

**MSHA Approval Number: 50M-05.0**  
**50-psi MICON MAIN LINE HYBRID SEAL**  
**Covered by U.S. Patent No. 5,385,504 and/or**  
**one or more pending U.S. and international patent applications**  
**MICON, Inc.**  
**For information, contact George Watson at (412) 664-7788, Ext. 15**

**INSTALLATION GUIDELINES**  
**(In up to 20-ft High by up to 28-ft Wide Mine Openings)**

1. The materials used in the installation of the MICON Hybrid seal are solid, concrete masonry unit (cmu) blocks, HybriCrete blocks, prepackaged bags or prepackaged buckets of #57 stone, and MICON 70 & HybriBond, which are two-component, liquid polymers. Each component of MICON 70 and HybriBond is contained in sealed, 55-gallon drums. The storage restriction for the CMU blocks, HybriCrete blocks, and prepackaged (e.g., bags or buckets) #57 stone is a dry location and protected with a water-tight covering. The storage restriction for the sealed, 55-gallon drums containing the components of MICON 70 and HybriBond – 24 hours before use underground - is a temperature equal to or higher than 40° F, but not more than 105° F.
2. The location(s) for the MICON seal would be chosen by the mine and documented in their MSHA-approved, ventilation/seal plan and would be in compliance with the mine's MSHA-approved, roof control/other plan(s). MICON would not start construction of any MICON seal until the mine has verified to them that the location(s) for the seal and the roof control in those proposed, seal location(s) are in compliance with the appropriate, MSHA regulations. The mine's MSHA-approved, ventilation/sealing plan would specify the piping, fittings, traps, material, and locations for sampling and water-drainage pipes.
3. The front face of the outby wall and the back face of the inby wall of the MICON Hybrid seal should ideally be 10 feet from any rib line, but not less than 5 feet. If only a shorter distance than 10 feet, but greater than 5 feet is possible, the mine's P.E. would assure the ribs are competent before MICON would start construction of their seal.
4. The location for the MICON seal shall be free of standing water. Any running water will be diverted from the seal location. If water is present, prior to seal construction, the water shall be removed and "B" Bond, or equal, shall be used to dry the area.
5. All metallic material, such as roof screens, conduit lines, mine rails, etc., shall be removed in the location for the MICON seal for at least its total thickness. No metallic material shall be allowed to penetrate through any part of the MICON seal's interior.
6. Remove all loose material from the roof, ribs, and floor, exposing competent rock/coal/strata at the seal location for at least the total thickness of the seal. Clear exposed surfaces to minimize dusts. Hitching into the competent ribs is not required. All debris in the area 50 feet inby the seal location and 50 feet outby the seal location will be removed.
7. After all loose material is removed from the roof, ribs, and floor, measurements would be taken to determine the maximum height and width of the "cleaned" mine opening through the

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thickness of the proposed seal. MICON personnel would take and/or verify the maximum, dimensions of the “cleaned” mine opening.

