FINAL REPORT OF THE
DEPARTMENT OF STATE POLICE

NEED FOR STANDARDS FOR RECAPPED TIRES

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

HOUSE DOCUMENT NO. 24

COMMONWEALTH OF VIRGINIA
RICHMOND
2000

Col. M. Wayne Huggins
Superintendent

(804) 674-2000

COMMONWEALTH of VIRGINIA

DEPARTMENT OF STATE POLICE

P. O. BOX 27472, RICHMOND, VA 23261-7472

November 24, 1999

To: The Honorable James S. Gilmore, III, Governor of Virginia
The Members of the General Assembly

Pursuant to House Joint Resolution No. 545 (1999), I have the honor of submitting herewith, a study entitled "*Need for Standards for Recapped Tires.*" This study is a compilation of the efforts and coordination of federal, state, and private entities.

I wish to express my appreciation to the Virginia Tire Dealers Association, the Virginia Trucking Association, the Department of Motor Vehicles, the Department of Transportation, Ryder Transportation Services, and the Central Tire Corporation. Their efforts were indispensable in the completion of this report.

Sincerely,

M. Wayne Huggins

Superintendent

MWH/NGM

PREFACE

In the 1999 session of the Virginia General Assembly, House Joint Resolution Number 545 was passed, requesting the Department of State Police to study the need for state standards for recapped vehicle tires. Based on their professional experience, the following individuals were appointed to serve on the committee:

Mr. Steve Akridge
Virginia Tire Dealers Association
Midlothian, Virginia 23112

Mr. Dale Bennett
Virginia Trucking Association
Richmond, Virginia 23230-5018

Lieutenant Herbert B. Bridges
Motor Carrier Safety Manager
Department of State Police

Mr. Lynwood Butner
Assistant Commissioner
Department of Motor Vehicles
Motor Carrier and Tax Services

Captain W. Steven Flaherty (Chairman)
Safety Officer
Department of State Police

Lieutenant T. Stephen Goff
Safety Division
Department of State Police

Mr. Frank Jenkins
Senior Engineer
Va. Department of Transportation

Mrs. Nancy G. Maiden
Planning Unit
Department of State Police

Mr. Ed McDonnell
Ryder Transportation Services
2300 Station Road
Richmond, Virginia 23234

Mr. Terry Westhafer, President
Central Tire Corporation
Verona, Virginia 24482-0901

The Department of State Police gratefully acknowledges the Tire Retread Information Bureau, Fleet Tire Consultants, The Maintenance Council of the American Trucking Association, Virginia Trucking Association, Commercial Vehicle Safety Alliance, International Tire and Rubber Association, Virginia Tire Dealers Association, Ryder Transportation Services, Central Tire Corporation, Virginia Department of Transportation, and Virginia Department of Motor Vehicles for their participation and information relating to this study.

The resolution requiring this study was initiated because failed tires, many of them believed to be retreaded tires commonly associated with heavy duty trucks and other large, heavy over-the-road equipment, are routinely found lying on and alongside roadways. Committee findings revealed a very small percentage of discarded tire debris came from tires that failed as a result of poor industry quality. The Committee also learned only 3.5 percent of retreading businesses are located within the State of Virginia. Therefore, the findings of the study do not support the establishment of state standards for retreading vehicle tires, as standards would not correct the problem.

TABLE OF CONTENTS

	PAGE
EXECUTIVE SUMMARY.....	ix
PURPOSE.....	1
BACKGROUND.....	2
RELATED STUDIES AND RESOURCES.....	4
METHODOLOGY.....	10
FINDINGS.....	11
RECOMMENDATIONS.....	14
APPENDICES.....	15

EXECUTIVE SUMMARY

In the 1999 Session of the Virginia General Assembly, House Joint Resolution Number 545 was passed, requesting the Department of State Police to study the need for state standards for recapped vehicle tires. A Committee was developed which was composed of members representing the tire industry, trucking industry, and the public safety community.

Initial research revealed there are federal standards applicable to passenger car/light truck retreading, but none pertaining to large truck tires. The only state that currently regulates the production and use of retreaded tires is California. The standards that were adopted in California were drafted jointly by the California Highway Patrol and representatives of the tire and retreading industry. They are almost identical to the recommended retreading and repairing standards published by the tire industry.

The Committee also determined there are 43 retreading businesses in the State of Virginia that produce between 4-6 percent of all retreads. There are 1,244 retreading operations throughout the United States, which indicates Virginia Standards would only impact 3.5 percent of the retread producers.

The Committee reviewed two surveys of rubber found on the roadway that were conducted by The Maintenance Council of the American Trucking Association and two laboratory tests performed by The American Retreader's Association. The comparison of the two surveys revealed there is a problem with tire debris on the highway, but the causes of tire failures are not usually due to recap failure, which is the perception. They concluded that both new and retreaded tires would overheat and shred into sections of debris if proper air pressure is not maintained. In one of the laboratory experiments, a plunger strength test was performed on a new, randomly selected recapped tire and it was determined that the tire exceeded standards by almost twice the minimum strength requirement. In the other laboratory experiment, a burst strength test was conducted that compared new radial truck tires with worn radial truck tires. The results of the burst test concluded the strength of the worn and new samples to be very similar. The worn tires, which were typical of those selected for retreading, did not show any loss of strength as a result of previous use. In this study, tread wear did not diminish the strength of low-profile radial truck tire casings compared to new tires.

Members also reviewed the President's Executive Order 13101 that sets forth environmental protection initiatives by requiring the federal government fleet to be equipped with retreaded tires. The retreading program introduced by the U. S. Army Tank-Automotive & Armaments Command provided information that demonstrated retread tires can be cost-effective without compromising on performance needs.

Information was reviewed that outlined the manner in which industry standards are developed and distributed by a standing committee composed of officials from different tire manufacturing organizations. The entire industry is concerned about the problems of tire debris on the roadway and is actively seeking solutions. It was also reported that the

retreading industry maintains self-imposed standards of quality. Trucking industry contacts advised trucking officials view retreads as safe, reliable, and cost-effective.

In addition to self-imposed standards, major rubber companies control the production quality of retreaders through franchise agreements. The companies publish retreading specifications and operations manuals on the retreading process and require franchisees to comply with their recommended practices. They also offer or require training of production and management personnel. It is estimated that this rubber company control would affect at least 70 percent of the retreads produced in the United States.

The Committee reviewed previous VDOT studies in detail and determined that during their 2½ year study utilizing recapped tires, the failure rate was less than one percent. Their success was so positive, the use of retreads will be expanded from the Fredericksburg District to all the VDOT Districts.

Virginia Department of Transportation conducted a Tire Debris Collection Survey on three different sections of heavily traveled interstate highways. During the eight-week survey, an estimated 127,522 pounds of tire debris was collected over 658 miles of highway. This confirmed there is a problem with tire debris being spread along the shoulders of roadways.

The Committee conducted an analysis of tire debris collected by VDOT from the entire 72 miles of I-295 extending around Richmond. Examination revealed the debris made up the remains of 27 tires, eight of which were new, 18 retreads, and one could not be determined due to deterioration. Of the entire survey, it was determined only one of the 27 tires failed due to poor recapping practices. In this case, the cause was determined to be human error. The remaining recapped tires still had the retread portion attached to the casing, which indicates the problems were not related to the separation of the retread rubber from the tire casing.

After careful review of available information and completion of the research projects, the Study Committee is convinced the problem of tire debris along the highways is not due solely to retreaded tires. All previous studies, including this study, have determined a small percentage of the rubber on the roadway actually comes from retreaded tires that failed due to production standards related to the retreading tire industry. Examination of the debris reveals many of the tires are new and have never been recapped. Most of the retreaded tires that are torn apart still have the tread rubber intact, and the failures are due to other factors, such as punctures or overheating due to underinflation. Experts believe failure to maintain sufficient air pressure causes the tire casings to become extremely hot and to eventually come apart and spread debris beside the highways. When citizens observe pieces of rubber along the roadway, they perceive the debris as coming from tractor-trailers having improperly recapped tires. Careful research indicates that perception is not reality in the majority of the actual cases. New tires will fail the same as retreaded tires under similar conditions.

Based on the results of this study, this Committee does not recommend the development of state standards. There is a misconception that all tire debris problems are attributed to retreading operations, which is not factual. Furthermore, imposing standards would only affect the 3.5 percent of retreaders that operate in Virginia.

In lieu of developing state standards, the Committee recommended the following action:

- **Concentrate on public education concerning proper tire maintenance and the importance of maintaining recommended air pressure in tires.**

- **Encourage key members of the tire industry to maintain strict industry standards and follow recommended practices and processing guidelines.**

- **Forward all available information to the National Highway Transportation Safety Administration for their review and consideration in developing Federal Standards for recapped tires designed for large commercial motor vehicles.**

PURPOSE

The purpose of this study is to determine any problems associated with retreaded tires and to determine if state standards would correct the problems.

BACKGROUND

In the 1999 session of the Virginia General Assembly, House Joint Resolution Number 545 was passed, requesting the Department of State Police to study the need for state standards for recapped tires. House Joint Resolution is as follows:

> **WHEREAS, the Code of Virginia (§ 46.2-1043) specifies the minimum allowable tread depth for tires of vehicles operated on the public highways; and**
>
> **WHEREAS, the Code of Virginia (§ 46.2-1042) similarly specifies the minimum standards applicable both to vehicle tires generally and to "recut or regrooved" tires, specifically, but does not reference specific standards applicable to recapped tires; and**
>
> **WHEREAS, because of the relatively high cost of new tires used on heavy duty trucks and other large, heavy over-the-road vehicles, recapped tires are often used on such vehicles when their tires become worn or damaged; and**
>
> **WHEREAS, if the recapping on any such tire fails while the vehicle is in operation on a highway, the driver of the vehicle could experience a loss of control of the vehicle, thus creating a danger for himself and for other motorists; and**
>
> **WHEREAS, there exists ample impressionistic and anecdotal evidence in the form of exfoliated tire recaps, many of them from large tires commonly associated with heavy duty trucks and other large, heavy over-the-road equipment, lying on and alongside highway roadways to suggest that present standards applicable to recapped tires may not be adequate to safeguard the motoring public; now, therefore, be it**
>
> **RESOLVED by the House of Delegates, the Senate concurring, that the Department of State Police be requested to study the need for State standards for recapped vehicle tires.**

The Department shall complete its work in time to submit its findings and recommendations to the Governor and the 2000 Session of the General Assembly as provided in the procedures of the Division of Legislative Automated Systems for the processing of legislative documents.

On August 20, 1999, the International Tire & Rubber Association (ITRA), Louisville, Kentucky, provided statistics which indicated there are 1,244 retreaders currently in operation within the United States. Of these recapping businesses, 43

are located in the State of Virginia, which accounts for only 3.5 percent of the total. Mr. Terry Westhafer, President of Central Tire Corporation, Verona, Virginia served on this Committee. Mr. Westhafer, who is recognized nationally as an expert in tire retreading, estimated Virginia retreaders produce between 4-6 percent of the total recapped tires in this country.

Federal Motor Vehicle Safety Standard Number 117, which is included in the Appendices of this report, sets forth federal standards for the performance, labeling, and certification requirements for retreaded pneumatic passenger car tires. (See Appendix A.) There are no established federal standards for commercial truck tires. Mr. Tim Hurd, spokesman for the National Highway Transportation Safety Administration, was quoted in The Detroit News on September 30, 1998, as stating, "No work is under way to create a federal retread rule for commercial truck tires." NHTSA is the organization that writes all Federal Vehicle-Performance and Safety Standards.

RELATED STUDIES AND RESOURCES

The Maintenance Council of the American Trucking Association has conducted two surveys of rubber found on the roadway. Peggy J. Fisher, Fleet Tire Consulting, provided the Committee with information concerning the two surveys, the first having been conducted in 1995 and the second in 1998. Mr. David Laubie, Director of Engineering at Bridgestone/Firestone, Inc., coordinated the physical studies and maintains the study data base for The Maintenance Council. Ms. Fisher serves as the Chairman of the Tire Debris Prevention Task Force for The Maintenance Council.

The Maintenance Council recently published its results comparing the two surveys, which are included in the Appendices of this report. (See Appendix B.) The overall purpose of the studies was to determine the cause of tire failures. In conducting the surveys, tire pieces were collected from three truck stops and ten different State Highway Transportation Departments throughout the United States. In the 1995 survey, 1,720 tires were inspected, compared to 2,200 in the 1998 survey. These figures represent an increase of 28 percent of discarded tires at the same locations over a three-year period. The report emphasized the majority of tire failures were attributed to underinflation. Information from the survey revealed the following information:

- 64% of the tires were truck tires; 36% were passenger and light truck tires.
- Tire debris increased 28% in 1998 over the 1995 collections. This fact was attributed to extremely high temperatures in the Southwest and increased speed limits of up to 75 mph in the Western states.
- Underinflation was a causative factor in 86% of the tire pieces inspected.
- 71% of the tire treads of truck tires were rib patterns, which indicate they came off of trailers.
- 87% of the medium-duty truck tires had been retreaded.

The members of The Maintenance Council Survey Committee had knowledge, through previous studies and experience, that trailer tires are most often retreaded tires. Mr. Larry Strawhorn, Vice President, Engineering for the American Trucking Association, assessed the issue of trailer tire damage when he stated, "Trailer tires are most susceptible to damage. This is because the tires on the tractor pulling the trailer tend to set up and align nails and other penetrating matter in their path. The trailer tires are then punctured by the objects and fail due to loss of air. Since most trailer tires are retreaded, it is logical that these are the tires that most commonly fail. Prohibiting the use of retreaded tires on trailers would only result in a like number of new tires failing from loss of air and underinflation since they have no special defense against penetrations."

It was observed that new tires fail due to lack of inflation pressure in the same manner as retreads. Regulating or restricting truck tire retread use will not reduce road debris. The studies also revealed the general public should be advised of the need to regularly check the inflation pressure of passenger car and pick-up truck tires, as over a third of tire debris comes from those vehicles. The Committee advised this is an obvious void in public education that should be filled.

The overall findings of these two comparative surveys indicate lack of tire maintenance, particularly the monitoring of proper air pressure, is the major causative factor for tire failure and discarded tires pieces found on the highways. Low tire pressure increases heat and flexing, which eventually results in tire separation. In the majority of retread failures, the casing comes apart, with the tread rubber still attached to the tire casing, spreading debris along the roadway. The casings, regardless of whether new or retreaded, are the part of the tire that fails; however, the tire pieces observed on the highway are perceived to be failed retreads.

Fleet Equipment Magazine reported recently released results of a laboratory test by The American Retreaders' Association which was conducted to determine the average breaking energy value of a specific retreaded radial truck tire casing. The results have been published in a technical report, "Plunger Test Study", that outlines the procedure and results. (See Appendix C.)

The retreaded tire used for the test was a randomly selected 11R24.5, H-rated highway tread with an all-steel casing. It was subjected to the strength, or plunger test, that is part of the Federal Motor Vehicle Safety Standard (FMVSS) 571.119, a test that applies to all new truck tires.

The test requires that the tire be penetrated at center tread by a 1½ inch steel plunger until either the tire breaks or the plunger is stopped by the rim. The process is repeated every 72 degrees around the rim, with the force and distance being recorded just as the tire breaks or the plunger meets the rim.

To meet minimum standards, the average static breaking energy for the five points of penetration must exceed 18,500 inch-pounds. The subject retread resisted on average 34,580 inch-pounds of energy, almost twice the minimum required for new tires under FMVSS. While noting that different casings can and will vary in strength depending on the belt material used and the construction of the tire, ARA concludes that the integrity of this particular casing was far greater than necessary to pass the test.

The entire report is available through the Tire Retread Information Bureau, 900 Weldon Grove, Pacific Grove, California 93950.

The American Retreaders' also conducted a research project in 1993 referred to as the Burst Strength Study, which compared new verses worn radial truck tires. (See Appendix D.) In this project, thirteen worn, retreadable radial truck tires from various tire manufacturers were selected to provide a typical cross section of low-profile radial tubeless truck tires. Visual inspection revealed these tires were free of structural damage or defects other than tread wear. Three new tires, also low-profile, were donated by the manufacturers as control tires. All sixteen tires were shipped to Standard Testing Laboratories in Massillon, Ohio, where they were tested according to procedures written by the ARA technical staff.

The tires were tested by mounting and hydrostatically bursting them using pressurized water. Pressurization with water is very even and accurate, and it is the safest method to determine the integrity of any type of container. Using photographs and videos of the procedures, the burst pressure and type of failure were recorded for each tire. Burst pressures are accurate to within one psi, plus or minus. The results of the burst test concluded the strength of the worn and new samples to be very similar. The worn tires, which were typical of those selected for retreading, did not show any loss of strength as a result of previous use. In this study, tread wear did not diminish the strength of low-profile radial truck tire casings compared to new tires.

United States President William J. Clinton signed Executive Order 13101 on September 14, 1998. Titled GREENING THE GOVERNMENT THROUGH WASTE PREVENTION, RECYCLING, AND FEDERAL ACQUISITION, the order continues to mandate the use of retreaded tires on all government vehicles. Retreaded tires are widely regarded as being environmentally friendly. Tires are basically petro-chemical products, and it takes 22 gallons of oil to manufacture one new truck tire. Most of the oil is found in the casing, which is re-used in the retreading process. As a result, it takes only seven gallons of oil to produce a retread truck tire.

The section of the Executive Order dealing with retreaded tires is as follows:

> Sec. 507. Procurement of Re-refined Lubricating Oil and Retread Tires.
>
> (a) Agencies shall implement the EPA procurement guidelines for re-refined lubricating oil and retread tires. Fleet and commodity managers shall take immediate steps, as appropriate to procure these items in accordance with section 6002 of RCRA.
>
> (b) The FEE shall work to educate executive agencies about the new Department of Defense Cooperative Tire Qualification Program, including the Cooperative Plant Qualification Program, as they apply to retread tires.

As a result of the President's Executive Order 13101, combined with strong endorsements by the General Services Administration and the Environmental Protection Agency, most federal government fleet vehicles are using retread tires. The United States Postal Service has successfully utilized retreads on all their vehicles for several years. In addition to the Postal Service, the United Parcel Service and Federal Express routinely use retreads on thousands of fleet vehicles. According to Mr. Harvey Brodsky, Managing Director of the Tire Retread Information Bureau, the safety record for retreads is equivalent to new tires. Commercial and military airplanes, school buses, emergency vehicles, and millions of passenger cars and trucks are routinely using retread tires.

On May 25, 1999, Team Tire at the U. S. Army Tank-Automotive & Armaments Command (TACOM) won a recycling award from the Clinton administration for its program in retreading tactical tires. The Office of the Federal Environmental Executive announced the TACOM Division won in the Affirmative Procurement Category of the White House Closing the Circle Awards, based on their retreading program that processed more than 2,500 tires in fiscal year 1998. TACOM demonstrated that retread tires can be purchased cost-effectively, without compromising on performance needs.

