

**WEARWELL®**

You're in good company™

---

## **Dynamic Ergonomics**

---

Anti-Fatigue Matting  
Increases Productivity

**A 12 Month Study**

## Part 1

At the 1992 National Safety Show, Ed G. Mohr, C.S.P Coordinator of Ergonomics and Safety Engineering for General Motors Corporation in Auburn Hills, presented a lecture on the importance of Ergonomic interventions. He said, *“We have a moral, as well as legal, responsibility to send our employees home at the end of the workday in a condition no worse than when they come in that morning.”* That statement applies to all of us and is the purpose of Ergonomics.

We live by that doctrine at Tennessee Mat Company, Inc., and also manufacture products that assist in bringing it to fruition.

Although anti-fatigue matting is widely used in most industries, we still get many questions about how and why these products work.

The number one question is:

**Why should standing workers use anti-fatigue matting?**

## Dynamic Ergonomics

There is more than one legitimate answer. Standing workers should use anti-fatigue matting because:

- 1.** Anti-fatigue matting increases worker productivity
- 2.** Anti-Fatigue matting reduces muscle aches, blood pooling, and the incidence of back pain.
- 3.** Anti-Fatigue matting increases worker morale. A person who is more comfortable will have higher morale.
- 4.** The proper anti-fatigue matting can decrease the incidence of slip and fall injuries
- 5.** Anti-fatigue matting can decrease down time and strengthen the value of Early-Return-To-Work programs.



Another popular question is:

### “How does anti-fatigue matting work?”

There are several theories, but by far the most popular one is the **Muscle Pump Theory**.

#### The “**Muscle Pump**” Theory

When a person stands on a hard surface, leg muscles are totally constricted (static). Physical fatigue occurs when muscles are constricted because they are working overtime to keep the person in an upright position. A resilient work surface such as an anti-fatigue mat however, causes the person to subtly shift his weight. His leg muscles contract and relax as they work to keep him in an upright position. This muscle movement increases blood-flow, dramatically reducing blood pooling and maintaining a consistent flow of oxygen from the heart.



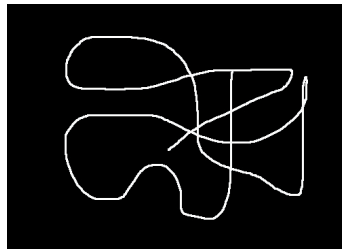
## Dynamic Ergonomics

Finally, the question that has been surfacing more in recent years is: **“Are there any tests that prove anti-fatigue mats work?”** The short answer to that question is **“Yes”**. There are quantitative and qualitative studies.

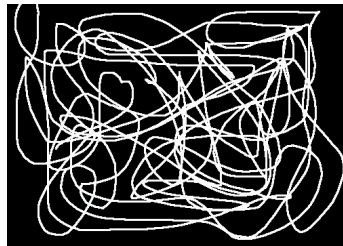
### Quantitative Studies

The most often cited quantitative study was performed at the University of Loughborough. The purpose of this research was to compare leg muscle activity as the participant stood on the equivalent of concrete and then stood on an anti-fatigue mat.

Normal muscle movement as participant stood on concrete



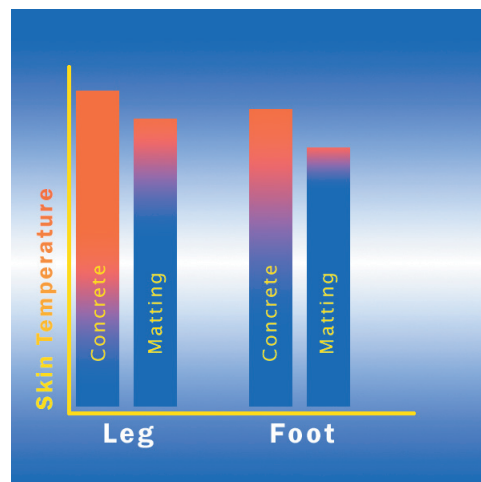
Participant on an Anti-Fatigue Mat



**Results** - While standing on the mat, participants experienced over 50% more muscle movement and felt substantially less fatigued.

