

# Coverity Support for AUTOSAR Coding Standards

**Ensure the safety, reliability, and security of software written in C++14**

## AUTOSAR 19.03

The AUTOSAR R19-03 standard provides guidelines for the use of the C++14 language in critical and safety-related systems. Tables 1 and 2 show Coverity coverage of these rules (both required and advisory). Not all rules are supported, as some are not statically verifiable.

## Overview

According to the [AUTOSAR website](#), "The AUTOSAR partnership is an alliance of OEM manufacturers, Tier 1 automotive suppliers, semiconductor manufacturers, software suppliers, tool suppliers and others. Considering the different automotive E/E architectures in the current and future markets, the partnership established a de-facto open industry standard for an automotive software architecture. It will serve as a basic infrastructure for the management of functions within both future applications and standard software modules." The AUTOSAR standards are used in safety-critical industries, such as automotive, with emerging applications in highly automated driving and new connected automotive software systems.

[Coverity® Static Analysis](#) supports the AUTOSAR Adaptive Platform 19.03 by providing checkers for statically verifiable rules of this standard.

**Table 1**

Category	Supported	Unsupported	All	Percent coverage
Required	334	29	363	92%
Advisory	29	5	34	85%
All	363	34	397	91%

**Table 2**

Automation type	Supported	Unsupported	All	Percent coverage
Automated	327	2	329	99%
Partially automated	22	0	22	100%
Non-automated	14	32	46	30%
All	363	34	397	91%

## Automation type definitions

**Automated:** These are rules that are automatically enforceable by means of static analysis.

**Partially automated:** These are the rules that can be supported by static code analysis, e.g. by heuristic or by covering some error scenarios, as a support for a manual code review.

**Non-automated:** These are the rules where the static analysis cannot provide any reasonable support by a static code analysis and they require other means, e.g. manual code review or other tools.

Rule	Description	Automation type	Category	Supported
A0-1-1	A project shall not contain instances of non-volatile variables being given values that are not subsequently used.	Automated	Required	Yes
A0-1-2	The value returned by a function having a non-void return type that is not an overloaded operator shall be used.	Automated	Required	Yes
A0-1-3	Every function defined in an anonymous namespace, or static function with internal linkage, or private member function shall be used.	Automated	Required	Yes
A0-1-4	There shall be no unused named parameters in non-virtual functions.	Automated	Required	Yes
A0-1-5	There shall be no unused named parameters in the set of parameters for a virtual function and all the functions that override it.	Automated	Required	Yes
A0-1-6	There should be no unused type declarations.	Automated	Advisory	Yes
A0-4-1	Floating-point implementation shall comply with IEEE 754 standard.	Non-automated	Required	No
A0-4-2	Type long double shall not be used.	Automated	Required	Yes
A0-4-3	The implementations in the chosen compiler shall strictly comply with the C++14 Language Standard.	Automated	Required	No
A0-4-4	Range, domain and pole errors shall be checked when using math functions.	Partially automated	Required	Yes
A1-1-1	All code shall conform to ISO/IEC 14882:2014 - Programming Language C++ and shall not use deprecated features.	Automated	Required	Yes
A1-1-2	A warning level of the compilation process shall be set in compliance with project policies.	Non-automated	Required	No
A1-1-3	An optimization option that disregards strict standard compliance shall not be turned on in the chosen compiler.	Non-automated	Required	No
A1-2-1	When using a compiler toolchain (including preprocessor, compiler itself, linker, C++ standard libraries) in safety-related software, the tool confidence level (TCL) shall be determined. In case of TCL2 or TCL3, the compiler shall undergo a "Qualification of a software tool", as per ISO 26262-8.11.4.6 [6].	Non-automated	Required	No
A1-4-1	Code metrics and their valid boundaries shall be defined and code shall comply with defined boundaries of code metrics.	Non-automated	Required	No
A1-4-3	All code should compile free of compiler warnings.	Automated	Advisory	No
A2-3-1	Only those characters specified in the C++ Language Standard basic source character set shall be used in the source code.	Automated	Required	Yes
A2-5-1	Trigraphs shall not be used.	Automated	Required	Yes
A2-5-2	Digraphs shall not be used.	Automated	Required	Yes
A2-7-1	The character \ shall not occur as a last character of a C++ comment.	Automated	Required	Yes
A2-7-2	Sections of code shall not be "commented out".	Non-automated	Required	Yes
A2-7-3	All declarations of "user-defined" types, static and non-static data members, functions and methods shall be preceded by documentation.	Automated	Required	Yes
A2-7-5	Comments shall not document any actions or sources (e.g. tables, figures, paragraphs, etc.) that are outside of the file.	Non-automated	Required	No
A2-8-1	A header file name should reflect the logical entity for which it provides declarations.	Non-automated	Required	No
A2-8-2	An implementation file name should reflect the logical entity for which it provides definitions.	Non-automated	Advisory	No

