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Leaks?.....Why now after all this time?

By: Trnka Engineers Company (I-ENG-A Member, Seattle, WA)

As investigative engineers we are often asked by insurance companies why a condition would exist when there is no apparent reason for it. For instance, our firm was called recently to investigate the cause and origin of leaking pipes at a fire station. Fire stations are typically regarded as near pristine facilities kept in perfectly good repair. This fire station was no exception. It was superbly maintained.

The problem we were called to investigate involved leaking copper water pipes. The station facility was constructed about thirteen years prior to our site visit. This is not old for a building of this type and one would not expect piping problems to begin showing up in less than thirty or forty years after construction, if ever.

At the time of our investigation the station Battalion Chief explained that leaks in the piping began about one year earlier. The manner in which the leaks presented themselves, at irregular intervals during the previous year, suggested several possible causes. Among the possibilities was high acid level in the city supplied water system. Also considered was the possibility of an electrolysis condition caused by some stray electrical current. Either of these conditions could cause long term damage to copper piping and warranted further investigation.

The Battalion Chief contacted the city water department and asked to have the water acid level tested. As would be expected, the water system, serving many thousands of people, tested OK.

The Battalion Chief then contacted the electrical utility to investigate the possibility of stray electrical current that could be the cause of an electrolysis condition causing the pipes to be eroded and eventually leak. Again, no problems with the electrical system were discovered.

The Battalion Chief had carefully recorded important details related to the leaking pipes, and he had records of the previous investigation efforts that were attempted to discover the cause of the leaking pipe problem. He explained to us that all leaks had occurred in the hot water re-circulation loop, with no leaks having occurred in any other part of the water pipe system. This information was considered, along with the inspection of a piece of the copper pipe that included an elbow fitting. It was explained that this piece was removed from the re-circulation system due to a leak through a pinhole located near the elbow fitting, which was provided. It is important to note that the location of the pinholes were observed to be in the pipe and not in the fitting to pipe joint connection.

Following our interview with the Battalion Chief and our site work, we prioritized all possible causes of leaks in the pipes. These possibilities included poor workmanship during installation, excessive use of acid based solder flux, electrolysis, over pressurization, high acid water and excessive water velocity.

Causes of the leaks that were eliminated, according to the information provided by the Battalion Chief, included high acid level of the water and high pressure in the water system.

The possibility of excessive use of acid based flux was also eliminated as a cause, since the leaks had occurred in a hot water system. The hot water would likely have dissolved any excessive flux and would have been flushed out very early in the system operation.

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At this point we are left with only poor workmanship and high water velocity as causes of our leaks. Our experience is that poor workmanship is most often revealed shortly after the work is completed. Since the system had operated for about twelve years with no problems this cause was also ruled out.

Finally, we examined the hot water recirculation pump to obtain the pump operating data. Using the pump data and pipe size, we calculated the water velocity and determined the velocity to be nearly three times the maximum recommended in a continuously flowing piping system. The high water velocity would likely cause cavitation within the piping system.

Cavitation is the phenomenon of the sudden formation and collapse of low-pressure bubbles in liquids by means of mechanical forces such as rotating ships propellers. It occurs also in piping systems, in pumps and other places of high turbulence in the liquid flow. Cavitation results in the microscopic pitting of solid surfaces, not by force, but by the repetitive impact of these small bubbles many times at the same spot.

High velocities in piping systems such as in this situation will cause cavitation on the downstream side of valves and pipe fittings. Cavitation, when severe and/or long term, can cause erosion on the interior of the pipe. This phenomenon of cavitation erosion will eventually result in leaks through the pipe wall over a long period of time or can happen in a few months in extreme cases. As we discovered in this investigation, the cavitation erosion resulted in leaks after a period of twelve years.

A curious point to note here is that cavitation erosion very seldom occurs in facilities such as fire stations, office buildings or retail shops. Cavitation erosion more frequently occurs in industrial situations where system flow rates are much higher due to the necessity of accomplishing some industrial process.

The photo below shows how the cavitation on the inside of the pipe eroded the protective copper oxide and the copper base material of the pipe.

"CLASSIC PROPHETIC" QUOTES

"Computers in the future may weigh no more than 1.5 tons." -- Popular Mechanics, forecasting the relentless march of science, 1949

"I have traveled the length and breadth of this country and talked with the best people, and I can assure you that data processing is a fad that won't last out the year." -- The editor in charge of business books for Prentice Hall, 1957

"There is no reason anyone would want a computer in their home." -- Ken Olson, president, chairman and founder of Digital Equipment Corp., 1977

"This 'telephone' has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us." -- Western Union internal memo, 1876

"The wireless music box has no imaginable commercial value. Who would pay for a message sent to nobody in particular?" -- David Sarnoff's associates in response to his urgings for investment in the radio in the 1920s

"The concept is interesting and well formed, but in order to earn better than a 'C,' the idea must be feasible." -- A Yale University management professor in response to Fred Smith's paper proposing reliable overnight delivery service. Smith went on to found Federal Express Corp.