## Dynamic Ergonomics

Several tests, which simply measured the skin temperature of standing workers, show that the skin temperature of workers who stand on concrete is higher than the skin temperature of those individuals who stand on anti-fatigue mats. This indicates blood pooling in the lower extremities. And it can be surmised that the discomfort these participants felt was related to that blood pooling in the lower extremities and not actual muscle fatigue. These results give more credence to the **Muscle Pump Theory** and the relation to muscle movement and reduced fatigue. Blood pools if a person's muscles are forced to be static to keep the individual in a totally upright position.



## Qualitative Studies

The most well-known and often cited research is the study performed by Mark Redfern at the **Ford Chesterfield Trim Plant**. This test was completed in 1987 when the use of anti-fatigue matting was just beginning to be considered part of the “ergonomic movement”. At this point, there were many questions about the efficacy of mats.

Dr. Redfern set out to determine if standing workers actually felt less fatigue if they stood on surfaces other than concrete. This test is somewhat dated because the mats used in the study do not characterize what any industry specialists would currently deem comfortable, but the materials do represent a series of products that are, by degree, softer than a concrete floor. Nine different surfaces were tested including concrete and insoles. Each participant worked for two weeks using a particular surface and throughout the process, assessed the materials. Through a series of questionnaires, Redfern determined how the standing workers felt at the beginning of their shift and at the end of their shift. He asked questions about overall body fatigue as well as the level of discomfort and fatigue in certain body parts such as legs, back and feet.



## Dynamic Ergonomics

The following results were based on worker's perceived levels of fatigue before and after standing on nine (9) different flooring surfaces including concrete and shoe insoles.

	Perceived Hardness	Overall Tiredness	Leg Tiredness
1/16" thick rubber runner	3.5	3.5	3.7
1/4" thick rubber runner	3.4	3.1	3.1
3/8" thick rubber runner	2.4	2.1	2.1
Hard Mat with trilaminate padding	2.2	2.4	2.5
Hard mat w/o trilaminate padding	4.7	3.8	3.9
Concrete	4.8	4.2	4.5
A viscoelastic mat	4.0	3.8	3.7
Shoe insert	2.5	2.4	2.0
Uneven/soft mat	1.9	3.3	3.2

1 = very comfortable, or not tired

5 = very hard, or very tired

The research demonstrated that workers who are required to stand for prolonged periods of time, experience significant levels of fatigue and discomfort in several areas of the body. This study also showed a significant correlation between leg tiredness and general tiredness, which indicates that flooring not only affects legs, but the entire body as well. Worker's perceptions of this tiredness and discomfort were affected by the floor surfaces on which they stood. To put this in very simplistic terms, Dr. Redfern concluded that standing on unforgiving floors is uncomfortable and makes workers fatigued. So if you want to keep your standing employees comfortable and less fatigued, they need to have anti-fatigue mats.

However, no one was able to show that the level of discomfort or fatigue really affected the worker's ability to effectively do his job. And therefore, to some companies, it was still difficult to justify the purchase of matting.



## Part 2

### The Wearwell® Study

The first anti-fatigue mats were introduced shortly after standing work became the norm. They were not really mats at all, but rather wooden pallets, flat cardboard boxes and old rugs that employees brought from home. Although these “mats” were somewhat hazardous because workers were not accustomed to having such objects on the floor, they did offer a softer work surface and lessened fatigue and discomfort. In the early 1960's the first real anti-fatigue mats were introduced and they have been gaining popularity ever since. In fact, by 1990 they reached ultimate notoriety when safety professionals dubbed them “ergonomic” products.

Now anti-fatigue mats are a common facet of many Ergonomic and Safety programs. Although standing workers love them, production managers still must justify the cost of purchasing them. There are several well-known perception studies such as Dr. Redfern's, which strongly indicate that standing workers are less fatigued and feel less discomfort at the end of the day if they stand on anti-fatigue mats. But does that justify the cost? Is the company that purchased the mats getting anything other than goodwill? We decided to conduct a long-term study to test that very premise.



## Dynamic Ergonomics

---

In 1998 we were introduced to a company in Tennessee that was experiencing a significant accident rate and a high level of absenteeism. Our workers compensation insurance provider suggested that we talk to this firm about using mats in their facility. We took that one step further and offered to provide mats to them in exchange for their participation in a long-term study.

