SECTION 2xx—BLASTING FOR ROCK CUT SLOPE EXCAVATION

2xx.1 DESCRIPTION—This work is excavation of rock using controlled blasting and production blasting to achieve a uniform face in the rock along the plane of the specified excavation backslope. Blasting required for rock cut slopes must be constructed in a safe manner to the line and grade shown on the Contract Drawings.

(a) Controlled Blasting. Blasting that uses explosives and proper blasting equipment placed in carefully spaced and aligned blastholes to produce a uniform surface in the rock along a specified excavation backslope. Controlled blasting methods include:

1. Presplit Blasting—A controlled blasting method in which the row of blastholes are drilled along the plane of the specified final excavation backslope. Presplitting uses reduced blasthole spacing, diameter, and explosive charges. The initiation of blasting in the presplit blastholes precedes the initiation of the adjacent production blasthole explosives by a delay. The delay decouples the final excavated rock face from the excavation and prevents energy from production blasts from propagating to, and damaging, the final cut face.

2. Trim Blasting—A controlled blasting method that cleanly shears a rock face when there is insufficient burden for production blasting. It is essentially identical to presplit blasting, but without production blast holes.

(b) Production Blasting. Rock fragmentation blasting that typically has more widely spaced blastholes than controlled blastholes. Production blastholes are drilled in a pattern throughout the main excavation area adjacent to the controlled blast row. Production blastholes are detonated in a controlled delay sequence toward an open face or relief produced by blastholes firing on an earlier delay. Production blasting fragments the rock in the area to be excavated, to the size required for removal and placement.

2xx.2 MATERIALS—

(a) General. Provide non-electric explosives and initiating devices that are not damaged or deteriorated, and have not been exposed to weather. Non-electric explosives and initiating devices include, but are not limited to, all explosive materials, initiators, blasting caps, detonating cord, delays and timing devices, and all other materials and devices necessary to perform the work. Provide copies of the technical data sheets and material safety data sheets for all materials to the Department with the Blasting Plan. All blasting caps for any individual shot must come from one lot number.

1. Stemming. Fine Aggregate, Manufactured (not natural), Type A, Cement Concrete Sand—Section 703.1

2xx.3 CONSTRUCTION—

(a) General. Use controlled and production blasting for excavations in rock when mechanical excavations methods cannot produce a uniform excavated surface at the specified slope angle. Conduct all blasting, explosive handling, and monitoring operations in accordance with the latest Occupational Safety and Health Act (OSHA) standards, 29 CFR Parts 1926.900 through 1926.914 and Pennsylvania Code, Title 25 Environmental Resources, Article IV – Chapter 77, Chapter 210, and Chapter 211, and in compliance with all local requirements. Maintain a copy of all standards on site including health and safety requirements and make available to any inspector upon request.

1. All blasting operations must be performed by a blaster licensed in the Commonwealth of Pennsylvania meeting the following qualifications: The blaster must submit to the Department a list containing at least five successfully completed similar projects that, together, demonstrate a minimum of three years of experience in surface rock blasting including controlled blasting. Include a brief description of each project, and the name and telephone number of the owner’s representative knowledgeable in each project listed. The Department will review and approve the blaster. Receipt of written approval must be obtained before any blasting operations including drilling of blastholes are initiated. Allow at least 21 calendar days for approval.
2. When blasting is used to excavate rock, use controlled blasting techniques for all portions of any rock cut slope exceeding a vertical height of ten feet and a slope equal to or steeper than 0.5(V):1(H). The Department may require the Contractor to use controlled blasting to form the faces of more gradual slopes or excavations, even if the slopes could be formed by non-blasting methods. Presplit test sections must be conducted to determine the presplit blast pattern and design necessary to achieve the required results. The conditions of each presplit section will be evaluated by the Representative. Revisions to the presplit blast design must be made by the blaster as necessary to achieve the required results before drilling can proceed in adjacent presplit sections.

3. Production blasting must be designed to control flyrock, minimize ground vibrations and noise, and result in fragmented, in-situ rock that can be removed, processed, and/or placed as required. The production blasthole must be located and drilled in accordance with the requirements indicated in Section 2xx.3(g). Prepare the production blasting plan so as not to affect the controlled blastholes. Where blasting is adjacent to highways with lane closure restrictions, the volume of rock cannot exceed the Contractor’s ability to remove the blasted material from the highway within the established maximum allowable closure time.

