

Space Flight Operations Contract

HAL/S COMPILER TEST RESULTS REPORT

PASS 29.0/BFS 14.0

Baseline

January 29, 1999

1.4.3.8-e

Contract NAS9-2000



HAL/S COMPILER TEST RESULTS REPORT

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DRD-1.4.3.8-e

Contract NAS9-20000

Change History

The Test Report for the HAL/S Compiler has been revised and issued on the following dates:

<u>Revision</u>	<u>Date</u>	<u>Compiler</u>	<u>Release</u>	<u>Sections Changed</u>
Baseline	01/29/99	29.0/14.0	Initial Release	-

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1.0 Introduction

This is the test report for the PASS 29.0/BFS 14.0 compiler releases. The compilers were tested according to the PASS 29.0/BFS 14.0 Test Plan (12/02/98).

The PASS 29.0/BFS 14.0 Test Expansion Report is included in Appendix A.

The following information is available upon request:

Functional Test Results Logs

BFS
 BFS-ERROR
 PASS-#DOFF
 PASS-#DON
 PASS-ERROR-#DOFF
 PASS-ERROR-#DON

PASS FSW Object Code Differences

PASS FSW (APPL) - OI2803000
 Differences - Compared to the 28.0 Baseline

PASS FSW (APPL #D Target List) - OI2803000
 Differences - Compared to the 28.0 Baseline

BFS FSW Object Code Differences

BFS FSW – BFS271XX
 Differences - Compared to the 12.0 Baseline

2.0 Baseline

The base system for the PASS 29.0 and BFS 14.0 compiler releases will be the PASS 28.0 and BFS 12.0 compilers, respectively. The baseline for the PASS 29.0/BFS14.0 release is:

CR12891	HAL/S-FC PASS Compiler Year 2000 Update
CR12935A	Allow REMOTE Pass by Reference Parameters
CR12940A	Enhance Compiler Listing
CR12952	Put 'C' Version of SDFPKG Under Configuration Control
CR12975	HAL/S-FC Compiler YR2K Listing Update
CR13043	Documentation Changes For PASS 29.0/BFS 14.0
CR13044	Baseline Tools For PASS 29.0/BFS 14.0
CR13078	Provide a User's Guide for SDFPKG
DR109052	Arithmetic Expression in CONSTANT/INITIAL Value Gets Error
DR109053	Stack Entries Not Returned For PROGRAM/TASK in BFS
DR109056	Structure Parameter Receives an Invalid DQ101 Error

DR109057	Incorrect Indention and Extra S-Line in Listing
DR109059	Indirect Stack Entry For EVENT Not Returned
DR109060	Bad Object Code For EVENT Comparison
DR109061	Level Number Missing on Line With Label
DR109062	Space Missing in Macro Text
DR109063	Shifting More Than 55 Spaces Does Not Load Shift Amount Into a Register
DR109064	Indirect Stack Entry Not Returned For %COPY
DR109065	Overpunch Character is Missing
DR109066	Line of Labels Doesn't Wrap Around
DR109067	Indirect Stack Entry Not Returned For STRUCTURE Initialization
DR109068	Indirect Stack Entry Not Returned For Checkpointed Register
DR109069	Indirect Stack Entry Not Returned For REMOTE STRUCTURE Compare
DR109070	DI3 Error Incorrectly Emitted
DR109071	STRUCTURE in ASSIGN Parameter Gets Error
DR109074	DOWNGRADE of DI21 Error Fails When Including a Remotely-Included COMPOOL
DR109075	BS112 Error is Emitted on the 99 th NAME REMOTE Dereference
DR109076	REPLACE Macro Split on Two Lines
DR109077	FT100 Error For SIZE(STRUC.NAME_STRUC.ARRAY)
DR109078	Bad Setup to VV1S3 For Multi-copy NAME Node LHS
DR109079	No Error Generated When DEFINE Blocks Have Same Name
DR109081	Lookup Failure For Long Token Lists
DR109082	PASS2 STRUCTURE Template Table Incorrect in Listing
DR109083	CONSTANT DOUBLE SCALAR Converted to a CHARACTER as Single Precision
DR109084	Structure Initialization May Cause Incorrect HALMAT
DR109085	Record Index Out of Range
DR109086	No DA10 Error Message For DENSE, ALIGNED or RIGID
DR109087	BI516 Error Emitted For Nested Function Call
DR109089	Stack Walkback Loop Causes Bad Object Code
DR109090	NAME REMOTE Dereference of Structure Node Fails
DR109091	Array Index Out of Range For Nested DO-CASE
DR109092	Index Out of Range For HALMAT Operand Array
DR109093	NAME REMOTE Dereference of Minor Structure Node Fails
DR109094	Bad Object Code Generated When a Variable is Passed to a Remote Library
DR109095	BIT Store Via DATA_REMOTE NAME REMOTE Dereference Fails
DR109097	Incorrect ZB1 or BS123 Error Generated
DR109098	Optimizer Generates Wrong HALMAT For Long Statements

DR109100	Index Out of Range For DIFF_PTR and DIFF_NODE
DR111302	BI506 Error on AUTOMATIC Bit Initialization
DR111303	BS123 Error For Structure Bit Operation
DR111306	Index Out of Range For A_PARITY and ADD
DR111315	VR0SN Fails with a NAME REMOTE Array Structure Node
DR111317	NAME REMOTE Dereference of STRUCTURE Node Fails

3.0 Testing Overview

Testing included the standard procedure of unit, expansion, functional, independent, and FSW acceptance level testing.

For PASS, unit and functional testing were performed with and without DATA_REMOTE. The APES 3V2 was used for unit, functional, and independent test execution. OI2803000 was used for the PASS FSW acceptance testing as stated in the test plan.

PASS FSW was initially tested "as is". All FSW members that are candidates for DATA_REMOTE were also tested with the DATA_REMOTE directive. These members were copied to a separate dataset and edited to insert the DATA_REMOTE directive. This modified dataset was used for PASS FSW DATA_REMOTE testing. For BFS FSW testing, BFS271XX was used.