As part of their program, TACOM instituted the Cooperative Tire Qualification Program (CTQP), which is a tire product certification program, previously managed by the General Services Administration. The CTQP tests and certifies tires for quality and provides approved tire lists as a guide for government agencies to purchase quality tires, both new and retreaded.

There is also a shop inspection component of the TACOM program known as the Cooperative Plant Quality Certification (CPQC). Trade associations, such as the Associated Consultants of Technical Services, Incorporated (ACTS) offer retread tire inspection and certification programs. They are independent contractors for the administration of the government's CPQC, which also includes the CPQP. Once a retreader's facility and process is approved, the certification is valid for one year. To remain qualified, a facility and process must be re-inspected and CPQC certified within each year.

There is considerable influence from major rubber companies such as Goodyear, Michelin, Bandag, Oliver, and others that control retreaders through franchise agreements. These companies publish retreading specifications and operations manuals on the retreading process. Franchisees are required to comply with recommended practices and are subject to periodic unannounced inspections. They also offer or require training of production and management personnel. It is estimated that this rubber company control would affect at least seventy percent of the retreads produced in the United States.

The Virginia Department of Transportation began experimenting with the use of retread tires in the mid-1980's with little success. In 1994, they began a Retread Tire Pilot Project in the Salem and Staunton Districts, but with the loss of key personnel during the Workforce Transition Act in 1995, results were inconclusive.

In 1996, the Equipment Division developed a strategic initiative to establish a tire management program, which would identify the optimal methods for purchasing and servicing new, and retread tires. In 1996, Goodyear Tire and Rubber Company was selected to provide onsite tire products and services in the Fredericksburg District. In addition, all purchases of retread and new replacement tires within that district were from Goodyear. The Fredericksburg District piloted the Tire Program that extended from December of 1996 through June of 1999.

Services provided by Goodyear at VDOT sites, or Goodyear locations, included:

- Supply all new replacement tires.
- Supply dump truck/off road radial retread tires.
- Provide Labor/materials for removal and replacement of tires.
- Repair damaged tires.
- Pre-mount tires on VDOT supplied rims.
- Dispose of non-repairable/non-retreadable tires.
- Provide a computerized tire management system.

Performance and quality measures were established to compare service and reliability of new versus retread radial tires. The tires chosen to be compared were rear truck tires, 11R22.5 and off-road motor grader/loader/tractor tires. VDOT specifications for retread tires required the use of radial casings, and they could only be retreaded once. Michelin, Goodyear, or Bridgestone brand casings, which passed the vendor's quality control, were the only casings to be used.

The VDOT Equipment Division considered several basic factors in support of testing the use of retread tires. One consideration was the anticipated reduction of annual tire expenditures, which was projected at 32 percent Statewide for truck tires, and 55 percent Statewide for off-road tires. They also recognized that retread tires are environmentally preferable, and they looked at the overall success the transportation industry has experienced in the use of retread tires. They considered the quality standards of recaps, the safety and reliability of retread tires, and recognized operators of their vehicles will have to be aware of proper tire maintenance. As a result of the last consideration, VDOT employees are required to conduct a morning pre-trip inspection that includes checking the air pressure of vehicle and equipment tires.

During the 2½ year study, the failure rate of the retread tires was less than one percent. Based on the overwhelming success, their proposal to the VDOT Executive Leadership Group was to continue with the VDOT/Goodyear contract in the

Fredericksburg District and to provide Invitation For Bid (IFB) for all districts to begin contracting tire services, including the use of retread tires. It was also recommended that VDOT Equipment Division Specifications call for the use of retread tires for trucks and off-road equipment Statewide.

METHODOLOGY

A Recapped Tire Study Committee was established consisting of members of the tire industry, trucking industry, and the public safety community. Members of the Virginia Trucking Association were consulted to determine their position on the issue. Possible action being taken by the tire industry was explored. The Commercial Vehicle Safety Alliance was contacted to obtain information concerning action taken by other states. Information contained in previous studies on recapped tires was accessed, and federal mandates were researched and reviewed. Environmental issues were examined, and the International Tire and Rubber Association was consulted to determine the number of retreading businesses located in the State of Virginia, as well as the total number of businesses nationwide. This factor was researched to determine how much impact standards would actually have if they were developed on the State level.

Virginia Department of Transportation conducted a Tire Debris Collection evaluation over an eight-week period at three different sections of heavily traveled interstate highways. During the specified weeks beginning May 30, 1999, and ending July 30, 1999, tire debris was collected and weighed on I-95 between the North Carolina State Line and Caroline County for a total distance of 101 miles in each direction. Debris was also collected on I-81 between the Tennessee State Line and Mile Post 72, which extends 72 miles in each direction. The third location was I-77 between the West Virginia State Line and the North Carolina State Line, and I-81 between Mile Post 72 to the Pulaski County Line. This was completed to assist in determining how much discarded rubber is actually left on the most heavily traveled highways.

Virginia Department of Transportation also retrieved tire debris from the entire 72 miles of I-295 extending around Richmond. The debris was secured in VDOT facilities immediately after being collected, and the portions of tires were separated and examined in an effort to identify the type of each casing, as well as, the cause of failure. Mr. Terry Westhafer, in the presence of VDOT and State Police members of the Committee, was successful in determining the desired information, with the exception of one piece of tire. Each piece was marked for identification and photographed. (See Appendix E.)

FINDINGS

The findings of other related surveys and tests were reported in previous sections of this report.

A combined standing committee from the International Tire & Rubber Association, the National Tire Dealers and Retreaders Association and the Tread Rubber and Tire Repair Material Manufactures' Group periodically reviews and updates industry standards for tire retreading. Industry standards are offered as recommendations and the information is prepared and disseminated to retreading businesses by the Tire Retread Information Bureau. The standing committee does not have the authority to enforce compliance by industry members; however, recommended industry standards are provided for them as a service. According to the Executive Director of the Virginia Tire and Automotive Service Dealers Association, the tire industry as a whole is concerned about the problems with tire debris along the highways. They understand there are many components which contribute to this problem, and the different associations and large companies work together to find solutions. It was further reported that the retreading industry has self-imposed standards, and the competitive nature of the industry requires constant planning and effort to produce higher quality retread tires. Retreaders are also controlled by major rubber companies through franchise agreements, which require the franchisees to comply with recommended practices. Franchise agreements control at least 70 percent of the total retread production.

According to the trucking industry contacts, trucking companies using retreaded tires realize savings of over $2 billion dollars annually in North America. For most fleets, tires represent the third largest item in their operating budget. In 1998, of the 33.9 million replacement tires purchased by fleets, 19.4 million were retreads. Trucking officials view retreads as safe, reliable, and cost-effective.

The Commercial Vehicle Safety Administration advised there are no other states currently considering establishment of standards for recapping tires.

The International Tire & Rubber Association (ITRA), Louisville, Kentucky, advised the Committee that of 1,244 retreaders in operation, 43 are located in the State of Virginia. Based on their information, Virginia retreading businesses only account for 3.5 percent of the total. It was further estimated that Virginia retreaders produce between 4-6 percent of the total recapped tires in the country. Recognizing that a certain portion of the discarded tires left along the highways originate on commercial vehicles merely passing through, regulating only Virginia retreaders would have little, if any, impact toward solving the problem.

The tire debris collection study conducted by VDOT for an eight-week period at the three locations resulted in 42,997 pounds of debris being collected from I-95, 42,475 pounds from I-81, and 42,050 pounds collected from I-81/I-77. All debris was weighed revealing a total of 127,522 pounds spread out over 658 miles of interstate highway in an eight- week period.

The Virginia Department of Transportation also collected tire debris from the entire 72 miles of I-295 extending around Richmond. Examination of the debris provided a great deal of insight into the reasons tires disintegrate and spread pieces of rubber materials along the roadways. Photographs and individual explanations of the findings for each tire are represented in Appendix E. A total of 27 tires were recovered and identified and the following is a summary of the findings:

Of the 27 tires, eight (30%) had never been retreaded, 18 (67%) were retreads, and one (3%) could not be determined. Six of the tires that had never been retreaded were from light trucks or passenger cars. Two failed because of low pressure (unknown why pressure was low), one because it was an aged, deteriorated tire, one was damaged by the dual tire next to it going flat, and the reasons for the failure of the other two could not be determined.

Nine of the 27 tires came from trailers, with one being new and eight being retreads. The one new tire failed because of low pressure, five retreads failed because of punctures, two could not be determined, and one tire failed because of manufacturer's error during the recapping process. Of the entire survey, this was the only failure attributed to improper retreading practices. The quality of the casing was satisfactory, but the inspector apparently missed a puncture in the casing during the pre-inspection phase of the process.

Five of the 27 tires were retreaded drive-wheel truck tires. Of the five, three failed because of punctures and the other two reasons could not be determined.

The last seven tires were nylon bias/ply tires with no belts. They are the type usually found on containerized trailers, referred to as intermodal, that are used to transfer containerized loads from one mode of transportation to another. Market statistics indicate only fourteen percent of retreads are bias/ply tires. Of the seven of these type tires recovered, one was new, five were retreaded, and one could not be determined. One tire failed as the result of a heat generated blowout, and the reason could not be determined on the other six.

Containerized loads are normally pulled from location to location by individual tractor owner/operators who transport containers mounted on chassis that are not owned or maintained by the transporting owner/operators. However, current legal and intermodal equipment interchange agreements hold the trucker responsible for replacement and repair of tires that become unserviceable while he/she is transporting the container and chassis on a public highway. As a result, oftentimes

the replacement tires are the most inexpensive available, and are purchased with the goal of getting the container and chassis to the next destination only. These last seven tire samples represent that particular situation.

The overall findings of this Committee revealed the quality of materials and methods of producing retreaded tires are not major factors in the problem of tire debris along the highways. Committee findings, supported by other studies, attributed less than 4% of the tire failures to problems with retreaded tires. Also, only 3.5 percent of the total retreading businesses are located in the State of Virginia.

The consensus of the members of this Committee is that the establishment of state standards would have little, if any, impact on the problem.

RECOMMENDATIONS

Virginia state standards for recapped tires are not recommended.

The following recommendations are made with regard to this study:

- **The public should be educated concerning proper tire maintenance. Members of the tire industry, the Department of Motor Vehicles, Virginia Department of Transportation, National Highway Transportation Safety Alliance, Office of Motor Carrier and Highway Safety, law enforcement agencies, and trucking associations are capable of distributing information to citizens that impress the importance of maintaining proper air pressure and tire maintenance.**

- **Key members of the tire industry should be encouraged to maintain strict industry standards and follow recommended practices and processing guidelines.**

- **Information should be forwarded to the National Highway Transportation Safety Administration for their review and consideration in developing federal standards for recapped tires. Federal regulations have the capability of reducing the problems nationwide with intermodal containerized trailers being equipped with poorly manufactured retreaded tires.**

APPENDICES

Contact person for obtaining the full text of the appendix is Captain W. S. Flaherty, Virginia State Police, Safety Division, 491 Southlake Boulevard, Richmond, VA 23236, (804) 378-3472.

APPENDIX A

MOTOR VEHICLE SAFETY STANDARD NO. 117

MOTOR VEHICLE SAFETY STANDARD NO. 117

Retreaded Pneumatic Tires

(Docket No. 1-8; Notice 7)

S1. Scope. This standard specifies performance, labeling, and certification requirements for retreaded pneumatic passenger car tires.

S2. Purpose. The purpose of this standard is to require retreaded pneumatic passenger car tires to meet safety criteria similar to those for new pneumatic passenger car tires.

S3. Application. This standard applies to retreaded pneumatic tires for use on passenger cars manufactured after 1948.

S4. Definitions.

S4.1 "Casing" means a used tire to which additional tread may be attached for the purpose of retreading.

"Retreaded" means manufactured by a process in which a tread is attached to a casing.

S4.2 All terms defined in § 571.109 and § 571.110 are used as defined therein.

S5. Requirements.

S5.1 Retreaded tires.

S5.1.1 Except as specified in S5.1.3, each retreaded tire, when mounted on a test rim of the width specified for the tire's size designation in Appendix A of § 571.109, shall comply with the following requirements of § 571.109:

(a) S4.1 (Size and construction).

(b) S4.2.1 (General).

(c) S4.2.2.3 (Tubeless tire resistance to bead unseating).

(d) S4.2.2.4 (Tire strength).

S5.1.2 Except as specified in S5.1.3, each retreaded tire, when mounted on a test rim of the width specified for the tire's size designation in Appendix A of § 571.109, shall comply with the requirements of S4.2.2.2 of § 571.109, except that the tire's section width shall not be more than 110 percent of the section width specified, and the tire's size factor shall be at least 97 percent of the size factor specified, in Appendix A of § 571.109 for the tire's size designation.

S5.1.3 Each retreaded tire shall be capable of meeting the requirements of S5.1.1 and S5.1.2 when mounted on any rim in accordance with those sections.

S5.1.4 No retreaded tire shall have a size designation, recommended maximum load rating, or maximum permissible inflation pressure that is greater than that originally specified on the casing pursuant to S4.3 of § 571.109, or specified for the casing in Table I.

S5.2 Casings.

S5.2.1 No retreaded tire shall be manufactured with a casing—

(a) On which bead wire or cord fabric is exposed before processing.

(b) On which any cord fabric is exposed during processing, except that cord fabric that is located at a splice, i.e., where two or more segments of the same ply overlap, or cord fabric that is part of the belt material, may be exposed but shall not be penetrated or removed to any extent whatsoever.

S5.2.2 No retreaded tire shall be manufactured with a casing—

(a) From which a belt or ply, or part thereof, is removed during processing; or

(b) On which a belt or ply, or part thereof, is added or replaced during processing.

S5.2.3 Each retreaded tire shall be manufactured with a casing that bears, permanently molded at the time of its original manufacture into or onto the tire sidewall, each of the following:

(a) The symbol DOT;

(b) The size of the tire; and

(c) The actual number of plies or ply rating

S5.2.4 [Reserved]

S6. Certification and labeling.

S6.1 Except as specified in S6.2, each manufacturer of a retreaded tire shall certify that his product complies with this standard, pursuant to section 114 of the National Traffic and Motor Vehicle Safety Act of 1966, by labeling the tire with the symbol DOT in the location specified in § 574.5 of this chapter.

S6.2 From June 1, 1973 to July 31, 1973, a manufacturer may certify compliance by affixing to the tread or sidewall of the tire, in such a manner that it is not easily removable, a label that states in letters not less than three thirty-seconds of an inch high:

This retreaded tire was manufactured after June 1, 1973 and conforms to all applicable Federal motor vehicle safety standards.

S6.3 Labeling.

S6.3.1 Each retreaded pneumatic tire manufactured on or after June 1, 1973, shall be labeled, in at least one location on the tire sidewall in letters and numerals not less than 0.078 inches high, with the following information:

(a) The tire's size designation;

(b) The tire's maximum permissible inflation pressure, either as it appears on the casing or as set forth in Table I;

(c) The tire's maximum load, either as it appears on the casing or as set forth in Table I;

(d) The actual number of plies, ply rating, or both;

(e) The word "tubeless" if the tire is a tubeless tire, or the words "tube type" if the tire is a tube-type tire;

(f) If the tire is of bias/belted construction, the words "bias/belted", or the actual number of plies in the sidewall and the actual number of plies in the tread area.

(g) The word "radial" if the tire is of radial construction.

The information shall either be retained from the casing used in the manufacture of the tire, or may be labeled into or onto the tire during the retreading process, either permanently (through molding, branding, or other method that will produce a permanent label) or by the addition of a label that is not easily removable.

S6.3.2 Each retreaded tire manufactured on or after May 12, 1975, shall bear permanent labeling (through molding, branding, or other method that will produce a permanent label, or through the retention of original casing labeling) in at least one location on the tire sidewall, in letters and numbers not less than 0.078 inches high, consisting of the following information:

(a) The tire's maximum permissible load,

(b) The actual number of plies in the tire sidewall, and the actual number of plies in the tire tread area, if different; and

(c) The generic name of each cord material used in the plies (both sidewall and tread area) of the tire.

TABLE I—PLIES

Tire Size	2 Ply—4 Ply (4 Ply Rating)		4 Ply (6 Ply Rating)		4 Ply (8 Ply Rating)	
	Maximum Load	Maximum Inflation Pressure	Maximum Load	Maximum Inflation Pressure	Maximum Load	Maximum Inflation Pressure
6.00–13	1010	32	1080	36	1140	40
6.50–13	1150	32	1230	36	1300	40
7.00–13	1270	32	1360	36	1440	40
6.45–14	1120	32	1200	36	1270	40
6.95–14	1230	32	1310	36	1390	40
7.35–14	1360	32	1450	36	1540	40
7.75–14	1500	32	1600	36	1690	40
8.25–14	1620	32	1730	36	1830	40
8.55–14	1770	32	1890	36	2000	40
8.85–14	1860	32	1990	36	2100	40
5.60–15	970	32	1040	36	1105	40
5.90–15	1050	32	1130	36	1200	40
6.85–15	1230	32	1320	36	1390	40
7.35–15	1390	32	1480	36	1570	40
7.75–15	1490	32	1590	36	1690	40
8.85–15	1610	32	1720	36	1820	40
8.25–15	1620	32	1730	36	1830	40
8.45–15	1740	32	1860	36	1970	40
8.55–15	1770	32	1890	36	2000	40
8.85–15	1860	32	1980	36	2100	40
9.00–15	1900	32	2030	36	2150	40
9.15–15	1970	32	2100	36	2230	40
8.90–15	2210	32	2360	36	2500	40

TABLE I—PLIES—Continued

Tire Size	2 Ply—4 Ply (4 Ply Rating)		4 Ply (6 Ply Rating)		4 Ply (8 Ply Rating)	
	Maximum Load	Maximum Inflation Pressure	Maximum Load	Maximum Inflation Pressure	Maximum Load	Maximum Inflation Pressure
A70-13	1060	32	1130	36	1200	40
D70-13	1320	32	1410	36	1490	40
D70-14	1320	32	1410	36	1490	40
E70-14	1400	32	1490	36	1580	40
F70-14	1500	32	1610	36	1700	40
G70-14	1620	32	1730	36	1830	40
H70-14	1770	32	1890	36	2010	40
J70-14	1860	32	1980	36	2100	40
L70-14	1970	32	2100	36	2230	40
C70-15	1230	32	1320	36	1390	40
D70-15	1320	32	1410	36	1490	40
E70-15	1400	32	1490	36	1580	40
F70-15	1500	32	1610	36	1700	40
G70-15	1620	32	1730	36	1830	40
H70-15	1770	32	1890	36	2010	40
J70-15	1860	32	1980	36	2100	40
K70-15	1900	32	2030	36	2150	40
L70-15	1970	32	2100	36	2230	40

TABLE I—PLIES—Continued

Tire Size	2 Ply—4 Ply (4 Ply Rating)		4 Ply (6 Ply Rating)		4 Ply (8 Ply Rating)	
	Maximum Load	Maximum Inflation Pressure	Maximum Load	Maximum Inflation Pressure	Maximum Load	Maximum Inflation Pressure
165-13	1050	32	1130	36	1200	40
175-13	1150	32	1240	36	1350	40
185-13	1270	32	1390	36	1510	40
155R13	950	32	1015	36	1075	40
155R14	1010	32	1080	36	1140	40
155R15	1015	32	1085	36	1150	40
165R13	1010	32	1080	36	1140	40
165R14	1120	32	1200	36	1270	40
165R15	1130	32	1200	36	1270	40
175R14	1230	32	1310	36	1390	40
185R14	1360	32	1450	36	1540	40
185/70R13	1090	32	1140	36	1190	40
145-14*	865	32	905	36	935	40
145-15	895	32	940	36	975	40
195-15	1550	32	1680	36	1820	40
205-15	1700	32	1840	36	2000	40

* Dash Radial—Not an "R" Radial

36 F.R. 7315
April 17, 1971

APPENDIX B

THE MAINTENANCE COUNCIL SURVEY RESULTS

Tire Debris Prevention Efforts
An Industry Update

Rubber on the Road Survey 1995 vs 1998

- **PRESENTATION AGENDA**
  - Participants
  - Location
  - Data Analysis
  - Conclusions

1998 Rubber on the Road Participants

Michelin North America, Inc.

