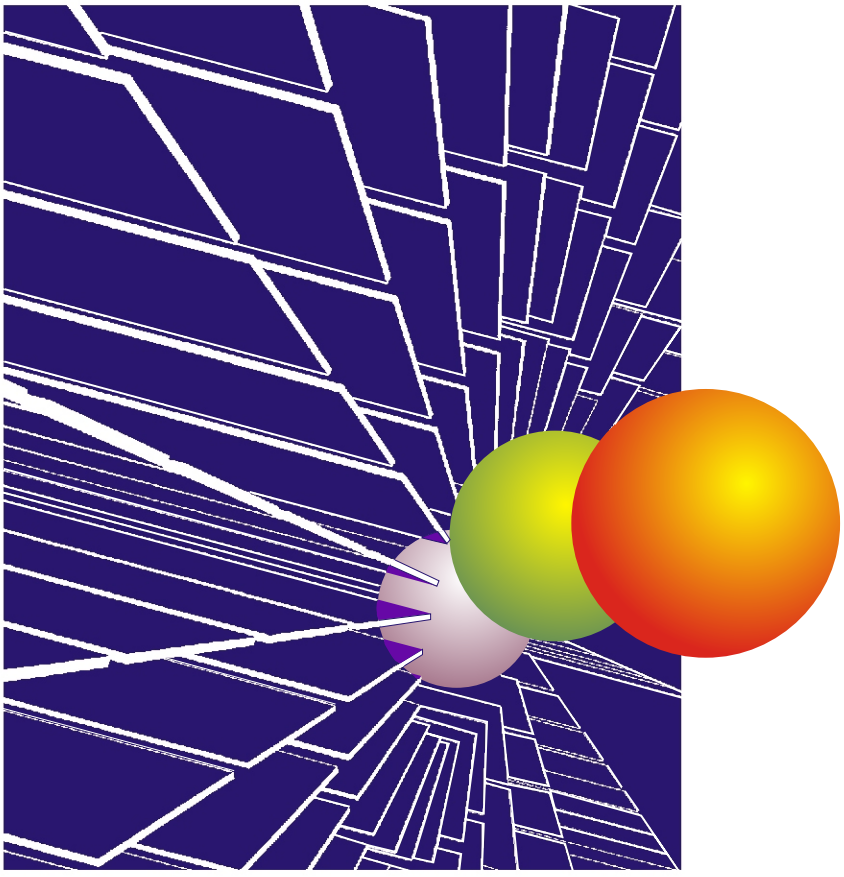
MoDOT

Research, Development and Technology

RDT 04-018

Evaluation of Cutco Sawing and Sealing Method

RI 00-030



June, 2004

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. RDT 04-18	2. Government Accession No.	3. Recipient's Catalog No. RI 00-030
4. Title and Subtitle Evaluation of Cutco Sawing and Sealing Method		5. Report Date 06/21/2004
		6. Performing Organization Code
7. Author(s) John MacIver, Xinge Yin, John Wenzlick, Carl Simmons		8. Performing Organization Report No.
9. Performing Organization Name and Address Missouri Department of Transportation Research, Development and Technology P. O. Box 270-Jefferson City, MO 65102		10. Work Unit No.
		11. Contract or Grant No.
12. Sponsoring Agency Name and Address Missouri Department of Transportation Research, Development and Technology P. O. Box 270-Jefferson City, MO 65102		13. Type of Report and Period Covered Final Report
		14. Sponsoring Agency Code
15. Supplementary Notes The investigation was conducted in cooperation with the U. S. Department of Transportation, Federal Highway Administration.		
16. Abstract This investigation is conducted to evaluate the potential benefits associated with Cutco sawing and sealing method in the comparison to MoDOT traditional method cutting contraction joints on newly placed PCCP. The evaluation indicates that Cutco method can provide excellent joints. Compared to MoDOT traditional method, it has about the same installation cost, and may have the benefits of less maintenance. It is recommended the state should consider an increased use of this method on PCCP joints.		
17. Key Words PCCP joint, saw, seal, concrete pavement	18. Distribution Statement No restrictions. This document is available to the public through National Technical Information Center, Springfield, Virginia 22161	

19. Security Classification (of this report) Unclassified	20. Security Classification (of this page) Unclassified	21. No. of Pages 14	22. Price