8. Using the seal-thickness chart, MICON personnel would establish the minimum thickness of the MICON seal’s core for the maximum height and width measured (both rounded upward to the nearest foot) for the “cleaned” mine opening. If the “cleaned”, mine-opening width exceeds 28 ft., the MICON seal could not be constructed. If the “cleaned”, mine-opening height exceeds 20-ft., the MICON seal could not be constructed. If the “cleaned”, mine-opening height is less than 4 ft., the minimum, core thickness for a 4 ft. height shall be used.
9. If the minimum, total thickness for the MICON seal – as determined in Step 8. – exceeds what had been “cleaned” in Step 6., remove all loose material from “uncleaned” roof, ribs, and floor to assure the MICON seal through its total thickness would abut competent strata.
10. Establish the locations for the inby and outby, MICON 70-glued, solid, concrete masonry unit (cmu) walls. Assure that the minimum, core thickness as per the seal- thickness chart for the maximum, “cleaned” mine height could be installed.
11. The mine would assure that all materials and equipment to be used in the construction of the MICON seal and the sampling/water pipes to be installed in same would be delivered to the seal location prior to MICON starting construction of the MICON seal.
12. The MICON Hybrid seal shall only be installed by personnel who either (a) have been trained on the installation of the MICON seal and are working under the direction of a MICON representative or (b) are trained MICON employees.
13. The 50-psi, MICON Hybrid, mainline seal could have multiple, sampling pipes up to 1-inch in diameter. Any high-density polyethylene or polypropylene pipe having an internal pressure rating of at least 100-psi would be acceptable. Uncoated PVC pipe is not acceptable. PVC pipe, which is at least Schedule 40 and which had been precoated over its exterior surface with a 1/8-inch layer of either MICON 70 or Hybribond, would be acceptable. The valves and fittings outside of the mine seal should be made of corrosion-resistant or plastic-coated, metallic material having an internal pressure rating of 100-psi. Non-metallic valves and fittings can be used as long as they have an internal pressure rating of 100-psi. At least one sampling pipe shall be used and shall be no more than 12 inches from the roof on the inby side and extend to the center of 1<sup>st</sup>, inby crosscut supported along its length with preferably non-corrosive or plastic-coated, metallic roof hangers, 6-ft. or less on centers. Standing cribs, either made of hard wood or cementitious material, 6-ft. or less on centers, could also be used to support the sampling pipe from below.
14. The 50-psi, MICON Hybrid, mainline seal could have no more than either a single, 8-inch diameter or up to four (4), no more than 6-inches in diameter, water pipe(s). Any high-density

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polyethylene or polypropylene pipe having an internal pressure rating of at least 100-psi would be acceptable. Uncoated PVC pipe is not acceptable. PVC pipe, which is at least Schedule 40 and which had been precoated over its exterior surface with a 1/8-inch layer of either MICON 70 or Hybribond, would be acceptable. The valves and fittings outside of the mine seal should be made of corrosion-resistant or plastic-coated, metallic material having an internal pressure rating of 100-psi. Non-metallic valves and fittings can be used as long as they have an internal pressure rating of 100-psi. The location requirement is that any two water pipes and/or their U-traps shall be spaced at least 3-ft. on centers away from any other water pipe/U-trap and at least 3-ft. on center away from either rib. The U-trap(s) may or may not be recessed into the mine floor. Because no one location for a water pipe and its U-trap would be best for all seal installations, mine operators in submitting their seal plan to the MSHA District office shall include the location(s) of those water pipe(s) to best handle potential water build-up behind the seal; which location(s) shall meet the aforementioned number and spacing requirements (i.e., no more than 6-inches in diameter and at least 3-ft. on center from one another and the ribs). The maximum height of water behind the seal should be no more than 2-ft, therefore, the inby invert of the water pipe should not exceed 24 inches from the mine floor.

15. Prior to the installation of each MICON Hybrid seal, and/or whenever a change-out in the two-component, pumping system is made, MICON personnel would prepare at least three, "beam" samples made by gluing with MICON 70, the abutting faces of three (3), 3-1/2" x 3-1/2" x 3-1/2" cubes of HybriCrete block to form 3-1/2" x 3-1/2" x 10-1/2" test specimens. Then, the six, exterior sides of each "beam" specimen would be coated with MICON 70. The "beam" test specimens would be cured at their respective seal site for at least 1-hour before being sent for testing.
16. The collected, quality control samples would be delivered to MICON, a testing laboratory, or a laboratory technician on site by either the mining company or MICON personnel.
17. A technician, who had been trained and certified for the direct shear test, would conduct the tests on the "beam" specimens. These quality control tests could be conducted on site or back in the laboratory.
18. Three (3), consecutive "beam" samples shall exhibit a minimum, shear strength of 200-psi in a direct shear test of the MICON 70/HybriCrete block interface.
19. A certified copy of the test results for each seal would be given to the mining company for transmittal to the MSHA District Office.
20. Each MICON Hybrid seal would not be considered to have reached its design strength until a certified copy of tests results are received by the MSHA District Office.

