



CLEVE HILL SOLAR PARK

RESPONSES TO THE EXA'S WRITTEN QUESTIONS - APPENDICES **Appendix 6 – Arna Wood Solar Farm Piling Noise Investigation**

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SOLAR PARK



ARCUS

**ARNA WOOD SOLAR FARM
PILING NOISE INVESTIGATION**

FEBRUARY 2017



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1 INTRODUCTION

Arcus Consultancy Services (Arcus) was commissioned by Canadian Solar to undertake an assessment of noise impacts associated with piling works at Arna Wood Solar Farm ('the Development'), situated in Aldcliffe, Lancaster.

The aim of this report is to determine the level of noise associated with the piling works, assess these noise levels against appropriate criteria for the disturbance of wading birds using the nearby Morecombe Bay Special Protection Area (SPA), and propose appropriate mitigation to minimise the level of impact.

2 OVERVIEW

Arna Wood Solar Farm was approved by Lancaster City Council in June 2015 (application number 14/00907/FUL), and is currently under construction. In 2015, Natural England (NE) agreed that no significant impacts were anticipated with regard to Morecombe Bay SPA, providing works were not undertaken during the winter months. However, as works are currently ongoing, NE has asked that all site works are stopped until an appropriate assessment has been undertaken, and an appropriate mitigation scheme agreed.

Based upon experience of the works undertaken to date, it is understood that noise due to piling operations is considered to have the greatest level of impact, and is the primary concern of NE. As such, providing noise from piling can be successfully mitigated, and that noise from other site operations is minimised through the application of general best-practice methods, it is considered that winter working would be acceptable.

3 GUIDANCE

A literature review has been undertaken to inform the determination of appropriate assessment criteria. The following sources are considered most pertinent to this assessment:

- Construction and Waterfowl: Defining Sensitivity, Response, Impacts and Guidance¹;
- Exploring Behavioural Responses of Shorebirds to Impulsive Noise²; and
- BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites³.

3.1 Construction and Waterfowl: Defining Sensitivity, Response, Impacts and Guidance

The aim of this study was to develop a tool to inform decision-makers when assessing the suitability of a given development in the Humber Estuary.

A detailed literature review and data analysis was undertaken with regard to noise disturbance effects to avifauna, and in particular, construction effects to waterfowl, and suitable sensitivity criteria were then established based upon the findings of this work.

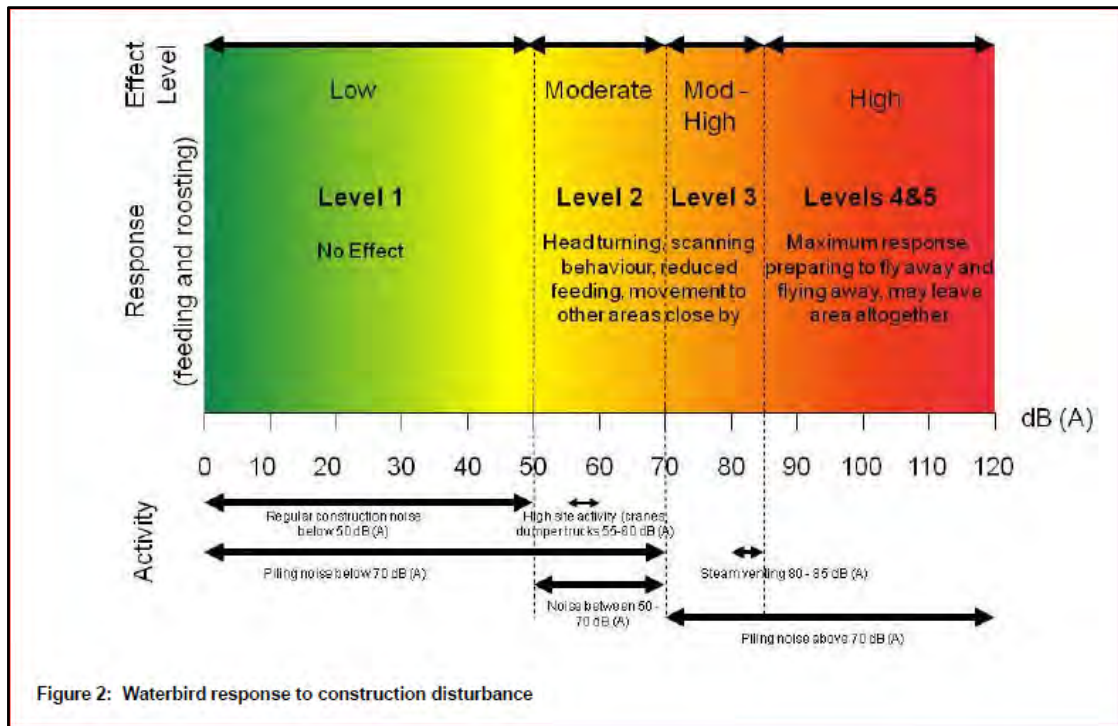
With regard to the impact of construction noise, four distinct levels of disturbance were established:

¹ Cutts, N., Phelps, A. and Burdon, D. Construction and Waterfowl: Defining Sensitivity, Response, Impacts and Guidance, Hull University for the Institute of Estuarine & Coastal Studies, 2009.

² Wright MD, Goodman P, Cameron TC. Exploring behavioural responses of shorebirds to impulsive noise. University of Leeds for the WWT, 2010.

³ BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites, BSI 2014.

Chart 1: Waterbird Response to Construction Disturbance (Cutts et. al (2009))



The study recommends that construction noise levels should be restricted to below 70 dB(A), with birds habituating to regular noise below this level. As can be seen from the above chart, this criterion is applicable to both general construction noise and piling, providing the piling noise is of a regular nature, rather than sudden, isolated events. *Cutts et al.* also recommend that instances of sudden irregular noise above 50 dB(A) are avoided.

3.2 Exploring Behavioural Responses of Shorebirds to Impulsive Noise

This experimental study intentionally disturbed birds making use of an agricultural field on the south bank of the Humber Estuary. The researcher sounded an air-horn at decreasing distances from a mixed species flock of shorebirds, and recorded their behavioural response.

$L_{Aeq,3sec}$ noise levels for the period of each air horn activation were recorded at two previously-installed sound level meters in the general vicinity of the flock, and then corrected using a simple noise propagation model to establish the noise level at the flock location.

The study demonstrated a positive relationship between the noise level experienced by the birds, and the behavioural response observed. On the basis that a non-flight response were taken to be relatively harmless, and flight responses potentially costly, then for those species studied at the site, a costly outcome was shown to become more likely than not at a noise level of 69.9 dB, L_{Aeq} . In terms of a threshold for significant impact, a level of 70 dB, L_{Aeq} is therefore suggested.

3.3 BS 5228:2009+A1:2014

BS 5228 refers to the need for the protection against noise and vibration of persons living and working in the vicinity of, and those working on, construction and open sites. It also recommends procedures for noise and vibration control in respect of construction operations, and provides source levels for various types of plant, equipment and construction activities.

Recommendations are made regarding the supervision, planning, preparation and execution of works, emphasising the need to consider noise at every stage of the construction works.

Measures to control noise are described, including:

- Substitution of plant or activities by less noisy ones;
- Modification of plant or equipment to reduce noise emissions;
- The use of noise control enclosures;
- The siting of equipment and its method of use;
- Equipment maintenance; and
- Controlling the spread of noise, e.g., by increasing the distance between plant and noise-sensitive receptors or by the provision of acoustic screening.

The assessment criteria in BS 5228 relate to the impact of construction noise on human receptors, and are therefore not relevant to this assessment. However, the discussion of noise mitigation measures, and advice provided with regard to minimising noise impact through best practice working methods, are equally applicable to the assessment of the impact on birds.

4 ASSESSMENT CRITERIA

Based upon the findings of the literature review, and through consultation between the NE and the Arcus Principal Ecologist, it is considered that an appropriate threshold of significance for noise due to piling works is 70 dB, L_{Aeq} .

In addition, based upon the work of *Cutts et al.*, it is desirable to minimise the number of sudden irregular noise level in excess of 50 dB, L_{Aeq} as far as practicable. This criterion is discussed further in Section 7.2.1.

5 METHODOLOGY

5.1 Plant Noise Emissions

In order to inform this assessment, Canadian Solar provided specifications for the piling rigs used on site (Pauselli 500); this information is provided in Appendix A. Up to three piling rigs are to be used at any one time.

Noise data due to operation of the plant is limited. However, noise levels at the position of the operator are provided for two scenarios:

- Plant is operating but not piling: 88.2 dB, L_{Aeq} ; and
- Plant actively piling: 110 dB, L_{Aeq} .

It should be noted that C-weighted peak noise levels are also provided at the same position. However, these are not applicable to this assessment, and are provided for the protection of workers under the Control of Noise at Work Regulations⁴ only.

Study of the information provided has established that the operator position is approximately 1 m from the plant's primary noise source (the hammer). From this, the

⁴ UK Government, The Control of Noise at Work Regulations 2005.

sound power level of the plant has been determined for each operating scenario, using the following equation:

$$L_W = L_p - 10\log(1/(4\pi r^2))$$

Where:

- L_W is the sound power level;
- L_p is the sound pressure level; and
- r is the distance from the source in metres.

This results in the following sound power levels:

- Plant is operating but not piling 99 dB, L_{WA} ; and
- Plant actively piling 121 L_{WA} .

An octave-band frequency spectrum for piling was taken from the BS 5228 noise emission data⁵, and scaled to the above sound power levels, to give frequency spectra for the two operational scenarios. Whilst the relative contribution of each octave-band is likely to be different for the two operational scenarios in practice, active piling contains a high contribution of low-frequency noise. As low-frequency noise is attenuated less by distance, the application of this spectrum is considered to be a conservative approach.

The resulting frequency spectra are presented in Tables 1 and 2.

Table 1: Octave-band Spectra, Pauselli 500 (Engine on, not piling)

Octave-band Centre Frequency, f, Hz								Sum, dB, L_{WA}
63	125	250	500	1000	2000	4000	8000	
Octave-band Sound Power Level, dB, L_{WA}								
97.5	91.5	87.5	82.5	78.5	74.5	66.5	60.5	99

Table 2: Octave-band Spectra, Pauselli 500 (piling)

Octave-band Centre Frequency, f, Hz								Sum, dB, L_{WA}
63	125	250	500	1000	2000	4000	8000	
Octave-band Sound Power Level, dB, L_{WA}								
119.5	113.5	109.5	104.5	100.5	96.5	88.5	82.5	121

As stated in Jackson (2010)⁶, research shows that the shape of most birds' audibility curves are similar to those of humans. Therefore, whilst the A-weighted frequency curve correction was not specifically designed with avian receptors in mind, it is considered appropriate for the purposes of this assessment.

⁵ BS 5228 Emission spectra, Table C3, item 6.

⁶ Jackson, P. Noise Impact Assessment on Wintering Birds Anna's Road Exploration Well Site, Westby Blackpool. Spectrum Acoustics 2012.

5.2 Noise Predictions

Noise predictions have been made using the ISO 9613-2⁷ noise propagation model, implemented using SoundPlan Essential noise modelling software. A mixed ground type (G=0.5) has been assumed along the entire propagation path.

The ISO 9613-2 method employed provides a prediction of noise levels likely to occur under conditions favourable to the propagation of sound, i.e. down-wind or under a moderate, ground-based temperature inversion, and is therefore considered to be a conservative approach.

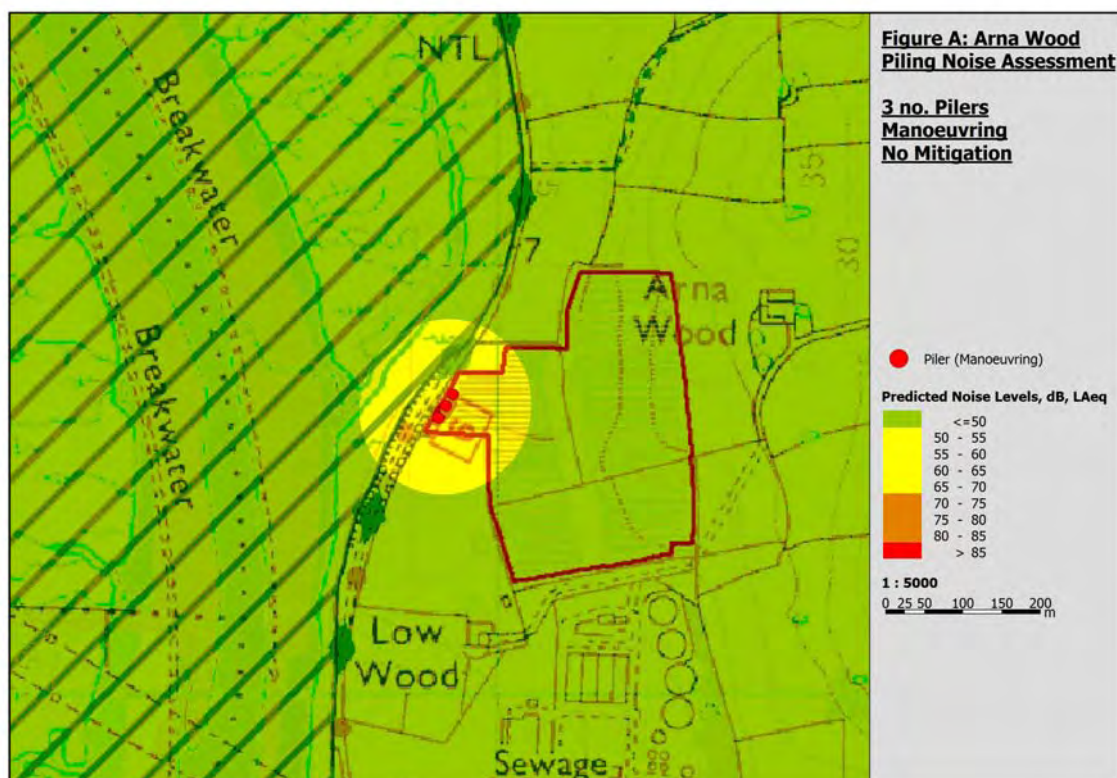
Noise from each piling rig has been assumed to be a point source at located at 3 m above ground level, equivalent to the approximate maximum hammer height given in the Pauselli 500 specifications.

Noise predictions have been calculated at a height of 1 m, based upon a conservative estimation of the head height of the tallest avian species likely to be found within the SPA.

6 RESULTS

6.1 Manoeuvring of Plant

Figure A presents worst-case noise emission levels due to the simultaneous manoeuvring of three piling rigs, at the closest position in the solar array to the SPA (hatched area). Predicted noise levels are shown as a series of distinct areas, shaded in accordance with levels of response presented in the *Cutts et. al (2009)* chart presented in Section 3.1 of this assessment.

