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SCE-ACCREDITED CONSULTANT ELECTRICAL ENGINEER

GCC ENGINEERING REFERENCE SERIES

SOLAR PANEL CLEANING TECHNOLOGIES DESERT ENVIRONMENTS

Complete manual, wet, dry, robotic, electrostatic, water-quality, scheduling, safety, reliability and lifecycle calculations for desert photovoltaic plants.



ENGINEERING
REFERENCE SERIES

Solar Panel Cleaning Technologies for Desert Environments

A GCC PERSPECTIVE

A practical engineering handbook for selecting, sizing, operating, verifying and maintaining manual, mechanized, robotic and emerging PV cleaning systems.

GCC DESERT PV CLEANING ENGINEERING SERIES

A structured reference for engineers, operators, cleaning contractors, technicians, owners and asset managers who need transparent, auditable cleaning calculations.

200 PRACTICAL SOLAR PANEL CLEANING SHEETS

Methods | Robots | Water | Brushes | Scheduling | Safety | QA | Economics

Prepared by

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ENGINEERING USE

This handbook supports solar panel cleaning technology selection and operation in desert environments. Verify module limits, access, weather, water quality, equipment ratings and current standards before use.

ILLUSTRATIVE DATA

Worked values are transparent teaching examples and are not operating instructions, equipment guarantees, safety permits, procurement specifications or certified performance reports.

PROFESSIONAL RESPONSIBILITY

Cleaning work requires competent personnel, safe access and isolation, suitable PPE, approved equipment, controlled water and chemicals, and post-cleaning engineering verification.



Preface

WHY THIS BOOK WAS PREPARED

PURPOSE

Desert PV cleaning connects soiling diagnosis, technology selection, surface protection, water and energy use, safe execution, quality verification and lifecycle economics. This volume makes that chain explicit.

METHOD

Each sheet presents one governing relationship, defined values with units, a transparent worked substitution, an engineering check and the decision supported by the result.

SCOPE

The 200 sheets progress from baselines and technology screening through manual, vehicle, robotic, electrostatic and emerging systems, water quality, scheduling, safety, reliability and procurement.

USE WITH JUDGMENT

Replace examples with approved procedures, manufacturer cleaning limits, site-specific soiling data, safe work controls, verified water quality, equipment manuals and reviewed conclusions.



Acknowledgments

PEOPLE AND PRACTICE BEHIND DISCIPLINED PV CLEANING

CLEANING COMMUNITY

This volume reflects methods used by engineers, operators, technicians, cleaning contractors, robot suppliers, water specialists, owners and researchers in arid regions.

ENGINEERING DISCIPLINE

Effective cleaning depends on representative soiling data, suitable equipment, surface-compatible contact, controlled water, verified coverage, safe access and post-cleaning checks.

STANDARDS AND INSTITUTIONS

The framework draws on IEC, ISO, ASTM, WMO, IEA PVPS, manufacturer guidance, national requirements and current GCC operating practice.

READERS

Corrections and verified engineering observations are welcome through the author's LinkedIn QR printed throughout the book.



About the Author

WHO WROTE THIS BOOK

ENG. ZAFAR HUSSAIN

SCE-Accredited Consultant Electrical Engineer with more than seventeen years of Gulf experience in substation commissioning and maintenance, low-voltage distribution, industrial installations and technical training.

PROFESSIONAL PRACTICE

He has served in electricity-distribution roles in the United Arab Emirates and Qatar and later moved to training and consultancy in the Kingdom of Saudi Arabia. His work includes calculation sheets, test records, training posters and field reference material.

EDUCATION AND INDUSTRY

As an instructor at the Energy and Water Academy in Dammam, he delivers technical courses supporting electricity-sector engineers and technicians. This reference series extends that practical teaching format to renewable-energy engineering.

CONTACT AND CORRECTIONS

Readers are invited to report corrections and request calculations for later editions. Scan the footer QR code to reach the author's LinkedIn profile.



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Abbreviations

COMMON SOLAR CLEANING TECHNOLOGY TERMS

AC	Alternating current	RPN	Risk priority number
DC	Direct current	FMEA	Failure modes and effects analysis
GCC	Gulf Cooperation Council	ROI	Return on investment
PV	Photovoltaic	CAPEX	Capital expenditure
SR	Soiling ratio	OPEX	Operating expenditure
SL	Soiling loss	NPV	Net present value
PPE	Personal protective equipment	LCOE	Levelized cost of energy
LOTO	Lockout/tagout	RUL	Remaining useful life
TDS	Total dissolved solids	MTBF	Mean time between failures
EC	Electrical conductivity	MTTR	Mean time to repair
RO	Reverse osmosis	SCADA	Supervisory control and data acquisition
DI	Deionized water	IEC	International Electrotechnical Commission
QA	Quality assurance	ISO	International Organization for Standardization
QC	Quality control	ASTM	ASTM International
KPI	Key performance indicator	WMO	World Meteorological Organization
SLA	Service-level agreement	IEA	International Energy Agency
O&M	Operations and maintenance	SCE	Saudi Council of Engineers



Symbols and Units

CALCULATION NOTATION

A	Area - m2	PF	Power factor
A	Availability - % or fraction	Q	Reactive power or flow - context specific
CF	Capacity factor - % or fraction	R	Resistance or rate - context specific
D	Diameter - m	rho	Density - kg/m3
E	Energy - kWh, MWh or GWh	S	Apparent power - VA, kVA or MVA
eta	Efficiency - % or fraction	t	Time - s, min, h or year
f	Frequency - Hz	T	Temperature - C or K
H	Head, irradiation or inertia constant - context specific	V	Voltage or volume - context specific
I	Electrical current - A	v	Velocity - m/s
m	Mass - kg or t	X	Reactance - ohm
N	Number of items	Z	Impedance - ohm or per unit
P	Active power - W, kW or MW	Delta	Difference between two values

UNIT DISCIPLINE

Every worked example shows its units. Convert inputs before substitution, retain sufficient precision during calculation, and round only the final reported result. Prefixes are case-sensitive: k = kilo, M = mega, G = giga and m = milli.



Safety Notice

READ BEFORE USING ANY CALCULATION

- 01

De-energize, isolate, lock out and verify absence of voltage before electrical work.
- 02

Treat PV strings as energized whenever illuminated; open-circuit voltage remains present.
- 03

Battery systems can deliver extreme fault current and may create toxic or flammable gases.
- 04

Hydrogen is highly flammable and requires classified-area, ventilation and leak-detection design.
- 05

Wind turbines involve work at height, rotating machinery, stored energy and remote access.
- 06

CSP and solar-thermal systems contain hot fluids, pressure and thermal-storage hazards.
- 07

Use approved arc-flash, earthing, fire, lifting and confined-space procedures.
- 08

Only competent persons may approve settings, protection schemes and energization plans.

STOP-WORK RULE

Stop work whenever actual conditions differ from the approved design basis, permit, isolation or risk assessment.



How to Use This Book

A REPEATABLE WORKFLOW FOR EVERY SHEET

- 1

CHOOSE THE SHEET
Use the contents or index to find the required engineering quantity.
- 2

DEFINE THE BOUNDARY
Confirm whether values are AC or DC, gross or net, instantaneous or interval energy.
- 3

COLLECT VERIFIED INPUTS
Use approved drawings, nameplates, measurements, contracts and current standards.
- 4

CONVERT UNITS
Place every value in one consistent unit system before substitution.
- 5

FOLLOW THE THREE STEPS
Calculate the base result, apply the project factor, then check the criterion and margin.
- 6

REVIEW THE GCC NOTE
Temperature, dust, humidity, salt, water and grid strength can change the design.
- 7

RECORD ASSUMPTIONS
Keep calculation revision, data source, author, checker and approval status traceable.
- 8

VERIFY INDEPENDENTLY
Use detailed software, vendor data and competent review for final engineering.



Introduction

HOW THE DESERT CLEANING HANDBOOK IS ORGANIZED

Solar panel cleaning in desert environments is an engineered operating system, not a single task. It joins soiling measurement, method selection, surface compatibility, water and energy use, equipment reliability, safe field logistics, quality verification and economic timing. This volume organizes 200 worked methods around measurable inputs, standard equations and auditable decisions.

01	CLEANING OBJECTIVES AND PERFORMANCE BASELINES	11	WATER SUPPLY, TREATMENT AND QUALITY
02	TECHNOLOGY SELECTION AND SITE SUITABILITY	12	BRUSHES, CONTACT PRESSURE AND WEAR
03	MANUAL DRY-BRUSHING SYSTEMS	13	DETERGENTS AND CLEANING CHEMICALS
04	MANUAL WET-WASHING SYSTEMS	14	CLEANING SCHEDULING AND TRIGGER LOGIC
05	LOW-PRESSURE AND HIGH-PRESSURE WASHING	15	WATER CONSUMPTION AND CONSERVATION
06	VEHICLE-MOUNTED CLEANING EQUIPMENT	16	ENERGY, FUEL AND CARBON REQUIREMENTS
07	AUTONOMOUS ROBOTIC CLEANING	17	LABOR, SAFETY AND FIELD LOGISTICS
08	RAIL AND MODULE-EDGE ROBOTS	18	QUALITY ASSURANCE AND VERIFICATION
09	ELECTROSTATIC DUST REMOVAL	19	CLEANING-SYSTEM RELIABILITY AND MAINTENANCE
10	AIR-JET, VIBRATION AND EMERGING METHODS	20	LIFECYCLE ECONOMICS AND PROCUREMENT

Every worked value is illustrative. Live cleaning must use approved access and electrical safety controls; module-compatible tools and chemicals; controlled water quality; site weather limits; equipment manuals; and post-cleaning inspection before return to service.



1 CALCULATE CLEANING RECOVERY EFFICIENCY

FORMULA

C_001 = (P_after-P_before) / (P_clean-P_before) x 100

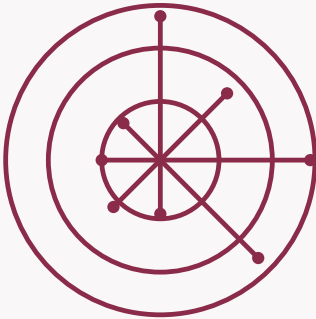
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_001 = (536.0-474) / (544.5-474) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 001



CLEANING RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning	474 W
After cleaning	536.0 W
Clean reference	544.5 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RESIDUAL SOILING LOSS

FORMULA

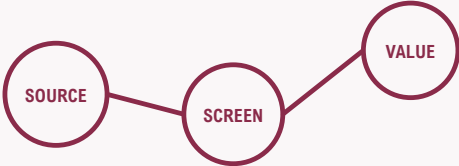
C_002 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_002 = (545-538.8) / 545 x 100 = 1.147%
Calculated result = 1.147 %

CLEANING FIGURE 002



RESIDUAL SOILING LOSS

EXAMPLE VALUES

Clean reference	545 W
Post-cleaning output	538.8 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.15 % x 1.05 = 1.2 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.15 %
K_design	1.05
X_design	1.2 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.32 % - 1.2 % = 0.12 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

1.15 %

worked result

DESIGN

1.2 %

factor 1.05

LIMIT

1.32 %

project criterion

MARGIN

0.12 %

available difference

GCC design note: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BASELINE CLEANING PRODUCTIVITY

FORMULA

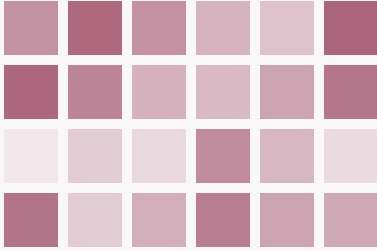
C_003 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_003 = 4,575 / 7 = 653.6 m2/h
Calculated result = 653.6 m2/h

CLEANING FIGURE 003



BASELINE CLEANING PRODUCTIVITY

EXAMPLE VALUES

Cleaned area	4,575 m2
Productive time	7 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 653.6 m2/h x 0.95 = 620.9 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	653.6 m2/h
K_design	0.95
X_design	620.9 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 620.9 m2/h - 558.8 m2/h = 62.1 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

653.6 m2/h

worked result

CONSERVATIVE

620.9 m2/h

factor 0.95

MINIMUM

558.8 m2/h

project criterion

MARGIN

62.1 m2/h

available difference

GCC design note: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE UNCLEANED-MODULE PREVALENCE

FORMULA

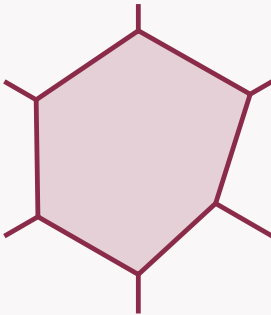
C_004 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_004 = 8 / 562 x 100 = 1.423%
Calculated result = 1.423 %

CLEANING FIGURE 004



UNCLEANED-MODULE PREVALENCE

EXAMPLE VALUES

Missed or failed items	8
Inspected items	562



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.42 % x 1.05 = 1.49 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.42 %
K_design	1.05
X_design	1.49 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.64 % - 1.49 % = 0.149 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1.42 %

worked result

DESIGN

1.49 %

factor 1.05

LIMIT

1.64 %

project criterion

MARGIN

0.149 %

available difference

GCC design note: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE POST-CLEANING UNIFORMITY

FORMULA

C_005 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_005 = 1.095 / 96.25 x 100 = 1.138%
Calculated result = 1.138 %

CLEANING FIGURE 005



POST-CLEANING UNIFORMITY

EXAMPLE VALUES

Standard deviation	1.095
Mean performance	96.25

i

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.14 % x 1.05 = 1.19 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.14 %
K_design	1.05
X_design	1.19 %

i

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.31 % - 1.19 % = 0.119 %

i

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

i

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK

SUMMARY

CALCULATED

1.14 %

worked result

DESIGN

1.19 %

factor 1.05

LIMIT

1.31 %

project criterion

MARGIN

0.119 %

available difference

GCC design note: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RECOVERY DEGRADATION PER CYCLE

FORMULA

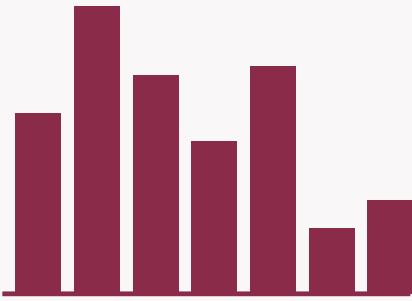
C_006 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_006 = |0.520-0.370| / 5 = 0.030 %/cycle
Calculated result = 0.03 %/cycle

CLEANING FIGURE 006



RECOVERY DEGRADATION PER CYCLE

EXAMPLE VALUES

Later quality indicator	0.520%
Initial quality indicator	0.370%
Cleaning cycles	5

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.03 %/cycle x 1.05 = 0.032 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.03 %/cycle
K_design	1.05
X_design	0.032 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.035 %/cycle - 0.032 %/cycle = 0.003 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.03 %/cycle

worked result

DESIGN

0.032 %/cycle

factor 1.05

LIMIT

0.035 %/cycle

project criterion

MARGIN

0.003 %/cycle

available difference

GCC design note: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BASELINE VERIFICATION COVERAGE

FORMULA

C_007 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_007 = 287 / 292 x 100 = 98.29%
Calculated result = 98.29 %

CLEANING FIGURE 007



BASELINE VERIFICATION COVERAGE

EXAMPLE VALUES

Completed work units	287
Planned work units	292



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 98.3 % x 0.95 = 93.4 %

GIVEN VALUES FOR EXAMPLE

X_calculated	98.3 %
K_design	0.95
X_design	93.4 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 93.4 % - 84 % = 9.34 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

98.3 %

worked result

CONSERVATIVE

93.4 %

factor 0.95

MINIMUM

84 %

project criterion

MARGIN

9.34 %

available difference

GCC design note: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



Expected Recleaning Modules

Section 01 - Cleaning Objectives and Performance Baselines | Worked GCC engineering example.

1 CALCULATE EXPECTED RECLEANING MODULES

FORMULA

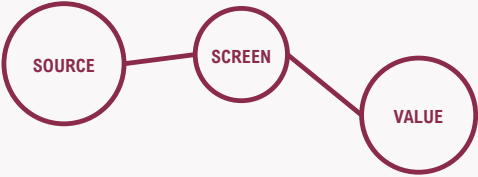
C_008 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_008 = 5420 x 0.222 / 100 = 12.03 modules
Calculated result = 12.03 modules

CLEANING FIGURE 008



EXPECTED RECLEANING MODULES

EXAMPLE VALUES

Asset population	5420 modules
Intervention rate	0.222%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 12 modules x 1.05 = **12.6 modules**

GIVEN VALUES FOR EXAMPLE

X_calculated	12 modules
K_design	1.05
X_design	12.6 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 13.9 modules - 12.6 modules = **1.26 modules**



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

12 modules

worked result

DESIGN

12.6 modules

factor 1.05

LIMIT

13.9 modules

project criterion

MARGIN

1.26 modules

available difference

GCC design note: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CLEANING-BASELINE RISK PRIORITY

FORMULA

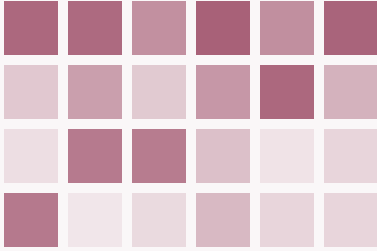
C_009 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_009 = 5 x 3 x 3 = 45
Calculated result = 45 score

CLEANING FIGURE 009



CLEANING-BASELINE RISK PRIORITY

EXAMPLE VALUES

Severity rank	5
Occurrence rank	3
Detection rank	3

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 45 score x 1.05 = 47.2 score

GIVEN VALUES FOR EXAMPLE

X_calculated	45 score
K_design	1.05
X_design	47.2 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 52 score - 47.2 score = 4.73 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

45 score

worked result

DESIGN

47.2 score

factor 1.05

LIMIT

52 score

project criterion

MARGIN

4.73 score

available difference

GCC design note: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BASELINE CLEANING COST

FORMULA

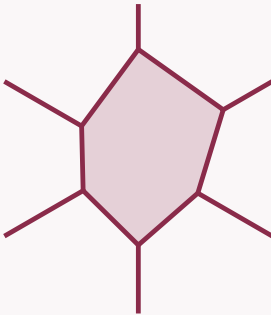
C_010 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_010 = 21 x 3,285 = 68,985 USD/year
Calculated result = 68,985 USD/year

CLEANING FIGURE 010



BASELINE CLEANING COST

EXAMPLE VALUES

Annual cleaning cycles	21
Cost per cycle	3,285 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 68,985 USD/year x 1.05 = 72,434 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	68,985 USD/year
K_design	1.05
X_design	72,434 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 79,678 USD/year - 72,434 USD/year = 7,243 USD/year



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

68,985 USD/year

worked result

DESIGN

72,434 USD/year

factor 1.05

LIMIT

79,678 USD/year

project criterion

MARGIN

7,243 USD/year

available difference

GCC design note: Apply this calculation to cleaning objectives and baseline performance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE SELECTED-METHOD RECOVERY EFFICIENCY

FORMULA

C_011 = (P_after-P_before) / (P_clean-P_before) x 100

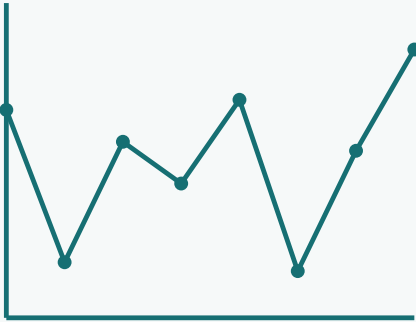
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_011 = (540.5-478) / (549-478) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 011



SELECTED-METHOD RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning478 W

After cleaning540.5 W

Clean reference549 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated88 %

K_design0.95

X_design83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE METHOD SUITABILITY LOSS

FORMULA

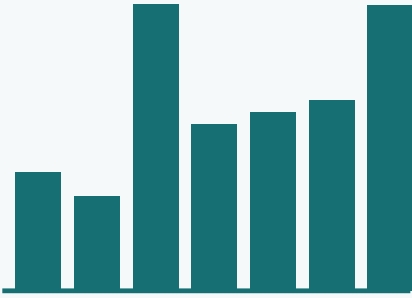
C_012 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_012 = (550-543) / 550 x 100 = 1.273%
Calculated result = 1.273 %

CLEANING FIGURE 012



METHOD SUITABILITY LOSS

EXAMPLE VALUES

Clean reference	550 W
Post-cleaning output	543 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.27 % x 1.05 = 1.34 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.27 %
K_design	1.05
X_design	1.34 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.47 % - 1.34 % = 0.134 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1.27 %

worked result

DESIGN

1.34 %

factor 1.05

LIMIT

1.47 %

project criterion

MARGIN

0.134 %

available difference

GCC design note: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE TECHNOLOGY SCREENING THROUGHPUT

FORMULA

C_013 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_013 = 4,950 / 8 = 618.8 m2/h
Calculated result = 618.8 m2/h

CLEANING FIGURE 013



TECHNOLOGY SCREENING THROUGHPUT

EXAMPLE VALUES

Cleaned area	4,950 m2
Productive time	8 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 618.8 m2/h x 0.95 = 587.8 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	618.8 m2/h
K_design	0.95
X_design	587.8 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 587.8 m2/h - 529 m2/h = 58.8 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

618.8 m2/h

worked result

CONSERVATIVE

587.8 m2/h

factor 0.95

MINIMUM

529 m2/h

project criterion

MARGIN

58.8 m2/h

available difference

GCC design note: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE UNSUITABLE-BLOCK PREVALENCE

FORMULA

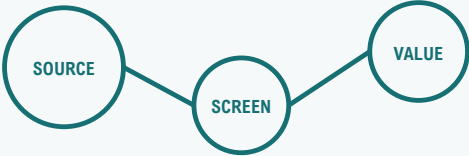
C_014 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_014 = 10 / 604 x 100 = 1.656%
Calculated result = 1.656 %

CLEANING FIGURE 014



UNSUITABLE-BLOCK PREVALENCE

EXAMPLE VALUES

Missed or failed items	10
Inspected items	604

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.66 % x 1.05 = 1.74 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.66 %
K_design	1.05
X_design	1.74 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.91 % - 1.74 % = 0.174 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

1.66 %

worked result

DESIGN

1.74 %

factor 1.05

LIMIT

1.91 %

project criterion

MARGIN

0.174 %

available difference

GCC design note: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE METHOD SCORE VARIABILITY

FORMULA

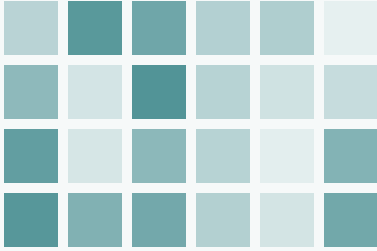
C_015 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_015 = 1.190 / 96.50 x 100 = 1.233%
Calculated result = 1.233 %

CLEANING FIGURE 015



METHOD SCORE VARIABILITY

EXAMPLE VALUES

Standard deviation	1.190
Mean performance	96.50

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.23 % x 1.05 = 1.29 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.23 %
K_design	1.05
X_design	1.29 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.42 % - 1.29 % = 0.129 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

1.23 %

worked result

DESIGN

1.29 %

factor 1.05

LIMIT

1.42 %

project criterion

MARGIN

0.129 %

available difference

GCC design note: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE SUITABILITY DRIFT PER REVIEW

FORMULA

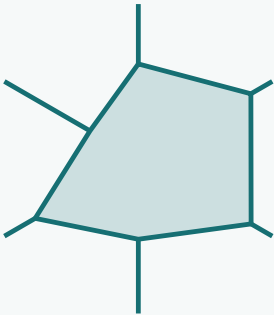
C_016 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_016 = |0.550-0.390| / 6 = 0.027 %/cycle
Calculated result = 0.0267 %/cycle

CLEANING FIGURE 016



SUITABILITY DRIFT PER REVIEW

EXAMPLE VALUES

Later quality indicator	0.550%
Initial quality indicator	0.390%
Cleaning cycles	6

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.027 %/cycle x 1.05 = 0.028 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.027 %/cycle
K_design	1.05
X_design	0.028 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.031 %/cycle - 0.028 %/cycle = 0.003 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.027 %/cycle

worked result

DESIGN

0.028 %/cycle

factor 1.05

LIMIT

0.031 %/cycle

project criterion

MARGIN

0.003 %/cycle

available difference

GCC design note: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE SITE-SURVEY COVERAGE

FORMULA

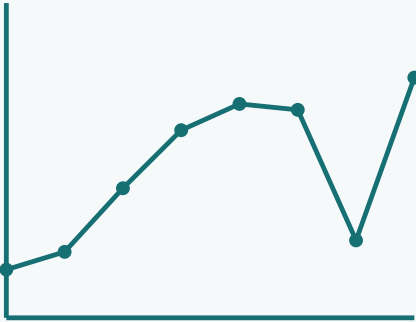
C_017 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_017 = 318 / 324 x 100 = 98.15%
Calculated result = 98.15 %

CLEANING FIGURE 017



SITE-SURVEY COVERAGE

EXAMPLE VALUES

Completed work units	318
Planned work units	324

WHERE

The symbols and values shown are the inputs used in this worked example.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 98.1 % x 0.95 = 93.2 %

GIVEN VALUES FOR EXAMPLE

X_calculated	98.1 %
K_design	0.95
X_design	93.2 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 93.2 % - 83.9 % = 9.32 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

98.1 %

worked result

CONSERVATIVE

93.2 %

factor 0.95

MINIMUM

83.9 %

project criterion

MARGIN

9.32 %

available difference

GCC design note: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED TECHNOLOGY EXCEPTIONS

FORMULA

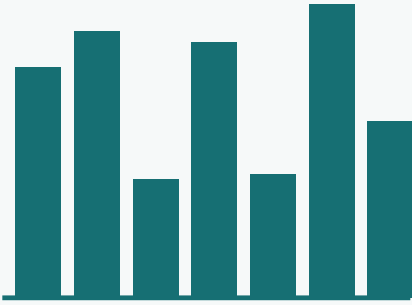
C_018 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_018 = 6040 x 0.264 / 100 = 15.95 modules
Calculated result = 15.95 modules

CLEANING FIGURE 018



EXPECTED TECHNOLOGY EXCEPTIONS

EXAMPLE VALUES

Asset population	6040 modules
Intervention rate	0.264%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 15.9 modules x 1.05 = 16.7 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	15.9 modules
K_design	1.05
X_design	16.7 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 18.4 modules - 16.7 modules = 1.67 modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

