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NATIONAL TRANSPORTATION SAFETY BOARD SAFETY STUDY FATIGUE, ALCOHOL, OTHER DRUGS, AND MEDICAL FACTORS IN FATAL-TO-THE-DRIVER HEAVY TURCK CRASHES (VOLUME 1)

NATIONAL TRANSPORTATION SAFETY BOARD
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16. Abstract

This report is an analysis of human factors involvement in fatal-to-the-driver, heavy truck accidents in eight States over a 1-year period, October 1, 1987 through September 30, 1988. Data presented are derived from in-depth investigation of 182 accidents which involved 186 heavy trucks and resulted in 207 fatalities. The accident investigations were conducted in California, Colorado, Georgia, Maryland, New Jersey, North Carolina, Tennessee, and Wisconsin. These accidents represent approximately 25 percent of this type of accident nationwide. Volume 1 (NTSB/SS-90/01) of the study includes an analysis of fatigue, alcohol, and other drug prevalence and medical factors in these accidents, presents findings, and makes recommendations to improve heavy truck safety. Volume 2 (NTSB/SS-90/02) contains the 182 case summaries that provided the data discussed in Volume 1.

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EXECUTIVE SUMMARY

For many years, the National Transportation Safety Board has documented the major role played by alcohol and other drug abuse in causing accidents throughout the U.S. transportation system. The current study focuses on such abuse in accidents involving heavy trucks. The primary purpose in investigating fatal-to-the-driver heavy truck accidents was to assess the role that alcohol and other drugs played in these accidents.

For a one year period, October 1, 1987 through September 30, 1988, the Safety Board investigated every accident in eight States in which a driver of a heavy truck was fatally injured. One hundred and eighty two accident investigations involving 186 heavy trucks were conducted in California, Colorado, Georgia, Maryland, New Jersey, North Carolina, Tennessee and Wisconsin.

Fatal-to-the-driver heavy truck accidents in the eight States represent approximately 25 percent of this type of accident nationwide. While the Safety Board considers this a significant portion of the total fatal-to-the-driver accidents, it is not a random sample from the annual population of fatally injured truck drivers. However, because of the large sample size and methodology, the Safety Board believes that these accidents are representative of such truck accidents nationwide. The Safety Board does not suggest that fatal-to-the-driver heavy truck accidents are representative of all fatal truck accidents. The accidents are a census of fatal-to-the-driver heavy truck accidents in these States in the year of the study, and their number appears to be consistent with past years. The Safety Board cautions readers to avoid generalizing the results of the analysis of these fatal accidents to either all fatal truck accidents or all truck accidents.

From NTSB toxicological tests, the Safety Board found that 33 percent of the fatally injured drivers tested positive for alcohol and other drugs of abuse. The most prevalent drugs found were marijuana and alcohol (13 percent each), followed by cocaine (9 percent), methamphetamine/amphetamines (7 percent), other stimulants (8 percent), and codeine and phencyclidine (PCP) (less than 1 percent each). Stimulants are the most frequently identified drug class among fatally injured truck drivers.

Fatigue and fatigue-drug interactions were involved in more fatalities in this study than alcohol and other drugs of abuse alone.

In addition, the study found that for the fatally injured drivers:

- The most frequently cited accident probable cause was fatigue (57 drivers or 31 percent) followed by alcohol and other drug use impairment (53 drivers or 29 percent);

- Of the 57 drivers who were fatigued, 19 were also impaired by alcohol and/or other drugs;

- There is a strong association between violation of the Federal hours of service regulations and drug usage;

- Drivers with at least one suspended or revoked license are more likely than other fatally injured drivers to have used drugs of abuse;

- There is a significant relationship between a driver's prior alcohol and/or other drug offenses and a positive test for drugs of abuse in these accidents. This points up the need for thorough background checks and pre-employment drug tests;

- There is a significant relationship between drug positive test results among professional drivers and a shipment deadline for the load being carried;

- There is a significant relationship between drug positive test results and the type of trucking service provided, truckload (TL) vs. less-than-truckload (LTL). Nearly 42 percent of fatally injured TL carrier drivers tested positive compared with 14 percent of LTL carrier drivers;

- There is a significant relationship between drug positive test results and the day of the week. Saturday, Sunday, and Monday are the days with the highest percentages of drug positive tests;

- While time of day and drug positive tests are not significantly related, 70 percent of the drug positive tests occurred in the following times: 9:00-9:59 am; 1:00-3:59 pm; and 6:00 pm-1:59 am. 1988 FARS data indicates that 48 percent of truck fatal accidents occurred during these times;

- A disproportionately high percentage of drivers who used drugs are single, separated or divorced;

- The driver's medical condition caused or contributed to 10 percent of the accidents. Over 90 percent of medical condition related accidents involved some form of cardiac incident. This calls into question the effectiveness of the Federal program to assure the proper medical qualification of commercial vehicle drivers;

- Older drivers are less likely to have tested positive for drugs, but are more likely to have had an incapacitating medical incident;

- Occupant protection issues are the most frequently identified non-causal factors involved in a heavy truck fatal accident (68 of 185); and

- In 115 of the 185 accident involved trucks (62 percent), some management deficiency in oversight of the driver or the proper condition of the vehicle was identified. Deficiencies in oversight of both the driver and the vehicle were identified in 32 of 185 (18 percent) accidents.

The study also reviews: the regulations and legislation governing commercial truck operations; previous relevant research in the field of alcohol and other drug abuse; and the highway accident databases now in existence. The study notes the limitations of those databases as a means with which to assess the scope of the alcohol and other drug abuse problem in heavy truck accidents.

The Safety Board noted that there is also the need for a standardized national set of procedures for conducting alcohol and other drug tests when a fatal heavy truck accident takes place.

As a result of this safety study, recommendations have been issued to: the Department of Transportation, the National Highway Traffic Safety Administration, the Federal Highway Administration, the Department of Health and Human Services, Governors of the States, the National Governors Association, trucking industry trade associations, the International Brotherhood of Teamsters, law enforcement associations, the National Home Study Council, the National Association of Trade and Technical Schools, and the Professional Truck Driver Institute of America. Recommendations include:

- Review of industry structure, operations, and conditions which may create incentives for drivers to violate hours of service regulations and to use drugs of abuse;

- Establishment of a program to merge different truck databases into a national commercial truck database to provide information on fatal truck accidents and trucking operations;

- Establishment of a program to standardize post-accident toxicological specimen collection, testing, and reporting for truck accidents;

- Revision of the Fatal Accident Reporting System to include standard drug toxicological test results;

- Improvement of regulations to establish hours of service violations, logbook irregularities, multiple logbooks, and a commercial vehicle operation alcohol offense as a reasonable cause requiring a drug test of the driver;

- Improvement of pre-employment drug and alcohol screening including frequent, unannounced drug testing, for an appropriate period, of drivers with an identified alcohol or other drug abuse problem;

- Improvement of medical screening and disqualification standards;

- Requirements for automated devices to identify commercial drivers who exceed hours of service regulations;

- Establishment of fatigue, alcohol and other drug education campaigns oriented toward commercial drivers;

- Improvement of drug recognition capabilities among law enforcement and other personnel with commercial truck driver oversight responsibilities;

- Development of programs to conduct selective alcohol and other drug enforcement actions including a roadside drug testing demonstration at truck inspection lanes, weigh stations, and/or sobriety checkpoints; and,

- Enactment of State legislation to: establish 0.01 blood alcohol concentration (BAC) as the per se offense level for commercial vehicle operators; require collection of blood samples for toxicological testing of all operators in fatal commercial truck accidents; require employers to perform pre-employment drug tests for all commercial truck drivers, to review applicants' prior history, and to require frequent, unannounced testing, for an appropriate period of drivers with an identified alcohol or other drug abuse problem.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

SAFETY STUDY

FATIGUE, ALCOHOL, OTHER DRUGS AND MEDICAL FACTORS IN FATAL-TO-THE-DRIVER HEAVY TRUCK CRASHES

CHAPTER 1

BACKGROUND

Alcohol and other drug involvement in transportation accidents has been a key concern of the National Transportation Safety Board for many years. The Safety Board's investigations have found alcohol or other drug involvement in aviation, railroad, marine, and highway accidents (NTSB 1979, 1988a, 1988c, 1989a). Of all modes of transportation, the highway mode produces the greatest loss of life. Of all causes or factors in highway deaths, alcohol and other drug use ranks as the single leading factor (NTSB 1984b).

While there is concern about alcohol and drug use by drivers of all types of highway vehicles, the incidence of alcohol and other drug involvement in truck accidents has become a special concern to local, State, and Federal governments and to the trucking industry. From 1982 through 1988, 33,174 fatal accidents involving heavy trucks[1] occurred in the United States.[2] These accidents resulted in 38,965 fatalities (including pedestrians, cyclists, truck and automobile occupants). Of these, 5,458 (14.0 percent) were fatal to the driver of the heavy truck involved in the accident. An additional 1,210 truck passengers were killed in these accidents.[3] Alcohol and/or drug impairment has been reported by researchers as an important factor in heavy truck accidents. However, the frequency of drug and alcohol use by truck drivers varied greatly among the studies. The precise role that alcohol and other drugs may have played in causing fatal-to-the-driver heavy truck accidents has not been studied previously.

This report is one of a series of safety study reports on heavy truck safety and is the first safety study report based on the investigation, by the Safety Board's field investigators, of accidents which were fatal to the drivers of heavy trucks.

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[1] Both the National Highway Traffic Safety Administration (NHTSA) and the Federal Highway Administration (FHWA) define a medium truck as a single unit truck with a gross vehicle weight rating (GVWR) of between 10,000 and 26,000 pounds. A heavy truck is defined as a single unit truck with a GVWR in excess of 26,000 pounds, a single unit truck with trailer, a single tractor not pulling a trailer (bobtail), or a tractor-trailer combination. In this study, unless specified otherwise, the term "heavy truck" refers to vehicles with either the medium or heavy truck gross vehicle weight rating.

[2] Fatal Accident Reporting System (FARS) data.

[3] FARS data.

This study report includes:

- a review of current regulations on heavy truck safety and driver substance abuse testing;
- a review of previous studies of heavy truck safety and previous Safety Board recommendations;
- a summary of national data on heavy truck accidents, as well as data on alcohol and other drugs;
- a review of data and studies on fatigue and drugs as well as on alcohol and other drug abuse in the workplace;
- a review of the pharmacology of drugs for which the fatally injured drivers were tested;
- a description of the study design and rationale for the study;
- an analysis of alcohol and other drug prevalence in the fatally injured drivers in the study and the evaluation of the role that fatigue, alcohol, and other drugs played in those accidents;
- findings derived from the analysis;
- and recommendations to prevent recurrence of such accidents.

Federal Truck Safety Legislation and Regulation

In response to continuing public concern, Congress enacted a series of truck safety laws during the 1980's. These laws are designed to improve the safety practices of motor carriers and to improve driver and vehicle safety standards.

The first of these acts was the Surface Transportation Assistance Act of 1982 (P.L. 97-424) which created the Motor Carrier Safety Assistance Program (MCSAP). This program is a Federal/State partnership under which motor carriers and their vehicles and drivers are inspected for compliance with the appropriate Federal Motor Carrier Safety Regulations. The Act provides funds to:

> ...reduce the number and severity of accidents and hazardous materials incidents involving commercial motor vehicles by substantially increasing the level of enforcement activity and the likelihood that safety defects, driver deficiencies and unsafe carrier practices will be detected and corrected. (49 CFR 350.7)

MCSAP funding increased from $8 million in 1984 to a contract authority level of $60 million per year for fiscal years 1989 through 1991. In 1987, over one million State MCSAP inspections were reported, resulting in 57,581 driver out-of-service violations. It has proven successful in substantially increasing the number of inspections performed and the number of unsafe drivers or vehicles removed from service for rules violations.

The Commercial Motor Vehicle Safety Act (CMVSA) of 1986 (P.L. 99-570) requires, among other things, that States: issue and administer commercial driver's licenses (CDL) consistent with Federal standards; prohibit the possession of multiple licenses by commercial drivers; establish uniform minimum testing, licensing, and disqualification standards, including Federal disqualification of truck drivers convicted of operating commercial vehicles while under the influence of alcohol or controlled substances. The

law provides for a 1-year suspension for a first offense conviction and a lifetime suspension for a subsequent offense conviction. A first offense conviction for a driver of a placarded vehicle carrying hazardous materials carries a 3-year disqualification.

The 1986 law required a National Academy of Sciences (NAS) study to define the appropriate blood alcohol concentration (BAC) for "being under the influence." The resulting NAS study, conducted by its Transportation Research Board, concluded that any job-related consumption of alcohol by commercial drivers is "inappropriate for the workplace and incompatible with traffic safety" (Transportation Research Board 1987). This means that the safe operation of a truck decreases with any BAC above zero. The NAS study committee recommended a 0.04 percent BAC as the per se offense level. The Federal Highway Administration (FHWA), in a final rule issued on October 4, 1988, established the 0.04 percent or higher BAC as the level at which commercial vehicle operators would be subject to disqualification. FHWA also imposed a 24-hour out-of-service penalty for commercial drivers with any measurable BAC or presence of alcohol.

On November 21, 1988, the FHWA issued a regulation requiring the pre-employment, reasonable cause, periodic, postaccident, and random drug testing of commercial motor vehicle operators (53 FR 47134). The regulation requires the testing, in accordance with standards developed by the U.S. Department of Health and Human Services (DHHS), of a biological specimen (urine) for the presence of five drugs: marijuana or its metabolites, cocaine, opiates, amphetamines, and phencyclidine (PCP). Tests for other substances, including alcohol, require prior Department of Transportation (DOT) approval. The regulations are included in appendix J.

The drug testing regulation applies to employee and contract drivers of vehicles with a GVWR of 26,001 pounds or more and which operate in interstate commerce. The regulation includes those vehicles requiring placarding for hazardous materials transportation and those designed to transport more than 15 passengers. The random test provision and "random selection process" means that the tests are to be unannounced. The FHWA has estimated that 3 million drivers and 200,000 carriers are subject to the rule.

Recently, the Secretary of Transportation announced his support for an amendment to the 1988 regulation to include alcohol in the drug testing program. The U.S. Department of Transportation issued an Advance Notice of Proposed Rulemaking on alcohol abuse prevention on November 2, 1989. Alcohol testing may require collection of an additional specimen, such as breath, to facilitate the collection and analysis process.

Safety Board comments on the proposed DOT regulation recommended expanding the list of drugs to include barbiturates, benzodiazepines, certain antihistamines, and other drugs which the DOT, DHHS, and other departments determine to be appropriate for inclusion. The Board recommended inclusion of alcohol testing, a de facto zero alcohol standard, and the use of breath testing as the appropriate biological sample for alcohol tests. The Board found the allowable postaccident sample collection delay (up to 36 hours) to be excessive, and it recommended a maximum 4-hour time limit for sample collection. Subsequently, the Safety Board issued Recommendations I-89-4

through I-89-12 which addressed the need for separate postaccident and postincident testing, testing for alcohol and other drugs, prompt collection of blood and urine specimens, and lower threshold concentration cutoff testing requirements.

The Board also reiterated its belief that effective pre-employment testing, periodic medical testing, postaccident/incident testing, aggressive reasonable cause testing, effective management supervision, and competent drug/alcohol education and treatment require full implementation prior to embarking on the additional measure of random testing. The Board suggested that if random testing is used, the frequency required to achieve deterrence is likely to be close to 125 percent of the workforce to be annually tested. However, the FHWA drug testing rule requires only a 50 percent minimum testing rate for random testing.

The Safety Board has reviewed the drug testing regulations adopted by all modal administrations of the DOT. The Safety Board found serious inconsistencies in the postaccident/incident sampling and testing requirements among the transportation modes and between the drug testing policies for DOT employees in safety sensitive positions and private sector employees. The Safety Board has a number of concerns regarding the basis for the DOT drug testing regulations as they relate to commercial vehicle safety.

First, as noted above, the regulations do not include alcohol, the most frequently abused drug. Second, they do not include tests for prescription medications which are impairing. Third, the measurement threshold cutoffs are exceptionally high considering that performance impairing levels could have been present at the time of the accident. Fourth, the regulations do not include a blood test. Fifth, the DHHS guidelines were not intended to be used for a forensic purpose. That is, they were not intended for use in determining a causal relationship between drugs and a transportation accident as DOT has directed in its postaccident/incident testing regulations. The Safety Board believes that postaccident/incident drug tests are qualitatively different from pre-employment, random, and for-cause testing. Therefore, the list of drugs for which postaccident and postincident tests are conducted should be more extensive and the measurement threshold cutoff levels should be significantly lower than the DHHS urine test guidelines recommend.[4]

The Owner-Operator Independent Drivers Association (OOIDA) filed suit against the DOT in the U.S. District Court for the Northern District of California requesting an injunction against the mandatory drug testing regulations. A preliminary injunction against mandatory postaccident testing and random testing was granted in the OOIDA suit. The International Brotherhood of Teamsters, Amalgamated Transit Workers Union and three other unions have filed related suits which have been consolidated and referred to the Ninth Circuit Court of Appeals for hearing. The Ninth Circuit is now reviewing this case.

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[4] For further information, see NTSB Safety Recommendation letter I-89-4 through I-89-12, issued December 5, 1989.

Safety Board Truck Safety Studies

Prior to this study, the Safety Board has conducted 60 major accident investigations involving heavy trucks since 1971[5]. Fourteen of these accidents involved hazardous materials transportation. Concern about growing traffic congestion and increasing heavy truck accidents in the early 1980's prompted the Safety Board to undertake a more comprehensive review of these crashes.

In 1985, the Safety Board initiated a series of studies on heavy truck safety. One study, published in 1986, considered the training, licensing, and qualification standards for truck drivers (NTSB 1986). The Board noted that unqualified drivers frequently entered the field without first acquiring the needed skills, despite programs for training and licensing, employer screening, and government regulation. The Safety Board recommended: establishment of a commercial driver's license with national standards for training, testing, and licensing; evaluation of driver training schools; insurance incentives for training; and a comprehensive driver records information system to help prevent drivers from maintaining multiple licenses. Many of these recommendations were included in the Commercial Motor Vehicle Safety Act (CMVSA) passed by Congress in 1986.

In January 1986, to develop more information on the causes of accidents and to document the interrelationship of the driver, motor carrier, vehicle, and roadway as factors in accidents, the Safety Board began a multiple part study. Board investigators completed investigations of 189 accidents involving trucks of at least 10,000 pounds gross vehicle weight rating (GVWR) and towaway damage to the truck. In October 1988, the Safety Board published summaries of the 189 completed accident investigations (NTSB 1988a). Driver issues discussed in the summaries included duty hours, fatigue, training and experience, use of alcohol and other drugs, and driving records. Other issues discussed included motor carrier oversight of the truck and the driver, braking deficiencies and adjustments, hazardous materials transportation, operation of double trailers, grade crossings, environmental issues, conspicuity, and crashworthiness.

To develop an estimate of the use of impairing drugs and alcohol among truck drivers, the Safety Board developed a project to collect data on all fatally injured truck drivers in eight selected States for one year from October 1, 1987 through September 30, 1988. The Safety Board focused on fatal-to-the-driver accidents, since it is in such accidents that there is the highest likelihood of obtaining a biological specimen for toxicological testing to determine the presence and role of drugs. In this project, 182 fatal-to-the-driver accidents were investigated in the eight States. The study design will be described in chapter 3 of this report.

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[5] In general, the Board investigates highway accidents involving issues of wide-ranging safety significance. The Board also uses "severity criteria" which can trigger an investigation of an accident involving: five or more fatalities; three or more fatalities in a schoolbus; or a hazardous materials spill resulting in a fatality. Accidents meeting these criteria may be designated as "major" accidents by the Board.

CHAPTER 2

NATIONAL ALCOHOL AND OTHER DRUG DATA AND RESEARCH

The Safety Board found it necessary to undertake its own data collection for this safety study because adequate data were not available from other sources. National or State data regarding alcohol and other drug use in highway traffic fatalities, injury accidents, and arrests generally are not available or are of limited usefulness.

National Databases

The most reliable database on fatal highway accidents is the Fatal Accident Reporting System (FARS) operated by the National Highway Traffic Safety Administration (NHTSA). The FARS, according to a U.S. Senate report, is "...the most complete database for fatal accidents." (U.S. Senate 1989). When the system is used to estimate alcohol-related fatal crashes nationwide, estimates are extrapolated from findings in 28 States in which a chemical test is obtained from at least 85 percent of the fatally injured drivers. The FARS data field for toxicological test results, however, does not list all drugs that could be tested for under common protocols. The FARS does not seek data on drugs for which the State routinely tests. Maryland, for example, tests fatally injured drivers for an extensive list of drugs, but does not routinely test for marijuana. Other States routinely test for alcohol, but not for other drugs.

The differences in toxicological testing occur not only from State to State, but also within States. The number of drugs for which a toxicological test is performed in certain States depends upon the tests requested. The most frequently requested test is for alcohol. Several States, such as New Jersey, use an extensive standard test protocol for each region in the State. Large States, such as California, typically use a combination of State-certified private and public testing laboratories. Screening tests may be used alone or in combination with confirmation tests which quantify the drug level in the specimen.

This variety of toxicological test options tends to diminish the usefulness of State data in both national and State analyses unless the same test protocol and techniques are used in each test. Therefore, the FARS drug data are limited by the variability of sample testing and reporting. Until standard toxicological testing is available in the same percentage of cases as alcohol and in a sufficient number of States to develop accurate national estimates, the usefulness of data regarding drug involvement will be limited. For these reasons, both previous research and this safety study are based on a specific drug testing protocol and identical procedures for all cases in the study.

Despite its limitations in drug related fatal crashes, FARS is still the

impaired[7] driver or pedestrian (down from 46 percent in 1982).[8] In 1988, 46 percent of fatally injured drivers had some measurable amount of alcohol in their blood (down from 53 percent in 1982).[9]

The NHTSA reported that the decrease in alcohol involvement was especially large for drivers under 21 years of age. The reductions for the 21 through 44 age group were much smaller, while those persons age 45 and older experienced a large reduction in alcohol-related crashes on weekday nights and during the day.

The NHTSA recently published a review of the experimental literature on the effects of alcohol on driving-related behavior. The reviewers segregated the studies into behavioral categories to determine the BAC at which impairment began. The driving-related categories included: reaction time, tracking, concentrated attention, divided attention, information processing, visual functions, perception, psychomotor skills, and driving. The reviewers determined that these behavioral areas vary in their susceptibility to impairment by alcohol. The divided attention task was most likely to be impaired at low BACs (below 0.02 percent). The most important finding is "that there is no lower threshold below which impairment does not exist for alcohol" (Moskowitz and Robinson 1988). This finding is consistent with the NAS report recommendation for a zero alcohol tolerance for commercial drivers.

Research by Sutton and others indicates that evidential breath test instruments are reliable and accurate when operated in a consistent and uniform manner (Sutton 1988). DOT approved instruments meet the accuracy requirement of plus or minus 5 percent of a known standard. In tests with human subjects, sampling also yields consistent readings on approved instruments. DOT instruments test accurately at low BAC levels (0.00 to 0.05 percent) as well as at high BAC levels (0.15 to 0.20 percent). Actual readings in Sutton's study varied by as much as 0.015 percent BAC at high BAC levels. The range of test results at the lowest test level (0.00 percent BAC) was as great as 0.008 percent BAC. The practical effect of measurement accuracy (instrument sensitivity and individual differences) is that a zero alcohol level using breath measurement must allow for a level of 0.01 percent BAC before an offender should be liable for prosecution. Further, the National Safety Council Committee on Alcohol and Other Drugs recommends collection of two separate breath samples from the same individual within a 15 minute time frame.

Other Drugs and Highway Safety

Information on the involvement of drugs other than alcohol in highway crashes is more anecdotal than statistical. Such information has been

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[7] BAC of .10 percent or greater

[8] NHTSA-"Drunk Driving Facts", July 1989

[9] NHTSA - Fatal Accident Reporting System 1988

largely unavailable in both general traffic fatalities and in fatal-accident involved truck drivers. Until recently, States did not have either the capability or the routine procedures to conduct toxicological tests on fatally injured drivers. Even now, toxicological testing is limited by available funds, since a complete drug screen and confirmation can cost up to $500.

Until recently, the drugs for which tests were performed and drug testing techniques have varied greatly both between States and within States. The DHHS now requires certification of laboratories participating in employee drug testing programs. DHHS certification promotes uniform collection, preservation, handling, screening, and confirmation of biological samples. As a result, drug testing, confirmation and reporting of results have the potential of becoming more reliable statistics in future analyses of fatally injured drivers. However, significant inconsistencies are evident when applying DHHS employee drug testing standards to postaccident testing in transportation. For postaccident drug testing to become standard within and among the States, a standard protocol of test procedures and drugs for which tests are conducted must be developed and followed.

A 1985 NHTSA review of studies of drug use incidence by drivers indicates that drugs were detected in 10 to 15 percent of fatally injured drivers, 22 percent of injured accident-involved drivers, and 14 to 50 percent of arrested drivers (with BACs below 0.10 percent) (Compton 1985). The drugs identified in the NHTSA report (in descending frequency) were: marijuana, tranquilizers, sedatives such as barbiturates and methaqualone, phencyclidine, cocaine and amphetamines, codeine, and antihistamines. Drugs other than alcohol were detected by themselves in 2 to 15 percent of these drivers. The report also indicated that between 54 and 80 percent of drug-using, fatally injured drivers also had high concentrations of alcohol in their bodies.

The most recent NHTSA report on the subject (NHTSA 1988) indicates that the frequency of drug use by crash involved drivers was 10-22 percent, with 53-77 percent of the drug-involved drivers also using alcohol. The Los Angeles Police Department Drug Recognition Expert officers have estimated that 20 percent of drivers arrested for driving while impaired are under the influence of drugs other than alcohol. The most common drug found in fatally injured drivers was marijuana, followed by diazepam (Valium R), barbiturates, cocaine, codeine, phencyclidine (PCP), and amphetamines.

Virtually all the reports reviewed found a high incidence of the same hazardous drugs and combinations of drugs: marijuana, diazepam, barbiturates, amphetamines, cocaine, and phencyclidine (PCP). Approximately the same percentage (10-22 percent) of drugs are found in studies of fatality injured and other injured drivers. Studies found that a higher percentage of drivers arrested for driving under the influence of drugs tested positive. The similarities in drug frequencies among the NHTSA-reviewed studies, and the potential hazards involved with drug use and driving are supported by impaired-driving-related-skills studies in laboratories, simulators, and on closed courses.

Roadside survey studies of police-detained impaired drivers indicate a drug use incidence of between 14 and 50 percent. However, arrest data for

driving while under the influence of drugs are less standard and reliable than the toxicological test result data. Alcohol-related arrest data are a commonly used and reliable measure of effort and of deterrence. Drug arrest data are less useful because of the infrequency of such arrests as shown in the different percentage of arrests and drug use incidence. However, the value of arrest data on driving under the influence of drugs may improve as the NHTSA-developed Drug Recognition Expert program training is provided nationwide.

Heavy Truck Research and Data

Data available from the FARS indicate that the number of fatal accidents involving heavy trucks is relatively stable from year to year and that most of the accidents are not fatal to the truck driver. From 1982 through 1988, there were between 4396 and 4893 fatal accidents per year involving heavy trucks. Between 708 and 884 of these accidents per year were fatal to the truck driver. The table below shows the number of such accidents per year.

Table 1.--Fatal accidents involving heavy trucks 1982-1988

Year	Number of fatal heavy truck accidents	Truck driver fatalities	Percentage of fatal truck accidents in which truck driver was killed
1982	4,396	754	17.2
1983	4,615	784	17.0
1984	4,831	884	18.3
1985	4,841	797	16.5
1986	4,785	765	16.0
1987	4,813	708	14.7
1988	4,893	766	15.7

Heavy truck involvement in fatal accidents and drug involvement in truck accidents has been the subject of inquiry in several research efforts in recent years. A recent UMTRI report, based on its database, surveyed fatal accident involvement by age of truck driver (Campbell and Wolfe 1988a). The report found that fatal accident involvement rates for drivers of "large" (over 10,000 lbs GVWR) trucks generally increased with decreasing driver age. Drivers under the age of 19 were over involved by a factor of 4, but drivers age 19 and 20 were over-involved by a factor of 6. This over involvement continued, but declined, until the overall rate was reached at age 26. Age has been identified in surveys to be a factor: in a person's drug of choice, e.g., marijuana v. alcohol; in risk-taking behavior; and in driver inexperience. Another recent UMTRI report focused on the safety implications and driving difficulty of various truck configurations (up to 117,500 lbs gross combination weight), rather than on human performance factors (Fancher and Mathew 1989).

A 1987 Insurance Institute for Highway Safety (IIHS) report addressed the effect of driver hours of service on tractor-trailer (over 26,000 lbs GVWR) crash involvement (Jones and Stein 1987). It found that drivers become

overinvolved in crashes when they exceed 8 hours driving, violate logbook regulations, are young drivers, or are involved in interstate operations. The report did not include a survey or analysis of drug use.

The IIHS studied the crash involvement of large trucks (10,000 lbs GVWR and above) by configuration over a 2-year period in Washington State (Stein 1988). The study cited a 1985 report by Cerelli showing that the number of crashes and the percentage of fatal crashes involving large trucks had been increasing through 1984. The IIHS study included all crashes involving heavy trucks from June 1984 through July 1986. Tractor-trailers were involved in 59 percent of the crashes, doubles in 21 percent, truck-trailers in 9 percent and single unit trucks in 8 percent. The study found that empty trucks were overinvolved and partially loaded trucks were underinvolved in crashes, compared to fully loaded trucks. Doubles were overinvolved by a factor of two to three in both single-vehicle and multiple-vehicle crashes. Doubles were overinvolved on grades, on curves, and if the driver had been driving 6 or more hours.

Alcohol in Heavy Truck Accidents

DOT noted in its ANPRM of November 2, 1989, that statistics from 1982 to 1985 indicate that about fifty percent of all fatally injured motor vehicle drivers had a measurable amount of alcohol in their blood, compared to 15 percent of the fatally injured truck drivers (121 of 805 drivers). Sixty percent of these 121 drivers had a BAC of .10 percent or higher, 18 percent had a BAC between .04 and .10 percent, and 21 percent had a BAC of .03 percent or less.[10] Drivers of heavy and medium trucks with positive BACs are involved in about 750 fatal crashes each year, 7,700 injury crashes, and 4,750 property damage-only crashes (Transportation Research Board 1987).

Other Drugs in Heavy Truck Accidents

Perhaps the most significant research on drug use by drivers of heavy trucks (over 26,000 lbs GVWR) is another IIHS study. In 1986, IIHS researchers asked 359 randomly selected tractor-trailer drivers on Interstate Highway (I-40) in Tennessee to participate in a voluntary study (Lund and others 1988). Of the 359 drivers, 317 provided blood or urine samples for analysis. Of these 317 drivers, 29 percent had evidence of drugs in their blood or urine. Cannabinoids were found in 15 percent, nonprescription stimulants in 12 percent, prescription stimulants in 5 percent, cocaine metabolites in 2 percent, and alcohol in less than 1 percent. (The percentages add to more than 29 percent due to multiple drug use.) The study recognized that these findings may be conservative because 12 percent of the drivers (42 of 359) refused to participate or were unable/unwilling to provide a sufficient sample for testing.

Another significant research effort is the annual Regular Common Carrier Conference survey (Beilock 1989) of 878 drivers of heavy trucks (over 26,000 lbs GVWR) at inspection stations on I-10, I-75, and I-95 in northern Florida.

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[10] NHTSA FARS data tapes, 1982-1985.

The 1989 survey report stated that because of the driver sample and the destinations of the loaded trucks, "the results presented in this report are likely to hold true for truck drivers and motor carriers in the U.S. as a whole." However, the survey recognized that, "In the absence of mandatory and randomly-conducted drug and alcohol testing, it is impossible to develop reliable statistics regarding usage levels." This survey found that:

- 52 percent of the drivers were employed by for-hire fleets, 27 percent were owner-operators, and 21 percent worked for private carriers.
- Average age was 41; average years of experience was 15.7 years; 10 percent were union members.
- As part of their conditions of employment, 43 percent had been tested for alcohol (33 percent in 1987), 50 percent had undergone drug tests (38 percent in 1987).
- 68 percent supported mandatory random drug and alcohol testing (73 percent in 1987).

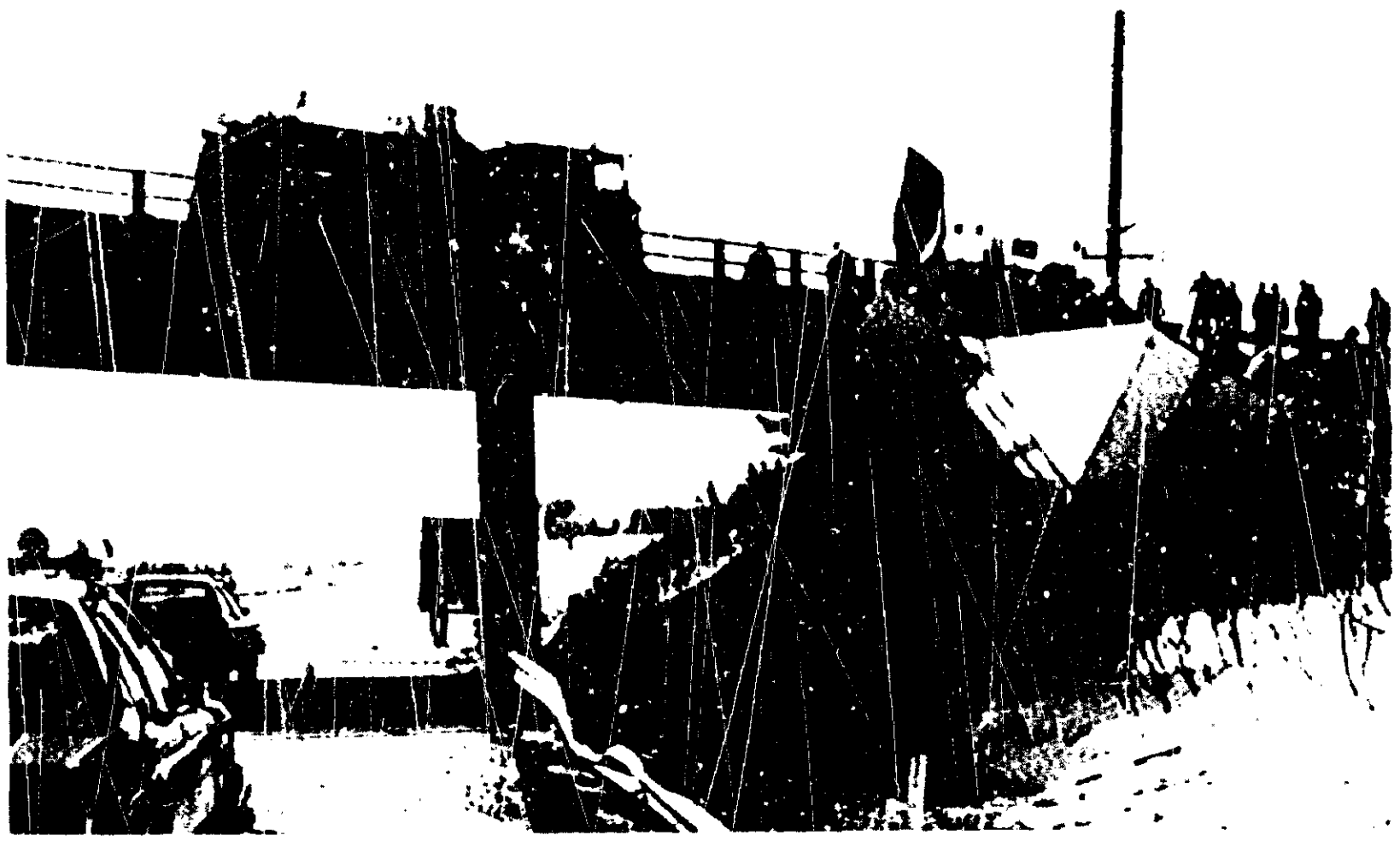

Figure 1.--Fatigue-methamphetamine-related accident
1985 Freightliner tractor and loaded trailer
Dane County, WI
February 25, 1988

The survey also contains data on the drivers' perception of drug use by their peers. Ninety-two percent of respondents perceived that at least 5 percent of drivers were regular users of illegal drugs; 84 percent believed that 10 percent were regular users; 64 percent believed that 20 percent were regular users, and 43 percent believed that 30 percent were regular users. Marijuana, "speed," cocaine/"crack," amphetamines, and "uppers" were the most frequently mentioned drugs. Approximately 13 percent of the drivers believed that some drugs are "helpful." The most frequently mentioned "helpful" drugs were "speed," "uppers," and amphetamines.

In addition, the survey contains information on fatigue in heavy truck crashes. In the RCCC survey, 93 percent of the drivers indicated that they were paid by the mile or by the load, thus providing an incentive to drive when tired. The average respondent claimed to be able to drive for 10.6 hours before requiring extended rest. Thirty percent claimed to be able to drive longer than 16 hours. The respondents estimated that, on the average, 36 percent of truck accidents are due to driver fatigue. Similarly, the American Automobile Association (AAA) Foundation for Highway Safety recently estimated driver fatigue to be involved in 40 percent of truck accidents (AAA 1985).

In summary, the studies reviewed above seem to indicate that heavy (combination) trucks, particularly doubles, are more difficult to operate than other trucks. The IIHS studies found accident over involvement of: empty trucks; doubles; doubles where the driver had been driving more than 6 hours; young drivers; drivers with logbook violations; drivers who exceed 8 hours driving; and drivers involved in interstate operations. Surveys indicate that approximately 30 percent of tractor-trailer drivers have evidence of drugs in their blood or urine and that 43 percent of drivers surveyed believe that 30 percent of their fellow drivers are regular drug users. Drivers surveyed also believed they could safely exceed 8 hours driving. Such research results may be able to be translated into information, education, training, and other programs for drivers, as well as into policies and regulations for safer heavy truck operations.

Alcohol and Other Drug Abuse in the Workplace

Workplace alcohol and drug use has an enormous impact on the health, safety, and productivity of the entire population. Heavy truck accidents are noticed by large numbers of people both through personal inconvenience and through the media. However, the transportation industry is only one of many affected by workplace drug abuse. There is no systematic research database on the extent of workplace-related drug use and its impact. To further the state of knowledge about workplace drug use and to provide a comparison with the alcohol and other drug use in fatally injured drivers of heavy trucks, an extensive review of alcohol and other drug abuse in the workplace is contained in appendix D.

CHAPTER 3

STUDY DESIGN AND RATIONALE

To develop an estimate of drug and alcohol use among fatally injured truck drivers, the Safety Board developed a project to collect data on all fatally injured truck drivers in selected States for 1 year. Investigations developed information on the involvement of impairing drugs, including alcohol, in crashes that were fatal to the drivers of heavy trucks. By concentrating on these crashes, it was possible to obtain toxicological tests to determine the presence and role of drugs.

State Selection Criteria

An original objective of this study was to obtain a sample equal to approximately 25 to 30 percent of the 1982-1985 average number of fatally injured truck drivers nationwide. States were selected for inclusion in the study based on several factors, including:

- Average annual number of fatally injured truck drivers--so that the above objective could be obtained;
- Compliance with/participation in the Fatal Accident Reporting System (FARS);
- Willingness to participate and cooperation of State and local agencies (especially police, health department, medical examiner/coroner, and Governor's highway safety representative);
- Geographical region and NTSB Regional Office accessibility to the State; and,
- The degree to which the State is generally representative of trucking operations nationwide.

The eight States selected for inclusion in this study were: California, Colorado, Georgia, Maryland, New Jersey, North Carolina, Tennessee, and Wisconsin.

Sample Size Objective and Background Data

The sample includes all fatally injured drivers of heavy trucks (over 10,000 pounds GVWR) in eight States during a one year period (October 1987-September 1988). "Fatally injured" is defined as dead at the scene or within 4 hours of the accident.

The tables below show the fatal accidents and fatalities nationwide in total and for truck drivers, passengers, and others for 1982 through 1988.

Table 2.--Fatal accidents and fatalities, all vehicles vs. heavy trucks (FARS)

Year	Fatal accidents	Fatalities	Fatal accidents involving heavy trucks	Fatalities in heavy truck accidents
1982	39,092	43,945	4,396	5,229
1983	37,976	42,589	4,615	5,491
1984	39,631	44,257	4,831	5,640
1985	39,196	43,825	4,841	5,734
1986	41,090	46,087	4,785	5,579
1987	41,435	46,386	4,813	5,598
1988	42,119	47,093	4,893	5,694

Table 3.--Fatalities in accidents involving heavy trucks (FARS)

Year	Total fatalities	Truck driver fatalities	Truck passenger fatalities	All other fatalities*
1982	5,229	754	190	4,285
1983	5,491	784	198	4,509
1984	5,640	884	190	4,566
1985	5,734	797	180	4,757
1986	5,579	765	161	4,653
1987	5,598	708	144	4,746
1988	5,694	766	147	4,781

* Includes occupants of non-truck vehicles and non-occupants (pedestrians and pedalcyclists).