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Using 6" x 8" x 16" or 8" x 8" x 16", solid-concrete blocks, construct the inby, cmu wall using MICON 70 to fully glue-grout the cmu together such that the inby-wall thickness is a nominal 8". Fully glue-grout the base course of the solid-concrete blocks to the mine floor with MICON 70. Voids and/or depressions in the mine floor can be filled/leveled with MICON 70 - with or without #57 stone. After each row of cmu is installed, fully fill the gaps between the end blocks and ribs with MICON 70 - with or without #57 stone - and/or shaped pieces of cmu - to firmly tighten the cmu blocks in place. Fully fill the gaps between the last course and mine roof with MICON 70 - with or without #57 stone and/or untreated, hardwood wedges. The construction of the core (or adjacent, subcore(s)), and/or interior/outby, cmu walls could be constructed simultaneously.

21. Construct the core (or subcore) of HybriCrete block by fully glue-grouting all such blocks to each other and to the surface of the completed, cmu wall(s) using MICON 70. Fully glue-grout the first course of the HybriCrete block to the mine floor fully using MICON 70. Voids and/or depressions in the mine floor can be filled/leveled with MICON 70 - with or without #57 stone. After each course/row of HybriCrete block is installed, fully fill the gaps/voids between the end blocks and ribs with MICON 70 – with or without #57 stone – to tighten the blocks in place. Another alternative for fully filling the gaps/voids at the ribs would be to install HybriBond - with or without #57 stone - as long as the mean distance between the end of the course/row of HybriCrete block and the rib is 4-inches or less. When the last course/row of HybriCrete block is completed, fully fill the gaps/voids at the mine roof with shaped pieces of HybriCrete block, which are fully glue-grouted to one another and to the mine roof using MICON 70. Another alternative for fully filling the gaps/voids at the mine roof would be to install HybriBond - with or without #57 stone - as long as the mean distance between the top course/row of HybriCrete block and the mine roof is 4-inches or less. The construction of the interior/outby, cmu walls and/or outby subcore(s) could be constructed simultaneously.
22. Using 6" x 8" x 16" or 8" x 8" x 16", solid-concrete blocks, construct the next, cmu wall using MICON 70 to fully glue-grout the cmu together such that the cmu-wall thickness is a nominal 8". Fully glue-grout the base course of the solid-concrete blocks to the mine floor with MICON 70. Voids and/or depressions in the mine floor can be filled/leveled with MICON 70 - with or without #57 stone. After each row of cmu is installed, fully fill the gaps between the end, cmu blocks and ribs with MICON 70 - with or without #57 stone and/or shaped pieces of cmu – or HybriBond to firmly tighten the cmu blocks in place. Fully fill the gaps between the last course and mine roof with MICON 70 - with or without #57 stone and/or untreated, hardwood wedges - or HybriBond.
23. Install water trap pipe(s) and sampling tube(s) as specified by the mine when reaching the appropriate heights of seal construction to accommodate same as directed by mine personnel. Mine personnel would be responsible for assuring that the sampling/water pipes through the seal are installed at the locations and of the nonmetallic material specified in the mine's MSHA-approved, ventilation/sealing plan and in Steps 13 and 14 above. CMU and

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HybriCrete blocks can be cut or shaped to receive the sampling/water drainages pipes. MICON personnel would grout the pipes/tubes to the surrounding cmu and HybriCrete blocks with MICON 70 or HybriBond, assuring that all voids are filled between the pipes/tubes and the cmu & HybriCrete block throughout the seal's thickness.