Rule	Description	Automation type	Category	Supported
A2-10-1	An identifier declared in an inner scope shall not hide an identifier declared in an outer scope.	Automated	Required	Yes
A2-10-4	The identifier name of a non-member object with static storage duration or static function shall not be reused within a namespace.	Automated	Required	Yes
A2-10-5	An identifier name of a function with static storage duration or a non-member object with external or internal linkage should not be reused.	Automated	Advisory	Yes
A2-10-6	A class or enumeration name shall not be hidden by a variable, function or enumerator declaration in the same scope.	Automated	Required	Yes
A2-11-1	Volatile keyword shall not be used.	Automated	Required	Yes
A2-13-1	Only those escape sequences that are defined in ISO/IEC 14882:2014 shall be used.	Automated	Required	Yes
A2-13-2	String literals with different encoding prefixes shall not be concatenated.	Automated	Required	Yes
A2-13-3	Type wchar_t shall not be used.	Automated	Required	Yes
A2-13-4	String literals shall not be assigned to non-constant pointers.	Automated	Required	Yes
A2-13-5	Hexadecimal constants should be upper case.	Automated	Advisory	Yes
A2-13-6	Universal character names shall be used only inside character or string literals.	Automated	Required	Yes
A3-1-1	It shall be possible to include any header file in multiple translation units without violating the One Definition Rule.	Automated	Required	Yes
A3-1-2	Header files, that are defined locally in the project, shall have a file name extension of one of: ".h", ".hpp" or "..hxx".	Automated	Required	Yes
A3-1-3	Implementation files, that are defined locally in the project, should have a file name extension of ".cpp".	Automated	Advisory	Yes
A3-1-4	When an array with external linkage is declared, its size shall be stated explicitly.	Automated	Required	Yes
A3-1-5	A function definition shall only be placed in a class definition if (1) the function is intended to be inlined (2) it is a member function template (3) it is a member function of a class template.	Partially automated	Required	Yes
A3-1-6	Trivial accessor and mutator functions should be inlined.	Automated	Advisory	Yes
A3-3-1	Objects or functions with external linkage (including members of named namespaces) shall be declared in a header file.	Automated	Required	Yes
A3-3-2	Static and thread-local objects shall be constant-initialized.	Automated	Required	Yes
A3-8-1	An object shall not be accessed outside of its lifetime.	Non-automated	Required	Yes
A3-9-1	Fixed width integer types from <cstdint>, indicating the size and signedness, shall be used in place of the basic numerical types.	Automated	Required	Yes
A4-5-1	Expressions with type enum or enum class shall not be used as operands to built-in and overloaded operators other than the subscript operator [], the assignment operator =, the equality operators == and !=, the unary & operator, and the relational operators <, <=, >, >=.	Automated	Required	Yes
A4-7-1	An integer expression shall not lead to data loss.	Automated	Required	Yes
A4-10-1	Only nullptr literal shall be used as the null-pointer-constant.	Automated	Required	Yes
A5-0-1	The value of an expression shall be the same under any order of evaluation that the standard permits.	Automated	Required	Yes
A5-0-2	The condition of an if-statement and the condition of an iteration statement shall have type bool.	Automated	Required	Yes

Rule	Description	Automation type	Category	Supported
A5-0-3	The declaration of objects shall contain no more than two levels of pointer indirection.	Automated	Required	Yes
A5-0-4	Pointer arithmetic shall not be used with pointers to non-final classes.	Automated	Required	Yes
A5-1-1	Literal values shall not be used apart from type initialization, otherwise symbolic names shall be used instead.	Partially automated	Required	Yes
A5-1-2	Variables shall not be implicitly captured in a lambda expression.	Automated	Required	Yes
A5-1-3	Parameter list (possibly empty) shall be included in every lambda expression.	Automated	Required	Yes
A5-1-4	A lambda expression object shall not outlive any of its reference-captured objects.	Automated	Required	Yes
A5-1-6	Return type of a non-void return type lambda expression should be explicitly specified.	Automated	Advisory	Yes
A5-1-7	A lambda shall not be an operand to decltype or typeid.	Automated	Required	Yes
A5-1-8	Lambda expressions should not be defined inside another lambda expression.	Automated	Advisory	Yes
A5-1-9	Identical unnamed lambda expressions shall be replaced with a named function or a named lambda expression.	Automated	Advisory	Yes
A5-2-1	Dynamic_cast should not be used.	Automated	Advisory	Yes
A5-2-2	Traditional C-style casts shall not be used.	Automated	Required	Yes
A5-2-3	A cast shall not remove any const or volatile qualification from the type of a pointer or reference.	Automated	Required	Yes
A5-2-4	reinterpret_cast shall not be used.	Automated	Required	Yes
A5-2-5	An array or container shall not be accessed beyond its range.	Automated	Required	Yes
A5-2-6	The operands of a logical && or    shall be parenthesized if the operands contain binary operators.	Automated	Required	Yes
A5-3-1	Evaluation of the operand to the typeid operator shall not contain side effects.	Non-automated	Required	Yes
A5-3-2	Null pointers shall not be dereferenced.	Partially automated	Required	Yes
A5-3-3	Pointers to incomplete class types shall not be deleted.	Automated	Required	Yes
A5-5-1	A pointer to member shall not access non-existent class members.	Automated	Required	Yes
A5-6-1	The right hand operand of the integer division or remainder operators shall not be equal to zero.	Automated	Required	Yes
A5-10-1	A pointer to member virtual function shall only be tested for equality with null-pointer-constant.	Automated	Required	Yes
A5-16-1	The ternary conditional operator shall not be used as a sub-expression.	Automated	Required	Yes
A6-2-1	Move and copy assignment operators shall either move or respectively copy base classes and data members of a class, without any side effects.	Automated	Required	Yes
A6-2-2	Expression statements shall not be explicit calls to constructors of temporary objects only.	Automated	Required	Yes
A6-4-1	A switch statement shall have at least two case-clauses, distinct from the default label.	Automated	Required	Yes
A6-5-1	A for-loop that loops through all elements of the container and does not use its loop-counter shall not be used.	Automated	Required	Yes
A6-5-2	A for loop shall contain a single loop-counter which shall not have floating-point type.	Automated	Required	Yes

Rule	Description	Automation type	Category	Supported
A6-5-3	Do statements should not be used.	Automated	Advisory	Yes
A6-5-4	For-init-statement and expression should not perform actions other than loop-counter initialization and modification.	Automated	Advisory	Yes
A6-6-1	The goto statement shall not be used.	Automated	Required	Yes
A7-1-1	Constexpr or const specifiers shall be used for immutable data declaration.	Automated	Required	Yes
A7-1-2	The constexpr specifier shall be used for values that can be determined at compile time.	Automated	Required	Yes
A7-1-3	CV-qualifiers shall be placed on the right hand side of the type that is a typedef or a using name.	Automated	Required	Yes
A7-1-4	The register keyword shall not be used.	Automated	Required	Yes
A7-1-5	The auto specifier shall not be used apart from following cases: (1) to declare that a variable has the same type as return type of a function call, (2) to declare that a variable has the same type as initializer of non-fundamental type, (3) to declare parameters of a generic lambda expression, (4) to declare a function template using trailing return type syntax.	Automated	Required	Yes
A7-1-6	The typedef specifier shall not be used.	Automated	Required	Yes
A7-1-7	Each expression statement and identifier declaration shall be placed on a separate line.	Automated	Required	Yes
A7-1-8	A non-type specifier shall be placed before a type specifier in a declaration.	Automated	Required	Yes
A7-1-9	A class, structure, or enumeration shall not be declared in the definition of its type.	Automated	Required	Yes
A7-2-1	An expression with enum underlying type shall only have values corresponding to the enumerators of the enumeration.	Automated	Required	Yes
A7-2-2	Enumeration underlying base type shall be explicitly defined.	Automated	Required	Yes
A7-2-3	Enumerations shall be declared as scoped enum classes.	Automated	Required	Yes
A7-2-4	In an enumeration, either (1) none, (2) the first or (3) all enumerators shall be initialized.	Automated	Required	Yes
A7-2-5	Enumerations should be used to represent sets of related named constants.	Non-automated	Advisory	No
A7-3-1	All overloads of a function shall be visible from where it is called.	Automated	Required	Yes
A7-4-1	The asm declaration shall not be used.	Automated	Required	Yes
A7-5-1	A function shall not return a reference or a pointer to a parameter that is passed by reference to const.	Automated	Required	Yes
A7-5-2	Functions shall not call themselves, either directly or indirectly.	Automated	Required	Yes
A7-6-1	Functions declared with the [[noreturn]] attribute shall not return.	Automated	Required	Yes
A8-2-1	When declaring function templates, the trailing return type syntax shall be used if the return type depends on the type of parameters.	Automated	Required	Yes
A8-4-1	Functions shall not be defined using the ellipsis notation.	Automated	Required	Yes
A8-4-2	All exit paths from a function with non-void return type shall have an explicit return statement with an expression.	Automated	Required	Yes
A8-4-3	Common ways of passing parameters should be used.	Non-automated	Advisory	No
A8-4-4	Multiple output values from a function should be returned as a struct or tuple.	Automated	Advisory	Yes
A8-4-5	"consume" parameters declared as X && shall always be moved from.	Automated	Required	Yes