The sequence of blasting at any blast is as follows:

- Conduct and submit the Pre-blast Survey
- Submit and obtain acceptance of the Blasting Plan
- Submit and obtain acceptance of the Blasting Safety Plan
- Conduct and submit the Water Supply Monitoring Report
- Notify appropriate entities of blasting schedule (owners, utilities, traffic, flagging, and police)
- Schedule and conduct the Pre-blast meeting
- Drill and conduct test section blasting
- Obtain Department approval and selection of the test section
- Proceed with full-scale drilling and blasting
- Submit required Blasting Report including Vibration and Airblast Monitoring Reports
- Remove rock and scale if required
- Inspect and evaluate rock face/excavation results (including any required modifications)
- If applicable, submit a modified Blasting Plan for adjacent blasts in that project work area
- Conduct and submit the Post-Blast Survey
- Conduct and submit the Water Supply Monitoring Report

(b) Pre-blast Survey. Conduct an exterior and interior pre-blast survey on all structures, buildings or utilities within 300 feet of the blasting site, and within 1,000 feet of the blasting site if the blast is designed for a peak particle velocity exceeding 0.5 in/sec (confirm by vibration monitoring). If no structure or building is located within these limits, complete a survey on the closest structure or building within one half mile of the blasting operations. At a minimum, complete one survey as directed by the Department on the closest structure or building within one mile. The pre-blast survey will serve as proof of the condition of the existing residential and commercial structures prior to blasting. Complete the pre-blast survey no sooner than four weeks before the beginning of blasting operations.

Complete the exterior and interior pre-blast survey using Form TR-42. Include structural observations and descriptions, locating any existing cracks, including length and size. Where significant cracks, structural defects, or damage exists, collect digital images to supplement the written description. Provide a scale and a date stamp on each digital image taken. Digital images must be taken and submitted electronically at a minimum eight megapixel resolution with the pre-blast survey.

Request, in writing, property access from each property owner to complete a pre-blast survey. If the property owner fails to permit access to the property for the pre-blast survey, notify the Department. If the property owner declines the pre-blast survey, submit to the Department, a notification letter and Form TR-43 – Survey Waiver signed by the property owner. If the property owner refuses to sign, the qualified independent blasting consultant must indicate as such and sign the waiver. A copy of the letter and waiver must be kept on file as part of the pre-blast survey records. Do not enter any private property without written permission. The pre-blast survey must be conducted by a qualified independent blasting consultant.
in the presence of the property owner. At the conclusion of the pre-blast survey, the property owner must sign both Exterior and Interior Pre-blast Survey Forms and be provided a copy. Submit the Exterior and Interior Pre-blast Survey Forms, including diagrams and digital images, to the Department at least five days before commencement of blasting operations. Notify the respective utility company within a minimum of 7 days prior to blasting of any utility within 300 feet of the blasting site, and within 1000 feet of the blasting site if the blast is designed for a peak particle velocity exceeding 0.5 in/sec. Provide notice in writing at two weeks and again 48 hours before blasting begins to all property owners where a pre-blast survey was performed. Inform the residents that blasting signals will be issued in accordance with OSHA standard, 29 CFR Part 1926.909 to warn of imminent blasting. The Contractor is solely responsible for any damage resulting from blasting.

(c) Blasting Plan. Provide the Representative a separate Blasting Plan at least three weeks before commencement of drilling for blasting for each proposed rock cut excavation that requires blasting, and at any time the drilling and blasting operations change. The Blasting Plan will be reviewed by the Department for conformance with this specification and any concerns will be discussed with the Contractor prior to acceptance of the Blasting Plan. Do not drill any blastholes until the Blasting Plan is accepted by the Department. Schedule and attend a pre-blast meeting at least one week prior to any explosives being brought onto the project site to review the following: the safety plan including requirements concerning explosives being brought onto the project site, and the restrictions and requirements during the loading of explosives; the sequence of operations prior to, during, and after each blast; all required traffic control; all inspection procedures of blast zones for misfires, stability, and blast material debris clean up; and any other relevant issues. At a minimum, the following must attend the pre-blast meeting: the Representative, the blaster, the prime contractor, the qualified independent blasting consultant(s), and any other personnel designated necessary by the Representative. Submittal of the Blasting Plan is for quality control, conformance, and record keeping purposes. Review and acceptance of any Blasting Plan by the Department does not release the Contractor of full responsibility for the accuracy of the plans, safety of operations, quality of work or conformance to specification performance requirements, when implemented in the field.

