution and Analysis System (TEXAS) Communication's API Guide, Version 4.1	12-Dec-2014	Describes integration points between Performer technology and the Test & Evaluation eXecution and Analysis System (TEXAS).
IARPA STONESOUP Phase 3 Test Case Creation User Guide, Version 1.2	12-Dec-2014	Guide to creating test cases that can be run through the Test and Evaluation Analysis and Execution System (TEXAS) developed for the IARPA STONESOUP program.
IARPA STONESOUP Phase 3 Test & Evaluation eXecution and Analysis System (TEXAS) System Design Document, Version 3.1	12-Dec-2014	Describes essential elements of TEXAS with required relationships between components to ensure test objectives are achievable. Includes sufficient information on architecture and component functionality to allow an implementer to design a functional system.
IARPA STONESOUP Phase 3 Test & Evaluation Plan, Version 1.1	12-Dec-2014	Provides detailed procedures and schedule of the program's plans as related to test case generation, test metrics, baseline evaluation, rules of engagement, adversary work factor evaluation metrics, dry run goals and procedures, scoring procedures, and data analysis algorithms.
IARPA STONESOUP Phase 3 Test Data Generation Plan, Version 2.1	12-Dec-2014	Guides the test generation team in creating fault injection-based test cases for Phase 3, defines the criteria for test cases to be generated, and defines the format of test meta-data.
IARPA STONESOUP Phase 3 Test and Evaluation Report, Version 1.0	24-Dec-2014	Detailed review of the test and evaluation activity for STONESOUP Phase 3 with results and analyses of testing conducted during evaluation of three technologies.
IARPA STONESOUP Phase 3 Initial Analysis of Raw Test Results: COLUMBIA Final Results Draft Rev 1 GrammaTech Final Results Draft Rev 1 Kestrel Final Results Draft Rev 1	2-Dec-2014	First look at test data to confirm test objectives met includes quick analysis of results and predetermined analysis to predict results.
IARPA STONESOUP Phase 3 T&E System Specifications, Data, Software, and Software Documentation	31-Dec-2014	Phase 3 T&E System Specifications, Data, Software, and Software Documentation for testing system consisting of networking equipment, hardware, and software that will support the T&E activity. Includes: ▪ TEXAS System Design Document ▪ TEXAS Communication's API Users Guide ▪ TEXAS Command Line Interface (CLI) Users Guide ▪ Test Case Creation User Guide ▪ TEXAS 4.0 code with Change Log and Read-Me file (instructions on project and how to develop extensions for TEXAS) ▪ Test Corpus Specification Tool User Guide ▪ Test Corpus Specification Tool code ▪ Virtual Machine loaded with code and instructions (on virtual machine [VM] specs, passwords, etc.)
IARPA STONESOUP Phase 3 Test Generation Software and Software Documentation	31-Dec-2014	Phase 3 Test Case Generation Software and Software Documentation for framework to automatically insert vulnerabilities into host programs in a scalable and flexible manner. Includes: ▪ Test Generation Report ▪ Test Case Generation Framework Users Guide ▪ Weakness Class Algorithmic Variant (Snippet) Documentation ▪ Test Case Generation Framework code (packager, Vinject

Document	Release Date	Purpose
		(C injector), Vinject4j (Java injector), snippets) ▪ Virtual Machine loaded with code and instructions (specs, passwords, etc.)
IARPA STONESOUP Phase 3 Technology Transition package for each performer	31-Dec-2014	Technology transition package for each performer technology that would assist a U.S. Government agency in installing the technology into a testing network for evaluation purposes. Includes: ▪ Virtual Machines used for Final T&E with last performers' technology installed
IARPA STONESOUP Phase 3 Technology Transition Package	31-Dec-2014	Documents the test data used for T&E in such a way that external researchers can use the data for further research. Describes packaging format and process for test cases and the specifications and software for the test system for delivery to NIST.

More detailed information on many of the topics discussed in this report appears in the deliverable documents listed in **Table 1-3**.

Table 1-3 Software Deliverable Articles

Software	Purpose
Test Case Specification Software	STONESOUP software to generate test suite of test cases in compliance with Test Data Generation Plan (TGP) v 1.1. Software will also provide statistical information on uniformity of the test suite.
TEXAS	Phase 3 testing was performed using TEXAS, a system for test automation written in Python developed by T&E Team. This code includes the auto provision database in Mongo.
Test Data Generation Framework Software	This the framework that injects the test cases into the Base Programs using ROSE for C/Binary language or Eclipse Java language.

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2.0 Testing Methodology

To verify achievement of the goals of the STONESOUP program, a testing methodology was developed to guide the test and evaluation activity. This section details the foundational elements of this methodology. The T&E team coordinated the testing activities, developed the T&E plan that specified how evaluations were performed, provided the primary test environment for the evaluations, and executed testing of the proposed technologies. The T&E team included the:

- Systems Engineering Team, which documented all plans and requirements for all aspects of T&E
- Test Data Generation Team, which created the extensive corpus of test data that covers the wide spectrum of vulnerabilities represented by the Weakness Classes targeted by each performer
- Independent Verification & Validation (IV&V) Team, which provided an objective assessment of both the weakness algorithmic variants created to simulate CWEs and the test cases after they had been injected with the variants.
- Test and Evaluation eXecution and Analysis System (TEXAS) Development Team, which developed and maintained testing software and the test infrastructure

Initially the T&E team planned the testing and designed the test system through systems engineering documentation which included:

- Test and Evaluation Plan
- Test and Evaluation eXecution and Analysis System (TEXAS) Design Document
- Collaboration Users Guide
- Test Data Generation Plan
- Test Corpus Specifications
- Test Case Creation Guide
- Test & Evaluation Rules of Engagement
- Dry Run Rules of Engagement (includes Rehearsal of Concept (ROC) script, Communications API & TEXAS Command Line Users Guides)
- Dry Run and Manual Altered Functionality Test Evaluation Reports

Second, the Test Data Generation team determined which host base test programs would be used to be representative of real world software which had an average size of 500,000 source lines of code (SLOC) to meet the Phase 3 goal. Also, this team devised a system to build and inject test cases into the base programs. The test cases applied in T&E needed to contain a wide variety of vulnerability types, and placed throughout the test programs. Given the desire to have many thousands of test cases available for T&E, the T&E team could not create these programs by hand, and therefore, developed a mechanism to automatically insert vulnerabilities into host base test programs in a scalable and flexible manner. Hence the team developed the Test Case Generation Framework (TCGF), a system designed to take C and Java programs, render them to their Abstract Syntax Tree (AST) representation, inject target vulnerabilities into the AST, and re-emit source code. At the same time, the TCGF also automatically created the corresponding input required to exploit the injected vulnerability. The TCGF had been created to scale across multiple systems to allow for high levels of parallelization. The TCGF used the ROSE compiler from the Lawrence Livermore National Laboratory (LLNL) for AST processing for C programs and the Eclipse framework for Java programs.

For both languages, the Test Data Generation team developed and modified code snippets (i.e., weakness algorithmic variants) to drive the injection process. These snippets are effectively simple, unique representations of each vulnerability. Each injected vulnerability has at least two snippets that represent different ways to demonstrate each vulnerability. These snippets are written in their native languages (C and Java) with some pseudo code/placeholders in the snippets to allow the TCGF to customize each injection.

Third, IV&V was conducted to provide an objective assessment of both the weakness algorithmic variants created to simulate CWEs and the test cases after they had been injected with the variants into the base programs.

Fourth, the Test and Evaluation eXecution and Analysis System (TEXAS) Development Team developed and maintained testing software and the test infrastructure. The T&E activity success lies in the ability of the T&E team to measure the effectiveness and performance of each performer's technology against program metrics. A sufficient number of measurements were performed to produce high confidence in the overall performance score. This process required careful management of the test data and the testing environment with the TEXAS automated tools so a high volume of tests could be conducted in a short period of time. All test data was available and all test configurations fully documented so the evaluation is reproducible.

2.1 Metrics

The testing methodology relies on the ability to score each proposed technology using a set of metrics. The goals of the Phase 3 T&E activity are to evaluate the performer prototype technologies against the Phase 3 program metrics.

The metrics for previous phases and Phase three included:

- evaluating the test cases successfully processed

evaluating the vulnerabilities rendered unexploitable.

Metrics added for Phase 3 included:

- evaluating the increase in run time
- evaluating if the performer technology altered functionality.

The program metrics are shown in **Table 2-1**.

Table 2-1. STONESOUP Program Metrics

Metric	Target	Phase 1 Goal	Phase 2 Goal	Phase 3 Goal
% Test Cases Successfully Processed	Software Class A (Java)	100%	100%	100%
	Software Class B (C, C++)	90%	90%	90%
	Software Class C (x86 Binary Executables)	75%	75%	75%
% Seeded Vulnerabilities Rendered Unexploitable (of successful Test Cases)	First 2 Weakness Classes	75%	90%	95%
	Second 2 Weakness Classes	N/A	80%	95%
	Final 2 Weakness Classes	N/A	N/A	90%
% Increase in Running Time	All	N/A	N/A	10%
% Altered Functionality	All	N/A	N/A	0%

2.2 Scoring Mechanisms

Proposed technologies developed for the STONESOUP program were evaluated on their ability to render vulnerabilities in a given weakness class unexploitable (each performer selected four software/weakness class combinations to address from a pool of three software classes and eight weakness classes). A successful proposed technology was expected to demonstrate its efficacy against more than one type of vulnerability as well as its ability to perform outside a controlled laboratory environment. A proposed technology was expected to understand a wide range of vulnerabilities and their related weaknesses in an application. In addition, a proposed technology was expected to operate on any code or binary given to it (within their selected software and weakness classes), representing a more real-world situation.

To measure a proposed technology's breadth of capability, the testing methodology relied upon the creation and execution of test cases. As discussed in greater detail in **Section 6.0**, each test case used specific code complexity features and targeted a specific weakness type within an associated weakness class. GOOD and BAD I/O-Pairs that were supplied with each test case. A GOOD I/O-Pair is constructed so as to produce normal base program behavior, whereas a BAD IO-Pair is constructed so as to initiate/trigger a vulnerability behavior. Through the use of the exploitability of each embedded weakness was evaluated. To accomplish this, a collection of test cases was assembled to assess a proposed technology's ability to render un-exploitable a diversity of weaknesses and complexity features.

The basic scoring mechanism worked as follows:

- For an individual test case and GOOD I/O-Pairs–the test and evaluation infrastructure confirmed that proper functionality was preserved. This was measured by comparing the test case output (executed with the proposed technology in place) to that specified by an I/O-Pair. If none of the actual outputs from a test case deviate from expected behavior, the test case was counted in the preserved functionality metric.
- For an individual test case and BAD I/O-Pairs–the test and evaluation infrastructure confirmed that the seeded weakness was rendered unexploitable. This was measured by comparing the test case output (executed with the proposed technology in place) to that specified by the corresponding I/O-Pair. In this case, the infrastructure was looking for dissimilar values or behaviors (for example, a controlled program exit verses a specific error message). If all the inputs associated with BAD I/O-Pairs for a test case were mitigated, the test case was counted in the rendered unexploitable metric.

A test case score is an aggregation of results on a set of I/O-Pairs, and a test suite score is an aggregation of results of individual test cases.

2.3 Testing Event

The defined testing methodology required an evaluation of each proposed technology to be performed by the test and evaluation team at the end of Phase 3. The goal of these evaluations was to determine how well the proposed technologies did at meeting the defined targets.

2.3.1 Original and Final Plans

The original plan to conduct final T&E included a fully automated TEXAS, a web-based Dashboard, Machine Learning for server programs, and an Adaptive Queuing technology. Due to changing client needs and directives, however, that methodology and its underlying technology evolved over the course of Phase 3.

Final T&E was conducted with a fully automated TEXAS, but the design and architecture underpinning it changed significantly. Instead of using a broker to queue test case jobs and an independent scoring utility to calculate overall statistics and report them; were replaced by a database for queues of test case jobs and a script was designed to calculate many of the overall statistics. These changes simplified the design and made it less fault tolerant but were ultimately sufficient to conduct final T&E.

The original plan called for a web-based Dashboard for viewing and controlling the entire T&E process. It was determined early on that a web-based Dashboard was not strictly necessary to the success of final T&E. Because of this, plans to build it were scrapped, and it was replaced with a number of command line scripts that directly interacted with the database architecture.

Machine learning for server programs was also a possible target for the performers during Phase 3. This feature was designed and implemented in TEXAS to allow performers to learn from one execution of a weakness to the next and attempt to improve their mitigation of the weakness such that it they were not forced to exit the program. More information about this feature is available in the TEXAS Users Guide.

One of the largest changes between the original plan and the actual methodology and technology used for final T&E was the change from an Adaptive Queuing algorithm to static ordered queues. The Adaptive Queuing algorithm originally envisioned would monitor the test cases that had been run based on a number of factors (described in **Section 5.2**) and intelligently select the next test case to be run based on the recorded results and the uniformity of test case parameters. This was simplified to using queues that were ordered during their specification such that if processed in order they would result in a uniform corpus. This move allowed for the simplification of the overall architecture to a simpler database because all of the test cases could be loaded in the specified order without the need for a process to monitor the results.

2.3.2 Schedule

Initially the planning and design for testing was conducted in the first period of Phase 3, primarily from October 2013 through May 2014. The T&E team planned the testing and designed the test system through systems engineering documentation described in **Table 1-2.**

- Test and Evaluation Plan
- Test and Evaluation eXecution and Analysis System (TEXAS) Design Document
- Collaboration Users Guide
- Test Data Generation Plan
- Test Corpus Specifications
- Test Case Creation Guide
- Test & Evaluation Rules of Engagement
- Dry Run Rules of Engagement (includes Rehearsal of Concept (ROC) script, Communications API & TEXAS Command Line Users Guides)
- Dry Run and Manual Altered Functionality Test Evaluation Reports

Also, during that same period test data generation research was done to determine which host base test programs would be used. Programs were selected to be representative of real world software which had an average size of 500,000 source lines of code (SLOC) to meet the Phase 3 goal.

From October 2013 until the beginning of final T&E in November 2014, the Test Data Generation team devised a system to build and inject test cases into the base programs. For both languages, during this 14-month period the Test Data Generation team also developed and modified code snippets (i.e., weakness algorithmic variants) to drive the injection process.

To mitigate risk for the final T&E testing, three dry run tests and additional manual testing to check for altered functionality were conducted during May, July-August, September-October and October 2014, respectively. These risk mitigation tests are described in **Section 2.4**. Final T&E was conducted during November 2014.

2.4 Risk Mitigation Strategy

The evaluations were critically important and labor intensive. To mitigate risk associated with them, the testing methodology included three dry runs to prove the viability of the test environment, increase communication with the performers, anticipate potential issues, and ensure efficient, reliable data collection.

2.4.1 Dry Run #1

This section summarizes the information from the following document(s), and it is recommended that the reader reference this documentation for more information:

- IARPA STONESOUP Dry Run 1 Evaluation and Rehearsal of Concept (ROC) Drill Hosting, Version 1.022-May-2014

2.4.1.1 Purpose

Dry Run 1 (DR1) for Phase 3 of the STONESOUP program was performed 14-16 May 2014. The Dry Run involved all three STONESOUP performers and the STONESOUP Test & Evaluation (T&E) team. Over the three day event, the performer technologies were executed on the Test and Evaluation eXecution and Analysis (TEXAS) testing system and against a subset of the final STONESOUP test corpus.

2.4.1.2 Objectives

The STONESOUP dry run schedule was created to reduce risk to the T&E process by demonstrating iteratively advancing capabilities throughout the T&E system development process. Each dry run built upon the previous to show increasing capability and a progress to reach final T&E with a complete TEXAS system and test corpus. DR1 was the first significant step in this process. The formal stated objectives were:

- Demonstrate Integration of Performers Technology with TEXAS Command Line Interface
- Determine Suitability of Commercial Cloud Services
- Mitigate Final Test and Evaluation (T&E) Risk
- Validate Test Case Generation Framework
- Measure Analysis Times for final T&E Cloud Planning

2.4.1.3 Approach

The T&E team delivered a suite of virtual machine images that served as a central test system (which included the test manager), a performer test system (the system used for test case execution), and a customized analysis system, if required. These virtual machines were customized to support the performers' chosen operating system.

Performers were expected to install their proposed technologies on the performer test system (and on the analysis system, if required), and then provide detailed feedback as to the status of their integration.

For DR1, the T&E team ran test cases on an individual basis utilizing the TEXAS command line interface (CLI). The TEXAS CLI exposed all TEXAS host functionality including the ability to compile code, apply performer technology, run I/O pairs through the software under test, and score the result. For DR1, the following high level process stages were followed for each test case: Stage 1 and Stage 2 as follows.

To determine the validity of a test case on a target system, the test case must first be run on the target system without any performer technology. In Stage 1 testing, the test case is downloaded and un-archived in the appropriate workspace directory. TEXAS then compiles the program (in the case of C and Java performers) producing a binary. That resulting binary is then used in the execute phase. In the execute phase, the binary is invoked for all good and bad I/O Pairs described in the metadata. Finally the results of the I/O Pair runs are scored against the expected results. If the test case results are the same as the expected outputs, the test case is considered valid and available to be used for testing against performer technology. If the results are different, the test is rejected and not used.

Assuming the test case passes Stage 1, it is available for Stage 2 testing. The first part of Stage 2 testing is “analyze.” In this step, the test case is given to the performer technology for analysis. This process, euphemistically called ‘STONESOUP-ifying’, can take anywhere from a few minutes to a few hours depending on the complexity of the program, the specific weaknesses involved, and the capabilities enabled in the performer technology.

Once the analysis phase is complete, the resulting binary is sent to the “execute” phase. In this execute step, the same good and bad I/O pairs used in Stage 1 are used again in this Stage. Results of the tests are compared against expected outputs. If the results for any good I/O pair vary from expected results, the test case is failed due to “Altered Functionality.” If any of the bad I/O pairs match expected results, then the performer technology didn’t mitigate the exploit and the test case is failed. Finally, if the test case crashes in a manner the performer did not catch, it is failed. Otherwise, in general, the test case is successful and the performer receives credit for passing it.

For DR1, test cases for Stage 1 and Stage 2 for each performer were manually queued by the T&E team. The team monitored each stage and moved test cases from analysis systems to execute systems as analysis completed.

2.4.1.4 System Specifications

For T&E, the performers can use analysis machines with enough CPU and memory to support their analysis needs. Each performer has a different analysis process and as such is utilizing different Amazon EC2 instances for analysis. However, to keep a “level playing field,” each performer must use the same EC2 instance type for execution. This is representative of what would happen in a normal enterprise. An enterprise would expect ‘STONESOUP-ified’ binaries to run on standard computers with nominal specifications.

The Amazon instance types used for each performer in DR1 is listed in **Table 2-2**.

Table 2-2 Performers' Analysis and Execute Cloud Instances

Performer	Analysis Instance	Execute Instance
Columbia	m3.2xlarge	m3.xlarge
GrammaTech	r3.xlarge	m3.xlarge
Kestrel	r3.4xlarge	m3.xlarge

2.4.1.5 Test Corpus

The test corpus used for DR1 is representative sample of the final test corpus to be used in the final T&E activities. TEXAS and the test case development processes are still under development so not all capabilities were available. At a high level, the overall defining properties of the DR1 test corpus were:

- Five Java Base Programs
- Three C Base Programs (for use by C and Binary performers)

- 5 Good I/O pairs and 2 Bad I/O pairs per test case
- All code complexity features for C and Java were included in the corpus
- One code complexity feature was included per test case
- Three Taint Sources
- Phase 2 CWE's from Phase 2 weaknesses
- Three Phase 3 CWE's from three Phase 3 weaknesses

The T&E team attempted to use 60 test cases for each performer. While 60 test cases were created for each performer, not all test cases successfully completed independent verification and validation activities in time for DR1. **Table 2-3**, indicates the number of test cases per performer.

Table 2-3 Number of Test Cases Per Performer

Performer	Number of Test Cases
Columbia	55
GrammaTech	55
Kestrel	46

2.4.1.6 Outcome

Stated Dry Run One goals with result:

- **Demonstrate Integration of Performers Technology with TEXAS Command Line Interface (CLI)**: Performer technology proved compatible with Texas CLI.
- **Determine Suitability of Commercial Cloud Services**: Amazon Web Services was used very successfully.
- **Mitigate Final Test and Evaluation (T&E) Risk**: Process and infrastructure necessary to final T&E success were implemented and performed satisfactorily.
- **Validate Test Case Generation Framework**: Framework operated as expected producing usable test cases for the test.
- **Measure Analysis Times for final T&E Cloud Planning**: Time data was collected and used.

Dry Run 1 captured scoring results for each execution of the I/O pairs of a test case in order to better test the scoring functionality of the system. Because the data was captured, the T&E team processed it in a manner similar to how it would be analyzed and presented after final T&E. It should be noted that while these results are accurate, this early in the phase the performers are still modifying their technologies and in many cases were using beta versions of their technology or did not have all of their protections enabled. As such, these results should not be taken as indicative of the actual capabilities of the performer technology. Dry Run 1 was intended to be a test of the integration between performers and TEXAS which was very successful.

During DR1 two bad I/O Pairs were used for each test case.

2.4.2 Dry Run #2

This section summarizes the information from the following document(s), and it is recommended that the reader reference this documentation for more information:

- IARPA STONESOUP Dry Run 1 Evaluation and Rehearsal of Concept (ROC) Drill Hosting, Version 1.022 – May-2014

2.4.2.1 Purpose

Dry Run 2 (DR2) for Phase 3 of the STONESOUP program was performed during 28 July through 1 August 2014. The Dry Run involved all three STONESOUP performers, Kestrel, Columbia and GrammaTech, and the STONESOUP Test & Evaluation (T&E) team. Over the 5-day event, the performer technologies were executed via the Test and Evaluation eXecution and Analysis (TEXAS) testing system against a nearly complete subset of the final STONESOUP test corpus Common Weakness Enumerations (CWE) and Algorithmic Variants.

2.4.2.2 Objectives

The STONESOUP Phase 3 Dry Run schedule was created to reduce risk to the T&E process by iteratively demonstrating advancing capabilities throughout the T&E Phase 3 system development process. Each Dry Run builds upon the previous to show increasing capability and a progress to reach final T&E with a complete TEXAS system and test corpus. DR2 was the second significant step in this process and achieved the following goals. DR2 objectives included:

- Validate Entire Corpus of CWE and Algorithmic Variants Expected for final T&E
- Conduct Analysis of all Base Programs with Performer Technology
- Validate Scoring Aggregation and Manual Execution of Test Cases Approach with TEXAS Command Line Interface (CLI)
- Determine test productivity throughput (i.e., number of tests that Test Administrator(s) can manually conduct during an 8-hour period)

2.4.2.3 Approach

The test and evaluation team created and used a suite of virtual machine images that served as a central test system (which included the test manager), a performer test system (the system used for test case execution), and a customized analysis system if required. These virtual machines were customized to support the performers' chosen operating system.

Performers were expected to install their proposed technologies on the performer test system (and on the analysis system if required), and then provide detailed feedback as to the status of their integration.

For DR2, the T&E team ran test cases on an individual basis utilizing the TEXAS Command Line Interface (CLI). The TEXAS CLI exposes all TEXAS host functionality including the ability to compile code, apply performer technology, run I/O pairs through the software under test and score the result. For DR2, the following high level process stages were followed for each test case: Stage 1 and Stage 2.

For DR2, test cases for Stage 1 and Stage 2 for each performer were manually queued by the T&E team. The team monitored each stage and moved test cases from analysis systems to execute systems as analysis completed.

2.4.2.4 System Specifications

For T&E, the performers can use analysis machines with enough CPU and memory to support their analysis needs. Each performer has a different analysis process and as such is utilizing different Amazon EC2 instances for analysis. However, to keep a "level playing field," each performer must use the same EC2 instance type for execution. This is representative of what would happen in a normal enterprise. An enterprise would expect 'STONESOUP-ified' binaries to run on standard computers with nominal specifications. Columbia, given the nature of their technology, was given a slightly larger instance for execution to help enable concurrent, rather than serial, execution of their containers.

The Amazon instance types used for each performer in DR2 is listed in **Table 2-4**.

Table 2-4 Performers' Analysis and Execute Cloud Instances

Performer	Analysis Instance	Execute Instance
Columbia	m3.2xlarge	m3.xlarge
GrammaTech	r3.xlarge	m3.large
Kestrel	r3.4xlarge	m3.large

2.4.2.5 Test Corpus

The test corpus used for DR2 is a representative sample of the final test corpus to be used in the final T&E activities. TEXAS and the test case generation processes are still under development so not all capabilities were available. At a high level, here are the overall traits of the DR2 test corpus:

- 6 Java Base Programs for Analysis Only
- 6 C Base Programs (for use by C and Binary performers) for Analysis Only
- 1 Small Java Program (< 1,500 Lines of Code) For Analysis and Execution
- 1 Small C Program (<1,500 Lines of Code) for Analysis and Execution
- Sample of code complexity features for:
- C: 4 of 4 Taint Source, 7 of 7 Data Type, 11 of 26 Controlled Flow and 13 of 18 Data Flow and
- Java: 3 of 4 Source Taint, 3 of 7 Data Type, 13 of 26 Controlled Flow and 6 of 18 Data Flow
- One code complexity feature per test case
- Phase 2 CWEs from Phase 2 weaknesses
- 3 Phase 3 CWE's from Phase 3 weaknesses

The T&E team used up to 85 test cases for each performer. **Table 2-5**, indicates the number of test cases per performer.

Table 2-5 Number of Test Cases Per Performer

Performer	Number of Test Cases	Number of iopairs
Columbia	85	10
GrammaTech	83	10
Kestrel	55	10

2.4.2.6 Outcome

Stated Goals of Dry Run Two with results:

- **Validate Entire Corpus of CWE and Algorithmic Variants Expected for final T&E**: In preparation for DR2, the Test Data Generation team developed 140 test case snippets for weakness algorithmic variants. These snippets were then evaluated by an Independent Verification & Validation (IV&V) team to determine if they demonstrated the CWE. Accepted snippets were then injected into a micro program (CTRE/JTRE) to create mock test cases. These mock test cases were executed then to ensure inputs and outputs were properly processed by the Test and Evaluation eXecution and Analysis System (TEXAS). The validated test cases were then used during the Execution phase of Dry Run 2.
- **Conduct Analysis of all Base Programs with Performer Technology**: This goal was used to estimate length of analysis time during final T&E. The analysis times varied from 59 seconds to 3 hours 22 minutes 53 seconds. Table 1, Base Program Analysis Times by Performer During DR2, reflects the times for each performer's analysis of six base programs. There are no times for GrammaTech's analysis of GIMP or Wireshark because during DR2 they skipped the analysis of these programs due to their size.

- **Validate Scoring Aggregation and Manual Execution of Test Cases Approach with TEXAS Command Line Interface (CLI)**: Dry Run 2 continued the same approach used in DR1 by manually executing all test cases using the TEXAS Command Line Interface (CLI). Raw results from scoring were collected and aggregated in .csv files for each performer. Then the T&E team analyzed the results and posted a summary of the results in separate files showing combined summary results across CWEs, CWE Classes, Base Programs and Taint Sources.
- **Determine test productivity throughput (i.e., number of tests that Test Administrator(s) can manually conduct during an 8-hour period)**: The ability of the TEXAS CLI to accept commands for multiple test cases and multiple I/O pairs in a single invocation means that a test administrator can queue up many test cases and just monitor the results for abnormalities in processing times at given intervals. In this light, TEXAS is a huge success and actually running T&E manually from the command line is entirely possible given enough staff, virtual machines and coordination for result aggregation.

Dry Run 2 captured scoring results for each execution of the I/O pairs of a test case in order to better test the scoring functionality of the system. Because the data was captured, the T&E team processed it in a manner similar to how it would be analyzed and presented after final T&E. While these DR2 results are accurate, the performers were still modifying their technologies and in many cases were using beta version technology. As such, these results should not be taken as indicative of the actual capabilities of the performer technology. DR2 was intended to be a test of the integration between performers' technologies and TEXAS, which was very successful.

2.4.3 Dry Run #3

This section summarizes the information from the following document(s), and it is recommended that the reader reference this documentation for more information:

- IARPA STONESOUP Rules of Engagement Dry Run 3, Version 1.09-Sep-2014

2.4.3.1 Purpose

Dry Run 3 (DR3) for Phase 3 of the STONESOUP program was performed during 25 September through 30 September 2014 and then restarted make-up tests from 9 October to 14 October 2014. The Dry Run involved all three STONESOUP performers, Kestrel, Columbia and GrammaTech; and the STONESOUP Test & Evaluation (T&E) team. Over the two periods, the performer technologies were executed via the Test and Evaluation eXecution and Analysis (TEXAS) testing system against a 25% subset of the final STONESOUP test cases.

2.4.3.2 Objectives

The STONESOUP Phase 3 Dry Run schedule was created to reduce risk to the T&E process by iteratively demonstrating advancing capabilities throughout the T&E Phase 3 system development process. Each Dry Run builds upon the previous to show increasing capability and a progress to reach final T&E with a complete TEXAS system and test corpus. DR3 was the third significant step in this process and achieved the following goals.

- Simulate full T&E and run 25% of final T&E test cases per weakness class during 5-day time frame
- Test every combination of Base Program, Injection Point and Taint Source for each language (Java: 180 combinations, C: 240 combinations)
- Validate that implementation of database is scalable for queuing test cases

- Validate aggregation of scoring results for final T&E
- Generate mock/straw man T&E Report to assure content and layout for final report
- Validate performance testing
- Validate learning implementation in TEXAS
- Test technologies using both release (production) and test modes

2.4.3.3 Approach

For DR3, the TEXAS ran the tests via a database which contained all the test cases. The TEXAS CLI exposes all TEXAS host functionality including the ability to compile code, apply performer technology, run I/O pairs through the software under test and score the result. The following preliminary steps were completed before beginning the tests:

- Clone one Analysis and one Execute virtual machines (VM)
- Configure cloned VMs as daemons, which communicated with the database to get test case metadata to start the test case and to store test results
- Clone those VMs the appropriate number of times
- Load test cases into the appropriate performer test queue
- Mark performer test queue as active

For DR3, test cases for Stage 1 and Stage 2 for each performer were queued in a database by the T&E team. The team monitored each stage and moved test cases from analysis systems to execute systems as analysis completed.

The Test Administrator started the high level process Stage1 and Stage 2 for each performer and monitored the progress and results of the queue. During and after DR3, the T&E team analyzed the results from the database. The test and evaluation team delivered a suite of virtual machine images that served as a central test system (which included the test manager), a performer test system (the system used for test case execution), and a customized analysis system if required. These virtual machines were customized to support the performers' chosen operating system.

2.4.3.4 System Specifications

For T&E, the performers can use analysis machines with enough CPU and memory to support their analysis needs. Each performer has a different analysis process and as such is utilizing different Amazon EC2 instances for analysis. However, to keep a "level playing field," each performer must use the same EC2 instance type for execution. This is representative of what would happen in a normal enterprise. An enterprise would expect 'STONESOUP-ified' binaries to run on standard computers with nominal specifications. Columbia, given the nature of their technology, was given a slightly larger instance for execution to help enable concurrent, rather than serial, execution of their containers. This was done, in order to more accurately test their technology however it means that it would make their solution less feasible given current standard issue government systems.

The Amazon instance types and number of VMs used for each performer in DR3 are listed in **Table 2-6**.

Table 2-6 Performers' Analysis and Execute Cloud Instances

Performer	Analysis Instance (#)	Execute Instance (#)
Columbia	m3.2xlarge (7)	m3.2xlarge (20)
GrammaTech	r3.xlarge (25)	m3.large (40)
Kestrel	r3.4xlarge (22)	m3.large (18)

2.4.3.5 General Throughput Observations

By extrapolating the scalability of DR3, the T&E team expects that Final T&E can complete 100% of the test cases (9876) within the November time frame with the planned number of VM instances used during DR3. The following are general observations on DR3 throughput. Detailed observations and conclusions for each performer's throughput are included in **Section 2.4.3.7**.

- An issue causing a positive impact on throughput is more detrimental to planning than a negative impact since it is better to overestimate the resources needed and finish early rather than underestimate and not finish T&E.
- Console program I/O Pair runs take anywhere from 1 second to ~45 seconds on average.
- GUI and server program I/O Pair runs take ~ 1 minute to 2.5 minutes on average
- Console base program-based test cases are more likely to create a positive impact on throughput than server and GUI base program-based test cases because of how they're designed.
  - Console programs do not have co processes that block waiting for the main process to spin up like server and GUI programs do, which means if they crash then TEXAS immediately returns.
  - When a GUI or server program crashes, the co-processes continue to block until they are killed at timeout.
  - This blocking behavior effectively means that crashing GUI and server programs are very unlikely to cause a positive impact on throughput because they will cause the test case to run to timeout instead of prematurely exiting.

2.4.3.6 Test Corpus

The test corpus used for DR3 is a representative sample (25%) of the final test corpus to be used in the final T&E activities. At a high level, here are the overall traits of the DR3 test corpus:

- 4 Java Base Programs (Elastic Search, Lucene and Jena)
  - T&E did not use the Google WebToolKit base program and consequently will replace it with Apache POI during Final T&E. T&E could not trace the Google WebToolKit program for injection points since it compiles part of itself, calls that to compile other parts of itself and then recompiles other parts of itself into JavaScript.
  - Lenya test cases (for Kestrel) were not tested in Dry Run 3 due to issues running them in IV&V because of stability issues with Ubuntu's X display.
  - CoffeeMUD test cases were not run in Dry Run 3 due to issues running them in IV&V because of an issue with missing TTY when run as a daemon.
- 3 Binary Base Programs (for use by C and Binary performers) Subversion, OpenSSL, FFmpeg)
  - GIMP test cases (for GrammaTech) were not tested in Dry Run 3 because of stability issues with the Ubuntu X display.
  - Wireshark test cases were not tested (for GrammaTech) in Dry Run 3 because of stability issues with the Ubuntu X display.
  - PostgreSQL test cases were not tested (for Columbia) in Dry Run 3 due to issues running it on the CentOS operating system during IV&V as root in GOOD I/O Pair 1.
- All code complexity features for:
  - C: 4 of 4 Source Taint, 7 of 7 Data Type, 26 of 26 Controlled Flow and 18 of 18 Data Flow

  - Java: 4 of 4 Source Taint, 7 of 7 Data Type, 26 of 26 Controlled Flow and 18 of 18 Data Flow
- One code complexity feature per test case
- Phase 2 CWE's from Phase 2 weaknesses
- All Phase 3 CWE's from Phase 3 weaknesses

The T&E team used the following number of test cases validated during Stage 1 for each performer during Stage 2 tests. **Table 2-7**, indicates the number of test cases per performer.

Table 2-7 Number of Test Cases Per Performer

Performer	Number of Test Cases	Number of iopairs
Columbia	381	10
GrammaTech	478	10
Kestrel	412	10

2.4.3.7 Outcome

Stated Goals for Dry Run Three with results:

- **Simulate full T&E and run 25% of final T&E test cases per weakness class during 5-day time frame**: T&E met this goal because enough data was collected to estimate the time and resources needed for Final T&E. T&E successfully observed the analysis times of two of the performers, the number and size of Amazon virtual machines (VM) and time required to execute 25% of the final T&E test. However, T&E could not validate the workflow of conducting scalable tests for final T&E because GrammaTech tests exceeded the allotted 5-day period due to stability issues stemming from a Network File System (NFS) share which caused their Amazon Execute machines to intermittently get stuck rebooting.
- **Test every combination of Base Program, Injection Point and Taint Source for each language (Java: 180 combinations, C: 240 combinations)**: T&E did not meet this goal because not all base programs were used and not all injection points were successful. However, each taint source was successfully injected into each program.
- **Validate that implementation of database is scalable for queuing test cases**: T&E met this goal and used 17 terabytes (TB) for the database in DR3 (included development, IV&V tests, etc.). For Final T&E T&E will split the database into 3 separate databases, one for each performer, with 20TB each.
- **Validate aggregation of scoring results for final T&E**: T&E met this goal by building scripts to query the database for aggregate scoring results. T&E will provide these scripts to the performers to view the test status themselves during Final T&E. Also, T&E will add a calculation for the Confidence Level/Margin of Error per weakness class as tests are conducted for Final T&E.
- **Generate mock/straw man T&E Report to assure content and layout for final report**: T&E met this goal by creating an outline for the Final T&E Report and verified that T&E could collect the necessary data for the report.
- **Validate performance testing**: T&E met this goal after the Stage 2 test cases were completed for each performer. T&E recorded the results and scripts to automatically tabulate this data are being developed.

- **Validate learning implementation in TEXAS**: Although a learning approach was implemented in TEXAS, it was tabled during DR3 because none of performers implemented anything for it yet.
- **Test technologies using both release (production) and test modes**: T&E met this goal. The original set of test cases was added without the release mode flag and any duplicate runs of test cases were added with the release flag.

Dry Run 3 also captured scoring results for each execution of the I/O pairs of a test case in order to better test the scoring functionality of the system. Because the data was captured, the T&E team processed it in a manner similar to how it would be analyzed and presented after final T&E. While these DR3 results are accurate, the performers were still modifying their technologies and in many cases were using beta version technology. As such, these results should not be taken as indicative of the actual capabilities of the performer technology. Dry Run 3 was intended to be a test of the scalability and throughput of TEXAS, which was very successful, to validate planning for final T&E.

2.4.4 Manual Testing to Check Altered Functionality

This section summarizes the information from the following document(s), and it is recommended that the reader reference this documentation for more information:

- STONESOUP Manual Testing For Altered Functionality Report – November 2014

2.4.4.1 Purpose

The purpose of the manual testing is to further test altered functionality form the user's perspective on selected Base Programs. The STONESOUP project includes extensive, automated testing of the three protective technologies under development. The Manual Testing effort was added to augment and reinforce this effort, while providing early user-feedback to the software development teams. It also placed a human in the testing loop. This facilitated direct observation of impacts to the user experience possibly introduced by the STONESOUP performer technologies, and illuminated the process whereby a user could use the Texas software to launch the base programs for demonstration or test.

2.4.4.2 Objectives

The object is to help the Performers correct their mitigations that alter program functionality. This is not intended for 100% code coverage of all functions.

- Observe and report on the performance of a limited set of base programs in both the unhardened (of-the-shelf) and the hardened (with performer technology applied) configurations.
- Provide immediate feedback to the software development Teams.

2.4.4.3 Approach

In order to exercise each of the three development team's unique technology, an Amazon Web Services (AWS) instance was created on which that technology had been installed and configured by each of the three development teams. In some cases, it was also necessary to implement firewall rules allowing remote access to these virtual machines (VMs) from inside protected networks.

The three VMs were configured as shown in **Table 2-8**.

Table 2-8 VMs Configured for Performer Manual Testing

	Columbia	GrammaTech	Kestrel
Tech Name	MINESTRONE	PEASOUP	VIBRANCE
OS	CentOS 6.5 (Final) X86_64	Ubuntu 12.04 LTS 64 bit	Ubuntu 12.04 LTS 64 bit
Memory	29.3 GiB	29.7 GiB	119.8 GiB
Processors*	8	4	16
Base Program	Wireshark	Wireshark/Gimp	Apache Lenya
*All processors are Intel Xeon CPU E5-2670 v2 @ 2.50 GHz			

Each VM was configured to use a remote desktop service so that visual interactions (GUIs) could be monitored. The software selected for this purpose is the open-source client-server package called NoMachine, but others are possible. For the purposes of this testing, the NoMachine client was installed and configured on any local computers wishing to observe the remote system's desktop.

Manual testing employed the TEXAS python package to analyze (compile) – and then run -- the target base programs. First the Texas software was used to analyze (compile) the target base program with and without the STONESOUP hardening technologies. This analysis is referred to, respectively as "Stage 1" and "Stage 2" where stage 2 includes the protective technology. For manual testing, shell scripts were then created to execute the Texas command line interface with the right arguments in four different configurations: in unhardened (off-the-shelf) configuration, hardened (using STONESOUP tech), automated and manually.

Base programs executed in the 'automatic' configuration used the Texas command line utility and the ten (benign) test cases provided in the 'validation' set. This is accomplished by executing the appropriate shell script and observing the activity of the base program's graphical user interface (GUI).

Details of additional configuration are available in the **STONESOUP Manual Testing for Altered Functionality Report**.

The first manual test of the base programs was to simply reproduce the simplest automatic testing by hand. The Texas command line interface (texas_cli) was used in execute mode against the compressed archives used for validation (found in /opt/share/bases). By physically observing the action of the python-scripted Sikuli code, we were able to verify basic execution and confirm or deny results of automated testing.

The second manual test of the base programs was to again use the Texas command line interface but to execute it against the modified compressed archive that would allow for essentially unlimited user interaction with the base program GUI.

Each test was conducted for record five times for each system. The observed results were identical each time.

2.4.4.4 Outcome

Stated Goals and Results:

1. **Observe and report on the performance of a limited set of base programs in both the unhardened (of-the-shelf) and the hardened (with performer technology applied) configuration:** The results of this goal are described below in detail and summarized here.
   - **Columbia's** MINESTRONE system introduced a five minute startup delay and significant sluggishness to the user interface. When asked to ingest a 150 megabyte

(MB) packet capture file, the system consistently froze. Unhardened Wireshark did not freeze when asked to process the same file. Unhardened Wireshark experiences no startup delays or GUI sluggishness.

- **GrammaTech's** PEASOUP system could not successfully pass TEXAS phase 2 analysis on Wireshark or GIMP and therefore could not be assessed during the testing period. It should be noted that they currently do pass, but too late for evaluation.
- **Kestrel's** VIBRANCE system was tested using the Apache Lenya web content management software. There was no measurable impact to the program's functionality or its user experience. No delays were introduced. There was literally no indication that the hardened version was in use outside of internal TEXAS log information.

2. **Provide immediate feedback to the software development Teams***:* A collaboration space was established using the Atlassian JIRA bug-tracking software and observations were recorded there as they were made. The development teams had unrestricted access and could exchange ideas freely. Concurrent direct email correspondence with the development teams was also used and seemed to be preferred.

- **Columbia – MINESTRONE**

The base program initially targeted for testing with this technology was Wireshark, because it is C-based and has a graphical user interface. Stage-one and stage-two testing completed successfully.

Stage-two, hardened, execution currently exhibits some behaviors worthy of note. Upon initial execution, a sizeable delay occurs. This delay is on the order of a minute or two. Many of the automated tests fail, possibly due to a timing mismatch in the automated testing scripts.

In manual testing, the delays associated with routine user actions like menu pull-down and selection are significant. The 'contrail' of the mouse is clearly visible when moving it on the screen, two pointers are momentarily visible. Delays of a few seconds often occur in the response to such selections. However the program is usable.

It was initially impossible to execute a live packet capture due to the inability to specify a network interface on which to execute the capture. The development team responded with a fix that made that possible. Unfortunately, this also exposed the behavior wherein the hardened Wireshark toll consistently froze when asked to process a 150 MB packet capture file. The file was processed easily by unhardened Wireshark.

- **GrammaTech – PEASOUP**

The base program initially targeted for testing was Wireshark, because it is C-based and has a graphical user interface. Stage-one analysis and execution complete successfully. Stage-two, however, does not, and, therefore, no manual testing is possible at this time.

GIMP was substituted for Wireshark, but is failing stage-two analysis. We attempted a developer-suggested workaround wherein the performer_analyze.sh script was modified to allow success even on a skipped test case; however the workaround resulted in what appeared to be GIMP failing to launch completely, so no manual testing of PEASOUP was possible during the manual testing window.

- **Kestrel – VIBRANCE**

  The base program targeted for testing with this configuration was Apache Lenya, because it is Java-based and can use a Graphical interface. Initial testing resulted in failure to execute despite successful analysis and re-compilation by the VIBRANCE software. Upon investigation, it became clear that it was necessary to update the version of the VIBRANCE software on the test platform. This was accomplished readily by the development team.

  After software update, manual testing continued, but halted when a change to the test input files, and thereby a change to the execution flow of the base program occurred. The Texas software would now restart certain processes before each I/O-pair (including the first pair.). This meant the shell script which executed the base program could no longer be run from a terminal window inside the remote desktop. Such a terminal window was in fact being destroyed by the process it started when that process restarted the desktop software it was contained in.

  The new paradigm: In order to execute the base program, a secure shell must be opened, outside of the NoMachine interface, using a program such as Putty, and the script must be executed from within that shell. When this is done, the execution of the Lenya base program, with and without the VIBRANCE protective technology, proceeds smoothly.

  Testing of the Lenya software with VIBRANCE has revealed no impact to the user experience. There is no discernible change in responsiveness with or without the VIBRANCE technology. Some of the ‘good’ I/O-pairs fail in automated testing with a timeout.

2.4.5 Observations, Limitations, and Lessons Learned

The testing methodology developed for the STONESOUP program proved to be adequate for evaluating the performer’s prototypes against Phase Three goals. There were, however, challenges during execution, obstacles to overcome, and opportunities for improvement. Key suggestions or lessons learned for TEXAS are:

- A one-size-fits-all solution for Test and Evaluation is definitely possible
  - However, minor tweaks per performer were necessary
- Interacting with performers and giving them early copies and continuous access to TEXAS was extremely helpful (to both the TEXAS developers and hopefully Performers)
- MongoDB, which is a ‘NoSQL’ database system performed fairly well and convenient to develop since it allows dynamic ragged schemas (not every document has to have every field)
- MongoDB requires learning curve for new developers, especially those familiar with relational databases
  - GridFS (Mongo’s ability to store large files) is useful and can be utilized for large files
  - But it is not necessarily best choice for files that are GB in size
- Logging can produce lots of data very, very fast
- Cleaning up contents of archives to reduce overall size or potentially creating a diff file from original may have been another way to reduce some of data bulk

Key suggestions or lessons learned for Test Data Generation are:

- Automatically seeding vulnerabilities into programs this large usually required modification to base program
- Getting expected behavior of vulnerability in programs this large is exceedingly difficult because the complexity of their architecture can often influence what resources are available at a given point in time (such as standard out/error, files, etc)
- Large programs do some really odd things during both compilation and execution including compiling parts of themselves and then using that to compile other parts of the larger program
- Static linking, standard out, standard error, and error handling get dealt with in lots of different ways in large programs, and are not necessarily consistent even across functions in the same file
- Dynamic linking may have made automated injection require less modification to the base programs
- Injecting a weakness that links to a different copy of itself is sometimes possible and sometimes not (Injection 089 CWEs into PSQL)
- Controlling dependency versions is very useful to ensure consistent and reliable building and execution of vulnerabilities
  - But non trivial task for large programs
- Generating uniform corpus list to actually inject is non-trivial since existing tools for generating corpora may ensure entire population is represented
  - But they do not ensure they are represented evenly (spread)
- Graphical programs are extremely hard to automate because there are so many different variables that can affect them
- Linux does not make automating graphical programs any easier because programmatically operating keyboard and mouse is reasonably considered security vulnerability

2.4.6 Evaluation Schedule

The schedule defined by the risk mitigation testing methodology proved to be rushed without sufficient time or funding to conduct another Dry Run 4, which would have prepared the performers more effectively for final T&E. The methodology could have been improved by adding another dry run which could have executed new test cases that had tracing included in the vulnerability injections. These traces had not been included in any of the other tests for DR1, DR2 or DR3.

Also, the schedule for final T&E proved to be too short to allow performers to fix their technologies as they reviewed on-going results during the month-long testing. The T&E team allowed performers to update their technologies during final T&E provided coordination and concurrence were obtained in advance. However, with more time for final T&E, the T&E team may have been able to re-run all test cases after performers updated their technologies.

2.4.7 Metrics and Scoring

Various observations and limitations were identified with the metrics and scoring processes implemented in the test and evaluation methodology. These issues often were the result of test cases not executing properly, insufficient integration of the proposed technologies, or unpredicted failure states. Specifically, the Rendered Un-exploitable, Increased Runtime, Preserved Functionality, and Weakness Identified metrics had identified issues. **Table 2-9**, describes these issues and how each affected the evaluation results.

Table 2-9 Metric Observations and Limitations

Metric	Observations and Limitations
Increased Runtime	This metric was based only on a single sample from Stages 1 and 2; hence, exogenous variables could skew the results. Examples of such variables include the following: ▪ **Cloud Load** – Varying loads on the AWS Cloud host machines influenced the time allotted to the execution of each test harness, which then influenced the execution time of a test case. ▪ **Test Harness OS Load** – Because each test harness was running on its own guest operating system, the load on a test harness at any time varied resulting in different execution times. ▪ **Network performance** – Some test cases depended on network services, such as HTTP servers and databases. Therefore, varying load and latency of the network influenced the performance of these test cases.
Preserved Functionality	The preserved functionality metric measured whether a proposed technology inadvertently modified normal functionality. However, test case execution failures unrelated to a proposed technology cause incorrect outputs, which caused the test case to be scored as not preserving functionality. For example, a network timeout or the exhaustion of a shared resource (e.g., disk space) during test case execution, causing its failure.
Weakness Identified	Incorrect weaknesses were not scored negatively against the performer. This allowed the performer to report excessive weaknesses in an attempt to increase its overall score.

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3.0 Phase 3 Test Environment

The test environment is a collection of Amazon Machine Instances (AMI), or virtual server machines hosted by Amazon Web Services (AWS). The methodology in constructing an AMI consist of consulting with the performers on the required computing power expected of a server, then translating that to the comparative virtual environment. The TEXAS AMI Instance types are presented below in **Table 3-1**.

Table 3-1 Instance Types

Instance Type	vCPU	Mem (GiB)	Description
m3.medium	1	3.75	This is a general purpose system type with 1 Central Processing Unit (CPU) processors and 3.7575 (GiB**) of Random Access Memory (RAM). It is meant for Small and mid-size databases, data processing tasks that require additional memory, caching fleets, and for running backend servers for SAP, Microsoft SharePoint, and other enterprise applications.
m3.large	2	7.5	This is a general purpose system type with 2 CPU processors and 7.55 (GiB) of RAM. It is meant for Small and mid-size databases, data processing tasks that require additional memory, caching fleets, and for running backend servers for SAP, Microsoft SharePoint, and other enterprise applications.
m3.xlarge	4	15	This is a general purpose system type with 4 CPU processors and 1515 (GiB) of RAM. It is meant for Small and mid-size databases, data processing tasks that require additional memory, caching fleets, and for running backend servers for SAP, Microsoft SharePoint, and other enterprise applications.
m3.2xlarge	8	30	This is a general purpose system with 8 CPU processors and 3030 (GiB) of RAM. It is meant for Small and mid-size databases, data processing tasks that require additional memory, caching fleets, and for running backend servers for SAP, Microsoft SharePoint, and other enterprise applications.
r3.xlarge	4	30	This is a memory optimized system with 4 CPU processors and 30.5gb (GiB) of RAM. It is meant for high performance databases, distributed memory caches, in-memory analytics, genome assembly and analysis, larger deployments of SAP, Microsoft SharePoint, and other enterprise applications.
r3.4xlarge	16	122	This is a memory optimized system with 16 CPU processors and 122122 (GiB) of RAM. It is meant for high performance databases, distributed memory caches, in-memory analytics, genome assembly and analysis, larger deployments of SAP, Microsoft SharePoint, and other enterprise applications.
** Note that the unit GiB (binary Gigabyte) represents 2^30 or 1,073,741,824 bytes. This varies from the unit GB (digital Gigabyte) which is 10^9 or 1,000,000,000 bytes. The 73 MB difference between GiB and GB multiplies with each GiB, growing significant for large numbers of GiB.			

Each virtual machine was configured to meet the needs of the test performers proposed technology that was installed and run on it. **Table 3-2**, shows the performer machine type, instance types, and dry run amounts that the performers used for the testing period.

Table 3-2 Virtual Machine Configurations

Performer	Type	Instance Type	DR1	DR2	DR3	T&E	Description
Columbia	Analysis	m3.2xlarge	3	4	5	8	This is a general purpose system with 8 CPU processors and 30 GiB** of RAM. It is meant for Small and mid-size databases, data processing tasks that require additional memory, caching fleets, and for running backend servers for SAP, Microsoft SharePoint, and other enterprise applications.
GrammaTech	Analysis	r3.xlarge	3	5	25	27	This is a memory optimized system with 4 CPU processors and 30.5 GiB of RAM. It is meant for high performance databases, distributed memory caches, in-memory analytics, genome assembly and analysis, larger deployments of SAP, Microsoft SharePoint, and other enterprise applications.
Kestrel	Analysis	r3.4xlarge	3	5	22	14	This is a memory optimized system with 16 CPU processors and 122 GiB of RAM. It is meant for high performance databases, distributed memory caches, in-memory analytics, genome assembly and analysis, larger deployments of SAP, Microsoft SharePoint, and other enterprise applications.
Columbia	Execute	m3.2xlarge	3	5	20	33	This is a general purpose system with 8 CPU processors and 30gb (GiB) of RAM. It is meant for Small and mid-size databases, data processing tasks that require additional memory, caching fleets, and for running backend servers for SAP, Microsoft SharePoint, and other enterprise applications.
GrammaTech	Execute	m3.large	3	5	24	40	This is a general purpose system type with 2 CPU processors and 7.5gb (GiB) of RAM. It is meant for Small and mid-size databases, data processing tasks that require additional memory, caching fleets, and for running backend servers for SAP, Microsoft SharePoint, and other enterprise applications.
Kestrel	Execute	m3.large	3	5	18	18	(As per above)

** Note that the unit GiB (binary Gigabyte) represents 2^30 or 1,073,741,824 bytes . This varies from the unit GB (digital Gigabyte) which is 10^9 or 1,000,000,000 bytes.

Extensive testing of this environment was conducted leading up to each testing period. This included the dry runs, any integration of test case verification and development tasks into the environment, and targeted experiments focused on the performance of the environment.

Figure 3-1, shows an instance hourly chart over the months of April thru the second week of December of 2014. The stacks are color coded by instance types. One should note that the first week of Nov. had the potential of showing 323,000 hours by the end of the month with only six instances because final T&E was a four-week effort. The actual total number of compute-hours for November was 157,623. The total for the project is 446,786 hours as of December 12, 2014.

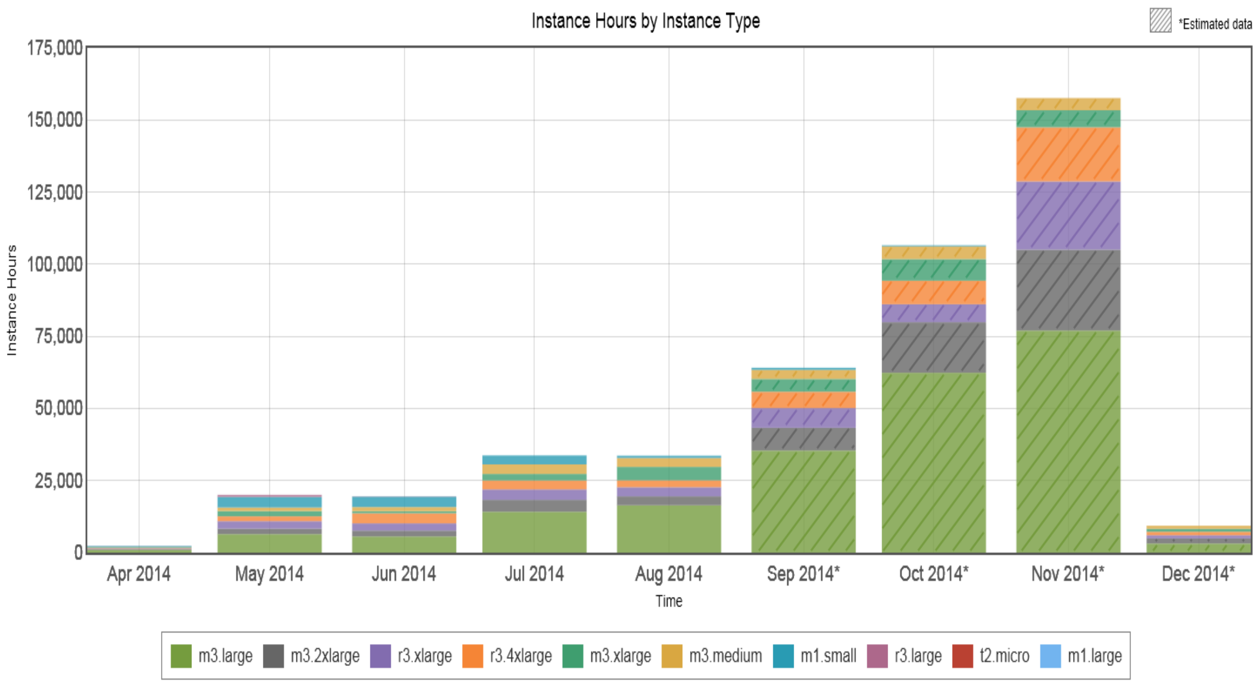

Figure 3-1 An Example of Instance Usage as of 12 December 2014

After creating the environment for the performers, the TEXAS T&E (Test & Evaluation) team created parallel AMI's to test the performance criteria, as presented by the performers. AMI Instances can be created for the Windows or Linux Operating systems. The TEXAS AMI Instances are exclusively created for Linux. In order to connect to the T&E AMI instances, the T&E team used different methods, depending on the operating system. If we were connecting to a Windows Instance the connection type would be Windows Remote Desktop Protocol (RDP). For Linux, the methods vary, from Windows-compatible remote network systems (Public Teletype [PuTTY], Bitvise xterm Secure Shell (SSH), and NoMachine Graphical User Interface (GUI). For Linux or Macintosh users, it was generally the SSH connection method.

- Windows RDP: RDP is a proprietary protocol developed by Microsoft, which provides a user with a graphical interface to connect to another computer over a network connection. The user employs RDP client software for this purpose, while the other computer must run RDP server software.
- PuTTY: PuTTY is an open-source terminal emulator, serial console and network file transfer application. It supports several network protocols, including SCP, SSH, Telnet, rlogin, and raw socket connection.
- Bitvise xterm SSH: Bitvise xterm SSH provides secure remote login capabilities for Linux remote servers to Windows workstations and servers. Bitvise SSH Server encrypts data during transmission.
- No Machine: NoMachine is a remote desktop tool and is also a fast remote desktop GUI for Linux. It provides remote login capabilities to a Linux remote connection.
- Linux SSH: Linux SSH is a cryptographic network protocol for secure data communications, remote command-line login, remote command execution, and other secure network services between two networked computers. It connects, via a secure channel over an insecure network, a server and a client running SSH server and SSH client programs.

3.1 AWS Setup Observations

3.1.1 Creating the Environment based on T&E requirements

- **Creating the basic Virtual Private Cloud (VPC):**

The VPC enables you to launch AWS resources into a virtual network that you've defined. This virtual network closely resembles a traditional network that you'd operate in your own data center, with the benefits of using the scalable infrastructure of AWS. The following steps detail the creation of a VPC. First, you need a BASE Key Pair token, and then you can create additional VPC's as desired.

- **Creating the individual subnets:**

Within each VPC, you can create a subnetwork. A subnetwork, or subnet, is a logically visible subdivision of an IP network. In this case, we have created separate subnets for the TEXAS actors (Columbia, GrammaTech, Kestrel, TEXAS Development). This assures that each created AMI will remain segregated and independent.

- **Creating the Elastic Compute Cloud (EC2) AMI's:**

Elastic Compute Cloud (EC2) is the heart of AWS; it provides scalable computing capacity in the cloud. Amazon EC2 will launch as many or as few AMI's as needed. AMI's are created by using a template, generally known as an AMI Image, then configuring that running AMI as you would a server. Because the template can be reused, you can create multiple AMI's based on one (1) Image. Instances equate to a desktop computer with the following caveats. The Instance Type equates to the CPU and RAM, and the Elastic Block Store (EBS) Storage equates to the computer's hard drive.

- **Creating a file storage system:**

The Network File System (NFS) in TEXAS is a distributed file system protocol allowing a user on a client computer to access files over a network much like local storage is accessed. In this case the NFS system is a way the actors, in their own subsystems, can store and share files. It is created as a subnet AMI, however the network address is used and connected within each individual AMI in that subnet.

- **Creating a Database Server system:**

The current TEXAS database servers use the MongoDB database and a redundant array of inexpensive disks; now commonly referred to as redundant array of independent disks (RAID) 5 configuration. It is also connected to a subnet, like a file system above. This allows the actors to use this system as if it were attached to their instance. To create this type of system, the instance type must be memory optimized with at least 16 GiB of RAM. The EBS requirements are at a minimum, Solid State drives (not Magnetic Based) with advanced and recommended AWS storage as high-cost Provisioned Input Output Per Second (IOPS) fast speed drives.

3.1.2 Connections to the AMIs

- **Connecting to a Windows Instance:**

To connect to a Windows instance, you will need to use Windows Remote Desktop Protocol (RDP) (or Windows Remote Desktop Connection [RDC] for Windows 7 and above). Your Windows computer includes an RDP/RDC client by default, and is in the accessories folder.

When you bring up the screen, the public DNS name of the instance will go in the computer dialog box. To get the public DNS name of the instance , you can use the Amazon EC2 console (check the Public DNS column; if this column is hidden, click the Show/Hide icon and select Public DNS), Or if you prefer, you can use the describe-instances in the AWS Command Line Interface (CLI) or ec2-describe-instances (Amazon EC2 CLI) command.

- **Connecting from Windows using PuTTY:**

PuTTY will connect you to your LINUX instance. PuTTY is a small footprint program designed to establish a secure SSH connection to a remote computer. You can get the PuTTY application in a download from.

http://www.chiark.greenend.org.uk/~sgtatham/putty/

PuTTY uses the Public DNS name and a secure private key file. To get the public DNS name of the instance , you can use the Amazon EC2 console (check the Public DNS column; if this column is hidden, click the Show/Hide icon and select Public DNS), Or if you prefer, you can use the describe-instances (AWS CLI) or ec2-describe-instances (Amazon EC2 CLI) command. Instead of the private key .pem file that you created when you created the instance, you will need the PuTTY generated .ppk key. This can be created using the .pem file and with the supplied PuTTYgen software.

- **Connecting on Windows using Bitvise xterm SSH:**

Bitvise xterm SSH is a method for Windows users to connect to a LINUX instance. It is unique, in that not only do you connect to a remote LINUX terminal, but it allows you to transfer files between your LINUX session and Windows. It is designed for all Windows platforms and supports the following; Secure remote access via console, and Secure remote access via GUI. Bitvise SSH Server allows clients to obtain some of the fastest transfer speeds available. With Bitvise SSH Client, Secure File Transfer Protocol (SFTP) file transfer speeds in the tens of MB/s can be obtained.

- **Connecting on Windows using NoMachine GUI:**

NoMachine is a Windows GUI that allows you to connect to your LINUX session as a VM. Its interface is the same as if you had a LINUX computer to use. All of the applications you can use on a LINUX GUI connection are available in the NoMachine connection.

- **Connecting via Linux SSH:**

SSH will allow you to connect to your instance. If you are on a LINUX or MAC, this method allows a secure connection. This is established with a Key file and Key-pair handshake. This method uses the CLI interface in the system that you use to connect. This system uses the Public DNS name and a secure private key file in the connection command to establish a link.

3.1.3 AWS Maintenance Issues

- **Installing the Linux AWS Command Line Interface (CLI):**

The AWS CLI is a unified tool to manage your AWS services. With just one tool to download and configure, you can control multiple AWS services from the command line and automate them through scripts. Over a dozen of the AWS services can be accessed using this tool. To install it visit:

http://docs.aws.amazon.com/cli/latest/userguide/installing.html

- **Installing the EC2 CLI:**

Amazon EC2 CLI is a subset of the AWS CLI application. The Amazon EC2 CLI tools wrap the Amazon EC2 API actions. These tools are written in Java and include shell scripts for Windows and Linux, OS X, or Unix. A list of these can be found here: **http://docs.aws.amazon.com/AWSEC2/latest/CommandLineReference/command-reference.html**.

To install the application, visit:

http://docs.aws.amazon.com/AWSEC2/latest/CommandLineReference/ec2-cli-get-set-up.html

- **Installing the CloudWatch CLI:**

As with the EC2 CLI, the Amazon CloudWatch CLI is a subset of the AWS CLI application. Amazon CloudWatch is a monitoring service for AWS cloud resources and the applications you run on AWS. You can use Amazon CloudWatch to collect and track metrics, collect and monitor log files, and set alarms. Amazon CloudWatch can monitor AWS resources such as Amazon EC2 instances, Amazon DynamoDB tables, and Amazon Relational Database Service (RDS) instances, as well as custom metrics generated by your applications and services, and any log files your applications generate. To install the CloudWatch CLI, use this link:

http://docs.aws.amazon.com/AmazonCloudWatch/latest/cli/SetupCLI.html

3.2 Initial EC2 Service Limitations

- **Instance Limits:**

When you get an Amazon account, your limits on the amount of instances are small. The normal startup limitation is 20 general instance types (i.e. c3.x and m3.x) and about 2 specialty instance types (r3.x, i2.x and cr1.x). To increase these you need to request a 'Limit' Increase from the EC2 management console.

- **EBS Limits:**

The initial EBS limit(s) are; Provisioned IOPS (40,000), Provisioned IOPS (Solid State Drive [SSD]) volumes in Terabytes (TiB) [20], General Purpose (SSD) storage; 20 TiB, and Magnetic storage; 20 TiB. Again to increase these limits you will need to request a 'Limit' Increase from the EC2 management console.

- **Network Limits:**

Amazon network limits include; 5 EC2-Classic Elastic IPs, 5 EC2-VPC Elastic IPs, 50 Rules per VPC security group, 5 VPC security groups per elastic network interface, 5 VPCs, 200 subnets per VPC, 100 Security groups per VPC, 200 Network Access Control List(s) (ACL) per VPC, 20 Rules per network ACL, 200 Route tables per VPC, and 50 Routes per route table.

- **Auto Scaling Limits:**

Include both Auto Scaling Groups (20) and Launch configurations (100).

- **Minimal Video memory:**

AWS has a default limit of 4MB of RAM for video usage. This lead to an issue with the X Display. The X Display for Ubuntu, lightdm and its desktop Unity are somewhat fragile on this amount of video RAM. The Ubuntu 'Unity' desktop software will often crash when it has access to only 4 MB of video RAM.

- **Lag Time:**

Depending on the geographic location of the performer, there was significant network delay in response time when accessing an Instance. This was particularly true in the case of Kestrel in Northern California. To mitigate this we established T&E instances in California.

- **Bandwidth:**

In AWS, smaller instance types have smaller bandwidth. This is tied to the instance type, and is not adjustable. Low corresponds to 50Mb/s, Moderate corresponds to 300Mb/s and High corresponds to 1Gb/s

3.3 AWS Observations and Lessons Learned

Observations for Amazon Web Services (AWS) include:

- T&E made machines available to the Performers throughout the entire length of Phase 3
- T&E scaled up to as many as >200 virtual machines during November
- T&E was able to quickly and effectively add virtual machines as necessary
- T&E used five different subnets: one development, two Kestrel (N. VA and N. CA), one GrammaTech, one Columbia
- T&E provided Network File Shares to each of the machines
  Amazon Web Services has instance limits that prevent a single account from spinning up large numbers of boxes without some prior coordination. These instance limits can be by instance type or by group of instance types and should be coordinated with Amazon at least 2 days prior to actual event.
- Instance types (i.e., # of CPUs and memory) can be dynamically changed on stopped instances
- Elastic Block Storage (EBS) can only be allocated in up to 1 TiB[1] blocks

Key suggestions or lessons learned for Amazon Web Services (AWS) are:

- **Redundant Array Of Independent Disks (RAID):**

  Must be utilized for larger disks on AWS.

- **EBS Volumes:**

  Cannot be resized once created.

- **Provisioned IOPS (I/O per second) Blocks:**

  Are available and useful for databases but can be pricey.

- **Using Instance backed storage (ephemeral):**

  Means that they cannot be stopped without losing the volume.

[1] **Note**: 1 TiB is Amazon's TeriByte = 1024 GiB = 2^12 bytes, whereas 1 TB = 1000 GB

- **Network traffic:**

  On instances network traffic is variable depending on instance type.

- **Throttled Bandwidth:**

  Affects smaller instances more.

- **Not Being Able To Directly Access Console:**

  Is problematic when dealing with disk issues, or even boot issues.

- **Waiting To Mount NFS Shares, Resizing Disks, Degraded RAID Arrays)**

  Rebooting, stopping or starting virtual machine from web interface is not immediate and can take 2 to 3 minutes to actually run command on VM.

- **Default Xen Configuration Of 4 MB Of Memory:**

  Amazon uses for this small 4MB of memory for local display which can cause issues for Linux distributions with memory-hungry graphical environments.

- **Rebooting Machines:**

  Can take significantly longer in AWS.

- **Dedicated Instances:**

  Are optional in AWS but they are expensive (would have been 679% increase).

- **Limit Increases**:

  Coordinate with AWS, at least two days prior to the desired increase. In spite of this, it is always prudent to plan these increases well in advance of the actual event. To view your current limits, go into the amazon console, go to the EC2 dashboard, and select limits in the upper left corner. You will then be able to view, not only the instance limits, but the EBS (Disk volumes), Networking, and auto-scaling limits as well. To request an increase of any element, press the 'Request Limit increase' link on the right of the item.

- **EBS Increases:**

  Since the initial EBS limit is set to 50 TiB, we needed to increase this amount, as we have created 3 Mongo DB databases that have 20 TiB RAID storage devices. This is requested as above, via the Limit increase function in the AWS console.

- **Creating multiple AMI Images:**

  Multiple numbers of Amazon AMIs can be started simultaneously from a cloned image. This allows rapid builds of AMIs. With the time saved, any additional configuration efforts can begin earlier.

- **Instance Availability:**

  During normal AWS operations, an Instance type may become unavailable in a particular Availability Zone (AZ). The capacity is always fluctuating in any zone during operation. To solve this you must create a subnet in your Virtual Private Cloud (VPC) that points to another AZ. Create the instance based on that AZ and the issue is rectified.

- **Using Shell Scripting:**

To configure each AVMI, it takes time to manually enter CLI functions. However, using shell (or bash) scripts, you can automatically run these commands. This saves time and effort in the configuration process.

- **Changing the Instance Type:**

Using the AWS console (or AWS CLI), you can change the instance type in a stopped AMI. This is important, in that you do not have to recreate the AMI, and it retains the data and configuration when it is stopped. The instance type determines the amount of CPUs, the available RAM and the optimization Type (i.e., Compute, Graphics, Memory, or Storage Optimized) that are available.

- **Networking:**

Smaller instances have throttled network bandwidth that can affect how quickly test cases can be run. This is not an adjustable parameter and is tied to the instance type.

- **Subnet Connections:**

The initial subnet is created without access to the internet in the initial route table. Without internet access you will not be able to connect to the attached instances in this subnet. The new route table must have the internet gateway (IGW) destination installed.

- **Metrics and Scoring Processes:**

Various observations and limitations were identified with the metrics and scoring processes implemented in the test and evaluation methodology. These issues often were the result of test cases not executing properly, insufficient integration of the proposed technologies, or unpredicted failure states. Specifically, the Rendered Un-exploitable, Increased Runtime, Preserved Functionality, and Weakness Identified metrics had identified issues. **Table 3-3**, describes these issues and how each affected the evaluation results.

Table 3-3 Metric Observations and Limitations

Metric	Observations and Limitations
Increased Runtime	This metric was based only on a single sample from Stages 1 and 2; hence, exogenous variables could skew the results. Examples of such variables include the following: ▪ **Cloud Load** – Varying loads on the AWS Cloud host machines influenced the time allotted to the execution of each test harness, which then influenced the execution time of a test case. ▪ **Test Harness OS Load** – Because each test harness was running on its own guest operating system, the load on a test harness at any time varied resulting in different execution times. ▪ **Network performance** – Some test cases depended on network services, such as HTTP servers and databases. Therefore, varying load and latency of the network influenced the performance of these test cases.
Preserved Functionality	The preserved functionality metric measured whether a proposed technology inadvertently modified normal functionality. However, test case execution failures unrelated to a proposed technology cause incorrect outputs, which caused the test case to be scored as not preserving functionality. For example, a network timeout or the exhaustion of a shared resource (e.g., disk space) during test case execution, causing its failure.
Weakness Identified	Incorrect weaknesses were not scored negatively against the performer. This allowed the performer to report excessive weaknesses in an attempt to increase its overall score.

- **Using common storage between actors:**

To communicate between actors (Columbia, GrammaTech, Kestrel, and Development), you will need to create a separate instance, and or a separate security group, then use the security groups to communicate with the new instance. Each group connection is independent by nature.

- **Use of On-Demand vs On-Demand/Dedicated VM instances:**

T&E encountered slow responses and problems in rebooting VMs which is now suspected to be due to AWS shared residency. That is, T&E shared computing hardware with one or more other users, which may have caused slower response times. T&E could have mitigated this problem by purchasing on-demand and dedicated VM instances from AWS, but chose not to do so due to higher cost.

The VM instances used during the final T&E consisted of on-demand instances of m3.medium, m2.large, m3.xlarge, m3.2xlarge, r3.xlarge, and r2.4xlarge. Just during the first week of the final T&E test, the on-demand fee was about $13k. The use of a dedicated set of instances would have cost 10% more plus a utilization fee of $2/hr. Had that week been with a dedicated set of instances the fee would have been about $91K, or a 679% increase!

- **Additional Suggestions from Amazon Web Services Personnel**

DynamoDB is an alternative to MongoDB and is suited for applications that require a high volume of requests per second to a NoSQL database. This can be accomplished because the data that is stored in DynamoDB is replicated in at least 3 availability zones (a.k.a data centers) which increases its performance, durability, and availability by distributing CRUD (Create, Update, Delete) operations across multiple servers while still maintaining data integrity.

For heavy I/O applications AWS personnel recommended to either use ephemeral storage (local disk space on the instance's host) or EBS Optimized instances that use Provisioned IOPS (IOPS). EBS optimized instances come with a dedicated connection to the EBS volume and Provisioned IOPS guarantees a specific amount of I/O to be available between the instance and its EBS volume.

- **Involve Amazon Staff Early In Architecture Design**

These suggestions from Amazon came too late to be explored during program execution, and may not have improved performance, but the lesson learned is to involve Amazon staff early in architecture design.

4.0 STONESOUP Test and Evaluation eXecution and Analysis System (TEXAS)

The testing methodology calls for a large collection of test cases required an testing infrastructure that could manage the execution of each test case as well as the collection of observables related to each test case's performance. This section summarizes the major components of that infrastructure, known as the STONESOUP TEXAS.

This section summarizes the information from the following document(s), and it is recommended that the reader reference this documentation for more information:

- System Design Document
- Communications API User's Guide
- Rules of Engagement (ROE)
- Collaboration User's Guide
- Command Line Interface User's Guide
- Dry Run Reports

The major components of the TEXAS system design are covered in the System Design Document (SDD). The details include the TEXAS system, Test System Components, Test Cases, Test System Operation.

Phase 3 testing was performed using TEXAS, a system for test automation written in Python developed by the TASC team. This infrastructure provided a command line interface on each machine to invoke test cases and interact with performer technology. The architecture also supported each test machine operating as a daemon and receiving jobs from a centralized database. While no graphical element was developed, the database and the command line interface were documented in the TEXAS CLI Users Guide and the interaction between TEXAS and performer technology was established via a documented API in the TEXAS Communications API Guide.

TEXAS included all the components required to manage and execute test cases during the test and evaluation activity. See **Figure 4-1**, for a high-level view of this infrastructure.

4.1 Test System Components

TEXAS can be operated in two different modes, the command line or in a distributed manner. When it is deployed in a distributed manner is a complex system comprised of several different networks, test hosts, and a central database/file storage machine.

4.1.1 Creating VM Base Image

Creating a base image is the first step in deploying TEXAS on a large scale. A number of different components need to be installed on the base VM image to support the overall deployment of the larger framework.

4.1.1.1 Linux Distribution Template

The Linux Distribution Template is an installation of a chosen Linux distribution in a VM format. The choice of distributions is largely influenced by those supported by the performer technology. Currently Ubuntu 12.04 and CentOS 6.5 only are known to work with TEXAS and the generated test cases so if the performer technology works on those distributions they should be preferred. Creating an image of this once it has been installed simplifies creating additional Test Host Templates in the future.

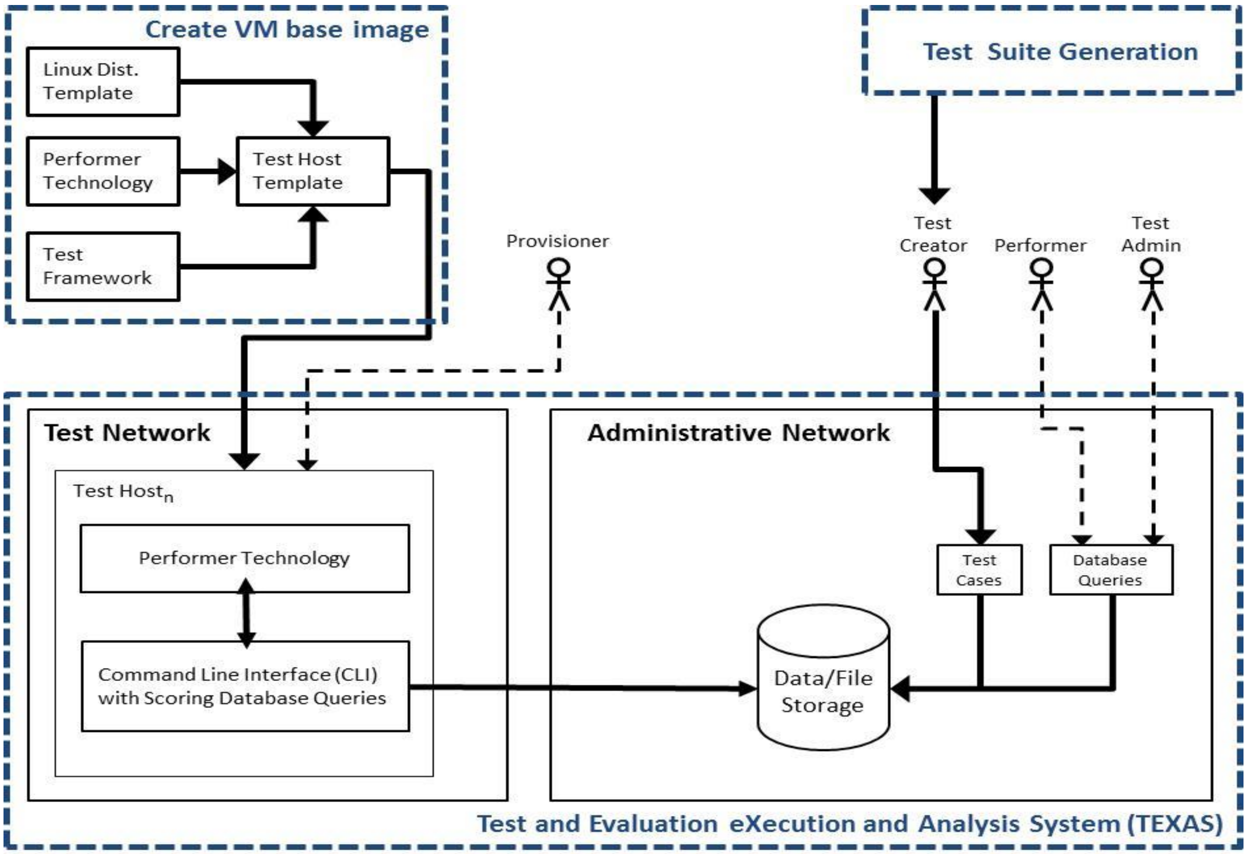

Figure 4-1 Test and Evaluation eXecution and Analysis System (TEXAS) Architecture

4.1.1.2 Performer Technology

Software developed by the performers designed to accomplish the STONESOUP goals of securely using executable of unknown provenance and rendering any exploits or bad behavior benign to the host operating system automatically.

Each Performer technology will be hosted on a machine of appropriate capabilities. Performers will be asked to provide their technology suitable for loading onto the appropriate virtual machine image. These images will be stored for use during test execution and used to initiate test operations without modification and to scale capability as required to meet test load. Each Performer may have unique target machines and/or special requirements to be considered.

4.1.1.3 Test Framework

The Test Framework consists of a Python 2.7.6 virtual environment, the TEXAS Command Line Interface (CLI), and any dependencies needed for the base programs intending to be executed on that instance. TEXAS configuration

4.1.1.4 Test Host Template

Once the Linux Distribution Template has been created, the Performer Technology and the Test framework installed an image can be captured. This image is the Test Host Template that can then be cloned to create a large number of Test Host Instances at need. Test Host

4.1.2 Test Network

The Test Network(s) is where the Test Hosts reside in the TEXAS infrastructure. Each performer was provisioned their own subnet to act as their Test Network throughout the program, this was done to segregate performers and their network traffic from each other. In addition to their Test Host systems, supporting systems like Network File Shares (NFS) systems and in the case of Grammatech, an Interactive Disassembler (IDA Pro) system, resided in the individual Test Networks.

4.1.3 Administrative/Development Network

The Administrative/Development network is where development, IV&V test hosts, and the databases for test cases and results reside in the TEXAS infrastructure. This network is where the majority of TEXAS development and testing occurred. This is also the network utilized for all IV&V activities and for Manual Altered Functionality Testing.

4.2 Test System Operation

TEXAS can be operated in two different modes: command line or daemon. In the command line mode, the user issues one of the available subcommands via the terminal on the Test Host system. This method of operation was utilized for Dry Run 1 and 2 as well as for the majority of testing by both the development team and the performers. More information about the specific subcommands that are available can be found in the **TEXAS Command Line Interface User's Guide**.

In this mode of operation, TEXAS is invoked via a cron job on every reboot after the initial command is invoked. The daemon polls the configured database on a configured queue for jobs. Once a job has been selected, the daemon downloads the needed files, executes the job and reports the results back to the database. Operating TEXAS using the daemon functionality was utilized for Dry Run 3, IV&V and Final T&E because of the large number of test cases in the corpus.

4.3 TEXAS Documentation

The TEXAS delivered documentation includes: Systems Design Document, Communications API User's Guide, Rules of Engagement (ROE), Collaboration User's Guide, and the Command Line Interface User's Guide.

4.4 Lessons Learned

Building a new system for Phase 3 was a large undertaking that was not without its own drawbacks. During the course of development and operation quite a few lessons were learned, both about automating tests, and the performer technology itself. Please see the Dry Run Reports for lessons learned from each of the dry runs, following is a summarization of overall lessons learned for Final T&E.

One of the biggest lessons learned, is that interacting with the performers early and providing them continuous access to TEXAS and an environment to test their technology using TEXAS was extremely helpful both to the TEXAS development team and the performers. This interaction and constant use meant that bugs were normally discovered before actual testing occurred and could be patched appropriately,; it also allowed performers to adapt their technologies to the system on a rolling basis as

MongoDB performed well during Final T&E for the most part. Its biggest drawbacks seemed to be that it had a fairly high learning curve for developers used to rational databases (SQL); and

GridFS, it’s inline storage method for large files, was most likely not the best choice for storing terabytes worth of data. Its ability to support dynamic ragged schemas (schema where not every record must have every field) was convenient to develop with.

Additionally, Final T&E produced upwards of 40 terabytes of data. Some of this data came from logging which can produce lots of data very, very fast. Because of this fact, and the fact that a large portion of the files file test case archives remain the same, cleaning up the contents of the archives by only archiving certain folders at certain points in the process would likely have resulted in large space savings. The drawback of that approach though is that reconstituting the environment that a particular execution was run in would be moderately more difficult.

5.0 Test Suite

This section summarizes the generation of test cases for use by the STONESOUP T&E activity during Phase 3.

The success of the STONESOUP T&E activity depended upon the generation of an extensive set of test cases (known collectively as the Test Suite) that covered the weakness classes and software classes selected by the performers. The T&E activity used these test cases to evaluate the effectiveness of the proposed technologies and how well they met the outlined goals.

The generation of the test cases is covered in the Test Case Generation Plan (TGP). The details include the Test Data Generation Approach, Axes of Variation, Test Suite Details, Base Programs, and the Independent Verification and Validation (IV&V) Plan.

This section summarizes the information from the following document(s), and it is recommended that the reader reference this documentation for more information:

- Test Data Generation Plan (TGP)
- System Design Document

5.1 Test Suite Specification Approach

An effective test and evaluation activity for the STONESOUP program, Phase 3, requires using test cases that cover a broad selection of individual weaknesses and code-complexity features. Because of the large number of variables that go into creating a test case as well as a finite amount of time to run test cases it was determined that a small subset of the exhaustive corpus of tests could be run.

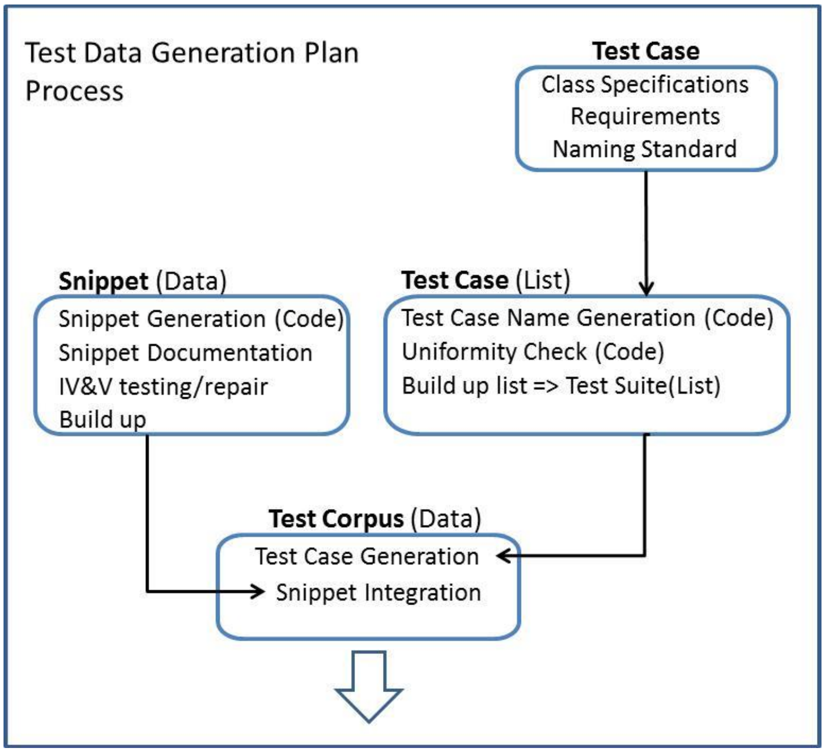

Figure 5-1. Overall Test Data Generation Process

The overall test data generation process and responsibilities are depicted in **Figure 5-1**. The generation of test cases (Test Corpus) is preceded by Weakness Algorithmic Variant (Snippet) data (**Section 7.1.1**) and the Test Suite list (**Section 5.5**). The Test Suite list is also preceded by the Test Case specifications, requirements and naming standards (TGP v1.1 **Appendix B**). The generated test cases are then submitted to the test and evaluation team, and upon verification are added to the overall collection of test cases. This process is repeated for all test cases submitted.

Specifics related to the different types of individual weakness types and code-complexity features are addressed in **Sections 5.2.2** and **5.2.3** of this document.

5.1.1 Description of Uniform Distribution

Because of the large number of axes of variation that make up an individual test case being tested (described in **Section 5.3**) and the number of different options within those axes, the creation of an exhaustive corpus of tests prohibitive in both time and disk space. Due to those concerns a smaller subset of tests must be selected: the distribution of that subset of selected test cases that will be generated and run against the performers. Uniformity, defined as the lowest possible delta between the counts of each of the possible values (or combinations of values) for a configured check; is desirable because it allows the results to be examined for trends with a higher degree of accuracy.

To ensure this uniformity a number of checks were selected to keep the corpus as balanced as possible across these particular axes or combinations of axes. A check is defined as the axes of variations that need to be combined to determine different combinations of values. Each test case selected is then binned according to its different attributes for each check to so that the uniformity across the corpus can be calculated for that particular check. The checks listed below are the combinations used to generate the specification for the corpus used to generate the STONESOUP Phase 3 test cases.

- Control Flow
- Data Type
- Data Flow
- Weakness
- Taint Source
- Weakness Class
- Injection Point
- Base Program
- Data Type/Control Flow
- Base Program/Control Flow
- Taint Source/Data Flow
- Weakness/Taint Source
- Base Program/Taint Source
- Weakness/Data Type
- Base Program/Data Flow
- Weakness/Base Program
- Weakness/Data Flow
- Data Flow/Control Flow
- Taint Source/Control Flow
- Base Program/Injection Point
- Base Program/Data Type
- Taint Source/Data Type
- Data Type/Data Flow
- Weakness/Control Flow
- Taint Source/Data Type/Control Flow
- Taint Source/Data Type/Data Flow
- Weakness/Base Program/Injection Point
- Taint Source/Data Flow/Control Flow
- Taint Source/Data Type/Data Flow/Control Flow

Each of these checks was required to be separately as uniform as possible with the entire collection of checks providing optimum uniformity.

5.1.2 Description of Corpus Generation Algorithm

A number of different tools and algorithms tested before the final algorithm was developed that provided good deltas across large corpora. The uniformity checks listed in **Section 4.1** were invaluable to this algorithm; though additional checks could be added and removed at will to produce a corpus that met the criteria.

The general process for algorithm is to select the least chosen value from the allowed value for an axis of variation, pass that selection and any previous selections for other axes to the uniformity checks to determine if the current set of selections passed all of the uniformity checks collectively. If the value(s) pass all of the uniformity check then the algorithm moves onto the next axes of variations. If the selections do not collectively pass all of the uniformity checks then the next least chosen value is tried and so on until all values for that axes of variation have been tried. If no values are valid then the algorithm falls back to the previous axis and selects a new value and begins the process again (implemented via a recursive call). This process is shown in **Figure 5-2**.

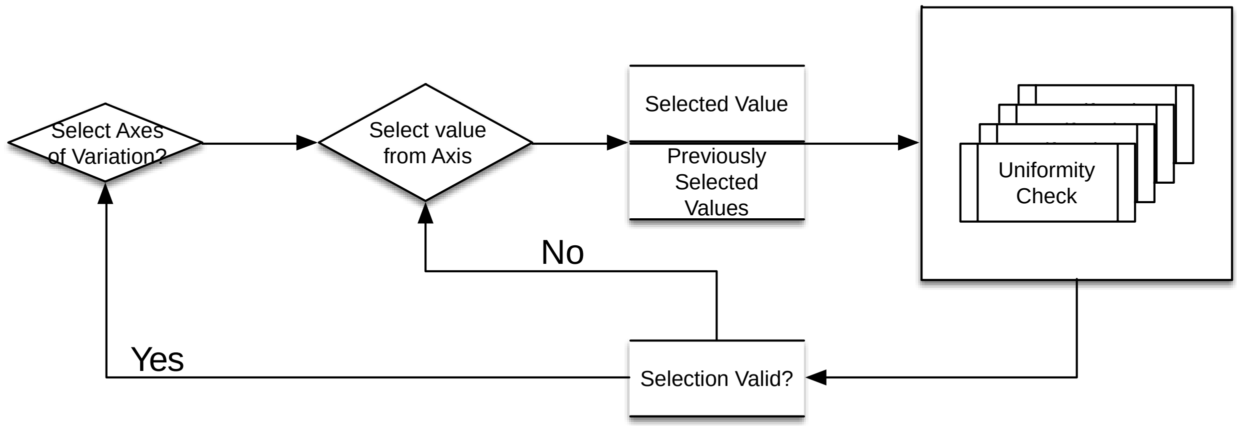

Figure 5-2 Process for Test Corpus Generation Algorithm

This methodology performs fairly well with just that process however eventually it will fail to produce a test case that passes all of the checks if a single delta value is utilized this. To combat this, each of the checks individually was made to calculate how many times it had been failed during the selection of a single test case and increasing the allowed delta by 1 to allow a valid test case to be found. Each of the checks therefore was required to maintain its own delta value such that additional processing was curtailed getting back to the current delta.

Another optimization of the algorithm was to have each check calculate if the values were valid even if all of the columns the particular check required were not present. This was done by finding all of the values in the check that had the selected values for the particular columns and returning a pass on the check if at least one of them was within the current delta. Additional details on the script and the operation can be found in the **Test Corpus Generation Tool User's Guide**.

5.2 Axes of Variation

Each of these test cases was varied in several different ways to produce a unique test case, these different variations, known as axes of variation are described in the following sections. For more information on the individual options please reference the Test Data Generation Plan (TGP).

5.2.1 Language Class

The three language classes are based on 1) high-level operating environment using Type-Safe or Type-Unsafe languages, and 2) low-level operating environment using Binary which is supported by the performer GrammaTech.

Type-Safe languages are defined so that a language is type-safe if the only operations that can be performed on data in the language are those sanctioned by the type of the data. Java is a type-safe language and is supported by performer Kestrel.

Type –Unsafe language is defined as a non-Type-Safe language, as such, exceptions or within limited contexts. For example, the C programming language, as support by the performer Columbia, has issues with a number of common operations. These issues are addressed in the common weakness enumerations (CWE) in **Section 5.2.2**.

Binary language is a low-level language and as such does not a defined issue with data type safety.

5.2.2 Weakness Class

The STONESOUP BAA, used in Phase 3 specified the program's intent to address eight weakness classes in three software languages, resulting in 24 language-weakness combinations as problem areas for performers to solve. Phase 3 continues to address the same eight weakness classes as defined in the Test Generation Report. This report identifies the CWEs across the eight weakness classes as shown in **Table 5-1**.

Table 5-1 Weakness Classes mapped to Language

Weakness Class	Languages
Number Handling	Java, C, Binary
Tainted Data	Java
Error Handling	Java
Resource Drain	Java, C, Binary
Injection	Java, C, Binary
Concurrency Handling	Java, C, Binary
Memory Corruption	C, Binary
Null Pointer Error	C, Binary

Each of the eight Weakness classes and associated CWEs are defined in the Test Generation Report, **Section 3.2** Weakness Class as part of **Section 3.2.1**: Number Handling through **3.2.8**: Null Pointer Error.

The original selections of the CWEs are described in MITRE's STONESOUP Phase 2, Test and Evaluation Final Report, **Section 5.4.3**: Target Weakness Coverage, 13 September 2013. The selection of the CWEs used in Phase 3 differ from Phase 2, by four CWEs in Tainted Data, and the CWEs in Concurrency Handling as shown in **Figure 5-3**. Concurrency Handling was one of the eight weakness classes in the STONESOUP BAA, but was not addressed in Phase 2.

Number Handling	Phase 2	Phase 3
	9	9
190		
191		
194		
195		
193		
197		
369		
682		
839		

Tainted Data	Phase 2	Phase 3
	9	4
015		
023		
036		
041		
239		
470		
606		
626		

Error Handling	Phase 2	Phase 3
	8	8
209		
248		
252		
253		
390		
391		
460		
584		

Resource Drain	Phase 2	Phase 3
	11	11
400		
401		
459		
674		
771		
773		
774		
775		
789		
834		
835		

Injection	Phase 2	Phase 3
	4	4
078		
088		
089		
564		

Concurrency Handling	Phase 2	Phase 3
	18	18
363		
367		
412		
414		
489		
543		
567		
572		
609		
663		
764		
765		
820		
821		
828		
831		
832		
833		

Memory Corruption	Phase 2	Phase 3
	17	17
120		
124		
126		
127		
129		
134		
170		
415		
416		
590		
761		
785		
805		
806		
822		
824		
843		

Null Pointer Errors	Phase 2	Phase 3
	1	1
476		

Figure 5-3 CWEs and Weakness Cases for Phase 2 and 3

The assignment of CWE's to the STONESOUP weakness classes was performed during Phase 1 of the STONESOUP program. The Phase 1 T&E team worked with the government Program Manager to take a subset of the CWE's created and maintained by MITRE and bin them in to the various STONESOUP weakness classes. There are many CWE's that represent weaknesses not covered by the weakness classes, so those CWE's are not included in STONESOUP. Rather, the subset of CWE's chosen are representative of commonly seen vulnerabilities that fit in to each weakness class.

Over the course of the three phases of STONESOUP, the T&E team worked with the government to continually refine the list of CWE's assigned to each weakness class. Some CWE's were deemed impractical to write or simply not able to be rendered concrete by the T&E team. Other CWE's were parents of already included CWE's and caused overrepresentation of some weaknesses within the weakness class. Additional information about the selection or de-selection of CWEs can be found in the Final Test Data Generation Report.

5.2.3 Code Complexity

This section addresses the four sub-groups (a.k.a., parameters) of the code complexity are defined in **Section 3.4** of the Test Data Generation Plan (TGP). These parameters are: Taint Source, Data Type, Control Flow, and Data Flow.

The Source Taint sub-group is commonly referred to in Phase 3 as "taint source" because of its unique parameter value "Socket" being required whenever the weakness class Tainted Data is used. Taint Source is referenced separately from the other three Code Complexity parameters.

As stated in the TGP document, "Different types of control-flow and data-flow complexity can affect a proposed technology's ability to detect a given vulnerability. These complexities should be represented in the collection of test cases to validate the various approaches taken by the proposed technologies and to evaluate their effectiveness against the broad range of coding styles likely to be seen in a real-world environment."

5.2.3.1 Taint Source

Table 5-2, is a list of the Source Taint values (a.k.a., features) and is addressed in more depth in the TGP v1.1 document, **Section 3.4.1**. This parameter represents the different methods that can be used to introduce malicious input into an application. In particular, the focus is on input that could be supplied by, or manipulated by, an attacker (and thereby considered tainted). Additionally the issue of structured versus unstructured data complicates the issue of how data might be introduced to the application being tested because it can be much more difficult to craft a malicious input that can be expressed in a structured data format than it is for an unstructured format. It is the intention that the specific taint source be involved in the flow of code execution from the INTERACTION_POINT to the TRIGGER_POINT.

Table 5-2 Source Taint Features Implementation

Implementable Source Taint Features	
Environment Variable	Java and C
File Contents	Java and C
Socket	Java and C, Client/Server based
Shared Memory	C only

5.2.3.2 Data Type

Table 5-3, is a list of the Data Type values (a.k.a., features) and is addressed in more depth in the TGP v1.1 document, **Section 3.4.2**. Data used in an application is stored in memory using a variety of different constructs and structures. A technology looking to identify and confine flaws must understand these different types of data structures. For the purposes of STONESOUP, these data types must be involved with the flow of the vulnerable code. When working with the Source Taint, they should try to interact with the Source Taint to affect the data flow towards the weakness.

Table 5-3 Data Type Features Implementation

Data Type Features	
Array	Java, C, and Binary
Simple	Java, C, and Binary
Void pointer	Java, C and Binary
Heap Pointer	C and Binary
Struct	C and Binary
Typedef	C and Binary
Union	C and Binary

5.2.3.3 Control Flow

Table 5-4, is a list of the Control Flow values (a.k.a., features) and is addressed in more depth in the TGP v1.1 document, **Section 3.4.3**. Determining that a given weakness is present in an application often involves following tainted input through many different types and levels of control flow. Control flow refers to the order in which individual instructions are executed.

Table 5-4 Control Flow Features Implementation

Implementable Control Flow Features	
CallBack	Java, C and Binary
Indirectly Recursive	Java, C and Binary
Infinite Loop	Java, C and Binary
Inter Class	Java
Inter-procedural	Java, C and Binary
Interrupt	Java
Interrupt Continue	Java
Pointer to Function	C and Binary
Recursive	Java, C and Binary
Sequence	Java, C and Binary
Macros	C only
Setjmp_Longjmp	C only
Unconditional Jump	C only
Break with Label	Java only
Function Invocation Overloading	Java only

5.2.3.4 Data Flow

Table 5-5, is a list of the Data Flow values (a.k.a., features) and is addressed in more depth in the TGP v1.1 document, **Section 3.4.4**. Determining that a given weakness is present in an application often involves following tainted input through many different names and locations as values are passed between blocks of code and transformed or combined to create derived values. Different approaches toward the assessment of weaknesses may or may not be able to follow these variations. Data flow is how the code passes a source input through the program.

Table 5-5 Data Flow Features Implementation

Implementable Data Flow Features	
Address Aliasing	C and Binary
Address as a Constant	Java, C and Binary
Address as a function return value	Java, C and Binary
Index Alias	Java, C and Binary
Basic	Java, C and Binary
Variable Argument List	Java, C and Binary
Address as a linear expression	Java, C and Binary
Address as a non-linear expression	C and Binary
Address as a variable	C and Binary
Buffer Address Array Index	C and Binary
Buffer Address Pointer	C and Binary
Java Generics	Java only

5.3 Test Suite Specification Analysis

This section presents an analysis of the test corpus, illustrates its size and diversity (i.e., test case coverage), and defines the statistical approach to desired number of test cases. Additional information on the Test Suite can be found in the Test Case Generation Plan, **Section 4.0** Test Suite Details. Results of the analysis can be found in **Section 5.5**.

5.3.1 Composition of the Test Cases

The test and evaluation activity needs an extensive set of test cases that cover the weakness classes and software classes selected by performers. This section defines the requirements for the Test Data Generation team to follow in creating test cases to support the Phase 3 test and evaluation activity.

5.3.2 Number of Test Cases

A statistical approach to determine the number of test cases needed to reach a certain confidence level that a performer could mitigate the weaknesses of a particular weakness class was developed during Phase 2. The Phase 2 STONESOUP team desired a one-sided Confidence Level (one-sided because only performance below the desired level is of interest) of 90% (statistical hypothesis testing frequently uses 90% to 95% confidence levels) with an Error

Bound (i.e., margin of error) of no more than one percentage point that would define the number of ttest cases (i.e., sample number) required.).

Statistically a Confidence Level of 90% implies that if a STONESOUP evaluation determines that a technology rendered X% of the target weaknesses unexploitable, and if it was then run 100 more times (using a related but different collection of test cases), the percentage rendered unexploitable would be (X-1)% or better in 90 of those 100 evaluations. For STONESOUP, a 90% confidence level implies that 90% of the confidence intervals would include the true successful test result. It was the choice of the Phase 3 T&E team, as was the case with the Phase 2 STONESOUP team, to choose a confidence level to assure a reasonable certainty of success in mitigating the weaknesses in the weakness class in the testing process.

The margin of error is called the Error Bound for a population mean (abbreviated EBM). The EBM depends on the Confidence Level, where the confidence level is the probability that the confidence interval produced contains a true sample success (i.e., truly represents the total population of all possible test cases). **Figure 5-4**, shows the Normal distribution curve with values of 5 and 15 on the x-axis. Vertical upward lines from points 5 and 15 extend upward to the curve. The confidence interval area between these two points is equal to 90% (i.e., 0.90) of the total area below the curve.

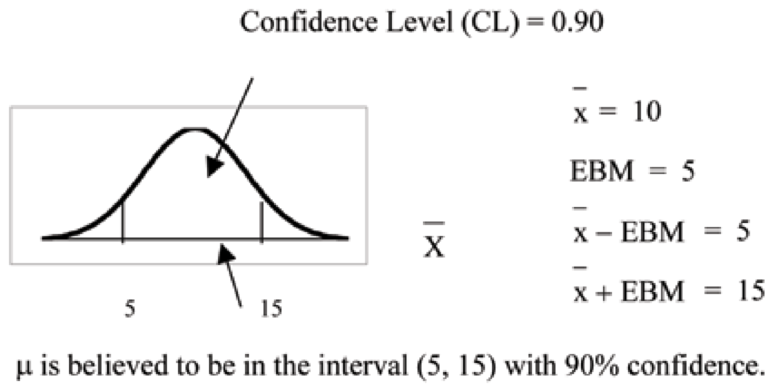

Figure 5-4 Graphic representation of statistical terms used

Depending on the number of test cases (i.e., sample number), statistical methods can be used with a selected Confidence Level to determine the Error Bound associated with an Observed Proportion (i.e., Probability of Success—true sample success). A commonly used method uses the standard normal distribution as an approximation of the binomial distribution, or the Wald Interval. This approximation is considered reasonable when sample sizes are large (>=30) and when the underlying proportion is not close to 0 or 1.

Statistical research has shown a key problem with the Wald Interval is that the confidence interval is incorrectly characterized. Two improvements over the Wald Interval include:

1. Wilson Interval where the actual coverage probability is closer to the nominal value (i.e., value expected on the curve), and
2. Clopper-Pearson interval which is based on the cumulative probabilities of the binomial distribution (i.e., exactly the correct distribution rather than an approximation).

In Phase 1, an analysis of these three methods showed that the difference between the most and least conservative estimates was no more than 1.3 percentage points, with a sample size of 150 test cases. With the aforementioned information in hand, the Wilson Interval method was used since it calculated neither the most nor the least conservative values. Phases 2 and 3 used the 90% Confidence Level plot, which was based on the Phase 1 results of the Wilson Interval.

The graph in Figure 6Error Limits and Sample Sizes defined in Phase 2 assumes the desired 90% confidence level (CL) and shows the lower error bound vs. the number of samples or test cases (N). The multiple plots for observed proportions (probability of success) are from Phase 1 of the STONESOUP program, which indicates that the performers demonstrated observed proportions within the 0.75 to 0.95 range. The term “observed proportion” (P) is the expected number of correct responses (S) (i.e., test cases rendered unexploitable) for a given sample size (N) as shown in the far right side of **Figure 5-5**.

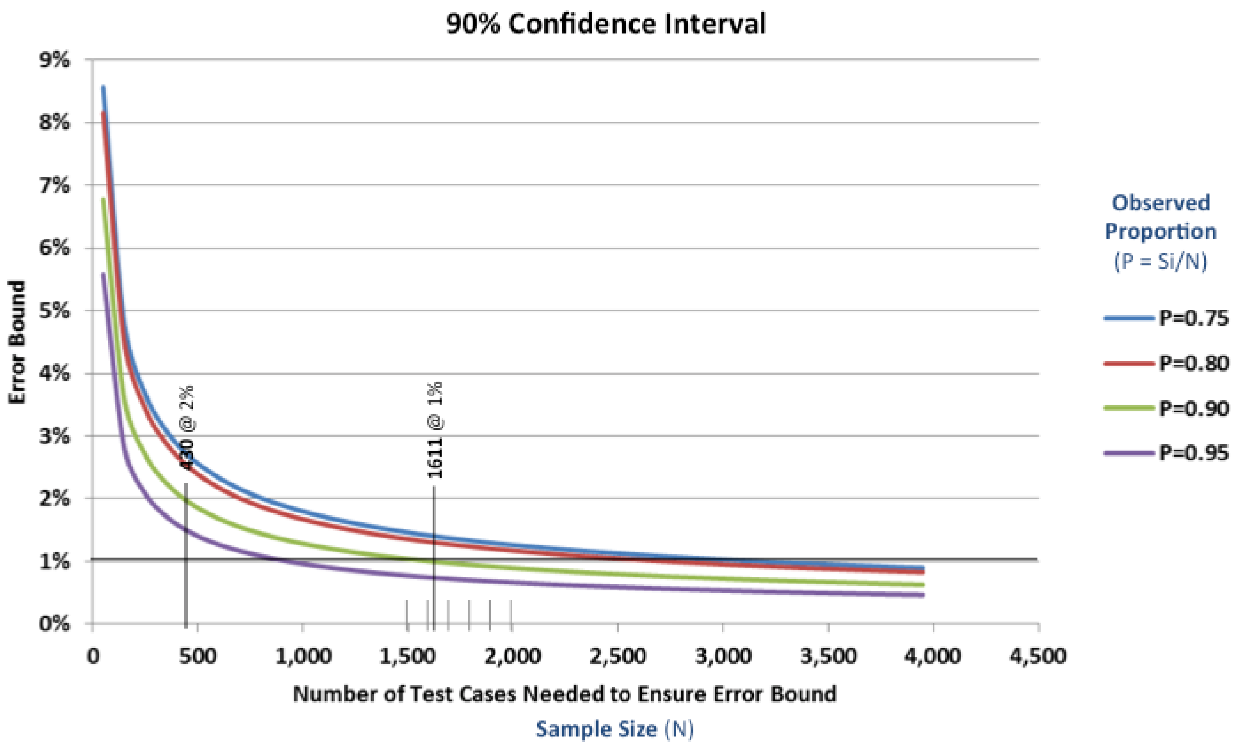

Figure 5-5 Error Limits and Sample Sizes defined in Phase 2/3

Contrary to Phase 1 and 2 results, it should be noted that each performer technology is different and statistically they would not have a constant observed proportion. This is because each technology is associated with different base programs, weakness classes, code complexities, injection points, etc.

Figure 5-5, shows that the observed proportion value is significant when determining the necessary sample size (i.e., test suite size) to achieve an error bound of a given percentage point. In Phase 2, if the observed proportion is 0.75, upwards of about 3,000 test cases are needed. If the observed proportion is 0.95, only about 1,000 test cases are needed, where both used of the same 1% error bound line.

For Phase 2, the observed proportion was estimated to be 0.90 based on results from Phase 1. Combined with a defined Error Bound of 1%, this has resulted in the original sample size (N) of 1611 to be used in Phase 3. Factors including the time required by performers to analyze the larger tests cases, funding to support the necessary infrastructure to run that number of tests and changing client priorities however led to this metric being relaxed to 430 which equates to a 0.90 observed proportion with a 2% error bound sample size (N) of 1611 to be used in Phase 3.

The allowed number of test cases the performer is allowed to skip or not process must also be accounted for when determining the full corpus size. The percentage each performer must process is show in **Table 5-6**.

To provide sufficient test cases so a performer processing only the minimum percentage will still process the desired number of test cases, some additional test cases were generated (**Table 5-7**).

Past experience has shown that even when all test cases are successfully run and processed by the test and evaluation team using the test infrastructure in the test environment, some test cases do not run in the performer's environment or there is some reasonable disagreement about the technical impact of some bad inputs; therefore, these test cases are removed from the final analysis. Enough test cases will need to be generated in anticipation of such situations while still continuing to enable the proposed technology to be scored against the desired target number of test cases per test suite. **Table 5-8**, shows how these additional needs affect the number of test cases that must be generated.

Table 5-6 BAA Benchmarks for the Successfully Processed Metric

Software Class	For Each Test Suite: Percent of Test Cases Successfully Processed
Java	100%
C	90%
Binary	75%

Table 5-7 Calculations for Minimum Number of Test Cases

Software Class	For Each Test Suite: Min # to Process / % to Successfully Processed = Min # of Test Cases Needed
Java	430 / 1.00 = 430 test cases
C	430 / 0.90 = 478 test cases
x86 Linux Binary	430 / 0.75 = 573 test cases

Based on the analysis, each Java test suite should contain a total of 478 test cases. For each C test suite, a total number of 531 test cases are needed. For each x86 Linux binary test suite, a total of 637 test cases are needed, as shown in **Figure 5-6**.

The performers have selected six weakness class/software class combinations for each language. Test cases needed only for these combinations result in a total number of 2,867 test cases for Java, 3,185 test cases for C, and 3,822 test cases for Binary. This would make the grand total 9,874 test cases required.

Table 5-8 Calculations for a Sufficient Number of Test Cases

Software Class	For Each Test Suite: Min # Test Cases Needed/% Expected to Succeed = Adjusted # of Test Cases Needed
Java	430 / 0.90 = 478 test cases
C	478 / 0.90 = 531 test cases
x86 Linux Binary	573 / 0.90 = 637 test cases

5.4 Observations, Limitations, and Lessons Learned

The Dry Run 1 corpus was largely created from the previously designed Phase 2 weaknesses, a subset of preliminary Phase 3 weaknesses and available Phase 3 base programs with good I/O pairs. The purpose of the dry run was to test the functionality of the TEXAS Command Line Interface and also to validate the Test Case Generation framework, which in both cases it was largely successful. Given that it was not extremely balanced it was hard to determine systematic issues for performers unless they were glaring. It was however successful for the goals it was designed to meet. It is recommended though that a more balanced or more deliberate corpus be used for future Dry Runs and final T&E.

5.4.1 Dry Run 1

Producing a test case for each weakness and algorithmic variant into small quickly run programs was immensely useful in testing both the weaknesses themselves, their associated scoring formula and the TEXAS system in general.

5.4.2 Dry Run 2

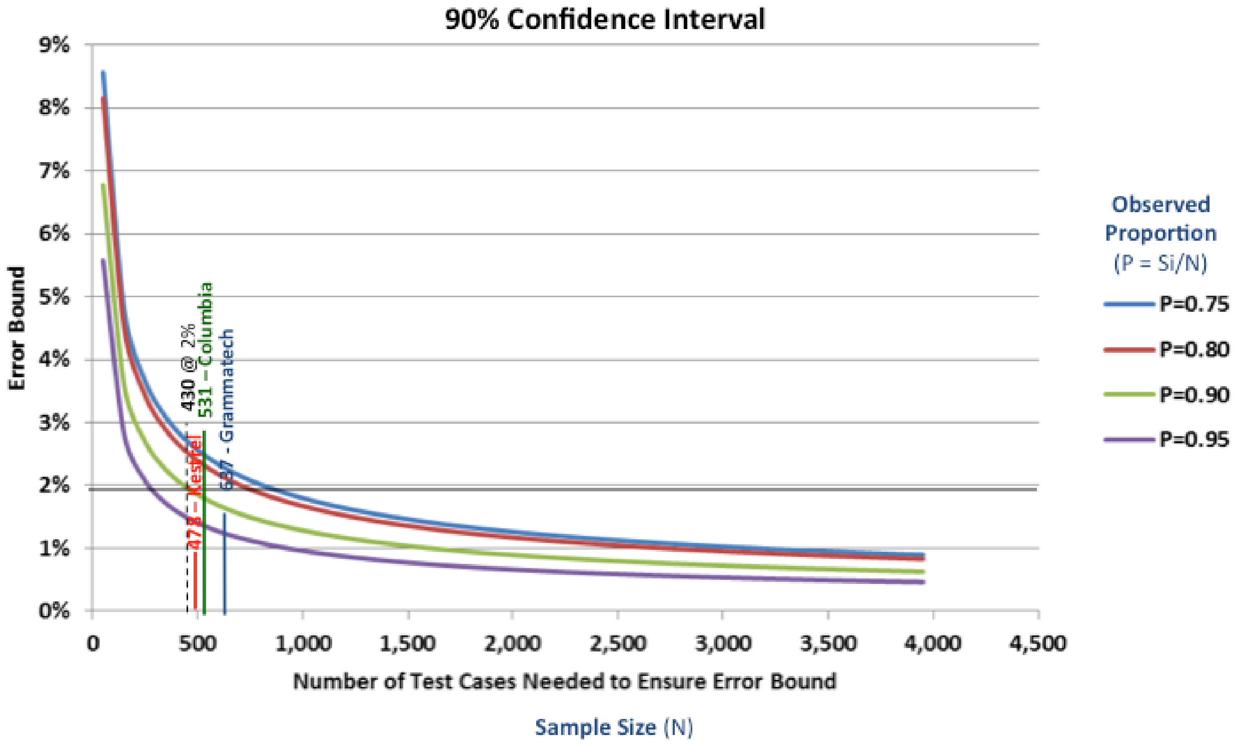

Figure 5-6 Phase 3 Final Test and Evaluation Test Suite Sizes by Performer

Producing a test case for each weakness and algorithmic variant into small quickly run programs was immensely useful in testing both the weaknesses themselves, their associated scoring formula and the TEXAS system in general.

5.4.3 Dry Run 3

Using the same test cases to be used in final T&E really allowed the T&E team to find out where there were issues with the base program packages and where the performers were having more systematic than isolated problems. It also gives performers a preview of what to expect in final T&E which is great in allowing them to prioritize what issues they need to fix before final T&E. Using this strategy would definitely be recommended for future phases.

5.4.4 Final T&E

The corpus generated for final T&E was deliberately developed to be uniform however during generation of the corpus it was determined that some weaknesses could not be injected into certain base programs. While it was unlikely this could have been found beforehand, it did slightly skew some of the corpora when those test cases were reassigned other values to fix the offending value.

5.5 Test Suite List and Uniformity Results

This section shows the associated results for each test suite. This section summarizes the information from the following document(s), and it is recommended that the reader reference this documentation for more information:

- **Final Test Generation Report**

Each corpus below is described by several metrics; the metrics used are the following:
Name – the name of the uniformity check the metrics were calculated for

- Columns – the number of axes of variation in the check (i.e., a single axes has 1 column, a quad has 4 columns)
- Count – the number of unique variations of the column(s) that are applicable (i.e. Control Flow for C has 10 unique variations, Base Program for C has 6, so Base Program/Control Flow has 6x10=60 unique variations)
- Min – the count of the least used unique variation
- Max – the count of the most used variation
- Delta – the difference of the final Min and Max values for the uniformity check
- Max Delta – the largest difference between the Min and the Max values for a uniformity check that was reached anywhere in the corpus

Additionally, each test suite has a chart showing the progression of the delta as progress is made through the test cases in the order they are specified. These charts illustrate the fact that the algorithm used to generate the corpus specification was to an extent self-healing in that it would attempt to lower the delta whenever possible. Each of these test suites had deltas that were acceptable to the client.

5.5.1 Columbia Test Suites

The metrics in this section represent the test suites that were generated for Final T&E.

5.5.1.1 Concurrency

Table 5-9 Uniformity Metrics for Generated Columbia Concurrency Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	52	54	2	3
Data Type	1	7	75	76	1	3
Data Flow	1	11	47	49	2	3
Weakness	1	16	33	34	1	2
Taint Source	1	4	132	133	1	2
Weakness Class	1	1	531	531	0	1
Injection Point	1	10	53	54	1	2
Base Program	1	6	88	89	1	2
Data Type/Control Flow	2	70	5	10	5	5
Base Program/Control Flow	2	60	4	11	7	7
Taint Source/Data Flow	2	44	8	15	7	7
Weakness/Taint Source	2	64	6	11	5	5
Base Program/Taint Source	2	24	18	24	6	6
Weakness/Data Type	2	112	1	6	5	5
Base Program/Data Flow	2	66	4	11	7	7
Weakness/Base Program	2	96	2	7	5	5
Weakness/Data Flow	2	176	0	4	4	4
Data Flow/Control Flow	2	110	1	8	7	7
Taint Source/Control Flow	2	40	9	15	6	6
Base Program/Injection Point	2	60	5	11	6	6
Base Program/Data Type	2	42	8	15	7	7
Taint Source/Data Type	2	28	17	22	5	6
Data Type/Data Flow	2	77	4	8	4	5
Weakness/Control Flow	2	160	1	5	4	4
Taint Source/Data Type/Control Flow	3	280	0	3	3	3

Name	Columns	Count	Min	Max	Delta	Max Delta
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	960	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

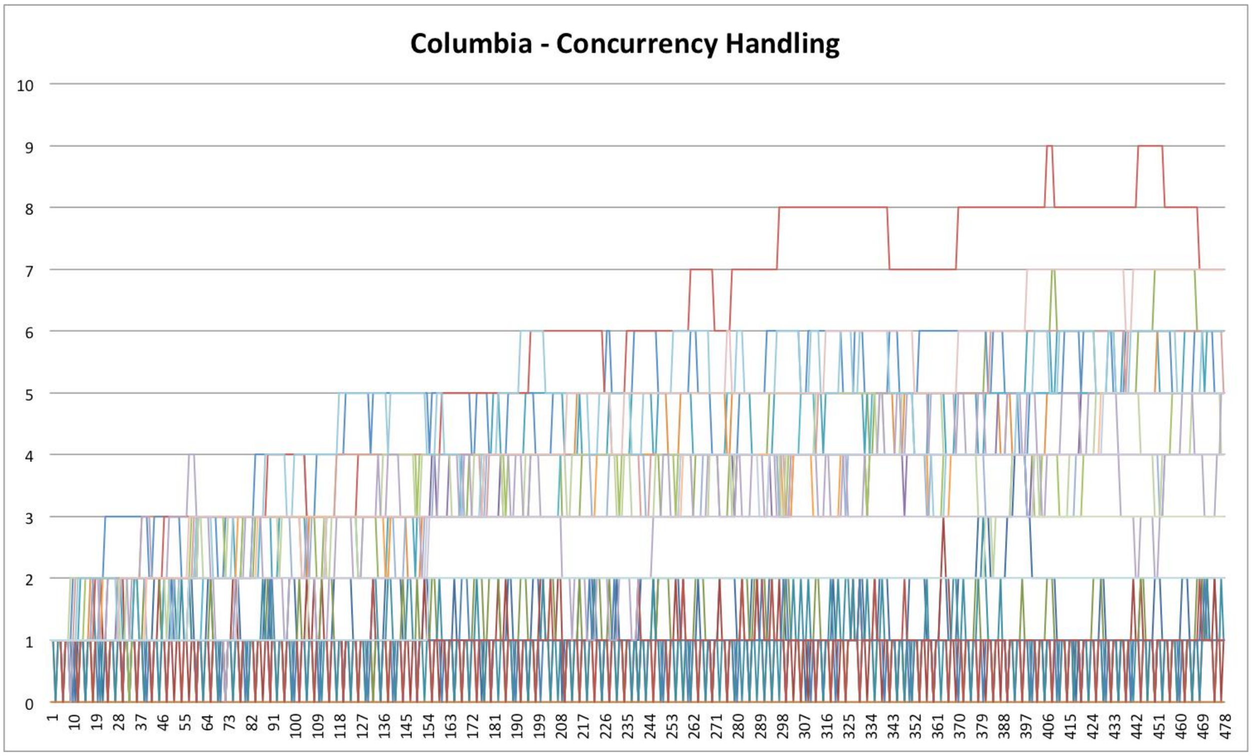

Figure 5-7 Delta Progression Chart for Generated Columbia Concurrency Handling Test Suite

5.5.1.2 Injection

Table 5-10 Uniformity Metrics for Generated Columbia Injection Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	52	54	2	3
Data Type	1	7	75	76	1	2
Data Flow	1	11	47	49	2	3
Weakness	1	8	56	87	31	32
Taint Source	1	4	132	133	1	2
Weakness Class	1	1	531	531	0	1
Injection Point	1	10	53	54	1	2
Base Program	1	6	88	89	1	2
Data Type/Control Flow	2	70	5	10	5	5
Base Program/Control Flow	2	60	5	11	6	6
Taint Source/Data Flow	2	44	7	14	7	7
Weakness/Taint Source	2	32	11	25	14	17
Base Program/Taint Source	2	24	18	25	7	7
Weakness/Data Type	2	56	5	16	11	11
Base Program/Data Flow	2	66	5	10	5	6
Weakness/Base Program	2	48	0	34	34	34
Weakness/Data Flow	2	88	1	13	12	12

Name	Columns	Count	Min	Max	Delta	Max Delta
Data Flow/Control Flow	2	110	2	8	6	6
Taint Source/Control Flow	2	40	11	15	4	4
Base Program/Injection Point	2	60	6	11	5	5
Base Program/Data Type	2	42	9	15	6	6
Taint Source/Data Type	2	28	16	22	6	6
Data Type/Data Flow	2	77	3	9	6	6
Weakness/Control Flow	2	80	3	12	9	9
Taint Source/Data Type/Control Flow	3	280	0	3	3	3
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	480	0	5	5	5
Taint Source/Data Flow/Control Flow	3	440	0	2	2	2
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

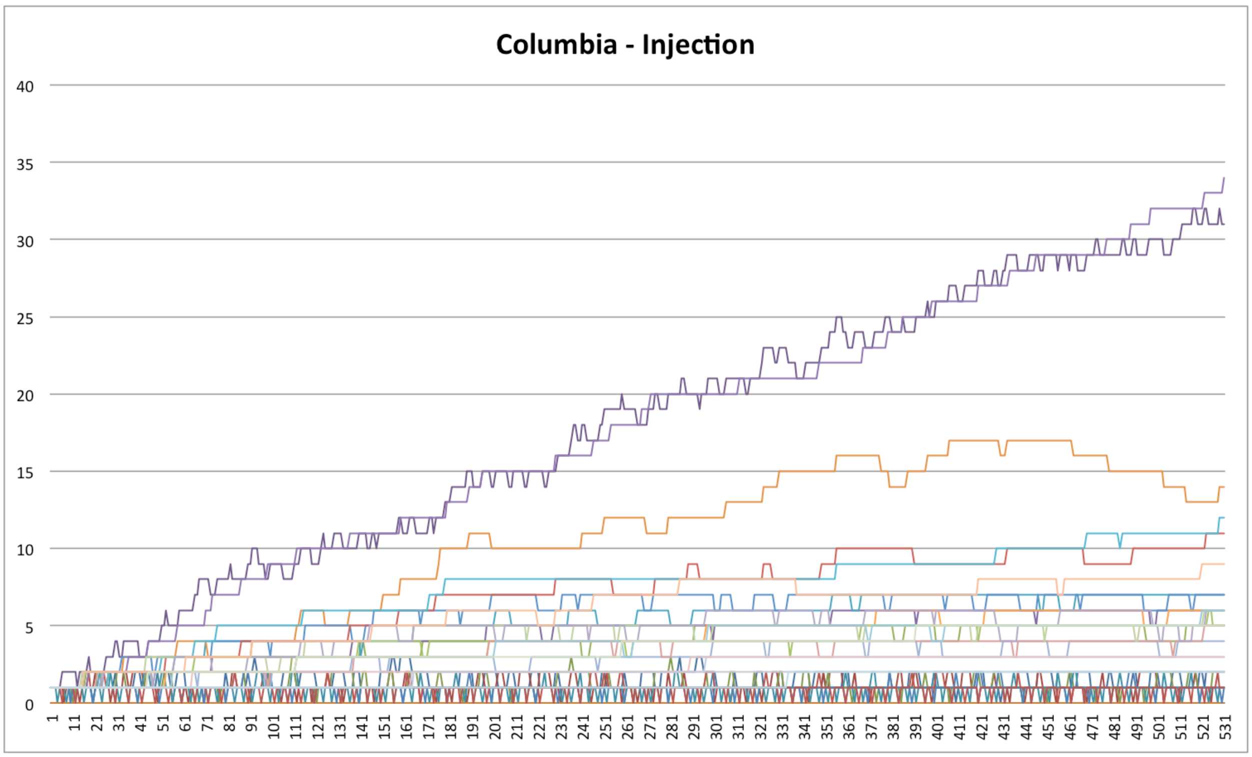

Figure 5-8 Delta Progression Chart for Generated Columbia Injection Test Suite

5.5.1.3 Memory Corruption

Table 5-11 Uniformity Metrics for Generated Columbia Memory Corruption Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	52	54	2	3
Data Type	1	7	75	76	1	2
Data Flow	1	11	48	49	1	2
Weakness	1	41	12	13	1	1
Taint Source	1	4	132	133	1	3
Weakness Class	1	1	531	531	0	1

Name	Columns	Count	Min	Max	Delta	Max Delta
Injection Point	1	10	53	54	1	2
Base Program	1	6	88	89	1	2
Data Type/Control Flow	2	70	4	10	6	6
Base Program/Control Flow	2	60	6	11	5	5
Taint Source/Data Flow	2	44	8	14	6	6
Weakness/Taint Source	2	164	0	5	5	5
Base Program/Taint Source	2	24	20	24	4	4
Weakness/Data Type	2	287	0	5	5	5
Base Program/Data Flow	2	66	4	10	6	6
Weakness/Base Program	2	246	0	3	3	3
Weakness/Data Flow	2	451	0	3	3	3
Data Flow/Control Flow	2	110	2	6	4	4
Taint Source/Control Flow	2	40	10	16	6	6
Base Program/Injection Point	2	60	5	12	7	7
Base Program/Data Type	2	42	10	15	5	5
Taint Source/Data Type	2	28	15	21	6	7
Data Type/Data Flow	2	77	4	10	6	6
Weakness/Control Flow	2	410	0	3	3	3
Taint Source/Data Type/Control Flow	3	280	0	3	3	3
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	2460	0	1	1	1
Taint Source/Data Flow/Control Flow	3	440	0	2	2	2
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	1	1	1

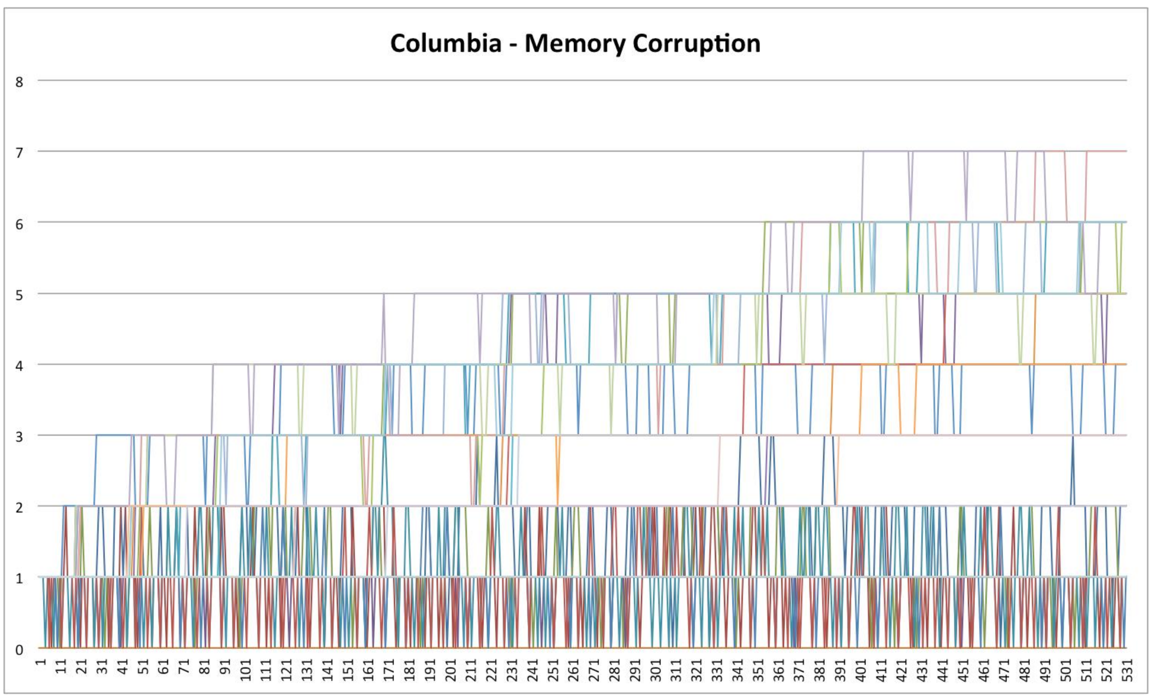

Figure 5-9 Delta Progression Chart for Generated Columbia Memory Corruption Test Suite

5.5.1.4 Null Pointer

Table 5-12 Uniformity Metrics for Generated Columbia Null Pointer Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	53	54	1	3
Data Type	1	7	75	76	1	2
Data Flow	1	11	48	49	1	3
Weakness	1	7	75	76	1	2
Taint Source	1	4	132	133	1	3
Weakness Class	1	1	531	531	0	1
Injection Point	1	10	53	54	1	2
Base Program	1	6	88	89	1	2
Data Type/Control Flow	2	70	4	10	6	6
Base Program/Control Flow	2	60	6	11	5	6
Taint Source/Data Flow	2	44	9	15	6	6
Weakness/Taint Source	2	28	17	21	4	4
Base Program/Taint Source	2	24	18	24	6	7
Weakness/Data Type	2	49	8	13	5	5
Base Program/Data Flow	2	66	4	10	6	6
Weakness/Base Program	2	42	9	15	6	6
Weakness/Data Flow	2	77	3	8	5	5
Data Flow/Control Flow	2	110	1	6	5	5
Taint Source/Control Flow	2	40	11	15	4	4
Base Program/Injection Point	2	60	6	11	5	6
Base Program/Data Type	2	42	9	15	6	6
Taint Source/Data Type	2	28	15	21	6	7
Data Type/Data Flow	2	77	4	10	6	6
Weakness/Control Flow	2	70	4	9	5	5
Taint Source/Data Type/Control Flow	3	280	0	3	3	3
Taint Source/Data Type/Data Flow	3	308	0	4	4	4
Weakness/Base Program/Injection Point	3	420	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

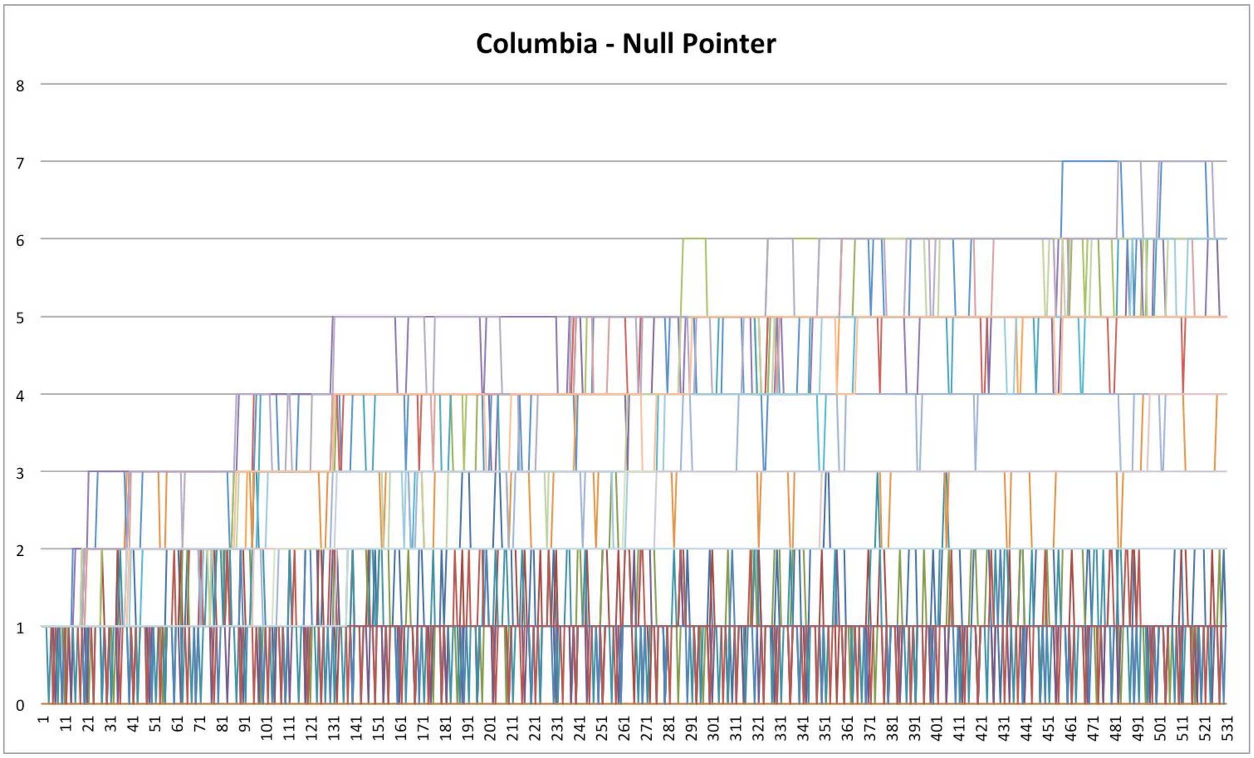

Figure 5-10 Delta Progression Chart for Generated Columbia Null Pointer Test Suite

5.5.1.5 Number Handling

Table 5-13 Uniformity Metrics for Generated Columbia Number Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	52	54	2	3
Data Type	1	7	75	76	1	3
Data Flow	1	11	48	49	1	2
Weakness	1	11	48	49	1	2
Taint Source	1	4	132	134	2	2
Weakness Class	1	1	531	531	0	1
Injection Point	1	10	53	54	1	2
Base Program	1	6	88	89	1	2
Data Type/Control Flow	2	70	4	10	6	7
Base Program/Control Flow	2	60	5	11	6	7
Taint Source/Data Flow	2	44	10	14	4	4
Weakness/Taint Source	2	44	8	14	6	6
Base Program/Taint Source	2	24	19	24	5	5
Weakness/Data Type	2	77	3	9	6	6
Base Program/Data Flow	2	66	4	11	7	7
Weakness/Base Program	2	66	4	12	8	8
Weakness/Data Flow	2	121	1	6	5	5
Data Flow/Control Flow	2	110	1	7	6	6
Taint Source/Control Flow	2	40	11	15	4	5
Base Program/Injection Point	2	60	7	11	4	4
Base Program/Data Type	2	42	8	15	7	7
Taint Source/Data Type	2	28	16	21	5	5
Data Type/Data Flow	2	77	4	9	5	5
Weakness/Control Flow	2	110	2	8	6	6

Name	Columns	Count	Min	Max	Delta	Max Delta
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	660	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	2	2	2
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

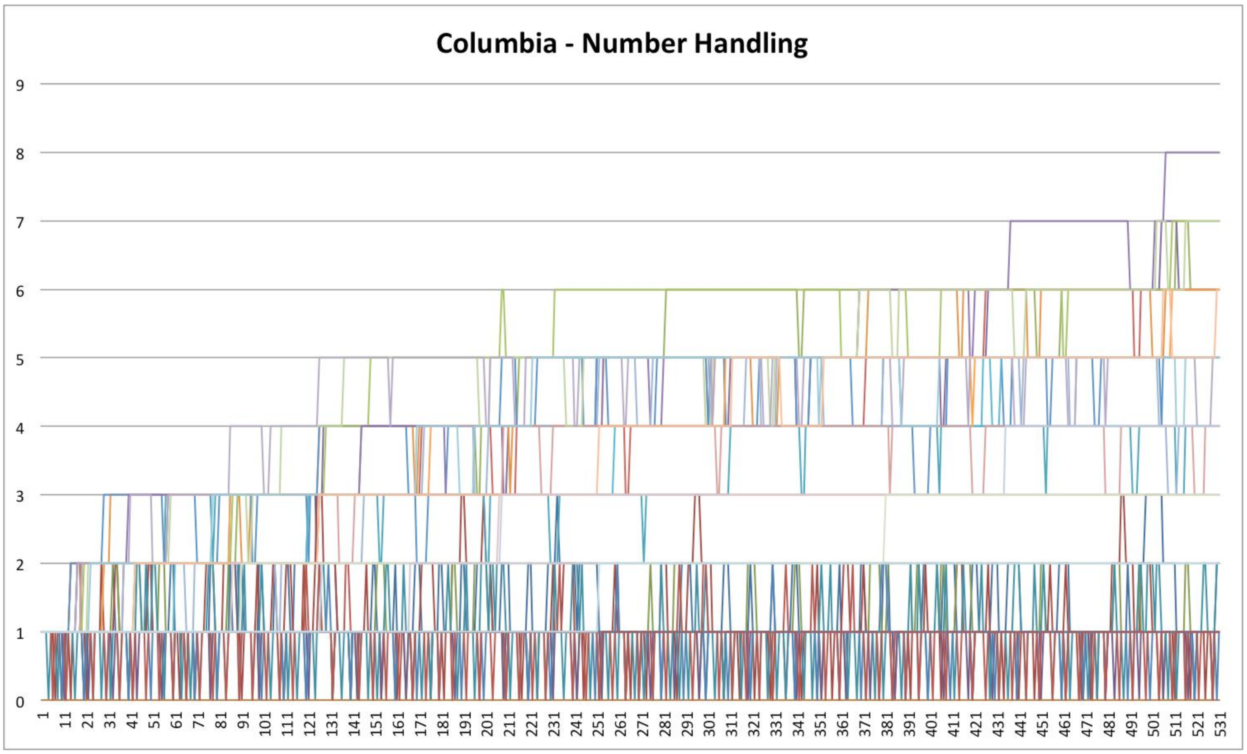

Figure 5-11 Delta Progression Chart for Generated Columbia Number Handling Test Suite

5.5.1.6 Resource Drains

Table 5-14 Uniformity Metrics for Generated Columbia Resource Drains Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	52	54	2	3
Data Type	1	7	75	76	1	3
Data Flow	1	11	47	49	2	2
Weakness	1	12	44	45	1	2
Taint Source	1	4	132	133	1	3
Weakness Class	1	1	531	531	0	1
Injection Point	1	10	53	54	1	2
Base Program	1	6	88	89	1	2
Data Type/Control Flow	2	70	3	9	6	6
Base Program/Control Flow	2	60	4	11	7	7
Taint Source/Data Flow	2	44	8	14	6	7
Weakness/Taint Source	2	48	7	15	8	8

Name	Columns	Count	Min	Max	Delta	Max Delta
Base Program/Taint Source	2	24	18	25	7	7
Weakness/Data Type	2	84	3	8	5	5
Base Program/Data Flow	2	66	5	12	7	7
Weakness/Base Program	2	72	3	10	7	7
Weakness/Data Flow	2	132	0	5	5	5
Data Flow/Control Flow	2	110	1	7	6	6
Taint Source/Control Flow	2	40	10	16	6	6
Base Program/Injection Point	2	60	5	10	5	6
Base Program/Data Type	2	42	8	15	7	7
Taint Source/Data Type	2	28	17	21	4	4
Data Type/Data Flow	2	77	3	9	6	7
Weakness/Control Flow	2	120	1	6	5	5
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	720	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

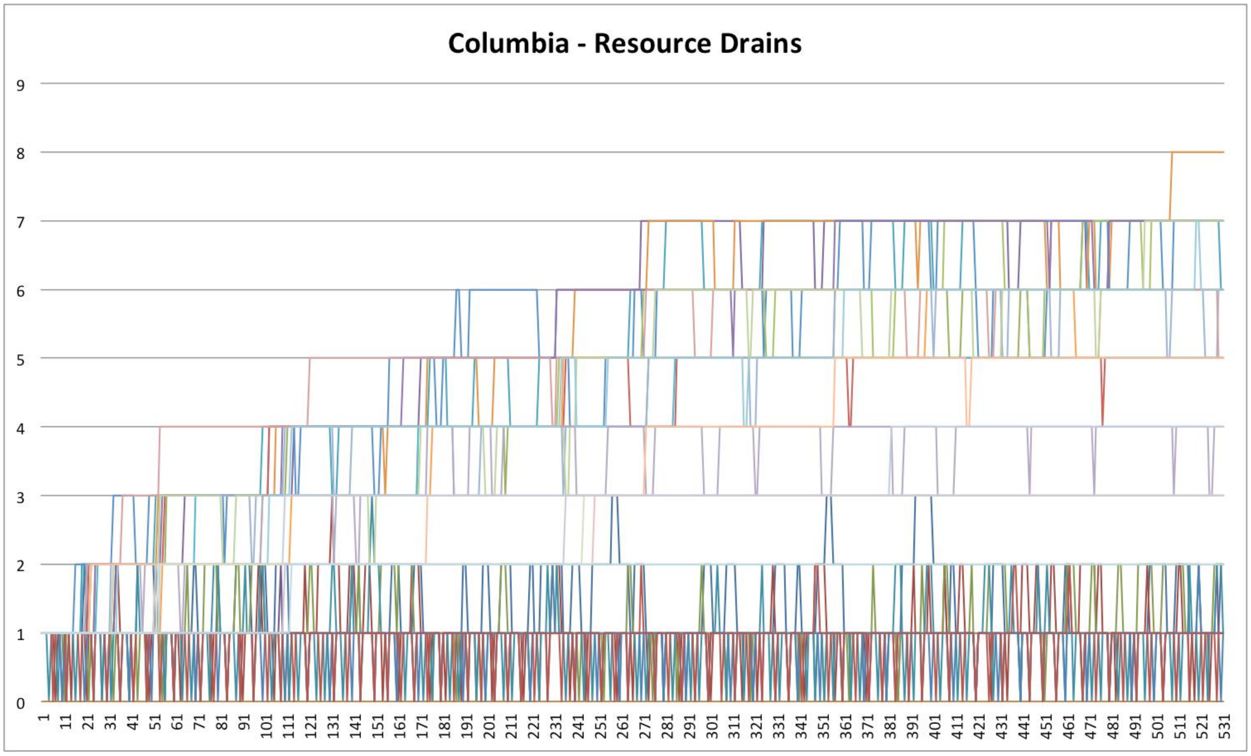

Figure 5-12 Delta Progression Chart for Generated Columbia Resource Drains Test Suite

5.5.2 GrammaTech Test Suites

The metrics in this section represent the test suites that were generated for Final T&E.

5.5.2.1 Concurrency

Table 5-15 Uniformity Metrics for Generated Grammatech Concurrency Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	63	64	1	3
Data Type	1	7	91	91	0	3
Data Flow	1	11	57	58	1	3
Weakness	1	16	39	40	1	2
Taint Source	1	4	158	160	2	2
Weakness Class	1	1	637	637	0	1
Injection Point	1	10	63	64	1	2
Base Program	1	6	106	107	1	2
Data Type/Control Flow	2	70	6	12	6	6
Base Program/Control Flow	2	60	6	13	7	7
Taint Source/Data Flow	2	44	11	18	7	7
Weakness/Taint Source	2	64	7	13	6	6
Base Program/Taint Source	2	24	22	28	6	6
Weakness/Data Type	2	112	2	8	6	6
Base Program/Data Flow	2	66	6	12	6	7
Weakness/Base Program	2	96	3	8	5	5
Weakness/Data Flow	2	176	0	5	5	5
Data Flow/Control Flow	2	110	2	9	7	7
Taint Source/Control Flow	2	40	12	19	7	7
Base Program/Injection Point	2	60	7	14	7	7
Base Program/Data Type	2	42	10	18	8	8
Taint Source/Data Type	2	28	18	25	7	7
Data Type/Data Flow	2	77	4	10	6	6
Weakness/Control Flow	2	160	1	6	5	5
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	4	4	4
Weakness/Base Program/Injection Point	3	960	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

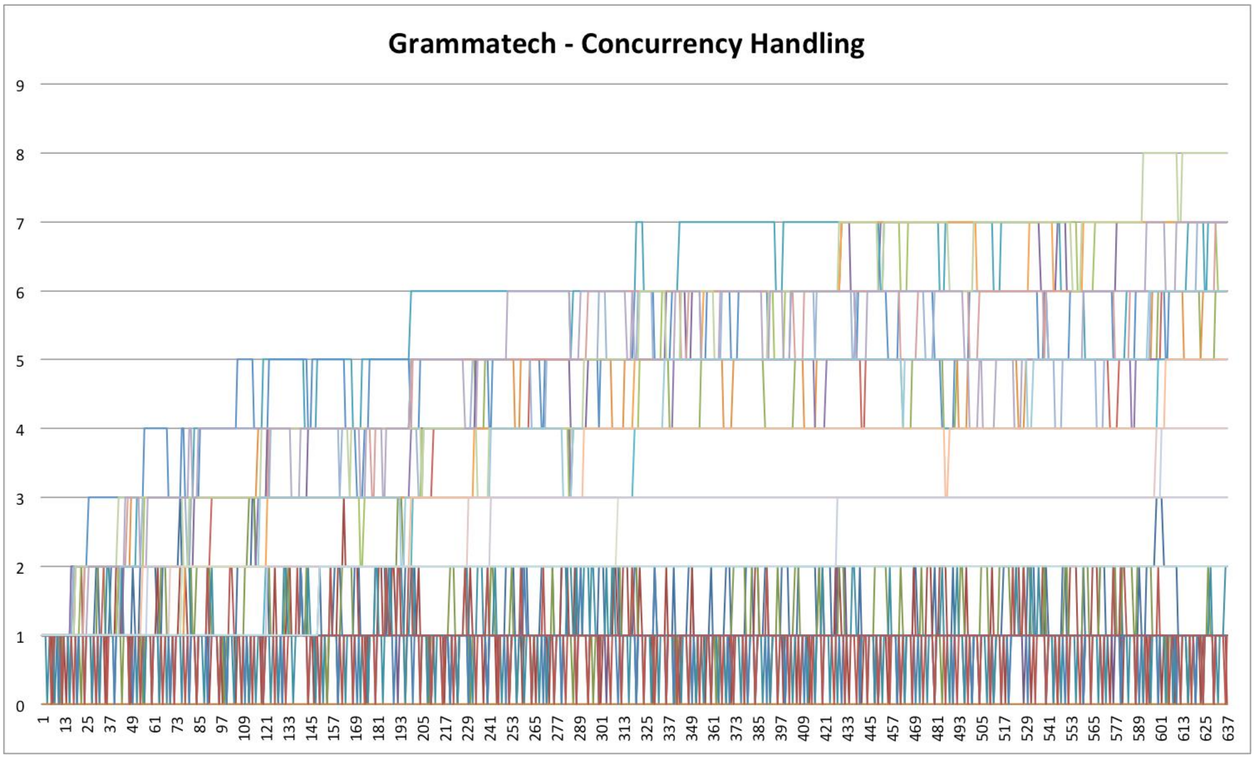

Figure 5-13 Delta Progression Chart for Generated GrammaTech Concurrency Handling Test Suite

5.5.2.2 Injection

Table 5-16 Uniformity Metrics for Generated GrammaTech Injection Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	63	64	1	3
Data Type	1	7	91	91	0	2
Data Flow	1	11	57	58	1	3
Weakness	1	8	65	107	42	42
Taint Source	1	4	159	160	1	2
Weakness Class	1	1	637	637	0	1
Injection Point	1	10	63	64	1	2
Base Program	1	6	106	107	1	2
Data Type/Control Flow	2	70	6	11	5	5
Base Program/Control Flow	2	60	7	13	6	7
Taint Source/Data Flow	2	44	9	18	9	9
Weakness/Taint Source	2	32	14	32	18	18
Base Program/Taint Source	2	24	23	30	7	8
Weakness/Data Type	2	56	6	19	13	13
Base Program/Data Flow	2	66	5	12	7	7
Weakness/Base Program	2	48	0	42	42	42
Weakness/Data Flow	2	88	1	13	12	12
Data Flow/Control Flow	2	110	2	8	6	6
Taint Source/Control Flow	2	40	13	18	5	5
Base Program/Injection Point	2	60	7	12	5	5
Base Program/Data Type	2	42	11	18	7	7
Taint Source/Data Type	2	28	20	26	6	6
Data Type/Data Flow	2	77	5	11	6	7
Weakness/Control Flow	2	80	3	15	12	12

Name	Columns	Count	Min	Max	Delta	Max Delta
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	4	4	4
Weakness/Base Program/Injection Point	3	480	0	7	7	7
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

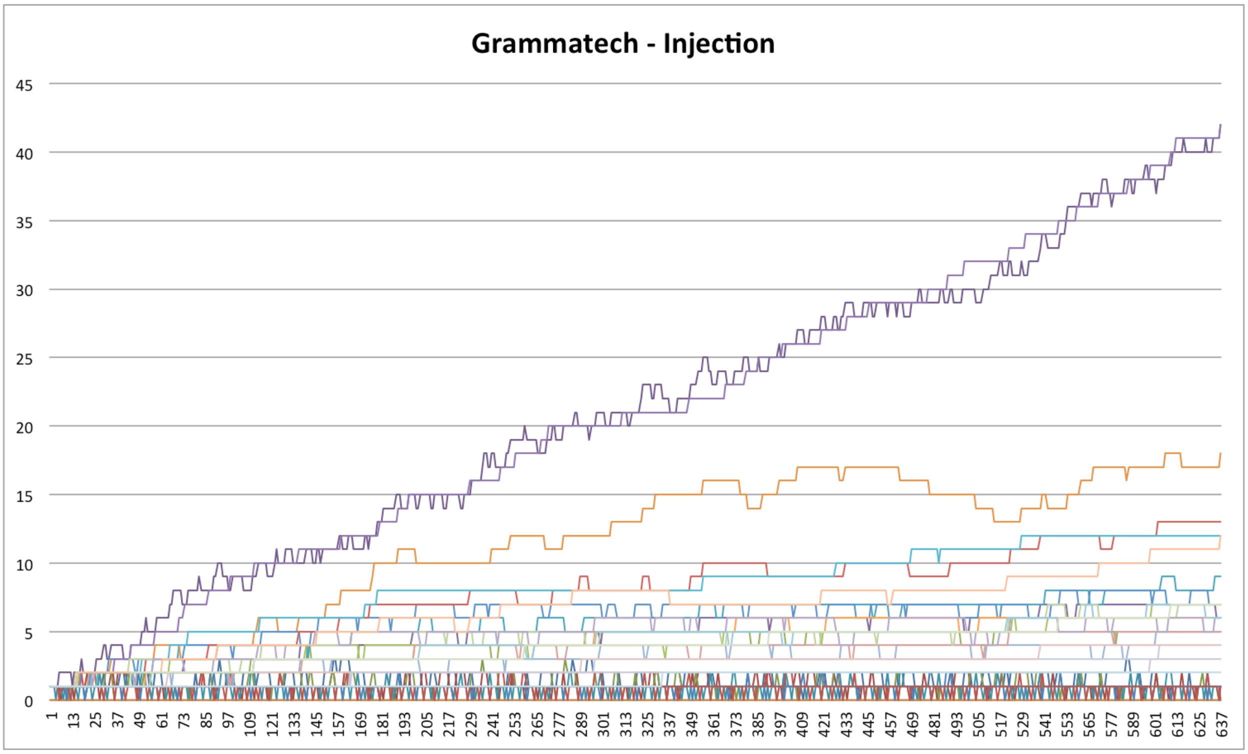

Figure 5-14 Delta Progression Chart for Generated GrammaTech Injection Test Suite

5.5.2.3 Memory Corruption

Table 5-17 Uniformity Metrics for Generated GrammaTech Memory Corruption Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	63	65	2	3
Data Type	1	7	91	91	0	2
Data Flow	1	11	57	58	1	2
Weakness	1	41	15	16	1	1
Taint Source	1	4	159	160	1	3
Weakness Class	1	1	637	637	0	1
Injection Point	1	10	63	64	1	2
Base Program	1	6	106	107	1	2
Data Type/Control Flow	2	70	5	12	7	7
Base Program/Control Flow	2	60	7	12	5	5
Taint Source/Data Flow	2	44	11	17	6	6
Weakness/Taint Source	2	164	1	6	5	5

Name	Columns	Count	Min	Max	Delta	Max Delta
Base Program/Taint Source	2	24	24	28	4	4
Weakness/Data Type	2	287	0	5	5	5
Base Program/Data Flow	2	66	7	12	5	6
Weakness/Base Program	2	246	0	4	4	4
Weakness/Data Flow	2	451	0	4	4	4
Data Flow/Control Flow	2	110	4	8	4	4
Taint Source/Control Flow	2	40	13	18	5	6
Base Program/Injection Point	2	60	7	14	7	7
Base Program/Data Type	2	42	11	18	7	7
Taint Source/Data Type	2	28	19	25	6	7
Data Type/Data Flow	2	77	4	10	6	6
Weakness/Control Flow	2	410	0	3	3	3
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	2460	0	1	1	1
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	1	1	1

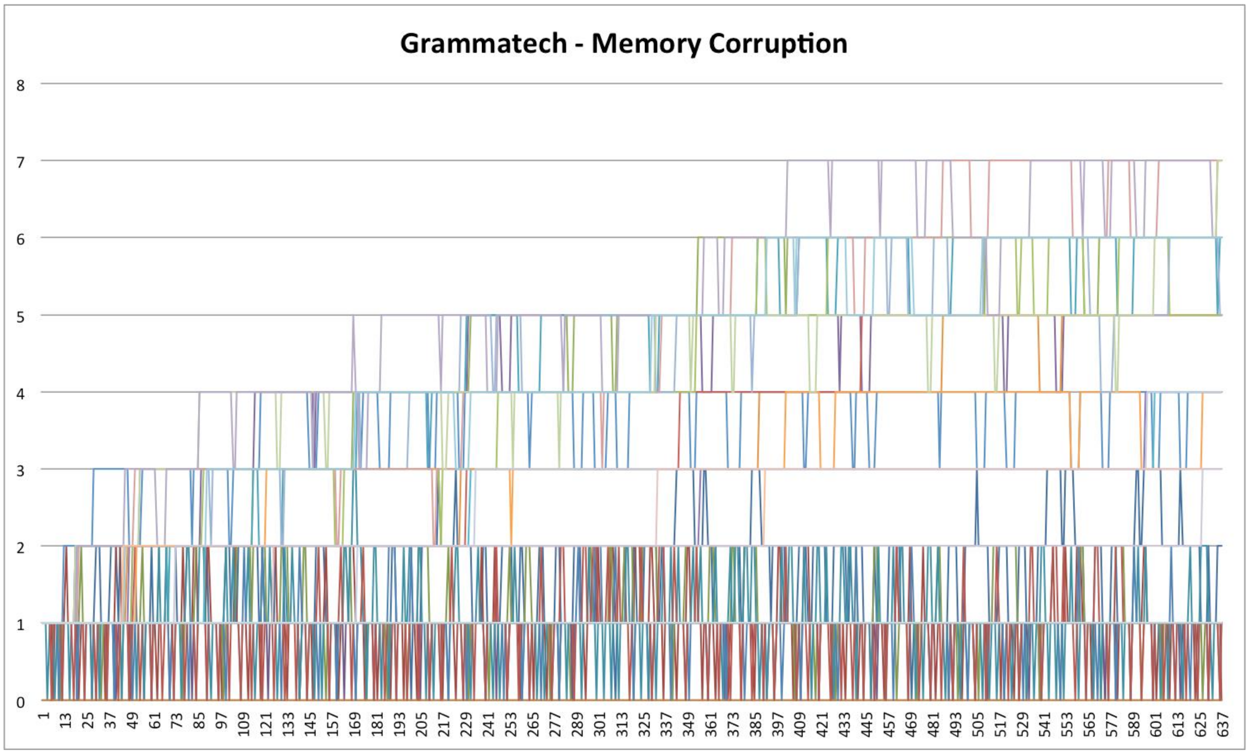

Figure 5-15 Delta Progression Chart for Generated GrammaTech Memory Corruption Test Suite

5.5.2.4 Null Pointer

Table 5-18 Uniformity Metrics for Generated GrammaTech Null Pointer Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	63	65	2	3
Data Type	1	7	91	91	0	2
Data Flow	1	11	57	58	1	3
Weakness	1	7	91	91	0	2
Taint Source	1	4	159	160	1	3
Weakness Class	1	1	637	637	0	1
Injection Point	1	10	63	64	1	2
Base Program	1	6	106	107	1	2
Data Type/Control Flow	2	70	6	12	6	6
Base Program/Control Flow	2	60	6	12	6	6
Taint Source/Data Flow	2	44	11	17	6	6
Weakness/Taint Source	2	28	21	25	4	4
Base Program/Taint Source	2	24	23	29	6	7
Weakness/Data Type	2	49	9	15	6	6
Base Program/Data Flow	2	66	6	12	6	6
Weakness/Base Program	2	42	12	17	5	6
Weakness/Data Flow	2	77	4	10	6	6
Data Flow/Control Flow	2	110	2	7	5	5
Taint Source/Control Flow	2	40	13	18	5	5
Base Program/Injection Point	2	60	8	13	5	6
Base Program/Data Type	2	42	12	18	6	6
Taint Source/Data Type	2	28	20	26	6	7
Data Type/Data Flow	2	77	5	12	7	7
Weakness/Control Flow	2	70	5	11	6	6
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	4	4	4
Weakness/Base Program/Injection Point	3	420	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

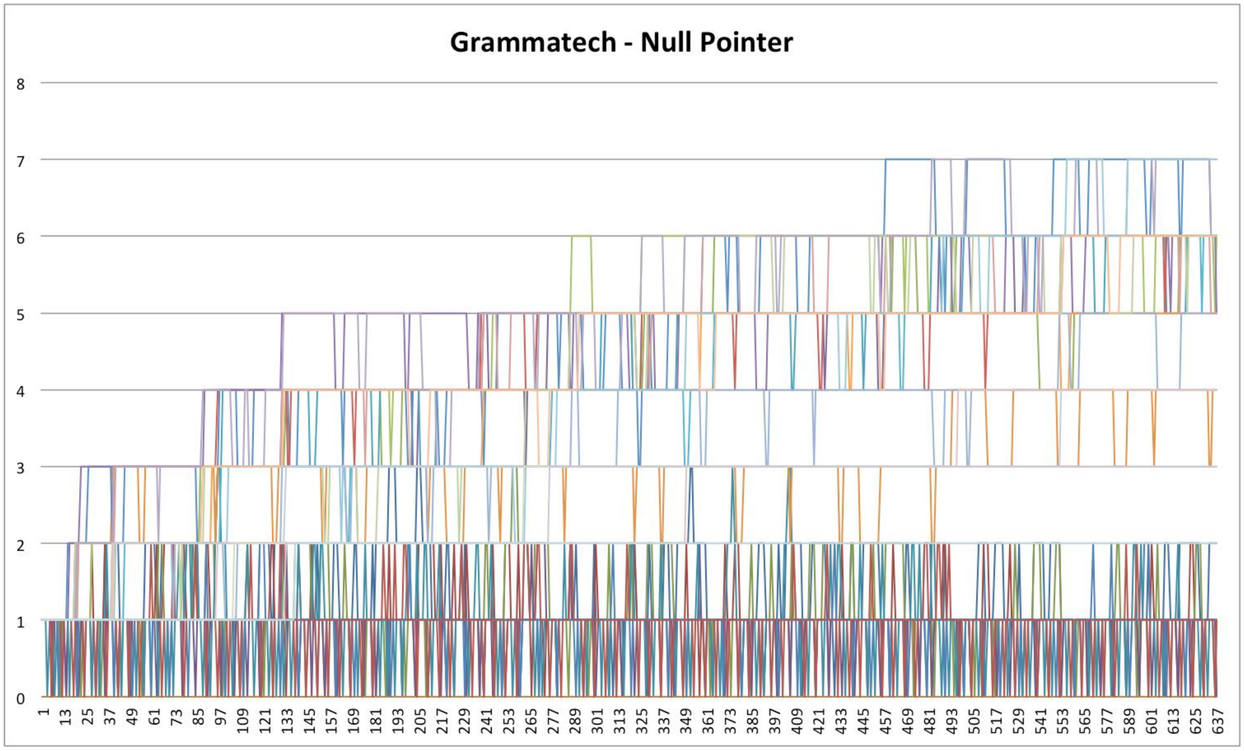

Figure 5-16. Delta Progression Chart for Generated GrammaTech Null Pointer Test Suite

5.5.2.5 Number Handling

Table 5-19 Uniformity Metrics for Generated GrammaTech Number Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	62	64	2	3
Data Type	1	7	91	91	0	3
Data Flow	1	11	57	59	2	2
Weakness	1	11	57	58	1	2
Taint Source	1	4	159	160	1	2
Weakness Class	1	1	637	637	0	1
Injection Point	1	10	63	64	1	2
Base Program	1	6	106	107	1	2
Data Type/Control Flow	2	70	5	12	7	7
Base Program/Control Flow	2	60	6	13	7	7
Taint Source/Data Flow	2	44	12	17	5	5
Weakness/Taint Source	2	44	10	16	6	6
Base Program/Taint Source	2	24	23	29	6	6
Weakness/Data Type	2	77	4	11	7	7
Base Program/Data Flow	2	66	5	12	7	7
Weakness/Base Program	2	66	5	13	8	8
Weakness/Data Flow	2	121	2	7	5	5
Data Flow/Control Flow	2	110	2	8	6	6
Taint Source/Control Flow	2	40	13	19	6	6
Base Program/Injection Point	2	60	8	12	4	4
Base Program/Data Type	2	42	11	18	7	7
Taint Source/Data Type	2	28	20	25	5	5
Data Type/Data Flow	2	77	5	11	6	6
Weakness/Control Flow	2	110	3	8	5	6
Taint Source/Data Type/Control	3	280	0	4	4	4

Name	Columns	Count	Min	Max	Delta	Max Delta
Flow						
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	660	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	2	2	2
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

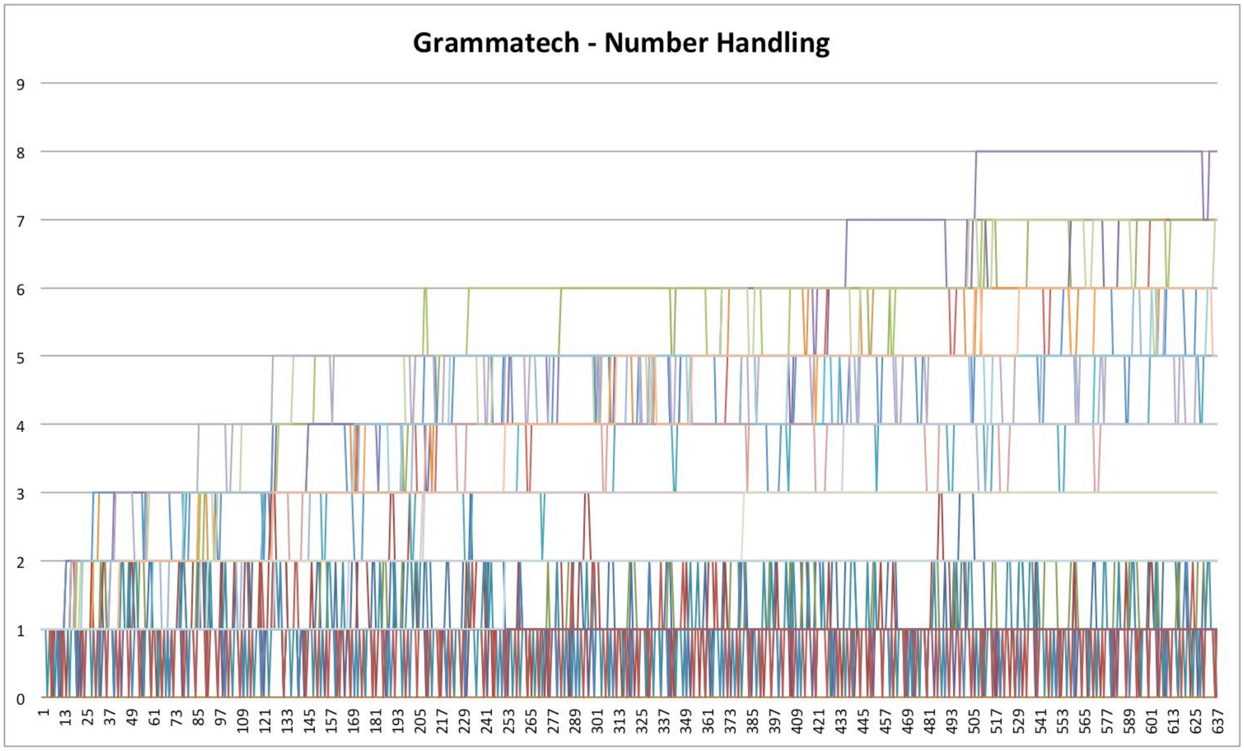

Figure 5-17 Delta Progression Chart for Generated GrammaTech Number Handling Test Suite

5.5.2.6 Resource Drains

Table 5-20 Uniformity Metrics for Generated GrammaTech Resource Drains Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	63	64	1	3
Data Type	1	7	91	91	0	3
Data Flow	1	11	57	58	1	2
Weakness	1	12	53	54	1	2
Taint Source	1	4	159	160	1	3
Weakness Class	1	1	637	637	0	1
Injection Point	1	10	63	64	1	2
Base Program	1	6	106	107	1	2
Data Type/Control Flow	2	70	4	11	7	7
Base Program/Control Flow	2	60	5	13	8	8
Taint Source/Data Flow	2	44	9	16	7	7
Weakness/Taint Source	2	48	8	16	8	8
Base Program/Taint Source	2	24	23	30	7	7

Name	Columns	Count	Min	Max	Delta	Max Delta
Weakness/Data Type	2	84	4	10	6	6
Base Program/Data Flow	2	66	6	13	7	7
Weakness/Base Program	2	72	4	11	7	7
Weakness/Data Flow	2	132	0	7	7	7
Data Flow/Control Flow	2	110	2	8	6	6
Taint Source/Control Flow	2	40	13	18	5	6
Base Program/Injection Point	2	60	7	14	7	7
Base Program/Data Type	2	42	10	18	8	8
Taint Source/Data Type	2	28	21	25	4	5
Data Type/Data Flow	2	77	4	11	7	7
Weakness/Control Flow	2	120	1	7	6	6
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	4	4	4
Weakness/Base Program/Injection Point	3	720	0	4	4	4
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

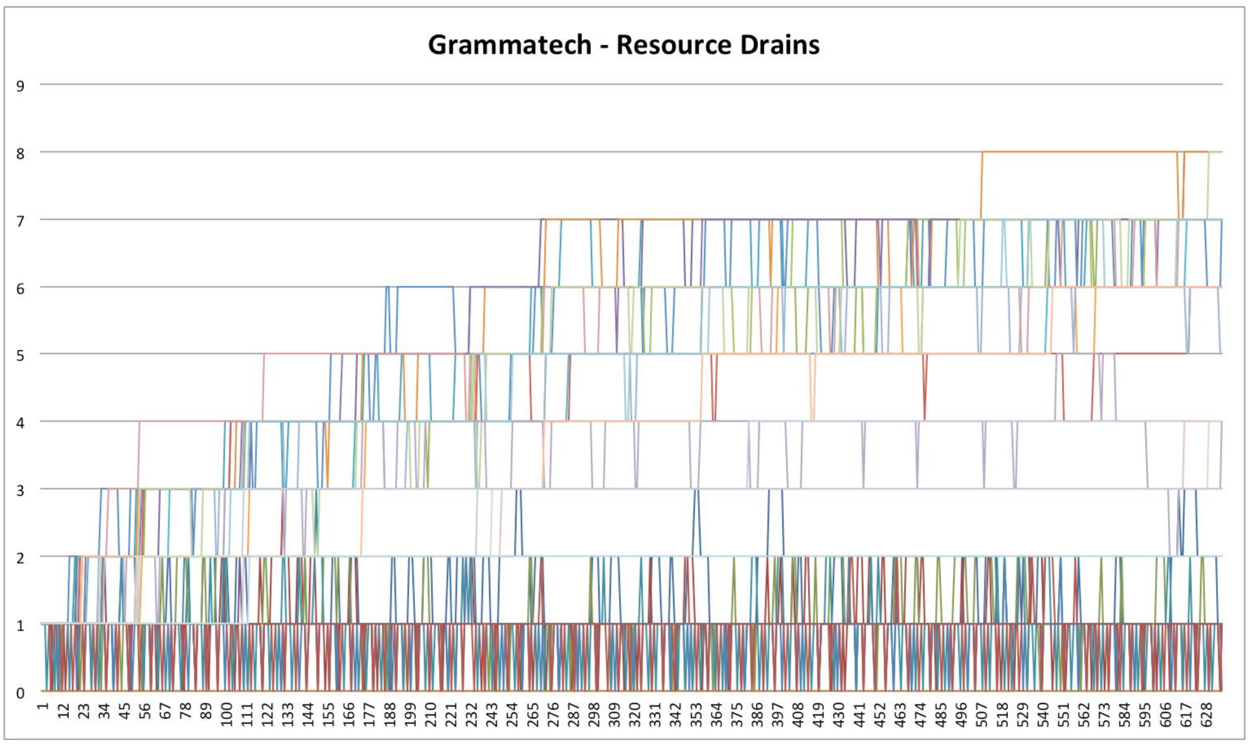

Figure 5-18 Delta Progression Chart for Generated GrammaTech Resource Drains Test Suite

5.5.3 Kestrel Test Suites

The metrics in this section represent the test suites that were generated for Final T&E.

5.5.3.1 Concurrency

Table 5-21 Uniformity Metrics for Generated Kestrel Concurrency Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	11	43	44	1	4
Data Type	1	3	159	160	1	3
Data Flow	1	6	79	80	1	2
Weakness	1	15	31	32	1	1
Taint Source	1	3	159	160	1	3
Weakness Class	1	1	478	478	0	1
Injection Point	1	10	47	48	1	2
Base Program	1	6	79	80	1	2
Data Type/Control Flow	2	33	11	17	6	7
Base Program/Control Flow	2	66	4	9	5	5
Taint Source/Data Flow	2	18	23	29	6	6
Weakness/Taint Source	2	45	7	13	6	6
Base Program/Taint Source	2	18	24	29	5	6
Weakness/Data Type	2	45	7	14	7	9
Base Program/Data Flow	2	36	10	15	5	5
Weakness/Base Program	2	90	2	7	5	5
Weakness/Data Flow	2	90	1	7	6	6
Data Flow/Control Flow	2	66	4	8	4	4
Taint Source/Control Flow	2	33	12	16	4	4
Base Program/Injection Point	2	60	5	10	5	6
Base Program/Data Type	2	18	24	28	4	5
Taint Source/Data Type	2	9	51	56	5	5
Data Type/Data Flow	2	18	23	29	6	6
Weakness/Control Flow	2	165	0	5	5	5
Taint Source/Data Type/Control Flow	3	99	1	6	5	5
Taint Source/Data Type/Data Flow	3	54	5	12	7	7
Weakness/Base Program/Injection Point	3	900	0	3	3	3
Taint Source/Data Flow/Control Flow	3	198	0	4	4	4
Taint Source/Data Type/Data Flow/Control Flow	4	594	0	2	2	2

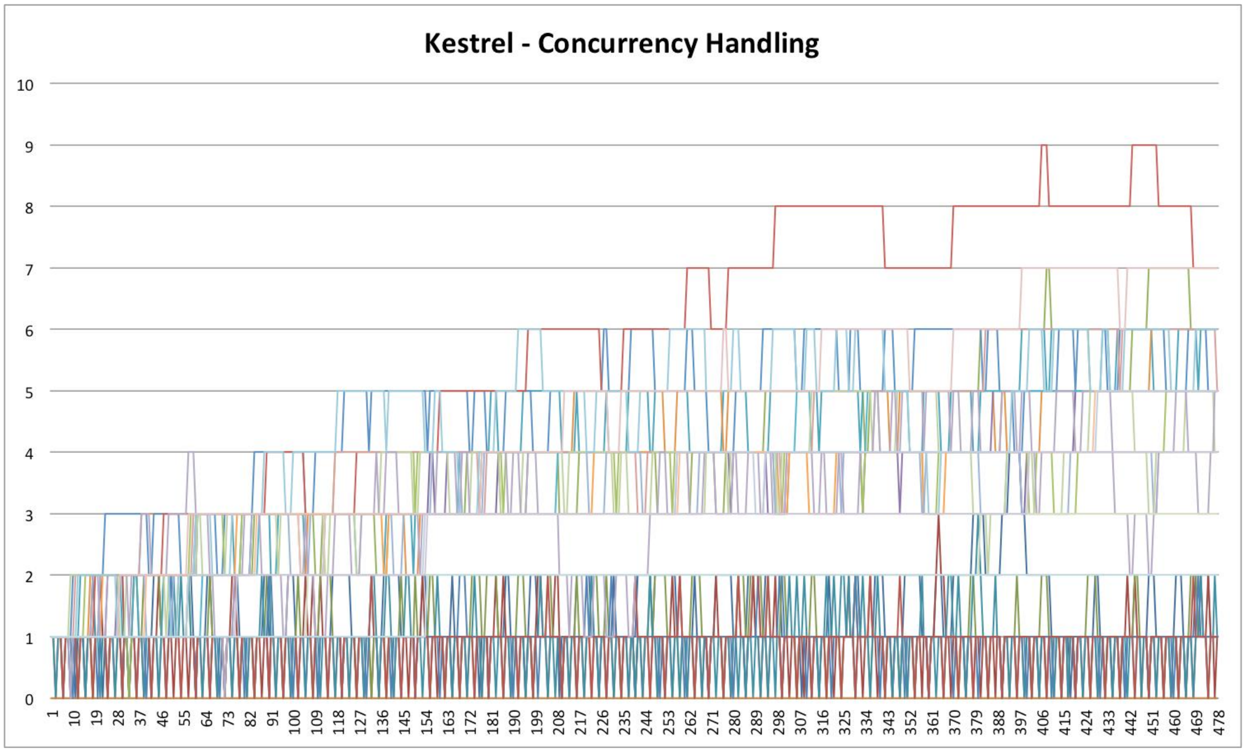

Figure 5-19. Delta Progression Chart for Generated Kestrel Concurrency Handling Test Suite

5.5.3.2 Error Handling

Table 5-22. Uniformity Metrics for Generated Columbia Concurrency Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	11	43	44	1	3
Data Type	1	3	159	160	1	2
Data Flow	1	6	79	81	2	3
Weakness	1	9	46	55	9	9
Taint Source	1	3	159	160	1	2
Weakness Class	1	1	478	478	0	1
Injection Point	1	10	47	48	1	2
Base Program	1	6	79	80	1	2
Data Type/Control Flow	2	33	12	17	5	6
Base Program/Control Flow	2	66	4	9	5	5
Taint Source/Data Flow	2	18	24	28	4	4
Weakness/Taint Source	2	27	13	21	8	9
Base Program/Taint Source	2	18	23	29	6	6
Weakness/Data Type	2	27	14	21	7	8
Base Program/Data Flow	2	36	9	15	6	6
Weakness/Base Program	2	54	0	12	12	12
Weakness/Data Flow	2	54	5	11	6	7
Data Flow/Control Flow	2	66	4	10	6	6
Taint Source/Control Flow	2	33	11	16	5	5
Base Program/Injection Point	2	60	5	10	5	6
Base Program/Data Type	2	18	24	29	5	5
Taint Source/Data Type	2	9	50	55	5	5
Data Type/Data Flow	2	18	25	28	3	4

Name	Columns	Count	Min	Max	Delta	Max Delta
Weakness/Control Flow	2	99	1	7	6	6
Taint Source/Data Type/Control Flow	3	99	2	6	4	5
Taint Source/Data Type/Data Flow	3	54	6	11	5	5
Weakness/Base Program/Injection Point	3	540	0	2	2	2
Taint Source/Data Flow/Control Flow	3	198	0	4	4	4
Taint Source/Data Type/Data Flow/Control Flow	4	594	0	2	2	2

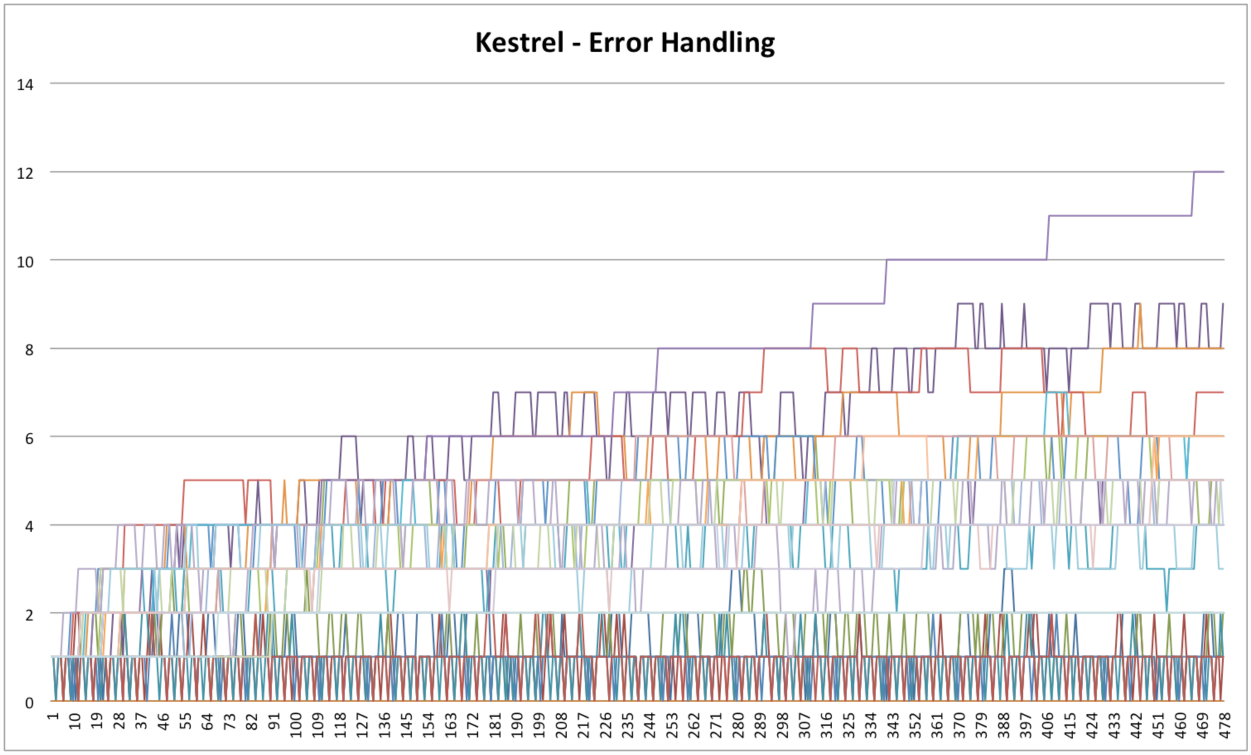

Figure 5-20 Delta Progression Chart for Generated Kestrel Error Handling Test Suite

5.5.3.3 Injection

Table 5-23. Uniformity Metrics for Generated Kestrel Injection Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	11	43	44	1	3
Data Type	1	3	159	160	1	3
Data Flow	1	6	79	80	1	3
Weakness	1	8	59	60	1	2
Taint Source	1	3	159	160	1	3
Weakness Class	1	1	478	478	0	1
Injection Point	1	10	47	48	1	2
Base Program	1	6	79	80	1	3
Data Type/Control Flow	2	33	12	17	5	5
Base Program/Control Flow	2	66	5	9	4	5
Taint Source/Data Flow	2	18	25	28	3	4

Name	Columns	Count	Min	Max	Delta	Max Delta
Weakness/Taint Source	2	24	17	22	5	5
Base Program/Taint Source	2	18	23	29	6	6
Weakness/Data Type	2	24	17	22	5	6
Base Program/Data Flow	2	36	9	15	6	6
Weakness/Base Program	2	48	7	13	6	7
Weakness/Data Flow	2	48	6	13	7	7
Data Flow/Control Flow	2	66	5	9	4	4
Taint Source/Control Flow	2	33	12	16	4	4
Base Program/Injection Point	2	60	5	10	5	6
Base Program/Data Type	2	18	23	29	6	6
Taint Source/Data Type	2	9	51	55	4	5
Data Type/Data Flow	2	18	24	28	4	6
Weakness/Control Flow	2	88	2	7	5	5
Taint Source/Data Type/Control Flow	3	99	2	6	4	4
Taint Source/Data Type/Data Flow	3	54	6	12	6	6
Weakness/Base Program/Injection Point	3	480	0	3	3	3
Taint Source/Data Flow/Control Flow	3	198	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	594	0	2	2	2

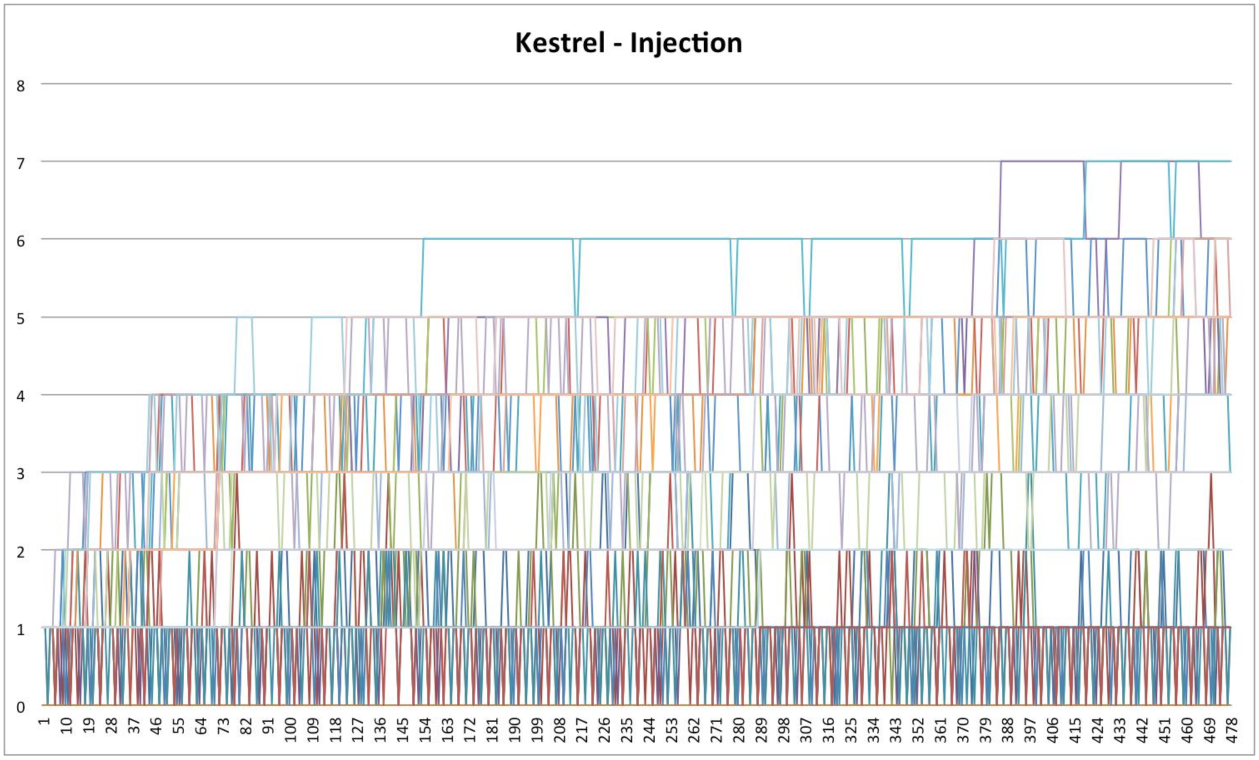

Figure 5-21. Delta Progression Chart for Generated Kestrel Injection Test Suite

5.5.3.4 Number Handling

Table 5-24. Uniformity Metrics for Generated Kestrel Number Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	11	43	44	1	3
Data Type	1	3	159	160	1	4
Data Flow	1	6	79	80	1	3
Weakness	1	9	53	54	1	2
Taint Source	1	3	159	160	1	2
Weakness Class	1	1	478	478	0	1
Injection Point	1	10	47	48	1	2
Base Program	1	6	79	80	1	2
Data Type/Control Flow	2	33	12	17	5	5
Base Program/Control Flow	2	66	5	9	4	4
Taint Source/Data Flow	2	18	24	29	5	6
Weakness/Taint Source	2	27	15	20	5	6
Base Program/Taint Source	2	18	23	29	6	6
Weakness/Data Type	2	27	16	21	5	5
Base Program/Data Flow	2	36	9	16	7	7
Weakness/Base Program	2	54	5	11	6	6
Weakness/Data Flow	2	54	5	11	6	6
Data Flow/Control Flow	2	66	4	9	5	5
Taint Source/Control Flow	2	33	12	16	4	4
Base Program/Injection Point	2	60	6	10	4	5
Base Program/Data Type	2	18	23	28	5	5
Taint Source/Data Type	2	9	50	56	6	6
Data Type/Data Flow	2	18	23	29	6	7
Weakness/Control Flow	2	99	2	7	5	5
Taint Source/Data Type/Control Flow	3	99	3	7	4	4
Taint Source/Data Type/Data Flow	3	54	5	11	6	6
Weakness/Base Program/Injection Point	3	540	0	2	2	2
Taint Source/Data Flow/Control Flow	3	198	0	4	4	4
Taint Source/Data Type/Data Flow/Control Flow	4	594	0	2	2	2

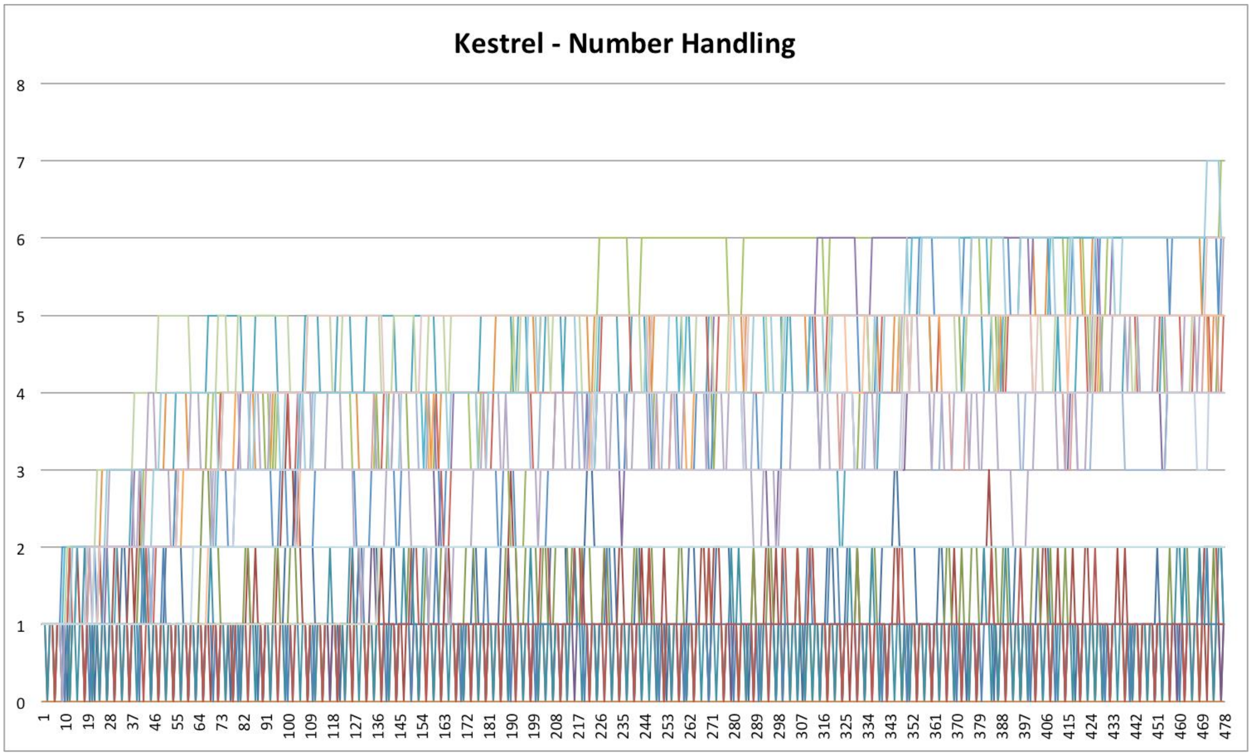

Figure 5-22. Delta Progression Chart for Generated Kestrel Number Handling Test Suite

5.5.3.5 Resource Drains

Table 5-25. Uniformity Metrics for Generated Kestrel Resource Drains Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	11	43	44	1	3
Data Type	1	3	159	160	1	2
Data Flow	1	6	79	80	1	3
Weakness	1	9	53	54	1	2
Taint Source	1	3	159	160	1	3
Weakness Class	1	1	478	478	0	1
Injection Point	1	10	47	48	1	2
Base Program	1	6	79	80	1	2
Data Type/Control Flow	2	33	11	17	6	6
Base Program/Control Flow	2	66	5	9	4	4
Taint Source/Data Flow	2	18	24	28	4	5
Weakness/Taint Source	2	27	14	20	6	6
Base Program/Taint Source	2	18	25	28	3	4
Weakness/Data Type	2	27	15	20	5	5
Base Program/Data Flow	2	36	8	15	7	7
Weakness/Base Program	2	54	6	11	5	5
Weakness/Data Flow	2	54	6	11	5	5
Data Flow/Control Flow	2	66	3	9	6	6
Taint Source/Control Flow	2	33	12	17	5	5
Base Program/Injection Point	2	60	5	10	5	5
Base Program/Data Type	2	18	23	31	8	8
Taint Source/Data Type	2	9	51	55	4	6
Data Type/Data Flow	2	18	23	28	5	7
Weakness/Control Flow	2	99	2	7	5	5

Name	Columns	Count	Min	Max	Delta	Max Delta
Taint Source/Data Type/Control Flow	3	99	1	6	5	5
Taint Source/Data Type/Data Flow	3	54	6	11	5	5
Weakness/Base Program/Injection Point	3	540	0	3	3	3
Taint Source/Data Flow/Control Flow	3	198	0	4	4	4
Taint Source/Data Type/Data Flow/Control Flow	4	594	0	3	3	3

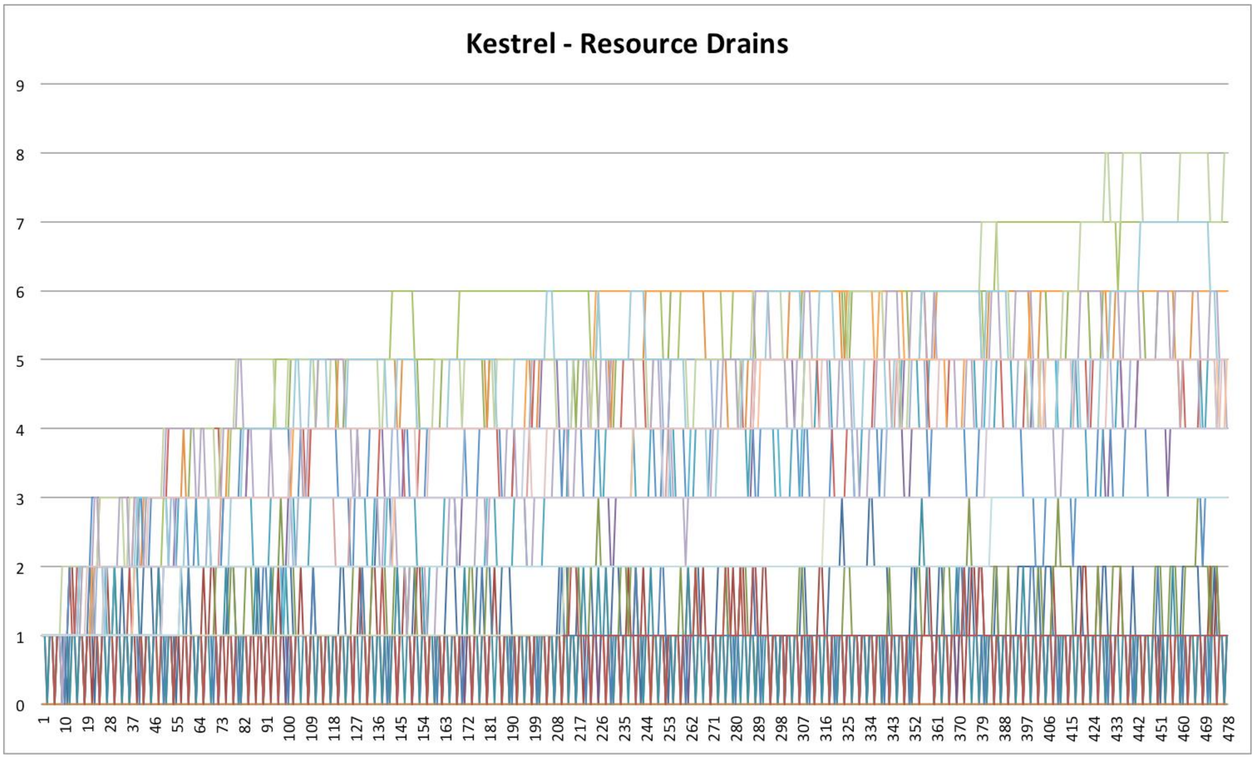

Figure 5-23. Delta Progression Chart for Generated Kestrel Resource Drains Test Suite

5.5.3.6 Tainted Data

Table 5-26. Uniformity Metrics for Generated Kestrel Tainted Data Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	11	43	44	1	3
Data Type	1	3	159	160	1	3
Data Flow	1	6	79	81	2	3
Weakness	1	6	79	80	1	2
Taint Source	1	3	52	372	320	320
Weakness Class	1	1	478	478	0	1
Injection Point	1	10	47	48	1	2
Base Program	1	6	79	80	1	2
Data Type/Control Flow	2	33	11	16	5	5
Base Program/Control Flow	2	66	4	9	5	6
Taint Source/Data Flow	2	18	5	66	61	61

Name	Columns	Count	Min	Max	Delta	Max Delta
Weakness/Taint Source	2	18	0	80	80	80
Base Program/Taint Source	2	18	6	65	59	59
Weakness/Data Type	2	18	24	29	5	6
Base Program/Data Flow	2	36	10	15	5	5
Weakness/Base Program	2	36	10	15	5	5
Weakness/Data Flow	2	36	10	15	5	5
Data Flow/Control Flow	2	66	4	9	5	5
Taint Source/Control Flow	2	33	2	36	34	34
Base Program/Injection Point	2	60	4	10	6	6
Base Program/Data Type	2	18	24	28	4	5
Taint Source/Data Type	2	9	14	127	113	113
Data Type/Data Flow	2	18	23	28	5	6
Weakness/Control Flow	2	66	4	9	5	5
Taint Source/Data Type/Control Flow	3	99	0	13	13	13
Taint Source/Data Type/Data Flow	3	54	0	25	25	25
Weakness/Base Program/Injection Point	3	360	0	4	4	4
Taint Source/Data Flow/Control Flow	3	198	0	9	9	9
Taint Source/Data Type/Data Flow/Control Flow	4	594	0	5	5	5

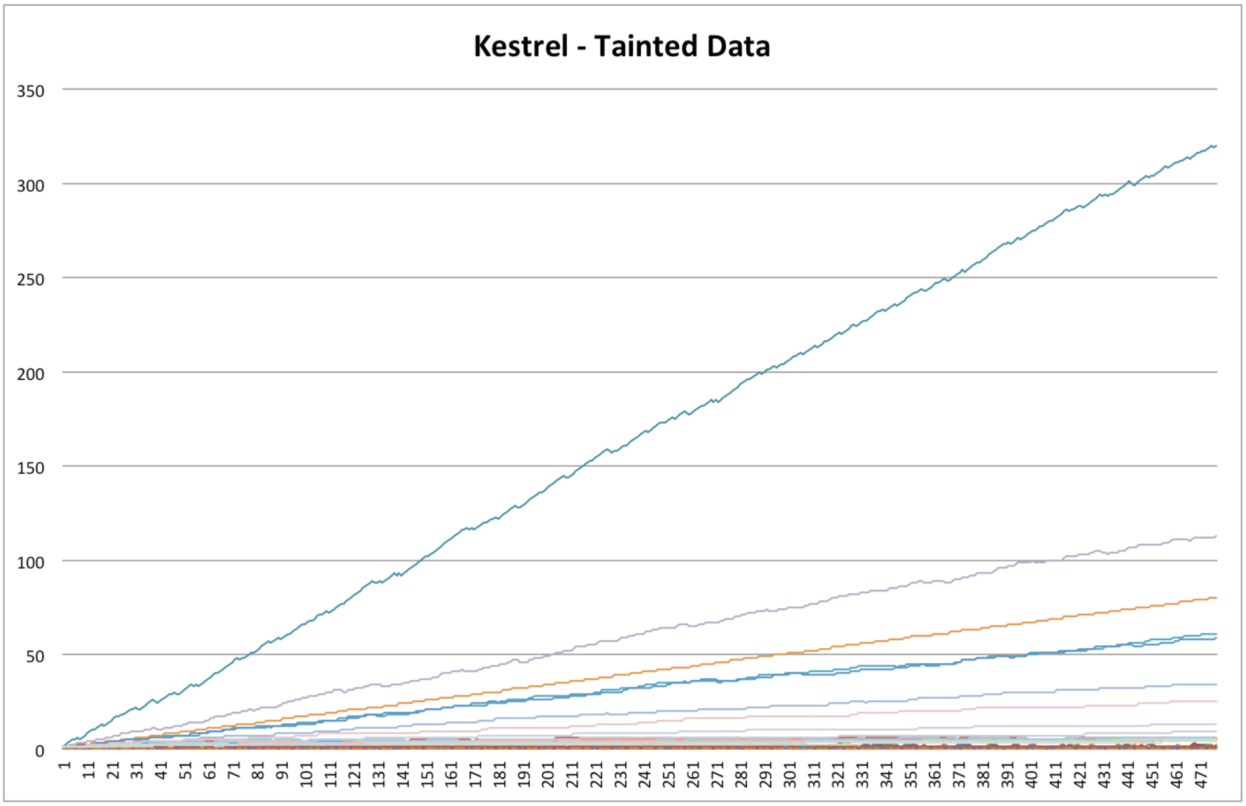

Figure 5-24. Delta Progression Chart for Generated Kestrel Tainted Data Test Suite

6.0 Test Case Generation

This section provides a summary description of the Test Case Generation. The description of the test generation system and software is covered in the Final Test Generation Report. The details of this section include summaries of the approach to generate the test cases and approach to creating VM base images.

This section summarizes the information from the following document(s), and it is recommended that the reader reference this documentation for more information:

- Final Test Generation Report
- Test Data Generation Plan (TGP)
- Test Case Creation Guide

Approach to Generating Test Cases

Phase 2 and 3 required a large number of test cases (on the order of thousands) to assess performer technology. Because of the number, size and complexity of the desired test cases, it was not possible to hand-develop individual test cases in which each demonstrated a single vulnerability. Accordingly, T&E developed a strategy to inject vulnerabilities into large open source software projects. T&E also developed a process for automated the injection, building, execution, and evaluation of the test case, so that thousands of test cases could be used for each performer technology.

T&E performed the following tasks:

- Selecting and modifying base programs
- Developing weakness code with benign and exploiting inputs
- Injecting weakness code into the base programs
- Packaging test cases

For more details, see Section 2 of the Final Test Generation Report.

6.1 Weakness Algorithmic Variants

Initially the test plan called for one weakness to be created for each relevant Common Weakness Enumeration (CWE). In the course of developing vulnerabilities, it became apparent that some CWEs could occur in different ways, and that it might be appropriate to have more than one weakness for some CWEs. For instance, CWE-120: Buffer Overflow might occur:

1. On the stack into uncontrolled stack space
2. On the heap into uncontrolled heap space
3. On the stack within a struct, into stack space allocated for that struct
4. On the heap within a struct, into heap space allocated for that struct

T&E addressed this issue by developing multiple weakness algorithmic variants for a single CWE when it made sense to exercise the CWE in different situations. Each of the weakness algorithmic variants existed as a separate snippet of code that could be injected into the underlying base program.

T&E developed 98 weakness snippets in C and 56 weakness snippets in Java that each cause unintended program behavior.

For more details, see Section 10 of the Final Test Generation Report.

6.2 Selection of Base Programs

T&E chose base programs for Phase 3 to average 500,000 lines of code. The base programs chosen are listed in **Table 6-1** and **Table 6-2**.

Table 6-1. C/Binary Base Programs

Identifier	Base Program	Category	Version	Repository	LOC
ELAS	Elastic Search	Service	1.0.0	http://www.elasticsearch.org/	297,491
CMUD	Coffee MUD	Service	5.8	http://www.coffeemud.org/	537,199
LENY	Apache Lenya	Service/GUI	2.0.4	http://lenya.apache.org/	358,003
LUCE	Apache Lucene	Console	4.5.0	http://lucene.apache.org/	440,299
JENA	Jena	Console	2.11.0	https://jena.apache.org/	377,160
GWTX	Google Web Toolkit	GUI	2.6.0-rc3	http://www.gwtproject.org/	656,421

Table 6-2. Java Base Programs

Identifier	Base Program	Category	Version	Repository	LOC
FFMP	FFMpeg	Console	1.2.2	https://www.ffmpeg.org/	566,908
GIMP	Gimp	GUI	2.8.8	http://www.gimp.org/	711,339
OSSL	OpenSSL	Console	1.0.1e	https://www.openssl.org/	274,204
PSQL	PostgreSQL	Service	9.2.4	http://www.postgresql.org/	731,469
SUBV	Subversion	Console/Service	1.8.3	https://subversion.apache.org/	798,636
WIRE	Wireshark	GUI	1.10.2	https://www.wireshark.org/	2,523,396

In addition, in Phase 3 T&E injected vulnerabilities into four small base programs, two each in C and Java, for testing the injection system. These programs, listed in **Table 6-3**, were much smaller than the Phase 3 base programs and provided a simpler system for debugging.

Table 6-3. Test Programs

Identifier	Base Program	Category	Version	Repository	LOC
CTREE	C-Tree	Console	1.7.0	http://mama.indstate.edu/users/ice/tree/	2,751
JTREE	J-Tree	Console	-	Written by T&E	284
GREP	Grep	Console	2.14	http://www.gnu.org/software/grep/	47,741
JMET	JMeter	Console	2.8	http://jmeter.apache.org/	103,105

For more details, see Sections 3, 5 and 6 of the Final Test Generation Report.

6.2.1 Approach to Injecting Test Cases into Base Programs

T&E performed the following steps to ready the base programs for injection:

1. Identified possible base programs.
2. Created scripts to build the base programs from source.
3. Modified the base programs so they could be built with the injection frameworks.
4. Modified the base programs to respect library environment variables.
5. Verified identity translation for the base programs.
6. Injected function logging statements into each base program, producing log-injected base programs.
7. For each base program, built a skeleton directory structure, created an XML file containing build and run instructions, and identified 10 different inputs to base program.
8. Ran log-injected base programs on each of the 10 inputs.
9. Determined functions used by all inputs for each base program.
10. Selected 10 injection points from the common set for each base program.

T&E developed injection frameworks in both C and Java to inject vulnerabilities into the base programs at the identified injection points. In both C and Java, the injected code included the following components:

- Atomic barrier to ensure weakness runs only once
- Taint source through which user provides data to the vulnerability
- Three complexity features to obfuscate the vulnerability
  - Control Flow
  - Data Flow
  - Data Type
- Weakness algorithmic variant

T&E packaged together compressed tar files for each test case. The test cases contained:

- The injected base program together
- A skeleton directory to use in running the base program
- An XML file and YAML file with information for TEXAS about how to build and run the base program, and how to evaluate the execution

For more details, see **Sections 4.0, 7.0, 8.0, and 9.0** of the Final Test Generation Report.

6.2.2 ROSE Transformation

T&E developed the ss_vuln_injector system to inject code into C files. This system used the ROSE Compiler Infrastructure developed at Lawrence Livermore National Laboratory to create, manipulate, and output C abstract syntax trees.

The ROSE Compiler Infrastructure uses gcc as its backend, so using it required the initial base program to also use gcc (not clang, or cc). T&E dealt with this by searching for open source programs that used gcc as their primary compiler.

It is difficult to work with C abstract syntax trees, because C is a pre-processed language. When gcc (or the ROSE Compiler Infrastructure) reads in a C file, the first thing it does is run the pre-processor on it to expand pre-processor directives such as #include and #define. For gcc, after the pre-processor directives have been expanded, they are never examined again. However, the ROSE Compiler Infrastructure needs to pre-process C code, manipulate it, and then output readable C code again at the end. C code that has been pre-processed is often hundreds of times longer than the original code, and parts of it are substantially different in structure. The ROSE Compiler Infrastructure tries to output readable C code, so it tries to remove the alterations made by the C pre-processor. If the pre-processor directives are sufficiently complicated, this is not possible.

The pre-processor directives caused many issues in working with the ROSE Compiler Infrastructure. T&E attempted to hand-alter pre-processor directives to allow the ROSE Compiler Infrastructure to understand and access the code. However, in some cases the directives were so complicated this was not possible. Ultimately, T&E developed an option for skipping files that could not be processed with the ROSE Compiler Framework. This was a small subset of the files in any given project, but they were unavoidable.

6.2.3 Eclipse Transformation

T&E developed a separate system, called ss_vinject4j to inject code into Java files. ss_vinject4j used the Eclipse Java Development Toolkit (JDT) to create, manipulate, and output Java abstract syntax trees.

The Java injection framework used an ant build process to build systems. One limitation of this is that to compile a base program with the injection framework, the base program itself must also use an ant build process. Base programs that use other build processes (such as maven) are not compatible with the Java injection framework.

Unlike C, Java does not have a pre-processing step, so there were many fewer problems processing files with the Eclipse JDT. In addition, the Eclipse JDT is a widely-used tool with a large installed user base, so the API has been streamlined for ease-of-use. The major problems that arose using the Eclipse JDT came from differing orders of type promotion in the native javac compiler and in the Eclipse JDT.

7.0 Independent Verification and Validation (IV&V)

7.1 Independent Verification and Validation (IV&V) Summary

The objective of IV&V to provide an objective assessment of both the weakness algorithmic variants created to simulate CWEs and the test cases after they had been injected with the validated snippets.

7.1.1 Weakness Algorithmic Variants (a.k.a., snippets)

7.1.1.1 Evaluating Weakness Algorithmic Variants

Every Algorithmic Weakness Variant (aka snippet) was evaluated by the IV&V team to answer the following questions:

- Is the vulnerability described in the CWE included in the weakness snippet?
- Is the code sound and without error?
- Does each benign test case produce the correct output?
- Does each exploit test case trigger the correct failure mode?
- Should there be additional benign inputs?
- Should there be additional exploits (e.g., more edge cases)?

7.1.1.2 Snippet Validation Process:

The interaction between the Test Data Generation Team and the IV&V team is shown in **Figure 7-1**.

1.The developer is assigned a Weakness.
a) A JIRA ticket (Issue) is created and the status is designated as "New".
2.The developer work on the snippet.
a) The JIRA ticket status is changed to "In Progress"
3.The developer completes the snippet.
4.The developer submits the snippet for internal review.
a) The JIRA ticket status is changed to "Internal Review"
5.The Test Data Generation (TDG) Team reviews the snippet.
a) If the snippet is accepted, the snippet is uploaded to the repository.
    i. The JIRA ticket status is changed to "In Review - IV&V" and assigned to the IV&V Team.
b) If the snippet is rejected, the snippet is sent back to the developer.
    i. The JIRA ticket status is changed to "In Progress".
6.The IV&V Team retrieves the snippet.
7.The snippet is assigned to a member of the IV&V Team
8.The team member reviews the snippet
a) The review is based on the snippet's logic and execution.
b) If the snippet passes, the work is considered complete.
    i. The JIRA ticket status is set to "Done".
c) If the snippet fails, the snippet is reassigned for a second review.
    i. If the snippet passes, the JIRA ticket is set to "Done".
    ii. If the snippet fails, the TDG Team is notified and provided with the results.

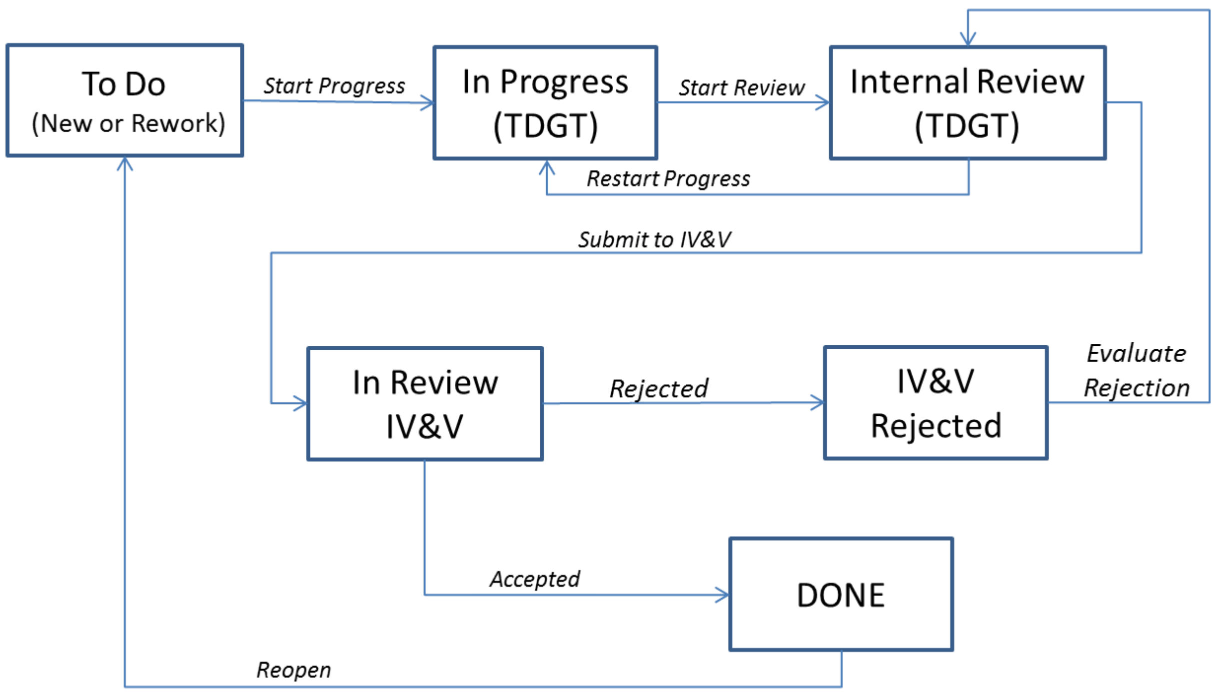

Figure 7-1. Test Generation and IV&V Interaction

To facilitate communication between the development team and the IV&V team, each snippet has its own JIRA page. An IV&V tab is available for the IV&V team to document information about the snippet and capture comments if a snippet fails evaluation or the IV&V team needs additional information. The JIRA documentation for all the snippets is captured in appendix xxx

For Dry Run 3, the snippets were modified to include LLTng tracing statements. Every snippet was compared to the original code to determine if any additional changes were made beyond the tracing statements. If there were additional changes the snippets were re-evaluated as if they were new. There were also new snippets developed and evaluated in that phase.