24. Continue construction of the seal by repeating steps 22. and 23. above until all the subcore(s) of HybriCrete block, the interior, cmu wall(s), and the outby, cmu wall are completed. As mentioned above, all cmu walls and HybriCrete block core/subcore(s) could be constructed simultaneously, but in a stepped fashion. The outby, 0-4 inches of the core could be either HybriBond or MICON-70, with or without #57 stone, in lieu of HybriCrete block.
25. Seals having a specified, minimum, core thickness of 48-inches or greater, would be constructed in two or more stages with interior, MICON 70-glued, single-wythe or double-wythe, cmu wall(s) breaking up the HybriCrete block into two or more "subcores", each within +/- 6 inches in thickness of one another, but with no HybriCrete block "subcore" exceeding 48 inches. Each wythe of MICON 70-glued, interior, cmu walls would count toward the minimum, core thickness for the 120-psi, MICON Hybrid, mainline seal. See the attached schematic drawings for typical seal construction involving an interior, cmu wall.

**ADDITIONAL QUALITY CONTROL DETAILS:**

No quality control/assurance samples of the cmu, HybriCrete block, or MICON 70/HybriBond are required to be taken underground and subsequently tested than what had been mentioned above for the "beam" specimens of HybriCrete block/MICON 70. All quality control on these other building materials are conducted by MICON, a testing laboratory, and/or their manufacturer prior to the materials being sent to the mine. Usually the mine would purchase the cmu used in the seal's construction. MICON requires the mine to supply them with the manufacturer's "mill sheet", which documents that the quality control samples from the manufactured lot of the cmu have been tested as per ASTM C-140-97 showing that the cmu's compressive strength is at least 1,800-psi. A Technical Support-sanctioned laboratory conducts quality control tests on samples from the manufactured lots of HybriCrete block as per ASTM D-1621-04a; compressive samples are taken and run on at least one block per hundred manufactured. Only those lots of HybriCrete block, which pass ASTM D-1621-04a, are shipped by MICON to the mine. As also mentioned above, the sealed, 55-gallon drums containing the two components of MICON 70 and HybriBond are quality-controlled by their manufacturer (Dow Chemical) and marked with the appropriate, quality control lot number prior to shipment to MICON. MICON's application/mixing equipment, which is used only by MICON's trained personnel underground to apply MICON 70 and HybriBond, are quality-controlled tested by MICON prior to each seal installation(s) at a given mine. Furthermore, MICON technicians, who are the only ones to use this equipment to construct the MICON Hybrid seal, are trained to recognize when that equipment is "off ratio". Should that equipment be suspected of being "off-ratio", a back-up application system would be employed

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by MICON's technicians. Prior to the use of the back-up system, at least three, quality-control "beam" specimens would be constructed and stored underground at least 1-hour before being removed for testing. The quality-control testing of the "beam" samples by a trained and lab-certified technician is a check on not only the shear strength of the MICON 70/HyбриCrete block interface, but also the effectiveness of the two-component mixer operating properly.