Complete the Blasting Plan using Form TR-40. The Blasting Plan must include, but is not limited to, the following:

- A completed Blasting Activity Permit approved by the PADEP Bureau of Mining and Reclamation. Include any other necessary permits required to complete blasting activities in accordance with all current applicable federal, state, and local requirements.
- Station limits of the proposed shots, critical distances to structures, buildings, or utilities, and pre-blast survey limits detailed on the plan view sheets.
- One plan and section view for each rock cut excavation showing the proposed drill pattern for any blastholes, including blasthole spacing, blasthole diameters, blasthole angles, lift height, drill depth, buffer rows, and burden. Accurately show to scale each cut area to be blasted.
- Loading diagram(s) detailing the type, amount, and specific gravity of explosives, primers, and initiators. Also include the location and depth of stemming.
- Initiation sequence(s) of any blastholes including delay times and delay system(s).
- Schedule and timeframes for notification of the blasting sequence.
- Manufacturer’s product data sheets for all explosives, primers, and initiators to be used in the work.
- A MPT Plan which details how traffic will be protected and managed during blasting.
- Methods to control site security, vibration, flyrock, and airblast levels.
- Method and quality control of the depth, direction, and alignment of the drilled blastholes for blasting.
- Licensing information, experience, and qualifications of the blaster who will be directly responsible for the loading and firing of each shot.
- The name and qualifications of the person(s) responsible for designing and directing the blasting operation
- The qualified independent blasting consultant(s) proposed to conduct and complete the Pre- and Post-blast Surveys, and the Airblast, Vibration, and Water Supply Monitoring Reports.

(d) Blasting Safety Plan. Provide the Department a detailed description of transportation, pick-up and delivery locations, blasting procedures, and the use of explosives at the project work area at least three weeks before commencement of drilling for blasting. The blasting safety plan must include, but is not limited to, the following:
Details about hazard communication programs for employees.

Equipment that will be used to monitor the approach of lightning storms, and evacuation and site security plans in the event of a storm.

Methods for preventing spills or losses of explosives, drilling fluids, oil, or any other pollutants into the ground during all handling and blasthole loading operations. Include details of all containment and contingency plans for quickly and effectively cleaning up any spilled materials.

A safe and approved disposal method of all explosive packaging materials.

Detailed contingency plan(s) for handling misfires of explosives resulting from cutoffs or other causes.

Fire prevention plan details, including smoking policies, procedures and limitations for work involving any open flames or sparks, and description and location of all firefighting equipment and evacuation plans.

One hard or electronic copy of the Blaster’s valid Pennsylvania blasting license and the Contractor’s ATF blasting license.

Other required county or state permits required for explosive use and storage.

A copy of the explosive transporters’ commercial driver’s license(s) with HazMat endorsements and an explanation of how the explosive transport vehicles will meet all applicable ATF, OSHA, federal, state, county, and local regulations.

If applicable and when underground mining is identified during design, provide air quality monitoring plans for local buildings.

Post and maintain in a visible area all current licenses required for blasting and explosive handling. A blaster licensed in the Commonwealth of Pennsylvania meeting the qualifications in accordance with Section 2xx.3(a)1 is required to perform all blasting. Provide a certificate of insurance to the Department showing that the blasting Contractor retains the required insurance to the applicable limits to meet all local, state, and federal regulations. Store explosives on and off the project site in accordance with OSHA standard, 29 CFR Part 1926.904, Title 27 CFR 181, Part 55, Subpart K, and in compliance with all local requirements. Adequate magazine records must be maintained for stored explosives. On-site storage of bulk blasting agents such as Ammonium Nitrate and Fuel Oil (ANFO) is prohibited. The blasting Contractor is required to remain on site once the blastholes are loaded with explosives until any misfires are resolved or remediated and the blast is completed. In no instance must explosives, blasting agents, detonators, or loaded blastholes be left unguarded or unattended.