7.1.1.3 Eclipse Testing of Snippets

See **Appendix E**: Eclipse Testing of Snippets

7.1.1.4 IV&V Environment

For individual snippet and test case evaluations the IV&V team set up eclipse on local environments. The setup can be found here:

https://stonesoup.atlassian.net/wiki/display/IVV/Eclipse+configuration

Linux Eclipse Setup can be found here:

https://stonesoup.atlassian.net/wiki/pages/viewpage.action?pageId=8978509

7.1.1.5 Results of Snippet IV&V

For Dry Run 2, of 140 submitted for evaluation, 111 passed, and 29 were sent back to the TDG Team for rework. Ultimately 140 were used for Dry Run 2.

For Dry Run 3, of 155 submitted for evaluation, 151 passed, and 4 were sent back to the TDG Team for rework. Ultimately 155 were used for Dry Run 3.

7.1.2 Approach to Evaluate Test Case Execution

Test Case Validation Process:

1.The Test Data Generation Team creates test cases based on a previously evaluated snippet and a base program
2.The TDG Team tests the TEST Case for functionality (Pass/Fail).
3.Test cases are submitted to the IV&V team.
a) For Dry One 1 he IV&V team manually evaluated the test cases by executing each test case with the I/O pairs, and verifying every I/O pairs result against the expected results in the test case xml.
b) For Dry Run 2, 3 and T&E, The Test Case is tested using TEXAS STAGE-ONE Analysis/Executing/Scoring cycles to validate that the code operates as expected with both the good and the bad I/O pairs.
4.If the Test Case fails:
a) The TDG Team is notified of the results.
b) The TDG Team is given the test data for troubleshooting.
5.If the Test Case passes:
a) The Test Case is stored in a “data repository”

7.1.2.1 Results of Test Case IV&V

Even though test cases passed IV&V in stage-one on the IV&V machines, there were failures during Dry Run 2 and Dry Run 3, where the same test cases failed stage-one. This was due to environment differences between the IV&V virtual machines and the machines used for the Dry Runs. Results for test cases that failed stage-one were not included in the summary results for the dry run.

As a lesson learned from this, the performer machines for final T&E are based on the same environments as the IV&V machines.

7.2 Test Suite Uniformity After IV&V

This section contains the uniformity results for the test suites for each of the performers after the test cases had been executed through TEXAS on separate IV&V machines as well as the performer modified instances.

7.2.1 Columbia Stage 2 Test Suites

The metrics in this section represent the test suites considered valid for Stage 2. These test cases passed both IV&V as well as Stage 1 on the performer modified machines.

7.2.1.1 Concurrency

Table 7-1. Uniformity Metrics for Post IV&V Columbia Concurrency Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	38	43	5	9
Data Type	1	7	52	67	15	16
Data Flow	1	11	34	40	6	8
Weakness	1	16	22	30	8	9
Taint Source	1	4	73	113	40	42
Weakness Class	1	1	404	404	0	1
Injection Point	1	10	37	43	6	10
Base Program	1	6	21	82	61	61
Data Type/Control Flow	2	70	2	9	7	7
Base Program/Control Flow	2	60	0	11	11	11
Taint Source/Data Flow	2	44	4	14	10	11
Weakness/Taint Source	2	64	1	10	9	9
Base Program/Taint Source	2	24	2	24	22	22
Weakness/Data Type	2	112	1	6	5	6
Base Program/Data Flow	2	66	0	11	11	11
Weakness/Base Program	2	96	0	7	7	7
Weakness/Data Flow	2	176	0	4	4	4
Data Flow/Control Flow	2	110	1	8	7	7
Taint Source/Control Flow	2	40	4	14	10	10
Base Program/Injection Point	2	60	0	11	11	11
Base Program/Data Type	2	42	1	15	14	14
Taint Source/Data Type	2	28	6	20	14	14
Data Type/Data Flow	2	77	2	8	6	7
Weakness/Control Flow	2	160	0	5	5	5
Taint Source/Data Type/Control Flow	3	280	0	3	3	3
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	960	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

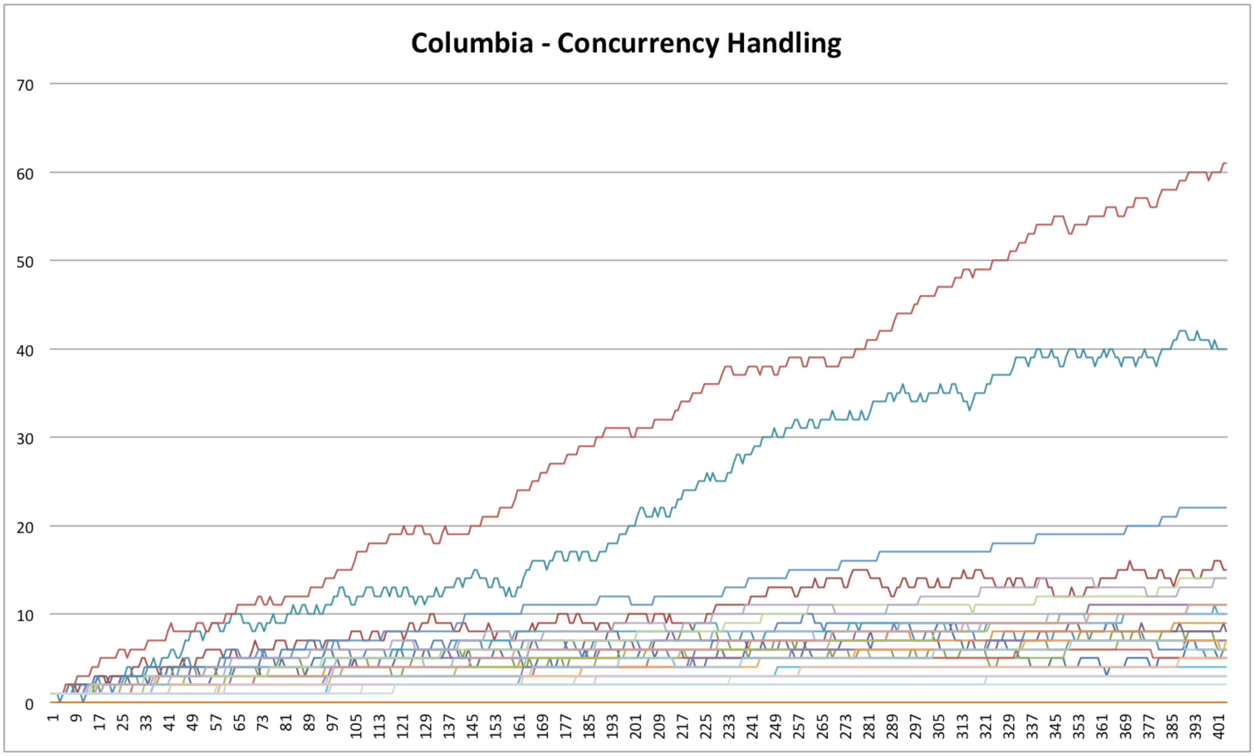

Figure 7-2. Delta Progression Chart for Post IV&V Columbia Concurrency Handling Test Suite

7.2.1.2 Injection

Table 7-2. Uniformity Metrics for Post IV&V Columbia Injection Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	44	52	8	9
Data Type	1	7	65	70	5	7
Data Flow	1	11	38	46	8	9
Weakness	1	8	45	82	37	37
Taint Source	1	4	111	121	10	11
Weakness Class	1	1	471	471	0	1
Injection Point	1	10	40	51	11	12
Base Program	1	6	68	83	15	16
Data Type/Control Flow	2	70	4	10	6	6
Base Program/Control Flow	2	60	3	11	8	8
Taint Source/Data Flow	2	44	6	14	8	10
Weakness/Taint Source	2	32	11	24	13	16
Base Program/Taint Source	2	24	15	25	10	10
Weakness/Data Type	2	56	4	14	10	11
Base Program/Data Flow	2	66	3	10	7	7
Weakness/Base Program	2	48	0	25	25	25
Weakness/Data Flow	2	88	1	12	11	11
Data Flow/Control Flow	2	110	1	7	6	6
Taint Source/Control Flow	2	40	8	15	7	8
Base Program/Injection Point	2	60	3	11	8	8
Base Program/Data Type	2	42	8	14	6	7
Taint Source/Data Type	2	28	14	20	6	7
Data Type/Data Flow	2	77	2	9	7	7
Weakness/Control Flow	2	80	1	10	9	9

Name	Columns	Count	Min	Max	Delta	Max Delta
Taint Source/Data Type/Control Flow	3	280	0	3	3	3
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	480	0	5	5	5
Taint Source/Data Flow/Control Flow	3	440	0	2	2	2
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

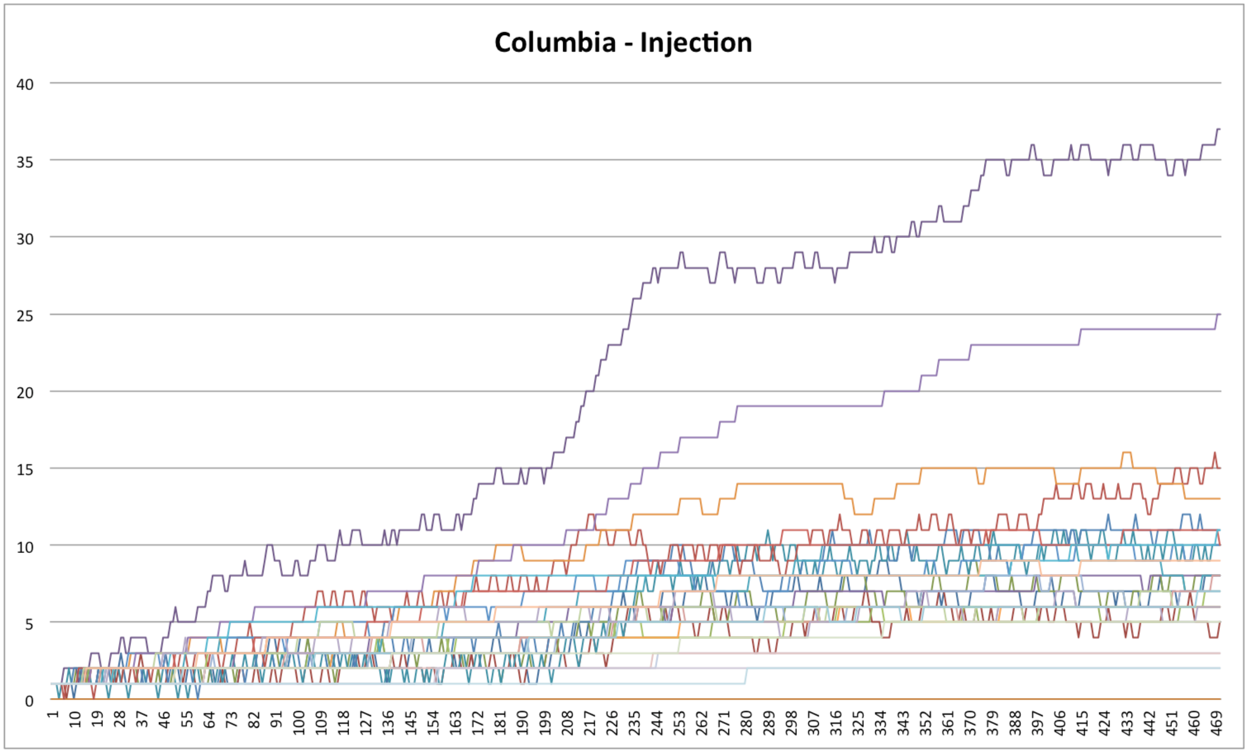

Figure 7-3. Delta Progression Chart for Post IV&V Columbia Injection Test Suite

7.2.1.3 Memory Corruption

Table 7-3. Uniformity Metrics for Post IV&V Columbia Memory Corruption Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	42	48	6	8
Data Type	1	7	59	67	8	11
Data Flow	1	11	37	43	6	7
Weakness	1	41	2	13	11	11
Taint Source	1	4	102	117	15	16
Weakness Class	1	1	442	442	0	1
Injection Point	1	10	41	50	9	10
Base Program	1	6	55	82	27	28
Data Type/Control Flow	2	70	3	10	7	7
Base Program/Control Flow	2	60	3	11	8	8
Taint Source/Data Flow	2	44	6	14	8	8
Weakness/Taint Source	2	164	0	5	5	5
Base Program/Taint Source	2	24	13	23	10	10

Name	Columns	Count	Min	Max	Delta	Max Delta
Weakness/Data Type	2	287	0	5	5	5
Base Program/Data Flow	2	66	3	10	7	7
Weakness/Base Program	2	246	0	3	3	3
Weakness/Data Flow	2	451	0	3	3	3
Data Flow/Control Flow	2	110	0	6	6	6
Taint Source/Control Flow	2	40	6	14	8	8
Base Program/Injection Point	2	60	3	12	9	9
Base Program/Data Type	2	42	4	15	11	11
Taint Source/Data Type	2	28	11	20	9	9
Data Type/Data Flow	2	77	2	9	7	7
Weakness/Control Flow	2	410	0	3	3	3
Taint Source/Data Type/Control Flow	3	280	0	3	3	3
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	2460	0	1	1	1
Taint Source/Data Flow/Control Flow	3	440	0	2	2	2
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	1	1	1

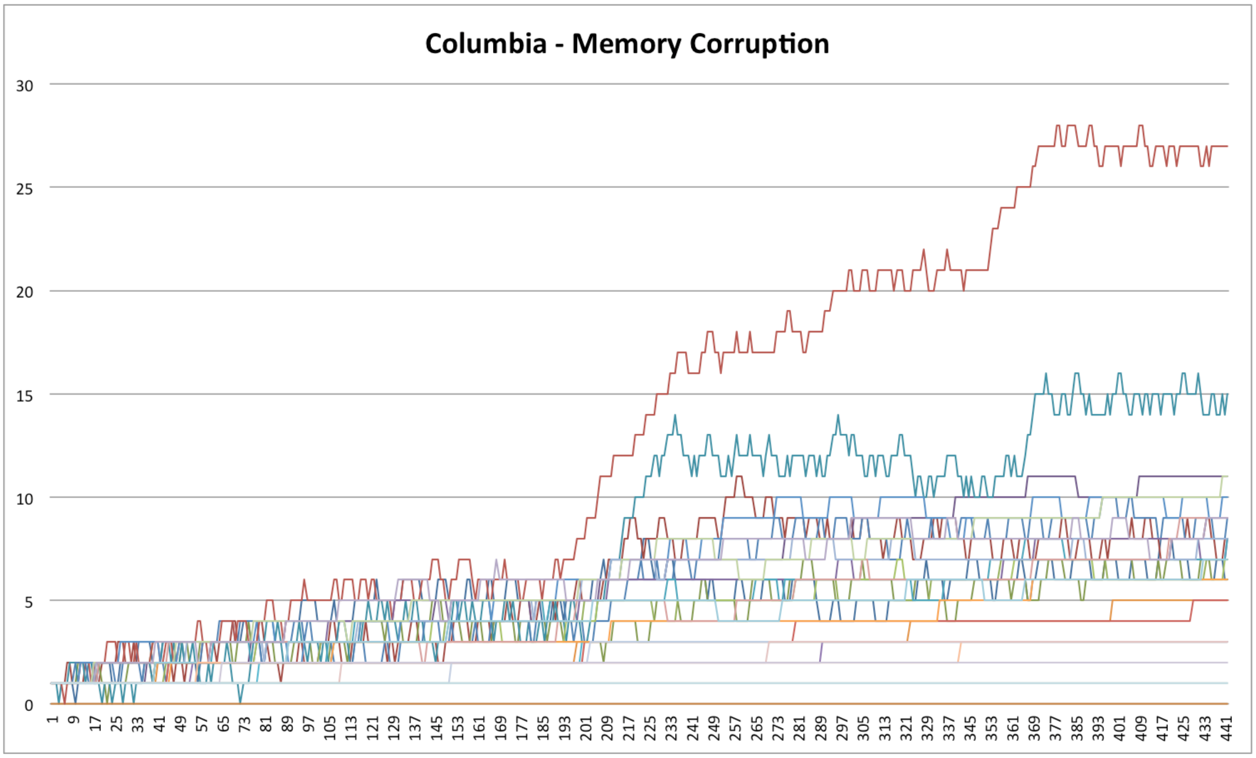

Figure 7-4. Delta Progression Chart for Post IV&V Columbia Memory Corruption Test Suite

7.2.1.4 Null Pointer

Table 7-4. Uniformity Metrics for Post IV&V Columbia Null Pointer Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	42	50	8	8
Data Type	1	7	61	71	10	11
Data Flow	1	11	37	47	10	11
Weakness	1	7	59	71	12	12
Taint Source	1	4	95	126	31	32
Weakness Class	1	1	460	460	0	1
Injection Point	1	10	41	50	9	11
Base Program	1	6	55	87	32	32
Data Type/Control Flow	2	70	3	10	7	7
Base Program/Control Flow	2	60	2	11	9	9
Taint Source/Data Flow	2	44	4	15	11	11
Weakness/Taint Source	2	28	9	20	11	11
Base Program/Taint Source	2	24	6	24	18	18
Weakness/Data Type	2	49	6	13	7	7
Base Program/Data Flow	2	66	2	10	8	8
Weakness/Base Program	2	42	5	15	10	10
Weakness/Data Flow	2	77	2	8	6	6
Data Flow/Control Flow	2	110	1	6	5	6
Taint Source/Control Flow	2	40	8	15	7	8
Base Program/Injection Point	2	60	2	11	9	10
Base Program/Data Type	2	42	5	15	10	10
Taint Source/Data Type	2	28	10	21	11	11
Data Type/Data Flow	2	77	3	9	6	7
Weakness/Control Flow	2	70	3	9	6	6
Taint Source/Data Type/Control Flow	3	280	0	3	3	3
Taint Source/Data Type/Data Flow	3	308	0	4	4	4
Weakness/Base Program/Injection Point	3	420	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

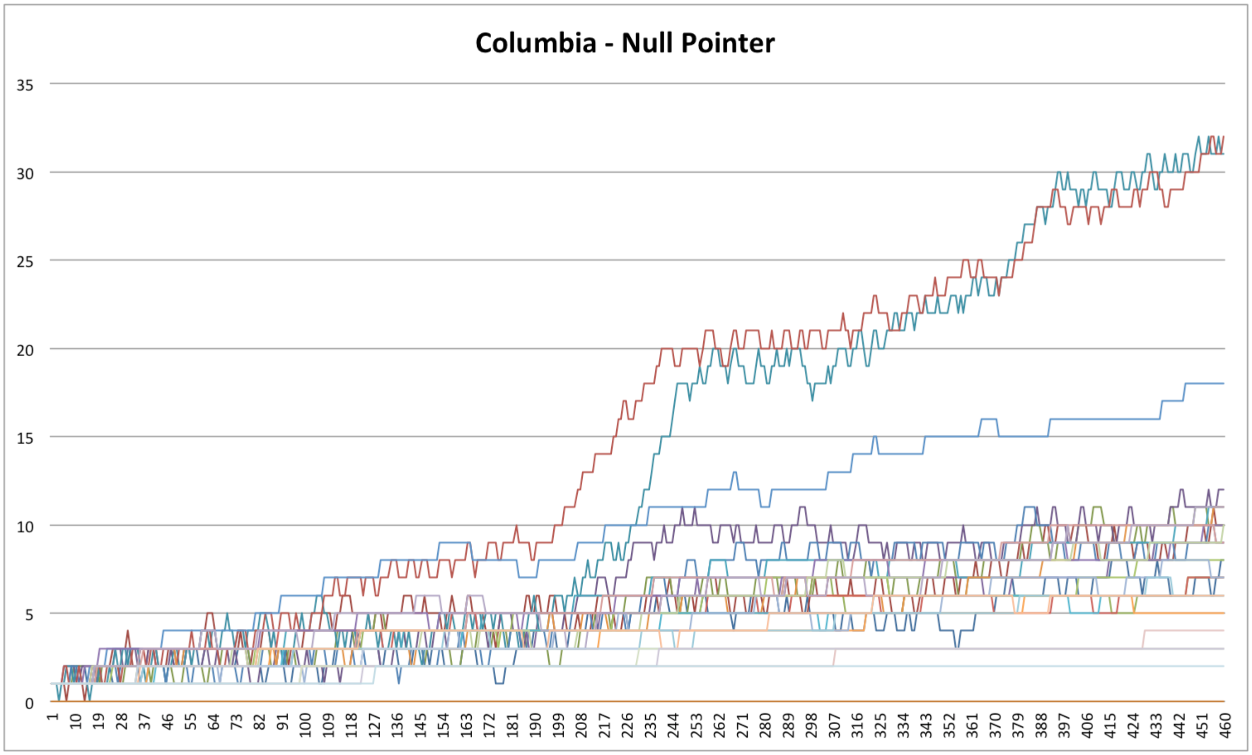

Figure 7-5. Delta Progression Chart for Post IV&V Columbia Null Pointer Test Suite

7.2.1.5 Number Handling

Table 7-5 Uniformity Metrics for Post IV&V Columbia Number Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	41	48	7	9
Data Type	1	7	59	65	6	9
Data Flow	1	11	35	44	9	9
Weakness	1	11	19	44	25	25
Taint Source	1	4	89	116	27	27
Weakness Class	1	1	432	432	0	1
Injection Point	1	10	38	47	9	10
Base Program	1	6	53	81	28	29
Data Type/Control Flow	2	70	2	9	7	8
Base Program/Control Flow	2	60	2	11	9	9
Taint Source/Data Flow	2	44	5	14	9	9
Weakness/Taint Source	2	44	3	14	11	11
Base Program/Taint Source	2	24	10	23	13	13
Weakness/Data Type	2	77	1	9	8	8
Base Program/Data Flow	2	66	3	11	8	8
Weakness/Base Program	2	66	0	12	12	12
Weakness/Data Flow	2	121	0	6	6	6
Data Flow/Control Flow	2	110	0	7	7	7
Taint Source/Control Flow	2	40	7	14	7	8
Base Program/Injection Point	2	60	3	11	8	8
Base Program/Data Type	2	42	4	14	10	10
Taint Source/Data Type	2	28	10	19	9	11
Data Type/Data Flow	2	77	2	9	7	7
Weakness/Control Flow	2	110	0	7	7	7

Name	Columns	Count	Min	Max	Delta	Max Delta
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	660	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	2	2	2
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

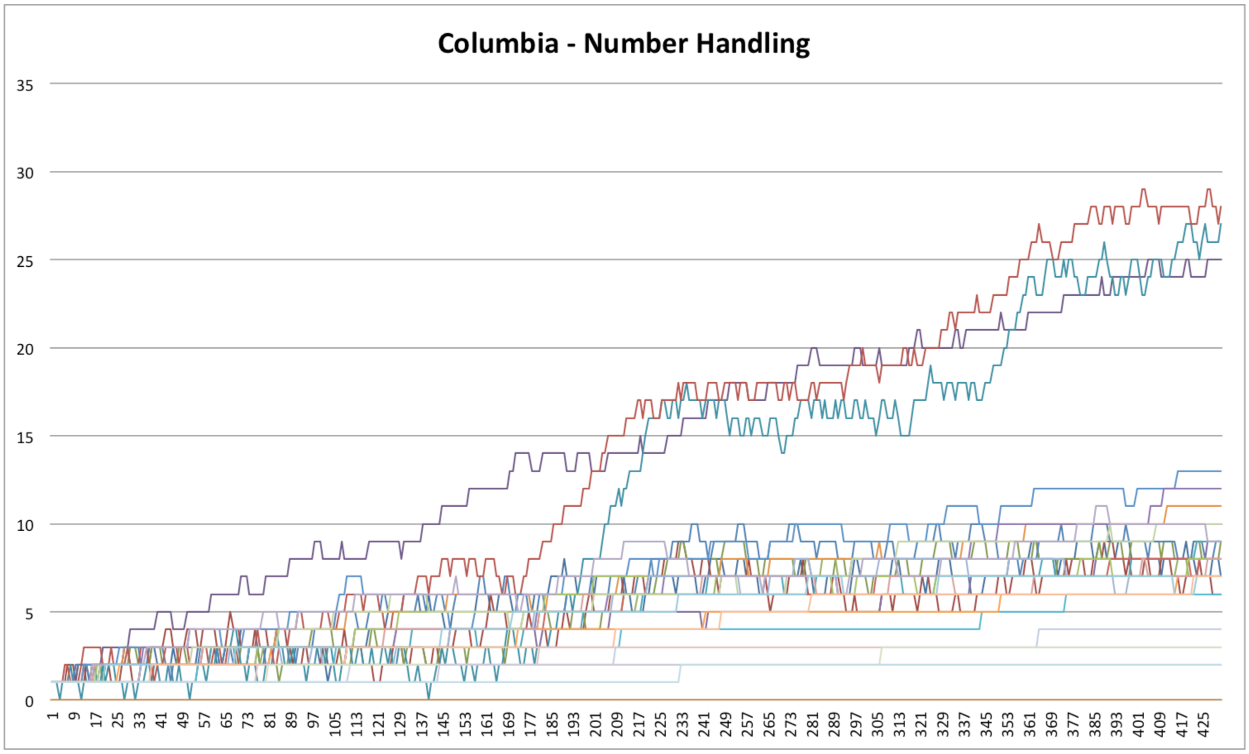

Figure 7-6. Delta Progression Chart for Post IV&V Columbia Number Handling Test Suite

7.2.1.6 Resource Drains

Table 7-6. Uniformity Metrics for Post IV&V Columbia Resource Drains Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	37	45	8	11
Data Type	1	7	55	63	8	9
Data Flow	1	11	34	41	7	8
Weakness	1	12	21	41	20	20
Taint Source	1	4	86	112	26	27
Weakness Class	1	1	413	413	0	1
Injection Point	1	10	36	46	10	10
Base Program	1	6	54	73	19	23
Data Type/Control Flow	2	70	1	9	8	8
Base Program/Control Flow	2	60	1	11	10	10
Taint Source/Data Flow	2	44	5	13	8	10
Weakness/Taint Source	2	48	0	13	13	13

Name	Columns	Count	Min	Max	Delta	Max Delta
Base Program/Taint Source	2	24	9	23	14	14
Weakness/Data Type	2	84	1	8	7	7
Base Program/Data Flow	2	66	3	12	9	10
Weakness/Base Program	2	72	0	10	10	10
Weakness/Data Flow	2	132	0	5	5	5
Data Flow/Control Flow	2	110	0	7	7	7
Taint Source/Control Flow	2	40	6	14	8	9
Base Program/Injection Point	2	60	3	10	7	8
Base Program/Data Type	2	42	5	14	9	10
Taint Source/Data Type	2	28	9	19	10	10
Data Type/Data Flow	2	77	2	9	7	7
Weakness/Control Flow	2	120	1	6	5	6
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	720	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

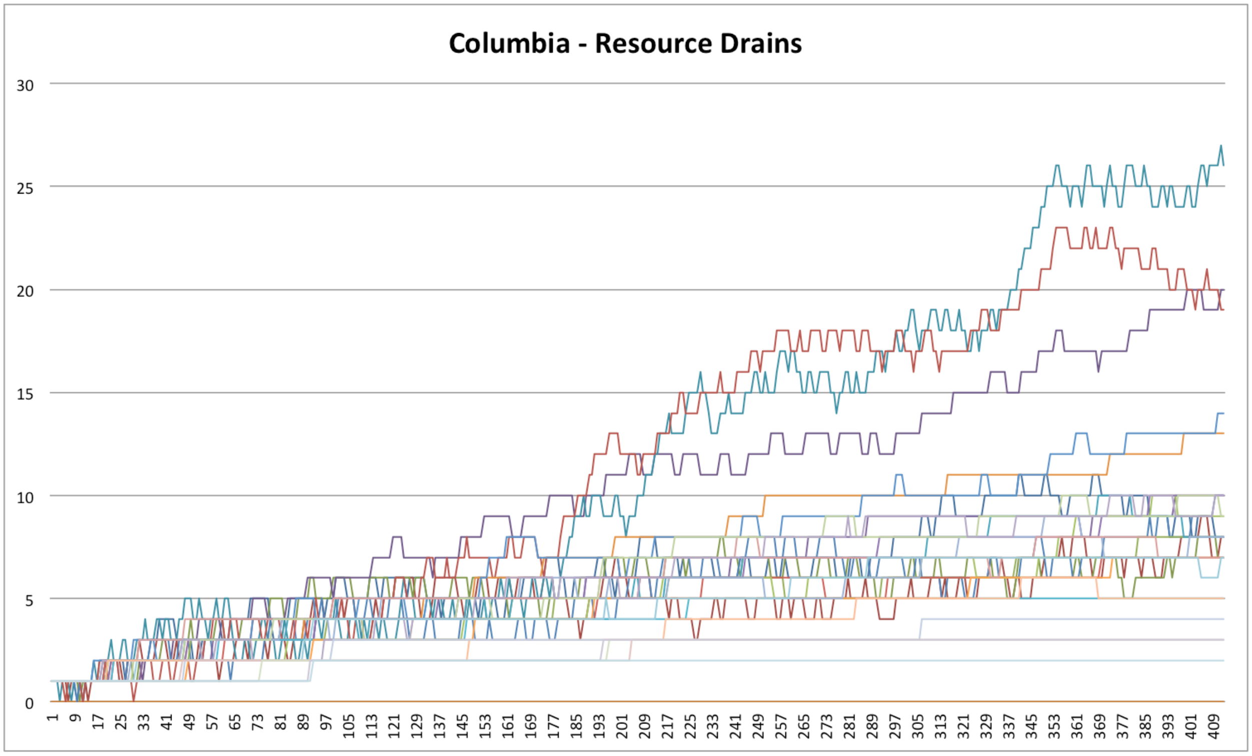

Figure 7-7. Delta Progression Chart for Post IV&V Columbia Resource Drains Test Suite

7.2.2 GrammaTech Stage 2 Test Suites

The metrics in this section represent the test suites considered valid for Stage 2. These test cases passed both IV&V as well as Stage 1 on the performer modified machines.

7.2.2.1 Concurrency

Table 7-7. Uniformity Metrics for Post IV&V GrammaTech Concurrency Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	29	36	7	9
Data Type	1	7	39	52	13	18
Data Flow	1	11	25	37	12	13
Weakness	1	16	0	32	32	32
Taint Source	1	4	56	92	36	36
Weakness Class	1	1	320	320	0	1
Injection Point	1	10	21	39	18	19
Base Program	1	6	19	81	62	62
Data Type/Control Flow	2	70	2	8	6	7
Base Program/Control Flow	2	60	0	11	11	11
Taint Source/Data Flow	2	44	4	12	8	8
Weakness/Taint Source	2	64	0	10	10	10
Base Program/Taint Source	2	24	2	24	22	22
Weakness/Data Type	2	112	0	7	7	7
Base Program/Data Flow	2	66	0	9	9	9
Weakness/Base Program	2	96	0	8	8	8
Weakness/Data Flow	2	176	0	4	4	4
Data Flow/Control Flow	2	110	0	8	8	8
Taint Source/Control Flow	2	40	3	12	9	10
Base Program/Injection Point	2	60	0	13	13	13
Base Program/Data Type	2	42	2	14	12	12
Taint Source/Data Type	2	28	6	15	9	12
Data Type/Data Flow	2	77	1	9	8	8
Weakness/Control Flow	2	160	0	5	5	5
Taint Source/Data Type/Control Flow	3	280	0	3	3	3
Taint Source/Data Type/Data Flow	3	308	0	4	4	4
Weakness/Base Program/Injection Point	3	960	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

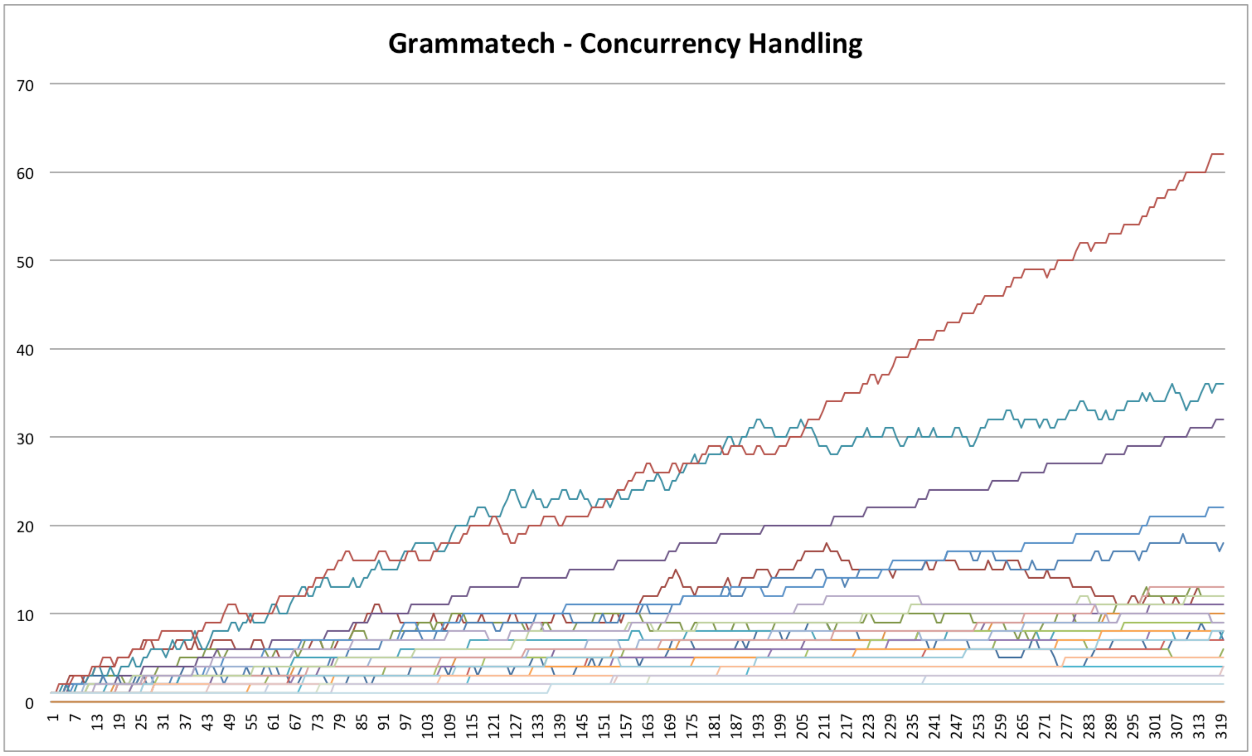

Figure 7-8. Delta Progression Chart for Post IV&V GrammaTech Concurrency Handling Test Suite

7.2.2.2 Injection

Table 7-8. Uniformity Metrics for Post IV&V GrammaTech Injection Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	44	56	12	12
Data Type	1	7	69	76	7	10
Data Flow	1	11	38	55	17	17
Weakness	1	8	57	79	22	23
Taint Source	1	4	119	132	13	13
Weakness Class	1	1	509	509	0	1
Injection Point	1	10	45	56	11	12
Base Program	1	6	49	105	56	56
Data Type/Control Flow	2	70	3	10	7	7
Base Program/Control Flow	2	60	3	13	10	10
Taint Source/Data Flow	2	44	6	15	9	9
Weakness/Taint Source	2	32	10	24	14	15
Base Program/Taint Source	2	24	8	30	22	22
Weakness/Data Type	2	56	4	14	10	10
Base Program/Data Flow	2	66	2	12	10	10
Weakness/Base Program	2	48	0	30	30	30
Weakness/Data Flow	2	88	1	10	9	9
Data Flow/Control Flow	2	110	1	8	7	7
Taint Source/Control Flow	2	40	9	17	8	8
Base Program/Injection Point	2	60	1	12	11	11
Base Program/Data Type	2	42	5	18	13	13
Taint Source/Data Type	2	28	13	23	10	11
Data Type/Data Flow	2	77	3	10	7	7
Weakness/Control Flow	2	80	2	12	10	10

Name	Columns	Count	Min	Max	Delta	Max Delta
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	4	4	4
Weakness/Base Program/Injection Point	3	480	0	7	7	7
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

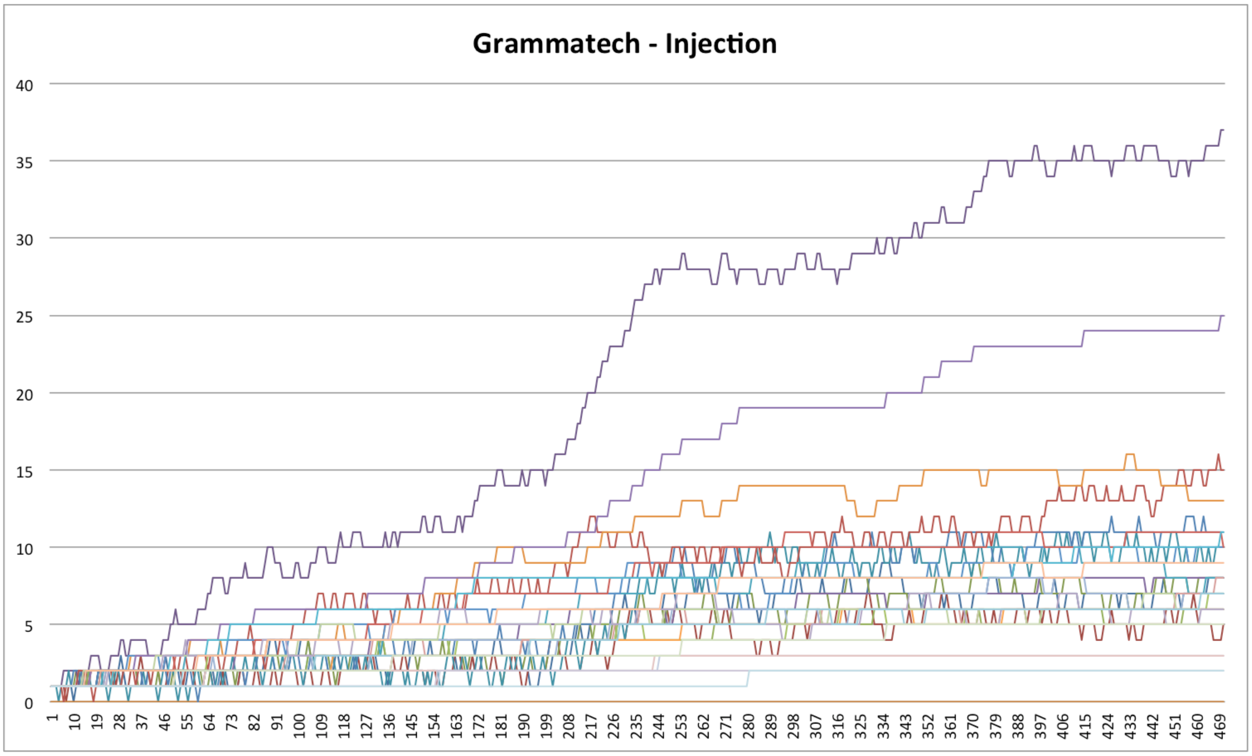

Figure 7-9. Delta Progression Chart for Post IV&V GrammaTech Injection Test Suite

7.2.2.3 Memory Corruption

Table 7-9. Uniformity Metrics for Post IV&V GrammaTech Memory Corruption Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	41	50	9	11
Data Type	1	7	60	68	8	12
Data Flow	1	11	35	46	11	11
Weakness	1	41	2	15	13	13
Taint Source	1	4	101	125	24	26
Weakness Class	1	1	450	450	0	1
Injection Point	1	10	37	49	12	13
Base Program	1	6	39	91	52	52
Data Type/Control Flow	2	70	3	10	7	8
Base Program/Control Flow	2	60	1	11	10	10
Taint Source/Data Flow	2	44	5	14	9	9
Weakness/Taint Source	2	164	0	5	5	5

Name	Columns	Count	Min	Max	Delta	Max Delta
Base Program/Taint Source	2	24	7	26	19	19
Weakness/Data Type	2	287	0	5	5	5
Base Program/Data Flow	2	66	2	12	10	10
Weakness/Base Program	2	246	0	4	4	4
Weakness/Data Flow	2	451	0	3	3	3
Data Flow/Control Flow	2	110	1	7	6	6
Taint Source/Control Flow	2	40	6	16	10	11
Base Program/Injection Point	2	60	1	12	11	12
Base Program/Data Type	2	42	3	16	13	13
Taint Source/Data Type	2	28	12	20	8	9
Data Type/Data Flow	2	77	3	10	7	7
Weakness/Control Flow	2	410	0	3	3	3
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	2460	0	1	1	1
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	1	1	1

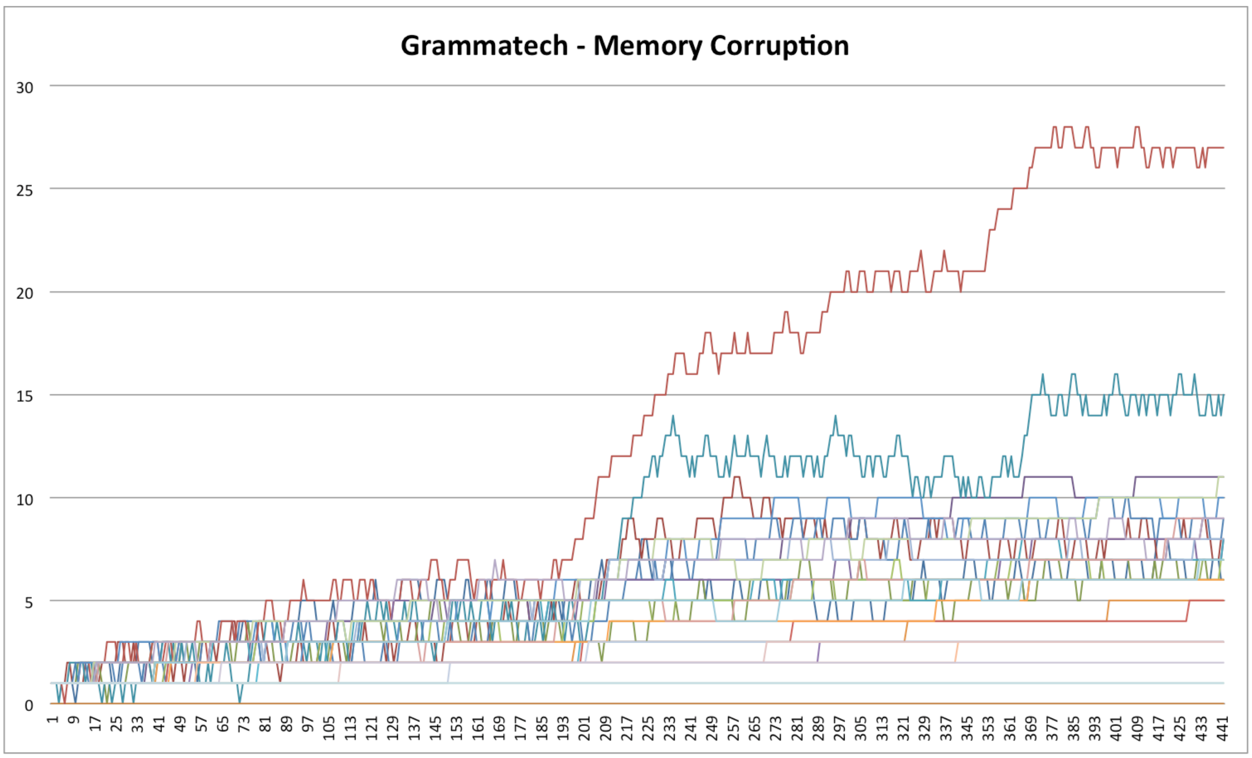

Figure 7-10. Delta Progression Chart for Post IV&V GrammaTech Memory Corruption Test Suite

7.2.2.4 Null Pointer

Table 7-10. Uniformity Metrics for Post IV&V GrammaTech Null Pointer Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	46	53	7	11
Data Type	1	7	63	76	13	14
Data Flow	1	11	39	49	10	12
Weakness	1	7	67	72	5	9
Taint Source	1	4	117	126	9	13
Weakness Class	1	1	486	486	0	1
Injection Point	1	10	42	55	13	15
Base Program	1	6	38	106	68	68
Data Type/Control Flow	2	70	3	9	6	7
Base Program/Control Flow	2	60	2	12	10	10
Taint Source/Data Flow	2	44	7	15	8	8
Weakness/Taint Source	2	28	14	21	7	7
Base Program/Taint Source	2	24	5	28	23	23
Weakness/Data Type	2	49	5	13	8	9
Base Program/Data Flow	2	66	1	11	10	10
Weakness/Base Program	2	42	4	17	13	13
Weakness/Data Flow	2	77	3	8	5	6
Data Flow/Control Flow	2	110	1	7	6	6
Taint Source/Control Flow	2	40	9	16	7	7
Base Program/Injection Point	2	60	0	13	13	13
Base Program/Data Type	2	42	2	17	15	15
Taint Source/Data Type	2	28	14	21	7	9
Data Type/Data Flow	2	77	3	9	6	7
Weakness/Control Flow	2	70	3	11	8	8
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	4	4	4
Weakness/Base Program/Injection Point	3	420	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

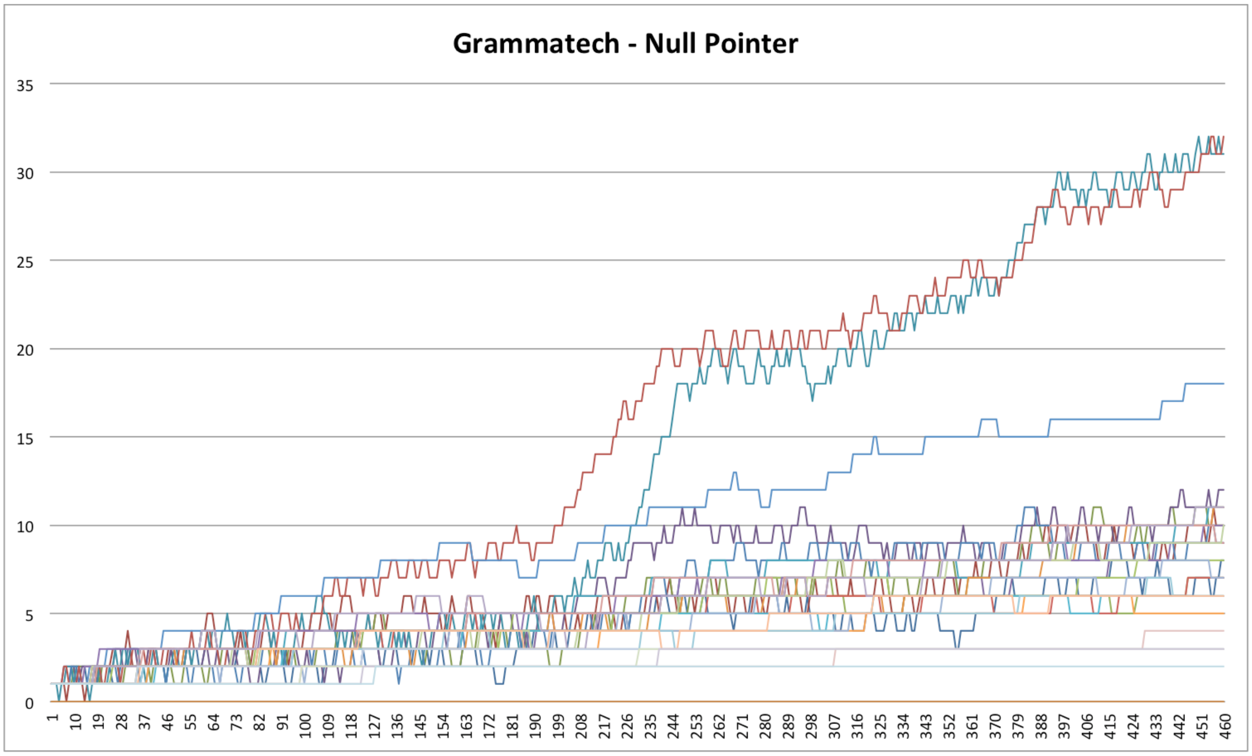

Figure 7-11. Delta Progression Chart for Post IV&V GrammaTech Null Pointer Test Suite

7.2.2.5 Number Handling

Table 7-11. Uniformity Metrics for Post IV&V GrammaTech Number Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	39	54	15	15
Data Type	1	7	57	70	13	15
Data Flow	1	11	38	44	6	8
Weakness	1	11	23	49	26	26
Taint Source	1	4	106	125	19	19
Weakness Class	1	1	463	463	0	1
Injection Point	1	10	41	52	11	12
Base Program	1	6	50	98	48	48
Data Type/Control Flow	2	70	3	11	8	8
Base Program/Control Flow	2	60	2	13	11	11
Taint Source/Data Flow	2	44	5	15	10	10
Weakness/Taint Source	2	44	5	14	9	10
Base Program/Taint Source	2	24	8	26	18	18
Weakness/Data Type	2	77	1	9	8	8
Base Program/Data Flow	2	66	1	12	11	11
Weakness/Base Program	2	66	1	13	12	12
Weakness/Data Flow	2	121	1	6	5	5
Data Flow/Control Flow	2	110	1	7	6	6
Taint Source/Control Flow	2	40	8	15	7	9
Base Program/Injection Point	2	60	0	12	12	12
Base Program/Data Type	2	42	5	16	11	11
Taint Source/Data Type	2	28	11	21	10	11
Data Type/Data Flow	2	77	2	9	7	7

Name	Columns	Count	Min	Max	Delta	Max Delta
Weakness/Control Flow	2	110	0	8	8	8
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	3	3	3
Weakness/Base Program/Injection Point	3	660	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	2	2	2
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

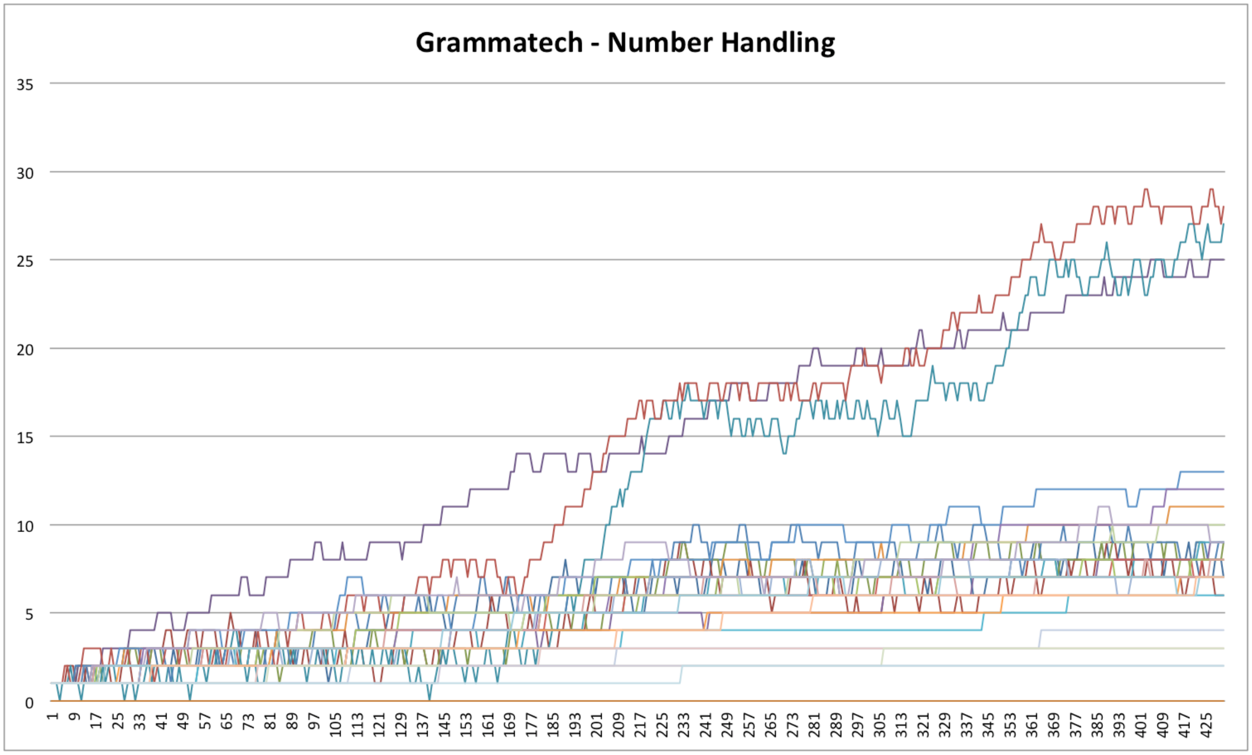

Figure 7-12. Delta Progression Chart for Post IV&V GrammaTech Number Handling Test Suite

7.2.2.6 Resource Drains

Table 7-12. Uniformity Metrics for Post IV&V GrammaTech Resource Drains Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	10	40	52	12	13
Data Type	1	7	58	69	11	11
Data Flow	1	11	37	44	7	11
Weakness	1	12	22	45	23	25
Taint Source	1	4	94	120	26	28
Weakness Class	1	1	450	450	0	1
Injection Point	1	10	41	50	9	13
Base Program	1	6	43	94	51	52
Data Type/Control Flow	2	70	2	10	8	8
Base Program/Control Flow	2	60	2	12	10	10
Taint Source/Data Flow	2	44	6	14	8	9

Name	Columns	Count	Min	Max	Delta	Max Delta
Weakness/Taint Source	2	48	0	15	15	15
Base Program/Taint Source	2	24	8	27	19	19
Weakness/Data Type	2	84	1	9	8	8
Base Program/Data Flow	2	66	2	12	10	10
Weakness/Base Program	2	72	0	11	11	11
Weakness/Data Flow	2	132	0	6	6	6
Data Flow/Control Flow	2	110	0	7	7	7
Taint Source/Control Flow	2	40	7	16	9	9
Base Program/Injection Point	2	60	1	12	11	11
Base Program/Data Type	2	42	4	16	12	12
Taint Source/Data Type	2	28	10	19	9	9
Data Type/Data Flow	2	77	2	9	7	8
Weakness/Control Flow	2	120	0	7	7	7
Taint Source/Data Type/Control Flow	3	280	0	4	4	4
Taint Source/Data Type/Data Flow	3	308	0	4	4	4
Weakness/Base Program/Injection Point	3	720	0	3	3	3
Taint Source/Data Flow/Control Flow	3	440	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	3080	0	2	2	2

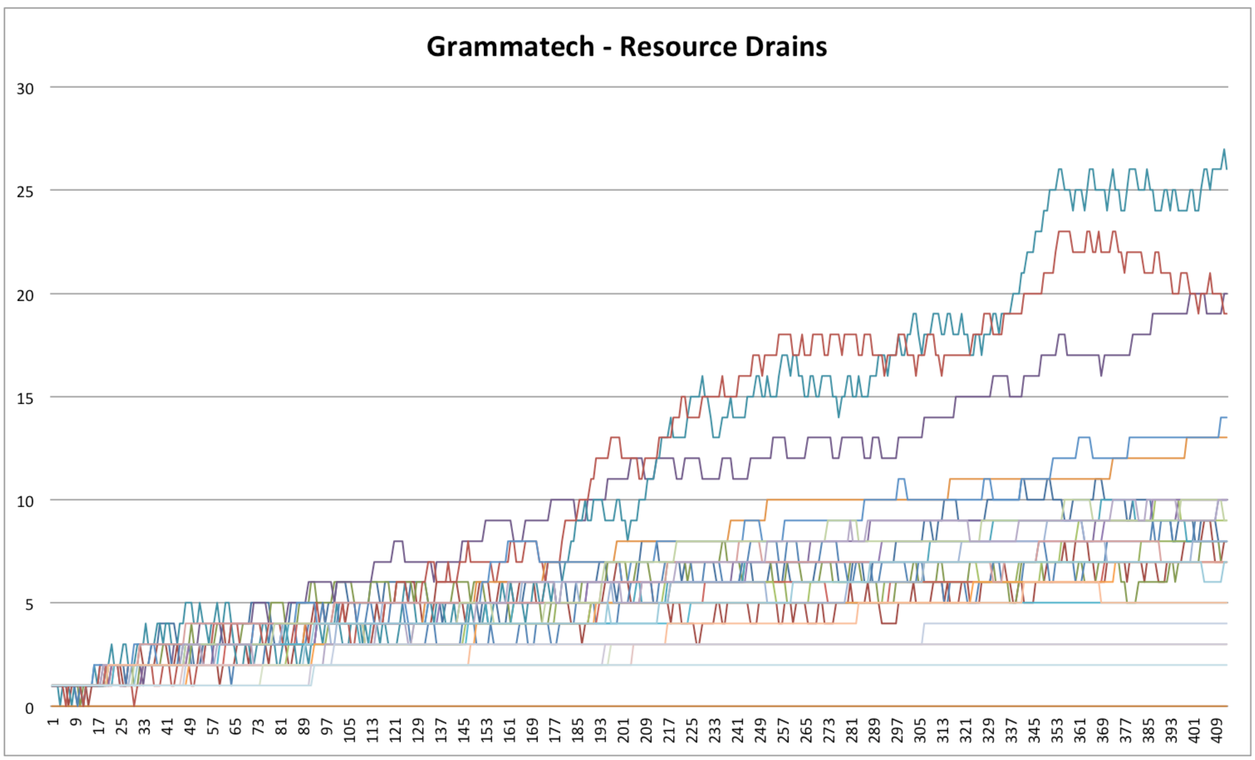

Figure 7-13. Delta Progression Chart for Post IV&V GrammaTech Resource Drains Test Suite

7.2.3 Kestrel Stage 2 Test Suites

The metrics in this section represent the test suites considered valid for Stage 2. These test cases passed both IV&V as well as Stage 1 on the performer modified machines.

7.2.3.1 Concurrency

Table 7-13. Uniformity Metrics for Post IV&V Kestrel Concurrency Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	11	39	42	3	5
Data Type	1	3	145	150	5	6
Data Flow	1	6	71	77	6	7
Weakness	1	15	23	32	9	9
Taint Source	1	3	147	149	2	5
Weakness Class	1	1	444	444	0	1
Injection Point	1	10	42	47	5	6
Base Program	1	6	64	80	16	16
Data Type/Control Flow	2	33	10	16	6	9
Base Program/Control Flow	2	66	3	9	6	6
Taint Source/Data Flow	2	18	21	29	8	8
Weakness/Taint Source	2	45	5	13	8	8
Base Program/Taint Source	2	18	19	29	10	11
Weakness/Data Type	2	45	5	14	9	9
Base Program/Data Flow	2	36	7	15	8	8
Weakness/Base Program	2	90	1	7	6	6
Weakness/Data Flow	2	90	1	7	6	6
Data Flow/Control Flow	2	66	4	8	4	5
Taint Source/Control Flow	2	33	11	16	5	6
Base Program/Injection Point	2	60	2	10	8	8
Base Program/Data Type	2	18	16	28	12	12
Taint Source/Data Type	2	9	47	52	5	6
Data Type/Data Flow	2	18	22	29	7	8
Weakness/Control Flow	2	165	0	5	5	5
Taint Source/Data Type/Control Flow	3	99	1	6	5	5
Taint Source/Data Type/Data Flow	3	54	5	12	7	7
Weakness/Base Program/Injection Point	3	900	0	3	3	3
Taint Source/Data Flow/Control Flow	3	198	0	4	4	4
Taint Source/Data Type/Data Flow/Control Flow	4	594	0	2	2	2

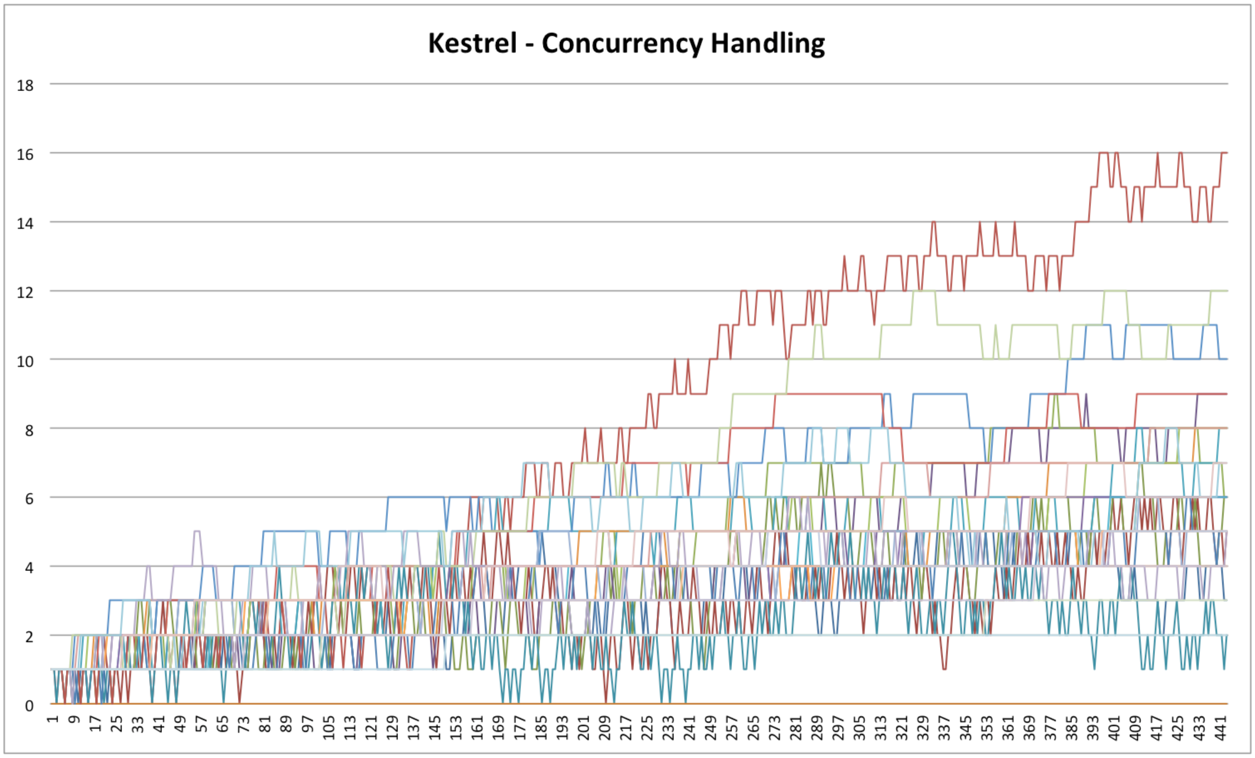

Figure 7-14. Delta Progression Chart for Post IV&V Kestrel Concurrency Handling Test Suite

7.2.3.2 Error Handling

Table 7-14. Uniformity Metrics for Post IV&V Kestrel Error Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	11	39	44	5	5
Data Type	1	3	151	152	1	5
Data Flow	1	6	72	78	6	7
Weakness	1	9	36	55	19	19
Taint Source	1	3	151	152	1	5
Weakness Class	1	1	455	455	0	1
Injection Point	1	10	43	47	4	4
Base Program	1	6	56	80	24	24
Data Type/Control Flow	2	33	11	17	6	7
Base Program/Control Flow	2	66	4	9	5	7
Taint Source/Data Flow	2	18	23	28	5	7
Weakness/Taint Source	2	27	10	21	11	11
Base Program/Taint Source	2	18	17	29	12	12
Weakness/Data Type	2	27	11	21	10	10
Base Program/Data Flow	2	36	6	15	9	10
Weakness/Base Program	2	54	0	12	12	12
Weakness/Data Flow	2	54	4	11	7	8
Data Flow/Control Flow	2	66	3	10	7	7
Taint Source/Control Flow	2	33	11	16	5	6
Base Program/Injection Point	2	60	4	10	6	7
Base Program/Data Type	2	18	16	29	13	13
Taint Source/Data Type	2	9	46	54	8	8
Data Type/Data Flow	2	18	22	27	5	8
Weakness/Control Flow	2	99	1	7	6	6

Name	Columns	Count	Min	Max	Delta	Max Delta
Taint Source/Data Type/Control Flow	3	99	2	6	4	5
Taint Source/Data Type/Data Flow	3	54	4	11	7	7
Weakness/Base Program/Injection Point	3	540	0	2	2	2
Taint Source/Data Flow/Control Flow	3	198	0	4	4	4
Taint Source/Data Type/Data Flow/Control Flow	4	594	0	2	2	2

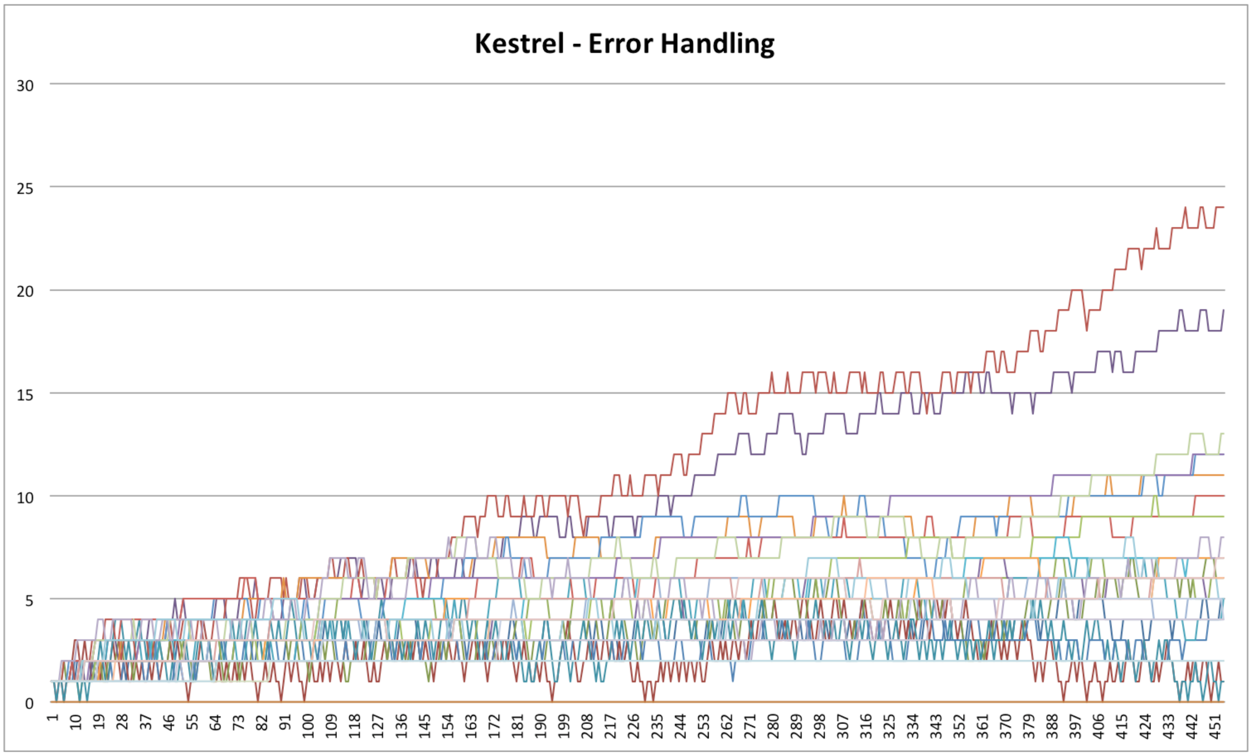

Figure 7-15. Delta Progression Chart for Post IV&V Kestrel Error Handling Test Suite

7.2.3.3 Injection

Table 7-15. Uniformity Metrics for Post IV&V Kestrel Injection Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	11	41	44	3	4
Data Type	1	3	157	157	0	4
Data Flow	1	6	77	80	3	5
Weakness	1	8	57	60	3	3
Taint Source	1	3	156	158	2	4
Weakness Class	1	1	471	471	0	1
Injection Point	1	10	45	48	3	4
Base Program	1	6	76	80	4	5
Data Type/Control Flow	2	33	12	16	4	5
Base Program/Control Flow	2	66	5	9	4	6
Taint Source/Data Flow	2	18	25	28	3	5
Weakness/Taint Source	2	24	16	22	6	6
Base Program/Taint Source	2	18	23	29	6	7

Name	Columns	Count	Min	Max	Delta	Max Delta
Weakness/Data Type	2	24	17	22	5	6
Base Program/Data Flow	2	36	9	15	6	6
Weakness/Base Program	2	48	6	13	7	8
Weakness/Data Flow	2	48	6	13	7	7
Data Flow/Control Flow	2	66	4	9	5	5
Taint Source/Control Flow	2	33	12	16	4	5
Base Program/Injection Point	2	60	5	10	5	6
Base Program/Data Type	2	18	21	29	8	8
Taint Source/Data Type	2	9	50	55	5	7
Data Type/Data Flow	2	18	23	28	5	7
Weakness/Control Flow	2	88	2	7	5	6
Taint Source/Data Type/Control Flow	3	99	2	6	4	4
Taint Source/Data Type/Data Flow	3	54	6	12	6	6
Weakness/Base Program/Injection Point	3	480	0	3	3	3
Taint Source/Data Flow/Control Flow	3	198	0	3	3	3
Taint Source/Data Type/Data Flow/Control Flow	4	594	0	2	2	2

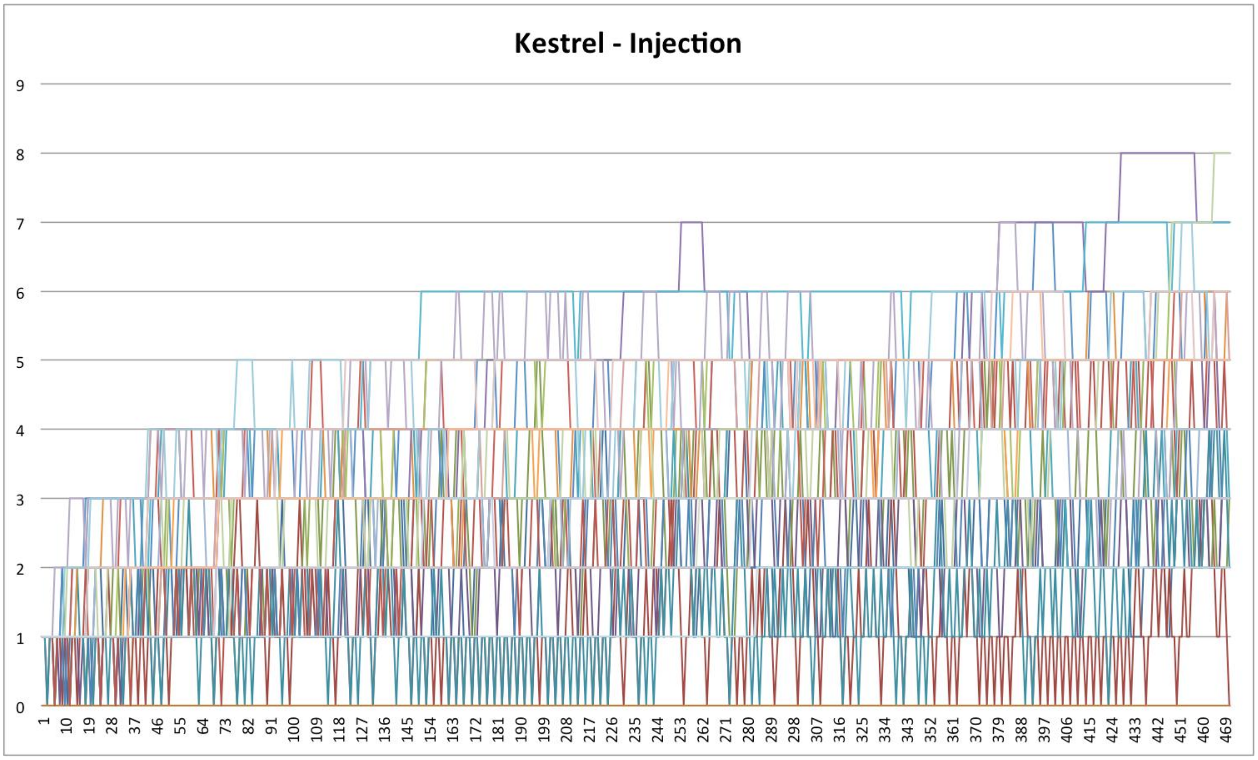

Figure 7-16. Delta Progression Chart for Post IV&V Kestrel Injection Test Suite

7.2.3.4 Number Handling

Table 7-16. Uniformity Metrics for Post IV&V Kestrel Number Handling Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	11	42	44	2	3
Data Type	1	3	156	157	1	5
Data Flow	1	6	77	79	2	4
Weakness	1	9	48	54	6	7
Taint Source	1	3	156	157	1	4
Weakness Class	1	1	470	470	0	1
Injection Point	1	10	44	48	4	4
Base Program	1	6	77	80	3	4
Data Type/Control Flow	2	33	11	17	6	6
Base Program/Control Flow	2	66	5	9	4	4
Taint Source/Data Flow	2	18	23	29	6	7
Weakness/Taint Source	2	27	12	20	8	9
Base Program/Taint Source	2	18	22	29	7	9
Weakness/Data Type	2	27	15	21	6	6
Base Program/Data Flow	2	36	8	16	8	8
Weakness/Base Program	2	54	5	11	6	6
Weakness/Data Flow	2	54	5	11	6	6
Data Flow/Control Flow	2	66	4	9	5	5
Taint Source/Control Flow	2	33	12	16	4	5
Base Program/Injection Point	2	60	5	10	5	5
Base Program/Data Type	2	18	23	28	5	7
Taint Source/Data Type	2	9	49	55	6	7
Data Type/Data Flow	2	18	23	29	6	8
Weakness/Control Flow	2	99	2	7	5	6
Taint Source/Data Type/Control Flow	3	99	2	7	5	5
Taint Source/Data Type/Data Flow	3	54	5	11	6	6
Weakness/Base Program/Injection Point	3	540	0	2	2	2
Taint Source/Data Flow/Control Flow	3	198	0	4	4	4
Taint Source/Data Type/Data Flow/Control Flow	4	594	0	2	2	2

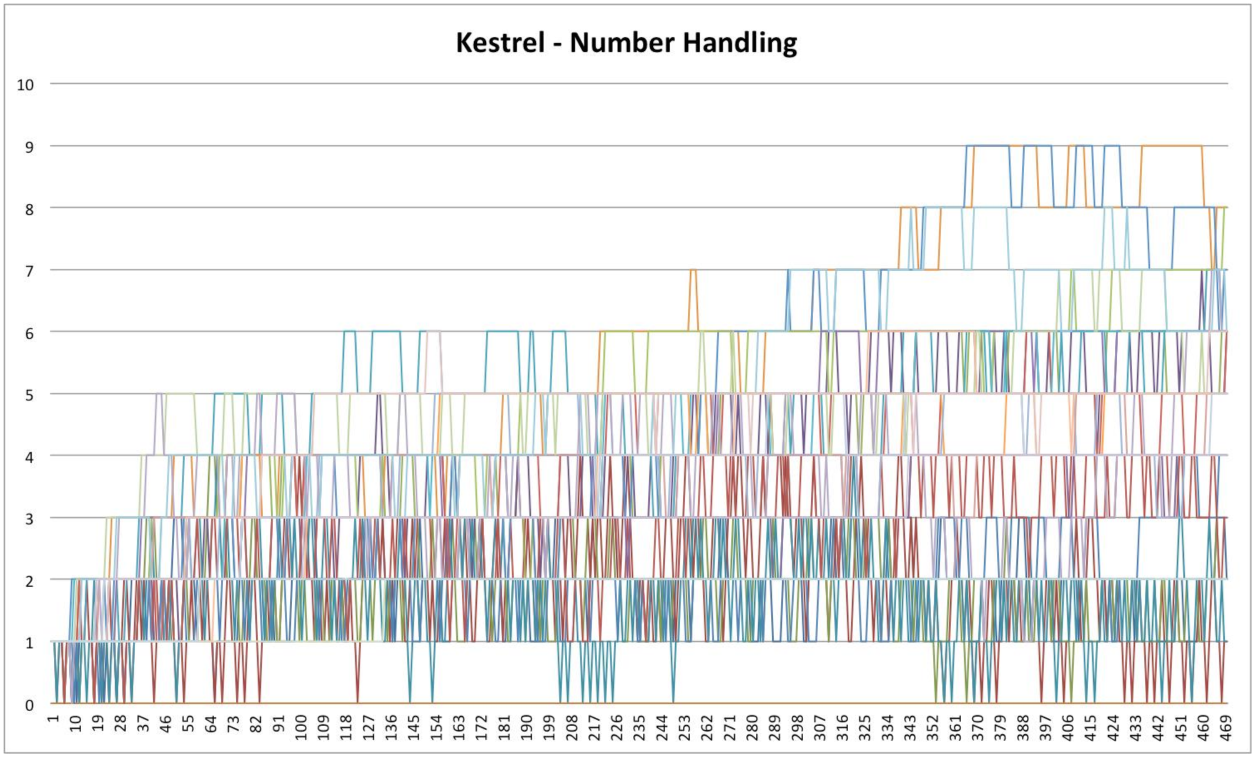

Figure 7-17. Delta Progression Chart for Post IV&V Kestrel Number Handling Test Suite

7.2.3.5 Resource Drains

Table 7-17. Uniformity Metrics for Post IV&V Kestrel Resource Drains Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	11	38	43	5	7
Data Type	1	3	148	154	6	8
Data Flow	1	6	74	77	3	6
Weakness	1	9	40	54	14	14
Taint Source	1	3	147	154	7	8
Weakness Class	1	1	452	452	0	1
Injection Point	1	10	43	46	3	5
Base Program	1	6	64	80	16	17
Data Type/Control Flow	2	33	10	17	7	8
Base Program/Control Flow	2	66	3	9	6	6
Taint Source/Data Flow	2	18	22	28	6	7
Weakness/Taint Source	2	27	11	20	9	10
Base Program/Taint Source	2	18	19	28	9	10
Weakness/Data Type	2	27	11	20	9	9
Base Program/Data Flow	2	36	6	15	9	9
Weakness/Base Program	2	54	0	11	11	11
Weakness/Data Flow	2	54	3	11	8	8
Data Flow/Control Flow	2	66	3	9	6	6
Taint Source/Control Flow	2	33	11	17	6	6
Base Program/Injection Point	2	60	5	10	5	6
Base Program/Data Type	2	18	20	30	10	11
Taint Source/Data Type	2	9	48	53	5	8
Data Type/Data Flow	2	18	20	27	7	8
Weakness/Control Flow	2	99	2	7	5	5

Name	Columns	Count	Min	Max	Delta	Max Delta
Taint Source/Data Type/Control Flow	3	99	0	6	6	6
Taint Source/Data Type/Data Flow	3	54	6	10	4	6
Weakness/Base Program/Injection Point	3	540	0	3	3	3
Taint Source/Data Flow/Control Flow	3	198	0	4	4	4
Taint Source/Data Type/Data Flow/Control Flow	4	594	0	3	3	3

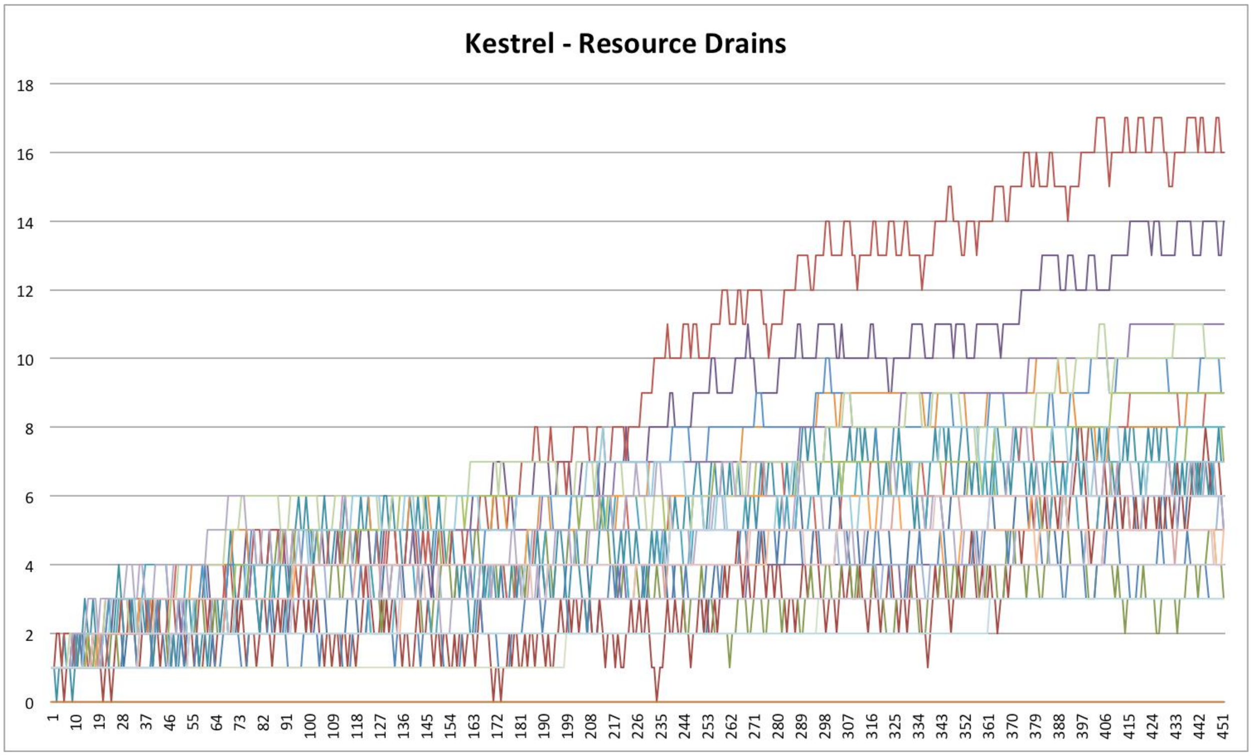

Figure 7-18. Delta Progression Chart for Post IV&V Kestrel Resource Drains Test Suite

7.2.3.6 Tainted Data

Table 7-18. Uniformity Metrics for Post IV&V Kestrel Tainted Data Test Suite

Name	Columns	Count	Min	Max	Delta	Max Delta
Control Flow	1	11	42	44	2	3
Data Type	1	3	157	159	2	4
Data Flow	1	6	77	80	3	4
Weakness	1	6	78	80	2	3
Taint Source	1	3	52	369	317	317
Weakness Class	1	1	474	474	0	1
Injection Point	1	10	45	48	3	4
Base Program	1	6	77	80	3	4
Data Type/Control Flow	2	33	11	16	5	5
Base Program/Control Flow	2	66	4	9	5	6
Taint Source/Data Flow	2	18	5	66	61	61
Weakness/Taint Source	2	18	0	80	80	80
Base Program/Taint Source	2	18	5	65	60	60

Name	Columns	Count	Min	Max	Delta	Max Delta
Weakness/Data Type	2	18	24	29	5	6
Base Program/Data Flow	2	36	10	15	5	5
Weakness/Base Program	2	36	10	15	5	5
Weakness/Data Flow	2	36	10	15	5	6
Data Flow/Control Flow	2	66	4	9	5	6
Taint Source/Control Flow	2	33	2	36	34	34
Base Program/Injection Point	2	60	4	10	6	6
Base Program/Data Type	2	18	23	28	5	6
Taint Source/Data Type	2	9	14	125	111	111
Data Type/Data Flow	2	18	22	28	6	7
Weakness/Control Flow	2	66	4	9	5	5
Taint Source/Data Type/Control Flow	3	99	0	13	13	13
Taint Source/Data Type/Data Flow	3	54	0	25	25	25
Weakness/Base Program/Injection Point	3	360	0	4	4	4
Taint Source/Data Flow/Control Flow	3	198	0	9	9	9
Taint Source/Data Type/Data Flow/Control Flow	4	594	0	5	5	5

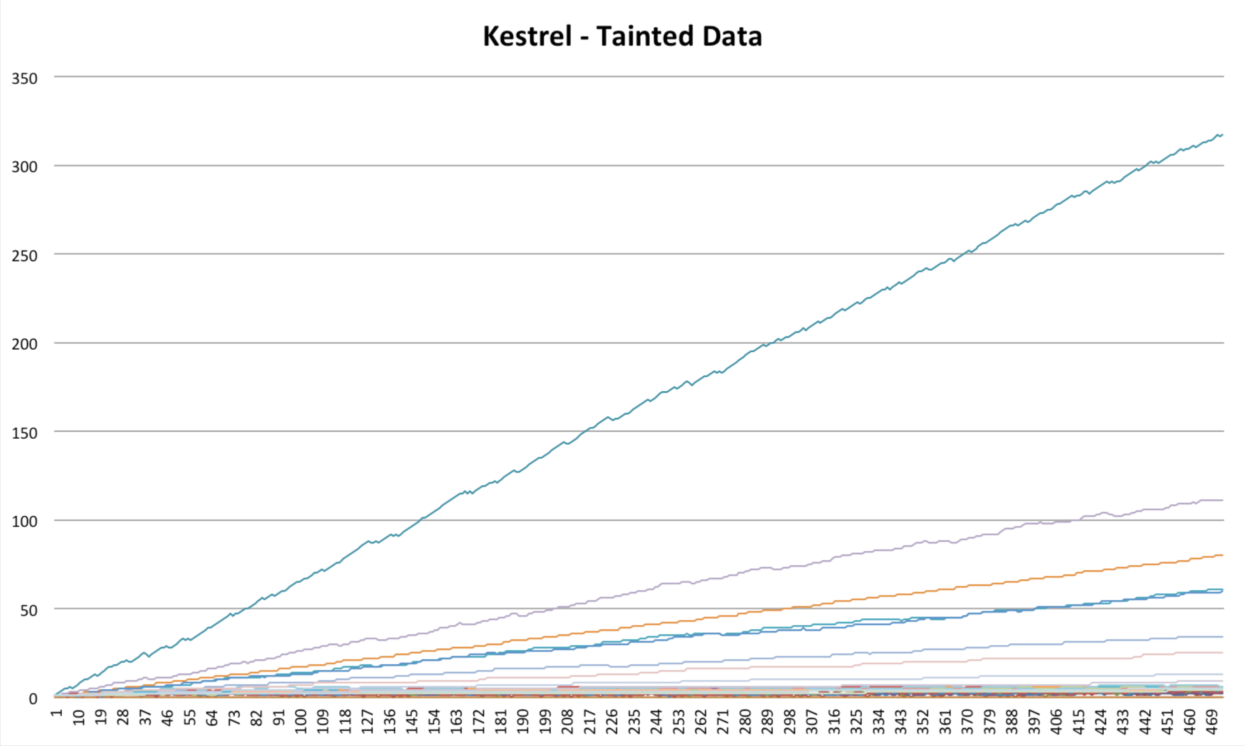

Figure 7-19. Delta Progression Chart for Post IV&V Kestrel Tainted Data Test Suite

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8.0 Performer Evaluations

The heart of the STONESOUP test and evaluation activity was the empirical evaluation of the performer's proposed technologies. This section summarizes the information from the following document(s), and it is recommended that the reader reference this documentation for more information:

The raw and processed results are stored in .xlsx format on the Phase 3 Specifications, Data, Software And Documentations external drive, delivered separately from this report. Mongo data is not provided in this report. The descriptions of the fields for the .csv and .xlsx source data are covered in Appendix H.

- Dry Run #1 Assessment Report
- Dry Run #2 Assessment Report
- Dry Run #3 Assessment Report
- Manual Testing Assessment to Check for Altered Functionality

ALTERED FUNCTIONALITY AND MITIGATION TESTING

During the evaluation activity, each performer's technology was run thousands of time, using the test cases generated via the process outlined in **Section 6.0**. **Figure 8-1** shows how a test case is applied in TEXAS. Additional details about TEXAS and the processes can be found in the System Design Document. Each test case includes applying GOOD I/O pairs and BAD I/O pairs in two stages. The first stage executes without the performer technology where all the I/O pairs for each test case are evaluated to determine if they properly execute in the environment. The second stage executes with performer technology. If in stage 1 all the I/O pairs in a test case perform as expected the test case is declared valid, and the results from stage two are then used in the evaluation of the results.

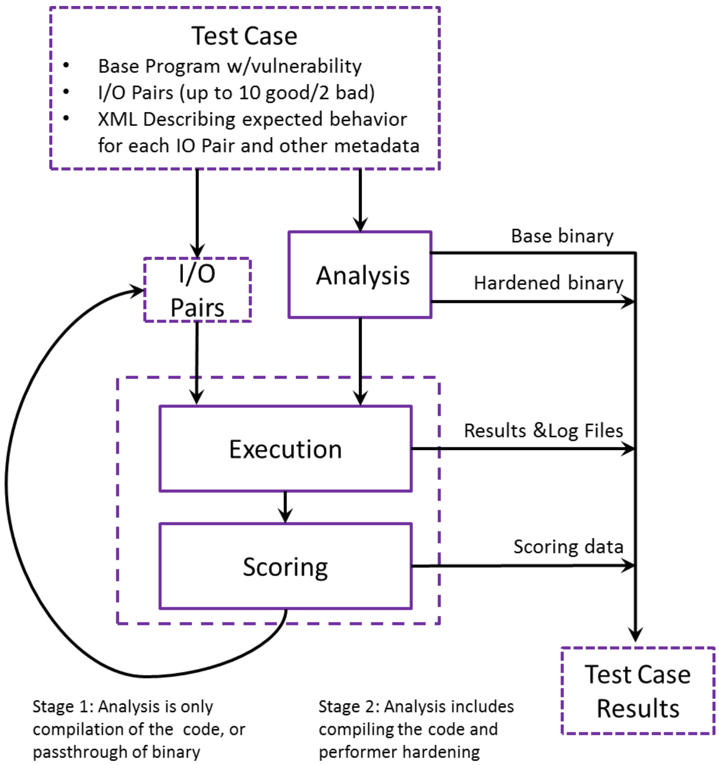

Figure 8-1. Test Case Execution

Each test case included ten GOOD I/O pairs and two BAD I/O pairs for Phase 3 T&E programs that were tested. For Phase 2-sized programs (JMeter and GREP) and Phase 1-sized programs that were tested after T&E completed, each test case included just five GOOD I/O pairs and two BAD I/O pairs.

The GOOD I/O pairs have no vulnerabilities injected and are used to determine if there was altered functionality when run with the performer technology. If all GOOD I/O pairs pass then the test cases is declared to have "No Altered Functionality." If one or more GOOD I/O pair fails, the test case is declared to have "Altered Functionality"

The BAD I/O pairs each have a vulnerability inserted into the code. During stage 1 (without performer technology) the expected performance is to expose the vulnerabilities. During stage 2 the tested performance is for the vulnerabilities to be mitigated. The results of the BAD I/O pairs are used to determine “Full Mitigation” - both BAD I/O pairs are mitigated, “Partial Mitigation” – one BAD I/O pair was mitigated, the other was not and “No Mitigation” – both BAD I/O pairs failed to mitigate the vulnerability.

A passing test case has No Altered Functionality and Full Mitigation. All other combinations of results constitute a failing test case.

After the tests were run for each performer, the results were extracted from the TEXAS database. These were imported into a scoring workbook for each performer.

The “Results-Data” tab includes: all the I/O pairs run for all test cases; a parsing of the test case name to provide fields for: Base Program, Injection Point, Taint Source, Data Type Complexity, Data Flow Complexity, Control Flow Complexity, CWE Class, and CWE Name. The “Results-Data” tab also determines whether the test case is valid based on manually entered IV&V results.

The “Summ X Test Case” tab is where the evaluations of the test cases are done. The major pivot table (Columns A through K) uses the data in the “Results-Data” tab as the source, and combines the I/O Pair results into one line per test case. Columns O through R are used to evaluate the stage 1 results, and columns T through W are used to evaluate the stage 2 results.

In column Y (Valid TC), stage 1 results are evaluated to determine if the stage 2 results should be included in the final calculations in columns Z through AF where the results are compiled.

Columns Y through AO are used as the source data for the pivot tables on the right, which show the results by different variables (base programs, weakness class, taint source, etc.). These are the results that are presented in the remainder of this section.

PERFORMANCE TESTING

It was expected that Stage 2 performance timing would always exceed the Stage 1 performance timings, this however turned out to not always be the case. Because of the complexity (or in some cases the sheer simplicity) of the programs employed in Phase 3 there are many reasons why this could occur. A few of these include, the concurrency protections put in place by performers potentially choosing a more optimized schedule, the analysis process producing more optimized code, or even the machine on which the test case was run having more resources available during a Stage 2 run than a Stage 1 run since these were not necessarily run on the same machine. Furthermore, because of the multi-process/multi-threaded nature of the programs, the performance data did not always appear exactly as anticipated leading to some edge cases being calculated in odd manners because they did not match assumptions. Additional analysis of the performance data could most likely shed more light on the exact reasons for why some Stage 2 runs were faster than Stage 1 runs, however time and effort were not available to manually examine the data.

While the methods employed to capture performance metrics were not perfect, they do allow for some rudimentary comparisons between unhardened software and software that had been hardened by the performer technology. A lot more work would be required to produce performance results that are more detailed and even then the solution may not be compatible with the performer technology. Given the time, effort, and performer constraints the performance results are sufficient to get an general idea of the performance degradation hardened programs experience, and calculate the metrics specified by the STONESOUP BAA for performer performance.

The "Performance" tab in the workbook uses the "Internal Run Time" and "External Run Time" results and computes the % increase from stage 1 to stage 2 by test case. The worksheet also summarizes the results by: base program; weakness class; taint source, data type complexity, data flow complexity and control flow complexity

8.1 Columbia University

The Columbia University (Columbia) proposed technology, known as MINESTRONE, was evaluated by the T&E team using the TEXAS system on AWS instances..

8.1.1 Proposed Technology

The proposed technology developed by Columbia operated on C bytecode and leveraged static analysis techniques to identify potential weaknesses and then added instrumentation to stop exploitation of those potential weaknesses.

8.1.2 Phase 3 Weakness Classes

In Phase 3, Columbia chose to work with C source code focusing on the following weakness classes: Concurrency Handling, Injection, Memory Corruption, Null Pointer, Number Handling and Resource Drains.

8.1.3 Results and Analysis of Phase 3 Programs

Results for the Phase 3 evaluation have been compiled and analyzed by the test and evaluation team. This section presents these results along with the analysis.

Columbia raised an issue with the interaction with their rollback technology and the weakness_started Linux Trace Toolkit Next Generation (LTTng) output check in each bad I/O pair's scoring formula. That particular scoring check was added to ensure that the exploit code is actually executed and is not a problem with a single execution of the program. Columbia, however, employees a rollback technology that allows them to rollback after an exploit and disable functionality in the program to prevent it from reoccurring. This rollback effectively removed the weakness_started message from being captured causing a failing score for Columbia. This issue was raised just prior to T&E and sufficient time was not available to address it so it was agreed that Columbia's results would be modified as a post process to essentially ignore the weakness_started LTTng output check if it was marked as false (i.e., make it always true).

As you can see from **Figure 8-2** and **Figure 8-3** total number of passing test cases (full mitigation, no altered functionality) improved from 193 to 571 (7.4% to 21.8%) by removing the requirement that the LLTng statement be executed.

The analyses of Columbia's results through the remainder of this document are based on using the modified results. The excel workbook for this section is: "T&E Columbia Results 20141216 (Modified Scoring) Final Analysis ResultsA.xlsx" Appendix I.2 presents more tables and charts detailing the results.

Overall MINESTRONE passed 21.8% of all the valid test cases.

The following sections present evaluations of the results based on: Base Programs; Weakness Class; Taint Source; Data Type Complexity, Data Flow Complexity, Control Flow Complexity and File Size.

PERCENTAGE OF SUBMITTED TEST CASES SUCCESSFULLY PROCESSED:

- Columbia (C) successfully processed 2623 out of 2623 test cases – 100 %

PERCENTAGE OF SEEDED VULNERABILITIES RENDERED UNEXPLOITABLE:

- Columbia passed 571 out of 2,623 test cases for a passing rate of 21.8% +1.4/-1.3% at a 0.90 confidence level.

PERCENTAGE INCREASE IN PERFORMANCE EXECUTION TIME:

- The overall average increase in processing time for Columbia's MINESTRONE was 472.7%

Numbers

		Altered?		
		No	Yes	Total
Mitigation?	Full	**193**	159	352
	Partial	219	204	423
	None	434	1,413	1,847
	Total	846	1,776	2,622

Percentages

		Altered?		
		No	Yes	Total
Mitigation?	Full	**7.4%**	6.1%	13.4%
	Partial	8.4%	7.8%	16.1%
	None	16.6%	53.9%	70.4%
	Total	32%	68%	100%

Figure 8-2. MINESTRONE Mitigation and Altered Functionality Results before modification of results

Totals

		Altered?		
		No	Yes	Total
Mitigation?	Full	**571**	592	1,163
	Partial	36	159	195
	None	240	1,025	1,265
	Total	847	1,776	2,623

Percentages

		Altered?		
		No	Yes	Total
Mitigation?	Full	**21.8%**	22.6%	44.3%
	Partial	1.4%	6.1%	7.4%
	None	9.1%	39.1%	48.2%
	Total	32%	68%	100%

Figure 8-3. MINESTRONE Mitigation and Altered Functionality Results After Modification of Results

8.1.3.1 MINESTRONE Results by Base Programs

Figure 8-4, **Table 8-1** and **Table 8-2**, show the results by each of the base programs. MINESTRONE was most successful in mitigating the vulnerabilities for OSSL at 58% of those test cases passing. Next was subversion at 49% of the test cases passing and FFMpeg at 18% passing. Minestrone failed to mitigate vulnerabilities in GIMP and WIRESHARK.

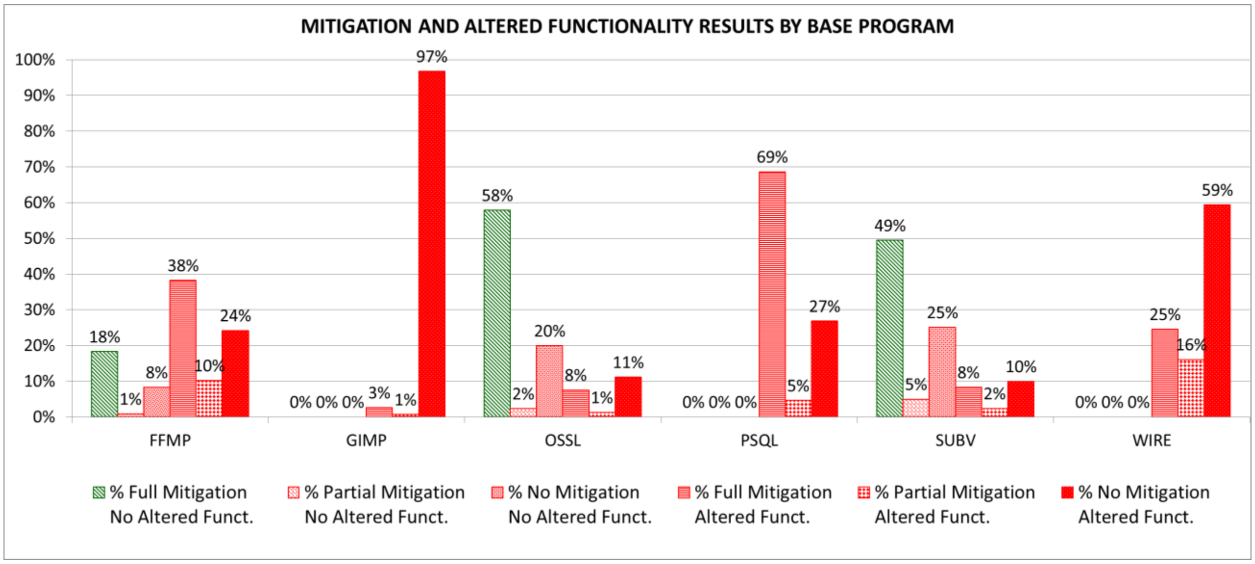

Figure 8-4. MINESTRONE Mitigation and Altered Functionality Results (Percentage by Base Program)

Table 8-1. MINESTRONE Mitigation and Altered Functionality Results (by Base Program)

Base Program	Total Test Cases	Full Mitigation No Altered Funct.	Partial Mitigation No Altered Funct.	No Mitigation No Altered Funct.	Full Mitigation Altered Funct.	Partial Mitigation Altered Funct.	No Mitigation Altered Funct.
FFMP	471	86	4	39	180	48	114
GIMP	461	0	0	0	12	3	446
OSSL	477	276	11	95	36	6	53
PSQL	306	0	0	0	210	14	82
SUBV	422	209	21	106	35	10	42
WIRE	485	0	0	0	119	78	288
Grand Total	**2622**	**571**	**36**	**240**	**592**	**159**	**1025**

Table 8-2. MINESTRONE Mitigation and Altered Functionality Results (Percentage by Base Program)

Base Program	% Full Mitigation No Altered Funct.	% Partial Mitigation No Altered Funct.	% No Mitigation No Altered Funct.	% Full Mitigation Altered Funct.	% Partial Mitigation Altered Funct.	% No Mitigation Altered Funct.
FFMP	18%	1%	8%	38%	10%	24%
GIMP	0%	0%	0%	3%	1%	97%
OSSL	58%	2%	20%	8%	1%	11%
PSQL	0%	0%	0%	69%	5%	27%
SUBV	49%	5%	25%	8%	2%	10%
WIRE	0%	0%	0%	25%	16%	59%
Grand Total	**22%**	**1%**	**9%**	**23%**	**6%**	**39%**

8.1.3.2 MINESTRONE Results by Weakness Classes and Target Weaknesses

Figure 8-5 and **Table 8-3**, show the results by each of the weakness classes. The table also shows the results for individual CWEs. MINESTRONE performed about equally in mitigating Null Pointer (30% pass rate), Number Handling (29% pass rate) and Memory corruption (28% pass rate). Next was the Injection class at 23%, Resource Drains at 15% and Concurrency handling at 4% passing rate.

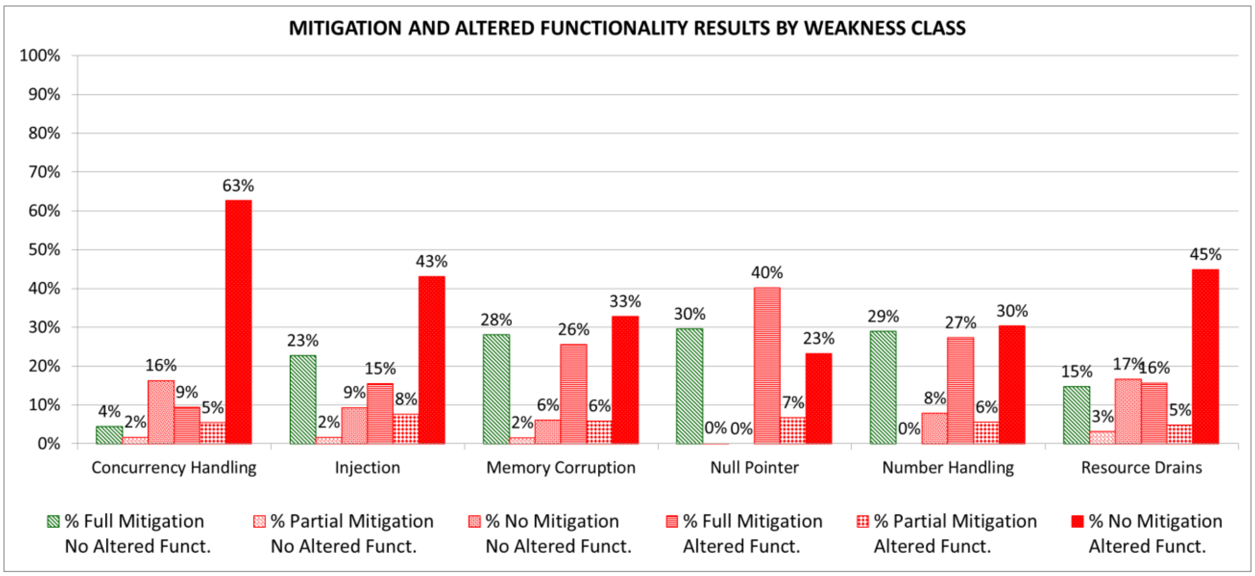

Figure 8-5. MINESTRONE Mitigation and Altered Functionality Results (Percentage by Weakness Class)

Table 8-3. MINESTRONE Mitigation and Altered Functionality Results ((by Weakness Class and CWE)

Weakness Class/CWE	Valid Test Cases	Preserved Funct	% Preserved Funct	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Funct)	% Pass
Concurrency Handling	**404**	**91**	**23%**	**56**	**14%**	**18**	**4%**
363A	26	10	38%	2	8%	0	0%
367A	29	10	34%	7	24%	3	10%
412A	24	11	46%	0	0%	0	0%
414A	22	0	0%	2	9%	0	0%

Weakness Class/CWE	Valid Test Cases	Preserved Funct	% Preserved Funct	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Funct)	% Pass
479A	30	16	53%	2	7%	0	0%
543A	27	0	0%	0	0%	0	0%
609A	23	1	4%	2	9%	1	4%
663A	22	10	45%	17	77%	9	41%
764A	25	7	28%	4	16%	1	4%
765A	22	0	0%	0	0%	0	0%
765B	24	0	0%	4	17%	0	0%
820A	22	0	0%	4	18%	0	0%
821A	26	1	4%	3	12%	1	4%
828A	27	12	44%	6	22%	2	7%
831A	28	13	46%	2	7%	1	4%
833A	27	0	0%	1	4%	0	0%
Injection	**471**	**159**	**34%**	**180**	**38%**	**107**	**23%**
078A	82	20	24%	22	27%	3	4%
078B	61	21	34%	11	18%	4	7%
088A	70	22	31%	23	33%	7	10%
088B	62	3	5%	9	15%	0	0%
089A	48	21	44%	27	56%	21	44%
089B	49	24	49%	30	61%	24	49%
089C	54	26	48%	32	59%	26	48%
089D	45	22	49%	26	58%	22	49%
Memory Corruption	**442**	**158**	**36%**	**237**	**54%**	**124**	**28%**
120A	11	3	27%	8	73%	2	18%
120B	12	5	42%	0	0%	0	0%
120C	12	5	42%	7	58%	5	42%
120D	11	5	45%	8	73%	5	45%
124A	12	5	42%	8	67%	5	42%
124B	6	3	50%	0	0%	0	0%
124C	10	5	50%	8	80%	5	50%
124D	10	3	30%	6	60%	3	30%
126A	12	5	42%	1	8%	1	8%
126B	12	3	25%	7	58%	3	25%
126C	11	2	18%	4	36%	0	0%
126D	12	2	17%	3	25%	0	0%
127A	11	3	27%	3	27%	1	9%
127B	9	4	44%	2	22%	0	0%
127C	10	4	40%	0	0%	0	0%
127D	13	4	31%	3	23%	0	0%
129A	2	0	0%	1	50%	0	0%
129B	12	5	42%	6	50%	5	42%
134A	13	6	46%	4	31%	4	31%
170A	11	4	36%	7	64%	4	36%
170B	11	1	9%	4	36%	1	9%
415A	11	6	55%	8	73%	6	55%
416A	9	4	44%	6	67%	4	44%
590A	13	4	31%	7	54%	4	31%
761A	9	3	33%	6	67%	3	33%
785A	10	2	20%	6	60%	2	20%
785B	12	4	33%	8	67%	4	33%
785C	10	3	30%	5	50%	3	30%
785D	12	4	33%	8	67%	4	33%

Weakness Class/CWE	Valid Test Cases	Preserved Funct	% Preserved Funct	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Funct)	% Pass
805A	11	4	36%	7	64%	4	36%
805B	10	5	50%	7	70%	5	50%
805C	12	6	50%	8	67%	6	50%
805D	10	4	40%	9	90%	4	40%
806A	11	3	27%	7	64%	2	18%
806B	12	4	33%	8	67%	4	33%
806C	12	5	42%	9	75%	5	42%
806D	11	4	36%	7	64%	4	36%
822A	11	2	18%	7	64%	2	18%
824A	12	6	50%	11	92%	6	50%
824B	9	4	44%	6	67%	4	44%
843A	12	4	33%	7	58%	4	33%
Null Pointer	**460**	**137**	**30%**	**321**	**70%**	**136**	**30%**
476A	59	22	37%	41	69%	22	37%
476B	65	23	35%	49	75%	23	35%
476C	68	26	38%	49	72%	26	38%
476D	66	24	36%	46	70%	24	36%
476E	65	25	38%	47	72%	24	37%
476F	66	17	26%	43	65%	17	26%
476G	71	0	0%	46	65%	0	0%
Number Handling	**432**	**159**	**37%**	**243**	**56%**	**125**	**29%**
190A	44	17	39%	3	7%	1	2%
191A	40	13	33%	27	68%	13	33%
191B	40	15	38%	28	70%	15	38%
194A	41	14	34%	29	71%	14	34%
195A	42	11	26%	31	74%	11	26%
196A	44	17	39%	3	7%	0	0%
197A	38	19	50%	23	61%	19	50%
369A	42	19	45%	33	79%	19	45%
682A	19	2	11%	10	53%	2	11%
682B	41	17	41%	29	71%	16	39%
839A	41	15	37%	27	66%	15	37%
Resource Drains	**414**	**143**	**35%**	**126**	**30%**	**61**	**15%**
400A	39	16	41%	2	5%	0	0%
400B	21	0	0%	2	10%	0	0%
401A	30	10	33%	12	40%	4	13%
459A	33	16	48%	20	61%	16	48%
674A	21	5	24%	10	48%	4	19%
771A	40	15	38%	15	38%	8	20%
773A	40	16	40%	12	30%	2	5%
774A	41	14	34%	7	17%	1	2%
775A	36	17	47%	7	19%	2	6%
789A	38	14	37%	25	66%	14	37%
834A	39	11	28%	14	36%	10	26%
835A	36	9	25%	0	0%	0	0%
Grand Total	**2623**	**847**	**32.3%**	**1163**	**44.3%**	**571**	**21.8%**

8.1.3.3 MINESTRONE Results by Taint Source

Table 8-4 shows the results by Taint Source, with MINESTRONE performing best on Shared_Memory (26.1% passing) and worst on the SOCKET Taint source at 15.9% passing.

Table 8-4. MINESTRONE Results by Taint Source

Taint Source	Valid TC	Passed (Full Mitigation, Preserved Function	% Pass
ENVIRONMENT_VARIABLE	683	152	22.3%
FILE_CONTENTS	691	150	21.7%
SHARED_MEMORY	694	181	26.1%
SOCKET	555	88	15.9%
Grand Total	**2623**	**571**	**21.8%**

8.1.3.4 MINESTRONE Results by Data Type Complexity

Table 8-5 shows the results by Data Type Complexity with MINESTRONE performing best on STRUCT (23.84% passing) and worst on the t-SIMPLE with 20.67% passing. Overall there was not much variation across the various Data Type Complexity types.

Table 8-5.MINESTRONE Results by Data Type Complexity

Data Type Complexity	Valid TC	Passed (Full Mitigation, Preserved Function	% Pass
ARRAY	369	86	23.31%
HEAP_POINTER	383	83	21.67%
SIMPLE	375	77	20.53%
STRUCT	365	87	23.84%
TYPEDEF	387	80	20.67%
UNION	383	79	20.63%
VOID_POINTER	361	79	21.88%
Grand Total	**2623**	**571**	**21.77%**

8.1.3.5 MINESTRONE Results by Data Flow Complexity

Table 8-6 shows the results by Data Flow Complexity with MINESTRONE performing best on ADDRESS_ALIAS_10 (27.42% passing) and worst on the ADDRESS_ALIAS_1 with 11.86% passing.

Table 8-6. MINESTRONE Results by Data Flow Complexity

Data Flow Complexity	Valid TC	Passed (Full Mitigation, Preserved Function	% Pass
ADDRESS_ALIAS_1	59	7	11.86%
ADDRESS_ALIAS_10	59	14	23.73%
ADDRESS_ALIAS_2	59	15	25.42%
ADDRESS_ALIAS_50	61	14	22.95%
ADDRESS_AS_CONSTANT	228	51	22.37%
ADDRESS_AS_FUNCTION_RETURN_VALUE	237	58	24.47%
ADDRESS_AS_LINEAR_EXPRESSION	242	58	23.97%
ADDRESS_AS_NONLINEAR_EXPRESSION	235	54	22.98%
ADDRESS_AS_VARIABLE	231	43	18.61%
BASIC	233	46	19.74%
BUFFER_ADDRESS_ARRAY_INDEX	246	58	23.58%
BUFFER_ADDRESS_POINTER	240	50	20.83%
INDEX_ALIAS_1	65	16	24.62%
INDEX_ALIAS_10	62	17	27.42%
INDEX_ALIAS_2	64	13	20.31%
INDEX_ALIAS_50	58	7	12.07%
VAR_ARG_LIST	244	50	20.49%
Grand Total	**2623**	**571**	**21.77%**

8.1.3.6 MINESTRONE Results by Control Flow Complexity

Table 8-7 shows the results by Control Flow Complexity with MINESTRONE performing best on INTERPROCEDURAL_2 (28.81% passing) and worst on the INTERPROCEDURAL_50 with 12.5% passing.

Table 8-7. MINESTRONE Results by Control Flow Complexity

Control Flow Complexity	Valid TC	Passed (Full Mitigation, Preserved Function	% Pass
CALLBACK	266	52	19.55%
INDIRECTLY_RECURSIVE	263	57	21.67%
INFINITE_LOOP	268	58	21.64%
INTERPROCEDURAL_1	67	15	22.39%
INTERPROCEDURAL_10	68	17	25.00%
INTERPROCEDURAL_2	59	17	28.81%
INTERPROCEDURAL_50	64	8	12.50%
MACROS	262	60	22.90%
POINTER_TO_FUNCTION	260	55	21.15%
RECURSIVE	256	51	19.92%
SEQUENCE	263	56	21.29%
SET_JUMP_LONG_JUMP	262	63	24.05%
UNCONDITIONAL_JUMP	265	62	23.40%
Grand Total	**2623**	**571**	**21.77%**

8.1.3.7 MINESTRONE Results by File Size

Table 8-8 shows the results by File Size with MINESTRONE performing best on the smallest file size. However, the results do not follow a monotonically decreasing curve, as the performance on the 566.9K lines of code file (18.26% pass rate) is significantly worse than the performance of the 798.6 K lines of code file (49.41% pass).

Table 8-8. MINESTRONE Results by File Size

Lines of Code	Valid TC	Passed (Full Mitigation, Preserved Function	% Pass
274,204	477	276	57.86%
566,908	471	86	18.26%
711,339	461	0	0.00%
731,469	306	0	0.00%
798,636	423	209	49.41%
2,523,396	485	0	0.00%
Grand Total	**2623**	**571**	21.77%

8.1.3.8 MINESTRONE Performance Overhead

The overall average increase in processing time from stage 1 to stage 2 for MINESTRONE was 472.7%. **Table 8-9** shows the overhead increases by base program

Table 8-9. MINESTRONE Performance Overhead by Base Program

Base Program	% Increase
FFMP	4511.8%
GIMP	509.6%
OSSL	4304.0%
PSQL	-52.9%
SUBV	3748.6%
WIRE	841.3%
Grand Total	472.7%

8.1.4 Results and Analysis of Phase 2-Sized Programs

Results for the Phase 2-sized evaluation of GREP have been compiled and analyzed by the test and evaluation team. This section presents these results along with the analysis.

For the Phase 3 programs MINESTRONE passed 21.8% of the 2,623 test cases. For GREP that number improved to 35.4% of 364 test cases (**Figure 8-5**).

The excel workbook for this section is: "T&E Columbia Results 20141202 GREP Analysis ResultsA.xlsx" Appendix I.3 presents additional tables and charts detailing the Columbia GREP results.

Overall MINESTRONE passed 35% of all the valid test cases for GREP.

The following sections present evaluations of the results based on: Base Programs; Weakness Class; Taint Source; Data Type Complexity, Data Flow Complexity, Control Flow Complexity and File Size.

8.1.4.1 MINESTRONE GREP Results

Columbia passed 129 out of 364 test cases for a passing rate of 35.4% +4.2/-4.0% at a 0.90 confidence level. **Figure 8-6**, **Figure 8-7**,.**Table 8-10** and **Table 8-11** show the mitigation and altered functionality results for the GREP base program.

Totals

		Altered?		
		No	Yes	Total
Mitigation?	Full	**129**	70	199
	Partial	54	30	84
	None	51	30	81
	Total	234	130	364

Percentages

		Altered?		
		No	Yes	Total
Mitigation?	Full	**35.4%**	19.2%	54.7%
	Partial	14.8%	8.2%	23.1%
	None	14.0%	8.2%	22.3%
	Total	64%	36%	100%

Figure 8-6. MINESTRONE GREP Mitigation and Altered Functionality Results

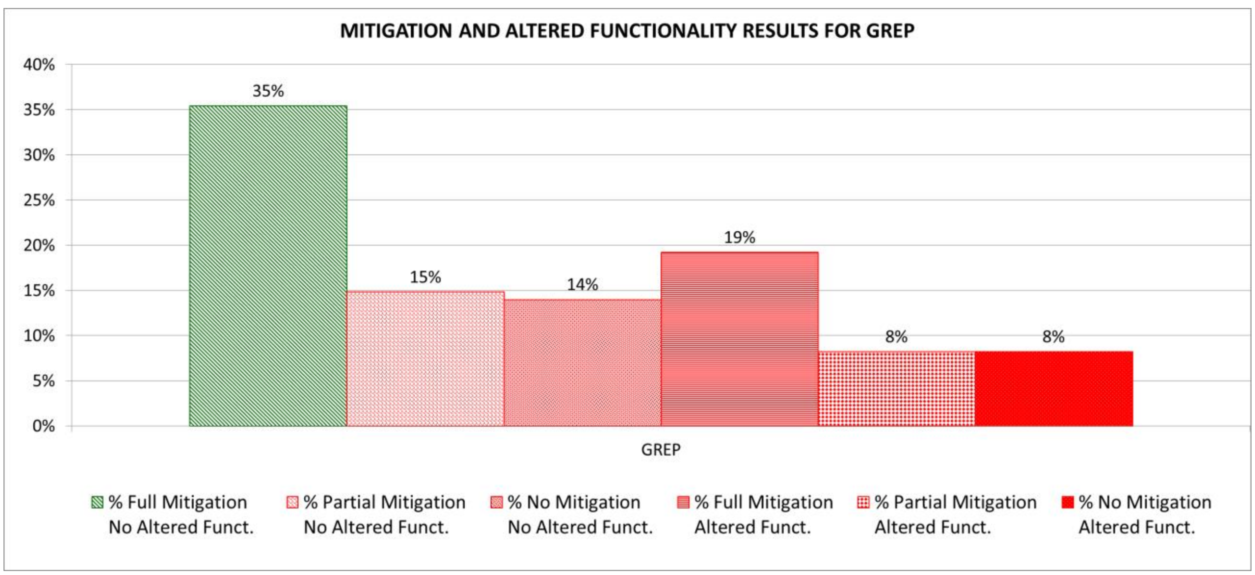

Figure 8-7. MINESTRONE GREP Mitigation and Altered Functionality Results

Table 8-10. MINESTRONE GREP Mitigation and Altered Functionality Results

Total Test Cases	Full Mitigation No Altered Funct.	Partial Mitigation No Altered Funct.	No Mitigation No Altered Funct.	Full Mitigation Altered Funct.	Partial Mitigation Altered Funct.	No Mitigation Altered Funct.
364	129	54	51	70	30	30
364	129	54	51	70	30	30

Table 8-11. MINESTRONE GREP Mitigation and Altered Functionality Results (Percentage)

Row Labels	% Full Mitigation No Altered Funct.	% Partial Mitigation No Altered Funct.	% No Mitigation No Altered Funct.	% Full Mitigation Altered Funct.	% Partial Mitigation Altered Funct.	% No Mitigation Altered Funct.
GREP	35%	15%	14%	19%	8%	8%
Grand Total	**35%**	**15%**	**14%**	**19%-**	**8%**	**8%**

8.1.4.2 MINESTRONE GREP Results by Weakness Classes and Target Weaknesses

Figure 8-8 and **Table 8-12** show the results by each of the weakness classes. The table also shows the results for individual CWEs. For GREP, MINESTRONE performed about equally in mitigating Null Pointer (50% pass rate), and Number Handling (48% pass rate). Memory corruption (36% pass rate), Resource Drains (36% pass rate) and .Injection (31% pass rate) were also about equal, with Concurrency Handling (19% pass rate) coming in with the lowest pass rate.

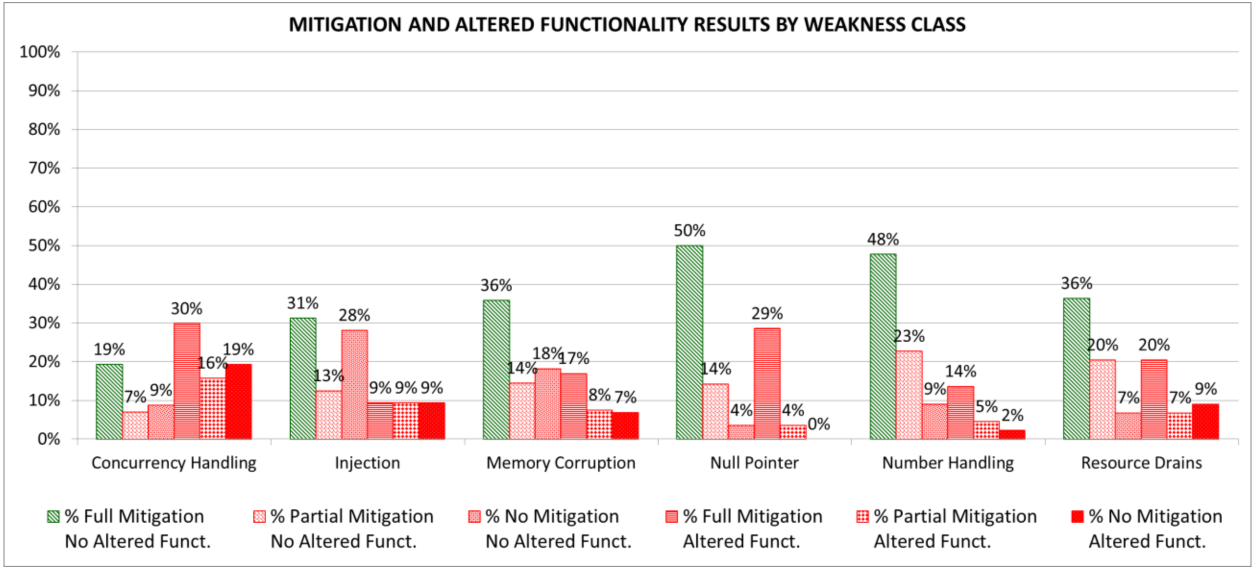

Figure 8-8. MINESTRONE GREP Mitigation and Altered Functionality Results (percentage by Weakness Class)

Table 8-12. MINESTRONE GREP Mitigation and Altered Functionality Results (by Weakness Class and CWE)

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling	**57**	**20**	**35%**	**28**	**49%**	**11**	**19%**
363A	4	3	75%	3	75%	2	50%
367A	4	3	75%	3	75%	2	50%
414A	3	0	0%	3	100%	0	0%
479A	4	3	75%	4	100%	3	75%
543A	4	1	25%	0	0%	0	0%
609A	4	0	0%	2	50%	0	0%
663A	2	0	0%	2	100%	0	0%
764A	4	2	50%	0	0%	0	0%

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
765A	4	0	0%	1	25%	0	0%
765B	4	0	0%	2	50%	0	0%
820A	4	0	0%	2	50%	0	0%
821A	4	0	0%	0	0%	0	0%
828A	4	3	75%	3	75%	2	50%
831A	4	3	75%	3	75%	2	50%
833A	4	2	50%	0	0%	0	0%
Injection	**32**	**23**	**72%**	**13**	**41%**	**10**	**31%**
078A	4	3	75%	0	0%	0	0%
078B	4	3	75%	0	0%	0	0%
088A	4	3	75%	1	25%	1	25%
088B	4	0	0%	3	75%	0	0%
089A	4	4	100%	3	75%	3	75%
089B	4	4	100%	2	50%	2	50%
089C	4	3	75%	2	50%	2	50%
089D	4	3	75%	2	50%	2	50%
Memory Corruption	**159**	**109**	**69%**	**84**	**53%**	**57**	**36%**
120A	4	3	75%	3	75%	2	50%
120B	4	2	50%	0	0%	0	0%
120C	4	3	75%	4	100%	3	75%
120D	4	3	75%	3	75%	2	50%
124A	4	3	75%	3	75%	3	75%
124B	3	2	67%	2	67%	1	33%
124C	4	2	50%	4	100%	2	50%
124D	4	2	50%	3	75%	1	25%
126A	4	3	75%	0	0%	0	0%
126B	4	3	75%	0	0%	0	0%
126C	4	0	0%	0	0%	0	0%
126D	4	2	50%	0	0%	0	0%
127A	4	3	75%	0	0%	0	0%
127B	4	3	75%	0	0%	0	0%
127C	4	4	100%	0	0%	0	0%
127D	4	3	75%	0	0%	0	0%
129A	1	0	0%	1	100%	0	0%
129B	4	2	50%	2	50%	0	0%
134A	4	3	75%	1	25%	1	25%
170A	4	3	75%	4	100%	3	75%
170B	4	1	25%	0	0%	0	0%
415A	4	3	75%	4	100%	3	75%
416A	4	2	50%	3	75%	1	25%
590A	4	3	75%	4	100%	3	75%
761A	4	3	75%	3	75%	3	75%
785A	4	2	50%	3	75%	1	25%
785B	4	4	100%	2	50%	2	50%
785C	4	3	75%	2	50%	1	25%
785D	4	2	50%	3	75%	2	50%
805A	4	3	75%	3	75%	2	50%
805B	4	3	75%	2	50%	2	50%
805C	4	4	100%	2	50%	2	50%
805D	4	3	75%	3	75%	2	50%
806A	4	2	50%	2	50%	1	25%

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
806B	4	4	100%	3	75%	3	75%
806C	4	3	75%	2	50%	1	25%
806D	3	3	100%	2	67%	2	67%
822A	4	3	75%	2	50%	2	50%
824A	4	2	50%	3	75%	1	25%
824B	4	3	75%	3	75%	2	50%
843A	4	4	100%	3	75%	3	75%
Null Pointer	**28**	**19**	**68%**	**22**	**79%**	**14**	**50%**
476A	4	2	50%	3	75%	1	25%
476B	4	3	75%	3	75%	2	50%
476C	4	3	75%	4	100%	3	75%
476D	4	4	100%	3	75%	3	75%
476E	4	3	75%	3	75%	2	50%
476F	4	4	100%	3	75%	3	75%
476G	4	0	0%	3	75%	0	0%
Number Handling	**44**	**35**	**80%**	**27**	**61%**	**21**	**48%**
190A	4	4	100%	3	75%	3	75%
191A	4	4	100%	2	50%	2	50%
191B	4	3	75%	3	75%	2	50%
194A	4	3	75%	1	25%	1	25%
195A	4	2	50%	3	75%	1	25%
196A	4	3	75%	3	75%	2	50%
197A	4	3	75%	3	75%	2	50%
369A	4	4	100%	3	75%	3	75%
682A	4	4	100%	2	50%	2	50%
682B	4	2	50%	2	50%	1	25%
839A	4	3	75%	2	50%	2	50%
Resource Drains	**44**	**28**	**64%**	**25**	**57%**	**16**	**36%**
400A	4	3	75%	3	75%	2	50%
400B	1	0	0%	0	0%	0	0%
401A	3	3	100%	2	67%	2	67%
459A	4	4	100%	2	50%	2	50%
674A	4	4	100%	2	50%	2	50%
771A	4	0	0%	3	75%	0	0%
773A	4	1	25%	2	50%	1	25%
774A	4	3	75%	2	50%	2	50%
775A	4	2	50%	3	75%	1	25%
789A	4	3	75%	2	50%	2	50%
834A	4	2	50%	1	25%	0	0%
835A	4	3	75%	3	75%	2	50%
Grand Total	**364**	**234**	**64.3%**	**199**	**54.7%**	**129**	**35.4%**

8.1.4.3 MINESTRONE GREP Results by Taint Source

Table 8-13 shows the results by Taint Source, with GREP on MINESTRONE performing best on Environment Variable (59.8% passing) and worst on the SHARED MEMORY taint source at 7.7% passing. This is significantly different from the results for the Phase 3 testing where MINESTRONE performed best on Shared_Memory (26.1% passing) and worst on the SOCKET Taint source at 15.9% passing (see **Table 8-4**).

Table 8-13. MINESTRONE GREP Results by Taint Source

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
ENVIRONMENT_VARIABLE	92	55	59.8%
FILE_CONTENTS	91	53	58.2%
SHARED_MEMORY	91	7	7.7%
SOCKET	90	14	15.6%
Grand Total	**364**	**129**	**35.4%**

8.1.4.4 MINESTRONE GREP Results by Data Type Complexity

For the GREP tests there were no variations in Data Type Complexity (**Table 8-14**).

Table 8-14. MINESTRONE GREP Results by Data Type Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
SIMPLE	364	129	35.44 %
Grand Total	**364**	**129**	**35.44 %**

8.1.4.5 MINESTRONE GREP Results by Data Flow Complexity

For the GREP tests there were no variations in Data Flow Complexity (**Table 8-15**).

Table 8-15. GREP MINESTRONE GREP Results by Data Flow Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Functionality)	% Pass
BASIC	364	129	35.44%
Grand Total	364	129	35.44%

8.1.4.6 MINESTRONE GREP Results by Control Flow Complexity

For the GREP tests there were no variations in Control Flow Complexity (**Table 8-16**).

Table 8-16. MINESTRONE GREP Results by Control Flow Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Functionality)	% Pass
SEQUENCE	364	129	35.44%
Grand Total	**364**	**129**	**35.44%**

8.1.4.7 MINESTRONE GREP Results by File Size

For the GREP tests there were no variations in File Size (**Table 8-17**).

Table 8-17. MINESTRONE GREP Results by File Size

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
711,339	364	129	35.44%
Grand Total	**364**	**129**	**35.44%**

8.1.4.8 MINESTRONE GREP Performance Overhead

The overall average increase in processing time from stage 1 to stage 2 for GREP on MINESTRONE was 3,154%. **Table 8-18** shows the overhead for GREP.

Table 8-18 MINESTRONE GREP Performance Overhead

Base Program	% Increase
GREP	3154.0%
Grand Total	**3154.0%**

8.1.5 Results and Analysis of Phase 1-Sized Programs

Results for the Phase 1-sized evaluation CTREE have been compiled and analyzed by the test and evaluation team. This section presents these results along with the analysis.

For the Phase 3 programs MINESTRONE passed 21.8% of the 2,623 test cases. For CTREE that number improved to 63.7% of 372 test cases (**Figure 8-9**).

Totals

		Altered?		
		No	Yes	Total
Mitigation?	Full	**237**	31	268
	Partial	15	3	18
	None	69	17	86
	Total	321	51	372

Percentages

		Altered?		
		No	Yes	Total
Mitigation?	Full	**63.7%**	8.3%	72.0%
	Partial	4.0%	0.8%	4.8%
	None	18.5%	4.6%	23.1%
	Total	86%	14%	100%

Figure 8-9. MINESTRONE CTREE Mitigation and Altered Functionality Results

The excel workbook for this section is: “T&E Columbia Results 20141202 CTREE Analysis ResultsA.xlsx” **Appendix I.4** presents additional tables and charts detailing the Columbia CTREE results.

Overall MINESTRONE passed 63.7% of all the valid test cases for CTREE.

The following sections present evaluations of the results based on: Base Programs; Weakness Class; Taint Source; Data Type Complexity, Data Flow Complexity, Control Flow Complexity and File Size.

8.1.5.1 MINESTRONE CTREE Results

Columbia passed 237 out of 372 test cases for a passing rate of 63.7% +4.0/-4.2% at a 0.90 confidence level. **Figure 8-10**, **Table 8-19** and **Table 8-20** show the mitigation and altered functionality results for the CTREE base program.

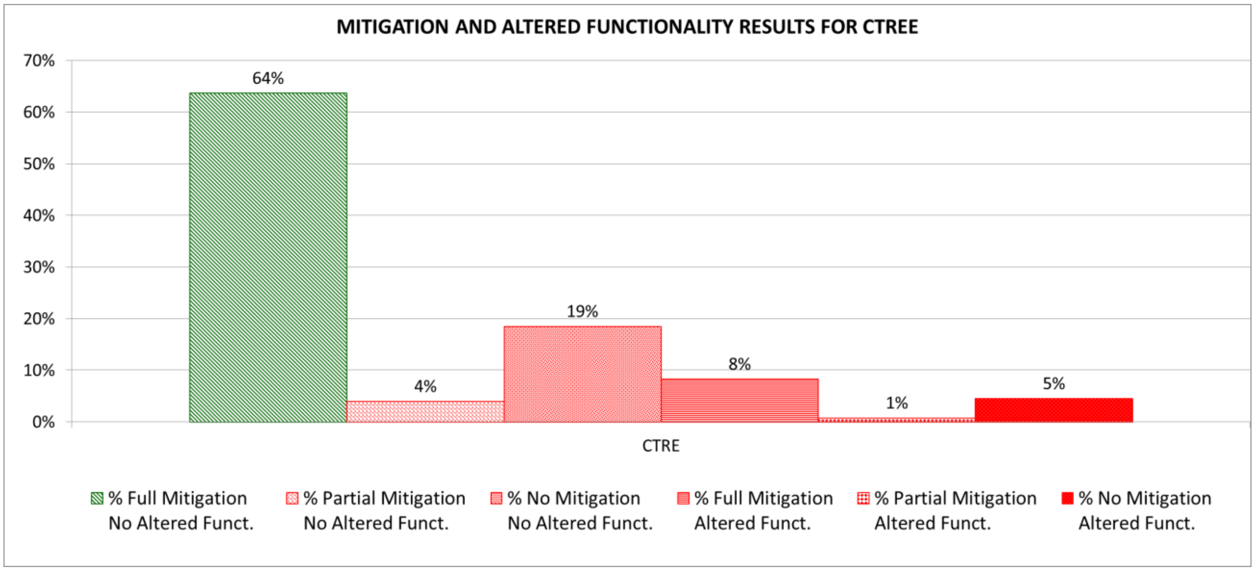

Figure 8-10. MINESTRONE CTREE Mitigation and Altered Functionality Results

Table 8-19. MINESTRONE CTREE Mitigation and Altered Functionality Results

Row Labels	Total Test Cases	Full Mitigation No Altered Function	Partial Mitigation No Altered Function	No Mitigation No Altered Function	Full Mitigation Altered Function	Partial Mitigation Altered Function	No Mitigation Altered Function
CTRE	372	237	15	69	31	3	17
Grand Total	**372**	**237**	**15**	**69**	**31**	**3**	**17**

Table 8-20. MINESTRONE CTREE Mitigation and Altered Functionality Results (Percentage)

Row Labels	% Full Mitigation No Altered Function	% Partial Mitigation No Altered Function	% No Mitigation No Altered Function	% Full Mitigation Altered Function	% Partial Mitigation Altered Function	% No Mitigation Altered Function
CTRE	64%	4%	19%	8%	1%	5%
Grand Total	**64%**	**4%**	**19%**	**8%**	**1%**	**5%**

8.1.5.2 MINESTRONE CTREE Results by Weakness Classes and Target Weaknesses

Figure 8-11 and **Table 8-21** show the results by each of the weakness classes. The table also shows the results for individual CWEs. For CTREE, MINESTRONE did best with the Number Handling (88% passing), Memory Corruption (79% passing) and Null Pointer (68% passing) weakness classes, and less well in the Resource Drains (53% passing), Injection (44% passing) and Concurrency Weakness Classes (25% passing).

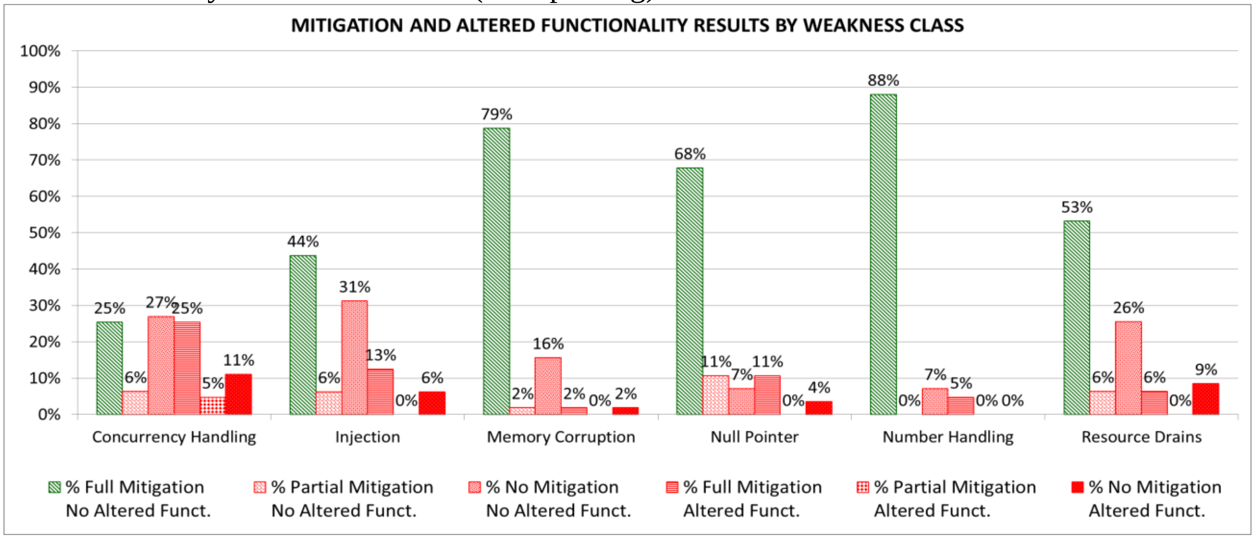

Figure 8-11. MINESTRONE CTREE Mitigation and Altered Functionality Results (Percentage by Weakness Class)

Table 8-21. MINESTRONE CTREE Mitigation and Altered Functionality Results (by Weakness Class and CWE)

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling	**63**	**37**	**59%**	**32**	**51%**	**16**	**25%**
363A	4	4	100%	3	75%	3	75%
367A	4	4	100%	4	100%	4	100%
412A	4	4	100%	0	0%	0	0%
414A	3	1	33%	1	33%	0	0%
479A	4	4	100%	3	75%	3	75%
543A	4	0	0%	0	0%	0	0%
609A	4	0	0%	3	75%	0	0%
663A	4	1	25%	3	75%	0	0%
764A	4	4	100%	1	25%	1	25%
765A	4	2	50%	1	25%	0	0%
765B	4	1	25%	3	75%	0	0%
820A	4	2	50%	2	50%	0	0%
821A	4	1	25%	2	50%	0	0%
828A	4	4	100%	2	50%	2	50%
831A	4	4	100%	3	75%	3	75%
833A	4	1	25%	1	25%	0	0%
Injection	**32**	**26**	**81%**	**18**	**56%**	**14**	**44%**
078A	4	4	100%	0	0%	0	0%
078B	4	3	75%	0	0%	0	0%
088A	4	4	100%	1	25%	1	25%
088B	4	0	0%	3	75%	0	0%
089A	4	4	100%	4	100%	4	100%
089B	4	4	100%	3	75%	3	75%
089C	4	3	75%	4	100%	3	75%
089D	4	4	100%	3	75%	3	75%
Memory Corruption	**160**	**154**	**96%**	**129**	**81%**	**126**	**79%**

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
120A	4	4	100%	4	100%	4	100%
120B	4	4	100%	4	100%	4	100%
120C	4	4	100%	4	100%	4	100%
120D	4	4	100%	4	100%	4	100%
124A	4	4	100%	4	100%	4	100%
124B	2	2	100%	2	100%	2	100%
124C	4	4	100%	4	100%	4	100%
124D	4	4	100%	4	100%	4	100%
126A	4	4	100%	4	100%	4	100%
126B	4	4	100%	4	100%	4	100%
126C	4	2	50%	4	100%	2	50%
126D	4	3	75%	4	100%	3	75%
127A	4	4	100%	4	100%	4	100%
127B	4	4	100%	4	100%	4	100%
127C	4	4	100%	0	0%	0	0%
127D	4	4	100%	0	0%	0	0%
129A	3	3	100%	3	100%	3	100%
129B	4	4	100%	4	100%	4	100%
134A	4	4	100%	4	100%	4	100%
170A	4	3	75%	3	75%	3	75%
170B	4	4	100%	4	100%	4	100%
415A	4	4	100%	3	75%	3	75%
416A	4	4	100%	3	75%	3	75%
590A	4	4	100%	3	75%	3	75%
761A	4	4	100%	3	75%	3	75%
785A	4	4	100%	3	75%	3	75%
785B	4	3	75%	2	50%	2	50%
785C	4	3	75%	2	50%	2	50%
785D	4	4	100%	3	75%	3	75%
805A	4	4	100%	3	75%	3	75%
805B	4	4	100%	3	75%	3	75%
805C	4	4	100%	3	75%	3	75%
805D	4	4	100%	3	75%	3	75%
806A	4	4	100%	3	75%	3	75%
806B	4	4	100%	3	75%	3	75%
806C	4	4	100%	3	75%	3	75%
806D	4	4	100%	3	75%	3	75%
822A	4	4	100%	3	75%	3	75%
824A	4	4	100%	3	75%	3	75%
824B	3	3	100%	2	67%	2	67%
843A	4	4	100%	3	75%	3	75%
Null Pointer	**28**	**24**	**86%**	**22**	**79%**	**19**	**68%**
476A	4	4	100%	3	75%	3	75%
476B	4	4	100%	3	75%	3	75%
476C	4	4	100%	3	75%	3	75%
476D	4	4	100%	3	75%	3	75%
476E	4	4	100%	3	75%	3	75%
476F	4	4	100%	4	100%	4	100%
476G	4	0	0%	3	75%	0	0%
Number Handling	**42**	**40**	**95%**	**39**	**93%**	**37**	**88%**
190A	4	3	75%	4	100%	3	75%
191A	4	4	100%	4	100%	4	100%
191B	4	4	100%	4	100%	4	100%

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
194A	4	4	100%	4	100%	4	100%
195A	4	3	75%	4	100%	3	75%
196A	4	4	100%	4	100%	4	100%
197A	4	4	100%	4	100%	4	100%
369A	4	4	100%	3	75%	3	75%
682A	3	3	100%	2	67%	2	67%
682B	3	3	100%	2	67%	2	67%
839A	4	4	100%	4	100%	4	100%
Resource Drains	**47**	**40**	**85%**	**28**	**60%**	**25**	**53%**
400A	4	4	100%	3	75%	3	75%
400B	4	1	25%	0	0%	0	0%
401A	3	3	100%	2	67%	2	67%
459A	4	4	100%	3	75%	3	75%
674A	4	4	100%	2	50%	2	50%
771A	4	1	25%	3	75%	0	0%
773A	4	4	100%	3	75%	3	75%
774A	4	4	100%	3	75%	3	75%
775A	4	3	75%	2	50%	2	50%
789A	4	4	100%	3	75%	3	75%
834A	4	4	100%	1	25%	1	25%
835A	4	4	100%	3	75%	3	75%
Grand Total	**372**	**321**	**86.3%**	**268**	**72.0%**	**237**	**63.7%**

8.1.5.3 MINESTRONE CTREE Results by Taint Source

Table 8-22 shows the results by Taint Source, with CTREE on MINESTRONE performing best on SOCKET (78.9% passing) and worst on the SHARED_MEMRORY taint source at 31.6% passing. This is the exact opposite from the results for the Phase 3 testing where MINESTRONE performed best on SHARED_MEMRORY (26.1% passing) and worst on the SOCKET Taint source at 15.9% passing (see **Table 8-4**).

Table 8-22. MINESTRONE CTREE Results by Taint Source

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
ENVIRONMENT_VARIABLE	$94	95	75.53%
FILE_CONTENTS	$93	95	69.89%
SHARED_MEMORY	$95	95	31.58%
SOCKET	$90	95	78.89%
Grand Total	**$372**	**380**	**63.71%**

8.1.5.4 MINESTRONE CTREE Results by Data Type Complexity

For the CTREE tests there were no variations in Data Type Complexity (**Table 8-23**).

Table 8-23. MINESTRONE CTREE Results by Data Type Complexity

Data Type Complexity	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
SIMPLE	$372	380	63.71 %
Grand Total	**$372**	**380**	**0.64**

8.1.5.5 MINESTRONE CTREE Results by Data Flow Complexity

For the CTREE tests there were no variations in Data Flow Complexity (**Table 8-24**).

Table 8-24. MINESTRONE CTREE Results by Data Flow Complexity

Data Flow Complexity	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
BASIC	$372	380	63.7%
Grand Total	**$372**	**380**	**63.7%**

8.1.5.6 MINESTRONE CTREE Results by Control Flow Complexity

For the CTREE tests there were no variations in Control Flow Complexity (**Table 8-25**).

Table 8-25. MINESTRONE Control Flow Complexity

Control Flow Complexity	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
SEQUENCE	$372	380	63.7%
Grand Total	**$372**	**380**	**63.7%**

8.1.5.7 MINESTRONE CTREE Results by File Size

For the CTREE tests there were no variations in File Size (**Table 8-26**).

Table 8-26. MINESTRONE CTREE Results by File Size

File Size	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
537,199	$372	380	63.7%
Grand Total	**$372**	**380**	**63.7%**

8.1.5.8 MINESTRONE Performance Overhead

For the CTREE tests **Tables 8-27** through **Table 8-33** show the performance overhead.

Table 8-27. MINESTRONE CTREE Performance Overhead by Weakness Class

Weakness Class	% Increase
Concurrency Handling	2,256.3%
Injection	1,545.4%
Memory Corruption	4,248.0%
Null Pointer	6,854.5%
Number Handling	13,497.1%
Resource Drains	825.4%
Grand Total	**1,287.1%**

Table 8-28. MINESTRONE CTREE Performance Overhead by Base Program

Base Program	% Increase
CTRE	1,287.1%
Grand Total	**1,287.1%**

Table 8-29. MINESTRONE CTREE Performance Overhead by Taint Source

Taint Source	% Increase
ENVIRONMENT_VARIABLE	1,285.8%
SOCKET	1,486,978.8%
Grand Total	**1,287.1%**

Table 8-30. MINESTRONE CTREE Performance Overhead by Data Type Complexity

Data Type Complexity	% Increase
SIMPLE	1287.1%
Grand Total	**1287.1%**

Table 8-31. MINESTRONE CTREE Performance Overhead by Data Flow Complexity

Data Flow Complexity	% Increase
BASIC	1287.1%
Grand Total	**1287.1%**

Table 8-32. MINESTRONE CTREE Performance Overhead by Control Flow Complexity

Control Flow Complexity	% Increase
SEQUENCE	1287.1%
Grand Total	**1287.1%**

Table 8-33. MINESTRONE CTREE Performance Overhead by File Size

File Size	% Increase
537,199	1287.1%
Grand Total	**1287.1%**

8.1.6 Summary

Columbia passed 571 out of 2,623 test cases for a passing rate of 21.8% +1.4/-1.3% at a 0.90 confidence level. **Table 8-34** summarizes the passing rates by corpus and weakness classes. Both summary across all weakness classes and individual weakness classes are presented with totals and passing rate presented. The + and – columns represent the confidence limits for each of the sample proportions and the total test cases. These were calculated using the Wilson Score calculator found on **http://epitools.ausvet.com.au**, with a confidence level of 0.90.

Results are presented for Phase 3 programs, the Phase 2 sized programs (GREP) and the Phase 1 sized programs (CTREE).

Table 8-34. Passing rates by Performer, Corpus and Weakness Classes

Performer	Corpus	Weakness Class	Total Test Cases	Passed	Passing Rate	+	-
Columbia	Phase 3	ALL	2623	571	21.8%	1.4%	-1.3%
Columbia	Phase 3	Concurrency Handling	404	18	4.5%	2.0%	-1.4%
Columbia	Phase 3	Injection	471	107	22.7%	3.3%	-3.0%
Columbia	Phase 3	Memory Corruption	442	124	28.1%	3.6%	-3.4%
Columbia	Phase 3	Null Pointer	460	136	29.6%	3.6%	-3.4%
Columbia	Phase 3	Number Handling	432	125	28.9%	3.7%	-3.4%
Columbia	Phase 3	Resource Drains	414	61	14.7%	3.1%	-2.6%
Columbia	GREP	ALL	364	129	35.4%	4.2%	-4.0%
Columbia	GREP	Concurrency Handling	57	11	19.3%	9.9%	-7.1%
Columbia	GREP	Injection	32	10	31.3%	14.5%	-11.6%
Columbia	GREP	Memory Corruption	159	57	35.8%	6.4%	-6.0%
Columbia	GREP	Null Pointer	28	14	50.0%	14.8%	-14.8%
Columbia	GREP	Number Handling	44	21	47.7%	12.2%	-11.9%
Columbia	GREP	Resource Drains	44	16	36.4%	12.4%	-10.8%
Columbia	CTREE	ALL	372	237	63.7%	4.0%	-4.2%
Columbia	CTREE	Concurrency Handling	63	16	25.4%	9.9%	-7.9%
Columbia	CTREE	Injection	32	14	43.8%	14.4%	-13.4%
Columbia	CTREE	Memory Corruption	160	126	78.8%	4.8%	-5.8%
Columbia	CTREE	Null Pointer	28	19	67.9%	12.4%	-15.5%
Columbia	CTREE	Number Handling	47	37	78.7%	8.1%	-11.2%
Columbia	CTREE	Resource Drains	42	25	59.5%	11.5%	-12.7%

8.1.6.1 Deployability and Usability of Performer Technology

The MINESTRONE technology is the least integrated of the three performer technologies making it the most complex to deploy and use.

A large part of this complexity is derived from the fact that MINESTRONE relies on OpenVZ containers to isolate each of its different underlying technologies. OpenVZ containers are lightweight virtual machines, which means that in addition to installing them they must be configured and maintained on an individual basis exactly like an entirely new system would require. Additionally, this strategy also means that the machines running MINESTRONE require significant CPU and memory resources to allow concurrent execution of multiple OpenVZ containers at once. Once installed and configured, the OpenVZ strategy also suffers from several other problems including environmental differences, I/O redirection, exploitation inside the container, and result selection.

Significant environmental differences are one of the largest problems for this strategy is that since the container is its own virtual machine there can be differences. For example, MINESTRONE currently uses Debian 7 containers with a CentOS 6.5 host system. These two distributions, while both Linux, do not share the same packages and therefore may compile and run programs slightly differently which can throw off a program or make it behave unexpectedly.

Even with identical environments between the host system and the container, there is also the problem of capturing I/O from the host system and supplying it to the running processes of the container is a significant undertaking that requires memory, network, file and other sources of input or output be replicated from the host to the container in real time. This technical hurdle is largely done for network and file I/O but memory and other sources like Unix sockets are still very experimental. Additional sources of I/O are not necessarily covered without input from the development team.

One other large problem for the OpenVZ strategy is that isolating the technologies allows a weakness, while caught in one container to exploit all the other containers. This is especially problematic for weaknesses where they communicate with some resource outside of the container like a database, it essentially means that the weakness succeeded despite it being caught in one of the containers.

Finally, another problem that arises using the OpenVZ strategy is result selection. The technology must choose which container's result to show at any given point in time, be it a file, the screen, etc. This can be extremely difficult depending on the complexity of the program and its I/O.

8.2 GrammaTech Incorporated

The GrammaTech Incorporated (GrammaTech) proposed technology, known as PEASOUP, was evaluated by the T&E team using the TEXAS system on AWS. On 19 November 2014, the PEASOUP technology underwent a significant software update. Results in this section reflect that update.

8.2.1 Proposed Technology

The proposed technology developed by GrammaTech operated on x86 binaries targeting the Linux operating system and leveraged static analysis techniques, concolic execution , binary rewriting, and runtime diversification.

8.2.2 Phase 3 Weakness Classes

In Phase 3, GrammaTech chose to work with binary code focusing on the following weakness classes: Concurrency Handling, Injection, Memory Corruption, Null Pointer, Number Handling and Resource Drains.

8.2.3 Results and Analysis of Phase 3 Programs

Results for the Phase 3 evaluation have been compiled and analyzed by the test and evaluation team. This section presents these results along with the analysis.

GrammaTech passed 818 out of 1,954 test cases for a success rate of 41.9% +/- 1.8% at a 0.90 confidence level. **Figure 8-12** summarizes the passing rates by corpus and weakness classes. Both summary across all weakness classes and individual weakness classes are presented with totals and passing rate presented. The + and – columns represent the confidence limits for each of the sample proportions and the total test cases. These were calculated using the Wilson Score calculator found on **http://epitools.ausvet.com.au**, with a confidence level of 0.90.

Results are presented for Phase 3 programs, the Phase 2 sized programs (GREP) and the Phase 1 sized programs (CTREE).

Totals

		Altered? No	Altered? Yes	Total
Mitigation?	Full	**818**	163	981
	Partial	93	34	127
	None	428	418	846
	Total	1,339	615	1,954

Percentages

		Altered? No	Altered? Yes	Total
Mitigation?	Full	**41.9%**	8.3%	50.2%
	Partial	4.8%	1.7%	6.5%
	None	21.9%	21.4%	43.3%
	Total	69%	31%	100%

Figure 8-12. PEASOUP Mitigation and Altered Functionality Results

The excel workbook for this section is: “T&E GrammaTech Results 20141202 Final Analysis Results8.xlsx” **Appendix J.1** presents additional tables and charts detailing the Columbia GREP results.

Overall PEASOUP passed 41.9% of all the valid test cases.

The following sections present evaluations of the results based on: Base Programs; Weakness Class; Taint Source; Data Type Complexity, Data Flow Complexity, Control Flow Complexity and File Size.

PERCENTAGE OF SUBMITTED TEST CASES SUCCESSFULLY PROCESSED:

- GrammaTech (Binary) successfully processed 1954 out of 1958 test cases – 99.8 %

PERCENTAGE OF SEEDED VULNERABILITIES RENDERED UNEXPLOITABLE:

- GrammaTech passed 818 out of 1,954 test cases for a success rate of 41.9% +/- 1.8% at a 0.90 confidence level.

PERCENTAGE INCREASE IN PERFORMANCE EXECUTION TIME:

- The overall average increase in processing time for GrammaTech’s PEASOUP was 18.5%

8.2.3.1 PEASOUP Results by Base Programs

Figure 8-13, **Table 8-35** and **Table 8-36**, show the results by each of the base programs. PEASOUP was most successful in mitigating the vulnerabilities for OSSL at 63% of those test cases passing. Next was subversion at 49% of the test cases passing and FFMpeg at 48% passing. Minestrone failed to mitigate vulnerabilities in GIMP and WIRESHARK.

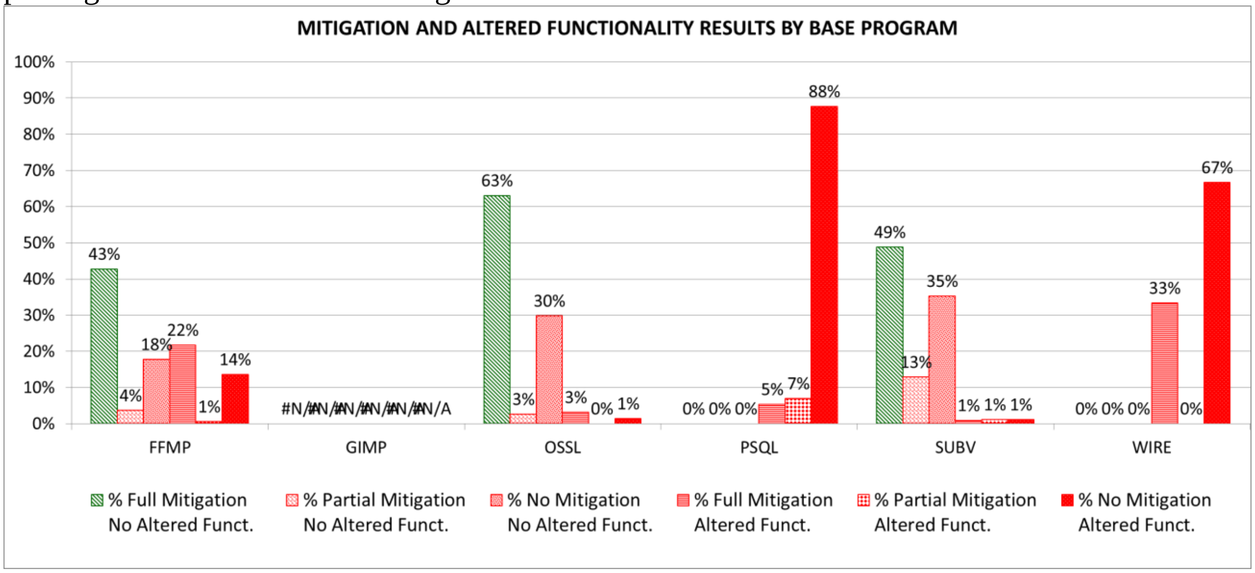

Figure 8-13. PEASOUP Mitigation and Altered Functionality Results (Percentage by Base Program)

Table 8-35. PEASOUP Mitigation and Altered Functionality Results (by Base Program)

Base Program	Total Test Cases	Full Mitigation No Altered Function	Partial Mitigation No Altered Function	No Mitigation No Altered Function	Full Mitigation Altered Function	Partial Mitigation Altered Function	No Mitigation Altered Function
FFMP	552	236	20	98	120	3	75
GIMP	0	0	0	0	0	0	0
OSSL	574	362	15	171	18	0	8
PSQL	374	0	0	0	20	26	328
SUBV	451	220	58	159	4	5	5
WIRE	3	0	0	0	1	0	2
Grand Total	**1954**	**818**	**93**	**428**	**163**	**34**	**418**

Table 8-36. PEASOUP Mitigation and Altered Functionality Results (Percentage by Base Program)

Base Program	% Full Mitigation No Altered Function	% Partial Mitigation No Altered Function	% No Mitigation No Altered Function	% Full Mitigation Altered Function	% Partial Mitigation Altered Function	% No Mitigation Altered Function
FFMP	43%	4%	18%	22%	1%	14%
GIMP						
OSSL	63%	3%	30%	3%	0%	1%
PSQL	0%	0%	0%	5%	7%	88%
SUBV	49%	13%	35%	1%	1%	1%
WIRE	0%	0%	0%	33%	0%	67%
Grand Total	**42%**	**5%**	**22%**	**8%**	**2%**	**21%**

8.2.3.2 PEASOUP Results by Weakness Classes and Target Weaknesses

Figure 8-14 and **Table 8-37**, show the results by each of the weakness classes. The table also shows the results for individual CWEs. PEASOUP performed well in mitigating Injection (64%) and Concurrency Handling (56% pass rate), middling well for Null Pointer (47%), Memory Corruption (42%) and Number Handling (36% pass rate). Resource Drains had a 7% passing rate.

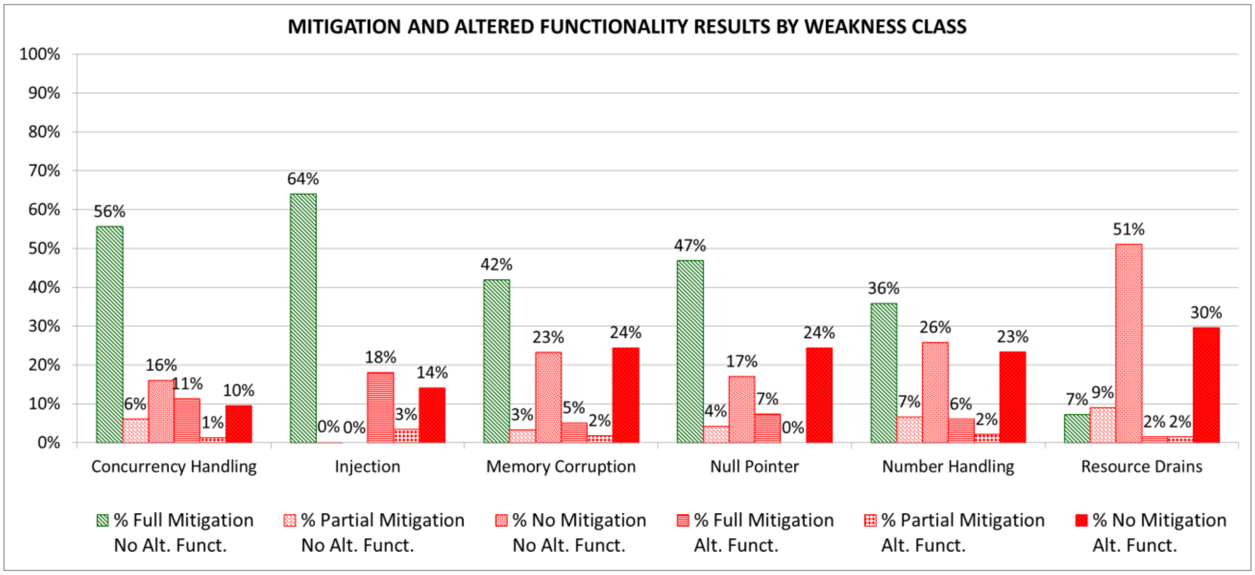

Figure 8-14. PEASOUP Mitigation and Altered Functionality Results (Percentage by Weakness Class)

Table 8-37. PEASOUP Mitigation and Altered Functionality Results (by Weakness Class and CWE)

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Funciont)	% Pass
Concurrency Handling	**230**	**179**	**78%**	**154**	**67%**	**128**	**56%**
414A	13	10	77%	11	85%	9	69%
479A	21	17	81%	13	62%	13	62%
543A	21	20	95%	0	0%	0	0%
609A	14	11	79%	12	86%	9	64%
663A	23	20	87%	21	91%	20	87%
764A	20	13	65%	16	80%	12	60%
765A	14	4	29%	11	79%	4	29%
765B	14	11	79%	9	64%	6	43%
820A	16	14	88%	6	38%	6	38%
821A	17	16	94%	15	88%	14	82%
828A	21	16	76%	14	67%	13	62%
831A	21	14	67%	11	52%	9	43%
833A	15	13	87%	15	100%	13	87%
Injection	**381**	**245**	**64%**	**313**	**82%**	**244**	**64%**
078A	69	33	48%	48	70%	33	48%
078B	49	39	80%	44	90%	39	80%
088A	62	29	47%	31	50%	28	45%
088B	48	31	65%	38	79%	31	65%
089A	39	33	85%	39	100%	33	85%

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Funciont)	% Pass
089B	39	24	62%	39	100%	24	62%
089C	39	33	85%	39	100%	33	85%
089D	36	23	64%	35	97%	23	64%
Memory Corruption	**331**	**227**	**69%**	**156**	**47%**	**139**	**42%**
120A	9	5	56%	4	44%	2	22%
120B	7	4	57%	0	0%	0	0%
120C	9	7	78%	5	56%	5	56%
120D	9	8	89%	6	67%	6	67%
124A	8	5	63%	4	50%	3	38%
124B	8	7	88%	0	0%	0	0%
124C	8	6	75%	6	75%	6	75%
124D	6	4	67%	3	50%	2	33%
126A	10	7	70%	0	0%	0	0%
126B	8	6	75%	0	0%	0	0%
126C	7	2	29%	0	0%	0	0%
126D	10	6	60%	0	0%	0	0%
127A	4	3	75%	0	0%	0	0%
127B	9	6	67%	0	0%	0	0%
127C	7	3	43%	0	0%	0	0%
127D	10	4	40%	0	0%	0	0%
129A	2	0	0%	0	0%	0	0%
129B	9	8	89%	9	100%	8	89%
134A	10	8	80%	9	90%	8	80%
170A	10	8	80%	8	80%	6	60%
170B	9	6	67%	0	0%	0	0%
415A	9	7	78%	8	89%	7	78%
590A	6	4	67%	5	83%	4	67%
761A	8	5	63%	6	75%	5	63%
785A	3	1	33%	1	33%	1	33%
785B	10	8	80%	8	80%	7	70%
785C	7	4	57%	3	43%	2	29%
785D	10	5	50%	4	40%	4	40%
805A	10	8	80%	7	70%	7	70%
805B	8	6	75%	7	88%	6	75%
805C	11	9	82%	7	64%	6	55%
805D	10	7	70%	5	50%	5	50%
806A	8	5	63%	5	63%	5	63%
806B	8	5	63%	5	63%	5	63%
806C	9	6	67%	3	33%	3	33%
806D	9	8	89%	6	67%	6	67%
822A	8	5	63%	6	75%	5	63%
824A	10	7	70%	3	30%	3	30%
824B	9	8	89%	7	78%	7	78%
843A	9	6	67%	6	67%	5	56%
Null Pointer	**352**	**240**	**68%**	**191**	**54%**	**165**	**47%**
476A	51	32	63%	23	45%	19	37%
476B	51	33	65%	29	57%	21	41%
476C	50	34	68%	29	58%	25	50%
476D	52	35	67%	28	54%	25	48%
476E	51	38	75%	28	55%	26	51%
476F	49	35	71%	27	55%	25	51%

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Funciont)	% Pass
476G	48	33	69%	27	56%	24	50%
Number Handling	**329**	**225**	**68%**	**138**	**42%**	**118**	**36%**
190A	33	22	67%	0	0%	0	0%
191A	33	22	67%	18	55%	16	48%
191B	31	24	77%	16	52%	15	48%
194A	29	17	59%	15	52%	10	34%
195A	34	23	68%	20	59%	18	53%
196A	35	22	63%	0	0%	0	0%
197A	31	25	81%	22	71%	20	65%
369A	32	17	53%	19	59%	13	41%
682A	13	7	54%	5	38%	5	38%
682B	26	20	77%	17	65%	15	58%
839A	32	26	81%	6	19%	6	19%
Resource Drains	**331**	**223**	**67%**	**29**	**9%**	**24**	**7%**
400A	35	22	63%	1	3%	0	0%
400B	22	8	36%	0	0%	0	0%
401A	21	13	62%	0	0%	0	0%
459A	32	26	81%	0	0%	0	0%
674A	10	7	70%	0	0%	0	0%
771A	30	22	73%	3	10%	3	10%
773A	34	26	76%	0	0%	0	0%
774A	27	16	59%	0	0%	0	0%
775A	33	24	73%	1	3%	1	3%
789A	28	17	61%	0	0%	0	0%
834A	33	22	67%	24	73%	20	61%
835A	26	20	77%	0	0%	0	0%
Grand Total	**1954**	**1339**	**68.5%**	**981**	**50.2%**	**818**	**41.9%**

8.2.3.3 PEASOUP Results by Taint Source

Table 8-38 shows the results by Taint Source, with PEASOUP performing best on Shared_Memory (49.7% passing) and worst on the SOCKET Taint source at 20.34% passing.

Table 8-38. PEASOUP Results by Taint Source

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
ENVIRONMENT_VARIABLE	509	234	45.97%
FILE_CONTENTS	530	249	46.98%
SHARED_MEMORY	507	252	49.70%
SOCKET	408	83	20.34%
Grand Total	**1954**	**818**	**41.86%**

8.2.3.4 PEASOUP Results by Data Type Complexity

Table 8-39 shows the results by Data Type Complexity with PEASOUP performing best on TYPEDEF (45.61% passing) and worst on the STRUCT with 38.43% passing. Overall there was not much variation across the various Data Type Complexity types.

Table 8-39. PEASOUP Results by Data Type Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
ARRAY	265	109	41.13%
HEAP_POINTER	286	127	44.41%
SIMPLE	284	119	41.90%
STRUCT	281	108	38.43%
TYPEDEF	285	130	45.61%
UNION	283	111	39.22%
VOID_POINTER	270	114	42.22%
Grand Total	**1954**	**818**	**41.86%**

8.2.3.5 PEASOUP Results by Data Flow Complexity

Table 8-40 shows the results by Data Flow Complexity with PEASOUP performing best on INDEX_ALIAS 10 (53.49% passing) and worst on the INDEX_ALIAS_1 with 34.04% passing.

Table 8-40. PEASOUP Results by Data Flow Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
ADDRESS_ALIAS_1	35	12	34.29%
ADDRESS_ALIAS_10	43	23	53.49%
ADDRESS_ALIAS_2	41	19	46.34%
ADDRESS_ALIAS_50	48	20	41.67%
ADDRESS_AS_CONSTANT	172	73	42.44%
ADDRESS_AS_FUNCTION_RETURN_VALUE	185	77	41.62%
ADDRESS_AS_LINEAR_EXPRESSION	192	79	41.15%
ADDRESS_AS_NONLINEAR_EXPRESSION	173	74	42.77%
ADDRESS_AS_VARIABLE	178	72	40.45%
BASIC	169	73	43.20%
BUFFER_ADDRESS_ARRAY_INDEX	180	84	46.67%
BUFFER_ADDRESS_POINTER	182	68	37.36%
INDEX_ALIAS_1	47	16	34.04%
INDEX_ALIAS_10	44	20	45.45%
INDEX_ALIAS_2	44	21	47.73%
INDEX_ALIAS_50	36	14	38.89%
VAR_ARG_LIST	185	73	39.46%
Grand Total	**1954**	**818**	**41.86%**

8.2.3.6 PEASOUP Results by Control Flow Complexity

Table 8-41 shows the results by Control Flow Complexity with PEASOUP performing best on INTERPROCEDURAL_2 (47.83% passing) and worst on the INTERPROCEDURAL_50 with 18.5% passing.

Table 8-41. PEASOUP Results by Control Flow Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
CALLBACK	195	78	40.00%
INDIRECTLY_RECURSIVE	200	88	44.00%
INFINITE_LOOP	201	85	42.29%
INTERPROCEDURAL_1	50	22	44.00%
INTERPROCEDURAL_10	50	20	40.00%

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
INTERPROCEDURAL_2	46	22	47.83%
INTERPROCEDURAL_50	49	9	18.37%
MACROS	190	84	44.21%
POINTER_TO_FUNCTION	190	86	45.26%
RECURSIVE	197	86	43.65%
SEQUENCE	195	75	38.46%
SET_JUMP_LONG_JUMP	189	81	42.86%
UNCONDITIONAL_JUMP	202	82	40.59%
Grand Total	**1954**	**818**	**41.86%**

8.2.3.7 PEASOUP Results by File Size

Table 8-42 shows the results by File Size with PEASOUP performing best on the smallest file size. However, the results do not follow a monotonically decreasing curve, as the performance on the 566.9K lines of code file (42.75% pass rate) is slightly worse than the performance of the 798.6 K lines of code file (48.78% pass).

Table 8-42. PEASOUP Results by File Size

File Size	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
440,299	574	362	63.07%
566,908	552	236	42.75%
711,339	0	0	0
731,469	374	0	0.00%
798,636	451	220	48.78%
2,523,396	3	0	0.00%
Grand Total	**1954**	**818**	**41.86%**

8.2.3.8 PEASOUP Performance Overhead

The overall average increase in processing time from stage 1 to stage 2 for PEASOUP was 18.5%. **Table 8-43** shows the overhead increases by base program.

Table 8-43. PEASOUP Performance Overhead by Base Program

Base Program	% Increase
FFMP	179.2%
OSSL	274.5%
PSQL	4.5%
SUBV	246.3%
WIRE	-92.9%
GIMP	-100.0%
Grand Total	**18.5%**

8.2.4 Results and Analysis of Phase 2-Sized Programs

Results for the Phase 2-sized evaluation of GREP have been compiled and analyzed by the test and evaluation team. This section presents these results along with the analysis.

For the Phase 3 programs PEASOUP passed 41.9% of the 1,954 test cases. For GREP that number was worse with 27.2% of 368 test cases passing (**Figure 8-15**).

The excel workbook for this section is: “T&E GrammaTech Results 20141202 GREP Analysis Results8.xlsx” Appendix J.2 presents additional tables and charts detailing the GrammatTech GREP results.

Overall PEASOUP passed 27% of all the valid test cases for GREP.

The following sections present evaluations of the results based on: Base Programs; Weakness Class; Taint Source; Data Type Complexity, Data Flow Complexity, Control Flow Complexity and File Size.

Totals

		Altered? No	Altered? Yes	Total
Mitigation?	Full	**100**	109	209
	Partial	4	18	22
	None	45	92	137
	Total	149	219	368

Percentages

		Altered? No	Altered? Yes	Total
Mitigation?	Full	**27.2%**	29.6%	56.8%
	Partial	1.1%	4.9%	6.0%
	None	12.2%	25.0%	37.2%
	Total	40%	60%	100%

Figure 8-15. PEASOUP GREP Mitigation and Altered Functionality Results

8.2.4.1 PEASOUP GREP Results

GrammaTech passed 100 out of 368 test cases for a passing rate of 27.2% +4.0/-3.6% at a 0.90 confidence level. **Figure 8-16**, **Table 8-44** and **Table 8-45** show the mitigation and altered functionality results for the GREP base program. PEASOUP passed 27% of the vulnerabilities.

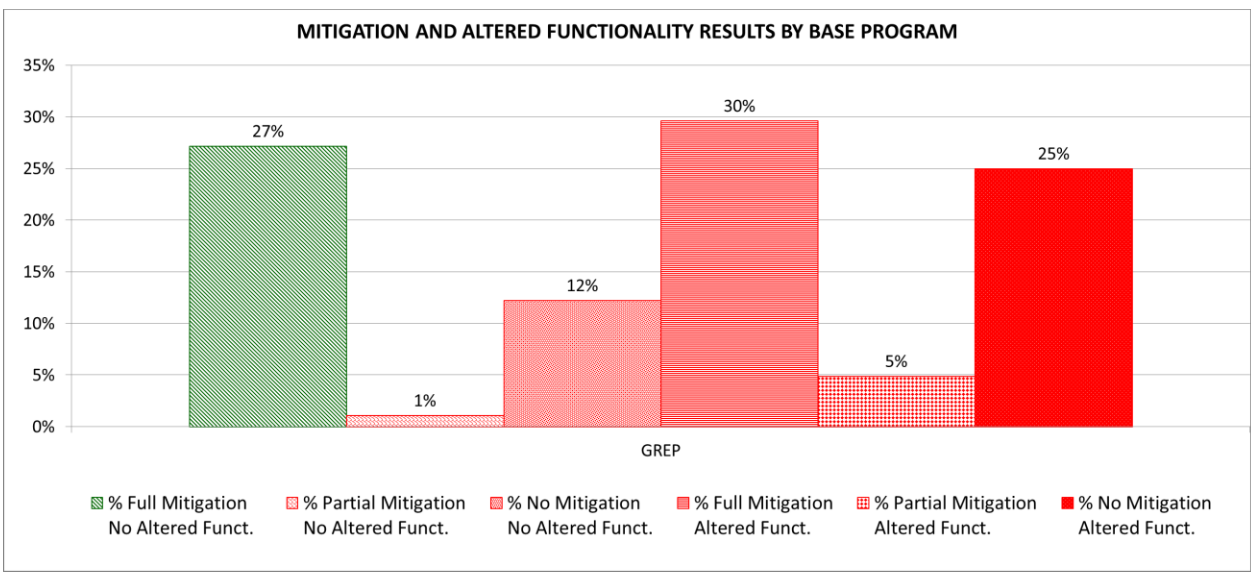

Figure 8-16. PEASOUP GREP Mitigation and Altered Functionality Results

Table 8-44. PEASOUP GREP Mitigation and Altered Functionality Results

Base Program	Total Test Cases	Full Mitigation No Altered Function	Partial Mitigation No Altered Function	No Mitigation No Altered Function	Full Mitigation Altered Function	Partial Mitigation Altered Function	No Mitigation Altered Function
GREP	368	100	4	45	109	18	92
Grand Total	**368**	**100**	**4**	**45**	**109**	**18**	**92**

Table 8-45. PEASOUP GREP Mitigation and Altered Functionality Results (Percentage)

Row Labels	% Full Mitigation No Altered Function	% Partial Mitigation No Altered Function	% No Mitigation No Altered Function	% Full Mitigation Altered Function	% Partial Mitigation Altered Function	% No Mitigation Altered Function
GREP	27%	1%	12%	30%	5%	25%
Grand Total	**27%**	**1%**	**12%**	**30%**	**5%**	**25%**

8.2.4.2 PEASOUP GREP Results by Weakness Classes and Target Weaknesses

Figure 8-17 and **Table 8-46** show the results by each of the weakness classes. The table also shows the results for individual CWEs. For GREP, PEASOUP performed about best for the INJECTION (47%) weakness class. Concurrency Handling, (32% passed), Number Handling (30%), Null Pointer (29%) and Memory Corruption had about the same performance, and Resource Drains were the most difficult for PEASOUP to pass with a 7% passing rate.

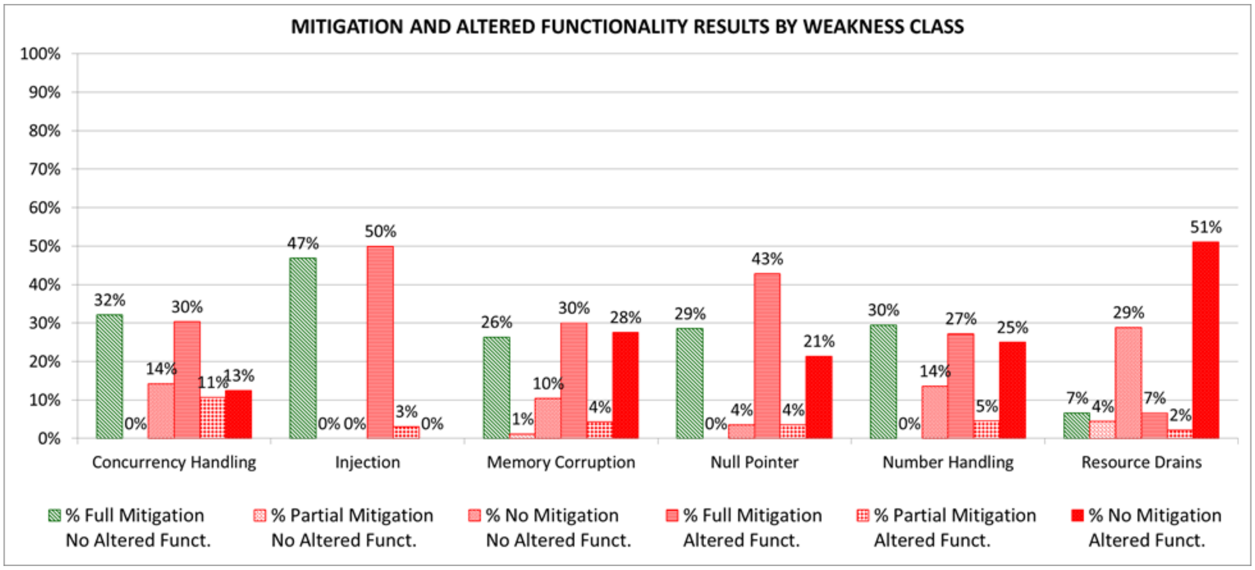

Figure 8-17. PEASOUP GREP Mitigation and Altered Functionality Results (Percentage by Weakness Class)

Table 8-46. PEASOUP GREP Mitigation and Altered Functionality Results (by Weakness Class and CWE)

Row Labels	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling	**56**	**26**	**46%**	**35**	**63%**	**18**	**32%**
363A	4	2	50%	0	0%	0	0%
367A	4	3	75%	2	50%	2	50%

Row Labels	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
414A	4	1	25%	2	50%	1	25%
479A	4	1	25%	3	75%	1	25%
543A	4	1	25%	0	0%	0	0%
609A	3	2	67%	3	100%	2	67%
663A	3	1	33%	2	67%	1	33%
764A	4	3	75%	4	100%	3	75%
765A	3	0	0%	3	100%	0	0%
765B	3	1	33%	2	67%	1	33%
820A	4	2	50%	3	75%	1	25%
821A	4	1	25%	3	75%	1	25%
828A	4	2	50%	3	75%	1	25%
831A	4	4	100%	3	75%	3	75%
833A	4	2	50%	2	50%	1	25%
Injection	**32**	**15**	**47%**	**31**	**97%**	**15**	**47%**
078A	4	3	75%	4	100%	3	75%
078B	4	2	50%	4	100%	2	50%
088A	4	2	50%	4	100%	2	50%
088B	4	3	75%	4	100%	3	75%
089A	4	1	25%	4	100%	1	25%
089B	4	1	25%	4	100%	1	25%
089C	4	3	75%	3	75%	3	75%
089D	4	0	0%	4	100%	0	0%
Memory Corruption	**163**	**62**	**38%**	**92**	**56%**	**43**	**26%**
120A	4	1	25%	3	75%	1	25%
120B	4	0	0%	0	0%	0	0%
120C	4	0	0%	3	75%	0	0%
120D	4	1	25%	3	75%	1	25%
124A	4	2	50%	1	25%	1	25%
124B	3	3	100%	0	0%	0	0%
124C	4	2	50%	3	75%	2	50%
124D	4	1	25%	3	75%	1	25%
126A	4	1	25%	0	0%	0	0%
126B	4	1	25%	0	0%	0	0%
126C	4	1	25%	0	0%	0	0%
126D	4	2	50%	0	0%	0	0%
127A	4	2	50%	0	0%	0	0%
127B	4	2	50%	0	0%	0	0%
127C	4	0	0%	0	0%	0	0%
127D	4	1	25%	0	0%	0	0%
129A	4	1	25%	3	75%	1	25%
129B	4	1	25%	4	100%	1	25%
134A	4	1	25%	4	100%	1	25%
170A	4	2	50%	4	100%	2	50%
170B	4	1	25%	0	0%	0	0%
415A	4	2	50%	4	100%	2	50%
416A	4	1	25%	1	25%	0	0%
590A	4	2	50%	4	100%	2	50%
761A	4	3	75%	4	100%	3	75%
785A	4	3	75%	3	75%	3	75%
785B	4	1	25%	4	100%	1	25%

Row Labels	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
785C	4	3	75%	3	75%	3	75%
785D	4	2	50%	3	75%	2	50%
805A	4	2	50%	3	75%	1	25%
805B	4	2	50%	4	100%	2	50%
805C	4	0	0%	3	75%	0	0%
805D	4	2	50%	3	75%	2	50%
806A	4	0	0%	3	75%	0	0%
806B	4	3	75%	4	100%	3	75%
806C	4	2	50%	3	75%	1	25%
806D	4	3	75%	3	75%	2	50%
822A	4	0	0%	2	50%	0	0%
824A	4	1	25%	1	25%	1	25%
824B	4	2	50%	3	75%	2	50%
843A	4	2	50%	3	75%	2	50%
Null Pointer	**28**	**9**	**32%**	**20**	**71%**	**8**	**29%**
476A	4	0	0%	3	75%	0	0%
476B	4	2	50%	3	75%	2	50%
476C	4	2	50%	3	75%	2	50%
476D	4	2	50%	3	75%	2	50%
476E	4	0	0%	3	75%	0	0%
476F	4	1	25%	2	50%	1	25%
476G	4	2	50%	3	75%	1	25%
Number Handling	**44**	**19**	**43%**	**25**	**57%**	**13**	**30%**
190A	4	1	25%	0	0%	0	0%
191A	4	2	50%	3	75%	2	50%
191B	4	4	100%	3	75%	3	75%
194A	4	1	25%	3	75%	1	25%
195A	4	2	50%	2	50%	1	25%
196A	4	2	50%	0	0%	0	0%
197A	4	2	50%	3	75%	2	50%
369A	4	1	25%	3	75%	1	25%
682A	4	0	0%	3	75%	0	0%
682B	4	3	75%	3	75%	2	50%
839A	4	1	25%	2	50%	1	25%
Resource Drains	**45**	**18**	**40%**	**6**	**13%**	**3**	**7%**
400A	4	0	0%	0	0%	0	0%
400B	3	1	33%	0	0%	0	0%
401A	3	2	67%	0	0%	0	0%
459A	4	1	25%	1	25%	0	0%
674A	4	3	75%	0	0%	0	0%
771A	4	3	75%	0	0%	0	0%
773A	4	1	25%	2	50%	1	25%
774A	4	2	50%	0	0%	0	0%
775A	4	0	0%	0	0%	0	0%
789A	4	2	50%	0	0%	0	0%
834A	3	2	67%	3	100%	2	67%
835A	4	1	25%	0	0%	0	0%
Grand Total	**368**	**149**	**40.5%**	**209**	**56.8%**	**100**	**27.2%**

8.2.4.3 PEASOUP GREP Results by Taint Source

Table 8-47 shows the results by Taint Source, with GREP on PEASOUP performing best on FILE_CONTENTS (35.48% passing) and worst on the SOCKET taint source at 10% passing.

Table 8-47. PEASOUP GREP Results by Taint Source

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
ENVIRONMENT_VARIABLE	92	31	33.70%
FILE_CONTENTS	93	33	35.48%
SHARED_MEMORY	93	27	29.03%
SOCKET	90	9	10.00%
Grand Total	**368**	**100**	**27.17%**

8.2.4.4 PEASOUP GREP Results by Data Type Complexity

For the GREP tests there were no variations in Data Type Complexity (**Table 8-48**).

Table 8-48. PEASOUP GREP Results by Data Type Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
SIMPLE	368	100	27.17%
Grand Total	**368**	**100**	**27.17%**

8.2.4.5 PEASOUP GREP Results by Data Flow Complexity

For the GREP tests there were no variations in Data Flow Complexity (**Table 8-49**).

Table 8-49. GREP PEASOUP GREP Results by Data Flow Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
BASIC	368	100	27.17%
Grand Total	**368**	**100**	**27.17%**

8.2.4.6 PEASOUP GREP Results by Control Flow Complexity

For the GREP tests there were no variations in Control Flow Complexity (**Table 8-50**).

Table 8-50. PEASOUP GREP Results by Control Flow Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
SEQUENCE	368	100	27.17%
Grand Total	**368**	**100**	**27.17%**

8.2.4.7 PEASOUP GREP Results by File Size

For the GREP tests there were no variations in File Size (**Table 8-51**).

Table 8-51. PEASOUP GREP Results by File Size

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
711,339	368	100	27.17%
Grand Total	**368**	**100**	**27.17%**

8.2.4.8 PEASOUP GREP Performance Overhead

The overall average increase in processing time from stage 1 to stage 2 for GREP on PEASOUP was 240.2%. **Table 8-52** shows the overhead for GREP.

Table 8-52. PEASOUP GREP Performance Overhead

Base Program	% Increase
GREP	240.2%
Grand Total	**240.2%**

8.2.5 Results and Analysis of Phase 1-Sized Programs

Results for the Phase 1-sized evaluation CTREE have been compiled and analyzed by the test and evaluation team. This section presents these results along with the analysis.

For the Phase 3 programs PEASOUP passed 41.9% of the 1,954 test cases. For CTREE that number improved to 57.5% of 372 test cases (**Figure 8-18**).

Totals

		Altered? No	Altered? Yes	Total
Mitigation?	Full	**214**	3	217
	Partial	11	-	11
	None	143	1	144
	Total	368	4	372

Percentages

		Altered? No	Altered? Yes	Total
Mitigation?	Full	**57.5%**	0.8%	58.3%
	Partial	3.0%	0.0%	3.0%
	None	38.4%	0.3%	38.7%
	Total	99%	1%	100%

Figure 8-18. PEASOUP CTREE Mitigation and Altered Functionality Results

The excel workbook for this section is: "T&E GrammaTech Results 20141202 CTREE Analysis Results7A.xlsx" **Appendix J.3** presents additional tables and charts detailing the GrammaTech CTREE results.

Overall PEASOUP passed 58% of all the valid test cases for CTREE.

The following sections present evaluations of the results based on: Base Programs; Weakness Class; Taint Source; Data Type Complexity, Data Flow Complexity, Control Flow Complexity and File Size.

8.2.5.1 PEASOUP CTREE Results

GrammaTech passed 214 out of 372 test cases for a passing rate of 57.5% +4.1/-4.3% at a 0.90 confidence level. **Figure 8-19**, **Table 8-53** and **Table 8-54** show the mitigation and altered functionality results for the GREP base program.

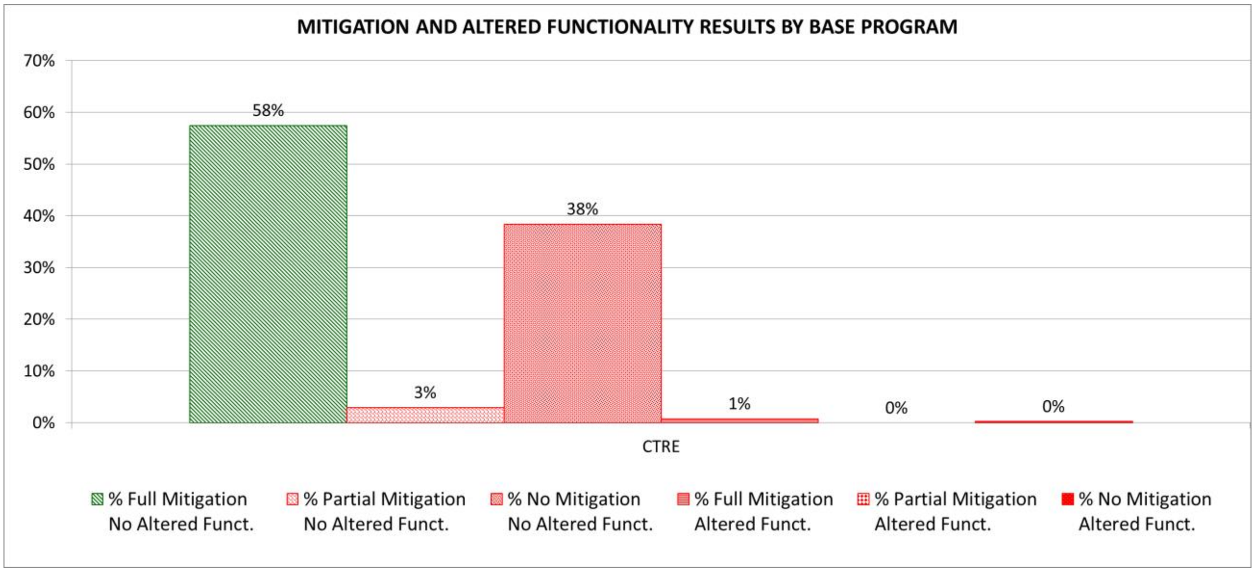

Figure 8-19. PEASOUP CTREE Mitigation and Altered Functionality Results

Table 8-53. PEASOUP CTREE Mitigation and Altered Functionality Results

Base Program	Total Test Cases	Full Mitigation No Altered Function	Partial Mitigation No Altered Function	No Mitigation No Altered Function	Full Mitigation Altered Function	Partial Mitigation Altered Function	No Mitigation Altered Function
CTRE	372	214	11	143	3	0	1
Grand Total	**372**	**214**	**11**	**143**	**3**	**0**	**1**

Table 8-54. PEASOUP CTREE Mitigation and Altered Functionality Results (Percentage)

Row Labels	% Full Mitigation No Altered Function	% Partial Mitigation No Altered Function	% No Mitigation No Altered Function	% Full Mitigation Altered Function	% Partial Mitigation Altered Function	% No Mitigation Altered Function
CTRE	58%	3%	38%	1%	0%	0%
Grand Total	**58%**	**3%**	**38%**	**1%**	**0%**	**0%**

8.2.5.2 PEASOUP CTREE Results by Weakness Classes and Target Weaknesses

Figure 8-20 and **Table 8-55**show the results by each of the weakness classes. The table also shows the results for individual CWEs. For CTREE, PEASOUP performed about best for the INJECTION (100%) weakness class. Null Pointer was next best at 75%. Concurrency Handling (61%), Memory Corruption (58%) and Number Handling (57%) had about the same passing rates. Resource Drains were the most difficult to handle with a passing rate of 13%.

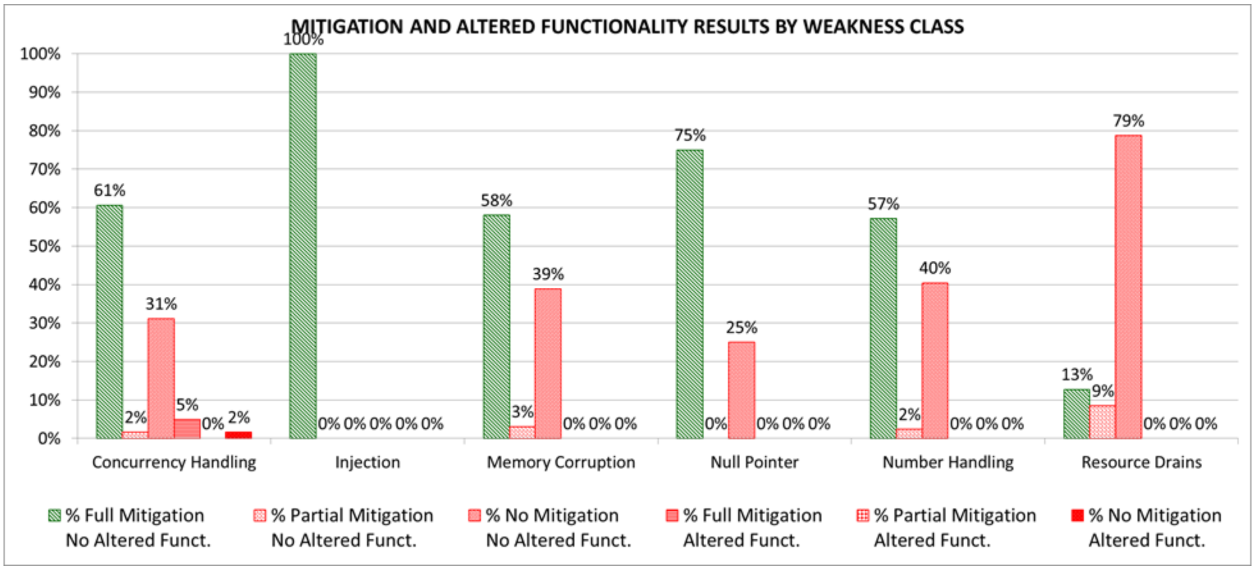

Figure 8-20. PEASOUP CTREE Mitigation and Altered Functionality Results (Percentage by Weakness Class)

Table 8-55. PEASOUP CTREE Mitigation and Altered Functionality Results (by Weakness Class and CWE)

Row Labels	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling	**61**	**57**	**93%**	**40**	**66%**	**37**	**61%**
363A	4	4	100%	0	0%	0	0%
367A	4	4	100%	3	75%	3	75%
412A	4	4	100%	0	0%	0	0%
414A	4	4	100%	3	75%	3	75%
479A	4	4	100%	3	75%	3	75%
543A	4	4	100%	0	0%	0	0%
609A	4	4	100%	3	75%	3	75%
663A	4	4	100%	3	75%	3	75%
764A	4	4	100%	4	100%	4	100%
765A	4	0	0%	3	75%	0	0%
765B	3	3	100%	3	100%	3	100%
820A	3	3	100%	3	100%	3	100%
821A	4	4	100%	3	75%	3	75%
828A	4	4	100%	3	75%	3	75%
831A	4	4	100%	3	75%	3	75%
833A	3	3	100%	3	100%	3	100%
Injection	**32**	**32**	**100%**	**32**	**100%**	**32**	**100%**
078A	4	4	100%	4	100%	4	100%
078B	4	4	100%	4	100%	4	100%
088A	4	4	100%	4	100%	4	100%
088B	4	4	100%	4	100%	4	100%
089A	4	4	100%	4	100%	4	100%
089B	4	4	100%	4	100%	4	100%
089C	4	4	100%	4	100%	4	100%
089D	4	4	100%	4	100%	4	100%

Row Labels	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Memory Corruption	**162**	**162**	**100%**	**94**	**58%**	**94**	**58%**
120A	4	4	100%	3	75%	3	75%
120B	4	4	100%	0	0%	0	0%
120C	4	4	100%	3	75%	3	75%
120D	4	4	100%	3	75%	3	75%
124A	4	4	100%	1	25%	1	25%
124B	2	2	100%	0	0%	0	0%
124C	4	4	100%	3	75%	3	75%
124D	4	4	100%	0	0%	0	0%
126A	4	4	100%	0	0%	0	0%
126B	4	4	100%	0	0%	0	0%
126C	4	4	100%	0	0%	0	0%
126D	4	4	100%	0	0%	0	0%
127A	4	4	100%	0	0%	0	0%
127B	4	4	100%	0	0%	0	0%
127C	4	4	100%	0	0%	0	0%
127D	4	4	100%	0	0%	0	0%
129A	4	4	100%	3	75%	3	75%
129B	4	4	100%	4	100%	4	100%
134A	4	4	100%	4	100%	4	100%
170A	4	4	100%	4	100%	4	100%
170B	4	4	100%	0	0%	0	0%
415A	4	4	100%	4	100%	4	100%
416A	4	4	100%	3	75%	3	75%
590A	4	4	100%	4	100%	4	100%
761A	4	4	100%	4	100%	4	100%
785A	4	4	100%	3	75%	3	75%
785B	4	4	100%	4	100%	4	100%
785C	4	4	100%	3	75%	3	75%
785D	4	4	100%	3	75%	3	75%
805A	4	4	100%	3	75%	3	75%
805B	4	4	100%	4	100%	4	100%
805C	4	4	100%	3	75%	3	75%
805D	4	4	100%	3	75%	3	75%
806A	4	4	100%	3	75%	3	75%
806B	4	4	100%	4	100%	4	100%
806C	4	4	100%	3	75%	3	75%
806D	4	4	100%	3	75%	3	75%
822A	4	4	100%	3	75%	3	75%
824A	4	4	100%	3	75%	3	75%
824B	4	4	100%	3	75%	3	75%
843A	4	4	100%	3	75%	3	75%
Null Pointer	**28**	**28**	**100%**	**21**	**75%**	**21**	**75%**
476A	4	4	100%	3	75%	3	75%
476B	4	4	100%	3	75%	3	75%
476C	4	4	100%	3	75%	3	75%
476D	4	4	100%	3	75%	3	75%
476E	4	4	100%	3	75%	3	75%
476F	4	4	100%	3	75%	3	75%
476G	4	4	100%	3	75%	3	75%

Row Labels	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Number Handling	**42**	**42**	**100%**	**24**	**57%**	**24**	**57%**
190A	4	4	100%	0	0%	0	0%
191A	4	4	100%	3	75%	3	75%
191B	4	4	100%	3	75%	3	75%
194A	4	4	100%	3	75%	3	75%
195A	4	4	100%	3	75%	3	75%
196A	4	4	100%	0	0%	0	0%
197A	4	4	100%	3	75%	3	75%
369A	4	4	100%	3	75%	3	75%
682A	3	3	100%	2	67%	2	67%
682B	3	3	100%	2	67%	2	67%
839A	4	4	100%	2	50%	2	50%
Resource Drains	**47**	**47**	**100%**	**6**	**13%**	**6**	**13%**
400A	4	4	100%	0	0%	0	0%
400B	4	4	100%	0	0%	0	0%
401A	3	3	100%	0	0%	0	0%
459A	4	4	100%	0	0%	0	0%
674A	4	4	100%	0	0%	0	0%
771A	4	4	100%	2	50%	2	50%
773A	4	4	100%	0	0%	0	0%
774A	4	4	100%	0	0%	0	0%
775A	4	4	100%	0	0%	0	0%
789A	4	4	100%	0	0%	0	0%
834A	4	4	100%	4	100%	4	100%
835A	4	4	100%	0	0%	0	0%
Grand Total	**372**	**368**	**98.9%**	**217**	**58.3%**	**214**	**57.5%**

8.2.5.3 PEASOUP CTREE Results by Taint Source

Table 8-56 shows the results by Taint Source, with GREP on PEASOUP performing best on FILE_CONTENTS (35.48% passing) and worst on the SOCKET taint source at 10% passing.

Table 8-56. PEASOUP CTREE Results by Taint Source

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
ENVIRONMENT_VARIABLE	92	62	67.39%
FILE_CONTENTS	94	67	71.28%
SHARED_MEMORY	95	66	69.47%
SOCKET	91	19	20.88%
Grand Total	**372**	**214**	**57.53%**

8.2.5.4 PEASOUP CTREE Results by Data Type Complexity

For the CTREE tests there were no variations in Data Type Complexity (**Table 8-57**).

Table 8-57. PEASOUP CTREE Results by Data Type Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
SIMPLE	372	214	57.53%
Grand Total	**372**	**214**	**57.53%**

8.2.5.5 PEASOUP CTREE Results by Data Flow Complexity

For the CTREE tests there were no variations in Data Flow Complexity (**Table 8-58**).

Table 8-58. PEASOUP CTREE Results by Data Flow Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
BASIC	372	214	57.53%
Grand Total	**372**	**214**	**57.53%**

8.2.5.6 PEASOUP CTREE Results by Control Flow Complexity

For the CTREE tests there were no variations in Control Flow Complexity (**Table 8-59**).

Table 8-59. PEASOUP CTREE Results by Control Flow Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
SEQUENCE	372	214	57.53%
Grand Total	**372**	**214**	**57.53%**

8.2.5.7 PEASOUP CTREE Results by File Size

For the CTREE tests there were no variations in file size (**Table 8-60**).

Table 8-60. PEASOUP CTREE Results by File Size

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
537199	372	214	57.53%
Grand Total	**372**	**214**	**57.53%**

8.2.5.8 PEASOUP Performance Overhead

The overall average increase in processing time from stage 1 to stage 2 for GREP on PEASOUP was 75.5%. **Table 8-61** shows the overhead for GREP.

Table 8-61. PEASOUP CTREE Performance Overhead by Base Program

Base Program	% Increase
CTREE	75.5%
Grand Total	**75.5%**

8.2.6 Summary

GrammaTech passed 818 out of 1,954 test cases for a success rate of 41.9% +/- 1.8% at a 0.90 confidence level. **Table 8-62** summarizes the passing rates by corpus and weakness classes. Both summary across all weakness classes and individual weakness classes are presented with totals and passing rate presented. The + and – columns represent the confidence limits for each of the sample proportions and the total test cases. These were calculated using the Wilson Score calculator found on **http://epitools.ausvet.com.au**, with a confidence level of 0.90.

Results are presented for Phase 3 programs, the Phase 2 sized programs (GREP) and the Phase 1 sized programs (CTREE).

Table 8-62. Passing rates by Performer, Corpus and Weakness Classes

Performer	Corpus	Weakness Class	Total Test Cases	Passed	Passing Rate	+	-
GrammaTech	Phase 3	ALL	1954	818	41.9%	1.8%	-1.8%
GrammaTech	Phase 3	Concurrency Handling	230	128	55.7%	5.3%	-5.4%
GrammaTech	Phase 3	Injection	381	244	64.0%	3.9%	-4.1%

Performer	Corpus	Weakness Class	Total Test Cases	Passed	Passing Rate	+	-
GrammaTech	Phase 3	Memory Corruption	331	139	42.0%	4.5%	-4.4%
GrammaTech	Phase 3	Null Pointer	352	165	46.9%	4.4%	-4.3%
GrammaTech	Phase 3	Number Handling	329	118	35.9%	4.4%	-4.2%
GrammaTech	Phase 3	Resource Drains	331	24	7.3%	2.7%	-2.0%
GrammaTech	GREP	ALL	368	100	27.2%	4.0%	-3.6%
GrammaTech	GREP	Concurrency Handling	56	18	32.1%	10.9%	-9.2%
GrammaTech	GREP	Injection	32	15	46.9%	14.2%	-13.7%
GrammaTech	GREP	Memory Corruption	163	43	26.4%	6.0%	-5.3%
GrammaTech	GREP	Null Pointer	28	8	28.6%	15.4%	-11.7%
GrammaTech	GREP	Number Handling	44	13	29.5%	12.2%	-9.9%
GrammaTech	GREP	Resource Drains	45	3	6.7%	8.9%	-4.0%
GrammaTech	CTREE	ALL	372	214	57.5%	4.1%	-4.3%
GrammaTech	CTREE	Concurrency Handling	61	37	60.7%	9.6%	-10.5%
GrammaTech	CTREE	Injection	32	32	100.0%	0.0%	-7.8%
GrammaTech	CTREE	Memory Corruption	162	94	58.0%	6.2%	-6.5%
GrammaTech	CTREE	Null Pointer	28	21	75.0%	10.8%	-15.2%
GrammaTech	CTREE	Number Handling	42	24	57.1%	11.7%	-12.6%
GrammaTech	CTREE	Resource Drains	47	6	12.8%	10.1%	54.7%

8.2.6.1 Deployability and Usability of Performer Technology

PEASOUP in the T&E team's experience was reasonably easy to deploy and update, since it consisted mainly of a single source archive that could be uncompressed and its scripts run from the command line. The only difficultly in deploying PEASOUP is that it's analysis phase requires access to a licensed IDA Pro instance (via a supplied IP address in the irdb_var configuration file).

Running an PEASOUPified program is likewise simple since they replace the actual executable with a script that starts it with their technology automatically making it seamless to the user.

8.3 Kestrel Incorporated

The Kestrel Incorporated (Kestrel) proposed technology, known as VIBRANCE, was evaluated was evaluated by the T&E team using the TEXAS system on AWS.

8.3.1 Proposed Technology

The proposed technology developed by Kestrel was named VIBRANCE. It operated on x86 binaries targeting the Linux operating system and leveraged static analysis techniques, concolic execution , binary rewriting, and runtime diversification.

8.3.2 Phase 3 Weakness Classes

In Phase 3, Kestrel chose to work with binary code focusing on the following weakness classes: Concurrency Handling, Injection, Memory Corruption, Null Pointer, Number Handling and Resource Drains.

8.3.3 Results and Analysis of Phase 3 Programs

Results for the Phase 3 evaluation have been compiled and analyzed by the test and evaluation team. This section presents these results along with the analysis.

As you can see from **Figure 8-21** VIBRANCE passed 78.6% of the 2,755 stage 2 test cases.

The following sections present evaluations of the results based on: Base Programs; Weakness Class; Taint Source; Data Type Complexity, Data Flow Complexity, Control Flow Complexity and File Size.

PERCENTAGE OF SUBMITTED TEST CASES SUCCESSFULLY PROCESSED:

- Kestrel (Java) successfully processed 2755 out of 2766 test cases – 99.6 %.

PERCENTAGE OF SEEDED VULNERABILITIES RENDERED UNEXPLOITABLE:

- Kestrel passed 2166 out of 2,755 test cases for a success rate of 78.6% +/- 1.3% at a 0.90 confidence level.

PERCENTAGE INCREASE IN PERFORMANCE EXECUTION TIME:

- The overall average increase in processing time for Kestrel's VIBRANCE was 11%

Totals		Altered?		
		No	Yes	Total
Mitigation?	Full	**2,166**	132	2,298
	Partial	26	7	33
	None	236	188	424
	Total	2,428	327	2,755

Percentages		Altered?		
		No	Yes	Total
Mitigation?	Full	**78.6%**	4.8%	83.4%
	Partial	0.9%	0.3%	1.2%
	None	8.6%	6.8%	15.4%
	Total	88%	12%	100%

Figure 8-21. VIBRANCE Mitigation and Altered Functionality Results

The excel workbook for this section is: "T&E Kestrel Results 20141202 Final Analysis Results7.xlsx" **Appendix K.1** presents additional tables and charts detailing the Kestrel Phase 3 results.

8.3.3.1 VIBRANCE Results by Base Programs

Figure 8-22, **Table 8-63**, and **Table 8-64**, show the results by each of the base programs. VIBRANCE was most successful in mitigating the vulnerabilities for POIX at 99% of those test cases passing. LUCE (97%), JENA (96%) and ELAS (96%) were processed almost as well. VIBRANCE had the most problems passing the CMUD test cases at a pass rate of 64%.

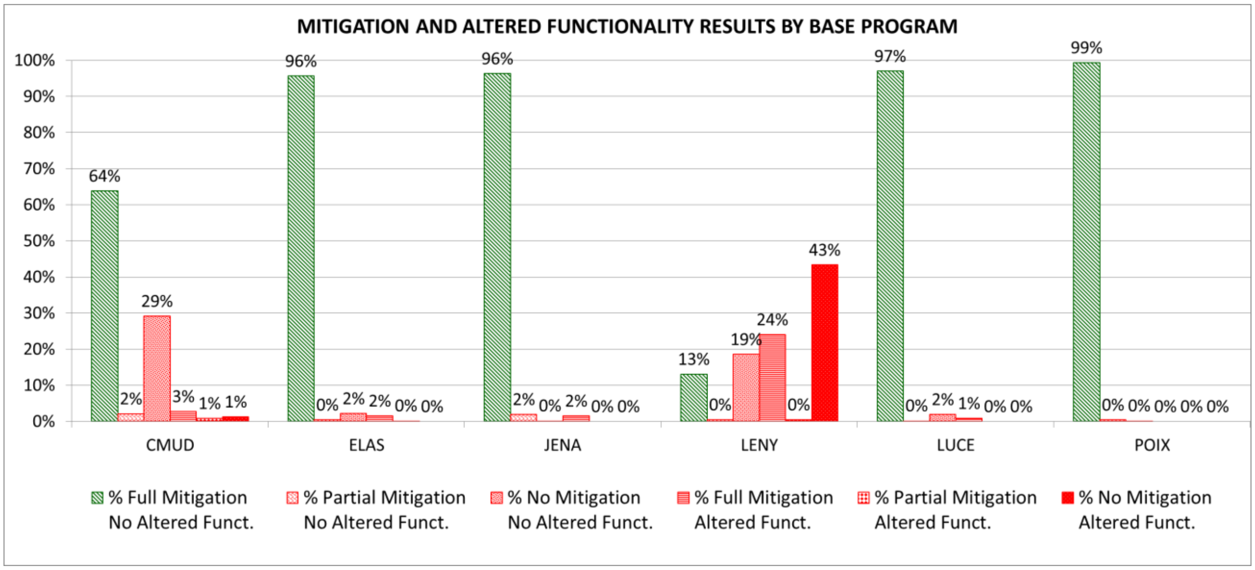

Figure 8-22. VIBRANCE Mitigation and Altered Functionality Results (Percentage by Base Program)

Table 8-63. VIBRANCE Mitigation and Altered Functionality Results (by Base Program)

Base Program	Total Test Cases	Full Mitigation No Altered Function	Partial Mitigation No Altered Function	No Mitigation No Altered Function	Full Mitigation Altered Function	Partial Mitigation Altered Function	No Mitigation Altered Function

Table 8-64. VIBRANCE Mitigation and Altered Functionality Results (Percentage by Base Program)

Row Labels	% Full Mitigation No Altered Function	% Partial Mitigation No Altered Function	% No Mitigation No Altered Function	% Full Mitigation Altered Function	% Partial Mitigation Altered Function	% No Mitigation Altered Function
CMUD	64%	2%	29%	3%	1%	1%
ELAS	96%	0%	2%	2%	0%	0%
JENA	96%	2%	0%	2%	0%	0%
LENY	13%	0%	19%	24%	0%	43%
LUCE	97%	0%	2%	1%	0%	0%
POIX	99%	0%	0%	0%	0%	0%
Grand Total	**79%**	**1%**	**9%**	**5%**	**0%**	**7%**

8.3.3.2 VIBRANCE Results by Weakness Classes and Target Weaknesses

Figure 8-23 and **Table 8-65**, show the results by each of the weakness classes. The table also shows the results for individual CWEs. VIBRANCE performed well in mitigating all the weakness classes varying from an 86% passing rate for the Injection weakness classes down to a 72% passing rate for Resource Drains.