**ADDITIONAL CONSTRUCTION DETAILS:**

MICON personnel would perform all the construction as listed below. Each HyбриCrete block is to be fully grouted to the previous HyбриCrete block course/row, the inby face of the outby, cmu wall, internal wall(s), and/or the inby face of the outby, cmu wall using MICON 70. End HyбриCrete blocks can be shaped to fit snug against the rib line. At this time the rib, and first row of HyбриCrete block, and the mine floor would be coated fully with MICON 70 to bond the block to the substrate. Continue HyбриCrete block placement, block-to-block and block-to-rib line, until at the mine roof. Fill the gaps/voids at the mine roof with shaped pieces of HyбриCrete block, which are glued fully to one another and to the mine roof with MICON 70. Another alternative for filling the gaps/voids at the mine roof would be to install HyбриBond - with or without #57 stone - as long as the mean distance between the top course/row of HyбриCrete block and the mine roof is 4-inches or less. It is not necessary to coat areas of the rib and floor with MICON 70 prior to the placement of each HyбриCrete block unless HyбриBond is used - with or without #57 stone - to fill the gaps/voids at the mine roof, in which case coating the roof ahead of time with MICON 70 is required. Uneven floor, or pot holes, can be leveled/filled using MICON 70 - with or without #57 stone. Voids underneath the first course/row of HyбриCrete block can be filled using MICON 70 - with or without #57 stone - to create a level floor and/or to keep all blocks tight to the mine floor. Any uneven voids remaining can be backfilled with MICON 70 - with or without #57 stone - using a two-component-pour applicator, row by row. As the seal's core matrix is being installed row-by-row, each course/row can be inspected for unwanted gaps and filled with MICON 70 prior to the next row installation. Some gaps would be easier to fill from the next block row, as gravity would enhance filling that void from above the next row outby, i.e., filling between walls, or backfilling between block walls using MICON 70, which gives free flow down and out to the voids in the last row installed. MICON 70 would seek unfilled, small, outer voids on walls/courses laid prior to setting to a solid plastic. Any leakage detected could be in the roof, floor, and/or the rib line, or in all of the above. MICON personnel would seal any leakage with a two-component, polymer or other MSHA-suitable sealant. If leakage is detected in the surrounding ribs, roof, and/or floor, MICON personnel would install Jam Rods, around perimeter and recheck for leakage. If rock conditions, or bolt communication of the two areas are more severe, MICON personnel would use the MICON grout ring injection technique. Grout ring injection includes drilling holes, installing grout stems with a packer, and pumping MICON 70 under pressure on angles into the problem rock formation. MICON 70 under pressure would fill cracks and voids to control the unwanted communication between the

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sealed area and the fresh-air side of the seal. See the attached schematic drawings for typical construction practices.

**CONVERGENCE MEASUREMENTS:**

A convergence measurement should be taken and recorded during the regular examination of the seal by mine personnel. A permanently placed “pogo” stick or extensometer could be placed at the outby face of the seal, preferably near the center of the mine opening, and extend from the bottom of the first course of cmu at the mine floor to the top of the topmost, cmu course at the mine roof. If this measurement exceeds the maximum allowable convergence specified, check to see that the top and bottom of the “pogo” stick or extensometer extend from the bottom of the first course of cmu to the top of the topmost, cmu course at the mine roof. Readjust the top and bottom of the “pogo” stick or extensometer, if required, and retake the measurement. If this measurement exceeds the maximum allowable convergence specified and/or the outby, cmu wall shows signs of cracking, MICON should be contacted immediately. If MICON determines that the convergence has compromised the seal’s strength, a P.E. must be contacted immediately to evaluate the effects of this convergence and certify the structural integrity of the seal and provide that certification to the MSHA District Office. Cracks in the outby, MICON 70-glued, cmu could be repaired by filling the cracks with MICON 70 by a MICON technician.

*Notes:*

- 1. In areas where roof convergence and/or floor heave is possible, one row of concrete block at the mine roof can be substituted with Phenolic Board, 30 CFR 75.335 (2). The Phenolic Board must be the same width of the concrete block, which it is replacing, and be glued to the cmu and mine roof & ribs with MICON 70.*

