

DEPARTMENT OF  
NATURAL RESOURCES AND ENVIRONMENT

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# ENVIRONMENTAL GUIDELINES

## Ground Vibration and Airblast Limits for Blasting in Mines and Quarries



Minerals & Petroleum Victoria – 2001

## 1. PURPOSE

This document describes the policy of the Department of Natural Resources and Environment with respect to the limits on blasting impacts at residential premises and other Sensitive Sites. This guideline does not apply to control of impacts at commercial or industrial premises where less stringent standards may be appropriate.

The ground vibration and airblast limits recommended by this guideline have been set to minimise annoyance to people as a result of blasting on mine and quarry sites. They are therefore considerably lower than the levels that could give rise to damage to competent structures. More stringent limits may be required, however, in cases where the objective is protection of fragile structures such as historic buildings.

This guideline is based on the Australian and New Zealand Environment and Conservation Council's *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration*, September 1990.

This guideline applies to new and existing mine and quarry sites (as defined in section 3). For new sites, limits are as specified in this guideline. For existing sites, limits for ground vibration and airblast are as specified in this guideline, unless otherwise specified in existing licence conditions.

## 2. INTRODUCTION

Blasting is necessary for the recovery of ore or stone in most underground mines, and many open cut mines and quarries. However, blasting can cause noise and vibration, which can have an impact upon neighbouring premises. Proper control of blasting practices is therefore necessary to ensure both the safety of employees and the protection of the community from adverse effects.

Blasting usually results in both ground and airborne vibration. The latter commonly includes both audible noise and vibration known as airblast, which can cause objects to rattle and make noise. At the levels experienced from blasting associated with mining, structural damage to adjoining properties is unlikely to occur. In addition, the noise levels experienced from blasting at a mine site, are unlikely to cause any hearing damage to anyone outside the worksite.

Annoyance and discomfort from blasting can occur when noise startles individuals or when airblast or ground vibration causes vibration of windows or other items at a Sensitive Site. The degree of annoyance will therefore be influenced by the level of airblast and vibration as well as factors such as the time of day, the frequency of occurrence and the sensitivity of individuals.

In most cases, a competent operator can reasonably predict the level of airblast and ground vibration. However the generation and transmission of airblast and ground vibration is affected by a number of factors including blast design, meteorology (particularly wind speed and direction and temperature inversions), topography, geology and soil water content. It is therefore possible that on some occasions the level of airblast and/or ground vibration will exceed the predicted levels.

The guideline also recognises that for new mine and quarry sites a greater degree of control will be expected and can be designed into the work program.

The guideline does not address the control of flyrock and dust from blasting. Operators are required to satisfy the Department as to the safety of blasting practices and rigorous control of flyrock is an important consideration. The control of dust from blasting must be considered in

conjunction with other sources of dust emission at the site. Operators should ensure that both these issues are addressed adequately.

### 3. IMPLEMENTATION OF LIMITS

Separate limits apply depending upon whether the site was in operation prior to the introduction of this guideline. Existing operations are defined as those where mining or extractive operations have been undertaken or where planning approvals for those operations existed prior to 1 July 2001 and where the existing Work Authority or Licence allows blasting.

In some cases the limits recommended by this guideline may not be consistent with current Mining Licence or Work Authority conditions. In such cases the applicable limits are those set down in the Licence or Authority.

Ground vibration and airblast levels are generally measured at the nearest Sensitive Site.

#### 3.1 Existing Sites

At most existing sites, Work Authority or Licence conditions set limits for airblast and ground vibration measured at Sensitive Sites.

For existing sites the limits are as follows.

- Ground vibration at Sensitive Sites should be below **10mm/s (ppv)** at all times, and
- Airblast at Sensitive Sites should be below **120dB (Lin Peak)** at all times.

#### 3.2 New Sites

At new sites, criteria at the site boundary or at other defined points may be set in Work Authority or Licence conditions to ensure vibration

and airblast are below appropriate limits at the most affected Sensitive Sites.

New sites should meet the requirements of part 3.1 as well as the following:

- Ground vibration at Sensitive Sites should be below **5 mm/s (ppv) for 95% of all blasts.** (
- Airblast at Sensitive Sites should be below **115dB (Lin Peak) for 95% of all blasts.**

**Note:** In situations where the location or the nature of the operations mean that this is not achievable, these standards may be varied, subject to the Department being satisfied that all effected people have given informed consent).

