Iowa Department of Transportation

SPECIAL PROVISIONS
FOR
USE OF EXPLOSIVES

Hardin County
BRFN-065-6(42)--39-42

Effective Date
July 20, 2010

THE STANDARD SPECIFICATIONS, SERIES 2009, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

090082.01 DESCRIPTION.
The primary objective for blasting rock is to construct the excavations and slopes in a safe and stable manner that leaves the rock outside the limits of excavation undisturbed, and results in excavation slopes that conform to the lines and grades indicated on the Plans. A secondary objective of the blasting operation is to provide material for applications such as embankment construction, erosion control, aggregate, and other project needs. The Contractor shall perform the blasting operations in a safe and professional manner to provide rock meeting project requirements.

The Contractor shall be responsible for vibration and crack monitoring during demolition/construction activities near vulnerable structures. Refer to Special Provisions for Vibration Monitoring for requirements.

090082.02 CONSTRUCTION.

A. MASTER BLASTING PLAN.
Not less than 10 working days before commencing test or production drilling and blasting operations, or at any time the Contractor proposes to change the drilling and blasting methods, the Contractor shall submit a blasting plan along with any comments from the Blasting Consultant to the Engineer for review. The blasting plan shall contain full details of the drilling and blasting patterns and controls that the Contractor proposes to use for both the controlled and the production blasting. All blasting plans shall contain the following minimum information:

1. Station limits of the proposed shot(s) including limits of blasting left and right of centerline, number of holes to be drilled and shot per blast.

2. Scaled plan and section views of the proposed drill pattern including free face, burden, spacing, blast hole diameter, blast hole angles, lift height and subdrill depth. Plan views

and section views shall be based upon the project plan sheets including topographic contours.

3. Loading diagram showing the type and amount of explosives, primers, initiators and location and depth of all stemming including the material to be used as stemming. Maximum quantity of explosive to be used per delay and per blast.

4. A diagram and explanation of the initiation sequence(s) of blast holes including delay times for each blast hole. The type of delay system shall be shown with all associated delay periods.

5. Manufacturer's product information sheets or technical bulletins for all explosives, primers, delays and initiators to be employed.

6. Proposed quantities of controlled blasting and production blasting.

7. Safety Plan – The safety plan shall contain at a minimum the following information:
- **a.** Proposed methods describing how fly rock or blast debris shall be prevented.
- **b.** The name and telephone number of the Blaster-in-Charge. The Blaster-in-Charge will be responsible for directing the day to day drilling and blasting operations, for clearing the blast site before excavation of the blasted material may proceed, and for all required report preparation such as daily blast logs, and daily explosive material consumption and loss reports.
- **c.** Methods proposed to clear the blast area and to control access to the blasting site during loading and blasting.
- **d.** Methods proposed to notify local residents and construction workers of an impending blast.
- **e.** Methods proposed to document, assess and correct misfires or undetonated explosives. A recovery and disposal plan shall also be developed in the event that misfires cannot be refired.
- **f.** Methods proposed and planned to control ground vibration and air blast as well as calculated scaled distances to each effected structure.
- **g.** A detailed vibration and blast monitoring plan.
- **h.** A fire prevention and protection plan.
- **i.** A plan to identify all potential blast site electrical hazards, including, but not limited to a lightning detection and protection plan.
- **j.** An emergency plan in the event an injury occurs. At least one blast crew member should be trained in first aid procedures.

After satisfactorily completing the test blast sections, and incorporating all test blast results and Blasting Consultant comments, the blasting plan shall be revised and submitted as the Master Blasting Plan.

The Contractor shall submit supplemental blasting plans anytime the blasting operation differs from the parameters provided in the Master Blasting Plan or as requested by the Engineer due to poor results of the blasting, damage to the backslope, or any unsafe condition. The requirements of the supplemental blasting plans shall be the same as those for the Master Blasting Plan.

Production blasting shall not begin until the Master Blasting Plan has been submitted and reviewed. The Engineer will review the blast submittals solely for conformance with the project plans and specifications. Review of the blast plans by the Engineer shall not relieve the Contractor of his responsibility for the accuracy, adequacy and safety of the plan when implemented in the field.

B. BLASTING OPERATIONS.

All blasting operations, including the transport, storage, handling, and loading of explosives and blasting agents, including primers and initiators, shall be performed under the direct supervision of the Blaster-in-Charge, and in accordance with the applicable provisions of the Standard Specifications and all other pertinent Federal, State, and local regulations.

Each cap period shall come from one lot number. Mixing of lot numbers for any one cap period is prohibited. All blasting materials used on the project shall be one year or less of age.