15.9 modules

worked result

DESIGN

16.7 modules

factor 1.05

LIMIT

18.4 modules

project criterion

MARGIN

1.67 modules

available difference

GCC design note: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE SELECTION RISK PRIORITY

FORMULA

C_019 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_019 = 6 x 4 x 4 = 96
Calculated result = 96 score

CLEANING FIGURE 019



SELECTION RISK PRIORITY

EXAMPLE VALUES

Severity rank	6
Occurrence rank	4
Detection rank	4

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 96 score x 1.05 = 100.8 score

GIVEN VALUES FOR EXAMPLE

X_calculated	96 score
K_design	1.05
X_design	100.8 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 110.9 score - 100.8 score = 10.1 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

96 score

worked result

DESIGN

100.8 score

factor 1.05

LIMIT

110.9 score

project criterion

MARGIN

10.1 score

available difference

GCC design note: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE TECHNOLOGY SELECTION COST

FORMULA

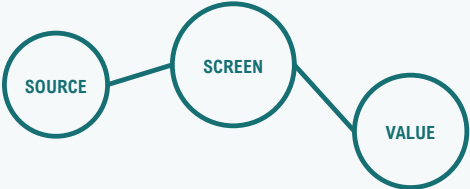
C_020 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_020 = 24 x 3,470 = 83,280 USD/year
Calculated result = 83,280 USD/year

CLEANING FIGURE 020



TECHNOLOGY SELECTION COST

EXAMPLE VALUES

Annual cleaning cycles	24
Cost per cycle	3,470 USD

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 83,280 USD/year x 1.05 = 87,444 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	83,280 USD/year
K_design	1.05
X_design	87,444 USD/year

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 96,188 USD/year - 87,444 USD/year = 8,744 USD/year

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

83,280 USD/year

worked result

DESIGN

87,444 USD/year

factor 1.05

LIMIT

96,188 USD/year

project criterion

MARGIN

8,744 USD/year

available difference

GCC design note: Apply this calculation to technology screening and site suitability. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE DRY-BRUSHING RECOVERY EFFICIENCY

FORMULA

$$C_{021} = (P_{after} - P_{before}) / (P_{clean} - P_{before}) \times 100$$

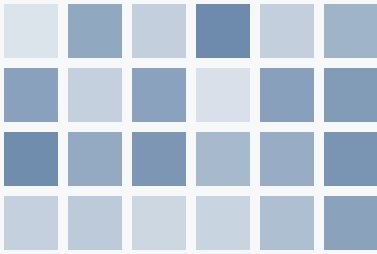
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{021} = (544.9 - 482) / (553.5 - 482) \times 100 = 88\%$$

Calculated result = 88 %

CLEANING FIGURE 021



DRY-BRUSHING RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning	482 W
After cleaning	544.9 W
Clean reference	553.5 W

WHERE

The symbols and values shown are the inputs used in this worked example.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

$$X_{design} = X_{calculated} \times K_{conservative}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{design} = 88\% \times 0.95 = 83.6\%$$

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

$$Margin = X_{design} - X_{min}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$Margin = 83.6\% - 75.2\% = 8.36\%$$

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RESIDUAL DRY-BRUSHING LOSS

FORMULA

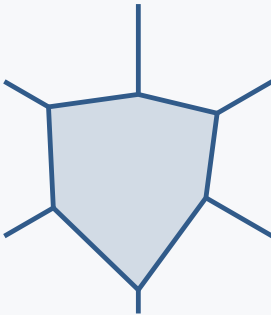
C_022 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_022 = (555-547.2) / 555 x 100 = 1.396%
Calculated result = 1.396 %

CLEANING FIGURE 022



RESIDUAL DRY-BRUSHING LOSS

EXAMPLE VALUES

Clean reference	555 W
Post-cleaning output	547.2 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.4 % x 1.05 = 1.47 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.4 %
K_design	1.05
X_design	1.47 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.61 % - 1.47 % = 0.147 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1.4 %

worked result

DESIGN

1.47 %

factor 1.05

LIMIT

1.61 %

project criterion

MARGIN

0.147 %

available difference

GCC design note: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE MANUAL BRUSH PRODUCTIVITY

FORMULA

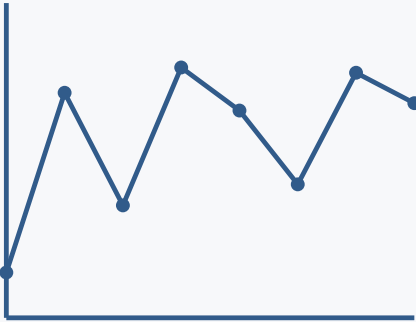
C_023 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_023 = 5,325 / 9 = 591.7 m2/h
Calculated result = 591.7 m2/h

CLEANING FIGURE 023



MANUAL BRUSH PRODUCTIVITY

EXAMPLE VALUES

Cleaned area	5,325 m2
Productive time	9 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 591.7 m2/h x 0.95 = 562.1 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	591.7 m2/h
K_design	0.95
X_design	562.1 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 562.1 m2/h - 505.9 m2/h = 56.2 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

591.7 m2/h

worked result

CONSERVATIVE

562.1 m2/h

factor 0.95

MINIMUM

505.9 m2/h

project criterion

MARGIN

56.2 m2/h

available difference

GCC design note: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE MISSED-ROW PREVALENCE

FORMULA

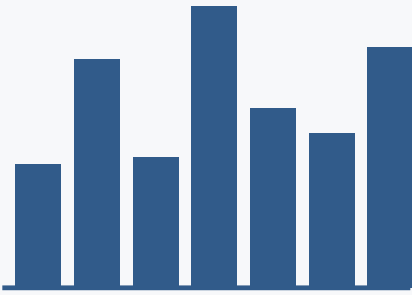
C_024 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_024 = 12 / 646 x 100 = 1.858%
Calculated result = 1.858 %

CLEANING FIGURE 024



MISSED-ROW PREVALENCE

EXAMPLE VALUES

Missed or failed items	12
Inspected items	646

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.86 % x 1.05 = 1.95 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.86 %
K_design	1.05
X_design	1.95 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.15 % - 1.95 % = 0.195 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

1.86 %

worked result

DESIGN

1.95 %

factor 1.05

LIMIT

2.15 %

project criterion

MARGIN

0.195 %

available difference

GCC design note: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CREW CLEANING UNIFORMITY

FORMULA

C_025 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_025 = 1.285 / 96.75 x 100 = 1.328%
Calculated result = 1.328 %

CLEANING FIGURE 025



CREW CLEANING UNIFORMITY

EXAMPLE VALUES

Standard deviation	1.285
Mean performance	96.75



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.33 % x 1.05 = 1.39 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.33 %
K_design	1.05
X_design	1.39 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.53 % - 1.39 % = 0.139 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1.33 %

worked result

DESIGN

1.39 %

factor 1.05

LIMIT

1.53 %

project criterion

MARGIN

0.139 %

available difference

GCC design note: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BRUSH-WEAR EFFECT PER CYCLE

FORMULA

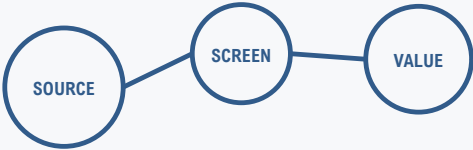
C_026 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_026 = |0.580-0.410| / 7 = 0.024 %/cycle
Calculated result = 0.0243 %/cycle

CLEANING FIGURE 026



BRUSH-WEAR EFFECT PER CYCLE

EXAMPLE VALUES

Later quality indicator	0.580%
Initial quality indicator	0.410%
Cleaning cycles	7

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.024 %/cycle x 1.05 = 0.026 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.024 %/cycle
K_design	1.05
X_design	0.026 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.028 %/cycle - 0.026 %/cycle = 0.003 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.024 %/cycle

worked result

DESIGN

0.026 %/cycle

factor 1.05

LIMIT

0.028 %/cycle

project criterion

MARGIN

0.003 %/cycle

available difference

GCC design note: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE DRY-BRUSHING ROUTE COVERAGE

FORMULA

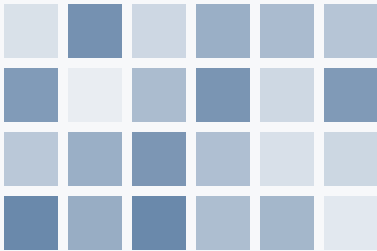
C_027 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_027 = 349 / 356 x 100 = 98.03%
Calculated result = 98.03 %

CLEANING FIGURE 027



DRY-BRUSHING ROUTE COVERAGE

EXAMPLE VALUES

Completed work units	349
Planned work units	356

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 98 % x 0.95 = 93.1 %

GIVEN VALUES FOR EXAMPLE

X_calculated	98 %
K_design	0.95
X_design	93.1 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 93.1 % - 83.8 % = 9.31 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

98 %

worked result

CONSERVATIVE

93.1 %

factor 0.95

MINIMUM

83.8 %

project criterion

MARGIN

9.31 %

available difference

GCC design note: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED MANUAL REWORK MODULES

FORMULA

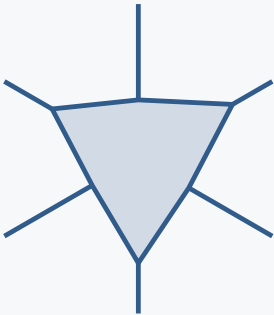
C_028 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_028 = 6660 x 0.306 / 100 = 20.38 modules
Calculated result = 20.38 modules

CLEANING FIGURE 028



EXPECTED MANUAL REWORK MODULES

EXAMPLE VALUES

Asset population	6660 modules
Intervention rate	0.306%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 20.4 modules x 1.05 = 21.4 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	20.4 modules
K_design	1.05
X_design	21.4 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 23.5 modules - 21.4 modules = 2.14 modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

20.4 modules

worked result

DESIGN

21.4 modules

factor 1.05

LIMIT

23.5 modules

project criterion

MARGIN

2.14 modules

available difference

GCC design note: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE DRY-BRUSHING RISK PRIORITY

FORMULA

C_029 = S x O x D

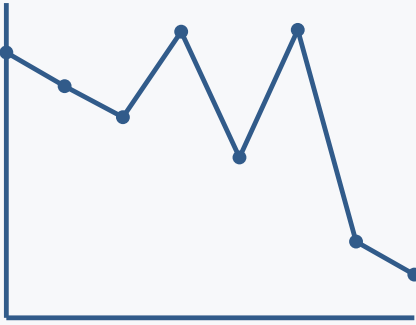
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_029 = 7 x 5 x 5 = 175

Calculated result = 175 score

CLEANING FIGURE 029



DRY-BRUSHING RISK PRIORITY

EXAMPLE VALUES

Severity rank	7
Occurrence rank	5
Detection rank	5

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 175 score x 1.05 = 183.8 score

GIVEN VALUES FOR EXAMPLE

X_calculated	175 score
K_design	1.05
X_design	183.8 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 202.1 score - 183.8 score = 18.4 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

175 score

worked result

DESIGN

183.8 score

factor 1.05

LIMIT

202.1 score

project criterion

MARGIN

18.4 score

available difference

GCC design note: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE MANUAL DRY-CLEANING COST

FORMULA

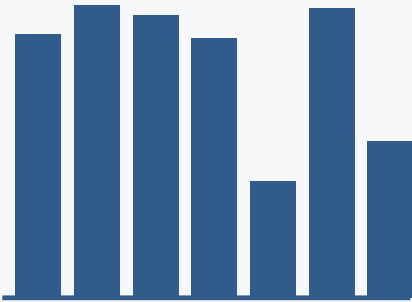
C_030 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_030 = 27 x 3,655 = 98,685 USD/year
Calculated result = 98,685 USD/year

CLEANING FIGURE 030



MANUAL DRY-CLEANING COST

EXAMPLE VALUES

Annual cleaning cycles	27
Cost per cycle	3,655 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 98,685 USD/year x 1.05 = 103,619 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	98,685 USD/year
K_design	1.05
X_design	103,619 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 113,981 USD/year - 103,619 USD/year = 10,362 USD/year



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

98,685 USD/year

worked result

DESIGN

103,619 USD/year

factor 1.05

LIMIT

113,981 USD/year

project criterion

MARGIN

10,362 USD/year

available difference

GCC design note: Apply this calculation to manual dry-brushing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WET-WASHING RECOVERY EFFICIENCY

FORMULA

C_031 = (P_after-P_before) / (P_clean-P_before) x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_031 = (549.4-486) / (558-486) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 031



WET-WASHING RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning	486 W
After cleaning	549.4 W
Clean reference	558 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RESIDUAL WET-WASHING LOSS

FORMULA

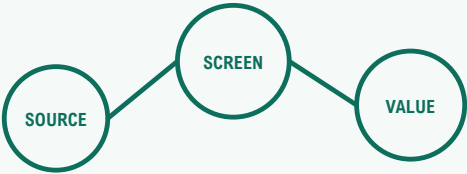
C_032 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_032 = (560-551.5) / 560 x 100 = 1.518%
Calculated result = 1.518 %

CLEANING FIGURE 032



RESIDUAL WET-WASHING LOSS

EXAMPLE VALUES

Clean reference	560 W
Post-cleaning output	551.5 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.52 % x 1.05 = 1.59 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.52 %
K_design	1.05
X_design	1.59 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.75 % - 1.59 % = 0.159 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

1.52 %

worked result

DESIGN

1.59 %

factor 1.05

LIMIT

1.75 %

project criterion

MARGIN

0.159 %

available difference

GCC design note: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WET-WASHING PRODUCTIVITY

FORMULA

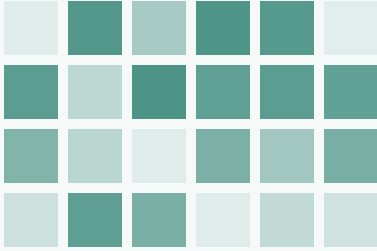
C_033 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_033 = 5,700 / 10 = 570 m2/h
Calculated result = 570 m2/h

CLEANING FIGURE 033



WET-WASHING PRODUCTIVITY

EXAMPLE VALUES

Cleaned area	5,700 m2
Productive time	10 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 570 m2/h x 0.95 = 541.5 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	570 m2/h
K_design	0.95
X_design	541.5 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 541.5 m2/h - 487.4 m2/h = 54.1 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

570 m2/h

worked result

CONSERVATIVE

541.5 m2/h

factor 0.95

MINIMUM

487.4 m2/h

project criterion

MARGIN

54.1 m2/h

available difference

GCC design note: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE INCOMPLETE-RINSE PREVALENCE

FORMULA

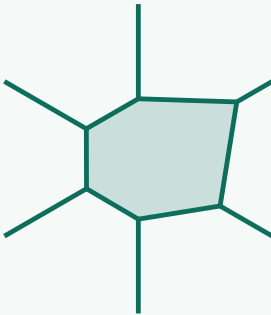
$C_{034} = N_{missed} / N_{inspected} \times 100$

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$C_{034} = 14 / 688 \times 100 = 2.035\%$
Calculated result = 2.035 %

CLEANING FIGURE 034



INCOMPLETE-RINSE PREVALENCE

EXAMPLE VALUES

Missed or failed items	14
Inspected items	688

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$X_{design} = X_{calculated} \times K_{upper}$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$X_{design} = 2.03 \% \times 1.05 = 2.14 \%$

GIVEN VALUES FOR EXAMPLE

X_calculated	2.03 %
K_design	1.05
X_design	2.14 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$Margin = X_{limit} - X_{design}$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$Margin = 2.35 \% - 2.14 \% = 0.214 \%$

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.03 %

worked result

DESIGN

2.14 %

factor 1.05

LIMIT

2.35 %

project criterion

MARGIN

0.214 %

available difference

GCC design note: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WET-CLEANING UNIFORMITY

FORMULA

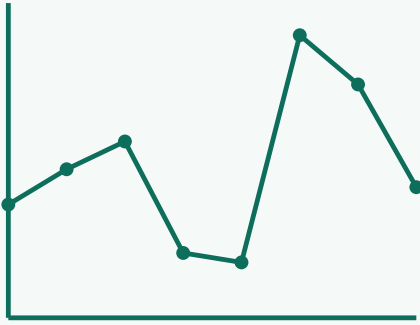
C_035 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_035 = 1.380 / 97 x 100 = 1.423%
Calculated result = 1.423 %

CLEANING FIGURE 035



WET-CLEANING UNIFORMITY

EXAMPLE VALUES

Standard deviation	1.380
Mean performance	97



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.42 % x 1.05 = 1.49 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.42 %
K_design	1.05
X_design	1.49 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.64 % - 1.49 % = 0.149 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1.42 %

worked result

DESIGN

1.49 %

factor 1.05

LIMIT

1.64 %

project criterion

MARGIN

0.149 %

available difference

GCC design note: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RINSE-QUALITY DRIFT PER CYCLE

FORMULA

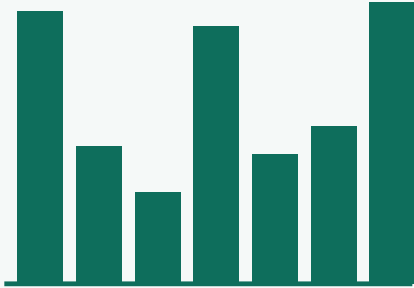
C_036 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_036 = |0.610-0.430| / 8 = 0.023 %/cycle
Calculated result = 0.0225 %/cycle

CLEANING FIGURE 036



RINSE-QUALITY DRIFT PER CYCLE

EXAMPLE VALUES

Later quality indicator	0.610%
Initial quality indicator	0.430%
Cleaning cycles	8

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.023 %/cycle x 1.05 = 0.024 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.023 %/cycle
K_design	1.05
X_design	0.024 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.026 %/cycle - 0.024 %/cycle = 0.002 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.023 %/cycle

worked result

DESIGN

0.024 %/cycle

factor 1.05

LIMIT

0.026 %/cycle

project criterion

MARGIN

0.002 %/cycle

available difference

GCC design note: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WET-WASHING ROUTE COVERAGE

FORMULA

C_037 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_037 = 380 / 388 x 100 = 97.94%
Calculated result = 97.94 %

CLEANING FIGURE 037



WET-WASHING ROUTE COVERAGE

EXAMPLE VALUES

Completed work units	380
Planned work units	388



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 97.9 % x 0.95 = 93 %

GIVEN VALUES FOR EXAMPLE

X_calculated	97.9 %
K_design	0.95
X_design	93 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 93 % - 83.7 % = 9.3 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK

SUMMARY

CALCULATED

97.9 %

worked result

CONSERVATIVE

93 %

factor 0.95

MINIMUM

83.7 %

project criterion

MARGIN

9.3 %

available difference

GCC design note: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED WET-CLEANING REWORK

FORMULA

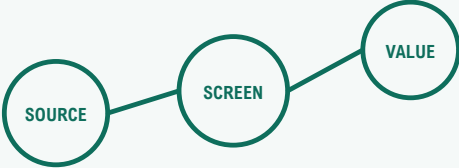
$$C_{038} = N_{asset} \times p_{intervention} / 100$$

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$C_{038} = 7280 \times 0.348 / 100 = 25.33$ modules
Calculated result = 25.33 modules

CLEANING FIGURE 038



EXPECTED WET-CLEANING REWORK

EXAMPLE VALUES

Asset population	7280 modules
Intervention rate	0.348%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{design} = X_{calculated} \times K_{upper}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$X_{design} = 25.3 \text{ modules} \times 1.05 = 26.6$ modules

GIVEN VALUES FOR EXAMPLE

X_calculated	25.3 modules
K_design	1.05
X_design	26.6 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$\text{Margin} = X_{limit} - X_{design}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$\text{Margin} = 29.3 \text{ modules} - 26.6 \text{ modules} = 2.66$ modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

25.3 modules

worked result

DESIGN

26.6 modules

factor 1.05

LIMIT

29.3 modules

project criterion

MARGIN

2.66 modules

available difference

GCC design note: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WET-WASHING RISK PRIORITY

FORMULA

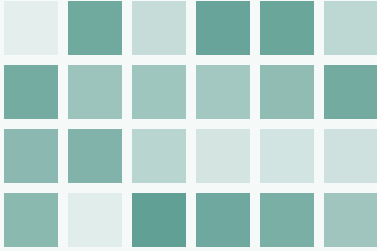
C_039 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_039 = 8 x 6 x 2 = 96
Calculated result = 96 score

CLEANING FIGURE 039



WET-WASHING RISK PRIORITY

EXAMPLE VALUES

Severity rank	8
Occurrence rank	6
Detection rank	2

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 96 score x 1.05 = 100.8 score

GIVEN VALUES FOR EXAMPLE

X_calculated	96 score
K_design	1.05
X_design	100.8 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 110.9 score - 100.8 score = 10.1 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

96 score

worked result

DESIGN

100.8 score

factor 1.05

LIMIT

110.9 score

project criterion

MARGIN

10.1 score

available difference

GCC design note: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE MANUAL WET-CLEANING COST

FORMULA

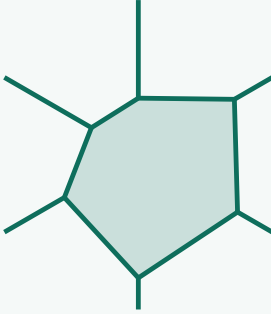
C_040 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_040 = 30 x 3,840 = 115,200 USD/year
Calculated result = 115,200 USD/year

CLEANING FIGURE 040



MANUAL WET-CLEANING COST

EXAMPLE VALUES

Annual cleaning cycles	30
Cost per cycle	3,840 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 115,200 USD/year x 1.05 = 120,960 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	115,200 USD/year
K_design	1.05
X_design	120,960 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 133,056 USD/year - 120,960 USD/year = 12,096 USD/year



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

115,200 USD/year

worked result

DESIGN

120,960 USD/year

factor 1.05

LIMIT

133,056 USD/year

project criterion

MARGIN

12,096 USD/year

available difference

GCC design note: Apply this calculation to manual wet-washing operations. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE PRESSURE-WASHING RECOVERY EFFICIENCY

FORMULA

C_041 = (P_after-P_before) / (P_clean-P_before) x 100

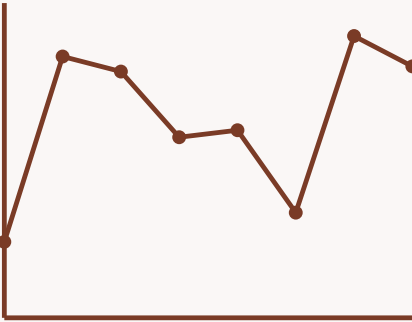
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_041 = (553.8-490) / (562.5-490) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 041



PRESSURE-WASHING RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning	490 W
After cleaning	553.8 W
Clean reference	562.5 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



Pressure-Wash Residual Loss

Section 05 - Low-Pressure and High-Pressure Washing | Worked GCC engineering example.