### 3.3 Evening & Night Operations

#### 3.3.1 Open Cuts and Surface Mines

Blasting at open cut or surface mines and quarries should only occur during the hours of 9.00am to 5.00pm Monday to Saturday (the “day period”). However, blasting outside these hours may in some cases be required either because of the practical constraints on an operation or where a blast planned for the day period could not be fired due to unforeseen circumstances. The Department may approve blasting outside the day period where the proponent can demonstrate that such approval is required for sound operational reasons and that any potential impacts will be subject to rigorous control. Where the blasting is required due to unforeseen circumstances, Department approvals are likely to require the operator to give adequate warning to occupants of Sensitive Sites. Surface blasting between 10:00pm and 7:00am would not normally be approved.

### 3.3.2 Underground Mines

Many of the risks that are of particular concern for surface blasting outside the day period are reduced for blasting in underground mines. The risks of flyrock or excess airblast are essentially eliminated for underground blasts and there is usually no risk of unauthorised public entry to the blast site. Blasting times at underground mines are often limited to shift changes or other times when personnel can be safely removed from the blast area. Blasting outside the day period is therefore often necessary. Where the Department approves night time blasting in underground mines it is considered appropriate to apply more stringent limits to ground vibration during the hours usually devoted to sleep. In these circumstances, the ground vibration level at Sensitive Sites should not exceed 3 mm/s and airblast should not exceed 115 dB (Lin Peak) between the hours 10:00pm and 7:00am.

- (ii) a significant change to the area to which a mining Work Plan applies, the airblast and ground vibration criteria will be reviewed.

Where the proposed change does not result in operations occurring closer to the nearest Sensitive Site (ie operations extend in other directions, and not towards the Sensitive Site), the existing limits should continue to apply. This will mean that the maximum airblast and ground vibration levels received at the Sensitive Sites will be unchanged.

Where a change to a Work Authority or Work Plan results in the area of operations moving closer to Sensitive Sites, the Department may set new limits at a level typical of the levels occurring at Sensitive Sites prior to the change. However, the new limits will not be lower than those set out in section 3.2 for new sites.

## **4. APPROACH TO CHANGED CONDITIONS**

A significant factor in determining the impact of blasting on Sensitive Sites is the separation distance between the blast site and the Sensitive Sites. This distance can be reduced by expansion of the operation or by the development of sensitive land uses closer to the operation. Different policies apply to these two situations.

### **4.1 Operator Initiated Change**

It is not proposed that this guideline will apply retrospectively to mine or extractive sites where a Work Authority or Licence has been issued. However where an operator proposes changes to an existing operation, and this requires

- (i) changing the area to which a Work Authority applies; or

### **4.2 Surrounding Land Use Change**

In cases where the separation distance is reduced as new Sensitive Sites are developed closer to an existing mine or quarry, the existing vibration and airblast criteria will be applied to the new properties.

This means that the encroachment of legally approved housing or other Sensitive Sites will impose restrictions on operating mines and quarries. Mining and quarrying operators should therefore ensure that they are aware of proposed new development.

## **5. MEASUREMENT & MONITORING**

Blast vibration and airblast monitoring should be carried out at all sites where blasting occurs and where there are Sensitive Sites that may be affected. The extent of monitoring and locations will be

considered prior to approval of the Work Plan for the operation. Applicants for a Work Plan should determine the proximity and directions of all Sensitive Sites around the proposed mine or quarry. These sites should include all sites that may be affected by blasting during the foreseeable future of the operation.

In addition to vibration and airblast monitoring, it is often useful to record video or photographic images of surface blasts. These records can be of significant assistance in analysis of blast impact problems.

The approved use of blasting will be set down in the Work Authority or Licence and monitoring requirements will usually be set out in the Environmental Monitoring Program.

### **5.1 Monitoring**

Monitoring should generally be in two parts, the initial monitoring and ongoing monitoring.