The Contractor shall conform to all applicable State and Federal laws governing explosives transport, handling, loading, and storage. The Contractor shall submit his storage plans along with the type of magazine or explosive storage facility to be used on and off the job site.

When, as determined by the Engineer or the Contractor, any blasting product is either of excessive age or in a deteriorated condition, all blasting work shall cease until the product's age or quality can be determined. Products that do not meet the manufacturer's specifications shall not be used on the project and shall be removed from the project and properly disposed of immediately.

No blasting product shall be brought to the job site if the date codes are missing. The Engineer may require the product to be tested by an independent organization to determine its performance as compared to the manufacturer's product information sheet. The independent testing organization shall be approved by the Engineer prior to performing the tests. If product performance or composition deviates by more than 10% in any manner from the manufacturer's data sheet that lot number shall be rejected, and the Contractor shall bear all costs for the testing and the replacement of the product.

Production blast holes shall be drilled on the patterns shown on the blasting plan submitted by the Contractor. The production blast holes shall be drilled within two blast hole diameters of the staked collar location. The location and staking of the blast holes shall be the responsibility of the Contractor and shall be incidental to the contract item. If more than 5% of the holes are drilled outside of this tolerance, the Contractor shall be required to fill these holes with crushed stone or approved material and then to re-drill them at the proper location.

Production holes shall not exceed 4 inches in diameter unless approved by the Engineer. Detonation of production holes shall be on a delay sequence toward a free face.

It is the Contractor's responsibility to take all necessary precautions in the production blasting to prevent blast damage to the rock final slope or backslope.

The blast holes shall be checked and measured by the Contractor and at the direction of the Engineer, verified by the Blasting Consultant, before any explosives are loaded into any of the blast holes. If the blast holes are not drilled to the correct depth, are plugged, or are unable to be fully loaded, the Contractor shall be required to clean out or re-drill those holes that do not meet the contract requirements or match the blasting plan. The Blasting Consultant shall verify that all blasting materials and stemming are installed in accordance with the approved blasting plan.

If more than 5% of the holes are short before loading, the Contractor shall be required to re-drill the short holes to proper depth at his expense.

Stemming for production blasting shall consist of angular crushed sand or other angular aggregate passing the 3/8 inch sieve but retained on the No. 8 sieve. The Contractor shall prove the proposed stemming material performs as required by a test blast.

Blast holes shall be fitted with a temporary plug to keep overburden, drill cuttings or other foreign material from falling into the holes after drilling. The depth of the blast hole shall be recorded and made visible to the Engineer at the drill hole collar.

The Contractor shall demonstrate the adequacy of the proposed blast plan by drilling, blasting and excavating short test sections up to 20 feet in length, until satisfactory results are achieved prior to commencing full-scale blasting operations. Test sections shall be performed for all variations of the blasting plan and backslopes. This will include final backslopes excavated with or without controlled blasting. The Blasting Consultant shall provide an evaluation of acceptable rock fragmentation, damage to the backslope, fly rock control, and ground vibration and air blast control. The test section shall be performed to demonstrate that the blast has not damaged the final slope, that acceptable rock fragmentation is provided, and that fly rock, ground vibration and air blast are properly controlled.

The Engineer will, at all times, have the authority to prohibit or halt the Contractor's blasting operations if it is apparent that, through the methods being employed, the required slopes are not being obtained in a stable condition or the safety of the public is being jeopardized.

Where controlled blasting is required to form the final backslope, the Contractor will not be allowed to drill ahead of the test shot area until the test section results have been completely evaluated by the Engineer and the Blasting Consultant. If the results of the test shot(s) are unsatisfactory as determined by the Engineer, the Contractor shall adopt such revised methods as are necessary to achieve the required results. Unsatisfactory test shot results include fragmentation beyond the indicated lines and grade, flyrock, excessive ground vibration or air blast or violation of other requirements within these specifications. All costs incurred by the Contractor in adopting revised blasting methods necessary to produce an acceptable test shot shall be the sole responsibility of the Contractor.

If at any time during the progress of the work, the methods of drilling and blasting do not produce the desired result of a stable, safe, and uniform slope, within the tolerances specified, the Contractor shall be required to drill, blast, and excavate in short sections, not exceeding 20 feet in length, until satisfactory results are achieved. All extra costs shall be the sole responsibility of the Contractor.

All other requirements for controlled and production blasting operations covered elsewhere in this specification shall also apply to the blasting carried out in conjunction with the test shots.