Rule	Description	Automation type	Category	Supported
A8-4-6	"forward" parameters declared as T && shall always be forwarded.	Automated	Required	Yes
A8-4-7	"in" parameters for "cheap to copy" types shall be passed by value.	Automated	Required	Yes
A8-4-8	Output parameters shall not be used.	Automated	Required	Yes
A8-4-9	"in-out" parameters declared as T & shall be modified.	Automated	Required	Yes
A8-4-10	A parameter shall be passed by reference if it can't be NULL.	Automated	Required	Yes
A8-4-11	A smart pointer shall only be used as a parameter type if it expresses lifetime semantics.	Automated	Required	Yes
A8-4-12	A std::unique_ptr shall be passed to a function as: (1) a copy to express the function assumes ownership (2) an lvalue reference to express that the function replaces the managed object.	Automated	Required	Yes
A8-4-13	A std::shared_ptr shall be passed to a function as: (1) a copy to express the function shares ownership (2) an lvalue reference to express that the function replaces the managed object (3) a const lvalue reference to express that the function retains a reference count.	Automated	Required	Yes
A8-4-14	Interfaces shall be precisely and strongly typed.	Non-automated	Required	No
A8-5-0	All memory shall be initialized before it is read.	Automated	Required	Yes
A8-5-1	In an initialization list, the order of initialization shall be following: (1) virtual base classes in depth and left to right order of the inheritance graph, (2) direct base classes in left to right order of inheritance list, (3) non-static data members in the order they were declared in the class definition.	Automated	Required	Yes
A8-5-2	Braced-initialization {}, without equals sign, shall be used for variable initialization.	Automated	Required	Yes
A8-5-3	A variable of type auto shall not be initialized using {} or ={} braced-initialization.	Automated	Required	Yes
A8-5-4	If a class has a user-declared constructor that takes a parameter of type std::initializer_list, then it shall be the only constructor apart from special member function constructors.	Automated	Advisory	Yes
A9-3-1	Member functions shall not return non-const "raw" pointers or references to private or protected data owned by the class.	Partially automated	Required	Yes
A9-5-1	Unions shall not be used.	Automated	Required	Yes
A9-6-1	Data types used for interfacing with hardware or conforming to communication protocols shall be trivial, standard-layout and only contain members of types with defined sizes.	Partially automated	Required	Yes
A9-6-2	Bit-fields shall be used only when interfacing to hardware or conforming to communication protocols.	Non-automated	Required	No
A10-0-1	Public inheritance shall be used to implement "is-a" relationship.	Non-automated	Required	No
A10-0-2	Membership or non-public inheritance shall be used to implement "has-a" relationship.	Non-automated	Required	No
A10-1-1	Class shall not be derived from more than one base class which is not an interface class.	Automated	Required	Yes
A10-2-1	Non-virtual public or protected member functions shall not be redefined in derived classes.	Automated	Required	Yes
A10-3-1	Virtual function declaration shall contain exactly one of the three specifiers: (1) virtual, (2) override, (3) final.	Automated	Required	Yes
A10-3-2	Each overriding virtual function shall be declared with the override or final specifier.	Automated	Required	Yes

Rule	Description	Automation type	Category	Supported
A10-3-3	Virtual functions shall not be introduced in a final class.	Automated	Required	Yes
A10-3-5	A user-defined assignment operator shall not be virtual.	Automated	Required	Yes
A10-4-1	Hierarchies should be based on interface classes.	Non-automated	Advisory	No
A11-0-1	A non-POD type should be defined as class.	Automated	Advisory	Yes
A11-0-2	A type defined as struct shall: (1) provide only public data members, (2) not provide any special member functions or methods, (3) not be a base of another struct or class, (4) not inherit from another struct or class.	Automated	Required	Yes
A11-3-1	Friend declarations shall not be used.	Automated	Required	Yes
A12-0-1	If a class declares a copy or move operation, or a destructor, either via “=default”, “=delete”, or via a user-provided declaration, then all others of these five special member functions shall be declared as well.	Automated	Required	Yes
A12-0-2	Bitwise operations and operations that assume data representation in memory shall not be performed on objects.	Partially automated	Required	Yes
A12-1-1	Constructors shall explicitly initialize all virtual base classes, all direct non-virtual base classes and all non-static data members.	Automated	Required	Yes
A12-1-2	Both NSDMI and a non-static member initializer in a constructor shall not be used in the same type.	Automated	Required	Yes
A12-1-3	If all user-defined constructors of a class initialize data members with constant values that are the same across all constructors, then data members shall be initialized using NSDMI instead.	Automated	Required	Yes
A12-1-4	All constructors that are callable with a single argument of fundamental type shall be declared explicit.	Automated	Required	Yes
A12-1-5	Common class initialization for non-constant members shall be done by a delegating constructor.	Partially automated	Required	Yes
A12-1-6	Derived classes that do not need further explicit initialization and require all the constructors from the base class shall use inheriting constructors.	Automated	Required	Yes
A12-4-1	Destructor of a base class shall be public virtual, public override or protected non-virtual.	Automated	Required	Yes
A12-4-2	If a public destructor of a class is non-virtual, then the class should be declared final.	Automated	Advisory	Yes
A12-6-1	All class data members that are initialized by the constructor shall be initialized using member initializers.	Automated	Required	Yes
A12-7-1	If the behavior of a user-defined special member function is identical to implicitly defined special member function, then it shall be defined “=default” or be left undefined.	Automated	Required	Yes
A12-8-1	Move and copy constructors shall move and respectively copy base classes and data members of a class, without any side effects.	Automated	Required	Yes
A12-8-2	User-defined copy and move assignment operators should use user-defined no-throw swap function.	Automated	Advisory	Yes
A12-8-3	Moved-from object shall not be read-accessed.	Partially automated	Required	Yes
A12-8-4	Move constructor shall not initialize its class members and base classes using copy semantics.	Automated	Required	Yes
A12-8-5	A copy assignment and a move assignment operators shall handle self-assignment.	Automated	Required	Yes

