Noise and vibration measurements of hand-held tools

Floatel Superior

Carried out for Floatel International

June 2023



WORLDWIDE REACH. HUMAN TOUCH.

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Summary

On the 21st – 24th of June 2023, International SOS conducted measurements of noise and vibration of handheld tools for Floatel International on Floatel Superior. The survey is part of Floatel International's continuous HSE-work.

The aims of these measurements were to map the level of exposure to noise and vibration when working with hand-held tools and to evaluate the results against action and limit values. The mapping should enable the recommendation of a maximum user time and the appropriate type of hearing protection for each of the assessed tools.

34 different tools were evaluated.

Noise and vibration measurements showed that:

- 2 of the tools have vibration levels above 20 m/s^2, meaning that the effective exposure time should not exceed 30 minutes each shift.
- 3 tools have a vibration level above 14 m/s^2, meaning that the effective exposure time should not exceed 1 hour each shift.
- 16 of the tools have high noise levels, 95 dB or above, meaning that double hearing protection is highly recommended for prolonged use.

The calculated allowable usage time for the different tools should be communicated to the staff and used as a basis when planning jobs that involve hand-held tools.

Further reference is made to the results in Chapter 4. A complete overview of the results, together with a calculation of allowed usage time for each tool, is presented in Appendix, Chapter 8.9.

A list of suggested measures are presented in Chapter 7.

In total there were:

- 0 deviations from regulations
- 0 deviation from recognized standards / guideline
- 6 improvement points

1. Background

International SOS (hereafter referred to as IntlSOS) is the occupational health service of Floatel International.

On request from Floatel International IntlSOS conducted measurements of noise and vibration from handheld tools on board Floatel Superior.

The purpose of the measurements was to map the level of exposure to noise and vibration when working with hand-held tools and to evaluate the results against action and limit values. The mapping should enable the recommendation of a maximum user time and the appropriate type of hearing protection for each of the assessed tools.

The measurements of noise and vibrations from hand-held tools are part of the employer's duty to map and risk assess the working environment, and is part of the company's systematic HSE work

Intl.SOS had previously conducted noise and vibration from handheld tools measurement (November/December 2022).

Occupational hygienist Knut Evjen was responsible for conducting the measurement and for reporting.

Before the survey, a Teams meeting was held on land with HSE Superintendent and Safety Officer/Security Officer for Floatel Superior. At the start of the survey offshore, a kick-off meeting was held on the rig with to ensure sufficient information, involvement and practical facilitation of the survey.

2 Methods

2.1 Measurement strategy

Work with hand-held tools were simulated in a way that most closely corresponds to the actual use on the Floatel Superior. Repairman, Bosun/Able Bodied Seaman/Crane Operator and Accommodation Technician simulated work tasks with relevant tools.

During this mapping noise and vibration measurements were carried out on 34 different tools.

The angle grinders were used on 5 mm steel plates fixed with a vice. Measurements were performed with cutting disc, grinding disc and steel brush. Drilling and screwing was performed on steel plate fixed with a vice, on steel plate and on a piece of wood. Sawing with jigsaw was performed on a piece of wood. Circular saw was measured while sawing wood, and the reciprocating saw on steel. Impact wrenches were measured when used on bolts, while the needle gun was measured while used on black steel.

The accelerometer was attached to the tool with cable ties where it is natural to hold the power tool. The measurements were performed in 3 orthogonal (perpendicular) directions, and equipment calculates a vector sum. Each measurement was performed for 20 seconds. A minimum of 3 measurements per working operation for both the trigger and support hand were conducted. In some cases, the operator used only one hand. The values from the hand with the highest vibration exposure were used for the calculation of the maximum usage time per 12-hour shift (daily dose).

The Sound Level Meter was held near the left ear of the operator during the work; and 3-6 measurements were conducted for each tool. Each measurement was performed for 20 seconds.

See appendix 8.2 for basic requirements; regulations/requirements relevant for the measurement strategy.

For detailed information about measurement equipment and calibrations relevant for the survey and detailed information regarding the measurements see appendix 8.3 and 8.9.

