Aircontact Services AS

Final Report: Project – Offshore Helideck Friction Documentation – Norwegian Continental Shelf

Abstract

The objective of the project "Offshore Helideck Friction Documentation – Norwegian Continental Shelf" is to establish documented friction coefficients for offshore helidecks operated by the participating companies on the Norwegian Continental Shelf.

The report presents the methodology used to document the friction characteristics of both aluminium and painted helidecks. Aluminium helidecks are documented either through direct laboratory friction documentation or by traceability to representative laboratory-tested reference surfaces. Painted helidecks are documented individually by harmonized field measurements using a portable friction tester.

The report also evaluates the influence of helideck markings, fire-suppression perforations and friction nets and concludes that these features have no significant practical effect on the assigned friction coefficient.

The documented friction coefficients presented in this report provide a common technical basis for demonstrating compliance with the surface friction requirements of BSL D 5-1.

The methodology and technical principles applied in this report are based on the findings and recommendations presented in Project Sklisikkerhet (ACS-FR-2024-001).

Document Identifier:	ACS-FR-2026-001
Document Status:	Issued
Date:	19.08.2026
Authors:	Henning Hagen, Ole Morten Løge, Morten Haugseng

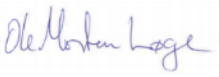
Prepared By:	Ole Morten Løge	Signature:	
Checked By:	Morten Haugseng	Signature:	
Approved By:	Henning Hagen	Signature:	

Table of Contents

1. Introduction 4
2. Project Mandate 4
3. Project Organization 5
4. Documentation of Aluminium Helidecks 6
4.1 Group A – Helidecks with Direct Friction Documentation 7
4.2 Group B – Helidecks with Indirect Friction Documentation 8
4.3 Group C – Merlin-type Helidecks 9
4.4 Representative Aluminium Plank Families 10
5. Documentation of Painted helidecks 12
5.1 Group D – Individually Documented Painted Helidecks 12
5.2 Harmonization of the Portable Friction Testers 13
5.3 Offshore Friction Measurements 14
6. Assessment of Factors Affecting Helideck Friction 14
6.1 Effect of Helideck Markings 15
6.2 Fire-Suppression Perforations 15
6.3 Friction Nets 16
6.4 Standardization of Anti-Skid Aggregate 16
7. Conclusions 17
Appendix A – Reference Documentation 18

1. Introduction

In 2019, the Norwegian Civil Aviation Authority introduced new requirements for helideck surface friction through BSL D 5-1 *Regulation on Helicopter Operations – Use of Offshore Helidecks* (FOR-2019-05-14-604). The requirements, described in §16 *Surface Friction* and the associated guidance material, introduced a new approach for documenting and maintaining helideck friction throughout the operational life of an installation.

To support implementation of the regulation, an industry consortium initiated the project "Sklisikkerhet", resulting in report ACS-FR-2024-001 issued on 15 May 2024. That project established the technical basis for helideck friction by:

- Determining the minimum friction required for safe helicopter operations;
- Evaluating available laboratory and field test methods;
- Assessing portable friction testers and harmonization procedures; and
- Recommending a practical verification regime for offshore helidecks.

While the previous project established the methodology, it did not provide friction documentation for individual helidecks operating on the Norwegian Continental Shelf.

The purpose of the present project, "Offshore Helideck Friction Documentation – Norwegian Continental Shelf", is therefore to apply the established methodology to the existing offshore helideck population and document the friction characteristics of each helideck. This includes identification of helideck types, evaluation of available laboratory documentation, grouping of legacy helidecks where appropriate, verification of painted helidecks by harmonized field measurements, and documentation of the resulting friction coefficients.

This report provides a common technical basis for operators to demonstrate compliance with the friction requirements of BSL D 5-1 and supports future maintenance and verification of helideck surface friction.

2. Project Mandate

The project "Offshore Helideck Friction Documentation – Norwegian Continental Shelf" was established on 29 October 2025 as a direct continuation of the findings and recommendations presented in ACS-FR-2024-001, Project Sklisikkerhet.