The eight selected States average 25.5 percent of the 1982-1988 national total of heavy truck fatal accidents. Below is a more detailed table.

Table 4.--Fatal accidents (eight states) involving heavy trucks

Year	U.S. Total	State								Eight State Total	Percentage of US Total
		CA	CO	GA	MD	NJ	NC	TN	MI		
1982	4,396	310	58	135	78	84	116	125	92	998	22.7
1983	4,615	347	59	187	75	70	136	113	93	1,080	23.4
1984	4,831	422	54	185	79	108	147	112	106	1,213	25.1
1985	4,841	395	76	186	86	105	160	138	116	1,262	26.1
1986	4,785	480	47	205	90	85	174	114	96	1,291	27.0
1987	4,813	451	49	197	97	86	169	144	114	1,307	27.2
1988	4,893	460	42	214	82	105	191	129	99	1,322	27.0
Total	33,174	2,865	385	1,309	587	643	1,093	875	716	8,473	25.5

Accident data for the eight States also represent 25 percent of the national total of fatal-to-the-driver heavy truck accidents for the same years.

By October 1, 1988, a total of 182 accidents involving 186 case vehicles in the eight States had been identified and investigated. This sample is equal to 23 percent of the 1982-1985 average annual number (805) of fatally injured truck drivers nationwide. Because of a decrease in such fatalities in recent years, the study sample represents about 25 percent of the 1987-1988 average annual number (737) of fatally injured truck drivers nationwide.

FARS data are usually reported by calendar year, however, the data collection period for this study was October 1, 1987 through September 30, 1988. According to FARS data, 761 drivers of heavy trucks were fatally injured (nationwide) from October 1, 1987 through September 30 1988. FARS data indicates that 191 drivers of heavy trucks died in the eight States during this period. The five cases not included in the study were reviewed and were found tc involve drivers of vehicles that were not medium and heavy trucks.

Accident Notification and Selection Procedure

Accident notification and selection procedures varied slightly in each State depending on the police and medical examiner system structures and authority. Study participation in a typical State was coordinated through the Governor's Representative for Highway Safety, the State Police or Highway Patrol, and the Chief Medical Examiner. Procedures in some States included notification of the local and county law enforcement agencies and county medical examiners.

The usual procedure upon the occurrence of a truck accident in which the driver was fatally injured was for the State or local police to notify a specific NTSB Regional Office which would dispatch a highway accident investigator.

If a highway accident investigator from the responsible regional office was unavailable, one from another office would be dispatched. The NTSB investigator was responsible for contacting the local coroner/medical examiner. The NTSB investigator would receive biological specimens for toxicological testing, which would be processed according to the procedure described below. The NTSB investigator then obtained all necessary documents, photographs, and records to complete the full, in-depth, accident investigation and prepare a report.

A secondary accident notification and selection procedure was also developed. In this procedure, NTSB staff reviewed fatal-to-the-driver heavy truck accidents as reported to the FARS. If the FARS reports identified a fatal-to-the-driver heavy truck accident in one of the eight selected States which was not being investigated, NTSB staff would determine if the accident met the study criteria. If it did, an investigator would be dispatched to the accident site.

Using these procedures, the Board was able to initiate an investigation of all crashes in which a truck driver was fatally injured in the eight States.

NTSB Highway Accident Investigation/Review Procedures

The investigator developed information to completely describe the operator(s), vehicle(s), and roadway at the time of the accident. In addition, the investigator interviewed representatives of the carrier, available witnesses, and family members to obtain more detailed information on hours of service, fatigue, carrier operations and maintenance, safety programs, training and testing, pre-employment screening, and other factors.

The case file developed by the investigator typically included: a factual accident report and narrative summary; a series of heavy truck project forms related to the driver, carrier, tractor(s), trailer(s); leases or contracts; interviews; police reports; State and national license and offense database checks; driver training, education, and qualification information; pre-employment checks and tests; driver's daily logs; load information; vehicle lease/purchase, insurance, and maintenance documents; carrier audits; toxicological tests; and accident scene/location and vehicle photographs. From this file, the investigator developed a summary accident description.

From the factual report, special forms which contained computer-keyed questions were completed by the accident investigator based on information developed. The forms contained a total of 346 questions on: general accident data; the accident vehicle; the trailer; the load; motor carrier operations; motor carrier oversight of the driver; human performance factor information from relatives and from the carrier; and on driver toxicological test and medical data. Where multiple trucks were involved as "case vehicles," multiple question sets were prepared. Data from these forms were coded and entered into a separate database.

Two levels of accident case file quality control were used in addition to the normal Regional Office supervisory review. First, all case files were sent to the Board's highway field program coordinator in Fort Worth. Case files were reviewed for accuracy of information collection and analysis, consistency of facts and description, summary consistency, need for additional information, and other actions as appropriate. Revisions were made by the responsible accident investigator. The second level of review was conducted by the project coordinator to ensure that data on the computer-keyed forms were consistent with the case file and with industrywide information. Inconsistencies were coordinated with the field program coordinator and the responsible investigator.

Toxicological Sample Collection and Chain of Custody

Local coroners/medical examiners in participating States were requested to obtain whole blood and urine specimens from the fatally injured truck driver(s). NTSB provided "tox kits" to each of the States and Regional Offices, consisting of two 10 ml teflon-lined (fracture-proof, silanized glass) blood collection vials and one 25 ml urine collection vial plus 1.5 percent sodium fluoride (NaF) preservative in a styrofoam mailing box. The kits also included instructions, chain of custody forms and documentation, and evidence tape to seal the kits.

Collection procedures requested closed system blood or, in the absence of a sufficient quantity, vitreous fluid. All samples were to be marked with date, time, victim identification, and where/how/and by whom the sample was collected. Samples were to be refrigerated and standard chain of custody records and security maintained. Where NTSB "tox kits" were not available, the coroner/medical examiners were asked to use their standard postmortem blood collection vials. The coroner was requested to release the samples to the NTSB investigator who then became responsible for shipment of the samples for toxicological testing.

Sample Testing Protocol

Toxicological samples were obtained in as many cases as possible and forwarded on ice, by express mail, to the Center for Human Toxicology (CHT) at the University of Utah for screening, confirmation, and quantification. In addition, many States conducted their own toxicological screening and/or confirmation tests. The CHT tests searched for the presence of 44 different drugs in the following drug or drug classes:

- Volatiles/gases
- Sedatives/tranquilizers
- Stimulants
- Opiates
- Antihistamines
- Hallucinogens
- Cannabinoids
- Analgesics
- Anticonvulsants

The Safety Board contract with CHT provided for toxicological analyses of up to 250 blood samples and 75 urine samples for the drugs in the analytic plan. CHT provided 1,500 toxicological sample collection kits described above. CHT was responsible for reporting the analytic results obtained on each sample within 30 days of sample receipt. CHT also provided technical assistance in review of the cases that tested positive.

Analytic Methods

The analytic scheme used by CHT was similar to that presented by Crouch in 1983 (Crouch and others 1983). The complete list of drugs for which samples were tested, the screening procedure, technique, and sensitivity, the confirmation procedure, technique and sensitivity are contained in the analytic plan in appendix C. In addition, appendix E provides a summary of the source, major physical and behavioral effects, and pharmacokinetics of many of the drugs included in the NTSB testing protocol.

Screening/Confirmation Test Sensitivity

The cutoff concentrations for screening and confirmation tests required by DOT regulation are substantially different from the cutoff concentrations used in this study as indicated in the table below:

Table 5.--DOT-NTSB toxicological test sensitivity comparison for drugs included in the DOT regulations

Drug	Screen sensitivity threshold		Confirmation sensitivity threshold	
	DOT (urine ng/ml)	NTSB (blood ng/ml)	DOT (urine ng/ml)	NTSB (blood ng/ml)
Marijuana/metabolite (COOH)	100	25	15	1.0 2.0 (COOH)
Cocaine/metabolite	300	25	150	25
Opiate metabolites	300	50	300	25
Phencyclidine(PCP)	25	10	25	10
Amphetamines	1,000	100	500	50

While the DOT sensitivity concentrations apply to urine tests and the NTSB concentrations apply to blood tests, the substantially higher cutoff concentrations for the DOT drug testing regulations are a concern to the Safety Board. High cutoff concentrations are too limiting to allow for a complete assessment of performance decrement. In general, urine measurement cannot be used to establish that impairment is present. A drug blood concentration is required. However, under certain circumstances, urine measurement may be used, although with less reliability. The different cutoff concentrations indicate the different purposes for which the DOT standards and this study were developed. If the DOT regulation concentrations had been used for postaccident testing in this study, many of the drug of abuse positive (DOAP) drivers would not have been detected.

Review Procedures

Safety Board and consultant staff reviewed factual and toxicological data to obtain the most accurate assessment of the role of alcohol and other drugs and potential impairment in each drug positive case.

The Safety Board, in conjunction with the National Institute for Drug Abuse (NIDA) and CHT, convened three scientific review panels to review the accident investigative information and toxicological results to establish whether impairment occurred as a result of drug use and what role alcohol or other drug impairment may have had in the accident. The scientific review panels consisted of forensic toxicologists and experts on the effects of drugs on human performance. Safety Board, CHT, and NIDA staff also participated in the reviews. Members of the scientific review panel are listed in appendix F of this report.

The procedure followed in each panel was the same. First, Safety Board staff provided the investigative factual information. Second, they answered any questions on the meaning or interpretation of factual information. Third, the toxicological results were presented and discussed. Fourth, questions regarding testing procedures, drug effects and interactions, sample quantities, and other sample characteristics were answered by CHT staff. Fifth, any relevant research on drug impairment, time of

consumption/ingestion, fatigue, and related issues was discussed. Finally, a consensus regarding the likelihood of impairment in each accident was reached.

Safety Board staff also conducted a technical review of each case to assess the quality of the information and to determine whether specific factors seemed to contribute to the accident. Such reviews identified potential study issues in addition to the role of alcohol and other drugs. Potential study issues include fatigue, medical issues, vehicle conspicuity, crashworthiness, carrier oversight, training, and others.

The final joint review process conducted by the Safety Board staff was a review of the scientific review panel recommendations, the technical reviews, and all available case file information to develop a proposed probable cause statement for each accident for consideration by the members of the Safety Board. This statement is part of each accident case summary. All case summaries are in a companion volume to this report.

CHAPTER 4

ALCOHOL AND OTHER DRUG ACCIDENT ANALYSIS

The primary purpose in investigating fatal-to-the-driver heavy truck accidents was to assess the role that alcohol and other drugs played in these accidents. Fatal-to-the-driver heavy truck accidents in the eight States represent approximately 25 percent of this type of accident nationwide. While the Safety Board considers this a significant portion of the total fatal-to-the-driver accidents, it is not a random sample from the annual population of fatally injured truck drivers. However, because of the large sample size and methodology, the Safety Board believes that these accidents are representative of such truck accidents nationwide. The Safety Board does not suggest that fatal-to-the-driver heavy truck accidents are representative of all fatal truck accidents. The accidents are a census of fatal-to-the-driver heavy truck accidents in these States in the year of the study, and their number appears to be consistent with past years. The Safety Board cautions readers to avoid generalizing the results of the analysis of these fatal accidents to either all fatal truck accidents or all fatal accidents.

Figure 2.--Heavy truck multiple vehicle accident
in which the truck driver was the only fatality
1969 Mack tractor with loaded 48 foot trailer
2.6 miles east of Claremont, NC
July 27, 1988

Other data on alcohol and other drug use were obtained in many cases by Safety Board investigators with the cooperation of State and local coroners and medical examiners. However, because of the variability in State tests, they were not included in the analysis. State toxicological test results were used in the determination of probable cause of the accident. State toxicological tests are contained in appendix I and discussed further in this chapter.

Overall Analysis

For the purposes of this study, drugs of abuse (DOA) include the following drugs identified in case drivers by toxicological tests: alcohol, cannabinoids, cocaine, amphetamines, methamphetamine, ephedrine, pseudoephedrine, phenylpropanolamine, opiates (codeine), and phencyclidine. Some of these drugs, including ephedrine, pseudoephedrine, phenylpropanolamine, and codeine are available in over-the-counter medications. These same drugs, as well as amphetamines, are also available as prescription medications. Alcohol is contained in many medications as well as in beverage form. Cocaine, marijuana, methamphetamine, and phencyclidine are illicit drugs. Drugs of abuse are used separately or in compounds, e.g. ephedrine and amphetamine compounds. Barbiturates and benzodiazepines and other drugs are also drugs of abuse; however, none of these drugs were identified through CHT toxicological tests. Drug abuse positive cases are referred to in text as DOAP cases for the purpose of brevity. In addition, a positive toxicological test (for drugs on the Safety Board analytic plan) may result from the presence of common drugs such as caffeine, salicylates (aspirin), acetaminophen, and ibuprofen. While such drugs can be abused, they are not considered drugs of abuse for this study.

Samples from 112 case drivers tested by CHT were found positive for <u>any</u> drug on the Safety Board analytic plan. Fifty-six of the 112 drug positive case drivers involved drugs of abuse. The 56 drivers who tested positive for drugs of abuse represent 33 percent of the 168 cases for which partial CHT toxicological results were obtained.

Although additional types of drugs and/or numbers of drug positive cases were identified through State toxicological tests, these data are not included in our analysis. As a result, the Safety Board believes that the alcohol and other drug prevalence discussed in this study is conservative and would constitute the lower limit of drug prevalence for this type of accident in these States.

Using the conservative approach described above, marijuana and alcohol are the most frequently used DOA among the fatally injured truck drivers, followed by cocaine, OTC stimulants, amphetamines, opiates, and hallucinogens. Drugs of abuse are listed in the table below.

Table 7.--Drugs of abuse

Drug[11]	Number of complete tests	Drivers positive	Percent positive
Marijuana (THC & COOH)	164	21	12.8
Alcohol	168	21	12.5
Cocaine/Metabolites	165	14	8.5
Meth/Amphetamine	164	12	7.3
OTC Stimulants	164	13	7.9
Ephedrine	164	8	4.9
Pseudoephedrine	164	6	3.7
Phenylpropanolamine	164	2	1.2
Codeine	157	1	.6
Phencyclidine (PCP)	168	1	.6

Analysis By Drug

Drivers in this study tested positive for the following drugs:

Marijuana prevalence.--Marijuana and/or its metabolite was identified in 21 of the 164 drivers for whom such tests were conducted. The relatively high prevalence (13 percent) of marijuana use among all fatally injured truck drivers is similar to alcohol prevalence and only slightly lower than the 15 percent level found by Lund and others in their survey of tractor-trailer drivers in Tennessee. This may be age-related since drug users among truck drivers in this study tend to be younger (see analysis below).

Case 005 provides an example of youth, inexperience, and drug use. In this case, the driver, a recent graduate of an advanced tractor-trailer course, with no driving experience, was on his first trip through the Colorado mountains. Fellow drivers advised him to stay on the interstate highways. The crash occurred on U.S. Route 160 west of Wolf Creek Pass on a 7 percent downgrade. The truck rolled on its right side while in a left horseshoe turn, hit a guardrail, struck the mountainside and slid 350 feet down into a crevasse (See Figure 2). The driver tested positive for cocaine, benzoylecgonine (metabolite of cocaine), marijuana, and marijuana metabolite. A syringe found in the driver's suitcase contained cocaine residue. Marijuana and cocaine levels indicated recent use.

Alcohol prevalence.--In this study, alcohol was identified in 21 of the 168 (13 percent) drivers for whom such tests were conducted. This compares

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[11] Throughout the analyses, cocaine and its benzoylecgonine metabolite are combined as are delta-9-tetrahydrocannibol (THC) and its carboxylic acid metabolite (COOH). Similarly, methamphetamine and amphetamine, while separate drugs, are combined because methamphetamine metabolizes into amphetamine. Therefore, the presence of amphetamine could mean either ingestion of amphetamine or ingestion of methamphetamine which metabolized into amphetamine. The differences in subjective effects are minimal.

Figure 3.--Case 005 fatigue-multiple drug use-driver inexperience accident
1987 Peterbuilt tractor and loaded 48 foot trailer
16 miles east of Pagosa Springs, CO
October 9, 1987

with the 15 percent alcohol involvement in fatal truck accidents reported by FARS. The mean alcohol concentration for the alcohol positive drivers in this study was 0.15 percent BAC. These findings indicate the resistance of alcohol abusers to deterrence efforts by Federal, State, and local law enforcement actions. Federal regulations mandate removal from service if a commercial driver tests positive for alcohol and a 1 year suspension if the test results are 0.04 percent BAC or higher. Alcohol is a central nervous system depressant which would enhance fatigue and therefore limit the ability to drive.

Stimulant prevalence.--It was expected that stimulants such as methamphetamine, amphetamine, ephedrine, cocaine, and caffeine would be identified as the principal class of drugs in the fatally injured truck driver population because in a truck driver survey conducted by the Regular Common Carrier Conference, these drugs were perceived by at least some drivers as beneficial in reducing fatigue and enhancing performance. Of the 56 DOA positive cases, 33 involved stimulants. Fourteen involved cocaine and 12 involved prescription stimulants. Thirteen cases involved OTC stimulants, but five of those were also positive for prescription stimulants. Therefore, 12 percent (20 of 164) of the cases for which complete stimulant tests were performed involved prescription (12 cases) or OTC stimulants (8 cases). Caffeine is not included in this number because it is not usually a drug of abuse and will be addressed separately.

The most frequently identified OTC stimulants were ephedrine and pseudoephedrine. Ephedrine is a common, non prescription stimulant found in both licit and illicit compounds. Ephedrine was identified in eight cases. Pseudoephedrine is a common, non-prescription, decongestant which is classed as a stimulant. Pseudoephedrine was identified in six cases. In most of these cases, pseudoephedrine was either the only drug found or was one of several stimulants, such as caffeine or phenylpropanolamine.

Multiple drug use.--Of the 56 drivers who were positive for drugs of abuse, 23, or 41 percent, were multiple drug users. In 6 of the 23 multiple drug cases (26 percent), the case driver tested positive for three or more drugs of abuse. Of the 23 multiple drug users, 8, or 35 percent, tested positive for alcohol. The average blood alcohol concentration of the alcohol-multiple-drug group was 0.13 percent. Only two drivers of the alcohol-multiple-drug group had a BAC below 0.10 percent. Other studies of alcohol and other drug use among all fatally injured drivers have identified alcohol as one of the drugs in 50-70 percent of the multiple drug users. While 35 percent is substantially lower than previous studies, the reason for the difference is unknown. Alcohol-involved multiple drug use is a substantial percentage of all multiple drug use and comprises over one-third of all multiple drug users in this study.

Detection of drug-impaired drivers is more difficult and requires more extensive police training than detection of alcohol-impaired drivers. Because of the high incidence of alcohol used in combination with other drugs, in cases where alcohol is detected, police and motor carrier inspectors should be alert to the possibility of the presence of other drugs. To identify multiple-drug-impaired drivers and to provide a deterrence, motor carrier inspectors could be trained in techniques such as

NHTSA's Standardized Field Sobriety Test (including horizontal gaze nystagmus) and Drug Recognition Expert (DRE) programs.

Other drug positive tests.--Phencyclidine (PCP) was identified in only one case. However, that case driver was a multiple drug user who also tested positive for benzoylecgonine, a metabolite of cocaine. Antihistamines were identified in only one case. There is only one case driver who used any of the opiate compounds (codeine). That driver is likely to have been taking cold medication since he also tested positive for chlorpheniramine, one of the antihistamines. As with the sedative/tranquilizers, the central nervous system depressant effects of the opiate compounds would limit the ability to drive. Analgesics, such as salicylates, acetaminophen, and ibuprofen, were identified in 13 cases. No anticonvulsants were identified.

Caffeine prevalence.--The drug which was most frequently identified in this study was caffeine. Caffeine was identified in 35 percent (56 of 159) of those for whom such tests were performed. Five fatally injured drivers had caffeine levels ir excess of 5,000 ng/mL. While it is difficult to give an exact comparison between nanograms/mL and cups of coffee, the average cup of coffee or tea in the United States contains between 40 and 100 milligrams of caffeine. Researchers have administered caffeine to subjects, tested plasma concentrations, and determined that 120 milligrams (1-3 cups of coffee) gives a plasma concentration of 3,000 ng/mL within 1 hour and 2,500 ng/mL within two hours. Based on this research, 5,000 ng/mL roughly equates to consuming between 2 and 6 cups of coffee within two hours. It is likely that such high concentrations were reached by using caffeine tablets alone or in combination with beverages containing caffeine. While caffeine can be abused, the highest concentration recorded in this study was 16,000 ng/mL which is far below the toxicity level of 55,000 ng/mL. A concentration of 16,000 ng/mL could be considered abusive because of the central nervous system effects of this amount. That driver also had high levels of methamphetamine/amphetamine and ephedrine. Another driver had a high caffeine level in combination with high levels of marijuana and methamphetamine/amphetamine. Two of the five accidents (with high levels of caffeine) clearly involved driver fatigue while two of the remaining three accidents involved combinations of drugs usually taken as stimulants to fend off the symptoms of fatigue. It is not unexpected that 80 percent of the drivers with very high caffeine levels were involved in fatigue-related accidents.

Sedative/tranquilizer prevalence.--No barbiturates and no benzodiazepines (diazepam, flurazepam, and chlordiazepoxide) were identified in the CHT tested fatally injured truck drivers. These drugs function as sedatives, hypnotics, or anxiolytics which relax muscles and/or depress the central nervous system. Use of these drugs would limit the truck driver's ability to drive safely. In two cases, State toxicological screening tests identified the presence of barbiturates. However, the presence was not confirmed and quantified by the Center for Human Toxicology.

State-by-State Analysis

The number of accidents that occurred and the number of toxicological tests conducted in each State varied substantially. The table below shows

the number of cases in each State and the percent of case drivers in the study from each State.

Table 8.--Cases by state

State of accident	Case drivers	Percent of total drivers
CA	75	40.5
CO	4	2.2
GA	28	15.1
MD	9	4.9
NC	25	13.5
NJ	9	4.9
TN	21	11.4
WI	14	7.6
Total	185	100.0

DOA positive cases were compared with the number of toxicological tests in each State. The effects of small numbers of tests and DOA positives are evident in the range of percentages in table 9.

Table 9.--Frequency of drug positive drivers in each state

State	Number of toxicological tests	Number positive for drugs of abuse	Percent positive for drugs of abuse
CA	71	27	38.0
CO	4	2	50.0
GA	24	7	29.2
MD	9	5	55.6
NC	25	6	24.0
NJ	4	1	25.0
TN	18	7	38.9
WI	13	1	7.7
Total	168	56	33.3

A chi square test was performed to determine if State DOA positive distributions were significantly different. See appendix K for a discussion of statistical tests. This test indicated that the differences are not statistically significant at the 0.05 level. There was no significant difference in drug of abuse positive tests among the States.

Case drivers testing positive for selected drugs of abuse were analyzed by State of accident. The cocaine positive cases were found primarily in California and Maryland. For amphetamines, virtually all such fatal accidents in this sample occurred in California.

Table 10.--Drug test results by State

	CA		CO		GA		MD		NC		NJ		TN		WI	
Drug	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)
Alcohol	71	3 (4.2)	4	1 (25.0)	24	4 (16.7)	9	3 (33.3)	25	5 (20.0)	4	0	18	5 (27.8)	13	0
Cocaine/Be	71	7 (9.9)	4	1 (25.0)	22	0	9	4 (44.4)	25	1 (4.0)	4	1 (25.0)	17	0	13	0
Meth/Amphetamine	71	10 (14.1)	4	0	22	0	9	0	24	0	4	0	17	1 (5.9)	13	1 (7.7)
Marijuana(THC/COOH)	70	11 (15.7)	4	1 (25.0)	22	2 (9.1)	9	2 (22.2)	25	3 (12.0)	4	1 (25.0)	17	1 (5.9)	13	0
Opiates	71	1 (1.4)	4	0	15	0	9	0	24	0	4	0	17	0	13	0
Other DOA	71*	8 (11.3)	4*	0	24*	2 (8.3)	9*	1 (11.1)	25*	1 (4.0)	4*	0	18*	3 (16.7)	13*	0
Any Drug of Abuse	71*	27 (38.0)	4*	2 (50.0)	24*	7 (29.2)	9*	5 (55.6)	25*	6 (24.0)	4*	1 (25.0)	18*	7 (38.9)	13*	1 (7.7)

* The number of tests used to compute percent positive is the number of drivers tested for at least one drug.

State of License Comparison with State of Accident

Since heavy truck operation frequently involves regional or long haul driving, the Board reviewed involvement of out-of-State driver drug use in fatal accidents. Overall, 64 percent (36 of 56) of all drivers testing positive for drugs of abuse were licensed in the State in which the accident occurred. Nine percent (5 of 56) of the DOA positive drivers held multiple valid licenses. Four percent (2 of 56) had no valid license. The table below provides a comparison.

Table 11.--State of license-state of accident comparison: drivers positive for drugs of abuse

		Positive for drug of abuse			
Accident State	Total drivers	Number	License same as accident State	Other state or no license	Multiple valid licenses
California	75	27	21	AZ, NM(3), TX(3), WA, 1-no valid lic	3
Colorado	4	2	0	IN, TX	0
Georgia	28	7	6	AL(2)	1
Maryland	9	5	3	AL, NJ,	0
North Carolina	25	6	3	GA, MS, 1-no valid lic	0
New Jersey	9	1	1	MA	1
Tennessee	21	7	2	IN, NJ, OH, TX, WV	0
Wisconsin	14	1	0	SD	0
Total: 8 States	185	56	36	25	5

Single vs. Multiple Vehicle Analysis

Because accidents which are fatal to drivers of heavy trucks are a small percentage of heavy truck fatal accidents, it is possible that drug of abuse prevalence might be affected by certain characteristics of these accidents. FARS data on 1988 fatal accidents involving a medium or heavy truck indicates that 38 percent were single vehicle accidents (truck only) and 62 percent were multiple vehicle accidents (truck and another vehicle). The Safety Board investigated 109 single vehicle accidents (60 percent) and 72 multiple vehicle accidents (40 percent). The large number of single vehicle accidents is expected because truck driver fatalities are only 14 percent (1988) of all heavy truck fatalities and truck drivers appear to be more at risk of fatal injury if the truck runs off the road and/or overturns. Low levels of seat belt use among truck drivers and the number of accidents involving occupant protection issues (68 of 185) seem to indicate that a truck driver is most at risk of fatal injury in the roll-over/run-off-the road accident.

The Safety Board conducted an analysis of single and multiple vehicle accidents and drugs of abuse use to determine whether any relationship existed between DOA positive tests and type of accident. However, no statistical differences were identified. A chi square test indicated that drug use was not statistically related to the type of accident at the 0.05 significance level. The table below describes the drug involvement for selected drugs of abuse by type of accident.

Table 12.--Drug test results by type of accident

	Type of Accident			
	Single vehicle		Multiple vehicle	
Drug	tests	pos (%)	tests	pos (%)
Alcohol (Eth)	95	16 (16.8)	67	4 (6.0)
Cocaine/Be	93	9 (9.7)	66	5 (7.6)
Meth/Amphetamine	93	4 (4.3)	65	8 (12.3)
Marijuana(THC/COOH)	92	15 (16.3)	66	6 (9.1)
Opiates	90	1 (1.1)	61	0
Other DOA	95*	9 (9.5)	67*	6 (9.0)
Any DOA	95*	37 (38.9)	67*	18 (26.9)

*The number of tests used to compute percent positive is the number of drivers tested for at least one drug.

Weight of Vehicle Analysis

US DOT drug testing rules apply primarily to drivers of commercial motor vehicles weighing in excess of 26,000 pounds GVWR (49 CFR 383.5 provides a complete definition). An analysis of drug involvement by weight of vehicle driven was conducted to determine DOA positive use among drivers covered by the Federal Motor Carrier Safety Regulations. One hundred forty-two (77 percent) of the case drivers included in this study were driving vehicles over 26,000 pounds GVWR. Of this group, 129 had toxicological tests for at least one drug of abuse. Forty-three (23 percent) of the case drivers were driving vehicles equal to or less than 26,000 pounds GVWR. Of this group, 39 had toxicological tests for at least one drug of abuse. The following table shows the positive toxicological tests and drugs of abuse by vehicle weight.

Table 13.--Positive toxicological tests by truck weight

Weight of vehicle	Toxicological tests	Positive for DOA	Percentage positive
26,000 lbs or less	39	12	30.8
more than 26,000 lbs	129	44	34.1

The drivers of trucks weighing under 26,001 pounds GVWR comprised 23 percent of the total tested case drivers and 21 percent of drivers testing positive for drugs of abuse. Drivers of trucks weighing over 26,000 pounds GVWR comprised 77 percent of the total tested case drivers and 79 percent of drivers testing positive for drugs of abuse. A chi square test was performed to determine whether a relationship exists between the DOA involvement of drivers and weight of vehicle. The test indicated that no statistically significant relationship exists at the 0.05 level.

Table 14 describes the drug involvement for selected drugs of abuse by weight of vehicle.

Table 14.--Drug test results by truck weight

	Truck weight			
	26,000 lbs or less		More than 26,000 lbs	
Drug	tests	pos (%)	tests	pos (%)
Alcohol (Eth)	39	7 (17.9)	129	14 (10.9)
Cocaine/Be	39	5 (12.8)	126	9 (7.1)
Meth/Amphetamine	39	1 (2.6)	125	11 (8.8)
Marijuana (THC/COOH)	37	2 (5.4)	127	19 (15.0)
Opiates	37	0	120	1 (0.8)
Other DOA	39*	3 (7.7)	129*	12 (9.3)
Any DOA	39*	12 (30.8)	129*	44 (34.1)

*The number of tests used to compute percent positive is the number of drivers tested for at least one drug.

As can be seen, virtually all of the amphetamine/methamphetamine cases are drivers of the over 26,000 pound trucks, and a greater percentage of marijuana use was identified in drivers of these heavier trucks. However, a chi square test determined that the difference in amphetamine and marijuana use between drivers of the two vehicle groups was not significant at the 0.05 significance level.

Area of Operation Analysis

Because Federal Motor Carrier Safety Regulations vary in application (weight, number of passengers, hazardous materials placarding, etc.), the Safety Board analyzed positive toxicological tests and drugs of abuse by area of operation. Drugs of abuse involvement by truck drivers in intrastate operations was 34 percent of the total, while such drug involvement was 33 percent in interstate operations. Based on the high incidence of amphetamines, marijuana, and other drugs of abuse in drivers of heavy trucks, it was expected that more stimulant use would be determined in drivers operating in interstate commerce. However, no observed or statistical differences were identified. A chi square test indicated that drug use by area of operation was not statistically different at the 0.05 significance level. The table below describes the drug involvement for selected drugs of abuse by area of operation.

Table 15.--Drug test results by area of operation

Drug	Intrastate tests	Intrastate pos (%)	Interstate test	Interstate pos (%)
Alcohol (Eth)	62	5 (8.1)	102	15 (14.7)
Cocaine/Be	61	7 (11.5)	100	7 (7.0)
Meth/Amphetamine	61	7 (11.5)	99	5 (5.1)
Marijuana (THC/COOH)	60	8 (13.3)	100	13 (13.0)
Opiates	57	0	97	1 (1.0)
Other DOA	62*	6 (9.7)	102*	9 (8.8)
Any DOA	62*	21 (33.9)	102*	34 (33.3)

*The number of tests used to compute percent positive is the number of drivers tested for at least one drug.

Age and Drug Use Analysis

Research from UMTRI cited above indicates that younger operators may be at a higher risk of crash. Other research indicated that the driving-under-the-influence population may differ substantially by age in their drug or drugs of choice. Alcohol is the drug of choice for older drivers and marijuana for younger drivers. Research also indicated that the multiple-drug-using population may be significantly different from the single-drug-using population. For example, multiple-drug users are likely to be younger than single-drug users, depending on the multiple combination of drugs used.

The average age of all fatally injured truck drivers in this study was 42.4 years. The average age of the drug-free truck drivers was 44.8 years. When compared with the ages of single and multiple drug users by choice of drug, there are a number of differences observed.

The single-drug users whose drug of choice is alcohol are considerably older (42.5 years) than any of the single-drug users whose drug of choice is other than alcohol (34.7 years). The "alcohol only" drivers average age is nearly identical to the average age of all drivers in the study (42.5 vs. 42.4 years). The fatally injured truck drivers not using drugs tended to be slightly older than the "alcohol only" drivers (44.8 years). Similarly, the single-drug users whose drug of choice is alcohol are older than any of the multiple-drug users. These results are consistent with prior research regarding age and drug of choice relationships.

Table 16.--Age-drug use comparison for selected drugs

	No.	Mean
Single Drug		
Alcohol(Eth)	13	42.5
Cocaine/Be	4	39.5
Meth/Amphetamine	5	36.4
Marijuana(THC/COOH)	8	31.5
Other DOA	3	45.7
Multiple Drug		
Alcohol(Eth)	8	32.5
Cocaine/Be	10	32.6
Meth/Amphetamine	7	30.3
Marijuana(THC/COOH)	13	34.6
Other DOA	12	32.3
All Drivers	185	42.4
Drivers negative for drugs of abuse	112	44.8
Drivers positive for drugs of abuse	56	36.5

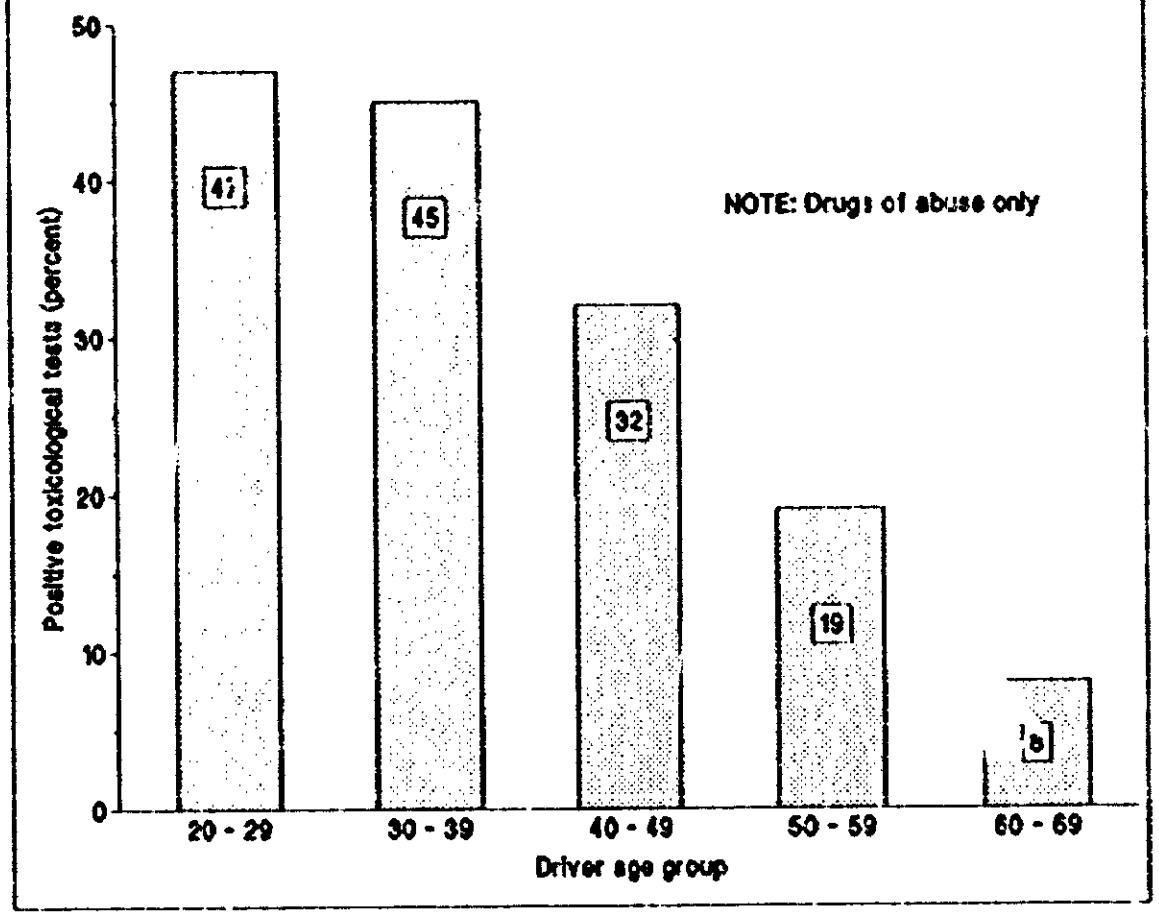
The mean age of drivers testing positive for drugs of abuse (36.5) is substantially lower than that of drug-free drivers (44.8). A "z test" (test of the difference in means) was performed to determine whether a significant difference exists between the two groups. The "z test" indicated that these two groups are statistically different at the 0.05 significance level. Thus, younger drivers in this study were more likely to test positive for drugs of abuse. The table indicates that marijuana users are the youngest of the single-drug users, while amphetamine users are the youngest of the multiple-drug users. A DOA positive test and the drug of choice appear to be related to mean age and to the generation of the driver.

Studies by Cook and Voss reported significantly more illicit drug use in younger employed persons, age 18-34 years. The highest rates of illicit drug use involved marijuana. One in nine employed persons reported current use of marijuana with one in five younger employed persons reporting current use (Gust 1989). In the same monograph, Voss found that daily alcohol consumption was more extensive among older age groups and that drinking patterns differed from marijuana and cocaine use patterns (Gust 1989).

Marijuana users in both the single-drug (31.5) and multiple-drug groups (34.6) are roughly similar in age, but much younger than the drug-free (44.8) drivers. The mean age of amphetamine users in the single-drug group is over 6 years older than that of amphetamine users in the multiple-drug group. Reasons for this difference are not identified. Overall, both multiple and single-drug users are younger than those not using drugs. However, the mean age of the "alcohol only" drivers is substantially older than that of the multiple drug (alcohol) group. The difference may be generational or may reflect attempts by the younger drug users to mask use of illicit drugs by using alcohol, a legal drug.

A final review of the age distributions was conducted by collapsing age groups into decade groups to provide larger groups for analysis. The decade groupings show a consistent decline, as indicated in the following figure in the percent of drivers testing positive for drugs of abuse.

Figure 4.--Drivers with positive toxicological tests by age group as a percentage of drivers with at least one conclusive test



To determine whether the age groups and drug use are statistically dependent, a chi square test was performed. This test indicated that age and DOA positive test results are related in a statistically significant manner at the 0.05 level. Older drivers are less likely to test positive for drugs of abuse than are younger drivers.

Marital Status Analysis

Marital status is a standard demographic factor analyzed to determine if there is any overrepresentation among certain groups. Alcohol and other drug use and abuse create performance, safety, and domestic difficulties for the drug abuser. These difficulties manifest themselves by clustering according to demographic variables such as age, sex, marital status, etc. Single, separated, and divorced men tend to be overrepresented in alcohol-related accidents as they are in many other social and health areas (HEW 1971). The table below shows the number of drivers and toxicological tests, alcohol use, drugs of abuse, and percent drugs of abuse by marital status. Alcohol has been identified as a separate category because of prior research on alcohol prevalence by marital status and because alcohol is a legal, and thus more accepted, drug.

The overrepresentation of alcohol and other drug use among fatally injured drivers by marital status is seen in the comparison table below. A possible effect of the status of alcohol as a legal, and thus more tolerated, drug can be seen when the single, separated, and divorced groups are combined.

Table 17.--Drug test results by marital status

					Not married breakdown					
	Married		Not married		Single		Separated		Divorced	
Drug	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)
Alcohol	102	10 (9.8)	53	9 (17.0)	29	4 (13.8)	6	1 (16.7)	18	4 (22.2)
Drug other than alcohol	102	16 (15.7)	53	24 (45.3)	29*	16 (55.2)	6	3 (50.0)	18	5 (27.8)
Any drug	102	23 (22.5)	53	30 (56.6)	29*	17 (58.6)	6	4 (66.7)	18	9 (50.0)

* The number of tests used to compute percent positive is the number of drivers tested for at least one drug.

A chi square test indicated that these differences are statistically significant at the 0.05 level. Unmarried (single, separated, and divorced) drivers' drug use is significantly greater than that of married drivers. The percentage of drug usage in those who are single, separated, or divorced is nearly twice that of all drivers in the study (60 v. 33 percent). Therefore, DOA use is related to marital status.

Vehicle Configuration Analysis

Research by the University of Michigan (UMTRI) in Washington State and in engineering tests indicates that different vehicle configurations require different levels of skills. Drivers of more complex vehicles requiring greater driving skills may be affected more by drugs of abuse. In an attempt to differentiate drug use by complexity of driving task, the drug involvement by type of vehicle (straight truck, combination unit, doubles, etc.) and type of drug was analyzed. The vehicle configurations in this analysis are representative of the types of vehicles commonly encountered in the traffic flow.