Our test was designed to determine if:

- 1.** Standing on the job contributes to fatigue (even-though we felt this had already been proven time and time again in other research).
- 2.** The use of anti-fatigue matting actually lessens fatigue (see above).
- 3.** The use of anti-fatigue matting can be linked to increased productivity.

We were most interested in the third premise. Our assumption was that a more comfortable worker is a more productive worker, but we did not have any proof. So we set out to see if we were correct.



## Dynamic Ergonomics

The company that participated in our study was a manufacturer of commercial ovens. It was the largest and “best” employer (in terms of wages and benefits) in a 30-mile radius.

### Other Stats:

# Employees:	175 in Mfg/Assembly
Number of Shifts:	2
Location:	population < 5,000)
Employee Tenure:	Average 4 years
Employee Age:	Average - 41
	Mean - 35

In 1999 there were several difficult issues that the company was facing, specifically a:

- High Injury Rate
- High Absenteeism - as high as 10% on Mondays

From the outset, we were curious as to whether or not the use of good quality anti-fatigue matting would moderate these issues.

## Dynamic Ergonomics

Our first step in the developing the parameters of the test, was to perform a complete **Facility Assessment** to determine the best mats for each area. It was our ultimate goal to install one type of matting throughout the manufacturing area. This would eliminate any deviation in test results based on the “comfort level” of the mats used. Unfortunately, this was not completely possible because there were several difficult areas that required matting with specific features. The manufacturing area contained the following applications:

- Automated spot-welding and some arc welding
- Assembly - on one level & two tier workstations
- Motor assembly - heavy parts
- Sheet metal fabrication
- Boxing

We determined that we could install Diamond-Plate SpongeCote No. 415 in 95% of the facility (in all but two of the areas).

Our second step was to design a questionnaire, which would be completed before and during the study. This questionnaire was like Dr. Redfern’s in that it assessed worker’s perceptions of their:

- current work surface (ie. Concrete),
- overall level of fatigue before and after work, and
- the fatigue and discomfort level of their legs and feet before and after work.

We then asked the workers to fill out the questionnaire for two weeks before the mats were installed. They completed the surveys before and after work on Mondays, Wednesdays and Fridays. We needed several weeks of data to use in a Before/After comparison. We also wanted to ascertain if there were any trends in the data. For example, did their perception of fatigue level change over the course of the week? Were they more uncomfortable and tired on Fridays than they were on Mondays? After collecting the data, we installed the matting.



# Dynamic Ergonomics

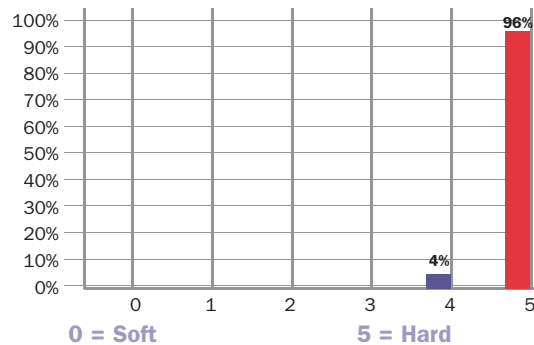
As a comparison, we then asked the workers to fill out the questionnaires:

- for the first 4 weeks after the mats were installed
- for 2 weeks during the middle of the study (after 6 months)
- for the last 4 weeks of the study (after 11 months)

The results of the questionnaires and related analysis are as follows:

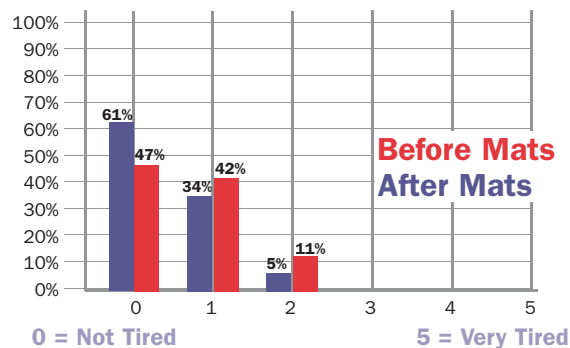
### Question 1:

Rate the comfort of the Concrete floor:  
Results



### Question 2:

How tired are you at the beginning of your shift?



Analysis: After mats were installed 30% more employees started the day feeling totally rested.

