

LOG OF MEETING
DIRECTORATE FOR ENGINEERING SCIENCES

CPSA 6 (b)(1) Cleared
No MTRs/P/VTLbls
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Firms Notified,
Comments Processed.
NO
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SUBJECT: Fire and Shock Safety Technology by Technology Research Corporation (TRC)

DATE OF MEETING: October 1, 1997

PLACE OF MEETING: East West Towers, Room 410A

LOG ENTRY SOURCE: Doug Lee, ESEE *DAL*

COMMISSION ATTENDEES:

Aaron Banerjee, ESEE
Sheela Kadambi, ESEE
William King, ESEE
Doug Lee, ESEE
Anna Luo, ESEE
Mai Ngo, ESEE
Andrew Trotta, ESEE

NON-COMMISSION ATTENDEES:

Frank Brugner, Technology Research Corporation
Ned Schiff, Technology Research Corporation
Bob Wiggins, Technology Research Corporation

SUMMARY OF MEETING:

Mr. Schiff presented an overview of TRC and described the need for technology to reduce cord related fires based on CPSC fire loss statistics. The typical source of cord related faults were described: pinched cords, overloaded cords, frequent flexing of cords, normal aging and wear of cords, and damage from appliances attached to cords. The causes of fires were series faults caused by damage within conductors leading to localized heating, arcing, and cross-line faults; and parallel faults between the conductors or to ground caused by insulation degradation leading to leakage currents, tracking, and arcing.

The Fire Shield cord is designed using a mesh shield around each conductor. In the event of a fault, leakage current is detected on the shield. The integral ALCI on the plug interrupts power to the cord when the leakage current on the shield exceeds 2.6 milliamps or a ground fault exceeds 5 milliamps.

Market feedback of the technology on appliances was presented. Over 60 OEMs are testing and qualifying samples. The CPSC staff provided additional questions and technical feedback on applications.

Mr. Schiff discussed the 1999 National Electrical Code proposals that were submitted by TRC. TRC proposes requiring this technology on extension cords, power strips, portable electric heaters, and room air conditioners. Mr. King explained the staff's position on the proposals and suggested ways to help

introduce this fire safety technology.

Dr. Brugner demonstrated the technology. First, a paper cutter was used to cut a type SPT-2 lamp cord. A loud pop was heard with arcs and hot glowing metal that was sufficient to start a fire was thrown from the fault. When one of the Fire Shield™ cords was cut, power was interrupted to the cord by the integral ALCI electronics mounted on the plug before arcing and combustion could occur.

A copy of the presentation is enclosed.

TRC's product line consists of:

Shock Shield™ - portable GFCIs (Ground Fault Circuit Interrupters, ELCIs (Equipment Leakage Current Interrupters) and ALCIs (Appliance Leakage Current Interrupters)

Electra Shield™ - surge suppression and equipment ground fault protection

Fire Shield™ - power cords with fire protection

Surge Guard™ - portable GFCI



Agenda

- TRC Overview
- Cord Faults and Electrical Fires
- Fire Shield Product Design
- Demonstration
- Application Focus / Market Feedback
- National Electric Code Proposals
- Fire Shield Home Wiring System
- Summary



TRC Mission Statement

**Provide customers with value through
innovative electrical safety products
and superior service.**



TRC Overview

- **Founded in 1981 (NASDAQ: TRCI)**
- **World Leader in Portable Ground Fault Circuit Technology**
- **Global Presence**
 - **International Sales and Marketing**
 - **International Manufacturing Facilities**
- **Strong Management Team**
- **\$17M in Revenues, \$11M in Working Capital**



TRC Markets

- **OEM**
 - Business Equipment, Sprayer Washers, Appliances
- **Brand-Label**
 - Woods Wire, Coleman Cable
- **Industrial**
 - DuPont, Ford, GM, UTC
- **Commercial**
 - Over 500 Distributors
- **Consumer**
- **Military Generator Set Controls**
- **Electric Vehicle Charging Systems**
- **Licensees**



TRC Products

- **Shock Shield™** - World's largest GFCI selection
 - Portable GFCI, ELCI, and ALCI
 - User attachable, adapters, quad boxes, trouble lights, etc.
- **Electra Shield™** - The Ultimate in Equipment Protection
 - Surge Suppression (Line, modem and cable)
 - Equipment Ground Fault and Fire Protection
- **Fire Shield™** - World's only fire-safe cord sets
 - Power Cord Sets
 - Extension Cords
- **Surge Guard™** - RV Surge and Shock Protection



