

1 Purpose

1.1. General approach

For construction, engineering or maintenance works, the adverse impacts and effects of noise and vibration should be avoided or minimised through consideration of the form and methods of construction, programming of works, mitigation of noise and vibration, monitoring and communications. This should include:

- a) noisy works, that are audible at the site boundary, should be undertaken during 'normal' daytime hours;

NOTE: Where this is not possible, preference should be given to undertaking works during the daytime over the weekend. Where this is not possible, noisy works should be confined to evening periods.

- b) night working should be considered a last resort, such as the need to obtain track possessions;
- c) obtaining prior consent under Section 61 of COPA 1974;
- d) selection of form and methods of construction and associated activities;
- e) appropriate specification and maintenance of plant and equipment;
- f) scheduling of works to avoid sensitive periods;
- g) reducing the duration of exposure (programme period);
- h) maximising noise attenuation through plant / equipment location and screening (landscape, buildings or localised screening) relative to noise sensitive receptors;
- i) monitoring of noise and vibration, and site inspections;
- j) undertaking effective communication with local authorities, residents and other stakeholders, including complaints handling;
- k) briefing and training of staff regarding control measures.

NOTE: Task briefings, work package plans, toolbox talks etc.

For service providers and suppliers, the adverse impacts and effects of noise and vibration should be avoided or minimised through means including:

- a) appropriate specification and maintenance of plant and equipment;
- b) reducing noise levels through plant / equipment location, screening or other control measures;
- c) scheduling of deliveries to avoid sensitive periods;
- d) briefing and training of staff regarding control measures;
- e) undertaking effective communication with stakeholders, including complaints handling.

The Network Rail Helpline shall be the first point of preferred contact for any queries or complaints resulting from the work. The responsible manager shall see that all complaints are recorded, investigated and any corrective actions implemented in accordance with the appropriate standards.

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1.2. Track possessions

1.2.1. Track possessions justification

Network Rail has an obligation to provide safety measures for both its employees and the general public. These safety measures may incorporate segregated areas where staff and machinery can carry out work away from the operation of the normal timetabled trains. Works which would be disruptive to the normal scheduled rail services are therefore undertaken outside the “normal” working hours for the construction industry. This could be during the night, over weekends, and/or on Bank Holidays. These track “possessions”, or “blockades” provide a means of providing a safe working environment. (Blockades are the same as possessions, but the duration is longer).

The designated tracks are handed over for the exclusive purpose of undertaking specific works. A possession has geographical limits and an intended scope of work and duration. These programmed possessions avoid, or minimise, disruption to the rail services and inconvenience to the travelling public. Outline possession planning for major works starts approximately 18 months before the works are programmed to commence. In certain circumstances, work can be planned within shorter timescales, provided that due notice is given to the TOCs. Possessions have cost implications associated with the contractual arrangements between Network Rail and the TOCs.

1.2.2. Criteria relevant to a track possession strategy

The criteria that should be taken into account in developing a track possession strategy are listed in table A-1.

Criteria	Description
Safety of the Railway	Safety is of paramount importance and remains the prime consideration in guiding and formulating both the track possession strategy and the method by which the works are undertaken
Rules of the Route	These are directions formulated to make certain that, whilst essential works to the track can be undertaken, the level of disruption to the train services is such that service performance targets can continue to be achieved and that the safety and convenience of the travelling public is not impaired
Scope of Works	The discrete characteristics of each work programme, together with safety considerations, should dictate the precise track possession requirements
Environmental Considerations	Potential annoyance to local residents, business and the community at large, is taken into account in track possession planning, such that weekday night-time possessions are kept to a minimum. Heavy civil works and particularly intrusive operations are scheduled for daytime possessions, where practicable. The use of appropriate construction programmes and worksite locations can help to facilitate this.

Table Error! No text of specified style in document.-1 – Criteria for developing a track possession strategy

1.2.3. Optimising the Usage of Track Possessions

Where possible, project works should be amalgamated with the established maintenance regime for the railway. This should enable the maximum number of works to be undertaken within a single possession period as the possession should allow; hence, reducing the overall disruption and minimising the knock-on effects to the train service.