Form DOT F 1700.7 (06/98)

Evaluation of Cutco Sawing and Sealing Method

RI 00 030

BY

John MacIver

Xinge Yin

John Wenzlick

Carl Simmons

Missouri Department of Transportation,
Research Development and Technology

Table of Contents

Figures

Executive Summary

Currently MoDOT is using only conventional saw cut and seal method for joints on newly placed PCCP. The objective of this study is to monitor the effectiveness of the Cutco method as compared to the conventional MoDOT joint sawing and sealing method. The proposed method is intended to enhance PCCP joint performance by improving resistance to water and debris penetration at the joint. This decreased water penetration is hoped to result in a lower maintenance cost.

There are three test locations: two test sections on the southbound lane of the Route 67 Bypass in Butler County, two test sections on the westbound lane of Route 44 in Greene County, and two test sections on the southbound lane of the Route 71 Bypass in Newton County. All sections are utilizing the conventional method of joint sealing in the opposite direction lane at each test location. Both types of joints were installed in the summer of 2000, and there was no problem encountered during the installations. The installation cost was about the same with Cutco cutting/sealing compared to MoDOT's traditional method.

So far, both types of joints are performing well. No maintenance work has been performed on either of them. Though a direct comparison between the maintenance cost of two types of joints cannot be made at this time, it can be said Cutco joints probably will provide a longer service. The MoDOT conventional joint is the type filled with hot pour full depth, and will deteriorate over the years. As the pavements expand and contract, sealer is pushed above the pavement surface and is removed by normal traffic and maintenance operations. With Cutco joint, the sealer will not protrude above the pavement, therefore the sealer would always be intact resulting in slower deterioration.

The evaluation indicates that Cutco method can provide excellent joints on newly placed concrete pavement. Compared to MoDOT's traditional method, it has about the same installation cost, and may have the benefits of less maintenance. Because all of the test sections are in the southern part of the state where a more temperate climate is experienced, it is unknown if the longer and deeper frost in the northern Missouri parts will have a bearing on the compared performance of the two types of joints. It is recommended the state should consider an increased use of this method on PCCP joints in southern locations of the state, and may be more testing in the northern parts of Missouri.

Background

Currently MoDOT is using conventional saw cut and seal method on newly placed PCCP. Usually the transverse and longitudinal joints in the pavement are sawed with the joint groove cut to the dimensions shown on the plans, (the standard plan calls for minimum 3/8" over transverse joints and 1/8" over centerline joints, in practice it is 3/16" in a single pass operation for both types of joints), then the saw cuts are sealed with sealing material before the pavement is opened to traffic. The sealing material should fill the joint opening uniformly from the bottom to approximately 1/8" from the top.

Using Cutco method, both the transverse and longitudinal contraction joints are sawed initially 1/8" wide by a depth of P/4 (a quarter of the pavement depth), then

a. All joints are sawed to a width of 3/8" and approximately depth of 1 1/8" to form the joint reservoir.
b. ½" backer rod foam is installed approximately 5/8" below surface in the bottom of the reservoir to assure proper shape and configuration of the actual sealant being placed in the joint.
c. Sealant is placed in the joint to an approximately depth and width of 3/8" with a 1/8" to ¼" recess below the pavement surface, which would allow future expansion to remain below the surface, while preventing non compression and moisture from entering the joints.
d. Joint sawing for widening will be followed immediately with high pressure washing of slurry from the joints to assure latent residue are removed and joint drying can take place.

Figure 1 below shows the cross section of a typical Cutco cut and seal configuration.