(e) **Blasting Requirements.** Requirements must be in accordance with the following for all blasting operations:

- Prior to commencing blasting operations, provide a copy of the Blaster’s License to the Representative.
- Remove all overburden soil and loose rock along the top of the proposed cut and lay back to a stable condition before drilling and blasting.
- The drilling of blastholes must be completed one pattern at a time. Do not conduct advanced drilling of any blastholes prior to completion of blasting on the previous blast section.
- Check, measure and record the depth of all blastholes as soon as the drill is retracted from the blasthole. If any blasthole is found not be open to the drilled depth, re-drill the short blastholes to the proper depth at no expense to the Department. If any blastholes are too deep, use stemming as specified in Section 2xx.2(a) 1 to fill the blastholes.
- Horizontal blastholes are not permitted.
- Complete and submit with the Blasting Report, the Blasthole Drill Log, using Form TR-39. Keep accurate drilling logs on each blasthole to show the depth of the geological features such as zones of soft or weathered rock, mud or clay seams, voids, and color of drill cuttings. Also include the drilling rate. Revise the Blasting Plan to address concerns during drilling. Obtain Department acceptance of the revised Blasting Plan before proceeding.
- Before commencing loading of blastholes, post warning signs at points of access to the blasting site.
- Blastholes must be covered and designed to keep material from falling into the blastholes after drilling. Place reusable plastic hole markers in each blasthole to identify all blasthole locations.
• Measure blastholes prior to loading any explosives into the blastholes to ensure each blasthole is open to the original drilled depth and free of obstructions prior to placing a charge. Use precaution to prohibit caving of material from borehole sidewalls during placement of the charges.

• While loading the explosives into the drilled blastholes, only the blaster and those persons necessary for the loading process are allowed within 50 ft. of a blast. Use the following equation to determine the amount of required explosive load for blastholes:

\[ L_e = \frac{(D_h)^2}{28} \]

where,

- \( L_e \) = Explosive Load (lb./ft.)
- \( D_h \) = Blasthole Diameter (in.)

• Stem all unloaded portions of the blastholes a minimum of 0.7 times the burden distance. Stemming material must be as specified in Section 2xx.2(a) 1.

• Appropriate explosives and accessories must be employed for the various conditions to achieve the specified cut slope design.

• If blasting is permitted on structure foundations, any overbreak beyond the desired Bottom of Footing Elevation (BOFE) must be repaired by excavating broken materials and leveling off to the BOFE with Class C concrete, or as required.

• Furnish and use sufficient approved blasting mats when necessary to hold and suppress flyrock and prevent subsequent damage to property and roadway.

• Perform all necessary repairs to roadway, structures, utilities, and any property damage as a result of blasting at no cost to the Department.

• The blasting Contractor is liable for all injuries or deaths of persons and/or farm/domestic animals, and any damage to property caused by blasting.

(f) Controlled Blasting.

1. Test Section. Conduct test blast sections prior to commencement of full-scale blasting operations in accordance with Section 2xx.3(e), and with the following.

   • Conduct initial test blast section as one presplit blast pattern using variable spacing of 18-inches over 18 feet, 24-inches over 24 feet, 30-inches over 30 feet, and 36-inches over 36 feet using a maximum lift of 30 feet.

   • Hole to hole spacing requirements for 18-inch and 24-inch presplit patterns must be maintained within 75 to 125 percent of the intended spacing. For 30-inch and 36-inch presplit patterns, hole to hole spacing must be within 6-inches of the intended spacing. Hole to hole spacing must be maintained throughout presplitting. If the deviation of presplit blastholes exceeds the allowable tolerance, provide the Department alternative drilling methods in a revised Blasting Plan to reduce deviation within the above specified tolerances. Alternative drilling methods may include, but are not limited to, revised procedures, drill tooling, cutting bits, or other equipment that provides specified spacing tolerances. Obtain Department acceptance of the revised Blasting Plan before proceeding.

   • Test sections must not exceed 110 feet.

   • The test section must demonstrate the suitability of the proposed blast plan relative to fragmentation requirements, overbreak control, flyrock control, adequacy of stemming, and other appropriate or necessary factors.

   • When results of the drill logs are unusual (i.e., encountering zones of soft or weathered rock, mud of clay pockets, voids; rate of penetration; and the color and character of drill cuttings), revise the Blasting Plan as necessary and obtain Department acceptance of the revised Blasting Plan before proceeding.

   • When rock of different characteristics is encountered, a blasting test section must be performed.