The primary objective of the project is to establish a documented friction basis for offshore helidecks operated by the participating companies on the Norwegian Continental Shelf. The

project is intended to provide a consistent and technically justified method for documenting friction characteristics for both existing and future helidecks.

To achieve this objective, the project comprised the following activities:

- Identification and classification of helidecks
  - Identify the construction type, surface configuration and supplier of each helideck.
  - Classify helidecks into groups with equivalent friction characteristics where individual laboratory documentation is unavailable.
- Documentation of aluminium helidecks
  - Review available laboratory test reports.
  - Identify representative reference reports for legacy helidecks.
  - Establish documented friction coefficients for each aluminium helideck.
- Documentation of painted helidecks
  - Verify friction characteristics by harmonized field measurements using a portable friction tester.
  - Establish documented friction coefficients for each painted helideck.
- Evaluation of helideck marking systems and fire-suppression perforations
  - Evaluate the influence of helideck marking paint, fire-suppression perforations and friction nets on friction performance.

The outcome of the project is a documented friction coefficient for each helideck included in the assessment together with the technical basis supporting the assigned friction coefficient.

The project was funded by the following participating oil and energy companies:

- Equinor
- Aker BP
- ConocoPhillips
- Vår Energi
- OKEA
- Knutsen OAS

3. Project Organization

The project was organized with a Core Team responsible for planning, coordination and execution of the project activities, supported by a Technical Advisory Team providing specialist knowledge within helideck design, laboratory testing and friction assessment.
Core Team

- Ole Morten Løge, Aircontact Services AS – Project Manager
- Morten Haugseng, Aircontact Services AS – Project Member
- Henning Hagen, Aircontact Services AS – Project Member / Quality Manager
- Arne Melheim, Equinor – Project Member / Industry Representative

Technical Advisory Team

- Jan de Jong, Royal NLR – Laboratory Testing and Friction Assessment
- Steffen Vikre, Marine Aluminium AS – Helideck Design and Technical Support

The project was managed using Microsoft Teams for document control, meeting administration and collaboration between the participating organizations.

4. Documentation of Aluminium Helidecks

Aluminium helidecks on the Norwegian Continental Shelf have been designed and constructed over a period of more than forty years by several manufacturers using different plank profiles and surface configurations. Consequently, the available technical documentation varies considerably between individual helidecks.

The objective of this project is not to document the original construction history of each helideck, but to establish a technically justified friction coefficient for every aluminium helideck included in the assessment.

The project adopts a documentation methodology based on the level of technical certainty by which the friction characteristics can be established.

Where the friction characteristics can be established directly, either through a dedicated laboratory test report or by positive identification of a laboratory-qualified aluminium plank profile, the helideck is assigned to Group A.

Where direct documentation is unavailable, the helideck is evaluated against documented reference surfaces with equivalent geometry and friction characteristics. These helidecks are assigned to Group B.

Legacy Merlin-type helidecks constitute a separate category due to their unique surface design and are assigned to Group C based on a dedicated laboratory assessment.

The following sections describe the documentation methodology applied to each group.

4.1 Group A – Helidecks with Direct Friction Documentation

Group A comprises aluminium helidecks where the friction characteristics can be established directly from documented laboratory testing.

This includes:

- helidecks supported by an individual laboratory friction test report prepared specifically for the installation during commissioning; and
- helidecks where the installed aluminium plank profile has been positively identified and is fully traceable to an approved laboratory friction test report.

For both categories, the laboratory-determined friction coefficient is considered directly applicable to the helideck. No further qualification or comparison with reference surfaces is required.

The helidecks included in Group A are listed in Table 4.1.

