

FRANK A. LOBIONDO
2ND DISTRICT, NEW JERSEY



REPLY TO:

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Congress of the United States
House of Representatives
Washington, DC 20515-3002

August 14, 2003

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TACTICAL AIR AND LAND FORCES

Dr. Jeffrey W. Runge
Administrator
National Highway Traffic Safety Administration
400 7th Street SW
Room 5220
Washington, D.C. 20590

Dear Dr. Runge:

I have received the enclosed information from [REDACTED]
[REDACTED] of Ocean City, New Jersey, regarding his concern about
brake line corrosion on his Lincoln Town Car.

I would appreciate your assistance in reviewing this matter,
and your providing me with any information that will enable me to
respond to Mr. [REDACTED]. If you have any questions, or need
further information, please contact my staff assistant, Pat
Poole, in my Mays Landing district office.

Thank you for your help, and I look forward to hearing from
you soon.

Sincerely,

Frank A. LoBiondo
Frank A. LoBiondo
Member of Congress

FAL/pmp
enc

EXECUTIVE SECRETARIAT
2003 AUG 21 P 2 44
NATIONAL HIGHWAY
TRAFFIC SAFETY ADM.

[REDACTED]
[REDACTED]
OCEAN CITY NJ [REDACTED]

The Honorable Frank LoBiondo
House of Representatives
U.S. Congressional House Office Bldg.
Washington, D.C.

July 12, 2003

Dear Representative LoBiondo : RE; Transportation Safety Matter

I have enclosed Letters of correspondence and some-technical material regarding a Serious Matter concerning BRAKE LINE CORROSION on my Lincoln Town Car. The details are spelled out in these letters that I have sent and/or received from Ford motor Co. to the attention of Mr. William Ford, Jr., CEO. and were mailed certified return receipt. I trust that when you review this material that you will understand that my efforts are about the safety of the lives of others on the highways, and are not about money. Ford Motor has been very indifferent in their attitude to these concerns.

I have spent a great deal of time in researching this problem. If you look at some of the technical information, you will find that the type of materials used in brake lines has been a source of great interest in the Automotive Industry. you will also find that there have been some some RE-CALLS of their products in recent years due to this problem.

My sincere concern for this issue after my "Near Miss" in August of 2002 and Ford Motor's apparent dis-concern prompted me to write a letter to the Director of the National Highway Transportation Administration on May 25, 2003 which spelled out all of the details of my experience. I had previously contacted the NHTSA by e-mail on 02/10/03 (ID # 02vio1000) and after getting no reply from them, I wrote to the Director of NHTSA. I still have not gotten any reply from either of the two parties. I have enclosed a copy of my letter to the Director to you. I realize that you are very busy and we are very pleased to hear that you are going to represent our District again in the coming elections. I want to thank you in advance for your interest in this matter, and if even one life is saved, I will feel that my persistent efforts, time and money will be worthwhile.

Sincerely yours
[REDACTED]

P.S. My phone # [REDACTED]
my e-mail is [REDACTED]

RECEIVED

JUL 21 2003

Frank A. LoBiondo, NC

[REDACTED]
Ocean City, New Jersey [REDACTED]

National Highway Transportation Admin.
U.S. Dept. of Transportation
400 7th street
Washington, D.C. 20590

Attn. Office of the Director
May 25, 2003

Dear Director: Re: NHTSA ID # 02V101000

Several months ago I notified the NHTSA of a potentially serious problem that I experienced with my Lincoln Town Car (1996 Model)

Briefly, I experienced a SUDDEN BRAKE LINE Failure just prior to entering a major Interstate Highway (I-295) in South Jersey. I have maintained and serviced this car diligently, but this problem is not something that is apparent to the eye under normal circumstances. The car had 61920 miles on it. Upon inspection it was found that brake fluid was all over the rear housing as a result of pin holes that were in the crossover line from from the left to the right wheel cylinders. My brake pedal went to the floor very suddenly. If I had been on I-295 which is a heavily travelled and high speed highway and if I had to use my brakes it could easily have been a multi-vehicle disaster.

I have had much correspondence with Ford Motors Headquarters but they have refused to disclose what measures, if any, that they have taken to address this issue. In the interest of preventing a major disaster, if there have not been any to date. Their responses to my many inquiries have been bluntly negative and based strictly upon the monetary concerns.