Drivers were written to automate the compiler build, unit, functional, and acceptance test procedures. These drivers are included in the delivery and are located in the following datasets:

NCAMCM.PASS.REL29V0.BUILD.CLIST
 NCAMCM.PASS.REL29V0.TEST.CLIST
 NCAMCM.BFS.REL14V0.BUILD.CLIST
 NCAMCM.BFS.REL14V0.TEST.CLIST
 NCAMCM.BFS.REL14V0.TEST.JCL

4.0 Build

The PASS and BFS COMPILER, MONITOR, and RUNLIB were rebuilt for testing. The PASS ZCONOBJ and BFS QCONLIB were also rebuilt. The build tools used were as follows:

The PASS and BFS compilers were built using the 90.2 version of the XPL compiler.

The MONITOR and SDFPKG were built using the 360 assembler version ASM H V02, located in SDF dataset SYS1.LINKLIB(IEV90), and the DFSMS/MVS V1 R3.0 program management services linker, located in SDF dataset SYS1.LINKLIB(IEWL).

For PASS and BFS, the AP101S assembler version 3.0, located in SDF dataset SPF28040.GO.ASM101, and linkage editor version 26.90, located in SDF dataset SPF28040.GO.LNK101 were used to assemble and link the RUNLIB.

For BFS, the RUNLIB build procedure was completed with SATSOBJ V2.1 and SATSLIST V3.1, both located in SDF dataset NROKSTB.SUPPORT.OILOAD.OI271.

Prior to the build, the source code was inspected to ensure that all DRs and CRs had been received from development. The build procedure was completed with no issues.

5.0 Test Results

The results for the unit, expansion, functional, independent (supplemental and isometric), and acceptance level testing are contained in the following subsections.

For all levels of testing, when comparing results from two compiles, the object code was compared. If there were differences, then the assembly code from the compilation was compared. These assembly code differences were examined manually to ensure that the new 29.0/14.0 code was functionally equivalent to the 28.0/12.0 code.

5.1 Unit Test Results

Unit testing was performed by the developers prior to the code walkthroughs. The developers created unit tests for every CR and DR that resulted in a compiler source code change. A total of 5268 test points in 306 unit test cases were generated for these CRs and DRs. All problems found were corrected prior to the code walkthroughs. Differences between the base system and the new compilers were examined and attributed to 29.0/14.0 CRs and DRs.

5.2 Expansion Test Results

After the development was complete for a DR or CR, the developers tested each other's changes by writing additional "expansion" tests. These tests were performed during development and verification. Expansion tests were not performed for documentation-only changes nor changes for which unit testing was sufficient.

The following CRs/DRs were selected for expansion test case development:

CR12935A	Allow REMOTE Pass by Reference Parameters
CR12940A	Enhance Compiler Listing
DR109052	Arithmetic Expression in CONSTANT/INITIAL Value Gets Error
DR109056	Structure Parameter Receives an Invalid DQ101 Error
DR109057	Incorrect Indention and Extra S-Line in Listing
DR109059	Indirect Stack Entry For EVENT Not Returned
DR109061	Level Number Missing on Line With Label
DR109063	Shifting More Than 55 Spaces Does Not Load Shift Amount Into a Register
DR109064	Indirect Stack Entry Not Returned For %COPY
DR109066	Line of Labels Doesn't Wrap Around

DR109067	Indirect Stack Entry Not Returned For STRUCTURE Initialization
DR109068	Indirect Stack Entry Not Returned For Checkpointed Register
DR109070	DI3 Error Incorrectly Emitted
DR109071	STRUCTURE in ASSIGN Parameter Gets Error
DR109074	DOWNGRADE of DI21 Error Fails When Including a Remotely-Included COMPOOL
DR109076	REPLACE Macro Split on Two Lines
DR109077	FT100 Error For SIZE(STRUC.NAME_STRUC.ARRAY)
DR109078	Bad Setup to VV1S3 For Multi-copy NAME Node LHS
DR109081	Lookup Failure For Long Token Lists
DR109082	PASS2 STRUCTURE Template Table Incorrect in Listing
DR109083	CONSTANT DOUBLE SCALAR Converted to a CHARACTER as Single Precision
DR109084	Structure Initialization May Cause Incorrect HALMAT
DR109086	No DA10 Error Message For DENSE, ALIGNED or RIGID
DR109087	BI516 Error Emitted For Nested Function Call
DR109089	Stack Walkback Loop Causes Bad Object Code
DR109090	NAME REMOTE Dereference of Structure Node Fails
DR109091	Array Index Out of Range For Nested DO-CASE
DR109092	Index Out of Range For HALMAT Operand Array
DR109093	NAME REMOTE Dereference of Minor Structure Node Fails
DR109094	Bad Object Code Generated When a Variable is Passed to a Remote Library
DR109095	BIT Store Via DATA_REMOTE NAME REMOTE Dereference Fails
DR109097	Incorrect ZB1 or BS123 Error Generated
DR109098	Optimizer Generates Wrong HALMAT For Long Statements

DR109100	Index Out of Range For DIFF_PTR and DIFF_NODE
DR111302	BI506 Error on AUTOMATIC Bit Initialization
DR111303	BS123 Error For Structure Bit Operation
DR111306	Index Out of Range For A_PARITY and ADD
DR111315	VR0SN Fails with a NAME REMOTE Array Structure Node
DR111317	NAME REMOTE Dereference of STRUCTURE Node Fails

A total of 2970 test points in 228 expansion test cases were generated to test these DRs/CRs. During expansion testing, eleven early errors, one process error, and nine latent DRs were found. For more information on the expansion tests, refer to Appendix A, Expansion and Supplemental Testing.

5.3 Functional Test Results

Functional testing was performed by verification. It consisted of a large, mostly self-checking, regression test suite. Unit and expansion test cases from previous compiler releases were included.