**Minimum Thickness for 50-psi, MICON Hybrid, Mainline Seal  
(Up to 28-ft Wide)**

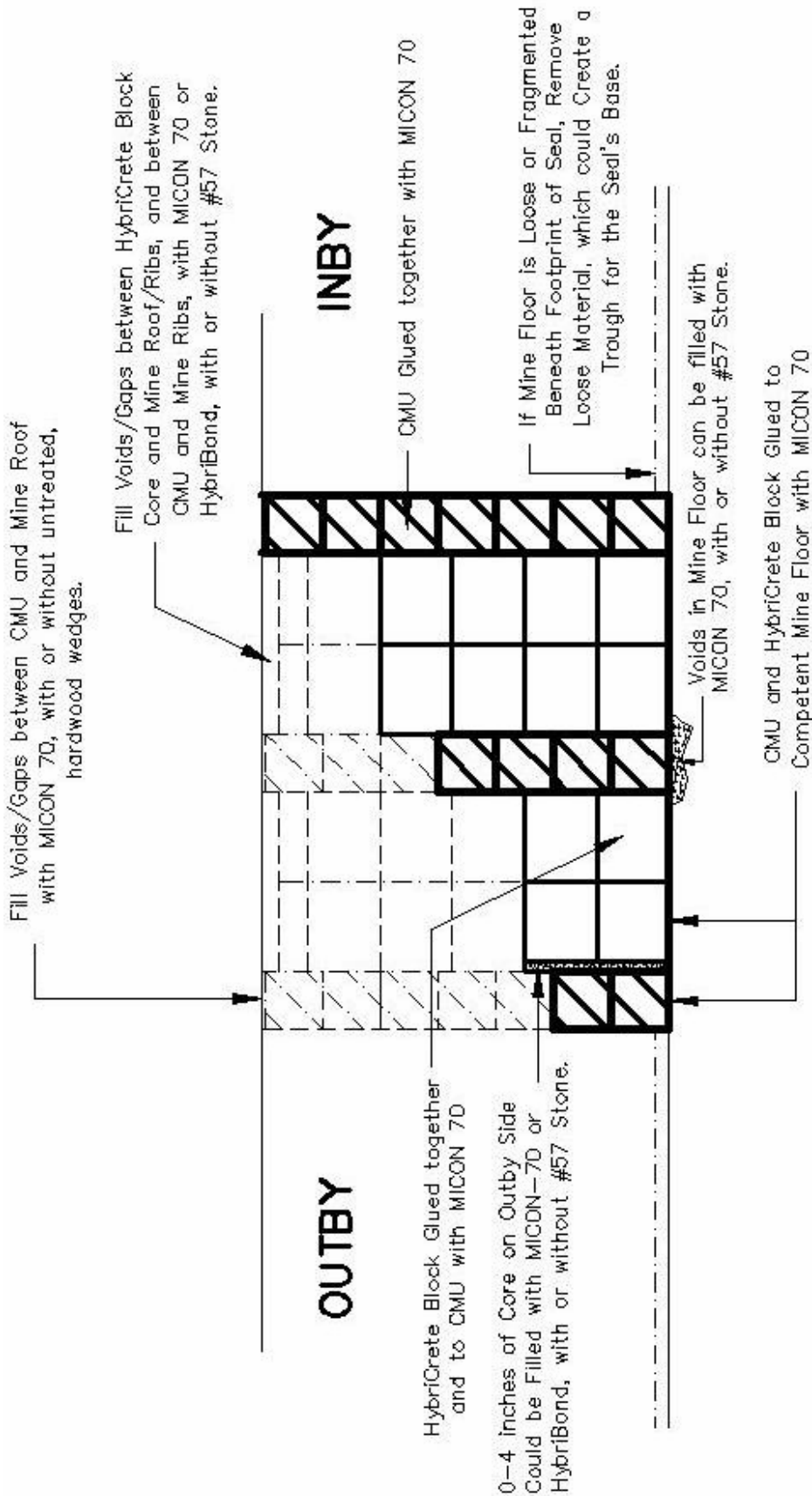
Height (ft)	Width (ft)	Minimum Core Thickness (in)	Minimum Total Thickness (in)	Maximum Convergence (in)
3	0-28	14	29.5	1.3
3.25	0-28	14	29.5	1.4
3.5	0-28	14	29.5	1.4
3.75	0-28	14	29.5	1.5
4	0-28	14	29.5	1.5
4.25	0-28	15.25	30.75	1.6
4.5	0-28	16.5	32	1.6
4.75	0-28	17.75	33.25	1.7
5	0-28	19	34.5	1.8
5.25	0-28	20.25	35.75	1.8
5.5	0-28	21.5	37	1.9
5.75	0-28	22.75	38.25	1.9
6	0-28	24	39.5	2.0
6.25	0-28	25	40.5	2.1
6.5	0-28	26	41.5	2.1
6.75	0-28	27	42.5	2.2
7	0-28	28	43.5	2.2
7.25	0-28	29.25	44.75	2.3
7.5	0-28	30.5	46	2.4
7.75	0-28	31.75	47.25	2.4
8	0-28	33	48.5	2.5
8.25	0-28	34.25	49.75	2.5
8.5	0-28	35.5	51	2.6
8.75	0-28	36.75	52.25	2.6
9	0-28	38	53.5	2.7
9.25	0-28	39	54.5	2.8
9.5	0-28	40	55.5	2.8
9.75	0-28	41	56.5	2.9
10	0-28	42	57.5	2.9
10.25	0-28	42.75	58.25	3.0
10.5	0-28	43.5	59	3.1
10.75	0-28	44.25	59.75	3.1
11	0-28	45	60.5	3.2
11.25	0-28	46.25	61.75	3.2