I have not had any reply to my report to your Department several months ago as to whether or not NHTSA has taken any action in this matter. I have enclosed a few bits of information on Brake Line Corrosion from the Internet. There is a lot more available and it seems that this issue has been the subject of a great deal of study and discussion. It really comes down to whether the auto mfg. uses low-carbon steel which is the cheapest; or alloys or coatings which are readily available but are corrosion-proof. The foreign car mfgs. use alloys which may cost a little more but provide a great deal more safety to all of our drivers. I also have a 1995 Toyota Camry with over 90,000 miles and it shows no sign of deterioration.

Thank you for your attention to this matter, and I look forward to your reply after you have had the opportunity to look into it. I have spent much time on this issue along with more than \$500.00 to resolve it; but my main objective is for my safety and the safety of others.

My phone # is [REDACTED]
my e-mail address is [REDACTED]

OCEAN CITY NJ

Ms. Heidi Tidman; Claims Supervisor
Ford Motor Customer Claims
P.O. Box 224688
Dallas, TX. 75222-4688

November 25 2002

Dear Ms. Tidman RE: Claims # 77643205

I am replying to your letter dated November 13th rejecting my above referenced claim for "Expired Membership" of my ESP. Please be advised that my claim was not for a worn part, but rather for a very serious defect just eight weeks following the expiration of my ESP by only eight weeks, but still well under the 75,000 miles.

I have had considerable correspondence with the Lincoln-Mercury Division regarding this potential GRAVE LIABILITY PROBLEM for the Ford Motor Co. I have suggested that they consider using a special alloy or stainless steel for a so vital part that is hidden from normal maintenance.

To date, their reply has been non-existent and yours only wants to address the monetary aspect of this. No one seems concerned about the real possibility of fatal accidents due to the CORROSION of the Brake Line. This is NOT a defect that just happened to occur after 6/24, the expiration date of my ESP. I have retained the defective line which is filled with tiny pin holes from corrosion. This corrosion problem, obviously had to begin and worsen long before it failed completely on 8/21 when the brakes suddenly gave out and my brake pedal went to the floor. It was very fortunate for my wife and me that it did not happen about ten minutes later when we would have entered Interstate 295 in South Jersey which is a heavily trafficked high speed road. With the sudden brake failure we experienced, it easily could have caused a catastrophic multi-car accident with several deaths and/or injuries

As I mentioned, this corrosion had to start many months before it gave out. We also own a 1995 Toyota Camry which I hurriedly took to a repair shop for an inspection of that brake line and we found no evidence of corrosion.

Yes, I feel very strongly that I should be compensated for my expenses, but I am more concerned that Ford Motor Co. is not showing any concern for the life and safety

of other owners and travellers whose lives are jeopardized by this unrecognized problem. I have written to the President of the Lincoln Division but I was advised that he is no longer with the company. I followed with a letter addressed to a Mr. Charles Conrad but it was returned to me unopened with an attached note stating that he also had left the Ford Motor Co.

Ms. Tidman, to be very frank with you, I am tired of trying to alert Ford Motor to a very serious liability exposure. The only answers that I get are a denial of my claim based upon a flimsy technicality. I have not received any mention of remedial action on their part to protect unwary buyers of Ford products. I have been a steady buyer of Ford products since 1950, owning several Country Squire Station Wagons, Crown Victorias, and three Lincolns. I would have grave doubts about future purchases however, if this problem is not addressed. My next approach might be to contact the N.H.T.S.A. and alert them to this hidden failure for the protection of other present and future owners.

I look forward to your favorable reply to resolve this matter in the best interest of your company and its' customers as well as other travellers.

Sincerely,

A large black rectangular redaction box covering the signature and name of the sender.

Ford Motor Company

December 12, 2002

Mr. [REDACTED]
[REDACTED]
Ocean City, NJ [REDACTED]

RE: 1996 Town Car (VIN 1LNLM87W3TY[REDACTED])

Dear Mr. [REDACTED]:

Ford Motor Company considers the satisfaction of its owners to be one of its most important objectives. We commit very substantial resources and effort in a sincere attempt to resolve the concerns of our owners. However, limits must be placed on those efforts. We regret to advise you that your vehicle is beyond those limits and we are, therefore, unable to assist financially with the repair of your vehicle.