Tire Retread Informtion Bureau

Oliver Rubber Company

Continental General Tire, Inc.

Pressure Systems International

Yokohama Tire Corporation

Bridgestone / Firestone Inc.

Eaton Corporation

Hercules Tire & Rubber Company

Hawkinson Companies

Teknor Apex Company

Goodyear Tire & Rubber Company

Bandag, Inc.

Survey Data

● TIRES INSPECTED / BY LOCATION

	1998	1995	% Change
– TA KENLEY, NC.	41	33	+24%
– TR STOP - COLUMBIA, SC.	45	27	+67%
– OHIO TURNPIKE	46	96	-52%
– DOT - MOBILE, AL.	68	118	-42%
– TA RALEIGH, NC.	71	99	-28%
– PENDLETONE, OR. (DOT)	90	347	-74%
– COLUMBIA, SC. (DOT)	91	110	-17%
– RALEIGH, NC. (DOT)	105	67	+43%
– NJTP, MILLTOWN MILE 70-90	137	37	+270%
– NJTP, CROSSWICKS NJ MILE 5	147	100	+47%
– LAS VEGAS, NV.	261	68	+283
– DALLAS, TX.	385	87	+466%
– TUCSON, AZ.	713	531	+34%
	2200	1720	+28%

Tire Debris Prevention Efforts
An Industry Update

Nashville, Tn.

March 17, 1999

Dave Laubie

Director, Engineering

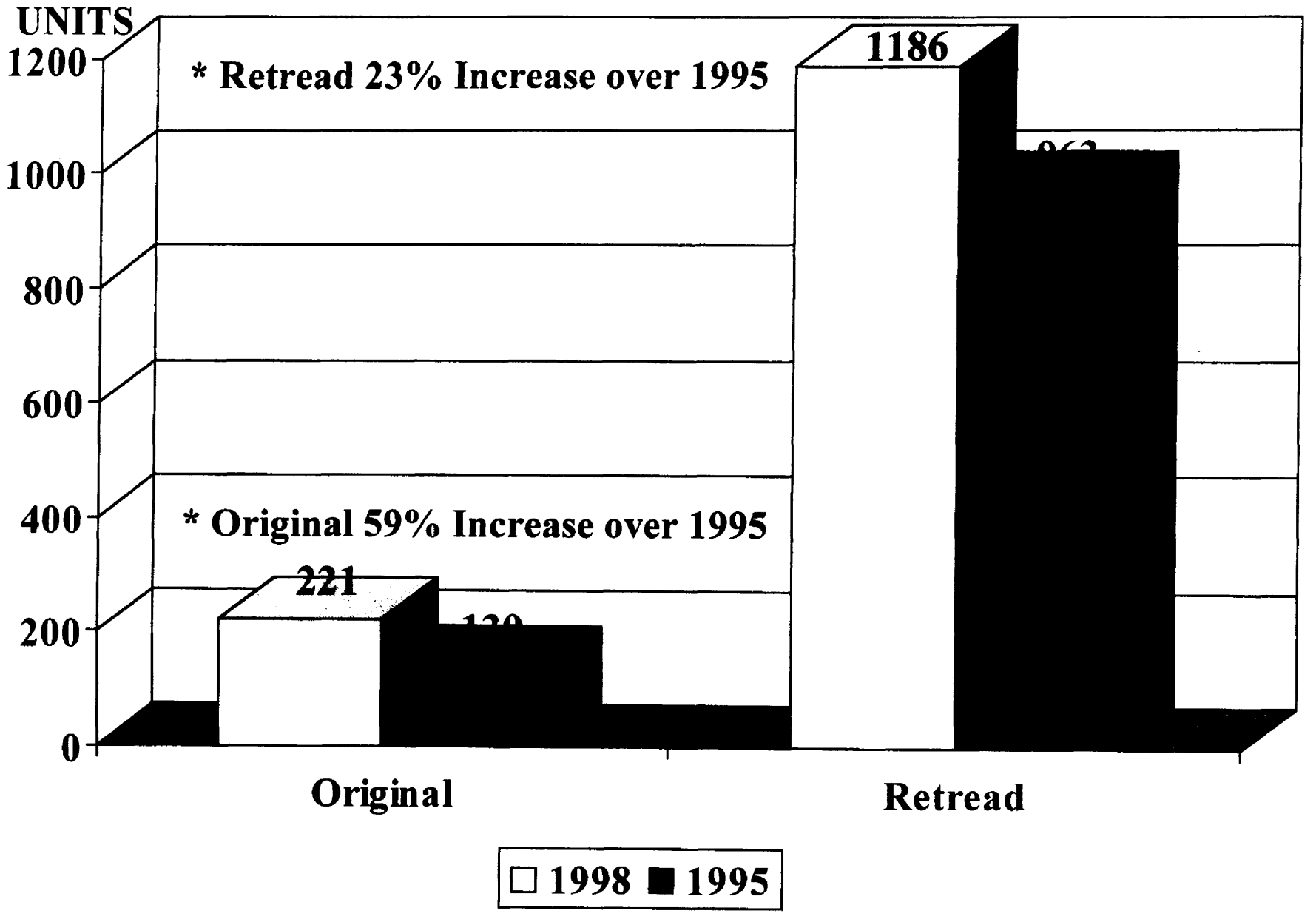
Bridgestone / Firestone

Survey Data

- Total number of tires inspected (by product group)

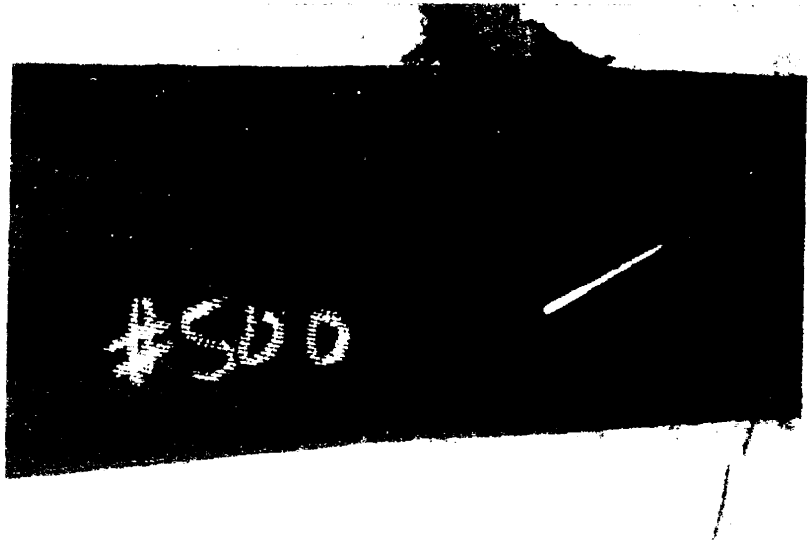
	1998	1995
– TBR -	1407 (64%)	1102 (64%)
– LT -	242 (11%)	146 (8%)
– PS -	551 (25%)	472 (27%)
TOTAL	**2200**	**1720**

