

Guide for
SOLID CONCRETE BLOCK SEALS

July, 2006

Mine Safety and Health Administration

SOLID CONCRETE BLOCK SEAL

Former section 30 CFR 75.335(a)(1) specifies requirements for seals constructed using solid concrete blocks. This summary is intended to provide guidance on practices that should have been followed during solid concrete block seal construction. In addition, standard masonry construction practices, such as for material tolerances, plumbness, etc., should always be followed.

Seal Materials

The solid concrete block seal uses 8 X 8 X 16 inch or 6 X 8 X 16 inch solid concrete blocks and mortar. No hollow core concrete blocks can be used.

The mortar used should meet ASTM C270-91a, as Type N, S, or M mortar. In addition, Quikrete BlocBond 1225-51 is considered an acceptable mortar. Although Quikrete BlocBond 1225-51 is a surface bonding mortar, it is an acceptable mortar with solid concrete blocks because of its high strength. Quikrete BlocBond 1225-51 is the only surface bonding mortar permitted to be used as a joint mortar in this type of seal construction.

Except for the use of Quikrete's BlocBond, the mortar used cannot be a surface bonding mortar containing fiber reinforcement. B-Bond MS Mine Sealant is one such mortar and is not to be used for the mortared joints in constructing a solid concrete block seal. BlocBond (Product Number 1225-51) comes in a blue bag and should not be confused with B-Bond (Product Number 1234-40; 1234-50) which comes in a green bag. These are different products.

All the vertical and horizontal joints should be fully-coated with mortar that is nominally 3/8-inch thick. The joint thickness should not exceed 5/8 inch nor be less than 1/4-inch thick. Concrete masonry units should not be wetted before mortar application.

Rock dust is not to be mixed into the joint mortar. In no case can solid-concrete-block seals be constructed in dry-stacked fashion or with concrete blocks smaller than 6 X 8 X 16 inch. Exceptions to using smaller size blocks is in constructing the top course with solid cap blocks where a full size block will not fit and at the ends of the courses for bond alignment.

SEAL CONSTRUCTION

Section 75.335 requires that construction of solid concrete block seals be as follows:

- (a)(1) Each seal constructed after November 15, 1992, shall be:

- (i) Constructed of solid concrete blocks at least 6 X 8 X 16 inches, laid in a transverse pattern with mortar between all joints (see attached figure);
- (ii) Hitched into solid ribs to a depth of at least 4 inches and hitched at least 4 inches into the floor;
- (iii) At least 16 inches thick. When the thickness of the seal is less than 24 inches and the width is greater than 16 feet or the height is greater than 10 feet, a pilaster shall be interlocked near the center of the seal. The pilaster shall be at least 16 inches by 32 inches; and
- (iv) Coated on all accessible surfaces with a flame-retardant material that will minimize leakage and that has a flame spread index of 25 or less. (Flame retardant materials are MSHA approved general purpose sealants.)

It should not be assumed that a standard block seal constructed to any height or width will be able to withstand the pressure from an explosion. As the height and/or width of a seal is increased, the flexural, shear and compressive stresses that the seal material will be subjected to from an explosion also will increase. In testing at the Lake Lynn facility, a 16-inch thick standard block seal with a 16-inch by 32-inch center pilaster, and with a size of approximately 6 feet high by 18 feet wide, withstood a 43-psi pressure without failure. Another 16-inch thick standard seal, with a center pilaster and a size of approximately 8 feet high by 16 feet wide, withstood pressure in a chamber test of up to 94 psi. However, the strengths of these test seals are thought to have been heavily influenced by internal arching, which can occur in the Lake Lynn facility because the test seals are coupled to rigid limestone. In a coal mine, where the strata surrounding a seal will typically be less rigid than the limestone at Lake Lynn, the arching effect will be less and the strength exhibited by a seal that relies on the arching effect will be less. For these reasons, larger size standard seals should be analyzed and/or tested to verify their strength or to determine what strength enhancements are required.