Differences between the base system and the new compilers were examined and attributed to CRs and DRs on this release. During functional testing, four process errors were found. All of these errors were corrected.

5.4 Independent Test Results

Independent testing is performed by an area other than development. It is done in parallel with functional testing. It consists of two types of testing: supplemental and “isometric”. For more information on the supplemental tests, refer to Appendix A, Expansion and Supplemental Testing.

5.4.1 Isometric Test Results

This stage of testing consisted of running all standard self-checking (“isometric”) test suites on the APES. All four standard test suites, plus a fifth new suite (Math Library Test Suite), were used to stress-test the compiler. This isometric testing revealed no additional problems. The test suites used were:

- 1) “IF” Test Suite – complex IF and IF-THEN-ELSE statement constructions involving comparisons between all HAL/S data types. This suite consists of 23 major tests, each comprised of 18 subtests.

- 2) Vector/Matrix Test Suite – tests all Matrix/Vector operations for 3-vector, n-vector, 3x3 matrix, and nxn matrix for both single and double precision. This suite consists of four major tests, each comprised of 22 subtests.
- 3) BIT String Subscripting Test Suite – tests bit string subscripting and partitioning for single bit strings and multi-dimensional arrays of bit strings. This suite consists of four major tests, each comprised of three subtests.
- 4) HAL/S Math Library Test Suite (new) – tests HAL/S Math Library routines (e.g., SIN, COS, TAN) by comparing with equivalent algorithms coded in HAL/S.
- 5) %MACRO Test Suite – tests %COPY, %NAMECOPY, and %NAMEADD macros.

5.5 Acceptance Test Results

5.5.1 OI280300

All FSW OI280300 HAL/S modules were compiled using 28.0 and 29.0. Object code differences were observed in FSW APPL module PMCCYC. Three “SRL” instructions were eliminated due to the fix for DR109060. The object code was correctly changed to treat an EVENT variable as a halfword. An object code difference was also observed in FSW APPL module GMGMAJ in the DATA_REMOTE candidate list. The object code change was attributed to DR109068. The runtime stack value was returned properly after the fix.

Differences in PASS FSW SDFs were attributed to CR12940A.

A visual inspection was performed on a random sampling of PASS FSW member listings to verify CR12940A and all DRs affecting the compiler listing.

The following 65 OI280300 FSW members are on the DATA_REMOTE candidate list and were compiled with DATA_REMOTE using 28.0 and 29.0:

ASISPE	DCDDS8	GC6ORB
GCFAER	GCMGCS	GCRORB
GDGDEO	GDJAMI	GDMSPI
GDTHUD	GDWASC	GDZAMI
GFDORB	GFHGRT	GFIGRT
GFKGRT	GFL12H	GFQPTI
GGRENT	GHKRTL	GKDASC
GKGMNV	GKLENT	GKORMO

GKWRMS	GKXRMC	GMGMAJ
GMQLSF	GP8HYD	GP0THC
GPPSRB	GPQSPT	GPZORB
GQCCOM	GR9RCS	GRORCS
GSAXFD	GSBENT	GSHHYD
GSNMPS	GSXRCS	GS5ASC
GV6STA	GWZRCS	GY1STS
GYUTAC	GZKENT	PMCCYC
PUSLS	RNCENC	ROVKYB
RYECNV	SACPMU	SPPPRECO
VAHCLEAN	VBQBITEA	VCMCSLMT
VCYCYCUP	VDEDEDDI	VDRDDURA
VM4BFSHU	VMBBDFLA	VNSNWSCY
VOM001	VRJDTOGG	

5.5.2 BFS271XX

All FSW BFS271XX HAL/S modules were compiled using 12.0 and 14.0. There were no object code differences found in BFS FSW.

Differences in BFS FSW SDFs were attributed to CR12940A.

A visual inspection was performed on a random sampling of BFS FSW member listings to verify CR12940A and all DRs affecting the compiler listing. One process error was found during the listing inspection of the BFS FSW listing. Incorrect output listing was observed in FSW member FDASDT due to an incomplete fix for DR109081. This problem was corrected and the revised fix was incorporated into the final release of the compiler.

6.0 Summary

The baseline for the PASS 29.0/BFS 14.0 releases consisted of 8 CRs and 45 DRs. For PASS, testing was performed with and without DATA_REMOTE.

Extensive expansion test cases were generated for 2 CRs and 37 DRs. Additional independent, supplemental test cases were generated for the same CRs and DRs, and the listings produced by these tests were used to extend the verification of “listing-only” changes such as CR 12940A. The number of test cases and test points for the supplemental expansion testing is shown after the ‘+’ signs in Appendix A. In other words, a test point count of 15+12 means that 15 test points were included in the expansion test cases, and 12 additional test points were included in the supplemental expansion tests. There were a total of ***FIX*** 2967 test points in 228 expansion and supplemental test cases.

A total of twenty-eight early errors were detected during unit and expansion testing. Five early errors caused by CR12935A, five caused by CR12940A, eight caused by DR109052, two caused by DR109071, three caused by DR109081, two caused by DR109083 and one each caused by DR109059, DR109067 and DR109095.

Six process errors were found during verification: one during expansion testing (caused by DR109052), four during functional testing (two caused by DR109095 and one each caused by DR109083 and CR12935A), and one during acceptance testing (caused by DR109081). All of these errors were corrected in the final release of the compiler. Nine latent DRs were found during expansion testing. These DRs are listed below:

- DR109090 - NAME REMOTE Dereference of Structure Node Fails
- DR109092 - Index Out of Range for HALMAT Operand Array
- DR109093 - NAME REMOTE Dereference of Minor Structure Node Fails
- DR109094 - Bad Object Code Generated When Variable Passed to Remote Library
- DR111310 - Optimizer infinite loop with Debug H(1)
- DR111314 - Include Fails With SRN Option
- DR111315 - VR0SN Fails with a NAME REMOTE Array Structure Node
- DR111318 - Name Remote Dereference With Virtual Base Fails
- DR111322 - Long Factor Declaration Appears as two statements in Output Listing

Five latent DRs (DR109090, DR109092, DR109093, DR109094 and DR111315) were added to the 29V0/14V0 baseline and these DR fixes were included in the final release of the compiler. DR111310, DR111314, DR111318 and DR111322 are scheduled to be fixed in the next compiler release, PASS 30V0/BFS 15V0.