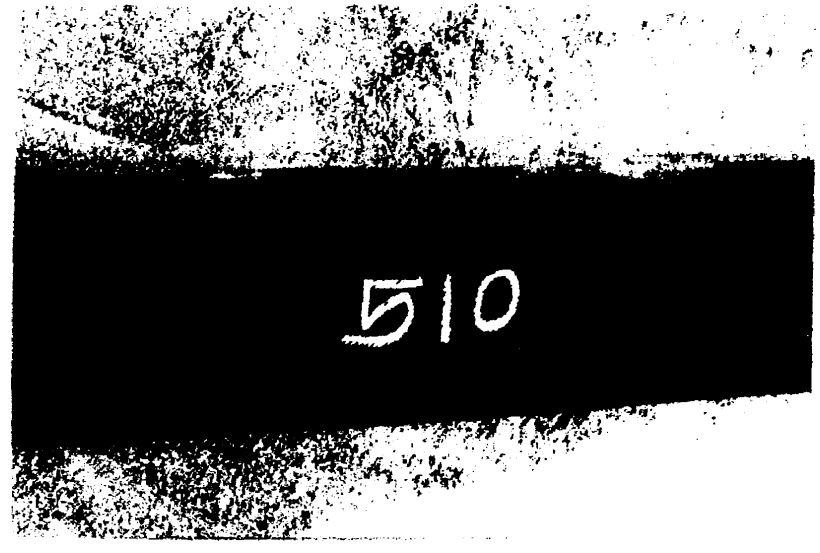
TIRES INSPECTED



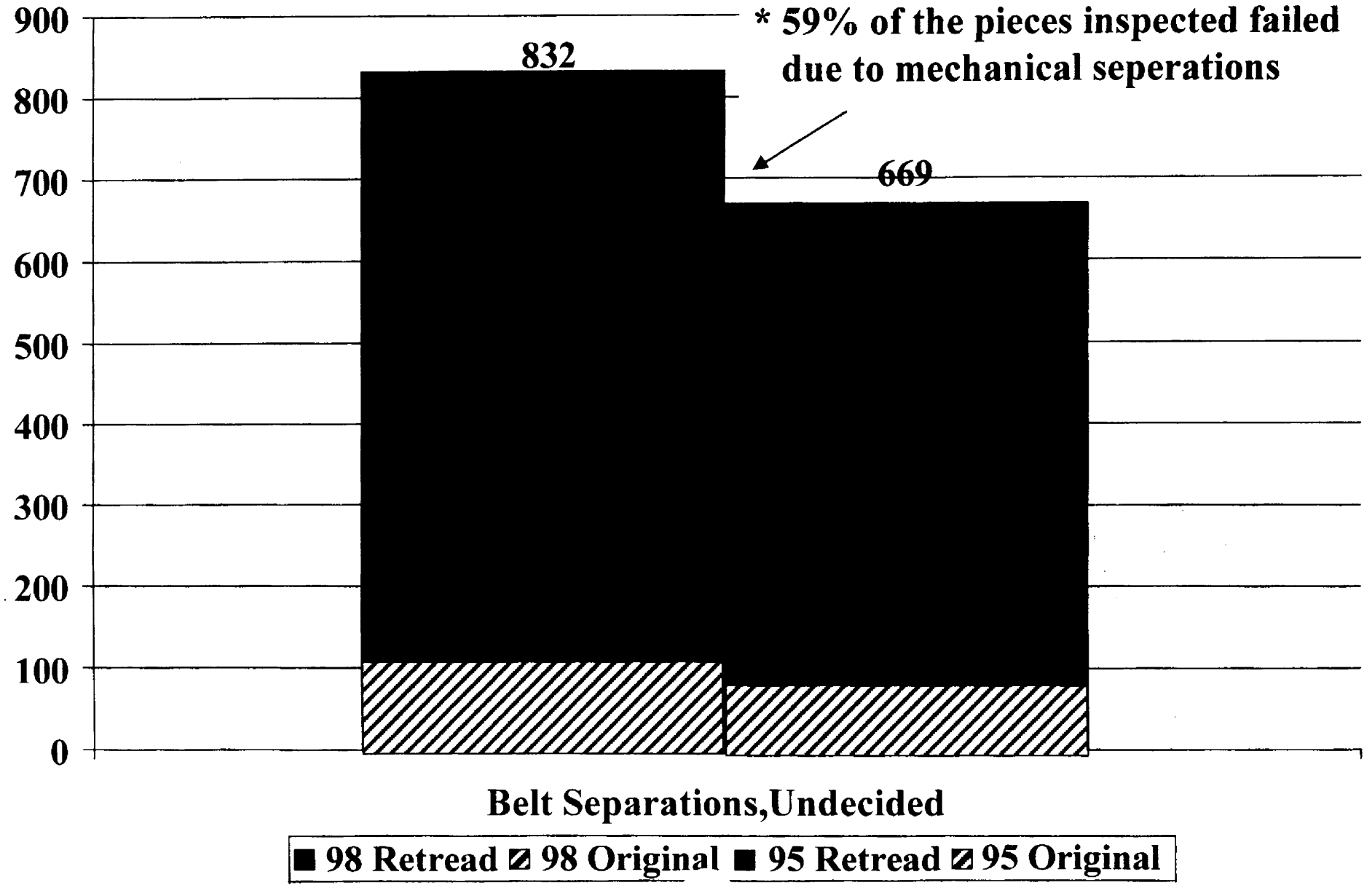
DATA ANALYSIS

Belt Separations, Undecided

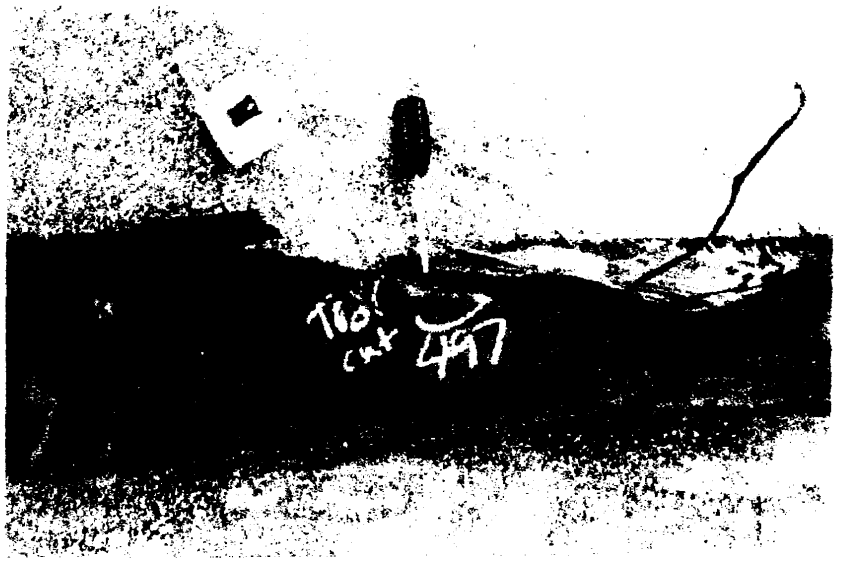




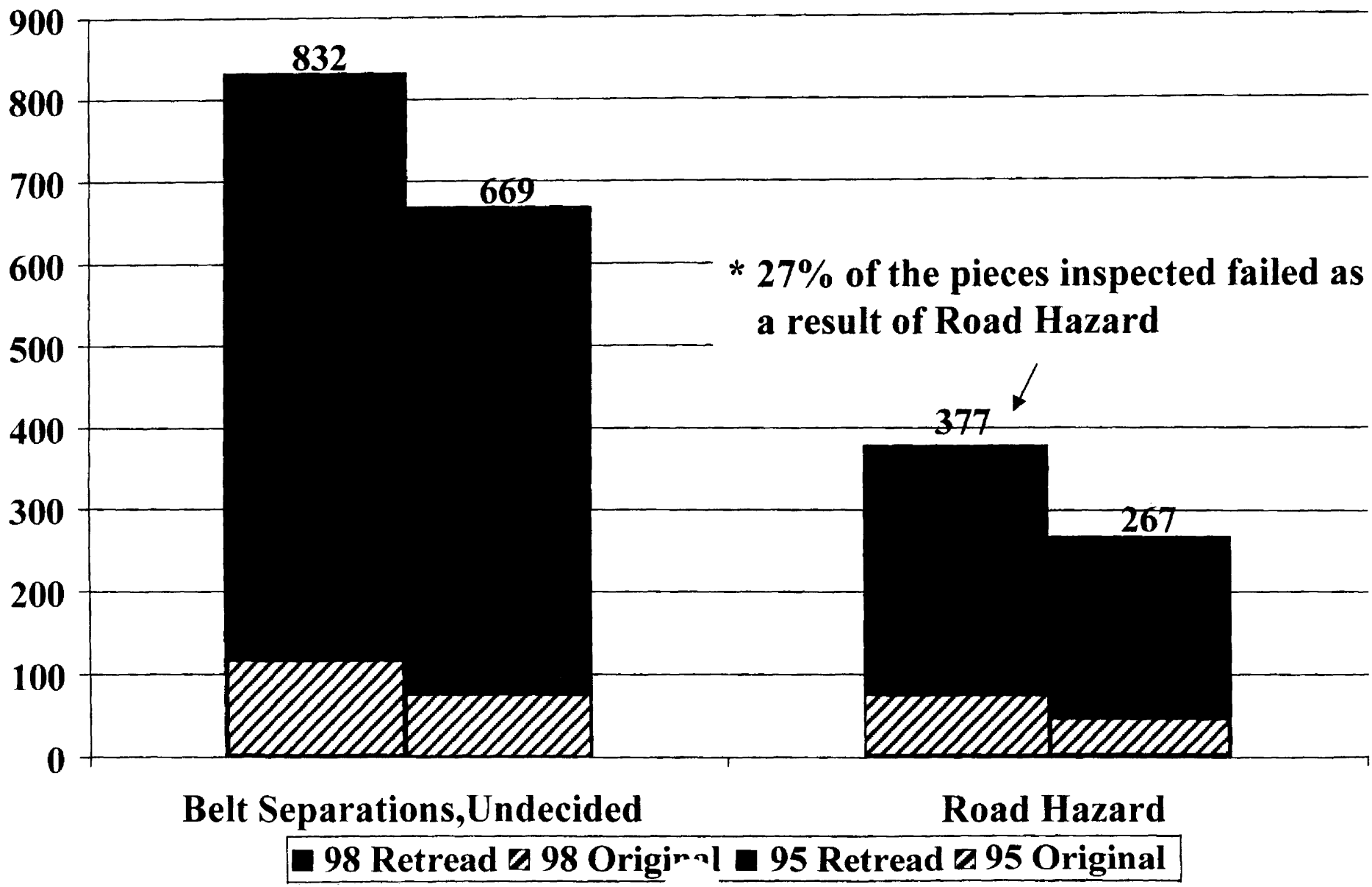
FAILURE REASONS



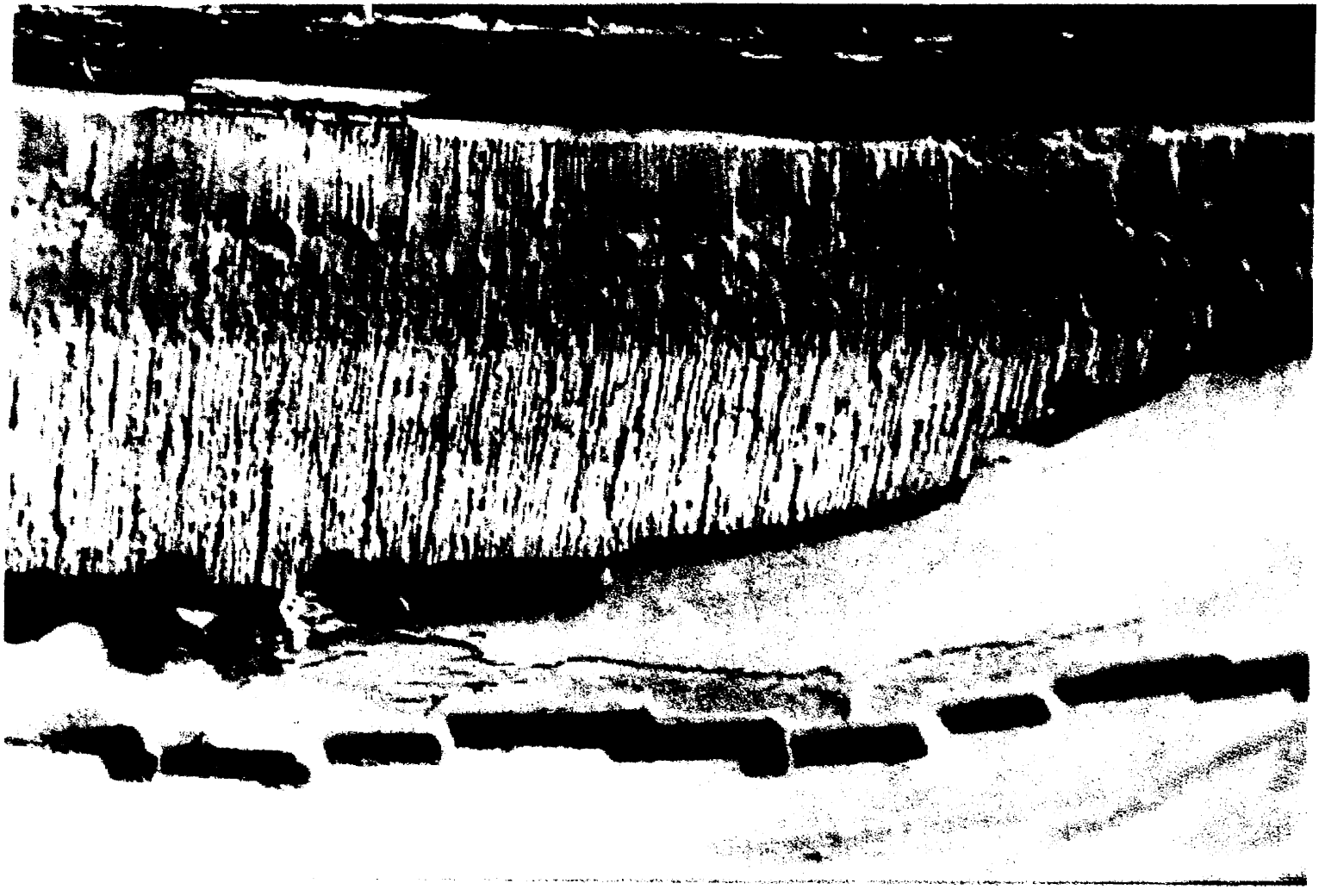
ROAD HAZARD (Nail/Puncture,R/H Impact,Cuts/Snags)



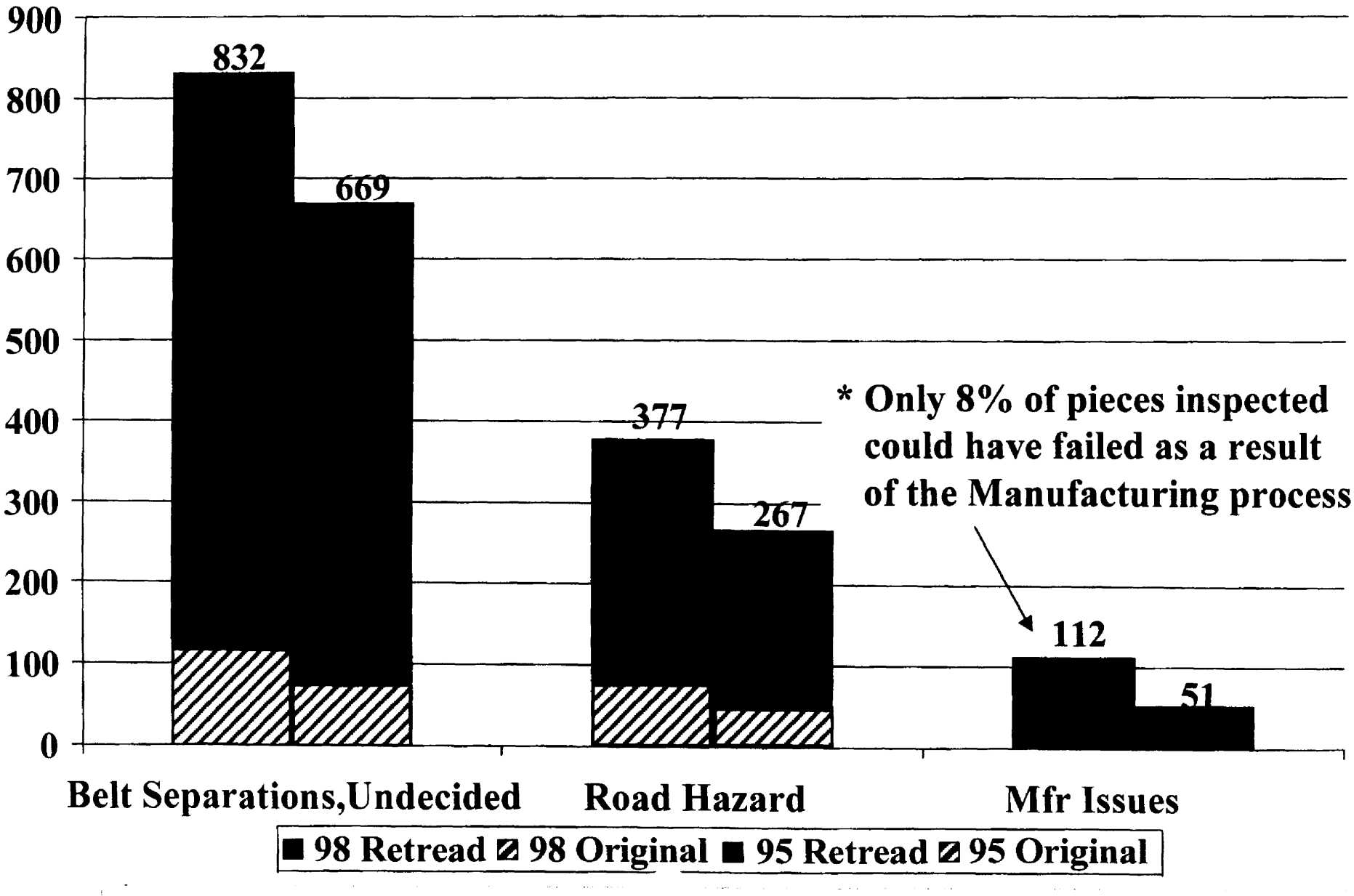
FAILURE REASONS



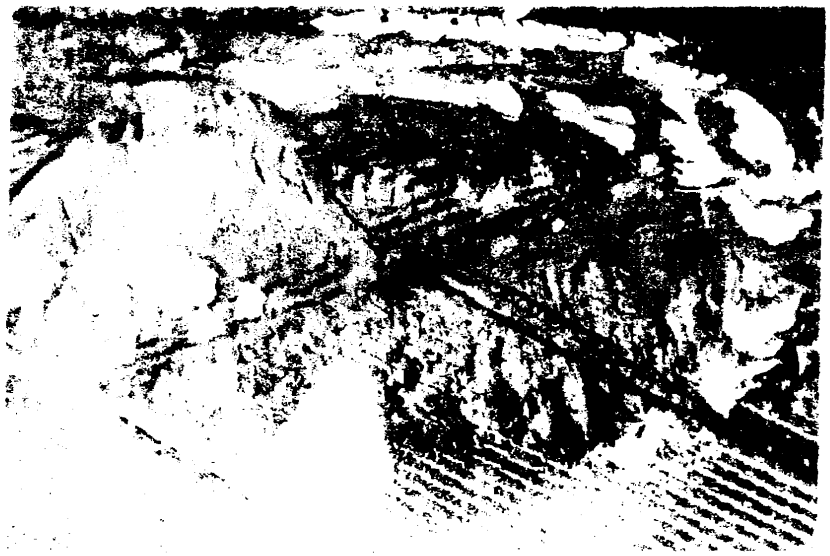
MFR Issues (Bond Failure,Missed Nail Hole,Tread Lift/Sep,Bead Failure Tread Chunking,Tread Sep)