1 CALCULATE PRESSURE-WASH RESIDUAL LOSS

FORMULA

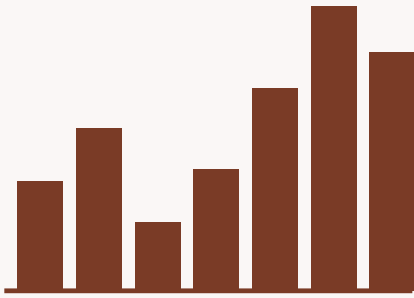
C_042 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_042 = (565-555.8) / 565 x 100 = 1.637%
Calculated result = 1.637 %

CLEANING FIGURE 042



PRESSURE-WASH RESIDUAL LOSS

EXAMPLE VALUES

Clean reference	565 W
Post-cleaning output	555.8 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.64 % x 1.05 = **1.72 %**

GIVEN VALUES FOR EXAMPLE

X_calculated	1.64 %
K_design	1.05
X_design	1.72 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.89 % - 1.72 % = **0.172 %**



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1.64 %

worked result

DESIGN

1.72 %

factor 1.05

LIMIT

1.89 %

project criterion

MARGIN

0.172 %

available difference

GCC design note: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE PRESSURE-WASHING THROUGHPUT

FORMULA

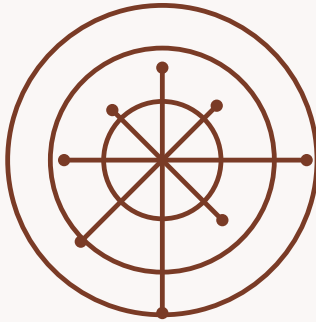
C_043 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_043 = 6,075 / 6 = 1,012.5 m2/h
Calculated result = 1,012.5 m2/h

CLEANING FIGURE 043



PRESSURE-WASHING THROUGHPUT

EXAMPLE VALUES

Cleaned area	6,075 m2
Productive time	6 h

i

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1,012 m2/h x 0.95 = 961.9 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	1,012 m2/h
K_design	0.95
X_design	961.9 m2/h

i

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 961.9 m2/h - 865.7 m2/h = 96.2 m2/h

i

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

i

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK

SUMMARY

CALCULATED

1,012 m2/h

worked result

CONSERVATIVE

961.9 m2/h

factor 0.95

MINIMUM

865.7 m2/h

project criterion

MARGIN

96.2 m2/h

available difference

GCC design note: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE OVERPRESSURE EVENT PREVALENCE

FORMULA

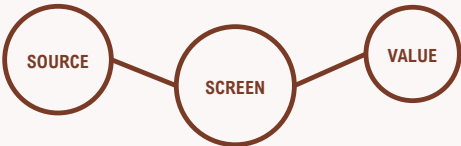
C_044 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_044 = 16 / 730 x 100 = 2.192%
Calculated result = 2.192 %

CLEANING FIGURE 044



OVERPRESSURE EVENT PREVALENCE

EXAMPLE VALUES

Missed or failed items	16
Inspected items	730



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.19 % x 1.05 = 2.3 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.19 %
K_design	1.05
X_design	2.3 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.53 % - 2.3 % = 0.23 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.19 %

worked result

DESIGN

2.3 %

factor 1.05

LIMIT

2.53 %

project criterion

MARGIN

0.23 %

available difference

GCC design note: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE NOZZLE-PRESSURE VARIABILITY

FORMULA

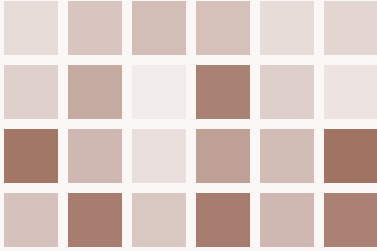
C_045 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_045 = 1.475 / 97.25 x 100 = 1.517%
Calculated result = 1.517 %

CLEANING FIGURE 045



NOZZLE-PRESSURE VARIABILITY

EXAMPLE VALUES

Standard deviation	1.475
Mean performance	97.25



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.52 % x 1.05 = 1.59 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.52 %
K_design	1.05
X_design	1.59 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.75 % - 1.59 % = 0.159 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1.52 %

worked result

DESIGN

1.59 %

factor 1.05

LIMIT

1.75 %

project criterion

MARGIN

0.159 %

available difference

GCC design note: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE NOZZLE DEGRADATION PER CYCLE

FORMULA

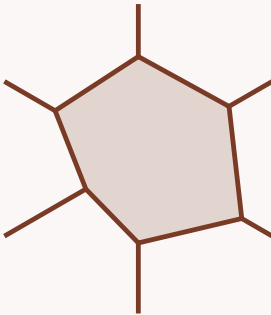
C_046 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_046 = |0.640-0.450| / 9 = 0.021 %/cycle
Calculated result = 0.0211 %/cycle

CLEANING FIGURE 046



NOZZLE DEGRADATION PER CYCLE

EXAMPLE VALUES

Later quality indicator	0.640%
Initial quality indicator	0.450%
Cleaning cycles	9

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.021 %/cycle x 1.05 = 0.022 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.021 %/cycle
K_design	1.05
X_design	0.022 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.024 %/cycle - 0.022 %/cycle = 0.002 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.021 %/cycle

worked result

DESIGN

0.022 %/cycle

factor 1.05

LIMIT

0.024 %/cycle

project criterion

MARGIN

0.002 %/cycle

available difference

GCC design note: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE PRESSURE-WASH COVERAGE

FORMULA

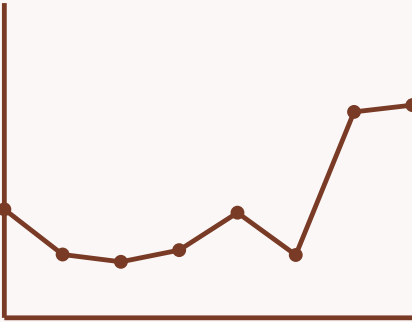
C_047 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_047 = 411 / 420 x 100 = 97.86%
Calculated result = 97.86 %

CLEANING FIGURE 047



PRESSURE-WASH COVERAGE

EXAMPLE VALUES

Completed work units	411
Planned work units	420



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 97.9 % x 0.95 = 93 %

GIVEN VALUES FOR EXAMPLE

X_calculated	97.9 %
K_design	0.95
X_design	93 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 93 % - 83.7 % = 9.3 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

97.9 %

worked result

CONSERVATIVE

93 %

factor 0.95

MINIMUM

83.7 %

project criterion

MARGIN

9.3 %

available difference

GCC design note: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED NOZZLE INTERVENTIONS

FORMULA

$$C_{048} = N_{asset} \times p_{intervention} / 100$$

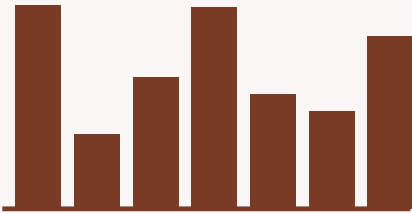
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{048} = 7900 \times 0.390 / 100 = 30.81 \text{ modules}$$

Calculated result = 30.81 modules

CLEANING FIGURE 048



EXPECTED NOZZLE INTERVENTIONS

EXAMPLE VALUES

Asset population	7900 modules
Intervention rate	0.390%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{design} = X_{calculated} \times K_{upper}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{design} = 30.8 \text{ modules} \times 1.05 = 32.4 \text{ modules}$$

GIVEN VALUES FOR EXAMPLE

X_calculated	30.8 modules
K_design	1.05
X_design	32.4 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$Margin = X_{limit} - X_{design}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$Margin = 35.6 \text{ modules} - 32.4 \text{ modules} = 3.24 \text{ modules}$$



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

30.8 modules

worked result

DESIGN

32.4 modules

factor 1.05

LIMIT

35.6 modules

project criterion

MARGIN

3.24 modules

available difference

GCC design note: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE PRESSURE-WASHING RISK PRIORITY

FORMULA

C_049 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_049 = 9 x 2 x 3 = 54
Calculated result = 54 score

CLEANING FIGURE 049



PRESSURE-WASHING RISK PRIORITY

EXAMPLE VALUES

Severity rank	9
Occurrence rank	2
Detection rank	3

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 54 score x 1.05 = 56.7 score

GIVEN VALUES FOR EXAMPLE

X_calculated	54 score
K_design	1.05
X_design	56.7 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 62.4 score - 56.7 score = 5.67 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

54 score

worked result

DESIGN

56.7 score

factor 1.05

LIMIT

62.4 score

project criterion

MARGIN

5.67 score

available difference

GCC design note: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE PRESSURE-WASHING ANNUAL COST

FORMULA

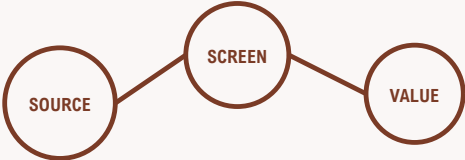
C_050 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_050 = 33 x 4,025 = 132,825 USD/year
Calculated result = 132,825 USD/year

CLEANING FIGURE 050



PRESSURE-WASHING ANNUAL COST

EXAMPLE VALUES

Annual cleaning cycles	33
Cost per cycle	4,025 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 132,825 USD/year x 1.05 = 139,466 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	132,825 USD/year
K_design	1.05
X_design	139,466 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 153,413 USD/year - 139,466 USD/year = 13,947 USD/year



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

132,825 USD/year

worked result

DESIGN

139,466 USD/year

factor 1.05

LIMIT

153,413 USD/year

project criterion

MARGIN

13,947 USD/year

available difference

GCC design note: Apply this calculation to pressure-controlled washing systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE VEHICLE-CLEANING RECOVERY EFFICIENCY

FORMULA

C_051 = (P_after-P_before) / (P_clean-P_before) x 100

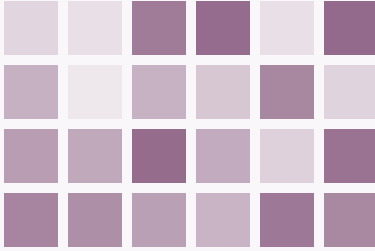
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_051 = (558.2-494) / (567-494) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 051



VEHICLE-CLEANING RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning	494 W
After cleaning	558.2 W
Clean reference	567 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = **83.6 %**

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = **8.36 %**

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE VEHICLE-CLEANING RESIDUAL LOSS

FORMULA

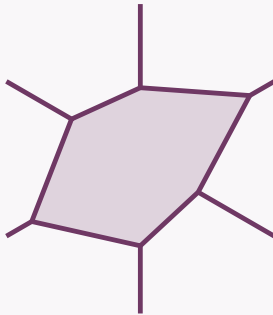
C_052 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_052 = (570-560) / 570 x 100 = 1.754%
Calculated result = 1.754 %

CLEANING FIGURE 052



VEHICLE-CLEANING RESIDUAL LOSS

EXAMPLE VALUES

Clean reference	570 W
Post-cleaning output	560 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.75 % x 1.05 = 1.84 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.75 %
K_design	1.05
X_design	1.84 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.03 % - 1.84 % = 0.184 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1.75 %

worked result

DESIGN

1.84 %

factor 1.05

LIMIT

2.03 %

project criterion

MARGIN

0.184 %

available difference

GCC design note: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE VEHICLE CLEANING PRODUCTIVITY

FORMULA

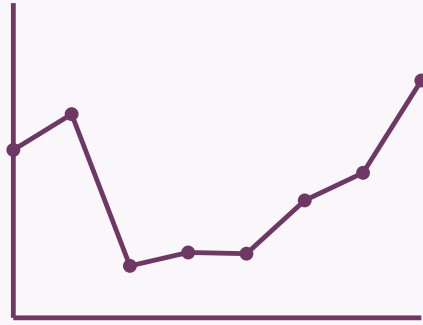
C_053 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_053 = 6,450 / 7 = 921.4 m2/h
Calculated result = 921.4 m2/h

CLEANING FIGURE 053



VEHICLE CLEANING PRODUCTIVITY

EXAMPLE VALUES

Cleaned area	6,450 m2
Productive time	7 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 921.4 m2/h x 0.95 = 875.4 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	921.4 m2/h
K_design	0.95
X_design	875.4 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 875.4 m2/h - 787.8 m2/h = 87.5 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

921.4 m2/h

worked result

CONSERVATIVE

875.4 m2/h

factor 0.95

MINIMUM

787.8 m2/h

project criterion

MARGIN

87.5 m2/h

available difference

GCC design note: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE SKIPPED-ROW PREVALENCE

FORMULA

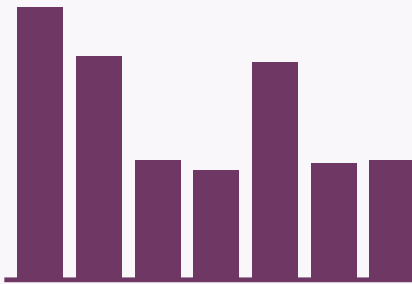
$C_{054} = N_{missed} / N_{inspected} \times 100$

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$C_{054} = 18 / 772 \times 100 = 2.332\%$
Calculated result = 2.332 %

CLEANING FIGURE 054



SKIPPED-ROW PREVALENCE

EXAMPLE VALUES

Missed or failed items	18
Inspected items	772

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$X_{design} = X_{calculated} \times K_{upper}$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$X_{design} = 2.33\% \times 1.05 = 2.45\%$

GIVEN VALUES FOR EXAMPLE

X_calculated	2.33 %
K_design	1.05
X_design	2.45 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$Margin = X_{limit} - X_{design}$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$Margin = 2.69\% - 2.45\% = 0.245\%$

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.33 %

worked result

DESIGN

2.45 %

factor 1.05

LIMIT

2.69 %

project criterion

MARGIN

0.245 %

available difference

GCC design note: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE VEHICLE-SPEED VARIABILITY

FORMULA

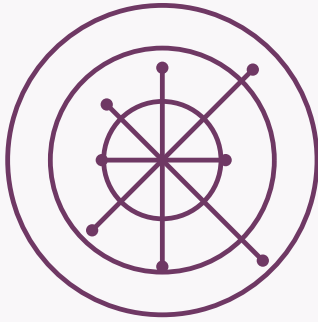
C_055 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_055 = 1.570 / 97.50 x 100 = 1.610%
Calculated result = 1.61 %

CLEANING FIGURE 055



VEHICLE-SPEED VARIABILITY

EXAMPLE VALUES

Standard deviation	1.570
Mean performance	97.50



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.61 % x 1.05 = 1.69 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.61 %
K_design	1.05
X_design	1.69 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.86 % - 1.69 % = 0.169 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1.61 %

worked result

DESIGN

1.69 %

factor 1.05

LIMIT

1.86 %

project criterion

MARGIN

0.169 %

available difference

GCC design note: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BRUSH-PERFORMANCE DRIFT PER CYCLE

FORMULA

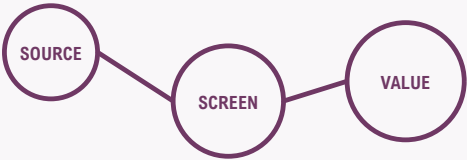
C_056 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_056 = |0.670-0.470| / 4 = 0.050 %/cycle
Calculated result = 0.05 %/cycle

CLEANING FIGURE 056



BRUSH-PERFORMANCE DRIFT PER CYCLE

EXAMPLE VALUES

Later quality indicator	0.670%
Initial quality indicator	0.470%
Cleaning cycles	4

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.05 %/cycle x 1.05 = 0.052 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.05 %/cycle
K_design	1.05
X_design	0.052 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.058 %/cycle - 0.052 %/cycle = 0.005 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.05 %/cycle

worked result

DESIGN

0.052 %/cycle

factor 1.05

LIMIT

0.058 %/cycle

project criterion

MARGIN

0.005 %/cycle

available difference

GCC design note: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE VEHICLE ROUTE COVERAGE

FORMULA

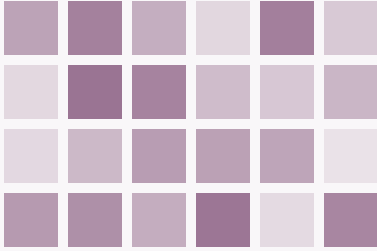
C_057 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_057 = 442 / 452 x 100 = 97.79%
Calculated result = 97.79 %

CLEANING FIGURE 057



VEHICLE ROUTE COVERAGE

EXAMPLE VALUES

Completed work units	442
Planned work units	452



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 97.8 % x 0.95 = 92.9 %

GIVEN VALUES FOR EXAMPLE

X_calculated	97.8 %
K_design	0.95
X_design	92.9 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 92.9 % - 83.6 % = 9.29 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

97.8 %

worked result

CONSERVATIVE

92.9 %

factor 0.95

MINIMUM

83.6 %

project criterion

MARGIN

9.29 %

available difference

GCC design note: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED VEHICLE REWORK MODULES

FORMULA

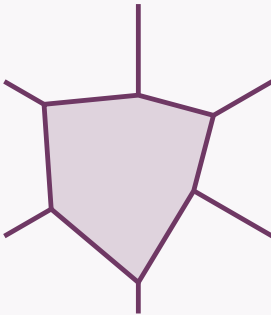
C_058 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_058 = 8520 x 0.432 / 100 = 36.81 modules
Calculated result = 36.81 modules

CLEANING FIGURE 058



EXPECTED VEHICLE REWORK MODULES

EXAMPLE VALUES

Asset population	8520 modules
Intervention rate	0.432%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 36.8 modules x 1.05 = 38.6 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	36.8 modules
K_design	1.05
X_design	38.6 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 42.5 modules - 38.6 modules = 3.86 modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

36.8 modules

worked result

DESIGN

38.6 modules

factor 1.05

LIMIT

42.5 modules

project criterion

MARGIN

3.86 modules

available difference

GCC design note: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE VEHICLE-CLEANING RISK PRIORITY

FORMULA

C_059 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_059 = 4 x 3 x 4 = 48
Calculated result = 48 score

CLEANING FIGURE 059



VEHICLE-CLEANING RISK PRIORITY

EXAMPLE VALUES

Severity rank	4
Occurrence rank	3
Detection rank	4

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 48 score x 1.05 = 50.4 score

GIVEN VALUES FOR EXAMPLE

X_calculated	48 score
K_design	1.05
X_design	50.4 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 55.4 score - 50.4 score = 5.04 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

48 score

worked result

DESIGN

50.4 score

factor 1.05

LIMIT

55.4 score

project criterion

MARGIN

5.04 score

available difference

GCC design note: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE VEHICLE CLEANING ANNUAL COST

FORMULA

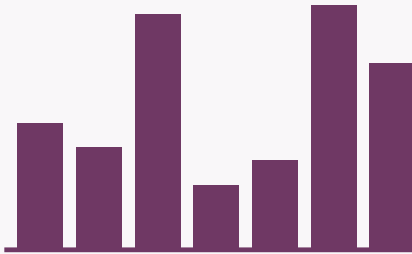
C_060 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_060 = 36 x 4,210 = 151,560 USD/year
Calculated result = 151,560 USD/year

CLEANING FIGURE 060



VEHICLE CLEANING ANNUAL COST

EXAMPLE VALUES

Annual cleaning cycles	36
Cost per cycle	4,210 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 151,560 USD/year x 1.05 = 159,138 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	151,560 USD/year
K_design	1.05
X_design	159,138 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 175,052 USD/year - 159,138 USD/year = 15,914 USD/year



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

151,560 USD/year

worked result

DESIGN

159,138 USD/year

factor 1.05

LIMIT

175,052 USD/year

project criterion

MARGIN

15,914 USD/year

available difference

GCC design note: Apply this calculation to vehicle-mounted cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ROBOTIC CLEANING RECOVERY EFFICIENCY

FORMULA

C_061 = (P_after-P_before) / (P_clean-P_before) x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_061 = (562.7-498) / (571.5-498) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 061



ROBOTIC CLEANING RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning	498 W
After cleaning	562.7 W
Clean reference	571.5 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ROBOTIC RESIDUAL SOILING LOSS

FORMULA

$$C_{062} = (P_{\text{clean}} - P_{\text{after}}) / P_{\text{clean}} \times 100$$

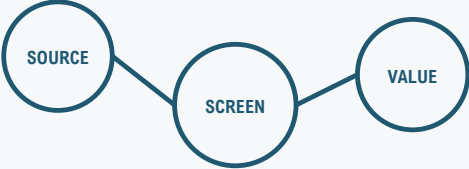
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{062} = (575 - 564.2) / 575 \times 100 = 1.870\%$$

Calculated result = 1.87 %

CLEANING FIGURE 062



ROBOTIC RESIDUAL SOILING LOSS

EXAMPLE VALUES

Clean reference	575 W
Post-cleaning output	564.2 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{\text{design}} = X_{\text{calculated}} \times K_{\text{upper}}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{\text{design}} = 1.87\% \times 1.05 = 1.96\%$$

GIVEN VALUES FOR EXAMPLE

X_calculated	1.87 %
K_design	1.05
X_design	1.96 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$\text{Margin} = X_{\text{limit}} - X_{\text{design}}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$\text{Margin} = 2.16\% - 1.96\% = 0.196\%$$

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

1.87 %

worked result

DESIGN

1.96 %

factor 1.05

LIMIT

2.16 %

project criterion

MARGIN

0.196 %

available difference

GCC design note: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ROBOT CLEANING THROUGHPUT

FORMULA

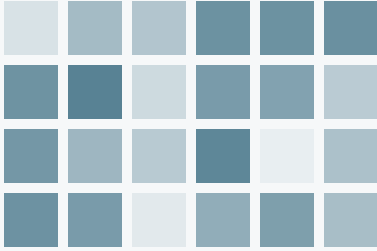
C_063 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_063 = 6,825 / 8 = 853.1 m2/h
Calculated result = 853.1 m2/h

CLEANING FIGURE 063



ROBOT CLEANING THROUGHPUT

EXAMPLE VALUES

Cleaned area	6,825 m2
Productive time	8 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 853.1 m2/h x 0.95 = 810.5 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	853.1 m2/h
K_design	0.95
X_design	810.5 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 810.5 m2/h - 729.4 m2/h = 81 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

853.1 m2/h

worked result

CONSERVATIVE

810.5 m2/h

factor 0.95

MINIMUM

729.4 m2/h

project criterion

MARGIN

81 m2/h

available difference

GCC design note: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ROBOT FAULT PREVALENCE

FORMULA

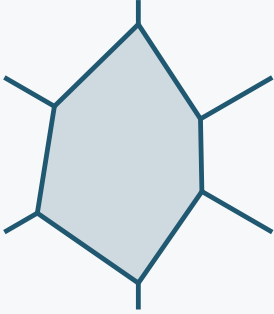
C_064 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_064 = 20 / 814 x 100 = 2.457%
Calculated result = 2.457 %

CLEANING FIGURE 064



ROBOT FAULT PREVALENCE

EXAMPLE VALUES

Missed or failed items	20
Inspected items	814

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.46 % x 1.05 = 2.58 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.46 %
K_design	1.05
X_design	2.58 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.84 % - 2.58 % = 0.258 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.46 %

worked result

DESIGN

2.58 %

factor 1.05

LIMIT

2.84 %

project criterion

MARGIN

0.258 %

available difference

GCC design note: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ROBOT-TO-ROBOT UNIFORMITY

FORMULA

C_065 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_065 = 1.665 / 97.75 x 100 = 1.703%
Calculated result = 1.703 %

CLEANING FIGURE 065



ROBOT-TO-ROBOT UNIFORMITY

EXAMPLE VALUES

Standard deviation	1.665
Mean performance	97.75



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.7 % x 1.05 = 1.79 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.7 %
K_design	1.05
X_design	1.79 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1.97 % - 1.79 % = 0.179 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1.7 %

worked result

DESIGN

1.79 %

factor 1.05

LIMIT

1.97 %

project criterion

MARGIN

0.179 %

available difference

GCC design note: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ROBOT PERFORMANCE DRIFT PER CYCLE

FORMULA

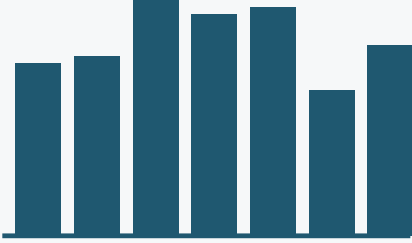
C_066 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_066 = |0.700-0.490| / 5 = 0.042 %/cycle
Calculated result = 0.042 %/cycle

CLEANING FIGURE 066



ROBOT PERFORMANCE DRIFT PER CYCLE

EXAMPLE VALUES

Later quality indicator	0.700%
Initial quality indicator	0.490%
Cleaning cycles	5

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.042 %/cycle x 1.05 = 0.044 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.042 %/cycle
K_design	1.05
X_design	0.044 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.049 %/cycle - 0.044 %/cycle = 0.004 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.042 %/cycle

worked result

DESIGN

0.044 %/cycle

factor 1.05

LIMIT

0.049 %/cycle

project criterion

MARGIN

0.004 %/cycle

available difference

GCC design note: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE AUTONOMOUS ROUTE COVERAGE

FORMULA

C_067 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_067 = 473 / 484 x 100 = 97.73%
Calculated result = 97.73 %

CLEANING FIGURE 067



AUTONOMOUS ROUTE COVERAGE

EXAMPLE VALUES

Completed work units	473
Planned work units	484

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 97.7 % x 0.95 = 92.8 %

GIVEN VALUES FOR EXAMPLE

X_calculated	97.7 %
K_design	0.95
X_design	92.8 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 92.8 % - 83.6 % = 9.28 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

97.7 %

worked result

CONSERVATIVE

92.8 %

factor 0.95

MINIMUM

83.6 %

project criterion

MARGIN

9.28 %

available difference

GCC design note: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED ROBOT INTERVENTIONS

FORMULA

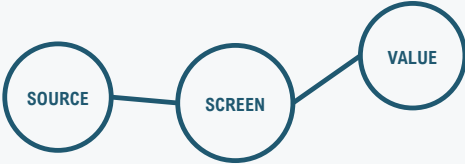
C_068 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_068 = 9140 x 0.474 / 100 = 43.32 modules
Calculated result = 43.32 modules

CLEANING FIGURE 068



EXPECTED ROBOT INTERVENTIONS

EXAMPLE VALUES

Asset population	9140 modules
Intervention rate	0.474%

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 43.3 modules x 1.05 = 45.5 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	43.3 modules
K_design	1.05
X_design	45.5 modules

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 50 modules - 45.5 modules = 4.55 modules

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

43.3 modules

worked result

DESIGN

45.5 modules

factor 1.05

LIMIT

50 modules

project criterion

MARGIN

4.55 modules

available difference

GCC design note: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE AUTONOMOUS CLEANING RISK PRIORITY

FORMULA

C_069 = S x O x D

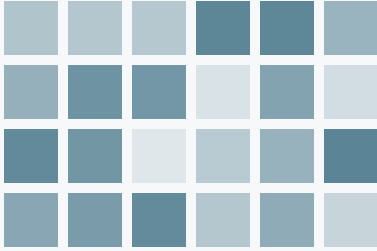
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_069 = 5 x 4 x 5 = 100

Calculated result = 100 score

CLEANING FIGURE 069



AUTONOMOUS CLEANING RISK PRIORITY

EXAMPLE VALUES

Severity rank	5
Occurrence rank	4
Detection rank	5

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 100 score x 1.05 = 105 score

GIVEN VALUES FOR EXAMPLE

X_calculated	100 score
K_design	1.05
X_design	105 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 115.5 score - 105 score = 10.5 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

100 score

worked result

DESIGN

105 score

factor 1.05

LIMIT

115.5 score

project criterion

MARGIN

10.5 score

available difference

GCC design note: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE AUTONOMOUS CLEANING ANNUAL COST

FORMULA

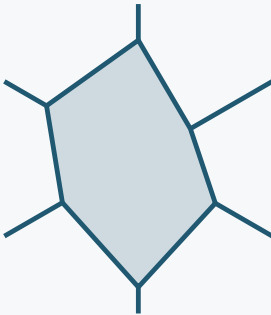
C_070 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_070 = 39 x 4,395 = 171,405 USD/year
Calculated result = 171,405 USD/year

CLEANING FIGURE 070



AUTONOMOUS CLEANING ANNUAL COST

EXAMPLE VALUES

Annual cleaning cycles	39
Cost per cycle	4,395 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 171,405 USD/year x 1.05 = 179,975 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	171,405 USD/year
K_design	1.05
X_design	179,975 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 197,973 USD/year - 179,975 USD/year = 17,998 USD/year



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

171,405 USD/year

worked result

DESIGN

179,975 USD/year

factor 1.05

LIMIT

197,973 USD/year

project criterion

MARGIN

17,998 USD/year

available difference

GCC design note: Apply this calculation to autonomous robotic cleaning systems. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RAIL-ROBOT RECOVERY EFFICIENCY

FORMULA

C_071 = (P_after-P_before) / (P_clean-P_before) x 100

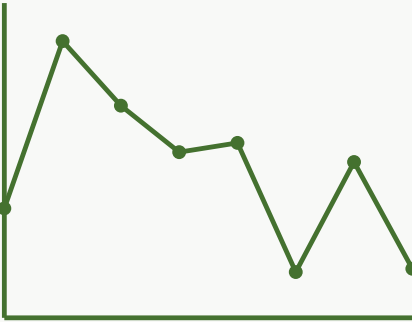
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_071 = (567.1-502) / (576-502) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 071



RAIL-ROBOT RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning502 W

After cleaning567.1 W

Clean reference576 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated88 %

K_design0.95

X_design83.6 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RAIL-ROBOT RESIDUAL LOSS

FORMULA

$$C_{072} = (P_{\text{clean}} - P_{\text{after}}) / P_{\text{clean}} \times 100$$

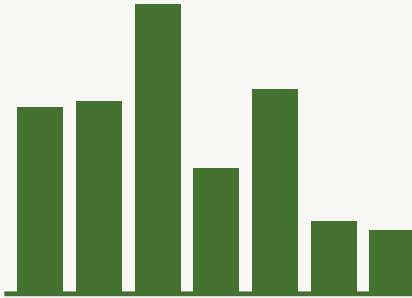
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{072} = (580 - 568.5) / 580 \times 100 = 1.983\%$$