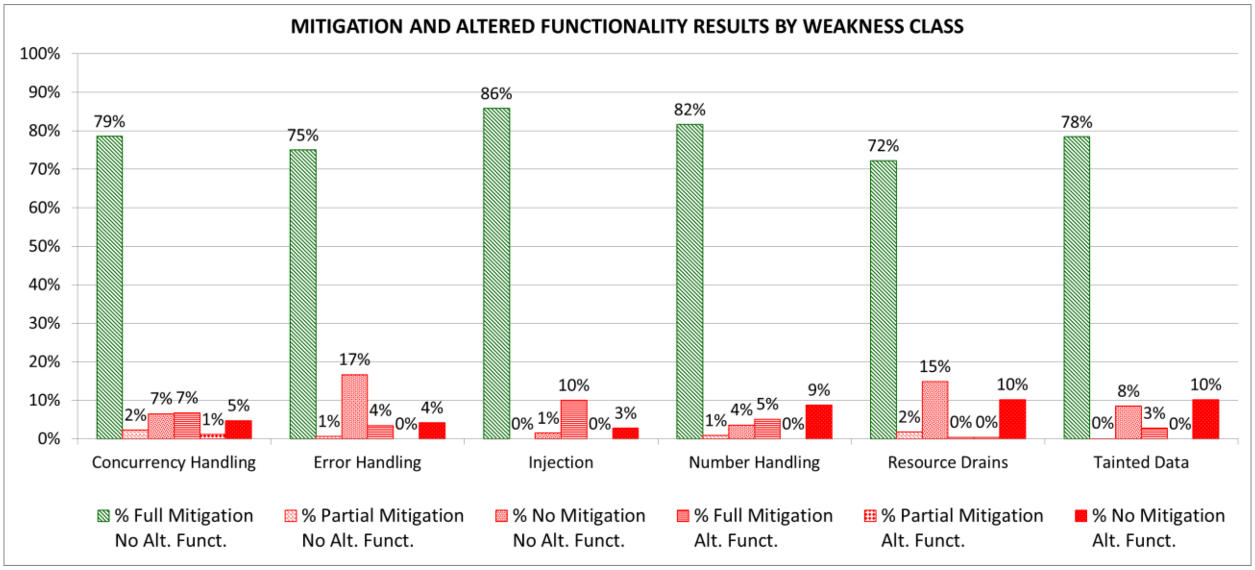

Figure 8-23. VIBRANCE Mitigation and Altered Functionality Results (Percentage by Weakness Class)

Table 8-65. VIBRANCE Mitigation and Altered Functionality Results ((by Weakness Class and CWE)

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling	**442**	**386**	**87%**	**377**	**85%**	**347**	**79%**
363A	32	24	75%	27	84%	24	75%
367A	31	27	87%	25	81%	24	77%
412A	32	27	84%	21	66%	21	66%
414A	29	25	86%	24	83%	21	72%
543A	28	23	82%	17	61%	17	61%
567A	28	24	86%	27	96%	24	86%
572A	32	29	91%	30	94%	27	84%
609A	28	26	93%	21	75%	20	71%
663A	23	20	87%	18	78%	17	74%
764A	32	28	88%	31	97%	28	88%
765A	30	29	97%	29	97%	28	93%
820A	28	24	86%	21	75%	18	64%
821A	30	26	87%	28	93%	25	83%
832A	28	27	96%	27	96%	26	93%
833A	31	27	87%	31	100%	27	87%
Error Handling	**455**	**420**	**92%**	**357**	**78%**	**341**	**75%**
209A	53	50	94%	34	64%	34	64%
248A	36	36	100%	25	69%	25	69%
252A	53	48	91%	53	100%	48	91%
252B	55	50	91%	55	100%	50	91%
253A	54	49	91%	36	67%	36	67%
390A	54	48	89%	35	65%	35	65%
391A	54	49	91%	54	100%	49	91%
460A	43	43	100%	29	67%	29	67%
584A	53	47	89%	36	68%	35	66%
Injection	**470**	**410**	**87%**	**450**	**96%**	**403**	**86%**

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
078A	59	51	86%	49	83%	48	81%
088A	60	54	90%	50	83%	50	83%
089A	59	52	88%	59	100%	52	88%
089B	58	49	84%	58	100%	49	84%
089C	60	52	87%	60	100%	52	87%
089D	58	52	90%	58	100%	52	90%
564A	59	52	88%	59	100%	52	88%
564B	57	48	84%	57	100%	48	84%
Number Handling	**467**	**402**	**86%**	**405**	**87%**	**381**	**82%**
190A	50	35	70%	39	78%	32	64%
190B	53	43	81%	40	75%	40	75%
191A	52	45	87%	44	85%	44	85%
194A	53	45	85%	42	79%	42	79%
195A	53	49	92%	45	85%	44	83%
196A	47	42	89%	37	79%	37	79%
197A	52	46	88%	52	100%	46	88%
369A	54	50	93%	53	98%	49	91%
839A	53	47	89%	53	100%	47	89%
Resource Drains	**450**	**400**	**89%**	**327**	**73%**	**325**	**72%**
400A	53	47	89%	33	62%	33	62%
400B	53	45	85%	26	49%	26	49%
459A	54	49	91%	36	67%	36	67%
674A	44	37	84%	35	80%	34	77%
774A	49	41	84%	38	78%	37	76%
774B	39	38	97%	38	97%	38	97%
789A	52	52	100%	52	100%	52	100%
834A	53	47	89%	37	70%	37	70%
835A	53	44	83%	32	60%	32	60%
Tainted Data	**471**	**410**	**87%**	**382**	**81%**	**369**	**78%**
023A	79	67	85%	62	78%	60	76%
023B	79	68	86%	65	82%	64	81%
036A	79	67	85%	62	78%	61	77%
041A	77	68	88%	66	86%	65	84%
606A	78	69	88%	49	63%	49	63%
606B	79	71	90%	78	99%	70	89%
Grand Total	**2755**	**2428**	**88.1%**	**2298**	**83.4%**	**2166**	**78.6%**

8.3.3.3 VIBRANCE Results by Taint Source

Table 8-66 shows the results by Taint Source, with VIBRANCE performing best on FILE_CONTENTS (80% passing) and worst on the SOCKET Taint source at 77.75% passing.

Table 8-66. VIBRANCE Results by Taint Source

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
ENVIRONMENT_VARIABLE	816	640	78.43%
FILE_CONTENTS	811	649	80.02%
SOCKET	1128	877	77.75%
Grand Total	**2755**	**2166**	**78.62%**

8.3.3.4 VIBRANCE Results by Data Type Complexity

Table 8-67 shows the results by Data Type Complexity with VIBRANCE performing best on VOID_POINTER (79.17% passing) and worst on the SIMPLE with 77.96% passing. Overall there was not much variation across the various Data Type Complexity types.

Table 8-67. VIBRANCE Results by Data Type Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
ARRAY	917	722	78.74%
SIMPLE	921	718	77.96%
VOID_POINTER	917	726	79.17%
Grand Total	**2755**	**2166**	**78.62%**

8.3.3.5 VIBRANCE Results by Data Flow Complexity

Table 8-68 shows the results by Data Flow Complexity with VIBRANCE performing best on JAVA_GENERICS (79.96% passing) and worst on the BASIC with 77.7%passing. Overall there was not much variation across the various Data Flow Complexity types.

Table 8-68. VIBRANCE Results by Data Flow Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
ADDRESS_AS_CONSTANT	456	361	79.17%
ADDRESS_AS_FUNCTION_RETURN_VALUE	464	363	78.23%
BASIC	453	352	77.70%
INDEX_ALIAS_1	468	369	78.85%
JAVA_GENERICS	459	367	79.96%
VAR_ARG_LIST	455	354	77.80%
Grand Total	**2755**	**2166**	**78.62%**

8.3.3.6 VIBRANCE Results by Control Flow Complexity

Table 8-69 shows the results by Control Flow Complexity with VIBRANCE performing best on INTERCLASS_2 (96.92% passing) and worst on the three complexities INTERCLASS_1, INTERPROCEDURAL_2 and INTERPROCEDURAL_50 each with 74.19% passing.

Table 8-69. VIBRANCE Results by Control Flow Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
BREAK_WITH_LABEL	248	196	79.03%
CALLBACK	252	195	77.38%
FUNCTION_INVOCATION_OVERLOAD	249	197	79.12%
INDIRECTLY_RECURSIVE	250	198	79.20%
INFINITE_LOOP	254	200	78.74%
INTERCLASS_1	62	46	74.19%
INTERCLASS_2	65	63	96.92%
INTERCLASS_50	64	48	75.00%
INTERPROCEDURAL_1	63	50	79.37%
INTERPROCEDURAL_10	63	55	87.30%
INTERPROCEDURAL_2	62	46	74.19%

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
INTERPROCEDURAL_50	62	46	74.19%
INTERRUPT	247	195	78.95%
INTERRUPT_CONTINUE	250	194	77.60%
RECURSIVE	251	192	76.49%
SEQUENCE	249	196	78.71%
Grand Total	**2755**	**2166**	**78.62%**

8.3.3.7 VIBRANCE Results by File Size

Table 8-70 shows the results by File Size with VIBRANCE performing best on the smallest file size. However, with the exception of LENY (297,491 lines of code) the performance was good for file sizes up to 440K lines of code, and then the passing rate dropped to 63.8% for the largest file of 537K lines of code.

Table 8-70. VIBRANCE Results by File Size

File Size	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
292,493	476	473	99.37%
297,491	459	439	95.64%
358,003	420	55	13.10%
377,160	462	445	96.32%
440,299	468	454	97.01%
537,199	470	300	63.83%
Grand Total	**2755**	**2166**	**78.62%**

8.3.3.8 VIBRANCE Performance Overhead

The overall average increase in processing time from stage 1 to stage 2 for VIBRANCE was 11%. **Table 8-71** shows the overhead increases by base program.

Table 8-71. VIBRANCE Performance Overhead by Base Program

Base Program	% Delta Internal
CMUD	-15.0%
ELAS	52.6%
JENA	7.0%
LENY	14.2%
LUCE	156.3%
POIX	28.6%
Grand Total	**11.0%**

8.3.4 Results and Analysis of Phase 2-Sized Programs

Results for the Phase 2-sized evaluation JMeter have been compiled and analyzed by the test and evaluation team. This section presents these results along with the analysis.

For the Phase 3 programs VIBRANCE passed 78.6% of the 2,755test cases. For JMeter that number was worse with 23.4% of 154 test cases passing (see **Figure 8-24**).

Totals

		Altered? No	Altered? Yes	Total
Mitigation?	Full	**36**	70	106
	Partial	1	2	3
	None	15	30	45
	Total	52	102	154

Percentages

		Altered? No	Altered? Yes	Total
Mitigation?	Full	**23.4%**	45.5%	68.8%
	Partial	0.6%	1.3%	1.9%
	None	9.7%	19.5%	29.2%
	Total	34%	66%	100%

Figure 8-24. VIBRANCE JMeter Mitigation and Altered Functionality Results

The excel workbook for this section is: "T&E Kestrel Results 20141202 JMet Analysis ResultsA.xlsx" Appendix K.2 presents additional tables and charts detailing the Kestrel Phase 3 results.

Overall JMeter on VIBRANCE passed 23.4% of all the valid test cases.

The following sections present evaluations of the results based on: Base Programs; Weakness Class; Taint Source; Data Type Complexity, Data Flow Complexity, Control Flow Complexity and File Size.

8.3.4.1 VIBRANCE JMeter Results

Kestrel passed 36 out of 154 test cases for a passing rate of 23.4% +6.0/-5.1% at a 0.90 confidence level. **Figure 8-25**, **Table 8-72** and **Table 8-73** show the mitigation and altered functionality results for the JMeter base program.

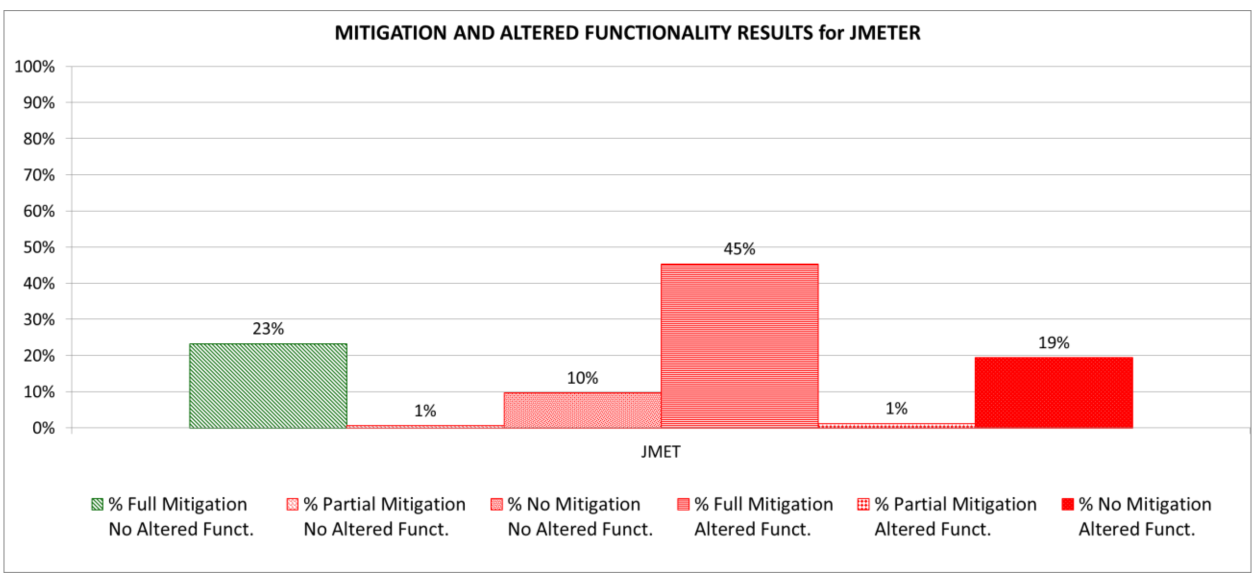

Figure 8-25. VIBRANCE JMeter Mitigation and Altered Functionality Results

Table 8-72. VIBRANCE JMeter Mitigation and Altered Functionality Results

Base Program	Total Test Cases	Full Mitigation No Altered Function	Partial Mitigation No Altered Function	No Mitigation No Altered Function	Full Mitigation Altered Function	Partial Mitigation Altered Function	No Mitigation Altered Function
JMET	154	36	1	15	70	2	30
Grand Total	**154**	**36**	**1**	**15**	**70**	**2**	**30**

Table 8-73. VIBRANCE JMeter Mitigation and Altered Functionality Results (Percentage)

Base Program	% Full Mitigation No Altered Function	% Partial Mitigation No Altered Function	% No Mitigation No Altered Function	% Full Mitigation Altered Function	% Partial Mitigation Altered Function	% No Mitigation Altered Function
JMET	23%	1%	10%	45%	1%	19%
Grand Total	**23%**	**1%**	**10%**	**45%**	**1%**	**19%**

8.3.4.2 VIBRANCE JMeter Results by Weakness Classes and Target Weaknesses

Figure 8-26 and **Table 8-74** show the results by each of the weakness classes. The table also shows the results for individual CWEs. For JMeter, VIBRANCE performed about best for the Tainted Data (50% passing rate) weakness class. Number Handling, (33% passed) weaknesses faired second best while Injection (25%), Concurrency Handling (20% passing rate) and Resource Drains (17%) and Error Handling (13%) fared the worst.

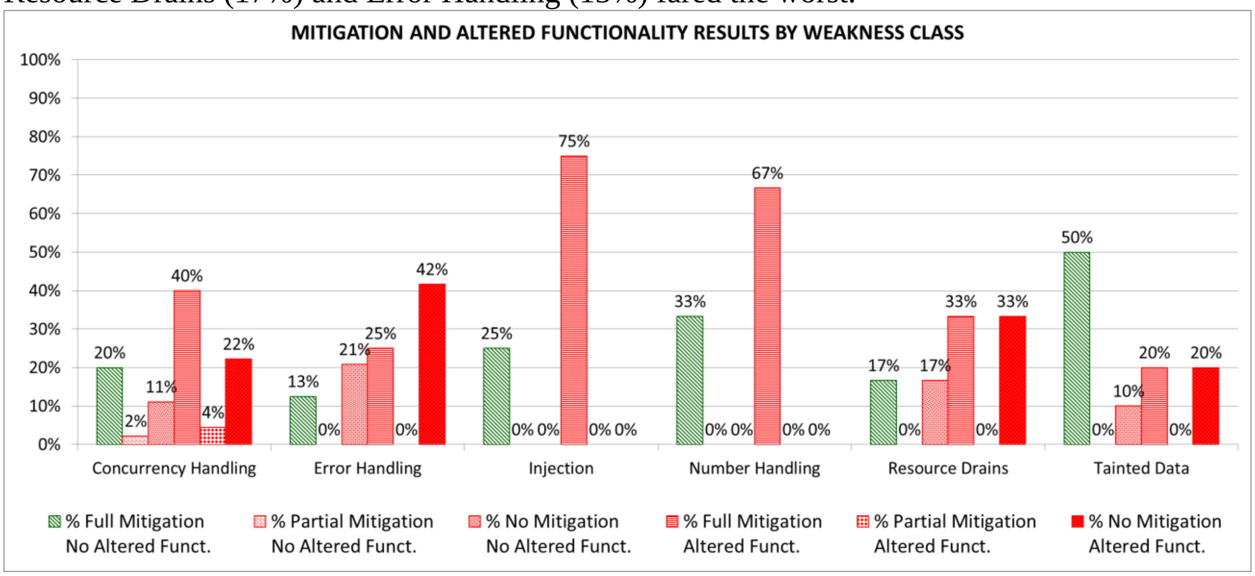

Figure 8-26. VIBRANCE JMeter Mitigation and Altered Functionality Results (Percentage by Weakness Class)

Table 8-74. VIBRANCE JMeter Mitigation and Altered Functionality Results (by Weakness Class and CWE)

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling	**45**	**15**	**33%**	**27**	**60%**	**9**	**20%**
363A	3	1	33%	3	100%	1	33%
367A	3	1	33%	3	100%	1	33%
412A	3	1	33%	0	0%	0	0%
414A	3	1	33%	0	0%	0	0%
543A	3	1	33%	0	0%	0	0%
609A	3	1	33%	0	0%	0	0%
663A	3	1	33%	0	0%	0	0%
764A	3	1	33%	3	100%	1	33%
765A	3	1	33%	3	100%	1	33%
820A	3	1	33%	0	0%	0	0%
821A	3	1	33%	3	100%	1	33%
833A	3	1	33%	3	100%	1	33%
567A	3	1	33%	3	100%	1	33%
572A	3	1	33%	3	100%	1	33%
832A	3	1	33%	3	100%	1	33%
Error Handling	**24**	**8**	**33%**	**9**	**38%**	**3**	**13%**
209A	3	1	33%	0	0%	0	0%
252A	3	1	33%	3	100%	1	33%
252B	3	1	33%	3	100%	1	33%
253A	3	1	33%	0	0%	0	0%
390A	3	1	33%	0	0%	0	0%
391A	3	1	33%	3	100%	1	33%
460A	3	1	33%	0	0%	0	0%
584A	3	1	33%	0	0%	0	0%
Injection	**24**	**6**	**25%**	**24**	**100%**	**6**	**25%**
078A	3	1	33%	3	100%	1	33%
088A	3	1	33%	3	100%	1	33%
089A	3	1	33%	3	100%	1	33%
089B	3	1	33%	3	100%	1	33%
089C	3	1	33%	3	100%	1	33%
089D	3	1	33%	3	100%	1	33%
564A	3	0	0%	3	100%	0	0%
564B	3	0	0%	3	100%	0	0%
Number Handling	**27**	**9**	**33%**	**27**	**100%**	**9**	**33%**
190A	3	1	33%	3	100%	1	33%
191A	3	1	33%	3	100%	1	33%
194A	3	1	33%	3	100%	1	33%
195A	3	1	33%	3	100%	1	33%
196A	3	1	33%	3	100%	1	33%
197A	3	1	33%	3	100%	1	33%
369A	3	1	33%	3	100%	1	33%
839A	3	1	33%	3	100%	1	33%
190B	3	1	33%	3	100%	1	33%
Resource Drains	**24**	**8**	**33%**	**12**	**50%**	**4**	**17%**
400A	3	1	33%	0	0%	0	0%

Weakness Class/CWE	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
400B	3	1	33%	0	0%	0	0%
459A	3	1	33%	3	100%	1	33%
774A	3	1	33%	3	100%	1	33%
789A	3	1	33%	3	100%	1	33%
834A	3	1	33%	0	0%	0	0%
835A	3	1	33%	0	0%	0	0%
774B	3	1	33%	3	100%	1	33%
Tainted Data	**10**	**6**	**60%**	**7**	**70%**	**5**	**50%**
023A	1	1	100%	1	100%	1	100%
023B	1	1	100%	1	100%	1	100%
036A	1	1	100%	1	100%	1	100%
041A	1	1	100%	1	100%	1	100%
606A	3	1	33%	0	0%	0	0%
606B	3	1	33%	3	100%	1	33%
Grand Total	**154**	**52**	**33.8%**	**106**	**68.8%**	**36**	**23.4%**

8.3.4.3 VIBRANCE JMeter Results by Taint Source

Table 8-75 shows the results by Taint Source, with JMeter on VIBRANCE performing best on SOCKET (66.67% passing) and failing all ENVIRONMENT_VARIABLE and FILE_CONTENTS taint sources.

Table 8-75. VIBRANCE JMeter Results by Taint Source

Taint Source	Valid TC	Passed (Full Mitigation Preserved **Function)**	% Pass
ENVIRONMENT_VARIABLE	50	0	0.00%
FILE_CONTENTS	50	0	0.00%
SOCKET	54	36	66.67%
Grand Total	**154**	**36**	**23.38%**

8.3.4.4 VIBRANCE JMeter Results by Data Type Complexity

For the JMeter tests there were no variations in Data Type Complexity (**Table 8-76**).

Table 8-76. VIBRANCE JMeter Results by Data Type Complexity

Data Type Complexity	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
SIMPLE	154	36	23.38%
Grand Total	**154**	**36**	**23.38%**

8.3.4.5 VIBRANCE JMeter Results by Data Flow Complexity

For the JMeter tests there were no variations in Data Flow Complexity (**Table 8-77**).

Table 8-77. JMeter VIBRANCE JMeter Results by Data Flow Complexity

Data Flow Complexity	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
BASIC	154	36	23.38%
Grand Total	**154**	**36**	**23.38%**

8.3.4.6 VIBRANCE JMeter Results by Control Flow Complexity

For the JMeter tests there were no variations in Control Flow Complexity (**Table 8-78**).

Table 8-78. VIBRANCE JMeter Results by Control Flow Complexity

Control Flow Complexity	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
SEQUENCE	154	36	23.38%
Grand Total	**154**	**36**	**23.38%**

8.3.4.7 VIBRANCE JMeter Results by File Size

For the JMeter tests there were no variations in File Size (**Table 8-79**).

Table 8-79. VIBRANCE JMeter Results by File Size

File Size	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
377,160	154	36	23.38%
Grand Total	**154**	**36**	**23.38%**

8.3.4.8 VIBRANCE JMeter Performance Overhead

The overall average increase in processing time from stage 1 to stage 2 for GREP on PEASOUP was 44.6%. **Table 8-80** shows the overhead for JMeter

Table 8-80. VIBRANCE JMeter Performance Overhead by Base Program

Base Program	% Increase
JMET	44.6%
Grand Total	**44.6%**

8.3.5 Results and Analysis of Phase 1-Sized Programs

Results for the Phase 1-sized evaluation JTREE have been compiled and analyzed by the test and evaluation team. This section presents these results along with the analysis.

For the Phase 3 programs VIBRANCE passed 78.6% of the 2,755test cases. For JMeter that number was improved with 99.4% of 160 test cases passing (see **Figure 8-27**).

Totals

		Altered? No	Altered? Yes	Total
Mitigation?	Full	159	-	159
	Partial	-	-	-
	None	1	-	1
	Total	160	-	160

Percentages

		Altered? No	Altered? Yes	Total
Mitigation?	Full	99.4%	0.0%	99.4%
	Partial	0.0%	0.0%	0.0%
	None	0.6%	0.0%	0.6%
	Total	100%	0%	100%

Figure 8-27. VIBRANCE JTREE Mitigation and Altered Functionality Results

The excel workbook for this section is: "T&E Kestrel Results 20141202 JTREE Analysis ResultsA.xlsx" **Appendix K.3** presents additional tables and charts detailing the Kestrel JTREE results.

Overall JTREE on VIBRANCE passed 99.4% of all the valid test cases.

The following sections present evaluations of the results based on: Base Programs; Weakness Class; Taint Source; Data Type Complexity, Data Flow Complexity, Control Flow Complexity and File Size.

8.3.5.1 VIBRANCE JTREE Results

Kestrel passed 159 out of 160 test cases for a passing rate of 99.4% +0.5/-2.1% at a 0.90 confidence level. **Figure 8-28**, **Table 8-81** and **Table 8-82** show the mitigation and altered functionality results for the JMeter base program.

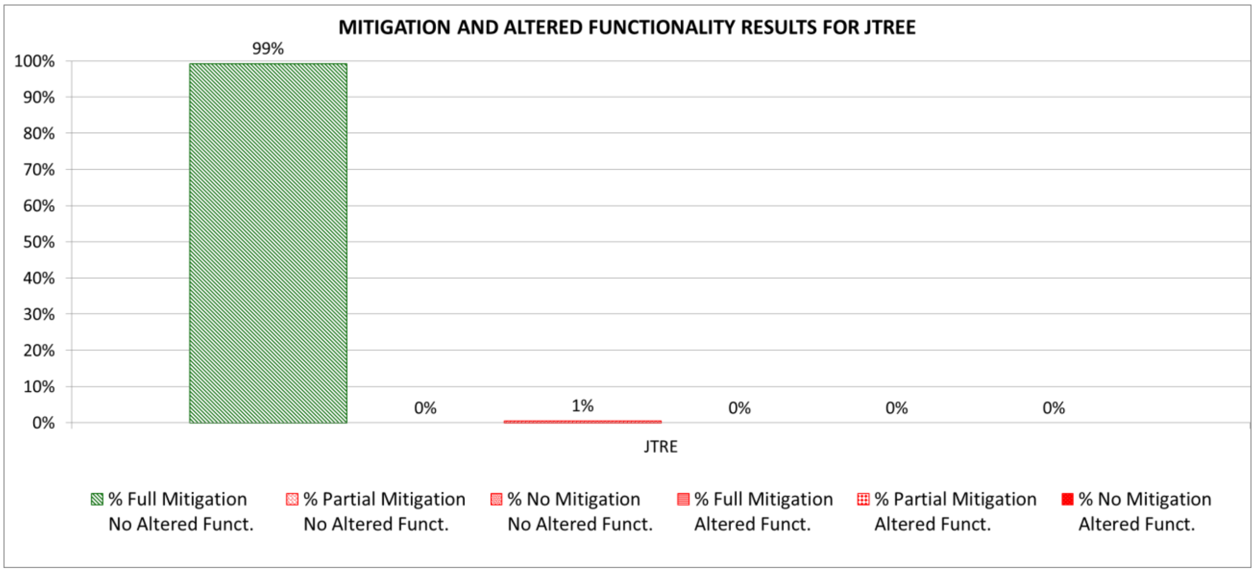

Figure 8-28. VIBRANCE JTREE Mitigation and Altered Functionality Results

Table 8-81. VIBRANCE JTREE Mitigation and Altered Functionality Results

Row Labels	Total Test Cases	Full Mitigation No Altered Function	Partial Mitigation No Altered Function	No Mitigation No Altered Function	Full Mitigation Altered Function	Partial Mitigation Altered Function	No Mitigation Altered Function
JTRE	160	159	0	1	0	0	0
Grand Total	**160**	**159**	**0**	**1**	**0**	**0**	**0**

Table 8-82. VIBRANCE JTREE Mitigation and Altered Functionality Results (Percentage)

Row Labels	% Full Mitigation No Altered Function	% Partial Mitigation No Altered Function	% No Mitigation No Altered Function	% Full Mitigation Altered Function	% Partial Mitigation Altered Function	% No Mitigation Altered Function
JTRE	99%	0%	1%	0%	0%	0%
Grand Total	**99%**	**0%**	**1%**	**0%**	**0%**	**0%**

8.3.5.2 VIBRANCE JTREE Results by Weakness Classes and Target Weaknesses\

Figure 8-29 and **Table 8-83** show the results by each of the weakness classes. The table also shows the results for individual CWEs. For JTREE, VIBRANCE the only weakness class that was under 100% passing rate was Resource Drains at 96%.

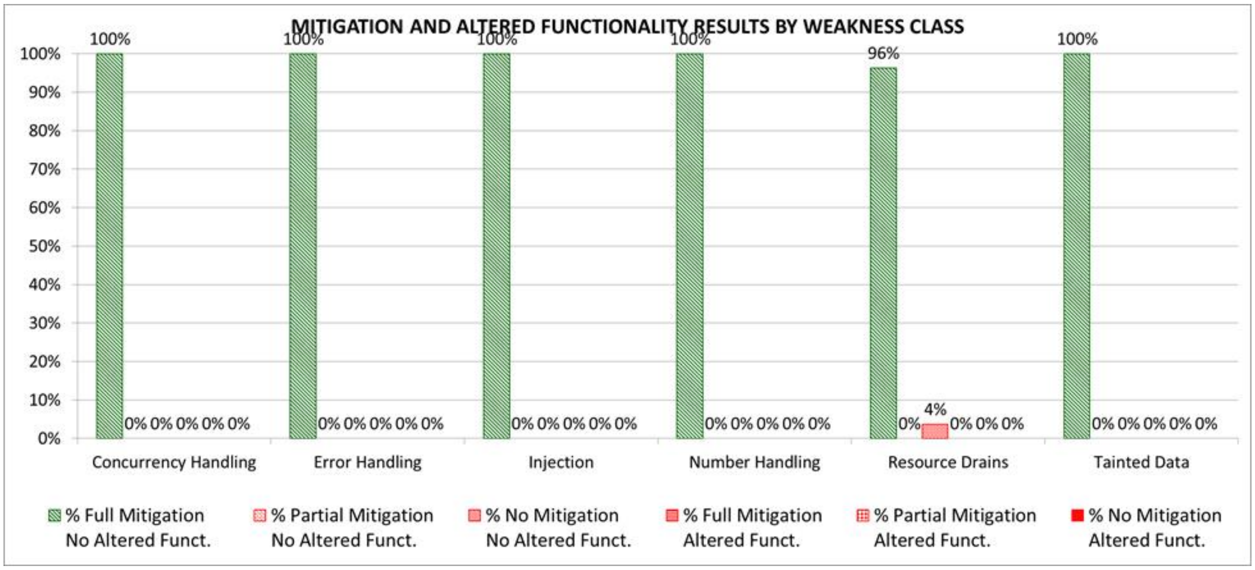

Figure 8-29. VIBRANCE JTREE Mitigation and Altered Functionality Results (percentage by Weakness Class)

Table 8-83. VIBRANCE JTREE Mitigation and Altered Functionality Results (by Weakness Class and CWE)

Row Labels	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling							
363A	3	3	100%	3	100%	3	100%
367A	3	3	100%	3	100%	3	100%
412A	3	3	100%	3	100%	3	100%
414A	3	3	100%	3	100%	3	100%
543A	3	3	100%	3	100%	3	100%
609A	3	3	100%	3	100%	3	100%
663A	3	3	100%	3	100%	3	100%
764A	3	3	100%	3	100%	3	100%
765A	3	3	100%	3	100%	3	100%
820A	3	3	100%	3	100%	3	100%
821A	3	3	100%	3	100%	3	100%
833A	3	3	100%	3	100%	3	100%
567A	3	3	100%	3	100%	3	100%
572A	3	3	100%	3	100%	3	100%
832A	3	3	100%	3	100%	3	100%
Error Handling							
209A	3	3	100%	3	100%	3	100%
248A	3	3	100%	3	100%	3	100%
252A	3	3	100%	3	100%	3	100%
252B	3	3	100%	3	100%	3	100%
253A	3	3	100%	3	100%	3	100%

Row Labels	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
390A	3	3	100%	3	100%	3	100%
391A	3	3	100%	3	100%	3	100%
460A	3	3	100%	3	100%	3	100%
584A	3	3	100%	3	100%	3	100%
Injection							
078A	3	3	100%	3	100%	3	100%
088A	3	3	100%	3	100%	3	100%
089A	3	3	100%	3	100%	3	100%
089B	3	3	100%	3	100%	3	100%
089C	3	3	100%	3	100%	3	100%
089D	3	3	100%	3	100%	3	100%
564A	3	3	100%	3	100%	3	100%
564B	3	3	100%	3	100%	3	100%
Number Handling							
190A	3	3	100%	3	100%	3	100%
191A	3	3	100%	3	100%	3	100%
194A	3	3	100%	3	100%	3	100%
195A	3	3	100%	3	100%	3	100%
196A	3	3	100%	3	100%	3	100%
197A	3	3	100%	3	100%	3	100%
369A	3	3	100%	3	100%	3	100%
839A	3	3	100%	3	100%	3	100%
190B	3	3	100%	3	100%	3	100%
Resource Drains							
400A	3	3	100%	3	100%	3	100%
400B	3	3	100%	2	67%	2	67%
459A	3	3	100%	3	100%	3	100%
674A	3	3	100%	3	100%	3	100%
774A	3	3	100%	3	100%	3	100%
789A	3	3	100%	3	100%	3	100%
834A	3	3	100%	3	100%	3	100%
835A	3	3	100%	3	100%	3	100%
774B	3	3	100%	3	100%	3	100%
Tainted Data							
023A	1	1	100%	1	100%	1	100%
023B	1	1	100%	1	100%	1	100%
036A	1	1	100%	1	100%	1	100%
041A	1	1	100%	1	100%	1	100%
606A	3	3	100%	3	100%	3	100%
606B	3	3	100%	3	100%	3	100%
Grand Total	**160**	**160**	**100.0%**	**159**	**99.4%**	**159**	**99.4%**

8.3.5.3 VIBRANCE JTREE Results by Taint Source

Table 8-84 shows the results by Taint Source, with JTREE on VIBRANCE passing all ENVIRONMENT _VARIABLE and FILE_CONTENT taint sources, and passing 98.2% of the SOCKET taint source test cases.

Table 8-84. VIBRANCE JTREE Results by Taint Source

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
ENVIRONMENT_VARIABLE	52	52	100.00%
FILE_CONTENTS	52	52	100.00%
SOCKET	56	55	98.21%
Grand Total	**160**	**159**	**99.38%**

8.3.5.4 VIBRANCE JTREE Results by Data Type Complexity

For the JTREE tests there were no variations in Data Type Complexity (**Table 8-85**).

Table 8-85. VIBRANCE JTREE Results by Data Type Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
SIMPLE	160	159	99.38%
Grand Total	**160**	**159**	**99.38%**

8.3.5.5 VIBRANCE JTREE Results by Data Flow Complexity

For the JTREE tests there were no variations in Data FLOW Complexity (**Table 8-86**).

Table 8-86. VIBRANCE JTREE Results by Data Flow Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
BASIC	160	159	99.38%
Grand Total	**160**	**159**	**99.38%**

8.3.5.6 VIBRANCE JTREE Results by Control Flow Complexity

For the JTREE tests there were no variations in Control FLOW Complexity (**Table 8-87**).

Table 8-87. VIBRANCE JTREE Results by Control Flow Complexity

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
SEQUENCE	160	159	99.38%
Grand Total	**160**	**159**	**99.38%**

8.3.5.7 VIBRANCE JTREE Results by File Size

For the JTREE tests there were no variations in file size (**Table 8-88**).

Table 8-88. VIBRANCE JTREE Results by File Size

Row Labels	Valid TC	Passed (Full Mitigation Preserved Function)	% Pass
377,160	160	159	99.38%
Grand Total	**160**	**159**	**99.38%**

8.3.5.8 VIBRANCE Performance Overhead

The overall average increase in processing time from stage 1 to stage 2 for GREP on PEASOUP was 230.3%. **Table 8-89** shows the overhead for JMeter

Table 8-89. VIBRANCE JTREE Performance Overhead by Base Program

Base Program	% Increase
JTREE	230.3%
Grand Total	230.3%

8.3.6 Summary

As you can see from **Table 8-90** VIBRANCE passed 78.6% of the 2,755 stage 2 test cases.

Table 8-90. Passing rates by Performer, Corpus and Weakness Classes

Performer	Corpus	Weakness Class	Total Test Cases	Passed	Passing Rate	+	-
Kestrel	Phase 3	ALL	2755	2166	78.6%	1.3%	-1.3%
Kestrel	Phase 3	Concurrency Handling	442	347	78.5%	3.0%	-3.4%
Kestrel	Phase 3	Error Handling	455	341	74.9%	3.2%	-3.5%
Kestrel	Phase 3	Injection	470	403	85.7%	2.4%	-2.9%
Kestrel	Phase 3	Number Handling	467	381	81.6%	2.8%	-3.1%
Kestrel	Phase 3	Resource Drains	450	325	72.2%	3.3%	-3.6%
Kestrel	Phase 3	Tainted Data	471	369	78.3%	3.0%	-3.3%
Kestrel	JMET	ALL	154	36	23.4%	6.0%	-5.1%
Kestrel	JMET	Concurrency Handling	45	9	20.0%	11.4%	-8.0%
Kestrel	JMET	Error Handling	24	3	12.5%	15.0%	-7.4%
Kestrel	JMET	Injection	24	6	25.0%	16.6%	-11.5%
Kestrel	JMET	Number Handling	27	9	33.3%	15.8%	-12.8%
Kestrel	JMET	Resource Drains	24	4	16.7%	15.7%	-9.0%
Kestrel	JMET	Tainted Data	10	5	50.0%	23.1%	-23.1%
Kestrel	JTREE	ALL	160	159	99.4%	0.5%	-2.1%
Kestrel	JTREE	Concurrency Handling	45	45	100.0%	0.0%	-5.7%
Kestrel	JTREE	Error Handling	27	27	100.0%	0.0%	-9.1%
Kestrel	JTREE	Injection	24	24	100.0%	0.0%	-11.7%
Kestrel	JTREE	Number Handling	27	27	100.0%	0.0%	-9.1%
Kestrel	JTREE	Resource Drains	27	26	96.3%	2.9%	-11.3%
Kestrel	JTREE	Tainted Data	10	10	100.0%	0.0%	-21.3%

8.3.6.1 Deployability and Usability of Performer Technology

VIBRANCE from the T&E teams experience was fairly easy to update and deploy. Kestrel supplies a script that is capable of installing it from scratch on a given machine. They do also provide a large number of pre-analyzed summaries that require a large amount of space (~20GB) for analysis to speed up the process but otherwise the technology is easy to install, though configuration seems to be somewhat complex.

Once installed, analyzing and running a program seem to be fairly straightforward and can be achieved through the command line, or in the case of running a program, it is very likely that it would be invisible to the end user since their technology hooks into the Java Virtual Machine.

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9.0 Summary and Observations

PERCENTAGE OF SEEDED VULNERABILITIES RENDERED UNEXPLOITABLE:

The Phase 3 goal for seeded vulnerabilities rendered unexploitable was 90%. None of the performers met that goal overall, however Kestrel surpassed that goal for four out of six of the base programs tested.

Columbia passed 571 out of 2,623 test cases for a passing rate of 21.8% +1.4/-1.3% at a 0.90 confidence level.

GrammaTech passed 818 out of 1,954 test cases for a success rate of 41.9% +/- 1.8% at a 0.90 confidence level.

Kestrel passed 2166 out of 2,755 test cases for a success rate of 78.6% +/- 1.3% at a 0.90 confidence level.

Table 9-1 summarizes the passing rates by performer, corpus and weakness classes. Both summary across all weakness classes and individual weakness classes are presented with totals and passing rate presented. The + and – columns represent the confidence limits for each of the sample proportions and the total test cases. These were calculated using the Wilson Score calculator found on http://epitools.ausvet.com.au, with a confidence level of 0.90.

Results are presented for Phase 3 programs, the Phase 2 sized programs (GREP, JMeter) and the Phase 1 sized programs (CTREE, JTREE).

Table 9-1. Passing rates by Performer, Corpus and Weakness Classes

Performer	Corpus	Weakness Class	Total Test Cases	Passed	Passing Rate	+	-
Columbia	Phase 3	ALL	2623	571	21.8%	1.4%	-1.3%
Columbia	Phase 3	Concurrency Handling	404	18	4.5%	2.0%	-1.4%
Columbia	Phase 3	Injection	471	107	22.7%	3.3%	-3.0%
Columbia	Phase 3	Memory Corruption	442	124	28.1%	3.6%	-3.4%
Columbia	Phase 3	Null Pointer	460	136	29.6%	3.6%	-3.4%
Columbia	Phase 3	Number Handling	432	125	28.9%	3.7%	-3.4%
Columbia	Phase 3	Resource Drains	414	61	14.7%	3.1%	-2.6%
Columbia	GREP	ALL	364	129	35.4%	4.2%	-4.0%
Columbia	GREP	Concurrency Handling	57	11	19.3%	9.9%	-7.1%
Columbia	GREP	Injection	32	10	31.3%	14.5%	-11.6%
Columbia	GREP	Memory Corruption	159	57	35.8%	6.4%	-6.0%
Columbia	GREP	Null Pointer	28	14	50.0%	14.8%	-14.8%
Columbia	GREP	Number Handling	44	21	47.7%	12.2%	-11.9%
Columbia	GREP	Resource Drains	44	16	36.4%	12.4%	-10.8%
Columbia	CTREE	ALL	372	237	63.7%	4.0%	-4.2%
Columbia	CTREE	Concurrency Handling	63	16	25.4%	9.9%	-7.9%
Columbia	CTREE	Injection	32	14	43.8%	14.4%	-13.4%
Columbia	CTREE	Memory Corruption	160	126	78.8%	4.8%	-5.8%
Columbia	CTREE	Null Pointer	28	19	67.9%	12.4%	-15.5%
Columbia	CTREE	Number Handling	47	37	78.7%	8.1%	-11.2%
Columbia	CTREE	Resource Drains	42	25	59.5%	11.5%	-12.7%
GrammaTech	Phase 3	ALL	1954	818	41.9%	1.8%	-1.8%
GrammaTech	Phase 3	Concurrency Handling	230	128	55.7%	5.3%	-5.4%
GrammaTech	Phase 3	Injection	381	244	64.0%	3.9%	-4.1%
GrammaTech	Phase 3	Memory Corruption	331	139	42.0%	4.5%	-4.4%
GrammaTech	Phase 3	Null Pointer	352	165	46.9%	4.4%	-4.3%
GrammaTech	Phase 3	Number Handling	329	118	35.9%	4.4%	-4.2%
GrammaTech	Phase 3	Resource Drains	331	24	7.3%	2.7%	-2.0%
GrammaTech	GREP	ALL	368	100	27.2%	4.0%	-3.6%

Performer	Corpus	Weakness Class	Total Test Cases	Passed	Passing Rate	+	-
GrammaTech	GREP	Concurrency Handling	56	18	32.1%	10.9%	-9.2%
GrammaTech	GREP	Injection	32	15	46.9%	14.2%	-13.7%
GrammaTech	GREP	Memory Corruption	163	43	26.4%	6.0%	-5.3%
GrammaTech	GREP	Null Pointer	28	8	28.6%	15.4%	-11.7%
GrammaTech	GREP	Number Handling	44	13	29.5%	12.2%	-9.9%
GrammaTech	GREP	Resource Drains	45	3	6.7%	8.9%	-4.0%
GrammaTech	CTREE	ALL	372	214	57.5%	4.1%	-4.3%
GrammaTech	CTREE	Concurrency Handling	61	37	60.7%	9.6%	-10.5%
GrammaTech	CTREE	Injection	32	32	100.0%	0.0%	-7.8%
GrammaTech	CTREE	Memory Corruption	162	94	58.0%	6.2%	-6.5%
GrammaTech	CTREE	Null Pointer	28	21	75.0%	10.8%	-15.2%
GrammaTech	CTREE	Number Handling	42	24	57.1%	11.7%	-12.6%
GrammaTech	CTREE	Resource Drains	47	6	12.8%	10.1%	54.7%
Kestrel	Phase 3	ALL	2755	2166	78.6%	1.3%	-1.3%
Kestrel	Phase 3	Concurrency Handling	442	347	78.5%	3.0%	-3.4%
Kestrel	Phase 3	Error Handling	455	341	74.9%	3.2%	-3.5%
Kestrel	Phase 3	Injection	470	403	85.7%	2.4%	-2.9%
Kestrel	Phase 3	Number Handling	467	381	81.6%	2.8%	-3.1%
Kestrel	Phase 3	Resource Drains	450	325	72.2%	3.3%	-3.6%
Kestrel	Phase 3	Tainted Data	471	369	78.3%	3.0%	-3.3%
Kestrel	JMET	ALL	154	36	23.4%	6.0%	-5.1%
Kestrel	JMET	Concurrency Handling	45	9	20.0%	11.4%	-8.0%
Kestrel	JMET	Error Handling	24	3	12.5%	15.0%	-7.4%
Kestrel	JMET	Injection	24	6	25.0%	16.6%	-11.5%
Kestrel	JMET	Number Handling	27	9	33.3%	15.8%	-12.8%
Kestrel	JMET	Resource Drains	24	4	16.7%	15.7%	-9.0%
Kestrel	JMET	Tainted Data	10	5	50.0%	23.1%	-23.1%
Kestrel	JTREE	ALL	160	159	99.4%	0.5%	-2.1%
Kestrel	JTREE	Concurrency Handling	45	45	100.0%	0.0%	-5.7%
Kestrel	JTREE	Error Handling	27	27	100.0%	0.0%	-9.1%
Kestrel	JTREE	Injection	24	24	100.0%	0.0%	-11.7%
Kestrel	JTREE	Number Handling	27	27	100.0%	0.0%	-9.1%
Kestrel	JTREE	Resource Drains	27	26	96.3%	2.9%	-11.3%
Kestrel	JTREE	Tainted Data	10	10	100.0%	0.0%	-21.3%

Figure 9-1 through **Figure 9-4** compare the results of the three performers by normalizing each performer's results to their best result. In this way we can see which variation may have caused problems across performers. The workbook for these comparisons is "Combined Results-ModifiedColumbiaR7.xlsx"

In **Figure 9-1** we see OSSL provided the best results for Columbia and GrammaTech, and FFMP was the most difficult. For Kestrel POIX provided the best results and LENY the worst.

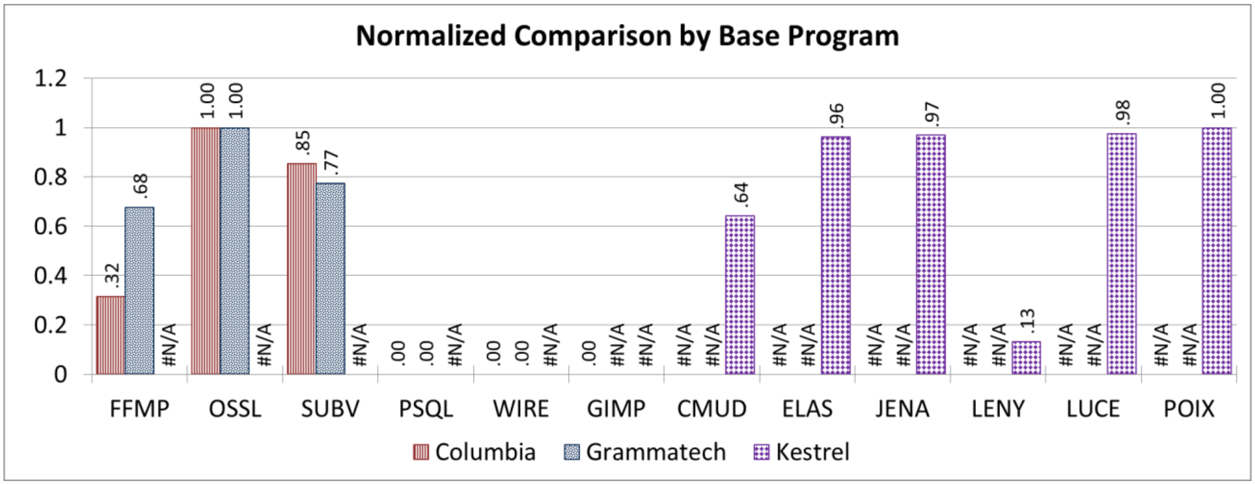

Figure 9-1. Normalized Comparison of Passing Test Cases (by Base Program)

In **Figure 9-2** we see that the Injection weakness class was easiest for GrammaTech and Kestrel, while Columbia found Number Handling easiest. Resource Drains were the most difficult for GrammaTech and Kestrel while Columbia had their most difficulty with the Concurrency Handling weakness class.

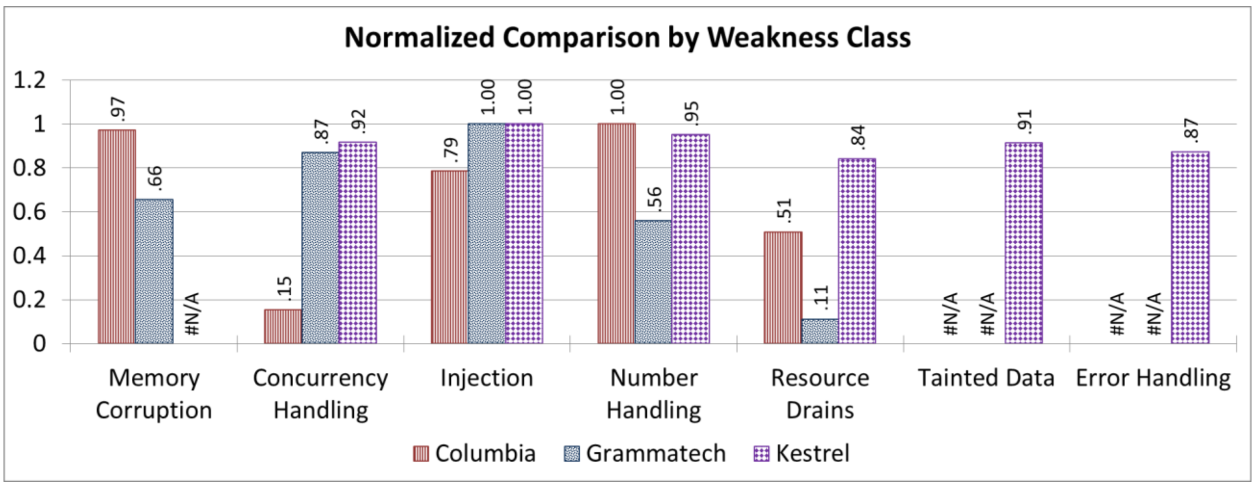

Figure 9-2. Normalized Comparison of Passing Test Cases (by Weakness Class)

In **Figure 9-3** we see that the shared memory taint source was handled easiest by Columbia and GrammaTech, while Kestrel did their best processing the File Contents Taint source. All three performers had their most difficulties processing the Socket taint source test cases.

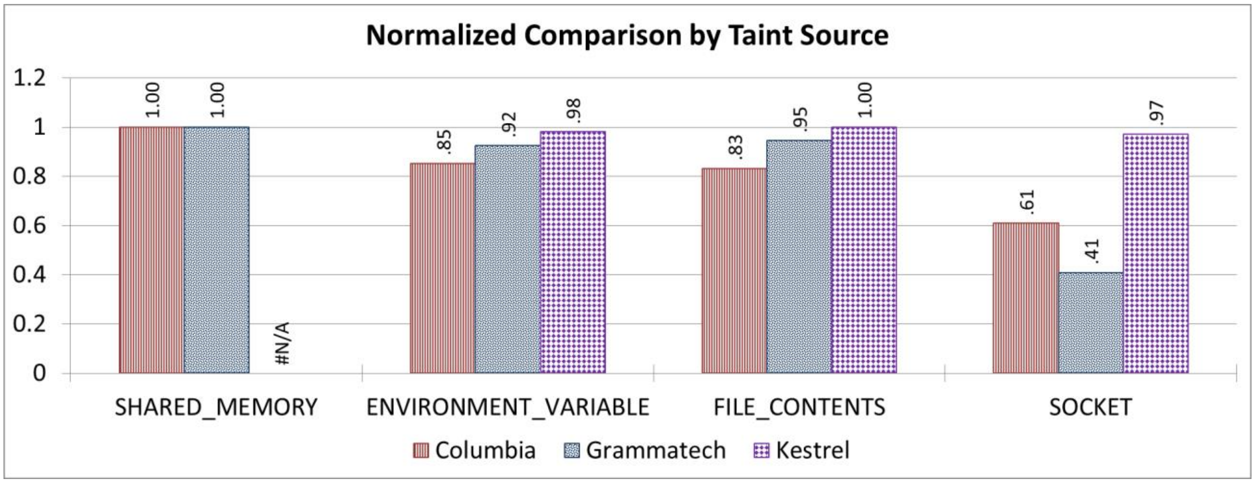

Figure 9-3. Normalized Comparison of Passing Test Cases (by Taint Source)

In **Figure 9-4** we can see the variations across the different data type complexities were minimal for Kestrel. GrammaTech did their best at the TYPEDEF data type complexity while Columbia did their best on the STRUCT complexity.

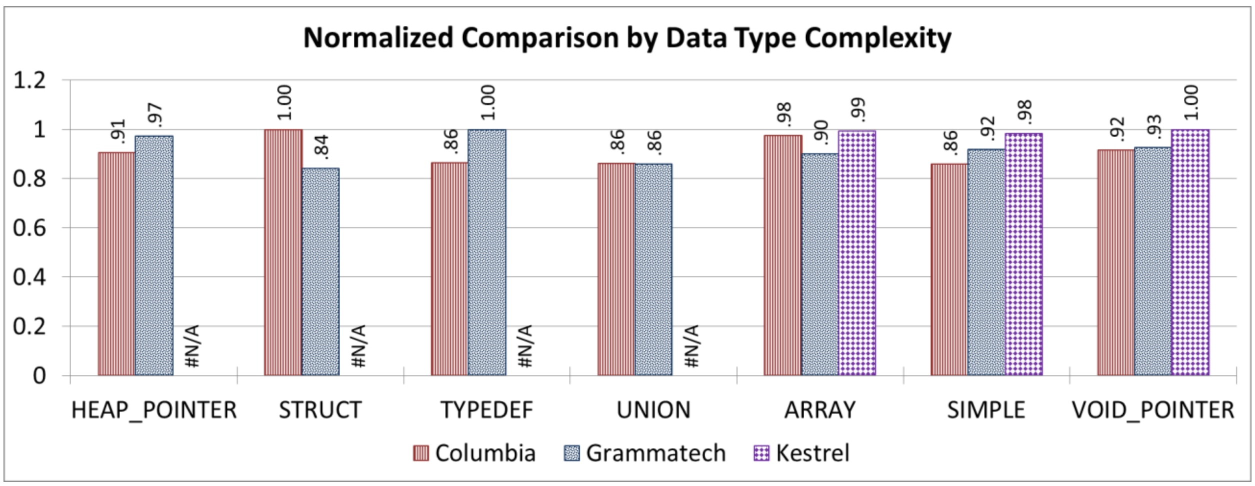

Figure 9-4. Normalized Comparison of Passing Test Cases (by Data Type Complexity)

Figure 9-5 and **Figure 9-6** are presented to compare the performance by file size. In general, the trend of the performance is to worsen as the file size increases, but the subversion results for both Columbia and GrammaTech defy the trend. Not enough variations in file size have been tested to come to conclusive results.

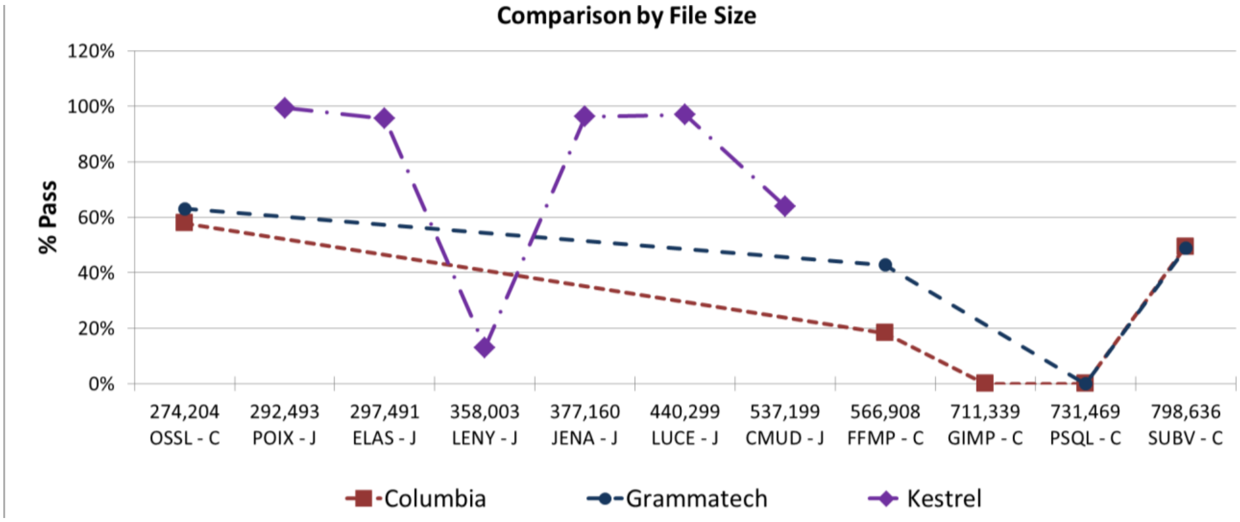

Figure 9-5 Comparison of Percentage of Passing Test Cases (by File Size)

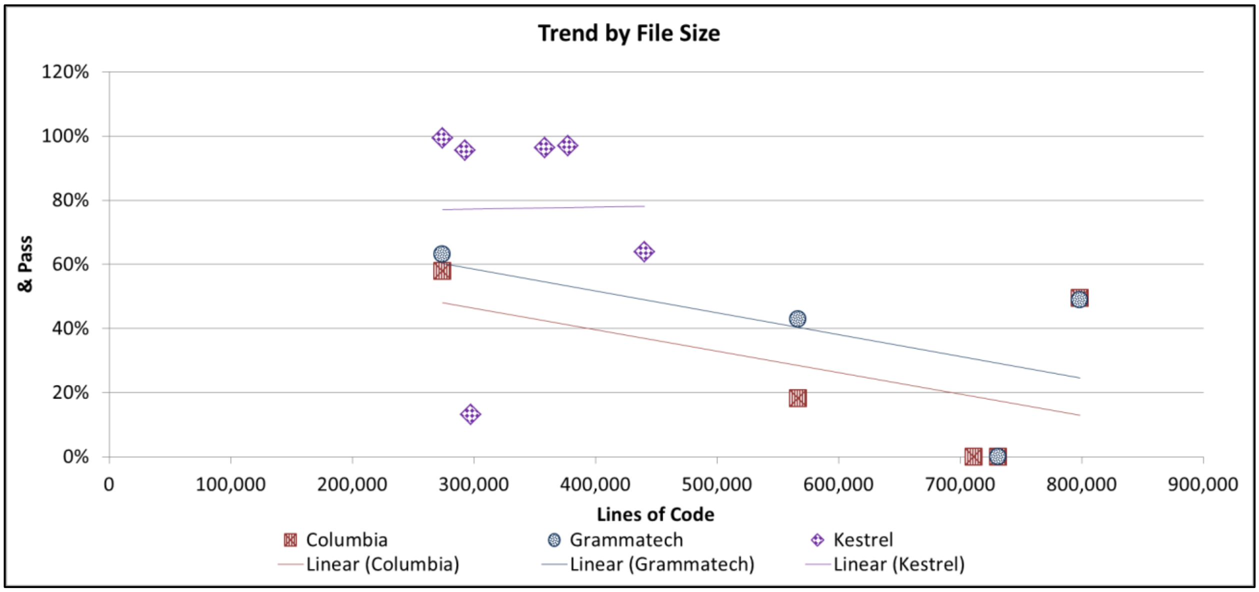

Figure 9-6 Trend of Passing Test Cases (by File Size)

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APPENDIX A—Post Evaluation Test Case Analysis

This appendix details any issues that were raised by performers with test cases during Final T&E.

- Kestrel raised an issue with timing on test cases using CMUD as a base program. The original test case called for a 22 second wait between the port opening and the execution of the script. Because their technology slowed down the initialization significantly it was determined that this was not sufficient time and that a timing issue was not cause enough to fail a test case. Consequently, each of the failing CMUD test cases was modified to have a 40 second wait between the port opening and the execution of the script. These test cases were then rerun.
- Kestrel raised an issue with the timing on Good IO pair 4 of any test case using LENY as the base program. Because it was a timing issue due to the slowdown by their technology it was deemed not reason enough to fail the test. This IO pair's script was modified to fix the timing issue and any of the effected test cases where they had failed LENY were rerun.
- Kestrel raised an issue with the handling of some controlled exits in the LENY base program. Since LENY is not really the server (it runs on a bundled Jetty instance), they argued that displaying an error to the user is a valid mitigation of the vulnerability. While the T&E team does not disagree with that assessment, there was no way to score those test cases as successful without running them by hand which was deemed infeasible. It was agreed that the results for the LENY base program would be caveated with a description of this issue. The T&E team also noted that displaying an error may leak important information so it is not necessarily a complete mitigation.
- Columbia raised an issue with the timing of both GIMP and WIRE base programs and their technology slowing down the program. Most of these issues were resolved before T&E, however, it is still possible that they failed some T&E test cases because of timing issues. It was agreed that GUI program results would be caveated with description of the timing difficulties.
- Columbia raised an issue with the interaction with their rollback technology and the weakness_started LTTng output check in each bad I/O pair's scoring formula. That particular scoring check was added to ensure that the exploit code is actually executed and is not a problem with a single execution of the program. Columbia however, employees a rollback technology that allows them to rollback after an exploit and disable functionality in the program to prevent it from reoccurring. This rollback effectively removes the weakness_started message from being captured leading to a failing score for Columbia. This issue was raised just prior to T&E and sufficient time was not available to address it so it was agreed that Columbia's results would be modified as a post process to essentially ignore the weakness_started LTTng output check if it was marked as false (i.e., make it always true).

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APPENDIX B—Weakness Class Breakdowns

This section provides a listing of the weakness classes used in Phase 3. For more information on Common Weakness Enumerations (CWE) or any of the listed CWEs below; reference the MITRE website[2].

Note: the Weakness Classes below are not affiliated with the MITRE CWE listings, and are a unique classification of weaknesses of the STONESOUP project.

NUMBER HANDLING

- CWE-190: Integer Overflow or Wraparound
- CWE-191: Integer Underflow (Wrap or Wraparound)
- CWE-194: Unexpected Sign Extension
- CWE-195: Signed to Unsigned Conversion Error
- CWE-196: Unsigned to Signed Conversion Error
- CWE-197: Numeric Truncation Error
- CWE-369: Divide By Zero
- CWE-682: Incorrect Calculation
- CWE-785: Use of Path Manipulation Function without Maximum-sized Buffer
- CWE-805: Buffer Access with Incorrect Length Value
- CWE-806: Buffer Access Using Size of Source Buffer
- CWE-839: Numeric Range Comparison Without Minimum Check

TAINTED DATA

- CWE-23: Relative Path Traversal
- CWE-36: Absolute Path Traversal
- CWE-41: Improper Resolution of Path Equivalence
- CWE-606: Unchecked Input for Loop Condition

ERROR HANDLING

- CWE-209: Information Exposure Through an Error Message
- CWE-248: Uncaught Exception
- CWE-252: Unchecked Return Value
- CWE-253: Incorrect Check of Function Return Value
- CWE-390: Detection of Error Condition Without Action
- CWE-391: Unchecked Error Condition
- CWE-460: Improper Cleanup on Thrown Exception
- CWE-584: Return Inside Finally Block

RESOURCE DRAINS

- CWE-400: Uncontrolled Resource Consumption (‘Resource Exhaustion’)
- CWE-401: Failure to Release Memory Before Removing Last Reference (‘Memory Leak’)
- CWE-459: Incomplete Cleanup

[2] Common Weakness Enumeration, A Community-Developed Dictionary of Software weakness types, CWE Lists, http://cwe.mitre.org/

- CWE-674: Uncontrolled Recursion
- CWE-771: Missing Reference to Active Allocated Resource
- CWE-773: Missing Reference to Active File Descriptor or Handle
- CWE-774: Allocation of File Descriptors or Handles Without Limits or Throttling
- CWE-775: Missing Release of File Descriptor or Handle after Effective Lifetime
- CWE-789: Uncontrolled Memory Allocation
- CWE-834: Excessive Iteration
- CWE-835: Infinite Loop

INJECTION

- CWE-78: Improper Neutralization of Special Elements used in an OS Command (‘Injection’)
- CWE-88: Argument Injection or Modification
- CWE-89: Improper Neutralization of Special Elements used in an SQL Command (‘Injection’)
- CWE-564: SQL Injection: Hibernate

CONCURRENCE HANDLING

- CWE-363: Race Condition Enabling Link Following
- CWE-367: Time-of-check Time-of-use (TOCTOU) Race Condition
- CWE-412: Unrestricted Externally Accessible Lock
- CWE-414: Missing Lock Check
- CWE-479: Signal Handler Use of a Non-reentrant Function
- CWE-543: Use of Singleton Pattern Without Synchronization in a Multithreaded Context
- CWE-567: Unsynchronized Access to Shared Data in a Multithreaded Context
- CWE-572: Call to Thread run() instead of start()
- CWE-609: Double-Checked Locking
- CWE-663: Use of a Non-reentrant Function in a Concurrent Context
- CWE-764: Multiple Locks of a Critical Resource
- CWE-765: Multiple Unlocks of a Critical Resource
- CWE-820: Missing Synchronization
- CWE-821: Incorrect Synchronization
- CWE-828: Signal Handler with Functionality that is not Asynchronous-Safe
- CWE-831: Signal Handler Function Associated with Multiple Signals
- CWE-832: Unlock of a Resource that is not Locked
- CWE-833: Deadlock

MEMORY CORRUPTION

- CWE-120: Buffer Copy without Checking Size of Input (‘Classic Buffer Overflow’)
- CWE-124: Buffer Underflow
- CWE-126: Buffer Over-read
- CWE-127: Buffer Under-read
- CWE-129: Improper Validation of Array Index
- CWE-134: Uncontrolled Format String
- CWE-170: Improper Null Termination
- CWE-415: Double Free
- CWE-416: Use After Free

- CWE-590: Free of Invalid Pointer Not on the Heap
- CWE-761: Free of Pointer not at Start of Buffer
- CWE-785: Use of Path Manipulation Function without Maximum-sized Buffer
- CWE-805: Buffer Access with Incorrect Length Value
- CWE-806: Buffer Access Using Size of Source Buffer
- CWE-822: Untrusted Pointer Dereference
- CWE-824: Access of Uninitialized Pointer
- CWE-843: Access of Resource Using Incompatible Type (‘Type Confusion’)

NULL POINTER ERRORS

- CWE-476: NULL Pointer Dereference

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APPENDIX C—Terminology

The terms in **Table C-1** are used throughout the STONESOUP program and the test and evaluation activity. A common understanding of their meaning is necessary in order to follow this document. This is a selective set of terms that deserve special mention related to their use in STONESOUP.

This section summarizes the information from the following document(s), and it is recommended that the reader reference this documentation for more information:

- Test Data Generation Plan (TGP)
- System Design Document (SDD)
- Rules of Engagements (ROEs)

Table C-1. List of Terminology Used

Term	Definition
Administrative Subnetwork	The administrative subnetwork consists of virtual machines that host the TEXAS servers which implement the test manager, orchestrator, broker, scoring, and analysis functions, as well as data and file storage services. These functions and services facilitate the management of test execution, collection, and analysis of test results. **See System Design Document (SDD)**
Amazon Elastic Block Storage (EBS) storage	EBS is a Network-Attached Storage (NAS) system that can be mounted as a file system and accessed from within an EC2 instance as a virtual storage device (e.g., a virtual hard disk drive). EBS will be used for TEXAS data and file storage. See System Design Document (SDD)
Amazon Elastic Compute Cloud (EC2)	Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides scalable compute capacity in the cloud. It is designed to make web-scale computing easier for developers. **See System Design Document (SDD)**
Amazon Machine Instance	An Amazon Machine Image (AMI) provides the information required to launch an instance of a virtual server in the cloud. You specify an AMI when you launch an instance, and you can launch as many instances from the AMI as you need. An AMI includes the following: ▪ Template for root volume instance (e.g., an operating system, application server, and applications) ▪ Launch permissions that control which accounts can use the AMI to launch instances ▪ Block device mapping that specifies volumes to attach to instance when launched **See System Design Document (SDD)**
Amazon Simple Storage Space (S3)	▪ Storage is a software component that provides storage and retrieval of Test Case Metadata, Score Results, Results Archive, and Test Case Archive. ▪ The archive is a snapshot of a set of files or binaries that represent the state of the Performer Technology and other relevant files on the Test Host. Archives can be taken after the Analysis Task or the Execute Task. ▪ A high-capacity SQL database will be used to store test data and test results. It will also store information used by the Test Administrator to control the overall evaluation effort, such as the current processing status of each test case and the aggregate results from all tests. The data storage services will be accessible to the performer subnetworks and the administrative network. By using a single data store, movement of data around the test network will be minimized. ▪ Storage will utilize a mixture of Amazon Simple Storage Space (S3) and Amazon Elastic Block Storage (EBS) storage. S3 is a Web service that provides HTTP-based access to files. Since files stored in S3 are referenced via a Web Uniform Resource Locator (URL), they can be accessed from any node in the

Term	Definition
	test network with access to the Internet. File retrieval in S3 is cheaper than upload and S3 provides high availability guarantees. S3 will be used for storage of critical data that is changed infrequently, such as the test case repository. **See System Design Document (SDD)**
Amazon Web Services (AWS)	Amazon Web Services (AWS) is a preferred method for computing infrastructure. AWS offers information technology infrastructure services in the form of web services - now commonly known as cloud computing. **See System Design Document (SDD)**
Amazon Web Services (AWS) Virtual Private Cloud (VPC), Subnet and Virtual Private Networking (VPN)	A virtual private cloud (VPC) is a virtual network dedicated to the STONESOUP AWS account. It is logically isolated from other virtual networks in the AWS cloud. You launch AWS resources, such as Amazon EC2 instances, into your VPC. When the test team creates VPC for the T&E environment and performer work areas, a set of IP addresses will be specified for the VPCs in the form of a Classless Inter-Domain Routing (CIDR) block (for example, 10.0.0.0/16). This is shown in Figure 8. Currently it is anticipated the IP addresses will be allocated as listed below with VPNs to redirect participants to their work are using a Virtual Private Network address accessible over the Internet. **See System Design Document (SDD)**
Attack Pattern	An attack pattern is a method (also referred to as an exploit technique) used to exploit vulnerable software systems. The Common Attack Pattern Enumeration and Classification (CAPECTM) project (http://capec.mitre.org) provides a formal list of known attack patterns. **See Test Data Generation Plan (TGP)**
AV-1	Overview and Summary - Describes a Project's Visions, Goals, Objectives, Plans, Activities, Events, Conditions, Measures, Effects (Outcomes), and produced objects See System Design Document (SDD)
AV-2	Integrated Dictionary - An architectural data repository with definitions of all terms used throughout the architectural data and presentations **See System Design Document (SDD)**
BAD I/O-pair	The term BAD I/O-pair refers to an I/O-pair with input that is expected to result in an exploit. This input could be malformed data or malicious data that has been crafted to target a known weakness. **See Test Data Generation Plan (TGP)**
Base Programs	A collection of programs in Phase 3 that should approach 500K source lines of code and that are injected with faults for representative tests of the performer technologies. **See System Design Document (SDD)**
Broker	A Test Broker is an automated system that accepts jobs to be performed on the performer test systems and publishes them to the appropriate queue for a performer host system to request from the Test Harness. These jobs are queued based on priorities assigned by the Test Orchestrator. **See System Design Document (SDD)**
CERT	The CERT Division of the Software Engineering Institute (SEI) of Carnegie Mellon University and is a national asset in the field of cybersecurity. The CERT Division has been extremely successful in the development of secure coding standards, which have been adopted at corporate levels **See Test Data Generation Plan (TGP)**
Code Complexity	The term code complexity represents a feature of an application that adds to the application’s overall complexity. For the STONESOUP program, code complexities exist in one of four high-level groups: Source taint, Data Type, Control Flow, and Data Flow. **See Test Data Generation Plan (TGP)**

Term	Definition
Communications Application Programming Interface (API)	The Communications application-programming interface (API) specifies how TEXAS components and the performer technology should interact with each other. The API comes in the form of a library with specifications for routines, data structures, object classes, and variables. In some other cases, notably for Simple Object Access Protocol (SOAP) and Representational State Transfer (REST) services, the API comes as just a specification of remote calls exposed to the API consumers. **See System Design Document (SDD)**
Dashboard	Displays testing progress and monitoring of test cases being processed through the architecture. **See System Design Document (SDD)**
Data/File Storage	To store the data files generated by the performer and base programs that can include database program created files of information, source files and generated executable files, system event data, internal program trace data that can be in the form of text or binary files. **See System Design Document (SDD)**
Exploit	An exploit is an input designed by an adversary to take advantage of a weakness and produce a malicious technical impact. An exploit is an implementation of an attack pattern. **See Test Data Generation Plan (TGP)**
External Dependency	Any external dependencies, or software component or system accessible from a Test Host that is required for the execution of the Performer Technology but is external to the Performer Technology and thus is not part of the Test and Evaluation. **See System Design Document (SDD)**
GOOD I/O-Pair	The term GOOD I/O-pair refers to an I/O-pair with input that does not produce an exploit. This input is usually well formed and expected during typical execution of the test case. The input in GOOD I/O-pairs is sometimes referred to as benign input. **See Test Data Generation Plan (TGP)**
I/O-Pair	The term I/O-pair refers to paired input/output for a test case. The specified output is the output expected from the test case when it is executed with the paired input. **See System Design Document (SDD) and Test Data Generation Plan (TGP)**
JIRA	JIRA is a proprietary issue tracking product, developed by Atlassian, used for bug tracking, issue tracking and project management. The product name, JIRA, is not an acronym but rather a truncation of "Gojira", the Japanese name for Godzilla. **See Test Data Generation Plan (TGP)**
Language Class	A language class is a general type of software programming language. Three distinct language classes have been identified for the STONESOUP program: type-safe, type-unsafe, and binary (i.e., machine code). Each language class contains one or more specific programming software (termed software classes). **See Test Data Generation Plan (TGP)**
Metadata	Metadata or "data about data is used to hold all the information about a test case and how it's to be executed. **See System Design Document (SDD)**
Mitigation	"Full" mitigation means that the performer technology mitigated both I/O Pairs. "Partial" mitigation means the performer technology mitigated one of the two I/O Pairs. "None" means the performer technology mitigated none of the I/O Pairs.
OV-1	High-Level Operational Concept Graphic - High-level graphical/textual description of the operational concept. **See System Design Document (SDD)**
OV-4	Organizational Relationships Chart - Organizational context, role or other relationships among organizations. **See System Design Document (SDD)**

Term	Definition
OV-6c	Event-Trace Description - One of three models used to describe activity (operational activity). It traces actions in a scenario or sequence of events. **See System Design Document (SDD)**
Performer	A performer is an organization that has been awarded funding by IARPA to develop a solution (i.e., a proposed technology) for the STONESOUP program that meets the metrics defined in the Broad Agency Announcement (BAA). The performer may use subcontractors to accomplish some program tasks. **See Test Data Generation Plan (TGP)**
Performer Subnetwork	Each performer will have a dedicated subnetwork (10.0.3.0 VIBRANCE, 10.0.4.0 PEASOUP and 10.0.5.0 MINESTRONE) of virtual machine hosts running the TEXAS client and their performer technology. The subnetwork will also include any external dependencies needed by the performer's technology or for the execution of individual tests, e.g., a SQL database, DNS server, Web server, or Internet Relay Chat (IRC) server. Each host workstation in this subnetwork running a performer's technology will be configured as either an analysis or execution host for that specific performer technology, with memory and computing resources appropriate to that role. **See System Design Document (SDD)**
Performer Technologies	Technologies advanced by the STONESOUP performers to test specific areas of technology. **See System Design Document (SDD)**
Proposed Technology	Each performer is funded by IARPA to develop a solution for the STONESOUP program. The entire solution (which may comprise multiple components) is known as a performer's proposed technology. **See Test Data Generation Plan (TGP)**
Rendered Unexploitable	For the purposes of the STONESOUP program, a vulnerability is rendered unexploitable if the input associated with BAD I/O-pairs no longer results in an undesired (either expected or unexpected) output (an exploit). **See Test Data Generation Plan (TGP)**
Provisioner	Cloud Platform-as-a-Service (PAAS) services enable flexible lease of computing resources on demand with very little lead-time, including workstations and servers with specified memory and processing power. This flexibility is managed by a Provisioner who adds new workstations, servers, or entire subnetworks to the test infrastructure as needed, configuring each new platform from a predefined virtual machine template for the role it will play in the overall architecture. **See System Design Document (SDD)**
Rehearsal of Concept (ROC) Drill	A ROC drill is an exercise where the test and performer teams of STONESOUP work together to discuss and synchronize their roles in the Test and Evaluation event. The ROC drill is intended as an opportunity for the team to step through test execution and understand the sequencing as well as to discuss shared challenges and opportunities ahead. The end result is to clarify roles, expectations and elicit feedback on implementation plans and resources required for the testing. **See System Design Document (SDD)**
ROSE	The ROSE compiler framework of LLNL is an open source compiler infrastructure to generate source-to-source analyzers and translators for multiple source languages including C, C++, and Fortran. ROSE is aimed to enable non-experts to leverage compiler technologies to build their own custom software analyzers and optimizers. ROSE is not an acronym or abbreviation. **See Test Data Generation Plan (TGP)**
Scoring Utility	The Scoring/Analysis Component is an automated system that scores test results and computes statistics across the database of completed tests. The Analysis function continuously updates statistics that show the distribution of different characteristics of the completed tests. These statistics are used by the Test Orchestrator to prioritize test case execution. Although each test case is scored by a

Term	Definition
	default algorithm immediately on test completion, the Scoring function is used to rescore tests based on alternate algorithms or in the presence of filters defined by the Test Administrator based on review of anomalous results - all generated data and snapshot (such as environment information, overrides, filters) are stored in the repository. **See System Design Document (SDD)**
Snippet	A snippet is an informal way in which to refer to the manifestation of the weakness and is used in internal discussions to avoid repeatedly saying the formal name: Weakness Algorithmic Variant. It is a re-usable source code written for insertion into a larger program called a 'base program" to exploit a specific CWE software vulnerability in that base program. **See Test Data Generation Plan (TGP)**
Software Class	A software class is a specific software programming language relevant to the STONESOUP program. Three specific software classes are defined for Phase 3: Java, C, and x86 Linux binaries. The evaluation will be limited to these three software classes. The binary-related software class may contain binaries that have been compiled from source languages other than C. **See Test Data Generation Plan (TGP)**
Stage-one Analysis	Stage 1 of testing is where the test case's source code is compiled without performer technology and the I/O pairs are also executed without performer technology to ensure the validity of the exploit. Stage 1 is designed to provide a baseline for comparison to the performer technologies. **See System Design Document (SDD)**
Stage-two Analysis	Stage 2 of testing is where the test cases are analyzed and modified with the respective performer hardening technologies. Stage 2 runs completely separate from Stage 1 however comparison to the Stage 1 results is required to determine the relative performance and impact of the performer's technology. **See System Design Document (SDD)**
Subnetwork	A smaller segment of network carved out of the network allocation. **See System Design Document (SDD)**
SV-1	Systems Interface Description – Identification of systems, system items, and their interconnections. **See System Design Document (SDD)**
SV-6	Systems Resource Flow Matrix – Details of system resource flow elements being exchanged between systems and the attributes of that exchange. **See System Design Document (SDD)**
Technical Impact	The term technical impact is borrowed from the CWE project. It relates to specific effects of running an application with malicious input. Each of the technical impacts that follow is considered sufficient to deem that the test case displays unacceptable behavior and the weakness as exploitable. There always will be room for discussion about what constitutes a serious exploit of a weakness. **See Test Data Generation Plan (TGP)**
Test Administrator	The Test Administrator is a user/system component member of the T&E team responsible for conducting the testing process according to the test plan, tuning and exercising engineering oversight of the test infrastructure as needed to successfully complete the testing. In practice the Test Administrator will choose one or more test cases to run against a performer and those test cases will be added to the appropriate job queues. System interface needs to be primarily pause and resume with automatic scoring and selection of next set of test cases to be run. Other control may be the size of the queue and number of available virtual machines to speed up or slow down adaption to test case results which the orchestrator attempts to maintain a flat distribution of completed tests across performers, weaknesses and other criteria. The Test Administrator keeps track of Jobs and specifically the jobs in analysis

Term	Definition
	those in execution by tracking how big the queues are against goals and use of external resources. The provision function is adjusted manually via configuration scripts and a graphical user interface. The Test Administrator must configure resources (how many instances, how many CPUs, how long, whether it is a re-run), must assess costs and ensure resources stay within those costs, and must initiate the Test Host so it can start running Test Cases. **See System Design Document (SDD)**
Test Case	A test case is a test program packaged for a specific software class, along with test inputs (including exploits), expected outputs, and information such as configuration metadata guiding appropriate compilation and/or deployment of the software. Some additional information is part of each test case, including a description of the target weaknesses and their technical context, error modes, and the ability to exploit the weaknesses. **See Test Data Generation Plan (TGP)**
Test Suite	The term Test Suite (a.k.a., Test Corpus) refers to a collection of test cases with a shared purpose (e.g., to provide representative coverage of a specific weakness class for a single software class). **See Test Data Generation Plan (TGP)**
Test Creator	User/system component that creates Test Cases and provides them to the T&E Framework. TEXAS uses a process developed during Phases 1 and 2 and carried on into Phase 3. For Phase 3, all methods were evaluated for effectiveness in collecting data and noninterference with the performer technologies. See System Design Document (SDD)
Test Framework	Software component residing on the Test Host with Performer technology to run Test Cases and to publish results. The Test Framework must be available for and compatible with a variety of Linux distributions. **See System Design Document (SDD)**
Test Harness	The software that interacts with other test functions to install and configure a test case, invoke the performer's technology, collect the test results, and send the results data to storage. The Test Harness function is implemented by a software application installed in each performer test host. The Test Harness is responsible for requesting tasks from a Test Broker when it is idle. **See System Design Document (SDD)**
Test Host	Physical or virtual system that contains the Linux distribution, modified with the requisite test framework components and the performer technology. To accommodate the three performers, Test Hosts are modified to meet their specific operating system requirements, technology and supporting artifacts. **See System Design Document (SDD)**
Test Host Template	A snapshot of a machine instance that has both a Performer Technology and a Test Framework installed that can be quickly provisioned. **See System Design Document (SDD)**
Test Manager	The Test Manager is a software component that allows the Test Administrator to orchestrate the running of Test Cases through a Dashboard that displays testing progress and real-time monitoring of the running test cases. The Test Manager should be able to run one test, run all tests, or run a set of test (where the set is chosen by search criteria). The Test Administrator should also be able to view metadata and Results in the Dashboard. **See System Design Document (SDD)**
Test Orchestrator	The Test Orchestrator is an automated rules engine that extracts Tasks from Jobs provided by the Test Manager according to a standard format (Analyze, Execute, Score). The Orchestrator attempts to maintain a flat distribution of completed tests across performers, weaknesses and other criteria. **See System Design Document (SDD)**

Term	Definition
Tracing	Tracing enables the Scoring Utility to collect accurate data during scoring and determination of where and when faults occur. Tracing instrumentation will be inserted with the Fault injection process during compiler translation. **See System Design Document (SDD)**
TEXAS	Phase 3 testing was performed using TEXAS, a system for test automation written in Python developed by T&E Team. This infrastructure provided a command line interface on each machine to invoke test cases and interact with performer technology. The architecture also supported each test machine operating as a daemon and receiving jobs from a centralized database. While no graphical element was developed, the database and the command line interface were documented in the TEXAS CLI Users Guide and the interaction between TEXAS and performer technology was established via a documented API in the TEXAS Communications API Guide. **See Test Data Generation Plan (TGP)**
Weakness	A weakness is an actual instantiation of a given weakness type within an application. **See Test Data Generation Plan (TGP)**
Weakness Algorithmic Variant	A weakness algorithmic variant is a specific manifestation of a target CWE weakness associated with a specific language. Individual CWEs do not define the ways in which the CWE in question may appear in a particular source code language. In addition, the complexities and nuances in various source code languages may exist in an unbounded set of possible manifestations of an individual CWE. **See Test Data Generation Plan (TGP)**
Weakness Class	The term weakness class refers to a collection of weakness types related to a common higher level category of weaknesses. For STONESOUP, eight weakness classes are defined: number handling, tainted data, error handling, resource drains, injection, concurrency handling, memory corruption, and NULL pointer errors. **See Test Data Generation Plan (TGP)**
Weakness Type	A weakness type is a specific type of software weakness that, if left unaddressed, could result in systems and networks being vulnerable to attack. The Common Weakness Enumeration (CWETM) project (http://cwe.mitre.org) provides a formal list of known software weakness types. **See Test Data Generation Plan (TGP)**

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APPENDIX D — Glossary and/or Acronyms

Table D-1. Glossary and/or Acronyms

Acronym	Acronym Definition
API	Application Programing Interface
BAA	Broad Agency Announcement
CAPECTM	Common Attack Pattern Enumeration and Classification
CMUD	CoffeeMUD
CPU	Central Processing Unit
CVE®	Common Vulnerabilities and Exposures
CWETM	Common Weakness Enumeration
DoS	Denial of Service
ELAS	Elastic Search
ELF	Executable and Linkable Format
FFMP	FFMPEG
FPU	Floating-Point Unit
GCC	GNU Compiler Collection
GIMP	GIMP
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
I/Opair	input/output pair
IARPA	Intelligence Advanced Research Projects Activity
ID	Identification
IDA Pro	Interactive Disassembler
IEEE	Institute of Electrical and Electronics Engineers
IGW	Internet Gateway
IO Pair	Input/Output Pair
IOPS	Input Output Per Second
IP	Internet Protocol
IRC	Internet Relay Chat
IV&V	Independent Verification and Validation
JDT	Java Development Toolkit
JENA	Apache Jena
JIRA	Proprietary issue tracking product, developed by Atlassian
JMET	JMeter
JTREE	Java tree nodes
LENY	Apache Lenya
LLNL	Lawrence Livermore National Laboratory
LTS	Long Term Support
LTTNG	Linux Trace Toolkit Next Generation
LUCE	Apache Lucene
MB	Megabyte
MIT	Massachusetts Institute of Technology
NAS	Network-Attached Storage
NFS	Network File System
NIST	National Institute of Standards and Technology
OS	Operating System
OSSL	OpenSSL (Secure Sockets Layer)
PAAS	Cloud Platform-as-a-Service
POI	Project run by the Apache Software Foundation for software originally with acronym for "Poor Obfuscation Implementation”
POIX	Apache POI
PSQL	PostgreSQL, often simply "Postgres", is an object-relational database management

	system
RAID	Redundant Array Of Inexpensive Disks; now commonly referred to as Redundant Array Of Independent Disks
RAM	Random Access Memory
RDC	Windows Remote Desktop Connection for Windows 7 and above
RDP	Remote Desktop Protocol
RDS	Amazon Relational Database Service
REST	Representational State Transfer (
ROC	Rehearsal of Concept
ROE	Rules of Engagement
SAMATE	Software Assurance Metrics and Tool Evaluation
SDD	System Design Document
SEI	Software Engineering Institute of Carnegie Mellon University
SFTP	Secure File Transfer Protocol
SLOC	Source Lines of Code
SOAP	Simple Object Access Protocol
SQL	Server Query Language
SSD	Solid State Drive
SSH	Secure Shell
STONESOUP	Securely Taking On New Executable Software of Uncertain Provenance
SUBV	Subversion
i_SW	Information Systems Worldwide
T&E	Test and Evaluation
TB	1,000,000,000,000 bytes = 10^{12}bytes = 1000 gigabytes
TC	Test Case
TCGF	Test Case Generation Framework
TDG	Test Data Generation
TEXAS	Test and Evaluation eXecution and Analysis System
TGP	Test Data Generation Plan
TOCTOU	Time-of-Check and Time-of-Use
TTY	Teleprinter or Teletype
URL	Web Uniform Resource Locator
VM	Cloud Virtual Machine
VPC	Virtual Private Cloud
VPN	Virtual Private Network
WIRE	Wireshark
XML	Extensible Markup Language
XSS	Cross-Site Scripting
YAML	Recursive acronym for "YAML Ain't Markup Language"—early in its development, YAML was said to mean "Yet Another Markup Language"

APPENDIX E—Eclipse Testing of Snippets

1. Create a Java project called 'stonesoup'

IN ECLIPSE:

a) Select 'File', then 'New', then 'Java Project'.
b) Set 'Project name' to 'stonesoup', then click on 'Finish'. 'stonesoup' should now appear in the Package Explorer view.

2. Import a Java snippet into the new project

IN THE PACKAGE EXPLORER:

1. Double-click on the 'stonesoup' project. You should see a directory labelled 'src'.

IN THE GIT REPOSITORIES VIEW:

1. Open 'java-snippets', then 'Working Directory', then 'src', 'com', 'pontetec', 'weakness', and finally (by way of example) 'numberhandling'. You should see a set of .java and .yaml files.
2. Double-click on 'CWE190A.java'. The file should open up in an editor. Select 'File', then 'Save As...'.
3. Navigate to:
   (WIndows) C:\Users\<your account>\workspace\stonesoup\src
   (Linux) /home/ssadmin/workspace/stonesoup/src
   then click on 'Save'.

IN THE PACKAGE EXPLORER:

1. You should see that the 'src' directory now has contents and can be opened.
2. Open 'src' and you should see a package named '(default package)'.

IN THE EDITOR:

1. You should see that the package name 'com.pontetec.weakness.numberhandling' is now flagged as an error.
2. Click on the package name.
3. Select the "quick fix" to move 'CWE190A.java' to package 'com.pontetec.weakness.numberhandling'.

IN THE PACKAGE EXPLORER:

1. You should see that '(default package)' has now been replaced by 'com.pontetec.weakness.numberhandling'.
2. Open 'com.pontetec.weakness.numberhandling' and you should see the file 'CWE190A.java' is now in its proper place in the project.

3. Import additional Java snippets into the new project

IN THE GIT REPOSITORIES VIEW:

1. Open 'java-snippets', then 'Working Directory', then 'src', 'com', 'pontetec', 'weakness', and finally (by way of example) 'numberhandling'. You should see a set of .java and .yaml files.
2. Open another .java file, then select 'File', and 'Save As...'.
3. Navigate to:
   (WIndows) C:\Users\<your account>\workspace\stonesoup\src
   (Linux) /home/ssadmin/workspace/stonesoup/src

then click on 'Save'.
In the Package Explorer:

1. you should see that the new file has been added to the 'com.pontetec.weakness.numberhandling' package.
2. Repeat for additional snippets.

4. Import required Java libraries

IN THE PACKAGE EXPLORER:

1. Right-click on the 'stonesoup' project, select 'New', then 'Folder'.
2. Enter 'lib' for the folder name, then click on 'Finish'.

IN WINDOWS/LINUX:

1. Open the folder:
   (WIndows) C:\Users\<your account>\git\java-snippets\lib
   (Linux) /home/ssadmin/git/java-snippets/lib
2. Select all of the files and drag them into Eclipse, dropping them on the 'lib' folder you just created. A dialog box will appear.
3. Select 'Copy files and folders', then click on 'OK'.

IN THE PACKAGE EXPLORER:

1. Open the 'lib' directory to verify that the files were successfully copied.
2. Right-click on the 'stonesoup' project, select 'Build Path', then 'Configure Build Path...'.
3. Select the 'Libraries' tab.
4. Click on 'Add JARs', open 'stonesoup', open 'lib', select all of the .jar's, then click on 'OK'.
5. The Java Build Path should now list all of these .jar's in addition to the 'JRE System Library'.
6. Click 'OK' to close the dialog.

5. Set up the test databases

Some testing will require access to a database. On the Linux VM both MySQL and Postgres are already installed, but the test database tables and values remain to be added.

IN LINUX:

1. Open a terminal window.
2. Run 'cd git/java-snippets/scripts'.
3. Run 'psql -U ss_db_user -d postgres -f northwind_lowercase.postgre.sql'.
4. Run 'mysql --user=ss_db_user --password=stonesoup2014 --port=3306 < northwind.MySQL5.sql'.

6. Create 'launch' configurations for each snippet

Most (all?) snippet code is configured to be run from a command line, but we can still run the code from within Eclipse without having to actually resort to a command line.

We can create 'Launch configurations' that can specify the command line parameters for each snippet/parameter combination, save them, and even export them to share with each other so that we aren't reinventing the wheel on each of our machines.

1. In the Package Explorer right-click on the 'stonesoup' project, select 'New', then 'Folder'.
2. Enter 'launch' for the folder name, then click on 'Finish'.
3. Right-click on the 'launch' folder, select 'New', then 'Folder'.
4. Enter 'java' for the folder name, then click on 'Finish'.
5. Right-click on the 'java' folder, select 'New', then 'Folder'.
6. Enter 'injection' for the folder name, then click on 'Finish'.
7. Right-click on the 'java' folder, select 'New', then 'Folder'.
8. Enter 'numberhandling' for the folder name, then click on 'Finish'.

TO CREATE A LAUNCH CONFIGURATION:

1. From the Eclipse menu, select 'Run', then 'Run Configurations...'.
2. Right-click on 'Java Application', then select 'New'.
3. Set 'Name:' to the name of a .java file followed by (a description of) the argument you will supply. For example: 'CWE190A - B - 200' or 'CWE088A - X - passwd'. (B for benign, X for exploit)
4. Verify that the 'Main class' refers to the same snippet referred to in your label.
5. Click on 'Apply' to save the launch config.
6. Under the '(x) = Arguments' tab, in the 'Program arguments' box, add the command line arguments (such as those included in the corresponding .yaml files).
7. Click on 'Apply'.
8. Under the 'Common' tab, select 'Shared file', click on 'Browse', open 'stonesoup', open 'launch', open 'java', select a weakness class folder, then click on 'OK'.
9. Click on 'Apply'.
10. Click on 'Run' to execute the launch config. The results will appear in the 'Console' tab at the bottom of Eclipse.
11. Once the configuration has been saved, you can run it again later by selecting the .launch file in Package Explorer, then click on the 'Run' icon in the toolbar.

7. Import 'launch' configurations

1. In Windows, open the folder C:\Users\<your_username>\workspace\stonesoup\launch\java\numberhandling
2. Extract the contents of file numberhandling.zip into the 'numberhandling' folder.
3. In Windows, open the folder C:\Users\<your_username>\workspace\stonesoup\launch\java\injection
4. Extract the contents of file injection.zip into the 'injection' folder.
5. In Windows, open the folder C:\Users\<your_username>\workspace\stonesoup\launch\java\resourcedrain
6. Extract the contents of file resourcedrain.zip into the 'resourcedrain' folder.

8. Test a snippet

1. From the Eclipse menu, select 'Run', then 'Run Configurations...'.
2. Open 'Java Application', select a launch configuration, then click on the 'Run' button.
   or
3. In the Package Explorer open the 'stonesoup' project, then open 'launch', then 'java', then a weakness class folder.
4. Select a launch configuration file.
5. From the Eclipse menu, select 'Run', then 'Run'.

6. The output will appear in the Console tab at the bottom.

NOTE: Some executions will enter infinite loops. You can interrupt these by clicking on either the red square or the red 'X' to the right of the 'Console' tab.

9. Create a C project called 'stonesoup-c'

IN ECLIPSE:

1. Select 'File', then 'New', then 'Project...', open 'C/C++', select 'C Project', then click on 'Next >'.
2. Set 'Project name' to 'stonesoup-c'.
3. Select project type of 'Makefile project', then select 'Empty Project'.
4. Select 'Linux GCC' for the toolchain, then click on 'Next >'.
5. Verify that 'Default' is the selected configuration, then click on 'Advanced settings...'.
6. Open 'C/C++ General', then select 'Paths and Symbols'.
7. Select the 'Includes' tab, select 'Assembly', click on 'Add', and enter '/opt/stonesoup/dependencies/include', then click on 'OK'.
8. Select the 'Library Paths' tab, click on 'Add', and enter '/opt/stonesoup/dependencies/lib64', then click on 'OK'.
9. (DR3) Open 'C/C++ Build', then select 'Build Variables', click on 'Add', set variable name to 'ENABLE_LTTng', set value to 'yes', then click on 'OK'.
10. Click on 'Apply', then on 'OK' to close the Properties window.
11. Click on 'Finish'. (If asked, click on 'Yes' to accept the 'C' perspective.) 'stonesoup-c' should now appear in the Package Explorer view.
12. From the Eclipse menu select 'Window', then 'Show View', then 'Other', open 'Git', then select 'Git Repositories', and finally 'OK'.

10. Import the C snippets into the new project

IN WINDOWS/LINUX DESKTOP:

1. Open the folder:
 (WIndows) C:\Users\<your account>\git\c-snippets
 (Linux) /home/ssadmin/git/c-snippets
2. Select all of the folders and the "Makefile" file and drag them into Eclipse, dropping them on the 'stonesoup-c' folder in Eclipse. A dialog box will appear.
3. Select 'Copy files and folders', then click on 'OK'.

11. Compile the C snippet code

IN THE ECLIPSE PACKAGE EXPLORER:

1. Right-click on the 'stonesoup-c' project, then select 'Build Project'. Eclipse will attempt to compile all of the C code according to the Makefile's instructions.
2. Examine the 'Console' tab for build output. Compilation errors and warnings will appear under the 'Problems' tab.

APPENDIX F—Test Corpus Suite Lists

F.1 Columbia Test Suite

C-C191B-OSSL-09-ST02-DT03-DF02-CF19-01
C-C805C-SUBV-09-ST01-DT05-DF11-CF18-01
C-C834A-PSQL-03-ST04-DT05-DF11-CF18-01
C-C078A-PSQL-09-ST02-DT02-DF15-CF02-01
C-C476G-OSSL-10-ST04-DT01-DF05-CF24-01
C-C828A-GIMP-01-ST04-DT06-DF05-CF14-01
C-C196A-PSQL-01-ST04-DT07-DF07-CF23-01
C-C126B-WIRE-05-ST02-DT03-DF06-CF23-01
C-C771A-GIMP-07-ST03-DT02-DF13-CF24-01
C-C089B-SUBV-10-ST04-DT06-DF11-CF18-01
C-C476D-WIRE-03-ST01-DT06-DF09-CF13-01
C-C479A-FFMP-05-ST02-DT01-DF14-CF01-01
C-C190A-GIMP-05-ST03-DT04-DF11-CF22-01
C-C126A-PSQL-03-ST03-DT01-DF14-CF12-01
C-C459A-SUBV-10-ST01-DT03-DF16-CF02-01
C-C089A-FFMP-05-ST01-DT07-DF09-CF19-01
C-C476F-FFMP-07-ST02-DT02-DF03-CF23-01
C-C833A-OSSL-10-ST03-DT04-DF11-CF20-01
C-C197A-FFMP-03-ST01-DT01-DF15-CF13-01
C-C124C-OSSL-02-ST04-DT02-DF17-CF20-01
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C-C088A-WIRE-08-ST03-DT04-DF14-CF22-01
C-C476C-PSQL-05-ST03-DT04-DF11-CF01-01
C-C363A-SUBV-07-ST01-DT02-DF16-CF18-01
C-C682A-SUBV-08-ST03-DT02-DF13-CF18-01
C-C805D-FFMP-04-ST04-DT04-DF16-CF22-01
C-C773A-OSSL-09-ST04-DT01-DF04-CF22-01
C-C088B-OSSL-07-ST02-DT03-DF13-CF03-01
C-C476B-GIMP-01-ST03-DT05-DF06-CF02-01
C-C765B-WIRE-04-ST01-DT03-DF15-CF24-01
C-C369A-WIRE-06-ST01-DT06-DF17-CF01-01
C-C124B-GIMP-08-ST01-DT07-DF01-CF24-01
C-C789A-FFMP-08-ST03-DT07-DF12-CF23-01
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C-C476A-SUBV-04-ST02-DT03-DF13-CF20-01
C-C820A-PSQL-06-ST02-DT05-DF13-CF02-01
C-C195A-FFMP-10-ST04-DT05-DF14-CF03-01
C-C806B-GIMP-10-ST02-DT06-DF10-CF02-01
C-C775A-PSQL-06-ST02-DT06-DF10-CF01-01
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C-C476B-WIRE-02-ST04-DT04-DF14-CF18-01
C-C414A-PSQL-09-ST04-DT03-DF08-CF19-01
C-C191A-SUBV-07-ST01-DT04-DF16-CF20-01
C-C824B-PSQL-07-ST04-DT03-DF05-CF19-01
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C-C476G-SUBV-08-ST01-DT02-DF15-CF22-01
C-C609A-SUBV-08-ST04-DT04-DF06-CF23-01
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C-C476C-GIMP-10-ST02-DT07-DF12-CF18-01
C-C412A-FFMP-06-ST01-DT07-DF01-CF19-01
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C-C834A-FFMP-05-ST02-DT01-DF16-CF13-01
C-C089C-OSSL-02-ST04-DT04-DF05-CF24-01
C-C476A-PSQL-08-ST04-DT05-DF02-CF14-01
C-C543A-PSQL-01-ST03-DT01-DF05-CF23-01
C-C191A-WIRE-02-ST01-DT07-DF01-CF03-01
C-C129A-SUBV-10-ST04-DT06-DF12-CF15-01
C-C775A-GIMP-10-ST01-DT07-DF14-CF18-01
C-C078A-FFMP-06-ST03-DT06-DF13-CF20-01
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C-C124D-FFMP-05-ST03-DT02-DF08-CF18-01
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C-C476D-SUBV-09-ST02-DT04-DF17-CF24-01
C-C765A-WIRE-08-ST02-DT02-DF02-CF15-01
C-C682B-GIMP-08-ST02-DT02-DF14-CF01-01
C-C120C-PSQL-04-ST01-DT04-DF13-CF02-01
C-C771A-PSQL-01-ST04-DT03-DF06-CF19-01
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C-C127B-WIRE-08-ST02-DT05-DF16-CF20-01
C-C789A-WIRE-06-ST01-DT05-DF13-CF22-01
C-C089C-GIMP-05-ST01-DT05-DF14-CF23-01
C-C476E-WIRE-06-ST02-DT05-DF05-CF01-01
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C-C682A-SUBV-04-ST04-DT06-DF06-CF19-01
C-C416A-GIMP-09-ST01-DT03-DF17-CF22-01

C-C835A-OSSL-03-ST04-DT07-DF07-CF02-01
C-C088A-PSQL-04-ST03-DT03-DF11-CF02-01
C-C476G-OSSL-02-ST03-DT07-DF14-CF19-01
C-C764A-FFMP-07-ST01-DT06-DF15-CF18-01
C-C196A-FFMP-10-ST02-DT04-DF12-CF12-01
C-C127C-PSQL-01-ST04-DT01-DF06-CF19-01
C-C400B-SUBV-02-ST04-DT02-DF01-CF23-01
C-C089A-SUBV-08-ST02-DT01-DF16-CF01-01
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C-C197A-PSQL-04-ST01-DT05-DF13-CF19-01
C-C170A-OSSL-06-ST01-DT02-DF11-CF22-01
C-C459A-OSSL-09-ST02-DT04-DF15-CF24-01
C-C089B-GIMP-07-ST02-DT04-DF07-CF20-01
C-C476C-FFMP-07-ST02-DT01-DF06-CF23-01
C-C414A-PSQL-08-ST02-DT07-DF11-CF03-01
C-C369A-FFMP-09-ST04-DT05-DF05-CF02-01
C-C785A-GIMP-05-ST02-DT06-DF16-CF03-01
C-C400A-GIMP-04-ST03-DT05-DF12-CF02-01
C-C078B-FFMP-03-ST04-DT02-DF12-CF01-01
C-C476B-GIMP-08-ST04-DT01-DF13-CF22-01
C-C821A-FFMP-01-ST04-DT07-DF13-CF22-01
C-C191B-SUBV-08-ST02-DT02-DF13-CF03-01
C-C805A-FFMP-02-ST04-DT03-DF03-CF02-01
C-C401A-PSQL-03-ST01-DT04-DF11-CF03-01
C-C089D-SUBV-02-ST03-DT02-DF06-CF18-01
C-C476C-SUBV-03-ST03-DT06-DF14-CF24-01
C-C609A-WIRE-09-ST03-DT03-DF05-CF01-01
C-C839A-OSSL-02-ST03-DT01-DF12-CF01-01
C-C120D-WIRE-08-ST03-DT04-DF12-CF19-01
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C-C088B-FFMP-08-ST01-DT06-DF15-CF23-01
C-C476G-WIRE-01-ST01-DT07-DF11-CF20-01
C-C412A-SUBV-07-ST01-DT04-DF12-CF02-01
C-C190A-PSQL-06-ST02-DT03-DF08-CF20-01
C-C824A-OSSL-04-ST01-DT01-DF04-CF20-01
C-C773A-SUBV-10-ST03-DT01-DF08-CF15-01
C-C089B-WIRE-06-ST03-DT03-DF16-CF19-01
C-C476A-PSQL-02-ST02-DT03-DF05-CF02-01
C-C543A-OSSL-06-ST03-DT06-DF09-CF13-01
C-C196A-FFMP-05-ST01-DT06-DF06-CF22-01
C-C415A-SUBV-09-ST02-DT05-DF05-CF24-01
C-C771A-WIRE-02-ST04-DT06-DF13-CF01-01
C-C088A-OSSL-01-ST02-DT07-DF04-CF24-01
C-C476E-OSSL-06-ST03-DT05-DF15-CF18-01
C-C820A-PSQL-04-ST02-DT01-DF06-CF24-01
C-C194A-SUBV-07-ST03-DT07-DF14-CF14-01
C-C806A-WIRE-03-ST04-DT07-DF13-CF14-01
C-C459A-FFMP-05-ST01-DT03-DF02-CF24-01
C-C078A-PSQL-05-ST04-DT01-DF15-CF22-01
C-C476F-SUBV-10-ST04-DT04-DF07-CF19-01
C-C367A-GIMP-05-ST01-DT02-DF14-CF23-01
C-C191A-WIRE-01-ST04-DT02-DF15-CF24-01
C-C785B-PSQL-10-ST03-DT02-DF15-CF23-01
C-C775A-PSQL-01-ST02-DT07-DF17-CF23-01
C-C088B-GIMP-10-ST04-DT05-DF10-CF02-01
C-C476D-FFMP-05-ST01-DT06-DF04-CF01-01
C-C765A-FFMP-03-ST04-DT03-DF17-CF20-01
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C-C785C-GIMP-01-ST02-DT02-DF14-CF01-01
C-C774A-OSSL-08-ST03-DT02-DF15-CF18-01
C-C078B-OSSL-04-ST01-DT04-DF11-CF03-01
C-C476G-GIMP-09-ST04-DT02-DF16-CF12-01
C-C831A-WIRE-02-ST03-DT06-DF16-CF19-01
C-C682B-GIMP-03-ST01-DT07-DF05-CF23-01
C-C124A-FFMP-07-ST04-DT05-DF17-CF23-01
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C-C682A-OSSL-01-ST02-DT05-DF17-CF22-01
C-C120A-SUBV-01-ST01-DT03-DF09-CF13-01
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C-C476C-PSQL-06-ST01-DT05-DF13-CF19-01
C-C663A-FFMP-10-ST01-DT04-DF05-CF03-01
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C-C126D-PSQL-03-ST03-DT04-DF11-CF24-01
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C-C476E-SUBV-08-ST03-DT07-DF06-CF15-01
C-C479A-OSSL-04-ST04-DT02-DF13-CF18-01
C-C197A-FFMP-08-ST03-DT03-DF17-CF03-01
C-C785D-FFMP-06-ST03-DT06-DF06-CF18-01
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C-C126C-WIRE-04-ST04-DT01-DF05-CF01-01
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C-C078A-WIRE-02-ST04-DT02-DF05-CF23-01
C-C476F-WIRE-02-ST03-DT02-DF17-CF20-01
C-C765A-GIMP-06-ST03-DT03-DF11-CF18-01
C-C191B-GIMP-06-ST04-DT06-DF14-CF20-01
C-C806C-GIMP-05-ST01-DT07-DF12-CF20-01
C-C835A-GIMP-01-ST01-DT01-DF03-CF01-01
C-C088A-GIMP-08-ST02-DT01-DF13-CF18-01
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C-C414A-SUBV-02-ST04-DT01-DF15-CF12-01
C-C196A-WIRE-10-ST02-DT01-DF11-CF18-01
C-C129B-OSSL-09-ST02-DT03-DF14-CF18-01
C-C400B-WIRE-03-ST04-DT04-DF09-CF22-01
C-C088A-PSQL-06-ST01-DT07-DF12-CF20-01
C-C476B-OSSL-03-ST01-DT03-DF16-CF24-01
C-C663A-PSQL-09-ST01-DT05-DF16-CF20-01

C-C839A-PSQL-09-ST03-DT06-DF13-CF02-01
C-C127D-OSSL-07-ST03-DT06-DF13-CF19-01
C-C674A-WIRE-02-ST03-DT05-DF11-CF23-01
C-C089A-SUBV-09-ST04-DT03-DF01-CF02-01
C-C476D-GIMP-10-ST04-DT03-DF14-CF03-01
C-C820A-OSSL-08-ST03-DT07-DF15-CF19-01
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C-C400B-GIMP-09-ST02-DT02-DF17-CF20-01
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C-C476C-WIRE-04-ST04-DT07-DF05-CF22-01
C-C828A-FFMP-05-ST02-DT06-DF12-CF23-01
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C-C590A-FFMP-10-ST02-DT01-DF11-CF02-01
C-C775A-FFMP-05-ST01-DT01-DF15-CF02-01
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C-C476A-OSSL-07-ST02-DT05-DF11-CF01-01
C-C821A-GIMP-01-ST04-DT04-DF03-CF24-01
C-C191A-WIRE-05-ST04-DT01-DF11-CF23-01
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C-C400A-SUBV-10-ST04-DT07-DF12-CF18-01
C-C078B-WIRE-07-ST03-DT07-DF15-CF18-01
C-C476F-SUBV-05-ST03-DT06-DF15-CF02-01
C-C479A-SUBV-03-ST02-DT02-DF11-CF24-01
C-C194A-GIMP-01-ST02-DT02-DF16-CF22-01
C-C134A-SUBV-04-ST04-DT02-DF02-CF03-01
C-C459A-PSQL-05-ST03-DT04-DF05-CF02-01
C-C089C-GIMP-09-ST04-DT06-DF17-CF03-01
C-C476G-FFMP-07-ST03-DT04-DF12-CF24-01
C-C833A-WIRE-04-ST02-DT04-DF14-CF18-01
C-C197A-SUBV-03-ST04-DT07-DF03-CF02-01
C-C822A-WIRE-07-ST02-DT07-DF07-CF22-01
C-C789A-OSSL-03-ST02-DT03-DF13-CF03-01
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C-C682B-SUBV-10-ST01-DT01-DF16-CF24-01
C-C805D-SUBV-06-ST01-DT01-DF17-CF18-01
C-C773A-OSSL-08-ST01-DT05-DF16-CF01-01
C-C089A-GIMP-02-ST03-DT04-DF13-CF24-01
C-C476B-PSQL-08-ST04-DT06-DF01-CF23-01
C-C367A-PSQL-05-ST01-DT01-DF06-CF01-01
C-C195A-OSSL-02-ST02-DT07-DF05-CF18-01
C-C590A-GIMP-09-ST03-DT05-DF06-CF22-01
C-C834A-WIRE-01-ST03-DT07-DF06-CF01-01
C-C089B-FFMP-05-ST01-DT06-DF01-CF03-01
C-C476F-OSSL-01-ST01-DT07-DF13-CF22-01
C-C831A-OSSL-07-ST01-DT03-DF13-CF01-01
C-C839A-FFMP-05-ST01-DT06-DF14-CF19-01
C-C126D-FFMP-03-ST01-DT06-DF14-CF24-01
C-C835A-GIMP-07-ST04-DT03-DF05-CF23-01
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C-C476D-GIMP-03-ST01-DT05-DF16-CF12-01
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C-C682B-PSQL-06-ST03-DT05-DF12-CF20-01
C-C170B-WIRE-01-ST04-DT03-DF06-CF20-01
C-C771A-SUBV-02-ST01-DT06-DF17-CF14-01
C-C078B-SUBV-08-ST02-DT04-DF06-CF23-01
C-C476A-SUBV-09-ST03-DT01-DF17-CF23-01
C-C543A-WIRE-03-ST02-DT01-DF13-CF20-01
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C-C124D-OSSL-02-ST03-DT05-DF17-CF02-01
C-C401A-FFMP-10-ST02-DT02-DF03-CF19-01
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C-C476C-WIRE-05-ST02-DT03-DF15-CF03-01
C-C609A-GIMP-01-ST04-DT02-DF14-CF22-01
C-C190A-WIRE-09-ST01-DT04-DF13-CF03-01
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C-C078A-OSSL-10-ST02-DT07-DF14-CF02-01
C-C476E-FFMP-06-ST04-DT04-DF13-CF20-01
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C-C191B-GIMP-04-ST04-DT04-DF06-CF14-01
C-C129B-GIMP-10-ST03-DT04-DF04-CF01-01
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C-C078B-FFMP-07-ST01-DT01-DF07-CF22-01
C-C476G-OSSL-04-ST03-DT02-DF14-CF01-01
C-C831A-GIMP-08-ST01-DT03-DF17-CF03-01
C-C191A-PSQL-08-ST02-DT01-DF17-CF01-01
C-C415A-OSSL-08-ST04-DT07-DF09-CF23-01
C-C789A-GIMP-04-ST02-DT05-DF15-CF22-01
C-C089B-SUBV-01-ST04-DT07-DF13-CF12-01
C-C476E-PSQL-02-ST02-DT04-DF06-CF02-01
C-C821A-WIRE-06-ST04-DT06-DF16-CF23-01
C-C195A-OSSL-04-ST01-DT02-DF11-CF23-01
C-C126A-SUBV-09-ST02-DT01-DF15-CF19-01
C-C401A-PSQL-08-ST01-DT02-DF13-CF23-01
C-C078A-WIRE-10-ST01-DT05-DF15-CF01-01
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C-C127C-WIRE-02-ST01-DT04-DF05-CF03-01
C-C835A-FFMP-09-ST02-DT06-DF06-CF24-01
C-C088A-OSSL-08-ST04-DT02-DF08-CF14-01
C-C476D-GIMP-01-ST04-DT06-DF09-CF01-01
C-C414A-SUBV-06-ST03-DT05-DF05-CF18-01
C-C369A-FFMP-01-ST04-DT07-DF15-CF19-01
C-C806B-PSQL-08-ST04-DT06-DF11-CF03-01
C-C400B-WIRE-03-ST04-DT01-DF14-CF02-01
C-C078A-PSQL-05-ST03-DT01-DF17-CF20-01
C-C476A-FFMP-06-ST01-DT03-DF05-CF18-01
C-C367A-PSQL-09-ST01-DT04-DF03-CF20-01
C-C196A-SUBV-03-ST02-DT03-DF05-CF02-01
C-C120C-FFMP-05-ST01-DT05-DF16-CF24-01
C-C771A-SUBV-10-ST01-DT07-DF11-CF19-01
C-C089C-GIMP-04-ST03-DT06-DF16-CF23-01
C-C476G-SUBV-04-ST02-DT07-DF02-CF20-01
C-C663A-OSSL-07-ST02-DT03-DF15-CF23-01
C-C194A-FFMP-06-ST03-DT02-DF07-CF23-01
C-C824B-PSQL-10-ST03-DT02-DF12-CF02-01
C-C773A-SUBV-01-ST03-DT04-DF12-CF18-01
C-C088B-SUBV-06-ST04-DT04-DF12-CF19-01

C-C476B-WIRE-08-ST03-DT01-DF12-CF14-01
C-C828A-OSSL-08-ST04-DT07-DF11-CF14-01
C-C682B-OSSL-09-ST04-DT06-DF13-CF18-01
C-C127A-WIRE-03-ST02-DT03-DF13-CF22-01
C-C459A-PSQL-04-ST04-DT03-DF07-CF20-01
C-C089D-OSSL-02-ST02-DT03-DF11-CF18-01
C-C476F-FFMP-09-ST04-DT05-DF11-CF24-01
C-C764A-WIRE-04-ST03-DT01-DF16-CF03-01
C-C190A-PSQL-07-ST03-DT07-DF12-CF24-01
C-C806D-FFMP-07-ST02-DT02-DF13-CF23-01
C-C834A-WIRE-06-ST02-DT01-DF17-CF15-01
C-C088B-WIRE-03-ST03-DT06-DF14-CF24-01
C-C476E-GIMP-05-ST02-DT07-DF14-CF19-01
C-C363A-PSQL-03-ST02-DT07-DF15-CF01-01
C-C839A-SUBV-08-ST01-DT01-DF17-CF20-01
C-C127B-OSSL-06-ST01-DT06-DF06-CF12-01
C-C674A-FFMP-05-ST01-DT06-DF15-CF03-01
C-C088A-PSQL-09-ST01-DT03-DF16-CF24-01
C-C476B-OSSL-07-ST04-DT01-DF06-CF03-01
C-C765A-FFMP-10-ST03-DT05-DF06-CF18-01
C-C369A-WIRE-10-ST02-DT02-DF09-CF13-01
C-C170A-SUBV-04-ST04-DT05-DF14-CF20-01
C-C400A-OSSL-02-ST04-DT04-DF14-CF22-01
C-C088A-FFMP-07-ST02-DT02-DF13-CF19-01
C-C476G-SUBV-02-ST01-DT05-DF12-CF23-01
C-C609A-GIMP-02-ST01-DT04-DF13-CF19-01
C-C194A-GIMP-05-ST04-DT03-DF06-CF03-01
C-C120B-GIMP-01-ST03-DT01-DF16-CF24-01
C-C774A-GIMP-07-ST03-DT03-DF16-CF24-01
C-C089B-GIMP-01-ST04-DT01-DF17-CF18-01
C-C476A-GIMP-10-ST03-DT04-DF03-CF22-01
C-C543A-SUBV-01-ST04-DT02-DF01-CF02-01
C-C682A-FFMP-07-ST03-DT06-DF03-CF22-01
C-C120A-SUBV-03-ST04-DT07-DF11-CF19-01
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C-C078B-FFMP-06-ST02-DT05-DF05-CF03-01
C-C476F-PSQL-06-ST04-DT02-DF17-CF20-01
C-C479A-PSQL-10-ST03-DT03-DF10-CF24-01
C-C196A-SUBV-01-ST04-DT05-DF11-CF24-01
C-C127D-GIMP-08-ST01-DT04-DF15-CF18-01
C-C401A-PSQL-10-ST03-DT05-DF01-CF02-01
C-C078A-GIMP-01-ST03-DT04-DF12-CF02-01
C-C476C-FFMP-05-ST02-DT06-DF16-CF22-01
C-C765B-GIMP-02-ST04-DT01-DF14-CF02-01
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C-C806A-FFMP-02-ST03-DT03-DF05-CF15-01
C-C835A-SUBV-03-ST04-DT02-DF11-CF01-01
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C-C476D-OSSL-09-ST01-DT04-DF13-CF02-01
C-C412A-FFMP-03-ST02-DT01-DF11-CF22-01
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C-C806C-WIRE-06-ST01-DT07-DF14-CF19-01
C-C459A-GIMP-09-ST01-DT02-DF06-CF03-01
C-C089D-OSSL-05-ST04-DT05-DF02-CF01-01
C-C476F-PSQL-10-ST03-DT03-DF16-CF23-01
C-C820A-SUBV-04-ST01-DT06-DF17-CF24-01
C-C195A-WIRE-08-ST03-DT03-DF16-CF02-01
C-C805C-PSQL-04-ST02-DT05-DF02-CF23-01
C-C775A-OSSL-05-ST04-DT01-DF13-CF24-01
C-C078B-WIRE-09-ST04-DT07-DF06-CF20-01
C-C476E-WIRE-02-ST01-DT05-DF10-CF02-01
C-C820A-OSSL-01-ST03-DT02-DF16-CF01-01
C-C191B-PSQL-09-ST02-DT04-DF14-CF23-01
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C-C476D-SUBV-03-ST02-DT01-DF05-CF22-01
C-C831A-WIRE-06-ST04-DT05-DF12-CF01-01
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C-C771A-OSSL-01-ST02-DT05-DF12-CF23-01
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C-C476G-FFMP-08-ST04-DT05-DF15-CF18-01
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C-C682B-GIMP-02-ST01-DT02-DF01-CF18-01
C-C124A-WIRE-09-ST01-DT04-DF12-CF23-01
C-C834A-GIMP-06-ST01-DT04-DF04-CF20-01
C-C078A-GIMP-08-ST01-DT03-DF14-CF22-01
C-C476A-GIMP-01-ST03-DT06-DF12-CF03-01
C-C412A-OSSL-05-ST01-DT06-DF05-CF22-01
C-C195A-SUBV-06-ST02-DT05-DF06-CF19-01
C-C785C-SUBV-10-ST02-DT02-DF17-CF22-01
C-C773A-WIRE-04-ST02-DT06-DF12-CF24-01
C-C089B-FFMP-02-ST03-DT04-DF16-CF13-01
C-C476B-PSQL-07-ST01-DT07-DF05-CF24-01
C-C414A-GIMP-09-ST02-DT04-DF17-CF19-01
C-C197A-WIRE-04-ST03-DT01-DF13-CF20-01
C-C120D-FFMP-01-ST04-DT03-DF11-CF01-01
C-C400A-SUBV-07-ST04-DT03-DF06-CF13-01
C-C088B-WIRE-10-ST02-DT01-DF12-CF23-01
C-C476C-SUBV-04-ST04-DT03-DF06-CF01-01
C-C764A-SUBV-08-ST03-DT03-DF11-CF19-01
C-C369A-PSQL-07-ST01-DT06-DF05-CF15-01
C-C126B-GIMP-03-ST02-DT02-DF05-CF02-01
C-C789A-PSQL-10-ST01-DT06-DF13-CF18-01
C-C088A-PSQL-02-ST04-DT05-DF17-CF15-01
C-C476G-WIRE-04-ST03-DT03-DF04-CF19-01
C-C479A-PSQL-01-ST04-DT06-DF15-CF03-01
C-C682A-FFMP-02-ST04-DT02-DF17-CF02-01
C-C126C-OSSL-07-ST03-DT05-DF01-CF03-01
C-C400B-FFMP-06-ST03-DT04-DF17-CF01-01
C-C089D-OSSL-10-ST01-DT01-DF06-CF19-01
C-C476F-PSQL-08-ST02-DT01-DF15-CF15-01
C-C828A-FFMP-08-ST01-DT07-DF04-CF03-01
C-C190A-OSSL-03-ST02-DT03-DF16-CF23-01
C-C134A-OSSL-02-ST02-DT03-DF15-CF19-01
C-C789A-PSQL-05-ST02-DT07-DF14-CF02-01
C-C089A-OSSL-08-ST04-DT03-DF09-CF23-01
C-C476B-OSSL-09-ST01-DT02-DF01-CF13-01
C-C367A-OSSL-03-ST04-DT05-DF13-CF23-01
C-C191B-WIRE-10-ST01-DT07-DF12-CF19-01
C-C785A-GIMP-09-ST03-DT07-DF06-CF20-01

C-C674A-OSSL-09-ST01-DT03-DF11-CF23-01
C-C088A-PSQL-01-ST03-DT07-DF04-CF22-01
C-C476D-SUBV-01-ST04-DT02-DF14-CF02-01
C-C821A-SUBV-10-ST01-DT03-DF05-CF20-01
C-C191A-SUBV-01-ST04-DT07-DF14-CF01-01
C-C785B-WIRE-04-ST04-DT06-DF17-CF02-01
C-C771A-SUBV-08-ST03-DT01-DF05-CF20-01
C-C078B-FFMP-04-ST02-DT04-DF05-CF01-01
C-C476E-OSSL-03-ST04-DT04-DF17-CF23-01
C-C765A-GIMP-04-ST02-DT07-DF09-CF20-01
C-C194A-PSQL-05-ST01-DT04-DF11-CF18-01
C-C761A-FFMP-06-ST01-DT01-DF08-CF22-01
C-C834A-GIMP-03-ST04-DT05-DF13-CF03-01
C-C078A-GIMP-03-ST01-DT02-DF15-CF03-01
C-C476A-FFMP-10-ST03-DT07-DF13-CF01-01
C-C609A-WIRE-09-ST03-DT02-DF17-CF15-01
C-C839A-FFMP-04-ST02-DT05-DF10-CF18-01
C-C785D-SUBV-08-ST01-DT03-DF16-CF20-01
C-C459A-WIRE-07-ST04-DT02-DF16-CF12-01
C-C089C-SUBV-05-ST04-DT06-DF13-CF24-01
C-C476C-GIMP-02-ST03-DT07-DF08-CF24-01
C-C833A-PSQL-06-ST03-DT02-DF15-CF22-01
C-C197A-GIMP-09-ST04-DT04-DF12-CF24-01
C-C824A-PSQL-10-ST02-DT04-DF17-CF24-01
C-C773A-FFMP-02-ST04-DT07-DF06-CF18-01
C-C089B-WIRE-07-ST03-DT03-DF03-CF20-01
C-C476D-WIRE-06-ST02-DT04-DF16-CF18-01
C-C363A-FFMP-07-ST03-DT04-DF12-CF24-01
C-C682B-PSQL-08-ST03-DT01-DF04-CF03-01
C-C416A-FFMP-05-ST01-DT02-DF06-CF03-01
C-C400B-GIMP-04-ST02-DT01-DF08-CF22-01
C-C088B-GIMP-09-ST01-DT07-DF13-CF18-01
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C-C765B-FFMP-02-ST01-DT01-DF16-CF12-01
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C-C129A-OSSL-01-ST04-DT07-DF05-CF18-01
C-C400A-PSQL-01-ST01-DT05-DF15-CF20-01
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C-C476E-SUBV-07-ST01-DT01-DF12-CF01-01
C-C663A-PSQL-05-ST02-DT01-DF13-CF18-01
C-C195A-SUBV-05-ST01-DT02-DF15-CF01-01
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C-C089D-OSSL-06-ST01-DT01-DF14-CF02-01
C-C476C-FFMP-03-ST03-DT03-DF07-CF14-01
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C-C191B-FFMP-04-ST03-DT01-DF11-CF24-01
C-C124C-GIMP-02-ST04-DT06-DF13-CF23-01
C-C775A-WIRE-08-ST01-DT03-DF17-CF02-01
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C-C476F-GIMP-06-ST02-DT05-DF13-CF19-01
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C-C682A-WIRE-03-ST02-DT04-DF16-CF20-01
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C-C839A-GIMP-02-ST04-DT03-DF13-CF19-01
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C-C765B-PSQL-01-ST04-DT07-DF05-CF01-01
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C-C773A-FFMP-02-ST02-DT03-DF11-CF02-01
C-C078B-WIRE-05-ST01-DT05-DF16-CF19-01
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C-C126C-WIRE-08-ST01-DT05-DF14-CF03-01
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C-C476F-FFMP-01-ST01-DT07-DF01-CF02-01
C-C363A-GIMP-04-ST03-DT06-DF13-CF02-01
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C-C126A-SUBV-03-ST02-DT02-DF09-CF14-01
C-C401A-WIRE-07-ST01-DT07-DF16-CF22-01
C-C078A-WIRE-08-ST02-DT01-DF13-CF02-01
C-C476B-SUBV-07-ST03-DT02-DF08-CF18-01
C-C821A-GIMP-08-ST02-DT06-DF12-CF03-01

C-C195A-FFMP-06-ST02-DT04-DF02-CF03-01
C-C805B-FFMP-04-ST02-DT01-DF13-CF01-01
C-C771A-GIMP-05-ST03-DT05-DF17-CF22-01
C-C088B-GIMP-06-ST02-DT05-DF11-CF19-01
C-C476E-GIMP-06-ST03-DT03-DF11-CF20-01
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C-C126D-OSSL-09-ST04-DT02-DF16-CF19-01
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C-C476C-PSQL-04-ST01-DT04-DF15-CF01-01
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C-C191B-WIRE-07-ST02-DT07-DF17-CF02-01
C-C805C-WIRE-05-ST03-DT07-DF11-CF22-01
C-C835A-PSQL-03-ST02-DT01-DF05-CF18-01
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C-C476D-OSSL-08-ST03-DT05-DF17-CF03-01
C-C831A-PSQL-07-ST03-DT02-DF06-CF19-01
C-C839A-GIMP-04-ST01-DT03-DF10-CF01-01
C-C785A-PSQL-06-ST01-DT06-DF12-CF20-01
C-C834A-FFMP-06-ST03-DT06-DF14-CF20-01
C-C089C-SUBV-10-ST01-DT03-DF12-CF12-01
C-C476G-WIRE-05-ST03-DT07-DF06-CF19-01
C-C833A-WIRE-06-ST04-DT05-DF17-CF23-01
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C-C476F-GIMP-02-ST04-DT02-DF12-CF22-01
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C-C682B-WIRE-01-ST01-DT03-DF15-CF22-01
C-C822A-WIRE-02-ST02-DT04-DF02-CF23-01
C-C771A-PSQL-01-ST01-DT01-DF12-CF01-01
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C-C476A-FFMP-09-ST02-DT06-DF17-CF13-01
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C-C835A-FFMP-04-ST01-DT02-DF07-CF15-01
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C-C543A-FFMP-09-ST03-DT06-DF14-CF01-01
C-C191B-GIMP-08-ST04-DT05-DF15-CF20-01
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C-C476E-SUBV-01-ST02-DT03-DF12-CF24-01
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C-C194A-OSSL-08-ST02-DT06-DF12-CF19-01
C-C416A-FFMP-02-ST03-DT06-DF17-CF20-01
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C-C089C-FFMP-04-ST03-DT05-DF15-CF20-01
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C-C765B-SUBV-07-ST01-DT02-DF13-CF20-01
C-C369A-PSQL-04-ST02-DT07-DF14-CF20-01
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C-C775A-SUBV-09-ST03-DT05-DF06-CF24-01
C-C078B-SUBV-04-ST04-DT07-DF16-CF01-01
C-C476B-WIRE-01-ST02-DT02-DF14-CF24-01
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C-C843A-FFMP-03-ST02-DT04-DF12-CF02-01
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C-C089D-WIRE-10-ST02-DT06-DF07-CF02-01
C-C476F-FFMP-02-ST01-DT01-DF11-CF18-01
C-C821A-OSSL-09-ST02-DT07-DF17-CF01-01
C-C190A-GIMP-10-ST03-DT01-DF17-CF19-01
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C-C834A-GIMP-06-ST02-DT04-DF16-CF24-01
C-C078A-SUBV-05-ST01-DT03-DF05-CF03-01
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C-C833A-GIMP-05-ST04-DT01-DF10-CF15-01
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C-C089C-FFMP-09-ST02-DT04-DF06-CF22-01
C-C476C-SUBV-03-ST01-DT05-DF10-CF22-01
C-C412A-WIRE-01-ST02-DT04-DF15-CF03-01
C-C195A-PSQL-02-ST03-DT07-DF07-CF19-01
C-C129B-GIMP-05-ST04-DT07-DF16-CF01-01
C-C400A-WIRE-08-ST04-DT05-DF12-CF02-01
C-C089A-GIMP-01-ST03-DT05-DF12-CF03-01
C-C476B-GIMP-08-ST03-DT06-DF15-CF23-01
C-C828A-SUBV-08-ST04-DT03-DF06-CF03-01
C-C197A-OSSL-03-ST01-DT02-DF16-CF02-01
C-C824B-OSSL-08-ST02-DT01-DF03-CF22-01
C-C400B-SUBV-05-ST02-DT04-DF02-CF20-01
C-C089B-OSSL-06-ST01-DT01-DF11-CF23-01
C-C476D-OSSL-09-ST02-DT02-DF02-CF19-01
C-C367A-GIMP-03-ST03-DT06-DF11-CF02-01
C-C839A-SUBV-01-ST02-DT05-DF03-CF23-01
C-C824A-WIRE-06-ST01-DT02-DF13-CF19-01
C-C834A-PSQL-07-ST03-DT07-DF17-CF23-01
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C-C476A-WIRE-06-ST04-DT05-DF06-CF15-01
C-C414A-FFMP-10-ST01-DT04-DF16-CF24-01
C-C191A-GIMP-07-ST02-DT03-DF13-CF18-01
C-C785D-FFMP-10-ST03-DT03-DF01-CF18-01
C-C674A-FFMP-02-ST04-DT01-DF15-CF03-01
C-C088B-OSSL-03-ST02-DT02-DF17-CF18-01
C-C476C-PSQL-05-ST03-DT03-DF05-CF20-01
C-C363A-WIRE-02-ST04-DT07-DF05-CF19-01
C-C682A-PSQL-05-ST01-DT01-DF05-CF01-01
C-C785B-PSQL-04-ST01-DT07-DF11-CF03-01
C-C400B-WIRE-01-ST03-DT02-DF09-CF18-01
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C-C476E-FFMP-10-ST01-DT01-DF17-CF03-01
C-C663A-SUBV-04-ST03-DT01-DF12-CF02-01
C-C369A-OSSL-05-ST04-DT03-DF16-CF23-01
C-C120B-GIMP-07-ST02-DT05-DF11-CF13-01
C-C789A-GIMP-01-ST01-DT03-DF17-CF19-01
C-C078A-GIMP-10-ST04-DT04-DF03-CF15-01

C-C476F-GIMP-06-ST02-DT04-DF16-CF12-01
C-C765A-PSQL-02-ST02-DT05-DF05-CF23-01
C-C195A-WIRE-09-ST03-DT06-DF05-CF20-01
C-C124A-SUBV-10-ST03-DT04-DF15-CF20-01
C-C774A-PSQL-04-ST02-DT06-DF15-CF22-01
C-C088A-PSQL-06-ST01-DT06-DF13-CF24-01
C-C476G-SUBV-02-ST01-DT02-DF17-CF01-01
C-C479A-GIMP-05-ST01-DT02-DF05-CF19-01
C-C197A-SUBV-07-ST02-DT04-DF09-CF22-01
C-C806B-OSSL-09-ST04-DT03-DF14-CF23-01
C-C771A-OSSL-05-ST02-DT05-DF12-CF23-01
C-C089D-WIRE-04-ST03-DT03-DF06-CF14-01
C-C476C-WIRE-10-ST04-DT07-DF15-CF20-01
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C-C190A-FFMP-10-ST04-DT02-DF11-CF18-01
C-C120A-WIRE-01-ST04-DT06-DF10-CF24-01
C-C401A-SUBV-02-ST03-DT06-DF05-CF14-01
C-C088A-FFMP-05-ST01-DT01-DF12-CF18-01
C-C476D-WIRE-01-ST04-DT03-DF11-CF18-01
C-C765A-OSSL-10-ST01-DT03-DF12-CF22-01
C-C682A-WIRE-03-ST03-DT04-DF14-CF18-01
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C-C775A-OSSL-06-ST01-DT01-DF10-CF03-01
C-C078A-OSSL-01-ST03-DT04-DF15-CF19-01
C-C476B-OSSL-04-ST02-DT06-DF07-CF02-01
C-C543A-SUBV-04-ST02-DT04-DF15-CF19-01
C-C839A-SUBV-06-ST01-DT02-DF17-CF15-01
C-C127C-PSQL-03-ST02-DT02-DF15-CF03-01
C-C773A-PSQL-10-ST04-DT04-DF11-CF20-01
C-C089D-SUBV-08-ST04-DT07-DF13-CF22-01
C-C476A-GIMP-07-ST03-DT01-DF13-CF24-01
C-C765B-WIRE-01-ST04-DT01-DF04-CF18-01
C-C191B-OSSL-08-ST04-DT05-DF04-CF22-01
C-C127D-OSSL-08-ST02-DT07-DF17-CF18-01
C-C674A-SUBV-07-ST03-DT07-DF14-CF24-01
C-C078B-WIRE-09-ST02-DT02-DF14-CF23-01
C-C476G-OSSL-05-ST02-DT05-DF05-CF23-01
C-C820A-PSQL-08-ST01-DT06-DF11-CF13-01
C-C194A-PSQL-01-ST02-DT01-DF15-CF24-01
C-C806D-GIMP-07-ST03-DT01-DF05-CF02-01
C-C400A-WIRE-03-ST01-DT02-DF16-CF22-01
C-C088B-PSQL-03-ST04-DT05-DF08-CF24-01
C-C476E-FFMP-08-ST03-DT04-DF06-CF22-01
C-C367A-FFMP-09-ST03-DT05-DF17-CF20-01
C-C191A-FFMP-02-ST01-DT05-DF13-CF02-01
C-C124D-WIRE-06-ST01-DT05-DF12-CF23-01
C-C459A-GIMP-08-ST04-DT06-DF06-CF01-01
C-C089A-FFMP-02-ST01-DT06-DF05-CF20-01
C-C476F-SUBV-06-ST01-DT07-DF03-CF18-01
C-C414A-GIMP-06-ST02-DT02-DF06-CF18-01
C-C682B-SUBV-04-ST03-DT07-DF15-CF01-01
C-C129A-FFMP-01-ST02-DT01-DF07-CF03-01
C-C835A-FFMP-09-ST02-DT03-DF03-CF18-01
C-C089B-GIMP-07-ST03-DT03-DF02-CF01-01
C-C476B-PSQL-09-ST04-DT01-DF12-CF19-01
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C-C196A-GIMP-10-ST01-DT07-DF12-CF18-01
C-C415A-SUBV-05-ST04-DT04-DF06-CF02-01
C-C400B-SUBV-10-ST04-DT05-DF16-CF03-01
C-C088B-GIMP-04-ST04-DT07-DF11-CF02-01
C-C476A-SUBV-02-ST04-DT03-DF14-CF23-01
C-C828A-GIMP-07-ST02-DT03-DF01-CF24-01
C-C194A-WIRE-07-ST03-DT04-DF05-CF01-01
C-C127B-OSSL-10-ST03-DT03-DF13-CF23-01
C-C773A-WIRE-09-ST01-DT07-DF12-CF01-01
C-C089D-SUBV-10-ST01-DT04-DF04-CF19-01
C-C476C-OSSL-03-ST02-DT04-DF04-CF24-01
C-C609A-WIRE-08-ST01-DT05-DF07-CF23-01
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C-C761A-WIRE-07-ST04-DT02-DF14-CF24-01
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C-C476E-WIRE-07-ST03-DT05-DF14-CF02-01
C-C764A-SUBV-02-ST04-DT02-DF16-CF01-01
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C-C400A-FFMP-07-ST03-DT04-DF14-CF19-01
C-C078A-FFMP-06-ST03-DT02-DF10-CF15-01
C-C476F-PSQL-04-ST01-DT06-DF17-CF14-01
C-C821A-PSQL-10-ST03-DT01-DF13-CF18-01
C-C682A-GIMP-06-ST04-DT07-DF17-CF03-01
C-C129A-GIMP-04-ST01-DT05-DF08-CF02-01
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C-C476G-GIMP-08-ST02-DT06-DF06-CF03-01
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C-C369A-GIMP-08-ST04-DT06-DF08-CF24-01
C-C806C-FFMP-03-ST04-DT02-DF04-CF18-01
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C-C078B-GIMP-08-ST03-DT06-DF06-CF22-01
C-C476D-FFMP-01-ST03-DT02-DF12-CF01-01
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C-C089C-WIRE-07-ST01-DT05-DF16-CF02-01
C-C476A-FFMP-03-ST01-DT07-DF15-CF23-01
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C-C195A-FFMP-03-ST03-DT01-DF14-CF03-01
C-C805B-OSSL-05-ST01-DT06-DF13-CF19-01
C-C401A-SUBV-04-ST02-DT02-DF08-CF24-01
C-C078A-OSSL-03-ST04-DT07-DF12-CF23-01
C-C476G-GIMP-09-ST04-DT03-DF09-CF24-01
C-C609A-PSQL-09-ST03-DT05-DF14-CF24-01
C-C190A-SUBV-04-ST02-DT06-DF12-CF01-01
C-C805C-SUBV-08-ST02-DT04-DF03-CF20-01

C-C771A-GIMP-03-ST04-DT06-DF15-CF20-01
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C-C476B-SUBV-10-ST02-DT05-DF11-CF18-01
C-C821A-GIMP-03-ST01-DT07-DF15-CF23-01
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C-C120B-PSQL-02-ST04-DT01-DF06-CF20-01
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C-C089C-FFMP-09-ST01-DT02-DF13-CF22-01
C-C476G-WIRE-05-ST03-DT04-DF13-CF20-01
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C-C196A-PSQL-01-ST01-DT02-DF06-CF20-01
C-C124D-GIMP-03-ST02-DT03-DF12-CF01-01
C-C835A-WIRE-05-ST03-DT03-DF11-CF03-01
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C-C195A-GIMP-10-ST01-DT04-DF17-CF19-01
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C-C089A-OSSL-04-ST03-DT05-DF12-CF19-01
C-C476E-PSQL-03-ST02-DT02-DF13-CF19-01
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C-C197A-WIRE-02-ST04-DT03-DF12-CF13-01
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C-C088A-WIRE-06-ST02-DT07-DF17-CF01-01
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C-C367A-WIRE-02-ST02-DT02-DF11-CF03-01
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C-C765A-SUBV-03-ST01-DT01-DF09-CF24-01
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C-C127B-WIRE-01-ST02-DT07-DF05-CF24-01
C-C400A-GIMP-03-ST01-DT04-DF16-CF19-01
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C-C476E-FFMP-04-ST04-DT02-DF12-CF02-01
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C-C476A-SUBV-09-ST03-DT04-DF07-CF22-01
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C-C476C-OSSL-10-ST02-DT01-DF11-CF03-01
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C-C839A-WIRE-01-ST03-DT03-DF15-CF19-01
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C-C459A-FFMP-07-ST02-DT04-DF09-CF20-01
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C-C476E-WIRE-02-ST01-DT06-DF14-CF24-01
C-C833A-SUBV-10-ST02-DT01-DF16-CF24-01
C-C190A-PSQL-10-ST04-DT02-DF16-CF02-01
C-C805A-WIRE-07-ST03-DT03-DF06-CF22-01
C-C400A-SUBV-04-ST02-DT01-DF15-CF18-01
C-C089A-SUBV-10-ST01-DT01-DF14-CF03-01
C-C476D-FFMP-08-ST02-DT07-DF09-CF02-01
C-C609A-PSQL-02-ST04-DT04-DF17-CF01-01
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C-C127C-GIMP-01-ST01-DT04-DF14-CF19-01
C-C774A-GIMP-09-ST04-DT07-DF12-CF02-01
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C-C820A-SUBV-06-ST04-DT03-DF11-CF23-01
C-C195A-WIRE-08-ST01-DT01-DF04-CF01-01
C-C120D-SUBV-08-ST02-DT06-DF17-CF23-01
C-C674A-WIRE-05-ST01-DT04-DF06-CF24-01
C-C089D-OSSL-06-ST02-DT03-DF13-CF23-01
C-C476B-GIMP-06-ST03-DT04-DF01-CF23-01
C-C765A-FFMP-09-ST01-DT06-DF15-CF02-01
C-C682B-OSSL-03-ST03-DT04-DF13-CF24-01
C-C824A-PSQL-02-ST04-DT03-DF08-CF18-01
C-C835A-FFMP-08-ST01-DT05-DF13-CF20-01
C-C089B-FFMP-08-ST03-DT07-DF16-CF20-01
C-C476G-PSQL-05-ST01-DT05-DF12-CF20-01
C-C367A-OSSL-03-ST03-DT07-DF08-CF03-01

C-C369A-SUBV-05-ST02-DT05-DF14-CF22-01
C-C843A-OSSL-04-ST02-DT02-DF16-CF19-01
C-C400B-OSSL-03-ST01-DT02-DF11-CF19-01
C-C078A-WIRE-03-ST02-DT01-DF07-CF24-01
C-C476F-SUBV-03-ST03-DT05-DF05-CF19-01
C-C414A-WIRE-07-ST01-DT02-DF05-CF22-01
C-C682A-GIMP-06-ST03-DT06-DF07-CF18-01
C-C785D-WIRE-09-ST01-DT04-DF11-CF12-01
C-C834A-PSQL-10-ST03-DT02-DF01-CF22-01
C-C078B-GIMP-01-ST03-DT02-DF15-CF23-01
C-C476B-WIRE-07-ST04-DT06-DF06-CF19-01
C-C363A-GIMP-05-ST04-DT04-DF03-CF24-01
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C-C415A-FFMP-09-ST03-DT05-DF12-CF24-01
C-C775A-WIRE-03-ST02-DT01-DF05-CF01-01
C-C088A-SUBV-09-ST01-DT05-DF11-CF18-01
C-C476A-SUBV-05-ST02-DT07-DF11-CF12-01
C-C764A-GIMP-06-ST03-DT03-DF12-CF20-01
C-C197A-GIMP-01-ST01-DT04-DF14-CF23-01
C-C806D-OSSL-04-ST04-DT06-DF15-CF01-01
C-C789A-SUBV-06-ST04-DT05-DF08-CF20-01
C-C088B-OSSL-07-ST04-DT03-DF17-CF22-01
C-C476C-GIMP-08-ST01-DT02-DF05-CF18-01
C-C765B-FFMP-02-ST02-DT05-DF13-CF14-01
C-C191B-PSQL-04-ST02-DT03-DF11-CF01-01
C-C761A-GIMP-06-ST03-DT07-DF13-CF18-01
C-C459A-FFMP-01-ST03-DT06-DF12-CF18-01
C-C078B-PSQL-06-ST01-DT04-DF05-CF02-01
C-C476D-WIRE-07-ST03-DT01-DF03-CF02-01
C-C821A-OSSL-07-ST01-DT01-DF14-CF01-01
C-C194A-OSSL-05-ST01-DT07-DF06-CF02-01
C-C124B-PSQL-01-ST04-DT05-DF04-CF03-01
C-C771A-OSSL-04-ST02-DT03-DF16-CF14-01
C-C089C-WIRE-01-ST03-DT04-DF10-CF20-01
C-C476E-OSSL-06-ST04-DT03-DF16-CF24-01
C-C828A-PSQL-01-ST04-DT06-DF16-CF19-01
C-C839A-SUBV-02-ST03-DT07-DF11-CF03-01
C-C785A-FFMP-08-ST01-DT01-DF16-CF23-01
C-C401A-GIMP-02-ST04-DT06-DF11-CF02-01
C-C088A-FFMP-10-ST02-DT05-DF17-CF02-01
C-C476C-PSQL-01-ST02-DT04-DF12-CF20-01
C-C663A-WIRE-03-ST03-DT06-DF12-CF03-01
C-C369A-FFMP-10-ST01-DT03-DF12-CF20-01
C-C806A-SUBV-07-ST02-DT04-DF05-CF22-01
C-C773A-PSQL-08-ST03-DT05-DF14-CF03-01
C-C089B-GIMP-04-ST04-DT06-DF02-CF22-01
C-C476G-FFMP-09-ST04-DT05-DF16-CF23-01
C-C412A-FFMP-08-ST01-DT03-DF15-CF23-01
C-C195A-GIMP-09-ST02-DT05-DF13-CF12-01
C-C806B-PSQL-05-ST03-DT03-DF09-CF02-01
C-C401A-FFMP-05-ST03-DT03-DF13-CF23-01
C-C088B-GIMP-02-ST02-DT03-DF16-CF19-01
C-C476B-OSSL-03-ST03-DT07-DF15-CF03-01
C-C479A-SUBV-05-ST02-DT04-DF14-CF22-01
C-C682A-FFMP-03-ST04-DT01-DF16-CF22-01
C-C127D-WIRE-10-ST02-DT01-DF02-CF15-01
C-C789A-WIRE-10-ST02-DT02-DF06-CF03-01
C-C078A-SUBV-03-ST03-DT01-DF13-CF18-01
C-C476F-WIRE-10-ST04-DT06-DF11-CF01-01
C-C833A-OSSL-10-ST03-DT01-DF17-CF15-01
C-C682B-WIRE-06-ST04-DT06-DF05-CF19-01
C-C124A-SUBV-02-ST01-DT02-DF13-CF20-01
C-C835A-GIMP-07-ST01-DT04-DF07-CF22-01
C-C088A-PSQL-08-ST01-DT07-DF15-CF22-01
C-C476A-FFMP-04-ST01-DT03-DF14-CF19-01
C-C831A-GIMP-09-ST04-DT05-DF11-CF20-01
C-C196A-OSSL-07-ST03-DT04-DF08-CF15-01
C-C126A-OSSL-03-ST04-DT07-DF12-CF03-01
C-C459A-SUBV-09-ST04-DT01-DF17-CF19-01
C-C089A-WIRE-05-ST04-DT02-DF14-CF24-01
C-C476D-PSQL-02-ST02-DT01-DF15-CF22-01
C-C543A-SUBV-04-ST02-DT06-DF07-CF18-01
C-C190A-SUBV-04-ST04-DT02-DF17-CF23-01
C-C785C-FFMP-04-ST01-DT06-DF14-CF23-01
C-C400B-OSSL-09-ST03-DT07-DF06-CF19-01
C-C089A-OSSL-03-ST01-DT07-DF06-CF01-01
C-C476E-SUBV-05-ST02-DT02-DF13-CF24-01
C-C363A-PSQL-04-ST03-DT02-DF02-CF23-01
C-C194A-PSQL-02-ST01-DT05-DF12-CF03-01
C-C129B-WIRE-02-ST04-DT05-DF15-CF19-01
C-C400A-PSQL-03-ST01-DT07-DF15-CF24-01
C-C089C-WIRE-01-ST04-DT03-DF11-CF13-01
C-C476G-GIMP-10-ST01-DT01-DF10-CF15-01
C-C543A-WIRE-10-ST04-DT05-DF11-CF02-01
C-C191A-GIMP-01-ST02-DT01-DF15-CF19-01
C-C127A-GIMP-03-ST02-DT06-DF11-CF24-01
C-C775A-OSSL-02-ST02-DT05-DF17-CF22-01
C-C078A-FFMP-07-ST02-DT04-DF17-CF19-01
C-C476D-SUBV-08-ST04-DT07-DF17-CF18-01
C-C820A-WIRE-03-ST02-DT06-DF13-CF01-01
C-C191B-OSSL-06-ST04-DT07-DF06-CF20-01
C-C134A-FFMP-08-ST02-DT03-DF13-CF14-01
C-C834A-WIRE-04-ST04-DT03-DF15-CF18-01
C-C088B-SUBV-09-ST03-DT06-DF12-CF03-01
C-C476E-PSQL-09-ST03-DT02-DF04-CF03-01
C-C367A-PSQL-07-ST01-DT07-DF16-CF18-01
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C-C124D-OSSL-06-ST01-DT07-DF06-CF02-01
C-C774A-SUBV-08-ST03-DT01-DF02-CF01-01
C-C089D-OSSL-02-ST01-DT01-DF05-CF24-01
C-C476B-OSSL-07-ST01-DT05-DF15-CF20-01
C-C821A-FFMP-08-ST04-DT01-DF06-CF22-01
C-C194A-WIRE-09-ST02-DT02-DF03-CF24-01
C-C170B-SUBV-07-ST03-DT02-DF01-CF01-01
C-C674A-FFMP-07-ST01-DT02-DF05-CF02-01
C-C089B-GIMP-05-ST03-DT06-DF12-CF01-01
C-C476F-GIMP-03-ST02-DT03-DF06-CF01-01
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C-C124A-PSQL-01-ST02-DT06-DF15-CF18-01
C-C771A-GIMP-01-ST02-DT03-DF10-CF24-01
C-C078B-PSQL-10-ST04-DT02-DF04-CF03-01

C-C476C-WIRE-06-ST04-DT04-DF12-CF22-01
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C-C191B-FFMP-08-ST03-DT03-DF14-CF18-01
C-C822A-GIMP-05-ST04-DT01-DF17-CF22-01
C-C773A-PSQL-05-ST04-DT04-DF16-CF19-01
C-C088A-FFMP-04-ST04-DT05-DF14-CF23-01
C-C476A-FFMP-02-ST03-DT06-DF13-CF02-01
C-C663A-GIMP-02-ST02-DT02-DF05-CF24-01
C-C369A-SUBV-07-ST03-DT04-DF05-CF20-01
C-C120A-PSQL-09-ST02-DT01-DF14-CF20-01
C-C400B-FFMP-06-ST01-DT05-DF17-CF02-01
C-C089B-FFMP-06-ST02-DT04-DF11-CF19-01
C-C476G-WIRE-01-ST02-DT01-DF02-CF14-01
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C-C196A-WIRE-03-ST02-DT07-DF09-CF02-01
C-C120C-GIMP-10-ST04-DT04-DF12-CF03-01
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C-C078B-WIRE-08-ST03-DT05-DF09-CF23-01
C-C476A-GIMP-04-ST01-DT02-DF14-CF20-01
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C-C197A-FFMP-04-ST01-DT01-DF11-CF19-01
C-C806D-OSSL-02-ST03-DT05-DF06-CF12-01
C-C835A-GIMP-10-ST02-DT06-DF11-CF20-01
C-C088B-SUBV-07-ST01-DT02-DF16-CF20-01
C-C476B-PSQL-01-ST04-DT06-DF11-CF19-01
C-C414A-FFMP-06-ST03-DT03-DF06-CF20-01
C-C682A-OSSL-02-ST04-DT04-DF12-CF01-01
C-C785A-FFMP-01-ST04-DT04-DF05-CF22-01
C-C400A-SUBV-09-ST04-DT02-DF03-CF23-01
C-C078A-PSQL-03-ST02-DT06-DF15-CF14-01
C-C476D-OSSL-06-ST03-DT03-DF06-CF23-01
C-C609A-GIMP-07-ST02-DT03-DF16-CF02-01
C-C190A-GIMP-06-ST02-DT02-DF06-CF22-01
C-C761A-WIRE-06-ST03-DT07-DF07-CF03-01
C-C774A-WIRE-01-ST02-DT06-DF05-CF23-01
C-C089C-OSSL-09-ST02-DT07-DF05-CF24-01
C-C476C-SUBV-08-ST01-DT04-DF16-CF02-01
C-C765A-WIRE-05-ST01-DT01-DF15-CF22-01
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C-C833A-SUBV-09-ST04-DT07-DF01-CF23-01
C-C839A-WIRE-07-ST03-DT03-DF16-CF24-01
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C-C459A-GIMP-06-ST04-DT07-DF16-CF18-01
C-C078A-WIRE-02-ST03-DT01-DF01-CF15-01
C-C476F-GIMP-02-ST02-DT07-DF17-CF24-01
C-C828A-WIRE-02-ST02-DT04-DF10-CF01-01
C-C191A-FFMP-09-ST04-DT07-DF13-CF18-01
C-C824B-SUBV-09-ST03-DT07-DF17-CF23-01
C-C771A-PSQL-04-ST01-DT04-DF14-CF24-01
C-C088A-OSSL-10-ST01-DT06-DF14-CF02-01
C-C476B-WIRE-09-ST02-DT05-DF08-CF22-01
C-C765B-GIMP-03-ST03-DT06-DF05-CF24-01
C-C197A-OSSL-10-ST04-DT01-DF15-CF03-01
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C-C773A-WIRE-02-ST03-DT03-DF17-CF20-01
C-C088A-GIMP-05-ST01-DT07-DF11-CF19-01
C-C476G-OSSL-03-ST04-DT06-DF15-CF18-01
C-C765B-SUBV-01-ST04-DT02-DF14-CF20-01
C-C194A-SUBV-01-ST01-DT06-DF04-CF23-01
C-C134A-OSSL-05-ST01-DT05-DF17-CF20-01
C-C834A-FFMP-03-ST04-DT05-DF13-CF12-01
C-C089D-FFMP-08-ST04-DT02-DF13-CF03-01
C-C476D-FFMP-10-ST04-DT04-DF14-CF03-01
C-C828A-FFMP-04-ST01-DT01-DF11-CF02-01
C-C195A-GIMP-03-ST03-DT06-DF09-CF13-01
C-C127C-GIMP-07-ST04-DT03-DF09-CF01-01
C-C674A-OSSL-07-ST01-DT02-DF11-CF01-01
C-C078A-SUBV-06-ST02-DT03-DF15-CF01-01
C-C476F-PSQL-04-ST03-DT03-DF05-CF01-01
C-C821A-PSQL-08-ST03-DT03-DF17-CF18-01
C-C839A-PSQL-08-ST02-DT05-DF05-CF18-01
C-C590A-PSQL-03-ST04-DT06-DF13-CF24-01
C-C775A-SUBV-08-ST02-DT07-DF05-CF22-01
C-C088A-PSQL-01-ST03-DT05-DF05-CF18-01
C-C476E-SUBV-05-ST01-DT01-DF06-CF20-01
C-C543A-OSSL-10-ST01-DT07-DF05-CF01-01
C-C682A-SUBV-02-ST03-DT03-DF13-CF19-01
C-C805D-PSQL-05-ST01-DT02-DF14-CF13-01
C-C774A-SUBV-02-ST04-DT01-DF07-CF24-01
C-C088B-FFMP-03-ST04-DT01-DF16-CF24-01
C-C476C-PSQL-01-ST02-DT07-DF16-CF23-01
C-C833A-WIRE-04-ST04-DT05-DF06-CF19-01
C-C196A-GIMP-05-ST01-DT02-DF14-CF01-01
C-C805C-OSSL-01-ST03-DT04-DF16-CF23-01
C-C400A-WIRE-05-ST02-DT06-DF14-CF03-01
C-C078A-PSQL-10-ST01-DT04-DF17-CF01-01
C-C476A-OSSL-04-ST04-DT02-DF08-CF20-01
C-C367A-GIMP-01-ST02-DT03-DF13-CF22-01
C-C682B-FFMP-06-ST04-DT04-DF16-CF20-01
C-C805B-WIRE-04-ST03-DT02-DF05-CF20-01
C-C775A-FFMP-10-ST03-DT04-DF16-CF22-01
C-C089B-GIMP-08-ST03-DT03-DF10-CF19-01
C-C476C-GIMP-05-ST01-DT01-DF03-CF02-01
C-C831A-PSQL-09-ST02-DT07-DF16-CF23-01
C-C190A-WIRE-10-ST03-DT01-DF17-CF02-01
C-C126D-GIMP-02-ST02-DT01-DF11-CF22-01
C-C773A-PSQL-06-ST01-DT05-DF15-CF18-01
C-C078B-OSSL-06-ST03-DT05-DF06-CF03-01
C-C476F-SUBV-09-ST03-DT05-DF13-CF01-01
C-C820A-FFMP-10-ST03-DT04-DF07-CF03-01
C-C191A-PSQL-03-ST02-DT06-DF11-CF24-01
C-C170A-FFMP-09-ST03-DT05-DF15-CF02-01
C-C674A-OSSL-01-ST03-DT07-DF02-CF20-01
C-C088B-SUBV-02-ST02-DT06-DF03-CF23-01
C-C476D-WIRE-08-ST02-DT03-DF17-CF22-01
C-C663A-OSSL-06-ST01-DT05-DF02-CF18-01
C-C369A-OSSL-09-ST04-DT04-DF13-CF23-01
C-C127A-SUBV-08-ST04-DT06-DF06-CF18-01

C-C459A-GIMP-04-ST01-DT01-DF06-CF23-01
C-C089C-WIRE-09-ST01-DT04-DF13-CF01-01
C-C476A-OSSL-02-ST04-DT07-DF12-CF19-01
C-C764A-WIRE-03-ST02-DT04-DF11-CF13-01
C-C191B-SUBV-08-ST01-DT07-DF06-CF14-01
C-C785D-PSQL-06-ST02-DT07-DF02-CF01-01
C-C835A-SUBV-09-ST04-DT02-DF12-CF01-01
C-C078B-OSSL-05-ST02-DT02-DF12-CF22-01
C-C476G-FFMP-03-ST01-DT04-DF11-CF03-01
C-C363A-SUBV-05-ST03-DT06-DF06-CF22-01
C-C682B-GIMP-04-ST02-DT02-DF12-CF01-01
C-C127B-GIMP-09-ST01-DT03-DF15-CF24-01
C-C401A-PSQL-03-ST02-DT03-DF13-CF02-01
C-C089B-SUBV-04-ST04-DT01-DF05-CF19-01
C-C476E-GIMP-10-ST03-DT02-DF17-CF18-01
C-C765A-SUBV-07-ST02-DT01-DF12-CF19-01
C-C195A-WIRE-07-ST01-DT07-DF16-CF22-01
C-C126B-FFMP-10-ST01-DT04-DF06-CF03-01
C-C789A-FFMP-08-ST04-DT06-DF06-CF19-01
C-C078A-FFMP-07-ST02-DT07-DF04-CF02-01
C-C476B-SUBV-06-ST04-DT03-DF16-CF20-01
C-C414A-GIMP-02-ST04-DT01-DF17-CF03-01
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C-C843A-WIRE-03-ST03-DT05-DF16-CF22-01
C-C834A-WIRE-07-ST01-DT04-DF03-CF18-01
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C-C476F-PSQL-07-ST01-DT06-DF14-CF23-01
C-C479A-FFMP-08-ST01-DT06-DF10-CF20-01
C-C191A-FFMP-08-ST04-DT03-DF01-CF02-01
C-C126C-OSSL-03-ST02-DT06-DF11-CF23-01
C-C771A-GIMP-10-ST02-DT02-DF11-CF03-01
C-C089D-WIRE-01-ST03-DT06-DF17-CF18-01
C-C476G-FFMP-08-ST02-DT06-DF13-CF22-01
C-C412A-OSSL-02-ST03-DT02-DF12-CF24-01
C-C369A-PSQL-10-ST03-DT05-DF12-CF03-01
C-C785B-SUBV-07-ST04-DT03-DF12-CF19-01
C-C400B-OSSL-04-ST03-DT03-DF15-CF15-01
C-C089A-GIMP-10-ST04-DT01-DF11-CF20-01
C-C476C-OSSL-04-ST03-DT02-DF15-CF13-01
C-C609A-SUBV-06-ST02-DT07-DF12-CF18-01
C-C194A-SUBV-06-ST02-DT03-DF17-CF03-01
C-C416A-OSSL-04-ST04-DT07-DF14-CF15-01
C-C789A-SUBV-06-ST04-DT05-DF14-CF01-01
C-C078B-SUBV-01-ST04-DT07-DF14-CF22-01
C-C476D-WIRE-05-ST03-DT07-DF05-CF24-01
C-C479A-WIRE-01-ST03-DT03-DF16-CF14-01
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C-C126A-PSQL-02-ST03-DT04-DF17-CF01-01
C-C835A-WIRE-01-ST02-DT07-DF08-CF20-01
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C-C476E-GIMP-06-ST01-DT04-DF11-CF19-01
C-C833A-PSQL-08-ST01-DT02-DF08-CF02-01
C-C197A-OSSL-09-ST02-DT06-DF05-CF01-01
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C-C674A-GIMP-08-ST03-DT01-DF17-CF22-01
C-C088A-GIMP-07-ST03-DT02-DF01-CF24-01
C-C476B-FFMP-07-ST02-DT05-DF12-CF01-01
C-C367A-FFMP-03-ST04-DT05-DF15-CF12-01
C-C682A-FFMP-07-ST01-DT03-DF13-CF24-01
C-C127D-FFMP-07-ST03-DT02-DF03-CF02-01
C-C775A-PSQL-07-ST01-DT06-DF12-CF24-01
C-C088A-PSQL-02-ST02-DT04-DF16-CF03-01
C-C476A-SUBV-03-ST04-DT01-DF02-CF03-01
C-C663A-GIMP-07-ST04-DT04-DF14-CF12-01
C-C839A-GIMP-02-ST02-DT04-DF14-CF02-01
C-C124B-WIRE-01-ST02-DT02-DF13-CF20-01
C-C401A-FFMP-09-ST04-DT04-DF05-CF23-01
C-C088B-WIRE-05-ST04-DT05-DF12-CF01-01
C-C476B-FFMP-02-ST01-DT02-DF06-CF24-01
C-C821A-PSQL-04-ST02-DT02-DF15-CF02-01
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C-C120D-GIMP-08-ST01-DT07-DF05-CF18-01
C-C400B-OSSL-05-ST01-DT06-DF16-CF19-01
C-C089B-OSSL-08-ST03-DT03-DF15-CF02-01
C-C476D-PSQL-01-ST03-DT07-DF07-CF18-01
C-C412A-GIMP-09-ST03-DT01-DF04-CF20-01
C-C190A-FFMP-05-ST01-DT06-DF05-CF19-01
C-C806B-WIRE-10-ST01-DT01-DF17-CF03-01
C-C834A-GIMP-02-ST03-DT07-DF11-CF01-01
C-C078A-GIMP-04-ST01-DT05-DF06-CF12-01
C-C476A-WIRE-09-ST01-DT05-DF01-CF01-01
C-C828A-FFMP-05-ST02-DT07-DF13-CF03-01
C-C196A-PSQL-03-ST03-DT04-DF17-CF23-01
C-C415A-PSQL-08-ST02-DT04-DF06-CF19-01
C-C774A-SUBV-03-ST02-DT03-DF15-CF20-01
C-C089A-FFMP-06-ST02-DT06-DF11-CF15-01
C-C476F-GIMP-08-ST04-DT04-DF10-CF03-01
C-C765B-OSSL-10-ST01-DT03-DF05-CF23-01
C-C195A-OSSL-10-ST03-DT02-DF06-CF20-01
C-C824A-SUBV-05-ST04-DT05-DF15-CF02-01
C-C400A-OSSL-03-ST04-DT02-DF06-CF02-01
C-C089C-SUBV-03-ST03-DT02-DF17-CF23-01
C-C476G-OSSL-10-ST02-DT06-DF11-CF02-01
C-C609A-OSSL-08-ST04-DT06-DF11-CF24-01
C-C194A-SUBV-05-ST04-DT05-DF11-CF22-01
C-C805A-FFMP-06-ST02-DT06-DF05-CF22-01
C-C771A-FFMP-02-ST02-DT05-DF09-CF13-01
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C-C476C-WIRE-07-ST04-DT01-DF14-CF23-01
C-C765A-WIRE-06-ST01-DT04-DF15-CF01-01
C-C191B-GIMP-01-ST01-DT02-DF12-CF24-01
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C-C459A-WIRE-09-ST01-DT01-DF13-CF24-01
C-C088A-WIRE-05-ST02-DT04-DF05-CF20-01
C-C476E-PSQL-06-ST02-DT03-DF12-CF18-01
C-C831A-PSQL-01-ST03-DT01-DF06-CF23-01
C-C369A-WIRE-02-ST02-DT01-DF06-CF12-01
C-C129A-GIMP-01-ST01-DT02-DF17-CF19-01
C-C773A-PSQL-04-ST03-DT06-DF04-CF23-01
C-C089D-OSSL-07-ST01-DT07-DF06-CF23-01
C-C476F-SUBV-02-ST02-DT05-DF06-CF03-01
C-C543A-SUBV-03-ST04-DT05-DF16-CF01-01

C-C839A-WIRE-04-ST04-DT07-DF15-CF20-01
C-C129B-SUBV-03-ST02-DT06-DF08-CF03-01
C-C459A-OSSL-06-ST01-DT03-DF14-CF22-01
C-C088B-OSSL-06-ST02-DT06-DF08-CF22-01
C-C476C-OSSL-04-ST03-DT05-DF17-CF02-01
C-C764A-GIMP-04-ST04-DT07-DF13-CF19-01
C-C682A-GIMP-07-ST01-DT03-DF11-CF23-01
C-C134A-GIMP-02-ST04-DT01-DF14-CF02-01
C-C771A-PSQL-08-ST02-DT04-DF05-CF02-01
C-C078B-PSQL-09-ST01-DT01-DF13-CF02-01
C-C476G-WIRE-03-ST03-DT06-DF16-CF19-01
C-C363A-WIRE-10-ST01-DT04-DF03-CF18-01
C-C682B-SUBV-03-ST03-DT06-DF03-CF03-01
C-C824B-WIRE-04-ST04-DT04-DF11-CF20-01
C-C401A-GIMP-05-ST04-DT07-DF13-CF24-01
C-C089B-FFMP-08-ST04-DT01-DF12-CF03-01
C-C476B-SUBV-01-ST01-DT03-DF15-CF12-01
C-C414A-PSQL-09-ST02-DT05-DF14-CF20-01
C-C197A-PSQL-06-ST02-DT02-DF10-CF22-01
C-C129B-PSQL-09-ST03-DT03-DF12-CF24-01
C-C834A-FFMP-01-ST03-DT01-DF16-CF03-01
C-C089A-WIRE-10-ST03-DT03-DF16-CF23-01
C-C476D-GIMP-05-ST01-DT07-DF13-CF23-01
C-C820A-SUBV-07-ST03-DT02-DF17-CF02-01
C-C191A-FFMP-08-ST02-DT01-DF16-CF01-01
C-C127A-OSSL-10-ST01-DT05-DF01-CF20-01
C-C775A-SUBV-07-ST02-DT05-DF17-CF19-01
C-C089C-SUBV-04-ST04-DT05-DF15-CF19-01
C-C476A-PSQL-10-ST03-DT01-DF05-CF22-01
C-C414A-FFMP-05-ST03-DT03-DF05-CF24-01
C-C839A-OSSL-09-ST04-DT05-DF14-CF18-01
C-C126A-FFMP-05-ST04-DT07-DF16-CF23-01
C-C774A-WIRE-10-ST03-DT02-DF12-CF12-01
C-C078A-GIMP-02-ST03-DT02-DF16-CF24-01
C-C476E-FFMP-09-ST04-DT02-DF11-CF14-01
C-C363A-OSSL-02-ST04-DT06-DF05-CF22-01
C-C196A-WIRE-06-ST04-DT03-DF11-CF20-01
C-C785C-WIRE-05-ST03-DT03-DF06-CF12-01
C-C400B-PSQL-06-ST04-DT01-DF17-CF13-01
C-C088A-GIMP-09-ST02-DT02-DF06-CF20-01
C-C476E-GIMP-01-ST02-DT06-DF05-CF19-01
C-C765A-SUBV-06-ST02-DT01-DF12-CF01-01
C-C191A-PSQL-09-ST03-DT05-DF17-CF12-01
C-C124D-GIMP-06-ST02-DT06-DF05-CF19-01
C-C400A-WIRE-03-ST01-DT07-DF16-CF18-01
C-C089B-OSSL-02-ST01-DT05-DF17-CF24-01
C-C476C-SUBV-07-ST04-DT02-DF13-CF24-01
C-C833A-WIRE-09-ST01-DT06-DF06-CF20-01
C-C194A-SUBV-02-ST02-DT07-DF05-CF02-01
C-C590A-OSSL-10-ST04-DT02-DF15-CF22-01
C-C674A-OSSL-02-ST01-DT05-DF06-CF23-01
C-C089D-WIRE-03-ST02-DT02-DF02-CF13-01
C-C476A-FFMP-02-ST02-DT07-DF14-CF22-01
C-C821A-PSQL-08-ST04-DT07-DF16-CF18-01
C-C191B-FFMP-03-ST03-DT02-DF16-CF19-01
C-C127D-FFMP-08-ST01-DT04-DF10-CF24-01
C-C773A-FFMP-09-ST04-DT06-DF11-CF20-01
C-C088B-PSQL-06-ST03-DT07-DF07-CF01-01
C-C476G-PSQL-10-ST03-DT04-DF06-CF24-01
C-C765B-OSSL-02-ST01-DT03-DF09-CF24-01
C-C682B-OSSL-04-ST01-DT06-DF06-CF14-01
C-C785D-PSQL-07-ST02-DT07-DF11-CF20-01
C-C835A-GIMP-08-ST02-DT03-DF12-CF18-01
C-C089A-SUBV-08-ST04-DT04-DF15-CF02-01
C-C476D-OSSL-05-ST01-DT03-DF04-CF20-01
C-C831A-GIMP-01-ST02-DT04-DF17-CF14-01
C-C369A-GIMP-08-ST04-DT04-DF08-CF23-01
C-C824A-SUBV-09-ST03-DT01-DF13-CF01-01
C-C789A-SUBV-04-ST03-DT04-DF15-CF22-01
C-C078B-FFMP-07-ST01-DT03-DF13-CF20-01
C-C476F-WIRE-08-ST01-DT04-DF16-CF18-01
C-C367A-FFMP-10-ST03-DT02-DF11-CF19-01
C-C682A-OSSL-07-ST03-DT01-DF15-CF24-01
C-C127B-PSQL-03-ST03-DT05-DF14-CF18-01
C-C789A-GIMP-05-ST02-DT02-DF05-CF03-01
C-C078A-FFMP-10-ST04-DT06-DF12-CF18-01
C-C476B-GIMP-03-ST04-DT05-DF17-CF02-01
C-C543A-OSSL-05-ST04-DT05-DF01-CF22-01
C-C190A-FFMP-01-ST04-DT04-DF13-CF03-01
C-C805A-OSSL-02-ST02-DT01-DF16-CF03-01
C-C400A-PSQL-07-ST01-DT03-DF10-CF01-01
C-C078B-PSQL-04-ST02-DT01-DF11-CF12-01
C-C476D-FFMP-04-ST03-DT01-DF12-CF23-01
C-C828A-WIRE-07-ST01-DT03-DF14-CF02-01
C-C195A-WIRE-10-ST01-DT06-DF02-CF18-01
C-C806A-GIMP-01-ST01-DT03-DF12-CF22-01
C-C834A-OSSL-10-ST03-DT02-DF14-CF19-01
C-C089C-OSSL-01-ST03-DT06-DF14-CF19-01
C-C476F-OSSL-09-ST02-DT03-DF09-CF01-01
C-C609A-PSQL-04-ST03-DT01-DF15-CF03-01
C-C197A-SUBV-05-ST02-DT05-DF12-CF20-01
C-C806C-WIRE-04-ST04-DT05-DF05-CF23-01
C-C775A-FFMP-01-ST04-DT05-DF01-CF18-01
C-C088B-GIMP-05-ST01-DT07-DF05-CF22-01
C-C476E-WIRE-06-ST04-DT01-DF15-CF01-01
C-C412A-FFMP-03-ST02-DT05-DF12-CF23-01
C-C195A-GIMP-03-ST04-DT07-DF08-CF24-01
C-C805B-FFMP-06-ST04-DT07-DF04-CF19-01
C-C401A-WIRE-10-ST02-DT01-DF11-CF01-01
C-C089A-WIRE-01-ST01-DT05-DF12-CF18-01
C-C476B-SUBV-04-ST02-DT07-DF04-CF20-01
C-C820A-GIMP-10-ST04-DT07-DF14-CF18-01
C-C197A-PSQL-08-ST03-DT03-DF13-CF01-01
C-C415A-FFMP-05-ST03-DT02-DF16-CF03-01
C-C835A-SUBV-03-ST03-DT04-DF06-CF02-01
C-C089B-SUBV-05-ST04-DT07-DF15-CF03-01
C-C476A-PSQL-05-ST04-DT04-DF11-CF13-01
C-C663A-SUBV-05-ST02-DT06-DF11-CF19-01
C-C191B-OSSL-01-ST01-DT02-DF05-CF22-01
C-C761A-SUBV-03-ST02-DT04-DF13-CF15-01
C-C459A-PSQL-04-ST04-DT07-DF07-CF03-01
C-C088A-OSSL-09-ST03-DT04-DF04-CF20-01

C-C476C-PSQL-07-ST01-DT02-DF12-CF18-01
C-C764A-FFMP-08-ST01-DT02-DF13-CF24-01
C-C191A-PSQL-06-ST02-DT01-DF15-CF15-01
C-C120A-GIMP-09-ST03-DT06-DF01-CF19-01
C-C400B-SUBV-01-ST01-DT06-DF16-CF14-01
C-C089D-FFMP-04-ST03-DT01-DF14-CF01-01
C-C476G-FFMP-10-ST03-DT01-DF17-CF22-01
C-C479A-SUBV-02-ST03-DT04-DF05-CF15-01
C-C369A-WIRE-05-ST01-DT07-DF17-CF03-01
C-C785B-WIRE-01-ST02-DT03-DF17-CF01-01
C-C771A-FFMP-08-ST04-DT01-DF05-CF03-01
C-C078B-WIRE-06-ST02-DT06-DF13-CF02-01
C-C476A-SUBV-02-ST03-DT06-DF05-CF23-01
C-C414A-OSSL-03-ST02-DT05-DF06-CF03-01
C-C682A-SUBV-09-ST04-DT04-DF12-CF19-01
C-C120D-PSQL-07-ST01-DT07-DF10-CF22-01
C-C674A-WIRE-09-ST02-DT06-DF04-CF24-01
C-C078A-PSQL-03-ST04-DT05-DF16-CF19-01
C-C476G-GIMP-03-ST01-DT07-DF15-CF02-01
C-C833A-GIMP-07-ST03-DT04-DF15-CF02-01
C-C839A-FFMP-02-ST02-DT03-DF11-CF23-01
C-C124C-SUBV-10-ST04-DT06-DF11-CF02-01
C-C774A-GIMP-05-ST01-DT03-DF14-CF23-01
C-C089D-SUBV-02-ST01-DT03-DF09-CF24-01
C-C476F-WIRE-01-ST02-DT02-DF06-CF12-01
C-C821A-WIRE-06-ST01-DT01-DF02-CF23-01
C-C190A-GIMP-07-ST03-DT06-DF14-CF02-01
C-C785A-OSSL-02-ST01-DT04-DF15-CF24-01
C-C773A-OSSL-02-ST01-DT02-DF17-CF22-01
C-C088B-GIMP-10-ST02-DT04-DF17-CF22-01
C-C476D-WIRE-08-ST03-DT06-DF13-CF03-01
C-C367A-SUBV-01-ST02-DT03-DF17-CF22-01
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C-C127C-SUBV-04-ST04-DT01-DF14-CF01-01
C-C835A-WIRE-06-ST03-DT07-DF15-CF02-01
C-C088A-PSQL-08-ST04-DT02-DF05-CF18-01
C-C476C-OSSL-06-ST04-DT03-DF07-CF24-01
C-C764A-PSQL-04-ST01-DT02-DF07-CF01-01
C-C194A-GIMP-04-ST03-DT01-DF06-CF01-01
C-C170A-PSQL-08-ST03-DT02-DF06-CF23-01
C-C400A-PSQL-09-ST03-DT06-DF17-CF01-01
C-C088A-GIMP-07-ST02-DT01-DF15-CF03-01
C-C476E-OSSL-09-ST02-DT04-DF14-CF18-01
C-C479A-WIRE-09-ST04-DT06-DF16-CF20-01
C-C196A-OSSL-07-ST01-DT03-DF04-CF19-01
C-C120B-FFMP-05-ST02-DT05-DF12-CF18-01
C-C773A-FFMP-07-ST02-DT04-DF12-CF02-01
C-C089C-FFMP-05-ST01-DT03-DF11-CF23-01
C-C476B-SUBV-07-ST04-DT02-DF16-CF19-01
C-C831A-PSQL-01-ST04-DT04-DF13-CF20-01
C-C196A-PSQL-02-ST03-DT02-DF17-CF23-01
C-C843A-GIMP-04-ST01-DT02-DF16-CF20-01
C-C774A-SUBV-02-ST03-DT03-DF16-CF19-01
C-C078A-WIRE-03-ST03-DT07-DF14-CF03-01
C-C476D-PSQL-02-ST01-DT05-DF11-CF24-01
C-C412A-OSSL-08-ST03-DT07-DF16-CF02-01
C-C682B-WIRE-04-ST02-DT04-DF14-CF19-01
C-C806B-WIRE-01-ST01-DT03-DF04-CF14-01
C-C834A-GIMP-03-ST04-DT04-DF13-CF19-01
C-C089B-OSSL-07-ST01-DT02-DF17-CF24-01
C-C476F-FFMP-05-ST02-DT04-DF05-CF02-01
C-C609A-FFMP-09-ST04-DT01-DF08-CF23-01
C-C194A-OSSL-05-ST04-DT01-DF16-CF18-01
C-C120C-OSSL-10-ST02-DT06-DF17-CF01-01
C-C401A-OSSL-04-ST02-DT05-DF06-CF15-01
C-C089D-SUBV-06-ST04-DT05-DF03-CF22-01
C-C476G-GIMP-04-ST03-DT05-DF14-CF15-01
C-C820A-GIMP-04-ST03-DT07-DF04-CF24-01
C-C197A-SUBV-09-ST02-DT02-DF11-CF20-01
C-C126B-WIRE-06-ST04-DT07-DF12-CF23-01
C-C771A-GIMP-06-ST01-DT01-DF15-CF20-01
C-C078B-GIMP-08-ST03-DT01-DF16-CF14-01
C-C476C-SUBV-10-ST04-DT06-DF01-CF22-01
C-C828A-PSQL-07-ST04-DT06-DF14-CF18-01
C-C369A-SUBV-01-ST01-DT01-DF12-CF18-01
C-C805D-PSQL-09-ST01-DT05-DF11-CF02-01
C-C674A-PSQL-08-ST04-DT02-DF10-CF20-01
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C-C476B-GIMP-09-ST03-DT01-DF16-CF01-01
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C-C191A-WIRE-10-ST04-DT05-DF09-CF02-01
C-C124A-FFMP-03-ST03-DT01-DF05-CF03-01
C-C789A-FFMP-10-ST04-DT07-DF01-CF24-01
C-C078A-FFMP-01-ST04-DT06-DF06-CF01-01
C-C476A-PSQL-03-ST02-DT03-DF15-CF03-01
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C-C400B-SUBV-07-ST01-DT05-DF14-CF22-01
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C-C476E-OSSL-08-ST01-DT07-DF09-CF23-01
C-C663A-GIMP-02-ST01-DT03-DF12-CF03-01
C-C839A-GIMP-08-ST01-DT07-DF01-CF22-01
C-C124B-OSSL-08-ST03-DT04-DF14-CF03-01
C-C459A-OSSL-05-ST03-DT03-DF13-CF01-01
C-C089A-WIRE-09-ST01-DT03-DF06-CF19-01
C-C476F-FFMP-06-ST04-DT06-DF06-CF20-01
C-C765A-OSSL-05-ST03-DT03-DF13-CF22-01
C-C191B-PSQL-03-ST01-DT03-DF05-CF03-01
C-C416A-GIMP-02-ST04-DT05-DF06-CF24-01
C-C775A-WIRE-01-ST02-DT07-DF12-CF23-01
C-C088A-SUBV-02-ST04-DT04-DF08-CF23-01
C-C476B-WIRE-01-ST01-DT01-DF13-CF19-01
C-C543A-FFMP-10-ST03-DT07-DF15-CF19-01
C-C682A-WIRE-09-ST02-DT06-DF06-CF23-01
C-C170B-PSQL-09-ST04-DT04-DF15-CF13-01
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C-C078A-FFMP-03-ST02-DT02-DF05-CF19-01
C-C476C-GIMP-03-ST01-DT02-DF13-CF01-01
C-C479A-SUBV-03-ST01-DT02-DF17-CF02-01
C-C190A-SUBV-08-ST04-DT04-DF15-CF01-01
C-C805C-FFMP-10-ST02-DT06-DF13-CF22-01

C-C834A-PSQL-06-ST02-DT02-DF11-CF22-01
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C-C476D-SUBV-05-ST04-DT05-DF12-CF18-01
C-C367A-OSSL-02-ST02-DT01-DF06-CF13-01
C-C191A-GIMP-03-ST03-DT06-DF05-CF23-01
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C-C771A-WIRE-02-ST04-DT04-DF16-CF18-01
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C-C476A-WIRE-09-ST02-DT04-DF17-CF23-01
C-C412A-WIRE-09-ST01-DT06-DF11-CF23-01
C-C839A-PSQL-02-ST04-DT02-DF03-CF24-01
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C-C835A-GIMP-07-ST01-DT01-DF14-CF19-01
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C-C476E-OSSL-01-ST03-DT02-DF08-CF02-01
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C-C126C-PSQL-01-ST01-DT07-DF05-CF20-01
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C-C088A-PSQL-07-ST02-DT07-DF14-CF18-01
C-C476C-PSQL-10-ST04-DT07-DF06-CF20-01
C-C543A-GIMP-10-ST02-DT02-DF09-CF03-01
C-C194A-GIMP-04-ST01-DT02-DF07-CF20-01
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C-C401A-FFMP-04-ST02-DT05-DF11-CF18-01
C-C089D-GIMP-01-ST04-DT01-DF10-CF13-01
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C-C459A-GIMP-03-ST03-DT06-DF12-CF23-01
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C-C476F-GIMP-07-ST01-DT03-DF12-CF19-01
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C-C124B-FFMP-08-ST02-DT03-DF12-CF20-01
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C-C078A-PSQL-02-ST03-DT05-DF06-CF20-01
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C-C363A-FFMP-01-ST01-DT05-DF16-CF20-01
C-C190A-WIRE-05-ST04-DT04-DF14-CF15-01
C-C785D-WIRE-02-ST01-DT04-DF14-CF01-01
C-C774A-PSQL-08-ST03-DT02-DF13-CF03-01
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C-C476G-WIRE-06-ST03-DT05-DF03-CF22-01
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C-C197A-PSQL-03-ST03-DT05-DF06-CF01-01
C-C805B-SUBV-09-ST03-DT06-DF03-CF18-01
C-C773A-WIRE-06-ST01-DT01-DF02-CF02-01
C-C078A-OSSL-03-ST02-DT04-DF07-CF23-01
C-C476D-PSQL-09-ST02-DT06-DF16-CF19-01
C-C833A-GIMP-08-ST04-DT06-DF12-CF19-01
C-C682A-SUBV-07-ST01-DT07-DF16-CF22-01
C-C805C-GIMP-01-ST04-DT05-DF06-CF03-01
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C-C089D-FFMP-09-ST01-DT07-DF17-CF02-01
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C-C764A-WIRE-01-ST03-DT04-DF01-CF22-01
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C-C775A-FFMP-10-ST03-DT07-DF08-CF01-01
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C-C120D-FFMP-07-ST02-DT04-DF16-CF18-01
C-C774A-WIRE-09-ST02-DT02-DF14-CF18-01
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C-C476D-OSSL-02-ST02-DT05-DF13-CF22-01
C-C663A-PSQL-02-ST04-DT04-DF05-CF23-01
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C-C590A-WIRE-02-ST04-DT06-DF12-CF23-01
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C-C089C-GIMP-06-ST02-DT01-DF02-CF02-01
C-C476C-WIRE-06-ST03-DT07-DF11-CF15-01
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C-C191A-PSQL-01-ST01-DT04-DF05-CF03-01
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C-C835A-SUBV-08-ST04-DT01-DF16-CF15-01
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C-C476E-FFMP-10-ST04-DT07-DF13-CF03-01
C-C414A-SUBV-09-ST01-DT05-DF03-CF01-01
C-C197A-GIMP-09-ST04-DT07-DF17-CF22-01
C-C124C-PSQL-04-ST01-DT02-DF05-CF15-01
C-C401A-GIMP-03-ST01-DT03-DF09-CF18-01
C-C078B-SUBV-02-ST03-DT05-DF14-CF14-01
C-C476G-PSQL-04-ST02-DT02-DF05-CF20-01
C-C414A-FFMP-04-ST04-DT03-DF17-CF20-01
C-C195A-OSSL-02-ST02-DT05-DF11-CF24-01
C-C805D-OSSL-10-ST02-DT03-DF06-CF02-01
C-C773A-PSQL-07-ST02-DT04-DF11-CF24-01
C-C089D-FFMP-07-ST04-DT06-DF17-CF20-01
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C-C191B-WIRE-04-ST03-DT02-DF14-CF13-01
C-C127B-PSQL-08-ST04-DT01-DF13-CF02-01
C-C789A-WIRE-05-ST04-DT05-DF17-CF24-01
C-C078A-PSQL-10-ST01-DT02-DF11-CF22-01
C-C476B-GIMP-01-ST04-DT04-DF17-CF02-01
C-C543A-GIMP-03-ST02-DT07-DF15-CF18-01
C-C369A-FFMP-06-ST01-DT06-DF15-CF14-01
C-C126C-SUBV-06-ST01-DT01-DF02-CF23-01
C-C400B-PSQL-02-ST03-DT04-DF03-CF20-01
C-C089B-WIRE-08-ST02-DT05-DF13-CF23-01
C-C476G-SUBV-03-ST01-DT01-DF05-CF24-01
C-C833A-SUBV-05-ST01-DT06-DF06-CF24-01

C-C194A-GIMP-10-ST03-DT03-DF06-CF19-01
C-C806C-GIMP-09-ST03-DT03-DF15-CF24-01
C-C459A-SUBV-04-ST03-DT06-DF12-CF22-01
C-C088A-OSSL-08-ST01-DT06-DF16-CF03-01
C-C476C-OSSL-06-ST02-DT06-DF02-CF14-01
C-C479A-PSQL-10-ST02-DT05-DF14-CF22-01
C-C682B-OSSL-08-ST04-DT01-DF13-CF23-01
C-C129A-OSSL-08-ST01-DT02-DF06-CF22-01
C-C674A-GIMP-08-ST04-DT03-DF15-CF02-01
C-C089C-WIRE-05-ST02-DT02-DF12-CF01-01
C-C476B-SUBV-07-ST02-DT07-DF17-CF01-01
C-C820A-FFMP-08-ST04-DT04-DF10-CF03-01
C-C190A-SUBV-03-ST01-DT05-DF10-CF03-01
C-C124D-WIRE-03-ST02-DT05-DF16-CF14-01
C-C834A-FFMP-07-ST02-DT07-DF06-CF20-01
C-C089A-SUBV-07-ST03-DT01-DF05-CF02-01
C-C476F-WIRE-01-ST04-DT01-DF15-CF23-01
C-C821A-OSSL-04-ST01-DT07-DF13-CF02-01
C-C839A-PSQL-02-ST02-DT04-DF12-CF02-01
C-C134A-FFMP-10-ST04-DT06-DF09-CF01-01
C-C771A-OSSL-02-ST01-DT01-DF08-CF23-01
C-C088B-GIMP-04-ST04-DT03-DF06-CF18-01
C-C476E-PSQL-08-ST01-DT05-DF16-CF20-01
C-C828A-GIMP-03-ST03-DT02-DF11-CF23-01
C-C194A-SUBV-07-ST03-DT06-DF16-CF24-01
C-C785C-GIMP-07-ST04-DT04-DF17-CF20-01
C-C459A-OSSL-06-ST03-DT05-DF12-CF19-01
C-C088B-SUBV-03-ST03-DT04-DF15-CF24-01
C-C476D-FFMP-05-ST03-DT03-DF06-CF02-01
C-C609A-GIMP-06-ST01-DT03-DF11-CF14-01
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C-C806A-WIRE-06-ST01-DT07-DF17-CF18-01
C-C773A-FFMP-03-ST01-DT02-DF13-CF01-01
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C-C476C-OSSL-03-ST04-DT02-DF05-CF03-01
C-C764A-PSQL-10-ST04-DT01-DF05-CF24-01
C-C191B-PSQL-09-ST01-DT01-DF13-CF20-01
C-C120C-OSSL-05-ST03-DT03-DF02-CF19-01
C-C771A-WIRE-01-ST02-DT03-DF11-CF01-01
C-C089D-GIMP-06-ST01-DT03-DF14-CF03-01
C-C476A-GIMP-04-ST03-DT03-DF12-CF19-01
C-C765B-FFMP-09-ST02-DT02-DF16-CF19-01
C-C682B-WIRE-04-ST02-DT02-DF09-CF18-01
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C-C774A-GIMP-09-ST04-DT01-DF02-CF22-01
C-C088A-PSQL-02-ST04-DT01-DF16-CF01-01
C-C476B-WIRE-02-ST01-DT06-DF13-CF24-01
C-C412A-SUBV-01-ST03-DT04-DF13-CF03-01
C-C196A-OSSL-05-ST03-DT03-DF05-CF22-01
C-C126B-SUBV-01-ST03-DT01-DF15-CF18-01
C-C834A-PSQL-10-ST03-DT05-DF05-CF19-01
C-C078B-WIRE-10-ST01-DT06-DF12-CF19-01
C-C476C-SUBV-09-ST03-DT02-DF06-CF18-01
C-C765A-WIRE-02-ST04-DT01-DF17-CF02-01
C-C197A-GIMP-10-ST04-DT06-DF01-CF01-01
C-C127D-GIMP-04-ST01-DT04-DF11-CF23-01
C-C400A-FFMP-05-ST02-DT04-DF17-CF13-01
C-C089A-FFMP-09-ST02-DT07-DF11-CF18-01
C-C476E-PSQL-10-ST01-DT07-DF11-CF22-01
C-C367A-FFMP-07-ST02-DT07-DF01-CF23-01
C-C190A-GIMP-03-ST01-DT04-DF06-CF19-01
C-C127C-FFMP-04-ST02-DT07-DF05-CF02-01
C-C401A-SUBV-09-ST01-DT07-DF14-CF20-01
C-C078A-OSSL-08-ST03-DT04-DF09-CF03-01
C-C476F-FFMP-04-ST02-DT01-DF14-CF18-01
C-C363A-OSSL-09-ST01-DT06-DF14-CF01-01
C-C369A-FFMP-01-ST02-DT07-DF15-CF22-01
C-C785B-FFMP-02-ST04-DT05-DF09-CF24-01
C-C789A-WIRE-02-ST04-DT06-DF16-CF03-01
C-C088A-PSQL-05-ST04-DT05-DF05-CF15-01
C-C476D-WIRE-07-ST04-DT05-DF15-CF19-01
C-C663A-SUBV-08-ST03-DT03-DF15-CF15-01
C-C191A-WIRE-06-ST02-DT05-DF12-CF18-01
C-C120B-WIRE-09-ST02-DT02-DF14-CF13-01
C-C775A-OSSL-04-ST02-DT02-DF13-CF12-01
C-C078B-FFMP-03-ST02-DT02-DF17-CF24-01
C-C476A-GIMP-03-ST04-DT04-DF16-CF01-01
C-C543A-WIRE-04-ST01-DT05-DF12-CF24-01
C-C195A-OSSL-09-ST01-DT06-DF11-CF01-01
C-C416A-SUBV-05-ST03-DT01-DF16-CF23-01
C-C835A-PSQL-10-ST01-DT01-DF06-CF19-01
C-C088A-WIRE-10-ST04-DT02-DF08-CF20-01
C-C476G-OSSL-06-ST02-DT01-DF17-CF02-01
C-C609A-OSSL-03-ST03-DT04-DF08-CF19-01
C-C682A-PSQL-07-ST04-DT04-DF13-CF02-01
C-C126A-OSSL-06-ST01-DT07-DF13-CF22-01
C-C400B-GIMP-05-ST03-DT04-DF15-CF02-01
C-C089D-SUBV-09-ST03-DT03-DF13-CF22-01
C-C476F-PSQL-05-ST03-DT05-DF01-CF20-01
C-C414A-GIMP-10-ST02-DT05-DF16-CF18-01
C-C196A-SUBV-05-ST03-DT01-DF17-CF24-01
C-C805A-PSQL-03-ST04-DT05-DF05-CF01-01
C-C674A-SUBV-07-ST04-DT05-DF05-CF23-01
C-C089B-GIMP-06-ST01-DT01-DF15-CF23-01
C-C476B-FFMP-01-ST01-DT03-DF08-CF12-01
C-C663A-PSQL-05-ST04-DT02-DF06-CF20-01
C-C369A-WIRE-08-ST04-DT02-DF10-CF03-01
C-C415A-OSSL-07-ST03-DT03-DF16-CF20-01
C-C400B-WIRE-08-ST02-DT03-DF06-CF24-01
C-C088B-FFMP-02-ST03-DT07-DF06-CF18-01
C-C476E-OSSL-09-ST04-DT06-DF05-CF22-01
C-C367A-WIRE-07-ST03-DT01-DF13-CF20-01
C-C191A-OSSL-04-ST03-DT07-DF12-CF20-01
C-C120A-GIMP-08-ST02-DT02-DF10-CF01-01
C-C773A-OSSL-06-ST01-DT06-DF15-CF18-01
C-C089A-GIMP-07-ST01-DT06-DF05-CF12-01
C-C476G-FFMP-02-ST01-DT02-DF02-CF03-01
C-C363A-GIMP-06-ST02-DT06-DF10-CF22-01
C-C682A-GIMP-10-ST02-DT03-DF11-CF12-01
C-C824A-FFMP-01-ST04-DT04-DF04-CF24-01
C-C771A-SUBV-03-ST04-DT07-DF17-CF03-01
C-C078A-PSQL-01-ST04-DT05-DF14-CF22-01

C-C476A-WIRE-10-ST02-DT07-DF07-CF24-01
C-C821A-SUBV-02-ST04-DT03-DF11-CF03-01
C-C195A-PSQL-02-ST03-DT03-DF15-CF23-01
C-C126D-WIRE-10-ST01-DT06-DF15-CF19-01
C-C835A-PSQL-01-ST03-DT02-DF04-CF20-01
C-C078A-WIRE-04-ST02-DT05-DF17-CF24-01
C-C476D-SUBV-08-ST03-DT04-DF16-CF23-01
C-C831A-FFMP-01-ST01-DT01-DF17-CF19-01
C-C194A-SUBV-03-ST01-DT04-DF05-CF18-01
C-C824B-GIMP-08-ST02-DT05-DF17-CF03-01
C-C400A-FFMP-09-ST03-DT04-DF12-CF19-01
C-C088B-OSSL-04-ST02-DT04-DF14-CF13-01
C-C476C-GIMP-06-ST02-DT06-DF14-CF20-01
C-C765A-PSQL-07-ST03-DT06-DF04-CF03-01
C-C839A-FFMP-05-ST04-DT06-DF17-CF23-01
C-C761A-SUBV-10-ST04-DT02-DF12-CF22-01
C-C401A-GIMP-10-ST04-DT02-DF14-CF22-01
C-C089A-SUBV-02-ST04-DT06-DF03-CF02-01
C-C476B-PSQL-02-ST01-DT05-DF17-CF03-01
C-C820A-OSSL-06-ST02-DT02-DF15-CF20-01
C-C191B-GIMP-09-ST02-DT05-DF16-CF03-01
C-C127A-PSQL-04-ST01-DT04-DF06-CF20-01
C-C774A-FFMP-04-ST01-DT07-DF11-CF24-01
C-C089C-WIRE-10-ST02-DT07-DF12-CF03-01
C-C476D-GIMP-05-ST04-DT03-DF11-CF01-01
C-C764A-FFMP-02-ST03-DT04-DF12-CF01-01
C-C682B-PSQL-08-ST01-DT07-DF03-CF15-01
C-C785A-PSQL-02-ST03-DT07-DF14-CF19-01
C-C789A-PSQL-01-ST02-DT06-DF10-CF18-01
C-C089D-SUBV-08-ST03-DT01-DF06-CF19-01
C-C476G-PSQL-04-ST04-DT07-DF06-CF14-01
C-C479A-GIMP-09-ST01-DT07-DF06-CF02-01
C-C197A-OSSL-06-ST01-DT02-DF14-CF24-01
C-C170B-OSSL-09-ST04-DT03-DF11-CF03-01
C-C834A-SUBV-08-ST02-DT01-DF16-CF01-01
C-C088A-OSSL-09-ST01-DT04-DF16-CF18-01
C-C476A-FFMP-10-ST03-DT04-DF15-CF19-01
C-C412A-PSQL-05-ST02-DT03-DF05-CF12-01
C-C190A-FFMP-01-ST02-DT01-DF13-CF22-01
C-C129B-SUBV-01-ST02-DT01-DF13-CF24-01
C-C459A-WIRE-03-ST04-DT03-DF13-CF23-01
C-C078A-PSQL-07-ST04-DT03-DF02-CF20-01
C-C476E-SUBV-08-ST01-DT01-DF12-CF02-01
C-C833A-SUBV-04-ST04-DT05-DF14-CF18-01
C-C839A-WIRE-02-ST03-DT05-DF17-CF20-01
C-C822A-FFMP-06-ST01-DT06-DF17-CF02-01
C-C775A-GIMP-02-ST01-DT05-DF09-CF03-01
C-C078B-FFMP-05-ST01-DT04-DF11-CF19-01
C-C476C-FFMP-09-ST04-DT03-DF17-CF18-01
C-C828A-OSSL-08-ST04-DT04-DF06-CF22-01
C-C194A-WIRE-07-ST04-DT05-DF02-CF01-01
C-C129A-WIRE-05-ST03-DT07-DF15-CF20-01
C-C674A-OSSL-06-ST03-DT07-DF11-CF20-01
C-C089B-GIMP-06-ST03-DT02-DF15-CF01-01
C-C476F-OSSL-07-ST03-DT02-DF05-CF23-01
C-C765B-WIRE-01-ST03-DT07-DF09-CF20-01
C-C195A-SUBV-04-ST04-DT01-DF06-CF22-01
C-C805B-GIMP-03-ST03-DT04-DF13-CF23-01
C-C775A-FFMP-07-ST04-DT02-DF06-CF02-01
C-C088A-WIRE-01-ST03-DT02-DF11-CF14-01
C-C476B-WIRE-03-ST02-DT01-DF11-CF24-01
C-C820A-SUBV-10-ST01-DT05-DF12-CF01-01
C-C682B-OSSL-10-ST02-DT07-DF06-CF23-01
C-C824B-OSSL-04-ST04-DT06-DF16-CF13-01
C-C773A-SUBV-05-ST01-DT03-DF15-CF14-01
C-C089B-SUBV-03-ST02-DT06-DF07-CF19-01
C-C476E-SUBV-01-ST03-DT04-DF14-CF24-01
C-C367A-WIRE-02-ST02-DT07-DF17-CF24-01
C-C190A-SUBV-01-ST03-DT02-DF14-CF01-01
C-C806A-PSQL-07-ST02-DT05-DF07-CF19-01
C-C674A-GIMP-05-ST02-DT04-DF14-CF03-01
C-C089A-GIMP-09-ST01-DT05-DF12-CF02-01
C-C476G-OSSL-05-ST01-DT06-DF16-CF22-01
C-C479A-GIMP-03-ST04-DT01-DF15-CF23-01
C-C369A-GIMP-03-ST01-DT01-DF16-CF02-01
C-C416A-SUBV-08-ST01-DT03-DF14-CF18-01
C-C771A-WIRE-07-ST03-DT01-DF05-CF18-01
C-C089D-FFMP-05-ST04-DT03-DF05-CF23-01
C-C476D-PSQL-09-ST02-DT02-DF15-CF23-01
C-C831A-OSSL-07-ST02-DT03-DF14-CF23-01
C-C682A-FFMP-05-ST01-DT03-DF15-CF02-01
C-C785D-SUBV-10-ST04-DT02-DF06-CF23-01
C-C400A-OSSL-02-ST01-DT05-DF17-CF01-01
C-C078B-PSQL-08-ST03-DT07-DF04-CF19-01
C-C476A-GIMP-02-ST02-DT05-DF12-CF02-01
C-C663A-FFMP-03-ST04-DT06-DF03-CF01-01
C-C191B-PSQL-04-ST02-DT04-DF05-CF19-01
C-C127C-FFMP-09-ST01-DT01-DF12-CF24-01
C-C459A-PSQL-09-ST04-DT06-DF13-CF24-01
C-C089C-OSSL-03-ST04-DT01-DF13-CF18-01
C-C476F-WIRE-03-ST01-DT07-DF06-CF20-01
C-C363A-PSQL-09-ST03-DT02-DF13-CF18-01
C-C191A-GIMP-06-ST04-DT01-DF12-CF12-01
C-C590A-WIRE-07-ST02-DT06-DF01-CF02-01
C-C400B-FFMP-03-ST03-DT07-DF03-CF02-01
C-C078A-SUBV-07-ST01-DT05-DF16-CF01-01
C-C476E-SUBV-01-ST03-DT01-DF13-CF18-01
C-C765B-GIMP-10-ST01-DT02-DF16-CF03-01
C-C196A-OSSL-08-ST01-DT04-DF11-CF19-01
C-C806D-GIMP-06-ST04-DT02-DF15-CF03-01
C-C835A-PSQL-08-ST02-DT05-DF16-CF22-01
C-C088B-GIMP-02-ST02-DT06-DF17-CF20-01
C-C476F-FFMP-07-ST04-DT04-DF03-CF01-01
C-C765A-WIRE-01-ST04-DT07-DF05-CF02-01
C-C197A-WIRE-09-ST03-DT07-DF08-CF03-01
C-C126C-FFMP-02-ST03-DT05-DF11-CF12-01
C-C834A-OSSL-10-ST03-DT06-DF06-CF20-01
C-C089D-SUBV-01-ST02-DT07-DF10-CF24-01
C-C476G-GIMP-08-ST02-DT03-DF09-CF22-01
C-C821A-OSSL-05-ST02-DT01-DF11-CF22-01
C-C194A-PSQL-10-ST04-DT06-DF14-CF20-01
C-C127B-SUBV-05-ST01-DT03-DF05-CF22-01

C-C789A-SUBV-04-ST01-DT04-DF12-CF22-01
C-C078A-PSQL-06-ST03-DT03-DF06-CF02-01
C-C476A-WIRE-10-ST01-DT06-DF05-CF19-01
C-C412A-SUBV-06-ST01-DT06-DF11-CF19-01
C-C190A-WIRE-07-ST02-DT06-DF17-CF24-01
C-C126A-WIRE-08-ST03-DT04-DF16-CF18-01
C-C401A-WIRE-01-ST04-DT03-DF14-CF19-01
C-C089A-FFMP-04-ST04-DT02-DF05-CF03-01
C-C476D-PSQL-06-ST04-DT07-DF14-CF03-01
C-C833A-FFMP-08-ST03-DT04-DF17-CF24-01
C-C195A-SUBV-02-ST04-DT03-DF05-CF18-01
C-C120D-OSSL-01-ST02-DT07-DF12-CF02-01
C-C774A-GIMP-06-ST02-DT02-DF16-CF23-01
C-C088B-OSSL-10-ST04-DT04-DF16-CF20-01
C-C476B-OSSL-04-ST03-DT05-DF10-CF03-01
C-C609A-PSQL-04-ST01-DT03-DF12-CF02-01
C-C369A-FFMP-07-ST03-DT02-DF11-CF02-01
C-C785C-PSQL-01-ST02-DT02-DF11-CF01-01
C-C400B-GIMP-03-ST02-DT01-DF13-CF23-01
C-C078B-WIRE-04-ST01-DT01-DF01-CF23-01
C-C476C-OSSL-08-ST01-DT04-DF12-CF13-01
C-C764A-FFMP-03-ST01-DT05-DF06-CF24-01
C-C191B-PSQL-03-ST03-DT02-DF12-CF22-01
C-C126B-PSQL-10-ST01-DT01-DF06-CF01-01
C-C400A-PSQL-01-ST04-DT03-DF15-CF15-01
C-C089B-FFMP-01-ST01-DT05-DF06-CF22-01
C-C476B-SUBV-10-ST03-DT02-DF16-CF24-01
C-C828A-WIRE-05-ST03-DT06-DF07-CF22-01
C-C839A-FFMP-09-ST01-DT05-DF07-CF24-01
C-C785B-OSSL-03-ST03-DT06-DF14-CF24-01
C-C834A-WIRE-06-ST01-DT04-DF07-CF13-01
C-C089C-GIMP-10-ST03-DT02-DF15-CF20-01
C-C476F-GIMP-07-ST04-DT06-DF13-CF20-01
C-C543A-PSQL-10-ST04-DT03-DF16-CF15-01
C-C191A-OSSL-08-ST02-DT03-DF16-CF20-01
C-C124B-WIRE-03-ST04-DT03-DF17-CF22-01
C-C771A-OSSL-05-ST02-DT05-DF12-CF18-01
C-C088A-WIRE-05-ST02-DT04-DF13-CF15-01
C-C476E-FFMP-03-ST02-DT05-DF17-CF19-01
C-C414A-SUBV-04-ST03-DT04-DF13-CF23-01
C-C682B-SUBV-10-ST04-DT06-DF15-CF14-01
C-C124A-GIMP-06-ST03-DT01-DF08-CF14-01
C-C674A-SUBV-09-ST03-DT06-DF17-CF01-01
C-C089A-OSSL-09-ST04-DT06-DF17-CF24-01
C-C476A-WIRE-04-ST04-DT07-DF11-CF22-01
C-C765A-GIMP-01-ST02-DT05-DF05-CF19-01
C-C682A-GIMP-01-ST03-DT07-DF04-CF23-01
C-C805D-SUBV-05-ST04-DT04-DF13-CF20-01
C-C789A-FFMP-10-ST04-DT01-DF05-CF20-01
C-C078A-PSQL-03-ST02-DT01-DF14-CF22-01
C-C476C-PSQL-06-ST02-DT01-DF06-CF18-01
C-C820A-OSSL-09-ST04-DT01-DF15-CF03-01
C-C196A-PSQL-02-ST02-DT05-DF13-CF19-01
C-C761A-FFMP-04-ST01-DT07-DF17-CF19-01
C-C459A-WIRE-02-ST01-DT07-DF01-CF03-01
C-C089C-FFMP-08-ST03-DT07-DF11-CF01-01
C-C476D-SUBV-02-ST01-DT03-DF15-CF12-01
C-C412A-OSSL-08-ST04-DT07-DF07-CF01-01
C-C197A-SUBV-04-ST01-DT04-DF06-CF23-01
C-C124C-GIMP-07-ST02-DT07-DF03-CF18-01
C-C774A-PSQL-08-ST03-DT02-DF11-CF03-01
C-C089D-GIMP-06-ST01-DT03-DF17-CF03-01
C-C476G-FFMP-09-ST03-DT02-DF13-CF02-01
C-C363A-FFMP-07-ST02-DT04-DF13-CF01-01
C-C191B-FFMP-06-ST03-DT07-DF12-CF01-01
C-C124D-FFMP-02-ST04-DT03-DF05-CF03-01
C-C835A-FFMP-07-ST01-DT07-DF09-CF24-01
C-C088A-WIRE-02-ST01-DT07-DF06-CF02-01
C-C476D-PSQL-05-ST01-DT04-DF04-CF01-01
C-C609A-GIMP-02-ST01-DT07-DF02-CF14-01
C-C195A-OSSL-05-ST04-DT04-DF11-CF03-01
C-C129B-OSSL-05-ST01-DT05-DF06-CF23-01
C-C401A-SUBV-04-ST03-DT04-DF11-CF24-01
C-C078B-SUBV-07-ST04-DT04-DF12-CF18-01
C-C476E-WIRE-08-ST02-DT05-DF09-CF23-01
C-C821A-WIRE-06-ST02-DT02-DF05-CF20-01
C-C369A-WIRE-04-ST02-DT02-DF06-CF18-01
C-C805C-WIRE-09-ST03-DT01-DF01-CF24-01
C-C773A-GIMP-10-ST04-DT01-DF16-CF19-01
C-C088B-OSSL-06-ST03-DT06-DF04-CF23-01
C-C476C-GIMP-01-ST03-DT07-DF11-CF24-01
C-C765B-SUBV-09-ST03-DT06-DF06-CF18-01
C-C191A-GIMP-08-ST01-DT03-DF02-CF03-01
C-C806B-GIMP-01-ST02-DT06-DF14-CF23-01
C-C775A-OSSL-05-ST02-DT03-DF03-CF01-01
C-C088A-PSQL-03-ST02-DT01-DF11-CF01-01
C-C476B-OSSL-04-ST04-DT03-DF02-CF19-01
C-C663A-PSQL-07-ST01-DT01-DF14-CF20-01
C-C682B-WIRE-07-ST01-DT05-DF16-CF24-01
C-C120A-PSQL-10-ST02-DT05-DF15-CF03-01
C-C789A-SUBV-07-ST01-DT02-DF06-CF02-01
C-C089C-OSSL-09-ST04-DT03-DF15-CF03-01
C-C476A-OSSL-09-ST04-DT01-DF16-CF20-01
C-C833A-GIMP-06-ST01-DT01-DF12-CF22-01
C-C196A-SUBV-06-ST02-DT01-DF13-CF01-01
C-C127A-OSSL-09-ST01-DT02-DF12-CF18-01
C-C674A-OSSL-08-ST02-DT05-DF14-CF02-01
C-C088B-WIRE-08-ST03-DT02-DF10-CF02-01
C-C476G-SUBV-03-ST02-DT06-DF12-CF03-01
C-C543A-PSQL-05-ST02-DT03-DF17-CF24-01
C-C682A-GIMP-02-ST04-DT06-DF17-CF13-01
C-C127D-PSQL-06-ST03-DT01-DF12-CF01-01
C-C775A-GIMP-02-ST04-DT06-DF12-CF12-01
C-C089B-GIMP-02-ST02-DT05-DF12-CF23-01
C-C476F-PSQL-07-ST03-DT02-DF14-CF02-01
C-C831A-FFMP-02-ST04-DT02-DF15-CF13-01
C-C197A-OSSL-03-ST03-DT05-DF15-CF18-01
C-C824A-FFMP-03-ST01-DT04-DF13-CF15-01
C-C400B-PSQL-03-ST03-DT02-DF15-CF23-01
C-C078B-PSQL-07-ST01-DT07-DF13-CF24-01
C-C476A-WIRE-05-ST01-DT04-DF17-CF23-01
C-C479A-SUBV-03-ST03-DT05-DF16-CF23-01