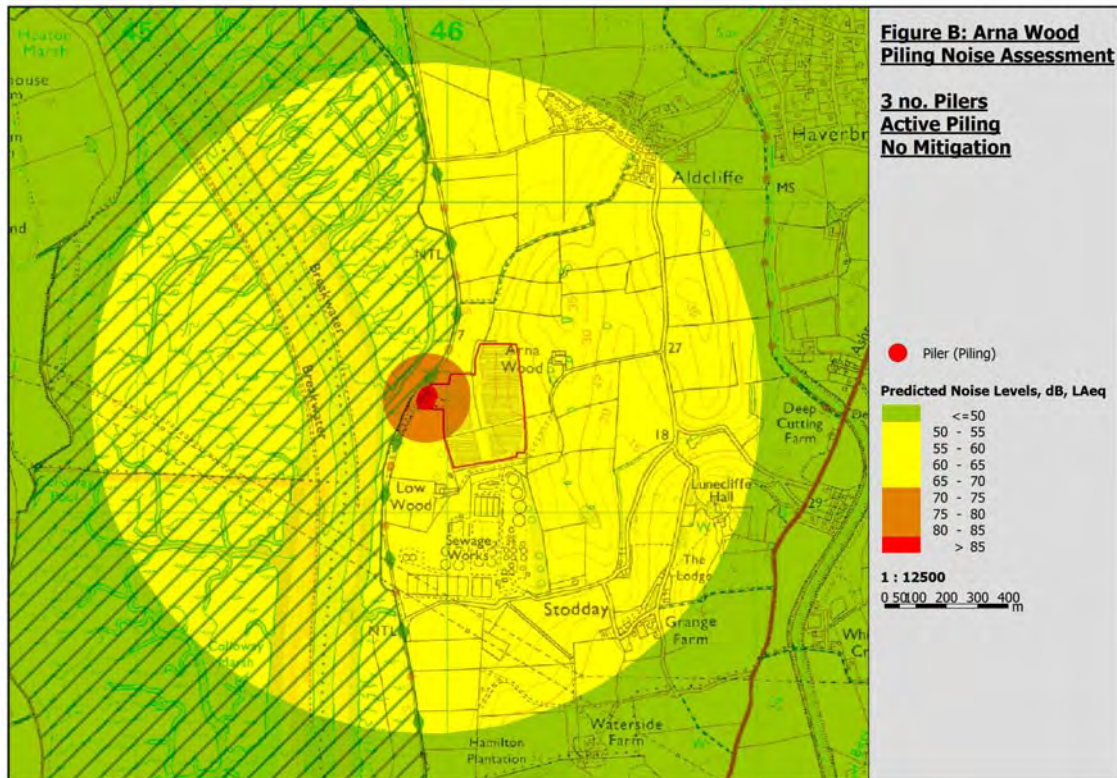


⁷ ISO 9613-2:1996, Acoustics – Attenuation of sound during propagation outdoors, ISO, 1996.

As can be seen, no part of the SPA is predicted to experience noise levels in excess of 70 dB, L_{Aeq} . As such, the impact of manoeuvring the piling rigs is considered to be negligible, and has not been considered further.

6.2 Piling Operations

Figure 2 presents worst-case noise emission levels due to the simultaneous piling of three piling rigs on adjacent solar array rows, at the closest position to the SPA.



As can be seen, based upon a worst-case assessment, an area of significant impact (i.e. noise levels in excess of 70 dB, L_{Aeq}) is anticipated, extending approximately 150 m into the SPA.

7 MITIGATION

7.1 Discussion

As Figure A shows, no significant impacts are predicted from the manoeuvring of the piling rigs. As such, mitigation measures only apply to active piling.

As advocated by BS 5228, fundamental noise control measures include minimising the number of plant in simultaneous use, and maximising the distance between the noise source and receptor.

In light of this, two further noise models have been run, based upon that presented in Figure B. These are:

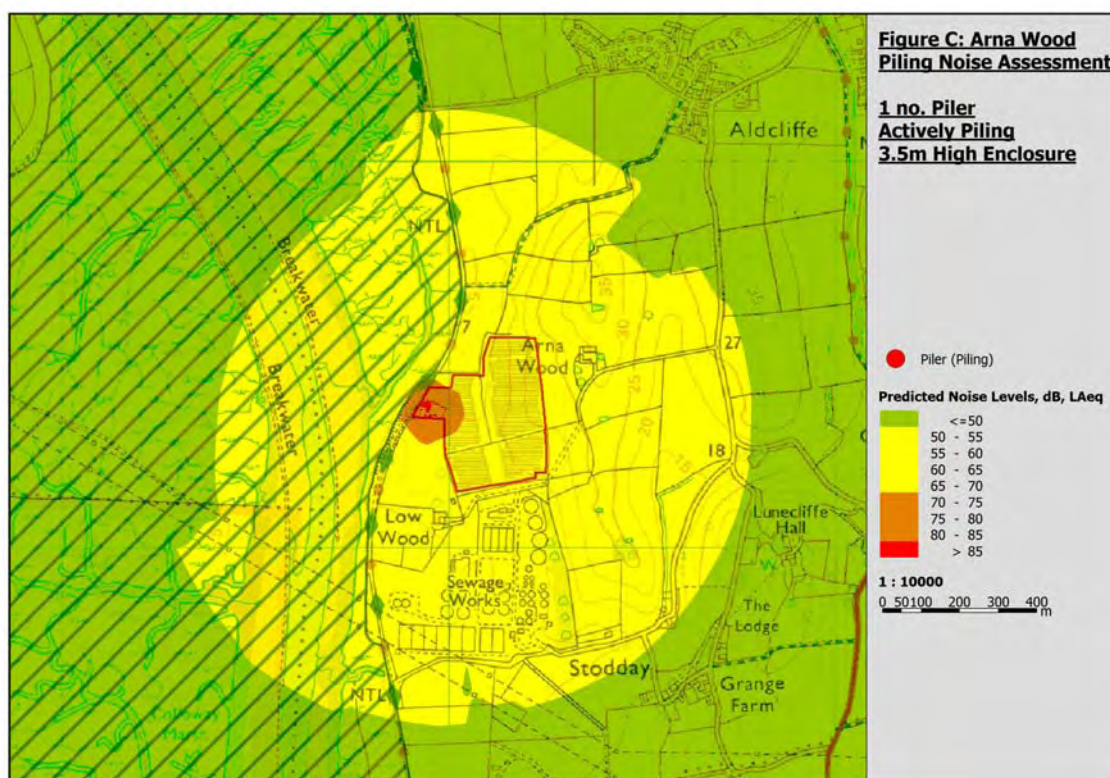
- Two pilers, actively piling on adjacent solar array rows; and
- One piler actively piling;

The results of this modelling, combined with the results presented in Figure A, provide appropriate set-back distances from the SPA, to ensure noise levels remain below 70 dB, L_{Aeq} . These setback distances (rounded up to the nearest 10 m as a conservative approach) are:

- Three pilers, actively piling on adjacent solar array rows = 150 m
- Two pilers, actively piling on adjacent solar array rows = 120 m
- One piler, actively piling = 90 m

For those areas where piling is required within 90 m of the SPA, additional mitigation measures will be required. It is recommended that during active piling, screening is erected around the piler to three sides, to a height of at least 0.5 m above the highest point on the piling rig.

As can be seen on Figure C below, such screening is sufficient to ensure no significant impacts on the SPA.



7.1.1 Acoustic Screening

With regard to suitable acoustic screening, a number of proprietary products are available. The use of 'acoustic quilts' is commonplace in the mitigation of construction noise, and when correctly fitted to a wheeled scaffold structure, would be likely to provide a suitable mobile enclosure.

Appendix B provides details of such an acoustic quilt; advice should be sought from an appropriate supplier regarding the project-specific requirements.

7.2 Proposed Mitigation Scheme

Figure 1 in Appendix C shows a number of setback distances, based upon those presented in Section 7.1. The requirements for each setback boundary are as follows:

>150 m from SPA

- Up to three piling rigs able to pile simultaneously;

<150 m from SPA

- A maximum of two piling rigs able to pile simultaneously;

< 120 m from SPA

- A maximum of one piling rig able to pile;

<90 m from SPA

- A maximum of one piling rig able to pile. Piler must be acoustically screened to three sides, to a height of at least 0.5 m above the highest point on the piling rig.

Pilers may be operated simultaneously in different areas, providing their positioning complies with all the above criteria.

7.2.1 Irregular Noise Levels

In order to minimise the impact of sudden, irregular noise, it is recommended that piling works begin as far from the SPA as practicable (i.e. on the east of the site), and work westward. Once piling has begun, it should be undertaken with as few breaks as possible.

7.2.2 Minimising the Period of Construction

In order to minimise the length of time the SPA is exposed to construction noise, and to ensure construction noise levels are as consistent as possible, it is suggested that all three pilers are utilised in all areas of the site, whilst ensuring that the maximum number of pilers actively piling is restricted accordingly. For example, when working within 90 m of the SPA, it would be acceptable to manoeuvre two pilers into position, whilst piling with a third (with an appropriate acoustic enclosure).

As noted in Section 7.2, pilers may also pile simultaneously in different areas, subject to the applicable setback distances.

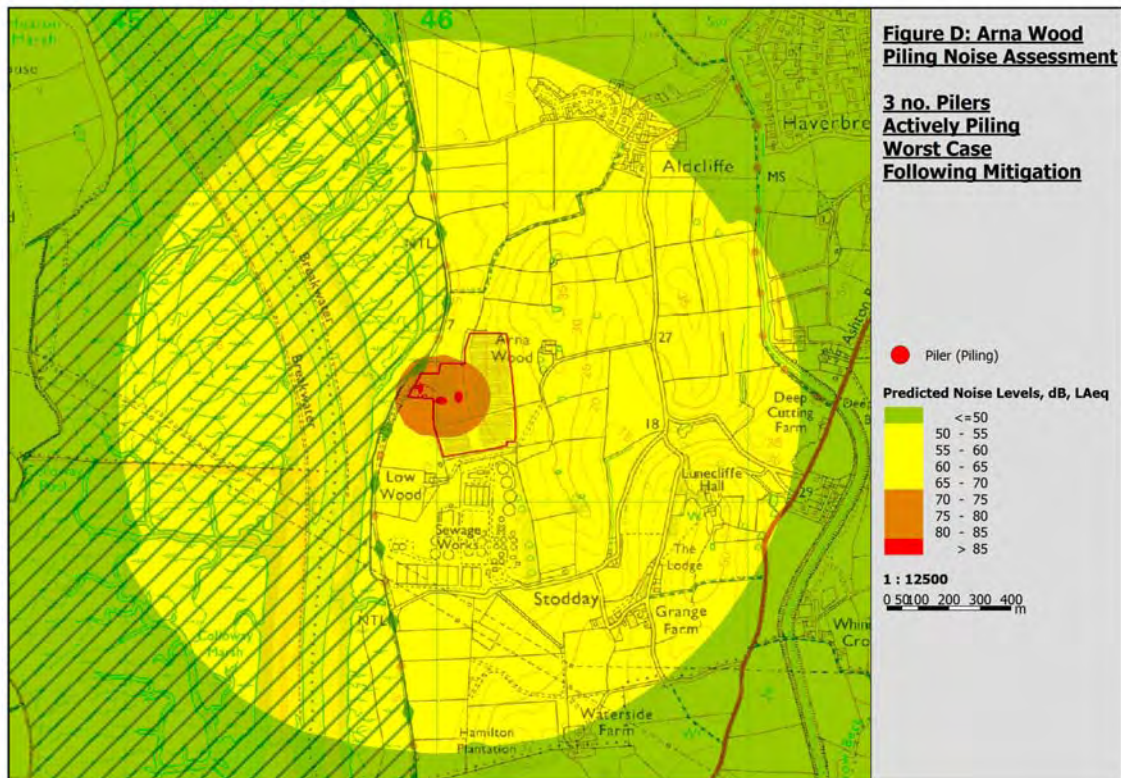
It is recommended that a piling schedule is developed in consultation with Arcus' Ecological Clerk of Works, to ensure the schedule complies with the above requirements.

7.2.3 Predicted Piling Noise Levels Following Mitigation

Figure D presents worst-case predicted noise levels following implementation of the above mitigation scheme. It assumes:

- One piler with suitable acoustic enclosure at the closest point to the SPA;
- One piler at a distance of 120 m from the SPA; and
- One piler at a distance of 150 m from the SPA.

As can be seen, significant noise impacts extend no more than 20 m into the SPA based upon this scenario. It should be noted that Figure D assumes that all pilers are piling simultaneously, and in their worst-case positions. As such, the presented noise levels are unlikely to occur in practice.



7.3 Best Practice Mitigation Measures for All Construction Activities

In addition to the setback distances for piling works, general best practice measures should be applied to all construction activities (including piling), as follows:

- Use the quietest item of plant suitable for the required task;
- Static noisy plant (such as generators) should be located as far from the SPA as is feasible for the particular activity;
- Plant access/maintenance panels to be kept closed.
- Plant should be turned off when not in use;
- No manoeuvring alarms to be fitted to pilers;
- Minimise the use of reversing alarms through the considerate positioning of plant and vehicles;
- Fit broadband, rather than tonal reversing alarms where practicable;
- Walkie-talkies/mobile phones should be used to communicate across the site; no shouting unless in an emergency;

Application of the above measures to manage construction noise will ensure that effects are minimised as far as reasonably practicable.

It should be noted that additional mitigation measures are available to further minimise the level of impact, based upon the specific behaviour of the birds using the SPA. These measures are presented in an ecological summary document, to which this assessment is appended.

8 CONCLUSION

Arcus Consultancy Services (Arcus) was commissioned by Canadian Solar to undertake an assessment of noise impacts associated with piling works at Arna Wood Solar Farm.

It has been found that, subject to the implementation of the recommended mitigation measures, construction noise impacts on the SPA would be acceptable.

9 GLOSSARY

Decibel (dB): The decibel is the basic unit of noise measurement. It relates to the cyclical changes in air pressure created by the sound (Sound Pressure Level) and operates on a logarithmic scale, ranging upwards from 0 dB. 0 dB is equivalent to the normal threshold of hearing at a frequency of 1000 Hz. Each increase of 3 dB on the scale represents a doubling in the Sound Pressure Level, and is typically the minimum noticeable change in sound level under normal listening conditions. For example, while an increase in noise level from 32 dB to 35 dB represents a doubling in sound pressure level, this change would only just be noticeable to the majority of listeners.

dB(A): Environmental noise levels are usually discussed in terms of dB(A). This is known as the A-weighted sound pressure level, and indicates that a correction factor has been applied, which corresponds to the human ear's response to sound across the range of audible frequencies. The ear is most sensitive in the middle range of frequencies (around 1000-3000 Hertz (Hz)), and less sensitive at lower and higher frequencies. The A-weighted noise level is determined by analysing the level of a sound at a range of frequencies and applying a specific correction factor for each frequency before calculating the overall level. In practice this is carried out automatically within noise measuring equipment by the use of electronic filters, which adjust the frequency response of the instrument to mimic that of the ear.

Frequency: The frequency of a sound is equivalent to its pitch in musical terms. The units of frequency are Hertz (Hz), which represents the number of cycles (vibrations) per second.

Noise Emission: The sound power level emitted from a given source.

$L_{Aeq,t}$: This term is known as the A-weighted equivalent continuous sound pressure level for a period of time, t. It is similar to an average, and represents the sound pressure level of a steady, continuous noise which has the same energy as the actual measured noise.

Noise: Unwanted sound. May refer to both natural (e.g. wind, birdsong etc.) and artificial sounds (e.g. traffic)

Noise sensitive receptors: Locations that may potentially be adversely affected by the addition of a new source of noise.