Manufacturing Overview

Clearwater Facility

- Pilot production of new products
- Redundant production capabilities
- Final product testing

Honduras Facility

- Production of mature product designs
- High-volume production

Contract Manufacturing



Manufacturing - Honduras



Located in San Pedro Sula, Honduras

- Plant startup - April 1997
- Free Trade Zone (Zip)
- 42,000 sq. ft. (31,000 Manufacturing)
- \$1.4 million initial investment



Manufacturing - Honduras

- **Production capability**
 - Processes designed to improve quality and productivity
 - 195,000 units per month (one shift only)
 - Additional facilities planned
- **Quality System**
 - Designed to meet ISO-9002 requirements
 - Complete incoming inspection
 - Passed Xerox MN Survey (First Attempt)
 - UL, CSA and VDE approved



Engineering

- World leader in GFCl technology
- Strong patent position/portfolio
- Custom designs
- Customer partnering
- Rapid design cycle
- Work closely with standards organizations (UL, CSA, VDE, Dentori)



Corporate Summary

- Recognized leader in electrical safety products
- Strong financial position
- High quality manufacturing
- World class engineering
- Providing value with innovative electrical safety solutions



Cord Faults and Electrical Fires

- Flexible cords are the leading cause of electrical fires
 - 50% of attended and unattended fires
 - 7,700 attended fires resulted in 132 deaths and \$118 million in property damage
- Majority of victims are children and the elderly
- Cost effective reliable solution is available.



Residential Fire Statistics

CPSC Data for Electrical Equipment:

- 34% of all residential fires
- Over 760 civilian deaths
- \$1.3 billion in property losses

Appliances were responsible for a significant portion of the fires:

- Over 30,000 appliance-related fires
- Over \$250 million in damage

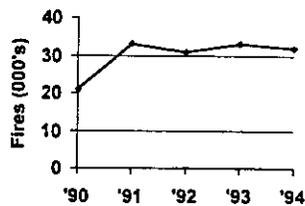
*Figures taken from CPSC 1994 Residential Fire Loss Estimates.



Appliance Fire Statistics

Between 1990 and 1994

- The number of residential fires has *decreased* by 25,000
- Appliance fires have remained flat



Extension Cord Fire Statistics

CPSC Data for Extension Cords:

- 3,300 attended residential fires
- 50,000 unattended residential fires
- 50-60 civilian deaths per year
- \$50 million in property losses
- 2,500 Burns from chewed cords

Extension cords are particularly susceptible to misuse by:

- Damage from attached equipment
- Running cords under rugs and furniture
- Overloading
- Movement and storage



Market Forces - CPSC

CPSC "Home Electrical System Fires Project"

Seek to encourage:

- Electrical inspections for older homes
- New wiring methods for rehabilitation work
- Innovative Technology for fire prevention
 - Fire Shield was chosen as one of 15 products for review by UL.



Causes of Cord-Related Fires

Series Faults are caused by damage within a single conductor.



Conductor breakage leads to:

- Localized heating
- Arcing
- Cross-line faults

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Causes of Cord-Related Fires

Parallel Faults occur *between* the conductors within a cord or to ground.



Usually caused by insulation degradation, this leads to:

- Leakage currents
- Tracking
- Arcing

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Causes of Cord Faults

- Pinched, crimped or frayed cords
- Overheated/overloaded cords
- Application-related damage (e.g. heater, tools, vacuums, etc.)
- Frequent movement of appliance
- Normal aging and wear



Fire Shield Product

Fire Shield™

The only power cord set with built-in Fire and Shock protection.

- Appliances
- Business Equipment & Medical Instruments
- Commercial Equipment
- Consumer Electronics
- Exercise Equipment
- Extension Cords and Power Strips
- Lift Chairs and Electric Beds



Product Design Considerations

- Detect conductor breakage
- Detect insulation degradation
- Detect ground faults
- Continuously monitor for faults
- Automatically shut off power