C-C839A-PSQL-01-ST04-DT03-DF05-CF20-01
C-C170B-WIRE-08-ST02-DT04-DF11-CF02-01
C-C773A-WIRE-09-ST04-DT07-DF05-CF22-01
C-C088A-FFMP-01-ST04-DT05-DF14-CF12-01
C-C476D-GIMP-06-ST02-DT01-DF05-CF15-01
C-C764A-WIRE-04-ST03-DT03-DF03-CF03-01
C-C190A-FFMP-10-ST02-DT07-DF14-CF22-01
C-C806C-SUBV-02-ST04-DT07-DF08-CF22-01
C-C401A-FFMP-06-ST03-DT03-DF13-CF18-01
C-C078A-SUBV-05-ST03-DT06-DF16-CF19-01
C-C476E-OSSL-10-ST03-DT03-DF15-CF01-01
C-C828A-WIRE-08-ST01-DT05-DF13-CF19-01
C-C194A-WIRE-05-ST01-DT06-DF14-CF19-01
C-C134A-GIMP-07-ST03-DT03-DF05-CF20-01
C-C400A-OSSL-04-ST02-DT06-DF17-CF19-01
C-C089D-WIRE-04-ST02-DT02-DF15-CF22-01
C-C476C-FFMP-02-ST01-DT05-DF05-CF18-01
C-C414A-OSSL-01-ST04-DT02-DF05-CF19-01
C-C191B-GIMP-09-ST03-DT01-DF04-CF20-01
C-C785A-WIRE-04-ST04-DT06-DF16-CF02-01
C-C459A-FFMP-01-ST01-DT04-DF05-CF20-01
C-C089A-GIMP-10-ST01-DT04-DF05-CF19-01
C-C476F-SUBV-01-ST02-DT07-DF15-CF03-01
C-C367A-FFMP-10-ST02-DT06-DF14-CF18-01
C-C369A-SUBV-08-ST03-DT04-DF17-CF02-01
C-C170A-FFMP-02-ST04-DT04-DF14-CF01-01
C-C834A-PSQL-09-ST03-DT05-DF14-CF03-01
C-C078B-SUBV-09-ST03-DT01-DF05-CF24-01
C-C476B-FFMP-01-ST01-DT06-DF06-CF18-01
C-C412A-GIMP-04-ST01-DT04-DF11-CF02-01
C-C191A-FFMP-05-ST04-DT02-DF06-CF02-01
C-C805A-PSQL-04-ST03-DT05-DF13-CF19-01
C-C774A-WIRE-06-ST01-DT01-DF11-CF13-01
C-C078A-FFMP-02-ST04-DT03-DF07-CF02-01
C-C476G-GIMP-08-ST04-DT05-DF10-CF01-01
C-C821A-SUBV-02-ST02-DT05-DF12-CF12-01
C-C839A-OSSL-02-ST01-DT01-DF08-CF24-01
C-C126D-SUBV-03-ST02-DT05-DF05-CF20-01
C-C771A-SUBV-01-ST02-DT03-DF06-CF22-01
C-C078A-PSQL-05-ST02-DT05-DF03-CF20-01
C-C476A-WIRE-10-ST04-DT02-DF01-CF22-01
C-C828A-PSQL-07-ST04-DT07-DF10-CF23-01
C-C194A-PSQL-09-ST02-DT02-DF15-CF03-01
C-C415A-WIRE-08-ST01-DT02-DF09-CF03-01
C-C835A-GIMP-04-ST03-DT05-DF01-CF01-01
C-C088B-WIRE-03-ST01-DT02-DF06-CF20-01
C-C476D-PSQL-03-ST03-DT04-DF14-CF15-01
C-C414A-OSSL-09-ST03-DT02-DF14-CF24-01
C-C682B-WIRE-01-ST03-DT04-DF13-CF22-01
C-C822A-OSSL-09-ST01-DT01-DF05-CF19-01
C-C771A-OSSL-10-ST04-DT06-DF08-CF19-01
C-C088A-OSSL-10-ST01-DT06-DF16-CF01-01
C-C476F-WIRE-04-ST02-DT03-DF16-CF24-01
C-C765A-GIMP-10-ST03-DT04-DF11-CF22-01
C-C196A-OSSL-03-ST02-DT06-DF12-CF12-01
C-C120C-FFMP-01-ST04-DT07-DF17-CF19-01
C-C835A-SUBV-02-ST04-DT01-DF13-CF18-01
C-C089D-GIMP-04-ST04-DT01-DF14-CF14-01
C-C476C-FFMP-07-ST03-DT02-DF13-CF23-01
C-C820A-PSQL-08-ST02-DT03-DF06-CF03-01
C-C190A-GIMP-04-ST04-DT05-DF05-CF19-01
C-C120B-PSQL-07-ST03-DT03-DF17-CF23-01
C-C401A-PSQL-07-ST01-DT07-DF16-CF20-01
C-C089C-OSSL-08-ST03-DT01-DF12-CF18-01
C-C476E-GIMP-02-ST01-DT06-DF06-CF19-01
C-C479A-OSSL-01-ST01-DT07-DF17-CF18-01
C-C682A-PSQL-07-ST01-DT07-DF16-CF18-01
C-C843A-OSSL-10-ST02-DT02-DF03-CF22-01
C-C789A-WIRE-03-ST02-DT02-DF15-CF23-01
C-C089B-SUBV-01-ST02-DT03-DF17-CF03-01
C-C476B-OSSL-05-ST04-DT01-DF12-CF22-01
C-C609A-FFMP-03-ST04-DT01-DF04-CF01-01
C-C195A-SUBV-06-ST03-DT03-DF09-CF23-01
C-C785A-SUBV-06-ST02-DT07-DF06-CF14-01
C-C834A-FFMP-08-ST02-DT01-DF17-CF02-01
C-C089D-FFMP-06-ST01-DT04-DF13-CF23-01
C-C476G-PSQL-09-ST02-DT07-DF15-CF02-01
C-C765B-SUBV-05-ST02-DT06-DF15-CF02-01
C-C197A-FFMP-03-ST04-DT04-DF11-CF18-01
C-C805A-GIMP-05-ST01-DT01-DF16-CF18-01
C-C459A-GIMP-05-ST04-DT04-DF12-CF01-01
C-C078A-PSQL-07-ST02-DT07-DF12-CF19-01
C-C476E-SUBV-06-ST04-DT07-DF16-CF14-01
C-C543A-WIRE-05-ST04-DT07-DF16-CF24-01
C-C191B-WIRE-10-ST02-DT06-DF17-CF01-01
C-C170B-SUBV-10-ST03-DT06-DF15-CF23-01
C-C674A-SUBV-09-ST01-DT06-DF16-CF22-01
C-C088B-PSQL-07-ST03-DT07-DF17-CF18-01
C-C476D-WIRE-06-ST03-DT04-DF11-CF20-01
C-C367A-PSQL-06-ST01-DT01-DF16-CF20-01
C-C839A-OSSL-04-ST01-DT01-DF05-CF19-01
C-C124A-GIMP-02-ST04-DT04-DF12-CF18-01
C-C775A-GIMP-06-ST03-DT07-DF17-CF23-01
C-C089A-OSSL-04-ST04-DT05-DF11-CF22-01
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C-C833A-FFMP-06-ST03-DT06-DF12-CF19-01
C-C197A-GIMP-01-ST03-DT02-DF16-CF20-01
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C-C773A-PSQL-02-ST02-DT02-DF13-CF19-01
C-C078B-GIMP-05-ST04-DT03-DF09-CF01-01
C-C476A-OSSL-09-ST01-DT01-DF13-CF23-01
C-C831A-WIRE-03-ST03-DT05-DF17-CF15-01
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C-C120C-WIRE-04-ST03-DT06-DF14-CF02-01
C-C400B-OSSL-08-ST01-DT04-DF05-CF03-01
C-C089B-WIRE-02-ST02-DT06-DF15-CF15-01
C-C476C-GIMP-10-ST04-DT06-DF07-CF03-01
C-C663A-GIMP-04-ST01-DT03-DF11-CF18-01
C-C682A-PSQL-06-ST04-DT07-DF06-CF01-01
C-C416A-PSQL-07-ST02-DT05-DF10-CF23-01
C-C400A-FFMP-03-ST03-DT05-DF12-CF24-01
C-C088A-FFMP-10-ST03-DT02-DF01-CF22-01

C-C476B-SUBV-01-ST03-DT03-DF14-CF20-01
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C-C369A-SUBV-10-ST01-DT03-DF12-CF22-01
C-C126B-OSSL-06-ST02-DT02-DF13-CF24-01
C-C774A-WIRE-04-ST04-DT03-DF10-CF02-01
C-C089C-SUBV-01-ST01-DT04-DF16-CF02-01
C-C476G-PSQL-07-ST04-DT02-DF05-CF02-01
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C-C190A-FFMP-09-ST02-DT03-DF15-CF24-01
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C-C476E-GIMP-02-ST02-DT07-DF16-CF18-01
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C-C682B-GIMP-02-ST01-DT07-DF11-CF02-01
C-C824A-OSSL-08-ST03-DT07-DF11-CF01-01
C-C771A-OSSL-01-ST04-DT02-DF02-CF18-01
C-C089B-OSSL-06-ST04-DT01-DF06-CF02-01
C-C476F-SUBV-05-ST02-DT02-DF11-CF22-01
C-C367A-PSQL-01-ST03-DT05-DF09-CF03-01
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C-C590A-GIMP-03-ST02-DT02-DF02-CF03-01
C-C401A-WIRE-10-ST01-DT07-DF15-CF23-01
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C-C476B-FFMP-08-ST03-DT03-DF15-CF19-01
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C-C124B-FFMP-10-ST04-DT04-DF15-CF22-01
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C-C191B-WIRE-01-ST01-DT05-DF13-CF23-01
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C-C089D-GIMP-05-ST04-DT02-DF02-CF23-01
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C-C400B-GIMP-01-ST02-DT05-DF15-CF14-01
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C-C476E-GIMP-10-ST02-DT05-DF04-CF24-01
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C-C088A-SUBV-01-ST03-DT07-DF12-CF22-01
C-C476D-PSQL-09-ST01-DT01-DF12-CF12-01
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C-C369A-OSSL-08-ST01-DT03-DF14-CF23-01
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C-C089C-FFMP-03-ST02-DT03-DF14-CF20-01
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C-C126C-FFMP-04-ST02-DT07-DF14-CF20-01
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C-C088A-GIMP-09-ST04-DT07-DF08-CF19-01
C-C476G-WIRE-04-ST03-DT04-DF06-CF18-01
C-C479A-PSQL-03-ST02-DT06-DF11-CF02-01
C-C839A-GIMP-10-ST02-DT01-DF11-CF19-01
C-C806C-SUBV-03-ST03-DT01-DF06-CF03-01

C-C401A-OSSL-08-ST01-DT04-DF17-CF03-01
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C-C476A-FFMP-09-ST04-DT03-DF05-CF02-01
C-C833A-OSSL-05-ST03-DT01-DF16-CF18-01
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C-C476D-WIRE-05-ST01-DT07-DF15-CF20-01
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C-C682A-WIRE-09-ST01-DT02-DF15-CF20-01
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C-C400B-GIMP-09-ST02-DT03-DF05-CF20-01
C-C078A-PSQL-06-ST02-DT05-DF15-CF18-01
C-C476F-GIMP-06-ST04-DT02-DF13-CF18-01
C-C543A-PSQL-02-ST01-DT04-DF15-CF23-01
C-C191A-GIMP-07-ST03-DT06-DF13-CF01-01
C-C824B-PSQL-05-ST02-DT04-DF11-CF22-01
C-C834A-PSQL-06-ST02-DT01-DF14-CF12-01
C-C089D-GIMP-08-ST03-DT06-DF11-CF12-01
C-C476C-SUBV-02-ST02-DT05-DF14-CF19-01
C-C367A-GIMP-01-ST01-DT07-DF05-CF22-01
C-C197A-OSSL-06-ST02-DT04-DF04-CF02-01
C-C806A-OSSL-01-ST02-DT06-DF16-CF24-01
C-C771A-SUBV-02-ST03-DT07-DF10-CF02-01
C-C078B-SUBV-10-ST04-DT06-DF13-CF24-01
C-C476B-OSSL-10-ST02-DT04-DF11-CF01-01
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C-C089B-OSSL-05-ST01-DT01-DF05-CF18-01
C-C476E-PSQL-07-ST01-DT03-DF12-CF02-01
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C-C124C-FFMP-07-ST01-DT02-DF14-CF20-01
C-C400A-OSSL-04-ST01-DT04-DF16-CF01-01
C-C088B-FFMP-07-ST03-DT04-DF12-CF01-01
C-C476A-FFMP-01-ST03-DT07-DF01-CF03-01
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C-C191B-OSSL-08-ST01-DT06-DF17-CF24-01
C-C805D-OSSL-04-ST04-DT03-DF13-CF01-01
C-C400A-FFMP-05-ST04-DT02-DF13-CF20-01
C-C089B-SUBV-07-ST02-DT02-DF17-CF02-01
C-C476D-PSQL-03-ST02-DT06-DF16-CF24-01
C-C831A-WIRE-08-ST02-DT03-DF14-CF03-01
C-C195A-GIMP-05-ST02-DT01-DF14-CF02-01
C-C120D-WIRE-06-ST01-DT01-DF15-CF02-01
C-C773A-PSQL-03-ST02-DT05-DF15-CF24-01
C-C078B-PSQL-06-ST02-DT01-DF02-CF22-01
C-C476F-SUBV-08-ST03-DT01-DF17-CF01-01
C-C765A-SUBV-05-ST04-DT07-DF13-CF24-01
C-C196A-FFMP-04-ST03-DT02-DF06-CF19-01
C-C126A-PSQL-09-ST02-DT05-DF10-CF20-01
C-C834A-SUBV-06-ST01-DT03-DF12-CF20-01
C-C089C-WIRE-08-ST01-DT05-DF07-CF19-01
C-C476B-OSSL-09-ST04-DT02-DF09-CF20-01
C-C828A-PSQL-07-ST03-DT02-DF17-CF22-01
C-C195A-PSQL-01-ST04-DT07-DF14-CF23-01
C-C120B-FFMP-10-ST04-DT07-DF05-CF24-01
C-C789A-WIRE-07-ST03-DT01-DF06-CF02-01
C-C078A-GIMP-09-ST04-DT02-DF14-CF01-01
C-C476G-FFMP-05-ST01-DT05-DF02-CF19-01
C-C765B-GIMP-02-ST01-DT06-DF05-CF14-01
C-C191B-SUBV-10-ST02-DT03-DF09-CF01-01
C-C785B-GIMP-03-ST03-DT01-DF11-CF03-01
C-C674A-GIMP-04-ST04-DT06-DF09-CF19-01
C-C088B-OSSL-01-ST03-DT03-DF11-CF22-01
C-C476G-GIMP-04-ST04-DT04-DF06-CF23-01
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C-C806B-SUBV-02-ST01-DT06-DF16-CF19-01
C-C400B-OSSL-09-ST02-DT02-DF11-CF22-01
C-C089D-FFMP-03-ST02-DT01-DF10-CF03-01
C-C476C-WIRE-10-ST02-DT07-DF05-CF18-01
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C-C191A-WIRE-02-ST03-DT03-DF05-CF24-01
C-C134A-SUBV-05-ST02-DT05-DF12-CF22-01
C-C401A-SUBV-10-ST03-DT04-DF17-CF23-01
C-C089A-SUBV-05-ST01-DT06-DF16-CF14-01
C-C476B-SUBV-06-ST01-DT06-DF16-CF03-01
C-C412A-WIRE-04-ST04-DT02-DF03-CF01-01
C-C194A-WIRE-03-ST04-DT05-DF02-CF20-01
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C-C774A-PSQL-02-ST01-DT03-DF12-CF13-01
C-C088A-PSQL-10-ST04-DT03-DF05-CF24-01
C-C476F-OSSL-01-ST03-DT05-DF17-CF22-01
C-C764A-FFMP-03-ST01-DT07-DF11-CF24-01
C-C839A-GIMP-06-ST01-DT02-DF06-CF03-01
C-C761A-GIMP-07-ST04-DT04-DF17-CF14-01
C-C459A-WIRE-08-ST03-DT05-DF14-CF01-01
C-C089B-FFMP-04-ST01-DT04-DF03-CF20-01
C-C476E-WIRE-07-ST03-DT01-DF07-CF02-01
C-C765A-GIMP-09-ST03-DT04-DF16-CF02-01
C-C369A-OSSL-09-ST02-DT06-DF13-CF03-01
C-C785B-PSQL-08-ST01-DT02-DF14-CF22-01
C-C771A-OSSL-01-ST04-DT01-DF15-CF03-01
C-C089C-OSSL-02-ST04-DT05-DF13-CF23-01
C-C476A-GIMP-02-ST01-DT02-DF12-CF24-01
C-C609A-OSSL-01-ST02-DT05-DF15-CF03-01
C-C190A-FFMP-08-ST04-DT03-DF11-CF19-01
C-C120A-WIRE-03-ST03-DT07-DF15-CF13-01
C-C775A-GIMP-05-ST01-DT07-DF13-CF20-01
C-C078B-GIMP-10-ST03-DT07-DF15-CF01-01
C-C476D-FFMP-10-ST04-DT07-DF11-CF22-01
C-C479A-SUBV-10-ST01-DT03-DF13-CF18-01
C-C682B-SUBV-01-ST03-DT07-DF17-CF22-01
C-C824B-OSSL-07-ST01-DT05-DF05-CF23-01
C-C835A-FFMP-06-ST02-DT01-DF05-CF24-01
C-C089D-WIRE-06-ST01-DT02-DF17-CF02-01
C-C476D-PSQL-04-ST03-DT03-DF15-CF23-01
C-C764A-PSQL-03-ST04-DT07-DF11-CF03-01

C-C682A-WIRE-02-ST04-DT05-DF12-CF22-01
C-C785D-OSSL-06-ST02-DT04-DF17-CF03-01
C-C773A-WIRE-10-ST04-DT04-DF03-CF02-01
C-C078A-SUBV-03-ST03-DT03-DF12-CF22-01
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C-C363A-PSQL-09-ST03-DT05-DF02-CF02-01
C-C197A-FFMP-09-ST01-DT06-DF06-CF20-01
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C-C775A-SUBV-01-ST03-DT06-DF13-CF03-01
C-C088A-OSSL-05-ST02-DT06-DF06-CF20-01
C-C476F-WIRE-09-ST01-DT06-DF13-CF20-01
C-C831A-SUBV-05-ST02-DT06-DF12-CF20-01
C-C194A-PSQL-10-ST02-DT04-DF17-CF18-01
C-C124C-WIRE-05-ST01-DT03-DF01-CF02-01
C-C401A-OSSL-04-ST02-DT07-DF16-CF01-01
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C-C476E-PSQL-02-ST03-DT04-DF16-CF03-01
C-C414A-FFMP-08-ST01-DT01-DF17-CF12-01
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C-C835A-GIMP-09-ST01-DT03-DF14-CF23-01
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C-C476B-FFMP-05-ST02-DT07-DF04-CF19-01
C-C412A-GIMP-06-ST04-DT02-DF13-CF23-01
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C-C120C-GIMP-02-ST02-DT06-DF14-CF18-01
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C-C476A-GIMP-08-ST02-DT03-DF06-CF13-01
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C-C761A-SUBV-08-ST03-DT07-DF08-CF20-01
C-C400A-PSQL-03-ST04-DT05-DF02-CF12-01
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C-C476G-SUBV-06-ST04-DT01-DF17-CF02-01
C-C821A-WIRE-02-ST02-DT03-DF15-CF01-01
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C-C124D-PSQL-10-ST04-DT05-DF03-CF01-01
C-C834A-OSSL-02-ST02-DT07-DF11-CF18-01
C-C088A-PSQL-04-ST03-DT03-DF17-CF24-01
C-C476A-PSQL-01-ST02-DT02-DF11-CF18-01
C-C367A-PSQL-04-ST01-DT02-DF14-CF24-01
C-C190A-PSQL-05-ST02-DT01-DF12-CF24-01
C-C806B-OSSL-04-ST04-DT07-DF14-CF22-01
C-C400B-FFMP-08-ST01-DT05-DF17-CF22-01
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C-C476F-SUBV-07-ST01-DT03-DF14-CF01-01
C-C820A-SUBV-07-ST03-DT04-DF16-CF18-01
C-C682A-WIRE-03-ST02-DT07-DF07-CF01-01
C-C805C-FFMP-07-ST01-DT01-DF06-CF02-01
C-C774A-GIMP-04-ST02-DT04-DF05-CF19-01
C-C089B-GIMP-08-ST03-DT07-DF11-CF23-01
C-C476C-FFMP-03-ST04-DT04-DF08-CF12-01
C-C828A-FFMP-02-ST02-DT07-DF06-CF02-01
C-C682B-FFMP-07-ST04-DT02-DF12-CF20-01
C-C127D-SUBV-05-ST02-DT02-DF11-CF19-01
C-C771A-PSQL-08-ST01-DT02-DF12-CF02-01
C-C078B-FFMP-04-ST04-DT02-DF06-CF19-01
C-C476G-GIMP-02-ST02-DT01-DF05-CF20-01
C-C765B-GIMP-10-ST01-DT05-DF17-CF13-01
C-C191B-SUBV-09-ST03-DT06-DF16-CF14-01
C-C127A-WIRE-10-ST03-DT04-DF16-CF01-01
C-C789A-WIRE-09-ST03-DT03-DF08-CF22-01
C-C088A-WIRE-03-ST01-DT05-DF14-CF22-01
C-C476B-WIRE-09-ST03-DT05-DF15-CF03-01
C-C543A-WIRE-09-ST04-DT03-DF12-CF22-01
C-C369A-GIMP-08-ST01-DT05-DF03-CF02-01
C-C843A-GIMP-01-ST01-DT03-DF12-CF01-01
C-C459A-SUBV-01-ST03-DT06-DF16-CF18-01
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C-C476D-OSSL-07-ST01-DT02-DF12-CF18-01
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C-C839A-SUBV-02-ST04-DT03-DF13-CF03-01
C-C129B-SUBV-04-ST04-DT06-DF05-CF23-01
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C-C088B-FFMP-08-ST01-DT06-DF04-CF03-01
C-C476E-FFMP-05-ST02-DT06-DF06-CF22-01
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C-C839A-FFMP-04-ST02-DT06-DF16-CF22-01
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C-C674A-WIRE-10-ST01-DT01-DF07-CF24-01
C-C088A-PSQL-10-ST03-DT01-DF16-CF20-01
C-C476D-SUBV-04-ST04-DT04-DF13-CF02-01
C-C479A-GIMP-06-ST02-DT01-DF10-CF20-01
C-C194A-GIMP-01-ST03-DT02-DF08-CF18-01
C-C415A-OSSL-09-ST02-DT04-DF13-CF18-01
C-C400B-GIMP-06-ST04-DT05-DF11-CF18-01
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C-C476E-PSQL-10-ST03-DT07-DF13-CF19-01
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C-C129A-WIRE-02-ST03-DT07-DF17-CF03-01
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C-C078A-GIMP-05-ST02-DT06-DF05-CF24-01
C-C476A-OSSL-08-ST01-DT05-DF11-CF23-01
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C-C196A-OSSL-05-ST03-DT05-DF01-CF19-01
C-C170B-GIMP-08-ST04-DT06-DF04-CF20-01
C-C400A-OSSL-07-ST02-DT04-DF13-CF23-01
C-C089D-OSSL-02-ST04-DT04-DF01-CF24-01
C-C476C-GIMP-01-ST02-DT02-DF15-CF20-01
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C-C191B-WIRE-06-ST01-DT04-DF13-CF23-01
C-C126A-FFMP-06-ST02-DT02-DF07-CF20-01
C-C775A-PSQL-02-ST01-DT03-DF12-CF03-01
C-C078B-GIMP-07-ST02-DT05-DF14-CF03-01
C-C476G-WIRE-06-ST03-DT03-DF16-CF18-01
C-C820A-PSQL-03-ST02-DT02-DF01-CF22-01
C-C195A-OSSL-10-ST04-DT01-DF17-CF13-01
C-C124B-OSSL-09-ST01-DT05-DF15-CF20-01
C-C774A-SUBV-03-ST04-DT07-DF05-CF24-01
C-C089C-WIRE-01-ST03-DT01-DF11-CF22-01

C-C476F-GIMP-10-ST04-DT01-DF14-CF02-01
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C-C190A-PSQL-05-ST01-DT07-DF05-CF24-01
C-C124A-PSQL-03-ST03-DT01-DF16-CF02-01
C-C835A-PSQL-04-ST03-DT07-DF17-CF03-01
C-C078A-PSQL-05-ST01-DT07-DF09-CF23-01
C-C476B-PSQL-09-ST01-DT06-DF10-CF24-01
C-C543A-FFMP-01-ST03-DT04-DF11-CF15-01
C-C369A-GIMP-03-ST02-DT04-DF11-CF18-01
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C-C401A-WIRE-06-ST01-DT02-DF15-CF24-01
C-C088B-FFMP-08-ST01-DT03-DF12-CF20-01
C-C476A-SUBV-03-ST02-DT07-DF17-CF01-01
C-C765A-GIMP-10-ST01-DT04-DF06-CF24-01
C-C682A-FFMP-07-ST03-DT07-DF15-CF03-01
C-C126B-GIMP-01-ST01-DT03-DF13-CF24-01
C-C459A-GIMP-08-ST02-DT04-DF06-CF03-01
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C-C476B-OSSL-06-ST04-DT01-DF03-CF15-01
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C-C682B-WIRE-01-ST02-DT02-DF05-CF23-01
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C-C834A-FFMP-01-ST03-DT01-DF01-CF22-01
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C-C806D-GIMP-08-ST03-DT06-DF17-CF19-01
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C-C476F-WIRE-02-ST02-DT02-DF12-CF23-01
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C-C127B-WIRE-05-ST02-DT07-DF06-CF24-01
C-C834A-OSSL-09-ST04-DT07-DF06-CF23-01
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C-C127C-OSSL-01-ST03-DT04-DF12-CF18-01
C-C401A-GIMP-06-ST04-DT01-DF15-CF18-01
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C-C088B-WIRE-08-ST03-DT03-DF10-CF15-01
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C-C476G-OSSL-02-ST03-DT07-DF17-CF14-01
C-C764A-GIMP-02-ST02-DT07-DF05-CF02-01
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C-C089B-WIRE-07-ST01-DT06-DF14-CF19-01
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C-C194A-WIRE-02-ST01-DT02-DF17-CF24-01
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C-C195A-GIMP-03-ST04-DT04-DF15-CF19-01
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C-C765B-OSSL-01-ST02-DT04-DF04-CF18-01
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C-C805A-WIRE-06-ST02-DT02-DF06-CF22-01
C-C771A-PSQL-09-ST04-DT04-DF02-CF02-01
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C-C476B-GIMP-05-ST04-DT02-DF14-CF22-01
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C-C124B-PSQL-02-ST03-DT06-DF13-CF24-01
C-C401A-FFMP-03-ST02-DT05-DF09-CF03-01
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C-C476A-SUBV-07-ST01-DT06-DF02-CF02-01
C-C543A-PSQL-02-ST01-DT02-DF12-CF23-01
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C-C089A-GIMP-08-ST03-DT05-DF09-CF03-01
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C-C764A-GIMP-07-ST04-DT01-DF14-CF01-01
C-C196A-FFMP-01-ST01-DT05-DF01-CF12-01
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C-C400B-PSQL-07-ST03-DT06-DF03-CF23-01
C-C088B-WIRE-07-ST04-DT03-DF13-CF01-01
C-C476F-PSQL-03-ST01-DT01-DF10-CF22-01
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C-C785C-WIRE-01-ST03-DT03-DF17-CF22-01
C-C774A-WIRE-02-ST01-DT05-DF12-CF20-01
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C-C476E-FFMP-06-ST02-DT04-DF15-CF01-01
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C-C773A-SUBV-01-ST02-DT02-DF17-CF15-01
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C-C476A-GIMP-05-ST02-DT06-DF15-CF24-01
C-C828A-PSQL-05-ST01-DT04-DF17-CF20-01
C-C191A-SUBV-07-ST01-DT06-DF08-CF02-01
C-C126C-GIMP-03-ST04-DT05-DF05-CF20-01
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C-C089C-GIMP-06-ST01-DT07-DF14-CF14-01
C-C476B-WIRE-01-ST01-DT07-DF17-CF18-01
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C-C196A-WIRE-08-ST03-DT07-DF16-CF01-01
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C-C835A-PSQL-10-ST04-DT07-DF06-CF19-01
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C-C821A-GIMP-07-ST02-DT05-DF11-CF24-01
C-C195A-PSQL-02-ST01-DT04-DF12-CF24-01
C-C415A-SUBV-06-ST03-DT07-DF08-CF18-01
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C-C078A-WIRE-10-ST03-DT02-DF08-CF20-01
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C-C412A-WIRE-10-ST04-DT01-DF06-CF19-01
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C-C834A-GIMP-05-ST04-DT02-DF15-CF22-01
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C-C476D-FFMP-06-ST03-DT01-DF11-CF24-01
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C-C682A-GIMP-03-ST03-DT03-DF14-CF22-01
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C-C476E-OSSL-04-ST04-DT03-DF13-CF03-01
C-C609A-FFMP-02-ST03-DT06-DF12-CF20-01
C-C839A-OSSL-04-ST04-DT02-DF06-CF03-01
C-C126D-WIRE-04-ST04-DT01-DF06-CF24-01
C-C401A-SUBV-01-ST03-DT05-DF16-CF24-01
C-C088A-WIRE-07-ST02-DT03-DF05-CF23-01
C-C476E-PSQL-07-ST01-DT03-DF05-CF20-01
C-C543A-WIRE-09-ST01-DT02-DF05-CF03-01

C-C194A-WIRE-01-ST03-DT06-DF13-CF03-01
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C-C089B-FFMP-01-ST04-DT04-DF17-CF22-01
C-C476G-WIRE-02-ST02-DT04-DF12-CF15-01
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C-C170A-GIMP-09-ST01-DT07-DF16-CF23-01
C-C400A-GIMP-02-ST04-DT02-DF05-CF01-01
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C-C476C-OSSL-07-ST03-DT01-DF16-CF19-01
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C-C089C-OSSL-07-ST01-DT01-DF11-CF01-01
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C-C369A-WIRE-07-ST04-DT01-DF06-CF18-01
C-C590A-GIMP-04-ST02-DT04-DF10-CF01-01
C-C400B-GIMP-07-ST01-DT01-DF14-CF12-01
C-C078B-WIRE-06-ST04-DT04-DF14-CF24-01
C-C476F-GIMP-02-ST01-DT02-DF15-CF24-01
C-C820A-PSQL-10-ST02-DT05-DF16-CF13-01
C-C191A-GIMP-01-ST02-DT04-DF12-CF20-01
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C-C089C-GIMP-03-ST04-DT01-DF16-CF19-01
C-C476E-WIRE-05-ST04-DT05-DF16-CF20-01
C-C765B-GIMP-07-ST03-DT03-DF02-CF23-01
C-C682B-OSSL-04-ST01-DT07-DF11-CF01-01
C-C129A-OSSL-05-ST02-DT05-DF17-CF02-01
C-C774A-OSSL-10-ST03-DT05-DF17-CF22-01
C-C088B-SUBV-02-ST03-DT02-DF13-CF12-01
C-C476B-FFMP-03-ST02-DT02-DF05-CF22-01
C-C412A-FFMP-09-ST04-DT02-DF10-CF24-01
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C-C124A-SUBV-06-ST01-DT03-DF05-CF20-01
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C-C089B-WIRE-10-ST01-DT07-DF02-CF01-01
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C-C663A-SUBV-02-ST01-DT01-DF14-CF02-01
C-C190A-GIMP-05-ST01-DT05-DF14-CF01-01
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C-C771A-WIRE-08-ST03-DT03-DF15-CF19-01
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C-C682A-FFMP-03-ST02-DT06-DF04-CF02-01
C-C134A-GIMP-09-ST01-DT02-DF17-CF24-01
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C-C476A-PSQL-10-ST04-DT03-DF06-CF19-01
C-C363A-WIRE-01-ST01-DT07-DF13-CF23-01
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C-C126A-FFMP-07-ST03-DT07-DF14-CF01-01
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C-C089D-GIMP-05-ST01-DT06-DF06-CF18-01
C-C476G-FFMP-06-ST04-DT07-DF08-CF23-01
C-C414A-SUBV-02-ST04-DT06-DF13-CF18-01
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C-C126B-SUBV-04-ST02-DT04-DF13-CF23-01
C-C401A-GIMP-05-ST01-DT06-DF17-CF20-01
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C-C476D-WIRE-03-ST02-DT03-DF17-CF15-01
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C-C682B-WIRE-05-ST02-DT01-DF10-CF03-01
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C-C476G-SUBV-07-ST03-DT04-DF15-CF18-01
C-C609A-OSSL-10-ST02-DT04-DF16-CF02-01
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C-C401A-GIMP-08-ST03-DT05-DF06-CF02-01
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C-C476A-PSQL-08-ST02-DT05-DF13-CF18-01
C-C828A-OSSL-09-ST04-DT02-DF15-CF18-01
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C-C120C-SUBV-01-ST01-DT05-DF12-CF03-01
C-C834A-SUBV-03-ST01-DT03-DF11-CF24-01
C-C089A-OSSL-02-ST01-DT03-DF13-CF22-01

C-C476C-OSSL-09-ST01-DT06-DF03-CF23-01
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C-C194A-FFMP-10-ST04-DT06-DF12-CF24-01
C-C805C-FFMP-05-ST03-DT02-DF14-CF01-01
C-C771A-FFMP-02-ST01-DT07-DF02-CF19-01
C-C089B-WIRE-06-ST03-DT05-DF05-CF14-01
C-C476E-SUBV-04-ST04-DT02-DF10-CF23-01
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C-C191B-WIRE-04-ST02-DT05-DF15-CF23-01
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C-C476B-WIRE-05-ST01-DT03-DF06-CF22-01
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C-C476G-WIRE-10-ST02-DT02-DF14-CF12-01
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C-C785C-OSSL-04-ST03-DT07-DF16-CF13-01
C-C459A-FFMP-08-ST02-DT01-DF14-CF23-01
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C-C839A-WIRE-10-ST04-DT04-DF14-CF03-01
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C-C789A-PSQL-04-ST04-DT07-DF16-CF19-01
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C-C476C-GIMP-07-ST03-DT06-DF06-CF02-01
C-C831A-SUBV-07-ST01-DT04-DF12-CF18-01
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C-C416A-FFMP-10-ST01-DT07-DF13-CF23-01
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C-C833A-FFMP-09-ST02-DT02-DF16-CF01-01
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C-C124B-GIMP-09-ST01-DT02-DF11-CF01-01
C-C771A-WIRE-07-ST04-DT05-DF15-CF20-01
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C-C476C-SUBV-05-ST02-DT03-DF02-CF01-01
C-C821A-PSQL-06-ST04-DT07-DF14-CF22-01
C-C682B-WIRE-09-ST01-DT06-DF15-CF19-01
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C-C476F-OSSL-09-ST01-DT01-DF11-CF22-01
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C-C088B-WIRE-01-ST02-DT01-DF06-CF19-01
C-C476B-GIMP-04-ST02-DT04-DF05-CF03-01
C-C363A-SUBV-08-ST03-DT05-DF11-CF20-01
C-C197A-OSSL-05-ST02-DT02-DF17-CF14-01
C-C761A-PSQL-01-ST03-DT05-DF16-CF24-01
C-C775A-GIMP-07-ST03-DT04-DF15-CF23-01
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C-C400B-GIMP-08-ST01-DT06-DF14-CF02-01
C-C078A-FFMP-05-ST04-DT06-DF13-CF12-01
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C-C194A-PSQL-03-ST01-DT05-DF05-CF22-01
C-C806C-SUBV-10-ST03-DT03-DF17-CF02-01
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C-C476B-SUBV-01-ST03-DT05-DF12-CF22-01
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C-C124C-SUBV-06-ST04-DT01-DF14-CF22-01
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C-C682B-SUBV-06-ST04-DT01-DF09-CF19-01
C-C806A-GIMP-03-ST03-DT06-DF12-CF03-01
C-C401A-WIRE-04-ST01-DT06-DF17-CF18-01
C-C089B-FFMP-04-ST01-DT07-DF12-CF15-01
C-C476A-PSQL-05-ST02-DT04-DF14-CF02-01
C-C833A-SUBV-09-ST02-DT01-DF14-CF01-01
C-C195A-WIRE-09-ST01-DT04-DF16-CF03-01
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C-C835A-PSQL-03-ST03-DT03-DF12-CF01-01
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C-C476E-GIMP-08-ST03-DT01-DF01-CF19-01
C-C663A-FFMP-10-ST03-DT04-DF06-CF24-01
C-C196A-OSSL-04-ST02-DT05-DF13-CF01-01
C-C805D-WIRE-02-ST02-DT02-DF01-CF20-01
C-C834A-SUBV-01-ST04-DT04-DF10-CF22-01
C-C089C-GIMP-03-ST03-DT01-DF06-CF19-01
C-C476D-WIRE-04-ST01-DT06-DF05-CF01-01
C-C828A-WIRE-07-ST04-DT05-DF11-CF19-01
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C-C170B-PSQL-07-ST01-DT04-DF07-CF01-01
C-C774A-FFMP-05-ST02-DT07-DF01-CF24-01
C-C089A-SUBV-06-ST01-DT02-DF14-CF01-01
C-C476F-FFMP-07-ST04-DT07-DF16-CF24-01
C-C412A-PSQL-02-ST01-DT02-DF04-CF18-01
C-C369A-FFMP-07-ST02-DT03-DF06-CF24-01
C-C415A-GIMP-09-ST02-DT03-DF15-CF22-01
C-C775A-SUBV-10-ST01-DT02-DF16-CF20-01
C-C078A-SUBV-10-ST04-DT06-DF15-CF23-01
C-C476G-FFMP-06-ST03-DT05-DF08-CF20-01
C-C479A-PSQL-01-ST01-DT02-DF15-CF24-01
C-C197A-GIMP-01-ST04-DT07-DF01-CF18-01
C-C127D-FFMP-02-ST03-DT05-DF11-CF18-01
C-C773A-GIMP-09-ST03-DT05-DF11-CF14-01
C-C089D-OSSL-08-ST01-DT06-DF13-CF20-01
C-C476G-GIMP-03-ST02-DT07-DF16-CF23-01
C-C831A-WIRE-06-ST02-DT06-DF09-CF02-01
C-C191B-WIRE-06-ST03-DT01-DF11-CF18-01
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C-C088B-FFMP-06-ST02-DT07-DF16-CF18-01
C-C476C-SUBV-08-ST01-DT03-DF15-CF03-01
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C-C190A-SUBV-05-ST01-DT02-DF12-CF03-01
C-C126A-OSSL-10-ST01-DT01-DF05-CF23-01
C-C459A-WIRE-03-ST02-DT02-DF14-CF22-01
C-C078B-WIRE-05-ST03-DT01-DF05-CF23-01
C-C476A-OSSL-05-ST03-DT05-DF06-CF23-01
C-C367A-GIMP-07-ST03-DT07-DF17-CF01-01
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C-C806D-WIRE-09-ST01-DT06-DF06-CF18-01
C-C835A-OSSL-10-ST02-DT06-DF13-CF02-01
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C-C476F-PSQL-04-ST02-DT01-DF12-CF03-01
C-C820A-SUBV-01-ST04-DT04-DF15-CF20-01
C-C839A-OSSL-08-ST03-DT04-DF06-CF23-01
C-C129A-PSQL-07-ST04-DT04-DF04-CF15-01
C-C401A-PSQL-07-ST04-DT01-DF06-CF20-01
C-C088B-GIMP-07-ST01-DT03-DF15-CF24-01
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C-C682B-FFMP-02-ST01-DT05-DF17-CF20-01
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C-C821A-WIRE-05-ST03-DT06-DF16-CF23-01
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C-C400A-WIRE-04-ST01-DT01-DF16-CF19-01
C-C078B-FFMP-09-ST03-DT05-DF06-CF01-01
C-C476D-SUBV-09-ST02-DT02-DF07-CF02-01
C-C609A-OSSL-08-ST02-DT02-DF05-CF03-01
C-C194A-GIMP-07-ST04-DT04-DF16-CF22-01
C-C129B-GIMP-08-ST03-DT07-DF12-CF19-01
C-C400B-PSQL-08-ST04-DT07-DF13-CF18-01
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C-C476D-GIMP-10-ST01-DT04-DF17-CF22-01
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C-C197A-WIRE-03-ST01-DT01-DF13-CF02-01
C-C120A-FFMP-01-ST01-DT07-DF17-CF03-01
C-C771A-OSSL-05-ST01-DT05-DF05-CF23-01
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C-C774A-FFMP-09-ST03-DT04-DF17-CF13-01
C-C089A-WIRE-08-ST02-DT07-DF17-CF19-01
C-C476G-PSQL-06-ST04-DT03-DF05-CF12-01
C-C414A-GIMP-02-ST03-DT01-DF12-CF22-01
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C-C789A-SUBV-02-ST02-DT01-DF06-CF24-01
C-C089C-GIMP-01-ST01-DT03-DF03-CF18-01
C-C476C-WIRE-01-ST01-DT07-DF11-CF01-01
C-C764A-SUBV-09-ST01-DT07-DF06-CF02-01
C-C369A-OSSL-03-ST01-DT02-DF04-CF23-01
C-C120C-WIRE-02-ST02-DT01-DF13-CF18-01
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C-C089A-GIMP-03-ST04-DT04-DF05-CF02-01
C-C476E-FFMP-09-ST04-DT06-DF16-CF23-01
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C-C127B-PSQL-05-ST04-DT03-DF14-CF19-01
C-C773A-WIRE-03-ST02-DT02-DF08-CF03-01
C-C078B-OSSL-05-ST02-DT02-DF16-CF18-01
C-C476B-GIMP-03-ST03-DT02-DF04-CF24-01
C-C414A-WIRE-08-ST01-DT04-DF13-CF24-01
C-C196A-SUBV-01-ST02-DT06-DF05-CF20-01
C-C120D-GIMP-06-ST02-DT04-DF05-CF12-01
C-C835A-FFMP-02-ST03-DT07-DF12-CF18-01
C-C088B-PSQL-04-ST03-DT06-DF14-CF20-01
C-C476F-SUBV-04-ST03-DT05-DF15-CF19-01
C-C367A-OSSL-03-ST03-DT05-DF14-CF18-01
C-C682A-WIRE-10-ST04-DT07-DF05-CF24-01
C-C805A-FFMP-03-ST02-DT02-DF17-CF23-01
C-C400B-GIMP-09-ST01-DT01-DF06-CF20-01
C-C089D-FFMP-10-ST03-DT04-DF12-CF23-01
C-C476B-WIRE-02-ST01-DT03-DF13-CF02-01
C-C833A-SUBV-10-ST01-DT02-DF02-CF15-01

C-C191B-FFMP-02-ST03-DT05-DF11-CF19-01
C-C120B-SUBV-10-ST01-DT05-DF05-CF01-01
C-C834A-PSQL-04-ST01-DT06-DF07-CF02-01
C-C078A-WIRE-06-ST01-DT01-DF15-CF01-01
C-C476A-OSSL-01-ST02-DT06-DF11-CF19-01
C-C609A-GIMP-09-ST04-DT07-DF15-CF20-01
C-C194A-GIMP-04-ST03-DT02-DF08-CF02-01
C-C124D-OSSL-07-ST03-DT04-DF06-CF02-01
C-C774A-SUBV-07-ST03-DT05-DF11-CF22-01
C-C089C-SUBV-01-ST01-DT02-DF14-CF24-01
C-C476F-OSSL-07-ST02-DT01-DF13-CF01-01
C-C363A-PSQL-07-ST02-DT04-DF11-CF03-01
C-C196A-PSQL-06-ST02-DT02-DF14-CF18-01
C-C806B-GIMP-08-ST01-DT01-DF13-CF20-01
C-C401A-PSQL-06-ST04-DT02-DF05-CF19-01
C-C089B-SUBV-07-ST02-DT07-DF05-CF13-01
C-C476G-PSQL-08-ST04-DT07-DF17-CF18-01
C-C820A-WIRE-02-ST03-DT01-DF13-CF22-01
C-C682A-GIMP-09-ST01-DT01-DF06-CF01-01
C-C805B-OSSL-04-ST04-DT07-DF14-CF24-01
C-C400A-WIRE-05-ST02-DT03-DF11-CF23-01
C-C088A-OSSL-03-ST04-DT06-DF08-CF03-01
C-C476D-FFMP-10-ST01-DT02-DF14-CF03-01
C-C412A-PSQL-04-ST04-DT06-DF14-CF23-01
C-C197A-WIRE-08-ST03-DT03-DF14-CF22-01
C-C805C-SUBV-01-ST01-DT06-DF08-CF03-01
C-C775A-OSSL-08-ST02-DT04-DF14-CF12-01
C-C088A-PSQL-09-ST01-DT03-DF06-CF02-01
C-C476C-GIMP-05-ST03-DT03-DF06-CF22-01
C-C479A-SUBV-01-ST03-DT01-DF06-CF19-01
C-C369A-FFMP-05-ST01-DT01-DF17-CF03-01
C-C170A-PSQL-09-ST04-DT03-DF12-CF18-01
C-C771A-SUBV-10-ST01-DT07-DF03-CF01-01
C-C078A-GIMP-02-ST04-DT05-DF11-CF02-01
C-C476E-FFMP-06-ST04-DT05-DF15-CF23-01
C-C663A-GIMP-05-ST04-DT03-DF04-CF02-01
C-C190A-OSSL-02-ST04-DT04-DF03-CF14-01
C-C127A-FFMP-04-ST03-DT03-DF15-CF19-01
C-C459A-FFMP-06-ST04-DT03-DF17-CF20-01
C-C089C-FFMP-08-ST03-DT01-DF02-CF18-01
C-C476G-SUBV-07-ST01-DT04-DF16-CF20-01
C-C831A-FFMP-09-ST01-DT04-DF05-CF01-01
C-C195A-SUBV-01-ST02-DT04-DF15-CF02-01
C-C785A-WIRE-10-ST02-DT07-DF11-CF03-01
C-C789A-GIMP-10-ST03-DT02-DF16-CF18-01
C-C089B-WIRE-02-ST02-DT04-DF16-CF22-01
C-C476D-OSSL-06-ST02-DT04-DF05-CF19-01
C-C821A-OSSL-10-ST04-DT05-DF07-CF12-01
C-C682B-PSQL-09-ST03-DT03-DF12-CF18-01
C-C785D-GIMP-06-ST03-DT02-DF06-CF24-01
C-C775A-FFMP-02-ST01-DT07-DF05-CF24-01
C-C078B-GIMP-04-ST01-DT01-DF17-CF22-01
C-C476A-WIRE-02-ST04-DT01-DF04-CF18-01
C-C764A-GIMP-08-ST02-DT06-DF16-CF01-01
C-C839A-GIMP-04-ST04-DT07-DF16-CF20-01
C-C805C-WIRE-03-ST04-DT04-DF16-CF23-01
C-C773A-PSQL-07-ST04-DT06-DF15-CF03-01
C-C089D-WIRE-08-ST04-DT05-DF12-CF20-01
C-C476C-FFMP-01-ST03-DT06-DF07-CF22-01
C-C765B-WIRE-06-ST02-DT03-DF15-CF23-01
C-C191A-WIRE-05-ST04-DT03-DF10-CF19-01
C-C120C-OSSL-01-ST01-DT05-DF01-CF22-01
C-C674A-SUBV-03-ST02-DT04-DF13-CF19-01
C-C088A-OSSL-10-ST03-DT02-DF13-CF19-01
C-C476B-PSQL-04-ST01-DT07-DF12-CF15-01
C-C543A-OSSL-02-ST03-DT02-DF12-CF22-01
C-C190A-SUBV-07-ST01-DT04-DF13-CF20-01
C-C785C-SUBV-02-ST02-DT01-DF16-CF14-01
C-C774A-GIMP-08-ST03-DT01-DF14-CF02-01
C-C088B-SUBV-06-ST02-DT07-DF03-CF23-01
C-C476E-WIRE-05-ST02-DT02-DF11-CF20-01
C-C828A-SUBV-07-ST01-DT01-DF17-CF03-01
C-C191B-FFMP-08-ST02-DT06-DF06-CF19-01
C-C590A-FFMP-09-ST02-DT06-DF09-CF22-01
C-C771A-OSSL-09-ST01-DT02-DF17-CF23-01
C-C078A-FFMP-09-ST01-DT04-DF17-CF14-01
C-C476F-GIMP-10-ST04-DT05-DF06-CF02-01
C-C367A-FFMP-05-ST04-DT04-DF05-CF19-01
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C-C824B-GIMP-07-ST03-DT06-DF06-CF20-01
C-C400B-WIRE-05-ST02-DT05-DF09-CF03-01
C-C088A-PSQL-05-ST03-DT05-DF15-CF23-01
C-C476E-SUBV-09-ST02-DT02-DF10-CF03-01
C-C765B-PSQL-03-ST02-DT07-DF12-CF18-01
C-C191A-WIRE-10-ST03-DT01-DF01-CF22-01
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C-C789A-FFMP-01-ST03-DT03-DF04-CF14-01
C-C078B-GIMP-01-ST02-DT03-DF16-CF22-01
C-C476D-WIRE-08-ST01-DT01-DF12-CF24-01
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C-C195A-FFMP-06-ST01-DT07-DF05-CF12-01
C-C127B-SUBV-08-ST04-DT07-DF15-CF02-01
C-C835A-OSSL-04-ST04-DT06-DF12-CF22-01
C-C088B-PSQL-07-ST04-DT07-DF10-CF24-01
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C-C828A-SUBV-01-ST03-DT03-DF14-CF24-01
C-C196A-PSQL-04-ST04-DT05-DF13-CF22-01
C-C785A-PSQL-03-ST03-DT02-DF14-CF18-01
C-C834A-PSQL-09-ST04-DT05-DF15-CF18-01
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C-C197A-OSSL-09-ST02-DT03-DF12-CF18-01
C-C416A-WIRE-07-ST01-DT05-DF05-CF24-01
C-C401A-GIMP-07-ST02-DT07-DF06-CF22-01
C-C089C-OSSL-06-ST02-DT03-DF12-CF01-01
C-C476F-SUBV-01-ST01-DT04-DF05-CF02-01
C-C412A-GIMP-01-ST02-DT05-DF13-CF24-01
C-C839A-SUBV-03-ST04-DT05-DF17-CF24-01
C-C806D-FFMP-08-ST04-DT01-DF11-CF13-01
C-C459A-SUBV-03-ST01-DT04-DF11-CF19-01
C-C089D-WIRE-05-ST04-DT06-DF11-CF19-01

C-C476B-PSQL-03-ST02-DT03-DF16-CF20-01
C-C764A-WIRE-02-ST03-DT07-DF16-CF22-01
C-C682B-GIMP-01-ST02-DT02-DF16-CF23-01
C-C126D-OSSL-01-ST02-DT03-DF12-CF23-01
C-C400A-WIRE-05-ST03-DT01-DF05-CF20-01
C-C089A-SUBV-10-ST02-DT02-DF14-CF24-01
C-C476C-FFMP-02-ST04-DT06-DF13-CF23-01
C-C609A-OSSL-04-ST01-DT06-DF02-CF20-01
C-C194A-PSQL-08-ST01-DT01-DF11-CF24-01
C-C134A-WIRE-10-ST03-DT05-DF04-CF23-01
C-C789A-PSQL-01-ST02-DT05-DF16-CF23-01
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C-C476C-PSQL-08-ST02-DT03-DF17-CF19-01
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C-C682A-WIRE-06-ST01-DT07-DF15-CF01-01
C-C127C-SUBV-06-ST01-DT02-DF17-CF01-01
C-C400B-WIRE-08-ST04-DT04-DF06-CF01-01
C-C078B-GIMP-07-ST03-DT04-DF05-CF12-01
C-C476E-OSSL-04-ST03-DT01-DF14-CF03-01
C-C363A-OSSL-05-ST01-DT01-DF15-CF19-01
C-C197A-OSSL-02-ST03-DT04-DF07-CF03-01
C-C806B-PSQL-09-ST02-DT07-DF12-CF19-01
C-C400A-GIMP-10-ST01-DT03-DF10-CF02-01
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C-C476A-SUBV-07-ST04-DT07-DF12-CF18-01
C-C833A-GIMP-07-ST04-DT03-DF13-CF02-01
C-C190A-GIMP-05-ST02-DT05-DF15-CF23-01
C-C843A-FFMP-04-ST04-DT03-DF05-CF22-01
C-C774A-SUBV-02-ST03-DT02-DF16-CF01-01
C-C078A-PSQL-08-ST01-DT06-DF06-CF24-01
C-C476G-WIRE-05-ST01-DT04-DF09-CF20-01
C-C831A-WIRE-09-ST02-DT05-DF06-CF23-01
C-C191A-FFMP-10-ST01-DT06-DF04-CF02-01
C-C126B-OSSL-02-ST04-DT04-DF11-CF19-01
C-C674A-OSSL-04-ST02-DT06-DF12-CF15-01
C-C089D-SUBV-03-ST04-DT05-DF01-CF20-01
C-C476D-GIMP-09-ST01-DT02-DF16-CF14-01
C-C821A-SUBV-10-ST04-DT02-DF17-CF01-01
C-C839A-SUBV-07-ST02-DT03-DF17-CF13-01
C-C785B-GIMP-05-ST03-DT01-DF02-CF02-01
C-C835A-FFMP-06-ST04-DT07-DF15-CF02-01
C-C089A-OSSL-04-ST01-DT01-DF12-CF01-01
C-C476F-FFMP-10-ST02-DT06-DF11-CF03-01
C-C543A-PSQL-08-ST03-DT04-DF14-CF03-01
C-C191B-PSQL-05-ST03-DT02-DF13-CF15-01
C-C806C-PSQL-02-ST01-DT06-DF16-CF01-01
C-C401A-WIRE-03-ST01-DT04-DF01-CF18-01
C-C088A-FFMP-03-ST02-DT03-DF11-CF01-01
C-C476B-FFMP-04-ST03-DT07-DF06-CF01-01
C-C479A-GIMP-08-ST01-DT03-DF06-CF01-01
C-C682B-GIMP-03-ST04-DT01-DF05-CF01-01
C-C124C-FFMP-04-ST02-DT06-DF06-CF20-01
C-C775A-GIMP-08-ST03-DT06-DF11-CF20-01
C-C078A-WIRE-07-ST03-DT02-DF16-CF18-01
C-C476G-OSSL-02-ST04-DT03-DF13-CF22-01
C-C765A-WIRE-09-ST02-DT06-DF17-CF19-01
C-C369A-FFMP-04-ST02-DT06-DF14-CF01-01
C-C805B-WIRE-05-ST01-DT03-DF15-CF20-01
C-C773A-SUBV-04-ST04-DT01-DF17-CF19-01
C-C088A-SUBV-05-ST03-DT04-DF17-CF15-01
C-C476F-PSQL-10-ST03-DT01-DF05-CF19-01
C-C367A-OSSL-02-ST01-DT06-DF12-CF18-01
C-C682A-WIRE-07-ST03-DT05-DF16-CF18-01
C-C824A-GIMP-01-ST04-DT01-DF16-CF03-01
C-C834A-FFMP-01-ST01-DT05-DF13-CF13-01
C-C089A-GIMP-09-ST02-DT07-DF07-CF03-01
C-C476E-SUBV-08-ST02-DT05-DF15-CF13-01
C-C820A-FFMP-07-ST02-DT07-DF09-CF23-01
C-C195A-SUBV-02-ST04-DT03-DF12-CF23-01
C-C126C-SUBV-07-ST03-DT04-DF17-CF18-01
C-C771A-PSQL-02-ST02-DT07-DF14-CF22-01
C-C078B-PSQL-10-ST04-DT03-DF13-CF19-01
C-C476A-WIRE-09-ST01-DT05-DF17-CF24-01
C-C414A-PSQL-01-ST03-DT05-DF12-CF02-01
C-C194A-OSSL-08-ST01-DT04-DF05-CF02-01
C-C805D-GIMP-09-ST02-DT05-DF13-CF02-01
C-C459A-OSSL-07-ST01-DT01-DF02-CF24-01
C-C089D-OSSL-08-ST03-DT05-DF05-CF22-01
C-C476C-GIMP-03-ST04-DT06-DF14-CF22-01
C-C831A-SUBV-03-ST04-DT01-DF05-CF20-01
C-C196A-GIMP-10-ST02-DT07-DF06-CF03-01
C-C120A-OSSL-08-ST04-DT07-DF05-CF02-01
C-C400A-GIMP-09-ST03-DT03-DF08-CF23-01
C-C078A-SUBV-04-ST01-DT06-DF06-CF23-01
C-C476D-GIMP-07-ST03-DT02-DF03-CF22-01
C-C412A-OSSL-10-ST03-DT04-DF15-CF20-01
C-C197A-FFMP-06-ST04-DT02-DF11-CF19-01
C-C129B-OSSL-06-ST02-DT02-DF14-CF24-01
C-C789A-PSQL-05-ST04-DT02-DF17-CF24-01
C-C089C-OSSL-02-ST01-DT04-DF05-CF02-01
C-C476B-OSSL-01-ST01-DT04-DF16-CF18-01
C-C663A-WIRE-06-ST02-DT02-DF16-CF22-01
C-C682A-PSQL-01-ST01-DT01-DF14-CF22-01
C-C805A-SUBV-03-ST01-DT02-DF13-CF24-01
C-C773A-WIRE-06-ST02-DT02-DF16-CF01-01
C-C089B-FFMP-06-ST02-DT01-DF14-CF18-01
C-C476D-SUBV-05-ST02-DT04-DF08-CF01-01
C-C828A-FFMP-05-ST04-DT03-DF03-CF18-01
C-C190A-SUBV-09-ST03-DT06-DF09-CF24-01
C-C415A-PSQL-10-ST03-DT06-DF12-CF22-01
C-C771A-SUBV-04-ST03-DT04-DF13-CF20-01
C-C088B-WIRE-01-ST04-DT01-DF12-CF22-01
C-C476A-PSQL-06-ST04-DT05-DF14-CF13-01
C-C833A-GIMP-04-ST01-DT04-DF14-CF03-01
C-C191B-OSSL-08-ST01-DT05-DF02-CF19-01
C-C170A-WIRE-04-ST03-DT01-DF03-CF15-01
C-C834A-FFMP-10-ST02-DT01-DF12-CF03-01
C-C088A-GIMP-02-ST02-DT02-DF06-CF18-01
C-C476B-FFMP-07-ST02-DT02-DF13-CF02-01
C-C821A-SUBV-09-ST03-DT02-DF11-CF24-01
C-C839A-WIRE-02-ST03-DT07-DF11-CF12-01
C-C127A-FFMP-10-ST04-DT04-DF06-CF01-01

C-C400B-OSSL-10-ST01-DT07-DF14-CF02-01
C-C088A-PSQL-10-ST03-DT03-DF17-CF20-01
C-C476E-WIRE-04-ST03-DT07-DF05-CF23-01
C-C363A-GIMP-08-ST04-DT06-DF17-CF01-01
C-C369A-OSSL-03-ST04-DT03-DF15-CF22-01
C-C120B-PSQL-08-ST02-DT03-DF17-CF20-01
C-C775A-GIMP-01-ST04-DT05-DF15-CF01-01
C-C078A-SUBV-06-ST01-DT06-DF11-CF18-01
C-C476F-FFMP-08-ST01-DT03-DF15-CF18-01
C-C765A-PSQL-10-ST01-DT01-DF11-CF14-01
C-C194A-FFMP-04-ST04-DT04-DF06-CF18-01
C-C761A-FFMP-07-ST01-DT05-DF15-CF18-01
C-C835A-WIRE-08-ST03-DT03-DF05-CF22-01
C-C089B-OSSL-07-ST04-DT05-DF09-CF03-01
C-C476C-SUBV-06-ST04-DT01-DF02-CF20-01
C-C765B-FFMP-04-ST04-DT04-DF16-CF22-01
C-C196A-WIRE-10-ST03-DT02-DF17-CF01-01
C-C120D-SUBV-01-ST02-DT07-DF14-CF19-01
C-C774A-PSQL-06-ST02-DT06-DF06-CF18-01
C-C089A-WIRE-08-ST03-DT07-DF14-CF23-01
C-C476G-GIMP-03-ST02-DT05-DF11-CF23-01
C-C764A-PSQL-05-ST02-DT05-DF10-CF19-01
C-C682B-GIMP-07-ST02-DT01-DF12-CF23-01
C-C124A-GIMP-09-ST03-DT05-DF11-CF23-01
C-C401A-SUBV-03-ST04-DT06-DF12-CF03-01
C-C088B-GIMP-09-ST02-DT01-DF13-CF19-01
C-C476A-WIRE-01-ST03-DT06-DF17-CF19-01
C-C543A-OSSL-01-ST03-DT07-DF13-CF02-01
C-C191A-PSQL-06-ST01-DT03-DF13-CF03-01
C-C170B-OSSL-05-ST04-DT02-DF07-CF13-01
C-C674A-FFMP-07-ST01-DT05-DF12-CF15-01
C-C089C-FFMP-03-ST04-DT06-DF08-CF20-01
C-C476D-OSSL-02-ST01-DT06-DF06-CF03-01
C-C609A-WIRE-02-ST01-DT06-DF05-CF24-01
C-C195A-SUBV-09-ST02-DT02-DF16-CF24-01
C-C822A-WIRE-03-ST01-DT03-DF10-CF18-01
C-C401A-OSSL-09-ST01-DT04-DF07-CF23-01
C-C078B-WIRE-05-ST01-DT03-DF16-CF20-01
C-C476C-PSQL-10-ST04-DT01-DF16-CF01-01
C-C479A-WIRE-07-ST03-DT07-DF05-CF03-01
C-C190A-PSQL-01-ST01-DT05-DF11-CF20-01
C-C124D-WIRE-02-ST03-DT04-DF06-CF03-01
C-C459A-SUBV-05-ST04-DT02-DF11-CF19-01
C-C078A-PSQL-01-ST02-DT07-DF15-CF22-01
C-C476G-OSSL-05-ST02-DT07-DF12-CF02-01
C-C765B-SUBV-06-ST02-DT02-DF14-CF15-01
C-C682A-FFMP-05-ST01-DT06-DF13-CF18-01
C-C126A-GIMP-06-ST01-DT07-DF13-CF01-01
C-C774A-PSQL-02-ST02-DT01-DF04-CF02-01
C-C089B-FFMP-04-ST01-DT02-DF05-CF23-01
C-C476B-SUBV-09-ST03-DT03-DF05-CF02-01
C-C479A-OSSL-03-ST04-DT03-DF16-CF24-01
C-C191B-WIRE-02-ST02-DT04-DF08-CF19-01
C-C129A-FFMP-09-ST04-DT06-DF05-CF03-01
C-C789A-FFMP-07-ST03-DT03-DF15-CF20-01
C-C088A-PSQL-05-ST04-DT05-DF17-CF02-01
C-C476F-WIRE-09-ST04-DT04-DF12-CF24-01
C-C820A-FFMP-05-ST02-DT01-DF04-CF18-01

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F.2 GrammaTech Test Suite

C-C191B-OSSL-09-ST02-DT03-DF02-CF19-01
C-C805C-SUBV-09-ST01-DT05-DF11-CF18-01
C-C834A-PSQL-03-ST04-DT05-DF11-CF18-01
C-C078A-PSQL-09-ST02-DT02-DF15-CF02-01
C-C476G-OSSL-10-ST04-DT01-DF05-CF24-01
C-C828A-GIMP-01-ST04-DT06-DF05-CF14-01
C-C196A-PSQL-01-ST04-DT07-DF07-CF23-01
C-C126B-WIRE-05-ST02-DT03-DF06-CF23-01
C-C771A-GIMP-07-ST03-DT02-DF13-CF24-01
C-C089B-SUBV-10-ST04-DT06-DF11-CF18-01
C-C476D-WIRE-03-ST01-DT06-DF09-CF13-01
C-C479A-FFMP-05-ST02-DT01-DF14-CF01-01
C-C190A-GIMP-05-ST03-DT04-DF11-CF22-01
C-C126A-PSQL-03-ST03-DT01-DF14-CF12-01
C-C459A-SUBV-10-ST01-DT03-DF16-CF02-01
C-C089A-FFMP-05-ST01-DT07-DF09-CF19-01
C-C476F-FFMP-07-ST02-DT02-DF03-CF23-01
C-C833A-OSSL-10-ST03-DT04-DF11-CF20-01
C-C197A-FFMP-03-ST01-DT01-DF15-CF13-01
C-C124C-OSSL-02-ST04-DT02-DF17-CF20-01
C-C401A-WIRE-05-ST02-DT04-DF14-CF03-01
C-C088A-WIRE-08-ST03-DT04-DF14-CF22-01
C-C476C-PSQL-05-ST03-DT04-DF11-CF01-01
C-C363A-SUBV-07-ST01-DT02-DF16-CF18-01
C-C682A-SUBV-08-ST03-DT02-DF13-CF18-01
C-C805D-FFMP-04-ST04-DT04-DF16-CF22-01
C-C773A-OSSL-09-ST04-DT01-DF04-CF22-01
C-C088B-OSSL-07-ST02-DT03-DF13-CF03-01
C-C476B-GIMP-01-ST03-DT05-DF06-CF02-01
C-C765B-WIRE-04-ST01-DT03-DF15-CF24-01
C-C369A-WIRE-06-ST01-DT06-DF17-CF01-01
C-C124B-GIMP-08-ST01-DT07-DF01-CF24-01
C-C789A-FFMP-08-ST03-DT07-DF12-CF23-01
C-C078A-GIMP-02-ST01-DT01-DF12-CF24-01
C-C476A-SUBV-04-ST02-DT03-DF13-CF20-01
C-C820A-PSQL-06-ST02-DT05-DF13-CF02-01
C-C195A-FFMP-10-ST04-DT05-DF14-CF03-01
C-C806B-GIMP-10-ST02-DT06-DF10-CF02-01
C-C775A-PSQL-06-ST02-DT06-DF10-CF01-01
C-C089D-FFMP-03-ST04-DT05-DF16-CF23-01
C-C476E-PSQL-06-ST01-DT07-DF16-CF03-01
C-C663A-WIRE-03-ST03-DT07-DF17-CF22-01
C-C194A-GIMP-02-ST02-DT01-DF12-CF02-01
C-C822A-FFMP-01-ST03-DT05-DF13-CF01-01
C-C835A-WIRE-02-ST01-DT02-DF05-CF14-01
C-C078B-PSQL-01-ST03-DT05-DF02-CF13-01
C-C476B-WIRE-02-ST04-DT04-DF14-CF18-01
C-C414A-PSQL-09-ST04-DT03-DF08-CF19-01
C-C191A-SUBV-07-ST01-DT04-DF16-CF20-01
C-C824B-PSQL-07-ST04-DT03-DF05-CF19-01
C-C774A-FFMP-04-ST01-DT04-DF17-CF19-01
C-C088A-SUBV-06-ST01-DT02-DF17-CF20-01
C-C476E-FFMP-09-ST04-DT03-DF17-CF19-01
C-C764A-GIMP-02-ST03-DT02-DF12-CF03-01
C-C682B-OSSL-04-ST03-DT05-DF06-CF24-01
C-C120B-SUBV-06-ST03-DT07-DF15-CF03-01
C-C400A-SUBV-01-ST02-DT05-DF06-CF20-01
C-C089B-OSSL-04-ST03-DT01-DF06-CF01-01
C-C476G-SUBV-08-ST01-DT02-DF15-CF22-01
C-C609A-SUBV-08-ST04-DT04-DF06-CF23-01
C-C839A-WIRE-03-ST04-DT02-DF05-CF22-01
C-C170B-OSSL-06-ST02-DT01-DF12-CF24-01
C-C674A-GIMP-09-ST04-DT06-DF15-CF20-01
C-C089D-GIMP-10-ST02-DT07-DF05-CF12-01
C-C476C-GIMP-10-ST02-DT07-DF12-CF18-01
C-C412A-FFMP-06-ST01-DT07-DF01-CF19-01
C-C190A-PSQL-05-ST02-DT06-DF16-CF24-01
C-C806D-WIRE-03-ST01-DT06-DF15-CF01-01
C-C400B-OSSL-08-ST03-DT03-DF05-CF01-01
C-C078B-WIRE-03-ST04-DT03-DF17-CF19-01
C-C476F-OSSL-05-ST03-DT06-DF16-CF22-01
C-C821A-OSSL-05-ST02-DT06-DF06-CF03-01
C-C194A-WIRE-01-ST03-DT03-DF15-CF23-01
C-C761A-OSSL-07-ST02-DT04-DF05-CF03-01
C-C834A-FFMP-05-ST02-DT01-DF16-CF13-01
C-C089C-OSSL-02-ST04-DT04-DF05-CF24-01
C-C476A-PSQL-08-ST04-DT05-DF02-CF14-01
C-C543A-PSQL-01-ST03-DT01-DF05-CF23-01
C-C191A-WIRE-02-ST01-DT07-DF01-CF03-01
C-C129A-SUBV-10-ST04-DT06-DF12-CF15-01
C-C775A-GIMP-10-ST01-DT07-DF14-CF18-01
C-C078A-FFMP-06-ST03-DT06-DF13-CF20-01
C-C476D-FFMP-04-ST03-DT01-DF15-CF20-01
C-C831A-GIMP-09-ST01-DT05-DF07-CF22-01
C-C195A-PSQL-07-ST04-DT03-DF17-CF18-01
C-C124D-FFMP-05-ST03-DT02-DF08-CF18-01
C-C773A-SUBV-07-ST03-DT06-DF17-CF03-01
C-C088B-WIRE-01-ST01-DT04-DF03-CF18-01
C-C476D-SUBV-09-ST02-DT04-DF17-CF24-01
C-C765A-WIRE-08-ST02-DT02-DF02-CF15-01
C-C682B-GIMP-08-ST02-DT02-DF14-CF01-01
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C-C088A-PSQL-07-ST02-DT06-DF12-CF22-01
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C-C191B-OSSL-06-ST01-DT01-DF09-CF02-01
C-C127B-WIRE-08-ST02-DT05-DF16-CF20-01
C-C789A-WIRE-06-ST01-DT05-DF13-CF22-01
C-C089C-GIMP-05-ST01-DT05-DF14-CF23-01
C-C476E-WIRE-06-ST02-DT05-DF05-CF01-01
C-C363A-SUBV-02-ST04-DT05-DF14-CF20-01
C-C682A-SUBV-04-ST04-DT06-DF06-CF19-01
C-C416A-GIMP-09-ST01-DT03-DF17-CF22-01
C-C835A-OSSL-03-ST04-DT07-DF07-CF02-01
C-C088A-PSQL-04-ST03-DT03-DF11-CF02-01
C-C476G-OSSL-02-ST03-DT07-DF14-CF19-01
C-C764A-FFMP-07-ST01-DT06-DF15-CF18-01
C-C196A-FFMP-10-ST02-DT04-DF12-CF12-01
C-C127C-PSQL-01-ST04-DT01-DF06-CF19-01

C-C400B-SUBV-02-ST04-DT02-DF01-CF23-01
C-C089A-SUBV-08-ST02-DT01-DF16-CF01-01
C-C476F-OSSL-07-ST04-DT06-DF12-CF02-01
C-C765B-GIMP-10-ST03-DT05-DF17-CF01-01
C-C839A-GIMP-09-ST03-DT07-DF11-CF20-01
C-C127A-SUBV-02-ST03-DT07-DF14-CF23-01
C-C774A-WIRE-04-ST03-DT01-DF11-CF20-01
C-C078A-WIRE-09-ST04-DT07-DF06-CF03-01
C-C476A-PSQL-01-ST01-DT02-DF08-CF03-01
C-C828A-OSSL-03-ST02-DT04-DF16-CF02-01
C-C197A-PSQL-04-ST01-DT05-DF13-CF19-01
C-C170A-OSSL-06-ST01-DT02-DF11-CF22-01
C-C459A-OSSL-09-ST02-DT04-DF15-CF24-01
C-C089B-GIMP-07-ST02-DT04-DF07-CF20-01
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C-C414A-PSQL-08-ST02-DT07-DF11-CF03-01
C-C369A-FFMP-09-ST04-DT05-DF05-CF02-01
C-C785A-GIMP-05-ST02-DT06-DF16-CF03-01
C-C400A-GIMP-04-ST03-DT05-DF12-CF02-01
C-C078B-FFMP-03-ST04-DT02-DF12-CF01-01
C-C476B-GIMP-08-ST04-DT01-DF13-CF22-01
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C-C191B-SUBV-08-ST02-DT02-DF13-CF03-01
C-C805A-FFMP-02-ST04-DT03-DF03-CF02-01
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C-C476C-SUBV-03-ST03-DT06-DF14-CF24-01
C-C609A-WIRE-09-ST03-DT03-DF05-CF01-01
C-C839A-OSSL-02-ST03-DT01-DF12-CF01-01
C-C120D-WIRE-08-ST03-DT04-DF12-CF19-01
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C-C088B-FFMP-08-ST01-DT06-DF15-CF23-01
C-C476G-WIRE-01-ST01-DT07-DF11-CF20-01
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C-C190A-PSQL-06-ST02-DT03-DF08-CF20-01
C-C824A-OSSL-04-ST01-DT01-DF04-CF20-01
C-C773A-SUBV-10-ST03-DT01-DF08-CF15-01
C-C089B-WIRE-06-ST03-DT03-DF16-CF19-01
C-C476A-PSQL-02-ST02-DT03-DF05-CF02-01
C-C543A-OSSL-06-ST03-DT06-DF09-CF13-01
C-C196A-FFMP-05-ST01-DT06-DF06-CF22-01
C-C415A-SUBV-09-ST02-DT05-DF05-CF24-01
C-C771A-WIRE-02-ST04-DT06-DF13-CF01-01
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C-C476E-OSSL-06-ST03-DT05-DF15-CF18-01
C-C820A-PSQL-04-ST02-DT01-DF06-CF24-01
C-C194A-SUBV-07-ST03-DT07-DF14-CF14-01
C-C806A-WIRE-03-ST04-DT07-DF13-CF14-01
C-C459A-FFMP-05-ST01-DT03-DF02-CF24-01
C-C078A-PSQL-05-ST04-DT01-DF15-CF22-01
C-C476F-SUBV-10-ST04-DT04-DF07-CF19-01
C-C367A-GIMP-05-ST01-DT02-DF14-CF23-01
C-C191A-WIRE-01-ST04-DT02-DF15-CF24-01
C-C785B-PSQL-10-ST03-DT02-DF15-CF23-01
C-C775A-PSQL-01-ST02-DT07-DF17-CF23-01
C-C088B-GIMP-10-ST04-DT05-DF10-CF02-01
C-C476D-FFMP-05-ST01-DT06-DF04-CF01-01
C-C765A-FFMP-03-ST04-DT03-DF17-CF20-01
C-C369A-OSSL-10-ST03-DT04-DF04-CF19-01
C-C785C-GIMP-01-ST02-DT02-DF14-CF01-01
C-C774A-OSSL-08-ST03-DT02-DF15-CF18-01
C-C078B-OSSL-04-ST01-DT04-DF11-CF03-01
C-C476G-GIMP-09-ST04-DT02-DF16-CF12-01
C-C831A-WIRE-02-ST03-DT06-DF16-CF19-01
C-C682B-GIMP-03-ST01-DT07-DF05-CF23-01
C-C124A-FFMP-07-ST04-DT05-DF17-CF23-01
C-C674A-GIMP-07-ST02-DT03-DF12-CF19-01
C-C078A-SUBV-09-ST03-DT05-DF17-CF22-01
C-C476B-WIRE-04-ST02-DT04-DF12-CF03-01
C-C833A-SUBV-10-ST02-DT05-DF04-CF22-01
C-C682A-OSSL-01-ST02-DT05-DF17-CF22-01
C-C120A-SUBV-01-ST01-DT03-DF09-CF13-01
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C-C089C-FFMP-10-ST02-DT03-DF06-CF15-01
C-C476C-PSQL-06-ST01-DT05-DF13-CF19-01
C-C663A-FFMP-10-ST01-DT04-DF05-CF03-01
C-C195A-PSQL-03-ST04-DT04-DF16-CF01-01
C-C126D-PSQL-03-ST03-DT04-DF11-CF24-01
C-C789A-SUBV-08-ST01-DT07-DF05-CF19-01
C-C089A-OSSL-05-ST01-DT02-DF14-CF14-01
C-C476E-SUBV-08-ST03-DT07-DF06-CF15-01
C-C479A-OSSL-04-ST04-DT02-DF13-CF18-01
C-C197A-FFMP-08-ST03-DT03-DF17-CF03-01
C-C785D-FFMP-06-ST03-DT06-DF06-CF18-01
C-C400A-PSQL-07-ST02-DT06-DF06-CF12-01
C-C089D-SUBV-03-ST03-DT06-DF08-CF01-01
C-C476A-GIMP-09-ST01-DT01-DF17-CF18-01
C-C363A-WIRE-07-ST01-DT07-DF10-CF23-01
C-C190A-SUBV-02-ST01-DT05-DF15-CF18-01
C-C126C-WIRE-04-ST04-DT01-DF05-CF01-01
C-C401A-OSSL-06-ST03-DT06-DF14-CF24-01
C-C078A-WIRE-02-ST04-DT02-DF05-CF23-01
C-C476F-WIRE-02-ST03-DT02-DF17-CF20-01
C-C765A-GIMP-06-ST03-DT03-DF11-CF18-01
C-C191B-GIMP-06-ST04-DT06-DF14-CF20-01
C-C806C-GIMP-05-ST01-DT07-DF12-CF20-01
C-C835A-GIMP-01-ST01-DT01-DF03-CF01-01
C-C088A-GIMP-08-ST02-DT01-DF13-CF18-01
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C-C414A-SUBV-02-ST04-DT01-DF15-CF12-01
C-C196A-WIRE-10-ST02-DT01-DF11-CF18-01
C-C129B-OSSL-09-ST02-DT03-DF14-CF18-01
C-C400B-WIRE-03-ST04-DT04-DF09-CF22-01
C-C088A-PSQL-06-ST01-DT07-DF12-CF20-01
C-C476B-OSSL-03-ST01-DT03-DF16-CF24-01
C-C663A-PSQL-09-ST01-DT05-DF16-CF20-01
C-C839A-PSQL-09-ST03-DT06-DF13-CF02-01
C-C127D-OSSL-07-ST03-DT06-DF13-CF19-01
C-C674A-WIRE-02-ST03-DT05-DF11-CF23-01
C-C089A-SUBV-09-ST04-DT03-DF01-CF02-01
C-C476D-GIMP-10-ST04-DT03-DF14-CF03-01
C-C820A-OSSL-08-ST03-DT07-DF15-CF19-01

C-C369A-FFMP-04-ST02-DT04-DF06-CF24-01
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C-C400B-GIMP-09-ST02-DT02-DF17-CF20-01
C-C088B-FFMP-04-ST02-DT02-DF16-CF24-01
C-C476C-WIRE-04-ST04-DT07-DF05-CF22-01
C-C828A-FFMP-05-ST02-DT06-DF12-CF23-01
C-C682A-OSSL-07-ST01-DT03-DF10-CF15-01
C-C590A-FFMP-10-ST02-DT01-DF11-CF02-01
C-C775A-FFMP-05-ST01-DT01-DF15-CF02-01
C-C089B-OSSL-01-ST01-DT05-DF05-CF22-01
C-C476A-OSSL-07-ST02-DT05-DF11-CF01-01
C-C821A-GIMP-01-ST04-DT04-DF03-CF24-01
C-C191A-WIRE-05-ST04-DT01-DF11-CF23-01
C-C805B-PSQL-02-ST01-DT02-DF16-CF13-01
C-C400A-SUBV-10-ST04-DT07-DF12-CF18-01
C-C078B-WIRE-07-ST03-DT07-DF15-CF18-01
C-C476F-SUBV-05-ST03-DT06-DF15-CF02-01
C-C479A-SUBV-03-ST02-DT02-DF11-CF24-01
C-C194A-GIMP-01-ST02-DT02-DF16-CF22-01
C-C134A-SUBV-04-ST04-DT02-DF02-CF03-01
C-C459A-PSQL-05-ST03-DT04-DF05-CF02-01
C-C089C-GIMP-09-ST04-DT06-DF17-CF03-01
C-C476G-FFMP-07-ST03-DT04-DF12-CF24-01
C-C833A-WIRE-04-ST02-DT04-DF14-CF18-01
C-C197A-SUBV-03-ST04-DT07-DF03-CF02-01
C-C822A-WIRE-07-ST02-DT07-DF07-CF22-01
C-C789A-OSSL-03-ST02-DT03-DF13-CF03-01
C-C088B-PSQL-03-ST03-DT01-DF14-CF19-01
C-C476E-PSQL-10-ST02-DT01-DF10-CF18-01
C-C764A-FFMP-09-ST04-DT06-DF17-CF02-01
C-C682B-SUBV-10-ST01-DT01-DF16-CF24-01
C-C805D-SUBV-06-ST01-DT01-DF17-CF18-01
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C-C089A-GIMP-02-ST03-DT04-DF13-CF24-01
C-C476B-PSQL-08-ST04-DT06-DF01-CF23-01
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C-C195A-OSSL-02-ST02-DT07-DF05-CF18-01
C-C590A-GIMP-09-ST03-DT05-DF06-CF22-01
C-C834A-WIRE-01-ST03-DT07-DF06-CF01-01
C-C089B-FFMP-05-ST01-DT06-DF01-CF03-01
C-C476F-OSSL-01-ST01-DT07-DF13-CF22-01
C-C831A-OSSL-07-ST01-DT03-DF13-CF01-01
C-C839A-FFMP-05-ST01-DT06-DF14-CF19-01
C-C126D-FFMP-03-ST01-DT06-DF14-CF24-01
C-C835A-GIMP-07-ST04-DT03-DF05-CF23-01
C-C088A-PSQL-06-ST01-DT03-DF05-CF01-01
C-C476D-GIMP-03-ST01-DT05-DF16-CF12-01
C-C765B-PSQL-10-ST03-DT05-DF08-CF02-01
C-C682B-PSQL-06-ST03-DT05-DF12-CF20-01
C-C170B-WIRE-01-ST04-DT03-DF06-CF20-01
C-C771A-SUBV-02-ST01-DT06-DF17-CF14-01
C-C078B-SUBV-08-ST02-DT04-DF06-CF23-01
C-C476A-SUBV-09-ST03-DT01-DF17-CF23-01
C-C543A-WIRE-03-ST02-DT01-DF13-CF20-01
C-C197A-GIMP-07-ST03-DT03-DF05-CF12-01
C-C124D-OSSL-02-ST03-DT05-DF17-CF02-01
C-C401A-FFMP-10-ST02-DT02-DF03-CF19-01
C-C089D-WIRE-04-ST02-DT05-DF11-CF20-01
C-C476C-WIRE-05-ST02-DT03-DF15-CF03-01
C-C609A-GIMP-01-ST04-DT02-DF14-CF22-01
C-C190A-WIRE-09-ST01-DT04-DF13-CF03-01
C-C805B-PSQL-05-ST02-DT07-DF12-CF01-01
C-C774A-PSQL-06-ST04-DT01-DF16-CF20-01
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C-C476E-FFMP-06-ST04-DT04-DF13-CF20-01
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C-C191B-GIMP-04-ST04-DT04-DF06-CF14-01
C-C129B-GIMP-10-ST03-DT04-DF04-CF01-01
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C-C078B-FFMP-07-ST01-DT01-DF07-CF22-01
C-C476G-OSSL-04-ST03-DT02-DF14-CF01-01
C-C831A-GIMP-08-ST01-DT03-DF17-CF03-01
C-C191A-PSQL-08-ST02-DT01-DF17-CF01-01
C-C415A-OSSL-08-ST04-DT07-DF09-CF23-01
C-C789A-GIMP-04-ST02-DT05-DF15-CF22-01
C-C089B-SUBV-01-ST04-DT07-DF13-CF12-01
C-C476E-PSQL-02-ST02-DT04-DF06-CF02-01
C-C821A-WIRE-06-ST04-DT06-DF16-CF23-01
C-C195A-OSSL-04-ST01-DT02-DF11-CF23-01
C-C126A-SUBV-09-ST02-DT01-DF15-CF19-01
C-C401A-PSQL-08-ST01-DT02-DF13-CF23-01
C-C078A-WIRE-10-ST01-DT05-DF15-CF01-01
C-C476C-WIRE-03-ST01-DT02-DF11-CF19-01
C-C833A-FFMP-05-ST02-DT02-DF12-CF19-01
C-C682A-WIRE-02-ST03-DT05-DF02-CF01-01
C-C127C-WIRE-02-ST01-DT04-DF05-CF03-01
C-C835A-FFMP-09-ST02-DT06-DF06-CF24-01
C-C088A-OSSL-08-ST04-DT02-DF08-CF14-01
C-C476D-GIMP-01-ST04-DT06-DF09-CF01-01
C-C414A-SUBV-06-ST03-DT05-DF05-CF18-01
C-C369A-FFMP-01-ST04-DT07-DF15-CF19-01
C-C806B-PSQL-08-ST04-DT06-DF11-CF03-01
C-C400B-WIRE-03-ST04-DT01-DF14-CF02-01
C-C078A-PSQL-05-ST03-DT01-DF17-CF20-01
C-C476A-FFMP-06-ST01-DT03-DF05-CF18-01
C-C367A-PSQL-09-ST01-DT04-DF03-CF20-01
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C-C120C-FFMP-05-ST01-DT05-DF16-CF24-01
C-C771A-SUBV-10-ST01-DT07-DF11-CF19-01
C-C089C-GIMP-04-ST03-DT06-DF16-CF23-01
C-C476G-SUBV-04-ST02-DT07-DF02-CF20-01
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C-C194A-FFMP-06-ST03-DT02-DF07-CF23-01
C-C824B-PSQL-10-ST03-DT02-DF12-CF02-01
C-C773A-SUBV-01-ST03-DT04-DF12-CF18-01
C-C088B-SUBV-06-ST04-DT04-DF12-CF19-01
C-C476B-WIRE-08-ST03-DT01-DF12-CF14-01
C-C828A-OSSL-08-ST04-DT07-DF11-CF14-01
C-C682B-OSSL-09-ST04-DT06-DF13-CF18-01
C-C127A-WIRE-03-ST02-DT03-DF13-CF22-01
C-C459A-PSQL-04-ST04-DT03-DF07-CF20-01
C-C089D-OSSL-02-ST02-DT03-DF11-CF18-01

C-C476F-FFMP-09-ST04-DT05-DF11-CF24-01
C-C764A-WIRE-04-ST03-DT01-DF16-CF03-01
C-C190A-PSQL-07-ST03-DT07-DF12-CF24-01
C-C806D-FFMP-07-ST02-DT02-DF13-CF23-01
C-C834A-WIRE-06-ST02-DT01-DF17-CF15-01
C-C088B-WIRE-03-ST03-DT06-DF14-CF24-01
C-C476E-GIMP-05-ST02-DT07-DF14-CF19-01
C-C363A-PSQL-03-ST02-DT07-DF15-CF01-01
C-C839A-SUBV-08-ST01-DT01-DF17-CF20-01
C-C127B-OSSL-06-ST01-DT06-DF06-CF12-01
C-C674A-FFMP-05-ST01-DT06-DF15-CF03-01
C-C088A-PSQL-09-ST01-DT03-DF16-CF24-01
C-C476B-OSSL-07-ST04-DT01-DF06-CF03-01
C-C765A-FFMP-10-ST03-DT05-DF06-CF18-01
C-C369A-WIRE-10-ST02-DT02-DF09-CF13-01
C-C170A-SUBV-04-ST04-DT05-DF14-CF20-01
C-C400A-OSSL-02-ST04-DT04-DF14-CF22-01
C-C088A-FFMP-07-ST02-DT02-DF13-CF19-01
C-C476G-SUBV-02-ST01-DT05-DF12-CF23-01
C-C609A-GIMP-02-ST01-DT04-DF13-CF19-01
C-C194A-GIMP-05-ST04-DT03-DF06-CF03-01
C-C120B-GIMP-01-ST03-DT01-DF16-CF24-01
C-C774A-GIMP-07-ST03-DT03-DF16-CF24-01
C-C089B-GIMP-01-ST04-DT01-DF17-CF18-01
C-C476A-GIMP-10-ST03-DT04-DF03-CF22-01
C-C543A-SUBV-01-ST04-DT02-DF01-CF02-01
C-C682A-FFMP-07-ST03-DT06-DF03-CF22-01
C-C120A-SUBV-03-ST04-DT07-DF11-CF19-01
C-C774A-WIRE-02-ST02-DT07-DF05-CF19-01
C-C078B-FFMP-06-ST02-DT05-DF05-CF03-01
C-C476F-PSQL-06-ST04-DT02-DF17-CF20-01
C-C479A-PSQL-10-ST03-DT03-DF10-CF24-01
C-C196A-SUBV-01-ST04-DT05-DF11-CF24-01
C-C127D-GIMP-08-ST01-DT04-DF15-CF18-01
C-C401A-PSQL-10-ST03-DT05-DF01-CF02-01
C-C078A-GIMP-01-ST03-DT04-DF12-CF02-01
C-C476C-FFMP-05-ST02-DT06-DF16-CF22-01
C-C765B-GIMP-02-ST04-DT01-DF14-CF02-01
C-C191A-OSSL-10-ST01-DT04-DF12-CF22-01
C-C806A-FFMP-02-ST03-DT03-DF05-CF15-01
C-C835A-SUBV-03-ST04-DT02-DF11-CF01-01
C-C089C-SUBV-07-ST01-DT07-DF11-CF02-01
C-C476D-OSSL-09-ST01-DT04-DF13-CF02-01
C-C412A-FFMP-03-ST02-DT01-DF11-CF22-01
C-C197A-GIMP-05-ST02-DT07-DF15-CF03-01
C-C806C-WIRE-06-ST01-DT07-DF14-CF19-01
C-C459A-GIMP-09-ST01-DT02-DF06-CF03-01
C-C089D-OSSL-05-ST04-DT05-DF02-CF01-01
C-C476F-PSQL-10-ST03-DT03-DF16-CF23-01
C-C820A-SUBV-04-ST01-DT06-DF17-CF24-01
C-C195A-WIRE-08-ST03-DT03-DF16-CF02-01
C-C805C-PSQL-04-ST02-DT05-DF02-CF23-01
C-C775A-OSSL-05-ST04-DT01-DF13-CF24-01
C-C078B-WIRE-09-ST04-DT07-DF06-CF20-01
C-C476E-WIRE-02-ST01-DT05-DF10-CF02-01
C-C820A-OSSL-01-ST03-DT02-DF16-CF01-01
C-C191B-PSQL-09-ST02-DT04-DF14-CF23-01
C-C124B-OSSL-05-ST03-DT06-DF10-CF01-01
C-C674A-FFMP-08-ST03-DT07-DF11-CF22-01
C-C078A-PSQL-03-ST02-DT06-DF15-CF19-01
C-C476D-SUBV-03-ST02-DT01-DF05-CF22-01
C-C831A-WIRE-06-ST04-DT05-DF12-CF01-01
C-C196A-OSSL-03-ST04-DT06-DF15-CF01-01
C-C843A-PSQL-07-ST04-DT01-DF13-CF03-01
C-C771A-OSSL-01-ST02-DT05-DF12-CF23-01
C-C089C-SUBV-04-ST03-DT02-DF11-CF03-01
C-C476G-FFMP-08-ST04-DT05-DF15-CF18-01
C-C543A-WIRE-07-ST02-DT07-DF06-CF20-01
C-C682B-GIMP-02-ST01-DT02-DF01-CF18-01
C-C124A-WIRE-09-ST01-DT04-DF12-CF23-01
C-C834A-GIMP-06-ST01-DT04-DF04-CF20-01
C-C078A-GIMP-08-ST01-DT03-DF14-CF22-01
C-C476A-GIMP-01-ST03-DT06-DF12-CF03-01
C-C412A-OSSL-05-ST01-DT06-DF05-CF22-01
C-C195A-SUBV-06-ST02-DT05-DF06-CF19-01
C-C785C-SUBV-10-ST02-DT02-DF17-CF22-01
C-C773A-WIRE-04-ST02-DT06-DF12-CF24-01
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C-C414A-GIMP-09-ST02-DT04-DF17-CF19-01
C-C197A-WIRE-04-ST03-DT01-DF13-CF20-01
C-C120D-FFMP-01-ST04-DT03-DF11-CF01-01
C-C400A-SUBV-07-ST04-DT03-DF06-CF13-01
C-C088B-WIRE-10-ST02-DT01-DF12-CF23-01
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C-C764A-SUBV-08-ST03-DT03-DF11-CF19-01
C-C369A-PSQL-07-ST01-DT06-DF05-CF15-01
C-C126B-GIMP-03-ST02-DT02-DF05-CF02-01
C-C789A-PSQL-10-ST01-DT06-DF13-CF18-01
C-C088A-PSQL-02-ST04-DT05-DF17-CF15-01
C-C476G-WIRE-04-ST03-DT03-DF04-CF19-01
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C-C476F-PSQL-08-ST02-DT01-DF15-CF15-01
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C-C134A-OSSL-02-ST02-DT03-DF15-CF19-01
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C-C476B-OSSL-09-ST01-DT02-DF01-CF13-01
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C-C191B-WIRE-10-ST01-DT07-DF12-CF19-01
C-C785A-GIMP-09-ST03-DT07-DF06-CF20-01
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C-C088A-PSQL-01-ST03-DT07-DF04-CF22-01
C-C476D-SUBV-01-ST04-DT02-DF14-CF02-01
C-C821A-SUBV-10-ST01-DT03-DF05-CF20-01
C-C191A-SUBV-01-ST04-DT07-DF14-CF01-01
C-C785B-WIRE-04-ST04-DT06-DF17-CF02-01

C-C771A-SUBV-08-ST03-DT01-DF05-CF20-01
C-C078B-FFMP-04-ST02-DT04-DF05-CF01-01
C-C476E-OSSL-03-ST04-DT04-DF17-CF23-01
C-C765A-GIMP-04-ST02-DT07-DF09-CF20-01
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C-C834A-GIMP-03-ST04-DT05-DF13-CF03-01
C-C078A-GIMP-03-ST01-DT02-DF15-CF03-01
C-C476A-FFMP-10-ST03-DT07-DF13-CF01-01
C-C609A-WIRE-09-ST03-DT02-DF17-CF15-01
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C-C459A-WIRE-07-ST04-DT02-DF16-CF12-01
C-C089C-SUBV-05-ST04-DT06-DF13-CF24-01
C-C476C-GIMP-02-ST03-DT07-DF08-CF24-01
C-C833A-PSQL-06-ST03-DT02-DF15-CF22-01
C-C197A-GIMP-09-ST04-DT04-DF12-CF24-01
C-C824A-PSQL-10-ST02-DT04-DF17-CF24-01
C-C773A-FFMP-02-ST04-DT07-DF06-CF18-01
C-C089B-WIRE-07-ST03-DT03-DF03-CF20-01
C-C476D-WIRE-06-ST02-DT04-DF16-CF18-01
C-C363A-FFMP-07-ST03-DT04-DF12-CF24-01
C-C682B-PSQL-08-ST03-DT01-DF04-CF03-01
C-C416A-FFMP-05-ST01-DT02-DF06-CF03-01
C-C400B-GIMP-04-ST02-DT01-DF08-CF22-01
C-C088B-GIMP-09-ST01-DT07-DF13-CF18-01
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C-C765B-FFMP-02-ST01-DT01-DF16-CF12-01
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C-C129A-OSSL-01-ST04-DT07-DF05-CF18-01
C-C400A-PSQL-01-ST01-DT05-DF15-CF20-01
C-C089D-WIRE-06-ST02-DT04-DF15-CF18-01
C-C476E-SUBV-07-ST01-DT01-DF12-CF01-01
C-C663A-PSQL-05-ST02-DT01-DF13-CF18-01
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C-C805A-WIRE-09-ST03-DT01-DF11-CF18-01
C-C401A-FFMP-03-ST03-DT02-DF09-CF19-01
C-C089D-OSSL-06-ST01-DT01-DF14-CF02-01
C-C476C-FFMP-03-ST03-DT03-DF07-CF14-01
C-C479A-OSSL-07-ST04-DT04-DF06-CF02-01
C-C191B-FFMP-04-ST03-DT01-DF11-CF24-01
C-C124C-GIMP-02-ST04-DT06-DF13-CF23-01
C-C775A-WIRE-08-ST01-DT03-DF17-CF02-01
C-C078A-SUBV-01-ST02-DT05-DF06-CF24-01
C-C476F-GIMP-06-ST02-DT05-DF13-CF19-01
C-C412A-WIRE-09-ST02-DT03-DF14-CF19-01
C-C682A-WIRE-03-ST02-DT04-DF16-CF20-01
C-C785C-PSQL-07-ST03-DT06-DF16-CF22-01
C-C774A-SUBV-09-ST02-DT04-DF15-CF23-01
C-C089A-FFMP-08-ST03-DT07-DF17-CF03-01
C-C476B-PSQL-10-ST03-DT02-DF11-CF22-01
C-C765A-SUBV-03-ST04-DT06-DF14-CF24-01
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C-C124B-SUBV-05-ST02-DT04-DF06-CF01-01
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C-C476G-PSQL-07-ST04-DT03-DF13-CF18-01
C-C828A-GIMP-08-ST01-DT05-DF15-CF22-01
C-C194A-FFMP-01-ST01-DT07-DF11-CF20-01
C-C120C-GIMP-04-ST04-DT05-DF12-CF14-01
C-C789A-PSQL-10-ST04-DT04-DF12-CF13-01
C-C088B-PSQL-07-ST01-DT02-DF11-CF01-01
C-C476A-OSSL-02-ST02-DT06-DF11-CF20-01
C-C663A-OSSL-04-ST02-DT01-DF07-CF23-01
C-C197A-WIRE-08-ST01-DT06-DF08-CF23-01
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C-C400A-GIMP-06-ST01-DT06-DF05-CF01-01
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C-C476E-SUBV-09-ST01-DT06-DF05-CF03-01
C-C543A-FFMP-06-ST01-DT02-DF11-CF03-01
C-C190A-GIMP-09-ST03-DT05-DF06-CF22-01
C-C170B-PSQL-06-ST01-DT03-DF15-CF02-01
C-C459A-OSSL-05-ST02-DT07-DF16-CF03-01
C-C088A-PSQL-04-ST04-DT02-DF12-CF20-01
C-C476C-OSSL-08-ST01-DT01-DF14-CF20-01
C-C765B-PSQL-01-ST04-DT07-DF05-CF01-01
C-C369A-PSQL-10-ST04-DT03-DF17-CF22-01
C-C805D-OSSL-01-ST03-DT01-DF07-CF20-01
C-C400B-WIRE-04-ST03-DT01-DF15-CF23-01
C-C089C-GIMP-03-ST03-DT03-DF17-CF23-01
C-C476B-FFMP-05-ST02-DT04-DF14-CF03-01
C-C367A-WIRE-05-ST03-DT04-DF09-CF18-01
C-C196A-SUBV-06-ST03-DT01-DF14-CF02-01
C-C806C-FFMP-10-ST02-DT05-DF14-CF19-01
C-C773A-FFMP-02-ST02-DT03-DF11-CF02-01
C-C078B-WIRE-05-ST01-DT05-DF16-CF19-01
C-C476D-GIMP-04-ST04-DT05-DF06-CF23-01
C-C820A-SUBV-10-ST01-DT03-DF02-CF12-01
C-C369A-OSSL-07-ST02-DT02-DF13-CF24-01
C-C126C-WIRE-08-ST01-DT05-DF14-CF03-01
C-C774A-SUBV-07-ST01-DT05-DF14-CF24-01
C-C088A-FFMP-09-ST03-DT04-DF14-CF01-01
C-C476G-WIRE-03-ST02-DT01-DF16-CF02-01
C-C609A-FFMP-02-ST02-DT05-DF16-CF24-01
C-C190A-SUBV-02-ST04-DT06-DF06-CF23-01
C-C126B-GIMP-10-ST03-DT04-DF17-CF15-01
C-C674A-SUBV-02-ST04-DT02-DF14-CF19-01
C-C078A-PSQL-10-ST04-DT06-DF05-CF19-01
C-C476F-FFMP-01-ST01-DT07-DF01-CF02-01
C-C363A-GIMP-04-ST03-DT06-DF13-CF02-01
C-C682A-OSSL-05-ST04-DT01-DF05-CF13-01
C-C126A-SUBV-03-ST02-DT02-DF09-CF14-01
C-C401A-WIRE-07-ST01-DT07-DF16-CF22-01
C-C078A-WIRE-08-ST02-DT01-DF13-CF02-01
C-C476B-SUBV-07-ST03-DT02-DF08-CF18-01
C-C821A-GIMP-08-ST02-DT06-DF12-CF03-01
C-C195A-FFMP-06-ST02-DT04-DF02-CF03-01
C-C805B-FFMP-04-ST02-DT01-DF13-CF01-01
C-C771A-GIMP-05-ST03-DT05-DF17-CF22-01
C-C088B-GIMP-06-ST02-DT05-DF11-CF19-01
C-C476E-GIMP-06-ST03-DT03-DF11-CF20-01
C-C764A-SUBV-03-ST04-DT01-DF05-CF18-01

C-C196A-PSQL-09-ST03-DT02-DF12-CF12-01
C-C126D-OSSL-09-ST04-DT02-DF16-CF19-01
C-C775A-OSSL-08-ST04-DT04-DF05-CF03-01
C-C089B-OSSL-09-ST02-DT02-DF09-CF22-01
C-C476C-PSQL-04-ST01-DT04-DF15-CF01-01
C-C414A-OSSL-05-ST01-DT07-DF12-CF14-01
C-C191B-WIRE-07-ST02-DT07-DF17-CF02-01
C-C805C-WIRE-05-ST03-DT07-DF11-CF22-01
C-C835A-PSQL-03-ST02-DT01-DF05-CF18-01
C-C089A-FFMP-01-ST03-DT07-DF15-CF24-01
C-C476D-OSSL-08-ST03-DT05-DF17-CF03-01
C-C831A-PSQL-07-ST03-DT02-DF06-CF19-01
C-C839A-GIMP-04-ST01-DT03-DF10-CF01-01
C-C785A-PSQL-06-ST01-DT06-DF12-CF20-01
C-C834A-FFMP-06-ST03-DT06-DF14-CF20-01
C-C089C-SUBV-10-ST01-DT03-DF12-CF12-01
C-C476G-WIRE-05-ST03-DT07-DF06-CF19-01
C-C833A-WIRE-06-ST04-DT05-DF17-CF23-01
C-C191A-SUBV-10-ST03-DT06-DF16-CF18-01
C-C127A-GIMP-07-ST04-DT03-DF15-CF24-01
C-C459A-GIMP-10-ST03-DT02-DF06-CF18-01
C-C088B-WIRE-02-ST04-DT01-DF01-CF03-01
C-C476F-GIMP-02-ST04-DT02-DF12-CF22-01
C-C831A-OSSL-02-ST02-DT04-DF11-CF20-01
C-C682B-WIRE-01-ST01-DT03-DF15-CF22-01
C-C822A-WIRE-02-ST02-DT04-DF02-CF23-01
C-C771A-PSQL-01-ST01-DT01-DF12-CF01-01
C-C089A-GIMP-07-ST04-DT02-DF06-CF22-01
C-C476A-FFMP-09-ST02-DT06-DF17-CF13-01
C-C764A-PSQL-10-ST04-DT03-DF03-CF22-01
C-C194A-FFMP-03-ST04-DT05-DF14-CF14-01
C-C170A-OSSL-01-ST01-DT02-DF05-CF18-01
C-C835A-FFMP-04-ST01-DT02-DF07-CF15-01
C-C088A-PSQL-08-ST01-DT04-DF17-CF23-01
C-C476D-OSSL-10-ST01-DT04-DF05-CF23-01
C-C543A-FFMP-09-ST03-DT06-DF14-CF01-01
C-C191B-GIMP-08-ST04-DT05-DF15-CF20-01
C-C590A-PSQL-08-ST01-DT01-DF05-CF12-01
C-C773A-WIRE-09-ST04-DT03-DF13-CF19-01
C-C088A-OSSL-05-ST03-DT06-DF16-CF18-01
C-C476E-SUBV-01-ST02-DT03-DF12-CF24-01
C-C820A-WIRE-01-ST01-DT05-DF14-CF02-01
C-C194A-OSSL-08-ST02-DT06-DF12-CF19-01
C-C416A-FFMP-02-ST03-DT06-DF17-CF20-01
C-C401A-OSSL-04-ST02-DT03-DF04-CF01-01
C-C089C-FFMP-04-ST03-DT05-DF15-CF20-01
C-C476G-PSQL-04-ST04-DT06-DF13-CF01-01
C-C765B-SUBV-07-ST01-DT02-DF13-CF20-01
C-C369A-PSQL-04-ST02-DT07-DF14-CF20-01
C-C134A-SUBV-01-ST03-DT05-DF16-CF19-01
C-C775A-SUBV-09-ST03-DT05-DF06-CF24-01
C-C078B-SUBV-04-ST04-DT07-DF16-CF01-01
C-C476B-WIRE-01-ST02-DT02-DF14-CF24-01
C-C609A-PSQL-06-ST03-DT03-DF12-CF22-01
C-C196A-FFMP-06-ST01-DT04-DF06-CF24-01
C-C843A-FFMP-03-ST02-DT04-DF12-CF02-01
C-C789A-OSSL-03-ST04-DT07-DF11-CF02-01
C-C089D-WIRE-10-ST02-DT06-DF07-CF02-01
C-C476F-FFMP-02-ST01-DT01-DF11-CF18-01
C-C821A-OSSL-09-ST02-DT07-DF17-CF01-01
C-C190A-GIMP-10-ST03-DT01-DF17-CF19-01
C-C124C-PSQL-09-ST03-DT03-DF14-CF24-01
C-C834A-GIMP-06-ST02-DT04-DF16-CF24-01
C-C078A-SUBV-05-ST01-DT03-DF05-CF03-01
C-C476A-PSQL-07-ST04-DT07-DF16-CF02-01
C-C833A-GIMP-05-ST04-DT01-DF10-CF15-01
C-C682B-WIRE-09-ST04-DT06-DF11-CF03-01
C-C120D-SUBV-04-ST04-DT06-DF06-CF22-01
C-C774A-FFMP-10-ST01-DT06-DF13-CF12-01
C-C089C-FFMP-09-ST02-DT04-DF06-CF22-01
C-C476C-SUBV-03-ST01-DT05-DF10-CF22-01
C-C412A-WIRE-01-ST02-DT04-DF15-CF03-01
C-C195A-PSQL-02-ST03-DT07-DF07-CF19-01
C-C129B-GIMP-05-ST04-DT07-DF16-CF01-01
C-C400A-WIRE-08-ST04-DT05-DF12-CF02-01
C-C089A-GIMP-01-ST03-DT05-DF12-CF03-01
C-C476B-GIMP-08-ST03-DT06-DF15-CF23-01
C-C828A-SUBV-08-ST04-DT03-DF06-CF03-01
C-C197A-OSSL-03-ST01-DT02-DF16-CF02-01
C-C824B-OSSL-08-ST02-DT01-DF03-CF22-01
C-C400B-SUBV-05-ST02-DT04-DF02-CF20-01
C-C089B-OSSL-06-ST01-DT01-DF11-CF23-01
C-C476D-OSSL-09-ST02-DT02-DF02-CF19-01
C-C367A-GIMP-03-ST03-DT06-DF11-CF02-01
C-C839A-SUBV-01-ST02-DT05-DF03-CF23-01
C-C824A-WIRE-06-ST01-DT02-DF13-CF19-01
C-C834A-PSQL-07-ST03-DT07-DF17-CF23-01
C-C078B-PSQL-02-ST04-DT03-DF14-CF18-01
C-C476A-WIRE-06-ST04-DT05-DF06-CF15-01
C-C414A-FFMP-10-ST01-DT04-DF16-CF24-01
C-C191A-GIMP-07-ST02-DT03-DF13-CF18-01
C-C785D-FFMP-10-ST03-DT03-DF01-CF18-01
C-C674A-FFMP-02-ST04-DT01-DF15-CF03-01
C-C088B-OSSL-03-ST02-DT02-DF17-CF18-01
C-C476C-PSQL-05-ST03-DT03-DF05-CF20-01
C-C363A-WIRE-02-ST04-DT07-DF05-CF19-01
C-C682A-PSQL-05-ST01-DT01-DF05-CF01-01
C-C785B-PSQL-04-ST01-DT07-DF11-CF03-01
C-C400B-WIRE-01-ST03-DT02-DF09-CF18-01
C-C089C-SUBV-07-ST02-DT07-DF16-CF20-01
C-C476E-FFMP-10-ST01-DT01-DF17-CF03-01
C-C663A-SUBV-04-ST03-DT01-DF12-CF02-01
C-C369A-OSSL-05-ST04-DT03-DF16-CF23-01
C-C120B-GIMP-07-ST02-DT05-DF11-CF13-01
C-C789A-GIMP-01-ST01-DT03-DF17-CF19-01
C-C078A-GIMP-10-ST04-DT04-DF03-CF15-01
C-C476F-GIMP-06-ST02-DT04-DF16-CF12-01
C-C765A-PSQL-02-ST02-DT05-DF05-CF23-01
C-C195A-WIRE-09-ST03-DT06-DF05-CF20-01
C-C124A-SUBV-10-ST03-DT04-DF15-CF20-01
C-C774A-PSQL-04-ST02-DT06-DF15-CF22-01
C-C088A-PSQL-06-ST01-DT06-DF13-CF24-01

C-C476G-SUBV-02-ST01-DT02-DF17-CF01-01
C-C479A-GIMP-05-ST01-DT02-DF05-CF19-01
C-C197A-SUBV-07-ST02-DT04-DF09-CF22-01
C-C806B-OSSL-09-ST04-DT03-DF14-CF23-01
C-C771A-OSSL-05-ST02-DT05-DF12-CF23-01
C-C089D-WIRE-04-ST03-DT03-DF06-CF14-01
C-C476C-WIRE-10-ST04-DT07-DF15-CF20-01
C-C831A-FFMP-07-ST03-DT07-DF14-CF22-01
C-C190A-FFMP-10-ST04-DT02-DF11-CF18-01
C-C120A-WIRE-01-ST04-DT06-DF10-CF24-01
C-C401A-SUBV-02-ST03-DT06-DF05-CF14-01
C-C088A-FFMP-05-ST01-DT01-DF12-CF18-01
C-C476D-WIRE-01-ST04-DT03-DF11-CF18-01
C-C765A-OSSL-10-ST01-DT03-DF12-CF22-01
C-C682A-WIRE-03-ST03-DT04-DF14-CF18-01
C-C805A-SUBV-02-ST01-DT04-DF16-CF01-01
C-C775A-OSSL-06-ST01-DT01-DF10-CF03-01
C-C078A-OSSL-01-ST03-DT04-DF15-CF19-01
C-C476B-OSSL-04-ST02-DT06-DF07-CF02-01
C-C543A-SUBV-04-ST02-DT04-DF15-CF19-01
C-C839A-SUBV-06-ST01-DT02-DF17-CF15-01
C-C127C-PSQL-03-ST02-DT02-DF15-CF03-01
C-C773A-PSQL-10-ST04-DT04-DF11-CF20-01
C-C089D-SUBV-08-ST04-DT07-DF13-CF22-01
C-C476A-GIMP-07-ST03-DT01-DF13-CF24-01
C-C765B-WIRE-01-ST04-DT01-DF04-CF18-01
C-C191B-OSSL-08-ST04-DT05-DF04-CF22-01
C-C127D-OSSL-08-ST02-DT07-DF17-CF18-01
C-C674A-SUBV-07-ST03-DT07-DF14-CF24-01
C-C078B-WIRE-09-ST02-DT02-DF14-CF23-01
C-C476G-OSSL-05-ST02-DT05-DF05-CF23-01
C-C820A-PSQL-08-ST01-DT06-DF11-CF13-01
C-C194A-PSQL-01-ST02-DT01-DF15-CF24-01
C-C806D-GIMP-07-ST03-DT01-DF05-CF02-01
C-C400A-WIRE-03-ST01-DT02-DF16-CF22-01
C-C088B-PSQL-03-ST04-DT05-DF08-CF24-01
C-C476E-FFMP-08-ST03-DT04-DF06-CF22-01
C-C367A-FFMP-09-ST03-DT05-DF17-CF20-01
C-C191A-FFMP-02-ST01-DT05-DF13-CF02-01
C-C124D-WIRE-06-ST01-DT05-DF12-CF23-01
C-C459A-GIMP-08-ST04-DT06-DF06-CF01-01
C-C089A-FFMP-02-ST01-DT06-DF05-CF20-01
C-C476F-SUBV-06-ST01-DT07-DF03-CF18-01
C-C414A-GIMP-06-ST02-DT02-DF06-CF18-01
C-C682B-SUBV-04-ST03-DT07-DF15-CF01-01
C-C129A-FFMP-01-ST02-DT01-DF07-CF03-01
C-C835A-FFMP-09-ST02-DT03-DF03-CF18-01
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C-C476B-PSQL-09-ST04-DT01-DF12-CF19-01
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C-C196A-GIMP-10-ST01-DT07-DF12-CF18-01
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C-C400B-SUBV-10-ST04-DT05-DF16-CF03-01
C-C088B-GIMP-04-ST04-DT07-DF11-CF02-01
C-C476A-SUBV-02-ST04-DT03-DF14-CF23-01
C-C828A-GIMP-07-ST02-DT03-DF01-CF24-01
C-C194A-WIRE-07-ST03-DT04-DF05-CF01-01
C-C127B-OSSL-10-ST03-DT03-DF13-CF23-01
C-C773A-WIRE-09-ST01-DT07-DF12-CF01-01
C-C089D-SUBV-10-ST01-DT04-DF04-CF19-01
C-C476C-OSSL-03-ST02-DT04-DF04-CF24-01
C-C609A-WIRE-08-ST01-DT05-DF07-CF23-01
C-C191A-PSQL-04-ST04-DT02-DF01-CF19-01
C-C761A-WIRE-07-ST04-DT02-DF14-CF24-01
C-C674A-OSSL-08-ST02-DT01-DF13-CF02-01
C-C078A-PSQL-09-ST02-DT06-DF11-CF23-01
C-C476E-WIRE-07-ST03-DT05-DF14-CF02-01
C-C764A-SUBV-02-ST04-DT02-DF16-CF01-01
C-C839A-FFMP-09-ST02-DT07-DF13-CF22-01
C-C120C-PSQL-09-ST03-DT06-DF05-CF14-01
C-C400A-FFMP-07-ST03-DT04-DF14-CF19-01
C-C078A-FFMP-06-ST03-DT02-DF10-CF15-01
C-C476F-PSQL-04-ST01-DT06-DF17-CF14-01
C-C821A-PSQL-10-ST03-DT01-DF13-CF18-01
C-C682A-GIMP-06-ST04-DT07-DF17-CF03-01
C-C129A-GIMP-04-ST01-DT05-DF08-CF02-01
C-C789A-GIMP-01-ST03-DT01-DF01-CF23-01
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C-C476G-GIMP-08-ST02-DT06-DF06-CF03-01
C-C833A-OSSL-01-ST01-DT04-DF16-CF03-01
C-C369A-GIMP-08-ST04-DT06-DF08-CF24-01
C-C806C-FFMP-03-ST04-DT02-DF04-CF18-01
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C-C682B-OSSL-01-ST02-DT03-DF06-CF20-01
C-C124C-WIRE-02-ST02-DT05-DF17-CF18-01
C-C459A-FFMP-02-ST04-DT07-DF05-CF22-01
C-C089C-WIRE-07-ST01-DT05-DF16-CF02-01
C-C476A-FFMP-03-ST01-DT07-DF15-CF23-01
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C-C191B-WIRE-05-ST01-DT01-DF16-CF23-01
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C-C088A-WIRE-05-ST04-DT01-DF11-CF24-01
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C-C663A-FFMP-05-ST03-DT02-DF13-CF02-01
C-C195A-FFMP-03-ST03-DT01-DF14-CF03-01
C-C805B-OSSL-05-ST01-DT06-DF13-CF19-01
C-C401A-SUBV-04-ST02-DT02-DF08-CF24-01
C-C078A-OSSL-03-ST04-DT07-DF12-CF23-01
C-C476G-GIMP-09-ST04-DT03-DF09-CF24-01
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C-C805C-SUBV-08-ST02-DT04-DF03-CF20-01
C-C771A-GIMP-03-ST04-DT06-DF15-CF20-01
C-C088B-PSQL-01-ST03-DT04-DF13-CF03-01
C-C476B-SUBV-10-ST02-DT05-DF11-CF18-01
C-C821A-GIMP-03-ST01-DT07-DF15-CF23-01
C-C197A-OSSL-02-ST03-DT05-DF11-CF02-01
C-C120B-PSQL-02-ST04-DT01-DF06-CF20-01

C-C834A-OSSL-10-ST04-DT02-DF17-CF24-01
C-C089C-FFMP-09-ST01-DT02-DF13-CF22-01
C-C476G-WIRE-05-ST03-DT04-DF13-CF20-01
C-C412A-SUBV-06-ST03-DT04-DF17-CF20-01
C-C196A-PSQL-01-ST01-DT02-DF06-CF20-01
C-C124D-GIMP-03-ST02-DT03-DF12-CF01-01
C-C835A-WIRE-05-ST03-DT03-DF11-CF03-01
C-C078B-SUBV-07-ST02-DT03-DF05-CF20-01
C-C476F-OSSL-08-ST01-DT07-DF14-CF22-01
C-C831A-OSSL-04-ST02-DT06-DF14-CF23-01
C-C195A-GIMP-10-ST01-DT04-DF17-CF19-01
C-C805D-FFMP-09-ST03-DT07-DF06-CF01-01
C-C674A-PSQL-02-ST01-DT03-DF04-CF12-01
C-C089A-OSSL-04-ST03-DT05-DF12-CF19-01
C-C476E-PSQL-03-ST02-DT02-DF13-CF19-01
C-C820A-OSSL-05-ST04-DT03-DF06-CF19-01
C-C197A-WIRE-02-ST04-DT03-DF12-CF13-01
C-C822A-GIMP-04-ST04-DT01-DF11-CF23-01
C-C774A-OSSL-07-ST03-DT06-DF05-CF02-01
C-C088A-WIRE-06-ST02-DT07-DF17-CF01-01
C-C476D-OSSL-10-ST04-DT07-DF05-CF01-01
C-C367A-WIRE-02-ST02-DT02-DF11-CF03-01
C-C191B-SUBV-09-ST03-DT06-DF15-CF24-01
C-C416A-OSSL-10-ST03-DT04-DF14-CF22-01
C-C789A-SUBV-08-ST02-DT04-DF12-CF01-01
C-C089D-GIMP-03-ST04-DT04-DF14-CF20-01
C-C476D-GIMP-02-ST01-DT01-DF16-CF19-01
C-C765A-SUBV-03-ST01-DT01-DF09-CF24-01
C-C682A-FFMP-08-ST02-DT04-DF05-CF23-01
C-C127B-WIRE-01-ST02-DT07-DF05-CF24-01
C-C400A-GIMP-03-ST01-DT04-DF16-CF19-01
C-C088A-PSQL-02-ST01-DT02-DF16-CF18-01
C-C476C-WIRE-07-ST03-DT03-DF17-CF03-01
C-C663A-FFMP-07-ST04-DT07-DF11-CF22-01
C-C194A-OSSL-07-ST03-DT05-DF16-CF15-01
C-C824B-SUBV-07-ST01-DT03-DF11-CF19-01
C-C835A-WIRE-04-ST04-DT05-DF14-CF23-01
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C-C476E-FFMP-04-ST04-DT02-DF12-CF02-01
C-C414A-PSQL-08-ST04-DT04-DF12-CF02-01
C-C369A-SUBV-03-ST01-DT02-DF14-CF02-01
C-C126C-PSQL-06-ST04-DT02-DF17-CF02-01
C-C773A-FFMP-09-ST03-DT01-DF06-CF22-01
C-C088B-SUBV-08-ST01-DT01-DF15-CF12-01
C-C476B-PSQL-06-ST02-DT06-DF17-CF13-01
C-C828A-OSSL-10-ST01-DT05-DF05-CF18-01
C-C196A-OSSL-05-ST04-DT03-DF13-CF22-01
C-C126B-FFMP-08-ST01-DT06-DF12-CF03-01
C-C400B-SUBV-06-ST01-DT06-DF11-CF18-01
C-C078B-PSQL-10-ST03-DT03-DF08-CF24-01
C-C476A-SUBV-09-ST03-DT04-DF07-CF22-01
C-C764A-GIMP-01-ST02-DT06-DF13-CF13-01
C-C839A-PSQL-06-ST02-DT01-DF06-CF03-01
C-C170B-GIMP-03-ST03-DT05-DF10-CF13-01
C-C401A-OSSL-01-ST01-DT07-DF15-CF13-01
C-C088A-FFMP-05-ST02-DT05-DF15-CF01-01
C-C476F-GIMP-01-ST04-DT04-DF05-CF20-01
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C-C190A-FFMP-09-ST02-DT01-DF01-CF14-01
C-C126D-PSQL-05-ST02-DT07-DF13-CF20-01
C-C834A-GIMP-02-ST02-DT07-DF13-CF01-01
C-C089D-WIRE-07-ST03-DT07-DF05-CF02-01
C-C476A-PSQL-09-ST01-DT05-DF15-CF22-01
C-C479A-GIMP-09-ST03-DT01-DF15-CF01-01
C-C682B-PSQL-07-ST04-DT07-DF10-CF18-01
C-C590A-SUBV-06-ST03-DT02-DF05-CF24-01
C-C771A-WIRE-06-ST03-DT03-DF17-CF03-01
C-C089B-SUBV-04-ST01-DT04-DF12-CF22-01
C-C476F-FFMP-04-ST03-DT03-DF13-CF18-01
C-C543A-FFMP-01-ST03-DT05-DF04-CF12-01
C-C191A-GIMP-04-ST01-DT06-DF11-CF03-01
C-C170A-WIRE-10-ST04-DT01-DF16-CF02-01
C-C775A-PSQL-01-ST04-DT03-DF14-CF23-01
C-C078A-OSSL-09-ST02-DT05-DF03-CF18-01
C-C476C-OSSL-10-ST02-DT01-DF11-CF03-01
C-C363A-WIRE-08-ST01-DT02-DF06-CF18-01
C-C839A-WIRE-01-ST03-DT03-DF15-CF19-01
C-C785B-OSSL-05-ST01-DT05-DF15-CF01-01
C-C459A-FFMP-07-ST02-DT04-DF09-CF20-01
C-C089A-GIMP-02-ST04-DT06-DF14-CF01-01
C-C476E-WIRE-02-ST01-DT06-DF14-CF24-01
C-C833A-SUBV-10-ST02-DT01-DF16-CF24-01
C-C190A-PSQL-10-ST04-DT02-DF16-CF02-01
C-C805A-WIRE-07-ST03-DT03-DF06-CF22-01
C-C400A-SUBV-04-ST02-DT01-DF15-CF18-01
C-C089A-SUBV-10-ST01-DT01-DF14-CF03-01
C-C476D-FFMP-08-ST02-DT07-DF09-CF02-01
C-C609A-PSQL-02-ST04-DT04-DF17-CF01-01
C-C191A-FFMP-02-ST02-DT05-DF17-CF20-01
C-C127C-GIMP-01-ST01-DT04-DF14-CF19-01
C-C774A-GIMP-09-ST04-DT07-DF12-CF02-01
C-C078A-PSQL-05-ST04-DT02-DF06-CF02-01
C-C476G-OSSL-01-ST01-DT02-DF06-CF01-01
C-C820A-SUBV-06-ST04-DT03-DF11-CF23-01
C-C195A-WIRE-08-ST01-DT01-DF04-CF01-01
C-C120D-SUBV-08-ST02-DT06-DF17-CF23-01
C-C674A-WIRE-05-ST01-DT04-DF06-CF24-01
C-C089D-OSSL-06-ST02-DT03-DF13-CF23-01
C-C476B-GIMP-06-ST03-DT04-DF01-CF23-01
C-C765A-FFMP-09-ST01-DT06-DF15-CF02-01
C-C682B-OSSL-03-ST03-DT04-DF13-CF24-01
C-C824A-PSQL-02-ST04-DT03-DF08-CF18-01
C-C835A-FFMP-08-ST01-DT05-DF13-CF20-01
C-C089B-FFMP-08-ST03-DT07-DF16-CF20-01
C-C476G-PSQL-05-ST01-DT05-DF12-CF20-01
C-C367A-OSSL-03-ST03-DT07-DF08-CF03-01
C-C369A-SUBV-05-ST02-DT05-DF14-CF22-01
C-C843A-OSSL-04-ST02-DT02-DF16-CF19-01
C-C400B-OSSL-03-ST01-DT02-DF11-CF19-01
C-C078A-WIRE-03-ST02-DT01-DF07-CF24-01
C-C476F-SUBV-03-ST03-DT05-DF05-CF19-01
C-C414A-WIRE-07-ST01-DT02-DF05-CF22-01

C-C682A-GIMP-06-ST03-DT06-DF07-CF18-01
C-C785D-WIRE-09-ST01-DT04-DF11-CF12-01
C-C834A-PSQL-10-ST03-DT02-DF01-CF22-01
C-C078B-GIMP-01-ST03-DT02-DF15-CF23-01
C-C476B-WIRE-07-ST04-DT06-DF06-CF19-01
C-C363A-GIMP-05-ST04-DT04-DF03-CF24-01
C-C196A-WIRE-08-ST04-DT02-DF05-CF24-01
C-C415A-FFMP-09-ST03-DT05-DF12-CF24-01
C-C775A-WIRE-03-ST02-DT01-DF05-CF01-01
C-C088A-SUBV-09-ST01-DT05-DF11-CF18-01
C-C476A-SUBV-05-ST02-DT07-DF11-CF12-01
C-C764A-GIMP-06-ST03-DT03-DF12-CF20-01
C-C197A-GIMP-01-ST01-DT04-DF14-CF23-01
C-C806D-OSSL-04-ST04-DT06-DF15-CF01-01
C-C789A-SUBV-06-ST04-DT05-DF08-CF20-01
C-C088B-OSSL-07-ST04-DT03-DF17-CF22-01
C-C476C-GIMP-08-ST01-DT02-DF05-CF18-01
C-C765B-FFMP-02-ST02-DT05-DF13-CF14-01
C-C191B-PSQL-04-ST02-DT03-DF11-CF01-01
C-C761A-GIMP-06-ST03-DT07-DF13-CF18-01
C-C459A-FFMP-01-ST03-DT06-DF12-CF18-01
C-C078B-PSQL-06-ST01-DT04-DF05-CF02-01
C-C476D-WIRE-07-ST03-DT01-DF03-CF02-01
C-C821A-OSSL-07-ST01-DT01-DF14-CF01-01
C-C194A-OSSL-05-ST01-DT07-DF06-CF02-01
C-C124B-PSQL-01-ST04-DT05-DF04-CF03-01
C-C771A-OSSL-04-ST02-DT03-DF16-CF14-01
C-C089C-WIRE-01-ST03-DT04-DF10-CF20-01
C-C476E-OSSL-06-ST04-DT03-DF16-CF24-01
C-C828A-PSQL-01-ST04-DT06-DF16-CF19-01
C-C839A-SUBV-02-ST03-DT07-DF11-CF03-01
C-C785A-FFMP-08-ST01-DT01-DF16-CF23-01
C-C401A-GIMP-02-ST04-DT06-DF11-CF02-01
C-C088A-FFMP-10-ST02-DT05-DF17-CF02-01
C-C476C-PSQL-01-ST02-DT04-DF12-CF20-01
C-C663A-WIRE-03-ST03-DT06-DF12-CF03-01
C-C369A-FFMP-10-ST01-DT03-DF12-CF20-01
C-C806A-SUBV-07-ST02-DT04-DF05-CF22-01
C-C773A-PSQL-08-ST03-DT05-DF14-CF03-01
C-C089B-GIMP-04-ST04-DT06-DF02-CF22-01
C-C476G-FFMP-09-ST04-DT05-DF16-CF23-01
C-C412A-FFMP-08-ST01-DT03-DF15-CF23-01
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C-C401A-FFMP-05-ST03-DT03-DF13-CF23-01
C-C088B-GIMP-02-ST02-DT03-DF16-CF19-01
C-C476B-OSSL-03-ST03-DT07-DF15-CF03-01
C-C479A-SUBV-05-ST02-DT04-DF14-CF22-01
C-C682A-FFMP-03-ST04-DT01-DF16-CF22-01
C-C127D-WIRE-10-ST02-DT01-DF02-CF15-01
C-C789A-WIRE-10-ST02-DT02-DF06-CF03-01
C-C078A-SUBV-03-ST03-DT01-DF13-CF18-01
C-C476F-WIRE-10-ST04-DT06-DF11-CF01-01
C-C833A-OSSL-10-ST03-DT01-DF17-CF15-01
C-C682B-WIRE-06-ST04-DT06-DF05-CF19-01
C-C124A-SUBV-02-ST01-DT02-DF13-CF20-01
C-C835A-GIMP-07-ST01-DT04-DF07-CF22-01
C-C088A-PSQL-08-ST01-DT07-DF15-CF22-01
C-C476A-FFMP-04-ST01-DT03-DF14-CF19-01
C-C831A-GIMP-09-ST04-DT05-DF11-CF20-01
C-C196A-OSSL-07-ST03-DT04-DF08-CF15-01
C-C126A-OSSL-03-ST04-DT07-DF12-CF03-01
C-C459A-SUBV-09-ST04-DT01-DF17-CF19-01
C-C089A-WIRE-05-ST04-DT02-DF14-CF24-01
C-C476D-PSQL-02-ST02-DT01-DF15-CF22-01
C-C543A-SUBV-04-ST02-DT06-DF07-CF18-01
C-C190A-SUBV-04-ST04-DT02-DF17-CF23-01
C-C785C-FFMP-04-ST01-DT06-DF14-CF23-01
C-C400B-OSSL-09-ST03-DT07-DF06-CF19-01
C-C089A-OSSL-03-ST01-DT07-DF06-CF01-01
C-C476E-SUBV-05-ST02-DT02-DF13-CF24-01
C-C363A-PSQL-04-ST03-DT02-DF02-CF23-01
C-C194A-PSQL-02-ST01-DT05-DF12-CF03-01
C-C129B-WIRE-02-ST04-DT05-DF15-CF19-01
C-C400A-PSQL-03-ST01-DT07-DF15-CF24-01
C-C089C-WIRE-01-ST04-DT03-DF11-CF13-01
C-C476G-GIMP-10-ST01-DT01-DF10-CF15-01
C-C543A-WIRE-10-ST04-DT05-DF11-CF02-01
C-C191A-GIMP-01-ST02-DT01-DF15-CF19-01
C-C127A-GIMP-03-ST02-DT06-DF11-CF24-01
C-C775A-OSSL-02-ST02-DT05-DF17-CF22-01
C-C078A-FFMP-07-ST02-DT04-DF17-CF19-01
C-C476D-SUBV-08-ST04-DT07-DF17-CF18-01
C-C820A-WIRE-03-ST02-DT06-DF13-CF01-01
C-C191B-OSSL-06-ST04-DT07-DF06-CF20-01
C-C134A-FFMP-08-ST02-DT03-DF13-CF14-01
C-C834A-WIRE-04-ST04-DT03-DF15-CF18-01
C-C088B-SUBV-09-ST03-DT06-DF12-CF03-01
C-C476E-PSQL-09-ST03-DT02-DF04-CF03-01
C-C367A-PSQL-07-ST01-DT07-DF16-CF18-01
C-C197A-PSQL-10-ST03-DT06-DF02-CF23-01
C-C124D-OSSL-06-ST01-DT07-DF06-CF02-01
C-C774A-SUBV-08-ST03-DT01-DF02-CF01-01
C-C089D-OSSL-02-ST01-DT01-DF05-CF24-01
C-C476B-OSSL-07-ST01-DT05-DF15-CF20-01
C-C821A-FFMP-08-ST04-DT01-DF06-CF22-01
C-C194A-WIRE-09-ST02-DT02-DF03-CF24-01
C-C170B-SUBV-07-ST03-DT02-DF01-CF01-01
C-C674A-FFMP-07-ST01-DT02-DF05-CF02-01
C-C089B-GIMP-05-ST03-DT06-DF12-CF01-01
C-C476F-GIMP-03-ST02-DT03-DF06-CF01-01
C-C831A-SUBV-01-ST03-DT07-DF13-CF03-01
C-C682B-SUBV-05-ST01-DT04-DF15-CF22-01
C-C124A-PSQL-01-ST02-DT06-DF15-CF18-01
C-C771A-GIMP-01-ST02-DT03-DF10-CF24-01
C-C078B-PSQL-10-ST04-DT02-DF04-CF03-01
C-C476C-WIRE-06-ST04-DT04-DF12-CF22-01
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C-C191B-FFMP-08-ST03-DT03-DF14-CF18-01
C-C822A-GIMP-05-ST04-DT01-DF17-CF22-01
C-C773A-PSQL-05-ST04-DT04-DF16-CF19-01
C-C088A-FFMP-04-ST04-DT05-DF14-CF23-01

C-C476A-FFMP-02-ST03-DT06-DF13-CF02-01
C-C663A-GIMP-02-ST02-DT02-DF05-CF24-01
C-C369A-SUBV-07-ST03-DT04-DF05-CF20-01
C-C120A-PSQL-09-ST02-DT01-DF14-CF20-01
C-C400B-FFMP-06-ST01-DT05-DF17-CF02-01
C-C089B-FFMP-06-ST02-DT04-DF11-CF19-01
C-C476G-WIRE-01-ST02-DT01-DF02-CF14-01
C-C412A-OSSL-06-ST04-DT02-DF17-CF03-01
C-C196A-WIRE-03-ST02-DT07-DF09-CF02-01
C-C120C-GIMP-10-ST04-DT04-DF12-CF03-01
C-C789A-OSSL-10-ST03-DT04-DF13-CF14-01
C-C078B-WIRE-08-ST03-DT05-DF09-CF23-01
C-C476A-GIMP-04-ST01-DT02-DF14-CF20-01
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C-C476B-PSQL-01-ST04-DT06-DF11-CF19-01
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C-C190A-GIMP-06-ST02-DT02-DF06-CF22-01
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C-C774A-WIRE-01-ST02-DT06-DF05-CF23-01
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C-C476C-SUBV-08-ST01-DT04-DF16-CF02-01
C-C765A-WIRE-05-ST01-DT01-DF15-CF22-01
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C-C828A-WIRE-02-ST02-DT04-DF10-CF01-01
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C-C824B-SUBV-09-ST03-DT07-DF17-CF23-01
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C-C476B-WIRE-09-ST02-DT05-DF08-CF22-01
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C-C773A-WIRE-02-ST03-DT03-DF17-CF20-01
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C-C839A-PSQL-08-ST02-DT05-DF05-CF18-01
C-C590A-PSQL-03-ST04-DT06-DF13-CF24-01
C-C775A-SUBV-08-ST02-DT07-DF05-CF22-01
C-C088A-PSQL-01-ST03-DT05-DF05-CF18-01
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C-C805D-PSQL-05-ST01-DT02-DF14-CF13-01
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C-C088B-FFMP-03-ST04-DT01-DF16-CF24-01
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C-C833A-WIRE-04-ST04-DT05-DF06-CF19-01
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C-C367A-GIMP-01-ST02-DT03-DF13-CF22-01
C-C682B-FFMP-06-ST04-DT04-DF16-CF20-01
C-C805B-WIRE-04-ST03-DT02-DF05-CF20-01
C-C775A-FFMP-10-ST03-DT04-DF16-CF22-01
C-C089B-GIMP-08-ST03-DT03-DF10-CF19-01
C-C476C-GIMP-05-ST01-DT01-DF03-CF02-01
C-C831A-PSQL-09-ST02-DT07-DF16-CF23-01
C-C190A-WIRE-10-ST03-DT01-DF17-CF02-01
C-C126D-GIMP-02-ST02-DT01-DF11-CF22-01
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C-C476F-SUBV-09-ST03-DT05-DF13-CF01-01
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C-C127A-SUBV-08-ST04-DT06-DF06-CF18-01
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C-C476A-OSSL-02-ST04-DT07-DF12-CF19-01
C-C764A-WIRE-03-ST02-DT04-DF11-CF13-01
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C-C785D-PSQL-06-ST02-DT07-DF02-CF01-01

C-C835A-SUBV-09-ST04-DT02-DF12-CF01-01
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C-C682B-GIMP-04-ST02-DT02-DF12-CF01-01
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C-C089B-SUBV-04-ST04-DT01-DF05-CF19-01
C-C476E-GIMP-10-ST03-DT02-DF17-CF18-01
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C-C195A-WIRE-07-ST01-DT07-DF16-CF22-01
C-C126B-FFMP-10-ST01-DT04-DF06-CF03-01
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C-C834A-WIRE-07-ST01-DT04-DF03-CF18-01
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C-C476F-PSQL-07-ST01-DT06-DF14-CF23-01
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C-C400B-OSSL-04-ST03-DT03-DF15-CF15-01
C-C089A-GIMP-10-ST04-DT01-DF11-CF20-01
C-C476C-OSSL-04-ST03-DT02-DF15-CF13-01
C-C609A-SUBV-06-ST02-DT07-DF12-CF18-01
C-C194A-SUBV-06-ST02-DT03-DF17-CF03-01
C-C416A-OSSL-04-ST04-DT07-DF14-CF15-01
C-C789A-SUBV-06-ST04-DT05-DF14-CF01-01
C-C078B-SUBV-01-ST04-DT07-DF14-CF22-01
C-C476D-WIRE-05-ST03-DT07-DF05-CF24-01
C-C479A-WIRE-01-ST03-DT03-DF16-CF14-01
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C-C835A-WIRE-01-ST02-DT07-DF08-CF20-01
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C-C476E-GIMP-06-ST01-DT04-DF11-CF19-01
C-C833A-PSQL-08-ST01-DT02-DF08-CF02-01
C-C197A-OSSL-09-ST02-DT06-DF05-CF01-01
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C-C674A-GIMP-08-ST03-DT01-DF17-CF22-01
C-C088A-GIMP-07-ST03-DT02-DF01-CF24-01
C-C476B-FFMP-07-ST02-DT05-DF12-CF01-01
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C-C127D-FFMP-07-ST03-DT02-DF03-CF02-01
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C-C663A-GIMP-07-ST04-DT04-DF14-CF12-01
C-C839A-GIMP-02-ST02-DT04-DF14-CF02-01
C-C124B-WIRE-01-ST02-DT02-DF13-CF20-01
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C-C088B-WIRE-05-ST04-DT05-DF12-CF01-01
C-C476B-FFMP-02-ST01-DT02-DF06-CF24-01
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C-C196A-WIRE-04-ST01-DT05-DF14-CF18-01
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C-C400B-OSSL-05-ST01-DT06-DF16-CF19-01
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C-C476D-PSQL-01-ST03-DT07-DF07-CF18-01
C-C412A-GIMP-09-ST03-DT01-DF04-CF20-01
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C-C806B-WIRE-10-ST01-DT01-DF17-CF03-01
C-C834A-GIMP-02-ST03-DT07-DF11-CF01-01
C-C078A-GIMP-04-ST01-DT05-DF06-CF12-01
C-C476A-WIRE-09-ST01-DT05-DF01-CF01-01
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C-C196A-PSQL-03-ST03-DT04-DF17-CF23-01
C-C415A-PSQL-08-ST02-DT04-DF06-CF19-01
C-C774A-SUBV-03-ST02-DT03-DF15-CF20-01
C-C089A-FFMP-06-ST02-DT06-DF11-CF15-01
C-C476F-GIMP-08-ST04-DT04-DF10-CF03-01
C-C765B-OSSL-10-ST01-DT03-DF05-CF23-01
C-C195A-OSSL-10-ST03-DT02-DF06-CF20-01
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C-C400A-OSSL-03-ST04-DT02-DF06-CF02-01
C-C089C-SUBV-03-ST03-DT02-DF17-CF23-01
C-C476G-OSSL-10-ST02-DT06-DF11-CF02-01
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C-C194A-SUBV-05-ST04-DT05-DF11-CF22-01
C-C805A-FFMP-06-ST02-DT06-DF05-CF22-01
C-C771A-FFMP-02-ST02-DT05-DF09-CF13-01
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C-C765A-WIRE-06-ST01-DT04-DF15-CF01-01
C-C191B-GIMP-01-ST01-DT02-DF12-CF24-01
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C-C831A-PSQL-01-ST03-DT01-DF06-CF23-01
C-C369A-WIRE-02-ST02-DT01-DF06-CF12-01
C-C129A-GIMP-01-ST01-DT02-DF17-CF19-01
C-C773A-PSQL-04-ST03-DT06-DF04-CF23-01
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C-C476F-SUBV-02-ST02-DT05-DF06-CF03-01
C-C543A-SUBV-03-ST04-DT05-DF16-CF01-01
C-C839A-WIRE-04-ST04-DT07-DF15-CF20-01
C-C129B-SUBV-03-ST02-DT06-DF08-CF03-01
C-C459A-OSSL-06-ST01-DT03-DF14-CF22-01
C-C088B-OSSL-06-ST02-DT06-DF08-CF22-01
C-C476C-OSSL-04-ST03-DT05-DF17-CF02-01
C-C764A-GIMP-04-ST04-DT07-DF13-CF19-01

C-C682A-GIMP-07-ST01-DT03-DF11-CF23-01
C-C134A-GIMP-02-ST04-DT01-DF14-CF02-01
C-C771A-PSQL-08-ST02-DT04-DF05-CF02-01
C-C078B-PSQL-09-ST01-DT01-DF13-CF02-01
C-C476G-WIRE-03-ST03-DT06-DF16-CF19-01
C-C363A-WIRE-10-ST01-DT04-DF03-CF18-01
C-C682B-SUBV-03-ST03-DT06-DF03-CF03-01
C-C824B-WIRE-04-ST04-DT04-DF11-CF20-01
C-C401A-GIMP-05-ST04-DT07-DF13-CF24-01
C-C089B-FFMP-08-ST04-DT01-DF12-CF03-01
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C-C476A-PSQL-10-ST03-DT01-DF05-CF22-01
C-C414A-FFMP-05-ST03-DT03-DF05-CF24-01
C-C839A-OSSL-09-ST04-DT05-DF14-CF18-01
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C-C196A-WIRE-06-ST04-DT03-DF11-CF20-01
C-C785C-WIRE-05-ST03-DT03-DF06-CF12-01
C-C400B-PSQL-06-ST04-DT01-DF17-CF13-01
C-C088A-GIMP-09-ST02-DT02-DF06-CF20-01
C-C476E-GIMP-01-ST02-DT06-DF05-CF19-01
C-C765A-SUBV-06-ST02-DT01-DF12-CF01-01
C-C191A-PSQL-09-ST03-DT05-DF17-CF12-01
C-C124D-GIMP-06-ST02-DT06-DF05-CF19-01
C-C400A-WIRE-03-ST01-DT07-DF16-CF18-01
C-C089B-OSSL-02-ST01-DT05-DF17-CF24-01
C-C476C-SUBV-07-ST04-DT02-DF13-CF24-01
C-C833A-WIRE-09-ST01-DT06-DF06-CF20-01
C-C194A-SUBV-02-ST02-DT07-DF05-CF02-01
C-C590A-OSSL-10-ST04-DT02-DF15-CF22-01
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C-C089D-WIRE-03-ST02-DT02-DF02-CF13-01
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C-C821A-PSQL-08-ST04-DT07-DF16-CF18-01
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C-C127D-FFMP-08-ST01-DT04-DF10-CF24-01
C-C773A-FFMP-09-ST04-DT06-DF11-CF20-01
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C-C476G-PSQL-10-ST03-DT04-DF06-CF24-01
C-C765B-OSSL-02-ST01-DT03-DF09-CF24-01
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C-C785D-PSQL-07-ST02-DT07-DF11-CF20-01
C-C835A-GIMP-08-ST02-DT03-DF12-CF18-01
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C-C476D-OSSL-05-ST01-DT03-DF04-CF20-01
C-C831A-GIMP-01-ST02-DT04-DF17-CF14-01
C-C369A-GIMP-08-ST04-DT04-DF08-CF23-01
C-C824A-SUBV-09-ST03-DT01-DF13-CF01-01
C-C789A-SUBV-04-ST03-DT04-DF15-CF22-01
C-C078B-FFMP-07-ST01-DT03-DF13-CF20-01
C-C476F-WIRE-08-ST01-DT04-DF16-CF18-01
C-C367A-FFMP-10-ST03-DT02-DF11-CF19-01
C-C682A-OSSL-07-ST03-DT01-DF15-CF24-01
C-C127B-PSQL-03-ST03-DT05-DF14-CF18-01
C-C789A-GIMP-05-ST02-DT02-DF05-CF03-01
C-C078A-FFMP-10-ST04-DT06-DF12-CF18-01
C-C476B-GIMP-03-ST04-DT05-DF17-CF02-01
C-C543A-OSSL-05-ST04-DT05-DF01-CF22-01
C-C190A-FFMP-01-ST04-DT04-DF13-CF03-01
C-C805A-OSSL-02-ST02-DT01-DF16-CF03-01
C-C400A-PSQL-07-ST01-DT03-DF10-CF01-01
C-C078B-PSQL-04-ST02-DT01-DF11-CF12-01
C-C476D-FFMP-04-ST03-DT01-DF12-CF23-01
C-C828A-WIRE-07-ST01-DT03-DF14-CF02-01
C-C195A-WIRE-10-ST01-DT06-DF02-CF18-01
C-C806A-GIMP-01-ST01-DT03-DF12-CF22-01
C-C834A-OSSL-10-ST03-DT02-DF14-CF19-01
C-C089C-OSSL-01-ST03-DT06-DF14-CF19-01
C-C476F-OSSL-09-ST02-DT03-DF09-CF01-01
C-C609A-PSQL-04-ST03-DT01-DF15-CF03-01
C-C197A-SUBV-05-ST02-DT05-DF12-CF20-01
C-C806C-WIRE-04-ST04-DT05-DF05-CF23-01
C-C775A-FFMP-01-ST04-DT05-DF01-CF18-01
C-C088B-GIMP-05-ST01-DT07-DF05-CF22-01
C-C476E-WIRE-06-ST04-DT01-DF15-CF01-01
C-C412A-FFMP-03-ST02-DT05-DF12-CF23-01
C-C195A-GIMP-03-ST04-DT07-DF08-CF24-01
C-C805B-FFMP-06-ST04-DT07-DF04-CF19-01
C-C401A-WIRE-10-ST02-DT01-DF11-CF01-01
C-C089A-WIRE-01-ST01-DT05-DF12-CF18-01
C-C476B-SUBV-04-ST02-DT07-DF04-CF20-01
C-C820A-GIMP-10-ST04-DT07-DF14-CF18-01
C-C197A-PSQL-08-ST03-DT03-DF13-CF01-01
C-C415A-FFMP-05-ST03-DT02-DF16-CF03-01
C-C835A-SUBV-03-ST03-DT04-DF06-CF02-01
C-C089B-SUBV-05-ST04-DT07-DF15-CF03-01
C-C476A-PSQL-05-ST04-DT04-DF11-CF13-01
C-C663A-SUBV-05-ST02-DT06-DF11-CF19-01
C-C191B-OSSL-01-ST01-DT02-DF05-CF22-01
C-C761A-SUBV-03-ST02-DT04-DF13-CF15-01
C-C459A-PSQL-04-ST04-DT07-DF07-CF03-01
C-C088A-OSSL-09-ST03-DT04-DF04-CF20-01
C-C476C-PSQL-07-ST01-DT02-DF12-CF18-01
C-C764A-FFMP-08-ST01-DT02-DF13-CF24-01
C-C191A-PSQL-06-ST02-DT01-DF15-CF15-01
C-C120A-GIMP-09-ST03-DT06-DF01-CF19-01
C-C400B-SUBV-01-ST01-DT06-DF16-CF14-01
C-C089D-FFMP-04-ST03-DT01-DF14-CF01-01

C-C476G-FFMP-10-ST03-DT01-DF17-CF22-01
C-C479A-SUBV-02-ST03-DT04-DF05-CF15-01
C-C369A-WIRE-05-ST01-DT07-DF17-CF03-01
C-C785B-WIRE-01-ST02-DT03-DF17-CF01-01
C-C771A-FFMP-08-ST04-DT01-DF05-CF03-01
C-C078B-WIRE-06-ST02-DT06-DF13-CF02-01
C-C476A-SUBV-02-ST03-DT06-DF05-CF23-01
C-C414A-OSSL-03-ST02-DT05-DF06-CF03-01
C-C682A-SUBV-09-ST04-DT04-DF12-CF19-01
C-C120D-PSQL-07-ST01-DT07-DF10-CF22-01
C-C674A-WIRE-09-ST02-DT06-DF04-CF24-01
C-C078A-PSQL-03-ST04-DT05-DF16-CF19-01
C-C476G-GIMP-03-ST01-DT07-DF15-CF02-01
C-C833A-GIMP-07-ST03-DT04-DF15-CF02-01
C-C839A-FFMP-02-ST02-DT03-DF11-CF23-01
C-C124C-SUBV-10-ST04-DT06-DF11-CF02-01
C-C774A-GIMP-05-ST01-DT03-DF14-CF23-01
C-C089D-SUBV-02-ST01-DT03-DF09-CF24-01
C-C476F-WIRE-01-ST02-DT02-DF06-CF12-01
C-C821A-WIRE-06-ST01-DT01-DF02-CF23-01
C-C190A-GIMP-07-ST03-DT06-DF14-CF02-01
C-C785A-OSSL-02-ST01-DT04-DF15-CF24-01
C-C773A-OSSL-02-ST01-DT02-DF17-CF22-01
C-C088B-GIMP-10-ST02-DT04-DF17-CF22-01
C-C476D-WIRE-08-ST03-DT06-DF13-CF03-01
C-C367A-SUBV-01-ST02-DT03-DF17-CF22-01
C-C682B-FFMP-10-ST04-DT05-DF16-CF13-01
C-C127C-SUBV-04-ST04-DT01-DF14-CF01-01
C-C835A-WIRE-06-ST03-DT07-DF15-CF02-01
C-C088A-PSQL-08-ST04-DT02-DF05-CF18-01
C-C476C-OSSL-06-ST04-DT03-DF07-CF24-01
C-C764A-PSQL-04-ST01-DT02-DF07-CF01-01
C-C194A-GIMP-04-ST03-DT01-DF06-CF01-01
C-C170A-PSQL-08-ST03-DT02-DF06-CF23-01
C-C400A-PSQL-09-ST03-DT06-DF17-CF01-01
C-C088A-GIMP-07-ST02-DT01-DF15-CF03-01
C-C476E-OSSL-09-ST02-DT04-DF14-CF18-01
C-C479A-WIRE-09-ST04-DT06-DF16-CF20-01
C-C196A-OSSL-07-ST01-DT03-DF04-CF19-01
C-C120B-FFMP-05-ST02-DT05-DF12-CF18-01
C-C773A-FFMP-07-ST02-DT04-DF12-CF02-01
C-C089C-FFMP-05-ST01-DT03-DF11-CF23-01
C-C476B-SUBV-07-ST04-DT02-DF16-CF19-01
C-C831A-PSQL-01-ST04-DT04-DF13-CF20-01
C-C196A-PSQL-02-ST03-DT02-DF17-CF23-01
C-C843A-GIMP-04-ST01-DT02-DF16-CF20-01
C-C774A-SUBV-02-ST03-DT03-DF16-CF19-01
C-C078A-WIRE-03-ST03-DT07-DF14-CF03-01
C-C476D-PSQL-02-ST01-DT05-DF11-CF24-01
C-C412A-OSSL-08-ST03-DT07-DF16-CF02-01
C-C682B-WIRE-04-ST02-DT04-DF14-CF19-01
C-C806B-WIRE-01-ST01-DT03-DF04-CF14-01
C-C834A-GIMP-03-ST04-DT04-DF13-CF19-01
C-C089B-OSSL-07-ST01-DT02-DF17-CF24-01
C-C476F-FFMP-05-ST02-DT04-DF05-CF02-01
C-C609A-FFMP-09-ST04-DT01-DF08-CF23-01
C-C194A-OSSL-05-ST04-DT01-DF16-CF18-01
C-C120C-OSSL-10-ST02-DT06-DF17-CF01-01
C-C401A-OSSL-04-ST02-DT05-DF06-CF15-01
C-C089D-SUBV-06-ST04-DT05-DF03-CF22-01
C-C476G-GIMP-04-ST03-DT05-DF14-CF15-01
C-C820A-GIMP-04-ST03-DT07-DF04-CF24-01
C-C197A-SUBV-09-ST02-DT02-DF11-CF20-01
C-C126B-WIRE-06-ST04-DT07-DF12-CF23-01
C-C771A-GIMP-06-ST01-DT01-DF15-CF20-01
C-C078B-GIMP-08-ST03-DT01-DF16-CF14-01
C-C476C-SUBV-10-ST04-DT06-DF01-CF22-01
C-C828A-PSQL-07-ST04-DT06-DF14-CF18-01
C-C369A-SUBV-01-ST01-DT01-DF12-CF18-01
C-C805D-PSQL-09-ST01-DT05-DF11-CF02-01
C-C674A-PSQL-08-ST04-DT02-DF10-CF20-01
C-C078A-PSQL-10-ST02-DT01-DF16-CF20-01
C-C476B-GIMP-09-ST03-DT01-DF16-CF01-01
C-C363A-FFMP-06-ST02-DT02-DF06-CF13-01
C-C191A-WIRE-10-ST04-DT05-DF09-CF02-01
C-C124A-FFMP-03-ST03-DT01-DF05-CF03-01
C-C789A-FFMP-10-ST04-DT07-DF01-CF24-01
C-C078A-FFMP-01-ST04-DT06-DF06-CF01-01
C-C476A-PSQL-03-ST02-DT03-DF15-CF03-01
C-C765B-WIRE-03-ST02-DT05-DF11-CF01-01
C-C195A-FFMP-06-ST02-DT07-DF13-CF24-01
C-C822A-SUBV-07-ST02-DT03-DF07-CF18-01
C-C400B-SUBV-07-ST01-DT05-DF14-CF22-01
C-C088B-OSSL-04-ST03-DT04-DF11-CF02-01
C-C476E-OSSL-08-ST01-DT07-DF09-CF23-01
C-C663A-GIMP-02-ST01-DT03-DF12-CF03-01
C-C839A-GIMP-08-ST01-DT07-DF01-CF22-01
C-C124B-OSSL-08-ST03-DT04-DF14-CF03-01
C-C459A-OSSL-05-ST03-DT03-DF13-CF01-01
C-C089A-WIRE-09-ST01-DT03-DF06-CF19-01
C-C476F-FFMP-06-ST04-DT06-DF06-CF20-01
C-C765A-OSSL-05-ST03-DT03-DF13-CF22-01
C-C191B-PSQL-03-ST01-DT03-DF05-CF03-01
C-C416A-GIMP-02-ST04-DT05-DF06-CF24-01
C-C775A-WIRE-01-ST02-DT07-DF12-CF23-01
C-C088A-SUBV-02-ST04-DT04-DF08-CF23-01
C-C476B-WIRE-01-ST01-DT01-DF13-CF19-01
C-C543A-FFMP-10-ST03-DT07-DF15-CF19-01
C-C682A-WIRE-09-ST02-DT06-DF06-CF23-01
C-C170B-PSQL-09-ST04-DT04-DF15-CF13-01
C-C775A-SUBV-10-ST03-DT05-DF05-CF02-01
C-C078A-FFMP-03-ST02-DT02-DF05-CF19-01
C-C476C-GIMP-03-ST01-DT02-DF13-CF01-01
C-C479A-SUBV-03-ST01-DT02-DF17-CF02-01
C-C190A-SUBV-08-ST04-DT04-DF15-CF01-01
C-C805C-FFMP-10-ST02-DT06-DF13-CF22-01
C-C834A-PSQL-06-ST02-DT02-DF11-CF22-01
C-C089C-GIMP-09-ST02-DT07-DF13-CF03-01
C-C476D-SUBV-05-ST04-DT05-DF12-CF18-01
C-C367A-OSSL-02-ST02-DT01-DF06-CF13-01
C-C191A-GIMP-03-ST03-DT06-DF05-CF23-01
C-C806D-SUBV-04-ST03-DT02-DF13-CF02-01

C-C771A-WIRE-02-ST04-DT04-DF16-CF18-01
C-C089A-SUBV-06-ST03-DT05-DF11-CF24-01
C-C476A-WIRE-09-ST02-DT04-DF17-CF23-01
C-C412A-WIRE-09-ST01-DT06-DF11-CF23-01
C-C839A-PSQL-02-ST04-DT02-DF03-CF24-01
C-C126D-GIMP-05-ST01-DT01-DF11-CF01-01
C-C835A-GIMP-07-ST01-DT01-DF14-CF19-01
C-C088B-OSSL-08-ST01-DT06-DF01-CF01-01
C-C476G-FFMP-02-ST02-DT03-DF11-CF03-01
C-C821A-SUBV-06-ST03-DT05-DF05-CF19-01
C-C196A-FFMP-07-ST03-DT05-DF15-CF20-01
C-C129A-WIRE-03-ST03-DT02-DF08-CF19-01
C-C789A-OSSL-05-ST01-DT06-DF05-CF23-01
C-C078B-SUBV-05-ST01-DT03-DF12-CF23-01
C-C476E-OSSL-01-ST03-DT02-DF08-CF02-01
C-C765A-PSQL-05-ST04-DT04-DF13-CF01-01
C-C195A-OSSL-01-ST03-DT01-DF13-CF02-01
C-C126C-PSQL-01-ST01-DT07-DF05-CF20-01
C-C674A-FFMP-01-ST04-DT04-DF17-CF14-01
C-C088A-PSQL-07-ST02-DT07-DF14-CF18-01
C-C476C-PSQL-10-ST04-DT07-DF06-CF20-01
C-C543A-GIMP-10-ST02-DT02-DF09-CF03-01
C-C194A-GIMP-04-ST01-DT02-DF07-CF20-01
C-C124A-OSSL-07-ST04-DT07-DF15-CF12-01
C-C401A-FFMP-04-ST02-DT05-DF11-CF18-01
C-C089D-GIMP-01-ST04-DT01-DF10-CF13-01
C-C476B-FFMP-04-ST03-DT01-DF14-CF13-01
C-C820A-PSQL-07-ST01-DT07-DF17-CF22-01
C-C369A-OSSL-06-ST02-DT06-DF11-CF03-01
C-C806B-OSSL-06-ST02-DT01-DF17-CF24-01
C-C459A-GIMP-03-ST03-DT06-DF12-CF23-01
C-C088A-WIRE-04-ST03-DT06-DF05-CF22-01
C-C476F-GIMP-07-ST01-DT03-DF12-CF19-01
C-C831A-OSSL-08-ST04-DT03-DF15-CF18-01
C-C191B-FFMP-10-ST02-DT03-DF17-CF18-01
C-C124B-FFMP-08-ST02-DT03-DF12-CF20-01
C-C400B-OSSL-09-ST04-DT03-DF06-CF24-01
C-C078A-PSQL-02-ST03-DT05-DF06-CF20-01
C-C476E-OSSL-08-ST04-DT04-DF15-CF24-01
C-C363A-FFMP-01-ST01-DT05-DF16-CF20-01
C-C190A-WIRE-05-ST04-DT04-DF14-CF15-01
C-C785D-WIRE-02-ST01-DT04-DF14-CF01-01
C-C774A-PSQL-08-ST03-DT02-DF13-CF03-01
C-C078B-OSSL-10-ST04-DT02-DF13-CF01-01
C-C476G-WIRE-06-ST03-DT05-DF03-CF22-01
C-C609A-SUBV-04-ST02-DT01-DF14-CF02-01
C-C197A-PSQL-03-ST03-DT05-DF06-CF01-01
C-C805B-SUBV-09-ST03-DT06-DF03-CF18-01
C-C773A-WIRE-06-ST01-DT01-DF02-CF02-01
C-C078A-OSSL-03-ST02-DT04-DF07-CF23-01
C-C476D-PSQL-09-ST02-DT06-DF16-CF19-01
C-C833A-GIMP-08-ST04-DT06-DF12-CF19-01
C-C682A-SUBV-07-ST01-DT07-DF16-CF22-01
C-C805C-GIMP-01-ST04-DT05-DF06-CF03-01
C-C400A-SUBV-04-ST02-DT07-DF15-CF22-01
C-C089D-FFMP-09-ST01-DT07-DF17-CF02-01
C-C476A-SUBV-08-ST01-DT04-DF10-CF18-01
C-C764A-WIRE-01-ST03-DT04-DF01-CF22-01
C-C682B-SUBV-06-ST04-DT01-DF12-CF02-01
C-C843A-SUBV-03-ST03-DT07-DF11-CF19-01
C-C775A-FFMP-10-ST03-DT07-DF08-CF01-01
C-C088B-WIRE-04-ST04-DT03-DF15-CF19-01
C-C476F-SUBV-07-ST01-DT03-DF14-CF23-01
C-C765B-WIRE-05-ST02-DT02-DF12-CF18-01
C-C682A-FFMP-08-ST03-DT02-DF02-CF18-01
C-C120D-FFMP-07-ST02-DT04-DF16-CF18-01
C-C774A-WIRE-09-ST02-DT02-DF14-CF18-01
C-C088A-PSQL-05-ST01-DT04-DF12-CF24-01
C-C476D-OSSL-02-ST02-DT05-DF13-CF22-01
C-C663A-PSQL-02-ST04-DT04-DF05-CF23-01
C-C196A-WIRE-05-ST02-DT03-DF16-CF01-01
C-C590A-WIRE-02-ST04-DT06-DF12-CF23-01
C-C400A-OSSL-01-ST01-DT06-DF05-CF03-01
C-C089C-GIMP-06-ST02-DT01-DF02-CF02-01
C-C476C-WIRE-06-ST03-DT07-DF11-CF15-01
C-C828A-OSSL-07-ST03-DT01-DF16-CF24-01
C-C191A-PSQL-01-ST01-DT04-DF05-CF03-01
C-C170A-GIMP-05-ST03-DT05-DF14-CF22-01
C-C835A-SUBV-08-ST04-DT01-DF16-CF15-01
C-C089A-FFMP-01-ST03-DT03-DF15-CF18-01
C-C476E-FFMP-10-ST04-DT07-DF13-CF03-01
C-C414A-SUBV-09-ST01-DT05-DF03-CF01-01
C-C197A-GIMP-09-ST04-DT07-DF17-CF22-01
C-C124C-PSQL-04-ST01-DT02-DF05-CF15-01
C-C401A-GIMP-03-ST01-DT03-DF09-CF18-01
C-C078B-SUBV-02-ST03-DT05-DF14-CF14-01
C-C476G-PSQL-04-ST02-DT02-DF05-CF20-01
C-C414A-FFMP-04-ST04-DT03-DF17-CF20-01
C-C195A-OSSL-02-ST02-DT05-DF11-CF24-01
C-C805D-OSSL-10-ST02-DT03-DF06-CF02-01
C-C773A-PSQL-07-ST02-DT04-DF11-CF24-01
C-C089D-FFMP-07-ST04-DT06-DF17-CF20-01
C-C476A-GIMP-05-ST03-DT06-DF12-CF01-01
C-C831A-WIRE-06-ST03-DT06-DF05-CF12-01
C-C191B-WIRE-04-ST03-DT02-DF14-CF13-01
C-C127B-PSQL-08-ST04-DT01-DF13-CF02-01
C-C789A-WIRE-05-ST04-DT05-DF17-CF24-01
C-C078A-PSQL-10-ST01-DT02-DF11-CF22-01
C-C476B-GIMP-01-ST04-DT04-DF17-CF02-01
C-C543A-GIMP-03-ST02-DT07-DF15-CF18-01
C-C369A-FFMP-06-ST01-DT06-DF15-CF14-01
C-C126C-SUBV-06-ST01-DT01-DF02-CF23-01
C-C400B-PSQL-02-ST03-DT04-DF03-CF20-01
C-C089B-WIRE-08-ST02-DT05-DF13-CF23-01
C-C476G-SUBV-03-ST01-DT01-DF05-CF24-01
C-C833A-SUBV-05-ST01-DT06-DF06-CF24-01
C-C194A-GIMP-10-ST03-DT03-DF06-CF19-01
C-C806C-GIMP-09-ST03-DT03-DF15-CF24-01
C-C459A-SUBV-04-ST03-DT06-DF12-CF22-01
C-C088A-OSSL-08-ST01-DT06-DF16-CF03-01
C-C476C-OSSL-06-ST02-DT06-DF02-CF14-01
C-C479A-PSQL-10-ST02-DT05-DF14-CF22-01

C-C682B-OSSL-08-ST04-DT01-DF13-CF23-01
C-C129A-OSSL-08-ST01-DT02-DF06-CF22-01
C-C674A-GIMP-08-ST04-DT03-DF15-CF02-01
C-C089C-WIRE-05-ST02-DT02-DF12-CF01-01
C-C476B-SUBV-07-ST02-DT07-DF17-CF01-01
C-C820A-FFMP-08-ST04-DT04-DF10-CF03-01
C-C190A-SUBV-03-ST01-DT05-DF10-CF03-01
C-C124D-WIRE-03-ST02-DT05-DF16-CF14-01
C-C834A-FFMP-07-ST02-DT07-DF06-CF20-01
C-C089A-SUBV-07-ST03-DT01-DF05-CF02-01
C-C476F-WIRE-01-ST04-DT01-DF15-CF23-01
C-C821A-OSSL-04-ST01-DT07-DF13-CF02-01
C-C839A-PSQL-02-ST02-DT04-DF12-CF02-01
C-C134A-FFMP-10-ST04-DT06-DF09-CF01-01
C-C771A-OSSL-02-ST01-DT01-DF08-CF23-01
C-C088B-GIMP-04-ST04-DT03-DF06-CF18-01
C-C476E-PSQL-08-ST01-DT05-DF16-CF20-01
C-C828A-GIMP-03-ST03-DT02-DF11-CF23-01
C-C194A-SUBV-07-ST03-DT06-DF16-CF24-01
C-C785C-GIMP-07-ST04-DT04-DF17-CF20-01
C-C459A-OSSL-06-ST03-DT05-DF12-CF19-01
C-C088B-SUBV-03-ST03-DT04-DF15-CF24-01
C-C476D-FFMP-05-ST03-DT03-DF06-CF02-01
C-C609A-GIMP-06-ST01-DT03-DF11-CF14-01
C-C839A-FFMP-01-ST04-DT07-DF14-CF19-01
C-C806A-WIRE-06-ST01-DT07-DF17-CF18-01
C-C773A-FFMP-03-ST01-DT02-DF13-CF01-01
C-C089B-OSSL-01-ST02-DT07-DF13-CF22-01
C-C476C-OSSL-03-ST04-DT02-DF05-CF03-01
C-C764A-PSQL-10-ST04-DT01-DF05-CF24-01
C-C191B-PSQL-09-ST01-DT01-DF13-CF20-01
C-C120C-OSSL-05-ST03-DT03-DF02-CF19-01
C-C771A-WIRE-01-ST02-DT03-DF11-CF01-01
C-C089D-GIMP-06-ST01-DT03-DF14-CF03-01
C-C476A-GIMP-04-ST03-DT03-DF12-CF19-01
C-C765B-FFMP-09-ST02-DT02-DF16-CF19-01
C-C682B-WIRE-04-ST02-DT02-DF09-CF18-01
C-C806D-PSQL-02-ST02-DT06-DF12-CF03-01
C-C774A-GIMP-09-ST04-DT01-DF02-CF22-01
C-C088A-PSQL-02-ST04-DT01-DF16-CF01-01
C-C476B-WIRE-02-ST01-DT06-DF13-CF24-01
C-C412A-SUBV-01-ST03-DT04-DF13-CF03-01
C-C196A-OSSL-05-ST03-DT03-DF05-CF22-01
C-C126B-SUBV-01-ST03-DT01-DF15-CF18-01
C-C834A-PSQL-10-ST03-DT05-DF05-CF19-01
C-C078B-WIRE-10-ST01-DT06-DF12-CF19-01
C-C476C-SUBV-09-ST03-DT02-DF06-CF18-01
C-C765A-WIRE-02-ST04-DT01-DF17-CF02-01
C-C197A-GIMP-10-ST04-DT06-DF01-CF01-01
C-C127D-GIMP-04-ST01-DT04-DF11-CF23-01
C-C400A-FFMP-05-ST02-DT04-DF17-CF13-01
C-C089A-FFMP-09-ST02-DT07-DF11-CF18-01
C-C476E-PSQL-10-ST01-DT07-DF11-CF22-01
C-C367A-FFMP-07-ST02-DT07-DF01-CF23-01
C-C190A-GIMP-03-ST01-DT04-DF06-CF19-01
C-C127C-FFMP-04-ST02-DT07-DF05-CF02-01
C-C401A-SUBV-09-ST01-DT07-DF14-CF20-01
C-C078A-OSSL-08-ST03-DT04-DF09-CF03-01
C-C476F-FFMP-04-ST02-DT01-DF14-CF18-01
C-C363A-OSSL-09-ST01-DT06-DF14-CF01-01
C-C369A-FFMP-01-ST02-DT07-DF15-CF22-01
C-C785B-FFMP-02-ST04-DT05-DF09-CF24-01
C-C789A-WIRE-02-ST04-DT06-DF16-CF03-01
C-C088A-PSQL-05-ST04-DT05-DF05-CF15-01
C-C476D-WIRE-07-ST04-DT05-DF15-CF19-01
C-C663A-SUBV-08-ST03-DT03-DF15-CF15-01
C-C191A-WIRE-06-ST02-DT05-DF12-CF18-01
C-C120B-WIRE-09-ST02-DT02-DF14-CF13-01
C-C775A-OSSL-04-ST02-DT02-DF13-CF12-01
C-C078B-FFMP-03-ST02-DT02-DF17-CF24-01
C-C476A-GIMP-03-ST04-DT04-DF16-CF01-01
C-C543A-WIRE-04-ST01-DT05-DF12-CF24-01
C-C195A-OSSL-09-ST01-DT06-DF11-CF01-01
C-C416A-SUBV-05-ST03-DT01-DF16-CF23-01
C-C835A-PSQL-10-ST01-DT01-DF06-CF19-01
C-C088A-WIRE-10-ST04-DT02-DF08-CF20-01
C-C476G-OSSL-06-ST02-DT01-DF17-CF02-01
C-C609A-OSSL-03-ST03-DT04-DF08-CF19-01
C-C682A-PSQL-07-ST04-DT04-DF13-CF02-01
C-C126A-OSSL-06-ST01-DT07-DF13-CF22-01
C-C400B-GIMP-05-ST03-DT04-DF15-CF02-01
C-C089D-SUBV-09-ST03-DT03-DF13-CF22-01
C-C476F-PSQL-05-ST03-DT05-DF01-CF20-01
C-C414A-GIMP-10-ST02-DT05-DF16-CF18-01
C-C196A-SUBV-05-ST03-DT01-DF17-CF24-01
C-C805A-PSQL-03-ST04-DT05-DF05-CF01-01
C-C674A-SUBV-07-ST04-DT05-DF05-CF23-01
C-C089B-GIMP-06-ST01-DT01-DF15-CF23-01
C-C476B-FFMP-01-ST01-DT03-DF08-CF12-01
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C-C369A-WIRE-08-ST04-DT02-DF10-CF03-01
C-C415A-OSSL-07-ST03-DT03-DF16-CF20-01
C-C400B-WIRE-08-ST02-DT03-DF06-CF24-01
C-C088B-FFMP-02-ST03-DT07-DF06-CF18-01
C-C476E-OSSL-09-ST04-DT06-DF05-CF22-01
C-C367A-WIRE-07-ST03-DT01-DF13-CF20-01
C-C191A-OSSL-04-ST03-DT07-DF12-CF20-01
C-C120A-GIMP-08-ST02-DT02-DF10-CF01-01
C-C773A-OSSL-06-ST01-DT06-DF15-CF18-01
C-C089A-GIMP-07-ST01-DT06-DF05-CF12-01
C-C476G-FFMP-02-ST01-DT02-DF02-CF03-01
C-C363A-GIMP-06-ST02-DT06-DF10-CF22-01
C-C682A-GIMP-10-ST02-DT03-DF11-CF12-01
C-C824A-FFMP-01-ST04-DT04-DF04-CF24-01
C-C771A-SUBV-03-ST04-DT07-DF17-CF03-01
C-C078A-PSQL-01-ST04-DT05-DF14-CF22-01
C-C476A-WIRE-10-ST02-DT07-DF07-CF24-01
C-C821A-SUBV-02-ST04-DT03-DF11-CF03-01
C-C195A-PSQL-02-ST03-DT03-DF15-CF23-01
C-C126D-WIRE-10-ST01-DT06-DF15-CF19-01
C-C835A-PSQL-01-ST03-DT02-DF04-CF20-01
C-C078A-WIRE-04-ST02-DT05-DF17-CF24-01

C-C476D-SUBV-08-ST03-DT04-DF16-CF23-01
C-C831A-FFMP-01-ST01-DT01-DF17-CF19-01
C-C194A-SUBV-03-ST01-DT04-DF05-CF18-01
C-C824B-GIMP-08-ST02-DT05-DF17-CF03-01
C-C400A-FFMP-09-ST03-DT04-DF12-CF19-01
C-C088B-OSSL-04-ST02-DT04-DF14-CF13-01
C-C476C-GIMP-06-ST02-DT06-DF14-CF20-01
C-C765A-PSQL-07-ST03-DT06-DF04-CF03-01
C-C839A-FFMP-05-ST04-DT06-DF17-CF23-01
C-C761A-SUBV-10-ST04-DT02-DF12-CF22-01
C-C401A-GIMP-10-ST04-DT02-DF14-CF22-01
C-C089A-SUBV-02-ST04-DT06-DF03-CF02-01
C-C476B-PSQL-02-ST01-DT05-DF17-CF03-01
C-C820A-OSSL-06-ST02-DT02-DF15-CF20-01
C-C191B-GIMP-09-ST02-DT05-DF16-CF03-01
C-C127A-PSQL-04-ST01-DT04-DF06-CF20-01
C-C774A-FFMP-04-ST01-DT07-DF11-CF24-01
C-C089C-WIRE-10-ST02-DT07-DF12-CF03-01
C-C476D-GIMP-05-ST04-DT03-DF11-CF01-01
C-C764A-FFMP-02-ST03-DT04-DF12-CF01-01
C-C682B-PSQL-08-ST01-DT07-DF03-CF15-01
C-C785A-PSQL-02-ST03-DT07-DF14-CF19-01
C-C789A-PSQL-01-ST02-DT06-DF10-CF18-01
C-C089D-SUBV-08-ST03-DT01-DF06-CF19-01
C-C476G-PSQL-04-ST04-DT07-DF06-CF14-01
C-C479A-GIMP-09-ST01-DT07-DF06-CF02-01
C-C197A-OSSL-06-ST01-DT02-DF14-CF24-01
C-C170B-OSSL-09-ST04-DT03-DF11-CF03-01
C-C834A-SUBV-08-ST02-DT01-DF16-CF01-01
C-C088A-OSSL-09-ST01-DT04-DF16-CF18-01
C-C476A-FFMP-10-ST03-DT04-DF15-CF19-01
C-C412A-PSQL-05-ST02-DT03-DF05-CF12-01
C-C190A-FFMP-01-ST02-DT01-DF13-CF22-01
C-C129B-SUBV-01-ST02-DT01-DF13-CF24-01
C-C459A-WIRE-03-ST04-DT03-DF13-CF23-01
C-C078A-PSQL-07-ST04-DT03-DF02-CF20-01
C-C476E-SUBV-08-ST01-DT01-DF12-CF02-01
C-C833A-SUBV-04-ST04-DT05-DF14-CF18-01
C-C839A-WIRE-02-ST03-DT05-DF17-CF20-01
C-C822A-FFMP-06-ST01-DT06-DF17-CF02-01
C-C775A-GIMP-02-ST01-DT05-DF09-CF03-01
C-C078B-FFMP-05-ST01-DT04-DF11-CF19-01
C-C476C-FFMP-09-ST04-DT03-DF17-CF18-01
C-C828A-OSSL-08-ST04-DT04-DF06-CF22-01
C-C194A-WIRE-07-ST04-DT05-DF02-CF01-01
C-C129A-WIRE-05-ST03-DT07-DF15-CF20-01
C-C674A-OSSL-06-ST03-DT07-DF11-CF20-01
C-C089B-GIMP-06-ST03-DT02-DF15-CF01-01
C-C476F-OSSL-07-ST03-DT02-DF05-CF23-01
C-C765B-WIRE-01-ST03-DT07-DF09-CF20-01
C-C195A-SUBV-04-ST04-DT01-DF06-CF22-01
C-C805B-GIMP-03-ST03-DT04-DF13-CF23-01
C-C775A-FFMP-07-ST04-DT02-DF06-CF02-01
C-C088A-WIRE-01-ST03-DT02-DF11-CF14-01
C-C476B-WIRE-03-ST02-DT01-DF11-CF24-01
C-C820A-SUBV-10-ST01-DT05-DF12-CF01-01
C-C682B-OSSL-10-ST02-DT07-DF06-CF23-01
C-C824B-OSSL-04-ST04-DT06-DF16-CF13-01
C-C773A-SUBV-05-ST01-DT03-DF15-CF14-01
C-C089B-SUBV-03-ST02-DT06-DF07-CF19-01
C-C476E-SUBV-01-ST03-DT04-DF14-CF24-01
C-C367A-WIRE-02-ST02-DT07-DF17-CF24-01
C-C190A-SUBV-01-ST03-DT02-DF14-CF01-01
C-C806A-PSQL-07-ST02-DT05-DF07-CF19-01
C-C674A-GIMP-05-ST02-DT04-DF14-CF03-01
C-C089A-GIMP-09-ST01-DT05-DF12-CF02-01
C-C476G-OSSL-05-ST01-DT06-DF16-CF22-01
C-C479A-GIMP-03-ST04-DT01-DF15-CF23-01
C-C369A-GIMP-03-ST01-DT01-DF16-CF02-01
C-C416A-SUBV-08-ST01-DT03-DF14-CF18-01
C-C771A-WIRE-07-ST03-DT01-DF05-CF18-01
C-C089D-FFMP-05-ST04-DT03-DF05-CF23-01
C-C476D-PSQL-09-ST02-DT02-DF15-CF23-01
C-C831A-OSSL-07-ST02-DT03-DF14-CF23-01
C-C682A-FFMP-05-ST01-DT03-DF15-CF02-01
C-C785D-SUBV-10-ST04-DT02-DF06-CF23-01
C-C400A-OSSL-02-ST01-DT05-DF17-CF01-01
C-C078B-PSQL-08-ST03-DT07-DF04-CF19-01
C-C476A-GIMP-02-ST02-DT05-DF12-CF02-01
C-C663A-FFMP-03-ST04-DT06-DF03-CF01-01
C-C191B-PSQL-04-ST02-DT04-DF05-CF19-01
C-C127C-FFMP-09-ST01-DT01-DF12-CF24-01
C-C459A-PSQL-09-ST04-DT06-DF13-CF24-01
C-C089C-OSSL-03-ST04-DT01-DF13-CF18-01
C-C476F-WIRE-03-ST01-DT07-DF06-CF20-01
C-C363A-PSQL-09-ST03-DT02-DF13-CF18-01
C-C191A-GIMP-06-ST04-DT01-DF12-CF12-01
C-C590A-WIRE-07-ST02-DT06-DF01-CF02-01
C-C400B-FFMP-03-ST03-DT07-DF03-CF02-01
C-C078A-SUBV-07-ST01-DT05-DF16-CF01-01
C-C476E-SUBV-01-ST03-DT01-DF13-CF18-01
C-C765B-GIMP-10-ST01-DT02-DF16-CF03-01
C-C196A-OSSL-08-ST01-DT04-DF11-CF19-01
C-C806D-GIMP-06-ST04-DT02-DF15-CF03-01
C-C835A-PSQL-08-ST02-DT05-DF16-CF22-01
C-C088B-GIMP-02-ST02-DT06-DF17-CF20-01
C-C476F-FFMP-07-ST04-DT04-DF03-CF01-01
C-C765A-WIRE-01-ST04-DT07-DF05-CF02-01
C-C197A-WIRE-09-ST03-DT07-DF08-CF03-01
C-C126C-FFMP-02-ST03-DT05-DF11-CF12-01
C-C834A-OSSL-10-ST03-DT06-DF06-CF20-01
C-C089D-SUBV-01-ST02-DT07-DF10-CF24-01
C-C476G-GIMP-08-ST02-DT03-DF09-CF22-01
C-C821A-OSSL-05-ST02-DT01-DF11-CF22-01
C-C194A-PSQL-10-ST04-DT06-DF14-CF20-01
C-C127B-SUBV-05-ST01-DT03-DF05-CF22-01
C-C789A-SUBV-04-ST01-DT04-DF12-CF22-01
C-C078A-PSQL-06-ST03-DT03-DF06-CF02-01
C-C476A-WIRE-10-ST01-DT06-DF05-CF19-01
C-C412A-SUBV-06-ST01-DT06-DF11-CF19-01
C-C190A-WIRE-07-ST02-DT06-DF17-CF24-01
C-C126A-WIRE-08-ST03-DT04-DF16-CF18-01

C-C401A-WIRE-01-ST04-DT03-DF14-CF19-01
C-C089A-FFMP-04-ST04-DT02-DF05-CF03-01
C-C476D-PSQL-06-ST04-DT07-DF14-CF03-01
C-C833A-FFMP-08-ST03-DT04-DF17-CF24-01
C-C195A-SUBV-02-ST04-DT03-DF05-CF18-01
C-C120D-OSSL-01-ST02-DT07-DF12-CF02-01
C-C774A-GIMP-06-ST02-DT02-DF16-CF23-01
C-C088B-OSSL-10-ST04-DT04-DF16-CF20-01
C-C476B-OSSL-04-ST03-DT05-DF10-CF03-01
C-C609A-PSQL-04-ST01-DT03-DF12-CF02-01
C-C369A-FFMP-07-ST03-DT02-DF11-CF02-01
C-C785C-PSQL-01-ST02-DT02-DF11-CF01-01
C-C400B-GIMP-03-ST02-DT01-DF13-CF23-01
C-C078B-WIRE-04-ST01-DT01-DF01-CF23-01
C-C476C-OSSL-08-ST01-DT04-DF12-CF13-01
C-C764A-FFMP-03-ST01-DT05-DF06-CF24-01
C-C191B-PSQL-03-ST03-DT02-DF12-CF22-01
C-C126B-PSQL-10-ST01-DT01-DF06-CF01-01
C-C400A-PSQL-01-ST04-DT03-DF15-CF15-01
C-C089B-FFMP-01-ST01-DT05-DF06-CF22-01
C-C476B-SUBV-10-ST03-DT02-DF16-CF24-01
C-C828A-WIRE-05-ST03-DT06-DF07-CF22-01
C-C839A-FFMP-09-ST01-DT05-DF07-CF24-01
C-C785B-OSSL-03-ST03-DT06-DF14-CF24-01
C-C834A-WIRE-06-ST01-DT04-DF07-CF13-01
C-C089C-GIMP-10-ST03-DT02-DF15-CF20-01
C-C476F-GIMP-07-ST04-DT06-DF13-CF20-01
C-C543A-PSQL-10-ST04-DT03-DF16-CF15-01
C-C191A-OSSL-08-ST02-DT03-DF16-CF20-01
C-C124B-WIRE-03-ST04-DT03-DF17-CF22-01
C-C771A-OSSL-05-ST02-DT05-DF12-CF18-01
C-C088A-WIRE-05-ST02-DT04-DF13-CF15-01
C-C476E-FFMP-03-ST02-DT05-DF17-CF19-01
C-C414A-SUBV-04-ST03-DT04-DF13-CF23-01
C-C682B-SUBV-10-ST04-DT06-DF15-CF14-01
C-C124A-GIMP-06-ST03-DT01-DF08-CF14-01
C-C674A-SUBV-09-ST03-DT06-DF17-CF01-01
C-C089A-OSSL-09-ST04-DT06-DF17-CF24-01
C-C476A-WIRE-04-ST04-DT07-DF11-CF22-01
C-C765A-GIMP-01-ST02-DT05-DF05-CF19-01
C-C682A-GIMP-01-ST03-DT07-DF04-CF23-01
C-C805D-SUBV-05-ST04-DT04-DF13-CF20-01
C-C789A-FFMP-10-ST04-DT01-DF05-CF20-01
C-C078A-PSQL-03-ST02-DT01-DF14-CF22-01
C-C476C-PSQL-06-ST02-DT01-DF06-CF18-01
C-C820A-OSSL-09-ST04-DT01-DF15-CF03-01
C-C196A-PSQL-02-ST02-DT05-DF13-CF19-01
C-C761A-FFMP-04-ST01-DT07-DF17-CF19-01
C-C459A-WIRE-02-ST01-DT07-DF01-CF03-01
C-C089C-FFMP-08-ST03-DT07-DF11-CF01-01
C-C476D-SUBV-02-ST01-DT03-DF15-CF12-01
C-C412A-OSSL-08-ST04-DT07-DF07-CF01-01
C-C197A-SUBV-04-ST01-DT04-DF06-CF23-01
C-C124C-GIMP-07-ST02-DT07-DF03-CF18-01
C-C774A-PSQL-08-ST03-DT02-DF11-CF03-01
C-C089D-GIMP-06-ST01-DT03-DF17-CF03-01
C-C476G-FFMP-09-ST03-DT02-DF13-CF02-01
C-C363A-FFMP-07-ST02-DT04-DF13-CF01-01
C-C191B-FFMP-06-ST03-DT07-DF12-CF01-01
C-C124D-FFMP-02-ST04-DT03-DF05-CF03-01
C-C835A-FFMP-07-ST01-DT07-DF09-CF24-01
C-C088A-WIRE-02-ST01-DT07-DF06-CF02-01
C-C476D-PSQL-05-ST01-DT04-DF04-CF01-01
C-C609A-GIMP-02-ST01-DT07-DF02-CF14-01
C-C195A-OSSL-05-ST04-DT04-DF11-CF03-01
C-C129B-OSSL-05-ST01-DT05-DF06-CF23-01
C-C401A-SUBV-04-ST03-DT04-DF11-CF24-01
C-C078B-SUBV-07-ST04-DT04-DF12-CF18-01
C-C476E-WIRE-08-ST02-DT05-DF09-CF23-01
C-C821A-WIRE-06-ST02-DT02-DF05-CF20-01
C-C369A-WIRE-04-ST02-DT02-DF06-CF18-01
C-C805C-WIRE-09-ST03-DT01-DF01-CF24-01
C-C773A-GIMP-10-ST04-DT01-DF16-CF19-01
C-C088B-OSSL-06-ST03-DT06-DF04-CF23-01
C-C476C-GIMP-01-ST03-DT07-DF11-CF24-01
C-C765B-SUBV-09-ST03-DT06-DF06-CF18-01
C-C191A-GIMP-08-ST01-DT03-DF02-CF03-01
C-C806B-GIMP-01-ST02-DT06-DF14-CF23-01
C-C775A-OSSL-05-ST02-DT03-DF03-CF01-01
C-C088A-PSQL-03-ST02-DT01-DF11-CF01-01
C-C476B-OSSL-04-ST04-DT03-DF02-CF19-01
C-C663A-PSQL-07-ST01-DT01-DF14-CF20-01
C-C682B-WIRE-07-ST01-DT05-DF16-CF24-01
C-C120A-PSQL-10-ST02-DT05-DF15-CF03-01
C-C789A-SUBV-07-ST01-DT02-DF06-CF02-01
C-C089C-OSSL-09-ST04-DT03-DF15-CF03-01
C-C476A-OSSL-09-ST04-DT01-DF16-CF20-01
C-C833A-GIMP-06-ST01-DT01-DF12-CF22-01
C-C196A-SUBV-06-ST02-DT01-DF13-CF01-01
C-C127A-OSSL-09-ST01-DT02-DF12-CF18-01
C-C674A-OSSL-08-ST02-DT05-DF14-CF02-01
C-C088B-WIRE-08-ST03-DT02-DF10-CF02-01
C-C476G-SUBV-03-ST02-DT06-DF12-CF03-01
C-C543A-PSQL-05-ST02-DT03-DF17-CF24-01
C-C682A-GIMP-02-ST04-DT06-DF17-CF13-01
C-C127D-PSQL-06-ST03-DT01-DF12-CF01-01
C-C775A-GIMP-02-ST04-DT06-DF12-CF12-01
C-C089B-GIMP-02-ST02-DT05-DF12-CF23-01
C-C476F-PSQL-07-ST03-DT02-DF14-CF02-01
C-C831A-FFMP-02-ST04-DT02-DF15-CF13-01
C-C197A-OSSL-03-ST03-DT05-DF15-CF18-01
C-C824A-FFMP-03-ST01-DT04-DF13-CF15-01
C-C400B-PSQL-03-ST03-DT02-DF15-CF23-01
C-C078B-PSQL-07-ST01-DT07-DF13-CF24-01
C-C476A-WIRE-05-ST01-DT04-DF17-CF23-01
C-C479A-SUBV-03-ST03-DT05-DF16-CF23-01
C-C839A-PSQL-01-ST04-DT03-DF05-CF20-01
C-C170B-WIRE-08-ST02-DT04-DF11-CF02-01
C-C773A-WIRE-09-ST04-DT07-DF05-CF22-01
C-C088A-FFMP-01-ST04-DT05-DF14-CF12-01
C-C476D-GIMP-06-ST02-DT01-DF05-CF15-01
C-C764A-WIRE-04-ST03-DT03-DF03-CF03-01

C-C190A-FFMP-10-ST02-DT07-DF14-CF22-01
C-C806C-SUBV-02-ST04-DT07-DF08-CF22-01
C-C401A-FFMP-06-ST03-DT03-DF13-CF18-01
C-C078A-SUBV-05-ST03-DT06-DF16-CF19-01
C-C476E-OSSL-10-ST03-DT03-DF15-CF01-01
C-C828A-WIRE-08-ST01-DT05-DF13-CF19-01
C-C194A-WIRE-05-ST01-DT06-DF14-CF19-01
C-C134A-GIMP-07-ST03-DT03-DF05-CF20-01
C-C400A-OSSL-04-ST02-DT06-DF17-CF19-01
C-C089D-WIRE-04-ST02-DT02-DF15-CF22-01
C-C476C-FFMP-02-ST01-DT05-DF05-CF18-01
C-C414A-OSSL-01-ST04-DT02-DF05-CF19-01
C-C191B-GIMP-09-ST03-DT01-DF04-CF20-01
C-C785A-WIRE-04-ST04-DT06-DF16-CF02-01
C-C459A-FFMP-01-ST01-DT04-DF05-CF20-01
C-C089A-GIMP-10-ST01-DT04-DF05-CF19-01
C-C476F-SUBV-01-ST02-DT07-DF15-CF03-01
C-C367A-FFMP-10-ST02-DT06-DF14-CF18-01
C-C369A-SUBV-08-ST03-DT04-DF17-CF02-01
C-C170A-FFMP-02-ST04-DT04-DF14-CF01-01
C-C834A-PSQL-09-ST03-DT05-DF14-CF03-01
C-C078B-SUBV-09-ST03-DT01-DF05-CF24-01
C-C476B-FFMP-01-ST01-DT06-DF06-CF18-01
C-C412A-GIMP-04-ST01-DT04-DF11-CF02-01
C-C191A-FFMP-05-ST04-DT02-DF06-CF02-01
C-C805A-PSQL-04-ST03-DT05-DF13-CF19-01
C-C774A-WIRE-06-ST01-DT01-DF11-CF13-01
C-C078A-FFMP-02-ST04-DT03-DF07-CF02-01
C-C476G-GIMP-08-ST04-DT05-DF10-CF01-01
C-C821A-SUBV-02-ST02-DT05-DF12-CF12-01
C-C839A-OSSL-02-ST01-DT01-DF08-CF24-01
C-C126D-SUBV-03-ST02-DT05-DF05-CF20-01
C-C771A-SUBV-01-ST02-DT03-DF06-CF22-01
C-C078A-PSQL-05-ST02-DT05-DF03-CF20-01
C-C476A-WIRE-10-ST04-DT02-DF01-CF22-01
C-C828A-PSQL-07-ST04-DT07-DF10-CF23-01
C-C194A-PSQL-09-ST02-DT02-DF15-CF03-01
C-C415A-WIRE-08-ST01-DT02-DF09-CF03-01
C-C835A-GIMP-04-ST03-DT05-DF01-CF01-01
C-C088B-WIRE-03-ST01-DT02-DF06-CF20-01
C-C476D-PSQL-03-ST03-DT04-DF14-CF15-01
C-C414A-OSSL-09-ST03-DT02-DF14-CF24-01
C-C682B-WIRE-01-ST03-DT04-DF13-CF22-01
C-C822A-OSSL-09-ST01-DT01-DF05-CF19-01
C-C771A-OSSL-10-ST04-DT06-DF08-CF19-01
C-C088A-OSSL-10-ST01-DT06-DF16-CF01-01
C-C476F-WIRE-04-ST02-DT03-DF16-CF24-01
C-C765A-GIMP-10-ST03-DT04-DF11-CF22-01
C-C196A-OSSL-03-ST02-DT06-DF12-CF12-01
C-C120C-FFMP-01-ST04-DT07-DF17-CF19-01
C-C835A-SUBV-02-ST04-DT01-DF13-CF18-01
C-C089D-GIMP-04-ST04-DT01-DF14-CF14-01
C-C476C-FFMP-07-ST03-DT02-DF13-CF23-01
C-C820A-PSQL-08-ST02-DT03-DF06-CF03-01
C-C190A-GIMP-04-ST04-DT05-DF05-CF19-01
C-C120B-PSQL-07-ST03-DT03-DF17-CF23-01
C-C401A-PSQL-07-ST01-DT07-DF16-CF20-01
C-C089C-OSSL-08-ST03-DT01-DF12-CF18-01
C-C476E-GIMP-02-ST01-DT06-DF06-CF19-01
C-C479A-OSSL-01-ST01-DT07-DF17-CF18-01
C-C682A-PSQL-07-ST01-DT07-DF16-CF18-01
C-C843A-OSSL-10-ST02-DT02-DF03-CF22-01
C-C789A-WIRE-03-ST02-DT02-DF15-CF23-01
C-C089B-SUBV-01-ST02-DT03-DF17-CF03-01
C-C476B-OSSL-05-ST04-DT01-DF12-CF22-01
C-C609A-FFMP-03-ST04-DT01-DF04-CF01-01
C-C195A-SUBV-06-ST03-DT03-DF09-CF23-01
C-C785A-SUBV-06-ST02-DT07-DF06-CF14-01
C-C834A-FFMP-08-ST02-DT01-DF17-CF02-01
C-C089D-FFMP-06-ST01-DT04-DF13-CF23-01
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C-C765B-SUBV-05-ST02-DT06-DF15-CF02-01
C-C197A-FFMP-03-ST04-DT04-DF11-CF18-01
C-C805A-GIMP-05-ST01-DT01-DF16-CF18-01
C-C459A-GIMP-05-ST04-DT04-DF12-CF01-01
C-C078A-PSQL-07-ST02-DT07-DF12-CF19-01
C-C476E-SUBV-06-ST04-DT07-DF16-CF14-01
C-C543A-WIRE-05-ST04-DT07-DF16-CF24-01
C-C191B-WIRE-10-ST02-DT06-DF17-CF01-01
C-C170B-SUBV-10-ST03-DT06-DF15-CF23-01
C-C674A-SUBV-09-ST01-DT06-DF16-CF22-01
C-C088B-PSQL-07-ST03-DT07-DF17-CF18-01
C-C476D-WIRE-06-ST03-DT04-DF11-CF20-01
C-C367A-PSQL-06-ST01-DT01-DF16-CF20-01
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C-C124A-GIMP-02-ST04-DT04-DF12-CF18-01
C-C775A-GIMP-06-ST03-DT07-DF17-CF23-01
C-C089A-OSSL-04-ST04-DT05-DF11-CF22-01
C-C476F-FFMP-03-ST01-DT05-DF17-CF22-01
C-C833A-FFMP-06-ST03-DT06-DF12-CF19-01
C-C197A-GIMP-01-ST03-DT02-DF16-CF20-01
C-C120A-WIRE-05-ST04-DT03-DF11-CF24-01
C-C773A-PSQL-02-ST02-DT02-DF13-CF19-01
C-C078B-GIMP-05-ST04-DT03-DF09-CF01-01
C-C476A-OSSL-09-ST01-DT01-DF13-CF23-01
C-C831A-WIRE-03-ST03-DT05-DF17-CF15-01
C-C196A-SUBV-08-ST02-DT05-DF14-CF03-01
C-C120C-WIRE-04-ST03-DT06-DF14-CF02-01
C-C400B-OSSL-08-ST01-DT04-DF05-CF03-01
C-C089B-WIRE-02-ST02-DT06-DF15-CF15-01
C-C476C-GIMP-10-ST04-DT06-DF07-CF03-01
C-C663A-GIMP-04-ST01-DT03-DF11-CF18-01
C-C682A-PSQL-06-ST04-DT07-DF06-CF01-01
C-C416A-PSQL-07-ST02-DT05-DF10-CF23-01
C-C400A-FFMP-03-ST03-DT05-DF12-CF24-01
C-C088A-FFMP-10-ST03-DT02-DF01-CF22-01
C-C476B-SUBV-01-ST03-DT03-DF14-CF20-01
C-C764A-OSSL-10-ST02-DT04-DF13-CF23-01
C-C369A-SUBV-10-ST01-DT03-DF12-CF22-01
C-C126B-OSSL-06-ST02-DT02-DF13-CF24-01
C-C774A-WIRE-04-ST04-DT03-DF10-CF02-01
C-C089C-SUBV-01-ST01-DT04-DF16-CF02-01

C-C476G-PSQL-07-ST04-DT02-DF05-CF02-01
C-C363A-SUBV-09-ST04-DT07-DF06-CF02-01
C-C190A-FFMP-09-ST02-DT03-DF15-CF24-01
C-C785C-FFMP-09-ST01-DT01-DF06-CF19-01
C-C775A-PSQL-07-ST03-DT03-DF11-CF24-01
C-C089C-SUBV-09-ST01-DT03-DF05-CF13-01
C-C476E-GIMP-02-ST02-DT07-DF16-CF18-01
C-C831A-FFMP-07-ST01-DT02-DF15-CF22-01
C-C682B-GIMP-02-ST01-DT07-DF11-CF02-01
C-C824A-OSSL-08-ST03-DT07-DF11-CF01-01
C-C771A-OSSL-01-ST04-DT02-DF02-CF18-01
C-C089B-OSSL-06-ST04-DT01-DF06-CF02-01
C-C476F-SUBV-05-ST02-DT02-DF11-CF22-01
C-C367A-PSQL-01-ST03-DT05-DF09-CF03-01
C-C194A-OSSL-07-ST04-DT06-DF10-CF22-01
C-C806D-SUBV-01-ST01-DT05-DF16-CF22-01
C-C773A-FFMP-05-ST02-DT05-DF06-CF20-01
C-C089D-GIMP-03-ST03-DT05-DF11-CF24-01
C-C476G-OSSL-04-ST01-DT04-DF17-CF01-01
C-C414A-OSSL-02-ST04-DT04-DF14-CF20-01
C-C195A-PSQL-05-ST03-DT01-DF06-CF15-01
C-C590A-GIMP-03-ST02-DT02-DF02-CF03-01
C-C401A-WIRE-10-ST01-DT07-DF15-CF23-01
C-C088B-PSQL-08-ST02-DT02-DF14-CF03-01
C-C476B-FFMP-08-ST03-DT03-DF15-CF19-01
C-C609A-GIMP-08-ST02-DT01-DF02-CF18-01
C-C191A-FFMP-05-ST03-DT04-DF07-CF01-01
C-C124B-FFMP-10-ST04-DT04-DF15-CF22-01
C-C400A-GIMP-10-ST03-DT01-DF14-CF24-01
C-C078B-FFMP-06-ST04-DT04-DF06-CF23-01
C-C476C-PSQL-07-ST01-DT05-DF03-CF24-01
C-C765A-WIRE-05-ST01-DT03-DF05-CF01-01
C-C191B-WIRE-01-ST01-DT05-DF13-CF23-01
C-C127B-SUBV-07-ST03-DT06-DF17-CF15-01
C-C774A-SUBV-08-ST04-DT04-DF06-CF15-01
C-C078A-WIRE-07-ST01-DT07-DF11-CF24-01
C-C476A-WIRE-01-ST03-DT01-DF06-CF01-01
C-C828A-SUBV-09-ST02-DT02-DF15-CF23-01
C-C839A-GIMP-08-ST02-DT02-DF03-CF18-01
C-C127D-PSQL-03-ST04-DT03-DF07-CF23-01
C-C789A-FFMP-09-ST02-DT06-DF16-CF18-01
C-C088A-FFMP-09-ST02-DT06-DF05-CF19-01
C-C476D-OSSL-03-ST02-DT06-DF12-CF20-01
C-C765B-WIRE-10-ST03-DT06-DF08-CF24-01
C-C191A-PSQL-09-ST04-DT06-DF15-CF23-01
C-C129A-FFMP-02-ST03-DT06-DF15-CF01-01
C-C834A-PSQL-05-ST01-DT02-DF17-CF02-01
C-C089A-SUBV-08-ST03-DT01-DF13-CF20-01
C-C476G-PSQL-05-ST04-DT01-DF11-CF19-01
C-C764A-PSQL-03-ST04-DT01-DF12-CF20-01
C-C194A-WIRE-03-ST01-DT04-DF11-CF13-01
C-C805C-OSSL-06-ST01-DT05-DF12-CF12-01
C-C459A-SUBV-04-ST01-DT05-DF05-CF01-01
C-C089A-WIRE-03-ST03-DT07-DF16-CF03-01
C-C476C-WIRE-02-ST03-DT06-DF14-CF22-01
C-C479A-FFMP-02-ST04-DT05-DF05-CF14-01
C-C682A-OSSL-02-ST03-DT05-DF12-CF02-01
C-C127A-WIRE-05-ST02-DT03-DF05-CF01-01
C-C835A-WIRE-07-ST04-DT06-DF11-CF03-01
C-C088B-PSQL-02-ST02-DT03-DF15-CF02-01
C-C476F-FFMP-08-ST04-DT07-DF08-CF23-01
C-C833A-OSSL-06-ST01-DT07-DF17-CF03-01
C-C197A-FFMP-07-ST02-DT07-DF05-CF24-01
C-C170A-GIMP-08-ST01-DT07-DF04-CF13-01
C-C674A-GIMP-02-ST03-DT07-DF07-CF19-01
C-C089D-GIMP-05-ST04-DT02-DF02-CF23-01
C-C476A-SUBV-04-ST01-DT03-DF06-CF03-01
C-C820A-GIMP-07-ST02-DT02-DF13-CF01-01
C-C190A-PSQL-06-ST04-DT01-DF01-CF20-01
C-C124D-PSQL-04-ST04-DT01-DF02-CF19-01
C-C400B-GIMP-01-ST02-DT05-DF15-CF14-01
C-C088A-PSQL-04-ST01-DT06-DF13-CF01-01
C-C476E-GIMP-10-ST02-DT05-DF04-CF24-01
C-C543A-SUBV-04-ST03-DT06-DF16-CF01-01
C-C682B-SUBV-04-ST02-DT02-DF17-CF03-01
C-C843A-PSQL-09-ST01-DT05-DF17-CF24-01
C-C775A-SUBV-06-ST01-DT04-DF14-CF18-01
C-C078A-OSSL-10-ST04-DT05-DF17-CF20-01
C-C476B-SUBV-06-ST03-DT02-DF05-CF13-01
C-C663A-WIRE-01-ST02-DT03-DF01-CF19-01
C-C196A-SUBV-10-ST04-DT07-DF13-CF19-01
C-C127C-SUBV-01-ST03-DT02-DF11-CF24-01
C-C459A-OSSL-03-ST03-DT01-DF13-CF22-01
C-C088A-SUBV-01-ST03-DT07-DF12-CF22-01
C-C476D-PSQL-09-ST01-DT01-DF12-CF12-01
C-C412A-SUBV-08-ST03-DT03-DF06-CF02-01
C-C369A-OSSL-08-ST01-DT03-DF14-CF23-01
C-C785D-OSSL-10-ST04-DT04-DF12-CF02-01
C-C774A-PSQL-05-ST02-DT07-DF12-CF19-01
C-C078B-WIRE-01-ST01-DT04-DF14-CF18-01
C-C476C-GIMP-08-ST02-DT04-DF13-CF23-01
C-C363A-FFMP-06-ST01-DT04-DF11-CF22-01
C-C195A-FFMP-02-ST01-DT03-DF16-CF18-01
C-C129B-WIRE-08-ST01-DT03-DF13-CF18-01
C-C773A-WIRE-10-ST04-DT06-DF04-CF23-01
C-C089C-FFMP-03-ST02-DT03-DF14-CF20-01
C-C476E-OSSL-03-ST04-DT06-DF17-CF14-01
C-C821A-GIMP-04-ST04-DT05-DF14-CF24-01
C-C190A-WIRE-01-ST03-DT05-DF05-CF22-01
C-C126C-FFMP-04-ST02-DT07-DF14-CF20-01
C-C789A-FFMP-03-ST04-DT03-DF01-CF18-01
C-C088A-GIMP-09-ST04-DT07-DF08-CF19-01
C-C476G-WIRE-04-ST03-DT04-DF06-CF18-01
C-C479A-PSQL-03-ST02-DT06-DF11-CF02-01
C-C839A-GIMP-10-ST02-DT01-DF11-CF19-01
C-C806C-SUBV-03-ST03-DT01-DF06-CF03-01
C-C401A-OSSL-08-ST01-DT04-DF17-CF03-01
C-C078A-OSSL-02-ST01-DT02-DF16-CF03-01
C-C476A-FFMP-09-ST04-DT03-DF05-CF02-01
C-C833A-OSSL-05-ST03-DT01-DF16-CF18-01
C-C682B-PSQL-04-ST04-DT04-DF10-CF14-01
C-C805B-GIMP-06-ST04-DT02-DF16-CF03-01

C-C835A-FFMP-01-ST03-DT02-DF11-CF24-01
C-C089A-WIRE-04-ST03-DT04-DF06-CF23-01
C-C476D-WIRE-05-ST01-DT07-DF15-CF20-01
C-C609A-WIRE-10-ST04-DT02-DF07-CF19-01
C-C682A-WIRE-09-ST01-DT02-DF15-CF20-01
C-C822A-GIMP-02-ST03-DT06-DF13-CF02-01
C-C400B-GIMP-09-ST02-DT03-DF05-CF20-01
C-C078A-PSQL-06-ST02-DT05-DF15-CF18-01
C-C476F-GIMP-06-ST04-DT02-DF13-CF18-01
C-C543A-PSQL-02-ST01-DT04-DF15-CF23-01
C-C191A-GIMP-07-ST03-DT06-DF13-CF01-01
C-C824B-PSQL-05-ST02-DT04-DF11-CF22-01
C-C834A-PSQL-06-ST02-DT01-DF14-CF12-01
C-C089D-GIMP-08-ST03-DT06-DF11-CF12-01
C-C476C-SUBV-02-ST02-DT05-DF14-CF19-01
C-C367A-GIMP-01-ST01-DT07-DF05-CF22-01
C-C197A-OSSL-06-ST02-DT04-DF04-CF02-01
C-C806A-OSSL-01-ST02-DT06-DF16-CF24-01
C-C771A-SUBV-02-ST03-DT07-DF10-CF02-01
C-C078B-SUBV-10-ST04-DT06-DF13-CF24-01
C-C476B-OSSL-10-ST02-DT04-DF11-CF01-01
C-C414A-SUBV-09-ST03-DT01-DF04-CF13-01
C-C194A-FFMP-03-ST03-DT01-DF12-CF03-01
C-C415A-WIRE-09-ST04-DT04-DF06-CF18-01
C-C674A-WIRE-07-ST04-DT06-DF06-CF22-01
C-C089B-OSSL-05-ST01-DT01-DF05-CF18-01
C-C476E-PSQL-07-ST01-DT03-DF12-CF02-01
C-C663A-FFMP-07-ST02-DT04-DF06-CF20-01
C-C369A-SUBV-05-ST04-DT05-DF16-CF15-01
C-C124C-FFMP-07-ST01-DT02-DF14-CF20-01
C-C400A-OSSL-04-ST01-DT04-DF16-CF01-01
C-C088B-FFMP-07-ST03-DT04-DF12-CF01-01
C-C476A-FFMP-01-ST03-DT07-DF01-CF03-01
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C-C805D-OSSL-04-ST04-DT03-DF13-CF01-01
C-C400A-FFMP-05-ST04-DT02-DF13-CF20-01
C-C089B-SUBV-07-ST02-DT02-DF17-CF02-01
C-C476D-PSQL-03-ST02-DT06-DF16-CF24-01
C-C831A-WIRE-08-ST02-DT03-DF14-CF03-01
C-C195A-GIMP-05-ST02-DT01-DF14-CF02-01
C-C120D-WIRE-06-ST01-DT01-DF15-CF02-01
C-C773A-PSQL-03-ST02-DT05-DF15-CF24-01
C-C078B-PSQL-06-ST02-DT01-DF02-CF22-01
C-C476F-SUBV-08-ST03-DT01-DF17-CF01-01
C-C765A-SUBV-05-ST04-DT07-DF13-CF24-01
C-C196A-FFMP-04-ST03-DT02-DF06-CF19-01
C-C126A-PSQL-09-ST02-DT05-DF10-CF20-01
C-C834A-SUBV-06-ST01-DT03-DF12-CF20-01
C-C089C-WIRE-08-ST01-DT05-DF07-CF19-01
C-C476B-OSSL-09-ST04-DT02-DF09-CF20-01
C-C828A-PSQL-07-ST03-DT02-DF17-CF22-01
C-C195A-PSQL-01-ST04-DT07-DF14-CF23-01
C-C120B-FFMP-10-ST04-DT07-DF05-CF24-01
C-C789A-WIRE-07-ST03-DT01-DF06-CF02-01
C-C078A-GIMP-09-ST04-DT02-DF14-CF01-01
C-C476G-FFMP-05-ST01-DT05-DF02-CF19-01
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C-C191B-SUBV-10-ST02-DT03-DF09-CF01-01
C-C785B-GIMP-03-ST03-DT01-DF11-CF03-01
C-C674A-GIMP-04-ST04-DT06-DF09-CF19-01
C-C088B-OSSL-01-ST03-DT03-DF11-CF22-01
C-C476G-GIMP-04-ST04-DT04-DF06-CF23-01
C-C821A-FFMP-06-ST03-DT06-DF06-CF20-01
C-C196A-PSQL-07-ST01-DT04-DF15-CF18-01
C-C806B-SUBV-02-ST01-DT06-DF16-CF19-01
C-C400B-OSSL-09-ST02-DT02-DF11-CF22-01
C-C089D-FFMP-03-ST02-DT01-DF10-CF03-01
C-C476C-WIRE-10-ST02-DT07-DF05-CF18-01
C-C363A-OSSL-10-ST02-DT01-DF08-CF23-01
C-C191A-WIRE-02-ST03-DT03-DF05-CF24-01
C-C134A-SUBV-05-ST02-DT05-DF12-CF22-01
C-C401A-SUBV-10-ST03-DT04-DF17-CF23-01
C-C089A-SUBV-05-ST01-DT06-DF16-CF14-01
C-C476B-SUBV-06-ST01-DT06-DF16-CF03-01
C-C412A-WIRE-04-ST04-DT02-DF03-CF01-01
C-C194A-WIRE-03-ST04-DT05-DF02-CF20-01
C-C126D-FFMP-01-ST03-DT03-DF06-CF18-01
C-C774A-PSQL-02-ST01-DT03-DF12-CF13-01
C-C088A-PSQL-10-ST04-DT03-DF05-CF24-01
C-C476F-OSSL-01-ST03-DT05-DF17-CF22-01
C-C764A-FFMP-03-ST01-DT07-DF11-CF24-01
C-C839A-GIMP-06-ST01-DT02-DF06-CF03-01
C-C761A-GIMP-07-ST04-DT04-DF17-CF14-01
C-C459A-WIRE-08-ST03-DT05-DF14-CF01-01
C-C089B-FFMP-04-ST01-DT04-DF03-CF20-01
C-C476E-WIRE-07-ST03-DT01-DF07-CF02-01
C-C765A-GIMP-09-ST03-DT04-DF16-CF02-01
C-C369A-OSSL-09-ST02-DT06-DF13-CF03-01
C-C785B-PSQL-08-ST01-DT02-DF14-CF22-01
C-C771A-OSSL-01-ST04-DT01-DF15-CF03-01
C-C089C-OSSL-02-ST04-DT05-DF13-CF23-01
C-C476A-GIMP-02-ST01-DT02-DF12-CF24-01
C-C609A-OSSL-01-ST02-DT05-DF15-CF03-01
C-C190A-FFMP-08-ST04-DT03-DF11-CF19-01
C-C120A-WIRE-03-ST03-DT07-DF15-CF13-01
C-C775A-GIMP-05-ST01-DT07-DF13-CF20-01
C-C078B-GIMP-10-ST03-DT07-DF15-CF01-01
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C-C479A-SUBV-10-ST01-DT03-DF13-CF18-01
C-C682B-SUBV-01-ST03-DT07-DF17-CF22-01
C-C824B-OSSL-07-ST01-DT05-DF05-CF23-01
C-C835A-FFMP-06-ST02-DT01-DF05-CF24-01
C-C089D-WIRE-06-ST01-DT02-DF17-CF02-01
C-C476D-PSQL-04-ST03-DT03-DF15-CF23-01
C-C764A-PSQL-03-ST04-DT07-DF11-CF03-01
C-C682A-WIRE-02-ST04-DT05-DF12-CF22-01
C-C785D-OSSL-06-ST02-DT04-DF17-CF03-01
C-C773A-WIRE-10-ST04-DT04-DF03-CF02-01
C-C078A-SUBV-03-ST03-DT03-DF12-CF22-01
C-C476C-OSSL-03-ST04-DT05-DF14-CF24-01
C-C363A-PSQL-09-ST03-DT05-DF02-CF02-01