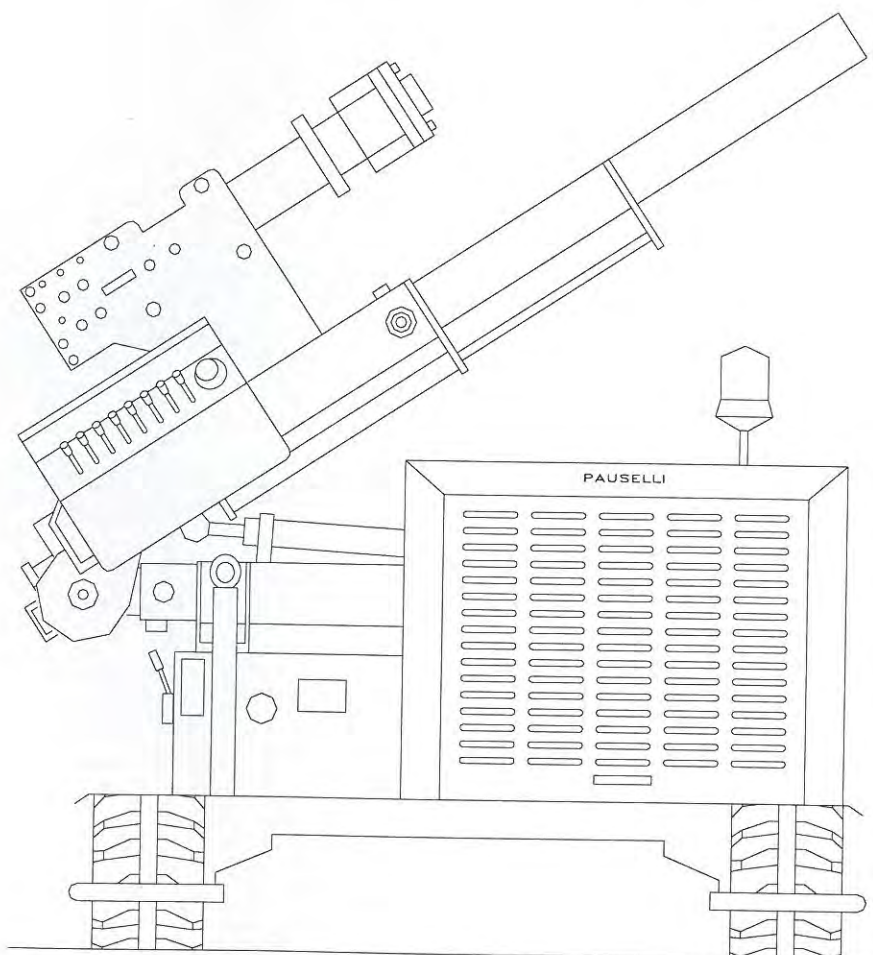
APPENDIX A – PAUSELLI 500 SPECIFICATION



Nv 1



SELF-PROPELLED CRAWLER PILE DRIVER



Use and maintenance manual

Issue 03_01/10



IMPORTANT: read carefully the use and maintenance instructions contained in this manual before starting any operation.



Conform to the Machinery Directive 2006/42/CE

EC Conformity Declaration

Conform to the Machinery Directive 2006/42/EC

The subscribed company **PAUSELLI SRL**
with head office in
Zona artigianale Cinquemiglia 06012 Città di Castello PG

declares under its own responsibility that the

SELF-PROPELLED CRAWLER PILE DRIVER

model: serial number : construction year:

whose functions are described in this manual

is conform to the Essential Requirements of Safety and Health Protection, as per
Machinery Directive 2006/42/EC
and Directive 2000/14/EC concerning environmental acoustic emission of the machines and equipments
destined to work outside,
to the Directive 2004/108/EC and the Directive 2006/95/EC
To the check the conformity of the law rules mentioned up here, the next harmonising rules of the
EN have been applied:

EN 12100-1: Safety of the Machine - Main concepts, general designing
principles – Part 1: Terms, Basic methods (2003)

EN 12100-2: Safety of the Machine - Main concepts, general designing principles
– Part 2: Specifications and technical principles (2003)

EN 294: Safety of the Machine - Range safety to avoid reaching
dangerous areas with the upper limbs (1993)

EN 418: Safety of the Machine - Emergency Shutdown, Functional
Aspects – Designing principles (1994)

EN 349: Safety of the Machine - Minimum range safety to avoid
crushing of parts of the body (1994)

EN 982: Safety Protections concerning oildynamic
Systems and their components - Oilhydraulic (1997)

Citta' di Castello, 15/12/11.....

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INTRODUCTION

A1 Preliminary information

The pile driver is the modern equipment for the driving of guardrail posts. It's specifically designed as a self-propelled machine. As it's supplied with rubber crawler tracks, the machine is highly stable, safe and reliable. The use of high quality components guarantees high performances on any type of ground or road surface, and therefore it is able to satisfy all the quality and quantity needs required by the building site, as for example: driving speed and precision in its movements. Furthermore, with auxiliary equipments of our construction, it is able to perform different supplementary operations, such as: coring, drilling with a down hole hammer, boring with an Archimedes' screw etc. All the pile driver functions, the movement of the rubber crawler tracks included, are achieved with a hydraulic circuit, which works on a diesel engine.

The company **PAUSELLI** SRL (hereafter mentioned as 'Constructor') designed and realised the machine respecting appropriate safety rules with the precise intention to safe-guard the operation personnel manouvring the machine and working nearby the machine as well as the whole operative system. In any way, the Constructor keeps the right to modify the pile drivers in production, with the purpose to improve the product without any obligation to inform the Customer and neither to readjust the machines constructed previously.

Every pile driver is supplied with a copy of this manual, which has to be read very carefully before using the machine. Lack of knowledge about its operating system and about its function, and therefore an improper and incorrect use of the machine may cause accidents with damages to the operator and to the pile driver itself. Every pile driver is supplied with all the manuals and handbooks of use and maintenance concerning some of the components applied on it. Those manuals are integrating part of this one and should be kept together with this one in one single case. Therefore, even if the Constructor provides all the information concerning the pile driver when the machine is supplied (function, use and maintenance) the Customer has to read all the manuals and to observe the contained instructions.

A2 Warranty

The company Pauselli guarantees that the pile driver is exempt from defects in any part of it since it has been submitted to testing before its delivery to the Customer. **The warranty has a one-year validity starting from the indicated date on the fiscal document of delivery and the accessories and tools of the machine are not covered by the warranty.** In any way, when the Customer receives the machine, he has to check its integrity and completeness in every part of it. Eventual complaints should be notified to the Constructor in written form within 8 (eight) days from the receipt of the pile driver.

Within the warranty period the Constructor undertakes to substitute, without any charges and at its location, spare parts in case of damages due to fabrication or material defects. Should it not be possible to substitute the spare parts in its own location, the Constructor will send the needed parts to the Customer's office or directly to the building site and however within less time possible. The investigation of the defect can only be carried out by the Constructor or by authorised technical personnel. But it is necessary to remember that:

- defect parts will remain Constructor's property;
- in the case that the substitution is carried out at the Customer's location or in the building site, the defect parts have to be sent back to the Constructor, intact, without any breaking and **without any transport charge to the Constructor;**
- in the case that the defect parts won't be returned to the Constructor within 30 (thirty) days (from the date of receipt of the new ones), the company Pauselli keeps the right to invoice the new parts shipped.

The warranty is not recognised:

- if it concerns approved or recognised commercial components not produced by the Constructor, and therefore the Customer has to refer to the warranties released by the respective Manufacturers;



- during the transport, as the pile driver travels under the responsibility of the Customer;
- if the failures are caused by an improper or incorrect use of the pile driver, by the carelessness or lack of experience of the operator;
- if the failures are caused by normal wear-out even if the machine is out of service;
- in case of a belated notify a defect part due to construction;
- in case of accidents or in case of circumstances beyond one's control.

The warranty declines if:

- the instructions and norms contained in this manual as well as in all the other manuals enclosed are not respected or carried out;
- the expected maintenance interventions are not carried out;
- the Customer modifies the pile driver without the written authorisation of the Constructor or when the Customer effects tampering at components;
- there are used not original or not conform spare parts instead of those recommended by the Constructor.

The Constructor **does not postpone the warranty period** for the time in which the machine remains out of service due to reparations covered by the warranty and **he neither recognises any compensation or indemnity** to the Customer for costs or damages (directly or indirectly) due to reparations mentioned above. **In any way, the recognised warranty period for the pile driver does not have validity for the engine and for the hammer. For these last two, the warranty period concerns the one quoted in the respective manuals of use and maintenance.**

A3 Information about the manual

This manual has to be well conserved, clean and complete in every part of it and kept in an appropriate package, placed on the machine chassis, ready for any consultation. While reading, some instructions may occur incomprehensible, it is appropriate to contact the Constructor who provides all the desired information. The Constructor keeps the right to modify the manual in case there are new European law rules (machine directive), concerning technical contents or simply to improve the comprehension.

Contained signals in the manual:

- the word **ATTENTION** stands for an actual possibility of danger. This means that the operator must be careful and use his common sense. The information written under this word must be absolutely known by the operator;
- the word **IMPORTANT** means that the subject has absolutely to be known by the operators.
- the word **Note** indicates that the treated matter can make it easier for the operators to carry out their work.

In the case that part of the contents give rise to controversies, the valid text to refer to remains the one written in the Italian language.

A4 Identification

Every pile driver has a metallic plate on which are punched the machine's identification data. Such plate, placed well in sight, contains:

- the name of the constructor;
- the model of the machine;
- the serial number;
- the construction year;
- the power of the engine in kW;
- the weight in Kg.

		COSTRUZIONI MECCANICHE	
		<small>Zona Artigianale Cinquemiglia 08012 Città di Castello (PG) Tel. 075 8540925 - Fax 075 8540928</small>	
Modello	<input type="text"/>		
Matricola	<input type="text"/>		
Anno	<input type="text"/>	<input type="text"/>	
Kw	<input type="text"/>		
Kg	<input type="text"/>	<input type="text"/>	
	<input type="text"/>	<input type="text"/>	

IMPORTANT: it is absolutely forbidden to alter and/or erase the information punched on the identification plate or those punched on the machine's components. Such data is indispensable when spare parts from the Construction Company are requested.



A5 Standard equipments and accessories on request

Standard equipment

- fast anti drop clutches industrial model
- supporting foot on column base
- extractible and reversible pile guide bearing
- approved chain for loading
- approved pile extraction chain
- reducers with automatic brakes
- pile height pole divided into millimetres
- traffic indicator
- standard pile hammer
- standard pile hammer template
- proportional device for the regulation of the accessories rpm

Accessories:

- complete DOWNHOLE DRILL equipment
- standard core barrel
- core barrel WITH INDEPENDENT COLUMN
- MULTIPLE core barrel
- drilling equipment
- approved loading ramps
- longitudinal inclination of the column
- radio control for machine management on distance
- pile hammers and pile hammer templates for any type of pile section
- liquid cooling engine

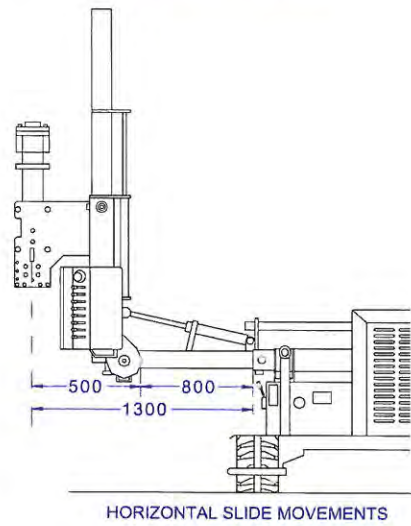
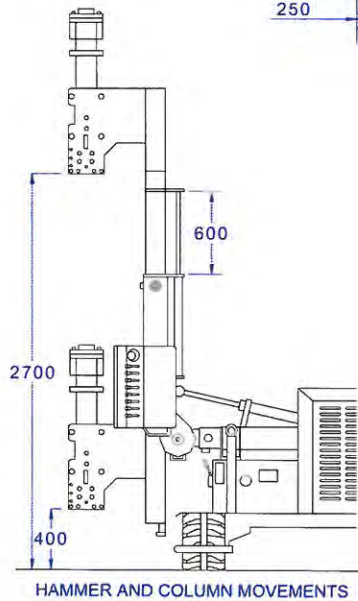
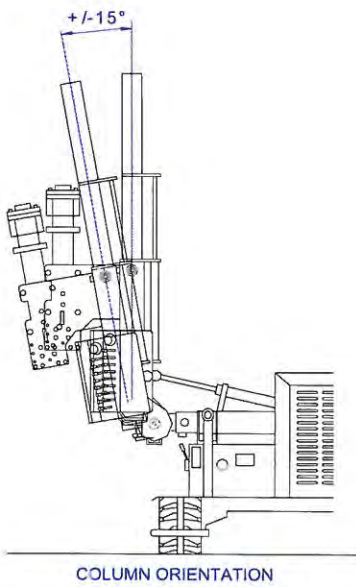
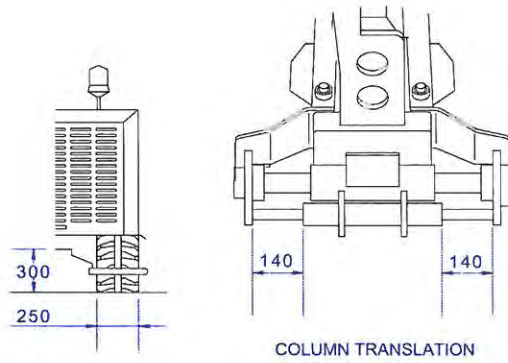
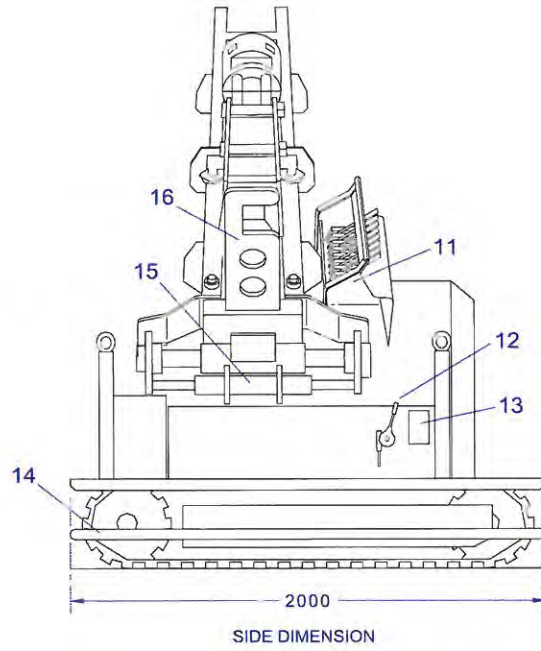
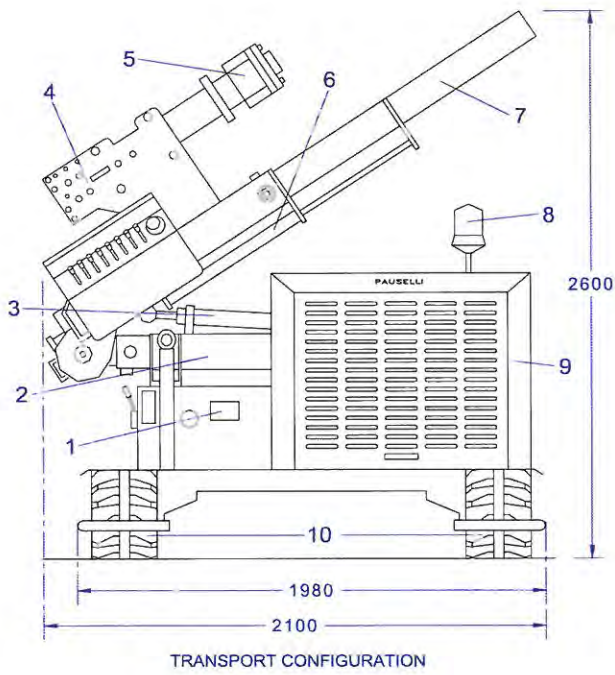
A6 Constructional elements

The constructional elements of the pile driver can be essentially grouped in the following way:

- **chassis group:** this is a complex structure of which take part: the basis level, the fuel and hydraulic oil tanks, the slide with its components, the column with its components and the hammer group. All the components of the chassis group are built with high quality components and therefore highly reliable and functional.
- **undercarriage:** the whole chassis group of the pile driver is set up on a crawler undercarriage which makes it able to move the machine. Other complete equipments are installed on the undercarriage and all these elements make the pile driver a 'complex machine', able to move itself also on difficult grounds that often are not adapted to vehicles on wheels. Besides the chassis structure the crawler wheels (two) also are part of the undercarriage. They're necessary for the transmission of the motion. Every single one is composed with a dynamic oil engine, a reducer with a negative brake (this means that the brake is automatically in function, so the machine can't move when it's operating), a gear wheel, two little crawler tightening wheels and two rubber crawler tracks, which receiving the motion and being the only components that adhere to the ground, are the ones which definitely move the pile driver.
- **engine:** this one is mounted on the basis level of the chassis group and a metallic belt guard, which protects it that has a lock and that can be opened manually. This is definitely the most important component of the machine, as the motor reducers and the hydraulic circuit pumps, with which all the operative functions of the machine can be realised, are connected to. All the technical information about the engine are mentioned in the use and maintenance manual of the engine itself enclosed to this manual.