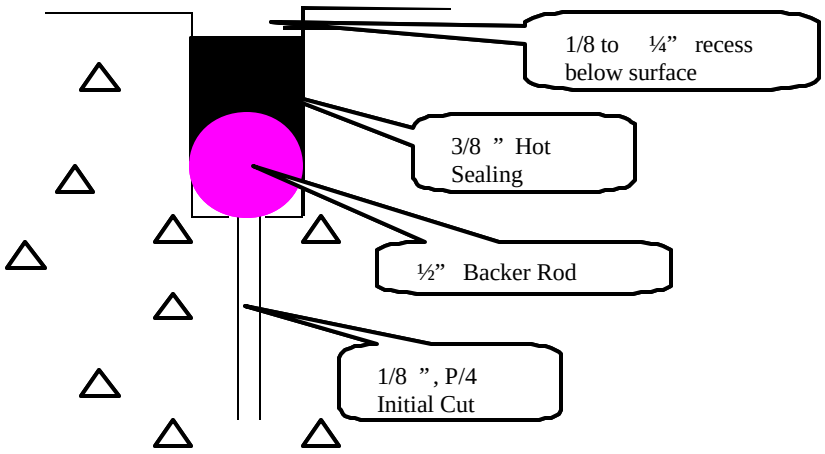


Figure 1.Drawing of Cutco Cut and Seal

Evaluation

Due to the fact that proper shape, joint cleaning, and adhesion of joint sealant is very critical in the performance of all joint sealant, theoretically Cutco joints may perform

better than conventional joints, as a result of easier control of joint cleaning and sealant shape and adhesion. Consequently, Cutco method should provide a more uniform seal when the sealant is applied in the sealed joint. In addition, because of less volume of sealing material, and being easier to regulate the 1/8" below standard, so the sealing generally will not stick up above the pavement when expansion happens. The use of the backer rod foam as part of the seal will prevent joint sealant from sinking down into the joint bottom. This should keep water and debris from entering the joint and extend the life of the roadway striping and pavement, which may lead to less maintenance cost of reseal joints after a period of time open to traffic. It is up to this evaluation to find out the potential benefits associated with Cutco methods if there is any.

Evaluation Objective

The objective of this study is to monitor the effectiveness of the Cutco method as compared to the conventional MoDOT joint sawing and sealing method. The proposed method is intended to enhance PCCP joint performance by improving resistance to water and debris penetration at the joint. This decreased water penetration is hoped to result in a lower maintenance cost.

Evaluation Methodology

The "Cutco" sawing and sealing method was utilized on PCCP joints on projects at three locations in southern Missouri. These test locations are: two test sections on the southbound lane of the Route 67 Bypass in Butler County, two test sections on the westbound lane of Route 44 in Greene County, and two test sections on the southbound lane of the Route 71 Bypass in Newton County. All sections are utilizing the conventional method of joint sealing in the opposite direction lane at each test location.

1) Route 71 Bypass, Newton County, 53 + 00 to SB 63 + 00, SB 828 + 00 to 836 + 00, Cutco joints.

   On July 11, 2000, the test sections on Route 71 Bypass, Newton County, were laid out. The northbound lanes at the same stationing have the conventional saw cut in the joints. The control section and test section have the same roadway base rock fill-composite.

2) Route 67 Bypass, Butler County, SB 68 + 00 to 78 + 00, SB 265 + 00 to 275 + 00, Cutco joints.

   On August 9, 2000, test sections for alternate saw cuts and sealing for Route 67 Bypass in Butler County, were laid out for study. Northbound lanes from station 68 + 00 to 78 + 00 and station 265 + 00 to 275 + 00 have the conventional saw cut in the joints. The control section and the test section have the same type of roadway base rock fill-composite.

3) Route 44, Green County, WB 70 + 00 to 80 + 00, WB 150 + 00 to 160 + 00, Cutco joints.

   On Sep. 19, 2000, test sections for saw cut and sealing for Route 44 in Green County, were laid out for study. Eastbound lanes from station 70 + 00 to 80 + 00, and station 150 + 00 to 160 + 00 have conventional saw cut and sealing. Both the control section and test section are on 8" unbounded concrete overlay.

During construction of Rt. 71 in Newton County, Rt. 67 in Butler County, and Rt. 44 in Green county, Cutco Inc. sawed joints and installed the foam backer rod then sealed the longitudinal and transverse joints. There were many spot observations and measurements by RDT personnel or construction personnel on the projects. (There is not much documentation kept, but a few installation pictures are available. See Figure 2 and 3 for the transverse and longitudinal joints cutting by Cutco method, and Figure 4 for placing backer rod, and Figure 5 for the hot pouring over the surface).

Figure 2. Longitudinal Sawing by Cutco

Figure 3. Transverse Sawing by Cutco

Figure 4. Placing Backer Rod (Cutco)

Figure 5. Installing Longitudinal Joint Filler (Cutco)

The 1/8" cut was completed prior to the diamond grinding operation. After the diamond grinding of the pavement, the 3/8" cut was made followed by the high pressure washing, light sand blasting, backer rod placement and sealing (See Figure 6 for the 2 passes cutting by Cutco method, Figure 7 shows the cut depth by MoDOT traditional method).