2.2 Tools assessed

Type of tool	Energy	Maker	Model
Drill	Battery	Milwaukee	M18DD2
Drill	Battery	HITACHI	14 DSL
Popnit	Battery	Dewault	POP MCS 5800
Popnit	Battery	Super POP	PB 2500
Reciprocating saw	Battery	DeWault	DSC 380
Angle Grinder	Air	Toku	TAG-50MLH

Type of tool	Energy	Maker	Model
Circular Saw	Electric	Festool	TS 55 EBQ
Edge routeredge miller	Electric	Festool	OFK 700 EQ
TruTool	Electric	Trumpf	C250
Angle grinder	Battery	DeWault	DCD 740
Combination Hammer	Electric	Metabo	KHE 56
Pneumatic Finish Nailer	Air	Paslode	FN1 1850.1
High pressure cleaner	Air	Oertzen	E 320
High pressure cleaner	Electric	Nilfisk	MC 5M
Impact Wrench	Air	Ingersol Rand	Unknown
Saw	Air	Unknown	Unknown
Chipping Hammer	Air	Yokota	F25
Angle Grinder	Air	Luna	AAG 115
Tiger saw	Electric	Makita	JR3070CT
Angle Grinder	Electric	BOSCH	GWS 22-180 LVI
Drill	Battery	Milwaukee	M18 ONEDD2
Impact Wrench	Air	Universal	UT 8326
Impact Wrench	Battery	Makita	TW 0350
Angle Grinder	Air	LUNA	Unknown
Drill	Battery	Milwaukee	M18 FDD2-OX
Drill	Battery	HITACHI	DS 14DSL
Rotating file	Battery	BOSCH	GGS 28CE
Angel grinder	Electric	FERAX	BAG-900
Saw	Air	LUNA	Unknown
Drill	Air	LUNA	AD-13 QC / 26-40
Angle grinder	Air	Ingersol Rand	Unknown

Type of tool	Energy	Maker	Model
Drill	Electric	Metabo	UHE 28 Multi
Needle Gun	Air	Mannesmann	Demage GNV19
Needle Scaler	Air	Red Rooster Industrial	RRI-4600
Jig Saw	Electric	HITACHI	CJ 90VST
Needle Gun (Large)	Air	Unknown	Unknown
Impact Wrench	Battery	Makita	BTW251

Table 2.2. List of tools assessed

3 Conditions during measurements

3.1 Technical and operation data

Floatel Superior is an accommodation and construction support vessel. The personnel duties normally include operational and maintenance work, and during this work the use of hand-held tools occurs regularly.

3.2 Weather conditions

The measurements were carried out in the Welders workshop and the Deck Workshop. Wind will not have affected the measurements as doors to both workshops were closed during measurements.

3.3 Preventative measures

3.3.1 Technical measures

Maintenance program keeping the handheld tools in normal function and minimizing the risk of extreme vibration levels due to malfunction of tools.

3.3.2 Organizational measures

Job rotation is practiced to some extent for the deck crew, reducing prolonged work with tools having very high noise or vibration levels.

3.3.3 Personal protective equipment

The Floatel International staff at the Floatel Superior have access to, and use, hearing protector 3M PELTOR Standard Two-way Communication EX Headsets with built-in radio, which has an SNR-value of 33 dB. In addition, ear plugs of various sizes are available.

4 Results

Results from the noise- and vibration measurements are presented below in table 4.1.

See also chapter 8.9, where the results are presented together with maximum usage time according to action values and limit values for the respective tool/operation during a 12-hour shift (daily dose).

Please note that if an operator uses more than one tool on the same day, the usage time per tool will have to be reduced so that the overall usage time is kept within the action and limit values. Also note that the effective, real usage time (trigger time) is given, not the operation time/time estimated in a work order for the task.

Type of tool	Source Energy	Brand	Model	Measurement setup	Vibration level Trigger hand	Vibration level Support hand	Noise level (dBA)
Drill	Battery	Milwaukee	M18DD2	Drilling into wood	3.4		77
Drill	Battery	HITACHI	14 DSL	Drilling into wood	4.8		81
Popnit	Battery	DeWalt	POP MCS 5800	Rivets in plate	0.6		71
Popnit	Battery	Super POP	PB 2500	Rivets in plate	0.6		77
Reciprocating saw	Battery	DeWault	DSC 380	Sawing on piece of wood	33.3	32.0	94/95
Circular Saw	Electric	Festool	TS 55 EBQ	Sawing on piece of wood	3.4		96
Edge routeredge miller	Electric	Festool	OFK 700 EQ	Used on wood	3.6		102
TruTool	Electric	Trumpf	C250	Cutting/clipped metal plate	4.0		91
Angle grinder	Battery	DeWault	DCD 740	Screwing screws into a piece of wood	1.9		84
Combination Hammer	Electric	Metabo	KHE 56	Was not used during this survey. Used previously conducted measurements, June 2015.	22.7	12.2	108