1. **Safety Procedures.**
   - **a.** No blasting shall take place before sunrise or after sunset.
   - **b.** A fire prevention and protection plan, and lightning detection and protection plan shall be included in the Contractor’s blasting plan.
   - **c.** The Contractor shall provide a plan to prevent entry into the blasting site by unauthorized personnel during the loading and blasting operations.
   - **d.** Prior to each blast, all explosive packing materials shall be removed from the site and be properly disposed of.
   - **e.** Warnings and Signals. The Contractor shall establish a method of warning all personnel on the job site of an impending blast. The signal shall consist of a 5 minute warning signal to notify all in the area that a blast will be fired within a 5 minute period. A second warning signal shall be sounded 1 minute before the blast. After the blast is over, there shall be an all clear signal sounded so all in the area understand that all blasting operations are finished.
   - **f.** Check for Misfires. The Contractor shall observe the entire blast area for a minimum of 5 minutes following a blast to guard against rock fall before commencing work in the area.

After the 5 minute delay, it shall be the Blaster-in-Charge's responsibility to go into the shot area and check all holes to make sure that they have detonated. If any holes have not fired, these misfires will be handled by the Blaster-in-Charge before others enter the work area. Traffic shall remain closed and the blast site shall remain off limits to all but authorized personnel until all potential explosion hazards have been eliminated. The Blaster-in-Charge shall correct all misfires in a safe manner. If a misfire poses problems that cannot safely be corrected by the Blaster-in-Charge, then a consultant or an explosive company representative skilled in the art of correcting misfires shall be called in to rectify the problem. The Contractor shall be solely responsible for all costs resulting from misfires.

g. Flyrock Control. Before the firing of any blast in areas where flying rock may result in personal injury or unacceptable damage to property or the work, the Contractor shall provide an acceptable method to control flyrock. If flyrock occurs during the blasting operations to the extent of endangering workers, equipment, or is propelled outside the project limits all blasting operations shall cease until the Contractor reviews the blast and determines the cause and solution to the flyrock problem. Before blasting resumes, a written report shall be submitted to the Engineer for his review. The written report shall include determined cause and remedial steps to ensure correction.

h. Scaling and Stabilization. All rock on the cut face that is loose, hanging, or otherwise may create a potentially dangerous situation as determined by the Engineer, shall be removed or stabilized during or upon completion of the excavation in each lift. Drilling of the next lift shall not be allowed until this work has been completed.

The slopes shall be scaled throughout the duration of the contract and at such frequency as required to remove all loose rocks, overhangs, or hazards. The slopes shall be hand scaled using a suitable standard steel mine scaling rod. Subject to the Engineer's approval, other methods such as machine scaling, hydraulic splitters or light blasting may be used in lieu of or to supplement hand scaling. The extent of the scaling will be determined by the Engineer who will determine the completion of the work. Scaling necessitated by the structural geology of the rock shall be paid for at the appropriate unit price or force account.

If in-place stabilization is required, as determined by the Engineer, rock bolting, rock dowelling or other Engineer approved stabilization techniques shall be used. Stabilization necessitated by the structural geology of the rock and unaffected by the blasting shall be paid for at the appropriate unit price or force account.

Stabilization or scaling necessitated, in the opinion of the Engineer, by the Contractor's blasting operations, shall be performed at the Contractor's expense.

2. **Daily Blasting Logs.**

The Contractor shall provide the Engineer, on a weekly basis, a daily log of blasting operations. The log shall be updated at the close of each business day. The log shall include the number of blasts, times, dates of blasts, blasting locations, patterns and all information shown below:

a. Station limits of the shot(s) and the number of holes blasted including limits left and right of centerline and the number and depth of holes blasted.

b. Plan and section views of drill pattern including free face, burden, blast hole spacing, blast hole diameters, blast hole angles, lift height, and sub drill depth.

c. Loading diagram showing type and amount of explosive, primers, initiators and location and depth of stemming.

d. Initiation sequence of blast holes including delay times and delay system in each blast hole.

e. Trade names and sizes of all explosives, primers, and initiators to be employed.

f. Signature of the Blaster-in-Charge.

g. All ground vibration and air blast (noise) records.

The blasting logs are for quality control and record keeping purposes. Review of the blast log by the Engineer shall not relieve the Contractor of his responsibility for the accuracy and adequacy of the blasting log.

3. Daily Explosive Material Consumption and Report of Loss Report.
Shall include the signature of the Blaster-in-Charge. The Contractor shall comply with all Federal, State and Local law, regulations, and conditional use permits.