Figure 6. Cutco Transverse Joint 1st and 2nd wider Cut

Figure 7. MoDOT Transverse Joint Depth

The only problems on the saw joints were on longitudinal joints, where the saw machine used the edge of the new roadway as a guide. If the paving screed left the edge of the roadway uneven, then the saw had to follow the uneven edge, which transmitted an uneven looking longitudinal joint (See Figure 8 below).

Figure 8. Uneven Longitudinal Sawed Joint Due to Uneven Roadway Edge

In the early stages of placing the foam backer rod on RT 71 bypass in Newton County, it was determined that the backer rod was not pliable toward the end of the spool. The foam material would not straighten out, it tended to curl and conform to the shape of the spool it came off of. Changing suppliers of the foam backer rod, which met the approval criteria, solved this problem. Placement of the joints sealant application presented no problems. Sealant installation was normal and the only problem that occurred was equipment breakdown, which was taken care of by the contractor on the job site with little or no loss of time (See Figure 9 and 10 for cut and seal dimensions by Cutco).

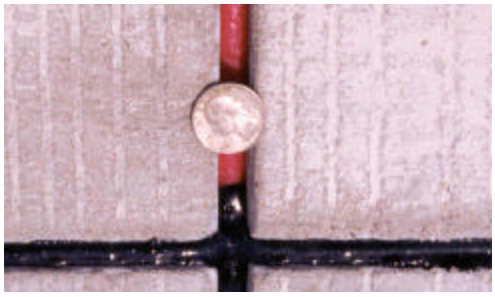


Figure 9. Joint Filler Installed in Longitudinal Joint

Figure 10. Quarter Showing Depth of Backer Rod Before Sealing

Evaluation Findings

The following are observations made after three years of Cutco joint service by RDT personnel.

RT 67 Bypass in Butler County, September 4 2003

Station 68+00 to 78+00:

There is one blue test sign indicating this test section. It is on the northbound embankment at the north end of the section. The south sign has been removed. Both the northbound and southbound lanes were observed.

The southbound test section that contained the Cutco joints is still in excellent shape after three years in service. There are no cracks emanating from the joints, and all of the sealing compound appears to be in place. The red seal strip is visible at the edge base of the joint. The south end of the test section is located just after the "gas this exit" and the "Green Forest Church " signs where the power line goes over RT 67. The only discrepancy found in the section is periodic, singular, plant growth between concrete and joint seal at some joint edges. They are small and no worse than that found on the traditionally sealed joints.

Station 265+00 to 275+00

The test section starts at the end of the RT 160 and M entrance to southbound RT 67, which falls at the un-designated 265+00 station. There is a blue "test section" sign at the start and end of the section, located on the northbound embankment. The joints are in excellent condition, and the same information recorded above applies to the Cutco joints. The northbound traditional joints have configurations generally wider than the Cutco joints but they were also in good condition. (They appeared to be wider because of the excess hot pour on the surface).

Email from Jeffrey K Lambert, D.10, dated 06/23/2003:

From what I observed on Rt. 67, the new type of joints worked very well. At the conventional joints the sealer was visible and could be heard when driving over them. As the joint sealer is sticking above the pavement surface, the sealer will likely be pulled out over time. I liked the appearance of the new joints much better. The subcontractor constructing the joints believed that they were saving money and producing a better product despite the fact that it worked two saw passes instead of one. The key to getting a good product seems to be in the second saw cut and the cleaning process. The subcontractor's operation produced a very clean joint before sealing occurred because the joint was re-sawed and cleaned just before the sealer was placed. This will hopefully cause a better bond between concrete and sealer.

RT 44 Bypass, Green County, September 15 2003

Station 150+00 to 160+00: Station 160 is at the east end of the section. There is one repaired area at mile marker 94 (see Figure 11 below.) Repaired crack is parallel to and about ten inches from the joint. The cause of this cracking is unknown. All of the joints look good.