C-C197A-FFMP-09-ST01-DT06-DF06-CF20-01
C-C134A-FFMP-09-ST03-DT01-DF09-CF23-01
C-C775A-SUBV-01-ST03-DT06-DF13-CF03-01
C-C088A-OSSL-05-ST02-DT06-DF06-CF20-01
C-C476F-WIRE-09-ST01-DT06-DF13-CF20-01
C-C831A-SUBV-05-ST02-DT06-DF12-CF20-01
C-C194A-PSQL-10-ST02-DT04-DF17-CF18-01
C-C124C-WIRE-05-ST01-DT03-DF01-CF02-01
C-C401A-OSSL-04-ST02-DT07-DF16-CF01-01
C-C088B-PSQL-09-ST04-DT04-DF16-CF03-01
C-C476E-PSQL-02-ST03-DT04-DF16-CF03-01
C-C414A-FFMP-08-ST01-DT01-DF17-CF12-01
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C-C120D-PSQL-01-ST04-DT02-DF05-CF19-01
C-C835A-GIMP-09-ST01-DT03-DF14-CF23-01
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C-C476B-FFMP-05-ST02-DT07-DF04-CF19-01
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C-C196A-SUBV-03-ST01-DT02-DF15-CF23-01
C-C120C-GIMP-02-ST02-DT06-DF14-CF18-01
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C-C088B-FFMP-07-ST01-DT05-DF15-CF18-01
C-C476A-GIMP-08-ST02-DT03-DF06-CF13-01
C-C663A-OSSL-01-ST04-DT04-DF17-CF19-01
C-C191A-OSSL-04-ST04-DT01-DF14-CF01-01
C-C761A-SUBV-08-ST03-DT07-DF08-CF20-01
C-C400A-PSQL-03-ST04-DT05-DF02-CF12-01
C-C078A-WIRE-02-ST04-DT07-DF05-CF12-01
C-C476G-SUBV-06-ST04-DT01-DF17-CF02-01
C-C821A-WIRE-02-ST02-DT03-DF15-CF01-01
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C-C124D-PSQL-10-ST04-DT05-DF03-CF01-01
C-C834A-OSSL-02-ST02-DT07-DF11-CF18-01
C-C088A-PSQL-04-ST03-DT03-DF17-CF24-01
C-C476A-PSQL-01-ST02-DT02-DF11-CF18-01
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C-C190A-PSQL-05-ST02-DT01-DF12-CF24-01
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C-C400B-FFMP-08-ST01-DT05-DF17-CF22-01
C-C089A-SUBV-09-ST02-DT04-DF13-CF01-01
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C-C682A-WIRE-03-ST02-DT07-DF07-CF01-01
C-C805C-FFMP-07-ST01-DT01-DF06-CF02-01
C-C774A-GIMP-04-ST02-DT04-DF05-CF19-01
C-C089B-GIMP-08-ST03-DT07-DF11-CF23-01
C-C476C-FFMP-03-ST04-DT04-DF08-CF12-01
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C-C682B-FFMP-07-ST04-DT02-DF12-CF20-01
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C-C127A-WIRE-10-ST03-DT04-DF16-CF01-01
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C-C843A-GIMP-01-ST01-DT03-DF12-CF01-01
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C-C089C-OSSL-01-ST02-DT02-DF08-CF02-01
C-C476D-OSSL-07-ST01-DT02-DF12-CF18-01
C-C833A-OSSL-07-ST03-DT05-DF05-CF03-01
C-C839A-SUBV-02-ST04-DT03-DF13-CF03-01
C-C129B-SUBV-04-ST04-DT06-DF05-CF23-01
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C-C088B-FFMP-08-ST01-DT06-DF04-CF03-01
C-C476E-FFMP-05-ST02-DT06-DF06-CF22-01
C-C764A-OSSL-04-ST01-DT06-DF14-CF19-01
C-C839A-FFMP-04-ST02-DT06-DF16-CF22-01
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C-C088A-PSQL-10-ST03-DT01-DF16-CF20-01
C-C476D-SUBV-04-ST04-DT04-DF13-CF02-01
C-C479A-GIMP-06-ST02-DT01-DF10-CF20-01
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C-C415A-OSSL-09-ST02-DT04-DF13-CF18-01
C-C400B-GIMP-06-ST04-DT05-DF11-CF18-01
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C-C476E-PSQL-10-ST03-DT07-DF13-CF19-01
C-C412A-FFMP-01-ST04-DT03-DF12-CF18-01
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C-C129A-WIRE-02-ST03-DT07-DF17-CF03-01
C-C771A-SUBV-05-ST04-DT06-DF04-CF22-01
C-C078A-GIMP-05-ST02-DT06-DF05-CF24-01
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C-C765B-PSQL-05-ST03-DT07-DF15-CF01-01
C-C196A-OSSL-05-ST03-DT05-DF01-CF19-01
C-C170B-GIMP-08-ST04-DT06-DF04-CF20-01
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C-C089D-OSSL-02-ST04-DT04-DF01-CF24-01
C-C476C-GIMP-01-ST02-DT02-DF15-CF20-01
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C-C191B-WIRE-06-ST01-DT04-DF13-CF23-01
C-C126A-FFMP-06-ST02-DT02-DF07-CF20-01
C-C775A-PSQL-02-ST01-DT03-DF12-CF03-01
C-C078B-GIMP-07-ST02-DT05-DF14-CF03-01
C-C476G-WIRE-06-ST03-DT03-DF16-CF18-01
C-C820A-PSQL-03-ST02-DT02-DF01-CF22-01
C-C195A-OSSL-10-ST04-DT01-DF17-CF13-01
C-C124B-OSSL-09-ST01-DT05-DF15-CF20-01
C-C774A-SUBV-03-ST04-DT07-DF05-CF24-01
C-C089C-WIRE-01-ST03-DT01-DF11-CF22-01
C-C476F-GIMP-10-ST04-DT01-DF14-CF02-01
C-C663A-SUBV-09-ST01-DT06-DF13-CF23-01
C-C190A-PSQL-05-ST01-DT07-DF05-CF24-01
C-C124A-PSQL-03-ST03-DT01-DF16-CF02-01
C-C835A-PSQL-04-ST03-DT07-DF17-CF03-01
C-C078A-PSQL-05-ST01-DT07-DF09-CF23-01

C-C476B-PSQL-09-ST01-DT06-DF10-CF24-01
C-C543A-FFMP-01-ST03-DT04-DF11-CF15-01
C-C369A-GIMP-03-ST02-DT04-DF11-CF18-01
C-C126C-WIRE-06-ST02-DT01-DF11-CF18-01
C-C401A-WIRE-06-ST01-DT02-DF15-CF24-01
C-C088B-FFMP-08-ST01-DT03-DF12-CF20-01
C-C476A-SUBV-03-ST02-DT07-DF17-CF01-01
C-C765A-GIMP-10-ST01-DT04-DF06-CF24-01
C-C682A-FFMP-07-ST03-DT07-DF15-CF03-01
C-C126B-GIMP-01-ST01-DT03-DF13-CF24-01
C-C459A-GIMP-08-ST02-DT04-DF06-CF03-01
C-C078B-OSSL-06-ST04-DT07-DF15-CF13-01
C-C476B-OSSL-06-ST04-DT01-DF03-CF15-01
C-C367A-SUBV-05-ST04-DT03-DF09-CF01-01
C-C682B-WIRE-01-ST02-DT02-DF05-CF23-01
C-C805A-SUBV-10-ST04-DT05-DF06-CF01-01
C-C789A-OSSL-05-ST04-DT02-DF14-CF20-01
C-C089D-WIRE-09-ST02-DT04-DF13-CF01-01
C-C476G-FFMP-07-ST03-DT06-DF05-CF01-01
C-C609A-WIRE-07-ST03-DT02-DF14-CF18-01
C-C191A-SUBV-04-ST02-DT05-DF06-CF02-01
C-C170A-FFMP-04-ST03-DT02-DF12-CF22-01
C-C834A-FFMP-01-ST03-DT01-DF01-CF22-01
C-C089C-SUBV-04-ST03-DT02-DF06-CF23-01
C-C476C-WIRE-08-ST01-DT04-DF13-CF03-01
C-C414A-OSSL-04-ST02-DT01-DF11-CF02-01
C-C369A-PSQL-09-ST04-DT03-DF11-CF01-01
C-C806D-GIMP-08-ST03-DT06-DF17-CF19-01
C-C771A-FFMP-02-ST01-DT05-DF16-CF02-01
C-C078A-SUBV-03-ST02-DT06-DF17-CF18-01
C-C476F-WIRE-02-ST02-DT02-DF12-CF23-01
C-C833A-GIMP-08-ST04-DT06-DF05-CF23-01
C-C190A-GIMP-02-ST04-DT06-DF12-CF02-01
C-C416A-OSSL-02-ST04-DT01-DF03-CF15-01
C-C775A-PSQL-10-ST01-DT03-DF11-CF20-01
C-C089B-FFMP-10-ST04-DT03-DF15-CF02-01
C-C476E-OSSL-01-ST01-DT03-DF05-CF24-01
C-C821A-OSSL-06-ST01-DT05-DF15-CF02-01
C-C682A-OSSL-06-ST01-DT06-DF09-CF20-01
C-C127B-WIRE-05-ST02-DT07-DF06-CF24-01
C-C834A-OSSL-09-ST04-DT07-DF06-CF23-01
C-C088A-PSQL-07-ST01-DT05-DF13-CF15-01
C-C476D-PSQL-04-ST04-DT05-DF12-CF19-01
C-C831A-FFMP-02-ST03-DT07-DF08-CF24-01
C-C839A-SUBV-08-ST03-DT01-DF06-CF23-01
C-C805D-FFMP-07-ST03-DT04-DF05-CF23-01
C-C789A-SUBV-07-ST02-DT06-DF10-CF19-01
C-C088A-GIMP-02-ST02-DT03-DF11-CF24-01
C-C476A-FFMP-05-ST03-DT02-DF09-CF20-01
C-C828A-SUBV-03-ST02-DT01-DF12-CF03-01
C-C191A-WIRE-08-ST01-DT07-DF17-CF19-01
C-C806A-PSQL-02-ST01-DT07-DF11-CF23-01
C-C674A-WIRE-05-ST03-DT02-DF16-CF14-01
C-C088A-GIMP-05-ST04-DT02-DF04-CF19-01
C-C476D-GIMP-07-ST02-DT07-DF14-CF22-01
C-C479A-PSQL-10-ST04-DT05-DF03-CF22-01
C-C197A-FFMP-01-ST02-DT05-DF14-CF03-01
C-C126D-PSQL-10-ST04-DT03-DF15-CF03-01
C-C774A-GIMP-07-ST02-DT04-DF17-CF01-01
C-C078B-OSSL-09-ST03-DT01-DF17-CF02-01
C-C476C-SUBV-10-ST01-DT06-DF06-CF19-01
C-C821A-WIRE-09-ST01-DT03-DF14-CF20-01
C-C194A-PSQL-10-ST04-DT01-DF15-CF18-01
C-C805B-SUBV-06-ST02-DT06-DF14-CF02-01
C-C400A-FFMP-03-ST03-DT03-DF14-CF19-01
C-C078A-FFMP-06-ST03-DT07-DF16-CF22-01
C-C476G-OSSL-01-ST01-DT05-DF15-CF18-01
C-C609A-SUBV-01-ST03-DT04-DF16-CF19-01
C-C195A-SUBV-02-ST02-DT03-DF03-CF14-01
C-C127C-OSSL-01-ST03-DT04-DF12-CF18-01
C-C401A-GIMP-06-ST04-DT01-DF15-CF18-01
C-C089D-SUBV-10-ST01-DT04-DF14-CF20-01
C-C476B-FFMP-04-ST02-DT04-DF17-CF20-01
C-C367A-WIRE-05-ST02-DT02-DF06-CF22-01
C-C682B-OSSL-03-ST03-DT04-DF11-CF22-01
C-C120B-FFMP-04-ST04-DT05-DF13-CF20-01
C-C400B-PSQL-08-ST02-DT05-DF05-CF23-01
C-C089A-WIRE-02-ST04-DT06-DF05-CF01-01
C-C476F-WIRE-08-ST01-DT01-DF16-CF03-01
C-C833A-FFMP-04-ST04-DT07-DF06-CF03-01
C-C191B-FFMP-06-ST04-DT02-DF11-CF01-01
C-C590A-WIRE-03-ST01-DT02-DF16-CF19-01
C-C459A-SUBV-01-ST03-DT02-DF05-CF20-01
C-C088B-WIRE-08-ST03-DT03-DF10-CF15-01
C-C476E-SUBV-06-ST04-DT03-DF11-CF23-01
C-C663A-OSSL-06-ST02-DT06-DF13-CF12-01
C-C196A-GIMP-05-ST01-DT03-DF16-CF03-01
C-C785A-GIMP-07-ST01-DT04-DF07-CF13-01
C-C835A-WIRE-04-ST01-DT06-DF13-CF15-01
C-C078A-PSQL-03-ST02-DT04-DF12-CF03-01
C-C476E-GIMP-05-ST03-DT05-DF11-CF13-01
C-C820A-GIMP-03-ST01-DT03-DF17-CF22-01
C-C197A-WIRE-04-ST04-DT05-DF13-CF20-01
C-C824A-SUBV-08-ST02-DT01-DF02-CF03-01
C-C773A-OSSL-02-ST04-DT07-DF12-CF14-01
C-C089C-OSSL-04-ST01-DT02-DF06-CF18-01
C-C476D-WIRE-03-ST04-DT06-DF01-CF02-01
C-C363A-PSQL-08-ST03-DT01-DF05-CF19-01
C-C191B-OSSL-07-ST03-DT07-DF07-CF24-01
C-C822A-FFMP-09-ST04-DT07-DF15-CF01-01
C-C789A-FFMP-09-ST02-DT01-DF15-CF19-01
C-C089D-FFMP-01-ST02-DT05-DF05-CF23-01
C-C476B-PSQL-09-ST03-DT03-DF13-CF22-01
C-C828A-WIRE-07-ST03-DT05-DF13-CF20-01
C-C191A-FFMP-09-ST02-DT04-DF06-CF22-01
C-C785C-PSQL-05-ST01-DT03-DF09-CF23-01
C-C775A-GIMP-10-ST03-DT04-DF14-CF02-01
C-C088A-SUBV-01-ST03-DT05-DF15-CF19-01
C-C476G-OSSL-02-ST03-DT07-DF17-CF14-01
C-C764A-GIMP-02-ST02-DT07-DF05-CF02-01
C-C839A-SUBV-07-ST03-DT06-DF15-CF22-01
C-C170B-GIMP-10-ST02-DT05-DF05-CF19-01

C-C835A-WIRE-08-ST04-DT06-DF13-CF01-01
C-C089B-WIRE-07-ST01-DT06-DF14-CF19-01
C-C476A-FFMP-08-ST04-DT02-DF05-CF01-01
C-C831A-SUBV-05-ST04-DT02-DF16-CF24-01
C-C194A-WIRE-02-ST01-DT02-DF17-CF24-01
C-C127D-SUBV-03-ST01-DT07-DF12-CF24-01
C-C834A-SUBV-05-ST01-DT03-DF06-CF01-01
C-C089C-OSSL-03-ST04-DT07-DF12-CF22-01
C-C476C-SUBV-01-ST02-DT01-DF07-CF23-01
C-C765A-FFMP-03-ST01-DT06-DF15-CF18-01
C-C195A-GIMP-03-ST04-DT04-DF15-CF19-01
C-C824A-OSSL-07-ST03-DT02-DF17-CF20-01
C-C400A-OSSL-10-ST01-DT01-DF17-CF24-01
C-C088B-GIMP-09-ST01-DT06-DF17-CF23-01
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C-C765B-OSSL-01-ST02-DT04-DF04-CF18-01
C-C369A-PSQL-04-ST03-DT07-DF02-CF20-01
C-C805A-WIRE-06-ST02-DT02-DF06-CF22-01
C-C771A-PSQL-09-ST04-DT04-DF02-CF02-01
C-C078A-PSQL-02-ST04-DT04-DF11-CF18-01
C-C476B-GIMP-05-ST04-DT02-DF14-CF22-01
C-C412A-PSQL-09-ST04-DT05-DF17-CF03-01
C-C682B-PSQL-08-ST02-DT06-DF14-CF19-01
C-C124B-PSQL-02-ST03-DT06-DF13-CF24-01
C-C401A-FFMP-03-ST02-DT05-DF09-CF03-01
C-C078B-SUBV-04-ST02-DT02-DF01-CF13-01
C-C476A-SUBV-07-ST01-DT06-DF02-CF02-01
C-C543A-PSQL-02-ST01-DT02-DF12-CF23-01
C-C190A-WIRE-06-ST04-DT01-DF16-CF23-01
C-C129B-FFMP-04-ST04-DT05-DF16-CF14-01
C-C674A-GIMP-04-ST03-DT03-DF16-CF18-01
C-C089A-GIMP-08-ST03-DT05-DF09-CF03-01
C-C476D-OSSL-04-ST03-DT03-DF16-CF18-01
C-C414A-WIRE-04-ST03-DT07-DF11-CF23-01
C-C682A-GIMP-05-ST01-DT03-DF05-CF18-01
C-C805B-GIMP-05-ST03-DT06-DF14-CF23-01
C-C459A-OSSL-06-ST04-DT07-DF11-CF22-01
C-C089A-FFMP-10-ST03-DT01-DF13-CF02-01
C-C476G-GIMP-10-ST04-DT07-DF04-CF03-01
C-C764A-GIMP-07-ST04-DT01-DF14-CF01-01
C-C196A-FFMP-01-ST01-DT05-DF01-CF12-01
C-C120D-OSSL-09-ST04-DT04-DF11-CF02-01
C-C400B-PSQL-07-ST03-DT06-DF03-CF23-01
C-C088B-WIRE-07-ST04-DT03-DF13-CF01-01
C-C476F-PSQL-03-ST01-DT01-DF10-CF22-01
C-C831A-OSSL-08-ST03-DT06-DF15-CF18-01
C-C190A-OSSL-10-ST02-DT02-DF13-CF02-01
C-C785C-WIRE-01-ST03-DT03-DF17-CF22-01
C-C774A-WIRE-02-ST01-DT05-DF12-CF20-01
C-C088A-OSSL-05-ST01-DT07-DF15-CF19-01
C-C476E-FFMP-06-ST02-DT04-DF15-CF01-01
C-C543A-SUBV-10-ST02-DT03-DF07-CF20-01
C-C197A-SUBV-09-ST03-DT01-DF12-CF23-01
C-C806D-SUBV-08-ST02-DT01-DF14-CF02-01
C-C773A-SUBV-01-ST02-DT02-DF17-CF15-01
C-C088A-PSQL-05-ST02-DT01-DF06-CF24-01
C-C476C-WIRE-09-ST03-DT05-DF12-CF01-01
C-C479A-FFMP-06-ST03-DT02-DF01-CF01-01
C-C682B-OSSL-06-ST02-DT05-DF05-CF19-01
C-C806B-WIRE-08-ST01-DT01-DF13-CF03-01
C-C400B-SUBV-08-ST02-DT01-DF07-CF20-01
C-C078B-PSQL-09-ST02-DT05-DF16-CF01-01
C-C476A-GIMP-05-ST02-DT06-DF15-CF24-01
C-C828A-PSQL-05-ST01-DT04-DF17-CF20-01
C-C191A-SUBV-07-ST01-DT06-DF08-CF02-01
C-C126C-GIMP-03-ST04-DT05-DF05-CF20-01
C-C775A-WIRE-06-ST01-DT04-DF11-CF18-01
C-C089C-GIMP-06-ST01-DT07-DF14-CF14-01
C-C476B-WIRE-01-ST01-DT07-DF17-CF18-01
C-C820A-OSSL-04-ST01-DT06-DF16-CF02-01
C-C196A-WIRE-08-ST03-DT07-DF16-CF01-01
C-C124C-OSSL-05-ST01-DT03-DF16-CF24-01
C-C835A-PSQL-10-ST04-DT07-DF06-CF19-01
C-C089B-OSSL-01-ST04-DT04-DF16-CF20-01
C-C476F-SUBV-10-ST04-DT05-DF06-CF02-01
C-C821A-GIMP-07-ST02-DT05-DF11-CF24-01
C-C195A-PSQL-02-ST01-DT04-DF12-CF24-01
C-C415A-SUBV-06-ST03-DT07-DF08-CF18-01
C-C674A-FFMP-04-ST02-DT03-DF13-CF24-01
C-C078A-WIRE-10-ST03-DT02-DF08-CF20-01
C-C476C-PSQL-08-ST03-DT02-DF17-CF23-01
C-C412A-WIRE-10-ST04-DT01-DF06-CF19-01
C-C191B-FFMP-05-ST04-DT01-DF17-CF18-01
C-C124D-PSQL-02-ST02-DT04-DF15-CF22-01
C-C834A-GIMP-05-ST04-DT02-DF15-CF22-01
C-C088B-SUBV-08-ST01-DT01-DF11-CF02-01
C-C476D-FFMP-06-ST03-DT01-DF11-CF24-01
C-C765A-SUBV-06-ST02-DT07-DF14-CF15-01
C-C682A-GIMP-03-ST03-DT03-DF14-CF22-01
C-C127A-FFMP-01-ST01-DT06-DF12-CF15-01
C-C459A-OSSL-07-ST01-DT05-DF04-CF03-01
C-C078B-FFMP-02-ST03-DT06-DF12-CF24-01
C-C476G-GIMP-09-ST01-DT04-DF11-CF19-01
C-C833A-FFMP-01-ST04-DT03-DF13-CF23-01
C-C369A-PSQL-10-ST02-DT07-DF11-CF20-01
C-C806A-FFMP-10-ST02-DT02-DF11-CF03-01
C-C774A-PSQL-09-ST03-DT06-DF14-CF01-01
C-C078A-PSQL-04-ST04-DT07-DF12-CF03-01
C-C476E-OSSL-04-ST04-DT03-DF13-CF03-01
C-C609A-FFMP-02-ST03-DT06-DF12-CF20-01
C-C839A-OSSL-04-ST04-DT02-DF06-CF03-01
C-C126D-WIRE-04-ST04-DT01-DF06-CF24-01
C-C401A-SUBV-01-ST03-DT05-DF16-CF24-01
C-C088A-WIRE-07-ST02-DT03-DF05-CF23-01
C-C476E-PSQL-07-ST01-DT03-DF05-CF20-01
C-C543A-WIRE-09-ST01-DT02-DF05-CF03-01
C-C194A-WIRE-01-ST03-DT06-DF13-CF03-01
C-C127B-OSSL-07-ST03-DT03-DF01-CF03-01
C-C789A-FFMP-03-ST01-DT04-DF05-CF03-01
C-C089B-FFMP-01-ST04-DT04-DF17-CF22-01
C-C476G-WIRE-02-ST02-DT04-DF12-CF15-01
C-C363A-PSQL-03-ST03-DT01-DF17-CF19-01

C-C194A-FFMP-09-ST01-DT01-DF15-CF20-01
C-C170A-GIMP-09-ST01-DT07-DF16-CF23-01
C-C400A-GIMP-02-ST04-DT02-DF05-CF01-01
C-C089A-SUBV-03-ST02-DT03-DF03-CF18-01
C-C476C-OSSL-07-ST03-DT01-DF16-CF19-01
C-C367A-GIMP-08-ST04-DT04-DF05-CF14-01
C-C197A-SUBV-06-ST04-DT05-DF16-CF01-01
C-C120A-PSQL-01-ST04-DT06-DF04-CF18-01
C-C771A-WIRE-05-ST02-DT06-DF11-CF02-01
C-C078A-GIMP-06-ST03-DT02-DF17-CF22-01
C-C476B-FFMP-03-ST02-DT05-DF14-CF02-01
C-C765B-OSSL-05-ST01-DT07-DF11-CF22-01
C-C196A-GIMP-02-ST02-DT04-DF05-CF15-01
C-C824B-SUBV-02-ST04-DT02-DF06-CF19-01
C-C773A-OSSL-01-ST03-DT07-DF06-CF13-01
C-C089C-OSSL-07-ST01-DT01-DF11-CF01-01
C-C476D-SUBV-09-ST02-DT06-DF03-CF01-01
C-C414A-SUBV-06-ST02-DT03-DF09-CF01-01
C-C191B-PSQL-09-ST01-DT02-DF17-CF13-01
C-C822A-PSQL-10-ST03-DT04-DF11-CF02-01
C-C400A-SUBV-09-ST04-DT01-DF13-CF23-01
C-C078A-FFMP-09-ST02-DT05-DF05-CF03-01
C-C476F-OSSL-08-ST03-DT07-DF12-CF03-01
C-C663A-OSSL-04-ST03-DT05-DF06-CF22-01
C-C839A-FFMP-08-ST03-DT03-DF10-CF22-01
C-C843A-FFMP-09-ST02-DT05-DF12-CF12-01
C-C775A-FFMP-02-ST02-DT03-DF12-CF18-01
C-C088A-PSQL-04-ST01-DT06-DF15-CF02-01
C-C476A-PSQL-06-ST04-DT01-DF14-CF18-01
C-C367A-WIRE-08-ST04-DT04-DF15-CF03-01
C-C369A-WIRE-07-ST04-DT01-DF06-CF18-01
C-C590A-GIMP-04-ST02-DT04-DF10-CF01-01
C-C400B-GIMP-07-ST01-DT01-DF14-CF12-01
C-C078B-WIRE-06-ST04-DT04-DF14-CF24-01
C-C476F-GIMP-02-ST01-DT02-DF15-CF24-01
C-C820A-PSQL-10-ST02-DT05-DF16-CF13-01
C-C191A-GIMP-01-ST02-DT04-DF12-CF20-01
C-C785D-WIRE-08-ST04-DT01-DF13-CF22-01
C-C834A-OSSL-03-ST02-DT02-DF12-CF20-01
C-C089C-GIMP-03-ST04-DT01-DF16-CF19-01
C-C476E-WIRE-05-ST04-DT05-DF16-CF20-01
C-C765B-GIMP-07-ST03-DT03-DF02-CF23-01
C-C682B-OSSL-04-ST01-DT07-DF11-CF01-01
C-C129A-OSSL-05-ST02-DT05-DF17-CF02-01
C-C774A-OSSL-10-ST03-DT05-DF17-CF22-01
C-C088B-SUBV-02-ST03-DT02-DF13-CF12-01
C-C476B-FFMP-03-ST02-DT02-DF05-CF22-01
C-C412A-FFMP-09-ST04-DT02-DF10-CF24-01
C-C195A-SUBV-10-ST03-DT03-DF13-CF19-01
C-C124A-SUBV-06-ST01-DT03-DF05-CF20-01
C-C459A-PSQL-06-ST01-DT06-DF08-CF23-01
C-C089B-WIRE-10-ST01-DT07-DF02-CF01-01
C-C476D-SUBV-04-ST01-DT06-DF13-CF12-01
C-C663A-SUBV-02-ST01-DT01-DF14-CF02-01
C-C190A-GIMP-05-ST01-DT05-DF14-CF01-01
C-C120B-OSSL-03-ST03-DT06-DF15-CF22-01
C-C771A-WIRE-08-ST03-DT03-DF15-CF19-01
C-C089A-OSSL-05-ST03-DT03-DF06-CF20-01
C-C476C-GIMP-01-ST03-DT04-DF11-CF20-01
C-C831A-GIMP-03-ST02-DT04-DF12-CF01-01
C-C682A-FFMP-03-ST02-DT06-DF04-CF02-01
C-C134A-GIMP-09-ST01-DT02-DF17-CF24-01
C-C835A-FFMP-04-ST04-DT04-DF16-CF02-01
C-C088A-SUBV-08-ST02-DT05-DF07-CF18-01
C-C476A-PSQL-10-ST04-DT03-DF06-CF19-01
C-C363A-WIRE-01-ST01-DT07-DF13-CF23-01
C-C190A-PSQL-06-ST03-DT02-DF14-CF23-01
C-C126A-FFMP-07-ST03-DT07-DF14-CF01-01
C-C674A-PSQL-10-ST04-DT04-DF12-CF03-01
C-C089D-GIMP-05-ST01-DT06-DF06-CF18-01
C-C476G-FFMP-06-ST04-DT07-DF08-CF23-01
C-C414A-SUBV-02-ST04-DT06-DF13-CF18-01
C-C197A-OSSL-01-ST04-DT03-DF06-CF24-01
C-C126B-SUBV-04-ST02-DT04-DF13-CF23-01
C-C401A-GIMP-05-ST01-DT06-DF17-CF20-01
C-C088B-PSQL-01-ST03-DT07-DF17-CF02-01
C-C476D-WIRE-03-ST02-DT03-DF17-CF15-01
C-C765A-PSQL-06-ST03-DT07-DF01-CF19-01
C-C682B-WIRE-05-ST02-DT01-DF10-CF03-01
C-C761A-PSQL-10-ST01-DT07-DF03-CF18-01
C-C789A-WIRE-04-ST03-DT02-DF14-CF23-01
C-C078A-OSSL-04-ST04-DT03-DF12-CF23-01
C-C476G-SUBV-07-ST03-DT04-DF15-CF18-01
C-C609A-OSSL-10-ST02-DT04-DF16-CF02-01
C-C682A-SUBV-08-ST04-DT05-DF17-CF19-01
C-C806C-WIRE-02-ST04-DT06-DF09-CF19-01
C-C773A-SUBV-09-ST02-DT07-DF13-CF18-01
C-C078B-FFMP-07-ST02-DT02-DF02-CF19-01
C-C476F-OSSL-02-ST03-DT01-DF16-CF03-01
C-C821A-FFMP-05-ST01-DT03-DF06-CF03-01
C-C369A-PSQL-02-ST03-DT04-DF05-CF12-01
C-C785B-WIRE-06-ST04-DT01-DF11-CF20-01
C-C400A-PSQL-01-ST02-DT03-DF05-CF15-01
C-C089C-SUBV-03-ST04-DT04-DF15-CF22-01
C-C476B-FFMP-01-ST01-DT07-DF12-CF01-01
C-C479A-GIMP-04-ST01-DT06-DF10-CF01-01
C-C195A-OSSL-07-ST04-DT07-DF03-CF18-01
C-C805D-PSQL-08-ST02-DT03-DF05-CF14-01
C-C401A-GIMP-08-ST03-DT05-DF06-CF02-01
C-C088A-PSQL-09-ST02-DT06-DF14-CF23-01
C-C476A-PSQL-08-ST02-DT05-DF13-CF18-01
C-C828A-OSSL-09-ST04-DT02-DF15-CF18-01
C-C191A-SUBV-03-ST01-DT02-DF13-CF22-01
C-C120C-SUBV-01-ST01-DT05-DF12-CF03-01
C-C834A-SUBV-03-ST01-DT03-DF11-CF24-01
C-C089A-OSSL-02-ST01-DT03-DF13-CF22-01
C-C476C-OSSL-09-ST01-DT06-DF03-CF23-01
C-C764A-WIRE-07-ST03-DT01-DF05-CF20-01
C-C194A-FFMP-10-ST04-DT06-DF12-CF24-01
C-C805C-FFMP-05-ST03-DT02-DF14-CF01-01
C-C771A-FFMP-02-ST01-DT07-DF02-CF19-01
C-C089B-WIRE-06-ST03-DT05-DF05-CF14-01

C-C476E-SUBV-04-ST04-DT02-DF10-CF23-01
C-C833A-FFMP-01-ST02-DT05-DF15-CF22-01
C-C191B-WIRE-04-ST02-DT05-DF15-CF23-01
C-C416A-GIMP-07-ST04-DT01-DF15-CF19-01
C-C674A-WIRE-07-ST04-DT01-DF07-CF22-01
C-C089C-FFMP-10-ST02-DT01-DF16-CF24-01
C-C476B-WIRE-05-ST01-DT03-DF06-CF22-01
C-C828A-SUBV-08-ST02-DT07-DF05-CF24-01
C-C839A-GIMP-09-ST02-DT06-DF16-CF02-01
C-C785A-OSSL-03-ST03-DT03-DF05-CF02-01
C-C774A-OSSL-06-ST02-DT04-DF15-CF01-01
C-C088A-GIMP-08-ST03-DT04-DF10-CF23-01
C-C476G-WIRE-10-ST02-DT02-DF14-CF12-01
C-C412A-PSQL-03-ST01-DT06-DF17-CF13-01
C-C196A-OSSL-01-ST01-DT07-DF12-CF23-01
C-C127C-PSQL-05-ST02-DT04-DF06-CF18-01
C-C775A-SUBV-06-ST04-DT02-DF16-CF24-01
C-C088B-PSQL-02-ST04-DT07-DF11-CF20-01
C-C476E-GIMP-06-ST03-DT07-DF15-CF20-01
C-C820A-GIMP-10-ST03-DT02-DF14-CF15-01
C-C190A-SUBV-03-ST02-DT04-DF02-CF01-01
C-C785C-OSSL-04-ST03-DT07-DF16-CF13-01
C-C459A-FFMP-08-ST02-DT01-DF14-CF23-01
C-C078A-GIMP-04-ST01-DT06-DF15-CF20-01
C-C476D-SUBV-03-ST04-DT01-DF05-CF24-01
C-C414A-WIRE-03-ST04-DT03-DF11-CF02-01
C-C369A-PSQL-06-ST03-DT01-DF11-CF24-01
C-C134A-WIRE-03-ST01-DT06-DF15-CF03-01
C-C773A-GIMP-01-ST03-DT06-DF05-CF22-01
C-C078B-SUBV-10-ST02-DT05-DF12-CF02-01
C-C476A-OSSL-01-ST01-DT04-DF14-CF19-01
C-C765B-PSQL-04-ST02-DT01-DF13-CF03-01
C-C682A-FFMP-04-ST03-DT02-DF05-CF02-01
C-C785D-SUBV-07-ST02-DT05-DF02-CF24-01
C-C400B-OSSL-02-ST03-DT04-DF11-CF12-01
C-C089D-FFMP-03-ST01-DT02-DF09-CF03-01
C-C476F-FFMP-08-ST04-DT05-DF11-CF24-01
C-C663A-OSSL-02-ST03-DT05-DF07-CF19-01
C-C839A-WIRE-10-ST04-DT04-DF14-CF03-01
C-C126C-GIMP-06-ST04-DT02-DF08-CF18-01
C-C789A-PSQL-04-ST04-DT07-DF16-CF19-01
C-C089A-OSSL-09-ST04-DT01-DF01-CF24-01
C-C476C-GIMP-07-ST03-DT06-DF06-CF02-01
C-C831A-SUBV-07-ST01-DT04-DF12-CF18-01
C-C191A-GIMP-05-ST01-DT03-DF07-CF22-01
C-C416A-FFMP-10-ST01-DT07-DF13-CF23-01
C-C835A-WIRE-09-ST01-DT05-DF06-CF18-01
C-C089B-WIRE-07-ST01-DT02-DF11-CF24-01
C-C476D-PSQL-02-ST03-DT07-DF17-CF02-01
C-C833A-FFMP-09-ST02-DT02-DF16-CF01-01
C-C196A-SUBV-02-ST03-DT03-DF06-CF20-01
C-C124B-GIMP-09-ST01-DT02-DF11-CF01-01
C-C771A-WIRE-07-ST04-DT05-DF15-CF20-01
C-C078A-PSQL-06-ST03-DT03-DF05-CF01-01
C-C476C-SUBV-05-ST02-DT03-DF02-CF01-01
C-C821A-PSQL-06-ST04-DT07-DF14-CF22-01
C-C682B-WIRE-09-ST01-DT06-DF15-CF19-01
C-C824B-FFMP-02-ST02-DT04-DF14-CF23-01
C-C459A-PSQL-03-ST02-DT07-DF09-CF01-01
C-C089D-OSSL-08-ST03-DT07-DF14-CF02-01
C-C476F-OSSL-09-ST01-DT01-DF11-CF22-01
C-C764A-OSSL-01-ST01-DT06-DF17-CF23-01
C-C191B-PSQL-08-ST04-DT07-DF11-CF02-01
C-C824A-WIRE-08-ST04-DT06-DF17-CF19-01
C-C789A-SUBV-10-ST03-DT03-DF12-CF03-01
C-C088A-SUBV-05-ST04-DT05-DF16-CF18-01
C-C476G-WIRE-10-ST04-DT02-DF13-CF19-01
C-C367A-WIRE-05-ST04-DT01-DF03-CF24-01
C-C194A-GIMP-07-ST02-DT01-DF16-CF13-01
C-C590A-OSSL-01-ST04-DT01-DF12-CF20-01
C-C400A-FFMP-05-ST01-DT02-DF03-CF03-01
C-C088B-WIRE-01-ST02-DT01-DF06-CF19-01
C-C476B-GIMP-04-ST02-DT04-DF05-CF03-01
C-C363A-SUBV-08-ST03-DT05-DF11-CF20-01
C-C197A-OSSL-05-ST02-DT02-DF17-CF14-01
C-C761A-PSQL-01-ST03-DT05-DF16-CF24-01
C-C775A-GIMP-07-ST03-DT04-DF15-CF23-01
C-C089B-GIMP-09-ST02-DT04-DF04-CF03-01
C-C476A-FFMP-09-ST02-DT06-DF09-CF18-01
C-C543A-GIMP-08-ST02-DT04-DF06-CF22-01
C-C195A-FFMP-10-ST04-DT02-DF13-CF20-01
C-C124A-OSSL-04-ST01-DT07-DF06-CF12-01
C-C400B-GIMP-08-ST01-DT06-DF14-CF02-01
C-C078A-FFMP-05-ST04-DT06-DF13-CF12-01
C-C476E-PSQL-02-ST01-DT02-DF17-CF20-01
C-C609A-FFMP-04-ST04-DT03-DF05-CF23-01
C-C194A-PSQL-03-ST01-DT05-DF05-CF22-01
C-C806C-SUBV-10-ST03-DT03-DF17-CF02-01
C-C773A-OSSL-06-ST02-DT01-DF13-CF19-01
C-C089A-OSSL-07-ST02-DT04-DF17-CF13-01
C-C476B-SUBV-01-ST03-DT05-DF12-CF22-01
C-C765A-GIMP-05-ST01-DT07-DF12-CF20-01
C-C191A-GIMP-08-ST03-DT06-DF15-CF18-01
C-C124C-SUBV-06-ST04-DT01-DF14-CF22-01
C-C674A-OSSL-02-ST04-DT05-DF05-CF02-01
C-C078B-PSQL-01-ST03-DT05-DF08-CF22-01
C-C476C-OSSL-10-ST04-DT03-DF13-CF14-01
C-C479A-OSSL-03-ST03-DT03-DF12-CF14-01
C-C682B-SUBV-06-ST04-DT01-DF09-CF19-01
C-C806A-GIMP-03-ST03-DT06-DF12-CF03-01
C-C401A-WIRE-04-ST01-DT06-DF17-CF18-01
C-C089B-FFMP-04-ST01-DT07-DF12-CF15-01
C-C476A-PSQL-05-ST02-DT04-DF14-CF02-01
C-C833A-SUBV-09-ST02-DT01-DF14-CF01-01
C-C195A-WIRE-09-ST01-DT04-DF16-CF03-01
C-C127C-FFMP-05-ST02-DT03-DF16-CF19-01
C-C835A-PSQL-03-ST03-DT03-DF12-CF01-01
C-C088A-WIRE-02-ST04-DT03-DF17-CF03-01
C-C476E-GIMP-08-ST03-DT01-DF01-CF19-01
C-C663A-FFMP-10-ST03-DT04-DF06-CF24-01
C-C196A-OSSL-04-ST02-DT05-DF13-CF01-01
C-C805D-WIRE-02-ST02-DT02-DF01-CF20-01

C-C834A-SUBV-01-ST04-DT04-DF10-CF22-01
C-C089C-GIMP-03-ST03-DT01-DF06-CF19-01
C-C476D-WIRE-04-ST01-DT06-DF05-CF01-01
C-C828A-WIRE-07-ST04-DT05-DF11-CF19-01
C-C839A-FFMP-02-ST03-DT07-DF14-CF23-01
C-C170B-PSQL-07-ST01-DT04-DF07-CF01-01
C-C774A-FFMP-05-ST02-DT07-DF01-CF24-01
C-C089A-SUBV-06-ST01-DT02-DF14-CF01-01
C-C476F-FFMP-07-ST04-DT07-DF16-CF24-01
C-C412A-PSQL-02-ST01-DT02-DF04-CF18-01
C-C369A-FFMP-07-ST02-DT03-DF06-CF24-01
C-C415A-GIMP-09-ST02-DT03-DF15-CF22-01
C-C775A-SUBV-10-ST01-DT02-DF16-CF20-01
C-C078A-SUBV-10-ST04-DT06-DF15-CF23-01
C-C476G-FFMP-06-ST03-DT05-DF08-CF20-01
C-C479A-PSQL-01-ST01-DT02-DF15-CF24-01
C-C197A-GIMP-01-ST04-DT07-DF01-CF18-01
C-C127D-FFMP-02-ST03-DT05-DF11-CF18-01
C-C773A-GIMP-09-ST03-DT05-DF11-CF14-01
C-C089D-OSSL-08-ST01-DT06-DF13-CF20-01
C-C476G-GIMP-03-ST02-DT07-DF16-CF23-01
C-C831A-WIRE-06-ST02-DT06-DF09-CF02-01
C-C191B-WIRE-06-ST03-DT01-DF11-CF18-01
C-C126D-SUBV-08-ST04-DT05-DF13-CF22-01
C-C674A-FFMP-01-ST04-DT03-DF17-CF03-01
C-C088B-FFMP-06-ST02-DT07-DF16-CF18-01
C-C476C-SUBV-08-ST01-DT03-DF15-CF03-01
C-C543A-OSSL-04-ST04-DT03-DF13-CF03-01
C-C190A-SUBV-05-ST01-DT02-DF12-CF03-01
C-C126A-OSSL-10-ST01-DT01-DF05-CF23-01
C-C459A-WIRE-03-ST02-DT02-DF14-CF22-01
C-C078B-WIRE-05-ST03-DT01-DF05-CF23-01
C-C476A-OSSL-05-ST03-DT05-DF06-CF23-01
C-C367A-GIMP-07-ST03-DT07-DF17-CF01-01
C-C682A-PSQL-04-ST02-DT06-DF17-CF24-01
C-C806D-WIRE-09-ST01-DT06-DF06-CF18-01
C-C835A-OSSL-10-ST02-DT06-DF13-CF02-01
C-C078A-PSQL-10-ST04-DT04-DF11-CF03-01
C-C476F-PSQL-04-ST02-DT01-DF12-CF03-01
C-C820A-SUBV-01-ST04-DT04-DF15-CF20-01
C-C839A-OSSL-08-ST03-DT04-DF06-CF23-01
C-C129A-PSQL-07-ST04-DT04-DF04-CF15-01
C-C401A-PSQL-07-ST04-DT01-DF06-CF20-01
C-C088B-GIMP-07-ST01-DT03-DF15-CF24-01
C-C476E-WIRE-02-ST04-DT04-DF12-CF13-01
C-C363A-FFMP-10-ST01-DT05-DF16-CF12-01
C-C682B-FFMP-02-ST01-DT05-DF17-CF20-01
C-C785B-SUBV-03-ST03-DT02-DF15-CF01-01
C-C834A-GIMP-06-ST03-DT06-DF15-CF01-01
C-C089B-OSSL-04-ST02-DT05-DF07-CF20-01
C-C476B-PSQL-03-ST04-DT06-DF14-CF18-01
C-C821A-WIRE-05-ST03-DT06-DF16-CF23-01
C-C191B-OSSL-10-ST04-DT03-DF15-CF15-01
C-C822A-OSSL-05-ST02-DT06-DF11-CF20-01
C-C400A-WIRE-04-ST01-DT01-DF16-CF19-01
C-C078B-FFMP-09-ST03-DT05-DF06-CF01-01
C-C476D-SUBV-09-ST02-DT02-DF07-CF02-01
C-C609A-OSSL-08-ST02-DT02-DF05-CF03-01
C-C194A-GIMP-07-ST04-DT04-DF16-CF22-01
C-C129B-GIMP-08-ST03-DT07-DF12-CF19-01
C-C400B-PSQL-08-ST04-DT07-DF13-CF18-01
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C-C476D-GIMP-10-ST01-DT04-DF17-CF22-01
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C-C197A-WIRE-03-ST01-DT01-DF13-CF02-01
C-C120A-FFMP-01-ST01-DT07-DF17-CF03-01
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C-C765A-PSQL-06-ST02-DT03-DF08-CF19-01
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C-C843A-WIRE-04-ST03-DT05-DF10-CF02-01
C-C774A-FFMP-09-ST03-DT04-DF17-CF13-01
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C-C476G-PSQL-06-ST04-DT03-DF05-CF12-01
C-C414A-GIMP-02-ST03-DT01-DF12-CF22-01
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C-C126B-PSQL-06-ST04-DT02-DF16-CF24-01
C-C789A-SUBV-02-ST02-DT01-DF06-CF24-01
C-C089C-GIMP-01-ST01-DT03-DF03-CF18-01
C-C476C-WIRE-01-ST01-DT07-DF11-CF01-01
C-C764A-SUBV-09-ST01-DT07-DF06-CF02-01
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C-C120C-WIRE-02-ST02-DT01-DF13-CF18-01
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C-C089A-GIMP-03-ST04-DT04-DF05-CF02-01
C-C476E-FFMP-09-ST04-DT06-DF16-CF23-01
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C-C367A-OSSL-03-ST03-DT05-DF14-CF18-01
C-C682A-WIRE-10-ST04-DT07-DF05-CF24-01
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C-C400B-GIMP-09-ST01-DT01-DF06-CF20-01
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C-C476B-WIRE-02-ST01-DT03-DF13-CF02-01
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C-C191B-FFMP-02-ST03-DT05-DF11-CF19-01
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C-C834A-PSQL-04-ST01-DT06-DF07-CF02-01
C-C078A-WIRE-06-ST01-DT01-DF15-CF01-01
C-C476A-OSSL-01-ST02-DT06-DF11-CF19-01
C-C609A-GIMP-09-ST04-DT07-DF15-CF20-01

C-C194A-GIMP-04-ST03-DT02-DF08-CF02-01
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C-C774A-SUBV-07-ST03-DT05-DF11-CF22-01
C-C089C-SUBV-01-ST01-DT02-DF14-CF24-01
C-C476F-OSSL-07-ST02-DT01-DF13-CF01-01
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C-C197A-WIRE-08-ST03-DT03-DF14-CF22-01
C-C805C-SUBV-01-ST01-DT06-DF08-CF03-01
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C-C476C-GIMP-05-ST03-DT03-DF06-CF22-01
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C-C078A-GIMP-02-ST04-DT05-DF11-CF02-01
C-C476E-FFMP-06-ST04-DT05-DF15-CF23-01
C-C663A-GIMP-05-ST04-DT03-DF04-CF02-01
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C-C127A-FFMP-04-ST03-DT03-DF15-CF19-01
C-C459A-FFMP-06-ST04-DT03-DF17-CF20-01
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C-C476G-SUBV-07-ST01-DT04-DF16-CF20-01
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C-C785A-WIRE-10-ST02-DT07-DF11-CF03-01
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C-C839A-GIMP-04-ST04-DT07-DF16-CF20-01
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C-C543A-OSSL-02-ST03-DT02-DF12-CF22-01
C-C190A-SUBV-07-ST01-DT04-DF13-CF20-01
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C-C774A-GIMP-08-ST03-DT01-DF14-CF02-01
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C-C476E-WIRE-05-ST02-DT02-DF11-CF20-01
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C-C590A-FFMP-09-ST02-DT06-DF09-CF22-01
C-C771A-OSSL-09-ST01-DT02-DF17-CF23-01
C-C078A-FFMP-09-ST01-DT04-DF17-CF14-01
C-C476F-GIMP-10-ST04-DT05-DF06-CF02-01
C-C367A-FFMP-05-ST04-DT04-DF05-CF19-01
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C-C824B-GIMP-07-ST03-DT06-DF06-CF20-01
C-C400B-WIRE-05-ST02-DT05-DF09-CF03-01
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C-C191A-WIRE-10-ST03-DT01-DF01-CF22-01
C-C127D-PSQL-05-ST01-DT04-DF13-CF03-01
C-C789A-FFMP-01-ST03-DT03-DF04-CF14-01
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C-C476D-WIRE-08-ST01-DT01-DF12-CF24-01
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C-C195A-FFMP-06-ST01-DT07-DF05-CF12-01
C-C127B-SUBV-08-ST04-DT07-DF15-CF02-01
C-C835A-OSSL-04-ST04-DT06-DF12-CF22-01
C-C088B-PSQL-07-ST04-DT07-DF10-CF24-01
C-C476A-OSSL-03-ST03-DT07-DF15-CF01-01
C-C828A-SUBV-01-ST03-DT03-DF14-CF24-01
C-C196A-PSQL-04-ST04-DT05-DF13-CF22-01
C-C785A-PSQL-03-ST03-DT02-DF14-CF18-01
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C-C401A-GIMP-07-ST02-DT07-DF06-CF22-01
C-C089C-OSSL-06-ST02-DT03-DF12-CF01-01
C-C476F-SUBV-01-ST01-DT04-DF05-CF02-01
C-C412A-GIMP-01-ST02-DT05-DF13-CF24-01
C-C839A-SUBV-03-ST04-DT05-DF17-CF24-01
C-C806D-FFMP-08-ST04-DT01-DF11-CF13-01
C-C459A-SUBV-03-ST01-DT04-DF11-CF19-01
C-C089D-WIRE-05-ST04-DT06-DF11-CF19-01
C-C476B-PSQL-03-ST02-DT03-DF16-CF20-01
C-C764A-WIRE-02-ST03-DT07-DF16-CF22-01
C-C682B-GIMP-01-ST02-DT02-DF16-CF23-01
C-C126D-OSSL-01-ST02-DT03-DF12-CF23-01
C-C400A-WIRE-05-ST03-DT01-DF05-CF20-01
C-C089A-SUBV-10-ST02-DT02-DF14-CF24-01

C-C476C-FFMP-02-ST04-DT06-DF13-CF23-01
C-C609A-OSSL-04-ST01-DT06-DF02-CF20-01
C-C194A-PSQL-08-ST01-DT01-DF11-CF24-01
C-C134A-WIRE-10-ST03-DT05-DF04-CF23-01
C-C789A-PSQL-01-ST02-DT05-DF16-CF23-01
C-C089C-WIRE-09-ST01-DT07-DF13-CF03-01
C-C476C-PSQL-08-ST02-DT03-DF17-CF19-01
C-C414A-FFMP-03-ST03-DT07-DF01-CF13-01
C-C682A-WIRE-06-ST01-DT07-DF15-CF01-01
C-C127C-SUBV-06-ST01-DT02-DF17-CF01-01
C-C400B-WIRE-08-ST04-DT04-DF06-CF01-01
C-C078B-GIMP-07-ST03-DT04-DF05-CF12-01
C-C476E-OSSL-04-ST03-DT01-DF14-CF03-01
C-C363A-OSSL-05-ST01-DT01-DF15-CF19-01
C-C197A-OSSL-02-ST03-DT04-DF07-CF03-01
C-C806B-PSQL-09-ST02-DT07-DF12-CF19-01
C-C400A-GIMP-10-ST01-DT03-DF10-CF02-01
C-C088B-FFMP-01-ST04-DT02-DF13-CF02-01
C-C476A-SUBV-07-ST04-DT07-DF12-CF18-01
C-C833A-GIMP-07-ST04-DT03-DF13-CF02-01
C-C190A-GIMP-05-ST02-DT05-DF15-CF23-01
C-C843A-FFMP-04-ST04-DT03-DF05-CF22-01
C-C774A-SUBV-02-ST03-DT02-DF16-CF01-01
C-C078A-PSQL-08-ST01-DT06-DF06-CF24-01
C-C476G-WIRE-05-ST01-DT04-DF09-CF20-01
C-C831A-WIRE-09-ST02-DT05-DF06-CF23-01
C-C191A-FFMP-10-ST01-DT06-DF04-CF02-01
C-C126B-OSSL-02-ST04-DT04-DF11-CF19-01
C-C674A-OSSL-04-ST02-DT06-DF12-CF15-01
C-C089D-SUBV-03-ST04-DT05-DF01-CF20-01
C-C476D-GIMP-09-ST01-DT02-DF16-CF14-01
C-C821A-SUBV-10-ST04-DT02-DF17-CF01-01
C-C839A-SUBV-07-ST02-DT03-DF17-CF13-01
C-C785B-GIMP-05-ST03-DT01-DF02-CF02-01
C-C835A-FFMP-06-ST04-DT07-DF15-CF02-01
C-C089A-OSSL-04-ST01-DT01-DF12-CF01-01
C-C476F-FFMP-10-ST02-DT06-DF11-CF03-01
C-C543A-PSQL-08-ST03-DT04-DF14-CF03-01
C-C191B-PSQL-05-ST03-DT02-DF13-CF15-01
C-C806C-PSQL-02-ST01-DT06-DF16-CF01-01
C-C401A-WIRE-03-ST01-DT04-DF01-CF18-01
C-C088A-FFMP-03-ST02-DT03-DF11-CF01-01
C-C476B-FFMP-04-ST03-DT07-DF06-CF01-01
C-C479A-GIMP-08-ST01-DT03-DF06-CF01-01
C-C682B-GIMP-03-ST04-DT01-DF05-CF01-01
C-C124C-FFMP-04-ST02-DT06-DF06-CF20-01
C-C775A-GIMP-08-ST03-DT06-DF11-CF20-01
C-C078A-WIRE-07-ST03-DT02-DF16-CF18-01
C-C476G-OSSL-02-ST04-DT03-DF13-CF22-01
C-C765A-WIRE-09-ST02-DT06-DF17-CF19-01
C-C369A-FFMP-04-ST02-DT06-DF14-CF01-01
C-C805B-WIRE-05-ST01-DT03-DF15-CF20-01
C-C773A-SUBV-04-ST04-DT01-DF17-CF19-01
C-C088A-SUBV-05-ST03-DT04-DF17-CF15-01
C-C476F-PSQL-10-ST03-DT01-DF05-CF19-01
C-C367A-OSSL-02-ST01-DT06-DF12-CF18-01
C-C682A-WIRE-07-ST03-DT05-DF16-CF18-01
C-C824A-GIMP-01-ST04-DT01-DF16-CF03-01
C-C834A-FFMP-01-ST01-DT05-DF13-CF13-01
C-C089A-GIMP-09-ST02-DT07-DF07-CF03-01
C-C476E-SUBV-08-ST02-DT05-DF15-CF13-01
C-C820A-FFMP-07-ST02-DT07-DF09-CF23-01
C-C195A-SUBV-02-ST04-DT03-DF12-CF23-01
C-C126C-SUBV-07-ST03-DT04-DF17-CF18-01
C-C771A-PSQL-02-ST02-DT07-DF14-CF22-01
C-C078B-PSQL-10-ST04-DT03-DF13-CF19-01
C-C476A-WIRE-09-ST01-DT05-DF17-CF24-01
C-C414A-PSQL-01-ST03-DT05-DF12-CF02-01
C-C194A-OSSL-08-ST01-DT04-DF05-CF02-01
C-C805D-GIMP-09-ST02-DT05-DF13-CF02-01
C-C459A-OSSL-07-ST01-DT01-DF02-CF24-01
C-C089D-OSSL-08-ST03-DT05-DF05-CF22-01
C-C476C-GIMP-03-ST04-DT06-DF14-CF22-01
C-C831A-SUBV-03-ST04-DT01-DF05-CF20-01
C-C196A-GIMP-10-ST02-DT07-DF06-CF03-01
C-C120A-OSSL-08-ST04-DT07-DF05-CF02-01
C-C400A-GIMP-09-ST03-DT03-DF08-CF23-01
C-C078A-SUBV-04-ST01-DT06-DF06-CF23-01
C-C476D-GIMP-07-ST03-DT02-DF03-CF22-01
C-C412A-OSSL-10-ST03-DT04-DF15-CF20-01
C-C197A-FFMP-06-ST04-DT02-DF11-CF19-01
C-C129B-OSSL-06-ST02-DT02-DF14-CF24-01
C-C789A-PSQL-05-ST04-DT02-DF17-CF24-01
C-C089C-OSSL-02-ST01-DT04-DF05-CF02-01
C-C476B-OSSL-01-ST01-DT04-DF16-CF18-01
C-C663A-WIRE-06-ST02-DT02-DF16-CF22-01
C-C682A-PSQL-01-ST01-DT01-DF14-CF22-01
C-C805A-SUBV-03-ST01-DT02-DF13-CF24-01
C-C773A-WIRE-06-ST02-DT02-DF16-CF01-01
C-C089B-FFMP-06-ST02-DT01-DF14-CF18-01
C-C476D-SUBV-05-ST02-DT04-DF08-CF01-01
C-C828A-FFMP-05-ST04-DT03-DF03-CF18-01
C-C190A-SUBV-09-ST03-DT06-DF09-CF24-01
C-C415A-PSQL-10-ST03-DT06-DF12-CF22-01
C-C771A-SUBV-04-ST03-DT04-DF13-CF20-01
C-C088B-WIRE-01-ST04-DT01-DF12-CF22-01
C-C476A-PSQL-06-ST04-DT05-DF14-CF13-01
C-C833A-GIMP-04-ST01-DT04-DF14-CF03-01
C-C191B-OSSL-08-ST01-DT05-DF02-CF19-01
C-C170A-WIRE-04-ST03-DT01-DF03-CF15-01
C-C834A-FFMP-10-ST02-DT01-DF12-CF03-01
C-C088A-GIMP-02-ST02-DT02-DF06-CF18-01
C-C476B-FFMP-07-ST02-DT02-DF13-CF02-01
C-C821A-SUBV-09-ST03-DT02-DF11-CF24-01
C-C839A-WIRE-02-ST03-DT07-DF11-CF12-01
C-C127A-FFMP-10-ST04-DT04-DF06-CF01-01
C-C400B-OSSL-10-ST01-DT07-DF14-CF02-01
C-C088A-PSQL-10-ST03-DT03-DF17-CF20-01
C-C476E-WIRE-04-ST03-DT07-DF05-CF23-01
C-C363A-GIMP-08-ST04-DT06-DF17-CF01-01
C-C369A-OSSL-03-ST04-DT03-DF15-CF22-01
C-C120B-PSQL-08-ST02-DT03-DF17-CF20-01

C-C775A-GIMP-01-ST04-DT05-DF15-CF01-01
C-C078A-SUBV-06-ST01-DT06-DF11-CF18-01
C-C476F-FFMP-08-ST01-DT03-DF15-CF18-01
C-C765A-PSQL-10-ST01-DT01-DF11-CF14-01
C-C194A-FFMP-04-ST04-DT04-DF06-CF18-01
C-C761A-FFMP-07-ST01-DT05-DF15-CF18-01
C-C835A-WIRE-08-ST03-DT03-DF05-CF22-01
C-C089B-OSSL-07-ST04-DT05-DF09-CF03-01
C-C476C-SUBV-06-ST04-DT01-DF02-CF20-01
C-C765B-FFMP-04-ST04-DT04-DF16-CF22-01
C-C196A-WIRE-10-ST03-DT02-DF17-CF01-01
C-C120D-SUBV-01-ST02-DT07-DF14-CF19-01
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C-C089A-WIRE-08-ST03-DT07-DF14-CF23-01
C-C476G-GIMP-03-ST02-DT05-DF11-CF23-01
C-C764A-PSQL-05-ST02-DT05-DF10-CF19-01
C-C682B-GIMP-07-ST02-DT01-DF12-CF23-01
C-C124A-GIMP-09-ST03-DT05-DF11-CF23-01
C-C401A-SUBV-03-ST04-DT06-DF12-CF03-01
C-C088B-GIMP-09-ST02-DT01-DF13-CF19-01
C-C476A-WIRE-01-ST03-DT06-DF17-CF19-01
C-C543A-OSSL-01-ST03-DT07-DF13-CF02-01
C-C191A-PSQL-06-ST01-DT03-DF13-CF03-01
C-C170B-OSSL-05-ST04-DT02-DF07-CF13-01
C-C674A-FFMP-07-ST01-DT05-DF12-CF15-01
C-C089C-FFMP-03-ST04-DT06-DF08-CF20-01
C-C476D-OSSL-02-ST01-DT06-DF06-CF03-01
C-C609A-WIRE-02-ST01-DT06-DF05-CF24-01
C-C195A-SUBV-09-ST02-DT02-DF16-CF24-01
C-C822A-WIRE-03-ST01-DT03-DF10-CF18-01
C-C401A-OSSL-09-ST01-DT04-DF07-CF23-01
C-C078B-WIRE-05-ST01-DT03-DF16-CF20-01
C-C476C-PSQL-10-ST04-DT01-DF16-CF01-01
C-C479A-WIRE-07-ST03-DT07-DF05-CF03-01
C-C190A-PSQL-01-ST01-DT05-DF11-CF20-01
C-C124D-WIRE-02-ST03-DT04-DF06-CF03-01
C-C459A-SUBV-05-ST04-DT02-DF11-CF19-01
C-C078A-PSQL-01-ST02-DT07-DF15-CF22-01
C-C476G-OSSL-05-ST02-DT07-DF12-CF02-01
C-C765B-SUBV-06-ST02-DT02-DF14-CF15-01
C-C682A-FFMP-05-ST01-DT06-DF13-CF18-01
C-C126A-GIMP-06-ST01-DT07-DF13-CF01-01
C-C774A-PSQL-02-ST02-DT01-DF04-CF02-01
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C-C476B-SUBV-09-ST03-DT03-DF05-CF02-01
C-C479A-OSSL-03-ST04-DT03-DF16-CF24-01
C-C191B-WIRE-02-ST02-DT04-DF08-CF19-01
C-C129A-FFMP-09-ST04-DT06-DF05-CF03-01
C-C789A-FFMP-07-ST03-DT03-DF15-CF20-01
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C-C476F-WIRE-09-ST04-DT04-DF12-CF24-01
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C-C191A-GIMP-10-ST03-DT07-DF17-CF22-01
C-C806A-PSQL-03-ST02-DT01-DF12-CF22-01
C-C400A-WIRE-08-ST03-DT07-DF13-CF03-01
C-C078B-SUBV-03-ST03-DT04-DF11-CF01-01
C-C476E-GIMP-05-ST01-DT02-DF11-CF23-01
C-C828A-GIMP-01-ST04-DT05-DF06-CF20-01
C-C682B-OSSL-08-ST04-DT02-DF05-CF02-01
C-C124B-SUBV-08-ST02-DT04-DF14-CF14-01
C-C674A-GIMP-05-ST01-DT02-DF16-CF12-01
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C-C476D-PSQL-08-ST03-DT06-DF13-CF18-01
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C-C367A-SUBV-09-ST01-DT04-DF11-CF23-01
C-C194A-OSSL-01-ST02-DT05-DF15-CF20-01
C-C806B-SUBV-05-ST03-DT05-DF02-CF20-01
C-C400B-FFMP-09-ST03-DT06-DF13-CF22-01
C-C088A-GIMP-10-ST01-DT07-DF03-CF14-01
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C-C195A-PSQL-04-ST02-DT06-DF14-CF23-01
C-C805C-OSSL-07-ST04-DT02-DF07-CF02-01
C-C773A-OSSL-01-ST04-DT04-DF05-CF24-01
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C-C369A-GIMP-05-ST04-DT01-DF06-CF15-01
C-C822A-PSQL-06-ST01-DT01-DF15-CF12-01
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C-C089D-SUBV-09-ST03-DT02-DF12-CF02-01
C-C476C-GIMP-07-ST02-DT05-DF17-CF03-01
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C-C170A-OSSL-10-ST02-DT03-DF16-CF20-01
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C-C078A-PSQL-04-ST02-DT04-DF14-CF24-01
C-C476A-WIRE-04-ST03-DT01-DF09-CF20-01
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C-C839A-FFMP-08-ST03-DT04-DF02-CF01-01
C-C805D-GIMP-05-ST04-DT06-DF14-CF03-01
C-C789A-OSSL-09-ST03-DT05-DF10-CF01-01
C-C078B-OSSL-03-ST04-DT07-DF16-CF23-01
C-C476B-OSSL-09-ST03-DT06-DF05-CF18-01
C-C663A-GIMP-08-ST03-DT05-DF15-CF23-01

C-C196A-SUBV-05-ST01-DT07-DF07-CF03-01
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C-C775A-OSSL-08-ST03-DT02-DF06-CF20-01
C-C088A-SUBV-05-ST04-DT06-DF07-CF19-01
C-C476E-SUBV-04-ST01-DT07-DF14-CF01-01
C-C609A-FFMP-09-ST04-DT02-DF13-CF02-01
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C-C773A-GIMP-07-ST01-DT07-DF11-CF22-01
C-C089A-GIMP-02-ST02-DT01-DF15-CF20-01
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C-C412A-SUBV-03-ST02-DT06-DF16-CF19-01
C-C682B-GIMP-01-ST02-DT03-DF09-CF19-01
C-C806D-WIRE-02-ST02-DT07-DF06-CF23-01
C-C834A-SUBV-01-ST02-DT04-DF13-CF23-01
C-C088B-FFMP-09-ST01-DT02-DF11-CF12-01
C-C476C-WIRE-03-ST04-DT02-DF16-CF12-01
C-C833A-WIRE-07-ST01-DT07-DF11-CF01-01
C-C191A-OSSL-06-ST04-DT02-DF06-CF01-01
C-C129B-FFMP-06-ST03-DT05-DF12-CF23-01
C-C771A-PSQL-06-ST04-DT01-DF14-CF18-01
C-C089A-OSSL-07-ST01-DT03-DF17-CF19-01
C-C476D-GIMP-01-ST04-DT03-DF14-CF20-01
C-C765B-PSQL-02-ST03-DT04-DF12-CF23-01
C-C190A-WIRE-02-ST03-DT01-DF05-CF18-01
C-C824A-WIRE-04-ST02-DT04-DF08-CF02-01
C-C459A-FFMP-03-ST02-DT05-DF17-CF01-01
C-C089C-WIRE-06-ST04-DT06-DF05-CF22-01
C-C476F-PSQL-05-ST03-DT05-DF02-CF23-01
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C-C127C-GIMP-10-ST04-DT01-DF17-CF18-01
C-C401A-WIRE-04-ST01-DT01-DF05-CF02-01
C-C088B-GIMP-10-ST03-DT05-DF01-CF01-01
C-C476G-PSQL-06-ST01-DT02-DF06-CF23-01
C-C479A-OSSL-10-ST04-DT04-DF14-CF13-01
C-C195A-GIMP-07-ST01-DT02-DF12-CF14-01
C-C124A-OSSL-01-ST01-DT02-DF05-CF01-01
C-C674A-SUBV-10-ST04-DT07-DF15-CF14-01
C-C078B-WIRE-01-ST02-DT04-DF13-CF20-01
C-C476F-WIRE-10-ST02-DT03-DF12-CF24-01
C-C820A-GIMP-04-ST02-DT05-DF05-CF20-01
C-C682A-FFMP-09-ST04-DT06-DF16-CF24-01
C-C126B-SUBV-08-ST03-DT06-DF11-CF01-01
C-C400B-WIRE-02-ST02-DT03-DF16-CF24-01
C-C088A-PSQL-04-ST02-DT03-DF14-CF15-01
C-C476A-OSSL-08-ST01-DT07-DF13-CF15-01
C-C821A-FFMP-05-ST02-DT02-DF03-CF01-01
C-C191B-SUBV-10-ST03-DT07-DF14-CF20-01
C-C126D-SUBV-09-ST04-DT03-DF13-CF15-01
C-C400A-FFMP-07-ST04-DT05-DF12-CF23-01
C-C088A-OSSL-02-ST01-DT01-DF12-CF03-01
C-C476D-SUBV-07-ST02-DT05-DF17-CF20-01
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C-C682B-PSQL-02-ST01-DT05-DF17-CF18-01
C-C416A-PSQL-05-ST01-DT01-DF17-CF22-01
C-C774A-GIMP-05-ST01-DT06-DF09-CF19-01
C-C089D-SUBV-08-ST03-DT05-DF14-CF18-01
C-C476B-GIMP-08-ST04-DT04-DF08-CF01-01
C-C828A-SUBV-02-ST03-DT06-DF02-CF22-01
C-C839A-OSSL-07-ST02-DT03-DF03-CF03-01
C-C134A-OSSL-03-ST02-DT05-DF03-CF02-01
C-C835A-PSQL-03-ST03-DT04-DF13-CF19-01
C-C078A-FFMP-07-ST04-DT07-DF06-CF24-01
C-C476E-FFMP-07-ST03-DT01-DF12-CF22-01
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C-C190A-PSQL-09-ST03-DT04-DF15-CF22-01
C-C785A-FFMP-10-ST01-DT03-DF11-CF14-01
C-C834A-GIMP-01-ST02-DT02-DF01-CF02-01
C-C078A-PSQL-09-ST04-DT02-DF13-CF23-01
C-C476C-OSSL-01-ST03-DT06-DF11-CF02-01
C-C764A-SUBV-04-ST03-DT05-DF15-CF03-01
C-C369A-OSSL-05-ST04-DT06-DF12-CF01-01
C-C785B-FFMP-01-ST02-DT07-DF16-CF18-01
C-C771A-FFMP-06-ST01-DT04-DF06-CF22-01
C-C078A-OSSL-06-ST02-DT02-DF17-CF13-01
C-C476E-WIRE-05-ST04-DT07-DF05-CF19-01
C-C367A-PSQL-09-ST04-DT06-DF12-CF19-01
C-C682A-GIMP-06-ST02-DT01-DF14-CF24-01
C-C843A-SUBV-02-ST04-DT04-DF14-CF03-01
C-C773A-OSSL-10-ST03-DT07-DF05-CF03-01
C-C089C-WIRE-05-ST03-DT05-DF04-CF02-01
C-C476B-GIMP-06-ST02-DT03-DF03-CF03-01
C-C414A-OSSL-01-ST02-DT07-DF09-CF22-01
C-C195A-WIRE-04-ST01-DT03-DF17-CF23-01
C-C126C-GIMP-08-ST02-DT02-DF15-CF23-01
C-C400A-PSQL-05-ST04-DT01-DF14-CF24-01
C-C088A-GIMP-04-ST01-DT04-DF16-CF22-01
C-C476G-SUBV-10-ST01-DT05-DF15-CF24-01
C-C833A-WIRE-10-ST01-DT02-DF11-CF20-01
C-C191B-SUBV-08-ST01-DT05-DF16-CF13-01
C-C120B-WIRE-07-ST03-DT07-DF13-CF22-01
C-C775A-WIRE-02-ST04-DT06-DF16-CF01-01
C-C088B-FFMP-10-ST04-DT03-DF05-CF18-01
C-C476F-PSQL-02-ST04-DT01-DF06-CF14-01
C-C663A-FFMP-08-ST03-DT01-DF14-CF14-01
C-C196A-FFMP-01-ST04-DT02-DF16-CF19-01
C-C124C-PSQL-06-ST01-DT05-DF06-CF19-01
C-C774A-WIRE-08-ST01-DT05-DF15-CF13-01
C-C078B-SUBV-08-ST02-DT07-DF12-CF02-01
C-C476A-FFMP-04-ST01-DT06-DF14-CF02-01
C-C543A-GIMP-05-ST04-DT01-DF13-CF18-01
C-C197A-SUBV-10-ST02-DT04-DF06-CF20-01
C-C824B-WIRE-09-ST04-DT02-DF05-CF24-01
C-C459A-SUBV-04-ST02-DT02-DF17-CF18-01
C-C088A-PSQL-03-ST03-DT06-DF09-CF24-01
C-C476C-FFMP-09-ST02-DT02-DF16-CF18-01
C-C765A-FFMP-06-ST02-DT04-DF16-CF24-01
C-C191A-GIMP-03-ST03-DT06-DF11-CF15-01
C-C805B-FFMP-08-ST03-DT01-DF12-CF20-01
C-C400B-FFMP-09-ST03-DT03-DF11-CF02-01
C-C089A-OSSL-01-ST03-DT02-DF11-CF19-01

C-C476D-GIMP-03-ST03-DT04-DF13-CF01-01
C-C412A-WIRE-03-ST01-DT03-DF16-CF24-01
C-C194A-PSQL-05-ST02-DT07-DF13-CF02-01
C-C126A-GIMP-04-ST03-DT03-DF12-CF03-01
C-C674A-SUBV-10-ST02-DT01-DF12-CF20-01
C-C088A-GIMP-06-ST01-DT01-DF05-CF03-01
C-C476A-PSQL-07-ST03-DT01-DF11-CF24-01
C-C828A-PSQL-05-ST02-DT01-DF05-CF23-01
C-C191B-FFMP-08-ST01-DT03-DF05-CF01-01
C-C415A-PSQL-02-ST01-DT06-DF01-CF22-01
C-C401A-PSQL-04-ST04-DT02-DF17-CF18-01
C-C089C-FFMP-01-ST04-DT03-DF15-CF01-01
C-C476E-WIRE-04-ST01-DT03-DF07-CF18-01
C-C412A-GIMP-09-ST04-DT05-DF15-CF02-01
C-C369A-OSSL-09-ST03-DT07-DF13-CF23-01
C-C805A-OSSL-01-ST02-DT04-DF09-CF19-01
C-C835A-GIMP-02-ST03-DT04-DF03-CF24-01
C-C089D-WIRE-09-ST01-DT07-DF06-CF20-01
C-C476D-OSSL-06-ST02-DT07-DF13-CF03-01
C-C764A-SUBV-07-ST01-DT04-DF06-CF18-01
C-C196A-WIRE-03-ST04-DT04-DF04-CF24-01
C-C124B-SUBV-03-ST04-DT06-DF11-CF22-01
C-C789A-OSSL-09-ST01-DT03-DF16-CF03-01
C-C078A-SUBV-10-ST02-DT04-DF14-CF02-01
C-C476B-SUBV-10-ST04-DT04-DF06-CF19-01
C-C765B-OSSL-03-ST03-DT06-DF01-CF23-01
C-C194A-PSQL-02-ST02-DT02-DF05-CF03-01
C-C785D-PSQL-04-ST04-DT01-DF15-CF24-01
C-C459A-OSSL-05-ST01-DT06-DF11-CF22-01
C-C088B-GIMP-04-ST04-DT06-DF11-CF12-01
C-C476F-PSQL-09-ST04-DT02-DF11-CF01-01
C-C543A-OSSL-08-ST03-DT01-DF17-CF01-01
C-C197A-GIMP-04-ST04-DT05-DF15-CF18-01
C-C127A-GIMP-05-ST01-DT07-DF05-CF02-01
C-C401A-WIRE-03-ST04-DT05-DF08-CF12-01
C-C078B-OSSL-07-ST01-DT05-DF10-CF23-01
C-C476C-GIMP-05-ST03-DT05-DF12-CF23-01
C-C765A-SUBV-01-ST04-DT02-DF06-CF22-01
C-C191A-FFMP-01-ST01-DT01-DF10-CF22-01
C-C120A-SUBV-09-ST03-DT05-DF06-CF01-01
C-C774A-FFMP-08-ST02-DT07-DF14-CF23-01
C-C089B-WIRE-08-ST03-DT01-DF15-CF03-01
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C-C190A-SUBV-10-ST03-DT02-DF12-CF19-01
C-C806A-WIRE-07-ST02-DT02-DF17-CF19-01
C-C400B-SUBV-06-ST03-DT05-DF05-CF19-01
C-C078A-PSQL-03-ST02-DT05-DF13-CF22-01
C-C476F-OSSL-02-ST01-DT07-DF17-CF22-01
C-C833A-PSQL-10-ST02-DT03-DF11-CF20-01
C-C682B-WIRE-06-ST02-DT06-DF11-CF02-01
C-C129A-PSQL-10-ST02-DT07-DF14-CF24-01
C-C773A-PSQL-07-ST03-DT04-DF06-CF20-01
C-C089C-SUBV-05-ST03-DT04-DF02-CF19-01
C-C476D-SUBV-08-ST03-DT02-DF04-CF02-01
C-C479A-FFMP-06-ST03-DT05-DF11-CF19-01
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C-C127D-OSSL-06-ST03-DT04-DF10-CF03-01
C-C771A-GIMP-01-ST02-DT06-DF12-CF01-01
C-C088B-FFMP-02-ST01-DT01-DF17-CF14-01
C-C476B-FFMP-06-ST02-DT05-DF14-CF20-01
C-C831A-GIMP-04-ST04-DT07-DF16-CF03-01
C-C839A-PSQL-03-ST03-DT01-DF14-CF01-01
C-C785C-FFMP-02-ST04-DT03-DF13-CF18-01
C-C674A-SUBV-05-ST01-DT02-DF13-CF23-01
C-C088A-PSQL-02-ST04-DT02-DF16-CF18-01
C-C476E-OSSL-03-ST04-DT04-DF15-CF24-01
C-C414A-WIRE-03-ST01-DT06-DF10-CF02-01
C-C682A-WIRE-06-ST04-DT07-DF06-CF20-01
C-C170B-SUBV-05-ST01-DT01-DF16-CF02-01
C-C789A-GIMP-02-ST04-DT03-DF14-CF20-01
C-C078B-SUBV-07-ST02-DT06-DF05-CF01-01
C-C476C-FFMP-07-ST01-DT03-DF05-CF19-01
C-C363A-SUBV-02-ST02-DT03-DF12-CF14-01
C-C682A-SUBV-02-ST01-DT03-DF15-CF19-01
C-C127B-GIMP-10-ST02-DT05-DF16-CF23-01
C-C834A-WIRE-09-ST04-DT07-DF15-CF01-01
C-C078A-OSSL-10-ST04-DT07-DF12-CF19-01
C-C476A-PSQL-10-ST02-DT01-DF03-CF02-01
C-C663A-GIMP-05-ST01-DT02-DF12-CF20-01
C-C194A-OSSL-07-ST02-DT05-DF11-CF03-01
C-C806C-OSSL-03-ST01-DT06-DF17-CF20-01
C-C775A-PSQL-01-ST01-DT01-DF11-CF22-01
C-C088A-GIMP-01-ST01-DT03-DF06-CF01-01
C-C476G-WIRE-08-ST03-DT06-DF07-CF22-01
C-C821A-PSQL-06-ST04-DT04-DF08-CF18-01
C-C196A-GIMP-08-ST03-DT06-DF12-CF18-01
C-C843A-WIRE-09-ST04-DT02-DF03-CF01-01
C-C400A-FFMP-06-ST03-DT01-DF13-CF19-01
C-C089A-FFMP-04-ST03-DT07-DF15-CF15-01
C-C476D-GIMP-02-ST04-DT03-DF12-CF12-01
C-C367A-FFMP-04-ST03-DT02-DF05-CF03-01
C-C839A-FFMP-09-ST02-DT07-DF17-CF23-01
C-C785D-FFMP-04-ST03-DT03-DF14-CF19-01
C-C835A-OSSL-04-ST02-DT05-DF05-CF02-01
C-C089B-WIRE-06-ST02-DT03-DF16-CF23-01
C-C476C-SUBV-09-ST01-DT05-DF16-CF20-01
C-C820A-GIMP-01-ST03-DT01-DF06-CF23-01
C-C191B-OSSL-05-ST03-DT01-DF10-CF20-01
C-C822A-OSSL-06-ST02-DT05-DF15-CF18-01
C-C400A-FFMP-08-ST02-DT04-DF16-CF03-01
C-C089A-WIRE-09-ST01-DT02-DF14-CF18-01
C-C476A-FFMP-01-ST03-DT04-DF06-CF03-01
C-C828A-OSSL-09-ST02-DT03-DF13-CF24-01
C-C682B-GIMP-01-ST04-DT02-DF14-CF22-01
C-C127D-GIMP-01-ST01-DT07-DF12-CF19-01
C-C834A-GIMP-10-ST01-DT02-DF10-CF18-01
C-C089B-FFMP-05-ST03-DT04-DF13-CF24-01
C-C476E-SUBV-05-ST02-DT01-DF14-CF18-01
C-C412A-FFMP-10-ST02-DT07-DF14-CF12-01
C-C197A-PSQL-10-ST01-DT05-DF06-CF24-01
C-C805B-PSQL-08-ST03-DT06-DF09-CF23-01

C-C771A-WIRE-03-ST03-DT07-DF15-CF24-01
C-C078A-PSQL-08-ST04-DT06-DF17-CF02-01
C-C476B-WIRE-04-ST01-DT02-DF13-CF23-01
C-C414A-PSQL-07-ST04-DT05-DF15-CF22-01
C-C369A-SUBV-04-ST04-DT03-DF03-CF13-01
C-C805A-OSSL-07-ST04-DT01-DF10-CF13-01
C-C773A-OSSL-07-ST04-DT03-DF12-CF24-01
C-C089C-SUBV-03-ST02-DT01-DF08-CF23-01
C-C476G-GIMP-05-ST04-DT06-DF17-CF01-01
C-C543A-PSQL-08-ST01-DT04-DF03-CF19-01
C-C191A-FFMP-04-ST03-DT04-DF16-CF20-01
C-C126D-FFMP-06-ST03-DT04-DF05-CF22-01
C-C400B-PSQL-01-ST01-DT06-DF02-CF23-01
C-C088A-OSSL-07-ST02-DT05-DF04-CF22-01
C-C476F-PSQL-03-ST02-DT07-DF15-CF19-01
C-C831A-SUBV-03-ST04-DT06-DF11-CF01-01
C-C195A-WIRE-08-ST04-DT04-DF14-CF22-01
C-C416A-WIRE-09-ST04-DT03-DF06-CF02-01
C-C674A-SUBV-06-ST03-DT01-DF17-CF02-01
C-C078B-GIMP-09-ST01-DT06-DF11-CF22-01
C-C476F-OSSL-06-ST03-DT03-DF11-CF23-01
C-C663A-WIRE-10-ST02-DT05-DF17-CF02-01
C-C190A-OSSL-10-ST02-DT02-DF05-CF01-01
C-C134A-PSQL-04-ST01-DT02-DF15-CF23-01
C-C775A-FFMP-09-ST04-DT06-DF17-CF14-01
C-C088B-OSSL-03-ST04-DT02-DF12-CF24-01
C-C476A-OSSL-03-ST04-DT07-DF17-CF22-01
C-C367A-OSSL-02-ST03-DT04-DF04-CF01-01
C-C682A-PSQL-01-ST02-DT03-DF12-CF24-01
C-C170A-SUBV-07-ST02-DT04-DF11-CF01-01
C-C789A-PSQL-04-ST02-DT02-DF06-CF15-01
C-C089D-SUBV-04-ST03-DT01-DF11-CF03-01
C-C476E-WIRE-07-ST01-DT04-DF13-CF03-01
C-C609A-SUBV-09-ST01-DT02-DF13-CF13-01
C-C369A-SUBV-05-ST01-DT06-DF13-CF18-01
C-C806A-GIMP-08-ST03-DT01-DF13-CF20-01
C-C774A-GIMP-10-ST01-DT04-DF06-CF19-01
C-C078A-GIMP-08-ST03-DT03-DF06-CF03-01
C-C476C-SUBV-04-ST04-DT01-DF05-CF20-01
C-C764A-FFMP-06-ST02-DT07-DF14-CF24-01
C-C190A-WIRE-07-ST01-DT05-DF15-CF02-01
C-C127A-SUBV-01-ST02-DT05-DF13-CF03-01
C-C835A-SUBV-05-ST04-DT03-DF11-CF01-01
C-C089A-FFMP-10-ST02-DT07-DF16-CF13-01
C-C476B-PSQL-01-ST03-DT05-DF10-CF02-01
C-C765A-OSSL-01-ST01-DT01-DF16-CF18-01
C-C196A-GIMP-03-ST04-DT07-DF05-CF14-01
C-C785C-WIRE-10-ST01-DT06-DF14-CF18-01
C-C401A-OSSL-07-ST02-DT07-DF16-CF20-01
C-C088A-PSQL-05-ST01-DT05-DF12-CF01-01
C-C476D-FFMP-09-ST01-DT02-DF11-CF13-01
C-C833A-WIRE-05-ST03-DT06-DF05-CF20-01
C-C191A-FFMP-06-ST03-DT02-DF16-CF03-01
C-C124C-FFMP-03-ST04-DT07-DF11-CF22-01
C-C459A-WIRE-02-ST03-DT05-DF13-CF18-01
C-C088B-WIRE-06-ST01-DT04-DF05-CF20-01
C-C476G-PSQL-02-ST02-DT06-DF14-CF24-01
C-C820A-GIMP-04-ST04-DT03-DF14-CF22-01
C-C195A-SUBV-09-ST02-DT01-DF08-CF23-01
C-C120B-WIRE-05-ST01-DT04-DF01-CF24-01
C-C400A-PSQL-08-ST04-DT01-DF03-CF03-01
C-C089B-OSSL-02-ST04-DT02-DF14-CF19-01
C-C476A-GIMP-10-ST03-DT05-DF15-CF01-01
C-C821A-WIRE-07-ST03-DT05-DF16-CF23-01
C-C839A-OSSL-02-ST04-DT01-DF07-CF02-01
C-C785A-OSSL-06-ST03-DT02-DF06-CF19-01
C-C789A-WIRE-03-ST01-DT07-DF12-CF22-01
C-C089D-WIRE-01-ST04-DT07-DF17-CF18-01
C-C476C-FFMP-08-ST04-DT07-DF12-CF18-01
C-C363A-GIMP-08-ST02-DT04-DF05-CF23-01
C-C191B-GIMP-06-ST02-DT05-DF11-CF23-01
C-C129B-FFMP-02-ST04-DT05-DF16-CF19-01
C-C773A-FFMP-01-ST02-DT03-DF14-CF20-01
C-C078A-PSQL-07-ST03-DT01-DF07-CF22-01
C-C476D-GIMP-09-ST02-DT01-DF16-CF23-01
C-C479A-OSSL-01-ST01-DT01-DF12-CF03-01
C-C197A-WIRE-10-ST03-DT04-DF13-CF20-01
C-C806B-SUBV-09-ST04-DT03-DF12-CF20-01
C-C459A-GIMP-02-ST03-DT05-DF07-CF24-01
C-C078B-FFMP-01-ST01-DT06-DF15-CF24-01
C-C476G-OSSL-04-ST04-DT06-DF06-CF18-01
C-C765B-SUBV-10-ST04-DT02-DF11-CF19-01
C-C682B-PSQL-09-ST01-DT07-DF06-CF19-01
C-C126C-PSQL-08-ST02-DT01-DF17-CF15-01
C-C775A-OSSL-07-ST01-DT04-DF15-CF01-01
C-C088B-SUBV-10-ST02-DT04-DF02-CF19-01
C-C476F-WIRE-02-ST03-DT03-DF05-CF03-01
C-C367A-PSQL-09-ST02-DT03-DF06-CF01-01
C-C194A-FFMP-07-ST03-DT06-DF17-CF24-01
C-C120A-GIMP-02-ST02-DT06-DF05-CF18-01
C-C834A-SUBV-05-ST02-DT06-DF05-CF23-01
C-C089C-GIMP-05-ST02-DT03-DF13-CF20-01
C-C476E-PSQL-08-ST01-DT02-DF04-CF24-01
C-C663A-FFMP-03-ST03-DT06-DF15-CF01-01
C-C190A-GIMP-02-ST04-DT03-DF01-CF03-01
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C-C400B-PSQL-03-ST04-DT02-DF06-CF13-01
C-C089A-FFMP-04-ST04-DT05-DF17-CF01-01
C-C476B-SUBV-05-ST02-DT04-DF12-CF22-01
C-C412A-SUBV-05-ST04-DT07-DF10-CF24-01
C-C369A-FFMP-01-ST01-DT03-DF06-CF01-01
C-C590A-GIMP-01-ST02-DT05-DF06-CF24-01
C-C674A-GIMP-08-ST03-DT01-DF14-CF03-01
C-C078A-GIMP-03-ST03-DT07-DF05-CF23-01
C-C476E-OSSL-10-ST02-DT04-DF02-CF15-01
C-C821A-PSQL-08-ST01-DT01-DF02-CF02-01
C-C682B-SUBV-03-ST01-DT04-DF02-CF22-01
C-C126B-PSQL-03-ST03-DT07-DF05-CF01-01
C-C835A-SUBV-10-ST04-DT04-DF09-CF18-01
C-C088A-WIRE-09-ST04-DT03-DF06-CF03-01
C-C476C-FFMP-03-ST01-DT03-DF17-CF02-01
C-C479A-WIRE-06-ST01-DT02-DF17-CF19-01

C-C196A-OSSL-08-ST02-DT06-DF15-CF12-01
C-C120C-SUBV-05-ST01-DT04-DF14-CF23-01
C-C771A-FFMP-09-ST03-DT07-DF16-CF19-01
C-C089B-SUBV-02-ST01-DT02-DF13-CF02-01
C-C476B-SUBV-03-ST04-DT01-DF11-CF19-01
C-C820A-OSSL-07-ST02-DT06-DF05-CF20-01
C-C191A-PSQL-04-ST03-DT07-DF16-CF19-01
C-C129A-OSSL-04-ST04-DT06-DF16-CF22-01
C-C401A-OSSL-06-ST02-DT06-DF17-CF02-01
C-C088A-PSQL-06-ST02-DT01-DF11-CF18-01
C-C476A-GIMP-07-ST01-DT02-DF15-CF20-01
C-C833A-FFMP-02-ST04-DT03-DF13-CF19-01
C-C197A-WIRE-05-ST04-DT01-DF13-CF24-01
C-C170B-WIRE-07-ST03-DT02-DF13-CF03-01
C-C774A-WIRE-04-ST01-DT05-DF04-CF22-01
C-C078B-OSSL-08-ST03-DT04-DF12-CF22-01
C-C476D-WIRE-06-ST03-DT06-DF14-CF03-01
C-C609A-SUBV-04-ST03-DT05-DF14-CF15-01
C-C195A-SUBV-08-ST02-DT04-DF11-CF12-01
C-C761A-WIRE-03-ST03-DT03-DF07-CF24-01
C-C773A-GIMP-10-ST03-DT02-DF05-CF24-01
C-C089B-OSSL-05-ST04-DT05-DF16-CF24-01
C-C476F-FFMP-01-ST01-DT07-DF16-CF01-01
C-C831A-GIMP-06-ST02-DT04-DF12-CF22-01
C-C682A-OSSL-04-ST03-DT02-DF17-CF01-01
C-C824B-OSSL-01-ST01-DT07-DF15-CF12-01
C-C674A-PSQL-09-ST02-DT03-DF08-CF02-01
C-C089D-WIRE-06-ST01-DT03-DF14-CF01-01
C-C476G-PSQL-05-ST02-DT07-DF09-CF23-01
C-C764A-WIRE-03-ST04-DT07-DF17-CF18-01
C-C194A-GIMP-10-ST04-DT05-DF05-CF18-01
C-C124D-FFMP-10-ST02-DT03-DF04-CF15-01
C-C400A-FFMP-03-ST04-DT04-DF11-CF01-01
C-C078A-PSQL-02-ST02-DT06-DF09-CF20-01
C-C476D-WIRE-04-ST04-DT05-DF05-CF01-01
C-C414A-PSQL-01-ST01-DT05-DF15-CF03-01
C-C191B-FFMP-03-ST02-DT01-DF14-CF18-01
C-C805D-SUBV-09-ST04-DT01-DF17-CF23-01
C-C835A-WIRE-06-ST01-DT06-DF15-CF03-01
C-C088A-GIMP-08-ST03-DT05-DF01-CF13-01
C-C476A-OSSL-10-ST03-DT05-DF13-CF19-01
C-C363A-GIMP-10-ST03-DT03-DF07-CF23-01
C-C839A-PSQL-01-ST01-DT05-DF09-CF23-01
C-C127C-GIMP-06-ST03-DT02-DF11-CF02-01
C-C775A-SUBV-07-ST04-DT03-DF12-CF23-01
C-C088B-SUBV-10-ST03-DT06-DF15-CF03-01
C-C476F-SUBV-08-ST03-DT03-DF17-CF12-01
C-C543A-OSSL-08-ST04-DT02-DF06-CF20-01
C-C196A-WIRE-05-ST03-DT03-DF12-CF02-01
C-C806C-PSQL-05-ST04-DT06-DF13-CF03-01
C-C400B-OSSL-08-ST01-DT02-DF15-CF20-01
C-C078B-FFMP-03-ST04-DT07-DF03-CF18-01
C-C476B-GIMP-02-ST02-DT04-DF06-CF24-01
C-C828A-FFMP-09-ST03-DT04-DF06-CF18-01
C-C197A-SUBV-06-ST04-DT02-DF04-CF03-01
C-C124A-PSQL-07-ST02-DT04-DF02-CF18-01
C-C771A-WIRE-02-ST02-DT07-DF13-CF14-01
C-C078A-FFMP-01-ST02-DT02-DF13-CF02-01
C-C476G-OSSL-07-ST04-DT01-DF14-CF20-01
C-C765B-GIMP-04-ST02-DT07-DF01-CF03-01
C-C194A-FFMP-09-ST01-DT07-DF15-CF24-01
C-C124B-OSSL-04-ST01-DT05-DF06-CF18-01
C-C774A-FFMP-01-ST01-DT01-DF11-CF18-01
C-C089A-OSSL-09-ST03-DT04-DF16-CF23-01
C-C476C-PSQL-09-ST01-DT02-DF13-CF22-01
C-C765A-SUBV-07-ST01-DT01-DF05-CF24-01
C-C191B-OSSL-02-ST03-DT06-DF17-CF20-01
C-C415A-WIRE-02-ST03-DT07-DF12-CF02-01
C-C401A-GIMP-04-ST04-DT05-DF06-CF22-01
C-C089A-WIRE-07-ST02-DT01-DF17-CF19-01
C-C476E-FFMP-01-ST03-DT06-DF16-CF19-01
C-C821A-FFMP-05-ST04-DT06-DF09-CF22-01
C-C369A-GIMP-07-ST04-DT01-DF13-CF01-01
C-C127B-SUBV-06-ST02-DT07-DF05-CF20-01
C-C834A-PSQL-05-ST03-DT05-DF01-CF18-01
C-C088A-PSQL-04-ST04-DT06-DF12-CF20-01
C-C476B-WIRE-06-ST04-DT02-DF15-CF02-01
C-C543A-WIRE-02-ST03-DT05-DF11-CF02-01
C-C195A-WIRE-01-ST01-DT06-DF05-CF02-01
C-C805C-FFMP-08-ST04-DT03-DF14-CF20-01
C-C459A-SUBV-09-ST03-DT06-DF16-CF24-01
C-C078A-SUBV-07-ST01-DT05-DF06-CF03-01
C-C476E-GIMP-08-ST02-DT03-DF12-CF02-01
C-C414A-PSQL-02-ST01-DT06-DF12-CF15-01
C-C682A-PSQL-05-ST02-DT03-DF12-CF22-01
C-C126A-GIMP-03-ST01-DT04-DF17-CF13-01
C-C789A-OSSL-08-ST02-DT04-DF17-CF20-01
C-C078B-GIMP-06-ST01-DT07-DF11-CF20-01
C-C476G-SUBV-02-ST01-DT05-DF01-CF18-01
C-C765A-OSSL-05-ST02-DT07-DF15-CF14-01
C-C839A-SUBV-10-ST03-DT05-DF16-CF22-01
C-C824A-GIMP-10-ST04-DT01-DF15-CF23-01
C-C401A-OSSL-02-ST03-DT03-DF12-CF23-01
C-C088A-PSQL-01-ST01-DT03-DF10-CF14-01
C-C476F-PSQL-03-ST03-DT01-DF05-CF03-01
C-C765B-SUBV-03-ST03-DT02-DF17-CF03-01
C-C190A-FFMP-06-ST04-DT04-DF11-CF20-01
C-C806D-FFMP-05-ST02-DT02-DF16-CF01-01
C-C774A-WIRE-03-ST04-DT07-DF13-CF20-01
C-C089C-SUBV-08-ST04-DT04-DF15-CF23-01
C-C476D-OSSL-05-ST02-DT07-DF06-CF18-01
C-C479A-PSQL-08-ST02-DT04-DF16-CF22-01
C-C682B-PSQL-03-ST02-DT07-DF06-CF18-01
C-C120D-SUBV-02-ST01-DT05-DF08-CF18-01
C-C771A-PSQL-06-ST01-DT01-DF14-CF19-01
C-C088B-WIRE-04-ST03-DT02-DF05-CF22-01
C-C476C-WIRE-10-ST04-DT04-DF11-CF22-01
C-C609A-GIMP-10-ST01-DT01-DF13-CF20-01
C-C191A-OSSL-09-ST01-DT02-DF13-CF19-01
C-C806B-WIRE-07-ST03-DT06-DF11-CF22-01
C-C400B-FFMP-07-ST02-DT02-DF05-CF24-01
C-C089D-OSSL-10-ST02-DT05-DF14-CF18-01

C-C476A-SUBV-06-ST04-DT06-DF08-CF20-01
C-C831A-WIRE-04-ST04-DT03-DF14-CF23-01
C-C194A-GIMP-07-ST01-DT03-DF14-CF22-01
C-C761A-PSQL-08-ST01-DT03-DF13-CF02-01
C-C459A-GIMP-04-ST01-DT04-DF05-CF20-01
C-C078A-FFMP-09-ST01-DT01-DF14-CF19-01
C-C476D-GIMP-04-ST01-DT03-DF11-CF03-01
C-C828A-OSSL-06-ST03-DT03-DF04-CF01-01
C-C369A-WIRE-04-ST03-DT02-DF15-CF03-01
C-C806D-OSSL-09-ST04-DT07-DF06-CF03-01
C-C773A-SUBV-05-ST03-DT01-DF06-CF13-01
C-C089B-GIMP-05-ST04-DT07-DF10-CF24-01
C-C476E-FFMP-07-ST03-DT07-DF13-CF23-01
C-C764A-FFMP-07-ST04-DT02-DF16-CF02-01
C-C191A-PSQL-02-ST04-DT01-DF11-CF23-01
C-C120A-SUBV-04-ST02-DT06-DF12-CF24-01
C-C835A-OSSL-01-ST04-DT02-DF01-CF19-01
C-C089A-GIMP-03-ST03-DT04-DF06-CF02-01
C-C476C-GIMP-09-ST02-DT05-DF14-CF15-01
C-C663A-SUBV-01-ST02-DT05-DF17-CF18-01
C-C195A-WIRE-05-ST02-DT07-DF03-CF19-01
C-C805B-FFMP-01-ST04-DT05-DF14-CF14-01
C-C834A-FFMP-10-ST04-DT05-DF11-CF03-01
C-C078B-PSQL-02-ST02-DT06-DF12-CF15-01
C-C476A-PSQL-01-ST01-DT04-DF12-CF24-01
C-C412A-WIRE-09-ST01-DT04-DF15-CF24-01
C-C682B-OSSL-10-ST01-DT04-DF16-CF13-01
C-C127A-GIMP-08-ST03-DT02-DF17-CF22-01
C-C674A-PSQL-10-ST02-DT07-DF15-CF01-01
C-C089D-OSSL-01-ST04-DT01-DF05-CF01-01
C-C476G-FFMP-08-ST03-DT01-DF05-CF20-01
C-C367A-GIMP-05-ST01-DT06-DF11-CF24-01
C-C682A-GIMP-08-ST02-DT06-DF05-CF03-01
C-C805D-PSQL-03-ST01-DT04-DF03-CF03-01
C-C789A-WIRE-08-ST03-DT06-DF12-CF22-01
C-C089C-WIRE-04-ST02-DT02-DF16-CF01-01
C-C476F-WIRE-03-ST04-DT06-DF09-CF18-01
C-C833A-PSQL-01-ST03-DT01-DF08-CF22-01
C-C190A-FFMP-08-ST03-DT05-DF07-CF19-01
C-C120C-WIRE-01-ST03-DT01-DF15-CF19-01
C-C400A-SUBV-04-ST01-DT03-DF17-CF18-01
C-C088A-FFMP-07-ST03-DT03-DF11-CF19-01
C-C476B-SUBV-05-ST02-DT01-DF15-CF14-01
C-C363A-OSSL-04-ST04-DT07-DF05-CF20-01
C-C196A-WIRE-07-ST04-DT05-DF17-CF01-01
C-C416A-OSSL-09-ST02-DT01-DF09-CF24-01
C-C775A-GIMP-05-ST02-DT05-DF16-CF02-01
C-C088B-SUBV-06-ST01-DT06-DF01-CF22-01
C-C476D-OSSL-10-ST01-DT07-DF17-CF23-01
C-C820A-FFMP-08-ST02-DT05-DF13-CF03-01
C-C191B-SUBV-06-ST01-DT02-DF06-CF18-01
C-C170A-OSSL-02-ST03-DT02-DF05-CF23-01
C-C789A-OSSL-06-ST03-DT06-DF13-CF02-01
C-C089C-GIMP-08-ST03-DT01-DF13-CF24-01
C-C476F-WIRE-06-ST02-DT02-DF01-CF22-01
C-C543A-SUBV-10-ST04-DT01-DF12-CF02-01
C-C839A-GIMP-04-ST04-DT01-DF12-CF20-01
C-C124C-WIRE-07-ST03-DT06-DF16-CF01-01
C-C401A-GIMP-01-ST01-DT02-DF12-CF03-01
C-C089D-FFMP-09-ST01-DT07-DF15-CF20-01
C-C476G-GIMP-01-ST03-DT04-DF13-CF02-01
C-C833A-WIRE-06-ST03-DT06-DF06-CF12-01
C-C197A-PSQL-03-ST02-DT03-DF05-CF14-01
C-C824A-PSQL-04-ST02-DT03-DF11-CF22-01
C-C459A-PSQL-03-ST02-DT04-DF14-CF23-01
C-C089A-WIRE-03-ST04-DT04-DF15-CF03-01
C-C476C-SUBV-09-ST01-DT06-DF17-CF19-01
C-C831A-GIMP-03-ST01-DT07-DF15-CF18-01
C-C682A-OSSL-09-ST03-DT07-DF06-CF24-01
C-C127D-FFMP-05-ST02-DT07-DF16-CF02-01
C-C400B-WIRE-02-ST04-DT03-DF08-CF01-01
C-C088B-SUBV-02-ST02-DT03-DF17-CF18-01
C-C476E-FFMP-04-ST04-DT02-DF06-CF01-01
C-C820A-FFMP-07-ST04-DT02-DF14-CF23-01
C-C191B-SUBV-01-ST02-DT06-DF13-CF23-01
C-C124A-GIMP-10-ST01-DT05-DF11-CF01-01
C-C835A-SUBV-09-ST02-DT01-DF06-CF22-01
C-C078A-PSQL-05-ST01-DT05-DF13-CF23-01
C-C476A-OSSL-07-ST02-DT03-DF16-CF24-01
C-C765A-PSQL-02-ST02-DT03-DF06-CF01-01
C-C682B-FFMP-02-ST04-DT04-DF02-CF22-01
C-C785B-SUBV-06-ST04-DT04-DF13-CF02-01
C-C674A-FFMP-07-ST03-DT07-DF07-CF19-01
C-C089B-WIRE-10-ST02-DT02-DF06-CF03-01
C-C476B-PSQL-02-ST04-DT05-DF14-CF01-01
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C-C476C-FFMP-06-ST01-DT03-DF16-CF19-01
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C-C127C-WIRE-06-ST01-DT06-DF01-CF24-01
C-C774A-PSQL-09-ST01-DT07-DF05-CF01-01
C-C088A-SUBV-09-ST04-DT01-DF17-CF24-01
C-C476F-WIRE-01-ST03-DT04-DF12-CF03-01
C-C367A-WIRE-03-ST02-DT05-DF12-CF13-01
C-C839A-FFMP-03-ST01-DT06-DF16-CF01-01
C-C805C-SUBV-02-ST03-DT07-DF17-CF22-01
C-C400A-GIMP-03-ST01-DT01-DF15-CF03-01
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C-C476B-OSSL-02-ST02-DT05-DF06-CF24-01
C-C821A-FFMP-06-ST02-DT06-DF03-CF22-01
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C-C785C-GIMP-05-ST04-DT03-DF06-CF18-01
C-C771A-OSSL-08-ST03-DT05-DF16-CF12-01
C-C088B-GIMP-02-ST04-DT07-DF16-CF22-01
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C-C197A-WIRE-09-ST02-DT04-DF08-CF15-01
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C-C412A-FFMP-05-ST02-DT04-DF13-CF19-01

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F.3 Kestrel Test Suite

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J-C820A-POIX-07-ST01-DT03-DF12-CF16-01
J-C252A-POIX-08-ST03-DT01-DF07-CF20-01
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J-C674A-JENA-10-ST03-DT02-DF06-CF02-01
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J-C078A-LUCE-03-ST02-DT03-DF05-CF19-01
J-C023A-CMUD-07-ST03-DT03-DF05-CF03-01
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J-C190A-JENA-05-ST02-DT03-DF12-CF03-01
J-C400B-JENA-09-ST03-DT03-DF06-CF26-01
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APPENDIX G—The Wilson Interval

LIMITS OF APPLICABILITY OF THE WILSON INTERVAL

This note discusses the conditions under which the Wilson interval is an acceptable approximation to use when stating the results of binomial measurements. From published simulations it is found that even with as few as five measurements the confidence level is quite accurate, except for the most extreme 4.2 % of cases when the probability is closest to zero or one. It is noted, however, for few measurements the confidence interval itself is quite large.

THE WILSON INTERVAL

Statistical results are often reported as a confidence interval such the true value of a measurement is within the interval a given percentage of the time. Often a 95 percent confidence is used, meaning that the true value would have only a 5 percent chance of being outside the stated range.

For experiments that test whether a result X does or does not occur, the Wald formula can estimate the confidence interval. The Wald interval[3] is:

$$\hat{p} \pm \left(z_{\alpha/2} \times \mathrm{se}(\hat{p}) \right)$$

where p is the fraction of results X in n trials, and the standard error is approximated by:

$$se(\hat{p}) = \sqrt{\hat{p}\,(1-\hat{p})\,/\,n}$$

The value of $z_{\alpha/2}$ is the number of standard deviations required to be in the percentile 1-α/2.

The Wald formula makes the assumption that the binomial distribution is well approximated by a Gaussian. The binomial distribution is not well-approximated by a Gaussian for small *n* or *P* close to zero or one. To better handle these cases, the Wilson formula finds, for a measurement *p*, the two values of the true probability *P* that would place *p* at the outermost limits of the confidence interval about *P*. This amounts to solving the equation

$$|p-\hat{p}| = z_{\alpha/2}\sqrt{p(1-p)/n}$$

for *p*. The solution gives the Wilson interval as

$$\left(\hat{p} + z^2_{\alpha/2}/2n \pm z_{\alpha/2}\sqrt{\left(\hat{p}(1-\hat{p}) + z^2_{\alpha/2}/4n\right)/n} \right) \,/\, \left(1 + z^2_{\alpha/2}/n\right)$$

LIMITS OF APPLICABILITY

The question arises concerning the values of P and n for which the Wilson interval is applicable. A few authors have conducted numerical experiments to check the validity of various improvements on the Wald interval. The authors base their analysis on the use of a 95 percent confidence interval, and the efficacy of an estimate is described in terms of what the actual confidence level is, based on the results of the experiments. In other words, they measure what percent of the time the actual value is indeed within the stated interval as computed by Wald, Wilson, Jeffries, etc. It was found that the Wilson interval gives very good results even for values of n as low as five, and values of P between 0.05 and 0.95. The actual confidence levels are within a few percent of 95 in these cases.

[3] http://support.sas.com/documentation/cdl/en/procstat/63104/HTML/default/viewer.htm#procstat_freq_a0000000660.htm

SENSITIVITY TO THE NUMBER OF MEASUREMENTS

This plot from the article of Brown, Cai, and DasGupta[4] shows how the actual confidence interval, or “coverage probability”, only varies a small amount from 95 percent at low values of n.

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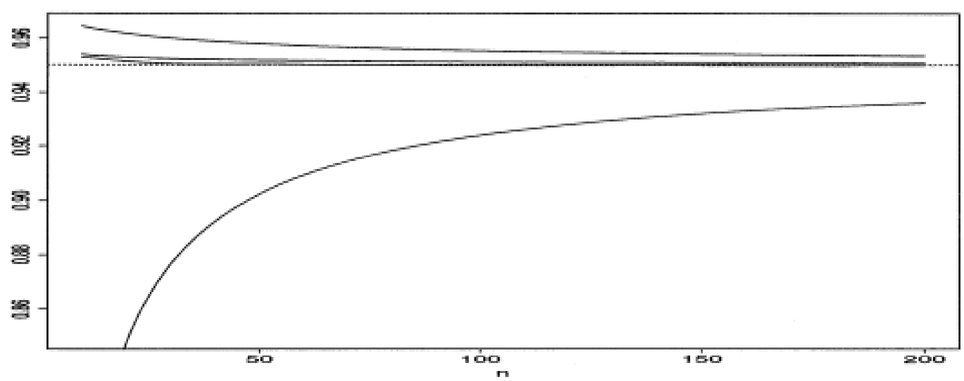

FIG. 6. *Comparison of the average coverage probabilities. From top to bottom: the Agresti–Coull interval* CI_{AC}, *the Wilson interval* CI_W, *the Jeffreys prior interval* CI_J *and the standard interval* CI_s. *The nominal confidence level is* 0.95.

SENSITIVITY TO THE SHAPE OF THE ACTUAL PROBABILITY DISTRIBUTION

A similar plot from Agresti and Coull’s article[5] shows the Wilson, or “Score” approximation is not sensitive to the shape of the true probability distribution, as similar results were obtained for a constant and skewed distributions. Their simulations used n as low as 5. It can be seen that the Wilson approximation is close to 95 percent in the whole range for both distributions.

[4] Brown, Lawrence D., T. Tony Cai, and Anirban DasGupta. "Interval estimation for a binomial proportion." Statistical Science (2001): 101-117.
[5] Agresti, Alan, and Brent A. Coull. "Approximate is better than “exact” for interval estimation of binomial proportions." The American Statistician 52.2 (1998): 119-126.

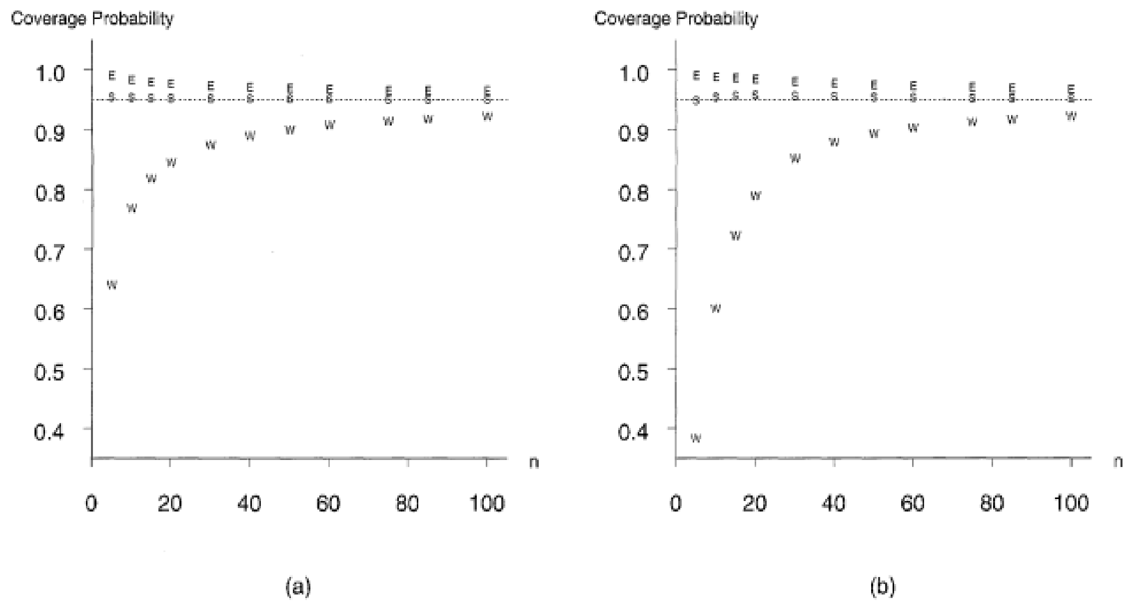

Figure 1. Mean Coverage Probability as a Function of Sample Size for the Nominal 95% Exact (E), Score (S), and Wald (W) Intervals, When p has (a) a Uniform (0,1) Distribution and (b) a Beta Distribution with μ = .10 and σ = .05.

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SENSITIVITY TO THE ACTUAL PROBABILITY

Regarding sensitivity to the actual probability itself, simulations by Brown, Cai, and DasGupta showed that the Wilson interval approximation is indeed least accurate near zero and one, as shown in the following plots for n=50. Note that the Jeffrey's interval is slightly better as P nears zero and one.

INTERVAL ESTIMATION FOR BINOMIAL PROPORTION 131

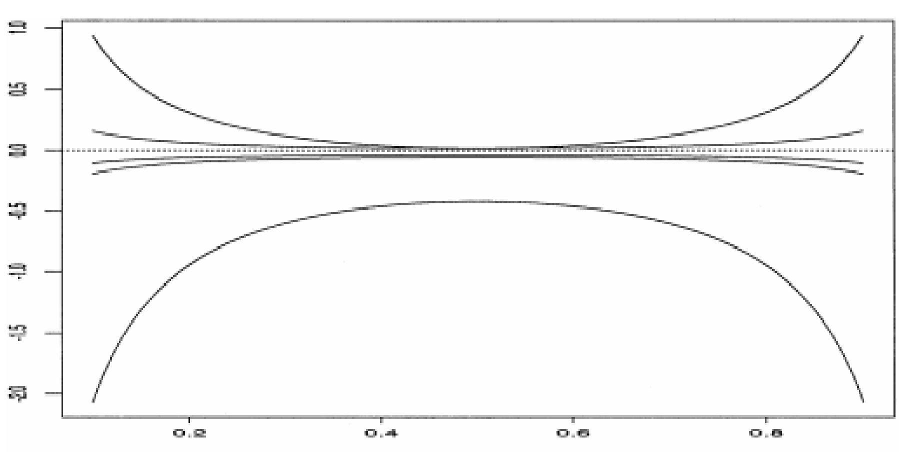

FIG. 2. *Comparison of the systematic coverage biases. The y-axis is $nS_n(p)$. From top to bottom: the systematic coverage biases of the Agresti–Coull, Wilson, Jeffreys, likelihood ratio and Wald intervals, with $n = 50$ and $\alpha = 0.05$.*

Even so, simulations with n=5 by Agresti and Coull showed that for only 4.2 percent of the values of P does the Wilson interval overstate the confidence level as 95 percent when in reality it is 90 percent or less.

The above plot only shows values of P between 0.05 and 0.95. More extreme values are show in these plots from Brown, Cai, and DasGupta. At the lower probabilities, only two have confidence levels less than 90 percent. Though not stated in the text, it appears these are probabilities within 0.02 of zero.

INTERVAL ESTIMATION FOR BINOMIAL PROPORTION 107

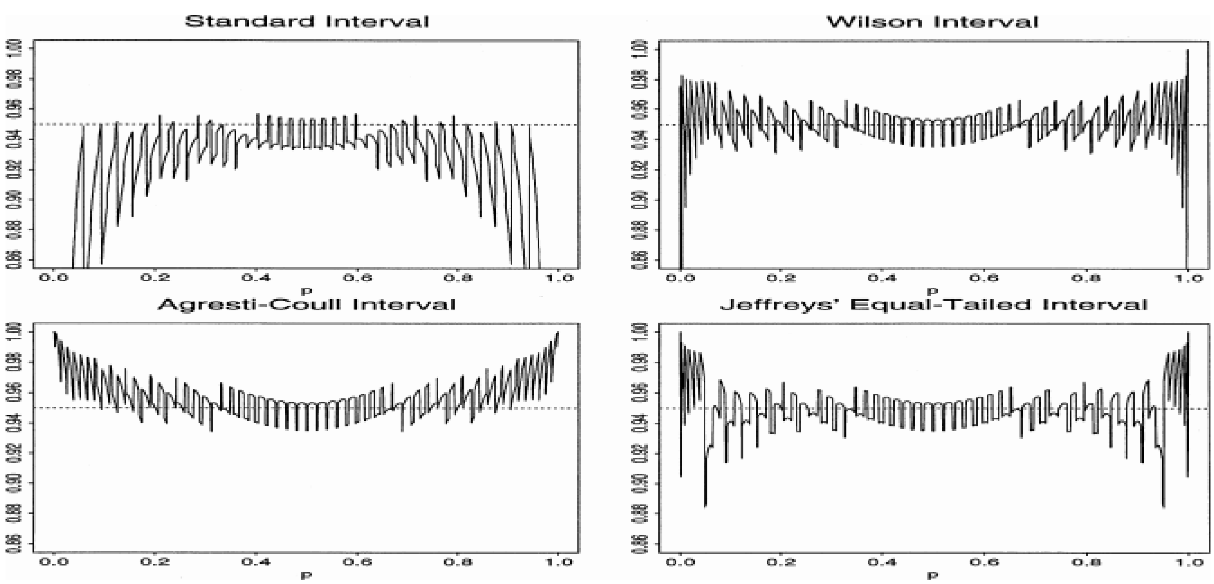

FIG. 5. *Coverage probability for* $n = 50$.

CONFIDENCE INTERVALS FOR A SMALL NUMBER OF MEASUREMENTS

It's important to note that for small values of n the interval itself is quite large, which overshadows the small discrepancies in confidence level. An excerpt from a table of Jeffries intervals for small n included in Brown, Cai, and DasGupta illustrates the issue.

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TABLE 5
95% Limits of the Jeffreys prior interval

x	$n = 7$		$n = 8$		$n = 9$		$n = 10$		$n = 11$		$n = 12$	
0	0	0.292	0	0.262	0	0.238	0	0.217	0	0.200	0	0.185
1	0.016	0.501	0.014	0.454	0.012	0.414	0.011	0.381	0.010	0.353	0.009	0.328
2	0.065	0.648	0.056	0.592	0.049	0.544	0.044	0.503	0.040	0.467	0.036	0.436
3	0.139	0.766	0.119	0.705	0.104	0.652	0.093	0.606	0.084	0.565	0.076	0.529
4	0.234	0.861	0.199	0.801	0.173	0.746	0.153	0.696	0.137	0.652	0.124	0.612
5					0.254	0.827	0.224	0.776	0.200	0.730	0.180	0.688
6									0.270	0.800	0.243	0.757

If ten measurements showed zero instances of success, all one could say with 95 percent confidence that the true success rate is less than 21.7 %. If five of the ten measurements showed success, all one could say with 95 percent confidence is that the true success rate is somewhere between 22.4 % and 77.6 %. From the complete table, to say with 95 percent confidence that a success rate is less than 10 % requires 24 measurements showing zero instances of success.

APPENDIX H—Result Field Descriptions

RAW RESULTS

Raw results delivered in a separate external hard drive with all Phase 3 Specifications, Data, Software and Documentation can be retrieved from the database in three different csv files: analyze, execute, and perf. Each of these files contains different fields according to their purpose.

ANALYSIS FIELD DESCRIPTIONS

- **Test Case Name**: The name of the test case that this particular row refers to.
- **Analysis Stage**: The stage of the run, i.e. is it 'Stage 1' means it was run without performer technology, 'Stage 2' means it was run with performer technology
- **Run ID**: The unique identifier of the run in the database for reference
- **Run Time**: The runtime captured by TEXAS from the start of the action until the end until then end of the action. This value mirrors what the number outputted to the screen by the TEXAS CLI
- **CWE Found**: A Boolean value or 'Unknown' as to whether the performer technology reported the correct CWE of the test case in the Analysis stage.
- **CWEs Found**: A comma delimited list of all of the CWEs reported by the performer technology
- **Impact Found**: A Boolean value or 'Unknown' as to whether the performer technology reported the correct negative technical impact of the test case in the Analysis stage.
- **Impacts Found**: A comma delimited list of all of the negative technical impacts reported by the performer technology
- **Result**: The value representing the outcome of the Analysis action. Can be True, False, Skip, or Error
- **Error**: A string field for capturing an error output from TEXAS

EXECUTE FIELD DESCRIPTIONS

- **Test Case Name**: The name of the test case that this particular row refers to.
- **Analysis Stage**: The stage of the run, i.e. is it 'Stage 1' means it was run without performer technology, 'Stage 2' means it was run with performer technology
- **Execute Stage**: The stage of the run, i.e. is it 'Stage 1' means it was run without performer technology, 'Stage 2' means it was run with performer technology
- **IOPair Name**: The name of the IOPair that this particular row refers to.
- **IOPair Type**: The type of IOPair that the run represents: GOOD or BAD.
- **Analysis ID**: The unique identifier of the Analysis run in the database for reference
- **Run ID**: The unique identifier of the Execute run in the database for reference
- **Analysis Time**: The runtime captured by TEXAS from the start of the Analysis action until the end until then end of the Analysis action. This value mirrors what the number outputted to the screen by the TEXAS CLI
- **Run Time**: The runtime captured by TEXAS from the start of the Execute action until the end until then end of the Execute action. This value mirrors what the number outputted to the screen by the TEXAS CLI
- **External Run Time**: A calculated run time of the test case based on measurements captured outside of the actual test program.
- **Internal Run Time**: A calculated run time of the test case based on measurements captured from within the actual test program via LTTng.

- **CWE Found**: A Boolean value or 'Unknown' as to whether the performer technology reported the correct CWE of the test case in the Execute stage.
- **CWEs Found**: A comma delimited list of all of the CWEs reported by the performer technology
- **Impact Found**: A Boolean value or 'Unknown' as to whether the performer technology reported the correct negative technical impact of the test case in the Execute stage.
- **Impacts Foun**d: A comma delimited list of all of the negative technical impacts reported by the performer technology
- **Timed Out**: A Boolean value as to whether the run was considered to have hit timeout.
- Score Type: An enumeration of the particular score type: 'overall', 'formula', or 'check'. An 'overall' value represents the overall score of a particular row, this is the value that determines whether the overall run is considered a Pass or a Fail. A 'formula' value means that this row represents the calculated score of a particular formula designated for the IOPair. A 'check' value means that this row represents the calculated score of a particular output check designated for the IOPair.
- **Score Name**: This is the name of the formula or output check that the result refers to from the IOPair metadata.
- **Check**: A field that contains information about the type of output check the row represents or the full formula that the row represents.
- **Result**: The value representing the outcome of the Analysis action. Can be True, False, Skip, or Error
- **Error**: A string field for capturing an error output from TEXAS
- **Modified Scoring**: A 'Yes' or 'No' field representing whether the score has been modified from the original as part of the manual score analysis.

PERF FIELD DESCRIPTIONS

- **Test Case Name**: The name of the test case that this particular row refers to.
- **Execute Stage**: The stage of the run, i.e. is it 'Stage 1' means it was run without performer technology, 'Stage 2' means it was run with performer technology
- **IOPair Name**: The name of the IOPair that this particular row refers to.
- **IOPair Type**: The type of IOPair that the run represents: GOOD or BAD.
- **Analysis ID**: The unique identifier of the Analysis run in the database for reference
- **Run ID**: The unique identifier of the Execute run in the database for reference
- **Run Time**: The runtime captured by TEXAS from the start of the Execute action until the end until then end of the Execute action. This value mirrors what the number outputted to the screen by the TEXAS CLI
- **Timed Out**: A Boolean value as to whether the run was considered to have hit timeout.
- **Point Type**: An enumeration value representing whether the point was 'Internel' or 'External'. An 'Internal' value means the row refers to a point captured inside of the actual test program via LTTng. An 'External' value means the row refers to a point captured outside of the actual test program from TEXAS
- **Point Ordinal**: A integer value representing the numerical order in which the point was captured. So a row with Ordinal 0 for a particular Run ID (identification) was captured before a row with Ordinal 1 and the same Run ID and Point Type.
- **Point Name**: The name designated for a particular point (free text though in practice it more of an enumeration)
- **Point Timestamp**: The timestamp that the point was captured.

- **Point Delta**: The delta between the timestamp of the point and a different timestamp. For 'Internal' points it is between the Point Timestamp and the Point Timestamp of the LTTng captured point directly before it. In 'External' points it is the delta between the captured timestamp and the timestamp designated as the first 'External' timestamp by whatever script or automation was being utilized.

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APPENDIX I—Columbia Detailed T&E Results

Numbers

		Altered?		
		No	Yes	Total
Mitigation?	Full	**193**	159	352
	Partial	219	204	423
	None	434	1,413	1,847
	Total	846	1,776	2,622

Percentages

		Altered?		
		No	Yes	Total
Mitigation?	Full	**7.4%**	6.1%	13%
	Partial	8.4%	7.8%	16%
	None	16.6%	53.9%	70%
	Total	32%	68%	100%

Figure I-1. MINESTRONE Mitigation and Altered Functionality Results (Unmodified)

I.1 MINESTRONE Basic Results

Numbers

		Altered?		
		No	Yes	Total
Mitigation?	Full	**193**	159	352
	Partial	219	204	423
	None	434	1,413	1,847
	Total	846	1,776	2,622

Percentages

		Altered?		
		No	Yes	Total
Mitigation?	Full	**7.4%**	6.1%	13%
	Partial	8.4%	7.8%	16%
	None	16.6%	53.9%	70%
	Total	32%	68%	100%

Figure I-2. MINESTRONE Mitigation and Altered Functionality Results (Modified)

I.1.1 MINESTRONE Results by Base Programs

Table I-1 MINESTRONE Mitigation and Altered Functionality Results (by Base Program)

Base Program	Total Test Cases	Full Mitigation No Altered Function	Partial Mitigation No Altered Function	No Mitigation No Altered Function	Full Mitigation Altered Function	Partial Mitigation Altered Function	No Mitigation Altered Function
FFMP	471	32	29	68	56	68	218
GIMP	461	0	0	0	0	1	460
OSSL	477	94	104	184	12	15	68
PSQL	306	0	0	0	19	24	263
SUBV	422	67	86	182	13	11	63
WIRE	485	0	0	0	59	85	341
Grand Total	**2622**	**193**	**219**	**434**	**159**	**204**	**1413**

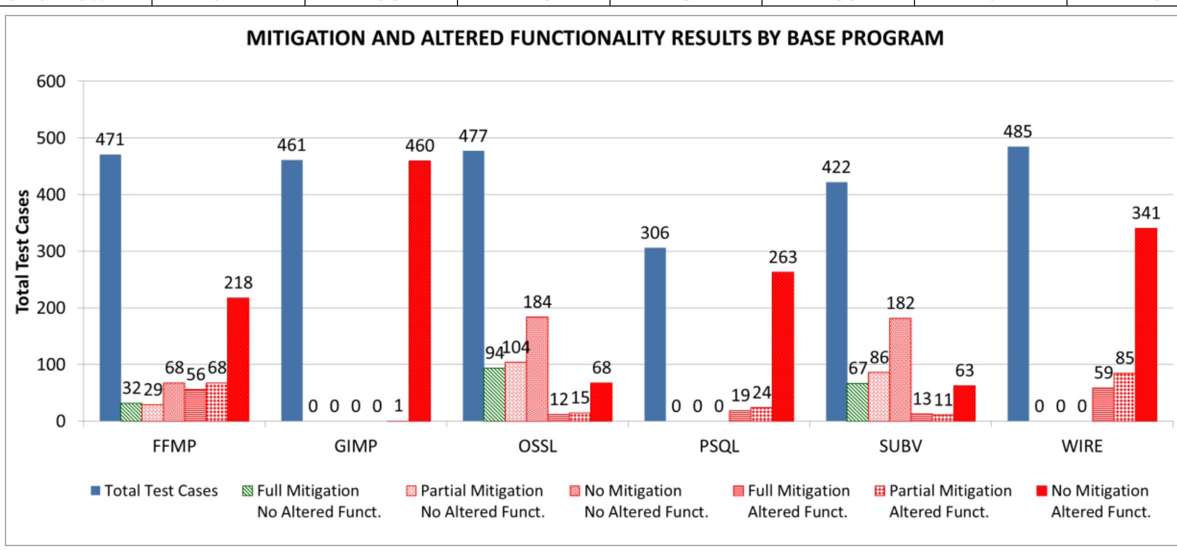

Figure I-3. MINESTRONE Mitigation and Altered Functionality Results (by Base Program)

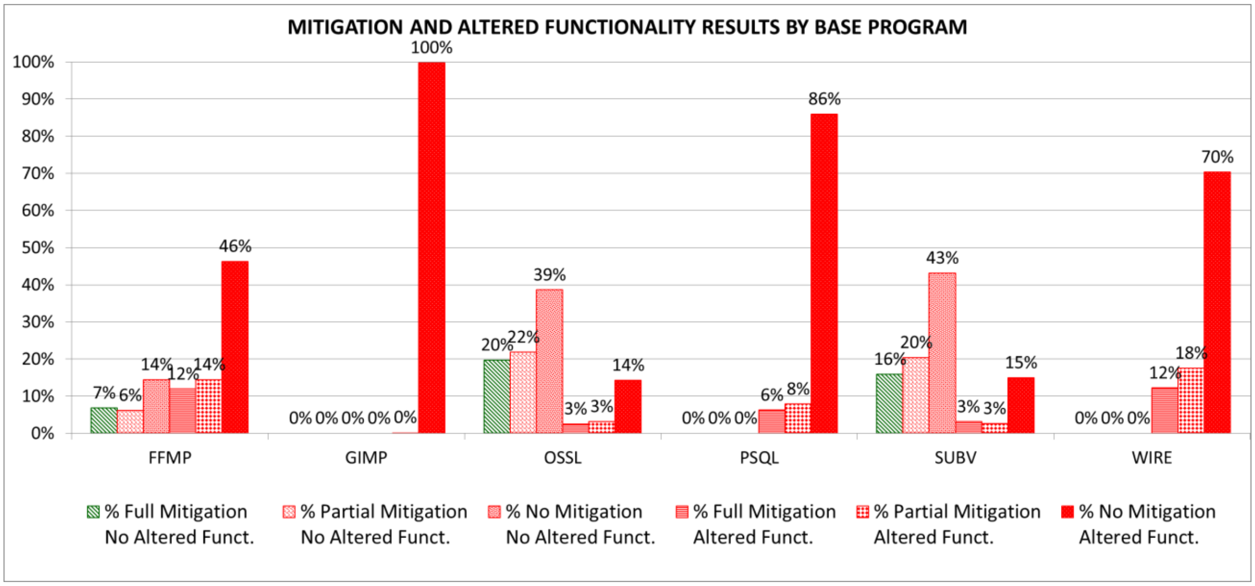

Figure I-4. MINESTRONE Mitigation and Altered Functionality Results (Percentage by Base Program)

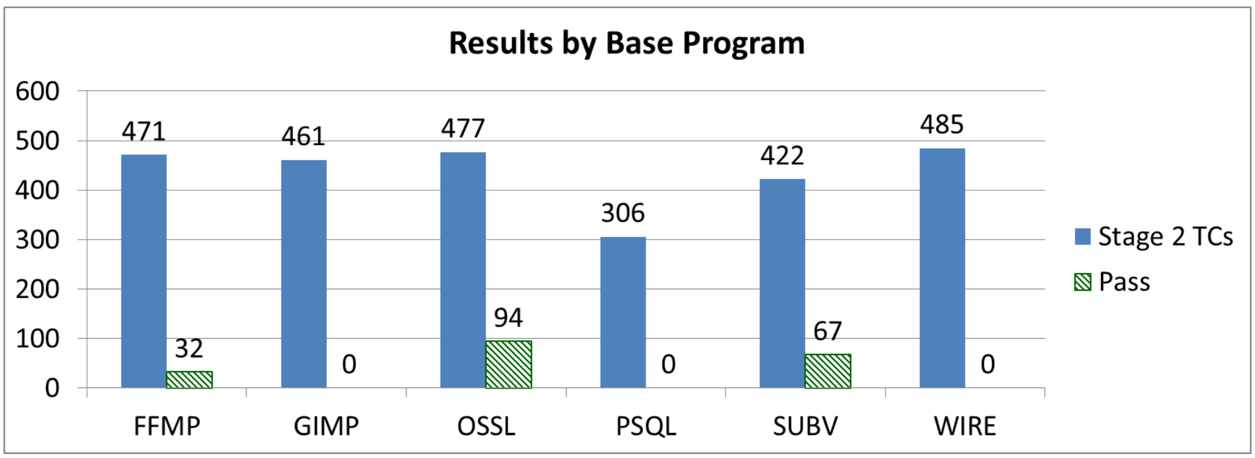

Figure I-5. MINESTRONE Number of Passing Test Cases (by Base Program)

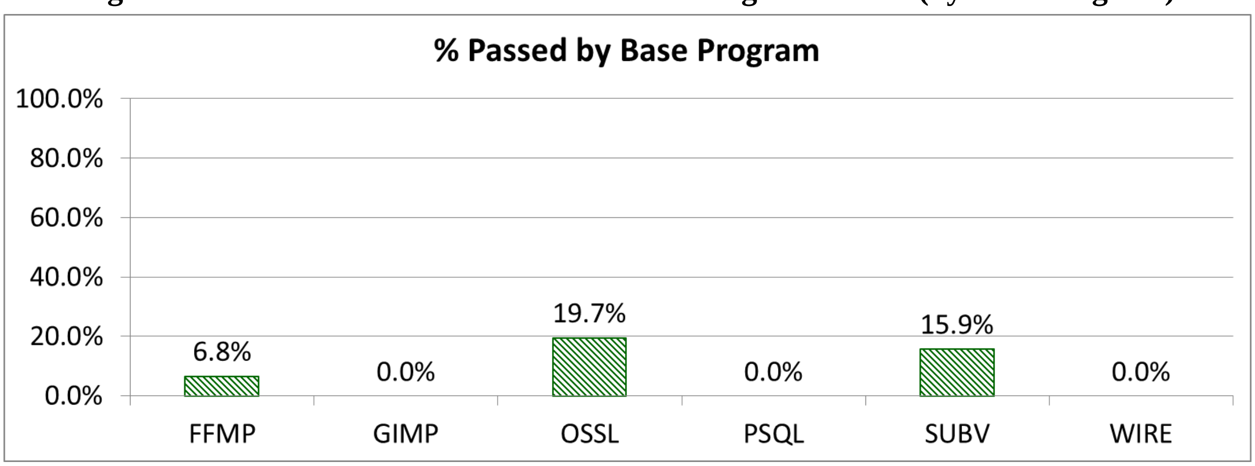

Figure I-6. MINESTRONE Percentage of Passing Test Cases (by Base Program)

I.1.2 MINESTRONE Results by Weakness Classes and Target Weaknesses

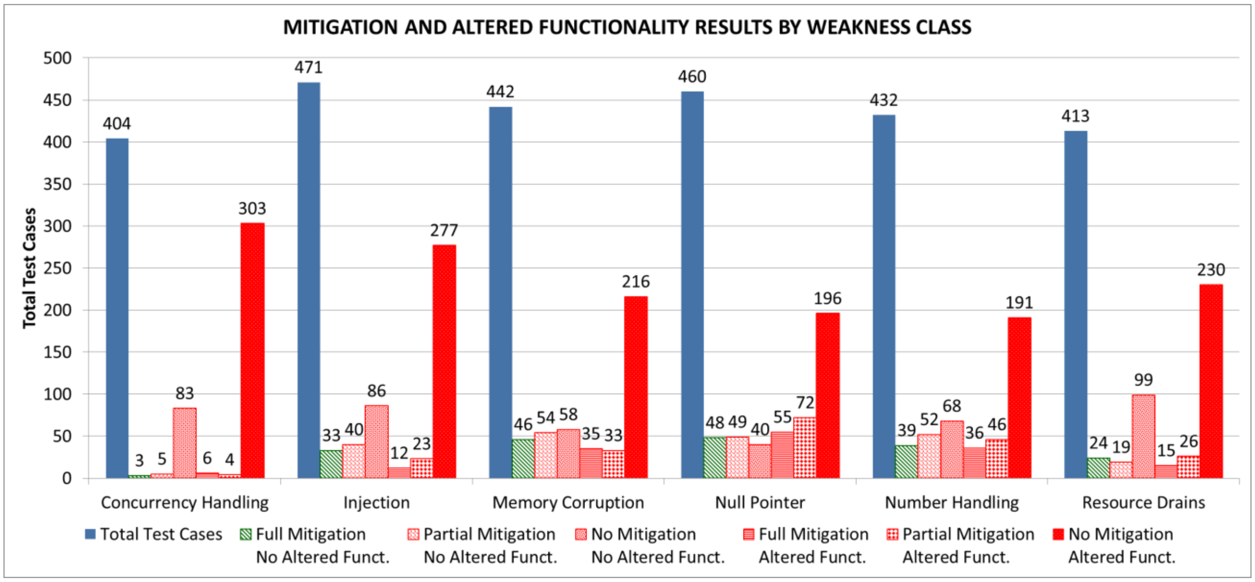

Figure I-7. MINESTRONE Mitigation and Altered Functionality Results (by Weakness Class)

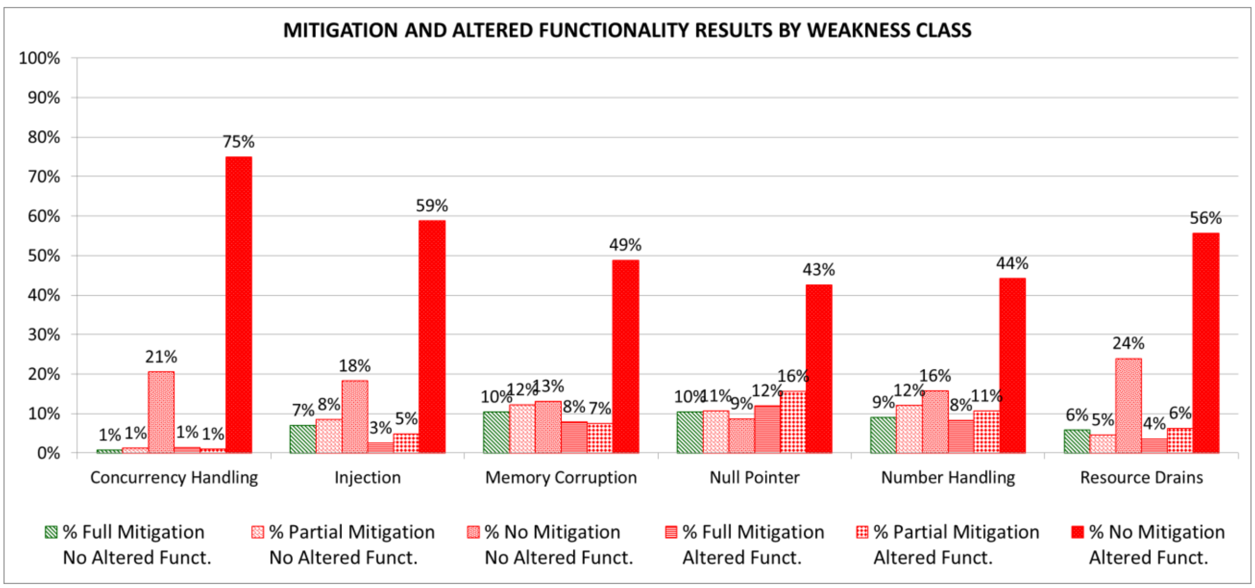

Figure I-8. MINESTRONE Mitigation and Altered Functionality Results (percentage by Weakness Class)

Table I-2. MINESTRONE Mitigation and Altered Functionality Results (by Weakness Class)

Target Weakness Class	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & No Alt Function)	% Pass
Concurrency Handling	438	404	91	23%	9	2%	3	1%
Injection	518	471	159	34%	45	10%	33	7%
Memory Corruption	497	442	158	36%	81	18%	46	10%

Target Weakness Class	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & No Alt Function)	% Pass
Null Pointer	506	460	137	30%	103	22%	48	10%
Number Handling	493	432	159	37%	75	17%	39	9%
Resource Drains	469	413	142	34%	39	9%	24	6%
Grand Total	**2921**	**2622**	**846**	**32.3%**	**352**	**13.4%**	**193**	**7.4%**

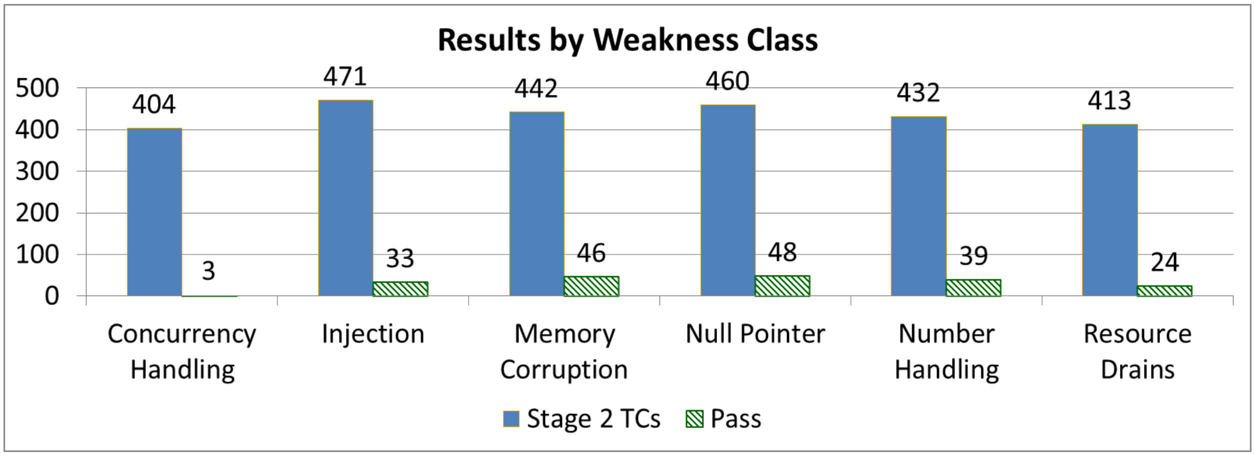

Figure I-9. MINESTRONE Number of Passing Test Cases (by Weakness Class)

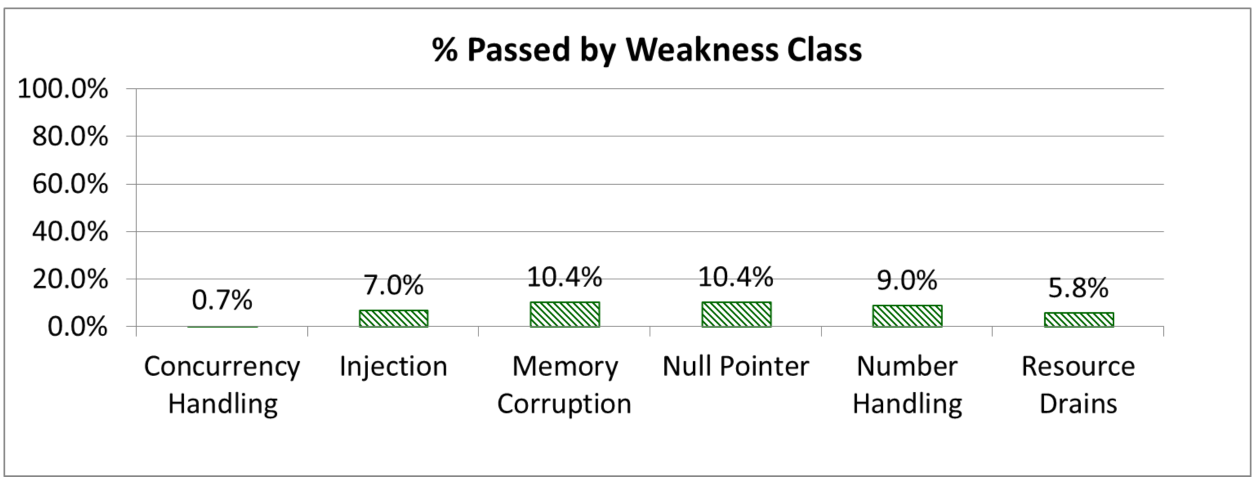

Figure I-10. MINESTRONE Percentage of Passing Test Cases (by Weakness Class)

Table I-3. MINESTRONE Mitigation and Altered Functionality Results (by CWE)

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling								
363A	28	26	10	38%	0	0%	0	0%
367A	30	29	10	34%	1	3%	1	3%
412A	28	24	11	46%	0	0%	0	0%
414A	23	22	0	0%	0	0%	0	0%
479A	31	30	16	53%	0	0%	0	0%
543A	27	27	0	0%	0	0%	0	0%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
609A	23	23	1	4%	1	4%	0	0%
663A	24	22	10	45%	3	14%	2	9%
764A	31	25	7	28%	0	0%	0	0%
765A	25	22	0	0%	0	0%	0	0%
765B	25	24	0	0%	1	4%	0	0%
820A	24	22	0	0%	2	9%	0	0%
821A	28	26	1	4%	1	4%	0	0%
828A	31	27	12	44%	0	0%	0	0%
831A	31	28	13	46%	0	0%	0	0%
833A	29	27	0	0%	0	0%	0	0%
Injection								
078A	83	82	20	24%	0	0%	0	0%
078B	63	61	21	34%	0	0%	0	0%
088A	81	70	22	31%	5	7%	3	4%
088B	66	62	3	5%	2	3%	0	0%
089A	56	48	21	44%	8	17%	5	10%
089B	56	49	24	49%	9	18%	7	14%
089C	57	54	26	48%	10	19%	8	15%
089D	56	45	22	49%	11	24%	10	22%
Memory Corruption								
120A	13	11	3	27%	2	18%	1	9%
120B	12	12	5	42%	0	0%	0	0%
120C	13	12	5	42%	3	25%	3	25%
120D	11	11	5	45%	3	27%	3	27%
124A	13	12	5	42%	4	33%	1	8%
124B	9	6	3	50%	0	0%	0	0%
124C	12	10	5	50%	3	30%	2	20%
124D	13	10	3	30%	3	30%	2	20%
126A	13	12	5	42%	0	0%	0	0%
126B	13	12	3	25%	2	17%	0	0%
126C	13	11	2	18%	2	18%	0	0%
126D	12	12	2	17%	0	0%	0	0%
127A	13	11	3	27%	1	9%	0	0%
127B	13	9	4	44%	0	0%	0	0%
127C	13	10	4	40%	0	0%	0	0%
127D	13	13	4	31%	0	0%	0	0%
129A	3	2	0	0%	0	0%	0	0%
129B	13	12	5	42%	2	17%	2	17%
134A	13	13	6	46%	0	0%	0	0%
170A	12	11	4	36%	2	18%	2	18%
170B	13	11	1	9%	1	9%	0	0%
415A	13	11	6	55%	4	36%	4	36%
416A	9	9	4	44%	3	33%	1	11%
590A	13	13	4	31%	1	8%	1	8%
761A	12	9	3	33%	3	33%	1	11%
785A	13	10	2	20%	1	10%	0	0%
785B	13	12	4	33%	1	8%	1	8%
785C	11	10	3	30%	2	20%	2	20%
785D	12	12	4	33%	2	17%	1	8%
805A	12	11	4	36%	5	45%	3	27%
805B	12	10	5	50%	4	40%	3	30%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
805C	13	12	6	50%	2	17%	2	17%
805D	12	10	4	40%	3	30%	1	10%
806A	11	11	3	27%	2	18%	1	9%
806B	13	12	4	33%	2	17%	1	8%
806C	13	12	5	42%	4	33%	2	17%
806D	13	11	4	36%	2	18%	0	0%
822A	12	11	2	18%	4	36%	1	9%
824A	13	12	6	50%	4	33%	2	17%
824B	11	9	4	44%	3	33%	2	22%
843A	13	12	4	33%	1	8%	1	8%
Null Pointer								
476A	71	59	22	37%	13	22%	6	10%
476B	69	65	23	35%	18	28%	9	14%
476C	75	68	26	38%	17	25%	9	13%
476D	74	66	24	36%	14	21%	9	14%
476E	72	65	25	38%	15	23%	6	9%
476F	71	66	17	26%	20	30%	9	14%
476G	74	71	0	0%	6	8%	0	0%
Number Handling								
190A	46	44	17	39%	0	0%	0	0%
191A	46	40	13	33%	12	30%	6	15%
191B	45	40	15	38%	5	13%	3	8%
194A	47	41	14	34%	12	29%	7	17%
195A	47	42	11	26%	10	24%	3	7%
196A	48	44	17	39%	0	0%	0	0%
197A	45	38	19	50%	4	11%	4	11%
369A	47	42	19	45%	13	31%	8	19%
682A	31	19	2	11%	4	21%	1	5%
682B	46	41	17	41%	7	17%	3	7%
839A	45	41	15	37%	8	20%	4	10%
Resource Drains								
400A	43	38	15	39%	0	0%	0	0%
400B	35	21	0	0%	0	0%	0	0%
401A	34	30	10	33%	2	7%	0	0%
459A	41	33	16	48%	6	18%	6	18%
674A	23	21	5	24%	3	14%	0	0%
771A	43	40	15	38%	5	13%	4	10%
773A	42	40	16	40%	2	5%	0	0%
774A	43	41	14	34%	1	2%	0	0%
775A	38	36	17	47%	0	0%	0	0%
789A	41	38	14	37%	6	16%	4	11%
834A	43	39	11	28%	14	36%	10	26%
835A	43	36	9	25%	0	0%	0	0%
Grand Total	**2921**	**2622**	**846**	**32.3%**	**352**	**13.4%**	**193**	**7.4%**

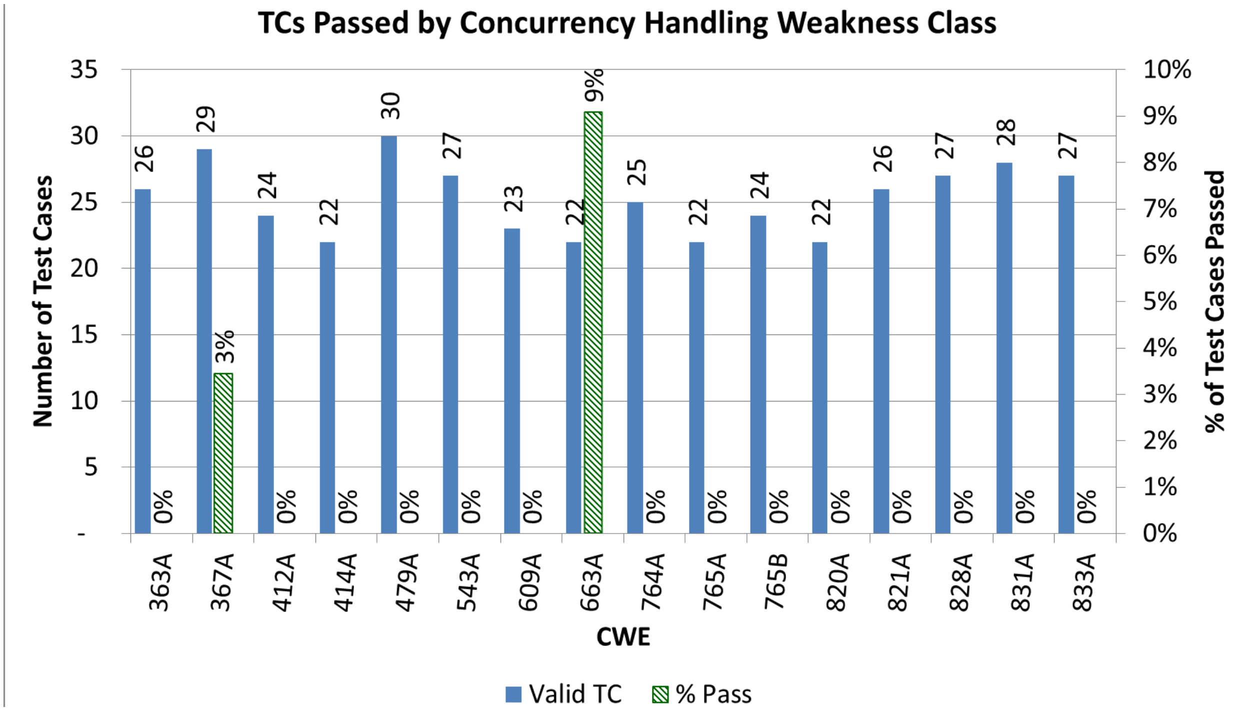

Figure I-11. MINESTRONE Passing Test Cases (by Concurrency Handling CWEs)

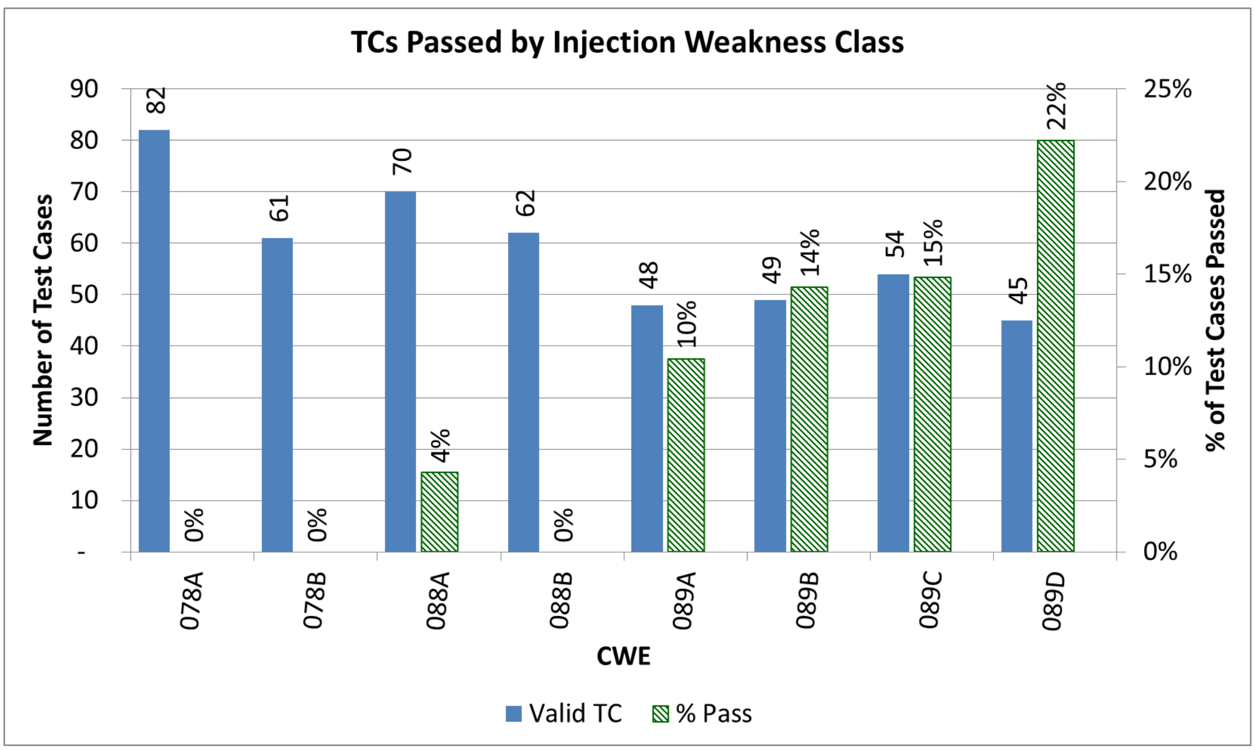

Figure I-12. MINESTRONE Passing Test Cases (by Injection CWEs)

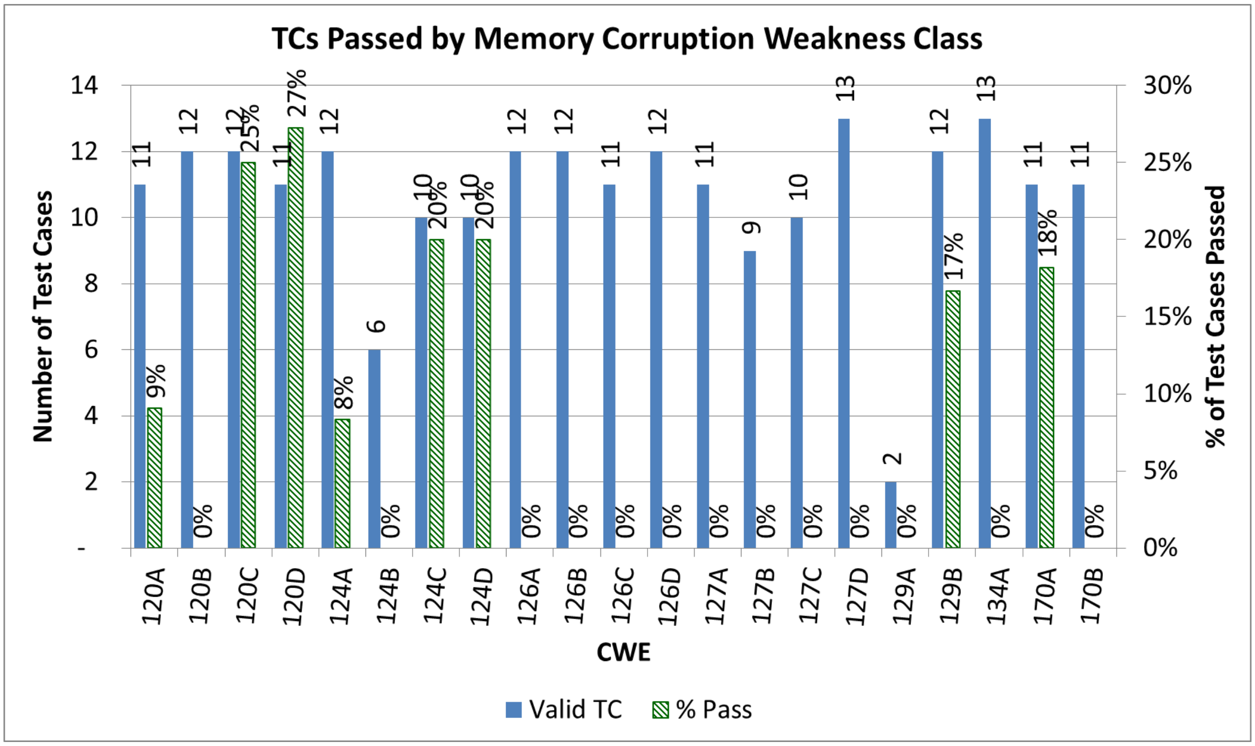

Figure I-13. MINESTRONE Passing Test Cases (by Memory Corruption CWEs) (Part 1)

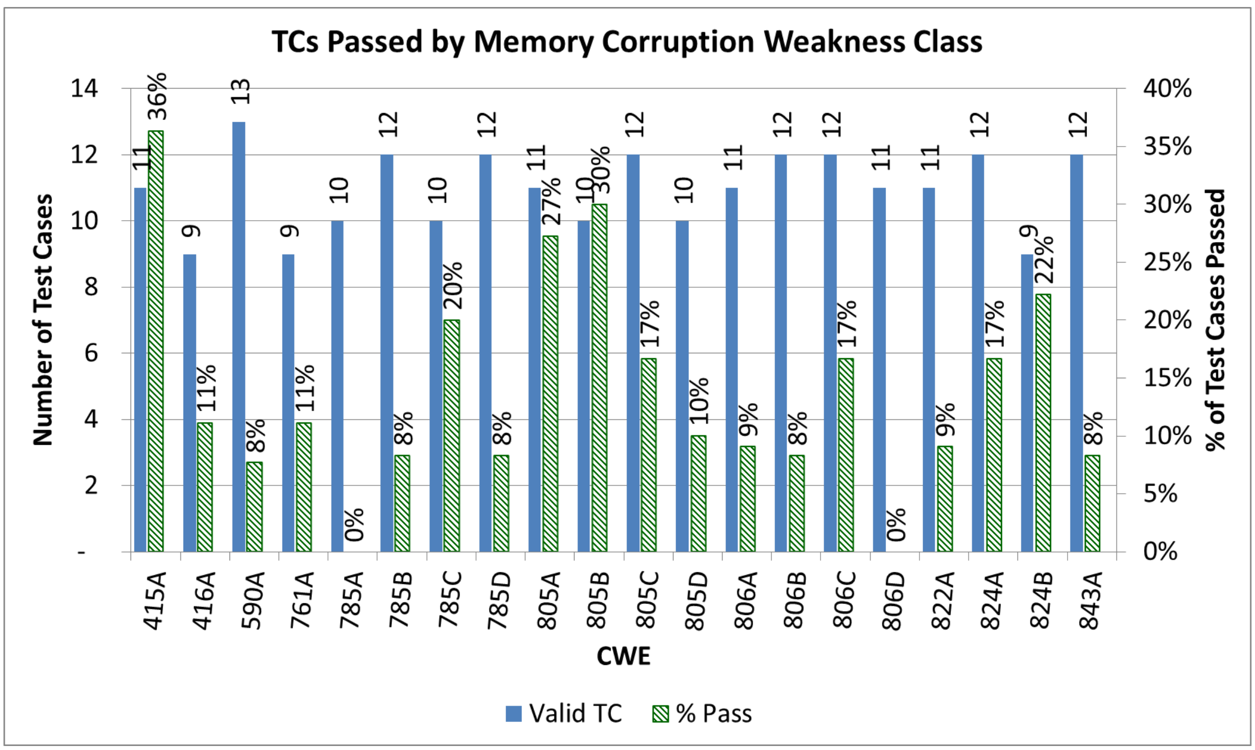

Figure I-14. MINESTRONE Passing Test Cases (by Memory Corruption CWEs) (Part 2)

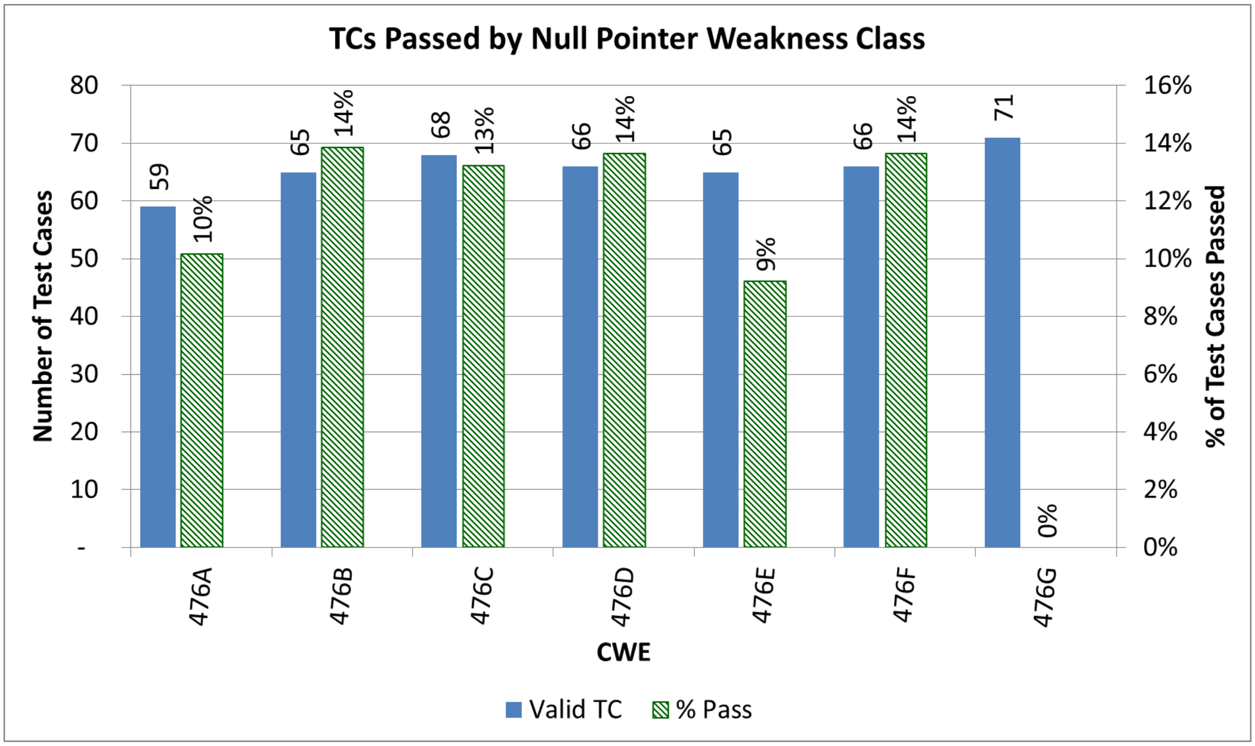

Figure I-15. MINESTRONE Passing Test Cases (by Null Pointer CWEs)

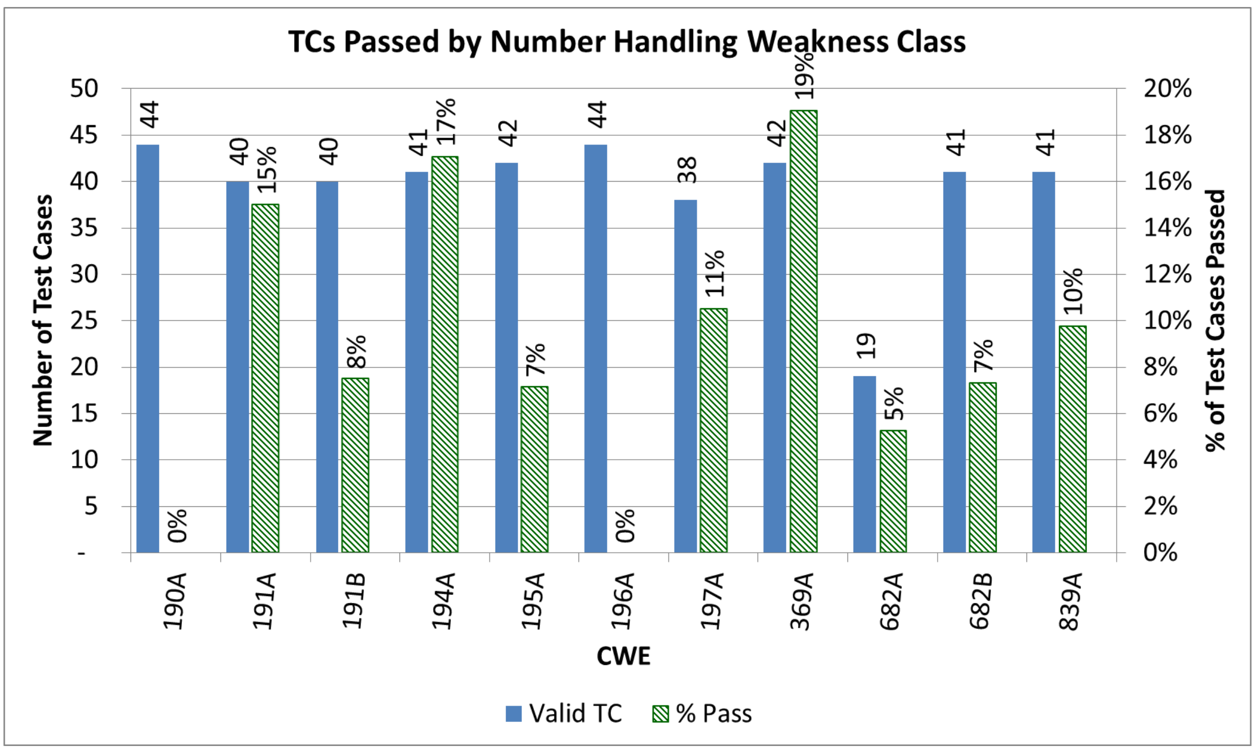

Figure I-16. MINESTRONE Passing Test Cases (by Number Handling CWEs)

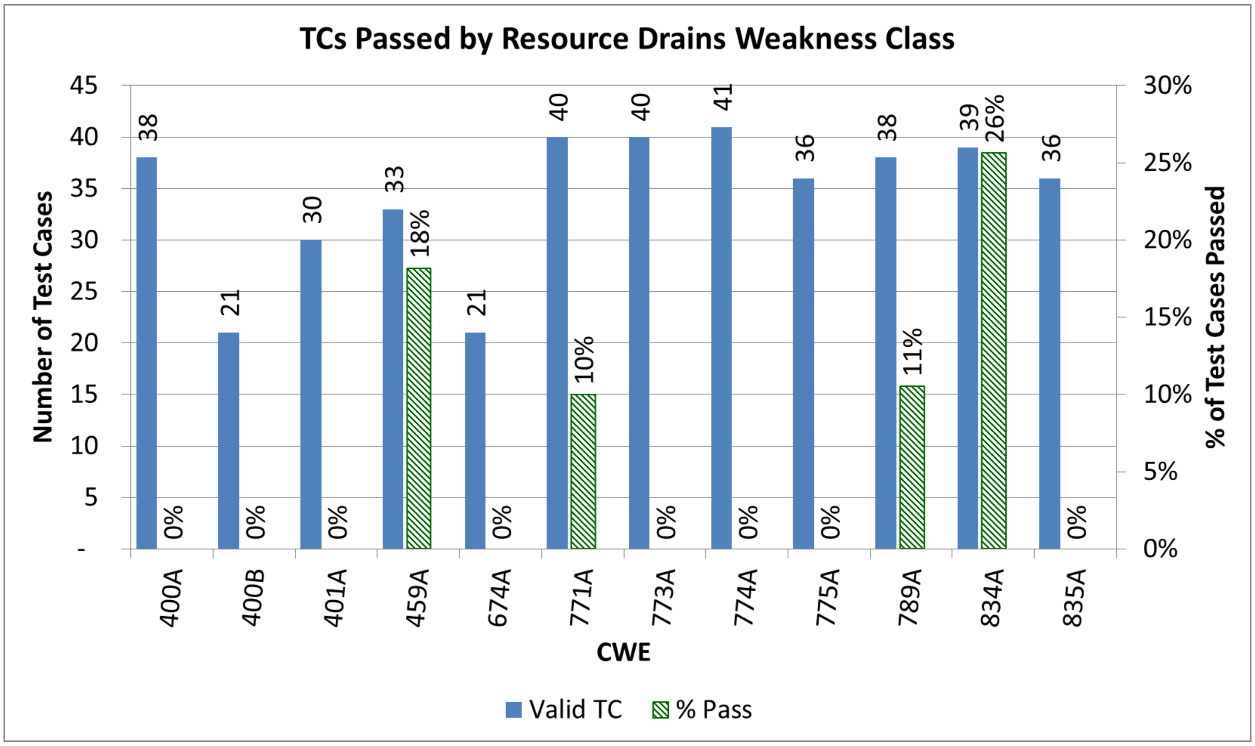

Figure I-17. MINESTRONE Passing Test Cases (by Resource Drain CWEs)

I.1.3 MINESTRONE Results by Taint Source

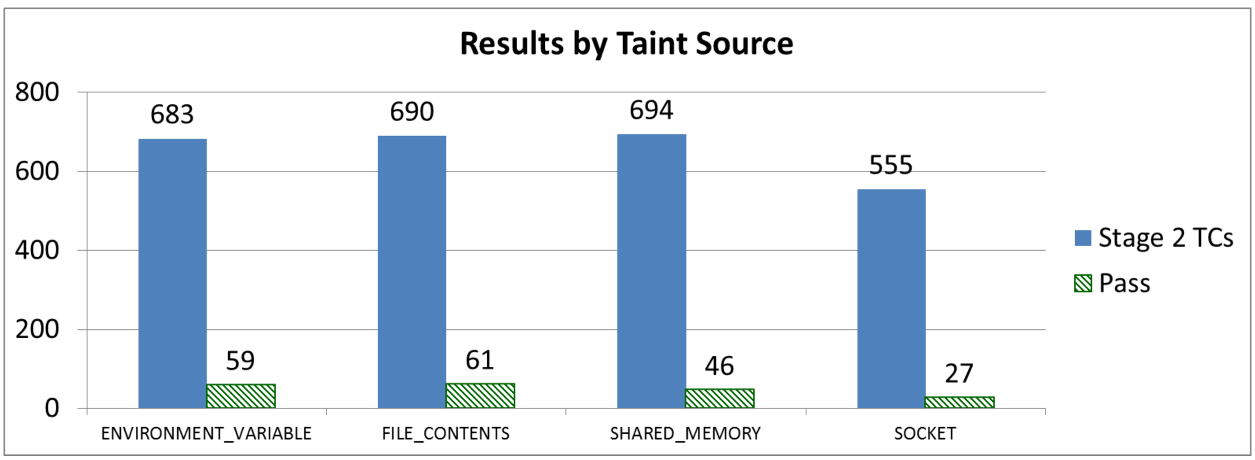

Figure I-18. MINESTRONE Number of Passing Test Cases (by Taint Source)

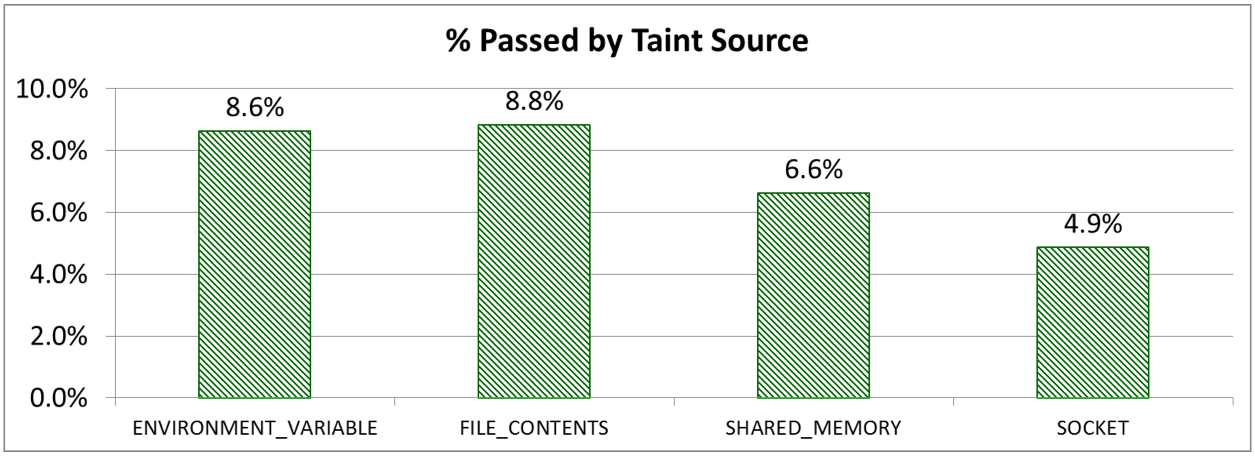

Figure I-19 MINESTRONE Percentage of Passing Test Cases (by Taint Source)

I.1.4 MINESTRONE Results by Data Type Complexity

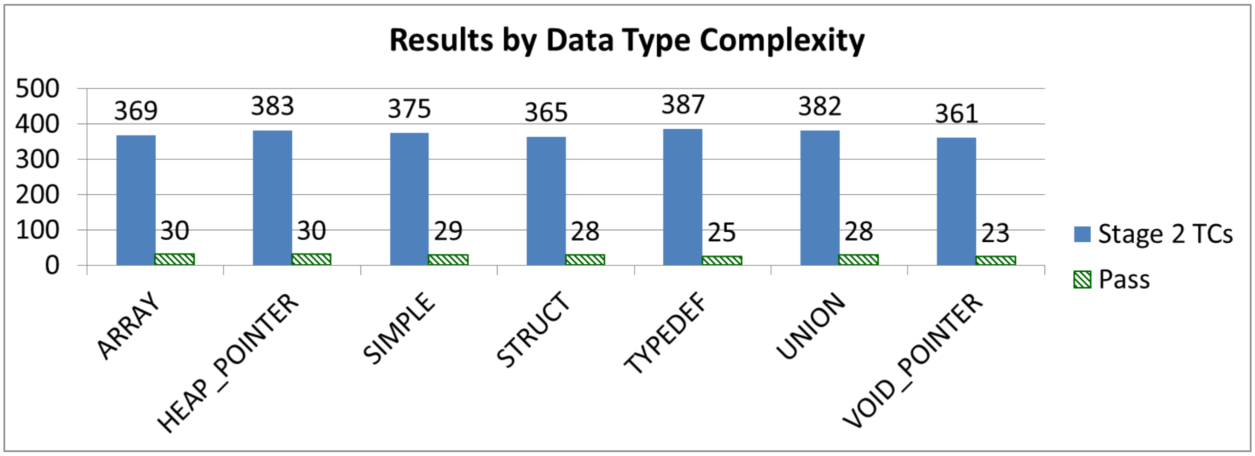

Figure I-20. MINESTRONE Number of Passing Test Cases (by Data Type Complexity)

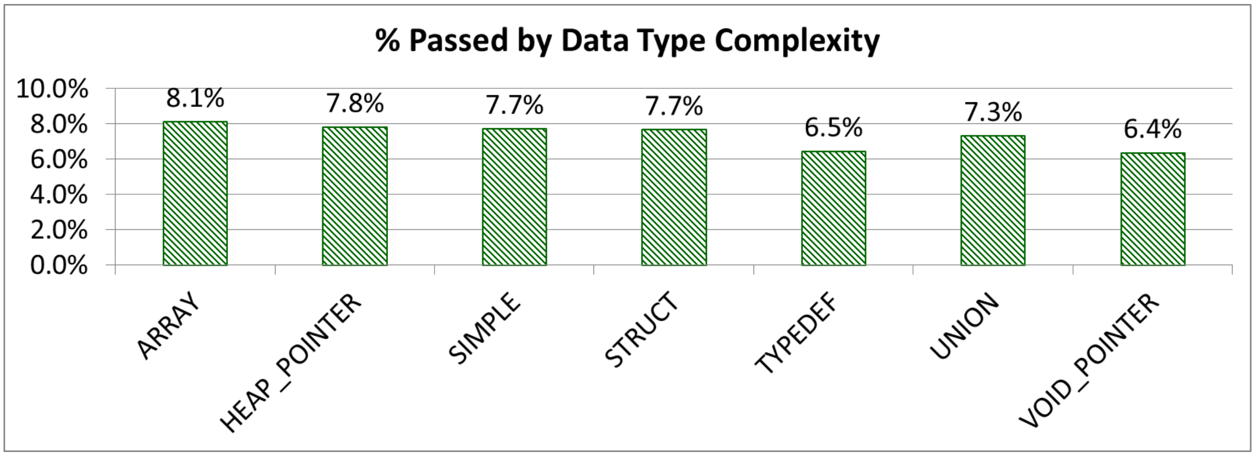

Figure I-21 MINESTRONE Percentage of Passing Test Cases (by Data Type Complexity)

I.1.5 MINESTRONE Results by Data Flow Complexity

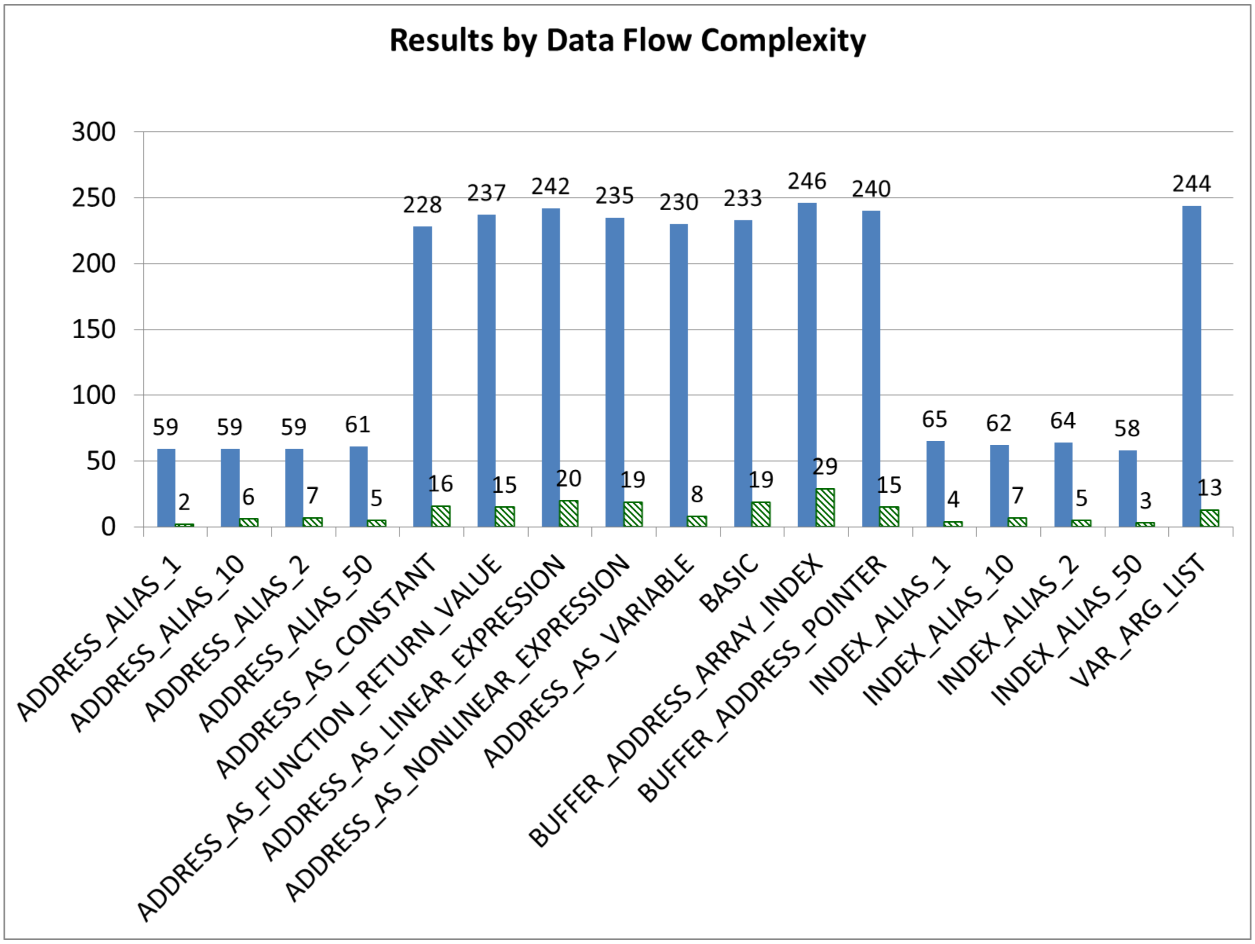

Figure I-22. MINESTRONE Number of Passing Test Cases (by Data Flow Complexity)

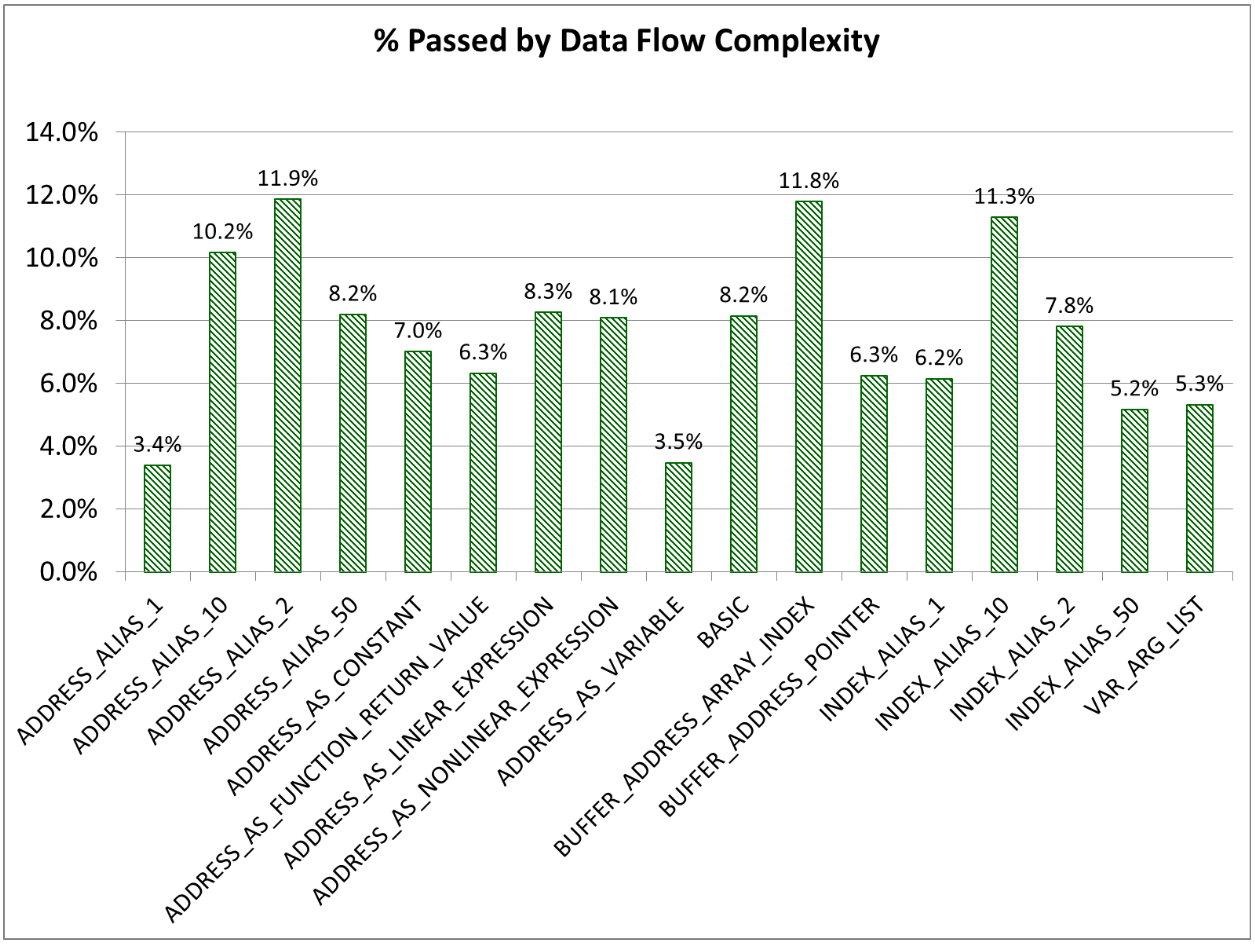

Figure I-23. MINESTRONE Percentage of Passing Test Cases (by Data Flow Complexity)

I.1.6 MINESTRONE Results by Control Flow Complexity

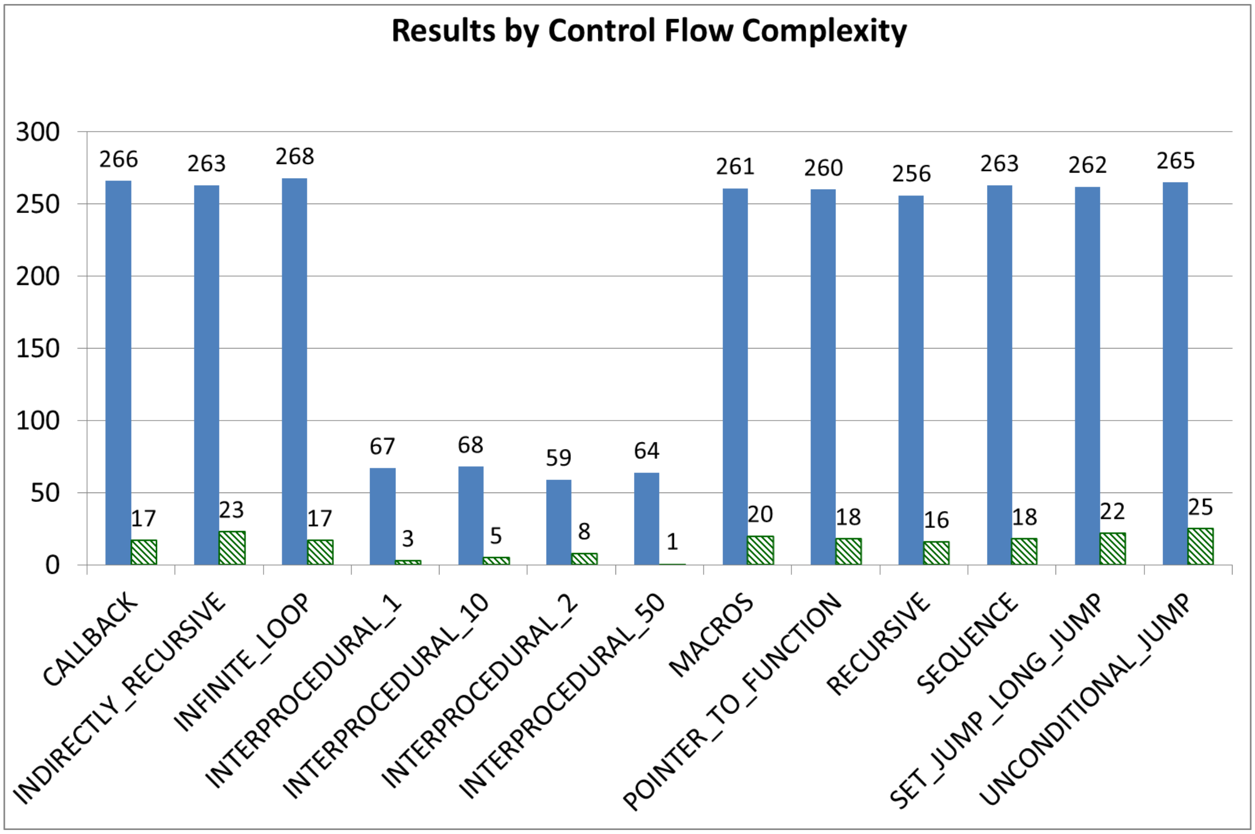

Figure I-24. MINESTRONE Number of Passing Test Cases (by Control Flow Complexity)

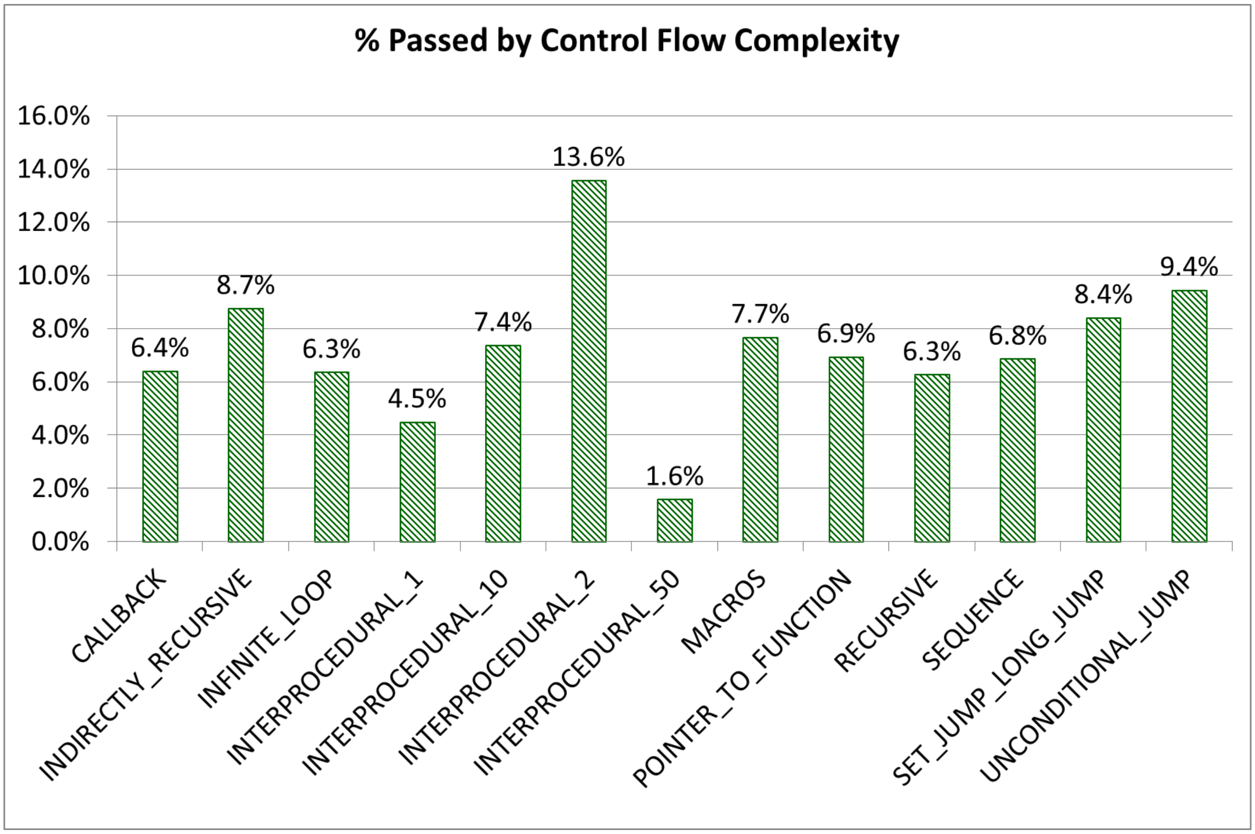

Figure I-25 MINESTRONE Percentage of Passing Test Cases (by Control Flow Complexity)

I.1.7 MINESTRONE Results by File Size

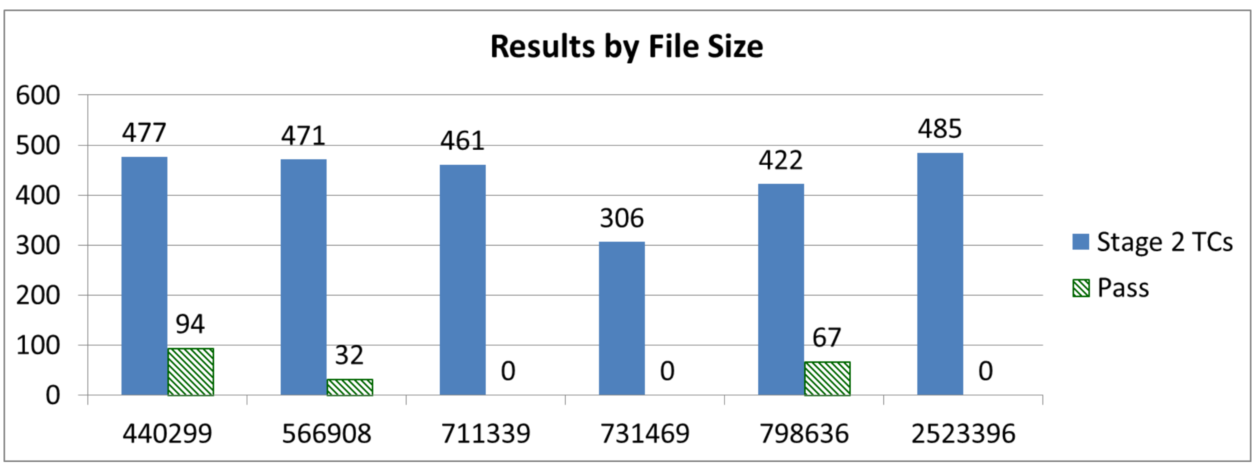

Figure I-26. MINESTRONE Number of Passing Test Cases (by File Size)

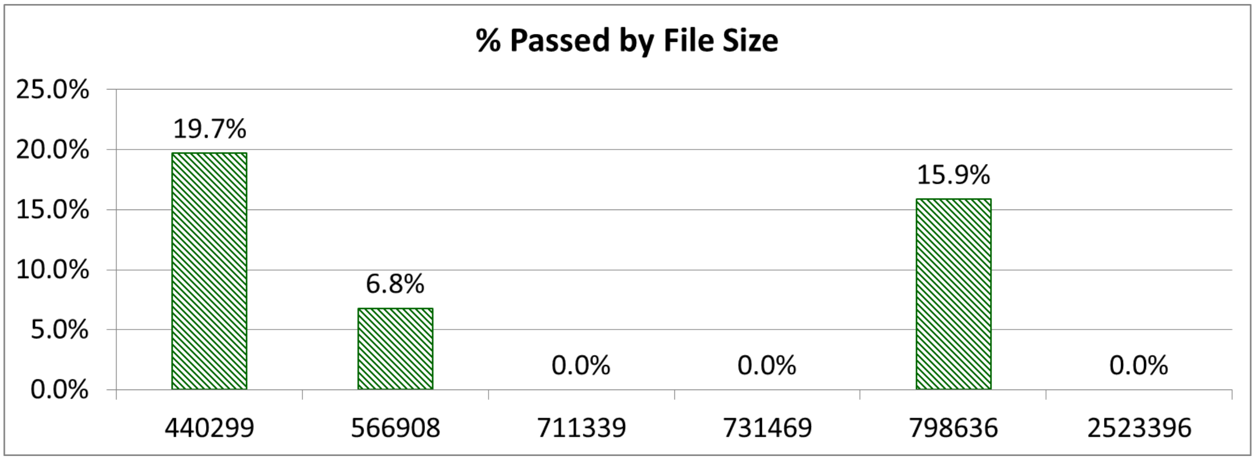

Figure I-27 MINESTRONE Percentage of Passing Test Cases (by File Size) I.1.8 MINESTRONE Performance Overhead

Table I-4. MINESTRONE Performance Overhead by Weakness Class

Weakness Class	% Increase
Concurrency Handling	1251.6%
Injection	287.8%
Memory Corruption	288.3%
Number Handling	342.9%
Resource Drains	473.8%
Null Pointer	361.2%
Grand Total	**472.7%**

Table I-5. MINESTRONE Performance Overhead by Base Program

Base Program	% Increase
FFMP	4511.8%
OSSL	4304.0%
PSQL	-52.9%
SUBV	3746.4%
WIRE	841.3%
GIMP	509.6%
Grand Total	**472.7%**

Table I-6. MINESTRONE Performance Overhead by Taint Source

Taint Source	% Increase
FILE_CONTENTS	306.1%
SHARED_MEMORY	345.8%
SOCKET	1391.9%
ENVIRONMENT_VARIABLE	955.4%
Grand Total	**472.7%**

Table I-7. MINESTRONE Performance Overhead by Data Type Complexity

Data Type Complexity	% Increase
ARRAY	398.2%
HEAP_POINTER	480.6%
SIMPLE	929.6%
STRUCT	293.7%
TYPEDEF	305.8%
UNION	754.9%
VOID_POINTER	420.7%
Grand Total	**427.7%**

Table I-8. MINESTRONE Performance Overhead by Data Flow Complexity

Data Flow Complexity	% Increase
ADDRESS_ALIAS_1	441.4%
ADDRESS_ALIAS_10	410.7%
ADDRESS_ALIAS_2	1173.4%
ADDRESS_ALIAS_50	220.6%
ADDRESS_AS_CONSTANT	694.7%
ADDRESS_AS_FUNCTION_RETURN_VALUE	292.9%
ADDRESS_AS_LINEAR_EXPRESSION	403.4%
ADDRESS_AS_NONLINEAR_EXPRESSION	324.6%
ADDRESS_AS_VARIABLE	344.6%
BASIC	640.2%
BUFFER_ADDRESS_ARRAY_INDEX	445.3%
BUFFER_ADDRESS_POINTER	554.6%
INDEX_ALIAS_1	342.0%
INDEX_ALIAS_10	831.5%
INDEX_ALIAS_2	318.1%
INDEX_ALIAS_50	356.1%
VAR_ARG_LIST	741.5%
Grand Total	**472.7%**

Table I-9. MINESTRONE Performance Overhead by Control Flow Complexity

Control Flow Complexity	% Increase
CALLBACK	767.3%
INDIRECTLY_RECURSIVE	257.0%
INFINITE_LOOP	309.8%
INTERPROCEDURAL_1	686.1%
INTERPROCEDURAL_10	498.2%
INTERPROCEDURAL_2	1314.6%
INTERPROCEDURAL_50	1583.3%
MACROS	369.6%
POINTER_TO_FUNCTION	275.4%
RECURSIVE	270.5%
SEQUENCE	1188.6%
SET_JUMP_LONG_JUMP	795.9%
UNCONDITIONAL_JUMP	264.8%
Grand Total	**472.7%**

Table I-10. MINESTRONE Performance Overhead by File Size

File Size	% Increase
440,299	4304.0%
566,908	4511.8%
711,339	509.6%
731,469	-52.9%
798,636	3746.4%
2,523,396	841.3%
Grand Total	**472.7%**

I.2 MINESTRONE Modified Results

Totals

		Altered? No	Altered? Yes	Total
Mitigation?	Full	571	592	1,163
	Partial	36	159	195
	None	240	1,025	1,265
	Total	847	1,776	2,623

Percentages

		Altered? No	Altered? Yes	Total
Mitigation?	Full	21.8%	22.6%	44.3%
	Partial	1.4%	6.1%	7.4%
	None	9.1%	39.1%	48.2%
	Total	32%	68%	100%

Figure I-28. MINESTRONE Mitigation and Altered Functionality Results

I.2.1 MINESTRONE Modified Results by Base Programs

Table I-11 MINESTRONE Mitigation and Altered Functionality Results (by Base Program)

Base Program	Total Test Cases	Full Mitigation No Altered Function	Partial Mitigation No Altered Function	No Mitigation No Altered Function	Full Mitigation Altered Function	Partial Mitigation Altered Function	No Mitigation Altered Function
FFMP	471	86	4	39	180	48	114
GIMP	461	0	0	0	12	3	446
OSSL	477	276	11	95	36	6	53
PSQL	306	0	0	0	210	14	82
SUBV	422	209	21	106	35	10	42
WIRE	485	0	0	0	119	78	288
Grand Total	**2622**	**571**	**36**	**240**	**592**	**159**	**1025**

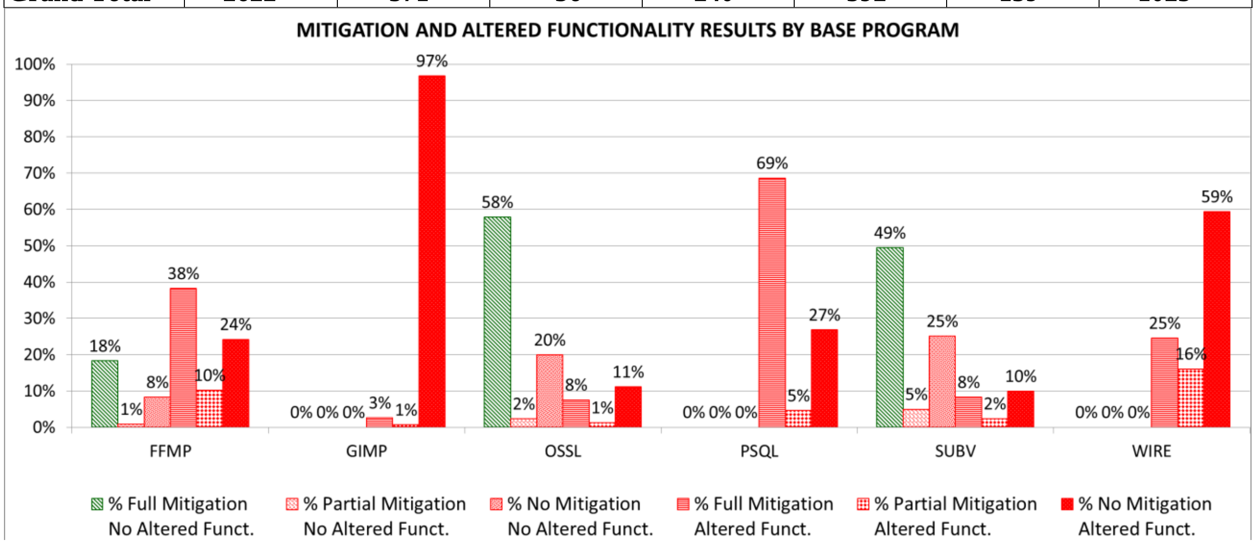

Figure I-29. MINESTRONE Mitigation and Altered Functionality Results (by Base Program)

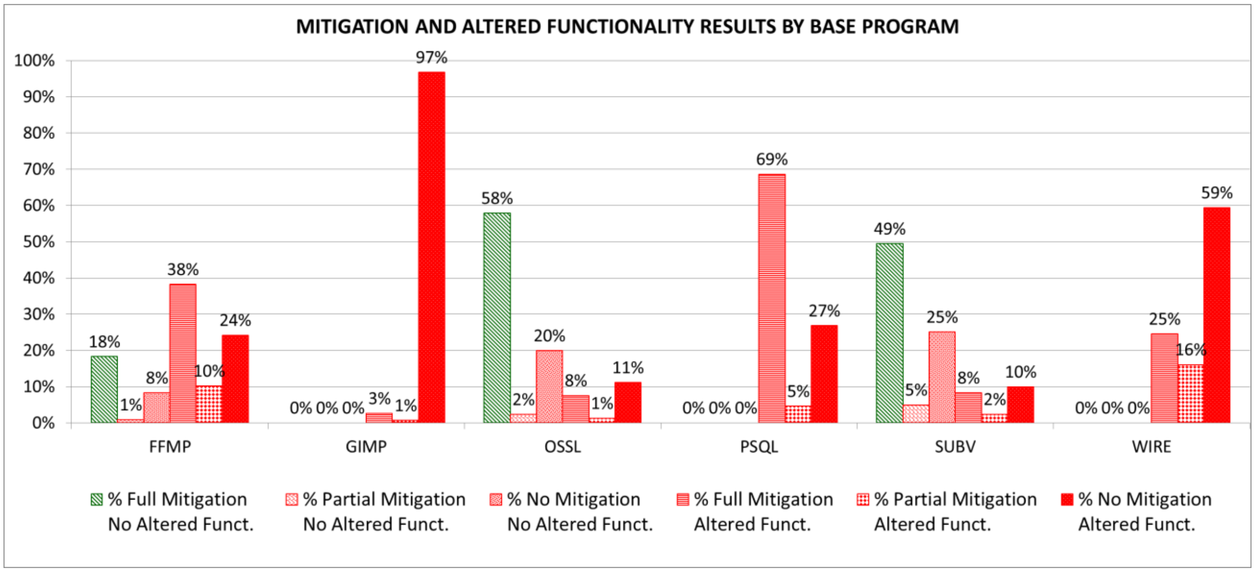

Figure I-30. MINESTRONE Mitigation and Altered Functionality Results (percentage by Base Program)

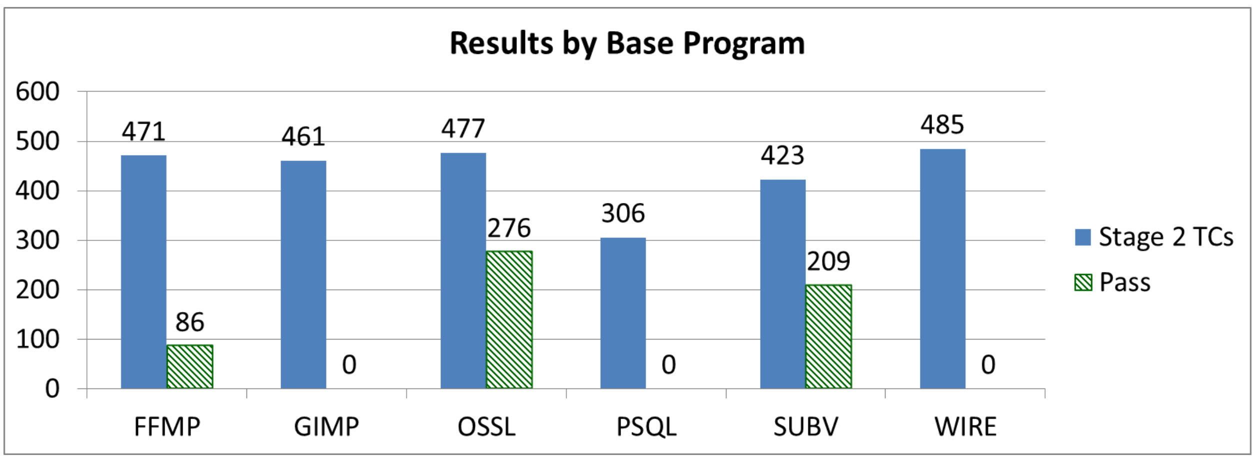

Figure I-31. MINESTRONE Number of Passing Test Cases (by Base Program)

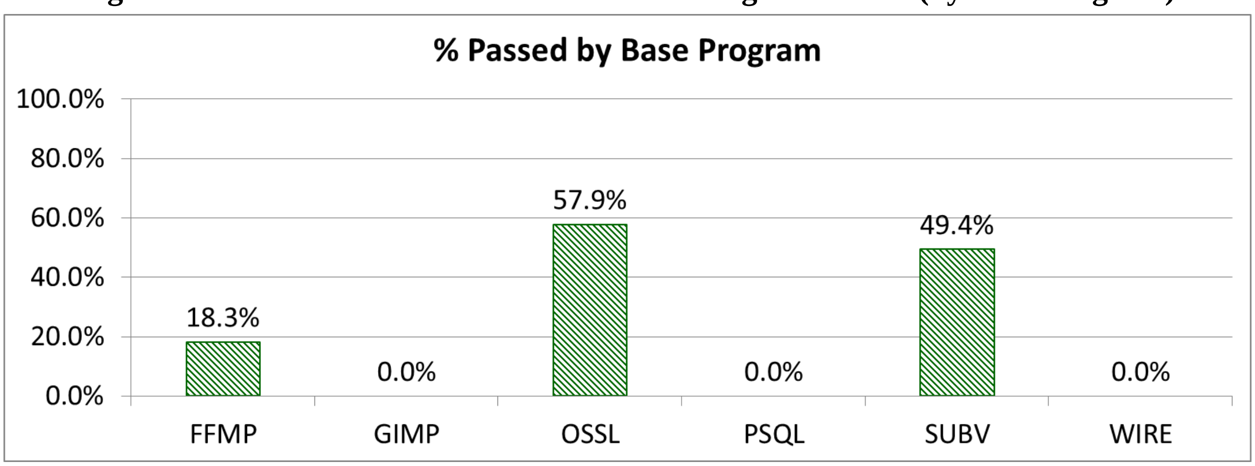

Figure I-32. MINESTRONE Percentage of Passing Test Cases (by Base Program)