We are sorry that our response could not be more favorable to you. Thank you for contacting us. We appreciate the opportunity to review your concern.

Executive Offices
Ford Motor Company

*They still only address the merical
\$ money issue but nothing about
the real problem and threats
to life on unknowing owners of
these Ford Products and other
thousands of motorists on the
Highways.
Why did the Brake Line, Huddles
form normal wear, Corrode and fail
??*

[REDACTED]
[REDACTED]
OCEAN CITY NJ [REDACTED]

Mr. William Ford, Jr. CEO
Ford Motor Co.
P.O. Box 6248
Dearborn, MI 48126

January 23, 2003

Dear Mr. Ford : RE: Brake Line Corrosion
 A potentially serious liability problem.

First I would like to commend you for turning a profit in the 3rd Qtr. And seemingly, breathing new life into Ford Motor Co. As a stockholder in several Mutual Funds, I read with great interest the article concerning your aggressive strategy for improving the fortunes of Ford Motor Co.

As a retired former business owner and a corporate vice-president of another, I can sympathize with your efforts as was written in the November issue of FORTUNE. I know that you are very busy, but I have an issue that I feel is very important and that it should be brought to your attention.

Back in August, 2002, I was driving my 1996 Town Car when the brakes suddenly gave out. I had to get the car off the highway as quickly as possible and I saw a MIDAS shop and pulled in. The manager put the car on the lift and showed me that it was not a wheel cylinder, the entire rear housing and most of the axle were covered with brake fluid. He called the nearest Lincoln dealer and they did not have a replacement line in stock. This happened on a Friday afternoon about 3:30 and my wife and I were about 110 miles from home. We had to get a car rental from Enterprise. When he purchased a new cross-over line to replace mine he found that the line was filled with small pin holes from corrosion.

I have enclosed pertinent paperwork related to this and a copy of my letter to Ms. Tidman dated Nov. 25, 2002. I would hope that you will read the letter carefully since it refers to a VERY SERIOUS POTENTIAL LIABILITY for your Co. I have tried to alert three of your managers to this liability, but they just seem to want to address only the monetary issue, which is relatively minor, instead of the safety issue. My first letter was addressed to Brian Kelly, who I was told was no longer with Ford. My second letter was sent Charles Conrad and that was returned to me unopened. My main concern is that no one seems to want to address the real issue, and I have never received any answer as to Ford's thoughts on this matter. As I stated in my letter to Ms. Tidman, I would be very reluctant to consider remaining a Ford customer after 42 years, and I would feel obligated to convey my feelings to my grown children, friends and neighbors, not for any spite, but as advice for their safety.

I still have the corroded line in my possession if any one is interested in it.
Thank you for your anticipated interest in this matter.

Sincerely,
[REDACTED]

My phone # [REDACTED]; Fax [REDACTED]; my e-mail [REDACTED]

✓

AUTOMOTIVE**Copper-Nickel Automotive Vehicle Brake Tubing**

In this document: Automobile Life-Expectancy, Worldwide Data On Wear, Added Cost of Coatings, The Move to Copper-Nickel Tubing, The Right Tubing for the Job, Disclaimer

A vehicle's braking system is as crucial to a vehicle's performance as its engine and drive train. The tubing carrying pressurized air or fluid through the system is the vital link between master cylinder and slave cylinders at the wheels.

Brake system tubing is vulnerable to the pressures of air or fluid flowing through it, to corrosion from road mud and salt, and to damage of any protective coatings on its surfaces from stone pecking where it is exposed under the chassis.

Prior to 1930, copper and brass, having excellent inherent pressure containing and anti-corrosion characteristics, were the materials of choice for brake tubing. By post World War II, automotive industry mass production economics dictated adoption of a low-cost form of double wrapped, furnace-brazed steel tubing that is still in use today worldwide.

Having excellent initial pressure bearing characteristics, steel tubing is, however, susceptible to corrosion. To retard its inherent corrodability, coatings of various materials, e.g., zinc-rich paint, terne (a lead/tin alloy) and epoxy, have been applied to steel tubing exteriors. However, no coating has proven to be totally impervious to pitting, scuffing and chipping due to flawed manufacture, careless installation and exposure to hostile environmental conditions like loose gravel. A penetrated coating allows the corrosion process to begin.