Installation	Group	Plank Type	Mu	Documentation Basis
Askeladden	A	353-B	0.70	NLR-CR-2017-241
Askepott	A	353-B	0.70	NLR-CR-2017-241
Edvard Grieg	A	353-B	0.70	NLR-CR-2017-241
Ekofisk 2/4 L	A	353-B	0.70	NLR-CR-2017-241
Eldfisk 2/7 S	A	353-B	0.70	NLR-CR-2017-241
Gina Krog	A	353-B	0.70	NLR-CR-2017-241
Gjøa	A	MA010	0.69	NLR-CR-2017-376
Goliat	A	MA015	0.68	NLR-CR-2018-148
Hanne Knutsen/Martin Linge B	A	MA005	0.69	NLR-CR-2017-167
Hod B	A	353-B	0.70	NLR-CR-2017-241
Ivar Aasen	A	353-B	0.70	NLR-CR-2017-241
Johan Sverdrup	A	353-B	0.70	NLR-CR-2017-241
Jotun A	A	353-B	0.70	NLR-CR-2017-241
Martin Linge	A	353-B	0.70	NLR-CR-2017-241
Valhall Flanke Nord	A	MA008	0.66	NLR-CR-2017-376
Valhall Flanke Sør	A	MA008	0.66	NLR-CR-2017-376
Valhall Flanke Vest	A	353-B	0.70	NLR-CR-2017-241
Valhall PH	A	MA010	0.69	NLR-CR-2017-376

Table 4.1

4.2 Group B – Helidecks with Indirect Friction Documentation

Group B comprises aluminium helidecks where the friction characteristics cannot be established directly from an installation-specific laboratory friction test report or from a positively identified laboratory-qualified plank profile.

For these helidecks, the friction coefficient has been established through indirect documentation based on documented traceability to laboratory-tested reference surfaces with equivalent surface geometry, manufacturing characteristics and friction mechanisms.

The reference surface assigned to each helideck has been selected following a technical assessment based on available drawings, photographs, manufacturer information, installation records and other relevant technical documentation. The assigned laboratory friction coefficient is therefore considered representative of the helideck's friction characteristics.

This methodology provides a consistent and technically justified basis for documenting the friction characteristics of legacy aluminium helidecks while avoiding unnecessary laboratory testing.

The aluminium helidecks included in Group B are listed in Table 4.2.

Installation	Group	Reference Plank Type	Mu	Documentation Basis
Alvheim	B	MA008	0.66	NLR-CR-2017-376
Balder	B	MA008	0.66	NLR-CR-2017-376
Draugen	B	MA008	0.66	NLR-CR-2017-376
Grane	B	MA008	0.66	NLR-CR-2017-376
Gudrun	B	353-B	0.70	NLR-CR-2017-241
Heidrun B	B	UNI10SK10-XE	0.71	NLR-CR-2023-146
Johan Castberg	B	UNI10SK10-XE	0.71	NLR-CR-2023-146
Jorunn Knutsen/Åsgard C	B	MA008	0.66	NLR-CR-2017-376
Kristin	B	MA008	0.66	NLR-CR-2017-376
Njord A	B	353-B	0.70	NLR-CR-2017-241
Njord B	B	MA008	0.66	NLR-CR-2017-376
Norne	B	MA008	0.66	NLR-CR-2017-376
Oseberg Sør	B	MA008	0.66	NLR-CR-2017-376
Skarv	B	MA008	0.66	NLR-CR-2017-376
Sleipner A	B	MA008	0.66	NLR-CR-2017-376

Installation	Group	Reference Plank Type	Mu	Documentation Basis
Sleipner B	B	MA008	0.66	NLR-CR-2017-376
Snorre A	B	MA008	0.66	NLR-CR-2017-376
Tambar	B	MA008	0.66	NLR-CR-2017-376
Valemon	B	UNI10SK10-XE	0.71	NLR-CR-2023-146
Visund	B	MA008	0.66	NLR-CR-2017-376
Åsgard A	B	MA008	0.66	NLR-CR-2017-376
Åsgard B	B	MA008	0.66	NLR-CR-2017-376
Ringhorne	B	MA008	0.66	NLR-CR-2017-376
Aasta Hansteen	B	UNI10SK10-XE	0.71	NLR-CR-2023-146

Table 4.2

4.3 Group C – Merlin-type Helidecks

Group C comprises legacy aluminium helidecks fitted with Merlin-type plank profiles. These helidecks represent a distinct family of aluminium helidecks employing friction mechanisms that differ from those used on other aluminium helideck designs.

