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Technical Report

for the testing of the

Software Tool for Safety Related Development

Klocwork

Applicant

Perforce Software, Inc.

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Minnesota 55401

USA

Report no. KB85026T

Revision: 2.23, Date 2023-08-31

Testing Laboratory for Safety Components

TÜV SÜD Rail GmbH

Rail Automation

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Revision history

Revision	Status	Date	Author	Modifications
1.0	-	2013-08-29	Martin Braun	initial
1.1	-	2014-07-08	Martin Braun	Address change
1.2	-	2016-04-19	Walter Schlögl	Annual inspection in 2016 Name change (from “Klocwork Insight” to “Klocwork”), New checkers for C and C++ added Support for Continuous Integration (CI)
1.3	-	2016-04-25	Walter Schlögl	Removal of references to the old version “Insight” Detailed “Identification”
1.4	-	2016-08-22	Walter Schlögl	New Version 2016.1
1.5	-	2017-01-19	Walter Schlögl	New Version 2016.3
1.6	-	2017-04-27	Walter Schlögl	New Version 2017
2.0	-	2017-09-12	Walter Schlögl	New Version 2017.1 + EN 50128
2.1	-	2017-09-19	Claudio Gregorio	Correct section 2.1.4 typo
2.2	-	2017-10-20	Walter Schlögl	New Version 2017.2
2.3	-	2017-11-23	Walter Schlögl	New Version 2017.3
2.4	-	2018-05-17	Walter Schlögl	New Version 2018
2.5	-	2018-09-28	Walter Schlögl	New Version 2018.1
2.6	-	2018-10-11	Walter Schlögl	New Version 2018.2
2.7	-	2018-12-07	Walter Schlögl	New Version 2018.3
2.8	-	2019-03-26	Walter Schlögl	New Version 2019 + ISO 26262:2018
2.9	-	2019-07-08	Walter Schlögl	New Version 2019.1
2.10	-	2019-08-30	Walter Schlögl	New Version 2019.2
2.11	-	2019-12-18	Walter Schlögl	New Version 2019.3, IEC 62304
2.12	-	2020-04-16	Walter Schlögl	New Version 2020.1
2.13	-	2020-08-17	Walter Schlögl	New Version 2020.2
2.14	-	2020-10-09	Walter Schlögl	New Version 2020.3
2.15	-	2021-03-29	Walter Schlögl	New Version 2020.4 SR1
2.16	-	2021-06-30	Walter Schlögl	New Version 2021.1 Update to EN 50128:2011/A2:2020
2.17	-	2021-09-14	Walter Schlögl	New Version 2021.2
2.18	-	2022-01-14	Walter Schlögl	New Version 2021.3
2.19	-	2022-02-01	Walter Schlögl	New Version 2021.4
2.20	-	2022-08-12	Walter Schlögl	New Version 2022.2, certificate owner is now Perforce Software, Inc.
2.21	-	2023-02-01	Walter Schlögl	New Version 2022.4
2.22	-	2023-04-26	Walter Schlögl	New Version 2022.4 SR1
2.23	active	2023-08-31	Walter Schlögl	New Version 2023.2 Report template v26 considered

Table 1: Revision history

Content

List of Tables

1 Target of Evaluation (ToE)

On 7th September 2012 the company Klocwork requested TÜV SÜD Rail GmbH to test and certify the Source Code Analysis Tool (SCA Tool) “Klocwork”. The Project No. related to this Technical Report was as follows: 717506641.

The testing comprised the requirements for tools according to IEC 61508:2010 and ISO 26262:2011.

At 14th of March 2016 a re-audit took place in Kanata. The purpose was to assess the updated product “Klocwork 2016”. The project number related to this version of the technical report is 717512509.

In August 2016 the company Rogue Wave requested TÜV SÜD Rail GmbH to update the reports for the certificate Z10 16 04 89117 002 due to a newer version of the Source Code Analysis Tool Klocwork 2016.1. The project number related to this update is 717512509.

In January 2017 Rogue Wave requested TÜV SÜD Rail GmbH to update the reports for the certificate Z10 16 04 89117 002 due to a newer version of the Source Code Analysis Tool Klocwork 2016.3. The project number related to this update is 717512509.

In April 2017 Rogue Wave requested TÜV SÜD Rail GmbH to update the reports for the certificate Z10 16 04 89117 002 due to a newer version of the Source Code Analysis Tool Klocwork 2017. The project number related to this update is 717514394.

In August 2017 Rogue Wave requested TÜV SÜD Rail GmbH to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2017.1. Furthermore, the certification has been extended to also cover the railway standard EN 50128. The project numbers related to this update are 717514394 and 717515043.

In October 2017 Rogue Wave requested TÜV SÜD Rail GmbH to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2017.2. The project number related to this update is 717514394.

In November 2017 Rogue Wave requested TÜV SÜD Rail GmbH to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2017.3. The project number related to this update is also 717514394.

In May 2018 Rogue Wave requested TÜV SÜD Rail GmbH to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2018. The project number related to this update is also 717516907.

In August 2018 Rogue Wave requested TÜV SÜD Rail GmbH to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2018.1. The project number related to this update is also 717517538.

In September 2018 Rogue Wave requested TÜV SÜD Rail GmbH to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2018.2. The project number related to this update is also 717517796.

In November 2018 Rogue Wave requested TÜV SÜD Rail GmbH to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2018.3. The project number related to this update is also 717518102.

In February 2019, Rogue Wave Software, Inc. was acquired by Perforce Software, Inc.. The certification of the tool Klocwork is not affected by this acquisition.

In March 2019 Rogue Wave Software, Inc. requested TÜV SÜD Rail GmbH to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2019. Furthermore, the second edition of ISO 26262 (ISO 26262:2018) was included in the certification. The project number related to this update is 717518686.

In June 2019 Rogue Wave Software, Inc. requested TÜV SÜD Rail GmbH to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2019.1. The project number related to this update is 717519223.