In hitching this seal into the floor, the blocks in the course of block at floor level should extend approximately mid-block above the floor level. The purpose of this provision is to prevent having a horizontal joint flush with the floor. In lieu of hitching, a minimum of 6" x 6" x 1/2" angle can be installed on both sides of the seal. The angle should be bolted to the mine floor and ribs with 1-inch diameter (or greater), case hardened bolts, at least 18 inches long. The bolts should be grouted into the mine floor and installed on 18 inch centers. These bolts should be equipped with top nuts that can be tightened against the angle. Any gaps between the angle and the seal or the angle and the strata should be filled with mortar. **Construction of a solid concrete block seal with angles in lieu of hitching constitutes "an alternative method or materials" under 75.335(a)(2).**

The standard seal is built of rigid materials and can fail in squeezing conditions. This seal can be built in dry, damp, or wet conditions, but not in standing water.

After a location is chosen, all the loose material needs to be removed from the roof, ribs, and floor back to competent, solid material. A hitch is cut into the floor and ribs or a 6-

inch by 6-inch by ½ -inch angle is to be bolted to the floor and ribs in contact with the seal. The floor should be leveled or a footer constructed to provide a suitable foundation for the placement of the first course of blocks. Mortar is to be mixed with suitable quality water according to manufacturer's recommendations. The first course of blocks is to be laid in mixed mortar. All vertical and horizontal joints are to have a full application of mortar applied. Concrete blocks are to be laid in a manner that causes vertical joints to be staggered, as shown in the attached drawing.

The top row of blocks should be solidly wedged against the roof. The gaps between the seal and the roof, and between the wedges, are to be completely filled with mortar. The area between the seal and both ribs is also to be completely filled with mortar. No sealant bags or other materials are permitted to be used to fill these gaps.

Seal construction should be supervised, including quality control and procedures, by a responsible person(s) who is knowledgeable of construction techniques and the specific seal construction requirements.

Storage, transportation, and mixing of all seal materials should be according to the manufacturer's specifications. Materials should not be used beyond the manufacturer's specified shelf life. The storage of mortar material should be in a dry environment. A visual check of the material should be made before use. Bagged material should be relatively soft, indicating limited exposure to moisture.

Water quality and the temperature of the mine atmosphere during construction should be within the manufacturer's specifications. Safety precautions provided by material manufacturers should be followed. Personnel involved in erecting the seals should be familiarized with the methods and the seals intended function.