   • Excavate the blasted test section to fully expose the presplit face and provide the means to access the face so that the Department can examine and evaluate the results of the blasted test sections. The
Department will examine the completed test section and select the blasthole spacing that demonstrates the best presplit face quality. If no acceptable conditions are found by the Department upon examination of the test section, revise and submit to the Department a new Blasting Plan for review and acceptance. Drilling and blasting will be suspended until the Blasting Plan is accepted. At no additional cost to the Department, conduct additional test sections at the same blasthole diameter and spacing used for the previous test section and by adjusting the explosive load until desired/acceptable results are obtained. Unsatisfactory results include, but are not limited to, excessive fragmentation beyond the indicated lines and grade, excessive flyrock, and poor timing delays. Upon completion of test blasting, obtain written approval from the Department to proceed with full scale blasting operations.

- If the contractor has conducted repeated test blasts using different drilling techniques, reduced the height of the lift in an attempt to meet the borehole deviation limits, provided evidence that the magnitude and direction of deviation between each blasthole has remained constant, and ultimately determined that due to geologic conditions deviation tolerances are not achievable, the Department may review the findings and make an informed decision of any acceptable deviations.
- The Department’s approval of the test blasting program and the techniques and procedures associated with test blasting does not relieve the Contractor of any responsibilities to employ appropriate safety measures and exercise proper supervision of blasting operations.

2. Presplit. Complete all presplitting, including test section blasting in accordance with Section 2xx.3(e), and with the following:

- Employ a surveyor licensed in the Commonwealth of Pennsylvania to locate and mark each presplit blasthole shown on the Blasting Plan to produce an excavated slope to the lines and grade on the Contract Drawings. Drill presplit blastholes within 3 inches of the staked location. Blastholes drilled beyond this limit will be rejected.
- Control the angle and bearing at which the drill steel enters the rock with an electro-mechanical or electronic device (smart level meeting accuracy conditions of plus or minus 0.2 degree) by attaching to or resting on the drilling equipment. Blasthole drilling will not be permitted if this device is missing or inoperative. Complete a borehole deviation survey of each presplit blasthole prior to loading the blastholes using an electronic, rodded borehole deviation measuring system with a probe resolution of 0.1 degree accuracy. Electronic, cable borehole deviation measuring systems are prohibited. Provide a report of each blasthole deviation survey to the Department including blasthole alignment and graphical output data. Also, the report must show that the alignment will produce the excavated face to the line and grade indicated on the Contract Drawings within the specified tolerances. Terrestrial Surveying may be employed as necessary to produce this report. The output software must be capable of plotting vertical profiles parallel and perpendicular to the slope. No blasthole must deviate by more than 6 inches parallel and perpendicular from the planned slope. Hole to hole spacing must be maintained throughout presplitting as specified in Section 2xx.3(f)1.
- Abandon presplit blastholes not meeting the accuracy requirements and a replacement blasthole will be required at no cost to the Department. Completely backfill the rejected blastholes with minimum 4000 psi high-early strength grout. The Representative may require grout samples for laboratory testing to verify minimum strength.
- Drill presplit blastholes between 2.5 inches and 3 inches in diameter.
- Do not exceed a length of 30 feet in blastholes for any lift. The Department maintains the right to decrease the length of the presplit blastholes at any time due to poor performance.
- Drill presplit blastholes a minimum of 30 feet longitudinally beyond the limits of the production blastholes to be detonated or to the end of the cut.
- If the cut height requires more than one lift, a maximum offset of 24-inches between lifts will be permitted for drill equipment clearance. Begin the presplit blasthole drilling at a point that allows for the necessary offsets and adjust to compensate for any drift that may occur in the upper lifts.
- Use only explosives manufactured specifically for presplitting in presplit blastholes. Bulk ANFO is prohibited in presplit blastholes. The maximum diameter of the explosives must not exceed one half the diameter of the presplit blasthole.
- Detonation of explosives in each blasthole in a presplit shot may be simultaneous or delayed due to noise or vibration concerns provided the hole to hole delay does not exceed 25 milliseconds.
- Initiate the blasting in the presplit blastholes before initiating the production blasthole explosives by a minimum of 25 milliseconds.

3. Trim. If the horizontal distance between the existing rock face and the design cut face is less than 15 feet, the Contractor may use trim blasting. Perform trim blasting in accordance with Section 2xx.3(f)1 and 2, except there are no production blastholes.