Type of tool	Source Energy	Brand	Model	Measurement setup	Vibration level Trigger hand	Vibration level Support hand	Noise level (dBA)
Pneumatic Finish Nailer	Air	Paslode	FN1 1850.1	Was not used during this survey. Used previously conducted measurements, June 2015.	5.3		87
High pressure cleaner	Air	Oertzen	E 320	High-pressure cleaning, open deck	3.5	2.9	85/84
High pressure cleaner	Electric	Nilfisk	MC 5M	High-pressure cleaning, open deck	2.5		88
Impact Wrench	Air	Ingersol Rand	Unknown	Used on bolt – Fixed in a vice	12		102
Saw	Air	Unknown	Unknown	Sawing on black steel	6.2		95
Chipping Hammer	Air	Yokota	F25	Used on black steel	32.2		112
Angle Grinder with wire brush	Air	Luna	AAG 115	Used on black steel	15.1	16.2	95/93
Tiger saw	Electric	Makita	JR3070CT	Sawing on black steel	23.7		91
Angle Grinder with cutting disc	Electric	BOSCH	GWS 22-180 LVI	Used on black steel	9.5	9.4	101/ 100
Drill	Battery	Milwaukee	M18 ONEDD2	Drilling into black steel	3.0		89
Impact Wrench	Air	Universal	UT 8326	Used on bolt – Fixed in a vice	11.3		106
Impact Wrench	Battery	Makita	TW 0350	Used on bolt – Fixed in a vice	16.9		110
Angle Grinder with wire brush	Air	LUNA	Unknown	Used on black steel	9.4		89
Drill	Battery	Milwaukee	M18 FDD2-OX	Drilling into wood	4.1		84

Type of tool	Source Energy	Brand	Model	Measurement setup	Vibration level Trigger hand	Vibration level Support hand	Noise level (dBA)
Drill	Battery	HITACHI	DS 14DSL	Drilling into wood	3.6		84
Rotating file	Battery	BOSCH	GGS 28CE	Grinding/ sanding on black steel plate	7.1		73
Angel grinder with cutting disc	Electric	FERAX	BAG-900	Used on black steel	10.1	16.3	105/ 105
Saw	Air	LUNA	Unknown	Sawing on black steel	21.3		93
Drill	Air	LUNA	AD-13 QC / 26-40	Drilling into black steel	3.6		88
Angle grinder with wire brush	Air	Ingersol Rand	Unknown	Used on black steel	6.7	15.0	82/83
Drill	Electric	Metabo	UHE 28 Multi	Drilling into black steel	6.2		89
Needle Gun	Air	Mannes-mann	Demage GNV19	Was not used during this survey. Used previously conducted measurements, June 2015. Used on black steel	5.0		105
Needle Scaler	Air	Red Rooster Industrial	RRI-4600	Used on black steel	19.2		112
Jig Saw	Electric	HITACHI	CJ 90VST	Sawing on piece of wood	3.9		88/83
Needle Gun (Large)	Air	Unknown	Unknown	Used on black steel	4.6	4.4	109/ 110
Impact Wrench	Battery	Makita	BTW251	Used on bolt – Fixed in a vice	10.8		102

Table 4.1. Results from noise- and vibrations measurements of hand held tools on Floatel Superior

5 Evaluation of results

Several of the assessed tools have vibrations and noise levels which will require restrictions on their usage during a 12-hour shift. Refer to Chapter 8.9 for a complete list of the measured noise and vibration values, which include time limits applicable for each tool.

Vibration measurements showed that:

- 5 tools had vibration levels above 20 m/s^2, limiting the use to less than 30 minutes per shift
- 3 tools had vibration levels above 14 m/s^2, limiting the use to less than 1 hour per shift
- 3 tools had vibration levels above 10 m/s^2, limiting the use to less than 2 hours per shift
- 7 of the tools had vibration levels above 5 m/s^2, limiting the use to less than 8 hours per shift
- 16 of the tools had vibration levels below 5 m/s^2, in practice providing no restrictions for use with regards to vibration exposure.

The noise measurements showed that:

- 2 of the tools will have restricted use of less than 1 hour, even if the recommended use of double hearing protection is adhered to
- 4 of the tools will have restricted use of less than 8 hours, even if the recommended use of double hearing protection is adhered to
- 16 of the tools had noise levels exceeding 95 dBA, and the use of double hearing protection is highly recommended
- 16 of the tools had a noise level above 80 dBA, and the use of single hearing protection is required
- 4 of the tools had a noise level of below 80 dBA.