Rule	Description	Automation type	Category	Supported
A12-8-6	Copy and move constructors and copy assignment and move assignment operators shall be declared protected or defined “=delete” in base class.	Automated	Required	Yes
A12-8-7	Assignment operators should be declared with the ref-qualifier &.	Automated	Advisory	Yes
A13-1-2	User defined suffixes of the user defined literal operators shall start with underscore followed by one or more letters.	Automated	Required	Yes
A13-1-3	User defined literals operators shall only perform conversion of passed parameters.	Automated	Required	Yes
A13-2-1	An assignment operator shall return a reference to “this”.	Automated	Required	Yes
A13-2-2	A binary arithmetic operator and a bitwise operator shall return a “prvalue”.	Automated	Required	Yes
A13-2-3	A relational operator shall return a boolean value.	Automated	Required	Yes
A13-3-1	A function that contains “forwarding reference” as its argument shall not be overloaded.	Automated	Required	Yes
A13-5-1	If “operator[]” is to be overloaded with a non-const version, const version shall also be implemented.	Automated	Required	Yes
A13-5-2	All user-defined conversion operators shall be defined explicit.	Automated	Required	Yes
A13-5-3	User-defined conversion operators should not be used.	Automated	Advisory	Yes
A13-5-4	If two opposite operators are defined, one shall be defined in terms of the other.	Automated	Required	Yes
A13-5-5	Comparison operators shall be non-member functions with identical parameter types and noexcept.	Automated	Required	Yes
A13-6-1	Digit sequences separators ‘ ’ shall only be used as follows: (1) for decimal, every 3 digits, (2) for hexadecimal, every 2 digits, (3) for binary, every 4 digits.	Automated	Required	Yes
A14-1-1	A template should check if a specific template argument is suitable for this template.	Non-automated	Advisory	Yes
A14-5-1	A template constructor shall not participate in overload resolution for a single argument of the enclosing class type.	Automated	Required	Yes
A14-5-2	Class members that are not dependent on template class parameters should be defined in a separate base class.	Partially automated	Advisory	Yes
A14-5-3	A non-member generic operator shall only be declared in a namespace that does not contain class (struct) type, enum type or union type declarations.	Automated	Advisory	Yes
A14-7-1	A type used as a template argument shall provide all members that are used by the template.	Automated	Required	Yes
A14-7-2	Template specialization shall be declared in the same file (1) as the primary template (2) as a user-defined type, for which the specialization is declared.	Automated	Required	Yes
A14-8-2	Explicit specializations of function templates shall not be used.	Automated	Required	Yes
A15-0-1	A function shall not exit with an exception if it is able to complete its task.	Non-automated	Required	No
A15-0-2	At least the basic guarantee for exception safety shall be provided for all operations. In addition, each function may offer either the strong guarantee or the nothrow guarantee.	Partially automated	Required	Yes
A15-0-3	Exception safety guarantee of a called function shall be considered.	Non-automated	Required	Yes
A15-0-4	Unchecked exceptions shall be used to represent errors from which the caller cannot reasonably be expected to recover.	Non-automated	Required	No

Rule	Description	Automation type	Category	Supported
A15-0-5	Checked exceptions shall be used to represent errors from which the caller can reasonably be expected to recover.	Non-automated	Required	No
A15-0-6	An analysis shall be performed to analyze the failure modes of exception handling. In particular, the following failure modes shall be analyzed: (a) worst time execution time not existing or cannot be determined, (b) stack not correctly unwind, (c) exception not thrown, other exception thrown, wrong catch activated, (d) memory not available while exception handling.	Non-automated	Required	No
A15-0-7	Exception handling mechanism shall guarantee a deterministic worst-case time execution time.	Partially automated	Required	Yes
A15-0-8	A worst-case execution time (WCET) analysis shall be performed to determine maximum execution time constraints of the software, covering in particular the exceptions processing.	Non-automated	Required	No
A15-1-1	Only instances of types derived from std::exception should be thrown.	Automated	Advisory	Yes
A15-1-2	An exception object shall not be a pointer.	Automated	Required	Yes
A15-1-3	All thrown exceptions should be unique.	Automated	Advisory	Yes
A15-1-4	If a function exits with an exception, then before a throw, the function shall place all objects/resources that the function constructed in valid states or it shall delete them.	Partially automated	Required	Yes
A15-1-5	Exceptions shall not be thrown across execution boundaries.	Non-automated	Required	Yes
A15-2-1	Constructors that are not noexcept shall not be invoked before program startup.	Automated	Required	Yes
A15-2-2	If a constructor is not noexcept and the constructor cannot finish object initialization, then it shall deallocate the object's resources and it shall throw an exception.	Partially automated	Required	Yes
A15-3-2	If a function throws an exception, it shall be handled when meaningful actions can be taken, otherwise it shall be propagated.	Non-automated	Required	No
A15-3-3	Main function and a task main function shall catch at least: base class exceptions from all third-party libraries used, std::exception and all otherwise unhandled exceptions.	Partially automated	Required	Yes
A15-3-4	Catch-all (ellipsis and std::exception) handlers shall be used only in (a) main, (b) task main functions, (c) in functions that are supposed to isolate independent components and (d) when calling third-party code that uses exceptions not according to AUTOSAR C++14 guidelines.	Non-automated	Required	Yes
A15-3-5	A class type exception shall be caught by reference or const reference.	Automated	Required	Yes
A15-4-1	Dynamic exception-specification shall not be used.	Automated	Required	Yes
A15-4-2	If a function is declared to be noexcept, noexcept(true) or noexcept(<true condition>), then it shall not exit with an exception.	Automated	Required	Yes
A15-4-3	The noexcept specification of a function shall either be identical across all translation units, or identical or more restrictive between a virtual member function and an overrider.	Automated	Required	Yes
A15-4-4	A declaration of non-throwing function shall contain noexcept specification.	Automated	Required	Yes
A15-4-5	Checked exceptions that could be thrown from a function shall be specified together with the function declaration and they shall be identical in all function declarations and for all its overriders.	Automated	Required	Yes