Table 18.--Drug test results by vehicle configuration

Drug test result	Straight truck		Bobtail		Tractor with one trailer		Tractor with two trailers		Other		Total	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Positive	11	33.3	5	45.5	34	33.7	5	22.7	1	100.0	56	33.3
Negative	22	66.7	6	54.5	67	66.3	17	77.3	0	0.0	112	66.7
Total	33		11		101		22		1		168	

A chi square test was performed to determine if the relative drug involvements by vehicle configuration are statistically different. The differences are not statistically significant at the 0.05 level.

Case 128 provides a good example of an alcohol-impaired driver of a relatively unstable vehicle. In this case, the driver of a bobtail tractor, traveling 60-75 miles per hour in a 45 mph zone, went through a red traffic light, entered a left curve, ran off the road, struck a road sign, reentered the roadway, struck a passenger car, veered off the road again, and plunged 25 feet into a flood control channel. From 7:30 am to 11:00 am, the driver and helper had loaded and delivered produce, dropped the trailer at the terminal and returned the helper to his home. The driver left the helper's home about 1:00 pm and had the crash about 1:15 pm. Toxicological testing revealed that the driver had a 0.20 blood alcohol concentration. The helper stated that no alcohol had been consumed during the time they were together. Any BAC could impair the driver's ability to operate the tractor. A BAC five times the legal commercial driver level and twice the level for automobile drivers would be more indicative of the driver's dependency on that drug. Records checks indicated one prior accident, one driving while intoxicated (DWI) conviction, and two other violations.

While any use of drugs by commercial vehicle drivers is disturbing, the high percentage of alcohol involvement across all vehicle configurations is especially surprising because of the difficulty of driving heavy trucks and the depressant effects of alcohol and some other drugs. The use of stimulants such as amphetamines when fatigued is an especially dangerous combination for any truck driver. Stimulant use attempting to compensate for fatigue is even more dangerous for "doubles" drivers because of the inherent complexity in driving these trucks and the attention required.

Table 19.--Drug test results by vehicle configuration

	Straight truck		Bobtail		Tractor with one trailer		Tractor with two trailers		Other	
Drug	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)
Alcohol	33	6 (18.2)	11	2 (18.2)	101	13 (12.9)	22	0	1	0
Cocaine/Be	32	3 (9.4)	11	1 (9.1)	100	10 (10.0)	21	0	1	0
Meth/Amphetamine	32	2 (6.3)	11	0	99	5 (5.1)	21	4 (19.0)	1	1 (100.0)
Marijuana(THC/COOH)	31	5 (16.1)	10	0	100	14 (14.0)	22	2 (9.1)	1	0
Opiates	29	0	10	1 (10.0)	96	0	21	0	1	0
Other DOA	33*	3 (9.1)	11*	2 (18.2)	101*	8 (7.9)	22*	2 (9.1)	1*	0
Any Drug of Abuse	33*	11 (33.3)	11*	5 (45.5)	101*	34 (33.7)	22*	5 (22.7)	1*	1 (100.0)

* The number of tests used to compute percent positive is the number of drivers tested for at least one drug.

Time of Day and Day of Week Analysis

Time of day and day of week are standard measures of accident incidence. Such data are used in a variety of ways, but especially for planning enforcement activities.

Time of Day--Drug incidence data by time of day seems to be of limited value. Sample sizes are small, and the only apparent variability is with alcohol, marijuana, and other drugs of abuse (primarily OTC stimulants). Alcohol incidence is lowest in the late morning period and increases to a high point from 6 pm to midnight and then declines in early morning to a level equal to the afternoon level. The time period with the highest percentage of alcohol accidents is similar to that of alcohol involvement in all motor vehicle accidents. Marijuana incidence is similar to that of alcohol in that 6 pm to midnight is the time period of highest incidence. The percent of marijuana involvement in other time periods is approximately equal. Other drugs-of-abuse incidence is highest in the 6 pm to midnight time period as well. The higher percentage of drug involvement in this time period indicates that it is the period when drug-involved truck drivers are most at risk of a fatal accident. The table below shows the distribution of drugs of abuse by time of day.

Table 20.--Drug test results by accident time period

	Accidents Occurring Between							
	12:01 am-6:00 am		6:01 am-12:00 noon		12:01 pm-6:00 pm		6:01 pm-12:00 mid	
Drug	tests	pos(%)	tests	pos(%)	tests	pos(%)	tests	pos(%)
Alcohol	37	5(13.5)	50	2(4.0)	51	7(13.7)	30	7(23.3)
Cocaine/Be	36	3(8.3)	49	4(8.2)	51	5(9.8)	29	2(6.9)
Meth/Amphetamine	36	3(8.3)	49	4(8.2)	50	3(6.0)	29	2(6.9)
Marijuana(THC/COOH)	36	5(13.9)	50	5(10.0)	49	5(10.2)	29	6(20.7)
Opiates	36	1(2.8)	43	0	50	0	28	0
Other DOA	37*	4(10.8)	50*	4(8.0)	51*	1(2.0)	30*	6(20.0)
Any DOA	37*	11(29.7)	50*	12(24.0)	51*	19(37.3)	30*	14(46.7)

* The number of tests used to compute percent positive is the number of drivers tested for at least one drug.

To determine whether the distributions of drug use over time are statistically different, a chi square test was performed. The test showed that the distributions are not statistically different at the 0.05 significance level.

A closer review of DOA positives by hour of the day determined that 70 percent of the DOA positives occurred during one of the following time periods: 9:00-9:59 am; 1:00 pm-3:59pm; and 6:00 pm-1:59 am. A review of all fatal accidents in 1988 from FARS indicated that 58.2 percent of all fatal accidents occurred during these hours. Further analysis of medium and heavy truck fatal accidents in 1988 indicated that 47.5 percent of such fatal

accidents occurred during these hours. The differences observed in the time of day in which fatal-to-the-driver heavy truck accidents occur may be useful in scheduling enforcement activities.

Figure 5a shows all test results with positive tests shown as a component of all tests. Figure 5b identifies the proportion of drug positive tests by hour of the day.

Figure 5a.--Toxicological test results by hour of day for drivers with at least one conclusive test

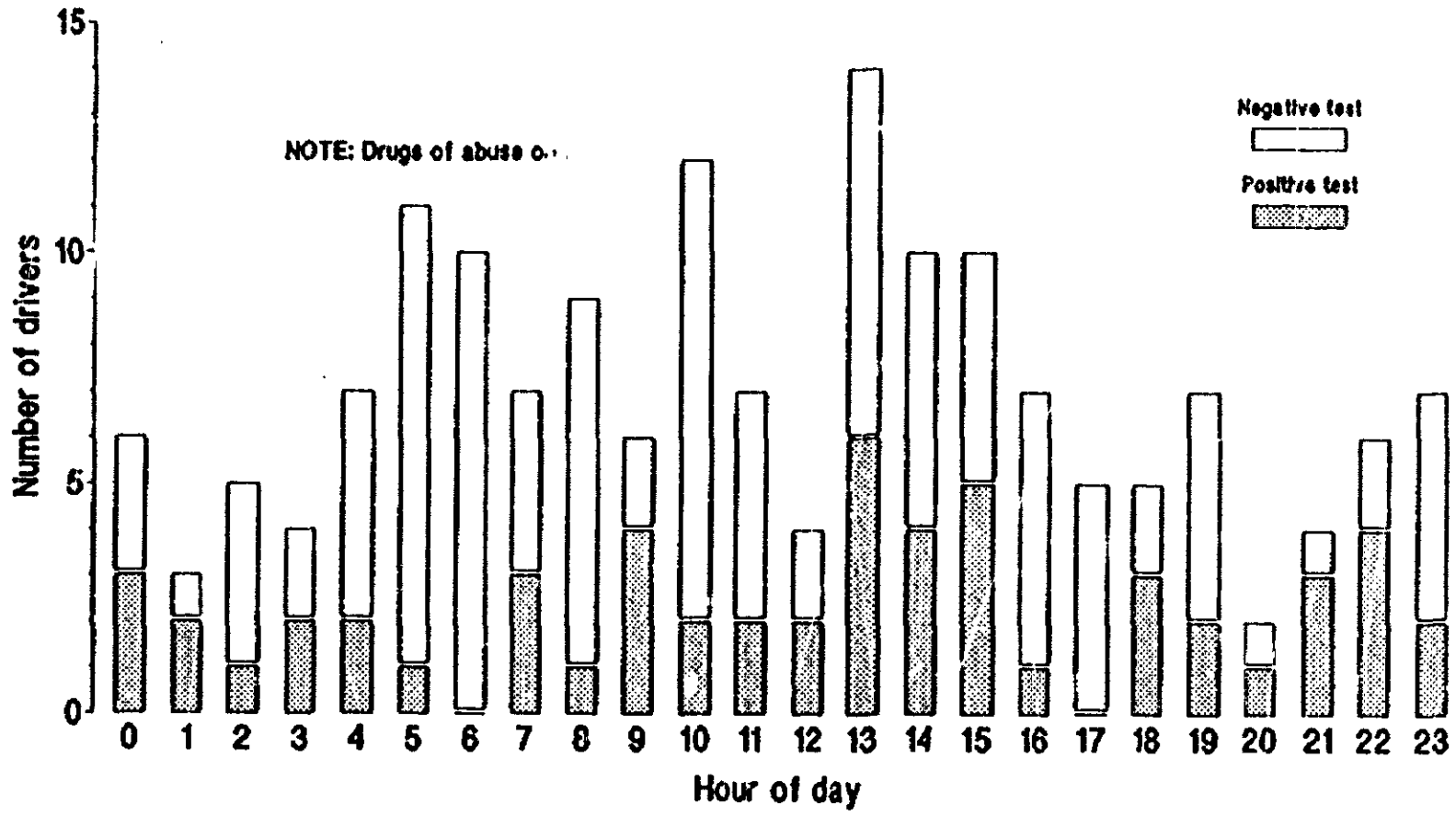
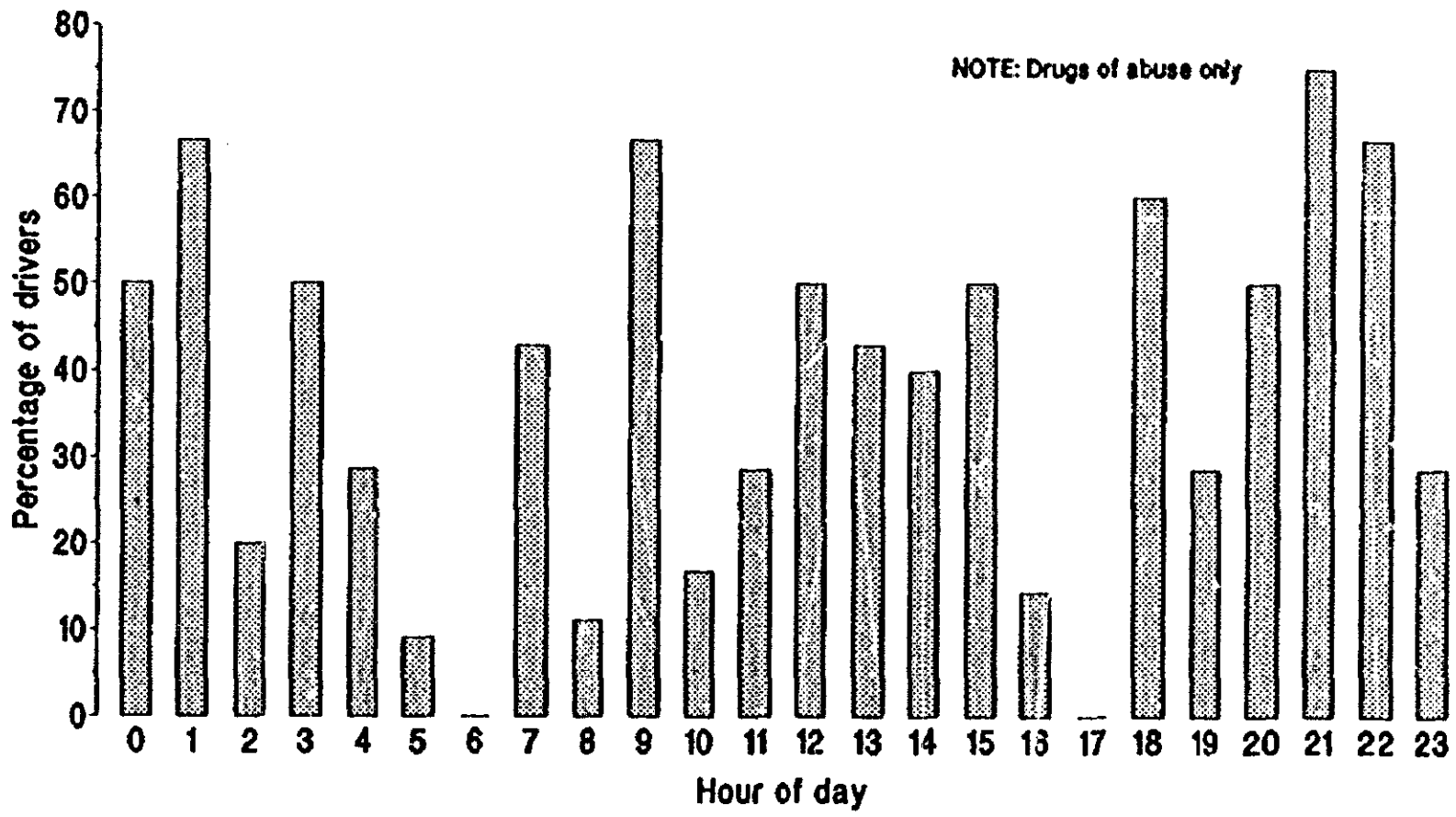


Figure 5b.--Percentages of drug positive drivers by hour for drivers with at least one conclusive test



The trucking industry operates 7 days per week. However, most trucking operations are concentrated in 5 days, Monday through Friday. In reviewing DOA positive cases by time of day for Monday through Friday, some differences in the times of DOA positive cases were identified. For example, 71 percent of the DOA positive cases occurred in the following time periods: 7:00 am--9:59 am; 1:00--3:59 pm; 7:00--11:59 pm. Figure 6a identifies total drug tests by time of day, Monday through Friday, with positive tests as a component of the total. Figure 6b shows the proportion of drug-positive tests by hour of the day, Monday through Friday.

Figure 6a.--Toxicological test results by hour of day for drivers with at least one conclusive test; accidents which occurred between Monday and Friday

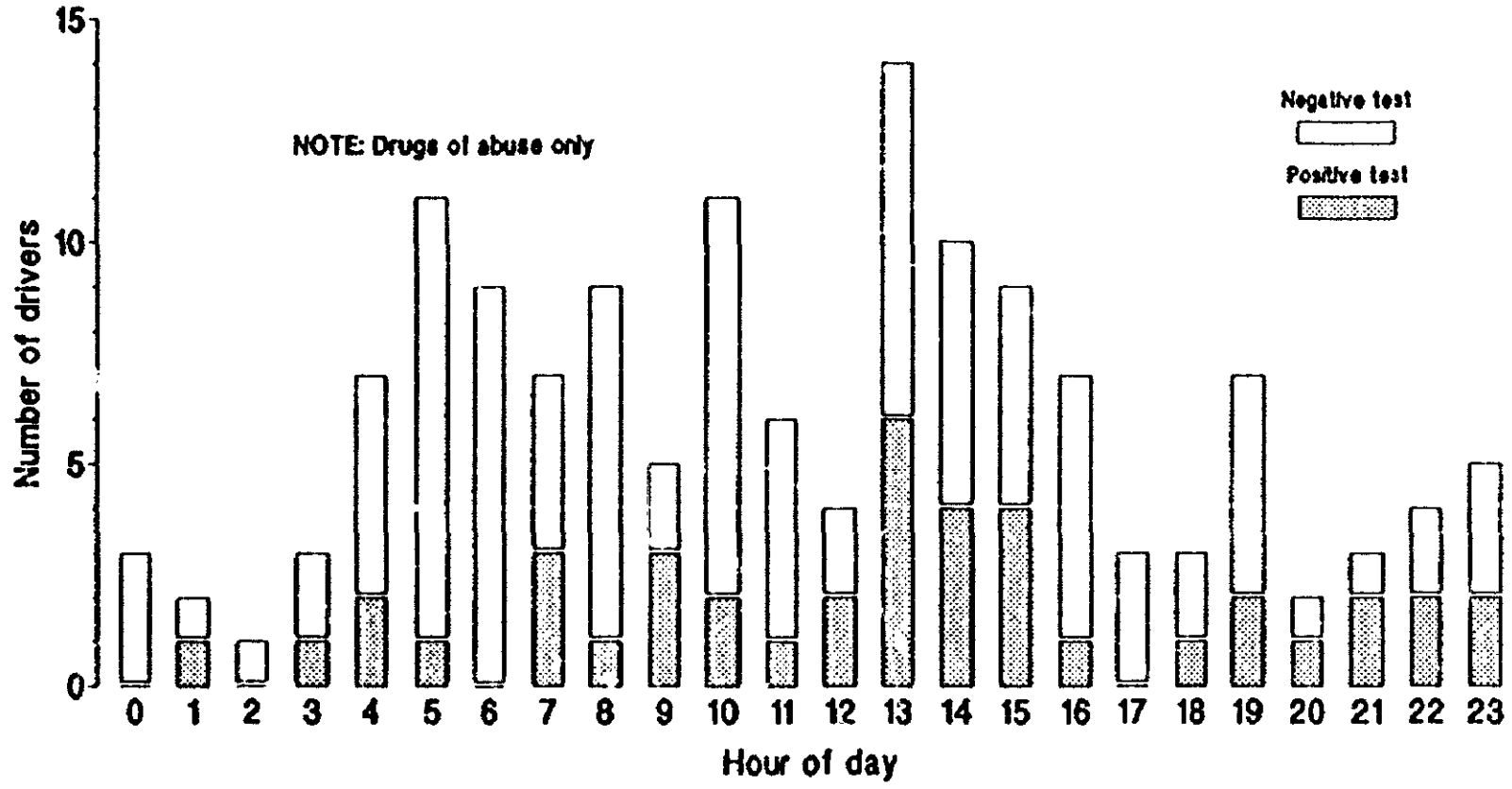
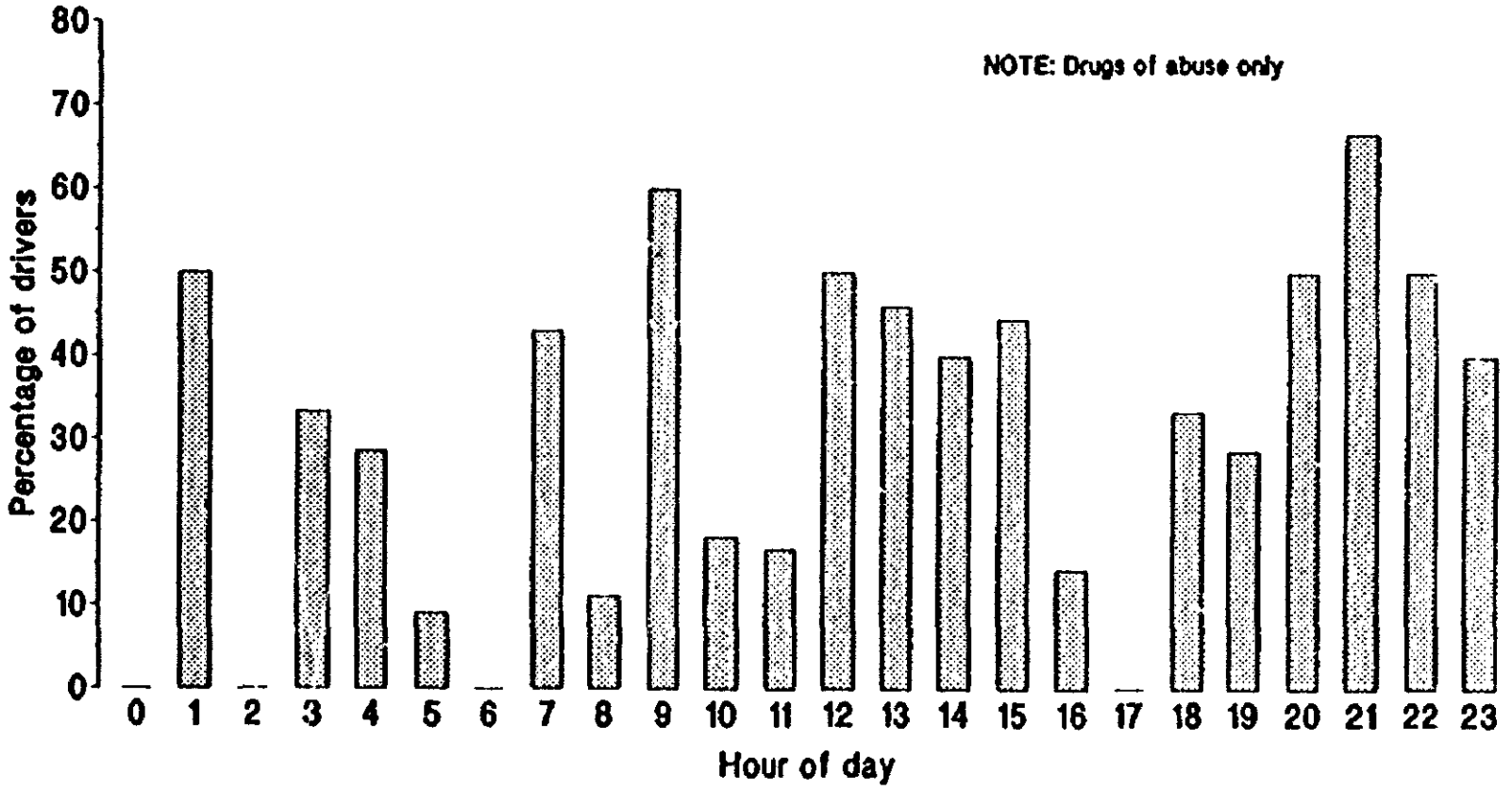


Figure 6b.--Percentages of drug positive drivers by hour for drivers with at least one conclusive test; accidents which occurred between Monday and Friday



Day of Week.--Given the nature of the trucking industry, it is not surprising that most fatal accidents occurred on weekdays, rather than on weekends, as is the situation with automobile fatal accidents. Both fatal accidents and those involving drugs of abuse occur most frequently on Mondays. The percentages of drug-involved accidents aries greatly from a low of 21 percent on Tuesday and increases to 53 perc nt on Saturday and 83 percent on Sunday. Drug involvement as a percentage of accidents by day of week is highest on Saturday (including Friday after midnight) and Sunday (including Saturday after midnight).

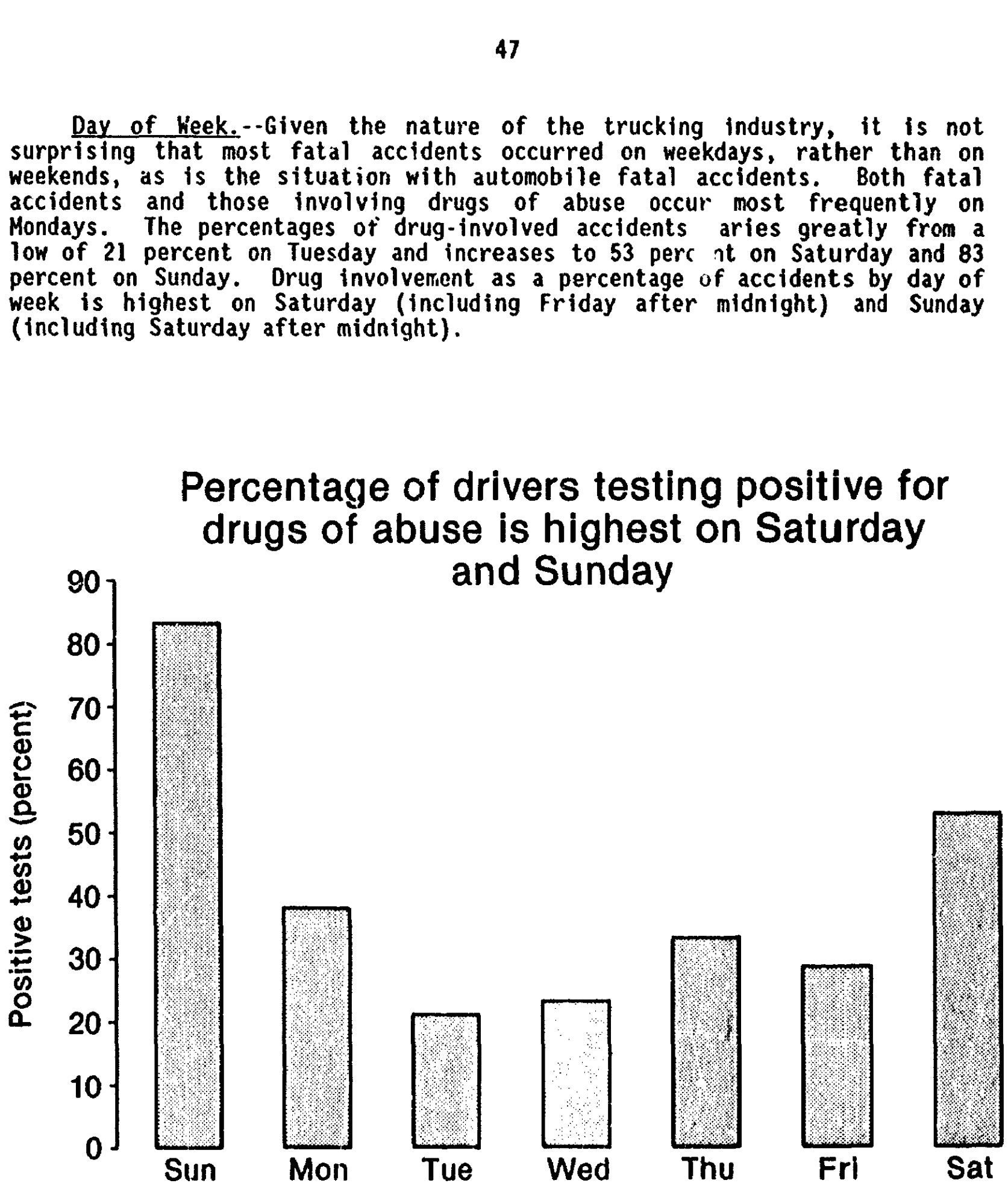


Figure 7.--Drug prevalence by day of the week

Table 21.--Drug test results by day of the week

Day of the week	Drivers	Any DOA tests	Any DOA pos(%)	Alcohol tests	Alcohol pos(%)
Monday	39	34	13 (38.2)	34	5 (14.7)
Tuesday	35	33	7 (21.2)	33	3 (9.1)
Wednesday	32	30	7 (23.3)	30	1 (3.3)
Thursday	30	27	9 (33.3)	27	2 (7.4)
Friday	25	21	6 (28.6)	21	1 (4.8)
Saturday	17	17	9 (52.9)	17	5 (29.4)
Sunday	7	6	5 (83.3)	6	4 (66.7)

To determine whether the distributions of DOA positives by day of the week are statistically independent, a chi square test was performed. The test showed that the distributions are statistically dependent at the 0.05 significance level. That is, DOA use is related to the day of the week.

Alcohol involvement among fatally injured truck drivers also clusters on the weekend as does alcohol involvement in other highway crashes. Information concerning alcohol and other drug use frequency by day of week may provide some assistance in planning enforcement activities.

Vehicle Ownership Analysis

The trucking industry is divided into two major types of carriers, private and for-hire carriers. Approximately one-half of all combination trucks are owned by private carriers and private carriers account for about 40 percent of combination truck mileage. For-hire carriers own a similar number of combination trucks, but account for 60 percent of combination truck miles traveled. An estimated 100,000 owner-operators are in the for-hire group and account for an estimated 10-15 percent of the nearly 50 million for-hire miles traveled annually (Transportation Research Board, 1989).

An analysis of vehicle ownership determined that 15 percent of the fatally injured drivers were owner operators; 16 percent were owned by leasing companies; and 61 percent were owned by carriers. The vehicles identified as being owned by leasing companies are likely to be distributed between owner drivers and carriers; however, information upon which to make that distribution is unavailable. Good information is available on vehicle ownership in the carrier and owner operator groups. Therefore, the frequency of owner operators and carrier ownership determined in this study is likely to be conservative.

As shown below, 13 percent (7 of 56) of drivers testing positive for drugs of abuse were owner operators. Of the drivers for whom tests were obtained, 30 percent of the owner operators tested positive for a drug of abuse (primarily alcohol) and 36 percent of carrier employed drivers tested positive for a drug of abuse (primarily marijuana). Stimulant and cocaine use are also high among this group. As noted above, 33 percent of all drivers in this study tested positive for drugs of abuse.

The table below addresses drug prevalence by type of ownership and type of drug. The highest percentage of drug mentions is for alcohol among the driver-owners and alcohol and marijuana among the drivers of vehicles owned by carriers.

Table 22.--Drug test results by vehicle ownership

	Vehicle owner							
	Driver		Leasing company		Carrier		Other	
Drug	tests	pos(%)	tests	pos(%)	tests	pos(%)	tests	pos(%)
Alcohol	23	5(21.7)	26	2(7.7)	105	12(11.4)	14	2(14.3)
Cocaine/Be	23	0	24	2(8.3)	105	11(10.5)	13	1(7.7)
Meth/Amphetamine	23	1(4.3)	24	2(8.3)	105	7(6.7)	12	2(16.7)
Marijuana(THC/COOH)	23	0	24	2(8.3)	103	17(16.5)	14	2(14.3)
Opiates	23	0	25	0	96	1(1.0)	13	0
Other DOA	23*	2(8.7)	26*	2(7.7)	105*	10(9.5)	14*	1(7.1)
Any DOA	23*	7(30.4)	26*	6(23.1)	105*	38(36.2)	14*	5(35.7)

* The number of tests used to compute percent positive is the number of drivers tested for at least one drug.

To determine whether the differences in the percent of DOA positives were related to vehicle ownership, a chi square test was performed. The test indicated that the differences are not statistically significant at the 0.05 level.

Alcohol/Drug Abuse History Analysis

The National Highway Traffic Safety Administration has estimated that the likelihood of arrest for an alcohol-related offense, generally defined as DWI at 0.10 percent BAC or above, to be between 1 in 200 and 1 in 2000. Safety professionals from NHTSA believe that an alcohol-related arrest is an infrequent event considering the probable number of alcohol-impaired trips (NTSB 1984). Therefore, prior offenses or a history of alcohol or drug abuse are generally considered to be good indicators of a substance dependency problem and predictors of subsequent offenses. Safety Board investigators were able to obtain such information on 154 of the fatally injured case drivers.

Case 28 provides a good example of a driver whose driving record indicated a substance abuse problem. In this case, the driver was northbound on I-5 in Westley, California traveling in excess of 65 miles per hour and weaving. Fellow drivers tried, by radio, to get the driver to pull over and rest. The driver ran off the travelled way and collided with a parked and properly marked (flashers and triangles) truck. The driver was killed in the ensuing fire. He had driven 3,824 miles in the previous 7 days and had loaded and unloaded some shipments. His Arkansas license had been suspended for his failure to pay speeding tickets in Texas and Tennessee. From 1979 to the time of the accident, the records indicated 11 suspensions, 6 DWI convictions, 9 speeding violations, 5 driving-while-suspended citations, 1

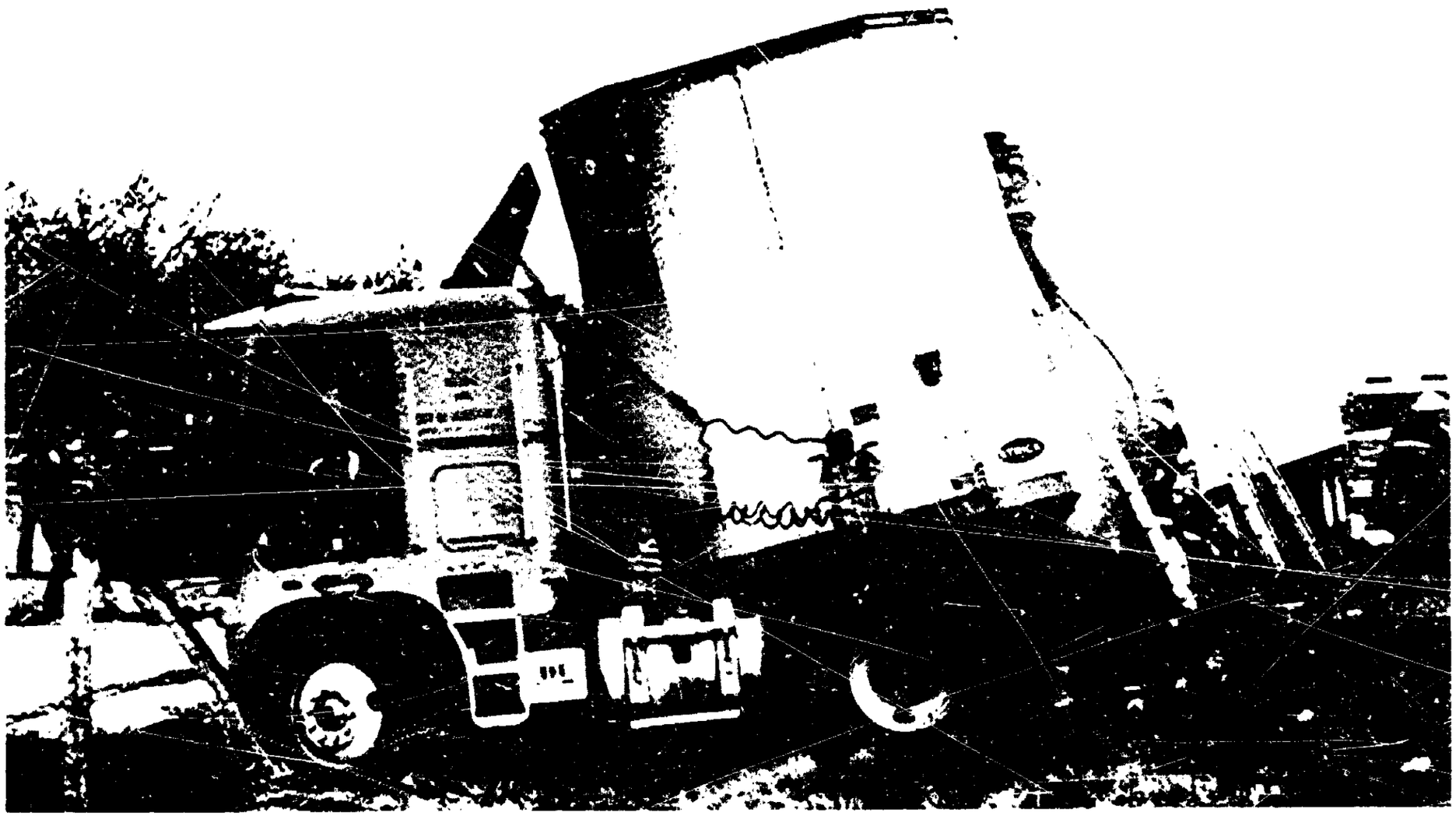


Figure 8.--Driver prior history-multiple drug related accident
Methamphetamine/amphetamine, cocaine, and marijuana
1988 Peterbuilt tractor and loaded 48 foot trailer
vs.
1984 Freightliner tractor and loaded 48 foot trailer
2 miles south of Westley, CA
December 4, 1987

too-fast-for-conditions citation, 1 red-light violation, and 2 accidents. The driver also possessed a New Mexico license. The driver tested positive for methamphetamine, amphetamine, benzoylecgonine (metabolite of cocaine), and marijuana metabolite. A syringe containing methamphetamine and amphetamine was found in the cab debris. The National Driver Register had no record of the driver. This case provides strong support for development of a complete licensing database, which is under way, and for pre-employment driver records, prior employers, and other checks.

The data below show the relationship between prior alcohol and drug history and a positive toxicological test for drugs of abuse among case drivers.

Table 23.--Drug test results by driver history

Drug	Prior history tests	Prior history pos(%)	No prior history tests	No prior history pos(%)
Alcohol	17	4 (23.5)	124	13 (10.5)
Cocaine/Be	17	7 (41.2)	124	4 (3.2)
Meth/Amphetamine	17	3 (17.6)	121	3 (2.5)
Marijuana(THC/COOH)	16	7 (43.8)	121	11 (9.1)
Opiates	17	0	115	1 (0.9)
Other DOA	17*	2 (11.8)	124*	8 (6.5)
Any Drug of Abuse	17*	14 (82.4)	124*	28 (22.6)

* The number of tests used to compute percent positive is the number of drivers tested for at least one drug.

A chi square test was performed to determine whether the relationship between prior history and DOA positive results is statistically significant. The test determined that prior history and DOA positives are related and statistically significant at the 0.05 level.

The high percentage of DOA positives among drivers with a prior history indicates the need for background checks and pre-employment drug testing. Background checks with prior employers and with the Department of Motor Vehicles could provide valuable information to the prospective employer. Because of chemical dependency, relapses occur. Therefore, pre-employment toxicological testing may provide the employer with valuable information necessary for hiring. This finding may be especially important since only 21 percent of the employers of drivers in this study required pre-employment drug testing. Pre-employment testing may identify habitual drug users and act as a deterrent to recreational drug users. Only 14 companies of 160 (9 percent) from whom information was obtained employed random drug testing. About 12 percent of the employers required testing for cause. Seventy-six percent of the companies had no drug testing program even for new hires.

While the number of alcohol-positive drivers with a prior history is small, both the mean BAC and the BAC range suggests dependency on the drug. Conversely, those with no prior history have a substantially lower mean BAC.

Table 24.--Mean BAC and driver history

Driver history	Drivers found positive for alcohol		
	Number	BAC range	Mean BAC
Prior History	4	.09-.31	.203
No Prior History	13	.02-.25	.!15

Seven of the drivers with no prior history had BACs of 0.10 or less. NHTSA research has indicated that a person with a BAC of 0.15 percent or above is highly likely to be a problem drinker. Crancer, in "The Myth of the Social Drinker," argued that between 70 and 90 percent of first DWI offenders are likely to be problem drinkers. If this is accurate, there are likely to be few social drinkers in either group (Crancer 1986). The BAC distribution for the no-prior-history group seems to be balanced by four cases with BACs less than 0.05 percent and three cases with BACs greater than 0.20 percent. The seriousness of the alcohol problem may be evidenced by the five drivers with no prior history who had BACs in excess of 0.15 percent when they died.

Over 65 percent of companies providing information reported having a policy requiring pre-employment checks before a driver is permitted behind the wheel. In 55 percent of the case drivers in this study, companies reported that the driver's pre-employment check was completed prior to his being permitted to drive. A large number of companies reported checking driver qualifications and history in the following manner (owner-operators are omitted):

Table 25.--Driver qualification checks
(158 Cases-Multiple Responses)

Previous employers	State driving record	Road test	Written test
65%	67%	70%	46%

Nearly 80 percent of employers did not require pre-employment drug testing, yet nearly the same percentage of employers required some form of driver qualification check. The Safety Board expects that the percentage of carriers requiring pre-employment drug testing should have increased substantially after the termination of accident data collection for this study, September 30, 1988. On November 21, 1988, the Federal Highway Administration published a final rule on controlled substances testing which included a requirement for pre-employment testing for the use of controlled substances. As a result, carriers subject to Federal regulation should have implemented at least the pre-employment testing requirement by this time.

Union Affiliation Analysis

The Safety Board obtained information on union membership among the fatally injured truck drivers. Union drivers tend to work for larger trucking firms, to be more senior, and are, by definition, professional drivers. The Safety Board analyzed drug incidence by union affiliation to focus on a readily identifiable group of professional drivers. Union affiliation, in this analysis, was defined as membership in a truck union as compared with membership in any other union, such as a building trades union.

Of the 185 fatally injured truck drivers, 16 were identified as union members. For 21 of the 185 drivers, no information about union affiliation could be obtained by investigators. Therefore, 10 percent (16 of 164) of the drivers whose union affiliation is known were union members. Fourteen of the 16 union drivers and 136 of the 148 non-union drivers were tested for drugs. Twenty-one percent (3 of 14) of the union drivers and 34 percent (46 of 136) of the non-union drivers tested positive for drugs of abuse. The percentage of DOA positives among drivers whose affiliation is unknown is larger than for either of the other groups, especially in alcohol involvement. The table below lists drug test results for union and other drivers.

Table 26.--Drug test results by union affiliation

	Union affiliation					
	Union		Non-union		Unknown	
Drug	tests	pos(%)	tests	pos(%)	tests	pos(%)
Alcohol	14	0	136	16 (11.8)	18	5 (27.8)
Cocaine/Be	14	2 (14.3)	133	10 (7.5)	18	2 (11.1)
Meth/Amphetamine	14	1 (7.1)	133	11 (8.3)	17	0
Marijuana(THC/COOH)	14	1 (7.1)	132	19 (14.4)	18	1 (5.6)
Opiates	14	0	125	1 (0.8)	18	0
Other DOA	14*	0	136*	14 (10.3)	18*	1 (5.6)
Any DOA	14*	3 (21.4)	136*	46 (33.8)	18*	7 (38.9)

* The number of tests used to compute percent positive is the number of drivers tested for at least one drug.