Calculated result = 1.983 %

CLEANING FIGURE 072



RAIL-ROBOT RESIDUAL LOSS

EXAMPLE VALUES

Clean reference	580 W
Post-cleaning output	568.5 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{\text{design}} = X_{\text{calculated}} \times K_{\text{upper}}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{\text{design}} = 1.98 \% \times 1.05 = \mathbf{2.08 \%}$$

GIVEN VALUES FOR EXAMPLE

X_calculated	1.98 %
K_design	1.05
X_design	2.08 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$\text{Margin} = X_{\text{limit}} - X_{\text{design}}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$\text{Margin} = 2.29 \% - 2.08 \% = \mathbf{0.208 \%}$$



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1.98 %

worked result

DESIGN

2.08 %

factor 1.05

LIMIT

2.29 %

project criterion

MARGIN

0.208 %

available difference

GCC design note: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RAIL-ROBOT CLEANING THROUGHPUT

FORMULA

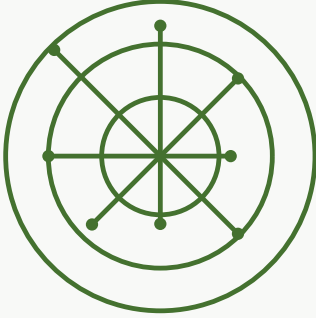
C_073 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_073 = 7,200 / 9 = 800 m2/h
Calculated result = 800 m2/h

CLEANING FIGURE 073



RAIL-ROBOT CLEANING THROUGHPUT

EXAMPLE VALUES

Cleaned area	7,200 m2
Productive time	9 h

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 800 m2/h x 0.95 = 760 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	800 m2/h
K_design	0.95
X_design	760 m2/h

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 760 m2/h - 684 m2/h = 76 m2/h

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

800 m2/h

worked result

CONSERVATIVE

760 m2/h

factor 0.95

MINIMUM

684 m2/h

project criterion

MARGIN

76 m2/h

available difference

GCC design note: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE DOCKING-FAILURE PREVALENCE

FORMULA

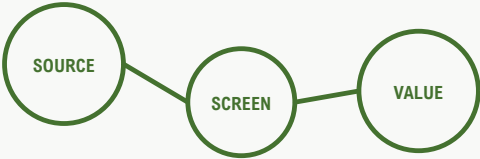
C_074 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_074 = 22 / 856 x 100 = 2.570%
Calculated result = 2.57 %

CLEANING FIGURE 074



DOCKING-FAILURE PREVALENCE

EXAMPLE VALUES

Missed or failed items	22
Inspected items	856

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.57 % x 1.05 = 2.7 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.57 %
K_design	1.05
X_design	2.7 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.97 % - 2.7 % = 0.27 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.57 %

worked result

DESIGN

2.7 %

factor 1.05

LIMIT

2.97 %

project criterion

MARGIN

0.27 %

available difference

GCC design note: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RAIL ALIGNMENT VARIABILITY

FORMULA

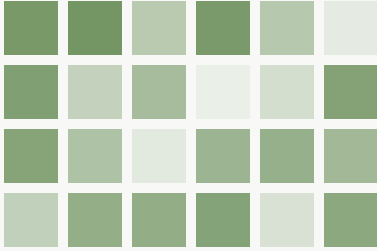
C_075 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_075 = 1.760 / 98 x 100 = 1.796%
Calculated result = 1.796 %

CLEANING FIGURE 075



RAIL ALIGNMENT VARIABILITY

EXAMPLE VALUES

Standard deviation	1.760
Mean performance	98



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.8 % x 1.05 = 1.89 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.8 %
K_design	1.05
X_design	1.89 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.07 % - 1.89 % = 0.189 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

1.8 %

worked result

DESIGN

1.89 %

factor 1.05

LIMIT

2.07 %

project criterion

MARGIN

0.189 %

available difference

GCC design note: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WHEEL-WEAR EFFECT PER CYCLE

FORMULA

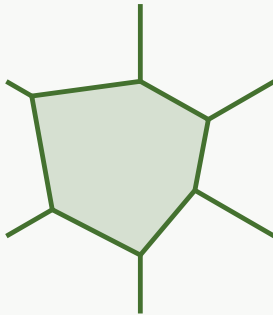
C_076 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_076 = |0.730-0.510| / 6 = 0.037 %/cycle
Calculated result = 0.0367 %/cycle

CLEANING FIGURE 076



WHEEL-WEAR EFFECT PER CYCLE

EXAMPLE VALUES

Later quality indicator	0.730%
Initial quality indicator	0.510%
Cleaning cycles	6

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.037 %/cycle x 1.05 = 0.038 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.037 %/cycle
K_design	1.05
X_design	0.038 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.042 %/cycle - 0.038 %/cycle = 0.004 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.037 %/cycle

worked result

DESIGN

0.038 %/cycle

factor 1.05

LIMIT

0.042 %/cycle

project criterion

MARGIN

0.004 %/cycle

available difference

GCC design note: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RAIL-ROBOT ROUTE COVERAGE

FORMULA

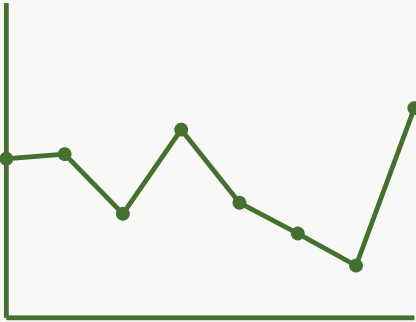
C_077 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_077 = 504 / 516 x 100 = 97.67%
Calculated result = 97.67 %

CLEANING FIGURE 077



RAIL-ROBOT ROUTE COVERAGE

EXAMPLE VALUES

Completed work units	504
Planned work units	516



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 97.7 % x 0.95 = 92.8 %

GIVEN VALUES FOR EXAMPLE

X_calculated	97.7 %
K_design	0.95
X_design	92.8 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 92.8 % - 83.5 % = 9.28 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

97.7 %

worked result

CONSERVATIVE

92.8 %

factor 0.95

MINIMUM

83.5 %

project criterion

MARGIN

9.28 %

available difference

GCC design note: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED DOCKING INTERVENTIONS

FORMULA

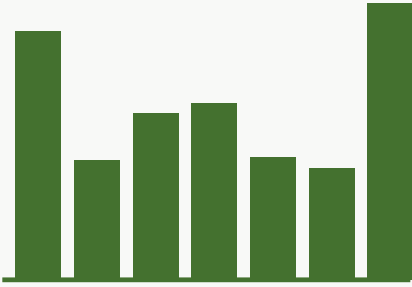
$$C_{078} = N_{asset} \times p_{intervention} / 100$$

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$C_{078} = 9760 \times 0.516 / 100 = 50.36$ modules
Calculated result = 50.36 modules

CLEANING FIGURE 078



EXPECTED DOCKING INTERVENTIONS

EXAMPLE VALUES

Asset population	9760 modules
Intervention rate	0.516%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{design} = X_{calculated} \times K_{upper}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$X_{design} = 50.4 \text{ modules} \times 1.05 = 52.9 \text{ modules}$

GIVEN VALUES FOR EXAMPLE

X_calculated	50.4 modules
K_design	1.05
X_design	52.9 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$Margin = X_{limit} - X_{design}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$Margin = 58.2 \text{ modules} - 52.9 \text{ modules} = 5.29 \text{ modules}$



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

50.4 modules

worked result

DESIGN

52.9 modules

factor 1.05

LIMIT

58.2 modules

project criterion

MARGIN

5.29 modules

available difference

GCC design note: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RAIL-ROBOT RISK PRIORITY

FORMULA

C_079 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_079 = 6 x 5 x 2 = 60
Calculated result = 60 score

CLEANING FIGURE 079



RAIL-ROBOT RISK PRIORITY

EXAMPLE VALUES

Severity rank	6
Occurrence rank	5
Detection rank	2

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 60 score x 1.05 = 63 score

GIVEN VALUES FOR EXAMPLE

X_calculated	60 score
K_design	1.05
X_design	63 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 69.3 score - 63 score = 6.3 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

60 score

worked result

DESIGN

63 score

factor 1.05

LIMIT

69.3 score

project criterion

MARGIN

6.3 score

available difference

GCC design note: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RAIL-ROBOT ANNUAL COST

FORMULA

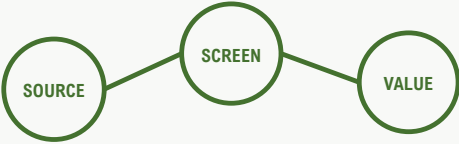
C_080 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_080 = 42 x 4,580 = 192,360 USD/year
Calculated result = 192,360 USD/year

CLEANING FIGURE 080



RAIL-ROBOT ANNUAL COST

EXAMPLE VALUES

Annual cleaning cycles	42
Cost per cycle	4,580 USD

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 192,360 USD/year x 1.05 = 201,978 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	192,360 USD/year
K_design	1.05
X_design	201,978 USD/year

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 222,176 USD/year - 201,978 USD/year = 20,198 USD/year

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

192,360 USD/year

worked result

DESIGN

201,978 USD/year

factor 1.05

LIMIT

222,176 USD/year

project criterion

MARGIN

20,198 USD/year

available difference

GCC design note: Apply this calculation to rail-guided and module-edge cleaning robots. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ELECTROSTATIC REMOVAL EFFICIENCY

FORMULA

$$C_{081} = (P_{after} - P_{before}) / (P_{clean} - P_{before}) \times 100$$

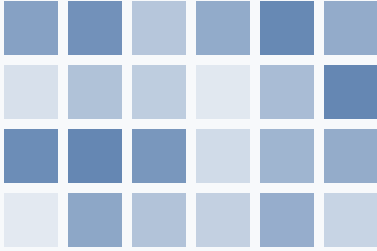
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{081} = (571.6 - 506) / (580.5 - 506) \times 100 = 88\%$$

Calculated result = 88 %

CLEANING FIGURE 081



ELECTROSTATIC REMOVAL EFFICIENCY

EXAMPLE VALUES

Before cleaning	506 W
After cleaning	571.6 W
Clean reference	580.5 W

WHERE

The symbols and values shown are the inputs used in this worked example.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

$$X_{design} = X_{calculated} \times K_{conservative}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{design} = 88\% \times 0.95 = 83.6\%$$

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

$$Margin = X_{design} - X_{min}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$Margin = 83.6\% - 75.2\% = 8.36\%$$

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RESIDUAL ELECTROSTATIC LOSS

FORMULA

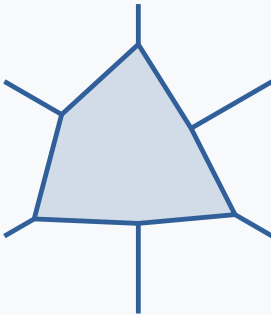
C_082 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_082 = (585-572.8) / 585 x 100 = 2.094%
Calculated result = 2.094 %

CLEANING FIGURE 082



RESIDUAL ELECTROSTATIC LOSS

EXAMPLE VALUES

Clean reference	585 W
Post-cleaning output	572.8 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.09 % x 1.05 = 2.2 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.09 %
K_design	1.05
X_design	2.2 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.42 % - 2.2 % = 0.22 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.09 %

worked result

DESIGN

2.2 %

factor 1.05

LIMIT

2.42 %

project criterion

MARGIN

0.22 %

available difference

GCC design note: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



Electrostatic Cleaning Throughput

Section 09 - Electrostatic Dust Removal | Worked GCC engineering example.

1 CALCULATE ELECTROSTATIC CLEANING THROUGHPUT

FORMULA

C_083 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_083 = 7,575 / 10 = 757.5 m2/h
Calculated result = 757.5 m2/h

CLEANING FIGURE 083



ELECTROSTATIC CLEANING THROUGHPUT

EXAMPLE VALUES

Cleaned area	7,575 m2
Productive time	10 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 757.5 m2/h x 0.95 = **719.6 m2/h**

GIVEN VALUES FOR EXAMPLE

X_calculated	757.5 m2/h
K_design	0.95
X_design	719.6 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 719.6 m2/h - 647.7 m2/h = **72 m2/h**



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

757.5 m2/h

worked result

CONSERVATIVE

719.6 m2/h

factor 0.95

MINIMUM

647.7 m2/h

project criterion

MARGIN

72 m2/h

available difference

GCC design note: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE DISCHARGE-FAULT PREVALENCE

FORMULA

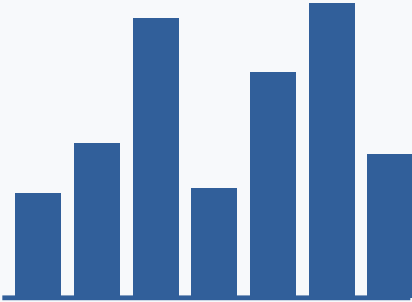
C_084 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_084 = 24 / 898 x 100 = 2.673%
Calculated result = 2.673 %

CLEANING FIGURE 084



DISCHARGE-FAULT PREVALENCE

EXAMPLE VALUES

Missed or failed items	24
Inspected items	898



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.67 % x 1.05 = 2.81 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.67 %
K_design	1.05
X_design	2.81 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.09 % - 2.81 % = 0.281 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.67 %

worked result

DESIGN

2.81 %

factor 1.05

LIMIT

3.09 %

project criterion

MARGIN

0.281 %

available difference

GCC design note: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE FIELD-STRENGTH VARIABILITY

FORMULA

C_085 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_085 = 1.855 / 98.25 x 100 = 1.888%
Calculated result = 1.888 %

CLEANING FIGURE 085



FIELD-STRENGTH VARIABILITY

EXAMPLE VALUES

Standard deviation	1.855
Mean performance	98.25



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.89 % x 1.05 = 1.98 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.89 %
K_design	1.05
X_design	1.98 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.18 % - 1.98 % = 0.198 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

1.89 %

worked result

DESIGN

1.98 %

factor 1.05

LIMIT

2.18 %

project criterion

MARGIN

0.198 %

available difference

GCC design note: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ELECTRODE PERFORMANCE DRIFT

FORMULA

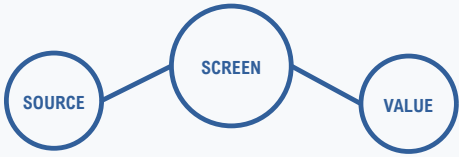
C_086 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_086 = |0.760-0.530| / 7 = 0.033 %/cycle
Calculated result = 0.0329 %/cycle

CLEANING FIGURE 086



ELECTRODE PERFORMANCE DRIFT

EXAMPLE VALUES

Later quality indicator	0.760%
Initial quality indicator	0.530%
Cleaning cycles	7

WHERE

The symbols and values shown are the inputs used in this worked example.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.033 %/cycle x 1.05 = 0.035 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.033 %/cycle
K_design	1.05
X_design	0.035 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.038 %/cycle - 0.035 %/cycle = 0.003 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.033 %/cycle

worked result

DESIGN

0.035 %/cycle

factor 1.05

LIMIT

0.038 %/cycle

project criterion

MARGIN

0.003 %/cycle

available difference

GCC design note: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ELECTROSTATIC ARRAY COVERAGE

FORMULA

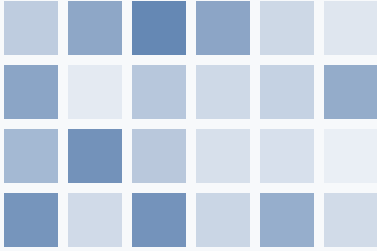
C_087 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_087 = 544 / 548 x 100 = 99.27%
Calculated result = 99.27 %

CLEANING FIGURE 087



ELECTROSTATIC ARRAY COVERAGE

EXAMPLE VALUES

Completed work units	544
Planned work units	548



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 99.3 % x 0.95 = 94.3 %

GIVEN VALUES FOR EXAMPLE

X_calculated	99.3 %
K_design	0.95
X_design	94.3 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 94.3 % - 84.9 % = 9.43 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

99.3 %

worked result

CONSERVATIVE

94.3 %

factor 0.95

MINIMUM

84.9 %

project criterion

MARGIN

9.43 %

available difference

GCC design note: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED ELECTRODE INTERVENTIONS

FORMULA

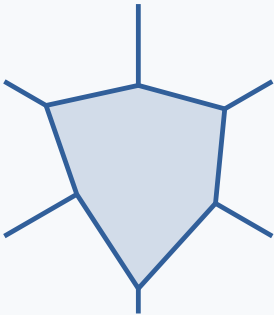
C_088 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_088 = 10380 x 0.558 / 100 = 57.92 modules
Calculated result = 57.92 modules

CLEANING FIGURE 088



EXPECTED ELECTRODE INTERVENTIONS

EXAMPLE VALUES

Asset population	10380 modules
Intervention rate	0.558%

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 57.9 modules x 1.05 = 60.8 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	57.9 modules
K_design	1.05
X_design	60.8 modules

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 66.9 modules - 60.8 modules = 6.08 modules

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

57.9 modules

worked result

DESIGN

60.8 modules

factor 1.05

LIMIT

66.9 modules

project criterion

MARGIN

6.08 modules

available difference

GCC design note: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ELECTROSTATIC CLEANING RISK PRIORITY

FORMULA

C_089 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_089 = 7 x 6 x 3 = 126

Calculated result = 126 score

CLEANING FIGURE 089



ELECTROSTATIC CLEANING RISK PRIORITY

EXAMPLE VALUES

Severity rank	7
Occurrence rank	6
Detection rank	3

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 126 score x 1.05 = 132.3 score

GIVEN VALUES FOR EXAMPLE

X_calculated	126 score
K_design	1.05
X_design	132.3 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 145.5 score - 132.3 score = 13.2 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

126 score

worked result

DESIGN

132.3 score

factor 1.05

LIMIT

145.5 score

project criterion

MARGIN

13.2 score

available difference

GCC design note: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



Electrostatic Cleaning Annual Cost

Section 09 - Electrostatic Dust Removal | Worked GCC engineering example.

1 CALCULATE ELECTROSTATIC CLEANING ANNUAL COST

FORMULA

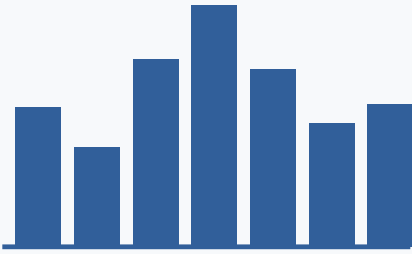
C_090 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_090 = 45 x 4,765 = 214,425 USD/year
Calculated result = 214,425 USD/year

CLEANING FIGURE 090



ELECTROSTATIC CLEANING ANNUAL COST

EXAMPLE VALUES

Annual cleaning cycles	45
Cost per cycle	4,765 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 214,425 USD/year x 1.05 = **225,146 USD/year**

GIVEN VALUES FOR EXAMPLE

X_calculated	214,425 USD/year
K_design	1.05
X_design	225,146 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 247,661 USD/year - 225,146 USD/year = **22,515 USD/year**



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

214,425 USD/year

worked result

DESIGN

225,146 USD/year

factor 1.05

LIMIT

247,661 USD/year

project criterion

MARGIN

22,515 USD/year

available difference

GCC design note: Apply this calculation to electrostatic dust-removal technologies. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE AIR-JET CLEANING RECOVERY EFFICIENCY

FORMULA

C_091 = (P_after-P_before) / (P_clean-P_before) x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_091 = (576-510) / (585-510) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 091



AIR-JET CLEANING RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning	510 W
After cleaning	576 W
Clean reference	585 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE VIBRATION-CLEANING RESIDUAL LOSS

FORMULA

$$C_{092} = (P_{\text{clean}} - P_{\text{after}}) / P_{\text{clean}} \times 100$$

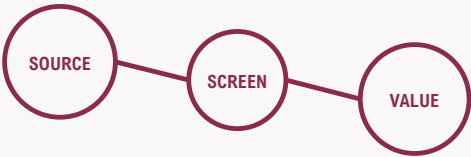
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{092} = (590 - 577) / 590 \times 100 = 2.203\%$$

Calculated result = 2.203 %

CLEANING FIGURE 092



VIBRATION-CLEANING RESIDUAL LOSS

EXAMPLE VALUES

Clean reference 590 W

Post-cleaning output 577 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{\text{design}} = X_{\text{calculated}} \times K_{\text{upper}}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{\text{design}} = 2.2 \% \times 1.05 = 2.31 \%$$

GIVEN VALUES FOR EXAMPLE

X_calculated 2.2 %

K_design 1.05

X_design 2.31 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$\text{Margin} = X_{\text{limit}} - X_{\text{design}}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$\text{Margin} = 2.54 \% - 2.31 \% = 0.231 \%$$



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.2 %

worked result

DESIGN

2.31 %

factor 1.05

LIMIT

2.54 %

project criterion

MARGIN

0.231 %

available difference

GCC design note: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE AIR-JET CLEANING THROUGHPUT

FORMULA

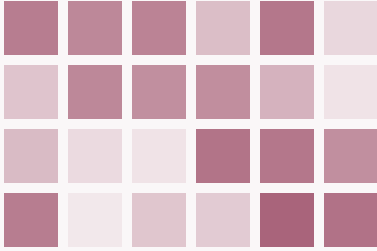
C_093 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_093 = 7,950 / 6 = 1,325 m2/h
Calculated result = 1,325 m2/h

CLEANING FIGURE 093



AIR-JET CLEANING THROUGHPUT

EXAMPLE VALUES

Cleaned area	7,950 m2
Productive time	6 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1,325 m2/h x 0.95 = 1,259 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	1,325 m2/h
K_design	0.95
X_design	1,259 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1,259 m2/h - 1,133 m2/h = 125.9 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1,325 m2/h

worked result

CONSERVATIVE

1,259 m2/h

factor 0.95

MINIMUM

1,133 m2/h

project criterion

MARGIN

125.9 m2/h

available difference

GCC design note: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE NOZZLE-BLOCKAGE PREVALENCE

FORMULA

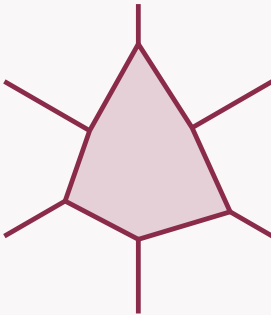
C_094 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_094 = 26 / 940 x 100 = 2.766%
Calculated result = 2.766 %

CLEANING FIGURE 094



NOZZLE-BLOCKAGE PREVALENCE

EXAMPLE VALUES

Missed or failed items	26
Inspected items	940



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.77 % x 1.05 = 2.9 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.77 %
K_design	1.05
X_design	2.9 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.19 % - 2.9 % = 0.29 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.77 %

worked result

DESIGN

2.9 %

factor 1.05

LIMIT

3.19 %

project criterion

MARGIN

0.29 %

available difference

GCC design note: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE VIBRATION-AMPLITUDE VARIABILITY

FORMULA

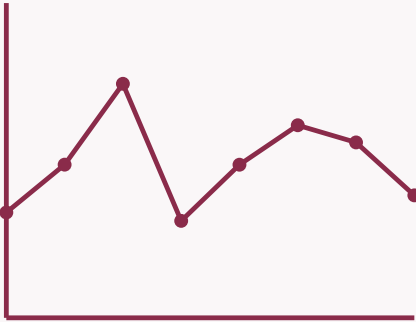
C_095 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_095 = 1.950 / 98.50 x 100 = 1.980%
Calculated result = 1.98 %

CLEANING FIGURE 095



VIBRATION-AMPLITUDE VARIABILITY

EXAMPLE VALUES

Standard deviation	1.950
Mean performance	98.50



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1.98 % x 1.05 = 2.08 %

GIVEN VALUES FOR EXAMPLE

X_calculated	1.98 %
K_design	1.05
X_design	2.08 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.29 % - 2.08 % = 0.208 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1.98 %

worked result

DESIGN

2.08 %

factor 1.05

LIMIT

2.29 %

project criterion

MARGIN

0.208 %

available difference

GCC design note: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE AIRFLOW PERFORMANCE DRIFT

FORMULA

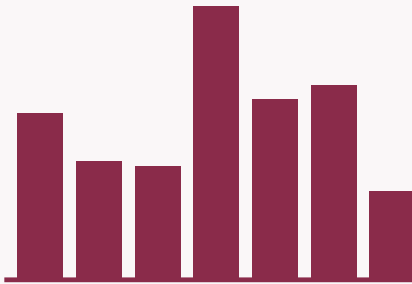
C_096 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_096 = |0.790-0.550| / 8 = 0.030 %/cycle
Calculated result = 0.03 %/cycle

CLEANING FIGURE 096



AIRFLOW PERFORMANCE DRIFT

EXAMPLE VALUES

Later quality indicator	0.790%
Initial quality indicator	0.550%
Cleaning cycles	8

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.03 %/cycle x 1.05 = 0.032 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.03 %/cycle
K_design	1.05
X_design	0.032 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.035 %/cycle - 0.032 %/cycle = 0.003 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.03 %/cycle

worked result

DESIGN

0.032 %/cycle

factor 1.05

LIMIT

0.035 %/cycle

project criterion

MARGIN

0.003 %/cycle

available difference

GCC design note: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EMERGING-METHOD TRIAL COVERAGE

FORMULA

C_097 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_097 = 575 / 580 x 100 = 99.14%
Calculated result = 99.14 %

CLEANING FIGURE 097



EMERGING-METHOD TRIAL COVERAGE

EXAMPLE VALUES

Completed work units	575
Planned work units	580

i

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 99.1 % x 0.95 = 94.2 %

GIVEN VALUES FOR EXAMPLE

X_calculated	99.1 %
K_design	0.95
X_design	94.2 %

i

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 94.2 % - 84.8 % = 9.42 %

i

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

i

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

99.1 %

worked result

CONSERVATIVE

94.2 %

factor 0.95

MINIMUM

84.8 %

project criterion

MARGIN

9.42 %

available difference

GCC design note: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED EMERGING-SYSTEM INTERVENTIONS

FORMULA

C_098 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_098 = 11000 x 0.600 / 100 = 66 modules
Calculated result = 66 modules

CLEANING FIGURE 098



EXPECTED EMERGING-SYSTEM INTERVENTIONS

EXAMPLE VALUES

Asset population	11000 modules
Intervention rate	0.600%

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 66 modules x 1.05 = 69.3 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	66 modules
K_design	1.05
X_design	69.3 modules

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 76.2 modules - 69.3 modules = 6.93 modules