#### 5.1.1 Initial Monitoring

Initial monitoring should be conducted where it is possible that one or more Sensitive Sites may be exposed to airblast or ground vibration to ensure that the blasting program is able to comply with the prescribed criteria. This will enable changes to be made to the blasting methods if it is found that the levels do not comply with the criteria.

Initial monitoring should be done over a sufficient number of blasts to show consistent results, usually a minimum of five. These tests should be done at the most affected Sensitive Sites in two or more directions (unless there are Sensitive Sites only in one direction)

Initial monitoring should be undertaken directly at or adjacent to

Sensitive Sites or where this is not practical may be at defined locations. Where monitoring cannot be done at Sensitive Sites initial monitoring may be done at sites such as at site boundaries, depending upon the requirements of the Work Authority or Licence and the specifications of the approved Environmental Monitoring Plan.

#### 5.1.2 Ongoing Monitoring

On-going monitoring should generally be conducted around each mine and quarry to confirm that the airblast and ground vibration levels do not exceed the criteria specified. The monitoring program will generally be included in the approved Environmental Monitoring Plan. Blasts should be randomly selected or monitored on a fixed schedule (eg five continuous blasts).

Where initial monitoring shows that all blasts are below 3 mm/s and below 115 dB (Lin Peak) ongoing monitoring may not be required. However, any change in the methods of blasting or other factors such as the direction of a rock face, or proximity to Sensitive Sites, should be monitored as for an initial monitoring program.

### **5.2 Monitoring Data**

Data from a number of approved monitoring sites may be aggregated for the purpose of assessing compliance with percentile limits. However, data records should identify specific measurement sites so that individual site results can be reviewed if necessary.

For comparison with the percentile limits applying to new sites, a rolling 12 month data set should be used. However, if there are too few blasts in a 12 month period to establish an adequate basis for assessment, a longer

period may be used. Statistical outcomes should be recalculated on a monthly basis so that the percentage exceedance of the lower limits is known for the immediate past twelve month (or longer) period.

Records of initial monitoring data should be reported to DNRE within four weeks of being completed.

In the event of complaints, or suspected non-compliance with blasting limits, the Department may request submission of on-going monitoring data by the proponent.

Blast monitoring results should be stored and maintained in a systematic manner. Data should be available for perusal by the Department when and if necessary. Data may be stored in electronic or hard copy form. However, operators should ensure themselves that whatever storage

medium is used is secure and that data is retained for an appropriate length of time.

### **5.3 Measurement**

Measurements should be conducted by suitably trained personnel using appropriate equipment. Equipment used for blast monitoring should meet or exceed the relevant Australian Standards or equivalent overseas standards for field equipment.

Equipment should be calibrated on a regular basis in accordance with the manufacturers recommendations or other appropriate standards.

Measurement Procedures should be in accordance with the equipment manufacturers' recommendations. In particular, the use of the ground vibration transducer should be consistent with achieving optimum coupling with the ground.

**Appendix 1: Definitions**

1. *Sensitive Site:*

Includes any land within 10 metres of a residence, hospital, school, or other premises in which people could reasonably be expected to be free from undue annoyance and nuisance caused by blasting.

2. *Airblast:*

Is the maximum noise level in dB Linear Peak due to a blast measured anywhere on a Sensitive Site which is located at least 3.5 metres from any building or other acoustically reflective surface (other than the ground).

3. *Ground Vibration:*

Is the level of vibration (peak particle velocity) measured in mm/s in the ground anywhere on a Sensitive Site. The measurement point should be at least the longest dimension of the foundations of a building or structure away from the building or structure if possible. If this is not possible, the site should be chosen to be as far from the building or structure as is practical.

4. *Existing operations:*

Are those where mining or extractive operations have been undertaken or where planning approvals for those operations existed prior to 1 July 2001.

5. *PPV*

Peak Particle Velocity – the instantaneous sum of the velocity vectors (measured in millimetres per second) of the ground movement caused by the passage of vibration from blasting.

6. *Lin Peak*

Linear Peak – the maximum level of air pressure fluctuation measured in decibels without frequency weighting. (NB frequency weightings are often applied to sound measurements to ensure the measured parameter is indicative of the level experienced by the human auditory system. Weighting is not applied to airblast measurements as much of the sound from an airblast is at inaudible frequencies and would therefore be excluded).