(g) Production Blasting. Complete all production blasting in accordance with Section 2xx.3(e), and with the following:

- Do not exceed 4 inches in diameter for the production blastholes.
- Drill the production blastholes in the patterns and to the depths established in the Blasting Plan. Do not drill blastholes to a depth that exceeds 30 feet.
- Drill the row of production blastholes adjacent to trim blastholes, drill the row of production blastholes on a plane parallel to the trim blastholes. Do not drill production blastholes within 6 feet of the trim blastholes.
- Drill the bottom of the production blastholes at an equal depth/elevation to the bottom of the controlled blastholes, except for the bottom lift for subdrilling up to a depth of 4 feet.
- Drill a line of buffer holes on a parallel plane adjacent to the presplit blastholes. Buffer hole spacing can range from one half the production blasthole spacing to two times the presplit blasthole spacing. Drill buffer holes between 2.5 and 3 inches in diameter, and 3 feet from the presplit line. Do not load the buffer holes with more than 50% of the full explosive load that could be placed in a 3 inch production blasthole.
- Maintain a burden distance which is not more than one half the bench height in order to control blasting effects. Required burden distance must be determined by the Contractor so as not to over or under confine the blast. Burdens must be determined to prevent flyrock and backbreak of the presplit face.
- Drill the production blastholes within two blasthole diameters from the staked drill collar location. Survey the elevation at the collar of each drilled production blasthole to foundation grade and verify the production blastholes are not sub-drilled below final foundation grade. Blastholes drilled outside either tolerance must be backfilled with stemming and re-drilled at the proper location and grade as directed by the Representative and at no additional expense to the Department.
- Detonate production blastholes on a delay sequence toward the free face as specified in the Blasting Plan. Delay the detonation sequence from hole to hole within a row by a minimum of 1.5 milliseconds per foot of hole spacing. Delay the detonation sequence from row to row by a minimum of 2.5 times the hole to hole delay.
- Take all necessary precautions to minimize blast damage to the rock backslope during production blasting.
- Remove or stabilize rock along the cut face that is loose, hanging, or creates a potentially dangerous condition during or on completion of the excavation in each lift. Do not drill the next lift until this work is performed.

(h) Blasting Report. Complete and sign the Blasting Report using Form TR-41 and submit to the Department within 48 hours after making any blast and obtain Department acceptance before drilling of the next blast section is initiated. Only the blaster who was reviewed and approved by the Department may perform blasting operations including drilling of blastholes. At a minimum, the Blasting Report must include the following:

- Drill logs, drilling remarks, and loading and timing delays used in each blasthole of the blast.
- All blast monitoring documentation, which includes vibration and airblast monitoring data.
- Contractor’s evaluation of the blast performance.
• Two High-definition (minimum 1080p resolution and 60p frame rate) digital video recordings submitted in MPEG-4 file format (or acceptable variant as determined by the Representative) on a CD, DVD, or flash drive of any test, controlled, and/or production blasting. The two videos must be recorded at opposite angles of the blast and, if feasible, from an elevated angle and a ground angle.

• All damage incurred and details of complaints or comments.

• Blast area description, weather, blasting Contractor /crew, layout and timing diagram.

(i) Maintenance and Protection of Traffic (MPT) during Blasting Operations. Coordinate MPT activities with the Department for any portion(s) of roadway that must have temporary closures or lane restrictions during blasts. The MPT plan for any partial or full roadway closures and detours must be approved by the District Traffic Engineer. At a minimum, all traffic must be stopped during blasting operations on roadways where the blasting Contractor or the Representative has determined that road users may be impacted by blasting operations. Traffic may be halted for periods not to exceed 15 minutes or unless otherwise approved by the Representative. Traffic may not resume after a blast until the area is clear of any debris, the excavated slope face is free of any loose material, and the blasted material is stockpiled into a stable mass until it can be removed from the site. An adequate barrier to temporarily separate blasted material must be in place between active roadway lanes and blasted material. Time between traffic stoppages will be determined by the Department. Blasting operations will not be permitted during peak traffic hours as determined by the Department’s District Traffic Engineer (DTE). Roadway closures are permitted Monday through Friday, 9:00 a.m. to 3:00 p.m. or as specified by the District Traffic Engineer. No blasting is permitted during holiday periods or local events as determined by the Department’s DTE.