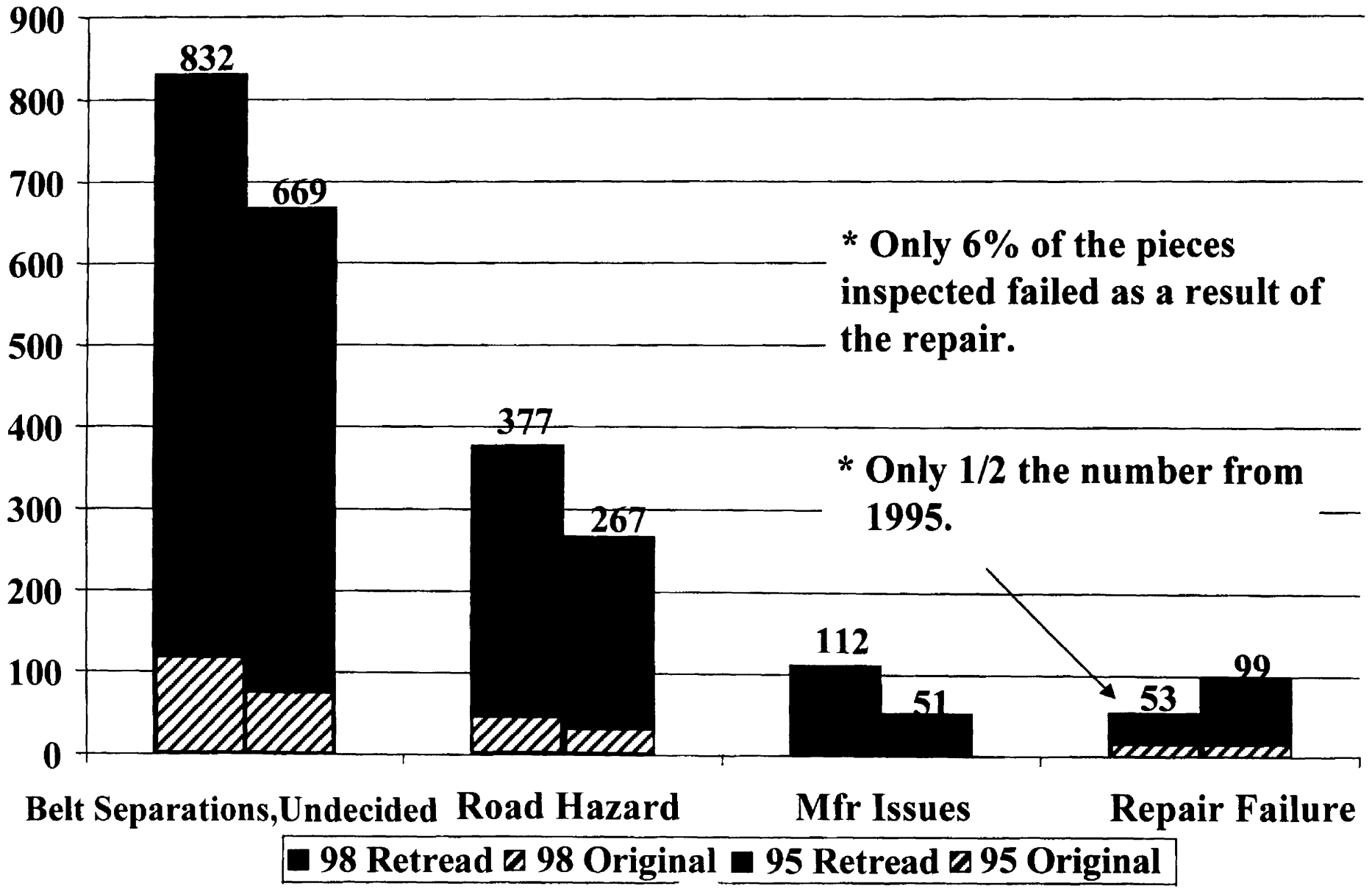
FAILURE REASONS



REPAIR FAILURE / IMPROPER REPAIR

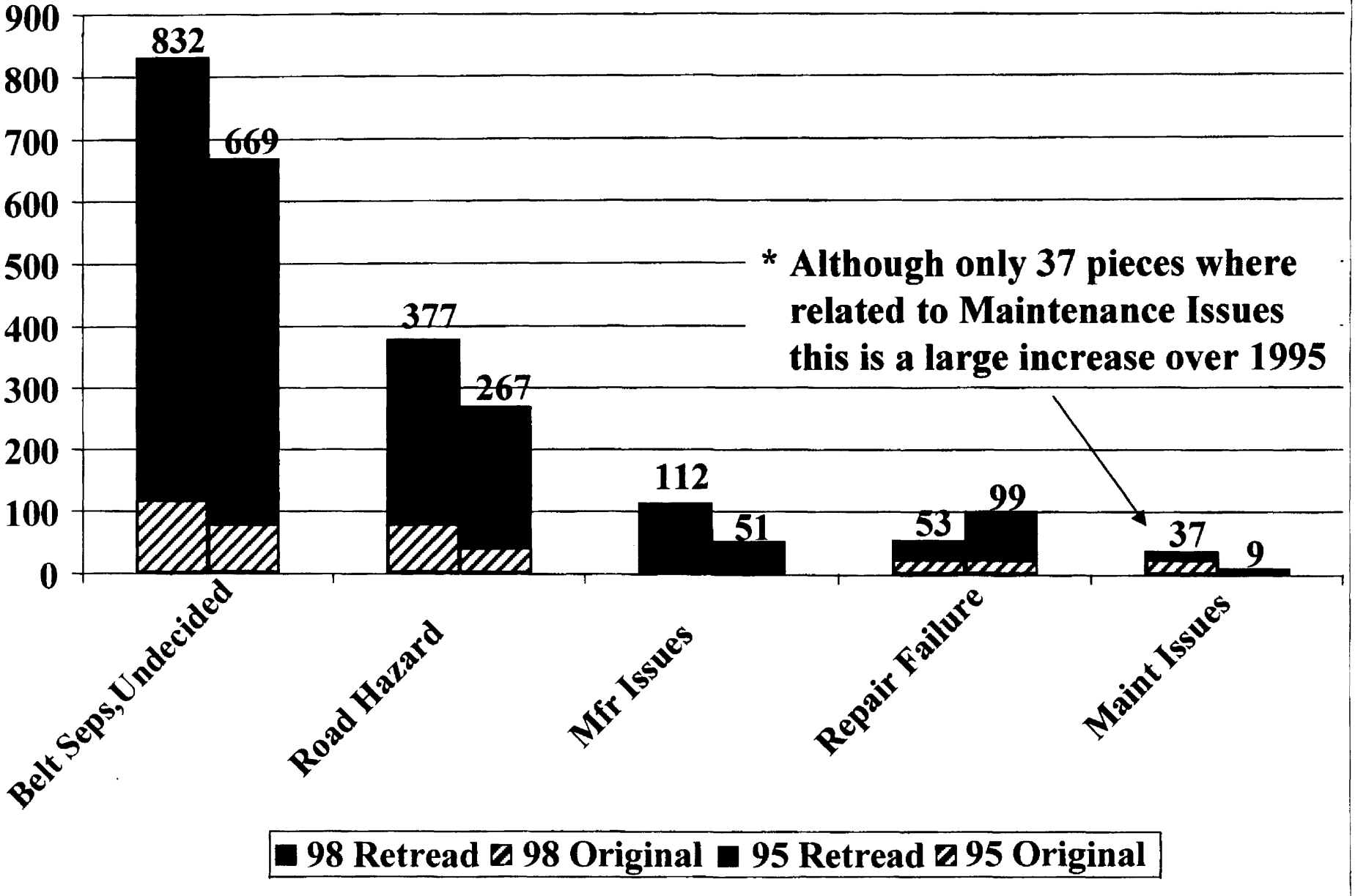


FAILURE REASONS

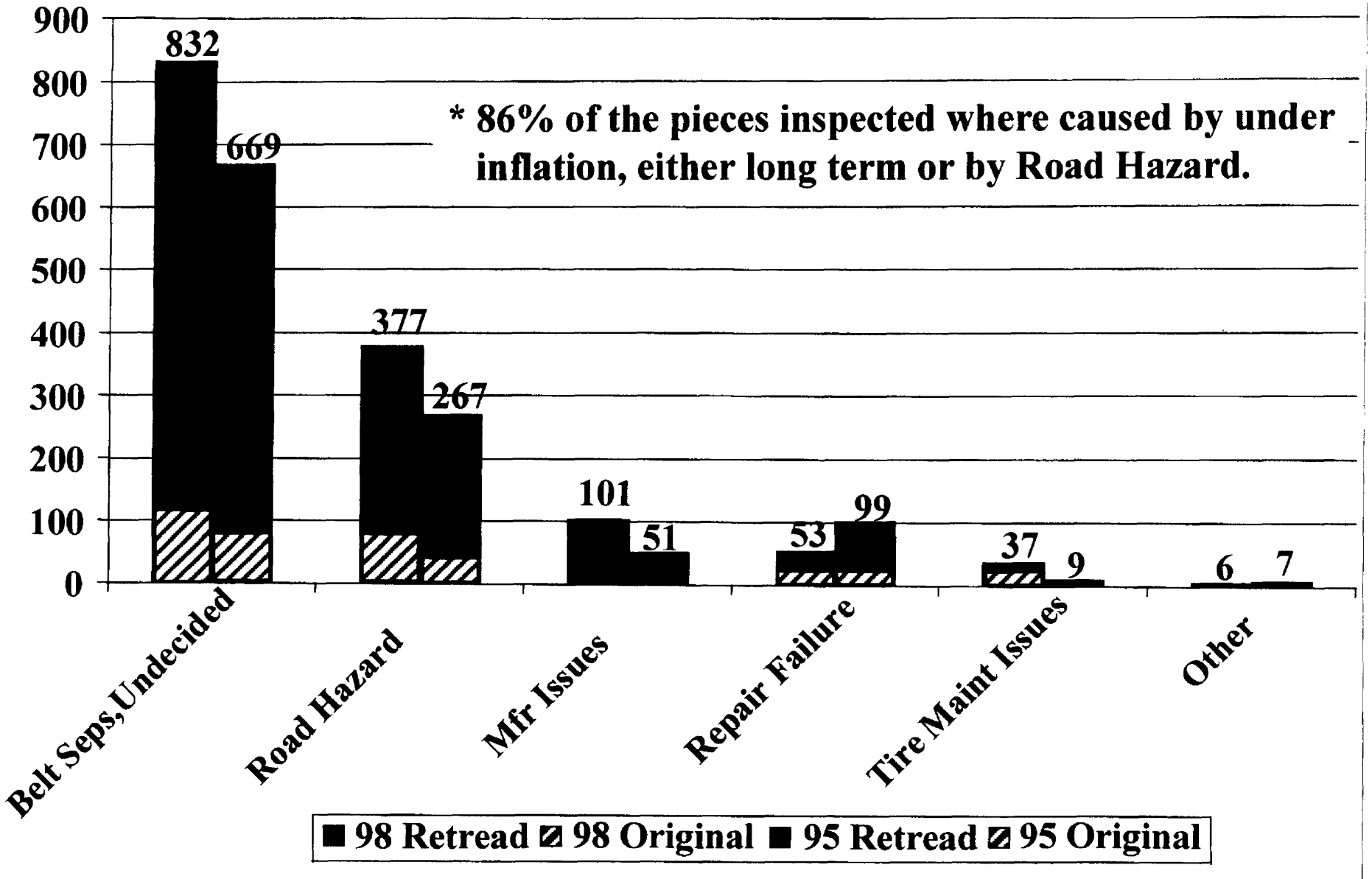


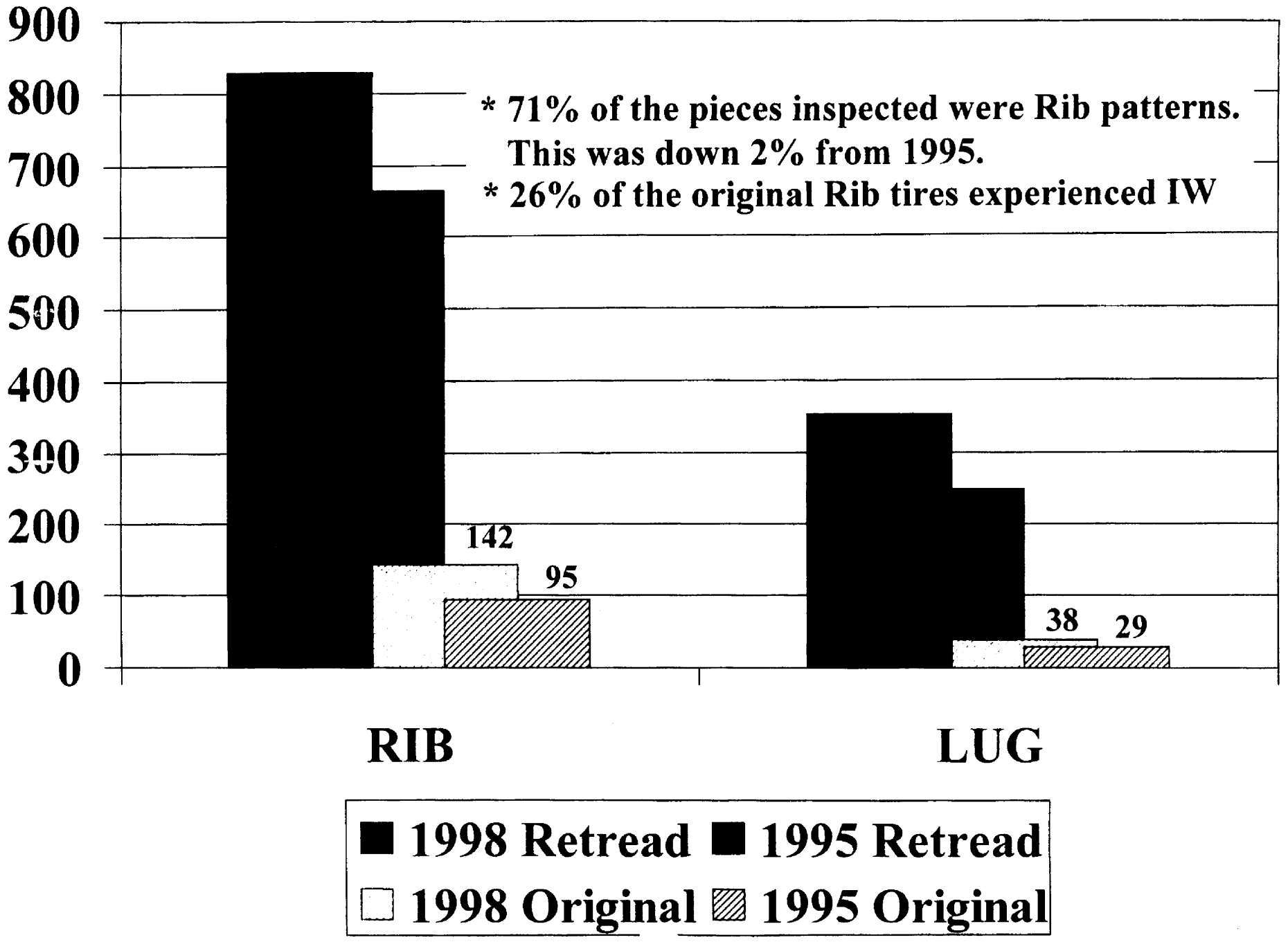
Tire Maintenance Issues (Excessive wear, Brake Skid, Stone Drill)

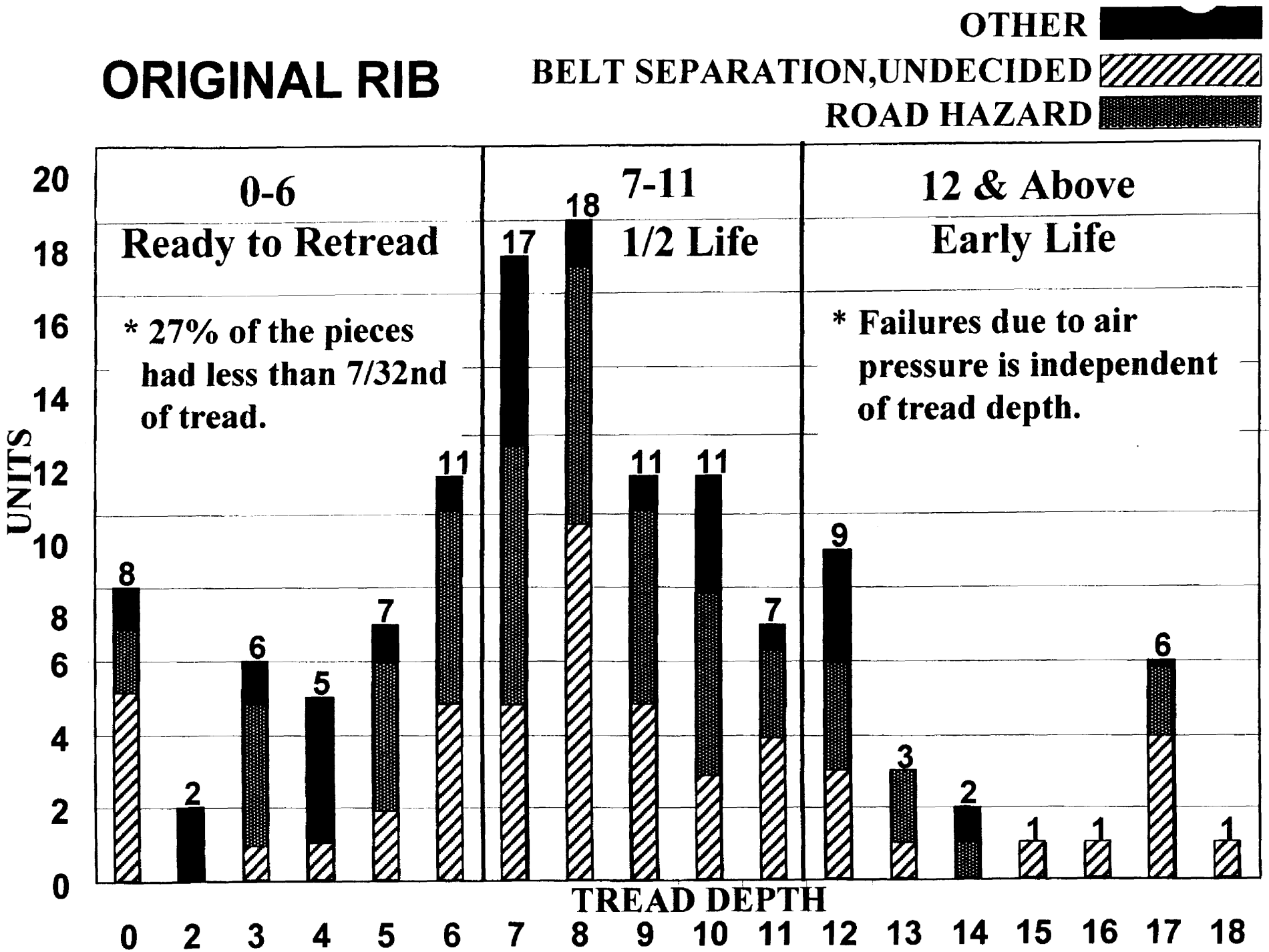
FAILURE REASONS

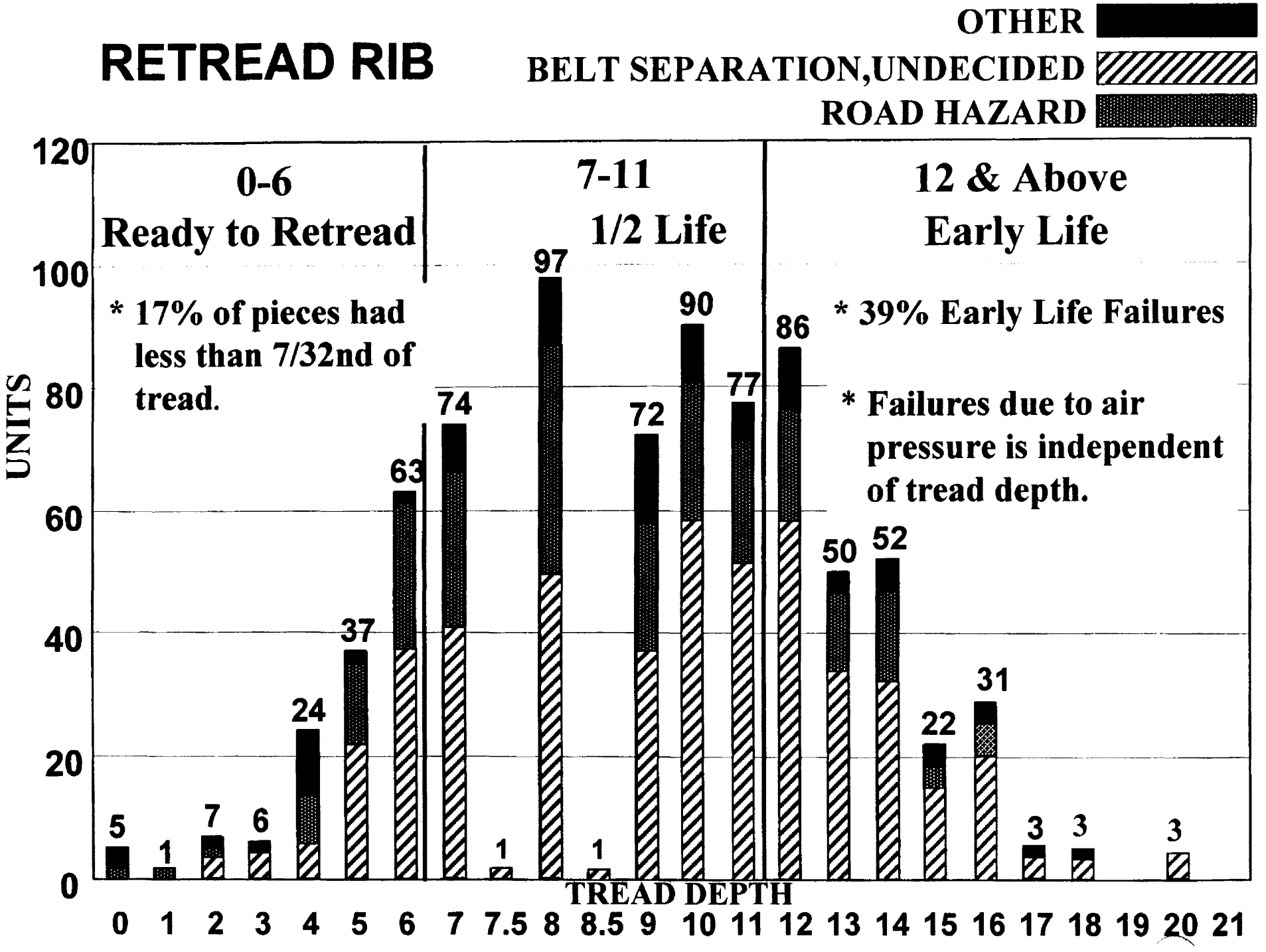


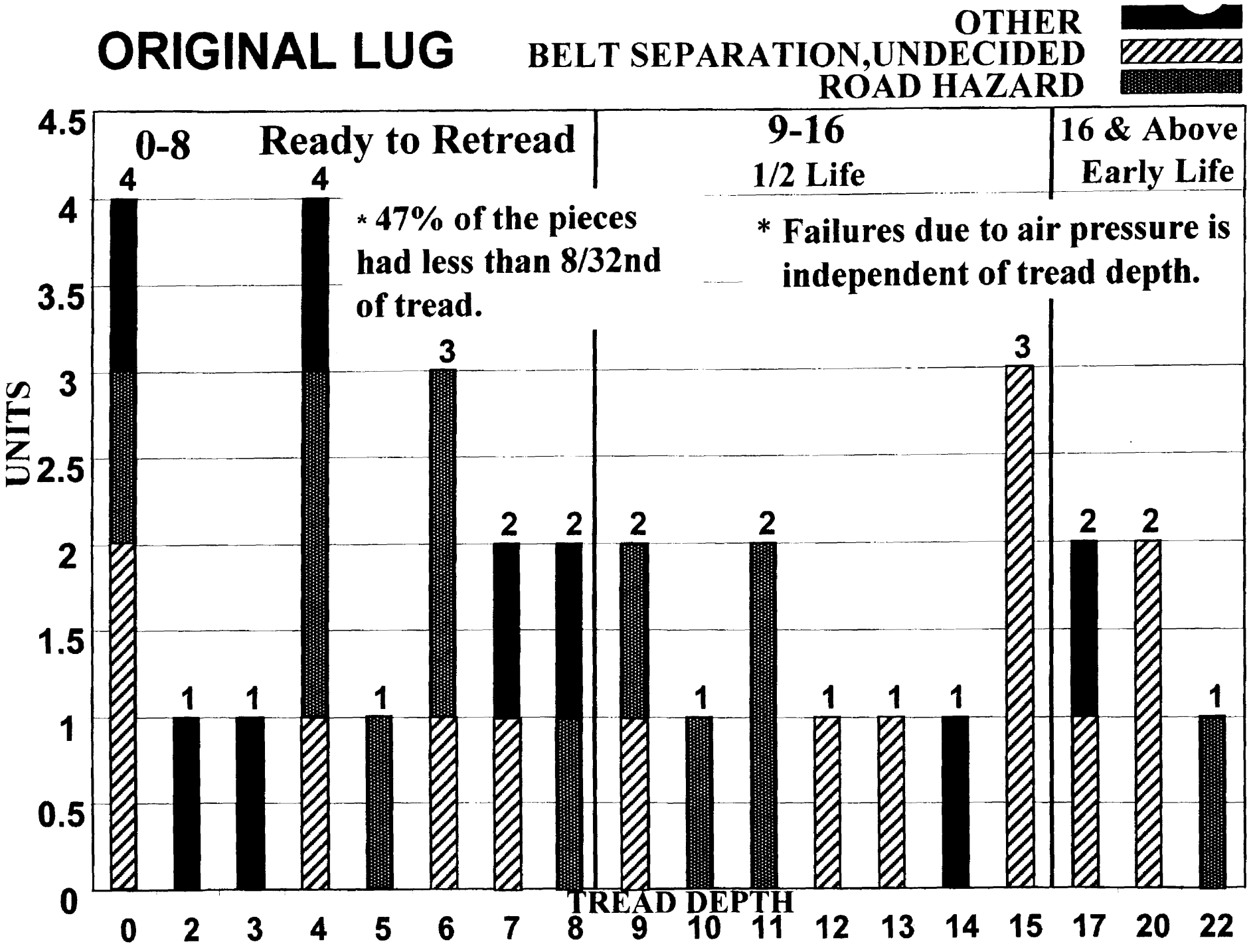
FAILURE REASONS

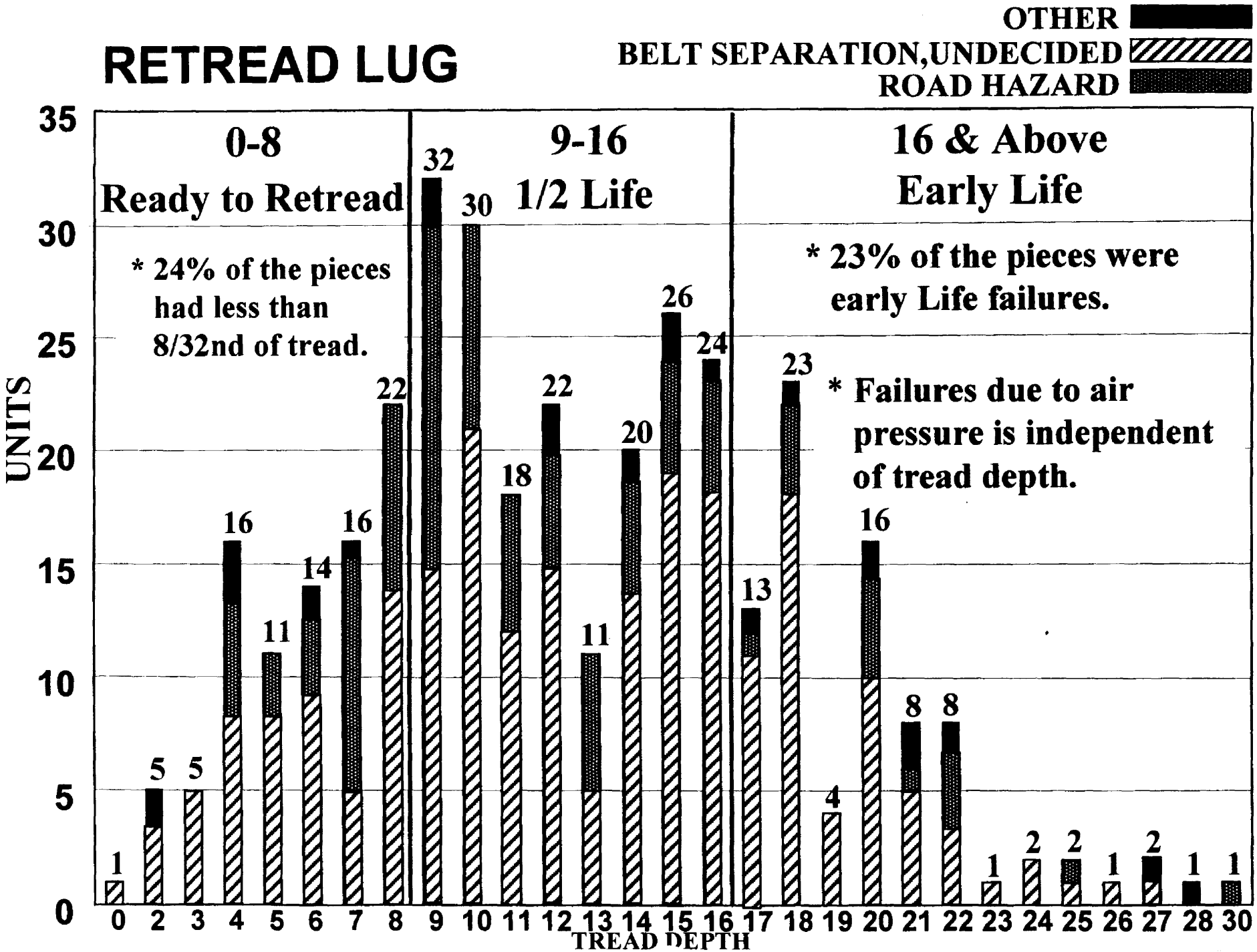



900
800
700
600
500
400
300
200
100
0
* 71% of the pieces inspected were Rib patterns.
This was down 2% from 1995.
* 26% of the original Rib tires experienced IW
142
95
38
29
RIB
LUG
1998 Retread
1995 Retread
1998 Original
1995 Original