Appendix A. Expansion and Supplemental Testing

228 expansion test cases covering 2969 test points were developed for 2 CRs and 37 DRs during development and testing of the 29.0/14.0 compilers. In addition, 27 supplemental test cases covering 426 test points were developed to further extend the testing envelope. DR109090, DR109092, DR109093, DR109094, DR111310, DR111314, DR111315, DR111318 and DR111322 were written to document latent problems detected during expansion testing. Five latent DRs (DR109090, DR109092, DR109093, DR109094 and DR111315) were added to the 29V0/14V0 baseline and these DR fixes were included in the final release of the compiler. Two errors related to CR12935A, two errors related to DR109071 and one each related to CR12940A, CR109052, DR109059, DR109067, DR109077, DR109083, DR109093 and DR111315 were found during expansion testing. These errors were corrected prior to the delivery of 29.0/14.0.

For each of the selected 2 CRs and 37 DRs, the CR/DR scenario, the associated expansion and supplemental test cases, and the errors identified are described in this report. The matrix at the end of the report summarizes the number of test cases, test points, problems identified, and new DRs written by associated CR/DR.

CR12935A - Allow REMOTE Pass by Reference Parameters

This CR has added the ability to pass REMOTE pass by reference parameters and removed the FT108 message for all cases except some unverified RTL routines. There must still be a restriction on passing a NAME variable that lives REMOTE as an ASSIGN parameter because its address must be passed to the procedure, and there is no way in the HAL/S language to declare the formal parameter properly. The FT112 error message has been modified to restrict this case. Also the D14 error message (INPUT PARAMETER ?? MAY NOT POSSESS THE ATTRIBUTE REMOTE) has been removed. For expansion testing, remote structures and structure terminals were used as ASSIGN parameters and input parameters. Variables were passed as ASSIGN parameters with all data types, various attributes and in NAME pseudo functions. ASSIGN parameters were also passed to external PROCEDURES from the main program and from an external PROCEDURES. Remotely included COMPOOLS were also used for the testing.

Expansion test cases: 41 test cases with a total of 1065 test points.

Problems found: Two early errors were found:

DI110 error was no longer being generated.

FT102 error was not always being generated for REMOTE NAME REMOTE structure terminals.

These two errors were corrected.

Supplemental test cases: 3 test cases with a total of 115 test points. Special attention was made to the situation with nested procedures, in which remote parameters were successively passed on to other procedures. As an additional test (although the parameters were clearly not “remote”), various types of stack-resident data (temporaries) were also passed as parameters.

CR12940A - Listing Enhancements for 29.0/14.0

This CR has improved the information and format of the HAL/S compiler listing. The developer's test cases were expanded to mix statement labels in the main PROGRAM, PROCEDURE, FUNCTION, and REENTRANT PROCEDURE. For phase 1 compiler output listing, test cases were expanded to test version numbers of statements in COMPOOLS, INCLUDE files, long statements, structure declarations multiple lines, PROCEDURES and inline FUNCTIONS. Replace macros were extensively used to test the version levels and to ensure that no extra lines were printed. For phase 2 assembly listings, some functional tests were used to extensively test for branching-related modifications, reporting of literal, changes to the structure template layout table and reporting of execution times.

Expansion test cases: 3 test cases with a total of 74 test points.

Problems found: One early error and a latent DR were found during the expansion testing:

Some of the instructions generated and checked, one instruction (SRR) execution time was reported incorrectly. This problem was corrected.

COMPOOLS compiled with the SRN and TPLT options are not correctly included into a program using the NOSDF keyword. DR111314 – “Included Fails With SRN Option” was written to document this problem.

Supplemental test cases: 1 test case with a total of 11 test points.

DR109052 - Arithmetic Expression in CONSTANT/INITIAL Value Gets Error

The initialization of CHARACTER values to arithmetic expressions generated DI6 and DI100 errors. For expansion testing, different combinations of characters, numbers, mathematical expressions, and built-in functions were used in the initialization statements of structure and non-structure character variables. Double precision, REMOTE, and AUTOMATIC variables were also used as well as factored and compound declares.

Expansion test cases: 4 test cases with a total of 206 test points.

Problems found: Expansion testing found an early error and one latent DR:

- 1) When the repetition factor (#) was used and the value to repeat was not enclosed in parentheses, DI6 or DI100 errors were still generated. This problem was corrected.

Initialization of character arrays in AUTOMATIC declarations would fail when the DATA_REMOTE option was used. DR109094 – “Bad Object Code Generated When Variable Passed to Remote Library” was written to document this problem. This DR was added to the 29V0/14V0 baseline and the problem was corrected in the final release of the compiler.

Supplemental test cases: 1 test case with a total of 34 test points.

DR109056 - Structure Parameter Receives Invalid DQ101 Error

Indirect stack entries for structures are supposed to contain the symbol table number of the structure template in the variable DEL. This was the case except when the structure node was of structure type, in which case DEL pointed to the symbol table number of the node. The expansion testing passed several different structure templates to user-defined functions.

Expansion test cases: 2 test cases with a total of 13 test points.

Supplemental test cases: 1 test case with a total of 7 test points.

DR109057 - Incorrect Indentation and Extra S-Line in Listing

After an IF-THEN statement without a DO, but with an E/S line, an ELSE or the statement before the ELSE statement could be indented incorrectly and have a blank E/S line. Also, if the IF-THEN statement contains an error, a duplicate error message could be printed. Expansion testing mixed different combinations of DO, DO-CASE, IF-THEN, and ELSE-IF statements along with REPLACE macros. For the expansion testing, SET, RESET, WAIT, and SIGNAL were used inside of user-defined PROCEDURES and TASK blocks. %COPY and %NAMEADD were also performed inside of PROCEDURES with and without DENSE BITS.