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

66 modules

worked result

DESIGN

69.3 modules

factor 1.05

LIMIT

76.2 modules

project criterion

MARGIN

6.93 modules

available difference

GCC design note: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EMERGING-TECHNOLOGY RISK PRIORITY

FORMULA

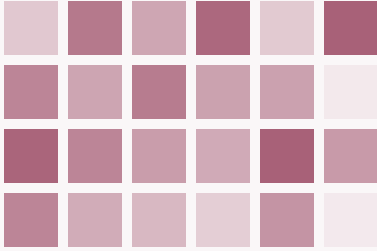
C_099 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_099 = 8 x 2 x 4 = 64
Calculated result = 64 score

CLEANING FIGURE 099



EMERGING-TECHNOLOGY RISK PRIORITY

EXAMPLE VALUES

Severity rank	8
Occurrence rank	2
Detection rank	4

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 64 score x 1.05 = 67.2 score

GIVEN VALUES FOR EXAMPLE

X_calculated	64 score
K_design	1.05
X_design	67.2 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 73.9 score - 67.2 score = 6.72 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

64 score

worked result

DESIGN

67.2 score

factor 1.05

LIMIT

73.9 score

project criterion

MARGIN

6.72 score

available difference

GCC design note: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EMERGING CLEANING ANNUAL COST

FORMULA

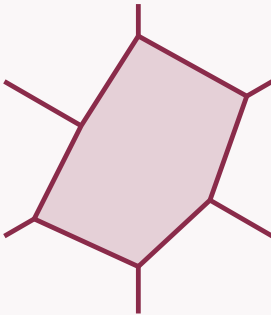
C_100 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_100 = 48 x 4,950 = 237,600 USD/year
Calculated result = 237,600 USD/year

CLEANING FIGURE 100



EMERGING CLEANING ANNUAL COST

EXAMPLE VALUES

Annual cleaning cycles	48
Cost per cycle	4,950 USD

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 237,600 USD/year x 1.05 = 249,480 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	237,600 USD/year
K_design	1.05
X_design	249,480 USD/year

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 274,428 USD/year - 249,480 USD/year = 24,948 USD/year

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

237,600 USD/year

worked result

DESIGN

249,480 USD/year

factor 1.05

LIMIT

274,428 USD/year

project criterion

MARGIN

24,948 USD/year

available difference

GCC design note: Apply this calculation to air-jet, vibration and emerging cleaning methods. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE TREATED-WATER CLEANING RECOVERY

FORMULA

$$C_{101} = (P_{after} - P_{before}) / (P_{clean} - P_{before}) \times 100$$

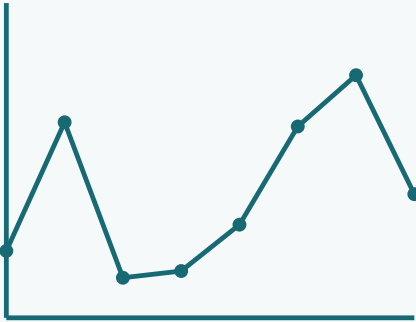
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{101} = (580.4 - 514) / (589.5 - 514) \times 100 = 88\%$$

Calculated result = 88 %

CLEANING FIGURE 101



TREATED-WATER CLEANING RECOVERY

EXAMPLE VALUES

Before cleaning	514 W
After cleaning	580.4 W
Clean reference	589.5 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

$$X_{design} = X_{calculated} \times K_{conservative}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{design} = 88\% \times 0.95 = 83.6\%$$

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

$$Margin = X_{design} - X_{min}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$Margin = 83.6\% - 75.2\% = 8.36\%$$

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WATER-SPOT RESIDUAL LOSS

FORMULA

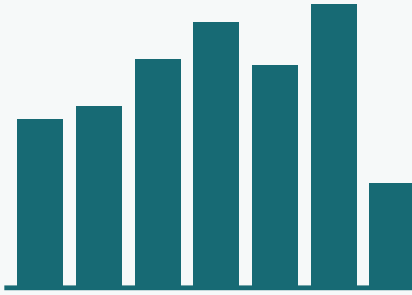
C_102 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_102 = (595-581.2) / 595 x 100 = 2.311%
Calculated result = 2.311 %

CLEANING FIGURE 102



WATER-SPOT RESIDUAL LOSS

EXAMPLE VALUES

Clean reference	595 W
Post-cleaning output	581.2 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.31 % x 1.05 = 2.43 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.31 %
K_design	1.05
X_design	2.43 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.67 % - 2.43 % = 0.243 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.31 %

worked result

DESIGN

2.43 %

factor 1.05

LIMIT

2.67 %

project criterion

MARGIN

0.243 %

available difference

GCC design note: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE TREATED-WATER PRODUCTION RATE

FORMULA

C_103 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_103 = 8,325 / 7 = 1,189.3 m2/h
Calculated result = 1,189.3 m2/h

CLEANING FIGURE 103



TREATED-WATER PRODUCTION RATE

EXAMPLE VALUES

Cleaned area	8,325 m2
Productive time	7 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1,189 m2/h x 0.95 = 1,130 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	1,189 m2/h
K_design	0.95
X_design	1,130 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1,130 m2/h - 1,017 m2/h = 113 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1,189 m2/h

worked result

CONSERVATIVE

1,130 m2/h

factor 0.95

MINIMUM

1,017 m2/h

project criterion

MARGIN

113 m2/h

available difference

GCC design note: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE OUT-OF-SPEC WATER PREVALENCE

FORMULA

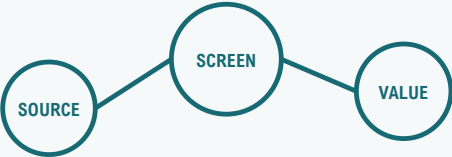
C_104 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_104 = 28 / 982 x 100 = 2.851%
Calculated result = 2.851 %

CLEANING FIGURE 104



OUT-OF-SPEC WATER PREVALENCE

EXAMPLE VALUES

Missed or failed items	28
Inspected items	982

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.85 % x 1.05 = 2.99 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.85 %
K_design	1.05
X_design	2.99 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.29 % - 2.99 % = 0.299 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.85 %

worked result

DESIGN

2.99 %

factor 1.05

LIMIT

3.29 %

project criterion

MARGIN

0.299 %

available difference

GCC design note: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WATER-CONDUCTIVITY VARIABILITY

FORMULA

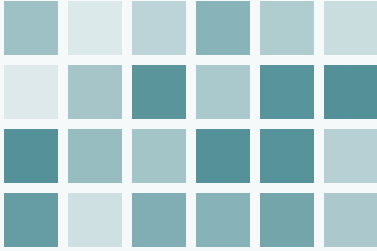
C_105 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_105 = 2.045 / 98.75 x 100 = 2.071%
Calculated result = 2.071 %

CLEANING FIGURE 105



WATER-CONDUCTIVITY VARIABILITY

EXAMPLE VALUES

Standard deviation	2.045
Mean performance	98.75



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.07 % x 1.05 = 2.17 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.07 %
K_design	1.05
X_design	2.17 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.39 % - 2.17 % = 0.217 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.07 %

worked result

DESIGN

2.17 %

factor 1.05

LIMIT

2.39 %

project criterion

MARGIN

0.217 %

available difference

GCC design note: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE MEMBRANE PERFORMANCE DRIFT

FORMULA

C_106 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_106 = |0.820-0.570| / 9 = 0.028 %/cycle
Calculated result = 0.0278 %/cycle

CLEANING FIGURE 106



MEMBRANE PERFORMANCE DRIFT

EXAMPLE VALUES

Later quality indicator	0.820%
Initial quality indicator	0.570%
Cleaning cycles	9

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.028 %/cycle x 1.05 = 0.029 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.028 %/cycle
K_design	1.05
X_design	0.029 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.032 %/cycle - 0.029 %/cycle = 0.003 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.028 %/cycle

worked result

DESIGN

0.029 %/cycle

factor 1.05

LIMIT

0.032 %/cycle

project criterion

MARGIN

0.003 %/cycle

available difference

GCC design note: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WATER-QUALITY TEST COVERAGE

FORMULA

C_107 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_107 = 606 / 612 x 100 = 99.02%
Calculated result = 99.02 %

CLEANING FIGURE 107



WATER-QUALITY TEST COVERAGE

EXAMPLE VALUES

Completed work units	606
Planned work units	612



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 99 % x 0.95 = 94.1 %

GIVEN VALUES FOR EXAMPLE

X_calculated	99 %
K_design	0.95
X_design	94.1 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 94.1 % - 84.7 % = 9.41 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

99 %

worked result

CONSERVATIVE

94.1 %

factor 0.95

MINIMUM

84.7 %

project criterion

MARGIN

9.41 %

available difference

GCC design note: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED TREATMENT INTERVENTIONS

FORMULA

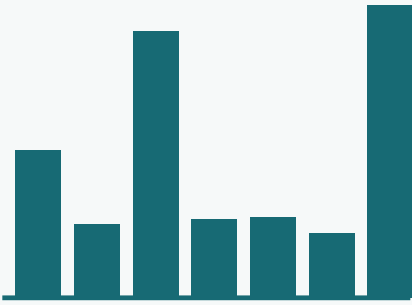
C_108 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_108 = 11620 x 0.642 / 100 = 74.60 modules
Calculated result = 74.6 modules

CLEANING FIGURE 108



EXPECTED TREATMENT INTERVENTIONS

EXAMPLE VALUES

Asset population	11620 modules
Intervention rate	0.642%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 74.6 modules x 1.05 = 78.3 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	74.6 modules
K_design	1.05
X_design	78.3 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 86.2 modules - 78.3 modules = 7.83 modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

74.6 modules

worked result

DESIGN

78.3 modules

factor 1.05

LIMIT

86.2 modules

project criterion

MARGIN

7.83 modules

available difference

GCC design note: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WATER-SYSTEM RISK PRIORITY

FORMULA

C_109 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_109 = 9 x 3 x 5 = 135
Calculated result = 135 score

CLEANING FIGURE 109



WATER-SYSTEM RISK PRIORITY

EXAMPLE VALUES

Severity rank	9
Occurrence rank	3
Detection rank	5

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 135 score x 1.05 = 141.8 score

GIVEN VALUES FOR EXAMPLE

X_calculated	135 score
K_design	1.05
X_design	141.8 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 155.9 score - 141.8 score = 14.2 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

135 score

worked result

DESIGN

141.8 score

factor 1.05

LIMIT

155.9 score

project criterion

MARGIN

14.2 score

available difference

GCC design note: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CLEANING WATER ANNUAL COST

FORMULA

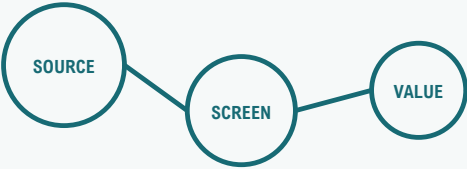
C_110 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_110 = 51 x 5,135 = 261,885 USD/year
Calculated result = 261,885 USD/year

CLEANING FIGURE 110



CLEANING WATER ANNUAL COST

EXAMPLE VALUES

Annual cleaning cycles	51
Cost per cycle	5,135 USD

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 261,885 USD/year x 1.05 = 274,979 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	261,885 USD/year
K_design	1.05
X_design	274,979 USD/year

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 302,477 USD/year - 274,979 USD/year = 27,498 USD/year

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

261,885 USD/year

worked result

DESIGN

274,979 USD/year

factor 1.05

LIMIT

302,477 USD/year

project criterion

MARGIN

27,498 USD/year

available difference

GCC design note: Apply this calculation to cleaning-water supply and treatment. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BRUSH CONTACT RECOVERY EFFICIENCY

FORMULA

C_111 = (P_after-P_before) / (P_clean-P_before) x 100

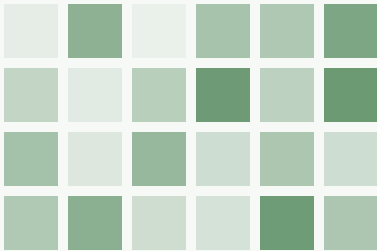
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_111 = (584.9-518) / (594-518) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 111



BRUSH CONTACT RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning	518 W
After cleaning	584.9 W
Clean reference	594 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BRUSH-INDUCED RESIDUAL LOSS

FORMULA

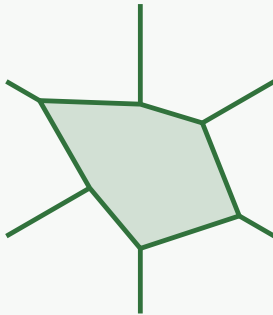
C_112 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_112 = (600-585.5) / 600 x 100 = 2.417%
Calculated result = 2.417 %

CLEANING FIGURE 112



BRUSH-INDUCED RESIDUAL LOSS

EXAMPLE VALUES

Clean reference	600 W
Post-cleaning output	585.5 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.42 % x 1.05 = 2.54 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.42 %
K_design	1.05
X_design	2.54 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.79 % - 2.54 % = 0.254 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.42 %

worked result

DESIGN

2.54 %

factor 1.05

LIMIT

2.79 %

project criterion

MARGIN

0.254 %

available difference

GCC design note: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BRUSH CLEANING THROUGHPUT

FORMULA

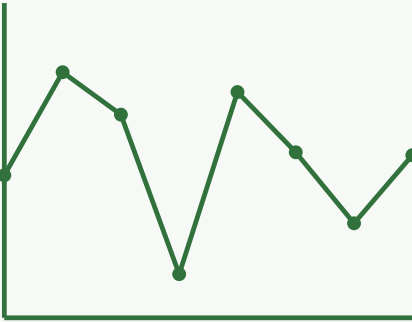
C_113 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_113 = 8,700 / 8 = 1,087.5 m2/h
Calculated result = 1,087.5 m2/h

CLEANING FIGURE 113



BRUSH CLEANING THROUGHPUT

EXAMPLE VALUES

Cleaned area	8,700 m2
Productive time	8 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1,088 m2/h x 0.95 = 1,033 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	1,088 m2/h
K_design	0.95
X_design	1,033 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1,033 m2/h - 929.8 m2/h = 103.3 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1,088 m2/h

worked result

CONSERVATIVE

1,033 m2/h

factor 0.95

MINIMUM

929.8 m2/h

project criterion

MARGIN

103.3 m2/h

available difference

GCC design note: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE DAMAGED-BRISTLE PREVALENCE

FORMULA

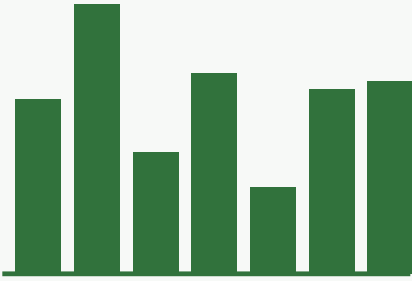
$C_{114} = N_{missed} / N_{inspected} \times 100$

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$C_{114} = 30 / 1024 \times 100 = 2.930\%$
Calculated result = 2.93 %

CLEANING FIGURE 114



DAMAGED-BRISTLE PREVALENCE

EXAMPLE VALUES

Missed or failed items	30
Inspected items	1024

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$X_{design} = X_{calculated} \times K_{upper}$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$X_{design} = 2.93 \% \times 1.05 = 3.08 \%$

GIVEN VALUES FOR EXAMPLE

X_calculated	2.93 %
K_design	1.05
X_design	3.08 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$Margin = X_{limit} - X_{design}$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$Margin = 3.38 \% - 3.08 \% = 0.308 \%$

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.93 %

worked result

DESIGN

3.08 %

factor 1.05

LIMIT

3.38 %

project criterion

MARGIN

0.308 %

available difference

GCC design note: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CONTACT-PRESSURE VARIABILITY

FORMULA

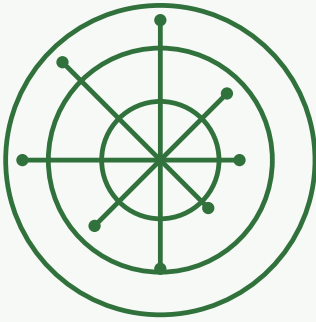
C_115 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_115 = 2.140 / 99 x 100 = 2.162%
Calculated result = 2.162 %

CLEANING FIGURE 115



CONTACT-PRESSURE VARIABILITY

EXAMPLE VALUES

Standard deviation	2.140
Mean performance	99



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.16 % x 1.05 = 2.27 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.16 %
K_design	1.05
X_design	2.27 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.5 % - 2.27 % = 0.227 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.16 %

worked result

DESIGN

2.27 %

factor 1.05

LIMIT

2.5 %

project criterion

MARGIN

0.227 %

available difference

GCC design note: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BRUSH-WEAR RATE PER CYCLE

FORMULA

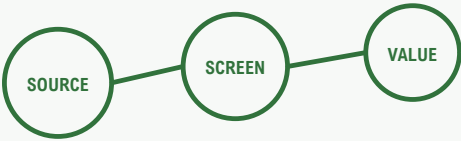
C_116 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_116 = |0.850-0.590| / 4 = 0.065 %/cycle
Calculated result = 0.065 %/cycle

CLEANING FIGURE 116



BRUSH-WEAR RATE PER CYCLE

EXAMPLE VALUES

Later quality indicator	0.850%
Initial quality indicator	0.590%
Cleaning cycles	4

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.065 %/cycle x 1.05 = 0.068 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.065 %/cycle
K_design	1.05
X_design	0.068 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.075 %/cycle - 0.068 %/cycle = 0.007 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.065 %/cycle

worked result

DESIGN

0.068 %/cycle

factor 1.05

LIMIT

0.075 %/cycle

project criterion

MARGIN

0.007 %/cycle

available difference

GCC design note: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BRUSH INSPECTION COVERAGE

FORMULA

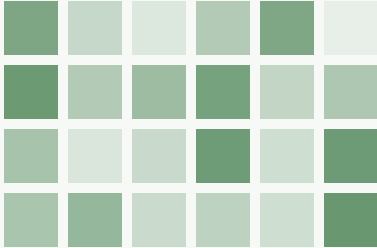
C_117 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_117 = 637 / 644 x 100 = 98.91%
Calculated result = 98.91 %

CLEANING FIGURE 117



BRUSH INSPECTION COVERAGE

EXAMPLE VALUES

Completed work units	637
Planned work units	644

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 98.9 % x 0.95 = 94 %

GIVEN VALUES FOR EXAMPLE

X_calculated	98.9 %
K_design	0.95
X_design	94 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 94 % - 84.6 % = 9.4 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

98.9 %

worked result

CONSERVATIVE

94 %

factor 0.95

MINIMUM

84.6 %

project criterion

MARGIN

9.4 %

available difference

GCC design note: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED BRUSH REPLACEMENTS

FORMULA

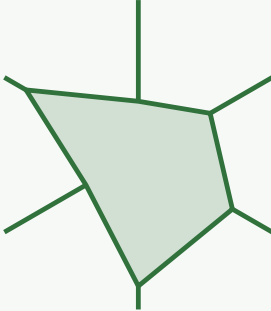
C_118 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_118 = 12240 x 0.684 / 100 = 83.72 modules
Calculated result = 83.72 modules

CLEANING FIGURE 118



EXPECTED BRUSH REPLACEMENTS

EXAMPLE VALUES

Asset population	12240 modules
Intervention rate	0.684%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 83.7 modules x 1.05 = 87.9 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	83.7 modules
K_design	1.05
X_design	87.9 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 96.7 modules - 87.9 modules = 8.79 modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

83.7 modules

worked result

DESIGN

87.9 modules

factor 1.05

LIMIT

96.7 modules

project criterion

MARGIN

8.79 modules

available difference

GCC design note: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BRUSH-SYSTEM RISK PRIORITY

FORMULA

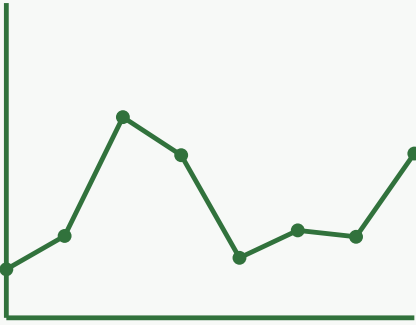
C_119 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_119 = 4 x 4 x 2 = 32
Calculated result = 32 score

CLEANING FIGURE 119



BRUSH-SYSTEM RISK PRIORITY

EXAMPLE VALUES

Severity rank	4
Occurrence rank	4
Detection rank	2

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 32 score x 1.05 = 33.6 score

GIVEN VALUES FOR EXAMPLE

X_calculated	32 score
K_design	1.05
X_design	33.6 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 37 score - 33.6 score = 3.36 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

32 score

worked result

DESIGN

33.6 score

factor 1.05

LIMIT

37 score

project criterion

MARGIN

3.36 score

available difference

GCC design note: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BRUSH REPLACEMENT ANNUAL COST

FORMULA

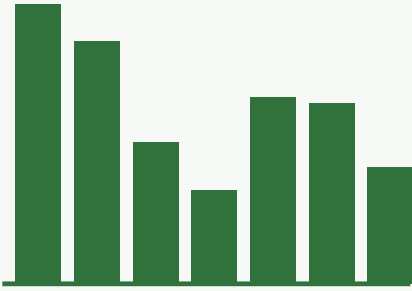
C_120 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_120 = 54 x 5,320 = 287,280 USD/year
Calculated result = 287,280 USD/year

CLEANING FIGURE 120



BRUSH REPLACEMENT ANNUAL COST

EXAMPLE VALUES

Annual cleaning cycles	54
Cost per cycle	5,320 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 287,280 USD/year x 1.05 = 301,644 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	287,280 USD/year
K_design	1.05
X_design	301,644 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 331,808 USD/year - 301,644 USD/year = 30,164 USD/year



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

287,280 USD/year

worked result

DESIGN

301,644 USD/year

factor 1.05

LIMIT

331,808 USD/year

project criterion

MARGIN

30,164 USD/year

available difference

GCC design note: Apply this calculation to brush selection, contact pressure and wear. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE DETERGENT CLEANING RECOVERY EFFICIENCY

FORMULA

$$C_{121} = (P_{after} - P_{before}) / (P_{clean} - P_{before}) \times 100$$

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{121} = (589.3 - 522) / (598.5 - 522) \times 100 = 88\%$$

Calculated result = 88 %

CLEANING FIGURE 121



DETERGENT CLEANING RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning	522 W
After cleaning	589.3 W
Clean reference	598.5 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

$$X_{design} = X_{calculated} \times K_{conservative}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{design} = 88\% \times 0.95 = 83.6\%$$

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

$$Margin = X_{design} - X_{min}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$Margin = 83.6\% - 75.2\% = 8.36\%$$



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CHEMICAL-RESIDUE OPTICAL LOSS

FORMULA

$$C_{122} = (P_{\text{clean}} - P_{\text{after}}) / P_{\text{clean}} \times 100$$

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{122} = (605 - 589.8) / 605 \times 100 = 2.521\%$$

Calculated result = 2.521 %

CLEANING FIGURE 122



CHEMICAL-RESIDUE OPTICAL LOSS

EXAMPLE VALUES

Clean reference	605 W
Post-cleaning output	589.8 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{\text{design}} = X_{\text{calculated}} \times K_{\text{upper}}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{\text{design}} = 2.52\% \times 1.05 = 2.65\%$$

GIVEN VALUES FOR EXAMPLE

X_calculated	2.52 %
K_design	1.05
X_design	2.65 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$\text{Margin} = X_{\text{limit}} - X_{\text{design}}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$\text{Margin} = 2.91\% - 2.65\% = 0.265\%$$



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.52 %

worked result

DESIGN

2.65 %

factor 1.05

LIMIT

2.91 %

project criterion

MARGIN

0.265 %

available difference

GCC design note: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CHEMICAL CLEANING THROUGHPUT

FORMULA

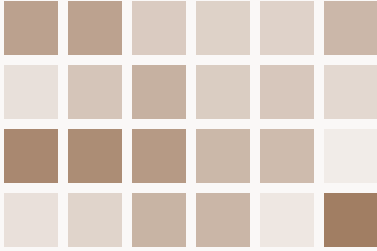
C_123 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_123 = 9,075 / 9 = 1,008.3 m2/h
Calculated result = 1,008.3 m2/h

CLEANING FIGURE 123



CHEMICAL CLEANING THROUGHPUT

EXAMPLE VALUES

Cleaned area	9,075 m2
Productive time	9 h

i

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1,008 m2/h x 0.95 = 957.9 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	1,008 m2/h
K_design	0.95
X_design	957.9 m2/h

i

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 957.9 m2/h - 862.1 m2/h = 95.8 m2/h

i

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

i

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK

SUMMARY

CALCULATED

1,008 m2/h

worked result

CONSERVATIVE

957.9 m2/h

factor 0.95

MINIMUM

862.1 m2/h

project criterion

MARGIN

95.8 m2/h

available difference

GCC design note: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RESIDUE-DEFECT PREVALENCE

FORMULA

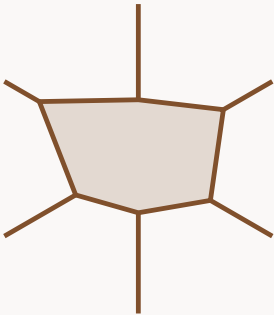
C_124 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_124 = 32 / 1066 x 100 = 3.002%
Calculated result = 3.002 %

CLEANING FIGURE 124



RESIDUE-DEFECT PREVALENCE

EXAMPLE VALUES

Missed or failed items	32
Inspected items	1066



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 3 % x 1.05 = 3.15 %

GIVEN VALUES FOR EXAMPLE

X_calculated	3 %
K_design	1.05
X_design	3.15 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.47 % - 3.15 % = 0.315 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

3 %

worked result

DESIGN

3.15 %

factor 1.05

LIMIT

3.47 %

project criterion

MARGIN

0.315 %

available difference

GCC design note: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE SOLUTION-CONCENTRATION VARIABILITY

FORMULA

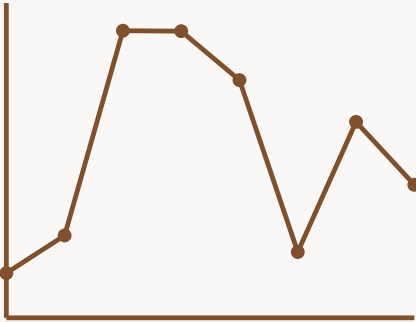
C_125 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_125 = 2.235 / 99.25 x 100 = 2.252%
Calculated result = 2.252 %