A chi square test was performed to determine whether the DOA involvement of union and non-union drivers are statistically different. The differences are not statistically significant at the 0.05 level.

Multiple Licenses Analysis

A recent study by NHTSA (Edwards and Benkowski 1989) analyzed 1986 FARS data and estimated that "11 percent of heavy truck drivers in fatal accidents held valid heavy truck driver's licenses in two or more states." In the Safety Board study, 10 case drivers or 5 percent of the total case drivers (185) had multiple valid licenses. Twenty-one drivers had suspended or revoked licenses. Of the 21, 2 had two valid licenses plus a suspended/revoked license; 3 had no valid license; and 16 had one valid license plus at least one suspended/revoked license. A total of 29 drivers

or 16 percent held either multiple valid licenses, two valid and one suspended/revoked, one valid and one suspended/revoked, or no valid license.

Table 27.--Valid, suspended and revoked licenses

Number of valid licenses	Number of drivers	Number of drivers with suspended or revoked licenses
None	4	3
1	171	16
2	9	2
3	1	0
Total	185	21

A comparison was made between the drug-free and DOA positive test results among the suspended and revoked drivers and those with no suspended or revoked licenses. The table below shows the data.

Table 28.--Current driver's license suspended or revoked at the time of the accident and drug test results

	No known suspended or revoked license		Suspended or revoked license	
Drug test result	no.	percent	no.	percent
Positive	45	30.2	11	57.9
Negative	104	69.8	8	42.1
Total	149		19	

A chi square test was performed to determine if the relationship between suspended or revoked licenses and DOA positive results is statistically independent. The test result confirmed that a statistically significant relationship exists at the 0.05 significance level. That is, DOA positive tests are related to the driver's license status.

The difference in percentage of drug use among the two groups is striking and may be indicative of a disregard for the law in two areas, illegal drug use and driver's licenses. Based on the data above, it appears that a driver in this study who had at least one suspended or revoked license is more likely to have used drugs of abuse.

Medical Condition and Qualification

Assessment of the driver's health condition from toxicological tests, family reports, and--most important--from autopsy reports and medical records revealed an important finding. Nineteen of the 185 (10 percent) fatally injured drivers in the core sample had such severe health problems that

health was a major factor in, or the probable cause of, the accident. Seventeen of the 19 (89 percent) accidents involved a form of cardiac incident at the time of the accident. The Safety Board believes this percentage may be conservative because information in other accident reports indicated possible cardiac problems which were not confirmed because an autopsy had not been conducted.

Increased cardiac risk is usually associated with age, heredity, environment, and lifestyle (e.g. smoking, alcohol consumption, diet, and exercise). The only cardiac risk factor routinely obtained in this study was age. The average age of drivers with health problems was significantly higher than the average age of those with no identified health problems. A "z test" (test of the difference in means) indicated that these two groups were statistically different at the 0.05 significance level. The table below shows the age disparity between drivers with medical problems contributing to the accident and those without medical problems.

Table 29.--Age-medical problem comparison

Driver health	no.	Mean age
Medical problem	18	54.8
No medical problem	164	40.9
Total	182*	42.1

*Medical condition unknown in three cases.

The statistically significant difference in age between the fatally injured drivers with health problems and those without suggests that age may be an important factor in health-related fatal crashes among the truck driving population. The rigors of heavy truck operation, disruption of circadian rhythms, scheduling, and other health factors, such as diet and drug use, suggests the need for more frequent and thorough health screening and prevention programs, especially for older drivers.

Federal regulations require that commercial truck drivers be physically qualified to perform their job safely. Physical qualification is determined by a medical examination, which each driver must undergo at least every 2 years. The examining physician fills out and signs a form indicating whether the driver meets physical standards established in FHWA regulations. Those regulations stipulate, for example, that a commercial driver who is fit for service is one who:

> "Has no current clinical diagnosis of myocardial infarction, angina pectoris, coronary insufficiency, thrombosis, or any other cardiovascular disease of a variety known to be accompanied by syncope, dyspnea, collapse, or congestive heart failure." [49 CFR 391.41(b)(4)] and

"Has no current clinical diagnosis of high blood pressure likely to interfere with his ability to operate a motor vehicle safely." [49 CFR 391.41(b)(6)].

The large percentage of cardiac cases among the medically incapacitated drivers in this study raises questions regarding the effectiveness of commercial driver medical qualification regulations.

Case 147 appears to be the best example of questionable medical qualification. In this case, a tractor trailer carrying pulpwood on a straight, four-lane divided highway, in clear, sunny, and dry conditions, veered onto the right shoulder. The vehicle continued along the shoulder and the roadway for 164 feet before striking a small tree. It came to rest at about a 20-degree angle from the roadway in a wooded area. Although the tractor sustained only minor damage, and no trauma was observed, the driver was found dead at the scene.

The driver was medically qualified as having no cardiovascular disease by the family physician on three DOT physical examinations, yet the truck driver's treatment records (from the same physician) for the previous 5 years indicated a history of gout and hypertension, for which various drugs were prescribed. According to his wife, the driver had been taking prescribed heart medication for several years.

FHWA regulations [49 CFR 391.43(c)] require the physician conducting a DOT physical to examine the thorax and heart by stethoscope and to take the blood pressure by sphygmomanometer. The physician is required to:

"Note murmurs and arrhythmias, and any past or present history of cardiovascular disease, of a variety known to be accompanied by syncope, dyspnea, collapse, enlarged heart, or congestive heart failures. Electrocardiogram is required when findings so indicate. . . . If the blood pressure is consistently above 160/90 mm. Hg., further tests may be necessary to determine whether the driver is qualified to operate a motor vehicle."

Eleven of the 18 blood pressure readings in the driver's treatment record were at levels of 160/90 mm or above. One reading taken on March 29, 1986 was recorded as 190/110 mm. The driver's DOT physical taken the same day from the same physician reported a blood pressure of 140/90 mm. The physician of record was not interviewed, therefore, the reason for the different readings is unexplained. No evidence is available that the examining physician was aware of the specific requirements of the regulation or that the physician had been informed of the regulations.

According to available records, neither a "stress electrocardiogram" nor a cardiac risk assessment had been completed on this driver or on any of the others who were cardiac fatalities in this study. While a risk assessment is not required by regulation, older drivers appear to be more at risk of a health-related incident and more likely to benefit from a cardiac risk assessment. In the above case, the State Medical Examiner determined that the driver's cause of death was "myocardial failure."

A related medical issue is the lack of forthrightness by drivers in providing information on their medical history to examining physicians, as well as possible forgery of medical certificates. Several cases in this study are examples of the potential forgery problem. In Case 70, a bobtail tractor went off a rain-soaked road into a dirt and grass median strip and rolled over. The cab was crushed, and the unrestrained driver died from compressional asphyxiation. The driver had provided his employer with a medical qualification certificate from a physician who had not examined the driver and whose office manager certified that the signature was not the physician's. The carrier had not verified the medical certificate with the physician. In Case 61, the driver had an apparently valid medical certificate in his possession, while the carrier had no medical certificate in the driver's file. Upon investigation, it was determined that the examining physician was a thoracic and cardiovascular surgeon who did not give DOT physical examinations and who had no record of any visit by the deceased driver. The carrier had made no check of the certificate's validity.

Case 56 is an example of problems resulting from medical certification of a driver with a known history of cardiovascular disease. In this case, the driver had 28 years of experience with conventional tractors and tanker trailers and a one-million-mile safe-driving pin, but also a history of heart disease and diabetes. He had had a heart attack and double bypass surgery 6 months prior to the accident. The examining physician had identified the pre-existing heart disease, diabetes, and hypertension, all of which had been certified as being under control. The driver was certified as medically qualified. The carrier also contacted the driver's personal physician who stated that the driver had recovered from surgery and was capable of driving an articulated vehicle. The accident trip was the driver's first since surgery, first with this carrier, and first with this type of vehicle. A training supervisor accompanied the driver on the accident trip. The driver was directed to exit one interstate highway and enter another. During the exit maneuver, the driver stiffened and did not respond to directions to straighten out the vehicle. The driver apparently died prior to the accident. The adequacy of the DOT medical certification standards and system to prevent drivers with potentially incapacitating conditions from operating commercial vehicles is called into question as a result of this accident.

In another accident, investigated prior to this study, on February 24, 1983, near Willow Creek, California, a dumptruck crossed the highway centerline and collided with a schoolbus. The investigation disclosed that the dumptruck driver had several medical problems. The Safety Board concluded that the truck driver did not properly advise the doctor who performed the DOT-required medical examination of all his medical problems. As a result of its investigation, the Safety Board, on December 5, 1983, recommended that the Federal Highway Administration (FHWA):

H-83-68

Revise Federal Motor Carrier Safety Regulation 49 CFR 391.43 to incorporate a provision, similar to that specified in 14 CFR 67.20(a) for airmen medical certification, which will prohibit the falsification or omission of medical information in connection with a medical certification physical examination.

Figure 10.--Medical (cardiac) condition-related accident
1985 International tractor and 48 foot trailer
Bellmawr, NJ
March 3, 1988

In 1988, the FHWA issued a final rule that prohibits falsification of information on an employment application, certificate, or record required by Federal regulation (49 CFR 390.35). The Safety Board subsequently classified Safety Recommendation H-83-68 as "Closed-Acceptable Action." However, the rule does not prohibit omission of information, and a driver can simply choose not to answer completely a question that might reveal a medically disqualifying condition.

The Safety Board addressed the issue of medical information omission in its report on an accident in which a Greyhound Lines, Inc., intercity bus went out of control and overturned in Nashville, Tennessee, on November 19, 1988. The Board's investigation found that on at least two occasions, the bus driver had failed to provide pertinent information about his medical history during his federally required physical examination. The omitted medical conditions included vision problems, high blood pressure, hypothyroidism, and depressive neurosis with anxiety reaction. The Board concluded that these omissions "prevented accurate assessments by company physicians of [the driver's] qualifications to drive a bus in commercial service" (NTSB 1989b). The Board therefore issued the following recommendation to the FHWA:

> Revise Section 391.43 of the Federal Motor Carrier Safety Regulations to: incorporate a provision that will prohibit the omission of medical information in connection with a medical certification physical examination; require that when commercial drivers are examined, they sign a statement certifying that the medical history they have provided is both complete and accurate and that the motor carrier has the authority to obtain information on the bus drivers' medical history from their personal health care providers; and require that the medical history form elicit more complete information on drivers, using commonly understandable terminology. (H-89-31)

A reply to this recommendation has not yet been received.

On August 25, 1985, a westbound intercity bus went out of control and struck the left side of a bridge rail on the Monocacy River on I-70 near Frederick, Maryland. The Safety Board investigation found that the driver had received a kidney transplant and was being treated for high blood pressure, an insulin-dependent diabetic condition, and a recent urinary tract infection. When the driver received his DOT-required physical from a physician who was not familiar with his complete medical history, he did not advise the physician of his insulin-dependent diabetic condition (NTSB 1987a). As a result of its investigation, the Safety Board, on January 22, 1987, issued the following recommendations to the American Medical Association (AMA):

> H-87-8
>
> Urge local chapters in each State and the District of Columbia to disseminate information on State and Federal medical qualifications for commercial vehicle drivers to practicing physicians who examine or provide care for commercial vehicle operators.

H-87-9

Encourage practicing physicians to use Federal and State medical qualification information when counseling patients on their medical fitness to drive.

On January 25, 1989, the AMA was notified that the Safety Board had received no response regarding Safety Recommendations H-87-8 and -9. On July 12, 1989, still having no response from the AMA, the Safety Board classified these safety recommendations as "Closed--Unacceptable Action." On August 3, 1989, the AMA asked the Safety Board for copies of the safety recommendations and stated that it would consider commenting. The Safety Board awaits the AMA's further response.

On September 6, 1987, an intercity bus ran off the northbound local lane of the Garden State Parkway near Middletown, New Jersey, struck a guardrail and bridge rail and overturned. In this investigation and one of another bus accident near Walker, California on May 30, 1986, the medical certificate provided to the carrier by the driver was a forgery (NTSB 1988b). As a result of the New Jersey investigation, the Safety Board recommended that FHWA:

H-88-24

Revise Part 391 of the Federal Motor Carrier Safety Regulations to require a motor carrier to verify the authenticity of a medical examiner's certificate if the certificate has been prepared by a physician who has not been selected by the motor carrier to perform the examination. Information concerning the fact that the verification was made should be retained as part of the driver's qualification file.

The FHWA responded to this safety recommendation on October 6, 1988, citing an ongoing rulemaking project regarding the physical examination form and the examiner's certificate. The safety recommendation was classified as "Open--Acceptable Action" by the Safety Board on November 8, 1988.

Previous Safety Board recommendations identified specific problems based on the circumstances disclosed in each accident investigation. However, when these prior findings are viewed together with the findings from this study, the Safety Board believes that they constitute evidence that a review of medical qualification regulations for commercial drivers is necessary. A registry of physicians who perform physical examinations of commercial drivers could be maintained at the State or Federal level (such as that for Aviation Medical Examiners) and could be used to disseminate pertinent medical qualification information. It could also provide carriers with a means to query registered physicians regarding the authenticity of medical certificates.

Forgery of medical examination forms and providing erroneous medical qualification information appears to be a problem that could be deterred by the threat of criminal penalties. From this study, it appears that serious medical conditions, especially cardiac conditions, should disqualify commercial drivers until they are cleared by competent medical authorities

based on a clear set of medical standards and risk assessment. The Safety Board believes that research findings on medical standards and risk assessment, physician registration, and criminal penalties should be incorporated into a revision of the medical qualification regulations.

Driver Income

The Safety Board attempted to measure the effects that DOA usage would have on income. Tractor-trailer drivers interviewed in the RCCC survey responded that drugs such as stimulants might be "helpful" in driving longer and meeting shipment requirements, thus increasing income. Salary information was difficult to obtain from family and employers in a sufficient number of cases to conduct a meaningful analysis. In addition, there were numerous discrepancies between driver income reports from employers and relatives. Therefore, the Safety Board was unable to complete an accurate analysis of drug use effect on driver income.

Shipment Deadline (Just-in-Time Shipment) Analysis

One third of tractor-trailer drivers surveyed by RCCC indicated that one solution to reducing fatigue would be to eliminate schedules and other requirements imposed by shippers, receivers, and dispatchers which induce hours of service violations (Beilock 1989). Alternatively, drivers recommended some form of control over those dictating schedules. Shipment deadlines may cause an economic incentive to violate hours of service regulations and, by inference, to use drugs, such as stimulants, in an attempt to maintain alertness. An analysis was conducted to determine whether DOA positive test results correlate with the presence of a shipment deadline.

Table 30.--Drug test results by presence of shipment deadline

Shipment deadline	Number of toxicological tests	Tests positive for DOA	Percentage positive
Yes	36	16	44.4
No	116	32	27.6

A chi square test was performed to ascertain whether a significant difference exists between the two groups, those with a schedule deadline and those without such a deadline. While the differences approached significance, they were not statistically significant at the 0.05 level.

All fatally injured truck drivers were included in this analysis. In a subsequent section, the professional driver group is defined and an analysis of drug use by presence of a shipment deadline is included. The analysis indicates a significant relationship exists between DOA positive test results and the presence of a shipment deadline. This is the only comparison which does not test significant in the overall analysis, but does test significant in the professional driver analysis.

Trucking Service Analysis

For-hire and private carriers tend to specialize in one of two kinds of shipment service: truckload (TL) freight, and less-than-truckload freight (LTL). The TL sector has been reported as being large and fragmented with up to 75,000 for-hire and private carriers providing TL services. By comparison, the LTL sector companies are small in number (less than 500 companies), but quite large in size, e.g., United Parcel Service, Yellow Freight, and Consolidated Freightways. LTL carriers maintain extensive networks and terminals and operate on regular schedules between terminals (Transportation Research Board 1989).

The type of trucking service was compared with DOA positive toxicological test results to determine whether a relationship exists. The table below indicates the alcohol and other drug involvement among fatally injured drivers engaged in TL, LTL, and TL/LTL service.

Table 31.--Drug test results by trucking service

Type of service	Number of tox tests	Tests positive for DOA	Percentage positive
LTL	21	3	14.3
TL	77	32	41.6
TL/LTL	41	10	24.4

A chi square test was performed to determine whether a relationship exists between DOA positive test results and type of trucking service. The chi square test determined that type of trucking service and DOA positive test results are related and statistically significant at the 0.05 level.

Fatally injured drivers in this study who provided truckload (TL) service or worked for a carrier providing such service were more likely to have used and tested positive for drugs of abuse. The differences between the TL and LTL service sectors could be related to a variety of factors such as size of operation, economic pressures and competition, training, differences in line-haul operation or other factors. However, the data available are insufficient for a more detailed analysis.

Professional Driver Analysis

While the data analyzed above constitutes the main analysis of this report, not all drivers in the overall analysis can be considered to be professional drivers. The Safety Board notification criteria included any heavy truck accident in which the driver was killed; therefore, the sample includes drivers of vehicles such as swimming pool, lawn, and septic service trucks. The sample also included drivers of vehicles which were borrowed or operated to repay a favor including a loaned water truck and a tractor owned by a teacher who did not register or normally use it. While such vehicles may be representative of the types of vehicles, operators, and hazards encountered in daily driving, these cases did not seem to be representative of professional truck drivers on the highways. Therefore, the Safety Board analyzed each case to determine if the driver could be considered a professional truck driver, i.e., a person who makes his or her primary living by driving a truck. The professional driver group includes long and short haul drivers, truck-load and less-than-truck-load operators, drivers of medium and heavy trucks, contract and employee drivers, etc. The Safety Board determined that 151 of the 185 case drivers were professional truck drivers.

All tabulations that were performed in the core analysis were also conducted for professional drivers and are contained in appendix M. Since the professional drivers are such a substantial percentage (82 percent) of all fatally injured drivers in the study, it was expected that few differences would be found in comparing the professional drivers and the core sample. With the exception of drug test results compared with the presence of a shipment deadline, the Safety Board found analytical results between the two groups to be consistent. As a result, a separate professional driver analysis has not been included in this report.

While the results of the professional driver and overall analyses are consistent, this does not mean that the professional and non-professional drivers are comparable. However, the number of non-professional drivers was not sufficiently large to change the overall analysis results.

In only one analysis did tests of DOA positives among professional drivers differ from the results obtained in the overall analysis. As noted above, parties external to the truck driver may dictate schedules and deadlines. In these situations, drivers may exceed hours of service and use drugs of abuse in an attempt to maintain a sense of alertness. The table below shows the drug test results for professional drivers who were operating with a shipment deadline.

Table 32.--Drug test results by presence of shipment deadline

Shipment deadline	Number of toxicological tests	Tests positive for DOA	Percentage positive
Yes	34	16	47.0
No	94	25	26.6

A chi square test was performed to determine whether a relationship exists between the presence of a shipment deadline and DOA positive test results from the fatally injured drivers. The test determined that a shipment deadline and DOA positive results are related and statistically significant at the 0.05 level.

These results would tend to support driver contentions in the RCCC survey that deadlines have an effect on fatigue and on use of drugs which are perceived by truck drivers as being "helpful." However, the data are not sufficient for a more detailed analysis of dispatching, shipping, and receiving operations which affect truck drivers.

Profile of the Fatally Injured DOA Positive Driver

The data and analyses above led to the development of the following profile of the 56 (33 percent of drivers with at least one complete drug test) fatally injured DOA positive drivers in this study:

- 33 percent (14 of 42*) had a prior history of alcohol/drug problems or treatment;
- 41 percent (23 of 56) abused multiple drugs; 61 percent (14 of 23) of these drivers were using either cocaine and marijuana or cocaine, marijuana, and amphetamines in combination; 35 percent (8 of 23) were using alcohol and another drug of abuse;
- 59 percent (33 of 56) were using one drug; 39 percent (13 of 33) used alcohol, 15 percent (5 of 33) used amphetamines, and 24 percent (8 of 33) used marijuana;
- 20 percent (11 of 56) had suspended or revoked licenses; 64 percent (36 of 56) held a valid license for the State in which the accident occurred; 9 percent (5 of 56) held multiple valid licenses;
- 57 percent (30 of 53*) were single, separated, or divorced;
- 84 percent (47 of 56) were professional drivers (who drove a truck for a living), and 79 percent (44 of 56) drove a truck weighing more than 26,000 pounds GVWR;
- 66 percent (37 of 56) were employed by carriers, 13 percent (7 of 56) were owner-operators;
- 18 percent (10 of 56) had less than one year of heavy truck driving experience, 18 percent (10 of 56) had no heavy vehicle training, 11 percent (6 of 56) had only on-the-job training, and 11 percent (6 of 56) had truck driver school training;
- 46 percent (26 of 56) were moderate or heavy smokers; and

- o 29 percent (16 of 56) of the DOA positive drivers were involved in weekend accidents.

*Information not available on all drivers

Profile of the Driver Fatally Injured on a Weekend

Data in the analysis above suggested that DOA use is related to the day of the week. Also, previous studies of all fatal accidents have indicated that weekends are a period of increased risk of alcohol-related accidents. For the purposes of this profile, the weekend period is defined as 6:00 pm Friday through 5:59 am Monday (consistent with the FARS definition). Analysis indicated that 32 drivers died on weekends. Of this number, 30 were tested for alcohol and other drugs. The distribution of weekend accidents is included in the table below:

Table 32.--Drugs of abuse and weekend truck fatalities

Test result	Friday(6-11:59pm)	Saturday	Sunday	Monday(12:00-5:59am)
Positive	1	9	5	1
Negative	1	8	1	4
No Test	0	0	1	1
Total	2	17	7	6

A profile indicates that the drivers had the following characteristics:

- o 53 percent tested positive for drugs of abuse (16 of 30); 33 percent (10 of 30) tested positive for alcohol;
- o 10 percent had a previous drug history (3 of 30); all weekend fatally injured drivers with a previous accident history tested positive for drugs of abuse;
- o 63 percent (10 of 16) of the DOA positives abused multiple drugs, 5 for alcohol and a stimulant and 3 for marijuana and a stimulant, 3 drivers used at least 3 drugs of abuse;
- o the mean BAC for alcohol-involved drivers was 0.16 percent and included one driver with a 0.03 percent BAC;
- o 92 percent (23 of 25) of the drivers whose affiliation was known were non-union drivers, 12 of whom tested DOA positive, and 8 percent (2 of 25) were union members, neither of whom tested DOA positive;
- o 25 percent (8 of 32) had suspended or revoked licenses;
- o 62 percent (18 of 29) with a known marital status were married; 38 percent (11 of 29) were single, separated, or divorced; 10 of the 11 single, separated, or divorced group tested DOA positive;

- 50 percent (16 of 32) drove tractors and single trailers; 22 percent (7 of 32) drove straight trucks; 22 percent (7 of 32) drove doubles combinations; and 6 percent (2 of 32) drove bobtail tractors;

- 78 percent (25 of 32) of the fatal weekend accidents occurred at night although 7 of these occurred on bright nights or in lighted areas;

- 63 percent (20 of 32) drove carrier-owned vehicles, 22 percent (7 of 32) drove leased vehicles, 6 percent (2 of 32) were driver owned, and 9 percent (3 of 32) were owned by other parties; and

- the 32 weekend accidents occurred in 5 States; 12 in California (5 DOA positive); 6 in Tennessee (3 DOA positive, 1 not tested); 6 in Georgia (3 DOA positive, 1 not tested); 5 in Maryland (4 DOA positive); and 3 in North Carolina (1 DOA positive).

Probable Cause Analysis

A review of the probable cause of each of the accidents provides an opportunity to determine the extent to which drugs of abuse cause accidents. The Safety Board reviewed all information available regarding each accident and determined the probable cause of each accident. Factors such as roadway, vehicle maintenance, driver fatigue, medical incapacitation, and drugs of abuse were typically cited as a probable cause or contributing factor.

All probable cause statements were reviewed to identify the incidence of alcohol and other drug use in accident causation. Concurrently, an analysis of the incidence of fatigue and fatigue-drug interaction accident causation was conducted. In some cases, drugs such as alcohol may have been present, but may not have been causal due to mechanical failure, on-going medical problem, very low level of alcohol or the fact that actions by other drivers caused the accident.

In the review of accident causation, 16 categories were developed to summarize similar causes or factors. The 16 categories are:

- physical incapacitation;
- impairment due to fatigue;
- impairment due to alcohol;
- impairment due to other drugs;
- driver inexperience;
- unsafe movement;
- disregard of warnings or signs;
- misjudgment of safe speed;
- failure to yield, perceive, or observe (a sign, vehicle, or condition);
- occupant protection;
- conspicuity;
- brake adjustments or deficiencies;
- mechanical or maintenance factors;
- signs, roadway, or environmental conditions;

- o load, load shift, or center of gravity factors; and
- o failures for unknown reasons.

An accident may have more than one cause as well as one or more factors which contributed to the crash. These multiple causes and factors have been compiled into the categories described above. Because of the multiple causes and factors in each accident, the total number of causes and factors will necessarily exceed both the 181 accidents and the 185 accident involved vehicles and drivers. There were 328 causes and factors listed in the 181 accidents. In assessing the causes and factors involved, 185 case vehicles is used as the denominator for percent involvement. This is slightly more conservative than using the 181 accidents, but more accurate because it considers all accident vehicles and drivers.

The Safety Board also reviewed each accident investigation and probable cause to determine whether there was a management or carrier oversight contribution to the accident. Carrier oversight was separated into oversight of the driver and oversight of the vehicle. Carrier oversight of the driver included deficiencies in recordkeeping, pre-employment records screening, violation of hours of service etc. Carrier oversight of the vehicle included deficiencies in maintenance, repair, and similar mechanical factors. A total of 115 of the 185 cases (62 percent) indicated a management deficiency in oversight of the driver or the vehicle. Of the 115 cases, 111 involved oversight of the driver and 37 involved oversight of the vehicle. Four cases involved vehicle oversight alone, while 79 cases involved oversight of the driver alone. Deficiencies in both driver and vehicle oversight were identified in thirty-two cases (18 percent). While deficient management oversight is not a specific probable cause or factor category, the high number of these cases is a concern to the Safety Board and indicates a need for more safety oriented management.

The table below is a summary of causes and factors by category. A case-by-case table of causes and factors is included in appendix L.

Table 33.--Accident causes and factors in case vehicle

	CASES WITH THIS FACTOR	OTHER FACTORS CITED IN COMBINATION WITH THIS FACTOR															
		PHYS INCAP	IM-PRMT FA-TIGUE	IM-PRMT AL-COHOL	IM-PRMT DRUGS	DRIVR IN-EXPER	UNSAF MVMNT	DIS REGRD WRNGS OR SIGNS	MIS-JUDGE SAFE SPEED	FAILD TO YIELD PERCV OBSRV	OCCUP PROT	CNSPI CUITY	BRAKE ADJ/ DEFI-CIENT	MECH/ MAINT	SIGNS RDWAY ENVIR	LOAD/ LOADT SHIFT C.G.	FAIL-URE UNKNW REASN
PHYSICAL INCAPACITATION	19	--	3	0	1	0	0	0	0	0	1	1	0	0	0	0	0
IMPAIRMENT DUE TO FATIGUE	57	3	--	4	15	3	0	0	4	2	23	4	2	1	3	0	0
IMPAIRMENT DUE TO ALCOHOL	22	0	4	--	8	0	0	0	0	0	11	1	0	2	2	0	0
IMPAIRMENT DUE TO DRUGS	39	1	15	8	--	2	0	1	1	0	13	2	2	1	5	0	0
DRIVER INEXPERIENCE	9	0	3	0	2	--	0	0	4	0	4	0	1	1	0	0	0
UNSAFE MOVEMENT	11	0	0	0	0	0	--	0	2	0	4	0	0	0	2	0	0
DISREGARD OF WARNINGS OR SIGNS	5	0	0	0	1	0	0	--	1	0	3	0	0	0	0	0	0
MISJUDGEMENT OF SAFE SPEED	25	0	4	0	1	4	2	1	--	0	13	0	0	1	3	3	0
FAILURE TO YIELD, PERCEIVE, OBSERVE	13	0	2	0	0	0	0	0	0	--	2	2	0	0	2	1	0
OCCUPANT PROTECTION	68	1	23	11	13	4	4	3	13	2	--	2	4	6	10	4	1
CONSPICUITY	9	1	4	1	2	0	0	0	0	2	2	--	0	0	0	1	0
BRAKE ADJUSTMENT/DEFICIENCIES	8	0	2	0	2	1	0	0	0	0	4	0	--	4	0	0	0
MECHANICAL/MAINTENANCE	11	0	1	2	1	1	0	0	1	0	6	0	4	--	2	0	0
SIGNS, ROADWAY, ENVIRONMENAL	22	0	3	2	5	0	2	0	9	2	10	0	0	2	--	0	0
LOAD/LOAD SHIFT/CENTER OF GRAVITY	5	0	0	0	0	0	0	0	3	1	4	1	0	0	0	--	0
FAILURE FOR UNKNOWN REASONS	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	--

Alcohol and other drugs are not the only significant factors in accident causation among truck drivers. Fatigue, health and medical problems, mechanical, and roadway factors are important as well. Impairment due to fatigue was the most frequently cited accident cause or factor (57); followed by impairment due to alcohol and other drug use (53); misjudgment of a safe operating speed (25); signs, roadway, and environmental factors (22); and physical incapacitation (19).

Alcohol, other drugs, fatigue, and their interaction as accident causes or factors are mentioned 118 times. Impairment by fatigue, alcohol, and other drug use either alone or in combination is substantial.

- 31 percent (57 of 185) of the case drivers were fatigued.
- Of this number, 33 percent (19 of 57) also were impaired by alcohol and/or other drugs.
- 12 percent (22 of 185) of the case drivers were impaired by alcohol but, of that number, 55 percent (12 of 22) were also impaired by fatigue and/or other drugs.
- Impairment due to use of drugs other than alcohol was a factor in 21 percent (39 of 185) of the case drivers.
- Of that number, 59 percent (23 of 39) also involved impairment due to fatigue and/or alcohol use.

In addition to abuse of alcohol and other drugs, major factors in accident causation appear to include fatigue, the use of drugs which are taken to counteract the symptoms of fatigue, and the use of drugs which aggravate fatigue, as well as the interaction of fatigue and drugs.

It seems apparent that fatigue and drug usage are common causes of accidents which are fatal to drivers of heavy trucks. This close relationship is aggravated by perceptions from the RCCC survey (Beilock 1989) that some drugs are "helpful" and that drivers of heavy trucks can routinely drive 10 hours or more before requiring extended rest. Some truck drivers apparently do not realize that fatigue is aggravated after the initial effects of stimulants. Sleep deprivation becomes a deficit which drugs cannot overcome. Further, depressants, such as alcohol, aggravate fatigue and reduce the initial effect of stimulants. Sleep researchers, such as Dement and Dinges, indicate that the only way to repay the "deficit" is to sleep (Strah 1989).

Physical incapacitation, primarily due to cardiac conditions, was described in detail above. Unlike the interaction of fatigue, alcohol, and other drugs, there is little interaction of other factors with physical incapacitation. This suggests such incapacitation may be a cause in itself and more susceptible to prevention through improved regulatory actions.

The degree of occupant protection in a vehicle does not precipitate an accident, but often was a significant factor in the accident's survivability. Occupant protection factors include, but are not limited to, safety belt

availability and use and tractor cab crashworthiness. Occupant protection was found to be a factor in 37 percent (68 of 185) and in all types of accidents in this study. Therefore, it may be that a substantial number of driver fatalities and injuries could be prevented by providing greater protection to the drivers of heavy trucks. The Safety Board is particularly concerned about the low safety belt usage rate among drivers of heavy trucks.

The Safety Board obtained information on safety belt equipment and usage in 170 cases. Only nine of the fatally injured drivers were wearing a safety belt. In 19 cases, the fatally injured drivers were driving a truck which was not equipped with seat belts or which had the belts removed. In 125 driver fatalities, the truck was equipped with safety belts, but the belts were not in use. Safety belt use could have saved a number of drivers who were ejected or who were fatally injured by contact with the cab interior.

Sixty percent of the heavy truck fatal accidents were single vehicle accidents. Many of these accidents, as well as many of the multiple vehicle accidents, involved a partial or complete roll-over of the tractor and either partial or complete crush of the tractor cab to dashboard level. Safety Board review indicates that cab crashworthiness and safety belt use could be improved. A more detailed study of these factors is being considered.

This review of heavy truck accident causes and factors indicates a potential for reducing fatalities by acting on their causes and related factors, particularly crashworthiness, fatigue impairment, alcohol and other drug impairment, and speed.

State Toxicological Tests

Toxicological testing variability between, and within, States was described earlier in chapter 4. Some State tests include screening and confirmation tests while others include screening tests alone. Also, while analytic methods among laboratories are becoming more standardized with the use of gas chromatography/mass spectrometry techniques, there continues to be a high degree of variability in the number and types of analyses employed. The number of drugs for which States perform a toxicological test depended upon the tests requested by the police investigators. The most frequently requested toxicological test was for alcohol. State tests for alcohol tend to be consistent and of good quality.

The usefulness of State data in both national and State analyses is diminished unless the same protocol and analytic methods are used for each test. State toxicological test results could not be used for comparative analyses in this report. Even so, all State test results were considered in the development of the probable cause of each accident. For example, in case 146, CHT did not have a sufficient sample volume to test for all drugs. The State toxicological test determined that the driver had a 0.13 percent BAC and tested positive for both marijuana and cocaine. Alcohol impairment was determined to be the probable cause of this accident, with cocaine and marijuana impairment as contributing factors. Similarly, in case 181, CHT did not receive a biological specimen. The Safety Board probable cause analysis of impairment depended upon the State toxicological test which found 0.10 percent BAC. A complete list of State toxicological test results is included in appendix I.

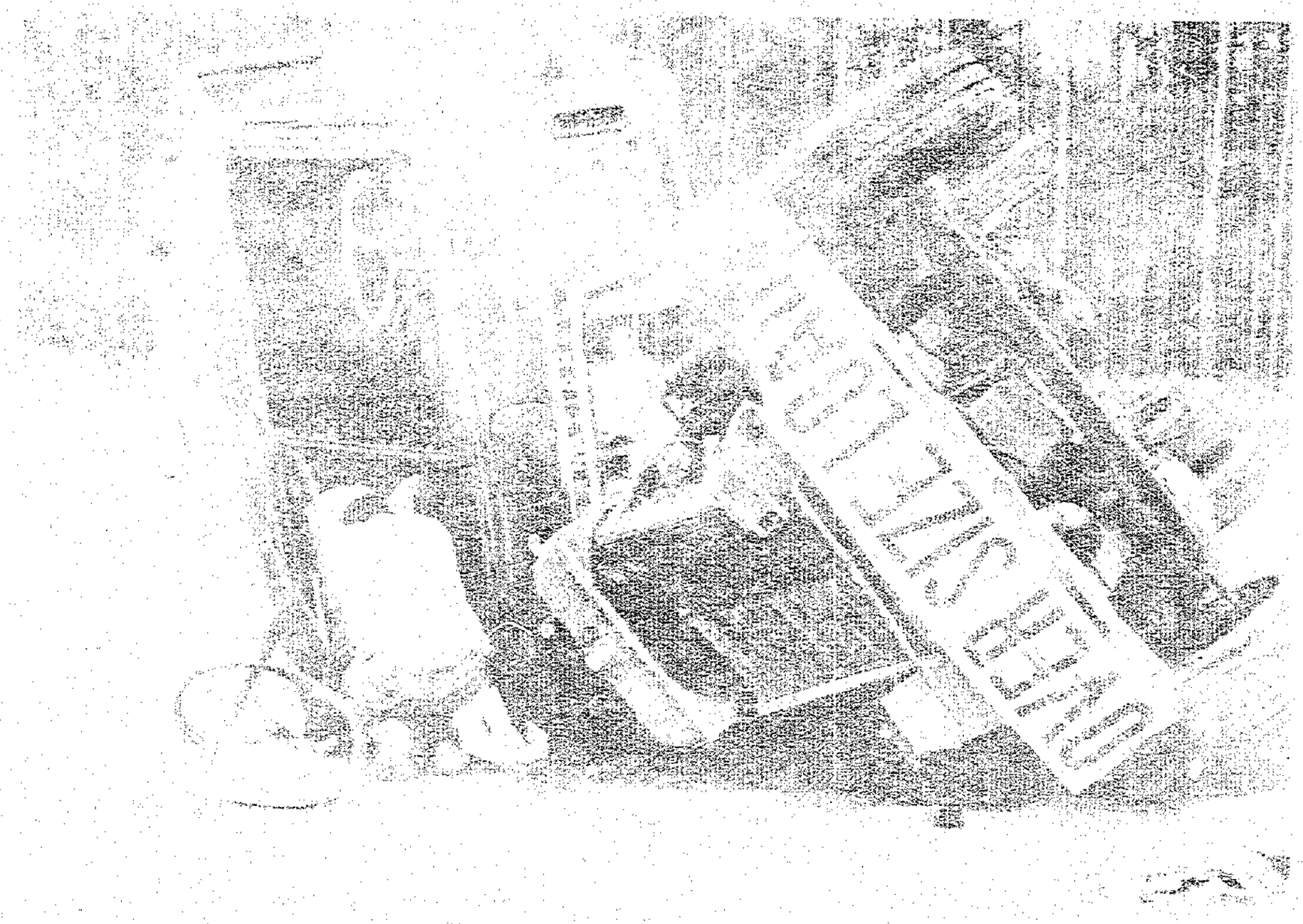


Figure 11.--Alcohol, fatigue, construction zone accident-State alcohol test
1977 International tractor towing a pickup truck
3 miles east of Pearson, GA
August 31, 1988

In almost all of the accidents investigated by the Safety Board, a State toxicological test was conducted on the fatally injured driver. Safety Board investigators were able to obtain State test results for 167 of the 185 case drivers. Sixteen State tests for alcohol were obtained in cases for which CHT had received either no sample or a sample of insufficient quantity to test for alcohol. Seven of these 16 State alcohol tests were positive. Two State toxicological tests identified the presence of barbiturates, one State test identified the presence of morphine, and one test found quinine which could have been combined with heroin.

While State tests were not included in the comparative analyses, additional DOA positive cases among the State tests suggests that the Safety Board drug-positive frequencies may be conservative.

CHAPTER 5

FATIGUE AND FATIGUE-DRUG INTERACTION

Background

The Safety Board's concern with operator fatigue has been addressed in numerous highway accident reports (NTSB 1984a, 1985a, 1985b, 1987b, 1988b) and has been most recently discussed by the Safety Board in a letter of recommendation to the Department of Transportation. On May 12, 1989, the Safety Board issued Safety Recommendations I-89-1 through -3 (NTSB 1989c) which asked the DOT to:

> Expedite a coordinated research program on the effects of fatigue, sleepiness, sleep disorders, and circadian factors on transportation system safety. (I-89-1)
>
> Develop and disseminate educational material for transportation industry personnel and management regarding shift work; work and rest schedules; and proper regimens of health, diet, and rest. (I-89-2)
>
> Review and upgrade regulations governing hours of service for all transportation modes to assure that they are consistent and that they incorporate the results of the latest research on fatigue and sleep issues. (I-89-3)

A major concern of this study is the potential for the interaction of drugs and alcohol and fatigue in the commercial trucking industry to precipitate the failure of human performance resulting in accidents.

The Interstate Commerce Commission (ICC), created in 1887, established hours of service regulations for railroad workers in the United States among its early acts (U.S. Code 45, use Sec. 61). These regulations recognized that the Federal government has an interest in duty time, and that issues concerning human physical limitations and fatigue within the transportation industry represent an area of valid government attention.

Within the highway industry, hours-of-service regulations were established on a national basis as a result of the Motor Carrier Act of 1935. Commercial vehicles engaged in interstate commerce are subject to Federal limitations in the total hours of driving permitted without an extended rest (10 hours of driving), total hours on duty without an extended rest (15 hours), and total hours of driving within a 1-week or 8-day consecutive period (60 or 70 hours, respectively). Drivers are also required to keep daily logs of their professional activities which are available for government inspection to monitor compliance.

Ninety-eight of the 113 carriers in this study stated that they used logbooks to monitor driver safety and performance. Fifteen of the carriers stated they used on-board computers to monitor driver activity. However, only five case vehicles were equipped with on-board computers. Safety Board

On April 29, 1985, a tractor-semitrailer collided with the rear end of a school bus near Tuba City, Arizona, resulting in two fatalities and injuries to 26 schoolchildren (NTSB 1985b). Investigation determined that the truck driver had been on duty a total of 88 hours during the 8 days before the accident, which was 18 hours more than allowed by Federal hours-of-service regulations. The driver had frequently violated the hours-of-service regulations on individual work days due to excessive duty time. On the night before the accident, the driver had received only a few hours of sleep on the floor of a motel room he shared with other truck drivers. The Safety Board determined that the probable cause of this accident was the truck driver's chronic fatigue, and that contributing to the accident was the failure of the truck company to properly monitor the truck driver's activities to prevent excessive hours of service.