Expansion test cases: 1 test case with a total of 10 test points.

DR109059 - Indirect Stack Entry for EVENT Not Returned

When an EVENT variable is used in an initialization, assignment or comparison, an indirect stack entry may not be returned. When an element of an array of EVENT variables is used with SET, RESET, SIGNAL, SCHEDULE or WAIT, an indirect stack entry will not be returned. An indirect stack entry will also not be returned when an EVENT is passed as an ASSIGN parameter in a CALL statement. Over 100 of these types of statements could cause a BS106 error. For the expansion testing, SET, RESET, WAIT, and SIGNAL were used inside of user-defined PROCEDURES and TASK blocks. %COPY and %NAMEADD were also performed inside of PROCEDURES with and without DENSE BITS.

Expansion test cases: 1 test case with a total of 75 test points.

Problems found: One early error was discovered during expansion testing:

Indirect stack entries were not returned for statements with EVENT variables passed as ASSIGN parameters to user-defined PROCEDURES. This problem was corrected.

DR109061 - Level Number Missing on Line with Label

When a label's length is equal to or 1 less than the current indentation, the level number does not print for the executable statement in the compiled listing. Also, if the level number is ten or greater and the length of the label is two less than the indentation level, there is not a space between the label name and the level number. Expansion testing used DO-WHILE and IF-THEN loops with labels, and with REPLACE macros in place of the labels.

Expansion test cases: 2 test cases with a total of 5 test points.

DR109063 - Shifting More than 55 Spaces

When a literal shift amount greater than 55 is used in a HAL/S SHL or SHR function, the shift amount is not loaded into the appropriate register (defined by the AP101/S POO) thus producing bad object code. After the implementation of DR109063, the shift count is loaded into the correct register and correct object code is generated. Also, literal shift counts outside the range of 1 to 63 were allowed in the SHL and SHR functions. In expansion testing, shift variables used in the SHL and SHR instructions were declared as INTEGER DOUBLE, SCALAR, SCALAR DOUBLE, VECTOR, MATRIX, BIT, and REMOTE.

Expansion test cases: 5 test cases with a total of 56 test points.

DR109064 - -Indirect Stack Entry Not Returned for %COPY

See DR109059.

DR109066 - Line of Labels Doesn't Wrap Around

A group of labels that exceeded the length of a line did not wrap-around to the next line. Additionally, the labels that should have been printed on the following line were not printed at all. Expansion testing used labels with GOTO statements, DO-END groups, REPLACE macros, and imbedded comments.

Expansion test cases: 1 test case with a total of 3 test points.

DR109067 - -Indirect Stack Entry Not Returned for STRUCTURE Initialization

NAME multi-copied structure initializations may cause indirect stack entries not to be returned (which could cause a BS106 error - Indirect stack overflow), and incorrect BS122 errors (Indirect stack usage conflict) may occur. Expansion testing used NULL initializations for different types of variables. Structures and multi-copied structures were also declared AUTOMATIC inside REENTRANT PROCEDURES and FUNCTIONS.

Expansion test cases: 1 test case with a total of 60 test points.

Problems found: One early error was discovered during expansion testing:

Indirect stack entries were not returned for multi-copied structure initialization using # in the declare statement. This problem was corrected.

DR109068 - Indirect Stack Entry Not Returned for Checkpointed Register

When a register that was previously used as a base register is checkpointed, an indirect stack entry and a runtime stack entry may not be returned. Expansion testing tested arrays of matrices, double precision matrices, and matrices inside a dense structure template. These matrices were manipulated by both user-defined and library PROCEDURES and FUNCTIONS.

Expansion test cases: 1 test case with a total of 55 test points.

DR109070 - DI3 Error Incorrectly Emitted

An attempt to initialize NAME STRUCTUREs to point to either ASSIGN parameters or STRUCTUREs declared AUTOMATIC in a REENTRANT PROCEDURE/FUNCTION does not receive a DI3 error while at times correctly initialized NAME STRUCTUREs erroneously generate DI3 errors. Different attributes of structures were used in expansion testing such as DENSE, RIGID, and nested structures. Multi-copied structures were tested in REENTRANT PROCEDURES and FUNCTIONS, and other data types such as double precision integer and BOOLEAN were also tested.

Expansion test cases: 4 test cases with a total of 61 test points.

Supplemental test cases: 1 test case with a total of 13 test points.

DR109071 - STRUCTURE in ASSIGN Parameter Gets Error

Inappropriate and missing error messages were occurring with major structure declarations; secondly, terminals, which had inherited the DENSE attribute, were receiving an invalid error message; and thirdly, structure terminals, which inherit the LOCK attribute of their major structure, were also receiving an invalid error message. For expansion testing, major structures were declared with the LOCK or DENSE attribute then the minor structures were passed as assign arguments. NAME variables and multi-copied structures were also tested as well as different variations on the way DENSE structures can be defined.

Expansion test cases: 4 test cases with a total of 186 test points.

Problems found: Two early errors were found in the expansion testing:

Incorrect errors were generated for minor structure nodes passed into PROCEDURES.

Incorrect errors were generated for major structures initialized to point to LOCKed variables.

Both of the above problems were corrected.

Supplemental test cases: 1 test case with a total of 23 test points.

DR109074 - DOWNGRADE of DI21 Error Fails When Including a Remotely-Included COMPOOL

The following DOWNGRADE errors are occurring: 1) a DI21 severity 1 error is not downgraded when the REMOTE keyword is used while including a COMPOOL, 2) DOWNGRADEs for the errors XD7 and XI10 are performed for multiple statements, and 3) all DOWNGRADEs within INCLUDE statements with the NOSDF keyword are not performed when the INCLUDE statement is inside a DEFINE block. Expansion testing used included COMPOOLS, PROCEDURES, FUNCTIONS, and blocks for a variety of Severity 1 errors. Nested INCLUDEs and REPLACE macros were also tested.