A7 Main components and technical data

1. identification plate
2. slide
3. column orientation jack
4. pile hammer
5. hammer
6. column movement jack
7. column
8. traffic indicator
9. engine room
10. crawler tracks
11. control levers
12. accelerator lever
13. starter frame
14. protection bar
15. column translation jack
16. pile guide bearing



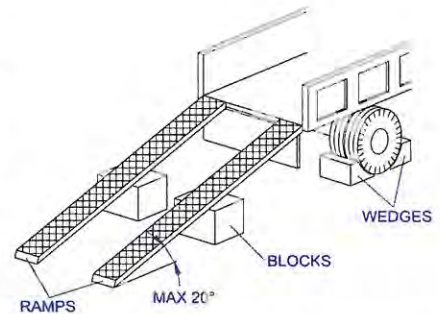
SAFETY

B1 General rules

Most of the working accidents happen because the most elementary safety rules are not respected. In this manual are described the ones to observe for the use of the pile driver. Therefore, before using the machine it's obligatory to know everything written in this manual. The use of the pile driver must be entrusted to adult, qualified and trained personnel. **Therefore, the Constructor is not responsible for accidents caused by carelessness of the personnel, improper or incorrect use of the pile driver or to the not respecting of the safety rules. Furthermore the warranty of the machine would immediately void.**

B2 Safety Precautions for the pile driver

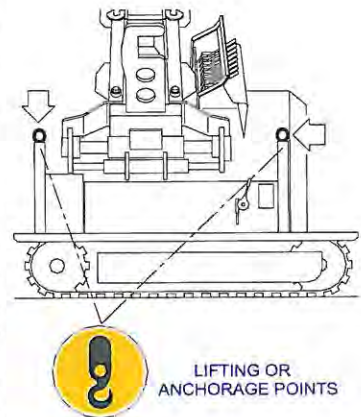
1. **Transport:** the pile driver is an extremely practical and useful self-propelled crawler machine. It has to limit, however, its movements obligatorily inside closed building sites or delimited by signal ribbon as **the movement of the pile driver on the road is totally forbidden because the machine does not have a driver and because it is not approved for circulation.** This means that outside the building site, also for short distances, the pile driver has to be necessarily transported on a vehicle.



The loading and unloading of the machine on the vehicle happens with the help of ramps (showed in the figure) anchored on the vehicle or if the vehicle is not provided with, by using a crane or a lift. Especially with regard to this last one the pile driver has three metal rings which makes it possible to lift and anchor the machine.

Both operations (loading and unloading) always involve dangerous situations and for that reason it's necessary to use a lot of caution during the intervention and to observe, always, the following **precautions:**

- the intervention has to take place on flat ground and on a safe distance from the edge of ditches and escarpments;
- using the ramps it's indispensable to make sure that:
 - they have a sufficient hanging load to the sustained load (equivalent to the total weight of the pile driver, quoted on the identification plate);
 - they are in perfect conditions and free from any trace of oil, grease, ice or earth;
 - they are firmly anchored to the vehicle, placed parallel to each other and positioned with an angle of maximal 30°;
 - after loading, the vehicle's engine is off and the starting key is drawn out of the frame. The machine has to be immobilised with the rods or the chains attached in the rings or points of anchorage or lifting, signalled by relative pictograms (representing a hook), like those showed in the figure;
 - the vehicle is blocked with wedges placed in front and behind every wheel, as showed in the figure;
- using a crane or a lift make sure that:
 - the medium used for lifting has got approved characteristics for the load it has to sustain (equivalent to the total weight of the pile driver quoted on the identification plate);
 - **only and exclusively the approved loading chains supplied by the Constructor are used. Check their integrity before using them;**



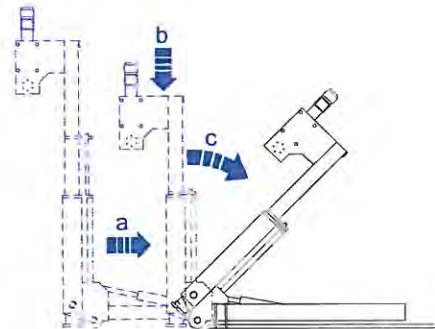


- after loading, the machine is immobilised with tie rods or chains attached in the anchorage points signalled by the relative pictograms (representing a hook), like those presented in the figure;
- the vehicle is blocked with wedges applied in front and behind every wheel, as showed in the figure.

Both operations of loading and unloading need to be carried out by qualified personnel, trained for the job and with full respect of the safety rules. This counts especially for the lifting of the pile driver (by using a crane or a lift). **For short, If there should happen accidents because the safety precautions aren't carried out or aren't respected, the Constructor's responsibility as well as the warranty will void immediately.**

To share out the total weight and to achieve more balance in the movements or the lifting, it's necessary that the pile driver assumes a precise **configuration of transport or for movements**. This can be achieved in the following way:

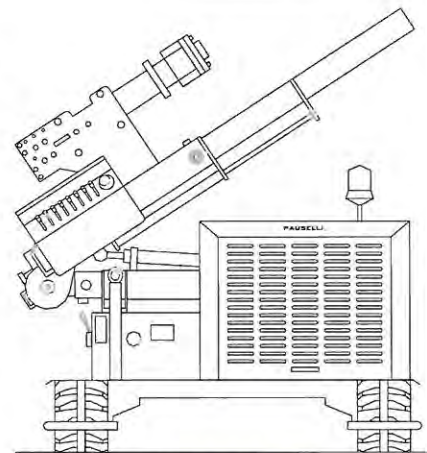
- if extended, return the slide completely retracting the relative jack at the end stop point;
- following return the column completely by retracting the relative jack at the end stop point;
- at the end, set down carefully the entire column in its rest position, retracting the relative jack at the end stop point.



- Movements:** for any movement, on a flat surface as well as on inclined surface, the pile driver has always to assume **the transport configuration or movements configuration**, as showed in the figure.

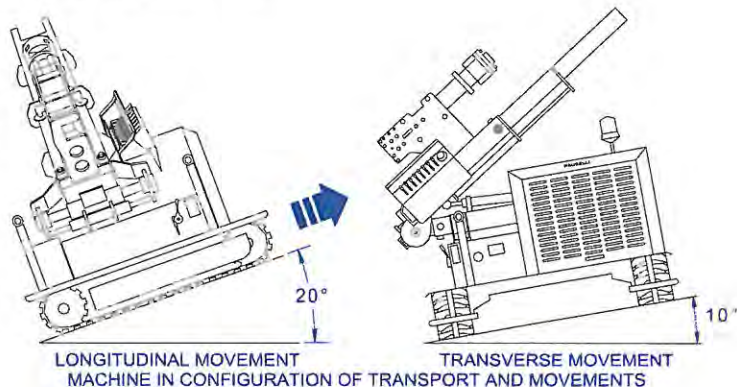
For the movements of the pile driver on inclined surfaces the following **precautions** are necessary:

- In longitudinal direction the maximal road grade consented of the soil on which the machine can move itself with safety and balance should be 20° with hard and compact soil. If the soil is gravelled and not compact the consented maximal road grade should be 10°;
- In transversal direction, the maximal road grade consented of the soil on which the machine can move itself with safety and balance, should be 10° with hard and compact soil. If the soil is gravelled and not compact the maximal consented road grade should be 5°.



CONFIGURATION OF TRANSPORT AND MOVEMENTS

The Constructor distrusts the Customer to operate on surfaces with higher road grades to those indicated and/or in different ways to those described.



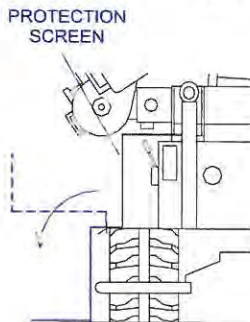
LONGITUDINAL MOVEMENT

TRANSVERSE MOVEMENT

MACHINE IN CONFIGURATION OF TRANSPORT AND MOVEMENTS

3. **Starting and controls:** the operator, before starting the machine has to carry out the following checks:
- check if all the control levers are in the neutral position;
 - make sure that the emergency button is inactive. If it results active a little rotation clockwise inactivates it;
 - check the hydraulic oil level in the relative tank and in the reducers in the way described in the Maintenance chapter of this manual;
 - check if the hydraulic tubes are connected in a safe way and that they don't have bottlenecks;

Note: *If the machine is started after one or more days of inactivity it is necessary to consult the maintenance programs and follow up all the prescribed information, before starting the machine. This should be done also if the time in which the machine results inactive, results longer.*



The operator should lower the **protection screen** to have access to the starter frame, placed on the basis level as showed in the figure. Such screen is designed and applied on the machine essentially for the protection of the operator when he stands by the control post and the machine is in movement, against feet injuries that could be caused by the rubber crawler tracks. At the same time, when the machine is still and the engine off this screen protects the starter frame and all the controls placed in its closeness.

The operator after having carried out the preliminary controls and after the lowering of the protection screen first needs to place the accelerator on about $\frac{1}{4}$ of its range and then effect the starting, following the instructions in the manual of use and maintenance of the engine. When the machine is on, it's advisable to wait some minutes, so the engine oil and the hydraulic oil will reach the optimal temperature.

At this point before using the pile driver, it's advisable to check all the functions by manoeuvring, one at a time, the respective control levers to make sure that they work well. In that way, the operator, if not already expert, would get familiar with the control levers and would learn to know all the associated functions and their operative sequences. Every lever can be moved in two or more positions. The movement of a lever consents the realisation of a precise function, as for example the column orientation. In that way, the operator effects a check of all the functions by moving the levers slowly and separately.

IMPORTANT: during this phase it's indispensable that the operator observes all the safety rules (described later on) and that he's alone in the working area. The missing observance of this safety rules may cause physique damages or even death.

4. **Use:** the pile driver should be used only for the driving of guardrail posts, or to carry out some other specific functions, later on described, upon installation of equipments of our construction. **Therefore, different functions as well as the application of not adequate or tested equipments and not of our production, are considered as improper and are consequently forbidden.**

The machine works with safety devices and technical characteristics which have been elaborated during the projecting phase respecting all the appropriate safety rules. With as consequence that the Customer cannot alter the technical characteristics of the pile driver for the modification of its performances. **If this should happen anyway, the warranty of the machine as well as the responsibility of the Constructor will immediately void.**

Before positioning the machine in the building site and starting to use it, it's indispensable to make sure that where the pile driving or the drilling should be done, are no **underground service lines**, as for example: water conductions, gas or combustible oil lines, electrical lines, optical waveguide



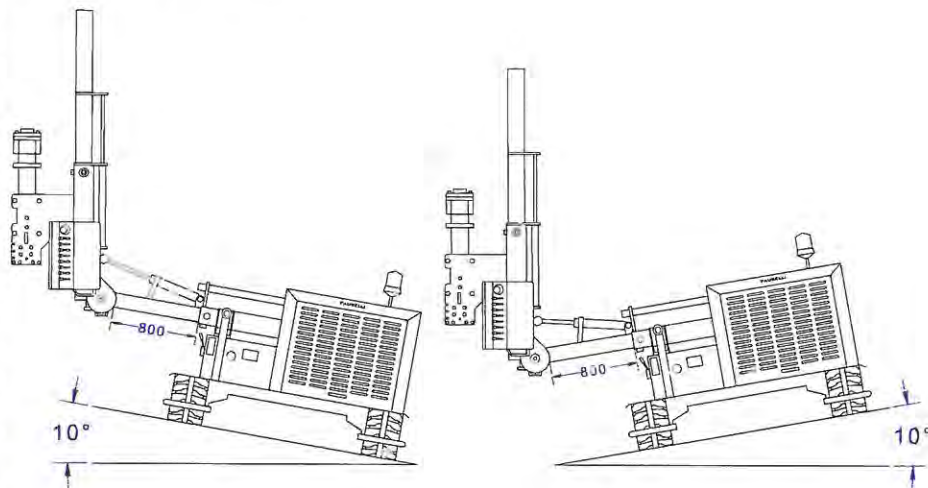
nets, phone lines or other kind of service nets. Therefore, it is necessary to contact the owner of the ground or the responsible government society, in order that they may supply information or detailed maps of the working area. However, in presence of underground lines, it is obligatory that there is a technician of the responsible government society present during the operation.

For **electrical high tension airlines**, instead, if there is one of those lines present in the working area, it's necessary to observe that between the cable lines and the highest part of the pile driver exists a minimum safety distance (which can be different in every country, in behalf on climate and moisture in the air. As per information, it is advisable to follow the indications mentioned in the list below.) If the distance should result smaller, the responsible owner of the ground has to be contacted, in order to raise the line or to install the opportune protections.

Voltage of the cables	Minimum distance to be kept
1,0 kV (distribution line)	5 mt
6,6 kV (2+3 insulators)	5,2 mt
33 kV (min. 3 insulators)	5,5 mt
66 kV (min. 6 insulators)	6 mt
154 kV (min. 10 insulators)	8 mt
275 kV (min. 19 insulators)	10 mt

From the atmospheric point of view, the pile driver is able to operate in a vast range of **temperatures**, (see paragraph C2) and should be used during **daytime** as it isn't supplied with a proper lightening system. If for different reasons the pile driver should be used during the **night**, it's obligatory that the machine as well as the working area is sufficiently illuminated, in order to work respecting all the necessary safety rules.

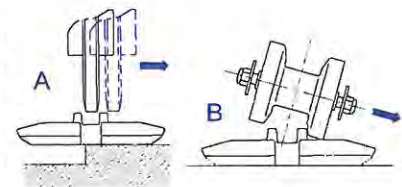
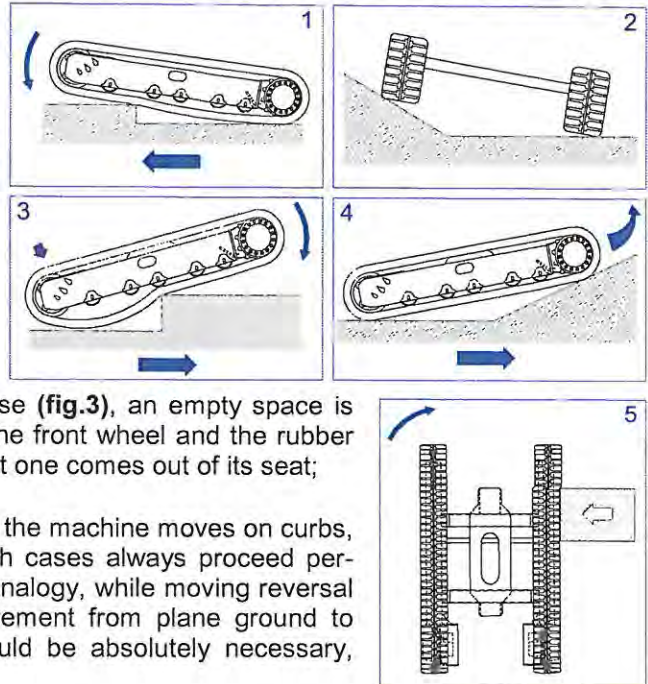
The pile driver can operate on any kind of ground or road surface and as we already mentioned, also on inclinations. Using it on the latter, the pile driver has always to work in the way as showed in the figure, for functional reasons and for stability and consequently for safety. In any case the maximum working grade is 10°.