1.3. Specific activity controls

1.3.1. Managing noise from vehicle movements

- Road vehicles should not wait or queue up with engines running on the site or on the public highway;
- Noise from reversing alarms should be controlled and limited through adoption of the following measures;
- The site layout should be designed to limit and where reasonably practicable, avoid the need for the reversing of vehicles by installing one-way systems or turning circles. The Contractor should seek to demonstrate that drivers are familiar with the worksite layout;
- Banks-person should be utilised to help manage the movement of vehicles;
- Reversing alarms incorporating one of more of these features or any other comparable system should be used where reasonably practicable:
 - highly directional sounders;
 - use of broadband signals;
 - self-adjusting output sounders;
 - flashing warning lights.
- Reversing alarms should be set to the minimum output noise level required for health and safety compliance;
- Equipment, including vehicles, should be shut down when not in use;
- Engine compartments should be closed when equipment is in use;
- Plant and equipment should be examined for defects daily prior to the start of works and under no circumstances is defective plant to be used;
- Semi-static equipment is to be sited and orientated as far away from noise-sensitive buildings as is reasonably practicable and might need to have localised screening;
- Wherever possible, mains electricity is to be used rather than placing reliance on generators to supply power;
- Generators, compressors and pumps etc. required for 24-hour operation should be super-silenced and screened/enclosed as appropriate;
- Crane spindles, pulley wheels, telescopic sections and moving parts of working platforms should be adequately lubricated in order to prevent undue screeching and squealing;
- Where practicable as many materials as possible should be prepared off-site;

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- Wherever practicable, rotating or impacting machines should be positioned on anti-vibration mountings;
- Modern, silenced and well-maintained plant fitted with efficient attenuators, mufflers or acoustic covers, where appropriate, should be used;
- All relevant plant and equipment should be expected to meet the noise limit and noise marking requirements prescribed by the Noise Emission in the Environment by Equipment for Use Outdoors Regulations 2001, implementing the EU Directive 2000/14/EC.

1.3.2. Demolition works

- Demolition methods should always suit the circumstances, and should reflect the differences between structure-borne and air-borne noise;
- In connection with demolition and other works of a similar nature, the presumption should be to minimise the amount of breaking up of material on-site. Where practicable the material should be removed from site to a less sensitive location where it can be broken down further as necessary;
- Peckers should not be used at any time where the use of quieter alternatives, such as pulverisers, is practicable. Hydraulic pulverisers (munchers) should be used where reasonably practicable in preference to breakers;
- However, if there are no other alternatives, breakers should incorporate integral mufflers, acoustically damped moils (tool pieces) and acoustically damped body casings, where the nature of the work makes this practicable. Also, an oversized breaker should be used to minimise the blow rate and noise produced.
- Concrete bursting and innovative methods of material cutting such as diamond saw cutting should be considered in preference to other noisier methods;
- Wherever it is logistically practicable to do, noisy works should be programmed to take place during 'normal' daytime hours;
- Wherever practicable and especially during particularly sensitive periods, e.g. night time possessions, the quietest methods of material breaking should be utilised, e.g. by use of saw cutting or pulverisers. Percussive breaking methods should only be used only as a last resort where quieter methods are not practicable;
- Demolition work occurring at night should seek to break bridges or other structures into sections which are as large as possible for subsequent removal to a less sensitive location before being broken up;
- If during overnight working concrete obstructions arise these should be removed and taken to a less sensitive location before being broken up. Where possible hand breakout of structures should be encouraged, and walls/structures should be dismantled or "pushed over" rather than conventionally broken-out using pneumatic drills;
- Where practicable, material from overnight demolition should be stockpiled for subsequent removal during normal working hours, rather than removing during the night-time period;
- All materials should be handled, stored and used in a manner that minimises noise. It should be necessary to demonstrate the efficient handling of materials to avoid unnecessary double handling and to minimise drop heights. Wherever practicable, materials should be lowered, not dropped. For safety reasons, at no time should poles be dropped;

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- Buildings should be demolished using munchers or shears in preference to breakers;
- Saw cuts should be introduced to sever links between structures to be demolished and those being retained to reduce structural noise and vibration transmission.