ORIGINAL RIB
OTHER
BELT SEPARATION,UNDECIDED
ROAD HAZARD
0-6
Ready to Retread
* 27% of the pieces had less than 7/32nd of tread.
7-11
1/2 Life
12 & Above
Early Life
* Failures due to air pressure is independent of tread depth.
UNITS
TREAD DEPTH
0 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
8 2 6 5 7 11 17 18 11 11 7 9 3 2 1 1 6 1


RETREAD RIB
OTHER
BELT SEPARATION,UNDECIDED
ROAD HAZARD
0-6
Ready to Retread
* 17% of pieces had less than 7/32nd of tread.
7-11
1/2 Life
12 & Above
Early Life
* 39% Early Life Failures
* Failures due to air pressure is independent of tread depth.
UNITS
TREAD DEPTH
0 20 40 60 80 100 120
0 1 2 3 4 5 6 7 7.5 8 8.5 9 10 11 12 13 14 15 16 17 18 19 20 21
5 1 7 6 24 37 63 74 1 97 1 72 90 77 86 50 52 22 31 3 3 3


ORIGINAL LUG
OTHER
BELT SEPARATION,UNDECIDED
ROAD HAZARD
0-8 Ready to Retread
9-16
1/2 Life
16 & Above
Early Life
* 47% of the pieces had less than 8/32nd of tread.
* Failures due to air pressure is independent of tread depth.
UNITS
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
4 1 1 4 1 3 2 2 2 1 2 1 1 1 3 2 2 1
TREAD DEPTH
0 2 3 4 5 6 7 8 9 10 11 12 13 14 15 17 20 22


RETREAD LUG
OTHER
BELT SEPARATION,UNDECIDED
ROAD HAZARD
0-8
Ready to Retread
* 24% of the pieces had less than 8/32nd of tread.
9-16
1/2 Life
16 & Above
Early Life
* 23% of the pieces were early Life failures.
* Failures due to air pressure is independent of tread depth.
UNITS
TREAD DEPTH
0 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 30
0 5 10 15 20 25 30 35
1 5 5 16 11 14 16 22 32 30 18 22 11 20 26 24 13 23 4 16 8 8 1 2 2 1 2 1 1

CONCLUSIONS

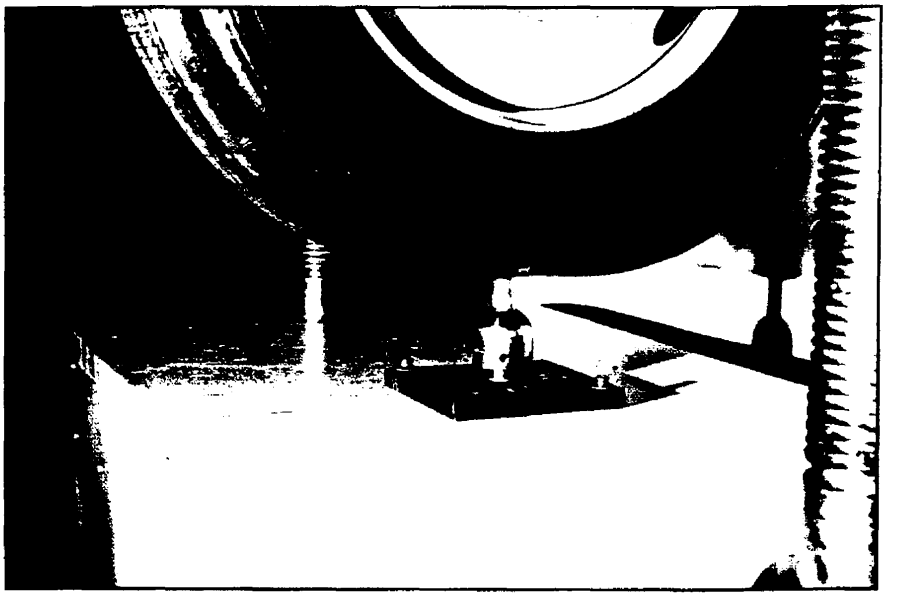
- 28% more pieces were inspected 1998 than 1995
- Truck tires inspected were up 28% while light truck is up 60% and passenger tires were up 16%
- Both original and retread pieces for truck were up from 1995
- Almost 90% of all the pieces inspected are the result of under inflation
- Repair failures have decreased
- Maintenance issues have increased
- Rib patterns represent over 70% of the pieces
- Remaining tread depth has a normal distribution curve
- 21% of the pieces inspected were off tires that were ready for retread evaluation

APPENDIX C

PLUNGER TEST STUDY

PLUNGER TEST STUDY

PART OF FMVSS 119 WHEEL TEST FOR ORIGINAL TRUCK TIRE CASING STRENGTH



RESEARCH PROJECT OF THE
AMERICAN RETREADERS' ASSOCIATION

1993

Index

	PAGE
OBJECTIVE	2
METHODOLOGY	3
SUMMARY OF FINDINGS	4
CONCLUSION	4

OBJECTIVE

This test was conducted to find the average breaking energy value for a specific retreaded radial truck tire casing in order to determine whether the original casing strength is maintained after retreading.

METHODOLOGY

One retreaded tire was subjected to the strength or plunger test, which is part of the Federal Motor Vehicle Safety Standard 571.119 code of federal regulations which applies to all new truck tires. The retread was randomly picked from the inventory of Community Tire Retreading Co. Inc. of St. Louis, Missouri. It was an 11R24.5 load range H, 16 ply rating highway tread design, all steel casing model 943 Hercules, produced by Kumho. The tire was visually inspected for possible defects or structural damage, numbered, and the information was recorded for future reference.

The tire was then shipped to Standard Testing Laboratories in Massillon, Ohio. The ARA technical staff authorized the test in accordance with the FMVSS 119 procedures. After installing the inner tube, the tire was mounted on a model rim assembly and inflated to the maximum load rating of the tire. After conditioning the tire in accordance with FMVSS 571.119 S7.1.2., a cylindrical steel plunger with a hemispherical tip 1-1/2" in diameter was forced into the center of the tread at a rate of 2 inches per minute.

According to the test procedures, the plunger continues to penetrate until the tire breaks or the plunger is stopped by the rim. The force and the distance of penetration is recorded just as the tire breaks or just before the plunger is stopped by the rim. This process is repeated every 72 degrees around the circumference of the tire. The static breaking energy is monitored and an average of the five points must exceed the minimum 18,500 inch pounds for this particular tire to be acceptable. The breaking force or energy value changes for every different load range, type of tire and specific size.

Tire breakage at point of penetration

SUMMARY OF FINDINGS

To compute the breaking energy force, the following formula was used:
(Load x Deflection / 2) = Breaking Energy

Test results are as follows:

Point	Load	Deflection	Energy at Breaking
1	11,850 #	5.46"	32,351" lbs.
2	12,100 #	5.50"	33,275" lbs.
3	11,800 #	5.40"	31,860" lbs.
4	12,650 #	5.84"	36,938" lbs.
5	13,500 #	5.70"	38,475" lbs.

Test Tire Average:	34,580" lbs.
FMVSS Required Minimum:	18,500" lbs.

FMVSS 119 requires the tire to resist 18,500 inch pounds of energy. The tire in this test resisted, on average, almost 1.9 times the required force before breaking. It can be concluded, therefore, that the integrity of the casing was far greater than necessary to pass the test. (Different casings can and will vary in strength depending on the belt material used and the construction of the tire.)

CONCLUSION

The ARA is pleased to report to the retreading industry that tire body strength in the belt package area of this retreaded tire maintained its integrity after retreading. The force required to break the tire was nearly 1.9 times greater than required by FMVSS 119.

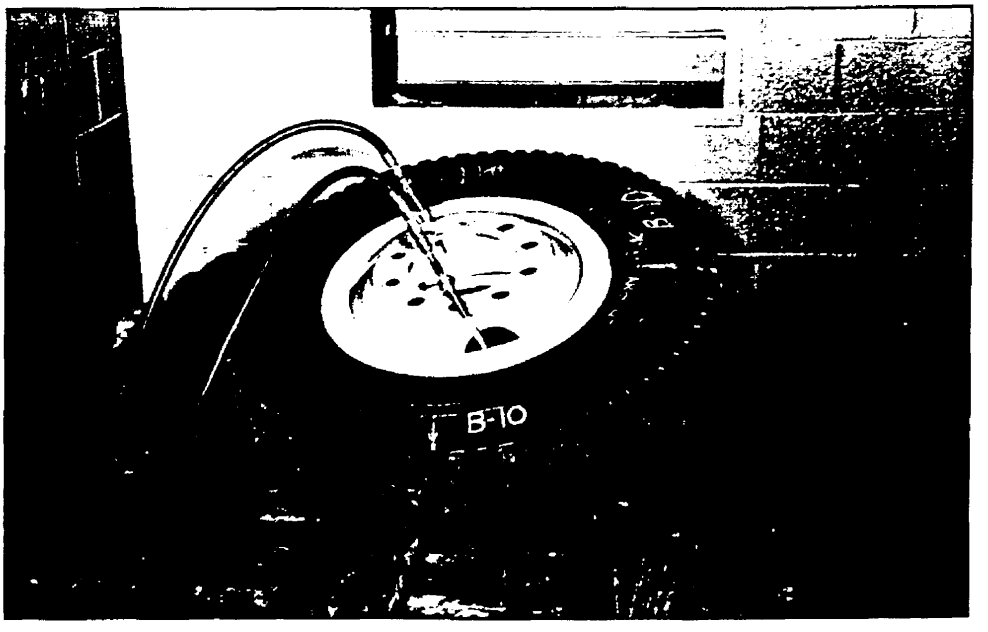
The American Retreaders' Association is pleased to offer this research report for the benefit of the tire and transportation industry.

APPENDIX D

BURST STRENGTH STUDY

BURST STRENGTH STUDY

NEW VS. WORN
RADIAL TRUCK TIRES



RESEARCH PROJECT OF THE
AMERICAN RETREADERS' ASSOCIATION

1993

Index

	PAGE
OBJECTIVE	3
METHODOLOGY	3
SUMMARY OF FINDING	4
CONCLUSION	5
APPENDIX	6

OBJECTIVE

To measure the burst strength of worn low-profile radial truck tires compared to new low-profile tires, in order to determine whether the integrity of worn casings remains equal to or changes in strength compared to new tires.

METHODOLOGY

Thirteen worn, retreadable radial truck tires from various tire manufacturers were selected to provide a typical cross section of low profile radial tubeless truck tires. The tires were of relatively recent production in sizes 295/75R22.5 and 275/80R22.5. The production dates varied from 360 to 033.

On the basis of visual inspection, these tires were determined to be free of structural damage or defects other than tread wear. They were then numbered and recorded for future reference.

Three new tires were donated by the manufacturers as control tires. These tires were also low profile, in sizes 295/75R22.5 and 275/80R22.5.

All sixteen tires were shipped to Standard Testing Laboratories in Massillon, Ohio, where they were tested according to procedures written by the ARA technical staff.

The tires were tested by mounting and hydrostatically bursting them using pressurized water. Pressurization with water is very even and accurate, and it is the safest method to determine the integrity of any type of container. Using photographs and videos of the procedures, the burst pressure and type of failure were recorded for each tire. Burst pressures are accurate to ± one psi.

SUMMARY OF FINDINGS

Samples	Mean burst pressure (psi)	Standard deviation (psi)	Failure Mode	
			Broken beads (Figure A)	Distorted beads (Figure B)
13 worn radial truck tire casings	456	72	7	6
3 new radial truck tires	400	115	3	-

The following results compare mean burst pressure of the worn tires to the equivalent new tire controls:

Mean burst pressure—worn: 456 psi
Mean burst pressure—new: 400 psi
Average deviation—new to worn: + 56 psi

From these results, it must be concluded that the strength of these two samples are very similiar. The worn tires, which are typical of those selected for retreading, do not show any loss of strength as a result of previous use.

This study, similar to the 1978 and 1988 studies conducted by ARA, shows the influence of various factors in tire design and clearly finds that burst pressures obtained on the worn tires were equal to or better than those obtained on similar new tire samples. Following is a brief discussion of a possible reason for that finding.

One would anticipate a slight reduction in cord strength over the life of a tire due simply to fatigue effects from low air pressure and overloads which tend to degrade the tensile strength of the material. On the other hand, it is known that, due to "material creep effect," the load on individual cords tends to equalize as the tire runs over a period of time. In new tires, certain parts of the cord may be heavily loaded while other parts are only lightly loaded. As the tire slowly matures and takes a set (or "creeps"), this situation is corrected. These factors—*material fatigue vs. material creep effect*—tend to counteract each other, and may, as was the case in this study, result in an improvement in tire strength as the tire wears.

During this study, it was presumed that construction methods and materials remained essentially constant between the new tires and the worn tire samples. The study shows that the low profile tire maintains strength which, in turn, contributes to good retreadability and casing integrity. However, since compounds and constructions often change in the tire industry, the burst strength of other types and sizes of tires may vary.

CONCLUSION

In this study, tread wear did not diminish the strength of low-profile radial truck tire casings compared to new tires.

Although similar to tests of 1978 and 1988, the ARA is pleased to report to the tire and transportation industries that the residual body strength in worn tires is at least equal to that of new tires, and in some cases actually improves with time. In comparison to the 1988 study of the 11R22.5 conventional radial size, we see no significant loss or increase in strength.

Initial attempts to burst these tires resulted in the destruction of several standard truck rims. It was necessary to have specially reinforced rims constructed in order to complete this test.

Fig. A Bead Break

Fig. B Bead Distortion

The American Retreaders' Association is pleased to offer this research report for the benefit of the tire and transportation industries.

APPENDIX

SUMMARY OF THE RADIAL TRUCK TIRE BURST STRENGTH TESTS

CONDITION	TEST #	LOAD RANGE	TYPE FAILURE		P.S.I BURST PRESS.
NEW	ARA2-35 B2	G	BEAD BREAK	OSS	515
NEW	ARA3-1 B17	G	BEAD BREAK	OSS	320
NEW	ARA3-4 B14	G	BEAD BREAK	OSS	365
USED	ARA2-37 B4	G	BEAD BREAK	OSS	460
USED	ARA2-38 B5	G	BEAD BREAK	SS	520
USED	ARA2-39 B6	G	BEAD DISTORTION	SS	500
USED	ARA2-40 B7	G	BEAD BREAK	OSS	520
USED	ARA2-41 B8	G	BEAD BREAK	SS	520
USED	ARA2-42 B9	G	BEAD DISTORTION	SS	518
USED	ARA2-44 B1	G	BEAD BREAK	OSS	540
USED	ARA2-45 B12	G	BEAD DISTORTION	OSS	480
USED	ARA2-46 B13	G	BEAD DISTORTION	OSS	460
USED	ARA3-5 B15	G	BEAD DISTORTION	SS	390
USED	ARA3-6 B16	G	BEAD DISTORTION	SS	380
USED	ARA3-2 B18	G	BEAD DISTORTION	OSS	300
USED	ARA3-3 B19	G	BEAD DISTORTION	SS	350

SS = Serial side
OSS = Opposite serial side

APPENDIX E

TIRE DEBRIS PHOTOGRAPHS AND INFORMATION

Exhibit #1 was a new passenger car or light truck tire, approximately 4-5 years old. Tread depth was 3/32 inch and reason for failure was not apparent.

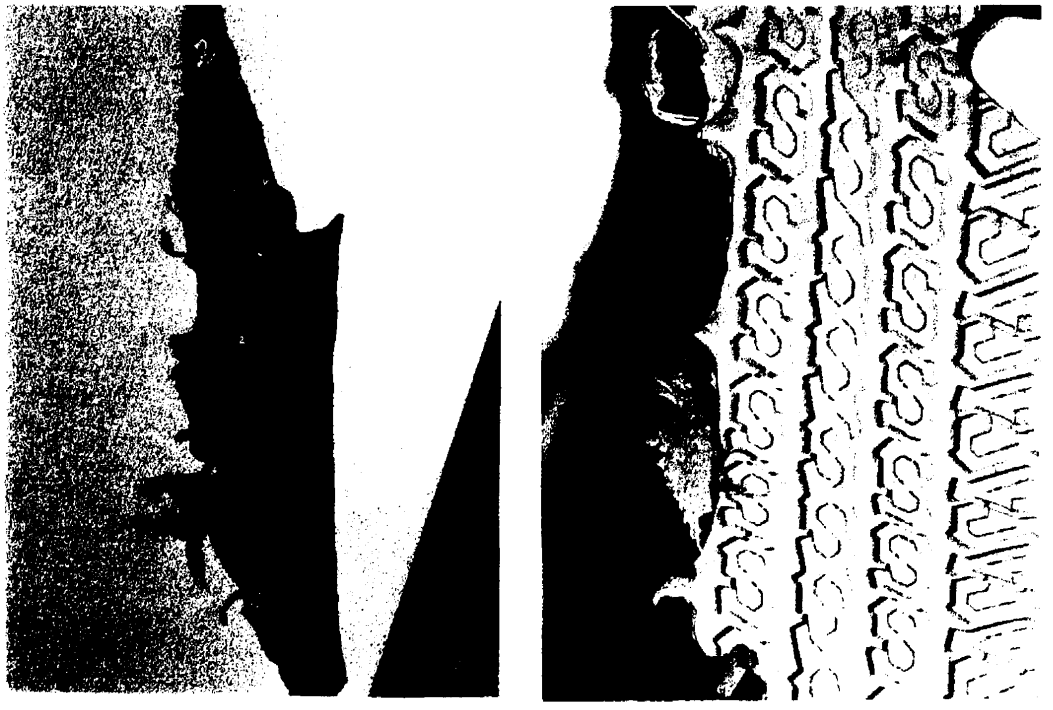


Exhibit #2 was a new passenger car or light truck tire, which could have been on a small trailer. The tire had minimum miles, and the tread depth was 10½/32 inch. Reason for failure was not conclusive, but indications made it more than likely the tire had insufficient air pressure.