Concerning **the movements of the rubber crawler tracks**, the operator has necessarily to observe the following indications:

- normally the pile driver moves itself with its crawler wheels positioned on the back, as to the driving direction. **The opposite way of such a condition makes the rubber crawler track and the crawler wheel coupling difficult and should be carried out only if it's strictly necessary.** The preferred way of advancing has to be that one in which the tight part of the rubber crawler track is placed on the ground and the slack one is placed upwards;

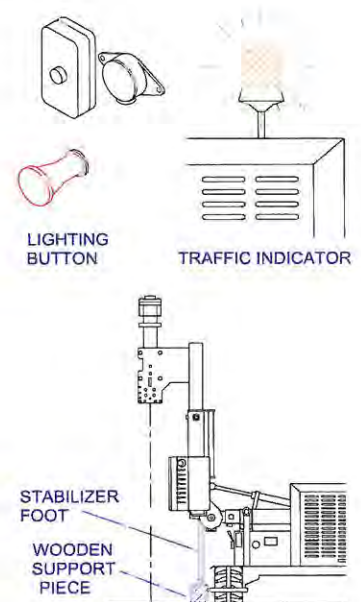
- when you proceed by passing over an obstacle, an empty space is created between the carrying rollers and the crawler track, with the risk that this last one gets out of its position (**fig.1**);
- avoid proceeding along the border of slopes or on uneven grounds with one crawler track on horizontal level and the other one on inclined level (**fig.2**). Always proceed with the sliding blocks on the same horizontal level, in order not to damage the rubber crawlers.
- when the machine proceeds in reverse (**fig.3**), an empty space is created between the carrying roller, the front wheel and the rubber crawler track, with the risk that this last one comes out of its seat;
- don't effect changes of direction while the machine moves on curbs, rocks or big level differences. In such cases always proceed perpendicularly regarding to obstacles. Analogy, while moving reversal uphill (**fig.4**), don't steer in the movement from plane ground to inclined ground. Though, if this should be absolutely necessary, effect the manoeuvre gradually;
- when you change direction in a situation in which the crawler track moves itself slowly because it needs to surpass an obstacle (**fig.5**), the crawler track can be damaged and get out of its seat;
- when the machine proceeds in reverse in the conditions showed in figure **A**, the crawler track will come out of its seat;
- when you steer in the conditions showed in figure **B**, the crawler track would come out of its seat.



Every movement of the pile driver in spite of the fact that it's effected inside the operative zone or building site, must always be carried out with the **traffic indicator** on. This light, placed on the protection belt guard of the engine, gets into action with a button, placed under the starter frame (see the figure).

The preparation for the **driving** of piles is very easy: the pile's body is positioned in an appropriate support, named pile guide bearing, placed in the inferior part of the column and making the vertical movement easier. Its headstock needs to be inserted in the pile hammer template. This one besides driving it in a precise and fast way, protects it to get loosen from the pile hammer during the peening phase. After all this, it will be possible to activate the hammer and start the driving.

The pile driver is supplied with a stabiliser foot, placed in the inferior part of the column. It has the purpose to supply more stability to the machine when it's used for the **extraction** of piles. It's advisable to place a solid support between the ground and the stabiliser foot (this can be a piece of wood or metal) as it is not





possible to make sure what the real consistence of the soil is like. The use of the stabiliser foot **is obligatory** for the extraction of piles, while it's not absolutely necessary for the driving of piles.

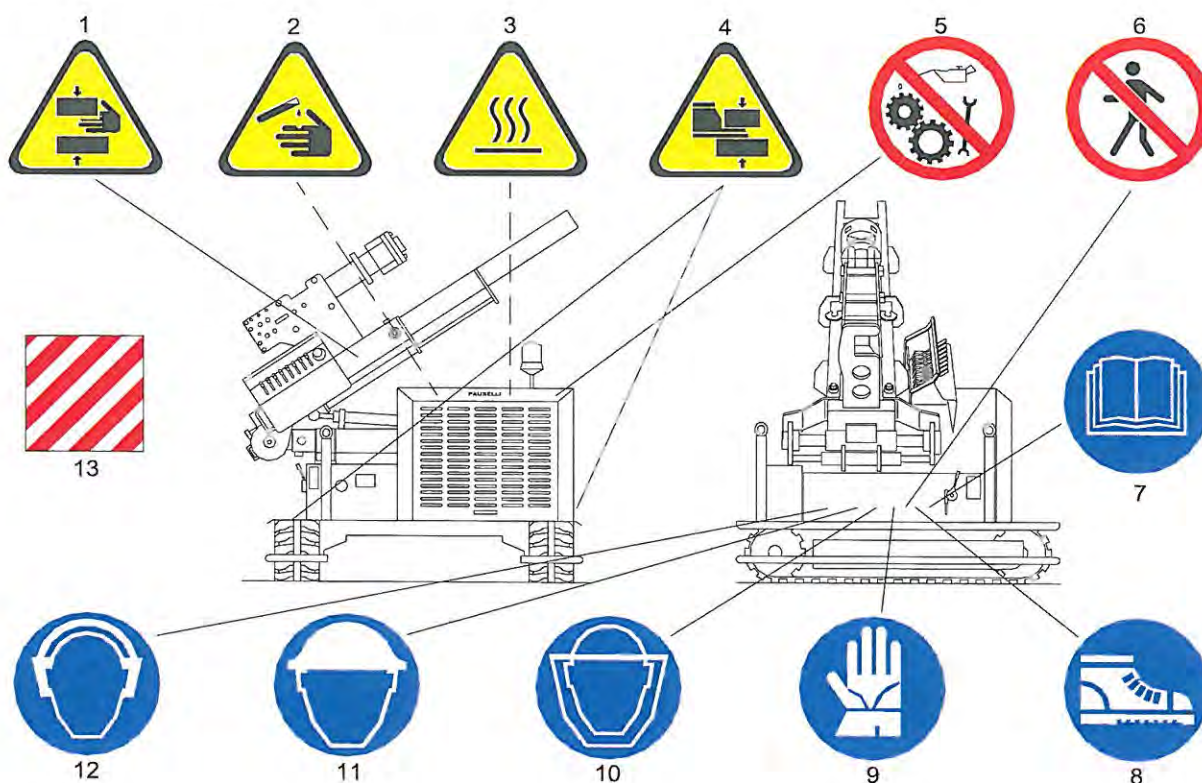
B3 People safety precautions

Even though knowing that the pile driver is extremely secure, it should be used by qualified, trained, adult personnel who is familiar with the instructions in this manual. Safety is of primary importance for the personnel who uses the machine or who carries out reparations or maintenance tasks to the machine. As the supplied instructions can't include all the possible working situations inside the building site, the personnel must use caution, have common sense and must respect all the safety rules valid in behalf on work.

All the functions of the pile driver, with an exception for the starting of the engine, are realised with the activation of the corresponding levers (placed on a hydraulic control device). Every operator, therefore, has to know in which way the levers move and what their functions are. Every lever can be moved in one or more positions and has a precise function as for example the column orientation. The operator moving the levers slowly in its possible directions will know all their operational functions and sequences. In case the operator is already an expert regarding the machine, it's still advisable to effect a check of all the functions before using the machine.

IMPORTANT: during the 'getting familiar with' phase of the levers or the check of all the functions it's indispensable that the operator observes all the safety rules and that there aren't any objects and people around the machine. This could be dangerous.

Further to the contained indications in this manual, there are some adhesive labels in different parts of the machine to make the job easier for the operators. These labels represent the safety rules to respect. The labels vary in shape and colour, depending on the norms they are related to. Therefore, who operates has to know that the circular labels stand for **obligation** (blue and white colours) or **prohibition** (red, white and black colours). The triangular labels stand for **danger** (yellow and black colours). Other triangular labels further to the warning for danger supply more information about the safety rules that need to be respected.





The illustrated norms on the labels placed on the pile driver are:

1. crushing danger and/or shearing danger to upper limbs. Pay maximum attention during the movements. Use protective gloves;
2. corrosion danger. The battery contains sulfuric acid, a corrosive substance that irritates the skin. Use protective gloves;
3. burning danger. Parts of the engine achieve high temperatures and that's why the engine itself has got an appropriate avalanche protector supplied with a lock;
4. crushing danger and/or shearing danger to inferior limbs. Pay maximum attention during movements. Use protective shoes;
5. prohibition to effect reparations or maintenance interventions with parts in movement. When it's strictly necessary to do this anyway, act with a lot of caution;
6. prohibition for people to stay or move in the working area of the machine when this one is in function. Take the necessary safety distance and when it's necessary to move, do this with a lot of caution;
7. obligation to read the manual of use and maintenance;
8. obligation to wear protective shoes. Use only approved ones;
9. obligation to wear protective gloves. Use only approved ones that fit well;
10. obligation to wear a safety visor. Use only the approved one;
11. obligation to wear a protective helmet. Use only the approved ones;
12. obligation of sound protection. Only the use of idoneous protection and an approved type is consented;
13. signalling ribbon. The operator has to use this to delimit the working area (closed building site) in which the pile driver can move without limits.

IMPORTANT: the adhesive labels must obligatory be substituted when they become unreadable. When one of them does, the operator isn't allowed to use the equipment until the application of a new label.

The pile driver is supplied with safety and control devices (hereunder described) for the protection of the operators, which make it extremely safe:

- a **control distributor**, placed on the machine in an appropriate way, assures the absolute control of the functions. The operator can't accidentally activate a lever while another lever is still in action. All the levers have an automatic return, so when you release them they return by themselves in their initial or neutral position. For safety reasons, the lever for the activation of the hammer has a mechanic block at the end point, to assure that the operator has enough time to take an opportune distance from the machine while this one is hammering;
- all the jacks have **blocking valves** that intervene by blocking the function in action when the respective lever is released (voluntary or involuntary) or when there's a problem in the hydraulic installation with a lack of pressure inside the circuit. The intervention of such valves prevents the jacks from any possible movement caused by the lack of pressure in the circuit;
- the movement of the rubber crawler tracks is arrested by the respective **motor reducers** that are supplied with an emergency brake (of the negative type with plates) with the brake control integrated in the blocking valves, present in the circuit. Such valves, like the ones of the jacks, stop the function in action in this case the movement of the rubber crawler tracks, when the lever is released (voluntary or involuntary). But also when there's a problem in the hydraulic installation with a lack of pressure inside the circuit;
- the activation of all the functions, except the one for the hammer, force the operator to remain in the control post. In this position the operator risks the crushing of his foot by the crawler track. To protect the operator for such danger, the pile driver is supplied with a **protection screen**. When it's closed it protects the starter frame and all the controls placed nearby the screen. When it's open, it protects the operator against the **crushing danger** of his foot. Therefore, to have access to the starter frame, it's necessary to lower the protection screen; On this purpose it is advisable to remember that this screen has to be kept lowered during the whole operation.



USE AND FUNCTION

C1 Use

The pile driver, as already said, should be used by a qualified, adult and trained operator who knows everything about its use and maintenance. The operator must consequently know all the instructions written in this manual and those punched on the adhesive labels (safety rules and lever movements).

For a correct use and operation of the machine it's indispensable that the pile driver is used only for the job it's built for and that all the maintenance tasks foreseen by the Constructor, furtherwards described, are respected.

It's further advisable to point out that the safety controls and the technical characteristics of the pile driver have been elaborated in accordance to the appropriate safety rules, during the projection phase. It's strictly forbidden for the Customer to alter the technical characteristics or to erase the safety devices placed on the pile driver with the purpose to modify its performances. **Whenever this happens anyway, or when the pile driver is used in an improper or incorrect way, the warranty as well as the responsibility of the Constructor will immediately void.**

C2 Use in cold climates

The pile driver is designed for the use in a temperature range between -20° and $+40^{\circ}\text{C}$. **If the machine is used in other types of climates, the Constructor doesn't answer to accidents due to a bad function of the machine.** However, if the machine is used in very cold climates, with temperatures between -20° and $+5^{\circ}\text{C}$ the following interventions are necessary:

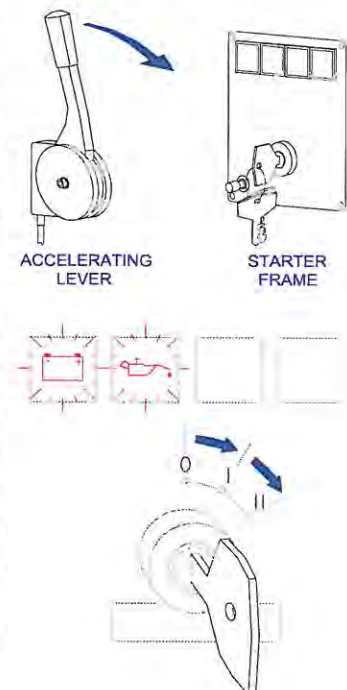
- use oils suitable to those temperatures (engine and hydraulic), it's advisable to consult a lubrication list for the choice of the oils;
- wait five minutes before starting any movements in order to bring the engine up to the right temperature. Activate the controls for some minutes inoccupied to get the hydraulic installation on the right temperature.

C3 Function

C3.1 Starting

After the preliminary checks, described in paragraph B2 point 3, and before starting the engine, the operator has to position the accelerator lever at about $\frac{1}{4}$ of its range. The starting process can be obtained by inserting the key in the relative device, placed on the starter frame. Rotate the key clockwise first in position I and then in position II. The indication lights of the oil pressure and the battery will illuminate. As soon as the engine has started, release the key that will automatically return in position I. As soon as the engine works regularly, the two indication lights (oil pressure and battery) will switch off and the operator reduces the revolutions with the accelerating lever. If one of the indicators should still be illuminated, the engine must be switched off immediately. This can be done by returning the key in position 0 or by pushing the emergency button. **In this case, always remember to unlock it before you reactivate the engine (by rotating the button slowly clockwise).** Anyway, regarding the use and maintenance manual of the engine (supplied with this manual). Such consultation is also advisable before starting the engine (see cold start).

After that, depending on the function of the machine, the operator can increase the number of revolutions of the engine by moving the acceleration lever adequately.





C3.2 Controls and check components

The controls of the pile driver (services and transmissions) are assured by a device assembled by settled elements, activated by as many levers as the elements are and by a pressure relief valve. All the levers, with an exception for the first one (the one indicated in the figure with n.), can be activated in two positions and, as we already mentioned, they have an automatic return. This means that released, they will automatically turn back in their starting or neutral position. The first lever, the one for the hammer activation, can block itself due to a mechanic block at the end point. The movement of a lever in a position in any case consents the realisation of a precise function, as for example the column orientation.

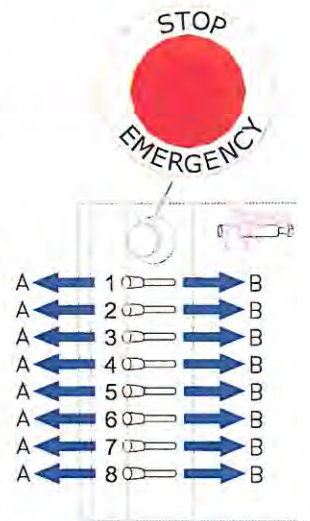
The controls and functions are as follows:

- | | |
|---|---|
| <p>1. hammer activation
A - hammering activation (blocking)
B - auxiliary (not active)</p> <p>2. hammer movements
A - downwards
B - upwards</p> <p>3. column movements
A - downwards
B - upwards</p> <p>4. column orientation
A - opening
B - closing</p> | <p>5. column translation
A - left direction
B - right direction</p> <p>6. column slidement
A - exit
B - re-entry</p> <p>7. right crawler track (*)
A - forwards
B - back</p> <p>8. left crawler track (*)
A - forwards
B - back</p> |
|---|---|

(*): for the rectilinear movement of the machine (forwards/back) both levers nr.7 (right crawler track) and nr. 8 (left crawler track) should be activated contemporarily and in the same way.