Figure 11. Crack at Mile Marker 94, RT 44

Figure 12. Cracks at Station 74 + 00, RT 44

Station 70+00 to 80+00: Test area is between mile Marker 92 and 93. All of the joints in the section look good with the following exceptions. One joint has two cracks emanating from it (see Figure 12 above).The joint with the two cracks is located just east of station 74 + 00 across from the cell phone tower. Another joint, (one joint west of station 72 + 00), has damage at one corner where the longitudinal joint meets the transverse joint (see Figure 13 below).

Figure 13. Damage at edge joint intersection at Station 72 + 00, RT 44

Rt 71, Newton County, September 2 2003

SB 63 + 00 to 53 + 00, SB 828 + 00 to 836 + 00: Both the test sections look like new, with only a weed or two between the rubber and the concrete at a few joints. Condition is

as good or better than the conventional joints on the northbound lanes. The Cutco joints do look nicer and more uniform.

The conventional type joints in northbound lanes are also in excellent condition, with only occasional weed growth between concrete and seal material at the edges of the roadway. Since this is a normal occurrence, and both types of joint exhibit a similar amount of plant growth, it appears that the sealing quality of the two types of joint seal is of equal worth. While the Cutco joint sealing method is more aesthetically pleasing due to its clean appearance (see Figure 13 below), the conventional method seems to perform as well. A conventional joint is generally wider and the sealing material applied in a less clean appearing manner (see joints on Figure 15, 16 and 17). Observing the following joint photographs you can tell the aesthetic difference between the two styles of joint seal.

While maybe not as clean looking as the Cutco method appears, both the Cutco and the conventional method seem to be experiencing similar life resilience after 3-years in service. But it is not known now if the two types of joints will compete at the same level after a prolonged time period into the future.

Figure 14. Cutco Joint Seal Method, RT 71

Figure 15. Conventional Joint Seal Method, RT 71

Figure 16. Conventional Joint Seal Method, RT 71

Figure 17. Conventional Joint Seal Method, RT 71

Letter from Steve Campbell, RE, Newton County (Dated 06/23/2003)

I feel like the joints installed by Cutco provide a better product to MoDOT. The process they used involved an initial cut, followed by a full cut, then sand blasting, with backer rod installation, and finally the joint compound. In my opinion, the sand blasting and joint filler with backer rod provided an improved joint. The joint compound application was easier than on conventional joints because the depth of joint to be filled was less. Because the depth was nearly equal to the width, I feel the joint compound adhered to the sides of the joint better. I think this was also due part to the sand blasting. In summary, I would recommend the continued use of the joint construction methods tried here.

Cost Effectiveness Analysis

An emphasis was also placed on determining if there were any potential additional benefits involved with Cuto method. So far, it appears the only actual difference between the two systems is aesthetic; a comparison in cost between the conventional and Cutco method should be made. The investigation intended to gather data on installation and maintenance, the following is what has been obtained.

Installation Cost

The cost of Cutco method was $1.39/ SY for the joint sawing/ sealing on the Rt. 71 job. The conventional joints were a little cheaper, but not much. There was a paving job in 1997 and the cost was $1.06/SY, but that was 3 years earlier.

The owner of Cutco, Hank Bowdoin, told Stephen Bubanovich (D.10) on the Rt. 67 job that the cost to build the Cutco joint and the conventional joint are virtually the same.

The Cutco joint requires a little more labor while cutting. Filling the joints is less labor intensive and significantly less hot pour material is used.

There was no record of cost comparison from the contractor. However, Jeffrey Lambert, RE on the Rt. 67 job, reasoned that the contractors do not like to lose money so Cutco's method must have provided some financial gain for them, making their process cheaper either in material, equipment, or labor costs. This reasoning is consistent with what the Cutco owner stated.

Maintenance Cost

No joint maintenance has been performed on the concrete pavement, on either Rt. 67 or 71. Normally, this process does not occur within the first 5 years of the pavement. However, joint maintenance (cleaned the joint and then resealed) was performed at the bridge approach and on the bridges of Rt. 71.

Cutco's owner said that the life expectancy of Cutco joint is significantly longer than MoDOT's conventional joint. The MoDOT conventional joint is the type filled with hot pour full depth, and will deteriorate over the years. As the pavements expand and contract, sealer is pushed above the pavement surface and is removed by normal traffic and maintenance operations. With Cutoco joint, the sealer will not protrude above the pavement, therefore the sealer would always be intact. This is because the depth of the filler was so shallow.