A major question raised by the Tuba City investigation was how widespread and common the types of abuses shown by this truck driver might be throughout the trucking industry. Recently, the FHWA began a 4-year research program to examine driver fatigue and loss of alertness among commercial vehicle operators in actual highway operation (FHWA 1989). The research will be useful for examining the relations between hours-of-service regulations and actual driver fatigue. A parallel study, planned by the American Trucking Associations, Inc. (ATA) Foundation, will examine additional physiological evidence of fatigue in conjunction with the FHWA study. The Safety Board strongly supports research such as that planned by the FHWA and the ATA Foundation, and continues to believe that driver fatigue is a major safety concern in the trucking industry.

A review of background literature found little direct examination of the overlap of fatigue and drug usage. Only recently has evidence become available reflecting both laboratory and field approaches in this area (Moskowitz 1989). Other researchers (Nelson 1989 and Stein 1989) provide evidence that alcohol exposure seriously increases fatigue problems in driving situations. Lauber and Kayten (1989) summarize evidence from major transportation accidents in which fatigue and drug use may have jointly figured as causal factors. The present study was intended to expand this literature. The overlap of drug usage and fatigue is one of the major areas of focus of the present study. An attempt was made to document whether drugs of abuse, and which drugs of abuse, tended to be associated with evidence of fatigue.

One problem in studying fatigue is the difficulty of defining what fatigue is and specifying exactly when a driver is suffering from it. From a practical standpoint, however, there are three aspects of trucking that are commonly associated with fatigue problems: long hours of driving, driving in the middle of the night, and driving off the road due to "dozing at the wheel." These three aspects served as a basis for examining the relationship between drug use and fatigue.

Hours of Service

Many sources, such as the RCCC survey of truck drivers, suggest that drivers may routinely violate the Federal regulations which set strict hours of service limits for drivers engaged in interstate operation. The

structure of the trucking industry may create economic incentives to continue driving even after a driver feels tired. Research evidence indicates that accident rates for trucks tend to increase dramatically the longer the driver continues beyond 8 hours of continuous driving (Mitler and others 1988, Moore-Ede and others 1988).

For this study, investigators from the Safety Board made a careful attempt to reconstruct the activities of each driver before the accident to determine the actual hours of service. Log book entries by the driver were examined when available, but these entries were found in several cases to be inaccurate and to seriously understate the actual hours worked. Safety Board investigators reported use of multiple logbooks in a number of cases. The principal sources of information were interviews with family and relevant witnesses, as well as information derived from paperwork found in the wreckage or obtained in the course of the investigation. These included pickup and delivery paperwork, fuel and lodging receipts, weighing and inspection paperwork, traffic citations, and other documents related to the trip. In several cases, vehicle tachograph information was essential to reconstructing vehicle use and driver duty time.

In 1977, the Safety Board recommended that FHWA:

H-77-032

Conduct scientifically controlled studies to determine the effects and merits of the use of tachographs on commercial vehicles in reducing accidents.

The FHWA responded on April 5, 1978, indicating that the subject of recording speedometers (tachographs) had been reconsidered and rejected based on insufficient credible evidence of tachograph effectiveness in preventing accidents. FHWA stated that it had contracted with the Chilton Company to study modified tachographs as an alternative to driver logs. On June 3, 1980, the Safety Board classified the recommendation as "Closed--Acceptable Action."

Many major carriers of hazardous material in this country, such as Shell, Exxon, Texaco, Mobil and DuPont, have been using tachographs or other on-board recording devices for more than 20 years. They have found that the devices increase efficiency, reduce speeding, and are helpful in accident investigations. The FHWA has permitted the use of these recording devices as an alternative to written log books (49 CFR 395.15). Other fleets have also begun using on-board computer systems. For example, Frito Lay Corporation began installing the devices in 1986. Most drivers are reportedly enthusiastic about their new-found freedom from paper work. When fully operational, the system will eliminate double logs, incomplete logs, and log falsification (IIHS 1986).

In Europe, these devices have been in use for more than 30 years. In 1957, West Germany became the first country to mandate them. The United Kingdom joined other European countries by requiring tachographs in 1980. They are used, in addition to monitoring driver performance, to analyze fuel efficiency and vehicle utilization. The tachograph is considered the chief evidence for hours-of-service violations, as supporting evidence in speeding

cases, and as an important tool in accident investigations. Originally opposed by British unions as an invasion of privacy, today, the unions now supports their use (Parker 1990). Based on the use of multiple and fraudulent logbooks, the Safety Board believes there is a need for tamperproof, non-paper, recording devices.

For the purpose of studying fatigue, it was judged important to determine how many drivers in the sample were driving beyond the limits of the Federal guidelines in the course of their daily work. A driver was considered in excess of the Federal hours of service regulations if, at the time of the accident, the driver had violated one or more of the following:

1) driven more than 10 hours since the last extended rest of 8 hours duration;

2) been on duty more than 15 hours since the last extended rest of 8 hours duration;

3) driven more than 60 hours in the preceding 7 days;

4) driven more than 70 hours in the preceding 8 days.

In keeping with Federal regulations, outside work for which the driver was compensated was included as on-duty time for purpose of computation. It should be noted that many drivers in the sample operated intrastate only and so were not legally subject to the Federal requirements. However, these hours-of-service regulations were deemed to be reasonable guidelines for determining fatigue.

Fatigue was examined only in cases involving professional drivers, since this sample was judged to be of greatest interest for factors involving hours of service and serious fatigue problems. Of the 151 cases reviewed, a determination of-hours-of service was made for 135 cases (89 percent). Twenty six of these drivers (19 percent) were judged to be in excess of the Federal guidelines. A driver was included in the excess category only if there was clear evidence that the driver was in excess when the accident occurred. There was evidence, as noted above, that additional drivers exceeded Federal guidelines routinely, or would have been required to violate guidelines to complete the accident trip on time, but these additional drivers were still within hours when the accident occurred. They were not included in the excess category.

Table 34.--Drugs of abuse by hours of service for fatally injured truck drivers

Drug	In excess of hours	Within hours
Any drug of abuse	54% (14/26)	27% (29/109)
Alcohol	15% (4/26)	10% (11/109)
Cocaine/Be	12% (3/25)	6% (6/98)
Meth/Amphetamine	12% (3/25)	6% (6/98)
Marijuana (THC/COOH)	24% (6/25)	11% (11/98)
Other drugs of abuse	4% (1/26)	12% (13/109)

As shown in the table, there was a strong association between hours of service and drug usage. More than half the drivers who violated Federal guidelines tested positive for some type of drug of abuse. This was significantly higher than drug usage found for drivers who were within hours. A chi square test confirmed the statistical significance of the difference at the 0.05 level. The largest difference among these two groups of drivers appeared to occur with marijuana, which was the most prevalent drug of abuse among the drivers who were in excess of Federal guidelines. Differences were also suggested for the amphetamines, cocaine, and alcohol.

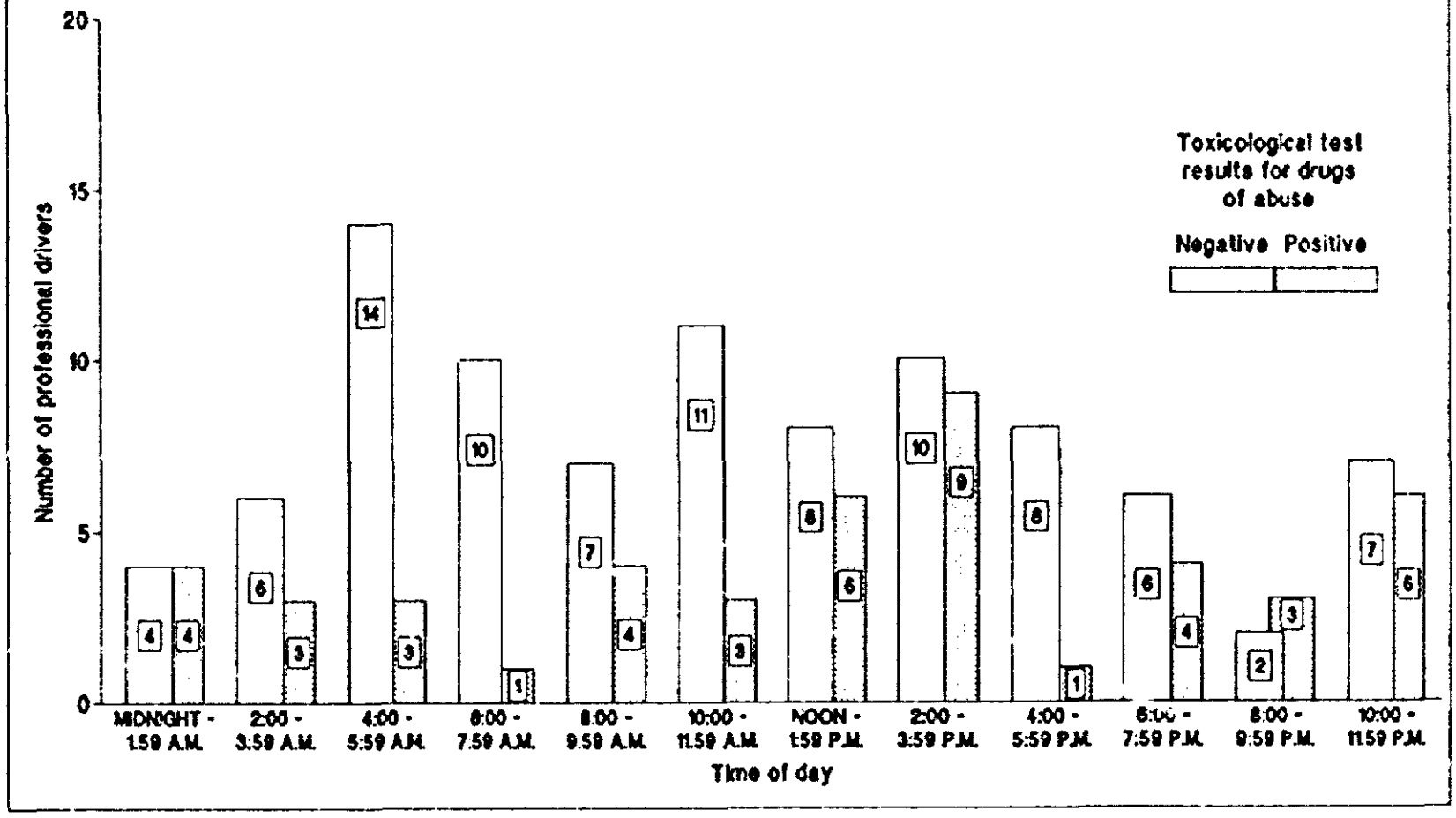
Drivers who were in excess of hours of service were found more likely to take drugs in multiple combinations (54 percent of the drivers, 14/26) than were the remaining drivers (13 percent, 14/109).

Time of Day

A second way to examine fatigue is by the time of day when the accident occurred. Research indicates that humans tend to be less alert during certain times of the day as a result of their normal physiological processes. These times occur especially, "during certain early morning hours (circa 2-7 am) and, to a lesser degree, during a period in the midafternoon (circa 2-5 pm) whether or not we have slept" (Mitler and others 1988). There are strong indications that accidents related to fatigue may occur during these periods (Moore-Ede and others 1988, Mitler and others 1988).

The bar graph shown in figure 12 plots the number of accidents in the study as a function of the time of day that they occurred, with separate bars for drivers in whom drugs were found and those in whom drugs were not found. Among drivers who were free of drugs, accidents appear more likely during the morning and afternoon hours when there is increased exposure to both truck and other vehicular traffic. Accidents also appear common in the early morning hours when exposure is lower, but fatigue is a problem. They appear to be lowest in the evening hours when both exposure and fatigue considerations predict fewer accidents. By contrast, drivers in whom drugs of abuse were found appear to have accidents at all times of the day. There is less evidence of daily cycles, suggesting that drug use is an important accident factor and not affected by circadian rhythm.

Figure 12.--Toxicological test results by time of day for professional drivers with at least one conclusive test



An earlier table in this report displayed individual drug usage as a function of accident time. Although the difference is only suggestive, it may be noted that methamphetamine/amphetamine and cocaine are the only drug groups used prevalently across all time periods.

Accidents Related to Lack of Alertness

A third way to examine fatigue is by the type of accident that occurs. Certain accidents are caused by the driver's lack of alertness, even by a driver "dozing at the wheel," and these accidents can often be identified through information developed in the investigation. Such accidents were generally indicated in cases in which a truck gradually drifted into trouble without timely evasive maneuvers by the driver. The accidents had two forms:

the truck overtakes and collides with a slower vehicle in front of it; or the truck veers out of its lane into open land, a guard rail, or oncoming traffic.

The first type of accident, in which the truck collides with a vehicle in front, suggests a lack of driver alertness. There were 15 such accidents in the professional truck driver sample (10 percent of the total accidents). These accidents, nearly all of which occurred at night, will be discussed in detail in a separate report concerning conspicuity issues (NTSB safety study report of conspicuity of heavy trucks and trailers, in preparation).

The second type of accident, in which the truck veers out of its lane with no evasive maneuver, is one which is closely associated with problems of fatigue. There were 31 such accidents in the truck study sample (21 percent of the total accidents). In most cases, the accident truck was the only vehicle involved in the accident. In the remaining accidents, there was clear evidence that it veered into oncoming traffic. Examination of the accident site indicated a failure of the driver to brake or steer in the early stages of the accident in time to prevent collision. In several cases, there were statements from eyewitnesses indicating that the truck "just veered off the road" and that there was no braking by the driver.

These accidents would appear to be good evidence of fatigue and "dozing at the wheel." However, complete investigation indicated that, in 12 cases (39 percent of these accidents), there was good evidence that a medical problem rather than fatigue was involved. In one accident, for example, a passenger reported that the driver stiffened suddenly and could not be aroused. In four accidents, drivers were found dead in the cab in situations in which crash injury would not have caused death. In the remaining cases the evidence was less direct, but was judged compelling. Crash dynamics indicated a complete absence of driver response, autopsy evidence indicated coronary issues, witnesses reported that the driver "didn't feel well" before the accident, and investigation uncovered serious medical histories (including previous heart attacks, heart surgery, and seizures).

The remaining 19 cases were judged likely to include a fatigue component. These were combined with the 15 cases involving collisions with the vehicle in front to produce a selected sample of 34 fatigue-related accidents. Complete drug data were available for 32 of these cases, and these are shown in the following table.

Table 35.--Drugs of abuse in accidents showing lack of driver alertness

Drug	Selected accidents	Remaining accidents
Alcohol	9% (3/32)	13% (14/108)
Cocaine/Be	9% (3/32)	8% (8/106)
Meth/Amphetamine	19% (6/32)	4% (4/105)
Marijuana (THC/COOH)	13% (4/32)	14% (15/106)
Other DOA	13% (4/32)	8% (9/108)
Any DOA	38% (12/32)	32% (35/108)

As shown in the table, drivers in the selected sample had a slightly greater presence of drugs of abuse than drivers in the rest of the sample. This difference was due almost entirely to the stimulants, methamphetamine and amphetamine. They were the single highest substance detected in the selected drivers even though the presence in the remaining drivers was quite low. A chi square test confirmed that the difference in positive methamphetamine/amphetamine toxicological results between selected drivers and the remaining drivers is statistically significant at the 0.05 level. There appeared to be little difference in alcohol or multiple drug uses between the selected accidents and the remaining accidents. Drivers in the selected accidents were found more likely to take drugs in multiple combinations (19 percent of the drivers, 6/32) than were the remaining drivers (12%, 13/108).

Comments on Fatigue and Drug Usage

The stimulants methamphetamine and amphetamine provide the most obvious connection between drug use and fatigue. These stimulants appeared often in relation to all three tests performed: they appeared to be relatively high among drivers involved in accidents between midnight and 6:00 a.m., relatively high among drivers who were in excess of the Federal hours of service guidelines, and very high among drivers who veered off the road or collided. These stimulants have been used commonly for several decades by truck drivers to help keep them alert for extended driving efforts. It is, therefore, not surprising to find these drugs associated with fatigue-related accidents.

Cocaine and marijuana were overrepresented in drivers who were in excess of Federal hours-of-service regulations. Cocaine is a stimulant, and it reputedly has been used by truck drivers along with other stimulants to

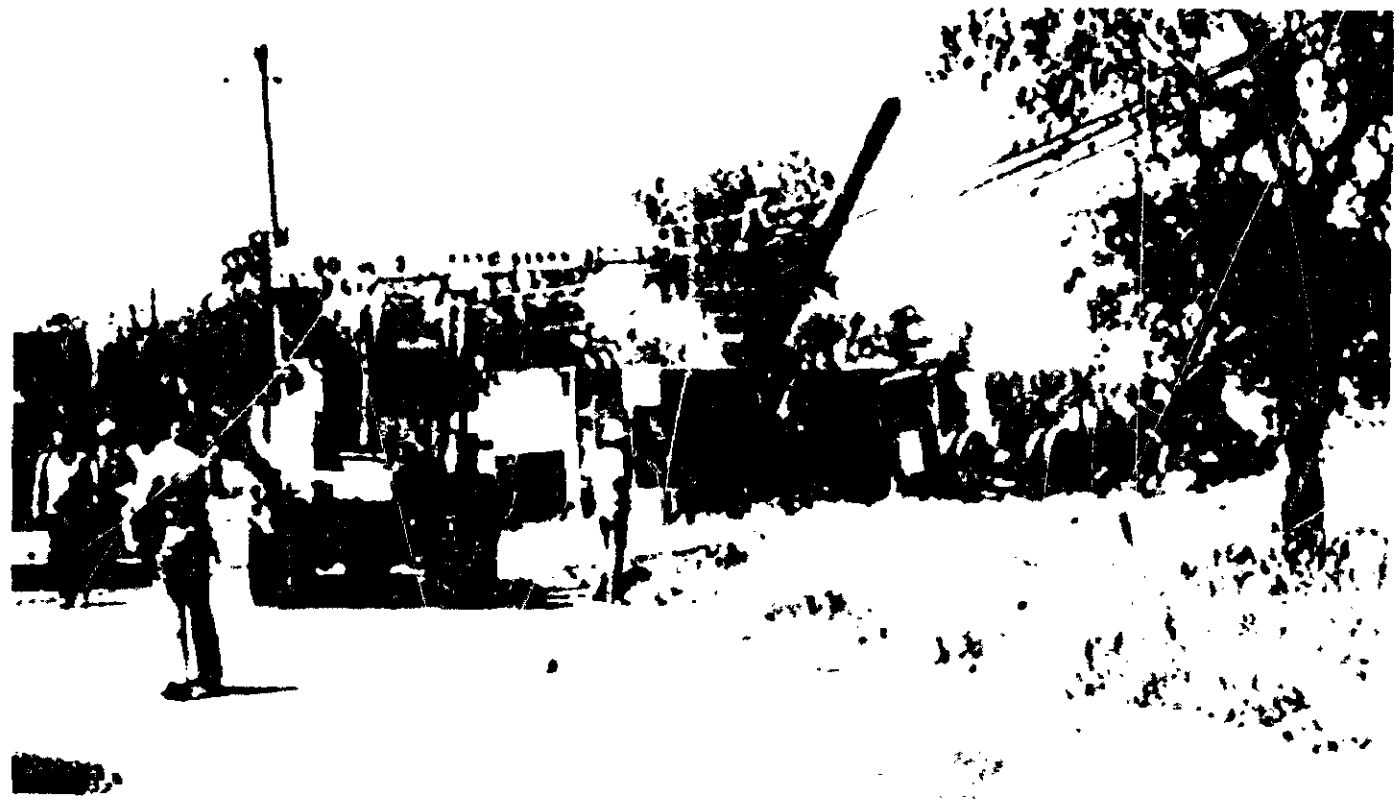


Figure 13.--Fatigue and marijuana use accident
Crack cocaine and amphetamine found in passenger's purse
1981 Peterbuilt tractor and loaded 48 foot trailer vs. 1973 Ford dumptruck
Galt, CA
May 23, 1988

Figure 14.--Drug paraphernalia (marijuana and papers) found in cab wreckage of 1981 Peterbuilt tractor above

help fight fatigue. Marijuana, on the other hand, is a recreational drug that could make drivers drowsy. The presence of this drug in these drivers is more surprising than that of cocaine, and suggests a recreational use during working hours that speaks poorly for safety.

Fatigue, drugs which are taken to counteract the symptoms of fatigue, and drugs which aggravate fatigue appear to be a major factor in accident causation. As evidenced by the 34 cases which were fatigue related, fatigue alone can be a significant factor in accidents fatal to the driver of a heavy truck. Its combination with alcohol and other drugs of abuse causes an especially severe situation.

FINDINGS

1. Alcohol and other drug use by fatally injured drivers of heavy trucks is a significant problem.

2. The most frequently cited accident probable cause or factor in fatal-to-the-driver heavy truck accidents was fatigue (57 cases or 31 percent), followed by alcohol and other drug impairment (53 cases or 29 percent). Of the 57 drivers who were fatigued, 19 were also impaired by alcohol and/or other drugs.

3. Fatigue and fatigue-drug interactions were involved in more fatalities in this study than alcohol and other drugs of abuse alone.

4. Fatigue, drugs which are taken to counteract the symptoms of fatigue, and drugs which aggravate fatigue and the interaction of fatigue and drugs appear to be major factors in accident causation.

5. There is a strong association between violation of the Federal hours of service regulations and drug usage. More than half the drivers who had violated Federal hours of service regulations tested positive for some drug of abuse. The largest difference among these two groups of drivers appeared to occur with marijuana, which was the most prevalent drug of abuse among the drivers who were in excess of the Federal regulations. Greater use of amphetamines, cocaine and alcohol by drivers who violated Federal hours of service regulations was also indicated.

6. Toxicological test results indicated that drugs of abuse, including alcohol, were found in 33 percent of the fatally injured drivers of heavy trucks.

7. Marijuana (cannabinoids) was the most frequently identified drug of abuse among fatally injured truck drivers (21 of 164 tests or 13 percent). Marijuana incidence and that of alcohol were essentially the same.

8. Alcohol incidence among fatally injured drivers was high (21 of 168 tests or 13 percent). Alcohol incidence among drivers who died on a weekend was higher than for other days of the week and approximated the alcohol involvement level among all fatal highway accidents.

9. Cocaine incidence (14 of 165 tests or 9 percent) was greater than the incidence of other illicit stimulants (methamphetamine/amphetamine)(12 of 164 tests or 7 percent). However, when all stimulants (cocaine, methamphetamine/amphetamine, and the OTC stimulants, ephedrine, pseudoephedrine, and phenylpropanolamine) are combined, stimulants are the most frequently identified drug class in the study. Twenty percent (33 of 165 tested drivers) of the drivers tested positive for one of these stimulants.

18. Drug of abuse positive test results are related to the type of trucking service provided in a statistically significant manner. Nearly 42 percent of truckload (TL) carrier drivers tested positive for drugs of abuse compared to 14 percent for less-than-truckload (LTL) carrier drivers and 24 percent for drivers of carriers providing both TL and LTL service.

19. Sixteen percent (29 of 185) of the case drivers held either multiple valid licenses, two valid and one suspended/revoked, one valid and one suspended/revoked, or no valid license.

20. A driver with at least one suspended or revoked license is more likely to have used drugs of abuse.

21. Prior alcohol abuse and/or drug use history is strongly related to a positive test for drugs of abuse among fatally injured drivers in this study. Among fatally injured truck drivers, prior history correlates with subsequent drug involved accidents and indicates the need for pre-employment checks and drug testing.

22. Nearly 80 percent of responding carriers reportedly conducted pre-employment qualification checks. Pre-employment drug tests were required by 24 percent of the reporting companies. Random tests were conducted by 8 percent of reporting companies; and testing for cause was employed by 12 percent of the reporting companies. Most importantly, 76 percent of the reporting companies had no ongoing drug testing program even for new hires.

23. Drug of abuse usage had no apparent relationship with State of license, weight of vehicle, area of operation, vehicle configuration, vehicle ownership and driver income levels.

24. Observation of toxicological test results indicated that three States (California, Tennessee, and Wisconsin) accounted for all the amphetamine cases in this study. Two States (California and Maryland) accounted for 11 of the 14 cocaine cases. Statistical analysis indicated no statistically significant differences.

25. In 10 percent of the fatally injured drivers, the driver's medical condition was a contributing factor to, or the probable cause of, the accident. The Safety Board definition of "medical condition" is based on medical records and autopsy reports and is likely to be conservative. Over 90 percent of medical condition related accidents involved some form of cardiac incident. Apparent falsification of medical certificates and inappropriate medical qualification of drivers occurs sufficiently frequently to warrant concern and action.

26. The average age of drivers who died as a result of a medical incident was 14 years older than drivers without medical problems at the time of death (55 years vs. 41 years). A statistically significant relationship exists between driver age and an incapacitating medical incident.

27. Investigators found that logbooks were routinely falsified where they were required by regulation. It was common to find two sets of logbooks (3 sets in one case) kept by the accident involved drivers. In only one case was a vehicle equipped with a tachograph. Five case vehicles were equipped with on board computers.

28. There is no reliable database for truck accidents involving drugs other than alcohol. The FARS database has the best available alcohol test data, but extremely limited drug and truck-specific data. FARS alcohol data could be improved if more States reported alcohol test data with greater frequency.

29. State toxicological tests vary widely in the drugs for which tests are requested and performed, type of test performed (screening/ confirmation), and analytic methods used. As a consequence, reliable and consistent State data on involvement of drugs in fatal accidents are not available.

30. There is no comprehensive and standardized legislation, policy, or program (Federal or State) for drug testing of vehicle operators involved in fatal truck accidents. The Safety Board has previously called upon the States to enact legislation requiring alcohol testing of all drivers involved in a fatal accident.

31. DOT drug testing regulations do not cover all drugs which have an effect on driver performance, most notably alcohol.

32. DOT cutoff levels and specimens collected for drugs are inappropriate for postaccident and postincident testing and do not aid in probable cause determination.

33. Occupant protection issues are the most frequently identified non-causal factors involved in a heavy truck fatal accident (68 of 185).

34. In 115 of the 185 accident involved trucks (62 percent), some management deficiency in oversight of the driver or the proper condition of the vehicle was identified. Deficiencies in oversight of both the driver and the vehicle were identified in 32 of 185 (18 percent) accidents.

RECOMMENDATIONS

As a result of this safety study, the National Transportation Safety Board made the following recommendations:

--to the Department of Transportation:

With the assistance of the Department of Labor, Occupational Safety and Health Administration and the Interstate Commerce Commission, conduct a detailed review of, and report on, trucking industry structure, operations, and conditions, especially shipping, dispatching, and receiving requirements, shipment broker operations, just-in-time shipments, and truckload/less-than-truckload operations which may create incentives for drivers to violate hours of service regulations and to use drugs of abuse. (Class II, Priority Action) (H-90-10)

Assess and revise, as appropriate, the reporting and accuracy of existing database elements regarding toxicological tests for DOT operated and supported highway accident databases and trucking operations databases to provide complete and accurate reporting of toxicological tests requested and results obtained. (Class II, Priority Action) (H-90-11)

Develop a program to merge elements concerning commercial vehicle operations of the separate DOT operated and supported highway accident databases. These elements should include, but not be limited to, driver history, carrier, vehicle and roadway characteristics, hazardous materials transportation, and alcohol and other drug involvement. (Class II, Priority Action) (H-90-12)

With the assistance of the Department of Health and Human Services, the States, the American Academy of Forensic Sciences, the National Safety Council Committee on Alcohol and Other Drugs, and other organizations as appropriate, standardize procedures for postaccident toxicological specimen collection, chain of custody, testing, and reporting among the States for accidents involving medium and heavy trucks. (Class II, Priority Action) (H-90-13)

Establish, with the Department of Health and Human Services and other organizations as appropriate, a postaccident alcohol and other drug analytic test plan for tests to be conducted on a wide range of impairing drugs with results reported at state-of-the-art sensitivity levels. (Class II, Priority Action) (H-90-14)

Provide funding incentives, guidance and assistance to the States to obtain complete toxicological tests and report results (including drug tests requested) to DOT on all vehicle operators involved in fatal commercial vehicle accidents. (Class II, Priority Action) (H-90-15)

--to the National Highway Traffic Safety Administration:

Revise the Fatal Accident Reporting System to include standardized drug toxicological tests requested in each fatal accident and results, both single and multiple drug, which would include an estimating system similar to that now used to estimate national alcohol involvement in fatal accidents. (Class II, Priority Action) (H-90-16)

--to the Federal Highway Administration:

Require pre-employment alcohol and other drug tests on all drivers of commercial trucks with a gross vehicle weight rating of 10,000 pounds and above as a condition of employment. (Class II, Priority Action) (H-90-17)

Amend 49 CFR 391.21 "Application for employment" and 391.23 Investigations and inquiries" to include a complete review of alcohol and other drug abuse treatment history prior to employment as a commercial truck driver. (Class II, Priority Action) (H-90-18)

Require commercial truck driver applicants with a prior history of drug and/or alcohol abuse to complete a certified treatment program and obtain a physician's evaluation of substance abuse and dependency. (Class II, Priority Action) (H-90-19)

Require close supervision, including frequent, unannounced drug testing, for an appropriate period, of commercial truck drivers with an identified alcohol or other drug abuse problem. Such testing should be sufficiently frequent to create the likelihood of detection if the person uses drugs of abuse. (Class II, Priority Action) (H-90-20)

Disseminate safety information to national, State, and local police agencies, public service and safety agencies, professional truck driver groups and individual truck drivers, regarding: the effects of fatigue, alcohol and other drug use; the interaction of alcohol, drugs and fatigue; the prevalence of drug and alcohol abuse among professional commercial vehicle operators; and, methods of minimizing conditions which lead to commercial vehicle operators driving while fatigued. (Class II, Priority Action) (H-90-21)

Establish a demonstration project(s) to deter the use of alcohol and other drugs by drivers of medium and heavy trucks that includes alcohol and other drug testing at special

roadside sobriety check-points, truck inspection lanes, and truck weigh stations. (Class II, Priority Action) (H-90-22)

Establish and fund a program to train instructors to provide drug recognition expert training to Federal agency inspectors/ investigators, police, and other public service personnel with commercial truck and truck driver oversight responsibilities. (Class II, Priority Action) (H-90-23)

Amend 49 CFR 391.43 to require more extensive and frequent state of tne art cardiac screening tests and examinations of older commercial truck drivers (age 40 and above) and for all commercial drivers with cardiac conditions. Commercial drivers with a cardiac history or condition should be disqualified until cleared by a competent medical authority. (Class II, Priority Action) (H-90-24)

Develop a clear set of medical standards for cardiac risk assessment and require physicians to use them in qualifying older commercial truck drivers and for commercial drivers with cardiac conditions. Medical certification should include medical state of the art cardiac risk factors. (Class II, Priority Action) (H-90-25)

Provide for criminal penalties for physicians who deliberately qualify commercial truck drivers with serious medical conditions in spite of contradictory medical evidence and for physicians, commercial drivers, and others who falsify the medical examiner's certificate. (Class II, Priority Action) (H-90-26)

Improve the medical examination form in 49 CFR 391.43 to ensure that the examining physician is aware of truck operation risk factors and of the physical and other stress producing requirements of commercial truck operation. Provide for a means for physicians to acknowledge that they understand the rigors of commercial truck operation and that the driver being examined is qualified for such commercial truck operations. The physician should also certify that he understands the penalties for deliberate and/or false statements on the medical certificate and for medical certificate falsification. (Class II, Priority Action) (H-90-27)

Require automated/tamper-proof on-board recording devices such as tachographs or computerized logs to identify commercial truck drivers who exceed hours of service regulations. (Class II, Priority Action) (H-90-28)

As part of the FHWA on-going study of fatigue and loss of alertness among commercial vehicle operators, investigate the interactions of fatigue and drug usage. (Class II, Priority Action) (H-90-29)

Revise 49 CFR Parts 391 and 395 to establish driver hours of service violations, logbook irregularities, or the presence of multiple logbooks as a reasonable cause requiring a drug test of the driver. Amend the regulations and provide notice to drivers of these revised regulations. (Class II, Priority Action) (H-90-30)

Revise 49 CFR Parts 391 and 392 to establish violation of the commercial vehicle operation alcohol offense (49 CFR 392.4, 392.5) as a reasonable cause requiring a drug test of the driver. Amend the regulations and provide notice to drivers of these revised regulations. (Class II, Priority Action) (H-90-31)

Amend 49 CFR Part 392 and 395 to prohibit employers, shippers, receivers, brokers, or drivers from accepting and scheduling a shipment which would require that the driver exceed the hours of service regulations in order to meet the delivery deadline (similar to current regulations regarding schedules which would require the driver to exceed the speed limit [49 CFR 392.6]). In conjunction with the Interstate Commerce Commission, provide for operating certificate and financial penalties appropriate to the offense. (Class II, Priority Action) (H-90-32)

--to the Department of Health and Human Services:

Assist the Department of Transportation, the States, the American Academy of Forensic Sciences, the National Safety Council Committee on Alcohol and Drugs, and other organizations as appropriate, in standardizing procedures for postaccident toxicological specimen collection, chain of custody, testing, and reporting among the States for accidents involving medium and heavy trucks. (Class II, Priority Action) (H-90-33)

Establish, with the Department of Transportation and other organizations as appropriate, a postaccident alcohol and other drug analytic test plan for tests to be conducted on a wide range of impairing drugs with results reported at state-of-the-art sensitivity levels. (Class II, Priority Action) (H-90-34)

--to the American Trucking Associations, Regular Common Carrier Conference, the Private Carrier Conference, the National Private Truck Council, the National Tank Truck Carriers, the Owner-Operator Independent Drivers Association, the Shippers National Freight Claim Council, the Commercial Vehicle Safety Alliance, and the International Brotherhood of Teamsters:

Actively promote and encourage your members to use or support: pre-employment tests for alcohol and other drugs; driver violation history checks; and alcohol or other drug abuse

treatment history checks. (Class II, Priority Action) (H-90-35)

Encourage your membership to participate in alcohol and other drug education and information programs aimed at commercial drivers. (Class II, Priority Action) (H-90-36)

Encourage your membership to participate in education and public information programs regarding: scheduling and its impact on driver fatigue; and the effects of alcohol and other drug use; and, the interaction of drugs and fatigue. (Class II, Priority Action) (H-90-37)

--to the International Association of Chiefs of Police, the Commercial Vehicle Safety Alliance, and the International Association of Directors of Law Enforcement Standards and Training:

Disseminate to your members information regarding the prevalence of alcohol and other drug use/abuse and fatigue among professional commercial truck drivers. (Class II, Priority Action) (H-90-38)

Encourage your members to provide training in drug recognition for those personnel with commercial truck and truck driver enforcement and oversight responsibilities. (Class II, Priority Action) (H-90-39)

--to the National Governors Association:

Coordinate development of national programs for State implementation of standardized testing for alcohol and other drugs. (Class II, Priority Action) (H-90-40)

Develop a program for the reporting of all accident toxicological results to the national commercial truck database system. (Class II, Priority Action) (H-90-41)

--to the Governors of the 50 States, the Commonwealth of Puerto Rico, the Virgin Islands, and the Territories:

Enact legislation or issue regulations to require the collection of blood samples for alcohol and other drug toxicological testing from all vehicle operators involved in fatal commercial truck accidents. (Class II, Priority Action) (H-90-42)

Report alcohol and other drug toxicological tests requested and results obtained in fatal accidents to the Fatal Accident Reporting System operated by the National Highway Traffic Safety Administration. (Class II, Priority Action) (H-90-43)

commercial truck drivers (age 40 and older) and for commercial drivers with cardiac conditions. (Class II, Priority Action) (H-90-52)

Enact legislation or adopt regulations, as appropriate, to define the alcohol concentration level that constitutes driving a commercial motor vehicle "under the influence" at the lowest possible level consistent with the capability of testing equipment to measure any ingested alcohol. (Class II, Priority Action) (H-90-53)

Enact legislation to establish 0.01 percent (the practical scientific level which allows for instrument sensitivity and individual differences) as the per se offense blood alcohol concentration for operators of commercial vehicles in your State. (Class II, Priority Action) (H-90-54)

--to the National Association of Trade and Technical Schools, the National Home Study Council, and the Professional Truck Driver Institute of America:

Encourage your membership to disseminate information to the commercial trucking industry and commercial vehicle operators regarding:

- o the effects of fatigue, alcohol and other drug use;
- o the interaction of alcohol, drugs and fatigue;
- o the differences between truck driver perception of fatigue and the actual onset of fatigue;
- o methods of minimizing conditions which lead to commercial vehicle operators driving while fatigued. (Class II, Priority Action) (H-90-55)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ James L. Kolstad
Acting Chairman

/s/ Jim Burnett
Member

/s/ John K. Lauber
Member

/s/ Lemoine V. Dickinson, Jr.
Member

Adopted: February 5, 1990

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APPENDIX A

ABBREVIATIONS

AMA-American Medical Association
ATA-American Trucking Associations
BAC-Blood Alcohol Concentration (sometimes referred to as BAL-Blood Alcohol Level)
BE-Benzoylecgonine, a metabolite of cocaine
CDL-Commercial Driver's License
CFR-Code of Federal Regulations
CHT-Center for Human Toxicology at the University of Utah
CMVSA-Commercial Motor Vehicle Safety Act
CNS-Central Nervous System
COOH-Carboxylic acid metabolite of marijuana
DHHS-U.S. Department of Health and Human Services
DOT-U.S. Department of Transportation
EAP-Employee Assistance Program
EIMS-Electron Impact Mass Spectrometry
FARS-Fatal Accident Reporting System
FHWA-Federal Highway Administration
FMCSR-Federal Motor Carrier Safety Regulations
GC-ECD-Gas Chromatography with Electron Capture Detection
GC-MS-Gas Chromatography-Mass Spectrometry
GC-NPD-Gas Chromatography/Nitrogen Phosphorous Detection
GVWR-Gross Vehicle Weight Rating
HEW-U.S. Department of Health, Education, and Welfare (which became HHS)
HHS-U.S. Department of Health and Human Services
HPLC-High Performance (Pressure) Liquid Chromatography
ICC-Interstate Commerce Commission
IIHS-Insurance Institute for Highway Safety
MCSAP-Motor Carrier Safety Assistance Program
NAS-National Academy of Sciences
NHTSA-National Highway Traffic Safety Administration
NIDA-National Institute on Drug Abuse
OMCS-Office of Motor Carrier Safety in FHWA
OOIDA-Owner-Operator Independent Drivers Association
OTC-Over-the-Counter (medications)
PCP-Phencyclidine
RCCC-Regular Common Carrier Conference
RIA-RadioImmunoAssay
STAA-Surface Transportation Assistance Act
THC-delta-9 TetraHydroCannibol (Psychoactive component of marijuana)
TIFA-Trucks Involved in Fatal Accidents
UMTRI-University of Michigan Transportation Research Institute

APPENDIX B

DEFINITIONS

ALIQUOT--A part or portion of a sample which is equally divided with no remainder. The last whole part of a sample.

DRUGS OF ABUSE--For this study, drugs of abuse include licit and illicit drugs which were identified in fatally injured drivers of heavy trucks through toxicological testing at the Center for Human Toxicology. These drugs include: alcohol; marijuana (THC) and metabolites (COOH); cocaine and its benzoylecgonine metabolite; methamphetamine and amphetamine; other stimulants such as ephedrine, pseudoephedrine, and phenylpropanolamine; opiates; and phencyclidine. Other drugs which are commonly abused and for which CHT toxicological test tests were performed, but not identified include sedative/tranquilizers such as barbiturates and benzodiazepines. Caffeine, analgesics and anticonvulsants are not included in drugs of abuse.

FATALLY INJURED--In order to be included as a fatally injured driver in this study, the driver must have been driving a medium (more than 10,000 lbs but less than 26,001 lbs) or heavy (more than 26,000 lbs) truck in one of the eight States and must have died within four hours of the accident. Drivers of motorhome, bus, and other heavy vehicles are not included.

GROSS VEHICLE WEIGHT RATING--As defined in the Federal Motor Carrier Safety Regulations, 49 CFR 383.5, "the value specified by the manufacturer as the loaded weight of a single vehicle."

HEAVY TRUCK--A vehicle whose gross vehicle weight rating is 10,000 pounds or above. For the purposes of this study, the term "heavy truck" includes the conventional categories of both medium and heavy trucks. A medium truck is one with a gross vehicle weight rating of 10,000 pounds or more, but less than 26,001 pounds. A heavy truck is one with a gross vehicle weight rating of 26,001 pounds or more.