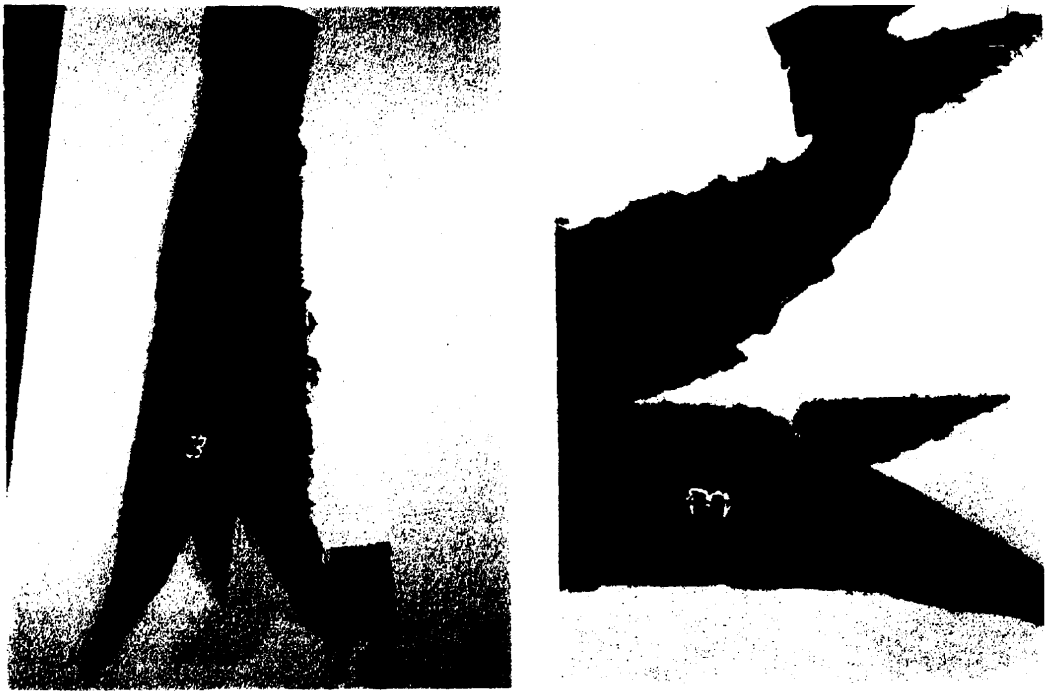


Exhibit #3 was a new passenger car or light truck tire that had probably been used as a spare tire for some period of time. The tire was 4-5 years old, and the tread depth was 3/32 inch. The rubber was deteriorated from age and weather.

Exhibit #4 was a new light truck tire that was 3 years old or less, and the tread depth was 8/32 inch. There was not enough tire left to be conclusive, but the small pieces have evidence that indicate insufficient air pressure.

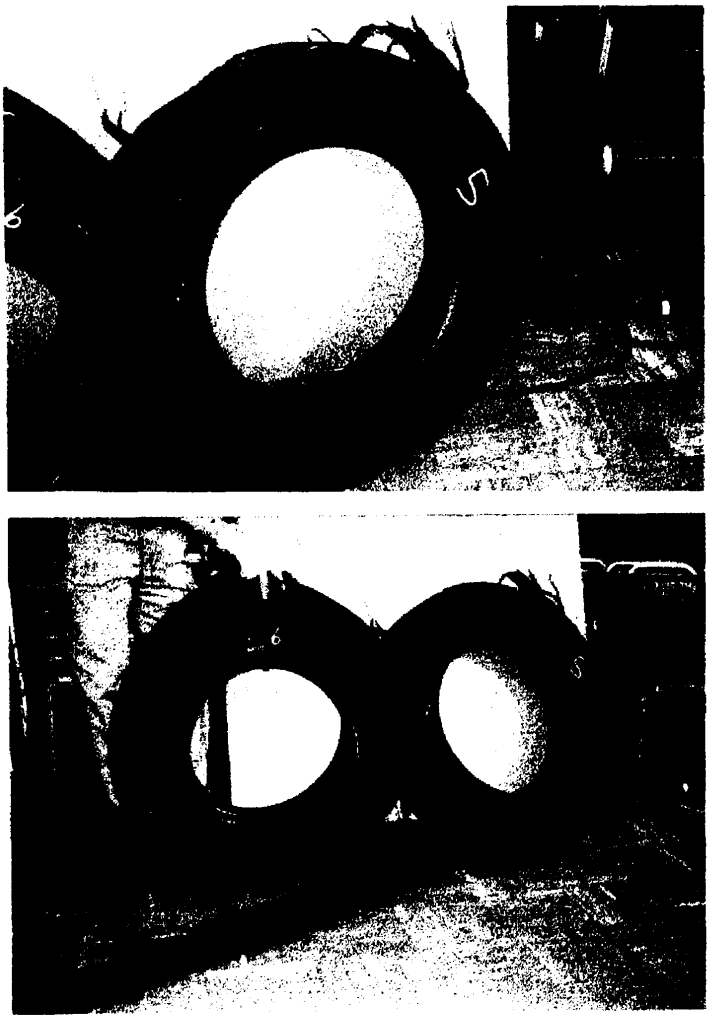


Exhibit #5 and #6 were new light truck tires that appeared to have been on the dual wheels of a motor home. The size of both tires was 8R 195, and the tread depth of #5 was 12/32 inch and #6 was 11/32 inch. Evidence indicated tire #6 was on the inside of the dual and went flat. Additional stress heated tire #6 until tire #5 was also destroyed. Both tires were changed beside the roadway and the old rubber was abandoned.

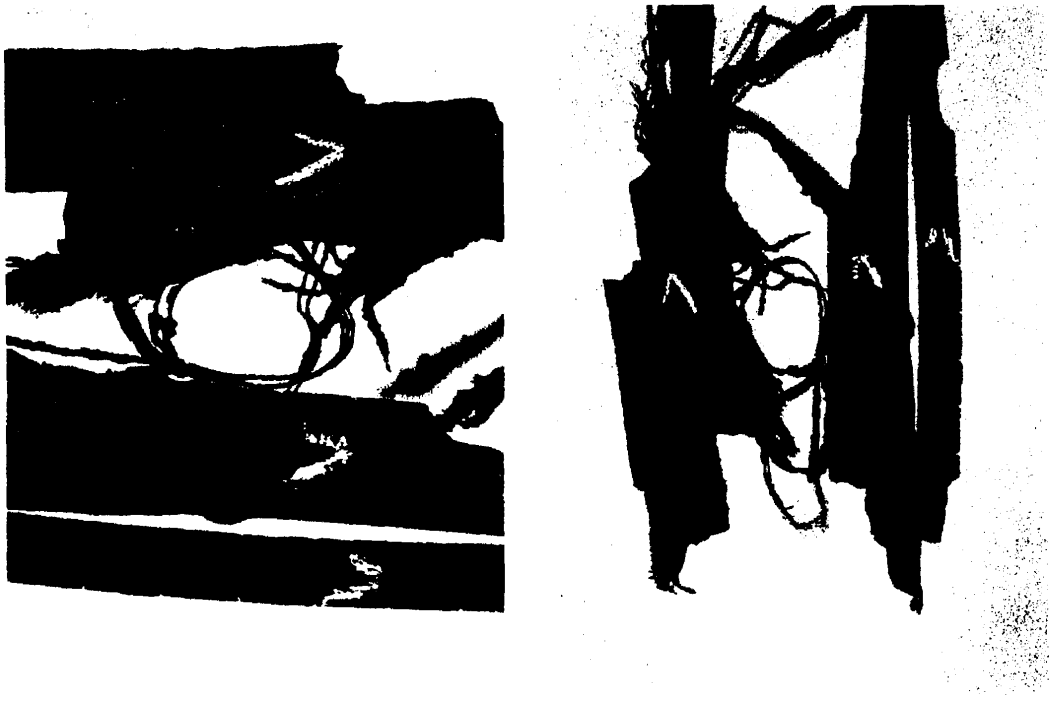


Exhibit #7 was a new medium duty Goodyear trailer tire with 11/32 tread depth. Original tread depth was 12/32 inch. There was not enough evidence to determine the exact cause of failure, but air pressure had to have been lowered for the tire to come apart. Reason for low pressure cannot be determined from the sample.

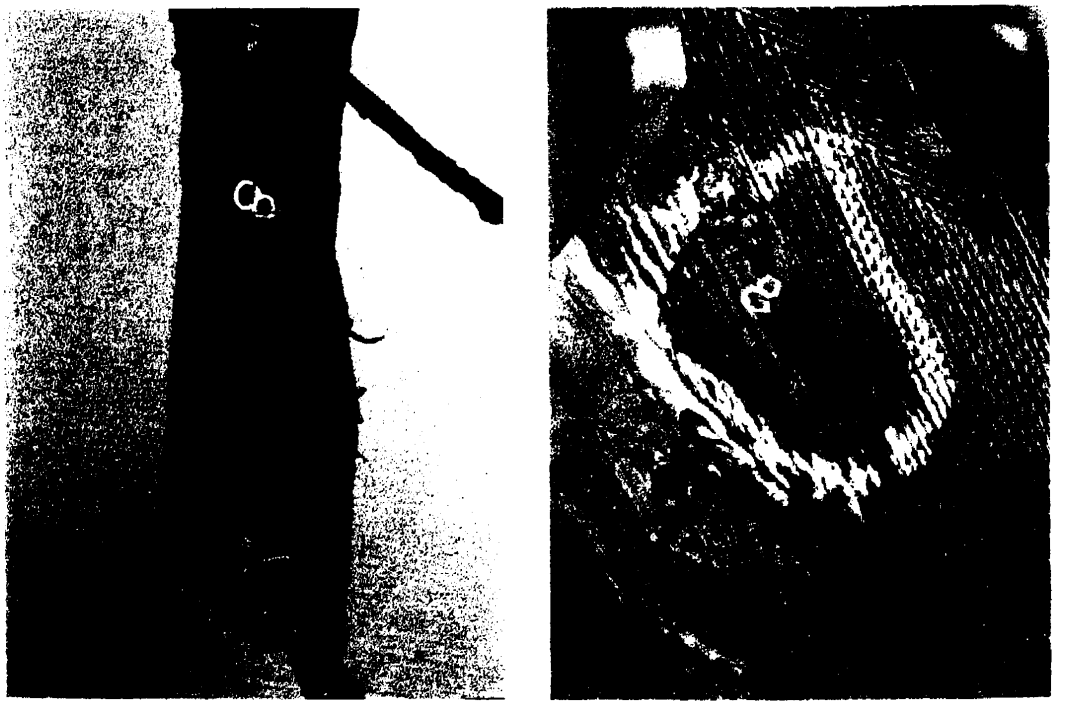


Exhibit #8 was a retreaded trailer tire with 9/32 inch tread remaining. Cause of failure was determined to be a puncture. The retread did not come off the casing, and the failure had nothing to do with the tire being a retread.

Exhibit #9 was a new retread with less than 20 miles traveled that had 15/32 inch tread depth. This tire came apart as the result of manufacturer's human error. The casing had a nail hole which was apparently missed during inspection prior to recapping, and the retread came off the casing immediately upon reaching travel heat levels.

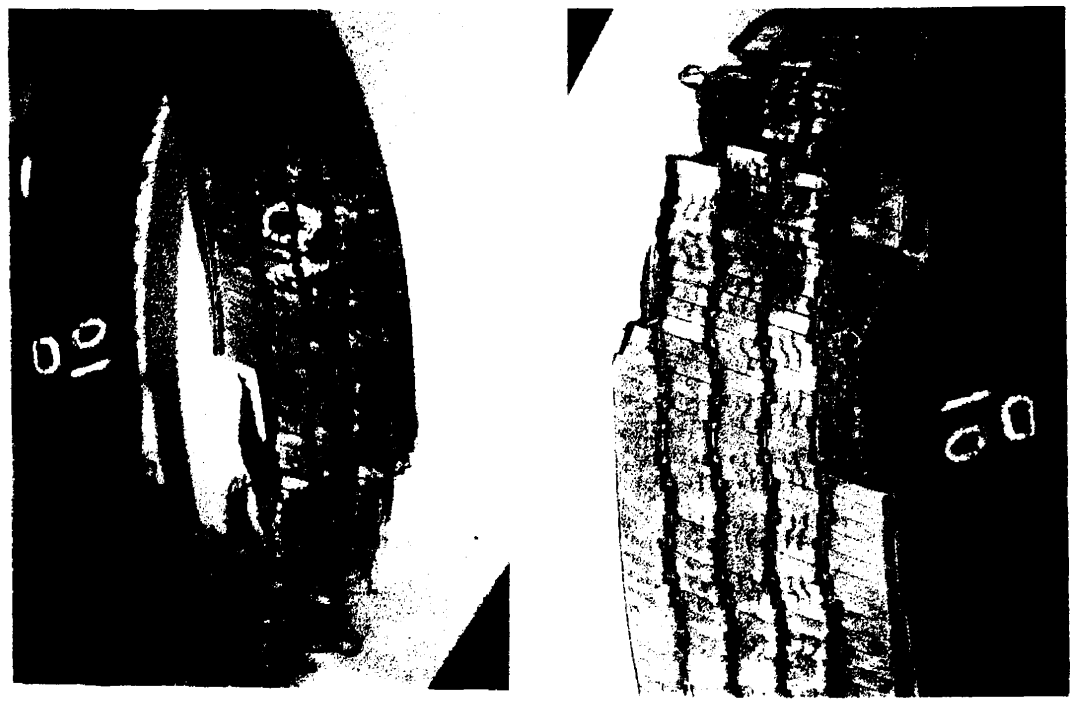


Exhibit #10 was a retreaded trailer tire with 12/32 inch tread depth. Original tread depth was 15/32 inch. A nail hole caused the tire to lose air pressure, and the tire overheated. The retread did not come apart, and the belt package was still intact.

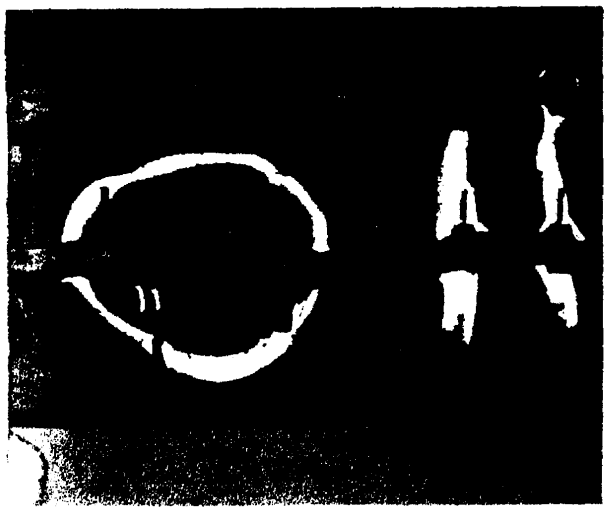


Exhibit #11 was a new retreaded trailer tire with 13/32 inch tread depth. A road hazard, such as a nail hole caused the tire to lose air pressure, and the tire overheated. The retread did not come apart, and the belt package was still intact.

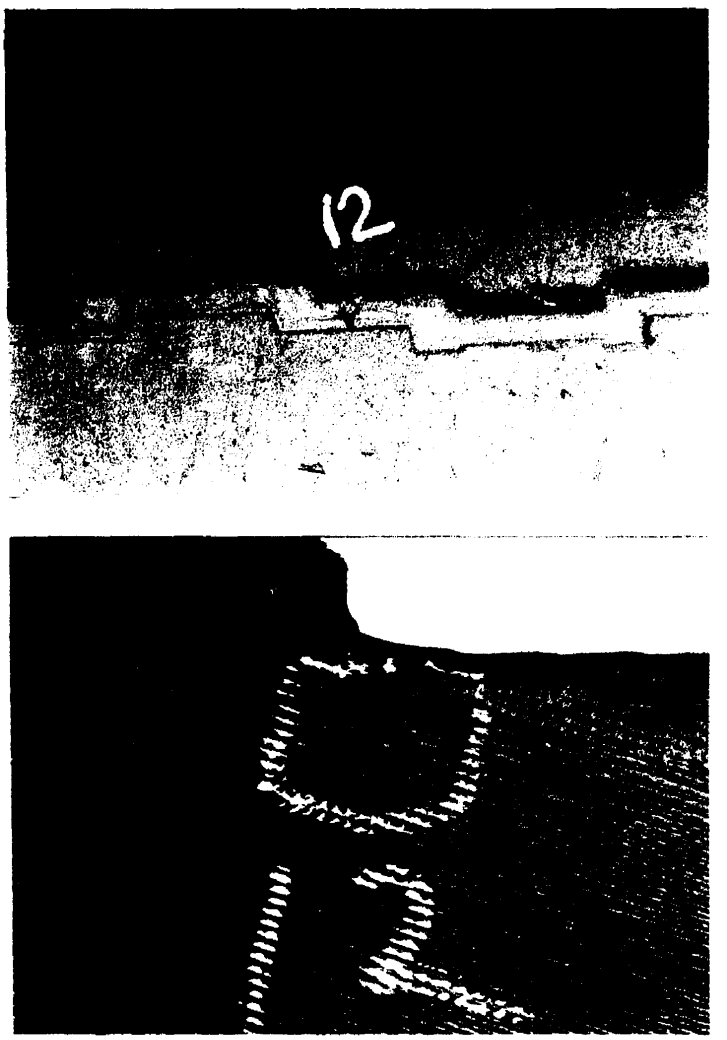


Exhibit #12 was a retreaded trailer tire with 5/32 inch tread depth. A road hazard, such as a nail hole was observed, but positive determination could not be made as to the reason the tire lost air pressure. The retread did not detach from the casing, and the belt package was still intact.