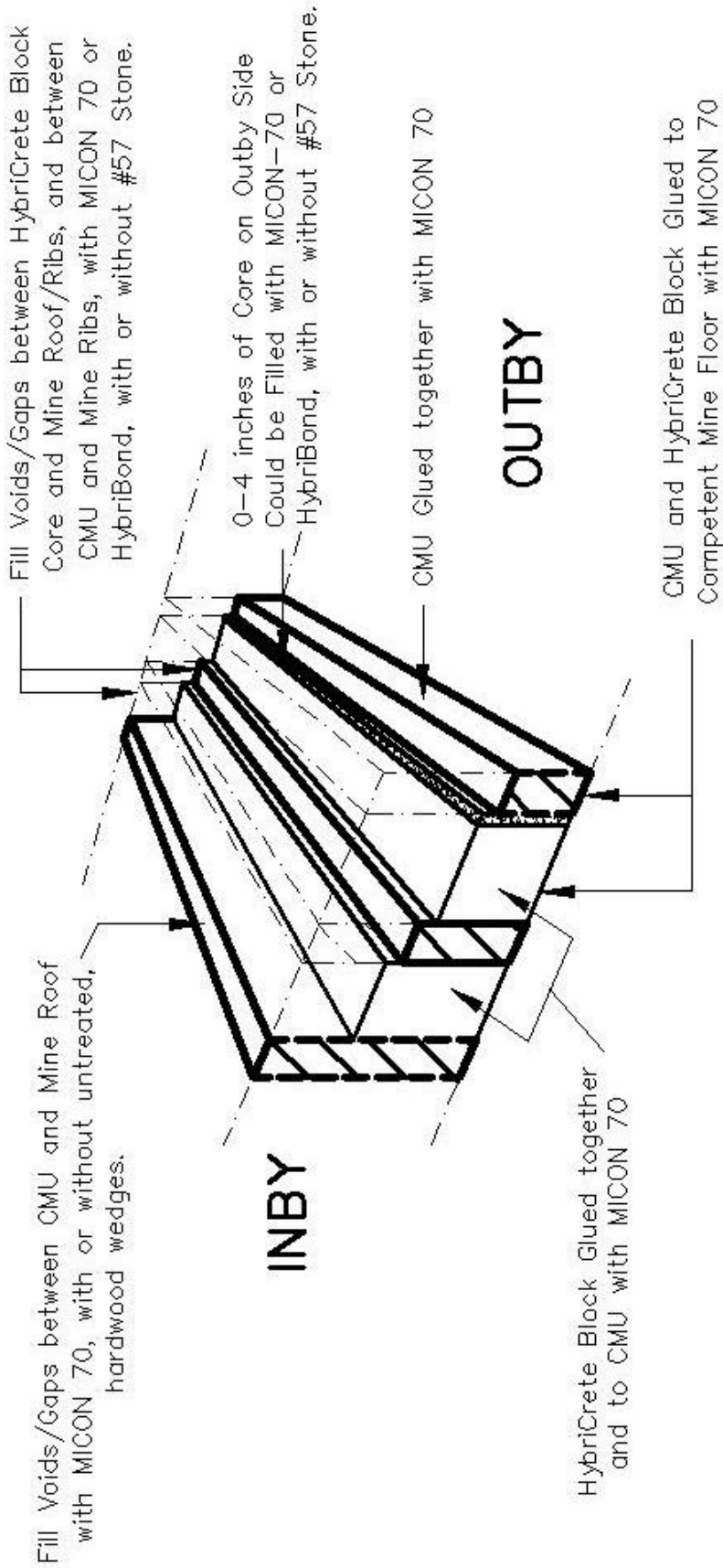
11.5	0-28	47.5	63	3.3
11.75	0-28	48.75	64.25	3.4
12	0-28	50	65.5	3.4
12.25	0-28	50.75	66.25	3.5
12.5	0-28	51.5	67	3.5
12.75	0-28	52.25	67.75	3.6
13	0-28	53	68.5	3.6
13.25	0-28	54	69.5	3.7
13.5	0-28	55	70.5	3.8
13.75	0-28	56	71.5	3.8
14	0-28	57	72.5	3.9
14.25	0-28	57.75	73.25	3.9
14.5	0-28	58.5	74	4.0
14.75	0-28	59.25	74.75	4.1
15	0-28	60	75.5	4.1
15.25	0-28	61	76.5	4.2
15.5	0-28	61.75	77.25	4.2
15.75	0-28	62.5	78	4.3
16	0-28	64	79.5	4.4
16.25	0-28	64.75	80.25	4.4
16.5	0-28	65.5	81	4.5
16.75	0-28	66.25	81.75	4.5
17	0-28	67	82.5	4.6
17.25	0-28	67.75	83.25	4.6
17.5	0-28	68.5	84	4.7
17.75	0-28	69.25	84.75	4.8
18	0-28	70	85.5	4.8
18.25	0-28	70.75	86.25	4.9
18.5	0-28	71.5	87	4.9
18.75	0-28	72.25	87.75	5.0
19	0-28	73	88.5	5.1
19.25	0-28	73.75	89.25	5.1
19.5	0-28	74.5	90	5.2
19.75	0-28	75.25	90.75	5.2
20	0-28	76	91.5	5.3