Expansion test cases: 3 test cases with a total of 16 test points.

DR109076 - Replace Macro Split on Two Lines

When a REPLACE macro is used in a DECLARE, DO CASE or an IF-THEN-ELSE statement, the replace macro may be split across two lines in the compiler listing. If a "C" card or a "D" card is placed after a DO CASE or ELSE, the macro will split on two lines and the statement will be indented incorrectly. For expansion testing, the REPLACE macro was tested in DO-FOR, DO-WHILE, and DO-UNTIL statements. The macro was also used with other REPLACE macros and in the place of structure template definitions and INITIAL clauses.

Expansion test cases: 1 test case with a total of 8 test points.

DR109077 - FT100 Error for SIZE(STRUC.NAME_STRUC.ARRAY)

Statements of the form SIZE(structure.name_structure.array) receive a FT100 error (illegal argument to SIZE function) rather than returning the number of elements in the array. For expansion testing, multiple nesting of structures was used in conditional and assignment statements. Error generating statements were also tested such as subscripted arrays, multi-dimensional arrays, and non-arrayed variables.

Expansion test cases: 2 test case with a total of 5 test points.

Problems found: One process error was found associated with the implementation of DR109052.

A DI100 error message was incorrectly emitted due to a NAME ARRAY, NAME VECTOR or NAME MATRIX terminal being initialized and the structure template they were in also had at least one CHARACTER terminal.

This problem was corrected.

Supplemental test cases: 1 test case with a total of 8 test points. Testing was done to verify that the SIZE function would work on structures which were stack-resident (temporaries and formal parameters).

DR109078 - Bad Setup to VV1S3 for Multi-copy NAME Node LHS

It is possible for a load of a NAME structure node, which uses a virtual base register value to use the same register that contained the virtual value without the compiler noting the change. This could result in a bad load if another variable being referenced needed that same virtual base value, because the compiler would mistakenly believe the register contained the needed base value. Expansion testing tested assignment of vectors into a NAME node of a multi-copied structure with different combinations of subscripts using variables, literals, expressions, and partitions. Nested structures, double precision values, and REMOTE variables were also used.

Expansion test cases: 8 test cases with a total of 154 test points.

Problems found: One latent DR was found during the testing:

Some NAME REMOTE dereferencing of multi-copied structure nodes with variable subscripts failed. DR109090 – “NAME REMOTE Dereference of Structure Node Fails” was written to document this problem.

This DR was added to the 29V0/14V0 baseline and the problem was corrected in the final release of the compiler.

Supplemental test cases: 2 test cases with a total of 37 test points.

DR109081 - Lookup Failure for Long Token Lists

Long statements with over 250 tokens that contain subscripts, exponents, or character strings may not be printed correctly or may receive a BI100 Error Lookup Failure error depending on the placement of the variables. Subscripts or exponents with more than 11 levels may also receive a BI100 error or may cause other unpredictable results. Expansion testing created long token lists for factor declarations, REPLACE macros, and DO-WHILE loops. Multi-level exponentials and subscripts were also tested.

Expansion test cases: 3 test cases with a total of 17 test points.

Problems found: Two latent DRs were found during the expansion testing:

D9081C test case received an Abend in the optimizer. DR109092 – “Index Out of Range for HALMAT Operand Array” was written to document this problem. This DR was added to the 29V0/14V0 baseline and the problem was corrected in the final release of the compiler.

A factored declaration occupies two statement numbers, and the following statement is merged on the same line in the output listing. DR111322 – “Long Factor Declaration Appear as Two statement in Output Listing” was written to document this problem.

DR109082 - PASS2 STRUCTURE Template Table Incorrect in Listing

Structure templates are currently listed incorrectly in the "VARIABLE OFFSET TABLE" section of the Phase 2 compiler listing. In several cases, nodes or terminals that are not part of a structure are listed with that structure's template. The expansion testing used nested and arrayed structures.

Expansion test cases: 2 test cases with a total of 2 test points.

Supplemental test cases: 1 test case with a total of 3 test points.

DR109083 - CONSTANT DOUBLE SCALAR Converted to CHARACTER as Single Precision

Arithmetic expressions are always converted to character strings in single precision. Expansion testing included scalar expressions in declarations, scalar shaping functions, factored declarations, nested structures declared with the RIGID attribute, NAME dereferences, and mixing single and double precision scalars in expressions. Tests were also performed with FUNCTIONS, PROCEDURES, and comsubs.

Expansion test cases: 2 test cases with a total of 12 test points.

Problems found: One early error was found:

- 1) When a scalar arithmetic expression that contains only literals and non-aggregate constants is converted to a character string via a runtime library routine (ETOC or DTOC), the calculation and conversion will be in single precision.

This problem was documented in the HAL/S-FC User's Manual.

Supplemental test cases: 1 test case with a total of 6 test points.

DR109084 - -Structure Initialization May Cause Incorrect HALMAT

See DR109067.

DR109086 - No DA10 Error Message for DENSE, ALIGNED or RIGID

No DA10 error message was generated for DENSE, ALIGNED or RIGID attributes that were assigned to a major structure DECLARE. Expansion testing covered structures declared with different combinations of the attributes RIGID, ALIGNED, DENSE, AUTOMATIC, and REMOTE. These declarations were performed inside a COMPOOL, FUNCTION, PROCEDURE, and task block.

Expansion test cases: 2 test cases with a total of 12 test points.

DR109087 - BI516 Error Emitted for Nested Function Call

A reference of a scoped parameter (one that is declared in an outer PROCEDURE/FUNCTION of a nested PROCEDURE/FUNCTION) may cause the BI516 error to be emitted if the scoped parameter is either a major structure or structure node. The expansion cases tested stack walkbacks to SCALAR and INTEGER scoped formal parameters. Local and external PROCEDURES which performed stack walkbacks to SCALAR parameters, SCALAR ASSIGN parameters, STRUCTURE parameters, MATRIX parameters and INTEGER DOUBLE ASSIGN parameters.