In September 2019 Rogue Wave Software, Inc. requested TÜV SÜD Rail GmbH to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2019.2. The project number related to this update is 717519679.

In December 2019 Rogue Wave Software, Inc. requested TÜV SÜD Rail GmbH to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2019.3. In addition, the certification has been extended to also cover the medical standard IEC 62304. The project number related to this update is 717520134.

In March 2020 TÜV SÜD Rail GmbH was requested to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2020.1. The project number related to this update is 717520730.

In July 2020 TÜV SÜD Rail GmbH was requested to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2020.2. The project number related to this update is 717521430.

In October 2020 TÜV SÜD Rail GmbH was requested to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2020.3. The project number related to this update is 717521746.

In March 2021 TÜV SÜD Rail GmbH was requested to update the certificate and the corresponding reports due to a newer version of the Source Code Analysis Tool Klocwork 2020.4 Service Release 1 (SR1). The project number related to this update is 717522718.

In June 2021 the certification has been extended to cover the tool version Klocwork 2021.1. Furthermore, the certification was updated with respect to EN 50128:2011/A2:2020. The project number related to this update is 717523226.

In September 2021 the certification has been extended to cover the tool version Klocwork 2021.2. The project number related to this update is 717523612.

In January 2022 the certification has been extended to cover the tool version Klocwork 2021.3. The project number related to this update is 717524316.

In February 2022 the certification has been extended to cover the tool version Klocwork 2021.4. The project number related to this update is 717524618.

In August 2022 the certification has been extended to cover the tool version Klocwork 2022.2. Furthermore, the certificate owner has changed to Perforce Software, Inc.. The project number related to this update is 717525423.

In February 2023 the certification has been extended to cover the tool version Klocwork 2022.4. The project number related to this update is 717526629.

In April 2023 the certification has been extended to cover the version Klocwork 2022.4 SR1. The project number related to this update is 717526629.

In August 2023 the certification has been extended to cover the tool version Klocwork 2023.2. The project number related to this update is 717528242.

The ToE is a software test and verification tool for source code analysis and testing within C/C++ development.

2 Scope of Testing

2.1 Test specimen

Klocwork provides static software analysis techniques to source code, including inter-procedural control flow, data flow, value-range propagation, and symbolic logic evaluation.

The process flow of the Klocwork is depicted in Figure 1. The architecture of Klocwork is described in [D6].

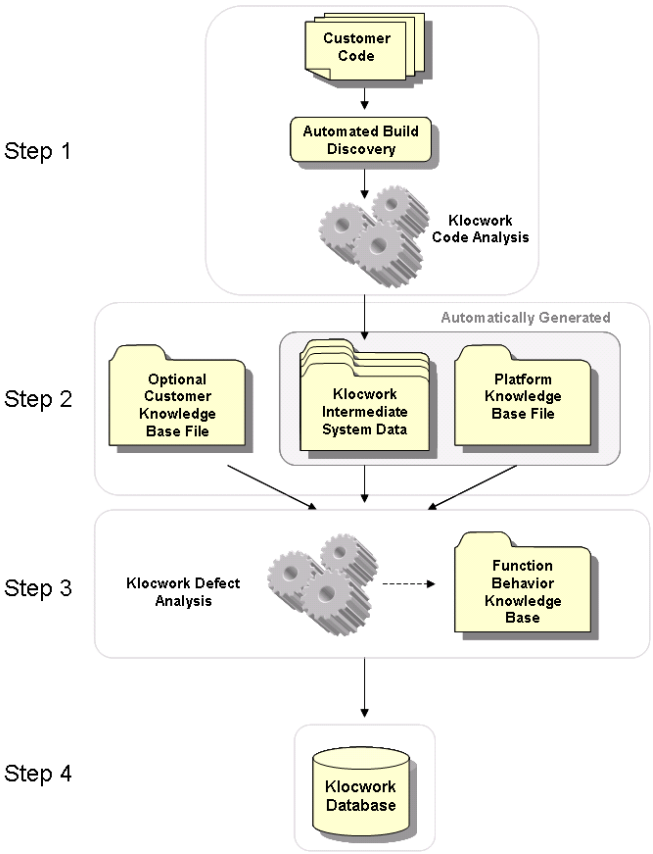

Figure 1: Klocwork Process Flow

Klocwork functionality in the scope of certification:

The scope of testing comprised a subset of the checkers out of the overall functionality of Klocwork. This subset consists of the following groups of checkers:

- MISRA C:2004 (MISRA C2),
- MISRA C++:2008,

- MISRA C:2012, and
- Severity 1 or Severity 2 checkers as designated in a default Klocwork installation.

The scope of the certification together with a complete catalogue of checkers included in the ISO 26262 / IEC 61508 certification is documented in detail in [D3].

2.1.1 C/C++ checkers, severities 1 and 2

Details about the “Klocwork” C/C++ checkers including their severity are available on the internet (currently valid web addresses):

https://docs.roguewave.com/en/klocwork/current/candccheckerreference

2.1.2 MISRA C:2004 (MISRA C2) suite of checkers

Details about the “Klocwork” MISRA-C checkers are available on the internet (currently valid web addresses):

https://docs.roguewave.com/en/klocwork/current/misraccheckerreference1nolinks

2.1.3 MISRA C++:2008 suite of checkers

Details about the “Klocwork” MISRA-C++ checkers are available on the internet (currently valid web addresses):
https://docs.roguewave.com/en/klocwork/current/misraccheckerreferencenolinks

2.1.4 MISRA C:2012 suite of checkers

Details about the “Klocwork” MISRA-C:2012 checkers are available on the internet (currently valid web addresses):

https://docs.roguewave.com/en/klocwork/current/misraccheckerreference_2012nolinks

https://docs.roguewave.com/en/klocwork/current/misrac2012_amd1nolinks

2.1.5 Tool usage / Use case

For functional safety Klocwork supports the workflow “UC1 Integration build analysis“.