Note: *limited movements of the levers consent the carrying out of little movements. Avoid keeping the lever too long on the end point, because the hydraulic oil can become too hot.*

- Emergency button:** if the operator notices a dangerous situation or simply to interrupt the work, he can push the button and the pile driver will block totally. With the engine being off and the pump being disactivated, you have the full stop of the functions in action at that moment. In that situation all the controls are inhibited. **The operator has to unblock the emergency button, rotate it slowly clockwise,** and start the engine again to regain the normal working conditions.
- Lighting button:** such button is placed on the starter frame and must be pushed for the activation of the traffic indicator before any movement of the machine. The activation of the indicator is indispensable for the safety in operative areas or building sites;
- Pressure relief valve:** the pressure relief valve is placed on the distributor and contains the working pressure of the hydraulic fluid in the range values. It intervenes in case of increase or decrease of pressure in the hydraulic circuit, stopping the oil flow and unload the oil in the tank. The range or eventual corrections are effected only by the Constructor who seals the valve (with red paint or metallic cable) to avoid manumissions;
- Heat exchanger:** (is not a standard accessory - installation only on request). The heat exchanger or more common called oil cooler, is a device used for the cooling of the



hydraulic oil, in the unloading phase, before it reaches the tank. The exchanger, supplied electrically, is activated by a thermic sensor that constantly points out the temperature of the oil when this one reaches 80°C. Under this temperature the exchanger doesn't work. The temperature check can easily be carried out by watching the appropriate thermometer, placed outside the tank.

C3.3 Pile driving

Preliminary interventions:

Before any other thing, the operator has to delimit the area (building site) in which he moves the pile driver and in which he drives the piles (standard work) or, like we already mentioned, supplementary functions with different accessories. According to the conformation of this area, he'll fix up the specific signals, which have to be well in sight and approved.

Afterwards, the operator will bring the pile driver to the place where he wants to carry out the work and will position it in an opportune way. The pile driver has to be set in a precise working configuration in order to drive the piles. Therefore, the operator, by manoeuvring one at a time the regarding levers of the distributor will position the machine. A level, placed on the column (see the figure), makes it able for the operator to effect this intervention faster.



LEVEL

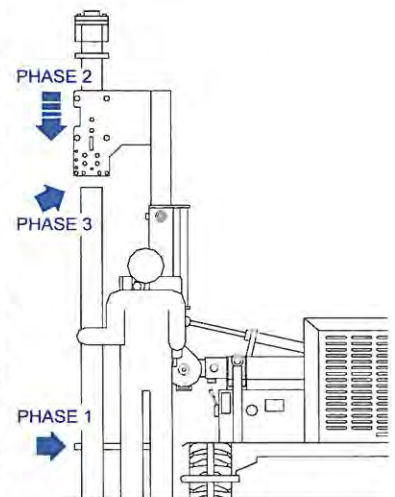
FASTEN PINS PILE GUIDE BEARING



Once the machine is set on the working configuration, the pile driver should be prepared for the driving with the help of the **pile guide bearing**, showed in the figure. The operator unthreads the two fixing pins, placed in the inferior part of the column as showed in the figure. He'll insert the guide bearing and secures it by reinserting the two pins previously taken off, in the respective holes. Done that, the pile driver is ready for the driving of guardrail posts.

Pile driving:

the operator places the pile into the guide bearing, as showed in the figure (**phase 1**). Then he'll lower the hammer (**phase 2**) until the pile hammer template covers the headstock of the pile, which prevents the pile against coming out (**phase 3**). After that, still activating the same lever for another few seconds, he provokes the lowering of the movement support of the hammer group, blocked on the chain, and so the hammer group will unhook.

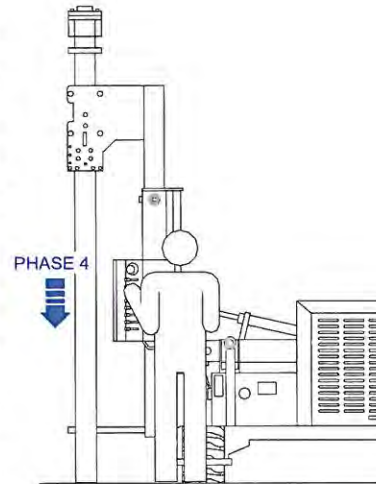


In this way, the hammer isn't tied up anymore by the movement of the chain during the hammering phase and will go down per its own weight and therefore per gravity. Done these things, the operator activates the hammering by bringing the respective lever to its end point and by blocking it there. In that way the driving process will start. (**phase 4**).

C3.4 Pile extraction

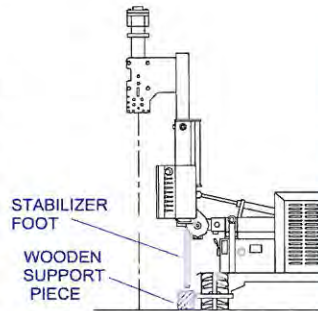
- **Preliminary interventions:**

Repeat the operation as described in the analogue part of paragraph C3.3, with the addition though of the placement of the supporting foot, as showed in the figure. Normally this foot is only used for the extraction of piles. It is mounted in the inferior part of the column. It gives stability to the machine during the extraction phase. It's even an obligation to use it during the extraction. The operator has to take the fixing pin out and has to lower the supporting foot that will come out of its seat. It's not always possible to determine the consistence of the soil and that's why it's always advisable to place a solid support between the ground and the supporting foot, as for example a wooden piece or a metallic plate. After that, the operator has to secure the supporting foot by reinserting the fixing pin, previously extracted, in the concerning hole. At the end, he has to lower the column until it is placed well on the supporting piece. In that way, the extraction work could start;



- **pile extraction:**

a metallic bar will be inserted in the lateral holes of the pile, as showed in the figure. The bar will be the shot pin for the extraction. Attached to this one and to the lateral hooks of the hammer group will be the pile extraction chain, as showed in the figure, operating as a tie rod. Activating the concerning lever the column will be hoisted. The column will lift as well the hammer group as the pile. The extraction process finishes with the exiling of the pile.



IMPORTANT: for this intervention the operator has to use exclusively the pile extraction chain. This one is supplied by the company Pauselli as standard equipment of the pile driver. If it's not possible to use this chain, use an approved chain which is sufficiently resistant and conform to the extraction. **In this last case, the Constructor doesn't answer to accidents to people or to the machine if the used chain doesn't result idoneous for such operation.**

C3.5 Operations at the end of a task

At the end of the working day or for long working interruptions, the operator has to bring the pile driver in the transport configuration (see the instructions described on page 8). Switch the engine off by bringing the starting key in position "0", then extract the key from the frame and at the end raise the protection screen (described on page 9) with the purpose to safeguard the whole starter frame and the other control posts nearby.

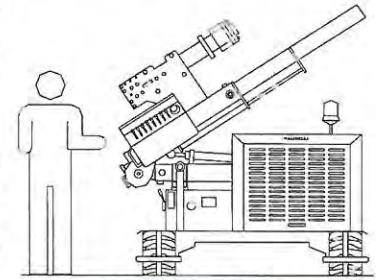
C4 Components substitution and various regulations

C4.1 Substitution of the pile hammer template and the pile hammer

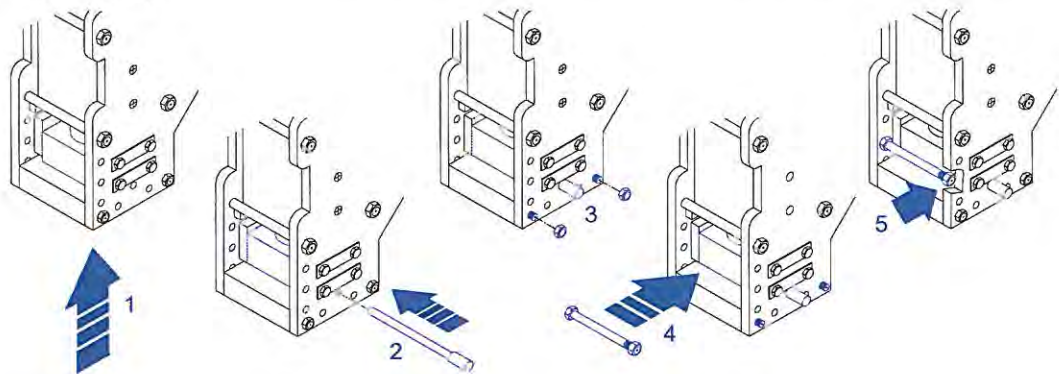
Depending on their use, piles may have different sections one from another and therefore the pile hammer template and the pile hammer have to be adapted to each pile section. Therefore, if it is necessary to drive piles with a different section from the standard ones, it would be

necessary to change both pile hammer and pile hammer template on the hammer group. Both accessories are produced by the company Pauselli and are delivered to the Customer only on request. The instructions for the substitution of the pile hammer template and the pile hammer are described as follows:

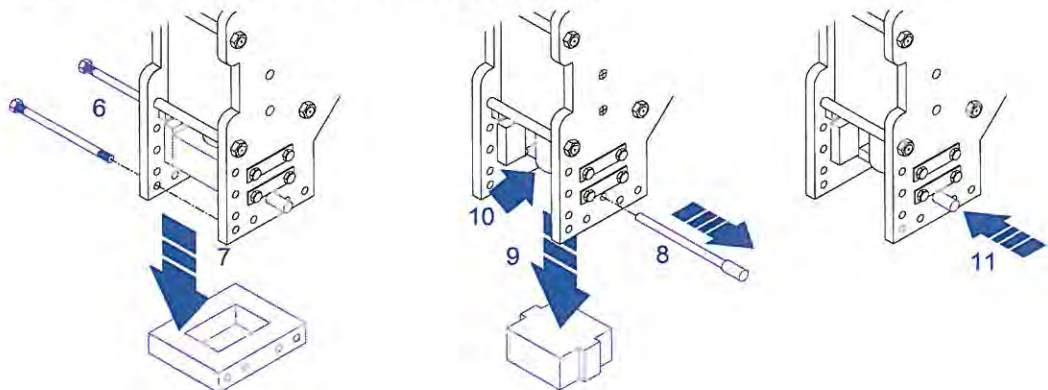
- to make the intervention phase easier, it's necessary that the machine assumes the transport configuration, as showed in the figure, and then the engine has to be switched off;
- insert one hand in the pile hammer template **(1)** so the pile hammer will be pushed up with the purpose to insert a bearing pin **(2)** in the appropriate hole, as showed in the figure, in order to block the descent of the pile hammer;
- done that, the operator removes only two of the screw nuts, showed in the figure **(3)**, that fix the pile hammer template to the structure of the hammer group without extracting the pins;
- after that, the operator will insert the dilator bolt with screw nut into the structure of the hammer group, as showed in the figure **(4)**. Then the operator will activate the screw nut placed on the same bolt, **(5)** with a key. Such action opens the sides of the hammer group structure and that makes it easy to remove the pile hammer template;
- holding the pile hammer template still with one hand, extract the two pins that fix it to the hammer group structure **(6)**. After that, remove the template out of its seat **(7)**, as showed in the figure;



CONFIGURATION OF TRANSPORT AND MOVEMENTS



- holding the pile hammer still with one hand, extract the bearing pin out of its seat **(8)** and put it on a mobile table. After that, remove the pile hammer **(9)** carefully with the other hand and make sure the bit doesn't fall down **(10)**;

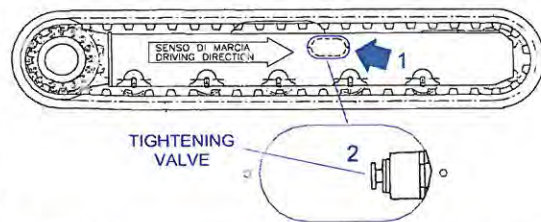


- hold the bit still and insert the bearing pin again in the appropriate hole **(11)** in order to block the descent of the bit. Then, mount the new pile hammer and the new pile hammer template. This can be done inverting the above described operation.

C4.2 Substitution and tightening of the tracks

- **Substitution:** the crawler track substitution must be carried out when there are **10 mm** of tread left, but also previously to the presence of cuts. Anyway, for such intervention it will be necessary to lift the pile driver up from the ground for at least 40 cm. The lifting of the machine can be done by an elevator group, as described in paragraph B2 point 1 or by using a lifting bogie able to carry such burden. In this case the forks of the lifting carriage will take it on the connecting crosspieces of the two backstays. **In both ways, the general rule for hanging loads must be respected.** Proceed with the substitution of the crawler track in the following way:

- clean carefully the parts of the undercarriage;
- remove the closing tally **(1)** on the backstay, showed in the figure;
- loosen the tightening valve **(2)** inside the space as showed in the figure. After that, when it's certain that there isn't any grease pressure left, remove the valve;
- withdraw the front wheel by pressuring the rubber crawler track with a foot (see figure);



- lift the track on the inferior white line using protective gloves. Make it come out of its seat towards the outer side by working between the track and the idler gear;
IMPORTANT: pay a lot of attention when the track falls on the ground;
- for the installation of the new crawler track proceed as indicated before, but in the opposite order.

- **tightening:** normally such intervention is carried out in the operative area (building sites) and is effectuated by introducing grease in the tightening valve with the help of a hand pump. Therefore, not having a manometer, the tightening is effectuated in an appropriate measure at sight. If instead, the intervention takes place in an authorised workshop, the grease will be injected, under pressure. The standard value of tightening read on the manometer has to be 200 bar.

IMPORTANT: in both ways, in the moment when the pump will be extracted from the valve, the intervention of a shut-off valve will prevent the outcoming of grease, especially for that under pressure, to be dangerous.

C4.3 Regulation of the slippage plugs

- **Regulation:** all the running parts of the pile driver slide on particular slippage plugs. They are constructed in Teflon and therefore self lubricant. There are two types: rectangular ones (blocked and not for registration), and round ones (free and for registration). These last ones, ferrules, soldered on the slippage structure, are pushed towards the running part by a ledger with a hexagonal head, as those showed in the figure. If you





MAINTENANCE

D1 Maintenance Instructions

The Constructor, following to functional tests, has foreseen some maintenance programmes which permit, if respected and carried out with care by the Customer, to maintain unchanged the machine's efficiency and capacity preserving the equipment of any functional damages.

The operator has to be an adult, qualified and trained person. In any case, he mustn't rely on his memory, but he must always read the instructions of this manual and carry them out in an accurate way, respecting the safety rules.

The maintenance interventions, once started, have always to be completed and never be postponed. The same instructions have to be carried out for reparations. Before any kind of task though, the operator has to apply a folder on the pile driver with the written words '**machine in reparation**' for his own safety and to prevent damages to the machine. In that way he avoids that someone not knowing about the task, activates the pile driver.

The use of tools in order to carry out the interventions on the pile driver is subordinated to the safety rules. At the same time it's indispensable to use authorised products and not to use them in an improper way, as for example using benzine for cleaning or using pliers instead of the monkey wrench. Substitute the worn-out or broken parts with original spare parts or with those recommended by the Constructor.

At the end of the maintenance or reparation interventions, clean the area from water, oil, grease, rags, equipments or other material.

IMPORTANT: be careful concerning the loss of fluids under pressure and the excess vibration of the pipes, what means that the nitrogen in the hammer head is not sufficient. Proceed immediately with the loading process as described in the concerning manual of the hammer.