PROFESSIONAL DRIVER SAMPLE--This is a subset of the total number of fatal-to-the-driver heavy truck accidents occurring in the eight States in the time period of the study. The professional driver sample excludes all cases where the driver's primary occupation was other than driving and includes those cases where the truck driver earned his living by driving a truck. Examples of excluded drivers are: drivers of service trucks such as insulation installation service, pool service, septic service, lawn service; borrowed vehicles such as cement or water tank trucks; a crane; a tractor owned by a teacher, but not registered. Examples of included drivers are those driving: tractor trailers, flatbeds, doubles combinations, bobtail tractors, straight trucks, and dump trucks.

PROBABLE CAUSE SAMPLE--This is a data set which includes all fatally injured drivers. The sample is based on the probable cause developed by the Safety Board. As such, the probable cause is developed from all available data including State toxicological tests, interviews, and other reports. Therefore, data in this sample, such as toxicological data, will not be consistent with the more conservative "core" analysis of CHT toxicological test results.

APPENDIX C

TOXICOLOGICAL TEST METHODOLOGY AND ANALYTIC PLAN

Analytic Methods

Volatile compounds were screened by gas chromatography (GC) with flame ionization detection to a sensitivity of 0.01 percent w/v (weight per volume) for ethanol, methanol, isopropanol, and acetone.

Tranquilizers, and sedatives such as diazepam/metabolites, flurazepam/metabolites, and chlordiazepoxide/metabolites were screened by gas chromatography with electron capture detection (GC-ECD). The sensitivity limit was 100 ng/mL for benzodiazepines except chlordiazepoxide which was 3000 ng/mL. Confirmation of chlordiazepoxide was performed by electron impact mass spectrometry (EIMS) and quantitation by high pressure liquid chromatography (HPLC). Confirmation of other benzodiazepines was performed by EIMS and quantitation by GC-ECD. Methaqualone was screened by radioimmunoassay (RIA), confirmed by EIMS, confirmed and quantitated by chemical ionization gas chromatography mass spectrometry (CIMS). Barbiturates represented the remainder of the class of sedatives for which samples were screened. These were screened by RIA to a sensitivity of 200 ng/mL, confirmed by EIMS, and quantitated by high performance liquid chromatography (HPLC).

Stimulants were screened using both RIA and CIMS. Although the RIA screen was specific only for amphetamine, the CIMS was specific for amphetamine, methamphetamine, phentermine, ephedrine, pseudoephedrine, and phenylpropanolamine. Any positives were confirmed and quantitated by CIMS using the method Wilkins presented to the American Academy of Forensic Sciences in February 1989 (Wilkins and others 1989). The confirmation sensitivity was 50 ng/mL for amphetamine, methamphetamine, and phentermine and 100 ng/mL for the over-the counter drugs. Cocaine and benzoylecgonine were also included in the stimulant class and were screened for by RIA to a sensitivity of 25 ng/mL and confirmed by CIMS to a sensitivity of 10 ng/mL for each analyte (after Chinn and others 1980).

The opiates, morphine and codeine, were screened by RIA to a sensitivity of 50 ng/mL and confirmed by CIMS to 25 ng/mL. Opioid compounds such as meperidine, methadone, pentazocine, and propoxyphene were screened by the method described by Kopiak and others (1979), by gas chromatography nitrogen phosphorous detection (GC-NPD) with a sensitivity limit of 200 ng/mL. All positive findings were confirmed by EIMS and quantitated by capillary gas chromatography nitrogen phosphorus detection.

The antihistamines and other basic compounds, such as caffeine, were screened by the Kopiak method noted above. All presumptive positives were confirmed by EIMS with quantitations performed by GC-NPD. The screening sensitivity for these compounds was 200 ng/mL for diphenhydramine, chlorpheniramene and brompheniramine and 1 ug/mL for caffeine. The confirmation sensitivities were 100 ng/mL for the antihistamines and 1 ug/mL for caffeine. Acetaminophen and salicylates were detected by TDx

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methodologies (Fluorescence Polarization Immunoassay) to a sensitivity of 10 ug/mL. Ibuprofen was screened and confirmed by high performance liquid chromatography (HPLC) to a sensitivity of 10 ug/mL.

Other compounds in the analytical protocol included phencyclidine and cannabinoids. Screening was performed by RIA for both compounds. The sensitivity of screening for phencyclidine was 10 ng/mL and 25 ng/mL for cannabinoids. In the event that phencyclidine-presumptive positives were detected, the confirmation was performed by chemical ionization/mass spectrometry to a sensitivity of 10 ng/mL (See Foltz and others 1980). Cannabinoids, which have been a significant finding in recent drug and driving studies, were confirmed, if present, to a sensitivity of 1 ng/mL for delta-9-tetrahydrocannibol and 2 ng/mL for the carboxylic acid metabolite by negative ion chemical ionization mass spectrometry. (See Foltz and others 1983).

Since all samples were handled as forensic cases with the potential for litigation, a complete chain-of-custody document was maintained with each specimen and each aliquot. An aliquot in this context is a portion of a biological specimen. Tiered review processes were implemented to ensure accuracy of data transcription and analysis. All files included indication of appropriate quality control and certifying official review.

CHT provided individual reports, aggregate case listings, tabulations of cases testing positive for drugs in the analytic plan, and a separate tabulation of cases testing positive for drugs of abuse. The analytic scheme for drug screening by CHT took the following path:

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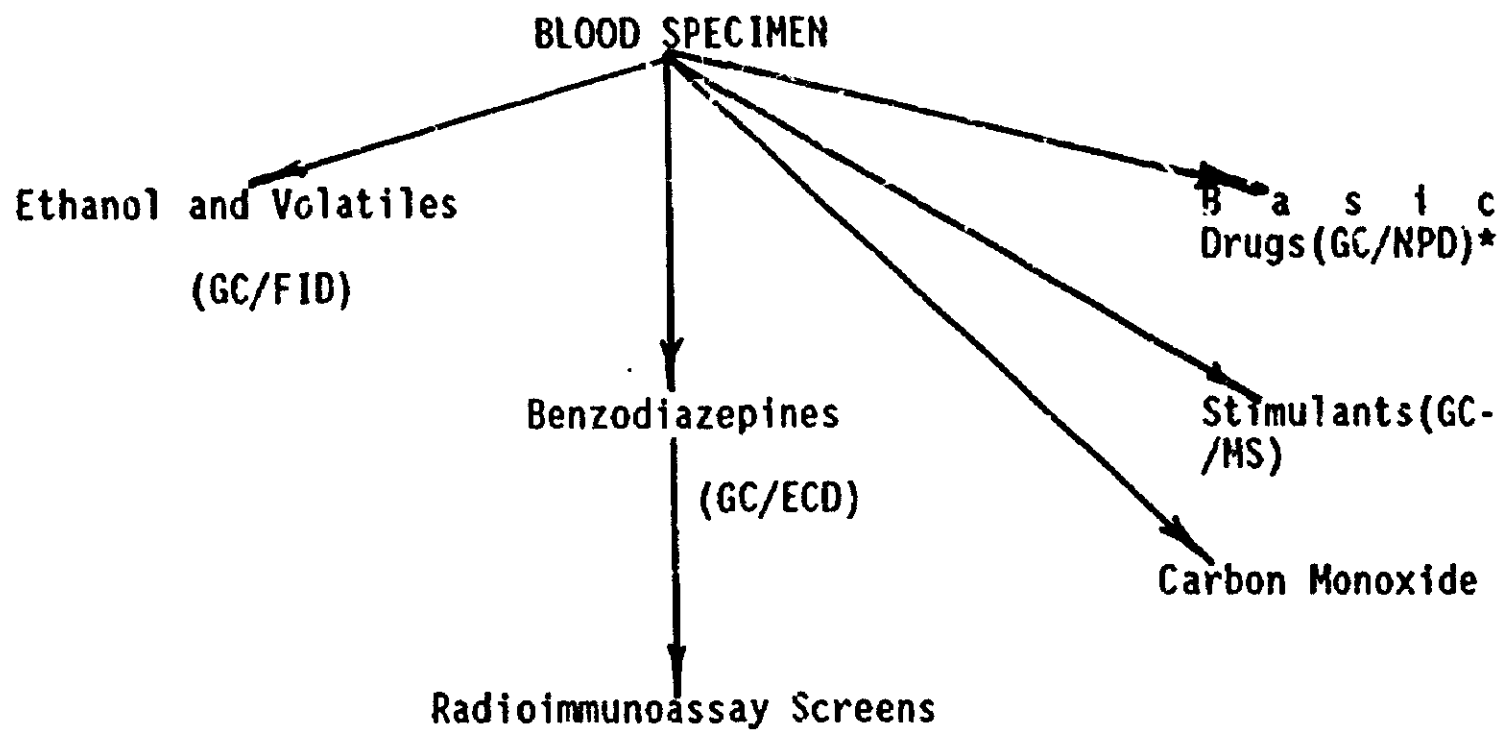

*Basic drugs identified by this method include: the opiates except morphine (codeine, meperidine, methadone, pentazocine, and propoxyphene); antihistamines (diphenhydramine, chlorpheniramine, and brompheniramine); and caffeine. Other basic drugs such as stimulants and benzodiazepines are identified by GC-MS or GC-ECD.

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NTSB-CHT Drug Test Plan

VOLATILES

	Screen		Confirmation	
	Procedure	Sensitivity	Procedure	Sensitivity
Ethanol	GC/FID	0.01% w/v	GC/FID	0.01% w/v
Methanol	GC/FID	0.01% w/v	GC/FID	0.01% w/v
Isopropanol	GC/FID	0.01% w/v	GC/FID	0.01% w/v
Acetone	GC/FID	0.01% w/v	GC/FID	0.01% w/v

SEDATIVE/TRANQUILIZERS

	Screen		Confirmation	
	Procedure	Sensitivity	Procedure	Sensitivity
Butalbital	RIA	200 ng/ml	MS/Quant HPLC	200 ng/ml
Amobarbital	RIA	200 ng/ml	"	200 ng/ml
Secobarbital	RIA	200 ng/ml	"	200 ng/ml
Pentobarbital	RIA	200 ng/ml	"	200 ng/ml
Butabarbital	RIA	200 ng/ml	"	200 ng/ml
Phenobarbital	RIA	1000 ng/ml	"	500 ng/ml
Methaqualone	RIA	1000 ng/ml	GC/MS	500 ng/ml
Diazepam/Desmethyl	GC/ECD	100 ng/ml	MS/GC ECD	100 ng/ml
Flurazepam/Desalkyl	GC/ECD	100 ng/ml	MS/GC ECD	100 ng/ml
Chlordiazepoxide/ Desmethyldiazepam	GC/ECD	3000 ng/ml	MS/Quant HPLC	300 ng/ml

STIMULANTS

	Screen		Confirmation	
	Procedure	Sensitivity	Procedure	Sensitivity
Cocaine/ Benzoylecgonine	RIA	25 ng/ml	GC/MS	25 ng/ml
Amphetamine	GC/NPD	100 ng/ml	"	50 ng/ml
Methamphetamine	"	100 ng/ml	"	50 ng/ml
Phentermine	"	100 ng/ml	"	50 ng/ml
Ephedrine	"	200 ng/ml	"	100 ng/ml
Pseudoephedrine	"	200 ng/ml	"	100 ng/ml
Phenylpropanolamine	"	200 ng/ml	"	100 ng/ml
Caffeine	"	1000 ng/ml	MS/Quant GC/NPD	1000 ng/ml

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OPIATES

	Screen		Confirmation	
	Procedure	Sensitivity	Procedure	Sensitivity
Morphine	RIA	50 ng/ml	GC/MS	25 ng/ml
Codeine	RIA	50 ng/ml	GC/MS	25 ng/ml
Meperidine	GC/NPD	250 ng/ml	MS/Quant GC/NPD	100 ng/ml
Methadone	GC/NPD	250 ng/ml	MS/Quant GC/NPD	100 ng/ml
Pentazocine	GC/NPD	250 ng/ml	MS/Quant GC/NPD	100 ng/ml
Propoxyphene	GC/NPD	250 ng/ml	MS/Quant GC/NPD	100 ng/ml

ANTIHISTAMINES

	Screen		Confirmation	
	Procedure	Sensitivity	Procedure	Sensitivity
Diphenhydramine	GC/NPD	200 ng/ml	MS/Quant GC/NPD	100 ng/ml
Chlorpheniramine	GC/NPD	200 ng/ml	MS/Quant GC/NPD	100 ng/ml
Brompheniramine	GC/NPD	200 ng/ml	MS/Quant GC/NPD	100 ng/ml

HALLUCINOGENS

	Screen		Confirmation	
	Procedure	Sensitivity	Procedure	Sensitivity
Phencyclidine	RIA	10 ng/ml	GC/MS	10 ng/ml

CANNABINOIDS

	Screen		Confirmation	
	Procedure	Sensitivity	Procedure	Sensitivity
Δ^9-THC	---		GC/MS	1.0 ng/ml
Carboxy THC	RIA	25 ng/ml	GC/MS	2.0 ng/ml

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ANALGESIC

	Screen		Confirmation	
	Procedure	Sensitivity	Procedure	Sensitivity
Acetaminophen	HPLC	10,000 ng/ml	HPLC	10,000 ng/ml
Salicylate	HPLC	10,000 ng/ml	HPLC	10,000 ng/ml
Ibuprofen	HPLC	10,000 ng/ml	HPLC	10,000 ng/ml

ANTICONVULSANTS

	Screen		Confirmation	
	Procedure	Sensitivity	Procedure	Sensitivity
Phenytoin	HPLC	5,000 ng/ml	HPLC	5,000 ng/ml
Carbamazepine	HPLC	5,000 ng/ml	HPLC	5,000 ng/ml
Phenobarbital (See Barbiturates)				

Other:

Carboxyhemaglobin	Visible/Spec	10%

APPENDIX D

ALCOHOL AND OTHER DRUG ABUSE IN THE WORKPLACE

Given that a large majority of the adult population of the U.S. is employed, workplace-related drug use has potentially enormous impact on the health, safety, and productivity of the Nation. Missing, however, is any sizable systematic research database on the extent of workplace-related drug use, its impact on performance and productivity, and on the efficacy of various workplace-based strategies to reduce drug use and its consequences.

Prevalence of Drug Use by the Workforce

National estimates of drug use in workplace populations have been difficult to obtain. Several studies (Cook and Harrell 1987; Voss 1989), utilizing survey data from national samples, demonstrate that drug use is not simply a problem in unemployed people or students, but that significant drug use is occurring in employed people. Two 1985 surveys, providing replication of findings in two independent samples, report significantly more illicit drug use in younger persons (18 - 34 years), with highest rates for marijuana. Approximately one in nine employed people report current use of marijuana, with nearly double that rate (one in five) for younger people aged 18 - 34 yrs. In addition, there are significant differences in drug use among different occupational categories, with relatively lower rates in professional and managerial personnel compared to skilled and semi-skilled labor.

In Newcomb, one of the few existing studies examining drug use at work, results from a sample of young (19 - 24 year old) employed individuals in California showed that a large fraction (35.6 percent) of those employed full-time admitted using drugs or alcohol while at work at least once in the last 6 months (Newcomb 1988). Further breakdown of these data indicated that 19.3 percent reported having used alcohol, 20.1 percent had used marijuana, and 15.8 percent had used hard drugs while at work at least once during the 6 months prior to data collection. The reported frequency of marijuana use was particularly alarming in that 3 percent of the sample had used it more than 30 times while working in the last 6 months.

In addition to national estimates of employment-related drug use based on self-report data, some regional and industry-specific estimates based on chemical testing have been made. As described above, the Insurance Institute for Highway Safety sponsored a study of 317 randomly selected tractor-trailer drivers who provided blood and urine specimens for drug analysis (Lund and others 1988). Overall, 29 percent tested positive for drugs of abuse. Of these, 15 percent were positive for marijuana, 12 percent for over-the-counter stimulants, 5 percent for prescription stimulants, 2 percent for cocaine, and less than 1 percent for alcohol. This study represents a particularly fine example of the application of rigorous scientific methodology in a field experiment and demonstrates that valid estimates of recent drug use in workplace environments are attainable.

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Drug use by the workforce may have regional as well as occupational variability. Data from the California Commercial Laboratory Drug Testing Project, which monitors drug use trends throughout that State using data provided by commercial laboratories involved in drug testing, show that levels of drug use among employed populations are consistently lower than in criminal justice and drug treatment populations (Anglin and Westland 1989). The employment testing data showed that 4 to 7 percent of employees tested positive for marijuana, 1 to 2 percent for cocaine, and 1 to 3 percent for amphetamines. Results were relatively constant over the 12 months of the study.

Data from self-report studies and from various types of workplace drug testing programs are beginning to fill a need for information on the extent and nature of workplace-related drug use. Such data are critical prerequisites to further study of the effects of drugs on performance and productivity.

Relationship of Drug Use to Performance and Productivity

The impact of drug use on measures of performance and productivity in the workplace has been difficult to assess, partially because of the difficulty in defining the extent of drug use by the workforce, but, perhaps more importantly, because of the difficulty in designing and carrying out controlled studies in workplace environments. Estimates of prevalence, as described above, can be inferred from self-report data collected in surveys or from various types of drug testing programs. Surveys have generally not collected data which lend themselves to analysis of the impact of drug use in the workplace, however.

The estimated costs to society of drug abuse are substantial, according to the Alcohol, Drug Abuse, and Mental Health Administration (Harwood and others 1984). The costs to society of drug abuse were estimated to be $60 billion in 1983. The costs due to reduced productivity and lost employment, that is, workplace-related costs, were $34 billion. This study estimated the value of unrealized productivity due to drug use based upon assumptions which need additional validation and which address a narrow range of performance indicators. Several recent studies have begun to expand on the study, in both retrospective as well as prospective manners, looking at correlations between indicators of job performance and measures of drug use, primarily absenteeism and job turnover rates.

The U.S. Postal Service is conducting a study to assess drug use prevalence in its job applicant population and to evaluate the relationship between drug testing results and job performance indicators (Normand and Salyards 1989). A total of 5,465 job applicants at 21 sites were urine tested for the presence of illicit drugs at the time of job application. Test results were not disseminated to hiring officials and had no bearing on these applicants' success or failure in obtaining a position with the Postal Service. Overall, 8.4 percent of those hired tested positive, approximately two-thirds for marijuana, one-quarter for cocaine and 10 percent for other drugs. Analysis of the data showed a significant association between test results and each of the targeted employment measures, absenteeism and job

turnover. Employees who tested positive were found to be absent at a rate 43 percent greater than those who tested negative. Subjects who tested positive for cocaine were more than three times as likely to be heavy leave users as their drug-free counterparts. Involuntary job separation measured 40 percent higher among the drug positive group members. Cocaine-positive applicants displayed involuntary separation rates nearly twice that of those who tested negative. Accidents, injuries, and employee benefit claims are additional measures earmarked for analysis in this ongoing study. This study is the first of its kind, a large-scale, prospective evaluation of the utility of job applicant drug testing, and promises to provide valuable objective data on a controversial subject.

A study of U.S. Navy recruits shares a key design feature with the U.S. Postal Service study - the identification of drug users through urinalysis and subsequent prospective performance evaluation. The study compares a group of approximately 500 male recruits who had tested positive for marijuana (THC) at the time of induction with a matched group who tested negative for any illicit drugs (Blank and Fenton 1989). Demographic differences in education level, Armed Forces Qualification Test (AFQT) scores and race were factors between the THC positive and negative groups that reached significance. Analysis of such variables as age, marital status and place of origin, on the other hand, revealed no appreciable differences between groups. Examination of retention patterns showed that a greater percentage of the THC negative group (81 percent) than the THC positive group (57 percent) were still in the Navy after 2 1/2 years. A total of 14 percent of those from the THC positive group left the Navy for drug or alcohol-related problems, and another 21 percent were discharged early for other behavioral or performance problems. In contrast, only 1 percent of the THC negative group were removed for drug/alcohol-related difficulties and only an additional 8 percent for behavioral or performance problems.

In a considerably larger military sample, the utility of self-report of pre-employment drug use in predicting on-the-job suitability was examined (McDaniel 1988). Subjects studied were those 10,188 individuals who entered military service within one year of taking a survey that included a number of drug related items. The employment unsuitability measure was defined as discharge from military service for reasons classified as "failure to meet minimum behavioral or performance criteria" on or before September 30, 1987. In the sample studied, 16 percent were discharged for unsuitability. Results indicated that, in general, the earlier one begins to use drugs and the more one uses drugs, the greater the probability of being unsuitable for employment. However, operational validity of pre-employment drug use measures was limited, and supplementation of the drug screening program with other unsuitability predictors was recommended.

Kandel and Yamaguchi (1987) found drug use to be predictive of job turnover rate and decreased tenure on the job. Results obtained from their sample of 24-year and 25-year olds were attributed to pre-existing differences among individuals who start using drugs, rather than to the effects of the drugs themselves. A history of job mobility was predictive of future mobility and decreased earnings over the life cycle.

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Similar studies are emerging from the private sector. The Utah Power and Light Co. (UP&L) drug program was studied and provides additional data on the correlation between drug use and job performance (Crouch and others 1989). Drug-using employees were found to be absent more often than controls, with drug-positive employees taking sick leave at a rate 35 percent greater than control employees and unexcused absences at a rate 240 percent greater than control employees. While medical cost data analysis was inconclusive, drug-positive employees were five times more likely to have a reportable vehicle accident than were controls. In a detailed cost-benefit analysis, the program was found to provide a potential yearly cost savings to the company of $660,000 if the differences in these measures between drug users and non-users could be eliminated.

In an ongoing, NIDA-sponsored, evaluation of drug use at the Georgia Power Company, data were collected for a 5-year period on employees who 1) drug-tested positive, 2) drug-tested negative, 3) entered an Employee Assistance Program (EAP) for drug/alcohol-related problems, 4) obtained medical benefits for alcohol or drug treatment, 5) entered an EAP for other problems, or 6) were discharged for problems other than drug and alcohol use (Sheridan and Winkler 1989). To date, those testing positive were compared to those testing negative and to the workforce as a whole on several measures of job performance and productivity. As in the Postal Service study, employees who tested positive for drugs had higher rates of absenteeism. Differences were found both in measures of absenteeism due to sickness as well as due to various non-paid types of leave (docked time, disciplinary suspensions, etc.). Employees testing positive averaged 48 hours of sick leave per year, while the workforce as a whole averaged only 23 hours per year. Even more dramatic differences existed in measures of non-paid leave, with those testing positive averaging 75 hours of non-paid leave per year compared to 15 hours for the entire workforce. Additional analyses will compare drug-using groups and the other groups of employees mentioned above with matched controls over a 1-year observation period on measures of absenteeism, accidents, and medical claims.

Although there are few data available on the relationship between drug use and on-the-job accidents, studies, such as the ones cited above, are beginning to provide some initial relevant information concerning this important indicator of job safety.

While not specified as directly work-related, data from patients admitted to a shock trauma center in Baltimore may have relevance (Soderstrom and others 1988). Over a third of those admitted (35 percent) had blood levels of THC indicating recent use, which was approximately equal to the percent (34 percent) who had significant levels of alcohol in the blood. This study focused on marijuana and alcohol, but did not test for the presence of other drugs. It should be noted that most of the shock-trauma admissions were from motor vehicle accidents.

APPENDIX D

Until recently, the lack of accurate toxicological data has presented one of the major obstacles in defining the extent of alcohol and other drug involvement in occupational injuries. Technological advances over the past decade which insure accuracy and reliability of test results are finally making studies of this nature feasible.

Lewis and Cooper (1989) assessed the proportion of work-related injuries resulting in fatalities in which alcohol and other drugs were involved. Statistics reported comprised select mortality records from Harris County, Texas from the years 1984 and 1985. Demographic and toxicological information was extracted from nearly 200 autopsy reports in which deaths were classified as having occurred at work. Of those examined, close to 88 percent were tested for alcohol and/or a variety of drugs. A sizable fraction of this group (13 percent) displayed detectable blood alcohol content levels (BACs); a somewhat smaller group (7 percent) showed detectable traces of drugs. Interestingly, in cases where substances were detected, they were most frequently alcohol and prescription drugs rather than illicit substances. Demographic data showed that nearly all fatalities tested for either alcohol or drugs (92 percent each) were men. All with detectable BACs and all who tested positive for drugs, with only one exception, were male subjects. Almost 61 percent of positive BACs and over half of the drug positive individuals were under 35 years of age.

External cause of death statistics showed several interesting trends. Percentages of transportation vehicle accidents (30 percent) and homicides (16 percent) with detectable BACs were substantial. Similar trends were apparent among subjects testing positive for drugs other than alcohol. Noteworthy results were also evident from an employment industry perspective. Small sample sizes made data interpretation somewhat problematic. However, the transportation/utilities industry data was of particular interest, showing a disproportionately large number of deaths occurring while at work as well as a disproportionate fraction with positive BAC or drug test results in comparison with other industries examined.

APPENDIX E

PHARMACOLOGY/PHARMACOKINETICS OF MAJOR PSYCHOACTIVE DRUGS ON THE NTSB ANALYTICAL TEST PLAN

The following section summarizes material from Goodman and Gilman's The Pharmacological Basis of Therapeutics (Seventh Edition), A.G. Gilman, L.S. Goodman et. al. (Eds.), Pharmacology The Third Generation of Progress, H.Y. Meltzer (Ed.), and The Encyclopedia of Psychoactive Drugs (vols. 1,6,9,13,16,17,18, & 19) S.H. Snyder (General Editor). This section provides a concise summary of the source, major physical and behavioral effects, and pharmacokinetics of many of the drugs detected in fatally injured truck drivers.

Alcohol

Ethyl alcohol is commercially available in a variety of beverage forms differing primarily in their method of preparation and resulting potency. Classed as a general anesthetic and a depressant of the central nervous system (CNS), alcohol is typically ingested orally. Although it was formerly considered to have clinical utility in a variety of conditions, its current usage predominantly is of a social nature.

Ordinarily, a systematic relationship exists between the degree of alcohol's effects on the CNS and its plasma concentration. Following ingestion of moderate amounts of alcohol, impairment in performing tasks which rely heavily on prior training or practice becomes apparent. Other signs and symptoms which characteristically emerge include substantial decrements in concentration, discrimination, motor coordination, and memory. Cardiovascular function appears relatively unchanged following acute episodes of alcohol ingestion. A state of severe intoxication, however, may indirectly result in a depression of cardiovascular function. Detrimental cardiac effects also are often evident when excessive alcohol use occurs on a chronic basis. The degree and nature of alcohol's effects on the gastrointestinal system of an individual user depends upon his or her level of alcohol tolerance, that person's general state of health, and the composition of recently consumed meals. Generally, however, alcohol acts as an irritant on mucous membranes. Due to its evaporation, alcohol lowers the skin temperature when applied topically and has found some utility in the treatment of febrile conditions due to this action.

For centuries, alcohol has enjoyed sustained popularity due to its extensive availability and its wide social acceptance. Therefore, it has enormous abuse potential as well as significant possibilities for dependence development. Tolerance to alcohol generally develops after repeated use, in that characteristic effects require increasingly larger and larger doses to achieve.

Following ingestion, rapid absorption of alcohol takes place from all areas of the gastrointestinal mucosa. Uniformity in its distribution is quickly achieved throughout the body. Due to the rich vasculature in the CNS, its alcohol concentration quickly approaches that found in the blood. Ingested alcohol is largely oxidized by the liver, and the remainder is

its rate of accumulation often exceeds its rate of elimination in chronic sers. Marijuana use may be detectable by urinalysis for relatively longer periods in chronic users than in occasional users as a result of this accumulation.

The use of marijuana with other pharmacological compounds such as alcohol is frequently reported. The combined effects of marijuana and alcohol are additive. Consequently, the concurrent use of both compounds has the potential for producing even more erratic driving skills than the use of either of these compounds alone.

Central Nervous System Stimulants

Cocaine

Cocaine, in its most commonly abused form, is a white crystalline powder-like substance obtained from the coca plant, indigenous to Bolivia and Peru. Since cocaine's most prominent systemic effect is found in its potential for central nervous system stimulation, it is generally classed as a psychomotor stimulant. The drug is self-administered through a variety of routes including intranasal, intravenous, or in the case of its base, smoking (commonly termed "freebasing").

The complexity of cocaine's psychological effects results from the influence of many factors. The dose and route of administration are critical determinants of its impact. However, the overall impact may be somewhat modulated by factors specific to the individual and the prevailing environment. Cocaine's initial actions are generally to produce a sense of increased energy, exhilaration and euphoria. By the intranasal route, the sensations experienced reach a peak after 10-20 minutes and have generally dissipated within 60 minutes after administration. The intravenous route, in contrast, provides more immediate and more pronounced effects but for only half the duration. Increased mental alertness and sensory awareness are frequently reported. Users also describe enhanced levels of self-confidence. A profound decrease in appetite is often experienced. Nutritional problems and severe sleep deprivation may result when abuse of the drug is chronic. Subjectively undesirable effects often follow the initial pleasurable ones. These may include irritability, depression and sleepiness. Cardiovascular involvement related to cocaine use includes vasoconstriction leading to a prominent rise in blood pressure and increased heart rate. In addition, an increase in body temperature occurs after cocaine use. Since the use of cocaine alters the brain's normal electrical activity, seizures may occur.

Cocaine's initial clinical use was as a local anesthetic. Although its current utility as such is limited, its potent vasoconstrictive properties do make it the topical anesthetic of choice in certain upper respiratory surgical procedures in which excessive nasal bleeding is a prominent risk.

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It is not clear whether cocaine use results in any form of physiological dependence. Since no characteristic withdrawal symptoms appear once cocaine use is discontinued, true physical dependence is doubtful. Although a wide range of negative symptoms do follow cessation of use, the mechanism underlying these effects are, as yet, undefined. While tolerance occurs to a number of cocaine's effects to a limited degree, a reverse form of tolerance seems to develop for a second set of its effects. The abuse potential held by cocaine is unquestionibly enormous. While its sought-after stimulant effects are clearly a contributing factor to its abuse, alleviation of the undesirable after-effects may trigger further use in some individuals.

The absorption of cocaine after intranasal, intravenous and smoking ingestion is rapid. The cocaine time course characteristic by the intravenous and smoking routes are similar and are more intense and rapid than intake by the intranasal route. Cocaine is extensively and rapidly metabolized by liver and plasma enzymes producing the metabolite benzoylecgonine which is excreted in the urine.

Serious toxicity may result from the use of multiple drug combinations that include cocaine.

Sympathomimetic Amines

The sympathetic nervous system is responsible for the regulation of a homeostatic balance in a variety of organ systems. Agents which mimic or modify the normal functioning of this system, therefore, have useful clinical application, particularly as psychostimulants.

Amphetamines

Amphetamine and methamphetamine, synthetic substances categorized as psychostimulants, are considered members of this class. Most commonly, these drugs are administered orally, intravenously, or intranasally, although the smoking of methamphetamine has also recently gained popularity. The behavioral and psychological effects of amphetamines are numerous and varied. The most noteworthy effects include increased physical activity, euphoria, and alertness. Elevation of mood and level of self-confidence also are often reported. Performance of simple repetitive tasks seems to be enhanced following low doses. In contrast, however, impairment is evident involving tasks which rely on complex thought processes. The effects of amphetamines on the cardiovascular system are generally dose-dependent. Small doses result in elevated blood pressure. Larger doses additionally produce an increase in heart rate and force of contraction and may, sometimes, result in arrhythmias or irregular heart rates. Ingestion of amphetamines results in a reduction of food intake and, consequent , in weight loss. Dilated pupils and dry mouth may also be identifiers of amphetamine use. The pupil dilation may result in both extreme sensitivity to light and blurred vision.

Clinically, amphetamines have most often been used in the treatment of obesity. Amphetamine cessation results in a number of adverse symptoms, although scientific evidence for physiological dependence on these drugs has not been demonstrated. Tolerance does appear to result from chronic use.

Following ingestion, amphetamines are partially metabolized to inactive compounds by the liver and partially excreted unchanged in the urine. Differences in urine pH cause the fraction of the administered dose which is excreted unchanged to vary considerably.

Attempts to employ amphetamines in counteracting alcohol's effects on tasks such as driving have been, in the majority of instances, ineffective and extremely risky. A similar hazard is the use of amphetamines to maintain alertness in individuals who are fatigued. Increased alertness is of short duration and does not compensate for impairment in judgment. Even the use of amphetamines alone poses a substantial hazard to an individual engaging in activities such as driving. The ability of these drugs to increase a sense of self-confidence may consequently increase the probability of risk-taking.

Ephedrine

A naturally occurring substance found in a variety of plants, ephedrine is similar to, but less prominent than, the amphetamines in its CNS effects. Its most noteworthy clinical utility lies in its bronchial muscle relaxation and, consequently, its relief of bronchial constriction in respiratory conditions such as asthma.

Phenylephrine

Phenylephrine is another widely used agent in this category whose predominant action is its vasoconstrictive effect on peripheral arterioles. Since local application of phenylephrine results in marked blanching and vasoconstriction of nasal and pharyngeal passages a variety of upper respiratory conditions may be alleviated by its use.

Caffeine

Caffeine, obtained from the fruits of naturally occurring plant species, has been categorized as a xanthine derivative. Caffeine as well as two additional xanthine derivatives, theophylline and theobromine, are most commonly present in commercially available beverages such as coffee, tea, and cocoa. Oral ingestion is, in most cases, the preferred route of administration.

The primary action of all the xanthine derivatives is their stimulation of the CNS. The ingestion of moderate amounts generally produces arousing effects including a decrease in fatigue and an increase in the clarity of thought processes. In contrast, however, skills dependent upon fine muscular coordination, reaction time, and arithmetic accuracy may display clearly adverse effects. Although direct evidence regarding caffeine's effects on behavior is complex, certain consistencies appear to be

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present: caffeine enhances performance of simple tasks in which attention plays a critical role, but causes performance decrements in tasks involving short term memory. Undesirable indicators of CNS stimulation such as tremors and increased restlessness begin to emerge as the dose of caffeine is increased. Prominent cardiovascular effects are often characteristic of moderate caffeine ingestion. Tachycardia and other cardiac arrhythmias are sometimes evident in sensitive individuals. Other noteworthy characteristics of xanthine derivatives include diuresis and bronchial muscle relaxation which is useful in the treatment of asthma.

Due to the diversity in pharmacological actions of xanthine derivatives, they have been employed in a variety of therapeutic applications. A number of over-the-counter preparations used as analgesics have incorporated caffeine. Caffeine has often been claimed as the most popular drug in the world due to its widespread availability and use. Caffeine is commonly ingested in excessive quantities. Therefore, the abuse potential is large. However, tolerance to many of its effects develops quickly.

Caffeine is readily absorbed from the stomach and small intestine and becomes widely distributed, reaching its peak plasma concentration within 60 minutes of ingestion. The majority of the dose ingested is slowly metabolized by the liver. Only a small fraction is excreted unchanged in the urine. The rate at which a person metabolizes caffeine is influenced to a large extent by other drugs present. The simultaneous use of nicotine increases the body's rate of metabolism of caffeine whereas the use of alcohol decreases it.

Caffeine has often been credited as useful in counteracting the depressant effects of alcohol when rapid elimination of its effects are desired. Although much scientific research has focused on investigating caffeine's utility in this regard, results have not conclusively supported this notion. This drug combination may, in fact, add to the risk involved in performing complex tasks by increasing the alertness of the individual, but not concurrently enhancing his psychomotor performance. Similar confusion exists concerning caffeine's interaction with other drugs, such as tranquilizers or marijuana.

Opioids

The entire class of drugs which possess morphine-like actions have collectively been termed opioids. This group consists of both natural and synthetic compounds.

Opium

Opium is extracted from the poppy plant, results in a number of alkaloids including three which have clinical significance - morphine, codeine, and papaverine - all of which are primarily employed as analgesics. The opioids are administered by a variety of routes which include smoking, oral ingestion and injection.

The major effects of the opioids are exerted on the CNS and the gastrointestinal system. Although the most noteworthy effect of these drugs lies in their ability to produce analgesia without loss of consciousness, they additionally produce a wide array of symptoms including drowsiness, decreased gastrointestinal motility and respiratory depression. Undesirable effects often result when these drugs are administered to individuals who are pain-free and include nausea, vomiting, difficulty in concentration, and feelings of lethargy. Since moderate doses of these drugs by themselves show evidence of impairment in various cognitive processes, tasks such as driving are extremely dangerous. The most potentially dangerous CNS effect of these drugs, however, is the respiratory depression they produce.

Opium's recognized clinical utility in relieving adverse gastrointestinal symptoms preceded its known potential as an analgesic. The adverse effects produced by opioids may be responsible for lessening their abuse potential. Characteristic features of drugs in this class are the significant level of physiological dependence and degree of tolerance they are capable of producing. Clinically, these features constitute major limitations to their therapeutic use. The severity of withdrawal symptoms which occur following the cessation of use are dependent upon the degree of drug dependence and the time frame within which the drug is withdrawn.

The opioids are readily absorbed following administration by the intranasal, intramuscular, subcutaneous and smoking routes. A large fraction of the drug administered undergoes metabolism by the liver and is recovered as metabolites in the urine during the day following use.

The depressant effects characteristic of this group of compounds may be extended in duration or increased in severity when used in combination with other drugs. The mild respiratory depression caused by a therapeutic dose of one of these drugs coupled with that produced by another CNS depressant such as alcohol (ethanol) can, and has proven to, be fatal.

Sedatives/Tranquilizers

Anxiolytics/Benzodiazepines

Chlordiazepoxide (Librium) and diazepam (Valium) are two chemically related synthetic compounds exemplary of the over one dozen available members of the class termed benzodiazepines. With only a few exceptions, all drugs in this group share a similar pharmacological profile. The benzodiazepines, due to their primary purpose, are classified as minor tranquilizers or anxiolytics. Typically, ingestion is by an oral or intravenous route.

The benzodiazepines' actions on the CNS account for all their major effects. These compounds are effective in the relaxation of muscles, producing sedation and the relief of anxiety. Behavioral impairments characteristically include increased reaction time, a decrement in motor coordination and an impairment of recent memory and various psychomotor

functions. Motor performance generally exhibits more profound effects than cognition. The impairment of driving and similar complex psychomotor skills may be significant.

Therapeutically, these drugs are valuable in the treatment of anxiety, insomnia, muscle spasms and neuromuscular disorders as well as assisting in detoxification and withdrawal from alcohol or barbiturates and its associated symptoms. When used under proper medical supervision, the level of acute and chronic toxicity of the benzodiazepines is low. However, their relative safety and what was considered to be their low risk of dependence potential generated their enormous popularity and, in many cases, their tendency to be prescribed and abused excessively.

Following oral administration of these compounds, extensive metabolism occurs in the liver. Some of the metabolites produced are credited with pharmacological activity which may account for effects still present on the day following ingestion. The benzodiazepines vary widely in their duration of action and their rates of elimination. Since most of these compounds tend to be eliminated slowly, chronic use may result in detectable urinary concentrations for up to months after they are discontinued.

Use of the benzodiazepines in combination with alcohol (ethanol) may be particularly hazardous.

Barbiturates

Barbiturates are compounds derived from barbituric acid and classed as sedative hypnotics or central nervous system depressants. These compounds are often subdivided into categories based on their duration of action and their rate of elimination. Most commonly, barbiturates are either ingested orally or injected intravenously. These compounds clearly produce a diversity of dose-related effects on behavior. Since their primary action is to depress the central nervous system, symptoms such as sedation and an overall depression of physiological and behavioral functions result in a dose dependent fashion and range from mild sedation to general anesthesia. A decrease in inhibitions is also attributed to these drugs. Although the effect of drowsiness produced by a therapeutic dose of a barbiturate is no longer evident several hours following administration, an overall CNS depressant effect is often still noticed on the day following drug use. Although they may be subtle, impairments in fine motor skills and judgment are often evident and may pose a significant risk when attempting to perform complex tasks dependent upon these skills such as driving.

Although these drugs formerly enjoyed widespread clinical usage as sedatives, the relatively safer benzodiazepines have largely superseded them in recent years. Due to the widespread availability of these drugs, however, poisoning resulting from their ingestion in excessive quantities has become a major clinical problem. Those agents found to have the greatest abuse potential are those in the short to intermediate acting categories such as pentobarbital (Nembutal) or secobarbital (Seconal). The repeated administration of these drugs leads to physical dependence and increased

tolerance or decreased response to a known constant dose of the compound. The severity of withdrawal symptoms is largely dependent upon the frequency of drug administration and the duration of action of the drug employed.

Following oral ingestion, barbiturate absorption takes place largely from the intestine and is followed by extensive liver metabolism.

Barbiturates in combination with other CNS depressants are capable of causing a severe degree of depression. These interactions are most commonly reported with alcohol (ethanol) and, to a lesser extent, with the antihistamines.

Psychedelics (Hallucinogens)

Natural and synthetic hallucinogenic drugs are substances that distort the perception of objective reality. Hallucinogens create a state of excitation in the central nervous system. The effect of CNS stimulation is unpredictable and may appear as a mood alteration such as euphoria or depression; severe depression may so impair the individual's judgment that suicide is possible. Perceptions of time, distance, direction, color, and sound are distorted. Delusions and visual hallucinations may occur depending on the dose. CNS stimulation may also result in anxiety and restlessness until the drug effects are eliminated. Hallucinogens can also cause "flashbacks" of the psychedelic effects long after the drug has been metabolized. There is no evidence of physical dependence, however, repeated use can cause psychological dependence.