6 Conclusion

Thirty-four different tools were evaluated. Noise and vibration measurements showed that several of the tools have high vibration levels, above 14 m/s^2, meaning that the effective exposure time should not exceed one hour per shift. Sixteen of the tools have high noise levels, 95 dB or above, meaning that double hearing protection is highly recommended for prolonged use.

For the majority of the tools, the vibration level is the limiting factor regarding both action value and limit value for allowable use. This presumes use of double hearing protection for noise levels above 95 dB. The last two columns in the table in appendix 8.9, table 8.9.2 show which operating times must be kept within at the noise and vibration levels that were measured for the work operations in question to comply with action values and limit values. Limit values must not be exceeded. The action values can be exceeded, but this entails an obligation to carry out measures to reduce the exposure to a minimum, such as effective rotation of employees carrying out tasks and time restrictions.

It is important to take into account that if several tools are used on the same day, each of these tools will contribute to the overall vibration and noise exposure. The permitted run time will then be lower for each of the tools than when these are used alone during a shift. Furthermore, the area noise where the work takes place affects noise exposure and must therefore also be taken into account when calculating total noise exposure over an entire shift.

7 Suggested measures

The noted observations listed in the below table will either be deviations from regulations, deviations from recognized guidelines and standards, or improvement points. The categorisation of observations into deviations and improvement points, is based on International SOS's interpretation of the regulations, experience transfer based previous inspection reports by the Petroleum Safety Authority Norway, as well as academic discretion. Deviations and improvement points may be corrected by implementing proposed measures. Measures to reduce exposure at source should be prioritized. Personal protective equipment is the last barrier after all technical and organizational measures have been considered.

Risk classification has been performed on the basis that deviations from regulations are always considered as first priority (Risk classification 1). Furthermore, we use assessment criteria from Kokstadmetoden®, the precautionary principle and professional judgment as a basis for risk classifying other observations as second or third priority (Risk classification 2 or 3). The customer is free to change these priorities, as well as set deadlines for handling these.

It was found in total:

• 0 deviations from regulations

• 0 deviation from recognized standards / guidelines

• 6 improvement points

Risk Classification 1	1	Deviations from regulations
Risk Classification 2	2A	Deviation from recognized guidelines and standards.
	2F	Improvement points that will significantly improve the working environment.
Risk Classification 3	3A	Deviations from recognized guidelines and standards, of less importance.
	3F	Improvement points that will to some extent improve the working environment.

1. TECHNICAL MEASURES				
No	**Description**	**Suggested measures**	**Reference**	**Risk class.**
1.1	**Vibration and noise** Good maintenance of tools helps keep noise and vibration levels as low as possible.	Maintain best practice routines for the maintenance of the tools, and replacement of interchangeable parts like grinding and cutting discs, saw blade, steel brushes.	• AR §§ 38 and 39 • ROME §§ 10 -1a), b) and d), 10-4	3F

2. ORGANISATIONAL MEASURES				
No	**Description**	**Suggested measures**	**Reference**	**Risk class.**
2.1	**Vibration and noise** High noise and vibration levels were measured for several hand-held tools.	Establish and implement a procedure of organisational measures which limits the maximum user time in accordance with measurement results and recommendations in this report. See appendix 8.9, table 8.9.2.	• AR §§ 38 and 39 • RAL §§ 3-1,3-2 • PW §§ 14-8, 14-9	2F
2.2	**Vibration and noise** Appropriate organisational measures help keeping both noise and vibration level as low as possible by removing/avoiding tools with particularly high vibration levels.	Primarily use the tools with the lowest noise and vibration level when possible. Use other working methods/tools that will cause reduced noise and vibration exposure, if possible. Choose the tool with the lowest noise and vibration exposure levels whenever this is possible when purchasing. Label tools according to risk group defined in this report and include maximum usage time on the label.	• AR §§ 38 and 39 • RAL §§ 3-1 and 3-2	2F