4. Traffic Safety.
Whenever blasting is planned within 1000 feet of a roadway, road and pedestrian signs shall be provided. The signs shall be covered or removed when there are no explosives in the area or the area is otherwise secure. Prior to blasting, the Blaster-in-Charge shall determine whether road and pedestrian users in the blasting zone will be endangered by the blasting operation. If there is danger, road users shall not be permitted to pass through the blasting zone during blasting operations.

5. Pre-blast Survey.
Prior to any blasting on the project, the Blasting Consultant shall conduct a Pre-blast Survey of both the interior and exterior of all adjacent buildings, structures, and utilities and other structures that may be subject to damage from blast induced ground vibration or air blast over pressure or any structure as directed by the Engineer. The Pre-blast Survey shall document the existing condition of these items in sufficient detail to later determine if the Contractor's blasting operation has caused any damage. The Contractor shall submit a copy of the Blasting Consultant’s survey to the Engineer and the owners of the structures no less than 7 days prior to any blasting.

6. Post-blast Survey
Not later than 2 weeks after the conclusion of blasting operations or as required by the Engineer, the Blasting Consultant shall re-examine all of the items inspected during the Pre-blast Survey. Each item will be re-examined using the Pre-blast Survey photos, and audio and/or video tape to confirm that no change has occurred to any of these items. Owners shall be notified if any change has occurred. The property owner/resident shall be pre-contacted for an inspection appointment. The Blasting Consultant shall initial a check off sheet for all structures included in the Pre blast Survey.

Within 30 days after the conclusion of blasting operations, or as directed, the Blasting Consultant shall submit to the Engineer and the property owners a final written Post-blast Survey Report addressing all of the items inspected in the Pre-blast Survey as performed by the Blasting Consultant. Any apparent damages observed or measured in the Post-blast Survey shall be specifically noted in the report.

All damage to public or private property caused by the use of explosives shall be repaired, as a first order of work, by the Contractor, at no additional expense to the State, and as specified by the Engineer.

C. CONTROLLED BLASTING.
Controlled blasting shall consist of drilling and shooting a linear series of line holes for controlling the neat line of the final back slope along the final excavation line. Only those holes drilled, loaded with explosives, and detonated for the above purpose will be considered and measured as controlled blasting.

Controlled blasting techniques, as covered herein, shall be used for forming final rock cut slopes at the locations shown on the plans or called for in the Special Provisions or as directed by the Engineer.

Controlled blasting refers to the controlled use of explosives and blasting accessories in carefully spaced and aligned drill holes to produce a free surface or shear plane in the rock along the specified final excavation backslope. Controlled blasting techniques covered by this specification shall include presplitting and cushion blasting.

Presplitting is defined as the detonation of the presplit holes before the detonation of any adjacent production holes has occurred. Cushion blasting is defined as the detonation of the cushion blast holes after the detonation of the adjacent production holes has occurred.

Production blasting, as covered herein, refers to the rock fragmentation blasts resulting from more widely spaced production holes drilled throughout the main excavation area adjacent to the controlled blast line. Production holes shall be detonated in a controlled delay sequence.

Controlled blasting shall be required in the excavation of rock or cemented materials where cut slopes, shown on the plans, are equal to or steeper than 1V: 3/4H (53 degrees). This provision shall apply even if the main excavation can be ripped.

Unless otherwise allowed by the Engineer, the Contractor shall begin the controlled blasting tests with the controlled blast holes spaced 24 inches apart, and then adjust the spacing only as approved in writing by the Engineer. Blast hole spacing for controlled blasting shall not exceed 30 inches.

Pioneering the top of cuts and preparing a working platform to begin the controlled blast drilling operations may require unusual working methods and use of equipment. The Contractor may use angle drilled holes or fan drilled holes during the initial pioneering operations to obtain the desired rock face. The blast hole diameter requirements for controlled blasting are applicable for pioneering work.

The Contractor shall completely remove all overburden soil and loose or decomposed rock along the top of the excavation for a sufficient distance in all directions beyond the excavation limits or to the limits and slopes shown on the plans before drilling the controlled blast holes.

At the direction of the Engineer, potentially dangerous boulders or other material located beyond the excavation limits shall also be removed before drilling controlled blast holes. Payment for removal of the material located beyond the excavation limits shall be considered incidental.