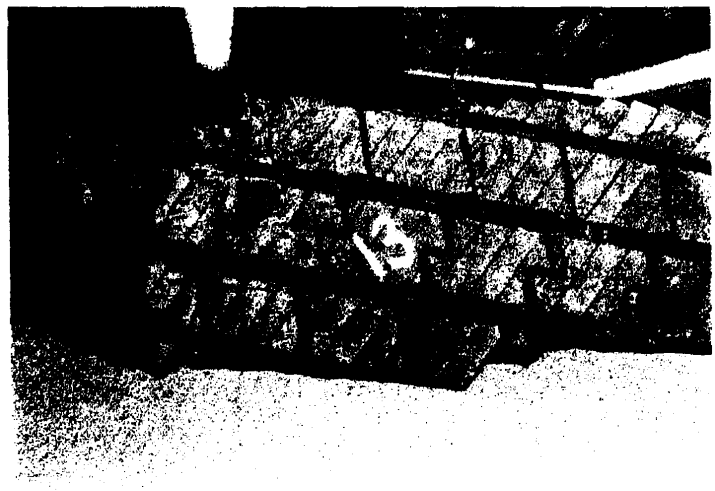


Exhibit #13 was a retreaded trailer tire with 8/32 inch tread depth. The original tread depth was 12/32 inch. There was not enough debris to determine cause of failure. The belt and retread were still together, and the failure occurred in the casing, as opposed to the retread.

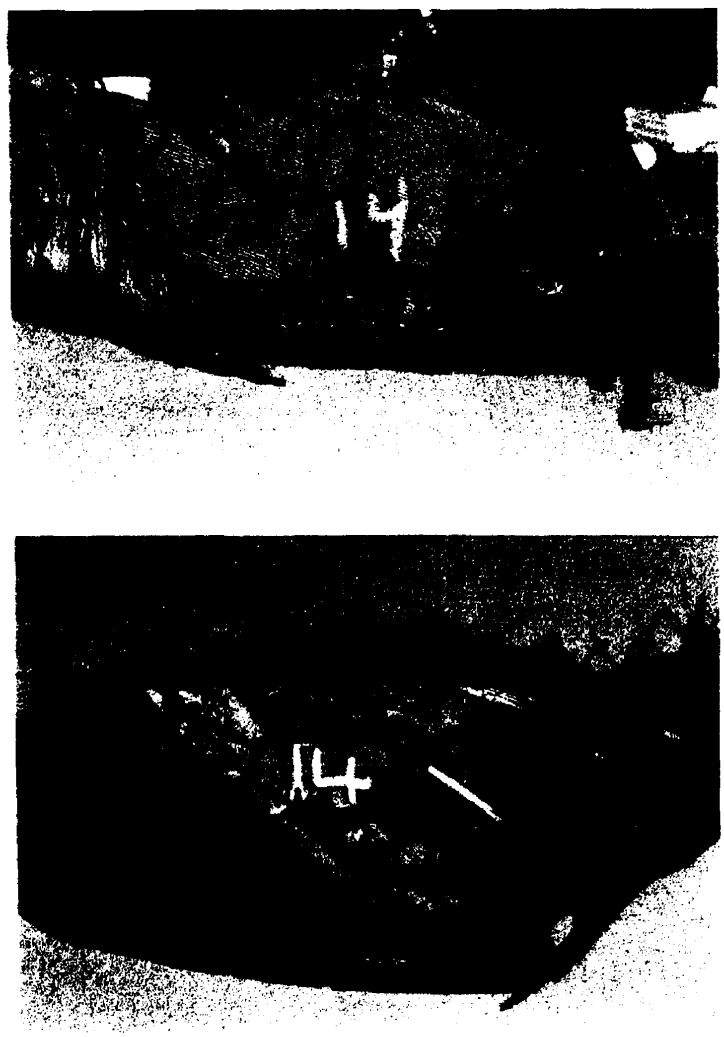


Exhibit #14 was a retreaded trailer tire with 8/32 inch tread depth. There was not enough debris to determine cause of failure. The belt and retread were still together, and the failure occurred in the casing, as opposed to the retread.

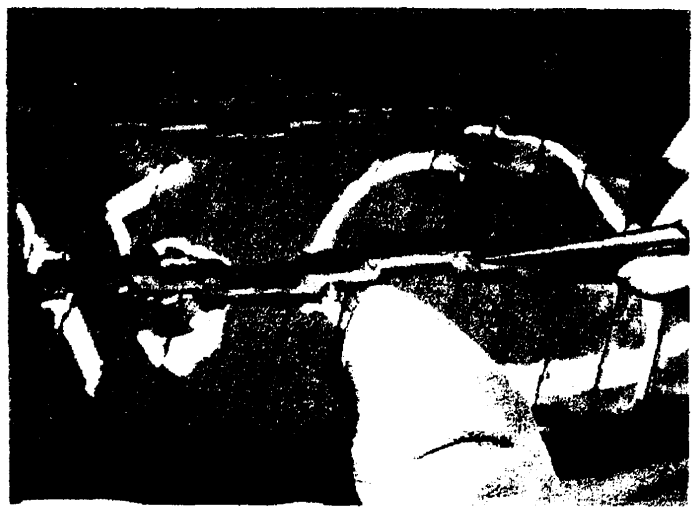


Exhibit #15 was a retreaded trailer tire with 9/32 inch tread depth. The original tread depth was 15/32 inch. A puncture caused the tire failure, and the belt and retread were not separated.

Exhibit #16 was a retreaded medium duty truck tire that would have been on the drive axle of the truck. The tire was almost new, with 18/32 inch tread depth. Cause of failure was a puncture through the tire, and the retread did not separate from the casing.

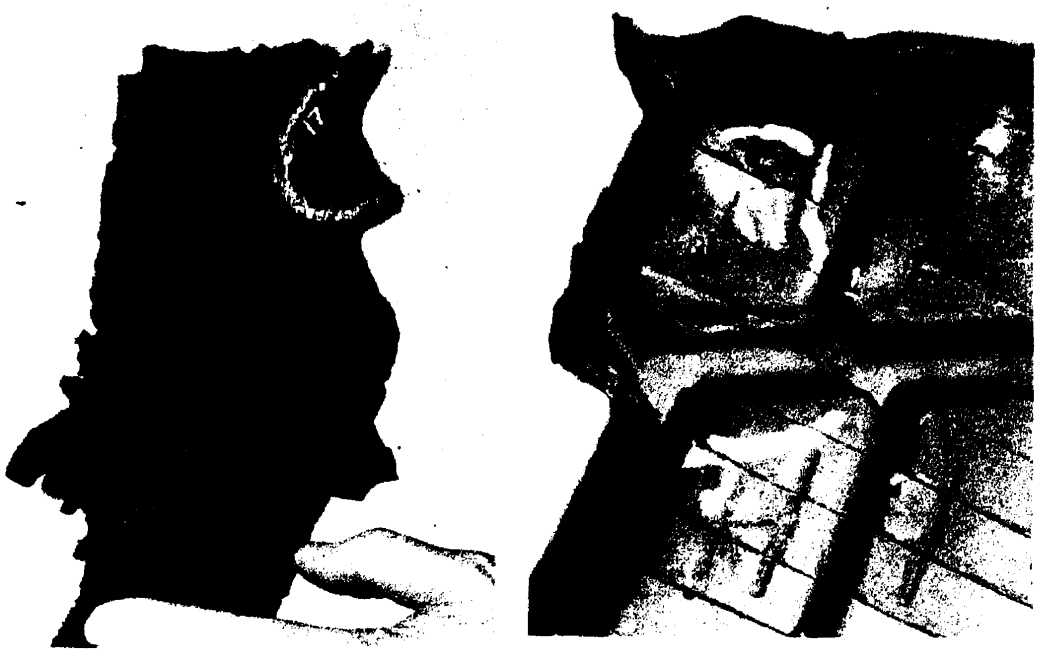
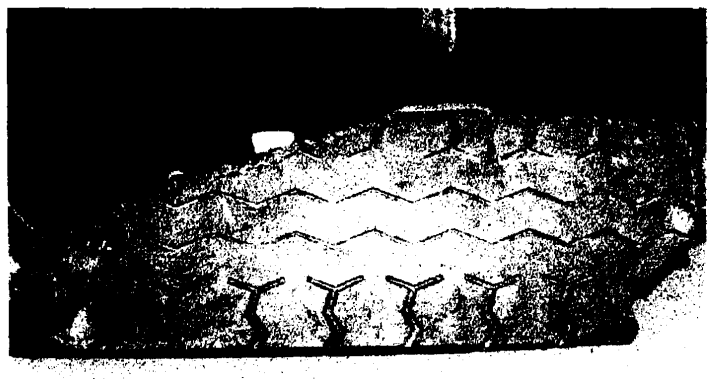


Exhibit #17 was a retread medium duty truck tire that was almost new, with 18/32 inch tread depth. Cause of failure was a puncture bolt hole through the tire, and the retread did not separate from the casing.

Exhibit #18 was a retread medium duty truck tire that had 9/32 inch tread depth. Cause of failure could not be determined, and the retread did not separate from the casing.



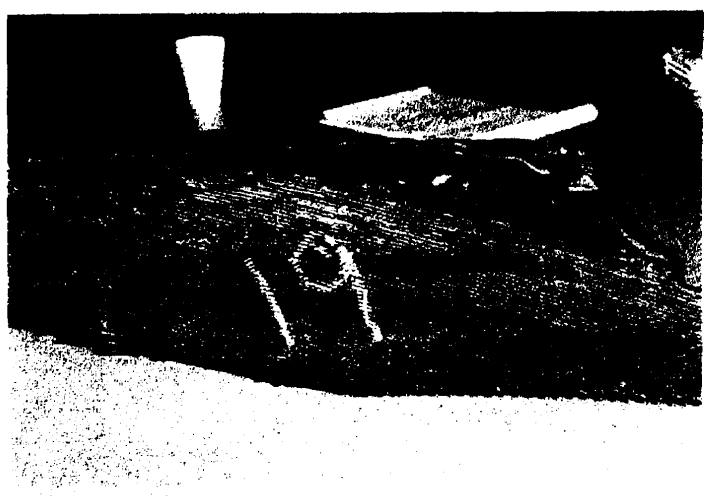


Exhibit #19 was a retread medium duty truck tire that had 6/32 inch tread depth. Cause of failure could not be determined, and the retread did not separate from the casing.

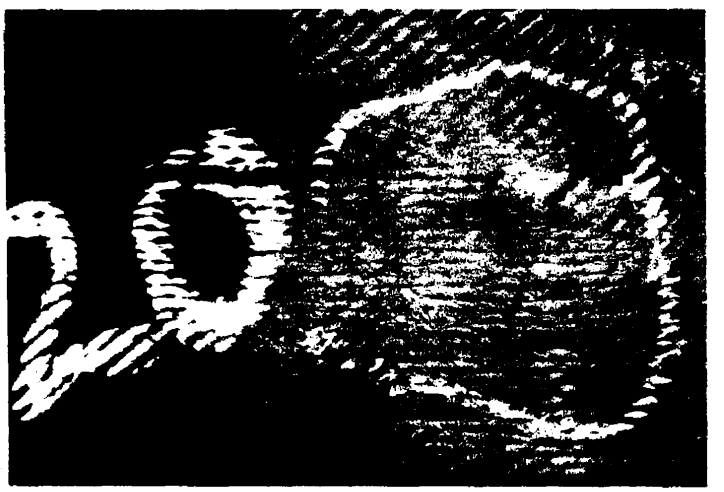
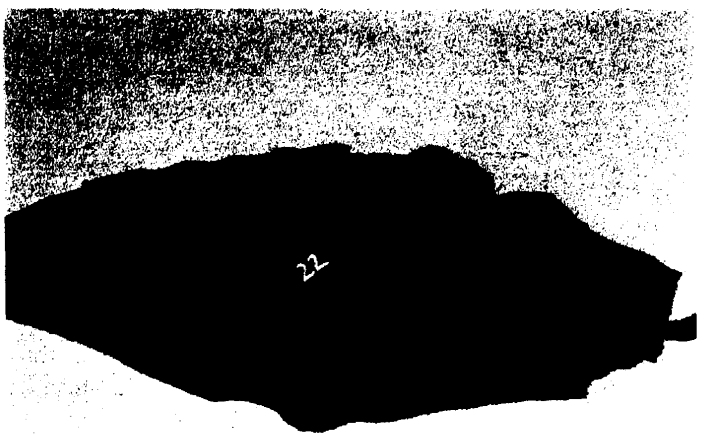
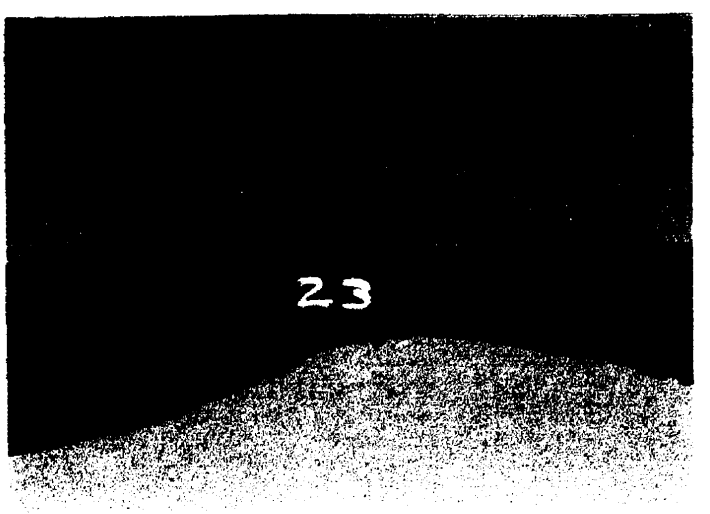


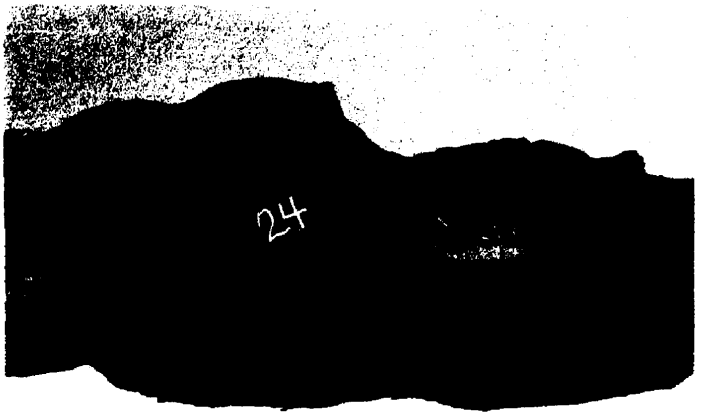
Exhibit #20 was a portion of a belt package only. It had been a retread tire and had a puncture hole. With only a number of belt sections, the tire type could not be determined.

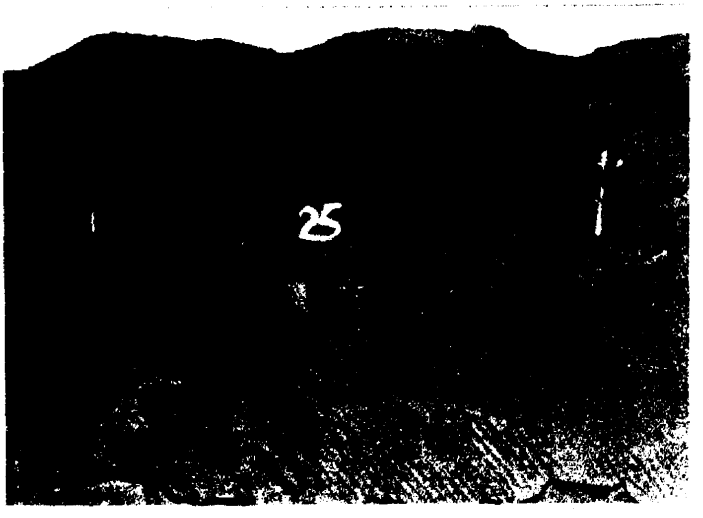
Exhibit #21 was a nylon bias/ply tire with no belts. It is the type usually found on containerized trailers, referred to as Intermodal, that are used to transfer containerized loads from one mode of transportation to another. This was a heat-generated blowout, but due to lack of additional materials, there was no way to determine tread depth. This tire may or may not have been a retread.



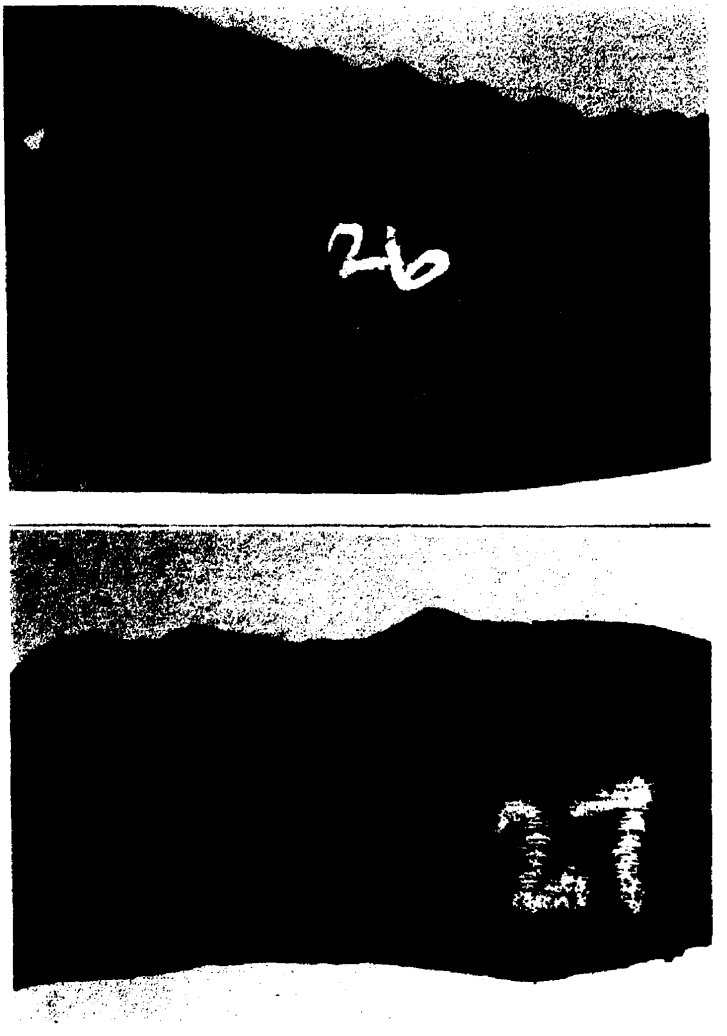


Exhibits #22 and #23 came from a group of seven different tires, with at least five of them being the type usually found on containerized trailers, referred to as Intermodal, that are used to transfer containerized loads from one mode of transportation to another. The tires were not radial and were cheap casings. Of the seven, five were retreads, one was new, and one could have been either. Three of the tires had been recapped twice.





Exhibits #24 and #25 came from a group of seven different tires, with at least five of them being the type usually found on containerized trailers, referred to as Intermodal, that are used to transfer containerized loads from one mode of transportation to another. The tires were not radial and were cheap casings. Of the seven, five were retreads, one was new, and one could have been either. Three of the tires had been recapped twice.



Exhibits #26 and #27 came from a group of seven different tires, with at least five of them being the type usually found on containerized trailers, referred to as Intermodal, that are used to transfer containerized loads from one mode of transportation to another. The tires were not radial and were cheap casings. Of the seven, five were retreads, one was new, and one could have been either. Three of the tires had been recapped twice.