3. PERSONAL PROTECTIVE EQUIPMENT				
No	**Description**	**Suggested measures**	**Reference**	**Risk class.**
3.1	**Noise** Several of the tools generate noise above 95 dB.	For extended operations (more than 10 minutes), use double hearing protection when noise levels for the tools are above 95 dB. See Appendix 8.9, table 8.9.2 for recommendations.	• AR § 38 • Offshore Norge No. 114	2F
3.2	**Noise** Most of the tools generate noise above 80 dB.	Use single hearing protection when noise levels are above 80 dB. See Appendix 8.9, table 2 for recommendations.	• AR § 38 • Offshore Norge No. 114	2F

4. TRAINING				
No	**Description**	**Suggested measures**	**Reference**	**Risk Class.**
4.1	It is important that the staff is familiar with the vibration and noise level from the various handheld tools they use.	Present noise and vibration results from this report to employees. Makes information about noise and vibration levels, as well as operating times and use of single / double hearing protection easily accessible to employee.	• AR § 44	2F

8 Appendix

8.1 Abbreviations and definitions

The followings set of abbreviations and definitions are used in this report.

Abbreviation	Explanation
Action value	An exposure value that requires measures to be implemented in order to reduce the health risk and unfortunate exposure to a minimum.
AR	Activity regulations
Limit value	An exposure value that must not be exceeded
	Offshore Norge
PW	Regulation Concerning the Performance of Work
RAL	Regulations concerning Action and Limit Values
ROME	Regulations Concerning Organisation, Management and Employee Participation

8.2 Basic requirements for measurement strategy

The noise measurements are performed according to the Norwegian standard NS 4814:2007 “Acoustics- Measurement of occupational noise exposure of workers- Area noise measurements and preparation of noise contour line maps”.

The vibration measurements are performed according to the International standards from 2001 ISO 5349-1 Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration —Part 1: General requirements” and ISO 5349-2 “Mechanical vibration -- Measurement and evaluation of human exposure to hand-transmitted vibration -- Part 2: Practical guidance for measurement at the workplace”.

The results are compared to action values and limit values for noise and vibration exposure, and a maximum usage time for each of the tools are calculated. The noise measurements form the basis of recommendations of type of hearing protectors; if the usage time must be restricted due to high noise level, even when considering the effect of the use of hearing protection, this will be noted.

When assessing the results from the survey, the 90th percentile is used for assessing the vibration level, and a calculation of the expected sound pressure taken from NS 4815-1 2006 when assessing the noise level for each tool

8.3 Measurement equipment

Noise levels were measured with Norsonic Sound Level Meter type 131. Calibration is carried out every second year according to the requirements in NS 4814. The Sound Level Meter is calibrated before the measurements, and this calibration is verified after the measurements. If the noise level after the measurements have been performed deviates more than 0.5 dB the measurement result must be discarded. No results were discarded due to this criterion. The calibrator Norsonic Calibrator type 1251 is calibrated annually and fulfils the requirements in NEK EN 60942. The noise level meter and calibrator were calibrated on 21.11.2022 and 23.09.2022 respectively.

The vibration measurements were performed with Norsonic 136 vibration meter. The module contains a network to perform measurements according to ISO 8041 with weighing filter according to ISO 5349 in the frequency range 8 - 1000 Hz. The vibration meter and the accelerometer were last calibrated on 15.03.22. This equipment is calibrated every second year.

8.4 Measurement uncertainty, sources of error and variation

Each tool has been assessed using a set up that correspond to reported typical use. However, one cannot rule out that both noise and vibration levels in some situation may differ from the results provided in this report. Factors which contribute to variations in noise and vibration levels include:

- The surface the tool is used on
- The speed/effect selected on the tool
- How the tool is used (the grip on the tool and the power that is being used)
- The wear and tear on blade/slice/drill etc.
- Wear and tear on tool/lack of maintenance
- Training in the proper use of tools
- Background noise and contribution from the room/ acoustics in the room where the tools are used

8.5 Noise attenuation of hearing protection

In this report, the results are presented as noise levels both outside and within the hearing protection. It is the noise level outside the hearing protection that was actually measured during the monitoring; the estimated effect of hearing protectors is based on the type of hearing protection is used, the corporate and the installation-specific requirements to the use of hearing protection, the guidelines from Offshore Norge ("Recommended guidelines for the management of hearing harmful noise", nr 114 2014), as well as information and observations during the survey.

A single set of hearing protectors are given a conservative noise reduction effect of 12 dB, while double hearing protection provides a noise reduction effect of 18 dB.

8.6 Regulations and guidelines

In general

The Management Regulations (Styringsforskriften) §§ 16-18 requires that risk analyses are conducted to provide a basis for decisions regarding health, environment, and safety.