Notify the Department Regional Traffic Management Center and State/local Police two times prior to each blasting event. The initial notification must be made 24 hours in advance of the expected blast time. A second notification must be made 15 minutes prior to stopping traffic for the blast work. Sufficient flaggers must be present to control traffic on all impacted roadways. When traffic is stopped for blasting, monitor the traffic queue. Provide a vehicle on each affected approach that is equipped with a flashing, oscillating, or revolving warning light, one in each direction, at least 300 feet in advance of the last vehicle in the traffic queue. This vehicle must remain at least 300 feet in advance of the last vehicle as the length of the queue increases. It may be necessary to provide two of these vehicles with drivers working as a team if adequate shoulder or roadside is not available for a single vehicle to safely drive in reverse along the roadway.

Furnish, erect, and maintain on all affected roadways, appropriate standard signing as shown in the Manual On Uniform Traffic Control Devices, Part 6 Figure 6H-2 Blasting Zone (TA-2). These signs are in addition to any temporary traffic control devices required by an existing temporary traffic control plan or required by Publication 213, Temporary Traffic Control Guidelines.

Provide patrol vehicles, one in each direction, to drive through the blast area, to determine the site has been completely cleared before the blast is detonated. Employ suitable precautionary measures and devices to prevent roadway damage (including pavement, drainage features, signing, traffic barrier and/or guiderail, lighting, traffic control devices, and any other roadway element). Precautionary measures and devices may include barriers, blasting mats and other protective and control measures and devices. As soon as the blasting has been completed, inspect the work area for any unsafe conditions. An inspection of the roadway by one patrol vehicle in each direction must be completed before traffic is released. Provide excavation equipment on standby to clear any rock debris from the roadway immediately following inspection.

(j) Vibration Monitoring. Complete vibration monitoring by a qualified independent blasting consultant. Use a minimum of five portable seismographs for each blast that adhere to the International Society of Explosives Engineers Performance Specifications for Blasting Seismographs. Use seismographs capable of measuring particle velocities for three perpendicular components of vibration within a frequency response range from 2 to 250 Hz. Use seismographs that have received a factory calibration within the 12-month period preceding the blast recorded. The following procedures and requirements must be followed:

• Complete the Vibration Monitoring Report using Form TR-44.

• Place four of the seismographs north, south, east, and west of the blast at approved locations by the Department. Place the remaining seismograph at the nearest critical structure subject to blast induced damage.

• Monitor and record peak particle velocity and frequency for each blast.

• Provide the data recorded for each shot to the Department prior to the next blast.

• Do not blast within ten feet of the closest structure.
• Do not blast within 250 feet of less than three day old concrete.
• Do not blast within 30 feet of newly placed concrete until it has reached 28-day strength unless approved by the Department. For blasting greater than 30 feet away from new concrete, the ground vibration limits indicated in Table A apply.

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<td>Age of Concrete</td>
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<td>Less than 3 days</td>
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<td>After 3 days</td>
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• Prior to test blasting, calculate the value of maximum powder charge per delay permissible using an initial conservative scaled distance of 50 for the distance between the critical structure and shot. The scaled distance is calculated by dividing the true distance (ft.) from the blast to a point of concern by the square root of the maximum charge weight in lbs. per delay.
• Plot the peak particle velocity measured from each seismograph versus the scaled distance between the blast and seismograph location on a logarithmic-logarithmic graph. From this plot determine the site specific working scaled distance factor for a maximum particle velocity of 1.6 in/sec.
• The Representative and the qualified independent blasting consultant will confirm that the peak particle velocity of each component does not exceed the safe limits of the nearest structure subject to vibration damage. The limits for any of the three mutually perpendicular components of peak particle velocities are indicated in Table B.

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<th>Table B</th>
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<tr>
<td>Frequency</td>
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<td>≥ 40Hz</td>
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• For all subsequent blasts, the qualified independent blasting consultant will evaluate the resulting peak particle velocities measured by the seismographs by plotting the recorded peak particle velocities versus the scaled distance on a logarithmic-logarithmic graph and submit to the Department for approval. If at any time a maximum particle velocity of 2.0 in/sec is exceeded a modification to the initially established working scaled distance is required.
• Stop all blasting operations if the vibration limits are exceeded until the Contractor reports to the Department that no damage has occurred or will occur and that corrective action has been taken to lower vibrations to required limits so as to minimize the potential for any damage from future blasting.