Expansion test cases: 16 test cases with a total of 31 test points.

Supplemental test cases: 2 test cases with a total of 13 test points. Testing was also performed on scoped character strings and arrays of character strings since this has been a weak area in the past.

DR109089 - Bad Object Code Generated for Stack Walkback Loop

See DR109087.

DR109090 - NAME REMOTE Dereference of Structure Node Fails

A NAME REMOTE dereference of a structure node could fail for some cases that require a REMOTE RTL routine to perform the dereference. The expansion cases tested multi-copied structures with variable subscripts and NAME REMOTE node is or is not the 1st physical node. NAME REMOTE dereferences were also tested with subscripts in assignment statements using the COMPOOL structures.

Expansion test cases: 3 test cases with a total of 11 test points.

Problems found: One latent DR was found during the expansion testing:

When dereferencing a NAME REMOTE node of a minor structure, which is a node of a REMOTE structure, incorrect object code was generated. DR109093 – “NAME REMOTE dereference of minor structure node fails” was written to document this problem.

This DR was added to the 29V0/14V0 baseline and the problem was corrected in the final release of the compiler.

Supplemental test cases: 1 test case with a total of 7 test points.

DR109091 - Array Index Out of Range for Nested DO-CASE

When more than 11 DO-CASE statements are nested, the listing may be incorrect, incorrect error messages may be generated, or other unpredictable results may occur. The expansion testing was performed by nesting DO CASE clauses in the ELSE cases.

Expansion test cases: 1 test case with a total of 3 test points.

DR109092 - Index Out of Range for HALMAT Operand Array

Statements with over 50 operands that share common sub-expressions (CSE) with another statement could result in an Abend in the Optimizer, an infinite loop, or lead to other unpredictable results. The DR scenario was tested with CONSTANT and INITIAL clauses in DECLARE statements; in passing arguments to a FUNCTION; in an IF-THEN-ELSE or DO-END statements. Structure nodes with subscripts and exponents, NAME integer, and REPLACE macro were also tested.

Expansion test cases: 1 test case with a total of 10 test points.

DR109093 - NAME REMOTE Dereference Of Minor Structure Node Fails

Bad object code was generated when an operation required a dereference of a NAME node of a non-NAME minor structure that lives remote due to a NAME REMOTE node in a NAME pseudo-function. Bad object code was also generated when an operation required a dereference of a NAME REMOTE node of a non-NAME minor structure that lives remote and is not in a NAME pseudo-function. Expansion cases tested multiple assignments (i.e. initializing all elements of a multi-dimensional variable to 0) with a variety of REMOTE/non-REMOTE and NAME/non-NAME variables. Single assignments into vectors and arrays were also tested. SCALAR node and NAME scalar node of a REMOTE/non-REMOTE structure were passed to PROCEDURES. BIT assignments were also tested in various IF statements.

Expansion test cases: 4 test cases with a total of 217 test points.

Problems found: One latent DR was identified during the testing:

When an attempt was made to assign 0 to all elements in a NAME REMOTE array of vectors or matrices node using VROSN RTL failed. DR111315 - "VROSN Fails with a NAME REMOTE Array Structure Node" was written to document this latent problem.

This DR was added to the 29V0/14V0 baseline and the problem was corrected in the final release of the compiler.

Supplemental test cases: 2 test cases with a total of 44 test points.

DR109094 - Bad Object Code Generated When Variable Passed to Remote Library

Bad object code was sometimes generated when automatic declarations of character arrays and non-multi-copied structures containing at least one character terminal were initialized and DATA_REMOTE was active. Expansion cases tested automatic declaration of a nested non-multi-copied structure. Character string, vector, array of character string and array of vector were also tested as the structure nodes. Incorrect object code were generated in calls to CASR for character and array of character nodes.

Expansion test cases: 1 test case with a total of 16 test points.

Supplemental test cases: 1 test case with a total of 9 test points.

DR109095 - BIT Store Via DATA_REMOTE NAME REMOTE Dereference Fails

When dereferencing a NAME REMOTE node of a non-NAME structure, incorrect object code or error messages may be generated when DATA_REMOTE is used. There are basically four problems that can be observed in the object code. These are: 1) R1 is not restored at the correct time 2) R3 is not restored at all 3) checkpointed R1/R3 is restored to R2 instead of R1 and 4) an attempt is made to use R1 as a base register in an RS type instruction. Expansion cases tested NAME REMOTE dereferences with literal and variables subscripts for integer, boolean and bit type name nodes. Character strings were also tested. External PROCEDURE and FUNCTION which passed name nodes as arguments were also tested.

Expansion test cases: 6 test cases with a total of 25 test points.

Supplemental test cases: 2 test cases with a total of 13 test points.

DR109097 - Incorrect ZB1 or BS123 Error Generated

A ZB1 error was being generated for BIT(1) or BOOLEAN data declared AUTOMATIC and initialized to 1 or TRUE or ON. Also, data that is declared with both the REMOTE and AUTOMATIC attributes should get new error DA15. Expansion cases tested the declaration of various data types (bit, boolean, character string, array, structure, multi-copied structure, and nested structure) with the AUTOMATIC attribute. Declaration of various data types with REMOTE AUTOMATIC attributes were tested in PROGRAM, REENTRANT PROCEDURE/FUNCTION, external PROCEDURE, task block, and INCLUDE files.

Expansion test cases: 2 test cases with a total of 27 test points.

Supplemental test cases: 1 test case with a total of 14 test points.

DR109098 - Optimizer Generates Wrong HALMAT for Long Statements

Some statements with subtractions and Common Sub-Expressions were not rearranged properly by the Optimizer resulting in incorrect object code and execution results. After a CSE match is identified, the optimizer may swap an odd parity operand with the even parity subexpression which contains the newly found match, but then neglect to update the pointer to the newly matched subexpression after it is moved. When this pointer is used later, the expression becomes corrupted. Expansion cases were generated by a test case generator to generate expressions which were sums of six even and odd parity terms (variables and sub-expressions).