Since representative laboratory friction documentation was not available for these helidecks, a dedicated laboratory assessment was performed using original Merlin planks representative of the installed helideck surface. The laboratory assessment established the technical basis for documenting the friction characteristics of Merlin-type helidecks.

The aluminium helidecks included in Group C are listed in Table 4.3.

Installation	Group	Plank Type	Mu	Documentation Basis
Brage	C	Merlin-Type	0.58	NLR-CR-2026-026
Ekofisk 2/4 K	C	Merlin-Type	0.58	NLR-CR-2026-026
Embla	C	Merlin-Type	0.58	NLR-CR-2026-026
Gullfaks A	C	Merlin-Type	0.58	NLR-CR-2026-026
Gullfaks B	C	Merlin-Type	0.58	NLR-CR-2026-026
Gullfaks C	C	Merlin-Type	0.58	NLR-CR-2026-026
Heidrun	C	Merlin-Type	0.58	NLR-CR-2026-026
Kvitebjørn	C	Merlin-Type	0.58	NLR-CR-2026-026
Oseberg A	C	Merlin-Type	0.58	NLR-CR-2026-026
Oseberg C	C	Merlin-Type	0.58	NLR-CR-2026-026
Oseberg Øst	C	Merlin-Type	0.58	NLR-CR-2026-026
Snorre B	C	Merlin-Type	0.58	NLR-CR-2026-026

Installation	Group	Plank Type	Mu	Documentation Basis
Troll A	C	Merlin-Type	0.58	NLR-CR-2026-026
Troll B	C	Merlin-Type	0.58	NLR-CR-2026-026
Troll C	C	Merlin-Type	0.58	NLR-CR-2026-026

Table 4.3

4.4 Representative Aluminium Plank Families

Representative examples of the aluminium plank profiles included in Groups A, B and C are shown below. The photographs illustrate the characteristic surface geometry and friction mechanisms used to identify the respective plank families. The images are intended as representative examples only and do not necessarily depict the exact helideck installed on each individual offshore installation.

The photographs support the classification methodology described in Sections 4.1 to 4.3 and illustrate the principal differences between the various plank families.

Figure 4.1 shows a typical extruded aluminium plank with a continuous longitudinal friction rib profile. The plank has been sling blasted to provide a micro-texture finish which enhances the friction coefficient.