The analysis of the regular software build is called an integration build analysis. After running an analysis, detected issues and reports are available in Klocwork Review.

An integration build analysis involves four steps:

1. Create a project.
2. Capture your build settings.
3. Analyse the project (using the checkers).
4. Load your results into the database for further analysis.

See Functional Safety Manual for Klocwork ([D1]) for more details.

2.1.6 Identification

The version identifiers for the tested versions of Klocwork are shown in

Tool Component	Identification / Build
Klocwork 2016.1 (Linux, Windows, Mac, Solaris, AIX)	11.1.1.358
Klocwork 2016.3 (Linux, Windows, Mac, Solaris, AIX)	11.3.0.503
Klocwork 2017 (Linux, Windows, Mac, Solaris, AIX)	12.0.0.613

Klocwork 2017.1 (Linux, Windows, Mac, Solaris, AIX)	12.1.0.677
Klocwork 2017.2 (Linux, Windows, Mac, Solaris, AIX)	12.2.0.727
Klocwork 2017.3 (Linux, Windows, Mac, Solaris, AIX)	12.3.0.810
Klocwork 2018 (Linux, Windows, Mac, Solaris, AIX)	18.0.0.939
Klocwork 2018.1 (Linux, Windows, Mac, Solaris, AIX)	18.1.0.1045
Klocwork 2018.2 (Linux, Windows, Mac, Solaris, AIX)	18.2.0.1113
Klocwork 2018.3 (Linux, Windows, Mac, Solaris, AIX)	18.3.0.1173
Klocwork 2019 (Linux, Windows, Mac, Solaris, AIX)	19.0.0.1278
Klocwork 2019.1 (Linux, Windows, Mac, Solaris, AIX)	19.1.0.57
Klocwork 2019.2 (Linux, Windows, Mac, Solaris, AIX)	19.2.0.47
Klocwork 2019.3 (Linux, Windows, Mac, Solaris, AIX)	19.3.0.64
Klocwork 2020.1 (Linux, Windows, Mac, Solaris, AIX)	20.1.0.97
Klocwork 2020.2 (Linux, Windows, Mac, AIX)	20.2.0.89
Klocwork 2020.3 (Linux, Windows, Mac, AIX)	20.3.0.51
Klocwork 2020.4 SR1 (Linux, Windows, Mac)	20.4.0.81
Klocwork 2021.1 (Linux, Windows, Mac)	21.1.0.69
Klocwork 2021.2 (Linux, Windows, Mac)	21.2.0.74
Klocwork 2021.3 (Linux, Windows, Mac)	21.3.0.89
Klocwork 2021.4 (Linux, Windows, Mac)	21.4.0.22
Klocwork 2022.2 (Linux, Windows, Mac)	22.2.0.62
Klocwork 2022.4 (Linux, Windows, Mac)	22.4.0.53
Klocwork 2022.4 SR1 (Linux, Windows, Mac)	22.4.0.56
Klocwork 2023.2 (Linux, Windows)	23.2.0.66

Table 2: Identification

3 Basis of Testing

The regulations and guidelines which form the basis of the type testing are listed below.

3.1 Functional safety

No.	Reference	Description
[N1]	IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems Part 1: General requirements
[N2]	IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems Part 3: Software requirements

Table 3: Basic safety standards

No.	Reference	Description
[N3]	ISO 26262-2:2018	Road vehicles — Functional safety — Part 2: Management of functional safety
[N4]	ISO 26262-6:2018	Road vehicles — Functional safety — Part 6: Product development at the software level
[N5]	ISO 26262-8:2018	Road vehicles — Functional safety — Part 8: Supporting processes
[N6]	EN 50128:2011/A2:2020	Railway applications - Communication, signaling and processing systems Software for railway control and protection systems
[N7]	IEC 62304:2006/ AMD1:2015[1]	Medical device software - Software life-cycle processes

Table 4: Associated safety standards

3.2 Quality Management System

No.	Reference	Description
[M1]	QMS	Quality Management System TÜV SÜD Rail GmbH
	TR_RA_P_04.50	Test Program Functional Safety TR_RA_P_04.51 Definition Scope of testing TR_RA_P_04.07 Product modification TR_RA_P_04.52 Concept Phase & Safety Lifecycle TR_RA_P_04.54 Detail Phase Software (SW) TR_RA_P_04.55 Safety Manual TR_RA_P_04.56 Result of Testing (R)
[M3]	D-PL-11190-08-00	DAkkS accreditation according to DIN EN ISO 17025:2018 / EN ISO/IEC 17025:2017

Table 5: Quality Management System

[1] Was approved by other testing services

4 Performance of Testing

4.1 Requirements on software tools

ISO 26262, EN 50128 and IEC 61508 in their current versions contain explicit requirements on software tools.

They strongly recommend the application of development tools in software development. At the same time, they demand to perform an analysis of the tools used, and an analysis on how they are embedded in the development process:

- analysis of tool usage (IEC 61508 and EN 50128)
- analysis of tool use cases (ISO 26262)
- analysis on the effect of possible malfunctions of the applied tool(s).

Depending on the outcome of the above analysis, the standards referred to above demand

a) fault mitigation measures (process)
b) the qualification, respectively validation of tools.

These activities should complement each other, and the combination of both shall reduce the number of faults impacting the final product to a minimum.

IEC 62304 does not place specific requirements on software tools, or on the qualification of tools, but IEC 62304 advises that “IEC 61508 can be looked to as a source of methods, tools and techniques that can be used to implement the requirements in IEC 62304” (IEC 62304:2006, C.1).

4.2 Tool classification

According to IEC 61508-4 and EN 50128, the verification tools according to Table 2 are classified as T2 tools, since they support the test or verification of the design or executable code, where errors in the tool can fail to reveal defects but cannot directly create errors in the executable software.

According to ISO 26262-8, the classification depends on the detection of possible tool errors. The standard classifies software tools according to their tool impact (TI) and the probability of tool error detection (TD).