1.3.3. Groundworks

- Trench sheets should be hand dug;
- Where practicable, “silent” piling should be the preferred method where ground conditions allow, otherwise vibro-piling should be used. Percussive piling methods should be the last resort and should, where possible, implement measures to shroud the hammer or head of the pile;
- If sheet piling has to be used these should be the Giken Silent Piler, or similar, where ground conditions permit;
- Where practicable, pile caps should be cut and broken with hydraulic rams to minimise use of air-powered breakers;
- In certain ground conditions the leader rig may have to be percussive but where possible it should be vibrating;
- Parapet bolts should be cast in and shall only be post-drilled as a last resort;
- It should be noted that there may be scabbling between pours, however, this should be kept to the minimum required for the particular operation;
- For the operation of taking off the stop-ends of the concrete pours a water pressure-washer should be used, or, an air-lance to reduce the problems of dust/water;
- Obstructions that stop work should be rectified so that work can resume;
- Site entrances should avoid being opposite or adjacent to noise sensitive receptors, wherever practicable.

1.3.4. Acoustic Barriers

The responsible manager should determine how noise barriers are needed to shield sensitive receptors and reduce noise levels. Temporary barriers should be encouraged rather than permanent barriers as their use may set future precedents. Acoustic barriers may also fall within temporary work requirements. There should be a general presumption towards the screening or enclosure of mobile and fixed plant as a simple yet effective means of containing the noise at source as follows:

- Perimeter screens / site hoardings and acoustic barriers should be designed early in the contract and installed as soon as practicably possible to provide protection and reduce noise levels at noise sensitive premises;
- Temporary noise barriers should be used to reduce noise levels where appropriate and practicable. Temporary noise barriers should be erected to screen 'breaking out' activities wherever possible to protect noise sensitive receptors. Noise barriers should be imperforate, of an appropriate superficial mass, and have a suitable absorptive internal lining, in accordance with best industry practice;
- In other situations, barriers may take the form of 12mm plywood sheets on timber frames (hoardings / screens) as necessary, having a density of at least 7kg/m²;

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- In order to maximise noise reduction, screens should be erected from floor level to a height at least 1m above the highest sight line. In certain circumstances, such as near high-rise buildings, this may not be practicable.

1.3.5. Management of Works Programme

In laying out the site, where practicable the Contractor should avoid locating site entrances opposite or adjacent to noise sensitive receptors. The following measures should also be implemented:

- Areas, which have been excavated below ground level, should be utilised to locate static plant such as generators, compressors, pumps etc, where this is practicable;
- Preference should be given to undertaking noise generating works during the daytime over the weekend. Where this is not possible, noisy works should be confined to evening periods rather than during the night. Night working should be considered a last resort, i.e. where the practical considerations of the programme make this unavoidable, such as the need to obtain track possessions. If noisy work is unavoidable outside of the normal daytime hours, all steps must be taken to minimise noise produced and acoustic screens and/or barriers should be considered and used if at all possible;
- Wherever practicable, noisy works, which are audible at the site boundary, should be undertaken during 'normal' daytime hours, i.e. between 08.00 and 18.00 Monday to Friday and between 08.00 and 13.00 on Saturdays;
- In some areas where there are a high number of commercial premises and few residential premises the Local Authority may re-define the 'normal' daytime hours to accommodate the commercial premises. The hours of work should strike a balance between residential and commercial interests;
- Similarly, the hours of service for places of worship should be considered and taken into account;
- The choice of routes and programming for the transportation of construction materials, spoil, personnel etc should be carefully considered in order to minimise the overall noise impact generated by these movements upon the local community. However, the relevant Highway Authority may have considerations which should affect the programming of such works;
- Personnel should be instructed on BPM measures to reduce noise and vibration as part of their induction training;
- All plant being utilised on site should be regularly inspected in order to demonstrate compliance with the plant list identified in the Section 61 application for the specific activity;
- Shouting and raised voices should be kept to a minimum except in cases where warnings of danger must be given. The use of tannoy and radios is to be prohibited;
- Notwithstanding these points, given the reality of the rail environment much of the works should have to take place outside of 'normal' hours; this principle is recognised and is accepted by the local authorities concerned, (see track possession, below).

[NB: *the practical examples of BPM applications described here do not represent an exhaustive list. Each site is unique and should be considered on its own merits. See specific guidance*

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contained in BS 5228 and in other sources. Innovative and enterprising solutions are to be encouraged].