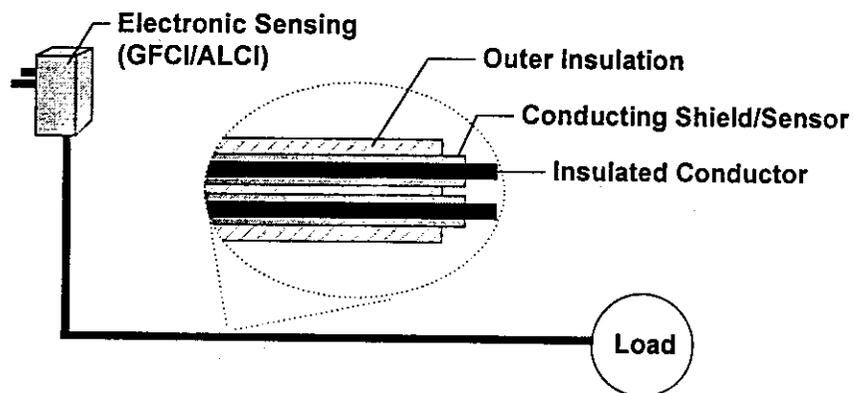
All before combustion can occur.

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Fire Shield™ Technology

Product Schematic

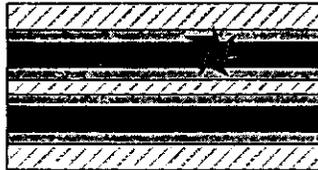


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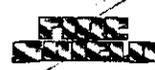
Fire Shield™ Technology

Series Faults



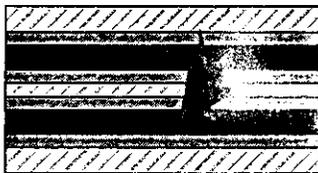
- A fault within a single conductor gives a path to the shield
- The shield conducts the signal to the sensing circuitry
- Power is shut off at the wall socket automatically

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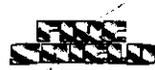
Fire Shield™ Technology

Parallel Faults



- Current leakage between conductors is detected and sent to the sensing device
- Leakage over 2.6mA causes power to be disconnected
- Faults from leakage, tracking and arcing are detected

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Fire Shield™ Technology

Additional Protection

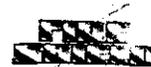
- Shock
- Ground-fault related fires
- Ground fault damage to equipment



Product Ratings

Product		Cord Gauge and Amperage				
		12 15 A	14 15 A	16 13 A	17 11 A	18 10 A
In-line User Attachable	2 Wire	*	*	*	*	*
	3 Wire	†	*	*	*	*
Right Angle User Attachable	2 Wire	*	*	*	*	*
	3 Wire	*	*	*	*	*
Extension Cord	2 Wire	*	*	*	*	*
	3 Wire	*	*	*	*	*

† Amperage rating for In-line, 3-wire is 20 Amps



Product Features

- Automatic detection of series or parallel cord faults
- Ground fault protection
- Detection method is self-contained
- Built-in functional test for reliability
- UL approved, CSA certified
- Eliminates power cord fires



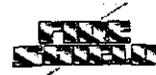
Application Focus

- Portable products
 - Cords exposed in application
 - Frequent movement and storage
 - Mounted in windows or through doors
- Used around children, elderly, or disabled
 - Likely Victims
 - Vaporizers, HVAC, extension cords, lift chairs, electric beds



Application Focus (cont.)

- Unattended operation
- Energized while sleeping
- Used in older dwellings
- Institutional or business installations
- High current products
- Used with or around water
- Heat involved in application



Market Feedback - Large Appliances

- Refrigerators
 - Institutional Applications (schools, offices, etc..)
 - Ground fault protection
- Window ac and dehumidifiers
 - Cord fires are a recognized problem
 - Shock is also a serious concern
 - Ground pin frequently lifted or removed
- Washing Machines



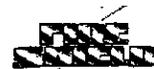
Market Feedback - Small Appliances

- Counter top products - Interest focused on microwave ovens and slow cookers
 - most applications are attended
 - low cost products
- Commercial cooking equipment
 - high interest level
 - higher cost products
 - customer willing to pay premium to reduce liability and down time



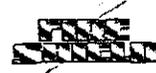
Market Feedback - Comfort Conditioning

- Electric space heaters
 - Cord Fires are a major concern
 - Wet locations (bathroom, basement, work shop, garage) require ALCI
 - Confusion and misapplication by customers
 - Cord damage will disconnect power even when not the original source
- Air purifiers, vaporizers, and humidifiers
 - Growing Market
 - Water involved in application
 - Unattended operation around children



Market Feedback - Extension Cords

- Largest Source of Cord Fires
 - Severe misuse and misapplication by consumers
 - 20% of all cord fires
 - 50% of cord fires attended by the fire service
- Fires are not limited to a few applications or a specific misuse
- Fire Shield Retail price is \$10-\$15
- Power Strips have the same problem



Market Feedback - Other Products

- Consumer Electronics
 - Limited interest
 - Changing to harmonized cord
- Electric beds and lift chairs
 - used by elderly and disabled
 - shock hazard
- Electric blankets and heating pads
- Exercise equipment
 - exposed cord
 - shock hazard



Market Feedback - OEM's

- Universally very positive response to product
- 60+ OEM's testing and qualifying samples
- Cord fire problem is well recognized
- Ground fault protection is a serious concern



Market Feedback - OEM's (cont.)