There are a large number of natural and synthetic hallucinogens including: peyote (mescaline from the peyote cactus); Psilocybin (psilocybin and psilocin from Psilocybe mushrooms); chemical variations of mescaline and amphetamines such as DOM (known as STP), DOB, MDA, and MDMA (known as XTC, "Ecstasy"); LSD; and Phencyclidine (PCP) and related chemicals (PCC, PHP, PCE, TPCP, and TCP). Many hallucinogens are taken orally, although some are taken intranasally or intravenously.

Phencyclidine

Phencyclidine (PCP) was the only hallucinogen identified in this study. PCP was formulated nearly forty years ago as a human anesthetic but was withdrawn because of its psychotropic effects. PCP was available until 1978 as an animal tranquilizer for veterinary use. PCP may be ingested in a variety of ways, but is most frequently applied to parsley, oregano, marijuana, or mint and smoked. PCP produces an unpredictable variety of effects including numbness, slurred speech, a blank stare, rapid and involuntary eye movement including nystagmus. PCP can create auditory hallucinations and visual distortions. The PCP user may feel detached or estranged from their surroundings; have feelings of futility or invulnerability and have severe mood disorders such as anxiety, violent hostility, paranoia, and schizophrenia. As with other hallucinogens, PCP may also cause "flashbacks" and is exceptionally dangerous because of its unpredictable mind altering effects.

APPENDIX F

SCIENTIFIC REVIEW PANEL

Dr. Merritt Birky, Ph.D., National Transportation Safety Board
Mr. Dennis Crouch, M.S., Center for Human Toxicology
Dr. Yale Caplan, Ph.D., Maryland State Toxicologist
Dr. Bryan Finkle, Ph.D., Center for Human Toxicology
Dr. Steven Gust, Ph.D., National Institute on Drug Abuse
Dr. Herbert Moskowitz, Ph.D., University of California, Los Angeles
Dr. Douglas Rollins, M.D., Ph.D., Center for Human Toxicology

Scientific Panel Support Staff
Mr. Ron Bickel, Center for Human Toxicology
Mr. John Moulden, National Transportation Safety Board
Mr. Kevin Quinlan, National Transportation Safety Board
Mr. Kennith Rogers, National Transportation Safety Board

APPENDIX G

PRIOR NTSB TRUCK STUDY RECOMMENDATIONS

The National Transportation Safety Board Safety Study on "Training, Licensing, and Qualification Standards for Drivers of Heavy Trucks" (NTSB/SS-86/02) included the following recommendations:

RECOMMENDATIONS

Legislation is pending in Congress to establish a National Driver License Program for commercial drivers. The Safety Board supports that concept and believes that under such a program:

1) State agencies should test applicants' knowledge and performance, and check their qualifications, using uniform standards and test procedures developed by the Department of Transportation. A requirement for formal training should be included in the prerequisites for obtaining a national license.

2) The functions of issuing the national license, maintaining driver records, and suspending and revoking licenses should be shared by Federal and state authorities, according to a plan developed by the Department of Transportation.

3) Applicants for the National Driver License should be required to surrender previously issued state driver licenses. Once a driver would be issued a national license, all traffic violations, regardless of vehicle driven, should be recorded in a single corresponding file.

4) A recordkeeping system should be developed for those files, identifying all license holders, so that no commercial driver could obtain more than one license.

Therefore, the National Transportation Safety Board made the following recommendations:

--to the Secretary of Transportation:

Develop a program under which State and Federal authorities would jointly administer a National Driver License for commercial truck drivers. Such a program should implement the one-license/one-record concept, and a system should be developed that will keep track of the records of all individuals holding a National Driver License. (Class II, Priority Action) (H-86-8)

--to the Professional Truck Driver Institute of the Trucking Industry Alliance:

Compile and submit to the Bureau of Motor Carrier Safety (BMCS) the views of members of the trucking and truck driver training industries concerning any needed revisions in the BMCS Proposed Minimum Standards and Model Curriculum for Training Tractor-Trailer Drivers. (Class II, Priority Action) (H-86-14)

Develop a program for evaluating truck driver training schools, using the Bureau of Motor Carrier Safety Minimum Standards as criteria, once the standards have been validated. Such a program could be established in coordination with the National Association of Trade and Technical Schools and the National Home Study Council. (Class II, Priority Action) (H-86-15)

Work with the National Safety Council to develop a guidance program designed to reach as many people as possible who are considering a career in commercial truck driving. The program should explain the considerations in such a vocational choice, the value of formal training, and the factors to consider in selecting a truck driver training school. The program also should inform prospective students about which schools have met the criteria established by the Bureau of Motor Carrier Safety Minimum Standards. (Class II, Priority Action) (H-86-16)

--to the National Safety Council:

Coordinate development of a guidance program designed to reach as many people as possible who are considering a career in commercial truck driving. The program should explain the considerations in such a vocational choice, the value of formal training and the factors to consider in selecting a truck driver training school. The program should also inform prospective students about which schools have met the criteria established by the Bureau of Motor Carrier Safety Minimum Standards. (Class II, Priority Action) (H-86-17)

--to the American Trucking Associations, Inc.:

Work with the National Safety Council to develop a guidance program designed to reach as many people as possible who are considering a career in commercial truck driving. The program should explain the considerations in such a vocational choice, the value of formal training, and the factors to consider in selecting a truck driver training school. The program also should inform prospective students about which schools have met the criteria established by the Bureau of Motor Carrier Safety Minimum Standards. (Class II, Priority Action) (H-86-18)

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In cooperation with the International Brotherhood of Teamsters, develop guidelines and requirements for an apprenticeship training program for commercial truck drivers. (Class II, Priority Action) (H-86-19)

Undertake a program urging member companies to hire only drivers who have received formal truck driver training. Once the Bureau of Motor Carrier Safety Proposed Minimum Standards for Training Tractor-Trailer Drivers have been validated, stipulate that only drivers who have graduated from schools that have met the criteria established by those standards should be hired. The program also should encourage member firms to participate in apprenticeship training programs. (Class II, Priority Action) (H-86-20)

--to the Private Truck Council of America, Inc.:

Work with the National Safety Council to develop a guidance program designed to reach as many people as possible who are considering a career in commercial truck driving. The program should explain the considerations in such a vocational choice, the value of formal training, and the factors to consider in selecting a truck driver training school. The program also should inform prospective students about which schools have met the criteria established by the Bureau of Motor Carrier Safety Minimum Standards. (Class II, Priority Action) (H-86-21)

Undertake a program urging membe. companies to hire only drivers who have received formal truck driver training. Once the Bureau of Motor Carrier Safety Proposed Minimum Standards for Training Tractor-Trailer Drivers have been validated, stipulate that only drivers who have graduated from schools that have met the criteria established by those standards should be hired. The program also should encourage member firms to participate in apprenticeship training programs. (Class II, Priority Action) (H-86-22)

--to the Owner-Operator Independent Drivers Association of America and the National Association of Truck Driving Schools:

Work with the National Safety Council to develop a guidance program designed to reach as many people as possible who are considering a career in commercial truck driving. The program should explain the considerations in such a vocational choice, the value of formal training, and the factors to consider in selecting a truck driver training school. The program also should inform prospective students about which schools have met the criteria established by the Bureau of Motor Carrier Safety Minimum Standards. (Class II, Priority Action) (H-86-23)

--to the International Brotherhood of Teamsters:

Work with the National Safety Council to develop a guidance program designed to reach as many people as possible who are considering a career in commercial truck driving. The program should explain the considerations in such a vocational choice, the value of formal training, and the factors to consider in selecting a truck driver training school. The program also should inform prospective students about which schools have met the criteria established by the Bureau of Motor Carrier Safety Minimum Standards. (Class II, Priority Action) (H-86-24)

In cooperation with the American Trucking Associations, Inc., develop guidelines and requirements for an apprenticeship training program for commercial truck drivers. (Class II, Priority Action) (H-86-25)

--to the United States Department of Labor:

Draft and issue national standards for apprenticeship programs in commercial truck driving, and include commercial truck driving in the Department of Labor's list of Occupations Recognized as Apprenticeable. (Class II, Priority Action) (H-86-26)

--to the Federal Highway Administration:

Expedite development of a battery of knowledge test questions and performance test procedures, based on the Model Curriculum of the Bureau of Motor Carrier Safety Proposed Minimum Standards for Training Tractor-Trailer Drivers, and begin as soon as possible the validation study and cost/benefit analysis of the Proposed Standards and Model Curriculum. (Class II, Priority Action) (H-86-27)

Undertake a program urging all States to impose licensing requirements on the truck driver training schools in their jurisdictions, and, once the Bureau of Motor Carrier Safety Proposed Minimum Standards for Training Tractor-Trailer Drivers have been validated, urge all States to adopt these standards in evaluating truck driver training schools when they apply for State licensure. (Class II, Priority Action) (H-86-28)

Develop a program for evaluating truck driver training schools, using the Bureau of Motor Carrier Safety Proposed Minimum Standards, once they have been validated. If the Professional Truck Driver Institute of the Trucking Industry Alliance, or another body, is designated to perform this evaluation function, provide advice and support to that organization. (Class II, Priority Action) (H-86-29)

Eliminate the exemption from Part 391 of the Federal Motor Carrier Safety Regulations granted to commercial drivers who work exclusively within a single city or commercial zone. (Class II, Priority Action) (H-86-30)

Clarify the purpose and procedures of the annual review of employee drivers' traffic records, which Section 391.25 of the Federal Motor Carrier Safety Regulations requires of motor carriers. (Class II, Priority Action) (H-86-31)

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Stipulate in the Federal Motor Carrier Safety Regulations that no driver may screen his or her own driving record in the annual review required by the regulations. Designate an impartial source to which commercial truck drivers who work independently must turn for the annual review. This same source should administer the required road test to independent operators. Require that independent operators using this source take the knowledge examination required of other drivers. (Class II, Priority Action) (H-86-32)

Restructure the written examination required of commercial drivers by the Federal Motor Carrier Safety Regulations. A battery of test questions should be developed dealing with issues of safe operating practice frequently encountered by most drivers. Drivers should be prohibited from consulting answer sheets or other reference materials while taking the examination, and a minimum passing score should be established. (Class II, Priority Action) (H-86-33)

Eliminate the exemptions from portions of the Federal Motor Carrier Safety Regulations granted to drivers not regularly employed as drivers who operate commercial vehicles on an intermittent, casual, or occasional basis. (Class II, Priority Action) (H-86-34)

--to the National Highway Traffic Safety Administration:

Take necessary action to assure that the Problem Driver Pointer System is fully operational and available to the States for their use by the Department of Transportation's published target date of February 1989. (Class II, Priority Action) (H-86-35)

Encourage State driver licensing authorities to use the Rapid Response System feature of the National Driver Register (NDR) at the earliest practicable date both to obtain prompter access to NDR records and to prepare for use of the Problem Driver Pointer System when it becomes available. (Class II, Priority Action) (H-86-36)

> Actively work with the States to prepare them to participate in the Problem Driver Pointer System by encouraging the adoption of necessary statutory changes, provision of adequate budget and other resources, implementation of appropriate administrative and technical changes, and other preparations as needed. (Class II, Priority Action) (H-86-37)

Also, the Safety Board reiterated Safety Recommendation H-83-21 made to the Bureau of Motor Carrier Safety on May 3, 1983:

> Upon completion of the testing of the Tractor-Trailer Driver Training Standards, the Sample Model Curriculum, and final examination criteria, amend Part 391, "Qualifications of Drivers," of the Federal Motor Carrier Safety Regulations to include criteria and standards for the training of tractor-trailer drivers.

and Safety Recommendation H-83-68 made to the Federal Highway Administration on December 5, 1983:

> Revise Federal Motor Carrier Safety Regulation 49 CFR 391.43 to incorporate a provision, similar to that specified in 14 CFR 67.20(a) for airmen medical certification, which will prohibit the falsification or omission of medical information in connection with a medical certification physical examination.

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In its study of "Braking Deficiencies on Heavy Trucks in 32 Selected Accidents" (NTSB/SS-88/06), the National Transportation Safety Board also made the following recommendations:

RECOMMENDATIONS

As a result of this study, the National Transportation Safety Board recommends:

--to the National Highway Traffic Safety Administration:

Publish a final rule by June 1990 that will require automatic slack adjusters on all new trucks equipped with air/mechanical brake systems. (Class II, Priority Action) (H-88-30)

--to the American Trucking Associations and the National Private Truck Council:

Recommend that your member carriers adopt written policies regarding on-the-road brake adjustment; if the drivers are responsible for performing such adjustments, provide them with the necessary training. (Class II, Priority Action) (H-88-31)

Recommend that your member carriers, as they replace worn brake chambers, install airbrake actuation devices that incorporate indicators to warn users when brakes must be adjusted. (Class II, Priority Action) (H-88-32)

APPENDIX H

TOXICOLOGICAL TEST RESULTS FOR TESTS PERFORMED BY THE CENTER FOR HUMAN TOXICOLOGY

The following abbreviations are used in this appendix to describe sample volumes and groups of substances for which sample volumes were insufficient:

QNS means that the specimen quantity was not sufficient to conduct a complete toxicological test.

ANALGS includes the analgesics, acetaminophen, salicylate, and ibuprofen.

ANTICONS are anticonvulsants, such as phenytoin and carbamazepine, but also include tests for the antihistamines: diphenhydramine, chlorpheniramine, and brompheniramine.

BASES include tests for the anticonvulsants identified above, caffeine which is a stimulant, and the opiates morphine, codeine, meperidine, methadone, pentazocine, and propoxyphene.

BENZOS include diazepam and its desmethyl metabolite, flurazepam and desalkyl, chlordiazepoxide, desmethyldiazepam and desmethyldiazepam metabolite.

STIMULANTS include cocaine and metabolites, amphetamine, methamphetamine, phentermine, ephedrine, pseudoephedrine, and phenylpropanolamine.

THC includes the cannabinoids Delta 9-THC and Carboxy THC.

CASE	SPECIMEN	RESULTS
001	Blood	Negative
002	Blood	Negative
003	Vitreous	Negative
	(QNS for BENZOS, STIMS, ANTICONS)	
003	Urine	Negative
	(QNS for BENZOS, STIMS, ANTICONS)	
004	Blood	Salicylate 23,000 ng/ml
005	Blood	Cocaine 200 ng/ml
		BE 130 ng/ml
		THC 3/ng/ml
		C-THC 25/ng/ml
006	Blood	Negative
	(QNS for THC, ANTICONS, ANALGS)	
	Vitreous	Negative
		(for THC, & ANTICONS)
007	Blood	Alcohol .18%
008	Blood	C-THC 8 ng/ml
		Acetaminophen 11,000 ng/ml
009	Blood	Negative
010	Blood	Negative
011	Blood	Salicylate 36,000 ng/ml

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CASE	SPECIMEN	RESULTS
012	Blood	Methamphetamine 1,400 ng/ml
013	Blood	Cocaine 500 ng/ml BE 870 ng/ml THC 12 ng/ml C-THC 36 ng/ml
014	Blood	Negative
015	Blood	Negative
016	Blood	Negative
017	Blood	Methamphetamine 350 ng/ml Pseudoephedrine 120 ng/ml
018	Blood	BE 390 ng/ml THC 4 ng/ml C-THC 35 ng/ml
019	Urine	C-THC 132 ng/ml
020	Blood	Negative
021	Blood	BE 280 ng/ml PCP 11 ng/ml
022	Blood	Negative
023	Blood	Negative
024	Blood	Negative
025	Blood	Salicylate 24,000 ng/ml
026	Blood	BE 88 ng/ml C-THC 5.9 ng/ml
027	Blood	Negative
028	Blood	Amphetamine 990 ng/ml Methamphetamine 300 ng/ml BE 57 ng/ml C-THC 22 ng/ml CO 35% saturation
029	Blood	Negative
030	Blood	CO 32% saturation Salicylate 25,000 ng/ml
031	Blood	Negative
032	Blood	Methamphetamine 160 ng/ml
	Urine	Methamphetamine 1000 ng/ml
033	Blood	C-THC 16 ng/ml
034	Blood	Negative
035	Blood	Negative
036	Blood	Negative (QNS for CO)
037	Specimen Not Received	
038	Blood	Alcohol .18%
039	Blood	Negative
040	Blood	Negative
041	Blood	Alcohol .22% CO 12% saturation
042	Blood	Negative
043	Blood	Alcohol .17% BE 80 ng/ml C-THC 5 ng/ml
044	Blood	Negative

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CASE	SPECIMEN	RESULTS
045	Blood	Negative
046	Blood (QNS for all but RIA [except THC] and Volatiles)	Negative
047	Blood	BE 120 ng/ml
048	Specimen Not Received	
049	Blood	Negative
050	Blood	Negative
051	Blood (QNS for BENZOS ANTICONS)	Negative
052	Blood	Methamphetamine 370ng/ml
053	Blood	CO 13% saturation
054	Blood	Caffeine 2,500 ng/ml
055	Blood	Alcohol .01% Caffeine 1,500 ng/ml
056	Blood	Negative
057	Blood	Salicylate 10,700 ng/ml
058	Blood	BE 160 ng/ml
059	Blood	Caffeine
060	Specimen Not Received	
061	Blood	Amphetamine 190 ng/ml Methamphetamine 750 ng/ml
062	Blood	Negative
063	Blood	Caffeine 1,900 ng/ml
064	Blood	Caffeine 2,000 ng/ml
065	Blood	Amphetamine 130 ng/ml Methamphetamine 1,600 ng/ml THC 9 ng/ml C-THC 174 ng/ml Caffeine 5,600 ng/ml
066	Blood	Caffeine 3,500 ng/ml
067	Vitreous	Negative
068	Specimen Not Received	
069	Specimen Not Received	
070	Blood	Codeine 700 ng/ml Chlorpheniramine 180 ng/ml Caffeine 5,000 ng/ml

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CASE	SPECIMEN	RESULTS
071	Blood	Negative
072	Blood	Caffeine 4,100 ng/ml
073	Blood	Ibuprofen - Positive
074	Blood	Negative
075	Blood	Amphetamine 64 ng/ml Methamphetamine 328 ng/ml Ephedrine 170 ng/ml Caffeine 16,000 ng/ml
076	Blood	Negative
077	Blood	Caffeine 2,000
078	Blood	Alcohol .06% Caffeine 1,500 ng/ml
079	Blood	Negative
080	Blood	THC 2 ng/ml C-THC 16 ng/ml Caffeine 1,400 ng/ml
081	Blood	CO 10% saturation Caffeine 4,100 ng/ml
082	Blood	THC 3 ng/ml C-THC 10 ng/ml
083	Blood	Caffeine 3,500 ng/ml
084	Blood	THC 4 ng/ml C-THC 17 ng/ml
085	Blood	Caffeine 1,700 ng/ml
086	Blood	Negative (QNS for BASES, ANTICONS, ANALGS)
087	Blood	Amphetamine 90 ng/ml Methamphetamine 830 ng/ml Ephedrine 350 ng/ml
088	Blood (QNS for BASES, ANTICONS)	Negative
089	Blood (QNS for STIMULANT confirmation)	Caffeine 3,100 ng/ml Ibuprofen - Positive
090	Blood	Negative
091A	Blood	Caffeine 2,700 ng/ml (codriver)
091B	Blood	Alcohol .02% (driver)
092	Blood	Alcohol .10% THC 22 ng/ml CO 11% saturation Ephedrine - Positive
	Vitreous	Alcohol .11%
093	Blood	Caffeine 1,600 ng/ml
094	Blood	Caffeine 1,500 ng/ml
095	Blood	Negative

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CASE	SPECIMEN	RESULTS
096	Blood	CO 41% saturation
097	Blood	Negative
098	Blood	Methamphetamine 500 ng/ml Ephedrine 90 ng/ml THC 1 ng/ml C-THC 18 ng/ml Caffeine 1,000 ng/ml
099	Blood	Ephedrine 160 ng/ml THC 3 ng/ml C-THC 66 ng/ml
100	Blood	Negative
101	Blood	Caffeine 3,300 ng/ml
102	Blood	Caffeine 2,900 ng/ml
103	Blood	Alcohol .05% CO 34% saturation
104	Blood	Caffeine 4,100 ng/ml CO 13% saturation
105	Blood	Alcohol .09% Caffeine 4,400 ng/ml
106	Blood	Caffeine 2,000 ng/ml CO 25% saturation
107	Blood	Negative
108	Blood	Caffeine 1,500 ng/ml Pseudoephedrine 610 ng/ml
109	Blood (QNS for THC)	Amphetamine 110 ng/ml Methamphetamine 160 ng/ml Ephedrine 120 ng/ml
110	Blood	Phenylpropanolamine 500 ng/ml Pseudoephedrine 2,700 ng/ml
111A	Blood	Caffeine 3,000 ng/ml
111B	Blood	BE 130 ng/ml Caffeine 1,400 ng/ml
112	Blood (QNS for THC and STIMS)	Negative
113	Specimen Not Received	
114	Blood	Alcohol .19% THC 2 ng/ml C-THC 28 ng/ml
115	Blood	Caffeine 2,500 ng/ml
116A	Blood	Caffeine 1,600 ng/ml
116B	Blood	Negative
117A	Urine	Caffeine 10,000 ng/ml (QNS for CO)
117B	Blood	Caffeine 1,900 ng/ml CO 26% saturation
118	Blood	Caffeine 3,500 ng/ml

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CASE	SPECIMEN	RESULTS
019	Blood	THC 10 ng/ml C-THC 47 ng/ml
120	Blood	Caffeine 1,700 ng/ml
121	Specimen Not Received	
122	Blood	Caffeine 4,900 ng/ml
123	Blood	Caffeine 3,100 ng/ml
124	Blood	Cocaine 80 ng/ml BE 2,300 ng/ml
125	Specimen Not Received	
126A	Specimen Not Received	
126B	Specimen Not Received	
127	Specimen Not Received	
128	Blood	Alcohol .20% Caffeine 1,100 ng/ml
129	Blood	Caffeine 3,600 ng/ml
130	Blood	Alcohol .18% THC 1.7 ng/ml C-THC 22 ng/ml BE 350 ng/ml
131	Blood	Caffeine 1,200 ng/ml
132	Blood	Alcohol .31% CO 52% saturation Caffeine 1,100 ng/ml
133	Blood	Negative
134	Blood (QNS for BASES ANTICONS)	Negative
135	Blood	Caffeine 1,300 ng/ml Salicylate - Positive
136A	Blood (QNS for BENZOS BASES, ANTICONS, ANALGS)	Negative
136B	Blood	Negative
137A (case vehicle)	Blood (QNS for BENZOS BASES, ANTICONS)	Negative
137B (non-case vehicle)	Blood	Caffeine 1,100 ng/ml
138	Blood (QNS for ANTICONS)	Alcohol .23% Caffeine 2,900 ng/ml CO 14% saturation
139	Blood	Alcohol .08%
140	Blood (QNS for BENZOS BASES, ANTICONS)	Negative
141A (case vehicle)	Blood (QNS for STIMS and BASES)	CO 61% saturation

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CASE	SPECIMEN	RESULTS
141B (case vehicle)	Blood (QNS for BENZOS, BASES, and STIMS)	CO 45% saturation
141C (non-case vehicle)	Blood (QNS for BENZOS BASES and STIMS)	Negative
142	Blood Urine	CO 12% saturation Negative for anticons
143	Blood (QNS for THC, BENZOS BASES, ANTICONS)	Pseudoephedrine - Positive
144	Blood	Negative
145	Blood	Caffeine 1,600 ng/ml
146	Blood (QNS for all but STIMS, ANALGS, and RIA [except THC])	Negative
147	Blood (QNS for BENZOS BASES, ANTICONS)	Alcohol .017% Salicylate - Positive
148	Blood (QNS for BASES)	Alcohol .04% Ephedrine
149	Blood	Negative
150	Blood	THC 1 ng/ml C-THC 30 ng/ml Caffeine 1,000
151	Specimen Not Received	
152	Blood	Negative
153	Blood	Alcohol .30% Caffeine 1,600 ng/ml
154	Specimen Not Received	
155	Urine	Amphetamine 2,700 ng/ml Methamphetamine >10,000 ng/ml Salicylates - Positive
156A	Blood	Caffeine 2,600 ng/ml
156B (case vehicle)	Blood	Caffeine 1,000 ng/ml
157	Specimen Not Received	
158	Blood	Caffeine 6,400 ng/ml
159	Blood	BE 480 ng/ml
160	Specimen Not Received	
161	Specimen Not Received	
162	Blood	Alcohol .17%
163	Specimen Not Received	
164	Blood	THC 1.4 ng/ml C-THC 18 ng/ml BE 234 ng/ml

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CASE	SPECIMEN	RESULTS
165	Blood	Alcohol .25% Caffeine 2,500 ng/ml
166	Blood (QNS for BASES)	Negative
167	Urine	Acetaminophen - Positive Salicylate - Positive Caffeine - Positive
168	Urine	Salicylate - Positive Caffeine - Positive
169	Blood	Caffeine 1,600 ng/ml
170	Blood	Caffeine 2,400 ng/ml
171	Blood	Negative
172	Liver (QNS for all but Volatiles, RIA)	Negative
173	Blood	Negative
174	Blood (QNS for BASES, STIMS, ANTICONS)	Negative
175A (passenger, case vehicle)	Blood	Negative
175B (driver, case vehicle)	Blood	Negative
176	Blood	Alcohol .14% Caffeine 1,200 ng/ml
177	Blood	Negative
178A (case vehicle)	Blood	Salicylate - Positive Caffeine - Positive
178B (non-case vehicle)	Blood (QNS for BASES, ANTICONS, ANALGS)	C-THC 10 ng/ml
179	Blood	Alcohol .02% Pseudoephedrine 1,600 ng/ml
180	Blood	Caffeine 1,700 ng/ml
181	Specimen Not Received	
182	Blood	Negative

APPENDIX I

TOXICOLOGICAL TEST RESULTS FOR TESTS PERFORMED BY STATE AND OTHER LABS

CASE	SPECIMEN	RESULTS
001	Blood	Negative
002	Blood	Alcohol .02%
003	Blood	Negative
004	No Other Lab	
005	Blood	Negative
006	No Other Lab	
007	Blood	Alcohol .17%
008	Blood	Negative
009	Blood	Negative
010	Blood	Negative
011	Urine	Negative
012	Blood	Methamphetamine 100 ng/ml
	Blood	CO 19% Saturation
	Urine	Amphetamine - Positive
013	Blood	Cocaine 1,960 ng/ml
	Blood	BE 430 ng/ml
014	Blood	Negative
015	Blood	Negative
016	Blood	Negative
017	Blood	Methamphetamine 350 ng/ml
		Pseudoephedrine 120 ng/ml
018	Blood	Cocaine 20 ng/ml
		BE 260 ng/ml
019	Blood	THC - Positive
	Urine	THC - Positive
020	Blood	Lidocaine 400 ng/ml
021	Bile	Cocaine Metabolites
		Positive
022	Blood	Negative
023	Blood	Negative
024	Blood	Negative
025	Blood	Salicylate 24,000 ng/ml
026	Blood	Negative
	Urine	Cocaine & metabolites, phencyclidine - positive
027	Blood	Negative
	Urine	Negative
028	Blood	CO 24.8% saturation
029	Blood	Negative
030	Blood	CO 26.5% saturation

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CASE	SPECIMEN	RESULTS
031	Blood	Negative
	Urine	Diltiazem & Nicotine positive
032	Blood	Methamphetamine 277 ng/ml
033	Blood	C-THC - positive
034	No Other Lab	
035	Blood & Urine	Negative
036	Blood	Negative
037	Blood	Hematocrit 35.5%
	Urine	Salicylate - positive
038	Blood	Alcohol .15%
039	Blood	Negative
040	Blood	Negative
041	Blood	Alcohol 0.21%
042	Blood	Negative
043	Blood	Alcohol .15%
044	Blood	Negative
045	No Other Lab	
046	Urine	Pseudoephedrine 5,870 ng/ml
	Liver	Pseudoephedrine 760 mg/Kg
047	Blood	Cocaine 37 ng/ml BE 51 ng/ml Amphetamine 37 ng/ml Methamphetamine 49 ng/ml
048	Blood	Caffeine 6,000 ng/ml
049	Blood	Negative
050	Blood	Negative
051	Blood	Negative
052	Blood	CO 7% saturation 053
	Blood & Urine	Negative
054	Blood	Negative
055	Blood	Negative
056	Blood	Negative
057	Blood	Salicylate 20,900 ng/ml
058	Blood	Cocaine/Metabolites 299 ng/ml
059	Blood	Negative
060	Blood	Negative
061	Blood	Amphetamine 50 ng/ml Methamphetamine 190 ng/ml
062	Blood	Negative
063	Blood	Negative
064	Blood	Acetaminophen 2,000 ng/ml
065	Blood	Amphetamine 130 ng/ml Methamphetamine 1,870 ng/ml Salicylates 4,700 ng/ml
066	Blood	Negative

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CASE	SPECIMEN	RESULTS
067	No Other Lab	
068	Blood	Negative
069	Blood	Negative
070	Blood	Barbiturates RIA - positive Phenobarbital 900 ng/ml
071	Blood	Negative
072	Blood	Negative
073	Blood	Negative
074	Blood	Negative
075	Blood	Amphetamine 50 ng/ml Methamphetamine 250 ng/ml Dimethylxanthines 29,000 ng/ml Phenylpropanolamine 6,600 ng/ml
076	Blood	Negative
077	Vitreous	Negative
078	Blood	Alcohol .06% Caffeine 1,500 ng/ml
079	Blood	Negative
080	Blood	Negative
081	Blood	CO 5% saturation
082	Blood	Negative
083	Blood	Negative
084	Blood	Negative
085	No Other Lab	
086	Blood	Negative
087	Blood	Methamphetamine 452 ng/ml
088	No Other Lab	
089	Blood	Alcohol .01% Chlorpheniramine 50 ng/ml
090	Blood	Negative
091A (codriver)	Blood	Negative
091B (driver)	Blood	Negative
092	Blood	Alcohol 0.09%,
093	Blood	Negative
094	Urine	Acetaminophen - positive Caffeine - positive Nicotine - positive
095	No Other Lab	
096	Blood	Negative
097	Blood	Negative
098	Blood	Methamphetamine 604 ng/ml Amphetamine 78 ng/ml Alcohol .02%

APPEDIX I

CASE	SPECIMEN	RESULTS
099	Urine	C-THC - positive Phenylpropanolamine positive
100	Blood	Negative
101	Urine	Caffeine - positive
102	Blood	Negative
103	Blood	Alcohol .05%
104	No Other Lab	
105	Blood	Alcohol .13%
106	Blood	CO 40% saturation
107	Blood	Negative
108	No Other Lab	
109	Blood	Negative
110	Blood	Methocarbamal 790 ng/ml Diphenhydramine 25 ng/ml Ephedrine 3,000 ng/ml Phenylpropanolamine 840 ng/ml
111A	No Other Lab	
111B	No Other Lab	
112	Blood	Negative
113	Blood	Alcohol .04% Hematocrit 52% Phentermine 500 ng/ml
114	Blood	Alcohol .10%
115	Blood	Caffeine - positive
116A	No Other Lab	
116B	No Other Lab	
117A	Blood	Negative
117B	Blood	CO 25% saturation
118	Blood	Negative
119	Blood	Negative
120	Urine	Caffeine - positive
121	Blood	Phenobarbital 900 ng/ml
122	Blood	Negative
123	Blood	Negative
124	Blood	Cocaine 320 ng/ml Cocaine and metabolites (Total) 7,500 ng/ml
125	Blood	Negative
126A	Blood	Phenylpropanolamine 462 ng/ml
	Urine	Phenylpropanolamine 46,030 ng/ml Pseudoephedrine 1,100 ng/ml
126B	Blood	Negative
127	Blood	Alcohol 0.28%
	Urine	Alcohol 0.277%
	Brain	Alcohol 0.204%

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CASE	SPECIMEN	RESULTS
	Stomach	Alcohol 1.228%
128	Blood	Alcohol .216%
129	Blood	Negative
130	Blood	Alcohol .12%
131	Blood	Negative
132	Blood	Alcohol .32% CO 52% saturation
133	Blood	Negative
134	Blood	Negative
135	Blood	Negative
136A	Blood	Negative
136B	Blood	Negative
137A (case vehicle)	Blood	Negative
137B (non-case vehicle)	Blood	Negative
138	Blood	Alcohol .26%
139	Blood	Alcohol .14%
	Urine	THC - positive
140	Blood	Negative
141A (case vehicle)	Blood	Alcohol .02%
141B (case vehicle)	Blood	Negative
141C (non-case vehicle)	Blood	Negative
142	Blood	Negative
143	Blood	Negative
144	Blood	Negative
145	Blood	Negative
146	Blood	Alcohol .13% THC - positive Cocaine 60 ng/ml BE 370 ng/ml
	Urine	BE - positive THC - positive
147	Blood	Negative
148	Blood	Alcohol .09%
149	Blood	Negative
150	Blood	Negative
	Urine	C-THC - positive
151	Blood	Negative
152	Blood	Negative
153	Blood	Alcohol .26%
154	Blood	Caffeine - positive Lidocaine - positive
155	Urine	Negative
156A	Blood	Negative

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CASE	SPECIMEN	RESULTS
156B (case vehicle)	Blood	Negative
157	Blood	Negative
158	Blood	CO 12% saturation Quinine - positive
	Urine	Acetaminophen - positive Quinine - positive
159	Blood	Negative
160	No Other Lab	
161	Blood	Negative
162	Blood	Alcohol 0.189%
163	No Other Lab	
164	Blood	BE 160 ng/ml
	Bile	BE 1,030 ng/ml
	Bile	Morphine 5,580 ng/ml
165	Check File	
166	No Other Lab	
167	Blood & Urine	Negative
168	Spleen	Negative
169	Blood	Negative
170	Blood	Negative
171	No Other Lab	
172	Spleen	Negative
173	Blood	Negative
174	Blood & Urine	Negative
175A (passenger, case vehicle)	No Other Lab	
175B (driver, case vehicle)	Blood & Urine	Negative
176	Blood	Alcohol .15%
177	Blood & Urine	Negative
178A (case vehicle)	No Other Lab	
178B (non-case vehicle)	Blood	THC - positive
179	Blood	Negative
180	Blood	Negative
181	Blood	Alcohol .10%
182	Blood	Negative

APPENDIX J

FHWA-MOTOR CARRIER DRUG TESTING REGULATIONS

Federal Register / Vol. 53, No. 224 / Monday, November 21, 1988 / Rules and Regulations 47151

PART 391—[AMENDED]

1. The authority citation for Part 391 continues to read as follows:

Authority: 49 App. U.S.C. 2505; 49 U.S.C. 504 and 3102; 49 CFR 1.48.

2. Part 391 is amended by adding Subpart H to read as follows:

Subpart H—Controlled Substance Testing

Sec.

§ 391.81 Purpose and scope.

(a) The purpose of this subpart is to reduce highway accidents that result from driver use of controlled substances, thereby reducing fatalities, injuries, and property damage.

(b) This subpart prescribes minimum Federal safety standards to detect and deter the use of controlled substances as defined in 49 CFR Part 40 (marijuana, cocaine, opiates, amphetamines and phencyclidine (PCP)).

(c) As part of reasonable cause drug testing programs established pursuant to this subpart, motor carriers may test for drugs in addition to those specified in this part only with approval granted by the Federal Highway Administrator under 49 CFR Part 40 and for substances for which the Department of Health and Human Services has established an approved testing protocol and positive threshold.

§ 391.83 Applicability.

(a) This subpart applies to motor carriers and persons who operate a commercial motor vehicle as defined in this subpart in interstate commerce and are subject to the driver qualification requirements of Part 391 of this subchapter.

(b) This subpart shall not apply to any person for whom compliance with this subpart would violate the domestic laws or policies of another country.

(c) This subpart is not effective until January 1, 1990, with respect to any person for whom a foreign government contends that application of this subpart raises questions of compatibility with that country's domestic laws or policies. On or before December 1, 1989, the Administrator shall issue any necessary amendment resolving the applicability of this subpart to such person on and after January 1, 1990.

§ 391.85 Definitions.

As used in this subpart—

"Collection site" means a place where individuals present themselves for the purpose of providing body fluid or tissue samples to be analyzed for specified controlled substances. The site must possess all necessary personnel, materials, equipment, facilities, and supervision to provide for the collection, security, temporary storage, and transportation or shipment of the samples to a laboratory.

"Commercial motor vehicle" means any self-propelled or towed vehicle used on public highways in interstate commerce to transport passengers or property when:

(a) The vehicle has a gross vehicle weight rating or gross combination

weight rating of 26,001 or more pounds; or

(b) The vehicle is designed to transport more than 15 passengers, including the driver; or

(c) The vehicle is used in the transportation of hazardous materials in a quantity requiring placarding under regulations issued by the Secretary under the Hazardous Materials Transportation Act (49 U.S.C. App. 1801-1813).

"Controlled substance" has the meaning assigned by 21 U.S.C. 802 and includes all substances listed on Schedules I through V as they may be revised from time to time (21 CFR 1308).

"Drivers subject to testing" means employee drivers and contract drivers under contract for 90 days or more in any period of 365 days.

"Drug" means any substance (other than alcohol) that is a controlled substance as defined in this section and 49 CFR Part 40.

"FHWA" means the Federal Highway Administration, U.S. Department of Transportation.

"Interstate commerce" means trade, traffic, or transportation in the United States which is between a place in a State and a place outside of such State (including a place outside of the United States) or is between two places in a State through another State or a place outside of the United States.

"Medical practitioner" means a licensed doctor of medicine (MD) or osteopathy (DO) or a doctor of dental surgery (DDS) authorized to practice by the State in which the person practices.

"Medical Review Officer" means a licensed doctor of medicine or osteopathy with knowledge of drug abuse disorders that is employed or used by a motor carrier to conduct drug testing in accordance with this part.

"Motor carrier" means a for-hire motor carrier or a private motor carrier of property. The term "motor carrier" includes a motor carrier's agents, officers and representatives as well as employees responsible for hiring, supervising, training, assigning, or dispatching of drivers and employees concerned with the installation, inspection, and maintenance of motor vehicle equipment and/or accessories. For purposes of subchapter B, the definition of *"motor carrier"* includes the terms *"employer"* and *"exempt motor carrier."*

"Random selection process" means that drug tests are unannounced; that every driver, of a motor carrier, subject to test-tests conducted annually shall equal or exceed fifty percent (50%) of the total number of drivers subject to testing of a motor carrier.

"Reasonable cause" means that the motor carrier believes the actions or appearance or conduct of a commercial motor vehicle driver, on duty as defined in § 395.2 of this subchapter, are indicative of the use of a controlled substance.

§ 391.87 Notification of test results and recordkeeping.

(a) A motor carrier shall notify its driver or driver-applicant of the results of a controlled substance test conducted under this subpart.

(b) A motor carrier shall notify—

(1) A driver-applicant of the results of a pre-employment controlled substance test conducted under this subpart provided the driver-applicant requests such results within 60 days of being notified of the disposition of the employment application; or

(2) A driver of the results of a periodic, random, or post-accident controlled substance test conducted under this subpart provided the results were positive. The driver must also be advised what drug was discovered.

(c) A motor carrier shall ensure that all records related to the administration and results of the drug testing program for its drivers subject to the testing requirements are maintained for a minimum period of 5 years except that individual negative test results shall be maintained for a minimum of 12 months.

(d) A medical review officer shall be the sole custodian of individuals test results. The medical review officer shall retain the reports of individual test results for a minimum of 5 years.

(e) A motor carrier shall retain in the employee's qualification file such information that will indicate only the following:

(1) The employee submitted to a controlled substance test.

(2) The date of such test.

(3) The location of such test.

(4) The identity of the person or entity performing the test.

(5) Whether the test finding was "positive" or "subnegative."

(f) A motor carrier shall produce upon demand and shall permit the Administrator to examine all records related to the administration and results of controlled substance testing performed under this part.

(g) A motor carrier shall maintain an annual (calendar year) summary of the records related to the administration and results of the controlled substance testing program performed under this subpart. This summary shall include, at a minimum:

(1) The total number of controlled substance tests administered;

(2) The number of controlled substance tests administered in each category (i.e., prequalification, periodic, reasonable cause, and random);

(3) The total number of individuals who did not pass a controlled substance test;

(4) The total number of individuals who did not pass a controlled substance test by testing category;

(5) The disposition of each individual who did not pass a controlled substance test;

(6) The number of controlled substances tests performed by a laboratory that indicated evidence of a prohibited controlled substance or metabolite in the screening test in a sufficient quantity to warrant a confirmatory test;

(7) The number of controlled substance tests performed by a laboratory that indicated evidence of a prohibited controlled substance or metabolite in the confirmatory test in a sufficient quantity to be reported as a "positive" finding to the medical review officer; and

(8) The number of controlled substance tests that were performed by a laboratory that indicated evidence of a prohibited controlled substance or metabolite in the confirmatory test in a sufficient quantity to be reported as a "positive" finding by substance category (e.g., marijuana, cocaine, opium, PCP, or amphetamine).