I.2.2 MINESTRONE Modified Results by Weakness Classes and Target Weaknesses

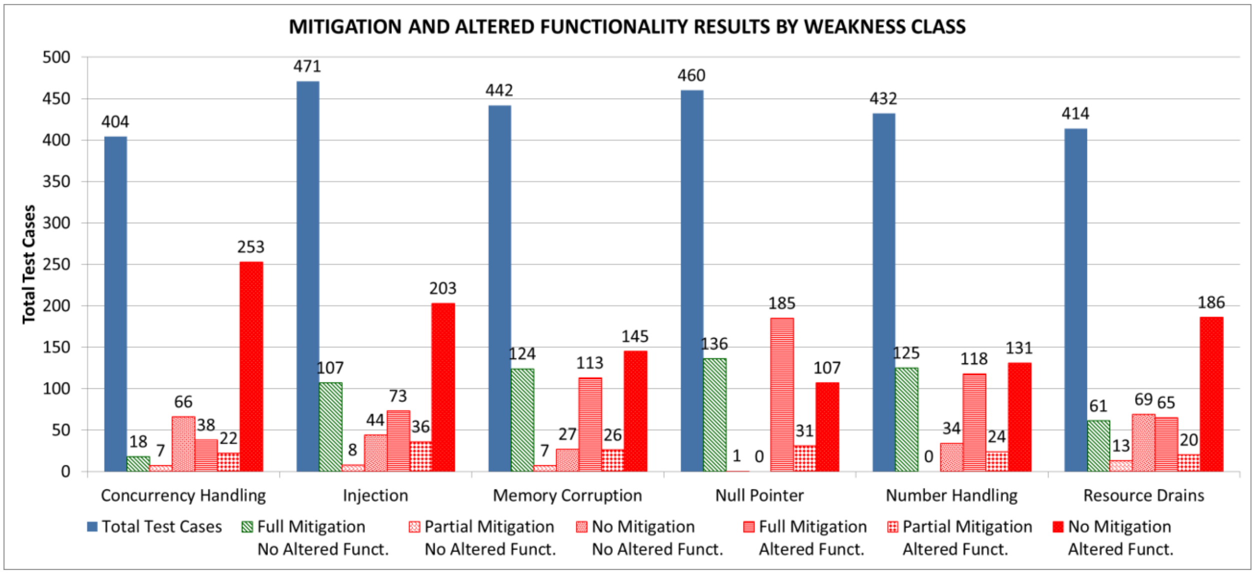

Figure I-33. MINESTRONE Mitigation and Altered Functionality Results (by Weakness Class)

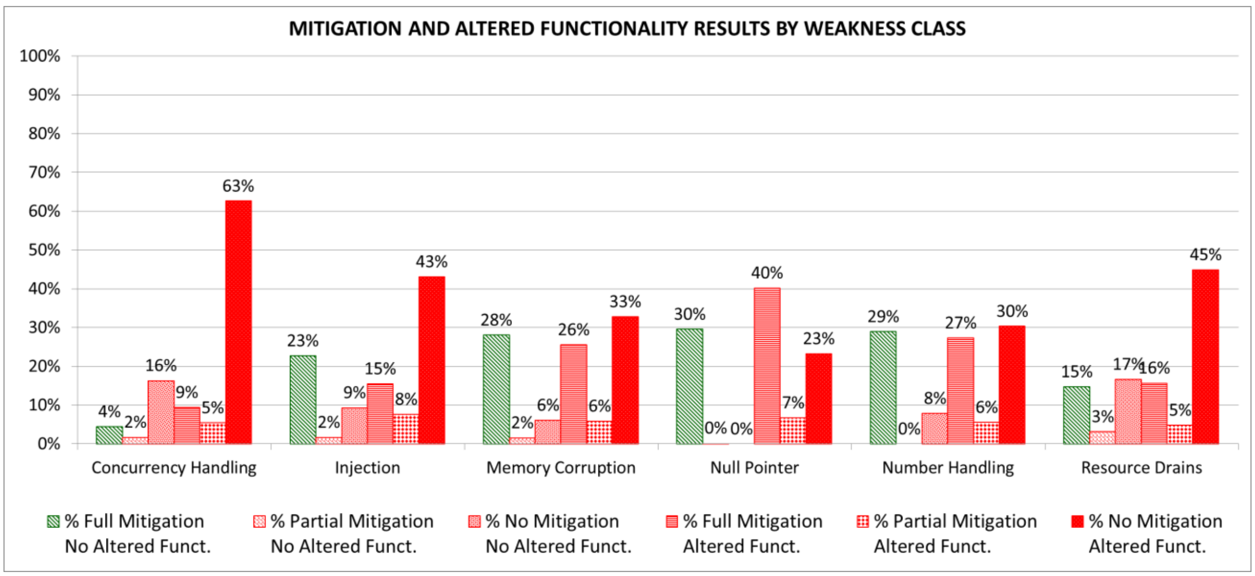

Figure I-34. MINESTRONE Mitigation and Altered Functionality Results (percentage by Weakness Class)

Table I-12 MINESTRONE Mitigation and Altered Functionality Results (by Weakness Class)

Target Weakness Class	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & No Alt Function)	% Pass
Concurrency Handling	438	404	91	23%	56	14%	18	4%
Injection	518	471	159	34%	180	38%	107	23%
Memory Corruption	497	442	158	36%	237	54%	124	28%
Null Pointer	506	460	137	30%	321	70%	136	30%

Target Weakness Class	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & No Alt Function)	% Pass
Number Handling	493	432	159	37%	243	56%	125	29%
Resource Drains	469	414	143	35%	126	30%	61	15%
Grand Total	**2921**	**2623**	**847**	**32.3%**	**1163**	**44.3%**	**571**	**21.8%**

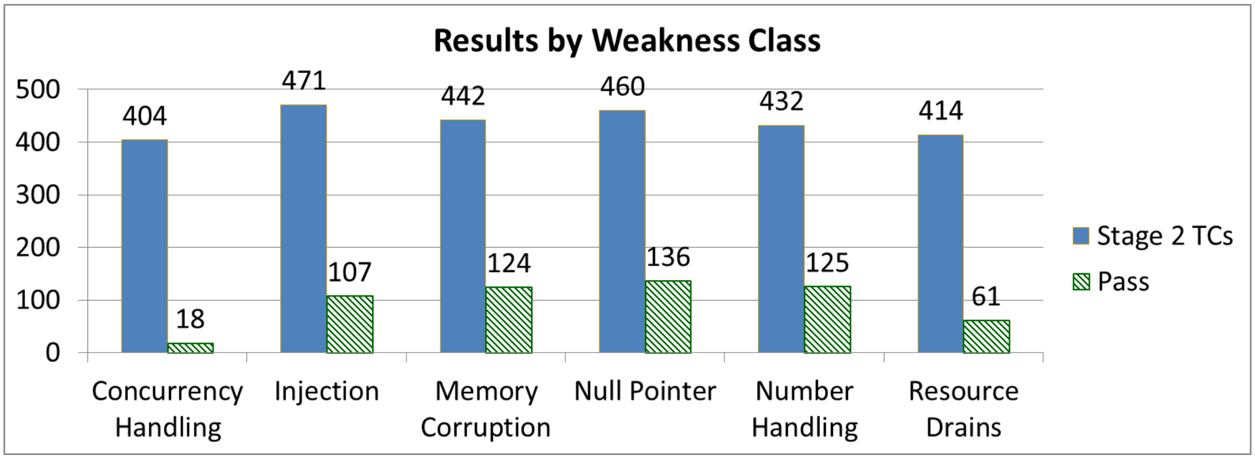

Figure I-35. MINESTRONE Number of Passing Test Cases (by Weakness Class)

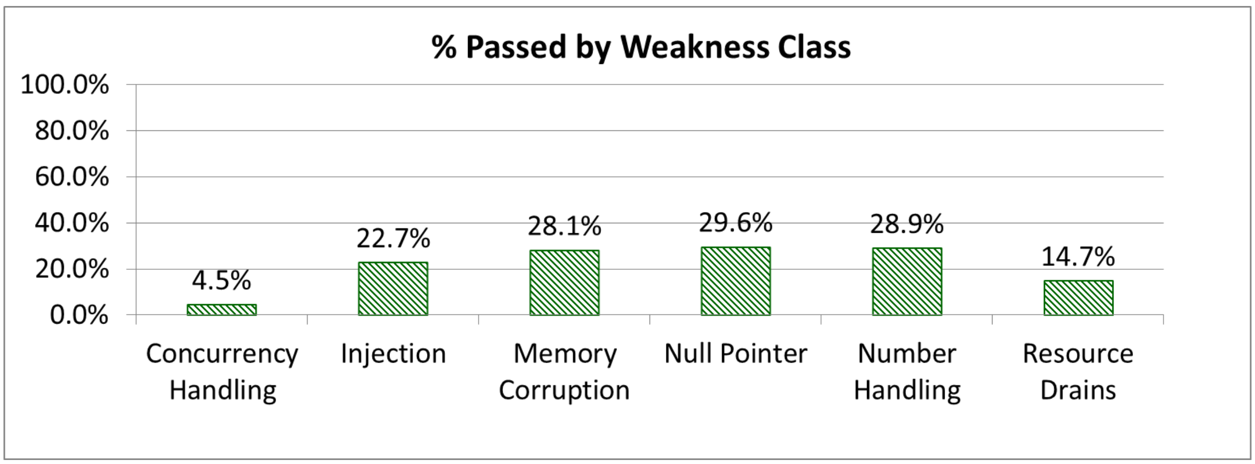

Figure I-36. MINESTRONE Percentage of Passing Test Cases (by Weakness Class)

Table I-13. MINESTRONE Mitigation and Altered Functionality Results (by CWE)

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling								
363A	28	26	10	38%	2	8%	0	0%
367A	30	29	10	34%	7	24%	3	10%
412A	28	24	11	46%	0	0%	0	0%
414A	23	22	0	0%	2	9%	0	0%
479A	31	30	16	53%	2	7%	0	0%
543A	27	27	0	0%	0	0%	0	0%
609A	23	23	1	4%	2	9%	1	4%
663A	24	22	10	45%	17	77%	9	41%
764A	31	25	7	28%	4	16%	1	4%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
765A	25	22	0	0%	0	0%	0	0%
765B	25	24	0	0%	4	17%	0	0%
820A	24	22	0	0%	4	18%	0	0%
821A	28	26	1	4%	3	12%	1	4%
828A	31	27	12	44%	6	22%	2	7%
831A	31	28	13	46%	2	7%	1	4%
833A	29	27	0	0%	1	4%	0	0%
Injection								
078A	83	82	20	24%	22	27%	3	4%
078B	63	61	21	34%	11	18%	4	7%
088A	81	70	22	31%	23	33%	7	10%
088B	66	62	3	5%	9	15%	0	0%
089A	56	48	21	44%	27	56%	21	44%
089B	56	49	24	49%	30	61%	24	49%
089C	57	54	26	48%	32	59%	26	48%
089D	56	45	22	49%	26	58%	22	49%
Memory Corruption								
120A	13	11	3	27%	8	73%	2	18%
120B	12	12	5	42%	0	0%	0	0%
120C	13	12	5	42%	7	58%	5	42%
120D	11	11	5	45%	8	73%	5	45%
124A	13	12	5	42%	8	67%	5	42%
124B	9	6	3	50%	0	0%	0	0%
124C	12	10	5	50%	8	80%	5	50%
124D	13	10	3	30%	6	60%	3	30%
126A	13	12	5	42%	1	8%	1	8%
126B	13	12	3	25%	7	58%	3	25%
126C	13	11	2	18%	4	36%	0	0%
126D	12	12	2	17%	3	25%	0	0%
127A	13	11	3	27%	3	27%	1	9%
127B	13	9	4	44%	2	22%	0	0%
127C	13	10	4	40%	0	0%	0	0%
127D	13	13	4	31%	3	23%	0	0%
129A	3	2	0	0%	1	50%	0	0%
129B	13	12	5	42%	6	50%	5	42%
134A	13	13	6	46%	4	31%	4	31%
170A	12	11	4	36%	7	64%	4	36%
170B	13	11	1	9%	4	36%	1	9%
415A	13	11	6	55%	8	73%	6	55%
416A	9	9	4	44%	6	67%	4	44%
590A	13	13	4	31%	7	54%	4	31%
761A	12	9	3	33%	6	67%	3	33%
785A	13	10	2	20%	6	60%	2	20%
785B	13	12	4	33%	8	67%	4	33%
785C	11	10	3	30%	5	50%	3	30%
785D	12	12	4	33%	8	67%	4	33%
805A	12	11	4	36%	7	64%	4	36%
805B	12	10	5	50%	7	70%	5	50%
805C	13	12	6	50%	8	67%	6	50%
805D	12	10	4	40%	9	90%	4	40%
806A	11	11	3	27%	7	64%	2	18%
806B	13	12	4	33%	8	67%	4	33%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
806C	13	12	5	42%	9	75%	5	42%
806D	13	11	4	36%	7	64%	4	36%
822A	12	11	2	18%	7	64%	2	18%
824A	13	12	6	50%	11	92%	6	50%
824B	11	9	4	44%	6	67%	4	44%
843A	13	12	4	33%	7	58%	4	33%
Null Pointer								
476A	71	59	22	37%	41	69%	22	37%
476B	69	65	23	35%	49	75%	23	35%
476C	75	68	26	38%	49	72%	26	38%
476D	74	66	24	36%	46	70%	24	36%
476E	72	65	25	38%	47	72%	24	37%
476F	71	66	17	26%	43	65%	17	26%
476G	74	71	0	0%	46	65%	0	0%
Number Handling								
190A	46	44	17	39%	3	7%	1	2%
191A	46	40	13	33%	27	68%	13	33%
191B	45	40	15	38%	28	70%	15	38%
194A	47	41	14	34%	29	71%	14	34%
195A	47	42	11	26%	31	74%	11	26%
196A	48	44	17	39%	3	7%	0	0%
197A	45	38	19	50%	23	61%	19	50%
369A	47	42	19	45%	33	79%	19	45%
682A	31	19	2	11%	10	53%	2	11%
682B	46	41	17	41%	29	71%	16	39%
839A	45	41	15	37%	27	66%	15	37%
Resource Drains								
400A	43	39	16	41%	2	5%	0	0%
400B	35	21	0	0%	2	10%	0	0%
401A	34	30	10	33%	12	40%	4	13%
459A	41	33	16	48%	20	61%	16	48%
674A	23	21	5	24%	10	48%	4	19%
771A	43	40	15	38%	15	38%	8	20%
773A	42	40	16	40%	12	30%	2	5%
774A	43	41	14	34%	7	17%	1	2%
775A	38	36	17	47%	7	19%	2	6%
789A	41	38	14	37%	25	66%	14	37%
834A	43	39	11	28%	14	36%	10	26%
835A	43	36	9	25%	0	0%	0	0%
Grand Total	**2921**	**2623**	**847**	**32.3%**	**1163**	**44.3%**	**571**	**21.8%**

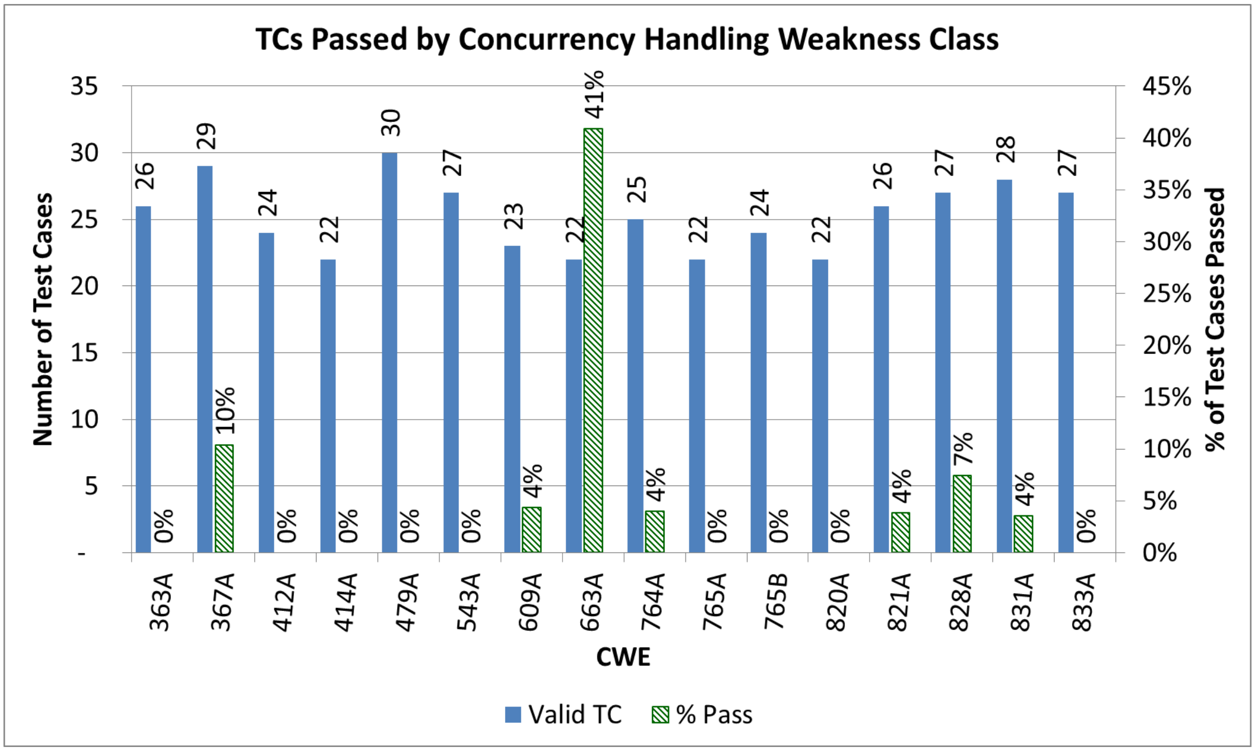

Figure I-37. MINESTRONE Passing Test Cases (by Concurrency Handling CWEs)

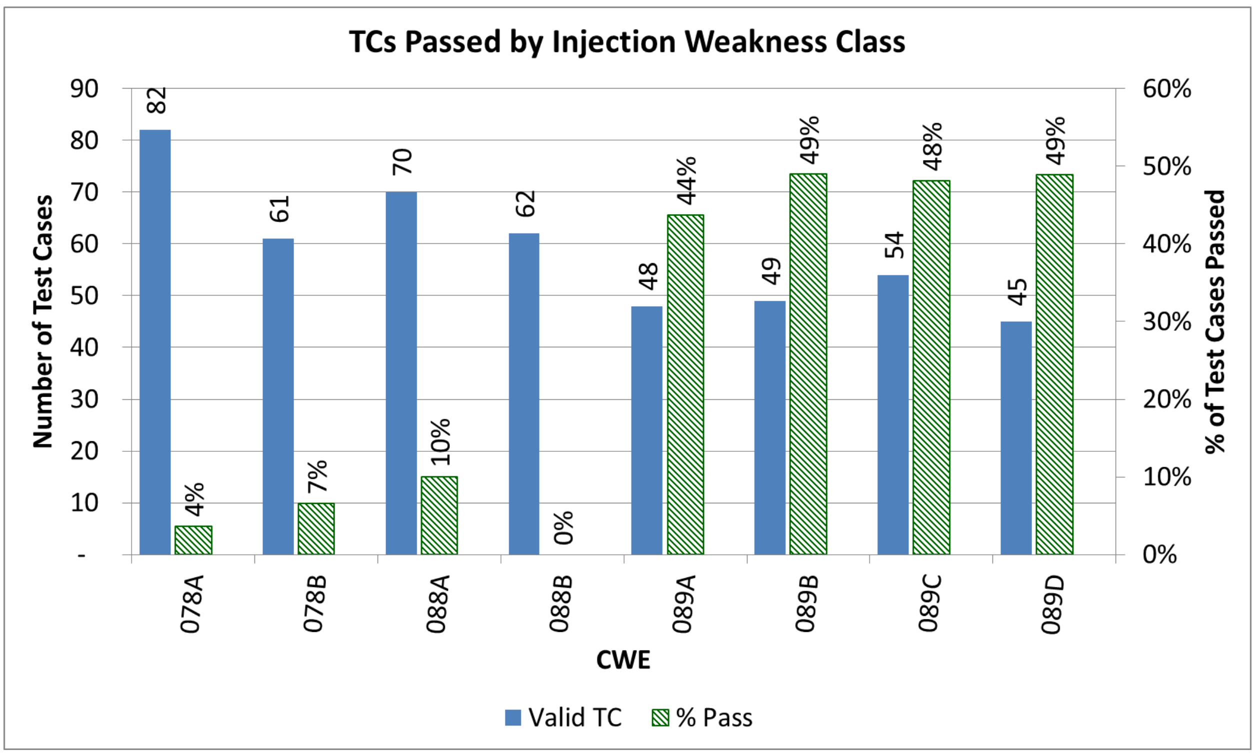

Figure I-38 MINESTRONE Passing Test Cases (by Injection CWEs)

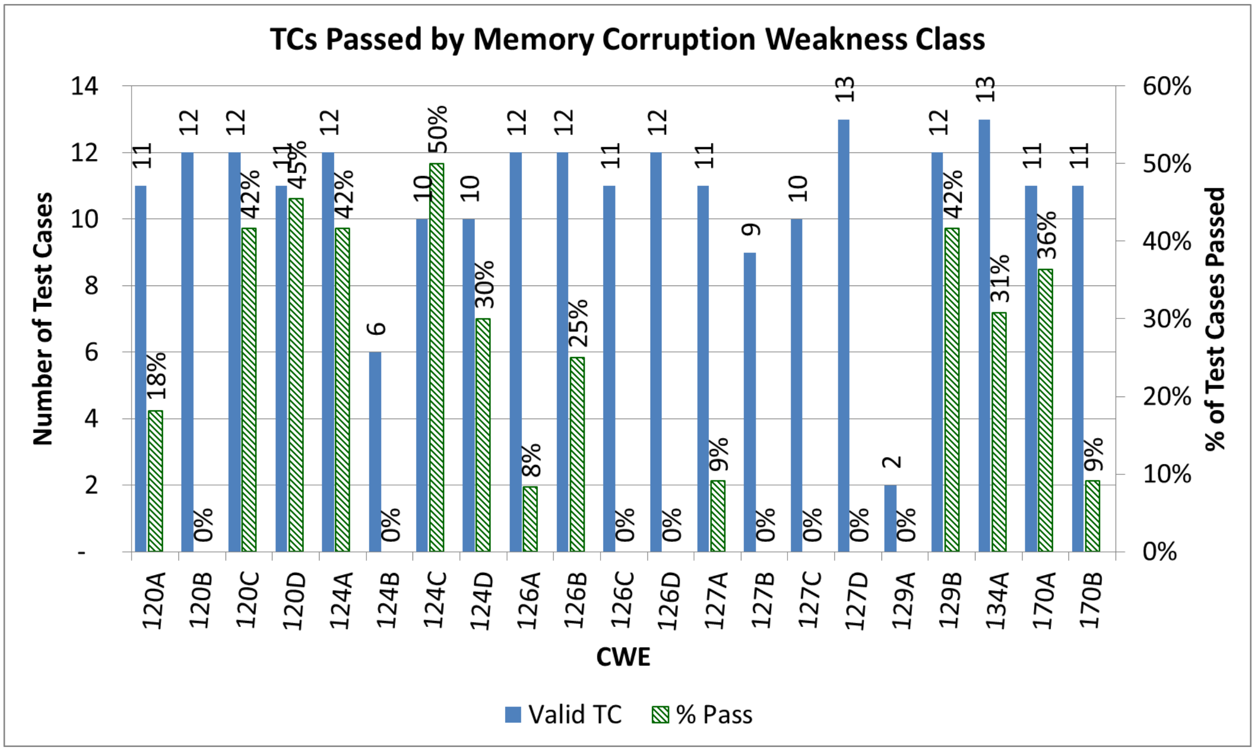

Figure I-39. MINESTRONE Passing Test Cases (by Memory Corruption CWEs) (Part 1)

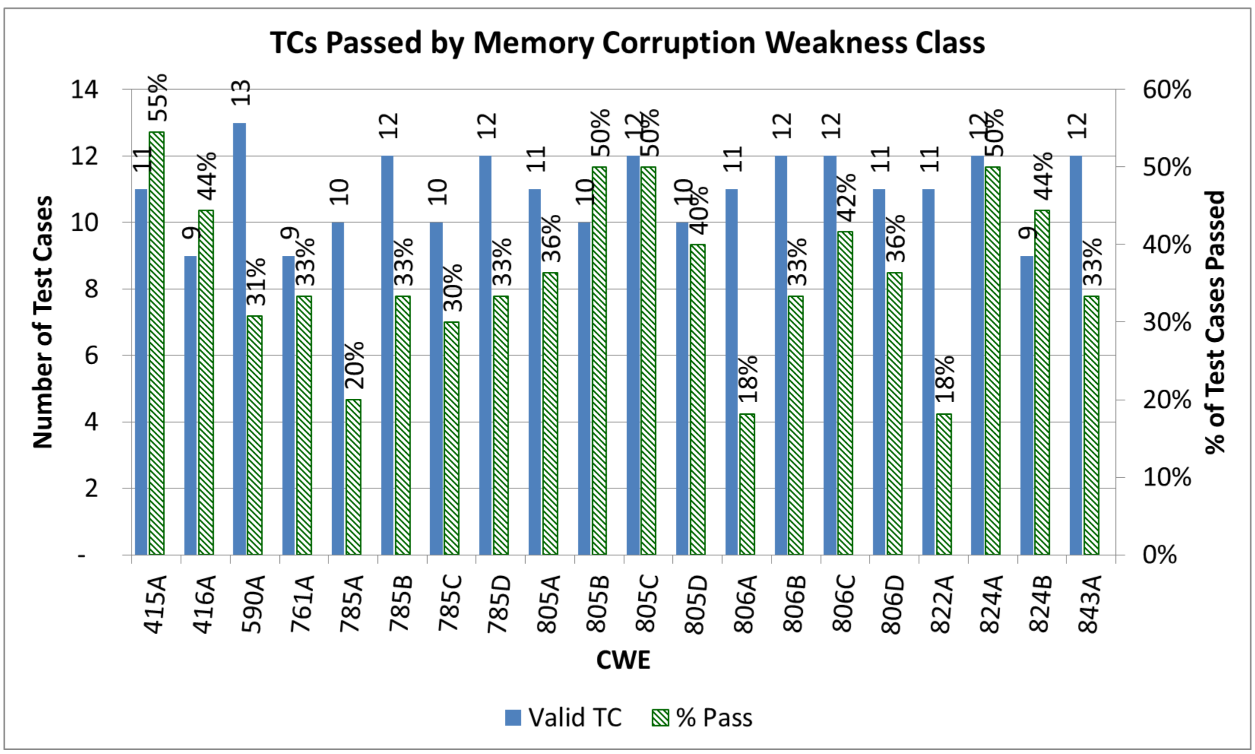

Figure I-40. MINESTRONE Passing Test Cases (by Memory Corruption CWEs) (Part 2)

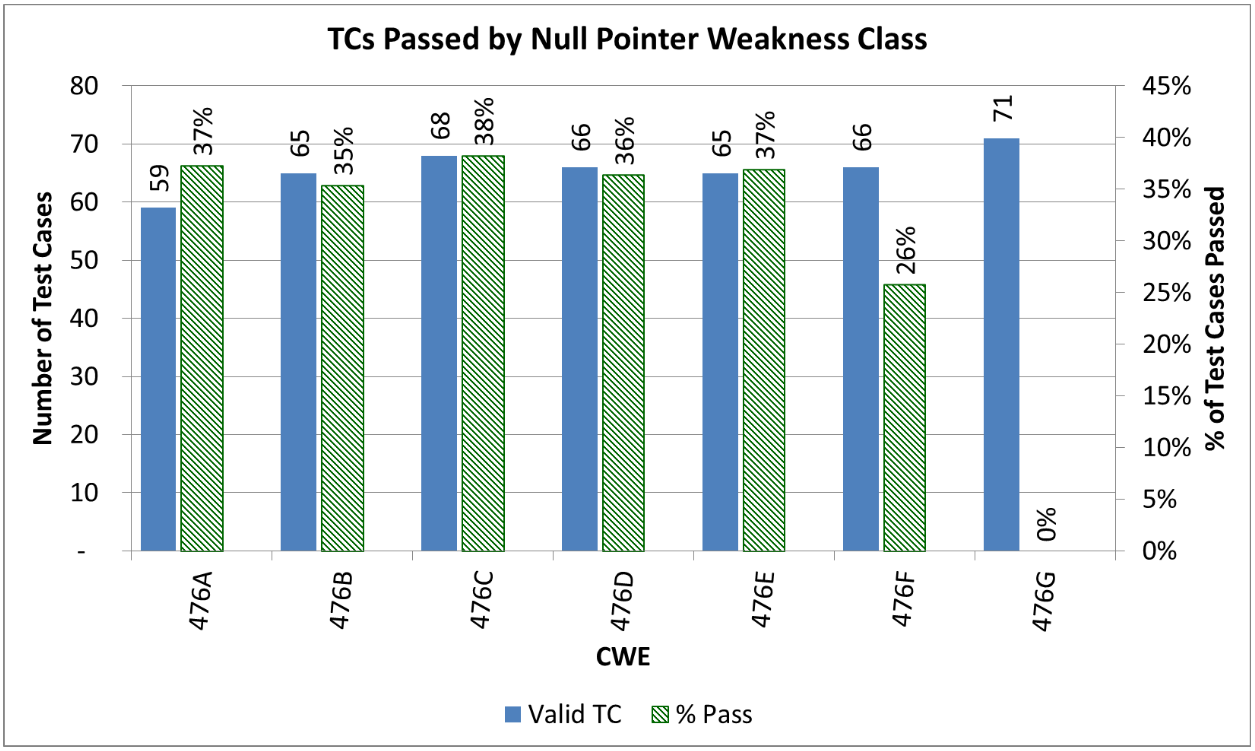

Figure I-41. MINESTRONE Passing Test Cases (by Null Pointer CWEs)

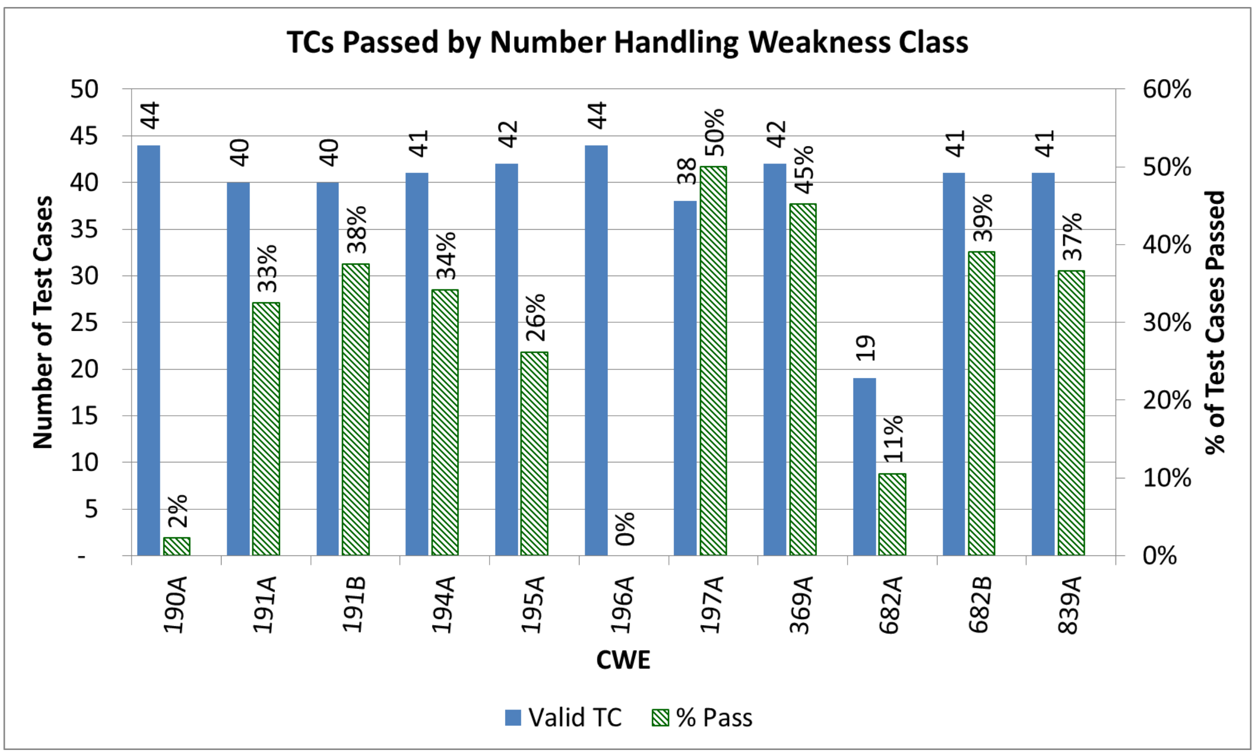

Figure I-42. MINESTRONE Passing Test Cases (by Number Handling CWEs)

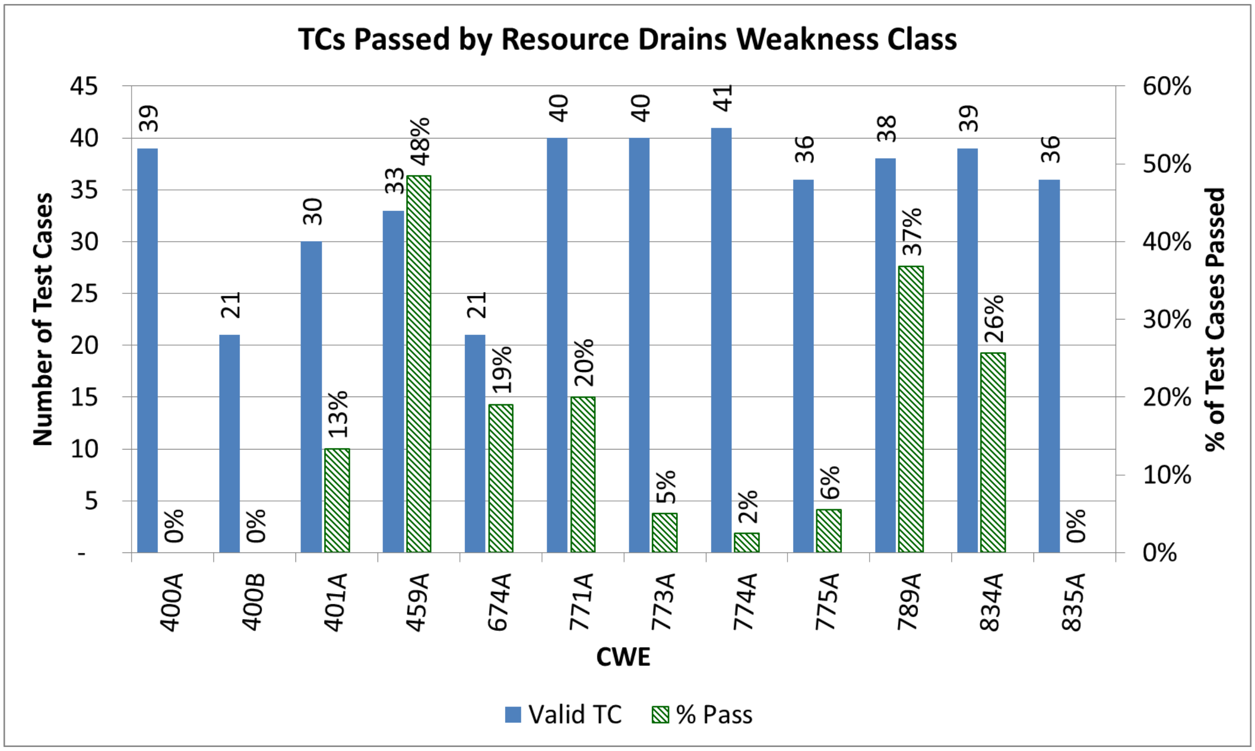

Figure I-43. MINESTRONE Passing Test Cases (by Resource Drain CWEs)

I.2.3 MINESTRONE Modified Results by Taint Source

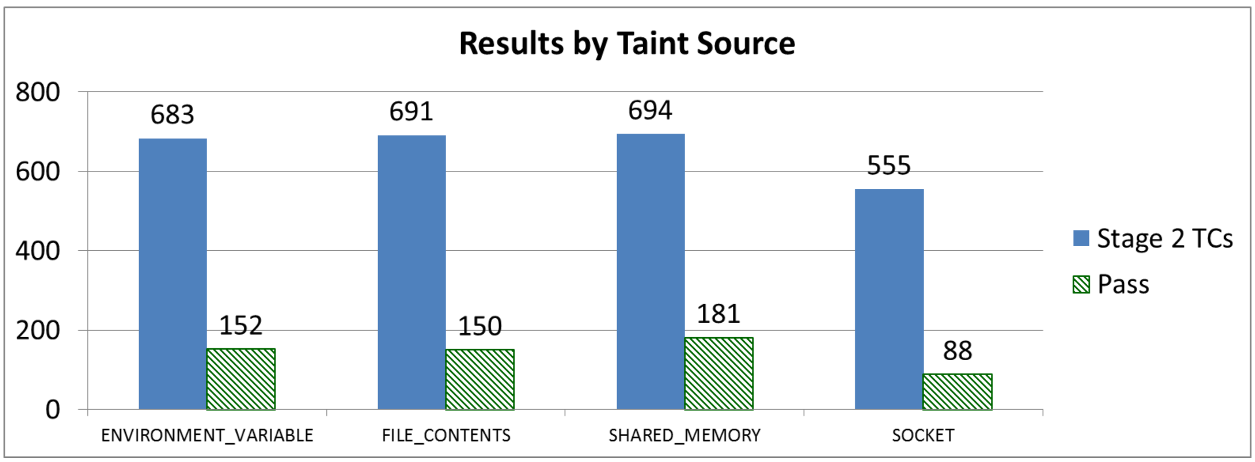

Figure I-44. MINESTRONE Number of Passing Test Cases (by Taint Source)

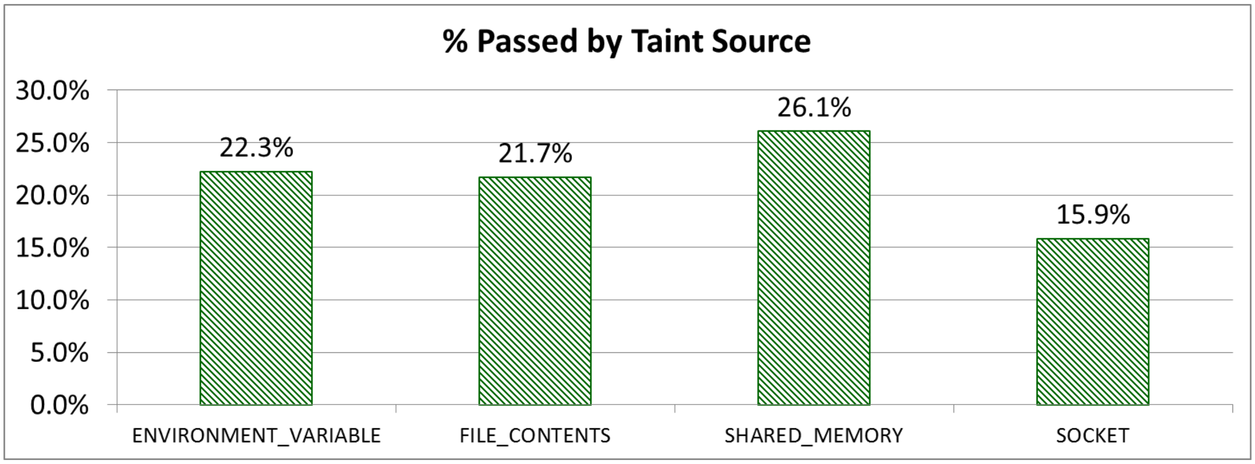

Figure I-45. MINESTRONE Percentage of Passing Test Cases (by Taint Source)

I.2.4 MINESTRONE Modified Results by Data Type Complexity

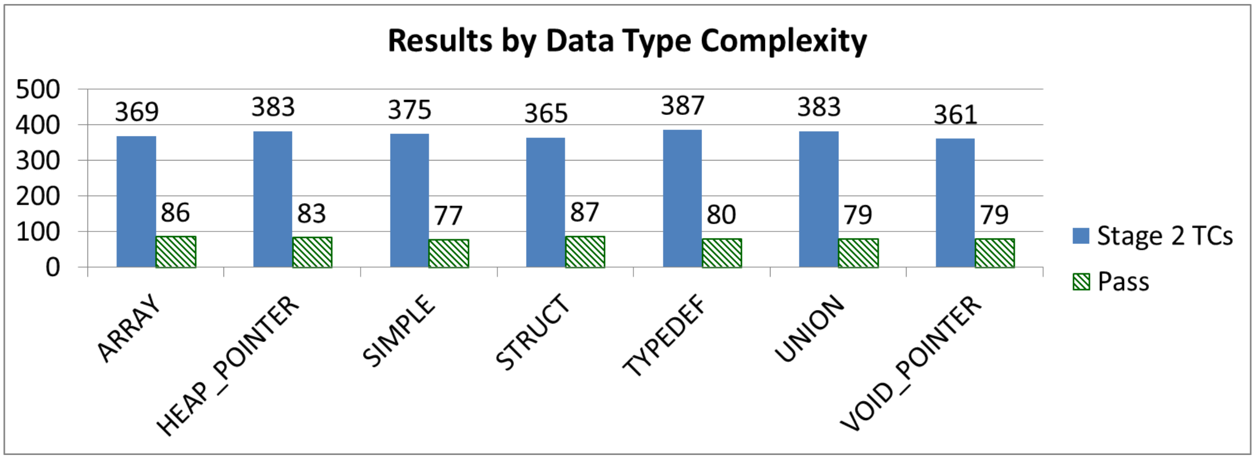

Figure I-46. MINESTRONE Number of Passing Test Cases (by Data Type Complexity)

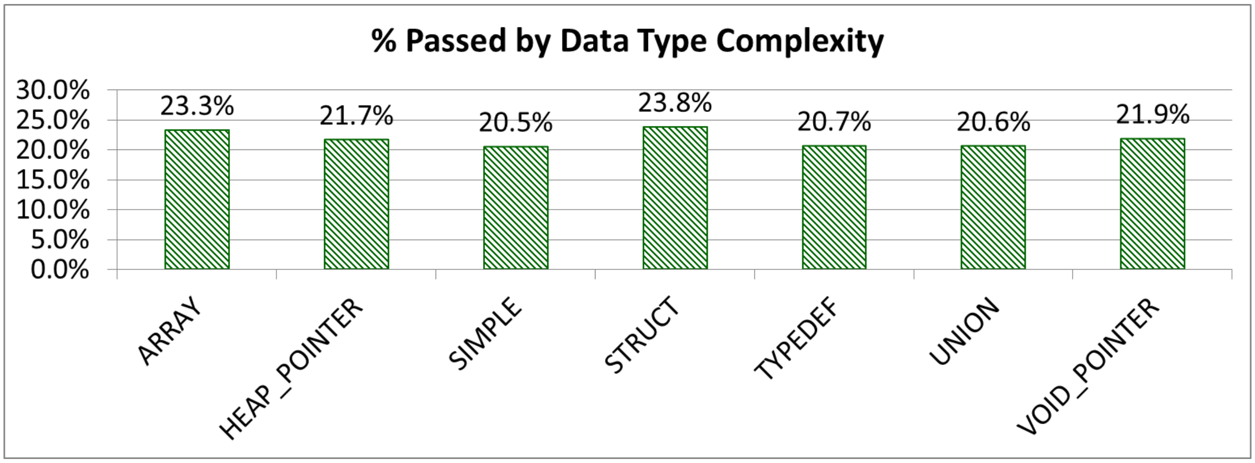

Figure I-47 MINESTRONE Percentage of Passing Test Cases (by Data Type Complexity)

I.2.5 MINESTRONE Modified Results by Data Flow Complexity

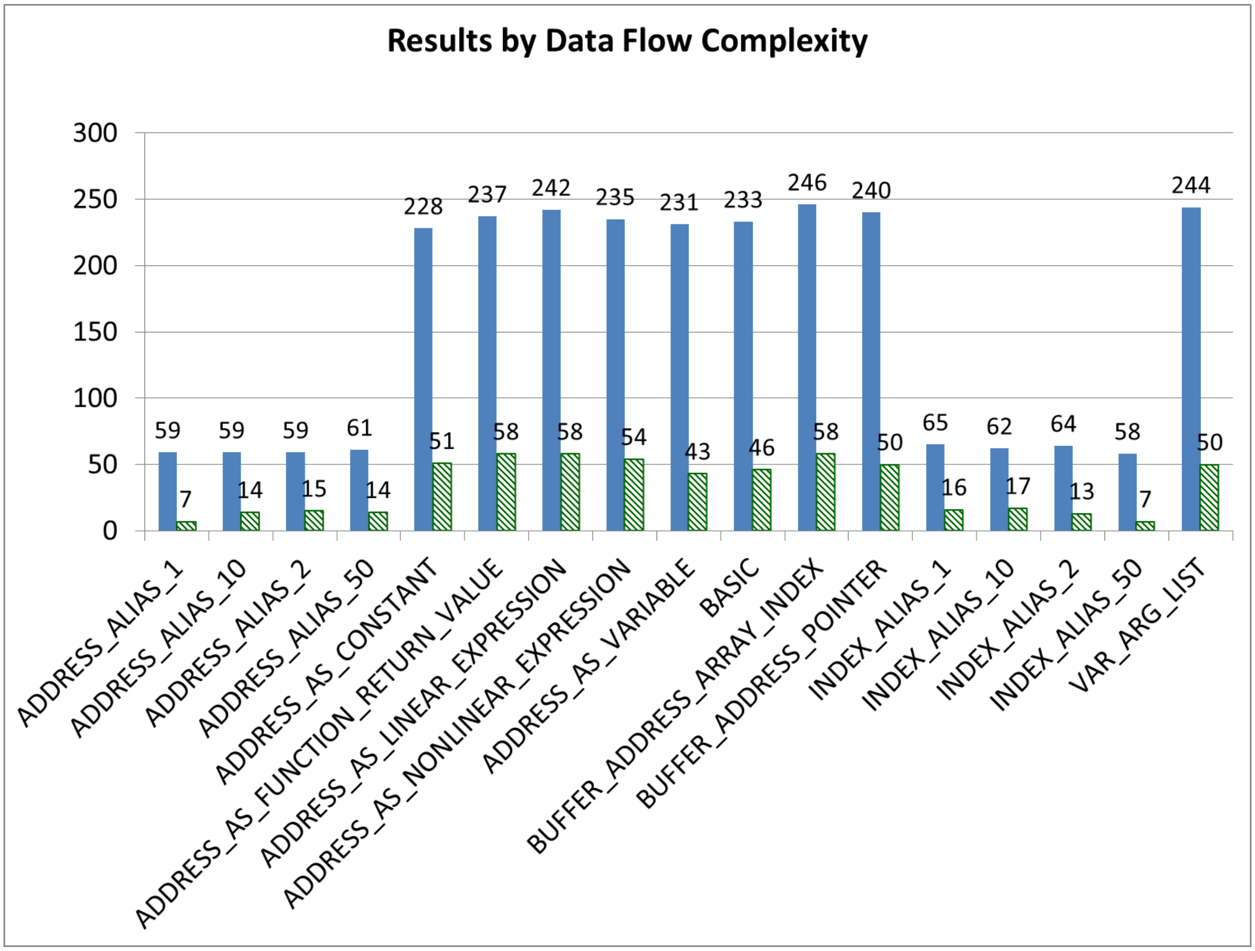

Figure I-48. MINESTRONE Number of Passing Test Cases (by Data Flow Complexity)

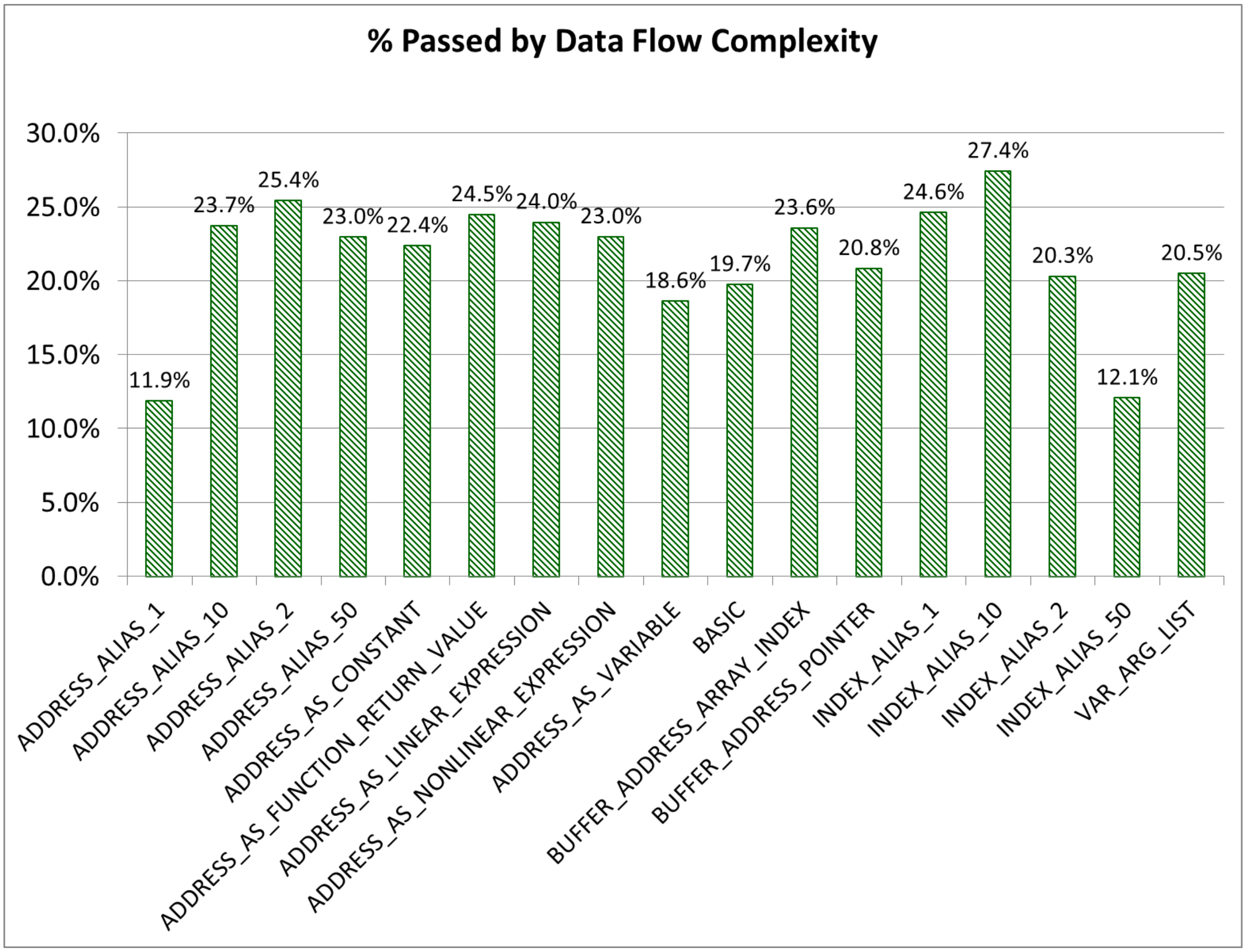

Figure I-49. MINESTRONE Percentage of Passing Test Cases (by Data Flow Complexity)

I.2.6 MINESTRONE Modified Results by Control Flow Complexity

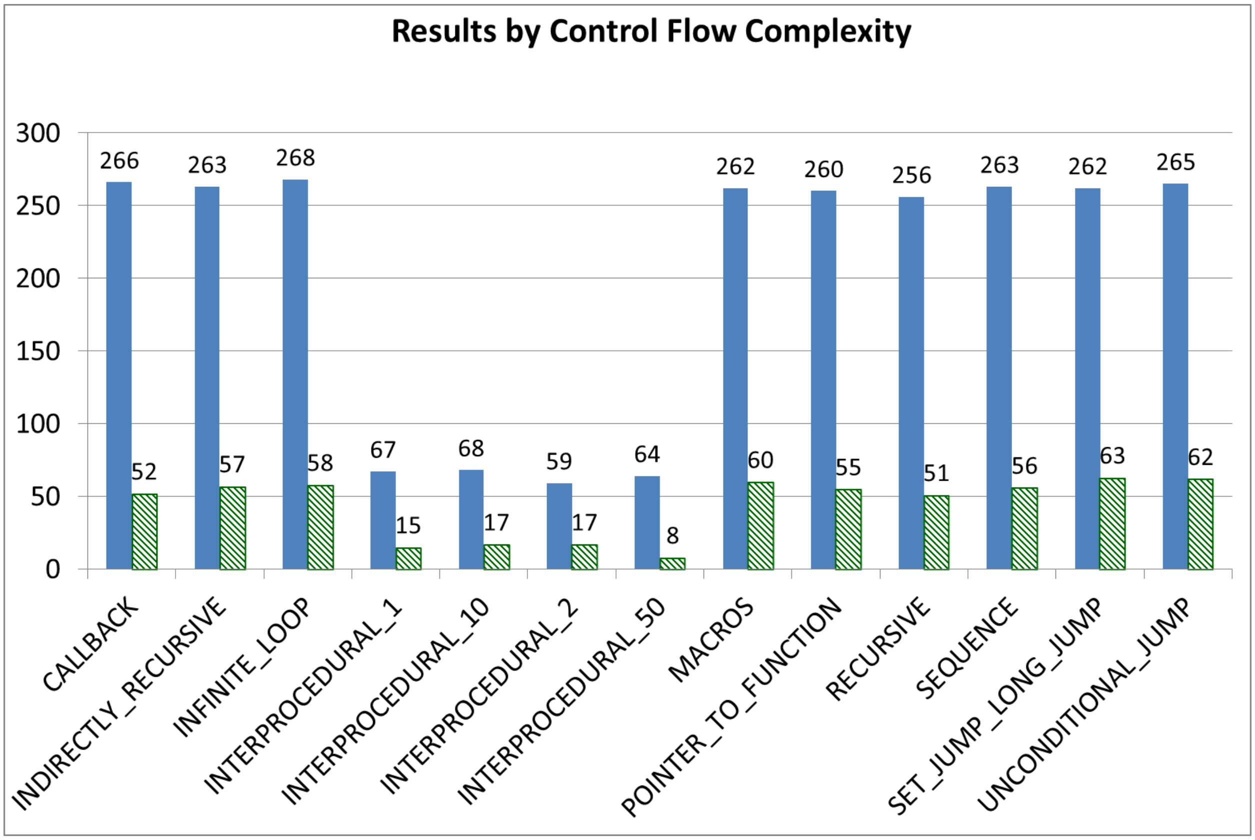

Figure I-50. MINESTRONE Number of Passing Test Cases (by Control Flow Complexity)

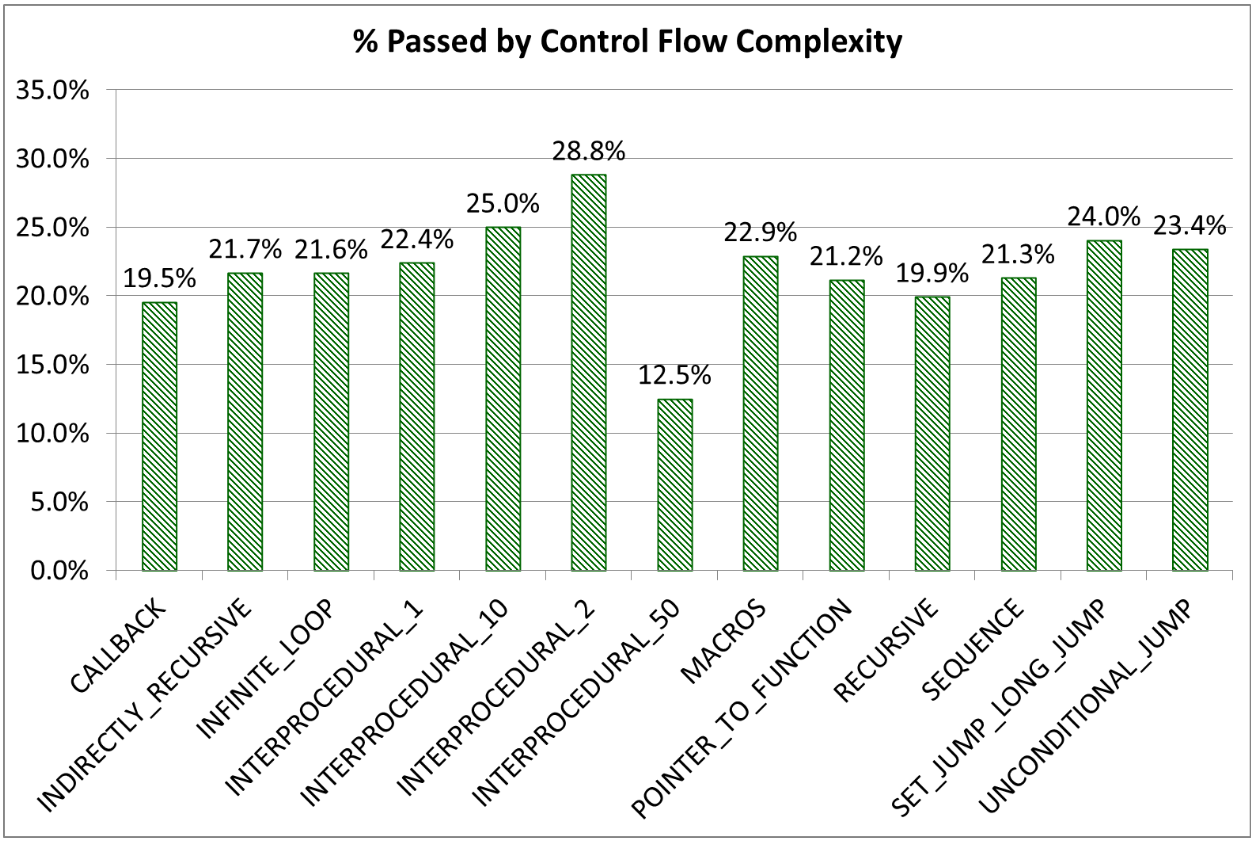

Figure I-51. MINESTRONE Percentage of Passing Test Cases (by Control Flow Complexity)

I.2.7 MINESTRONE Modified Results by File Size

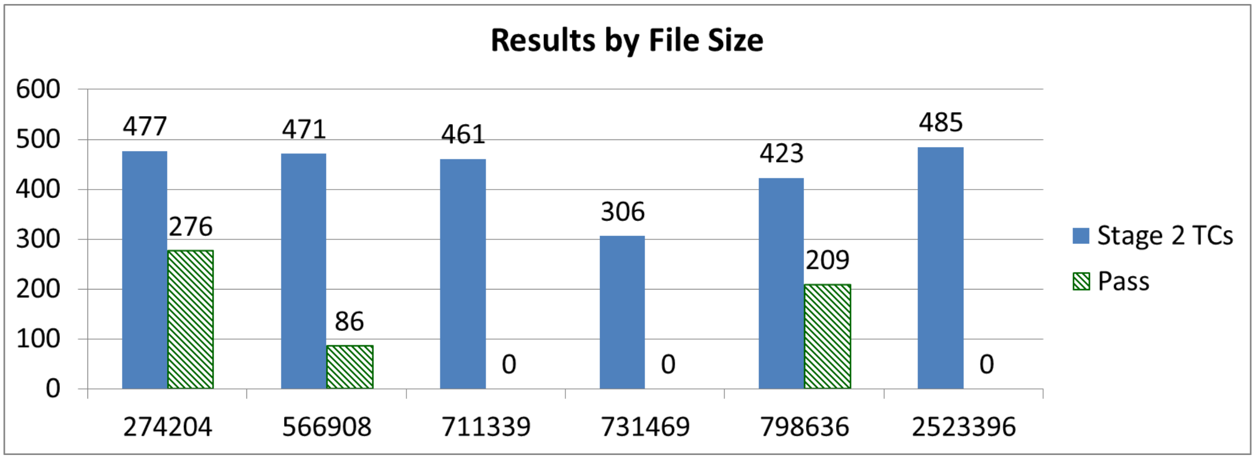

Figure I-52. MINESTRONE Number of Passing Test Cases (by File Size)

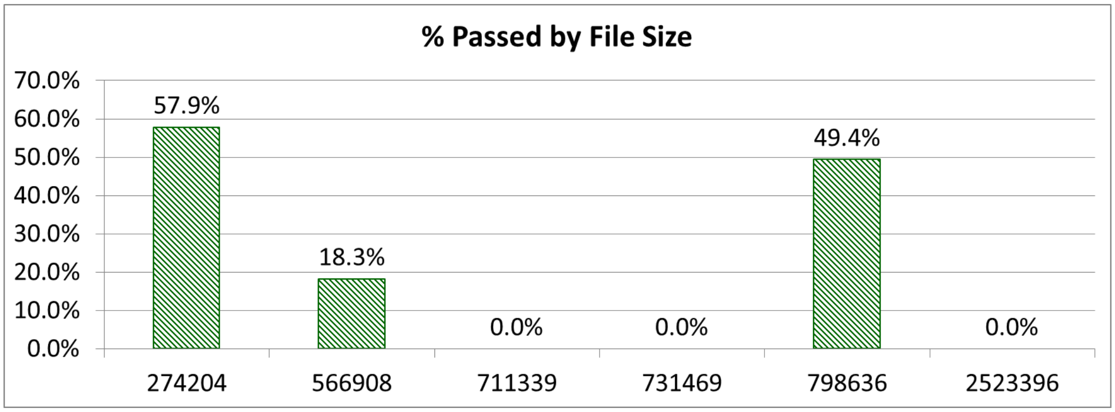

Figure I-53. MINESTRONE Percentage of Passing Test Cases (by File Size)

I.2.8 MINESTRONE Modified Performance Overhead

Table I-14. MINESTRONE Performance Overhead by Weakness Class

Weakness Class	% Increase
Concurrency Handling	1251.6%
Injection	287.8%
Memory Corruption	288.3%
Null Pointer	361.2%
Number Handling	342.9%
Resource Drains	473.9%
Grand Total	**472.7%**

Table I-15. MINESTRONE Performance Overhead by Base Program

Base Program	% Increase
FFMP	4511.8%
GIMP	509.6%
OSSL	4304.0%
PSQL	-52.9%
SUBV	3748.6%
WIRE	841.3%
Grand Total	**472.7%**

Table I-16. MINESTRONE Performance Overhead by Taint Source

Taint Source	% Increase
ENVIRONMENT_VARIABLE	1815.6%
FILE_CONTENTS	735.8%
SHARED_MEMORY	311.0%
SOCKET	651.0%
Grand Total	**472.7%**

Table I-17. MINESTRONE Performance Overhead by Data Type Complexity

Data Type Complexity	% Increase
ARRAY	398.2%
HEAP_POINTER	480.6%
SIMPLE	929.6%
STRUCT	293.7%
TYPEDEF	305.8%
UNION	755.1%
VOID_POINTER	420.7%
Grand Total	**472.7%**

Table I-18. MINESTRONE Performance Overhead by Data Flow Complexity

Data Flow Complexity	% Increase
ADDRESS_ALIAS_1	441.4%
ADDRESS_ALIAS_10	410.7%
ADDRESS_ALIAS_2	1173.4%
ADDRESS_ALIAS_50	220.6%
ADDRESS_AS_CONSTANT	694.7%
ADDRESS_AS_FUNCTION_RETURN_VALUE	292.9%
ADDRESS_AS_LINEAR_EXPRESSION	403.4%
ADDRESS_AS_NONLINEAR_EXPRESSION	324.6%
ADDRESS_AS_VARIABLE	345.0%
BASIC	640.2%
BUFFER_ADDRESS_ARRAY_INDEX	445.3%
BUFFER_ADDRESS_POINTER	554.6%
INDEX_ALIAS_1	342.0%
INDEX_ALIAS_10	831.5%
INDEX_ALIAS_2	318.1%
INDEX_ALIAS_50	356.1%
VAR_ARG_LIST	741.5%
Grand Total	**472.7%**

Table I-19. MINESTRONE Performance Overhead by Control Flow Complexity

Control Flow Complexity	% Increase
CALLBACK	767.3%
INDIRECTLY_RECURSIVE	257.0%
INFINITE_LOOP	309.8%
INTERPROCEDURAL_1	686.1%
INTERPROCEDURAL_10	498.2%
INTERPROCEDURAL_2	1314.6%
INTERPROCEDURAL_50	1583.3%
MACROS	370.0%
POINTER_TO_FUNCTION	275.4%
RECURSIVE	270.5%
SEQUENCE	1188.6%
SET_JUMP_LONG_JUMP	795.9%
UNCONDITIONAL_JUMP	264.8%
Grand Total	**472.7%**

Table I-20. MINESTRONE Performance Overhead by File Size

File Size	% Increase
274,204	4304.0%
566,908	4511.8%
711,339	509.6%
731,469	-52.9%
798,636	3748.6%
2,523,396	841.3%
Grand Total	**472.7%**

I.3 Results and Analysis of Phase 2-Sized Programs

Totals		Altered? No	Altered? Yes	Total
Mitigation?	Full	**129**	70	199
	Partial	54	30	84
	None	51	30	81
	Total	234	130	364

Percentages		Altered? No	Altered? Yes	Total
Mitigation?	Full	**35.4%**	19.2%	54.7%
	Partial	14.8%	8.2%	23.1%
	None	14.0%	8.2%	22.3%
	Total	64%	36%	100%

Figure I-54. MINESTRONE GREP Mitigation and Altered Functionality Results

I.3.1 MINESTRONE GREP Results by Weakness Classes and Target Weaknesses

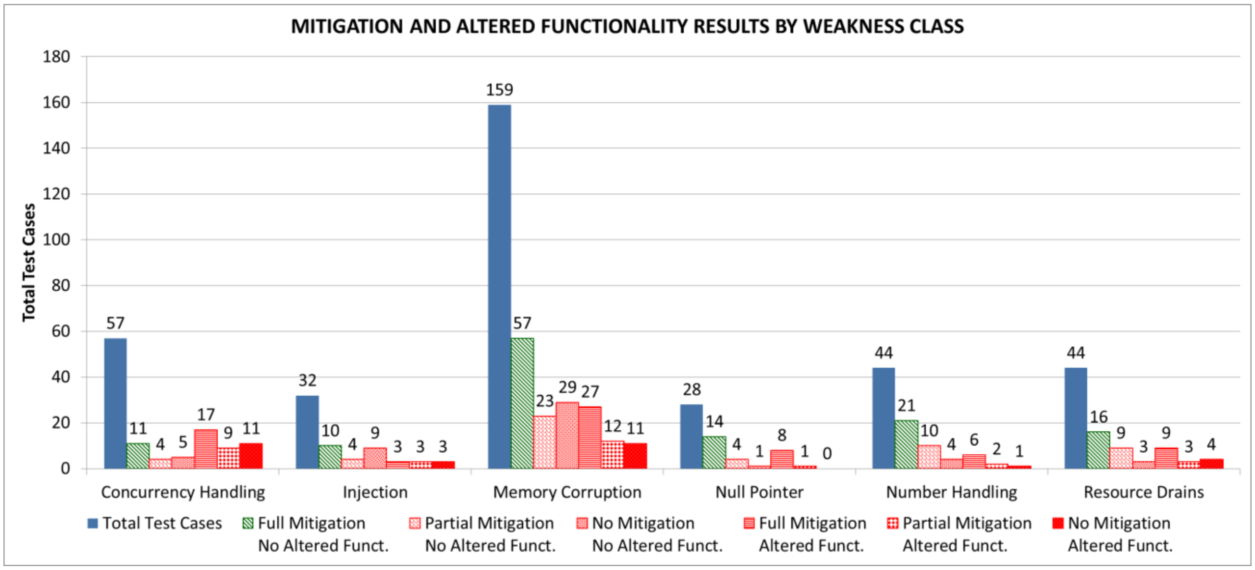

Figure I-55. MINESTRONE (GREP) Mitigation and Altered Functionality Results (by Weakness Class)

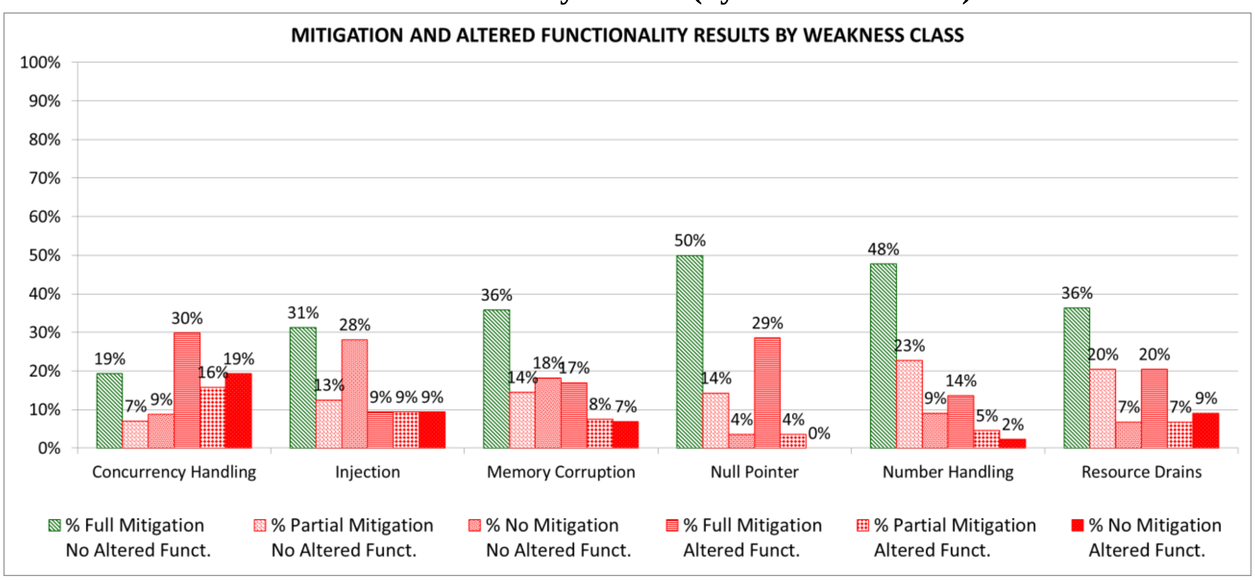

Figure I-56. MINESTRONE (GREP) Mitigation and Altered Functionality Results (percentage by Weakness Class)

Table I-21. MINESTRONE (GREP) Mitigation and Altered Functionality Results (by Weakness Class)

Target Weakness Class	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & No Alt Function)	% Pass
Concurrency Handling	64	57	20	35%	28	49%	11	19%
Injection	32	32	23	72%	13	41%	10	31%
Memory Corruption	164	159	109	69%	84	53%	57	36%
Null Pointer	28	28	19	68%	22	79%	14	50%
Number Handling	44	44	35	80%	27	61%	21	48%
Resource Drains	48	44	28	64%	25	57%	16	36%
Grand Total	**380**	**364**	**234**	**64.3%**	**199**	**54.7%**	**129**	**35.4%**

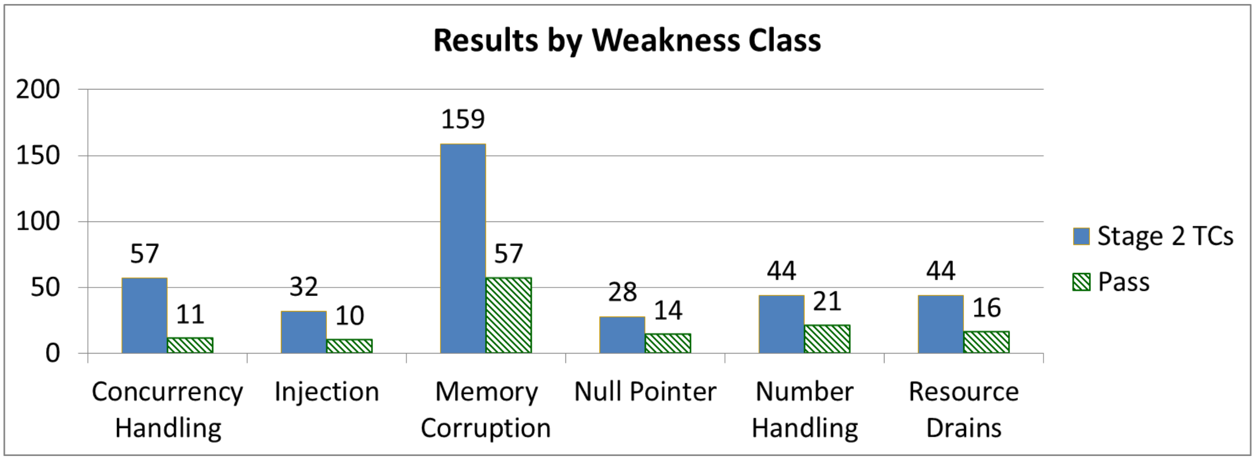

Figure I-57. MINESTRONE (GREP) Number of Passing Test Cases (by Weakness Class)

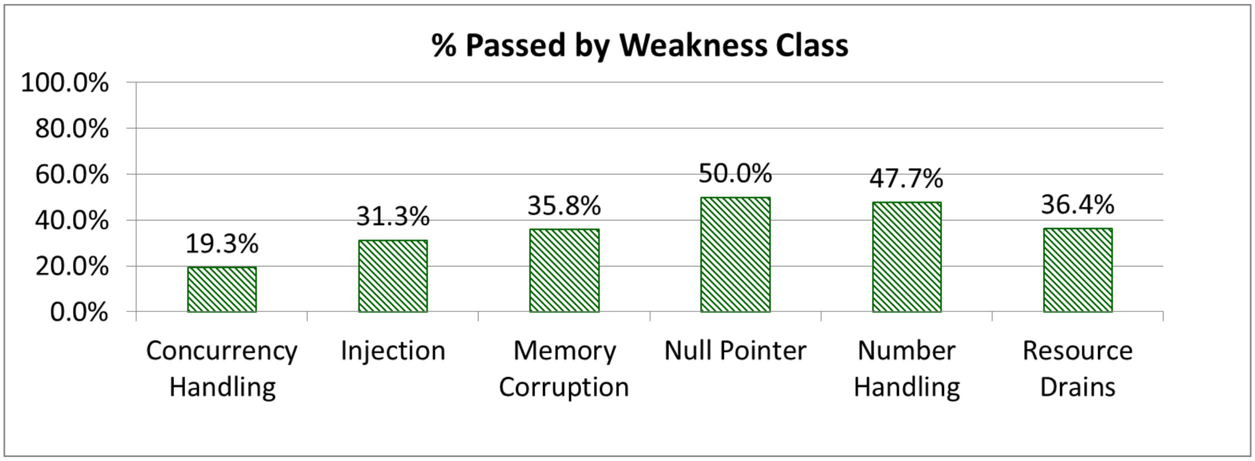

Figure I-58. MINESTRONE (GREP) Percentage of Passing Test Cases (by Weakness Class)

Table I-22. MINESTRONE (GREP) Mitigation and Altered Functionality Results (by CWE)

Weakness Class/CWE	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling								
363A	4	4	3	75%	3	75%	2	50%
367A	4	4	3	75%	3	75%	2	50%
412A	4	0	0	0	0	0	0	0
414A	4	3	0	0%	3	100%	0	0%
479A	4	4	3	75%	4	100%	3	75%
543A	4	4	1	25%	0	0%	0	0%
609A	4	4	0	0%	2	50%	0	0%
663A	4	2	0	0%	2	100%	0	0%
764A	4	4	2	50%	0	0%	0	0%
765A	4	4	0	0%	1	25%	0	0%
765B	4	4	0	0%	2	50%	0	0%
820A	4	4	0	0%	2	50%	0	0%
821A	4	4	0	0%	0	0%	0	0%
828A	4	4	3	75%	3	75%	2	50%
831A	4	4	3	75%	3	75%	2	50%
833A	4	4	2	50%	0	0%	0	0%
Injection								
078A	4	4	3	75%	0	0%	0	0%
078B	4	4	3	75%	0	0%	0	0%
088A	4	4	3	75%	1	25%	1	25%
088B	4	4	0	0%	3	75%	0	0%
089A	4	4	4	100%	3	75%	3	75%
089B	4	4	4	100%	2	50%	2	50%
089C	4	4	3	75%	2	50%	2	50%
089D	4	4	3	75%	2	50%	2	50%
Memory Corruption								
120A	4	4	3	75%	3	75%	2	50%
120B	4	4	2	50%	0	0%	0	0%
120C	4	4	3	75%	4	100%	3	75%
120D	4	4	3	75%	3	75%	2	50%
124A	4	4	3	75%	3	75%	3	75%
124B	4	3	2	67%	2	67%	1	33%
124C	4	4	2	50%	4	100%	2	50%
124D	4	4	2	50%	3	75%	1	25%
126A	4	4	3	75%	0	0%	0	0%
126B	4	4	3	75%	0	0%	0	0%
126C	4	4	0	0%	0	0%	0	0%
126D	4	4	2	50%	0	0%	0	0%
127A	4	4	3	75%	0	0%	0	0%
127B	4	4	3	75%	0	0%	0	0%
127C	4	4	4	100%	0	0%	0	0%
127D	4	4	3	75%	0	0%	0	0%
129A	4	1	0	0%	1	100%	0	0%
129B	4	4	2	50%	2	50%	0	0%
134A	4	4	3	75%	1	25%	1	25%
170A	4	4	3	75%	4	100%	3	75%
170B	4	4	1	25%	0	0%	0	0%

Weakness Class/CWE	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
415A	4	4	3	75%	4	100%	3	75%
416A	4	4	2	50%	3	75%	1	25%
590A	4	4	3	75%	4	100%	3	75%
761A	4	4	3	75%	3	75%	3	75%
785A	4	4	2	50%	3	75%	1	25%
785B	4	4	4	100%	2	50%	2	50%
785C	4	4	3	75%	2	50%	1	25%
785D	4	4	2	50%	3	75%	2	50%
805A	4	4	3	75%	3	75%	2	50%
805B	4	4	3	75%	2	50%	2	50%
805C	4	4	4	100%	2	50%	2	50%
805D	4	4	3	75%	3	75%	2	50%
806A	4	4	2	50%	2	50%	1	25%
806B	4	4	4	100%	3	75%	3	75%
806C	4	4	3	75%	2	50%	1	25%
806D	4	3	3	100%	2	67%	2	67%
822A	4	4	3	75%	2	50%	2	50%
824A	4	4	2	50%	3	75%	1	25%
824B	4	4	3	75%	3	75%	2	50%
843A	4	4	4	100%	3	75%	3	75%
Null Pointer								
476A	4	4	2	50%	3	75%	1	25%
476B	4	4	3	75%	3	75%	2	50%
476C	4	4	3	75%	4	100%	3	75%
476D	4	4	4	100%	3	75%	3	75%
476E	4	4	3	75%	3	75%	2	50%
476F	4	4	4	100%	3	75%	3	75%
476G	4	4	0	0%	3	75%	0	0%
Number Handling								
190A	4	4	4	100%	3	75%	3	75%
191A	4	4	4	100%	2	50%	2	50%
191B	4	4	3	75%	3	75%	2	50%
194A	4	4	3	75%	1	25%	1	25%
195A	4	4	2	50%	3	75%	1	25%
196A	4	4	3	75%	3	75%	2	50%
197A	4	4	3	75%	3	75%	2	50%
369A	4	4	4	100%	3	75%	3	75%
682A	4	4	4	100%	2	50%	2	50%
682B	4	4	2	50%	2	50%	1	25%
839A	4	4	3	75%	2	50%	2	50%
Resource Drains								
400A	4	4	3	75%	3	75%	2	50%
400B	4	1	0	0%	0	0%	0	0%
401A	4	3	3	100%	2	67%	2	67%
459A	4	4	4	100%	2	50%	2	50%
674A	4	4	4	100%	2	50%	2	50%
771A	4	4	0	0%	3	75%	0	0%
773A	4	4	1	25%	2	50%	1	25%
774A	4	4	3	75%	2	50%	2	50%
775A	4	4	2	50%	3	75%	1	25%
789A	4	4	3	75%	2	50%	2	50%

Weakness Class/CWE	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
834A	4	4	2	50%	1	25%	0	0%
835A	4	4	3	75%	3	75%	2	50%
Grand Total	**380**	**364**	**234**	**64.3%**	**199**	**54.7%**	**129**	**35.4%**

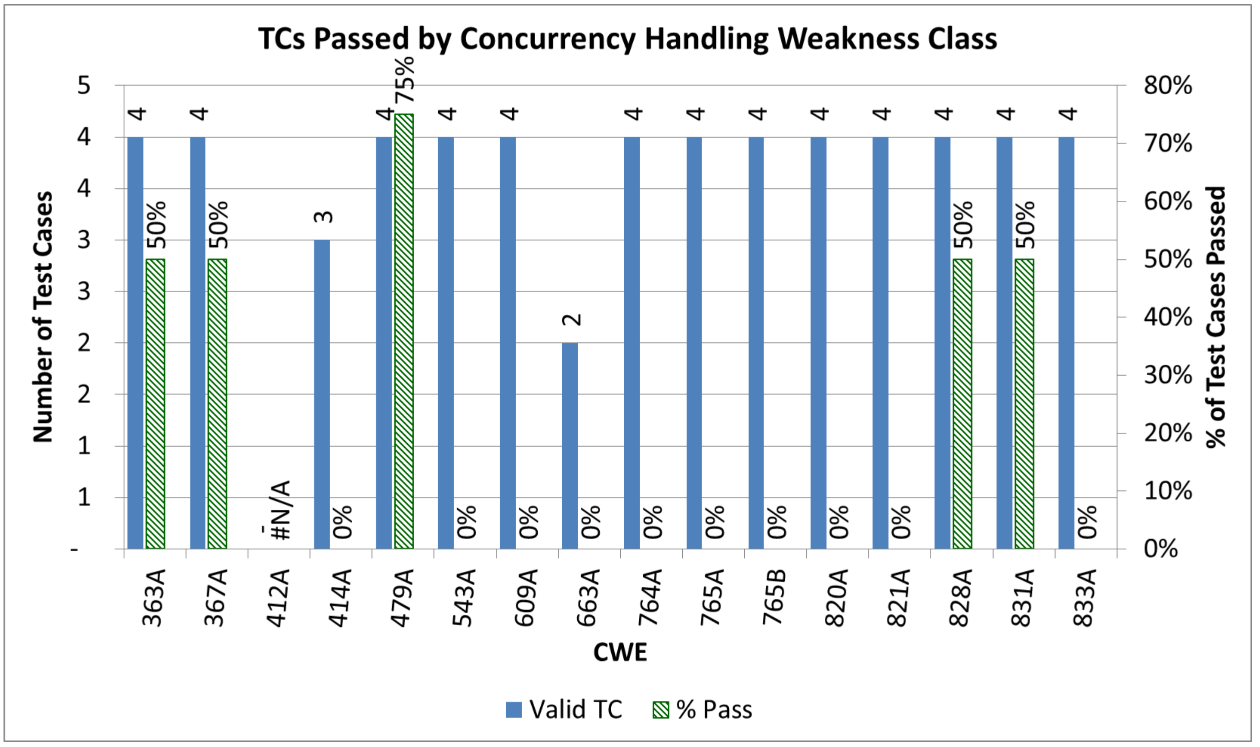

Figure I-59. MINESTRONE (GREP) Passing Test Cases (by Concurrency Handling CWEs)

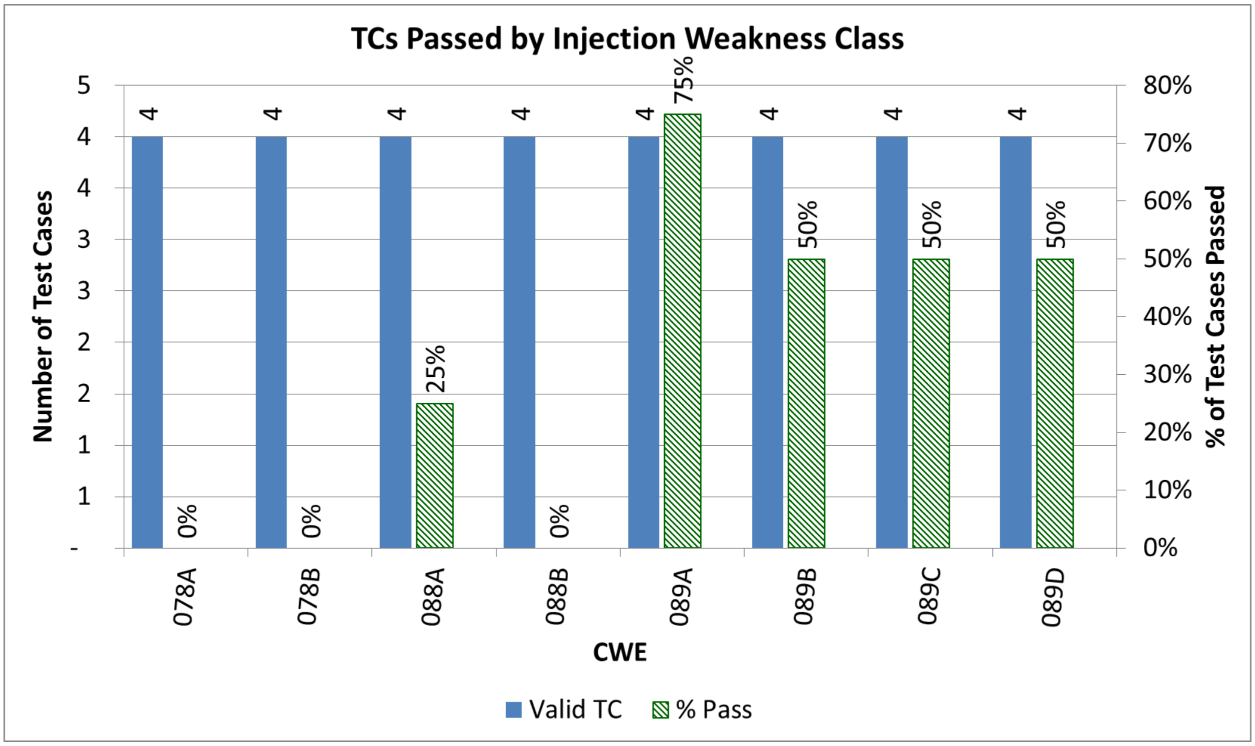

Figure I-60. MINESTRONE (GREP) Passing Test Cases (by Injection CWEs)

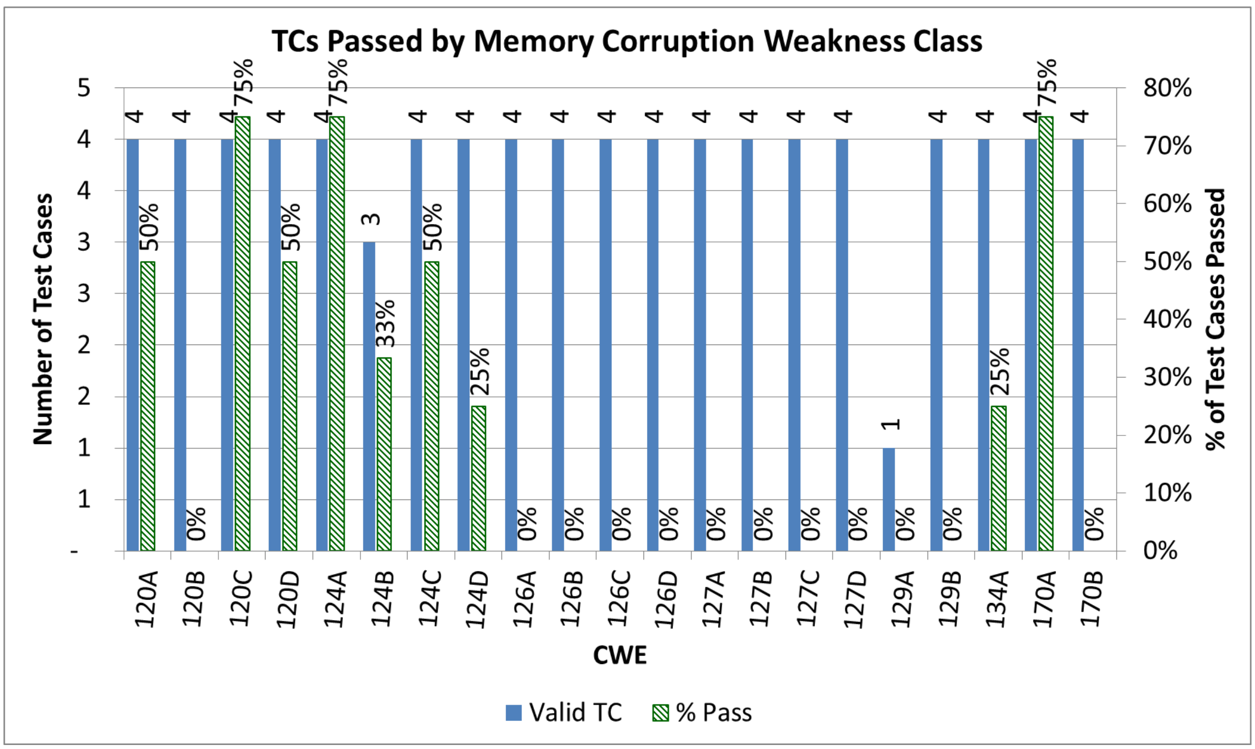

Figure I-61. MINESTRONE (GREP) Passing Test Cases (by Memory Corruption CWEs) (Part 1)

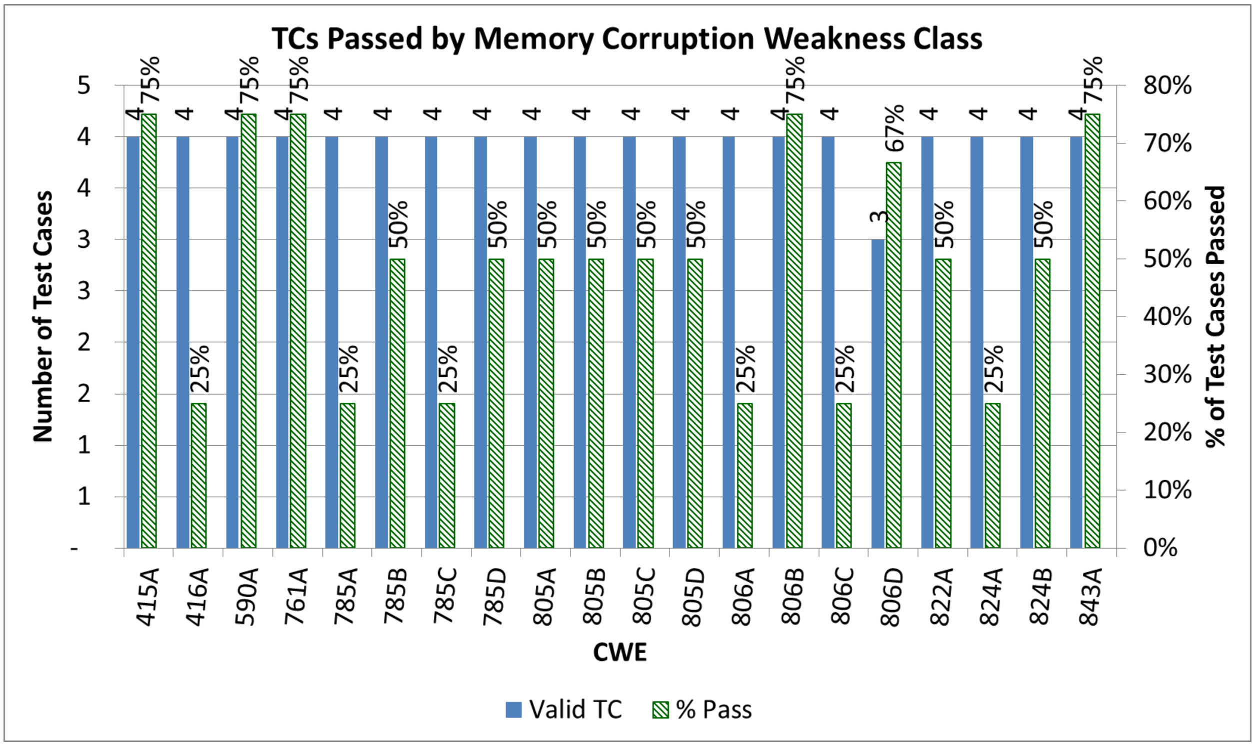

Figure I-62. MINESTRONE (GREP) Passing Test Cases (by Memory Corruption CWEs) (Part 2)

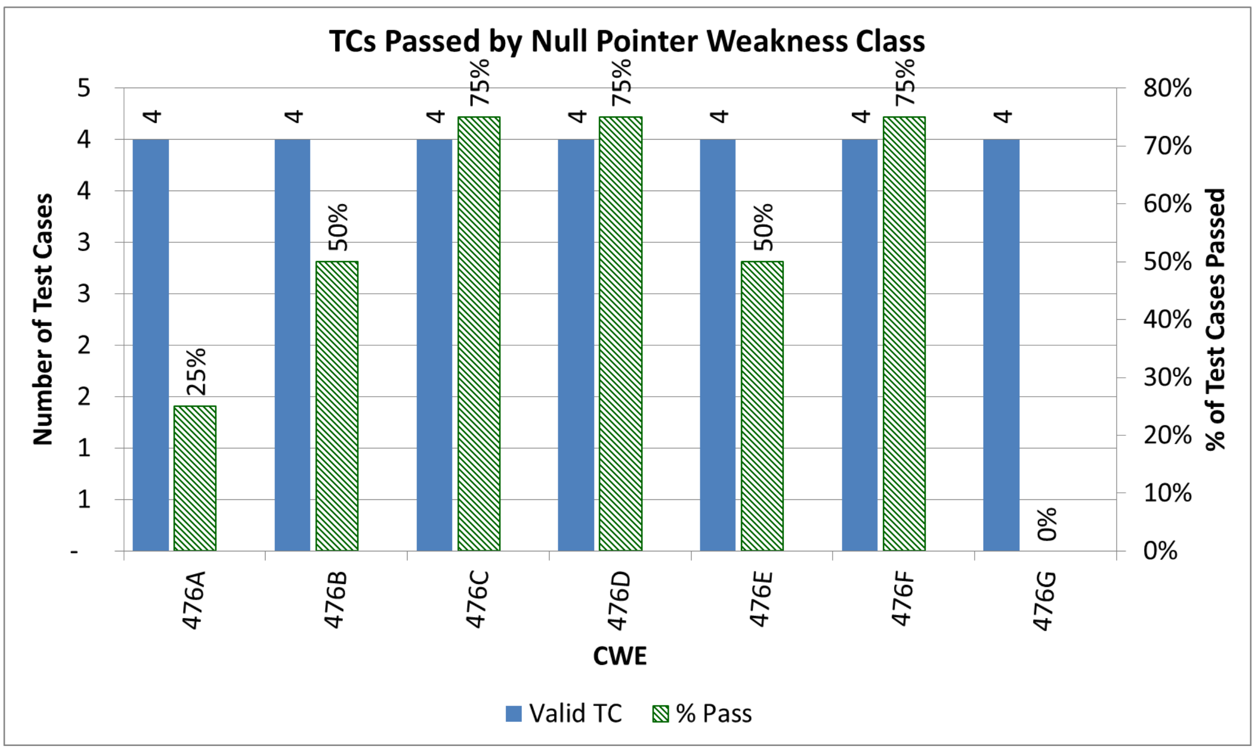

Figure I-63. MINESTRONE (GREP) Passing Test Cases (by Null Pointer CWEs)

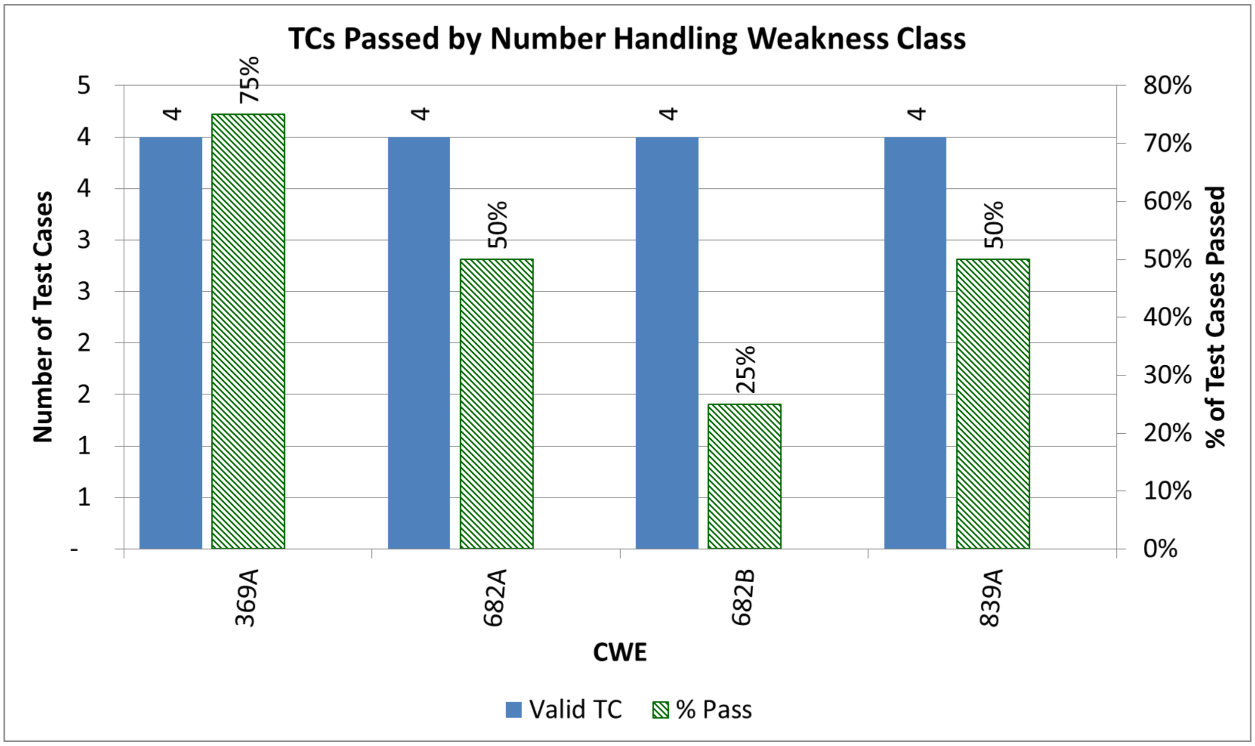

Figure I-64. MINESTRONE (GREP) Passing Test Cases (by Number Handling CWEs)

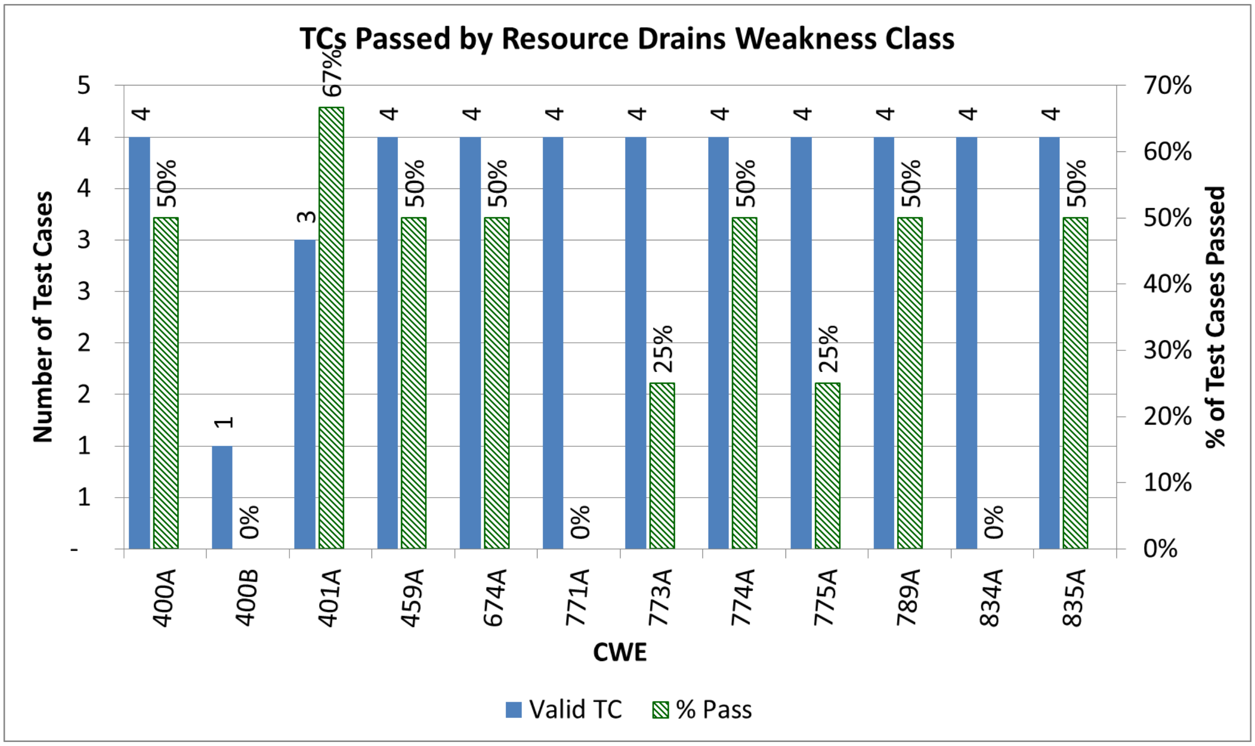

Figure I-65. MINESTRONE (GREP) Passing Test Cases (by Resource Drain CWEs)

I.3.2 MINESTRONE GREP Results by Taint Source

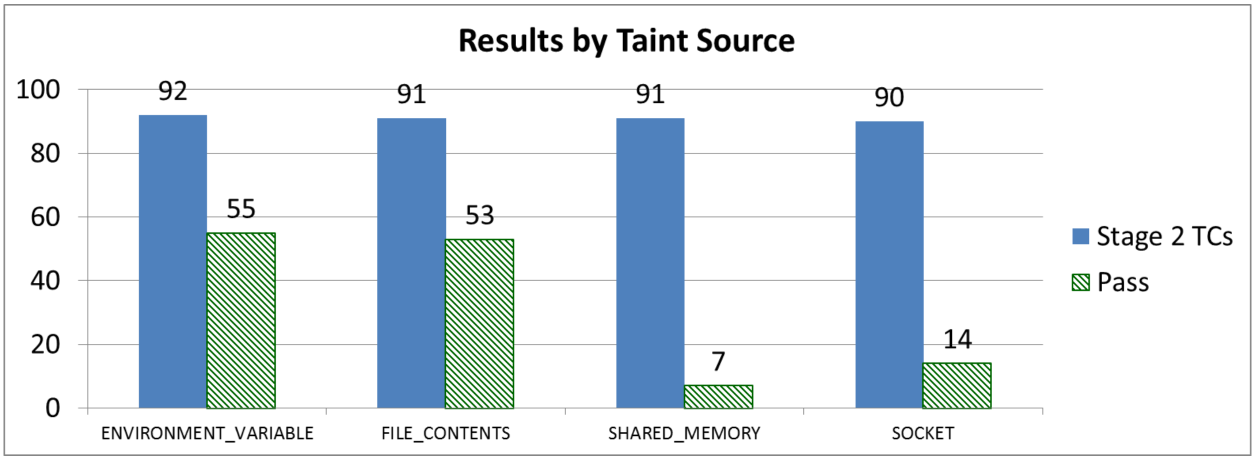

Figure I-66. MINESTRONE (GREP) Number of Passing Test Cases (by Taint Source)

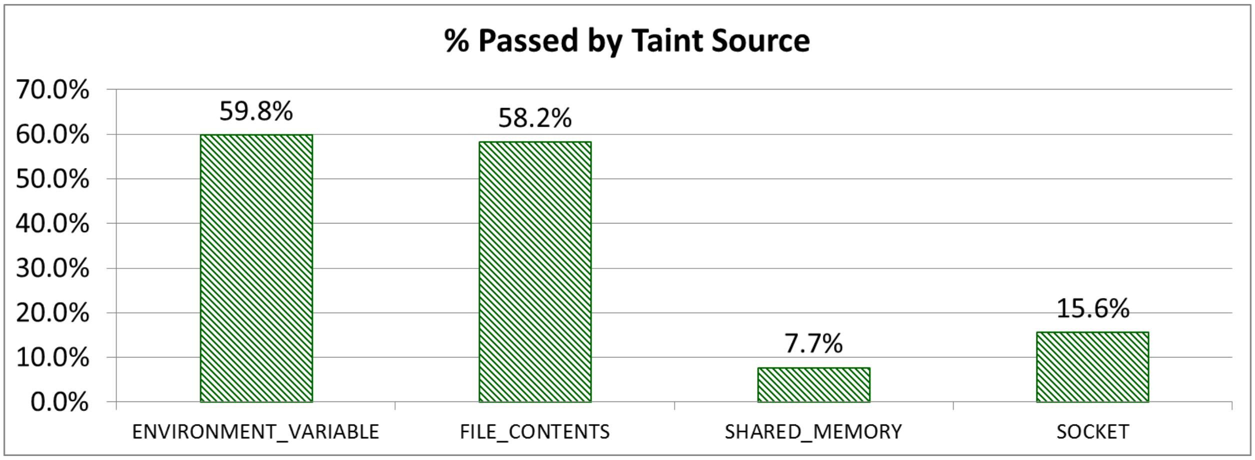

Figure I-67. MINESTRONE (GREP) Percentage of Passing Test Cases (by Taint Source)

I.3.3 MINESTRONE GREP Results by Data Type Complexity

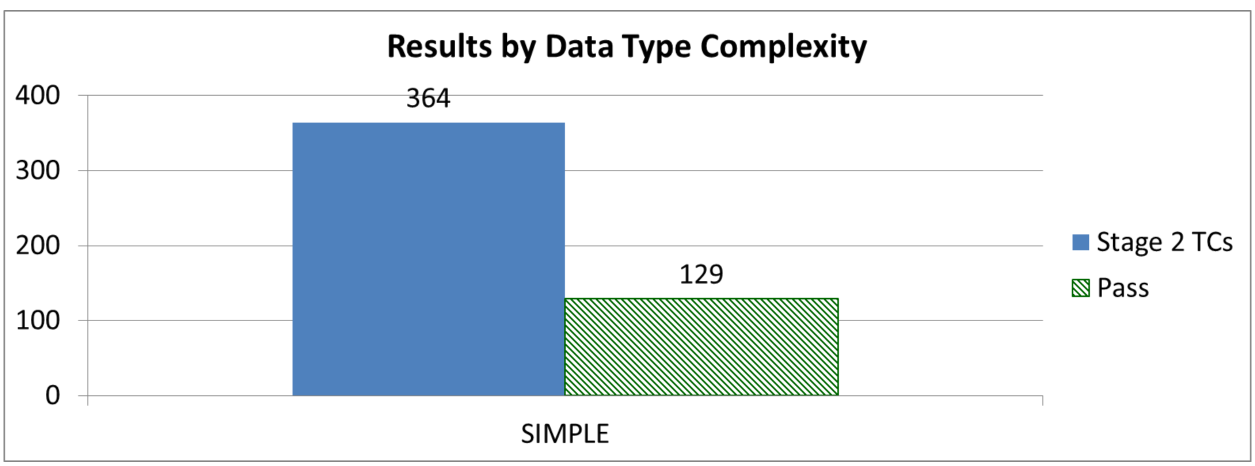

Figure I-68. MINESTRONE (GREP) Number of Passing Test Cases (by Data Type Complexity)

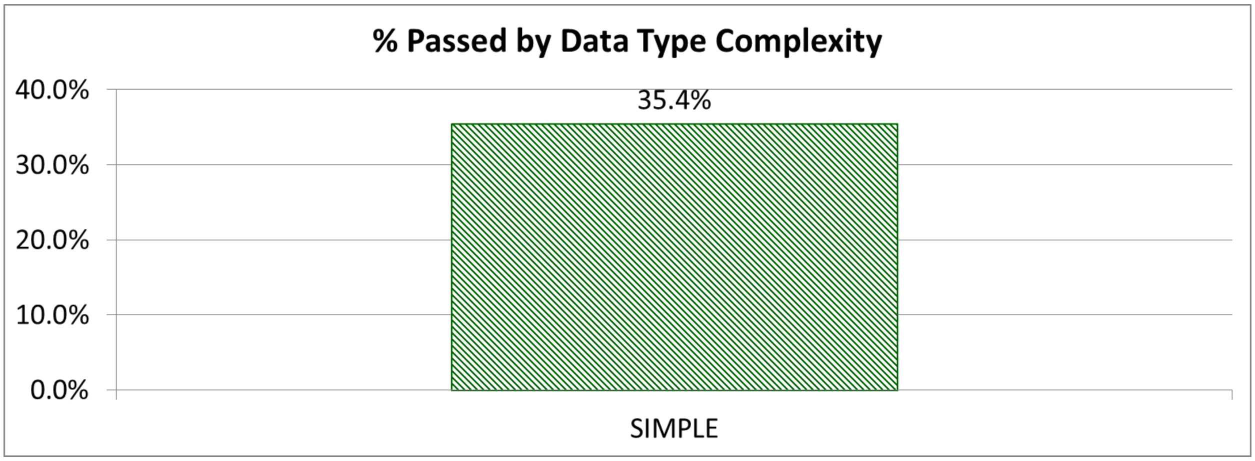

Figure I-69. MINESTRONE (GREP) Percentage of Passing Test Cases (by Data Type Complexity)

I.3.4 MINESTRONE GREP Results by Data Flow Complexity

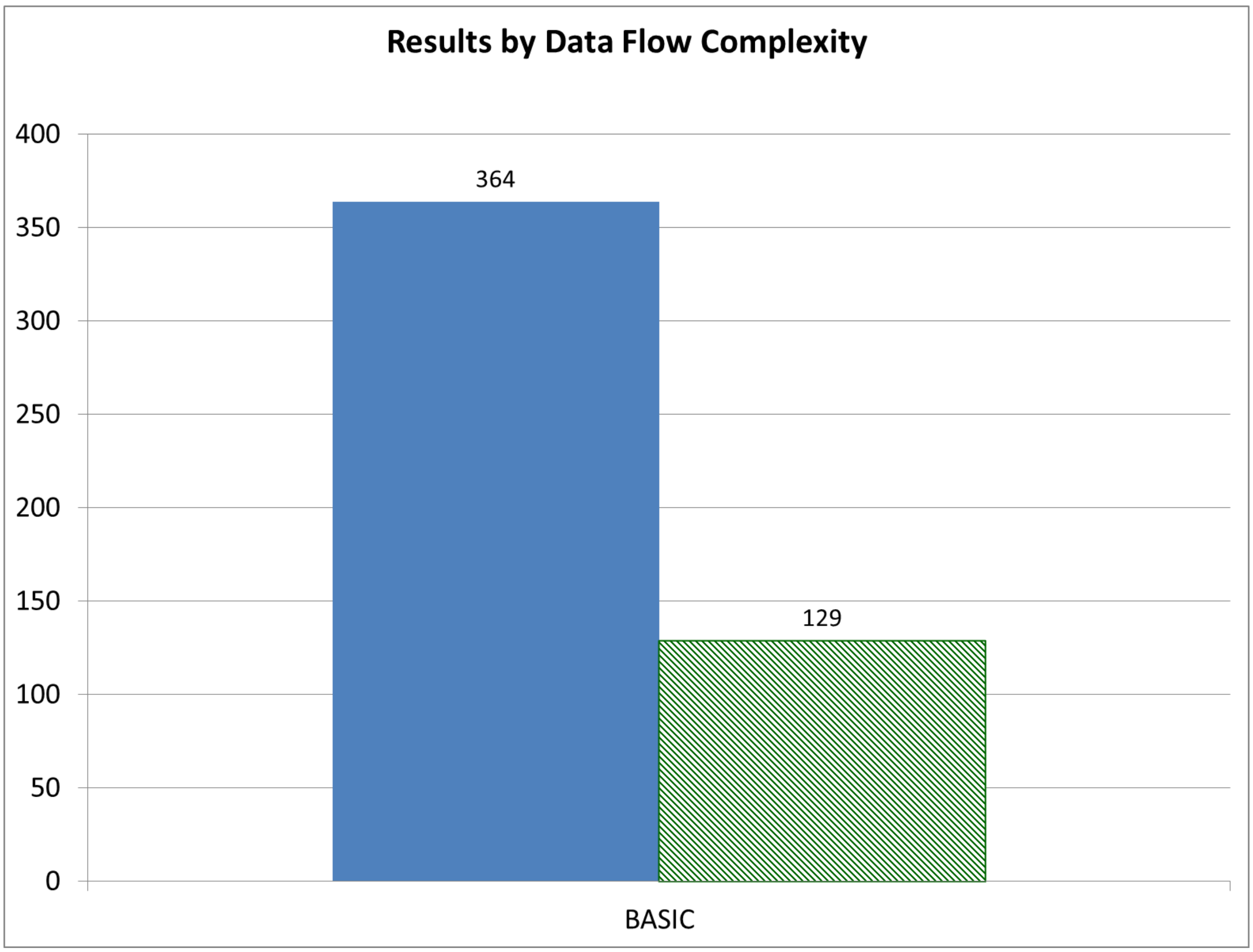

Figure I-70. MINESTRONE (GREP) Number of Passing Test Cases (by Data Flow Complexity)

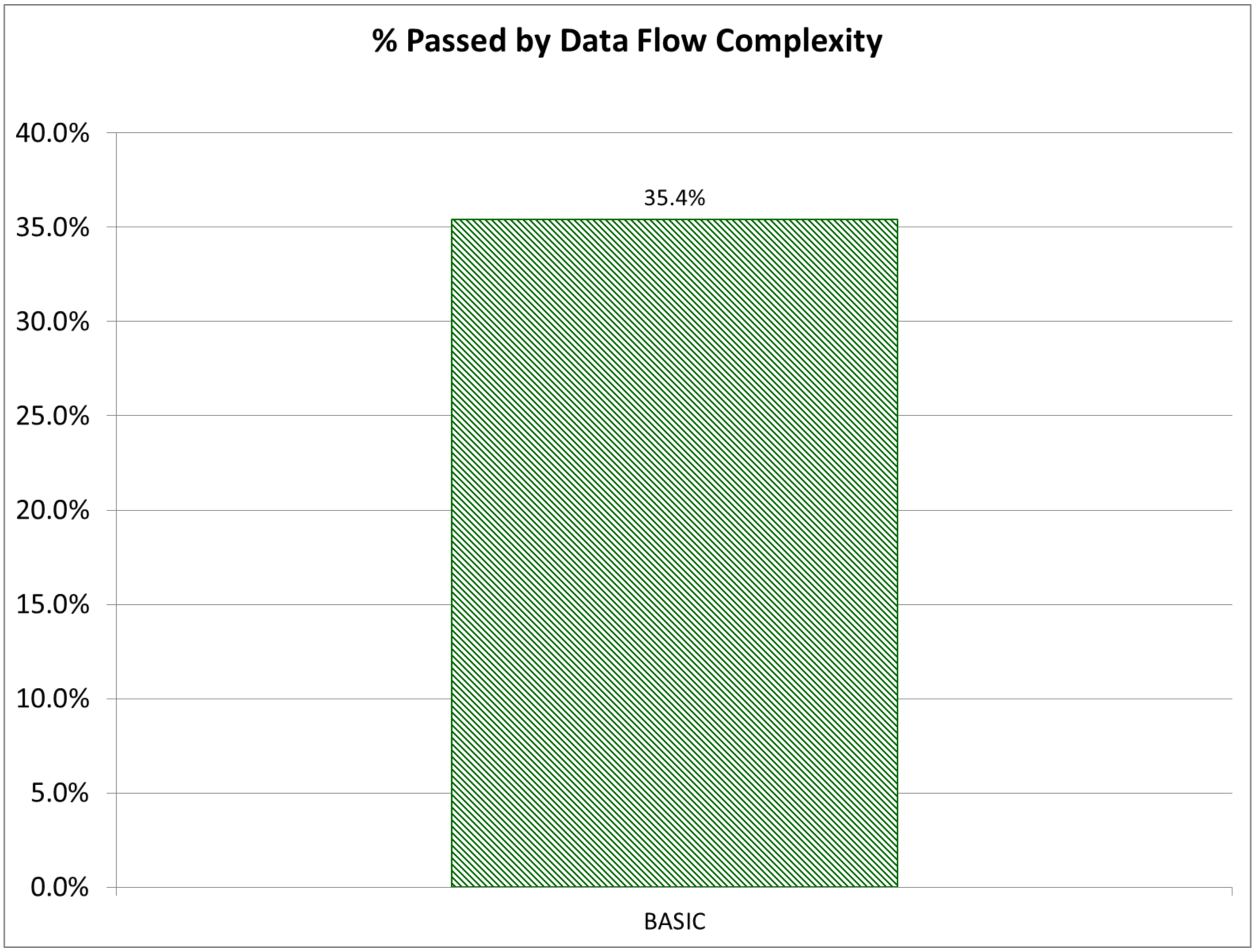

Figure I-71. MINESTRONE (GREP) Percentage of Passing Test Cases (by Data Flow Complexity)

I.3.5 MINESTRONE GREP Results by Control Flow Complexity

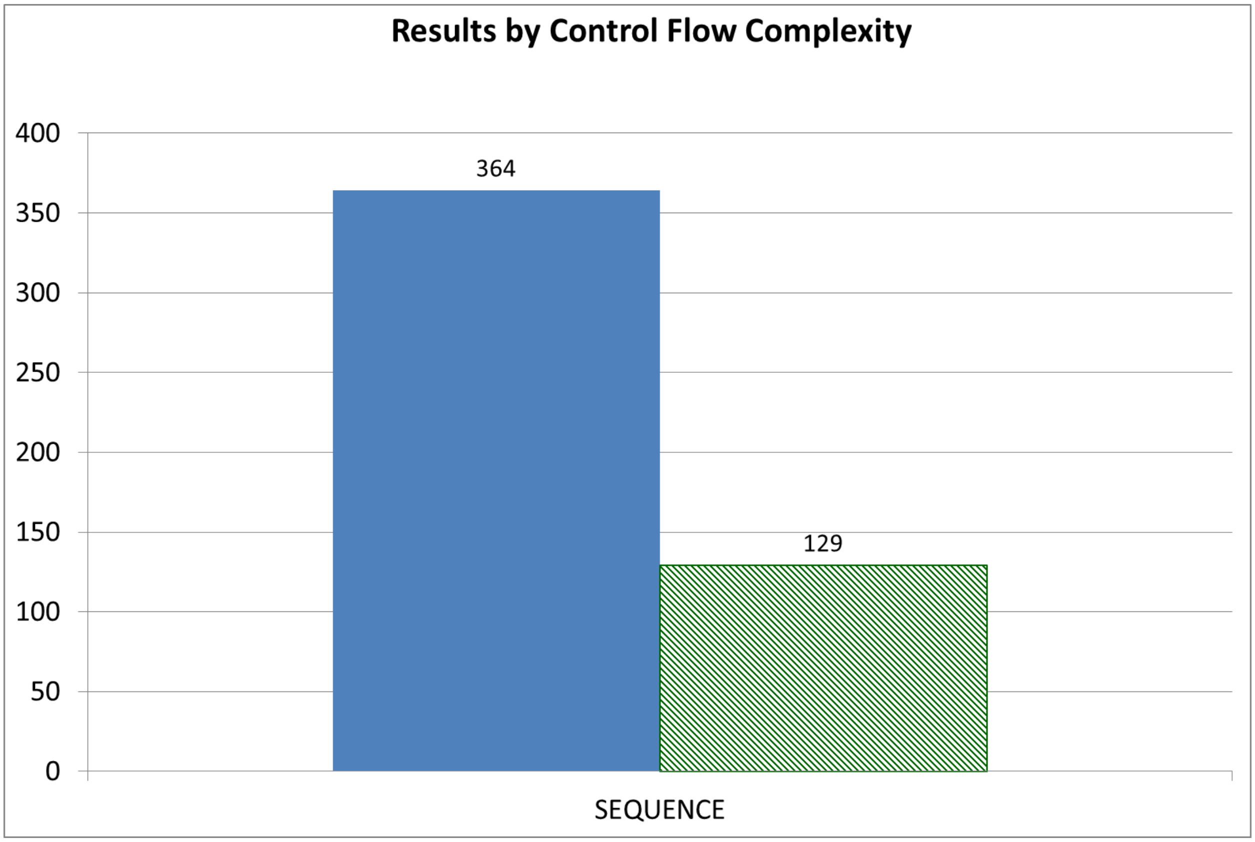

Figure I-72. MINESTRONE (GREP) Number of Passing Test Cases (by Control Flow Complexity)

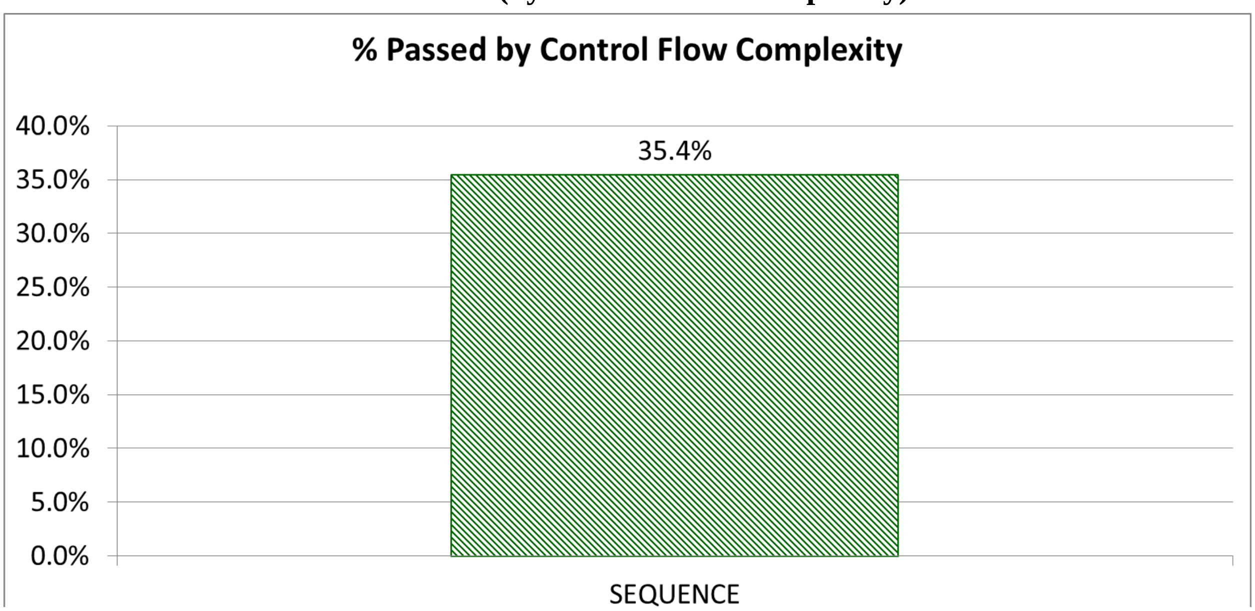

Figure I-73. MINESTRONE (GREP) Percentage of Passing Test Cases (by Control Flow Complexity)

I.3.6 MINESTRONE GREP Performance Overhead

Table I-23. MINESTRONE (GREP) Performance Overhead by Weakness Class

Weakness Class	% Increase
Concurrency Handling	3406.3%
Injection	3275.7%
Memory Corruption	6071.3%
Null Pointer	10831.1%
Number Handling	10596.3%
Resource Drains	1867.5%
Grand Total	**3154.0%**

Table I-24. MINESTRONE (GREP) Performance Overhead by Base Program

Base Program	% Increase
GREP	3154.0%
Grand Total	**3154.0%**

Table I-25. MINESTRONE (GREP) Performance Overhead by Taint Source

Taint Source	% Increase
ENVIRONMENT_VARIABLE	3154.0%
Grand Total	**3154.0%**

Table I-26. MINESTRONE (GREP) Performance Overhead by Data Type Complexity

Data Type Complexity	% Increase
SIMPLE	3154.0%
Grand Total	**3154.0%**

Table I-27. MINESTRONE (GREP) Performance Overhead by Data Flow Complexity

Data Flow Complexity	% Increase
BASIC	3154.0%
Grand Total	**3154.0%**

Table I-28. MINESTRONE (GREP) Performance Overhead by Control Flow Complexity

Control Flow Complexity	% Increase
SEQUENCE	3154.0%
Grand Total	**3154.0%**

Table I-29. MINESTRONE (GREP) Performance Overhead by File Size

File Size	% Increase
711,339	3154.0%
Grand Total	**3154.0%**

I.4 Results and Analysis of Phase 1-Sized Programs

Numbers

Mitigation?		Altered? No	Altered? Yes	Total
	Full	**237**	31	268
	Partial	15	3	18
	None	69	17	86
	Total	321	51	372

Percentages

Mitigation?		Altered? No	Altered? Yes	Total
	Full	**63.7%**	8.3%	72%
	Partial	4.0%	0.8%	5%
	None	18.5%	4.6%	23%
	Total	86%	14%	100%

Figure I-74. MINESTRONE CTREE Mitigation and Altered Functionality Results

I.4.1 MINESTRONE CTREE Results by Weakness Classes and Target Weaknesses

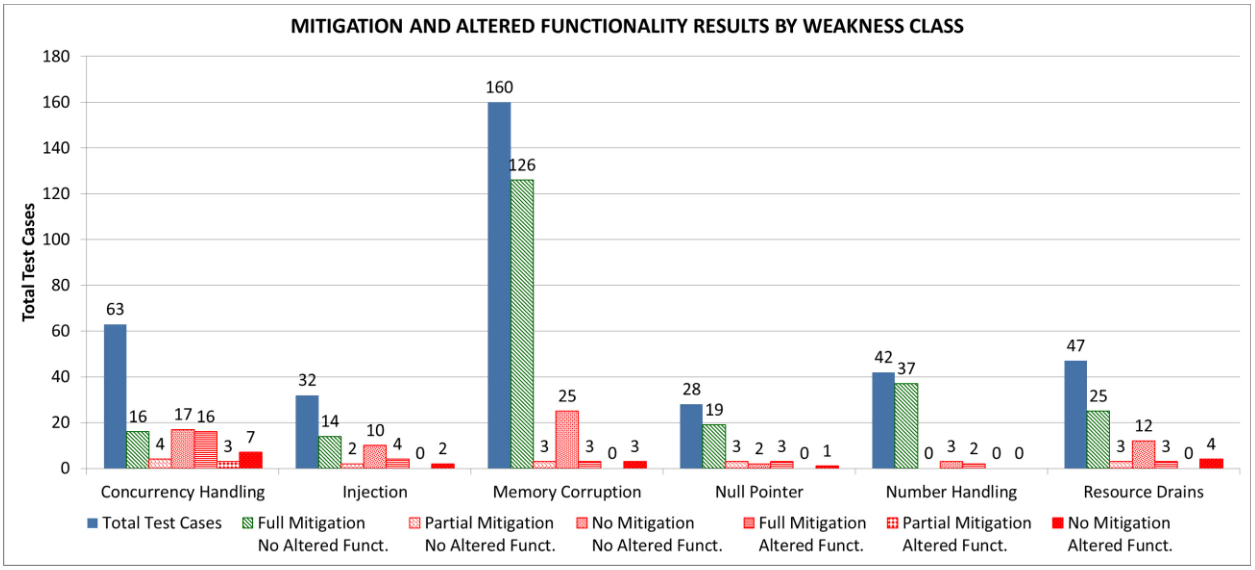

Figure I-75. MINESTRONE CTREE Mitigation and Altered Functionality Results (by Weakness Class)

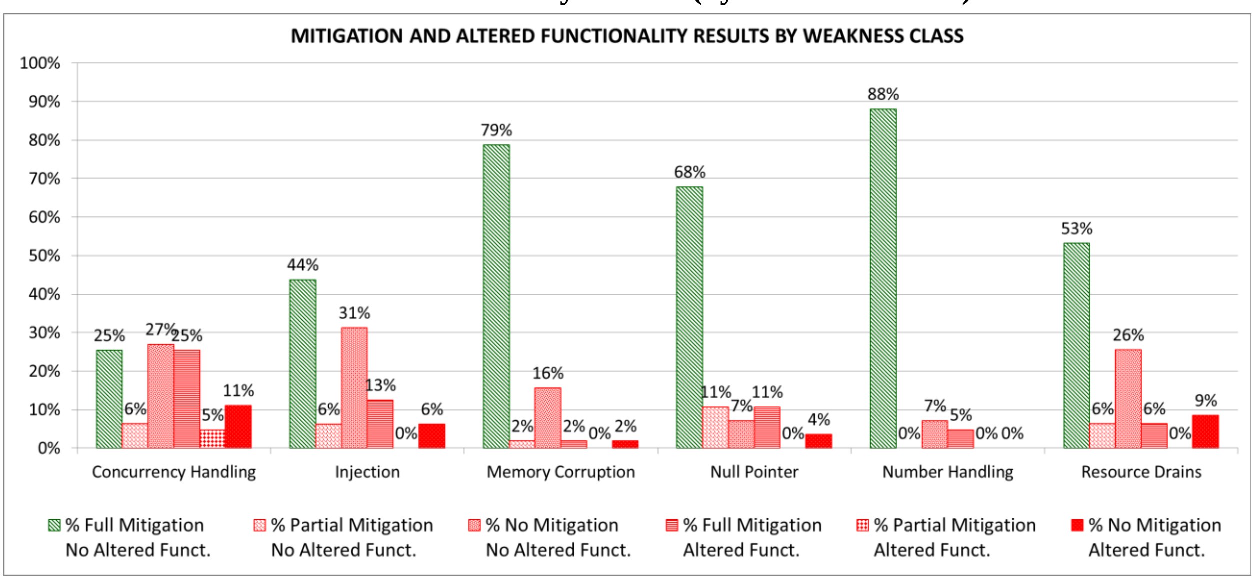

Figure I-76. MINESTRONE CTREE Mitigation and Altered Functionality Results (percentage by Weakness Class)

Table I-30. MINESTRONE CTREE Mitigation and Altered Functionality Results (by Weakness Class)

Target Weakness Class	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & No Alt Function)	% Pass
Concurrency Handling	64	63	37	59%	32	51%	16	25%
Injection	32	32	26	81%	18	56%	14	44%
Memory Corruption	164	160	154	96%	129	81%	126	79%
Null Pointer	28	28	24	86%	22	79%	19	68%
Number Handling	44	42	40	95%	39	93%	37	88%
Resource Drains	48	47	40	85%	28	60%	25	53%
Grand Total	**380**	**372**	**321**	**86.3%**	**268**	**72.0%**	**237**	**63.7%**

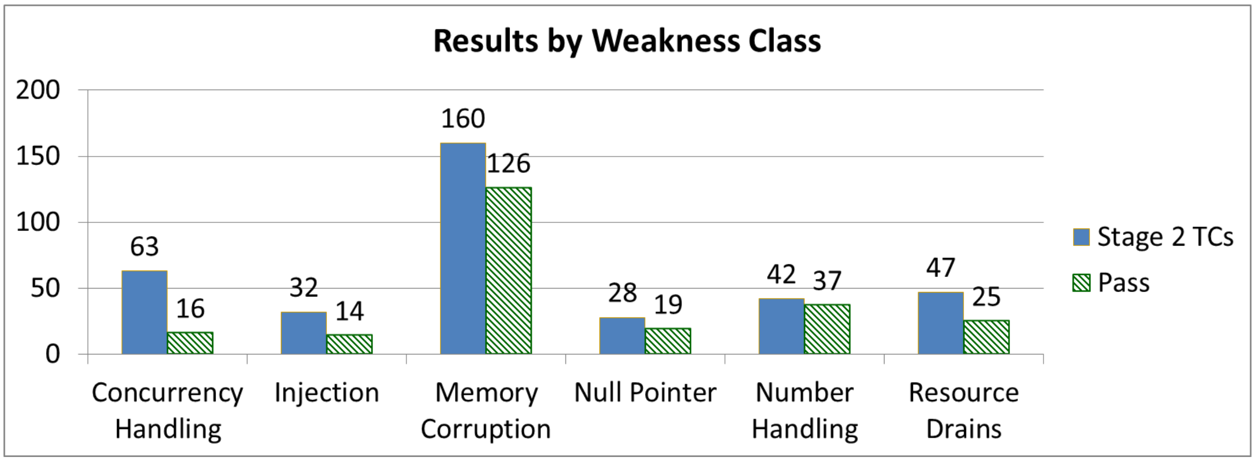

Figure I-77. MINESTRONE CTREE Number of Passing Test Cases (by Weakness Class)

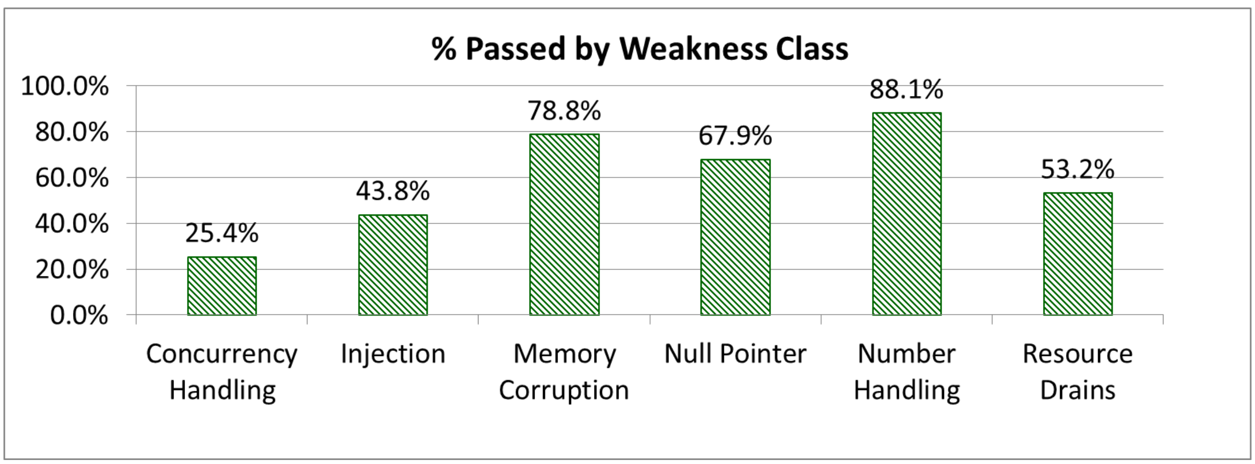

Figure I-78. MINESTRONE CTREE Percentage of Passing Test Cases (by Weakness Class)

Table I-31. MINESTRONE CTREE Mitigation and Altered Functionality Results (by CWE)

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling								
363A	4	4	4	100%	3	75%	3	75%
367A	4	4	4	100%	4	100%	4	100%
412A	4	4	4	100%	0	0%	0	0%
414A	4	3	1	33%	1	33%	0	0%
479A	4	4	4	100%	3	75%	3	75%
543A	4	4	0	0%	0	0%	0	0%
609A	4	4	0	0%	3	75%	0	0%
663A	4	4	1	25%	3	75%	0	0%
764A	4	4	4	100%	1	25%	1	25%
765A	4	4	2	50%	1	25%	0	0%
765B	4	4	1	25%	3	75%	0	0%
820A	4	4	2	50%	2	50%	0	0%
821A	4	4	1	25%	2	50%	0	0%
828A	4	4	4	100%	2	50%	2	50%
831A	4	4	4	100%	3	75%	3	75%
833A	4	4	1	25%	1	25%	0	0%
Injection								
078A	4	4	4	100%	0	0%	0	0%
078B	4	4	3	75%	0	0%	0	0%
088A	4	4	4	100%	1	25%	1	25%
088B	4	4	0	0%	3	75%	0	0%
089A	4	4	4	100%	4	100%	4	100%
089B	4	4	4	100%	3	75%	3	75%
089C	4	4	3	75%	4	100%	3	75%
089D	4	4	4	100%	3	75%	3	75%
Memory Corruption								
120A	4	4	4	100%	4	100%	4	100%
120B	4	4	4	100%	4	100%	4	100%
120C	4	4	4	100%	4	100%	4	100%
120D	4	4	4	100%	4	100%	4	100%
124A	4	4	4	100%	4	100%	4	100%
124B	4	2	2	100%	2	100%	2	100%
124C	4	4	4	100%	4	100%	4	100%
124D	4	4	4	100%	4	100%	4	100%
126A	4	4	4	100%	4	100%	4	100%
126B	4	4	4	100%	4	100%	4	100%
126C	4	4	2	50%	4	100%	2	50%
126D	4	4	3	75%	4	100%	3	75%
127A	4	4	4	100%	4	100%	4	100%
127B	4	4	4	100%	4	100%	4	100%
127C	4	4	4	100%	0	0%	0	0%
127D	4	4	4	100%	0	0%	0	0%
129A	4	3	3	100%	3	100%	3	100%
129B	4	4	4	100%	4	100%	4	100%
134A	4	4	4	100%	4	100%	4	100%
170A	4	4	3	75%	3	75%	3	75%
170B	4	4	4	100%	4	100%	4	100%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
415A	4	4	4	100%	3	75%	3	75%
416A	4	4	4	100%	3	75%	3	75%
590A	4	4	4	100%	3	75%	3	75%
761A	4	4	4	100%	3	75%	3	75%
785A	4	4	4	100%	3	75%	3	75%
785B	4	4	3	75%	2	50%	2	50%
785C	4	4	3	75%	2	50%	2	50%
785D	4	4	4	100%	3	75%	3	75%
805A	4	4	4	100%	3	75%	3	75%
805B	4	4	4	100%	3	75%	3	75%
805C	4	4	4	100%	3	75%	3	75%
805D	4	4	4	100%	3	75%	3	75%
806A	4	4	4	100%	3	75%	3	75%
806B	4	4	4	100%	3	75%	3	75%
806C	4	4	4	100%	3	75%	3	75%
806D	4	4	4	100%	3	75%	3	75%
822A	4	4	4	100%	3	75%	3	75%
824A	4	4	4	100%	3	75%	3	75%
824B	4	3	3	100%	2	67%	2	67%
843A	4	4	4	100%	3	75%	3	75%
Null Pointer								
476A	4	4	4	100%	3	75%	3	75%
476B	4	4	4	100%	3	75%	3	75%
476C	4	4	4	100%	3	75%	3	75%
476D	4	4	4	100%	3	75%	3	75%
476E	4	4	4	100%	3	75%	3	75%
476F	4	4	4	100%	4	100%	4	100%
476G	4	4	0	0%	3	75%	0	0%
Number Handling								
190A	4	4	3	75%	4	100%	3	75%
191A	4	4	4	100%	4	100%	4	100%
191B	4	4	4	100%	4	100%	4	100%
194A	4	4	4	100%	4	100%	4	100%
195A	4	4	3	75%	4	100%	3	75%
196A	4	4	4	100%	4	100%	4	100%
197A	4	4	4	100%	4	100%	4	100%
369A	4	4	4	100%	3	75%	3	75%
682A	4	3	3	100%	2	67%	2	67%
682B	4	3	3	100%	2	67%	2	67%
839A	4	4	4	100%	4	100%	4	100%
Resource Drains								
400A	4	4	4	100%	3	75%	3	75%
400B	4	4	1	25%	0	0%	0	0%
401A	4	3	3	100%	2	67%	2	67%
459A	4	4	4	100%	3	75%	3	75%
674A	4	4	4	100%	2	50%	2	50%
771A	4	4	1	25%	3	75%	0	0%
773A	4	4	4	100%	3	75%	3	75%
774A	4	4	4	100%	3	75%	3	75%
775A	4	4	3	75%	2	50%	2	50%
789A	4	4	4	100%	3	75%	3	75%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
834A	4	4	4	100%	1	25%	1	25%
835A	4	4	4	100%	3	75%	3	75%
Grand Total	**380**	**372**	**321**	**86.3%**	**268**	**72.0%**	**237**	**63.7%**

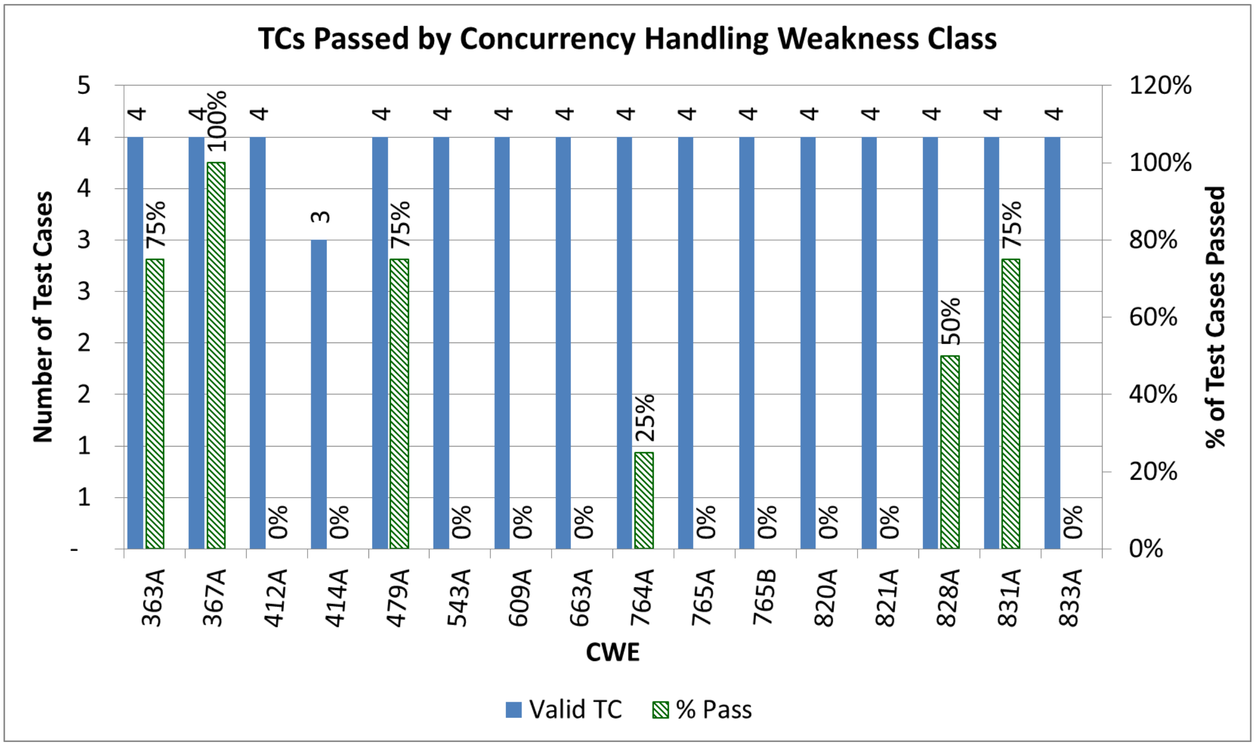

Figure I-79. MINESTRONE CTREE Passing Test Cases (by Concurrency Handling CWEs)

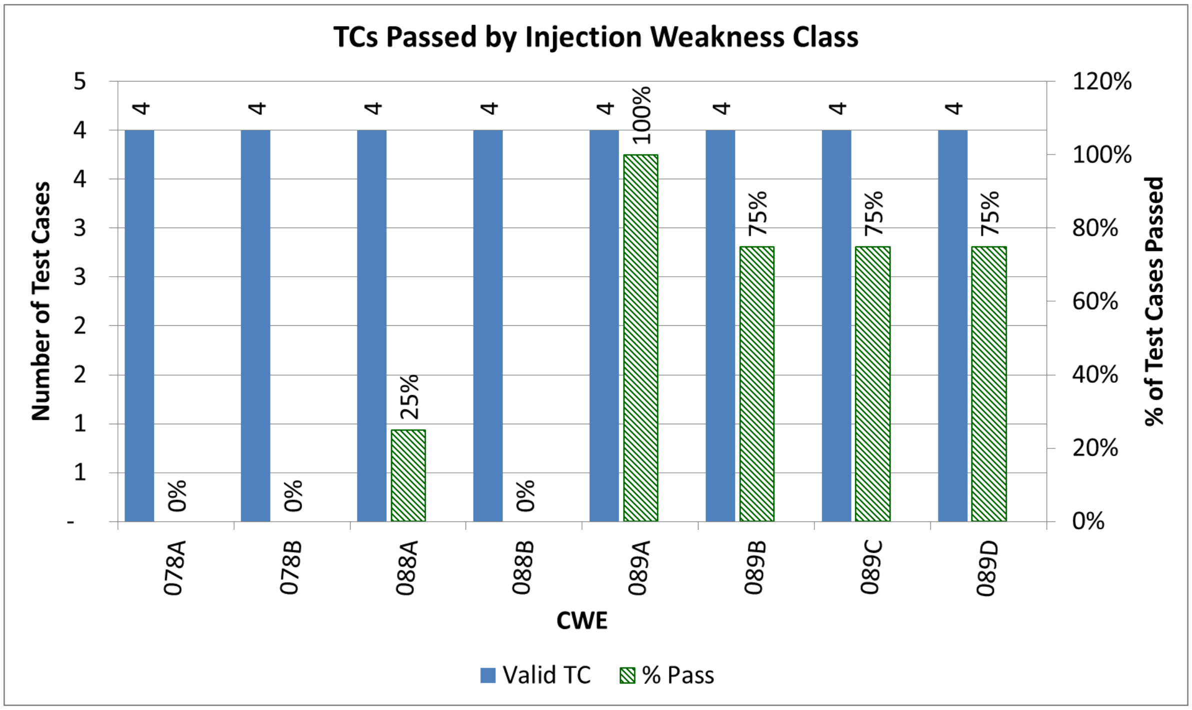

Figure I-80. MINESTRONE CTREE Passing Test Cases (by Injection CWEs)

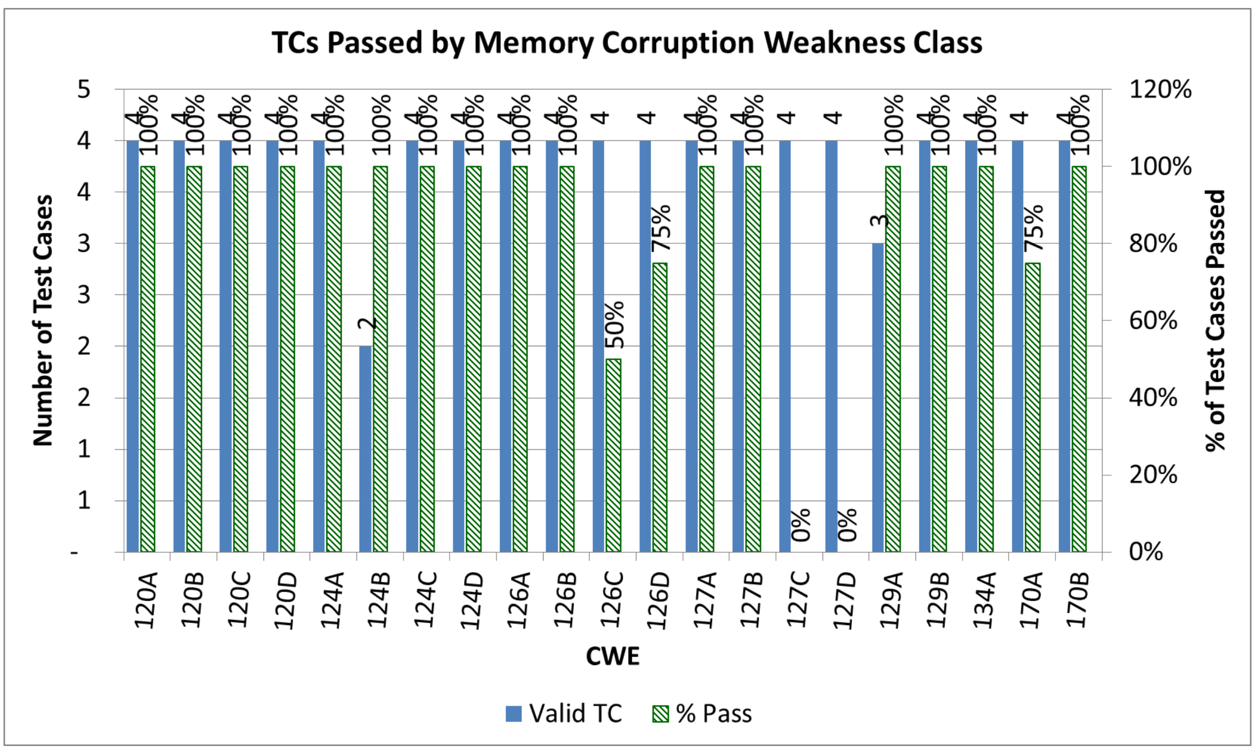

Figure I-81. MINESTRONE CTREE Passing Test Cases (by Memory Corruption CWEs) (Part 1)

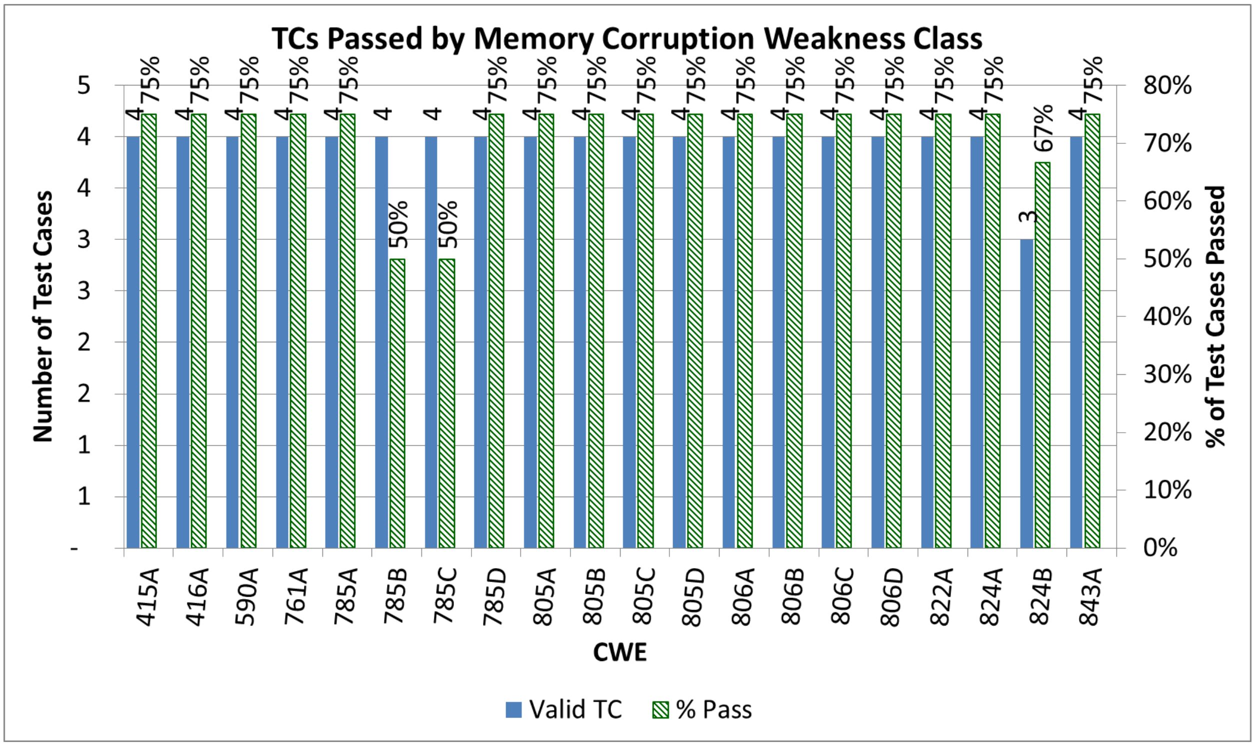

Figure I-82. MINESTRONE CTREE Passing Test Cases (by Memory Corruption CWEs) (Part 2)

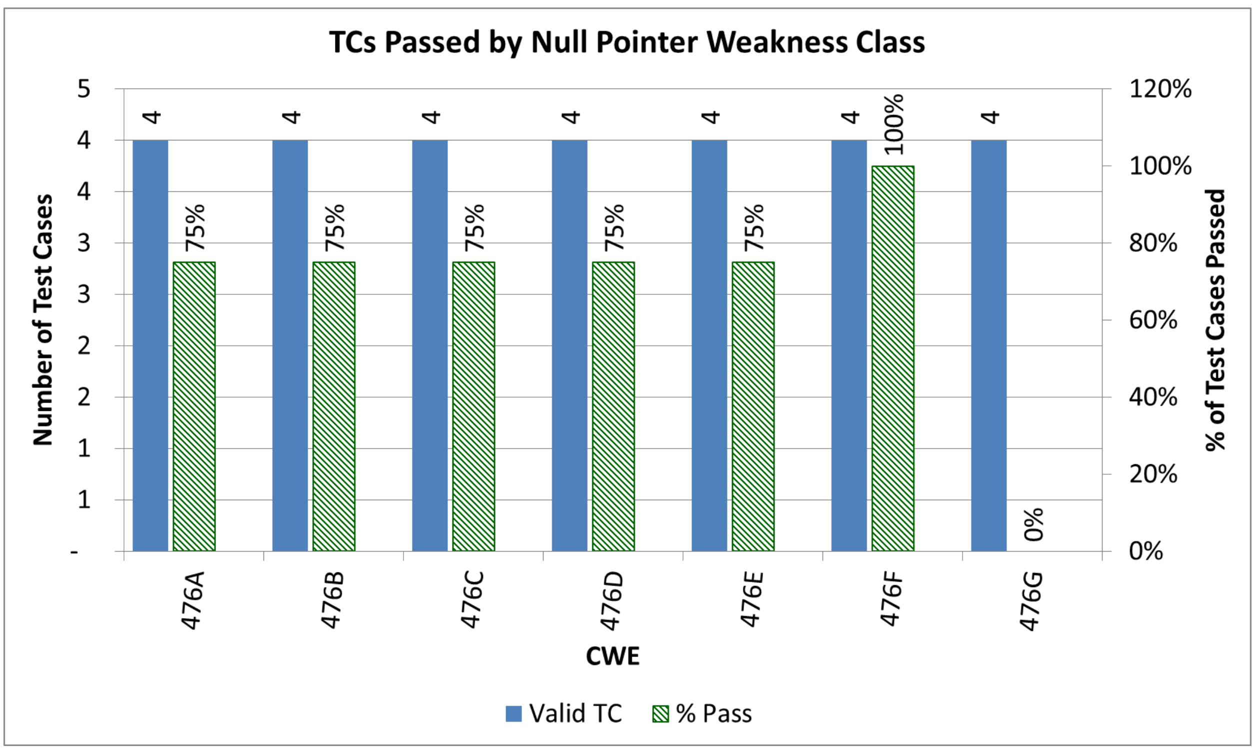

Figure I-83. MINESTRONE CTREE Passing Test Cases (by Null Pointer CWEs)

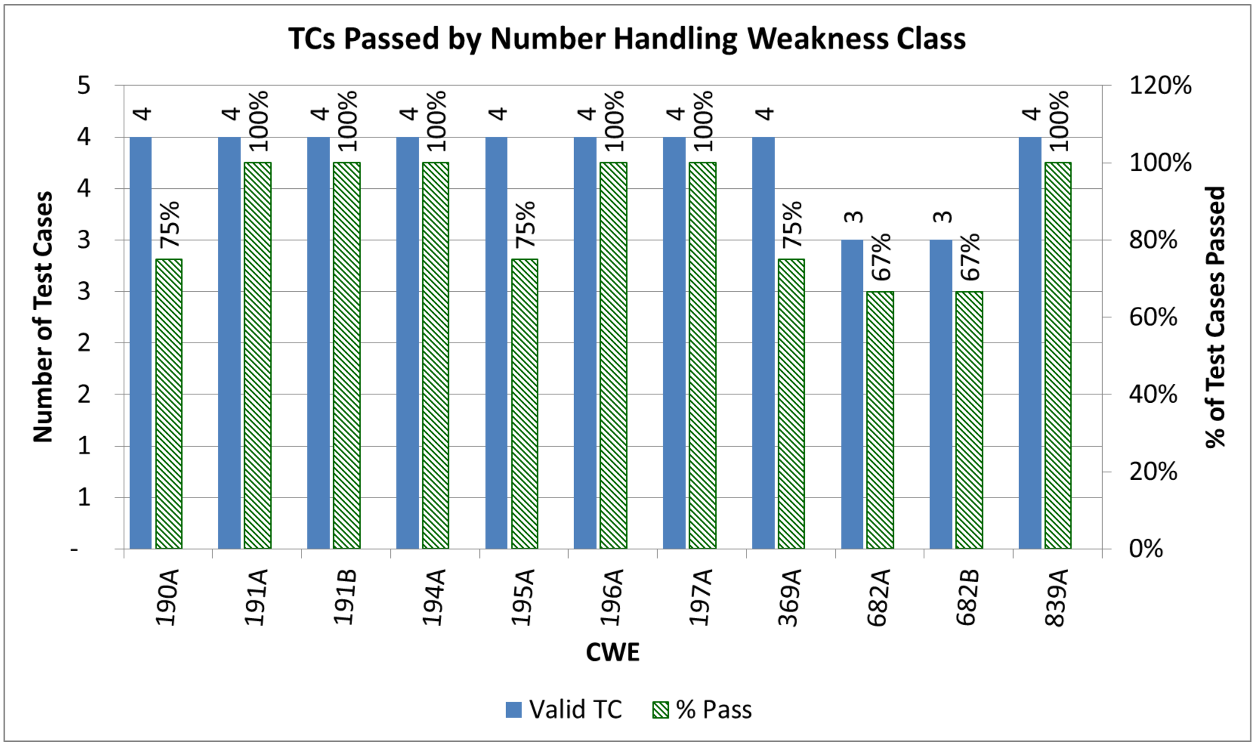

Figure I-84. MINESTRONE CTREE Passing Test Cases (by Number Handling CWEs)

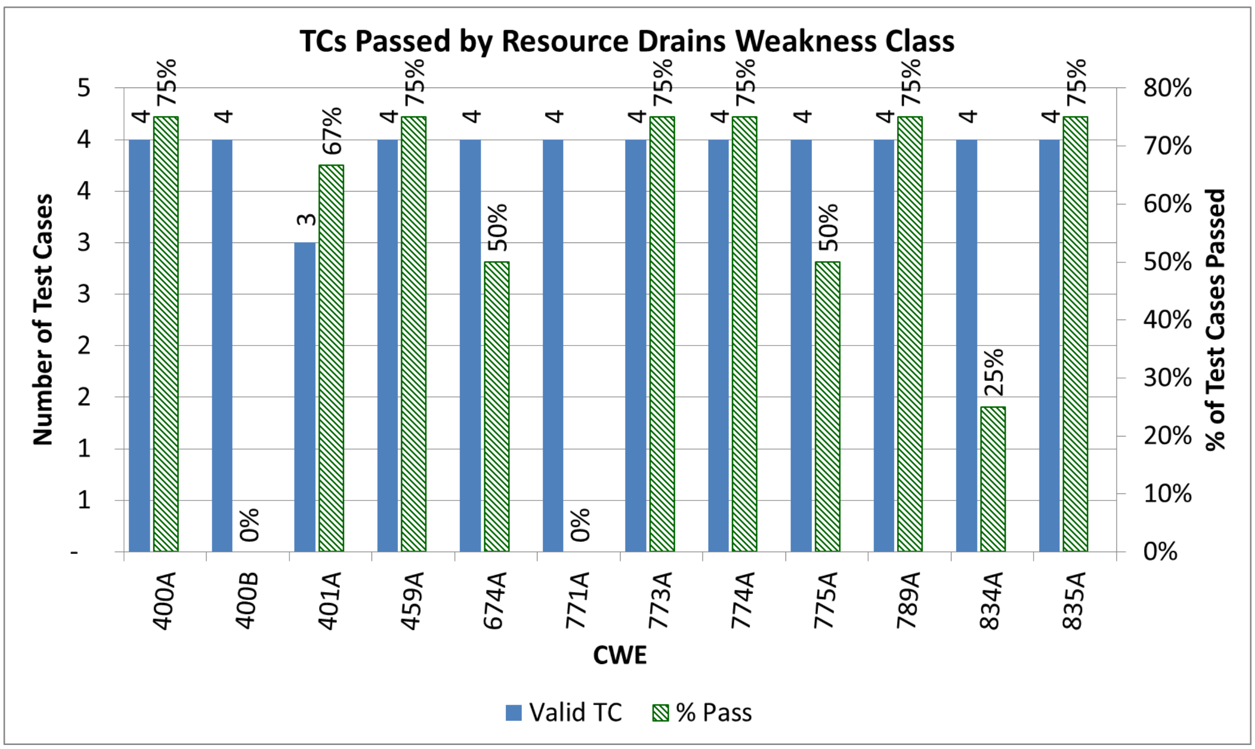

Figure I-85. MINESTRONE CTREE Passing Test Cases (by Resource Drain CWEs)

I.4.2 MINESTRONE CTREE Results by Taint Source

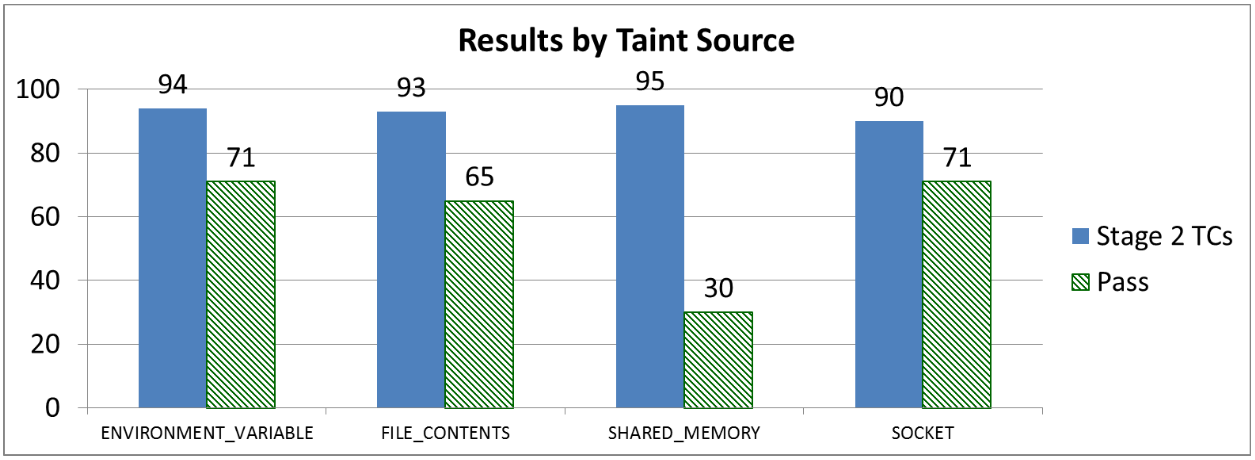

Figure I-86. MINESTRONE CTREE Number of Passing Test Cases (by Taint Source)

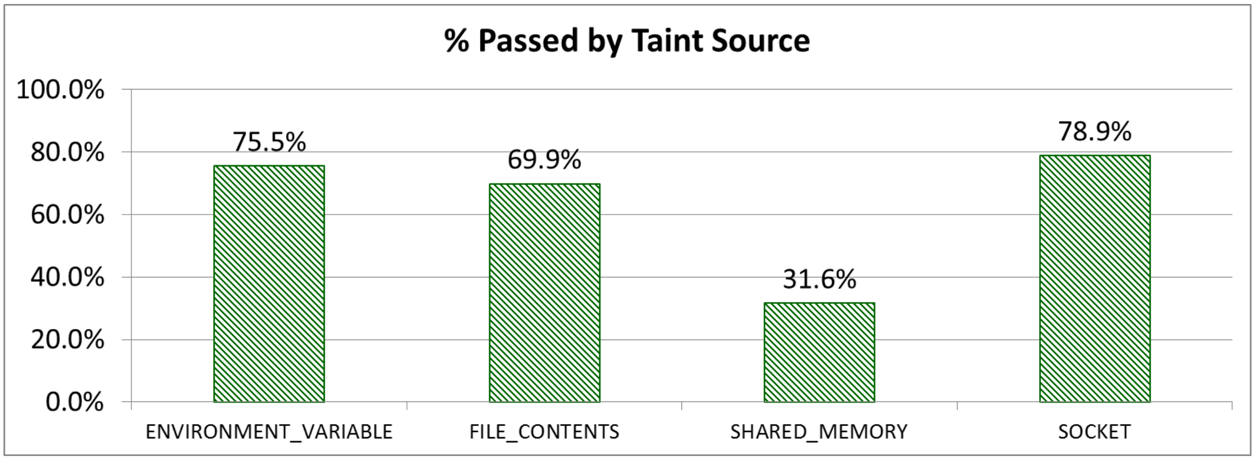

Figure I-87. MINESTRONE CTREE Percentage of Passing Test Cases (by Taint Source)

I.4.3 MINESTRONE CTREE Results by Data Type Complexity

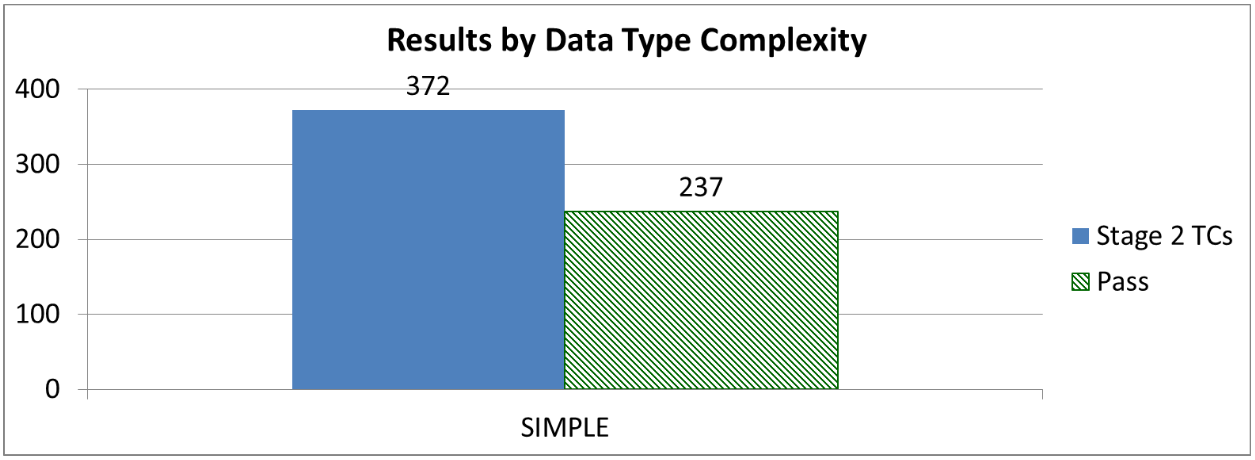

Figure I-88. MINESTRONE CTREE Number of Passing Test Cases (by Data Type Complexity)

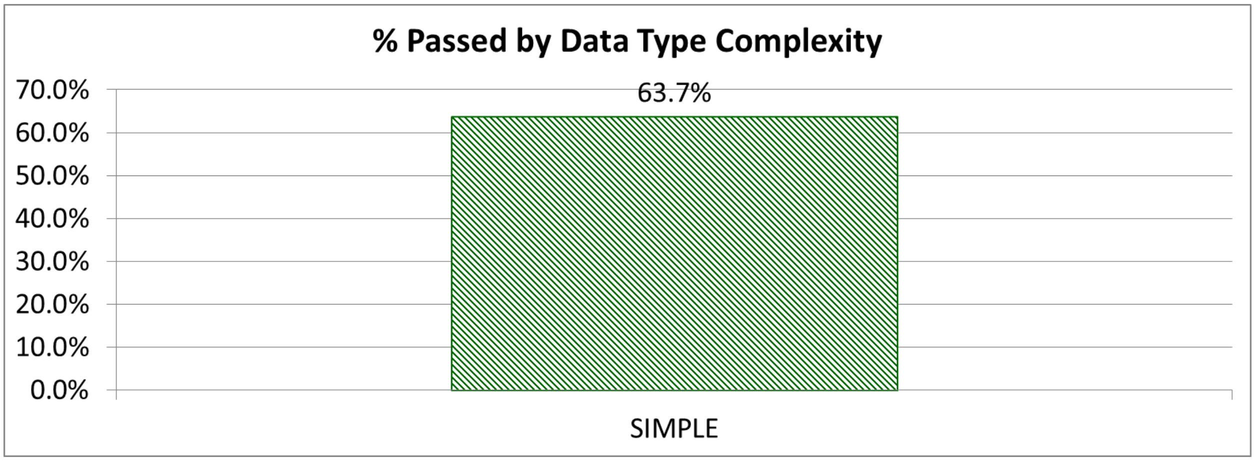

Figure I-89. MINESTRONE CTREE Percentage of Passing Test Cases (by Data Type Complexity)

I.4.4 MINESTRONE CTREE Results by Data Flow Complexity

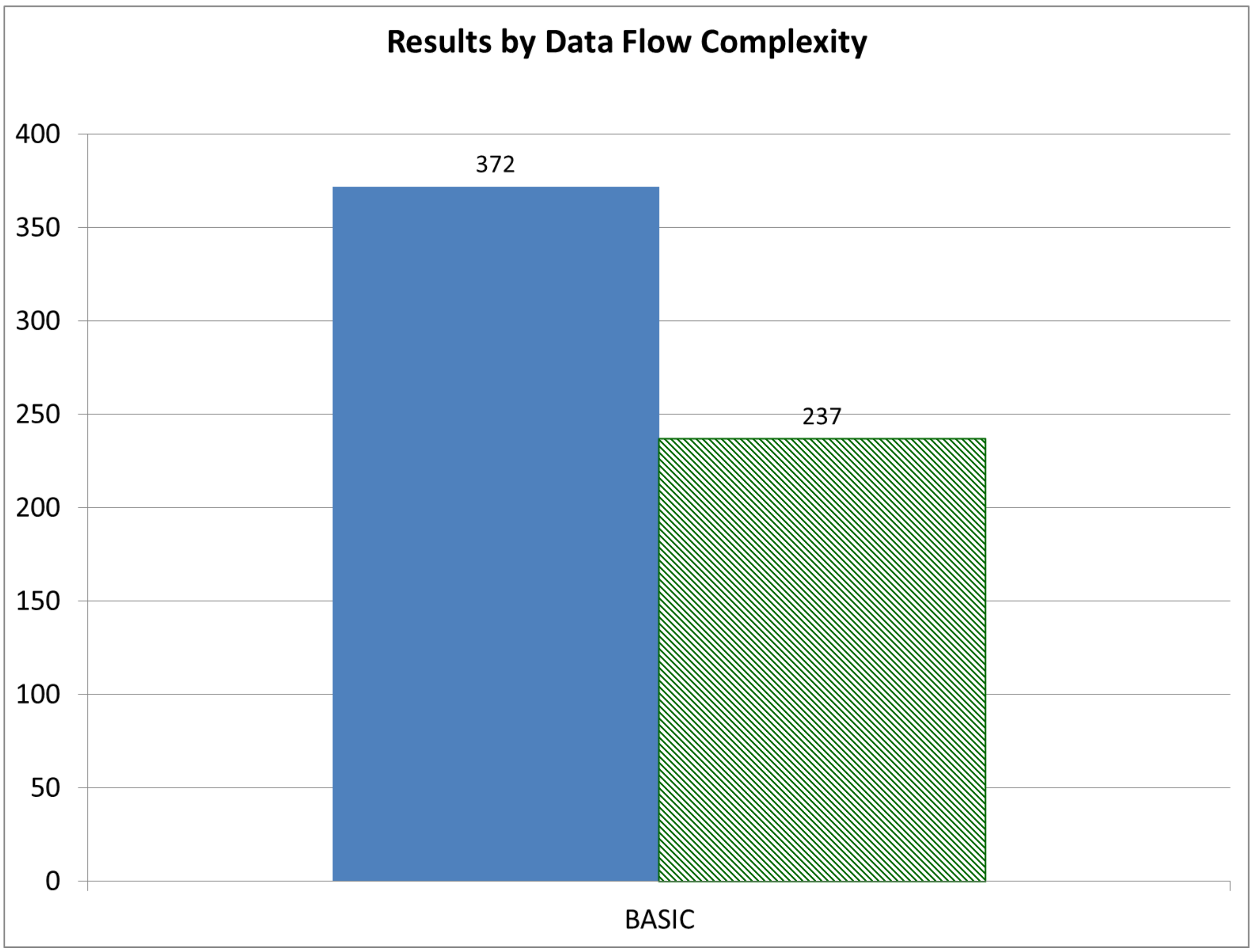

Figure I-90. MINESTRONE CTREE Number of Passing Test Cases (by Data Flow Complexity)

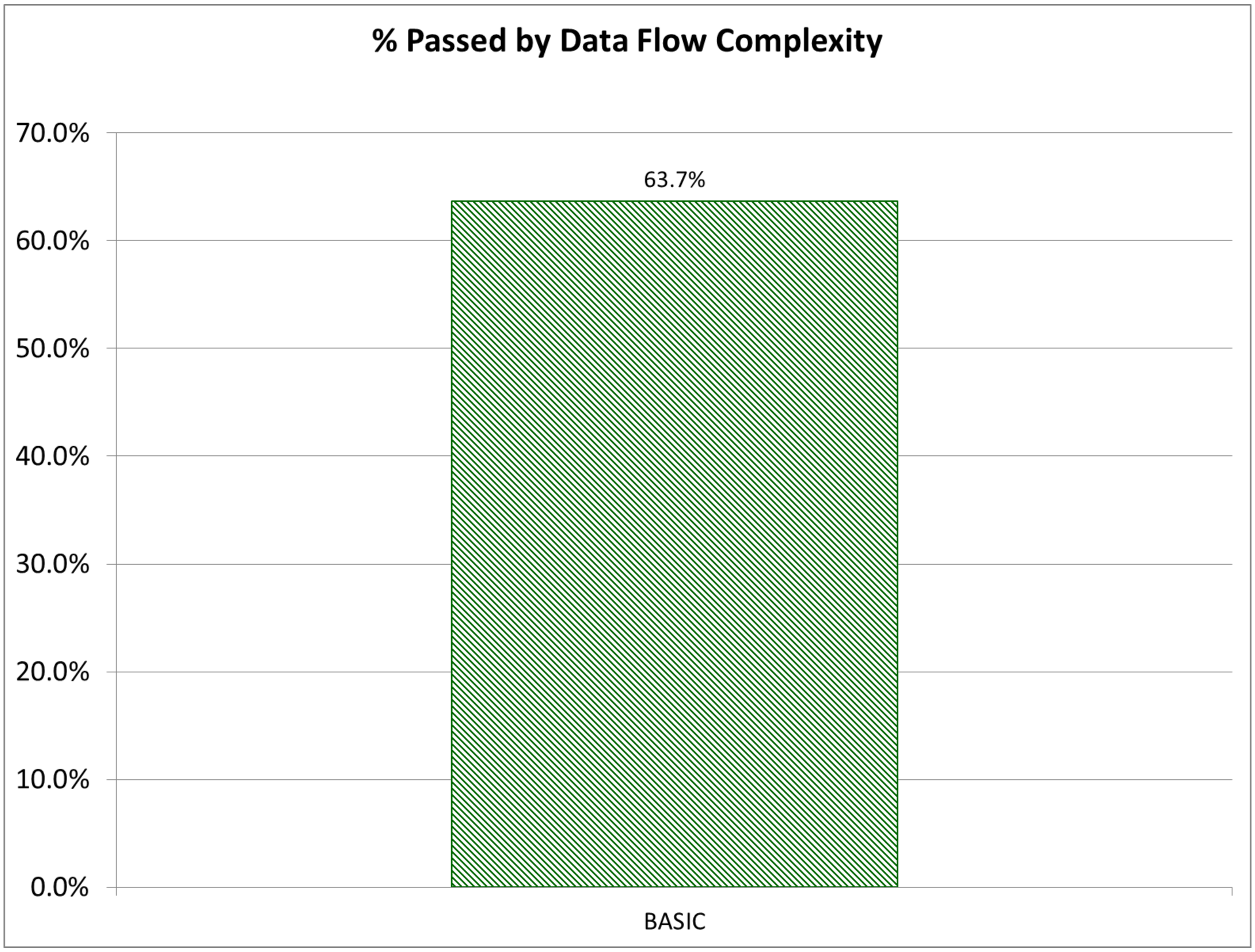

Figure I-91. MINESTRONE CTREE Percentage of Passing Test Cases (by Data Flow Complexity)

I.4.5 MINESTRONE CTREE Results by Control Flow Complexity

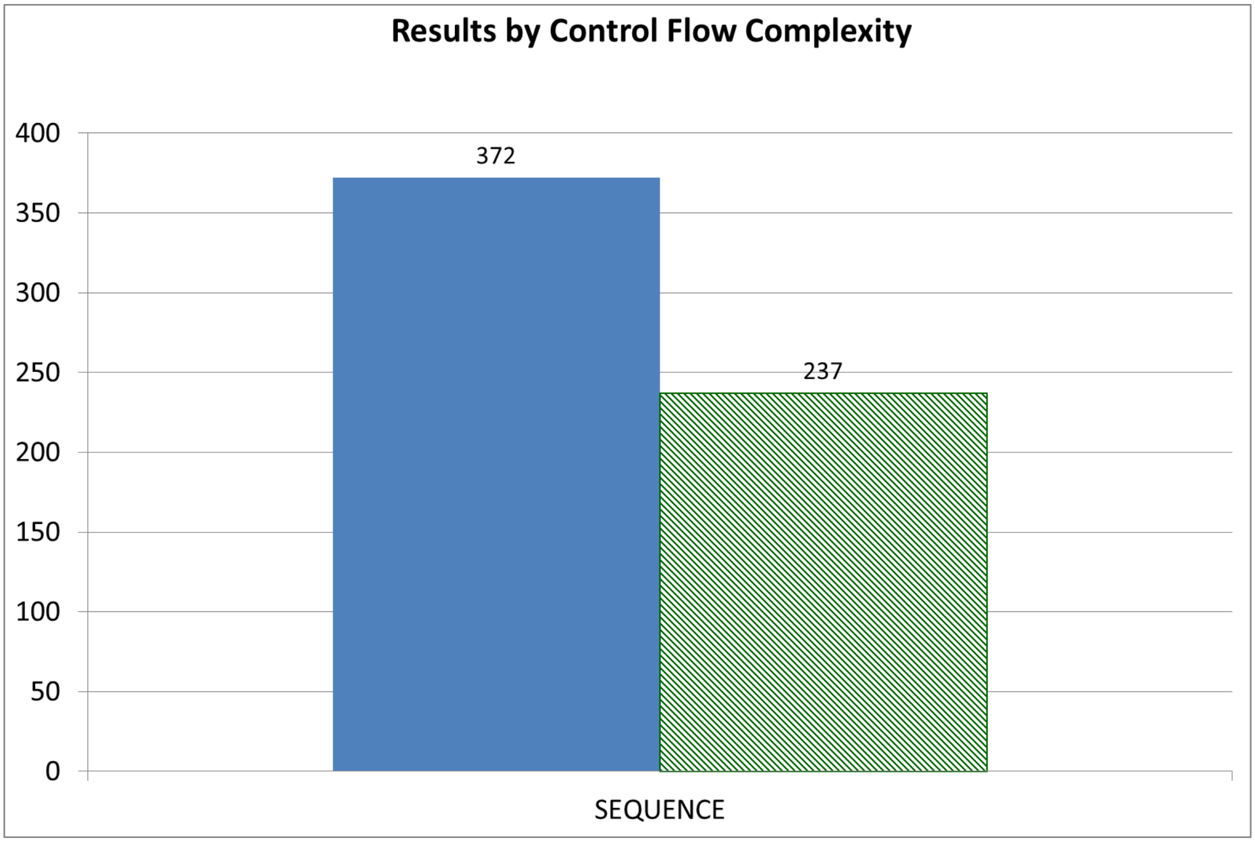

Figure I-92. MINESTRONE CTREE Number of Passing Test Cases (by Control Flow Complexity)

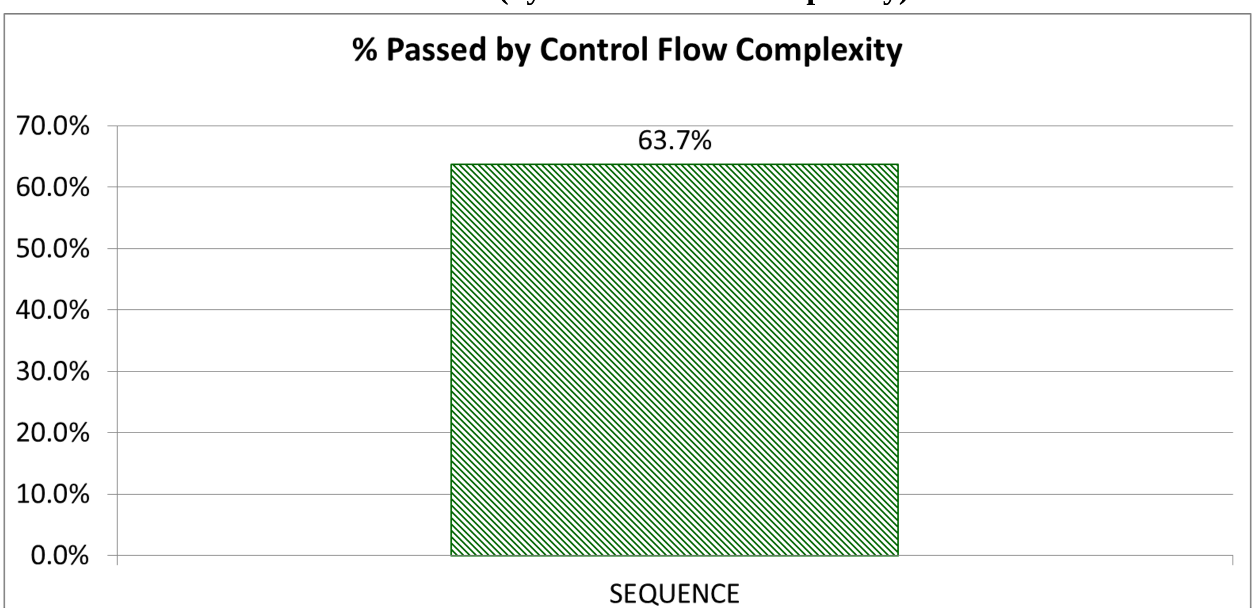

Figure I-93. MINESTRONE CTREE Percentage of Passing Test Cases (by Control Flow Complexity)

I.4.6 MINESTRONE CTREE Performance Overhead

Table I-32. MINESTRONE CTREE Performance Overhead by Weakness Class

Weakness Class	% Increase
Concurrency Handling	2256.3%
Injection	1545.4%
Memory Corruption	4248.0%
Null Pointer	6854.5%
Number Handling	13497.1%
Resource Drains	825.4%
Grand Total	**1287.1%**

Table I-33. MINESTRONE CTREE Performance Overhead by Base Program

Base Program	% Increase
CTRE	1287.1%
Grand Total	**1287.1%**

Table I-34. MINESTRONE CTREE Performance Overhead by Taint Source

Taint Source	% Increase
ENVIRONMENT_VARIABLE	1285.8%
SOCKET	1486978.8%
Grand Total	**1287.1%**

Table I-35. MINESTRONE CTREE Performance Overhead by Data Type Complexity

Data Type Complexity	% Increase
SIMPLE	1287.1%
Grand Total	**1287.1%**

Table I-36 MINESTRONE CTREE Performance Overhead by Data Flow Complexity

Data Flow Complexity	% Increase
BASIC	1287.1%
Grand Total	**1287.1%**

Table I-37. MINESTRONE CTREE Performance Overhead by Control Flow Complexity

Control Flow Complexity	% Increase
SEQUENCE	1287.1%
Grand Total	**1287.1%**

Table I-38. MINESTRONE CTREE Performance Overhead by File Size

File Size	% Increase
537,199	1287.1%
Grand Total	**1287.1%**

APPENDIX J—GrammaTech Detailed T&E Results

J.1 PEASOUP Basic Results

Totals

		Altered? No	Altered? Yes	Total
Mitigation?	Full	818	163	981
	Partial	93	34	127
	None	428	418	846
	Total	1,339	615	1,954

Percentages

		Altered? No	Altered? Yes	Total
Mitigation?	Full	41.9%	8.3%	50.2%
	Partial	4.8%	1.7%	6.5%
	None	21.9%	21.4%	43.3%
	Total	69%	31%	100%

Figure J-1. PEASOUP Mitigation and Altered Functionality Results

J.1.1 PEASOUP Results by Base Programs

Table J-1. PEASOUP Mitigation and Altered Functionality Results (by Base Program)

Base Program	Total Test Cases	Full Mitigation No Altered Function	Partial Mitigation No Altered Function	No Mitigation No Altered Function	Full Mitigation Altered Function	Partial Mitigation Altered Function	No Mitigation Altered Function
FFMP	552	236	20	38	120	3	75
GIMP	0	0	0	0	0	0	0
OSSL	574	362	15	171	18	0	8
PSQL	374	0	0	0	20	26	328
SUBV	451	220	58	159	4	5	5
WIRE	3	0	0	0	1	0	2
Grand Total	**1954**	**818**	**93**	**428**	**163**	**34**	**418**

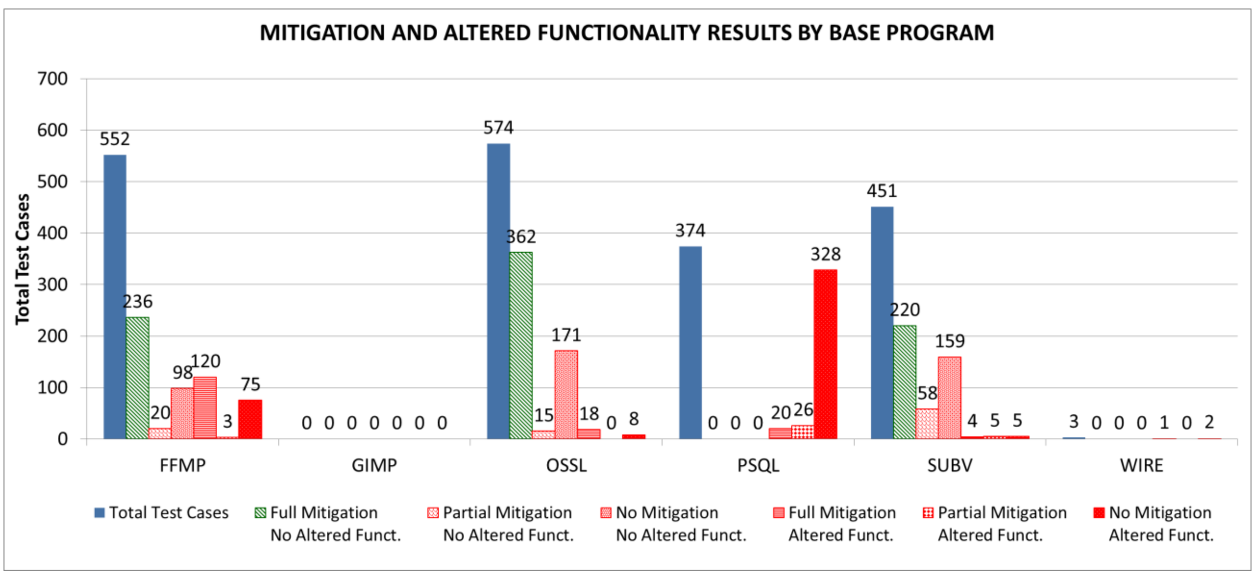

Figure J-2. PEASOUP Mitigation and Altered Functionality Results (by Base Program)

Table J-2. PEASOUP Mitigation and Altered Functionality Results (percentage by Base Program)

Base Program	% Full Mitigation No Altered Function	% Partial Mitigation No Altered Function	% No Mitigation No Altered Function	% Full Mitigation Altered Function	% Partial Mitigation Altered Function	% No Mitigation Altered Function
FFMP	43%	4%	18%	22%	1%	14%
GIMP						
OSSL	63%	3%	30%	3%	0%	1%
PSQL	0%	0%	0%	5%	7%	88%
SUBV	49%	13%	35%	1%	1%	1%
WIRE	0%	0%	0%	33%	0%	67%
Grand Total	**42%**	**5%**	**22%**	**8%**	**2%**	**21%**

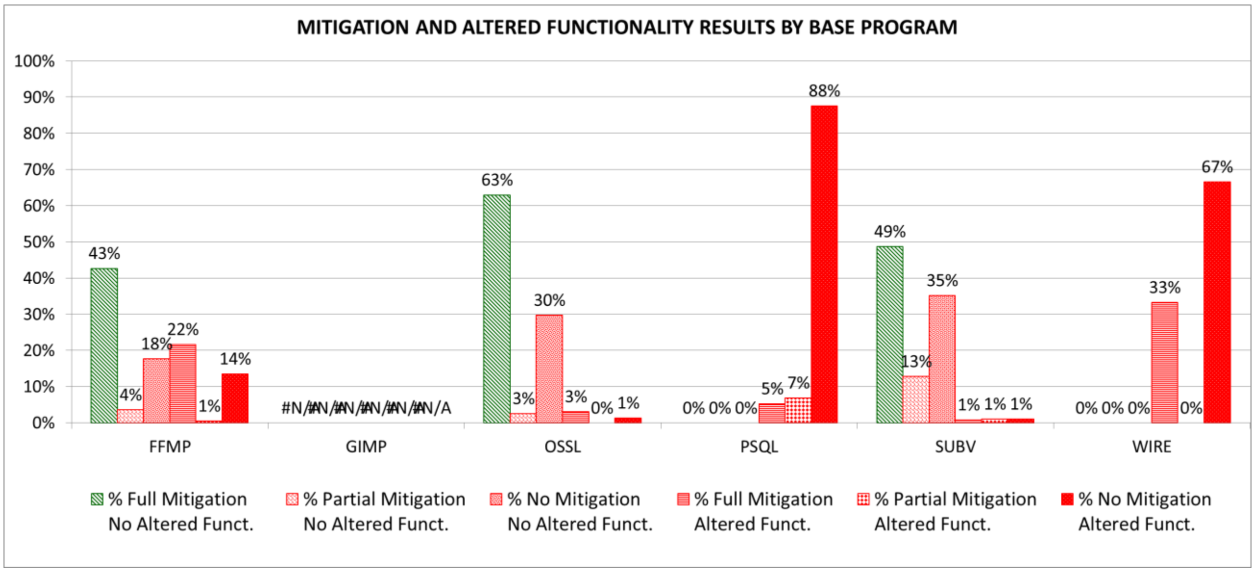

Figure J-3. PEASOUP Mitigation and Altered Functionality Results (percentage by Base Program)

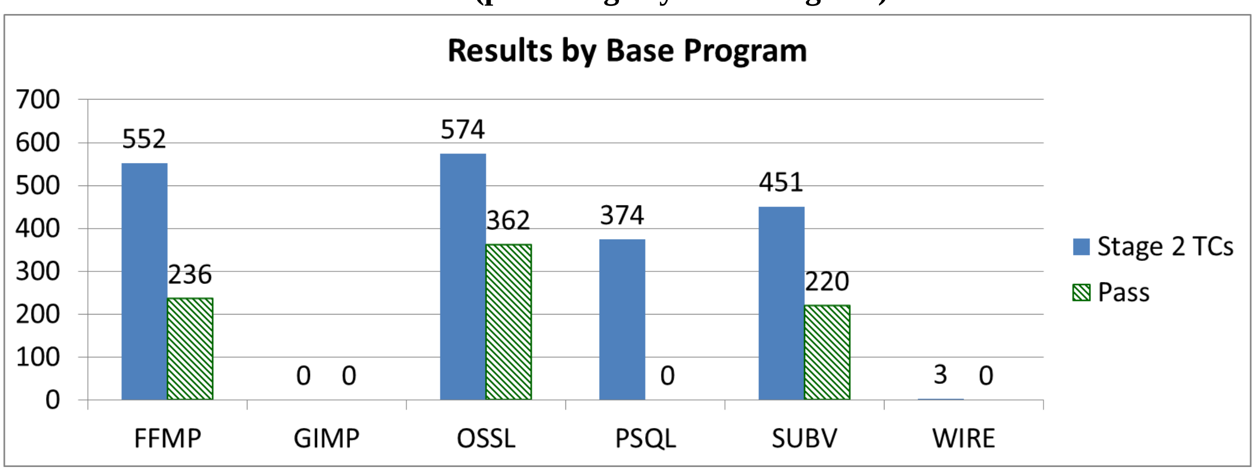

Figure J-4. PEASOUP Number of Passing Test Cases (by Base Program)

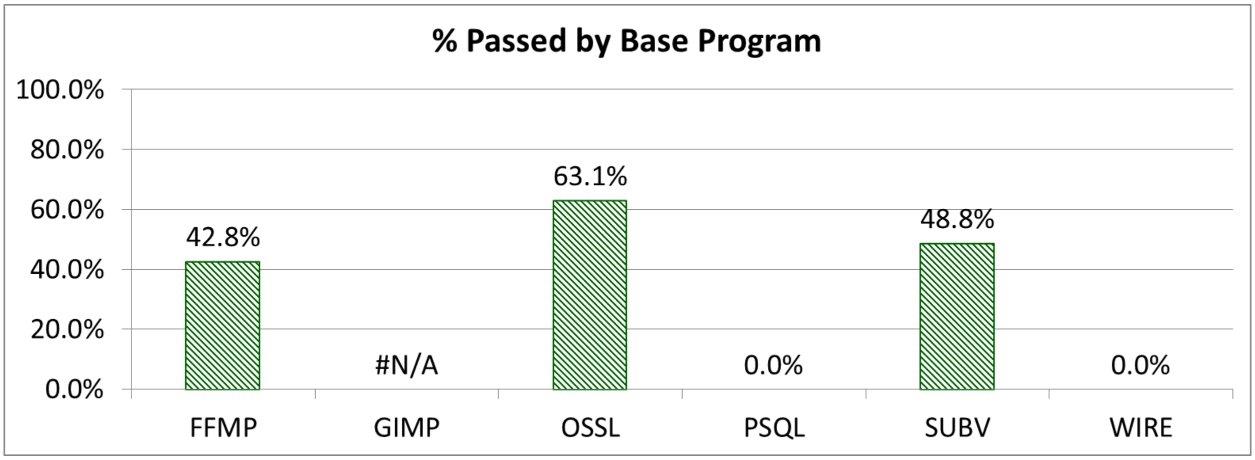

Figure J-5. PEASOUP Percentage of Passing Test Cases (by Base Program)

J.1.2 PEASOUP Results by Weakness Classes and Target Weaknesses

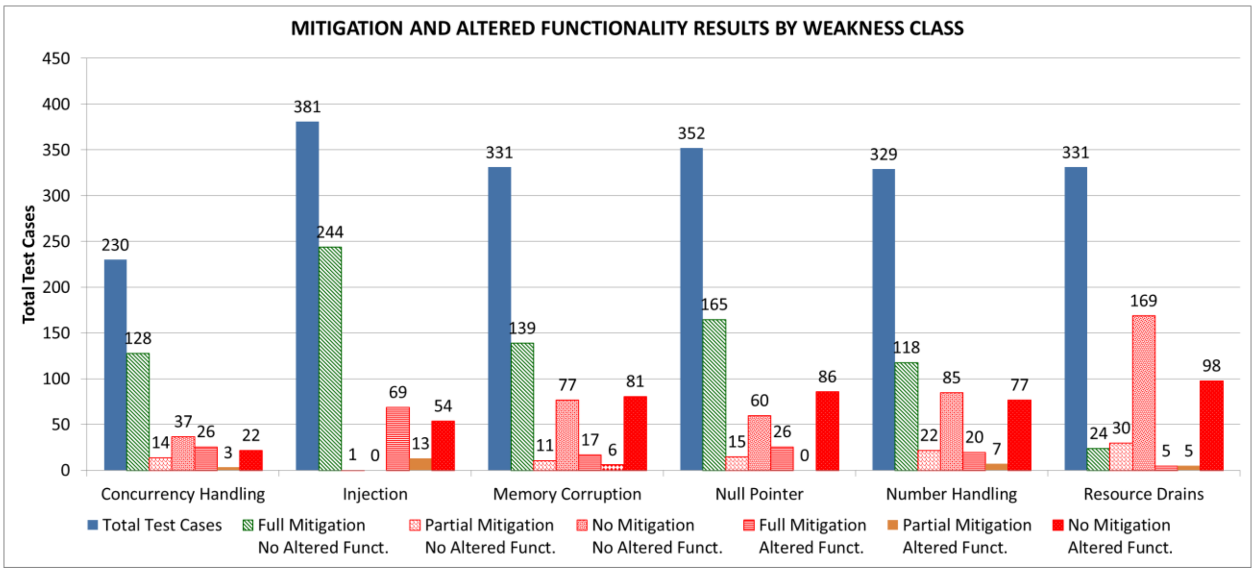

Figure J-6. PEASOUP Mitigation and Altered Functionality Results (by Weakness Class)

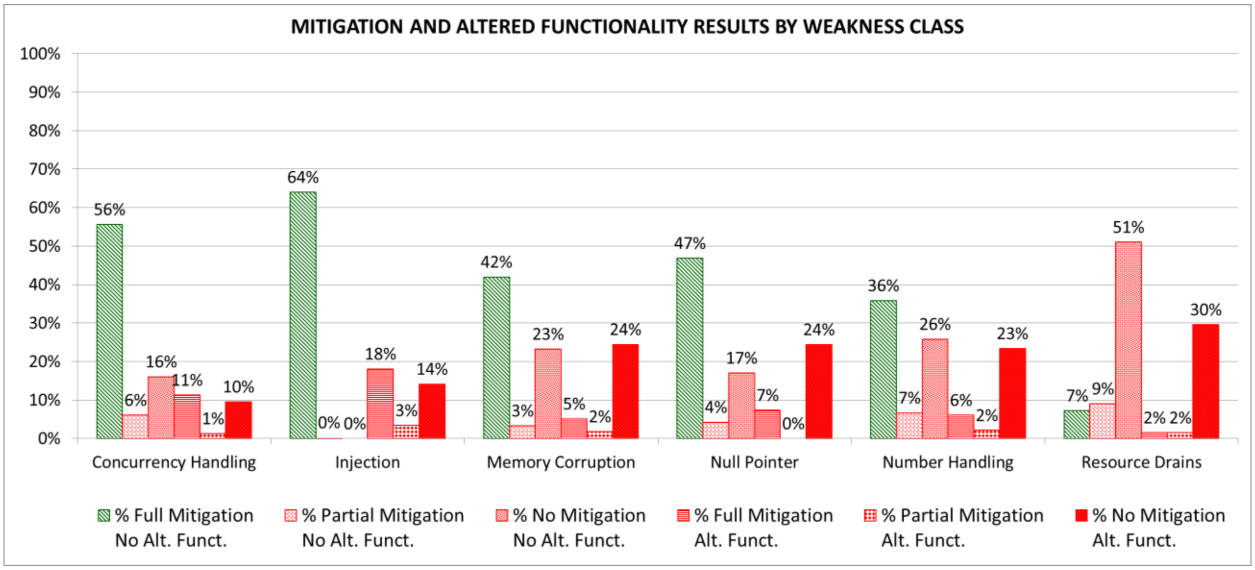

Figure J-7. PEASOUP Mitigation and Altered Functionality Results (percentage by Weakness Class)

Table J-3. PEASOUP Mitigation and Altered Functionality Results (by Weakness Class)

Target Weakness Class	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & No Alt Function)	% Pass
Concurrency Handling	429	230	179	78%	154	67%	128	56%
Injection	554	381	245	64%	313	82%	244	64%
Memory Corruption	510	331	227	69%	156	47%	139	42%
Null Pointer	544	352	240	68%	191	54%	165	47%
Number Handling	534	329	225	68%	138	42%	118	36%
Resource Drains	498	331	223	67%	29	9%	24	7%
Grand Total	**3069**	**1954**	**1339**	**68.5%**	**981**	**50.2%**	**818**	**41.9%**

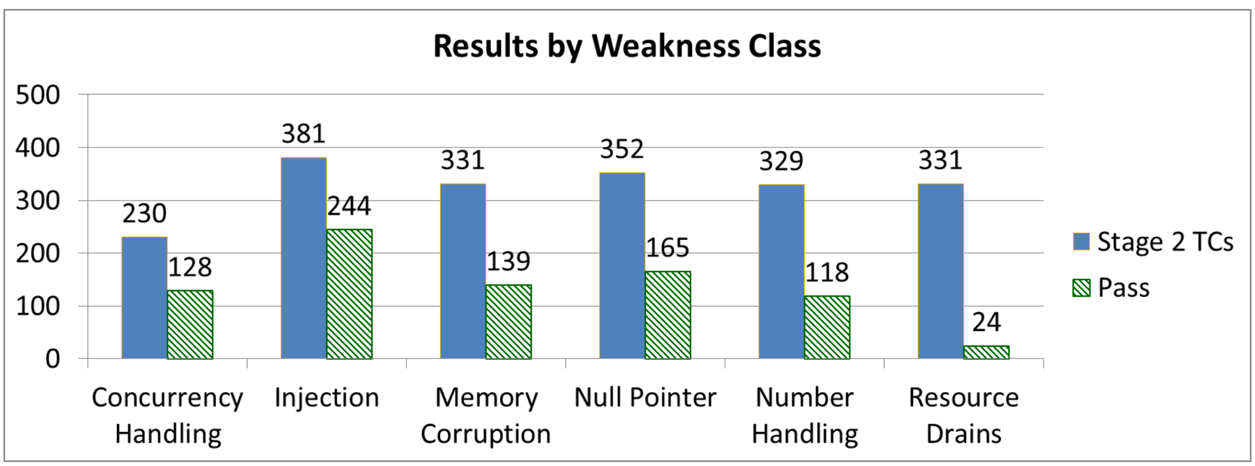

Figure J-8. PEASOUP Number of Passing Test Cases (by Weakness Class)

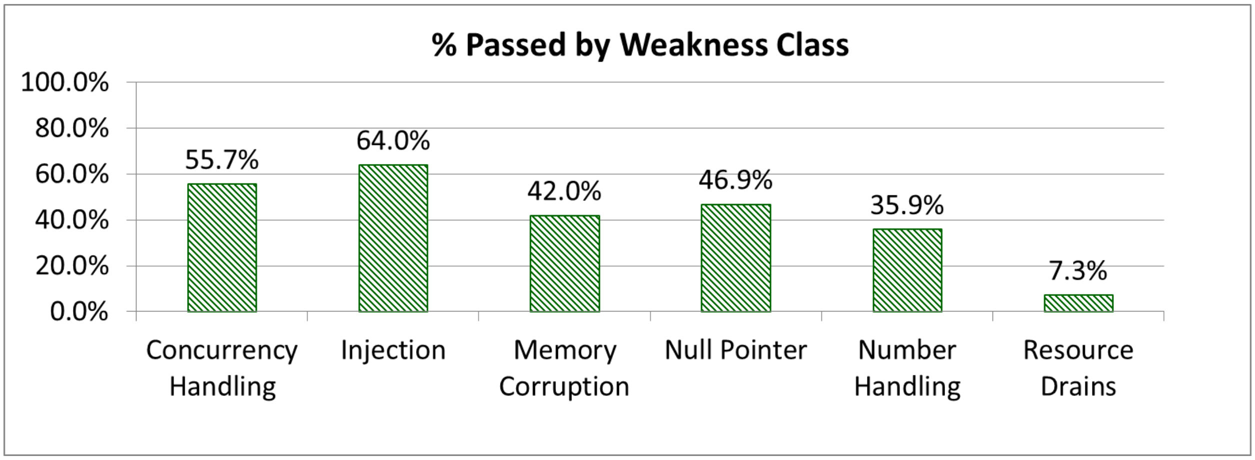

Figure J-9. PEASOUP Percentage of Passing Test Cases (by Weakness Class)

Table J-4. PEASOUP Mitigation and Altered Functionality Results (by CWE)

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling								
363A	20	0	0	0	0	0	0	0
367A	26	0	0	0	0	0	0	0
412A	14	0	0	0	0	0	0	0
414A	22	13	10	77%	11	85%	9	69%
479A	23	21	17	81%	13	62%	13	62%
543A	32	21	20	95%	0	0%	0	0%
609A	28	14	11	79%	12	86%	9	64%
663A	28	23	20	87%	21	91%	20	87%
764A	36	20	13	65%	16	80%	12	60%
765A	29	14	4	29%	11	79%	4	29%
765B	29	14	11	79%	9	64%	6	43%
820A	25	16	14	88%	6	38%	6	38%
821A	29	17	16	94%	15	88%	14	82%
828A	28	21	16	76%	14	67%	13	62%
831A	33	21	14	67%	11	52%	9	43%
833A	27	15	13	87%	15	100%	13	87%
Injection								
078A	90	69	33	48%	48	70%	33	48%
078B	69	49	39	80%	44	90%	39	80%
088A	81	62	29	47%	31	50%	28	45%
088B	68	48	31	65%	38	79%	31	65%
089A	61	39	33	85%	39	100%	33	85%
089B	65	39	24	62%	39	100%	24	62%
089C	60	39	33	85%	39	100%	33	85%
089D	60	36	23	64%	35	97%	23	64%
Memory Corruption								
120A	14	9	5	56%	4	44%	2	22%
120B	12	7	4	57%	0	0%	0	0%
120C	16	9	7	78%	5	56%	5	56%
120D	11	9	8	89%	6	67%	6	67%
124A	11	8	5	63%	4	50%	3	38%
124B	10	8	7	88%	0	0%	0	0%
124C	15	8	6	75%	6	75%	6	75%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
124D	13	6	4	67%	3	50%	2	33%
126A	12	10	7	70%	0	0%	0	0%
126B	13	8	6	75%	0	0%	0	0%
126C	13	7	2	29%	0	0%	0	0%
126D	14	10	6	60%	0	0%	0	0%
127A	7	4	3	75%	0	0%	0	0%
127B	13	9	6	67%	0	0%	0	0%
127C	13	7	3	43%	0	0%	0	0%
127D	13	10	4	40%	0	0%	0	0%
129A	2	2	0	0%	0	0%	0	0%
129B	13	9	8	89%	9	100%	8	89%
134A	15	10	8	80%	9	90%	8	80%
170A	14	10	8	80%	8	80%	6	60%
170B	14	9	6	67%	0	0%	0	0%
415A	12	9	7	78%	8	89%	7	78%
416A	3	0	0	0	0	0	0	0
590A	13	6	4	67%	5	83%	4	67%
761A	14	8	5	63%	6	75%	5	63%
785A	8	3	1	33%	1	33%	1	33%
785B	15	10	8	80%	8	80%	7	70%
785C	12	7	4	57%	3	43%	2	29%
785D	13	10	5	50%	4	40%	4	40%
805A	14	10	8	80%	7	70%	7	70%
805B	13	8	6	75%	7	88%	6	75%
805C	15	11	9	82%	7	64%	6	55%
805D	13	10	7	70%	5	50%	5	50%
806A	13	8	5	63%	5	63%	5	63%
806B	14	8	5	63%	5	63%	5	63%
806C	14	9	6	67%	3	33%	3	33%
806D	14	9	8	89%	6	67%	6	67%
822A	12	8	5	63%	6	75%	5	63%
824A	12	10	7	70%	3	30%	3	30%
824B	14	9	8	89%	7	78%	7	78%
843A	14	9	6	67%	6	67%	5	56%
Null Pointer								
476A	79	51	32	63%	23	45%	19	37%
476B	77	51	33	65%	29	57%	21	41%
476C	79	50	34	68%	29	58%	25	50%
476D	75	52	35	67%	28	54%	25	48%
476E	80	51	38	75%	28	55%	26	51%
476F	75	49	35	71%	27	55%	25	51%
476G	79	48	33	69%	27	56%	24	50%
Number Handling								
190A	51	33	22	67%	0	0%	0	0%
191A	49	33	22	67%	18	55%	16	48%
191B	50	31	24	77%	16	52%	15	48%
194A	54	29	17	59%	15	52%	10	34%
195A	54	34	23	68%	20	59%	18	53%
196A	54	35	22	63%	0	0%	0	0%
197A	48	31	25	81%	22	71%	20	65%
369A	46	32	17	53%	19	59%	13	41%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
682A	31	13	7	54%	5	38%	5	38%
682B	48	26	20	77%	17	65%	15	58%
839A	49	32	26	81%	6	19%	6	19%
Resource Drains								
400A	46	35	22	63%	1	3%	0	0%
400B	37	22	8	36%	0	0%	0	0%
401A	36	21	13	62%	0	0%	0	0%
459A	47	32	26	81%	0	0%	0	0%
674A	26	10	7	70%	0	0%	0	0%
771A	40	30	22	73%	3	10%	3	10%
773A	47	34	26	76%	0	0%	0	0%
774A	43	27	16	59%	0	0%	0	0%
775A	43	33	24	73%	1	3%	1	3%
789A	47	28	17	61%	0	0%	0	0%
834A	46	33	22	67%	24	73%	20	61%
835A	40	26	20	77%	0	0%	0	0%
Grand Total	**3069**	**1954**	**1339**	**68.5%**	**981**	**50.2%**	**818**	**41.9%**

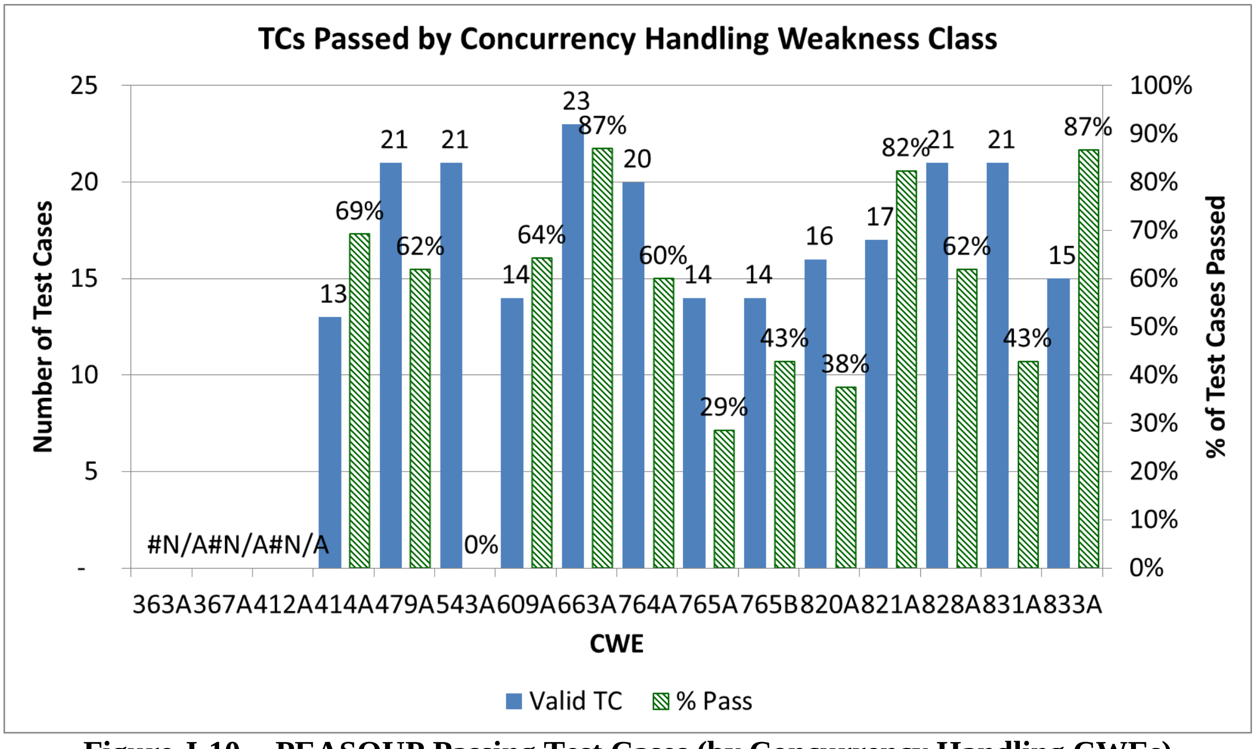

Figure J-10. PEASOUP Passing Test Cases (by Concurrency Handling CWEs)