The tool impact for Klocwork certified checkers is TI2, because a verification tool can fail to detect existing errors in the source code to be analysed although it may not introduce errors into an application.

TI2 requires an estimation of the tool error detection TD on customer side.

Software verification tool testing can be complete with respect to defined standards like MISRA C, but it cannot be complete with respect to all possible degrees of freedom of input variations (e.g. complexity, combinations of basic constructs). So, tool error detection always depends – besides the tool provider – also on measures of fault avoidance and error detection on customer side.

Depending on the applied measures of error prevention and error detection in the user development process, i.e. the applied techniques and intensity of validation activities, the resulting tool error detection can vary.

The user's development process including complete verification and validation should be conducted according to ISO 26262-6 in order to achieve the best possible TCL (Tool Confidence Level – ISO 26262-8, 11.4.5.4) value.

IEC 62304:2006 provides a framework of life cycle processes for the safe design and maintenance of medical device software.

IEC 62304 requires tools to be "suitably validated" (Table C.3). The tool validation according to IEC 61508 is a main aspect of the testing described in this report. Since IEC 62304 does not define how suitable validation is achieved, but refers to IEC 61508 with respect to tools, the validation can be considered suitable also in the sense of IEC 62304.

IEC 62304 AMD1:2015 does not contain changes with regard to tools.

4.3 Tool qualification

The aim of the testing and – in the case of a positive testing result – the certification is to enable customers to apply the tool Klocwork in safety-related development according to IEC 61508, EN 50128, ISO 26262 and IEC 62304 when applying to the recommendations and conditions documented in the Safety Manual [D1] and in the Report to the Certificate.

A qualification pack for customers is provided to ensure the integrity of their deployment [D5].

4.4 Tests

The testing comprised the requirements for tools according to IEC 61508, EN 50128, ISO 26262 and IEC 62304. In order, to satisfy these requirements, the testing includes the following sections:

- evaluation of the development process
- the verification and validation activities for Klocwork

Klocwork has been examined with regard to the following testing operations:

I. Functional safety
   - Tool development lifecycle
   - Quality assurance measures

II. Modification, configuration and release management

III. Verification and validation

IV. Customer Support and bug tracking

V. Safety information in the product documentation (safety manual, user guide)

5 Documents provided for testing of Klocwork

The documents for the re-audit of Klocwork 2023.2 that were provided by Perforce Software, Inc. to be checked and evaluated by the test house are listed in the table below.

(Customer documents from previous re-certifications are available in the folders of the respective projects (see chapter 1)).

No.	Title	Document-No./ File identifier	Rev.	Date
Klocwork 2023.2				
[D1]	What's new in Klocwork 2023.2	KW_2023.2_Whats New.pdf	-	-
[D2]	What's new in Klocwork 2023.1	What's new KW 2023.1.pdf	-	-
[D3]	KW Final Test Statement for Project - 2023.2 release	Eng-KWFinalTestStatementforProject-2023.2release-210723-1200.pdf	1.0	2023-07-20
[D4]	Functional Safety Manual for Klocwork	KW2023_2_001_Klocwork_Safety Manual.docx	6.6	2023-07-26
[D5]	Management of Functional Safety	KW2023_2_002_Klocwork_Management Of Functional Safety.pdf	6.6	2023-07-26
[D6]	Klocwork ISO 26262 / IEC 61508 / IEC 62304 / EN 50128 Certified Checkers	KW2023_2_003_Klocwork_Certified Checkers.pdf	6.6	2023-07-26
[D7]	Klocwork Configuration Management Plan	KW2023_2_004_Klocwork_Configuration Management Plan.pdf	6.6	2023-07-26
[D8]	Klocwork Checker Qualification Pack	KW2023_2_005_Klocwork_Qualification Pack.pdf	6.7	2023-07-26
[D9]	Klocwork Architecture	KW2023_2_006_Klocwork_Architecture.pdf	6.6	2023-07-26
[D10]	Klocwork Test Process	KW2023_2_007_Klocwork_Test Process.pdf	6.8	2023-07-26
[D11]	Klocwork Release Plan	KW2023_2_008_Klocwork_Release Plan.pdf	6.6	2023-07-26
[D12]	Klocwork 2023.2 Release Notes	KW2023_2_009_Klocwork_Release Notes.docx	6.7	2023-07-26
[D13]	QDP test results for build 23.2.0.66	QDP_2023.2_rev2.zip	-	-
[D14]	Attribution Report KW - 23.2 (Mend report)	Klocwork_attribution-report-23.2	-	-

Table 6: Documentation Klocwork

6 Performance and result of tests

6.1 Test reports

The following test reports were issued by TÜV SÜD Rail GmbH or other accredited test laboratories.

No.	Title	Document-No./ File identifier	Revision	Date
Certification Klocwork 9.6 (March 2013)				
[R1]	Minutes of Meeting Audit 19 & 20.02.13	Minutes-of-Meeting-Audit-19_20-02-13-final.pdf	1.0	2013-04-09
[R2]	Review Report Klocwork Insight	Review Report Klocwork_9.6-SR4 3.3.pdf	3.3	2013-08-07
[R3]	Checklist SW-Tools 26262	Klocwork-Prozessaudit-SW-Tools-ISO-26262.pdf	1.0	2013-03-06
[R4]	Checklist 61508 Manual	IEC 61508 Manual.pdf	1.0	2013-08-12
Re-Certification Klocwork 2016 (March 2016)				
[R5]	Minutes of Meeting Audit 2016-03-14	2016-03-04 MoM all Klocwork.docx	1.0	2016-03-14
[R6]	Review Report Klocwork 2016	Review Report Klocwork 2016.docx	1.1	2016-04-07
[R7]	Checklist SW-Tools 26262	Update2016_Klocwork-Prozessaudit-SW-Tools-ISO-26262.docx	2.0	2016-04-20
Re-Certification Klocwork 2016.1 (August 2016)				
[R8]	Review Report Klocwork 2016.1	Review Report Klocwork 2016.1.v1.1.pdf	1.1	2016-08-19
Re-Certification Klocwork 2016.3 (January 2017)				
[R9]	Review Report Klocwork 2016.3	Review Report Klocwork 2016.3.v1.1.pdf	1.1	2017-01-19
Re-Certification Klocwork 2017 (April 2017)				
[R10]	Review Protocol Klocwork 2017	Review Protocol Klocwork 2017_v1.1.pdf	1.1	2017-04-13
Re-Certification Klocwork 2017.1 (September 2017)				
[R11]	Review Protocol Klocwork 2017.1	Review Protocol. Klockwork-2017.1.v1_1.pdf	1.1	2017-09-08
Re-Certification Klocwork 2017.2 (October 2017)				
[R12]	Review Protocol Klocwork 2017.2	Review Protocol. Klockwork-2017.2.v1_0.pdf	1.0	2017-10-19
Re-Certification Klocwork 2017.3 (November 2017)				
[R13]	Review Protocol Klocwork 2017.3	Review Protocol. Klockwork-2017.3.v1_1.pdf	1.1	2017-11-17
Re-Certification Klocwork 2018 (May 2018)				