"Who the hell wants to hear actors talk?" --H.M. Warner, Warner Brothers, 1927.

"A cookie store is a bad idea. Besides, the market research reports say America likes crispy cookies, not soft and chewy cookies like you make." --Response to Debbi Fields' idea of starting Mrs. Fields' Cookies.

"We don't like their sound, and guitar music is on the way out." --Decca Recording Co. rejecting the Beatles, 1962.

"Heavier-than-air flying machines are impossible." --Lord Kelvin, president, Royal Society, 1895.

"Louis Pasteur's theory of germs is ridiculous fiction". --Pierre Pachet, Professor of Physiology at Toulouse, 1872

"The abdomen, the chest, and the brain will forever be shut from the intrusion of the wise and humane surgeon". --Sir John Eric Ericksen, British surgeon, appointed Surgeon- Extraordinary to Queen Victoria 1873.

"Drill for oil? You mean drill into the ground to try and find oil? You're crazy." --Drillers who Edwin L. Drake tried to enlist to his project to drill for oil in 1859.

"Stocks have reached what looks like a permanently high plateau." --Irving Fisher, Professor of Economics, Yale University, 1929.

"Everything that can be invented has been invented." --Charles H. Duell, Commissioner, U.S. Office of Patents, 1899.

"640K ought to be enough for anybody." -- Bill Gates, 1981

"Airplanes are interesting toys but of no military value." --Marechal Ferdinand Foch, Professor of Strategy, Ecole Superieure de Guerre.

A POTPOURRI OF AUTO RECALLS FROM FEBRUARY 2008

1. Nissan Recallng 480 Aftermarket Hitch Style Bike Racks, Part No. 999r5-Ar000. Consequence: When Moving The Bike Arm Bracket To Its Down Position, This Pinch Bolt Has The Potential Of Causing Severe Laceration Or Amputation To The User's Fingertips Or Hand.

2. Hyundai Is Recalling 3,387 Trailer Hitch Wiring Harnesses
Consequence: Excessive Heat May Cause Damage To The R Ear Bumper Area And May Potentially Result In A Fire.

3. Coach House Is Recalling 29 My 2007-2008 Platinum Motor Homes Equipped With Atwood Sealed Burner Ranges.
Consequence: This Condition Could Result In Carbon Monoxide Poisoning.

4. Kawasaki Is Recalling 532 My 2008 Ninja Ex250j8f And Ex250j8fl Motorcycles. The Tail Light Bulb May Prematurely Fail.
Consequence: Inappropriate Lighting Could Reduce Visibility Creating The Possibility Of A Crash Resulting In Injury Or Death.

5. New Flyer Is Recalling 431 My 1996-2001 D60hf Diesel Transit Buses Equipped With A Rooftop Air Conditioning Evaporator.
Consequence: Moisture In Sufficient Quantities Within The Lighting Panel May Result In A Shorting Of The Electrical Components And A Vehicle Fire.

6. Damon Is Recalling 126 My 2007-2008 Tuscany, My 2008 Astoria, And Astoria Pacific Motor Homes Built On Freightliner Chassis.
Consequence: Incorrectly Torqued Steering Arm Fasteners May Fatigue And Fracture Which Could Cause A Crash Without Warning.

7. Land Rover Is Recalling 12,353 My 2008 Lr2 Vehicles Built With A Sunroof.
Consequence: The Obstruction Could Cause The Sunroof, When Operated, To Bind, Twist, And Potentially Detach From The Operating Mechanism. If The Sunroof Is Subsequently Cycled And A Vertical Force Applied, I.E., A Customer Manually Aiding The Roof To Close Or Wind Lift, The Glass Panel Can Become Fully Detached From The Vehicle, Increasing The Risk Of Injury.

8. Ford Is Recalling 57,199 My 2006-2007 E-150, E-250, E-350, And My 2007 Expedition And Lincoln Navigator Vehicles Equipped With 5.4l Engines.
Consequence: Fuel Leakage In The Presence Of An Ignition Source Could Result In A Fire.

9. Ford Is Recalling 123,632 My 2007-2008 Expedition And Lincoln Navigator Vehicles.
Consequence: In The Event Of A Side Impact Crash, The Interior Door Handle May Cause The Door Latch To Open Increasing The Risk Of Injury To A Vehicle Occupant.

10. Chrysler Is Recalling 1,338 My 2008 Jeep Grand Cherokee And Commander Vehicles.
Consequence: This Could Cause The Engine To Stall While Driving Or Not To Start And/Or Cause The Windshield Wipers To Become Inoperative. Engine Stalling Or Inoperative Wipers Could Cause A Crash Without Warning.