Rule	Description	Automation type	Category	Supported
A15-5-1	All user-provided class destructors, deallocation functions, move constructors, move assignment operators and swap functions shall not exit with an exception. A noexcept exception specification shall be added to these functions as appropriate.	Automated	Required	Yes
A15-5-2	Program shall not be abruptly terminated. In particular, an implicit or explicit invocation of std::abort(), std::quick_exit(), std::_Exit(), std::terminate() shall not be done.	Partially automated	Required	Yes
A15-5-3	The std::terminate() function shall not be called implicitly.	Automated	Required	Yes
A16-0-1	The pre-processor shall only be used for unconditional and conditional file inclusion and include guards, and using the following directives: (1) #ifndef, (2) #ifdef, (3) #if, (4) #if defined, (5) #elif, (6) #else, (7) #define, (8) #endif, (9) #include.	Automated	Required	Yes
A16-2-1	The ', ", /*, //, \ characters shall not occur in a header file name or in #include directive.	Automated	Required	Yes
A16-2-2	There shall be no unused include directives.	Automated	Required	Yes
A16-2-3	An include directive shall be added explicitly for every symbol used in a file.	Non-automated	Required	Yes
A16-6-1	#error directive shall not be used.	Automated	Required	Yes
A16-7-1	The #pragma directive shall not be used.	Automated	Required	Yes
A17-0-1	Reserved identifiers, macros and functions in the C++ standard library shall not be defined, redefined or undefined.	Automated	Required	Yes
A17-0-2	All project's code including used libraries (including standard and user-defined libraries) and any third-party user code shall conform to the AUTOSAR C++14 Coding Guidelines.	Non-automated	Required	No
A17-1-1	Use of the C Standard Library shall be encapsulated and isolated.	Non-automated	Required	Yes
A17-6-1	Non-standard entities shall not be added to standard namespaces.	Automated	Required	Yes
A18-0-1	The C library facilities shall only be accessed through C++ library headers.	Automated	Required	Yes
A18-0-2	The error state of a conversion from string to a numeric value shall be checked.	Automated	Required	Yes
A18-0-3	The library <clocale> (locale.h) and the setlocale function shall not be used.	Automated	Required	Yes
A18-1-1	C-style arrays shall not be used.	Automated	Required	Yes
A18-1-2	The std::vector<bool> specialization shall not be used.	Automated	Required	Yes
A18-1-3	The std::auto_ptr type shall not be used.	Automated	Required	Yes
A18-1-4	A pointer pointing to an element of an array of objects shall not be passed to a smart pointer of single object type.	Automated	Required	Yes
A18-1-6	All std::hash specializations for user-defined types shall have a noexcept function call operator.	Automated	Required	Yes
A18-5-1	Functions malloc, calloc, realloc and free shall not be used.	Automated	Required	Yes
A18-5-2	Non-placement new or delete expressions shall not be used.	Partially automated	Required	Yes
A18-5-3	The form of the delete expression shall match the form of the new expression used to allocate the memory.	Automated	Required	Yes
A18-5-4	If a project has sized or unsized version of operator "delete" globally defined, then both sized and unsized versions shall be defined.	Automated	Required	Yes

Rule	Description	Automation type	Category	Supported
A18-5-5	Memory management functions shall ensure the following: (a) deterministic behavior resulting with the existence of worst-case execution time, (b) avoiding memory fragmentation, (c) avoid running out of memory, (d) avoiding mismatched allocations or deallocations, (e) no dependence on non-deterministic calls to kernel.	Partially automated	Required	Yes
A18-5-6	An analysis shall be performed to analyze the failure modes of dynamic memory management. In particular, the following failure modes shall be analyzed: (a) non-deterministic behavior resulting with nonexistence of worst-case execution time, (b) memory fragmentation, (c) running out of memory, (d) mismatched allocations and deallocations, (e) dependence on non-deterministic calls to kernel.	Non-automated	Required	No
A18-5-7	If non-realtime implementation of dynamic memory management functions is used in the project, then memory shall only be allocated and deallocated during non-realtime program phases.	Non-automated	Required	No
A18-5-8	Objects that do not outlive a function shall have automatic storage duration.	Partially automated	Required	Yes
A18-5-9	Custom implementations of dynamic memory allocation and deallocation functions shall meet the semantic requirements specified in the corresponding "Required behaviour" clause from the C++ Standard.	Automated	Required	Yes
A18-5-10	Placement new shall be used only with properly aligned pointers to sufficient storage capacity.	Automated	Required	Yes
A18-5-11	"operator new" and "operator delete" shall be defined together.	Automated	Required	Yes
A18-9-1	The std::bind shall not be used.	Automated	Required	Yes
A18-9-2	Forwarding values to other functions shall be done via: (1) std::move if the value is an rvalue reference, (2) std::forward if the value is forwarding reference.	Automated	Required	Yes
A18-9-3	The std::move shall not be used on objects declared const or const&.	Automated	Required	Yes
A18-9-4	An argument to std::forward shall not be subsequently used.	Automated	Required	Yes
A20-8-1	An already-owned pointer value shall not be stored in an unrelated smart pointer.	Automated	Required	Yes
A20-8-2	A std::unique_ptr shall be used to represent exclusive ownership.	Automated	Required	Yes
A20-8-3	A std::shared_ptr shall be used to represent shared ownership.	Automated	Required	Yes
A20-8-4	A std::unique_ptr shall be used over std::shared_ptr if ownership sharing is not required.	Automated	Required	Yes
A20-8-5	std::make_unique shall be used to construct objects owned by std::unique_ptr.	Automated	Required	Yes
A20-8-6	std::make_shared shall be used to construct objects owned by std::shared_ptr.	Automated	Required	Yes
A20-8-7	A std::weak_ptr shall be used to represent temporary shared ownership.	Non-automated	Required	Yes
A21-8-1	Arguments to character-handling functions shall be representable as an unsigned char.	Automated	Required	Yes
A23-0-1	An iterator shall not be implicitly converted to const_iterator.	Automated	Required	Yes
A23-0-2	Elements of a container shall only be accessed via valid references, iterators, and pointers.	Automated	Required	Yes