No.	Title	Document-No./ File identifier	Revision	Date
[R14]	Review Protocol Klocwork 2018	Review Protocol. Klockwork-2018.v1_2.pdf	1.2	2018-05-14
Re-Certification Klocwork 2018.1 (September 2018)				
[R15]	Review Protocol Klocwork 2018.1	Review Protocol. Klockwork-2018.1.v1_1.pdf	1.1	2018-09-28
Re-Certification Klocwork 2018.2 (October 2018)				
[R16]	Review Protocol Klocwork 2018.2	Review Protocol. Klockwork-2018.2.v1_1.pdf	1.1	2018-10-05
Re-Certification Klocwork 2018.3 (November/December 2018)				
[R17]	Review Protocol Klocwork 2018.3	Review Protocol. Klockwork-2018.3.v1_1.pdf	1.1	2018-12-06
Re-Certification Klocwork 2019 (March 2019)				
[R18]	Review Protocol Klocwork 2019	Review Protocol. Klockwork-2019.v1_0. pdf	1.0	2019-03-19
[R19]	ISO26262-8:2018 Delta Checklist	ISO26262-8:2018_ Clause11_DeltaCL.xlsx	-	2019-03-21
Re-Certification Klocwork 2019.1 (July 2019)				
[R20]	Review Protocol Klocwork 2019.1	Review Protocol.Klockwork -2019-1.v1_1.pdf	1.1	2019-07-05
Re-Certification Klocwork 2019.2 (September 2019)				
[R21]	Review Protocol Klocwork 2019.2	Review Protocol. Klockwork-2019-2.v1_1.pdf	1.1	2019-08-29
Re-Certification Klocwork 2019.3 (December 2019)				
[R22]	Review Protocol Klocwork 2019.3	Review Protocol. Klockwork-2019-3.v1_2.pdf	1.2	2019-12-17
[R23]	Minutes of meeting	Memo-2019-12-17.docx	-	2019-12-17
Re-Certification Klocwork 2020.1 (April 2020)				
[R24]	Review Protocol Klocwork 2020.1	Review Protocol. Klockwork-2020-1.v1_1.pdf	1.1	2020-04-14
[R25]	Minutes of meeting	Memo-2020-04-14.pdf	-	2020-04-14
Re-Certification Klocwork 2020.2 (July 2020)				
[R26]	Review Protocol Klocwork 2020.2	Review Protocol KW 2020.2-v1.2.pdf	1.2	2020-08-14
[R27]	Minutes of meeting	Memo-2020-07-30.pdf	-	2020-07-30
Re-Certification Klocwork 2020.3 (October 2020)				
[R28]	Review Protocol Klocwork 2020.3	Review Protocol KW 2020.3-v1.1.pdf	1.1	2020-10-08
[R29]	Minutes of meeting	Memo-2020-10-07.pdf	-	2020-10-07
Re-Certification Klocwork 2020.4 SR1 (March 2021)				

No.	Title	Document-No./ File identifier	Revision	Date
[R30]	Review Protocol Klocwork 2020.4	Review Protocol KW 2020.4-v1.1	1.1	2021-03-26
[R31]	Minutes of meeting	Memo-2021-03-24	-	2021-03-24
Re-Certification Klocwork 2021.1 (June 2021)				
[R32]	Review Protocol Klocwork 2021.1	Review Protocol-Klocwork-2021-1	1.0	2021-06-28
[R33]	Minutes of meeting	Memo-2021-06-08	-	2021-06-08
Re-Certification Klocwork 2021.2 (September 2021)				
[R34]	Review Protocol Klocwork 2021.2	Review Protocol-Klocwork-2021-2	1.0	2021-09-13
[R35]	Minutes of meeting	Memo-2021-09-10	-	2021-09-10
Re-Certification Klocwork 2021.3 (January 2022)				
[R36]	Review Protocol Klocwork 2021.3	Review Protocol-Klocwork-2021-3	1.1	2022-01-12
[R37]	Minutes of meeting	Memo-2021-12-16	-	2021-12-16
Re-Certification Klocwork 2021.4 (February 2022)				
[R38]	Review Protocol Klocwork 2021.4	Review Protocol-Klocwork-2021-4	1.1	2022-01-27
[R39]	Minutes of meeting	Memo-2022-01-27	-	2022-01-27
Re-Certification Klocwork 2022.2 (August 2022)				
[R40]	Review Protocol Klocwork 2022.2	Review Protocol-Klocwork-2022-2	1.2	2022-08-10
[R41]	Minutes of meeting	Memo-2022-07-25	-	2022-07-25
Re-Certification Klocwork 2022.4 (January/February 2023)				
[R42]	Review Protocol Klocwork 2022.4	Review Protocol-Klocwork-2022-4	1.2	2023-01-31
[R43]	Minutes of meeting	Memo-2023-01-12	-	2022-07-25
Re-Certification Klocwork 2022.4 SR1 (April 2023)				
[R44]	Review Protocol Klocwork 2022.4 SR1	Review Protocol Klocwork 2022.4SR1-v1.0	1.0	2023-04-26
Re-Certification Klocwork 2023.2 (August 2023)				
[R45]	Review Protocol Klocwork 2023.2	Review Protocol Klocwork 2023.2-v1.2	1.2	2023-08-25
[R46]	Minutes of meeting	Memo-2023-08-04	-	2023-08-04