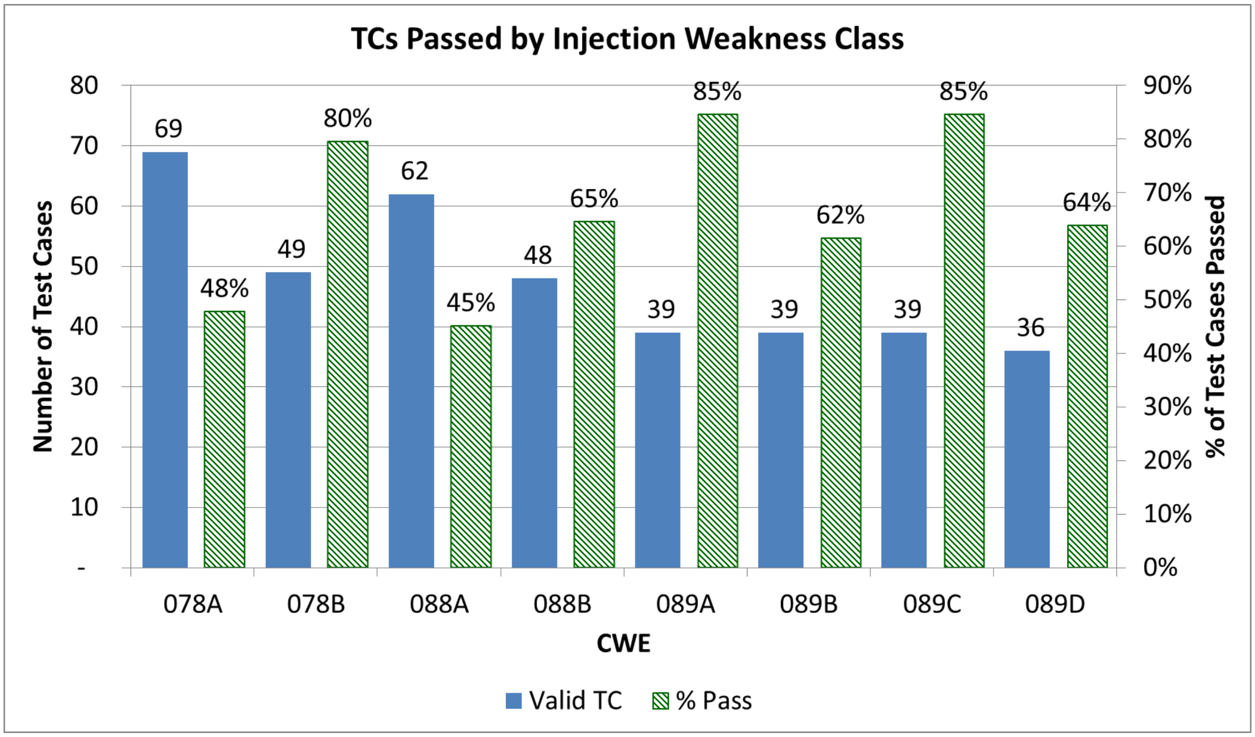

Figure J-11. PEASOUP Passing Test Cases (by Injection CWEs)

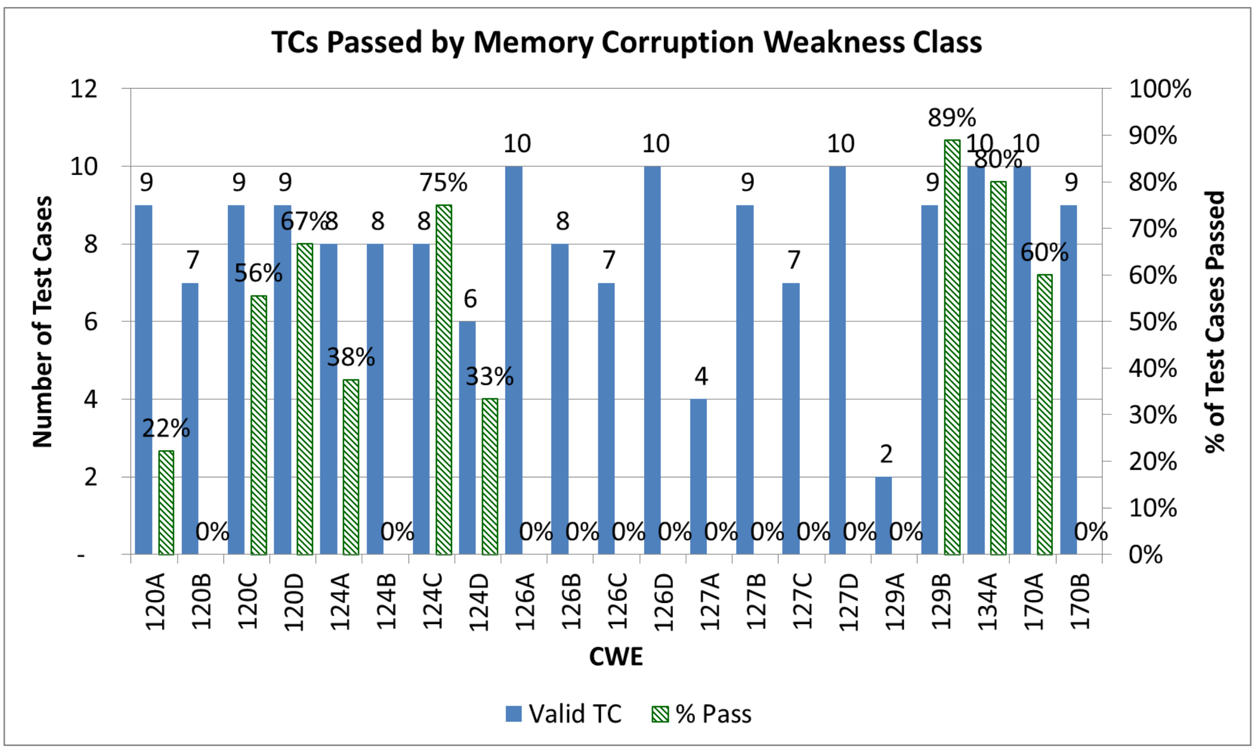

Figure J-12. PEASOUP Passing Test Cases (by Memory Corruption CWEs) (Part 1)

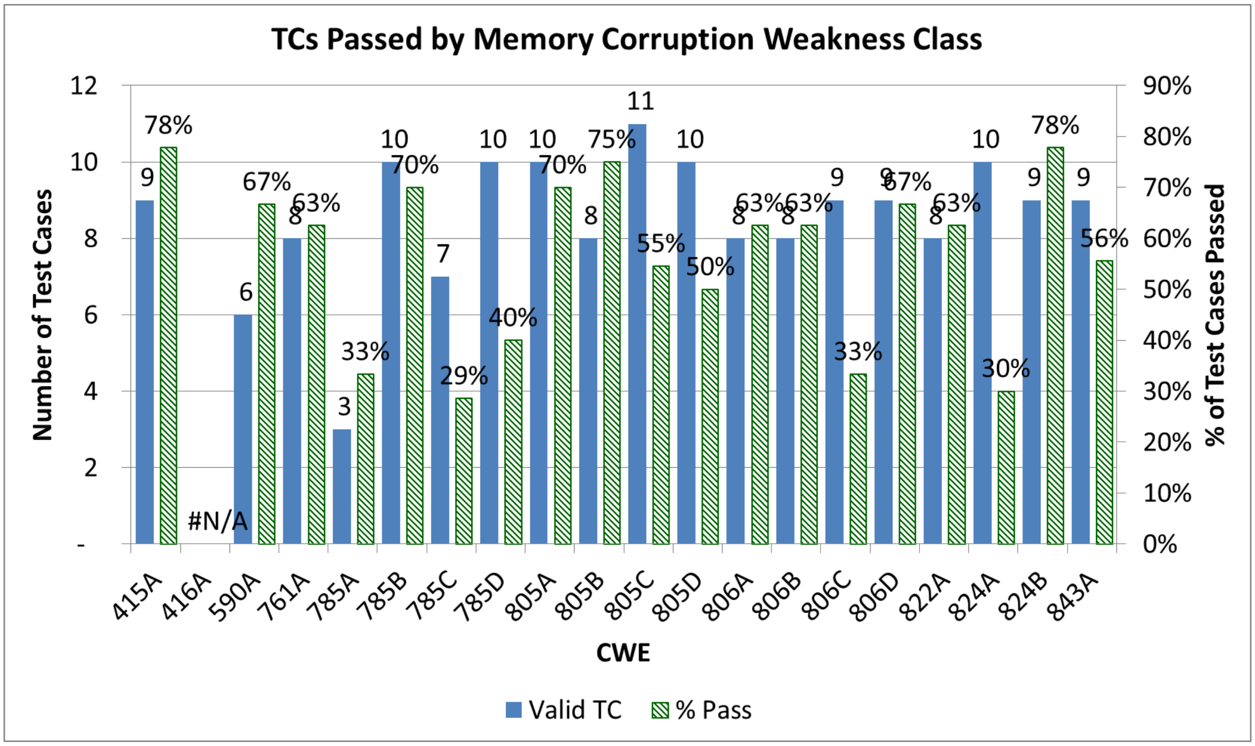

Figure J-13. PEASOUP Passing Test Cases (by Memory Corruption CWEs) (Part 2)

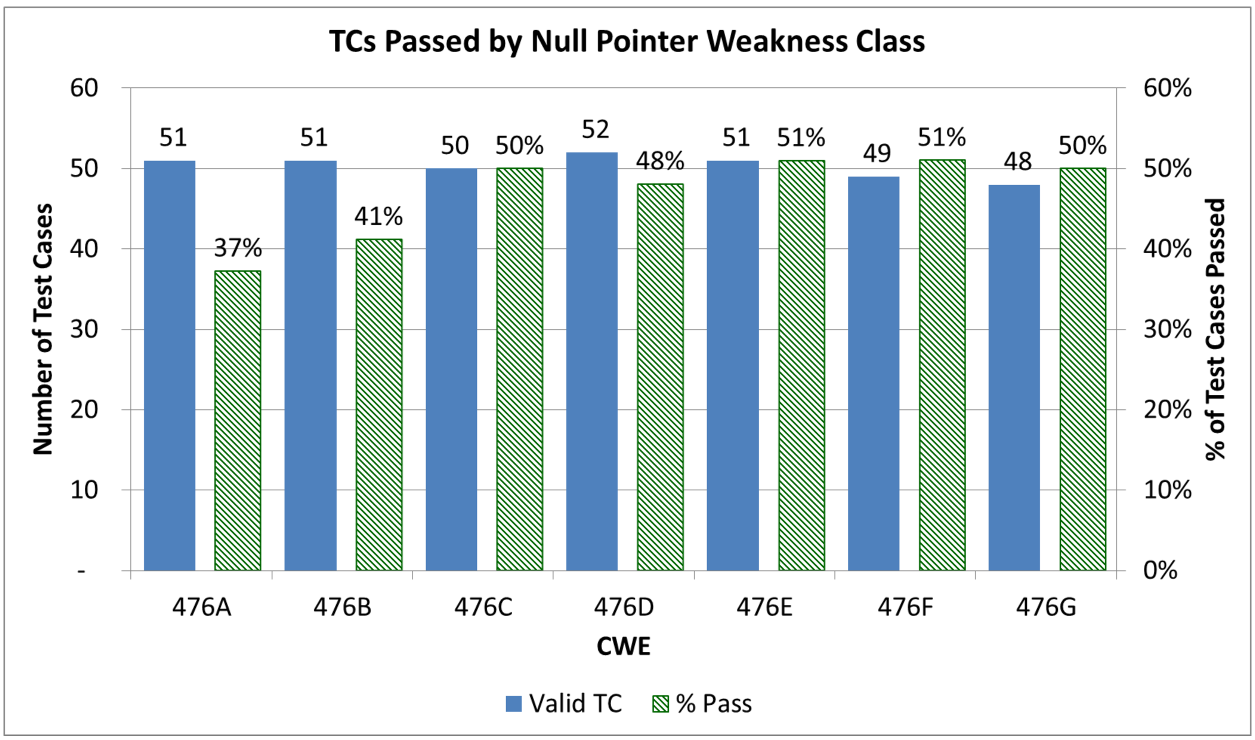

Figure J-14. PEASOUP Passing Test Cases (by Null Pointer CWEs)

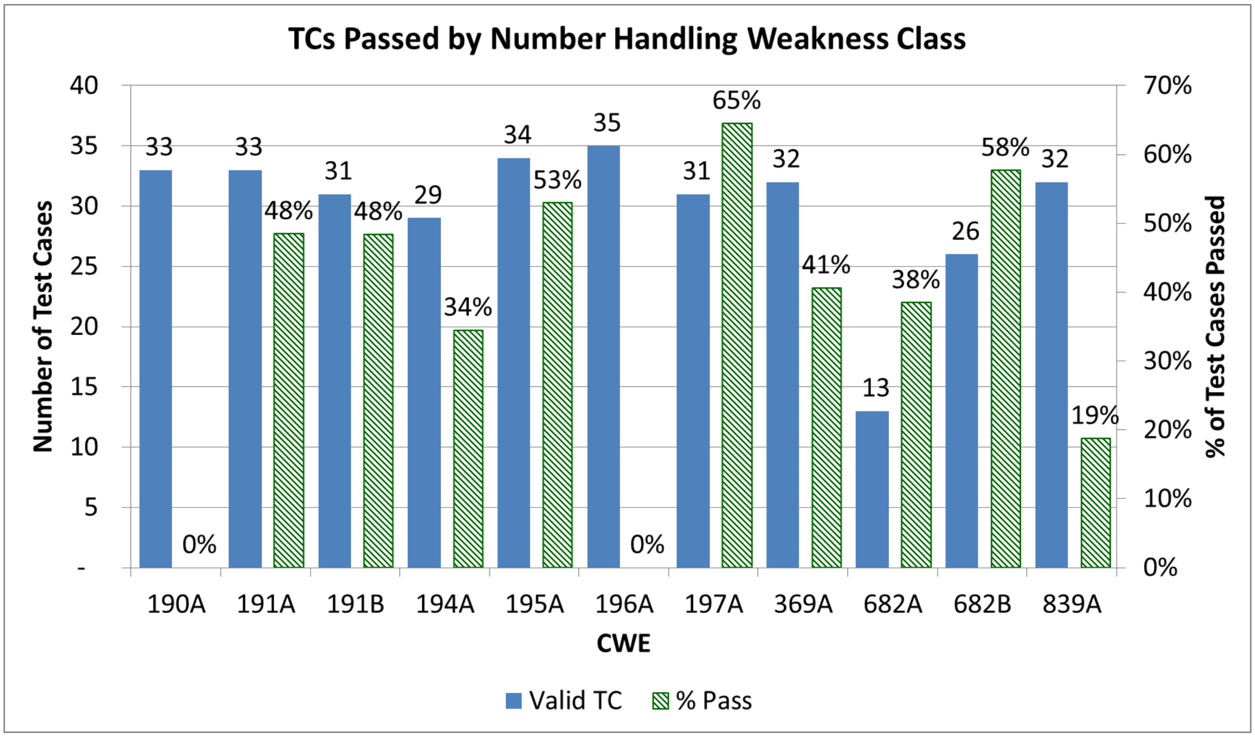

Figure J-15. PEASOUP Passing Test Cases (by Number Handling CWEs)

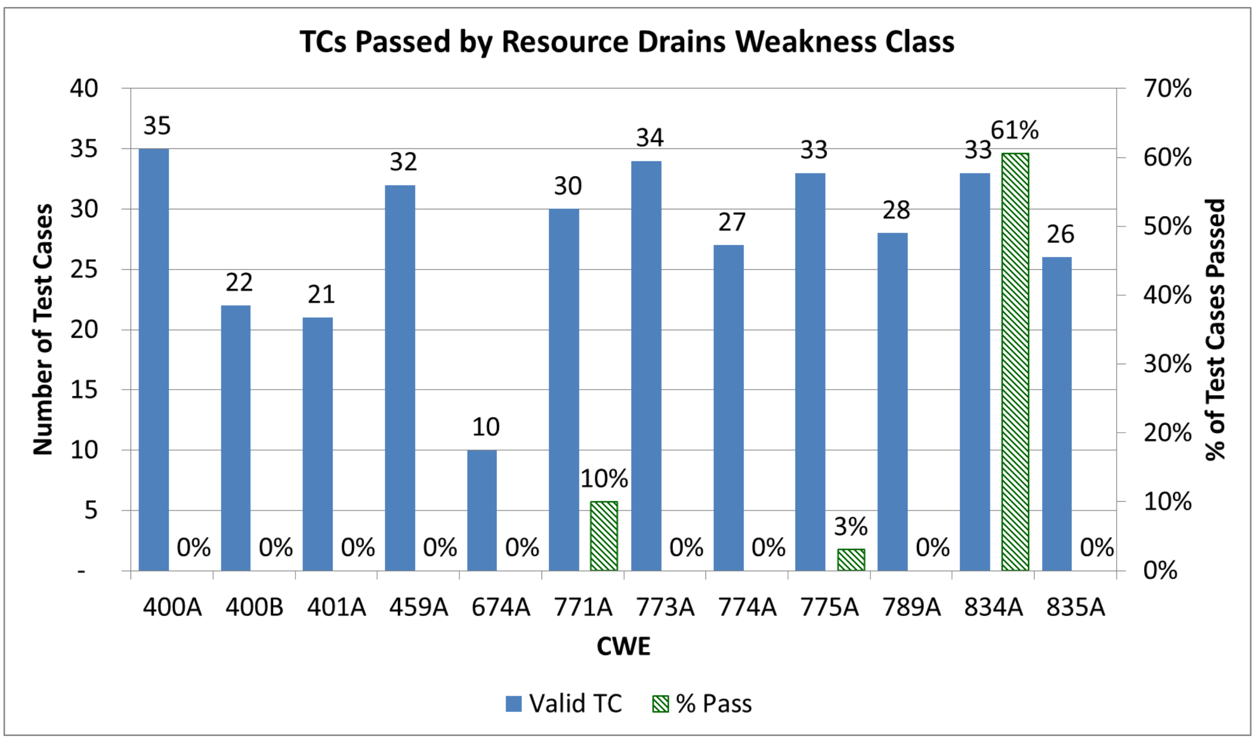

Figure J-16. PEASOUP Passing Test Cases (by Resource Drain CWEs)

J.1.3 PEASOUP Results by Taint Source

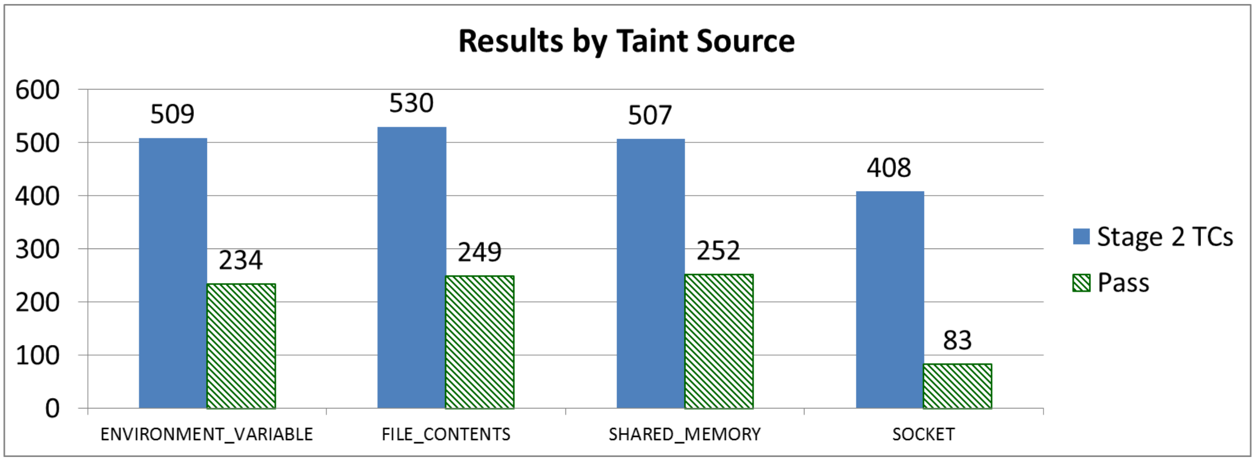

Figure J-17. PEASOUP Number of Passing Test Cases (by Taint Source)

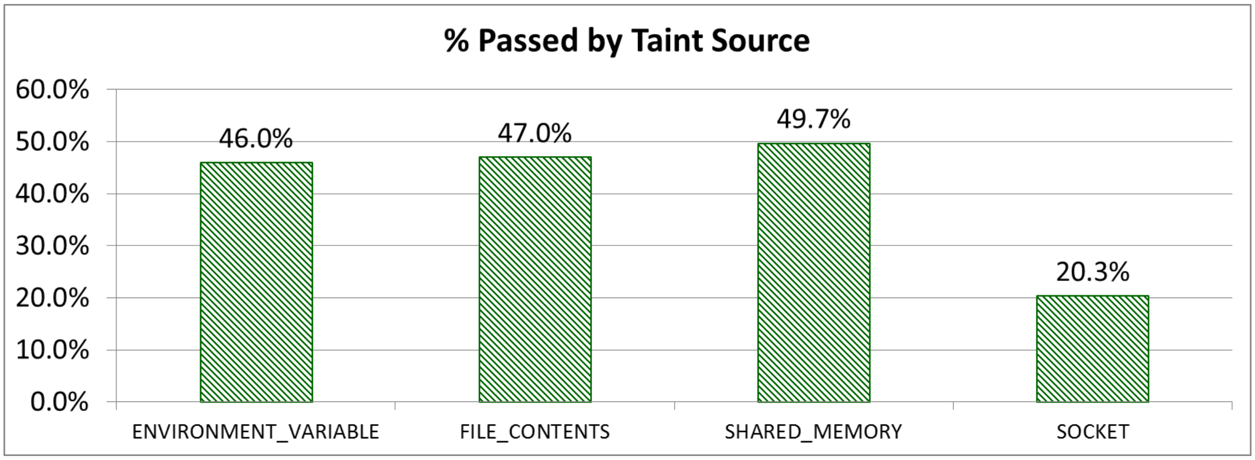

Figure J-18. PEASOUP Percentage of Passing Test Cases (by Taint Source)

J.1.4 PEASOUP Results by Data Type Complexity

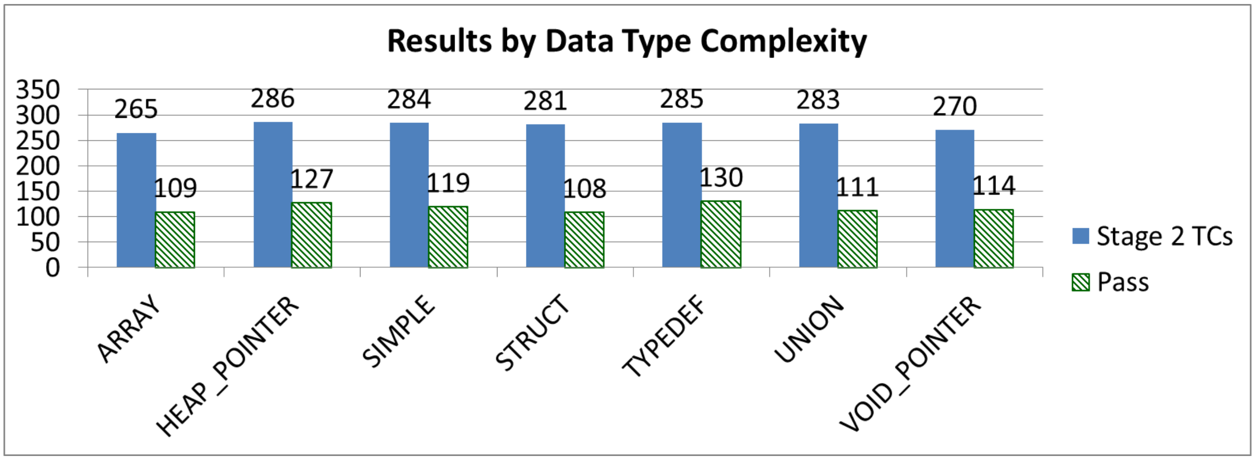

Figure J-19. PEASOUP Number of Passing Test Cases (by Data Type Complexity)

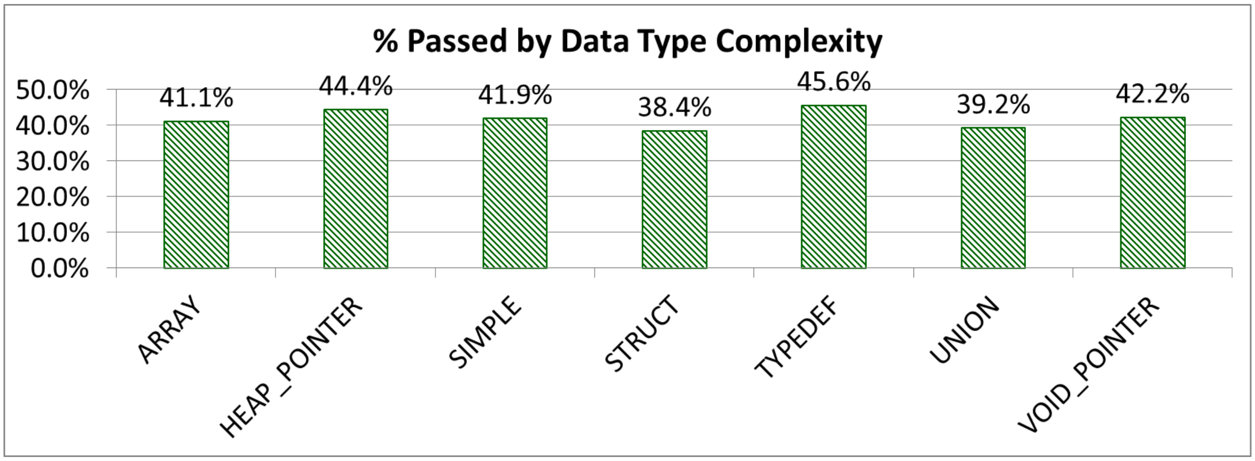

Figure J-20. MINESTRONE Percentage of Passing Test Cases (by Data Type Complexity)

J.1.5 PEASOUP Results by Data Flow Complexity

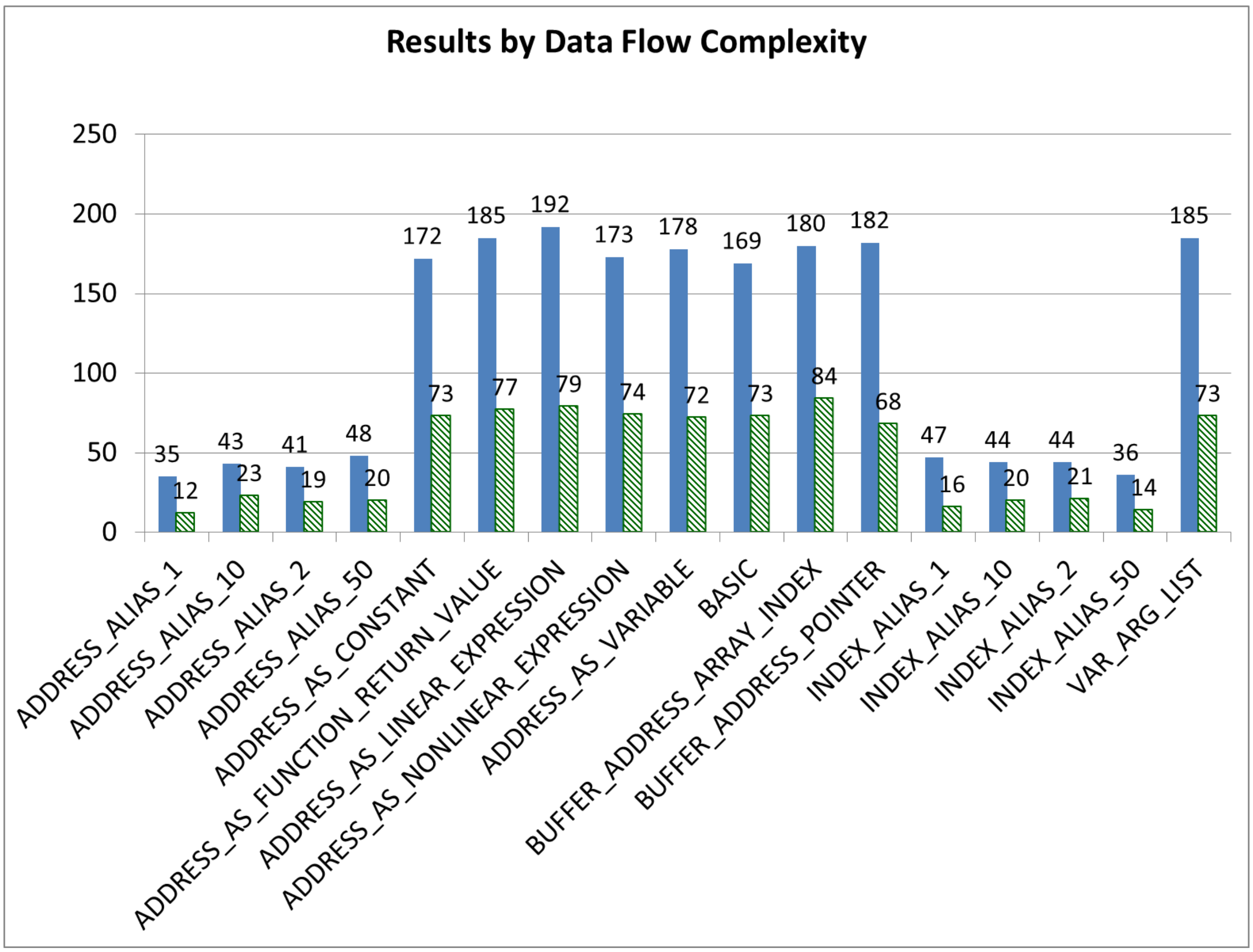

Figure J-21. PEASOUP Number of Passing Test Cases (by Data Flow Complexity)

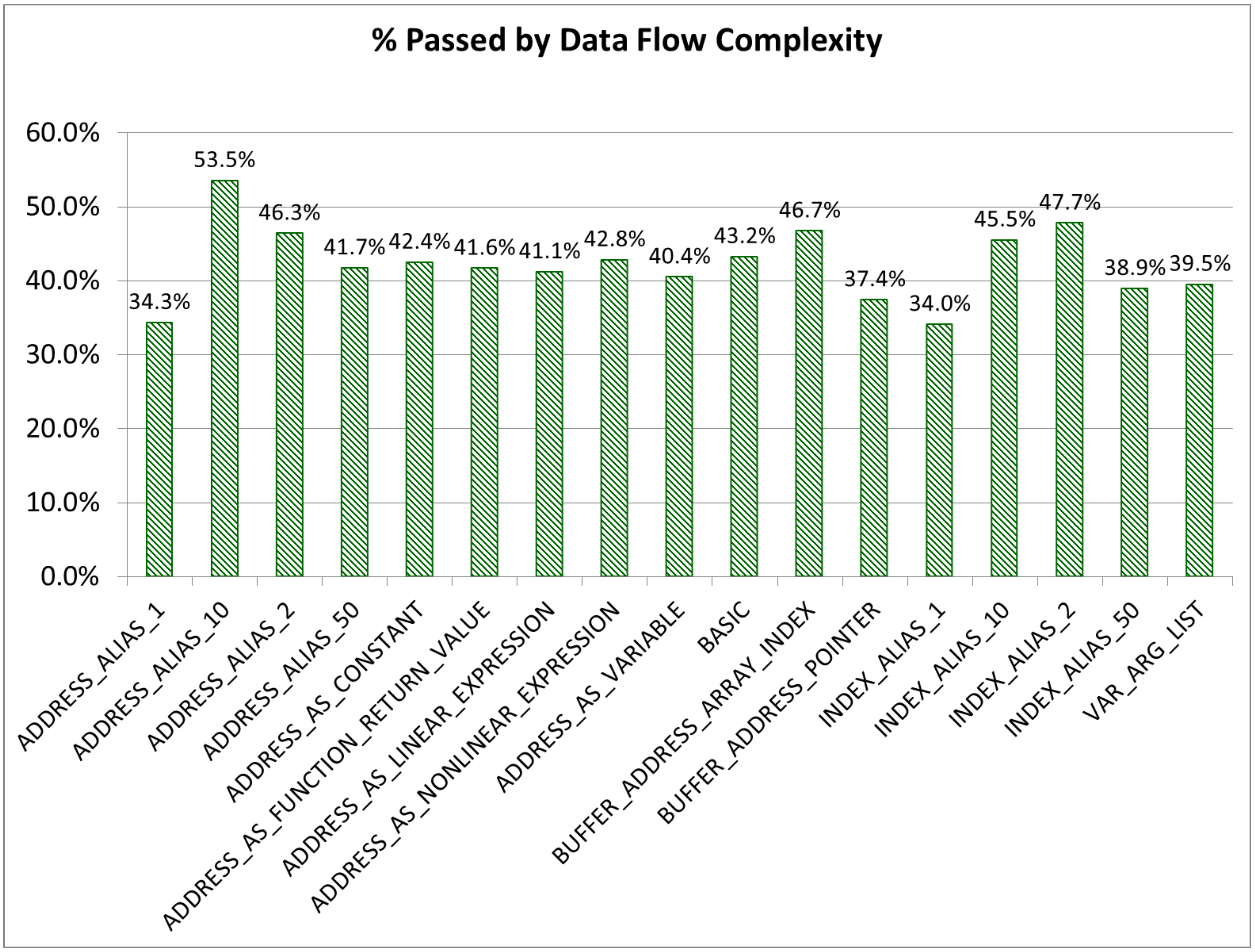

Figure J-22. PEASOUP Percentage of Passing Test Cases (by Data Flow Complexity)

J.1.6 PEASOUP Results by Control Flow Complexity

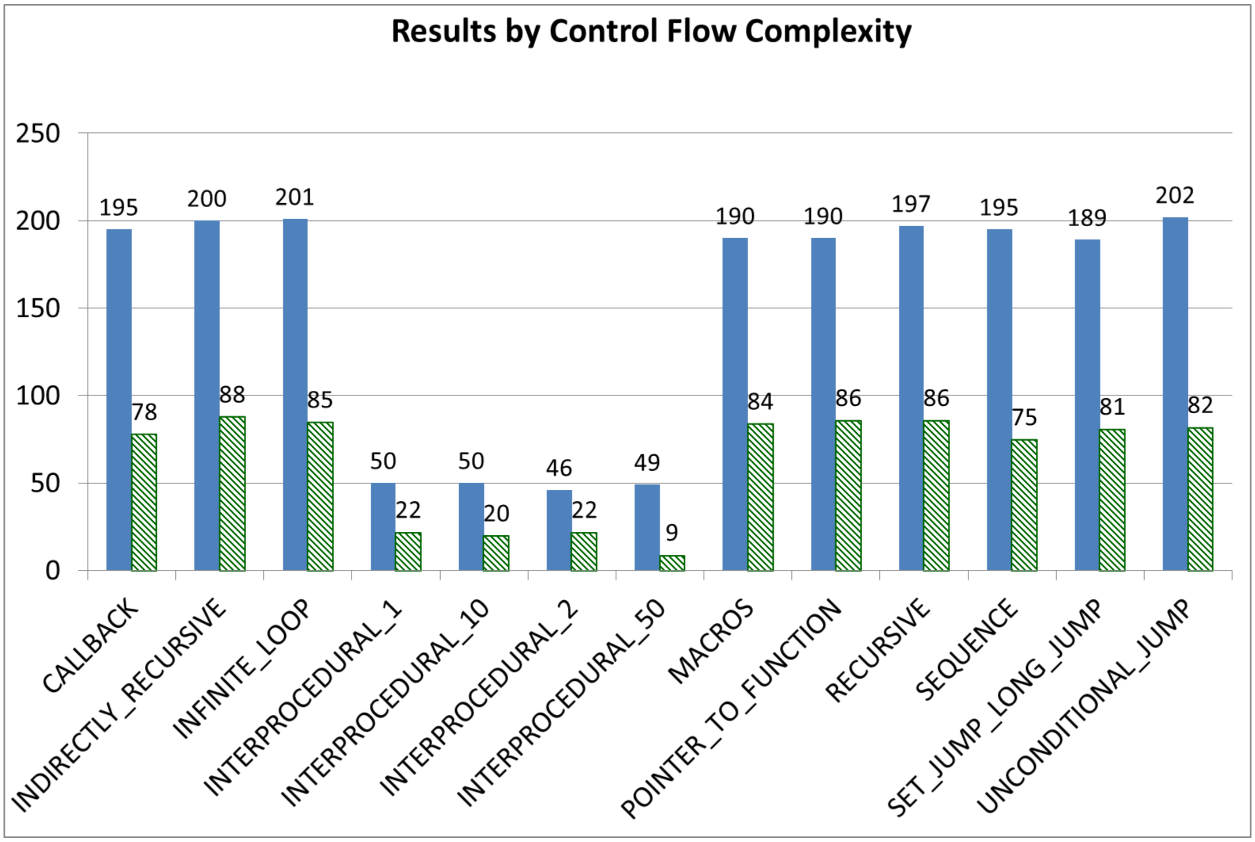

Figure J-23. PEASOUP Number of Passing Test Cases (by Control Flow Complexity)

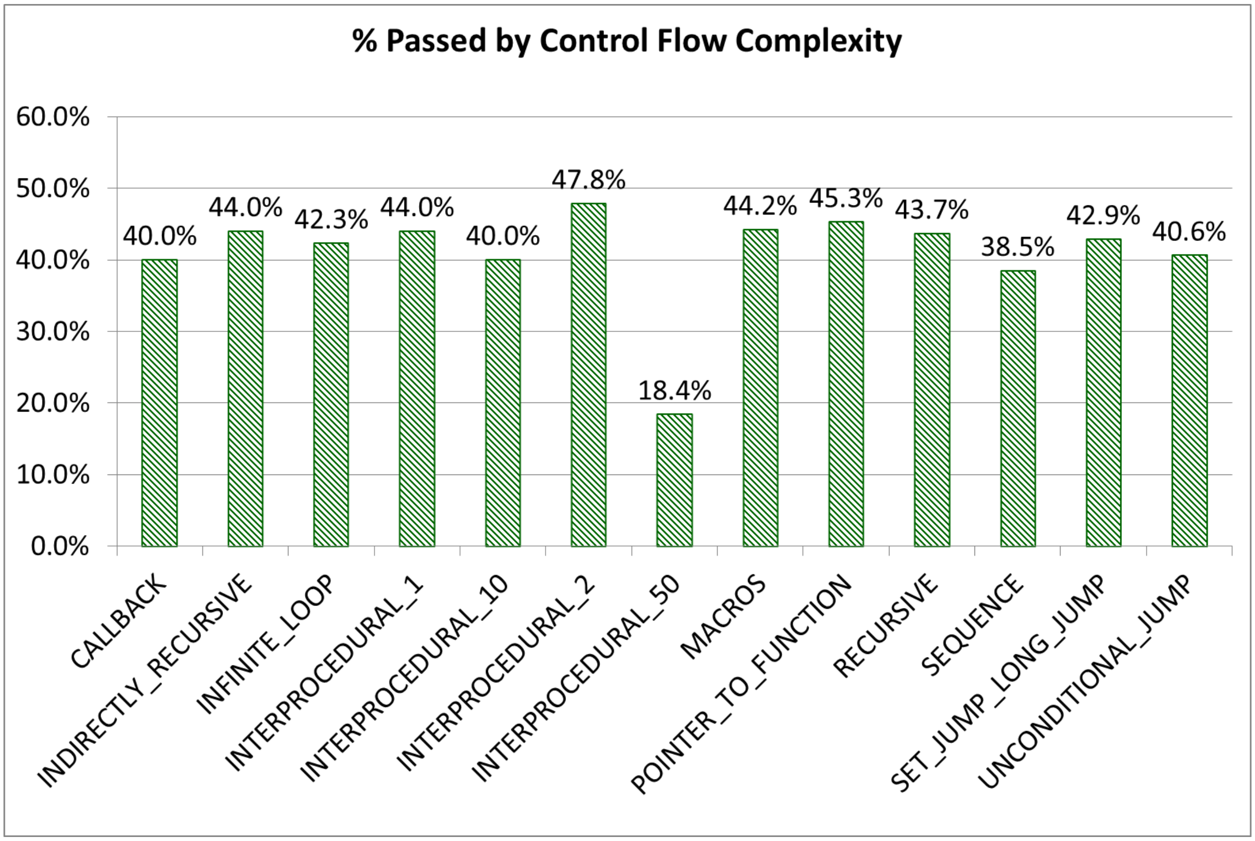

Figure J-24. PEASOUP Percentage of Passing Test Cases (by Control Flow Complexity)

J.1.7 PEASOUP Results by File Size

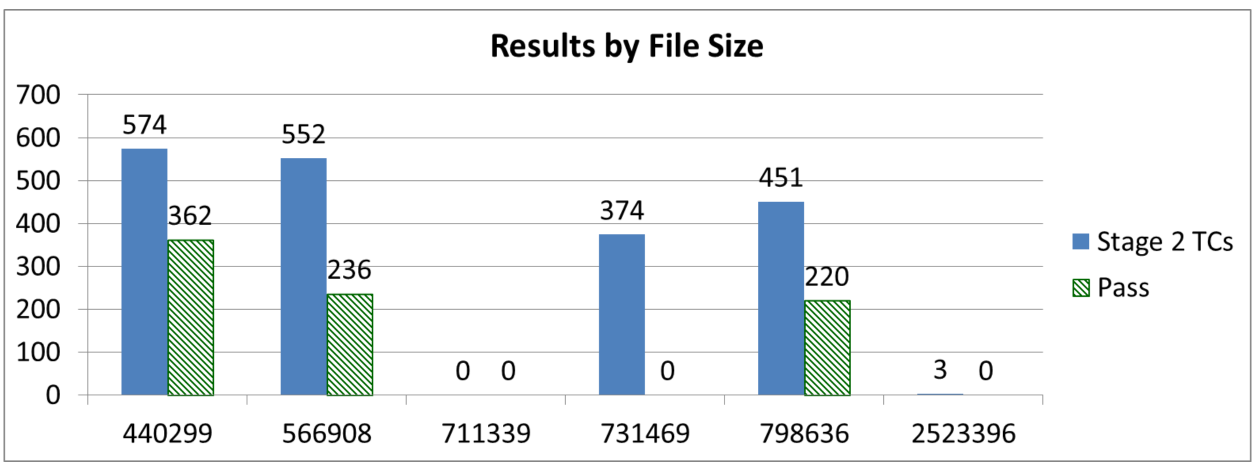

Figure J-25. PEASOUP Number of Passing Test Cases (by File Size)

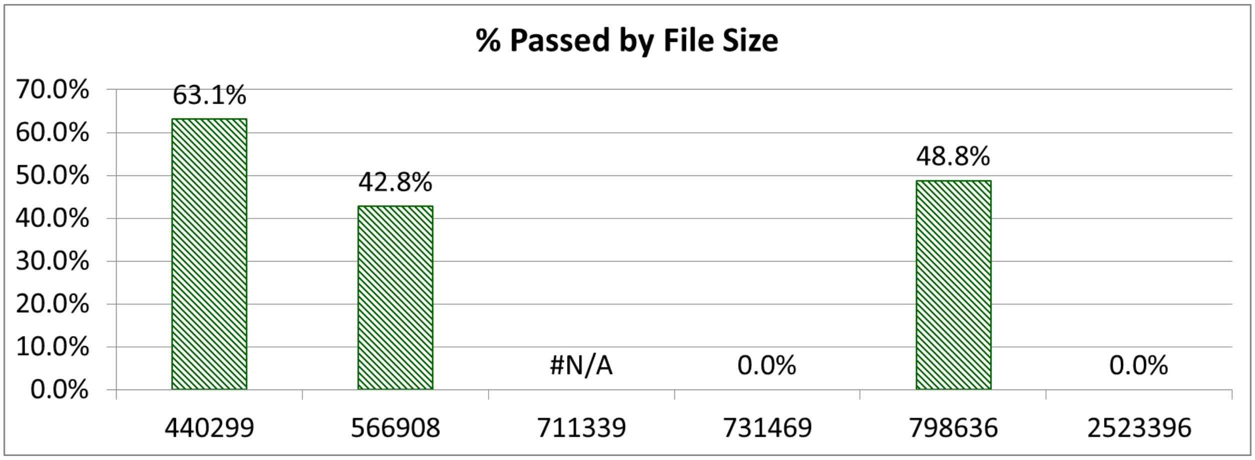

Figure J-26. PEASOUP Percentage of Passing Test Cases (by File Size)

J.1.8 PEASOUP Performance Overhead

Table J-5. PEASOUP Performance Overhead by Weakness Class

Weakness Class	% Increase
Concurrency Handling	17.2%
Injection	17.4%
Memory Corruption	18.4%
Number Handling	-32.3%
Resource Drains	49.2%
Null Pointer	6.5%
Grand Total	**18.5%**

Table J-6. PEASOUP Performance Overhead by Base Program

Base Program	% Increase
FFMP	179.2%
OSSL	274.5%
PSQL	4.5%
SUBV	246.3%
WIRE	-92.9%
GIMP	-100.0%
Grand Total	**18.5%**

Table J-7. PEASOUP Performance Overhead by Taint Source

Taint Source	% Increase
FILE_CONTENTS	19.6%
SHARED_MEMORY	-24.7%
SOCKET	-64.1%
ENVIRONMENT_VARIABLE	-37.2%
Grand Total	**18.5%**

Table J-8. PEASOUP Performance Overhead by Data Type Complexity

Data Type Complexity	% Increase
ARRAY	32.9%
HEAP_POINTER	-1.8%
SIMPLE	0.4%
STRUCT	16.9%
TYPEDEF	21.6%
UNION	19.3%
VOID_POINTER	39.6%
Grand Total	18.5%

Table J-9. PEASOUP Performance Overhead by Data Flow Complexity

Data Flow Complexity	% Increase
ADDRESS_ALIAS_1	-52.4%
ADDRESS_ALIAS_10	-3.7%
ADDRESS_ALIAS_2	21.6%
ADDRESS_ALIAS_50	14.4%
ADDRESS_AS_CONSTANT	15.2%
ADDRESS_AS_FUNCTION_RETURN_VALUE	39.8%
ADDRESS_AS_LINEAR_EXPRESSION	11.8%
ADDRESS_AS_NONLINEAR_EXPRESSION	-2.2%
ADDRESS_AS_VARIABLE	5.6%
BASIC	22.6%
BUFFER_ADDRESS_ARRAY_INDEX	67.5%
BUFFER_ADDRESS_POINTER	12.5%
INDEX_ALIAS_1	-16.8%
INDEX_ALIAS_10	0.4%
INDEX_ALIAS_2	29.9%
INDEX_ALIAS_50	-15.9%
VAR_ARG_LIST	24.1%
Grand Total	**18.5%**

Table J-10. PEASOUP Performance Overhead by Control Flow Complexity

Control Flow Complexity	% Increase
CALLBACK	-13.0%
INDIRECTLY_RECURSIVE	11.2%
INFINITE_LOOP	14.5%
INTERPROCEDURAL_1	21.6%
INTERPROCEDURAL_10	23.5%
INTERPROCEDURAL_2	168.3%
INTERPROCEDURAL_50	8.5%
MACROS	11.0%
POINTER_TO_FUNCTION	46.0%
RECURSIVE	22.3%
SEQUENCE	28.0%
SET_JUMP_LONG_JUMP	17.4%
UNCONDITIONAL_JUMP	0.5%
Grand Total	**18.5%**

Table J-11. PEASOUP Performance Overhead by File Size

File Size	% Increase
440,299	274.5%
566,908	179.2%
711,339	-100.0%
731,469	4.5%
798,636	246.3%
2,523,396	-92.9%
Grand Total	**18.5%**

J.2 Results and Analysis of Phase 2-Sized Programs

Numbers

		Altered? No	Altered? Yes	Total
Mitigation?	Full	**100**	109	209
	Partial	4	18	22
	None	45	92	137
	Total	149	219	368

Percentages

		Altered? No	Altered? Yes	Total
Mitigation?	Full	**27.2%**	29.6%	57%
	Partial	1.1%	4.9%	6%
	None	12.2%	25.0%	37%
	Total	40%	60%	100%

Figure J-27. PEASOUP GREP Mitigation and Altered Functionality Results

J.2.1 PEASOUP GREP Results by Weakness Classes and Target Weaknesses

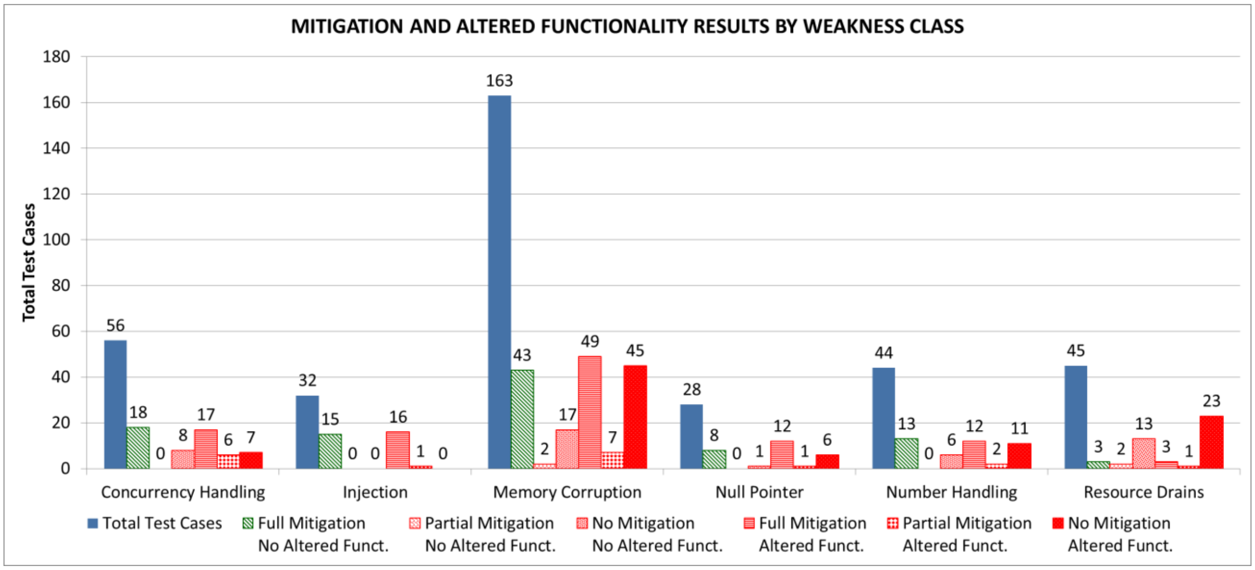

Figure J-28. PEASOUP (GREP) Mitigation and Altered Functionality Results (by Weakness Class)

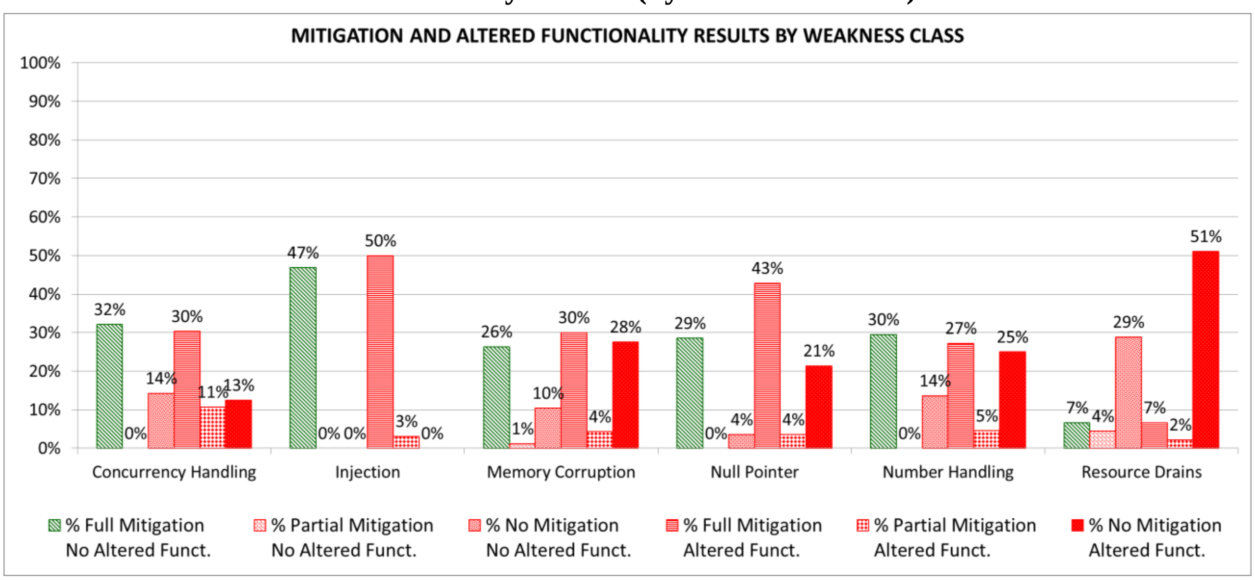

Figure J-29. PEASOUP (GREP) Mitigation and Altered Functionality Results (percentage by Weakness Class)

Table J-12. PEASOUP (GREP) Mitigation and Altered Functionality Results (by Weakness Class)

Target Weakness Class	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & No Alt Function)	% Pass
Concurrency Handling	64	56	26	46%	35	63%	18	32%
Injection	32	32	15	47%	31	97%	15	47%
Memory Corruption	164	163	62	38%	92	56%	43	26%
Null Pointer	28	28	9	32%	20	71%	8	29%
Number Handling	44	44	19	43%	25	57%	13	30%
Resource Drains	48	45	18	40%	6	13%	3	7%
Grand Total	**380**	**368**	**149**	**40.5%**	**209**	**56.8%**	**100**	**27.2%**

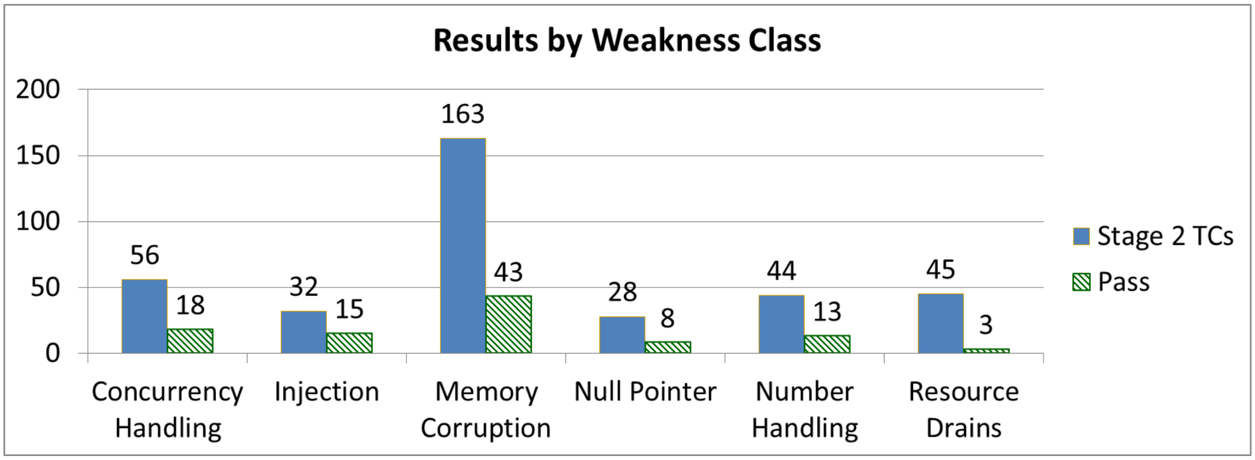

Figure J-30. PEASOUP (GREP) Number of Passing Test Cases (by Weakness Class)

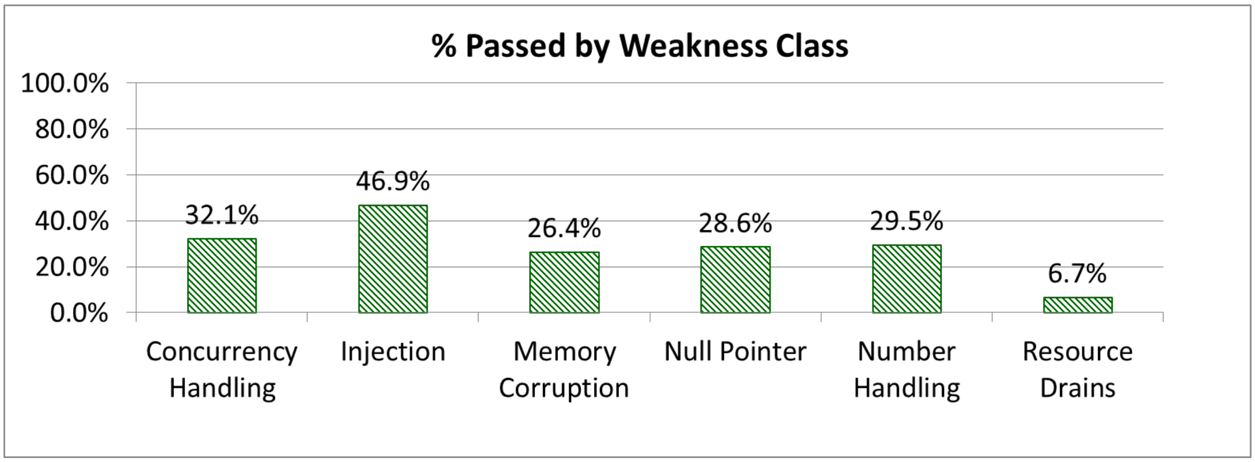

Figure J-31. PEASOUP (GREP) Percentage of Passing Test Cases (by Weakness Class)

Table J-13. PEASOUP (GREP) Mitigation and Altered Functionality Results (by CWE)

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling								
363A	4	4	2	50%	0	0%	0	0%
367A	4	4	3	75%	2	50%	2	50%
412A	4	0	0	0	0	0	0	0
414A	4	4	1	25%	2	50%	1	25%
479A	4	4	1	25%	3	75%	1	25%
543A	4	4	1	25%	0	0%	0	0%
609A	4	3	2	67%	3	100%	2	67%
663A	4	3	1	33%	2	67%	1	33%
764A	4	4	3	75%	4	100%	3	75%
765A	4	3	0	0%	3	100%	0	0%
765B	4	3	1	33%	2	67%	1	33%
820A	4	4	2	50%	3	75%	1	25%
821A	4	4	1	25%	3	75%	1	25%
828A	4	4	2	50%	3	75%	1	25%
831A	4	4	4	100%	3	75%	3	75%
833A	4	4	2	50%	2	50%	1	25%
Injection								
078A	4	4	3	75%	4	100%	3	75%
078B	4	4	2	50%	4	100%	2	50%
088A	4	4	2	50%	4	100%	2	50%
088B	4	4	3	75%	4	100%	3	75%
089A	4	4	1	25%	4	100%	1	25%
089B	4	4	1	25%	4	100%	1	25%
089C	4	4	3	75%	3	75%	3	75%
089D	4	4	0	0%	4	100%	0	0%
Memory Corruption								
120A	4	4	1	25%	3	75%	1	25%
120B	4	4	0	0%	0	0%	0	0%
120C	4	4	0	0%	3	75%	0	0%
120D	4	4	1	25%	3	75%	1	25%
124A	4	4	2	50%	1	25%	1	25%
124B	4	3	3	100%	0	0%	0	0%
124C	4	4	2	50%	3	75%	2	50%
124D	4	4	1	25%	3	75%	1	25%
126A	4	4	1	25%	0	0%	0	0%
126B	4	4	1	25%	0	0%	0	0%
126C	4	4	1	25%	0	0%	0	0%
126D	4	4	2	50%	0	0%	0	0%
127A	4	4	2	50%	0	0%	0	0%
127B	4	4	2	50%	0	0%	0	0%
127C	4	4	0	0%	0	0%	0	0%
127D	4	4	1	25%	0	0%	0	0%
129A	4	4	1	25%	3	75%	1	25%
129B	4	4	1	25%	4	100%	1	25%
134A	4	4	1	25%	4	100%	1	25%
170A	4	4	2	50%	4	100%	2	50%
170B	4	4	1	25%	0	0%	0	0%
415A	4	4	2	50%	4	100%	2	50%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
416A	4	4	1	25%	1	25%	0	0%
590A	4	4	2	50%	4	100%	2	50%
761A	4	4	3	75%	4	100%	3	75%
785A	4	4	3	75%	3	75%	3	75%
785B	4	4	1	25%	4	100%	1	25%
785C	4	4	3	75%	3	75%	3	75%
785D	4	4	2	50%	3	75%	2	50%
805A	4	4	2	50%	3	75%	1	25%
805B	4	4	2	50%	4	100%	2	50%
805C	4	4	0	0%	3	75%	0	0%
805D	4	4	2	50%	3	75%	2	50%
806A	4	4	0	0%	3	75%	0	0%
806B	4	4	3	75%	4	100%	3	75%
806C	4	4	2	50%	3	75%	1	25%
806D	4	4	3	75%	3	75%	2	50%
822A	4	4	0	0%	2	50%	0	0%
824A	4	4	1	25%	1	25%	1	25%
824B	4	4	2	50%	3	75%	2	50%
843A	4	4	2	50%	3	75%	2	50%
Null Pointer								
476A	4	4	0	0%	3	75%	0	0%
476B	4	4	2	50%	3	75%	2	50%
476C	4	4	2	50%	3	75%	2	50%
476D	4	4	2	50%	3	75%	2	50%
476E	4	4	0	0%	3	75%	0	0%
476F	4	4	1	25%	2	50%	1	25%
476G	4	4	2	50%	3	75%	1	25%
Number Handling								
190A	4	4	1	25%	0	0%	0	0%
191A	4	4	2	50%	3	75%	2	50%
191B	4	4	4	100%	3	75%	3	75%
194A	4	4	1	25%	3	75%	1	25%
195A	4	4	2	50%	2	50%	1	25%
196A	4	4	2	50%	0	0%	0	0%
197A	4	4	2	50%	3	75%	2	50%
369A	4	4	1	25%	3	75%	1	25%
682A	4	4	0	0%	3	75%	0	0%
682B	4	4	3	75%	3	75%	2	50%
839A	4	4	1	25%	2	50%	1	25%
Resource Drains								
400A	4	4	0	0%	0	0%	0	0%
400B	4	3	1	33%	0	0%	0	0%
401A	4	3	2	67%	0	0%	0	0%
459A	4	4	1	25%	1	25%	0	0%
674A	4	4	3	75%	0	0%	0	0%
771A	4	4	3	75%	0	0%	0	0%
773A	4	4	1	25%	2	50%	1	25%
774A	4	4	2	50%	0	0%	0	0%
775A	4	4	0	0%	0	0%	0	0%
789A	4	4	2	50%	0	0%	0	0%
834A	4	3	2	67%	3	100%	2	67%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
835A	4	4	1	25%	0	0%	0	0%
Grand Total	**380**	**368**	**149**	**40.5%**	**209**	**56.8%**	**100**	**27.2%**

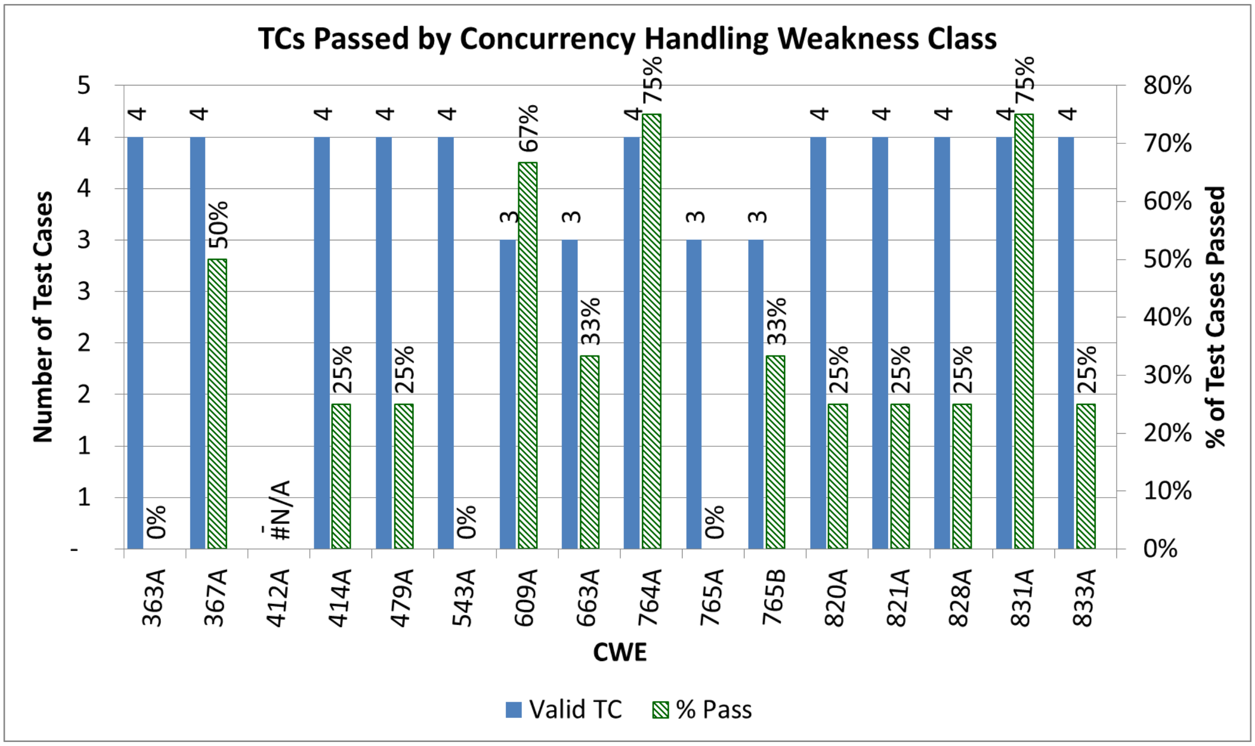

Figure J-32. PEASOUP (GREP) Passing Test Cases (by Concurrency Handling CWEs)

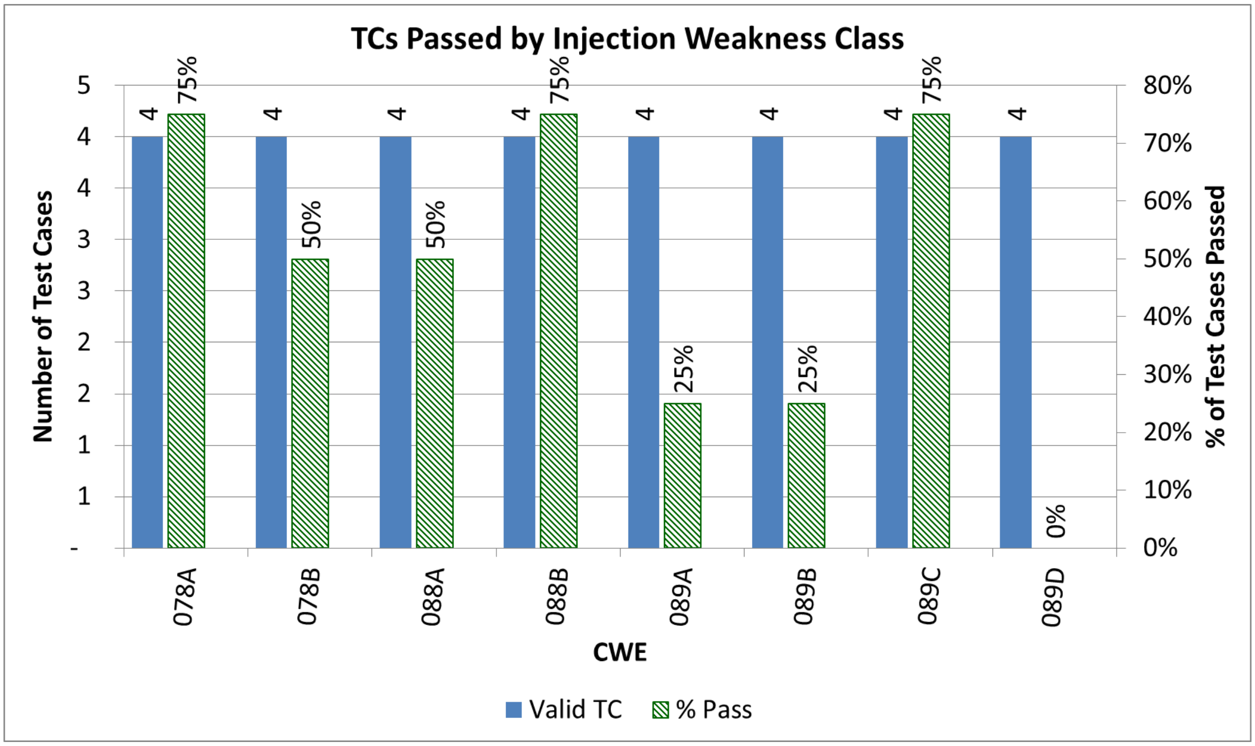

Figure J-33. PEASOUP (GREP) Passing Test Cases (by Injection CWEs)

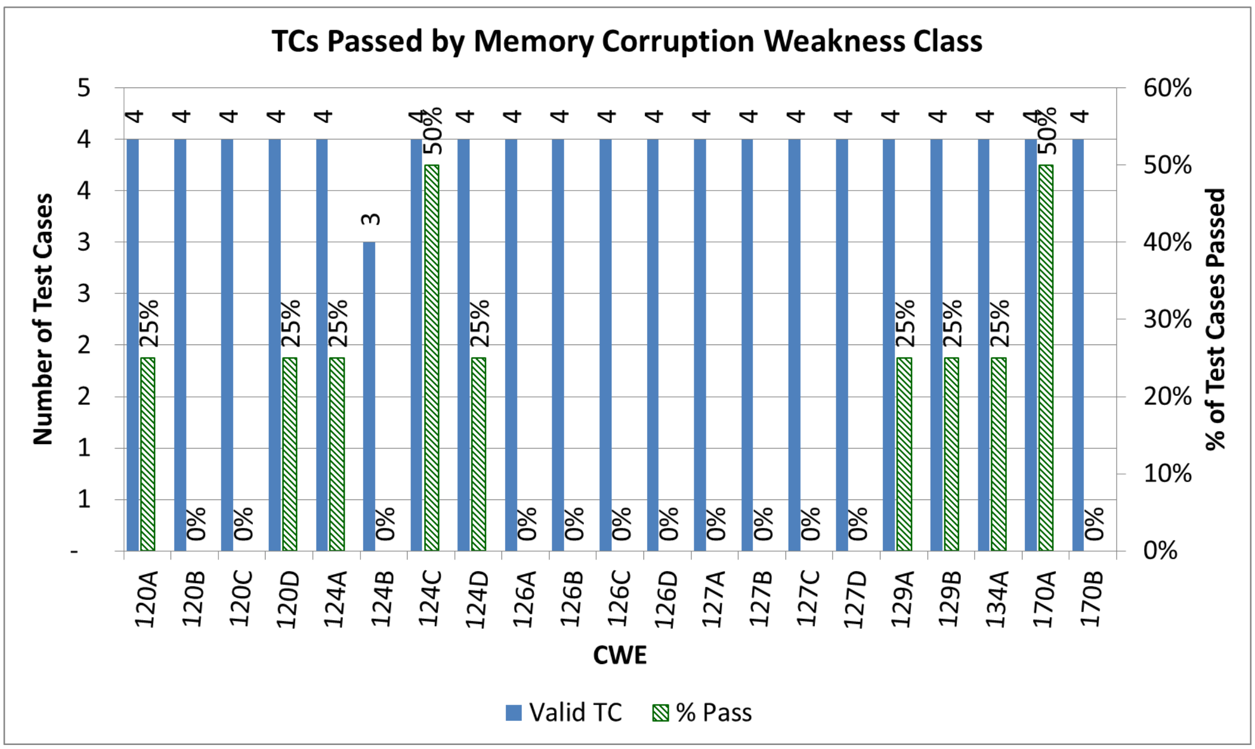

Figure J-34. PEASOUP (GREP) Passing Test Cases (by Memory Corruption CWEs) (Part 1)

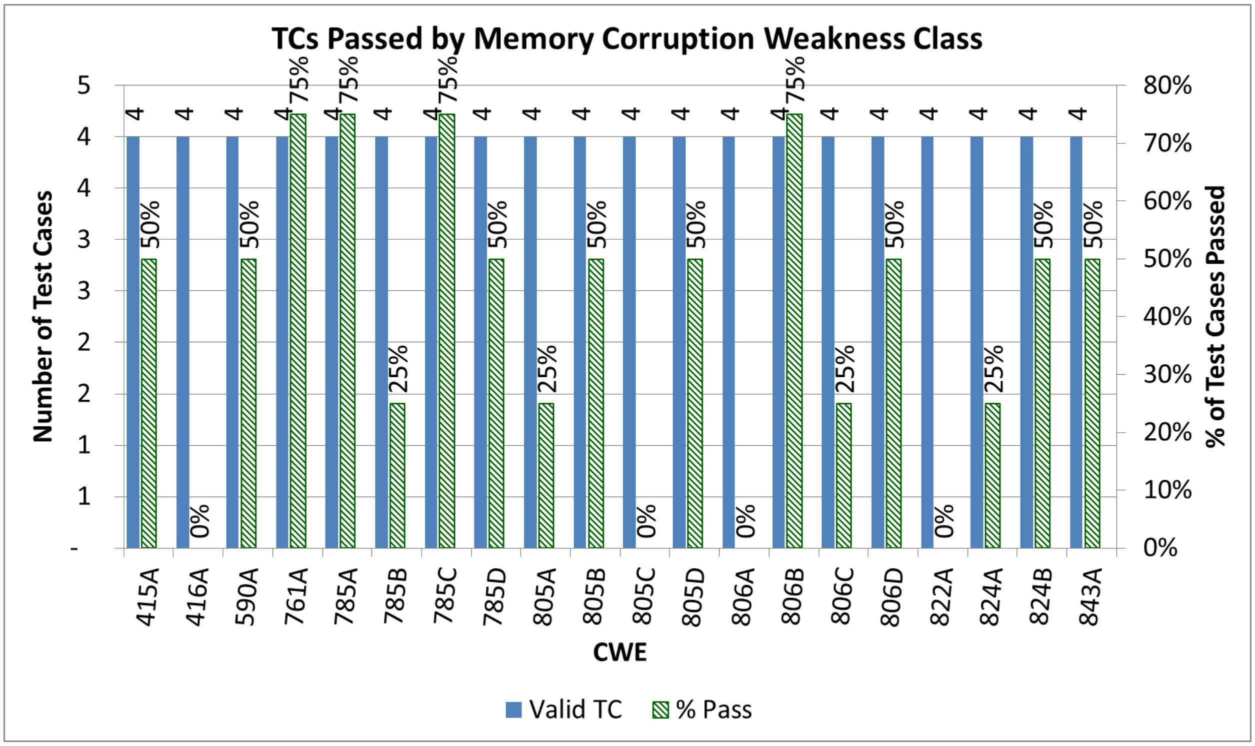

Figure J-35. PEASOUP (GREP) Passing Test Cases (by Memory Corruption CWEs) (Part 2)

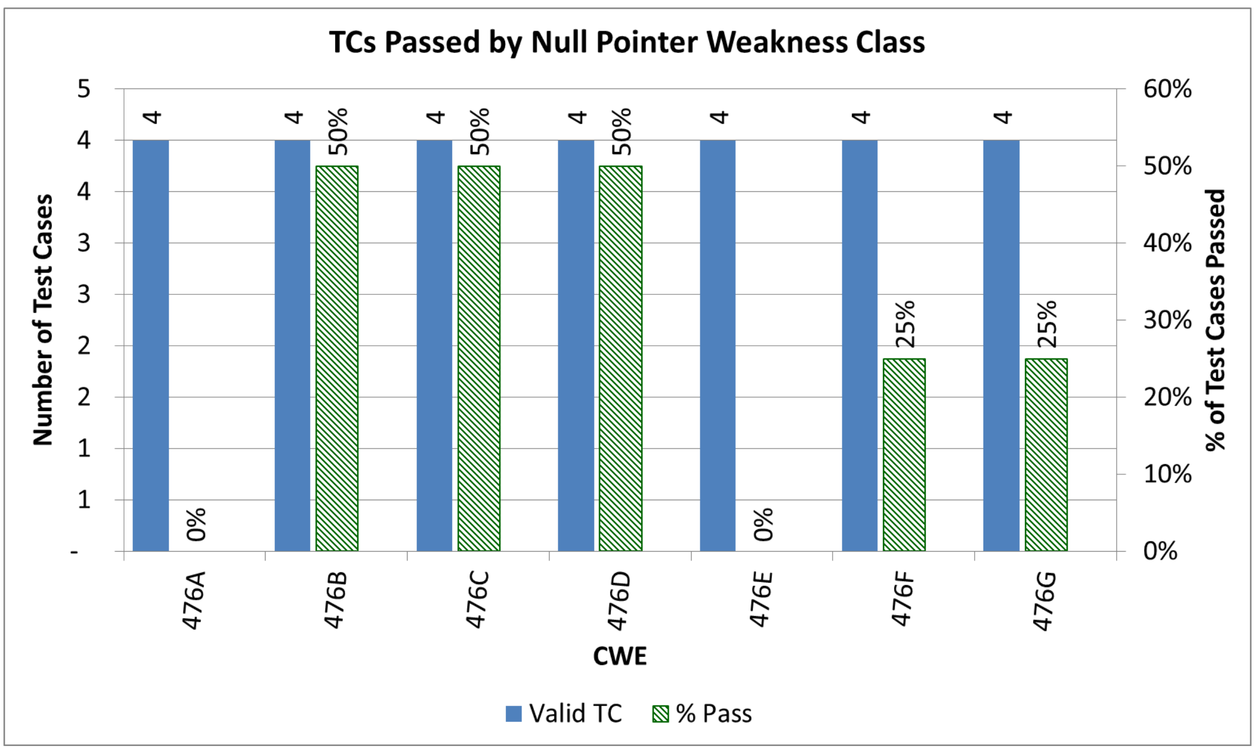

Figure J-36. PEASOUP (GREP) Passing Test Cases (by Null Pointer CWEs)

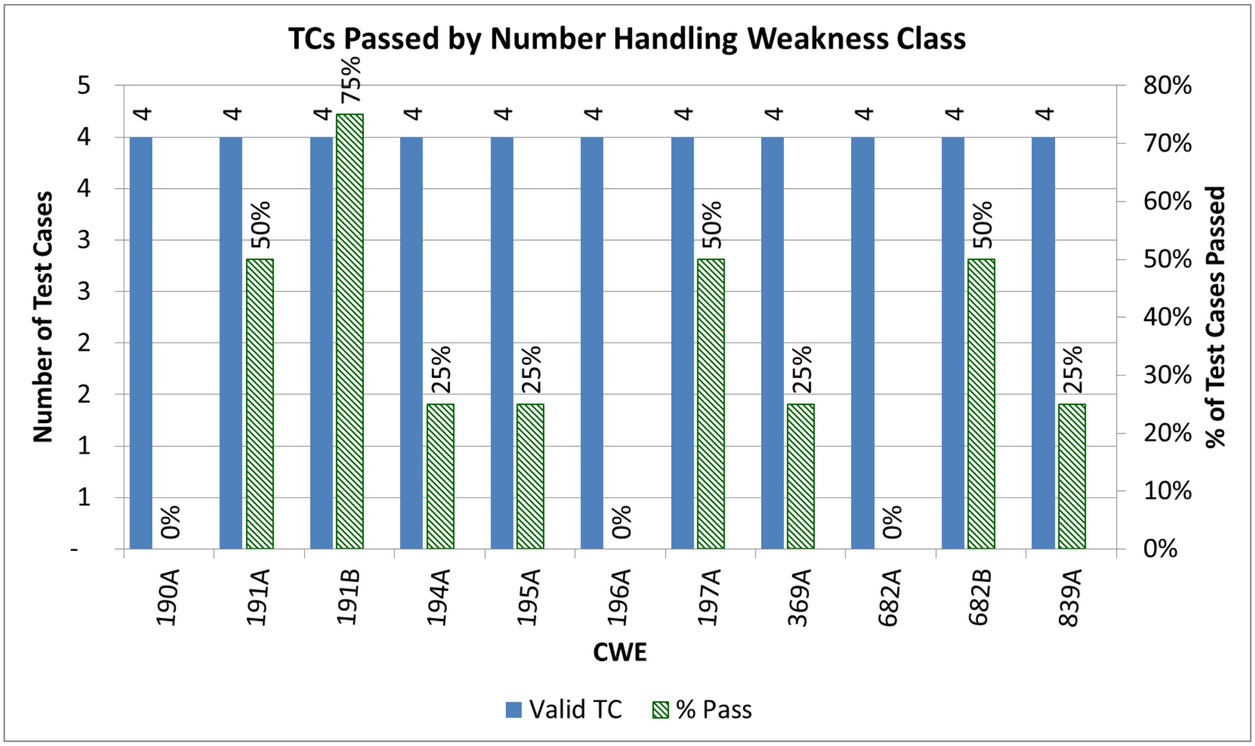

Figure J-37. PEASOUP (GREP) Passing Test Cases (by Number Handling CWEs)

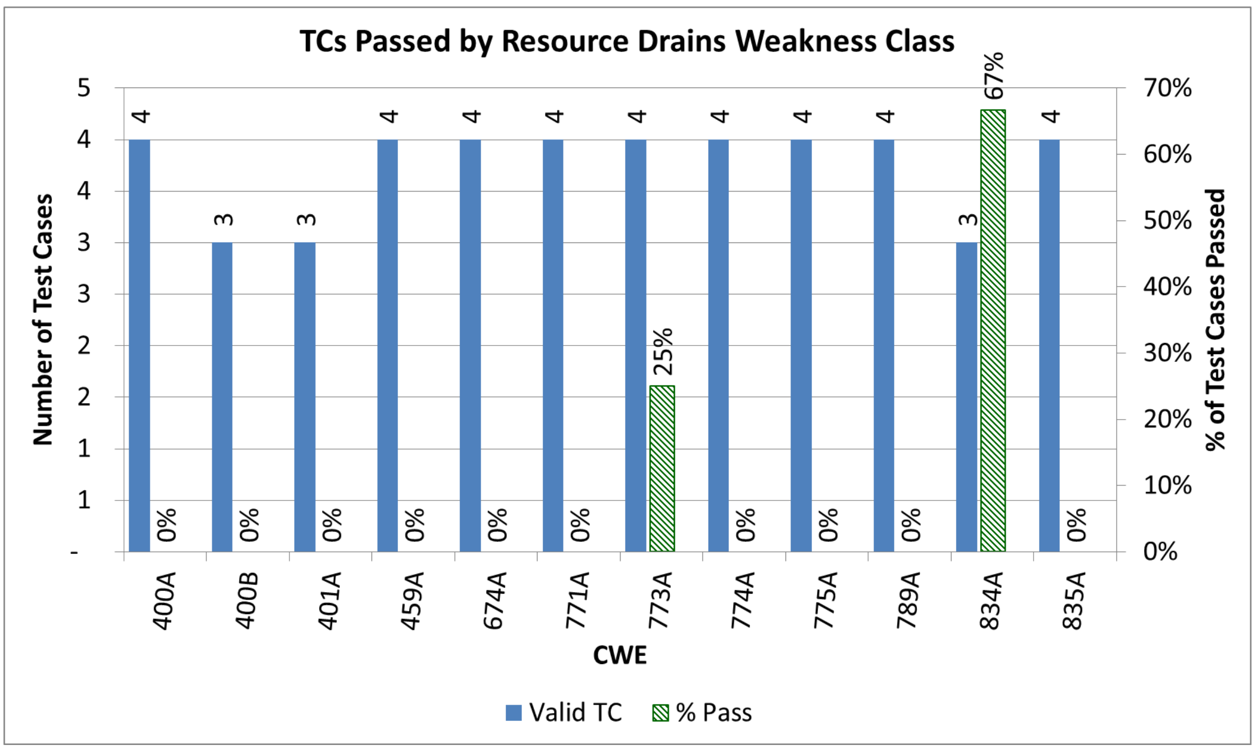

Figure J-38. PEASOUP (GREP) Passing Test Cases (by Resource Drain CWEs)

J.2.2 PEASOUP GREP Results by Taint Source

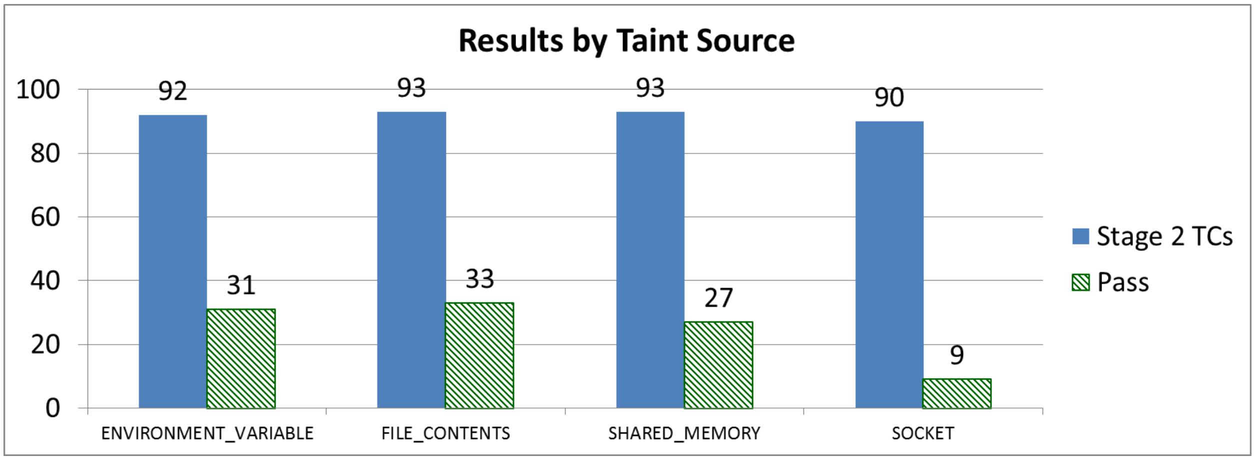

Figure J-39. PEASOUP (GREP) Number of Passing Test Cases (by Taint Source)

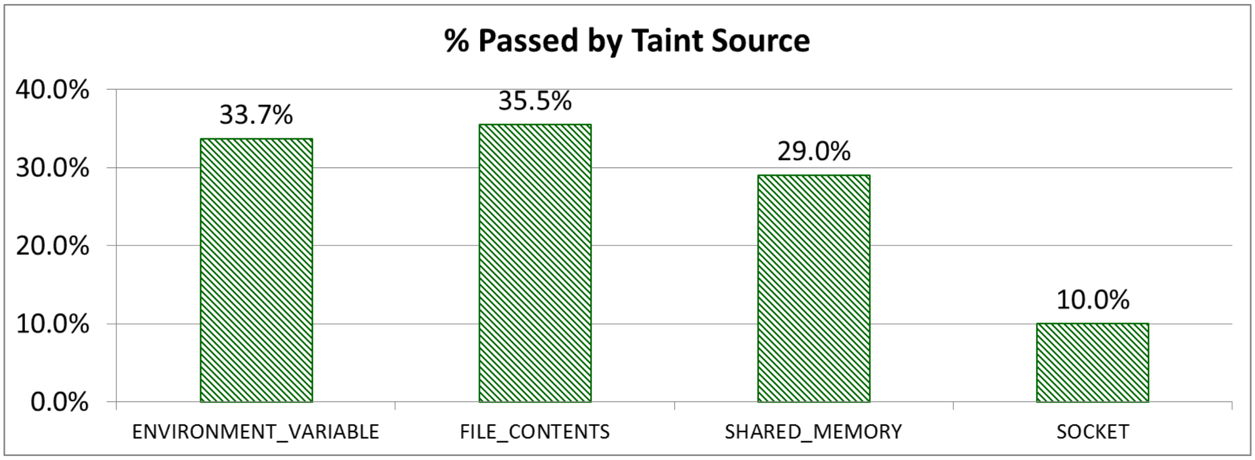

Figure J-40. PEASOUP (GREP) Percentage of Passing Test Cases (by Taint Source)

J.2.3 PEASOUP GREP Results by Data Type Complexity

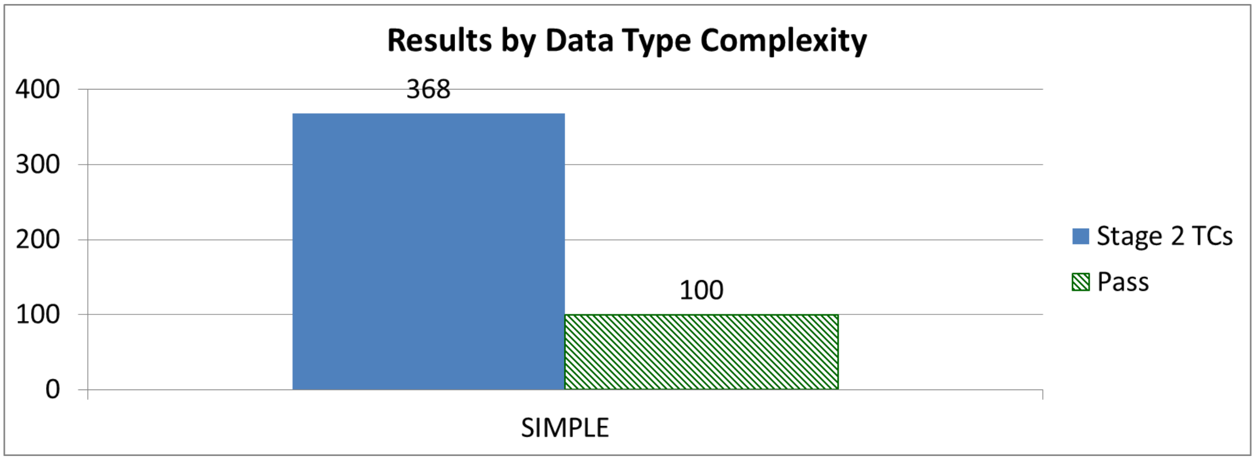

Figure J-41. PEASOUP (GREP) Number of Passing Test Cases (by Data Type Complexity)

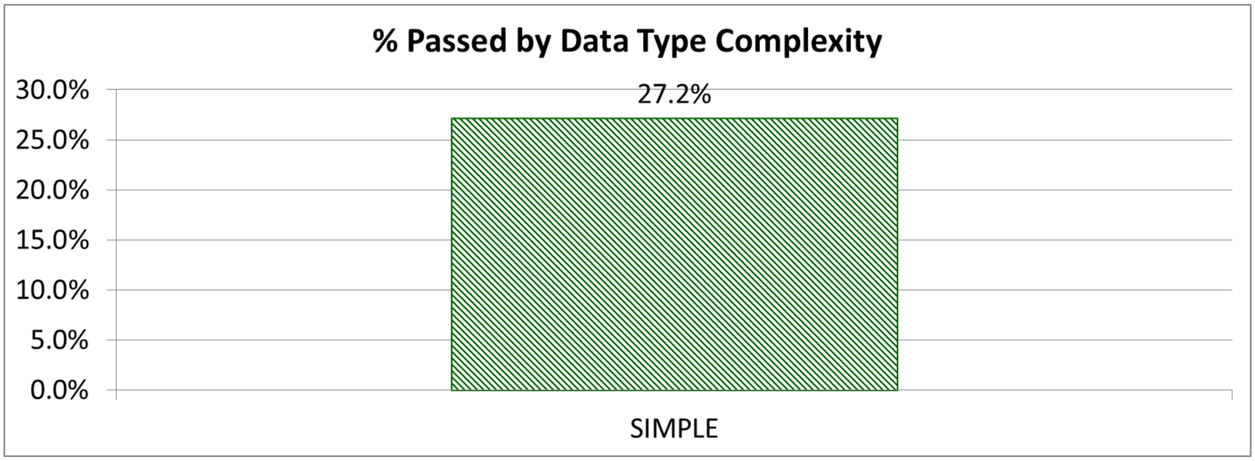

Figure J-42. PEASOUP (GREP) Percentage of Passing Test Cases (by Data Type Complexity)

J.2.4 PEASOUP GREP Results by Data Flow Complexity

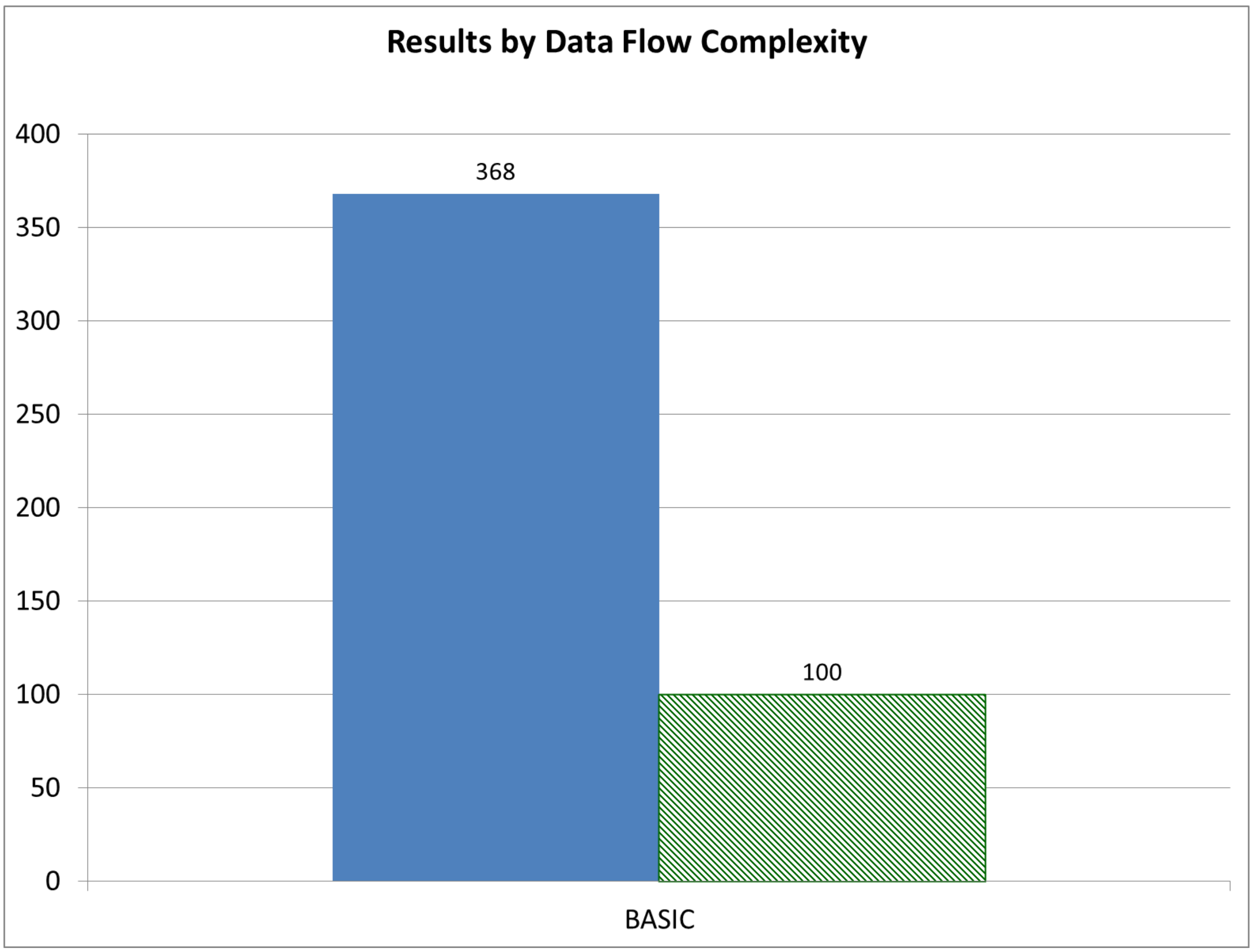

Figure J-43. PEASOUP (GREP) Number of Passing Test Cases (by Data Flow Complexity)

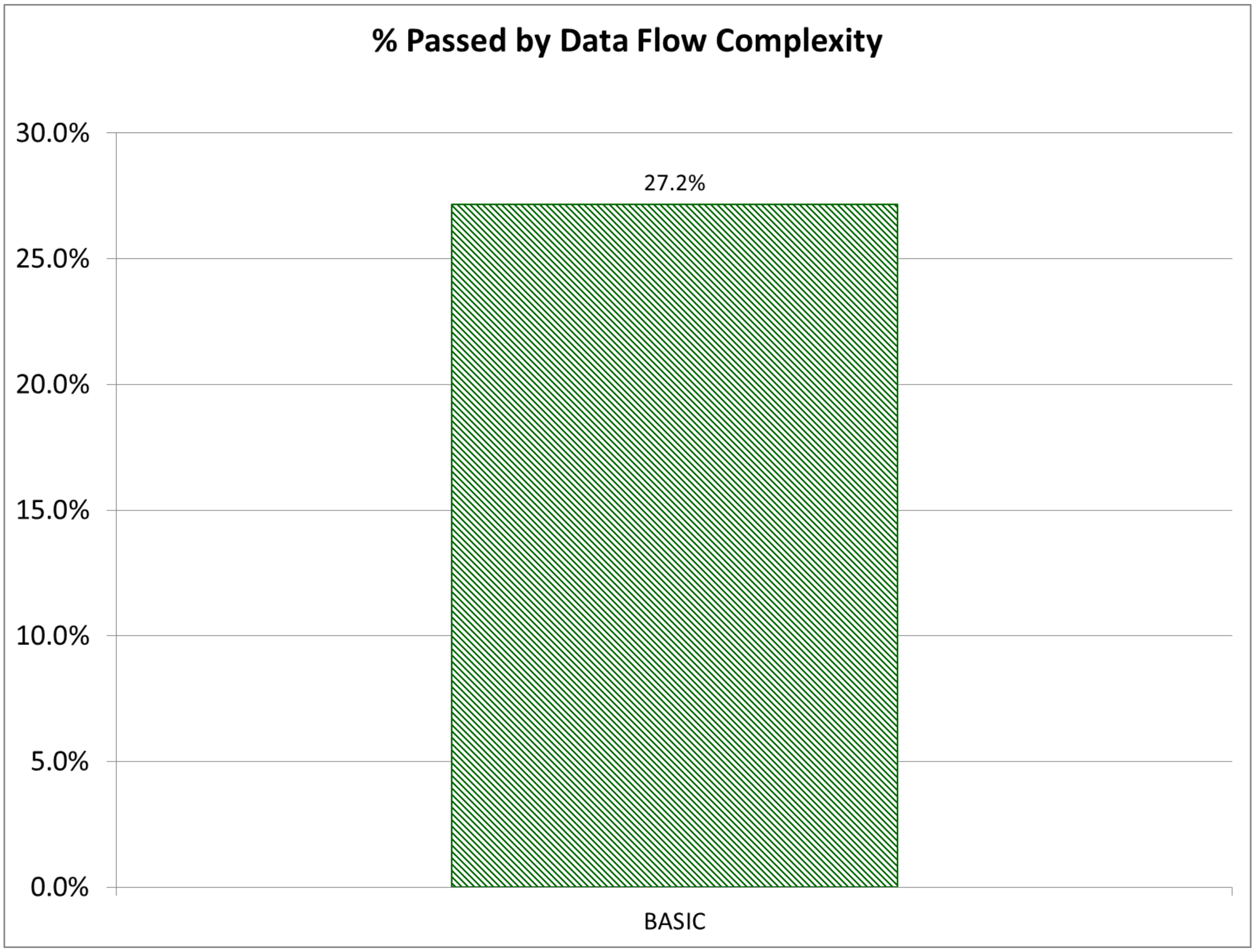

Figure J-44. PEASOUP (GREP) Percentage of Passing Test Cases (by Data Flow Complexity)

J.2.5 PEASOUP GREP Results by Control Flow Complexity

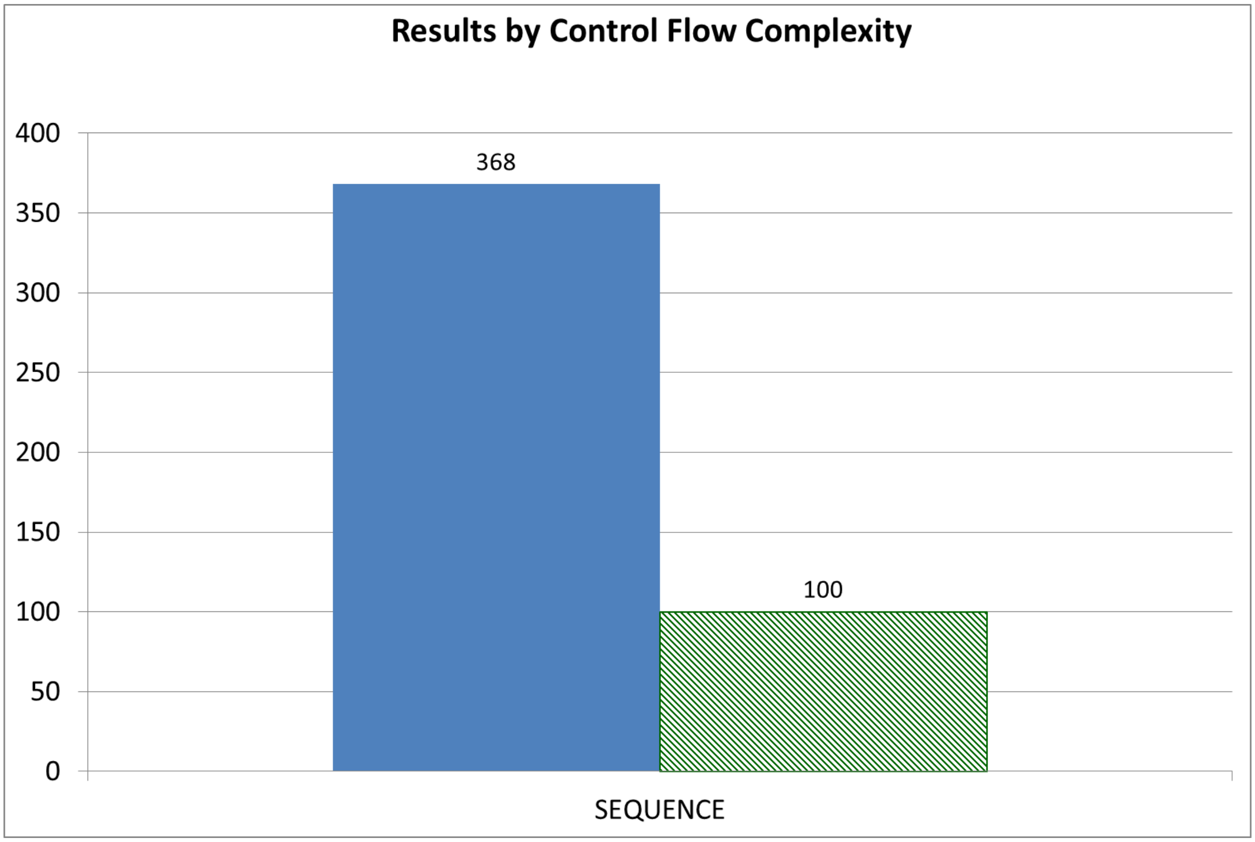

Figure J-45. PEASOUP (GREP) Number of Passing Test Cases (by Control Flow Complexity)

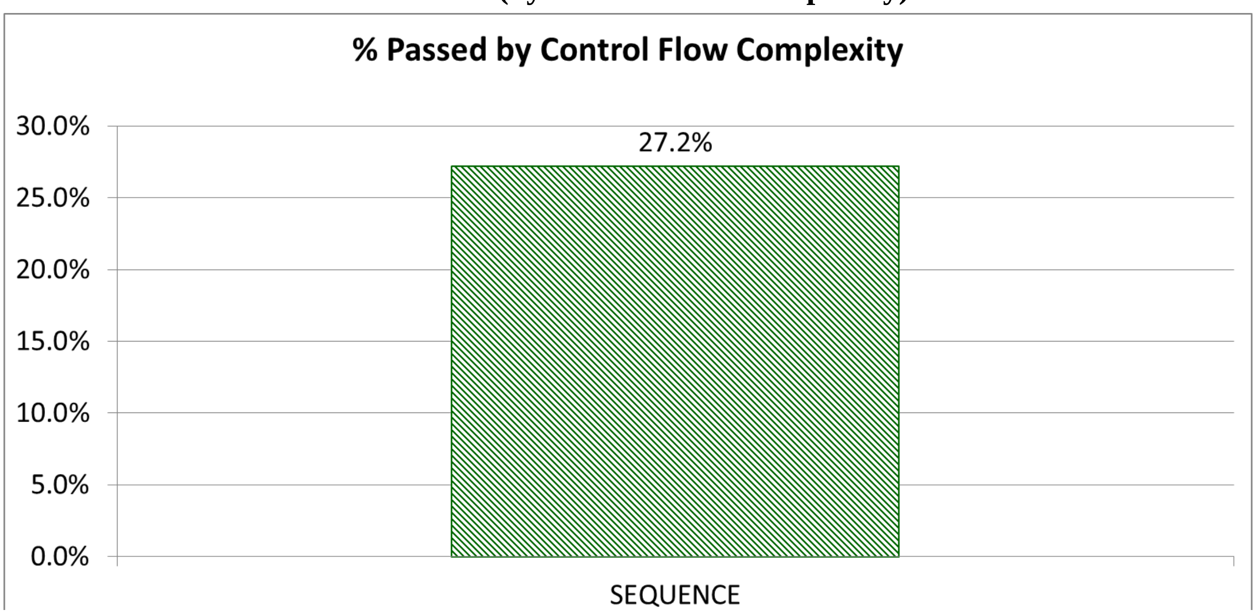

Figure J-46. PEASOUP (GREP) Percentage of Passing Test Cases (by Control Flow Complexity)

J.2.6 PEASOUP GREP Performance Overhead

Table J-14. PEASOUP (GREP) Performance Overhead by Weakness Class

Weakness Class	% Increase
Concurrency Handling	110.1%
Injection	312.4%
Memory Corruption	76.3%
Null Pointer	130.6%
Number Handling	119.1%
Resource Drains	301.4%
Grand Total	**240.2%**

Table J-15. PEASOUP (GREP) Performance Overhead by Base Program

Base Program	% Increase
GREP	240.2%
Grand Total	**240.2%**

Table J-16. PEASOUP (GREP) Performance Overhead by Taint Source

Taint Source	% Increase
ENVIRONMENT_VARIABLE	551.7%
FILE_CONTENTS	778.3%
SHARED_MEMORY	82.4%
SOCKET	68.4%
Grand Total	**240.2%**

Table J-17. PEASOUP (GREP) Performance Overhead by Data Type Complexity

Data Type Complexity	% Increase
SIMPLE	240.2%
Grand Total	**240.2%**

Table J-18. PEASOUP (GREP) Performance Overhead by Data Flow Complexity

Data Flow Complexity	% Increase
BASIC	240.2%
Grand Total	**240.2%**

Table J-19. PEASOUP (GREP) Performance Overhead by Control Flow Complexity

Control Flow Complexity	% Increase
SEQUENCE	240.2%
Grand Total	**240.2%**

Table J-20. PEASOUP (GREP) Performance Overhead by File Size

File Size	% Increase
711,339	240.2%
Grand Total	**240.2%**

J.3 Results and Analysis of Phase 1-Sized Programs

Numbers

		Altered? No	Altered? Yes	Total
Mitigation?	Full	**214**	3	217
	Partial	11	-	11
	None	143	1	144
	Total	368	4	372

Percentages

		Altered? No	Altered? Yes	Total
Mitigation?	Full	**57.5%**	0.8%	58%
	Partial	3.0%	0.0%	3%
	None	38.4%	0.3%	39%
	Total	99%	1%	100%

Figure J-47. PEASOUP CTREE Mitigation and Altered Functionality Results

J.3.1 PEASOUP CTREE Results by Weakness Classes and Target Weaknesses

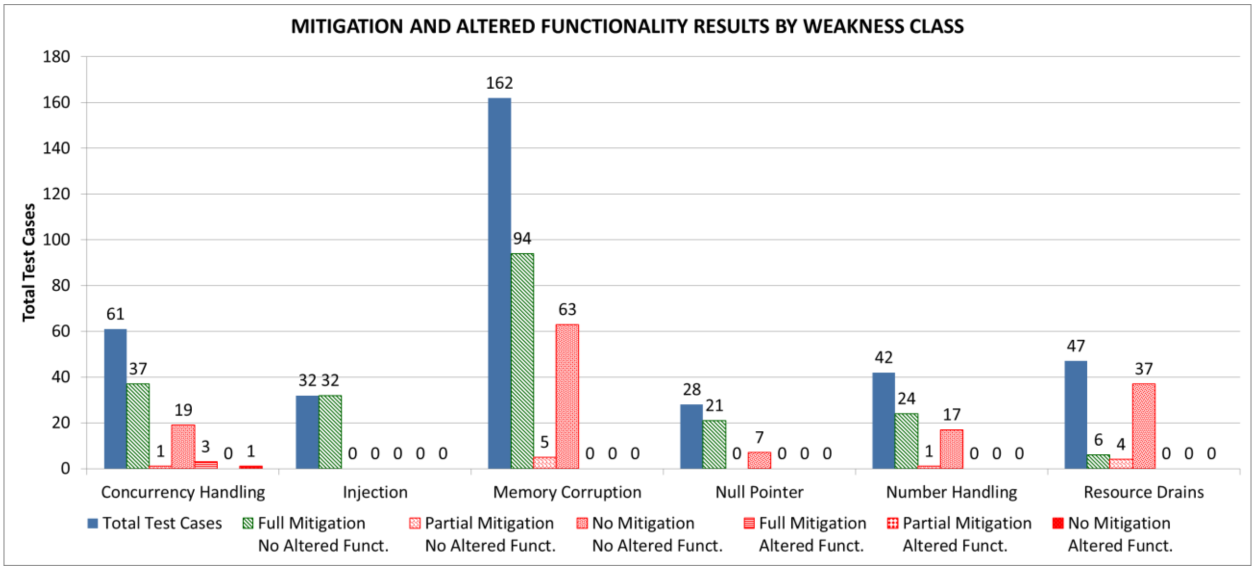

Figure J-48. PEASOUP CTREE Mitigation and Altered Functionality Results (by Weakness Class)

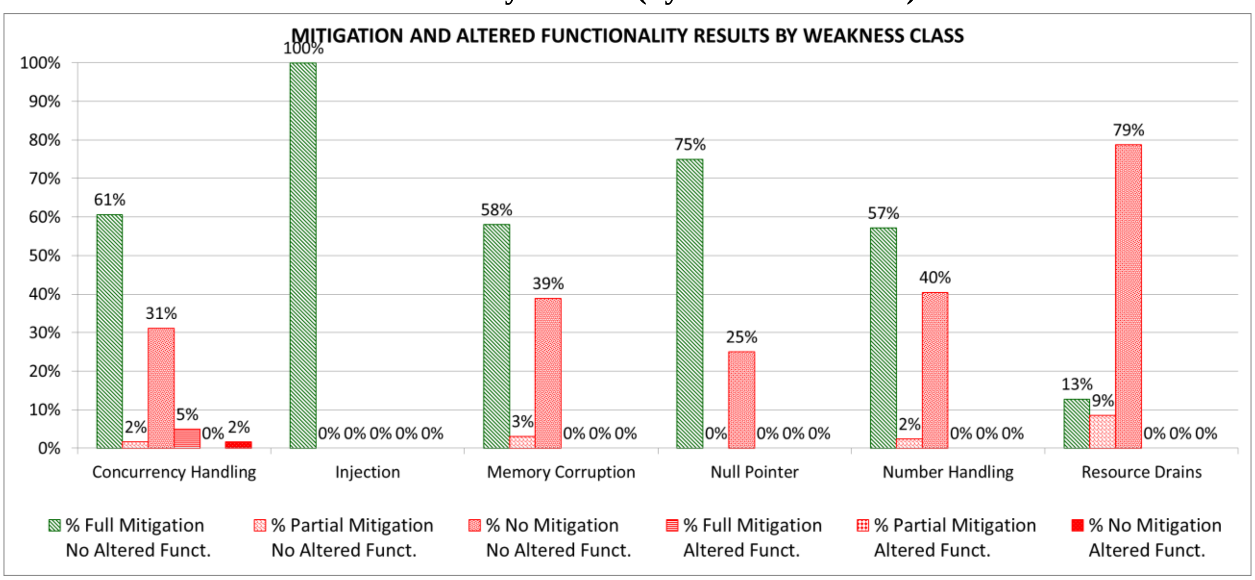

Figure J-49. PEASOUP CTREE Mitigation and Altered Functionality Results (percentage by Weakness Class)

Table J-21. PEASOUP CTREE Mitigation and Altered Functionality Results (by Weakness Class)

Target Weakness Class	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & No Alt Function)	% Pass
Concurrency Handling	64	61	57	93%	40	66%	37	61%
Injection	32	32	32	100%	32	100%	32	100%
Memory Corruption	164	162	162	100%	94	58%	94	58%
Null Pointer	28	28	28	100%	21	75%	21	75%
Number Handling	44	42	42	100%	24	57%	24	57%
Resource Drains	48	47	47	100%	6	13%	6	13%
Grand Total	**380**	**372**	**368**	**98.9%**	**217**	**58.3%**	**214**	**57.5%**

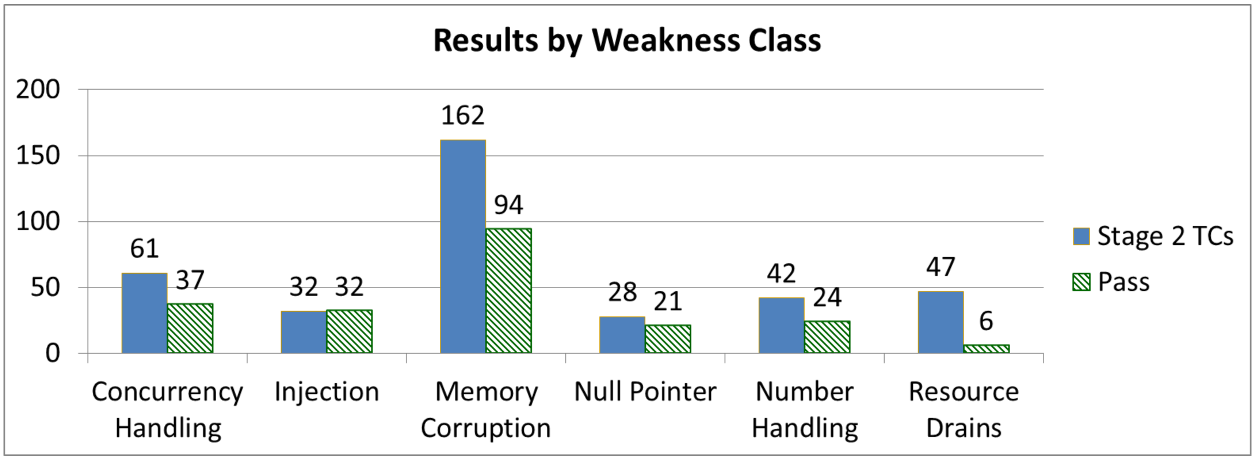

Figure J-50. PEASOUP CTREE Number of Passing Test Cases (by Weakness Class)

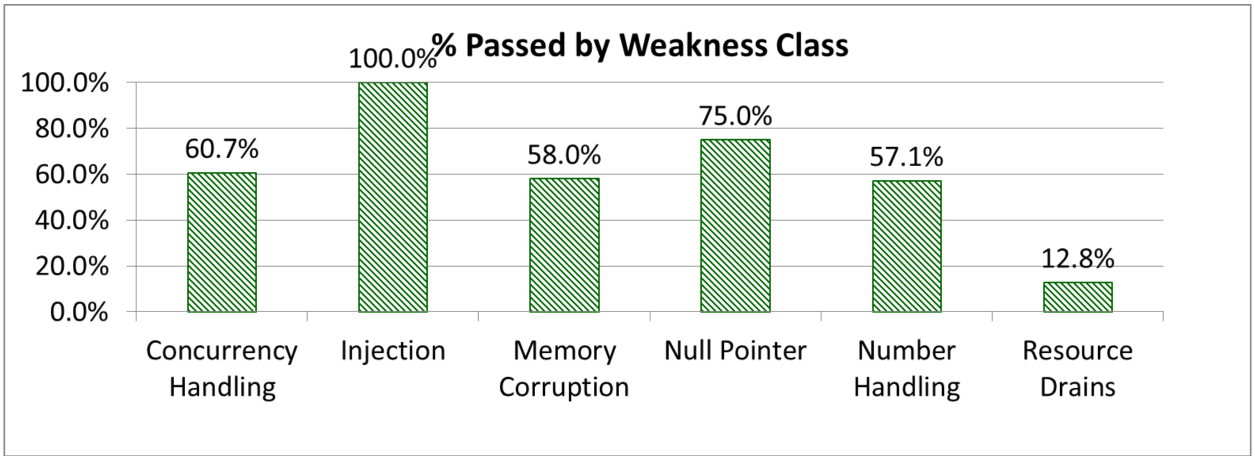

Figure J-51. PEASOUP CTREE Percentage of Passing Test Cases (by Weakness Class)

Table J-22. PEASOUP CTREE Mitigation and Altered Functionality Results (by CWE)

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling								
363A	4	4	4	100%	0	0%	0	0%
367A	4	4	4	100%	3	75%	3	75%
412A	4	4	4	100%	0	0%	0	0%
414A	4	4	4	100%	3	75%	3	75%
479A	4	4	4	100%	3	75%	3	75%
543A	4	4	4	100%	0	0%	0	0%
609A	4	4	4	100%	3	75%	3	75%
663A	4	4	4	100%	3	75%	3	75%
764A	4	4	4	100%	4	100%	4	100%
765A	4	4	0	0%	3	75%	0	0%
765B	4	3	3	100%	3	100%	3	100%
820A	4	3	3	100%	3	100%	3	100%
821A	4	4	4	100%	3	75%	3	75%
828A	4	4	4	100%	3	75%	3	75%
831A	4	4	4	100%	3	75%	3	75%
833A	4	3	3	100%	3	100%	3	100%
Injection								
078A	4	4	4	100%	4	100%	4	100%
078B	4	4	4	100%	4	100%	4	100%
088A	4	4	4	100%	4	100%	4	100%
088B	4	4	4	100%	4	100%	4	100%
089A	4	4	4	100%	4	100%	4	100%
089B	4	4	4	100%	4	100%	4	100%
089C	4	4	4	100%	4	100%	4	100%
089D	4	4	4	100%	4	100%	4	100%
Memory Corruption								
120A	4	4	4	100%	3	75%	3	75%
120B	4	4	4	100%	0	0%	0	0%
120C	4	4	4	100%	3	75%	3	75%
120D	4	4	4	100%	3	75%	3	75%
124A	4	4	4	100%	1	25%	1	25%
124B	4	2	2	100%	0	0%	0	0%
124C	4	4	4	100%	3	75%	3	75%
124D	4	4	4	100%	0	0%	0	0%
126A	4	4	4	100%	0	0%	0	0%
126B	4	4	4	100%	0	0%	0	0%
126C	4	4	4	100%	0	0%	0	0%
126D	4	4	4	100%	0	0%	0	0%
127A	4	4	4	100%	0	0%	0	0%
127B	4	4	4	100%	0	0%	0	0%
127C	4	4	4	100%	0	0%	0	0%
127D	4	4	4	100%	0	0%	0	0%
129A	4	4	4	100%	3	75%	3	75%
129B	4	4	4	100%	4	100%	4	100%
134A	4	4	4	100%	4	100%	4	100%
170A	4	4	4	100%	4	100%	4	100%
170B	4	4	4	100%	0	0%	0	0%
415A	4	4	4	100%	4	100%	4	100%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
416A	4	4	4	100%	3	75%	3	75%
590A	4	4	4	100%	4	100%	4	100%
761A	4	4	4	100%	4	100%	4	100%
785A	4	4	4	100%	3	75%	3	75%
785B	4	4	4	100%	4	100%	4	100%
785C	4	4	4	100%	3	75%	3	75%
785D	4	4	4	100%	3	75%	3	75%
805A	4	4	4	100%	3	75%	3	75%
805B	4	4	4	100%	4	100%	4	100%
805C	4	4	4	100%	3	75%	3	75%
805D	4	4	4	100%	3	75%	3	75%
806A	4	4	4	100%	3	75%	3	75%
806B	4	4	4	100%	4	100%	4	100%
806C	4	4	4	100%	3	75%	3	75%
806D	4	4	4	100%	3	75%	3	75%
822A	4	4	4	100%	3	75%	3	75%
824A	4	4	4	100%	3	75%	3	75%
824B	4	4	4	100%	3	75%	3	75%
843A	4	4	4	100%	3	75%	3	75%
Null Pointer								
476A	4	4	4	100%	3	75%	3	75%
476B	4	4	4	100%	3	75%	3	75%
476C	4	4	4	100%	3	75%	3	75%
476D	4	4	4	100%	3	75%	3	75%
476E	4	4	4	100%	3	75%	3	75%
476F	4	4	4	100%	3	75%	3	75%
476G	4	4	4	100%	3	75%	3	75%
Number Handling								
190A	4	4	4	100%	0	0%	0	0%
191A	4	4	4	100%	3	75%	3	75%
191B	4	4	4	100%	3	75%	3	75%
194A	4	4	4	100%	3	75%	3	75%
195A	4	4	4	100%	3	75%	3	75%
196A	4	4	4	100%	0	0%	0	0%
197A	4	4	4	100%	3	75%	3	75%
369A	4	4	4	100%	3	75%	3	75%
682A	4	3	3	100%	2	67%	2	67%
682B	4	3	3	100%	2	67%	2	67%
839A	4	4	4	100%	2	50%	2	50%
Resource Drains								
400A	4	4	4	100%	0	0%	0	0%
400B	4	4	4	100%	0	0%	0	0%
401A	4	3	3	100%	0	0%	0	0%
459A	4	4	4	100%	0	0%	0	0%
674A	4	4	4	100%	0	0%	0	0%
771A	4	4	4	100%	2	50%	2	50%
773A	4	4	4	100%	0	0%	0	0%
774A	4	4	4	100%	0	0%	0	0%
775A	4	4	4	100%	0	0%	0	0%
789A	4	4	4	100%	0	0%	0	0%
834A	4	4	4	100%	4	100%	4	100%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
835A	4	4	4	100%	0	0%	0	0%
Grand Total	**380**	**372**	**368**	**98.9%**	**217**	**58.3%**	**214**	**57.5%**

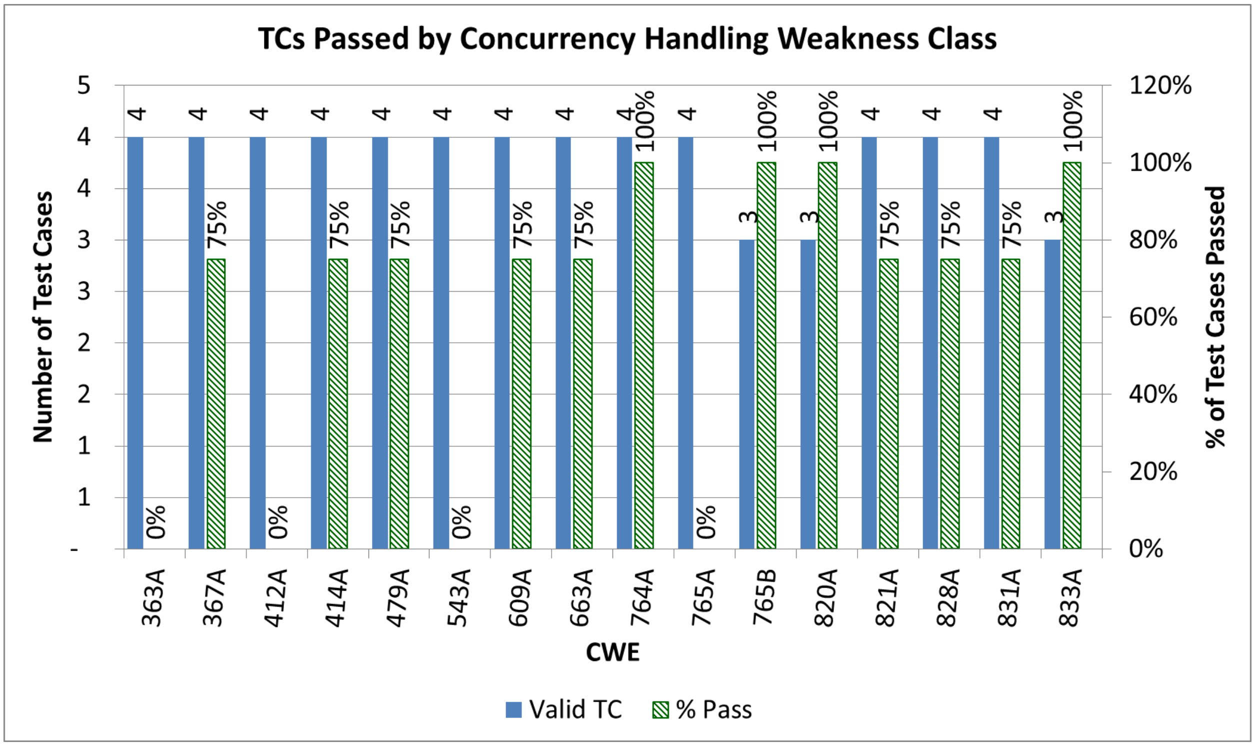

Figure J-52. PEASOUP CTREE Passing Test Cases (by Concurrency Handling CWEs)

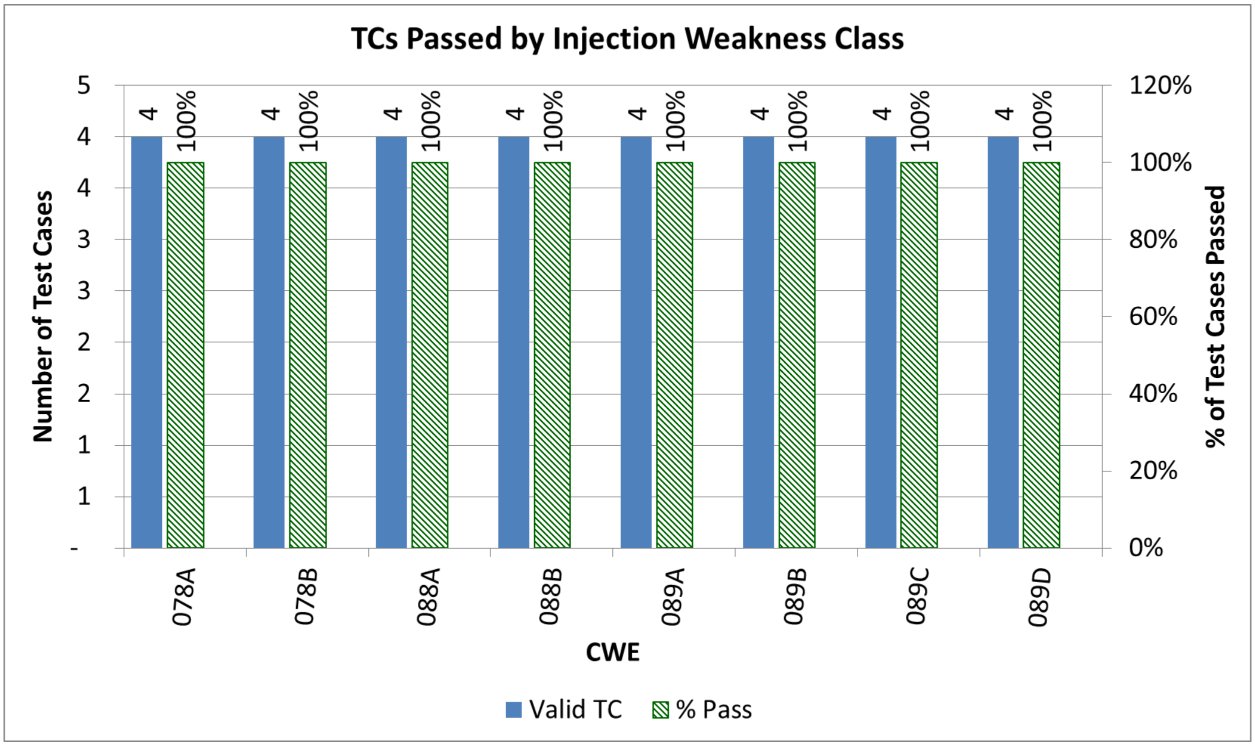

Figure J-53. PEASOUP CTREE Passing Test Cases (by Injection CWEs)

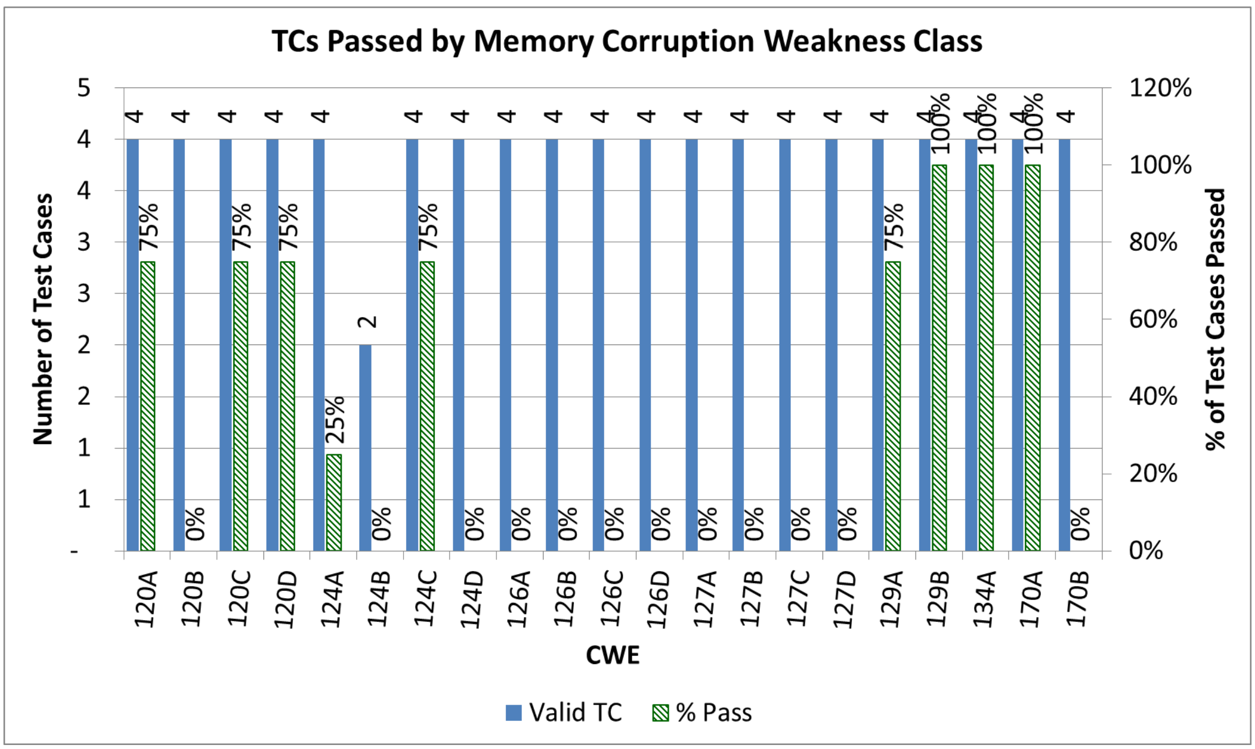

Figure J-54. PEASOUP CTREE Passing Test Cases (by Memory Corruption CWEs) (Part 1)

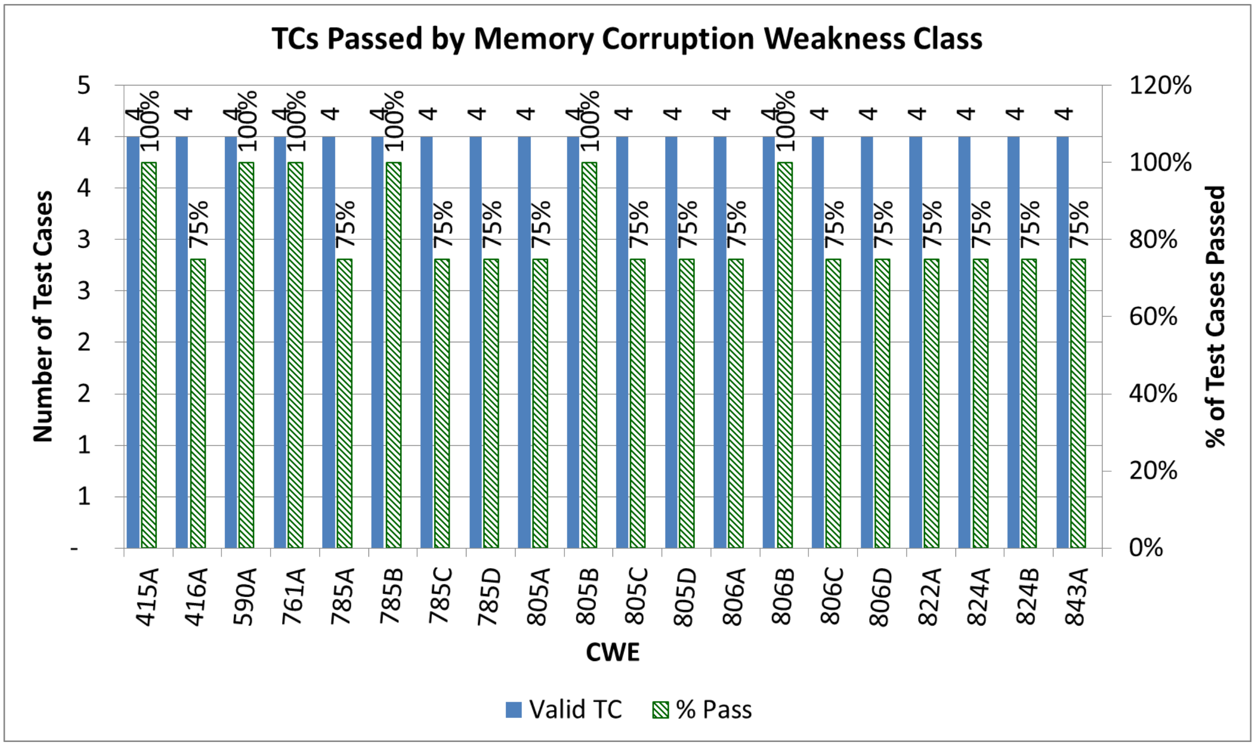

Figure J-55. PEASOUP CTREE Passing Test Cases (by Memory Corruption CWEs) (Part 2)

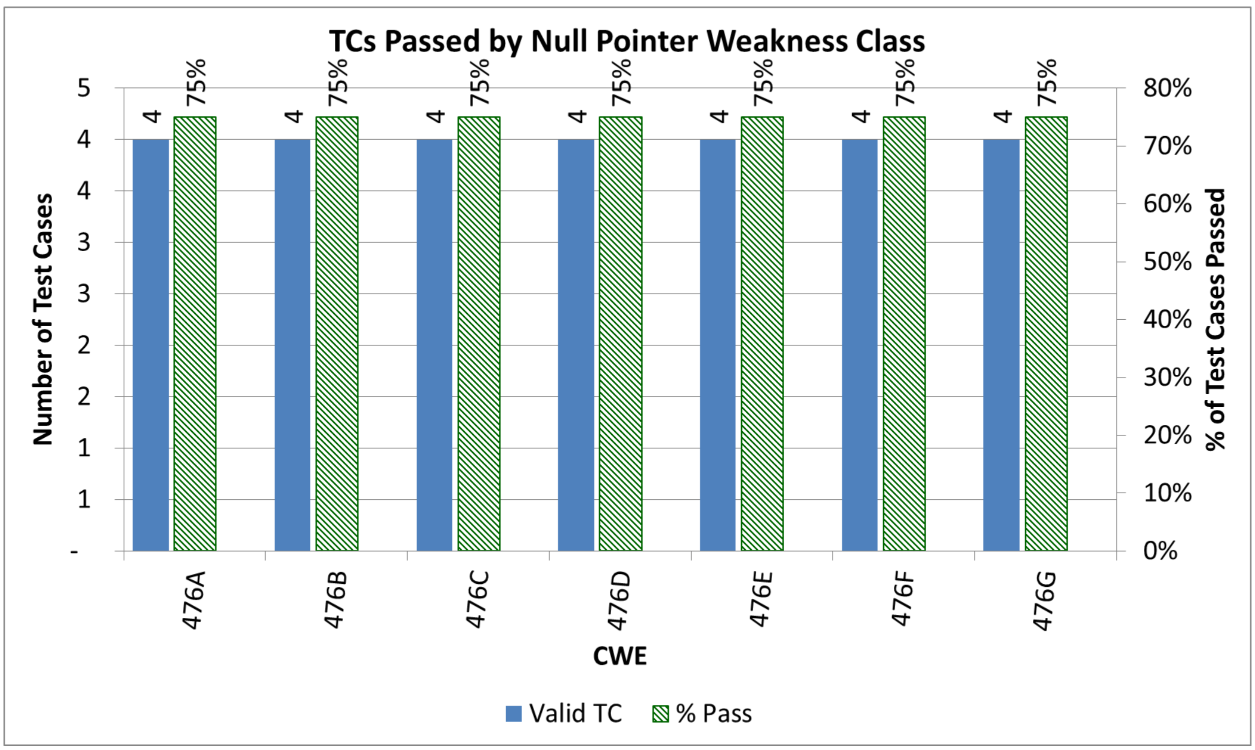

Figure J-56. PEASOUP CTREE Passing Test Cases (by Null Pointer CWEs)

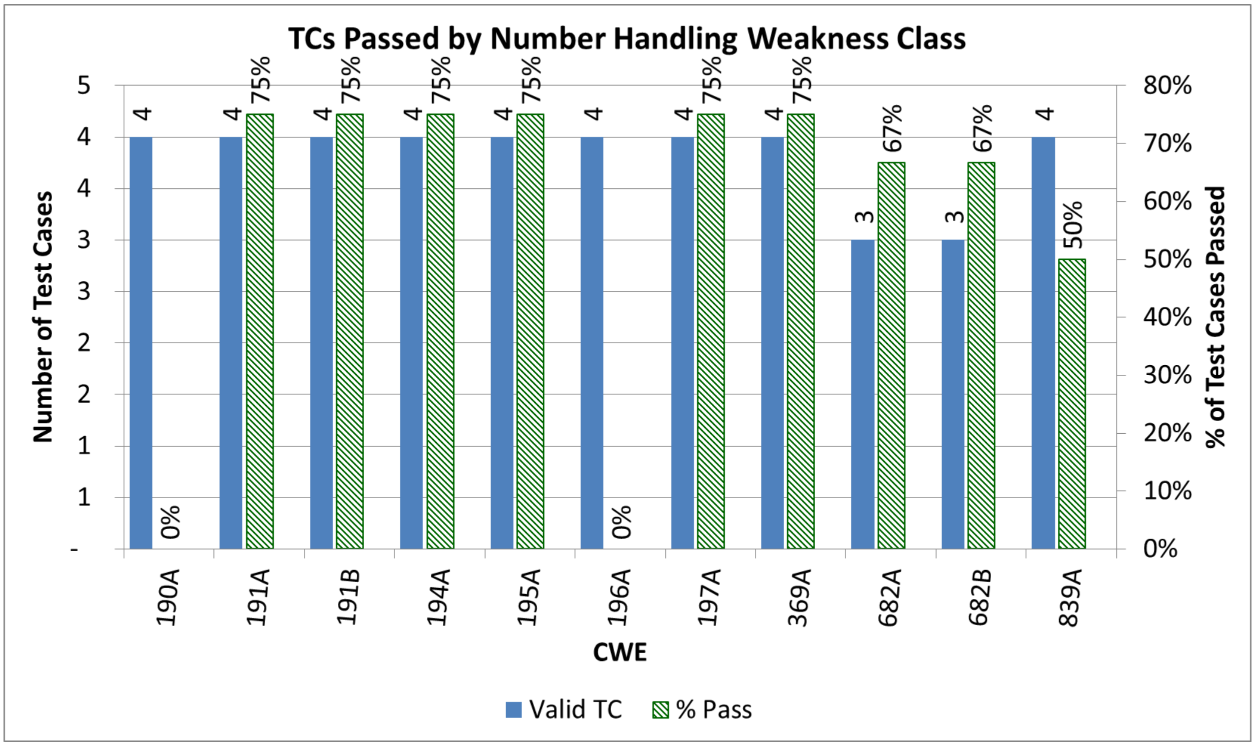

Figure J-57. PEASOUP CTREE Passing Test Cases (by Number Handling CWEs)

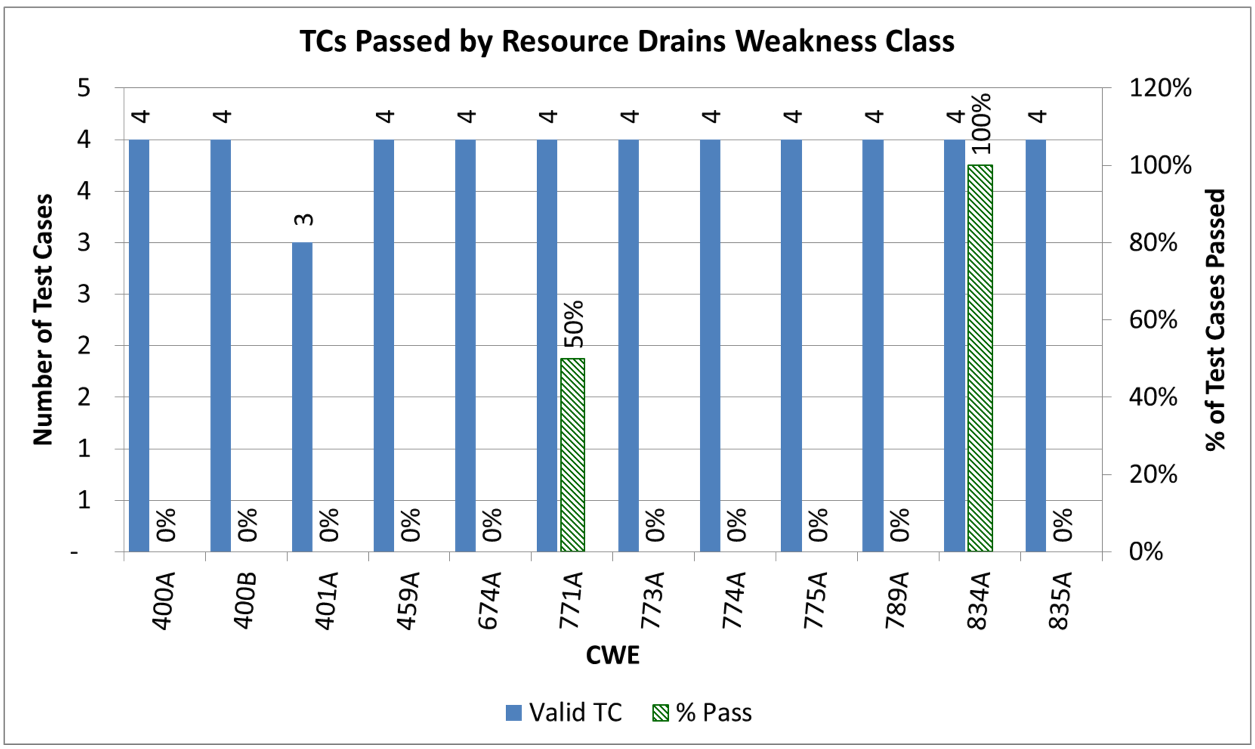

Figure J-58. PEASOUP CTREE Passing Test Cases (by Resource Drain CWEs)

J.3.2 PEASOUP CTREE Results by Taint Source

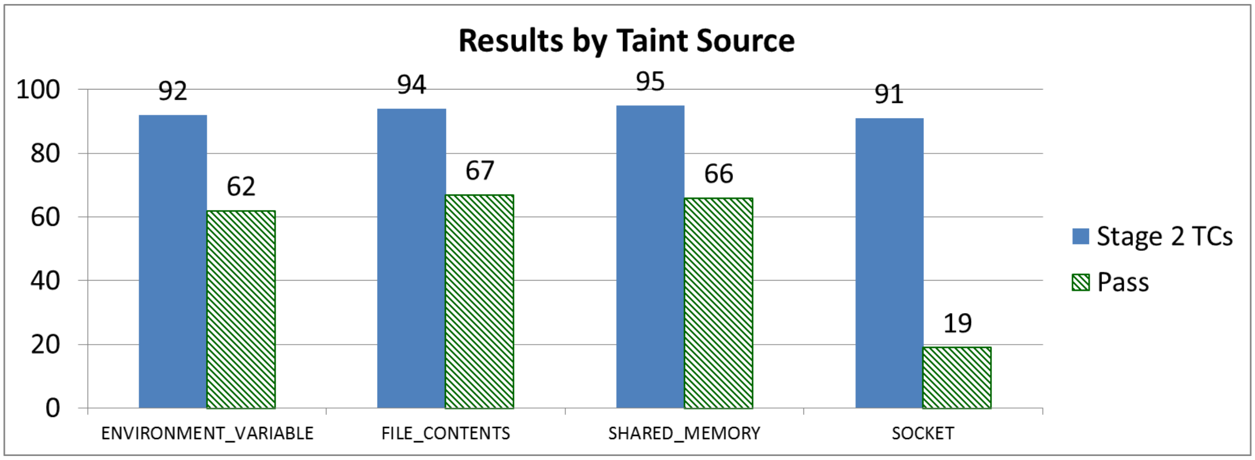

Figure J-59. PEASOUP CTREE Number of Passing Test Cases (by Taint Source)

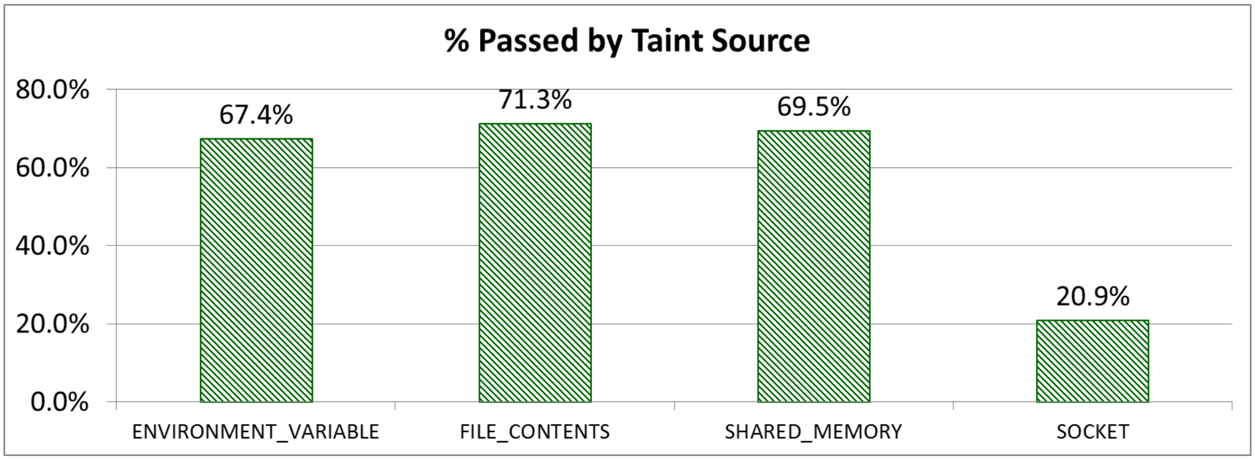

Figure J-60. PEASOUP CTREE Percentage of Passing Test Cases (by Taint Source)

J.3.3 PEASOUP CTREE Results by Data Type Complexity

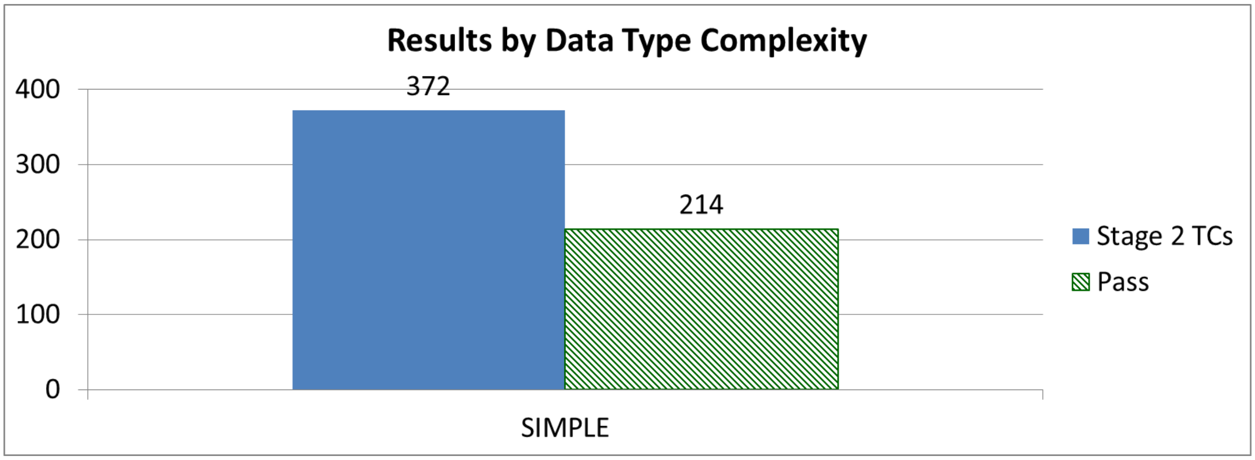

Figure J-61. PEASOUP CTREE Number of Passing Test Cases (by Data Type Complexity)

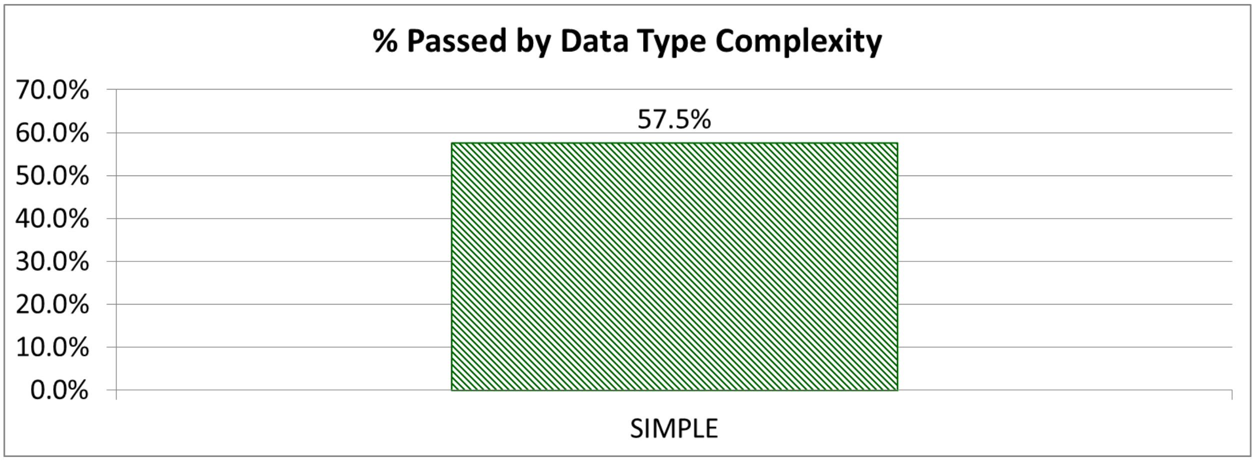

Figure J-62. PEASOUP CTREE Percentage of Passing Test Cases (by Data Type Complexity)

J.3.4 PEASOUP CTREE Results by Data Flow Complexity

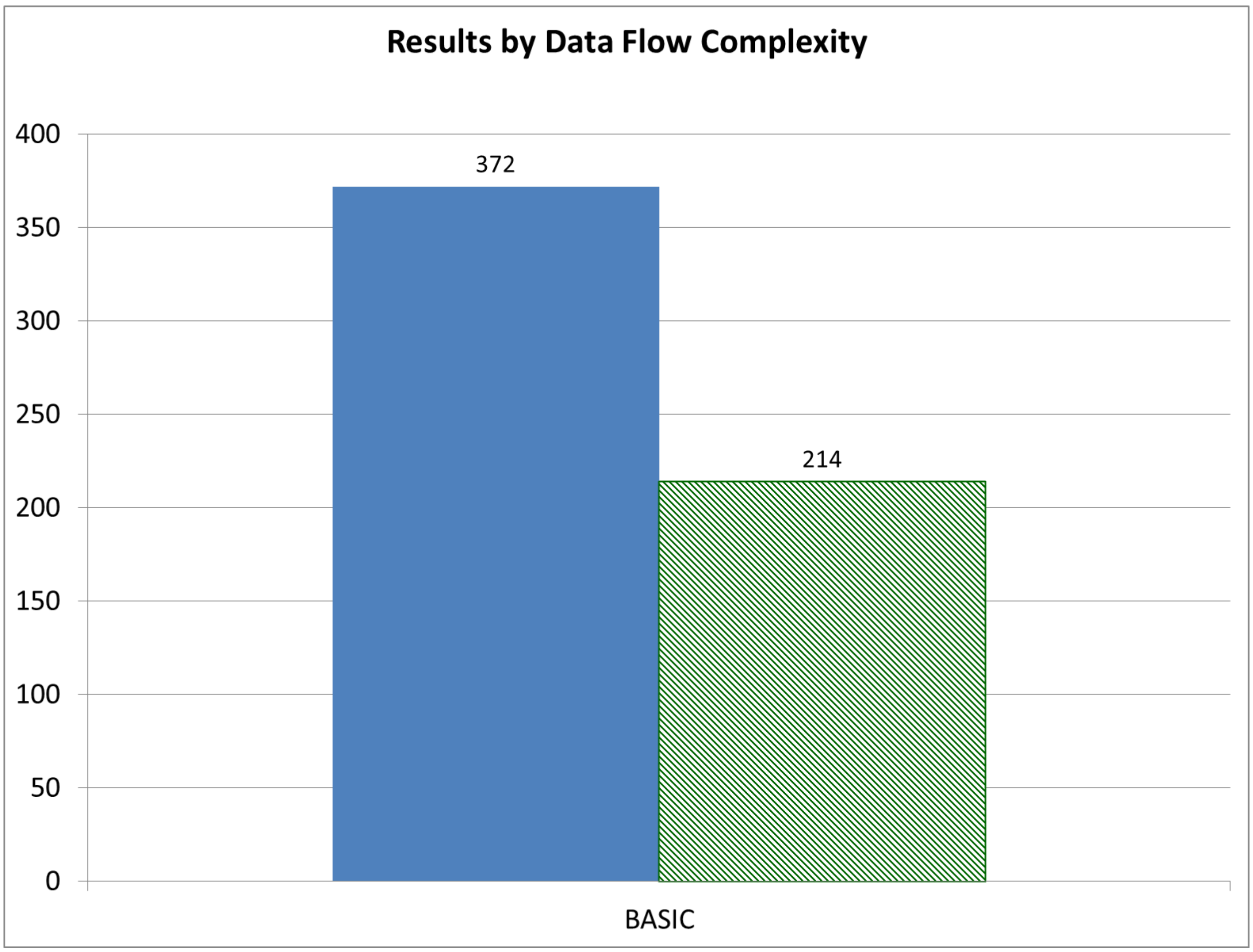

Figure J-63. PEASOUP CTREE Number of Passing Test Cases (by Data Flow Complexity)

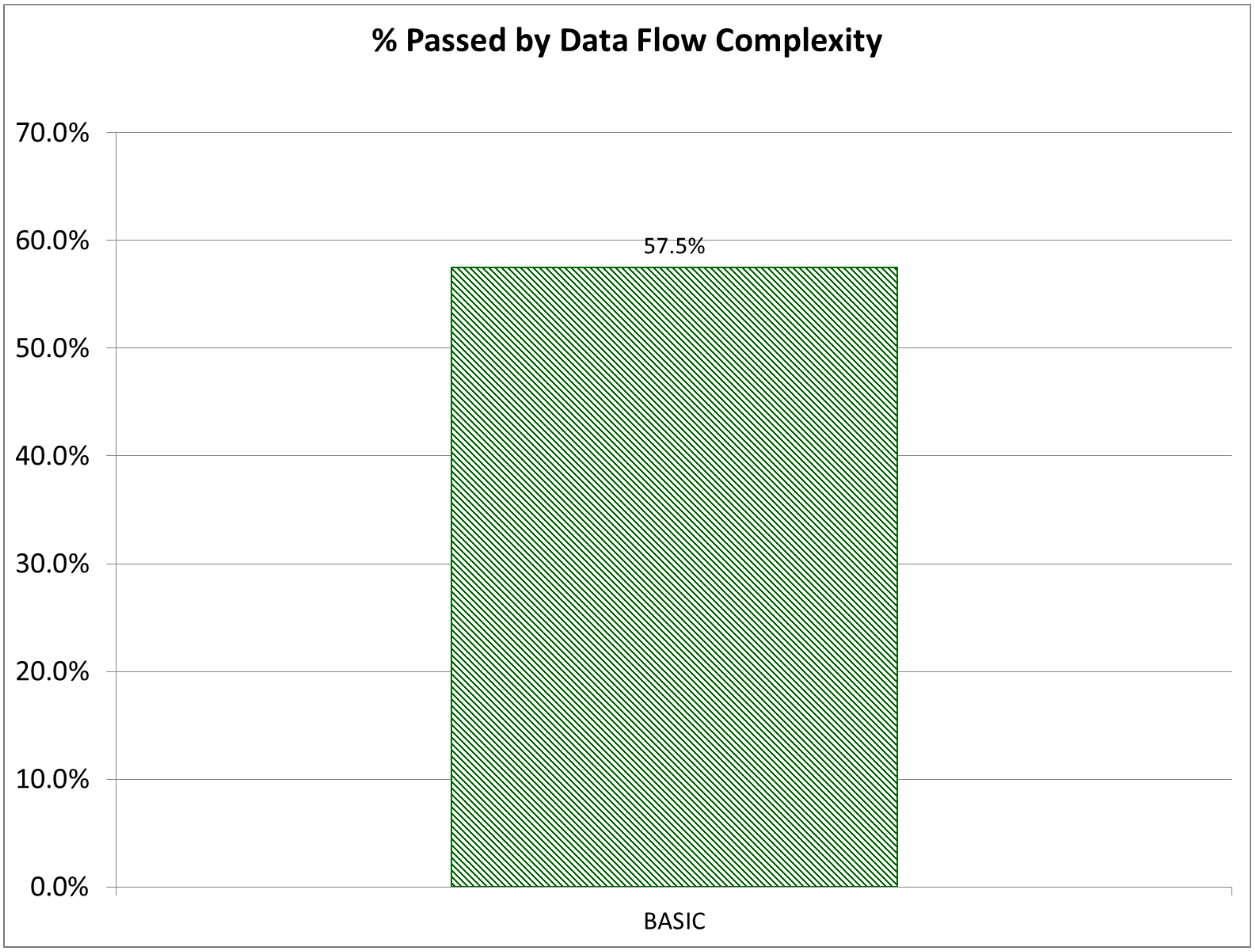

Figure J-64. PEASOUP CTREE Percentage of Passing Test Cases (by Data Flow Complexity)

J.3.5 PEASOUP CTREE Results by Control Flow Complexity

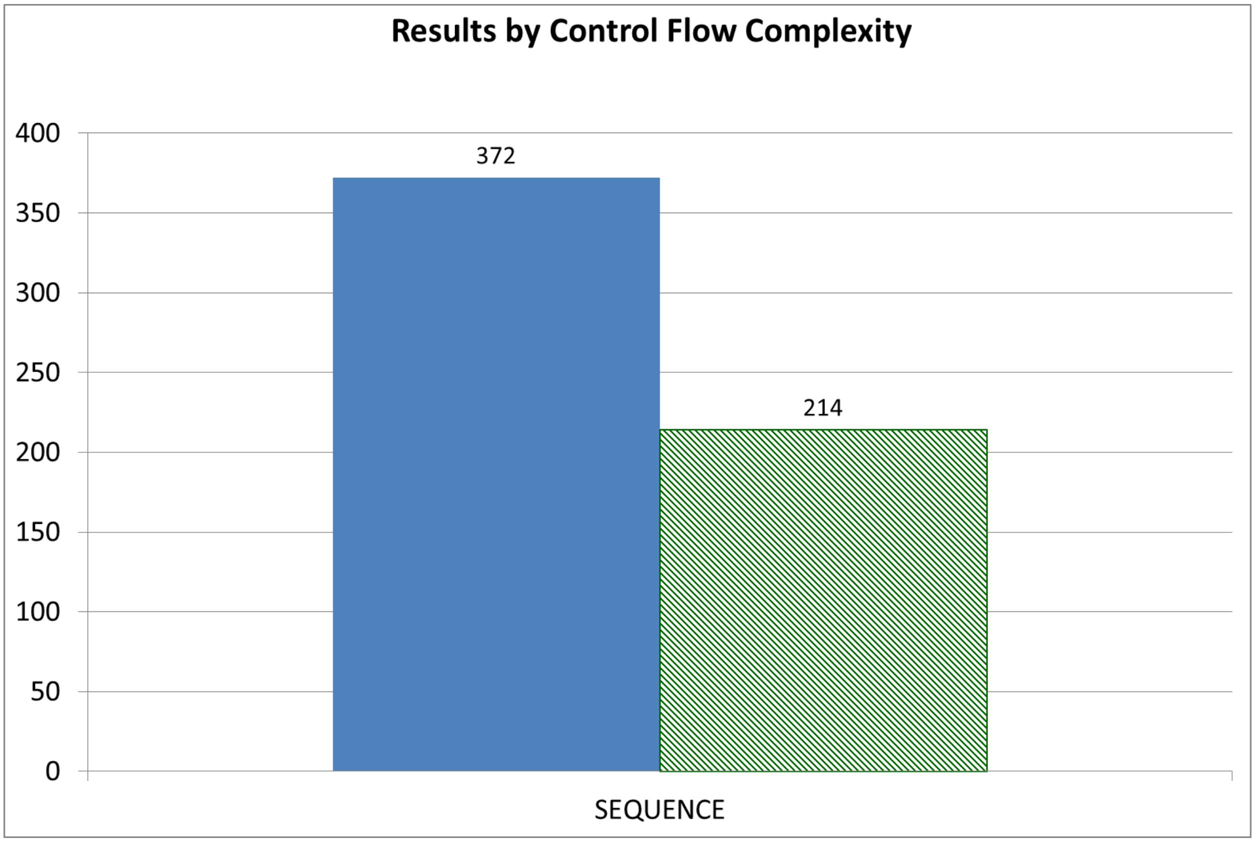

Figure J-65. PEASOUP CTREE Number of Passing Test Cases (by Control Flow Complexity)

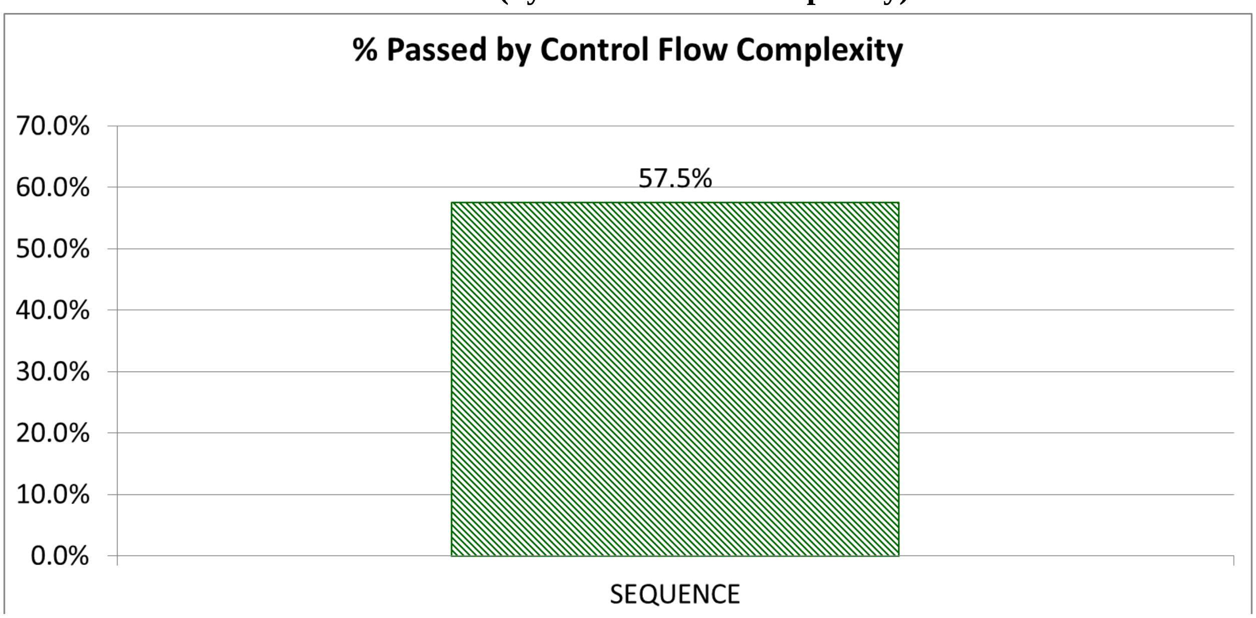

Figure J-66. PEASOUP CTREE Percentage of Passing Test Cases (by Control Flow Complexity)

J.3.6 PEASOUP CTREE Performance Overhead

Table J-23. PEASOUP CTREE Performance Overhead by Weakness Class

Weakness Class	% Increase
Concurrency Handling	100.9%
Injection	320.6%
Memory Corruption	35.4%
Null Pointer	37.6%
Number Handling	44.8%
Resource Drains	65.4%
Grand Total	**75.5%**

Table J-24. PEASOUP CTREE Performance Overhead by Base Program

Base Program	% Increase
CTRE	75.5%
Grand Total	**75.5%**

Table J-25. PEASOUP CTREE Performance Overhead by Taint Source

Taint Source	% Increase
ENVIRONMENT_VARIABLE	75.5%
FILE_CONTENTS	16584.6%
Grand Total	**75.5%**

Table J-26. PEASOUP CTREE Performance Overhead by Data Type Complexity

Data Type Complexity	% Increase
SIMPLE	75.5%
Grand Total	**75.5%**

Table J-27. PEASOUP CTREE Performance Overhead by Data Flow Complexity

Data Flow Complexity	% Increase
BASIC	75.5%
Grand Total	**75.5%**

Table J-28. PEASOUP CTREE Performance Overhead by Control Flow Complexity

Control Flow Complexity	% Increase
SEQUENCE	75.5%
Grand Total	**75.5%**

Table J-29. PEASOUP CTREE Performance Overhead by File Size

File Size	% Increase
537,199	75.5%
Grand Total	**75.5%**

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APPENDIX K—Kestrel Detailed T&E Result

K.1 VIBRANCE Basic Results

Numbers

Mitigation?		Altered? No	Altered? Yes	Total
	Full	2,166	132	2,298
	Partial	26	7	33
	None	236	188	424
	Total	2,428	327	2,755

Percentages

Mitigation?		Altered? No	Altered? Yes	Total
	Full	78.6%	4.8%	83%
	Partial	0.9%	0.3%	1%
	None	8.6%	6.8%	15%
	Total	88%	12%	100%

Figure K-1. VIBRANCE Mitigation and Altered Functionality Results

K.1.1 VIBRANCE Results by Base Programs

Table K-1. VIBRANCE Mitigation and Altered Functionality Results (by Base Program)

Base Program	Total Test Cases	Full Mitigation No Altered Function	Partial Mitigation No Altered Function	No Mitigation No Altered Function	Full Mitigation Altered Function	Partial Mitigation Altered Function	No Mitigation Altered Function
CMUD	470	300	10	137	13	4	6
ELAS	459	439	2	10	7	1	0
JENA	462	445	9	1	7	0	0
LENY	420	55	2	78	101	2	182
LUCE	468	454	1	9	4	0	0
POIX	476	473	2	1	0	0	0
Grand Total	**2755**	**2166**	**26**	**236**	**132**	**7**	**188**

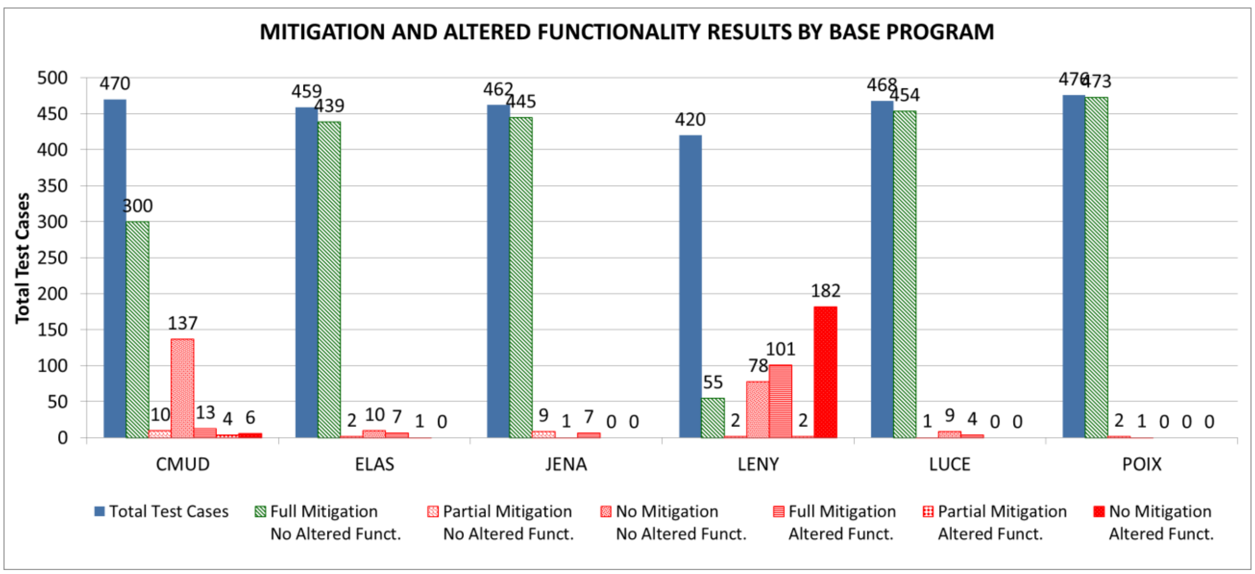

Figure K-2. VIBRANCE Mitigation and Altered Functionality Results (by Base Program)

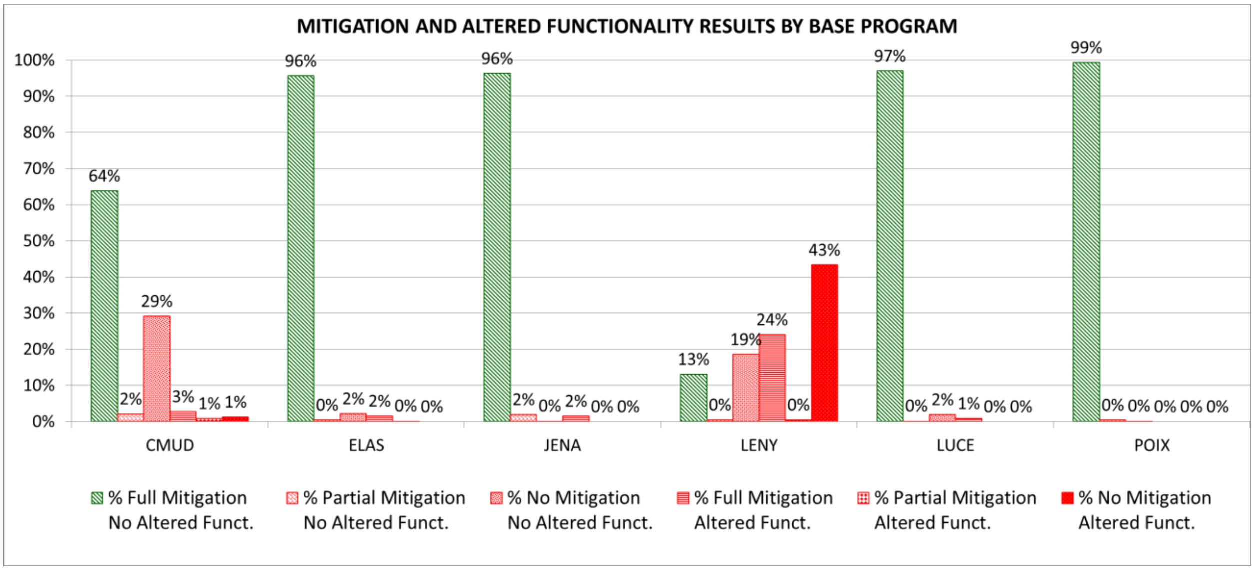

Figure K-3. VIBRANCE Mitigation and Altered Functionality Results (percentage by Base Program)

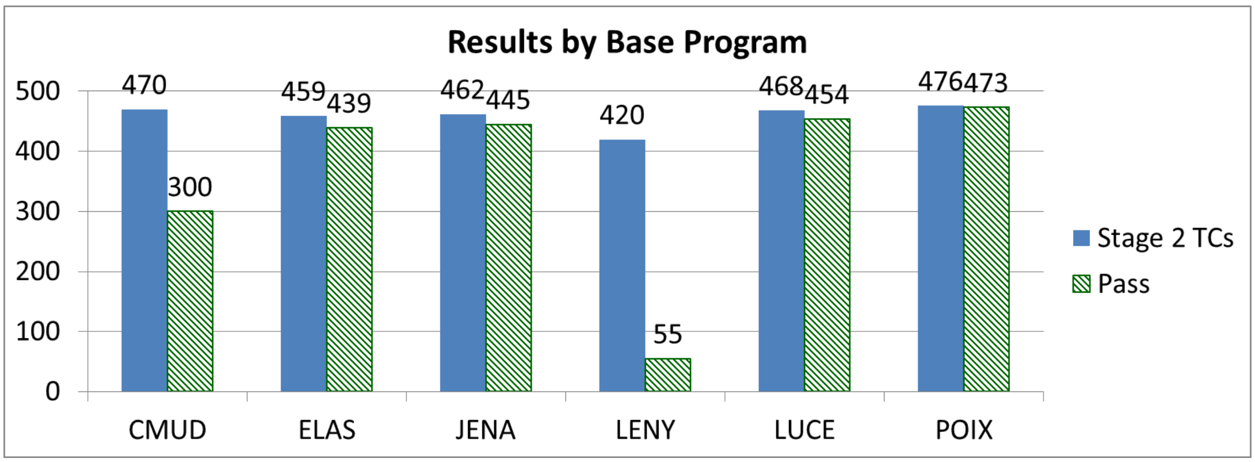

Figure K-4. VIBRANCE Number of Passing Test Cases (by Base Program)

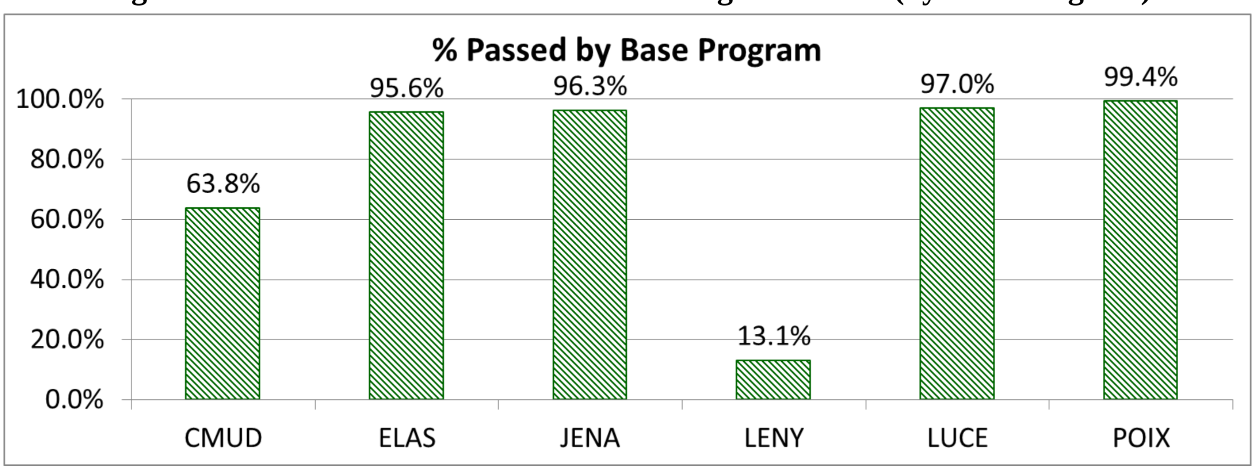

Figure K-5. VIBRANCE Percentage of Passing Test Cases (by Base Program)

K.1.2 VIBRANCE Results by Weakness Classes and Target Weaknesses

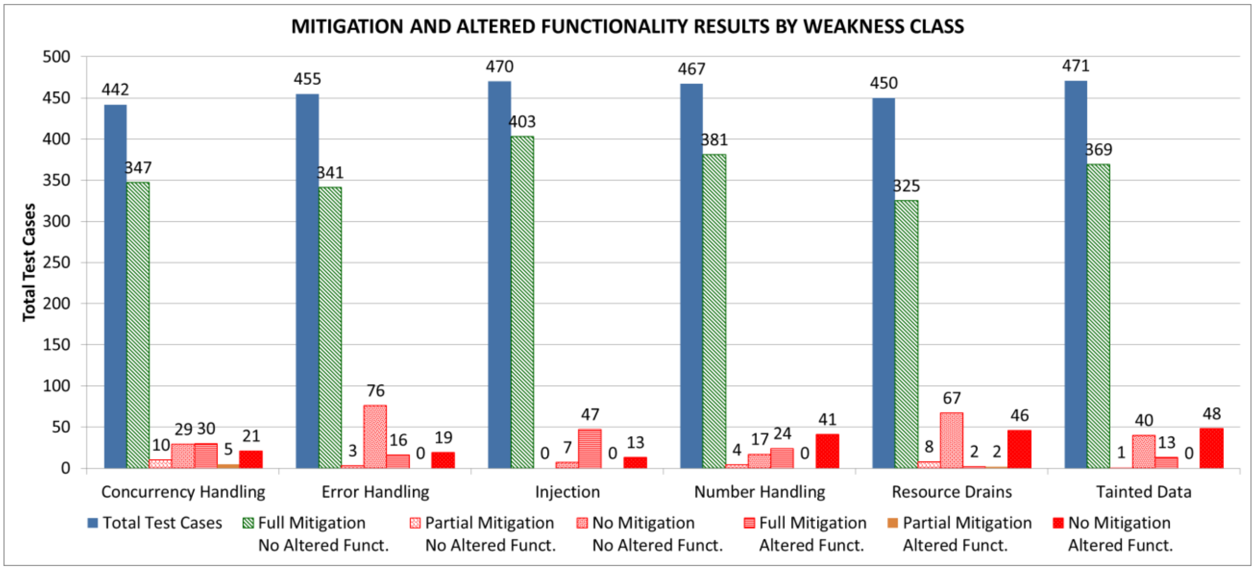

Figure K-6. VIBRANCE Mitigation and Altered Functionality Results (by Weakness Class)

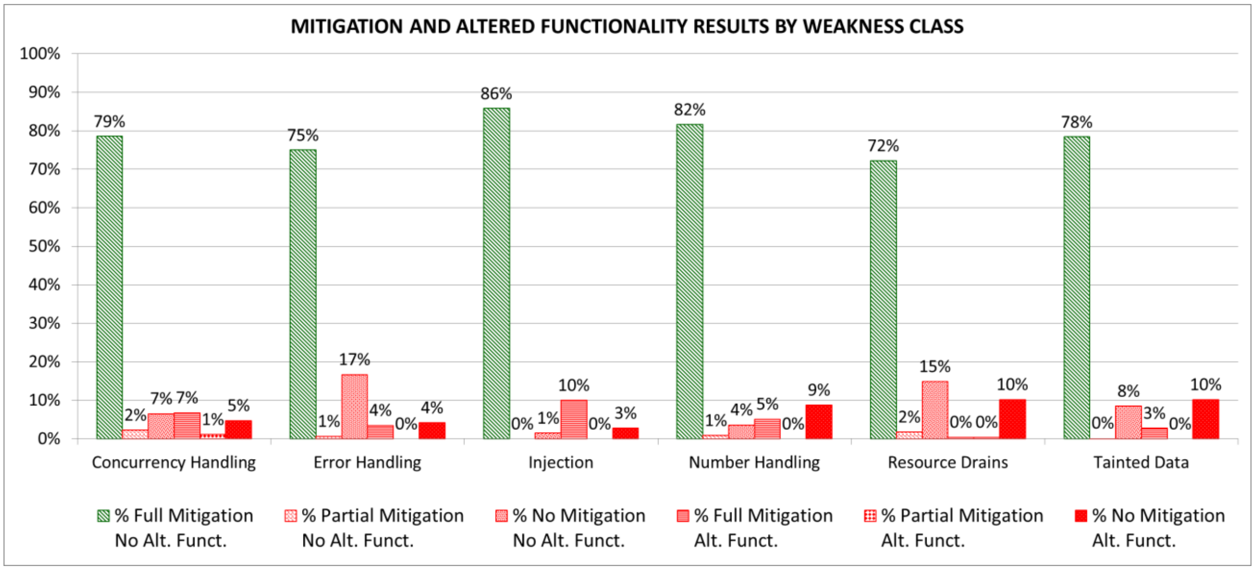

Figure K-7. VIBRANCE Mitigation and Altered Functionality Results (percentage by Weakness Class)

Table K-2. VIBRANCE Mitigation and Altered Functionality Results (by Weakness Class)

Target Weakness Class	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & No Alt Function)	% Pass
Concurrency Handling	442	442	386	87%	377	85%	347	79%
Error Handling	455	455	420	92%	357	78%	341	75%
Injection	470	470	410	87%	450	96%	403	86%
Number Handling	467	467	402	86%	405	87%	381	82%
Resource Drains	450	450	400	89%	327	73%	325	72%
Tainted Data	471	471	410	87%	382	81%	369	78%
Grand Total	**2755**	**2755**	**2428**	**88.1%**	**2298**	**83.4%**	**2166**	**78.6%**

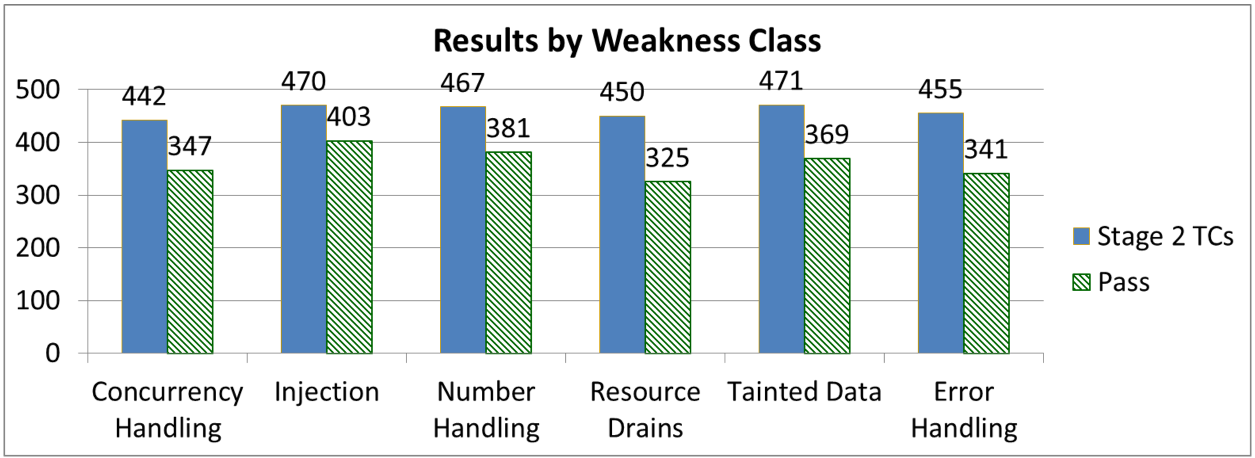

Figure K-8. VIBRANCE Number of Passing Test Cases (by Weakness Class)

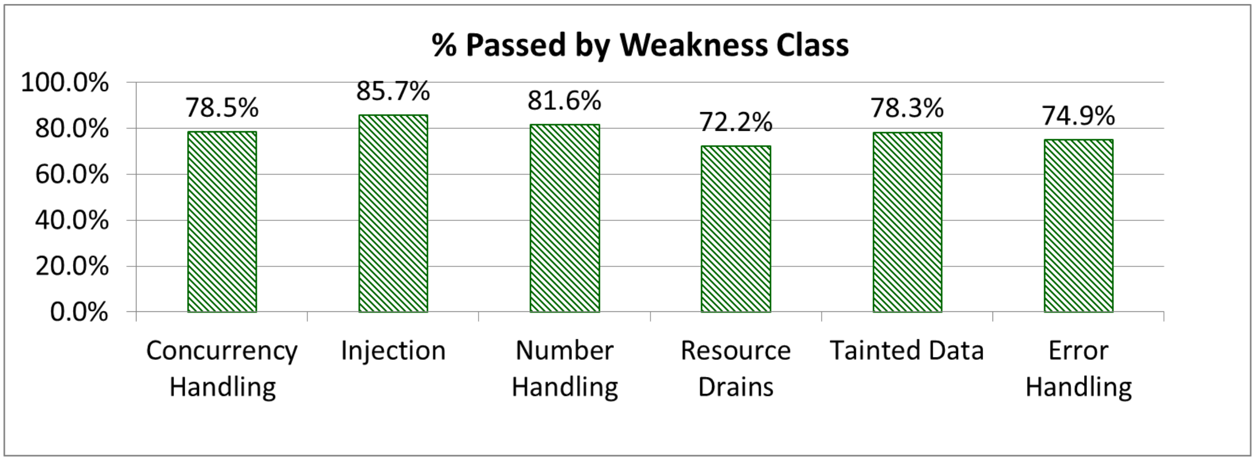

Figure K-9. VIBRANCE Percentage of Passing Test Cases (by Weakness Class)

Table K-3. VIBRANCE Mitigation and Altered Functionality Results (by CWE)

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling								
363A	32	32	24	75%	27	84%	24	75%
367A	31	31	27	87%	25	81%	24	77%
412A	32	32	27	84%	21	66%	21	66%
414A	29	29	25	86%	24	83%	21	72%
543A	28	28	23	82%	17	61%	17	61%
567A	28	28	24	86%	27	96%	24	86%
572A	32	32	29	91%	30	94%	27	84%
609A	28	28	26	93%	21	75%	20	71%
663A	23	23	20	87%	18	78%	17	74%
764A	32	32	28	88%	31	97%	28	88%
765A	30	30	29	97%	29	97%	28	93%
820A	28	28	24	86%	21	75%	18	64%
821A	30	30	26	87%	28	93%	25	83%
832A	28	28	27	96%	27	96%	26	93%
833A	31	31	27	87%	31	100%	27	87%
Error Handling								
209A	53	53	50	94%	34	64%	34	64%
248A	36	36	36	100%	25	69%	25	69%
252A	53	53	48	91%	53	100%	48	91%
252B	55	55	50	91%	55	100%	50	91%
253A	54	54	49	91%	36	67%	36	67%
390A	54	54	48	89%	35	65%	35	65%
391A	54	54	49	91%	54	100%	49	91%
460A	43	43	43	100%	29	67%	29	67%
584A	53	53	47	89%	36	68%	35	66%
Injection								
078A	59	59	51	86%	49	83%	48	81%
088A	60	60	54	90%	50	83%	50	83%
089A	59	59	52	88%	59	100%	52	88%
089B	58	58	49	84%	58	100%	49	84%
089C	60	60	52	87%	60	100%	52	87%
089D	58	58	52	90%	58	100%	52	90%
564A	59	59	52	88%	59	100%	52	88%
564B	57	57	48	84%	57	100%	48	84%
Number Handling								
190A	50	50	35	70%	39	78%	32	64%
190B	53	53	43	81%	40	75%	40	75%
191A	52	52	45	87%	44	85%	44	85%
194A	53	53	45	85%	42	79%	42	79%
195A	53	53	49	92%	45	85%	44	83%
196A	47	47	42	89%	37	79%	37	79%
197A	52	52	46	88%	52	100%	46	88%
369A	54	54	50	93%	53	98%	49	91%
839A	53	53	47	89%	53	100%	47	89%
Resource Drains								
400A	53	53	47	89%	33	62%	33	62%
400B	53	53	45	85%	26	49%	26	49%
459A	54	54	49	91%	36	67%	36	67%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
674A	44	44	37	84%	35	80%	34	77%
774A	49	49	41	84%	38	78%	37	76%
774B	39	39	38	97%	38	97%	38	97%
789A	52	52	52	100%	52	100%	52	100%
834A	53	53	47	89%	37	70%	37	70%
835A	53	53	44	83%	32	60%	32	60%
Tainted Data								
023A	79	79	67	85%	62	78%	60	76%
023B	79	79	68	86%	65	82%	64	81%
036A	79	79	67	85%	62	78%	61	77%
041A	77	77	68	88%	66	86%	65	84%
606A	78	78	69	88%	49	63%	49	63%
606B	79	79	71	90%	78	99%	70	89%
Grand Total	**2755**	**2755**	**2428**	**88.1%**	**2298**	**83.4%**	**2166**	**78.6%**

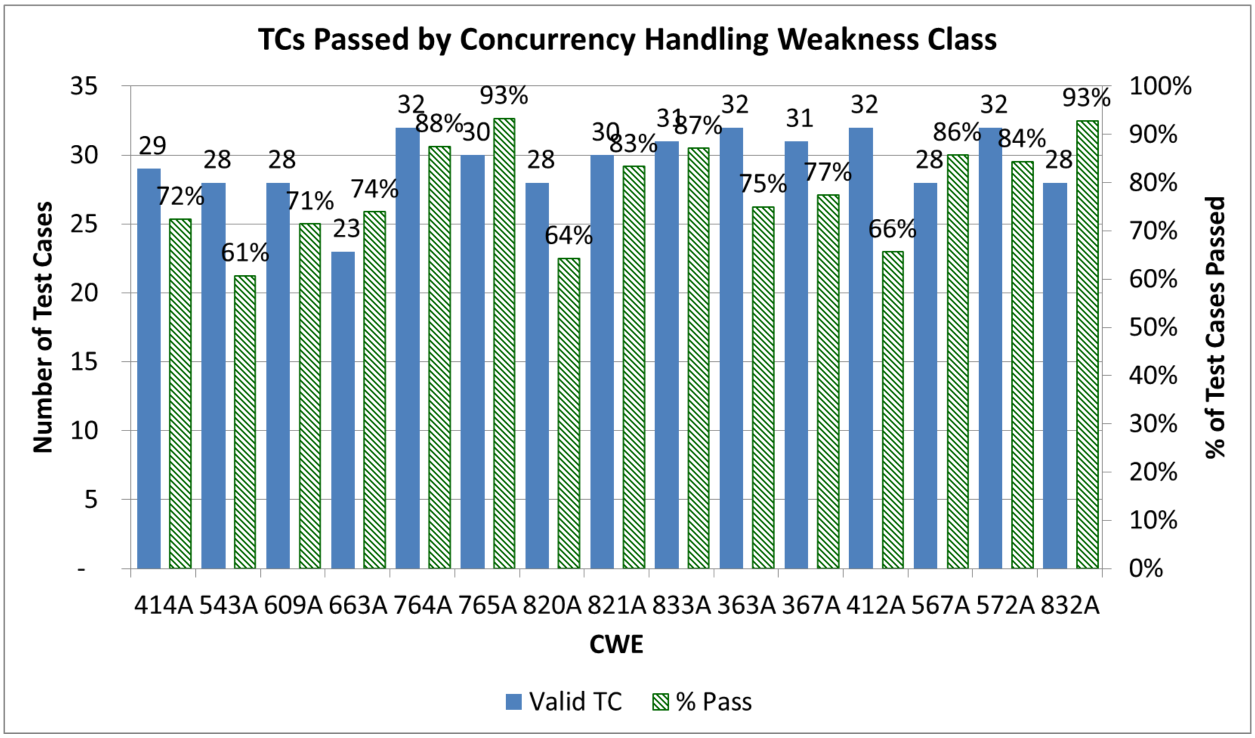

Figure K-10. VIBRANCE Passing Test Cases (by Concurrency Handling CWEs)

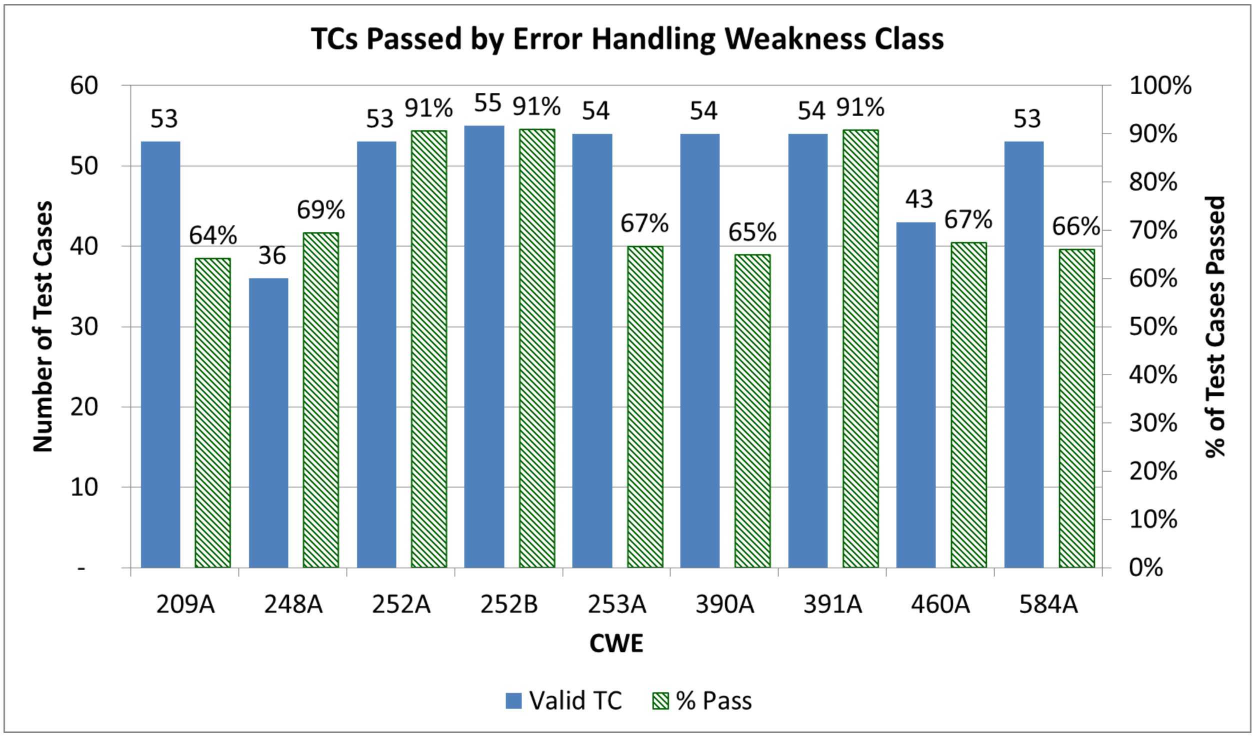

Figure K-11. VIBRANCE Passing Test Cases (by Error Handling CWEs)

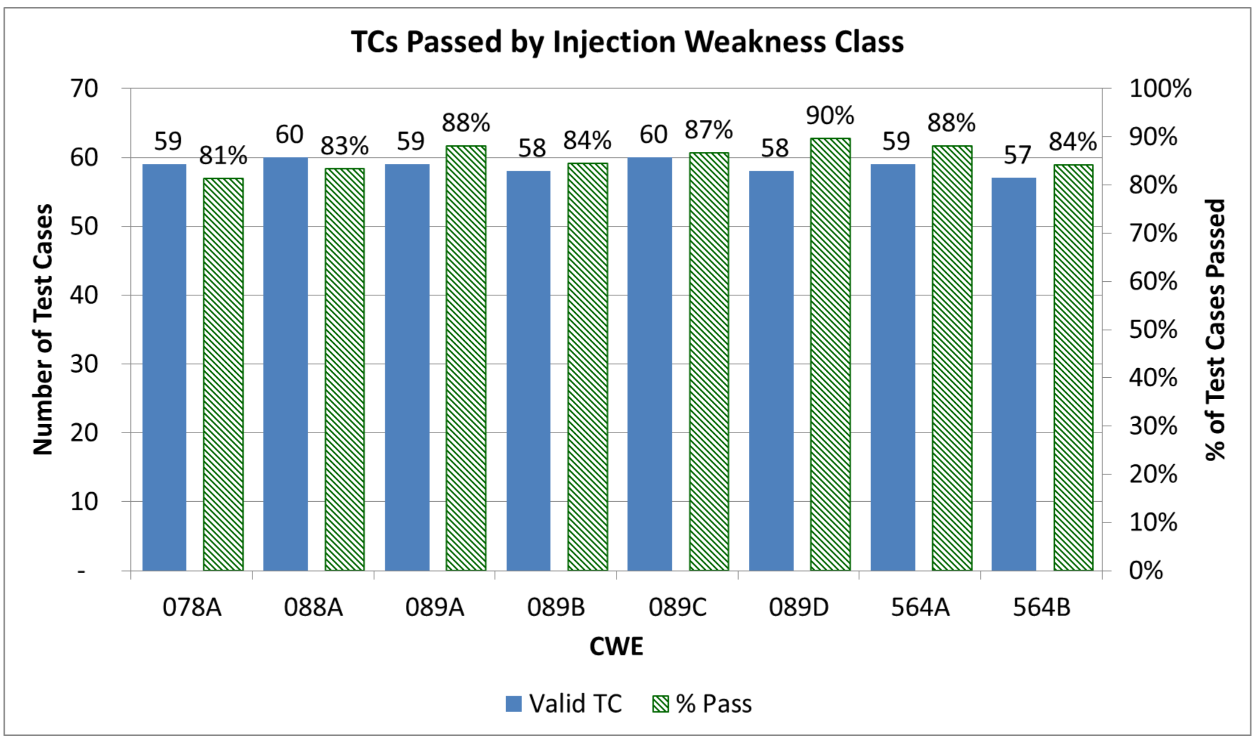

Figure K-12. VIBRANCE Passing Test Cases (by Injection CWEs)

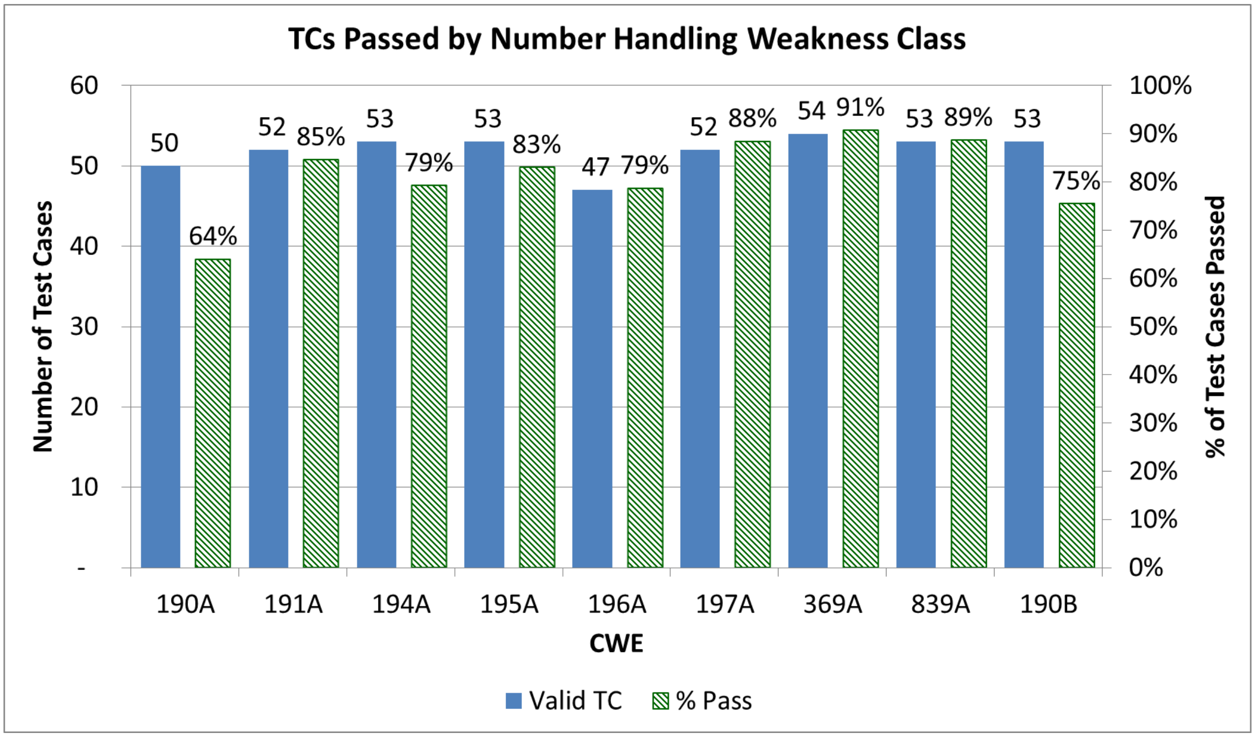

Figure K-13. VIBRANCE Passing Test Cases (by Number Handling CWEs)

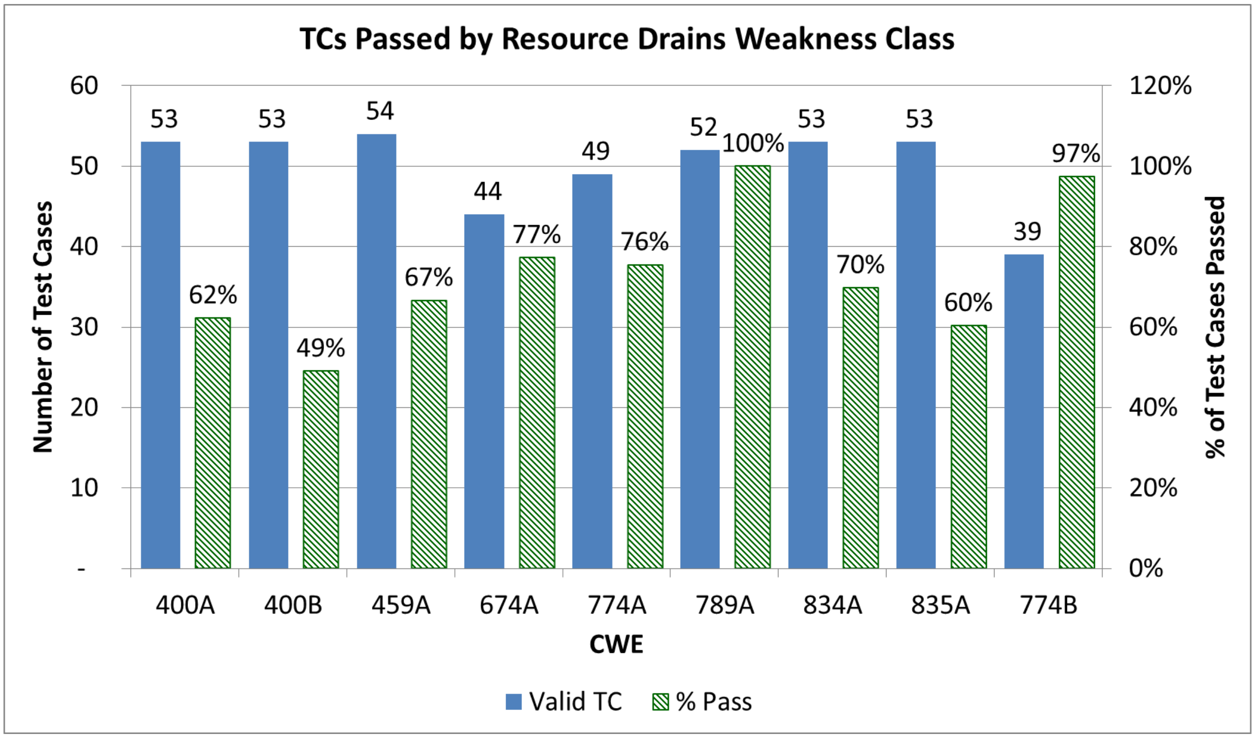

Figure K-14. VIBRANCE Passing Test Cases (by Resource Drain CWEs)

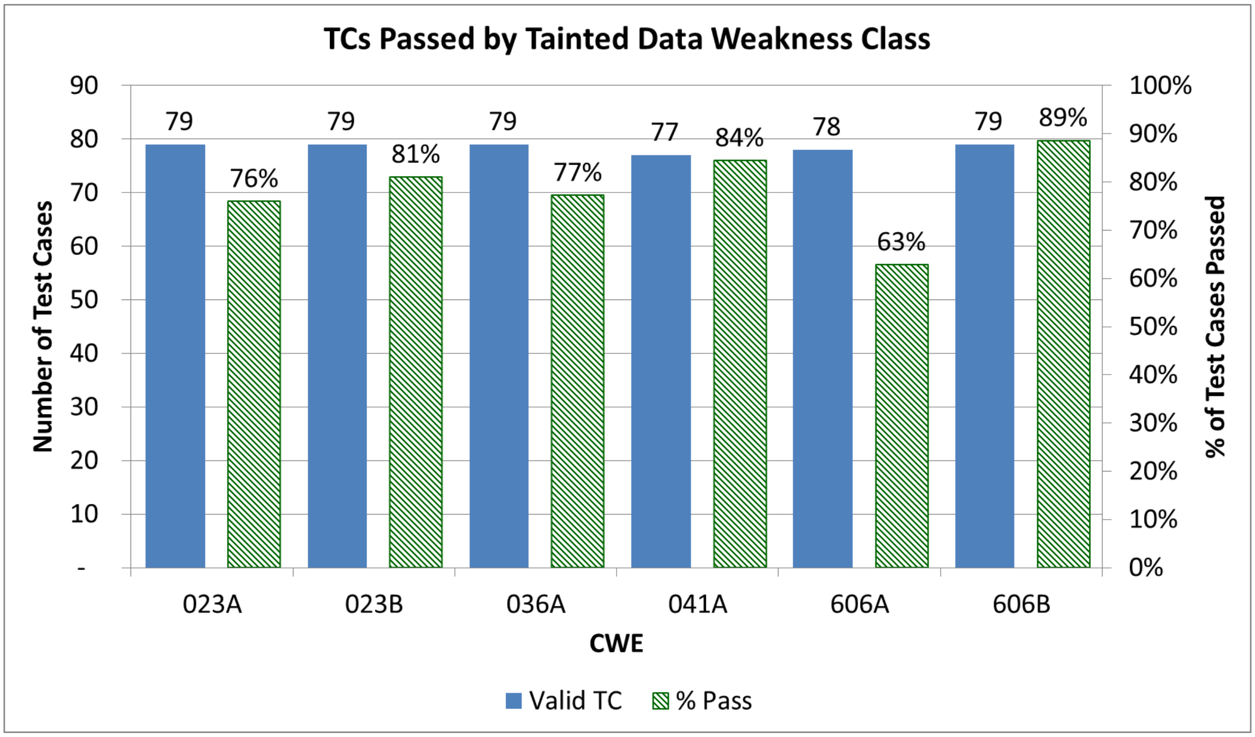

Figure K-15. VIBRANCE Passing Test Cases (by Tainted Data CWEs)

K.1.3 VIBRANCE Results by Taint Source

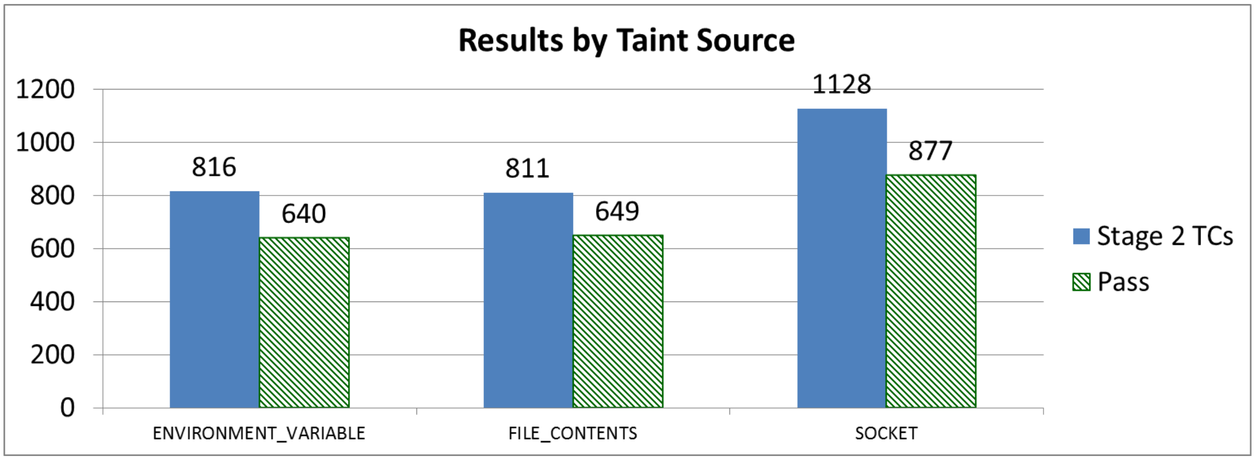

Figure K-16. VIBRANCE Number of Passing Test Cases (by Taint Source)

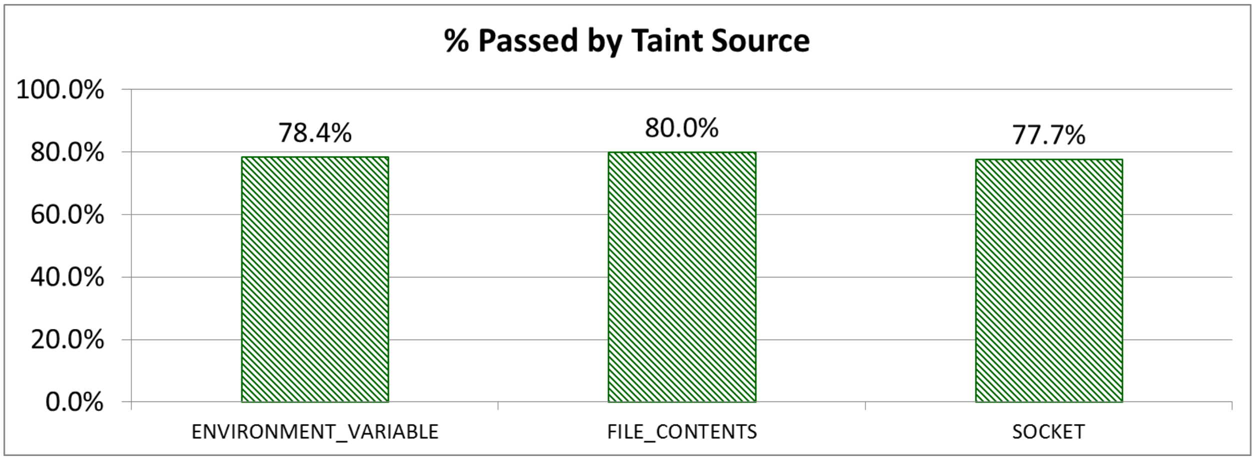

Figure K-17. VIBRANCE Percentage of Passing Test Cases (by Taint Source)