Rule	Description	Automation type	Category	Supported
A25-1-1	Non-static data members or captured values of predicate function objects that are state related to this object's identity shall not be copied.	Automated	Required	Yes
A25-4-1	Ordering predicates used with associative containers and STL sorting and related algorithms shall adhere to a strict weak ordering relation.	Non-automated	Required	Yes
A26-5-1	Pseudorandom numbers shall not be generated using std::rand().	Automated	Required	Yes
A26-5-2	Random number engines shall not be default-initialized.	Automated	Required	Yes
A27-0-1	Inputs from independent components shall be validated.	Non-automated	Required	No
A27-0-2	A C-style string shall guarantee sufficient space for data and the null terminator.	Automated	Required	Yes
A27-0-3	Alternate input and output operations on a file stream shall not be used without an intervening flush or positioning call.	Automated	Required	Yes
A27-0-4	C-style strings shall not be used.	Automated	Required	Yes
M0-1-1	A project shall not contain unreachable code.	Automated	Required	Yes
M0-1-2	A project shall not contain infeasible paths.	Automated	Required	Yes
M0-1-3	A project shall not contain unused variables.	Automated	Required	Yes
M0-1-4	A project shall not contain non-volatile POD variables having only one use.	Automated	Required	Yes
M0-1-8	All functions with void return type shall have external side effect(s).	Automated	Required	Yes
M0-1-9	There shall be no dead code.	Automated	Required	Yes
M0-1-10	Every defined function should be called at least once.	Automated	Advisory	Yes
M0-2-1	An object shall not be assigned to an overlapping object.	Automated	Required	Yes
M0-3-1	Minimization of run-time failures shall be ensured by the use of at least one of: (a) static analysis tools/techniques; (b) dynamic analysis tools/techniques; (c) explicit coding of checks to handle run-time faults.	Non-automated	Required	No
M0-3-2	If a function generates error information, then that error information shall be tested.	Non-automated	Required	Yes
M0-4-1	Use of scaled-integer or fixed-point arithmetic shall be documented.	Non-automated	Required	No
M0-4-2	Use of floating-point arithmetic shall be documented.	Non-automated	Required	No
M1-0-2	Multiple compilers shall only be used if they have a common, defined interface.	Non-automated	Required	No
M2-7-1	The character sequence /* shall not be used within a C-style comment.	Automated	Required	Yes
M2-10-1	Different identifiers shall be typographically unambiguous.	Automated	Required	Yes
M2-13-2	Octal constants (other than zero) and octal escape sequences (other than "\0") shall not be used.	Automated	Required	Yes
M2-13-3	A "U" suffix shall be applied to all octal or hexadecimal integer literals of unsigned type.	Automated	Required	Yes
M2-13-4	Literal suffixes shall be upper case.	Automated	Required	Yes
M3-1-2	Functions shall not be declared at block scope.	Automated	Required	Yes
M3-2-1	All declarations of an object or function shall have compatible types.	Automated	Required	Yes
M3-2-2	The One Definition Rule shall not be violated.	Automated	Required	Yes
M3-2-3	A type, object or function that is used in multiple translation units shall be declared in one and only one file.	Automated	Required	Yes

Rule	Description	Automation type	Category	Supported
M3-2-4	An identifier with external linkage shall have exactly one definition.	Automated	Required	Yes
M3-3-2	If a function has internal linkage then all re-declarations shall include the static storage class specifier.	Automated	Required	Yes
M3-4-1	An identifier declared to be an object or type shall be defined in a block that minimizes its visibility.	Automated	Required	Yes
M3-9-1	The types used for an object, a function return type, or a function parameter shall be token-for-token identical in all declarations and re-declarations.	Automated	Required	Yes
M3-9-3	The underlying bit representations of floating-point values shall not be used.	Automated	Required	Yes
M4-5-1	Expressions with type bool shall not be used as operands to built-in operators other than the assignment operator =, the logical operators &&,   , !, the equality operators == and !=, the unary & operator, and the conditional operator.	Automated	Required	Yes
M4-5-3	Expressions with type (plain) char and wchar_t shall not be used as operands to built-in operators other than the assignment operator =, the equality operators == and !=, and the unary & operator.	Automated	Required	Yes
M4-10-1	NULL shall not be used as an integer value.	Automated	Required	Yes
M4-10-2	Literal zero (0) shall not be used as the null-pointer-constant.	Automated	Required	Yes
M5-0-2	Limited dependence should be placed on C++ operator precedence rules in expressions.	Partially automated	Advisory	Yes
M5-0-3	A cvalue expression shall not be implicitly converted to a different underlying type.	Automated	Required	Yes
M5-0-4	An implicit integral conversion shall not change the signedness of the underlying type.	Automated	Required	Yes
M5-0-5	There shall be no implicit floating-integral conversions.	Automated	Required	Yes
M5-0-6	An implicit integral or floating-point conversion shall not reduce the size of the underlying type.	Automated	Required	Yes
M5-0-7	There shall be no explicit floating-integral conversions of a cvvalue expression.	Automated	Required	Yes
M5-0-8	An explicit integral or floating-point conversion shall not increase the size of the underlying type of a cvvalue expression.	Automated	Required	Yes
M5-0-9	An explicit integral conversion shall not change the signedness of the underlying type of a cvvalue expression.	Automated	Required	Yes
M5-0-10	If the bitwise operators ~and << are applied to an operand with an underlying type of unsigned char or unsigned short, the result shall be immediately cast to the underlying type of the operand.	Automated	Required	Yes
M5-0-11	The plain char type shall only be used for the storage and use of character values.	Automated	Required	Yes
M5-0-12	Signed char and unsigned char type shall only be used for the storage and use of numeric values.	Automated	Required	Yes
M5-0-14	The first operand of a conditional-operator shall have type bool.	Automated	Required	Yes
M5-0-15	Array indexing shall be the only form of pointer arithmetic.	Automated	Required	Yes
M5-0-16	A pointer operand and any pointer resulting from pointer arithmetic using that operand shall both address elements of the same array.	Automated	Required	Yes
M5-0-17	Subtraction between pointers shall only be applied to pointers that address elements of the same array.	Automated	Required	Yes