- Engineering focused on cost reduction
 - manufacturing overseas
 - any increase in cost requires senior management approval
- Marketing concerned with short term bottom line impact
 - Concerned that adoption implies that their other products are unsafe
 - Fear of being first
- Product liability cost not well defined and not assessed to product lines



Market Feedback - Conclusions

- Elimination of cord fires, ground fault protection, and reduction in product liability is important
- Product cost reduction is the number one priority for appliance manufactures
- Product incorporation will only be on high end or specialty products only
- To have a serious impact on reducing residential fires requires a mandate



National Electric Code Proposals

Section	Log No	Product	Proposal
400-15	6-138	Extension Cords	Protection against combustion of the cord from series and parallel faults within the cord
400-16	6-139	Power Strips	Protection against combustion of the cord from series and parallel faults within the cord
422-8d	20-20	Portable Electric Heaters	Protection against combustion of the cord from series and parallel faults within the cord
440-64	11-147	Room AC Units	Protection against combustion of the cord from series and parallel faults within the cord
625-2	12-77	Electric Vehicals	Remove exclusion for electri motor cycles from the standard for personnel protective systems



Extension Cords 400-15

- Leading cause of residential fires
 - 3,300 attended fires, 50-60 deaths, \$50 million in property damage
 - 10% of all electrical fires
- Major cause of catastrophic residential fires
 - 2 of 22 1996
 - 3 of 21 1995
- Broad base of applications
- Highest use is in older dwellings



Power Strips 400-16

- Increasing use in both home and office
- Frequent application in institutional buildings
- Very susceptible to mechanical damage
- Low cost, low quality manufacturing has and will continue to lead to recalls
- Uneducated user



Portable Electric Heaters 422-8.(d).(4)

- 53% of civilian injuries from heating fires (up from 34% in 1980)
- 126 deaths per year average (1984-93)
- short circuits are number two cause of fires (20%) and deaths (14%)
- power disconnected once cord damage or ground fault exists
- primary application is high risk older dwellings
- reduce misapplication in wet areas



Room Air Conditioners 440-64

- Primary application is older dwellings
- Cord is subject to extensive abuse
- Cord fires are a well recognized problem
- Short circuit and ground fault are the leading cause of fires (47%)
- Electric shock is a serious concern
 - lifting of ground pin
 - contact with water



Code Proposals Summary

- Focused on high incident applications
- Applications in older dwellings
- Eliminates cord fires
- Functional in nature
- minor cost impact
- Precedent exists
- Reduction in residential fires will only occur if mandated!!

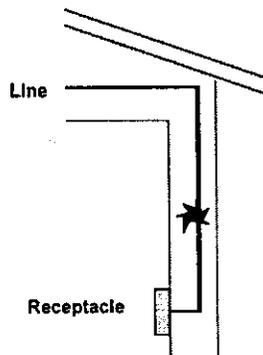


Installed Wiring Fires

Damaged or aging insulation in installed wiring leads to parallel, series or ground faults.

Fires may start within walls, ceiling or flooring of the home, hidden from view.

Arcs need not exceed the level detectable by AFCI's or circuit breakers to ignite.



Fire Shield Home Wiring

- Shield wiring for sensing leakage current
- Interrupt and / or alarm
- Sense levels below arcing threshold
- Eliminates **all** fixed wiring fires
- Differentiation between overload/overcurrent and damage wiring
- Cost effective
- Proven technology
- UL testing to begin this fall



Summary

- Reducing electrical fires is essential
- Fire Shield will eliminate cord fires
 - Proven product
 - UL approved, CSA certified
 - Cost effective solution
- Reduction of fires only through mandate
 - Cord fires are a serious problem
 - Focus on high incident applications / locations
 - Precedent exists for action
- Solution to fixed wiring fires in test
- CPSC support is critical