An inherently corrosion-resistant tubing material is the only way to insure continuing effective corrosion resistance.

Copper-nickel alloy C70600, an alloy of 90% copper and 10% nickel, is inherently corrosion resistant to road salt, and its use as brake tubing is increasing based on: 1) Changing life-expectancy for automotive vehicles; 2) Worldwide service-experience data on brake tubing wear; and 3) Increasing cost of corrosion-retarding coatings for steel brake tubing.

AUTOMOBILE LIFE-EXPECTANCY

More cars, 10 years old and older, are on the road today than ever before. Automobile Manufacturers Association data indicate that road worthy, 10-year-plus vehicles increased in number from 10 million in 1975 to 35 million in 1989.

Automobile use habits serve as an unspoken directive to manufacturers to continue their efforts in providing cars with extended lives.

The adoption of extended warranties by the automotive industry compels design engineers to

<http://automotive.copper.org/brake.html>

SEE END OF PAGE

2/15/03

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the light and ultra-portable hp digital projector



msn

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Police take Crown Vics off streets

Rust problems prompt some departments to remove cruisers from streets



Ford debuts the new Crown Victoria Interceptor concept car at the New York International Auto Show in Manhattan earlier this year

ASSOCIATED PRESS

EAST HARTFORD, Conn., Dec. 2 — Police departments in Connecticut and other states are taking some of their Ford Crown Victoria Interceptors off the streets because the police cars' frames are rusting.

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COMPLETE STORY

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LIVE
 OPINION
 POLL



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SafetyAlerts
 June 25, 2002

Ford Motor Company Has Recalled 1995-1996 Ford Windstar

(SafetyAlerts) - Ford Motor Company Has Recalled 1995-1996 Ford Windstar because of possibility of leaking brake fluid will result in brake light activation.

Number Involved: 250,283

Dates of Manufacture: January 1994 – May 1996

Defect: Affected vehicles are certain minivans built at the Oakville Assembly Plant and sold or currently registered in the states of Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin, and the District of Columbia. During assembly, some brake lines were installed in a twisted position, causing contact with the dash panel insulator above the catalytic converter. This contact could abrade the brake line corrosion protection; consequently, salt or water absorbed in the dash panel insulator could promote corrosion. This corrosion could ultimately lead to a leak in the brake line. Leaking brake fluid will result in brake light activation. Extended stopping distance could also result, increasing the risk of a crash.

Remedy: Dealers will inspect the brake line for corrosion

and clearance conditions. A brake line that is not corroded will be repositioned. A brake line that is corroded or leaking will be replaced with a nylon coated brake line and secured using three retaining clips to assure clearance from the insulator. The manufacturer has reported that owner notification began May 10, 2002. Owners who do not receive the free remedy within a reasonable time should contact Ford at 1-888-438-7332.

[NHTSA Recall No.02V101/Ford Recall No. 02S36].

Important Note Regarding Auto Recalls

Frequently SafetyAlerts will list auto recalls before your dealer will know about them. If you have a vehicle affected by one of these posted recalls be sure and write down the NHTSA CAMPAIGN ID Number.

If your dealer doesn't know about the recall when you check, ask them how they are notified of recalls and when the next update is due.

Did you know?

During 2000 there were over 1050 products recalled in the United States for safety reasons!

How many did you hear about?

Sign-up for SafetyAlerts by Email -

The free internet newsletter that could some day literally save your life - or the life of someone you know.

The information contained herein has been obtained from sources that the Company believes to be reliable, however, the Company has not independently verified or confirmed the information and the recipient acknowledges that no representations or warranties are being made in connection with the use of the information.



SafetyAlerts
April 16, 2002

Ford Motor Has Recalled the 1995 Windstar

(SafetyAlerts) - Ford Motor Has Recalled the 1995 Windstar because of a potential for brake line corrosion.