D2 Programmed maintenance

The intervention periods (programmed maintenance) only have an informative function, and they are relative to the normal environment conditions and use. Therefore they can undergo to variations in relation to the type of service, the environment in which the operating takes place, season factors, etc. Worse the operating conditions are, more the interventions have to increase.

• Daily check:

Do the following checks every day or after 8 (eight) operating hours:

- check if there are any hydraulic oil leaks or drafts present;
- check the automatic return of the control levers and the carrying out of all the functions;
- check the level of the engine oil;
- check the hydraulic oil level in the tank;
- make sure that the motor reducers work well;
- check the tightening of the crawler tracks;
- apply grease to all the present grease cups on the pile driver with the special pump. For such intervention, follow the described instructions in the concerning paragraph;
- clean the chain and grease its links;
- check if there are any extraneous parts present between the moving components of the crawler tracks;
- consult the manual of the engine and the hammer for the concerning interventions;

• Weekly check:

Do the following checks every week or after 50 operating hours:

- check if there are any hydraulic oil leaks or drafts present. If yes, check the closing links;
- check the automatic return of the control levers and the carrying out of all the functions;
- check the level of the engine oil;
- check the hydraulic oil level in the tank;
- make sure that the motor reducers work well;



- check the tightening of the crawler tracks;
 - apply grease to all the present grease cups on the pile driver with the special pump. For such intervention, follow the described instructions in the concerning paragraph;
 - clean the chain, check the state of the anchorage pins of its links, and then oil the links;
 - check the locking of all the nuts and bolts;
 - check if there are any extraneous parts present between the moving components of the crawler tracks;
 - check the state and the integrity of the loading chain and of the pile extraction chain;
 - consult the engine and hammer manual for relative tasks;
- **Interventions to carry out after 100 operating hours**
After about 100 operating hours (running), it will be necessary to substitute the engine oil, the engine oil filter and the hydraulic oil filter. For such task follow the instructions described in the concerning paragraph of the present manual.
 - **Checks and interventions to carry out every 300 operating hours**
Do the following checks after 300 operating hours and every 300 working hours:
 - substitute the engine oil
 - substitute the engine oil filter
 - check and restore the nitrogen level of the hammer (25-30 bar)
 - check the integrity of all the adhesive labels;
 - check the integrity of all the tubes (closing links, integrity of the protective braided wires, and hydraulic oil leaks or drafts);
 - check the automatic return of the control levers and the carrying out of all the functions;
 - check the hydraulic oil level in the tank;
 - check the oil level in the reducers.
 - check the tightening of the crawler tracks;
 - check the wear-out and the state of the crawler tracks. For the check and the substitution of these tracks, consult the instructions described in the relative paragraph;
 - apply grease to all the present grease cups on the pile driver with the special pump. For such intervention, follow the described instructions in the concerning paragraph;
 - clean the chain, check the state of the anchorage pins of its links, and then grease the links;
 - check the presence and the integrity of the holddowns and of the security devices;
 - check the locking of all the nuts and bolts;
 - check the state of the whole carpentry;
 - check the state and the integrity of the loading chain and of the pile extraction chain;
 - check the liquid level in the battery;
 - consult the engine and hammer manual for the concerning intervention;
 - **Intervention to carry out every 600 operating hours**
Do the following interventions after 600 operating hours and every 600 working hours:
 - substitute the diaphragm in the hammer head and restore the nitrogen level

The checks and interventions to be carried out every 300/600 hours have to be done regularly, consulting the present manual of use and maintenance as well as the one concerning the hammer.

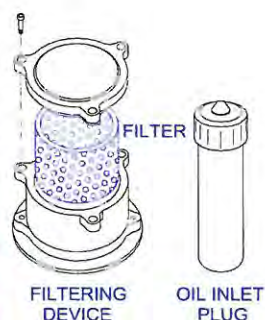
- **Yearly check or after 1200 operating hours**
Do the following checks after one year or after 1200 operating hours:
 - check the integrity of all the adhesive labels;
 - check the integrity of all the tubes (closing links, integrity of the protective braided wires, and the lack of hydraulic oil leaks or drafts);
 - substitute the engine oil;
 - substitute the engine oil filter;
 - substitute the hydraulic oil in the tank and the concerning filter completely. For such intervention consult the instructions described in the concerning paragraph;

Note: *it's advisable to effect the oil unloading when it's hot, so it will come out easier. Therefore it would be better to carry out this operation at the end of a job*
*When you restore the oil level, **don't mix different types of oil**, but always use the same type as the one contained in the tank.*
Substituting the hydraulic oil, it's possible to use a different brand, but it must have the same characteristics as the one recommended by the Constructor.

IMPORTANT: *to avoid pollution, it's absolutely forbidden to disperse oils, lubricants, filter cartridges or other noxious materials in the environment. Comply strictly with the instructions in force for the disposal of liquids or solid substances.*

D3.3 Substitution and check of the hydraulic oil filter in the tank

The hydraulic oil tank is equipped with an averaging device for the purification of the contained fluid. Such device is provided with a cartridge (filter) with a high filtering power. It purifies the oil on its return to the tank (unloading phase). To check the filter, it's necessary to remove the lid, to unscrew the three screws and extract it from its seat, as showed in the figure. Use only a new filter and of the same type.

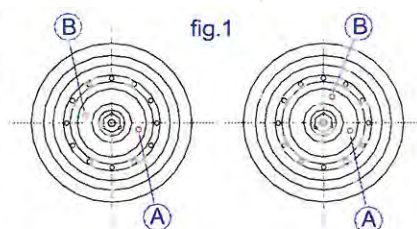


IMPORTANT: *to avoid pollution, it's absolutely forbidden to disperse oils, lubricants, filter cartridges or other noxious materials in the environment. Comply strictly with the instructions in force for the disposal of liquids or solid substances.*

D3.4 Substitution and level check of the oil in the motor reducers

Note: *every type of motor reducer has got n°2 plugs placed in different angles between each other. The types placed on the pile driver can have an angle of 90° or of 180°, as those showed in the figure.*

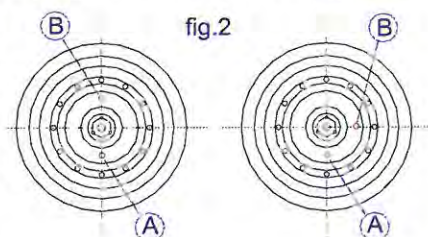
Level check: let the motor reducers turn until you bring the plugs in one of the configurations showed in figure 1. In both configurations the plug in position **A** represents the unloading one and has to be on about 15° under the white line in the middle of the reducer. The plug in position **B** represents the loading one.



Unscrew both plugs; put oil in the reducer through plug B, and when the oil comes out of the plug it means that the oil has reached the right level.

Note: *the oil contained in the motor reducers is the same one that lubricates the brakes (represented by the whole gear system inside every motor reducer). So when you check or substitute the oil in the reducers, you automatically check or substitute the oil of the brakes.*

Substitution: let the motor reducer turn until you bring the plugs in one of the configurations showed in figure 2. In both configurations the plug in position **A** represents the unloading one and has to be set on the maximal inferior point. The plug in position **B** represents the loading one.



Equip yourself with a container sufficiently capacious and place it under the plug in position A. After that, unscrew both plugs, let the oil come out completely and then remount the plug in position A.



Wash the motor reducer inside with detergent liquid suitable to the purpose and recommended by the producer of the lubricant in the following way: put liquid in the motor reducer, then remount the plug in position B, let the motor reducer turn for a couple of minutes on a sustained speed. Then empty the motor reducer from the detergent liquid again.

At the end, do the filling up: let the motor reducer turn until the plugs reach one of the configurations showed in figure 1 (check level). In both configurations the plug in position **A** represents the unloading one and has to be set at about 15° under the white line in the middle of the reducer while the plug in position **B** represents the loading one. Start with the filling of the reducer through plug B. And when the oil comes out of plug A, terminate the filling and screw both plugs. After that, let the reducer carry out some turns in order to eliminate eventual air binds. Recheck the levels following the described instructions for such intervention. It's better to use the recommended type of oil: **BP ENERGOL GR-XP 320**.

Note: *in case of level re-establishing, don't mix different types of oil, but always use the same type contained in the tank;*

it's advisable to do the unloading of the oil when it's hot. So it comes out easier. Therefore it would be better to carry out this operation at the end of a job. For the substitution of the hydraulic oil, it's possible to use a different brand but it should have though, the same characteristics as the one recommended by the Constructor.

IMPORTANT: to avoid pollution, it's absolutely forbidden to disperse oils, lubricants, filter cartridges or other noxious materials in the environment. Comply strictly with the instructions in force for the disposal of liquids or solid substances.

D4 Engine and hammer check

- **Engine:** for the oil level check of the engine and/or its substitution, for the check and/or the substitution of the concerning filter and for all the other checks concerning the engine, we recommend to follow all the instructions contained in the proper use and maintenance manual.
- **Hammer:** for the check and/or re-establishment of the charge of nitrogen in the accumulator and for all the other checks concerning the hammer, we recommend to follow the instructions in the proper use and maintenance manual of the hammer.

D5 Battery and electrical system check

- **Battery:** carry out the check of the electrolyte level of the battery with the engine off and with the pile driver parked on flat ground. The level of every element should be about 6 mm above the border of the plates. When it's necessary to re-establish the level, add distillate water, wearing waterproof gloves. It's better to add the water before starting the work. Check if the connecting chucks aren't oxidised. If they are, clean and grease them with antioxidant grease or substitute them.
- **Electrical system:** its check doesn't request a special intervention. That's also because on the pile driver everything works with an electrical-oildynamic alimentation. Therefore, the good operating of the machine is a constant check of the machine itself. There are some components that, even if they have an independent circuit of operating regarding the machine, have to be tested periodically. These components are the emergency button, the traffic indicator and the outlet.

D6 Troubleshooting

FAILURES	CAUSES	REMEDIES
Crawler tracks: Loosening of the crawler track	Lack of grease	Grease



	<p>Tightening valve defect</p> <p>Seal of the belt tightener is damaged</p> <p>Belt tightener components wear-out</p>	<p>Replace the valve</p> <p>Replace the seal of the belt tightener</p> <p>Replace the worn-out components</p>
<p>The superior part of the crawler track doesn't maintain the original position anymore</p>	<p>Slippage slide crawler track worn-out</p> <p>Superior roller worn-out</p>	<p>Replace the slide</p> <p>Replace the superior roller</p>
<p>The crawler track blocks in the steering phase</p>	<p>Interposition of material (stones, earth,..) between rollers, crawler wheel, and the rubber crawler track</p>	<p>Make the material coming out. Rotate the crawler track in both directions, slacken the tightening a little, and if it's possible lift the machine up.</p>
<p>Motor reducers:</p> <p>See the concerning use and maintenance manuals supplied enclosed to this one.</p>		
<p>Pile driver:</p> <p>The Diesel engine doesn't start (battery and oil indicators off)</p>	<p>Battery unloaded</p> <p>Fuse, placed inside the starter frame, interrupted</p> <p>If, after having checked the battery and/or the fuse, the engine still doesn't start, it will be necessary to check the whole wiring of battery/starter board/engine. If this turns out negative, please have a look at the use and maintenance manual of the engine</p>	<p>Load or replace the battery</p> <p>Replace the fuse (20 amp)</p> <p>Replace the wiring</p>
<p>The diesel engine doesn't start (battery and oil indicators on)</p>	<p>Electric stop device broken</p> <p>If the electric stop device has been removed, the connections are wrong</p>	<p>Replace electric stop device</p> <p>Carry out the connections following the electrical schedule enclosed</p>



	<p>After having checked the emergency button and/or the electric stop device it will be necessary to check the whole wiring of the emergency button/electric stop device/engine. If that results negative, please have a look at the use and maintenance manual of the engine</p>	<p>Replace the wiring</p>
<p>The diesel engine starts, but after a few seconds it turns off</p>	<p>Emergency button activated</p> <p>The lever for hammer activation lever has been left in position A (see paragraph C3.2) and blocked at the end point</p> <p>If after having checked the emergency button and the lever for hammer activation and after having started the engine again the result is still negative, please have a look at the use and maintenance manual of the engine.</p>	<p>Deactivate the emergency button (rotate slowly clockwise)</p> <p>Release the lever from position A (it returns automatically in the neutral position)</p>
<p>The Diesel engine turns, but no pressure arrives in the hydraulic circuit</p>	<p>Pump-engine joint broken</p> <p>Pumps damaged</p> <p>The relief valves unload all the oil</p> <p>The seal gaskets of the relief valves are damaged</p>	<p>Replace the pump-engine joint</p> <p>Repair or substitute the damaged pumps</p> <p>Check the calibration of the relief valves</p> <p>Replace the damaged seal gaskets</p>
<p>The distributor control levers don't work</p>	<p>Lack of oil</p> <p>Damaged or not connected tubes in the hydraulic system</p> <p>Hydraulic pump damaged</p> <p>Filter clogged</p>	<p>Add oil</p> <p>Substitute or connect the tubes</p> <p>Substitute the pump</p> <p>Substitute the filter</p>
<p>The jacks move in jerks</p>	<p>Air in the hydraulic circuit</p>	<p>Make the machine working unoccupied for a while, using one by one all the jacks to exit the air left in the hydraulic circuit.</p>



A jack moves without activating the lever	Blocking valve jammed Jack gasket wear-out Distributor gasket wear-out	Substitute the valve Substitute the gaskets Substitute the gaskets
Oil overheating	Filter clogged Tubes squashed Lack of oil	Substitute the filter Check and substitute the tubes Add oil
Oil leak from a connection	Slow connection Gasket wear-out	Tighten the tube Substitute the gasket
Hammer: The tubes of the hammer vibrate excessively.	The nitrogen accumulator is empty or lost pressure For all the other inconveniences concerning the hammer, please check the use and maintenance manual of the hammer	Check the nitrogen cartridge in the accumulator or re-establish it. IMPORTANT: it's advisable to react immediately in order not to perforate the diaphragm or damage the tubes.

Note: for all other failures or inconveniences not mentioned in the schedule above, always contact the Constructor.

D7 Request of spare parts

For the request of spare parts always mention:

- the identification data indicated on the concerning metal plate (model, serial number and construction year);
- the description of the part to be substituted, taken from the present manual;
- the quantity of the requested parts.

On the request for spare parts, concerning parts which are not of our production, mention the data written on the concerning identification plates and contact the company PAUSELLI.

The reparations, maintenances and substitutions of parts not conform to those described in this manual, are not covered by the warranty and the Constructor is not responsible for the bad operating of the machine and the eventual consequences due to the use of these parts.