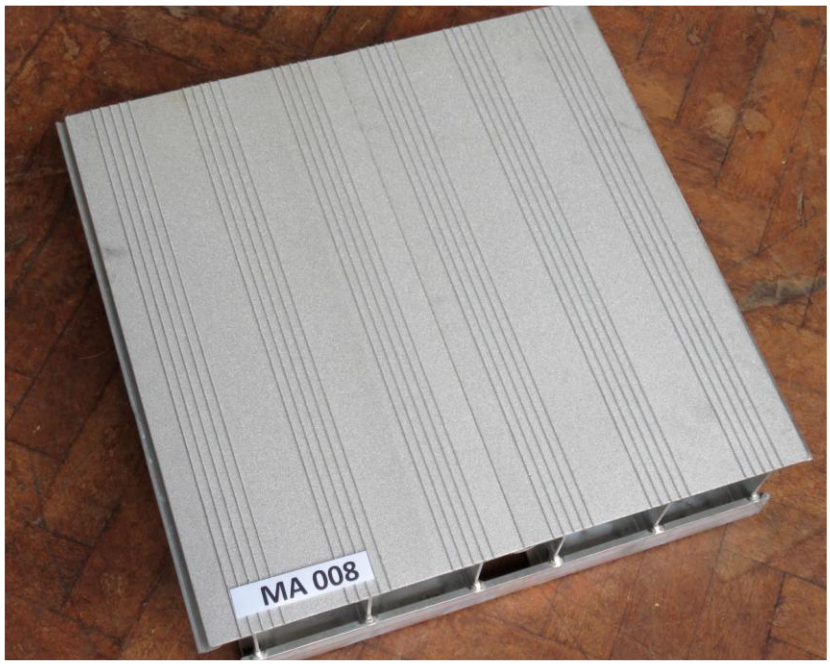


Figure 4.1

Figure 4.2 shows a typical extruded aluminium plank with longitudinal ribs and transverse machined interruptions. The plank has been sling blasted to provide a micro-texture finish which enhances the friction coefficient.

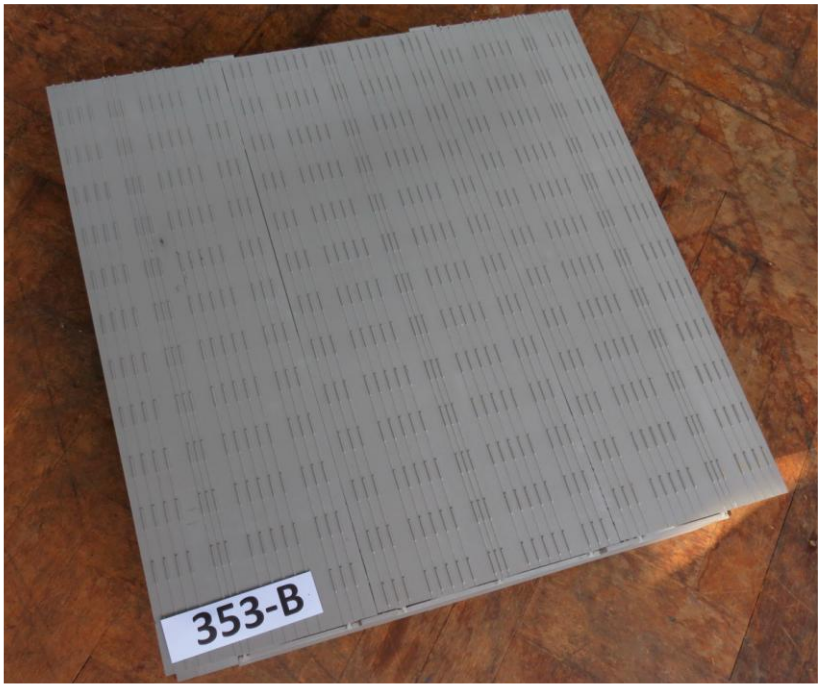


Figure 4.2

Figure 4.3 shows a typical extruded aluminium plank with longitudinal ribs, transverse machined interruptions, and drain holes.



Figure 4.3

Figure 4.4 shows a typical “Merlin-type” profile. This profile consists of extruded aluminium deck planks that have been provided with perforations and curved parts.