Potential Number of Units Affected: 250283

Manufactured: 01/1994 - 05/1996

Defect Summary:

VEHICLE DESCRIPTION: MINI VANS SOLD OR CURRENTLY REGISTERED IN THE STATES OF CONNECTICUT, DELAWARE, ILLINOIS, INDIANA, IOWA, MAINE, MARYLAND, MASSACHUSETTS, MICHIGAN, MINNESOTA, MISSOURI, NEW HAMPSHIRE, NEW JERSEY, NEW YORK, OHIO, PENNSYLVANIA, RHODE ISLAND, VERMONT, WEST VIRGINIA, WISCONSIN, AND THE DISTRICT OF COLUMBIA. DURING ASSEMBLY, SOME BRAKE LINES WERE INSTALLED IN A TWISTED POSITION CAUSING CONTACT WITH THE DASH PANEL INSULATOR ABOVE THE CATALYTIC CONVERTER. THIS CONTACT COULD ABRASE THE BRAKE LINE CORROSION PROTECTION, AND ALSO SALT OR WATER ABSORBED IN THE DASH PANEL INSULATOR WOULD PROMOTE CORROSION. THIS CORROSION COULD ULTIMATELY LEAD TO A LEAK IN THE BRAKE LINE.

Consequence Summary:
CONTINUED LOSS OF BRAKE FLUID WILL RESULT IN BRAKE LIGHT ACTIVATION. EXTENDED STOPPING DISTANCE COULD ALSO RESULT IF SIGNIFICANT FLUID LOSS OCCURS, INCREASING THE RISK OF A CRASH.

Corrective Summary:
~~DEALERS WILL INSPECT THE BRAKE LINE FOR CORROSION AND CLEARANCE CONDITIONS. A BRAKE LINE THAT IS NOT CORRODED WILL BE REPOSITIONED. A BRAKE LINE THAT IS CORRODED OR LEAKING WILL BE REPLACED WITH A NYLON COATED BRAKE LINE AND SECURED USING THREE RETAINING CLIPS TO ASSURE THE CLEARANCE WITH THE INSULATOR. FORD HAS NOT YET PROVIDED NHTSA WITH AN OWNER NOTIFICATION SCHEDULE. OWNERS WHO TAKE THEIR VEHICLES TO AN AUTHORIZED DEALER ON AN AGREED UPON SERVICE DATE AND DO NOT RECEIVE THE FREE REMEDY WITHIN A REASONABLE TIME SHOULD CONTACT FORD AT 1-866-438-7332.~~

NHTSA CAMPAIGN ID Number: 02V101000.

Important Note Regarding Auto Recalls
Frequently SafetyAlerts will list auto recalls before your dealer will know about them. If you have a vehicle affected by one of these posted recalls be sure and write down the NHTSA CAMPAIGN ID Number. If your dealer doesn't know about the recall when you check, ask them how they are notified of recalls and when the next update is due.

Did you know?
During 2000 there were over 1050 products recalled in the United States for safety reasons!

How many did you hear about?

Sign-up for SafetyAlerts by Email -
The free Internet newsletter that could
some day literally save your life - or

AUTOMOTIVE

Automotive Hydraulic Brake Tube: The Case For 90-10 Copper-Nickel Tubing

Abstract ◻ **Introduction** ◻ **Trailer Corrosion Tests**
Test Results ◻ **Summary and Conclusions**

Abstract ◻

For many years the tubing in automotive brake systems has been manufactured from low-carbon steel. One or more superficial coatings are applied after brazing to protect the steel substrate from corrosion, because steel has no inherent corrosion resistance to the road environment. Although coating composition has changed since the original hot-dip lead-tin coatings were used, coating flaws remain a problem. The addition of zinc-rich paints did little to improve the protection of the tube. Current aluminum-zinc coatings and added polyvinylfluoride coatings are still inadequate to totally protect the steel tube.

In a recent series of tests, 90-10 copper-nickel tube (UNS C70600) was fabricated into typical brake system 'shapes' which were then attached to a test trailer and conveyed through various corrosive and mechanically abusive test track environments. The tests included holding the tubes in a high humidity chamber for a portion of each 24-hour test cycle. After 40 cycles and at each 10 cycles thereafter, the individual tubes were required to pass a 20,684 kPa (3,000 psi) pressure test. Candidate tube materials had to complete 60 cycles to satisfy the minimum requirement.

Current production steel tubes passed the 60-cycle requirement but failed well before 120 cycles. The 90-10 copper-nickel tubes completed 200 cycles with essentially no reduction of their original burst strength.

Introduction ◻

Brake tubes are located in a high-corrosion area. Although many other automotive components operate in the same hostile environment, few are less forgiving.

in the event of a failure. Thus, one of the major considerations in the design of an automotive hydraulic brake system is the integrity of the brake tubing which distributes the system pressure.