Noise

The Facilities Regulations (Innretningsforskriften) § 23 on noise and acoustics states that; "Facilities shall be designed so that no employees are exposed to noise that is harmful to hearing. Limit values for hazardous noise are; for daily noise exposure, LEX12h = 83 dB and for peak sound pressure level, LpC,peak = 130 dB."

The Activities Regulations (Aktivitetsforskriften) § 38 has introduced an exposure action value for 12 hours of exposure that is 80 dB. If the action value is exceeded, risk-reducing measures should be considered. The limit value is 83 dB for 12-hour exposure.

The employer must ensure that employees and safety delegates receive information and training regarding relevant risks in connection with noise, if they are exposed to noise equal to or exceeding 80 dB over 12 hours or a peak of 130 dBC.

A single hearing protection is traditionally given a conservative estimated efficacy of 12 dB, while double hearing protection gives a deduction of 18 dB (ref. Norwegian Oil and Gas Association; Recommended guidelines for handling hazardous noise, No. 114 2012). The efficacy of hearing protection will depend on whether the hearing protection is used consistently, and if the user often removes one or both protectors to facilitate communication. There will also be individual differences depending on customization, fit and maintenance of hearing protectors.

Vibrations

The Facilities Regulations § 24 states that facilities shall be designed so that vibrations do not harm personnel at the facility or make it difficult for personnel to carry out important tasks.

Action- and limit values have been established by the Norwegian Labour Inspection Authority:

- The action value is 2.5 m/s^2 for hand-arm vibrations, standardised to a 8-hour working day. The value can be legally exceed but regular exceedance of this value will require measures to reduce exposure
- The limit value is 5 m/s^2 for hand-arm vibrations, standardised to a 8-hour working day. The limit value is an absolute value, and shall not be exceed

The allowed dose of vibration exposure is dependent on the length of the working day, and the time to reach the applicable action- and limit values are therefore the same for a 12-hour and an 8-hour working day.

8.7 Health effects

Noise

Noise can give short-term and permanent hearing loss also in addition to tinnitus. According to Arbeidstilsynets yearly report for 2020, hearing loss represents 45 % of the total reported registered work-related illnesses. In “Faktabok om arbeidsmiljø og helse 2021” from Statens Arbeidsmiljøinstitutt we find that 235,000 employees in Norway reported to be exposed to high noise levels in their daily work in 2019. This is 9% of the total work force. In addition to damage to the hearing like hearing loss and tinnitus, it has been reported that noise can cause stress and stress-related ailments such as cardiovascular diseases, gastrointestinal disorders, sleep disorders and reduced ability to concentrate. Noise in combination with the ototoxic chemicals (e.g. styrene, ethylbenzene and toluene) can worsen the noise-induced damage.

Vibrations

Hand-arm vibrations are mechanical vibrations transmitted from the working equipment to hand and/or arm and entails the risk of damage to the blood vessels, skeleton, joints, nerves or muscles. Acute effects can be impaired blood flow, decreased feeling with possibly decreased fine motor skills and increased muscle activation (tingling in the fingers). The time it takes before the normal sense is restored varies with exposure time and vibration level, but 10-30 min is common. Prolonged exposure can lead to chronic effects, permanent damage to the blood vessels, nerves, muscles and joints.

One should also be aware that cold can worsen the health effects of vibration, and workers should protect themselves with warm gloves when it's cold. Nicotine, in the same way that the cold, will cause narrowing of the small blood vessels and one should therefore also avoid nicotine use before and during vibration exposure.

Vibration exposure should be reduced as far as possible, and this is not limited to levels that exceed the action value. Individual circumstances, simultaneously exposure to other factors (for example solvents) or previous injuries can lead to health damage at lower exposure than the action value.

8.8 References

- The Petroleum Act
- Working Environment Act
- The Framework Regulations
- The Management Regulations
- The Activities Regulations
- The Facilities Regulations
- Regulations concerning Organization, Management and Employee Participation
- Regulations concerning the Performance of Work
- Regulations concerning Action and Limit values

- NORSOK Standard, S-002 Rev. 4, august 2004
- Norwegian Standard (NS) 4814
- Norwegian Standard (NS) 4815-1
- NS-EN ISO 5349-1 and NS-EN 5349-2
- Offshore Norge guideline No 114; Recommended guidelines for handling hazardous noise

8.9 Detailed results

The table in Appendix 8.9 displays an overview of the results from each of the tools that were considered during this mapping. In addition, the calculated maximum usage time to be within the action limit values for noise and exposure limit values for vibration are presented based on these results.