CLEANING FIGURE 125



SOLUTION-CONCENTRATION VARIABILITY

EXAMPLE VALUES

Standard deviation	2.235
Mean performance	99.25



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.25 % x 1.05 = 2.36 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.25 %
K_design	1.05
X_design	2.36 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.6 % - 2.36 % = 0.236 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.25 %

worked result

DESIGN

2.36 %

factor 1.05

LIMIT

2.6 %

project criterion

MARGIN

0.236 %

available difference

GCC design note: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CHEMICAL PERFORMANCE DRIFT

FORMULA

$$C_{126} = |X_2 - X_1| / N_{cycle}$$

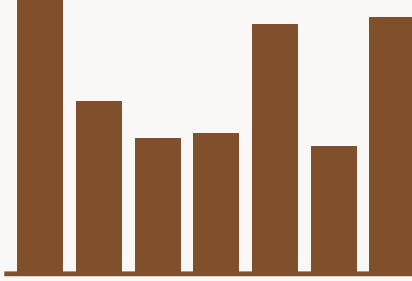
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{126} = |0.880 - 0.610| / 5 = 0.054 \text{ \%/cycle}$$

Calculated result = 0.054 %/cycle

CLEANING FIGURE 126



CHEMICAL PERFORMANCE DRIFT

EXAMPLE VALUES

Later quality indicator	0.880%
Initial quality indicator	0.610%
Cleaning cycles	5



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{design} = X_{calculated} \times K_{upper}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{design} = 0.054 \text{ \%/cycle} \times 1.05 = 0.057 \text{ \%/cycle}$$

GIVEN VALUES FOR EXAMPLE

X_calculated	0.054 %/cycle
K_design	1.05
X_design	0.057 %/cycle



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$Margin = X_{limit} - X_{design}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$Margin = 0.062 \text{ \%/cycle} - 0.057 \text{ \%/cycle} = 0.006 \text{ \%/cycle}$$



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

0.054 %/cycle

worked result

DESIGN

0.057 %/cycle

factor 1.05

LIMIT

0.062 %/cycle

project criterion

MARGIN

0.006 %/cycle

available difference

GCC design note: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CHEMICAL BATCH-TEST COVERAGE

FORMULA

C_127 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_127 = 668 / 676 x 100 = 98.82%
Calculated result = 98.82 %

CLEANING FIGURE 127



CHEMICAL BATCH-TEST COVERAGE

EXAMPLE VALUES

Completed work units	668
Planned work units	676

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 98.8 % x 0.95 = 93.9 %

GIVEN VALUES FOR EXAMPLE

X_calculated	98.8 %
K_design	0.95
X_design	93.9 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 93.9 % - 84.5 % = 9.39 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

98.8 %

worked result

CONSERVATIVE

93.9 %

factor 0.95

MINIMUM

84.5 %

project criterion

MARGIN

9.39 %

available difference

GCC design note: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED CHEMICAL REWORK MODULES

FORMULA

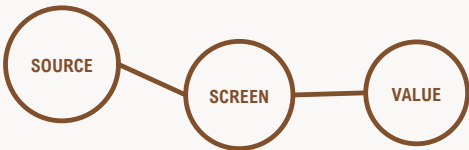
$$C_{128} = N_{asset} \times p_{intervention} / 100$$

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$C_{128} = 12860 \times 0.726 / 100 = 93.36$ modules
Calculated result = 93.36 modules

CLEANING FIGURE 128



EXPECTED CHEMICAL REWORK MODULES

EXAMPLE VALUES

Asset population	12860 modules
Intervention rate	0.726%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{design} = X_{calculated} \times K_{upper}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$X_{design} = 93.4 \text{ modules} \times 1.05 = 98$ modules

GIVEN VALUES FOR EXAMPLE

X_calculated	93.4 modules
K_design	1.05
X_design	98 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$\text{Margin} = X_{limit} - X_{design}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$\text{Margin} = 107.8 \text{ modules} - 98 \text{ modules} = 9.8$ modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

93.4 modules

worked result

DESIGN

98 modules

factor 1.05

LIMIT

107.8 modules

project criterion

MARGIN

9.8 modules

available difference

GCC design note: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CHEMICAL-CLEANING RISK PRIORITY

FORMULA

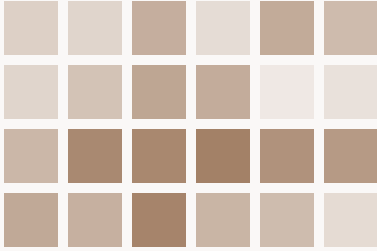
C_129 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_129 = 5 x 5 x 3 = 75
Calculated result = 75 score

CLEANING FIGURE 129



CHEMICAL-CLEANING RISK PRIORITY

EXAMPLE VALUES

Severity rank	5
Occurrence rank	5
Detection rank	3

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 75 score x 1.05 = 78.8 score

GIVEN VALUES FOR EXAMPLE

X_calculated	75 score
K_design	1.05
X_design	78.8 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 86.6 score - 78.8 score = 7.88 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

75 score

worked result

DESIGN

78.8 score

factor 1.05

LIMIT

86.6 score

project criterion

MARGIN

7.88 score

available difference

GCC design note: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CLEANING CHEMICAL ANNUAL COST

FORMULA

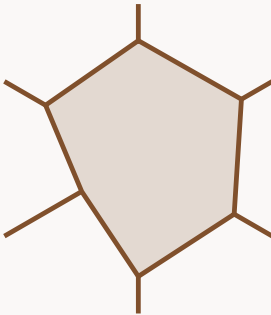
$C_{130} = N_{cycle} \times C_{cycle}$

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$C_{130} = 57 \times 5,505 = 313,785 \text{ USD/year}$
Calculated result = 313,785 USD/year

CLEANING FIGURE 130



CLEANING CHEMICAL ANNUAL COST

EXAMPLE VALUES

Annual cleaning cycles	57
Cost per cycle	5,505 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$X_{design} = X_{calculated} \times K_{upper}$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$X_{design} = 313,785 \text{ USD/year} \times 1.05 = 329,474 \text{ USD/year}$

GIVEN VALUES FOR EXAMPLE

X_calculated	313,785 USD/year
K_design	1.05
X_design	329,474 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$Margin = X_{limit} - X_{design}$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$Margin = 362,422 \text{ USD/year} - 329,474 \text{ USD/year} = 32,947 \text{ USD/year}$



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

313,785 USD/year

worked result

DESIGN

329,474 USD/year

factor 1.05

LIMIT

362,422 USD/year

project criterion

MARGIN

32,947 USD/year

available difference

GCC design note: Apply this calculation to cleaning chemicals and residue control. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE TRIGGERED-CLEANING RECOVERY EFFICIENCY

FORMULA

C_131 = (P_after-P_before) / (P_clean-P_before) x 100

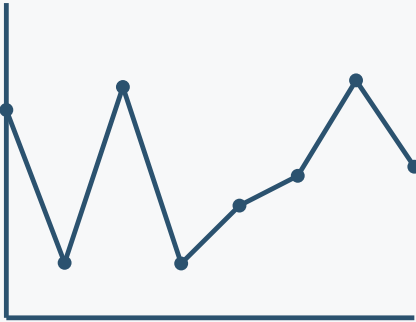
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_131 = (593.8-526) / (603-526) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 131



TRIGGERED-CLEANING RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning	526 W
After cleaning	593.8 W
Clean reference	603 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE DEFERRED-CLEANING RESIDUAL LOSS

FORMULA

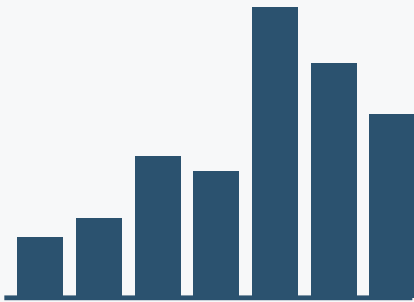
C_132 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_132 = (610-594) / 610 x 100 = 2.623%
Calculated result = 2.623 %

CLEANING FIGURE 132



DEFERRED-CLEANING RESIDUAL LOSS

EXAMPLE VALUES

Clean reference	610 W
Post-cleaning output	594 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.62 % x 1.05 = 2.75 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.62 %
K_design	1.05
X_design	2.75 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.03 % - 2.75 % = 0.275 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.62 %

worked result

DESIGN

2.75 %

factor 1.05

LIMIT

3.03 %

project criterion

MARGIN

0.275 %

available difference

GCC design note: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE SCHEDULED CLEANING THROUGHPUT

FORMULA

C_133 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_133 = 9,450 / 10 = 945 m2/h
Calculated result = 945 m2/h

CLEANING FIGURE 133



SCHEDULED CLEANING THROUGHPUT

EXAMPLE VALUES

Cleaned area	9,450 m2
Productive time	10 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 945 m2/h x 0.95 = 897.8 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	945 m2/h
K_design	0.95
X_design	897.8 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 897.8 m2/h - 808 m2/h = 89.8 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

945 m2/h

worked result

CONSERVATIVE

897.8 m2/h

factor 0.95

MINIMUM

808 m2/h

project criterion

MARGIN

89.8 m2/h

available difference

GCC design note: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE MISSED-TRIGGER PREVALENCE

FORMULA

C_134 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_134 = 34 / 1108 x 100 = 3.069%
Calculated result = 3.069 %

CLEANING FIGURE 134



MISSED-TRIGGER PREVALENCE

EXAMPLE VALUES

Missed or failed items	34
Inspected items	1108



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 3.07 % x 1.05 = 3.22 %

GIVEN VALUES FOR EXAMPLE

X_calculated	3.07 %
K_design	1.05
X_design	3.22 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.54 % - 3.22 % = 0.322 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

3.07 %

worked result

DESIGN

3.22 %

factor 1.05

LIMIT

3.54 %

project criterion

MARGIN

0.322 %

available difference

GCC design note: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE TRIGGER-THRESHOLD VARIABILITY

FORMULA

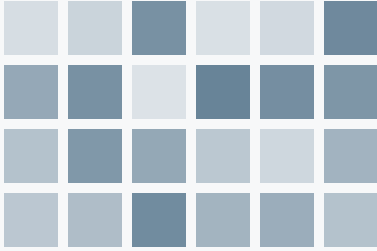
C_135 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_135 = 2.330 / 99.50 x 100 = 2.342%
Calculated result = 2.342 %

CLEANING FIGURE 135



TRIGGER-THRESHOLD VARIABILITY

EXAMPLE VALUES

Standard deviation	2.330
Mean performance	99.50

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.34 % x 1.05 = 2.46 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.34 %
K_design	1.05
X_design	2.46 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.7 % - 2.46 % = 0.246 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.34 %

worked result

DESIGN

2.46 %

factor 1.05

LIMIT

2.7 %

project criterion

MARGIN

0.246 %

available difference

GCC design note: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE SCHEDULE DRIFT PER CYCLE

FORMULA

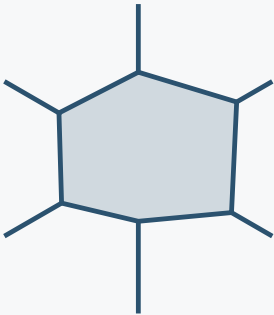
C_136 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_136 = |0.910-0.630| / 6 = 0.047 %/cycle
Calculated result = 0.0467 %/cycle

CLEANING FIGURE 136



SCHEDULE DRIFT PER CYCLE

EXAMPLE VALUES

Later quality indicator	0.910%
Initial quality indicator	0.630%
Cleaning cycles	6

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.047 %/cycle x 1.05 = 0.049 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.047 %/cycle
K_design	1.05
X_design	0.049 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.054 %/cycle - 0.049 %/cycle = 0.005 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.047 %/cycle

worked result

DESIGN

0.049 %/cycle

factor 1.05

LIMIT

0.054 %/cycle

project criterion

MARGIN

0.005 %/cycle

available difference

GCC design note: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CLEANING SCHEDULE COVERAGE

FORMULA

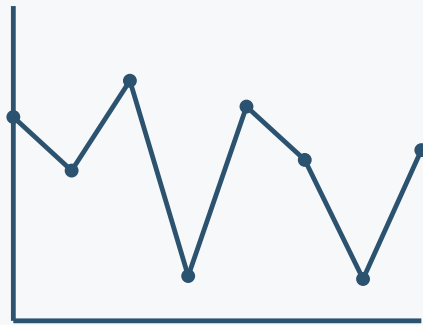
C_137 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_137 = 699 / 708 x 100 = 98.73%
Calculated result = 98.73 %

CLEANING FIGURE 137



CLEANING SCHEDULE COVERAGE

EXAMPLE VALUES

Completed work units	699
Planned work units	708

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 98.7 % x 0.95 = 93.8 %

GIVEN VALUES FOR EXAMPLE

X_calculated	98.7 %
K_design	0.95
X_design	93.8 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 93.8 % - 84.4 % = 9.38 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

98.7 %

worked result

CONSERVATIVE

93.8 %

factor 0.95

MINIMUM

84.4 %

project criterion

MARGIN

9.38 %

available difference

GCC design note: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED TRIGGERED INTERVENTIONS

FORMULA

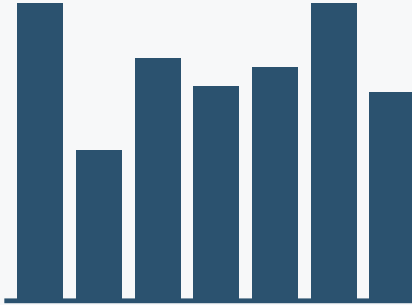
C_138 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_138 = 13480 x 0.768 / 100 = 103.5 modules
Calculated result = 103.5 modules

CLEANING FIGURE 138



EXPECTED TRIGGERED INTERVENTIONS

EXAMPLE VALUES

Asset population	13480 modules
Intervention rate	0.768%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 103.5 modules x 1.05 = 108.7 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	103.5 modules
K_design	1.05
X_design	108.7 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 119.6 modules - 108.7 modules = 10.9 modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

103.5 modules

worked result

DESIGN

108.7 modules

factor 1.05

LIMIT

119.6 modules

project criterion

MARGIN

10.9 modules

available difference

GCC design note: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CLEANING-SCHEDULE RISK PRIORITY

FORMULA

C_139 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_139 = 6 x 6 x 4 = 144

Calculated result = 144 score

CLEANING FIGURE 139



CLEANING-SCHEDULE RISK PRIORITY

EXAMPLE VALUES

Severity rank	6
Occurrence rank	6
Detection rank	4

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 144 score x 1.05 = 151.2 score

GIVEN VALUES FOR EXAMPLE

X_calculated	144 score
K_design	1.05
X_design	151.2 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 166.3 score - 151.2 score = 15.1 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

144 score

worked result

DESIGN

151.2 score

factor 1.05

LIMIT

166.3 score

project criterion

MARGIN

15.1 score

available difference

GCC design note: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE DEFERRED CLEANING ANNUAL COST

FORMULA

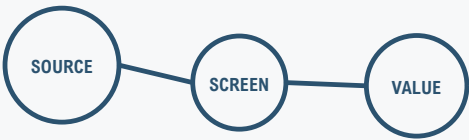
C_140 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_140 = 60 x 5,690 = 341,400 USD/year
Calculated result = 341,400 USD/year

CLEANING FIGURE 140



DEFERRED CLEANING ANNUAL COST

EXAMPLE VALUES

Annual cleaning cycles	60
Cost per cycle	5,690 USD

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 341,400 USD/year x 1.05 = 358,470 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	341,400 USD/year
K_design	1.05
X_design	358,470 USD/year

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 394,317 USD/year - 358,470 USD/year = 35,847 USD/year

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

341,400 USD/year

worked result

DESIGN

358,470 USD/year

factor 1.05

LIMIT

394,317 USD/year

project criterion

MARGIN

35,847 USD/year

available difference

GCC design note: Apply this calculation to condition-based cleaning schedules and triggers. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WATER-EFFICIENT RECOVERY PERFORMANCE

FORMULA

C_141 = (P_after-P_before) / (P_clean-P_before) x 100

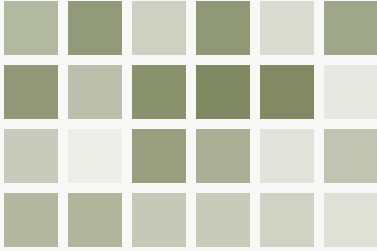
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_141 = (598.2-530) / (607.5-530) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 141



WATER-EFFICIENT RECOVERY PERFORMANCE

EXAMPLE VALUES

Before cleaning	530 W
After cleaning	598.2 W
Clean reference	607.5 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WATER-SAVING RESIDUAL LOSS

FORMULA

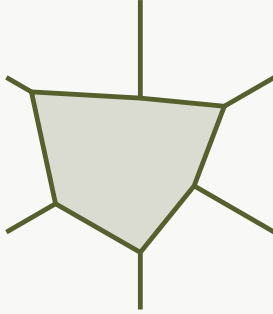
C_142 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_142 = (615-598.2) / 615 x 100 = 2.724%
Calculated result = 2.724 %

CLEANING FIGURE 142



WATER-SAVING RESIDUAL LOSS

EXAMPLE VALUES

Clean reference	615 W
Post-cleaning output	598.2 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.72 % x 1.05 = 2.86 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.72 %
K_design	1.05
X_design	2.86 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.15 % - 2.86 % = 0.286 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.72 %

worked result

DESIGN

2.86 %

factor 1.05

LIMIT

3.15 %

project criterion

MARGIN

0.286 %

available difference

GCC design note: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WATER-EFFICIENT CLEANING THROUGHPUT

FORMULA

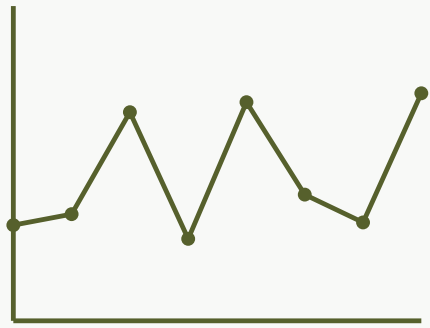
C_143 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_143 = 9,825 / 6 = 1,637.5 m2/h
Calculated result = 1,637.5 m2/h

CLEANING FIGURE 143



WATER-EFFICIENT CLEANING THROUGHPUT

EXAMPLE VALUES

Cleaned area	9,825 m2
Productive time	6 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1,638 m2/h x 0.95 = 1,556 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	1,638 m2/h
K_design	0.95
X_design	1,556 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1,556 m2/h - 1,400 m2/h = 155.6 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1,638 m2/h

worked result

CONSERVATIVE

1,556 m2/h

factor 0.95

MINIMUM

1,400 m2/h

project criterion

MARGIN

155.6 m2/h

available difference

GCC design note: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WATER-OVERUSE PREVALENCE

FORMULA

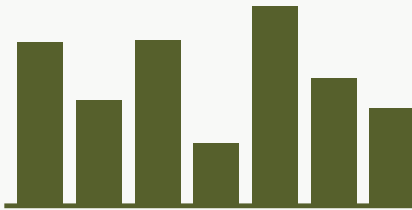
C_144 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_144 = 36 / 1150 x 100 = 3.130%
Calculated result = 3.13 %

CLEANING FIGURE 144



WATER-OVERUSE PREVALENCE

EXAMPLE VALUES

Missed or failed items	36
Inspected items	1150



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 3.13 % x 1.05 = 3.29 %

GIVEN VALUES FOR EXAMPLE

X_calculated	3.13 %
K_design	1.05
X_design	3.29 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.62 % - 3.29 % = 0.329 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

3.13 %

worked result

DESIGN

3.29 %

factor 1.05

LIMIT

3.62 %

project criterion

MARGIN

0.329 %

available difference

GCC design note: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE SPECIFIC WATER-USE VARIABILITY

FORMULA

C_145 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_145 = 2.425 / 99.75 x 100 = 2.431%
Calculated result = 2.431 %

CLEANING FIGURE 145



SPECIFIC WATER-USE VARIABILITY

EXAMPLE VALUES

Standard deviation	2.425
Mean performance	99.75



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.43 % x 1.05 = 2.55 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.43 %
K_design	1.05
X_design	2.55 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 2.81 % - 2.55 % = 0.255 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.43 %

worked result

DESIGN

2.55 %

factor 1.05

LIMIT

2.81 %

project criterion

MARGIN

0.255 %

available difference

GCC design note: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WATER-USE DRIFT PER CYCLE

FORMULA

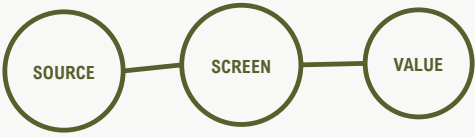
C_146 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_146 = |0.940-0.650| / 7 = 0.041 %/cycle
Calculated result = 0.0414 %/cycle

CLEANING FIGURE 146



WATER-USE DRIFT PER CYCLE

EXAMPLE VALUES

Later quality indicator	0.940%
Initial quality indicator	0.650%
Cleaning cycles	7

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.041 %/cycle x 1.05 = 0.044 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.041 %/cycle
K_design	1.05
X_design	0.044 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.048 %/cycle - 0.044 %/cycle = 0.004 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.041 %/cycle

worked result

DESIGN

0.044 %/cycle

factor 1.05

LIMIT

0.048 %/cycle

project criterion

MARGIN

0.004 %/cycle

available difference

GCC design note: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WATER-METERING COVERAGE

FORMULA

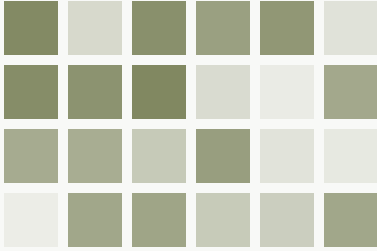
C_147 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_147 = 730 / 740 x 100 = 98.65%
Calculated result = 98.65 %

CLEANING FIGURE 147



WATER-METERING COVERAGE

EXAMPLE VALUES

Completed work units	730
Planned work units	740



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 98.6 % x 0.95 = 93.7 %

GIVEN VALUES FOR EXAMPLE

X_calculated	98.6 %
K_design	0.95
X_design	93.7 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 93.7 % - 84.3 % = 9.37 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

98.6 %

worked result

CONSERVATIVE

93.7 %

factor 0.95

MINIMUM

84.3 %

project criterion

MARGIN

9.37 %

available difference

GCC design note: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1

CALCULATE EXPECTED WATER-SAVING INTERVENTIONS

FORMULA

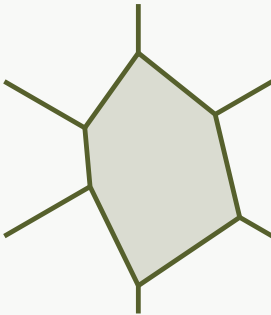
$$C_{148} = N_{asset} \times p_{intervention} / 100$$

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$C_{148} = 14100 \times 0.810 / 100 = 114.2$ modules
Calculated result = 114.2 modules

CLEANING FIGURE 148



EXPECTED WATER-SAVING INTERVENTIONS

EXAMPLE VALUES

Asset population	14100 modules
Intervention rate	0.810%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2

APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{design} = X_{calculated} \times K_{upper}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$X_{design} = 114.2 \text{ modules} \times 1.05 = 119.9$ modules

GIVEN VALUES FOR EXAMPLE

X_calculated	114.2 modules
K_design	1.05
X_design	119.9 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3

CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$\text{Margin} = X_{limit} - X_{design}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$\text{Margin} = 131.9 \text{ modules} - 119.9 \text{ modules} = 12$ modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK

SUMMARY

CALCULATED

114.2 modules

worked result

DESIGN

119.9 modules

factor 1.05

LIMIT

131.9 modules

project criterion

MARGIN

12 modules

available difference

GCC design note: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE WATER-CONSERVATION RISK PRIORITY

FORMULA

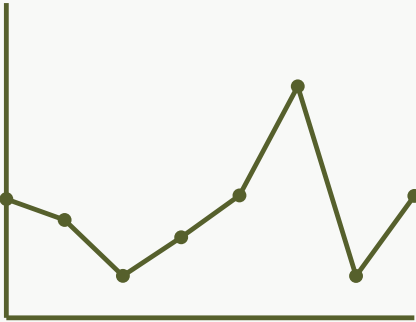
C_149 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_149 = 7 x 2 x 5 = 70
Calculated result = 70 score

CLEANING FIGURE 149



WATER-CONSERVATION RISK PRIORITY

EXAMPLE VALUES

Severity rank	7
Occurrence rank	2
Detection rank	5

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 70 score x 1.05 = 73.5 score

GIVEN VALUES FOR EXAMPLE

X_calculated	70 score
K_design	1.05
X_design	73.5 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 80.9 score - 73.5 score = 7.35 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

70 score

worked result

DESIGN

73.5 score

factor 1.05

LIMIT

80.9 score

project criterion

MARGIN

7.35 score

available difference

GCC design note: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ANNUAL WATER RESOURCE COST

FORMULA

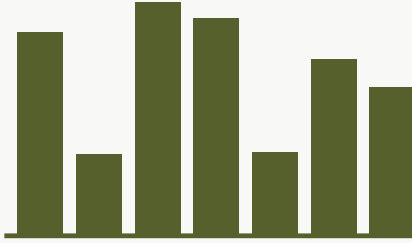
C_150 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_150 = 63 x 5,875 = 370,125 USD/year
Calculated result = 370,125 USD/year

CLEANING FIGURE 150



ANNUAL WATER RESOURCE COST

EXAMPLE VALUES

Annual cleaning cycles	63
Cost per cycle	5,875 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 370,125 USD/year x 1.05 = 388,631 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	370,125 USD/year
K_design	1.05
X_design	388,631 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 427,494 USD/year - 388,631 USD/year = 38,863 USD/year



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

370,125 USD/year

worked result

DESIGN

388,631 USD/year

factor 1.05

LIMIT

427,494 USD/year

project criterion

MARGIN

38,863 USD/year

available difference

GCC design note: Apply this calculation to water consumption and conservation. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ENERGY-EFFICIENT CLEANING RECOVERY

FORMULA

$$C_{151} = (P_{after} - P_{before}) / (P_{clean} - P_{before}) \times 100$$

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{151} = (602.6 - 534) / (612 - 534) \times 100 = 88\%$$

Calculated result = 88 %

CLEANING FIGURE 151



ENERGY-EFFICIENT CLEANING RECOVERY

EXAMPLE VALUES

Before cleaning	534 W
After cleaning	602.6 W
Clean reference	612 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

$$X_{design} = X_{calculated} \times K_{conservative}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{design} = 88\% \times 0.95 = 83.6\%$$