Rule	Description	Automation type	Category	Supported
M5-0-18	>, >=, <, <= shall not be applied to objects of pointer type, except where they point to the same array.	Automated	Required	Yes
M5-0-20	Non-constant operands to a binary bitwise operator shall have the same underlying type.	Automated	Required	Yes
M5-0-21	Bitwise operators shall only be applied to operands of unsigned underlying type.	Automated	Required	Yes
M5-2-2	A pointer to a virtual base class shall only be cast to a pointer to a derived class by means of dynamic_cast.	Automated	Required	Yes
M5-2-3	Casts from a base class to a derived class should not be performed on polymorphic types.	Automated	Advisory	Yes
M5-2-6	A cast shall not convert a pointer to a function to any other pointer type, including a pointer to function type.	Automated	Required	Yes
M5-2-8	An object with integer type or pointer to void type shall not be converted to an object with pointer type.	Automated	Required	Yes
M5-2-9	A cast shall not convert a pointer type to an integral type.	Automated	Required	Yes
M5-2-10	The increment (++) and decrement (--) operators shall not be mixed with other operators in an expression.	Automated	Required	Yes
M5-2-11	The comma operator, && operator and the    operator shall not be overloaded.	Automated	Required	Yes
M5-2-12	An identifier with array type passed as a function argument shall not decay to a pointer.	Automated	Required	Yes
M5-3-1	Each operand of the ! operator, the logical && or the logical    operators shall have type bool.	Automated	Required	Yes
M5-3-2	The unary minus operator shall not be applied to an expression whose underlying type is unsigned.	Automated	Required	Yes
M5-3-3	The unary & operator shall not be overloaded.	Automated	Required	Yes
M5-3-4	Evaluation of the operand to the sizeof operator shall not contain side effects.	Automated	Required	Yes
M5-8-1	The right hand operand of a shift operator shall lie between zero and one less than the width in bits of the underlying type of the left hand operand.	Partially automated	Required	Yes
M5-14-1	The right hand operand of a logical &&,    operators shall not contain side effects.	Automated	Required	Yes
M5-17-1	The semantic equivalence between a binary operator and its assignment operator form shall be preserved.	Non-automated	Required	No
M5-18-1	The comma operator shall not be used.	Automated	Required	Yes
M5-19-1	Evaluation of constant unsigned integer expressions shall not lead to wrap-around.	Automated	Required	Yes
M6-2-1	Assignment operators shall not be used in sub-expressions.	Automated	Required	Yes
M6-2-2	Floating-point expressions shall not be directly or indirectly tested for equality or inequality.	Partially automated	Required	Yes
M6-2-3	Before preprocessing, a null statement shall only occur on a line by itself; it may be followed by a comment, provided that the first character following the null statement is a white-space character.	Automated	Required	Yes
M6-3-1	The statement forming the body of a switch, while, do ... while or for statement shall be a compound statement.	Automated	Required	Yes

Rule	Description	Automation type	Category	Supported
M6-4-1	An if ( condition ) construct shall be followed by a compound statement. The else keyword shall be followed by either a compound statement, or another if statement.	Automated	Required	Yes
M6-4-2	All if ... else if constructs shall be terminated with an else clause.	Automated	Required	Yes
M6-4-3	A switch statement shall be a well-formed switch statement.	Automated	Required	Yes
M6-4-4	A switch-label shall only be used when the most closely-enclosing compound statement is the body of a switch statement.	Automated	Required	Yes
M6-4-5	An unconditional throw or break statement shall terminate every non-empty switch-clause.	Automated	Required	Yes
M6-4-6	The final clause of a switch statement shall be the default-clause.	Automated	Required	Yes
M6-4-7	The condition of a switch statement shall not have bool type.	Automated	Required	Yes
M6-5-2	If loop-counter is not modified by -- or ++, then, within condition, the loop-counter shall only be used as an operand to <=, <, > or >=.	Automated	Required	Yes
M6-5-3	The loop-counter shall not be modified within condition or statement.	Automated	Required	Yes
M6-5-4	The loop-counter shall be modified by one of: --, ++, -= n, or += n; where n remains constant for the duration of the loop.	Automated	Required	Yes
M6-5-5	A loop-control-variable other than the loop-counter shall not be modified within condition or expression.	Automated	Required	Yes
M6-5-6	A loop-control-variable other than the loop-counter which is modified in statement shall have type bool.	Automated	Required	Yes
M6-6-1	Any label referenced by a goto statement shall be declared in the same block, or in a block enclosing the goto statement.	Automated	Required	Yes
M6-6-2	The goto statement shall jump to a label declared later in the same function body.	Automated	Required	Yes
M6-6-3	The continue statement shall only be used within a well-formed for loop.	Automated	Required	Yes
M7-1-2	A pointer or reference parameter in a function shall be declared as pointer to const or reference to const if the corresponding object is not modified.	Automated	Required	Yes
M7-3-1	The global namespace shall only contain main, namespace declarations and extern "C" declarations.	Automated	Required	Yes
M7-3-2	The identifier main shall not be used for a function other than the global function main.	Automated	Required	Yes
M7-3-3	There shall be no unnamed namespaces in header files.	Automated	Required	Yes
M7-3-4	Using-directives shall not be used.	Automated	Required	Yes
M7-3-6	Using-directives and using-declarations (excluding class scope or function scope using-declarations) shall not be used in header files.	Automated	Required	Yes
M7-4-1	All usage of assembler shall be documented.	Non-automated	Required	No
M7-4-2	Assembler instructions shall only be introduced using the asm declaration.	Automated	Required	Yes
M7-4-3	Assembly language shall be encapsulated and isolated.	Automated	Required	Yes
M7-5-1	A function shall not return a reference or a pointer to an automatic variable (including parameters), defined within the function.	Non-automated	Required	Yes
M7-5-2	The address of an object with automatic storage shall not be assigned to another object that may persist after the first object has ceased to exist.	Non-automated	Required	Yes