(k) Airblast Monitoring. Monitor airblast between the main blasting area and the nearest structure subject to blast damage or annoyance. Monitor airblast at a second location as determined by the Representative. The following information is required for the completion of the airblast monitoring:

• Use airblast monitoring equipment of the type specifically manufactured for the purpose of airblast measurements.
• Maintain a peak overpressure below 128 dB (.007 psi) for residential structures. Provide a dated record of the peak overpressure measurements to the Department immediately after each shot or use the same reporting procedures and time intervals designated for vibration monitoring.
• Stop blasting operations if the established overpressure limits are exceeded until the airblast monitoring specialist reports to the Department that no damage has occurred or will occur and that corrective action has been taken to lower the peak airblast.

(l) Water Supply Monitoring. Monitor water supply and submit Water Supply Monitoring Reports to the Department before and after blasting operations, and when issues arise during blasting operations. The water supplies must include all wells, springs, or other ground water supplies used for human consumption.
Retain a qualified independent blasting consultant to oversee and complete the water supply monitoring program. Complete the Water Supply Monitoring Report using Form TR-45. The following information is required for the completion of the water supply monitoring program:

- Determine the quantity and quality of water by identifying and monitoring water supplies within 1000 feet of the blasting location(s). If geologic conditions warrant, water supplies beyond 1000 feet may be included if there are concerns for potential impact, or if deemed appropriate for risk management.
- Two weeks prior to the start of blasting operations and between six and eight weeks after blasting operations conclude, where permitted by the owners, for all water supplies identified, measure and record water levels, well depths, existing flow rates, well yield, and any other pertinent information.
- Two weeks prior to the start of blasting operations and between six and eight weeks after blasting operations conclude, complete field and laboratory analyses for the following field water quality data parameters (and any other requested parameters) from all identified water supplies: pH, Temperature, Specific Conductance, Turbidity, Total Coliforms, Fecal Coliforms/E. Coli, Nitrate, Nitrite, Chloride, Hardness, Iron, and Sulfates.
- Collect water samples using sample collection and preservation techniques specified by the testing laboratory.
- Complete water analyses by a PADEP certified laboratory.
- Within ten weeks after completion of blasting operations provide the Department a final report of the conclusions and results of the water supply monitoring program and, if applicable indicate any impacts to local water supplies from blasting activities.

The Contractor is not responsible for damages to the water supplies provided the blasting is done as specified in this specification and the Blasting Plan.

(m) Post-blast Survey. Conduct an exterior and interior post-blast survey within four weeks after completion of all blasting and rock excavation of all utilities, buildings, or structures for which a pre-blast survey was performed unless a waiver was/is obtained from the property owner. Complete the exterior and interior post-blast survey using Form TR-42. Follow the procedures set forth in the pre-blast survey to obtain arrangements for property access and submittal procedures to the Department. The post-blast survey must be completed by a qualified independent blasting consultant in the presence of the property owner. At the conclusion of the post-blast survey, the property owner must sign both Exterior and Interior Post-blast Survey Forms and be provided a copy. Submit the duly witnessed and signed Exterior and Interior Post-blast Survey Forms to the Department. Include in the report any diagrams and eight megapixel resolution minimum digital images of structures indicating size and location of cracks, separations or damage in foundations, walls, ceilings, floors or other structural components. Also include documentation of any reported damage to water supplies including wells and springs and any differences from the Exterior and Interior Pre-blast Survey Forms.

The Contractor is responsible for damage resulting from vibration or noise above the established allowable limits, and any other damages, including damages from flyrock, inadequate control or retention of blasted materials, improper or poor blast area security, or other damages resulting from improper or careless blasting practices or construction techniques.

2xx.4 MEASUREMENT AND PAYMENT—Blasting for Rock Cut Slope Excavation is incidental to excavation or borrow excavation. All material, explosives, labor, tools, and equipment needed for blasting operations including monitoring and survey activities will be considered incidental to the class of excavation specified and will not be paid for separately.

(a) Controlled Blasting. Linear Foot

Measured on linear foot of acceptable presplit or trim blasthole depth for blastholes drilled within the tolerance as specified in Section 2xx.3(f).