In 1965, an annual safety inspection of motor vehicles was introduced in Sweden and subsequently in other European countries. This procedure included the inspection of hydraulic brake tubes for the presence of rust. Concurrently, the Swedish Motor Vehicle Inspection Company began publishing annual reports on the results of these tests. ¹



Figure 1. Copper-nickel brake tube installed from master cylinder in 1990 Volvo.

In 1969, laboratory tests were reported comparing some inherently corrosion-resistant copper alloy tube materials with the then-current production materials. ²

Early in 1970, the Swedish Corrosion Institute approached the brake tube corrosion problem from the standpoint of using a corrosion-resistant material rather than trying to protect the surface. ¹

The European auto industry's initial response to brake tube corrosion problems was to terminate the use of the then-current hot-dipped ternary metal coating over steel tube. Laboratory testing in a 6% neutral vapor salt spray test indicated that corrosion resistance could be obtained by a 25-micron zinc coating in place of the ternary coating. In the years that followed, it became apparent that the laboratory testing had not accurately reflected conditions that exist in the actual operating environment. Subsequently, various plastic coatings were applied over the zinc and some are still being used to this date. ¹

Efforts to achieve a metallurgical solution to the corrosion problem continued. Volvo began the use of 90-10 copper-nickel ("Cunifer Alloy") tube in their 1976 model vehicles and have been using it since. Figure 1 shows the installation at the master cylinder in a 1990 model Volvo. Audi began using this material in 1990. The other European cars using this material are Porsche and Aston Martin. ¹

The bar graph shown in Figure 2 depicts the percentage of vehicles failing safety inspections because of defects in the

brake systems of eight-year-old Volvo passenger cars. The 1970 model cars had tarne-coated steel tubes. Tubes in the 1971 models were zinc coated. Defects other than rusted tubes are included in these values, but their effect on the data is minimal. The reduction in defects related to the introducing of 90-10 copper-nickel tube in 1976 is dramatic.

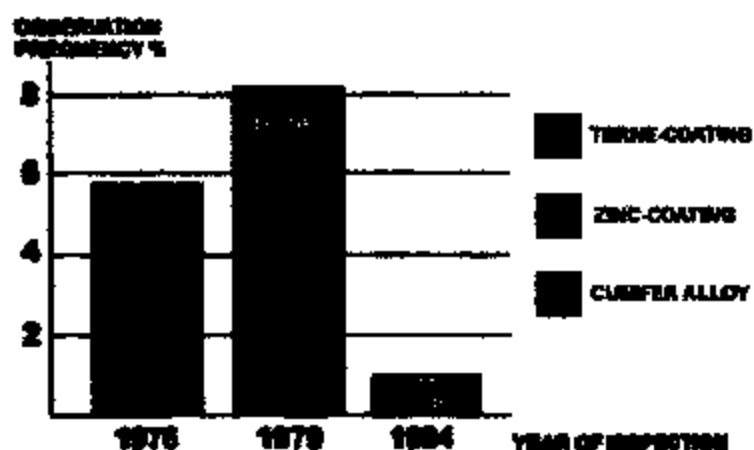


Figure 2. Annual Swedish Vehicle Safety Inspection Results. The bars indicate the percentage of 8-year old Volvo passenger cars inspected in the indicated year with brake lines which did not meet the inspection requirements. 1976 was the year Volvo introduced 90-10 copper-nickel tubes ("Copper Alloy") into their vehicles.

The paper presented at the SAE Annual Meeting in January 1970 dealt with the then "state of the art" in tube coatings; the data presented in that paper are still pertinent. voids, poor adhesion, discontinuities and physical damage to the superficial coatings used today can result in accelerated, localized corrosive attack which renders useless the value of any intact coating elsewhere on the tube.

An incident reflecting the latter condition was recorded in an SAE paper presented in 1991. A brake line which should have burst when tested at 115,832 to 158,579 kPa (16,800 - 23,000 psi), in fact burst at 4,825 kPa (700 psi). The paper states, "This particular tube portion was located at the end, above and behind the rear axle, and showed a great deal of corrosion, perhaps due to gravel impingement."

Against the background summarized above, a test program was undertaken by the Copper Development Association Inc., with the cooperation of an automotive vehicle manufacturer, to evaluate thoroughly the applicability of Copper Alloy C70600 tube, 90-10 copper-nickel, for automotive brake line application. The tube material is described in Table 1.