### Question 3:

How tired are your legs at the beginning of the day?  
“Before Mats” “With Mats”

0 = Not Tired	47%	71%
1	42%	25%
2	11%	4%
3		
4		
5 = Very Tired		

### Question 4:

How do your feet feel at the beginning of your shift?  
“Before Mats” “With Mats”

0 = Not Tired		80%
1	39%	19%
2	58%	1%
3		3%
4		
5 = Very Tired		

### Question 5:

How tired are you at the end of the day?  
“Before Mats” “With Mats”

0 = Not Tired		
1		39%
2		45%
3		19%
4	31%	
5 = Very Tired	69%	

## Dynamic Ergonomics

### Question 6:

Rank the level of discomfort you feel at days end.

	Feet Before	Feet After	Lower Legs Before	Lower Legs After	Lower Back Before	Lower Back After
0						
1						56%
2		75%		72%		31%
3		25%	22%	27%	14%	13%
4	13%		36%	1%	64%	
5	87%		42%		22%	

0 = No discomfort → 5 = Killing me

### Question 7:

What type of shoes do you wear to work?

Work Boots	12%
Athletic Shoes	88%

### Question 8:

Do you wear supplemental insoles in your shoes?

Yes	7%
No	93%

The results of the “Worker Perception” aspect of the study is very clear. The participants felt considerably less fatigued before and after work following the installation of anti-fatigue mats. In addition, the “at risk” areas of their bodies such as legs, feet and lower back, were much less uncomfortable when anti-fatigue mats were used.

## Dynamic Ergonomics

Worker's perception is very important, but the unique aspect of this study was that it revealed a strong correlation between the use of anti-fatigue mats and productivity. Before the installation of anti-fatigue matting, the rate of absenteeism and the "lost time" injury ratios were very high.

### Average Absenteeism Rates:

Before Mats	5.2%
Mondays	10%
<b>After Mats</b>	<b>4%</b>

### Injury (lost time) Ratio\*

Before Mats	> 3 per mo.
<b>After Mats</b>	<b>&lt; 1 per mo.</b>

\* Note: <1 = better than average in their industry

These **decreases** in **absenteeism** and **lost time injuries** resulted in a **significant gain in productivity**. We compared the stats of the twelve (12) months prior to our study - July 1, 1998 to July 1, 1999, to the twelve (12 months) of our study - July 2, 1999 to July 1, 2000, and were able to conclude that the **installation of anti-fatigue mats resulted** in an estimated **2.2% increase in productivity**.

It is interesting to note that fifty percent of the 2.2% increase in productivity was due to lower absenteeism rates. And the other 50% can be linked to decreased down time due to lost time injuries. It is worthy of note that the company had an established workforce and did not implement procedural changes that could be linked to increased productivity.

All companies look to increased productivity as an effective method of boosting the bottom line. That is exactly what happened at this test facility. There were substantial **"Hard Cost"** savings (costs that can be specifically documented).



**WEARWELL**  
You're in good company™



## Dynamic Ergonomics

Cost Savings Related to the use of Anti-fatigue Mats

	<b>Hard Costs</b>
Increased Productivity	\$300,000.00*
Reduced Insurance Premiums	<u>60,000.00</u>
<b>Total Cost Savings</b>	<b>\$360,000.00</b>

\*The substantial decrease in absenteeism increased the average daily unit production.

In addition to the Hard Cost savings, there were **other cost savings related to the use of anti-fatigue mats**. According to the Human Resources department, the turnover rate dropped significantly so less time and effort was spent hiring and retraining. This also impacted productivity. Insurance companies calculate “Soft Costs” by multiplying the Total “Hard” Cost Savings by a multiplier between 2 and 6. In our case, we chose to be conservative and used the lowest multiplier. The calculation for Soft Cost Savings is as follows:

### Soft Cost Savings

Total “Soft” Cost Savings:  
 $\$360,000.00 \times 2 = \$720,000.00$

### Test Results Summary

Lower rate of Absenteeism:	Avg. 23%
Increased Productivity:	2.2% increase
Total “Hard” Cost Savings:	\$360,000.00
Total “Soft” Cost Savings:	\$720,000.00

Not all companies have such dramatic results, but virtually all would tell you that anti-fatigue mats make a very positive impact on their employee’s morale and performance.