Table 7: Test results Klocwork

6.2 Functional Safety

The assessment of the development processes and lifecycle has been performed on basis of ISO 26262. The applied checklists ([R3] and [R7]) cover the requirements applicable to software tool development lifecycle and quality assurance measures. Basis of the checklists are the requirements from ISO 26262, parts 2, 6 and 8, as far as applicable to software tool development. Requirements of IEC 61508 have been considered additionally.

The quality assurance is part of the development Wiki (internal database for process, lifecycle planning and documentation). This has been presented during the assessment, and evaluated with respect to the requirements given in IEC 61508 ([N1] and [N2]) and in ISO 26262 ([N3] to [N5]).

The processes and documentation related to FSM were applied unaltered for the new versions.

Result:
The analysis of the organization and procedures of Rogue Wave Software, Inc. has shown that – as far as applicable - the requirements according to IEC 61508 ([N1] and [N2]) are fulfilled and that the requirements specified in checklists [R3] and [R7] according to ISO 26262 (see [N3] to [N5]) are covered.

6.3 Modification, configuration and release management

The procedures applied for implementation of changes, test implementation and test execution are adequate to guarantee stability of released versions. Every change to the software undergoes a defined approval procedure (see [D2] and [D8]).

Result:
The modification and release management of Rogue Wave Software, Inc. is suitable to ensure reliability and quality of the released software products, as documented in [R2], [R3], [R6] and [R8] - [R39].

6.4 Verification and validation

During development, automated regression testing on a known set of sample projects was applied, to ensure that the analysis results are consistent with those produced by a previous version of the product. Sanity check is done manually on functionality of the Klocwork tools that are not covered by automated testing.

Testing is complemented by a large set of code snippets from customers and open-source projects. A complete description of the applied tests can be found in the test process [D7] which includes the release testing summary, too.

Result:
The analysis (see chapter 6.1) of the verification and validation activities has shown that – as far as applicable - the requirements according to IEC 61508 ([N1] and [N2]) are fulfilled and that the requirements specified in checklists [R3]/[R7] according to ISO 26262 (see [N3] to [N5]) are covered.

6.5 Customer Support and Bug reporting

Customers can correspond with technical support either via email or via telephone. The Customer Support Request (CSR) system is available within the Klocwork developer network with support access (license) which provides a ticket system for the customer.

A “Known Limitation” section is included into the Release Notes.

The processes and tools for customer support and bug reporting have not been modified since the previous audits (see chapter 6.1).

Result:
The customer support and bug reporting facilities are appropriate to support customers developing safety-related systems. The audit results on customer support and bug tracking are documented in [R1], [R3], [R5] and [R7].

6.6 Inspection of the technical documentation

The general user documentation provided online in the Klocwork developer network is structured and understandable. It is complemented by a Safety Manual (see [D1]) that underlines aspects that require special care and describes the use case / tool usage when applying Klocwork in a safety-related development.

Result:
The results are documented in the reports [R2], [R6] and [R8] - [R39].

The technical documentation fulfils the requirements in accordance with IEC 61508 ([N1] to [N2]) and ISO 26262 ([N3] to [N5]).

6.7 EN 50128

EN 50128:2011 is an application standard derived from IEC 61508. The requirements for software tools are derived from the requirements on software tools according to IEC 61508-3:2010. Due to the equivalence of the requirements for software tools, no separate testing has been performed with respect to EN 50128. For T2 tools, EN 50128:2011/A2:2020 does not contain additional requirements.

Result:
Klocwork is suitable to be used in safety-related software development according to EN 50128:2011/A2:2020.

6.8 ISO 26262:2018

In the second Edition of ISO 26262 (ISO 26262:2018) are no significant changes regarding to the usage and qualification of software tools (see [R19]).

Result:
Klocwork is suitable to be used in safety-related software development according to ISO 26262:2018.

6.9 IEC 62304:2006/AMD1:2015

IEC 62304 requires tools to be “suitably validated” but does not place specific requirements on software tools, or on the qualification of tools. It refers to IEC 61508 as a source of methods, tools and techniques that can be used. So, by qualification against IEC 61508, the tool Klocwork can be said to be suitable for use in safety related development according to IEC 62304.

Result:
Klocwork is suitable to be used in safety-related software development according to IEC 62304:2006/AMD1:2015.

6.10 Re-certifications

All re-certifications have been done as a delta audit. Results from previous audits have been taken into account.

6.10.1 Klocwork 2016

In addition to new checkers for C/C++ and improvements related to fixed problems of prior releases, the new version “Klocwork 2016” contains also a MISRA C:2012 suite of checkers. The Continuous Integration (CI) capabilities of “Klocwork 2016” and the support of static code analysis for Java and C# are not in the scope of this certification.
The testing comprised the requirements for tools according to IEC 61508:2010 and ISO 26262:2011.

Result:
Klocwork 2016 was subject to review [R5] to [R7]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.2 Klocwork 2016.1

Main changes in the new version 2016.1 are related to improvements of continuous integration, supported compilers and checkers. Furthermore, support for additional systems (IDE’s, OS, Jenkins), changes to commands/options and some bug fixes are included in the new version.

Result:
Klocwork 2016.1 was subject to review [R8]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.3 Klocwork 2016.3

Main changes in the new version 2016.3 are: A plugin for Visual Studio, improvements concerning accuracy and performance of the analysis engine, support of several C# 6.0 features, support of new compilers and the introduction of new checkers.