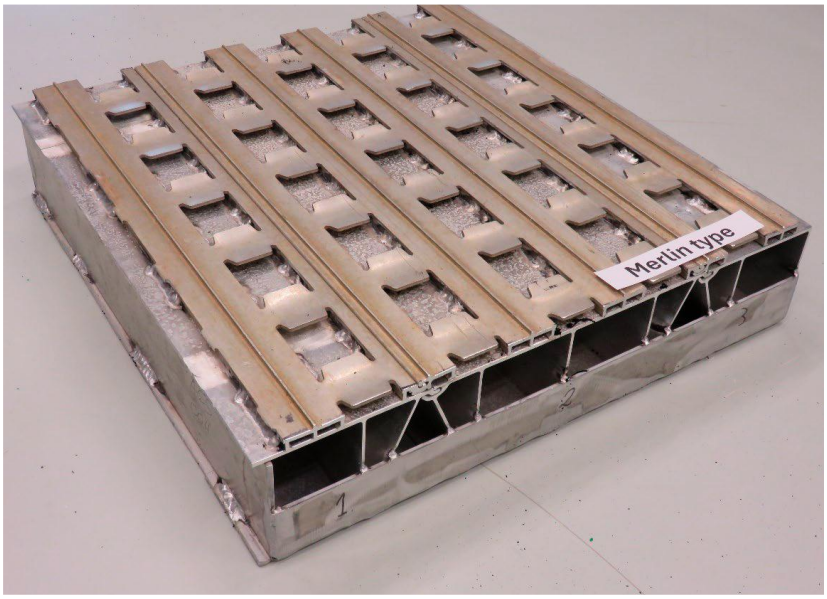


Figure 4.4

5. Documentation of Painted helidecks

Painted helidecks differ fundamentally from aluminium helidecks in that their friction characteristics cannot be determined from the surface design alone. Instead, the friction performance depends on the applied coating system, the anti-skid aggregate and the condition of the painted surface.

For this reason, painted helidecks are documented using a different methodology than aluminium helidecks and are classified as Group D.

5.1 Group D – Individually Documented Painted Helidecks

The friction characteristics of painted helidecks are established by field measurements using a harmonized portable friction tester. Since the friction performance depends on the actual condition of the painted surface, each helideck is documented individually.

To ensure consistency between installations, all field measurements are corrected using a harmonization factor determined from measurements performed on a laboratory-documented reference surface.

The harmonization procedure and offshore measurement methodology are described in Sections 5.2 and 5.3.

The painted helidecks included in Group D are listed in Table 5.1.

Installation	Group	Plank Type	Mu	Documentation Basis
Draupner	D	Painted	0.56	NLR-CR-2023-458
Eldfisk 2/7 B	D	Painted	0.63	NLR-CR-2023-458
Statfjord A	D	Painted	0.66	NLR-CR-2023-458
Statfjord B	D	Painted	0.65	NLR-CR-2023-458
Statfjord C	D	Painted	0.67	NLR-CR-2023-458
Ula	D	Painted	0.77	NLR-CR-2023-458
Yme	D	Painted	0.60	NLR-CR-2023-458

Table 5.1

5.2 Harmonization of the Portable Friction Testers

To ensure consistent and comparable friction measurements, the portable friction testers used for the offshore measurements were harmonized using a painted reference helideck with documented laboratory friction characteristics.

The reference helideck, located at the Aircontact Services facility, has previously been tested by Royal NLR under controlled laboratory conditions. The laboratory test report therefore provides a traceable reference for the friction characteristics of the painted surface.

Prior to the offshore measurement program, a portable friction tester was used to measure the reference helideck following the same measurement procedure intended for offshore use. The measured values and calculated friction coefficient were subsequently compared with the documented laboratory data, allowing a harmonization factor to be established.

The harmonization factor was applied to all subsequent offshore measurements to ensure that the documented friction values were consistent with the laboratory reference.

Figure 5.1 shows the painted reference helideck used for harmonization of the portable friction tester.