1.3.6. Piling

- The intention should be to use jacking (or pressed-in piling) as the preferred sheet piling method with pre-auguring if the ground conditions require. In the event that jacking with pre-auguring should not work due to the ground conditions, a vibrator on a leader rig shall be used after pre-boring;
- Where practicable, pre-auguring should be carried out. Only where geological conditions preclude the use of 'silent' piling methods such as the Giken Silent Piler or the Tosa Stillworker, should percussive piling methods be used but not during the most sensitive times of day/night. The use of drop hammers shall be avoided;
- If obstructions are encountered, work should be stopped and the cause of the obstruction examined and rectified before work continues;
- Where practicable, pile caps should be cut and then broken with hydraulic rams to minimise the use of percussive breakers;
- Burning equipment should be used in preference to cold cutting where possible;
- In general, concrete pours should be of a size small enough to enable the pour to be completed during the core hours. However, if a large concrete pour is unavoidable (for which an extension of working hours may be necessary) it should commence as early as possible during the day so that the work can be completed as soon as possible.
- Drop hammers, driven and vibro piling techniques and other percussive methods of sheet piling should be the method of last resort and only where all other systems have been considered and rejected;
- The use of casing vibrators should be avoided by using sufficiently powerful rigs. It is intended that a mix of small diameter and large diameter rotary piling with the casings twisted into the pile bores should be used;
- Subject to satisfactory ground conditions and having due regard to any logistical constraints, "silent" piling methods (e.g. Giken Silent Piler or Tosa Stillworker), where the pile is jacked, or pressed, into the ground, should be the preferred method and should be selected where conditions allow. Where this is not practicable, a vibrator on a leader rig should be used after pre-boring.

1.3.7. Plant and Equipment

All relevant plant and equipment should be expected to meet the noise limit and noise marking requirements prescribed by the current Noise Emission in the Environment by Equipment for Use Outdoors Regulation 5. This requires the responsible manager to see that:

- Equipment including vehicles should be shut down when not in use;
- Engine compartments should be closed when equipment is in use;
- Semi-static equipment should be sited as far as is reasonably practicable away from occupied buildings, placed to minimise noise impacts, and may need localised screening;
- Wherever possible, mains electricity, or battery-powered (including solar PV) should be used rather than using diesel or similar fuel generators;

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- Generators, compressors and pumps etc. required for 24-hour operation should be super-silenced and screened/enclosed as appropriate.

In particular, the following types of equipment should be considered:

1.3.8. Vibro-piling

There are various forms of vibro-piling, such as stone columns and vibro-compaction. However, these techniques are applicable only in a limited range of soil conditions and may not achieve the same load bearing and settlement criteria as conventional forms of piling. Where the soil conditions are not appropriate these forms of piling can give rise to increased levels of vibration.

Pile trimming should be carried out using a hydraulic munching system or using hydraulic splitters (wedge and feather splitters) inserted into holes drilled into the pile head at the cut-off level. In most cases the final trimming should still need to be carried out by hand using hand-held pneumatic breakers.

1.3.9. Concrete Breaking

There should be a general presumption against percussive breakers being used at any time where the use of quieter alternatives, such as pulverisers, is practicable.

Concrete bursting and innovative methods of material cutting such as diamond saw cutting should be considered in preference to other noisier methods. Hydraulic munchers should be used where reasonably practicable in preference to breakers. There are various types of procedures for the breaking up of concrete slabs and foundations and several of these are outlined below:

1.3.10. Hydraulic Splitters

- Initially the concrete must be perforated with drilled holes. A cylinder containing a control valve and a piston is inserted into one of the holes. The piston moves a plug between two 'feathers' which sit either side of the plug. The plug and feather end (bursting head) is placed into the drilled hole. The plug moves down between the two feathers forcing them against the wall of the hole. The split should occur when the tension increases beyond the tensile strength of the material the concrete. The hydraulic splitter is powered by a 10,000 P.S.I. pump (approximately 70MPa). Hydraulic bursting is achieved once cracks are formed in the concrete, these cracks should find the weakest route and the process is repeated until the whole structure is reduced to small sections which can be removed by hand.

1.3.11. Wire saw cutting

- Wire sawing enables the cutting of heavily reinforced concrete and masonry to virtually any size or shape and can also be used for cutting large structural openings. The beaded wire can be placed around an object such as a heavily reinforced concrete column and an almost unlimited cutting depth can be achieved by this method. The beaded wire is passed through a series of hydraulic pulleys thus pulling the wire through the concrete.

1.3.12. Hydro-demolition

- Dust is kept to a minimum with the use of water and any fire hazard is eliminated. Both straight lines and contours can be cut with this method. However, it does require the use of an abrasive and water-catching system during the cutting process and in certain circumstances this is not practicable. Also, it is usually a slow technique requiring exclusion zones around the work site.