1. Presplitting.

All presplitting, including that carried out in conjunction with the blasting test section requirements of this Special Provision, shall be performed in accordance with the following requirements:

- **a.** The Contractor shall completely remove all overburden soil and loose or decomposed rock along the top of the excavation for a sufficient distance beyond the end of the production hole drilling limits, or to the end of the cut, before drilling the presplitting holes.
- **b.** The presplit drill holes shall not be more than 3 inches in diameter.
- **c.** The Contractor shall control their drilling operations by the use of proper equipment and technique to insure that no hole shall deviate from the plane of the planned slope by more than 2 inches either parallel to or normal to the final excavation slope. The State will not pay for presplit holes exceeding these tolerances.
- **d.** Presplit holes shall be drilled within 3 inches of the staked collar location. If more than 5% of the presplit holes are outside of the 3 inch tolerance, they will be filled with crushed stone, stemmed and redrilled.
- **e.** All drilling equipment used to drill the presplit holes shall have mechanical, electro-mechanical, or electronic devices affixed to that equipment to accurately determine

the angle at which the drill steel enters the rock. Presplit hole drilling will not be permitted if these devices are either missing or inoperative.

f. Presplit holes shall extend a minimum of 30 feet beyond the limits of the production holes to be detonated or to the end of the cut as applicable.

g. The length of presplit holes for any individual lift shall not exceed 8 feet unless approved by the Engineer. Before the specified lift height may be exceeded, test blasting by the Contractor and at the expense of the Contractor may be performed if approved by the Engineer. Test blasts shall not be closer than 5 feet to the final excavation face and shall not be made part of the final excavation face.

h. When the cut height requires more than one lift, a maximum 24 inch offset between lifts shall be permitted to allow for drill equipment clearances. The Contractor shall begin the control blast hole drilling at a point, which will allow for necessary offsets and shall adjust, at the start of lower lifts, to compensate for any drift, which may have occurred in the upper lifts.

i. Before placing charges, the Contractor shall determine that the hole is free of obstructions for its entire depth. All necessary precautions shall be exercised so that the placing of the charges will not cause caving of material from the walls of the holes.

j. Drill hole conditions may vary from dry to filled with water. The Contractor shall use whatever type(s) of explosives and/or blasting accessories necessary to accomplish the specified results.

k. The diameter of explosives used in presplit holes shall not be greater than one-half the diameter of the presplit hole.

l. Bulk ammonium nitrate and fuel oil (ANFO) will not be accepted as explosive for controlled blasting.

m. Only standard explosives specifically manufactured for presplitting shall be used in presplit holes.

n. The bottom charge of a presplit hole may be larger than the line charges but shall not be large enough to cause overbreak. The top charge of the presplitting hole shall be placed far enough below the collar, and reduced sufficiently, to avoid overbreaking and heaving.

o. Proper stemming of all controlled blasting holes shall be required. Stemming for controlled blasting shall consist of angular crushed sand or other angular aggregate passing the 3/8 inch sieve but retained on the No. 8 sieve.

p. As long as satisfactory presplit slopes are obtained, as determined by the Engineer, the Contractor may either detonate the presplit blasting holes forming the slope face before drilling for production blasting or may detonate the presplit blasting holes forming the slope face and the production blast holes within the same blast event, provided that the presplitting drill holes are detonated ahead of the adjacent production blast holes. If required to reduce ground vibrations or noise, presplit holes may be delayed, provided the hole to hole delay is no more than 25 milliseconds.

q. The presplit slope face shall not deviate more than 6 inches from a plane passing through adjacent drill holes, except where the character of the rock is such that, as determined by the Engineer, irregularities are unavoidable. The 6 inch tolerance shall be measured perpendicular to the plane of the planned final cut slope.

r. The row of production blast holes immediately adjacent to the controlled blast line shall be drilled on a plane approximately parallel to the controlled blast line. Production blast holes shall not be drilled closer than 6 feet to the controlled blast line. The bottom of the production holes shall not be lower than the bottom of the controlled blast holes.

s. It is the Contractor's responsibility to take all necessary precautions in the production blasting to minimize blast damage to the final cut slope.

2. Cushion Blasting.

Where the horizontal distance from the cut face to the existing rock face is less than 15 feet, the Contractor may cushion blast in lieu of presplitting. Cushion blasting is where

the detonation along the final cut face will be performed only after the detonation of all adjacent production holes has occurred. Differences in delay times between the cushion blasting line and the nearest production row shall not be greater than 75 milliseconds or less than 25 milliseconds. With the exception of the above criteria, the requirements previously given for presplitting shall also apply to cushion blasting.

090082.03 METHOD OF MEASUREMENT AND BASIS OF PAYMENT.

The use of explosives in accordance with this special provision, will not be measured separately, but will be considered incidental to the bid item Class 22 Excavation. No separate payment will be made.