*Note: The minimum, core thickness shall be the summation of the total thickness of the HybriCrete block "subcores" and the interior, cmu wall(s). Both the HybriCrete block and the cmu shall be glued together with MICON 70. No "subcore" of HybriCrete shall exceed 48 inches in thickness. The "subcores" of HybriCrete block shall be within 6-inches of thickness of each other, separated from one another by an interior, glued, single or double-wythe, cmu wall. For example, the 12-ft. high seal could have two (2),*

*21-inch-thick +/- 3 inches "subcores" of HybriCrete block separated by a single-wythe (8-inches nominal), interior wall of MICON-70-glued cmu, which would provide the required 50-inches. The minimum, total seal thickness is a summation of the minimum, core thickness and the thickness of the inby and outby, MICON-70-glued, cmu walls, which for the example 12-ft seal would be 65.5 inches. The maximum convergence would be measured from the top of the outby, cmu wall to the base of the outby, cmu wall. Often the mine floor heaves up around the seal, which would require excavating to the base of the outby, cmu wall before taking convergence measurements. Should convergence exceed what is listed above, and/or the outby, cmu wall exhibits signs of cracking, a professional engineer shall evaluate the seal's integrity. Cracks in the outby, cmu wall can be repaired by filling the cracks with MICON 70.*



## TYPICAL, CROSS-SECTIONAL VIEW OF MICON HYBRID SEAL DURING AND AFTER ITS CONSTRUCTION (N.T.S.)



**TYPICAL, ISOMETRIC VIEW OF MICON HYBRID SEAL DURING AND AFTER ITS CONSTRUCTION (N.T.S.)**