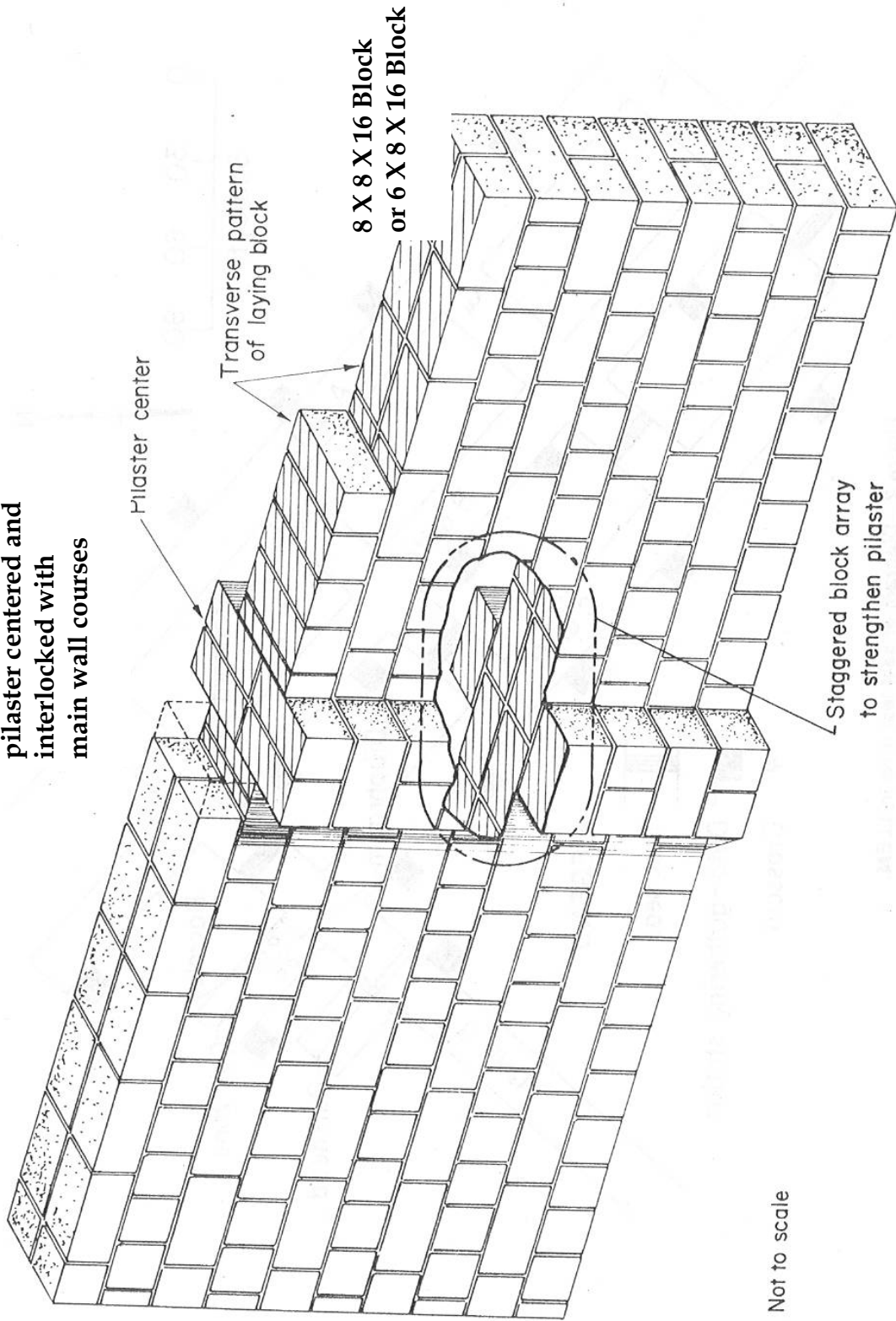
Seals should be set back at least 10-feet from the nearest corner of pillar to restrict air leakage around seal. Construction of seals at less than 10-feet from a pillar corner should be evaluated on a case-by-case basis.

Prior to seal construction, objects passing through the seal location, such as roof mesh, straps, rails, pipes and wires, should be safely removed.

Part 48 training should be provided to assure that all miners, including contractors, who construct or maintain the seals, are appropriately trained to perform such duties safely.

Solid Concrete Seal – Summary of Features		
Thickness	16 inches	24 inches
Type of construction	Solid concrete block wall, fully mortared and hitched into the floor and ribs.	
Hitching	Hitched at least 4 inches into the floor and both ribs; or hitched by bolting 6-inch by 6-inch by ½-inch angles along the floor and both ribs (alternative method).	
Wall construction	6-inch by 8-inch by 16-inch or 8-inch by 8-inch by 16-inch solid concrete blocks. Fully mortared joints with the block pattern alternated to stagger vertical joints.	
Mortar	Type N, S, M or Quikrete BlocBond product number 1225-51 (blue bag)	
Pilaster requirement	As per 75.335 (a)(1), required if opening is greater than 16 feet wide or greater than 10 feet high. Pilaster size is to be at least 16 inches by 32 inches, centered on the seal and interlocked with the wall blocks.	No pilaster is required based on 75.335 (a)(1).
Coating	Coated with MSHA-approved general purpose sealant.	
Size Limitations	Engineering analyses or full-scale tests are recommended for standard seals larger than those tested at Lake Lynn to either verify adequate strength or to determine required strength enhancements.	

16 in. by 32 in.
pilaster centered and
interlocked with
main wall courses



Not to scale

Solid concrete block seal, 16-inches thick with center pilaster.