K.1.4 VIBRANCE Results by Data Type Complexity

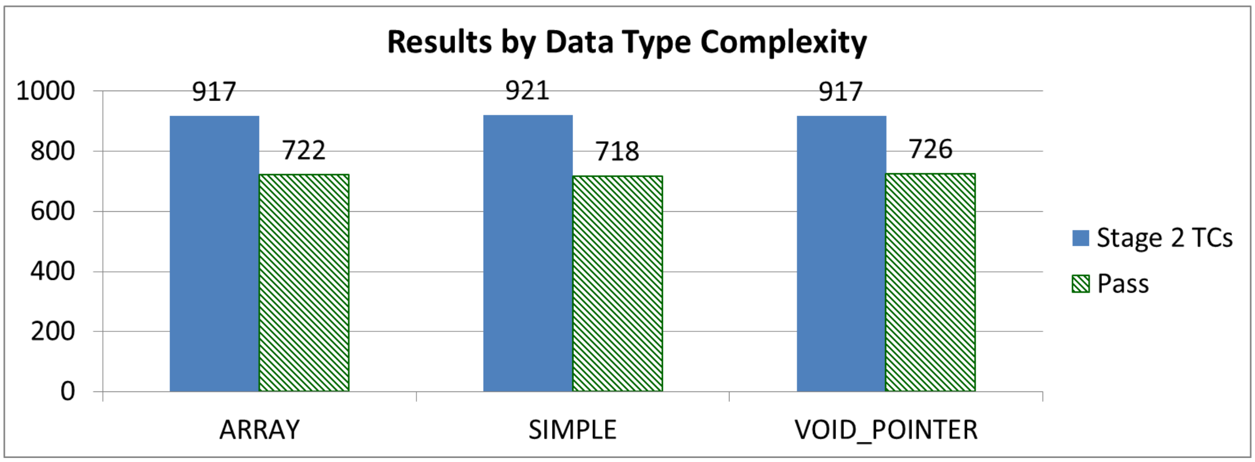

Figure K-18. VIBRANCE Number of Passing Test Cases (by Data Type Complexity)

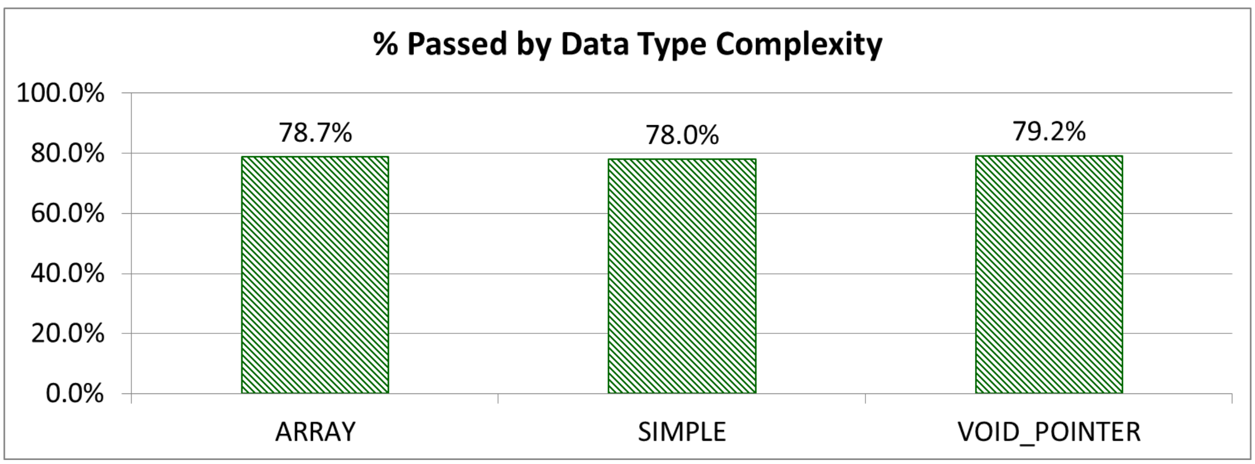

Figure K-19. VIBRANCE Number of Passing Test Cases (by Data Type Complexity)

K.1.5 VIBRANCE Results by Data Flow Complexity

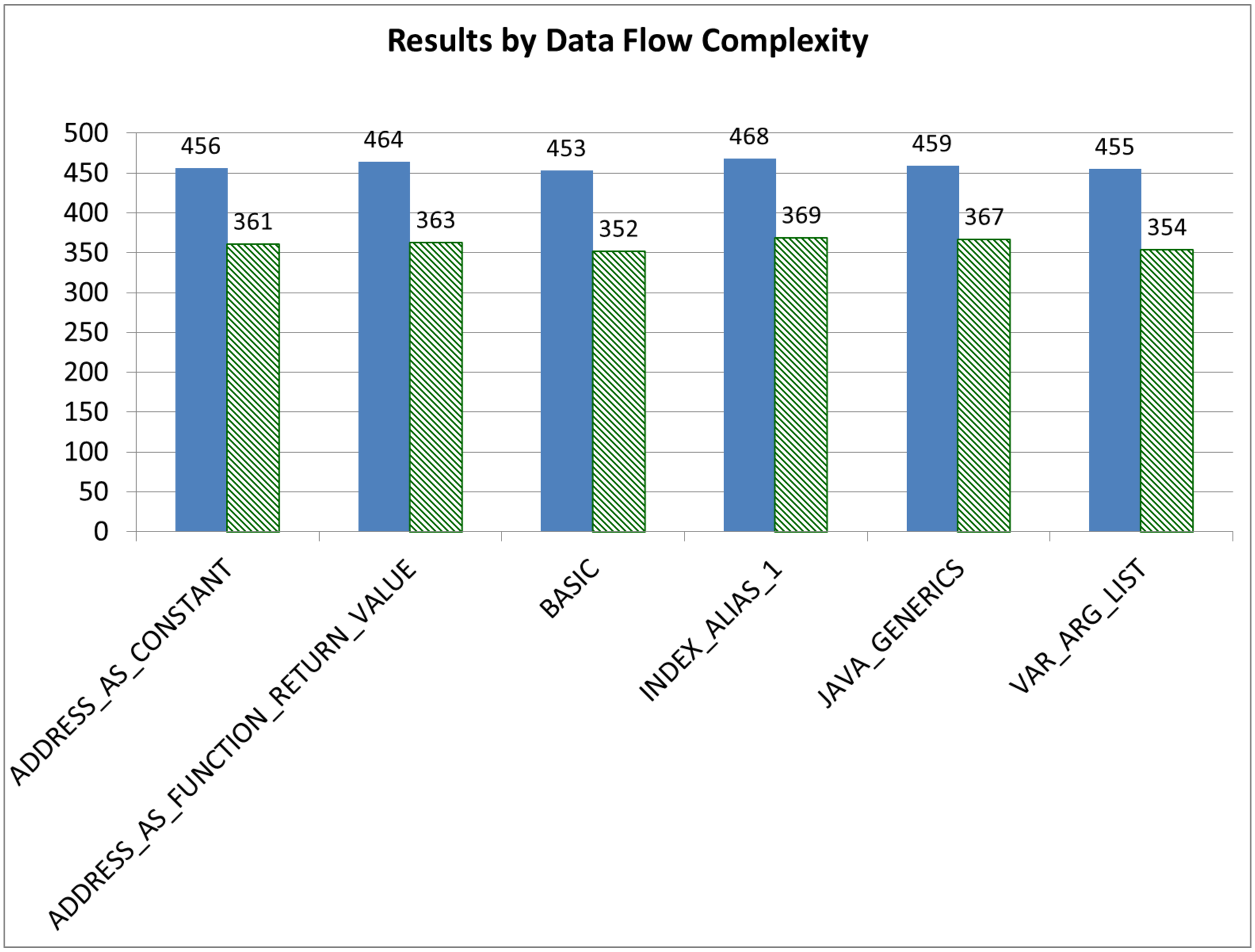

Figure K-20. VIBRANCE Number of Passing Test Cases (by Data Flow Complexity)

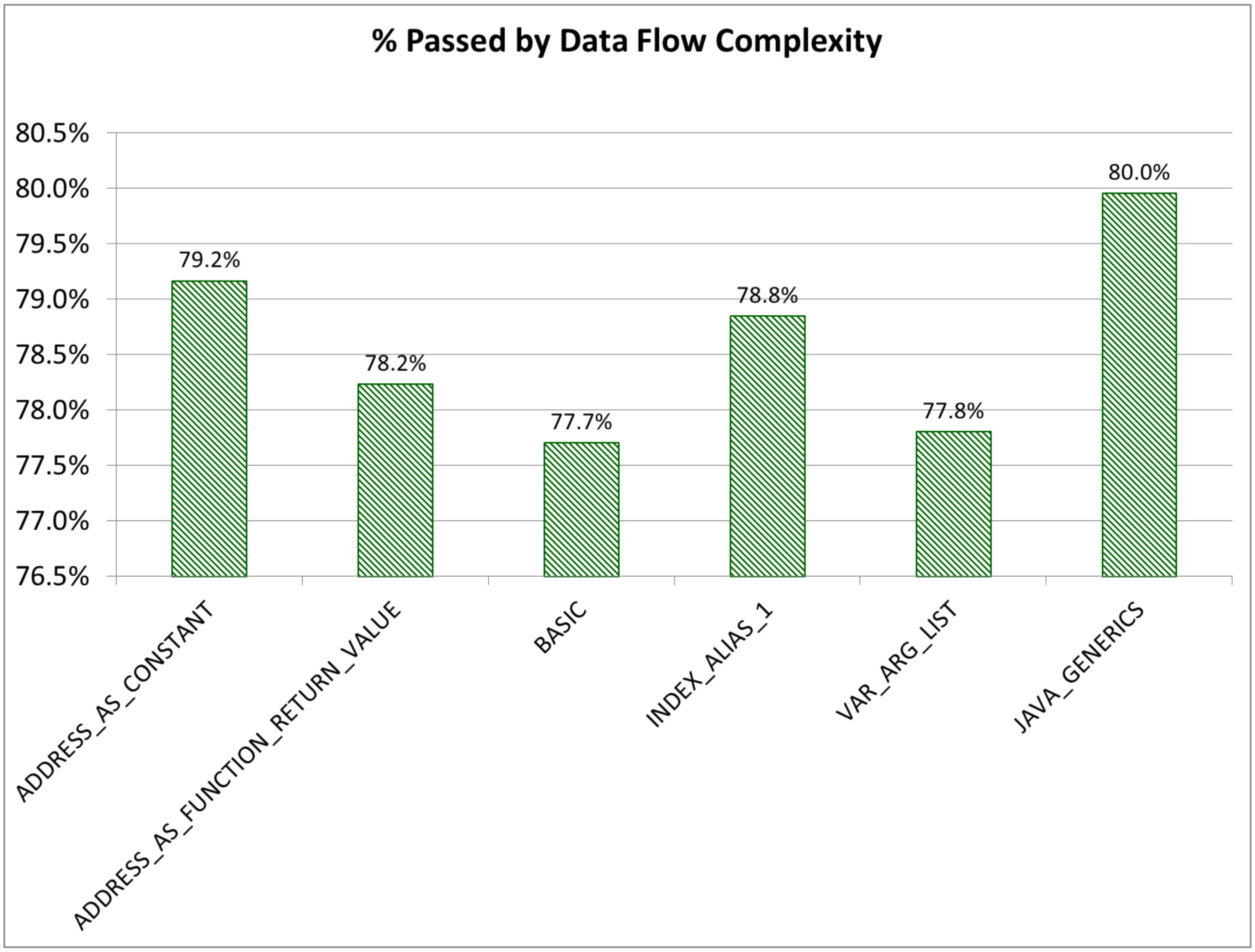

Figure K-21. VIBRANCE Percentage of Passing Test Cases (by Data Flow Complexity)

K.1.6 VIBRANCE Results by Control Flow Complexity

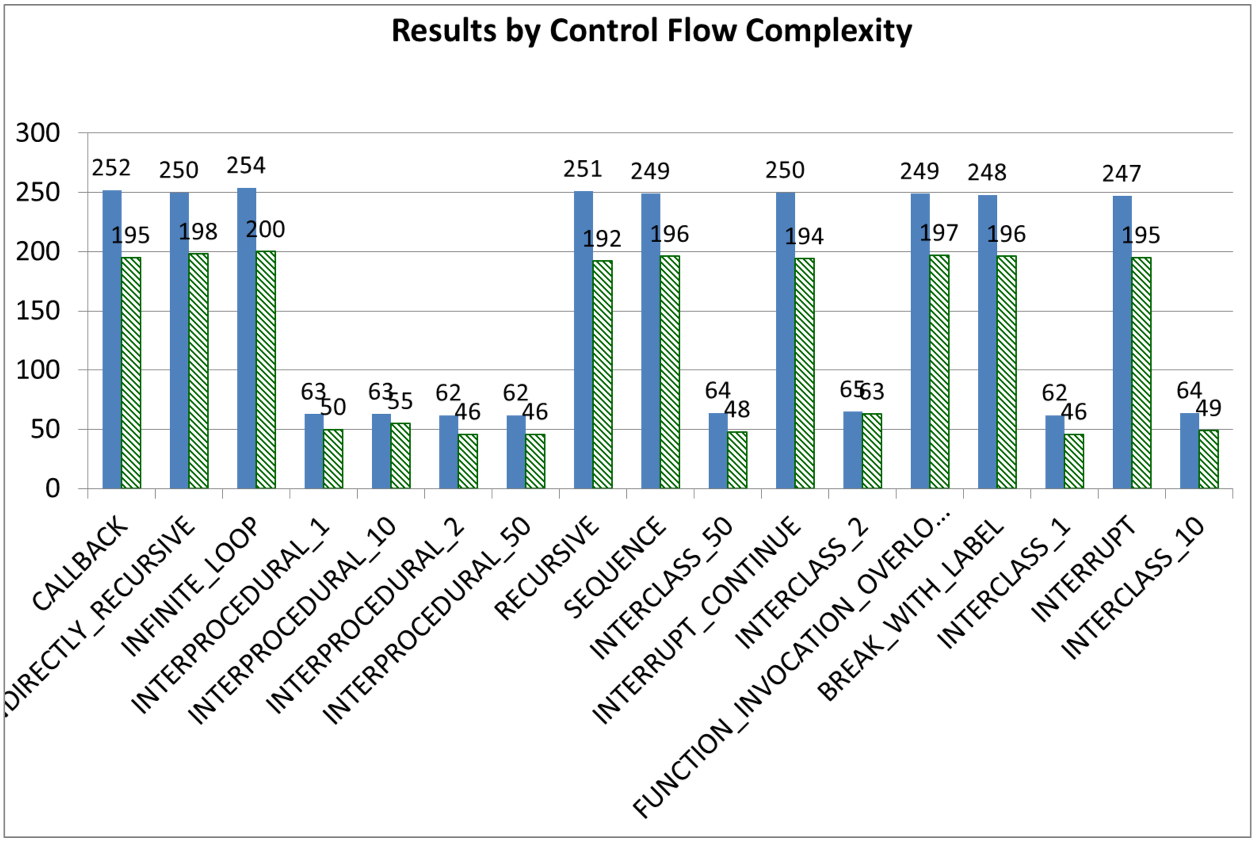

Figure K-22. VIBRANCE Number of Passing Test Cases (by Control Flow Complexity)

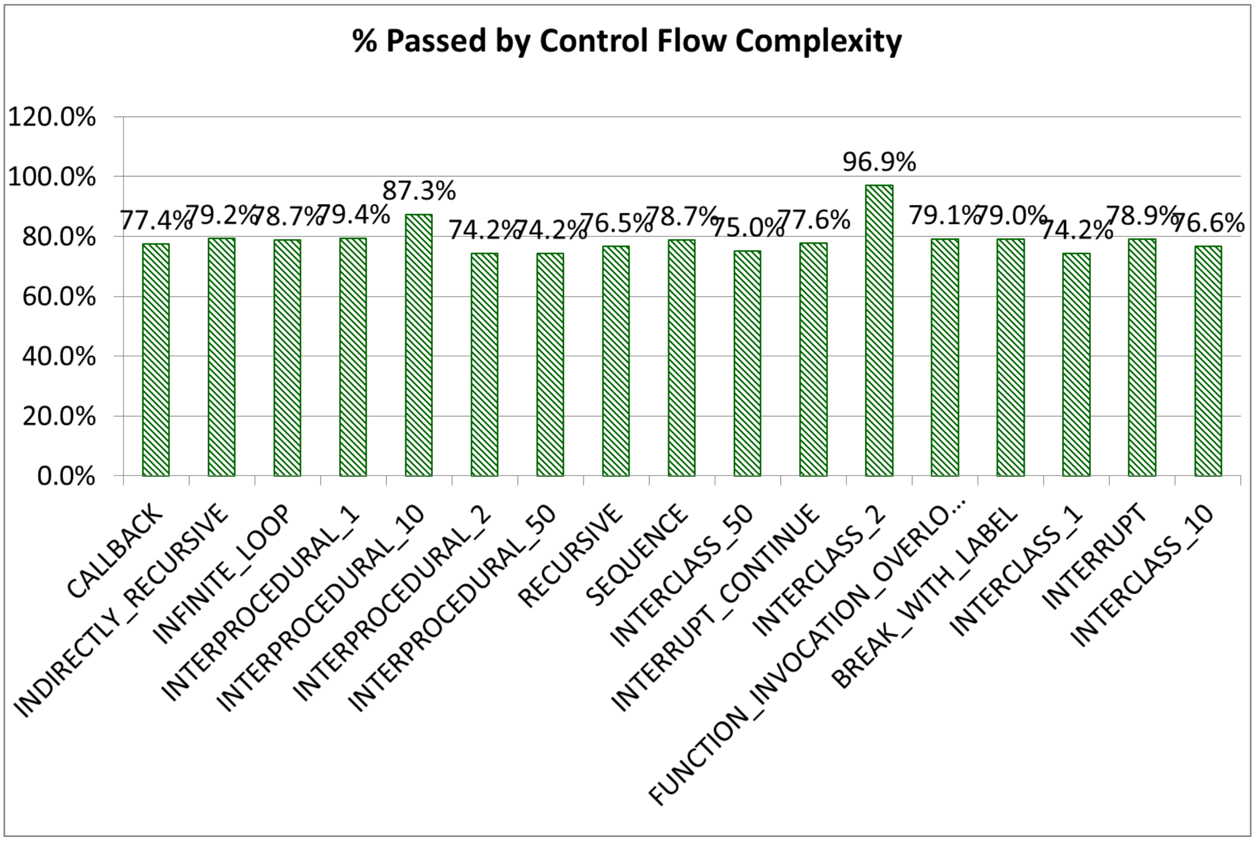

Figure K-23. VIBRANCE Percentage of Passing Test Cases (by Control Flow Complexity)

K.1.7 VIBRANCE Results by File Size

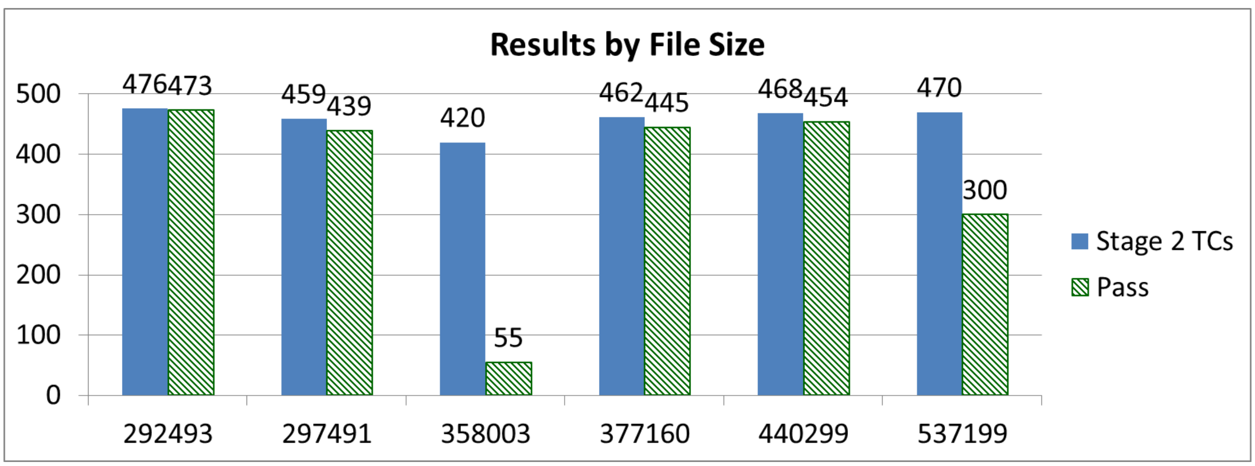

Figure K-24. VIBRANCE Number of Passing Test Cases (by File Size)

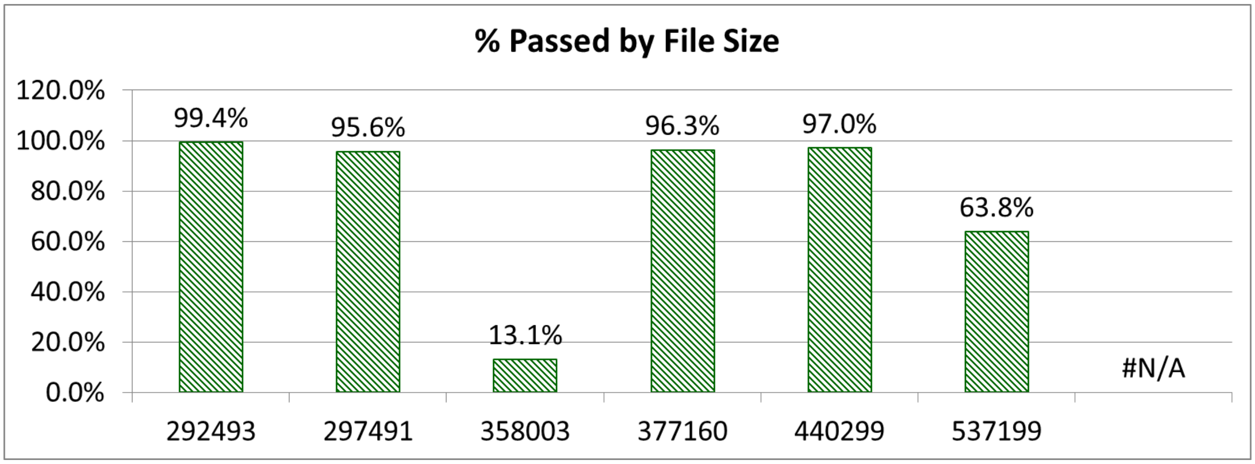

Figure K-25. VIBRANCE Percentage of Passing Test Cases (by File Size)

K.1.8 VIBRANCE Performance Overhead

Table K-4. VIBRANCE Performance Overhead by Weakness Class

Weakness Class	% Increase
Concurrency Handling	35.0%
Injection	10.4%
Number Handling	-9.3%
Resource Drains	4.7%
Tainted Data	-10.6%
Error Handling	-7.5%
Grand Total	**11.0%**

Table K-5. VIBRANCE Performance Overhead by Base Program

Base Program	% Increase
CMUD	-15.0%
ELAS	52.6%
JENA	7.0%
LENY	14.2%
LUCE	156.3%
POIX	28.6%
Grand Total	**11.0%**

Table K-6. VIBRANCE Performance Overhead by Taint Source

Taint Source	% Increase
FILE_CONTENTS	-2.7%
SOCKET	12.4%
ENVIRONMENT_VARIABLE	-1.2%
Grand Total	**11.0%**

Table K-7. VIBRANCE Performance Overhead by Data Type Complexity

Data Type Complexity	% Increase
ARRAY	11.9%
SIMPLE	11.9%
VOID_POINTER	8.9%
Grand Total	**11.0%**

Table K-8. VIBRANCE Performance Overhead by Data Flow Complexity

Data Flow Complexity	% Increase
ADDRESS_AS_CONSTANT	15.6%
ADDRESS_AS_FUNCTION_RETURN_VALUE	6.2%
BASIC	9.4%
INDEX_ALIAS_1	10.2%
VAR_ARG_LIST	17.5%
JAVA_GENERICS	7.0%
Grand Total	**11.0%**

Table K-9. VIBRANCE Performance Overhead by Control Flow Complexity

Control Flow Complexity	% Increase
CALLBACK	13.5%
INDIRECTLY_RECURSIVE	14.0%
INFINITE_LOOP	23.2%
INTERPROCEDURAL_1	4.4%
INTERPROCEDURAL_10	4.8%
INTERPROCEDURAL_2	3.3%
INTERPROCEDURAL_50	28.9%
RECURSIVE	8.5%
SEQUENCE	9.4%
INTERCLASS_50	19.6%
INTERRUPT_CONTINUE	4.6%
INTERCLASS_2	12.0%
FUNCTION_INVOCATION_OVERLOAD	-0.5%
BREAK_WITH_LABEL	21.3%
INTERCLASS_1	-10.6%
INTERRUPT	4.5%
INTERCLASS_10	0.8%
Grand Total	**11.0%**

Table K-10. VIBRANCE Performance Overhead by File Size

File Size	% Increase
292,493	28.6%
297,491	52.6%
358,003	14.2%
377,160	7.0%
440,299	156.3%
537,199	-15.0%
Grand Total	**11.0%**

K.2 Results and Analysis of Phase 2-Sized Programs

Numbers

Mitigation?		Altered? No	Altered? Yes	Total
	Full	**36**	70	106
	Partial	1	2	3
	None	15	30	45
	Total	52	102	154

Percentages

Mitigation?		Altered? No	Altered? Yes	Total
	Full	**23.4%**	45.5%	69%
	Partial	0.6%	1.3%	2%
	None	9.7%	19.5%	29%
	Total	34%	66%	100%

Figure K-26. VIBRANCE JMeter Mitigation and Altered Functionality Results

K.2.1 VIBRANCE JMeter Results by Weakness Classes and Target Weaknesses

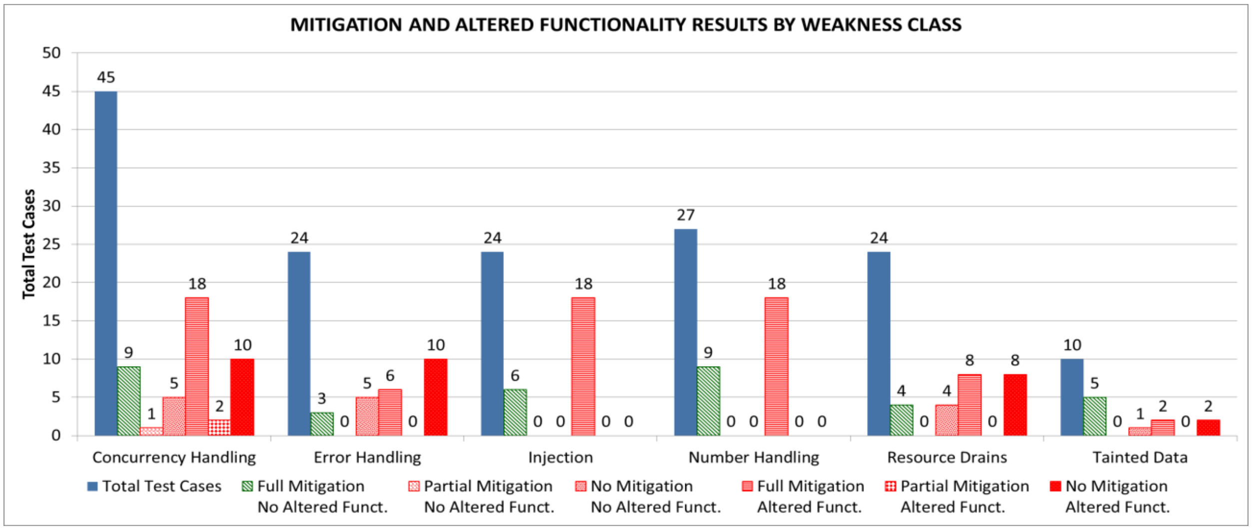

Figure K-27. VIBRANCE (JMeter) Mitigation and Altered Functionality Results (by Weakness Class)

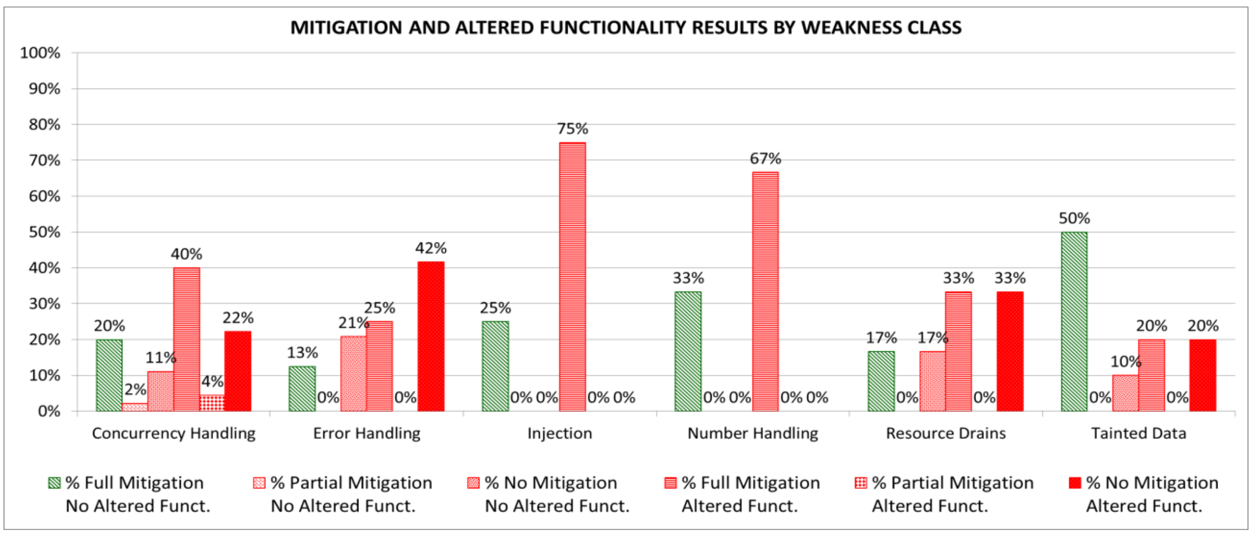

Figure K-28. VIBRANCE (JMeter) Mitigation and Altered Functionality Results (percentage by Weakness Class)

Table K-11. VIBRANCE (JMeter) Mitigation and Altered Functionality Results (by Weakness Class)

Target Weakness Class	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & No Alt Function)	% Pass
Concurrency Handling	45	45	15	33%	27	60%	9	20%
Error Handling	27	24	8	33%	9	38%	3	13%
Injection	24	24	6	25%	24	100%	6	25%
Number Handling	27	27	9	33%	27	100%	9	33%
Resource Drains	27	24	8	33%	12	50%	4	17%
Tainted Data	10	10	6	60%	7	70%	5	50%
Grand Total	**160**	**154**	**52**	**33.8%**	**106**	**68.8%**	**36**	**23.4%**

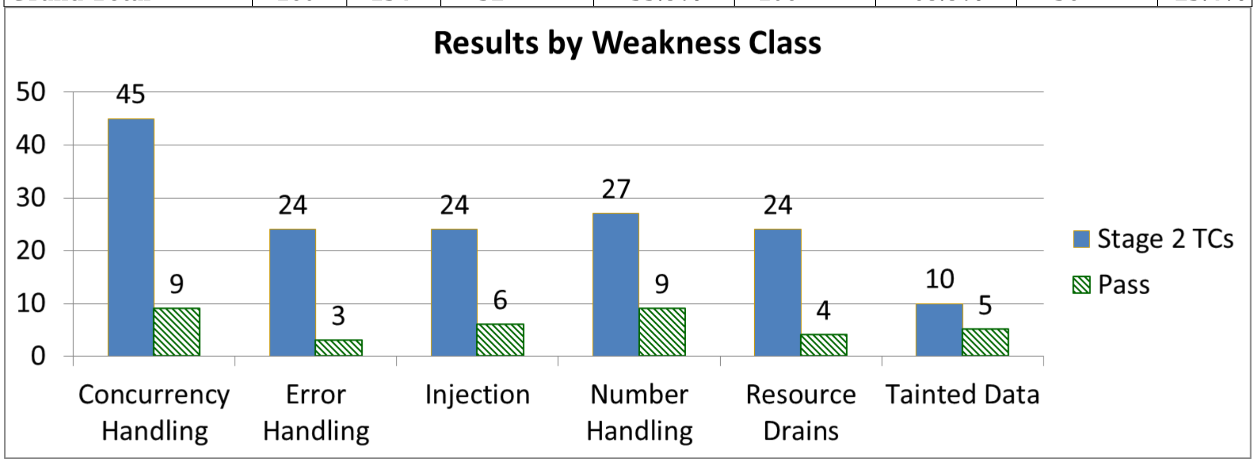

Figure K-29. VIBRANCE (JMeter) Number of Passing Test Cases (by Weakness Class)

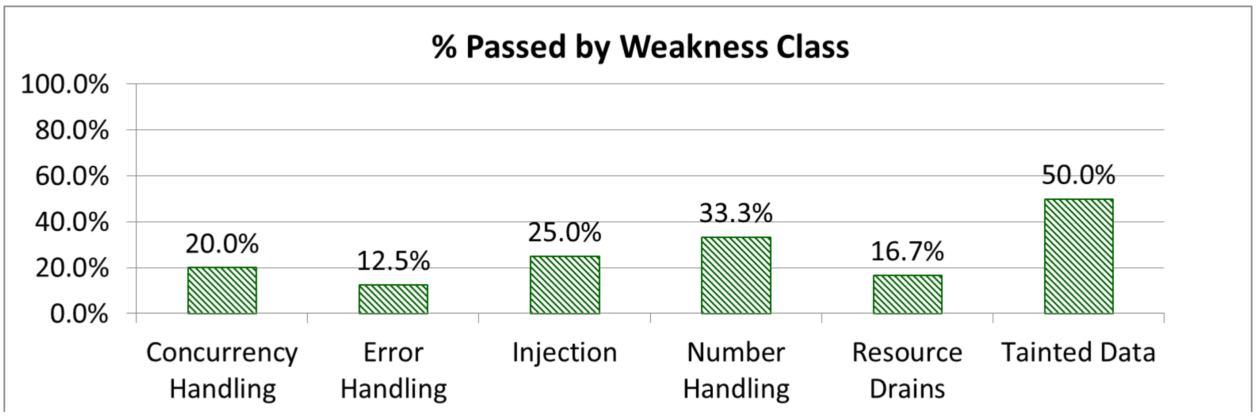

Figure K-30. VIBRANCE (JMeter) Percentage of Passing Test Cases (by Weakness Class)

Table K-12. VIBRANCE (JMeter) Mitigation and Altered Functionality Results (by CWE)

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling								
363A	3	3	1	33%	3	100%	1	33%
367A	3	3	1	33%	3	100%	1	33%
412A	3	3	1	33%	0	0%	0	0%
414A	3	3	1	33%	0	0%	0	0%
543A	3	3	1	33%	0	0%	0	0%
567A	3	3	1	33%	3	100%	1	33%
572A	3	3	1	33%	3	100%	1	33%
609A	3	3	1	33%	0	0%	0	0%
663A	3	3	1	33%	0	0%	0	0%
764A	3	3	1	33%	3	100%	1	33%
765A	3	3	1	33%	3	100%	1	33%
820A	3	3	1	33%	0	0%	0	0%
821A	3	3	1	33%	3	100%	1	33%
832A	3	3	1	33%	3	100%	1	33%
833A	3	3	1	33%	3	100%	1	33%
Error Handling								
209A	3	3	1	33%	0	0%	0	0%
248A	3	0	0	0	0	0	0	0
252A	3	3	1	33%	3	100%	1	33%
252B	3	3	1	33%	3	100%	1	33%
253A	3	3	1	33%	0	0%	0	0%
390A	3	3	1	33%	0	0%	0	0%
391A	3	3	1	33%	3	100%	1	33%
460A	3	3	1	33%	0	0%	0	0%
584A	3	3	1	33%	0	0%	0	0%
Injection								
078A	3	3	1	33%	3	100%	1	33%
088A	3	3	1	33%	3	100%	1	33%
089A	3	3	1	33%	3	100%	1	33%
089B	3	3	1	33%	3	100%	1	33%
089C	3	3	1	33%	3	100%	1	33%
089D	3	3	1	33%	3	100%	1	33%
564A	3	3	0	0%	3	100%	0	0%
564B	3	3	0	0%	3	100%	0	0%
Number Handling								
190A	3	3	1	33%	3	100%	1	33%
190B	3	3	1	33%	3	100%	1	33%
191A	3	3	1	33%	3	100%	1	33%
194A	3	3	1	33%	3	100%	1	33%
195A	3	3	1	33%	3	100%	1	33%
196A	3	3	1	33%	3	100%	1	33%
197A	3	3	1	33%	3	100%	1	33%
369A	3	3	1	33%	3	100%	1	33%
839A	3	3	1	33%	3	100%	1	33%
Resource Drains								
400A	3	3	1	33%	0	0%	0	0%
400B	3	3	1	33%	0	0%	0	0%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
459A	3	3	1	33%	3	100%	1	33%
674A	3	0	0	0	0	0	0	0
774A	3	3	1	33%	3	100%	1	33%
774B	3	3	1	33%	3	100%	1	33%
789A	3	3	1	33%	3	100%	1	33%
834A	3	3	1	33%	0	0%	0	0%
835A	3	3	1	33%	0	0%	0	0%
Tainted Data								
023A	1	1	1	100%	1	100%	1	100%
023B	1	1	1	100%	1	100%	1	100%
036A	1	1	1	100%	1	100%	1	100%
041A	1	1	1	100%	1	100%	1	100%
606A	3	3	1	33%	0	0%	0	0%
606B	3	3	1	33%	3	100%	1	33%
Grand Total	**160**	**154**	**52**	**33.8%**	**106**	**68.8%**	**36**	**23.4%**

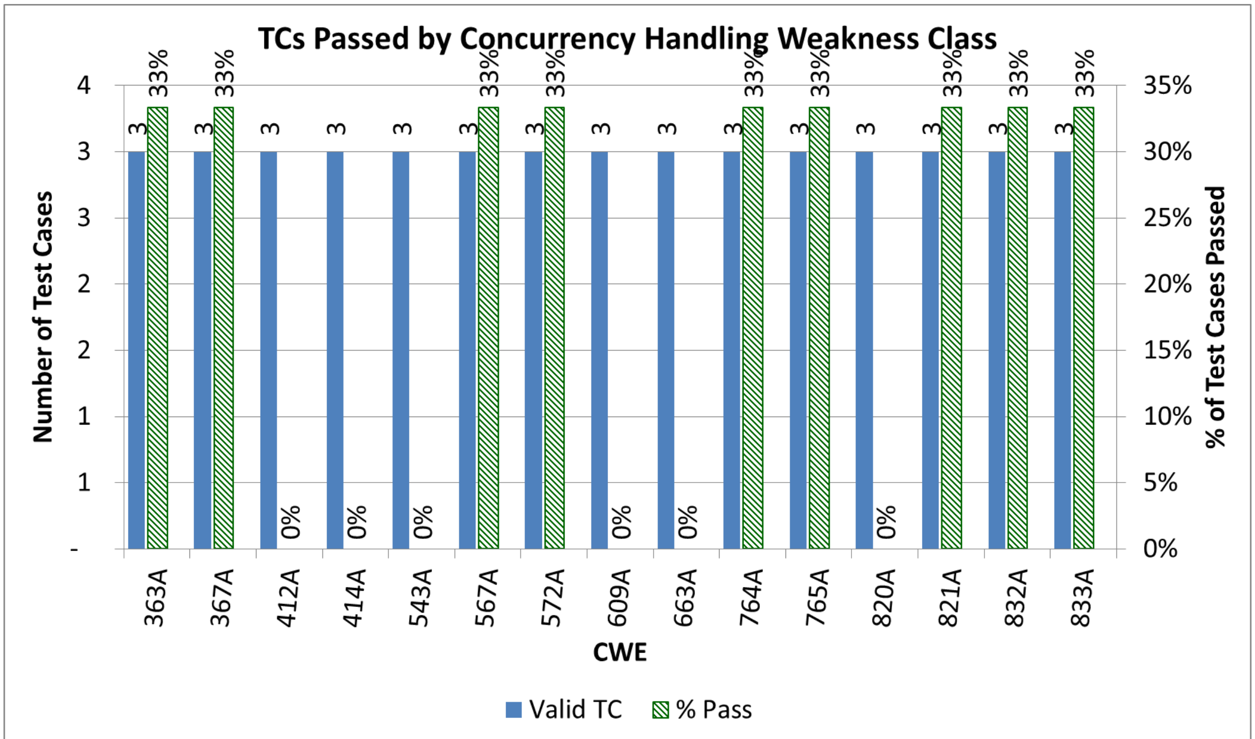

Figure K-31. VIBRANCE (JMeter) Passing Test Cases (by Concurrency Handling CWEs)

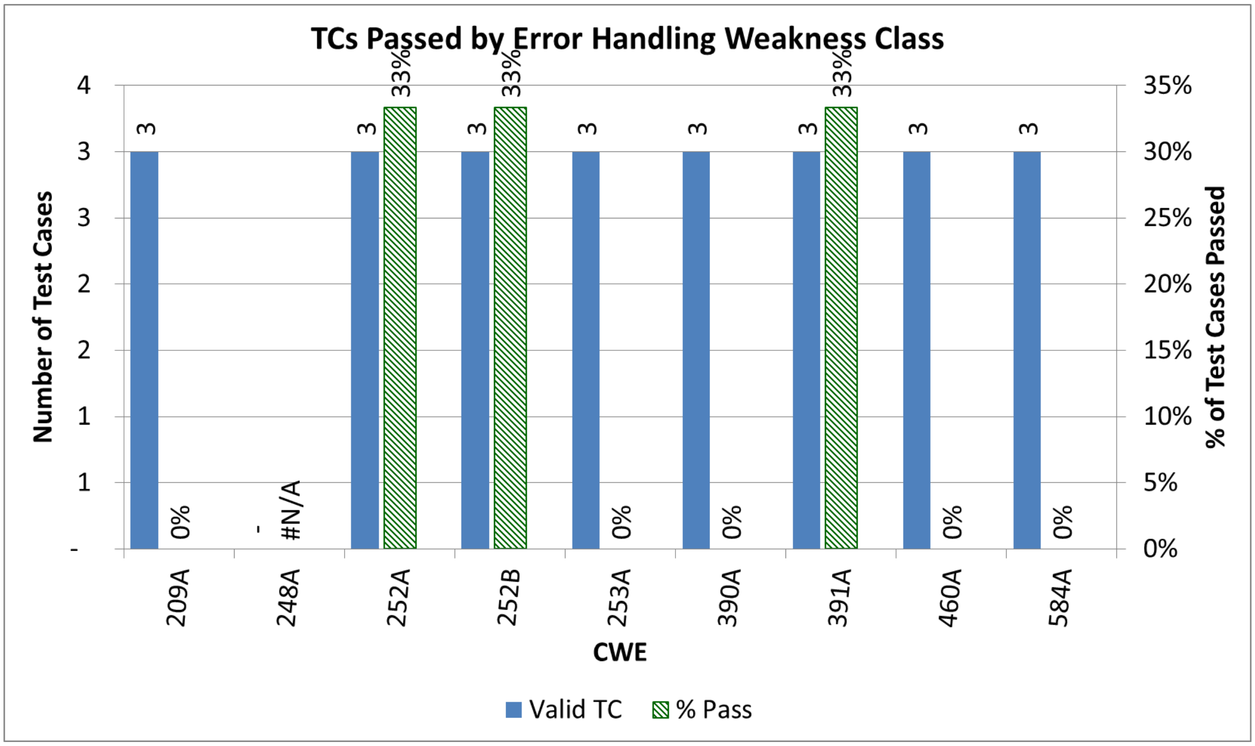

Figure K-32. VIBRANCE (JMeter) Passing Test Cases (by Error Handling CWEs)

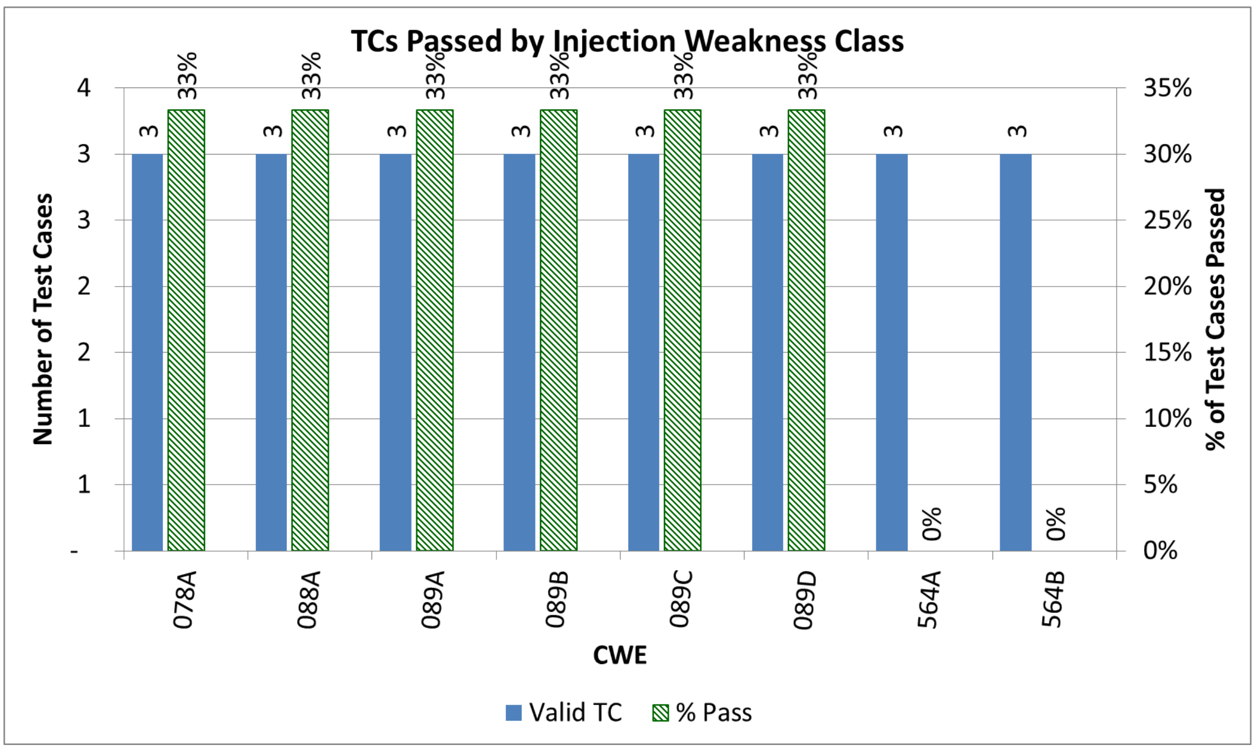

Figure K-33. VIBRANCE (JMeter) Passing Test Cases (by Injection CWEs)

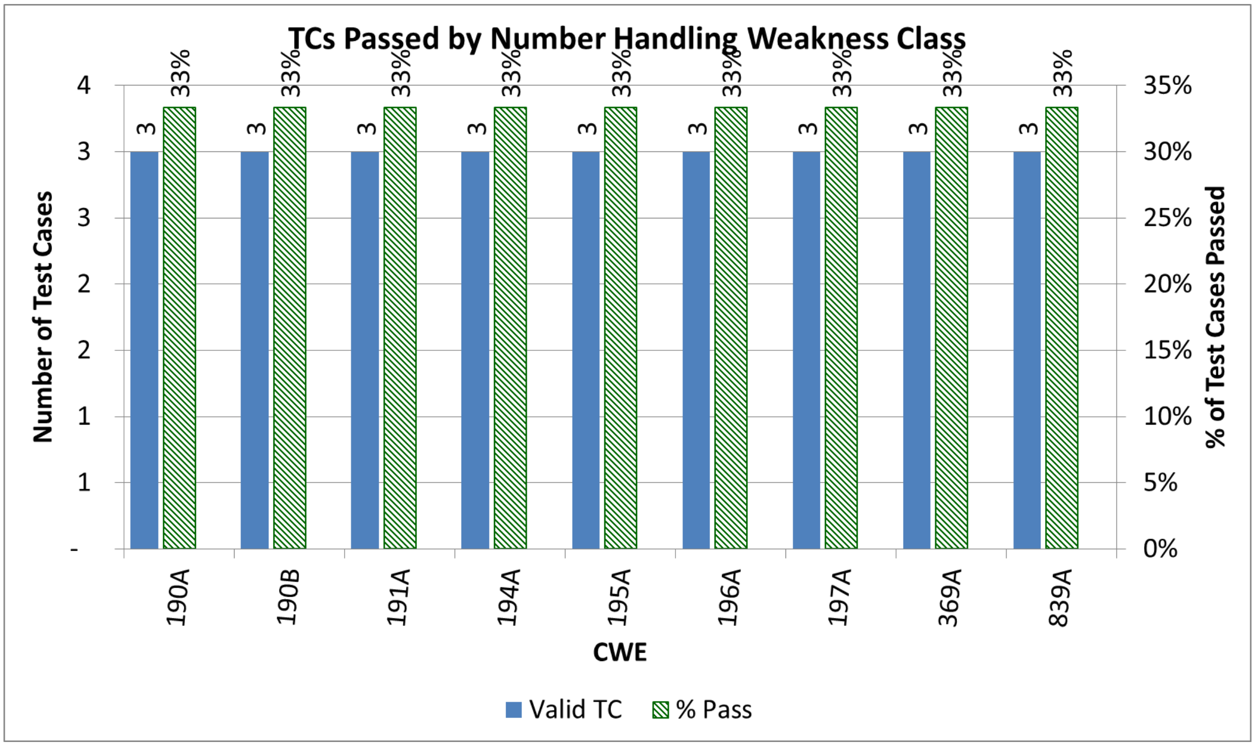

Figure K-34. VIBRANCE (JMeter) Passing Test Cases (by Number Handling CWEs)

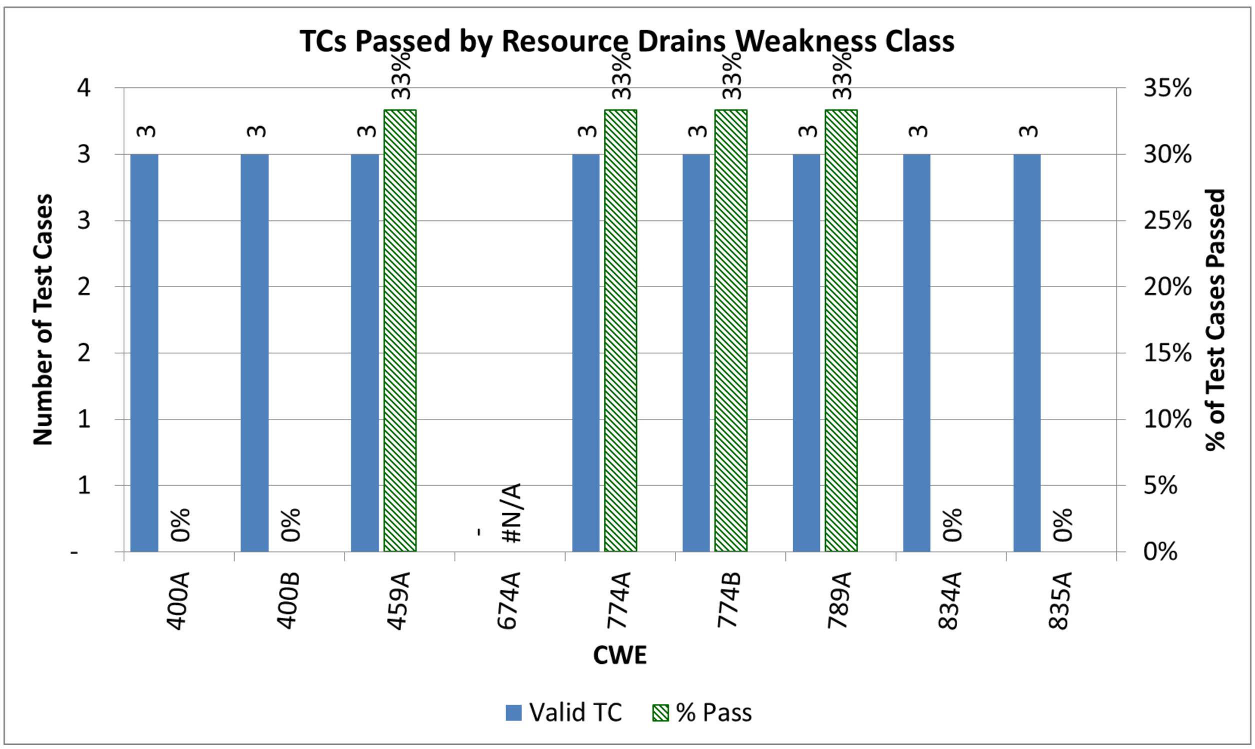

Figure K-35. VIBRANCE (JMeter) Passing Test Cases (by Resource Drain CWEs)

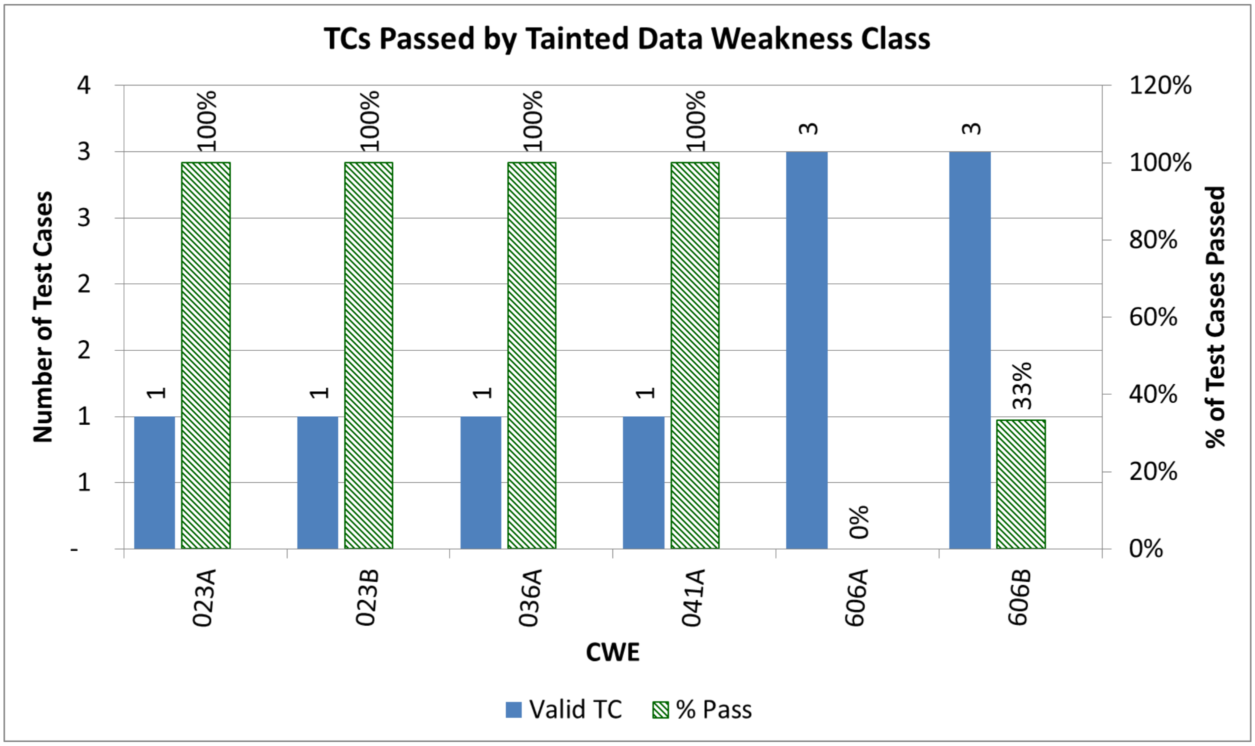

Figure K-36. VIBRANCE (JMeter) Passing Test Cases (by Tainted Data CWEs)

K.2.2 VIBRANCE JMeter Results by Taint Source

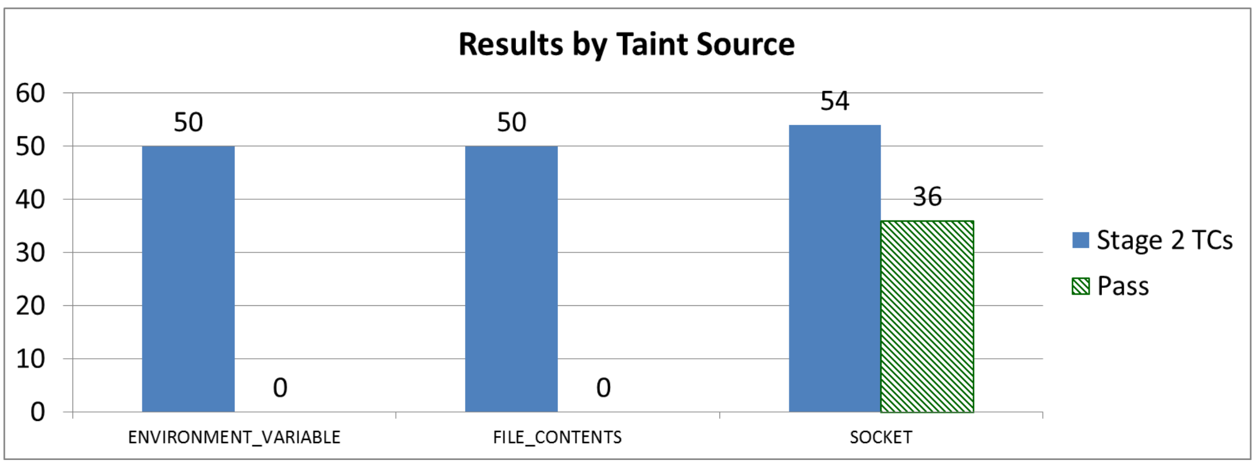

Figure K-37. VIBRANCE (JMeter) Number of Passing Test Cases (by Taint Source)

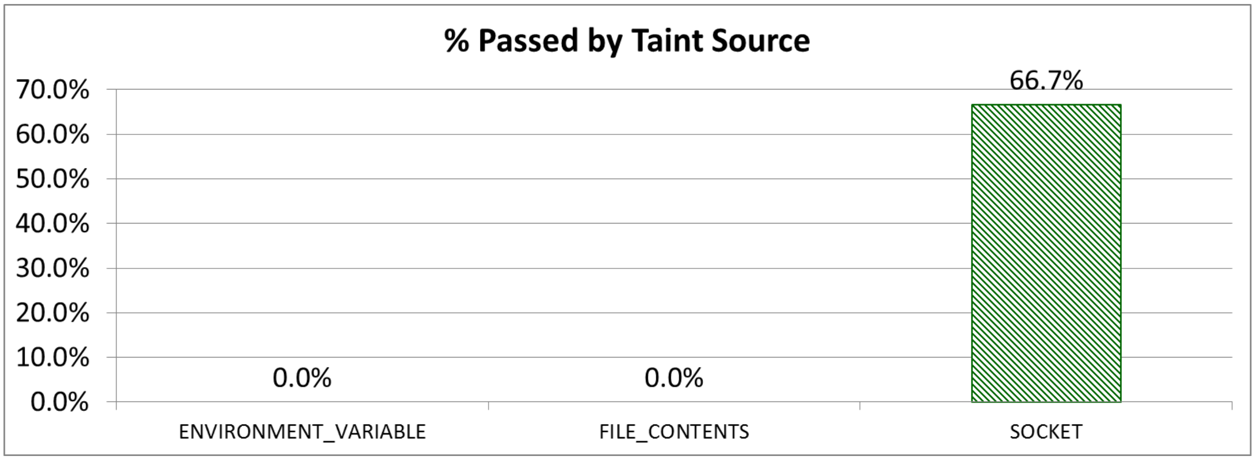

Figure K-38. VIBRANCE (JMeter) Percentage of Passing Test Cases (by Taint Source)

K.2.3 VIBRANCE JMeter Results by Data Type Complexity

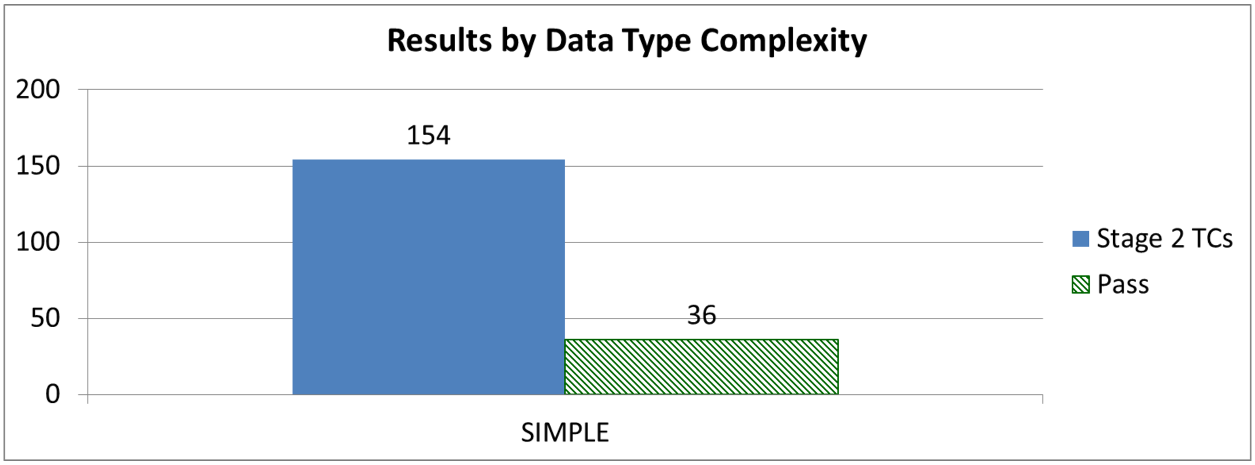

Figure K-39. VIBRANCE (JMeter) Number of Passing Test Cases (by Data Type Complexity)

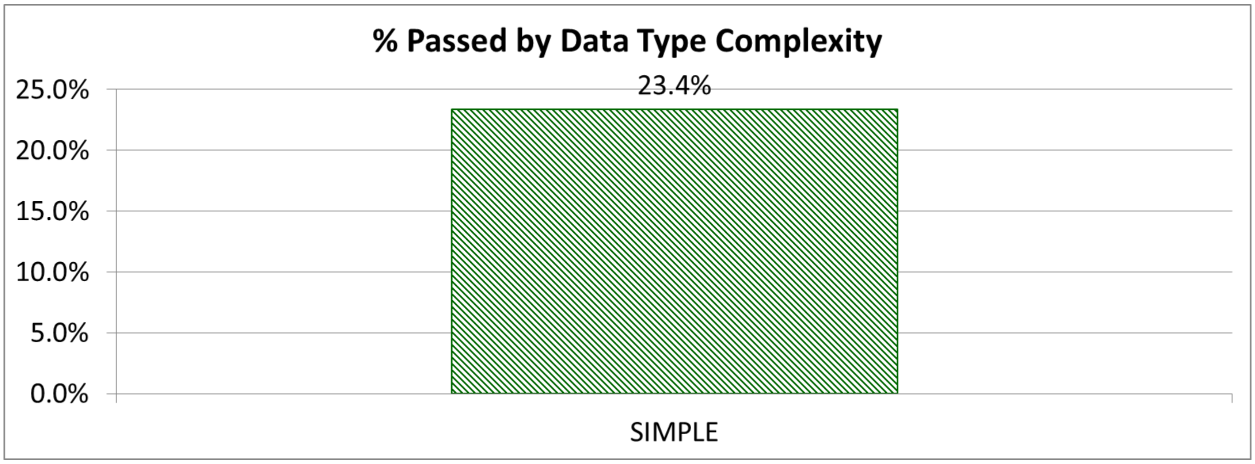

Figure K-40. VIBRANCE (JMeter) Percentage of Passing Test Cases (by Data Type Complexity)

K.2.4 VIBRANCE JMeter Results by Data Flow Complexity

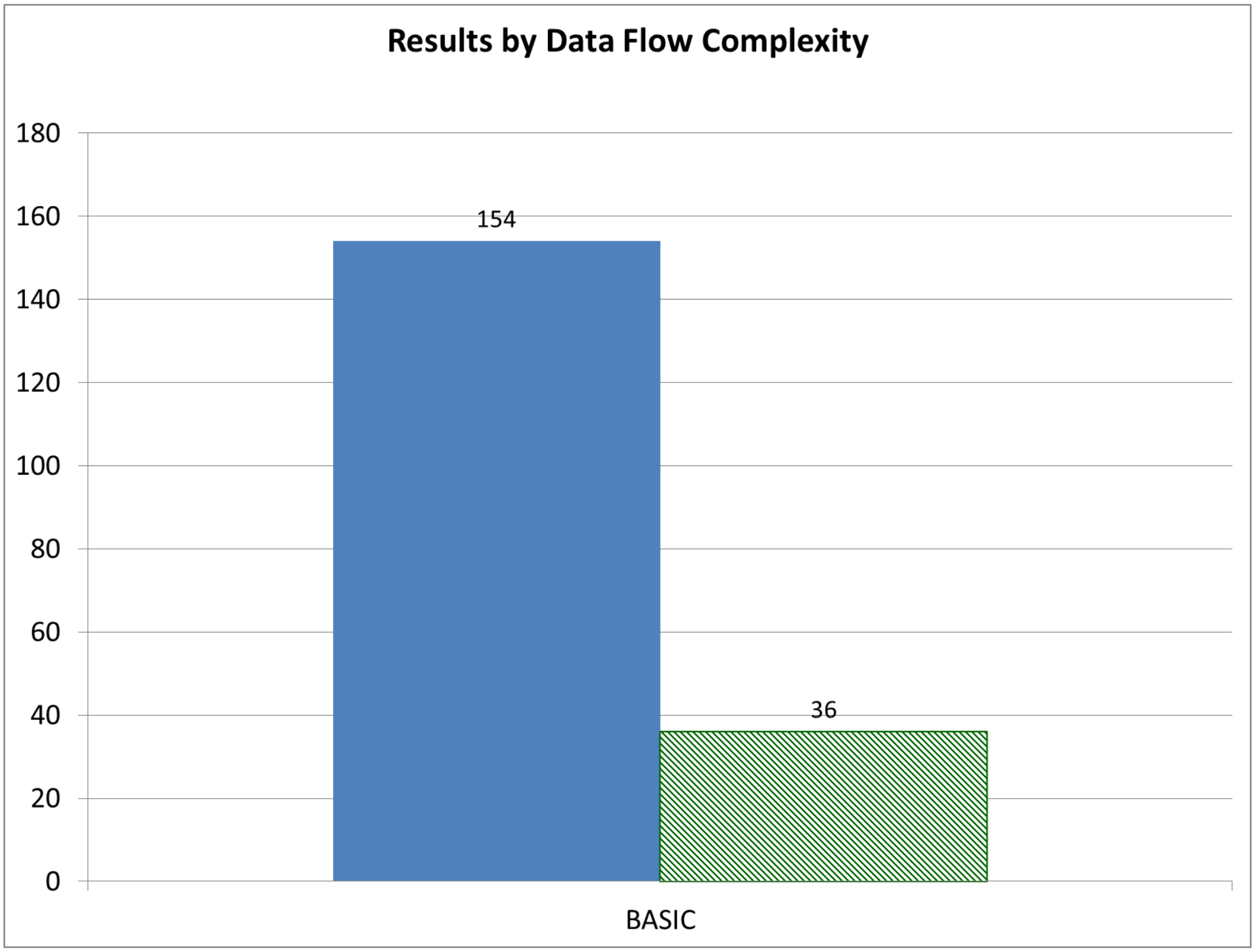

Figure K-41. VIBRANCE (JMeter) Number of Passing Test Cases (by Data Flow Complexity)

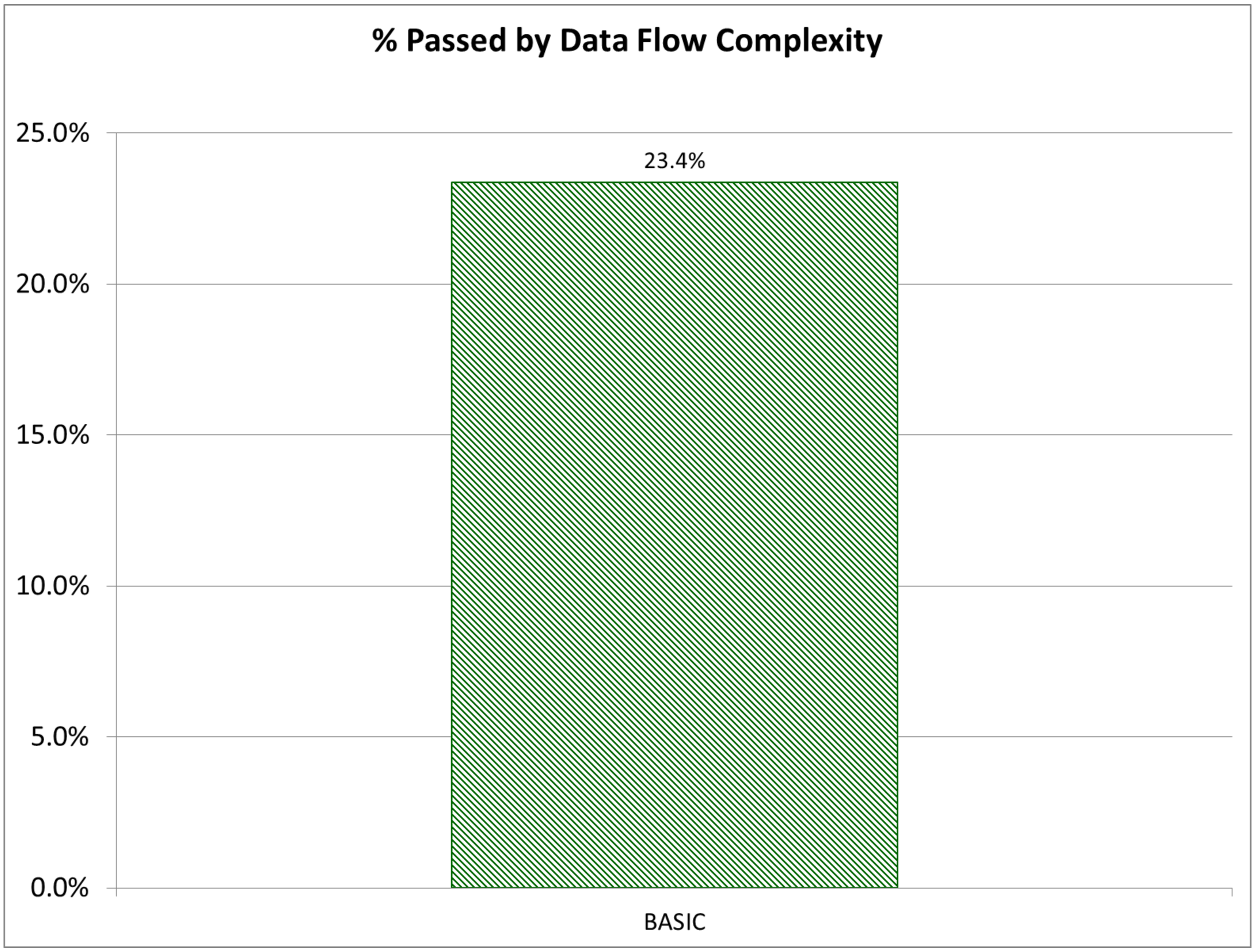

Figure K-42. VIBRANCE (JMeter) Percentage of Passing Test Cases (by Data Flow Complexity)

K.2.5 VIBRANCE JMeter Results by Control Flow Complexity

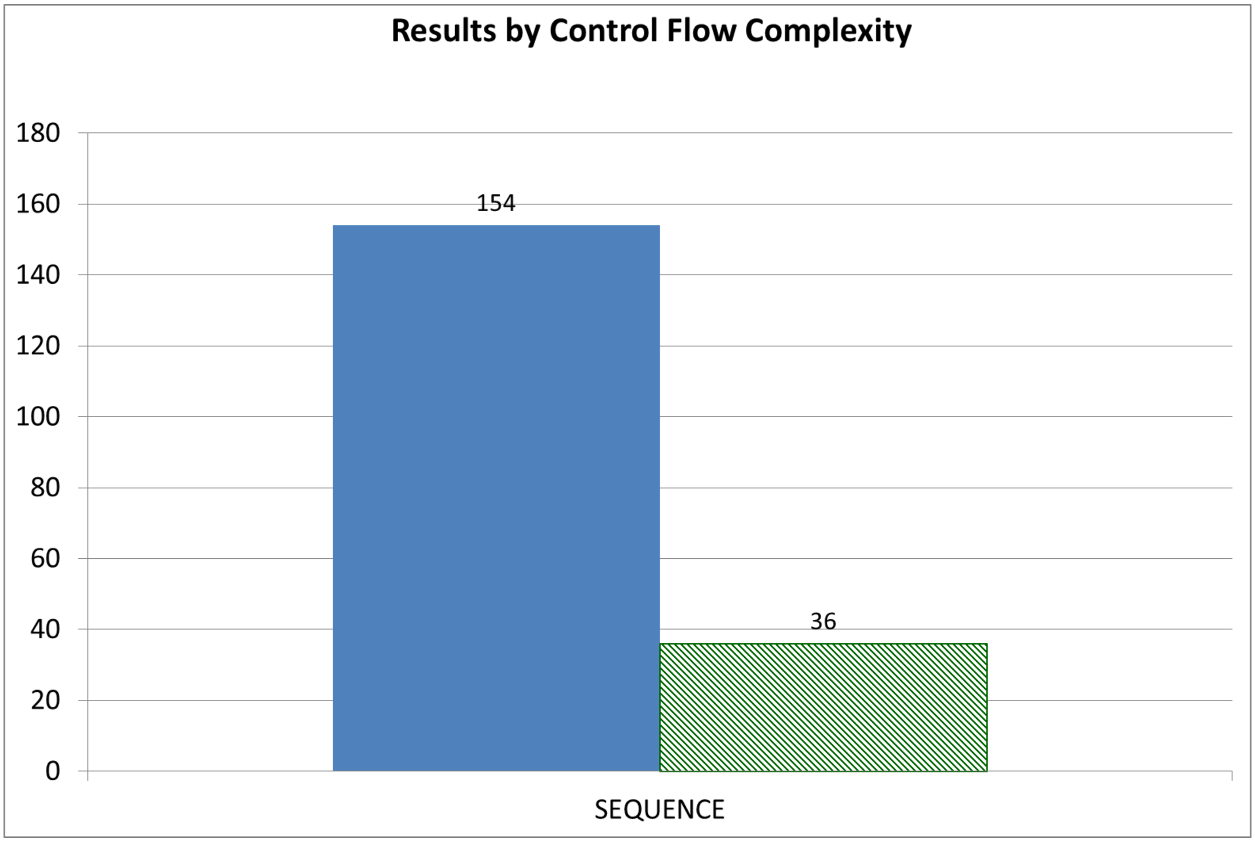

Figure K-43. VIBRANCE (JMeter) Number of Passing Test Cases (by Control Flow Complexity)

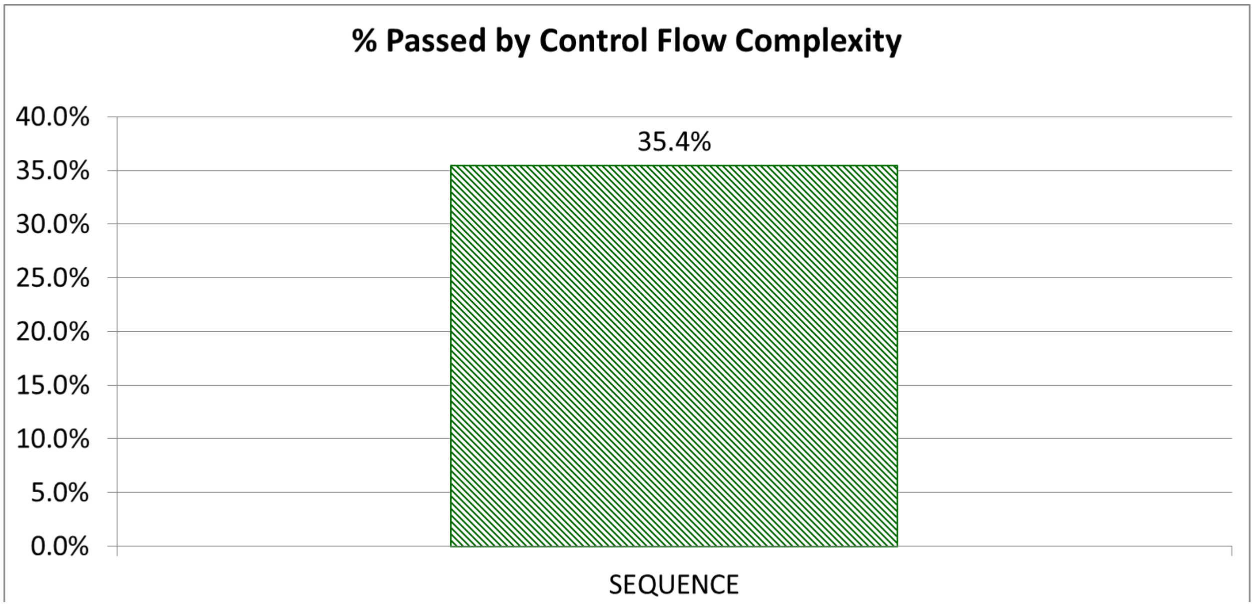

Figure K-44. VIBRANCE (JMeter) Percentage of Passing Test Cases (by Control Flow Complexity)

K.2.6 VIBRANCE JMeter Performance Overhead

Table K-13. VIBRANCE (JMeter) Performance Overhead by Weakness Class

Weakness Class	% Increase
Concurrency Handling	43.2%
Error Handling	48.1%
Injection	21.5%
Number Handling	52.2%
Resource Drains	56.8%
Tainted Data	42.1%
Grand Total	**44.6%**

Table K-14. VIBRANCE (JMeter) Performance Overhead by Base Program

Base Program	% Increase
JMET	44.6%
Grand Total	**44.6%**

Table K-15. VIBRANCE (JMeter) Performance Overhead by Taint Source

Taint Source	% Increase
SOCKET	44.6%
Grand Total	**44.6%**

Table K-16. VIBRANCE (JMeter) Performance Overhead by Data Type Complexity

Data Type Complexity	% Increase
SIMPLE	44.6%
Grand Total	**44.6%**

Table K-17. VIBRANCE (JMeter) Performance Overhead by Data Flow Complexity

Data Flow Complexity	% Increase
BASIC	44.6%
Grand Total	**44.6%**

Table K-18. VIBRANCE (JMeter) Performance Overhead by Control Flow Complexity

Control Flow Complexity	% Increase
SEQUENCE	44.6%
Grand Total	**44.6%**

Table K-19. VIBRANCE (JMeter) Performance Overhead by File Size

File Size	% Increase
377,160	44.6%
Grand Total	**44.6%**

K.3 Results and Analysis of Phase 1-Sized Programs

Totals

		Altered? No	Altered? Yes	Total
Mitigation?	Full	159	-	159
	Partial	-	-	-
	None	1	-	1
	Total	160	-	160

Percentages

		Altered? No	Altered? Yes	Total
Mitigation?	Full	99.4%	0.0%	99.4%
	Partial	0.0%	0.0%	0.0%
	None	0.6%	0.0%	0.6%
	Total	100%	0%	100%

Figure K-45. VIBRANCE JTREE Mitigation and Altered Functionality Results

K.3.1 VIBRANCE JTREE Results by Weakness Classes and Target Weaknesses

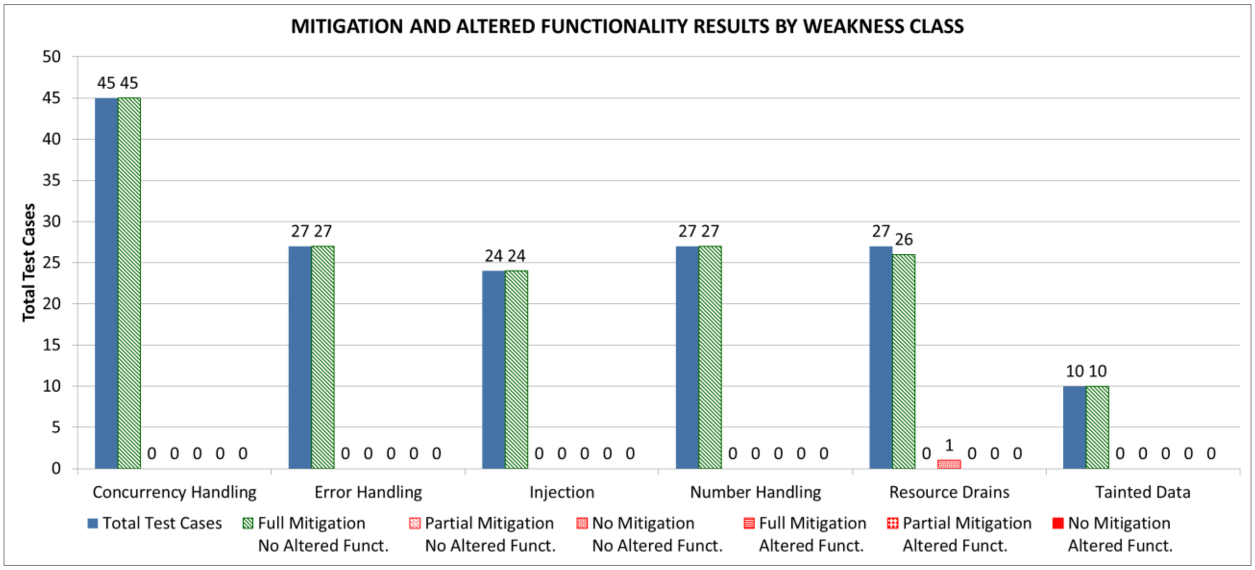

Figure K-46. VIBRANCE (JTREE) Mitigation and Altered Functionality Results (by Weakness Class)

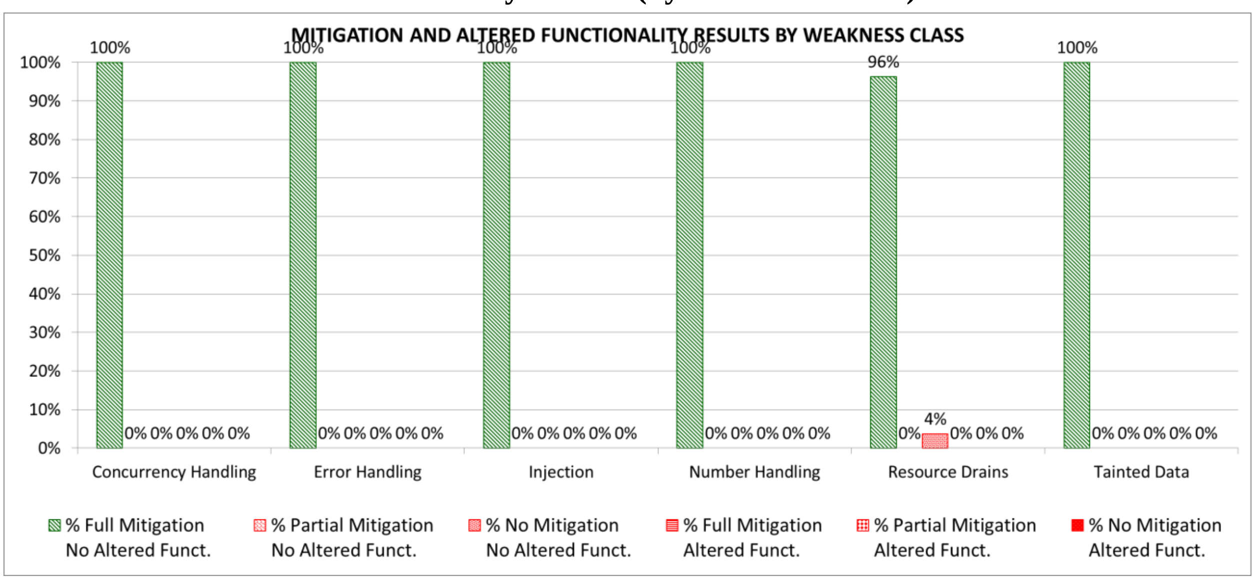

Figure K-47. VIBRANCE (JTREE) Mitigation and Altered Functionality Results (percentage by Weakness Class)

Table K-20. VIBRANCE (JTREE) Mitigation and Altered Functionality Results (by Weakness Class)

Target Weakness Class	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & No Alt Function)	% Pass
Concurrency Handling	45	45	45	100%	45	100%	45	100%
Error Handling	27	27	27	100%	27	100%	27	100%
Injection	24	24	24	100%	24	100%	24	100%
Number Handling	27	27	27	100%	27	100%	27	100%
Resource Drains	27	27	27	100%	26	96%	26	96%
Tainted Data	10	10	10	100%	10	100%	10	100%
Grand Total	**160**	**160**	**160**	**100.0%**	**159**	**99.4%**	**159**	**99.4%**

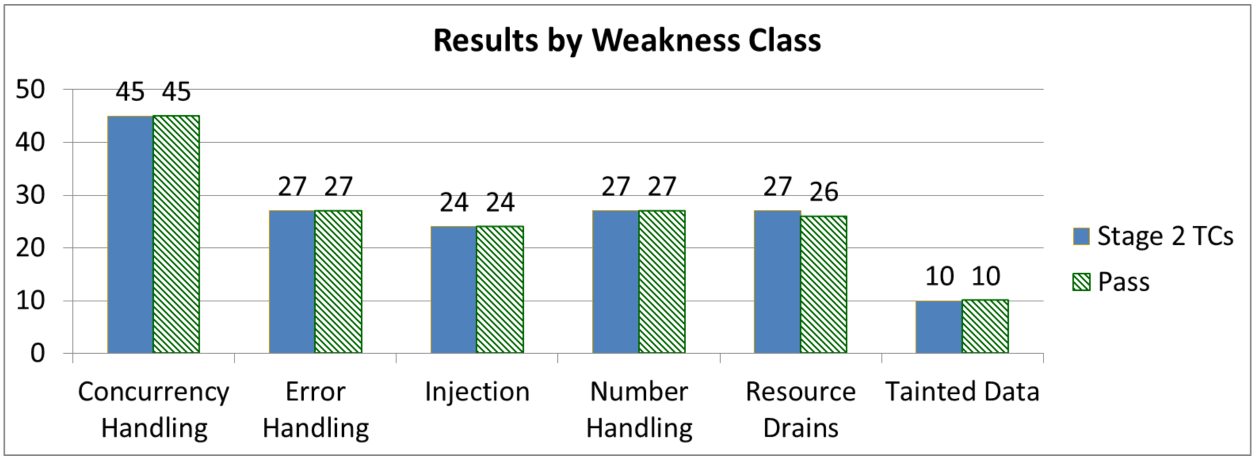

Figure K-48. VIBRANCE (JTREE) Number of Passing Test Cases (by Weakness Class)

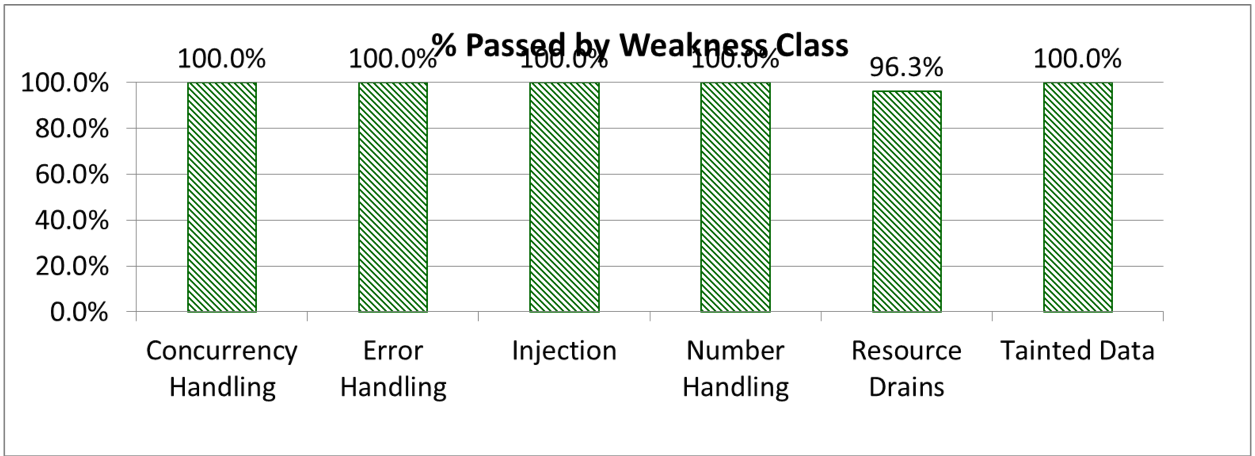

Figure K-49. VIBRANCE (JTREE) Percentage of Passing Test Cases (by Weakness Class)

Table K-21. VIBRANCE (JTREE) Mitigation and Altered Functionality Results (by CWE)

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
Concurrency Handling								
363A	3	3	3	100%	3	100%	3	100%
367A	3	3	3	100%	3	100%	3	100%
412A	3	3	3	100%	3	100%	3	100%
414A	3	3	3	100%	3	100%	3	100%
543A	3	3	3	100%	3	100%	3	100%
609A	3	3	3	100%	3	100%	3	100%
663A	3	3	3	100%	3	100%	3	100%
764A	3	3	3	100%	3	100%	3	100%
765A	3	3	3	100%	3	100%	3	100%
820A	3	3	3	100%	3	100%	3	100%
821A	3	3	3	100%	3	100%	3	100%
833A	3	3	3	100%	3	100%	3	100%
567A	3	3	3	100%	3	100%	3	100%
572A	3	3	3	100%	3	100%	3	100%
832A	3	3	3	100%	3	100%	3	100%
Error Handling								
209A	3	3	3	100%	3	100%	3	100%
248A	3	3	3	100%	3	100%	3	100%
252A	3	3	3	100%	3	100%	3	100%
252B	3	3	3	100%	3	100%	3	100%
253A	3	3	3	100%	3	100%	3	100%
390A	3	3	3	100%	3	100%	3	100%
391A	3	3	3	100%	3	100%	3	100%
460A	3	3	3	100%	3	100%	3	100%
584A	3	3	3	100%	3	100%	3	100%
Injection								
078A	3	3	3	100%	3	100%	3	100%
088A	3	3	3	100%	3	100%	3	100%
089A	3	3	3	100%	3	100%	3	100%
089B	3	3	3	100%	3	100%	3	100%
089C	3	3	3	100%	3	100%	3	100%
089D	3	3	3	100%	3	100%	3	100%
564A	3	3	3	100%	3	100%	3	100%
564B	3	3	3	100%	3	100%	3	100%
Number Handling								
190A	3	3	3	100%	3	100%	3	100%
191A	3	3	3	100%	3	100%	3	100%
194A	3	3	3	100%	3	100%	3	100%
195A	3	3	3	100%	3	100%	3	100%
196A	3	3	3	100%	3	100%	3	100%
197A	3	3	3	100%	3	100%	3	100%
369A	3	3	3	100%	3	100%	3	100%
839A	3	3	3	100%	3	100%	3	100%
190B	3	3	3	100%	3	100%	3	100%
Resource Drains								
400A	3	3	3	100%	3	100%	3	100%

Row Labels	Total Test Cases	Valid Test Cases	Preserved Function	% Preserved Function	Fully Mitigated	% Fully Mitigated	Passed (Full Mit & Presv'd Function)	% Pass
400B	3	3	3	100%	2	67%	2	67%
459A	3	3	3	100%	3	100%	3	100%
674A	3	3	3	100%	3	100%	3	100%
774A	3	3	3	100%	3	100%	3	100%
789A	3	3	3	100%	3	100%	3	100%
834A	3	3	3	100%	3	100%	3	100%
835A	3	3	3	100%	3	100%	3	100%
774B	3	3	3	100%	3	100%	3	100%
Tainted Data								
023A	1	1	1	100%	1	100%	1	100%
023B	1	1	1	100%	1	100%	1	100%
036A	1	1	1	100%	1	100%	1	100%
041A	1	1	1	100%	1	100%	1	100%
606A	3	3	3	100%	3	100%	3	100%
606B	3	3	3	100%	3	100%	3	100%
Grand Total	**160**	**160**	**160**	**100.0%**	**159**	**99.4%**	**159**	**99.4%**

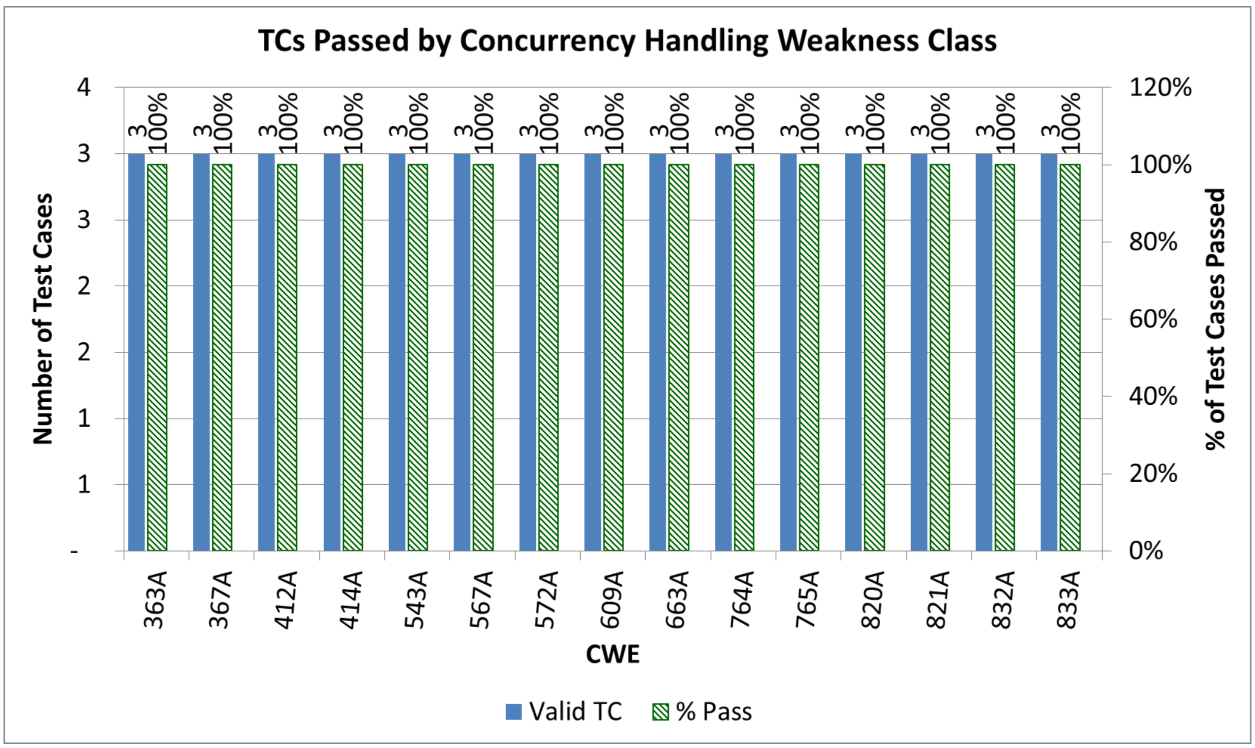

Figure K-50. VIBRANCE (JTREE) Passing Test Cases (by Concurrency Handling CWEs)

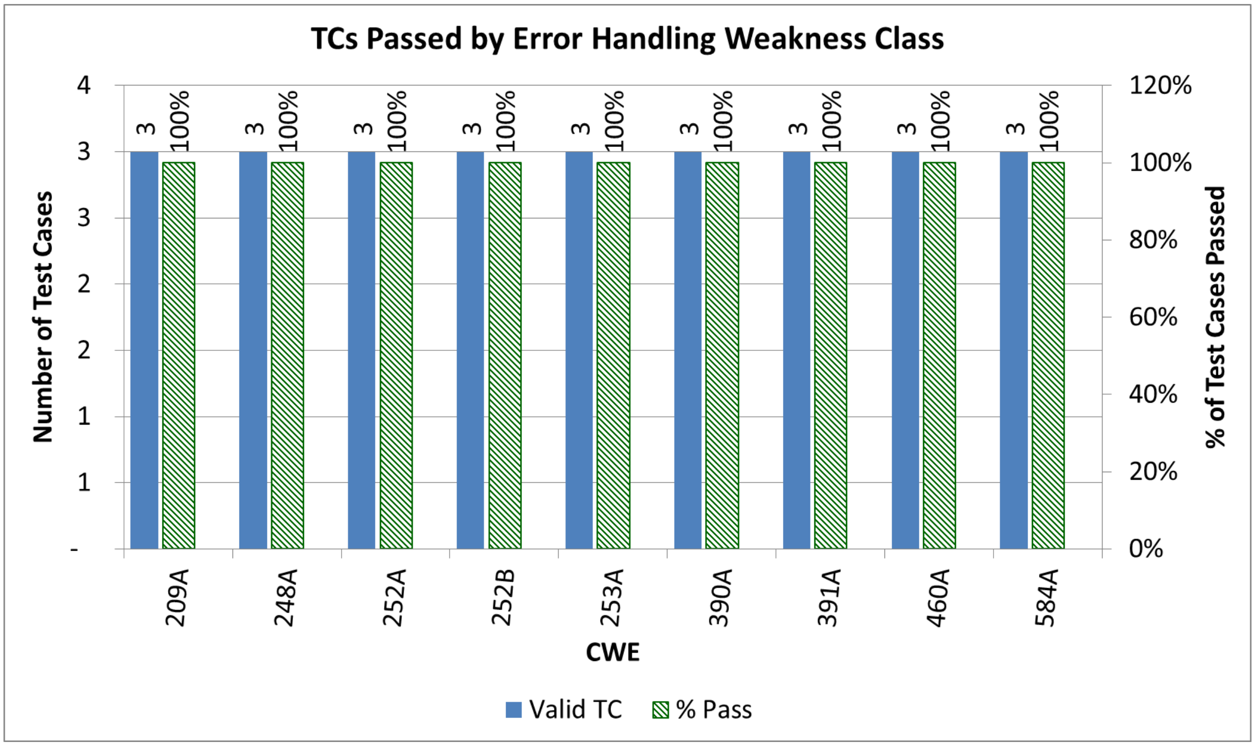

Figure K-51. VIBRANCE (JTREE) Passing Test Cases (by Error Handling CWEs)

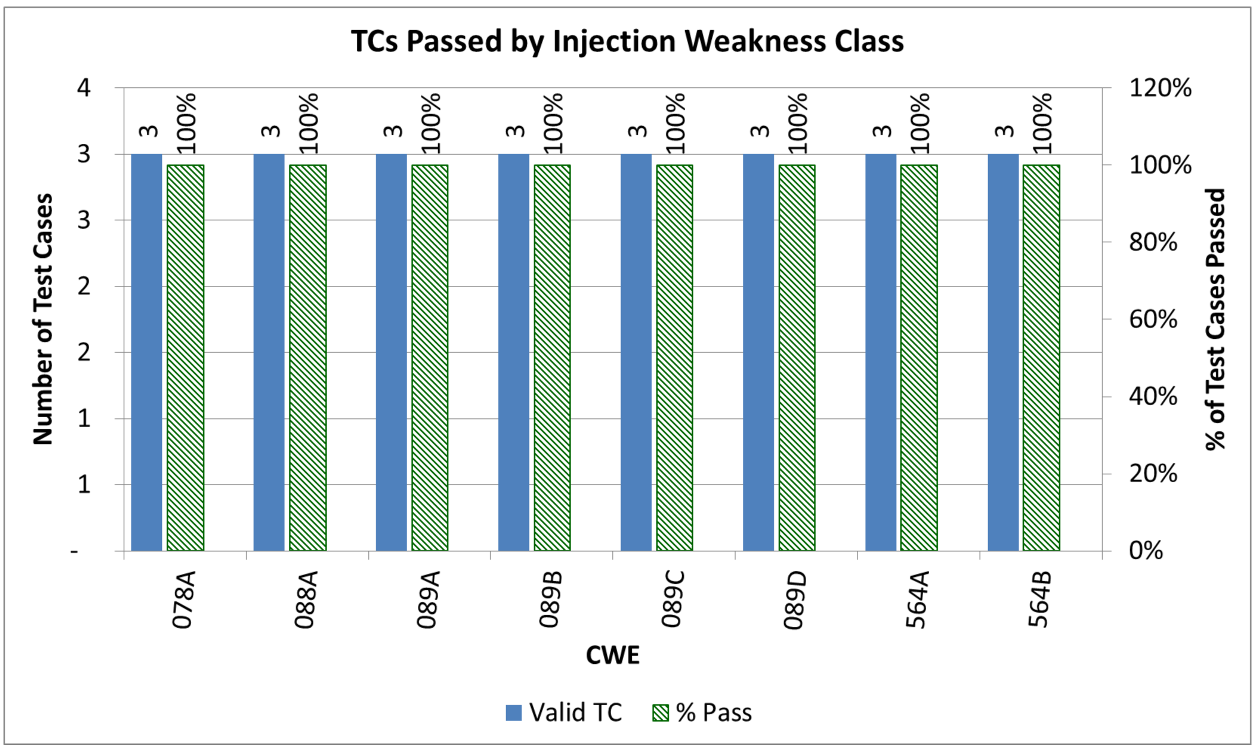

Figure K-52. VIBRANCE (JTREE) Passing Test Cases (by Injection CWEs)

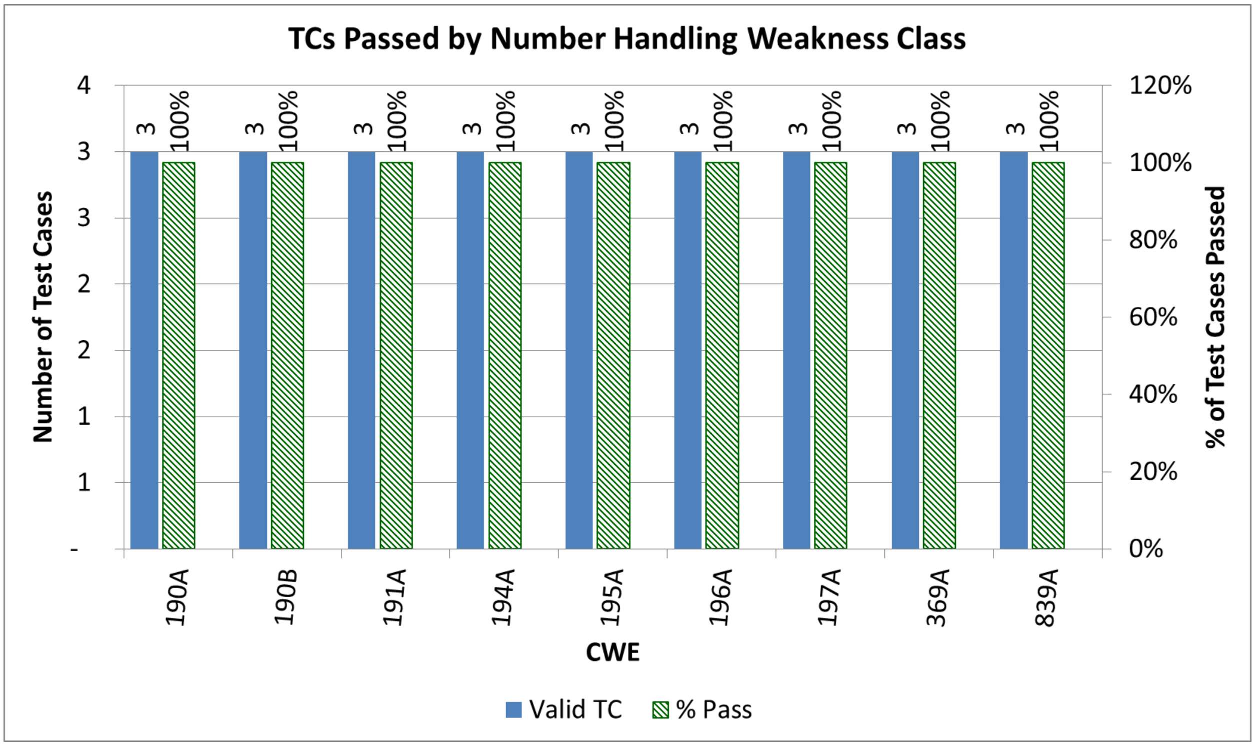

Figure K-53. VIBRANCE (JTREE) Passing Test Cases (by Number Handling CWEs)

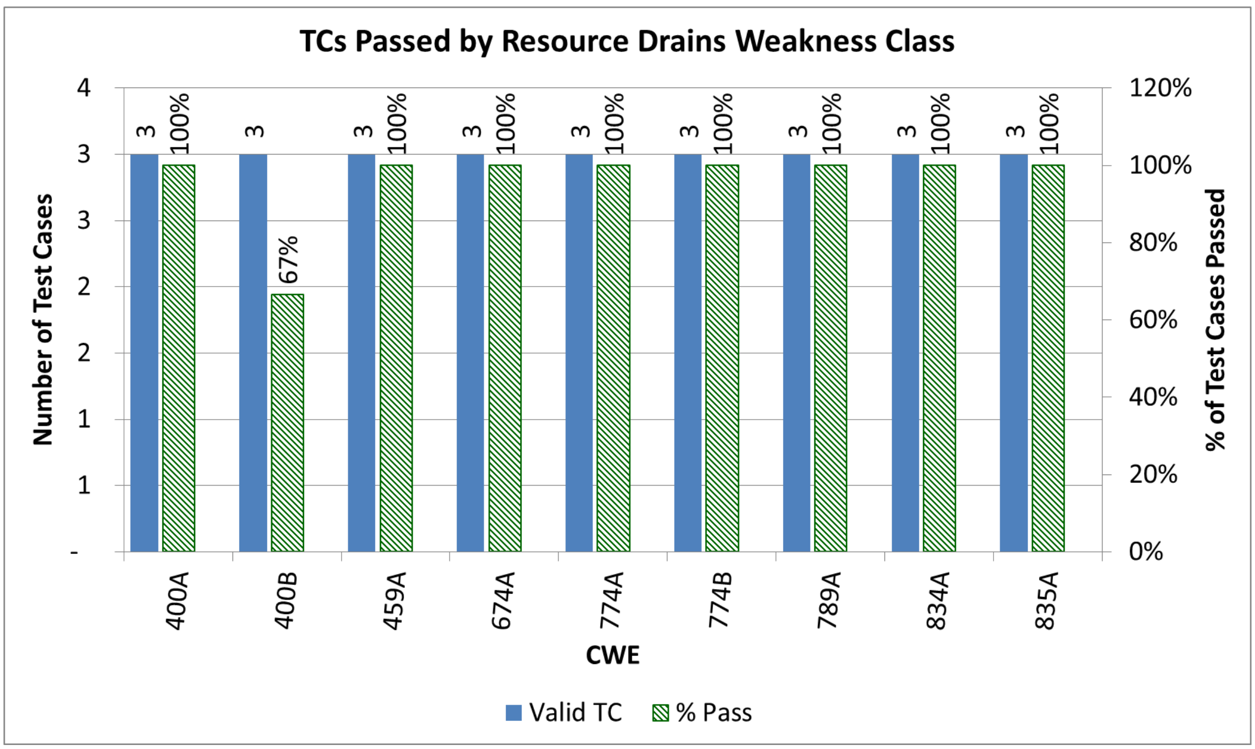

Figure K-54. VIBRANCE (JTREE) Passing Test Cases (by Resource Drain CWEs)

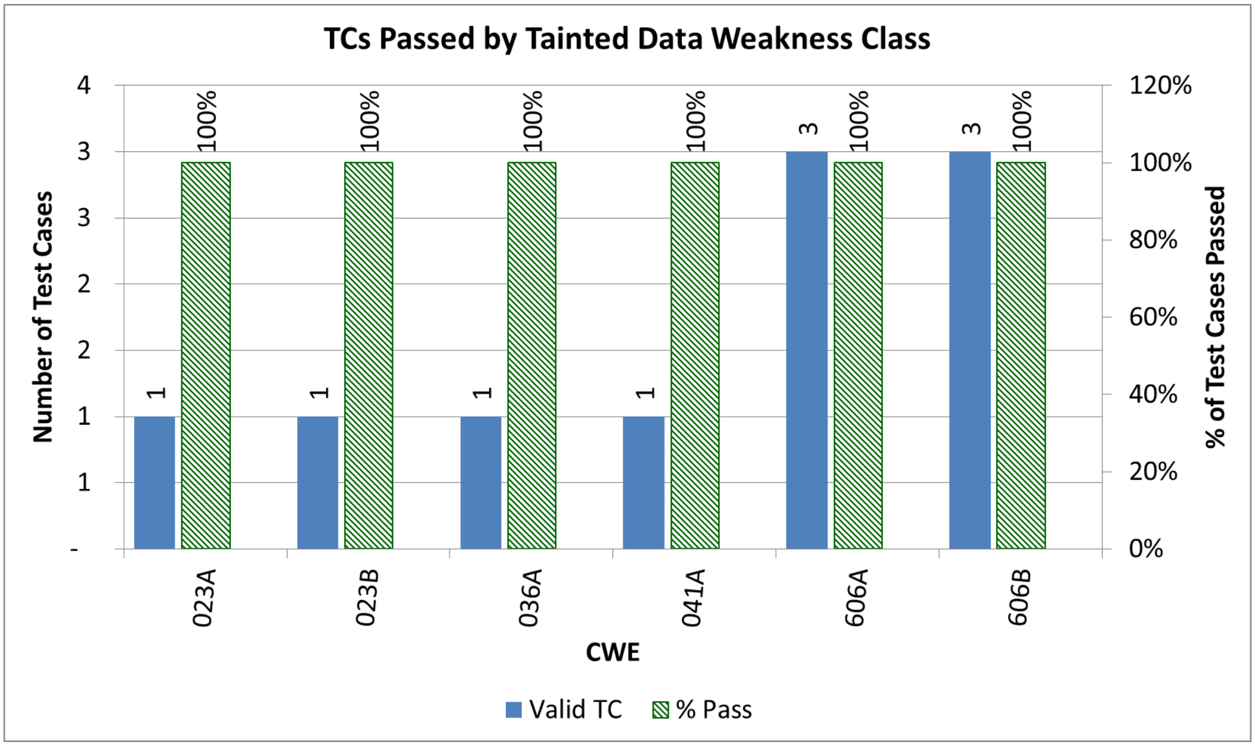

Figure K-55. VIBRANCE (JTREE) Passing Test Cases (by Tainted Data CWEs)

K.3.2 VIBRANCE JTREE Results by Taint Source

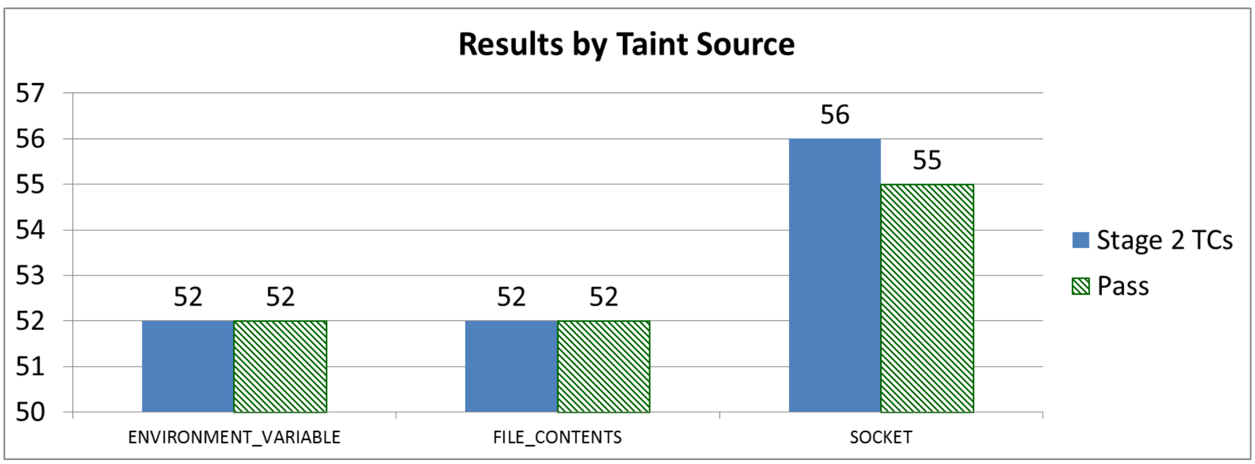

Figure K-56. VIBRANCE (JTREE) Number of Passing Test Cases (by Taint Source)

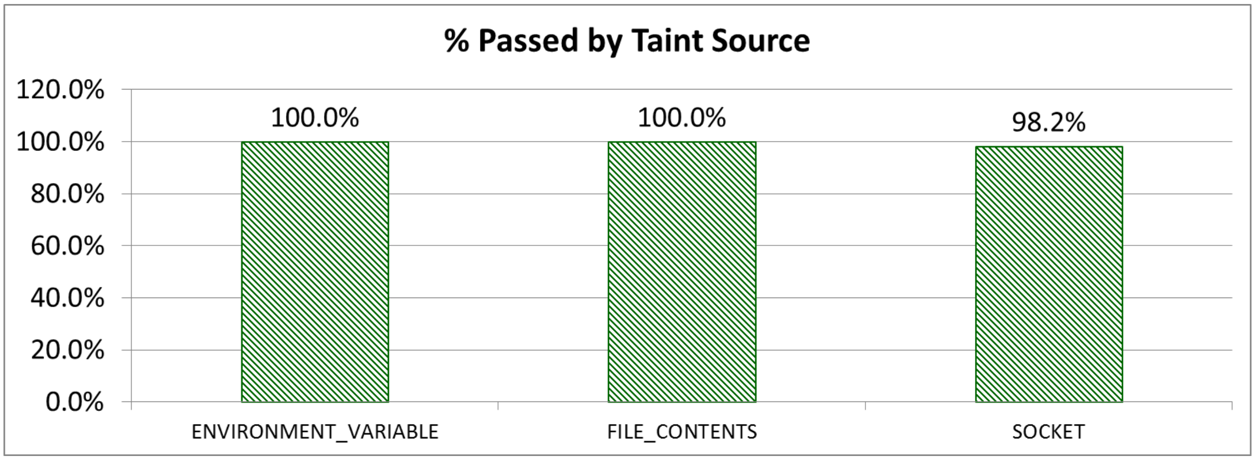

Figure K-57. VIBRANCE (JTREE) Percentage of Passing Test Cases (by Taint Source)

K.3.3 VIBRANCE JTREE Results by Data Type Complexity

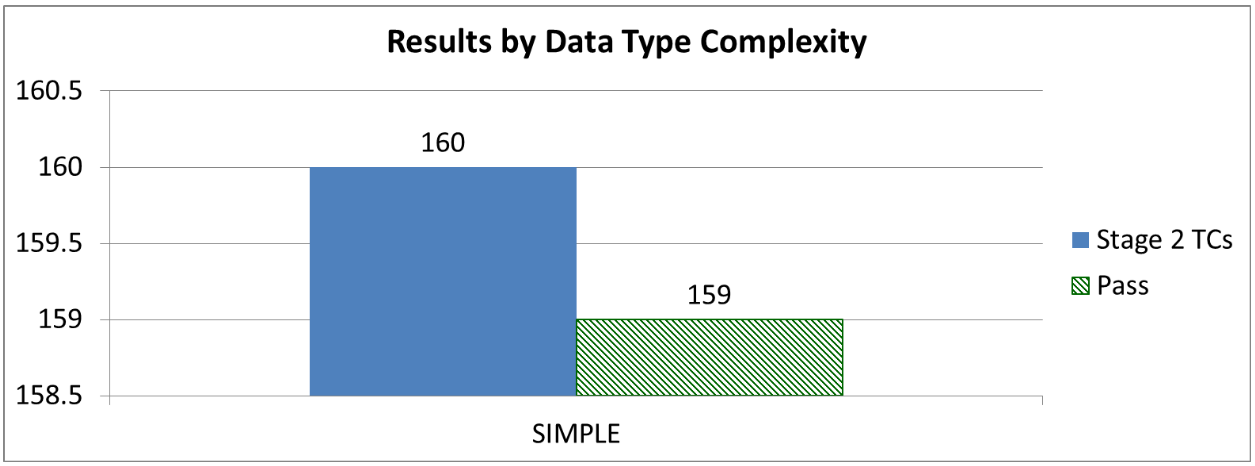

Figure K-58. VIBRANCE (JTREE) Number of Passing Test Cases (by Data Type Complexity)

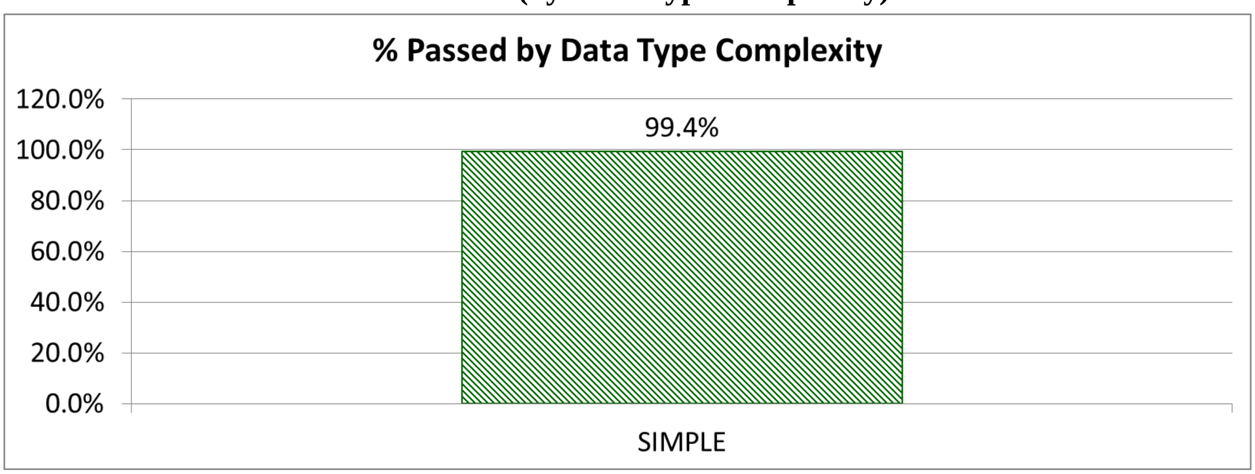

Figure K-59. VIBRANCE (JTREE) Percentage of Passing Test Cases (by Data Type Complexity)

K.3.4 VIBRANCE JTREE Results by Data Flow Complexity

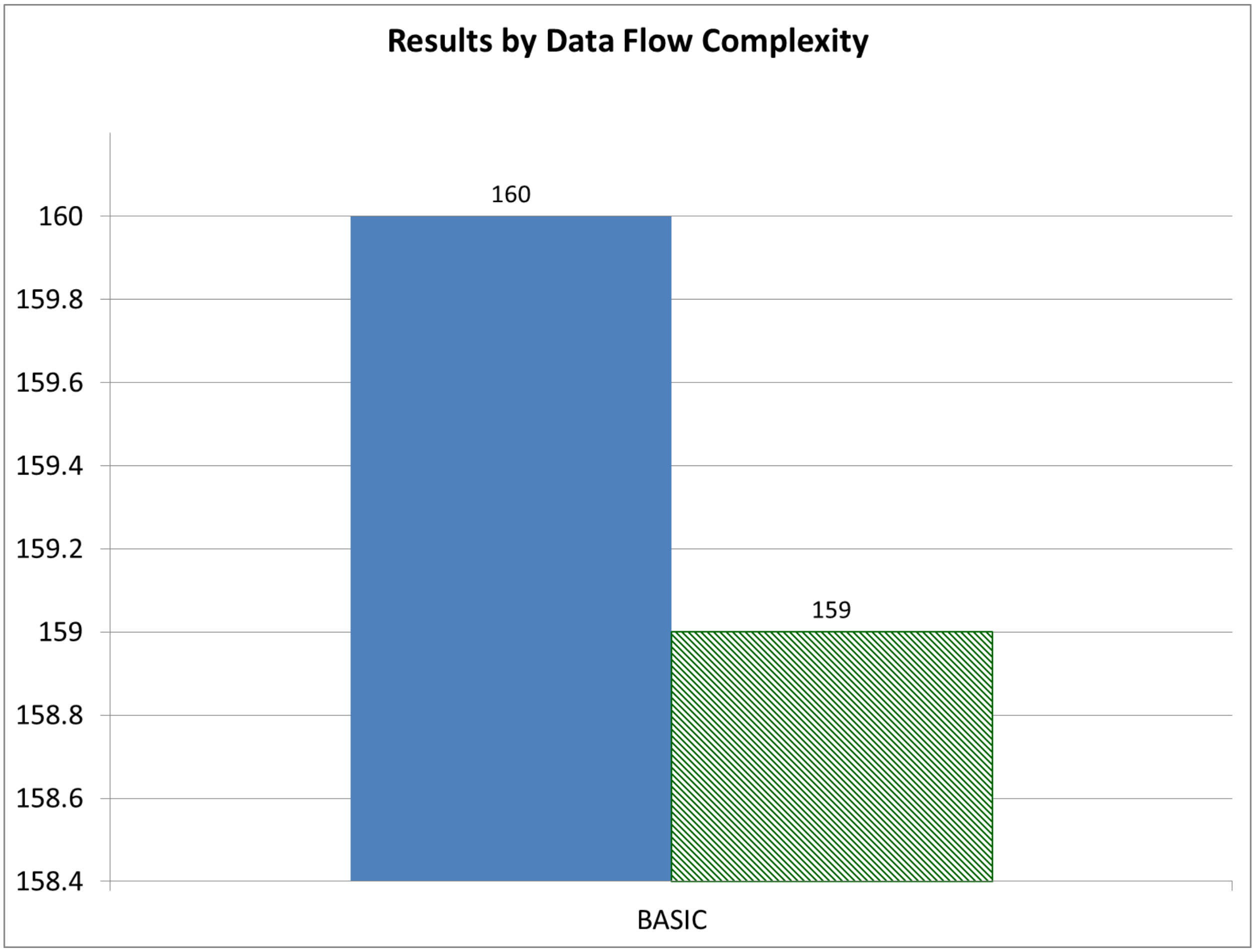

Figure K-60. VIBRANCE (JTREE) Number of Passing Test Cases (by Data Flow Complexity)

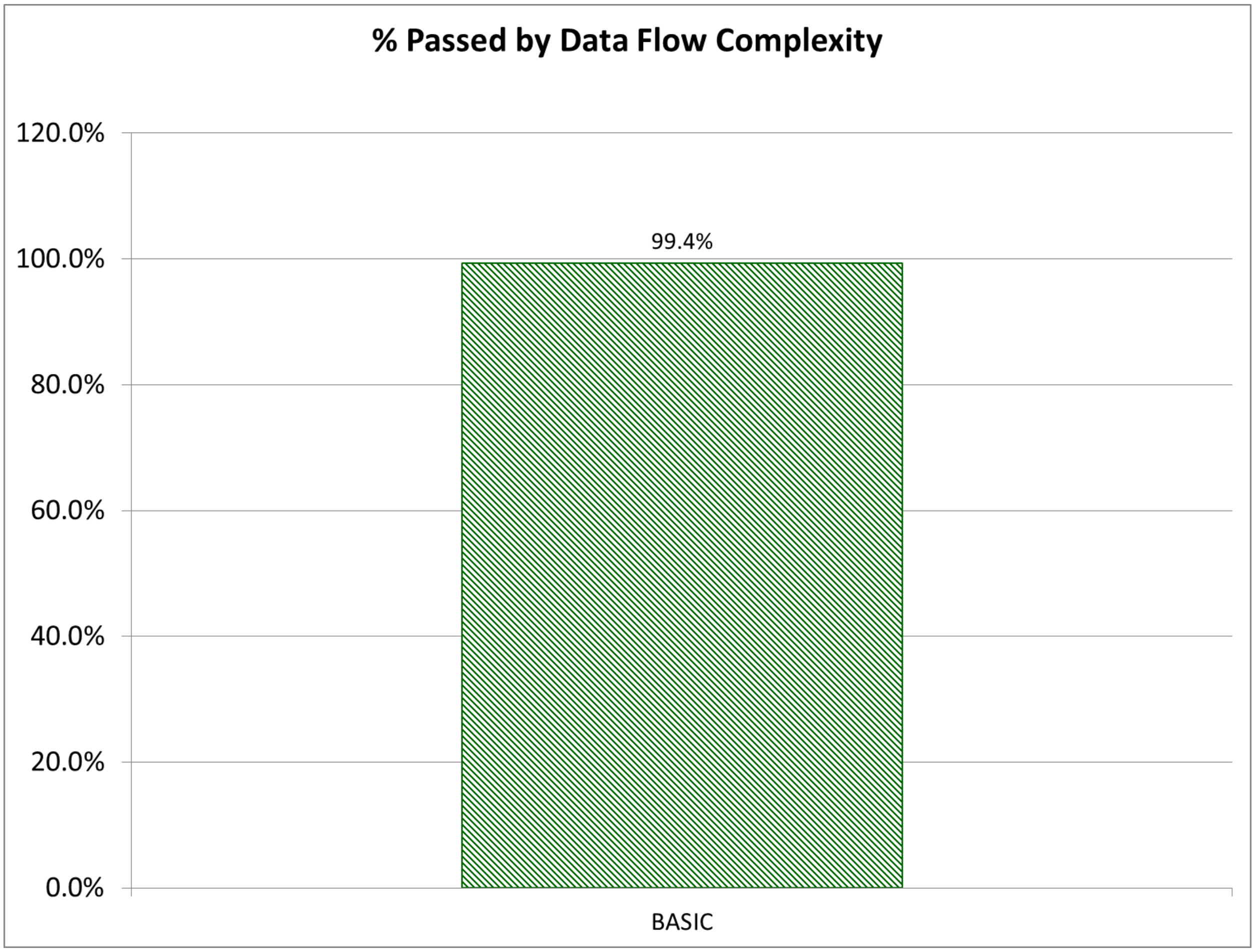

Figure K-61. VIBRANCE (JTREE) Percentage of Passing Test Cases (by Data Flow Complexity)

K.3.5 VIBRANCE JTREE Results by Control Flow Complexity

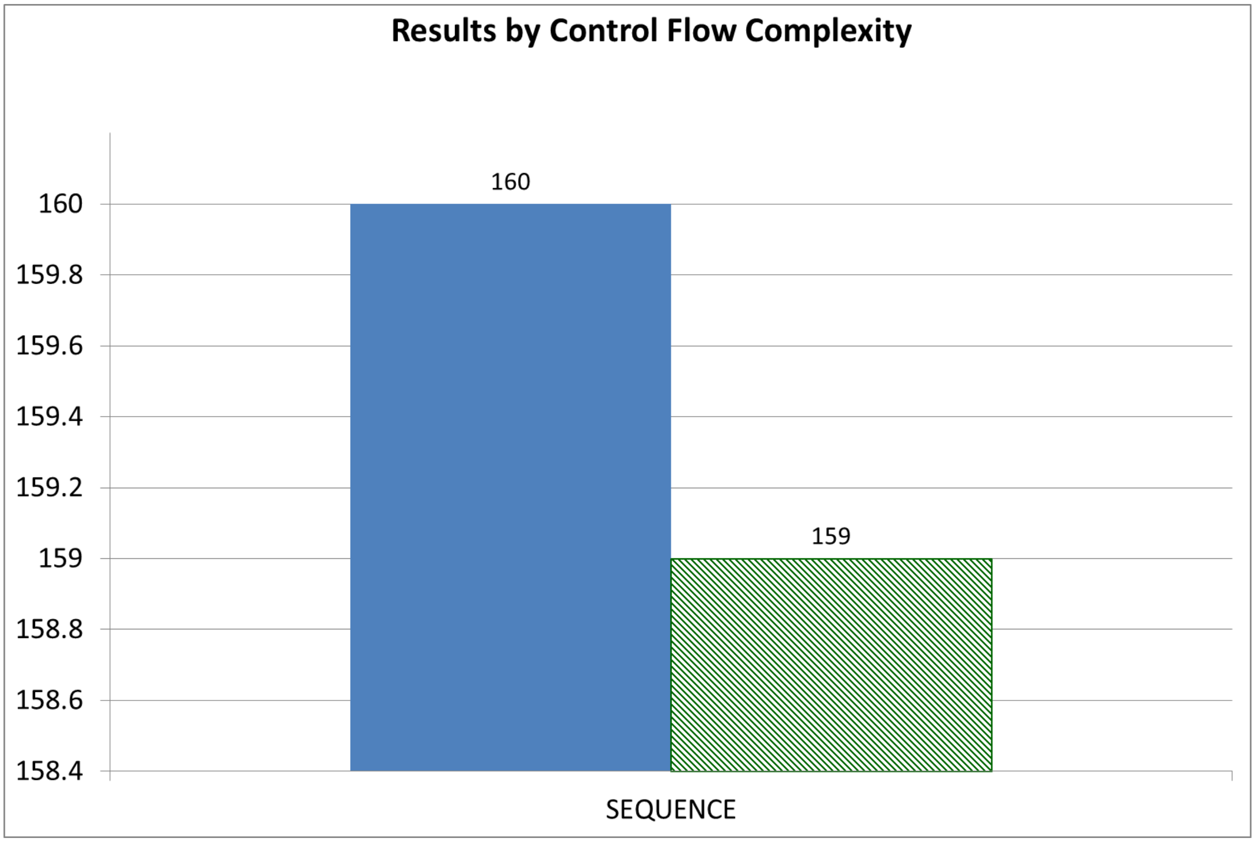

Figure K-62. VIBRANCE (JTREE) Number of Passing Test Cases (by Control Flow Complexity)

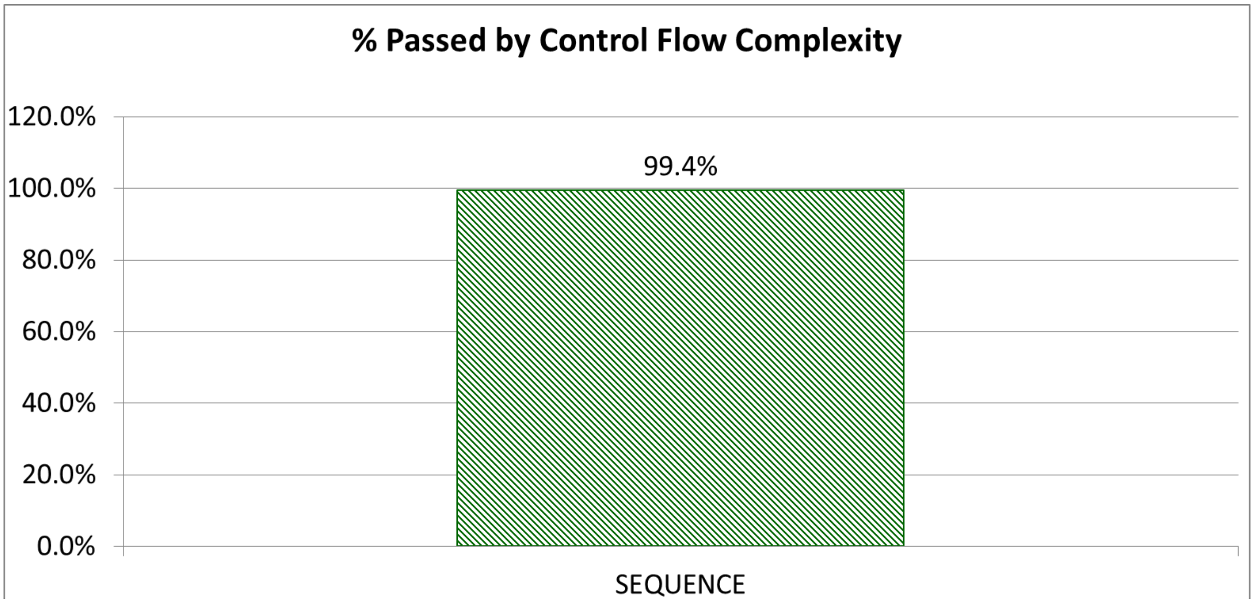

Figure K-63. VIBRANCE (v) Percentage of Passing Test Cases (by Control Flow Complexity)

K.3.6 VIBRANCE JTREE Performance Overhead

Table K-22. VIBRANCE (JTREE) Performance Overhead by Weakness Class

Weakness Class	% Increase
Concurrency Handling	288.6%
Error Handling	306.9%
Injection	-0.3%
Number Handling	13.9%
Resource Drains	73.4%
Tainted Data	550.2%
Grand Total	**230.3%**

Table K-23. VIBRANCE (JTREE) Performance Overhead by Base Program

Base Program	% Increase
JTREE	230.3%
Grand Total	**230.3%**

Table K-24. VIBRANCE (JTREE) Performance Overhead by Taint Source

Taint Source	% Increase
SOCKET	230.3%
Grand Total	**230.3%**

Table K-25. VIBRANCE (JTREE) Performance Overhead by Data Type Complexity

Data Type Complexity	% Increase
SIMPLE	230.3%
Grand Total	**230.3%**

Table K-26. VIBRANCE (JTREE) Performance Overhead by Data Flow Complexity

Data Flow Complexity	% Increase
BASIC	230.3%
Grand Total	**230.3%**

Table K-27. VIBRANCE (JTREE) Performance Overhead by Control Flow Complexity

Control Flow Complexity	% Increase
SEQUENCE	230.3%
Grand Total	**230.3%**

Table K-28. VIBRANCE (JTREE) Performance Overhead by File Size

File Size	% Increase
377,160	230.3%
Grand Total	**230.3%**

APPENDIX L—Comparison of Results and Analysis of Phase 3 Programs

L.1 Combined Results Columbia Modified & GrammaTech and Kestrel Basic

L.1.1 Combined Results by Base Programs

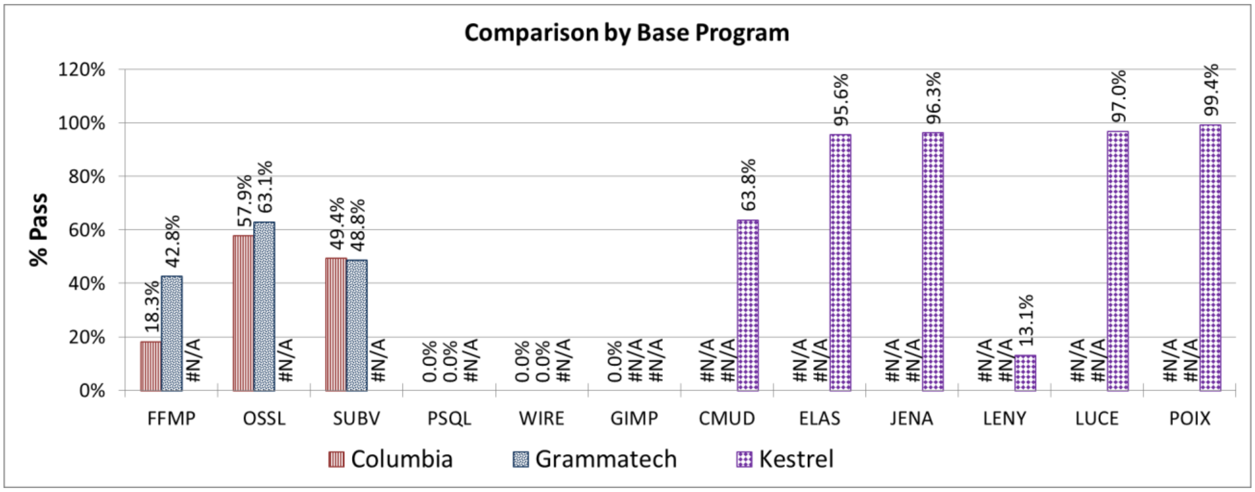

Figure L-1. Comparison of Percentage of Passing Test Cases (by Base Program)

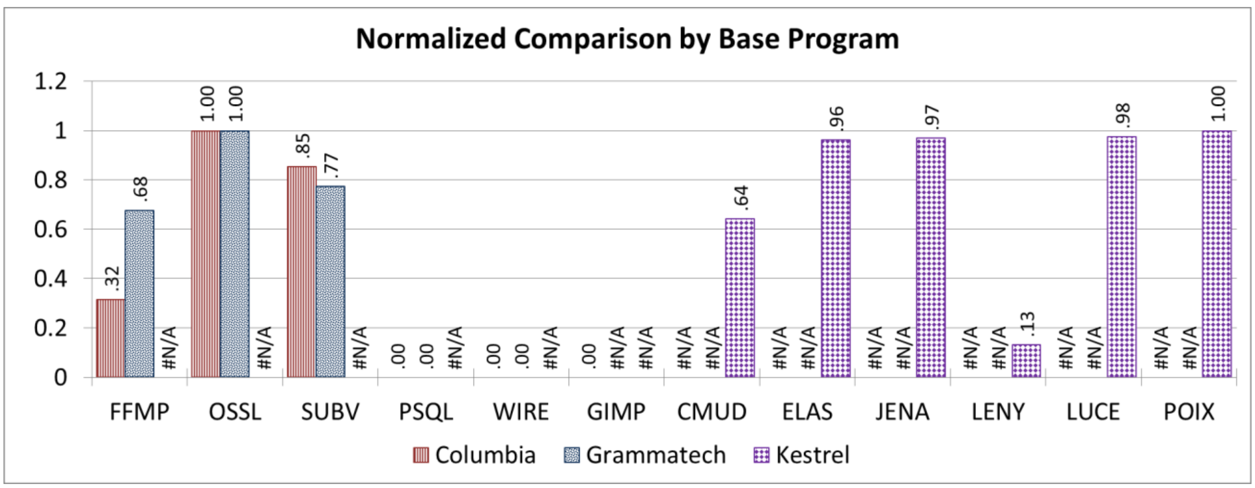

Figure L-2. Normalized Comparison of Passing Test Cases (by Base Program)

L.1.2 Combined Results by Weakness Classes and Target Weaknesses

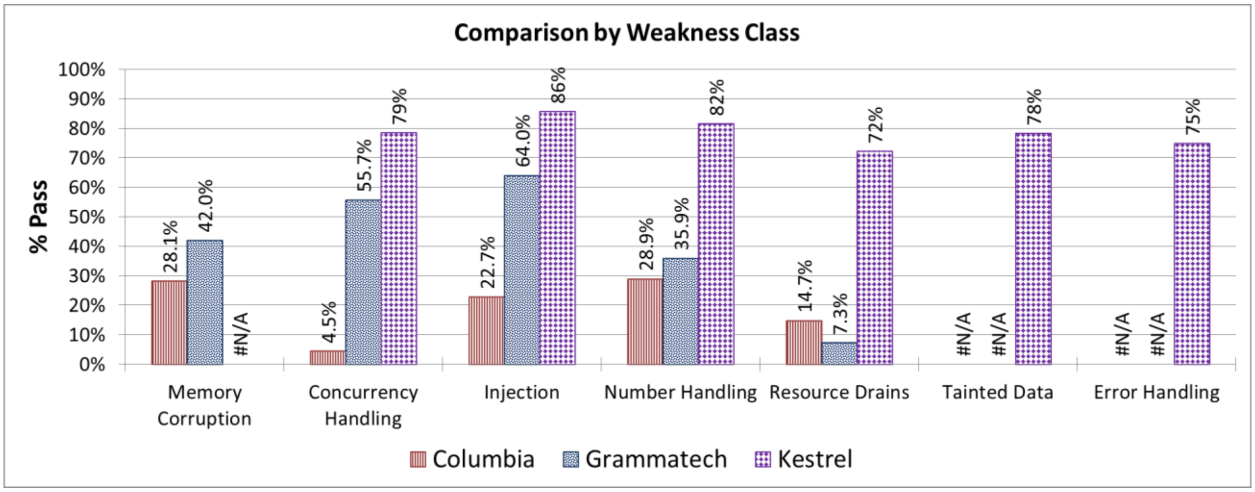

Figure L-3. Comparison of Percentage of Passing Test Cases (by Weakness Class)

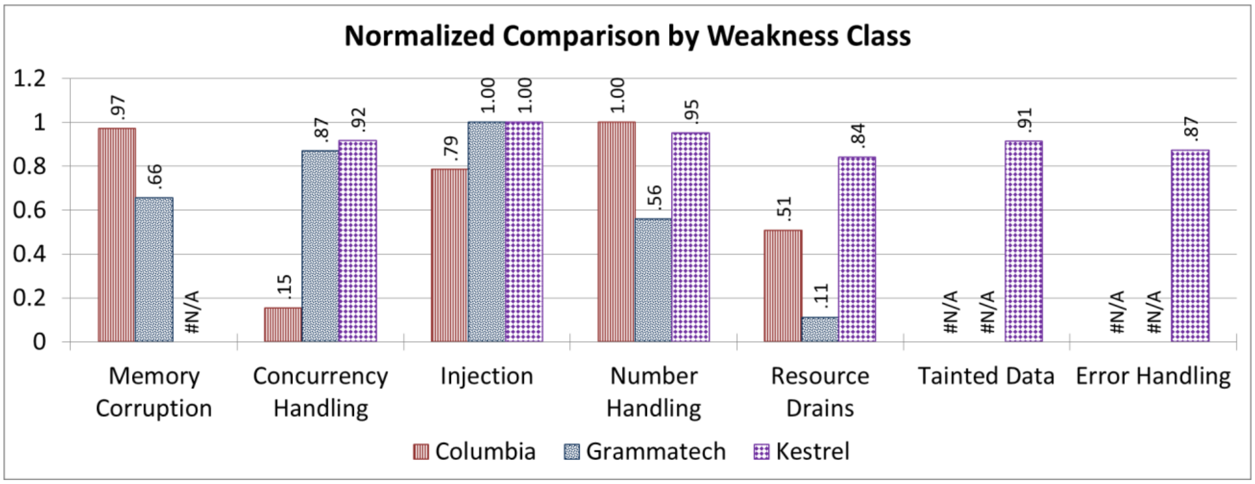

Figure L-4. Normalized Comparison of Passing Test Cases (by Weakness Class)

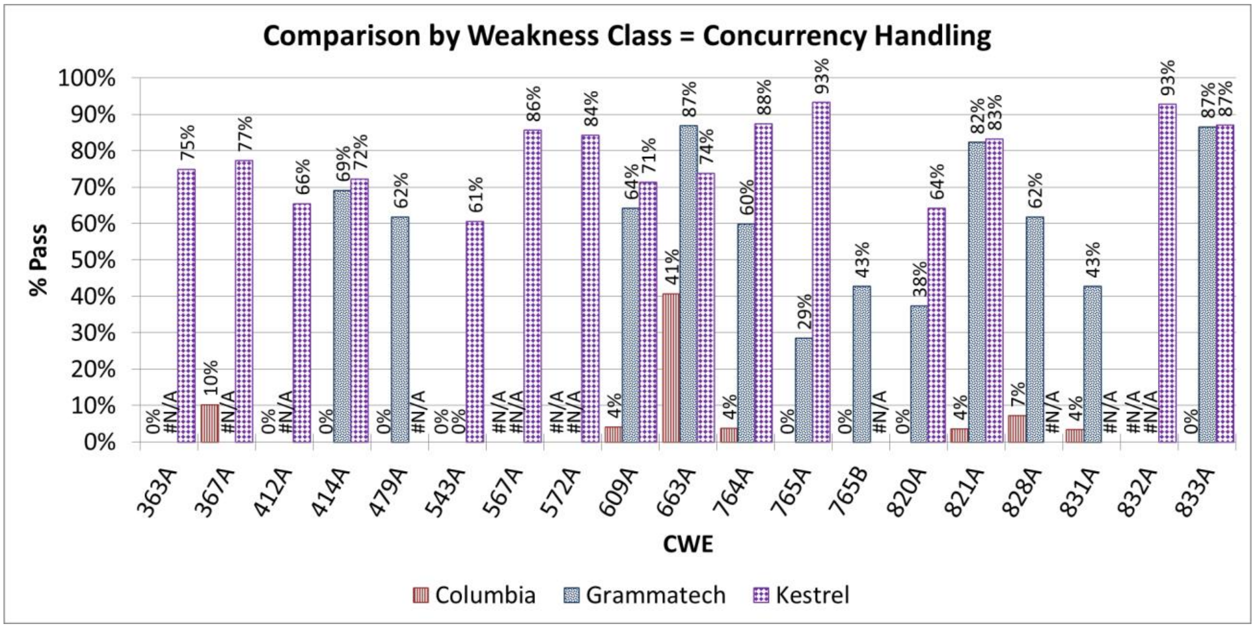

Figure L-5. Comparison of Passing Test Cases (by Concurrency Handling CWEs)

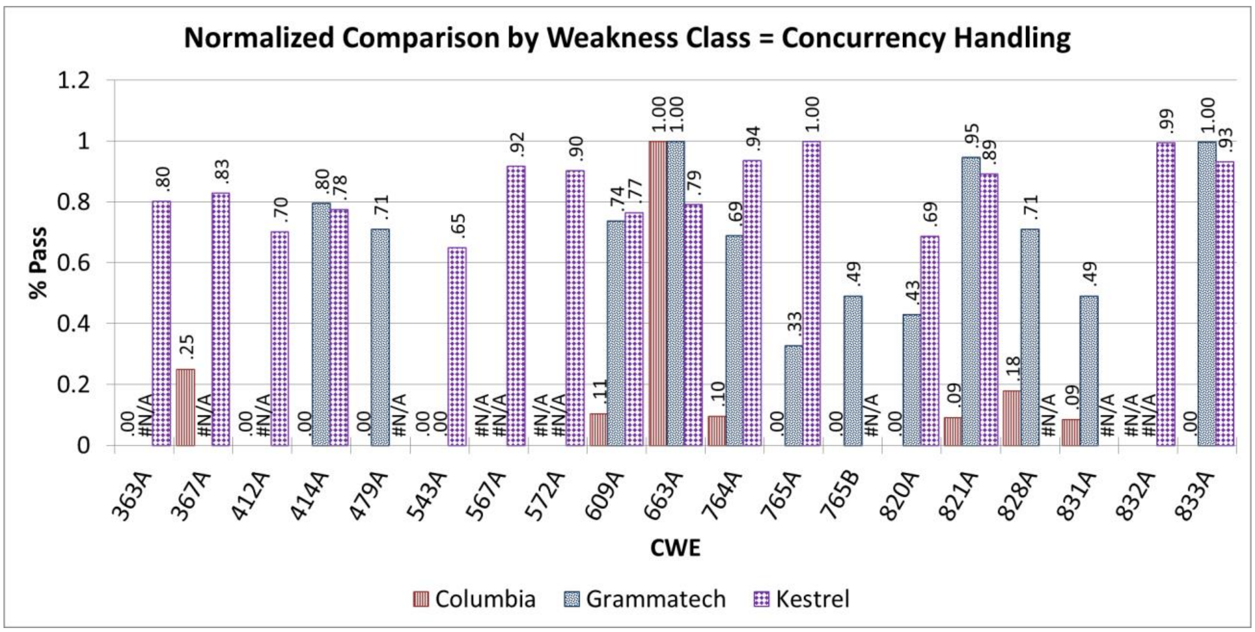

Figure L-6. Normalized Comparison of Passing Test Cases (by Concurrency Handling CWEs)

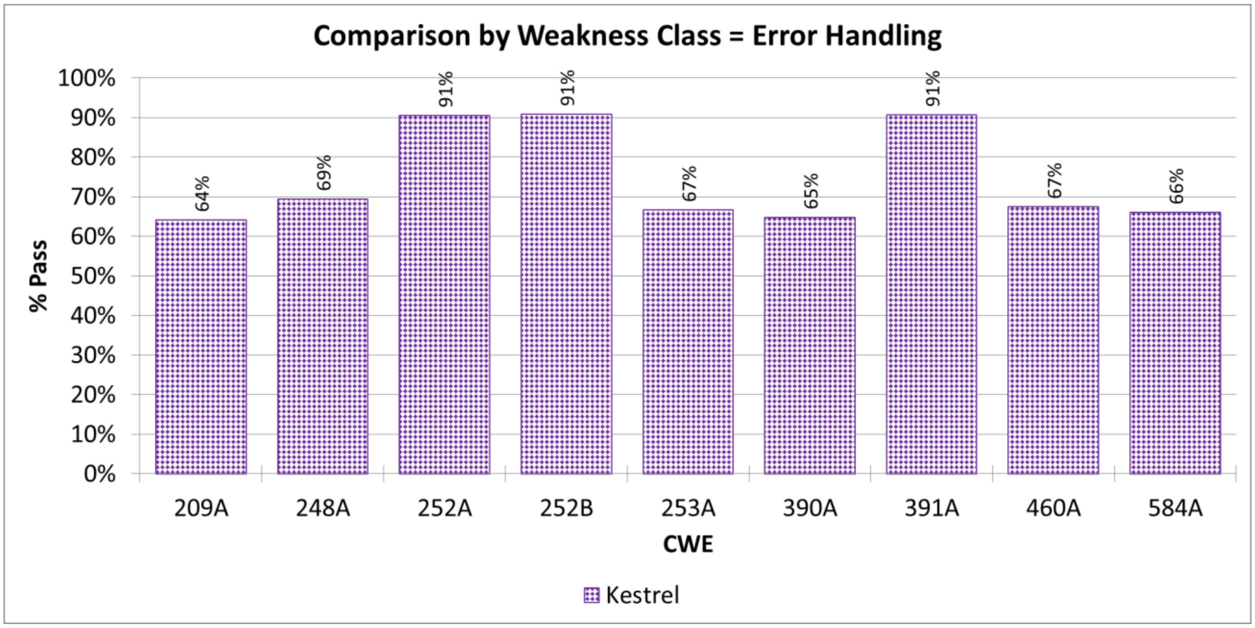

Figure L-7. Comparison of Passing Test Cases (by Error Handling CWEs)

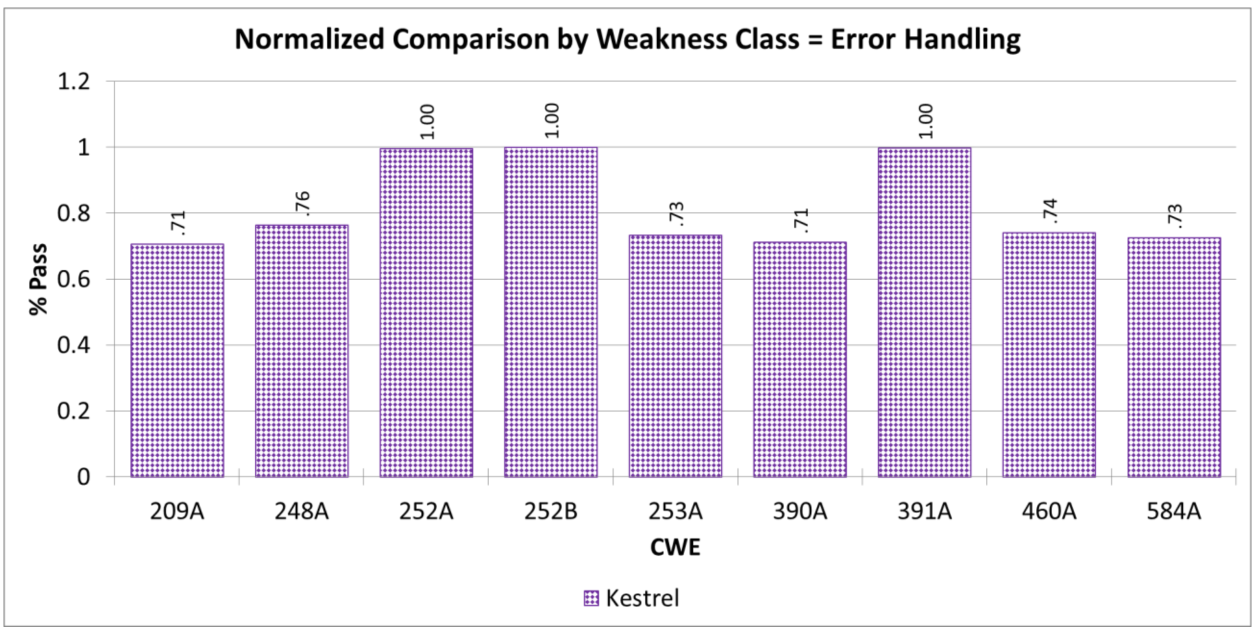

Figure L-8. Normalized Comparison of Passing Test Cases (by Error Handling CWEs)

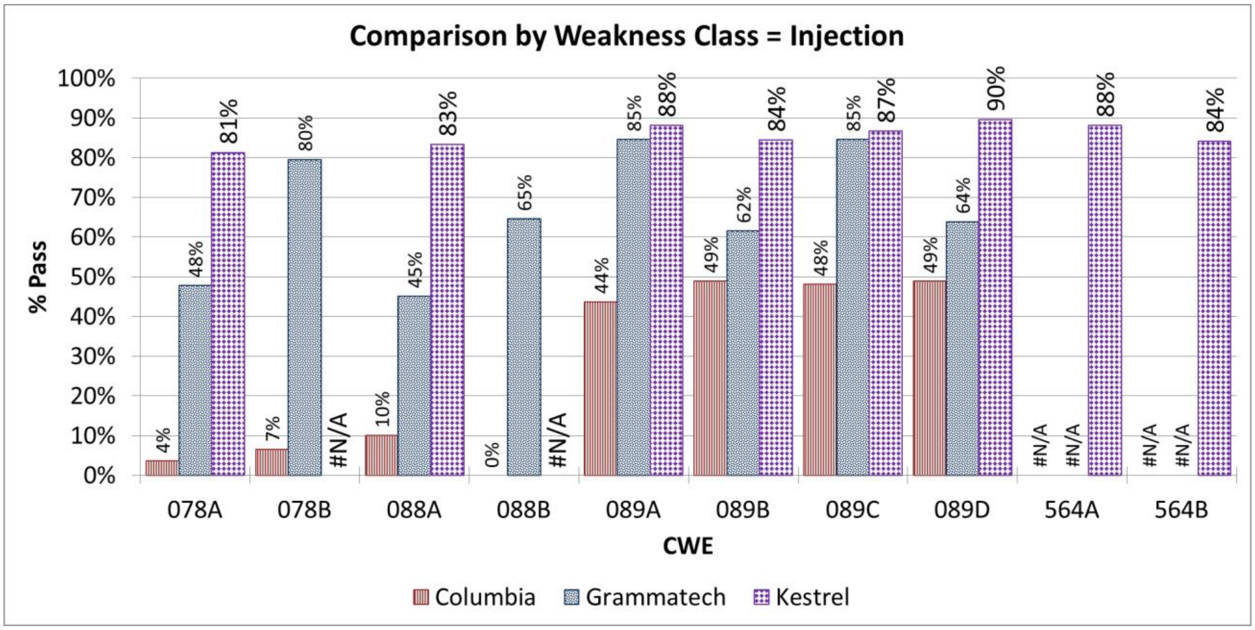

Figure L-9. Comparison of Passing Test Cases (by Injection CWEs)

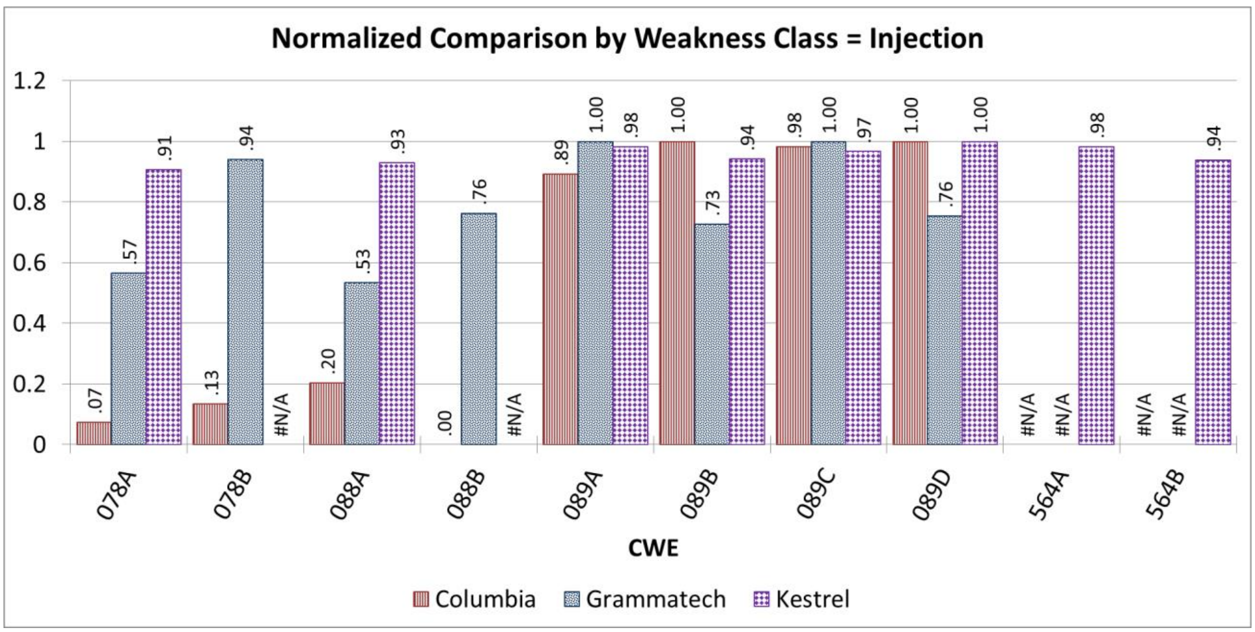

Figure L-10. Normalized Comparison of Passing Test Cases (by Injection CWEs)

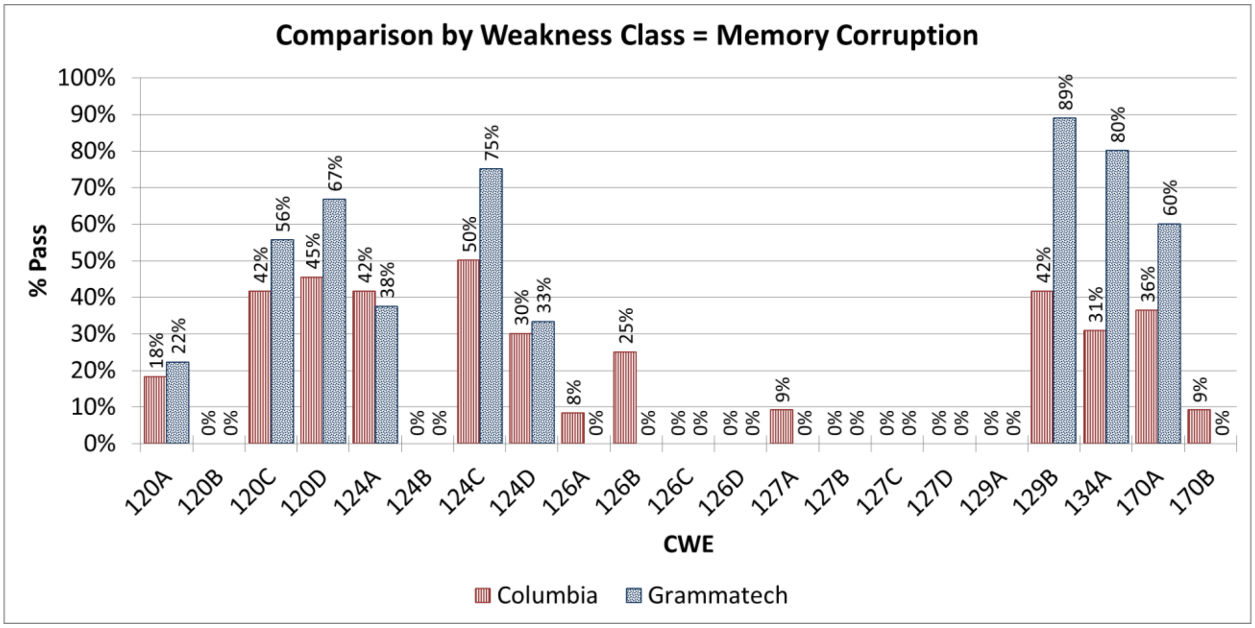

Figure L-11. Comparison of Passing Test Cases (by Memory Corruption CWEs) (Part 1)

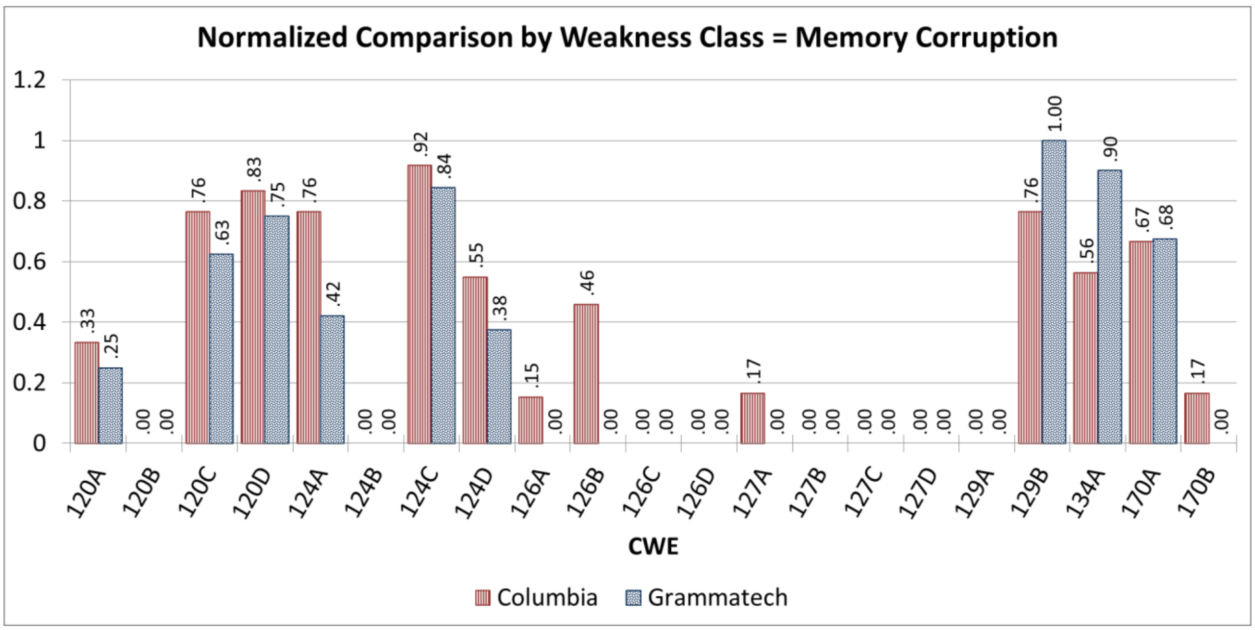

Figure L-12. Normalized Comparison of Passing Test Cases (by Memory Corruption CWEs) (Part 1)

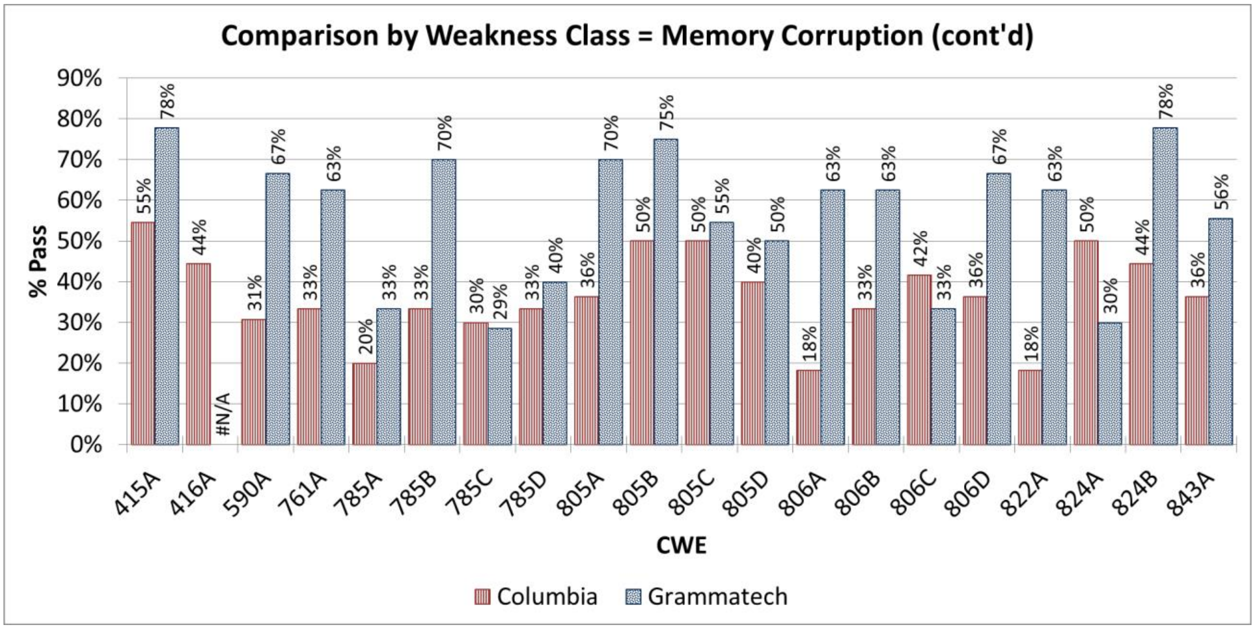

Figure L-13. Comparison of Passing Test Cases (by Memory Corruption CWEs) (Part 2)

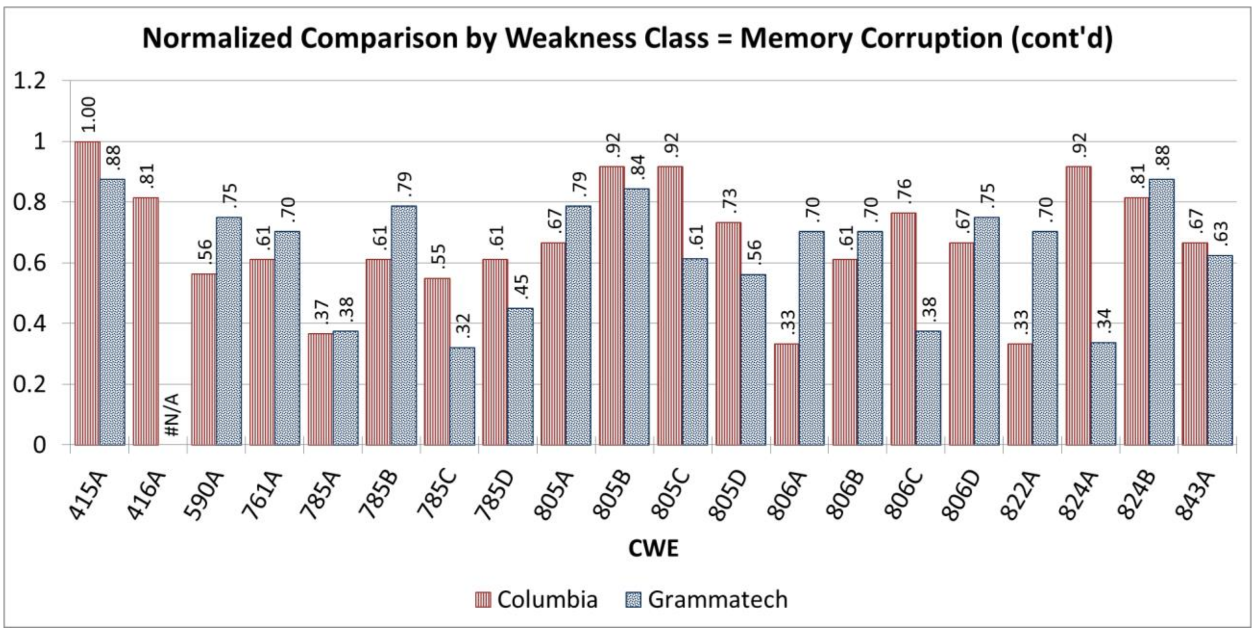

Figure L-14. Normalized Comparison of Passing Test Cases (by Memory Corruption CWEs) (Part 2)

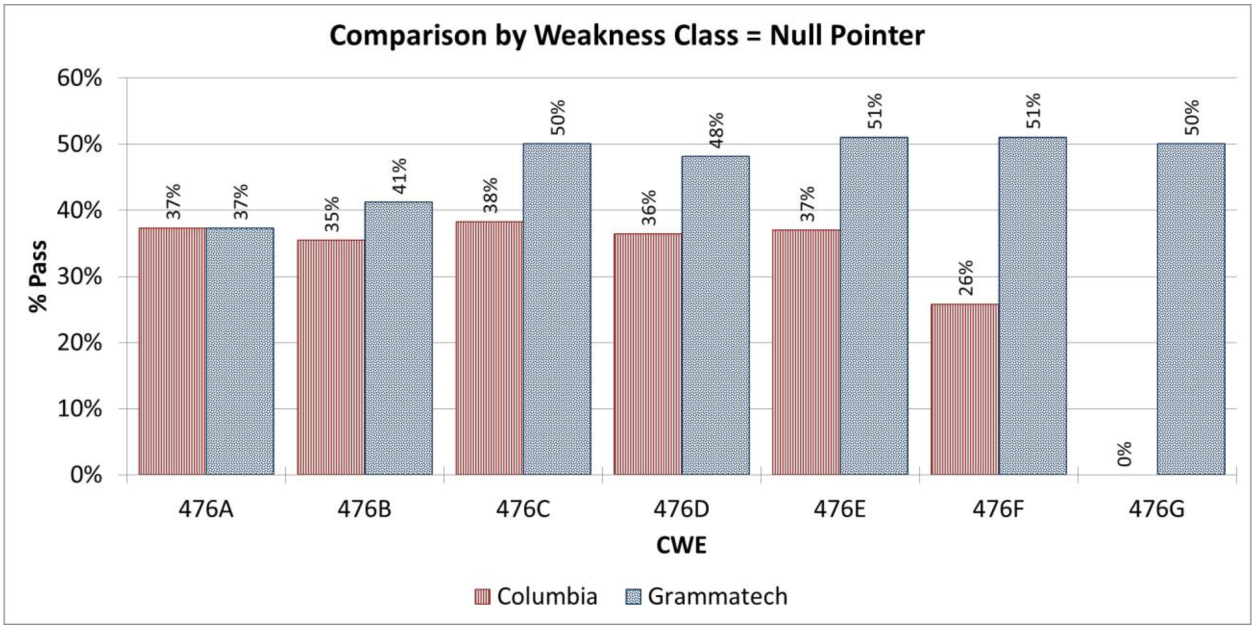

Figure L-15. Comparison of Passing Test Cases (by Null Pointer CWEs)

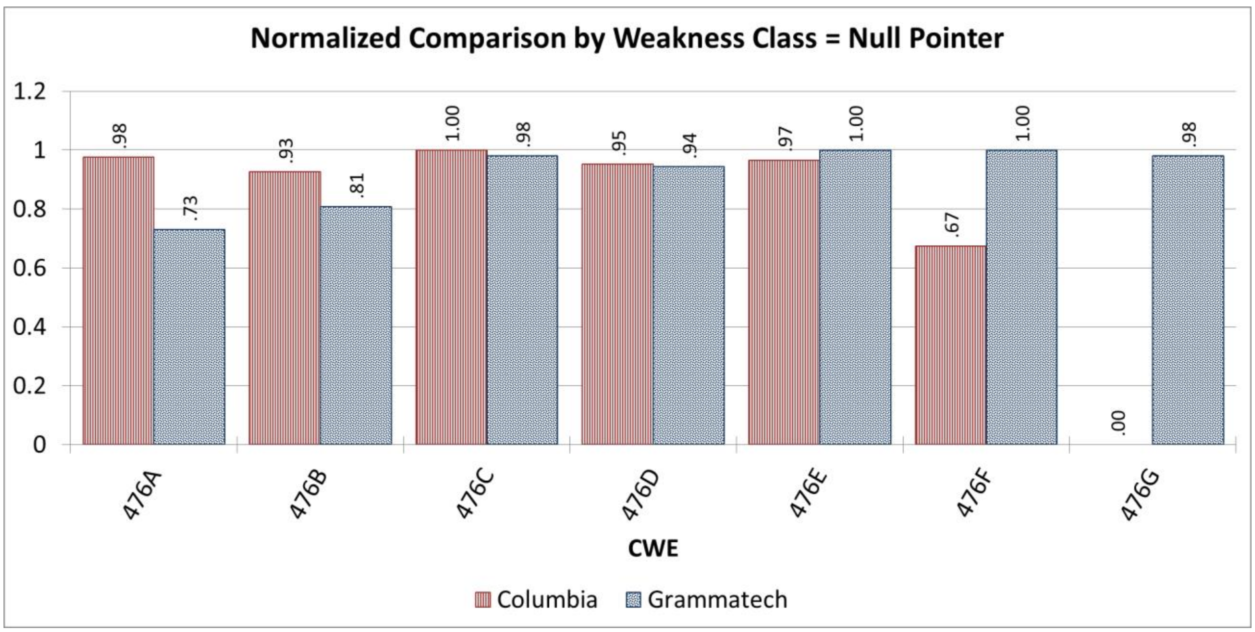

Figure L-16. Normalized Comparison of Passing Test Cases (by Null Pointer CWEs)

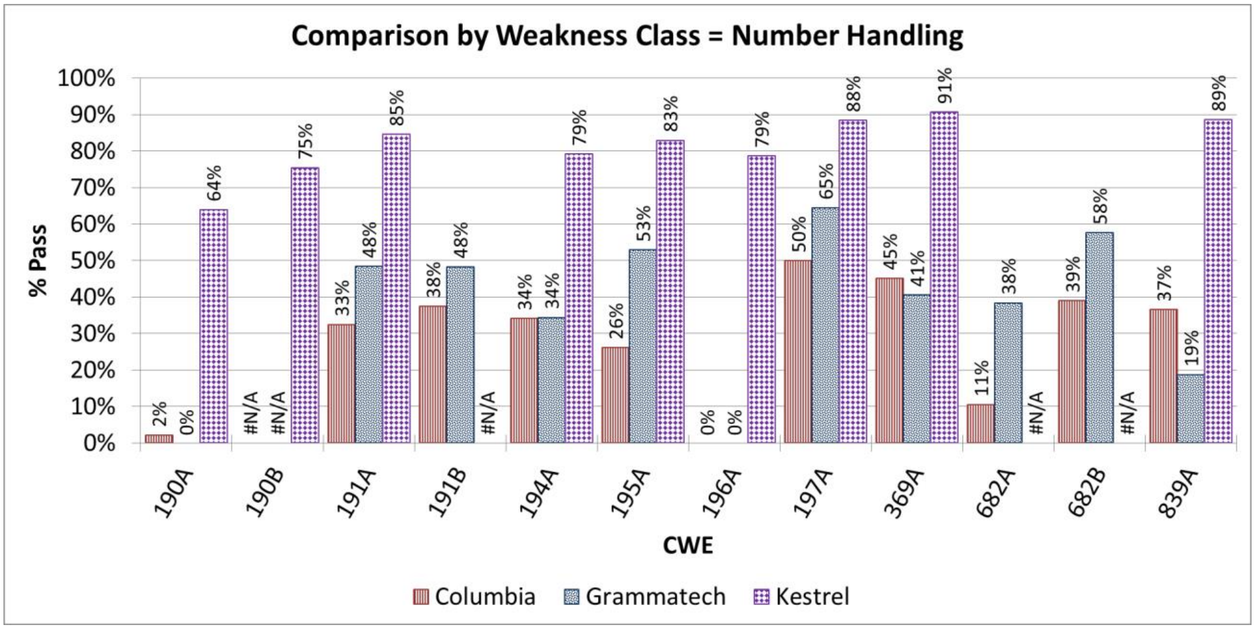

Figure L-17. Comparison of Passing Test Cases (by Number Handling CWEs)

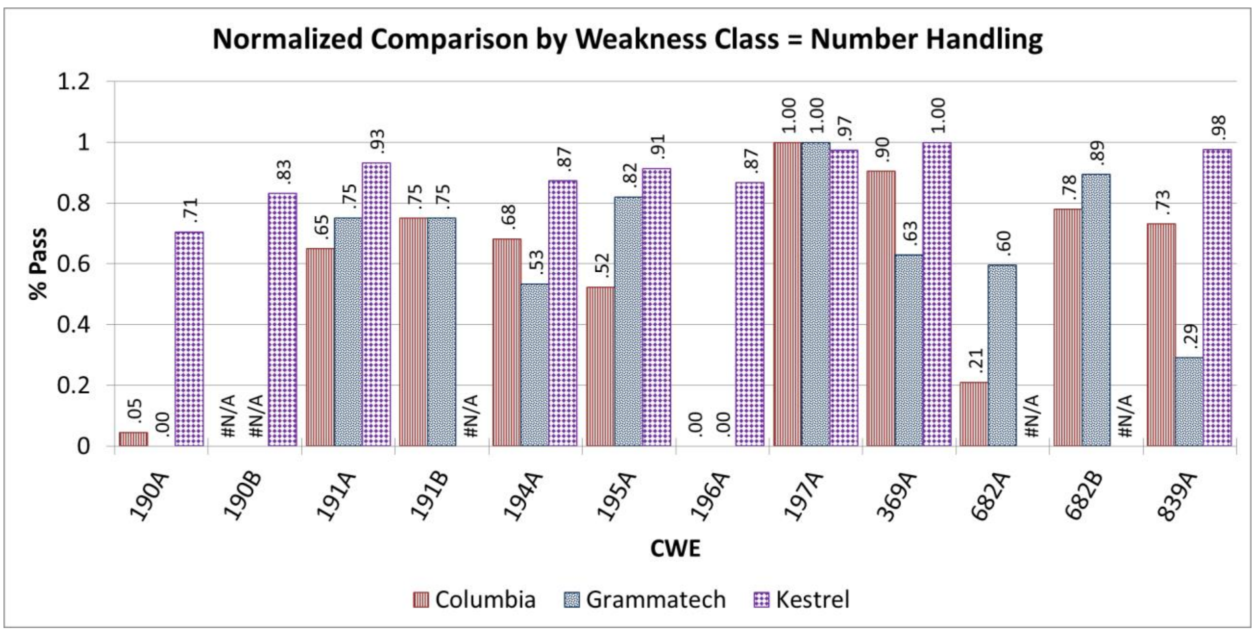

Figure L-18. Normalized Comparison of Passing Test Cases (by Number Handling CWEs)

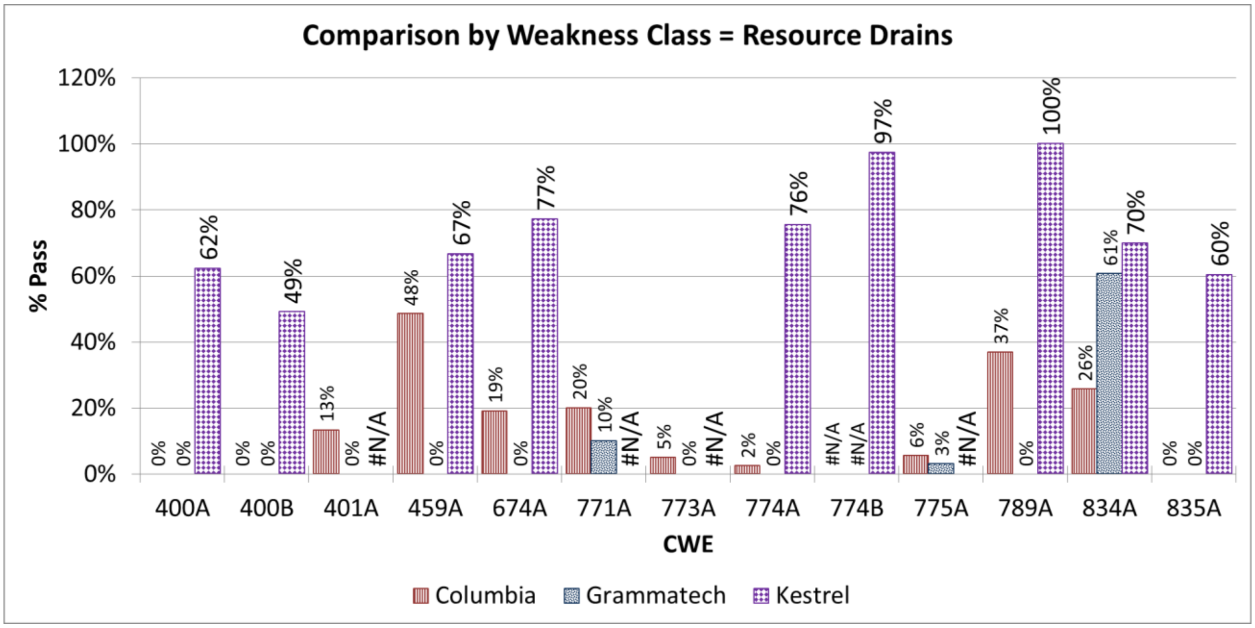

Figure L-19. Comparison of Passing Test Cases (by Resource Drain CWEs)

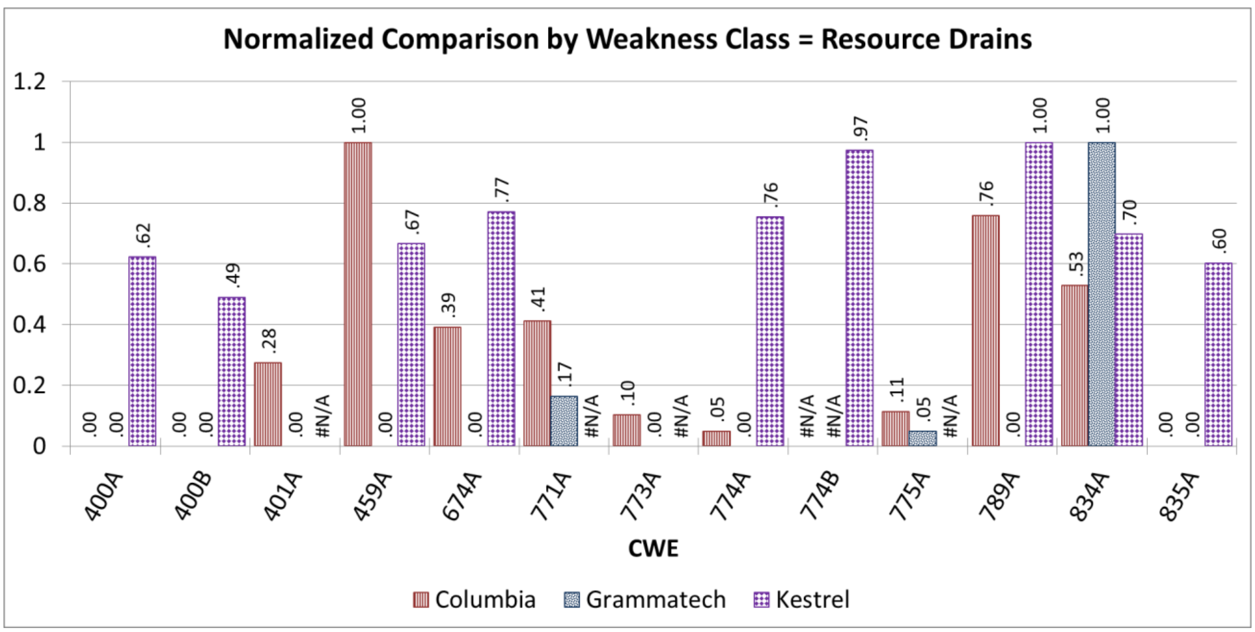

Figure L-20. Normalized Comparison of Passing Test Cases (by Resource Drain CWEs)

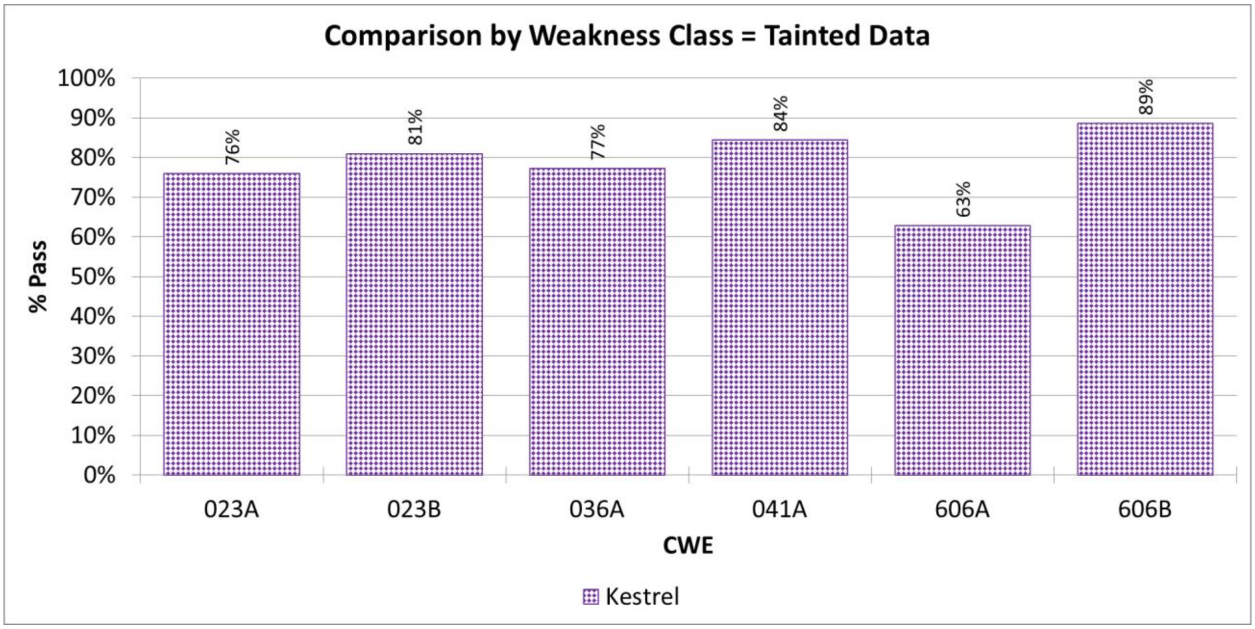

Figure L-21. Comparison of Passing Test Cases (by Tainted Data CWEs)

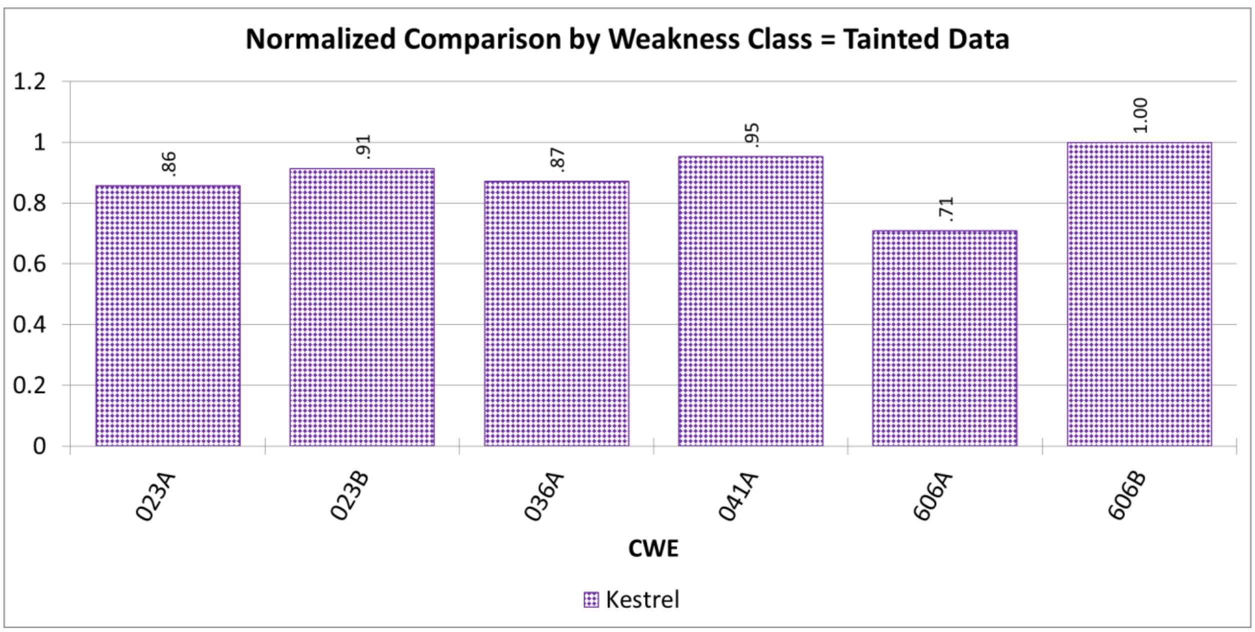

Figure L-22. Normalized Comparison of Passing Test Cases (by Tainted Data CWEs)

L.1.3 Combined Results by Taint Source

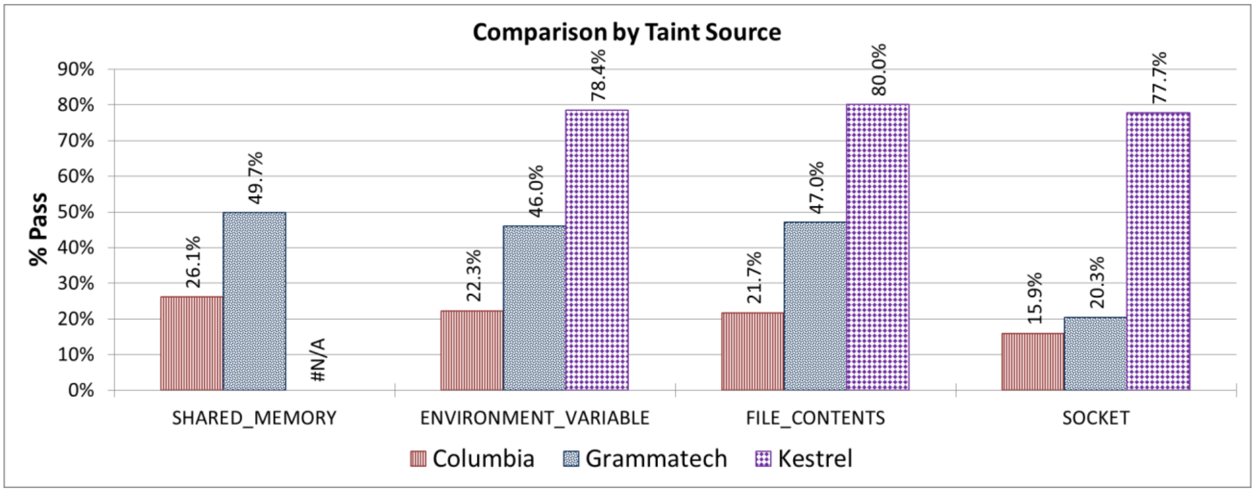

Figure L-23. Comparison of Percentage of Passing Test Cases (by Taint Source)

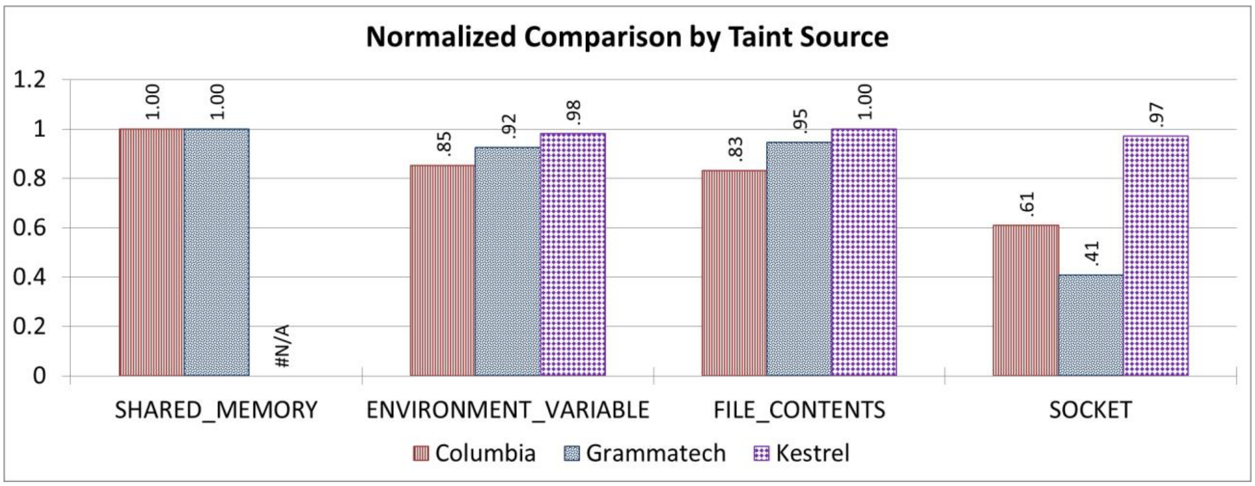

Figure L-24. Normalized Comparison of Passing Test Cases (by Taint Source)

L.1.4 Combined Results by Data Type Complexity

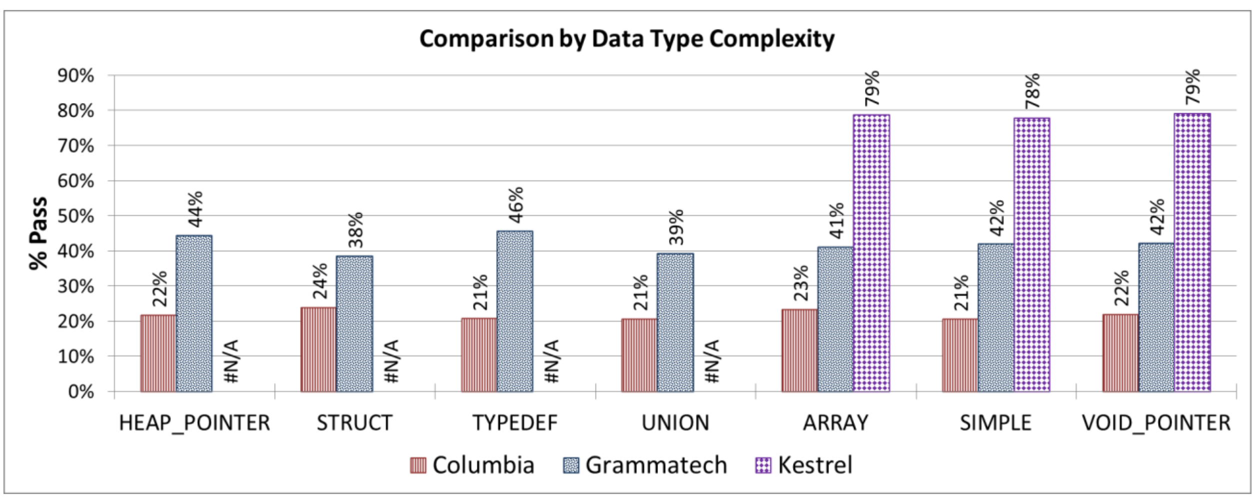

Figure L-25. Comparison of Percentage of Passing Test Cases (by Data Type Complexity)

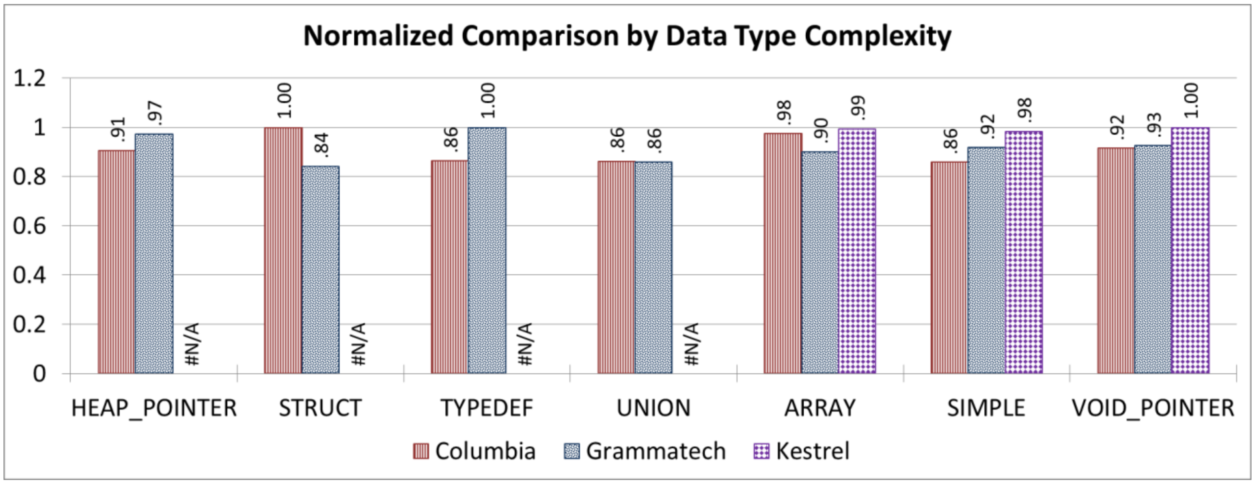

Figure L-26. Normalized Comparison of Passing Test Cases (by Data Type Complexity)

L.1.5 Combined Results by Data Flow Complexity

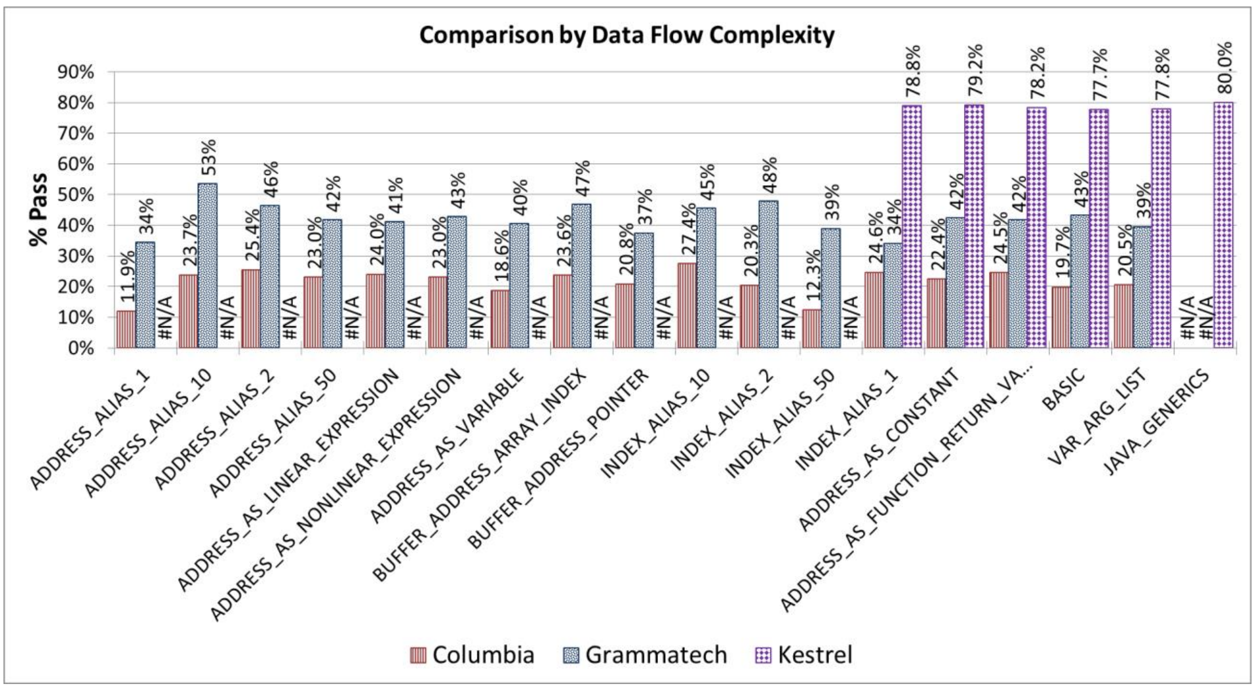

Figure L-27. Comparison of Percentage of Passing Test Cases (by Data Flow Complexity)

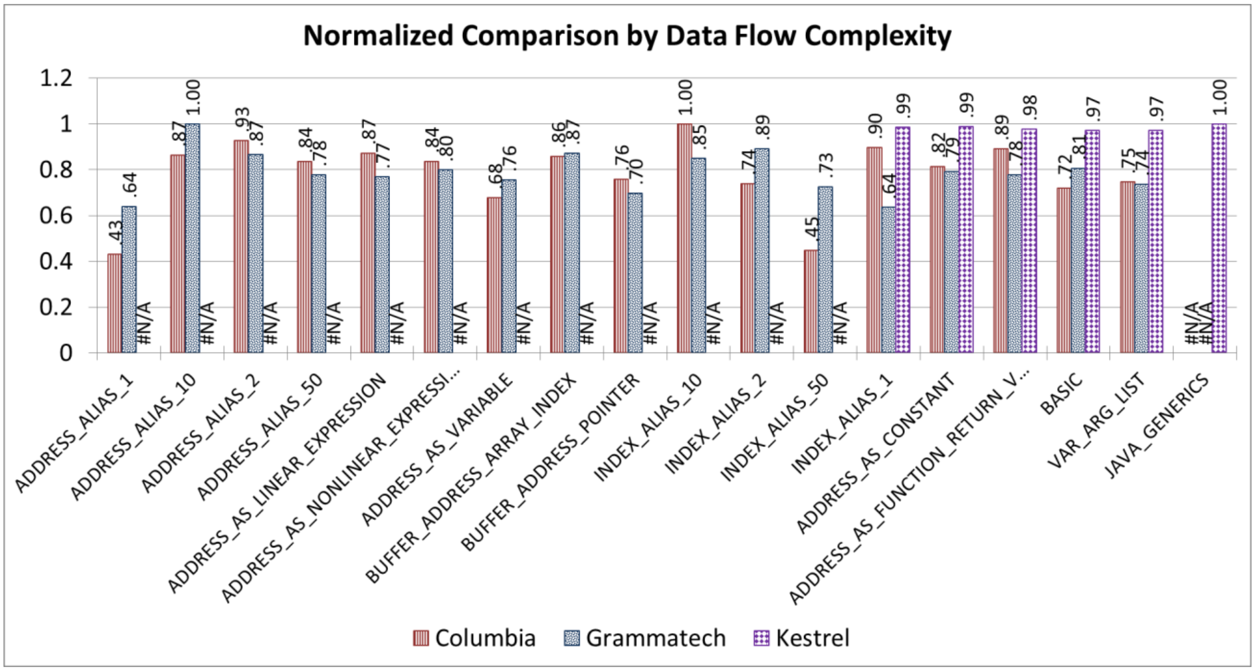

Figure L-28. Normalized Comparison of Passing Test Cases (by Data Flow Complexity)

L.1.6 Combined Results by Control Flow Complexity

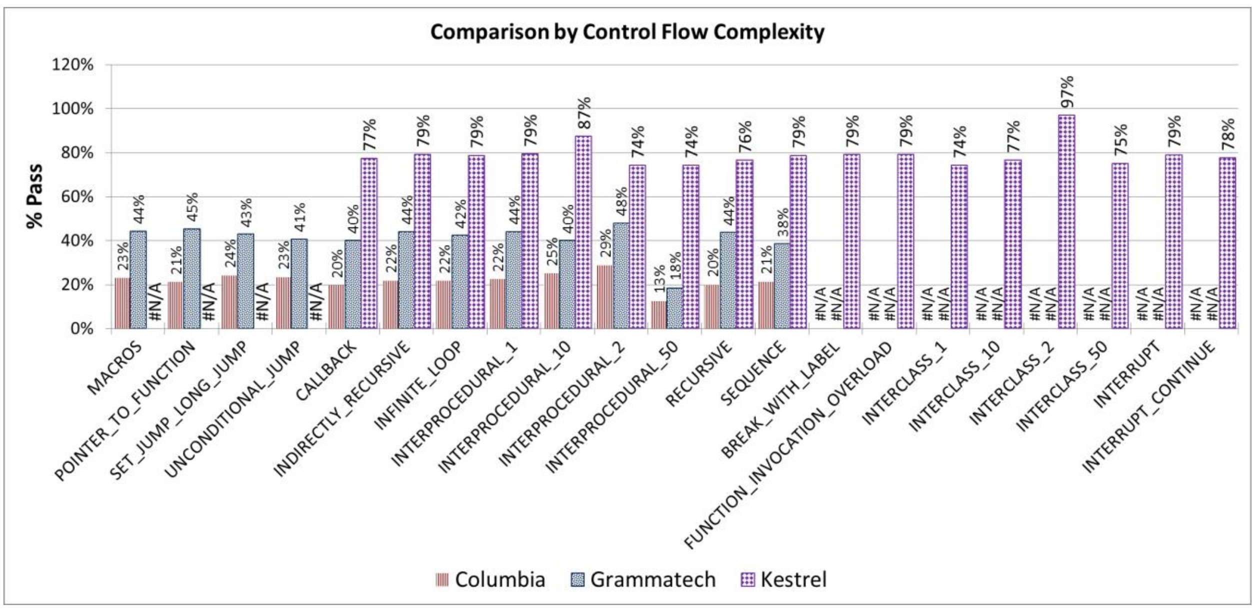

Figure L-29. Comparison of Percentage of Passing Test Cases (by Control Flow Complexity)

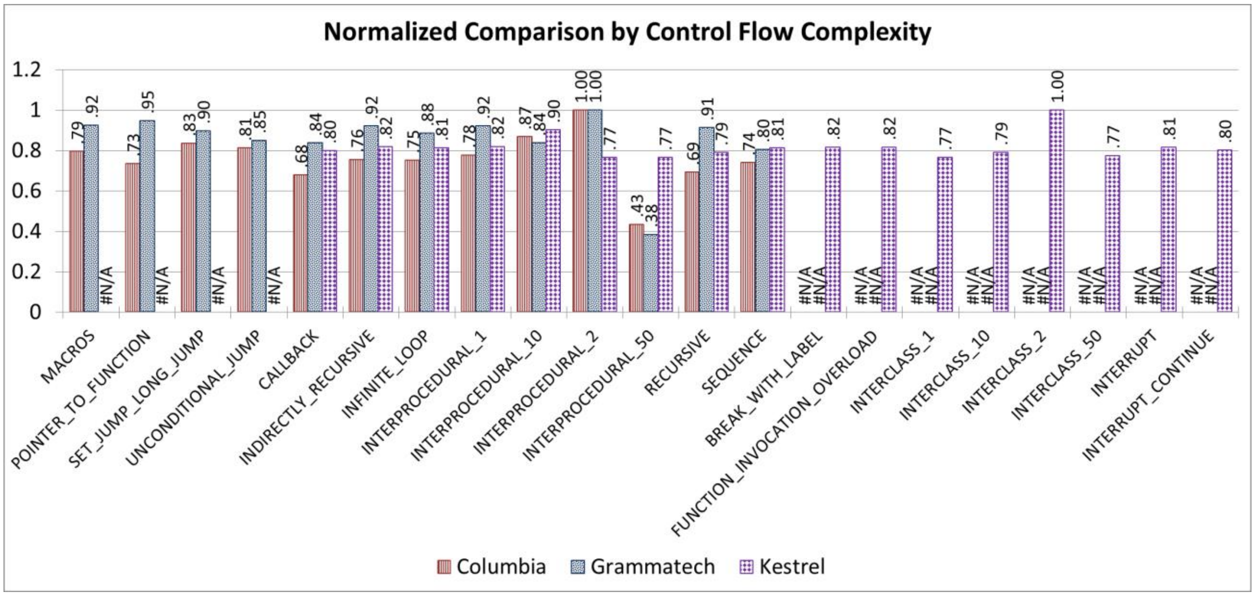

Figure L-30. Normalized Comparison of Passing Test Cases (by Control Flow Complexity)

L.1.7 Combined Results by File Size

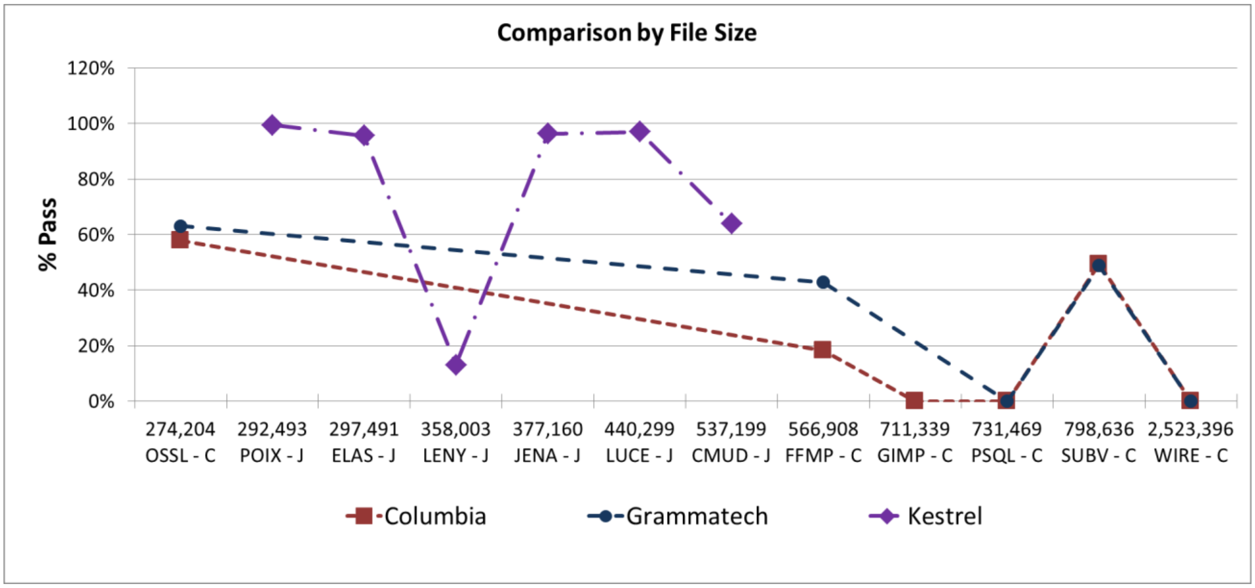

Figure L-31. Comparison of Percentage of Passing Test Cases (by File Size)

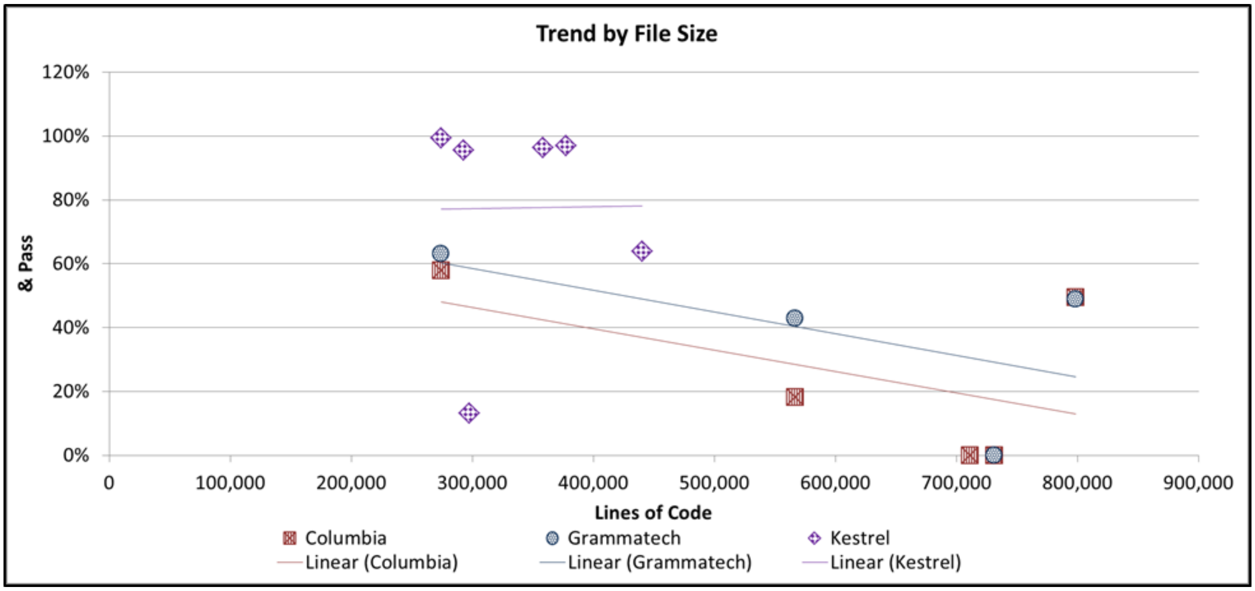

Figure L-32. Trend of Passing Test Cases (by File Size)

L.1.8 Combined Performance Overhead

- The overall average increase in processing time for Columbia's MINESTRONE was 472.7%
- The overall average increase in processing time for GrammaTech's PEASOUP was 18.5%
- The overall average increase in processing time for Kestrel'sVIBRANCE was 11%