Result:
Klocwork 2016.3 was subject to review [R9]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.4 Klockwork 2017

Main changes in Klocwork 2017 are: Introduction of SmartRank (issue prioritization), improvements in the Microsoft Visual Studio extension, improvements in the Analysis engine, support of additional C# 6.0 and C++11 features, support of new compilers and the introduction of new checkers.

Result:
Klocwork 2017 was subject to review [R10]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.5 Klockwork 2017.1

The certification has been extended to also cover the railway standard EN 50128. Main changes in Klocwork 2017.1 are: Support Microsoft Visual Studio 2017, overall stability and performance improvements and improvements concerning accuracy and performance of the analysis engine.

Result:

Klocwork 2017.1 was subject to review [R11]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.6 Klockwork 2017.2

Main changes in Klocwork 2017.2 are: Introduction of the “Quality Report”, extension of Microsoft Visual Studio (two issue filters), support of DISA-STIG version 4, several improvements and bug fixes.

Result:
Klocwork 2017.2 was subject to review [R12]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.7 Klockwork 2017.3

Main changes in Klocwork 2017.3 are: Accuracy and performance improvements of the analysis engine, more supported compilers, changes to the PATH API, Checker and Taxonomy improvements, changes to system requirements and bug fixes.

Result:
Klocwork 2017.3 was subject to review [R13]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.8 Klockwork 2018

Main changes in Klocwork 2018 are: New analysis engine with support for latest C++ 17 language features, Cross version support for builds, improvements for some compilers and checkers, changes to the Path API, to the system requirements and to some commands and bug fixes.

Result:
Klocwork 2018 was subject to review [R14]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.9 Klockwork 2018.1

Main changes in Klocwork 2018.1 are:

- Support of the AUTOSAR C++14 taxonomy
- Improvements concerning checkers, taxonomy, analysis engine and supported compilers
- Additional optional parameter in the Web API metrics
- Changes to system requirements and to commands and options
- Bug fixes and documentation issues

Result:
Klocwork 2018.1 was subject to review [R15]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.10 Klockwork 2018.2

Main changes in Klocwork 2018.2 are:

- Full support of C++11, C++14 and C++17 language features by the analysis engine
- Improvements concerning checkers, taxonomy and supported compilers
- Changes to system requirements and to commands, tools and options
- Bug fixes and documentation issues

Result:

Klocwork 2018.2 was subject to review [R16]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.11 Klockwork 2018.3

Main changes in Klocwork 2018.3 are:

- Full support of C++11, C++14 and C++17 language features by the analysis engine for Windows and Linux Systems
- New taxonomy for the AUTOSAR C++14 standard
- Improvements concerning checkers, taxonomy and supported compilers
- Changes to system requirements
- Bug fixes

Result:
Klocwork 2018.3 was subject to review [R17]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.12 Klockwork 2019

The second edition of ISO 26262 (ISO 26262:2018) was included in the certification.
Main changes in Klocwork 2019 are:

- Improved support for Microsoft Visual Studio C++ compiler for defect detection in C++11, C++14 and C++17
- New extension for Microsoft Visual Studio (analysis of C++11, C++14 and C++17)
- Improved cross version support for builds
- New lightweight Klocwork builds tool package
- Improvements to supported compilers
- Checker improvements
- Taxonomy improvements
- Changes concerning system requirements
- Bug fixes

Result:
Klocwork 2019 was subject to review [R18] / [R19]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.13 Klockwork 2019.1

Main changes in Klocwork 2019.1 are:

- Improvements to security vulnerability detection
- New Java taxonomy that covers the OWASP Top 10 Security Risks for 2017
- Analysis engine enhancement
- Enhanced coverage for MISRA C 2012
- Clearer build analysis reporting
- Improved support for Microsoft Visual Studio
- Improvements to supported compilers
- Checker improvements
- Support of further OSes
- Changes to commands, tools, and options
- Bug fixes

Result:

Klocwork 2019.1 was subject to review [R20]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.14 Klockwork 2019.2

Main changes in Klocwork 2019.2 are:

- New taxonomy that covers ISO/IEC TS 17961
- Support for Visual Studio 2019
- New MISRA C 2012 checkers
- Checker improvements
- Migration to OpenJDK
- Improved build analysis and clearer reporting
- Changes to PATH API
- Improvements to supported compilers
- Taxonomy improvements
- Changes to system requirements
- Changes to commands, tools, and options
- Bug fixes

Result:
Klocwork 2019.2 was subject to review [R21]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.15 Klockwork 2019.3

Main changes in Klocwork 2019.3 are:

- New C/C++ checkers
- New MISRA C 2012 checkers for rule 5.8 and 5.9
- Checker improvements
- Improvements to supported compilers
- Analysis engine enhancement
- Taxonomy improvements
- Changes to system requirements
- Changes to commands, tools, and options
- Bug fixes

Result:
Klocwork 2019.3 was subject to review [R22]/[R23]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.16 Klockwork 2020.1

Main changes in Klocwork 2020.1 are:

- New taxonomies and taxonomy improvements
- New community checkers (for C/C++, C#, and Java)
- Adding the community HIS Metrics configuration file
- Performance improvements
- Analysis engine enhancements
- Checker improvements
- Improvements to supported compilers
- Changes to system requirements
- Changes to commands, tools, and options
- Bug fixes

Result:
Klocwork 2020.1 was subject to review [R24]/[R25]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.17 Klockwork 2020.2

Main changes in Klocwork 2020.2 are:

- Strong improvements in support of C#
- Significant improvements to Java (including full support of the Java 9 language specification)
- New Jenkins Plugin, new CLion Plugin
- Taxonomies improvements
- Improvements related to the Knowledge Bases (e.g. C++ virtual methods)
- Analysis improvements
- Checker modifications (new checkers and improved checkers)
- Improvements to supported compilers
- Changes to system requirements, commands, tools, and options
- Bug fixes
- Solaris and AIX not anymore in the certification scope