§ 391.88 Access to individual test results or test findings.

(a) No person may obtain the individual tests results retained by a medical review officer, and no medical review officer shall release the individual test results of any employee to any person, without first obtaining written authorization from the tested employee. Nothing in this paragraph shall prohibit a medical review officer from releasing, to the employing motor carrier, the information delineated in § 391.87(e) of this subpart.

(b) No person may obtain the information delineated in § 391.87(e) of this part and retained by a motor carrier, and no motor carrier shall release such information about any employee or previous employee, without first obtaining written authorization from the tested employee.

§ 391.89 Implementation schedule.

(a) This rule is effective December 21, 1988.

(b) Motor carriers with 50 or more "drivers subject to testing" are required to implement a controlled substance testing program which meets the

provision of this Part by December 21, 1989, for those drivers.

(c) All motor carriers with less than 50 "drivers subject to testing" are required to implement a controlled substance testing program which meets the provisions of this subpart by December 21, 1990, for all drivers.

(d) During the first 12 months following the insititution of random drug testing pursuant to this rule, a motor carrier shall meet the following conditions:

(1) The random drug testing is spread reasonably through the 12-month period;

(2) The last test collection during the year is conducted at an annualized rate of 50 percent; and

(3) The total number of tests conducted during the 12 months is equal to at least 25 percent of the drivers subject to testing.

§ 391.95 Drug use prohibitions.

(a) No driver shall be on duty, as defined in § 395.2 of this subchapter, if the driver uses any controlled substances, except as provided in § 391.97 of this part.

(b) No driver shall be on duty, as defined in § 395.2 of this subchapter, if the driver tests positive for use of controlled substances, except as provided in § 391.97 of this part.

(c) A person who tests positive for the use of a controlled substance, as defined in 49 CFR Part 40, is medically unqualified to operate a commercial motor vehicle.

(d) A person who refuses to be tested under provisions of this subpart shall not be permitted to operate a commercial motor vehicle. Such refusal shall be treated as a positive test and subject the driver to the restrictions contained in paragraph (c) of this section.

§ 391.97 Prescribed drugs.

(a) *Affirmative defense.* Any driver who is alleged to have violated § 391.95 of this subpart shall have available as an affirmative defense, to be proven by the driver through clear and convincing evidence, that his/her use of a controlled substance (except for methadone) was prescribed by a licensed medical practitioner who is familiar with the driver's medical history and assigned duties. The MRO may provide an opportunity for a driver to discuss a positive test result and clarify if a prescribed medication was involved.

(b) The rules in this subpart do not prohibit a motor carrier from requiring a driver to notify the motor carrier of therapeutic drug use.

§ 391.99 Reasonable cause testing requirements.

(a) A motor carrier shall require a driver to be tested, upon reasonable cause, for the use of controlled substances.

(b) A driver shall submit to testing, upon reasonable cause, for the use of controlled substances when requested to do so by the employing motor carrier.

(c) The conduct must be witnessed by at least two supervisors, if at all feasible. If only one supervisor is available, only one supervisor need witness the conduct. The witnesses must have received training in the detection of probable drug use by observing a person's behavior.

(d) The documentation of the driver's conduct shall be prepared and signed by the witnesses within 24 hours of the observed behavior or before the results of the tests are released, whichever is earlier.

§ 391.101 Reasonable cause testing procedures.

(a) A motor carrier shall ensure that the driver is transported immediately to a collection site for the collection of a urine sample.

(b) A motor carrier shall ensure that the controlled substance testing performed under paragraph (a) of this section conforms with 49 CFR Part 40.

§ 391.103 Pre-employment testing requirements.

(a) A motor carrier shall require a driver-applicant who the motor carrier intends to hire or use to be tested for the use of controlled substances as a prequalification condition.

(b) A driver-applicant shall submit to controlled substance testing as a prequalification condition.

(c) Prior to collection of a urine sample under § 391.107 of this subpart, a driver-applicant shall be notified that the sample will be tested for the presence of controlled substances.

(d) *Exception.* (1) A motor carrier may use a driver who is a regularly employed driver of another motor carrier without complying with paragraph (a) of this section, if the driver meets the requirement of § 391.65 of this subchapter.

(2) A motor carrier may use a driver who is not employed and tested by the motor carrier provided the motor carrier assures itself that the driver participates in a controlled substance testing program which meets the requirements of this subpart. A motor carrier who uses a driver more than once a year may assure itself once every 6 months. The motor carrier's assurance shall, as a minimum, consist of contacting the controlled substance testing program entity prior to using the driver and obtaining the following information:

(i) Name and address of the program.

(ii) Verification that the driver participates in the program.

(iii) Verification that program conforms to the 49 CFR Part 40.

(iv) Verification that driver is qualified under the rules of this subpart.

(v) The date the driver was last tested for controlled substances.

(3) The motor carrier who exercises paragraph (d)(2) of this section shall include the information obtained from the controlled substance testing programs in § 391.103(d) separately from the motor carrier's own anti-drug program.

(4) The motor carrier shall retain the information required in § 391.103(d) in the driver's qualification file as required under § 391.51 of this subchapter.

§ 391.105 Biennial (periodic) testing requirements.

(a) A motor carrier shall require a driver to be tested once under the requirements of this section for the use of controlled substances during the first medical examination of the driver after implementation of the drug testing program.

(b) *Exception.* A motor carrier may use a driver who participates in a drug testing program of another motor carrier or controlled substance test consortium.

(c) A motor carrier may discontinue periodic testing after the first calendar year when the motor carrier has implemented its random drug testing program according to the implementation schedule and, therefore, is testing 50 percent of drivers subject to testing under its random drug testing program.

§ 391.107 Pre-employment and biennial testing procedures.

(a) The sample shall consist of a urine specimen.

(b) A motor carrier shall ensure its controlled substance testing program conforms with 49 CFR Part 40.

§ 391.109 Random testing requirements.

(a) A motor carrier shall use a random selection process to select and request a driver to be tested for the use of controlled substances.

(b) A driver shall submit to controlled substance testing when selected by a random selection process used by a motor carrier.

§ 391.111 Random testing procedures.

(a) The sample shall consist of a urine specimen.

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(b) A motor carrier shall ensure its drug testing program conforms with the 49 CFR Part 40.

§ 391.113 Post-accident testing requirements.

(a) A driver shall provide a urine specimen to be tested for the use of controlled substances as soon as possible after a reportable accident but in no case later than 32 hours after the accident.

(b) A driver who is seriously injured and cannot provide a specimen at the time of the accident shall provide the necessary authorization for obtaining hospital reports and other documents that would indicate whether there were any controlled substances in his/her system.

§ 391.115 Post-accident testing procedures.

(a) The sample shall consist of a urine specimen.

(b) A driver shall ensure that the specimen is forwarded and processed by a laboratory which conforms with the 49 CFR Part 40 Guidelines.

§ 391.117 Disqualification.

(a) *Disqualification for refusal.* Except for a driver who meets the conditions of § 391.113(b), a driver shall be disqualified by issuance of a letter of disqualification for a period of 1 year following a refusal to give a urine sample when the driver has been involved in a fatal accident.

(b) *Disqualification for use of controlled substances.*

A driver shall be disqualified by issuance of a letter of disqualification for a period of 1 year for a positive test of controlled substance use when the driver has been involved in a fatal accident.

§ 391.119 Employee Assistance Program (EAP).

(a) Every motor carrier shall establish an EAP program. The EAP program shall, as a minimum, include—

(1) An educational and training component for drivers which addresses controlled substances;

(2) An education and training component for supervisory personnel which addresses controlled substances; and

(3) A written statement, on file and available for inspection, at the motor carrier's principal place of business, outlining the motor carrier's EAP.

§ 391.121 EAP training program.

(a) Each EAP shall consist of an effective training program for the motor carrier supervisory personnel and all

(b) The training program must include at least the following elements:

(1) The effects and consequences of controlled substance use on personal health, safety, and the work environment;

(2) The manifestations and behavioral causes that may indicate controlled substance use or abuse; and

(3) Documentation of training given to drivers and motor carrier supervisory personnel.

(d) EAP training programs for all drivers and supervisory personnel must consist of at least 60 minutes of training.

§ 391.123 After-care monitoring.

After returning to work, drivers who test positive must continue in any after-care program and be subject to follow-up testing for not longer than 60 months folowing return to work.

3. In § 391.41, paragraph (b)(12) is revised to read as follows:

§ 391.41 Physical qualifications for drivers.

* * * * *

(b) * * *

(12) Does not use a Schedule I drug or other substance identified in Appendix D to this subchapter,[1] an amphetamine, a narcotic, or any other habit-forming drug; meets the requirements of Subpart H; and

* * * * *

4. In § 391.43, paragraph (c), a new instructional paragraph is added after the paragraph headed *Diabetes* and in paragraph (e) the first paragraph of the Medical Examiner's Certificate is revised to include controlled substance testing to read as follows:

§ 391.43 Medical examination; certificate of physical examination.

* * * * *

(c) * * *

Instructions for Performing and Recording Physical Examinations

* * * * *

Controlled Substance Testing. Testing procedures and requirements as contained in Subpart H, Controlled Substance Testing.

* * * * *

Medical Examiner's Certificate

I certify that I have examined (driver's name (print)) in accordance with the Federal Motor Carrier Safety Regulations (49 CFR 391.41 through 391.49) and with knowledge of his/her duties, I find him/her qualified under the regulations including the requirement for controlled substance testing as required by Subpart H of 49 CFR Part 391.

* * * * *

[1] A copy of the Schedule I drugs and other substances may be obtained by writing to the Director, Office of Motor Carrier Standards, Washington, DC 20590, or to any Regional Office of Motor Carrier and Highway Safety of the Federal Highway Administration at the address given in § 390.27 of this subchapter.

PART 394—[AMENDED]

5. The authority citation for Part 394 continues to read as follows:

Authority: 42 U.S.C. App. 2505; 49 U.S.C. 504 and 3102; 49 CFR 1.48.

6. In § 394.7, a new paragraph (b)(11) is added and reads as follows:

§ 394.7 Immediate notification of fatal accidents.

* * * * *

(b) * * *

(11) The results of a drug test performed in accordance with § 391.113 of this chapter.

* * * * *

7. In § 394.9, paragraph (b) is revised to read as follows:

§ 394.9 Reporting of accidents.

* * * * *

(b) The motor carrier must fill in the report form in accordance with the instructions in § 394.20, completely and accurately with the most reliable information available to it at the time the report is filed. Controlled substance testing, if performed, shall be noted under item number 27 of § 394.20(a) and under item number 28 of § 394.20(b).

* * * * *

8. In § 394.20, item 27 of paragraph (a) and item 28 of paragraph (b) are revised to include information concerning controlled substance testing and reads as follows:

§ 394.20 Instruction for preparing accident reports.

(a) * * *

Item 27: An account of the accident containing the most reliable information to which the motor carrier has access at the time of reporting, sufficiently detailed and complete to convey an understanding of his/her version of the accident shall be entered under this item. This account should be continued on an extra sheet of paper if more space is needed. Either on the form or a separate sheet of paper, indicate whether a test for controlled substances was performed, the type of test performed, and the results of the test.

* * * * *

(b) * * *

Item 28: An account of the accident containing the most reliable information to which the motor carrier has access at the time of reporting, sufficiently detailed and complete to convey an understanding of his version of the accident shall be entered under this item. This account should be continued on an extra sheet of paper if more space is needed. Either on the form or a separate sheet of paper, indicate whether a test for controlled substances was performed, the type of test performed, and the results of the test.

* * * * *

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APPENDIX K

STATISTICAL TESTS

USE OF CHI SQUARE TO DETERMINE SIGNIFICANCE

The comparison of the distributions of a variable in two populations or in a population and a sample is not as obvious as it may seem, since all observations involve some degree of uncertainty. The use of a procedure called chi square (X^2) permits the comparison of two distributions by making it possible to determine whether, at a particular probability level, the distributions are or are not the same. X^2 is particularly suited to situations where observed frequencies of a variable are to be compared to theoretical frequencies. It has extensive application in statistical work. X^2 is defined by

$$X^2 = \sum \frac{(O-E)^2}{E}$$

where O = an observed frequency
E = an expected frequency

If the discrepancy between the observed frequency and the expected frequency is large, X^2 will be large. As the number of observations increases, the critical value of X^2 (the point at which the differences between the two distributions is said to be significant) increases. A generally accepted level of confidence is chosen, and then the calculated values of X^2 are compared against those required to achieve the chosen level. In this report, a level of .05 was chosen as the minimum level at which the differences would be said to be significant. This means that the chances are 5 in 100 (or less) that the differences in the distributions would occur randomly, even with no actual differences between the expected and the observed distributions. An example of an appropriate application of the X^2 test would be in analyzing the time of day (or the day of the week) in which an accident occurred. Standard tables of the required values, as well as a more detailed explanation of this procedure, can be found in most introductory statistics texts.

APPENDIX K

USE OF A "Z" TEST TO DETERMINE DIFFERENCES OF MEANS

Let M_1 and M_2 be the sample means obtained in samples of sizes N_1 and N_2 drawn from respective populations having means of u_1 and u_2 and standard deviations of d_1 and d_2. Consider the null hypothesis that there is no difference between the population means, or the samples are drawn from two populations having the same mean. The sampling distribution of differences in means is approximately normally distributed with mean and standard deviation given by:

$$\text{Mean } (M_1 - M_2) = 0 \qquad \text{St. Dev } (M_1 - M_2) = \sqrt{\frac{d_1^2}{N_1} + \frac{d_2^2}{N_2}}$$

where we can, if necessary, use the sample standard deviations as estimates of d_1 and d_2.

By using the standardized variable or "z" score given by:

$$z = \frac{M_1 - M_2}{\text{St.Dev } (M_1 - M_2)}$$

we can test the null hypothesis against alternative hypotheses (or the significance of an observed difference) at an appropriate level of significance. In this report, a level of .05 was chosen as the minimum level at which the differences would be said to be significant. For a two-tailed test, the results are significant at an .05 level if "z" lies outside the range of -1.96 to 1.96. If "z" is greater than 1.96 or less than -1.96, we conclude that at the .05 level, there is a significant difference in the mean of the two groups. Hence, if a "z" test is being done on the mean age of drug abusers vs. the mean age of non-drug abusers and "z" corresponds to significant results, we conclude that one group probably is younger than the other.

For a two-tailed test, the results are significant at the .01 level if "z" lies outside the range of -2.58 and 2.58. If results are significant at the .05 level, but not at the .01 level, we conclude that the results are probably significant and further investigations of the phenomena are probably warranted.

APPENDIX L

PROBABLE CAUSE TABLES

The tables on the following pages summarize the probable cause of each accident in this study. Column abbreviations have the following meanings:

- "Prof" is the column for a professional driver which is indicated by the letters "Pr".
- "Phys Incap" means the driver was physically incapacitated by a health problem.
- "Imprmt Fatigue" means the driver was impaired by fatigue.
- "Imprmt Alcohol" means the driver was impaired by alcohol.
- "Imprmt Drugs" means the driver was impaired by drugs other than alcohol.
- "Drivr Inexper" means the driver's inexperience was causal.
- "Unsaf Mvmnt" means that the accident was caused by the driver's unsafe movement.
- "Disregrd Wrngs or Signs" means that the accident was caused by the driver's disregard of warnings or advisory signs.
- "Misjudge Safe Speed" means that the driver misjudged the safe operating speed for his vehicle for the roadway and conditions present.
- "Faild to Yield Percv Obsrv" means that the driver failed to see or perceive a potentially dangerous situation and/or failed to yield to other traffic in such a situation.
- "Occup Prot" means that a lack of vehicle integrity, safety belts, or safety belt use contributed to the driver's death or severity of injuries.
- "Conspicuity" means that a lack of vehicle visibility or conspicuity was a cause of the accident.
- "Brake adj/deficient" means that some form of braking problem was causal in the accident.
- "Mech/maint" means that a mechanical failure or lack of vehicle maintenance was causal in the accident.
- "Signs/rdway/envir" means that factors such as inadequate or improper signage, roadway factors such as skid coefficient, or environmental factors such as fog, smoke, rain, or snow were causal.

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- "Load/load shift C.G." means that the vehicle's load was improperly secured, shifted during transport, or was loaded on a high center of gravity vehicle which required special driving precautions.

- Finally, in some cases, the failure could not be documented and was included in the "Failure unknw reasn" category.

Three abbreviations included in the rows of this table are:

- "Pr" indicates a professional driver,

- "C" refers to the case driver (fatally injured truck driver)

- "NC" refers to the driver of a non-case vehicle (any vehicle which is not a medium or heavy truck.

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Figure 5.--Probable cause matrix

CASE	PROF	PHYS INCAP	IMPRMT FATIGUE	IMPRMT ALCOHOL	IMPRMT DRUGS	DRIVR INEXPER	UNSAF MVMNT	DISREGRD WRNGS OR SIGNS	MISJUDGE SAFE SPEED	FAILD TO YIELD PERCV OBSRV	OCCUP PROT	CNSPICUITY	BRAKE ADJ/ DEFICIENT	MECH/ MAINT	SIGNS RDWAY ENVIR	LOAD/ LOAD SHIFT C.G.	FAILURE UNKNW REASN
001	Pr						C										
002	Pr	C															
003	Pr								C								
004	Pr							C	C		C						
005	Pr		C		C	C											
006	Pr		C								C	C					
007				C													
008	Pr		C								C		C				
009	Pr	C															
010																	NC
011	Pr						C				C						
012	Pr				C												
013	Pr				C												
014	Pr									NC	C						
015										C	C						
016	Pr								C		C			C	C		
017	Pr			NC	NC						C						
018	Pr				C								C				
019	Pr		C		C												
020	Pr		C						C		C						
021	Pr				C						C						
022	Pr		C								C						
023	Pr		C										C				
024	Pr					C			C								
025		C															
026					C				C						C		
027	Pr		C														
028	Pr		C		C												
029	Pr						C								C		
030	Pr									C					C		
031	Pr	C	C								C						
032	Pr				C						C	C					
033	Pr								C		C					C	
034	Pr		NC														
035														NC			
036		C															
037	Pr								C		C				C		
038	Pr			C													
039	Pr						NC				C						
040	Pr									C					C		
041	Pr		C	C													
042	Pr								C						C		
043	Pr			C	C						C						
044			C														
045															C		
046	Pr								C		C				C		
047	Pr		C		C												
048	Pr										C		C	C			
049	Pr	C	C									C					
050	Pr										C				C		
051	Pr	C															
052	Pr		C		C										C		
053	Pr		C														
054			C			C					C						
055	Pr									C		C					
056	Pr	C															
057	Pr		C								C			C			
058					C	C											
059	Pr	NC								NC	C						
060						C					C		C	C			
061					C												

APPENDIX I.

CASE	PROF	PHYS INCAP	IM-PRMT FA-TIGUE	IM-PRMT AL-COHOL	IM-PRMT DRUGS	DRIVR IN-EXPER	UNSAF MVMNT	DIS REGRD WRNGS OR SIGNS	MIS-JUDGE SAFE SPEED	FAILD TO YIELD PERCV OBSRV	OCCUP PROT	CNSPI CUITY	BRAKE ADJ/ DEFI-CIENT	MECH/ MAINT	SIGNS RDWAY ENVIR	LOAD/ LOAD SHIFT C.G.	FAIL-URE UNKNW REASN
063			C														
064	Pr										C				C		
065	Pr				C								C				
066	Pr		C														
067	Pr		C								C						
068	Pr	C															
069	Pr		C								C						
070	Pr		C		C						C				C		
071	Pr						NC				C				C		
072	Pr						C				C				C		
073	Pr								C		C						
074	Pr	C															
075	Pr				C												
076	Pr								C		C					C	
077	Pr		C														
078	Pr			C								C					
079	Pr		C														
080	Pr		C		C						C						
081	Pr						C										
082	Pr				C						C						
083												C				C	
084	Pr		C		C						C						
085	Pr		C														
086	Pr								C						C		
087	Pr				C												
088	Pr					C			C								
089	Pr				NC		NC				C						
090														C			
091	Pr									C							
092	Pr			C	C									C	C		
093	Pr	C															
094	Pr							C									
095	Pr					C			C		C						
096	Pr		C														
097	Pr		C														
098	Pr		C		C							C					
099	Pr		C		C												
100	Pr		C								C						
101	Pr												C	C			
102	Pr		C									C					
103	Pr	C	C														
104	Pr			NC													
105	Pr		C	C						NC	C						
106	Pr		C				NC										
107	Pr	C															
108	Pr		C								C						
109			C		C												
110	Pr		C		C						C						
112	Pr		C			C			C		C						
113	Pr		C	C	C												
114	Pr			C	C						C						
115	Pr													C			
116	Pr		C														
117A	Pr		C														
117B	Pr		C														
118	Pr		C						C								
119					C												
120	Pr													C			
121	Pr						NC										
122											C		C	C			
123	Pr		C								C						
124	Pr				C						C						

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CASE	PROF	PHYS INCAP	IMPRMT FATIGUE	IMPRMT ALCOHOL	IMPRMT DRUGS	DRIVR INEXPER	UNSAF MVMNT	DIS REGRD WRNGS OR SIGNS	MISJUDGE SAFE SPEED	FAILD TO YIELD PERCV OBSRV	OCCUP PROT	CNSPICUITY	BRAKE ADJ/ DEFICIENT	MECH/ MAINT	SIGNS RDWAY ENVIR	LOAD/ LOAD SHIFT C.G.	FAILURE UNKNW REASN
125																	C
126A	Pr						C		C								
126B	Pr						C		C								
127				C							C						
128	Pr			C													
129	Pr								C		C					C	
130	Pr			C	C						C						
131	Pr						C										
132	Pr			C							C			C			
133	Pr										C						C
134	Pr		C							C							
135	Pr	C															
136	Pr							C			C		NC				
137										C							
138	Pr			C							C						
139	Pr			C	C												
140															C		
141A	Pr									C							
141B	Pr									C							
142	Pr									C	C					C	
143	Pr							C			C						
144	Pr								C						C		
145	Pr		C						C		C						
146				C	C						C						
147	Pr	C															
148	Pr			C													
149	Pr						C				C						
150	Pr		C		C						C						
151		C															
152	Pr		C				NC										
153				C													
154	Pr	C															
155	Pr				C			C									
156A	Pr																C
156B	Pr																C
157	Pr									C		C					
158							NC										
159	Pr		C		C												
160			NC						NC								
161	Pr								C								
162	Pr		C	C							C						
163											NC						
164	Pr				C												
165				C							C						
166	Pr		C								C						
167			C							C							
168	Pr																C
169	Pr									NC	C						
170	Pr		C								C				C		
171	Pr											NC					
172	Pr						NC								NC		
173	Pr						C				C						
174		C															
175	Pr								C		C				C		
176	Pr			C							C						
177	Pr									C							
178	Pr									NC	C						
179		C			C												
180						C											
181	Pr			C	C										C		
182	Pr						C										

APPENDIX M

PROFESSIONAL DRIVER TABLES

Table 36.--Drugs of abuse

Drug	Number of complete tests	Drivers positive	Percent positive
Marijuana (THC & COOH)	138	19	13.8
Alcohol	140	17	12.1
Cocaine/Metabolites	138	11	8.0
Meth/Amphetamine	137	10	7.3
OTC Stimulants			
Ephedrine	137	6	4.4
Pseudoephedrine	137	5	3.6
Phenylpropanolamine	137	2	1.5
Codeine	132	1	.8
Phencyclidine (PCP)	140	1	.7

Note: Throughout the analyses, cocaine and its benzoylecgonine metabolite are combined as are delta-9-tetrahydrocannibol and its carboxylic acid metabolite. Similarly, methamphetamine and amphetamine, while separate drugs, are combined because methamphetamine metabolizes into amphetamine. Therefore, the presence of amphetamine could mean either ingestion of amphetamine or ingestion of methamphetamine which metabolized into amphetamine. The differences in subjective effects are minimal.

Table 37.--Cases by State

State of accident	Case drivers	Percent of total drivers
CA	66	43.7
CO	4	2.6
GA	21	13.9
MD	6	4.0
NC	23	15.2
NJ	5	3.3
TN	17	11.3
WI	9	6.0
Total	151	100.0

Table 39. --Drug test results by state

	CA		CO		GA		MD		NC		NJ		TN		WI	
Drug	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)	Tests	Pos (%)
Alcohol	63	2(3.2)	4	1(25.0)	18	4(22.2)	6	2(33.3)	23	4(17.4)	3	0	15	4(26.7)	8	0
Cocaine/Be	63	6(9.5)	4	1(25.0)	17	0	6	2(33.3)	23	1(4.3)	3	1(33.3)	14	0	8	0
Meth/Amphetamine	63	8(12.7)	4	0	17	0	6	0	23	0	3	0	14	1(7.1)	8	1(12.5)
Marijuana(THC/COOH)	63	11(17.5)	4	1(25.0)	17	1(5.9)	6	1(16.7)	23	3(13.0)	3	1(33.3)	14	1(7.1)	8	0
Opiates	63	1(1.6)	4	0	12	0	6	0	22	0	3	0	14	0	8	0
Other DOA	63*	7(11.1)	4*	0	18*	2(11.1)	6*	1(16.7)	23*	0	3*	0	15*	3(20.0)	8*	0
Any Drug of Abuse	63*	23(36.5)	4*	2(50 .0)	18*	6(33.3)	6*	3(50.0)	23*	5(21.7)	3*	1(33.3)	15*	6(40.0)	8*	1(12.5)

* The number of tests used to compute percent positive is the number of drivers tested for at least one drug.

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Table 40.--State of license-state of accident comparison drivers positive for drugs of abuse

Accident State	Total drivers	Number positive for drugs of abuse	License same as accident state	Other state or no license	Multiple valid licenses
California	66	23	17	NM(3), TX(3), WA, 1-no valid lic	2
Colorado	4	2	0	IN, TX	0
Georgia	21	6	5	AL(2)	1
Maryland	6	3	1	AL, NJ,	0
North Carolina	23	5	2	GA, MS, 1-no val lic	0
New Jersey	5	1	1	MA	1
Tennessee	17	6	1	IN, NJ, OH, TX, WV	0
Wisconsin	9	1	0	SD	0
Total: 8 States	151	47	27	24	4

Table 41.--Drug test result by type of accident

	Single vehicle		Multiple vehicle	
Drug	tests	pos (%)	tests	pos(%)
Alcohol (Eth)	82	13 (15.8)	55	4 (7.3)
Cocaine/Be	81	8 (9.9)	54	3 (5.6)
Meth/Amphetamine	81	3 (3.7)	53	7 (13.2)
Marijuana (THC/COOH)	80	15 (18.8)	55	4 (7.3)
Opiates	78	1 (1.3)	51	0
Other DOA	82	8 (9.8)	55	5 (9.1)
Any DOA	82	33 (40.2)	55	14 (25.4)

A chi square test was performed to determine whether the DOA involvement of drivers by type of accident was statistically significant. The test indicated that the differences seen are not significant at the 0.05 level and could have occurred by chance.

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Table 42.--Positive tox tests/by weight of vehicle

Weight of vehicle	Number of drivers	Toxicological tests	Positive for DOA	Percentage positive
26,000 lbs or less	22	20	7	35.0
more than 26,000 lbs	129	120	40	33.3

A chi square test was performed to determine whether the DOA involvement of drivers by weight of vehicle are statistically different. The test indicated that these differences were not statistically significant at the 0.05 level.

The table below describes the drug involvement for selected drugs of abuse by weight of vehicle.

Table 43.--Drug test results by truck weight

	26,000 lbs or less		more than 26,000 lbs	
	tests	pos(%)	tests	pos(%)
Alcohol (Eth)	20	4(20.0)	120	13(10.8)
Cocaine/Be	20	3(15.0)	118	8 (6.8)
Meth/Amphetamine	20	0	117	10 (8.5)
Marijuana (THC/COOH)	20	1 (5.0)	118	18(15.3)
Opiates	19	0	113	1 (0.9)
Other DOA	20	1 (5.0)	120	12(10.0)
Any DOA	20	7(35.0)	120	40(33.3)

A chi square test determined that the difference in amphetamine and marijuana use between drivers of the two vehicle groups was not significant at the 0.05 level.

Table 44.--Motor carrier-area of operation

	Total drivers	Total with 1 or more tests	Drugs of abuse
Intrastate	46	43	14
Interstate	103	96	33
Unknown	2	1	0

A chi square test indicated that drug use by area of operation was not statistically different at the 0.05 level. The table below shows the interstate/intrastate toxicological data.

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Table 45.--Selected drug use by area of operation

Drug	Intrastate test	Intrastate pos(%)	Interstate test	Interstate pos(%)
Alcohol (Eth)	43	2 (4.7)	96	15 (15.6)
Cocaine/Be	43	5 (11.6)	94	6 (6.4)
Meth/Amphetamine	43	5 (11.6)	93	5 (5.4)
Marijuana (THC/COOH)	43	6 (14.0)	94	13 (13.8)
Opiates	41	0	91	1 (1.1)
Other DOA	43	4 (9.3)	96	9 (9.4)
Any DOA	43	14 (32.6)	96	33 (34.4)

Table 46.--Age-drug use comparison for selected drugs

Single Drug	No.	Mean age	Standard deviation
Alcohol(Eth)	11	41.9	11.9
Cocaine/Be	3	44.3	9.5
Meth/Amphetamine	4	35.3	7.7
Marijuana(THC&COOH)	7	28.9	7.1
Other DOA	3	45.7	9.5
Any DOA	28	38.4	11.1
Multiple Drug			
Alcohol(Eth)	6	34.7	9.0
Cocaine/Be	8	35.0	9.8
Meth/Amphetamine	6	31.8	4.8
Marijuana(THC&COOH)	12	35.3	7.5
Other DOA	10	33.5	8.6
Any DOA	19	34.9	8.4

All Professional Drivers	42.3 years.
Drivers negative for drugs of abuse	44.5 years.
Drivers positive for drugs of abuse	37.0 years

The mean age of drivers testing positive for drugs of abuse (37 years) appears to be substantially lower than the mean age of drug free drivers (44.5). A "z test" (test of the difference in means) was performed to determine whether a significant difference exists between the two groups. The "z test" indicated that these two groups are significantly different at the 0.05 level.

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Table 47.--Positive tox tests by marital status

	Total Drivers	Total with 1 or more tests	Drugs of abuse
Single	22	22	13
Married	98	87	20
Separated	5	5	4
Divorced	15	15	7
Not Known	11	11	3

A chi square test was performed. This test indicated that the distributions were significantly different at the 0.05 significance level. Therefore, there seems to he a relationship between marital status and drug use.

Table 48.--Marital status-drug use comparison (percentages)

					Not married					
Drug	Married		Not married		Single		Separated		Divorced	
	test	pos(%)	test	pos(%)	test	pos(%)	test	pos(%)	test	pos(%)
Alcohol	87	8 (9.2)	42	7 (16.7)	22	2 (9.1)	5	1 (20.0)	15	4 (26.7)
Drug other than alcohol	87	14 (16.1)	42	19 (45.2)	22	13 (59.1)	5	3 (60.0)	15	3 (20.0)
Any drug	87	20 (23.0)	42	24 (57.1)	22	13 (59.1)	5	4 (80.0)	15	7 (46.7)

A chi square test indicated that these differences seen in drug use of married vs. not currently married were statistically significant at the 0.05 level.

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Table 49.--Vehicle configuration-drugs of abuse comparison

	Straight truck	Bob-tail	1 trailer	Truck tractor 2 trailers	Total
Drivers with 1 or more test	9	10	99	22	140
DOA	4	5	33	5	47
Percent DOA	44.4	50.0	31.1	22.7	33.6
All Vehicles	11	11	106	23	151

A chi square test was performed to determine if the relative drug involvements by vehicle configuration are statistically different. The differences are not statistically significant at the 0.05 level.

Table 50.--Drug test result by vehicle configuration

	Straight truck		Bob-tail		tractor 1 trailer		tractor 2 trailer	
	test	pos(%)	test	pos(%)	test	pos(%)	test	pos(%)
Alcohol(Eth)	9	2(22.2)	10	2(20.0)	99	13(13.1)	22	0
Cocaine/Be	9	1(11.1)	10	1(10.0)	98	9 (9.2)	21	0
Meth/Amphetamine	9	1(11.1)	10	0	97	5 (5.2)	21	4(19.0)
Marijuana (THC/COOH)	9	3(33.3)	9	0	98	14(14.3)	22	2(9.1)
Opiates	8	0	9	1(11.1)	94	0	21	0
Other Drugs of Abuse	9	1(11.1)	10	2(20.0)	99	8 (8.1)	22	2(9.1)
Any drug of abuse	9	4(44.4)	10	5(50.0)	99	33(33.3)	22	5(22.7)

Table 51.--Drug test results by time period

	12:01 am-6:00 am		6:01 am-12:00 noon		12:01 pm-6:00 pm		6:01 pm-12:00 mid	
	test	pos(%)	test	pos(%)	test	pos(%)	test	pos(%)
Alcohol(Eth)	34	4(11.8)	36	0	43	7(16.3)	27	6(22.2)
Cocaine/Be	33	3 (9.1)	36	3 (8.3)	43	4 (9.3)	26	1 (3.7)
Meth/Amphetamine	33	3 (9.1)	36	4(11.1)	42	2 (4.8)	26	1 (3.8)
Marijuana(THC&COOH)	33	5(15.2)	36	3 (8.3)	42	5(11.9)	27	6(23.1)
Opiates	33	1 (3.0)	32	0	42	0	25	0
Other DOA	34	4(11.8)	36	3 (8.3)	43	1 (2.3)	27	5(18.5)
Any DOA	34	10(29.4)	36	8(22.2)	43	17(39.5)	27	12(44.4)

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To determine whether the distributions of drug use over time were statistically different, a chi square test was performed. The test showed that the distributions were not statistically different at the 0.05 significance level.

Table 52.--Drug test results by day of the week

	All drivers	Any DOA tests	Any DOA pos(%)	Alcohol tests	Alcohol pos(%)
Monday	31	27	11 (40.7)	27	3 (11.1)
Tuesday	31	30	7 (23.3)	30	3 (10.0)
Wednesday	26	24	4 (16.7)	24	1 (4.2)
Thursday	26	24	8 (33.3)	24	2 (8.3)
Friday	19	17	6 (35.3)	17	1 (5.9)
Saturday	12	12	6 (50.0)	12	3 (25.0)
Sunday	6	6	5 (83.3)	6	4 (66.7)

To determine whether the distributions of DOA positives by day of the week are statistically significant, a chi square test was performed. The test showed that the distributions are statistically dependent at the 0.05 significance level. That is, the differences seen are greater than can be attributed to chance.

Table 53.--Drug test results by vehicle ownership

	Vehicle owner							
	Owner-Driver		Leasing Company		Carrier		Other	
	test	pos(%)	test	pos(%)	test	pos(%)	test	pos(%)
Alcohol(Eth)	17	4(23.5)	22	2 (9.1)	89	9(10.1)	12	3(25.0)
Cocaine/Be	17	0	20	2(10.0)	89	8 (9.0)	12	1 (8.5)
Meth/Amphetamine	17	1 (5.9)	20	1 (5.0)	89	6 (6.7)	11	2(18.2)
Marijuana(THC&COOH)	17	0	21	2 (9.5)	88	15(17.0)	12	2(16.7)
Opiates	17	0	21	0	82	1 (1.2)	12	0
Other DOA	17	2(11.8)	22	1 (4.5)	89	9(10.1)	12	1 (8.5)
Any DOA	17	6(35.3)	22	5(22.7)	89	31(34.8)	12	5(41.7)

To determine whether the differences in the percent of DOA positives were related to vehicle ownership, a chi square test was performed. The test indicated that the differences are not statistically significant and the 0.05 significance level.

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Table 54.--Drug test results by driver history of drug abuse

Drug	Prior history tests	Prior history pos(%)	No prior history tests	No prior history pos(%)
Alcohol	15	4 (26.7)	103	11 (10.7)
Cocaine/Be	15	6 (40.0)	101	2 (2.0)
Meth/Amphetamine	15	2 (13.3)	100	3 (3.0)
Marijuana (THC/COOH)	15	7 (46.7)	101	9 (8.9)
Opiates	15	0	96	1 (1.0)
Other DOA	15	1 (6.7)	103	7 (6.8)
Any DOA	15	12 (80.0)	103	24 (23.3)

A chi square test was performed to determine whether the relationship of prior history and DOA positive results are statistically independent. The test determined that prior history and DOA positives are related and statistically significant at the 0.05 significance level.

Table 55.--Mean BAC and driver history

	Alcohol positive	Range	Mean BAC
Prior History	4	.09-.31	.203
No Prior History	13	.02-.22	.118

Table 56.--Driver qualification checks
(126 Cases-Multiple Responses)

Previous Employers	State Driving Record	Road Test	Written Test
82%	83%	85%	60%

Table 57.--Drug test results by union affiliation

Drugs	Union tests	Union pos(%)	Non-Union tests	Non-Union pos(%)	Unknown tests	Unknown pos(%)
Alcohol(Eth)	11	0	119	14 (11.8)	10	3 (30.0)
Cocaine/Be	11	1 (9.1)	117	10 (8.5)	10	0
Meth/Amphetamine	11	0	117	10 (8.5)	9	0
Marijuana(THC&COOH)	11	1 (9.1)	117	18 (15.4)	10	0
Opiates	11	0	111	1 (9.0)	10	0
Other DOA	11	0	119	12 (10.1)	10	1 (10.0)
Any DOA	11	1 (9.1)	119	42 (35.3)	10	4 (40.0)

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A chi square test was performed to determine whether the DOA involvement of union and non-union drivers are statistically different. The differences are not statistically significant at the 0.05 level.

Table 58.--Valid, suspended and revoked licenses

Valid licenses	Number of drivers	Suspnd/ revoked license
None	4	3
1	139	13
2	7	2
3	1	0
All cases	151	18

The chi square test results indicated that no statistically significant relationship exists at the 0.05 level.

Table 59.--Drug use-license status comparison

Drug test result	No known suspended or revoked license		Suspended or Revoked License	
	No.	percent	No.	percent
Positive	37	30.1	10	58.8
Negative	86	69.9	7	41.2
Total	123	100.0	17	100.0

A chi square test was performed to determine if the relationship between suspended or revoked licenses and DOA positive results is statistically independent. The test result confirmed that a statistically significant relationship exists at the 0.05 level.

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Table 60.--Age-medical problem comparison (Mean Age)

Driver health	No.	Mean age
Medical problem	13	53.8
No medical problem	136	41.2
Total	149*	42.3

(z=5.09, p<.05)
*Medical condition unknown in 2 cases

The average age of drivers with health problems differed significantly from the average age of those with no identified health problems. A "z test" (test of the difference in means) indicated that these two groups were statistically different at the 0.05 level.

The statistically significant difference in age between the fatally injured drivers with health problems and those without suggests that age may be an important factor in health-related fatal crashes among the truck driving population. The rigors of heavy truck operation, disruption of circadian rhythms, scheduling, and other health factors such as diet and drug use indicates the need for more frequent and thorough health screening and prevention programs, especially for older drivers.

Table 61.--Drug use-employment status comparison

	Employee(101)		Contract and other drivers(50)	
	tests	pos(%)	tests	pos(%)
Alcohol(Eth)	93	7 (7.5)	47	10 (21.3)
Cocaine/Be	93	7 (7.5)	45	4 (8.9)
Meth/Amphetamine	92	6 (6.5)	45	4 (8.9)
Marijuana (THC/COOH)	92	15 (16.3)	46	4 (8.7)
Opiates	88	1 (1.1)	44	0
Other drugs of abuse	93	9 (9.7)	47	4 (8.5)
Any drugs of abuse	93	30 (32.3)	47	17 (36.2)

A chi square test was performed to determine whether a statistically significant relationship between drug use and type of employment exists. The tests showed that no statistically significant dependent relationship exists at the 0.05 level.

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Table 62.--Drug test results by presence of shipment deadline

Shipment deadline	Number of toxicological tests	Test positive for DOA	Percentage positive
Yes	34	16	47.0
No	94	25	26.6

A corrected (Yates) chi square test was performed to determine whether the DOA involvement of drivers by the presence of a shipment deadline was statistically significant. The test indicated that the differences seen could not be due solely to chance and that a drug positive test result appears to be related to the presence of a shipment deadline.

Table 63.--Drug test results by type of trucking service

Type of service	Number of tox tests	Tests positive for DOA	Percentage positive
LTL	14	2	14.3
TL	71	31	43.7
TL/LTL	38	8	21.0

A chi square test was performed to determine whether a relationship exists between DOA positive test results and type of trucking service. The chi square test determined that the type of trucking service and DOA test results are related and differ significantly at the 0.05 level.

*U.S.GOVERNMENT PRINTING OFFICE:1990-761-991:00046