A colour scale is used to visualise shorter and longer usage time; short usage time is highlighted in blue or red, medium usage time in yellow, and longer usage time with green colour.

Violet: Risk Group 5	A risk assessment must be performed! Usage time is less than 30 minutes. A risk evaluation should be performed to ensure that the planned task will not exceed the stated usage time.
Red: Risk Group 4	30-minute limitation with no risk assessment! If a "red" tool is used during a shift, the time hand held tools may be used on the same shift is limited to 30 minutes in total. For use of handheld tools exceeding 30 minutes, a risk evaluation should be performed to ensure that the planned task will not exceed the stated usage time.
Orange: Risk Group 3	1-hour limitation with no risk assessment! If a "orange" tool is used during a shift, the time hand held tools may be used on the same shift is limited to 1 hour in total. For use of handheld tools exceeding 1 hour, a risk evaluation should be performed to ensure that the planned task will not exceed the stated usage time.
Yellow: Risk Group 2	2-hour limitation with no risk assessment! If a "yellow" tool is used during a shift, the time hand held tools may be used on the same shift is limited to 2 hours in total. For use of handheld tools exceeding 2 hours, a risk evaluation should be performed to ensure that the planned task will not exceed the stated usage time.
Green: Risk Group 1	The tool can be used without limitations with regards to vibrations. Tools with a "green" tag are to be included in risk evaluation when the vibration and noise exposure from more than one tools are performed.

Tabell 8.9.1 Risk groups for HAV with description of action needed within each group.

Depart-ment	Type of tool	Brand	Model	Vibration level (m/s^2)	Max usage time Action value [2,5 m/s^2] (h:min)	Max usage time Limit value [5 m/s^2] (h:min)	Noise level (dBA)	Required hearing protection	Usage time w/hearing protection Action vvalue [80 dBA] (h:min)	Usage time w/hearing protection Limit value [83 dBA] (h:min)	Usage time Action value (h:min)	Usage time Limit value (h:min)
Accommodation Technician	Drill	Milwaukee	M18DD2	3.4	04:20	>12	77	Single	>12	>12	04:20	>12
Accommodation Technician	Drill	HITACHI	14 DSL	4.8	02:10	08:41	81	Single	>12	>12	02:10	08:41
Accommodation Technician	Popnit	DeWalt	POP MCS 5800	0.6	>12	>12	71	Single	>12	>12	>12	>12
Accommodation Technician	Popnit	Super POP	PB 2500	0.6	>12	>12	77	Single	>12	>12	>12	>12
Accommodation Technician	Recipro-cating saw	DeWault	DSC 380	33.3	00:03	00:11	95	Double	>12	>12	00:03	00:11
Accommodation Technician	Circular Saw	Festool	TS 55 EBQ	3.4	04:20	>12	96	Double	>12	>12	04:20	>12
Accommodation Technician	Edge routeredg e miller	Festool	OFK 700 EQ	3.6	03:51	>12	102	Double	04:47	09:31	03:51	09:31[2]
Accommodation Technician	TruTool	Trumpf	C250	4.0	03:08	>12	91	Single	>12	>12	03:08	>12
Accommodation Technician	Angle grinder	DeWault	DCD 740	1.9	>12	>12	84	Single	>12	>12	>12	>12

Depart-ment	Type of tool	Brand	Model	Vibration level (m/s^2)	Max usage time Action value [2,5 m/s^2] (h:min)	Max usage time Limit value [5 m/s^2] (h:min)	Noise level (dBA)	Required hearing protection	Usage time w/hearing protection Action vvalue [80 dBA] (h:min)	Usage time w/hearing protection Limit value [83 dBA] (h:min)	Usage time Action value (h:min)	Usage time Limit value (h:min)
Accommodation Technician	Combi-nation Hammer	Metabo	KHE 56	22.7	00:06	00:23	108	Double	01:12	02:24	00:06	00:23
Accommodation Technician	Pneu-matic Finish Nailer	Paslode	FN1 1850.1	5.3	01:47	07:07	87	Single	>12	>12	01:47	07:07
Marine	High pressure cleaner	Oertzen	E 320	3.5	04:05	>12	85	Single	>12	>12	04:05	>12
Marine	High pressure cleaner	Nilfisk	MC 5M	2.5	08:00	>12	88	Single	>12	>12	08:00	>12
Marine	Needle Gun	Mannes-mann	Demage GNV19	5.0	02:00	08:00	105	Double	02:23	04:47	02:00	08:00
Marine	Needle Scaler	Red Rooster Industrial	RRI-4600	19.2	00:08	00:30	112	Double	00:29	00:57	00:08	00:30
Marine	Jig Saw	HITACHI	CJ 90VST	3.9	03:17	>12	88	Single	>12	>12	03:17	>12
Marine	Needle Gun (Large)	Unknown	Unknown	4.6	02:22	09:27	110	Double	00:45	01:36	00:45[1]	01:36[1]