Result:
Klocwork 2020.2 was subject to review [R26][R27]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.18 Klockwork 2020.3

Main changes in Klocwork 2020.3 are:

- Java improvements (partial support of Java 11 and better support of java constructions)
- New checkers related to “2019 CWE Top 25 Most Dangerous Software Errors”
- Improvements to existing checkers
- C# enhancements
- C/C++ analysis improvements
- New taxonomy that maps to MISRA C 2012 Amendment 2 (C11)
- Taxonomy improvements
- Improvements to supported compilers
- Bug fixes

Result:
Klocwork 2020.3 was subject to review [R28]/[R29]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.19 Klockwork 2020.4 SR1

Main changes in Klocwork 2020.4 SR1 are (see release notes for details):

- Entire C/C++ analysis toolchain is on 64-bit Linux
- Java improvements
- New/improved checkers related to “2019 CWE Top 25 Most Dangerous Software Errors”
- New/improved checkers
- C# enhancements
- C/C++ analysis improvements
- New Klocwork extension for Visual Studio
- New security compliance report

- Taxonomy improvements
- Improvements to supported compilers
- Bug fixes

Result:
Klocwork 2020.4 SR1 was subject to review [R30]/[R31]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.20 Klockwork 2021.1

Main changes in Klocwork 2021.1 are (see release notes for details):
- Full support of Java 10 language specification
- New quality-focused C/C++ checkers
- New C# CWE checkers and support for C# incremental build specification generation
- Improved support of some C/C++ coding standards
- Checker improvements and community checkers
- Taxonomy improvements
- Improved support of Wind River DIAB compiler
- Bug fixes

Result:
Klocwork 2021.1 was subject to review [R32]/[R33]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.21 Klockwork 2021.2

Main changes in Klocwork 2021.2 are (see release notes for details):
- Import and integration of Helix QAC diagnostic results into the Klocwork portal
- Support of JavaScript analysis
- Full support of Java 11 language specification
- New C# CWE checkers and support of differential C# analysis
- New and improved C/C++ checkers
- New community checkers
- Taxonomy improvements
- Improvements to supported compilers
- Bug fixes

Result:
Klocwork 2021.2 was subject to review [R34]/[R35]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.22 Klockwork 2021.3

Main changes in Klocwork 2021.3 are (see release notes for details):
- Introduction of project streams
- Python as new analysis language is available for server and desktop scanning
- Integration with “Secure Code Warrior”
- New Visual Studio Code IDE Plugin
- Improvements in the C#, C++ and Java analysis engines
- Support of new / expanded coding standards
- Bug fixes

Result:

Klocwork 2021.3 was subject to review [R36]/[R37]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.23 Klockwork 2021.4

Main (certification relevant) changes in Klocwork 2021.4 are (see release notes for details):

- Improvements in the C/C++ analysis engine and checker improvements
- Expanded MISRA coverage
- Support of new compilers and changes of system requirements
- Problem fixes

Result:
Klocwork 2021.4 was subject to review [R38]/[R39]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.24 Klockwork 2022.2

Main changes in Klockwork version 2022.2 are (see release notes for details):

- Kotlin is a new supported analysis language
- Performance improvements
- New and expanded coding standards coverage
- Log4j vulnerability checker
- Improvements related to project streams
- Support for incremental/differential Java analysis
- Improvements related to the C/C++ analysis engine
- New Visual Studio Code 2022 IDE Plugin
- Support of additional coding standards (CERT, CWE, DISA STIG, OWASP Top 10)
- Checker and taxonomy improvements
- Improvements to supported compilers
- Fixed issues

Result:
Klocwork 2022.2 was subject to review [R40]/[R41]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.25 Klockwork 2022.4

Main changes in Klockwork version 2022.4 are (see release notes for details):

- C/C++
  - enhanced defect suppression
  - added support for several MISRA rules
- New / improved support of several coding standards (Cert C, CWE, DISA STIG for Java, MISRA, OWASP)
- Improvements for C# (support of version 7.3), Java (support for Java 14), Android 13 and Kotlin
- Improved support of IDE plugins
- Management of Helix QAC configuration files
- Checker and taxonomy improvements
- Improvements to supported compilers
- Fixed issues

Result:

Klocwork 2022.4 was subject to review [R42]/[R43]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.26 Klockwork 2022.4 SR1

The changes in Klockwork version 2022.4 SR1 are related to three fixed bugs (see release notes for details).

Result:
Klocwork 2022.4 SR1 was subject to review [R44]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

6.10.27 Klockwork 2023.2

Main changes in Klockwork version 2023.2 are (see release notes for details):

- C/C++
    - support for several MISRA rules and increased coverage for MISRA C 2012 (up to AMD2).
    - increased coverage for DISA STIG high severity rules
    - improved coverage for CERT, OWASP, and CWE
    - enhanced support for C++14 and C++17 analysis
- New / improved support of several coding standards (Cert C, CWE, DISA STIG, MISRA, OWASP)
- Improvements for C# (support of version 8)
- Checker and taxonomy improvements
- Improvements to supported compilers
- Fixed issues
- macOS is not supported anymore

Result:
Klocwork 2023.2 was subject to review [R45]/[R46]. The requirements of clause 3 and the related standards and guidelines are fulfilled after modification.

7 Summary

The test results of clause 6 showed that the Source Code Analysis Tool Klocwork, as specified in clause 2.1, fulfils the requirements applicable to software verifications tools as given by the standards listed in chapter 3.

The tool Klocwork, classified as T2 off-line tool according to IEC 61508-4:2010, is suitable to be used in safety-related development according to IEC 61508:2010 for any SIL.

The tool Klocwork is qualified to be used in a standard-compliant development process according to ISO 26262:2018 for any ASIL.

The tool Klocwork is suitable to be used in safety-related software development according to EN 50128:2011/A2:2020 for any SIL.

The tool Klocwork is suitable to be used in safety related development according to IEC 62304:2006/AMD1:2015 for any software safety class.

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