Rule	Description	Automation type	Category	Supported
M8-0-1	An init-declarator-list or a member-declarator-list shall consist of a single init-declarator or member-declarator respectively.	Automated	Required	Yes
M8-3-1	Parameters in an overriding virtual function shall either use the same default arguments as the function they override, or else shall not specify any default arguments.	Automated	Required	Yes
M8-4-2	The identifiers used for the parameters in a re-declaration of a function shall be identical to those in the declaration.	Automated	Required	Yes
M8-4-4	A function identifier shall either be used to call the function or it shall be preceded by &.	Automated	Required	Yes
M8-5-2	Braces shall be used to indicate and match the structure in the non-zero initialization of arrays and structures.	Automated	Required	Yes
M9-3-1	Const member functions shall not return non-const pointers or references to class-data.	Automated	Required	Yes
M9-3-3	If a member function can be made static then it shall be made static, otherwise if it can be made const then it shall be made const.	Automated	Required	Yes
M9-6-1	When the absolute positioning of bits representing a bit-field is required, then the behavior and packing of bit-fields shall be documented.	Non-automated	Required	No
M9-6-4	Named bit-fields with signed integer type shall have a length of more than one bit.	Automated	Required	Yes
M10-1-1	Classes should not be derived from virtual bases.	Automated	Advisory	Yes
M10-1-2	A base class shall only be declared virtual if it is used in a diamond hierarchy.	Automated	Required	Yes
M10-1-3	An accessible base class shall not be both virtual and non-virtual in the same hierarchy.	Automated	Required	Yes
M10-2-1	All accessible entity names within a multiple inheritance hierarchy should be unique.	Automated	Advisory	Yes
M10-3-3	A virtual function shall only be overridden by a pure virtual function if it is itself declared as pure virtual.	Automated	Required	Yes
M11-0-1	Member data in non-POD class types shall be private.	Automated	Required	Yes
M12-1-1	An object's dynamic type shall not be used from the body of its constructor or destructor.	Automated	Required	Yes
M14-5-3	A copy assignment operator shall be declared when there is a template assignment operator with a parameter that is a generic parameter.	Automated	Required	Yes
M14-6-1	In a class template with a dependent base, any name that may be found in that dependent base shall be referred to using a qualified-id or this->.	Automated	Required	Yes
M15-0-3	Control shall not be transferred into a try or catch block using a goto or a switch statement.	Automated	Required	Yes
M15-1-1	The assignment-expression of a throw statement shall not itself cause an exception to be thrown.	Automated	Required	Yes
M15-1-2	NULL shall not be thrown explicitly.	Automated	Required	Yes
M15-1-3	An empty throw (throw;) shall only be used in the compound statement of a catch handler.	Automated	Required	Yes
M15-3-1	Exceptions shall be raised only after start-up and before termination.	Automated	Required	Yes

Rule	Description	Automation type	Category	Supported
M15-3-3	Handlers of a function-try-block implementation of a class constructor or destructor shall not reference non-static members from this class or its bases.	Automated	Required	Yes
M15-3-4	Each exception explicitly thrown in the code shall have a handler of a compatible type in all call paths that could lead to that point.	Automated	Required	Yes
M15-3-6	Where multiple handlers are provided in a single try-catch statement or function-try-block for a derived class and some or all of its bases, the handlers shall be ordered most-derived to base class.	Automated	Required	Yes
M15-3-7	Where multiple handlers are provided in a single try-catch statement or function-try-block, any ellipsis (catch-all) handler shall occur last.	Automated	Required	Yes
M16-0-1	#include directives in a file shall only be preceded by other pre-processor directives or comments.	Automated	Required	Yes
M16-0-2	Macros shall only be #define'd or #undef'd in the global namespace.	Automated	Required	Yes
M16-0-5	Arguments to a function-like macro shall not contain tokens that look like pre-processing directives.	Automated	Required	Yes
M16-0-6	In the definition of a function-like macro, each instance of a parameter shall be enclosed in parentheses, unless it is used as the operand of # or ##.	Automated	Required	Yes
M16-0-7	Undefined macro identifiers shall not be used in #if or #elif pre-processor directives, except as operands to the defined operator.	Automated	Required	Yes
M16-0-8	If the # token appears as the first token on a line, then it shall be immediately followed by a pre-processing token.	Automated	Required	Yes
M16-1-1	The defined pre-processor operator shall only be used in one of the two standard forms.	Automated	Required	Yes
M16-1-2	All #else, #elif and #endif pre-processor directives shall reside in the same file as the #if or #ifdef directive to which they are related.	Automated	Required	Yes
M16-2-3	Include guards shall be provided.	Automated	Required	Yes
M16-3-1	There shall be at most one occurrence of the # or ## operators in a single macro definition.	Automated	Required	Yes
M16-3-2	The # and ## operators should not be used.	Automated	Advisory	Yes
M17-0-2	The names of standard library macros and objects shall not be reused.	Automated	Required	Yes
M17-0-3	The names of standard library functions shall not be overridden.	Automated	Required	Yes
M17-0-5	The setjmp macro and the longjmp function shall not be used.	Automated	Required	Yes
M18-0-3	The library functions abort, exit, getenv and system from library <cstdlib> shall not be used.	Automated	Required	Yes
M18-0-4	The time handling functions of library <ctime> shall not be used.	Automated	Required	Yes
M18-0-5	The unbounded functions of library <cstring> shall not be used.	Automated	Required	Yes
M18-2-1	The macro offsetof shall not be used.	Automated	Required	Yes
M18-7-1	The signal handling facilities of <csignal> shall not be used.	Automated	Required	Yes
M19-3-1	The error indicator errno shall not be used.	Automated	Required	Yes
M27-0-1	The stream input/output library <cstdio> shall not be used.	Automated	Required	Yes

## About Black Duck

Black Duck® offers the most comprehensive, powerful, and trusted portfolio of application security solutions in the industry. We have an unmatched track record of helping organizations around the world secure their software quickly, integrate security efficiently in their development environments, and safely innovate with new technologies. As the recognized leaders, experts, and innovators in software security, Black Duck has everything you need to build trust in your software. Learn more at [www.blackduck.com](http://www.blackduck.com).