Because the data gathered is not complete, no definite conclusion can be drawn on the cost-benefit issue. However, it can be said that the installation cost of the Cutco method is about the same as MoDOT's traditional method. There was no maintenance work done on either type of joints, thus a comparison cannot be made at this point. But the use of the backer rod foam as part of the seal is preventing joint sealant from sinking down into the joint bottom. This should keep water and debris from entering the joint and extend the life of the paint and pavement, which may lead to less maintenance cost to reseal joints.

Conclusion and Recommendation

The evaluation conducted on the Cutco joint cut and seal indicates that it can provide excellent joints on newly placed concrete pavement. Compared to MoDOT's traditional method, it has about the same installation cost, and may have the benefits of less maintenance, too. Thus, it is recommended the state should consider an increased use of this method on PCCP joints in southern locations of the state.

Because all of the test sections are in the southern part of the state where a more temperate climate is experienced, it is unknown if the longer and deeper frost in the northern Missouri parts will have a bearing on the compared performance of these two types of joints. It would have been more beneficial to test the product on the harshest environment of the state in order to insure product adequacy all over Missouri. Testing in the northern regions should have been considered. Not having a cold environment test section restricts the ability of this department to recommend this product statewide.

Appendix

STUDY PROPOSAL

Date: August 7,2000 R.I./P.D. Number : RI-00-30

Title: Evaluation of Cutco Sawing and Sealing method on Concrete Roadways

Research Agency: Research, Development and Technology

Principal Investigator: Carl Simmons
Research and Development Assistant

Objective: To use a wider transverse and longitudinal joint in concrete pavement and install a backer rod (foam strip). This is proposed to provide a more uniform seal when the sealant is applied in the sawed joint.

Background and Significance of Work:

The use of the backer rod as seal to prevent joint sealant from sinking down in the bottom of the joint. This should keep water and debris from settling in the joint and extend the life of the joint and the pavement.

Action Plan:

Observations and measurements will be as follows:

1. During construction, monitor sawing and measure joint width in longitudinal and transverse joints.

2. Monitor placement of backer rod in joints and measure distance from top of backer rod to top of concrete pavement.

3. Monitor placement of joint sealant and measure recess from top of pavement when sealant cools.

4. Test sections (4). Control section of 850 feet or more will be layed out to compare the wider joint and backer rod compared to standard joint sawing and sealing. These control sections should have different pour dates. Also control sections will have a different type of roadway base rock fill-composite.

Post-construction. Observations and measurements will be as follows:

1. Monitor sealant in control sections for sinking of sealant around the backer rod.

2. Measure any joint with excess loss of sealant. Also, pictures at these joints.

3. Monitor joint sealant at normal saw joint for the same.

Literature Search:

1. Durafill 3405 by P & T Products.

2. Sec. 1057, "Materials for Joints", Highway Standard Specifications:

   ASTM D 3405
   AASHTO M301
   Fed. Spec. SS-S-1401C
   ASTM D 1190
   AASHTO M173

Method of Implementation:

A final analysis of the joints will be produced in the form of a report generated by Research, Development and Technology and distributed to appropriate MoDOT and Cutco, Inc. personnel.

Anticipated Benefits:

A successful wider sawed joint with backer rod will cut the cost of joint sealant and provide a more uniform depth of sealant and better blockage of water and foreign material entering the joint which relates to less maintenance cost of resealing joints after a period of years open to traffic. This would benefit MoDOT in maintenance cost.

Research and Evaluation Period:

The research period would be for five (5) years from summer of 2000 to summer of 2005 with 4 inspections per year (spring, summer, fall and winter).

Funding:

The monitoring and observation, travel expenses and personal salaries will be MoDOT state
funded.

Budget:

Survey of Route 71 in Newton County, and Route 67 Bypass in Butler County Sawed joints:

1 RDT personnel – 2 days, 1 vehicle) for 5 years.		
Salary (includes 1.693 benefit factor, 4% inflation)	$ 7,717	
Vehicle Expense (28 cents/mile, 4% inflation)	$ 2,262	
Lodging and Food (4% inflation)	$ 3,200	
5 year Total Survey Cost	$13,179	**(per each site)**

Staffing: (1) RDT assistance to observe and record sawed joints on Route 71 and Route 67 is required.

J:\simmco1\Cutco Inc. doc