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

$$Margin = X_{design} - X_{min}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$Margin = 83.6\% - 75.2\% = 8.36\%$$



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ENERGY-CONSTRAINT RESIDUAL LOSS

FORMULA

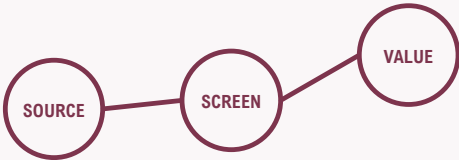
C_152 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_152 = (620-602.5) / 620 x 100 = 2.823%
Calculated result = 2.823 %

CLEANING FIGURE 152



ENERGY-CONSTRAINT RESIDUAL LOSS

EXAMPLE VALUES

Clean reference	620 W
Post-cleaning output	602.5 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.82 % x 1.05 = 2.96 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.82 %
K_design	1.05
X_design	2.96 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.26 % - 2.96 % = 0.296 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.82 %

worked result

DESIGN

2.96 %

factor 1.05

LIMIT

3.26 %

project criterion

MARGIN

0.296 %

available difference

GCC design note: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ENERGY-BASED CLEANING THROUGHPUT

FORMULA

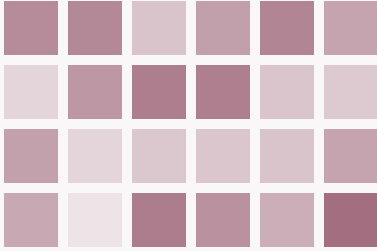
C_153 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_153 = 10,200 / 7 = 1,457.1 m2/h
Calculated result = 1,457.1 m2/h

CLEANING FIGURE 153



ENERGY-BASED CLEANING THROUGHPUT

EXAMPLE VALUES

Cleaned area	10,200 m2
Productive time	7 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1,457 m2/h x 0.95 = 1,384 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	1,457 m2/h
K_design	0.95
X_design	1,384 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1,384 m2/h - 1,246 m2/h = 138.4 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1,457 m2/h

worked result

CONSERVATIVE

1,384 m2/h

factor 0.95

MINIMUM

1,246 m2/h

project criterion

MARGIN

138.4 m2/h

available difference

GCC design note: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE HIGH-FUEL-USE PREVALENCE

FORMULA

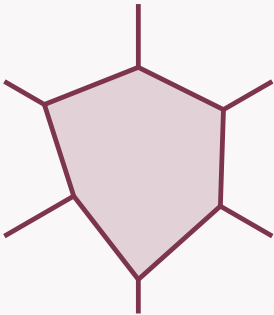
C_154 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_154 = 38 / 1192 x 100 = 3.188%
Calculated result = 3.188 %

CLEANING FIGURE 154



HIGH-FUEL-USE PREVALENCE

EXAMPLE VALUES

Missed or failed items	38
Inspected items	1192



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 3.19 % x 1.05 = 3.35 %

GIVEN VALUES FOR EXAMPLE

X_calculated	3.19 %
K_design	1.05
X_design	3.35 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.68 % - 3.35 % = 0.335 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

3.19 %

worked result

DESIGN

3.35 %

factor 1.05

LIMIT

3.68 %

project criterion

MARGIN

0.335 %

available difference

GCC design note: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ENERGY-USE VARIABILITY

FORMULA

$$C_{155} = s_X / X_{\text{mean}} \times 100$$

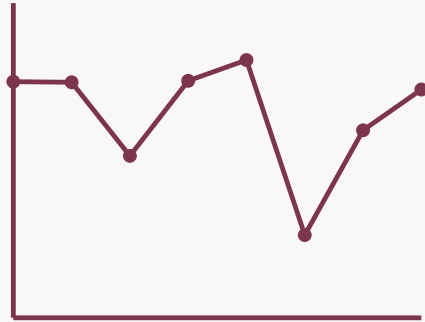
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{155} = 2.520 / 100 \times 100 = 2.520\%$$

Calculated result = 2.52 %

CLEANING FIGURE 155



ENERGY-USE VARIABILITY

EXAMPLE VALUES

Standard deviation	2.520
Mean performance	100



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{\text{design}} = X_{\text{calculated}} \times K_{\text{upper}}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{\text{design}} = 2.52 \% \times 1.05 = 2.65 \%$$

GIVEN VALUES FOR EXAMPLE

X_calculated	2.52 %
K_design	1.05
X_design	2.65 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$\text{Margin} = X_{\text{limit}} - X_{\text{design}}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$\text{Margin} = 2.91 \% - 2.65 \% = 0.265 \%$$



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.52 %

worked result

DESIGN

2.65 %

factor 1.05

LIMIT

2.91 %

project criterion

MARGIN

0.265 %

available difference

GCC design note: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE FUEL-CONSUMPTION DRIFT PER CYCLE

FORMULA

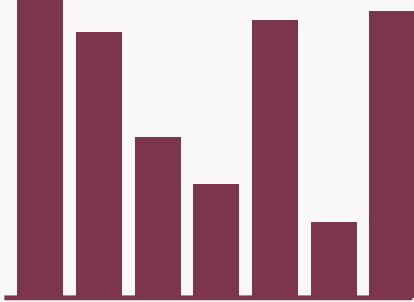
C_156 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_156 = |0.970-0.670| / 8 = 0.038 %/cycle
Calculated result = 0.0375 %/cycle

CLEANING FIGURE 156



FUEL-CONSUMPTION DRIFT PER CYCLE

EXAMPLE VALUES

Later quality indicator	0.970%
Initial quality indicator	0.670%
Cleaning cycles	8

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.038 %/cycle x 1.05 = 0.039 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.038 %/cycle
K_design	1.05
X_design	0.039 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.043 %/cycle - 0.039 %/cycle = 0.004 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.038 %/cycle

worked result

DESIGN

0.039 %/cycle

factor 1.05

LIMIT

0.043 %/cycle

project criterion

MARGIN

0.004 %/cycle

available difference

GCC design note: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ENERGY-METERING COVERAGE

FORMULA

C_157 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_157 = 761 / 772 x 100 = 98.58%
Calculated result = 98.58 %

CLEANING FIGURE 157



ENERGY-METERING COVERAGE

EXAMPLE VALUES

Completed work units	761
Planned work units	772

i

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 98.6 % x 0.95 = 93.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated	98.6 %
K_design	0.95
X_design	93.6 %

i

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 93.6 % - 84.3 % = 9.36 %

i

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

i

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK

SUMMARY

CALCULATED

98.6 %

worked result

CONSERVATIVE

93.6 %

factor 0.95

MINIMUM

84.3 %

project criterion

MARGIN

9.36 %

available difference

GCC design note: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED ENERGY-EFFICIENCY INTERVENTIONS

FORMULA

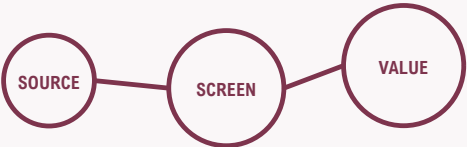
C_158 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_158 = 14720 x 0.852 / 100 = 125.4 modules
Calculated result = 125.4 modules

CLEANING FIGURE 158



EXPECTED ENERGY-EFFICIENCY INTERVENTIONS

EXAMPLE VALUES

Asset population	14720 modules
Intervention rate	0.852%

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 125.4 modules x 1.05 = 131.7 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	125.4 modules
K_design	1.05
X_design	131.7 modules

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 144.9 modules - 131.7 modules = 13.2 modules

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

125.4 modules

worked result

DESIGN

131.7 modules

factor 1.05

LIMIT

144.9 modules

project criterion

MARGIN

13.2 modules

available difference

GCC design note: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CLEANING-ENERGY RISK PRIORITY

FORMULA

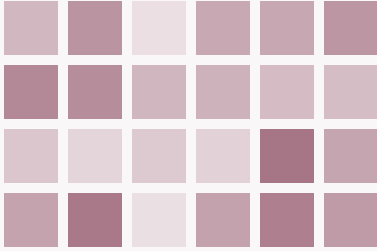
C_159 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_159 = 8 x 3 x 2 = 48
Calculated result = 48 score

CLEANING FIGURE 159



CLEANING-ENERGY RISK PRIORITY

EXAMPLE VALUES

Severity rank	8
Occurrence rank	3
Detection rank	2

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 48 score x 1.05 = 50.4 score

GIVEN VALUES FOR EXAMPLE

X_calculated	48 score
K_design	1.05
X_design	50.4 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 55.4 score - 50.4 score = 5.04 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

48 score

worked result

DESIGN

50.4 score

factor 1.05

LIMIT

55.4 score

project criterion

MARGIN

5.04 score

available difference

GCC design note: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ANNUAL ENERGY AND FUEL COST

FORMULA

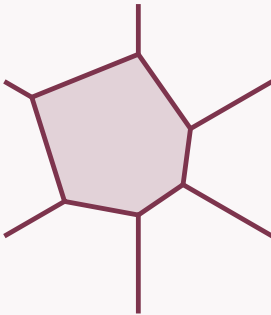
C_160 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_160 = 66 x 6,060 = 399,960 USD/year
Calculated result = 399,960 USD/year

CLEANING FIGURE 160



ANNUAL ENERGY AND FUEL COST

EXAMPLE VALUES

Annual cleaning cycles	66
Cost per cycle	6,060 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 399,960 USD/year x 1.05 = 419,958 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	399,960 USD/year
K_design	1.05
X_design	419,958 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 461,954 USD/year - 419,958 USD/year = 41,996 USD/year



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

399,960 USD/year

worked result

DESIGN

419,958 USD/year

factor 1.05

LIMIT

461,954 USD/year

project criterion

MARGIN

41,996 USD/year

available difference

GCC design note: Apply this calculation to energy, fuel and carbon requirements. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE SAFE-WORK CLEANING RECOVERY

FORMULA

$$C_{161} = (P_{after} - P_{before}) / (P_{clean} - P_{before}) \times 100$$

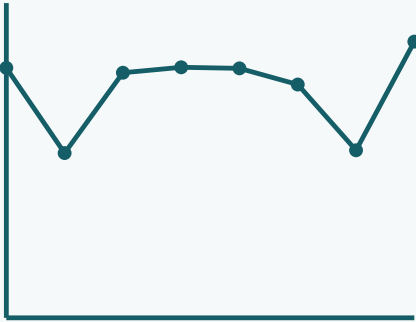
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{161} = (607.1 - 538) / (616.5 - 538) \times 100 = 88\%$$

Calculated result = 88 %

CLEANING FIGURE 161



SAFE-WORK CLEANING RECOVERY

EXAMPLE VALUES

Before cleaning	538 W
After cleaning	607.1 W
Clean reference	616.5 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

$$X_{design} = X_{calculated} \times K_{conservative}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{design} = 88\% \times 0.95 = 83.6\%$$

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

$$Margin = X_{design} - X_{min}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$Margin = 83.6\% - 75.2\% = 8.36\%$$

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ACCESS-CONSTRAINT RESIDUAL LOSS

FORMULA

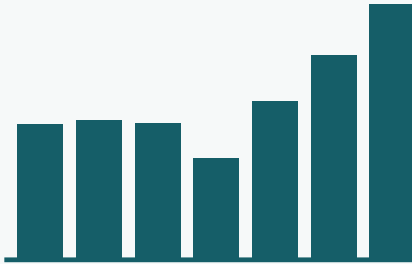
C_162 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_162 = (625-606.8) / 625 x 100 = 2.920%
Calculated result = 2.92 %

CLEANING FIGURE 162



ACCESS-CONSTRAINT RESIDUAL LOSS

EXAMPLE VALUES

Clean reference	625 W
Post-cleaning output	606.8 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.92 % x 1.05 = 3.07 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.92 %
K_design	1.05
X_design	3.07 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.37 % - 3.07 % = 0.307 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.92 %

worked result

DESIGN

3.07 %

factor 1.05

LIMIT

3.37 %

project criterion

MARGIN

0.307 %

available difference

GCC design note: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CREW CLEANING PRODUCTIVITY

FORMULA

C_163 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_163 = 10,575 / 8 = 1,321.9 m2/h
Calculated result = 1,321.9 m2/h

CLEANING FIGURE 163



CREW CLEANING PRODUCTIVITY

EXAMPLE VALUES

Cleaned area	10,575 m2
Productive time	8 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1,322 m2/h x 0.95 = 1,256 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	1,322 m2/h
K_design	0.95
X_design	1,256 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1,256 m2/h - 1,130 m2/h = 125.6 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1,322 m2/h

worked result

CONSERVATIVE

1,256 m2/h

factor 0.95

MINIMUM

1,130 m2/h

project criterion

MARGIN

125.6 m2/h

available difference

GCC design note: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE SAFETY-EXCEPTION PREVALENCE

FORMULA

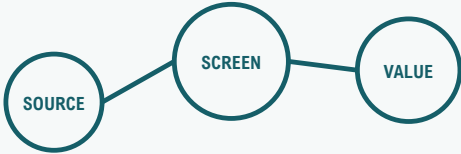
C_164 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_164 = 40 / 1234 x 100 = 3.241%
Calculated result = 3.241 %

CLEANING FIGURE 164



EXAMPLE VALUES

Missed or failed items	40
Inspected items	1234



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 3.24 % x 1.05 = 3.4 %

GIVEN VALUES FOR EXAMPLE

X_calculated	3.24 %
K_design	1.05
X_design	3.4 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.74 % - 3.4 % = 0.34 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

3.24 %

worked result

DESIGN

3.4 %

factor 1.05

LIMIT

3.74 %

project criterion

MARGIN

0.34 %

available difference

GCC design note: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CREW-TIME VARIABILITY

FORMULA

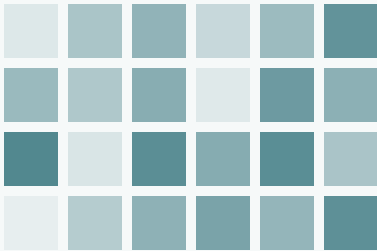
C_165 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_165 = 2.615 / 100.2 x 100 = 2.608%
Calculated result = 2.608 %

CLEANING FIGURE 165



CREW-TIME VARIABILITY

EXAMPLE VALUES

Standard deviation	2.615
Mean performance	100.2

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.61 % x 1.05 = 2.74 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.61 %
K_design	1.05
X_design	2.74 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.01 % - 2.74 % = 0.274 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

2.61 %

worked result

DESIGN

2.74 %

factor 1.05

LIMIT

3.01 %

project criterion

MARGIN

0.274 %

available difference

GCC design note: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE FATIGUE EFFECT PER CYCLE

FORMULA

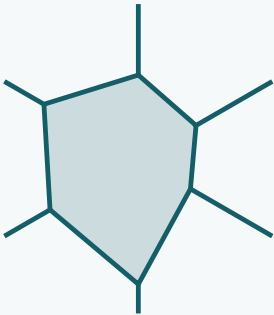
C_166 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_166 = |1-0.690| / 9 = 0.034 %/cycle
Calculated result = 0.0344 %/cycle

CLEANING FIGURE 166



FATIGUE EFFECT PER CYCLE

EXAMPLE VALUES

Later quality indicator	1%
Initial quality indicator	0.690%
Cleaning cycles	9

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.034 %/cycle x 1.05 = 0.036 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.034 %/cycle
K_design	1.05
X_design	0.036 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.04 %/cycle - 0.036 %/cycle = 0.004 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.034 %/cycle

worked result

DESIGN

0.036 %/cycle

factor 1.05

LIMIT

0.04 %/cycle

project criterion

MARGIN

0.004 %/cycle

available difference

GCC design note: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE PERMIT AND LOTO COVERAGE

FORMULA

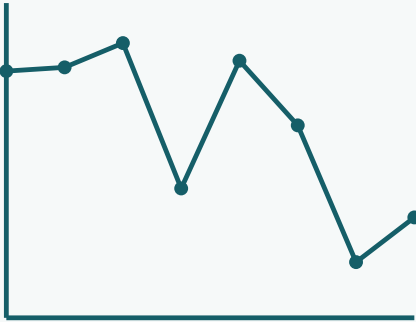
C_167 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_167 = 792 / 804 x 100 = 98.51%
Calculated result = 98.51 %

CLEANING FIGURE 167



PERMIT AND LOTO COVERAGE

EXAMPLE VALUES

Completed work units	792
Planned work units	804



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 98.5 % x 0.95 = 93.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated	98.5 %
K_design	0.95
X_design	93.6 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 93.6 % - 84.2 % = 9.36 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

98.5 %

worked result

CONSERVATIVE

93.6 %

factor 0.95

MINIMUM

84.2 %

project criterion

MARGIN

9.36 %

available difference

GCC design note: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED CREW INTERVENTIONS

FORMULA

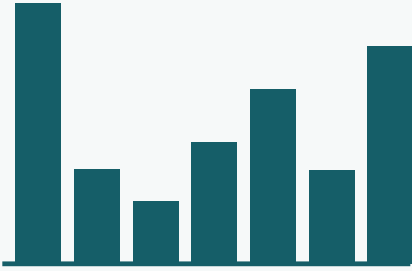
$$C_{168} = N_{asset} \times p_{intervention} / 100$$

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$C_{168} = 15340 \times 0.894 / 100 = 137.1$ modules
Calculated result = 137.1 modules

CLEANING FIGURE 168



EXPECTED CREW INTERVENTIONS

EXAMPLE VALUES

Asset population	15340 modules
Intervention rate	0.894%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{design} = X_{calculated} \times K_{upper}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$X_{design} = 137.1 \text{ modules} \times 1.05 = 144$ modules

GIVEN VALUES FOR EXAMPLE

X_calculated	137.1 modules
K_design	1.05
X_design	144 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$Margin = X_{limit} - X_{design}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$Margin = 158.4 \text{ modules} - 144 \text{ modules} = 14.4$ modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

137.1 modules

worked result

DESIGN

144 modules

factor 1.05

LIMIT

158.4 modules

project criterion

MARGIN

14.4 modules

available difference

GCC design note: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CLEANING SAFETY RISK PRIORITY

FORMULA

C_169 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_169 = 9 x 4 x 3 = 108

Calculated result = 108 score

CLEANING FIGURE 169



CLEANING SAFETY RISK PRIORITY

EXAMPLE VALUES

Severity rank	9
Occurrence rank	4
Detection rank	3

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 108 score x 1.05 = 113.4 score

GIVEN VALUES FOR EXAMPLE

X_calculated	108 score
K_design	1.05
X_design	113.4 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 124.7 score - 113.4 score = 11.3 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

108 score

worked result

DESIGN

113.4 score

factor 1.05

LIMIT

124.7 score

project criterion

MARGIN

11.3 score

available difference

GCC design note: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ANNUAL LABOR AND LOGISTICS COST

FORMULA

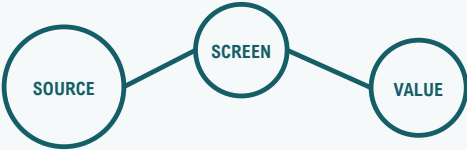
C_170 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_170 = 69 x 6,245 = 430,905 USD/year
Calculated result = 430,905 USD/year

CLEANING FIGURE 170



ANNUAL LABOR AND LOGISTICS COST

EXAMPLE VALUES

Annual cleaning cycles	69
Cost per cycle	6,245 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 430,905 USD/year x 1.05 = 452,450 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	430,905 USD/year
K_design	1.05
X_design	452,450 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 497,695 USD/year - 452,450 USD/year = 45,245 USD/year



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

430,905 USD/year

worked result

DESIGN

452,450 USD/year

factor 1.05

LIMIT

497,695 USD/year

project criterion

MARGIN

45,245 USD/year

available difference

GCC design note: Apply this calculation to labor, safety and field logistics. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE VERIFIED CLEANING RECOVERY

FORMULA

C_171 = (P_after-P_before) / (P_clean-P_before) x 100

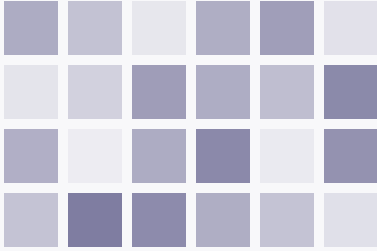
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_171 = (611.5-542) / (621-542) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 171



VERIFIED CLEANING RECOVERY

EXAMPLE VALUES

Before cleaning542 W

After cleaning611.5 W

Clean reference621 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated88 %

K_design0.95

X_design83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE POST-INSPECTION RESIDUAL LOSS

FORMULA

$$C_{172} = (P_{\text{clean}} - P_{\text{after}}) / P_{\text{clean}} \times 100$$

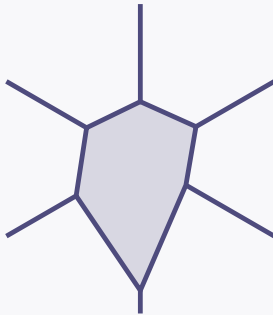
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

$$C_{172} = (630 - 611) / 630 \times 100 = 3.016\%$$

Calculated result = 3.016 %

CLEANING FIGURE 172



POST-INSPECTION RESIDUAL LOSS

EXAMPLE VALUES

Clean reference	630 W
Post-cleaning output	611 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

$$X_{\text{design}} = X_{\text{calculated}} \times K_{\text{upper}}$$

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

$$X_{\text{design}} = 3.02\% \times 1.05 = 3.17\%$$

GIVEN VALUES FOR EXAMPLE

X_calculated	3.02 %
K_design	1.05
X_design	3.17 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

$$\text{Margin} = X_{\text{limit}} - X_{\text{design}}$$

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

$$\text{Margin} = 3.48\% - 3.17\% = 0.317\%$$



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

3.02 %

worked result

DESIGN

3.17 %

factor 1.05

LIMIT

3.48 %

project criterion

MARGIN

0.317 %

available difference

GCC design note: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE QA INSPECTION THROUGHPUT

FORMULA

C_173 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_173 = 10,950 / 9 = 1,216.7 m2/h
Calculated result = 1,216.7 m2/h

CLEANING FIGURE 173



QA INSPECTION THROUGHPUT

EXAMPLE VALUES

Cleaned area	10,950 m2
Productive time	9 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1,217 m2/h x 0.95 = 1,156 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	1,217 m2/h
K_design	0.95
X_design	1,156 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1,156 m2/h - 1,040 m2/h = 115.6 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1,217 m2/h

worked result

CONSERVATIVE

1,156 m2/h

factor 0.95

MINIMUM

1,040 m2/h

project criterion

MARGIN

115.6 m2/h

available difference

GCC design note: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE FAILED-INSPECTION PREVALENCE

FORMULA

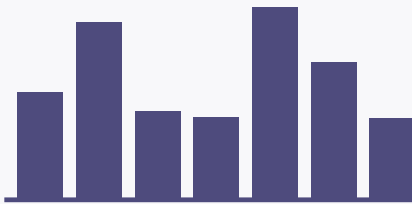
C_174 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_174 = 42 / 1276 x 100 = 3.292%
Calculated result = 3.292 %

CLEANING FIGURE 174



FAILED-INSPECTION PREVALENCE

EXAMPLE VALUES

Missed or failed items	42
Inspected items	1276

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 3.29 % x 1.05 = 3.46 %

GIVEN VALUES FOR EXAMPLE

X_calculated	3.29 %
K_design	1.05
X_design	3.46 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.8 % - 3.46 % = 0.346 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

3.29 %

worked result

DESIGN

3.46 %

factor 1.05

LIMIT

3.8 %

project criterion

MARGIN

0.346 %

available difference

GCC design note: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE VERIFICATION-RESULT VARIABILITY

FORMULA

C_175 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_175 = 2.710 / 100.5 x 100 = 2.697%
Calculated result = 2.697 %

CLEANING FIGURE 175



VERIFICATION-RESULT VARIABILITY

EXAMPLE VALUES

Standard deviation	2.710
Mean performance	100.5



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.7 % x 1.05 = 2.83 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.7 %
K_design	1.05
X_design	2.83 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.11 % - 2.83 % = 0.283 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.7 %

worked result

DESIGN

2.83 %

factor 1.05

LIMIT

3.11 %

project criterion

MARGIN

0.283 %

available difference

GCC design note: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE QUALITY DRIFT PER CYCLE

FORMULA

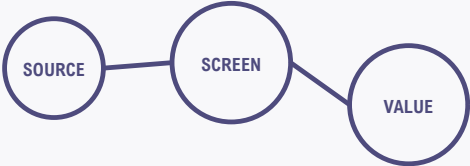
C_176 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_176 = |1.030-0.710| / 4 = 0.080 %/cycle
Calculated result = 0.08 %/cycle

CLEANING FIGURE 176



QUALITY DRIFT PER CYCLE

EXAMPLE VALUES

Later quality indicator	1.030%
Initial quality indicator	0.710%
Cleaning cycles	4

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.08 %/cycle x 1.05 = 0.084 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.08 %/cycle
K_design	1.05
X_design	0.084 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.092 %/cycle - 0.084 %/cycle = 0.008 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.08 %/cycle

worked result

DESIGN

0.084 %/cycle

factor 1.05

LIMIT

0.092 %/cycle

project criterion

MARGIN

0.008 %/cycle

available difference

GCC design note: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE POST-CLEANING VERIFICATION COVERAGE

FORMULA

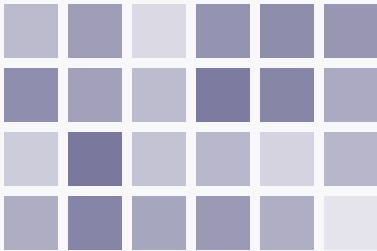
C_177 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_177 = 832 / 836 x 100 = 99.52%
Calculated result = 99.52 %

CLEANING FIGURE 177



POST-CLEANING VERIFICATION COVERAGE

EXAMPLE VALUES

Completed work units	832
Planned work units	836

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 99.5 % x 0.95 = 94.5 %

GIVEN VALUES FOR EXAMPLE

X_calculated	99.5 %
K_design	0.95
X_design	94.5 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 94.5 % - 85.1 % = 9.45 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

99.5 %

worked result

CONSERVATIVE

94.5 %

factor 0.95

MINIMUM

85.1 %

project criterion

MARGIN

9.45 %

available difference

GCC design note: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED QA REWORK MODULES

FORMULA

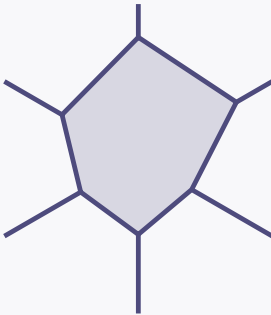
C_178 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_178 = 15960 x 0.936 / 100 = 149.4 modules
Calculated result = 149.4 modules