Depart-ment	Type of tool	Brand	Model	Vibration level (m/s^2)	Max usage time Action value [2,5 m/s^2] (h:min)	Max usage time Limit value [5 m/s^2] (h:min)	Noise level (dBA)	Required hearing protection	Usage time w/hearing protection Action vvalue [80 dBA] (h:min)	Usage time w/hearing protection Limit value [83 dBA] (h:min)	Usage time Action value (h:min)	Usage time Limit value (h:min)
Marine	Impact Wrench	Makita	BTW251	10.8	0:26	01:43	102	Double	04:46	09:31	0:26	01:43
Marine	Saw	Unknown	Unknown	6.2	01:18	05:12	95	Double	>12	>12	01:18	05:12
Technical	Impact Wrench	Ingersol Rand	Unknown	12	00:21	01:23	102	Double	04:46	09:31	00:21	01:23
Technical	Chipping Hammer	Yokota	F25	32.2	00:03	00:12	112	Double	00:29	00:57	00:03	00:12
Technical	Angle Grinder	Luna	AAG 115	16.2	00:11	00:46	95	Double	>12	>12	00:11	00:46
Technical	Tiger saw	Makita	JR3070CT	23.7	00:05	00:21	91	Single	>12	> 12	00:05	00:21
Technical	Angle Grinder	BOSCH	GWS 22-180 LVI	9.5	00:33	02:13	101	Double	06:00	12	00:33	02:13
Technical	Drill	Milwaukee	M18 ONEDD2	3.0	05:33	>12	89	Single	>12	> 12	05:33	>12
Technical	Impact Wrench	Universal	UT 8326	11.3	00:23	01:34	106	Double	01:54	03:48	00:23	01:34
Technical	Impact Wrench	Makita	TW 0350	16.9	00:11	00:42	110	Double	00:45	01:36	00:11	00:42
Technical	Grinder	LUNA	Unknown	9.4	00:34	02:16	89	Single	>12	>12	00:34	02:16

Depart-ment	Type of tool	Brand	Model	Vibration level (m/s^2)	Max usage time Action value [2,5 m/s^2] (h:min)	Max usage time Limit value [5 m/s^2] (h:min)	Noise level (dBA)	Required hearing protection	Usage time w/hearing protection Action vvalue [80 dBA] (h:min)	Usage time w/hearing protection Limit value [83 dBA] (h:min)	Usage time Action value (h:min)	Usage time Limit value (h:min)
Technical	Drill	Milwaukee	M18 FDD2-OX	4.1	02:58	>12	84	Single	>12	>12	02:58	>12
Technical	Drill	HITACHI	DS 14DSL	3.6	03:51	>12	84	Single	>12	>12	03:51	>12
Technical	Rotating file	BOSCH	GGS 28CE	7.1	01:00	03:58	73	Single	>12	>12	01:00	03:58
Technical	Angel grinder	FERAX	BAG-900	10.1	00:29	01:58	105	Double	02:23	04:47	00:29	01:58
Technical	Saw	LUNA	Unknown	21.3	00:07	00:26	93	Single	>12	>12	00:07	00:26
Technical	Drill	LUNA	AD-13 QC / 26-40	3.6	03:51	>12	88	Single	>12	>12	03:51	>12
Technical	Angle Grinder	Ingersol Rand	Unknown	6.7	01:07	04:27	83	Single	>12	>12	01:07	04:27
Technical	Drill	Metabo	UHE 28 Multi	6.2	01:18	05:12	89	Single	>12	>12	01:18	05:12

Table 8.9.2. Results from noise and vibration measurements of hand-held tools used by Floatel Superior

[1]Note that here it is the noise level that is the limiting factor with regard to both action value and limit value

[2]Note that here it is the noise level that is the limiting factor with regard to limit value

[3]Note that Risk Group 5 is violet in this report, in previously report (2018) Risk Group 5 is black