11. King Of The Road Is Recalling 20 My 2005-2007 Genesis G40qg, My 2006-2007 G40qh, G40tf, And My 2007 G40qi Motor Homes Built On Freightliner Chassis And Equipped With Zf Model 8018 Steering Gears.
Consequence: The Operator May Notice Higher Required Steering Wheel Inputs, Or The Need For More Steering Wheel Adjustments While Driving In A Straight Line In Combination With Metallic Cracking Noises Prior To A Loss Of Steering. Loss Of Steering Could Result In A Vehicle Crash.

12. Champion Is Recalling 20 My 2007-2008 M1235 Buses Built On Freightliner Chassis And Equipped With Bendix Sr-7 Spring Brake Modulating Valves.
Consequence: This Could Cause A Delay Or Failure In Applying The Parking Brakes Which Could Result In A Vehicle Roll Away, Increasing The Risk Of A Crash.

13. Blue Bird Is Recalling 45 My 2008-2009 Micro-Bird School Buses Manufactured From October 1, 2007 Through January 28, 2008, Mounted On General Motors Chassis With Option 3016-05 Or 30117-05 Led Rear Turn Signals.
Consequence: This Standard Specifies Requirements For Required Original And Replacement Lamps, Reflective Devices, And Associated Equipment And Their Installation. The Purpose Is To Reduce Traffic Crashes, Deaths And Injuries Resulting From Crashes By Providing Adequate Illumination Of The Roadway, And Enhancing The Conspicuity Of Motor Vehicles On The Public Roads So That Their Presence Is Perceived And Their Signals Understood, Both In Daylight And In Darkness Or Other Conditions Of Reduced Visibility.

14. Motor Coach Industries (Mci) Is Recalling 24 My 2008 D4505, D4500, D4000istv Coaches Equipped With Trw Steering Gears, Models Tas85.
Consequence: This Condition Has The Potential To Cause The Steering Gear To Stall And Restrict The Steering Turning Angle Of The Vehicle Which Could Result In A Vehicle Crash.

15. Volkswagen Is Recalling 720 My 2008 Audi Tt Coupe Vehicles.
Consequence: The Detached Trim Cover Could Pose A Risk Of Personal Injury For Vehicle Front Seat Occupants.

16. Paccar Is Recalling 6,169 My 2008 Kenworth T300, T660, T800, T2000, W900 And C500 Vehicles And My 2008-2009 Peterbilt Models 365, 367, 384, 387, 388, 389 And 389 Kits.
Consequence: In The Event Of A Crash, Force Could Cause The Rotor To Crack And The Door Would Not Have Primary Or Secondary Closing Security Which Could Possibly Lead To Injury Of The Vehicle Occupant

17. Nissan Is Recalling 16,365 My 2008 Infiniti Ex35 And My 2009 Nissan Murano Vehicles. Due To Incorrect Software Programming, The Air Bag Control Unit (Acu) May Cause The Passenger Air Bag Not To Operate As Designed If The Vehicle Battery Becomes Significantly Discharged.
Consequence: This Could Result In The Passenger Air Bag Not Inflating In A Crash In Which It Was Designed To Do So, And Increasing The Risk Of Injury.

18. Forest River Is Recalling 89 My 2003-2008 Tsunami Motor Homes Built On Freightliner Chassis And Equipped With Zf Model 8018 Steering Gears. Consequence: The Operator May Notice Higher Required Steering Wheel Inputs, Or The Need For More Steering Wheel Adjustments While Driving In A Straight Line In Combination With Metallic Cracking Noises Prior To A Loss Of Steering. Loss Of Steering Could Result In A Vehicle Crash.

19. 19. Champion Bus Is Recalling 14 My 2008 3035re Buses Built On Freightliner Chassis And Equipped With Zf Model 8018 Steering Gears.
Consequence: The Operator May Notice Higher Required Steering Wheel Inputs, Or The Need For More Steering Wheel Adjustments While Driving In A Straight Line In Combination With Metallic Cracking Noises Prior To A Loss Of Steering. Loss Of Steering Could Result In A Vehicle Crash.

20. Monaco Is Recalling 1,733 My 2006-2007 Diplomat And Holiday Rambler Endeavor Motor Homes Equipped With Wiper Systems Supplied By Am Equipment.
Consequence: When The Wiper System Fails, The Operator Will Have Reduced Visibility Which Could Result In A Crash.

21. Hyosung Is Recalling 3,292 My 2005-2007 Gt650 And Gv650 Motorcycles. These Motorcycles Were Built With Fuel Tank Cap Gaskets That Prevent Proper Tank Ventilation.
Consequence: This Could Result In Vehicle Stalling Which Could Result In A Crash And/Or Fuel Leakage Which Could Result In A Fire.

For more information visit: Article Resource: http://www.Safercar.Gov

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