1.3.13. Thermic lance cutting

- One of the disadvantages of thermic lance cutting is that excessive heat can cause some deterioration of the concrete adjacent to the cutting point. However, thermic lances work particularly well in the presence of reinforcing steel, and it eliminates the problems of vibration and dust problems. Because of the intense heat produced, smoke and fire hazards may be created which in certain circumstances can cause this method to be impractical.

1.3.14. Diamond drilling

- There are two main types of diamond drilling, wet and dry, and both techniques provide precise holes through all types of base materials such as mass concrete, reinforced concrete, brick masonry, and block work.
- There are several advantages of diamond drilling and these include less noise and a non-percussive way of forming holes and openings. The result is free from bursting or spoiling and requires little or no reinstatement work. Water and dust control attachments can be used where the drill is operated in a clean environment.
- Stitch drilling is a commonly used method of forming holes where the size or shape are abnormal. Drill motors vary in size and can be attached to various types of rigs, all of which can be powered by various means: air, electric, petrol, or diesel.

1.3.15. Concrete Pulverisers or Munchers

- Concrete pulverisers have jaws which apply hydraulic power to each side of the concrete and when the tensile strength of the concrete is exceeded, cracks should appear and the concrete should be crushed. Steel re-enforcing rods can then be removed with a lance. Some of the machines are small and manoeuvrable and can be controlled remotely by a banks-person.

1.4. Control of construction vibration

Network Rail and its Contractors should adopt BPM to control potential significant vibration impacts that may occur as a result of the works. Significant impacts shall include impacts upon the occupants of buildings, on buildings and structures themselves and on vibration sensitive equipment.

Where vibration risks are identified the responsible manager should carry out an assessment of vibration levels in order to evaluate potential impacts in line with the recommendations and criteria given within BS5228, BS6472, BS 7385, BS ISO 4866 and any other relevant sources.

The Contractor should also consider any specific vibration requirements arising from commitments or Undertakings given by Network Rail to third parties.

Where significant risks are identified it may be necessary for the responsible manager to arrange for defect, condition or other specialist surveys to be undertaken prior to the works, or vibration monitoring during the works.

Where exceptionally sensitive receptors are identified (e.g. in certain medical, scientific and commercial operations) the Contractor should draw up appropriate limits and protective measures for agreement with the third party and/or relevant Local Authority.

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1.5. Noise and vibration monitoring

Where the sensitivity of the location and the type of works and their potential to generate noise and vibration merit it, (and/or where required by the Local Authority), programmes for both baseline and BPM compliance monitoring before and during the execution of the works programme should be developed to meet the requirements of BS EN 61672-1 and BS EN 61672-2. The calibrator should comply with the requirements for a class 2 specification or better as defined in BS EN 60942. The complete measurement system should have traceable calibration to either National or International Standards by a United Kingdom Accreditation Service (UKAS) approved (or equivalent) test laboratory. The interval between the verification of the complete measurement system should not exceed two years. The interval between the verification of acoustic calibrators should not exceed one year.

The monitoring programme should be sufficient to meet the requirements of any Section 61 consents and specific commitments / undertakings given to third parties. Such a monitoring programme may constitute:

- Officer to agree Regular site observations and inspections of the works site, with particular reference to sensitive locations;
- Continuous noise and vibration monitoring;
- Attended noise and vibration monitoring to determine noise levels at nearby sensitive receptors and on-site to measure noise emission levels from specific plant and/or activities;
- Liaison with the Local Authority noise monitoring positions.

The noise and vibration measurements should be used to:

- Check whether all BPM are being used to control noise and vibration levels and investigate any noise complaints;
- Compare measured noise levels against noise and vibration limits or other threshold levels which are applied through Section 61 consents, agreements and undertakings;
- Routine recording of such checks in a log should be required as part of the site's noise management plan. Such a log should include information on:
 - weather conditions
 - construction activities
 - specific noise and vibration generating operations
 - mitigation measures in place
 - evidence of noise and vibration impacts, where appropriate
 - complaints received either by Network Rail or the Local Authority

Records of noise and vibration levels should be kept at the relevant site office and should be made available for inspection by the Local Authority and other parties where relevant.

Suitable mechanisms shall be developed to notify site supervisors, the relevant Local Authority(s) and other stakeholders if any limit or other threshold is exceeded.