Trailer Corrosion Test

The design test procedure generally used today to evaluate the corrosion resistance and

integrity of motor vehicle body and chassis components consists of 100 cycles of controlled humidity soaking and drying, salt spraying and mileage accumulation over various road surfaces with test samples mounted on a trailer. The sequence of test cycle events is listed in Table 2.

The trailer is exposed to salt, dust and stone pecking as well as temperature and humidity variations. The total humidity soak time is approximately 2,600 +/-25 hours. The total drying chamber soak time is 375 +/-25 hours. The test trailer accumulates approximately 13,800 km (8,600 miles) during the full test cycle. Total test time is approximately 26 weeks. Figure 3 shows test samples attached to a typical test trailer.



Figure 3. Brake line samples attached to test trailer.

The tube size used for the test was 4.76 mm (0.1875 in.) outside diameter, 0.7 mm (0.028 in.) wall thickness. It was fabricated into typical brake system configurations with flares and tube nuts. The ends were encapsulated to allow subsequent pressure testing. These test specimens were then attached to various areas of the test trailer to assure exposure to all test elements at various degrees of intensity.

Beginning with the 40th cycle, and at 10-cycle intervals thereafter, each tube is subjected to an internal pressure test of 20,684 kPa (3000 psi). Candidate materials must complete 60 cycles to satisfy the minimum requirement. Figure 4 shows the test equipment on which the hydrostatic pressure tests were made.



Figure 4. Equipment used to test hydrostatic pressure in brake tube.

This performance would be expected even if a measured superficial abrasion had been inflicted on the tube as a condition for the evaluation of the tube surface.

Test Results

The data in Table 3⁴ reveal that after 200 test cycles, which exceeds three times the minimum benchmark of 60 cycles, the copper-nickel material retained more than 89% of its initial average burst strength.

Also noteworthy is the narrow spread in post-test burst pressure. This attests to the uniformity of copper-nickel's strength and physical properties, a feature which is not present in the currently used coated carbon steel tube.

Additional Testing

Figure 5 shows the engine compartment of a 1976 model Volvo four-door sedan. The vehicle was located in the storage yard of a used automobile parts dealer. The engine had already been removed and the actual mileage is not known. However, using the corrosion in the engine compartment as a criterion, it can be concluded that the uncorroded copper-nickel brake tubes which can be seen exiting from the master cylinder had, indeed, survived a hostile, corrosive environment.



Figure 5. Engine compartment of 1976 Volvo showing uncorroded copper-nickel brake lines.

The brake tubes were removed from this vehicle and hydrostatic burst tested with the following results:

Tube No. 1	111,694.95 kPa	(16,200 psi)
Tube No. 2	106,869.82 kPa	(15,500 psi)

These real-world data are welcome confirmation of the trailer test results.

Summary and Conclusions

The automobile industry faces many challenges in the market place and on its test tracks. It must produce vehicles that will compete in a world market on the basis of quality, safety, reliability, durability and cost. The test results presented above demonstrate that 90-10 copper-nickel tube is a significantly better choice for automotive brake lines than low-carbon steel because:

1. The use of an inherently corrosion resistant material is the best protection against

long-term brake tube corrosion. This has been demonstrated by Volvo, which uses 90-10 copper-nickel tube in automobiles they have produced during the last 15 years.

2. The results of trailer corrosion testing indicate that 90-10 copper-nickel tube (UNS 70600) is a superior product compared to the coated steel tube used for brake lines in today's U.S.-made vehicles.
3. Current double-wrapped, brazed and coated steel tubing is susceptible to brazing voids, coating voids, poor coating adhesion and discontinuities. These susceptibilities, combined with random service damage, mean the actual service life of the brake tube materials presently used in U.S.-manufactured vehicles should be considered unacceptable.

It must be recognized that all underbody components, including the brake tubes, will be struck by objects thrown up by the tires. Such random damage must be considered the most vulnerable link in the chain.

The tubing designer generally specifies the addition of a metal or plastic sleeve to the tube areas believed to be most vulnerable to stone damage. However, an inherently corrosion-resistant copper-nickel tube provides the surest protection against such random service damage, especially compared to a coated steel tube.

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