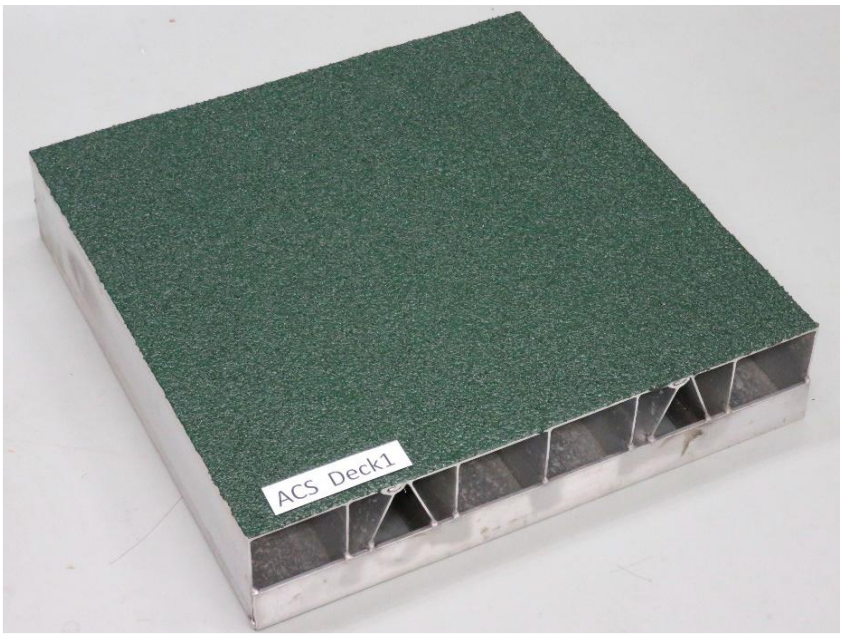


Figure 5.1

5.3 Offshore Friction Measurements

Friction measurements were performed on each painted helideck using a standardized measurement procedure.

The offshore measurements followed the general measurement procedure described in CAP 437. Multiple measurements were recorded across the operational landing area to provide a representative assessment of the helideck friction characteristics.

For each helideck, the recorded data set was evaluated to determine the average measured friction coefficient. The documented friction coefficient was then calculated by multiplying the average measured friction coefficient by the harmonization factor established in Section 5.2.

The documented friction coefficients for all painted helidecks included in Group D are presented in Table 5.1.

6. Assessment of Factors Affecting Helideck Friction

During the project, three surface features were identified as potentially influencing the friction characteristics of helidecks; helideck paint markings, fire-suppression perforations, and friction nets. All features are present on operational helidecks but are generally absent or only partially represented during laboratory testing of aluminium plank profiles. An assessment was therefore undertaken to determine whether these features have a significant practical effect on the documented friction coefficient.

6.1 Effect of Helideck Markings

Helideck markings are applied in accordance with applicable regulatory requirements and form part of the operational landing surface. Since the markings consist of paint containing anti-skid aggregate, they may influence the overall friction characteristics experienced by the helicopter.

Exposure to helicopter operations and environmental conditions causes the markings to deteriorate over time, requiring periodic repainting. The application of additional paint layers could potentially alter the effectiveness of the anti-skid aggregate and thereby influence the friction characteristics of the helideck.

Royal NLR was commissioned to evaluate the effect of additional paint layers on helideck friction (NLR-CR-2025-607). The results of this assessment were reviewed as part of the present project to determine whether repeated repainting has a measurable effect on the documented friction coefficient.

The test results showed an average variation in friction coefficient of approximately -0.02 between one and three paint layers. This variation is considered insignificant for the purpose of documenting helideck friction.

It is therefore concluded that the application of additional paint layers has no practical effect on the documented friction coefficient and does not require any adjustment of the friction values assigned in this report.

6.2 Fire-Suppression Perforations

Many modern aluminium helidecks incorporate perforations as part of the passive fire-suppression and drainage system. The perforations reduce the available contact area between the helicopter tyre and the landing surface and could therefore potentially influence the friction characteristics of the helideck.

Royal NLR has previously evaluated the influence of different perforation patterns on helideck friction (NLR-CR-2021-146). The results of this assessment were reviewed as part of the present project to determine whether perforations have a measurable influence on the documented friction coefficient.

The test results showed an average variation in friction coefficient of approximately ±0.01 between unperforated and perforated surfaces. This variation is considered insignificant for the purpose of documenting helideck friction.

It is therefore concluded that fire-suppression perforations have no practical effect on the documented friction coefficient and do not require any adjustment of the friction coefficient assigned in this report.

6.3 Friction Nets

The original purpose of friction nets was to enhance the grip of the helicopter tires on helidecks where the friction coefficient of the surface falls below the minimum requirement.

Within the scope of the present project, only five helidecks remain fitted with friction nets. All five are aluminium helidecks where the underlying deck surface incorporates dedicated friction features and has been assigned a documented friction coefficient in accordance with the methodology described in this report.