CLEANING FIGURE 178



EXPECTED QA REWORK MODULES

EXAMPLE VALUES

Asset population	15960 modules
Intervention rate	0.936%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 149.4 modules x 1.05 = 156.9 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	149.4 modules
K_design	1.05
X_design	156.9 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 172.5 modules - 156.9 modules = 15.7 modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

149.4 modules

worked result

DESIGN

156.9 modules

factor 1.05

LIMIT

172.5 modules

project criterion

MARGIN

15.7 modules

available difference

GCC design note: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CLEANING QA RISK PRIORITY

FORMULA

C_179 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_179 = 4 x 5 x 4 = 80
Calculated result = 80 score

CLEANING FIGURE 179



CLEANING QA RISK PRIORITY

EXAMPLE VALUES

Severity rank	4
Occurrence rank	5
Detection rank	4

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 80 score x 1.05 = 84 score

GIVEN VALUES FOR EXAMPLE

X_calculated	80 score
K_design	1.05
X_design	84 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 92.4 score - 84 score = 8.4 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

80 score

worked result

DESIGN

84 score

factor 1.05

LIMIT

92.4 score

project criterion

MARGIN

8.4 score

available difference

GCC design note: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ANNUAL CLEANING QA COST

FORMULA

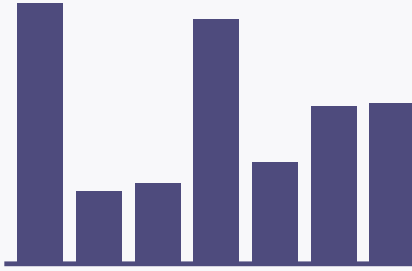
C_180 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_180 = 72 x 6,430 = 462,960 USD/year
Calculated result = 462,960 USD/year

CLEANING FIGURE 180



ANNUAL CLEANING QA COST

EXAMPLE VALUES

Annual cleaning cycles	72
Cost per cycle	6,430 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 462,960 USD/year x 1.05 = 486,108 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	462,960 USD/year
K_design	1.05
X_design	486,108 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 534,719 USD/year - 486,108 USD/year = 48,611 USD/year



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

462,960 USD/year

worked result

DESIGN

486,108 USD/year

factor 1.05

LIMIT

534,719 USD/year

project criterion

MARGIN

48,611 USD/year

available difference

GCC design note: Apply this calculation to cleaning quality assurance and verification. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE AVAILABLE-SYSTEM RECOVERY EFFICIENCY

FORMULA

C_181 = (P_after-P_before) / (P_clean-P_before) x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_181 = (616.0-546) / (625.5-546) x 100 = 88%

Calculated result = 88 %

CLEANING FIGURE 181



AVAILABLE-SYSTEM RECOVERY EFFICIENCY

EXAMPLE VALUES

Before cleaning546 W

After cleaning616.0 W

Clean reference625.5 W



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated88 %

K_design0.95

X_design83.6 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EQUIPMENT-DOWNTIME RESIDUAL LOSS

FORMULA

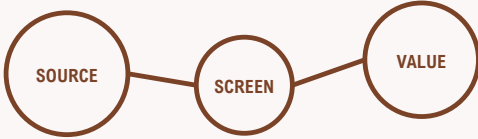
C_182 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_182 = (635-615.2) / 635 x 100 = 3.110%
Calculated result = 3.11 %

CLEANING FIGURE 182



EQUIPMENT-DOWNTIME RESIDUAL LOSS

EXAMPLE VALUES

Clean reference	635 W
Post-cleaning output	615.2 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 3.11 % x 1.05 = 3.27 %

GIVEN VALUES FOR EXAMPLE

X_calculated	3.11 %
K_design	1.05
X_design	3.27 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.59 % - 3.27 % = 0.327 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

3.11 %

worked result

DESIGN

3.27 %

factor 1.05

LIMIT

3.59 %

project criterion

MARGIN

0.327 %

available difference

GCC design note: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE MAINTENANCE SERVICE THROUGHPUT

FORMULA

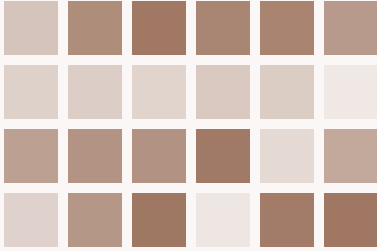
C_183 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_183 = 11,325 / 10 = 1,132.5 m2/h
Calculated result = 1,132.5 m2/h

CLEANING FIGURE 183



MAINTENANCE SERVICE THROUGHPUT

EXAMPLE VALUES

Cleaned area	11,325 m2
Productive time	10 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1,132 m2/h x 0.95 = 1,076 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	1,132 m2/h
K_design	0.95
X_design	1,076 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1,076 m2/h - 968.3 m2/h = 107.6 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

1,132 m2/h

worked result

CONSERVATIVE

1,076 m2/h

factor 0.95

MINIMUM

968.3 m2/h

project criterion

MARGIN

107.6 m2/h

available difference

GCC design note: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CLEANING-SYSTEM FAILURE PREVALENCE

FORMULA

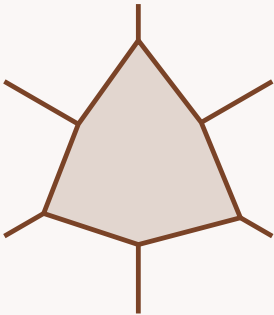
C_184 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_184 = 44 / 1318 x 100 = 3.338%
Calculated result = 3.338 %

CLEANING FIGURE 184



CLEANING-SYSTEM FAILURE PREVALENCE

EXAMPLE VALUES

Missed or failed items	44
Inspected items	1318



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 3.34 % x 1.05 = 3.51 %

GIVEN VALUES FOR EXAMPLE

X_calculated	3.34 %
K_design	1.05
X_design	3.51 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.86 % - 3.51 % = 0.351 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

3.34 %

worked result

DESIGN

3.51 %

factor 1.05

LIMIT

3.86 %

project criterion

MARGIN

0.351 %

available difference

GCC design note: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE FLEET AVAILABILITY VARIABILITY

FORMULA

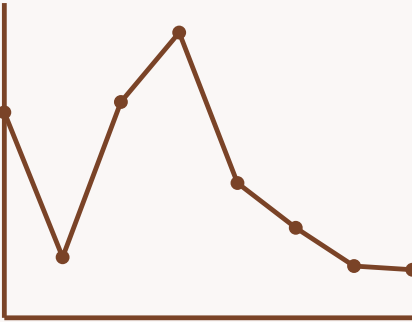
C_185 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_185 = 2.805 / 100.8 x 100 = 2.784%
Calculated result = 2.784 %

CLEANING FIGURE 185



FLEET AVAILABILITY VARIABILITY

EXAMPLE VALUES

Standard deviation	2.805
Mean performance	100.8



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.78 % x 1.05 = 2.92 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.78 %
K_design	1.05
X_design	2.92 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.22 % - 2.92 % = 0.292 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.78 %

worked result

DESIGN

2.92 %

factor 1.05

LIMIT

3.22 %

project criterion

MARGIN

0.292 %

available difference

GCC design note: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE RELIABILITY DRIFT PER CYCLE

FORMULA

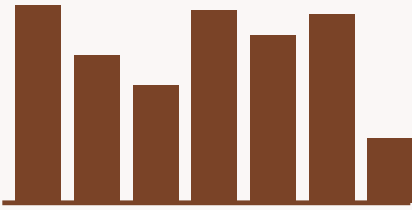
C_186 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_186 = |1.060-0.730| / 5 = 0.066 %/cycle
Calculated result = 0.066 %/cycle

CLEANING FIGURE 186



RELIABILITY DRIFT PER CYCLE

EXAMPLE VALUES

Later quality indicator	1.060%
Initial quality indicator	0.730%
Cleaning cycles	5

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.066 %/cycle x 1.05 = 0.069 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.066 %/cycle
K_design	1.05
X_design	0.069 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.076 %/cycle - 0.069 %/cycle = 0.007 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.066 %/cycle

worked result

DESIGN

0.069 %/cycle

factor 1.05

LIMIT

0.076 %/cycle

project criterion

MARGIN

0.007 %/cycle

available difference

GCC design note: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE PREVENTIVE-MAINTENANCE COVERAGE

FORMULA

C_187 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_187 = 863 / 868 x 100 = 99.42%
Calculated result = 99.42 %

CLEANING FIGURE 187



PREVENTIVE-MAINTENANCE COVERAGE

EXAMPLE VALUES

Completed work units	863
Planned work units	868



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 99.4 % x 0.95 = 94.5 %

GIVEN VALUES FOR EXAMPLE

X_calculated	99.4 %
K_design	0.95
X_design	94.5 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 94.5 % - 85 % = 9.45 %



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

99.4 %

worked result

CONSERVATIVE

94.5 %

factor 0.95

MINIMUM

85 %

project criterion

MARGIN

9.45 %

available difference

GCC design note: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED EQUIPMENT INTERVENTIONS

FORMULA

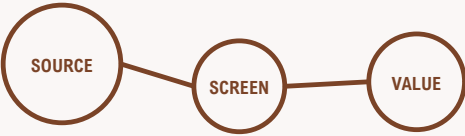
C_188 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_188 = 16580 x 0.978 / 100 = 162.2 modules
Calculated result = 162.2 modules

CLEANING FIGURE 188



EXPECTED EQUIPMENT INTERVENTIONS

EXAMPLE VALUES

Asset population	16580 modules
Intervention rate	0.978%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 162.2 modules x 1.05 = 170.3 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	162.2 modules
K_design	1.05
X_design	170.3 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 187.3 modules - 170.3 modules = 17 modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

162.2 modules

worked result

DESIGN

170.3 modules

factor 1.05

LIMIT

187.3 modules

project criterion

MARGIN

17 modules

available difference

GCC design note: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CLEANING-SYSTEM RELIABILITY RISK

FORMULA

C_189 = S x O x D

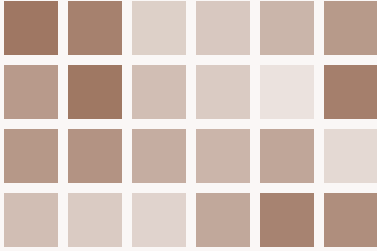
Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_189 = 5 x 6 x 5 = 150

Calculated result = 150 score

CLEANING FIGURE 189



CLEANING-SYSTEM RELIABILITY RISK

EXAMPLE VALUES

Severity rank	5
Occurrence rank	6
Detection rank	5

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 150 score x 1.05 = 157.5 score

GIVEN VALUES FOR EXAMPLE

X_calculated	150 score
K_design	1.05
X_design	157.5 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 173.2 score - 157.5 score = 15.8 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

150 score

worked result

DESIGN

157.5 score

factor 1.05

LIMIT

173.2 score

project criterion

MARGIN

15.8 score

available difference

GCC design note: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE ANNUAL CLEANING-SYSTEM MAINTENANCE COST

FORMULA

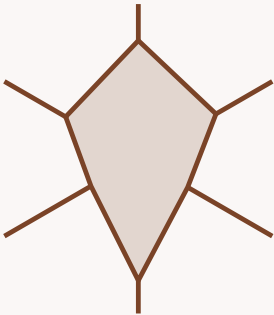
C_190 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_190 = 75 x 6,615 = 496,125 USD/year
Calculated result = 496,125 USD/year

CLEANING FIGURE 190



ANNUAL CLEANING-SYSTEM MAINTENANCE COST

EXAMPLE VALUES

Annual cleaning cycles	75
Cost per cycle	6,615 USD

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 496,125 USD/year x 1.05 = 520,931 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	496,125 USD/year
K_design	1.05
X_design	520,931 USD/year

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 573,024 USD/year - 520,931 USD/year = 52,093 USD/year

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

496,125 USD/year

worked result

DESIGN

520,931 USD/year

factor 1.05

LIMIT

573,024 USD/year

project criterion

MARGIN

52,093 USD/year

available difference

GCC design note: Apply this calculation to cleaning-system reliability and maintenance. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE LIFECYCLE CLEANING BENEFIT RETENTION

FORMULA

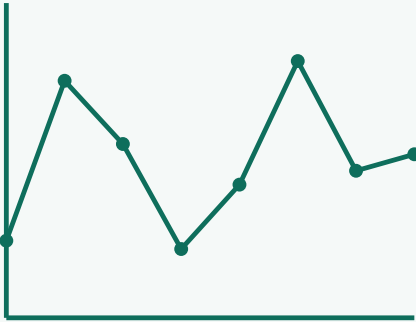
C_191 = (P_after-P_before) / (P_clean-P_before) x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_191 = (620.4-550) / (630-550) x 100 = 88%
Calculated result = 88 %

CLEANING FIGURE 191



LIFECYCLE CLEANING BENEFIT RETENTION

EXAMPLE VALUES

Before cleaning	550 W
After cleaning	620.4 W
Clean reference	630 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 88 % x 0.95 = 83.6 %

GIVEN VALUES FOR EXAMPLE

X_calculated	88 %
K_design	0.95
X_design	83.6 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 83.6 % - 75.2 % = 8.36 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

88 %

worked result

CONSERVATIVE

83.6 %

factor 0.95

MINIMUM

75.2 %

project criterion

MARGIN

8.36 %

available difference

GCC design note: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE UNRECOVERED PORTFOLIO SOILING LOSS

FORMULA

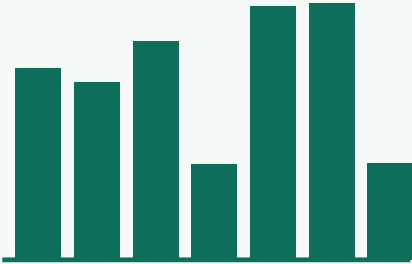
C_192 = (P_clean-P_after) / P_clean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_192 = (640-619.5) / 640 x 100 = 3.203%
Calculated result = 3.203 %

CLEANING FIGURE 192



UNRECOVERED PORTFOLIO SOILING LOSS

EXAMPLE VALUES

Clean reference	640 W
Post-cleaning output	619.5 W

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 3.2 % x 1.05 = 3.36 %

GIVEN VALUES FOR EXAMPLE

X_calculated	3.2 %
K_design	1.05
X_design	3.36 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.7 % - 3.36 % = 0.336 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

3.2 %

worked result

DESIGN

3.36 %

factor 1.05

LIMIT

3.7 %

project criterion

MARGIN

0.336 %

available difference

GCC design note: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CONTRACTOR CLEANING THROUGHPUT

FORMULA

C_193 = A_clean / t_clean

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_193 = 11,700 / 6 = 1,950 m2/h
Calculated result = 1,950 m2/h

CLEANING FIGURE 193



CONTRACTOR CLEANING THROUGHPUT

EXAMPLE VALUES

Cleaned area	11,700 m2
Productive time	6 h



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 1,950 m2/h x 0.95 = 1,852 m2/h

GIVEN VALUES FOR EXAMPLE

X_calculated	1,950 m2/h
K_design	0.95
X_design	1,852 m2/h



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 1,852 m2/h - 1,667 m2/h = 185.2 m2/h



WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.



IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

1,950 m2/h

worked result

CONSERVATIVE

1,852 m2/h

factor 0.95

MINIMUM

1,667 m2/h

project criterion

MARGIN

185.2 m2/h

available difference

GCC design note: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CONTRACT NONCONFORMANCE PREVALENCE

FORMULA

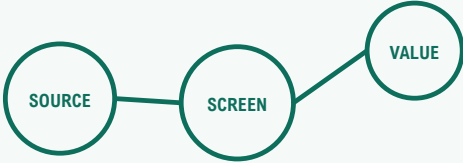
C_194 = N_missed / N_inspected x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_194 = 46 / 1360 x 100 = 3.382%
Calculated result = 3.382 %

CLEANING FIGURE 194



CONTRACT NONCONFORMANCE PREVALENCE

EXAMPLE VALUES

Missed or failed items	46
Inspected items	1360

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 3.38 % x 1.05 = 3.55 %

GIVEN VALUES FOR EXAMPLE

X_calculated	3.38 %
K_design	1.05
X_design	3.55 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.91 % - 3.55 % = 0.355 %

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

3.38 %

worked result

DESIGN

3.55 %

factor 1.05

LIMIT

3.91 %

project criterion

MARGIN

0.355 %

available difference

GCC design note: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE BID-COST VARIABILITY

FORMULA

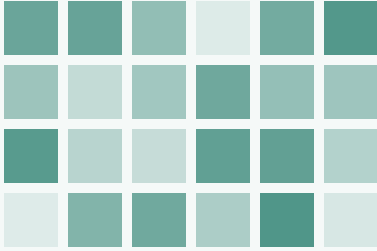
C_195 = s_X / X_mean x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_195 = 2.900 / 101 x 100 = 2.871%
Calculated result = 2.871 %

CLEANING FIGURE 195



BID-COST VARIABILITY

EXAMPLE VALUES

Standard deviation	2.900
Mean performance	101



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 2.87 % x 1.05 = 3.01 %

GIVEN VALUES FOR EXAMPLE

X_calculated	2.87 %
K_design	1.05
X_design	3.01 %



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 3.32 % - 3.01 % = 0.301 %



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

2.87 %

worked result

DESIGN

3.01 %

factor 1.05

LIMIT

3.32 %

project criterion

MARGIN

0.301 %

available difference

GCC design note: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE LIFECYCLE COST DRIFT PER CYCLE

FORMULA

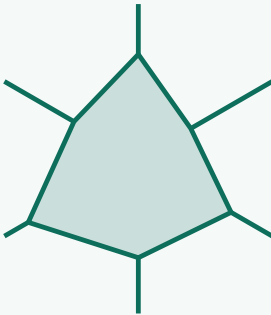
C_196 = |X_2-X_1| / N_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_196 = |1.090-0.750| / 6 = 0.057 %/cycle
Calculated result = 0.0567 %/cycle

CLEANING FIGURE 196



LIFECYCLE COST DRIFT PER CYCLE

EXAMPLE VALUES

Later quality indicator	1.090%
Initial quality indicator	0.750%
Cleaning cycles	6

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 0.057 %/cycle x 1.05 = 0.06 %/cycle

GIVEN VALUES FOR EXAMPLE

X_calculated	0.057 %/cycle
K_design	1.05
X_design	0.06 %/cycle

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 0.065 %/cycle - 0.06 %/cycle = 0.006 %/cycle

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

0.057 %/cycle

worked result

DESIGN

0.06 %/cycle

factor 1.05

LIMIT

0.065 %/cycle

project criterion

MARGIN

0.006 %/cycle

available difference

GCC design note: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE CONTRACT PERFORMANCE COVERAGE

FORMULA

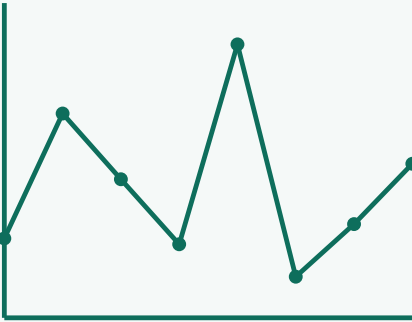
C_197 = N_complete / N_planned x 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_197 = 894 / 900 x 100 = 99.33%
Calculated result = 99.33 %

CLEANING FIGURE 197



CONTRACT PERFORMANCE COVERAGE

EXAMPLE VALUES

Completed work units	894
Planned work units	900

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE PERFORMANCE FACTOR

FORMULA

X_design = X_calculated x K_conservative

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 99.3 % x 0.95 = 94.4 %

GIVEN VALUES FOR EXAMPLE

X_calculated	99.3 %
K_design	0.95
X_design	94.4 %

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MINIMUM PROJECT CRITERION

FORMULA

Margin = X_design - X_min

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 94.4 % - 84.9 % = 9.44 %

WHERE IS THIS VALUE USED?

Performance guarantees, minimum acceptance values and conservative project forecasts.

IMPORTANT

Use a project-specific factor supported by measured data, manufacturer guarantees or the applicable standard.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

99.3 %

worked result

CONSERVATIVE

94.4 %

factor 0.95

MINIMUM

84.9 %

project criterion

MARGIN

9.44 %

available difference

GCC design note: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE EXPECTED CONTRACT INTERVENTIONS

FORMULA

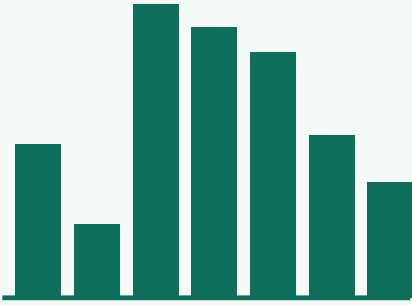
C_198 = N_asset x p_intervention / 100

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_198 = 17200 x 1.020 / 100 = 175.4 modules
Calculated result = 175.4 modules

CLEANING FIGURE 198



EXPECTED CONTRACT INTERVENTIONS

EXAMPLE VALUES

Asset population	17200 modules
Intervention rate	1.020%



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 175.4 modules x 1.05 = 184.2 modules

GIVEN VALUES FOR EXAMPLE

X_calculated	175.4 modules
K_design	1.05
X_design	184.2 modules



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 202.6 modules - 184.2 modules = 18.4 modules



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

175.4 modules

worked result

DESIGN

184.2 modules

factor 1.05

LIMIT

202.6 modules

project criterion

MARGIN

18.4 modules

available difference

GCC design note: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE PROCUREMENT RISK PRIORITY

FORMULA

C_199 = S x O x D

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_199 = 6 x 2 x 2 = 24
Calculated result = 24 score

CLEANING FIGURE 199



PROCUREMENT RISK PRIORITY

EXAMPLE VALUES

Severity rank	6
Occurrence rank	2
Detection rank	2

WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 24 score x 1.05 = 25.2 score

GIVEN VALUES FOR EXAMPLE

X_calculated	24 score
K_design	1.05
X_design	25.2 score

KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 27.7 score - 25.2 score = 2.52 score

WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.

IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.

OK SUMMARY

CALCULATED

24 score

worked result

DESIGN

25.2 score

factor 1.05

LIMIT

27.7 score

project criterion

MARGIN

2.52 score

available difference

GCC design note: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



1 CALCULATE TOTAL ANNUAL CLEANING PROGRAM COST

FORMULA

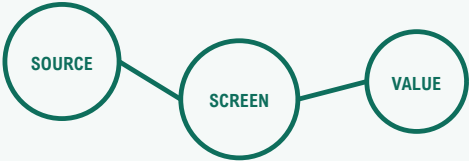
C_200 = N_cycle x C_cycle

Use one consistent unit system and define the calculation boundary before substitution.

WORKED EXAMPLE

C_200 = 78 x 6,800 = 530,400 USD/year
Calculated result = 530,400 USD/year

CLEANING FIGURE 200



TOTAL ANNUAL CLEANING PROGRAM COST

EXAMPLE VALUES

Annual cleaning cycles	78
Cost per cycle	6,800 USD



WHERE

The symbols and values shown are the inputs used in this worked example.

Basis: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.

2 APPLY CONSERVATIVE UPPER ALLOWANCE

FORMULA

X_design = X_calculated x K_upper

The factor illustrates a preliminary conservative design adjustment.

WORKED EXAMPLE

X_design = 530,400 USD/year x 1.05 = 556,920 USD/year

GIVEN VALUES FOR EXAMPLE

X_calculated	530,400 USD/year
K_design	1.05
X_design	556,920 USD/year



KEY POINT

Replace the illustrative factor with the approved project value during detailed design.

Design check: Retain traceable inputs, units, assumptions and source references in the design calculation.

3 CHECK MAXIMUM ALLOWABLE LIMIT

FORMULA

Margin = X_limit - X_design

A positive margin indicates that the illustrative project criterion is satisfied.

WORKED EXAMPLE

Margin = 612,612 USD/year - 556,920 USD/year = 55,692 USD/year



WHERE IS THIS VALUE USED?

Equipment limits, loss budgets, protection settings and compliance checks.



IMPORTANT

The allowable limit must come from the adopted code, grid rule, contract or manufacturer data.

Basis: Final acceptance remains subject to current local authority requirements and detailed engineering review.



SUMMARY

CALCULATED

530,400 USD/year

worked result

DESIGN

556,920 USD/year

factor 1.05

LIMIT

612,612 USD/year

project criterion

MARGIN

55,692 USD/year

available difference

GCC design note: Apply this calculation to lifecycle economics, procurement and fleet decisions. Confirm module-surface limits, site safety controls, environmental conditions, equipment data and post-cleaning verification.



References

SOLAR PANEL CLEANING TECHNOLOGY SOURCES

IEC 61724-1
Photovoltaic performance monitoring, including soiling measurement principles.
IEC 62446-1
PV system documentation, commissioning tests and inspection requirements.
IEC 62446-2
Maintenance requirements for grid-connected photovoltaic systems.
IEC 61215 series
PV module design qualification and environmental durability tests.
IEC 61730 series
Photovoltaic module safety qualification.
IEC TS 62446-3
Outdoor infrared thermography for PV modules and plants.
IEC 60364-7-712
Electrical installation requirements for photovoltaic power systems.
ISO 12103-1
Standardized test dusts for filter and environmental testing.
ISO 9060
Classification and performance requirements for solar-radiation instruments.
ISO 45001
Occupational health and safety management systems.
ISO 14001
Environmental management system requirements.
ASTM D1739
Collection and measurement of dustfall particulate matter.

ASTM G76
Solid-particle impingement erosion testing guidance.
WMO-No. 8
Meteorological instruments and methods of observation.
IEA PVPS Task 13
PV soiling losses, monitoring and mitigation guidance.
NREL soiling guidance
Soiling measurement, cleaning assessment and data-quality practices.
Module manufacturer manuals
Permitted tools, chemicals, pressure, temperature and warranty conditions.
Robot manufacturer manuals
Speed, slope, wind, temperature, charging, docking and maintenance limits.
Water-treatment data
Feed-water quality, recovery, membrane limits and product-water specifications.
Chemical safety data
Composition, dilution, handling, compatibility and environmental controls.
Local GCC requirements
Current water, environmental, labor, electrical and safety requirements.
Project HSE plan
Access, isolation, work-at-height, night work and emergency controls.
Project cleaning procedure
Method, route, frequency, acceptance criteria and verification.
Cleaning performance records
Area, time, water, energy, defects, recovery, downtime and cost.

Verify edition, module construction, cleaning technology, site climate, water quality, units, uncertainty and project requirements before using any source.



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