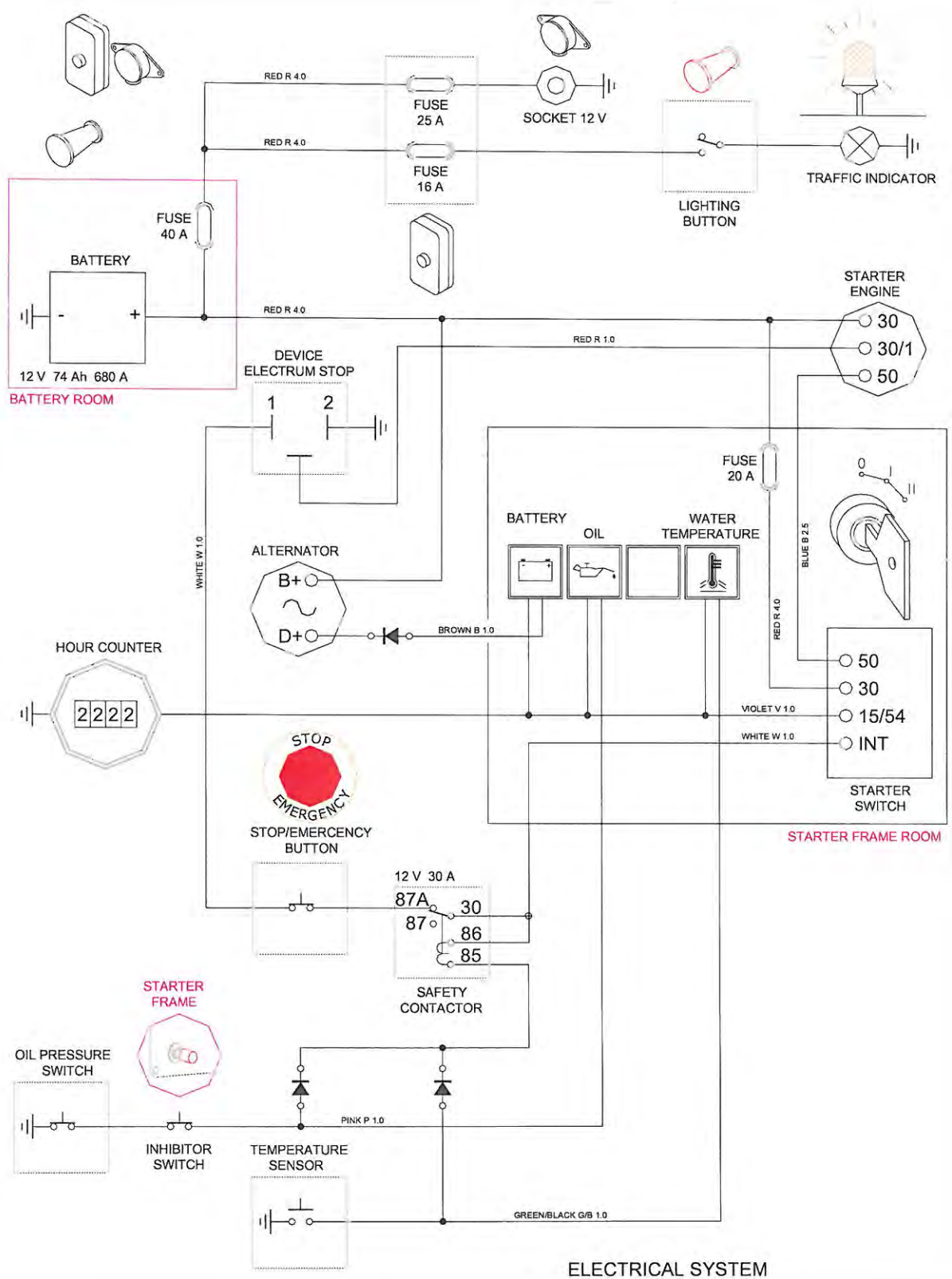
D8 Differentiated material splitting and disposal in case of demolition

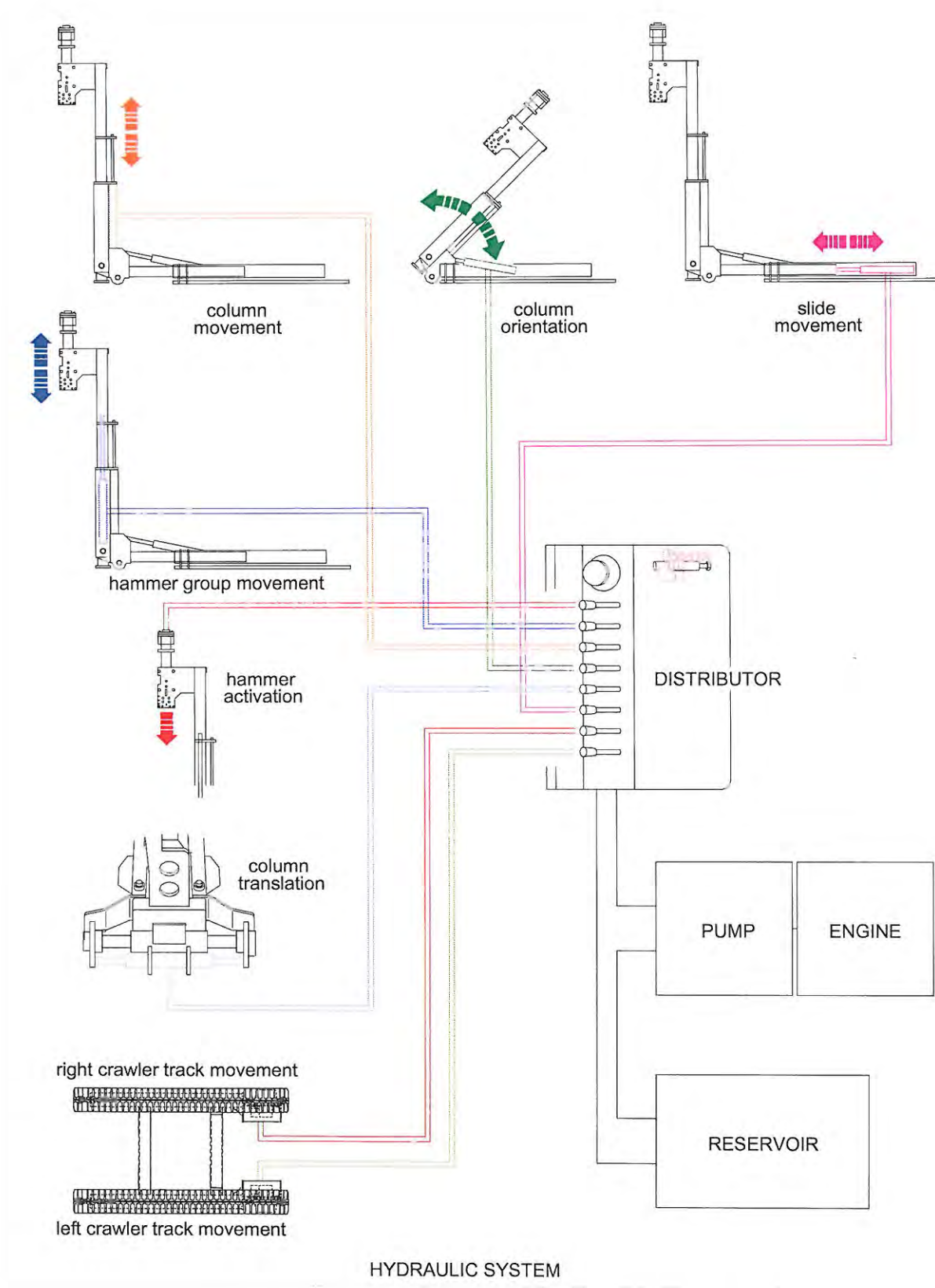
When the pile driver is out of function, the parts which could be dangerous for people, animals or the environment if dispersed, have to be made harmless. The material of the machine which have to be subdivided is:



- steel
- hydraulic oil
- rubber
- plastic

The loss of such material must be carried out respecting the orders of law of every single Country.





HYDRAULIC SYSTEM



DELIVERY AND WARRANTY CARD

COSTRUZIONI MECCANICHE PAUSELLI s.n.c.
zona artigianale Cinquemiglia - 06012 - Città di Castello (PG) italia


PAUSELLI S.R.L.
SIGNATURE AND STAMP

SERIAL NUMBER:

DELIVERY DATE:

USER: LIFTON POLSKA SP.J.
ADDRESS UL. KNUROWSKA 16
ZABRZE 41800
POLONIA

COPY FOR THE USER

SIGNATURE AND STAMP

CUT ALONG THE DOTTED LINE

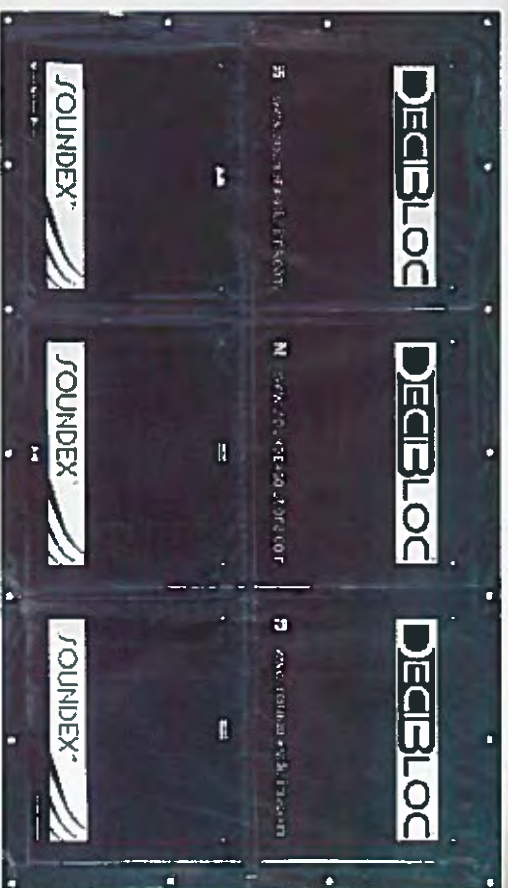


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APPENDIX B – EXAMPLE ACOUSTIC SCREENING PRODUCT

SOUNDEX®

SOUNDEX® Decibloc® Acoustic Barriers



Technical Data Sheet

SOUNDEX®

SOUNDEX® Decibloc® Acoustic Barriers

The SOUNDEX® Decibloc® products are a concise range of lightweight acoustic barriers that were designed for general noise control within construction and various industries.

The flexibility of these fire and weather resistant barriers makes it possible to construct an acoustic enclosure or fence of optimum performance. By utilising the eyelets which have been inserted on every side, the barriers can be attached by cable ties, screws or specialist fixing kits to site fencing, scaffolding, hoardings and many other structures. This range of products incorporates our signature easy-fold-down design for safe and economic palletised transportation and storage removing the potential issues associated with rolled-up products.

- Fire resistant
- Weather Resistant
- Up to 25.9 dB reduction in noise
- Independently tested and certified to BS EN ISO 717-1 : 1997; BS EN ISO 545 : 2003; EN ISO 11654 : 1997
- Non-irritant acoustic material with no glass-fibre content
- Lightweight
- Quick erection and easy palletised transportation
- Manufactured in the UK

SOUNDEX® Decibloc® Acoustic Barriers Dimensions

SIZE - Curtain	1250 x 2050 mm
WEIGHT - Curtain	5 Kg Each
SIZE - Curtain/Pals	1995 x 2000 mm
WEIGHT - Curtain/Pals	8 Kg Each
SIZE - Quic	3000 x 2050 mm
WEIGHT - Quic	15 Kg Each

SOUNDEX® Decibloc® Acoustic Barriers Test Data At Various Hz.

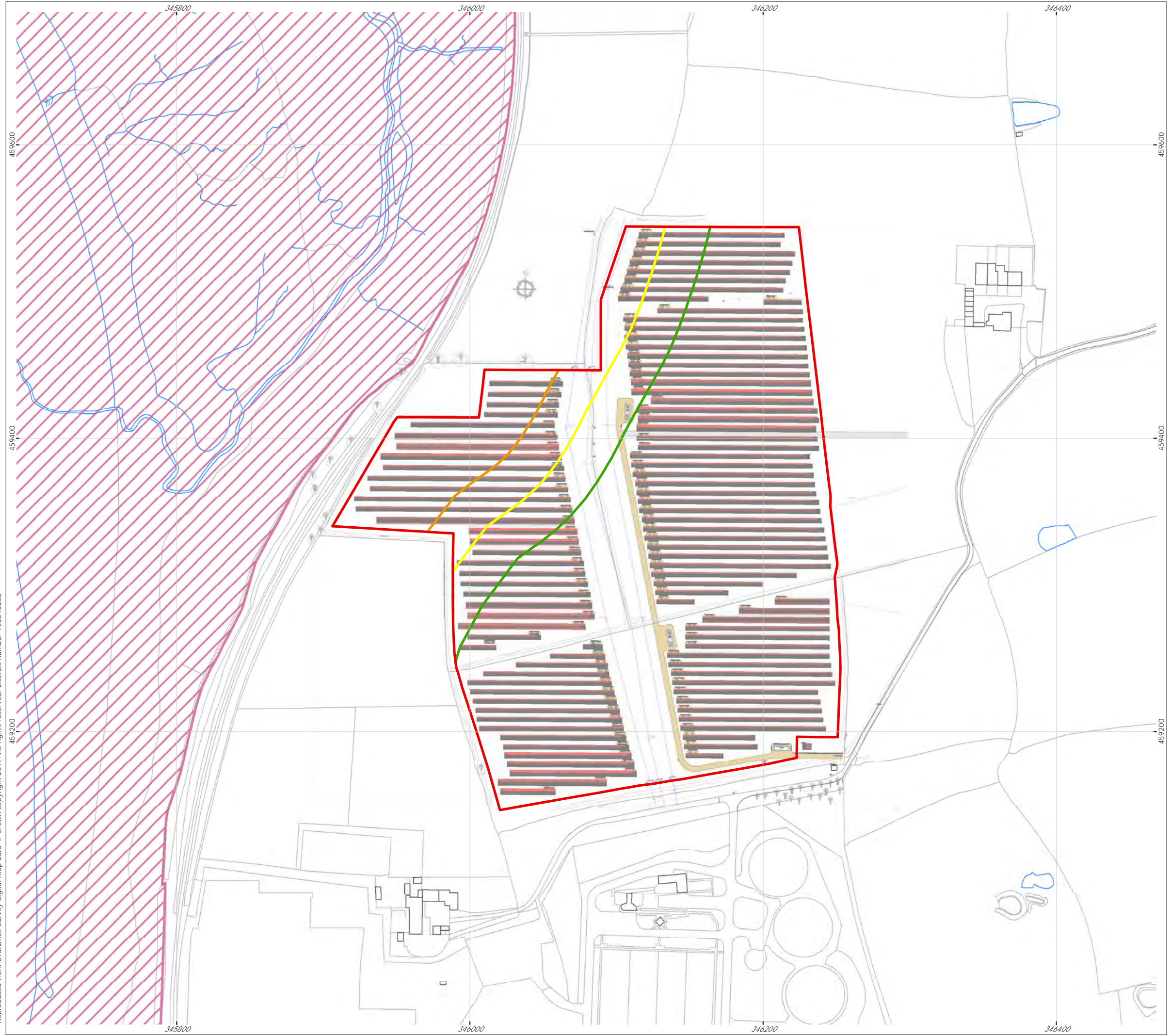
Tested and certified to BS EN ISO 717-1 : 1997; BS EN ISO 545 : 2003; EN ISO 11654 : 1997

Hz	250	500	1250	2500	4000	5000	Rw Value
Reflection dB	5.2	9.7	14.8	19.5	23.9	26.9	14.62
Absorption dB	0.12	0.17	0.25	0.51	0.52	0.53	0.28-05

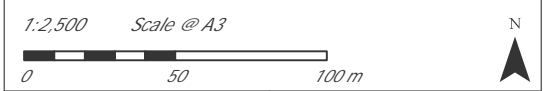
SOUNDEX® Decibloc® Acoustic Barrier Fire Ratings

Acoustic Vinyl Membrane	M2 / B1 / BS / B s2-d3 / (EPA)101
Acoustic Core	Class 0
Acoustic Mesh Membrane	M2
Perforating	Non Flammable Water Based Ink

APPENDIX C – FIGURE DETAILING PILING SETBACK DISTANCES



- Site Boundary
 - Morecombe Bay Special Protection Area
- Setback distances from SPA*
- 90 m
 - 120 m
 - 150 m



Produced: SC	Ref: 2411/REP/001
Approved: AM	Date: 16/02/2017

Piling Noise Setbacks
Figure 1

Arna Wood Solar Farm
Piling Noise Assessment