Royal NLR has previously investigated the effect of helideck friction nets on helicopter tyre friction (NLR-CR-2013-017). The study demonstrated that friction nets can increase the measured friction coefficient when installed on a smooth aluminium surface with low inherent friction. The test cases showed an increase in the friction coefficient of 0.07 to 0.25, depending on the position of the helicopter tyre relative to the net mesh. However, the study does not demonstrate that friction nets provide a practical or necessary contribution when the underlying helideck surface already has documented friction characteristics which satisfy the applicable requirements.

It is therefore concluded that, for the helidecks included in this project, the documented friction coefficient shall be based on the underlying aluminium helideck surface since the documented friction coefficients of the underlying aluminium helidecks exceed the minimum requirements. The presence of a friction net does not require adjustment of the documented friction coefficient.

6.4 Standardization of Anti-Skid Aggregate

During the course of this project, it became apparent that although NORSOK M-501 provides a standard for offshore coating systems and specifies the application method for anti-skid aggregate, it does not define the properties of the aggregate itself, such as particle size or application rate.

As a result, different aggregate types and application rates may be used on different offshore installations. In the absence of common specifications, the friction characteristics of applied helideck markings cannot be expected to be consistent across the Norwegian Continental Shelf.

The laboratory test program carried out as part of this project demonstrated that a helideck marking system incorporating anti-skid aggregate with a particle size of 1.4–2.0 mm, applied at a rate of 2.0 kg/m², achieved an average friction coefficient 0.71, well above the minimum requirements of 0.5 as defined in ACS-FR-2024-001.

The establishment of common specifications for anti-skid aggregate particle size and application rate would provide greater consistency in the friction characteristics of helideck markings and provide a common technical basis for future maintenance and repainting.

7. Conclusions

This project has established documented friction coefficients for offshore helidecks operated by the participating companies on the Norwegian Continental Shelf. The documented friction coefficients provide a common and technically justified basis for demonstrating compliance with the surface friction requirements of BSL D 5-1.

For aluminium helidecks, friction coefficients have been established either through direct laboratory friction documentation or through documented traceability to representative laboratory-tested reference surfaces. Legacy Merlin-type helidecks have been documented using a dedicated laboratory assessment of representative plank profiles.

For painted helidecks, friction coefficients have been established by harmonized field measurements using a portable friction tester referenced to a laboratory-documented painted helideck.

The project also assessed the influence of helideck markings, fire-suppression perforations and friction nets. Based on the available laboratory data, none of these features was found to have a significant practical effect on the assigned friction coefficients.

Appendix A – Reference Documentation

The following documents have been used as reference material in this project.

Document Title	Optional Info	Document Owner	Year of Issue
Research into helideck friction measurement with nets	NLR-CR-2013-017	CAA-UK	2014
Friction measurements on Marine Aluminium AS helicopter decks MA005, MA006 and MA007	NLR-CR-2017-167	Marine Aluminium	2017
Friction tests on Aluminium Offshore Pte Ltd helideck with designation 353-B	NLR-CR-2017-241	Aluminium Offshore Pte Ltd	2017
Friction measurements on Marine Aluminium AS helicopter decks MA008, MA009 and MA010	NLR-CR-2017-376	Marine Aluminium	2017
Friction measurements on Marine Aluminium AS helicopter deck MA011	NLR-CR-2018-148	Maritime Products AS	2018
Friction tests on Aluminium Offshore Pte Ltd helideck with designation UNI10SK10-XE	NLR-CR-2023-146		2023
Friction tests on a helideck for Aircontact Services	NLR-CR-2023-458	Aircontact Services	2023
Final Report Project Sklisikkerhet	ACS-FR-2024-001	Aircontact Services	2024
Friction tests on three painted helidecks for Aircontact Services AS	NLR-CR-2025-607	Aircontact Services	2025
Friction tests for Aircontact Services AS on a helideck with designation "Merlin type"	NLR-CR-2026-026	Aircontact Services	2026