Expansion test cases: 10 test cases with a total of 375 test points.

Problems found: One latent problem was found during the expansion testing:

A test case with the DEBUG H(1) directive caused the compiler to go to an infinite loop. DR111310 – “Optimizer infinite loop with Debug H(1)” was written to document this problem.

DR109100 - Index Out of Range for DIFF_PTR and DIFF_NODE

Excessive numbers of small assign statements may overindex internal arrays to the compiler resulting in errors such as BI403, BI404, or BI002, or an infinite loop. Expansion test cases contained over 300 statements with the combination of assignment statements using all data types. Test cases with over 51 non-arrayed vector assignments were also tested. These test cases caused infinite loop in the optimizer.

Expansion test cases: 3 test cases with a total of 12 test points.

DR111302 - BI506 Error on Automatic Bit Initialization

If (1) DATA_REMOTE was in effect, (2) consecutive BIT(1) or BOOLEAN components were declared in an ARRAY or STRUCTURE, (3) the ARRAY or STRUCTURE was declared with the AUTOMATIC attribute, and (4) at least two consecutive BIT(1)/BOOLEAN components were initialized to 1 or TRUE or ON, then an erroneous BI506 error message (EXTRA CODE RECORD) was generated. Expansion cases tested with COMPOOL, REENTRANT FUNCTION and task block using arrays, structure, nested structure and multi-copied structure nodes of BIT(1), BIT(N) and boolean data types.

Expansion test cases: 1 test case with a total of 43 test points.

Supplemental test cases: 1 test case with a total of 21 test points.

DR111303 - BS123 Error for Structure Bit Operation

A BS123 error message may be incorrectly generated for initialization or assignment of a bit structure node with the REMOTE attribute. The problem may also occur for other types of REMOTE structure nodes assigned using SUBBIT. Expansion cases tested the BS123 error using nested structure, multi-copied structure, REMOTE structure and DENSE structure.

Expansion test cases: 3 test cases with a total of 18 test points.

Supplemental test cases: 1 test case with a total of 12 test points.

DR111306 - Index Out of Range for A_Parity and ADD

Many multi-dimensional assign statements may overindex arrays internal to the compiler resulting in errors such as BS122, Z02, run time errors, or abends in the Optimizer. Expansion cases tested combination of assignments using structure terminal, nested structure, multi-copied structure node of scalar, vector, and matrix. Multiple initialization. Assignments using vector and matrix were also tested.

Expansion test cases: 3 test cases with a total of 3 test points.

DR111315 - VROSN Fails with a NAME REMOTE Array Structure Node

A dereference of a NAME REMOTE array structure node of a REMOTE multi-copied structure may fail if more than one structure copy is involved in the statement. Expansion cases tested the DR scenario using a variety of RTLs. "TO" and "AT" were used in multi-copied structure subscripts. Various array data types (character string, bit string, scalar, vector and matrix) were tested. The error scenario was also tested using a remotely included COMPOOL.

Expansion test cases: 6 test cases with a total of 62 test points.

Problems found: During the expansion testing, test cases using array of matrix and vector types also failed. The waiver was modified to reflex this fact.

Supplemental test cases: 2 test cases with a total of 23 test points.

DR111317 - NAME REMOTE Dereference of STRUCTURE Node Fails

When DATA_REMOTE is used, a NAME initialization may produce an incorrect ZCON address if it is initialized to point to a variable that has arrayness. Expansion cases used "INITIAL" clause to initialize NAME nodes of a non-NAME structure and tested NAME nodes of various data types. The error scenario were also tested using array of double scalar, character string, bit string and multi-copied structure. NAME multi-copied structure with NAME nodes of vector and matrix and subscripted multi-copied structure were also tested.

Expansion test cases: 6 test cases with a total of 21 test points.

Problems found: One latent problem was found during the expansion testing:

When DATA_REMOTE was in effect, a NAME REMOTE dereference with a virtual base could produce incorrect object code. DR111318 - "NAME REMOTE dereference with virtual base fails" was written to document this problem.

Supplemental test cases: 1 test case with a total of 13 test points.

29.0/14.0 EXPANSION TEST MATRIX

CR/DR	# of Test Cases	# of Test Points	# of Problems
CR12935A	41+3	1065+115	2 (corrected)
CR12940A	3+1	74+11	2 (1 corrected, latent DR111314 written)
DR109052	4+1	206+34	2 (1 corrected, latent DR109094 written and corrected)
DR109056	2+1	13+7	
DR109057	1	10	
DR109059/DR109064	1	75	1 (corrected)
DR109061	2	5	
DR109063	5	56	
DR109066	1	3	
DR109067/DR109084	1	60	1 (corrected)
DR109068	1	55	
DR109070	4+1	61+13	
DR109071	4+1	186+23	2 (corrected)

DR109074	3	16	
DR109076	1	8	
DR109077	2+1	5+8	1 (corrected)
DR109078	8+2	154+37	1 (latent DR109090 written and corrected)
DR109081	3	17	2 (latent DR111322 written, latent DR109092 written and corrected)
DR109082	2+1	2+3	
DR109083	2+1	12+6	1 (corrected)
DR109086	2	12	
DR109087/DR109089	16+2	31+13	
DR109090	3+1	11+7	1 (latent DR109093 written and corrected)
DR109091	1	3	
DR109092	1	10	
DR109093	4+2	217+44	2 (1 corrected, latent DR111315 written and corrected)
DR109094	1+1	16+9	
DR109095	6+2	25+13	
DR109097	2+1	27+14	
DR109098	10	375	1 (latent DR111310 written)
DR109100	3	12	
DR111302	1+1	43+21	
DR111303	3+1	18+12	
DR111306	3	3	
DR111315	6+2	62+23	
DR111317	6+1	21+13	1 (latent DR111318 written)
Totals	228+27	2969+426	